Announcement: 3-year position for doctoral researcher (PhD student): Post-simulation diagnostics of microphysical process rates with AI

Climate and weather models need to represent key state variables, and also physical mechanisms, realistically in order to produce reliable short-term forecasts and long-term projections. To evaluate their performance, there is a strong need for advanced process-oriented diagnostics (Maloney et al., 2019). Clouds and cloud feedbacks are a large factor of uncertainty in the simulation of future climate (Boucher et al., 2013).

For a true process-based analysis of cloud microphysics, aerosol-cloud interactions and pathways of precipitation formation in numerical models, information on microphysical process rates such as condensation, freezing and hydrometeor growth (see figure) is indispensable. The susceptibility of clouds and precipitation to perturbations (e.g., additional aerosols through anthropogenic emissions) can only be assessed if the microphysical pathways are understood. Snapshots of state variables such as the mixing ratios of hydrometeors are not sufficient to elucidate the microphysical pathways. However, microphysical process rates are not commonly output because they would comprise ~20-50 (depending on the desired level of detail) three-dimensional variables. This number of output variables easily triples the required storage compared to the default output and therefore limits the feasibility to short case studies and relatively small numbers of sensitivity experiments (e.g., Barthlott and Hoose, 2018).

What we propose here is to develop a method supported by artificial intelligence to estimate the microphysical process rates after simulation with the ICOsahedral Nonhydrostatic (ICON) model in a limited area configuration (Heinze et al., 2017), based on a limited set of standard output variables. This would enable the following:

- On-demand diagnostics of microphysical process rates in (temporal and spatial) regions of interest
- Targeted use of storage space
- Better analysis options for large ensembles
- Post-simulation analysis for expensive high-resolution simulations
We are looking for a Doctoral Researcher (PhD student) with a background in either meteorology/atmospheric or computer sciences, ideally with experiences in machine learning. Previous experience with numerical models is an asset. Very good knowledge of English is required. Due to its interdisciplinary nature the position will be located at two institutes: The Institute of Meteorology and Climate Research, Department for Troposphere Research (IMK-TRO)¹, and the Simulation and Data Life Cycle Lab Earth System Sciences (SDL ESS) at the Steinbuch Centre for Computing². Next to the research it is expected that the Doctoral Researcher supports climate researcher as part of the NHR³ funding. The dissertation that can be written during this project can either be in the field of Meteorology or Computer Sciences.

We are looking for a highly motivated, independent candidate and offer a dynamic work environment. KIT, the research university within the Helmholtz Association, combines three core tasks — research, education and innovation — into a single mission. With 9,400 employees and 25,000 students, it is one of the largest institutions of research and higher education in natural sciences and engineering in Europe. KIT’s Institute of Meteorology and Climate Research (IMK) is one of Germany's largest research institutes for atmospheric sciences. KIT offers attractive programs for early-career researchers⁴. KIT actively supports equality, diversity and inclusion, and as an equal opportunity employer, KIT explicitly encourages applications from women as well as from others with diverse backgrounds and perspectives. Applicants with disabilities will be preferentially considered if suitably qualified. Payment of the position is according to 75% TV-L E13, depending on the fulfillment of professional and personal requirements.

Please send applications for these positions to Corinna Hoose (corinna.hoose@kit.edu) and Uğur Çayoğlu (cayoğlu@kit.edu) including a pdf file with a letter of motivation, CV, certificates/transcripts of records, preferred starting date.

Review of applications for the position will start on June 15, 2022, and will continue until the position is filled.

References

¹ https://www.imk-tro.kit.edu/english/index.php
³ https://www.nhr.kit.edu/
⁴ http://www.khys.kit.edu