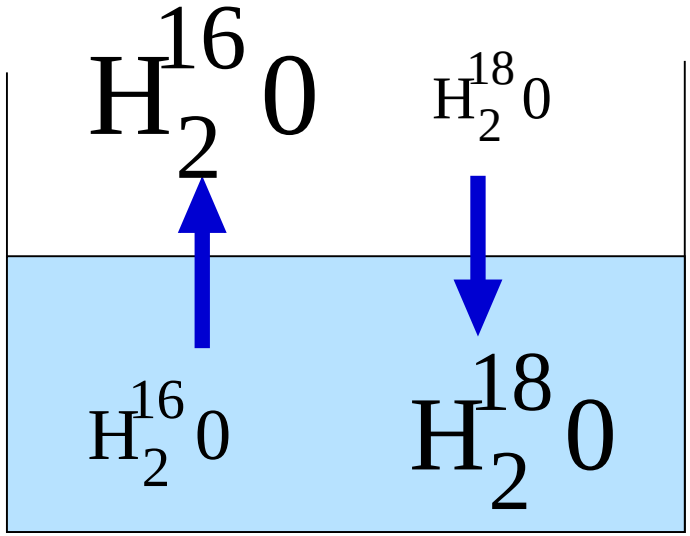
The variability of convective activity recorded by the isotopic composition of the precipitation in the Sahel

Camille Risi, Sandrine Bony, Françoise Vimeux, Luc Descroix

AMMA meeting, Toulouse

15 october 2008

Water stable isotopes



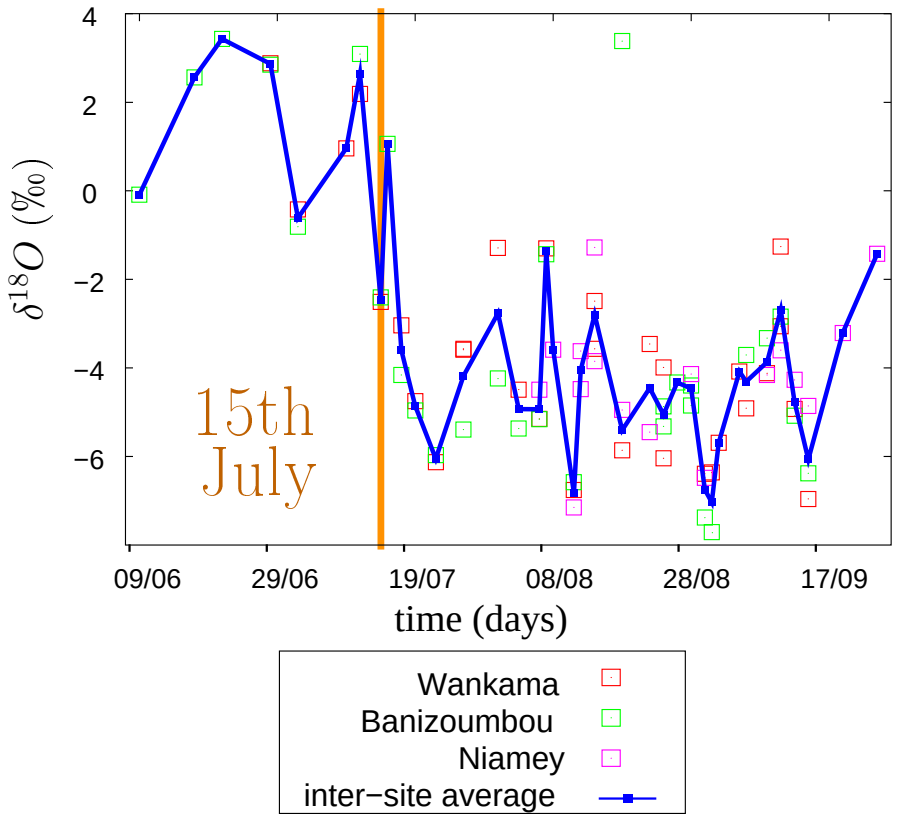
- water = light molecules ($H_2^{16}O$)
  + heavy molecules ($H_2^{18}O$, HDO)
- isotopic fractionation
- applications: past climates, present water cycle

