State Water Survey Division
METEOROLOGY SECTION
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SWS Contract Report 265

AN ANNOTATED BIBLIOGRAPHY ON THE EVALUATION AND STATISTICAL ISSUES OF WEATHER MODIFICATION

Volume 2 of the
OSET Final Reports

prepared by

Chin-Fei Hsu

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Stanley A. Changnon, Jr.
Principal Investigator

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INTRODUCTION

A collection of publications dealing with statistical issues and with weather modification has been compiled and stored in the CDC computer at the University of Illinois. These are publications which have appeared in journals or books, or in the form of technical and scientific reports. References chosen emphasize the evaluation' and the 'design' of weather modification. The concept of evaluation referred to here is fairly broad and includes all phases in assessing weather modification results.

Our OSET project addresses mainly the evaluation of operational weather modification. Its major objectives have been 1) the development of statistical-physical techniques for evaluation of operational projects, 2) the evaluation of operational projects to test the techniques, 3) the planning for future operational projects, including development of operational criteria, and 4) evaluating the utilization of meteorological covariates. As one approach to achieve some of these objectives, an extensive literature search was carried out. This report culminates the results obtained from this effort for the statistical evaluation part of the OSET project. The publications listed here include not only those referring to operational projects, but also those to randomized experiments.

Keywords and phrases were extracted from each reference to reflect its major content and scope of the research. Primary rationale for the choice of keywords rested in the design and evaluation aspects of weather modification. More specifically, issues of interests include:

1) statistical evaluation design-- target-control setup, area size, unit;

2) statistical evaluation techniques, assumed distribution functions, problem areas;

3) data--response variables, covariates, experimental units, sampling method;

4) project location, duration;

5) seeding related operations-- seeding rate, seeding criteria, seeding agent, seeding hypothesis, etc.;

6) instrumentation--radar, aircraft, delivery system;

7) assessed seeding effects, and their statistical significance;

8) impact studies-- agricultural, socio-economical effects, etc.

Advantages of using keywords, instead of coded numbers or whole abstracts, rest in the ease of extracting information, flexibility in updating, relatively large amount of information included, and most importantly, their usefulness. For example, in order to find information about the evaluation of NHRE, one would look for references listed under both 'evaluation' and 'NHRE'.

At the end of the report there are two sets of indexes. One is the AUTHOR

INDEX, and the other is the KEYWORD INDEX. Keywords extracted from each reference give clues to its important findings. Thus, readers interested in a particular subject can easily find relevant information from the KEYWORD INDEX.

Each reference is given a five-character code; an example is

50L01.

The first 2 characters of this code designate the year, 1950, when the reference was published; the third character is the first letter of the first author's last name; and the last 2 characters represent a sequential number of that reference among those with identical first 3 characters.

As an ongoing effort, publications included in this report contain only a fraction of available literature, and the selection is largely that of author's. However, we do hope that those publications not included here will later be added, and readers are encouraged to send in any publications not included in this report to the author.

For convenience, publications which have an extensive bibliography on the subject of weather modification are listed separately in a chapter. Additional publications with bibliography can also be found under 'bibliography' in the KEYWORD INDEX. These references were helpful in compilling the present bibliography.

ACKNOWLEDGEMENT

This work was supported by grants from National Science Foundataion ENV 77-01103 and ATM 79-05007, and was under the general direction of S. A. Changnon, Jr., Chief of the Illinois State Water Survey. Deep appreciation is extended to Rebecca Chan, Victoria Borre, and Alfred Cheng who provided considerable computer programming assistance in processing references and in updating both INDEXES. Furthermore, without the tireless help from the librarians of the Water Survey, many publications would never have appeared in this report.

PUBLICATIONS WITH AN EXTENSIVE BIBLIOGRAPHY ON WEATHER MODIFICATION

Breuer, G., 1976: Weather modification: Prospects and problems. Cambridge University Press, 178 pp.

Brown, R. J., 1980: Cloud seeding, citations from NTIS data base. PB80-811037, Nat. Tech. Inform. Service, Springfield, VA, 109 pp. Contains 132 abstracts covering 1976-May 1980.

Brown, R. J., (ed.), 1977: Weather modification effects and management (A bibliography with abstracts). National Tech. Inform. Serv., NTIS/PS-77/1106. Contains 204 abstracts excluding cloud physics, covering 1964-October 1977.

Envlsonmental Data Service, 1978: Weather modification. Second edition, NOAA packaged literature search 78-3, Washington, DC, 195 pp. Contains 1112 citations covering 1972-1973.

Farhar, B. C., 1978: An annotated bibliography on the social aspects of weatheer modification. Inst. Behavior Sci., University of Colorado, 49 pp. 60 Selected abstracts.

Grimes, A. E., 1972: An annotated bibliography on weather modification 1960-1969. NOAATMEDS ESIC-1, 407 pp. 858 abstracts, statistical evaluation, cloud physies, legal, economical, author index, subject index, geographic index.

Hanson, M. A., C. L. Bach, and E. A. Cooley, 1976: Bibliography of statistical and metaorologlcal methodology in weather modification. Report No. M388 (ONR TR-110), Department of Statistics, Florida State University, Tallahassee, FL, 138 pp.

Hanson, M. A., L. E. Baker, and C. H. Hunter, 1977: Bibliography of statistical and meteorological methodology in weather modification. Report No. M440 (ONR TR-126), Department of Statistics, Florida State University, Tallahassee, FL, 57 pp.

Hanson, M. A., L. E. Baker, E. A. Cooley, and C. H. Hunter, 1979: A bibliography of weather modification experiments. Commun. Statist.-Theor. &Meth., A8(11), 1129-1153.

Jenkinson, A. F., 1955: Some statistical aspects of a rain-making experiments. Meteor. Res. Comm., MRP 931, 15 pp.

Julian, P. R., and A. H. Murphy, 1972: Probability and statistics in meteorology: A review of some recent development. Presented at the 52nd Annual Meeting, Amer. Meteor. Soc., New Orleans, 31 pp.

Krick, I. P., 1956: A bibliography on weather modification and field operations, using the combined facilities of Irving P. Krick Associated, Inc., American Institute of Aerological Research (and) Water Resoures Development Corporation. Denver, CO, over 200 references.

Kramer, H. P., and M. Rigby, 1950: Selective annotated bibliography on cloud physics and "rain making". Meteor. Abs. and Bibliog., 1(3), 174-205. Containing 204 references.

Lehmann, E. J., (ed.), 1973: Cloud seeding, a bibligraphy with abstracts. National Tech. Inform. Serv., NTIS-WIN-73-071, 135 pp. Covering 1964-September 1973, 134 selected abstracts.

Rigby, M. E., 1957: Bibliography of scientific reports and literature. Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 322-409. Author index, subject index, geographical index.

State of California, 1955: Bibliography of published reports on cloud physics and weather modification. Wea. Mod. Operat. in Calif., Calif. Water Resous. Board, Bull. No. 16, 69-78.

Taborsky, O., and G. Thuronyi, 1960: Annotated bibliography on weather modification. Meteor. Geoastrophy. Abs., 11(12), 2181-2415. Containing 1016 abstracts, 278 supplementary articles, author index, subject index, geographical index.

Taborsky, O., and G. Thuronyi, 1962: Annotated bibliography on weather modification and microphysics of clouds. Meteor. Geoastrophy. Abs., 13(3), 702-762. Contains 254 items, author index, subject index, and geographical index.

Thuronyi, G., 1953: Annotated bibliography on weather modification. Meteor. Abs. and Bibliog., 4(8), 963-968.

Thuronyi, G., 1955: Annotated bibliography on weather modification. Meteor. Abs. and Bibliog., 6(10), 1433-1513. Contains 550 items.

Thuronyi, G., 1963: Annotated bibliography on weather modification and microphysics of clouds. Meteor. Geoastrophy. Abs., 14(1), 144-244. Contains 390 abstracts, author index, subject index, and geographical index.

Thuronyi, G., 1964: Recent literature on weather and climate modification. Meteor. Geoastrophy. Abs., 15(7), 1518-1553. Contains 123 abstracts.

U. S. Weather Bureau, 1955: A short bibliography on artificial production of rain. LS-5507, 8 pp.

Westcott, N., 1980: Annotated bibliography on predictor variables for weather modification applications. Progress Report, Illinois State Water Survey, Urbana, IL, 117 pp. Contains 174 abstracts with author index, geographic region index, and weather type index.

Williams, M. C., 1972: Progress in the South Dakota weather modification. Proc. South Plains Region Cloudtop Conf., Texas Water Develop. Board, 111-126.

Zikeev, N. T., and G. A. Doumani, 1967: Weather modification in the Soviet Union, 1946-1966: A selected annotated bibliography. Library of Congress, Washington, D. C., 78 pp.

BIBLIOGRAPHY

47B01
Bannon, J. K., 1947: Artificial stimulation of rain formation. Meteor. Magazine, No. 482, 170-174.
Discussion of Australian experiments; formation of ice crystals.

47K01
Kraus, E. B., and P. Squires, 1947: Experiments on the stimulation of clouds to produce rain. Nature, 159, 489-491.
Australia; 8 clouds; granulated dry ice; cloudtop seeding; radar; aircraft and farmer observations; seeding hypothesis of cloud modification.

48C01
Coons, R. D., R. C. Gentry, and R. Gunn, 1948: First partial report on the artificial production of precipitation: Stratiform clouds, Ohio, 1948. Bull. Amer. Meteor. Soc., 29(5), 266-269.
Cloud Physics Project; Wilmington, Ohio; height of base and top of seeded cloud deck; relative humidity above and below; temperatures inside and outside the clouds; lapse rates; optical characteristics and extent of seeded areas, and location, extent and character of the precipitation; radar; 38 stratiform clouda; rain was not produced by artificial methods unless precipitation was oceurring naturally within 30 miles of the seeded area.

48C02
Coons, R. D., E. L. Jones, and R. Gunn, 1948: Second partial report on the artificial production of µ--cumullform clouda--Ohlo--1948. Bull. Amer. Meteor. Soc., 29(10), 544-546.
Cloud Physics Project; Wilmington, Ohio; economic; dry ice; in most cases, not more than a trace of rain was recorded, but on June 28, 1948, an estimated 0.2 inches of rain fell from a seeded cloud; water as seeding agent.

48L01
Leopold, L. B., and M. H. Halstead, 1948: First trials of the Schaefer-Langmuir dry-ice cloud seeding technique in Hawaii. Bull. Amer. Meteor. Soc., 29(10), 525-534.
15 tests totalling 54 seedings; dry ice; cloud thickness.

48L02
Langmuir, I., 1948: The production of rain by a chain reaction in cumulus clouds at temperatures above freezing. J. Meteor., 5(5), 175-192.
Bergeron-Findeisen; dry ice; formation of heavy rain; Hawaiian experiments; widespread weather effects; Project CIRRUS.

49B01
Bergeron, T., 1949: The problem of artificial control of rainfall on the globe. I. General effects of ice-nuclei in clouds. Tellus, 1, 32-43.
Probability of increasing precipitation; dynamic seeding; seedability; orographic; overseeding; cloud temperature; seeding window.

49C01
Coons, R. D., E. L. Jones, and R. Gunn, 1949: Third partial report on artificial production of precipitation--orographic stratiform clouds--California, 1949. Bull. Amer. Meteor. Soc., 30(7), 255-256.
Cloud Physics Project; Donner Pass; two aircraft; a B-17; C-47; 10-cm search radar; orographic; no results of large enough scale to be observed were indicated; negative effect.

49C02
Coons, R. D., E. L. Jones, and R. Gunn, 1949: Fourth partial report on artificial production of precipitation: Cumulus clouds, Gulf states, 1949. Bull. Amer. Meteor. Soc., 30(8), 289-292.
Mobile, Alabama; Cloud Physics Project; B-17; C-47; 10-cm radar; 44 seedings; temperature at the tops of clouds; without exception clouds dissipated as a result of seeding.

50F01
Frith, R., 1950: Artificial nucleation of clouds. Meteor. Magazine, 79, 5-9.
Experiments by the Metorological Research Flight in the United Kingdom; two experiments to control clouds-Nov. 3, 1947 and August 30, 1949; dry ice; visual observations; two occasions to clear clouds-June 21, 1948, and Sept. 21, 1949.

50L01
Langmuir, I., 1950: A seven-day periodicity in weather in United States during April, 1950. Bull. Amer. Meteor. Soc., 31(10), 386-387.
Agl; ground-based generator; New Mexico; drought; Cirrus Project; regression; F-test; correlation.

50O01
Orr, J. L., D. Fraser, and K. G. Pettit, 1950: Canadian experiments on artificially inducing precipitation. Bull. Amer. Meteor. Soc., 31, 56-59.
4 areas; 57 seedings from June 1948 to January 1949; partly randomized; dry ice; summer cumulus; visual observation.

50V01
Vonnegut, B., 1950: Experiments with silver iodide smokes In the natural atmosphere. Bull. Amer. Meteor. Soc., 31(5), 151-157.
December 21, 1948; airplane; dry ice seedings; Project Cirrus; photographs.

51B01
Braham, R. R., S. E. Reynolds, and J. H. Harrell, Jr., 1951: Possibilities for cloud seeding as determined by a study of cloud height versus precipitation. J. Meteor., 8(6), 416-418.
Bergeron-Findeisen theory; summer of 1950; heights of the cloud bases and tops; Socorro, New Mexico; radar echoes; cloud-top temperatures; indicated considerable day-to-day variation in the percentage of clouds of a given height which develop radar returns; stratification by cloud cover; precipitation processes; Agl generator; overseeding; concentration of nuclei.

51H01
Houghton, H. G., 1951: An appraisal of cloud seeding as a means of increasing precipitation. Bull. Amer. Meteor. Soc., 32(2), 39-46.
Cloud physics; synoptic meteorology; nuclei; history; Bergeron-Findeisen process; effectiveness of cloud seeding.

51H02
Hall, W. F., 1951: An evaluation of the technique of cloud seeding to date. Symp. of Cloud Seeding, Oct. 23, Trans., N. Y. Acad. of Sci., 45-50.
Evaluations; United States Weather Bureau; seven-day periodicities; Project Cirrus; correlation; pressure difference; temperature at 700-mb; harmonic dial; cloud physics.

51L01
Langmuir, I., 1951: Cloud seeding by means of dry ice, silver iodide, and sodium chloride. Trans. New York Acad. Sci., 14(1), 40-44.
History; widespread effects; Project Cirrus; New Mexico; weekly periodic seeding; analysis of the periodicity in the rainfall.

51W01
Wahl, E., 1951: On a seven-day periodicity in weather in the United States during April, 1950. Bull. Amer. Meteor. Soc., 32(5), 193.
Dally temperature; harmonic analysis.

52B01
Brier, G. W., and I. Enger, 1952: An analysis of the results of the 1951 cloud seeding operations in central Arizona. Bull. Amer. Meteor. Soc., 33(5), 208-210.
One target (with 21 NWSstations) and one control (with 51 NWSstations); winter; seasonal; monthly; operational; regression with various lengths of time; scattergram; continuous historical target-control.

52B02
Bowen, E. G., 1952: Australian experiments in artificial rainmaking. Bull. Amer. Meteor. Soc., 33(5), 244-246.
Dry ice; cloudtop seeding; cloud top temperatures; Tasmania; thickness of the cloud.

52D01
Decker, W. L., 1952: Hail-damage frequency distributions for Iowa, and a method of evaluating the probability of a specified amount of hail damage. Trans. Amer. Geophy. Union, 33(2), 204-210.
Damage to crops; Iowa; negative exponential; Pearson's type-III curve.

52K01
Krick, I. P., 1952: Increase water resources through weather modification. J. Amer. Water Works Assoc., 44(11), 997-1020.
Direct distillation of sea water; history; commercial; Washington; nucleation; silver iodide; generator; evaluation; analog technique; historical-target; Nebraska; cost; snowpack increasing; laws.

52K02
Krick, I. P., and T. B. Smith, 1952: Some evaluations of sustained cloud-seeding operations. Trans. Amer. Geophys. Union, 33(1), 53-56, with discussion.
New Mexico; Colorado; Oregon; July to December 1950; multiple regression; silver-iodide; ground generator; total monthly precipitaion; seven monthly evaluations-six positive and one negative effect; correlations; total rainy days; visual observation; regression.

52M01
MacCready, P. B., Jr., 1952: Results of cloud seeding in central Arizona, winter 1951. Bull. Amer. Meteor. Soc., 33, 48-52.
10000 square miles; 4 months; 1 control area; NWS stations; scattergram; ratio; regression; large positive effect.

52R01
Reynolds, S. E., W. Hume, II, and M. McWhirter, 1952: Effects of sunlight and ammonia on the action of silver-iodide particles as sublimation nuclei. Bull. Amer. Meteor. Soc., 33(1), 26-31.
Exposure of AgI smoke to bright sunlight showed a decrease in concentration of effective nuclei (at -20C) of approxmiately two orders of magnitude per hour; the concentration of effective nuclei is increased greatly by the addition of a little ammonia vapor to the AgI smoke.

53B01
Beaumont, R. T., 1953: Cloud-seeding analysis in Oregon. Bull. Amer. Meteor. Soc., 34(6), 298-303.
Two evaluations; commercial; regression; no supporting evidence that cloud-seeding materially increased precipitation is found; 1, snow, Southern Oregon Cascades, November to March, winters of 1949-50, 1950-51; 2, Tri-Counties, September-June, 1950-51, 1951-52; serial correlation; trend; Student's t-test; analysis of covariance; percent of normal method.

53H01
Hall, W. F., T. J. Henderson, and S. A. Cundiff, 1953: Cloud seeding in the Sierra near Bishop, California. Bull. Amer. Meteor. Soc., 34, 111-116.
Winters of 1948-1950; runoff; target-control; dry ice; scattergram; multiple regression; positive effect of 9%.

53L01
Langmuir, I., 1953: Analysis of the effects of periodic seeding of the atmosphere with silver iodide, Part II. Final Report, RL-785, General Electric Research Lab., Schenectady, NY, 336 pp.
Project CIRRUS; dry ice seeding; AgI; seeding of stratus and cumulus clouds; visual; widespread effect; hurricane modification; periodic seeding in New Mexico; seven-day periodicity; correlation; persistence; skewness; 28-day cycle; cloudiness; wind; pressure; moisture flow; 700 mb temperature.

53S01
Stidd, C. K., 1953: Cube-root-normal precipitation distributions. Trans. Amer. Geophy. Union, 34(1), 31-35.
Normal distribution; single-station precipitation records; skewness; trace amount of rainfal; probability paper.

54B01
Brier, G. W., 1954: 7-day periodicities in May, 1952. Bull. Amer. Meteor. Soc., 35(3), 118-121.
Langmuir's 7-day periodicities; Oregon; April 27 to May 24, 1952; Washington; synoptic charts; 700-mb map; cloud seeding; cosine curve; correlation coefficient.

54B02
Brier, G. W., 1954: Comments on " 7-day periodicities in May, 1952". Bull. Amer. Meteor. Soc., 35(9), 411.
Discussion of papers by Langmuir, and by Schwerdtfeger; Argentina.

54D01
Dennis, A. S., 1954: Initiation of showers by snow. J. Meteor., 11(2), 157-162.
Radar; showers occurring in regions of snow trails more frequently than elsewhere; Bergeron process; cloud-top temperature; Montreal; 1949-1952; radar pictures in vertical section.

54E01
Elliott, R. D., and R. F. Strickler, 1954: Analysis of results of a group of cloud seeding projects in Pacific slope watershed areas. Bull. Amer. Meteor. Soc., 35, 171-179.
Seasonal rainfall; historical target-control design; California; Oregon; Idaho; 1951-1953; AgI; ground generator; at rate of 1012 crystals/sec; historical records weighted by the Thiessen polygon method; scattergram; regression; correlation; positive seeding effect.

55B01
Brier, G. W., 1955: Seven-day periodicities in certain meteorological parameters during the period 1899-1951. Bull. Amer. Meteor. Soc., 36(6), 265-277.
Periodicities; Project Cirrus; sinusoidal wave; northern Gulf of Mexico; phase; 700-mb temperature; Nebraska; 20 zones in U. S.; cloud seeding; harmonic dial; analysis of variance; result was non-significant.

55B02
Buell, C. E., 1955: An evaluation of the results of cloud seeding in Western New Mexico and Southern Arizona during July and August, 1951 and 1952. Bull. Amer. Meteor. Soc., 36(1), 6-15.
Using upper wind and radio-sonde data; 3 areas, no control; regression; raingages; rainfall increase no more than 10 %; ratio; logarithmic transformation.

55H01
Huff, F. A., 1955: A micrometeorological study of rainfall variability. Bull. Amer. Meteor. Soc., 36(9), 489-490.
Micro-network of raingages in central Illinois; 93 storms; storm differences; storm size; variation of point rainfall with distance.

55J01
Jeeves, T. A., L. LeCam, J. Neyman, and E. L. Scott, 1955: On the methodology of evaluating cloud seeding operations. Wea. Mod. Operat. in Calif., Calif. Water Resous. Board, Bull. No. 16, 79-125.
Percent of normal; regression; weakness of the regression method; evaluation of the Carrizo Plain cloud seeding operations in 1950/51 and 1951/52; California; classify storms according to the direction of the wind.

55L01
Ludlam, F. H., 1955: Artificial snowfall from mountain clouds. Tellus, 7(3), 277-290.
Optimal Icecrystal concentration is about 10-50 per litter; Swedish; growth of ice crystals by diffusion; radius of droplet; dry ice; concentration of snow crystals;.problem of evaluating; ground generator; AgI; estimate 100% increase at mountain tops and 25% increase over drainage basins.

55L02
Langmuir, I., 1955: Widespread control of weather by silver iodide seeding. Final Report, 55-RL-1263, General Electric Research Lab., Schenectady, NY, 175 pp.
Periodic seeding; 7-day periodicity of rainfall; 700 mb temperature; nonlinear seeding effect; 9 or 10 day periodicity; 2 seeding hypotheses; power spectrum; Cloud Physics Project (University of Chicago); sensitivity of experiment; Project Cirrus; evaluation in general; meteorology.

55S01
Smith, E. J., K. J. Heffernan, and B. K. Seely, 1955: The decay of ice-nucleating properties of silver iodide in the atmosphere. J. Meteor., 12(4), 379-385.
Zinc sulfide; detected at distances up to 56 kilometers downwind; the total number of freezing nuclei, effective at -17C, in AgI smoke from a hydrogen burner, decreased by a factor of ten after eight minutes of exposure in the free atmosphere. The corresponding time with use of a kerosene burner was 50 minutes; cloud cover; DC-3 aircraft; Australia.

55W01
Woodbridge, D. D., 1955: A storm analysis of the Tillamook burn cloud-seeding operation. Bull. Amer. Meteor. Soc., 36, 22-26.
700 square miles; Oregon; summer storms; recording stations; storm analysis correlation.

57A01
Advisory Committee on Weather Control, 1957: Final Report, Volumes I and II. U.S. Government Printing Office, Washington, D.C..
Bibliography.

57A02
Adderley, E. E., and S. Twomay, 1957: An experiment on artificial stimulation of precipitation in the Snowy Mountains region of Australia.
Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 291-295.
1955; random target-control; period is defined as the interval between the passage of successive anticyclone centres across the 150 E; AgI; Avro Anson aircraft; the ratios of target area to control area precipitations are greater during the seeded periods but the number of observations are far too. inadequate.

57A03
Ackerman, E. A., 1957: Design study for economic analysis of weather modification. Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 233-245.
Benefit-cost.

57B01
Berndt, G. D., 1957: Summary of the statistical evaluations by the Advisory Committee. Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 92-96.
Twelve different cloud seeding projects located in various parts of the United States, and one located in France, have been evaluated; regression analysis; statistical decision theory; cloud seeding has produced an increase in the precipitation of the orographic and West Coast projects by between 10 and 15%; dependent random variables.

57B02
Berndt, G. D., 1957: An evaluation of commercial cloud seeding operations conducted during the summer months in South Dakota.
Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 69-86.
Data are in many respects inadequate; project evaluability; 1952-1954; generators on the ground; AgI; rain period as unit; 1926-50 as historical; test for statistical dependence in the rainfall; test for year-to-year trend in the data; gamma distribution; Kolmogorov-Smirnov statistic; power of the test; sequential analysis; average sample size; benefit-cost ratio; Bayesian; economical; decision theory.

57D01
Decker, F. W., R. L. Lincoln, and J. A. Day, 1957: Analysis of cloud seeding efforts in the tri-county area, Oregon, 1950-54. Bull. Amer. Meteor. Soc., 38(3), 134-137. Comments by F. A. Berry, and G. D. Berndt, 497.
11-variable multiple regression; not significant at the 5% level; positive departure of approximately 6%is shown; daily; 700 mb height.

57H01
Houghton, H. G., 1957: Present position and future possibilities of weather control. Bull. Amer. Meteor. Soc., 38(10), 567-570.
Advisory Committee on Weather Control; research.

57N01
Neyman, J., 1957: Randomized cloud seeding experiment. Science, 125, 61-63.
General discussion; Santa Barbara Project; need for randomization; R. I. radar observations; freezing nuclei observations; path of neclei; nuclei concentration; AgI count; airborne nuclei count; synoptic analysis; ground generator.

57S01
Spar, J., 1957: Project SCUD. Metoer. Monog., 2(11), 5-23. (see 67N05 for further discussion)
Using 3 meteorological variables; ANOCOVA; east coast region of the U. S.; JAN.-April 1953 and Dec. 1953 to April 1954; randomized consecutive pairs; 24 hour area integrated precipitation and sea level pressure; no seeding effect.

57T01
Thom, H. C. S., 1957: A Statistical method of evaluating augmentation of precipitation by cloud seeding.
Final Report, Advisory Comm. on Wea. Control, Volume TI, U.S. Government Printing Office, Washington, D. C., 5-25. (see 60S02 for comment.)
Multiplicative seeding effect; regression; historical continuous target-control; transformation; theory of testing hypothesis; power curves; hydrologic data; history; sampling errors in the regression coefficients; combining significance test; meteorological controls; type 2 error; commercial

operations; stream flow; analysis of variance; single event tests; multiple event tests; confidence interval; Student's t test; hydrology; Western Quebec.

57T02
Thom, H. C. S., 1957: An evaluation of a series of orographic cloud seeding operations. Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 25-50.
11 projects in the United States; 1 in France; the orographic project class and the west coast class both showed inccreases of 14% in precipitation which are both significant at the 0.01 level of probability; the nonorographic projects showed no significant increase; groundbased AgI generators; Big Creek Project; Coeur d'Alene Project; Mokelumne-Stanislaus Project; Santa Barbara Project; Santa Clara Project; Tri-county Project; Dallas Project; Kentucky; Mohawk Project; South Carolina; Tignes, France; seasonal as unit; storm as unit; storm typing; regressions of target on control employing suitable historical; transformation; gamma; Fisher's z-transformation; confidence interval.

57T03
Thom, H. C. S., 1957: A method for the evaluation of hail suppression. Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 55-69.
Sequential analysis.

57T04
Thom, H. C. S., 1957: The frequency of hail occurrence. Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 50-55.
Poisson fitting; test for equality of mean and variance; negative binomial fitting; moment estimate first, if not efficient, use maximum likelihood estimator; sequential test; averaged sample number of Poisson and negative binomials.

57W01
Woodbury, M. A., 1957: Final Report of the Statistical Weather Advisory Project-New York University College of Engineering Research Division. Final Reeort, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 86-91.
South Dakota; rainfall analysis; gamma; power; possible trend of rainfall over time; Bartelett's test of homogeneity of variance; sun-spot; orthogonal polynomial; predictors; average relative humidity; stability index; stability index tendency.

57W02
Warner, J., and S. Twomey, 1957: The use of silver iodide for seeding individual clouds. Final Report, Advisory Comm. on Wea. Control, Volume II, U.S. Government Printing Office, Washington, D. C., 295-299.
35 supercooled clouds; three different aircraft; cloud-top temperature; 1953. Nhill, Victoria; 1955; Uranquinty, New South Wales; Australia; 1955, Hobart, Tasmania; most clouds are seen to precipitate between 20 and 25 minutes after seeding; cloud depth.

58A01
Adderley, E. E., and S. Twomey, 1958: An experiment on artificial stimulation of procipitation in the Snowy Mountains region of Australia. Tellus, 10(2), 275-280.
Randomised experiment; AgI; ground generator at rate of 500-800 gm per hour; cumalus and stratocumulus clouds; raingages; single ratio; positive seeding effects, no significance given; cross-over.

58H01
Howell, W. E., 1958: A reappraisal of an early cloud seeding evaluation. J. Meteor., 15, 562-563.
1951-1952; Salmon and Stillwater reservoires, New York; historical compariosn; runoff; t-test; z-test; positive effect.

58T01
Thom, H. C. S., 1958: A method for the evaluation of hail suppression. Zeit. Angew. Math. und Phys., 9(1), 37-64.
Sequential analysis; Magadino Plain in Switzerland; frequency of hail-days; tests of hypotheses; sequential test; negative binomial distribution; Poisson distribution.

59M01
Moran, P. A. P., 1959: The power of a cross-over test for the artificial stimulation of rain. Austral. J. Statist., 1, 47-52.
Regression; double ratio; target and control; Australia.

59001
Oddie, B. C. V., 1959: First results of the meteorological office experiments on the artificial stimulation of rainfall. Meteor. Magazine, 88(1043), 129-137.
19 experiments; decrease of rainfall; frontal clouds; Advisory Committee on Weather Control; AgI; five generators; Great Britain; 1946-1955 as historical; percentage of normal; isopleths.

60B01
Battan, L. J. and A. R. Kassander, 1960: Design of a program of randomized seeding of orographic cumuli. J. Meteor., 17, 583-590.
Arizona; precipitable water; Showalter stability index; cloud; day as experimental unit; randomized by pair target-only design; objective forecasting; seedable day was defined when the precipitable water on the 0500 MST sounding was equal to or greater than 1.10 inches and stability index was less than +4.5C; Supercub airplane; 3-cm radar set (An/TPS-10A); K-17 cloud cameras; 29 recording raingages; AgI.

60B02
Brownlee, K. A., 1960: Statistical evaluation of cloud seeding operations. J. Amer. Statist. Assoc., 55, 446-453.
Selection bias; 2 regression lines; cross-over design; commercial cloud seeding; Advisory Committee on Weather Control; design; experimental unit; 2 regressions.

60C01
Court A., 1960: Evaluation of seeding trials. J. Irrig. and Drainage Div., Proc. of Amer. Soc. of Civil Eng., 121-126.
Bias; storm; season; economic evaluation; rainfall intensity; Santa Clara; Santa Barbara projects; lightning; California; comparability pitfall; transformation pitfall.

60N01
Neyman, J., E. L. Scott, and M. Vasilevskis, 1960: Statistical evaluation of the Santa Barbara randomized cloud-seeding experiment. Bull. Amer. Meteor. Soc., 41, 531-547.
1957-1959; January-April; AgI; ground generator; raingages; F-test; inconclusive result.

60N02
Neyman, J., and E. L. Scott, 1960: Correction for bias introduced by a transformation of variables. Annals of Math. Statistics, 31(3) 643-655.
Normal distributions; transformed variables.

60S01
Semonin, R. G., 1960: Artificial precipitation potential during dry periods in Illinois. Physics of Precip., Meteor. Monograph No. 5, American Geophysical Union, 424-426. Discussion on 427-431.
1953-1955; precipitable water; low cloudiness; Showalter stability index; upper-air flow; surface temperature; general synoptic conditions; Advisory Committee on Weather Control; average areal; 31 cases; median; initiating low clouds; dust bowl drought of 1936; drought from 1951 to 1956.

60S02
Summers, P. W., and B. A. Power, 1960: The effect on cloud-seeding evaluation of errors in precipitation measurement due to the varying water equivalent of snow. Bull. Amer. Meteor. Soc., 41(2), 89-90.
Western Quebec (Gatineau-Lievre watersheds); October 1955 to November 1958,'a total of 28 months had been seeded; Advisory Committee on Weather Control; regression; normalized precipitation; 2 target stations; 12 control stations; unseeded months, April through November, gave no significant departure from the regression; 29 historical months; t-test; the unseeded winter months gave a highly significant departure; classified into above- and below-normal precipitation and above- or below-normal temperature.

61A01
Adderley, E. E., 1961: Non-parametric methods of analysis applied to large-scale cloud-seeding experiments. J. Meteor., 18, 692-694.
Australia; cross-over design; simulation; two regressions, square-root transformation; regression; Wilcoxon 2 sample test; single ratio; double ratio; median ratio; median test; t-test; Moran's t-test; difference of ratios; chi-square test; permutation test.

61B01
Battan, L. J., 1961: Soviet research in radar meteorology and cloud modification. Bull. Amer. Meteor. Soc., 42(11), 755-764.
Summary; "Kobal't" radar; weather modification in general; warm clouds; fog; seeding reagents; general evaluation.

61L01
Lopez, M. E., and W. E. Howell, 1961: The campaign against windstorms in the banana plantations near Santa Marta, Colombia, 1956-57.
Bull. Amer. Meteor. Soc., 42(4), 265-276.
1956 and 1957; a reduction perhaps as much 39% in damages; gamma distribution; origin of the damaging winds; weather modification in general; history; 40 string-burning AgI smoke generators in 1956; 50 in 1957; total of 260 days; Bayes procedure; economic; correlation; cube root transformation; regression; t-test.

61M01
McDonald, J. E., 1961: A historical note on an early cloud-modification experiment. Bull. Amer. Meteor. Soc., 42(3), 195.
Dissipation of low clouds over airfields; airplane; charged sand as seeding agent; Aberdeen, Maryland; August and September, 1924.

61N01
Neyman J., and E. L. Scott, 1961: Further comments on the "Final Report of the Advisory Committee on Weather Control". J. Amer. Statist. Assoc., 56, 580-600.
Bias; South Dakota; survey of projcet evaluation; Bayeslan; reinforce Brownlee's criticisms on the Final Report of ACWC.

61W01
Woodbury, M. A., E. Laska, and E. B. Kalotkin, 1961: Statistics in weather modification models, techniques and examples. Technical Report, College of Engineer., New York Univ., University Heights, NY, 101 pp.
History; correlation pattern of precipitation; factor analysis; rainfall estimation by radar and raingages; Goose Creek network in Illinois; 1906-1955; radar metoerology; Z-R relation; Santa Barbara.

62E01
Elliott, R. D., 1962: Note on cloud seeding evaluation with hourly precipitation data. J. Appl. Meteor., 1, 578-580.
Santa Barbara Project, January to April 1957-1960; randomized on 12-hour unit in 1957-1959, on storm unit in 1960; use hourly gage records; 4 stations; 4 categories of seeding oppoutunities; positive seeding effect; Mann-Whitney test for each mountian stations; 5 out of 9 cases showed 5% significant; unstable subset is even more significant.

62E02
Elliott, R. D., and R. W. Shaffer, 1962: The development of quantitative relationships between orographic precipitation and air-mass parameters for use in forecasting and cloud seeding evaluation. J. Appl. Meteor., 1(2), 218-228.
California; Santa Ynez mountain range; San Gabriel; hourly precipitation rates; relationship between instability and precipitation; regression; predictor.

62G01
Greenfield, S. M., R. E. Huschke, Y. Mintz, R. R. Rapp, and J. D. Sartor, 1962: A new'rational approach to weather-control research. Memorandum, RM-3205-NSF, RAND Corporation, 86pp.
Recommends a program od coordinated research in weather control within the context of all the atmospheric sciences; emphasize physics, meteorology, atmospheric science.

62G02
Gabriel, K. R., and J. Neumann: A Markov chain model for daily rainfall occurrence at Tel Aviv. Quart. J. Royal Meteor. Soc., 90-95.
Two states: wet and dry; the distribution of the number of rainy days per week; numbers of rainy days in different months are apparently independent.

62S01
Smith, T. B., 1962: Physical studies of the Santa Barbara Cloud Seeding Project. J. Appl. Meteor., 1(2), 208-217.
Vertical storm structure; area distribution of precipitation; transport of seeding material; seedability; orographic; stratifying target-control relationships according to storm type; natural rainfall variations; recording raingage; 3-cm APS-15 radar; echo tops; Elliott's storm model; storm stability; height and the wind direction at the -5C level; liquid water content; greater amounts of precipitation occur in the target during convective-type storms than in stable cases; natural bias.

63B01
Bourquard, A. D., 1963: Ice nucleus concentrations at the ground. J. Atmos. Sci., 20(5), 386-391.
Project Whitetop; in the average, the seeded periods showed a slightly increased nucleus count at the ground, but the increase was small when compared with natural variations in the nucleus count; persist; 1960, 1961, 1962; Bigg-Warner ice nuclei counter; counts at temperatures between -12C and -30C; stratified with respect to the wind directions observed at the surface and at 4000 ft and 10,000 ft.

63B02
Braham, R. R. Jr., 1963: Phloroglucinol seeding of undercooled clouds. J. Atmos. Sci., 20(6), 563-568.
Twelve releases; stratus clouds at temperatures of -7C to -17C; dry ice; phloroglucinol will induce the formation of ice in undercooled clouds; it was not nearly as effective as the dry ice; 18 and 19 December 1962, and 4 and 5 January 1963; northern Wisconsin; northern Michigan; cloud liquid-water contents; Johnson-Williams hot-wire device; particle-size distributions; nunbers of particles per gram of material; B-17 airplane; falling speeds of particles.

63C01
Court, A., 1963: How much weather control? Calif. Geographer, 4, 49-53.
Precipitation; Bergeron-Findeisen theory; freezing nuclei.

63C02
Crawford, N. H., and R. K. Linsley, 1963: Estimate of the hydrologic results of rainfall augmentation. J. Appl. Meteor., 2(3), 426-427.
Streamflow hydrographs; assume rainfall increased by 15%; Cottonwood Creek near Friant, California; flow duration curve; 29 and 56% of the hypothetical additional rainfall would have become runoff; soil moisture is increased by a maximum of 1.07 inches and 0.98 inches; flood peaks.

63G01
Grandoso, H. N., and J. V. Iribarne, 1963: Evaluation of the first three years in a hail prevention experiment in Mendoza (Argentina). Zeit. Angew. Math. und Phys., 14, 549-553.
4000 square km; AgI; generators from the ground; randomization of the seeding days; insurance; average percent damage; total damage; Mann-Whitney test; stratification by synoptic type; non-significant results; total damage per operation day is 34% lower for seeded days than for control days.

63H01
Huschke, R. E., 1963: A brief history of weather modification since 1946. Bull. Amer. Meteor. Soc., 44(7), 425-429.
Analysis of the literature; American Meteorological society's Meteorological and Geoastrophysical Abstracts; world distribution of cloud-modification activity; four eras of cloud modification; 1946-50 experimental era; Project Cirrus; Cloud Physics Project; 1949-54 Bandwagon era; 1952-57 evaluation era; physical analysis of cloud seeding; Project Overseed; Skyfire; Seabreeze; Sallplane; Santa Barbara Project; 1956- retrenchment era.

63S01
Siliceo, E. P., A. Ahumada A., and P. A. Mosino, 1963: Twelve years of cloud seeding in the Necaxa watershed, Mexico. J. Appl. Meteor., 2, 311-323.
Target-control; randomized; airborne electric are burner (25-50 AgI gm/hr) in 1949-1951, and 1953-1954; ground generator (electric-arc and butane-gas) (15-50 AgI gm/day); daily, monthly and seasonal rainfall; scattergram; regression; correlation; Wilcoxon 2 sample test, significant at .01 level; mass analysis; t-test; contingency table (classified by storm intensity); Mexican Light and Power Company; histogram; single ratio.

63S02
Smith, E. J., E. E. Adderley, and D. T. Walsh, 1963: A cloud-seeding experiment ir the Snowy Mountains, Australia. J. Appl. Meteor., 324-332.
1955-1959; ratio; inconclusive result; use of a closely spaced network of precipitation gages; 15 March to 1 December; randomized target-control; area-mean; lsohyets; silver-iodide burners; four aircraft types; daytime; regression; cube root transformations; t-test; significant at .03; significance level of .09; 2-sample Wilcoxon test on ratios; re-randomization test on ratios; using 10,000 samples gives the significance levels of .03.

63S03
Smith, E. J., E. E. Adderley, and F. D. Bethwaite, 1963: A cloud-seeding experiment in south Australia. J. Appl. Meteor., 2(5), 565-568.
Winter months of 1957, 1958, and 1959; randomized; airborne; AgI; 27 gages in the North; 28 gages in the South; read at 0900 local time each day; Wilcoxon Mann-Whitney; regression analysis; square-root transformation; inconclusive result.

63S04
Schaefer, V. J., 1963: Some problems concerning weather control. Zeit. Angew. Math. und Phys., 14, 523-527.
Seeding agent; economic.

63W01
Warburton, J. A., 1963: The detection of silver in rain water from cloud seeding experiments in Australia. J. Appl. Meteor., 2(5), 569-573.
Effective down to concentrations of 5×10^{-12} gm/ml; no silver was detected except when the rain fell from clouds which had been seeded with AgI; ice-crystal detection; cold-chamber; Eastern New South Wales.

63W02
Weickmann, H. K., 1963: A realistic appraisal of weather control. Zeit. Angew. Math. und Phys., 14, 528-543.
National Academy of Sciences; seeding agents in general; physical appraisal; cloud types; operational projects and logistic considerations; radiation budget.

64H01
Huff, F. A., 1964: Correlation between summer hail patterns in Illinois and associated climatological events. J. Appl. Meteor., 3(6), 240-246.
Regression; the distributions of thunderstorms, rainfall, maximum air temperature, dew-point temperature, and synoptic weather fronts were related to the hail distribution; frontal distribution pattern strongly influences the location of centers of maximum hail frequency; 1901 through 1950; number of days with hail; per 10-yr period; distribution of fronts; simple correlation analysis.

64S01
Siliceo, E. P., 1964: A note concerning "Twelve years of cloud seeding in the Necaxa watershed, Mexico. J. Appl. Meteor., 3(4), 483.
Seasonal; new precipitation data; Student's t test; aircraft; ground-based burners.

65B01
Battan, L. J., 1965: Comments on "Note on the potentialities of cumulonimbus and hurricane seeding experiments". J. Appl. Meteor., 4(3), 426-427. Reply by J. S. Simpson and R. H. Simpson.
Hypotheses for thunderstorm and hurricane modification; dynamic seeding; Project Cirrus; cloud physics; Project Stormfury; seeding rate; Arizona; reproductibility of cumulus clouds.

65B02
Beckwith, W. B., 1965: Supercooled fog dispersal for airport operations. Bull. Amer. Meteor. Soc., 46(6), 323-327.
Aircraft; Spokane, Washington; Boise, Idaho; Portland, Oregon; Salt Lake City; Medford, Oregon; ceiling; visibility.

65B03
Bowen, E. G., 1965: Lessons learned from long-term cloud-seeding experiments. Intern. Conf. on Cloud Phys., Tokyo and Sapporo, 24 May-1 June, IAMAP/WMO, 429-433.
Double ratio; Israeli project; Snowy Mountain project; New England, Australia; Warragamba project; South Australia project; Arizona project; daily as unit shows smaller seeding results than storm as unit; problem of changes in seeding sechedule.

65B04
Battan, L. J., 1965: A view of cloud physics and weather modification in the Soviet Union. Bull. Amer. Meteor. Soc., 46(6), 309-316.
5001gm of AgI per cloud used in 1961 and 1963; 50-500 gm AgI per experiment used in 1964; dissipation of supercooled fogs; cloud physics; cloud chamber; hail suppression; AgI; seeding rate; PbI; dry ice; artificial stimulation of precipitation.

65D01
Decker, W. L., 1965: Progress report on the evaluation of cloud seeding in Missouri. Current report of the U. of Missouri Extension Division, 9600-9601. Whitetop project; June-Aug. 1960-63.; half-day (noon to midnight) rainfall; Ts vs. Tns; Ts vs. Cs; .070"-.074" and .069"-.122" resp. for 4-year averages.; 50% randomized.

65G01
Gabriel, K. R., 1965: Artifical rainfall stimulation experiment in Israel-Some interim results. Intern. Conf. on Cloud Phys., Tokyo and Sapporo, 24 May-1 June, IAMAP/WMO, 163-166.
18% more rainfall at 10% significance; 24 hour as unit; AgI; DC-3; 550-600 grammes per hour; cloud base seeding; ratio of mean daily precipitation; double ratio; Wilcoxon two sample test; Bhapkar's test.

Godson, W. L., C. L. Crozier, and J. D. Holland, 1965: Silver iodide cloud seeding by aircraft in Western Quebec, Canada, 1959-63. Intern. Conf. on Cloud Phys., Tokyo and Sapporo, 24 May-1 June, IAMAP/WMO, 423-428.
1959-1963; organized cloud systems; May 15 to September 15; crossover; 3-cm radar 2 MK 3 B-25 Mitchell aircraft; DC-4M North Star aircraft; mean areal rainfall; Thiessen polygon method; Student t-test; liquid water equivalent; 45 storms seeded; slight negative effect from the seeding.

65H01
Howell, W. E., 1965: Cloud seeding against the 1964 drought in the Northeast. J. Appl. Meteor., 4(5), 553-559.
Seven cloud-seeding programs in the Northeast; normalized monthly data; increases varying from 1 to 60%, averaging 25%; non-randomization; N.Y.; Connecticut; N.J.; Mass.; New Hampshire; Maine; cube root transformation; run-off; regression; historical continuous target-control; central Potomac valley; suppression of hall; Pennsylvania; West Virginia; Virginia; Maryland.

