Holocene stability of the Amundsen-Ross ice divide, Central West Antarctica

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The Amundsen-Ross ice divide near the West Antarctic Ice Sheet (WAIS) Divide ice-core site is migrating today (Conway and Rasmussen, 2009), and because internal layers observed across the divide do not exhibit arches characteristic of a stationary divide, it is likely that the divide has been migrating and/or the basal ice has been sliding over the past few thousand years. It has been shown that the interior ice in this region can respond rapidly to perturbations near the margins (e.g. Payne et al., 2004), and that changes in the flow of WAIS outlet glaciers may have major implications for draw down of interior ice. While we expect divide migration through the Holocene and we expect that flow changes near the margins can affect interior ice, we have not yet been able to answer these questions: How far has the Ross-Amundsen ice divide migrated in the Holocene, and what were the drivers of this divide migration?

We find that the Ross-Amundsen ice divide has been relatively stable over the past 8.4 ka and has most likely migrated only ±10 km from the modern position. To bound plausible scenarios of divide migration we solve a suite of inverse problems to infer unknown boundary conditions that give the best fit to the available data. In our new work we use the high-resolution WAIS Divide ice-core timescale (WAIS Divide Project Members, 2013) to date all observed internal layers, and we use an accumulation history that we infer from the ice-core data and a 1-D model in order to constrain our 2.5-D transient flow modeling. We present a synthesized Holocene history of accumulation and ice flow that is consistent with the ice-core chronology and available internal layers, and we put bounds on the timing and magnitude of Holocene variations in the flow of outlet glaciers on the Amundsen Sea coast and of the Ross Ice Streams that could have altered interior layer shapes. The Amundsen-Weddell ice divide was also relatively stable through the Holocene (Ross et al., 2011), which puts our results in a broader West Antarctic context.

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