

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 year2019.....

Project Title: ...The Danish Climate Atlas: HCLIM experiments

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Computer Project Account: ...SPDKPEDE.....

Principal Investigator(s): ...Rasmus A. Pedersen

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Affiliation: ...Danish Meteorological Institute.....

Name of ECMWF scientist(s) collaborating to the project

(if applicable)

Start date of the project: ...January 1, 2019.....

Expected end date: ...December 31, 2021.....

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)	-	-	9,000,000	9,000,000
Data storage capacity	(Gbytes)	-	-	20,000	20,000

Summary of project objectives (10 lines max)

The Danish Meteorological Institute will in the coming years (2018-2021) develop a so-called Climate Atlas with detailed information on future climate projections for Denmark. The work will have a particular focus on extreme events, e.g. precipitation extremes and cloud bursts. Consequently, model simulations with high geographical detail, high temporal resolution and physics that improve the treatment of convective processes are needed. We will perform a series of regional climate model simulations with HCLIM (Belusic et al. 2019); the climate-adapted version of HARMONIE (Bengtsson et al., 2017). Part of the planned work will be done in a Nordic collaboration on HCLIM involving DMI (Denmark), SMHI (Sweden), MET Norway (Norway), and FMI (Finland); creating a consistent future projection ensemble of 3 km simulation over a Scandinavian domain. DMI has been responsible for a simulation covering 2081-2100 following the RCP8.5 emission scenario (van Vuuren et al., 2011). These Scandinavian simulations will be supplemented by simulations focusing solely on Denmark; potentially in even higher resolution.

Summary of problems encountered (10 lines max)

We encountered a small technical problem related to setting up the appropriate module environment, but otherwise none. The resources allocated for 2019 covered less than half of the 20-year Scandinavian experiment – but using additional resources from DMI's main allocation it has been finalized (in May 2019).

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

The Nordic HCLIM consortium has planned to extend the Scandinavian 3 km ensemble with (1) projections downscaling output from a second GCM, and (2) future projections following the RCP4.5 scenario (van Vuuren et al., 2011) downscaled from EC-Earth (as the current ensemble). As before, these simulations will be distributed among the countries/partners. The new allocation starting in 2020 will be used for performing (a part of) DMI's contribution – one 20 year experiment.

List of publications/reports from the project with complete references

Two joint general papers are being prepared in the Nordic consortium; one evaluating the model performance and one assessing the future projections. Additional papers with more specific foci (i.e. on specific processes and/or geographical regions) will follow.

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.

The resources for 2019 were used for DMIs contribution to the joint Nordic ensemble: 20-year simulations of historical, mid- and late 21st century conditions. With our choice of resource usage, the runtime for a 20-year experiment is more than 4 months meaning that the experiments have finished very recently. The full ensemble is now complete, and analyses aiming at two joint papers are ongoing. The first one will evaluate the performance in the observed period, and the second will assess the projected future changes.

Figure 1 shows a snap-shot of the near-surface temperature in the projection for the end of the 21st century (following the RCP8.5 scenario). The spatial pattern in the temperature field illustrates the high geographical detail and specific treatment of different surface types (cities, lakes, rivers, etc.).

