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:	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	55025	9500000	0
Data storage capacity	(Gbytes)	15000	7200	20 000	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) were planned. However, finding a final model configuration took longer than expected. In parallel, the model has been ported to a new Norwegian HPC system (Betzy) which is similar to the ECMWF ATOS system. The porting of the model took some additional time.

From 2022 on, new simulations are planned to include transient aerosol projections. This needs some further model development and testing which is ongoing. Thus, only short test- and evaluation runs on the convection permitting scale have been carried out and long-term simulations have not started yet.

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

The model has been ported to the ATOS system. Finding a common model setup and configuration is ongoing in 2022. This will also include an intermediate model setup which will contribute to downscaling CMIP6 simulations within the EURO-CORDEX initiative. For 2022, downscaling of NorESM-2 with HCLIM on the EURO-CORDEX 0.11° grid for several SSP scenarios is planned within this project.

Otherwise, we are further analysing and using the 150 years of convection permitting climate model data over northern Europe generated in the beginning of the project. This data will be used for instance in the upcoming "Climate in Norway – 2100" report and contribute to further publications.

List of publications/reports from the project with complete references

Lind, P., Belušić, D., Médus, E. et al.: Climate change information over Fenno-Scandinavia produced with a convection-permitting climate model. Submitted to Climate Dynamics.

Freistetter, NC., Médus, E., Hippi, M. et al., 2022: Climate change impacts on future driving and walking conditions in Finland, Norway and Sweden. Reg Environ Change 22, 58 (2022). doi: 10.1007/s10113-022-01920-4

Médus, E., Thomassen, E. D., Belušić, D. et al., 2022: Characteristics of precipitation extremes over the Nordic region: added value of convection-permitting modeling, Nat. Hazards Earth Syst. Sci., 22, 693–711. doi: 10.5194/nhess-22-693-2022

Olsson J, Du Y, An D, Uvo CB, Sörensen 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. doi: 10.6027/NA2021-901. Available from: http://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-7192

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

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

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

Summary of results

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.

The HCLIM-NorCP data for Northern Europe provides an important basis for the assessment of the added value of convection permitting simulations with respect to climate change and its impact on local scales. This is especially true in the mountainous areas of Norway.

The convection-permitting simulations 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 demanded by different users (e.g. hydrologists). This has led to several publications from a user's perspective (Lussana, 2020; Olsson et al., 2021; Stenmark et al., 2021). We expect this to continue in the final year of the project and beyond. Several reports and papers based on the model data are already in preparation.