REQUEST FOR A SPECIAL PROJECT 2020–2022

MEMBER STATE: Norway

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

If this is a continuation of an existing project, please state the computer project account assigned previously.	spnodobl	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2020	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2020-2022: (To make changes to an existing project please submit an amended version of the original form.)		**2020**	**2021**	**2022**
High Performance Computing Facility	(SBU)	9.5 million	9.5 million	9.5 million
Accumulated data storage (total archive volume)[2]	(GB)	10 000	15 000	20 000

Continue overleaf

1 The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide annual progress reports of the project's activities, etc.

2 These figures refer to data archived in ECFS and MARS. If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year etc.

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Extended abstract

The completed form should be submitted/uploaded at https://www.ecmwf.int/en/research/special-projects/special-project-application/special-project-request-submission.

All Special Project requests should provide an abstract/project description including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used.

Following submission by the relevant Member State the Special Project requests will be published on the ECMWF website and evaluated by ECMWF as well as the Scientific Advisory Committee. The evaluation of the requests is based on the following criteria: Relevance to ECMWF's objectives, scientific and technical quality, disciplinary relevance, and justification of the resources requested. Previous Special Project reports and the use of ECMWF software and data infrastructure will also be considered in the evaluation process.

Requests asking for 1,000,000 SBUs or more should be more detailed (3-5 pages). Large requests asking for 10,000,000 SBUs or more might receive a detailed review by members of the Scientific Advisory Committee.

Higher resolution in climate models is a main factor for more reliable climate data and information. Several studies have shown an improvement in the distribution of for instance extreme precipitation with increasing resolution (e.g., Déqué and Somot, 2008; Coppola et al., 2018; Knist et al. 2018). Further, some applications of convection-resolving climate models (i.e. below about 4 km grid resolution) have shown that the projected climate change signal may even change in sign with higher resolution (Prein et al., 2015) and demonstrated promising improvements in the daily cycle of rainfall and temperature, cyclone core pressure or the scaling behaviour of convective extreme events with temperature (e.g., Ban et al., 2015, Prein et al., 2015). Recently, a Nordic collaboration termed "NorCP" has been established, performing convection permitting regional climate model simulations at 3km grid resolution over a northern European domain (Fig. 1).

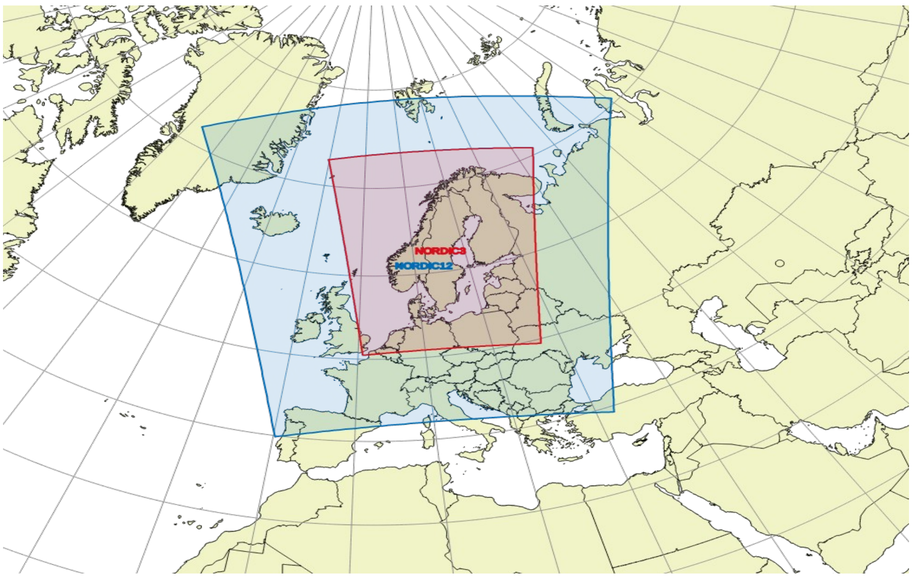

Fig. 1: The convection permitting (inner) and intermediate simulation domain for the HCLIM-NorCP simulations.

