NASA satellites provide a better measure of melting glaciers

Lauren Morello, Environment and Energy Publishing, 2-9-12

For years, scientists have warned that climate change is taking its toll on Earth's ice, thawing not just the massive ice sheets of Greenland and Antarctica but mountain glaciers and ice caps from the Andes to the Alps.

But with few long-term measurements of ice outside the polar regions, getting a handle on just how fast it was melting was tricky.

Now a new study, published yesterday in the journal *Nature*, attempts to solve that problem by using data from NASA satellites to provide a uniform, up-to-date survey of mountain glaciers and ice caps. Calculations by researchers at the University of Colorado show the world lost 150 billion tons of non-polar ice each year from 2003 to 2010, enough to raise sea level by 0.4 millimeters per year during that time.

"People have looked at Greenland and Antarctica for several years, and there are a lot of studies on that ice," said University of Colorado glaciologist John Wahr, an author of the new research. "But there are a lot of areas covered with ice that haven't been considered at all."

Fewer than 120 of the planet's 160,000 glaciers have been monitored by researchers, and only 37 of those have been tracked for more than 30 years.

That's due in many cases to the sheer difficulty of reaching that ice and operating in harsh alpine environments. Scientists have been forced to take measurements from a handful of glaciers and extrapolate their behavior to entire glacial systems, Wahr said, making many estimates of ice loss highly uncertain.

He and his colleagues attempted to circumvent that problem by analyzing data collected by NASA's twin GRACE satellites, which orbit the Earth in tandem 16 times a day.

The probes fly about 135 miles apart -- a distance that constantly changes as GRACE-1 and GRACE-2 pass over the Earth's surface. Small changes in the planet's gravity field can push the satellites together, ever so slightly, or pull them apart. Those minute variations -- as small as 1 micron -- allow scientists to measure changes in the mass of the Earth's surface.

"With GRACE, you get really comprehensive results over an entire glacier system," Wahr said. "We see all the glacier."

385B tons of polar ice melted per year

In addition to estimating ice loss from glaciers and ice caps outside the poles, the new study calculates that the massive ice sheets in Greenland and Antarctica shed 385 billion tons of ice per year during the eight-year study period, contributing 1.06 millimeters per year to sea-level rise.

That's in line with an earlier study, published last year in *Geophysical Research Letters*, that used GRACE data and other observations to estimate ice loss at the poles. One of the authors of that paper, glaciologist Eric Rignot of NASA's Jet Propulsion Laboratory and the University of California, Irvine, praised the new research.

"It's a great paper," said Rignot, who was not involved in the *Nature* study. "It's the first time that a uniform

method has been applied to all the mountain glaciers of the world so there is no regional bias, *a priori*."

While current observations and future climate change projections suggest that melting of polar ice will be the largest factor in future sea-level rise, Rignot said that "doesn't make mountain glaciers irrelevant," because in many areas they are important sources of water for drinking and agriculture.

But GRACE isn't perfect. Its twin probes have trouble measuring changes in smaller glacier systems, and can't zoom in on an individual glacier, limitations that Wahr readily acknowledges.

Those limitations should caution anyone against reading too much into the new study's estimates of ice loss from relatively small glacier systems, said Graham Cogley, a glaciologist at Trent University in Ontario who did not contribute to the research.

A measurement gap looms ahead

"Most mountain glaciers are too small for GRACE," he said. "The Alps, for instance."

The *Nature* paper estimates the Alps shed 2 billion tons of ice each year from 2003 to 2010 -- a figure that carries a margin of error of plus or minus 3 billion tons.

"There's absolutely no question from traditional measurements that Alpine glaciers are losing mass," Cogley said. "But they don't add up to enough for GRACE to be confident."

Meanwhile, time is running out for GRACE's twin probes. The tandem satellites, launched in 2002, were designed for a three-year lifetime they have far exceeded.

The satellites have experienced some problems with their batteries recently, but the scientists that manage the GRACE project hope to keep them up and running until their successor -- now being developed by NASA and the German space agency, DLR -- launches in late 2017.

"GRACE is going to go belly-up in the next couple of years," Cogley said. "They keep having to switch it off for periods now, and the orbits are getting lower all the time. ... There's going to be a gap between the GRACE we've got now and the [replacement] that is in the early planning stages -- which means that these traditional measurements [of glacial ice] have not outlived their usefulness yet."