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	2021
Project Title:	Arctic regional climate modelling with HCLIM
Computer Project Account:	spnoland
Principal Investigator(s):	Oskar Landgren
Affiliation:	Norwegian Meteorological Institute
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Andreas Dobler, Jan Erik Haugen
Start date of the project:	4 Jan 2021
Expected end date:	31 Dec 2022

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)			35 000 000	44 910
Data storage capacity	(Gbytes)			20 000	0

Summary of project objectives (10 lines max)

We will produce the first Pan-Arctic HCLIM simulation downscaling of ERA5, as well as downscaled climate projections from CMIP6. This will form the basis for the HCLIM collaboration's contribution to the regional climate model ensemble Arctic CORDEX. There are three purposes:

1. Downscaled global climate simulations will provide climate change projections for the pan-Arctic competitive with current state-of-the-art regional climate simulations. This will be useful in climate change assessments as well as for impact modelling.

2. Downscaled ERA5 will constitute a baseline for assessment of biases in the downscaled climate scenario as well as serve as an evaluation of the performance of HCLIM in the Arctic.

3. Downscaled ERA5 can complement Arctic reanalysis datasets (e.g. CARRA, ASRv2).

Summary of problems encountered (10 lines max)

We have currently used only a small fraction of the allocated resources. The reason for this is that there has been a lot of work in the last year to finalise the new version of HARMONIE Climate, HCLIM43. Since this will form the basis for all upcoming experiments, including Euro-CORDEX, we decided to wait with the production of longer Arctic simulations in this Special Project until there was more agreement on a few key model parameters.

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

After many sensitivity experiments by the HCLIM development team (not in this SP), we now plan to start Arctic simulations with HCLIM43 in July based on ERA5.
In the meantime we have conducted a few shorter tests, including continuing sensitivity experiments with different physics parameterisations and spatial resolutions. Compared to the initial 1-year test ensemble referred to in the Special Project plan, we have also concluded on using ALADIN physics rather than ALARO. This will help with consistency with other upcoming Euro-CORDEX simulations.

List of publications/reports from the project with complete references

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Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

There are few concrete scientific results yet. Perhaps the most promising is that we have conducted some more analysis on the effect of the prognostic sea-ice scheme (Simple Ice, SICE), for different setups. This has been performed at coarser 24 km resolution than the finer 12 km which is target for production. Fig. 1 shows the results of total sea-ice volume compared to PIOMAS as reference. It is clear that the prognostic sea-ice thickness scheme improves the representation of ice volume considerably. There also seem to be potential for further improvement by starting at a slightly higher initial thickness.

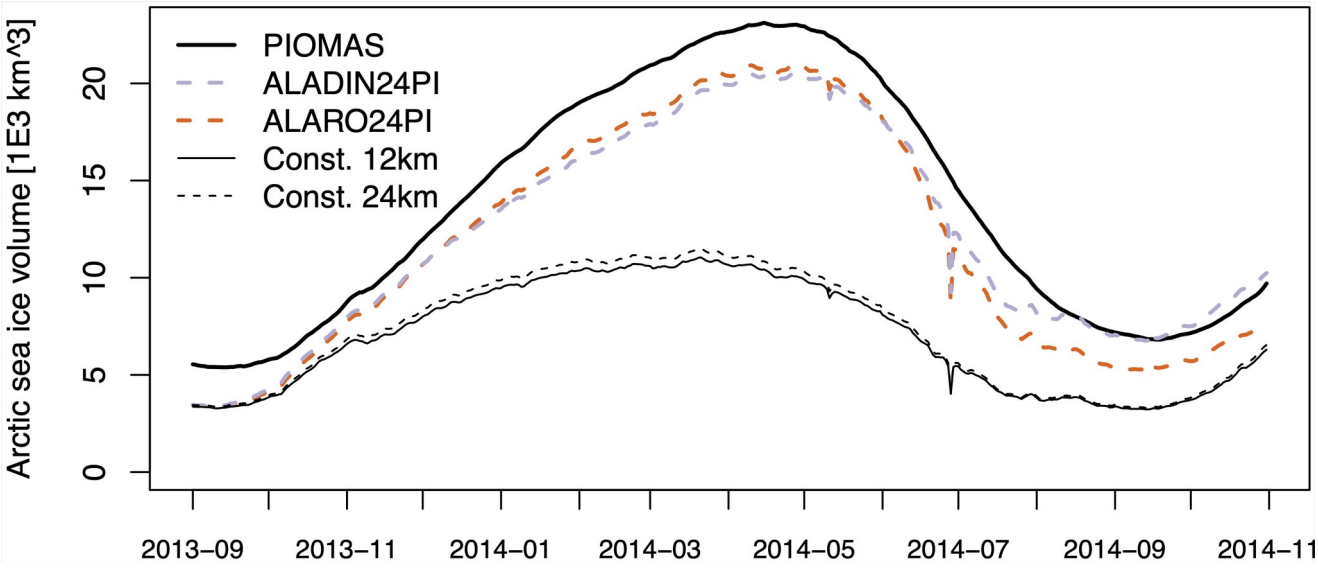

Fig. 1: Arctic sea ice volume (on y axis) over a 13 month period (time on x axis). Two Pan-Arctic HCLIM simulations with prognostic sea-ice thickness are shown as coloured dashed lines. The reference dataset PIOMAS is shown as a thick black line. Simulations with static sea-ice thickness are shown as black lines below. (The brief dip at 2014-06-28 is due to a known error in the ERA-Interim boundary files.)

We have also started to set up the model to run on the new TEMS HPC. It has not been fully tested or benchmarked, so no simulation results from that are available yet.