Hans Ertel Centre (HErZ) Project ICON-SmART

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The HErZ Project ICON-SmART addresses the role of aerosols and atmospheric chemistry for the simulation of seasonal to decadal climate variability and change. To this aim, the project will enhance the capabilities of the coupled composition, weather and climate modelling system ICON-ART (ICON, icosahedral nonhydrostatic model – developed by DWD, MPI-M and DKRZ with the atmospheric composition module ART, aerosols and
reactive trace gases – developed by KIT) for seasonal to decadal climate projections in seamless global to regional model configurations (ICON-Seamless-ART: ICON-SmART).
Thereby, this project will address a gap in Germany's model portfolio. The extension of ICON-ART to longer timescales will first require the implementation of additional processes not considered at weather timescales, in particular coupling to other compartments of the Earth system, including a comprehensive (troposphere and stratospheric) chemistry scheme, and scale-aware parameterizations of aerosol and trace gas processes (and corresponding emissions from the ocean and land surfaces). A second goal of the project will be to accelerate the model system by modularization, reducing complexity to include only the most relevant processes for the selected applications and scales, and by employing machine learning to speed up parts of the model. Based on previous work, chemistry processes are a promising candidate for speed-up by machine learning, but the project will also explore approaches for other processes. The enhanced model system will provide scientists, forecasters and policymakers with a novel tool to investigate atmospheric composition in a changing climate and to ask and answer questions previously out of reach. Specifically, we will use ICON-SmART to simulate the present-day carbon budget and global to regional emission scenarios projecting future aerosol radiative effects, impacts on photovoltaic power potential, and air quality.