Geophysical Research Abstracts
Vol. 21, EGU2019-4485, 2019
EGU General Assembly 2019

Continuous simulations over the last 40 million years with a coupled Antarctic ice sheet and sediment model

David Pollard (1) and Robert DeConto (2)

(1) Pennsylvania State University, Earth and Environmental Systems Institute, University Park, Pennsylvania 16802, United States (pollard@essc.psu.edu), (2) University of Massachusetts, Department of Geosciences, Amherst, Massachusetts 01003, United States (deconto@geo.umass.edu)

Much of the knowledge of Antarctic Ice Sheet variations since its inception ~34 Ma derives from marine sediments on the continental shelf, deposited in glacimarine or sub-ice environments by advancing and retreating grounded ice, and observed today by seismic profiling and coring. If coupled ice-sheet and sediment models can simulate these deposits explicitly, direct comparisons with the sediment record would help in linking it to Cenozoic ice and climate history. Here we apply an existing 3-D ice sheet and sediment model to the whole period of late Cenozoic Antarctic evolution. The ice-sheet model uses local parameterizations of grounding-line flux, ice-shelf hydrofracture and ice cliff failure. The sediment model includes quarrying of bedrock, sub-ice transport, and marine deposition. Atmospheric and oceanic forcing is determined by uniform shifts to modern climatology in proportion to records of atmospheric CO_2, deep-sea-core d18O, and orbital insolation variations. Initial ice-free bedrock topography can either be prescribed from geologic reconstructions for ~34 Ma (Wilson et al., Palaeo3, 2011) or deduced in an iterative procedure fitting to observed modern topography and total sediment amounts.

The model is run continuously from 40 Ma to the present, capturing post-Eocene Antarctic landscape evolution and off-shore sediment packages in a single self-consistent simulation. In order to make these long simulations feasible, the model resolution is very coarse, 80 km. However the ice model's use of local parameterizations for fine-scale dynamical processes yields results that are not seriously degraded compared to finer resolutions in short tests.
The primary goals are (1) to reproduce major recognized ice-sheet trends and fluctuations from the Eocene to today, and (2) to produce a 3-D model map of modern sediment deposits. "Strata" are tracked by recording times of deposition within the model sediment stacks, which can be compared with observed seismic profiles. Initial results are presented, and preliminary overall comparisons are made with observed sediment packages and the modern ice and bedrock state.