# NEWS IN FOCUS

**ASTROPHYSICS** Giant Argentine observatory nabs cosmic-ray discovery **p.440**

**SEISMOLOGY** Pair of Mexican earthquakes raises questions for researchers **p.442**

**ECOLOGY** Biologists race to study new Antarctic ecosystem **p.443**

**QUANTUM STATES** Gil Lonzarich uncovers surprising sources of superconductivity **p.448**

BRIAN BLANCO/GETTY

**Flooding near Venus, Florida, highlights the challenges people in the state face when picking up the pieces of their personal and professional lives.**

NATURAL DISASTERS

# Hurricanes send scientists scrambling for data

*Before getting their own lives settled, teams collect information on storms and their effects.*

**BY RACHAEL LALLENSACK**

When Hurricane Irma tore through Florida in early September, 40 scientists took shelter in the Archbold Biological Station, a fortified research facility in the south-central part of the state. They huddled there with friends, family and pets while floods and pounding winds destroyed homes across the state. It will take months for those researchers and others to assess the extent of the destruction left behind by both Irma and Hurricane Harvey, which blasted through the Caribbean and the Gulf of Mexico.

But even as they try to get their own lives in order, scientists across the region have already started gathering data that they hope will improve understanding of how these extreme storms behave, how to improve public safety and how delicate ecosystems react.

It is fairly rare to see such intense hurricanes hitting the US mainland, says Joshua Wurman, a meteorologist at the Center for Severe Weather Research in Boulder, Colorado. When they made landfall, Harvey and Irma were category 4 storms — the second most extreme rating on a scale of 1 to 5 — and their swirling winds were of particular interest to Wurman and his team. So the researchers drove an instrument called a Doppler-on-wheels (DOW) to Texas and Florida to collect data from the eyes of both hurricanes.

The DOW is a mobile Doppler radar dish ▶

bolted onto the back of a flatbed truck that scientists position in the path of hurricanes and tornados. It takes high-resolution measurements of wind speed and direction, as well as the speed and quantity of precipitation, in real time.

Wurman and his colleagues measured a surprising mosaic of wind speeds in Harvey and Irma. Some pockets within the hurricanes had wind speeds of up to 225 kilometres per hour (140 miles per hour), nearly 30% higher than those of nearby pockets. "In Harvey, 140-mile-per-hour gusts were ripping apart buildings and throwing cars," says Wurman. Understanding where the most extreme winds will materialize in a hurricane can help to improve the accuracy of public warnings, he says.

### SHELTER IN PLACE

The DOW crew was able to leave Texas and Florida soon after gathering the data. But the scientists who took shelter in the Archbold Biological Station — which is nestled in the headwaters of the Everglades wetland region in Venus, Florida — live and work in the state.

Evelyn Gaiser, an aquatic ecologist at Florida International University in Miami, was one of the researchers who weathered Irma at the station. After the storm, she says, "we were all outside collecting data".

Roughly 50 researchers work from the station throughout the year, says biologist Hilary Swain, Archbold's executive director. Their projects range from monitoring the area's lakes and ecosystems to carrying on a long-term observational study of a population of Florida scrub jays (*Aphelocoma coerulescens*) listed as threatened by the federal government. Initial checks on the birds found that they had weathered Irma just fine.

Gaiser studies nearby Lake Annie, and found that Irma had upended its temperature profile. Normally, layers of warm water rest on top of cooler layers — but the hurricane brought colder waters to the surface. In the next few months, Gaiser will be monitoring whether or not that inversion has affected the lake's plant communities.

***"It's a little less the science we're worried about. It's the people."***

Another priority for Gaiser is checking on a long-term ecological research project that she oversees in Everglades National Park in south Florida. Officials closed the park on 6 September in preparation for Irma and started reopening certain areas on 21 September. Gaiser is not sure when her team will be able to access the project's sites.

Increased amounts of salt water, carried in by storm surges, can disrupt the delicate balance of fresh- and saltwater systems that shape the region. "Fresh water is the lifeblood of the Everglades," Gaiser says. She is anxious to see how the mix of water from the storm surge, rain and run-off has affected the health of the wetlands, and is planning to submit a proposal for a rapid-response research grant from the US National Science Foundation to help collect those data.

### SALTING A MARSH

Merryl Alber, a marine ecologist at the University of Georgia in Athens, will be taking similar measurements at sites for her own long-term ecological research project on Sapelo Island, a barrier island off the Georgia coast that was also affected by Irma. In an ongoing experiment in the island's freshwater marshes, her team adds diluted salt water to 6.25-square-metre plots to simulate salinity increases from rising sea levels, storm surges or droughts.

After Irma, Alber returned to Sapelo briefly to check her experimental sites. She found that a 1.5-metre-high storm surge had raised salinity to 5 times the base levels in the artificially salted sites.

Irma's storm surge was a naturally occurring amplification of the experiment that Alber and her team have been doing for years, and Alber plans to compare its effects with their past findings. But that will take time. The labs and some of the researchers' homes on the island flooded during the storm.

The team will follow through on its annual data collection at the long-term research sites, says Alber. But with so much destruction in the region, her work isn't the only thing on her mind. "It's a little less the science we're worried about. It's the people." ■

SPACE

# Most-energetic cosmic rays originate outside Milky Way

*Giant observatory in Argentina finally confirms long-suspected theory.*

BY DAVIDE CASTELVECCHI

The Pierre Auger Observatory in Argentina finally has solid evidence that the most energetic particles in nature come from sources outside the Milky Way. Scientists have suspected this for decades, but weren't able to confirm it — until now.

"For the first time, we have proof that the highest-energy cosmic rays are of extragalactic origin," says Alan Watson, a UK astronomer and co-founder of the observatory. The result comes as a relief to the researchers, after previous claims regarding the rays' origin made ten years ago by the Pierre Auger Collaboration turned out to be premature.

The international team analysed 12 years' worth of data, and found that particles in the upper range of energies were more likely to come from a region of the sky outside the Milky Way's disk. That asymmetry is roughly consistent with the distribution of neighbouring galaxies, the researchers report in the 22 September issue of *Science* (The Pierre Auger Collaboration *Science* **357,** 1266–1270; 2017). The study does not pinpoint individual sources of the cosmic rays, or explain how they reach their highest energies. But the researchers hope that it is a first step towards understanding the rays' origins.

Most cosmic rays are protons or other charged particles, including atomic nuclei as heavy as iron. When such a particle collides with an atomic nucleus in Earth's atmosphere, it produces a shrapnel burst of subatomic particles. These hit other nuclei and produce more particles, generating an invisible 'shower' that is often spread over many square kilometres by the time it hits the ground.

To detect these showers, the Pierre Auger Observatory has 1,600 car-sized water tanks at 1.5-kilometre intervals, covering 3,000 square kilometres of grassy plains in Argentina's Mendoza province. Four sets of telescopes monitor the sky over the array, and — on moonless nights — can detect flashes of ultraviolet light generated by the showers. From its location relatively close to the equator, the array can pick up cosmic rays from 85% of the celestial sphere.

The observatory needs to be so big in order to catch enough of the most-sought-after particles. Cosmic rays have been detected