Revisiting the Antarctic contribution to Last Interglacial sea level variation; an ice sheet modeling parameter study

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Abstract

Proxy reconstructions indicate a Last Interglacial (LIG) sea level high-stand of 6-9 meters (e.g. Kopp et al. 2009) but are subject to both uncertainties in timing and magnitude (e.g. Rovere et al. 2016). Recent findings from continental scale ice sheet modelling highlight, that a considerable contribution to LIG sea level rise from the Antarctic Ice Sheet (AIS) is possible within a range of climatic boundary conditions derived from proxy data and climate modeling (Sutter et al. 2016; DeConto & Pollard 2016). However, proxy reconstructions for LIG climatic conditions in the high southern latitudes are sparse and results from climate modeling exhibit stark mismatches compared to surface temperature reconstructions from Antarctic ice cores (e.g. Otto-Bliesner et al. 2013). In light of the many uncertainties dominating LIG climate modeling and sea level reconstructions it is still unclear whether parts of the AIS collapsed during the LIG. Here we present results of a multi-dimensional parameter ensemble study with the ice dynamical model PISM (Bueler & Brown 2009) to identify model sensitivities to both ice sheet initialization and parameter space. We find, that within a range of conceivable LIG climate forcing and ice sheet model tuning, the ice sheet model can produce a relatively stable AIS exhibiting a gradual and moderate contribution to sea level increase (1-2.5 m) or a large-scale retreat by means of the marine ice sheet instability. The results highlight strong sensitivity of current ice sheet models to the chosen parameters and initialization and the necessity of better constraints on LIG temperature anomalies to improve the climatic boundary conditions applied to ice sheet models.

Keywords: Antarctica, Last Interglacial, sea level, marine ice sheet instability

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