NCAR Information Release

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Special to CAMERA's Outlook Section

NCAR MEETS THE CHALLENGE OF THE 80s

Thunderstorm-spawned wind shear events, which almost certainly caused several commercial airline accidents in the mid-1970s, is one of the many subjects of research which the National Center for Atmospheric Research (NCAR) will focus on as it meets the challenge of the 80s. The Boulder-based facility, nestled at the base of the Rockies at the west end of Table Mesa Drive, is sponsored by the National Science Foundation and operated by the nonprofit University Corporation for Atmospheric Research, comprising 49 universities with graduate programs in the atmospheric sciences.

NCAR was created in 1960 to provide a focus for vigorous and coherent efforts in atmospheric research--concentrating on problems of national and global import--to produce knowledge that can lead to better-informed policies and actions concerning our atmospheric environment. Its two broad missions are to initiate, coordinate, and conduct research that requires long-term, cooperative efforts among scientists at NCAR, universities, government laboratories, and other institutions, and to develop and provide facilities and related services for the atmospheric research community. Among these are facilities for scientific ballooning, research aviation, computing, and field observation and instrumentation. NCAR's research efforts include these major areas:

Climate

Climate is the matrix in which the weather develops, and as understanding of it grows so does the ability to predict weather. The climate is not stable but

rather fluctuates from ice ages to warm periods together with shorter-term swings, such as the severe winter of 1978-79 in Chicago, the 1930s Dust Bowl in the U.S., and the drought in Africa's Sahel. Some NCAR scientists study climate by simulating subtle influences on the gobal atmosphere with the most advanced scientific research computers available. Using various mathematical models, other NCAR scientists investigate the climatic effects of events such as injections of volcanic dust, variations in solar radiation, increases in carbon dioxide, and various human influences. Historical climate changes are also studied for clues to future climate behavior.

The Solar Connection

Studies at NCAR of solar behavior over the last century indicate a connection between solar cycles and the earth's climate that may be useful in predicting climate trends.

The research at the High Altitude Observatory (HAO) of NCAR, by Ronald L. Gilliland, follows studies by HAO colleagues and other scientists which show that the sun's diameter has been shrinking, at least over recent centuries. In particular, Gilliland has shown that in addition to this long-term trend, there are variations in the rate of shrinkage, and presumably, therefore, in the luminosity--or brightness--of the sun. Gilliland's analysis of all available data for the solar diameter showed variations of the diameter over periods of about 12, 22, and 76 years.

Using a simplified climate model, Gilliland examined temperature trends in the earth's Northern Hemisphere over the past 100 years. His model produced average Northern Hemisphere temperatures closest to those observed when not only volcanic activity and the worldwide increase in carbon dioxide were taken into account, but also when brightness variations of the sun, including the three-mentioned periods were also introduced. Although the magnitude of change of the solar luminosity over these three periods predicted by Gilliland is only detectable

with modern space-borne instrumentation, the effect may be significant in altering our worldwide climate. Research is continuing on the relationships between cycles of solar luminosity and the possible response of the earth's climate by scientists at NCAR as part of their quest to meet the challenge of change in the 80s.

Weather Prediction

Since weather is the short-term variation of many of the same interacting factors that determine climate, global weather patterns are also studied with computer models at NCAR. On a smaller scale, NCAR scientists are investigating the formation of weather in the layer of the atmosphere closest to the earth where forecasting has improved gradually but remains a frustrating mix of science and conjecture. These studies are directed mainly at convective storms, windstorms, and tropical weather, using a variety of advanced techniques for measuring and modeling. Studies of the formation and growth of raindrops, ice crystals, and hail, and the dynamics of severe storms by NCAR's Convective Storms, Atmospheric Analysis and Prediction, and Atmospheric Technology Divisions, should lead to more timely and accurate storm warnings and may provide ways of reducing the severity of some storms.

Radar techniques and automatic ground-based weather station systems, developed by NCAR scientists, represent important contributions in the ability to observe storms in ways that will greatly improve local forecasts in the future.

