

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: HCLIM-NorCP: Nordic Convection Permitting Climate Projections with the HCLIM model

Computer Project Account: spnodobl

Principal Investigator(s): Andreas Dobler

Affiliation: Norwegian Meteorological Institute

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

Start date of the project: 01.01.2020

Expected end date: 31.12.2022

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)	9500000	9551264.50	9500000	0
Data storage capacity	(Gbytes)	10000	7200	15000	7200

Summary of project objectives (10 lines max)

The Nordic modelling collaboration “NorCP” is performing convection permitting climate simulations at 3km grid resolution over a northern European domain. The collaboration is using a common model setup for the climate-adapted version “HCLIM” of the numerical weather prediction model HARMONIE and includes DMI (Denmark), FMI (Finland), MET Norway (Norway) & SMHI (Sweden). Within this special project, HCLIM simulations have been carried out in 2020, downscaling the GFDL-CM3 global model to 3km for the future period 2080-2100, following the RCP8.5 emission scenario. Other time periods and scenarios are covered by the other institutes involved. Beside the provision of high-resolution climate data, NorCP aims to increase the knowledge of climate processes and changes over the Fenno-Scandinavian region using next generation high-resolution climate models.

Summary of problems encountered (10 lines max)

The 9.5 MSBUs allocated for 2020 covered roughly 4.75 years of the 21-year time slice we have performed. Another two years were covered by a previous 1-year special project, while the remaining 14.25 years were covered by the national resources from MET Norway and FMI, allowing us to finalise the simulations in May 2020.

For 2021, simulations with a new model version (HCLIM43) are planned. The model setup is ongoing and simulations have not started yet. Additionally, we are porting the model to a new Norwegian HPC system (Betzy) that is similar to the upcoming ECMWF system. The porting of the model takes more time than expected but should give us a head-start once the new ECMWF ATOS system will take over.

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

After the successful generation of more than 150 years of convection permitting climate simulations over northern Europe, processing the data, analysing them with respect to extreme events and evaluating the added value have been in the focus. However, with the upcoming CMIP6 simulations, and taking the good results from the current simulations into account, further downscaling experiments are planned within the project in 2021 and 2022, also contributing to the EURO-CORDEX initiative.

List of publications/reports from the project with complete references

Olsson J, Du Y, An D, Uvo CB, Sørensen J, Toivonen E, Belušić D and Dobler A, 2021: An Analysis of (Sub-)Hourly Rainfall in Convection-Permitting Climate Simulations Over Southern Sweden From a User’s Perspective. *Front. Earth Sci.* 9:681312. doi: 10.3389/feart.2021.681312

Stenmark A, Olsson J, Dobler A, 2021: Downscaling climate projections – towards better adaptation strategies in the Nordic countries. Copenhagen: Nordic Council of Minister. Available from: <http://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-7192>

Lussana C., 2020: seNorge observational gridded dataset. seNorge_2018, version 20.05. MET Norway report 07/2020. Available from <https://www.met.no/publikasjoner/met-report/met-report-2020>

Lind, P., Belušić, D., Christensen, O.B. et al., 2020: Benefits and added value of convection-permitting climate modeling over Fenno-Scandinavia. *Clim Dyn* 55, 1893–1912. <https://doi.org/10.1007/s00382-020-05359-3>

More papers (and reports) on assessing the future projections, extremes etc. are in preparation.

Summary of results

The GFDL-CM3 global model was successfully downscaled to 3km for the future period 2080-2100 (RCP8.5 scenario). Together with the other institutes contributing to NorCP, the simulations now provide a small ensemble of high-resolution climate runs for the time periods 1998-2018 (ERA-Interim driven), 1986-2005, 2041-2060 and 2081-2100 (RCP8.5; EC-EARTH and GFDL-CM3 driven). The resulting data for Northern Europe provides an important basis for the assessment of climate change and its impact on local scales.

Usage and evaluation of the climate model data at national climate and weather services has started and is expected to continue and intensify in the coming year(s). One general paper (Lind et al., 2020) on the model evaluation has been written and published. This evaluation paper shows an added-value of high-resolution modelling and that high-resolution models should be taken into consideration in future climate change studies, especially in mountain areas as well as the design and implementation of climate services. More specific papers based on the model data are currently in preparation.

The data has also been shared with a range of users like for instance hydrologists. Although some results are still preliminary, the convection-permitting simulations seem to provide a step-change in RCM modelling, especially with respect to a correct representation of short-time precipitation and extremes. Although the sheer amount of data provides some challenges to the users, the data has been widely accepted and resulted in several publications from a user's perspective (Lussana, 2020; Olsson et al., 2021; Stenmark et al., 2021) so far.