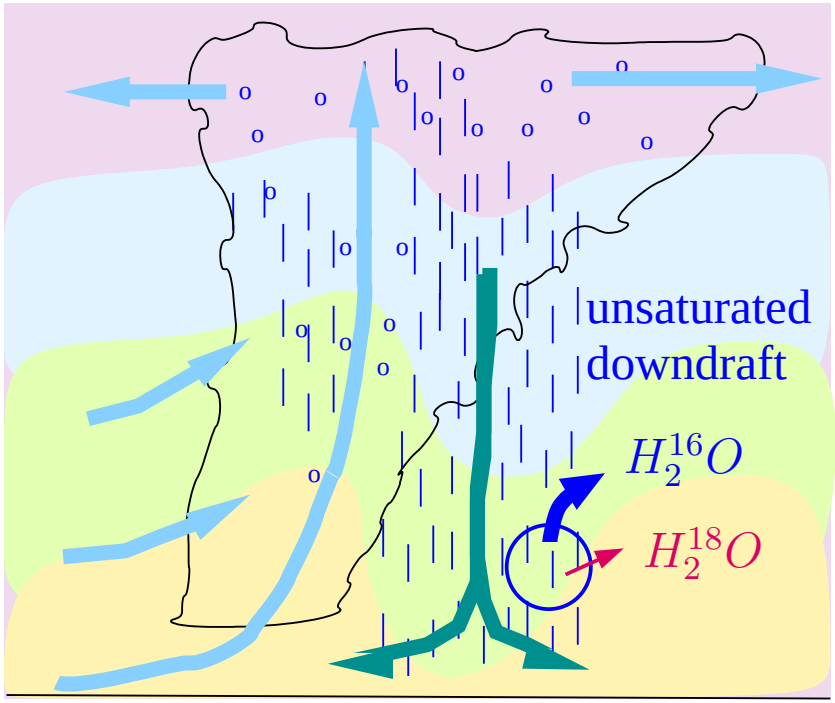
Goals

- What information does water isotopes record about convective activity and large scale processes?
- Rain water samples collected at the end of each event at Niamey, Wankama and Banizoumbou during the 2006 monsoon season
- measured $\delta^{18}O$

$$\delta^{18}O = \left(\frac{\left(\frac{H_2{}^{18}O}{H_2^{16}O} \right)_{rain}}{\left(\frac{H_2{}^{18}O}{H_2^{16}O} \right)_{ocean}} - 1 \right) \cdot 1000$$

