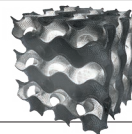


NEWS IN FOCUS

CONSERVATION Fate of primeval Polish forest at centre of legal battle **p.267**

CLIMATE SCIENCE Early success for France's plan to poach foreign researchers **p.269**

CANCER BIOLOGY Immune therapy moves closer to US approval **p.270**



TOPOLOGY Quantum physics gets in shape **p.272**

JOE RAEDLE/GETTY



As the Greenland ice sheet thaws, it is helping to swell the world's oceans.

REMOTE SENSING

Satellite error hid rising seas

Revised tallies confirm that the rate of sea-level increase is accelerating as Earth warms and ice sheets thaw.

BY JEFF TOLLEFSON

The numbers didn't add up. As Earth grew warmer and glaciers and ice sheets thawed, decades of satellite data seemed to show that the rate of sea-level rise was holding steady — or even declining.

Now, after puzzling over this discrepancy for years, scientists have identified its source: a problem with the calibration of a sensor on the first of several satellites launched to measure the height of the sea surface using radar. Adjusting the data to remove that error suggests that sea levels are indeed rising at faster rates each year.

"The rate of sea-level rise is increasing, and that increase is basically what we expected," says Steven Nerem, a remote-sensing expert

at the University of Colorado Boulder who is leading the re-analysis. He presented the as-yet-unpublished data on 13 July in New York City at a conference sponsored by the World Climate Research Programme and the International Oceanographic Commission, among others.

Nerem's team calculated that the rate of sea-level rise increased from around 1.8 millimetres per year in 1993 to roughly 3.9 millimetres per year today as a result of global warming. In addition to the satellite-calibration error, his analysis also takes into account other factors that have influenced sea-level rise in the last several decades, such as the eruption of Mount Pinatubo in the Philippines in 1991 and the recent El Niño climate pattern.

The results align with three recent studies

that have raised questions about the earliest observations of sea surface height, or altimetry, captured by the TOPEX/Poseidon spacecraft, a joint US–French mission that began acquiring data in late 1992. Three subsequent satellites continued collecting such measurements.

"Whatever the methodology, we all come up with the same conclusions," says Anny Cazenave, a geophysicist at the Laboratory for Studies in Space Geophysics and Oceanography (LEGOS) in Toulouse, France.

In an analysis published in *Geophysical Research Letters*¹ in April, Cazenave's team tallied up the various contributions to sea-level rise, including expansion resulting from warming ocean waters and from ice melt in places such as Greenland. Their results suggest ►

► that the satellite altimetry measurements were too high during the first six years that they were collected; after this point, scientists began using TOPEX/Poseidon's back-up sensor. The error in those early measurements distorted the trend, masking a long-term increase in the rate of sea-level rise.

GLITCH FIX

The problem was first identified in 2015 by a group that included John Church, an oceanographer at the University of New South Wales in Sydney, Australia. The researchers identified a discrepancy between sea-level data collected by satellites and those from tide gauges scattered around the globe². In a second paper, published in June in *Nature Climate Change*³, the team adjusted the altimetry records for the apparent bias and then calculated rates of sea-level rise using an approach similar to Cazenave's. The trends lined up, Church says.

Still, Nerem wanted to know what had gone wrong with the satellite measurements. His team first compared the satellite figures with data from tide gauges that showed an accelerating rate of sea-level rise. Then the researchers looked for factors to explain the difference between the two data sets.

The team eventually identified a minor calibration that had been built into TOPEX/Poseidon's altimeter to correct any flaws in its data that might be caused by problems with the instrument, such as ageing electronics. Nerem and his colleagues weren't sure that the calibration was necessary — and when they removed it, early satellite figures of sea-level rise aligned more closely with the tide-gauge data. The adjusted data showed the rate of sea-level rise increasing over time.

"As records get longer, questions come up," says Gavin Schmidt, a climate scientist who heads NASA's Goddard Institute for Space Studies in New York City. But the recent spate of studies suggests that scientists have homed in on an answer, he says.

If sea-level rise continues to accelerate at the current rate, the world's oceans could swell by about 75 centimetres over the next century, Nerem says. That is in line with projections made by the Intergovernmental Panel on Climate Change in 2013.

