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Modeling interactions between Antarctic Instability and Surface Mass Balance.

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In the context of future global warming, Antarctic contribution to sea level rise (SLR) depends on several processes leading to opposite impacts. First, under a warming climate, precipitation is supposed to increase, inducing a plausible negative impact on SLR. Contrary to the Greenland ice sheet case, ablation should stay a marginal process at least on grounded ice. Second, oceanic warming and/or surface ponding on ice shelves may trigger a Marine Ice Sheet Instability by reducing the backforce they exert on outlet glaciers. Once engaged on such a self-entertained retreat a large positive contribution to SLR may be expected. This dynamic process is already going on in the Admundsen sea sector. Although these two processes (surface mass balance – SMB – and ice dynamics) have been modeled separately to infer sea level contribution, little work has been done to study their interactions.

In this presentation we focus on how grounding line retreat can affect estimation of SMB in the future and the related contribution to sea level change. To evaluate the shift of precipitation pattern while the steep surface slope region migrates inward due to the grounding line retreat, we simulate surface mass balance on various surface topographies of the Antarctic ice sheet. Each ice sheet topography is obtained with an ice sheet model (GRISLI) in which grounding line retreat is parameterized according to glaciological considerations. Because we are looking at coastal changes, a high resolution is needed for the atmospheric model and here we use the regional circulation model MAR with a resolution of 40 km.

The preliminary results show that the topographic change induces a shift in the precipitation pattern as high accumulation regions tend to follow the slope break at the ice sheet / shelf transition. This affects the calculation of total SMB on the grounded ice sheet (and sea level contribution) and its amplitude is related to the amplitude of the retreat. In our simulations the increase of SMB on grounded ice between present and 2100 is reduced by up to 25% when taking into account both the reduced extent of grounded ice and the precipitation shifting. Some non local changes are also observed in the precipitation over the ocean indicating atmospheric circulation changes. This suggests that a simple parametrization of SMB pattern shifting may not be trivial to propose.

This work constitutes a step toward toward asynchronous coupling between atmospheric and ice sheet models improving our ability to perform SLR projections