Using networks of radars and ground stations, combined with radio links and computers that make these observations instantaneously available at a central location, NCAR scientists can provide an up-to-the-minute, three-dimensional analysis of current weather situations. During the 1980s, similar arrays, deployed in a heavily populated regions such as Denver, could serve many uses, including evaluation of air pollution episodes, provision of wind data to commercial aircraft en route and at airports, as well as identification of storm systems moving into or across the region, in order to give the public timely and accurate warnings of such events as snow squalls, high winds, and hailstorms.

A dual-wavelength color Doppler meteorological radar, recently developed by NCAR, can not only detect and differentiate among hail, rain, and droplets in clouds, but can also identify air movements that are likely to lead to storm development.

Dozens of small stations of the NCAR portable automated mesonet (PAM) system automatically measure pressure, temperature, winds, and other weather factors and radio tham quickly to a base station where the data can be displayed on a TV-like screen for immediate assessment. A similar system using satellite communications is under development at the Boulder facility.

NCAR scientists are working closely with other groups around the nation to improve such techniques, and they are participating in the planning of a national research program on local and regional weather and storm systems.

Atmospheric Quality

The shifting balances of minor substances in the atmosphere--such as ozone, carbon dioxide, and acids--may influence weather and alter climate. NCAR research into these subtle variations includes observations of the composition of the atmosphere, determination of the mechanisms that maintain and perturb the atmosphere's chemical and radiation balance, and construction of mathematical models that predict trends in the earth's chemical and physical environment. Scientists with NCAR's Atmospheric Chemistry and Aeronomy Division, working with university colleagues throughout the U.S., have recently determined that airborne acids form mainly within clouds and fuse with cloud droplets before leaving the cloud. The scientists, participants in the Acid Precipitation Experiment (APEX), are using data collected by NCAR aircraft in 1979 and 1980 over the Ohio River Valley and the Adirondack Mountains of New York State. Where the acids form is an important factor in understanding the complex chain of events between emission of pollutants in highly industrialized areas amd the occurrence of acid rain downwind.

The APEX team is now investigating how the necessary reactions occur in the cloud to produce the nitric and sulfuric acids found in acid rain. Especially, they seek to understand why, over the past 15 years, the increase in sulfates found in precipitation downwind from industrial areas has not kept pace with increases in sulfur dioxide emissions. It has been believed that an essential intermediate compound, hydrogen peroxide, was generated in only limited quantities, thus inhibiting the formation of acids in the clouds. APEX studies indicate, however, that hydrogen peroxide does not play a limiting role. The APEX group is now continuing research on what other limiting factors may exist.

Understanding the complex events leading to acid rain is essentail to determine what effects various regulatory steps might have in decreasing the severity of acid rain, and thus to serve as a sound basis for determining which regulations would be most effective in the future.

- The End -

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PHOTO CAPTIONS FOR NCAR Meets Challenge of the 80s story - Outlook Section

#1030-36 - The Mesa Laboratory in Boulder, Colorado, designed by architect I.M. Pei, is NCAR's headquarters and principal laboratory. The building is open to visitors for self-guided tours 8 a.m. to 5 p.m. weekdays and 9 a.m. to 3 p.m. weekends and holidays. And the mesa site and marked Mesa Nature Trail are always open to hikers, who are welcome to leave their cars in the parking lot while they enjoy the mountain parklands. (Please print this information in a box if you do not use the photograph.)

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#5490C-194 - The National Scientific Balloon Facility, a permanent NCAR installation, at Palestine, Texas, provides balloon flight services to scientists worldwide.

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980C-34 - The twin-jet Sabreliner, one of four instrumented aircraft NCAR operates to serve the scientific community.

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#2044B-1 - NCAR scientists and colleagues around the world collaborate to make ground-based and satellite observations of the solar atmosphere.

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#4614BC - The CRAY-1 computer, located at the National Center for Atmospheric Research in Boulder, Colorado, is the fastest computer in the world working on atmospheric problems. Its starting speed is a stunning 80 million computations per second. NCAR's Scientific Computing Division computers make it possible for scientists from more than 100 institutions to do advanced modeling and data analysis related to problems in climate, weather prediction, storm development, atmospheric chemistry, solar physics, and other fields.

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Please credit: The National Center for Atmospheric Research/National Science Foundation