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Tinkering with clouds

Researchers say evolving technologies could allow manipulation of major weather patterns. But should humans tamper?

By Peter N. Spotts | Staff writer of The Christian Science Monitor

On Sept. 11, 1992, hurricane Iniki slammed into the Hawaiian island of Kauai, packing winds gusting up to 175 m.p.h.

The storm inflicted an estimated $2 billion in damage and 105 casualties, damaged or destroyed 10,000 homes and businesses, and left once-lush tropical mountainsides looking as though they'd been mowed by a giant weed-whacker.

Ross Hoffman, an atmospheric scientist, looks back on the tragedy and asks a daring question: What might it have taken to nudge the hurricane's track 70 miles farther west - just enough to avoid the damage and casualties the storm left in its wake?

Over the past two decades, the idea of modifying large-scale storms such as hurricanes has lain dormant, following 20 years of inconclusive research. Now, however, a small group of atmospheric scientists is giving the concept a fresh look.

Armed with a deeper understanding of how the storms and atmosphere work and with more

sophisticated tools to measure and model atmospheric conditions, these scientists are seeking to move from Mark Twain's lament that no one does anything about the weather toward science-fiction writer Arthur C. Clarke's vision of modifying weather for humanity's benefit.

It is a long-term vision, acknowledges Dr. Hoffman, a vice president with Atmospheric and Environmental Research, Inc., a research and consulting firm in Lexington, Mass. Tugging on a hurricane's atmospheric reins is at least 30 to 40 years away, he estimates.

Others, such as Massachusetts Institute of Technology atmospheric scientist Kerry Emanuel, suggest such capabilities are "perhaps 100 years out."

"Before we can really control weather," Hoffman says, "we have to be able to observe the weather and forecast the weather much better than we do now."

More broadly, he adds, society must grapple with an increasingly common question as science places in human hands the ability to manipulate a range of physical processes at their most fundamental levels: "Even if we can do this, is this something we really want to do?"

Human activity has been a factor in weather

Indeed, humans have been modifying weather inadvertently as well as intentionally for decades.

For example, researchers in 1998 and 1999 looked at the impact of air pollution over the

Indian Ocean. They found an unexpectedly large amount of pollution, including dark soot and the much tinier dark aerosols, over the northern Indian Ocean. The soot came from burning coal and wood and from inefficiently burned diesel fuel on the Indian subcontinent. Researchers discovered that the soot and dark aerosols reradiated heat from the sun, drying out the surrounding air and suppressing cloud formation.

Meanwhile, according to the United Nations' World Meteorological Organization (WMO), at least 25 countries are engaged in weather modification projects to enhance rain and snowfall, or suppress hail. In the United States, 12 states have had weather modification programs. Texas runs a program at the county level for rain enhancement, while North Dakota is focusing on hail suppression.

These efforts have grown out of research dating back to the late 1940s, when scientists first discovered that dry ice and silver iodide particles could act as seeds to stimulate droplet formation in clouds.

While the concept has been easy to demonstrate in the lab, meeting the same level of scientific proof in the field has been more difficult.

A range of studies over the years has cast doubts on cloud-seeding techniques, especially the use of dry ice particles.

Natural variability in clouds and rainfall make it hard to verify scientifically if seeding is having any affect, says Brant Foote, director of the research applications program at the National Center for Atmospheric Research in Boulder, Colo.

Researchers seeded hurricanes in a 20-year federal research project dubbed Project Storm Fury. Scientists were testing the idea that seeding could be used to take some of the punch out of hurricanes before they made landfall. But the program foundered on inconclusive results.

Federal funds for weather-modification research have dried up as well. According to Colorado State University atmospheric scientist William Cotton, federal dollars for weather modification research peaked at roughly $19 million a year in the 1970s. They dropped to less than $5 million a year during the '90s, and now hover at about $500,000.

The field has entered what Dr. Cotton calls the "dark ages," where weather-modification programs are forging ahead with little or no scientific research programs to back them. The efforts are driven by dwindling groundwater supplies in many parts of the world, along with the demands growing populations are placing on rivers and reservoirs.

Yet, some analysts say, the science behind climate and meteorology has advanced to the point where weather modification deserves another, closer look.

"We know so much more about the physics, and computer modeling is so much better, that it's time to revisit the subject," says James Baker, former head of the National Oceanic and Atmospheric Administration.

Before leaving office, Dr. Baker commissioned a National Research Council study on weather-modification science and future research needs. The results are due by April.

In the meantime, researchers are finding funds where they can. Hoffman, for example, has drawn funding from the National Aeronautics and Space Administration's Institute for Advanced Concepts in Atlanta for modeling studies he and his colleagues have been carrying out on hurricane Iniki. "We're not aiming to eliminate hurricanes, but to control their paths so they do not strike population centers," he says.

Initial results in a "proof of concept" simulation suggest that Iniki could have been nudged sufficiently with one-time changes in sea-level temperatures and winds roughly 30 hours before landfall. To trigger those changes artificially in one shot, however, "would take way

too much energy.... It's unrealistic," Hoffman acknowledges.

He adds, however, that any operational system for steering severe storms would likely make several less energy-intensive changes as time progresses. A second round of modeling now under way is aimed at more clearly identifying the energy needs such efforts might require.

MIT's Dr. Emanuel notes that while some of the approaches to delivering or removing the energy needed to shift weather systems are exotic, they needn't be.

Even a 1 degree Celsius change in temperature can have a large effect over time, he notes. That change could be achieved by having aircraft lay out "black contrails" - thin manmade clouds - roughly 600 miles long and 60 miles wide to cool the atmosphere beneath by obscuring sunlight.

Potential ethical and legal implications

Yet as researchers weigh the scientific and technical aspects of large-scale weather modification, they remain mindful of its two-edged nature.

Hoffman notes that during the Vietnam War, the US military seeded monsoon clouds in Operation Popeye in an attempt to use weather to hamper troop and supply movements along the Ho Chi Minh Trail. When information about the program was declassified in the mid-1970s, the international community established the UN Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques.

Several scientific bodies, such as the WMO and the US American Meteorological Society, have issued cautionary policy statements on weather modification.

But Hoffman notes that a broader discussion is needed as technologies emerge that make large-scale weather modification possible. "If these trends continue, in a few decades we'll have all the parts we need to put a system together."

The ethical and legal implications are vast, he says. "Any change in weather helps some people and hurts others. Cost versus benefit is a difficult question. Is this something we want to do?"

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