REQUEST FOR A SPECIAL PROJECT 2017–2019

MEMBER STATE: Norway

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Project Title: FLEXPART transport simulations and inverse modelling of atmospheric components

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SPNOFLEX**	
Starting year: (Each project will have a well-defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2017	
Would you accept support for 1 year only, if necessary?	YES **X**	NO ☐

Computer resources required for 2017-2019: (To make changes to an existing project please submit an amended version of the original form.)		**2017**	**2018**	**2019**
High Performance Computing Facility	(SBU)	100000	100000	100000
Accumulated data storage (total archive volume)[2]	(GB)	150	150	150

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): 2016.06.30

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.

[2] If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year.

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Extended abstract

It is expected that Special Projects requesting large amounts of computing resources (1,000,000 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.

Introduction

The Lagrangian particle dispersion model FLEXPART is run on ECMWF data to explore the transport and dispersion of various atmospheric constituents from greenhouse gases, radionuclides and aerosols like black carbon to volcanic ash released during eruptions. The model is used with various inversion techniques to infer emission estimates of many atmospheric compounds. This helps improving transport simulations of these substances and to understand their contribution and effects on the climate system.

FLEXPART is a Lagrangian particle dispersion model developed and updated within this working group (Stohl et al., 1998; Stohl and Thomson, 1999; Stohl et al., 2005) (see www.flexpart.eu) and used by at least 37 international research institutes. FLEXPART was validated with data from continental scale tracer experiments (Stohl et al., 1998) and was used previously to study the transport of BB emissions into the Arctic (Stohl et al., 2006), as well as the transport of anthropogenic emissions between continents (Stohl et al., 2003) and into the Arctic (Eckhardt et al., 2007; Stohl et al. 2013). FLEXPART can be driven with analyses from the European Centre for Medium-Range Weather Forecasts (ECMWF).

Application and model development

Modelling global and regional transport of mineral dust

Mineral dust transport can affect climate, ecosystems, human health and ice sheet mass balances. We have recently developed a dust mobilization module, FLEXDUST, to calculate dust transport in combination with the Lagrangian particle dispersion model FLEXPART (Stohl et al., 1998). The dust mobilization and dust transport calculations are driven by ECMWF meteorological fields.

In the Arctic, dust constitutes a large fraction of the particulate matter found in the lower troposphere (e.g. Rahn et al., 1977). Dust may also have large impacts on climate and the ice sheet mass balance (e.g. Dumont et al., 2014). It is therefore of particular interest, yet has received only limited attention. In our research, we focus on increasing our understanding of dust mobilization, transport and deposition in the Arctic. We could show with FLEXDUST/FLEXPART model simulations that not only remote, but to a large extent also local dust sources (e.g. glaciofluvial sediments) influence Arctic dust load and dust deposition (Groot Zwaaftink et al., submitted). The model results also show a strong seasonal variation, depending on both mobilization (e.g. limited by snow covers) and transport pathways. We will continue this work in particular studying how mineral dust affects the radiation balance of the atmosphere in the Arctic.

Furthermore, we use our models for regional and local dust transport simulations. Dust events occur frequently in Iceland (e.g. Dagsson-Waldhauserova et al., 2014) where especially sandur areas are an important dust source (e.g. Arnalds et al., 2001). In our ongoing research, we investigate and aim to quantify dust mobilization and transport from Iceland. This will, for example, allow estimates of nutrient supply to the ocean and ecosystems and estimating the influence of dust events on snow/ice albedo. These model simulations will be driven by ECMWF analysis data.

Modelling of transport from volcanic eruptions

The FLEXPART model, based on ECMWF meteorological data, will be continued to be used for simulating the transport of volcanic ash in the atmosphere in case of future volcanic eruptions, and also for case studies of previous eruptions. In particular, a national project in collaboration with the Norwegian Meteorological Institute aims to improve on existing forecast systems for dispersion of volcanic ash clouds. Comparisons will be made with other models (EEMEP). Relevant case studies of volcanic eruptions are found in Eckhardt et al. (2008), Kristiansen et al. (2012) and Stohl et al. (2011).

Using ECMWF cloud water content for improved wet deposition

FLEXPART, in its latest version, is updated to make use of ECMWF cloud water content data for improved calculation of wet deposition of particulate matter. Comparisons will be made with results obtained from previous versions of the code.

Using ECMWF data to calculate aerosol radiative forcing

ECMWF analysis data of temperature, pressure, liquid water and ice water cloud amounts, together with surface temperature and albedo, will be used together with various aerosol data from other sources, to calculate the radiative forcing of the aerosol at high northern latitudes.

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