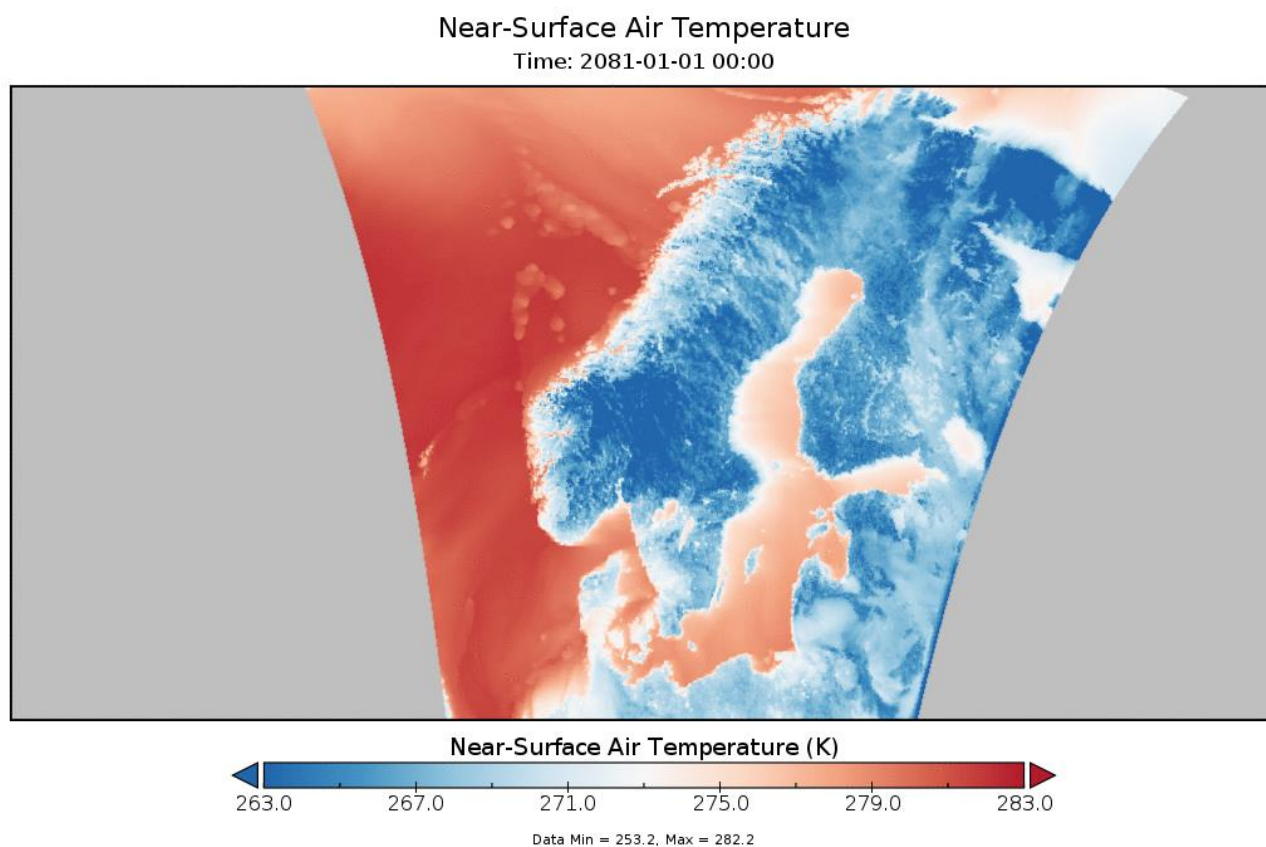


Figure 1 Near-surface air temperature simulated by HCLIM using 3 km horizontal resolution. Snap-shot from the late 21st century simulation (following the RCP8.5 scenario) performed by DMI.

References

- Belušić, D., H. de Vries, A. Dobler, O. Landgren, P. Lind, D. Lindstedt, R. A. Pedersen, J. C. Sánchez-Perrino, E. Toivonen, B. van Ulft, F. Wang, U. Andrae, Y. Batrak, E. Kjellström, G. Lenderink, G. Nikulin, J.-P. Pietikäinen, E. Rodríguez-Camino, P. Samuelsson, E. van Meijgaard, and M. Wu, 2019. HCLIM38: A flexible regional climate model applicable for different climate zones from coarse to convection permitting scales. Submitted to Geoscientific Model Development.
- Bengtsson, L., Andrae, U., Aspelien, T., Batrak, Y., Calvo, J., de Rooy, W., Gleeson, E., Hansen-Sass, B., Homleid, M., Hortal, M., Ivarsson, K.-I., Lenderink, G., Niemelä, S., Nielsen, K.P., Onvlee, J., Rontu, L., Samuelsson, P., Muñoz, D.S., Subias, A., Tijm, S., Toll, V., Yang, X., Køltzow, M.Ø., 2017. The HARMONIE–AROME Model Configuration in the ALADIN–HIRLAM NWP System. *Mon. Weather Rev.* 145, 1919–1935. <https://doi.org/10.1175/MWR-D-16-0417.1>
- van Vuuren, D.P., Edmonds, J., Kainuma, M., Riahi, K., Thomson, A., Hibbard, K., Hurtt, G.C., Kram, T., Krey, V., Lamarque, J.-F., Masui, T., Meinshausen, M., Nakicenovic, N., Smith, S.J., Rose, S.K., 2011. The representative concentration pathways: an overview. *Clim. Change* 109, 5–31. <https://doi.org/10.1007/s10584-011-0148-z>