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Impact of the spatial resolution of the Greenland ice sheet surface mass balance modelling using the regional climate model MAR with the aim to force an ice sheet model.

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In this work, we have modelled at different spatial resolutions (10, 15, 20... up to 50km) the Greenland ice sheet (GrIS) surface mass balance (SMB) over the 1991-2010 period by using the regional climate model MAR (Modèle Atmosphérique Régional), validated for the GrIS at 25km resolution and forced every 6 hours by the ERA-INTERIM reanalysis. As part of the ICE2SEA project, the 25km-resolution SMB outputs of the MAR model are used as forcing fields for ice sheet models, in order to produce future projections of the GrIS contribution to sea-level rise over the next 200 years.

Although the current spatial resolution of the MAR model (25km) is much higher than the general circulation models (GCM) resolution (150-300km), the ice sheet models often run at a higher resolution (typically 5-10km). Nevertheless, such higher-resolution runs of the MAR model on the same integration domain generate a significant additional computing time and are not doable until now. Moreover, conventional linear interpolations of the SMB outputs onto a higher-resolution grid, generally induce biases because ice sheet masks at different spatial resolutions do not match and the SMB is a very complex function of the spatial resolution/topography. Therefore, enhanced methods of spatial interpolation are needed for using the 25km MAR SMB outputs into the ice sheet models in the framework of the ICE2SEA project.

The SMB outputs provided by the 15, 20, … km-resolution MAR runs are interpolated onto the 10km MAR grid and compared with the SMB outputs coming from the 10km MAR runs. Several “intelligent” SMB interpolations are tested here for improving the comparison with the 10km MAR results. This work aims to assess the lack of accuracy when interpolating SMB outputs from the MAR model onto a higher-resolution grid, compared to results of MAR running at this higher resolution. We determine also which maximal resolution is required to force with reliability ice sheet models instead of using SMB outputs coming directly from very high resolution runs, taking into account the significant additional computing time needed for such simulations.