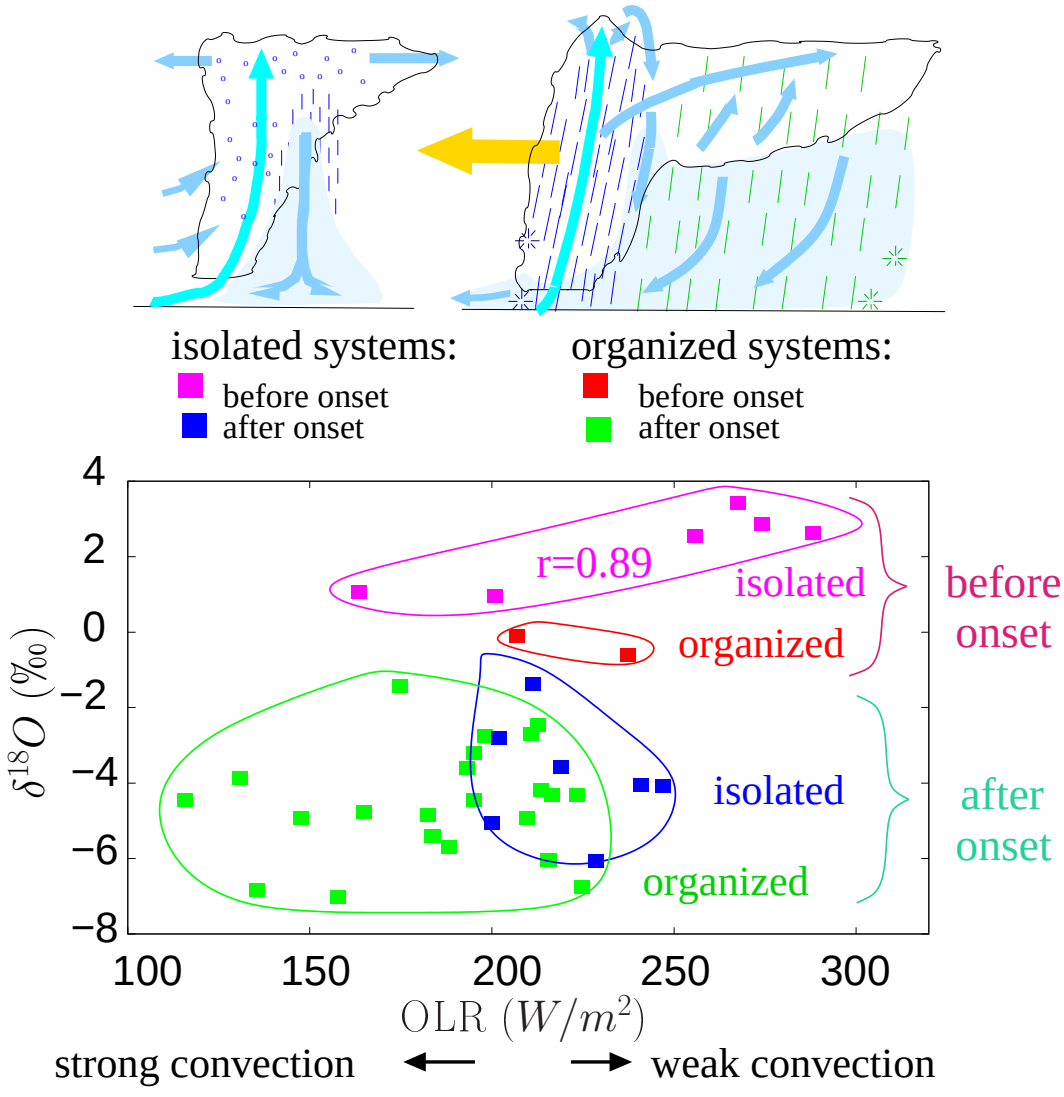
Evolution during the 2006 monsoon season



