INCREASING RAIN IN THE DESERT

From three continents come new ways of solving an old problem

Because of a population boom in the United Arab Emirates (UAE), government leaders are facing a fundamental challenge: keeping up with demand for water. The mostly desert country, which has grown from about 50,000 residents in 1975 to more than 3 million today, relies on desalination plants and underground aquifers. But desalination is very costly, and the aquifers are quickly becoming depleted.

In the past few years, the UAE has begun to explore an innovative solution. What if modern technology could produce more rain?

Scientists at NCAR, the UAE Department of Water Resource Studies, the University of Witwatersrand in South Africa, and elsewhere are analyzing the potential for cloud seeding. They hope to find storm clouds that can be induced to release rain over regions where the water would most benefit society by falling on crops or replenishing aquifers.

“This is a multidisciplinary analysis that considers hydrology, cloud science, atmospheric chemistry, and other disciplines,” explains NCAR scientist Roelof Bruintjes, who oversees the project. “Increasing the rainfall is just one aspect. We also have to consider what the impact would be. It might not help to seed clouds over a desert. If 90% of the rainfall evaporates, it may not be worth it.”

Making droplets bigger

NCAR is building on weather modification projects it has led or participated in over the last few years in Mexico and South Africa. The center has refined a technique to increase the size of particles in clouds and promote the coalescence of water droplets.

Called hygroscopic seeding, this technique uses flares mounted on aircraft to seed clouds with small salt particles. Water droplets can bond to the particles and grow large enough to fall out of the cloud as rain.

Initially, researchers used airplanes and a network of radars to examine clouds that form along the UAE’s coast during the winter. But only about 10 frontal

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Getting Help from Schoolchildren

When scientists from several nations head to Africa for a field project over the next few years to study the West African monsoon, they plan to tap an important resource: local primary and secondary school students.

The children are participants in GLOBE, a U.S. science program that enlists teachers and students from thousands of schools across the world.

NCAR’s Peggy LeMone is the chief scientist of GLOBE. She believes the field project, known as the African Monsoon Multidisciplinary Analysis (AMMA), provides an excellent opportunity for scientists to draw on West African students to collect local data on rainfall and other weather parameters. The students, in turn, will learn more about the scientific process.

“This will help both scientists who need to collect data across a wide area and students who want to be involved in real science and experience the excitement of a field campaign,” LeMone explains.

AMMA, a French-led project that includes scientists from Europe, the United States (including NCAR), and Africa, will seek to learn more about the monsoon and what causes it to vary from year to year. Researchers will also look at the monsoon’s impact on health, food security, and water in West African nations.

GLOBE students may pitch in on other major field projects, including the upcoming MIRAGE campaign in Mexico City (see “On the Trail of Urban Pollution,” page 24).

For more information: www.globe.gov or www.joss.ucar.edu/amma

Restoring Lake Victoria

Lake Victoria, Africa’s largest lake, is so immense that it influences regional climate. But pollution and the introduction of predatory species have changed the character of the lake, decimating the local fishing industry and leaving millions of people without a vital source of nutrition.

NCAR scientist Michael Glantz, who specializes in the societal impacts of natural events, has worked with the U.N. Food and Agriculture Organization to list the Lake Victoria Basin among the world’s important ecological and social hotspots. He is providing support to scientists in the countries bordering the lake who are working on a restoration program.

Glantz believes researchers need to increase scientific understanding of Lake Victoria’s ecosystem and its impact on both human population and climate. The goal is to restore the lake as much as possible and to ensure that future activities do not deplete its important resources.
systems form during a typical winter, and fewer than half contain the convective motions needed to produce rain.

Researchers next turned to the Oman Mountains, which form the boundary between Oman and the UAE. Although the mountains had received little attention from climate scientists in the past, the team discovered that clouds there typically form and release rain during about 40 days in the months of June, July, and August.

The research team has launched a randomized experiment to seed clouds over the mountains, measure the resulting rainfall, and trace the movement of the water once it reaches the ground.

In the near future, NCAR is likely to expand its research on weather modification to other regions as well. Oman is considering working with the center to build on the UAE program, and officials as far away as Thailand may explore the technology.

The African nation of Burkina Faso, where many rely on subsistence farming, may also benefit from weather modification. With technical assistance from NCAR, Burkina Faso has implemented a pair of state-of-the-art software systems to support cloud seeding efforts. The software is used to display and analyze radar data about cloud systems and precipitation, thereby guiding cloud seeding operations and helping scientists evaluate the results.

Bruintjes cautions that weather modification is still a developing field. In Mexico and South Africa, hygroscopic seeding trials produced more rain 30 to 60 minutes after seeding. But researchers need to conduct more experiments to evaluate the extent to which overall precipitation was increased.

Even if hygroscopic seeding proves effective in the UAE, that does not assure its success somewhere else. Only certain types of clouds produce rain. And air pollution may complicate the situation by changing the dynamics of clouds and precipitation.

Bruintjes stresses that nations interested in weather modification need to conduct thorough research before launching a full-scale program.

“If cloud seeding works in one area, it may not work in another,” Bruintjes says. “We shouldn’t just go out there and seed clouds blindly and hope for the best.”

For more information:
www.ral.ucar.edu/projects/UAE
As parts of Africa remain dangerously vulnerable to drought and famine, scientists are beginning to investigate the role of the Atlantic Ocean on the continent’s climate. NCAR’s James Hurrell is working on a research project with the University of Cape Town in South Africa and other institutions to study both the impact of the ocean and how industrial output may change Africa’s future climate.

The research focuses on several Atlantic phenomena that have implications for climate hundreds or thousands of miles away. These include the North Atlantic Oscillation, which is a seesaw in atmospheric pressure that influences weather across several continents, and tropical Atlantic variability, which alters sea surface temperatures. Such events affect freshwater and saltwater circulation in the ocean, exchanges of heat and energy between the surface of the ocean and the lower part of the atmosphere, and winds over the ocean. All these factors play a role in rainstorms and other weather events over Africa.

“The Atlantic basin is filled with many different and interesting phenomena,” Hurrell explains. “What we’re trying to do is see how the whole system works.”

The scientists are especially concerned about the impacts of industrial output on the North Atlantic Oscillation. Studies indicate that emissions of carbon dioxide and other greenhouse gases are warming surface waters, potentially causing the oscillation to remain stuck in a phase that could limit precipitation over Africa.

For more information: www.eo.ucar.edu/spotlight/nao