Contribution ID: **20** Type: **Talk**

Observations and simulations of stable water isotopes and their link to the mesoscale organization of shallow trade-wind clouds

Tuesday, 17 May 2022 15:30 (15 minutes)

Water molecules containing a heavy hydrogen or oxygen atom have lower saturation vapor pressures and diffusivities than their light counterparts, which leads to a change in their relative abundance during phase transitions. Each process controlling the water vapor budget of shallow cumulus clouds in the trade wind region such as ocean evaporation, convective and turbulent mixing, condensation and evaporation of hydrometeors is associated with a characteristic isotopic fingerprint. Therefore, stable water isotopes are expected to inform about the relative contribution of the processes mentioned above, which possibly link to the mesoscale organisation of clouds. To test this hypothesis and assess the timescales over which the pattern-specific anomalies in water vapor isotopes emerge, we use a combination of airborne measurements of stable water vapor isotopes and high-resolution simulations with the isotope-enabled numerical model COSMOiso. The isotope measurements in water vapor were performed on the French aircraft ATR-42 during 18 flights from 25 January to 13 February 2020 as a part of the international EUREC4A field campaign. The flights were conducted over the tropical ocean near Barbados with the aircraft staying predominantly at the height of cloud base. Complementary cloud radar and lidar data as well as in-situ turbulence and microphysics measurements are used to characterise the physical environment of the studied cloud fields. Our isotope measurements and simulations reveal substantial differences between flights and mesoscale organization patterns. Discrepancies between observed and modelled stable water isotopes are used to identify processes that are poorly represented in the model. A sensitivity experiment, testing different rates for the model's autoconversion from liquid clouds to precipitation, is performed. This study provides promising process-based insights into the cloud-circulation coupling conundrum and demonstrates the potential of water isotopes to identify relevant processes.

Primary author: VILLIGER, Leonie (Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland)

Co-authors: DÜTSCH, Marina (Institute of Meteorology and Geophysics, University of Vienna, Vienna, Austria); BONY, Sandrine (LMD/IPSL, Sorbonne Université, CNRS, Paris, Franc); BRILOUET, Pierre-Etienne (Laboratoire d'Aérologie, University of Toulouse, CNRS, Toulouse, France); CHAZETTE, Patrick (LSCE/IPSL, CNRS-CEA-UVSQ, University Paris-Saclay, Gif sur Yvette, France); COUTRIS, Pierre (LAMP, Université Clermont Auvergne, CNRS, Clermont-Ferrand, France); DELANOË, Julien (LATMOS/IPSL, Université Paris-Saclay, UVSQ, Guyancourt, France); FLAMANT, Cyrille (LATMOS/IPSL, Sorbonne Université, CNRS, Paris, France); LOTHON, Marie (Laboratoire d'Aérologie, University of Toulouse, CNRS, Toulouse, France); SCHWARZENBOEK, Alfons (LAMP, Université Clermont Auvergne, CNRS, Clermont-Ferrand, France); WERNLI, Heini (Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland); AEMISEGGER , Franziska (Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland)

Presenter: VILLIGER, Leonie (Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland)

Session Classification: Shallow convection