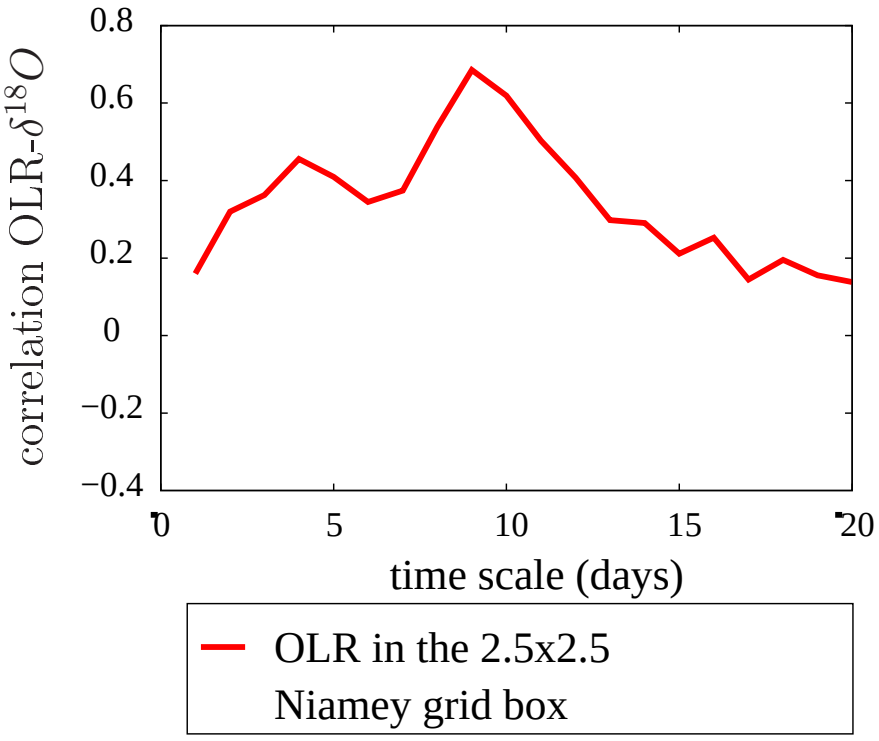


- record of the monsoon onset
- in agreement with the effect of convection on water isotopes

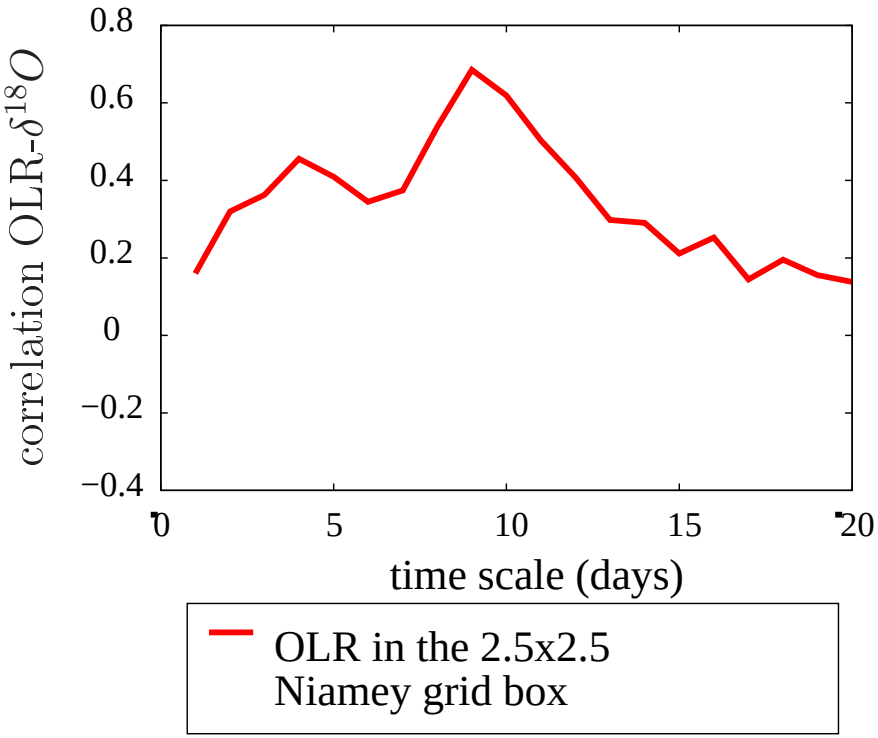
Before the onset: intensity and organization of individual convective systems

