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2002 Adventures, Ventures, and Misadventures of Weather Modification in Texas

Arquimedes Ruiz-Columbié*, Dale L. Bates*, Orlando Nuñez-Russis**
*8696 Hangar Rd. San Angelo, Texas
**B Willinston, P.O. 204, Deer, Texas

Abstract: 2002 cloud seeding operations, which began in March, were aided by daily and monthly evaluation reports using the TITAN evaluation software package. By comparison with unseeded control clouds, the evaluation program estimated the modifications that had occurred in particular seeded clouds in regards to timing, dosages, missed opportunities, etc. This paper serves as an annual summary of these results. A total of 897 clouds were seeded and identified by TITAN in 237 target-area operational days (tao days). A sub-total of 599 seeded clouds was evaluated with the classic TITAN tool; 56 seeded clouds did not obtain proper data files, and 242 clouds were reserved for the synergetic analysis (135 large and 107 type B clouds).

Reexamination of Historical Regression Analysis Applied to a Recent Idaho Cloud Seeding Project

Arlin B. Super* and James A. Heimbach, Jr.**
*St. Cloud, Minnesota
** Springvale, Maine

Abstract: A recently reported analysis of an Idaho operational winter cloud seeding project is examined in detail. The analysis used the traditional historical regression method. It appeared to provide impressive evidence that seeding was effective in increasing seasonal snowpack accumulation during each of four winters with a mean increase near 12%. The analysis was based on a strong relationship with the April 1st control station mean explaining 96% of the target area variance. However, frequent snow melt prior to April 1st was discovered at 4 of 7 control stations and 3 of 10 target stations. Snow melt is shown to have introduced an important but apparently unrecognized variable into the target-control relationship, making it inappropriate for evaluation of seeding effectiveness. Repeating the analysis procedures with March 1st observations from the same stations reduced the "seeding signal" to under 4%. Additional target and control stations were identified and used in comprehensive historical regression analyses. Once a limited number of stations with February melt were discarded, all possible combinations of available control stations were tested to detect target-control relationships which explained the most variance. These relationships did not support the hypothesis that cloud seeding significantly enhanced the seasonal snow water content. Additional testing was done with April 1st observations to demonstrate that a wide range of results can emerge from a large database even with the requirement of a strong target-control association. Recommendations are made for future application of this statistical approach.

NEW ASSESSMENT OF THE ECONOMIC IMPACTS FROM SIX WINTER SNOWPACK AUGMENTATION PROJECTS

Thomas J. Henderson
Atmospherics Incorporated Fresno, California U.S.A

ABSTRACT California has the longest history of continuous operational cloud seeding programs of any area in the world. The technology was first applied by the California Electric Power Company beginning on February 2, 1948. As the years evolved, additional programs funded by water agencies, municipalities and hydroelectric interests were organized over many California locales. During the 2001/02 winter season, thirteen operational programs were active. A broad range of statistical evaluations have been applied to many of these programs. In addition to statistical methods applied to precipitation and streamflow data, these evaluations have also focused on substantial radar data collected by operational 3cm and 5cm weather radar systems. The combined benefits are explored using six programs in California which have been active for various periods since 1950. The results from this study strongly suggest that very beneficial increases in water supplies have been produced by these long-term cloud seeding programs.

THE KINGS RIVER WEATHER RESOURCES MANAGEMENT PROGRAM

Thomas J. Henderson
Atmospherics Incorporated Fresno, California

ABSTRACT In 1954 a cloud seeding program designed to increase rainfall and

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snowpack was initiated over the watershed of the Kings River in the Sierra Range of California. The project has been funded by the Kings River Conservation District, Fresno, California. With the exception of a few suspension periods due to high runoff and the construction of a hydroelectric facility, the program has been operated for 6-7 months each year since its inception. At the end of the first three-year period, a multiple regression analysis was developed utilizing the unregulated historic flow of the Kings River and the flow of adjacent rivers presumed to be unaltered by the cloud seeding activities. When applied to the subsequent operational periods, his analysis indicated an apparent increase in streamflow amounting to 6% of the total predicted by the regression analysis. The apparent increase was significant at the 0.005 level. During the years following this first analysis, a number of studies have been conducted including a continuation of the statistics work plus an analysis of data from 3cm and 5cm project radar data.

ESTIMATIONS OF DOWNWIND CLOUD SEEDING EFFECTS IN UTAH

Mark E. Solak, David P. Yorty and Don A. Griffith
North American Weather Consultants, Inc. Sandy, Utah, U.S.A.

Abstract: Estimations of effects on precipitation downwind of a long-standing operational snowpack augmentation project in Utah are made, using an adaptation of the historical target/control regression technique which has been used to estimate the seasonal effects over more than twenty seasons within the project's target area. Target area analyses of December-March high elevation precipitation data for this project indicate an overall season-average increase of about 14%. Estimations of downwind effects are made for distance bands downwind as far as 150 miles. The downwind analyses indicate increases of similar magnitude to those for the target, expressed as percentages or ratio values, extending to about 100 miles downwind. Beyond 100 miles the ratio values decay, reaching 1.0 at about 125 miles. Expressed as average-depth precipitation amounts, the target area precipitation difference is about 1.4 inches of additional water, while the values within downwind distance bands range from 0.4 to 0.25 inches, reaching zero at about 125 miles.

Cloud seeding in Libya

Younis Al-Fenadi
Cloud seeding Senior weather forecaster Meteorology Department Tripoli – Libya
Fenadi@yahoo.com 1.

Abstract: Weather refers to the state of atmosphere at a certain geographical place and period of time. It is described in terms of many meteorological variables or elements such as dry and wet temperatures, wind speed and direction, precipitation and many others, while meteorology is the science which studies weather conditions and all the atmospheric process and its impacts or influences on our life in general. Although weather events and phenomena such as precipitations are needed in our life, weather may be considered one of the natural disasters which bring heavy rains, floods and strong winds lead to destroy, death, and economic losses when it occurs in some regions of the world. In addition, rainfall is one of the most meteorological elements and weather indicators to measure the wet seasons to be used in agriculture to plant a variety of food crops needed for both human and animal. In dry regions, weather modification could be a practical or operational solution to produce more precipitation to overcome the shortage arises. In this regard "meteorologists have concerned themselves with the development of means for increasing rainfall. Although techniques presently available are not at all likely to lead to a significant change in the water budget of the earth as a whole, there are indications that it may be possible to produce small but important changes in the clouds and precipitation over limited region." (Battan, 1965) This paper defines weather modification and will highlight some points and stages of the Libyan cloud seeding as a weather modification experiment for increasing rainfall.

A Brief Comment about Ergodicity and Rosenfeld-Lensky Method

Arquimedes Ruiz-Columbié
8696 Hangar Rd. San Angelo, Texas 76901

Abstract: The Rosenfeld-Lensky method to infer cloud microstructure from satellite information is analyzed under the ergodic hypothesis that states at its basis. However, processes of merging and clustering might undermine this assumption. Considerations about quasi-ergodicity are done to validate conclusions about the possible application of this method in the evaluation of operational cloud seeding programs.

Reply to "A Brief Comment about Ergodicity and Rosenfeld-Lensky Method"

Daniel Rosenfeld
Institute of Earth Sciences, The Hebrew University of Jerusalem, Israel

No Abstract Available

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Webmasters: Tara Jensen - taraj@windlogics.com & Stephanie Beall - wxbliiss21@yahoo.com

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