



Low post-glacial rebound rates in the Weddell Sea due to Late Holocene ice-sheet readvance

Sarah L Bradley (1), Richard C A Hindmarsh (1), Pippa Whitehouse (2), Michael J Bentley (2), and Matt King (3)
(1) British Antarctic Survey, United Kingdom (d80ngv@gmail.com), (2) Department of Geography, Durham University, Durham, UK, (3) Surveying and Space Group, School of Geography and Environmental Sciences, University of Tasmania, Hobart, Australia

The Holocene deglaciation of West Antarctica resulted in widespread ice surface lowering. While many ice-sheet reconstructions generally assume a monotone Holocene retreat for the West Antarctica Ice sheet (WAIS) [Ivins et al., 2013; Peltier, 2004; Whitehouse et al., 2012], an increasing number of glaciological observations infer it is readvancing, following retreat behind the present-day margin [Siegert et al., 2013].

We will show that a readvance in the Weddell Sea region can reconcile two outstanding problems: (i) the present-day widespread occurrence of seemingly stable ice-streams grounded on beds that deepen inland in apparent contradiction to theory [Schoof, 2007]; and (ii) the inability of models of Glacial Isostatic Adjustment (GIA) to match present-day uplift rates [Whitehouse et al., 2012]. Combining a suite of ice loading histories that include a readvance with a model of GIA provides significant improvements to predictions of present-day uplift rates, and we are able to reproduce previously unexplained observations of subsidence in the southern sector of the Weddell Sea. We hypothesize that retreat behind present grounding lines occurred when the bed was lower, and isostatic recovery led to shallowing, ice sheet re-grounding and readvance.

We will conclude that some sections of the current WAIS grounding line that are theoretically unstable, may be advancing and that the volume change of the WAIS may have been more complex in the Late Holocene than previously posited. This revised Holocene ice-loading history would have important implications for the GIA correction applied to Gravity Recovery and Climate Experiment (GRACE) data, likely resulting in a reduction in the GIA correction and a smaller estimate of present-day ice mass loss within the Weddell Sea region of the WAIS.

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