LATE REQUEST FOR A SPECIAL PROJECT 2010–2012

MEMBER STATE: …Norway……..…

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Other researchers: …Anna Benedictow, Alvaro Valdebenito, Peter Wind.……

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Project Title: …Meteorological data for EMEP……..……

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Would you accept support for 1 year only, if necessary?	YES **X**	NO

Computer resources required for 2010-2012: (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.)	**2010**	**2011**	**2012**
High Performance Computing Facility (units)		1 000 000	1 000 000
Data storage capacity (total archive volume) (gigabytes)		4 000	4 000

*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):

…….. 01 April 2011……

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.

Principal Investigator: …Michael Gauss……

Project Title: … Meteorological data for EMEP ……

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.

Aim of the project:

Generate a multi-year set of global IFS meteorological data on T799 spectral resolution for use in the Unified EMEP model.

Scientific use of the project outcome:

Use for air pollution trend analyses and for studying the effect of emission changes (filtering out inter-annual meteorological variability).

Background:

Air pollution continues to be a serious environmental and societal problem both in Europe and in other parts of the world. Under the UN Convention on Long-range Transboundary Air Pollution (LRTAP), which has been in force since 1979, the EMEP Programme (European Monitoring and Evaluation Programme, http://www.emep.int) has for many years provided the scientific background for policy decisions. During the last decade, interactions between air pollution and climate change have gained increasing scientific attention, which is reflected in the EMEP long-term strategy for 2010-2020.

The Meteorological Synthesizing Centre - West (MSC-W), hosted by the Norwegian Meteorological Institute (now as part of the Division for Climate Modelling and Air Pollution), is one of the five EMEP centres under the UN LRTAP convention and has been performing extensive modelling studies with focus on acidification (e.g. acid rain), eutrophication (increasing nutrient content in soil and water bodies), ground level ozone and particulate matter in air, which are relevant for both air pollution and climate. In addition MSC-W is involved in numerous national and international projects in support of EMEP.

The largest projects we are currently involved in are:

EMEP: http://www.emep.int, funded through UN ECE,
MACC: http://www.gmes-atmosphere.eu, funded through EU FP7,
PEGASOS: http://pegasos.iceht.forth.gr, funded through EU FP7,
CityZen: http://www.cityzen-project.eu, funded through EU FP7,
TRANSPHORM: http://www.transphorm.eu, funded through EU FP7,

as well as a large number of smaller projects funded in total or partially by, e.g.

- the Norwegian Ministry of the Environment
- the Nordic Council of Ministers
- the Norwegian Research Council
- the Norwegian Spacecentre
- the Helsinki Commission (HELCOM, Baltic Marine Environment Protection Commission)
- the Natural Environment Research Council in the UK (NERC)

Our main goal is to better understand air pollution, the couplings between air pollution and climate, and options to reduce the environmental impact of anthropogenic emissions. Scientists at MSC-W analyze air pollution episodes in the past and establish source-receptor relationships (transboundary transport of air pollutants). They are involved in chemical weather forecasting and calculate future development based on state-of-the-art emission scenarios. The impact of our results is ensured by our close contact to both the scientific community and the European air quality policy infrastructure.

The Unified EMEP model, which is our main research tool, is a so-called chemical transport model that uses meteorological data from other sources in order to calculate dispersion and deposition of air pollutants. At present, our main source of meteorological data is the IFS model at ECMWF. We generate these data ourselves at ECMWF. Nearly all our activities rely on the development and application of the Unified EMEP model. The code has been developed for more than 10 years and is recognized as one of the most accurate and efficient models for its purposes (www.emep.int/publ/reports/2003/emep report 1 part2 2003.pdf). It is also available as Open Source code and available at EMEP's international website http://www.emep.int. Results from the Unfified EMEP model are published in many peer-reviewed publications (list of most recent ones attached below), but also in the widely known EMEP reports that can be downloaded free of charge at http://emep.int/mscw/mscw_publications.html and serve as scientific input to policy decisions within UN ECE.

