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Science

Riders on the Storm

Can meteorologists armed with supercomputers and a few tons of soot stop a hurricane from reaching the Gulf Coast? Can they stop it without getting sued?

by Graeme Wood

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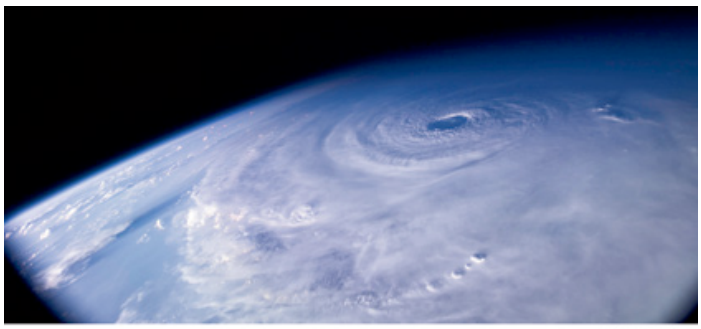

NASA/JSC

Most of the hurricanes that strike the United States are born off the coast of West Africa, and nursed on tropical waters. As air warmed over the Atlantic surges up to meet the cool atmosphere, its heat turns into kinetic energy, creating a violent twist of wind and rain. The bigger the temperature difference between the hot sea and the cold upper air, the more furious the storm can grow.

Climate scientists, aided by ever-more-powerful computer models, are investigating whether it's possible to choke these storms slowly, during their long drift west. They want to attack big hurricanes from above or below, sapping the storms' strength by either heating up their chilly tops or chilling their hot underbellies. According to some models, well-timed interventions could diminish a hurricane by 40 percent—enough to turn a possible Category 5 storm into a mere Category 2 or 3, which would break windows and wreck trailer parks but leave most buildings intact.

An atmospheric-science team from Israel and Colorado, led by Daniel Rosenfeld, has proposed seeding a hurricane's lower reaches with tiny particles, such as microscopic bits of salt. According to Bill Woodley, one of the team members, the storm's water vapor would condense on the particles, forming droplets too small to fall to Earth's surface as rain. Instead, the droplets would remain suspended, rise, and eventually evaporate, thereby cooling the hot air, just as wet skin is cooled in the breeze.

Meanwhile, a Boston-based team aims to attack a hurricane's cold ceiling. Ross Hoffman and Moshe Alamaro, this team's leaders, want to disperse tons of a special kind of soot as high as 50,000 feet—essentially spray-painting the top of the hurricane black, so the heat of the sun can warm the storm's upper layer, just as sunshine warms a black-roofed house. (This approach has obvious ecological drawbacks.)

Both teams of researchers would dump their particles out of large cargo planes, some of which can carry 125 tons or more. In Hoffman and Alamaro's scenario, the planes would disgorge the soot above the hurricane's eye and the storm would disperse it outward. In the other group's plan, planes would disperse the salt particles at the storm's outer edges, to be hoovered up by the storm's churn and delivered to its heart. In both cases, the immediate impact on the hurricane's intensity would probably be negligible, but the effect would compound over time as the storm drifted west. All told, it might take a dozen or so flights a day to set in motion the degradation of a big storm.

That's the theory. In practice, previous efforts to subdue the weather have proven humbling. Hopes for cloud seeding once ran so high that Congress considered literally legislating the weather: The Weather Modification Act of 1951, had it passed, would have aimed for "equitable distribution of precipitation among the states." Some 50 years later, we can barely make rain: Seeding

clouds with silver iodide can increase rainfall by as much as 20 percent, but only under narrow conditions. Airports clear out fog by seeding it and making it fall to the ground as snow, but that works only in extreme cold. As for mitigating hurricanes, the U.S. government sponsored research and experimentation through much of the mid-20th century—Project Stormfury and Project Cirrus were the largest efforts—to little, if any, practical effect.

