REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING SPECIAL PROJECT

MEMBER STATE: Switzerland……………………….……………………………

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Other researchers: Heini Wernli, Roman Attinger, Daniel Steinfeld, Elisa Spreitzer

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Project title: Diabatic effects in mid-latitude weather systems………………

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Project account: **SPCHBOJO**

Additional computer resources requested for	**2017**
High Performance Computing Facility (units)	550’000
Data storage capacity (total) (Gbytes)	30’000

Continue overleaf

[1] The Principal Investigator is the contact person for this Special Project

Technical reasons and scientific justifications why additional resources are needed

The additional demand is closely related to our progress report for 2017 and the request for the new phase 2018-2020. With the start of two PhD projects within the last 12 months, which involve the use of the 3-d temperature tendencies output of our special IFS versions, the need for computing time in our special project is higher than originally requested for 2017. The projects are within the framework of our special project request that is the investigation of the detailed diabatic processes and their effect on the dynamics of extratropical weather systems. Their plans are described as follows:

Project 1 (PhD Roman Attinger)
The aim of this project is the investigation of the generation of diabatically produced PV anomalies in extratropical weather systems in a systematic analyis. Therefore, a Lagrangian technique is applied where backward trajectories are calculated starting from the PV anomalies of interest, like e.g. positive anomalies at fronts or in the cyclone centre, or upper level negative anomalies in atmospheric blocks. Using our special IFS version with detailed output of the temperature tendencies, the contribution of all the microphysical processes to the formation of the selected anomalies are then investigated in detail, following the approach developed by Crezee et al., 2017. It can be shown that below cloud processes like evaporation of rain or sublimation of snow, as well as in-cloud processes like condensation and depositional growth of snow/ice contribute to the formation of low level PV anomalies at fronts. In addition to the previous study, we will now try to close the PV budget by using the complete set of diabatic temperature tendencies including radiation and turbulence. The method for the systematic investigation with the IFS has already been developed on the basis of a 7-day IFS simulation. In the following, a longer period of 3 months will be simulated and examined in a systematic way to generalize the findings. According to our test cases, the resolution TCo639, L137 and hourly output is suitable to capture the PV anomalies of all scales of interest. We expect 250’000 SBU and a storage capacity of 15 Tb due to the 17 additional 3-d temperature tendency fields for this simulation.

Project 2 (PhD Elisa Spreitzer)

This project focuses on the impact of changes in the microphysical parameterization and the related changes of release of latent heat on cyclone dynamics and associated WCBs as well as the downstream flow evolution. The aim is to generalize the findings of Joos and Forbes (2016) which found changes of the ridge structure in the region of the WCB outflow by changes in the microphysics scheme in a 5-day forecast of an extratropical cyclone. Sensitivity experiments will be performed where the latent heat release/consumption due to single microphysical processes or parameters in the microphysical setup will be modified based on the uncertainties in the microphysical parameterizations. In order to assess model performance, the results of the sensitivity experiments will also be compared to measurements conducted during the NAWDEX aircraft campaign. In a first case study, the microphysical characteristics of the WCB associated with cyclone Vladiana, which was probed on the 23th September 2016 during NAWDEX, are examined. First results show that the cyclonic and anticyclonic branches of the WCB differ in terms of their microphysical properties. The exact distribution into the two different branches and their impact on the upper level flow could be sensitive to changes in the microphysical parameterizations. A set of IFS simulations of cyclone Vladiana with all temperature tendencies is intended to be conducted this year, which involve a simulation for the comparison with NAWDEX measurements and 15min output and 3 further simulations with modified microphysical processes and 1-hourly output. The detailed investigation of mesoscale parts of the cyclone requires a high model resolution, so we planned TCo1279, L137 for 6 days lead time. The estimated computing time will be 300’000SBU, including tests, and the data storage 11Tb.

Project 3 (PhD Daniel Steinfeld)

The importance of moist-diabatic processes for blocking anticyclones is the topic of this project. A trajectory-based method will be applied to identify diabatically modified ascending airstreams into the blocking ridges. Since diabatic heating is hypothesized to be one major contribution for the blocking process, sensitivity experiments with the IFS will be performed with altered latent heat release during cloud formation. The modification in the IFS code will be confined to specific time periods in order to separately evaluate its effect on blocking onset, maintenance and decay. 5-6 experiments with the model resolution TCo319, L91, 10 days lead time and 6-hourly output are planned for this year. Computing time and storage capacity will be covered by our approved resources for 2017.

Preliminary results of all projects were presented and discussed at the joint meeting on Warm Conveyor Belts at the ECMWF in May 2017. The projects include close collaboration with Dr. Richard Forbes.
The special IFS versions mentioned above are already available and the projects are prepared for working with the IFS data.

References

Crezee B., Joos, H. and Wernli, H., 2017: The microphysical building blocks of low-level potential vorticity anomalies in an idealized extra-tropical cyclone. J. Atmos. Sci., 74, 1403-1416.

Joos H. and Forbes, R., 2016: Impact of different IFS microphysics on a warm conveyor belt and the downstream flow evolution, Q. J. R. Meteorol. Soc.,142, 2727-2739, doi:10.1002/qj.2863.