Water stable isotopes during AMMA: what information about land surface processes?
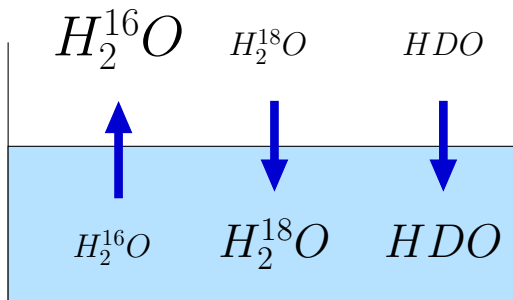
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LMD

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Water stable isotopes

- water = light ($H_2^{16}O$) + heavy ($H_2^{18}O$, HDO) molecules
- isotopic fractionation
- applications: past climate, present water cycle, land surface-atmosphere interactions

Goals and measurements during AMMA

- **Goals**
  - what controls the isotopic composition of tropical water?
  - what information from isotopes about water cycle, convection, land surface processes?
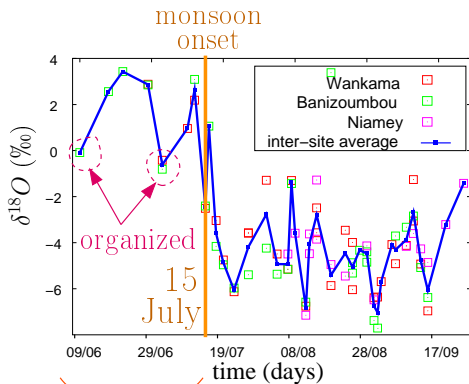 - potential to better constrain their representation in climate models?

- **Isotopic measurements in rain during AMMA**
  - rain sampled at event scale during the 2006 season in Niamey, Wankama et Banizoumbou *(Risi et al, GRL, 2008)*
  - $\delta^{18}O$ = enrichment in $H_2^{18}O$ in ‰ relatively to a standard
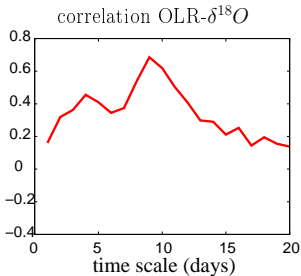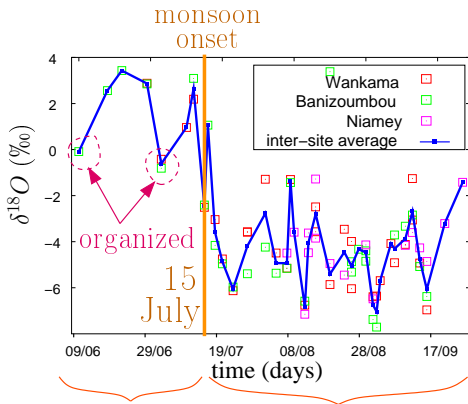
$\delta^{18}O$ evolution during the 2006 season
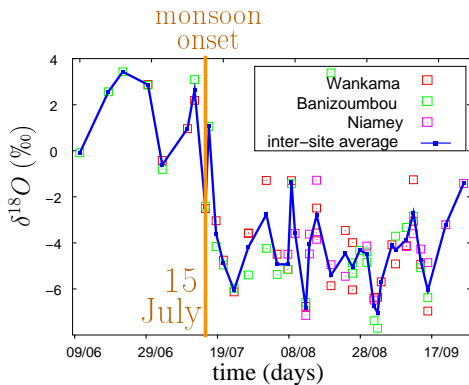
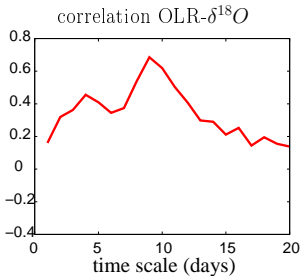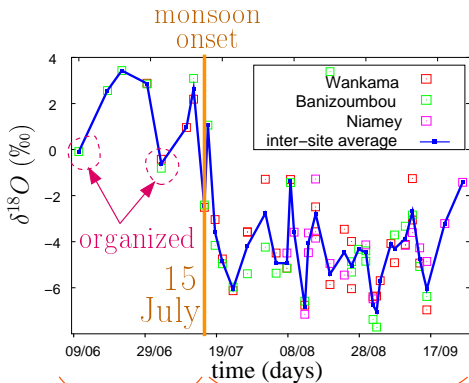# $\delta^{18}O$ evolution during the 2006 season

$\delta^{18}O$ evolution during the 2006 season

$\delta^{18}O$ evolution during the 2006 season

Questions

- what processes behind the **temporal integration** of convection?
  - role of soil water?
  - information about residence time?
- interprétation of **d-excess** data? land surface processes?
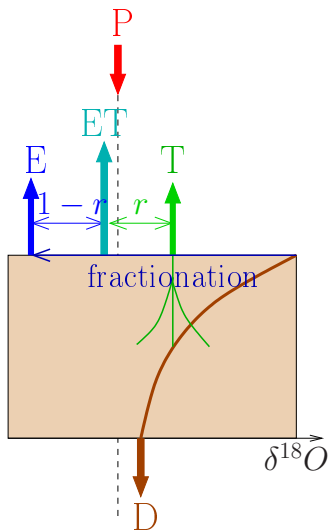
$$\text{d-excess} = \delta D - 8 \cdot \delta^{18} O$$
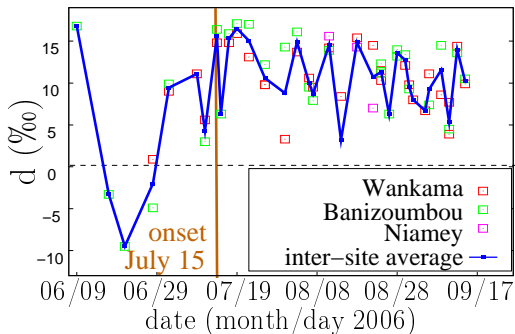
Why land surface processes impact isotopes?

- proportion transpiration / bare soil evaporation
- proportion evapotranspiration / surface runoff / drainage

(e.g. Gat 2000, Henderson-Sellers et al 2001)

Sensitivity tests with ORCHIDEE-iso offline on a site

- Strong sensitivity to:
    - soil isotopic profiles, soil water **vertical diffusion**
    - rain **infiltration**
    - partition recycling / surface runoff / drainage
    - partition evaporation / transpiration

- potential to **better constrain land surface processes representation** in models?
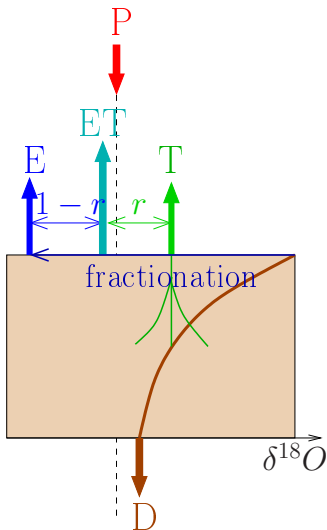
Study with LMDZ-ORCHIDEE zoomed on the AMMA region

- Isotopes implemented in:
  - **LMDZ** (no fractionation at land surface), global evaluation
  - **ORCHIDEE offline**, site evaluation
- in progress:
  - **LMDZ-ORCHIDEE** coupled simulations
  - global evaluation with isotopic data in precip, vapor, soil, rivers, biosphere
- in project: **zoomed nudged** simulations on AMMA region
  - interpretation of AMMA isotopic data
  - sensitivity tests
    - what information about land surface recycling, processes?