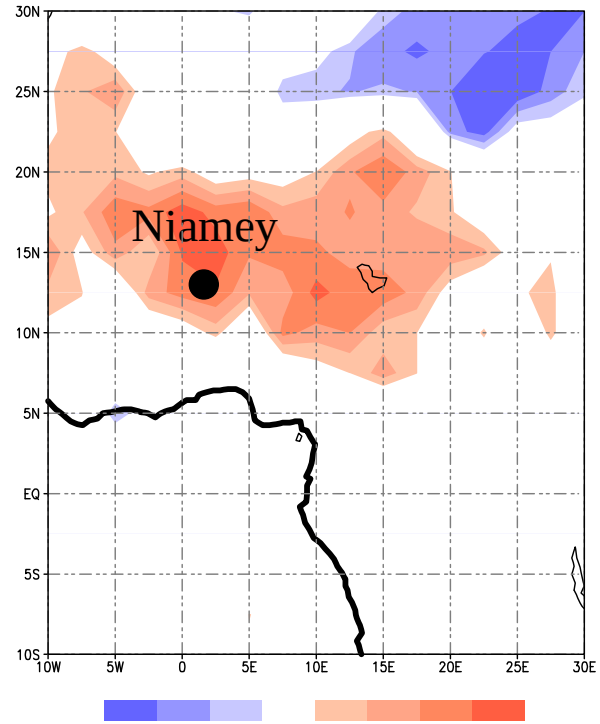


After the onset: $\delta^{18}O$ temporally integrates convection



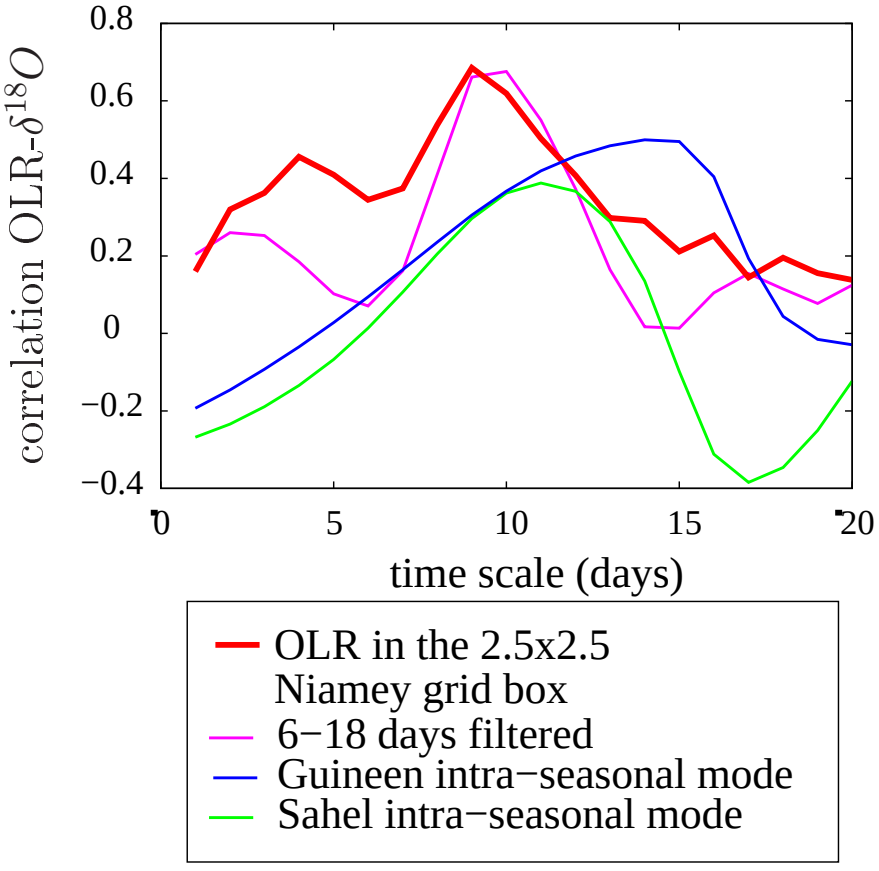
After the onset: $\delta^{18}O$ records a large-scale signal

