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Simulating the global ozone distribution with ICON-ART

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Ozone is one of the most important atmospheric trace gases within the stratosphere as well as in the troposphere. Atmospheric chemistry is driven by solar radiation induced photodissociation of atmospheric trace gases. Thus, the calculation of the actinic flux and hence of the photodissociation frequencies is an essential part in the simulation of atmospheric trace gas distributions.

The ICON-ART[1] model is an extension of the non-hydrostatic modeling framework ICON[2], jointly developed by the German Weather Service (DWD) and Max-Planck-Institute for Meteorology (MPI-M), and is used for numerical weather prediction as well as for future climate predictions. ICON-ART is developed with the goal to simulate interactions between trace substances and the state of the atmosphere.
For the dynamics (transport and diffusion) of gaseous tracers, the original ICON tracer framework is used. For the model physics, numerical time integration follows a process splitting approach separating physical processes. Each process is called independently via an interface module. Currently, the processes of emission, dry and wet deposition, sedimentation, and first order chemical reactions are included.

In this study we introduce a new gas-phase chemistry module for ICON-ART in combination with an online photolysis module. The new gas-phase chemical module uses the kpp formalism[3] and the photolysis module is based on Fast-JX[4], which provides online calculation of actinic flux for a wavelength region down to 170 nm, depending on the actual state of ozone, temperature, pressure, relative humidity and liquid water path, resulting in photolysis rates which are usable for the simulation of tropospheric as well as stratospheric trace gas distributions.

We will present first simulations of global ozone distribution by using the new gas-phase chemistry module and photolysis module within ICON-ART to show the ability of ICON-ART to investigate chemical mechanisms and transport of chemical trace gas constitutions on a global scale.

[1] D. Rieger et al., ICON-ART 1.0 - A new online-coupled model system from the global to regional scale (in preparation)

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