65H02
Howell, W. E., 1965: Twelve years of cloud seeding in the Andes of Northern Peru. J. Appl. Meteor., 4(6), 693-700. (See also 66V01).
AgI; winter drought; summer convective rain; rainfall increase estimated at from 8 to 15%; significance at about the 2% level; ground generator; 1952-1965 except 1961; sugar; flood; twice-daily rainfall observations at 0700 and 1700 local time; network of stations; continuous historical target only; seasonal rainfall as unit; Kolmogoroff-Smirnoff test for normality; t-test; 2 sample Wilcoxon test; Spearman correlation coefficient.

65101
Iribarne, J. V., and H. N. Grandoso, 1965: Results of the five-year experiment on hail prevention in Mendoza (Argentina). Intern. Conf. on Cloud Phys., Tokyo and Sapporo, 24 May-1 June, IAMAP/WMO, 454-457.
AgI; November to March; 100 ground generators; randomized; effected area; total damage; average percent damage; Mann-Whitney test; classified by cold front passage or not; stratified by 500 mb wind; statistically not significant.

65L01
Lopez, M. E., and W. E. Howell, 1965: Cloud seeding at Medellin, Columbia, during the 1962-64 dry seasons. J. Appl. Meteor., 4(1), 54-60.
AgI; evaluation; increases of 20 to 40%; significant at the 1% level; economic return; hydroelectric power; two target areas; watershed; 1200 square km; ground generators; NaI; totalling 9009 generator hours of seeding; networks of raingages; monthly as unit; cube-root transformation; continuous historial target-control; t test; z-test; specific raininess; number of rainy days.

65N01
Neyman, J., and E. L. Scott, 1965: Asymptotically opticmal tests of composite hypotheses for randomized experiments with noncontrolled predictor variables. J. Amer. Statist. Assoc., 60, 699-721.
Randomization by pair is better than total randomization; multiplicative seeding effect; randomized pairs; unrestricted randomization; optimal tests of class c(a); transformation; locally root n consistent estimator; Santa Barbara Project; indicated effect of seeding is clearly nonsignificant.

65S01
Smith, E. J., E. E. Adderley, and F. D. Bethwaite, 1965: A cloud-seeding experiment in New England, Australia. J. Appl. Meteor., 4(4), 433-441. (See 71001 for re-analysis.)
1958 to 1963; AgI; aircraft; two areas; 2000 square miles; 12 days; periodic cross-over design in 1959-1963; random cross-over design in 1958; 106 gages in the North; 145 in the South; suspension of excessive rainfall; seedability; period data are listed; double ratio; re-randomization test using sums of period rainfall; regression; square-root transformation; cross-difference; one-sided t-test; streamflow; monthly rainfall correlations; F-test for variance; cloudtop temperature.

65S02
Schleusener, R. A., J. D. Marwitz, and W. L. Cox, 1965: Hailfall data from a fixed network for the evaluation of a hail modification experiment. J. Appl. Meteor., 4(1), 61-68.
Colorado; passive hail pads located 2 miles apart; hail energies measured were poorly correlated; northeastern Colorado; 1960-62; impact energy; duration of hailfall; most common stone size; maximum stone size; number of stones per square inch; transformations; gamma distribution; chi-square goodness of fit; sequential analysis; a target-control analysis was not feasible for the analysis of hail suppression experiment; a period of 3 to 5 years is believed necessary to detect changes of 10 to 25% in the hail parameters; F test for homogentity; kurtosis; coefficient of variation; the period of time required to detect scale changes.

65S03
Sansom, H. M., 1965: A preliminary report on a hall suppression experiment in Kenya. Intern. Conf. on Cloud Phys., Tokyo and Sapporo, 24 May-1 June, IAMAP/WM0, 449-453.
Italian anti-hail rockets; TNT as seeding agent; 9 July, 1963 to 31 December 1964; hail damage; positive seeding effect.

65T01
Todd, C. J., 1965: Ice crystal development in a seeded cumulus cloud. J. Atmos. Sci., 22(1), 70-78.
Cloud base seeding; AgI; icecrystal size, type, and concentration; Flagstaff, Arizona; 15 August 1962; two calibrated airborne Skyfire generators.

65T01
Takeda, K., 1965: A quantitative determination of the amount of artificial precipitation in the case of dry-ice seeding. Intern. Conf. on Cloud Phys., Tokyo and Sapporo, 24 May-1 June, IAMAP/WMO, 441-445.
Kyushu, south-west Japan; March 1964; P2V aircraft; 3 cm radar; radar estimated rainfall; 0.6-0.9 mm/hr as the maximum intensity of rainfall and 0.03-0.06mm as the cumulative point rainfall.

65W01
Warburton, J. A., and C. T. Maher, 1965: The detection of silver in rainwater: Analysis of precipitation collected from cloud-seeding experiments. J. Appl. Meteor., 4(5), 560-564.
Ag was detected in 41 of 63 'seeded' samples and in three of 23 'unseeded' ones; Ag is detected more frequently when the precipitation falls from seeded clouds which have top temperatures -15C; eastern Australia; in convective situations the seeding aircraft normally flies at the base of the clouds and In stratiform conditions the seeding is usually done at about the -10C level; detectability of Ag was unaffected by cloud type; wash-out; rain-out.

65Y01
Yang, I. K., 1965: A preliminary survey for the seeding experiment in Korea. Intern. Conf. on Cloud Phys., Tokyo and Sapporo, 24 May-1 June, IAMAP/WMO, 434-436.
Ice nucleus concentration; AgI; 53 gages; Seoul; winters of 1962-1963 to 1964-1965; millipore filter; topographical influence; L-5 type aircraft.

66B01
Bowon, E. G., 1966: The effect of persistence in cloud seeding experiments. J. Appl. Meteor., 5(2), 156-159.
Cumulative effects; cloud physics; freezing nucleus; designs; independence of observations; randomized target-control; double ratio; periodic random target-only; ratio of successive seeded and unseeded; an apparent decrease in the seeding result of the experiment with increasing time; analysis of six experiments; change in seeding schedule; cumulative and decay effects follow a geometric progression; daily; storm periods; double ratio for those experiments scheduled on a daily basis showing a smaller result than those in which the change-over was by storm periods; cross-over; design; Tasmania.

66B02
Bethwaite, F. D., E. J. Smith, J. A. Warburton, and K. J. Heffernan, 1966: Effects of seeding isolated cumulus clouds with silver iodide. J. Appl. Meteor., 5(4), 513-520.
Sydney; 1964; aircraft; random choice of treatment; NaI; 11 specifications of seedability; temperature; cloud base; cloud shape; isolation; precipitation; rank sum test; positive seeding effect.

66B03
Battan, L. J., 1966: Silver-iodide seeding and rainfall from convective clouds. J. Appl. Meteor., 5(5), 669-683.
Randemized; target area of 15 by 20 miles; Santa Catalina Mountains; 1961; 1962; 1964; Arizona; airborne; seedability; precipitable water; 29 recording raingages; rank sum test; inconclusive seeding effect.

66B04
Butchbaker, A. F., L. A. Hagen, and D. J. Lacher, 1966: An analysis of precipitation records associated with a commercial hail suppression project in southwestern North Dakota. Agricultural Engineering Department, North Dakota State University, Fargo, ND, 61 pp.
Bowman-Slope project; aircraft seeding and ground generators; 3-cm radar; hail indicator; raingage; evaluation.

66B05
Butchbaker, A. F., D Hinkle, L. J., Hagen, and E. Rodakowski, 1966: Modification of convective storms in southwestern North Dakota during 1965. Agricultural Engineering Department, North Dakota State University, Fargo, ND, 19 pp.
Bowman-Slope project; ground generators and aircraft seeding; hail indicators; 3-cm radar; raingage; evaluation.

66B06
Butchbaker, A. F., D. Hinkle, L. A. Hagen, and E. Rodakowski, 1966: Observations of convective storms in connection with a hail suppression project, Part 2: Analysis of hailfall data. Agricultural Engineering Department, North Dakota State University, fargo, ND, 33 pp.
Bowman-Slope project; commercial; aircraft and ground generator seeding; raingage; hail indicators; 3-cm radar; hail energy; evaluation.

66B07
Braham, Roscoe R., Jr., 1966: Project Whitetop: Part I - Design of the experiment, Part II - Summary of operations. Final Report, Dept. of Geophys. Sci., University of Chicago, 156 pp.
AgI; radar; day; randomized; cloud physics; flight log; experiment were primarily directed toward afternoon airmass convective clouds.

66D01
Dennis, A. S., D. F. Kriege, 1966: Results of ten years of cloud seeding in Santa Clara county, California. J. Appl. Meteor., 5, 684-691.
Linear regressions; seasonal totals; winters; downwind; reservoirs; target area is 710 square mi; radar; aircraft; silver iodide generators; sodium iodide; 25 gm/hr per generator; twenty-five target stations; 16 control stations; 1945-1954 as historical; 1 December and 31 March; Thiessen method; total rainfall; ANOCOVA; scattergram; continuous-historical; two regression lines; stability variations; 1954-1964 except 1956; positive seeding effect.

66D02
Decker, W. L., and P. T. Schickedanz, 1966: Project Whitetop: Part IV - A summary of the rainfall analysis. Final Report, Soils Department, Univ. of Missouri, Columbia, 362 pp.
Chicogo plume; Missouri plume; houly rain; daily; t-test; shower intensity; logarithmic transformation; signed rank sum test; Wilcoxon 2-sample test; AgI; 198 days in 1960-1964; Thiessen polygon; data listing; contingency table.

66E01
Elliott, R. D., 1966: Effects of seeding on the energy of systems. J. Appl. Meteor., 5(5), 663-668.
Randomized in time; target of area 450 square mi.; Santa Barbara; California; 1957-1960; 25 ground generators; AgI; at a rate of 6 gm/hr; storms as unit; 35 non-seeded; 42 seeded cases; positive seeding effect.

66F01
Flannagan, M. J., 1966: Observations of convective storms in connection with a hail suppression project, Part 1: Description of cloud seeding operations and summary of meteorological data. Agricultural Engineering Department, North Dakota State University, Fargo, ND, 16 pp.
Bowman-Slope project; ground generator; 3-cm radar; aircraft seeding; ground generator; raingage.

66G01
Godson, W. L., C. L. Crozier, and J. D. Holland, 1966: An evaluation of silver iodide cloud seeding by aircraft in Western Quebec, Canada, 1960-1963. J. Appl. Meteor., 5(4), 500-512.
Two test areas 32 nautical miles square; randomized cross-over; 2X1015 nuclei/min active at -17C; 30 raingages in 1959; 60 raingages per area in 1960; ratios; slight negative effect.

66H01
Huff, F. A., 1966: The effect of natural rainfall variability in verification of rain modification experiment. Water Res. Research, 2(4), 791-801.
Cross-over design; four raingage networks in Illinois; target-control design; target only design; air mass storms; all storms; raingage density; climatology; storm as unit; simulation; spatial and temporal variation; 1955-1964; average network rainfall as response variable; area-depth curve; size of sampling area; sampling errors.

66H02
Huff, F. A., and S..A. Changnon, Jr., 1966: Development and utilization of Illinois precipitation networks. Symp. Design of Hydrol. Networks, No. 67, I.A.S.H., 97-125.
Description of seven raingage networks; El Paso Network; Panther Creek Network; Boneyard Network; East-Central Illinois Network; 19-acre Airport Network; Little Egypt Network; Shawnee Network; storm area-depth relations; sampling errors; rainfall variability; radar-rainfall research; severe storms; climatology.

66H03
Howell, W. E., M. E. Lopez, 1966: Cloud seeding in Southern Puerto Rico, April-July 1965. J. Appl. Meteor., 5, 692-696.
Drought; increase of 2.69 inches; 14% increase; significant at the 10% level; continuous-historical covarivate design; operational; trade wind; silver iodide; salt; 23 generator; 47 days; total of 2559 generator-hours; aircraft; 0.5 kg of salt per km of flight; 90 hours; regression; number of rainy days; specific raininess as response variable; daily rainfall; 1946-1964 as historical; 25 stations; May and June; transformation; t-test; sources of bias; sugar-cane.

66H04
Howell, W. E., 1966: Effect on mean rainfall of artificially increased variance. J. Appl. Meteor., 1(1), 128-129.
Effect of cloud seeding was an increase in the variance of the rainfall distribution, without any change in the median; skewness; cube-root transformation; size of the clouds; buoyancy; Whitetop; Project Stormfury; statistical indications derived on the basis of one program or another can be considered as applying only to the particular techniques and practices used.

66H05
Henderson, T. J., 1966: A ten year non-randomized cloud seeding program on the Kings River in California. J. Appl. Meteor., 5(5), 697-702.
October-April; increase rainfall and snowpack; AgI; ground generators; 11.6 gm/hr; airplanes; radar; flow of King's River; regression; correlation coeffieients; t-test; increase of 6%.

66H06
Howell, W. E., 1966: Conceptual models that guide applied cloud seeding. Bull. Amer. Meteor. Soc., 47(5), 397-400.
Dissipation of quasi-static cloud; precipitation from small and large clouds; cloud electrification; cloud-explosion model; hail modification; warm-front clouds.

66H07
W. E. Howell Assoc., Inc, 1966: Report and evaluation of precipitation stimulation for the Hackensack Water Company Sept 1964 -- April 1966. Technical Report, W. E. Howell Assoc., Inc, Lexington, MA, 7 pp.
September 1964 through Februry 1967; storm as unit; 19% rain increase; operational; New York; New Jersey; continuous target-control; t-test.

66K01
Knollenberg, R. G., 1966: Urea as an ice nucleant for supercooled clouds. J. Atmos. Sci., 23(2), 197-201.
Laboratory; three field releases of urea; it is concluded that urea is an effective seeding reagent for supercooled clouds; equally effective as dry ice; February 1965; Bigg-Warner chamber; northern Wisconsin; Beechcraft airplane; 5 and 10 pounds per mile; photographs.

66L01
Lopez, M. E., 1966: Cloud seeding trials in the rainy belt of western Colombia. 47th Annual Meeting of the American Geophysical Union, Washington, D. C. 19 April, 21p.
Daily streamflow; serial correlation; Bayes; regression; an increase of 13%; AgI; ground generators; 1963-1966; at a rate of about 6 gm/hr; pyrotechnic flares hung from hydrogen balloons; gamma; specific raininess; transformation; t test; probability of zero precipitation.

66M01
Markovic, R. D., 1966: Statistical evaluation of weather modification attainments. Hydrology Paper No. 16, Colorado State Univ., 44 pp.
Kings River Basin; 3-station linear model; 3-variate normal residual; hydrology; mean and variance as the test statistics; annual; t-test; chi-squared test; T-square test.

66N01
National Academy of Sciences-National research Council, 1966: Weather and Climate Modification: Problems and Prospects, Vol. II, Research and Development. Publ. No. 1350, NAS-NRC, Washington, D.C.
Rainfall increases of 10-20% can be induced by cloud seeding under favorable conditions.

66S01
Simpson, J., R. H. Simpson, J. R. Stinson, and J. W. Kidd, 1966: Stormfury cumulus experiments; Preliminary results 1965. J. Appl. Meteor., 5(4), 521-525.
Randomized; fifteen seeded and seven unseeded; Carribbean Sea between July 28 and August 10 1965; photographic; radar; humidity differences; 2/3 of seeded clouds undrewent marked vertical growth; 6/7 of the controls did not.

66S02
Summers, P. W., 1966: Note on the use of hail insurance data for the evaluation of hail suppression techniques. Research Council of Alberta, information series No. 52, 25pp.
Alberta; a large variation in the loss-to-risk ratio is evident from year to year and this variation becomes larger, the smaller the area considered; point out some of the difficulties involved in a statistical evaluation of the effectiveness of hail suppression; percent-normal method; Students t-test; scatter diagram.

66V01
Vickers, W. W., and J. F. Church, 1966: Investigation of optimal design for supercooled cloud dispersal equipment and techniques. J. Appl. Meteor., 5(1), 105-118.
Two-level, two-variable factorial design; dry-ice pellet; C-130 aircraft; cloud texture break; maximum area and width of the texture break area; sign test; Kolmogorov-Smirnov test; seeding rate; pellet size; strong influence on cloud response.

66V02
Vonnegut, B., 1966: Desirable requirement for scientific papers describing weather modification experiments. J. Appl. Meteor., 5(5), 742-744.
Technique used in the *seeding* operation; Peru; AgI; generator.

66W01
Woodley, W. L., 1966: Computations on cloud growth related to the seeding of tropical cumuli. Bull. Amer. Meteor. Soc., 47(5), 384-392.
Soundings; St. Martins Island; August of 1962; spectacular height increases due to seeding can be expected, but that such cases are relatively infrequent; cloud top prediction; wind; relative humidity.

67B01
Bernier, J., 1967: On the design and evaluation of cloud seeding experiments performed by Electricite de France.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 5, 35-54.
Survey of 4 projects: Tignes, Truyere, Maine-Touraine-Beauce (MTB), and Cere-Maronne; target and control; historical control; non-randomized and randomized; various experimental units; transformations used: squared root, cubic root, logarithm transformations; maximum likelihood ratio test; two regressions (ANOCOVA); t-statistics.

67B02
Brownlee, K. A., 1967: Review of "Weather and Climate Modification: problems and Prospects, Volumes I and II". J. Amer. Statist. Assoc., 62, 690-694.
NAS-NRC report 1966; 8 possible biases; imprecision in the choice of target area and the choice of control area; statistical design; definition of power; definition of "unbiased"; purpose of trial randomization.

67B03
Brier, G. W., T. H. Carpenter, and D. B. Kline, 1967: Some problems in evaluating cloud seeding effects over extensive areas.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 5, 209-221.
16 operational projects; cubic root transformation; historical regression; eastern U. S.; monthly (62 in all); t-test; 11 project areas; 41 additional unseeded months; extended target areas; negative seeding effect.

67B04
Battan, L. J., 1967: Cloud seeding and cloud-to-ground lightning.
J. Appl. Meteor., 6(1), 102-104.
Summers of 1958 to 1962; convective clouds; Arizona; airborne; AgI; inconclusive result; Project Skyfire; randomized; overseeding; days; Santa Catalina Mountains; 200 square mi; frequency of cloud-to-ground lightning; visual counting; periodic randomized target-only design; aircraft flying at about the -6C level; in 1958-1960 56% more strokes on the seeded days; signed-rank test; Mann-Whitney U test; one-tailed probabilities of 0.16 and 0.22, respectively; in 1961 and 1962 38% less lightning on the seeded days; one-tailed probabilities of 0.17 and 0.21, respectively.

67B05
Battan, L. J., 1967: Silver-iodide seeding and precipitation initiation in convective clouds. J. Appl. Meteor., 6(2), 317-322.
Santa Catalina Mountains; Arizona; target 15 by 20 miles; 1957 to 1964; randomized on pair of days; airborne; cloud-census technique; radar data; rank-sum test.

67B06
Biswas, K. R., R. K. Kapoor, K. K. Kanuga, Bh. V. R. Murty, 1967: Cloud seeding experiment using common salt. J. Appl. Meteor., 6(5), 914-923.
Warm cloud seeding; northwest India; randomized by days; ground-based generators; 2500 gms of salt mixture/min; network of raingages; daily; median ratio test; Wilcoxon-Mann-Whitney test; t-test; 21% increase in a season's total rainfall.

67B07
Battan, L. J., and A. R. Kassander, Jr., 1967: Summary of results of a randomized cloud seeding project in Arizona.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 29-33.
1957 to 1960; randomized; Santa Catalina Mountains; pairwise comparison; AgI; 29 recording raingages; signed rank test; Mann-Whitney U Test; 1961; 1962; 1964.

67C01
Changnon, S. A. Jr., and F. A. Huff, 1967: The effect of natural rainfall variability in verification of rain modification experiments.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 5, 177-189.
Central and southern Illinois; warm season rainfall; storm type; designs; gage density; sampling error; natural variability of rainfall in time and space; air mass or nonfrontal storms;. all summer storms; simulation; area size; gamma fitting.

67C02
Changnon, S. A. Jr., 1967: Areal-temporal variations of hail intensity in Illinois. J. Appl. Meteor., 6, 536-541.
Frequency of intense hail in the crop season was found to increase with time, reaching a maximum in September; insurance statistics corn damage from hail was usually greater in July; central Illinois hailstone sizes and number (volume of ice) and durations of hailstorms related moderately well with crop-hail damage; hail at Urbana, Ill., 1946-1965; monthly; a greater percentage of all hailstorms in the E, C(central), and SW districts were more intense.

67C03
Changnon, S. A. Jr., and G. E. Stout, 1967: Crop-hail intensity in central and northwest United States. J. Appl. Meteor., 6, 542-548.
Mean areal patterns; crop-insurance data; summer hailfalls at points in the lee of the Rocky Mountains were 5 to 15 times more intense than those in the Middle West; 19 major grain-producing states; 1957-1964; loss cost; crop susceptibility; storm-day frequencies; regional variations in the state; lack of significant geographical variability in the month of maximum corn damage; hail day correlation coefficient for the crop insurance intensity-frequency values was +0.89.

67C04
Court, A., 1967: Randomized cloud seeding in the United States.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 237-251.
15 field experiments; SCUD; ACN; Cloud Physics project; Santa Barbara project; Arizona; Eagle project; Skyfire project; Whitetop; Climax 1; Almanor project; N.A.R.P. project; Climax 2; Colorado Hail project; South Dakota project; Stormfury; experimental unit; design; nucleation; Advisory Committee on Weather Control; randomization.

67C05
Chamborlain, A. R., and L. O. Grant, 1967: Weather modification and its relationship to environment. Western Resources Conf., 69-79.
Definition of weather modification; change in precipitation intensity; change in precipitation duration; changes in the spatial distribution of precipitation; temporal redistribution of precipitation.

67D01
Dennis, A. S., 1967: Outline of design principles and data requirements for field programs in weather modification. Proc. Proect Skywater, II, Denver, 11-13, Oct., 25-39.
Experimental unit; contamination; radar; stratification.

67D02
Davis, L. G., and C. L. Hosier, 1967: The design, execution and evaluation of a weather modification experiment.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 253-269.
Mountain wave influence; terrain influences; need detailed observations of clouds; October 27, 1963; dry ice pellets; sounding; PPI radar plots; central Pennsylvania; observed height change versus the predicted height change.

67D03
Davies, R. B., and P. S. Puri, 1967: Some techniques of summary evaluations of several independent experiments.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 385-388.
Rain stimulation experiments; c(a)tests; gamma.

67D04
Deeker, W. L., and P. T. Schickedanz, 1967: The evaluation of rainfall records from a five year cloud seeding experiment in Missouri.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 5, 55-63.
1960 through 1964; south central Missouri; north central Arkansas; AgI; aircraft; Whitetop; precipitable water; Chicago plumes; Missouri plumes; 12000 square miles; in-plume rain; out-plume rain; logarithmic transformation; not significant for Chicago Plumes; t-test; Mann-Whitney U test; significant negative seeding effect for Missouri in-plume daily rainfall.

67D05
Dennis, A. S., M. R. Schock, A. Koscielski, and P. M. Mielke, 1967: Evaluation of cloud seeding experiments in South Dakota during 1965 and 1966. Report 67-1, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 71 pp.
Shadehill; summer; AgI; random target-only; sum of squared rank test; random target-control; Wilcoxon test; regression; Rapid City Project; randomized cross-over; day as unit; precipitable water; 850 mb wind; two regressions; chi-square test; dry ice seeding; Project Cloud Cooler; nonrandomized; NaCl seeding; drop size.

67E01
Elliott, R. D., and W. A. Lang, 1967: Weather modification in the southern Sierras. J. Irrig. and Drainage Div., Proc. of Amer. Soc. of Civil Eng., 45-59. Discussion by A. S. Dennis (p. 284, 1968)
Upper San Joaquin River Basin; runoff in streams; Merced River; Kings River Basin; Santa Clara County; economic; desirable for the Merced Basin to be kept free of cloud seeding experiments; ice nuclei concentration.

67E02
Eberly, D. L., and L. H. Robinson, 1967: Design and evaluation of randomized wintertime cloud seeding at high elevation.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 65-90.
AgI; Almanor; California; six sites; 27 grams per hour; January 28 through May 14, 1963; snow; 51 gages; wind direction; data; four basic weather types; variation of seeding effect with temperature; regression; variation of effect with time; crossover; random target control; contamination; ANOCOVA; F test; power; ratio; BIANOVA; transformations; the increase was 40% for all westerly cases and 60 per cent when only the cold cases were analyzed.

67E03
Eagleson, P. S., 1967: Optimum density of rainfall networks. Water Res. Research, 3(4), 1021-1033.
Harminic analysis; peak catchment discharge; spatial variability of convective and cyclonic storm rain; flood forecasting.

67G01
Gabriel, K. R., Y. Avichai, and R. Steinberg, 1967: A statistical investigation of persistence in the Israeli artificial rainfall stimulation experiment.
J. Appl. Meteor., 6(2), 323-325.
Randomized cross-over design using four areas with 2 additional controls; day as unit; AgI; aircraft; ratio; standard errors; correlations; no evidence of persistence of effects of cloud seeding.

67G02
Gabriel, K. R., 1967: Recent results of the Israeli artificial rainfall stimulation experiment. J. Appl. Meteor., 6(2), 437-438.
Day as unit; crossover design; AgI; airplane; Wilcoxon-Mann-Whitney test.

67G03
Gabriel, K. R., 1967: The Israeli artificial rainfall stimulation experiment. Statistical evaluation for the period 1961-65.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 91-113.
AgI; aircraft; randomized crossover; 24 hours; no persistence; ratio; double ratio; Wilcoxon-Mann-Whitney test; season to season differences; monthly differences; differences according to amounts of natural rainfall; concomitant variable; temperatures at 700 mb.

67G04
Grant, L. O., and P. W. Mielke, Jr., 1967: A randomized cloud seeding experiment at Climax, Colorado, 1960-65.
Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 115-131.
Seeding is effective when 500 mb temperature was -20C or warmer, but not effective when -20C or colder; randomization is unrestricted; 24 hours; operational procedures; CSU modified Skyfire, needle type ground generator; 20 gm of AgI per hour; southwest, west, and northwest of the target were chosen for controls; transformation; gamma; scale change; 1-sample Wilcoxon statistic; Mood test; concentration of ice nuclei; during the early part of the experiment, the seeded cases in the target area receivedconsiderably greater precipitation than the nonseeded cases; stratified by 500 mb temperatures; 14.8% less precipitation when the 500 mb temperature has been colder than -24C; 54.5%more precipitation when the 500 mb temperature has been -20C or warmer.

67H01
Hagen, L. A., and A. F. Butchbaker, 1967: Climatology of hailstorms and evaluation of cloud seeding for hail suppression in southwestern North Dakota.
Fifth Conf. on Severe Local Storms, St. Louis, 336-347.
Summer of 1966; commercial; 3 cm radar; reflectivities; questionnaire; crop damage; synoptic conditions; Bowman-slope project; 2,000 square miles; 155 passive hail impact indicators and raingages; two aircraft equipped with Lohse generators; 20 Skyfire; 4%silver-iodide-in-acetone solution; 3 1/2 lb per hour; completely random design; F-test; size distribution of hailstones; hail day; duration of hailfall; time of onset.

67H02
Hicks, J. R., 1967: Improving visibility near airports during periods of fog.
J Appl. Meteor.. 6(1), 39-42.
Liquefied propane; ground-based dispensers; 6 Oct. 1964 to 24 July 1965; six of these tests were conducted at Camp Century, Greenland, five were successful; six tests were made in the Hanover-Lebanon, N. H., five of these tests were successful; visibility; supercooled fogs; induce glaciation and subsequent improvement in visibility when temperatures at 2m are below 0C.

67H03
Hagen, L. A., 1967: Climatology of hailstorms and evaluation of cloud seeding for hail suppression in southwestern North Dakota. Unpublished Theses, North Dakota State University, Fargo.
Summer of 1966; commercial; 3 cm radar; reflectivities; questionnaire; crop damage; synoptic conditions; Bowman-slope project; 2,000 square miles; 155 passive hail impact indicators and raingages; two aircraft equipped with Lohse generators; 20 Skyfire; 4% silver-iodide-in-acetone solution; 3 1/2 lb per hour; completely random design; F-test; size distribution of hailstones; hail day; duration of hailfall; time of onset.

67J01
James, B. R., 1967: On Pitman efficiency of some tests of scale for the gamma distribution. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 389-393.
The exponential scores test offers greater Pitman efficiency than the Wilcoxon when the shape parameter is small; effect of seeding is multiplicative; square rank test; gamma scores statistic; exponential scores test.

67M01
Miclke, P. W. Jr., 1967: Note on some squared rank tests with existing ties. Technometrics, 9(2), 312-314.
Tied observations; Taha's squared rank test; Mood's squared rank test.

67M02
Mielke, P. W. Jr., 1967: Statistical design and weather modification. Proc. Project Skywater, II, Denver, 11-13, Oct., 259-273.
Design in general; evaluation in general; randomization; post stratification; robust statistical procedures.

67M03
Muller, H. G., 1967: Weather modification experiments in Bavaria. Proc. Fifth Berkerle Symp. on Math. Statist. and Prob., V, 223-235.
Region of Rosenheim; 320 square miles; suppress hail; insurance; seventy six rocket posts; ground generators; 1 gm of AgI per minute; three cm weather radar; damaged by hail; number of days with damage; 29% reduction; 1958-1965 seeded; 1950 to 1957 as historical control; ratio.

67N01
Neyman, J. 1967: Experimentation with weather control. J. Royal Statist. Soc. A, 130, 285-310.
Disadvantage of target-control regression; exploratory data analysis; NAS-NRC Panel on Weather and Climate Modification; problems of statistical theory.

67N02
Neyman, J., and E. L. Scott, 1967: Rationale of statistical design of a rain stimulation experiment. Proc. Project Skywater, II, Denver, 11-13, Oct., 193-258.
Necessity of randomization; danger of contamination of the control area; statistics in general; hypothesis testing; review of 23 experiments with rain stimulation; Western Quebec; Whitetop; Arizona experiments; SCUD project; Grossversuch III; Project Rapid; variability of rainfall.

67N03
Neyman, J., and E. L. Scott, 1967: Some outstanding problems relating to rain modification. Proc. Fifth Berkerley Symp. on Math. Statist, and Prob., V, 293-326.
Power function; asymptotic results; Grossversuch III; evidence of decreases in precipitation due to seeding; review of projects; Fisher's test; Arizona; optimal c(a)tests; Project SCUD; Whitetop; Wilcoxon-Mann-Whitney test; Kolmogorov-Smirnov test; median test; multiplicative effect; Monte Carlo; gamma distribution; power.

67N04
Neyman, J., and E. L. Scott, 1967: On the use of c(a) optimal tests of composite hypotheses. Bull. Inst. Intern. Statist., 41, 477-495, with discussion.
Multiplicative effect of seeding; transformation; if the effect of seeding is really multiplicative and if the effect of seeding is tested by the t-test based on the assumption of additivity in the transformed variables, then the resulting loss in efficiency is always substantial; power; gamma; Grossversuch III; Arizona; Whitetop.

67N05
Neyman, J., and E. L. Scott, 1967: Planing an experiment with cloud seeding. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 327-350.
Need efficient experimental design; SCUD; Arizona; Grossversuch III; experimental unit; power; variability of precipitation; predictor variables; examination of historical climatological data; gamma; regression; c(a) tests; sample size.

67N06
Neyman, J., and E. L. Scott, 1967: Note on the Weather Bureau ACN Project. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 351-356.
Washington; Oregon; dry ice; aircraft; 273 randomized; three types of targets; difference; measurement error; multiplicity of arithmetical operations; data; t test; bias in defining target.

67N07
Neyman, J., and E. L. Scott, 1967: Note on techniques of evaluation of single rain stimulation experiments. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 371-384.
Power of the tests; c(a) criterion; probability of zero precipitation; multiplicative seeding effect; three distinct hypotheses; conditional distribution of rainfall given that this rainfall is not zero.

67N08
Nason, C. K., and M. E. Lopez, 1967: A test of certain evaluation designs for cloud-seeding experiments. Technical Report B-3662, W. E. Howell Associates, Systems Development Division, 68 pp.
Simulation; multiplicative seeding effect models; exponentially variable seeding effect model; t-test; 3 raingage network; seedability; type I and II errors.

67P01
Prikhot'ko, G. F., 1967: Evaluation of effectiveness of artificially induced precipitation from convective clouds. Clearinghouse for Federal Scientific and Technical Information, U.S. Dept. of Commerce, 21 pp.
Summers of 1960-1964; Ukraine, USSR; 15% increase of rain; review of projects; dry ice; radar-estimated rainfall was 13,000 tons per shower; 1955-1959 as historical; continuous historical target-control; difference; monthly as unit; ratio; correlation; regression; t-test.

67S01
Simpson, J., 1967: Photographic and radar study of the Stormfury 5 August 1965 seeded cloud. J. Appl. Meteor., 6(1), 82-87.
APS-20 (10 cm) and APS-45 (3 cm) radars; maximum height of the cloud echo; cloud top temperature; support the inference by Ruskin that the freezing observed at the edge of the cloud occurred in situ and that, in all likelihood, it was due to the AgI seeding.

67S02
Simpson, J., G. W. Brier, and R. H. Simpson, 1967: Stormfury cumulus seeding experiment 1965: Statistical analysis and main results. J. Atmos. Sci., 24, 508-521.
Randomized; 23 tropical oceanic cumulus clouds on 9 days in the summer of 1965; 14 clouds were seeded; randomization.scheme was prepared by W. J. Yonden; a numerical model of cumulus dynamics was specified in advance of the field program; use cloud top as response variable; seeded clouds grew vertically an average of 1.6 km more following the seeding run; .01 singificant; 2/3 randomization; blocking; Caribbean Sea; 8-16 pyrotenic AgI generator (Alecto units) were used, each releasing 1.2 kg of AgI smoke.

67S03
Siliceo, E. P., 1967: A brief description of an experiment on artificial stimulation of rain in the Necaxa Watershed, Mexico. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 133-140.
Airplane; June through October; randomization; historical regression; seasonal; ground-based generators; daily; AgI; contamination; 15 years of historical data; histograms; there probably is an seeding effect for more than one day.

67S04.
Schmid, P., 1967: On "Grossversuch III," a randomized hail suppression experiment in Switzerland. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 141-159.
Day as unit; non-randomized (II); randomized (III); hailday; crop damage; negative effect; 1957-63; 3500 square km; May to September; days; 20 hail observation posts; categorical analysis; chi-square test; hail days; wind velocities at 5500 m; gamma distribution; sum of square rank test; increased rain by large amounts; hail results are not as conclusive.

67S05
Smith, E. J., 1967: Cloud seeding experiments in Australia. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 161-176.
History; experiments on single clouds; area experiments; Snowy Mountains; south Australia; New England; Warragamba Catchment; randomized; double ratio; regression; transformation; root double ratio; persistent effects of seeding; there is evidence that the results of seeding on rainfall are very variable and may sometimes be negative; cloud top temperature; variations in rainfall gradients; Tasmania.

67S06
Simpson, J., 1967: An experimental approach to cumulus clouds and hurricanes. Weather, 22(3), 95-114.
Convective clouds; prediction of seedability.

67W01
Wells, J. M., M. A. Wells, 1967: Note on Project SCUD. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 357-369.
East coastal region of the United States; AgI released from seventeen ground-based generators; dry ice dispensed from aircraft; two targets; 24 hour; covariates; geostrophic meridional circulation index; sum of net water vapor influx; latitude of the cyclone; observational data; 1953-1954; regression; geometric means; reevaluation; c(a)criterion; multiplicative effect of seeding.

67W02
Warner, J., and S. Twomey, 1967: The production of cloud nuclei by cane fires and the effect on cloud droplet concentration. J. Atmos. Sci., 24(6), 704-706.
Increase very greatly the number concentration of droplets in clouds formed well downwind from the fires; Queensland, Australia; November 1966; thermal diffusion chamber; no rain was recorded at Bundaberg during the period; the concentration was about 5 trillions/gm.

67Y01
Yates, F., 1967: Discussion of reports on cloud seeding experiments. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 5, 395-397.
Concomitant observations; long-term effects; blocking.

67Y02
Yevdjevich, V. M., 1967: Evaluation of weather modification as expressed in streamflow response. Proc. Fifth Berkerley Symp. on Math. Statist. and Prob., V, 283-292.
Criteria of reliable data; selection of variables; target and control basin approach; randomization of time series approach; past records as control; sampling errors; precipitation-runoff relationship.

68A01
Adderley, E. E., 1968: Rainfall increases down-wind from cloud seeding projects in Australia. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 42-46.
Rainfall; 2 areas; 1966 and 1967; AgI; airplane; 8" raingages; 24 hours; has downwind effects.

68A02
Adderley, E. E., 1968: Cloud-seeding in western Victoria in 1966. Austr. Meteor. Magaz., 16(2), 56-63.
Australia; re-analysis; 3 months in 1966; 45 raingages; 1 target area; two control areas; 1925-1965 as historical; monthly rainfall; areal mean; historical continuous target-control design; correlation coefficients.

68B01
Butchbaker, A. F., 1968: Evaluation of a hail suppression program in southwestern North Dakota. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 503-512.
Bowman-Slope Hail Suppression Project; 30 by 70 miles; Lohse wingtip silver-iodide generators; two AT-6 type aircraft; 20 Skyfire ground generators; 3-cm radar; two PPI; radar scope overlays every 15 minutes; 181 hail indicators and raingages; questionnaires; flight logs; radar reflectivity; total hail energies; logarithm transformation; analysis of variance; F-test; positive seeding effect.

68B02
Brown, K. J., and R. D. Elliott, 1968: Large scale dynamic effects of cloud seeding. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 16-25.
Whitetop; Coeur d'Alene Lake project in northern Idaho; storm precipitation totals; seed/unseed ratio; an area of high ratios located approximately 100 miles downwind from the intended target area; chi-square test; mean 700 mb wind flow; downwind effect is much stronger during storms with meteorological Mach numbers near 1.0 than with higher Mach values; stratification by 700 mb temperature; downwind ratio maximum is much more pronounced in the warm storm sample; Western U.S.; 1948-1964.

68B03
Bowen, E. G., 1968: Review of current Australian cloud-seeding activities. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 1-7.
Effect of persistence; Tasmania; seeded/unseeded ratio; Victoria; New southern Wales; western Australia; southern Australia.

68B04
Bradley, W. E., R. G. Semonin, 1968: The effect of artificially produced space charge on the electrification of clouds. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 114-121.
Summers of 1961 and 1962; 49 recording raingages; 1036 square km; a total of 160 cumulus clouds was studied; first echo study.

68B05
Beakwith, W. B., 1968: An analysis of airport fog disersal operations. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 361-368.
Medford-Jackson Airport, Oregon; 24 December 1967 to 11 January 1968; supercooled; dry ice method; liquid propane method; warm fog dispersal; economics.

68C01
Changnon, S. A. Jr., 1968: Effect of sampling density on areal extent of damaging hail. J. Appl. Meteor., 7(3), 518-521.
Two squared-shaped areas in central Illinois, one comprising 4000 and other 1000 square mi; 1952-1963; insurance data; hail days; study area with 1 point per 9 square mi will measure only 18% of the actual daily areal extent of damaging hail and an area with 1 point per 3 square mi will measure only 30% of the daily damage area; 1 or more observation sites per square mile is *necessary*.

68C02
Changnon, S. A., Jr., 1968: Evaluation of data to verify hail modification efforts. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 513-521.
Data quality; hail day; crop-hail loss data; radar data; areal extent of hail; hail energy; aerial photographs; airborne infrared sensor; hail intensity; hailstreak.

68C03
Chamberlain, A. R., and L. O. Grant, 1968: Weather modification and its relationship to environment. Man and the Quality of His Environ., J. E. Flack, and M. C. Shipley, eds., University Colorado., 69-79.
Definition of weather modification; change in precipitation intensity; change In duration of precipitation; changes in the spatial distribution of precipitation; temporal redistribution of precipitation.

68D01
Duran, B. S., and P. W. Mielke, Jr., 1968: Robustness of sum of squared ranks test. J. Amer. Statist. Assoc., 63, 338-344.
Multiplicative seeding effect; locally most powerful rank test; shape and scale parameters of gamma distribution; asymptotic relative efficiency; scale change.

68D02
Davis, R. J., 1968: New wine in old bottles: Weather modification legal analogies. Man and the Quality of His Environ., J. E. Flack, and M. C. Shipley, eds., University Colorado., 91-104.
Water law; liability law.

68D03
Dennis, A. S., A. Koscielski, and C. L. Hartzell, 1968: Rapid Project report for 1967. Report 68-5, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 57 pp.
Stratified by precipitable water, 850 mb wind; 700 square miles; crossover; seeding operation; AgI; square-root transformation; two regressions; chi-square test.

68E01
Elliott, R. D., 1968: Design of an orographic cloud seeding test program. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 423-432.
Weather modification in general; meteological models; cloud physics; design in general.

68F01
Flueck, J. A., 1968: A statistical analysis of project Whitetop's precipitation data. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 26-35.
1960-64; randomized; summer time cloud; southern Missouri; days; 60 x 60 square mi.; AgI; hourly precipitation data and ground radar; rank sum test; chi-square test; negative treatment effect.

68F02
Feig, A. M., 1968: An Evaluation of the precipitation patterns over the metropolitan St. Louis area. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 210-219.
Daily precipitation; July 1960 through December 1966; 12 gages; isohyetal chart; monthly; chi square test.

68G01
Gerdel, R. W., 1968: Note on the use of liquefied propane for fog dispersal at the Medford-Jackson Airport, Oregon. J. Appl. Meteor., 7(6), 1039-1040.
24 Dec 1967 to 8 Feb 1968; 25 fogs within a temperature range of 21-34F were treated, 15 successful cases; achievement of an operational minimum of 0.5-mi horizontal visibility and 200-ft ceiling as observed and reported by FAA was considered to represent successful fog dispersal; cold fog (21-31F), (32-34F); warm fog.

68G02
Grant, L. O., C. F. Chappell, and P. W. Mielke, Jr., 1968: The recognition of cloud seeding opportunity. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 372-385.
Randomized; SW, W, NWcontrol areas; NWSdata; Skyfire needle ground generators; regression; rank sum test; cloud model; rain efficiency; optimal ice crystal concentration for the orographic cloud is about 10-50 per litter; natural ice crystal concentration is insufficient when cloudtop temperature is warmer than -20C.

68H01
Huff, F. A., and W. L. Shipp, 1968: Mesoscale spatial variability in midwestern precipitation: J. Appl. Meteor., 7(5), 886-891.
Four dense raingage networks-east central Illinois, Little Egypt, Bone Yard, Panther Creek; storm, monthly, seasonal, areal mean precipitation; storm duration; precipitation type; synoptic type; size of sampling area; exponential variabiblity; correlation coefficient; regression.

68H02
Hurley, P. A., 1968: Augmenting Colorado River by weather modification. J. Irrig. and Drainage Div., Proc. of Amer. Soc. of Civil Eng., 363-380.
Precipitation-runoff; economic evaluations; President's Water Resources Policy Commission; NAS-NRC; temperature and seeding criteria; selection of target areas; aircraft vs ground generator; operating costs; unit cost is about $1.50 per acre-ft; benefits.

68H03
Huff, F. A., 1968: Area-depth curves – a useful tool in weather modification experiments. J. Appl. Meteor., 7(5), 940-943.
Gage density; a squall-line passage on a densely gaged network of raingages on a 550-sq mi area in southern Illinois on 16 August 1959; hypothetical seeding effects.

68H04
Henderson, T. J., 1968: An operational hail suppression program near Kericho, Kenya – Africa. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 474-483.
Rockets; 1967; aircraft; pyrotechnic seeding; operational summary; 70% reduction.

68H05
Hannaford, J. F., and M. C. Williams, 1968: Regional hydrologic area study as an anslysis tool in weather modification. Final Report for Bureau of Reclamation 14-06-D-5819, Atmos. Water Res. Research, Fresno State College, Fresno, CA, 10 pp.
Change in runoff; California; San Joaquin project; Kings River projectl Stanislaus and Mokelumne River Project; regression; trends in runoff; contamination; downwind effect.

68J01
Jiusto, J. E., R. J. Pilie, and W. C. Kocmond, 1968: Fog modification with giant hygroscopic nuclei. J. Appl. Meteor., 7(5), 860-869.
Warm fog; NaCl; the visibility in laboratory fog produced in a 600 cu m chamber was increased by factors of 3-10, with as little as 1.7 mg/cu m of NaCl being effective; dropsize distribution.

68J02
Jones, D. M. A., G. E. Stout, and E. A. Mueller, 1968: Raindrop spectra fro seeded and unseeded showers in Arizona. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 99-106.
1966 and 1967 near Flagstaff, Arizona; 1963 Illinois raindrop samples; aircraft; cloudbase seeding.

68K01
Kulkarni, S. R., 1968: On the optimal asymptotic tests for the effects of cloud seeding of rainfall:(1) The case of fixed effects. Austral. J. Statist., 10(3), 105-115.
General randomized design; asymptotic; power; optimal design; generalizes the crossover and other designs.

