Geophysical Research Abstracts
Vol. 13, EGU2011-7686-1, 2011
EGU General Assembly 2011

Investigating high-frequency variations in stable isotope composition of atmospheric water vapour

Franziska Aemisegger (1), Harald Sodemann (1), Stephan Pfahl (1), Patrick Sturm (2), and Heini Wernli (1)

(1) Institute for Atmospheric and Climate Sciences, ETH Zuerich, Switzerland (franziska.aemisegger@env.ethz.ch), (2) Institute of Plant, Animal and Agroecosystem Sciences, ETH Zuerich, Switzerland

Stable water isotopes (SWIs) can be regarded as naturally available tracers of phase changes in the atmosphere. The extent of the isotopic fractionation during phase changes, depends on environmental conditions, like temperature and relative humidity. Stable water isotopes can thus give us some hints on important moist atmospheric mechanisms like cloud formation, evaporation and transpiration at the land surface. There are still many open questions related to the processes determining isotope variability in atmospheric waters in particular with regard to high frequency variations and non-equilibrium fractionation. Measurements are needed to constrain and validate simulations from isotope-enabled numerical weather and climate prediction models.

High temporal resolution (<1 min) measurements of the SWI composition of vapour have become possible with recent progress in optical laser systems using laser spectroscopy. Traditional measurements involving cryogenic trapping and analysis of the isotopic composition of the sample with mass spectrometry could only be done at relatively low frequency (weekly to monthly). In this work, we use the capability of the novel laser measurement systems for process-based investigations of the atmospheric water cycle at the time scales of significant weather events.

In a first part we present results from a characterisation study of the measurement set up, consisting of a commercial laser spectrometer (Picarro, L1115-i) and a sampling system. Temperature dependent differences in response times for the two isotopes 18O and 2H are found. A comparison measurement between the Picarro system and another commercial laser spectrometer (from Los Gatos Research Inc) showed overall agreement.

Second, we present and interpret high-frequency variations of SWI signals in near-surface water vapour over land during single meteorological events (frontal rain showers, dry periods). The isotope signal is influenced by the prevailing local meteorological situation as well as remote conditions during evaporation. Trajectory analyses of water vapour origin show significant event-to-event differences.