Water isotopes and tracers in ORCHIDEE

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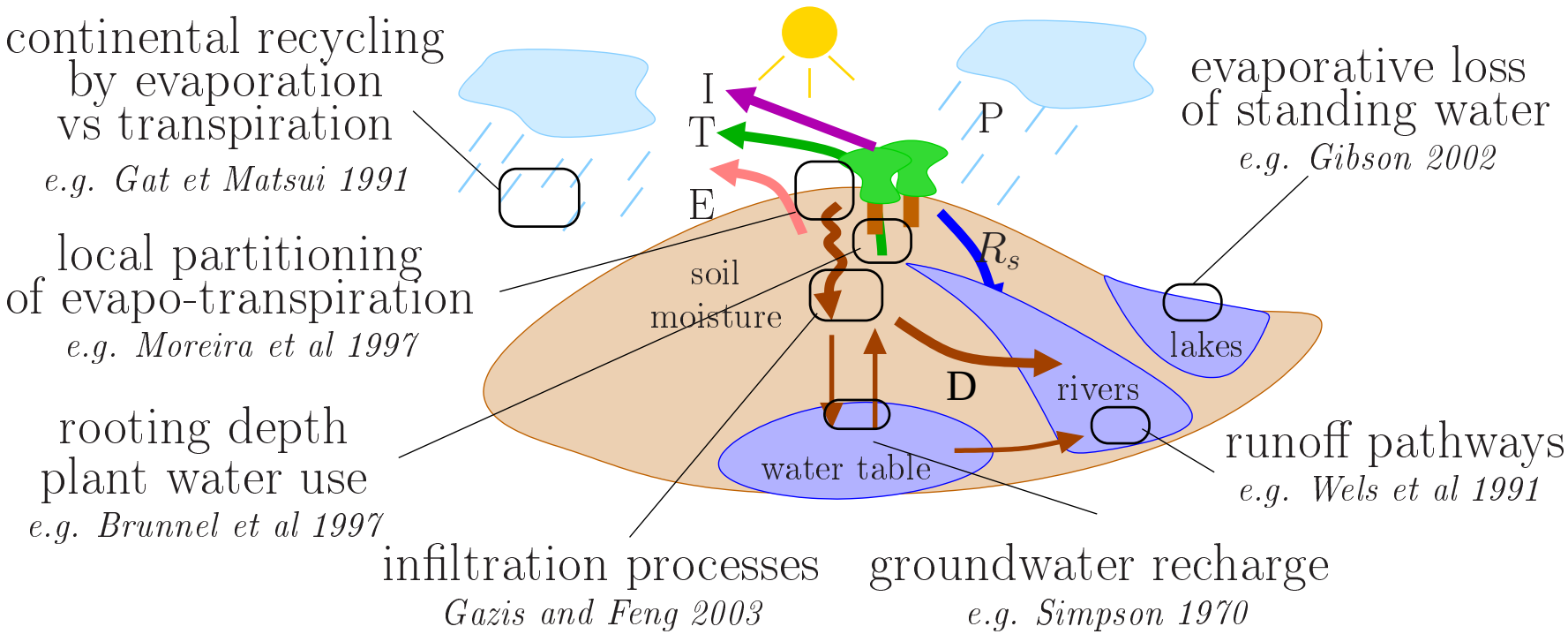
Réunion ORCHIDEE-DEV du 18 sept 2012

Outline

- motivations
- implementation
- evaluation examples
- application examples
- towards generic tracors

