

Investigating moisture pathways by comparing ICON-ART-Iso simulations with MetOP/IASI satellite data

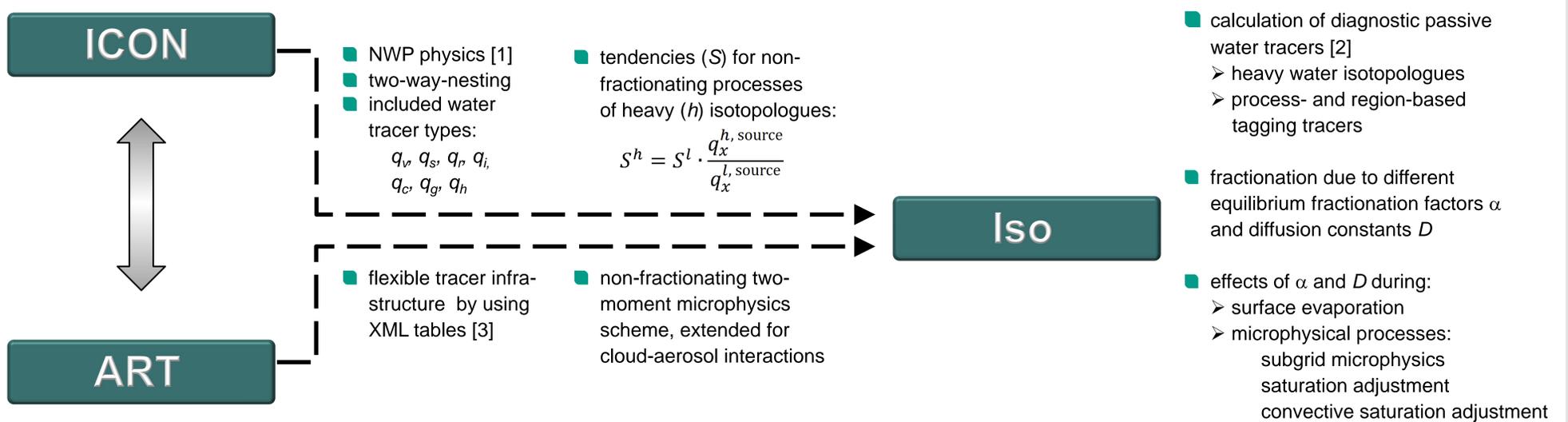
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Introduction

During the last decade investigating stable isotopologues of atmospheric water vapor has been developed as a promising tool for analyzing processes in the hydrological cycle, because the distributions of $\{H_2O, \delta D\}$ pairs depends on moisture transport pathways and sources (δD is the standardized ratio between HDO and H_2O).

In this work we present ICON-ART-Iso, the isotopologue enabled version of ICON, and discuss a method for adequately evaluating the modeled $\{H_2O, \delta D\}$ pair distributions with space-based remote sensing data obtained from the satellite nadir sensor IASI.



Retrieval Simulator

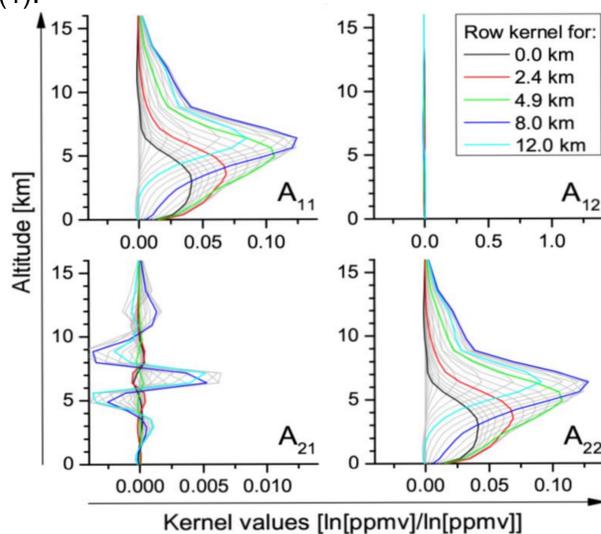
Remote sensing data (\hat{x}) have a limited vertical resolution and sensitivity which can be related to the real atm. state (x) and the a priori state (x_a) by:

$$\hat{x} = A(x - x_a) + x_a \quad (1)$$

This weighting needs to be considered for comparisons between model and remote sensing data [4]:

