REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING SPECIAL PROJECT

Please email the completed form to special_projects@ecmwf.int.

MEMBER STATE: Ireland

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Project title: HARMONIE Climate (HCLIM) Regional Downscaling Simulations for Ireland

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Project account: **spiemcgo**

Additional computer resources requested for		2020
High Performance Computing Facility	(units)	12.5 million
Data storage capacity (total)	(Gbytes)	

[1] The Principal Investigator is the contact person for this Special Project

Technical reasons and scientific justifications why additional resources are needed

We would like to apply for 12.5 million additional SBUs for the remainder of 2020.

This project aims to obtain downscaled projections of the Irish climate using the HARMONIE climate (HCLIM) model, with CMIP6 global EC-Earth data as input. A two-stage approach is adopted whereby EC-Earth data is downscaled first to 12-km with Aladin physics and subsequently to 4-km with Arome physics. The domains of the 12-km and 4-km resolution runs are shown respectively in Fig.1.

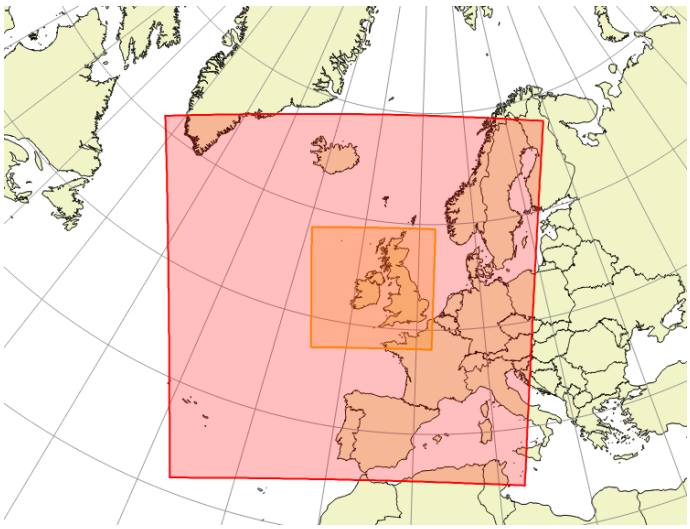

Fig. 1 *Domains of the 12-km resolution (red) and 4-km resolution runs (yellow)*

So far we have completed just over 20 years of 12-km and 4-km nested runs which has given us the opportunity to update the projected computational cost of the project. Our original estimate of 60 MSBUs was calculated using a lower estimate for the 4-km runs than what we have seen in our runs so far (the cost is approximately 60% higher than originally budgeted for). Additionally, we have realised that our original proposal neglected to budget for the 12-km runs. Based on our 20-year sample, the average cost of running 1 month at 12-km resolution is approximately 12 kSBUs, while 1 month at 4-km costs on average approximately 36 kSBUs. The combined average cost for the nested runs is therefore approximately 48 kSBUs per month.

The proposed simulations are a 21-yr 1980-2000 ERA5 run, a 35-yr 1980-2014 EC-Earth run and two 87-yr 2014-2100 runs for RCP4.5 and RCP8.5 respectively (the years listed are for 1st January to 31st December and include a spin-up year in each case which will be discarded). This results in a total of 230 years of nested runs, which at 48 kSBUs per month equates to 132.5 MSBUs. Adding 5% for a conservative estimate gives 139 MSBUs. Therefore, we put the total cost of the project somewhere in the range 130-140 MSBUs compared with our original estimate of 60 MSBUs.

In order to reduce the overall computational cost, we have decided to focus exclusively on the RCP4.5 future run, putting the RCP8.5 run on hold for the moment. Even with the exclusion of the RCP8.5 run, we will still have insufficient SBUs to complete the full 2014-2100 RCP4.5 run. As a result, we have decided to focus on the first half of the 21-st Century, namely from 2014-2050. Focusing on this shorter time period will reduce the computational cost while still providing a valuable climatological record for further analysis. Simulating the historical periods outlined above as well as RCP4.5 from 2014-2050 will result in a total of 92 simulation years, which will cost approximately 55 MSBUs in total.

A bug in the latest version of HCLIM when downscaling to 4-km using AROME physics was discovered during tests and resolved with the help of the HCLIM partners. In addition, some simple sensitivity tests as well as first trial runs were carried out before starting the production runs. The total cost of this debugging and testing was just under 2 MSBUs. From a project budget of 20 MSBUs for 2020, just over 1 MSBUs were used by our collaborator Dr Paul Nolan for another project. We therefore started with approximately 17 MSBUs for 2020 when starting our production runs. According to the project proposal, we are due to receive an additional 20 MSBUs in 2021. The NWP team at Met Eireann has also generously donated 5.5 MSBUs of their 2020 allocation in order to bridge the gap in resources needed for the project. As a result, we provisionally have a 2020/2021 total project budget of 42.5 MSBUs to work with, which is 12.5 MSBUs short of what would be required to complete the 2014-2050 RCP4.5 run.

The historical (1980-2000) ERA5 and EC-Earth (1980-2014) simulations at 4-km and 12-km are currently running, as well as the RCP4.5 EC-Earth (2014-) 4-km and 12-km simulations. These simulations are spread across three users (dujm, dujp and duca) in order to spread the load. Running all three experiments in this manner results in approximately 1.25 MSBUs used per 24 hours on cca. At this rate, we expect to exhaust our 2020 SBU allocation by the 20th/21st of December. An additional 12.5 MSBUs would enable us to run continuously until our new 2021 allocation arrives on January 4th, as well as bridging the 12.5 MSBU gap in resources needed to compete the 2014-2050 RCP4.5 run.

Without these additional units, the RCP4.5 run is likely to stop at approximately 2030. A minimum continuous period of 30 years of downscaled climate projections is necessary for a robust analysis of Ireland's future climate. These additional 12.5 MSBUs would allow this future RCP4.5 run to complete to 2050, which would result in a 36-year climatological record rather than one of less than half that length. We acknowledge that 12.5 MSBUs represents a significant number of additional resources on short notice and we understand if this figure is unrealistic at this moment in time. If this is the case, we would gratefully accept a lower number of additional units and seek to find additional resources in 2021.

As we have only recently started the simulations at the beginning of December, we have not yet had the opportunity to perform an in-depth analysis of the resulting output, aside from some basic sanity checks and plotting. These sanity checks have consisted of plotting the original ERA5 and EC-Earth data and comparing with the downscaled 12-km and 4-km runs (just with simple eye-balling for now). Based on this, we are satisfied that the model is running well. We intend to perform a more in-depth analysis of the output in the first quarter of 2021 and will include the results of this analysis in our next report.