SPECIAL PROJECT FINAL REPORT

All the following mandatory information needs to be provided.

Project Title:	The global circulation in various coordinate systems
Computer Project Account:	SPDLRDE
Start Year - End Year :	2011 – 2014
Principal Investigator(s)	(1) Klaus P. Hoinka (2) Joseph Egger
Affiliation/Address:	(1) Institut für Physik der Atmosphäre, DLR, Oberpfaffenhofen, Germany (2) Universität München, München , Germany
Other Researchers (Name/Affiliation):	

The following should cover the entire project duration.

Summary of project objectives

(10 lines max)

The impact of the choice of the coordinate system has been investigated with two particular topics in mind:
1) Wave forcing and zonal mean flow
2) Meridional mass circulation for various conserved meridional coordinates.

Summary of problems encountered

(If you encountered any problems of a more technical nature, please describe them here.)

Experience with the Special Project framework

(Please let us know about your experience with administrative aspects like the application procedure, progress reporting etc.)

Summary of results

(This section should comprise up to 10 pages and can be replaced by a short summary plus an existing scientific report on the project.)

It was the basic idea of this project to explore the impact of the choice of coordinates on various aspects of the zonal mean circulation. Much effort had been devoted in the past to the case of potential temperature 'Theta' as a vertical coordinate. This work resulted in new and important insights in the general circulation. Our project intended to make some steps beyond this classical case. In particular, new meridional coordinates had not been considered so far. It is an attractive idea to choose either 'Theta' or potential vorticity q as a meridional coordinate. Both are conserved for adiabatic frictionless flow. Moreover there are substantial undulations of the isolines which have a representation in the respective coordinate system which differs substantially from that if latitude is chosen as coordinate. It is, however, a drawback that one would not run a model with such coordinates because of the frequent formation of closed isolines. Such situations can be handled, however, after zonal averaging. The results (Egger and Hoinka 2014b) contain mean circulations which deviate widely from those known up to now.

The consideration of Eliassen-Palm fluxes in various coordinate systems (Egger and Hoinka 2014a) led to new insights into the concept of wave forcing. The work with q-coordinates suggested to the formulation of generalized potential vorticity in corresponding coordinates. A simple formula resulted even for nonhydrostatic conditions (Egger and Hoinka 2015b). Moreover, zonal mean potential vorticity budgets have been considered with special emphasis on the role of various q-fluxes and their nonuniqueness (Egger and Hoinka 2015a). This work sheds new light on the impermeability theorem.

List of publications/reports from the project with complete references

Egger, J. and K.-P. Hoinka, 2014a: Wave forcing of zonal mean angular momentum in various coordinate systems. J. Atmos. Sci, 71.2221-2239

Egger, J. and K.-P. Hoinka, 2014b: Zonal mean circulations for two conserved meridional coordinates. Quart. J. Roy. Meteorol. Soc., in press. (Published online, DOI: 10.1002/qj.2373)

Egger, J. and K,-P. Hoinka, 2015a: Aspects of potential vorticity fluxes: Climatology and Impermeability. J. Atmos. Sci.; in press

Egger, J. and K.-P. Hoinka, 2015b: Aspects of PV density: Vertical coodinates and inversion.
J. Atmos Sci., submitted.

Future plans

(Please let us know of any imminent plans regarding a continuation of this research activity, in particular if they are linked to another/new Special Project.)