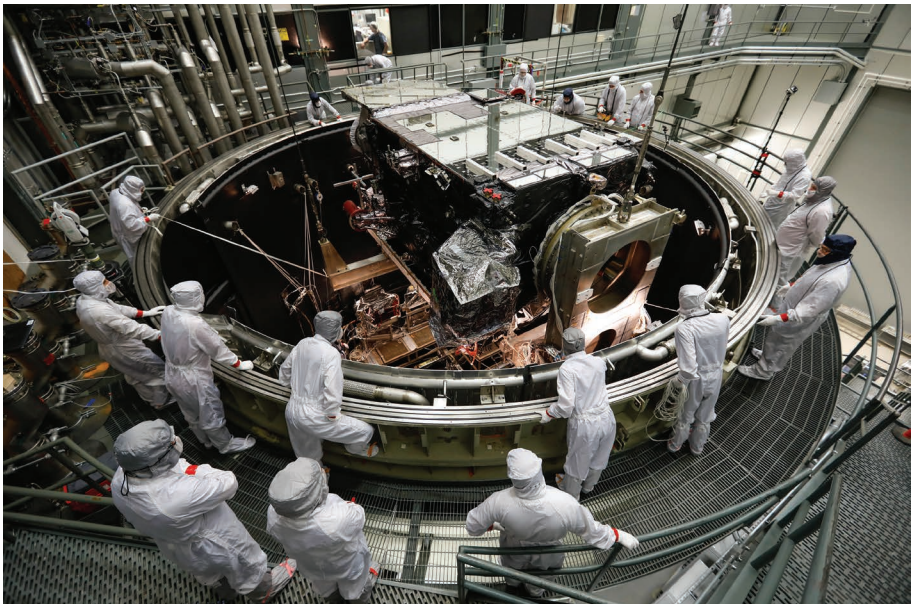

NASA

A US weather satellite undergoes testing in a thermal vacuum chamber before launch.

RESEARCH

Latest US satellite aids forecasters

Scientists tackle obstacles to using data in weather models.

BY JEFF TOLLEFSON

The United States filled a crucial gap in its weather-forecasting arsenal with the launch of its latest geostationary satellite on 1 March. The craft will enable meteorologists to track hurricanes and other threats as they develop. It will also beam down data that researchers can use to measure air temperature and humidity — if they can work out how to incorporate them into their models.

Scientists currently can't use much of the information collected by geostationary satellites, which sit above a particular location on Earth, and polar-orbiting satellites, which swing around the planet's poles. It's a long-standing problem caused by the kind of data collected and the large uncertainties that arise when forecasters try to integrate the measurements into their weather models. Now researchers are starting to overcome these technical challenges, with encouraging results for both short- and longer-term forecasts.

The Geostationary Operational Environmental Satellite-17 (GOES-17) will assume a position above the equatorial Pacific Ocean. When its data are combined with those from the identical GOES-16, which is already parked over the Atlantic Ocean, they will monitor Earth from Africa to New Zealand. Weather forecasters use such geostationary satellites to track storms, and their models incorporate limited data on atmospheric moisture and wind speed and direction.

"There is this huge treasure trove of information," says Fuqing Zhang, a meteorologist at Pennsylvania State University in University Park. He has experimented with incorporating some of the unused data from satellites into his models, with promising results. "We can show dramatic improvements in weather prediction, but you do need a dedicated research effort," he says.

"You can't just take a satellite image and just shove it into the model."

In a study currently in review at the *Bulletin of the American Meteorological Society*, Zhang shows that integrating high-resolution data from GOES-16 into an experimental weather model bolstered predictions of the early development and intensity of Hurricane Harvey, which struck Texas last August.

Without the extra data, a forecast predicted that the storm would become a category 1 hurricane; in fact, it grew into a category 4 monster before making landfall. Zhang also included the additional information in a weather model that the US National Weather Service is planning to roll out as early as this year. Those extra data improved forecasts of precipitation amounts and the storm's path.

Incorporating such information into the models has been difficult in part because geostationary data provide fewer measurements for any given vertical slice of the atmosphere than do polar orbiters, which circle Earth at lower altitudes. That means researchers have less information and higher uncertainties when it comes to translating the data into measurements that the models can use, such as air temperature and humidity.

"It's not trivial," says Dan Lindsey, a research meteorologist with the US National Oceanic and Atmospheric Administration in Fort Collins, Colorado, who works on the current GOES satellites. "You can't just take a satellite image and just shove it into the model."

Meteorologists also struggle to incorporate data on cloudy areas recorded by polar-orbiting satellites. This is because clouds have more-complex microphysics than does the open sky, so even small errors in the models can cascade into large uncertainties in the forecast. And that's the fundamental problem, says Alan Geer, an atmospheric scientist with the European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, UK. "It's those areas with clouds and precipitation that are associated with the most interesting weather."

The ECMWF has been leading the way in this field for more than a decade, and now incorporates much of the data from cloudy regions taken by polar-orbiting satellites; most major government forecasting centres are now following suit (A. J. Geer *et al. Q. J. R. Meteorol. Soc.* http://dx.doi.org/10.1002/qj.3202; 2018). Zhang cites an unpublished analysis comparing the European model with the latest US National Weather Service model. The US model performed on average as well as, or better than, the European model when using the full suite of atmospheric data from the ECMWF. But when researchers ran the same model with the usual data from the US forecasting programme, it came up short.

The lesson for the United States is that satellites and models aren't enough, Zhang says. "Our nation has put so much money into launching beautiful satellites, but we haven't really put as much effort into how to put the satellite information into the models." ■

CORRECTION

The News story 'Rescued radar maps reveal Antarctica's past (*Nature* **552,** 299–300; 2017) erroneously said that Delft University of Technology in the Netherlands helped to run a radar-mapping programme in Antarctica in the late 1960s. In fact, it was the Technical University of Denmark in Lyngby.