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Untangling Antarctic Peninsula deglaciation with dense GPS records

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The Holocene glacial history of the Antarctic Peninsula region is relatively poorly understood but can provide an insight into the evolution of ice sheets during deglaciation. Knowledge of deglacial load changes in the Antarctic Peninsula is also required to correct observations from the GRACE satellite mission for the contribution of Glacial Isostatic Adjustment (GIA) to changes in Earth's gravity field. The uncertainties in this correction propagate into estimates of the Antarctic Ice Sheet contribution to modern global sea-level rise, a question of high importance. We present a study of Antarctic Peninsula ice history based on a comparison of measurements of modern land surface motion with high resolution forward models of GIA. Global Positioning System (GPS) data were collected from Austral summer 2010-2014 in the Southern Antarctic Peninsula; the network remains in place. The models apply a range of ice histories to a spherical Earth with a visco-elastic rheology and produce predictions of present-day GIA. The GPS data were then used to discriminate between competing ice load histories, which consist of both published histories and modifications on published histories. Models of GIA produce uplift maxima with different magnitudes and spatial extent depending on input parameters. Significant uncertainty in the modelled GIA arises from the assumed structure of the solid Earth, which is poorly constrained. To understand how this uncertainty impacts the interpretation of the GPS data, we tested a plausible range of values for lithospheric thicknesses and mantle viscosity. The results of the data-model comparison provide an evaluation of the spatial and temporal sensitivity of regionally dense GPS records to deglaciation on the Antarctic Peninsula.