

SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year 2022

Project Title: Polar Regions in the Earth System: Role of local-regional scale polar processes in the changing polar and global climate system (PolarRES)

Computer Project Account: spdkoles

Principal Investigator(s): Martin Olesen, Climate scientist, PhD

Affiliation: Danish Meteorological Institute

Name of ECMWF scientist(s) collaborating to the project
(if applicable)

Start date of the project: 2022.03.15

Expected end date: 2024.12.31

Computer resources allocated/used for the current year and the previous one (if applicable)

Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	-	-	8.5 million	122,000
Data storage capacity	(Gbytes)	-	-	12000	850

Summary of project objectives (10 lines max)

The objectives of this project is to prepare the regional climate model Harmonie Climate (HCLIM) for polar downscaling experiments. HCLIM will be set up to dynamically downscale the ERA5 reanalysis dataset for the Arctic region as well as the Antarctic region. Furthermore, the global circulation model EC-Earth for selected future RCP-scenarios will be downscaled. The overall objective is to improve understanding of key local to regional scale physical processes for atmosphere-ocean-ice interactions in the Arctic and Antarctic and influence on projected changes in the global circulation and the implications of their consequences for society and the environment in the polar regions and beyond.

Summary of problems encountered (10 lines max)

The project started in March due to some ID issues in the project description. HCLIM cycle 38 has been set up with some test boundaries, resolution and time steps. This caused some instability problems witch are now more or less solved. Later during the year, we upgraded to cycle 43 which caused both minor and major issues regarding generating boundaries and some problems with the boundaries from MARS in the Prefetch_boundaries job, which we are working on solving.

Summary of plans for the continuation of the project (10 lines max)

HCLIM 43 will be set up with ALADIN physics for an Arctic domain defined within CORDEX in a 0.1 deg resolution forced with the GCM, EC-Earth version 3 for two transient 90 year periods for two different scenarios.

Summary of results

HCLIM Cycle 38 has been set up to downscale the reanalysis dataset from ECMWF (ERA5) from 31 km to 2.5 km for the southern part of Greenland shown in figure 1.

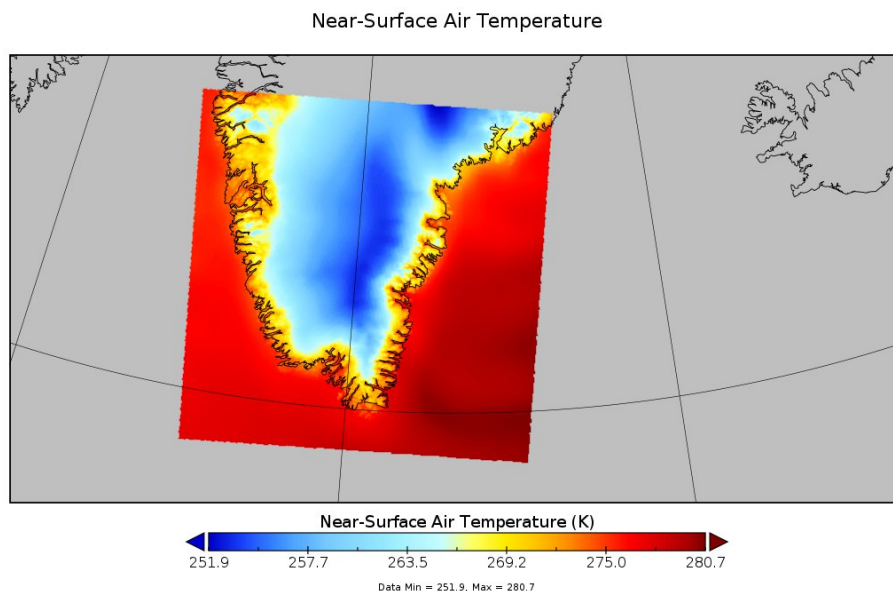


Figure 1. Near surface temperature for the southern Greenland domain.

To work closer together with colleagues within the Harmonie Climate consortium and in the Horizon2020 project PolarRES, we decided to switch to the latest updated version of HCLIM, cycle 43. With HCLIM cycle 43 we have tested different resolutions, domains and time steps enabling downscaling of the entire Greenland domain shown in figure 1.