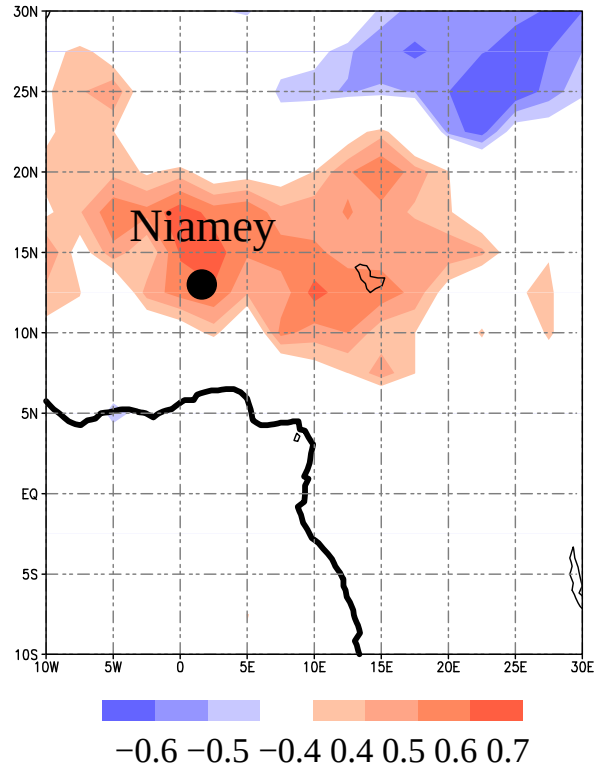




Correlation between $\delta^{18}O$ and OLR at 9 days

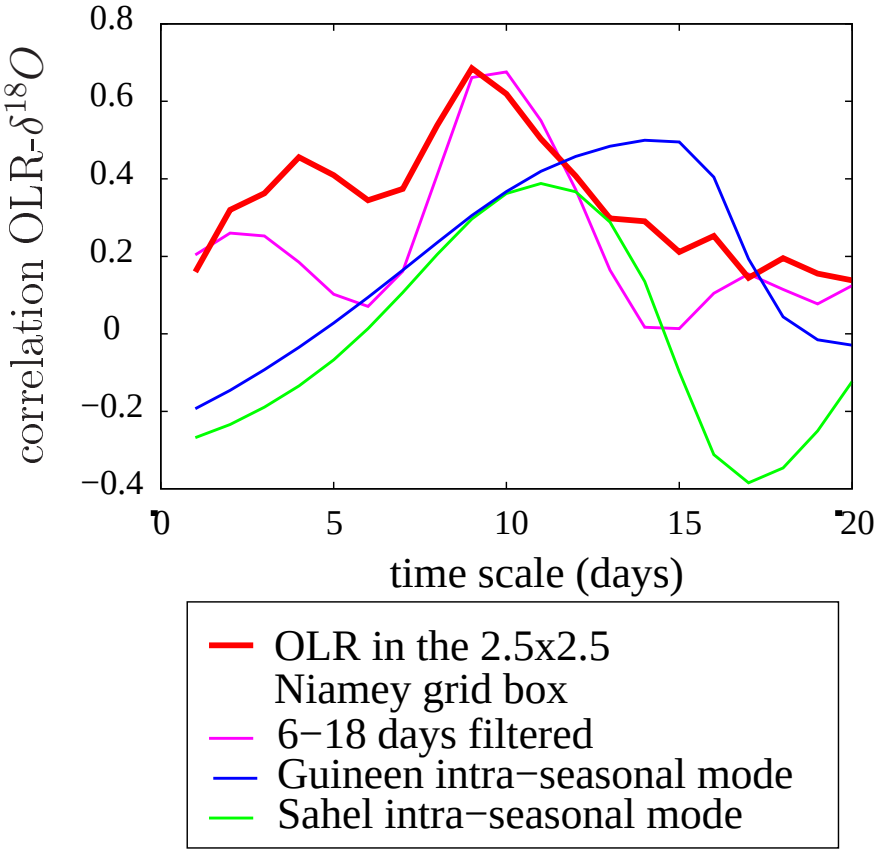
After the onset: $\delta^{18}O$ records the intra-seasonal variability

