

## NCAR Tip Sheet

[2003-42](#)

FOR IMMEDIATE RELEASE: Oct. 14, 2003

# Weather Modification Experts Tackle a Slippery Subject

BOULDER—Weather modification is big business, both in the United States and abroad. Commercial companies are hired to enhance rainfall by "seeding" clouds and farmers fire "hail cannons" that generate a shock wave in summertime storms in the hopes of reducing hail damage. But how reliable are these techniques?

Researchers at the National Center for Atmospheric Research (NCAR) have experimented with weather modification methods for decades. Now several NCAR scientists have contributed to a special report issued yesterday by the National Research Council of The National Academies. The report, "Critical Issues in Weather Modification Research," reviews the history and techniques of weather modification and makes recommendations for future research.

At NCAR, current weather modification work includes guiding research on the feasibility of rain enhancement in the United Arab Emirates. The experiment expands on a similar NCAR project that took place in Mexico in the late 1990s to investigate the effectiveness of a method of cloud seeding that uses water-absorbing hygroscopic flares to stimulate rain production in convective summertime clouds. The results of the Mexico experiment and the findings from the UAE should shed additional light on the potential that hygroscopic flare seeding has for increasing rainfall.

Below is a list of NCAR scientists who have participated in recent or historic weather modification experiments or who have played a key role in preparing the new NAS report. Their specialties and contact information are included.

### Weather Modification Experts

**Daniel Breed** 303-497-8933 [breed@ucar.edu](mailto:breed@ucar.edu)

NCAR Research Applications Program

*Specialties:* Cloud physics, rain enhancement, atmospheric electricity, radar meteorology, airborne instrumentation. Breed has served as project manager for NCAR's rainfall enhancement studies in Mexico and the United Arab Emirates. He also participated in the National Hail Research Experiment in the 1970s and subsequent cloud physics projects relevant to weather modification.

**Roelof Bruintjes** 303-497-8909 [roelof@ucar.edu](mailto:roelof@ucar.edu)

NCAR Research Applications Program

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**Specialties:** Weather modification of all sorts, including various types of cloud seeding and the study of the effects of smoke and pollution on clouds and rainfall. Bruintjes was a primary author of the NAS weather modification report. He headed NCAR's cloud seeding experiment in Mexico in the 1990s and is leading a similar research project in the United Arab Emirates. He first studied hygroscopic cloud seeding in his native South Africa.

**Brant Foote** 303-497-8458 [foote@ucar.edu](mailto:foote@ucar.edu)

NCAR Research Applications Program

**Specialties:** Severe storms; cloud physics; history and current state of weather modification, including silver iodide cloud seeding, hygroscopic cloud seeding, experiments in hail suppression and rainfall enhancement; and the effects of smoke and pollution on clouds and rain. Foote was a project leader with the National Hail Research Experiment. He was an invited speaker for the NAS panel that compiled the report on weather modification, and recently cochaired a World Meteorological Society meeting of experts on hail suppression.

**Robert Serafin** 303-497-8127 [serafin@ucar.edu](mailto:serafin@ucar.edu)

NCAR Environmental and Societal Impacts Group

**Specialties:** Past and current uses of radar in a wide range of meteorological applications, including weather modification. Serafin is an expert on the role of radar in monitoring storms, detecting and forecasting new storm development, and studying the behavior of precipitation from growth to dissipation. Radar observations can improve our understanding of basic processes relevant to weather modification and may lead to new seeding ideas and hypotheses that can be tested. A former director of NCAR, Serafin offers a general knowledge of meteorology, forecasting, cloud physics, and satellite instrumentation. He served on the NAS weather modification committee that produced the report.

**Charles Knight** 303-497-8940 [knightc@ucar.edu](mailto:knightc@ucar.edu)

NCAR Mesoscale and Microscale Meteorology Division

**Specialties:** Hail, ice, and snow, including the natural formation of snow and other precipitation in clouds, artificial snowmaking, the structure of snowflakes, and hail suppression. Knight is an expert on nucleation, a process that is important for both artificial snow production at ski resorts and natural snow formation in the atmosphere. He played a prominent role in the National Hail Research Experiment.

**Al Cooper** 703-292-8524 [wcooper@nsf.gov](mailto:wcooper@nsf.gov)

NCAR Advanced Study Program

**Specialties:** Clouds and cloud physics, especially the processes involved in the formation of precipitation in clouds; studies of cloud hydrometeors (droplets, raindrops, and ice particles); and the influences of aerosol particles on cloud microstructure and precipitation. Cooper also is an expert on research aircraft and their instrumentation. Currently on a term appointment at the National Science Foundation, Cooper has been the director of NCAR's Advanced Study Program for seven years. Throughout his career, he has sought to understand how precipitation forms and the degree to which both natural and human-produced particles can influence precipitation amounts.

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3438 x 2448)



The National Center for Atmospheric Research's mobile Doppler radars collect wind speed and precipitation data during the 1989 North Dakota Thunderstorm Project. The project supported a North Dakota program to seed clouds with silver iodide to enhance rainfall and reduce crop damage from hail. (Photo courtesy UCAR/NCAR/NSF.)

#### On the Web:

[National Academies news release about  
"Critical Issues in Weather Modification  
Research"](#)

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Last revised: Tuesday, October 14, 2003 5:02 PM