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Southern Hemisphere Glacioisostasy: A new assessment

E.R. Ivins[1] and T.S. James[2]

(1) JPL Caltech Pasadena, CA U.S.A, (2)Geological Survey Canada, Sidney, BC V8L 4B2 Canada (eri@fryxell.jpl.nasa.gov Fax: 8183549476)

Antarctic glacial isostatic adjustment (GIA) has a substantial importance globally, not just for its contribution to late-Pleistocene and Holocene eustatic sea-level rise,but also for its important role in the analysis of present-day low-wavelength gravity and sea-level change. The prediction of crustal motions and gravity change driven by GIA in Antarctica and Patagonia are critically dependent on the reconstruction of the configuration and thickness of ice during the Late Pleistocene and Holocene. The collection and analysis of field data to improve the reconstruction has occurred at an accelerated pace during the past decade. At the same time space-based imaging and altimetry, combined with on-ice velocity measurements using Global Positioning System (GPS) geodesy, has provided better assessments of the present-day mass balance of the Antarctic ice sheet. Present-day mass change appears to be dominated by deglaciation that is, in large part, a continuation of late-Holocene evolution. Here a new ice load model is constructed, based on a summary of the current constraints on past ice history and present-day mass balance, and is used to predict GIA crustal motion and geoid change. Compared to existing glacioisostatic models, the new ice history model is significantly improved in four ways: (i) the timing of volume losses in the region ranging from the Ross Sea sector to the Antarctic Peninsula; (ii) the maximum ice heights in parts of the Ellsworth and Transantarctic Mountains; (iii) maximum grounding line position in Pine Island Bay, the Antarctic Peninsula, and in the Ross Sea; (iv) incorporation of present-day net mass balance estimates. The predicted present-day GIA uplift rates peak at 14 - 18 mm/yr and geoid rates peak at 4 - 5 mm/yr for 'stiff' sub-cratonic and global 'average' mantle viscosity, respectively. If the asthenosphere underlying West Antarctica has a low viscosity then the predictions could change substantially due to the extreme sensitivity to recent (past two millennia) ice

mass variability. Observations of crustal motion and gravity change will substantially improve the understanding of sub-Antarctic lithospheric and mantle rheology.