Project: **1346**

Project title: **Deep-time large scale circulation patterns**

Principal investigator: **Fanni Kelemen**

Report period: **2023-11-01 to 2024-10-31**

In our paleoclimate research we are focusing on learning about the physical processes and meridional heat transport in the much warmer world of the Early Eocene Climatic Optimum (EECO). During the allocation period we planned to simulate deep-time paleoclimate with the model CESM1.2, targeting the EECO. Our research questions are concerning different physical processes, e.g. Hadley cell, monsoon systems, midlatitude cyclones in a warmer climate. We also investigate the influence of CO_2 increase and other boundary conditions to these processes. We aimed to base our simulations on results from the Deep-Time Model Intercomparison Project (DeepMIP) (Lunt et al., 2017, 2021, Zhu et al. 2019), to shorten the spin-up time needed for the simulations.

During the first quarter of 2024 we worked on testing the CESM1.2 model, which we ported to Levante at the end of 2023. We successfully run test simulations with the coupled model for deep-time conditions (modelling the Paleocene Eocene Thermal Maximum, PETM) with the boundary condition provided by the CESM community.

In the second quarter of 2024 we contacted a paleoclimate modeler in UCAR (USA), Jiang Zhu, to ask for the restart files of his DeepMIP CESM1.2 simulation. Our plan was to restart the coupled model, and continue the simulation with higher temporal output and if possible higher spatial resolution. This would enable a better look on the cyclones in the simulated climate. During the summer of 2024 we have received the restart files, nevertheless not all the input files and boundary conditions concerning the land-sea mask and coupling were shared with us. This caused some difficulties. During the third quarter of 2024, we tried to restart the model in coupled (atmosphere-ocean) mode, but the ocean model could not start properly, due to possible inconsistencies in the boundary conditions. Unfortunately, not all domain and mapping files of the original DeepMIP simulation are available for us. We reevaluated our available resources, and decided to continue on working with an atmosphere only simulation. We have prepared the ocean boundary input from DeepMIP data for the atmosphere only simulation and are currently trying to start the simulation. We are experiencing some technical issues but we are confident that they will be resolved. In the remaining allocation time, we are planning to finish the atmosphere only deep-time (1x CO_2 and 3xCO2) and preindustrial control simulations. Moreover, we want to use our experiences learnt with CESM to set up ICON-XPP (ICON eXtended Prediction and Projection) (Zängl et al., 2015) for simulating deep-time paleoclimate. After the ending of our VeWA project (www.vewa-project.de/de/), we want to continue our paleoclimate research using ICON-XPP, and for this, we are applying for our DKRZ project's prolongation to the next year.

In summary we were successful in setting up a deep-time paleo simulation with CESM1.2, but experienced some technical difficulties when trying to restart the specific simulation,

we planned for. Thus, we decided to focus on an atmosphere only simulation, and also starting work on the implementation of ICON-XPP for paleoclimate.

References

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