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Comparison between different Regional Climate Models applied to the present climate (1995-2005) of Greenland

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In the context of climate change, the Greenland Ice Sheet (GrIS) plays an important role in sea level variation and oceanic thermohaline circulation changes. Unfortunately, Global Climate Models do not illustrate enough the characteristics of Greenland. To solve that, specific RCMs have been developed to take into account the features of polar regions.

In this project, we compare three RCMs : the MAR model, the RACMO model and the Weather Research and Forecasting (WRF) model. WRF is an open source model developed by the Mesoscale and Microscale Meteorology Division of NCAR. WRF has been modified for polar regions by the Ohio State University. The key modifications are changes of surface energy balance and heat transfer, and an implementation of sea ice thickness, snow thickness and seasonally-varying sea ice albedo in the surface module (Noah LSM). We use here the standard WRF (version 3.2.1) and its polar optimization (called polar WRF). The MAR version tuned for the GrIS and coupled with a 1D surface scheme called SISVAT (for Soil Ice Snow Vegetation Atmosphere Transfer) is compared here. The version of RACMO is a specific version for the Greenland climate, RACMO2/GR. This model contains a special surface module for snow-ice treatment and other modifications concerning, for example, the surface turbulence heat flux or the surface roughness.

The comparison is made on a domain centered on Greenland at a 25-km horizontal resolution over the 1995-2005 period when Automatic Weather Station (AWS) measurements are available from the Greenland Climate NETwork (GC-NET). Statistics (mean, bias, RMSE, correlation coefficient) are calculated for the near-surface temperature, surface pressure, 10m-wind speed and specific humidity for winter (October to April) and summer (May to September). In addition, the modeled snowfall are evaluated with ice core-based snow accumulation climatologies.

Comparison shows a significant improvement from RCMs compared to the reanalyses (NCEP2 and ERA-INTERIM) in respect to the AWS measurements. RACMO and MAR seem to compare better with observations than WRF. However, we note a significant improvement between WRF and polarWRF.