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Antarctica’s brief rebound was caused by climate variability, not a ‘new normal’

Between 2021 and 2023, Antarctica appeared to be growing. Heavy snowfall caused parts of the continent to gain mass, leading some to question whether climate change is really causing irreversible melting. However, a new study by researchers at UC Santa Barbara and University of Washington shows that the precipitation increase was an anomaly related to extra warm tropical ocean temperatures, not part of a long-term trend.

Antarctica has been “shrinking” for decades as warm water melts ice from below and sends large chunks crashing into the ocean. Annual precipitation can’t keep up, causing a net mass loss. However, the snow that fell on East Antarctica — a vast area that contains nearly 80% of Earth’s land-bound ice — added mass faster than the ice was melting. Although mass loss continued in West Antarctica, the general trend seemed encouraging.

“Our study identifies the mechanisms responsible for this recent slowdown in melting and shows that it could be temporary,” said lead author Qinghua Ding, a professor of atmospheric and climate science at UC Santa Barbara.

“In the early 2020s, there was an exceptional amount of snowfall over parts of Antarctica. Because Antarctica is so big, it doesn’t take that much extra snow thickness to counter the loss of ice from the edges of the ice sheet, which led to the perception that the loss of ice is slowing down,” said co-author Eric Steig, a UW professor of Earth and space sciences.

The question nagging researchers was whether this would continue into the future. To answer it, they needed to trace the origins of the precipitation.

Warm air can hold more moisture than colder air, so higher latitudes could eventually see wetter conditions due to global warming. Scientists recognize that the average amount of moisture in the air will increase as global temperatures rise. Some saw the heavier snowfall as evidence that this expected trend was materializing in Antarctica.

“Warmer conditions favor storms shifting toward the poles, which could offset ice loss through snowfall,” said Ding.

But the data told a different story. Using a computational method that involves “tagging” water molecules, the researchers link the extra precipitation in Antarctica to the tropical warm pool, a warm patch of ocean in the western Pacific and eastern Indian oceans that has an outsized effect on extreme weather. Water temperature in the warm pool was notably higher than average between 2021 and 2023, which generated waves of moisture that blew toward East Antarctica.

Historical evidence shows that multi-year warming of is normal for this region. Every few decades or so, it heats up for a few years, then reverts to its average temperature.

“When something changes, it is very tempting, even to scientists, to think ‘oh, there’s a new normal happening,’ but this analysis shows that’s not the case,” Steig said. “This is most likely a short-lived phenomenon.”

The connection to global warming from human activity is tenuous, he added. It’s difficult to tease apart human impact from natural variability in the tropics, but because we see this pattern repeated in history, it is most likely just part of the natural background variability of the tropical climate system.

However, researchers have connected increased carbon dioxide emissions to the climatic conditions accelerating ice loss in west Antarctica. As a whole, the Antarctic Ice Sheet covers an area larger than the U.S. and Mexico combined and stores most of Earth's freshwater. It is also the greatest source of uncertainty in long-term sea-level rise projections. Understanding the balance between ice gain and loss in Antarctica helps researchers make predictions with global implications. Knowing the underlying dynamics provides important guidance for how to interpret new observations.

"There hasn't been much attention paid to the particular mechanism we identify, this is a reminder to not interpret short-term change as a long-term trend," Steig said.

"The climate system is complex," said Ding. "Every year brings new surprises and we have to stay curious, humble and open minded to improve our theories."

Additional co-authors include Yunhe Wang and Xiaofeng Li of the Chinese Academy of Sciences; Thomas J. Ballinger of the University of Alaska Fairbanks; Yoshihiro Nakayama of Dartmouth University and Dániel Topá of Université catholique de Louvain.

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Media Contact
Harrison Tasoff
Science Writer
(805) 893-7220

harrisontasoff@ucsb.edu

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