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Antarctic mass balance changes from GRACE

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The Antarctic ice sheet contains ∼30 million km3 of ice and constitutes a significant component of the global water balance with enough freshwater to raise global sea level by ∼60 m. Altimetry measurements and climate models suggest variable behaviour across the Antarctic ice sheet, with thickening occurring in a vast area of East Antarctica and substantial thinning in West Antarctica caused by increased temperature gradients in the surrounding ocean. However, the rate at which the polar ice cap is melting is still poorly constrained. To calculate the mass loss of an ice sheet it is necessary to separate present day mass balance changes from glacial isostatic adjustment (GIA), the response of the Earth's crust to mass loss, wherefore it is essential to undertake sufficient geological and geomorphological sampling. As there is only a limited possibility for this in Antarctica, all models (i.e. geological, hydrological as well as atmospheric) are very poorly constrained. Therefore, space-geodetic observations play an important role in detecting changes in mass and spatial variations in the Earth's gravity field. The Gravity Recovery And Climate Experiment (GRACE) observed spatial variations in the Earth's gravity field over the past ten years. The satellite detects mass variations in the Earth system including geophysical, hydrological and atmospheric shifts. GRACE itself is not able to separate the GIA from mass balance changes and, due to the insufficient geological and geomorphological database, it is not possible to model the GIA effect accurately for Antarctica. However, the results from GRACE can be compared with other scientific results, coming from other geodetic observations such as satellite altimetry and GPS or by the use of geological observations.
In our contribution we compare the GRACE data with recorded precipitation patterns and mass anomalies over East Antarctica to separate the observed GRACE signal into its two components: GIA as a result of mass loss and present day surface load changes due to possible snow/ice accumulation.