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### **OPERATIONAL FORECASTS OF MAXIMUM HAILSTONE DIAMETER IN MENDOZA, ARGENTINA**

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**Abstract.** A coupled one-dimensional cloud and hail growth model was used to simulate the growth of hailstones in Mendoza, Argentina. The model-derived maximum hail size forecasts were based on 115 representative soundings released during the 1999-2000 hail season. Model ensemble, persistence and subjective hail forecasts were also verified against daily observations of the maximum hail size. The model control and ensemble showed promising skill when forecasting the occurrence of hail as measured by the Heidke's Skill Score (HSS=-0.60). On days with severe hail (diameter of 2 cm or more), the model control forecasts showed the best skill (HSS=0.59). The model showed improved forecast skill when run using sounding and surface data from the Alberta Hail Project. This was likely attributable to the stringent criteria placed on the proximity soundings and the availability of real-time surface data in Alberta. Although certain cloud model parameters were useful for inferring the potential (and size) of hail in Mendoza, the best results were achieved using the coupled cloud and hail model. The data also suggest that the ensemble technique improves the accuracy and skill of the hail forecasts on some days.

### **ACIDIC CLOUD EPISODES IN THE NORTHERN COLORADO ROCKIES: INADVERTENT WEATHER MODIFICATION**

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**Abstract.** Acidic cloud episodes were detected in January 1998 and January 2000 at Storm Peak Laboratory (SPL) in the northern Colorado Rockies. The episodes were characterized by increased concentrations of small droplets and condensation nucleus concentrations and reduced liquid water contents, snowfall rates and sub-cloud relative humidities. The trajectories of the air parcels arriving at SPL before, during and after the episodes were studied. The parcels arriving during the episodes encountered the least precipitation during their journey to SPL suggesting little cloud and precipitation scavenging of aerosol particles. Further, much of the difference in acidity can be explained by dilution of the cloud droplets. Thus, the episodes may be primarily a natural phenomenon.

### **Secondary Seeding as a Means of Propagating Seeding Effects in Space and Time**

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**Abstract:** Secondary seeding, whereby unseeded clouds ingest ice particles from clouds that earlier had received direct glaciogenic (e.g., silver iodide) treatment, is hypothesized to be a possible additional mechanism for the propagation of seeding effects in space and time. The ingested ice particles, after experiencing some growth in the donor cloud, act to glaciate the receptor cloud during its active growth phase and provide it precipitation embryos. These embryos give the new cloud a head-start on precipitation development as they grow further as graupel to precipitation size in the updraft laden with high quantities of supercooled cloud water. This enhancement of precipitation-forming processes is postulated to be strongest in microphysically continental clouds in which natural and seeding-induced primary glaciation and hydrometeor growth are slow. A case study is presented to illustrate these processes.

### **ECONOMIC FEASIBILITY ASSESSMENT OF WINTER CLOUD SEEDING IN THE BOISE RIVER DRAINAGE, IDAHO**

Don A. Griffith and Mark E. Solak

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**Abstract:** The Boise River Drainage, located in Central Idaho, is productive in terms of annual streamflow, a large majority of which is derived from accumulated winter snow pack. There are three dams on the upper river: Anderson Ranch, Arrowrock

and Lucky Peak. Capacities of the three reservoirs are: 413,000, 272,000 and 306,000 acre feet, respectively. Both Anderson Ranch and Lucky Peak have hydroelectric production capabilities. Lucky Peak is located below the first two dams. North American Weather Consultants, Inc. conducted winter cloud seeding programs over the Boise River Drainage above Lucky Peak Reservoir during the water years of 1993-1996. A target/control analysis of these four seasons of seeding indicated an average increase in target area April 1st snowwater content of 12% (an average additional 2.50" of snow water content per season). Additional analyses were performed to estimate the potential economic benefit that might be derived from the seeding program based upon the value of the estimated increased hydro-power production from Lucky Peak Dam. Lucky Peak has an installed turbine capacity of 100 mw. It was estimated that a 12% increase in April 1st snow water content would result in an average 16,409 mwh of additional electricity production per year. This amount of additional electricity was estimated to have a value of \$820,182. The average annual cost of the cloud seeding program during the four seasons of operations was \$85,000. These values result in an average estimated benefit/cost ratio of 9.7/1. This analysis does not consider the value of the additional electricity produced from the Anderson Ranch Dam which is a Bureau of Reclamation facility or the value of the enhanced streamflow to irrigation interests downstream of the Lucky Peak Dam.

