# Dissertation abstract

Camille Risi

The stable isotopic composition of water ($H_2^{16}O$, $HDO$, $H_2^{18}O$, $H_2^{17}O$) is a promising tracer of the present day water cycle and past climates. While the isotopic composition recorded in polar ice core have long been used to reconstruct past temperatures, however, what controls the isotopic composition of the tropical precipitation is more complex. The goal of this thesis is thus to better understand the processes that affect the isotopic composition of tropical precipitation and atmospheric water, more particularly in the tropics. Since most of the tropical precipitation arises from atmospheric convection, and most isotopic archives are on land, we focus more particularly on the impact of convective and land surface processes. In turn, what can be learned about convection and land surface processes using isotopic measurements ? Can they help constrain their representation in models ? At the inter-annual to climate change scale, what information about the tropical climate variability is recorded in isotopic signals observed in archives ?

First, we investigate the influence of convection on water stable isotopes. We use both (1) numerical modeling, with a hierarchy of models (single column model, two-dimensional model of squall lines, general circulation model) and (2) data analysis, using isotopic data from rain collected in the Sahel during the African Monsoon Multidisciplinary Analysis campaign, at the event and intra-event scales. These studies highlight the strong impact of convection on the precipitation composition, and stress the importance of rain evaporation and convective or meso-scale subsidence in controlling the rain isotopic composition. Convection also plays an important role on isotopic profiles in the upper troposphere-lower stratosphere.

Second, we study what information about climatic variability is recorded by water stable isotopes in precipitation. We analyze simulations of present day and past climates with LMDZ, and evaluate to what extent isotopic archives of tropical precipitation can be used to reconstitute past precipitation changes. We also explore the added value of a new but promising isotopic tracer : $H_2^{17}O$.

Third, we analyse the influence of land surface processes on the isotopic composition of precipitation and land surface waters, using simulations with the land surface model ORCHIDEE in which we also introduced the isotopes. The isotopic composition of the different water pools of the land-atmosphere system may inform about the partitionning of precipitation into runoff, drainage, transpiration and bare soil evaporation.