68K02
Koscielski, A., and A. S. Dennis, 1968: A randomized seeding experiment in South Dakota. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 47-54.
Rapid City Project; randomized crossover; 700 square miles; aircraft; AgI; pyrotechnic; cloud base needing; with southwest flow aloft, seeding produces statistically significant rainfall increases; with northwest flow aloft, the results are conflicting and not statistically significant; 15 May to 15 August; precipitable water; vorticity; operational procedures; visual observations; 100 raingages; ice-nuclei counts; contamination; positive effects on type 3 days; decreases on type 4 days.

68L01
Langer, G., 1968: Ice nuclei generated by steel mill activity. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 220-227.
La Porte; August 1967 and January 1968; NCAR ice nucleus counter; Beech Queen Air aircraft; fairly strong and continuous source of active ice nuclei exists in the Gary area.

68L02
Lee, J. T., and E. Kessler, 1968: Aerial cloud photography as a technique for observing cloud growth and development. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-l, May, 343-349.
Above 60,000 ft; U-2 and RB-57F aircraft; 1962-1967.

68M01
MacCready, P. B. Jr., and R. G. Baughman, 1968: The glaciation of an AgI-seeded ccumul incloud. J. Appl. Meteor., 7(1), 132-135.
Cloud particle detector; Cessna 180 aircraft; two Skyfire generators; airborne; AgI; warm cloud; western Montana; Aug. 30, 1966.

68M02
Murty, Bh. V. R., and K. R. Biswas, 1968: Weather modification in India. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 71-80.
Salt; Delhi; Agra; Jaipur; Munnar; randomization; days; seeding operation; ground-based seeding; ratio of T/C; 41.9% increase; aircraft seeding in the plains;.median ratio test; Wilcoxon test; t-test.

68M03
McCarthy, J., 1968: Computer model comparisons of seeded and not-seeded convective cloud depth using project whitetop data. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 270-279.
Project Stormfury model; cloud base height; cloud with a radius of 922 m had a larger seedability on 55 percent of the days sampled, and on the remaining days, clouds with a radius of 1844 m have a greater seedability.

68M04
Morris, T. R., and R. R. Braham, Jr., 1968: The occurrence of ice particles in Minnesota cumuli. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-l, May, 306-315.
Project Whitetop; several cloud parameters; four growth stages Building, Mature, Dissipating, and No-Draft; 92 cumulus clouds; cloud top temperature; Spearman rank correlation coefficients.

68N01
Neyman, J., E. L. Scott, and M. A. Wells, 1968: Influence of atmospheric stability layers on the effects of ground-based cloud-seeding, I. Empirical results. Proc. Nat. Acad. Sci., 60, 416-423.
Grossversuch III; AgI; ground generator; 292 experimental days; precipitation decreased on days with uninhibited updraft, while increased with stability layers; stratified by stability.

68R01
Reinking, R. F., and L. O. Grant, 1968: The advection of artificial ice nuclei to mountain clouds from ground-based generators. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 433-445.
Climax; 20 gm AgI per hour; ice nuclei concentrations; ratios; air mass parcel stability.

68R02
Rhea, J. O., 1968: An attempt to explain variations of seasonal mesoscale target-to-control area precipitation ratios. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 446-454.
Park Range; Nov-Mar; 1955-1967.

68S01
Schickedanz, P. T., and W. L. Decker, 1968: The determination of optimum design and minimum duration of cloud seeding experiments. First Statist. Meteor. Conf., Amer. Meteor. Soc., Hartford, Conn., May, 124-132.
Simulation; daily rainfall; mixed distribution; gamma density; 50 % randomization; completely randomized design with sub-sampling; logarithmic transformation; t-test.

68S02
Schleusener, R. A., 1968: Hailfall damage suppression by cloud seeding -- a review of recent experience. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 484-493.
Seeding at rates of 2000 to 3000 gm/hr per storm is effective in reducing the total impact energy; experimental unit; maximum seeding rate per storm; Russian experiments; Scottsbluff Project, Argentina; Project Hailswath; Bowman-Slope Project; Shadehill Project, South Dakota; Rapid City Project; rain-hail relationship; Colorado.

63S03
Sehleusoner, R. A., 1968: Hailfall damage suppression by cloud seeding--A review of the evidence. J. Appl. Meteor., 76 , 1004-1011. (For comment, see 69B03).
Evaluation; seeding at rates of less than 1000 gm/hr per storm is ineffective; seeding at rates of 2000-3000 gm/hr per storm is effective; Argentina; Switzland; Hailsworth project; maximum AgI seeding rate per storm.

68S04
Spar, J., 1968: Design study for a cloud seeding experiment in the Northeastern United States. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 55-58.
National Academy of Sciences; test the sensitivity of the design; cross-over; AgI; aircraft.

68S05
Schleusener, R. A., 1968: A perspective on weather control.
J. Irrig. and Drainage Div., Proc. of Amer. Soc. of Civil Eng., 73-78.
National Academy of Sciences; dimension of various weather systems; tractability of cloud and storm systems.

68T01
Takeda, K., 1968: Some recent results of weather modification activities in Japan. First Nat. Conf. on Wea. Mod., Albany, N. Y., 28, April-1, May, 8-15.
Two results; winter; Kyushu; since 1961; Kwanto; dry ice pellets; AgI smoke; aircraft; snowfall; size of the raindrop.

68W01
Warner, J., 1968: A reduction in rainfall associated with smoke from sugar-cane fires--an inadvertent weather modification. J. Appl. Meteor., 7(2), 247-251.
Two areas; daily; comparison with previous sixty years; winds; raingages; scatter diagrams; reduction downwind.

69B01
Battan, L. J., 1969: Whitetop experiment. Science, 165, 618.
The two-tailed significance levels in the two tables are not so small as to make it self-evident that the rainfall differences were caused by seeding (see 69N03); extra-area effect; variability of rainfall; comment on Neyman's paper (Science, 1969, March).

69B02
Bigg, E. K., J. L. Brownscombe, and W. J. Thompson, 1969: Fog modification with long-chain alcohols. J. Appl. Meteor., 8(1), 75-82.
Condensation nuclei; warm fog; within 100 km of Sydney, Australia; diffusion chamber; droplet sizes were measured by exposing papers treated with "water blue" dye; acoustic counter; one satisfactory night's operation was obtained in the winter of 1966 and three in 1967; eight control days.

69003
Battan, L. J., 1969: Comments on silver iodide seeding and hailfall damage *suppression.* J. Appl. Meteor., 8(3), 466-467.
Number of nuclei per gram; uncertainties in knowing diffusion rates and deactivation rates of nuclei; critisize the definition of maximum AgI seeding rate per storm; Argentina project; Project Hailswath; Soviet's method; Grand River Project.

69B04
Butchbaker, A. F., 1969: Radar and hailfall observations of hailstorms in southwestern North Dakota during 1967. Agricultural Engineering Department, North Dakota State University, Fargo, ND, 46 pp.
Bowman-Slope project; hail supprssion; evaluation; continuous historical target-control; F-test; hail duration; hail energy; hail indicators; maximum echo height; 3-cm radar; significant decrease in radar reflectivity; 3 areal controls; seasonal.

69B05
Butchbaker, A. F., 1969: Radar and hailfall observations of hailstroms in southwestern North Dakota during 1968. Agricultural Engineering Department, North Dakota State University, Fargo, ND, 53 pp.
Bowman-Slope project; hail suppression; hail energy; continous historical target-control; hail duration; hail indicators; 3-cm radar; maximum echo height; significant decrease of hail energy; regression; ANOVA; seasonal; 3 areal controls; hail intensity.

69B06
Butchbaker, A. F. 1969: Hailstorm characteristics in the vicinity of a hail suppression project in southwestern North Dakota during 1966,61967, and 968. Agricultural Engineering Department, North Dakota State University, Fargo, ND, 19 pp.
Bowman-Slope project; radar reflectivity; echo top; hail energy; hail occurrence; storm motion; regression; AgI; 30-60% reduction in hail intensity; 4 cntrols.

69C01
Chapman, D. G., 1969: Statistical aspects of weather and climate modification.
Weather Modification, Science And Public Policy, ed. R. G. Fleagle, University of Washington Press, Seattle, 56-68.
Reviews; regression; transformation; bias; stratified by storm types; two or more regressions; dry-normal-wet; stratified random sampling; ANOCOVA; commercial projects; t-test.

69C02
Changnon, S. A. Jr., 1969: Hail measurement techniques for evaluating suppression projects. J. Appl. Meteor., 8(4), 596-603.
Statistical design; crop-hail damage; eight techniques for hail measurements are evaluated; hailstreaks; Project Hailswath; hail days; radar; hailpad; aerial photography; infrared temperature sensing.

69C03
Changnon, S. A. Jr., and P. T. Schickedanz, 1969: Utilization of hail-day data in designing and evaluating hail suppression projects. Monthly Weather Review, 97(2), 95-102.
Optimum design for hail-day data is the continuous seeding; cross-over design is not feassible; optimum test is the sequential test involving the Poisson and negative binomial distributions; Project Hailswath; insurance data; five areas in Illinois ranging in size from 500 to 3000 square mi; 1934-1963; recurrence interval; natural variability of hail days; Kolmogorov-Smirnov goodness of fit test; correlation of haildays between adjacent areas is poor; continuous seeding design on a single area without any control area; Poisson test; continuous seeding on all potential forecasted hail days in the context of a sequential analysis; average sampling numbers; operating characteristic; on the average, the sequential method reduced the number of required observations by 60% for the summer'data and 80% for the annual data.

69C04
Calvin, L. D., 1969: Review of "Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability, Volume V, Weather Modification."
J. Amer. Statist. Assoc., 1085-1087.
Randomization; statistical design; statistical problems.

69C05
Changnon, S. A., Jr., 1969: Recent studies of urban effects on precipitation in the United States. Bull. Amer. Meteor. Soc., 50(6), 411-421.
Review of results; Champaign-Urbana; Chicago; St. Louis; average annual precipitation patterns; La Porte; Kolmogorov-Smirnov goodness of fit test; t-test; rain-day frequencies; total number of excessive rainfall values; thunderstorm frequencies; hail-day frequencies; snowfall; precipitation mechanisms.

69C06
Cochran, W. G., 1969: The use of covariance in observational studies. Appl. Statist., 18, 270-275.
ANOCOVA; two regression; Belson procedure; estimation of sople.

69C07
Changnon, S. A., Jr., 1969: Hail evaluation techniques. Final Report Part I, NSF GA-482, Illinois State Water Survey, Urbana, IL, 97 pp.
Illinois; hall suppression; 80%-seeding random design is the best.

69D01
Decker, W. L., 1969: A perspective on weather control, a comment to paper by R. A. Schleusener. J. Irrig. and Drainage Div., Proc. of Amer. Soc. of Civil Eng., 239-240.
Whitetop; projects conducted in Missouri, Switzland, Israel, and Australia; evlauation.

69D02
Dennis, A. S., and A. Koscielski, 1969: Results of a randomized cloud seeding experiment in South Dakota. J. Appl. Meteor., 8, 556-565.
Supercooled convective clouds of spring and early summer; Rapid Project; Black Hills; daylight; 1964-1966; randomized crossover design; radar; two pairs of targets areas; mean winds between 700 and 500 mb; 700 square mi.; 100 raingages; randomized by days; treatment unit being the clouds passing over the seed target area between 0800 and 2000 MST; AgI; aircraft; cloud base seeding; days were stratified by upperair wind direction; radiosonde data for 0500 MST; supplementary pibal observation; precipitable water; positive vorticity advection; regression; F-test; square-root transformation; test for same slope; two-sample Wilcoxon test; three control stations; autocorrelation; seed/no-seed ratios; seeding appears to have increased rainfall on shower days, especially on storm days with NW-flow; 98 test days.

69D03
Dennis, A. S., and A. Koscielski, 1969: Report on the Rapid Project. Report 69-5, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 55 pp.
1966-1968; crossover; stratified by preoipitable water, 850 mb wind; vorticity advection; seeding operation; two regressions; square-root transformation; chi-square test; Wilcoxon test; ratio; AgI; radar- and gage-estimated rainfall comparion.

69G01
Gabriel, K. R., P. Feder, 1969: On the distribution of statistics suitable for evaluating rainfall stimulation experiments. Technometrics, 11, 149-160.
Wilcoxon-Mann-Whitney test; cross-over design; asymptotic; double ratio; days; randomization; single ratio; Israeli; simulation.

69H01
Hastay, M., and J. S. Gladwell, 1969: Statistical evaluations of a cloud-seeding program at the streamflow control level. J. Hydrology, 9, 117-135.
Skagit River, Washington; principal component regression; 40 days seeded in 1963, 90 days in 1963-1964; AgI generators; variables selection in regression; stepwise regresslon; 1929-1962 as historical periods; double mass technique; streamflow; multicollinearity; 4-5% increase in 1963, 15% increase in 1963-1964.

69H02
Huff, F. A., 1969: Precipitation detection by fixed sampling densities. J. Appl. Meteor., 8(5), 834-837.
Boneyard Network; East Central Illinois Network; Little Egypt Network; network mean rainfall, based on all network gages.

69H03
Huff, F. A., 1969: Climatological assessment of natural precipitation characteristics for use in weather modification. J. Appl. Meteor., 8(3), 401-410.
Nomograms; 1334 storms on a network of 49 recording raingages on a sampling area of 400 square mi in east central Illinois during 1955-1966; 57 stations; 1906-1955; areal mean precipitation in storms stratified by storm duration; wet and dry periods; precipitation type; synoptic weather types; storm occurrences; sampling problems; air mass storms; point-areal relations; seeding of non-precipitating clouds; cloud seeding must produce large increases in rainfall under favorable circumstances and/or initiate substantial rainfall from nonprecipitating clouds, if substantial contributions are to be made to the agricultural industry and municipal water supplies under Illinois climatic conditions.

69H04
Huff, F. A., and W. L. Shipp, 1969: Spatial correlation of storms, monthly and seasonal precipitation. J. Appl. Meteor., 8(4), 542-550.
Sampling requirements; monthly; seasonal; synoptic storm type; assuming a minimum acceptance of 75% explained variance between sampling points, a gage spacing of 0.3 mi is needed for 1-min rain rates compared with 7.5 mi for total storm rainfall in summer storms; sampling error; storm intensity and duration; storm movement; rain cells; wind flow; East Central Illinois Network; Little Egypt Network; Goose Creek Network; transformations; rain type; rainfall rate; standard error of correlation coefficients.

69H05
Hildebrand, P. H., 1969: An examination of a cumulus cloud width-heigh measure under the effects of seeding. Bull. Amer. Meteor. Soc., 50(1), 10-14.
Project Whitetop; width to height ratio for the echoes; Wilcoxon 2-sample rank test; t-test gave a probability of .076.

69H06
Huff, F. A., W. L. Shipp, and P. T. Schickedanz, 1969: Evaluation of precipitation modification experiments from precipitation rate measurements. Final Report, Illinois State Water Survey, Urbana, IL, 122 pp.
One-minute rain rate; 2 networks in Illinois; 1951-1953; synoptic types; sequential variability; lag correlation; area-depth curves; spatial correlation; sample size; log-normal; total storm rainfall; point and area storm duration; sampling error; mixed distribution; gamma; random target-only; random historical target-only; continuous historical target-only; continous target-control; crossover.

69K01
Kulkarni, S. R., 1969: On the optimal asymptotic tests for the effects of cloud seeding on rainfall: (2) The case of variable effect. Austral. J. Statist., 11(1), 39-51.
General randomized design; locally asymptotically most powerful tests; crossover design; randomized design; predictor variables; Quebec.

69K02
Knight, C. A., 1969: Small particle detection and identification by cystal growth: Preliminary work on AgI particle detection. J. Appl. Meteor., 8(4), 705-707.
PbI; silicone grease; density of AgI.

69K03
Kahan, A. M., and J. R. Stinson, and R. L. Eddy, 1969: Progress in precipitation modification. Bull. Amer. Meteor. Soc., 50(4), 208-214.
Snowy Mountain, Australia; Israel; Arizona; Whitetop; Rapid City Project; Climax 1; Climax 2; Wolf Creek Pass; India; ice nuclei.

69L01
Lovasich, J. L., J. Neyman, E. L. Scott, and J. A. Smith, 1969: Wind directions aloft and effects of seeding on precipitation in the Whitetop experiment. Proc. Nat. Acad. Sci., 64(3), 810-817.
Three stratifications; pibal observations; c(a)test; data of 192 gages; timing of the effects of seeding; Grossversuch III.

69L02
Lovasich, J. L., J. Neyman, E. L. Scott, and J. A. Smith, 1969: Timing of the apparent effects of cloud seeding. Science, 165, 892-893.
Hourly; 96 days without seeding; Whitetop; 102 days with seeding; overseeding; AgI; widespread cloudiness; Grossversuch III; Hughes' hypothesis.

69M01
McDonald, J. E., 1969: Evaluation of weather modification field tests. Weather Modification, Science and Public Policy, ed. R. G. Fleagle, University of Washington Press, Seattle, 43-55.
Anti-statistics; history of evaluation methods; seed and look; regression; randomization; ACWC; Santa Barbara Project; NAS-NRC report (1963 and 1966); commercial projects.

69M02.
Moran, P. A. P., 1969: Statistical inference with bivariate gamma distribution. Biometrika, 56(3), 627-634.
Scale parameter; maximum likelihood estimates; control; cross-over experiments.

69M03
Mooney, M. L., and G. W. Lunn, 1969: The area of maximum effect resulting from the Lake Almanor randomized cloud seeding experiment. J. Appl. Meteor., 8(1), 68-74.
Stratified by wind flow; crossover design; 2 targets with control areas; AgI; 25 g/hr of AgI; 49 NWS stations; regression; covariance analysis; F test; positive effects.

69N01
Neyman, J., E. L. Scott, and M. A. Wells, 1969: Statistics in meteorology. Rev. Intern. Statist. Inst., 37(2), 119-148.
History; variability of rain; design; inference; Whitetop; Grossversuch III; evaluate spread of seeding effects; cross-over design might be hazardous; downwind effects in excess of 100 miles; stratified by wind direction

69N02
Neyman, J., 1969: Science and politics of rainmaking: A rejoinder. Bull. Atomic Scient., 15(3), 27.
NAS-NRC report (1966); Whitetop.

69N03
Neyman, J., E. L. Scott, and J. A. Smith, 1969: Areal spread of the effect of cloud seeding at the Whitetop Experiment. Science, 163, 1445-1449.
Grossversuch III; c(a)test; cross-over design and its weakness.

69N04
Neyman, J., E. L. Scott and J. A. Smith, 1969: Whitetop Experiment. Science, 165, 618.
Negative seeding effect.

69N05
Neyman, J., 1969: Statistical problems in science. The symmetric test of a composite hypothesis. J. Amer. Statist. Assoc., 64, 1154-1171.
Interaction between the frequentist theory of probability and statistics, and research in science; optimal symmetric c(a) tests; Grossversuch III; stratified by stability; stratified by wind direction.

69N06
Neiburger, M., and H. C. Chin, 1969: The meteorological factors associated with the precipitation effects of the Swiss hail suppression project. J. Appl. Meteor., 8(2), 264-273.
Randomized; 1957-1963; Southern Alps; ground generators (23 total); AgI; 24 raingages; c(a) test; negative results of hail suppression; increased precipitation; unrepresentative draw in randomization.

69N07
Neiburger, M., 1969: Artificial modification of clouds and precipitation. Technical Report 105, World Meteorological Organization, Geneva, Switzerland, 33 pp.
Scale of weather modification; cloud physics; precipitation formation; seeding hypothesis; evaluation in general; Bergeron process; criticism of regression; selection bias; randomization; Advisory Committee for Weather Control; Australia; Israel; SCUD project; ACN project; Santa Barbara; Arizona; Whitetop; Grossversuch III; Quebec; warm and cold fog dissipation; hail, and lightning suppression; bibliography.

69P01
Parungo, F. P., and C. E. Robertson, 1969: Silver analysis of seeded snow by atomic absorption spectrophotometry. J. Appl. Meteor., 8(3), 315-321.
AgI; Park Range in northwestern Colorado; atomic absorption spectrophotometry; non-randomized; Ag concentration in the unseeded samples was 0.2 ppb or lower, while the seeded snow concentration averaged near 1 ppb; 1967-68 winter.

69R01
RAND Corporation, 1969: Weather-modification progress and the need for interactive research. Bull. Amer. Meteor. Soc., 50(4), 216-246.
Review of progress since 1966; drop nucleation; ice nucleation; models of atmospheric circulation; models of cloud dynamics; evaluation; stratify the experimental data.

69S01
Schickedanz, P. T., and W. L. Decker, 1969: A Monte Carlo Technique for designing cloud seeding experiments. J. Appl. Meteor., 8(2), 220-228.
Simulation; density of raingages; t-test; transformation; generalized likelihood ratio test; gamma distribution; mixed distribution; design of the experiment; experimental units; central Missouri; 1-15 June, 1935-1965; skewness of distribution; power of the test.

69S02
Schickedanz, P. T., S. A. Changnon, and C. G. Lonnquist, 1969: A statistical methodology for the planning and evaluation of hail supression experiments in Illinois. Final Report Part II, NSF GA-482, Illinois State Water Survey, Urbana, IL, 140 pp.
Continuous design is the best; use (1) NWS hail days - seasonal & annual; Poisson; negative binomial; (2) CHIAA - 1948-66, daily, yearly; gamma; lognormal; (3) ECIN hailstreak; changes of 5, 10, 20, 40, 60, 80%; area of 400-4000 square mi (5 areas).

69S03
Stiason, P. J., 1969: Experimental design and statistical evaluation of weather modification experiments. Final Report, Denver Research Institute, Univ. of Denver, Denver, CO, 95 pp.
Data process; design criteria; economic evaluation; regression; operational research; covariates; t-test; c(a)test; optimal statistical test; crossover; 2x2 Latin square design; spectral analysis; simulation; Kings River project; Elko Project (Nev); Santa Barbara; extra-area effect; Whitetop; Victoria, Australia; linear programming; Markov chain; missing data; bibliography; statistical in general.

69W01
Weinstein, A. I., and P. B. MacCready, Jr., 1969: An isolated cumulus cloud modification project. J. Appl. Meteor., 8(6), 936-947.
Cloud model; prediction of rainfall and duration; randomized; Flagstaff, Arizona; July and August of 1961; correlation coefficient; 10 seeded clouds and 11 nonseeded clouds on 11 days; for 9 days paired seed and nonseed clouds were studied; airplane; AgI; ground and aircraft observation; 3-cm radar; for the 21 test clouds there were increases in radar tops, precipitation and duration; on every one of the 9 paired days, the seeded clouds showed increased height, rainfall and duration.

70B01
Butchbaker, A. F., 1970: Results of the Bowman-Slope Hail Suppression Program. Farm research, 27(5), 11-16.
Radar; hail intensity; precipitation; Bowman-Slope Hail Suppression Association; 1961 to 1969 four-county; 3,200 square miles; Lohse wing-tip silver iodide generators; aircraft; 20 Sky-Fire ground generators; between 1963 and 1967; 3-cm radar; PPI; pyrotechnic flares; aluminum-foil-over-styrofoam hail indicators; raingages; questionnaires; pilot flight logs; facsimile weather charts; radar overlays, every 15 minutes; hailfall energy values in foot-pounds per square foot; mean radar reflectivities; down-wind effect.

70B02
Battan, L. J., 1970: Time elapsed between seeding and echo intensification. J. Appl. Meteor., 9(6), 950-951. Reply by J. Simpson, 951-952.
Assumptions of particle size distributions and the terminal velocities; use of a 4 m/sec downdraft; Sheets-Carlson method.

70B03
Battan, L. J., 1970: Summary of Soviet publications on weather modification. Bull. Amer. Meteor. Soc., 51(11), 1030-1041.
Since 1964; seeding agents; cloud microphysics following seeding; hailstorm modification; climate modification.

70B04
Boutin, C., H. Isaka, and G. Soulage, 1970: Statistical studies on French operations for hail suppression. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 134-139.
AEMLFA project, 1959-1968, season as unit, non-randomized, crop damage; ACMG. project, 1964-1968, day as unit, non-randomized, hailday, crop damage.

70B05
Braham, R. R. Jr., and J. A. Flueck, 1970: Some results of the Whitetop experiment. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 176-179.
Overseeding.

70C01
Court, A., 1970: Map Comparison. Economic Geography, 46(2).
Equivalent isopleths; confidence interval; Student's t.

70C02
Cocheme, J., 1970: Problems of the users of weather modification by cloud seeding. Rev. Intern. Statist. Inst., 38(1), 140-148.
Food and Agriculture Organisation of the United Nations; agriculture; UNESCO; WMO; operation should be technically effective; must be economically profitable; socially acceptable; ecologically harmless; must make trustworthy evaluation.

70C03
Changnon, S. A. Jr., 1970: Design factors of a hail suppression experiment in Illinois. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 150-155.
Consider statistical designs; geographical location; size of area; types of surface hail data to be collected; density of point observation; collection of allied weather data; seeding considerations; hail forecasting methods; monitoring of hail aloft; duration of the project, and methods for evaluating the results.

70C04
Cunningham, R. M., 1970: Problems in evaluating effects of seeding cumulus clouds. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 193-197.
Cloud Puff Project; White Sands Missile Test Range; August 1968; July 1969; New Mexico; C-130; comparing the growth histories of many clouds viewed by the ground cameras; cloud model; cloud updraft radius; temperature; cloud water content.

70E01
Elliott, W. P., and F. L. Ramsey, 1970: Comments on "Cloud condensation nuclei from industrial sources and their apparent influence on precipitation in Washington State". J. Atmos. Sci., 27(8), 1215-1216. Reply by Hobbs, P. V., L. F. Radke, and S. E. Shumway, 1216-1217.
Pulp and paper mills; the use of t values may be deceptive; stream-flow.

70E02
Elliott, R. D., and J. R. Thompson, 1970: Santa Barbara pyrotechnic seeding device test program 1967-68 and 1968-69 seasons. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 76-80.
Convection bands; three minutes emitting 400 grams of AgI; seedability decision; floating target; four categories of air mass stability; stratification by 500 mb temperature; double ratio; Mann-Whitney U Test; target to control ratios; the analysis shows maximum ratios in excess of 2.0 over a 350 square mile area centered 25 nautical miles eastward from the seeding site; seeding area of effect numerical model.

70F01
Frederick, R. H., 1970: Preliminary results of a study of precipitation by day-of-the-week over Eastern United States. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 209-214.
Weekly cycle of precipitation; 22 first-order Weather Bureau stations; 1912 to 1961; Sunday, Saturday and Monday have less than 1/7th of the total precipitation with Tuesday thru Friday having greater than 1/7th during the cool season; sums of the ranks; binomial test; Friedman two-way analysis of variance test; warm-season distribution shows randomness.

70G01

Gerber, H. E., P. A. Allee, U. Katz, C. I. Davis, and L. O. Grant, 1970: Some size distribution measurements of AgI nuclei with an aerosol spectrometer. J. Atmos. Sci., 27(7), 1060-1067.
Goetz Aerosol Spectrometer; 12,000-ft Chalk Mountain (Climax, Colo.); size distribution of the nuclei on seeding days proved similar to what might be expected; on non-seeding days, the number of active nuclei decreased sharply; particle shape; laboratory aerosol; September, 1969; on the seeding days the peak was located at approximately 0.1 μm; on the non-seeding days the peak shifted to the larger values.

70H01

Huff, F. A., 1970: Sampling errors in measurement of mean precipitation. J. Appl. Meteor., 9(1), 35-44.
Two dense networks of raingages in Illinois; areal mean precipitation on areas of 50-550 square mi; storm, monthly, and seasonal precipitation; synoptic storm type; duration; gage density; transformations of logarithms; cube root transformation; square root transformation; logarithm-square root transformation; air mass storms required the greatest sampling density; unstable types of rainfall in the warm season were found to require twice as many gages as steady rain; sampling requirements for monthly and seasonal precipitation were substantially lower than for storms; comparison of successive sampling periods.

70H02

Holzman, B. G., and H. C. S. Thom, 1970: The La Porte precipitation anomaly. Bull. Amer. Meteor. Soc., 51(4), 335-337. Reply. S. A. Changnon, Jr., 337-342.
Annual totals of precipitation; earily period 1898-1926; later period 1964-1968; t-test; the increase over the earlier period is statistically significant at the 95% level; seven other stations in the vicinity; change of observer and station location at La Porte; raingage measurement accuracy; validity of published Weather Bureau and ESSA weather data; annual hail days; crop-hail insurance annual loss cost values.

70H03

Hobbs, P. V., L. F. Radke, and S. E. Shumway, 1970: Cloud condensation nuclei from industrial sources and their apparent influence on precipitation in Washington State. J. Atmos. Sci., 27(1), 81-89. (see 70E01 for comment.)
Pulp and paper mill; rainfall increased; t-test; 1929-1946 as historical, 1947-1966 as effected; streamflow.

70H04

Henderson, T. J., 1970: Results from a two-year operational hail suppression program in Kenya, East Africa. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 140-144.
July, 1963; Italian anti-hail rockets fired from 13 positions; 1966; 800 grams of TNT; aircraft; pyrotechnic; AgI; 80 square miles; October 1, 1967 through September 30, 1969; seeding operations; radar surveillance; damage to tea; 58.5% reduction.

70H05

Huff, P. A., and S. A. Changnon, Jr., 1970: Urban effects on daily rainfall distribution. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soo., Santa Barbara, 6-9, April, 215-220.
St. Louis; Chicago; 1949-1968; 14-gage network in Chicago, an average increase of 17 – 33% in the number of daily rainfall equalling or exceeding 2.0, 2.5, and 3.0 inches in the urban area; there is a region of high, frequency a few miles east and norteast of the St. Louis urban industrial sites; motions of precipitation; Major Effect Area; Minor Effect Area; using a test between proportions; average weekday rainfall value in the Major Effect Area (La Porte) is 20% more than that in the Downwind Area (South Bend), and is 19% more than the Upwind Area value (Joliet). However, the weekend day rafall average of 4.78" at La Porte is 36% more than that at South Bend and 31% more than at Joliet; increase in the frequency of havy rainstorms downwind and within the city; greatest weekday increases in the Major Effect Areas of both cities are in the 0.25-in rain day class.

70H06

Hobbs, P. V., L. F. Radke, and S. E. Shumway, 1970: Cloud condensation nuclei from industrial sources and their influence on clouds and precipitation. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 237-241.
Washington; formation of clouds and precipitation; paper mills; "t" statistics; the rate of emission of CCN active at 1% from large paper mills can be as high as 10^{15}/sec; clouds often form downwind of these sources; streamflow.

70H07

Huff, F. A., 1970: Rainfall evaluation studies. Final Report, Illinois State Water Survey, Urbana, IL, 53 pp.
Three networks in Illinois; spatial variability; synoptic types; precipitation types; duration; constant seeding effect model; crossover; random target-onlu; correlatin; monthly; seasonal; diurnal; sampling error; areal extent; precipitation measurement requirement; sample size; area-depth curve; Whitetop; downwind effect; design of weather modification.

70H08

Huff, F. A., and P. T. Schickedanz, 1970: Rainfall evaluation studies -- Part II. Description of individual studies. Final Report, Illinois State Water Survey, Urbana, IL, 224 pp.
Mesoscale spatial variability in Midwestern precipitation; random target-only; crossover; synoptic types; precipitation types; temporal and spatial correlations; storm; monthly; seasonal; gage density; duration; sampling error; areal extent; sample size; point rain; Illinois; downwind effect; Whitetop; response surface.

70K01

Kocmond, W. C., R. J. Pilie, W. J. Eadie, and E. J. Mack, 1970: Recent fog modification research at Cornell Aeronautical Laboratory. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 112-116.
Warm fog; laboratory tests; NaCl; field tests in Elmira, New York; summer of 1968; fall of 1969; average drop diameter; liquid water content; cloud nuclei concentration; temperature inversions; disodium phosphate; urea; three twin engine Beech Baron aircraft; CH-46 helicopter; total of 12 fully implemented experiments; three seedings resulted in visibility improvements in excess of one half mile.

70L01

Lovasich, J. L., J. Neyman, E. L. Scott, and J. A. Smith, 1970: Statistical aspects of rain stimulation - problems and prospects. Rev. Intern. Statist. Inst., 38(1), 155-170.
Grossversuch III; Whitetop; negative seeding effect; experiments; call for the organization of an international interdisciplinary study group.

70M01

Moran, P. A. P., 1970: The methodology of rain-making experiments. Rev. Intern. Statist. Inst., 38(1), 105-119.
Problems associated with using a gamma distribution; criticizes the historical regression; short term answers.

70M02

Mason, B. J., 1970: The scientific problems of cloud seeding. Rev. Intern. Statist. Inst., 38(1), 149-154.
Numerical models; Project Whitetop.

70M03

Mielke, P. W., L. O. Grant, and C. F. Chappel, 1970: Elevation and spatial variation effect of wintertime orographic cloud seeding. J. Appl. Meteor., 9, 476-488.
Randomized; 24hr; central Colorado; rank sum test; mountains; 1960-65; 1 target data only; squared rank sum test; Skyfire needletype ground generator; 65 precipitation stations; at least .01" of precipitation forecasted was required as sampling unit.

70M04

Maybank, J., and W. Baier, W., 1970: Weather modification: A survey of the present status with respect to agriculture. 10th Ann. Meeting of the Canada Comm. on Agrometoer., Department of Agriculture, Ottawa, 81-84.
Discuss recent references; natural variability of rain; statistical vs. physical tests; target only; target-control; cross-over designs; sample size.

70M05

Mielke, P. W. Jr., L. O. Grant, and C. F. Chappell, 1970: Randomized orographic cloud seeding results for eight wintertime seasons at Climax, Colorado. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 66-69.
Optimum ice crystal concentration; stratifications of seeding effects by cloud top temperature; 1965-68 compared with 1960-65; two-sample Wilcoxon test; sum of squared ranks test; estimate of scale changes; 500 mb temperature; Wolf Creek Pass Project; stratification by vertical gradient of potential condensate; stratification by 500 mb wind speed.

70M06

McQuigg, J. D., 1970: Estimation of the potential economic impact of weather modification through use of simulation models. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 415-418.
Data problems; land price model; electric power simulation model; highway construction simulation model.

70M07

Musil, D. J., 1970: The North Dakota Pilot Project, Part II: Evaluation of Data - 1969. Report 70-3, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 39 pp.
Randomized; 75% seeded; 3% AgI acetone solution; day as unit; 2 AT-6 aricraft and 9 ground generators; 98 gages; S-NS ratio; square rank test; Wilcoxon test; APQ-13 radar; random target-control; correlation; hail energy; regression; hail day; problem in implementing randomization.

70R01

Rhea, J. O.,and L. G. Davis, 1970: Statistical results of the Park Range winter orographic cloud seeding experiment. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 70-75.
Randomized; 1 November 1968 to 1 April 1969; each six-hour block was subdivlded into two three-hour blocks, designated "seeded" and "unseeded"; AgI; 450 gm per hour; airborne droppable pyrotechnics; 240gm per hour for ground releases; crystal type, size, riming; rawinsondes; stratified by seeded-crystal travel time; data were thus classified either "in-plume" or "out-of-plume"; stratified by cloud top temperature; squared rank test; silver content averaged 0.844 parts per billion for the seeded, as compared to 0.354 for the unneeded; significant at the 0.1% level; frequency of occurrence of replica slides containing hexagonal plates averaged 62% for the seeded and 36% for the unseeded; significant at the 0.1% level; large snowfall rate increases (>100%) under conditions of west-northwest to northwest flow aloft when the cloud top temperature was warmer than or equal to -20C, and fairly large decreases for cloud tops colder than -20C.

70R02

Rango, A., 1970: Possible effects of precipitation modification on stream channel geometry and sediment yield. Water Res. Research, 6(6), 1765-1770.
Sediment yield will increase substantilly in semiarid regions with increasing precipitation until about 27 inches mean annual precipitation; at this point vegetation growth as a result of increased precipitation will begin to reduce sediment yield.

70S01

Schickedanz, P. T., and S. A. Changnon, Jr., 1970: The design and evaluation of hail suppression experiments. Monthly Weather Review, 98(3), 242-251.
Illinois; nomograms; power; insurance crop-loss data are the optimum hail measurement if the study area has more than 60% insurance coverage; optimum experimental design is the random-historical design; 400 to 4000 square mi; hailstreaks; hail areal extent; hail area-mean energy; gamma; log-normal; Kolmogorov- Smirnoy goodness-of-fit test; Liffiefors test; mixed distribution; chi-square goodness-of-fit test; truncated log-normal distribution; Poisson; negative binomial; single area-random; random-historical; continuous-historical; crossover; target-control; paired storm; sequential analysis; Wilcoxon 1 sample test.

70S02

Schickedanz, P. T., and F. A. Huff, 1970: An evaluation of downwind seeding effects from the Whitetop experiment. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 180-185.
Circular area of 300 miles radius; monthly rainfall; 1955-1959 as historical; 1960-1964 seeded; 175 and 290 miles downwind areas; dense raingage network; signed rank test; very weak downwind effect.

70S03

Schickedanz, P. T., and G. F. Krause, 1970: A test for the scale parameters of two gamma distributions using the generalized likelihood ratio. J. Appl. Meteor., 9(1), 13-16.
Power; t-test; logarithmic transformation; weekly rainfall; asymptotic results.

70S04

Schleusener, R. A., A. Koscielski, A. S. Dennis, and M. R. Schock, 1970: Hail experiment on eight project seasons of cloud seeding with silver iodide in the northern Great Plains. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 145-149.
Hail impact energies; 30 were unseeded; 18 were seeded; 0.5 tp 1.0 kg/hr; aircraft; cloud base; hail indicators; rank sum test; regression; reduction of hail energies by 70%; Rapid City project, 1966-1968; cross-over; Grand River project; melted hail volume; positive effect; areal extent.

70S05

Simpson, J., W. L. Woodley, H. A. Friedman, T. W. Slusher, R. S. Scheffee, and R. L. Steele, 1970: An airborne pyrotechnic cloud seeding system and its use. J. Appl. Meteor., 9(1), 109-122.
Randomized; Florida; May, 1968; Agl; airplane measurements; radar; 14 seeded clouds; 13 grew explosively.

70S06
Simpson J., 1970: On the radar-measured increase in precipitation within ten minutes following seeding. J. Appl. Meteor., 9(2), 318-320. (See 70B02 for comment).
University of Miami 10 cm radar; case study of cloud 6 on 16 May 1968; cloud water content; terminal velocity of water drops; droplet diameter; assume a downdraft of 4 m/sec; EMB68 numerical cloud model; the precipitation contained in a layer 2 km deep above -5C reaches the center of the radar beam within 10 min after seeding.

70S07
Smith, E. J., 1970: Effects of cloud-top temperature on the results of cloud seeding with silver iodide in Australia. J. Appl. Meteor., 9(5), 800-804.
Three areas; 1000-3000 square mi.; cross-over; airplanes; 30-150 raingages per area; read at 0900 hours; tables; graphs; reduced rainfall for worm cloud; increased rainfall for cold cloud.

70S08
Simpson, J., 1970: Cumulus cloud modification: Progress and prospects. A Century of Weather Progress, AMS, 143-155.
Dynamic seeding; 1965 and 1968; randomized; single clouds seeding; Caribbean and South Florida; numerical model; seedability; 100% increases; overseeding; seven aircraft; growth of seeded clouds exceeded that of the control clouds by 11,400 ft; area experiments; 1270 n square mi area east of Tampa; May 1969.

70S09
Sopper, W. E., and L. A. V. Hiemstra, 1970: Effects of simulated cloud seeding on streamflow of selected watersheds in Pennsylvania. Water Resources Bulletin, 6(5), 754-766.
Hydrographs; synthesized rainfall cycles consisting of increasing rainfall by 10, 20, and 30%; cloud model; prediction of rainfall following seeding; Penn State Watershed Model; Stanford Model IV.

70S10
Siliceo, E. P., 1970: 19 years of cloud seeding operations in the Necaxa, Puebla and Lerma, Mexico, Watersheds, from the periods 1949-1951 plus 1953-1968. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 87-90.
Regression; double mass analysis; only in the rains from 0 to 19.9 mm/day as measured in the control area there is an effect from seeding; ratio; random; daily; seasonal; AgI.

70S11
Schickedanz, P. T., and S. A. Changnon, 1970: A study of crop-hail insurance records for Northeastern Colorado with respect to the design of the National Hail Experiment. Final Report, Illinois State Water Survey, Urbana, IL, 47 pp.
Random experimental design; random historical target-only; continuous historical target-only; hail day; c(a)test; crop loss; liability; log-normal; gamma; sample size; random experimental with predictors; probability of hail; sequential; %of randomization; multiplicative seeding effect model; simulation; hail day areal pattern; radar-hail echoes; echo duration; echo motion.

70T01
Towery, N. G., and S. A. Changnon, Jr., 1970: Characteristics of hall-producing radar echoes in Tillnois. Monthly Weather Review, 98(5), 246-252.
103 hail echoes in 1967 and 50 no-hall echoes; location of echo formation and dissipation; echo reflectivity; echo-top heights; echo durationl direction of motion, speed; time of occurrance; synoptic condition; cold fronts; stationary fronts; low-pressure centers; average hail-echo top exhibited a 5000-ft growth in the 15-min period prior to the average time of hail; 65 raingage-hailpad

70T02
Tribus, M., 1970 Physical view of cloud seeding. Science, 1-10.
Decision analysis; Whitetop experiment; orographic; lakeshore snow removal; stratus clouds; hail reduction; hurricane modification; lightning modification; the role of statistics; Bayes' equation.

70T03
Takeuchi, D. M., 1970: Precipitation development in seeded and natural cumulus clouds. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 198-204.
Flagstaff, Arisona; 2% AgI acetone solution; aircraft-mounted pyrotechnic; cloud base seeding; precipitation development; liquid water structure; seeded clouds produced more total rain than the unseeded clouds by a factor of about eight.

70W01
Woodley, W. L., 1970: Precipitation results from a pyrotechnic cumulus seeding experiment. J. Appl. Meteor., 9(2), 242-257.
10 cm radar of University of Miami; Florida; Z-R equations for seeded, unseeded and conbined samples; precipitation particle size distributions for seeded and unseeded clouds at 20,000 ft and cloudbase; aricraft; AgI; ANOCOVA; rainfall rate; no significant difference of drop size distribution between seeded and nonseeded clouds; rainfall increase over 100%; randomized; single cloud seeding; dynamic seeding; t-test; normal score test; Wilcoxon-Mann-Whitney test.

70W02
Woodcock, A. H., and R. H. Jones, 1970: Rainfall trends in Hawaii. J. Appl. Meteor., 9(4), 690-696.
Florida; randomized; seedability; 10 cm radar of University of Miami.

70W03
Woodley, W. L., 1970: Rainfall enhancement by dynamic cloud modification. Science, 170, 127-132.
Florida program; AgI pyrotechnics; May 1968; aircraft; randomized; 14 seeded clouds and 5 control clouds; UM/10-cm radar; total radar-measured rainfall; radar-raingage comparison; maximum top growth; Project Whitetop; rainfall decreases are found for seedabilities less than about 0.8 kilometer; increases of several hundred acre-feet per cloud are associated with seedabilities above 3 kilometers.

70W04
Williams, M. C., and D. E. Lehrman, 1970: Sierra cumulus. Second Nat. Conf. on Wea. Mod., Amer. Meteor. Soc., Santa Barbara, 6-9, April, 81-86.
Hydrologic studies; runoff volume; number of occurrences; target watershed selected was the Bear Creek Basin, California; three test cases in 1967 and four in 1968; regression; target and control areas; three types of precipitation; randomized pair seeding; aircraft; dry ice and AgI; pyrotechnic; chi-ssquare; McNema statistical tests; t-test; increases in runoff of the order of 100% to 250%; forecast; predictors; cloud depth; cloud top temperature; cloud base temperature; precipitable water; 500 mb and 700 mb wind direction; seeding materials and rates; seeding level and temperature; discriminant analysis; rawinsondes; the resultant discriminant function derived by the analysis was statistically significant at the .999 level by te F-ratio test.

70W05
Woodley, W. L., R. Williamson, 1970: Design of a multiple cloud seeding experiment over a target area in South Florida. Technical Report ERLTM-AOML 7, ESSA Research Lab., Miami, FL, 24 pp.
UM 10-cm radar; dynamic seeding; 2700 n square miles; 2/3 seeded randomly; seeding operation; DC-6 and RFF B-57 aircraft; cloudtop seeding; evaluation; radar estimated rainfall; difference; areal rain; simulation.

71B01
Braham, R. R. Jr., J. McCarthy, and J. A. Flueck, 1971: Project Whitetop -- results and interpretation. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 127-129.
Overall negative treatment effect on the amount of precipitation; frequency of days with precipitation; Simpson-Wiggert precipitating cumulus model EMB68; maximum echo heights; overseeded; stratification by wind direction; need for continued studies of natural cloud microstructure; natural variability of precipitation.

71B02
Brier, G. W., and T. Carpenter, 1971: An analysis of a proposed design for a cloud seeding experiment. Trans. of Sem. on Ext. Area Effects of cloud Seeding, Santa Barbara, CA, Feb. 15-17, 11-20.
Simulation; multiple regression screening; Albany, New York; daily rainfall; winter months.