Science motivations

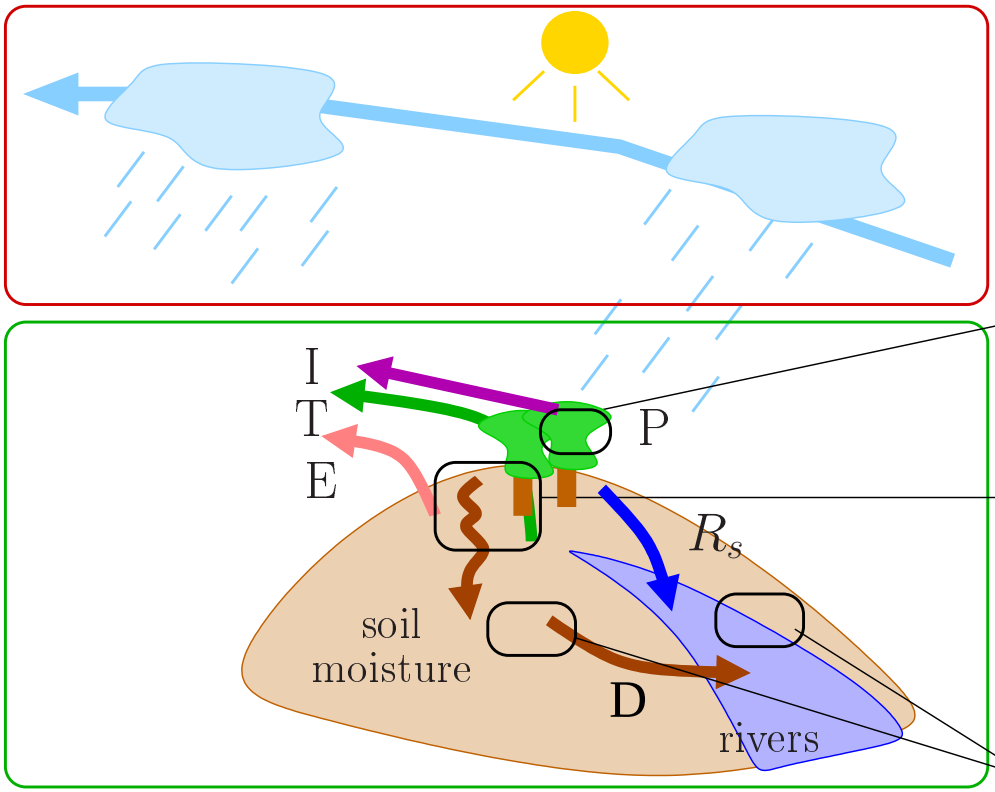
- isotopes to estimate budgets and study processes in nature



