

EGU21-16100

<https://doi.org/10.5194/egusphere-egu21-16100>

EGU General Assembly 2021

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Physics, Resolution and Data Assimilation: Making sense of Greenland climate and ice sheet Surface Mass Balance with HARMONIE Climate

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The development of the HARMONIE model system has led to huge advances in numerical weather prediction, including over Greenland where a numerical weather prediction (NWP) model is used to forecast daily surface mass budget over the Greenland ice sheet as presented on polarportal.dk. The new high resolution Copernicus Arctic Reanalysis further developed the possibilities in HARMONIE with full 3DVar data assimilation and extended use of quality-controlled local observations. Here, we discuss the development and current status of the climate version of the HARMONIE Climate model (HCLIM). The HCLIM system has opened up the possibility for flexible use of the model at a range of spatial scales using different physical schemes including HARMONIE-AROME, ALADIN and ALARO for different spatial and temporal resolutions and assimilating observations, including satellite data on sea ice concentration from ESA CCI+, to improve hindcasts. However, the range of possibilities means that documenting the effects of different physics and parameterisation schemes is important before widespread application.

Here, we focus on HCLIM performance over the Greenland ice sheet, using observations to verify the different plausible set-ups and investigate biases in climate model outputs that affect the surface mass budget (SMB) of the Greenland ice sheet.

The recently funded Horizon 2020 project PolarRES will use the HCLIM model for very high resolution regional downscaling, together with other regional climate models in both Arctic and Antarctic regions, and our analysis thus helps to optimise the use of HCLIM in the polar regions for different modelling purposes.