The influence of sea-level changes on ice-sheet evolution in Antarctica

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This presentation will focus on the influence of local sea-level changes and glacial isostatic adjustment on the stability and dynamics of marine ice in Antarctica. We will discuss the physics of sea level – ice sheet interactions using simplified modeling, then present the results of simulations using a more realistic, three-dimensional ice sheet-shelf model coupled to a gravitationally self-consistent global sea-level. The coupled model incorporates deformational and gravitational perturbations to a viscoelastic, rotating Earth and it captures the complex spatiotemporal geometry of post-glacial sea-level change, including at the grounding lines of marine-based ice. We apply the coupled model to simulate the evolution of the Antarctic Ice Sheet over the last 40,000 years, focusing in particular on ice distributions and sea levels from the Last Glacial Maximum to present. We also compare our model predictions to relative sea level (RSL) histories and GPS-derived present-day uplift rates at sites around the periphery of Antarctica. The results demonstrate that the sea-level feedback has a significant stabilizing influence on marine ice-sheets, acting to slow down grounding-line migration relative to ice sheet model simulations that do not include the sea-level coupling. Finally, we explore the sensitivity of the results to adopted Earth model parameters, and the implications of applying more realistic models of Earth structure on West Antarctic ice volume at the Last Glacial Maximum and the Antarctic contribution to sea-level rise over the Last Deglaciation.

We will submit this abstract to the theme “Marine ice sheet instability” (Free Fallin’), but it would also be suitable for “modeling of ice and polar ocean”.