Geophysical Research Abstracts
Vol. 17, EGU2015-7130, 2015
EGU General Assembly 2015

Downscaling RCM output to km resolution: effect on Greenland surface mass balance

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The relatively narrow ablation zone of the Greenland ice sheet (GrIS), typically ∼10-150 km wide, is not often accurately resolved even in regional climate models (RCMs). This may lead to underestimation of melt, runoff and other SMB components. Sub-km resolution SMB components would be necessary to capture the spatial variability of SMB associated to local variations in topography. However, such high-resolution simulations would require a huge computational effort and are therefore only restricted to small regions and short periods.

In this study, we statistically downscale individual SMB components of the regional climate model RACMO2.3 for the period 1958-2013, using their height dependency. We apply a bi-linear interpolation from the original RACMO2 resolution of 11 km to 1 km, and correct for elevation differences between the native and interpolated grid. This method allows a reconstruction of the GrIS SMB as a function of individually downscaled SMB components, i.e. precipitation, sublimation and runoff, instead of directly downscaling SMB which would provide less physical insight in the final product.

Interestingly, the spatially integrated amount of melt and runoff does not change significantly between the two fields. This is discussed and explained. Next we compare the modelled RACMO2.3 SMB values at the native 11 km grid and the downscaled field to in-situ measurements from 108 stake sites situated in the ablation zone of the ice sheet, a subset of a newly compiled ablation dataset. Finally, we compare results at 1km with another regional climate model, MAR.