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ICON-ART-ISO: Implementing water isotopologues into the new chemistry-transport model ICON-ART

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The stable isotopologues of water can help to understand processes that an airmass has undergone and that have influenced the distribution of water in its different states in the airmass. Measurements alone, by their limited temporal or spatial resolution, are often an insufficient tool for unraveling these processes. An atmospheric model capable of simulating the distribution of HDO and $H_2^{18}O$ at a high spatio-temporal resolution can therefore be very useful for the interpretation of data and the study of processes. Here, we present ICON-ART-ISO, the implementation of HDO and $H_2^{18}O$ into the new chemistry-transport model ICON-ART.

The core of the model is the new ICOsahedral Non-hydrostatic (ICON) modelling framework (Zaengl et al, 2014, Q. J. R. Meteorol. Soc.), a global model which allows to locally increase resolution. It is used for numerical weather prediction at the German Weather Service (DWD), but is also suitable for climate modelling. 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 and trace gases on the state of the atmosphere. We set up ICON-ART-ISO within this framework, following 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 isotopologues in the model, the water cycle is doubled diagnostically to mirror all processes dealing with water onto HDO and $H_2^{18}O$. Processes where isotopic fractionation has to be considered are the evaporation, the grid-scale formation of clouds and precipitation and processes related to convection. Evaporation is limited to the ocean surfaces in a first step. To consider grid-scale precipitation, the isotopologues have been implemented into the two-moment microphysical scheme by Seifert and Beheng, 2005 (Meteorol. Atmos. Phys.), an extensive scheme considering many processes and four ice classes. For convection, the Tiedtke-Bechtold scheme (Bechtold et al., 2013 (JAS)) is used.

We present the current status of our developments. For a first validation and application, 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, Brenninkmeijer, 2007 (ACP)).