REQUEST FOR A SPECIAL PROJECT 2015–2017

MEMBER STATE: Norway

Principal Investigator[1]: Jón Egill Kristjánsson

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Project Title:

Modeling of chemistry-climate interactions

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SPNOKRIS**	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2012	
Would you accept support for 1 year only, if necessary?	YES X	NO

Computer resources required for 2015-2017: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2017.)	**2015**	**2016**	**2017**
High Performance Computing Facility (units)	60 000	60 000	
Data storage capacity (total archive volume) (gigabytes)	2 000	2 000	

*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): 18 July 2014

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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Project Title: Chemistry-climate interactions

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.

At the Department of Geosciences of the University of Oslo, there is a strong research activity on modelling of atmospheric chemistry, aerosols and clouds. In addition, we carry out model studies of Arctic climate processes and atmosphere-ocean interactions. All these model studies make use of ECMWF reanalysis data for initialization and validation. These efforts can be divided into three themes:

1) **Chemical transport modelling**: The IFS model is run to produce meteorological input data for the off-line Chemical Transport Model Oslo CTM3 (Søvde et al., 2012), which is used to calculate the distribution and changes in chemically and radiatively active atmospheric compounds. The Oslo CTM3 covers both the troposphere and the stratosphere and includes gas-phase oxidant chemistry as well as aerosol modules (primary and secondary). Forecast data are used since fields that are crucial for CTM modelling of chemical tracers are not available in the MARS archive (e.g. convective statistics). Though convection statistics are available in the ERA-40 dataset, the spin-up for these data is short, and the residual circulation in this data set is most likely too strong, giving unrealistic ozone fluxes from the stratosphere into the troposphere.

The Oslo CTM3 and its predecessor CTM2 have been thoroughly validated against observations, showing that the use of the IFS data makes it very suitable for comparisons both with campaign data and long term observations. The IFS data are also suitable for doing specific process studies (transport and chemistry). The use of IFS data is essential for our participation in a number of EU projects (including ECLIPSE, ECATS) and non-funded international projects (e.g. AeroCom). We use the IFS 60 layer version (up to approximately 65 km), run at T319 resolution, to give full coverage of the stratosphere. We will continue to use the IFS 60 layer version to have a long continuous record, but because of changes done in the IFS model (new cycles and old cycles not available anymore) we have to rerun some of the years already run. The new meteorological data are crucial to make use of recent observations to further develop and validate the model.

Søvde, O. A., M. J. Prather, I. S. A. Isaksen, T. K. Berntsen, F. Stordal, X. Zhu, C. D. Holmes and J. Hsu, 2012: The chemical transport model Oslo CTM3, *Geosci. Model Dev.*, 5, 1441-1469.

2) **Aerosol and cloud modelling**: A new collaboration with the Norwegian Meteorological Institute, as well as NCAR in Boulder, Colorado and several other partners will seek to improve simulations of atmospheric icing, using the ALADIN/HARMONIE model system as well as WRF with the Thompson cloud microphysics scheme. The work follows up and extends an earlier research activity in our group on atmospheric icing (Nygaard et al., 2011). ECMWF reanalysis data will be essential to provide initial and boundary values for the WRF simulations.

Nygaard, B. E. K., J. E. Kristjánsson, and L. Makkonen, 2011: Prediction of in-cloud icing conditions at ground level using the WRF model. *J. Appl. Met. Clim.*, 50, 2445-2459.

3) **Atmosphere-cryosphere interactions:** Within the CRYO-MET project, we use the WRF model as a link between global climate models and soil models to study the influence of a changing climate on the cryosphere at Svalbard. A first step is to validate the surface energy budget (Aas et al., 2014), for which one full year of data are available at Ny-Ålesund (79°N, 12°E). Based on that validation, adjustments have been made to the surface parameterizations. Subsequently, WRF will be run for downscaling of future climate projections, as well as for upscaling, in order to capture the influence of permafrost thawing on the atmosphere. ECMWF reanalysis data will be essential to provide initial and boundary values for the WRF simulations**.** A new interdisciplinary collaboration involving hydrology, glaciology, biology and meteorology, LATICE, will extend the studies carried out in CRYO-MET to investigate other regions, e.g., northern Scandinavia as well as involve other aspects, such as e.g. vegetation changes.

Aas, K. S., T. K. Berntsen, J. Boike, B. Etzelmüller, J. E. Kristjánsson, M. Maturilli, T. V. Schuler, F. Stordal, and S. Westermann, 2014: A comparison between simulated and observed surface energy balance at the Svalbard archipelago. Submitted to *J. Appl. Met. Clim*.