- to evaluate land surface models ? *(e.g. Henderson-Sellers et al 2006)*

Isotopes in LMDZ and ORCHIDEE

LMDZ *(Risi et al 2010a)*



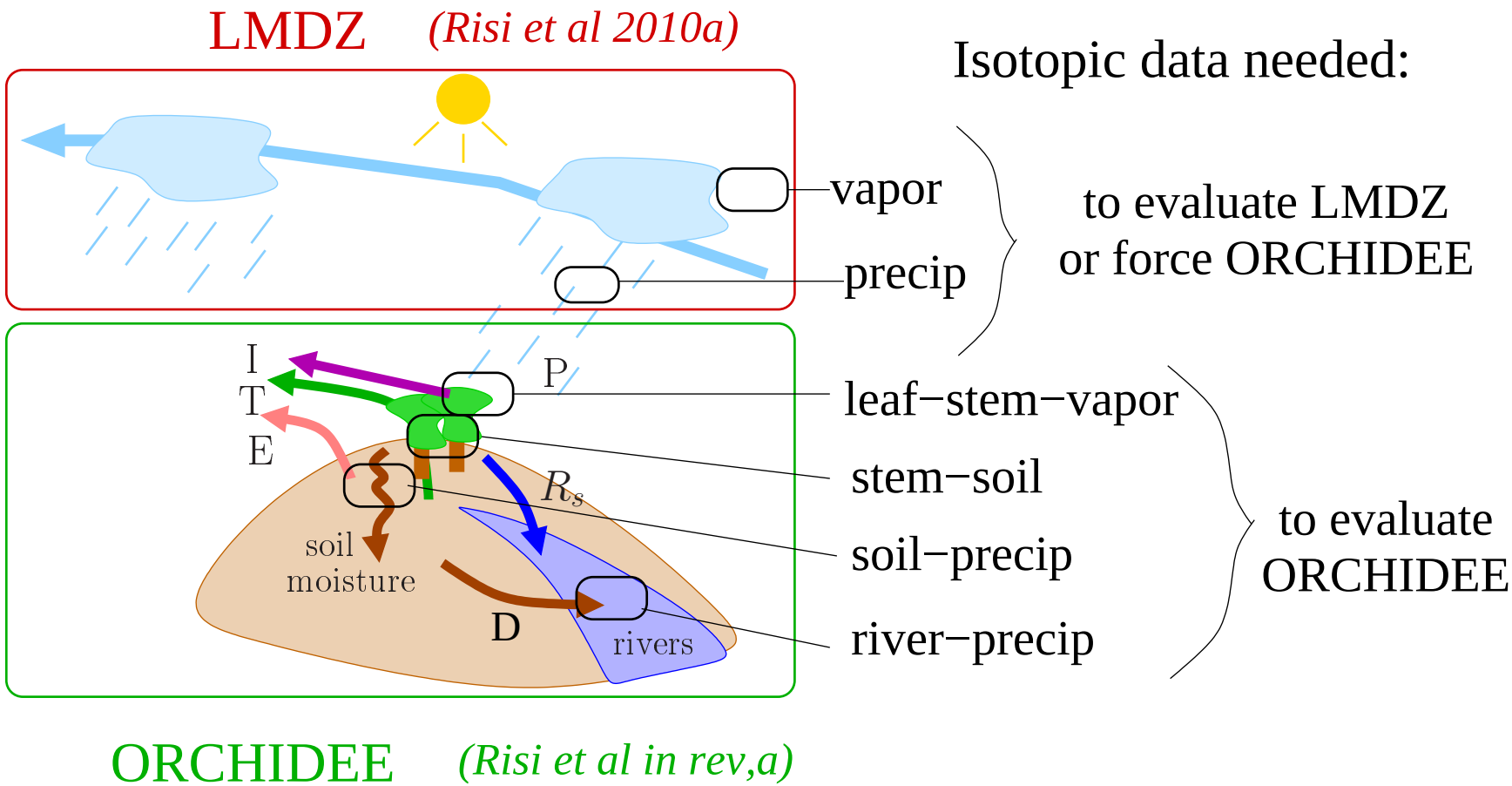
ORCHIDEE *(Risi et al in rev,a)*

fractionation in leaves

1.5 layers for hydrology
40 layers (5cm) for isotopes
fractionation at soil surface
+ vertical diffusion