The model used in the NorCP collaboration is the climate-adapted version of the numerical weather prediction model HARMONIE (Bengtsson et al. 2017), named “HCLIM” (Belusic et al. 2019, submitted). NorCP includes DMI (Denmark), SMHI (Sweden), MET Norway, and FMI (Finland). It is a subproject of the HCLIM consortium, which further includes KNMI (The Netherlands) and AEMET (Spain). The HCLIM consortium has the following list of scopes:

1. To ensure the existence of one common version of the HCLIM model among the collaborating institutes, making it easier to set up and run the model.

2. To administer work with HCLIM so that model development and evaluation can be efficiently distributed between the collaborating institutes.

3. To enhance possibilities on collaborating on climate scenario production leading to more efficient use of resources (staff, HPC, storage and downstream file processing, analysis and climate services provision).

4. To enhance technical and scientific collaboration between specialists on the NWP and climate branches of the model system within the institutes. A joint NWP-climate development has the potential to be beneficial to the NWP version of the model as this will be evaluated also in a climate perspective (e.g. stronger need for conservation of energy and water thereby requiring internal consistency).

5. To facilitate scientific collaboration between institutes.

The HCLIM model has been evaluated for instance in Lindstedt et al. (2015), where a good agreement with observations on regional scales and below has been shown. At convective permitting resolutions the AROME parametrisation package is used. This package is based on the AROME model physics (Seity et al., 2011) and optimized for high spatial resolutions. For Norway, the HCLIM model has been successfully applied in downscaling the ERA-Interim reanalysis to 2.5km, providing unprecedented climate data for estimating icing on power-lines for the Norwegian mainland (Dobler et al., 2019). The modelled precipitation data has further been used, together with Norwegian rain-gauge data, to create monthly precipitation climatologies for Norway at 1 km resolution (Crespi et al., 2019).

All in all, we believe that the good performance of the HCLIM model in providing such valuable data, justifies the use of a fair amount of CPU hours to extend the current reanalysis driven simulation period (2004-2017), as well as applying HCLIM in climate change studies to downscale past and future earth system model simulations to the same resolution. In NorCP, we use the most recent HCLIM version (v38h1, developed and tested at the Rossby Center at SMHI, Sweden) which includes changes in the radiation code and surface schemes, making the model more suitable for climate experiments (cf. HCLIM wiki webpage). The HCLIM modelling framework also underwent an optimization of pre- and post-processing components for climate purposes, e.g., on-the-fly conversion to NetCDF output.

Due to the heavy CPU load of the planned simulations, the work in NorCP has been split into several pieces. MET Norway has completed a 21-year future projection period following RCP8.5, downscaling boundary data from the EC-EARTH earth system model. Together with the other institutes participating in NorCP, we now have over 60 years of simulations based on EC-EARTH as well as 21 years based on ERA-Interim. However, to enable simulations based on other earth system models and not over-stress the national computing time quota, we apply for a special project. Beside the basic provision of high-resolution climate data, the NorCP work will also have a focus on analysing simulated and projected extreme (precipitation) events over the Nordic countries, and on evaluating the added value in simulating the daily cycle with the convection permitting model.

Simulations are done at ECMWF's facilities in order to easily share the model code, setup, in- and output data. Furthermore, the use of the ecFlow scheduler provides the possibility to monitor the progress of the long-running climate simulations and makes them easily manageable, e.g. restarting of aborted simulations or data conversions.

The analysis planned in NorCP will require information down to sub-hourly time-scales and cover a relatively large grid-space. However, most of the data needed will be restricted to 2D fields. The estimated model output will require about 1 TB of space per simulated model year and the data stored at ECMWF will be continuously reduced moving data to our own storing facilities.

References

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HCLIM wiki webpage, https://hirlam.org/trac/wiki/HarmonieClimate