Many meteorologists scoff at the new anti-hurricane efforts, but the idea's advocates, including a number of highly distinguished atmospheric scientists, are not daunted. They point out that their own promises are relatively modest: Rather than trying to change the weather decisively at a precise location—squeezing rain from blue skies, say, in South Texas—they're just trying to nudge existing storms slightly, in ways that are then slowly reinforced and magnified by the storms' own internal dynamics. And while newly realistic supercomputer simulations have inspired much of their confidence, so has empirical observation: We know that tiny particles of pollution trap water and cool clouds over cities; through the same mechanism, particles of salt would cool and weaken hurricanes. Likewise, when dust blows into a brewing hurricane, the hurricane tends to diminish. Last year, some scientists suspect, the East Coast was spared a severe hurricane season partly because West Africa spewed out an unusually large amount of dust, which traps water in the same way.

Still, few scientists believe these new ideas will be tried outside the computer lab anytime soon. The problem isn't the science. It's the lawyers. Modifying hurricanes entails big risks: Changing a hurricane's environment is likely to also change its path. Indeed, some hurricane researchers, including Hoffman and Alamaro, hope that their interventions will allow them to steer storms away from population centers in addition to diminishing them. But Hoffman says he fears that if his team tampers with a storm and pushes it even a dozen miles off its natural course, the storm could destroy towns that otherwise might not have been hit—and his team could end up drowned in civil suits, even if it's made the storm weaker, or pushed it away from a major city.

"There will never be large-scale weather modification in America," says Charles Hosler, a weather-modification pioneer. "All weather is good or bad for somebody, and when it's bad, that somebody's going to sue." (Hosler would know: He and his colleagues once successfully fought a suit by a tourist who had broken his leg after leaping out of a ski lift that had been struck by lightning. Hosler's group had been studying thunderstorms nearby, and the tourist claimed the scientists were responsible for the strike.)

American courts have been ruling on weather modification since at least the late 1800s, when a judge decided that a preacher who had prayed for rain wasn't liable for the thunderbolt that razed his neighbor's barn in the ensuing storm. (The preacher had prayed only for rain, said the court, not for lightning.) In the mid-1960s, farmers in Pennsylvania sued after fruit growers in the region had called in a cloud seeder to suppress hail over their orchards. (The fruit growers were accused of playing God and causing a drought.) The difficulty of proving causation saved the defendants in court, as it usually does in suits involving weather modification. But the courts have suggested that farmers might have a right to what legal analysts have called the "rivers flowing through [their] skies," just as they have a right to the water under their fields. Stealing clouds could be legally analogous to diverting a stream.

Past attempts to mitigate hurricanes have resulted in both legal and diplomatic headaches. In one early experiment, Hosler says, lawyers for General Electric (which was part of Project Cirrus at the time) counseled the company to keep silent about its cloud-seeding activities, after a storm with which it had been tinkering swerved and battered South Carolina. Fidel Castro later accused American scientists working on Project Stormfury of using hurricanes as a counterrevolutionary instrument of war.

In both cases, the experiments almost certainly did nothing to alter any hurricane's course—their methods, science now shows, were likely hopeless. But that's scant comfort to hurricane researchers today, some of whom may seek legal protection before field-testing their ideas. In a 2006 paper, for example, Alamaro and two collaborators proposed treaties that would eliminate civil liabilities for hurricane modifiers and guarantee compensation for hurricane victims.

Ultimately, whether lawmakers expand protections and financial support for weather modifiers will likely depend on the weather. "If there were another hurricane like Katrina," says Alamaro, "the legislature might initiate laws to help with these issues." Some evidence suggests that hurricanes in the North Atlantic have recently been increasing in strength and frequency, and historically, bad hurricane seasons have sometimes meant more money and support for hurricane-killers. "When people get themselves pounded into oblivion," says Woodley, "they start talking to their representatives." New approaches become more appealing.

Even hurricane-modification advocates admit their cause is risky and expensive. But the defensive crouch that we're in now is expensive, too, and is hardly guaranteed to work: The Army Corps of Engineers has estimated it may need more than $2.5 billion—several times what the hurricane modifiers think they'd need over the next decade—to buttress New Orleans against the next Katrina-level storm. Perhaps in this case it really would be better to fight them over seas, so we don't have to fight them at home.