How do atmospheric disturbances over the Pacific Ocean trigger major storms in Europe?

Can new forecasting systems help guide airplanes flying over complex terrain?

What happens to air pollutants downwind from one of Earth's growing tropical megacities?

To solve these and other pressing research questions, NCAR is working with scientists around the globe. The collaborations are of mutual benefit, providing nations with information about global weather and climate patterns as well as regional problems such as typhoons and wildfires.

“One of our principal goals is to advance research for the benefit of society,” explains NCAR director Tim Killeen. “We are always striving to serve the world community of scientists.”

NCAR’s international focus is particularly important as scientists piece together the global nature of our climate system.

Researchers at institutions across the United States and overseas share observations and computer models to home in on worldwide atmospheric patterns, such as the interactions between ocean temperatures and continental precipitation or the impact of tropical storms on midlatitude climate patterns. NCAR’s collaborations also extend beyond the Earth system, as scientists join forces to study the Sun’s mysterious magnetic fields and hunt for planets in other solar systems.

Pierre Friedlingstein of the Laboratory of Climate Science and the Environment in France, who works regularly with scientists at NCAR and elsewhere, says international collaboration is necessary to unravel the complexities of the atmosphere. “The climate issue is too important to be addressed by one single group,” he says. “The multiple brains approach is the most successful. You need different views, methods, and modeling approaches to get a better grip on the science.”

Founded in 1960 to study every part of our planet’s atmosphere, NCAR has spearheaded numerous types of international collaborations.

Field projects. NCAR researchers have helped to coordinate and conduct many of the landmark field experiments in atmospheric science of the last two generations. Multinational field programs such as the Global Atmospheric Research Program, World Ocean Circulation Experiment, and others have shed light on such essential atmospheric processes as the role of the oceans in global climate and the forces that generate life-sustaining monsoons.

Now NCAR is laying the groundwork for a series of new international field experiments. For example, the upcoming Megacity Impacts on Regional and Global Environments project will track air pollution that disperses from Mexico City, giving scientists insights into the regional impacts of urban pollution. NCAR scientists are also working with colleagues from several nations on a field program to study African monsoons, which will have the additional benefit of providing important training to students in Africa about scientific techniques.

Technology transfer. NCAR often collaborates with nations that need help coping with inclement weather and other hazards. After aircraft disasters in Taiwan, for example, NCAR scientists designed
and installed an advanced weather information and warning system for the Taiwan Civil Aeronautics Administration. NCAR has also equipped Australia, Burkina Faso, and other nations with tools such as new software systems to track atmospheric events, and it is collaborating with officials in the Middle East on an innovative project to study whether new technologies can generate more rain in arid regions.

**Instrument building.** To design and build the best possible research instruments, scientists from several countries frequently combine efforts. In one landmark project, NCAR researchers are working with colleagues in Germany and Spain to create a powerful solar telescope that will give scientists unprecedented views of the Sun’s small-scale magnetic fields that drive solar variability and affect Earth’s atmosphere. NCAR is collaborating on a number of other important research tools as well, including the creation of a unique lidar (a laser-based instrument) to measure water vapor.

**Computer modeling.** NCAR is home to one of the world’s premier computer climate simulators, the Community Climate System Model. The model’s underlying code is available to scientists throughout the United States and overseas, spurring important research collaborations into what Earth’s climate looked like in the past and how it is likely to change in the future. NCAR also shares other computer models with overseas collaborators, including weather models to help societies anticipate storms and wildfire models to scrutinize massive blazes.
**Data collection.** A key challenge for atmospheric scientists is piecing together limited records of weather and climate. NCAR researchers are working with their counterparts in Russia and China to digitize ship observations of weather events around the world dating back to the 19th century. In another major project, NCAR is collaborating with scientists in the United Arab Emirates to construct a climate database to help that desert nation manage its water resources.

**Global research initiatives.** Beyond conducting its own research, NCAR helps set the agenda for, and contributes to, worldwide research initiatives. Its scientists sit on the boards of international science bodies, such as the World Climate Research Programme and the International Geosphere-Biosphere Programme, that guide work in key climate and weather areas. In addition, NCAR scientists are among the lead writers of the assessments of the Intergovernmental Panel on Climate Change. The periodic assessments, which rely in part on NCAR data analyses and computer models, provide important guidance to policy makers and researchers.

**Education programs.** Year in and year out, NCAR provides training for scientists around the world. This sometimes takes the form of a specialized project geared toward international scientists (see “Training Young Scientists,” page 7). But much of the training is embedded in ongoing programs. Every year, NCAR’s Advanced Study Program brings 10–15 postdoctoral scientists from the United States and abroad to Boulder conduct research in critical areas with NCAR scientists. NCAR benefits from
Training Young Scientists

For Mitali Das Gupta, a doctoral candidate in energy economics at Jadavpur University in India, air quality in New Dehli and Calcutta is a major concern. “People in those cities breathe really dirty air and also pay a heavy economic price for the cities’ emissions,” she explains.

NCAR, which fosters worldwide research into the critical area of urban emissions, is providing mentoring and other support for Das Gupta and 18 of her colleagues. The young researchers are taking part in a two-year project that seeks to explore the impacts that cities around the world have on air quality and climate change. With urban areas growing ever larger and emitting significant amounts of pollutants, this is an increasingly important topic in public health.

Helping to orient the researchers, NCAR in 2003 hosted the Advanced Institute on Urbanization, Emissions, and the Global Carbon Cycle, a three-week intensive overview of issues related to urban emissions. “The problems ahead are very complicated,” warned Rosendo Pujol, an instructor at the institute and director of the Research Program on Sustainable Urban Development at the University of Costa Rica. He told the students, “You are the generation that needs to find solutions.”

Participants consist of a diverse mix of young engineers, urban planners, and social and natural scientists. Chosen from a large pool of international applicants, most are from developing nations where they are either pursuing doctoral degrees or are in the early and middle stages of their careers.

They enjoyed their time at NCAR scrutinizing the sources and possible impacts of urban emissions on the crowded, warmer world of the 21st century. “I’m here because I want to gain knowledge and keep up to date so I can transfer what I know to students,” said Dewi Kirono, a lecturer on climate and urban air pollution at Gadjah Mada University in Indonesia. “I also want to build a network to know what others are doing and strengthen my research capability.”

NCAR scientist Robert Harriss is helping to oversee the young scientists’ progress. The participants plan to reconvene in late 2005 to present their final reports.

For more information: www.isse.ucar.edu/start

Another program offers research fellowships to graduate students at universities in the United States and overseas. Named for Gordon Newkirk—a former director of NCAR’s High Altitude Observatory—the program is aimed at young scientists who study solar physics, the dynamics of the upper atmosphere, and related fields.

This publication provides highlights of NCAR’s international collaborations, organized by region. For more on these and other efforts at NCAR and UCAR, see www.ucar.edu.