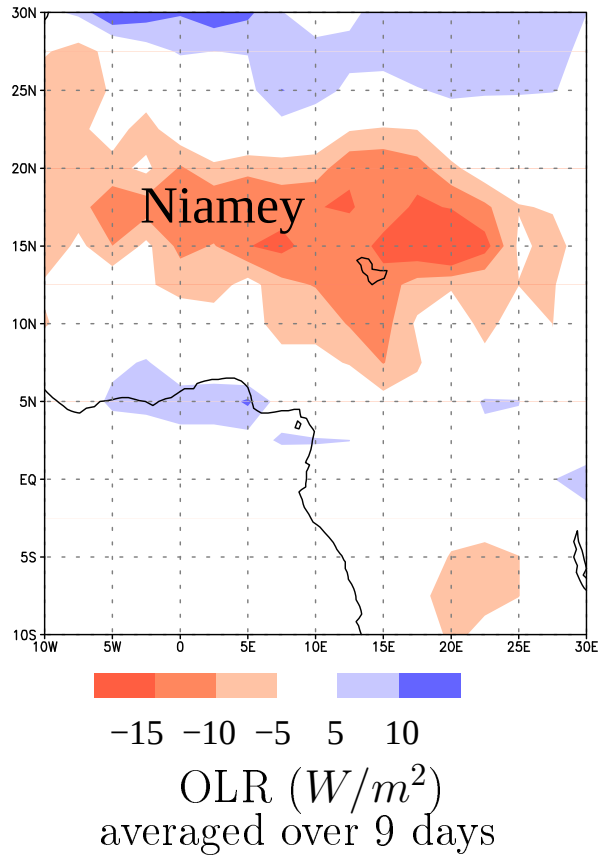




Correlation between $\delta^{18}O$ and OLR at 9 days

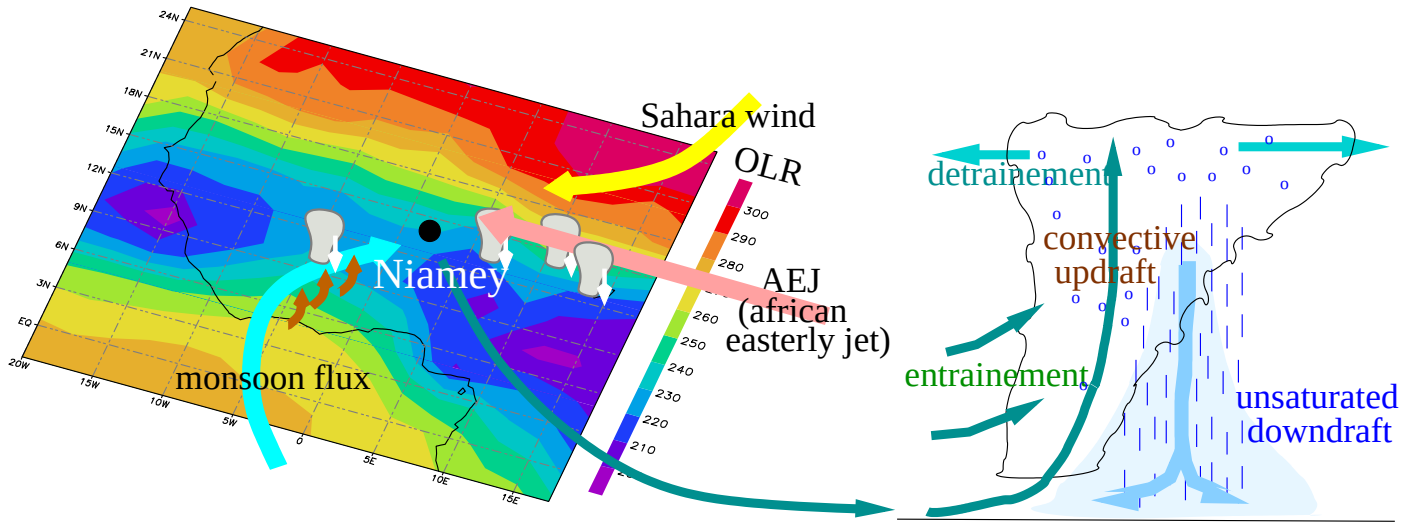
After the onset: $\delta^{18}O$ records the intra-seasonal variability





depleted - rich composite

Conclusion and perspectives



- water isotopes record the intra-seasonal variability
- questions
  - processus of temporal integration
  - relative role of local convective vs large-scale processes?
  - controls on d-excess?
- Perspectives: coupled land-atmosphere simulations zoomed on the AMMA regions with LMDZ-ORCHIDEE