



Satellite Laser Ranging Corrects Inaccurate GRACE and GRACE-FO Measurements of Antarctic Ice Mass Change



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The Gravity Recovery and Climate Experiment (GRACE) and GRACE Follow-On missions were designed to operate with two accelerometers (one on each spacecraft) to measure mass below them on earth. Since August 2016, the missions have been operating with a single accelerometer, which has made the measurements less accurate. Can satellite laser ranging (SLR) measurements be used to correct the GRACE and GRACE-FO errors?

GRACE and GRACE-FO had significant errors dealing with the Earth's true shape (not a perfect sphere, but a bit like a pear shape) when operating with a single accelerometer, which degrades their ability to measure mass changes in the Antarctic Ice Sheet. Fortunately, SLR-derived measurements are very accurate and can be used to replace the problematic estimates.

Without the recommended SLR correcting procedure, GRACE/GRACE-FO analysis would lead to the erroneous conclusion that the mass loss rate has slowed by 45% over the past three years as compared to the previous decade. In reality, the mass loss rate has remained consistent (see chart and graph to the right). The real ice loss rate was 170 billion tons a year.

The accurate measurement of changes to the Antarctic Ice Sheet is of utmost importance, as the ice contained therein has the potential to substantially impact sea level rise in the coming decades and centuries.

BD Loomis (61A), KE Rachlin (61A/kbr), DN Wiese, FW Landerer, and SB Luthcke (61A), 2020: "Replacing GRACE/GRACE-FO C₃₀ with satellite laser ranging: Impacts on Antarctic Ice Sheet mass change." *Geophysical Research Letters*, 47, <https://doi.org/10.1029/2019GL085488>