**Comments on the paper by Alexis B. Long entitled "Review of Persistence Effects of Silver Iodide Cloud Seeding"**

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No Abstract Available

**Reply to Bigg's Comments on "Review of Persistence Effects of Silver Iodide Cloud Seeding"**

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No Abstract Available

**AN OKLAHOMA WEATHER MODIFICATION PROGRAM STATUS REPORT AND PROJECT REVIEW**

Timothy E. Sedlock\*, Nathan R. Kuhnert\*\*, Rebecca L. Resler\*, Michael E. Mathis\*\*,  
Bruce A. Boe\*, and Brian Vance\*\*  
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**Abstract:** The recent history of the Oklahoma Weather Modification Program (OWMP) presented, the 2001 field program summarized, and the current status of the statewide rainfall stimulation and hail suppression program reported. Some suggestions for program improvement are also enumerated.

**Some Reflections on Hailstorms and Hail Suppression**

Andrew G. Detwiler  
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No Abstract Available

**A REVIEW OF THE EDWARDS AQUIFER PRECIPITATION ENHANCEMENT PROGRAM**

Rebecca L. Resler and Bruce A. Boe  
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**Abstract:** The organization and facilities of the Edwards Aquifer Precipitation Enhancement Project (EAPEP) is reviewed, and the resources applied in the 1999, 2000, and 2001 seasons are summarized. A preliminary evaluation of the 1999 and 2000 project seasons suggests a 24% increase in rainfall volume for floating target units of 1,964 km<sup>2</sup> that actually received treatment within the Edwards Aquifer fixed target. This corresponds to an average water increment of 626 acre-feet per unit. The full effect of seeding over the entire target area is presently unknown. The current estimate of the benefit-to-cost ratio is 9:1.

**MENDOZA HAIL MITIGATION PROJECT (<http://www.antigranizo.com>) FINAL REPORT 2000-2001 - EXECUTIVE SUMMARY**

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**Abstract:** This report summarizes the activities during the 2000-2001 field operations of the Mendoza Hail Mitigation Project. This was the second year of a 5 year contract between Weather Modification Inc. (WMI) of Fargo, North Dakota and the Ministry of Economy, Government of Mendoza. The two primary objectives of the Mendoza Hail Program are to reduce hail damage using airborne cloud seeding technology and to implement a re-search and technology transfer program for the people of Argentina.

**What is the actual benefit from cloud seeding?**

David L. Newsom  
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**ABSTRACT:** Since Vincent Schaefer's Cold Box experiment in the late 1940's, cloud seeding has been used to increase rainfall, enhance snowfall, and decrease damaging hail throughout the world. One of the most frequent uses of cloud seeding has been as an aid to dry land agriculture. There have been numerous programs conducted with claims of precipitation being increased by X%, it is often unclear whether this claimed increase applies to the entire Target Area or whether it occurs on a more localized area. While some portions of the Target Area will benefit greatly from seeding, an X% increase can sometimes be an insignificant amount of water in relation to the entire Target Area.

Even over a relatively small area like a single county, there will be natural variations in annual precipitation. These can be the result of topography as well as climatological influences and these variations in precipitation can have a major impact on the overall benefit of cloud seeding to the Target Area. However, with digital radar systems and software, such as TITAN, Thunderstorm Identification, Tracking And Nowcasting (Dixon and Weiner, 1993), in use today on many of these programs, a concerted effort should be made to determine the actual as opposed to the assumed, benefits from X%.

**The Monterey County Weather Modification Program In California: 1991-1995**

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\*\*Monterey County

\*\*\*California State Climatologist (ret.)

**ABSTRACT:** Precipitation enhancement cloud seeding program was funded by the Monterey County Water Resources Agency, Salinas, California during the winter seasons of 1991 through 1995. The operations were designed and conducted by Atmospherics Incorporated, Fresno, California. The target-control precipitation analyses show highly suggestive positive results on the order of 41% more rain in the target area than the control areas during the cloud seeding episodes. Since only a part of the rain seasons were seeded, this represents a 23% increase in annual precipitation over the target area. However, statistical tests did not provide conclusive evidence to support these initial findings.

**A high-level atmospheric management program plan for the new millennium**

T.P. DeFelice

No Abstract Available

**Modeling TITAN control clouds**

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**Abstract:** Operational programs of rain enhancement usually face great problems in the evaluation phase, mainly because of the nonexistence of appropriate control clouds to match the seeded clouds. TITAN is capable of proposing up to nineteen candidates for each seeded case, but these potential control clouds are determined using variables rates and, therefore, present big differences in the initial conditions. A model (the H-model) is presented in this paper to deal with the size problem.

**Weather Modification Scientific Management in Texas: The extensive and intensive uses of TITAN**

Dale L. Bates and Arquimedes Ruiz  
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**Abstract:** Nowadays Texas already has ten working operational rain-enhancement projects, which are focused to diminish the impact of periodic severe droughts by using cloud seeding techniques. These programs use TITAN and telemetry to perform and improve the operations and the TITAN analysis software to assess the performance and evaluate the results. This paper describes these uses.

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