71B03
Brown, K. J., 1971: Evidence of large scale effects of cloud seeding. Trans. of Sem. on Ext. Area Effects of cloud Seeding, Santa Barbara, CA, Feb. 15-17, 58-90.
Seed/no seed ratios; Rogue River Project in southwest Oregon; Coeur d'Alene Project; Bear River Project; San Joaquin; Kings River; Mokelumne-Stanislaus Project; Santa Barbara Weather Modification Project; double ratio; stratified by 500 mb temperature; stratification based on 700 mb wind direction.

71B04
Bigg, E. K., and R. T. Meade, 1971: Clear-air seeding in the presence of ice supersaturation. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 141-144.
Tasmania; 10 days in summer and 20 in winter; dry ice; visual.

71CO1
Changnon, S. A., Jr., and P. T. Schickedanz, 1971: Statistical studies of inadvertent modification of precipitation. Internat. Symp. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Honolulu, 1-4, June, 137-142.
Correlograms; power spectrum; Chicago; La Porte; South Bend; precipitation; differences in day-of-the-week distributions of raindays and rainfall amounts; Friedman two-way analysis of variance tests; binomial test; pattern vs. pattern comparisons; trend pattern.

71C02
Chappell, C. F., L. 0. Grant, and P. W. Mielke, Jr., 1971: Cloud seeding effects on preclpitaion intensity and duration of wintertime orographic clouds. J. Appl. Meteor., 10,1006-1010.
Climax; snow; 24 hour; ratios; chi-square test; t-test; experiment day was when at least .01" of snow is forecasted and also 500 mb wind is between 210 and 360 degree at Leadville by NWS; use 2NW recording gage at HAO of UC; 1960 Feb. through Jan. 31, 1970; 623 ex. days; 700 mb potential temperature using moving average over 5K temperature interval; simple randomized; 6 ground generator; 20 gm/hr of AgI; 65 gages.

71C03
Changnon, S. A. Jr., 1971: Hailfall characteristics related to crop damage. J. Appl. Meteor., 10(2), 270-274.
1000 square mi area in central Illinois; 1967, 1968 and 1969; 967 hailpads; relationship between hail impact energy and frequency of hailstones with diameters > 0.25 inch is not strong; wheat loss is poorly related to the energy; frequency-loss correlation coefficient was 0.94; corn loss related closely to stone frequency having a correlation coefficient of 0.98; correlation coefficients >= 0.9 for all three crops in all months of potential hail damage.

71C04
Cataneo, R., 1971: Comments on "Precipitation results from a pyrotechnic cumulus seeding experiment. J. Appl. Meteor., 10(2), 345-346. Reply by W. L. Woodley, 346-348.
Florida; UM/10-cm radar; reflectivity; Z-R equation; precipitation particle distribution; differences in rainfall rate; re-analysis; the seeded R's are greater than the NS cases by 37-73%; randomized; AgI; isolated supercooled cumulus clouds; cloud bases height; rainfall formation.

71C05
Changnon, S. A., Jr., F. A. Huff, and R. G. Semonin, 1971: METROMEX: An inverstigation of inadvertent weather modification. Bull. Amer. Meteor. Soc., 52(10), 958-968.
Examination of historical data at St. Louis has revealed summer increases in the immediate downwind area of: 1) rainfall (10-17%), 2) moderate rain days (11-23%), 3) heavy rainstorms (80%), 4) thunderstorms (21%), and 5) hailstorms (30%); La Porte; rural/urban ratios; project plans, organization, and management; facilities, types of equipment, and measurements.

71C06
Chappell, C. F., 1971: Cloud seeding affects on precipitation intensity and duration of wintertime orographic clouds. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 121-126.
Climax; randomized with a 24-hour sampling unit; 500 mb wind direction; six Skyfire needle-type ground generators; stratified by 500 mb temperature; contingency table; 700 mb equivalent potential temperature; t-test.

71C07
Changnon, S. A., Jr., 1971: Lessons from the La Porte anomaly. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 193-198.
Review; day-of-the-week differences; binomial test; St. Louis; average rural/urban ratios of summer rainfall; Cleveland; METROMEX.

71D01
Dennis, A. S., R. A. Schleusener, A. Koscielski, and M. R. Schock, 1971: Modification of precipitaion from convective clouds in the northern plains of the United States. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 103-110.
Project Skywater, 1966-1970; AgI; salt.

71D02
Decker, W. L., L. M. Chang, and G. F. Krause, 1971: An evaluation of the Whitetop cloud seeding experiment through a covariance analysis. J. Appl. Meteor., 10, 1193-1197.
An area adjacent to the treated area was taken as a covariant; AgI airplanes; days; average rainfall for days; analysis of covariance; difference between the adjusted seeded and non-seeded treatment means was not significant at the 5% level; negative seeding effect.

71D03
Dennis, A. S., and M. R. Schock, 1971: Evidence of dynamic effects in cloud seeding experiments in South Dakota. J. Appl. Meteor., 10(6), 1180-1184.
Randomized crossover; target areas of approximately 700 square mi. each; 300 gm/hr of AgI at cloud base; rainfall and hailfall; network of 90 stations; sum-of-squared-ranks test; gamma; positive seeding effect.

71E01
Elliott, R. D., P. St.-Amand, and J. R. Thompson, 1971: Santa Barbara pyrotechnic cloud seeding test results 1967-70. J. Appl. Meteor., 10(4), 785-795.
Convective bands; 60 recording raingages; GMD-1 radiosonde; double ratio; Mann-Whitney U test; randomized target control; increase 32% downwind effect; cloudtop temperature.

71E02
Elliott, R. D., and K. J. Brown, 1971: The Santa Barbara II project - downwind effects. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 179-184.
Winters of 67-68, 68-69, 69-70, and 70-71; convection band was randomly seeded; LW-83 pyrotechnic device (g. generator); 168 recording gages; 20,000 square mi.; study up to 150 mi downwind area; re-randomization test.

71E03
Estoque, M. A., 1971: Hurricane modification by cloud seeding. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 154-160.
Simulation; surface maximum wind; it is difficult to anticipate th effect of seeding.

71E04
Eccles, P. J., 1971: Liquid water content estimation and hail location by dual-wavelength radar in severe storms. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 227-230.
Need for digitized radar data; attenuation rate.

71F01
Fukuta, N. 1971: Weather modification activities in Japan. Bull. Amer. Meteor. Soc., 52(1), 4-14.
Early programs: 1947-1960; ice nuclei generators; evaluation of seeding results; radar; detection of AgI particles; five year project - 1961-1967; airborne instrumentation; ground generators; cloud physical observation.

71F02
Fletcher, R. D., 1971: Operational applications of fog modification. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 255-258.
Cold fog; history; warm-fog dissipation.

71F03
Falls, L. W., W. O. Willford, and M. C. Carter, 1971: Probability distributions for thunderstorm activity at Cape Kennedy, Florida. J. Appl. Meteor., 10, 97-104.
Negative binomial distribution; modification of the negative binomial distribution; number of thunder days; conditional probability.

71F04
Flueek, Jonn A., 1977: Project Whitetop : Part V - Statistical analyses of the ground level precipitation data. Final Report, Cloud Physics Lab., University of Chicago, 294 pp.
Statistical design; Missouri plume; Chicago plume; rotated 3-factor design; stratification variables - plume direction, wind direction, echo height, burner hour; additive and multiplicative constant seeding-effect model; additive and multiplicative variable seeding-effect model; exploratory analysis; daily; rainfall pattern; frequency of days with rain; extra-area

71G01
Grant, L. O., 1971: Some preliminary analyses to explore the possibility of extended area effects from the Climax seeding experiment. Trans. of Sem. on Ext. Area Effects of cloud Seeding, Santa Barbara, CA, Feb. 15-17, 103-120, Discussion, 121-124.
Randomized; 24-hour; 500 mb wind direction; Wolf Creek; Monarch Pass experiments; largest seed/no-seed ratios and highest test statistics are in the area generally downwind of the Climax experiment.

71G02
Grant, L. O., C. F. Chappell, and P. W. Mielke, Jr., 1971: The Climaxexperiment for seeding cold orographic clouds. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 78-84.
Natural ice crystal concentration is insufficient when cloudtop temperature is -20C or warmer; Wolf Creek; Monarch Pass; difference; ratios of seeded to non-seeded; Wilcoxon test; 500 mb temperature partitions; 700 mb equivalent potential temperature partitions; 700 mb wind velocity partions; 700 mb wind direction partitions; streamflow.

71G03
Goyer, G. G., 1971: The critical requirements for a sound hail suppression research program. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 219-222.
Forecasting; numerical models; require positive identification of hailers in real-time; need an accurate seeding system.

71G04
Grant, L. O., 1971: Priority problems for modifying cumulus precipitation. Proc. ASCE Spec. Conf.: Agricu. and Urban Consid. in I and D, Ft. Collins, CO, Aug. 22-24, 16pp.
Cloud types and weather modification potential; single cloud experiments; area experiments.

71H01
Hammond, A. L., 1971 Weather modification: A technology coming of age. Science, 172, 548-549.
General discussion; mathematical models; number of AgI molecules; Colorado River Basin Project; Project Skywater; snow; runoff; 1100 square miles; San Juan Montains; Durango; 33 ground generators; raingages; 500 mb temperature; 50% randomization; FACE; radar; cloud merging; Snow Redistribution Project; Buffalo.

71H02
Huff, F. A., 1971: Evaluation of precipitation records in weather modification experiments. Advances in Geophysics, 15, 59-195.
Gage density; accuracy of gage networks.

71H03
Hidore, J. J., 1971: The effects of accidental weather modification on the flow of the Kankakee River. Bull. Amer. Meteor. Soc., 52(2), 99-103.
1926 to 1960; trends; 5-year moving averages; 1926-1960, the annual runoff of the Kankakee River increased by 16%, and 17% at La Porte; correlation coefficients; support the La Porte weather anomaly.

71H04
Hawkins, H. F., 1971: Comparison of results of the hurricane Debbie (1969) modification experiments with those from Rosenthal's numerical model simulation experiments. Monthly Weather Review, 99(5), 427-434.
August 18; Aug. 20; Project Stormfury; AgI; wind-speed profiles; pyrotechnic; DC-6's; wind-speed maxima decreased by amounts that exceeded the most optimistic estimates; temperatures; the AgI seedings did have an effect on hurricane Debbie, which in a number of ways paralleled the reaction of

71H05
Hindman, E. E. II, S. D. Elliott, Jr., W. G. Finnegan, and B. T. Patten, 1971: Response of Stormfury cloudline cumulus to AgI and 2AgI. NaI ice nuclei from a solution-combustion generator. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 130-134.
1970; DC-6 aircraft; liquid and ice particle size-distributions; indicate that the cumulus began to glaciate at approximately -5C.

71H06
Hobbs, P. V., L. F. Radke, A. B. Fraser, and R. R. Weiss, 1971: The Cascade Project: A study of winter cyclonic storms in the Pacific Northwest. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 115-120.
Washington; B-23 aircraft; numerical model; case study; February 3 1971; caused large numbers of ice particles to form in an appreciable volume of cloud.

71L01
Lovasich, J. L., J. Neyman, E. L. Scott, and M. A. Wells, 1971: Further studies of the Whitetop cloud-seeding experiment. Proc. Nat. Acad. Sci., 68(1), 147-151.
West Plains, Missouri; stratified by wind direction and synoptic type (air mass and frontal); overseeding; non-significant for west wind and frontal days; significant decrease for east wind and air mass days up to 180 miles away; negative effect; wet days; moving grid method; 24-hr; precipitation at ground.

71L02
Lovasich, J. L., J. Neyman, E. L. Scott, and M. A. Wells, 1971: Hypothetical explanations of the negative apparent effects of cloud seeding in the Whitetop experiment. Proc. Nat. Acad Sci., 68(1), 2643-2646.
Three hypothses; negative seeding effect; overseeding; cloudiness; ground temperature; randomization not effective; upwind effect.

71L03
LeDuc, Sharon Key Orndoff, 1971: Comparison of some statistical tests for cloud seeding experiments. Ph. D. Thesis, Univ. of Missouri-Columbia, 126 pp.
For random target-only design Mann-Whitney U test is better than other nonparametric tests but not as good as the generalized likelihodd ratio test; gamma; Pitman efficiency; t-test; multiplicative seeding effect model; simulation; median test; Kolmogorov-Smirnov test; c(a) test; Lilliefors test; Moran's t-test; synoptic type; bibliography; east central Illinois raingage network, 1955-1967; Panther Creek network, IL, 1955-1961.

71L04
Lackner, J. D., 1971: Precipitation modification. Report NWC-EES-71-005, National Water Commission, Arlington, VA, 170 pp.
Hydrological models; downwind effect; environmental; economic feasibility; social; benefit-cost; legal; streamflow; history; orography; Climax; Lake Almanor, CA; Snowy Mountain project; Whitetop; Santa Barbara; Israel; Rapid City Project; Arizona; India; Soviet; south Florida; Illinois.

71M01
Moran, P. A. P., 1971: Analysing an experiment to find the causes of variability of a treatment effect. Austral. J. Statist., 13(3), 149-153.
Multiple regression lines; discover under what circumstances the seeding effect is positive or negative; predictor variable; additive seeding effect; significance test of regression coefficients; F-test; multiplicative seeding effect.

71M02
Mielke, P. W., L. O. Grant, and C. F. Chappeil, 1971: An independent replication of the Climax winter orographic cloud seeding experiment. J. Appl. Meteor., 10, 1198-1212.
Taha's sum of squared rank test; randomized; 24 hours as unit; 1965 and 1970; Colorado; two-sample Wilcoxon; temperature; wind partitions.

71M03
Mielke, P. W. Jr., 1971: Symposium of downwind effects of cloud seeding. Trans. of Sem. on Ext. Area Effects of cloud Seeding, Santa Barbara, CA, Feb. 15-17, 90-102.
Upwind seeding effects by the Park Range Project on the Climax experiment; stratification by 500 mb temperatures; stratified by 700 mb wind velocities; 76 contaminated experimental units.

71M04
Musil, D. J. 1971: The North Dakota Pilot Project, Part III: Evaluation of Data - 1970. Report 71-3, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 36 pp.
Two consecutive days from each 8-day time block were randomly selected as no-seeded days; 3% AgI-NaI acetone solution; AT-6G aircraft; 98 gages; ground generator; seeding operation; APS-42 3-cm radar; monthly; seasonal; S-NS ratio; sum of squared-rank test; gamma; downwind effect; hail energy; hail day.

71N01
Neyman, J., H. B. Osborne, 1971: Evidence of widespread effects of cloud seeding at two Arizona experiments. Proc. Nat. Acad. Sci., 68(3), 649-652.
Downwind effect; AgI; upwind; rain; time measured too short to show significance; 1957-1962, 1964; 24-hour precipitation at Walnut Gulch decreased 40% (p=0.025); Santa Clara Mountain; randomized pair; AgI.

71O01
Ogden, T. L., and K. O. L. F. Jayaweera, 1971: Cloud seeding effects on different daily rainfall amounts. J. Appl. Meteor., 10, 1002-1005.
New England, Australia; stratification by daily rainfall totals; no effect was detected on days with an area average rainfall of less than 0.1 inch; days with between 0.1 and 0.5 inch showed increases of 10-20%; the 0.5-1.0 inch class showed an apparent 10% decrease; mixed seeding effect; re-analyzed; root double ratio; AgI; aircraft; randomized; 1958-1963; persistence.

71P01
Picca, R., 1971: An operational method of hail suppression in France. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 211-212.
ACMG; 9,200 square km from 1964 to 1968; 15,000 square km since 1969; rockets; pyrotechnical; tobacco; hail days; percentage of the area; size of hailstones; Mann-Whitney test; t-test; nearly all the parameters show significant decreases; chi-square test.

71S01
Schickedanz, P. T., and S. A. Changnon, Jr., 1971: The design and evaluation of the National Hail Experiment in northeast Colorado. J. Wea. Mod., 3, 160-176.
Day as experimental unit; 3-county area-Weld, Logan, and Morgan; NHRE; target 600 square miles; insurance data, May-Oct., 1957-1969; parameters used--dollar loss, numbers of acres damaged, adjusted dollar loss, adjusted numbers of acres damaged, dollar extent, areal extent, %loss; log-normal, gamma; c(a) test; 4 designs - random-experimental, random-experimental with predictor, random-historical, continuous historical (the best for 40% and peta=.70); it was found that %loss, dollar extent, and areal extent were the most efficient hail parameters; Kolmogorov-Smirnov test; chi-square test; Poisson distribution; negative binomial distribution; hail days.

71S02
Sehickedanz, P. T., and F. A. Huff, 1971: The design and evaluation of rainfall modification experiments J. Appl. Meteor., 10(3), 502-514.
Sample sizes; ECI network data; areal storm precipitation and areal depth measurement as response variables; designs - random-experimental, random-historical, continuous-historical, cross-over, target-control; day as experimental unit; 7 synoptic types, 3 precipitation types, 5 kinds of storms; sequential and nonsequential analyses; lognormal distribution; variability of rain.

71S03
Simpson, J., W. L. Woodley, A. H. Miller, and G. F. Cotton, 1971: Precipitation results of two randomized pyrotechnic cumulus seeding experiments. J. Appl. Meteor., 10(3), 526-544.
Single cloud; dynamic seeding; South Florida; 1968 and 1970; airborne; AgI; cloud tops; seedability; 10-cm radar; precipitation rate; mean total seeded and unseeded rainfall; cloud as unit; Wilcoxon-Mann-Whitney; covariate regression; analysis of variance; daily means; dynamic seeding effect on rainfall is large, positive and significant.

71S04
Simpson, J., and W. L. Woodley, 1971: Seeding cumulus in Florida: New 1970 results. Science, 172, 117-126.
One-D cloud model; dynamic seeding; seedability; 15 April to 31 May 1970; randomizedl; multiple cloud seeding; public relation problem; single cloud experiment; 10-cm radar; echo area at cloud base; increase of 55-75% for the first 40 minutes; more than 100% increase for whole cloud lifetime; fourth-root transformation; Wilcoxon test; covariate regression; ANOCOVA; daily means; 2 regressions; seeded clouds averaged 19% taller, and 75% larger than control clouds; stratification; t-test; mergers; 2-1 randomization; total target; float target; precipitation rate; as much as 90% of ground precipitation was collected by the precipitation fallout from the actively rising tower in the cloud.

71S05
Simpson, J., and V. Wiggert, 1971: 1968 Florida cumulus seeding experiment: Numerical model results. Monthly Weather Review, 99(2), 87-118.
1-D. numerical cumulus model; randomized experimental; 9 out of 14 clouds were seeded with 1 kg of AgI each; disturbed period was less favorable for seeding; a high correlation was found between seedability and radar-measured rainfall increase from seeding; a high correlation was found between model predictions of the difference in precipitation between seeded and control clouds and the measured rainfall difference.

71S06
Super, A. B., and V. L. Mitchell, 1971: Preliminary evidence from the Montana State University randomized seeding program.
Trans. of Sem. on Ext. Area Effects of cloud Seeding, Santa Barbara, CA, Feb. 15-17, 20-29.
1969-70 and 1970-71; Bridger Mountain Range; 1 November to 1 April; 24 hour; 26 gages; squared rank test; Wilcoxon two sample; stratification by 600 mb temperature; no effect of seeding is suggested beyond about 20 miles downwind of the generators.

71S07
Simpson, J., and W. L. Woodley, 1971: On the EML cumulus seeding experiments in Florida. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 85-90.
Dynamic seeding; aircraft; pyrotechnic; cloud tower model; single cloud experiments; 10-cm radar; seeded-control difference; area experiment; randomize by days; June-July; persistent effects; did not find any obvious larger-scale rainfall decreases associated with seeded clouds.

71S08
Smith, E. J., E. E. Adderley, L. G. Veitch, and E. Turton, 1971: A cloud-seeding experiment in Tasmania. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 91-96.
1964 to 1970; AgI; aircraft; 54 gages; three control areas; Nal; operational procedures; double ratio; permutation test; regression; cube-root transformation; t-test; scatter diagrams; an increase in rainfall of about 15% to 20% in autumn and winter.

71S09
Swinbank, W. C., 1971: The national hail research experiment. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 203-206.
Dual-wavelength radar; hypothesis.

71S10
Summers, P. W., and J. H. Renick, 1971: Case studies of the physical effects of seeding hailstorms in Alberta. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 213-218.
1957-1971; storm as unit; non-randomized; hail impact energy; crop damage; radar reflectivity.

71S11
Simpson, J., and J. Pezier, 1971: Outline of a Bayesian approach to the EML multiple cloud seedng experiments. NOAA Technical Memorandum ERL OD-8, 43 pp.
Florida; gamma; fourth-root transformation; a seeding effect of a factor 2-3; decision theory; truncated normal; areal rain; computer program.

71S12
St. Amand, P., R. S. Clark, T. L. Wright, W. G. Finnegan, and E. A. Blomerth, Jr., 1971: Warm fog modification. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 259-264.
Project Foggy Cloud; Arcata-Eureka Airport, Northern California; 1968-1970; ammonium nitrate; urea; water; C-47; B-25; spray rates; droplet sizes; increase of 214 ft in ceiling and 1 1/16 miles in visibility.

71S13
Schock, M. R., and J. R. Miller, Jr., 1971: Interim Report on the North Dakota Pilot Project from 1 July 1970 to 30 June 1971. Report 71-20, S.IASSD ,13 pp.
APS-42 3-cm radar and NCPR 10-cm radar; AT-6G aircraft; Piper Comanche 250 aircrat; 3% AgI acetone solution; change of forecasting procedure; S-NS ratio; monthly; seasonal; squared rank test; Wilcoxon test.

71S14
Schock, M. R., and J. W. Gelhaus, 1971: The Grand River Randomized Project. Report 71-4, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 46 pp.
AgI, 300 gm per hour; 2 aircraft; cloudbase seeding; 75% seeding; 99 gages; gamma; hail day; hail impact energy; periodic random target-control; APS-42 3-cm and M-33 10-cm radars; contamination analysis; Bowman-Slope project; autocorrelation; squared rank test; bad draw in randomization; maximum echo height; chi-square test.

71S15
Shulman, M. D., and A. R. Greenway, 1971: Investigation of the effects of urbanization on precipitation type, frequency, areal and temporal distribution. Final Report , Water Resources Res. Inst., Rutgers Univ., 83 pp.
Review; annual; precipitation trend; exponential smoothing; monthly trend; test of homogeneity of variances; correlation; La Porte; gamma probability plot; New Jersey; New York and Connecticut; 1900-1970; stratified by 850 mb and surface wind direction; ANOVA; index of urbanization.

71S16
Schickedanz, P. T., 1971: Application of dense raingage data to regions of sparse data coverage. Final Report, Illinois State Water Survey, Urbana, IL, 67 pp.
Gage density; ANOVA; areal rain; sampling error; regression; spatial correlation; point rainfall estimation; standard error; daily; yearly; gamma; log-normal; Kolmogorov-Smirnov test.

71S17
Sutherland, J. L., L. W. Cooper, and D. R. Booker, 1971: Oklahoma drought relief operation. Final Report, Weather Science, Inc., Norman, Oklahoma, 50 pp.
Southwestern Oklahoma; August-September, 1971; aircraft pyrotechnic; 42,000 gm AgI; cloudbase seeding; digitized radar data; NSSL WSR-57 radar; rainfall increase of 50,000 acre-feet; seeding operation; piggyback; ammonium nitrate; urea; water as seeding agents; rain intensity; operational.

71V01
Vardiman, L., E. D. Figgins, and H. S. Appleman, 1971: Operational dissipation of supercooled fog using liquid propane. J. Appl. Meteor., 10(3), 515-525.
Washington; winter of 1969-70; stationary ground dispensers; usable clearings followed 25 of 29 seeding operations conducted; natural clearing; seeding failed to produce usable results in four cases in which the temperature was 31F or higher; visibility; ice crystal diffusion; effect of wind; snowfall.

71W01
Wurtele, Z. S., 1971: Analysis of the Israeli cloud seeding experiment by means of concomitant meteorological variables. J. Appl. Meteor., 10, 1185-1192.
1961 to 1967; 30 concomitant meteorological variables, both surface and upper air; cross-over; days randomized; 2.5% significant (2-sided) using t-test; 10% significant using 2 sample Wilcoxon test; contamination of one target; pressure; synoptic types; temperature; wind direction; stabiblity index; DC-3 aircraft; Whitetop; regression; areal extent.

71W02
Watson, B., and C. A. Denny, 1971: The use of streamflow data for the evaluation of cloud-seeding experiments in Tasmania. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 97-102.
1964 to 1970; difficulty; annual flow; 1950 to 1970; serial correlation; data; double ratio; cumulative residual ratios; coefficient of variation.

71W03
Warburton, J. A., 1971: Physical evidence of transport of cloud-seeding materials into areas outside primary targets. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 185-190.
25 wintertime storms; 1968 and 1971; Truckee-Tahoe Catchment area; New York; Ag tracing; Park Range-Colorado; Lake Effect Storms Project; tenfold increase; percentagen of released Ag detected.

71W04
Warner, J., 1971: Smoke form sugar-cane fires and rainfall. Proc. Internat. Conf. on Wea. Mod., Canberra, Australia, 6-11, Sept., 191-192.
Australia; general decrease in the September-November rainfall; ten-year totals of shower rainfall.

72B01
Black, P. G., H. V. Senn, and C. L. Courtright, 1972: Airborne radar observations of eye configuration changes, bright band distribution, and;precipitation tilt during 1969 multiple seeding experiments in hurricane Debbie. Monthly Weather Review, 100(3), 208-217.
Project Stormfury; Aug. 18 and 20; increases in the echo-free area within the eye; changes in major axis orientation; seeding hypothesis.

72B02
Brown, K. J., and R. D. Elliott, 1972: Mesoscale changes in the atmosphere due to convective band seeding. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 313-320.
Santa Barbara; study large scale effects of seeding; randomized; LW-83 pyrotechnic; Mann-Whitney U test; 56 seeded and 51 not-seeded bands; out of the 168 stations, twenty-nine are indicated to be significant at the 5% level; band duration; seed/no seed ratio; the pattern suggests lower pressure in the downwind area during seeding; diurnal variations of seeding effect; the precipitation ratios and differences are most significant at a slightly later time - 0700 to 1300.

72C01
Cunningham, R. M., and M. Glass, 1972: A warm cumulus modification experiment. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 175-178.
September 1971; east coast of Florida; C-130; encapsulated urea; 26 cloud cases; thermal size; data; cloud diameter; cloud model; drop diameter; cloud liquid water content; inconclusive result.

72D01
Dennis, A. S., J. W. Gelhaus, and M. R. Schock, 1972: Rainfall anomalies in a randomized seeding project. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 300-303.
June 1 to August 15 in 1969 and 1970; periodic randomized target-control design; northwestern South Dakota and southwestern North Dakota; evidence of a bad draw in a randomized seeding project; airborne acetone; 110 raingages; S-band radar; sum-of-squared-ranks; covariance analysis; experiment confirms that randomization does not by itself insure a successful experiment; cloud models; AgI.

72DO2
Dennis, A. S., and A. Koscielski, 1972: Height and temperature of first echoes in unseeded and seeded convective clouds in South Dakota. J. Appl. Meteor., 11(6),994-1000.
Cloud base height; cloud base temperature; maximum radar echo height; height and speed of maximum updraft; AgI; salt; 1969 and 1970; Project Cloud Catcher; three-way randomization; modified Nike-Ajax X-band radar; radar reflectivity; linear regression; Hirsch cloud model; both AgI and salt seeding can cause first echoes to appear closer to cloud base.

72D03
Dessens, J., and J. P. Lacaux, 1972: Ground seeding for hail prevention in south-western France: Possible overstepping of an economical efficiency level from 1963. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 268-271.
Aquitain Basin; April to October; 9 g/h of AgI; crop-hail insurance data; non-randomized; continuous historical target-control; Rhodanian Basin as control area; double-mass curve; change in slope indicates a relative decrease of hail damages in the target area from 1963; ratio.

72G01
Gabriel, K. R., 1972: Analysis of meteorological data by means of canonical decomposition and biplots. J. Appl. Meteor., 11(7), 1071-1077.
Rainfall analysis; MANOVA; Israeli rainmaking experiment, 1961-1967; day as unit.

72G02

Grant, L. O., J. M. Fritsch, and P. W. Mielke, Jr., 1972: Randomized seeding of continental convective clouds near Climax, Colorado. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 216-221.

Summer; blocked randomization; 4 generators; 116 seeded; 125 non-seeded; 1966 through 1969; S0-12 M/N X-band radars; p-value is less than 0.0001; chi-square test; echo area; stratified by time of day; 2-sample Wilcoxon rank test; sum of squared ranks tests; ratio; stratified by 500 mb temperature and wind direction and velocity; 700 mb temperature; wind direction and velocity; differences become more marked when 500 mb flow was from the northwest or southwest with 500 mb temperature -6C; downwind effects; Arizona; Whitetop; Rapid City Project.

72H01

Huff, F. A., *and* P. T. Schickedanz, 1972: Space-time uncertainties in precipitation measurement. Internat. Symp. on Uncertainties in Hydrol. and Water Res. Sys., NSF, Tucson, AZ, 11-14, Dec., 395-409.

Evaluations; stratification; 5 recording raingage networks in Illinois; spatial correlation; sampling errors; design in general; raingage density; pattern recognition.

72H02

Hannan, E. J., and P. A. P. Moran, 1972: The effects of serial correlation on a randomized rain-making experiment. Austral. J. Statist., 14(3), 256-261.

Completely randmized target only design; randomized periodic design; simple schemes of dependence; spectrum; optimal designs; Markov chain.

72H03

Huff, F. A., and S. A. Changnon, Jr., 1972: Evaluation of potential effects of weather modification on agriculture in Illinois. J. Appl. Meteor., 11(2), 376-384.

Corn; soybeans; 1931-68; multiple regression equations relating crop yield to technology trends and various temperature and precipitation parameters; frequency distributions; assumed seeding operations lasting 1, 2, 3 and 5 years; reaction to the potential seeding was fund to vary substantially between regions with the same seeding model; 15 weather variables used; constant percentage increases; 8 variable-change models; probability curves; in most regions of Illinois corn and soybean crops would be benefited economically in the majority of the growing seasons through a cloud seeding program, provided that the seeding operator had the capability to produce rainfall increases >= 10%.

72H04

Huff, F. A., and S. A. Changnon, Jr., 1972: Climatological assessment of urban effects on precipitation at St. Louis. J. Appl. Meteor., 11(5), 823-842.

Radar climatological studies; urban heat island; addition of ice nuclei; increase of low level mechanical turbulence; modification of the low level atmospheric moisture content; cooling towers; EDS stations; spatial pattern analysis; total precipitation on monthly and seasonal basis; frequency and intenslty of rainfall, hail.

72H05

Hoffdorson, and S. A. Changnon, Jr., 1972: Results from an applications program of hail suppression in Texas. Third Conf. on Wea. Mod., Amer. Meteor. Soe., Rapid City, S.D., 26-29, June, 260-267.

May-October periods of 1970 and 1971; three-aircraft; Agl at cloud base; 2,000 square miles; hail days; maximum hail frequency; pyrotechnic compositions; operational summary; crop-hail insurance loss data; loss cost; 1947-71 as historical control; percent normal method; 2-year moving averages; 47% below normal average loss cost.

72H06

Huff, F. A., 1972: Potential augmentation of precipitation from cooling tower effluents. Bull. Amer. Meteor. Soc., 53(7), 639-644.

Tower characteristics; natural-draft cooling towers; mechanical-draft towers; wet-type or evaporative cooling towers; dry-type towers; literature review; Zion towers, Illinois; La Porte; urban heat output; one-dimensional cloud models.

72H07

Henderson, T. J., 1972: Results from comparisons between the field applications of AgI-Nal and AgI-NH4I solutions in airborne generators on a hail suppression program in Kenya. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 333-336.

Pyrotechnic; cloud base seeding; March-August 1971; cloud temp.; echo top; hail damage; the numbers of both damaging and non-damaging hail instances is significantly less when cloud treatment utilizes the NH4I-2AgI solution; the damage per hail instance is also significantly less when this solution is used for treatment; the NH4I-2AgI solution appears that 75% more effective than the NaI-2AgI solution.

72H08

Henderson, T. J., 1972: Results from the use of LW-83 pyrotechnic seeding devices on operational orographic cumulus program in Africa and California. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 40-43.

May-September; 1971; Kings River; Kenya; Project Sierra Cumulus; summer orographic; annual streamflow; increases in runoff of 33%; hail damage reduction in excess of 60%; in terms of the streamflow approach, the LW-83 unit appears slightly more effective than the 600-001 and almost twice as effective as the WM-105 unit.

72H09

Huff, F. A., and S. A. Changnon, Jr., 1972: Inadvertent precipitation modification by major urban areas. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 73-78.

8 major U. S. cities; monthly and seasonal precipitation; frequency of thunder and hail days; weekday-weekend occurrences of precipitation; number of precipitation days in various intensity classes; daily; trend; six cities have thunder increases ranging from 13 to 47% above the climatic background, and three of these increases are highly significant; maximum area or point increases of haildays range from 90 to 350%; the warm season rainfall increase maximized 10-35 mi downwind of the cities.

72H10

Huff, F. A., and S. A. Changnon, Jr., 1972: Evaluation of potential effects of weather modification on agriculture in Illinois. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 222-225.

Simulation; corn and soybeans; economic; 13-region division; regression; crop yield and climatological data for 1931-68 were used; constant percentage changes and 8 varying seeding-effect models; frequency distributions of yield changes; assume seeding operations periods of 1 to 5 years; year-to-year variability in the efficiency of a given seeding model; from the standpoint of help or harm, it would usually be advantageous to initiate cloud seeding whenever a "dry spot" develops in the state.

72H11

Henderson, T. J., and W. J. Carley, 1972: The airborne seeding of six tornadoes. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 241-244.

Temperature; cloud base height; inflow velocity; turbulence; 14 May 1970 near Halfway, Texas; 13 August 1971 near Aiken, Texas; Twin Comanche seeding aircraft; visual; pyrotechnic; Agl; 3 cm radar; the tornado intensities have not in??ed following the seeding application.

72K01
Kunkel, B. A., 1972: A statistical approach to evaluating fog dispersal operations. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 69-72.
Warm fog; visibility of 1/2 mile; conditional probabilities of natural fog clearing; fog duration; evaluation method; sample size.

72K02
Keyes, C. G. Jr., D. Rottner, F. D. Stover, and R. D. Wilkins, 1972: An evaluation of the results of four years of randomized seeding in Northern New Mexico. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 137-142.
Orographic snowfall; Cuba, New Mexico; Jemez Mountains; 24-hour; radiosonde; twenty-five hourly recording precipitation stations; AgI generators; 6-hour; two sample Wilcoxon; two sample sum of squared ranks; stratified by 500 mb temperature, cloud top temperature, time of day, and 700 mb wind direction; 500 mb temperature stratification was contrary to the Climax results; the cloud top temperature results were unusually significant; the effect was larger in the first 12 hours of the seedable unit; regression.

72K03
Kosielski, A., and A. S. Dennis, 1972: Seeding effects in convective clouds in Western South Dakota. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 186-191.
Project Cloud Catcher; heavy AgI seeding; randomly allotted to no-seed, AgI seed, and salt seeded classes with a one-third probability; 3.2-cm radar; 10-cm FPS-6/18 S-band radar; 108 raingages; Hirsch Cloud Model; Musil Cloud Model; trajectories for salt particles; cloud base temperature; max. updraft; first-echo temperature; echo height; radar rainfall estimates; resulting seed/noseed ratios were 1.39 for AgI and 1.40 for salt; maximum echo height; regression; Wilcoxon rank test; hail impactor; little hail damage associated with the test cases; twice as much rain on salt seed days as on no-seed days; AgI seed days have yielded less rain than no-seed days.

72K04
Kopp, F. J., and H. D. Orville, 1972: The simulation of cloud seeding in a mountain cumulus numerical model. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 199-202.
Model is time-dependent, two-dimensional with 200 m grid intervals and covers an area 20 km wide by 10 km high.

72L01
Lovell, C. C., 1972: Some aspects of the suppression program in the nNtional hHil Research Experiment. Third Conf. on Wea. Mod., Amer. Meteor. Soo., Rapid City, S.D., 26-29, June, 44-47.
Spin-stabilized rocket; serial correlation; occurrence of a hail day; independent sample; Markov model; total mass of hail; correlation is high between adjacent days; average sequence length of 2.5 days; functional bias; operational biases; data collection bias; observational bias.

72M01
Mielke, P. W., Jr., 1972: Asymptotic behavior of two-sample tests based on powers of ranks for detecting scale and location alternatives. J. Amer. Statist. Assoc., 67, 850-854.
Asymptotically optimum; weather modification; sum of rank power test; Wilcoxon test; large sample skewness and kurtosis; asymptotic relative efficiency; gamma; t distribution.

72M02
McCarthy, J., 1972: Computer model determination of convective cloud seeded growth using project Whitetop data. J. Appl. Meteor., 11(5), 818-822. (See 73W01 for comment).
One-dimensional cumulus dynamics model of Simpson and Wiggert; cloud size; seedability; growth seedability; fallout seedability.

72M03
Mitchell, V. L., A. B. Super, and R. H. Yaw, 1972: Preliminary results of a randomized winter orographic cloud seeding experiment in the Northern Rocky Mountains. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 125-128.
Bridger Mountains of southwestern Montana; 24 hour beginning at 1200 MST; 2 modified Skyfire generator; 28 gages; RD-65 rawinsonde; a total of 203 experimental days; 1 November 1969 to 31 December 1971; 2 sample Wilcoxon rank sum and the 2 sample sum-of-squared rank tests; Climax; four gages were statistically significant at the 5% level, with an additional five being significant at the 10% level; ratio; 700 mb equivalent potential temperature.

72M04
Miller, A. H., and J. C. Eden, 1972: Airborne and ground-based drop size distribution in Florida summer showers and simultanous radar reflectivity and rainfall data. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 208-213.
3-cm RDR-1D radar; MRI Model 1220A Continuous Hydrometer Sampler (CHS); 1971; 225 raingages; ground-based Joss type RD-69 raindrop distrometer; UM/10-cm radar; regression; different Z-R relationships need be applied to seeded clouds and to unseeded clouds.

72M05
Magaziner, E. L., 1972: Statistical evidence of electrical modification of thunderstorms by artificially triggered lightnings. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 239-240.
Small rockets; Kennedy Space Center; June of 1971; mean of the experimental group is larger; Mann-Whitney test; significance of the increase in lightnings at the 0.09 level.

72M06
Miller, J. R. Jr., 1972: Interim Report on the North Dakota Pilot Project from 1 July 1971 to 30 June 1972. Report 72-16, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 14 pp.
Change of AgI solution concentration; ammonium iodide; 5 aircraft; change in forecasting function; salt seeding; NCPR-1 10-cm radar; Wilcoxon test; S-NS ratio; gamma; periodic random target-only; problem in delivering seeding agent.

72M07
Miller, J, R., Jr., and R. F. Riggio, 1972: The North Dakota Pilot Project, Evaluation of Data--1971. Report 72-3, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 62 pp.
10% AgI-NH3I acetone solution; airborne; on-site rawinsonde; project design change; equipment; NCPR-1 10-cm radar; seeding operation; Wilcoxon test; stratified by cloudbase temperature; chi-square test; frequency of hail occurrence; gamma; hail energy.

72M08
Miller, J. R. Jr., 1972: Interim Report on the North Dakota Pilot Project from 1 May 1972 to 31 August 1972. Report 72-16a, Inst. of Atmos. Sci, South Dakota School of Mines and Technology, Rapid City, 16 pp.
75% seeded randomly; periodic random target-only; 1972; NCPR-1 10-cm radar; Z-R relation; rawinsonde.

72N01

Neyman, J., H. B. Osborne, E. L. Scott, and M. A. Wells, 1972: Re-evaluation of the Arizona cloud-seeding experiment. Proc. Nat. Acad. Sci., 69(6), 1348-1352.

Whitetop; AgI; widespread seeding effect; rainfall variability; airborne; 24-hour precipitation at Walnut Gulch; 212 days; 1957-1962,1964; AgI.

72N02

Neumann, J., and E. Shimbursky, 1972: On the distribution of a ratio of interest in single-area cloud seeding experiments. J. Appl. Meteor., 11(2), 370-375.

The ratio S/U can be looked upon as the "result" of a two-area crossover experiment where the "rain" amounts of the "second" area are unity for all time units; root-double-ratio; 1961-67 Israeli randomized cloud seeding experiment; Monte Carlo; estimating the level of significance; asymptotic normality of the root of the single-area ratio.

72N03

Neyman, J., and E. L. Scott, 1972: Some current problems of rain stimulation research. Internat. Symp. on Uncertainties in Hydrol. and Water Res. Sys., NSF, Tucson, AZ, 11-14, Dec., 1167-1244.

History; Skywater Conference; extra-area effect; Grossversuch III; Arizona experiment; need for randomization; regression; NAS-NRC.

72001

Osborn, H. B., 1972: Comments by a hydrologic engineer on cloud seeding in Arizona. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 146-151.

Annual runoff; Santa Catalina Mountains; 1957 through 1960; 1961, 1962, and 1964; AgI; average hourly rainfall; Whitetop; widespread effects; eastern and central Arizona; seeding was on an individual cloud; July 20-August 15; no indication of an overall increase in the seeded area.

72R01

Reinking R. F., 1972: Target area persistence of cloud seeding material. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 109-112.

Two locations; Climax; Park Range Project; nucleus concentrations were measured with Bigg-Warner rapid expansion ice nucleus counters; two-sample Wilcoxon test; two-sample sum of squared ranks test; indicate definite persistence of seeding material into the first and second calendar days after seeding ceased in both the HAO and REP target areas; HAO D+1 sample shows nucleus concentration increases of about 3x(median) to 8x(mean) over the control sample.

72S01

Schickedanz, P. T., 1972: The raincell approach to the evaluation of rain modification experimeents. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 88-95.

Single cloud systems; all cloud systems; radar; raingage charts; rainfall rates; isohyet; design; planned rain modification; paired storm design; randomized-period cell design; sampling unit; experimental unit; target cells and control cells; inadvertent rain modification; plume area; raincells as the experimental unit; METROMEX data; 11-30 June 1971; total rain production per unit area; total areal extent; duration; maximum rain per 5-min period; maximumareal extent per 5-min period; 138 cell initiations; t value; correlation; cell separation period (CSP); lag correlation; spectrum analysis.

72S02

Simpson, J., W. L. Woodley, and R. M. White, 1972: Joint federal-state cumulus seeding program for mitigation of 1971 south Florida drought. Bull. Amer. Meteor. Soc., 53(3), 334-344.

Lake Okeechobee; 1-dimensional cloud model; 14 seeded days; radar and raingages; satellite; randomized; agriculture; drought; dynamic seeding; two targets of 7200 square miles; AgI; DC-6 aircraft; scattergrams; gain 180,000 acre-foot of water.

72S03

Stigler, S. M., 1972: Cloud seeding experiments: Possible bias. Science, 173, 850.

Selection bias; solutions.

72S04

Schleusener, R. A., A. Koscielski, A. S. Dennis, and M. R. Schock, 1972: Hail experience on eight project seasons of cloud seeding with silver iodide in the Northern Great Plains. J. Res. Atmos., 519-528.

Hail impact energy; summers from 1966 to 1969; 1968 Grand River Project; Rapid Project in 1966; Cloud Catcher in 1969; cloudbase seeding; regression; reduction of hail energies by 70%.

72S05

Simpson, J., 1972: Use of the gamma distribution in single-cloud rainfall analysis. Monthly Weather Review, 100(4), 309-312.

Multiplicative seeding effect; radar-evaluated rainfall; Florida; fourth root transformation; Bayesian; chi-square test; truncated normal; Weibull; log-normal; Rayleigh; inverted gamma; inverted Rayleigh.

72S06

Semonin, R. G., 1972: Tracer chemical experiments in midwest convective clouds. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 83-87.

1971 experiments; METROMEX; suitability of lithium as a tracer; 14 July; 14 August.

72S07

Summers, P. W., 1972: The silver fallout patterns in precipitation from seeded convective storms. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 279-286.,

Alberta; summers of 1970 and 1971; sixteen experiments; AgI pyrotechnic; radar reflectivity; hail patterns; cloud photography; hail damage statistics; Ag analysis; T-33 jet aircraft; X-band radar; Perkin Elmer Model 301 atomic absorption spectrophotometer; the earliest time at which Ag was detected in precipitation was in a rather narrow time range of 15 to 30 min after seeding, and at a distance of less than 22 mi away; in three cases, Ag was detected in precipitation falling >1 hour after seeding; widespread dispersion of AgI.

72W01

Wu, S. C., J. S. Williams, and P. W. Mielke, Jr., 1972: Some designs and analyses for temporally independent experiments involving correlated bivariate responses. Biometrics, 28, 1043-1061.

Balanced cross-over design; continued covariate design; augmented cross-over design; maximum likelihood; Fisher's information function; Wilk's lambda; analysis of covariance; Kings River Basin; logarithmic transformation; optimal design.

