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:	A large ensemble of climate projections at high resolution
Computer Project Account:	spsebelu
Principal Investigator(s):	Danijel Belušić
Affiliation:	Swedish Meteorological and Hydrological Institute
Name of ECMWF scientist(s) collaborating to the project (if applicable)	n/a
Start date of the project:	1 January 2021
Expected end date:	31 December 2023

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)	n/a	n/a	60 000 000	380 052
Data storage capacity	(Gbytes)	n/a	n/a	35 000	-

Summary of project objectives (10 lines max)

The project develops and utilises an on-demand climate downscaling procedure for high-impact weather events using a high-resolution regional climate model (convection permitting regional climate model - CPRCM). The procedure consists of two main steps:
1. detecting potential high-impact events of interest in a parent simulation, typically a global climate model (GCM),
2. using an automated downscaling procedure for extreme events, which includes re-running the parent model to save model levels and running the CPRCM for a large number (hundreds) of detected events.
The goal is to provide a sufficient number of simulations for a robust statistical analysis of extreme events.

Summary of problems encountered (10 lines max)

Two main issues delayed the start of the simulations:
1. The development of the new cycle of the CPRCM used in this project, HCLIM cycle 43, has taken longer than anticipated due to unforeseen difficulties with the code.
2. The development of the detection procedure of potential high-impact events in a GCM has taken longer than anticipated. This is mostly due to the staff reduced working hours as a result of Corona restrictions in schools and kindergartens.

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

The main two reasons for the delay are currently being addressed. The cycle 43 is in the evaluation phase and is expected to be operational soon. The event detection procedure is to a large extent developed and fine tuning is under way. We expect the method to be ready by Autumn 2021 and its implementation and testing to be finished by the end of 2021. Therefore, the originally planned simulations for 2021 and 2022 would start in 2022, with a potential reduction in simulation length per event to keep the large number of event simulations feasible. The plan for 2023 remains unchanged. We therefore ask to start using the allocated project resources from 2022, and would return the unused resources for 2021.

List of publications/reports from the project with complete references

The event detection procedure has several steps, one of which is based on the classification of large-scale circulation types. A new publication presents improvements in the circulation type classification methodology:
Hansen, F., Belušić, D., 2021: Tailoring circulation type classification outcomes. Int. J. Clim., doi: 10.1002/joc.7171.

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.

As a result of the delay in project activities, the planned simulations have not been performed yet and are postponed for 2022. Therefore, the main results of this project, which are based on model simulations, cannot be reported before 2022.

The ongoing project activities have been in planning and preparing the demanding downscaling procedure. The new improvements in circulation type classification result in physically consistent circulation types and consequently in better separation of high-impact weather events into different large scale circulation patterns (Hansen and Belušić, 2021). This contributes to a new high-impact event detection algorithm.

At the same time, the SMHI large ensemble GCM simulations have been completed (Wyser et al., 2021) and first re-runs have been made with model levels saved for further downscaling. Therefore, the main components for the downscaling procedure are ready and will be implemented after fine tuning and testing.

Wyser, K., Koenigk, T., Fladrich, U., Fuentes-Franco, R., Karami, M. P. and Kruschke, T. (2021) The SMHI large ensemble (SMHI-LENS) with EC-Earth3. Geosci. Model Dev. Discuss. https://doi.org/10.5194/gmd-2020-428.