Retreat of Humboldt Glacier, north Greenland

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Humboldt Glacier drains 5% of the Greenland Ice Sheet and has been retreating and accelerating since the late 1990s. The northern section of the terminus overlies a deep basal trough that raises the possibility of further acceleration as the grounding line retreats into thicker ice. Using the MPAS-Albany Land Ice model, we tune an ensemble of model runs to the observed retreat rates and simulate the glacier’s evolution to the year 2100. The runs that best match observations agree closely on a sea-level contribution of ~3.5 mm by 2100 under RCP8.5 climate forcing. While these runs match observed retreat rates, no ensemble member reproduces the observed acceleration of ice flow. This indicates that 3.5 mm is likely a lower bound on sea-level contribution. We examine mechanisms that could be controlling the acceleration of ice flow: loss of ice melange buttressing at the glacier terminus; increased basal lubrication from drainage of surface melt; and the degree of plasticity of the bed rheology. Preliminary experiments suggest that loss of ice melange buttressing cannot by itself explain the observed acceleration. Optimized basal friction fields from before and after the major acceleration suggest a decrease in basal traction, which could be an effect of lubrication or bed rheology. Experiments with a plastic bed rheology are forthcoming. A parallel set of experiments that examine the effect of subglacial hydrology on melt rates at the glacier front will determine whether this ensemble will need to include an explicit subglacial hydrology model.