Need for CPU quota at ECMWF:

In 2010, for the first time, we have used ECMWF data for the status runs that generate the scientific basis to EMEP. The report dealing with the status of air pollution in 2008 is published on the web: http://emep.int/publ/reports/2010/status_report_1_2010.pdf (In previous years ECMWF data had only been used for research applications, while data from the European HIRLAM model was used for the status runs).

The reasons for using ECMWF data include:

- high accuracy of data (good verification results)
- global data set with sufficient resolution of most of our purposes
- likely availability of IFS tools for many years to come
- high likelihood for IFS model to remain state-of-the-art

The transition towards ECMWF data means that we now have to generate ECMWF data on a regular basis. The reasons why we generate the meteorological data by running IFS ourselves include:

- we need to have a consistent multi-year data set for detailed trend analysis, i.e. meteorological data for various years generated with the same version of the IFS model, and on the same resolution

- we need to have meteorological parameters that are not included in the operational archive, mainly convective parameters (e.g. upward convective mass flux)

The EMEP strategy for the next 10 years has also increased focus on global applications and climate change. Responding to the new EMEP strategy, our model is now increasingly used at the global scale. At the same time we constantly need to increase the resolution of the model in order to keep the model state-of-the-art. On European scale, finer resolutions (e.g. 20 km instead of 50 km) show an improvement in the accuracy of the results (www.emep.int/publ/reports/2008/status report 1 2008.pdf). These runs also require meteorological data on higher resolution.

The generation of one meteorological year per year (for the annual EMEP status runs) could be achieved within the Norwegian CPU quota at ECMWF. However, the trend of scientific investigation has gone towards multi-year modeling thus requiring the generation of data for multiple years in the foreseeable future. In particular, the importance of meteorology for air pollution is being investigated more carefully. One of the reasons for this is that trends in emissions have become smaller in Europe so that inter-annual variability in meteorology has gained, in relative terms, a larger importance for air pollution and transport of gaseous pollutants and particles. Furthermore, the response of air pollution to climate change has become a hot topic within air pollution science but also in legislation and the assessments of future scenarios. As mentioned above, it is also reflected in the EMEP strategy for the next 10 years. In order to obtain robust results it is necessary to calculate air pollution and dispersion for multiple years for both present and future periods, in order to find statistically significant signals, e.g. of climate change.

As of March 2011 we have generated data for 2005, 2006, 2008, and 2009. At least 10 years of meteorological data are required for trend analyses or in order to obtain solid statistics for climate change signals in air pollution. The years of 2007 and 2010 will be generated using the Norwegian CPU quota. In order to obtain a 10-year data set, the years of 2001-2004 will be generated. Also, in early 2012 we have to produce data for 2011 for the EU BSR InnoShip project. We thus have to generate 5 additional years within this Special Project by mid-2012.

Generating one year of IFS data takes about 400000 SBUs so that 5 years will require approximately 2 million SBUs. Ideally, most of these SBUs should be used by 2011 as the period 2001 to 2004 should be generated as soon as possible. However, this is not crucial to the success of the project. Therefore the proposal asks for 1 million SBUs per year in 2011 and 2012. This would allow us to generate a full 10-year data set (plus 2011) by mid-2012, when trends have to be reported to EMEP and the data have to be used for other projects. One year of IFS data in T799 spectral resolution and including all necessary parameters requires about 3.6 Tbyte of disk storage. One year will be generated at a time and then downloaded to a local disc in Norway before the next year of data is generated. Thus, about 4 Tbyte of disk storage are needed.

As the goal of the project is to generate meteorological data the success of the project will be measured by the availability of meteorological data by the end of the project. The risk of failure of this project is minimal, because several years of IFS data have already been successfully generated for use in the EMEP model. However, the importance of the project impinges on the use for scientific questions such as the analysis of air pollution trends and the calculation of responses to different emission scenarios.

Scientific plan:

Summer and autumn 2011: Generation of IFS data (cycle 36r1) for 2004, 2003 and first half of 2002. First trend analysis using a 5-year data set (to be published in 2012 status report).

Winter and spring 2012: Generation of IFS data (cycle 36r1) for second half of 2002, 2001 and 2011. Second trend analysis using a 10-year data set (to be published in 2012 status report, or in 2013 status report at the latest). Meteorological data for the year 2011 will be used to assess the effect of ship emissions responding to new emission regulations.

