LATE REQUEST FOR A SPECIAL PROJECT 2012–2014

MEMBER STATE: IRELAND

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Emily Gleeson – Met Éireann

Project Title: Downscaling a wetter/hotter outlier GCM for the EURO-CORDEX initiative.

Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2012-2014: (The project duration is limited to a maximum of 3 years, agreed at the beginning of the project. For late requests the project will start in the current year.)		**2012**	**2013**	**2014**
High Performance Computing Facility	(units)	5,000,000	10,000,000	
Data storage capacity (total archive volume)	(gigabytes)	10,000	10,000	

*An electronic copy of this form **must be sent** via e-mail to:* *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date): ……4th July 2012……

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 an annual progress report of the project's activities, etc.

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Extended abstract

It is expected that Special Projects requesting large amounts of computing resources (500,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

Scientific Plan

Regional climate models (RCMs) have become increasingly important tools in the study of regional climate processes and in the generation of regional climate change projections and seasonal to decadal predictions. In particular, under the endorsement and scientific initiative of the World Climate Research Programme (WCRP), an international program, the Coordinated Regional climate Downscaling Experiment (CORDEX), has been implemented.

CORDEX aims to provide an internationally coordinated framework within which various regional climate downscaling (RCD) methodologies can be compared, improved, standardized and, where possible, best-practices recommended. The specific aims of CORDEX are to provide a framework to coordinate model evaluation and improvement, produce a new generation of RCD projections for land-regions worldwide based on new CMIP5 GCM projections, to foster the dialogue between the RCD communities and the impact, adaptation and vulnerability communities, and to engage developing nation scientists in the generation, evaluation and use of CORDEX data.

Within this framework, regional initiatives are formed. In Europe, the EURO-CORDEX initiative has been formed. EURO-CORDEX is a voluntary effort of many of the leading and most active institutions in the field of regional climate research in Europe and is coordinated by D. Jacob (CSC Germany) and A. Gobiet (WegCenter/UniGraz). EURO-CORDEX (similar to the entire CORDEX initiative) is not providing funding to any participant, but is fully relying on the enthusiasm of the participating researchers and institutions. This enthusiasm is based on the aim to improve climate projections, in order to enable the European society to better adapt to unavoidable climate change and to design more efficient mitigation strategies.

Unlike most other regions of the Earth, Europe already has coordinated ensembles of regional climate simulations (Ensembles, Prudence). These climate scenarios were provided on grid-sizes down to 25 km and are based on the previous generation of emission scenarios (SRES). In order to proceed from this point, the EURO-CORDEX simulations will not only consider new greenhouse gas emission scenarios, but will also use more recent version of Regional Climate Models (RCMs), and increase spatial resolution.

The EURO-CORDEX simulations consider the global climate simulations from the CMIP5 long-term experiments up to the year 2100. They are based on greenhouse gas emission scenarios (Representative Concentration Pathways, RCPs) corresponding to stabilization of radiative forcing after the 21st century at 4,5 W/m² (RCP4.5), rising radiative forcing crossing 8,5 W/m² at the end of 21st century (RCP8.5), and

peaking radiative forcing within the 21st century at 3,0 W/m² and declining afterwards (RCP2.6, also referred to as RCP3-PD)

EURO-CORDEX simulations will focus on grid-sizes of about 12 km (0.11 degree). Auxiliary simulations with the standard CORDEX resolution of about 50 km (0.44 degree) are being conducted. This initiative will allow new regional downscaling techniques to be evaluated in a consistent manner, and produce a new generation of regional climate projections for use in impact/adaptation studies. These projections will have a wide range of applications, and are essential to inform climate change policies at an international, national and regional scale within Europe.

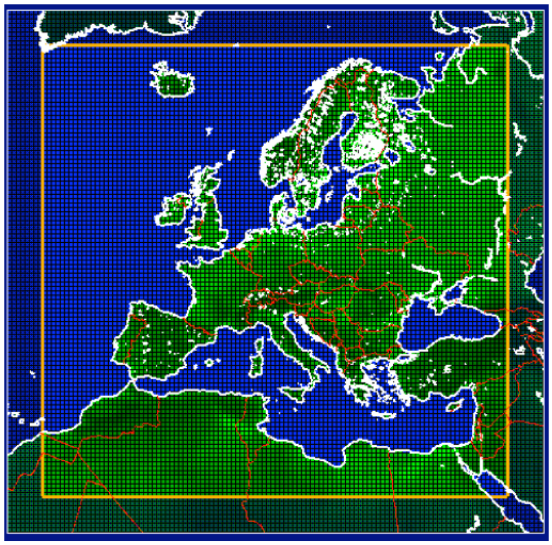

Figure 1: EURO-CORDEX region

EURO-CORDEX aims to:

- Coordinate joint evaluation in the European region: GCM evaluation, RCM evaluation, reference datasets.
- Coordinate the design of the EURO-CORDEX simulation matrix, and joint analysis of climate projections in the European region.
- Foster cooperation with GCM community: GCM analysis for European region.
- Foster cooperation with impact, adaptation, and mitigation community: Error correction, ensemble based products, regionally relevant CC indicators, etc.
- Foster dissemination of EURO-CORDEX results.

