Antarctic icecap is melting more slowly than previously estimated, scientists find

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(Phys.org)—The Antarctic icecap is melting more slowly than previously estimated, according to new estimates based on satellite measurements and GPS sensors on the ground.

The authors of the study, published in *Nature*, estimate an annual total ice loss of 69 billion tonnes, plus or minus 18 billion – between half and a third of previous estimates, and equivalent to only around 0.19mm of sea-level rise a year.

Changes in ice mass vary across the continent. The area along the Amundsen Sea coast is losing ice at a fast and accelerating rate, whereas West Antarctica as a whole is roughly stable and East Antarctica is gaining substantial amounts of ice.

Antarctica is warming due to worldwide climate change but it's still extremely cold; away from where the ice flows into the warming sea, it's very difficult for large volumes of ice to melt, so changes in ice mass in the continent's interior may have more to do with global patterns of precipitation – that is, how much it snows, replenishing ice stocks – than with the air temperature.

Recent ice-mass loss from West Antarctica has been largely counterbalanced by mass gain in the interior, so the continent's total contribution to sea level is less than previously believed. In the longer term, though, the scientists behind the study say that if temperatures keep rising, this balance cannot be depended on. Antarctica holds enough water to raise sea level by around 59 metres, so if it starts to melt more quickly there is the potential for a dramatic increase in the already worrying rate of sea-level rise.

'The concern is that sea levels are already rising about 3mm a year, but it now turns out that's without a large contribution from melting ice in Antarctica,' says Dr Rory Bingham of Newcastle University, one of the paper's authors. 'There are some areas with very heavy loss of ice mass, but at the moment the gain in ice mass in East Antarctica is largely compensating. Worryingly there are signs of acceleration in the regions of heavy mass loss. Should this continue sea-level rise could accelerate substantially.'

He says that the continent's western reaches already seem less stable than elsewhere, with fast changes to ice mass in places like the Pine Island Glacier where warmer seawater and air temperatures are promoting melting.

The findings will help scientists understand the history of the Antarctic ice since the last ice age, which has huge implications for how it will respond to climate change over the next few centuries, and hence how

much it might contribute to global sea-level rise.

During the last ice age, there was far more ice covering Antarctica. It was so heavy that it deformed the Earth below, forcing the hot rocks of its mantle away from Antarctica and causing the surface of the land to sink. Ever since the end of the ice age removed much of that weight of ice, the land has been slowly rebounding as the mantle has flowed back into the region - a process called Glacial Isostatic Adjustment, or GIA.

This makes it hard to measure changes in how much ice there is using satellites. The GRACE satellites have sensitive instruments to read minute variations in the strength of the Earth's gravity field caused by differences in the amount of mass from place to place - areas where the planet's crust is thicker have more mass, for example. Their results show a clear trend of decreasing mass in the Antarctic. But this fall in mass is made up of a combination of two trends - on the one hand ice melting causes mass to fall, and on the other GIA adds to the continent's mass by adding rock underneath it. Scientists haven't been sure exactly how much GIA has been happening, meaning they couldn't accurately estimate the rate of ice melt.

The new paper addresses that problem, assessing the rate of GIA - and hence also of ice loss - far more accurately than has ever before been possible. The researchers drew on earlier work by members of the same team installing GPS sensors on the rare rocky outcrops poking through the Antarctic icecap. This let them measure the speed of the rock's rebound directly. For this paper, they created a new model of GIA into which to feed the results. They could then subtract the GIA estimates from the readings of the overall change in the mass of the Antarctic provided by GRACE to pinpoint the contribution of ice melting.

They concluded that the landmass has been gaining mass more slowly than earlier estimates suggested, meaning that in order to make the

figures add up the loss of ice must also have been slower than had been assumed.

Bingham says the GRACE satellites probably won't be flying for much longer, and that it's vital replacements are launched soon so that researchers can continue to monitor changes in the land and ice mass of Antarctica over time.

More information: King, M. et al., Lower satellite-gravimetry estimates of Antarctic sea-level contribution, *Nature* 491, 586-589 (22 November 2012) doi:10.1038/nature11621.

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