REQUEST FOR A SPECIAL PROJECT 2010–2012

MEMBER STATE: GERMANY

Principal Investigator[1]: Dr. Andreas Dörnbrack

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Project Title: Influence of non-hydrostatic gravity waves on the stratospheric flow field above Scandianvia

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** DESCAN	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project. For projects started before 2009, please state 2009 as the start year.)	2009	
Would you accept support for 1 year only, if necessary?	YES ☐	NO ☒

Computer resources required for 2010-2012: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2012.)	**2010**	**2011**	**2012**
High Performance Computing Facility (units)	150000	150000	150000
Data storage capacity (total archive volume) (gigabytes)	80	80	80

*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): 23 April 2009

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 the Centre's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

Flow past orography excites internal gravity waves. Under favourable conditions these waves propagate up to stratospheric levels. The vertical displacements of air parcels by gravity waves influence the local temperature directly above and downwind of the mountain range. Especially in the winter months, these mesoscale temperature anomalies affect the formation of polar stratospheric clouds on the northern hemisphere. As documented in Carslaw et al.(1998), the subsequent heterogeneous chlorine activation reactions on particles of polar stratospheric clouds contribute significantly to the depletion of the Arctic stratospheric ozone layer. These mesoscale processes are currently underestimated in global weather prediction and climate models. It is the aim of our studies to support detailed information for an improved parameterization of these meso- and microscale processes (see Dörnbrack and Leutbecher, 2001).

In previous studies we studied stratospheric temperature anomalies by using mesoscale model simulations that resolve mountain waves with horizontal wavelengths greater than 50 km for the flow over Scandinavia (see References). Deviations of more than 10 K with respect to the synoptic-scale ECMWF analyses appear. The reasons for this strong deviation are inertia gravity waves that seem to be poorly resolved by the coarse grid of T106 L31 analyses. Radiosonde soundings and lidar observations of polar stratospheric clouds indicate that the simulated mesoscale temperature structure did exist at a particular day in January 1997. For example, the record low temperature of -94.5 C measured at 26 km some 500 km downstream of the Scandinavian mountain range could be simulated successfully by the mesoscale model (Dörnbrack et al., 1999).

Other in situ observations of polar stratospheric clouds indicate that non-hydrostatic mountain waves can significantly influence the temperature directly above the mountain ridge (Wirth etal., 1999). These shorter wavelengths (8....20 km) cannot resolved by mesoscale models, therefore small-scale numerical models as the scheme of Smolarkiewicz will be used to model this part of the wave spectrum.

This special project consists of two work packages:

First, we want to analyse the ECMWF stratospheric temperature fields on the northern hemisphere. For this purpose, we use the analyses with the recently increased horizontal and vertical resolution. We want to find out if signatures of mountain waves in the analyses above Scandinavia exist. The next step is the investigation of their characteristics in terms of horizontal wavelengths, amplitude and meteorological conditions of appearance. Subsequently, this analyis will be expanded to other mountain ranges as the Ural, Novjia Semljia, Greenland etc.

The second part comprises the small-scale numerical simulations of the three-dimensional flow over the Scandinavian mountain range by means of the code EULAG by Piotr K Smolarkiewicz. This code allows a much more realistic resolution of the Scandinavian topography. Here, the influence of shorter, non-hydrostatic mountain waves will be studied and compared with independent observations of European and international field campaigns.