72W02

Williams, M. C., W. F. Rowland, and J. N. Srivastava, 1972: On the choice of an experimental unit and a block system for weather modification experiments. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, *321-324.*

1949-1969; restricted randomization within blocks may provide an increase in information of the order of 25% to 30%; simulation; ratio; hourly precipitation data for eight stations; California; completely random design; orographically; the luck of the draw; eleven different storm types; 930 storms in all.

72W03

Woodley, W. L., and J. Simpson, 1972: Results of dynamic multiple cloud seeding in Florida. Third Conf. on Wea. Mod., Amer. Meteor. Soc., Rapid City, S.D., 26-29, June, 292-299.

Fixed target area; randomization weighted two to one in favor of seeding in 1970 and a 50-50 randomization in 1971; 5 cm and 10 cm radars; suitability factor; day as unit; maximum radar measured cloud tops; operational summary; radar representation of the rainfall; floating target rainfall analysis; guess the treatment decision; Mann-Whitney-Wilcoxon test; greater seeded rainfall at the 10% level for both adjusted and unadjusted floating target rainfall; Bayesian; gamma.

73B01

Butchbaker, A. F., 1973: Results of the Bowman-Slope hail suppression program. J. Wea. Mod., 5(1), 133-145.

North Dakota; 1966-1968; target with 5 controls; 2000-3000 square miles; storm as unit; aircraft and 20 ground generators; AgI and NaI; seasonal rain, maximal radar reflectivity as response variables; 30-60 %reduction.

73B02

Brier, G. W., L. O. Grant, and P. W. Mielke, Jr., 1973: An evaluation of expended area effects from attempts to modify local clouds and cloud systems. WMO Sci. Conf. on Wea. Mod., Tashkent, USSR, 1-7, Oct., WMO No. 399, 439-457.

Climax; Israeli; regression coefficients; effects found in the initial targets extend to downwind areas; NHRE.

73B03

Bryson, R. A., 1973: Climatic modification by air pollution II: The Sahelian effect. IES Report 9, Center for Climatic Research, Institute for Environmental Studies, University of Wisconsin, 12 pp.

Drought; Smagorinsky's Z criterion.

73C01

Changnon, S. A., Jr. 1973: A review of methods to evaluate precipitation modification in North America. WMO Sci. Conf. on Wea. Mod., Tashkent, USSR, 1-7, Oct., WMO No. 399, 397-422.

History; design; target-control; cross-over; continuous historical target only; radar; raingages; stream runoff; cost of each method; natural variablilty of rainfall.

73C02

Crovelli, R. A., 1973: A bivariate precipitation model. Third Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Boulder, CO., 19-22, June, 130-134.

Storm depth; storm duration; precipitation rate; bivariategamme.

73C03

Changnon, S. A., Jr., 1973: Precipitation enhancement program for Illinois. J. Irrig. and Drainage Div., Proc. of Amer. Soc. of Civil Eng., 99, 215-226.

PEP project (IL); agriculture and water supply benefits; seeding-induced increases in runoff; runoff/rainfall ratio for given rainfall increase; ecological studies; social impact; seeding concept.

73C04

Changnon, S. A., Jr., and F. A. Huff, 1973: Enhancement of severe weather by the St. Louis urban-industrial complex. EighthConf. on Severe Local Storms, 15-17 Oct., AMS,8 pp.

METROMEX; instrumentation; thunderstorm frequency; rainfall analyses; synoptic; spatial distribution of hail; duration of hailstreaks; diurnal distribution; 3 to 4 added thunder days (+30%); 4 to 5 more discrete rain periods with thunderstorms; 8 to 9 more discrete thunder periods per year.

73D01

Dennis, A. S., and R. A. Schleusener, 1973: Engineering and operational aspects of weather modification. WMO Sci. Conf. on Wea. Mod., Tashkent, USSR, 1-7, Oct., WMO No. 399, 325-332.

Types of generators; AgI consumption rates; rain increase; hail suppression in general; Bowman-Slope project; South Dakota; program design.

73D02

Dessens, J., and J. P. Lacaux, 1973: Results from a 7 year continuous seeding with a ground generator on the French Atlantic coast. J. Wea. Mod., 5(1), 116-125.

AgI; increase up to 15%; continuous historical target-control; operational; acetone vortex-generator; a posteriori target and control; annual rainfall; 16 gages; double-mass curves; percentages of the histroical mean values (11 years).

73F01

Flueck, J. A., and B. S. Holland, 1973: Ratio estimation problems in meteorological research. Third Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soo., Boulder, CO., 19-22, June, 87-90.

David-Fix formulation of correlated bivariate gamma random variables; bias in estimation of mean; two Australian experiments, New England and South Australia; root double ratio.

73G01

Grainger, C. A., A. B. Super, and R. H. Yaw, 1973: Preliminary investigations into the feassibility of precipitation augmentation on the Montana High Plains. Final Report for Bureau of Reclamation, Dept. Earth Sci., Montana State Univ., Bozeman, 64 pp.

Weistein-Davis and Hirsch cloud models; radiosonde; cloudbase height; cloud depth; correlation; rainfall prediction; radar-measured rainfall; hourly; daily; Z-R relation.

73G02

Gelhaus, J. W., 1973: Examination of the bad draw hypothesis for a randomized cloud seeding project. Report 73-1, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 34 pp.

Grand River project; Whitetop; 12-hour and 3-hour rainfall; S-NS ratio; sum of squared rank test; rainfall occurrences; re-analysis; bias in choosing control area sizes.

73H01

Haas, J. E., 1973; Social aspects of weather modification. Bull. Amer. Meteor. Soc., 54(7), 647-657.

Public reaction; flash flood; drought.

73H02
Huff, F. A., and S. A. Changnon, Jr., 1973: Precipitaion modification by major urban areas. Bull. Amer. Meteor. Soc., 54, 1220-1232.
8 urban areas were studied; warm seasonal rainfall had increased 9-17% from 1955-1970; this enhancement is related to city size and industrial nuclei generation.

73H03
Hutchinson, P., 1973: Increase in rainfall due to Lake Kariba. Weather, 28(12), 499-504.
1091-60 as historical; Zambia, Africa; isohyet; t-test; differences; annual rainfall; one station shows a significant (95% level) decrease; no surrounding station shows any significant change; hypothesis for increase; quasi "lake-breeze front"; an increase in rainfall has taken place.

73J01
Johnson, E. S., and P. W. Mielke, Jr., 1973: Some empirical comparison of certain probability distributions used to describe precipitation amounts. Third Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Boulder, CO., 19-22, June, 91-94.
Gamma; log-normal; kappa(2); kappa(3); likelihood function; Kolmogorov statistic; Kimball's statistic; Climax; south Florida; fourth root transformations; no serious disagreement among the distributions using three criteria of goodness of fit.

73K01
Kapoor, R. K., K. Krishna, U. S. De, K. G. S. Nair, I. C. Talwar, S. K. Sharma, and Bh. V. R. Murty, 1973: Results of operational cloud seeding experiment over Rihand catchment in northeast India. Indian J. Meteor. and Geophy. , 25, 379-384.
13000 square km of target; two controls of same size; daily; seedabiblity criteria; NaCl and soapstone mixture; August-September, 1973; target-control; increase of 17%; not statistically significant; DC-3 aircraft; 12-15 kg per 3 kmof flight path; visual observations; double ratio.

73K02
Krick, I. P., 1973: Applying ultra long range weather predictions and weather modification to environment management. J. Wea. Mod., 5, 296-317.
1972; Oklahoma; Lawton watershed; operational project; AgI ground generator; percent of normal precipitation; 1/2 gram per hour; 50 miles downwind from the generator; benefit to cost ratio.

73K03
Khemani, L. T., and Bh. V. R. Murty, 1973: Rainfall variations in an urban industrial region. J. Appl. Meteor., 12(1), 187-194.
1901-69; Bombay, India; with respect to the non-urban region, the region downwind of the urban industrial complex recorded an increase of rainfall by about 15%, significant at less than the 1% level, during 1941-69; target-control; June to September; decade mean seasonal rainfall; double mass curves; Lnfluence of urban pollution on rainfall; trend index of the ratio of rainfall; mean surface temperature.

73K04
Kunkel, B. A., 1973: A statistical approach to evaluating fog dispersal operations. J. Appl. Meteor., 12(5), 883-887.
Warm fog; probability of natural visibility improvement; visual observations; a visibility of 0.5 mi was chosen; Vandenberg AFB; conditional probabilities of natural fog clearing; time of day relative to sunrise and time interval; Los Angeles International Airport; Vancouver International Airport; sample size; cost effectiveness.

73M01
Mielke, P. W. Jr., 1973: Another family of distributions for describing and analyzing precipitation data. J. Appl. Meteor., 12, 275-280.
Two parameter kappa distributions; method-of-moments estimators; maximum likelihood estimators; 1965-70; Climax; scale changes; comparisons of one-parameter gamma, one-sided t, and kappa families of distributions; chi-square goodness-of-fit test; three-parameter kappa distribution.

73M02
Morel-Seytoux, H. J., and F. Saheli, 1973: Test of runoff increase due to precipitation management for Colorado River Basin Pilot Project. J. Appl. Meteor., 12(2), 322-337.
Review; concept of grouping of observations; constrained optimization procedure; power of the test; natural variability of hydrologic variables; San Juan Mountains of Colorado; seasonal runoff; chi-square test; Student t-test; target-control; target only; regression; new technique of testing yields a power over a 5-year period of experimentation slightly better than 50%

73M03
Mielke, P. W. Jr., and E. S. Johnson, 1973: Three-parameter kappa distribution maximum likelihood estimates and likelihood ratio tests. Monthly Weather Review, 101, 701-707.
fitting precipitation and streamflow data; 26 nonseeded; 26 seeded; southern Florida; 1968 and 1970; p value is 0.006; streamflow; kappa(2) and kappa(3) distributions are compared with the gamma and log-normal distributions; fourth root transformation; Climax.

73M04
Miller, J. R., Jr., And E. E. Cain., 1973: The North Dakota Pilot project evaluation of Data - 1972. Report 73-3, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 50 pp.
Periodic random target-control; 4% AgI-ammonium iodide acetone solution; salt seeding; rawinsonde; daily rain average; inconclusive results; Wilcoxon test; S-NS ratio; seeding operation; hail day; 1969-1972; chi-square test; gamma; hail occurrence; total hail energy; NCPR-1 radar; positive hail suppression results.

73N01
National Academy of Sciences-National Research Council, 1973: Weather and Climate Modification. Problems and Progress. NAS-NRC, Washington, D.C.

73N02
Neyman, J., E. L. Scott, and M. A. Wells, 1973:. Downwind and upwind effects in the Arizona cloud-seeding experiment. Proc. Nat. Acad. Sci., 70, 357-360.
Santa Catalina Mountains; moving grid method; evaluation; daily rainfall; AgI; cross-over not reliable here. 180 miles downwind; negative downwind effect.

73N03
Neyman, J., and E. L. Scott, 1973: Rain stimulation experiments; Design and evaluation. WMO Sci. Conf. on Wea. Mod., Tashkent, USSR, 1-7, Oct., WMO No. 399, 449-457.
Need for randomization; Grossversuch III; Arizona Experiment; moving grid study; importance of international cooperation.

73001
Olsen, A. R., W. L. Woodley, and A. Herdon, 1973: Investigation of the effect of natural rainfall variability and measurement errors in the detection of seeding effect. Third Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Boulder, CO., 19-22, June, 96-103.

73O02
Olsen, A. R., 1973: Development and comparison of Bayesian and classical Statistical methods as applied to randomized weather modification experiments. Third Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Boulder, CO., 19-22, June, 319-322.
Gamma distribution; multiplicative seeding effect; control distribution known; shape parameter known, scale parameter unknown; or both parameters unknown.

73O03
Olsen, A. R., 1973: Development and comparison of Bayesian and classical statistical methods as applied to randomized weather modification experiment. NOAATechnical Memorandum ERL WMPO-10.
EML single cloud experiment; Florida; dynamic seeding; gamma; multiplicative seeding effect; 1968, 1970; FACE, 1970-1972; power function.

73P01
Bybus, E. J., and W. L. Hughes, 1973: Neighborhood gradient analysis; Examination of variance in north central Oklahoma rainfall statistics. J. Appl. Meteor., 12(8), 1242-1253.
Spatial correlation coefficients; year-to-year variation in precipitation; contributes more to the variance statistic than does station-to-station variation during the same one year intervals; continuous historical target-control; stillwater experiment; water supply; Water Resources Development Corporation was selected to seed with AgI generators; 1950-71; regression of variance vs radial distance; simulated change in the target.

73R01
Reed, J. W., 1973: Cloud seeding at Rapid City: A dissenting view. Bull. Amer. Meteor. Soc., 54(7), 676-677. Comments, 678-684.
Flood on 9 June 1972; isohyets; NaCl; the estimated risk-benefit point falls far above the acceptable curve used for other safety evaluations; matters of public safety.

73S01
Schickedanz, P. T., 1973: A statistical approach to computerized rainfall patterns. Third Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Boulder, CO., 19-22, June, 104-109.
Visual examination; response surface analysis; regression; gamma distribution; variability rainfall; sampling error; near-neighbor analysis; Illinois; Indiana; Iowa; Missouri; Aransas; Tennessee; Kentucky; Ohio; Michigan; Wisconsin.

73S02
Simpson, J., W. L, Woodley, A. R. Olsen, and J. C. Eden, 1973: Bayesian statistics applied to dynamic modification experiments on Florida cumulus clouds. J. Atmos. Sci., 30, 1178-1190.
Gamma dist.; daily; random experimental design; 1968 and 1970 on isolated clouds; 1970 on groups of clouds; 10-cm radars; gamma distribution; sensitivity tests; effects of sampling errors; for the single clouds seeding increased rainfall, by a factor of about 3; single ratio; Monte Carlo.

73S03
Simpson, J., 1973: Bayesian statistics applied to Florida cumulus modification experiments. Third Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Boulder, CO., 19-22, June, 73-80.
Gamma dist.; daily; random experimental design.

73S04
Simpson, J., J. C. Eden, A. Olsen, and J. Pezier, 1973: On the use of gamma functions and Bayesian analysis in evaluating Florida cumulus seeding results. NOAA Technical Memorandum ERL OD-15, 86 pp.
EML experiment; randomized; single cloud seeding; dynamic seeding; 1968 and 1970; radar-estimated rainfall; fourth-root transformation; seeding factor; truncated normal distribution; Weibull; log-normal; inverse Raleigh distribution; distribution fitting for rainfall; inverse gamma distribution; chi-square test; sample size; computer program.

73S05
Schickedanz, P. T., 1973: Climatic studies of extra-area effects from seeding. Technical Report 5, Illinois State Water Survey, Urbana, IL, 53 pp.
Objective analysis; trend surface analysis; near-neighbor analysis; persistence; distribution of highs and lows; monthly rain; seasonal rain; urban effect; Chicago; Kansas City; St. Louis; response surface; areal rain; METROMEX, 1972; the most frequent distance between rainfall highs is in the range of 40-60 miles.

73T01
Twomey, S., and I. Robertson, 1973: Numerical simulation of cloud seeding experiments in selected Australian areas. J. Appl. Meteor., 12(3), 473-478.
Variations of rainfall in space and in time; show a marked superiority of the crossover design as compared with target-control or single-area experiments; difference in required sample sizes due to areas; double ratio; permutation test; p-value; 200 trials; postulated effect of seeding: 10% expected value with random normal fluctuations with standard deviation 1%; monthly rainfall.

73W01
Weinstein, A. I., 1973: Comments on "Computer model determination of convective cloud seeded growth using project Whitetop data". J. Appl. Meteor., 12(1), 238-239.
Simulated convective cloud growth; seedabilities; fallout seedabilities; effect of cloud size on seeding effectiveness; cloud top height and mixing ratio; cloud top minus cloud base height and mixing ratio; use of difference vs ratio.

74B01
Brier, G. W., 1974: Design and evaluation of weather modification experiments. Weather and Climate Modification, W. N. Hess, ed., John Wiley & Sons, N. Y., 206-225.
T-test; c(a)test; sign test; sign rank test; Wilcoxon 2 sample test; squared rank test; transformation; covariates; target only; target-control; contamination; cross-over; persistent effect.

74B02
Boyd, E. I., J. R. Miller, Jr., and R. A. Schleusener, 1974: Hail suppression effects from seeding with silver iodide in western North Dakata. J. Wea. Mod., 6(1), 246-259.
Reduce hail damage and increase rainfall; summers of 1969-1972 inclusive; randomized 75% seed; 3% AgI in NaI acetone solution; ground generator; aircraft; passive hail pads; raingages; crop-hail loss data; 10-cm radar; 2 regressions; a high probability that the seeding techniques used significantly reduced hail intensity; radar echo height; hail energy maximum; diameter of maximum hailstone; reflectivity; ANOCOVA.

74B03
Braham, R. R. Jr., and P. Spyers-Duran, 1974: Ice nucleus measurements in an urban atmosphere. J. Appl. Meteor., 13(8), 940-945.
Natural ice nuclei were deactivated in passing over St. Louis during March 1973; strongly suggest the possibility of local sources of ice nuclei; METROMEX; Wilcoxon-Mann-Whitney two-sample rank test.

74B04

Brown, K. J., R. D. Elliott, J. R. Thompson, P. St.-Amand, and S. D. Elliott, Jr., 1974: The seeding of convection bands. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 7-12.
Convective band description; Santa Barbara; 168 raingages; 50,000 square km area; aircraft; 48-hour as unit; ratio; average 700 mb wind direction; average direction of band movement; increase is on the order of 50 to 100% within the bands seeded and 25 to 50% for the storm total; downwind effect.

74B05

Brier, G. W., 1974: Weather modification experiments - design and evaluation. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 290-292.
Methods of data analysis; predictors; seedability concept; better stratification techniques; Bayesian analysis.

74B06

Brier, G. W., L. O. Grant, and P. W. Mielke, Jr., 1974: The evidence for extra-area effects from purposeful weather modification projects. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 510-515.
Summary of projects; Climax; Park Range; Santa Barbara; Israel; Arizona; Grossversuch; Whitetop; for winter projects, consistent evidence for increases at distances up to 50-150 miles in the downwinddirection; for summer projects, results were mixed.

74B07

Borland, S. W., and J. J. Snyder, 1974: Effects of weather variables on the prices of Great Plains cropland. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 545-550.
NHRE; limited insurance coverage problem; Colorado; Nebraska; crop sale price; regression; crop hail insurance loss cost ratio; hail day frequency; value of a 20% decrease in hail is approximztely equalled by that of a 5% increase in early seasona rainfall.

74B08

Bryson, M. C., 1974: Heavy-tailed distribution properties and tests. Technometrics, 16, 61-68.
Distributions with heavier than exponential tails; conditional mean exdeedance; Pareto distribution; kappa distribution; daily precipitation data; Climax; FACE; annual flows of the Weldon River, Missouri.

74B09

Boyd, E. I., 1974: Case studies of hail suppression attempts in western North Dakota. Report 74-6, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 43 pp.
North Dakota Pilot Project.

74C01

Calvin, L., J. A. Flueck, P. W. Mielke, J. Pezier, P. T. Schickedanz, J. Simpson, M. Tribus, and H. Weickmann, 1974: Quantitative methodology in weather modification: A panel discussion on design and evaluation. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 344-346.
Statistical decision theory; data analysis; cumulus cloud model; meso-climatology; physics.

74C02

Changnon, S. A., Jr., G. M. Morgan, Jr., G. L. Achtemeier, N. G. Towery, and R. C. Grosh, 1974: Design of a hail suppression project for Illinois. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 293-300.
DESH; social aspects; background silver; ecological; evaluation; midwestern hailstorms; radar; unwanted side effects; single and multiple convective clouds.

74C03

Changnon, S. A. Jr., 1974: A review of inadvertent mesoscale weather and climate modification and assessment of research needs. Fourth Conf. on Wea. Mod. Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 347-352.
Urban-produced weather changes; METROMEX; industrial complexes; deforestation; residue burning; irrigation.

74C04

Changnon, S. A., Jr., F. A. Huff, 1974: Interim report of METROMEX studies. Technical Report, Illinois State Water Survey, Urbana, IL, 181 pp.
Monthly; seasonal; storm rainfall; raincell; echo distribution; first echo; thunder data; surface temperature; moisture and wind; hydrometeorology; pollution; water quality; diurnal; synoptic; echo duration.

74D01

Dennis, A. S., J. R. Millers, and D. E. Cain, 1974: Effects of cloud seeding on growing season rainfall in North Dakota. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 484-489.
North Dakota Pilot Project (NDPP); 1969 through 1972; 75% as seeded; AgI; a 3% AgI-NaI in acetone solution; ammonium iodide; stratifications by precipitable water and 850-mb winds; stratification by cloud types, cloud base temperatures, years, and 500-mb temperatures; one-dimensional steady-state cloud model; chi-square test; comparing the frequency of rainfall events; ratio; Wilcoxon 2 sample test; permutation test; gamma dist.; possibility of bias; dynamic seedability stratifications; little convincing evidence of bias in the selection of no-seed days.

74D02

Dennis, A. S., J. H. Hirsch, and D. E. Cain, 1974: Evaluation of effects of silver iodide seeding in Project Cloud Catcher. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 24-27.
33 no-seed and the 18 AgI test cases in 1969-70; aircraft; one-dimensional, steady-state cloud model; maximum echo height; cloud top height; radar estimated rainfall; covariance test; two regression lines.

74D03

Davies, D., 1974: Towards the design of branch-point experiments on a synoptic scale. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 334-337.
Predict precipitation amount; several branch-point situations.

74D04

Dennis, A. S., and others, 1974: Cloud seeding to enhance summer rainfall in the Northern Plains. Report 74-10, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 161 pp.
Salt seeding; AgI; North Dakota Pilot project; large-area effect; Project Cloud Catcher; simulation; Project Skywater; cloud formation; synoptic; cloud modeling; precipitation formation; Grand River project; hail suppression.

74D05
Dennis, A. S., J. R. Miller, Jr., D. E. Cain, E, J. Boyd, and R. A. Schleusener, 1974: Interim Report on the North Dakota Pilot Project From 1 July 1973 to 30 June 1974. Report 74-21, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 25 pp.
67 gages; 1969-1972; permutation test; 1-D cloud model; stratified by 500 mb temperature and dynamic seedability; hail results not significant at 10%; crop hail insurance data; hail day; hail energy; Z-R relation; chi-square test; S-NS ratio; Wilcoxon test; gamma; hail volume; hail-rain ratio; seeding rate.

74E01
Elliott, R. D., and R. W. Shaffer, 1974: Alterations in orographic water balance due to cloud seeding. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 420-424.
Area of effect model; Colorado River Basin Pilot Project; 700 mb normal wind component; cloud toptemperature; 3-hour as sampling unit; ratio; no significant seeding effect.

74E02
Elliott, R. D., R. W. Shaffer, and J. F. Hannaford, 1974: Assessing the potential of orographic cloud seeding to enhance water supplies for hydroelectric power generation and irrigation. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 496-503.
Precipitation-temperature diagrams; area of effect model; Colorado River Basin Pilot Project; lifted cloud top temperature; hydrological approach; precipitation-runoff relationship; potential incremental streamflow within the upper Colorado major basins.

74E03
Estoque, M. A., and J. J. Fernandez-Partagas, 1974: Precipitation dependence on synoptic-scale conditions and cloud seeding. Technical Report, Univ. of Miami, Coral Gables, FL, 10 pp.
Variation of synoptic-scale conditions is much more important than multiple cloud seeding in determinating precipitation; FACE.

74F01
Fowler, W. B., and J. D. Helvey, 1974: Effect of large-scale irrigation on climate in the Columbia Basin. Science, 184(4133), 121-127.
Re-analysis; Washington; little or no change in July temperatures; July-August precipitation; t-test; 1959 to 1966; 1931 to 1950; double-mass plotting; evaporation; Sagebrush ring indications.

74G01
Gelhaus, J. W., A. S. Dennis, and M. R. Schock, 1974: Possibility of a type I statistical error in analysis of a randomized cloud seeding project on South Dakota. J. Appl. Meteor., 13, 383-386.
Garnd River randomized project; 12-hr rainfall; daily and hourly rainfall data; seed/no-seed daily average ratios; applied to 12-hr data; sum-of-squared-ranks test; negative effect; wet day; Fisher's exact test; rainfall decrease was not caused by seeding, but by a scarcity of seed wet days.

74G02
Grant, L. 0., and R. D. Elliott, 1974: The cloud seeding temperature window. J. Appl. Meteor., 13(3), 355-363.
Review; -10C to about -25C; cloud-top temperature; seven randomized experiments and four other experiments; evaluation; orographic; Climax; precipitation ratio of seed/no seed; Australia; Santa Barbara; Elko County, Nevada, randomized seeding project; Wolf Creek Pass; Park Range of northwestern Colorado; northern Utah; Bridger Range, Montana; Jemez Mountains of northern central New Mexico.

74G03
Grant, L. O., and A. M. Kahan, 1974: Weather modification for augmenting orographic precipitation. Weather and Climate Modification, W. N. Hess, ed., John Wiley &Sons, N. Y., 282-317.
Characteristics of orographic clouds; microphysical; seeding hypothesis; efficiency of natural clouds; Climax; Wolf Creek Pass; Monarch Pass; Wilcoxon statistic; stream flow; Snowy Mountains; New England; Park Range Project; Bridger Range Project; Jemez mountains; Santa Barbara; north central Utah; history; Project Skywater; Colorado River Basin Pilot Project.

74G04
Gagin, A., and J. Neumann, 1974: Rain stimulation and cloud physics in Israel. Weather and Climate Modification, W. N. Hess, ed., John Wiley &Sons, N. Y., 454-494.
Cloud base seeding; crossover; the 1961-1967; root-double-ratio; Wilcoxon-Mann-Whitney test; permutation test; daily rainfall; stratified by 850 mb wind; cloud physics aspects; cloud top heights and temperatures; Project Whitetop; Arizona.

74G05
Grant, L. O., 1974: Weather modification for augmenting orographic precipitation. Fourth Conf. on Wea. Mod., Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 408-413.
Type of orographic clouds; there is a potential for precipitation augmentation from some, but not all, orographic clouds; Climax; 500 mb temperature; seeding agents; microphysical responses to seeding; delivery systems; economic; Bergeron ice process; coalescence; accretion; social effects; extra-area effect.

74G06
Grant, L. O., G. W. Brier, and P. W. Mielke, Jr., 1974: Cloud seeding effectiveness for augmenting precipitation from continental convective clouds. Proc. Intern. Tropical Meteor., Nairobi, Kenya, Amer. Meteor. Soc., 31 January-6 Februry.
Climax; summer; 24-hour; randomized block design; four ground generators; partitioned by 500 mb temperature; 1966-1972; S/NS ratio is 0.57 and the p-value is .11.

74H01
Huff, F. A., and P. T. Schickedanz, 1974: METROMEX: Rainfall analysis. Bull. Amer. Meteor. Soc., 55(2), 90-93.
Summers of 1971 and 1972; surface raincells; strong evidence that the cell parameters have been altered by the urban-industrial environment.

74H02
Holle, R. L., 1974: Populations of parameters related to dynamic cumulus seeding over Florida. J. Appl. Meteor., 13(3), 364-373.
Radar populations of seedable clouds observed between 4.57 km (15,000 ft) and 7.62 km (25,000 ft); Miami; Tampa; one-dimensional Lagrangian cumulus model EMB 68K; seedability; compute rainfall changes due to seeding; radar tops; 10-cm radars; diurnal variations.

74H03
Haragan, D. R., 1974: Precipitation augmentation-Problems and progress. Water Resources Bulletin, 10(3), 547-554.
Water resources; cloud physics; evaluation; Whitetop; legal issues; seeding operation.

74H04
Hitschfeld, W. F., 1974: Hail suppression; Evaluation and other porblems. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 97-98.
Alberta; NHRE.

74H05
Hobbs, P. V., 1974: Artificial modification of orographic clouds and precipitation over the Cascade Mountains. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 414-419.
Cascade Project; 1969-1973; two numerical models; B-23 aircraft; mocrophysics data; 1 to 20 lb. per mile of dry ice; 100 to 1200 gm per hour of AgI; number and mass concentrations and the average masses of the ice particles.

74H06
Huff,F. A., and R. G. Semonin, 1974: Potential of precipitation modification in moderate to severe droughts. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 490-495.
One-dimensional cloud model; radiosonde.

74J01
Janssen, D. W., G. T. Meltesen, and L. O. Grant, 1974: Extended area effects from the Climax, Colorado seeding experiment. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 516-522.
Taha's sum of square rank test; wintertime; February, 1960 through April, 1970; experimental unit; spatial correlations; seed/no seed ratios; t-test; stratified by wind direction, 500 mb wind speed, and 500 mb temperature; downwind precipitation maximum on seeded days is most evident with 500 mb temperatures warmer than about -20C at Climax.

74J02
Johnson, J. E., er al, 1974: The effects of added rainfall during the growing season in North Dakota. Final report, Agricultual Experimental Station, NDSU, Fargo, ND, 227 pp.
Crop response; economic; agriculture; ecological effects; social; simulation; regression; questionaire; t-test.

74K01
Krishna, K., A. S. R. Murty, R. K. Kapoor, and Bh. V. R. Murty, 1974: Results of warm cloud seeding experiments in three different regions in India during the summer monsoon of 1973. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 79-84.
Cross-over design; Deccan Plateau; Santa-Cruz, Bombay; Rihand reservoir; salt and soapstone; root double ratio; not statistically significant according to Mann-Whitney test; ASR-3 radar; increased by 28.6% with reference to the left control area and 17.3% with reference to the right control area; not statistically significant; benefit-cost ratio.

74K02
Klazura, G. E., 1974: Analysis of weather modification project by the objective stratification of cases into categories of expected efficient or inefficient precipitators. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soo., Ft. Lauderdale, FL., 18-21, Nov., 338-343.
Project Cloud Catcher; June 1 to August of 1969 through 1972; 3.2-cm and 10-cm radars; condensed water estimates; thirteen hypotheses; rank sum test.

74L01
Lewis, B. M., and H. F. Hawkins, 1974: An experiment to test the modifying effects of hydrophilic powder on maritime cumulus clouds. Fourth Conf. on Wea. Mod. Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 85-88.
Portland cement as seeding agent; NOAA C-130; 1972; visual and radar observations; NOAA DC-6 aircraft; randomized.

74L02
Lovell, C. C., 1974: The statistical design in the NHRE. Fourth Conf. on Wea. Mod., Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 99-102.
Measure of effect; total hail mass; randomized target experimental design; experimental unit; radar reflectivity; size of hailstones; serial correlation.

74M01
Mielke, P. W., Jr., and E. S. Johnson, 1974: Some generalized beta distributions of the second kind having desirable application features in hydrology and meteorology. Water Res. Research, 10(2), 223-236.
Gamma; log normal; streamflow; precipitation amount; three goodness of fit criteria; maximum likelihood function; two-sided Kolmogorov statistic; Kimball's nonparametric statistic; neither the beta-k, the beta-p, the gamma, or the log normal distribution is categorically superior to the other three distributions in its ability to fit the four data sets.

74M02
Morgan, G. M. Jr., and N. G. Towery, 1974: Small scale variability of hail and its significance for hail prevention experiments. Fourth Conf. on Wea. Mod. Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 143-149.
Hailstreaks; very dense micronetwork over 0.1 square mi. in Illinois; 1967-72; hailstools; thirteen hailstreaks; NHRE; 1-square mile network in Nebraska; May-July 1973 period; 114 stations; maximum diameter; mass of hail; hail impact energy horizontal and vertical; areal hail sampling studies; total kinetic energy; percent loss; total loss; hail core.

74M03
Mielke, P. W., 1974: Squared rank test appropriate to weather modification cross-over design. Technometrics, 16, 13-16.
Experimental design; tied observations; asymptotically optimum; location alternatives; Wilcoxon and median tests.

74M04
Mueller, E. A., and S. A. Changnon, Jr., 1974 Comparison of echo statistics for seeded and non-seeded storms in NHRE 1973. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 114-118.
Evaluation; Israeli experiment; January 9, 1964 to April 15, 1965; two wavelengths; seeded days 28 June and 8 July compared with the unseeded hail days 21 May and 9 July; comparison of the reflectivity frequencies; target-control; NS/S ratio; all of the numbers in the no-seed sample are larger than in the seed sample.

74001
Olsen, A. R., and W. L. Woodley, 1974: On the effect of natural rainfall variability and measurement errors in the detection of seeding effect. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 323-328.
Compare data collected from raingages and gamma distribution for daily rain; radar adjusted by gages; Florida; measurement errors were calculated as function of gages density and/or radar systems.

74002
Olsen, A. R., 1974: Development and comparison of Bayesian and classical statistical methods as applied to randomized weather modification experiments. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 319-322.
Randomized treatment-control; gamma distribution; the effect of seeding is multiplicative.

74R01
Ramirez, J. M., 1974: Status and agricultural implications of operational weather modification in North Dakota. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 480-483.
History; impact of additional growing-season rainfall; rainfall increase models; crop yield responses.

74R02
Roesll, H. P., J. Joss, and M. Schuepp, 1974: Possible influence of evaporation below cloud base on rain enhancement. J. Appl. Meteor., 13(7), 783-787.
Introduce an evaporation parameter; Grossversuch III; need of careful measurements of the drop-size distribution beneath cloud base; rainfall duration.

74R03
Ruskin, R. E., and W. D. Scott, 1974: Weather modification instruments and their use. Weather and Climate Modification, W. N. Hess, ed., John Wiley & Sons, N. Y., 136-205.
Time and space scales and applicable measurement for various storm processes; airborne temperature measurements; airborne humidity measurements; radiosondes; dropsondes; liquid water; concentration factors; cloud particles; measurements of ice, raindrops, ice nucleus; CCN; aerosols.

74R04
Rottner, D., S. R. Brown, and O. H. Foehner, 1974: The effect of persistence of AgI on randomized weather modification experiments.
Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 301-306.
San Juan Mountains; Jemez experiment; 24-hour; Wilcoxon and sum of squared ranks test; aircraft measurements of ice nuclei.

74R05
Riggio, R. F., and J. T. Carr, Jr., 1974: An evaluation design of a commercial cloud seeding program. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 329-333.
Colorado River Municipal Water District; Big Spring; three-to-one randomization scheme; randomization was carried out on an individual flight basis; M-33 radar system; S-band; X-band; radar and gage comparison.

74R06
Rao, R. A., and R. G. S. Rao, 1974: Analyses of the effect of urbanization on rainfall characteristics. Technical Report 50, Water Res. Res. Center, Purdue Univ..
St. Louis; La Porte; Tulsa, OK; Kansas City; seasonal; ARIMA model; annual; IMA model and AR model; Bayesian; significant rainfall increase in warm and cold seasons; double mass curve; corrrelation; T-square test; sample size; principal component analysis; canonical correlation; ANOVA; t-test; chi-square test; likelihodd ratio test; periodicity; Kolmogorov-Smirnov test.

74S01
Schickedanz, P. T., 1974: Climatological assessment of extra-area seeding effects. J. Wea. Mod., 6(1), 92-108.
Southern Illinois; METROMEX; Whitetop; response surface; residual; near-neighbor analysis; lag correlation analyses; Significant Rainfall Excess (SRE); Significant Rainfall Deficit (SRD); major part of the downwind effect from sities occurs within 0-25 miles of the city.

74S02
Schickedanz, P. T., 1974: Inadvertent rain modification as indicated by surface raincells. J. Appl. Meteor., 13(8), 891-900.
605 potential effect cells; 870 non-effect cells; summer of 1971-72; urban heat island; industrial aerosols; METROMEX; Thunderstorm Project; target vs non-target comparison; log-normal; t-test; Bartelett's chi-square approximataon; cell parameters; synoptic types.

74S03
Schickedanz, P. T., 1974: Climate studies of extra-area effects in Midwest rainfall. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 504-509.
Extended area; variability of precipitation; METROMEX; 20 mi x 20 mi grid; regression; near-neighbor analysis; response surface; target area; urban effect.

74S04
Simpson, J., and J. C. Eden, 1974: On the design and evalutation of cumulus modification experiments. Fourth Conf. on Wea. Mod., Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 312-318.
1968 and 1970; Florida; fourth-root transforms; gamma distribution; single cloud seeding; Monte Carlo; Bayesian; possible effects of errors in the data; Wilcoxon-Mann-Whitney test; squared rank test; t-test; likelihood ratio test; c(a)test.

74S05
Simpson, J., and A. S. Dennis, 1974: Cumulus clouds and their modification. Weather and Climate Modification, W. N. Hess, ed., John Wiley & Sons, N. Y., 229-281.
Field-of-motion model; entity model; static approach; dynamic seeding; Florida experiment (ERL); seedability; Project Cloud Catcher; cumulonimbus mergers; Mann-Whitney test; Rapid Porject; FACE; extended area and persistence effects.

74S06
Sulakvelidze, G. K., and B. I. Kiziriya, and V. V. Tsykunov, 1974: Progress of hail suppression work in the USSR. Weather and Climate Modification, W. N. Hess, ed., John Wiley & Sons, N. Y., 410-431.
Concept of the mechanism of hail formation; limiting radius of a hailstone at the 0°C isotherm level; assessing the results; three methods of modification; northern Caucasus; Georgia.

74S07
Smith, E. J., 1974: Cloud seeding in Australia. Weather and Climate Modification, W. N. Hess, ed., John Wiley & Sons, N. Y., 432-453.
Dry ice seeding; 1947-1950; Sydney; AgI seeding; 1955-1963; Snowy Mountains; Warragamba; South Australia; Tasmania; operational; Victoria; cloud physics research; CCN.

74S08
Simpson, J., 1974: Weather modification: Where are we now and where should we be going? Convective cloud modification. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 1-6.
Challenges and problems in cumulus modification; recent advances; developments in the incorporation of statistics; model output statistics; Bayesian; need stratification of data.

74S09
Sax, R. I., 1974: On the microphysical differences between populations of seeded vs. non-seeded Florida cumuli. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 65-68.
1973 FACE; liquid water content; concentration of ice particles; updraft velocity; five no-seed GO days, 2 seed GO days, and 1 intentional NO GO day.

74S10
Semania, R. G., and S. A. Changnon, Jr., 1974: METROMEX: Lessons for precipitation enhancement in the midwest. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 353-357.
10-cm FPS-18 radar and 3-cm TPS-10 radar; evaluation in generation; raincell concept; synoptic types.

74S11
Super, A. B., and J. A. Heimbach, Jr., 1974: Statistical evaluation of the Bridger Range winter cloud seeding experiment. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 425-430.
Randomized; southwestern Montana; winters of 1969-1970 to 1971-1972; Skyfire-type AgI ground generator; 24-hour; 27 gages; rawinsondes; Wilcoxon rank sum test; bad draws; precipitation probability forecast; significant precipitation increases were associated with 30% probability forecasts; cloud top temperature; cloud thickness; 700 mb wind speed; mixing ratio.

74S12
Simpson, J., and W. L. Woodley, 1974: Florida Area Cumulus Experiments 1970-1973 rainfall results. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 58-64.
Bias; gamma; multiplicative seeding factor; Bayesian analysis; optimal c(a) tests; t-test; stratification by radar echo motions; Mann-Whitney-Wilcoxon test; seeding factor for floating targets is positive for both classes of days.

74W01
Woodley, W. L., and A. R. Olsen, 1974: Optimizing the measurement of convective rainfall in Florida. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 307-311.
1971 and 1973; measurement errors; gage density; WSR-57 radar; between gage- and radar-derived cluster rainfall; daily rainfall; radar when adjusted by gages, will do as well as the uniform gage array of 90 gages spread over the entire target.

74W02
Wisniewski, J., C. R. Cotton, and R. I. Sax, 1974: Tracing silver iodide in the south Florida area. Fourth Conf. on Wea. Mod. , Amer. Meteor. Soc., Ft. Lauderdale, FL., 18-21, Nov., 73-78.
1973 FACE; Ice nuclei; mean Ag concentrations in the rainwater at cloud base for non-seed days samples exceeded those for seed day samples.

74W03
Woodley, W. L., J. Donaldson, J. Simpson, A. R. Olsen, and J. C. Eden, 1974: On the design ad evaluation of cumulus modification experiments. NOAA Technical Memorandum ERL WMPO-13, Part I. Precipitation correlations for two areas as background for cross-over experimentation in Florida, Part II. On the use of predictors and covariates, 65 pp.
Crossover; 3 predictors; regression; ANOCOVA; Bayesian; biplot.

74Y01
Young, K. C., 1974: A numerical simulation of wintertime, orographic precipitation: Part II. Comparison of natural and AgI-seeded conditions. J. Atmos. Sci., 31(7), 1749-1767.
Multi-level, microphysical cloud model; cloud-top seeding is suggested to be more efficient than ground-based seeding; precipitation efficiency; Climax.

75B01
Burman, R. D., J. L, Wright, and J. D. Marwitz, 1975: Inadvertent climate modification near the surface of a large irrigated area. Conf. on Agricul. and Forestry Meteorol., AMS, Tucson, AZ, April, 2pp.
Idaho; air temperature decreased; vapor pressure Increased; wind velocity was dramatically reduced.

75B02
Burnash, R. J. C., and R. L. Ferral, 1975: Procedures for estimating the hydrologic effects of presumed precipitation modification. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 139-144.
Change in snow pack conditions; radiational melt; streamflow.

75B03
Bartlett, J. P., M. L. Mooney, and W. L. Scott, 1975: Lake Almanor cloud seeding program. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 106-111.
Randomized; California; winter; 1971-1974; eight ground-based AgI burners; program design; 50% randomized and ten to one randomized; rawinsonde; 2 regression lines; F test; storms in the cold-westerly category increase of about 35%; in the warm-southerly wind category decrease of 19%.

75C01
Changnon, S. A., Jr., 1975: Evaluation of an operational hail suppression project in Texas. J. Wea. Mod., 7(1), 88-100.
1970-1973 seeded; hail-day; NWS stations; 1947-1969 as historical; May-October; liability; loss cost ratio; losses; Illinois; county; continuoue-historical design; sequential test; decrease of hail damage.

75C02
Changnon, S. A., G. M. Morgan, Jr., G. L. Achtemeier, N. G. Towery, and R. C. Grosh, 1975: Design of hail suppression project for Illinois. J. Appl. Meteor., 14(5), 771-782.
Radar; social aspects; Ag background sampling; economic studies.

75C03
Court, A., 1975: Demonstration projects needed in weather modification. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 184-188.
The intended end product is proof.

75C04
Changon, S. A., and R. G. Semonin, 1975: Studies of selected precipitation cases from METROMEX. Report of Investigation 81 , Illinois State Water Survey, Urbana, IL, 329 pp.
Nine case studies in 1972-1973; 2 air mass storms; 6 squall lines; 1 cold front; synoptic; raincell; hail analysis; radar; tracer study.

75C05
Cotton, W. R., J. E. Jiusto, and R. C. Srivastava, 1975: Cloud physics and radar meteorology. Rev. Geophy. and Space Phys., 13(3), 753-760.
Review of major advances in 1971-1974.

75D01
Dennis, A. S., J. R. Miller, D. E. Cain, And R. L. Schwaller, 1975: Evaluation by Monte Carlo tests of effects of cloud seeding on growing season rainfall in North Dakota. J. Appl. Meteor., 14, 959-969.
Simulation; Western N. Dakota; summer 69-72; hail suppression and rain enhancement; 2750 square miles of target; randomized target-control; 25% randomization; AgI, Nacl, NH3I; 63 gages; 12 hour rain totals; inch increase of rain per season; North Dakota Pilot Project; stratification by upper wind; chi-square test; Wilcoxon two sample test; gamma fitting; E-test; Hirsch cloud model; single ratio.

75D02

Dennis, A. S., A. Koscielski, D. E. Cain, J. H. Hirsch, and P. L. Smith, Jr., 1975: Analysis of radar observations of a randomized cloud seeding experiment. J. Appl. Meteor., 14(5), 897-908.
Three-way randomized; echo areas; radar-estimated rainfall amounts; cloud depth is found to be the best single predictor; cube-root transformation; differences between no-seed and salt cases are of marginal statistical significance; the differences in echo area and rainfall between no-seed and AgI cases are significant at the 1% level; one-dimensional steady-state cloud model; cloud height; Cloud Catcher Project; radar and raingage comparison; precipitable water; cloud base height; cloud base temperature; first echo height; first echo temperature; regression.

75D03

Dennis, A. S., J. R. Miller, E. I. Boyd, and D. E. Cain, 1975: Effect of cloud seeding on summertime precipitation in North Dakota. Report 75-1, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 97 pp.
North Dakota Pilot project; 1969-1972; seeding concept; Rapid project; 700 square miles; 12-hr as unit; periodic random target-only design; cloud types; stratified by 500 mb temperature, year, and dynamic seedability; change in seeding operation; ice nucleus count; first echo; chi-square test; frequency of rain; S-NS ratio; Wilcoxon test; permutation test; autocorrelation; gamma; large-area effect; cloud model; hail energy; hail volume; hail/rain ratio; echo height.

75E01

Elliott, R. D., 1975: Design problems. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 113-118.
San Juan Project; orographic; meteorology; measurements required; cloud top temperature; need for considering seeding effects on both the upwind and downwind watersheds.