"All of this gives us much more confidence that we understand what is happening," says Church, who adds that humanity needs to reduce its output of greenhouse-gas emissions — and quickly. "The decisions we make now will have impacts for hundreds, and perhaps thousands, of years." ■

1. Dieng, H. B., Cazenave, A., Meyssignac, B. & Ablain, M. *Geophys. Res. Lett.* **44**, 3744–3751 (2017).
2. Watson, C. S., White, N. J., Church, J. A., King, M. A., Burgette, R. J. & Legresy, B. *Nature Clim. Change* **5**, 565–568 (2015).
3. Chen, X. *et al.* *Nature Clim. Change* **7**, 492–495 (2017).

COMMUNITY

Female astronomers of colour endure bias

Two-fifths of those surveyed report feeling unsafe at work.

BY RACHAEL LALLENSACK

Women of colour working in astronomy and planetary science experience high rates of harassment at work, a study finds. In a survey, a striking 40% of these scientists reported feeling unsafe in their workplaces owing to their gender, and 28% reported feeling unsafe on account of their race.

The findings, published on 10 July in the *Journal of Geophysical Research: Planets*, illustrate a well-researched phenomenon: a woman's risk of being subjected to gendered or race-based harassment is higher if she belongs to multiple minority groups (K. B. H. Clancy *et al.* *J. Geophys. Res. Planets* <http://doi.org/b9mz>; 2017). Women of colour were more likely than white women or men of colour to recall a negative workplace experience during a five-year period from 2011–15. Such incidents included having their mental or physical ability questioned.

"This is something that I've known about, that I've seen and experienced, as someone of colour, for as long as I've been in the field. So I'm not surprised," says Cristina Thomas, an astronomer at the Planetary Science Institute who is based at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "I was very

happy to see someone quantify what was happening so other people would see it."

The study, whose participants ranged from undergraduate students to senior researchers, suggests that the negative environment experienced by many female scientists of colour is often apparent to colleagues of other genders or ethnicities.

Eighty-eight per cent of the 474 participants — a group that was 84% white and included both men and women — had heard remarks that were racist, sexist or directed at a person's gender or intelligence in their current workplace (see 'Hostile climate').

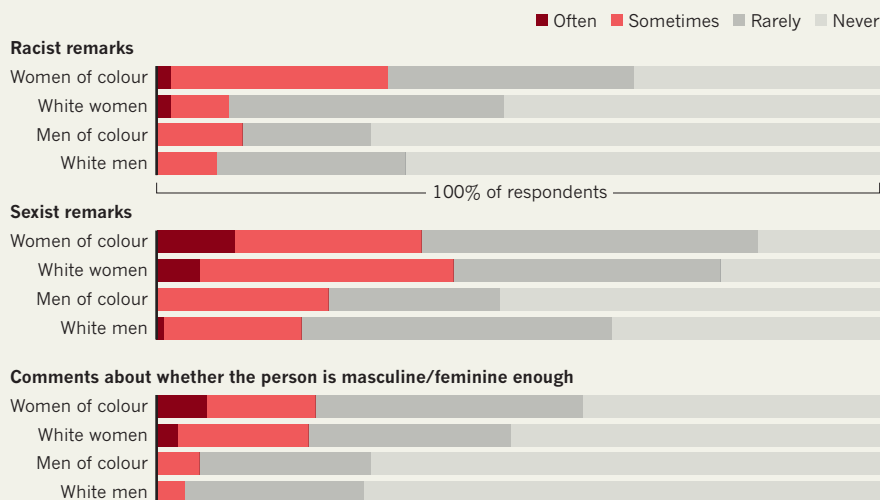
Survey respondents included 45 women of colour, who collectively accounted for 11% of participants. That proportion is double the percentage of minority women in the United States who hold bachelor's degrees in physical science.

The analysis is the first of its kind in the astronomy and planetary-science fields, and one of few in a science, technology, engineering or medicine discipline that specifically examines the experiences of women of colour,

"It doesn't matter what we do at the individual level because the system is broken."

HOSTILE CLIMATE

Women of colour who work in astronomy and planetary science reported hearing disparaging or hostile comments from their peers more often than white people of either gender or men of colour.



SOURCE: CLANCY, K. B. H. *ET AL.* *J. GEOPHYS. RES. PLANETS* [HTTP://DOI.ORG/B9MZ](http://doi.org/b9mz) (2017).