The EMEP model will be tested with the new meteorological data on a regular basis in order to ensure that any inconsistencies are detected at an early stage.

List of recent publications:

Peer-reviewed EMEP publications:

- Balkanski, Y., G. Myhre, M. Gauss, G. Rädel, E. J. Highwood, and K. P. Shine, 2010: Direct radiative effect of aerosols emitted by transport: from road, shipping and aviation.
Atmos. Chem. Phys., **10**, 4477-4489.

- Huijnen, V., Eskes, H. J., Poupkou, A., Elbern, H., Boersma, K. F., Foret, G., Sofiev, M., Valdebenito, A., Flemming, J., Stein, O., Gross, A., Robertson, L., D'Isidoro, M., Kioutsioukis, I., Friese, E., Amstrup, B., Bergstrom, R., Strunk, A., Vira, J., Zyryanov, D., Maurizi, A., Melas, D., Peuch, V.-H., and Zerefos, C.: Comparison of OMI NO2 tropospheric columns with an ensemble of global and European regional air quality models, Atmos. Chem. Phys., 10, 3273-3296, doi:10.5194/acp-10-3273-2010, 2010.

- Jericevic, A., L. Kraljevic, B. Grisogono, H. Fagerli, and Z. Vecenaj: Parameterization of vertical diffusion and the atmospheric boundary layer height determination in the EMEP model.

- Jonson, J. E., Stohl, A., Fiore, A. M., et al., A multi-model analysis of vertical ozone profiles. Atmos. Chem. Phys., 10, 5759–5783, 2010.

- Mills, G.; Hayes, F.; Simpson, D.; Emberson, L.; Norris, D.; Harmens, H. & Büker, P. Evidence of widespread effects of ozone on crops and (semnatural vegetation in Europe (1990-2006) in relation to AOT40- and flux-based risk maps Global Change Biology, Blackwell Publishing Ltd, 17, 592-613, 2011.

- Uherek, E., Halenka, T., Borken-Kleefeld, J., Balkanski, Y., Berntsen, T., Borrego, C., Gauss, M., Hoor, P., Juda-Rezler, K., Lelieveld, J., Melas, D., Rypdal, K., Schmid, S., 2010: Transport impacts on atmosphere and climate: Land transport. Atmospheric Environment, 4772-4816.

- Vieno, M., A. J. Dore, D. S. Stevenson, R. Doherty, M. R. Heal, S. Reis, S. Hallsworth, L. Tarrason, P. Wind, D. Fowler, D. Simpson, and M. A. Sutton, Modelling surface ozone during the 2003 heat-wave in the UK, Atmos. Chem. Phys., 10, 7963–7978, 2010.

EMEP reports:

- EMEP Status Report 1/10: "Transboundary acidification, eutrophication and ground level ozone in Europe in 2008", Joint MSC-W & CCC & CEIP Report, http://emep.int/publ/reports/2010/status_report_1_2010.pdf

- Supplementary material to EMEP Status Report 1/10, "EMEP Unified model performance for acidifying and eutrophying components and photo-oxidants in 2008", Joint MSC-W & CCC Report, http://emep.int/publ/reports/2010/Validation_2008.pdf

- EMEP Status Report 4/10, "Transboundary Particulate Matter in Europe: Status Report 2010", Joint CCC & MSC-W & CEIP & CIAM Report

- MSC-W Technical Report 1/10, "Development of the common EMEP global modelling framework: Progress report", edited by J. E. Jonson and O. Travnikov, http://emep.int/publ/reports/2010/emep_technical_1_2010.pdf

- MSC-W Technical Report 2/10, Atmospheric Supply of Nitrogen, Lead, Cadmium, Mercury and Dioxins/Furans to the Baltic Sea in 2008, Jerzy Bartnicki, Alexey Gusev, Wenche Aas and Semeena Valiyaveetil

- MSC-W Data Note 1/10, Transboundary data by main pollutants (S, N, O3) and PM.
Ágnes Nyíri, Michael Gauss and Heiko Klein, Russian translation: Svetlana Tsyro,
downloadable from http://emep.int/mscw/mscw_publications.html