75E02

Elliott, R. D., 1975: San Juan project evaluation resume. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 10-20.
Colorado River Basin Pilot Project; randomized; orographic; 1970-71 winter through the 1974-75; rawinsondes; ground-based AgI-NaI generators; 20 gram AgI/hr; day; no significant difference; cloud top temperature; overseeding; evaluation by six hour intervals; Mann-Whitney U Test; differences are positive and significantly so, reaching a maximum on the target area crest; synoptic climatology.

75F01

Farhar, B. C., 1975: Anticipated social effects of the Sierra Project: A preliminary assessment. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 194-200.
California; telephone survey.

75F02

Fowler, W. B., and J. D. Helvey, 1975: Irrigation increases rainfall? Science, 188, 281.
Double mass plot; drought; regression; t-test.

75G01

Goyer. G. G., 1975: Time-integrated radar echo tops as a measure of cloud seeding effect. J. Appl. Meteor., 14, 1362-1365.
Alberta hail studies; 23 seed cells compared with 23 randomly selected non-seed cells; AgI flares; cloud top seeding from aircraft; hailstorm is defined by echo top greater than 7.6 km; 10 cm radar; initial magnitude and total magnitude of echo top; growth factor; seeding rate; cumulative frequency distribution; Mann-Whitney test show seeding GF is smaller than non-seed GF at .025 level; log-normal probability paper.

75G02

Gatz, D. F., 1975: Background silver concentrations in Illinois precipitation and river water. J. Appl. Meteor., 14(2), 217-221.
The rainfall-weighted mean concentration in samples from several stations was 73 ng/l; Park Range Project; Alberta.

75G03

Griffith, D. A., 1975: Lessons from CENSARE design, synoptics. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 131-132.
California; 1968-1973; winter; storm typing; cloud top temperature; unit of a storm period.

75G04

Grant, L. O., 1975: Experimental design with respect to winter orographic precipitation augmentation programs in the Western United States. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 231-235.
Climax; primary goals of many of the orographic weather modification experiments; hypotheses testing; Kings River; seedability; five levels of control.

75H01

Henderson, T. J., 1975: The Kenya hail suppression program. J. Wea. Mod., 7, 93-100.
Operational; 45,000 acres of select tea in production; October 1967 through January 1975; AgI; total of 1,382 operational days; 2,910 seeding flight hours; more than 5,700 individual cumulus cells have been seeded; average damage to tea reduced by approximately 40%; evaluations; radar; 5,705 seeded storm cells; 2,195 not seeded.

75H02

Henderson, T. J., 1975: Background and summary information on the King's river weather modification program conducted during the 19-year period form 1954 throught 1973. J. Wea. Mod., 7, 184-191.
History; Calfornia; 3cm and 5cm weather radars; AgI; ground generators; Project Sierra Cumulus; operational; streamflow; 2 controls; multiple regression; historical continuous target-control design; positive effect.

75H03

Huff, F. A., 1975: Urban effects on the distribution of heavy convective rainfall. Water Res. Research, 11(6), 889-896.
A network of 225 recording raingages in 5500 square km; urban-rural comparison; the 25-mm rainstorms showed a pronounced maximum of occurrence in a region that frequently lies downwind of two urban-industrial areas; Project METROMEX; hydrometeorological analyses; 300 intense rain cells; synoptic weather storm type; movement of heavy rain cells; storm of August 11, 1972; increase of 54% in the urban-exposed cells; nonparametric U test; 2-tailed t tests for nontransformed and transformed (logarithms) data; percentage differences.

75H04

Hobbs, P. V., and L. F. Radke, 1975: The nature of winter clouds and precipitation in the Cascade Mountains and their modification by artificial seeding. Part II: Techniques for the physical evaluation of seeding. J. Appl. Meteor., 14(5), 805-818.
AgI; dry ice; 90 square km target area; visual observations; ice nuclei measurements; Doppler radar; precipitation rates; heavy seeding; increasing snowfall; B-23 aircraft; liquid water content.

75H05
Hobbs, P. V., 1975: The nature of winter clouds and precipitation in the Cascade Mountains and their modification by artificial seeding. Part III: Case studies of the effects of seeding. J. Appl. Meteor., 14(5), 819-858.
31 January 1972; stratocumulus clouds; heavily seeded; AgI; airborne observations; snowfall rate decreased; dry ice; 19 January 1973; amounts of silver in the snowfall increased; increase in the number concentration of ice particles; 27 March 1973; concentrations of freezing nuclei in the snow increased; Ag content; support predictions that snowfall across the Cascade Mountains can be redistributed and increased by artificial seeding; Washington State.

75H06
Huff, F. A., and R. G. Semonin, 1975: Potential of precipitation modification in moderate to severe droughts. J. Appl. Meteor., 14(5), 974-979.
1953-54 drought; one-dimensional cloud model; Illinois; 10 most severe droughts of 12-month duration in the 1906-55 period; synoptic types; radiosonde; modeling analyses indicate that about 1 day in 10 might be suitable for seeding in a drought of the 1953-54 type.

75H07
Henderson, T. J., 1975: The status of a hail suppression program in Texas. J. Wea. Mod., 84-92.
Airborne; AgI; hail days per season appear to have been reduced; hail damage reduced in the range of 40% - 50%; operations summary; 5cm weather radar; evaluations; 12-county area.

75H08
Hannaford, J. F., 1975: Hydrology and hydrologic application. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 158-164.
Sample size; sample unit; runoff; design of weather modification project; environmental impact.

75H09
Hill, G. E., 1975: Cold orographic clouds and cloud seeding in the northern Wasatch Mountains. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 53-60.
Project Skywater; three AgI generators; randomized; 1973-74 and 1974-75; rawinsonde; dew point depression at ice saturation; natural variability of cloud characteristics; 25 gms AgI per hour; a kinematic model.

75H10
Hobbs, P. V., 1975: Evaluation of cloud seeding experiments: Some lessons to be learned from the Cascade and San Juan Projects. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 27-32.
Need both physical and statistical analysis; 1969 through 1974; concentrations or ice particles.

75H11
Henderson, T. J., 1975: Kings River weather modification program. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 100-105.
AgI; ground-based generator; pyrotechnic; aircraft; streamflow; multiple regression; Kern and Merced Rivers basin as controls; 1925-1950 as historic period; overall positive effect is significant at the 0.01 level; 1,313,400 acre feet of additional water.

75H12
Howell, W. E., 1975: On rainfall downwind from the Santa Catalina cloud seeding experiments. Technical Report, U. S. Department of the Interior, 12 pp. Arizona.

75K01
Krick, I. P., and N. C. Stone, 1975: Hail suppression in Alberta 1956-1968. J. Wea. Mod., 7, 13-27.
History of formation of Krick Assoc.; history of early commercial projects; Salt River Vally, Arizona; Colorado; northeast New Mexico; California; Oregon.

75K02
Krick, I. P., 1975: A summary of rain increase operation in central Michigan during the summer of 1972, 1973, and 1974. J. Wea. Mod., 7, 44-48.
Jury trial; 60-mile downwind effect; 3 counties, Gratiot, Montcalm, and Isabella; July and August; graound generators; AgI; .5 gm/hr; percent normal; increase in corn yield.

75K03
Keyes, C. G. Jr., 1975: Jemez Project's evaluation procedures and results for the Sierra Nevadas. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 39-46.
Design; 1968-1972; winter; fifty-fifty; 24-hour; 25 gages; ground-based AgI generators; seed/non-seed precipitation ratios; running ratio graphs; seeding window; 500 mb temperature; cloud top temperature; compares the Jemez CTT results to Climax II, Santa Barbara II and Wolf Creek.

75L01
Lovell, C. C., 1975: Pilot program design for snow augmentation. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 172-178.
Statistical design concepts; target-control approach; definition of a sample unit; statistically independent; response variables.

75M01
Miller, J. R. Jr., E. I. Boyd, R. A. Schleusener, and A. S. Dennis, 1975: Hail suppression data from western North Dakota, 1969-1972. J. Appl. Meteor., 14, 755-762.
North Dakota Pilot Project; summer of 1969-1972; 75% randomization; aircraft using AgI in acetone generators; below cloud seeding; 3% AgI-NaI; ammonium iodide; powdered NaCl; single area random design; passive hail indicator; Mckenzie, Mounyrail, and Ward counties; hail depth; hail impact energy; permutation test; chi-square test; ratio of average hail impact energy to the average rainfall; seed/no-seed ratio; crop-hail loss; 60% reduction in crop damage for daytime seeding, 75% reduction for nighttime seeding; Mann-Whitney test; regression; results shows differences between seeded and unseeded storms in reflectivity factors and hailstone sizes, but not in maximum echo heights.

75M02
Miller, J. R. Jr., A. S. Dennis, J. H. Hirsch, and D. E. Cain, 1975: Statistics of shower echoes in western Norht Dakota. 16th Conf. on Radar Meteor., Houston, April 22-24.391-396.
North Dakota Pilot Project; 2457 convective echoes; non linear regression; echo tops; echo diameters; echo durations; one-dimensional, steady-state cloud model; updraft diameter.

75M03
Morgan, G. M. Jr., and N. G. Towery, 1975: Small-scale variability of hail and its significance for hail prevention experiments. J. Appl. Meteor., 14(5), 763-770.
Areal hail estimates; a square grid with 1 mi spacing would estimate the areal damage within 25% accuracy 80% of the time; hailswaths; hailstreaks; wind speed; Illinois; very dense micro-network; NHRE; 1 square mi network in

Nebraska during the May-July 1973 period; total kinetic energy; mass of hail storm; hail sampling.

75M04

Mielke, P. W. Jr., 1975: Convenient beta distribution likelihood techniques for deserlbing and comparing meteorological data. J. Appl. Meteor., 14(9), 985-990.
Reparameterization of the beta distribution; likelihood ratio tests; method-of-moments estimators; maximum likelihood (ML) estimators; South African hail suppression program; 1972 into 1974; storms; Agl; aircraft; assess possible differences between propeller and jet aircraft.

75M05

Mielke, P. W. Jr., 1975: Some design and evaluation considerations for the Sierra NevaJa wintertime orographic cloud seeding project. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 179-183.
Experimental unit; extended-effect area; evaluation procedures.

75M06

Miller, J. R., A. S; Dennis, D. E. Cain, and J. H. Hirsch, 1975: Precipitation management potential in western North Dakota as rescaled by radar echoes and cloud model studies. Report 75-4, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 163 pp.
North Dakota Pilot Project; echo size distribution; Z-R relation; echo diameter; echo height; echo duration; 1-D steady state cloud model; echo top; radar estimated rainfall; lifted index; correlation; cloud depth.

75N01

Neyman, J., 1975: Problems of design and of evaluation of rain making experiments. A Survey of Statistical Design and Linear Models, J. N. Srivastava, ed. North-Holland Publ. Co., 443-457.
Problems with effective randomization; area seeding of convective clouds; natural variability; probability of zero rain; response variable; extra-area effect; Grossversuch III; stratification by stability and wind direction; seeding effective time; Arizona experiment; moving grid; adoption of the crossover design in a future experiment would be most imprudent.

75001

Olsen, A. R., W. L. Woodley, 1975: On the effect of natural rainfall variability and measurement errors in the detection of seeding effect. J. Appl. Meteor., 14(5), 929-938.
Simulation; area cloud seeding; power functions; FACE; dynamic seeding; randomization on'days; random experimental design; air mass showers; EML mesonet and EML target areas; WSR 57 radar; 1971 and 1973; gamma distribution; measurement errors; gage density; mixed distributions; multiplicative seeding effect; likelihood ratio test for scale parameters; c(a)test; squared rank sum test; Wilcoxon test; two-sample t-test; fourth-root transformation; log transformation; likelihood ratio and c(a) tests are more powerful; sample size.

75002

Olsen, A. R., 1975: Bayesisn and classical statistical methods applied to randomized weather modification experiments. J. Appl. Meteor, 14(5), 970-973.
FACE; gamma; multiplicative seeding effect; inverse gamma priors for the seeding effect parameter; maximum likelihood estimator; chi-square test.

75P01

Petersen, P. A., 1975: An analysis of thirteen years of commercial hail suppression in central Alberta. J. Wea. Mod., 7, 153-170.
1956-1968 seeded; 1938-1955 and 1969-1972 as no-seed; hail loss/cost ratio; correlation; regression; 4 counties; variability of hail; ground generators; aircraft; hail/precipitation ratio; target only; scatter plot; crop yields (barley) were found to be statistically significant.

75P02

Peace, R. L., 1975: Radar observations of Sierra snowstorms. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 125-130.
CENSARE Project; NWS WSR-57 radar at Sacramento; precipitation bands; echo movement.

75P03

Peterson, N. R., 1975: Snow survey data for weather modification projects. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 165-171.
California Cooperative Snow Surveys Program; snow measurement accuracy.

75R01

Rottner, D., S. R. Brown, and O. H. Foehner, 1975: The effect of persistence of AgI on randomized weather modification experiments. J. Appl. Meteor., 14(5), 939-945.
Possibility of contaminate control experimental days; Colorado River Basin Pilot Project; Jemez Atmospheric Water Resources Research Project; orographic; ground-based AgI-acetone generators; 24 hour as unit; ratio; Wilcoxon test; aircraft measurements of ice nuclei; nuclei concentration.

75R02

Renick, J., 1975: The Alberta hail project: Update 1975. J. Wea. Mod., 7(2), 1-6.
Seeding hypothesis; 50/50 randomized; the growth factors for the seeded storms are smaller than for the non-seeded storms with the difference significant at the 2.5% level (Mann-Whitney test).

75S01

Schickedanz, P. T., and E. G. Bowen, 1975: Computation of climatological power spectra using variable record lengths.
Fourth Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Tallahassee, 18-21, Nov., 102-107.
Texas High Plains; multiple regression.

75S02

Schickedanz, P. T., and M. B. Busch, 1975: Data processing and analytical procedures for urban precipitation studies.
Nat. Symp. on Precip. Analy for Hydrol. Model., Davis, CA., August, 101-110.
METROMEX; 1971-1973; surface raincell; missing value estimation; objective storms.

75S03

Simpson, J., and W. L. Woodley, 1975: Florida Area Cumulus Experiments 1970-1973 rainfall results. J. Appl. Meteor., 14, 734-744.
Target 13,000 square km; 14 seeded and 23 control cases; areal seed-control rainfall differences between random and nonrandom controls; Bayesian; gamma; radar echo motion is shown to be a statistically sig. covariate; Mann-Whitney-Wilcoxon; squared rank; t-test; optimal c(a), floating targets.

75S04
Simpson, J. C. Eden, and A. R. Olsen, 1975: On the design and evaluation of cumulas modification experiments. J. Appl. Meteor., 14, 946-958.
Combining numerical simulation; randomized sample with non randomized controls; 26 pairs of clouds in FACE; 100-1000 g per clouds; 4th-root transformation; Wilcoxon-Whitney-Mann test; gamma; log-normal; beta-k; beta-p; Bayesian statisties; the seed-control rainfall difference was significant at better than 5%.

75S05
Sax, R. I., S. A. Changnon, L. O. Grant, W. F. Hitschfeld, P. V. Hobbs, A. M. Kahan, and J. Simpson, 1975: Weather modification: Where are we now and where should we be going? An editorial overview. J. Appl. Meteor., 14(5), 652-672.
Problems of classical statistical analysis: (1) require too long a period to verify, (2) can verify only one method of seeding at a time; hope statistical technique could be combined with: (1) physical variables, (2) radar, (3) stratification, etc.; problems in cumulus modification; statistics to calculate sample sizes; MOS; need for predictor variables; urban areas; industrial complexes; deforestation; agricultural; irrigation; NHRE; orographic; extra-area effects; developments in the incorporation of statistics; Bayesian; hurricane modification; fog modification.

75S06
Super, A. B., 1975: Three lessons learned during the Bridger Range experiment. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 47-52.
Randomized; winter; orographic; 169-70, 1970-71, and 1971-72; ground-based generators; design; type I statistical error; cloud thickness; rawinsondes; tie adjusted Wilcoxon rank sum test.

75S07
Stidd, C. K., 1975: Irrigation increases rainfall? Science, 188, 279-280. Reply by W. B. Fowler and J. D. Helvey, 281.
Columbia Basin, Washington; July and August rainfall; 50% higher during 1955-1975 than 1931-1950; one-sided t-test; 55 gages inside the target; 47 outside; percent normal method.

75S08
Simpson, J., P. N. Rosenzweig, and R. Biondini, 1975: On the role of highly-skewed distributions in weather modification.
Fourth Conf. on Prob. and Statist. in Atmos. Sci., Amer. Meteor. Soc., Tallaha33ee, 18-21, Nov., 70-75.
Conditional probability; log-normal; Weibull; gamma; extreme observations; lognormal distribution; FACE; 1970-1973; days as unit; radar echo; confidence limits; Monte Carlo.

75S09
Simpson, J., A. J. Olsen, and J. C. Eden, 1975: A Bayesian analysis of a multiplicative treatment effect in weather modification. Technometrics, 17(2), 161-166.
Randomized; Florida; AgI; rain volume; radar; gamma distribution; coefficients of variation; single cloud experiment; seed-control rainfall differences measured averaging 3.3 X 105 cu m per cloud; multiplicative seeding factor of about 2-3; dynamic seeding.

75S10
Steinhoff, H. W., 1975: Conclusions from the San Juan Ecology Project. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 201-205.
Environmental.

75S11
Smith, T. B., 1975: Physical design concepts for Sierra weather modification program. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 152-157.
Physical evaluation; observational tools; measurement systems; K-band; vertically pointing radar.

75T01
Torrance, J. D., 1975: Availabiblity of atmospheric water. Trans. Rhod. Scient. Assoc., 56(2), 31-43.
Rhodesia; daily rainfall index; 20 rainfall stations; precipitable water; cloud seeding; sounding; thunderstorm.

75V01
Vogel, J. L., and F. A. Huff, 1975: Fog effects resulting from power plant cooling lakes. J. Appl. Meteor., 14(5), 868-872.
Midwest; initiation of fog; cooling lake temperature distributions; potential downwind effect.

75V02
Vardiman, L., 1975: Seedability criteria. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 71-78.
Review; theoretical criteria; emperical criteria.

75W01
Woodley, W. L., A. R. Olsen, A. Herndon, and V. Wiggert, 1975: Comparison of gage and radar methods of convective rain measurement. J. Appl. Meteor., 14(5), 909-928.
Accuracy of gage networks; gage density; two collocated, calibrated 10 cm radars; FACE; measurement errors; area rain estimates; sampling error; S-band.

75W02
Warburton, J. A., 1975: Design, control and evaluation of the Pyramid Pilot Project. Special Reg. Wea. Mod. Conf. Aug. of Winter Orogr. Precip. in the Western U. S., San Francisco, AMS, 11-13 Nov., 239-245.
California; ground-based generators; AgI tracing; winter seasons 1970-71 and 1971-72; 24 hours; randomized pairs; seeding suspensions; operational procedure.

76A01
Ackerman, B., G. L. Achtemeier, H. Appleman, S. A. Changnon, Jr., F. A. Huff, G. M. Morgan, P. T. Schickedanz, and R. G. Semonin , 1976: Design of the High Plains experiment with specific focus on phase 2, Single cloud experimentation. Final Report, Bureau of Reclamation, 14-06-D-7197, Illinois State Water Survey, Urbana, 231 pp.
Seeding hypotheses; predictor variables; review of projects; Project Cloud Catcher; North DAkota Pilot Project; San Angelo Cumulus Project (TX); KANCUP; Rapid City Project; Southern Plains Skywater Project (OK); Big Spring Project; FACE; seeding effect models; evaluation; sample size; rainfall measurement; seeding operations; extra-area effects; social; economic; environmental; randomization; experimental unit; lognormal; raincell; METROMEX; synoptic types; discriminant analysis.

76B01
Baughman, R. G., D. M. Fuquay, and P. W. Mielke, Jr., 1976: Statistical analyses of a randomized lightning modificaion experiment. J. Appl. Meteor., 15, 790-794.
AgI; mountain area; likelihood ratio tests based on the log-normal dist.; 2-sample Wilcoxon tests; sample sum of squared ranks test; intr -cloud flashes frequency; 2-sided p-values are less than .04 for both nonparametric tests; for estimated reduction in the long continuing current intervals in cloud-to-ground flashes is about 1/4; 2-sided p-values are less than .03 for

both nonparametric tests; for the reduction of the frequency of cloud-to-ground flashes and the duration of ligthing activity by about 1/2; single target area in western Montana; randomized and non-seeded unit followed seeded unit; ground generator and airborne; suitable day was when NWS forecast with 30% of thunderstorm occurrence.

76B02

Biondini, R., 1976: Cloud motion and rainfall statistics. J. Appl. Meteor., 15(3), 205-224.
1968 and 1970; FACE; single cloud seeding; stratification by cloud motion; multiplicative seeding effect; log-normal; seeding tends to promote the merger; seeding increased the lifetime of no-merger by 40%; rainfall intensity; rank-indicated seeding effect; evaluation; pairwise seeding effect; dynamic seeding; randomizatin by clouds; radar; total rainfall volume; lifetime of cloud; Wilk-Shapiro normality test; F-test for variance; Pitman estimators; confidence limits; seeding factor is about 2.69; Welch's t-test; paired t-test; Bartelett's test.

76B03

Biondini, R., 1976: Some patterns of inference in the Florida cumulus experiments. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 159-164.
Stratified by echo motions; south Florida; randomized over days; AgI, both airborne and from fuses; cloud with top temperature near -10 C; estimation of p.d.f's of rainfall and cloud motion; data were separated into days of greater cloud motion and lesser cloud motion; conclude that weather modification experiment should take cloud motion into account.

76B04

Brier, G. W., G. T. Meltesen, 1976: The use of transformation to minimized the influence of extreme rainfall values in correlation analysis. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 181-186.
Monte Carlo simulation; Colorado; results for the transformations show no improvement over the results for the orignial data; power of the test; permutation test.

76B05

Buikov, M. V., E. E. Kornienko, and B. N. Leskov, 1976: Main results of research on the modification of precipitation in the U.S.S.R. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 135-142.
Ukraine; snow enhancement; Wilcoxon's test; 1 D cloud model; rain enhancement; regression; double ratio; numerical simulation; economical.

76C01

Cunning, J. B. Jr., 1976: Comparison of the Z-R relationships for seeded and nonseeded Florida cumuli. J. Appl. Meteor., 15, 1121-1125.
1971-73; FACE; rainfall estimation by radar; raindrop size distributions measured below cloud base; using a foil impactor; NOAA DC-6 aircraft; 5 seed and 29 control drop-size distributions for 1971, 29 seed and 64 control for 1973; maximum difference in rainfall rate less than 11%; no significant differences in the intercepts or coefficients between the seed and control equations at the 5% level.

76C02

Changaon, S. A. Jr., and G. Morgan, 1976: Design of hail suppression experiment for the central United States. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 257-264.
Raingages every 9 square miles; randomized; 1/3 seeded at cloud base, 1/3 seeded at mid-cloud; 1/3 not seeded; day as unit; AgI; hailstone size; hail day; echo characteristics; crop-hail loss.

76C03

Changnon, S. A., and G. M. Morgan, 1976: The present status and future potential of hail suppression. J. Wea. Mod., 8, 164-188.
Technology assessment; commercial hail suppression project in west Texas; Bowman-Slope project; North Dakota Pilot project; South Africa; South Dakota statewide seeding program; NHRE; Alberta; questionaire.

76C04

Crow, E. L., P. W. Summers, A. B. Long, C. A. Knight, G. B. Foote, and J. E. Dye, 1976: National Hail Research Experiment randomized seeding experiment 1972-1974: Volume I - Experimental results and overall summary. Final Report, National Center for Atmospheric Research, Boulder, CO, 260 pp.
1972-1974; day as unit; AgI; total mass of hail at ground as primary response variable; no significant seeding effect is detected; confidence interval; ratio; lognormal; gamma; Thiessen polygon method; isohyetal analysis; frequency of zero hail days; Kolmogorov-Smirnov test; Shapiro-Wilk test; chi-square test; kappa 3; beta; sum of rank power test; hail size distribution; radar reflectivity; hail embryo; stratified by storm intensity, storm type, and seeding coverage; representative darw analysis.

76C05

Changnon, S. A., Jr., and G. M. Morgan, Jr., 1976: Design of an experiment to suppress hail in Illinois. Report of Investigation 61, Illinois State Water Survey, Urbana, IL, 194 pp.
DESH; 3-cm and 10-cm radars; relatin of hail and reflectivity; CHILL radar; hail probability; surface dew point; maximum echo height; hail day determination; frequency of hail cells; cumulative lift index; seeding hypotheses and techniques; Soviet method; Alberta; South Africa project; NHRE; tracer study; economic; evaluation; Texas Panhandle project; sample size; North Dakota Pilot project; experimental unit; seeding operation; crop loss; ecological impacts; bibliography.

76D01

Donnan, J. A., J. L. Pellett, R. S. Leblang, and L. F. Ritter, 1976: The rise and fall of the South Dakota weather modification program. J. Wea. Mod., 8(1), 1-20.
Legislative history; Project Hailswath; state program; Rapid Project; Weather Control Commission.

76D02

Dye, J. E., A. J. Heymsfield, I. Paluch, and D. W. Breed, 1976: National Hail Research Experiment randomized seeding experiment 1972-1974: Volume II - Precipitation measurement. Final Report, National Center for Atmospheric Research, Boulder, CO, 529 pp.
Hailpad; instrumentation; data editing; hail/rain separator; data quality; measurement error; data listing; hailstone size distribution; data problem.

76E01

Elliott, R. D., R. W. Shaffer, 1976: Colorado River Basin Pilot Project comprehensive evaluation report, five winter seasons, 1970-1971 - - - 1974-1975. Report ARI-76-1, Aerometric Research Inc., Goleta, CA, 641 pp.
Possible bias in identifying seeding opportunity; nucleation; orographic; AgI; runoff; hydrology; rawinsonde; seeding potential; overseeding; stratified by cloudtop temperature, stability index, barrier trajectory index, thermal advection index, and condensation rate index; correlation; Wolf Creek Pass; contamination on the following day; 24-hour as experimental unit; 6-hour as sampling unit; no significant seeding effect; extra-area effect appeared to have occurred; wind direction; random target-control design.

76F01
Flaeck, J. A., 1976: Evaluation of operational weather modification projects. J. Wea. Mod., 8, 42-56.
History; percent-normal method; single ratio; target-control; regression; bias; 8 components of a complete evaluation; predictor variables; experimental unit; sampling unit; randomization; sample size; exploratory data analysis; stem-and-leaf plots; confirmatory data analysis.

76F02
Flueek, J. A., and B. S. Holland, 1976: Ratio estimators and some inherent problems in their utilization. J. Appl. Meteor., 15, 535-543.
Correlated bivariate gamma structure; sample size; transformations; "corrected" seeding effect; Grossversuch III; Florida EML single-cloud experiments; Snowy Mountains; double ratio.

76F03
Fournier d'Albe, E. M., and P. M. Aleman, 1976: A large-scale cloud seeding experiment in the Rio Nazas catchment area, Mexico. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 143-150.
Irrigation, 7/13/58-9/26/58 seeding; using salt; 15 raingages; daily rainfall; 1942-1956 and 1959-1974 as nonseeded; using ratio.

76F04
Fankhauser, J. C., A. C. Modahl, C. G. Mohr, and M. E. Solak, 1976: National Hail Research Experiment randomized seeding experiment 1972-1974: Volume III - Meteorological summary. Final Report, National Center for Atmospheric Research, Boulder, CO, 313 pp.
Synoptic influences; rawinsonde; predictors; 57 hail days; sounding representativeness; data listing.

76F05
Foote, G. B., R. C. Srivastava, J. C. Fankhauser, F. I. Harris, T. J. Kelly, R. E. Rinehart, C. G. Wade, P. J. Eccles, E. T. Garvey, M. E. Solak, R. L. Vaughan, B. E. Weiss, and R. J. Wolski, 1976: National Hail Research Experiment randomized seeding experiment 1972-1974: Volume IV - Radar summary. Final Report, National Center for Atmospheric research, Boulder, CO, 326 pp.
10.7-cm radar; data processing; data problems; cellular analysis; reflectivity envelopes; reflectivity integrals; storm intensity; daily summaries.

76G01
Gagin, A., and J. Neumann, 1976: The second Israeli cloud seeding experiment--The effect of seeding on varying cloud population. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 195-204.
Seeding successful when cloudtop temperature is between -13 and -25 C; 1969-1975; Lake Tibarias; Nort targer; a control are; a buffer zone; Southern target; correlation coefficients; daily; double ratio; F test; single area ratio; total 388 rain days; randomization tests; an increase of about 13-15% under seeding; cloud top heights; Wilcoxon-Mann-Whitney.

76I01
Iaman, R. L., P. G. Risaer, J. F. Harp, N. R. Nunnally, and J. R. Bohland, 1976: Evaluation of precipitation management effects in Oklahoma. Final Report, Office of grants and contracts, Univ. of Oklahoma, Norman, 228 pp.
Washita River Basln, Oklahoma; cloud model (Hirsch, Orville & Hubbard); 1948-61; monthly, seasonal, annual; senstivity analysis; U.S. Southern Great Plains Field Station at Woodward, Oklahoma; regression of total forage production by precipitation, 1" increase (2%), July, Aug, Jan, Feb in order of importance; tree-ring growth; runoff.

76K01
Koscielski, A., and A. S. Dennis, 1976: Comparison of first radar echoes in seeded and unseeded convective clouds in North Dakota. J. Appl. Meteor., 15, 309-311.
North Dakota Pilot Project; look only at 1972 radar data; randomized on days, 14 seed days, 10 unseeddays; first radar echoes appeared closer to cloud base and at higher temperatures on seeded days; t-test; ice (Bergeron) process; 10 cm radar.

76K02
Krishna, K., R. N. Chatterjee, S. Rajamani, K. K. Kanuga, L. T. Khemani, B. K. Mukherjee, S. K. Paul, R. V. Kumer, S. K. Sharma, B. Mohan, and Bh. V. R. Murty, 1976: An exploratory study by radar of the effect of seeding two maritime cumulus clouds. Indian J. Meteor. Hydrol. Geophys., 27(1), 78-81.
Bombay; two clouds were seeded and one cloud unseeded; end of the monsoon season of 1973; NaCl seeded at middle of cloud by DC-3 aircraft; X-band BEL radar; S-band surveillance radar; maximum echo height; maximum areal echo coverage; positive seeding effect; part of the Poona cloud experiment.

76K03
Kapoor, R. K., K. Krishna, R. N. Chatterjee, A. S. R. Murty, S. K, Sharma, and Bh. V. R. Murty, 1976: An operational rain stimulation experiment using warm technique over Rihand catchment in northeast India during summer monsoon of 1973 and 1974. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 15-20.
13000 square km of target; two adjacent controls of same size; daily; partially randomized; seedability criteria; raingages; ANOVA; correlation; increase of 16%, not significant.

76K04
Keyes, C. G. Jr., and F. Hackett, 1976: Comparison of JEMEZ analysis event results to seedable unit results. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 187-194.
Northern New Mexico, 24 hour 50% randomization; AgI, ground generator; raingages; Wilcoxon test; consider only winter storm with .01"; squared rank test; data suggested the existence of a temperature window, outside which seeding has little effect on orographic snow storms.

76K05
Klazura, G. E., and M. J. Schroeder, 1976: Development of prediction variables of areal precipitation characteristics. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 173-180.
HIPLEX; 5.4-cm radar; rawinsondes; maximum radar reflectivities; maximum echo height; precipitable water; mean mixing ratio; lifted index; correlations; F-ratios; stepwise regression.

76L01
Leonov, M. P., and G. I. Perelet, 1976: Cloud Modifications During the Cold Months. U.S. Departmment of Interior, TT 70-57253, 198 pp, translated from the monograph "Ativnye Vozdeistviya na Oblakav Kholodnoe Polugodie", Leningrad, 1967.
Visual observations; radar observations; cloud physics; winter precipitations; rain intensity; stratus clouds; nucleation; supercooled clouds; ice; Ukrainian, USSR; evaluation.

76L02
Lovell, C. C., A. K. Goroch, and K. W. Chu, 1976: Weather modification design study for streamflow augmentation in the Northern Sierra Nevada, Volume I - Meteorology and Hydrology of the Northern Sierra Nevada. Final Report MB-R-76/75A, MBAssociates, San Ramon, CA, 89 pp.
California; snow augmentation; CENSARE; meteorology; hydrology; cloud physics; precipitation rate and duration; seedability; precipitation analysis; orographic; correlation; echo top temperature; ice crystal concentration; auto-covariance; cross-covariance; review of cloud models; bibliography.

76L03
Lovell, C. C., A. K. Goroch, and K. W. Chu, 1976: Weather modification design study for streamflow augmentation in the Northern Sierra Nevada, Volume II - Physical and Statistical Design. FR MB-R-76/75A, MBAssociates, San Ramon, CA, 89 pp.
Snow augmentation; seeding hypotheses; CENSARE; crossover; random experimental; random historical target-control; experimental unit; covariates; extra-area effect; cloud types; stability index; orographic; random target-control; sampling unit; American River Basin, CA.

76L04
Lovell, C. C., A. K. Goroch, and K. W. Chu, 1976: Weather modification design study for streamflow augmentation in the Northern Sierra Nevada, Volume III - Operational Design. Final Report MB-R-76/75A, MBAssociates, San Ramon, CA, 73 pp.
Seeding operation; forecasting; seedability; instrumentation; data requirement; gage density; site selection; ground generator; airborne; radar requirement; snow augmentation; orographic; American River Basin, CA.; 24-hour as unit; CENSARE.

76L05
Lovell, C. C., A. K. Goroch, and K. W. Chu, 1976: Weather modification design study for streamflow augmentation in the Northern Sierra Nevada: Executive summary. Final Report MB-R-76/75A, MBAssociates, San Ramon, CA, 28 pp.
CENSARE; snow augmentation; seedability; seeding hypotheses; seeding suspension criteria; instrumentation; extra-area effect; environmental impacts; American River Basin, Ca.

76M01
Mielke, P. W., Jr. and J. A. Flueck, 1976: Distributions of ratios for some selected bivariate probability function. Proc. Social Statist. Sec., Amer. Statist. Assoc., 608-613.
Gamma; beta(1); lognormal; Weibull; beta-p; beta-kappa.

76M02
Mielke, P. W. Jr., 1976: Simple iterative procedures for two-parameter gamma distribution maximum likehood estimates. J. Appl. Meteor., 15(2), 181-183.
Likelihood ratio test; treatment-induced scale differences; southern Florida.

76M03
Mielke, P. W. Jr., K. J. Berry, and E. S. Johnson, 1976: Multi-response permutation procedures for a priori classifications.
Commun. Statist.-Theor. Meth., A5(14), 1409-1424.
Permutation tests; finite populations; symmetric functions.

76M04
Mather, G. K., L. W. Cooper, and D. S. Treddenick, 1976: The Nelspruit hail suppression program. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 295-302.
South Africa; Pacer III; a 5 cm radar; Learjet; seeding logistics; ontop seeding; cloud top heights; maximum reflectivities; maximum echo heights of the 45 dbz contours; crop damage assessments; hail day; three target areas; beta distribution; daily severity ratios; significant reductions in daily hail severity in all three operational areas have occurred.

76P01
Poellot, M. R., P. J. Brady, M. J. Schroeder, and J. D. Odegard, 1976: Extended-area effects from airborne seeding of cold cumulus clouds--a survey. Technical Report, Department of Aviation, Univ. of North Dakota, Grand Forks, ND, 61 pp.
Experimental design; natural variability of precipitation; evaluation techniques; bibliography; Australia; Grand River Project; Santa Barbara; Arizona; Whitetop; dynamic mechnism; HIPLEX; gage density; predictors.

76S01
Schickedanz, P. T., and W. C. Ackermann, 1976: Influence of irrigation on precipitation in semi-arid climates.
Proc. of Symp. on Arid Lands Irrig. in Developing Countries., Alexandria, Egypt, February.
Empirical orthogonal function; trend surface analyses; Kansas; Nebraska; Oklahoma; Texas; April-September; 1931-1970.

76S02
Smith, E. J., and D. E. Shaw, 1976: Some aspects of the assessment of a site for a cloud-seeding experiment. Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 165-172.
Simulation of experimental project; use double ratio; 1, 3, 7, 10, 20, 30 days as period lengths; 23, 18, 13, 10, 5, 3, 1 gages; duration of 10, 5, 2 years; 5 kinds of areal designs; covariates.

76S03
Sanborn, R. W., J. C. Fankhauser, G. B. Foote, C. A. Knight, G. Langer, C. J. Biter, T. J. Kelly, R. E. Rinehart, M. E. Solak, 1976: National Hail Research Experiment randomized seeding experiment 1972-1974: Volume V - Hail declaration procedures and seeding operation. Final Report, National Center for Atmospheric Research, Boulder, CO, 207 pp.
Hail day declaration procedure; seeding coverage; testing of seeding rockets; laboratory test; TB-1 and CSR-II seeding materials; MBA rocket-borne flare.

76S04
Schickedanz, P. T., 1976: The effect of irrigation on precipitation in the Great Plains. Final Report, Illinois State Water Survey, Urbana, IL, 105 pp.
April-September; factor analysis; monthly and seasonal; effect was the greatest in Texas during July, in Kansas during August, and in Nebraska during June; missing value estimation; 1931-1945 as non-treated; 1946-1970 as treated; ratio; ANOCOVA; t-test; mean areal rain; insurance liability; loss; hail day; synoptic; maximum daily temperature was lowered.

76W01
Woodley, W. L., J. Simpson, R. Biondini, and G. Sambataro, 1976: On NOAA's Florida Area Cumulus Experiment (FACE) main rainfall results 1970-1975.
Second WMO Sci. Conf. on Wea. Mod., Boulder, CO, 2-6, August, WMO No. 443, 151-158.
Dynamic seeding; randomized by day; clouds top seeding; AgI; stratified by echo motion; covariates; Welch t-test.

77A01
Achtemeier, G. L., and R. Y. Sun, 1977: Meteorological and physical selection of candidate covariates for HIPLEX. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 234-237.
Statistical-Physical-Estimator-Covariate (SPEC); 31 upper air prognostic SPECs; moisture; stability indices; triggering mechanisms; Dodge City; Kansas; 1200 GMT (morning) soundings; correlations; surface observations of 12 stations; objective analysis; 19 surface prognostic; convergence.

77A02
Atlas, D., 1977: The paradox of hail suppression. Science, 195(4274), 139-145.
Hail suppression concepts; evaluation in general; Nelspruit Project; Grossversuch III; Mendoza area of Argentina; NHRE; some physical reasons for increased hail; physical stratification; ice nuclei (IN) concentration; maximum hail size.

77A03
Achtemeier, G. L., P. H. Hildebrand, P. T. Schickedanz, B. Ackerman, S. A. Changnon, Jr., and R. G. Semonin, 1977: Illinois precipitation enhancement program (Phase I) and design and evaluation techniques for High Plains cooperative program. Final Reprot to Bureau of Reclamation, 14-06D-7197, Illinois State Water Survey, Urbana, 267 pp.
Predictor variables; HIPLEX; principal components; discriminant analysis; sample sizes; radar; rawinsonde; synoptic; 6-hour; daily; classification into rain/no-rain.

77B01
Biondini, R., J. Simpson, and W. L. Woodley, 1977: Empirical predictors for natural and seeded rainfall in the Florida Area Cumulus Experiment (FACE), 1970-1975. J. Appl. Meteor., 16, 585-594.
The need for predictor variables; echo motion speed as stratification variable.

77B02
Browning, K. A., and D. Atlas, 1977: Some new approaches in hail suppression experiments. J. Appl. Meteor., 16(4), 327-332.
Evaluating seeding effects; monitoring the physical structure of the hailstrom and the hail growth processes; extensive use of multiple Doppler radar; chemical tracer techniques; NHRE; dynamic hail potential as a covariate; maximum hail sizes.

77B03
Bradley, R. A., S. S. Srivastava, and A. Lanzdorf, 1977: Summarization of precipitation data for a weather modification experiment.
Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 201-205.
Response surface; Santa Barbara; 107 target-area and 34 control-area stations; 107 convective bands; polynomial regression; distribution of residuals; rain volumes.

77B04
Biondini, R., 1977: Review of the North Dakota Pilot Project. NCAR-7100-77/1, 29 PP.
Experimental design; 1969-1972; hail suppression; data of the project are of good quality; experimental unit; principle of randomization; questions of 8-day block and day-pair; question of Monte Carlo procedure.

77B05
Bach, C. L., 1977: An interpretive history of thirty-years (1945-1975) of weather modification. Technical Report M410, Dept. of Statistics , Florida State Univ., Tallahassee, FL, 102 pp.
Yearly totals of cloud seeding projects; cold fog; warm fog; hail suppression; lightning suppression; 3 decades: 1946-1955, 1956-1965, 1966-1975; bibliography.

77B06
Bradley, R. A., and S. S. Srivastava, 1977: Correlation in polynomial regression. Technical Report M409, Dept. of Statstics , Florida State Univ., Tallahassee, FL, 5 pp.
Computatinal problem; need for centering and scaling of the independent variables or the regression; sampling correlation of x term and x square term.

77B07
Bradley, R. A., S. S. Srivastava, and A. Lanzdorf, 1977: Data summarization in a weather modification experiment: I. A response surface approach. Technical Report M417, Dept. of Statistics, Florida State Univ., Tallahassee, FL, 73 pp.
Santa Barbara I; 2-D cubic functions were appropriate; 1967-68 to 1970-71; ground gnenrator; AgI; convective hand as experimental unit; randomized:

77B08
Borland, S. W., 1978: Hail suppression: Progress in assessing its costs and benefits. Hail: A Review of Hail Sci. and Hail Suppres., G. B. Foote, and C. A. Knight, ed., AMS, Meteor. Monog. 38, 155-175.
Social; biological; economic effects; ecological impacts; down-wind influences; reactions of people; legal; emphasize the extensiveness of the evaluation problem; history; crop losses to hail; indexes of hail damage potential; review of 7 projects; Alberta; Colorado; Bowman-Slope; Tri-County; Texas; NHRE.

77C01
Changnon, S. A., and N. G. Towery, 1977: Preliminary evaluation of the 1976 rain modification project in central Illinois. J. Wea. Mod., April 66-78.
Non-randomized; t-test; with no-rain gages; without no-rain gages; compare seeded (large echo envelop) with control on 6 seeded days only; 5 counties; July-Aug. 1976 daily rain.

77C02
Crow, E. L., 1977: Minimum variance unbiased estimators of the ratio of means of two lognormal variates and of two gamma variates.
Commun. Statist.-Theor. & Meth., A6(10), 967-975.
Median unbiased estimator; complete sufficient statistics; weather modification; with equal and unequal shape parameters; 1972-74; National Hail Research Experiment.

77C03
Crow, E. L., 1977: Confidence limits for seeding effect in single-area weather modification experiments. Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 206-211.
Log-normal.

77C04
Changnon, S. A., Jr., 1977: On the status of hail suppression.
Bull. Amer. Meteor. Soc., 58(1), 20-28.
Technology assessment; review of six recent projects; need for an extensive investigation of the data and results of these recent projects; NHRE; Texas project; Bowman-Slope Project; North Dakota Pilot Project; South Africa Project; crop severity ratio; South Dakota statewide project; opinion surveys.

77C05
Changnon, S. A., Jr., 1977: Accidental and planned weather modification in Illinois. Water Resources Bulletin, 13, 1165-1174.
Illinois State Water Survey; urban effect; METROMEX; effects of large industries and power plants.

77C06
Chin, E. H., and J. F. Miller, 1977: On the estimation of daily precipitation extremes. Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 217-220.
Curve fitting.

77C07
Changnon, S. A., Jr., R. J. Davis, B. C. Farhar, J. E. Haas, J. L. Ivens, M. V. Jones, D. A. Klein, D. Mann, G. M. Morgan, Jr., S. T. Sonka, E. R. Swanson, C. R. Taylor, J. V. Blokland, 1977: Hail suppression impacts and issues. Final Report, Illinois State Water Survey, Urbana, IL, 427 pp.
TASH project; hail characteristics; hail climate; evaluation; downwind effect; economic loss to hail; history; San Luis Valley project, CO; South Dakota; Texas Panhandle project; cloud physics; agriculture; insurance industry; societal influences; laws; environment; future adoption of hail suppression; benefit-cost analysis; future impacts.

77C08
Changnon, S. A., Jr., F. A. Huff, P. T. Schickedanz, and J. L. Vogel, 1977: Summary of METROMEX, Volume 1: Weather anomalies and impacts. Bulletin 62, Illinois State Water Survey, Urbana, IL, 260 pp.
Local increase of 30% in total rainfall; 40% in heavy rainfall rates and rainstorms, 45% in thunderstroms; 100% in strong surface winds and hailfall intensity; social; environmental.

77D01
Dennis, A. S., J. R. Miller, 1977: Physical processes associated with AgI seeding of convective clouds in the northern Great Plains. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 286-289.
Review; area experiments; Rapid City project; North Dakota Pilot Project (NDPP); aircraft and radar observations; Project Cloud Catcher; cloud modeling; Grand River Project.

