Uncertainty in 21st century oceanic heat content near Greenland

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Atmosphere-ocean general circulation models (AOGCMs) do not resolve small-scale oceanographic processes near ice sheet margins. For the purposes of projecting ocean-driven changes in the Greenland ice sheet, these global models might be best used to inform the range of possible changes in large-scale hydrography; "offline" techniques that account for oceanic, atmospheric, and glaciological processes in fjords and outlet glaciers may then be used to link climate changes to ice dynamics. Following this line of reasoning, Yin et al. (2011) find an ensemble (19 AOGCMs) mean subsurface warming of 1.7-2.0°C around Greenland, and suggest that this warming could drive widespread increases in ice loss. However, this increase in heat content is driven by only one emissions scenario, and does not capture the wide inter-model spread. In this analysis, we assess the range of subsurface temperature changes projected by CMIP5 models near ice sheet drainage basins that are susceptible to ocean-driven dynamic ice loss. The relative roles of model or forcing (emissions) uncertainty as a function of space and time are highlighted. Present-day observations are used to develop metrics for model performance and to examine whether observed relationships between ocean heat content at locations around Greenland persist in model simulations. We conclude by suggesting a strategy for combining AOGCM output to generate boundary conditions for offline simulations.

Reference

Yin, J., J.T. Overpeck, S.M. Griffies, A. Hu, J.L. Russell, and R.J. Stouffer, 2011: Different magnitudes of projected subsurface ocean warming around Greenland and Antarctica. Nature Geoscience, 4, 524-528.