Project: **893**

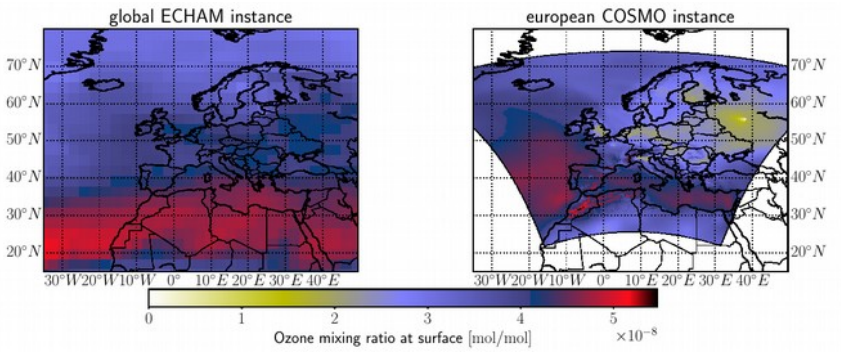
Project title: **Convection and Clouds in Earth System Modelling**

Principal investigator: **Holger Tost**

Report period: **2018-01-01 to 2018-12-31**

In the current allocation period the computing resources of the DKRZ have not been used so far. Only data analysis of previous WPs has taken place. This is mostly a consequence of the extended maternity leave of the PhD candidate working on WPII (biological aerosol particles) and a severe bicycle accident of the PI which caused more than 4 month of absence of the PI from work and supervision of the working group. However, the MISTRAL computing machine has been used for compilation and code development with the EMAC model (WP IV) without extended simulations by the PI, but other cooperating working groups (e.g. AerCHemMIP simulations performed by the EMAC consortium, Bacer et al.(GMD, 2018), Forrest et al. (GMD, 2018)). Furthermore, data analysis of EMAC simulations with the superparameterisation for convection has led to the finalisation of the PhD thesis of Harald Rybka and for permian conditions to the thesis of Steven Schneider.

For the remaining months of this allocation period an extensive use of the remaining CPU hours for WPI (regional air quality modelling) is planned making use of the MECO(n) model system. An example application is shown below for ozone (as presented by Barra et al. at the EGU 2018 in Vienna) elucidating the enhanced ozone pollution in European major cities and the Po valley.



Convection during the Permian:

Data analysis and the finalisation of the PhD thesis of S. Schneider has been performed to analyse the role of convection during the Permian. For that purpose the EMAC model had been run (in the previous allocation period) with an interactive ocean and respective boundary conditions for the Permian have been applied to reproduce this specific period of Earth climate. The graphic below indicates on average slightly weaker shallow convection in the tropics and stronger convective mass fluxes in the midlatitudes at elevated altitude.

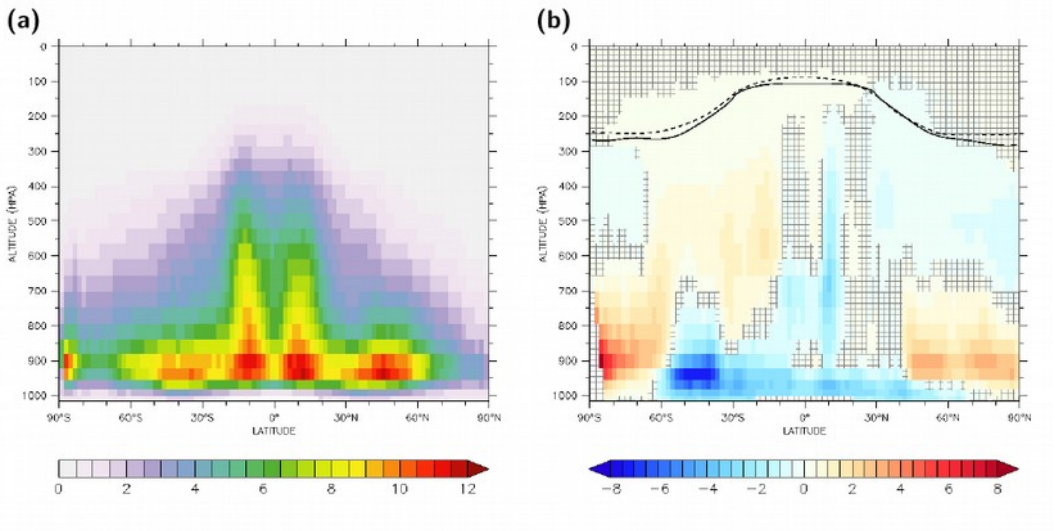


Figure 6.9.: Convective upward mass flux on zonal average: (a) The profile shows the annual average with respect to the simulated period of 5 years for the Permian 4×CO_2 scenario. (b) Comparison between the mean upward mass flux averaged over all convection events for the Permian and the present-day reference scenario. In hatched areas the difference is not highly significant based on an unpaired Student's t test and on a significance level of 95%. In addition the mean altitude of the tropopause is marked for both scenarios (solid: Present scenario, dashed: Permian scenario).

WP V: Vegetation modelling (as part of model development of the EMAC system):

The successful implementation of LPJ-GUESS in the EMAC modelling system has led to a publication, which describes the one way coupling of the two models (Forrest et al., GMD, 2018). Furthermore, the two way coupling has been presented at the annual EGU conference in Vienna and an accompanying manuscript is in preparation. The graphic on the right depicts the influence of meteorological and vegetation coupling on biogenic NO emission fluxes calculated with the EMAC model.