77D02
Dennis, A. S., 1977: Hail suppression concepts and seeding methods. Hail: A Review of Hail Sci. and Hail Suppres., G. B. Foote, and C. A. Knight, ed., AMS, Meteor. Monog. 38, 181-191.
Glaciation of supercooled water; competing hailstone embryos; change of cloud droplet size distribution; dynamic effect; AgI consumption; Alberta; Bowman-Slope; NHRE; Caucasus, USSR; cloudbase, broadcast, and direct injection seedings; Grossversuch III; review of projects; South Dakota statewide program.

77E01
Eastgate, J. T., 1977: Weather modification views of user-payers in North Dakota. J. Wea. Mod., 9(1), 193-201.
Weather modification in general; controversial.

77F01
Federer, B., 1977: Methods and results of hail suppression in Europe and in the USSR. Hail: A Review of Hail Sci. and Hail Suppres., G. B. Foote, and C. A. Knight, ed., AMS, Meteor. Monog. 38, 215-223.
Po Valley, Italy; Spain; Yugoslavia; Soviet technique; Grossversuch IV.

77F02
Flueck, J. A., 1977: The role of statistics in weather modification experiments. First Internat. Workshop on Hailfall Measurements, Banff, Alberta, Canada, October.
Statistics as a science of performing science; comparison between experimentation and data analysis; 6 states, 8 components of an experiment, and their interaction; Bayes theorem; hypothesis; model; natural variability; prescreening, blocking; concomitant information; replication; multiplicity; Climax I and II; Whitetop; Israel I and II; FACE I; Grossversuch III; clinical trial; University Group Diabetes Program; introducing the term Meteometrics.

77F03
Federer, B., A. Waldvogel, W. Schmid, F. Hampel, E. Rosini, D. Vento, P. Admirat, and J.-P. Rouet, 1977: Grossversuch IV: Design of a randomized hail suppression experiment using the Soviet method. Technical Report , No. 81, Lab. of Atmosphys., Zurich, Switzerland, 35pp.
Need prediction function and concomittant function; use hail kinetic energy as test variable.

77F04
Farhar, B. C., S. A. Changnon, Jr., E. R. Swanson, R. J. Davis, and J. E. Haas, 1977: Hail suppression and society. Technical Report, Illinois State Water Survey, Urbana, IL, 24 pp.
History; economic; political; legal; environmental; impacts; agriculture; technology assessment.

77F05
Plueck, J. A., and P. W. Mielke, 1977: Design and evaluation of hail suppression experiment. Hail: A Review of Hail Sci. and Hail Suppres., G. B. Foote, and C. A. Knight, ed., AMS, Meteor. Monog. 38, 225-235.
Review; NAS-NRC; experimental unit; response variables; Grossversuch II; Alberta hail studies; Mendoza, Argentina; France; Northeast Colo.; USSR; Hailswath Project; Rapid Project; Grand River Project; North Dakota Pilot Project; NHRE; treatment design; predictor variables; instrumentation; randomization; extended area treatment effects; sample size; hailswaths; stem-and-leaf plot.

77G01
Gertzman, H. S., and D. Atlas, 1977: Sampling errors in the measurement of rain and hail parameters. J. Geophy. Res., 82(31), 4955-4966.
Sampling errors; Poisson distribution; fractional standard deviation; exponential size spectra.

77G02
Girdzus, J., and G. W. Bomar, 1977: An examination of the rainfall distribution over the target area of the Colorado River Municipal Water District's weather modification program. J. Wea. Mod., 9, 93-99.
Isohyetal analysis; compare means; San Angelo Cumulus Project; 1971-1975; using 1935-1970 as historical control. 3500 square miles; Texas high and low rolling plains; AgI; 25% randomization in 1973-1975; aircraft; cloud-base seeding; monthly totals May to September;11 NWS stations in the control, 8 in the target; downwind effect; 500 mb wind; blocking of 5 years.

77G03
Gleeson, T. A., 1977: Data summarization in a weather modification experiment: II. Concomitant variables. Technical Report M419, Dept. of Statistics , Florida State Univ., Tallahassee, FL, 20 pp.
Santa Barbara; 1967-1968 to 1970-1971; mixing ratio; 700 mb wind speed and duration; 500 mb temperature; stability stratification; Showalter index; stability wind; instability tranport.

77H01
Hobbs, P. V., D. A. Bowdle, and L. F. Radke, 1977: Airborne measurements of aerosol over the high plains of the United States. Sixth Conf. on Planned and Inadv. Wea.Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 347-349.
HIPLEX; summers of 1975 and 1976; nuclei; ice nuclei (IN); Miles City, Montana; Big Spring, Texas; Goodland, Kansas; Washington; maritime, warm cumulus and warm stratus clouds; ambient CCN size distribution; accumulated rainfall; 6% increase in rainfall; not considered significant.

77H02
Hindman, E. E. II, P. M. Tag, B. A. Silverman, and P. V. Hobbs, 1977: Cloud condensation nuclei from a paper mill. Part II: Calculated effects on rainfall. J. Appl. Meteor., 16(7), 753-755.
Washington; cloud model; large and giant CCN emitted by the mill are not by themselves responsible for the increased rainfall; maritime, warm cumulus, and warm stratus clouds; ambient CCN size distribution; CCN size distribution; 6% increase in rainfall; not considered significant; air pollution.

77H03
Hanson, M. A., 1977: Rank tests in weather modification experiments. Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 212-216.
Gamma fit; Wilcoxon rank sum test; sum of rank square test; Santa Barbara I.

77H04
Howell, W. E., 1977: Environmental impacts of precipitation management: Results and inferences form Project Skywater. Bull. Amer. Meteor. Soc., 58(6), 488-501.
Orographic; effect on precipitation in nearby areas; agriculture; hydroelectric power; water supply; runoff; seeding agents; social.

77H05
Hill, G. E., 1977: Evaluation of southern and central Utah cloud seeding program. Technical Report, Utah Water Research Lab., Utah State Univ., Logan, Utah, 34 pp.
Operational project; winter; predictors; 24-hour as unit; no significant seeding effect; 1966-1973 as historical; 1974-1975 seeded; relative humidity; correlation; ratio; rawinsonde; 21 statiosn; temperature; pressure; objective analysis; vorticity; regression; seasonal; snow augmentation.

77H06
Huff, F. A., and J. L. Vogel, 1977: Assessment of weather modification in alleviating agricultural water shortages during droughts. Final Report, Illinois State Water Survey, Urbana, IL, 133 pp.
Rainfall pattern; area depth relation; July-August drought; May-September drought; areal extent of rain; seasonal; rainfall initiation; raincell; diurnal; synoptic types; storm rainfall; METROMEX; intensity of daily rain.

77H07
Hobbs; P.V., L. F. Radke, and J. Stith, 1977: Cloud active nuclei from power plants. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urban, IL., 10-13, Oct., 73-74.
Three coal-fired and two gas-fired plants; CCN; droplet diameter; power plants are not significant sources of ice nuclei.

77K01
Kahan, A. M., 1977: A review of the hydrological aspects of evaluation of precipitation enhancement. World Meteorological Organization, PEP Report No. 4, 14pp.
Streamflow; PEP; high variability of natural flows; time dependence of successive river flows; accuracy of streamflow measurements; Kings River Basin; t test; sampling unit; Wolf Creck Pass; regression; Skagit River; statistical evaluation in general; measurement of snowfall; errors of measurement.

77K02
Kempthorne, O., 1977: Why Randomize? J. of Statist. Plann. and Infer., N-Holland Publ. Co. , 1-15.
How to analyze an experiment; completely randomized design; role of concomitant variables; randomization statistical tests.

77L01
Linkletter, G. 0., and J. A. Warburton, 1977: An assessment of NHRE hail suppressionseeding technology based on silver analysis. J. Appl. Meteor., 16(12), 1332-1348. (See 781106 for comment.)
Three seeded storms; 1974; AgI; radar; aircraft; precipitation network; radiosondes; 18 storms in 1973 and 1974; there may be serious difficulties in aassessing hail mass modification based on the silver content of the precipitation; cloud-based seeding; hail mass.

77M01
Mather, G. K., 1977: An analysis of a possible crop response to hail suppression seeding: The Neilspruit hail suppression project. J. Appl. Meteor., 16, 959-970. (See 78S03 for comment.)
South Africa; tobaco; cloud top seeding; AgI; propeller and jet aircrafts; use same technique as in Project Hailstop in Alberta; primary target area 5700 square miles, secondary target (Ohrigstad), control(Badplass); October 1970 to March 1977, seeding began in December 1971; hail day as unit: response variables - area hit, total damage, severity ratio; stem-and leaves display; Wilcoxon rank sum test; kappa-3 distribution.

77M02
Mielke, P. W. Jr., J. S. Williams, and S. C. Wu, 1977: Covariance analysis technique based on bivariate log-normal distribution with weather modification applications. J. Appl. Meteor., 16, 183-187.
Bivariate log-normal distribution; regression; seeded vs. non-seeded with historical and areal controls; t-test.

77M03
Meltesen, G. T., J. O. Rhea, G. J. Mulvey, and L. O. Grant, 1977: Certain problems in post-hoc analysis of samples from heteorogeneous populations and skewness distribution. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 388-391.
Study Climax downwind effect; robustness; chi-square test; sum of rank power test.

77M04
Mielke, P. W., Jr., 1977: The application of multi-responsw premutation procedures for identifying associations among synoptic measurements. Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 75-78.
1960-70 Climax Project; 1964-70 Wolf Creek Pass Project; wind was used to stratify observations into light and heavy groups; 24 hour as unit.

77M05
Mulvey, G. J, J. O. Rhea, G. T. Meltesen, and L. O. Grant, 1977: A post hoc analysis and a numerical simulation of a possible mechenism of extra-area effects from the Climax I & Climax II winter orographic seeding experiments. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 138-141.
Problems in the post hoc statistical analysis; Mulvey number; Wilcoxon rank sum test; 41 days; chi-square test; positive precipitation anomaly occurred 120-250 km downwind of the original target for the Climax I experiment; upslope stratification.

77M06
Mulvey, G. J., 1977: Physical mechanisms of extra area effects from weather modification. Report 276, Department of Atmospheric Science, Colorado State University, Fort Collins, CO, 138 pp.
AgI; ground generators; winter of 1974-1975 and 1975-1976; silver concentration; 240 km downwind; numerical models; review; 1-D steady state cloud model; urban aerosol; radar study; synoptic; Climax.

77M07
Maybank, J., 1977: needs. The scientific planning and organization of precipitation enhancement experiments, with particular attention to agricultural Technical Report 154, World Mteorologlcal Organization, Geneva, Switzerland, 88 pp.
Crop; need for weather modification; cloud resources; natural rainfall variability; social; randomization; random target-only; random target-control; crossover; evaluation in general; ratio; power of test; sample size; normal distribution; predictor; seedability; stratification; t-test; operation cost; cost-benefits bibliography.

77N01
Neyman, J., 1977: Experimentation with weather control and statistical problems generated by it. Applications of Statistics, ed. P. R. Krishnaiah, North-Holland Pub. Co., Amsterdam, 1-25.
Commercial projects; Grossversuch III; Israeli experiment; daily rainfall; Climax I; stratification; Whitetop; Arizona experiment.

77N02
Neyman, J., 1977: A statistician's view of weather modification technology (a review paper). Proc. Nat. Acad. Sci., 74, 4714-4721.
Drought; national policy; operational cloud seeding; strict randomization; historical; validity of the historical regression; bias in the selection of control; Whitetop; NAS-NRC; far-away effects; Pyramid Lake experiment; Colorado River Basin Pilot Project; NHRE; FACE.

77001
Orville, H. D., and F. J. Kopp, 1977: Numerical simulation of the life history of a hailstorm. J. Atmos. Sci., 34, 1596-1618.
Two-dimentional, time-dependent cloud model; Bergeron-Findeisen process.

77P01
Pellett, J. L., R. S. Leblang, and M. R. Schock, 1977: Evaluation of recent operational weather modification projects in the Dakotas. North Dakota Weather Modification Board , WMB Report 77-1, 54 pp.
Objective analysis; loss-cost ratio (annual), 1947-1975; monthly summer rain, 1941-1976; Wilcoxon 2 sample test; statewide program; mean rank test; ratio.

77P02
Pellett, J. L., R. S. Leblang, and M. R. Schock, 1977: A rainfall evaluation of the 1972-1976 South Dakota and 1976 North Dakota weather modification projects. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 392-395.
Statewide program; May through August; 1972-1976; objective analysis; 1941-1971 as historical; seasonal as unit; target-control ratios; mean rank test; months as unit.

77P03
Pielke, R. A., R. Biondini, and G. Mullen, 1977: Rainfall in the (Experimental Meteorology Laboratory) EML target area as a function of synoptic parameters. Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 196-200.
Horizontal gradients of rainfall; predicting convective rainfall; empirical predictors; surface level geostrophic wind speed and direction; convective instability; moisture deficiency; one-way ANOVA.

77P04
Phonsombat, V., and S. K. LeDuc, 1977: Comparison of kappa and gamma distribtuions for wekly rainfall amounts in Thailand.
Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 221-224.
Fitting of precipitation; seeding in 1954-1973; kappa-3 fit best; kappa-2; Kolmogorov-Smirnov test.

77P05
Pollitte, F. E., M. D. Hale, and D. A. Mathew, 1977: The Bureau of Reclamation's Environmental Data Net Work. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 362-364.
NWS rawinsonde; Great Plains Cumulus model.

77R01
Rosenzweig, P. N., 1977: On statistical methods for evaluating seeding experiments. Technical Report, Department of Environmental Sciences, Univ. of Virginia, Charlottesville, VA, 129 pp.
Log-normal; Weibull; gamma; FACE; 1970-1973; extreme observations; sample size; predictors; seeding factor; confidence limits; simulation.

77R02
Radke, L. F., and P. H. Herzegh, 1977: Natural cloud seeding with accompanying release of precipitation. Beitrage Phys. Atmos., 50, 488-495.
Glaciated region; supercooled stratocumulus; cloudtop temperature; cirrostratus; CYCLES project; ice nuclei; Washinton State; rawindsondes; 1973; B-23 aircraft; weather radar; echo.

77S01
Smart, G. R., 1977: Weather modification in North Dakota.
Hail Suppression: Society and Environment, B. C. Farhar (ed.), institute of Behavioral Science, university of Colorado, 61-79.
History; social; legislative action; statewide program.

77S02
Schickedanz, P. T., and R. Y. Sun, :1977 Statistical techniques for the incorporation of covariates into the design and evaluation of HIPLEX.
Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 230-233.
Upper air soundings; surface (objective) field; NWSradar chart; prior and surrounding precipitation; synspec vs progspec; 29300 square mi.; Dodge City; 1965-70, May-Sept.; factor analysis (R-type); principal component analysis; stepwise discriminant analysis to predict rain and no rain days using principal components derived; jackknified classification.

77S03
Schickedanz, P. T., and M. B. Busch, 1977: Statistical design and evaluation of HIPLEX. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 319-322.
Single cloud experiment; day; storm; sampling unit; recommend that experimental unit for the single cloud experiment to be the storm and day and the sampling unit be the individual cloud; discuss the advantages and disadvantages of using storm as sampling unit; discuss the usage of discriminant analysis.

77S04
Schickedanz, P. T., 1977: Extra-area effects from inadvertent weather modification. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 134-137.
Evaluation in general; urban-industrial; rainfall; thunder-day increases; increases in the frequency of hail-days; several midwestern cities; irrigated-related anomalies; Great Plains; factor analysis; mechanisms for urban areas; mechanisms for irrigated areas; urban effects; the warm season rainfall increase maximized 16-56 km downwind of the cities and corresponded closely with the hail peak.

77S05
Schickedanz, P. T., and E. G. Bowen, 1977: The computation of climatological power spectra. J. Appl. Meteor., 16(4), 350-369.
Fast Fourier Transform; discrete Fourier transform; variable record length technique; non-integer technique; problem of resolution; F test; t test.

77S06
Sonka, S. T., and S. A. Changnon, Jr., 1977: A methodology to estimate the value of weather modification projects. An illustration for hail suppression. J. Appl. Meteor., 16, 677-682.
Data needed to evaluate seeding technology (economical view): 1. Relationship between benefits and change in physical factors due to seeding; 2. Probability distribution of changes in physical facators; 3. cost of development and operation.

77S07
Schickedanz, P. T., 1977: Applications of factor analysis in weather modification research. Fifth Conf. on Prob. and Statist. in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 190-195.
Effects of irrigation on climate; factor analysis; effects of urban-industrial areas on precipitation; METROMEX; pressure tendency; predictor variables; principal component regression; stepwise multiple discriminant analysis; jackknifed classification; Kansas; Nebraska; Colorado.

77S08
Schickedanz, P. T., M. B. Busch, and G. D. Green, 1977: METROMEX raincell studies for 1971-1975. Sixth Conf. on Planned and Inadv. Wea. Mod., Amer. Meteor. Soc., Urbana, IL., 10-13, Oct., 57-60.
Delineation of effect and non-effect cells; total rain production of cells; Thunderstorm Porject (Ohio); cell occurring in the urban-industrial areas produced the largest percentage increases with respect to the control cells; 125% for St. Louis; 211% for St. Louis-Industrial; 77% for Wood River; 75% for the Hills, and only 12% for the Bottonlands; stratied by cell path length.

77S09
Smith, T. B., S. M. Howard, and R. L. Peace, 1977: Radar evaluation of Big Spring weather modification program. Technical Report MRI 75 FR-1380, Meteorology Research, Inc., Altadena, CA, 50 pp.
1973-1974; summer; M33 dual-wave length radar; 25% unseeded; cloudtop height; areal extent; rain intensity; results are not statistically significant; airborne pyrotechnic seeding; randomized; AgI; raingage network; Z-R relation; gage- and radar-estimated rainfall; case studies; cloud depth; areal rain; problems of evaluation.

77S10
Schickedanz, P. T., P. V. Reddy, and S. A. Changnon, 1977: Spatial and temporal relationships in crop-hail loss data. Final Report, Illinois State Water Survey, Urbana, IL, 75 pp.
Loss-cost; loss; liability; hail day; interstate and intrastate studies; Kansas; Nebraska; North Dakota; canonical correlation analysis; trend; 19-state area; annual; factor analysis; spectral analysis.

77S11
Smith, E. J., L. G. Veitch, D. E. Shaw, and A. J. Miller, 1977: A cloud-seeding experiment in Tasmania 1964 - 1970. Final Report, Division of Cloud Physics, Commwealth Science and Industrial Research Organization, Australia, 120 pp.
Seeding operation; seeding suspension; stratified by season; rainfall measurement; double ratio; regression; transformation; scatter plot; 1944-1963 as historieal; data listing; F-test; permuation test; principal component

77S12
Schaek, M. R., 1977: Upper Midwest Weather Modification Activities. Report UND-77-2, Department of Aviation, University of North Dakota, Grand Forks, ND, 85 pp.
Decision theory; evauation; 1951-1976; North Dakota; South Dakota; Minnesota; design; extented-area effect; delivery system; environmental; bibliography.

77S13
Smith, T. B., and S. M. Howard, 1977: Radar evaluation of 1975 Colorado River Municipal Water District seeding. Technical Report MRI 77 FR-1485, Meteorology Research, Inc., Altadena, CA, 35 pp.
Big Spring project; summer of 1975; 30 case studies; M-33 dual-wave length radar; AgI; problems of evaluation; 131 gages; Z-R relation; echo top temperatur; cloud depth; araeal rain.

77S14
Serfling, R. J., 1977: Toward a nonparametric covariance analysis of a weather modification experiment. Technical Report M428, Dept. of Statistics, Florida State University, 13 pp.
Temporal ratio; stratified by stability of the convective band, and by the 500 mb temperature; difference; target-control; data is insufficient to arrive conclusion.

77T01
Tag, P. M., 1977: A numerical simulation Of warm fog dissipation by electrically enhanced coalescence: Part II charged drop seeding. J. Appl. Meteor., 16(7), 683-696.
Highly charged water drops; multi-level microphysical model; degree of visibility improvement; inconclusive result; evaluation; summers of 1975 and 1976 at Arcata, Calif.; DC-4; hygroscopic seedings.

77W01
Woodley, W. L., J. Simpson, R. Biondini, and J. Berkeley, 1977: Rainfall results, 1970-1975, FACE. Science, 195, 735-742.
FACE; dynamic seeding; seeding hypothesis; single-cloud seeding; stratified by echo motion; covariates; regression; rain intensity.

77W02
Williams, J. S., 1977: The design and analysis of weather modification experiments with stationary multivariate residuals.
Fifth Conf. on Prob. and Statist, in Atmos. Sci., AMS, Las Vegas, Nevada, Nov., 226-227.
Kings River Basin runoff study; linear model; additive changes; four hypotheses; contamination effects; direct effects; generalized likelihood ratio test; optimum design; continuous historical target-control design; crossover design; augmented covariate design; balanced switch-back design.

78A01
Arking, S., R. C. Lo, and A. Rosenfeld, 1978: A Fourier approach to cloud motion estimation. J. Appl. Meteor., 17, 735-744.
Cross-spectral density; phase difference is relatively sensitive to the presence of mixtures of motions, changes in cloud shape and edge effects; Fourier transform; simulation; phase difference method applied; cross-covariance method; ATS-1 geosynchronous satellite images.

78A02
Alkezweeny, A. J., 1978: Measurement of aerosol particles and trace gases in METROMEX. J. Appl. Meteor., 17(5), 609-614.
Measurements of particle size distributions at a fixed ground site; Cessna-411 aircraft; DC3 aircraft; Aitken nuclei; chemical composition of sulfate.

78A03
Ackerman, B., S. A. Changnon, Jr., G. Dzurisin, D. L. Gatz, R. C. Grosh, S. D. Hilberg, F. A. Huff, J. W. Mansell, H. T. Ochs, III, M. E. Peden, P. T. Schickedanz, R. G. Semonin, and J. L. Vogel, 1978: Summary of METROMEX, Volume 2: Causes of precipitation anomalies. Bulletin 63, Illinois State Water Survey, Urbana, 394 pp.
Raincell; factor analysis; discriminant analysis; mergers; varimax rotation; bias; stratification by cell movement, surface airflow, 850 mb airflow, 700 mb airflow; synoptic type; stratification by path length: stratification

month, year; 811% over the control, occured in cells that developed and/or over passed the St. Louis industrial area, and largest increases in raincell volume occurred with squall zones and squall lines.

78B01
Brown, B. G., 1978: Experimental design in weather modification: The value of stratification. Technical Memorandum 3, Department of Environmental Sciences, Univ. of Virgina, 158 pp.
Randomized block design; FACE, 1970-1976; evauation; completely random factorial design; simulation; stratified by mean layer wind speed and direction, and echo motion; ANOVA; sample size; bivariate gamme distribution; normal distribution; binomial distribution; Mann-Whitney test; computer program; bibliography.

78B02
Braham, R. R. Jr., and M. J. Dungey, 1978: A study of urban effects on radar first echoes. J. Appl. Meteor., 17(5), 644-654.
3 cm radar; a sample of 4553 first echoes; 1972-75; area-normalized frequency of first echo formation over the city and in the "near" downwind region is approximately a factor of 2 greater than for nearby rural regions; temperatures of first echo tops and bases indicate that precipitation initiation is most frequently through drop collection; METROMEX; wind direction partitions.

78B03
Bradley, R. A., and C. M. Yeh, 1978: Trend-free block designs: Theory. Technical Report M453, Dept. of Statistics , Florida State Univ., Tallahassee, FL, 19 pp.
Optimality of TFB design; estimability; connectedness; ANOVA.

78B04
Bradley, R. A., S. S. Srivastava, and A. Lanzdorf, 1978: An examination of the effects of cloud seeding in phase I of the Santa Barbara convective band seeding test program. Technical Report M467, Dept. of Statistics , Florida State Univ., Tallahassee, FL, 67 pp.
Regression; interactions; seeding factor; ANOVA; covariance analysis; 12 covariates.

78C01
Crow, E. L., 1978: Confidence limits for seeding effect in single-area weather modification experiments. J. Appl. Meteor., 17, 1652-1660.
NHRE 1972 to 1974; likelihood ratio test; ratio of means; lognormal and normal distributions.

78C02
Czelnai, R., and E. Wirth, 1978: Hail-suppression experiment in Hungary. WMO Bull., 27(3), 167-169.
Moldavian (U.S.S.R.) method; HEX; three-year; 1976-1977; agricultural; State Insurance Company; 11 rocket-launching stations; 1500 square km in the Villany vineyard region; X-band, MRL-1 type radar; S-band radar; the first two years of HEX operations seem to be successful; cost/benefit evaluations even; hail cubss; crop loss; loss-cost; target area compared to the whole country; continuous target-control.

78C03
Carte, A. E., and G. Held, 1978: Variability of hailstorms on the South African Plateau. J. Appl. Meteor., 17(3), 365-373.
Frequency of hail occurrence; ratios of areal to point frequencies; hail days; duration; amount of hail; size distribution of hailstones; hail paths; relationship between echo heights and probability of hail.

78C04
Changnon, S. A., Jr., 1978: Urban effects on severe local storms at St. Louis. J. Appl. Meteor., 17(5), 578-586.
METROMEX; localized increases were found in various thunderstorm characteristics (about +10 to +115%), in hailstorm conditions (+3 to +330%), in various heavy rainfall characteristics (+35 to +100%) and strong gusts (+99 to +100%); synoptic weather types; urban-induced factors alter the microphysical and dynamic properties of clouds and storms; frequency of hail periods; pattern of point hailfall frequencies; tornadoes.

78C05
Court, A., M. Berg, S. R. Frank, and D. Shiroma, 1978: Results of northern California weather modification project. Technical Report , ESCA-Tech Corporation, Playa del rey, CA, 44pp.
13 flight during Jan. 11 to Feb. 6, 1978; more precipitation fell in target than controls during 8 flights, for 3 flights targets had no precipitation, and no precipitation fell in target nor control during 1 flight; how much the precipitation was increased, if at all, by seeding cannot be estimated with any confidence: differences or ratios of precip. inside and outside each EAPE cannot be trusted to indicate effects.

78C06
Cook, R. D., and N. Holschuh, 1978: Statistical design for the evaluation of cloud seeding in Minnesota. Technical Report, Department of Applied Statistics, University of Minnesota, Saint Paul, MN, 50 pp.
Problems with non-randomized operations; benefit of randomization; Whitetop; bibliography; problems with historical regression; selection bias; review of seedin effects in many projects; design; experimental unit; measurements of rainfall and hail; covariates; extended area effect; persistence; restricted randomization; randomized block design; crossover; hypothesis testing.

78D01
Davis, A. W., and L. G. Veitch, 1978: Approximate confidence intervals for nonlinear functions, with applications to a cloud-seeding experiment. Technometrics, 20(3), 227-230.
Tasmania project; simulation; Bayesian; regression.

78D02
Davis, L. G., 1978: Operational weather modification prospects. Weather Modification: Technology and Law, R. J. Davis and L. O. Grant, eds., Western Press, CO., 11-21.
Weather modification in general; Libyan Arab Republic -- 1971-72 project; Republic of South Africa -- 1971-76 project; Republic of Zaire -- 1974-75 project; Central Illinois - 1976 project.

78D03
Decker, W. L., 1978: Operational weather modification: Prospects. Weather Modification: Technology and Law, R. J. Davis and L. O. Grant, eds., Western Press, CO., 23-27.
Need proof of precipitation increase; application of inappropriate cost-benefit analysis; NationalResearch Council; soil moisture; credibility of the meteorological science.

78E01
Elliott, R. D., R. W. Shaffer, A. Court, and J. F. Hannaford, 1978: Randomized cloud seeding in the San Juan Mountains, Colorado. J. Appl. Meteor., 17, 1298-1318.
24 hour as experimental unit; snow; no significant difference between precipitation; positive seeding effects may have been achieved during periods of warm cloud-top temperatures; hydrologic streamflow model; annual runoff; Colorado River Basin Pilot Project; 1970-71 through 1974-75; Climax; 33 ground-based AgI smoke generators; nucleation; Mann-Whitney rank-sum test; stratifications by lifted cloudtop temperature.

78F01
Farhar, B. C., 1978: What does weather modification need? A societal view. J. Appl. Meteor., 17, 878-888.
Cltizon surveys between 1968-1976; environmental concern; regulation of weather modification; extra-area effects; water rights; weather modification Industry; METROMEX; evaluation of operational projects; operational readiness of 12 weather modification technologies.

78F02
Fosse, E. R., 1978: What weather modification needs: An insurance perspective. J. Appl. Meteor., 17, 876-877.
Need to evaluate experimental and commercial projects.

78F03
Flueck, J. A., 1978: The role of statistics in weather modification experiments. Atmosphere-Ocean, 16(4), 337-395.
Statistics as a science of performing science; comparison between experimentation and data analysis; 6 states, 8 components of an experiment, and their interaction; Bayes theorem; hypothesis; model; natural variability; prescreening, blocking; concomitant information; replication; multiplicity; Climax I and II; Whitetop; Israel I and II; FACE I; Grossversuch III; clinical trial; University Group Diabetes Program; introducing the term Meteometrics.

78G01
Gabriel, K. R., and J. Neumann, 1978: A note of explanation on the 1961-67 Israeli rainfall stimulation experiment. J. Appl. Meteor., 17, 552-554.
Unit of experimentation; design.

78H01
Hill, G. E., 1978: Development and application of a prediction control for the evaluation of a winter orographic cloud seeding project. J. Appl. Meteor., 17(4), 489-497.
Transformation; regression.

78H02
Hobbs, P. V., and A. L. Rangno, 1978: A reanalysis of the Skagit cloud seeding project. J. Appl. Meteor., 17, 1661-1666.
Skagit River Basin, Washington; 1960; runoffs; show no significant effects due to seeding; regression.

78H03
Howell, W. E., 1978: Night versus day cloud seeding in Langmuir's periodic experiment. J. Appl. Meteor., 17(12), 1753-1757.
28-day cycles; periodicity of precipitation; periodicity of temperature; three generators; periodic historical target-control design; 15 regions; correlation; sinusoidal-wave; Fisher-Yates (1948) ordinal scores; Mann-Whitney rank test; nighttime-seeded cycles did indeed have a stronger 7-day periodicity of precipitation and associated temperature aloft than did either the daytime-seeded or the nonperiodic-seeded.

78H04
Held, G., 1978: The probability of hail in relation to radar echo heights on the South African highveld. J. Appl. Meteor., 17, 755-762.
S-bandradar; the mean of the maximum heights of hail-producing cells was found to be 6.3 km AGL for the 40 dBZ contour and 9.1 km for echo tops; the mean temperature in the free atmosphere at echo top height was -37C for hail-producing cells and -20C for rain-producing cells.

78H05
Holroyd, E. W. III, A. B. Super, and B. A. Silverman, 1978: The practicability of dry ice for on-top seeding of convective clouds. J. Appl. Meteor., 17(1), 49-63. (See 78H08 for comment.)
Crystal concentrations; Australia; HIPLEX; dry ice pellet sizes; dry ice sublimation rate; Aero Commander aircraft; B-23.

78H06
Henderson, T. J., 1978: What does weather modafication need? A view from the operational level. J. Appl. Meteor., 17(6), 889-894.
Societal scene; weather modification credibility; legal influence; evaluations; political aspects.

78H07
Huff, F. A., and J. L. Vogel, 1978: Urban, topographic and diurnal effects on rainfall in the St. Louis region. J. Appl. Meteor., 17(5), 565-577. (for comment, see 79B02.)
17 areas; METROMEX; urban enhancement maximized northeast of the St. Louis urban-industrial complex where it was computed to be approximately 30-35%; bluffs effect was calculated to be approximately 14%; hill effect was 9% for all rainstorms; diurnal distributions; t-test; spatial variations.

78H08
Hobbs, P. V., L. F. Radke, and M. K. Politovich, 1978: Comments on "The practicability of dry ice for on-top seeding of convective clouds". J. Appl. Meteor., 17(12), 1872-1874. Reply. Holroyd, E. W. III, A. B. Super, and B. A. Silverman, 1874-1876.
HIPLEX; ice particle concentration; instrumentation; seeding rates; conclude that the IPC aboard the B-23 aircraft during the 1976 HIPLEX was operating correctly but the IPC aboard the Aero Commander was unreliable.

78H09
Havens, B. S., J. E. Jiusto, and B. Bonnegut, 1978: Early history of cloud seeding. Langmuir Lab., New Mexico Inst. Mining and Tech., Socorro, NM, 75 pp.
Project Cirrus; first man-made snowstorm in 1946; stratus clouds; New Mexico (1948-1949); AgI; dry ice; periodic seeding; harricane.

78K01
Knight, R. W., 1978: An application of rank-order statistics to the study of hurricane variabiblity. J. Appl. Meteor., 17, 358-364.
Kendall's coefficient of concordance W; Kruskal-Wallis test; Jonckheere's trend test.

78K02
Knight, R. W., and G. W. Brier, 1978: A technique for evaluating the effectiveness of hurricane modification experiments. J. Appl. Meteor., 17, 222-227.
Randomization in time; Project Stormfury; hypothesized sequence and timing of events; time intervals within storms are proposed as the experimental units for evaluation; truncated normal distributions; temperature; dew point; pressure; B-score probabilities.

78K03
Kostecki, D. F., 1978: Weather modification activities in Kansas 1972-1977. Kansas Water News, Irrigation Issue, 21(1 2), The Kansas Water Reso. Board, Topeka, KS, 35-45.
KANCUP project; Muddy Road project; HIPLEX; radar echo; measurement of silver in rainwater; added rainfall effects study; variable seeding effect model.

78M01
Mielke, P. W. Jr., 1978: On criticism concerning the Israeli experiment. J. Appl. Meteor., 17, 555-556.
Time of the day precipitation was measured; squared rank and Wilcoxon tests applied to the complete set of 85 declared experimental units; Climax I.

78R01
Reynolds, D. W., T. H. von der Harr, and L. O. Grant, 1978: Meteorological satellites in support of weather modification. Bull. Amer. Meteor. Soc., 59(3), 269-281.
Cloud climatologies; HIPLEX; to aid in the "nowcasting" of target site conditions; evaluation; eliminate bias; radar; reflected cloud brightness; estimate rainfall; verification of cumulus cloud models; extra-area effects; opportunity recognition.

78R02
Rokicki, M. L., and K. C. Young, 1978: The initiation of precipitation in updraft. J. Appl. Meteor., 17, 745-754.
Optimal ice crystal concentrationis estimated to be between 100 and 1000 crystals per litter; large drops is more efficient than AgI when cloud base is warmer than 0°C.

78S01
Silverman, B. A., 1978: What do we need in weather modification? J. App. Meteor., 17, 867-871.
Precipitation management; atmospheric resource management; research vs. operational projects; OSET.

78S02
Sharon, D., 1978: Rainfall fields in Israel and Jordan and the effect of cloud seeding on them. J. Appl. Meteor., 17, 40-48.
Spatial correlation functions; direction of storm movement; an average increase of about 10 km in the dimensions of rainfall areas on seeded days; the size of rainfall areas is one of the fundamental factors controlling regional variations of rainfall as well as variations resulting from cloud seeding; downwind effect; 1960-67; rainfall duration.

78S03
Summers, P. W., 1978: Comments on "An analysis of a possible crop response to hail suppression seeding: the Nelspruit Hail suppression project". J. Appl. Meteor., 17, 1084-1090. Reply by Mather, G. K., 1090-1094.
Question of historical period as control; mean annual severity ratio; bias; economic effect; results shows that a 19-33% increase in the area hit by hail; while the area damaged to 100% remain constant.

78S04
Swanson, E. R., 1978: Weather modification: The economic context. J. Appl. Meteor., 17(6), 872-875.
Two types of agricultural production technology -- mechanical (labor-saving) and biological-chemical (land-saving); risk analysis.

78S05
Swanson, E. R., S. T. Sonka, C. R. Taylor, and P. J. van Blokland, 1978: An economic analysis of hail suppression. J. Appl. Meteor., 17(10), 1432-1440.
Two levels of hail suppression technology; USA in 1985 and 1995; benefit cost/ratios; TASH; estimates of crop losses; agriculture; wheat; corn; soybean; cotton; tabacco; simulated model; Great Plains area.

78S06
Simpson, J., 1978: What weather modification needs--A scientist's view. J. Appl. Meteor., 17(6)858-866.
Need greater credibility of weather modification in the scientific community; Santa Barbara experiment; predictors stratifications; environmental impacts; water resource management approach; solar energy; radiation alteration; alteration of the sea-air interface.

78S07
Sonka, S. T., 1978: The economic of weather modification: A review and suggestions for future economic analysis. J. Appl. Meteor., 17(6), 778-785.
A review; precipitation augmentation; lightning suppression; fog suppression; hurricane modification; hail suppression; viewpoint encompassing total economic activity; benefit-cost ratios; corn and soybean yield losses; weather-related losses.

78S08
Stidd, C. K., 1978: Evaluation of cloud seeding in California, July through September 1977. Final Report, San Diego, CA, 99 pp.
July 20-September 28, 1977; visual; operational; 20 out of 47 cases showed evidence of rain increases.

78S09
Scott, E., 1978: Data summarization in a weather modification experiment: III. A multivariate analysis. Technical Report M442, Dept. of Statistics , Florida State Univ., Tallahassee, FL, 27 pp.
Principal components on target and control respectively MANOVA to test uniformity of stations included and excluded using longitude, latitude and height of stations; results not significant.

78U01
Ulanski, S., and M. Garstang, 1978: Some aspects of Florida convective rainfall. Water Res. Research, 14(6), 1133-1139.
Networks of raingages on area of 660 square miles; summers of 1971 and 1973.

78V01
Vardiman, L., and J. A. Moore, 1978: Generalized criteria for seeding winter orographic clouds. J. Appl. Meteor., 17, 1769-1777.
Combined 7 randomized winter orographic projects; Rocky Mountain West; Pacific coast; Bridger Ranger Experiment in Montana; Climax; Colorado River Basin Pilot Project; Central Sierra Research Experiment in California (CENSARE); Jemez Project in New Mexico; Pyramid Lake Pilot Project in Nevada; Santa Barbara II; Precipitation, rawinsonde, seeding generator data; seed/noseed ratio; two sample Wilcoxon test; 4 stratification variables--barrier trajectory index, saturated mixing ratio at cloud base, lifted cloud-top temperature with respect to ice, and positive energy area; positive and negative seeding effects.

78V02
Vogel, J. L., and F. A. Huff, 1978: Relation between the St. Louis urban precipitation anomaly and synoptic weather factors. J. Appl. Meteor., 17(8), 1141-1152.
METROMEX; cold front conditions with the major convective entities moving from the southwest, and squall lines with any storm motion were associated the most intense rainstorms over the raingage network, and these storms were also largely responsible for the rainfall anomaly; the rainfall pattern based on air mass storms did not indicate any significant urban enhancement of rainfall; study of squall zone storms suggested possible reducton of rainfall in the urban region.

78W01
White, J. M., F. D. Eaton, and A. H. Auer, Jr., 1978: The net radiation budget of the St. Louis metropolitan area. J. Appl. Meteor., 17(5), 593-599.
METROMEX; solar noontime albedo values varied from 15-17% for rural land uses in contrast to 12-13% for most urban land uses; vegetative coverage.

78W02
Weather Modification Advisory Board. 1978: The management of weather resources. Volume I, "Proposals for a national policy and program". Report to the Secretary of Commerce, Dept. of Commerce, Washington, D. C., 229 pp.
Role of statistics; statistical design; downwind effects; hail suppression; operational; evaluation; drought relief; unintended weather modification; legal; political; economic; benefits and costs; environmental; federal-state-local programs.

73W03
Weather Modification Advisory Board. 1978: The management of weatherresources. Volume II, "The role of statistics in weather resources management". Report of the Statistical Task Force, Dept. of Commerce, Washington, D. C.
Randomization; exploratory; confirmatory; piggyback; blindness; covariates; blocking; evaluations; FACE; NHRE; Colorado River Basin; Israeli II; A;berta hail; Santa Barbara II; South Africa hail; North Dakota; Tasmania; remote effect; inadvertent modification; OJR blocking; re-randomization; two-stage randomization; robust resistant summaries; design; crossing over; experimental units; zero average effect; orthorgonal arrays; issues of multiplicity; complete orthogonal arrays; weeded orthogonal arrays.

78W04
Woodley, W. L., R. I. Sax, J. Simpson, R. Biondini, J. A. Flueck, and A. Gagin, 1978: The FACE confirmatory program (FACE-2): Design and evaluation specifications. NOAA Technical Memorandum ERL NHEML-2, Coral Gables, FL, 51 pp.
Need for confirmatory experiment; detailed design elements; facilities; data quality; radar and raingage estimation of rainfall; C-band CAPPI radar; dynamic seeding; exploratory analyses; seeding hypothesis; data collection and procesing; lightning discharge; echo height; mean layer wind; sample size; blocked randomization; double-blind experiment; seeding procedure; areal seeding; day as unit; seedability; AgI; rainfall in floating and total targets; randomization test; Wilcoxon test; t-test; F-test; Siegel-Tukey test.

79A01
Achtemeler, G. L., and P. T. Schickedanz, 1979: On the temporal decay of the relationship between environmental covariates and convective rainfall for the Kansas high plains. J. Appl. Meteor., 18(12), 1679-1683.
HIPLEX; areal average daily rainfall; 22 precipitation stations located within a 175 km square centered over Dodge City; 136 covariates; based on historical data for Junes 1958-70; precipitable water; saturation deficit; convective temperature; height; warm convective depth; mixing ratio; dewpoint; equivalent potential temperature; wind speed; wind direction; surface pressure; 3h area average rainfall; stability; dynamic trigger.

79A02
Achtameler, G. L., 1979: Planned weather modification and the severe weather threat in the central high plains. J. Appl. Meteor., 18(3), 348-354.
June daily rainfall; severe weather related operations suspensions; results show that anywhere from 45-87% of the June rain can fall when operations have been suspended; tornadoes; HIPLEX.

79A03
Ackerman, B., R. C. Grosh, and R. Y. Sun, 1979: Assessing Midwest cloud characteristics for weather modification. Final Report, Illinois State Water Survey, Urbana, IL, 128 pp.
METROMEX, 1973; 16 cloud penetrations; June 11 to July 30; average total liquid water; max. LW; cloud water; max. CW; vertical velocity; thermal buoyancy; cloud traversed; cloud unit; histogram; ANOVA; stratification var. - cloud types, synoptic conditions, low-level air mass types, lapse rates; wind shear, cloud length, cloud base temperature.

79B01
Bradley, R. A., S. S. Srivastava, and A. Lanzdorf, 1979: Some approaches to statistical analysis of a weather modification experiment. Commun. Statist.-Theor. &Meth., A8(11), 1049-1081.
Regression; contamination; Santa Barbara I; convective band; trasformation; 12 cloud-physics covariates; blocking; 1967-1971; randomized; AgI; ground generators; 51 unseeded, 56 seeded; simple average; response surface; ANOCOVA; F-test; two-sample t-test; two-sample Hotelling test.

79B02
Braham, R. R. Jr., 1979: Comments on "Urban, topographic and diurnal effects on rainfall in the St. Louis". J. Appl. Meteor., 371-375, Reply by Huff, F. A., and J. L. Vogel, 375-378.
METROMEX; two assumptions: one about acceptable reduced sampling uncertainty, the other about selected study areas; average summer rainfall for the 1941-69 period; sampling variability.

79B03
Braham, R. R. JR., 1979: Field experimentation in weather modification. J. Amer. Statist. Assoc., 74(365), 57-68.
Interation and collaboration between meteorologists and statisticians; experiment design; Project Whitetop; 1960-1964; cloudbase seeding; 2.7 Kg AgI per hour; randomization by days; Wilcoxon Mann-Whitney test; standardized difference between two means; multiplicity; seeding effect was found to vary with the maximum heights of clouds; downwind effect; large clouds were overseeded; clouds of intermediate size probably were benefited by seeding; unbalanced randomization; Climax; San Juan Project; FACE; METROMEX.

79B04
Bradley, R. A., and E. Scott, 1979: Randomization tests in support of some statistical analyses of a weather modification experiment. Technical Report M521, Dept. of Statistics , Florida State Univ., Tallahassee, FL, 16 pp.
Multiplicity; Santa Barbara; ANOVA; F-test; t-test; exploratory vs. confirmatory; transformation; statistics in general.

79B05
Breuer, B., 1979: Weather modification: Prospects and problems. Cambridge University Press, London, 178 pp.
History; rain; fog; hail; Soviet method; hurricane; cost-benefit; social; ecological; legal; international problem; cloudtop temperature.

79C01
Changnon, S. A. Jr., F. A. Huff, and C. F. Hsu, 1979: On the need to evaluate operational weather modification projects. Bull. Amer. Meteor. Soc., 60(7), 770-774.
Statistical Task Force; Kansas; regression; ANOCOVA; ANOCOVA (nonparametric); sum of rank power test; principal component regression; canonical correlation analysis; factor analysis; double ratio.

79C02
Cooter, W., and A. Eddy, 1979: Evaluation of operational cloud seeding in North Dakota: some results. Seventh Conf. on Inadv. and Planned Wea. Mod., Amer. Meteor. Soc., Banff, Canada, 8-12, Oct., J15-J16.
Statewide program; linear regression; 24-hour precipitation; crop yield; wind direction as a covariate; natural variability of rainfall.

