policy statement of the American Meteorological Society on purposeful and inadvertent modification of weather and climate

As adopted by the Council on January 28, 1973

Introduction

Man's ability to alter certain local weather conditions, either purposefully or inadvertently, in some areas is clearly established. However, most atmospheric scientists agree that man's ability to significantly alter the atmospheric environment in a purposeful manner is still in the early stages of development. Adequate research and operational support in the 1970s should permit major advances in developing weather modification techniques in the next decade.

A new statement by the American Meteorological Society (AMS) to inform the public and to answer scientific questions about weather and climate modification is therefore timely, and also useful in setting national scientific priorities. Specifically, four conditions have been significantly altered since the last AMS statement, issued in 1967, and the changes which have dictated this new statement include: 1) advances in knowledge and techniques of planned weather modification, 2) new evidence of urban-related inadvertent weather or climate modification, 3) a growing need to assess the partially developed and rapidly evolving weather modification technology in light of public interest and concerns, and 4) a need to issue recommendations regarding essential future weather modification efforts.

Status of planned weather modification

As we move into the 1970s there is mounting scientific evidence that cloud seeding using ice nuclei can produce substantial, albeit local, changes in clouds and storm systems. Definitive success in dispersing fog and in increasing rainfall and snowfall has been achieved in the United States and elsewhere in the 1960s.

Fog. Dissipation of cold (supercooled) fogs and low stratus is established as an operational application with clear economic benefits. Warm fog dissipation can generally be accomplished by expensive techniques, but a reliable and economically acceptable technique for dissipating warm fogs on a local scale is not established.

Precipitation. Precipitation amounts from certain cold orographic clouds in winter can apparently be substantially increased or decreased on a predictable basis, and thus seeding of these types of clouds for economic benefit appears to be justified. Seeding of cold orographic clouds sometimes increases, sometimes decreases, and sometimes has no effect on precipitation depending on the meteorological conditions. Overall increases from 5 to probably 30%, depending on location, seem reasonable with existing technology for certain mountainous areas of the western United States. Attempts to increase precipitation from convective clouds have provided local increases under certain circumstances, and under other circumstances local decreases. Too little is known about the physical, chemical, and dynamical processes of convective precipitation to make the outcome predictable in most areas. Precipitation increases from non-orographic and non-convective cloud systems, such as the shallow stratiform winter storms of the central United States, have not been demonstrated; but in theory, at least, it is possible to increase or relocate precipitation from such systems. There is also some evidence that precipitation alterations may occur 100 kilometers or more beyond the primary seeded areas, but much more proof and a better understanding of these "downwind effects" are needed.

Severe Storms. Results from efforts to mitigate the destruction of severe storms can be classed as encouraging but still indeterminate. Positive but unsubstantiated claims and growing optimism best describe results from lightning suppression efforts in the United States, recent hail suppression programs in the United States and abroad, and hurricane modification efforts in the Atlantic. Less optimism surrounds the possibilities of inhibiting tornadoes and severe local rainstorms. Too little controlled experimentation concerning modification of severe storms has been conducted to provide sufficient credible evidence of success. Recent evidence, particularly that from the Soviet Union and Europe, of hail suppression appears to make it more credible than the evidence for the control of other forms of severe storms

Inadvertent weather modification

There is growing worldwide concern over man's inadvertent modification of weather and climate. Urban-industrial pollutants (thermal, gaseous, and particulate emissions) have been shown to alter urban weather and climate, and new evidence establishes that alterations occur in clouds and precipitation from 8 to 80 kilometers downwind of urban-industrial sources. Recent investigations of major shifts in land use practices, such as irrigation and different cropping, have pointed to possible alterations in weather and climate over substantial regions.

Man's effect on global climate is suspected, since his activities have resulted in regional changes in the cloud cover and surface albedo, and widespread increases in CO_2 concentration and particulate concentration. However, there is no clear evidence yet that these changes have accounted for any substantial part of the climatic fluctuations of the past century.

Public issues

Recent advances towards achieving planned "weather management," and an awareness of the reality of inadvertent weather modification, make it imperative that a great deal more be understood about their social, ecological, and legal implications. Limited economic and ecological studies of the potential effects of planned weather modification have produced conflicting results that point to the need for comprehensive socioeconomic studies. Before planned weather modification becomes a widely applied technology, comprehensive analyses of the overall public interests on a local, regional, national, and international scale must be made in order to achieve rational judgments and decisions concerning the wise use of weather modification.

Recommendations

Significant progress in weather modification has occurred in recent years. It has been demonstrated that man can and does modify the weather. However, we still have much to learn about the following subjects: 1) the exact atmospheric conditions in which it is possible to increase, decrease or relocate precipitation; 2) those techniques that might reduce the damage caused by severe storms; or 3) the extent of climatic change being produced inadvertently by man. These three items should be included among the major goals of our national program in weather modification, and more unified and stronger federal programs must be developed to meet the demands created by a society which is increasing in size and complexity.

Some specific recommendations regarding weather modification activities in the 1970s include:

1) development of improved numerical models of convective clouds and storm systems relevant to weather modification efforts;

2) performance of comprehensive, randomized experiments involving precipitation enhancement and redistribution in each of the major climatic zones of the United States in each season and for each of the principal forms of precipitation, with provisions for evaluations of downwind effects;

3) pursuance of fundamental research and field experiments to ascertain means of mitigating severe storms (thunderstorms, hail, hurricanes, and tornadoes);

4) extended research on operational warm fog dispersion;

5) creation and expansion of facilities and expertise devoted to this subject, including application of current satellite programs, cloud physics research laboratories, laboratories for developing seeding devices and seeding agents, instrumented vehicles for penetrating severe storms, and statistical research groups; and

6) encouragement of programs to study inadvertent weather modification (a) by monitoring conditions critical to the global climate and man's well-being, including pollutants, water vapor, cloud cover, surface albedo, and heat balance, and (b) by measuring and defining the influences of urban development and land-use change on weather and climate.

For additional information

A few of many possible references were selected for this list describing the progress in all phases of weather and climate modification in recent years. Inclusion of a reference does not necessarily imply our sanction of the views or findings, but indicates it is a source of additional information for the interested reader.

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