ERA5 has already been downscaled with the regional climate model HIRHAM5 for 2019. HIRHAM5 is a hydrostatic regional climate model co-developed and used at DMI for more than a decade. To evaluate the HCLIM simulation we have downscaled ERA5 for 2019 and compared it corresponding HIRHAM5 experiment. We know that HIRHAM5 releases too much precipitation over certain areas in Greenland. In figure 3 the accumulated annual precipitation downscaled with HIRHAM5 from ERA5 is shown to exceed 25 meters in some of the mountains on the south east coast in Greenland. This amount of annual precipitation has never been observed in Greenland and may be considered as unrealistic.

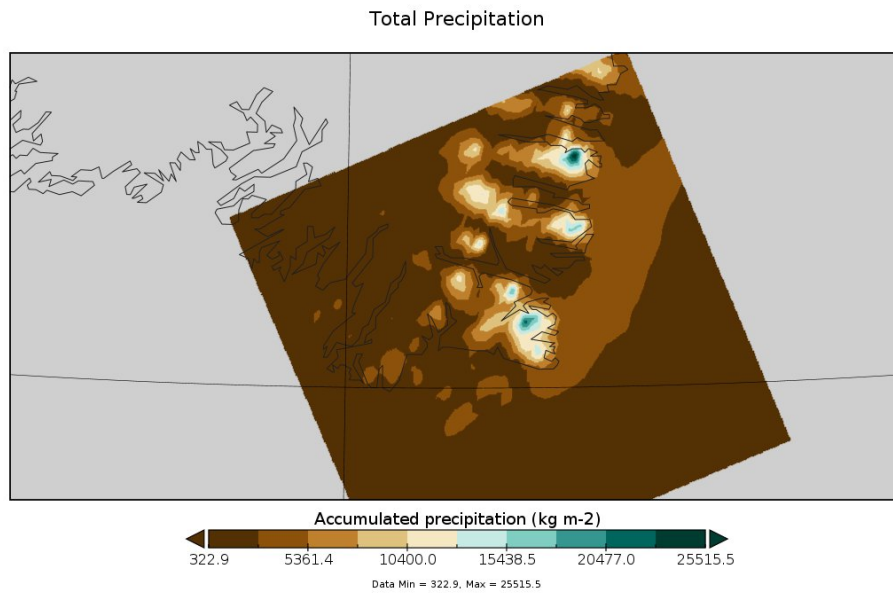


Figure 3. Accumulated precipitation (mm/yr) for 2019 simulated with HIRHAM5 forced with ERA5 on the boundaries.

With HCLIM, the downscaling of ERA5 for 2019 results in a more realistic amount of precipitation on the south-eastern coast, as shown in figure 4.

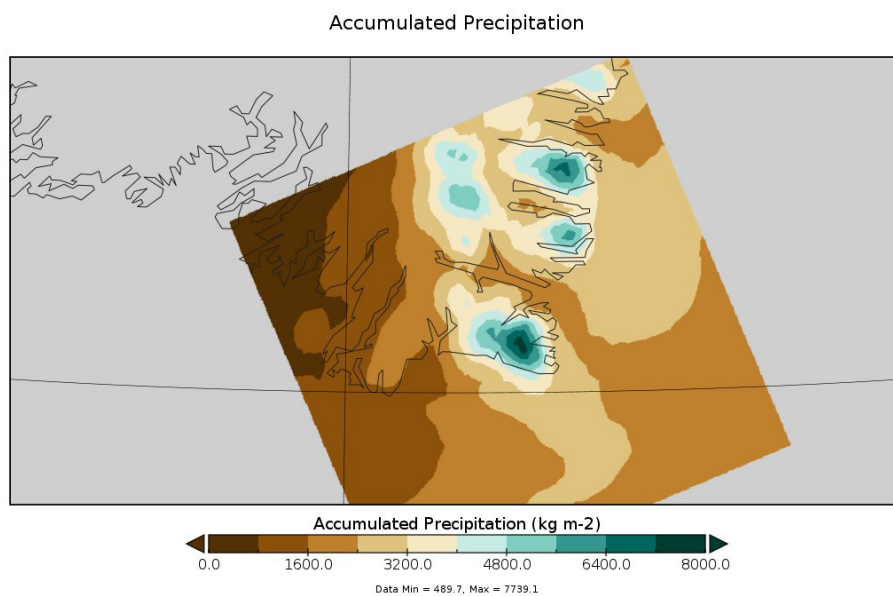


Figure 4. Accumulated precipitation (mm/yr) for 2019 simulated with Harmonie Climate forced with ERA5 on the boundaries.