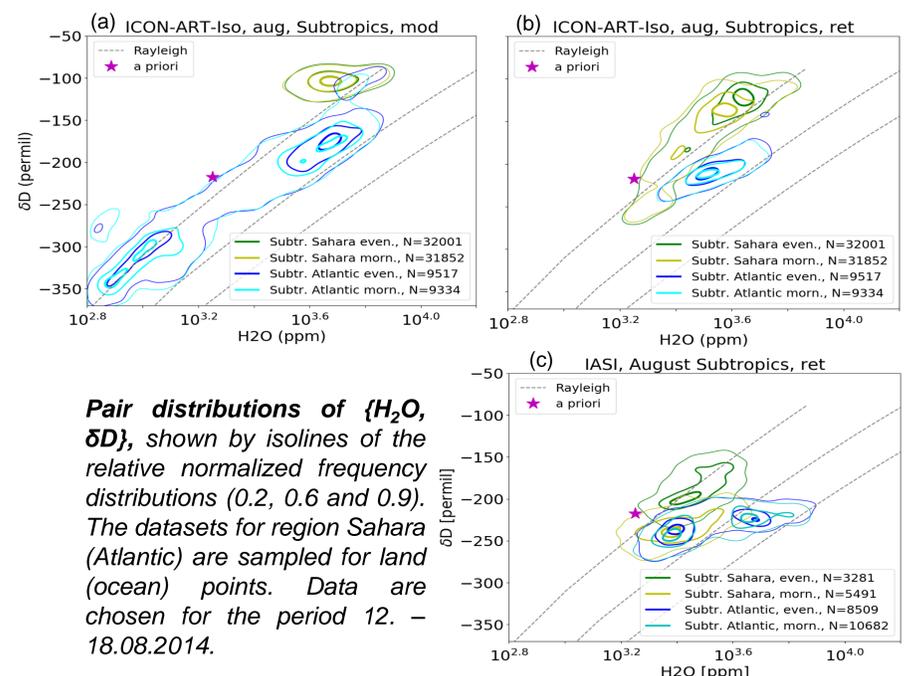
- The averaging kernel matrix A corresponding to a modeled atmosphere x is calculated by the retrieval simulator, based on a simple radiative transfer model.
- The model atmosphere as observable by the remote sensor is calculated according to eq.(1).
- This processed model output \hat{x} can then be compared to the remote sensing data.

Entries of the matrix A, describing the sensitivities with respect to H_2O and δD (A_{11} and A_{22}) and their cross-responses (A_{12} and A_{21}). The curves indicate the weighting functions for the different altitude regions.



Comparison to IASI data

The sensor IASI is carried by the polar-orbiting sun-synchronous satellite MetOp and measures at approx. 09:30 and 21:30 local time. Its spectra are processed by the MUSICA retrieval processor [5]. The model data are sampled and processed for morning and evening IASI overpasses over chosen regions. The raw ICON-ART-Iso output at 5km (a) is shown against the model data processed by the retrieval simulator (b). In this first comparison the retrieved model state achieves an overall good qualitative agreement to the IASI pairs (c), while the daily cycle over the Sahara is still underestimated.



Conclusion

- successful implementation of water isotopologues with ICON
- simulation of averaging kernels is needed for comparing model and satellite data
- first comparison of IASI and ICON-ART-Iso provides promising results

Outlook

- detailed studies for nested region over the West African Monsoon as part of the DFG-project MOTIV
- further model development of ICON-ART-Iso
- improvement of the radiative transfer model of the retrieval simulator

References:

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[5] Schneider, M. et al. (2016), Atmos. Meas. Tech., 9, 2845-2875