

As Ice Melts, Antarctic Bedrock Is on the Move

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A POLNET GPS site in West Antarctica. The GPS antenna is shown in the background (white cylinder topped by gray dome), with solar panels, batteries, wind generators, the GPS receiver, and Iridium satellite modem antenna in the foreground. Photo courtesy of Ohio State University

As ice melts away from Antarctica, parts of the continental bedrock are rising in response -- and other parts are sinking, scientists have discovered.

The finding will give much needed perspective to satellite instruments that measure ice loss on the continent, and help improve estimates of future sea level rise.

"Our preliminary results show that we can dramatically improve our

estimates of whether Antarctica is gaining or losing ice," said Terry Wilson, associate professor of earth sciences at Ohio State University.

Wilson reported the research in a press conference Monday, December 15, 2008 at the American Geophysical Union meeting in San Francisco.

These results come from a trio of global positioning system (GPS) sensor networks on the continent.

Wilson leads POLENET, a growing network of GPS trackers and seismic sensors implanted in the bedrock beneath the West Antarctic Ice Sheet (WAIS). POLENET is reoccupying sites previously measured by the West Antarctic GPS Network (WAGN) and the Transantarctic Mountains Deformation (TAMDEF) network.

In separate sessions at the meeting, Michael Bevis, Ohio Eminent Scholar in geodynamics and professor of earth sciences at Ohio State, presented results from WAGN, while doctoral student Michael Willis presented results from TAMDEF.

Taken together, the three projects are yielding the best view yet of what's happening under the ice.

When satellites measure the height of the WAIS, scientists calculate ice thickness by subtracting the height of the earth beneath it. They must take into account whether the bedrock is rising or falling. Ice weighs down the bedrock, but as the ice melts, the earth slowly rebounds.

Gravity measurements, too, rely on knowledge of the bedrock. As the crust under Antarctica rises, the mantle layer below it flows in to fill the gap. That mass change must be subtracted from Gravity Recovery and Climate Experiment (GRACE) satellite measurements in order to isolate gravity changes caused by the thickening or thinning of the ice.

Before POLENET and its more spatially limited predecessors, scientists had few direct measurements of the bedrock. They had to rely on computer models, which now appear to be incorrect.

"When you compare how fast the earth is rising, and where, to the models of where ice is being lost and how much is lost -- they don't match," Wilson said. "There are places where the models predict no crustal uplift, where we see several millimeters of uplift per year. We even have evidence of other places sinking, which is not predicted by any of the models."

A few millimeters may sound like a small change, but it's actually quite large, she explained. Crustal uplift in parts of North America is measured on the scale of millimeters per year.

POLENET's GPS sensors measure how much the crust is rising or falling, while the seismic sensors measure the stiffness of the bedrock -- a key factor for predicting how much the bedrock will rise in the future.

"We're pinning down both parts of this problem, which will improve the correction made to the satellite data, which will in turn improve what we know about whether we're gaining ice or losing ice," Wilson said. Better estimates of sea level rise can then follow.

POLENET scientists have been implanting sensors in Antarctica since December 2007. The network will be complete in 2010 and will record data into 2012. Selected sites may remain as a permanent Antarctic observational network.

Source: Ohio State University

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