Project: 105
Project title: ANDIVA (Analyse, Diagnose und Validation)
Report for period 01.01.2024 - 31.12.2024

During the year 2024, the project was mostly used for model calibration/configuration for different applications, as well as data analysis with high computing time and storage requirements. Additionally, resources were used for tasks within the CLM-Community for developing, testing and running specific tools (see below). In this report, we give a short overview of achieved and ongoing research projects.

Testing/Calibrating COSMO-CLM including Urban Scheme

Within the CORDEX-FPS-Urban project, the added-value of urban parametrization schemes are tested in a coordinated effort. KIT will contribute to these modeling activities with the COSMO-CLM including the urban scheme in the land surface model Terra (Terra-Urb). We used resources in this project to calibrate and test the urban scheme before starting the official STAGE 1 simulations ins CORDEX in 2025.

Development of a CMIP6-converter

KIT develops a converter that produces ready-to-use input files based on available CMIP6 data in the DKRZ data pool (pool/data). The overall aim is to build a flexible converter, that produces caf-files (that can be read by either COSMO-CLM and ICON-CLM) from selected CMIP6 models. The caf-files will be used in the next CORDEX activities by various modelling groups around the world (including BMBF-funded UDAG-project 1369). In 2024 caf-files creation is ongoing. Available caf-files as forcing data can be found in /pool/data/CLMcom/ICON-CLM/gcm/forcing. Further models/scenarios will be considered in the 2025. (https://gitlab.dkrz.de/clm-community/cmip2caf-converter)

Developing, testing, and running of the SPICE and the EvaSuite tool for the CLM-Community

KIT is jointly responsible for the development and execution of the SPICE tool (Starter Package for ICON-CLM Experiments) in the CLM-Community. SPICE is critically important for scientists as it manages the complex workflows required for climate simulations. SPICE streamlines these workflows by automating resource management, job scheduling, and data handling, ensuring that simulations are efficiently executed and reproducible. The ability to run controlled test simulations allows researchers to evaluate model performance, fine-tune parameters, and ensure that models accurately represent real-world climate processes. Currently, we are working on the new version of SPICE (v2.3). By improving and expanding SPICE, we aim to make it a more powerful tool for the climate science community, ensuring that researchers can effectively run and manage the complex simulations that are required to tackle urgent climate-related questions. (https://gitlab.dkrz.de/clm-community/spice)

Likewise, we used resources to enhance the EvaSuite tool, which is important for evaluating the results of climate models. EvaSuite plays a critical role in the CLM community by providing a standardized framework for analyzing and comparing climate models. This standardization is crucial for generating reproducible and comparable statistical results, allowing scientists from CLM community to assess the performance of different models across various regions and time periods. It enables scientists to identify biases, improve model accuracy, and make informed decisions in climate research. However, despite its current capabilities, EvaSuite is not yet fully optimized. Performance and usability improvements are needed to make it a more effective tool for widespread use. We are actively working

on these enhancements and preparing EvaSuite for an official release. Once fully developed, it will provide the scientific community with a more reliable and efficient platform, enabling better evaluation of climate models and contributing significantly to the development of more accurate climate predictions. (https://gitlab.dkrz.de/clm-community/evasuite)

Evaluation of CMIP6 ensemble in the context of ongoing and future heat stress

We analyzed CMIP6 output available at /pool/data to investigate how heat stress has changed in the historical period, with a special focus on extreme Northen Hemisphere summer 2023, and to what extend it will increase under different future scenarios until the end of the century. Beside the data provision at DKRZ, we used storage and computing time (mostly for jupyterhub) to calculate heat indices (e.g. Humidex[1]) for Northern Hemisphere countries. Figure A shows the number of days per year exceeding a Humidex threshold of 45, indicating dangerous heat for selected countries. A paper is currently under review in Frontiers.

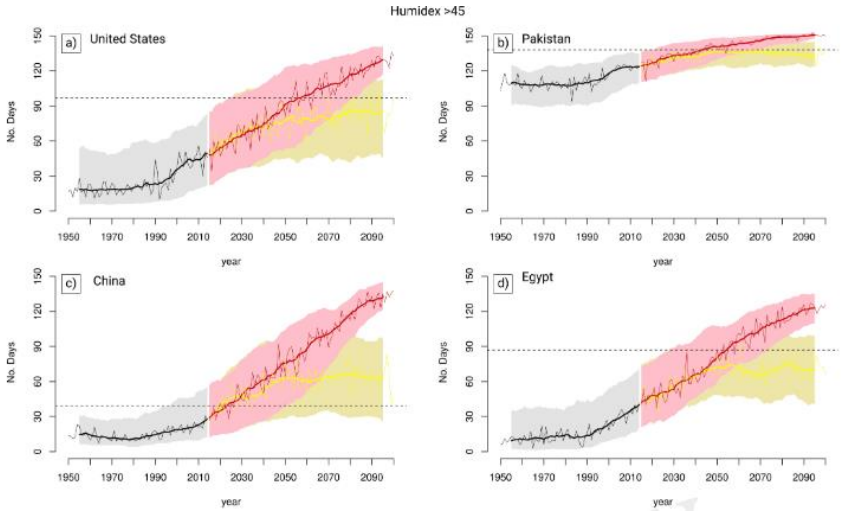

Figure A. Maximum number of days per extended summer (May-September) with Humidex≥45 based on CMIP6 ensemble for (a) United States, (b) Pakistan, (c) China, and (d) Egypt. Bold lines present 11-year running mean for historical (black), and scenarios (ssp126: yellow; ssp370; red), thin lines the respective annual values. Shading represents interquartile range. Black dashed line depicts the number of days based on ERA5 with Humidex≥45 for extended summer (May-September) 2023.

[1] Masterton, J. and Richardson, F. (1979). A method of quantifying human discomfort due to excessive heat and humidity. report cli 1-79. Atmospheric Environment Service, Environment Canada, Downsview