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Climate Change Has Shifted the Locations of Earth's North and South Poles

Increased melting of the Greenland Ice Sheet and other ice losses worldwide have helped to move the North Pole several centimeters east each year since 2005

By Richard A. Lovett and Nature magazine | Tuesday, May 14, 2013 | 37 comments

From *Nature* magazine

Scientists suspect that melting ice has tilted the North Pole toward Greenland.
Image: Patrick Robert/Corbis

Global warming is changing the location of Earth's geographic poles, according to a new study in *Geophysical Research Letters*.

Researchers at the University of Texas, Austin, report that increased melting of the Greenland ice sheet — and to a lesser degree, ice loss in other parts of the globe — helped to shift the North Pole several centimeters east each year since 2005.

"There was a big change," says lead author Jianli Chen, a geophysicist.

From 1982 to 2005, the pole drifted southeast toward northern Labrador, Canada, at a rate of about 2 milliarcseconds —or roughly 6 centimetres — per year. But in 2005, the pole changed course and began galloping east toward Greenland at a rate of more than 7 milliarcseconds per year.

Scientists have long known that the locations of Earth's geographic poles aren't fixed. Over the course of the year, they shift seasonally as the Earth's distributions of snow, rain, and humidity change. "Usually [the shift] is circular, with a wobble," says Chen.

But underlying the seasonal motion is a yearly motion that is thought to be driven in part by continental drift. It was the change in that motion that caught the attention of Chen and his colleagues, who used data collected by NASA's Gravity Recovery and Climate Experiment (GRACE) to determine whether ice loss had shifted and accelerated the yearly polar drift.

GRACE's twin probes measure changes in the Earth's gravity field, which can be used to track shifts in the distribution of water and ice. Chen's team used GRACE data to model how melting icecaps affect Earth's mass distribution. They found that recent accelerated ice loss and associated sea-level rise accounted for more than 90% of the post-2005 polar shift.

The results suggest that tracking polar shifts can serve as a check on current estimates of ice loss, says Erik Ivins, a geophysicist at NASA's Jet Propulsion Laboratory in Pasadena, California. When mass is lost in one part of a spinning sphere, its spin axis will tilt directly toward the position of the loss, he says — exactly as Chen's team observed for Greenland. "It's a unique indicator of the point where the mass is lost," says Ivins.

Scientists can locate the north and south poles to within 0.03 milliarcseconds by using Global Positioning System measurements to determine the angle of the Earth's spin. Knowing the motion of the poles constrains estimates of ice loss made by other methods, Chen says.

And that could help scientists watching Earth's ice bridge a likely data gap between GRACE and its replacement, GRACE II, which NASA has scheduled for launch in 2020. Researchers may also be able to use longstanding records of polar drift to improve estimates of ice loss and growth before the advent of satellite monitoring.

Chen estimates that data on polar shifts goes back roughly a century, well before the advent of Earth-monitoring satellites. "We don't have a long record of measuring the polar ice sheet," he says. "But for polar motion, we have a long record."

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