REQUEST FOR A SPECIAL PROJECT 2010–2012

MEMBER STATE: Germany

Principal Investigator[1]: Dr. Klaus Gierens

Affiliation: Institut für Physik der Atmosphäre
Deutsches Zentrum für Luft- und Raumfahrt

Address: Münchener Str. 20
D-82234 Wessling
Germany

E-mail: klaus.gierens@dlr.de

Other researchers:

Dr. Peter Spichtinger (ETHZ), Dr. Martina Krämer (FZJ)

Project Title:

Ice-supersaturation and cirrus clouds

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP**DEISSR	
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 X☐	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)	200000	200000	
Data storage capacity (total archive volume) (gigabytes)	100	100	

*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):

5 May 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.

Principal Investigator: Dr. Klaus Gierens

Project Title: Ice Supersaturation and cirrus clouds

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.

The Project had a couple of remarkable successes during the last year: The completion of the doctoral theses of Simon Unterstraßer and Ingo Sölch, the publication of a series of papers that describe the ice microphysics implemented in the EULAG model and applications of it (Spichtinger and Gierens, 2009a,b,c), and the publication of a comparison of humidity fields predicted by the IFS (the version that includes ice supersaturation) and observational data obtained from AIRS and CALIPSO (Lamquin et al., 2009). Details of these results can be found in these papers and will briefly be summarised in the annual report.

Contrail Research

We want to further develop our model in two respects: 1) Up to now we have only modelled contrails and contrail-to-cirrus transition in situations without synoptic dynamics. Since contrails can obtain quite long life spans (several hours) and ISSRs can exist even for days, we want to retrofit the model with the capability to simulate synoptic situations (in particular large-scale vertical motions). 2) Contrails often appear in clusters. We want to investigate how contrails develop within a cluster in comparison to a single contrail.

Cirrus Research

Within the framework of a Marie Curie Fellowship (IMDALCC, 07/2007-06/2009), the impact of mesoscale dynamics and aerosols on the life cycle of cirrus clouds is investigated. Here, we primarily focus on orographic waves but also on turbulence inside cirrus clouds, driven by breaking waves (Spichtinger and Smolarkiewicz, 2008). Additionally, the internal dynamics of cirrus clouds will be investigated during the next year. These studies will be continued further after the current Marie Curie Fellowship. In first simulations, the internal variations of cirrus clouds are investigated using idealized 2D setups. In a further step, within the framework of a PhD project, starting in 2009, 3D inhomogeneities of cirrus clouds will be simulated using idealized setups as well as meteorological analyses as initial conditions. In the following of this fellowship, the internal dynamics of cirrus clouds will be investigated in more detail. Here, we mostly focus on cirrus cloud convection and mesoscale instabilities. In first tests, cirrus cloud convection was investigated in 2D simulations. However, for a more detailed and complete picture of reorganisation processes in convective cirrus clouds (similar to convective cells in boundary layer clouds), more expensive simulations in 3D are necessary. These investigations will help us to develop more physical parameterisations for cirrus cloud representation in large-scale models.

ISSR Research

We are interested in IFS modelled fields of UT ice-supersaturation in order to study when and where they occur in various synoptic situations and how they develop. For this purpose we use and analyse data from the MARS archive.

Numerical weather prediction will benefit from this work:

- Information about life cycle and internal structure of cirrus clouds might help to improve the existing parameterisations for ice microphysics in NWP models.
- Validation of the ice supersaturation fields.
- Possibility to offer contrail forecasts to aviation services.
- Representation of contrail cirrus.

References

Lamquin, N., K. Gierens, C.J. Stubenrauch, R. Chatterjee, 2009: Evaluation of Upper Tropospheric Humidity forecasts from ECMWF using AIRS and CALIPSO data. Atmos. Chem. Phys., 9, 1779-1793. (http://www.atmos-chem-phys.net/9/1779/2009/acp-9-1779-2009.pdf)

Spichtinger, P., K. Gierens, 2009: Modelling of cirrus clouds - Part 1a: Model description and validation. Atmos. Chem. Phys., 9, 685-706. (http://www.atmos-chem-phys.net/9/685/2009/acp-9-685-2009.pdf)

Spichtinger, P., K. Gierens, 2009: Modelling of cirrus clouds - Part 1b: Structuring cirrus clouds by dynamics. Atmos. Chem. Phys., 9, 707-719. (http://www.atmos-chem-phys.net/9/707/2009/acp-9-707-2009.pdf)

Spichtinger, P., K. Gierens, 2009: Modelling of cirrus clouds - Part 2: Competition of different nucleation mechanisms. Atmos. Chem. Phys., 9, 2319-2334. (http://www.atmos-chem-phys.net/9/2319/2009/acp-9-2319-2009.pdf)