Next Up Previous

Next: Precipitation Augmentation---Summer Convective **Up:** Progress in planned weather **Previous:** Progress in planned weather

Introduction

This quadrennial marked progress in understanding basic cloud processes under natural and seeded conditions, development of conceptual models, and application of advanced computer cloud models and instrumentation. Conceptual models were revised so that effects on the scale of cloud particles, precipitation processes, and cloud development no longer are artificially distinguished from one another; for example hail suppression and precipitation enhancements are now viewed as possible concurrent effects from seeding. Transport and dispersion studies using tracers have begun to show the path of seeding material and have allowed documentation of physical effects. Application of two- and three-dimensional computer cloud models have helped to explain some results, to guide field operations, and to suggest further work. Instrumentation such as microwave radiometers and lidars have been used to document the spatial and temporal structure of supercooled liquid water.

Funding for planned weather modification in the United States has drastically decreased even as concern has heightened over the growing demand for fresh water, and as weather modification activity has increased elsewhere in the world. *Changnon and Lambright* [1990] examined some of the issues related to the funding decline for planned weather modification research in the United States. *Lambright* [1990] illustrated the importance of consensus building in initiating and maintaining weather modification programs, and showed how scientific debate has had both positive and negative impacts on the field. Over the past ten years, work in the United States has gradually shifted to a single federal/state program, the National Oceanic and Atmospheric Administration Federal-State Cooperative Program in Atmospheric Modification Research (or NOAA-AMP). *Reinking* [1992; 1985] and *Golden* [1994] reviewed the objectives and goals of the NOAA-AMP. *Reinking* [1993] compiled a comprehensive bibliography of the basic and applied research accomplishments of the NOAA-AMP.

Weather modification was last reviewed for the International Union of Geodesy and Geophysics (IUGG) for the period 1979-1982 [*Dirks,* 1983]. At that time, the *Weather Modification Advisory Board Report* [1978] stressed that significant strides needed to reach ``levels of objectivity, respectability, and predictability'' before new knowledge and results would be widely accepted. Since then, sufficient progress has been made to warrant both the *American Meteorological Society* [1994] and the *World Meteorological Organization* [1994] to issue revised policy statements on weather modification.

This review is limited to atmospheric research that is pertinent to planned weather modification. The focus is on physical studies and evaluations made from exploratory cloud seeding experiments. The large body of research on natural clouds and atmospheric systems that, by inference, might provide additional scientific basis for weather modification is beyond the scope of this review. Relevant progress from intervening years is also included for continuity. The decision was made not to cover inadvertent weather modification because it has been almost completely encompassed by research related to regional and global climate change. Reviews that address progress in cloud and precipitation research, in addition to several reviews related to inadvertent weather modification are provided elsewhere in this quadrennial report. Three major topics are addressed: augmentation of precipitation from summer convective clouds, hail suppression, and enhancement of precipitation from winter clouds.

Next Up Previous

Next: Precipitation Augmentation---Summer Convective **Up:** Progress in planned weather **Previous:** Progress in planned weather

U.S. National Report to IUGG, 1991-1994
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