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ICON-ART-ISO: Water isotopologues implemented in the chemistry-transport model ICON-ART

Johannes Eckstein (1), Roland Ruhnke (1), Daniel Reinert (2), and Stephan Pfahl (3)

(1) Karlsruhe Institute of Technology, IMK-ASF, Leopoldshafen, Germany (johannes.eckstein@kit.edu), (2) Deutscher Wetterdienst, Frankfurter Str. 135, 63067 Offenbach, Germany, (3) Institute for Atmospheric and Climate Science, ETH Zurich, 8092 Zurich, Switzerland

Stable isotopes of water can help to understand processes that have influenced the distribution of water in the atmosphere. Isotope enabled models, capable of simulating the distribution of HDO and $H_2{}^{18}O$, can be a very useful tool for understanding these processes and the distribution of isotope ratios which are observed. We present ICON-ART-ISO, the implementation of water isotopes into the chemistry-transport model ICON-ART.

The core of this global model is the ICOsahedral Non-hydrostatic (ICON) modelling framework (Zaengl et al, 2015 (Q. J. R. Meteorol. Soc.)), a joint development of the German Weather Service (DWD) and the Max Planck Institute for Meteorology. The model system ICON-ART (Aerosols and Reactive Trace gases, Rieger et al, 2015 (GMD)) is a two-way coupled extension to ICON, which allows to study the influence of aerosols, trace gases and their chemistry on the atmosphere. We set up ICON-ART-ISO within this framework, profitting from the model infrastructure. We follow the implementation of COSMOiso (Pfahl et al., 2012 (ACP)), the isotope-enabled version of the COSMO model, the predecessor of ICON.

In order to include the isotopes in the model, the water cycle is doubled diagnostically for each isotope. By the choice of physical parameters, these modelled isotopes are set to HDO and $H_2{}^{18}O$, but the simulation of a purely diagnostic H_2O is also possible.

Fractionation, i.e. the change of the isotope ratio changes during phase changes, is considered in evaporation, grid-scale precipitation and convection. For the source of evaporation, a constant isotope ratio is currently used. To consider grid scale precipitation, the processes in the two-moment microphysical scheme by Seifert and Beheng, 2005 (Meteorol. Atmos. Phys.) are diagnostically applied to the isotopes. For convection, the Tiedtke-Bechtold scheme (Bechtold et al., 2013 (JAS)) is used.

We present the current status of the model system. All processes have been implemented and we show first validation results. We plan to investigate three tropical storms, comparing with data from the ongoing measurement project CARIBIC (Civil Aircraft for the Regular Investigation of the atmosphere Based on an Instrument Container).