79C03
Changaon, S. A. Jr., and B. Ackerman, 1979: A new weather modification experiment designs for midwestern agriculture.
14th Conf. on Agr. & Forest Meteor., and 4th Conf. on Biometeor., AMS, April 2-6, Minneapolis, 45-46.
PACE, florida; summer rainfall; 3 phases of PACE; pre-experimental, experlmental, assessment and technology transfer; indicate stronger, more organized updrafts at the -10 C level, and only minor reductions of water with height and the. presence of lots of water needed for converting water to ice by seeding.

79C04
Changnon, S. A. Jr.,'1979: Histroy of planned weather modification activities and research at the Illinois State Water Survey, 1947-1978. J. Wea. Mod., 11(1), 156-165.
Whitetop; natural rainfall variation; design, verification and evaluation of weather modification; area-depth curve; rain rate; radar; project Hailswath; DESH; NHRE; economical, agricuture; social studies; legal; PEP; METROMEX; extra-area; HIPLEX; PACE; TASH; NOAA; operational projects.

79C05
Crow, E. L., A. B. Long, J. E. Dye, A. J. Heymsfield, and P. W. Mielke, Jr., 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part II: Surface data base and primary statistical analysis.
J. Appl. Meteor., 18(12), 1538-1558.
No effect of seeding is detected at the 10% significance level whether hail or rainfall response variables are considered; daily; ratios; large natural variance; hail mass; area of hailfall; hail kinetic energy; number of hailstones; rain mass; re-randomization analysis; two methods to calculate daily values of the various seeding response variables; for the entire target area; objective analysis; lognormal; gamma; kappa(3); test of independence of daily response data; confidence interval; analysis of variance; seeding effect on frequencies of zero days; rank power statistics.

79C06
Crow, E. L., A. B. Long, J. E. Dye, and C. W. Ulbrich, 1979: Results of a randomized hall suppression experiment in northeast Colorado. Part III: Analysis of hailstone size distributions for seeding and yearly effects.
J. Appl. Meteor., 18(12), 1559-1568.
Statistically significant results only for 1974; hailpads; yearly empirical hailstone size distributions; chi-squared test; binomial distribution; Gauss-Markoy theorem; confidence Intervals; modifled Fisher F test; exponential diatributions; Welch-Aspin modified Student t-test.

79C07
Changnon, S. A. Jr., 1979: Rainfall changes in summer caused by St. Louis.
Sclence, 205(4404), 402-404.
urban influences on summer precipitation conditions; 75% of the 16 rain patterns revealed a rainfall maximization downwind of the city; 22.7% more raiafall; low-lvel winds; urban plume; 302 individual rainfall events; monthly rain; binomial test; one-sample Wilcoxon test.

79C08
Changnon, S. A. Jr., and R. G. Semonin, 1979: Impact of man upon local and regional weather. Reviews Geophys. and Space Phys., 17(7), 1891-1900.
A review; inadvertent weather modification in general; METROMEX; Regional Atmospheric Pollution Study (RAPS); CAP; Multi-State Atmospheric Power Production Pollution Study (PAPPS); Sulfur Regional Experiment (SURE); Sulfur Transport And Transformation Experiment (STATE); acid rainfall.

79C09
Changnon, S. A., Jr., 1979: Agricultural impacts and adjustments from inadvertent precipitation modification in the St. Louis area.
Fourteenth Conf. on A ric. and Forest Metero., Minneapolis, 2-6 April, AMS, 49-52.
Urban climatoloty; heat island; METROMEX; hailstorms; double target-control analysis; corn and soybean data; 1930-1946 as no effect period, 1961-1976 as effect period; gain of 4.9 bu/acre in dry summer, and 2.3 bu/acre in wet summer; pollution; social and economic impacts; water supplies.

79C10
Changnon, S. A., Jr., 1979: The statistical and physical design and evaluation of precipitation enhancement projects. Workshop on Wea. Mod., Spain, WMO, 122-135.
A review of past major precipitation experiments; history; 17 projects; experimental unit; Climax; Israeli; design elements; evaluation elements; data requirement; Necaxa Project; Whitetop; Arizona; Rapid City Project; North Dakota Pilot Project; FACE I; Nonarch and Wolf Creek; Park Range; Colorado River Basin Pilot Project; Tasmania; Santa Barbara Phase 1.

79C11
Changnon, S. A., Jr., F. A. Huff, 1979: Review of the social, environmental, and legal aspects of precipitation modification in Illinois. Report, Illinois State Water Survey, Urbana, IL, 79 pp.
Agriculture; weather-caused crop yield loss; desirable corn and soybean weather; economics; 8 seeding effect models; hail suppression and rain enhancement; METROMEX; silver in precipitation; streamflow

79C12
Changnon, S. A., Jr., D. F. Gatz, A. R. Jameson, G. L. Dzurisin, R. W. Scott, and R. C. Grosh, 1979: Studies of urban and lake influences on precipitation in the Chicago area. Final Report, Illinois State Water Survey, Urbana, IL, 190 pp.
Temporal trends; synoptic types; rainfall pattern; thunderstorm characteristics; satellite; cloud distribution; echo top height; HOT radar; reflectivity; raincell; 1976-1978; La Porte anomaly; on the average, Chicago received 15% more rainfall in the summer.

79C13
Changnon, S. A., Jr., D. F. Gatz, J. Bertness, S. T. Sonka, J. Bartlett, and J. J. Hassett, 1979: Studies of impacts of urban-related weather and climate changes at Chicago and St. Louis. Final Report, Illinois State Water Survey, Urbana, IL, 112 pp.
Economic; La Porte anomaly; crop yield; crop hail loss; summer flooding; soil pollution; lake effect; hail day.

79C14
Cox, M., and P. R. Armtrong, 1979: A statistical model for assessing the risk of hail damage to any ground installation. Technical Report ALO/4291-1, Atlas Corp., 98 pp.
Insurance data; crop damage; property damage; hailday frequency; hailstone size; storm severity; storm duration; Poisson; negative binomial diatribution; Fortran program listing.

79C15
Cook, R. D., and N. Holschuh, 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 68-70.
Notion of experimental proof; treatment-unit nonadditivity; randomization; bad randomization; combine experiments.

79C16
Changnon, S. A., Jr., F. A. Huff, C. F. Hsu, G. L. Achtemeier, N. Westcott, and P. Rosenzweig, 1979: Operational Seeding Evaluation Techniques. Final Report, NSF ENV78-01003, Illinois State Water Survey, Urbana, IL, 63 pp.
Simulation; principal component regression; multiple regression; double ratio; two regression; sum of rank power tests; power of test; multiplicative seeding effect models; Kansas; monthly and seasonal; predictor variables.

79D01
Davis, A. W., 1979: On certain ratio statistics in weather modification experiments. Technometrics, 21(3), 283-289.
Permutation test; double ratio; root double ratio; power; asymptotic normality; simulation; multiplicative variable seeding effects; target-control design; 50% randomization; variance; western Australia coast (Perth to Albany); 19 stations; monthly, 1950-1953; block size is 2, 24 blocks; Tasmania--54 stations, weekly rainfall, 1965, 1966, 1969, 1972, 18 blocks of size-5; 400 runs, 100 randomizations per run.

79D02
Dawkins, S. M., and E. L. Scott, 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 70-77
Whitetop; c(a)test; stratification into air-mass days and frontal days; moving-target method of analysis; time of effects; hourly rainfall; there may be a carry-over effect into the morning following seeding.

79E01
Elliott, R. D., 1979: Physically meaningful covariates. Commun. Statist.-Theor. &Meth., A8(11), 1111-1127.
Orographic; rawinsonde; regression; snowfall; San Juan Mountains of Colorado; stability; mixing ratio; wind; mean cloud depth; lowest cloud temperature; Colorado River Basin Pilot Project; blowover effect; over-seeding; cloud top temperature; Whitetop; Sierra Nevada mountains; dynamic effect; FACE; Santa Barbara II; Sierra Cooperative Pilot Project.

79E02
Eddy, A., and E. Cooter, 1979: The evaluation of operational cloud seeding in North Dakota: Some preliminary findings. Final Report to North Dakota Weather Modification Board , Amos Eddy, Inc., 43 pp.
Statewide program; 1913-1948 as historical; 1951-1976 seeded; commercial projects; 13% less rain; 19% increase of ranfall occurrences; stratified by wind direction and soil moisture; t-test.

79E03
Eddy, A., E. Cooter, and W. Cooter, 1979: An evaluation of operational cloud seeding in North Dakota: An exploratory analysis. Final Report to North Dakota Weather Modification Board , Amos Eddy, Inc., 146 pp.
Stratified by soil moisture and wind direction; trend; spatial corrrlation; statewide program; regression; crop yield; economic; cost-benefit.

79E04
Elliott, R. D., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 77.
Whitetop; dynamic seeding response; 24-hour cloud top temperature forecast; renalysis.

79F01
Foote, G. B., and C. A. Knight, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part I: Design and conduct of the experiment. J. Appl. Meteor., 18(12), 1526-1537.
Physical hypothesis for hail suppression by seeding; single-area type; randomization was by day; Agl; cloud base seeding; rocket; total mass of hail; 1972, 1973 and 1974; NHRE; Soviet methods; probability of hail; hailpads; weighing rain-gages; hail/rain separator.

79F02
Foote, G. B., R. E. Rinehart, and E. L. Crow, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part IV: Analysis of radar data for seeding effect and correlation with hailfall. J. Appl. Meteor., 18(12), 1569-1582.
Daily integrals of reflectivity; areas of reflectivity above a given threshold; measuring hailfall by radar; ten radar variables were tested for seeding effect; Student's t-test; Wilcoxon-Mann-Whitney test; no variables tested showed a difference between seed and control days that was significant at the 10% level; regressions; difference; Kolmogorov-Smirnov two-sample test.

79F03
Foote, G. B., and C. G. Mohr, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part VI: Post hoc stratification by storm intensity and type. J. Appl. Meteor., 18(12), 1589-1600.
NHRE; one-dimensional steady-state cloud model; radar echo top heights; maximum updraft speed of the storm; do not show an effect of seeding as assessed by 90% confidence intervals; radar reflectivity; lognormal distribution; ratio; hail mass; rain mass.

79F04
Foote, G. B., C. G. Wade, J. C. Fankhauser, P. W. Summers, E. L. Crow, and M. E. Solak, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part VII: Seeding logistics and post hoc stratification by seeding coverage. J. Appl. Meteor., 18(12), 1601-1617.
The seeding coverage is found to be only about 50% on the average; seeding hypothesis; seeding rate; required seeding period; actual seeding period; "stem and leaf" plot; scatter diagram; daily hail mass; analysis of variance; F statistic.

79F05
Feuerverger, A., 1979: On some methods of analysis for weather experiments. Biometrika, 66(3), 655-658.
Australia; gamma distribution model with predictors; linear logistic model; maximum likelihood; single cloud seeding; mixture of distributions; rainfall probability; likelihood ratio; randomness test.

79F06
Flueck, J. A., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 77-80.
Exploratory versus confirmatory experients; operational; data analysis; randomization; Whitetop; randomization.

79G01
Gabriel, K. R., 1979: Some statistical issues in weather modification. Commun. Statist.-Theor. &Meth., A8(10), 978-1015.
Blocking; experimental unit; permutation test; multiplicity; non-randomized experiments.

79G02
Gatz, D. F., 1979: An investigation of pollutant source strength-rainfall relationships at St. Louis. J. Appl. Meteor., 18(10), 1245-1251.
METROMEX; physical relationships do not support an aerosol involvement in the urban rainfall anomaly; a correlation analysis between 1) daily factor scores and 2) storm rainfall in 21 selected areas; average rainfall for each storm; principal components model; Bonferroni's simultaneous inference; Fisher's z-transformation.

79G03
Grant, L. O., and W. R. Cotton, 1979: Weather modification. Reviews Geophys. and Space Phys., 17(7), Oct., 1872-1890.
1975-1978; Colorado River Basin Pilot Project; FACE; NHRE; METROMEX; Israel II; North Dekota Pilot Project; Tasmania Experiment; Cascade Experiment; TASH; fog; orographic; convective clouds; HIPLEX; Colorado State University South Park Area Cumulus Experiment (SPACE); PACE; hurricanes; seeding agents; generating systems; delivery of seeding agents; experimental design; evaluation; Statistical Task Force; predictors; the importance of linking the statistical experiments to physical evaluation; societal.

79G04
Gabriel, K. R., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 81-84.
Exploratory stage; Israeli; statistician's role in weather modification.

79H01
Hill, G. E., 1979: Analysis of randomized winter orographic cloud seeding experiments in Utah. J. Appl; Meteor., 18(4), 413-448.
Northern Wasatch Mountains; airborne pyrotechnics; mountain-top generators; storm type classifications; hypothesis that seeding of clouds would increase precipitation when the 500 mb temperature is warmer than -22C is rejected; precipitation increases are not found in orographic clouds when the cloud-top temperature is warmer than -29C; aircraft icing; Climax experiment; winters of 1969-70, 1970-71, 1971-72, 1973-74, 1974-75 and 1975-76; 11 remotely operated precipitation gages in the target area; rawinsonde soundings; a crude estimate of the total increase in winter orographic precipitation by seeding is about 15%; covariate; Hill Air Force Base TPQ-11 radar (0.86 cm); cloud-base and cloud-top mixing ratios; 9000 ft wind in knots normal; fourth root of precipitation is used; correlation; precipitation estimator; radar cloud-base height; isopleths of Ag; two regression lines; ratio.

79H02
Huff, F. A., 1979: Assessment of weather modification potential for alleviating agricultural droughts in the Midwest. J. Wea. Mod., 11(1), 28-50.
1900-1974; storm, monthly and seasonal rainfall amounts; July and August; May through September; area-depth curves; frequency and areal extent of daily rainfall; nomogram technique; synoptic weather; METROMEX; surface raincell mergers.

791103
Hobbs, P. V., and A. L. Rangno, 1979: Comments on the Climax and Wolf Creek Pass cloud seeding experiments. J. Appl. Meteor., 18(9), 1233-1237.
Physical hypotheses; showed that the concentrations of ice particles in the natural clouds are often much greater than originally assumed; no firm evidence to support the contention that 500 mb temperatures are a good measure of cloud-top temperatures over the Rockies; re-analysis; height of the 3 cm radar echo tops.

79H04
Haar, T. H. Vander, 1979: Use of meteorological satellite data for the design, operation and evaluation of weather modification experiments. Workshop on Wea. Mod., Spain, WMO, 79-100.
PEP; overview; satellite observing systems; satellite cloud climatologies; METEOSAT; Sierra Cooperative Pilot Project.

79H05
Huff, F. A., 1979: Spatial and temporal correlation of precipitation in Illinois. Circular 141, Illinois State Water Survey, Urbana, IL, 14 pp.
Annual; seasonal; monthly; storm; partial storm precipitation; May-September; 36 weather stations; 1906-1955; for all directions combined, the median correlation coefficients are 0.90, 0.72, 0.58, and 0.45 at distances of 25, 50, 100, and 150 miles; East Central Illinois Network; Little Egypt Network; Goose Creek Network; synoptic storm pattern; rain type; storm duration; directional effects; raingage spacing requirements.

79H06
Hsu, C. F., 1979: Two methods of computing statistical powers with application to Weather modification. Proc. Statist. Comp. Sec., Amer. Statist. Assoc., Washington, DC, 243-246.
Permutation test; power of test; naive method; exact method; double ratio; Kansas; simulation.

79H07
Hsu, C. F., 1979: Monte Carlo studies of statistical evauation techniques for weather modification. Seventh Conf. on Inadv. and Planned Wea. Mod., Amer. Meteor. Soc., Banff, Canada, 8-12, Oct., J3-J4.
Simulation; principal component regression; multiple regression; double ratio; two regression; sum of rank power tests; power of test; multiplicative seeding effect models; Kansas; monthly and seasonal; t-test.

79K01
Knight, C. A., and N. C. Knight, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part V: Hailstone embryo types. J. Appl. Meteor., 18(12), 1583-1588.
No significant correlations were found between embryo type and hail size, hail amount or cloud base temperature; 1972-74; embryos were classified as graupel, frozen drop or other; contingency tables; NHRE.

79K02
Knight, C. A., G. B. Foote, and P. W. Summers, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part IX: Overall discussion and summary-in the context of physical research. J. Appl. Meteor., 18(12), 1629-1639.
NHRE; using total mass within the target area as the primary response variable; no conclusion about a seeding effect can be drawn; accumulation zones rarely participate in the hailstone growth; virtually all radar echo from above the freezing level is from ice; hail embryos are predominantly graupel; Soviet seeding techniques; economic aspects; hail mass; seed/control ratios; Monte Carlo simulation; predictors.

79K03
Kruskal, W., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 84-86.
Physical vs. statistical evidence; Whitetop; multiplicity; randomization.

79M01
Miller, A. J., D. E. Shaw, L. G. Veitch, and E. J. Smith, 1979: Analyzing the results of a cloud-seeding experiment in Tasmania. Commun. Statist.-Theor. &Meth., A8(10), 1017-1047.
Permutation tests; residuals analysis; regression; double-ratio; variance-ratio; compare the merits of various alternative test-statistics; gamma distribution; ethical questions; weighting of data; target area was of about 3000 square km; 3 control areas -- north, south, northwest; area-average rainfall; periods of 10-18 days as experimental units; total of 108 periods in 1964-70; randomization in blocks of two; AgI; burners; aircraft; 1407 days available for the experiment; 191 were suspended; 24 periods in autumn; 28 in winter; 32 in spring; 24 in summer; period rainfall; daily rainfall; principal component regression; cube root transformation; F-test; 1000 randomizations; there is an effect associated with seeding in the eastern half of the target area in both autumn and summer; in autumn target east gives an estimated increase in rainfall of 40%; LUSH residuals; c(a)tests; highly desirable to ues permutation tests.

79M02
Mielke, P. W., P. J'. Brockwell, and K. J. Berry, 1979: Permutation analysis of multi-response data from single cloud seeding experiments. Seventh Conf. on Inadv. and Planned Wea. Mod., Amer. Meteor. Soc., Banff, Canada, 8-12, Oct., J7-J9.
Predictor variables; MRPP; equivalence of MEPP to other statistical techniques.

79M03
Melnichuk, Ju. V., 1979: Application of meteorological radars to weather modification. Workshop on Wea. Mod., Spain, WMO, 33-46.
Survey the new radar techniques; measurement of precipitation; radar equation; Z-R relation; Doppler radar.

79M04
Mielke, P. W., Jr., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 87-8.
Climax; Colorado River Basin Pilot Project; six-hour period; extended-area effects; type 1 statistical error; need for statisticians and physical scientists to be involved at all stages of the project.

79M05
Mosteller, F., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 88-90.
Collaboration between atmospheric scientists and statisticians; cost-benefit analysis; multiple analyses.

79N01
Neyman, J., 1979: Developments in probability and mathematical statistics generated by studies in meteorology and weather modification. Comman. Statist.-Theor. &Meth., A8(11), 1097-1110.
Characteristic function; outlier proneness and resistence; two chance mechanism; gamma distribution; log-normal distribution; c(a)test; NHRE.

79N02
Nickerson, E. C., 1979: FACE rainfall results: seeding effect or natural variability? J. Appl. Meteor., 18(9), 1097-1105. (See 81F01 for comment.)
Hourly rainfall; S/NS ratios; re-analysis; Wilcoxon-Mann-Whitney; natural variability appears to account for statistically significant differences between area-wide rainfall on seed and no-seed days; diurnal rainfall distribution; effects of missing data.

79N03
Neyman, J., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 90-94.
Whitetop; faraway effect; moving grid; regrets about Braham's persistence in using the nonplume as a control area; effective time after seeding.

79001
Orville, H. D., P. A. Eckhoff, J. E. Peak, J. H. Hirsch, and F. J. Kopp, 1979: Numerical simulation of the effects of cooling tower complexes on clouds and severe storms. Final Report NUREG/CR-0932, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 36 pp.
Two-dimensional time dependent model; a power park emitting 80% latent heat and 20% sensible heat has little effect on the simulated storm.

79002
Orville, H. D., R. D. Faeley, D. J. Musil, F. J. Kopp, and M. M. Bradley, 1979: Numerical simulations of hailstorms and hailstone. Report 79-3, Inst. of Atmos. Sci., South Dakota School of Mines and Technology, Rapid City, 96 pp.
Description of several 1-D, 2-D, 3-D numerical cloud models, and their testing by real data; NHRE.

79P01
Patrinos, A. A. N., N. C. J. Chen, and R. L. Miller, 1979: Spatial correlations of monthly rainfall: Applications in climatology and weather modification experiments. J. Appl. Meteor., 18(6), 719-732.
METER Project; Bowen power plant; Georgia; 1949-1971 (Dec.)-1977; 125x150 square km; 40 NWS stations; 3 target station are significant 200:65 with 300 replications.

79R01
Rangno, A. L., 1979: A reanalysis of the Wolf Creek Pass cloud seeding experiment. J. Appl. Meteor., 18(5), 579-605.
1964-1970; six-season; randomized-by-season; San Juan Mountains; Colorado; 500 mb temperature; bias selection; runoffs; rainfall increase reported earlier was not due to seeding; natural variability of precipitation; ground generators; increasing snowpack; three target watersheds; Climax; seed/no-seed precipitaion ratio; stratification by 500 mb temperature; Colorado River Basin Pilot Project; stratification by 700 mb wind direction; Student's t-test.

79R02
Rao, T. R., 1979: Inadvertent weather modification- A case study of rainfall around steel industries. Ph. D. theses, Dept. Meteor. and Ocean., Andhra University, Waltair, India, 280 pp.
Ice nuclei; La Porte anomaly; rainfall correlation; Monsoon rainfall; Burnpur-Jamshedpur region; wind; t-test; Mann-Whitney test; double mass curve; serial testing; trend; aerosol; hygroscopic nuclei; sulphate concentrations in rain water.

79S01
Smith, E. J., L. G., Veitch, D. E. Smith, and A. J. Miller, 1979: A cloud-seeding experiment in Tasmania. J. Appl. Meteor., 18, 804-815.
One target and three controls; randomized project; AgI; aircraft seeding; seeding increased rainfall in the eastern half of the target area during autumn; 1964-1970.

79S02
Sonka, S. T., 1979: Economics of weather modification: A review. Report of Investigation 89, Illinois State Water Survey , Urbana, 57 pp.
Hail suppression; hurricane suppression; precipitation augmentation; fog dipersal; lightning suppression; weather caused loss; crop production; drought; outdoor recreation; construction; tranportation; manufacturing; aviation; water supply; South Dakota; Kansas; Great Lake; Connecticut; Kings River Basin; Colorado River.

79S03
Summers, P. W., J. C. Fankhauser, G. M. Morgan, Jr., G. B. Foote, and A. C. Modahl, 1979: Results of a randomized hail suppression experiment in northeast Colorado. Part VIII: The representative draw analysis. J. Appl. Meteor., 18(12), 1618-1628.
Ratios; confidence limits; the random selection process produced an actual partitioning of sequence starts into seed or control such that a sequence this extreme, or more extreme, had a chance of only 3 in 100 of occurring; representative soundings; stability index; cloud-base temperature; surface mixing ratio; wind shear through cloud; Wilcoxon Mann-Whitney test; Student's t-test; stem-and-leaf plot; serial correlation; chi-square test.

79S04
Scott, E. L., 1979: Comparison of two treatments when there may be an initial effect. Presented at the Annual Statistical Meeting, 13-16 August, Washington, DC, 12 pp. Two kind of effects; c(a) test; power; simulation; Mann-Whitney test; Grossvershch III.

79S05
Sax, R. I., J. Thomas, M. Bonebrake, and J. Hallett, 1979: Ice evolution within seeded and nonseeded Florida cumuli. J. Appl. Meteor., 18(2), 203-214.
In-cloud microphysical data; FACE; AgI pyrotechnics; dynamical seeding; aircraft; 1975; Olin flares; 1976; NEI flares; NOAA DC-6 aircraft; Piper Navajo; 11 nonseeded and 9 seeded clouds in 1975; 21 nonseeded and 14 seeded clouds in 1976; crystal concentration; Student one-tailed t-test; concentration of crystalline ice observed in clouds seeded in 1976 greatly exceeds that detected in clouds seeded in 1975; within both years clouds seeded were found to contain significantly greater amounts of ice, both in the form of crystals and graupel, than those not seeded.

79S06
Smith, E. J., 1979: An experimenter's view of the application of statistics to cloud-seeding experiments. Commun. Statist.-Theor. & Meth., A8(10), 955-973.
Consulting; assumption of statistical analyses; transformation; stratification; extra-area effect; randomization imbalances; rainfall variability.

79S07
Sheets, R. C., and N. E. LaSeur, 1979: Project Stormfury: Present status--future plans. WMO Bullet., 17-23.
Seeding hypothesis; hurricane Debbie; digitized radar.

79S08
Strapp, J. W., H. G. Leighton, and G. A. Isaac, 1979: A comparison of model calculations of ice crystal growth with observations following silver iodide seeding. Atmosphere-Ocean, 17(3), 234-252.
Small crystals were continuously being produced as long as 15 min after seeding; crystal aggregation may have been occurring at a significant rate; T-33 Jet; DHC-6 Twin Otter; 1976 field experiments in Yellowknife.

79S09
Summers, P. W., 1979: Major weather modification activities other than preeipitation enhancement. Workshop on Wea. Mod., Spain, WMO, 153-171.
Scales of weather phenomena and their potential for modification; fog diapersal; hail suppression; summary of hail suppression programs; France; Alherta; Grossversuch; Bavaria; Argentina; USSR; Kenya; Bulgaria; North Dakota Pilot Project; Texas Panhandle; NHRE; Nelspruit; forecasting hail occurrence; evaloation; hurricane and typhoon modification.

79S10
Scott, E., 1979: A multivariate methodology for the analysis of weather modification experiments. Technical Report M514, Dept. of Statistics, Florida State Univ., Tallahassee, FL, 67 pp.
Principal component analysis; Santa Barbary I; correlation; t-test.

79S11
Simpson, J., 1979: Comment on Braham's paper. J. Amer. Statist. Assoc., 74, 95-97.
Climax; FACE; exploratory; confirmatory; Israeli.

79W01
Wisniewski, J., and R. I. Sax, 1979: Silver concentration in rainwater from seeded and nonseeded Florida cumuli; 1973-1975 results. J. Appl. Meteor., 18(8), 1044-1055.
FACE; review of projects with silver tracing; ecological impact; different air mass trajectory analysis; classifying data as either maritime or continental influenced; the concentration of silver in "continental rain" on nonseeded days approaches that of silver in "maritime rain" on seeded days; dynamic seeding technique as used in FACE does increase the mean silver concentration in rainwater on a localized shower basis by about a factor of 2.

79W02
Woodley, W. L., C. G. Griffith, J. S. Griffin, and S. C. Stromatt, 1979: Satellite-estimated rainfall in GATE. NOAA Technical Memorandum ERK NHEML-6, Boulder, CO, 54 pp.
Sea surface temperature; diurnal variation; Nimbus 5 m microwave imagery; radar and gage comparison; rain volume; satellite- and radar-estimated rainfall comparison.

79W03
Woodley, W. L., 1979: Precipitation measurements for evaluation of precipitation enhancement projects. Workshop on Wea. Mod., Spain, WMO, 63-78.
Estimates of rainfall using raingages; sampling requirements for network design; gage density; sampling error; measurement error; radar estimation of precipitation; comparison between gage and radar-derived cluster rainfall; hydrological evaluation.

79W04
Woodley, W. L., 1979: Meteorological considerations in weather modification experiments. Workshop on Wea. Mod., Spain, WMO, 101-121.
Site selection; climatological factors; measurements and analyses necessary for evaluation; predictor variables in veryfying the physical model.

79W05
Whilhite, D. A., and R. O. Hoffman, 1979: Drought in the Great Plains: A bibliography. Technical Report MP 39, Agr. Exp. Station, University Nebraska, Lincoln, 75 pp.
Subject index; author index; weather modification.

79W06
Westcott, N., 1979: Annotated bibliography of predictor variables for weather modification applications. Technical Report, Illinois State Water Survey, Urbana, IL, 117 pp.
174 references were abstracted; 1965 to present; geographic index; weather type; author index.

80A01
Achtemeler, G. L., 1980: On the development of covariates for the evaluation of operational seeding projects in areas without physiographic influences. J. Wea. Mod., 12(1), 16-23.
OSET; covariates derived from surface data fields; objective analyses; three variable fields explainedmore than 30% of the variance; 10 variables explain 53% of the rainfall variance.

80A02
Admirat, P., D. Vento, J.-F. Mezeix, J.-P. Rouet, and A. Aparo, 1980: Reproductibilite de la methode de depouillement.des donnees grelimetriques utilisees dans "Grossverch IV". Atmosphere-Ocean, 18(1), 27-42.
Hailpad; summer of 1978; number, diameter, and kinetic energy value.

80B01
Bradley, R. A., S. S. Srivastava, and A. Lanzdorf, 1980: Some approaches to statistical analysis of a weather modification experiment. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 33-53.
ANOCOVA; cumulus; convective band; correlation; covariates; Monte Carlo; principal components; radiosonde; randomization; response surface; Santa Barbara Project; transformation; Wilcoxon 2-sample test.

80B02
Bradley, R. A., 1980: Response to discussion. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 139-141.
ANOCOVA; Hotelling's T-square; response surface; Santa Barbara Project; Weather Modification Board.

80B03
Bradley, R. A., T. C. Redman, and T. A. Gleeson, 1980: An examination of the effects of cloud seeding in phase II of the Santa Barbara convective band seeding test program. Technical Report M535, Dept. of Statistics , Florida State. Univ., Tallahassee, FL, 67 pp.
1970-1974; gound generator; airborne seeding; predictors; weighted ANOVA; transformation; storm as sampling unit; design change; 48 hour as experimental unit; mixing ratio; 700 mb wind; 500 mb temperature; stability stratification; Showalter index; instability transport; ANOCOVA; sampling error.

80C01
Changnon, S. A. Jr., 1980: Is your weather being modified? J. Irrig. and Drainage Div., Proc. of Amer. Soc. of Civil Eng., 106, 37-48.
Design; energy; hydrology; water resources; inadvertent weather modification in general; reviews how land use changes alter the atmosphere; METORMEX; ; agriculture; transportation.

80C02
Changnon, S. A., Jr., 1980: The rationale for future weather modification program. Bull. Amer. Meteor. Soc., 61(6), 546-551.
Weather Modisication Advisory Board; problems of past weather modification experiments; instramentstion; operation weather modification; past aeeomplishments of weather modification; design and evaluation; knowledge of poteatial impacts; economic outlook.

80C03
Chaagnon, S. A., Jr., 1980: Evidence of urban and lake influences on precipitation in the Chicago area. J. Appl. Meteor., 19(10), 1137-1159.
Temporal trond in precipitation; heavy summer rainstorms; thunderstorm characteristics; GOES; radar echo study; surface raincell; rain periods; total rainfall; synoptic types; analysis of rainfall by land use areas; one-sample Wilcoxon test; matched-pair t-test; maximum and minimum rainfall centers; on the average, Chicago received 15% more rainfall in the summer, largely due to urhan *effects*, than would have occurred there without the city the inerease

80C04
Court, A., 1980: Limitations of statistics in weather modification. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 109-112.
Colorado River Basin Pilot Project; Project Whitetop.

80C05
Changnon, S. A., Jr., 1980: More on the La Porte anomaly. Bull. Amer. Meteor. Soc., 61(7), 702-711.
Changed station exposure; observer error; urban effect; streamflow; corn yield data; smoke-haze day; correlograms; power spectrum; cross-correlation; METROMEX; tree ring; crop-hail insurance loss cost; climate change.

80C06
Changnon, S. A., Jr., K. R. Gabriel, and C. F. Hsu. 1980: Evaluating operational cloud seeding projects. Third WMO Sci. Conf. on Wea. Mod., Clermont-Ferrand, France, 21-25 July, 493-499.
Simulation; principal component regression; multiple regression; double ratio; two regression; sum of rank power tests; power of test; multiplicative seeding effect models; Kansas; monthly and seasonal; biases; experimental units; multiplicity; validity of historical compsrison.

80D01
Dennis, Arnett, S., 1980: Weather modification by cloud seeding. Academic Press, NY, 267 pp.
Aerosol; formation of rain; AgI; statistical evaluation; operational project; random experiments; impacts.

80E01
Elliott, R. D., 1980: Physically meaningful covariates. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 79-87.
Cumuliform clouds; orographic clouds; cloudtop temperature; Colorado River Basin Pilot Project; FACE; regression; Santa Barbara Project; Sierra Cooperative Pilot Project.

80F01
Flynn, M. S., and J. F. Griffiths, 1980: Variations in precipitation parameters between drougnt and nondrought periods in Texas and some implications for cloud seeding. J. Appl. Meteor., 19(12), 1363-1370.
Monthly rainfall; perisitence of rainfall during very dry and very wet periods; probabilities that a run of rain hours would extend to a given length were determined; t and F tests; chi-square test; rainfall intensity.

80G01
Gabriel, K. R., and C. F. Hsu, 1980: Power studies of re-randomization tests. Third WMO Sci. Conf. on Wea. Mod., Clermont-Ferrand, France, 21-25 July, 507-513.
Simulation; power; double ratio; multiple regression; sum of rank power test.

80G02
Gabriel, K. R., 1980: Comments on the reanalysis of the Santa Barbara II cloud seeding experiments. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 113-129.
ANOCOVA; covariates; experimental unit; Grossversuch III; Hotelling's T-square; principal component analysis; Project Whitetop; randomization; response surface; Santa Barbara Project; Statistical Task Force; Weather Modification Board; Wilcoxon 2-sample test; using simple statisties.

80G03
Gupta, S. S., and S. Panchapakesan, 1980: Some statistical techniques for climatological data. Statist. Climatology, S. Ikeda et al ed., Developments in Atmos. Sci. 13, Elsevier Sci. Publ. Co., 35-48.
Gamma distribution; c(a) test; statistical techniques; ranking and selection procedurcs; normal population; predictors.

80H01
Hill, G. F., 1980: Reexamination of cloud-top temperatures used as criteria for stratification of cloud seeding effects in experiments on winter orographic clouds. J. Appl. Meteor., 19(10), 1167-1175.
Cloud-top temperatures derived from rawinsonde data are found to be typically about 20 C too warm during daytime in the years 1965-1972; temperature stratifications of seeding effects and the resulting conclusions in several studies are inappropriate; Climax; TPQ-11 cloud detection unit; radar-derived cloud-top temperature; Colorado River Basin Pilot Project; pressure thickness; maximum relative humidity.

90H02
Heimbach, J. A., Jr., and A. B. Super, 1980: Raingage network requirements from a sumulated convective complex weather modification experiment. J. Appl. Meteor., 19(10), 1176-1183.
Optimum raingage density; Miles City, Montana; May-July 1977; sample size; definition of convective complex; Skywater 5.4 cm radar; HIPLEX; sampling variance; natural variance of precipitation; Wilcoxon rank sum test.

80H03
Haff, F. A., and S. A. Changnon, Jr., 1980: Criteria for weather modification operations and effective evaluation. Final Report, NSF ATM79-05007, Illinois State Water Survey, Urbana, 22 pp.
Design an operational project; seedability; piggyback operation; data collection and recording.

80H04
Hanson, M., and L. Barker, 1980: Comparing the testing of hypotheses based on lognormal and gamma distributions. Statist. Analy. Wea. Mod. Exp., E. J. Weman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 55-59.
Re-randomization distribution; Santa Barbara Project.

80K01
Klazura, G. E., and R. G. Pritchard, 1980: Predictor variables of the maximum radar echo activity on convective days. J. Appl. Meteor., 19(3), 334-337.
Stability indexes and upper level wind speeds seemed to be the dominant predictor variables; HIPLEX; May-July 1976; Miles City, Montana; 5 cm radar; rawinsonde; regression; maximum echo height; maximum reflectivity factor; maximum total volume; maximum total echo area; precipitable water; mean mixing ratio; lifted index; total totals index; K index.

80K02
Kempthorae, O., 1980: Some statistical aspects of weather modification studies. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 89-107.
ANOCOVA; c(a)test; covariates; crossover disign; experimental unit; flying plgs; randomization; Santa Barbara Project; AgI; Israeli I project; slowness in the development of a reliable weather modification technology.

80L01
Long, A. B., 1980: On estimating hail frequency and hailfall area. J. Appl. Meteor., 19(12), 1351-1362.
Mean point frequency of hail; regional frequency of hail; NHRE, 1976; lognormal; hail core; Monte Carlo; point and areal hail relation; hail-site density.

80N01
Neyman, J., 1980: Comments on the special issue of Communications in Statistics (Vol. A8, No. 10) concerned with weather modification experiments. Commun. Statist.-Theor. &Meth., A9(9), 965-992.
Slanted and unreliable; ranalysis; Tasmania experiment; Israel I experiment.

80N02
Neyman, J., 1980: Developments in probability and mathematical statistics generated by studies in meteorology and weather modification. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 1-10.
C(a)test; central limit theorem; characteristic function; Climax ; air mass; frontal system; gamma distribution; J-shaped distribution; experimental unit; moment generating function; NHRE; outlier.

80N03
Neyman, J., 1980: Comments on the discussion at the workshop on the statistical design and analysis of weather modification experiments. Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 131-137.
Randomization; need of randomization; Whitetop; difficulty with randomization; Israeli experiment I; Climax I; question about selectivity of data used; probability of the response variable being exactly zero.

80O01
Ochs, H. T., III, and D. B. Johnson, 1980: Urban effects on the properties of radar first echoes. J. Appl. Meteor., 19(10), 1160-1166.
METROMEX; approximately 150 m lowering of urban first echo tops and 250 m lowering of urban first echo bases; Chicago TPS-10 3 cm radar; 82 days over 4 summers; cloud base heights.

80P01
Patrinos, A. A. N., and K. O. Bowman, 1980: Weather modification from cooling towers: A test based on the distributional properties of rainfall. J. Appl. Meteor., 19(3), 290-297.
49 recording gages; Georgia; sample skewness and kurtosis; February 1978 to August 1978; an anomaly in the target area rainfall with a 90% confidence level; square root transformation.

80P02
Peck, E., 1980: Design of precipitation networks. Bull. Amer. Meteor. Soc., 61(8), 894-902.
Precipitation variability; long-term and short-term spatial and temporal vatiability; measurement error; areal estimate of precipitation; satellite.

80R01
Rao, A. R., 1980: Stochastic analysis of annual rainfall affected by urbanization. J. Appl. Meteor., 19(1), 40-52.
St. Louis; La Porte; annual rainfall series at La Porte and St. Louis were found to be correlated; tests based on the standard errors of the parameter estimates; mass and double mass curves; IMA(2,2); IMA(1,1); Bayesian inferences; increased period mean precipitation at both La Porte and Edwardsville.

80R02
Rangno, A. L., and P. V. Hobbs, 1980: Comments on "Randomized cloud seeding in the San Juan Mountains, Colorado". J. Appl. Meteor., 19(3), 346-350, Reply by Elliott, R. D., R. W. Shaffer, A. Court, and J. F. Hannaford, 350-355.
Cloudtop temperature; need precise definition of seeding conditions; need demonstrate that the stratification is unbiased; problem of sampling unit; multiplicity.

80S01
Sassen, K., 1980: An initial application of polarization lidar for orographic cloud seeding operations. J. Appl. Meteor., 19(3), 298-304.
Commercial cloud seeding; aid in the determination of seeding criteria; cloud ice-water balance; lidar has detected changes in cloud layer structure and ice-water balance brought about by aerial seeding; Wasatch Mountains, Utah; seeding case of 27 March 1979; cloud base AgI seeding; evaluation.

80S02
Simpson, J., 1980: Downdrafts as linkages in dynamic cumulus seeding effects. J. Appl. Meteor., 19(4), 477-487.
Acceleration of the cloud tops invigorated by seeding can lead to enhanced dynamic entrainment, increased evaporation, and hence to more rapidly formed and stronger downdrafts than would be the case without seeding; GATE; FACE; merger process.

80S03
Stern, R. D., and A. Patel, 1980: Comments on "Independence of monthly rainfall over southeast Asia during the summer Monsoon season".
Monthly Weather Review, 108, 1913-1914. Reply by D. A. Mooley, 1914.
Contigency tables; chi-square test; Hyderabad, India; degrees of freedom.

80S04
Smith, E. J., D. E. Shaw, L. G. Veitch, and A. J. Miller, 1980: Cloud-seeding experiment in Tasmania results including fifth's operation. CP 272, Div. of Cloud Physies, CSIRO, Australia, 38 pp.
1964, 1966, 1968, 1970, and 1971; double ratio; regression; AgI; aircraft; period of 10-18 days as experimental unit; random pair seeded prior to 1971, 2/3 seeded in 1971; random block design; sifnificant rainfall increase (43%) in target east in autumn; F-test; permutation test; cubic transformation; ezlneme observations; stratified by cloud type; seeding operation.

80S05
St.-Amand, P., 1980: Some operational considerations in evaluation of weather modification programs: A short excursion into epistemology.
Statist. Analy. Wea. Mod. Exp., E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 11-32.
Aeetone burner; activation temperature; ammonium iodide; catalysis theory; cumulus; nucleation; Project Hotshot; Project Tignes; Project Whitetop; rain dancer; AgI; surface free energy; wind shear.

80S06
Scott, Elton, 1980: A multivariate methodology for the analysis of weather modification experiments. Statist. Analy. Wea. Mod. Exp, E. J. Wegman, and D. J. DePriest, ed., Mercel-Dekker Publ. Co., NY, 61-77.
Correlation; convective band; Hotelling's T-square; principal component asalysis; Santa Barbara Project.

80S07
Suanki,E., 1980: Asummarized review of theoretical distribution fitted to climatie factors and Markov chain models of weather sequences, with some examples. Statist. Climatology, S. Ikeda et al ed., Developments in Atmos. Set. 13, Elsevier Sci. Publ. Co., 1-20.
Maximan likelihood estimator; climate extreme; order of Markov chain; temperature, normal, Pearson type I; precipitation, gamma, lognormal, kappa; relative humidity, beta; wind speed, gamma, Weibull, lognormal,; wind direction, circular distribution; Poisson; negative binomial; extreme-value.

81F01
Flueck, J. A., W. L. Woodley, R. W. Burpee, and D. 0. Stram, 1981: Comments on . "FACE rainfall results: Seeding effect or natural variability?". J. Appl. Meteor., 20(1), 98-107.
Stem-and-leaf plot; total target radar-estimated, gage-adjusted precipitation; ratios; floating target; modified t test; Wilcoxon test; F test; modified Seigel-Tukey test; Spearman rank correlation coefficients; adequacy of the selected raingage network; area-wide rainfall; partitioning of the all days data by flare type; area-weighted 24 hour network rainfall; area of effect; the SOA rainfall, in at least the 6 hour after initiation of treatment, is contaminated by the treatment meaterial released in the target area; SOA-measured rainfall posterior to treatment initiation is not a proper covariate; linear model; analysis of covariance; transformation.

81G01
Gabriel, K. R., 1981: On the roles of physicsits and statisticains in weather modification experiementation. Bull. Amer. Meteor. Soc., 62(1), 62-69.
Exploratory and confirmatory analyses; Statistical Task Force; multiplicity; reanalysis; correlation; covariate.

81H01
Hsu, C. F., S. A. Changnon, Jr., F. A. Huff, and K. R. Gabriel, 1981: The assessment of statistical-physical techniques for evaluation of weather modification operations. Final Report, NSF ATM79-05007, Illinois State Water Survey, Urbana, IL.
Simulation; principal component regression; multiple regression; double ratio; two regression; sum of rank power tests; power of test; multiplicative seeding effect models; Kansas; monthly and seasonal; annual insurance loss-cost; Montana; Illinois, storm, 48-hr; moving target-control; variable seeding effect models; Muddy Road project; operational projects; Texas Panhandle hail supprssion project; piggyback.

81H02
Hsu, C. F., 1981: Weather modification activities in Taiwan, 1951-1979.
J. Wea. Mod., 13(1), 161-164.
Regression; ground generator; AgI; historical continuous target-control; aircraft seeding in 1977-1979; difference/predicted ratio.

81H03
Hsu, C. F., and S. A. Changnon, Jr., 1981: Assessment of summer 1979 weather modification effort in southeastern Illinois. J. Wea. Mod., 13(1), 132-140.
Permutation test; principal component regression; multiple regression; double ratio; isohyetal analysis; July-August; historical continuous target-control; ratio; radar echo motion.

81H04
Hsu, C. F., K. R. Gabriel, and S. A. Changnon, Jr., 1981: Statistical techniques and key issues for the evaluation of operational weather modification.
J. Wea. Mod., 13(1), 195-199.
Simulation; principal component regression; multiple regression; double ratio; two regression; sum of rank power tests; power of test; multiplicative seeding effect models; Kansas; monthly and seasonal; biases; experimental units; multiplicity; validity of historical comparison.

81N01
Nickerson, E. C., 1981: Reply-The FACE-1 seeding effect revisited.
J. Appl. Meteor., 20(1), 108-114.
Accuracy of the data; physical evidence; sea breeze; lake breeze; observed variability of meteorological predictors; flare type; correlation; regression; contamination problem; use of radar or gage estimates of areawide rainfall as primary indicators of the effectiveness of a randomized convective cloud seeding experiment needs to be rejected once and for all; must gather the appropriate mesoscaland cloud microphysical data.