In its first phase, EURO-CORDEX focuses on the evaluation of the high resolution simulations and on the construction of a simulation matrix that covers both the uncertainty induced by the driving global climate models and the uncertainty induced by the RCD methods in the best affordable manner. The need for such a simulation matrix was seen by evaluating CMIP3 GCMs. The GCMs contribute the major fraction to uncertainty over Europe (and worldwide). Further future activities include the analysis of future climate simulations, the joint analysis of dynamical and empirical-statistical methods, and the design and application of suitable bias correction techniques to provide EURO-CORDEX results that are directly applicable in climate change impact research.

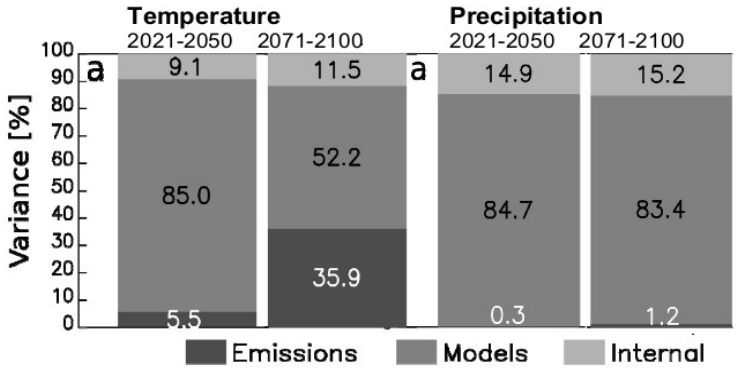

Figure 2: Uncertainty Components in CMIP3 (30 yrs, Europe)

Prein, A. F., A. Gobiet, and H. Truhetz (2011), Analysis of uncertainty in large scale climate change projections over Europe, Meteorologische Zeitschrift, 20(4), 383-395

At the European Geosciences Union General Assembly, in Vienna April 2012, presentations gave an overview of the current status and activities of the EURO-CORDEX community. A EURO-CORDEX splinter meeting was also held. Recent GCM analyses were presented at the splinter meeting, including updated dTemperature/dPrecip scatter plots. It was emphasised that there is a need for downscaling "hotter/wetter" GCMs. Judging from ongoing GCM analysis at annual time scales, such wetter and hotter GCMs are MIROC-ESM-CHEM, MIROC-ESM and CanESM2 in case of experiment RCP4.5. Looking at the seasonal cycle reveals that, particularly in summer, the two MIROC simulations are the more extreme ones.

MIROC-ESM and MIROC-ESM-CHEM currently provide the 6-hourly data that are necessary for downscaling via the Earth System Grid. Regarding the quality of these two models in recent history both show a better than average performance for upper air variables along the EURO-CORDEX domain boundaries, with MIROC-ESM-CHEM performing slightly better than MIROC-ESM.

Therefore, the aim of this Special Project is to downscale the wetter/hotter MIROC-ESM-CHEM GCM. The members of this project already have experience of running the RCM involved on the ECMWF HPCF. This project will involve running:

- Hindcast 1989-2009, 21 years
- Control 1950-2005, 56 years
- Scenario RCP4.5: 2006-2100, 95 years

EURO-CORDEX is a collaborative initiative, and by producing these downscaled data, the project team will have access to data produced by other members of the EURO-CORDEX initiative. It is expected that analyses of these data will lead to publications in leading, peer-reviewed journals.

Justification of Computer Resource

This project aims to use the COMSO-CLM model (http://www.clm-community.eu) to downscale the GCM data. COSMO-CLM has been used to downscale a different GCM for the EURO-CORDEX project. Using 256 parallel tasks on 128 Cores (4 nodes with 32 IBM Power 6 CPUs) in simultaneous multi threading (SMT) mode at DKRZ in Hamburg, the following information is available (kindly supplied by Dr. Klaus Keuler, Brandenburg technological university Cottbus):

CPU time:

0.11 degree: 10300 s/month

0.44 degree: 700 s/month

Using these values, we calculate the SBU required:

P = 3885000/(8640*86400)

SBU = P * 11,000 s/month * 172 years * 12 months * 4 * 32

= 15,000,000

Archive Volume:

0.11 degree: 890 GB/year full requested CCLM output (including 3 hourly 3D fields)

0.44 degree: appr. 1/8 of 0.11

Using these values, we calculate total archive volume as:

1 Terabyte/year * 172 years = 172 TB

Data will be retrieved from the ECMWF as simulations are being run, and stored on a local data server. Therefore, we only foresee using a maximum of 10TB data storage capacity at the ECMWF.

Technical characteristics of the code

The COSMO model in CLimate Mode (COSMO-CLM or CCLM) is a non-hydrostatic regional climate model developed from the Local Model (LM) of the German Weather Service by the CLM-Community. Since 2005 it is the Community-Model of the German climate research. The model has been used for simulations on time scales up to centuries and spatial resolutions between 1 and 50 km.

COSMO-CLM is a well-established RCM, and members of this project team have prior experience of running COSMO-CLM on the ECMWF HPCF.