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Evaluation of the Greenland ice sheet surface mass balance simulated by a regional climate model forced by some selected IPCC AR5/CMIP5 AOGCMs over the current climate.

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As part of the ICE2SEA project, the regional climate model MAR was forced by the general circulation models HadCM3 and ECHAM5 for making future projections of the Greenland Ice Sheet (GrIS) Surface Mass Balance (SMB) over 1980-2099 at a resolution of 25km. For the A1B scenario, the GCM-forced MAR projects that the SMB rate at the end of this century would be highly negative (-500 GT/yr) and the resulting mass loss would correspond to a sea level rise of 8 cm over 2000-2100. However, the comparison with MAR forced by the ERA-40 reanalysis over 1980-1999 shows that MAR forced by the 20C3M scenario is not able to represent reliably the current SMB due to biases in the general circulation and in the free atmosphere summer temperature modelled by these two GCMs around the GrIS. These biases induce in MAR an underestimation of the snow accumulation and an overestimation of the surface melt. Therefore, this questions the reliability of these future projections made for ICE2SEA by using these versions of HadCM3 and ECHAM5, knowing that these biases could be amplified in the MAR snow model due to the albedo-temperature feedback.

That is why, we suggest here to present the first results of MAR forced by the next generation of GCMs that will be used in the next Assessment Report in 2013 (IPCC AR5). These GCM outputs should be available in January 2011 on the CMIP5 web site (http://cmip-pcmdi.llnl.gov/cmip5/). Only the GCMs able to reproduce reliably the current climate of the Greenland ice sheet over 1961-1990 (from the Historical experiment) will be selected for forcing MAR over the GrIS. We will focus our evaluation on the GCMs ability to simulate :

1. the general circulation (impacting notably the simulated precipitation) over the GrIS by using a circulation type classification (see the abstract of Belleflamme et al.).
2. the free atmosphere summer temperature knowing that a bias of 2°C (in respect to the reanalysis) at the MAR boundaries is enough for significantly impacting the simulated surface melt over the GrIS.
3. the sea surface temperature and sea ice cover which are used in MAR as surface boundary conditions over ocean around the GrIS.