Transport in all reservoirs

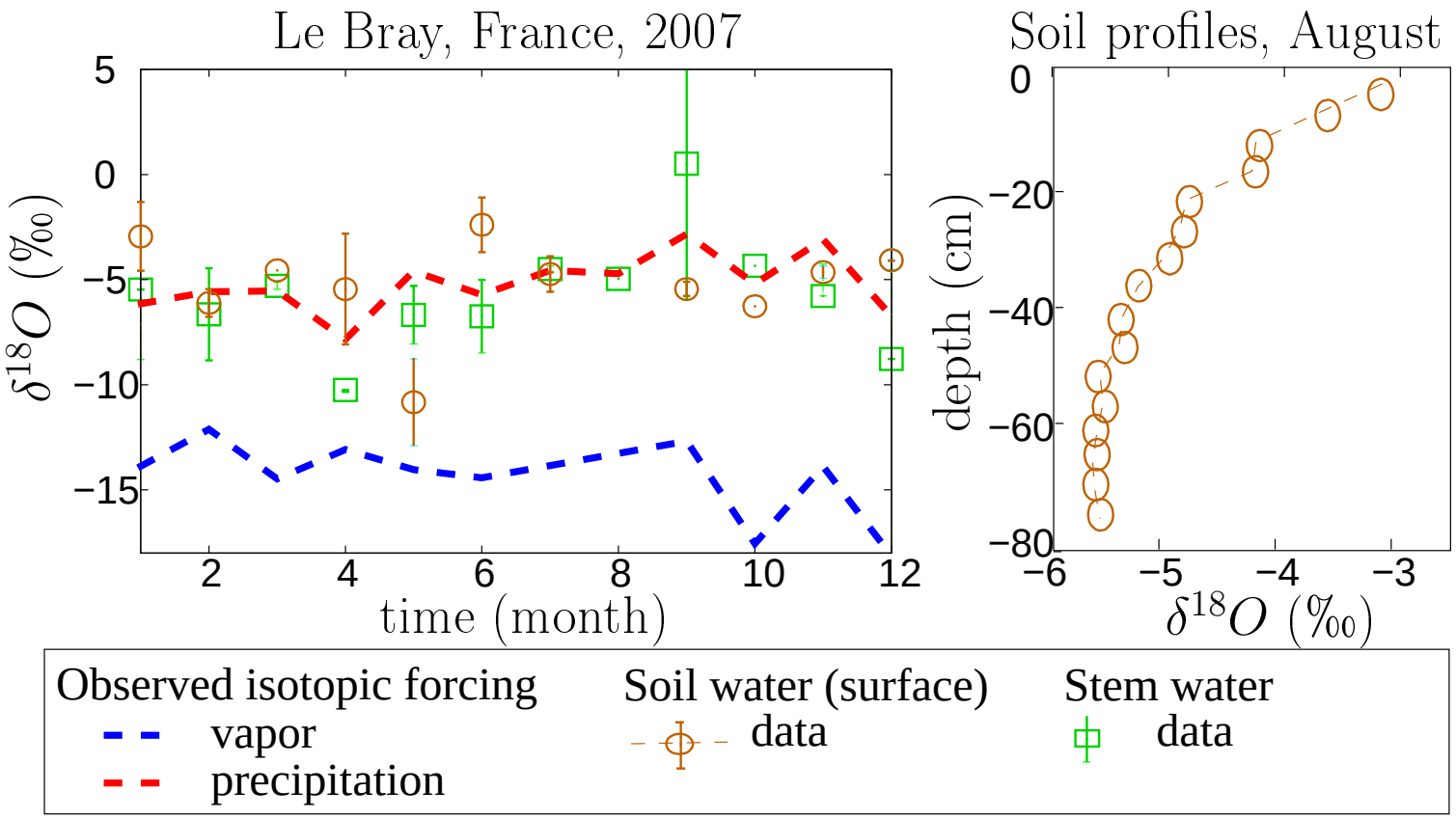
Evaluating isotopic models



$\Rightarrow$ need collocated measurements in different reservoirs at each site

Evaluation of soil and biosphere isotopes

- 2 MIBA sites : Yatir (Israel, *Raz-Yaseef et al 2009*) and Le Bray (France, *Wingate et al 2009*, shown here)



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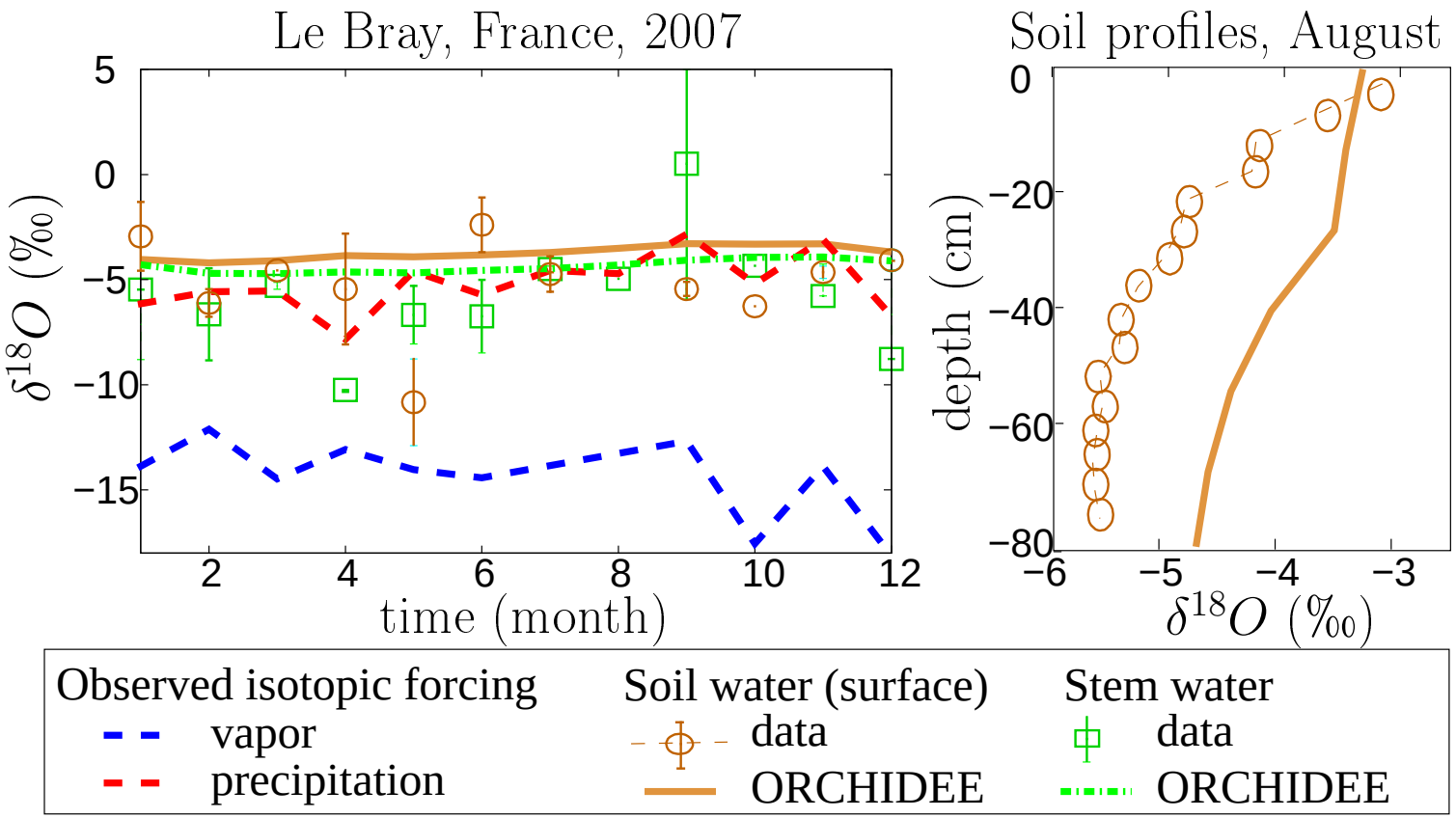

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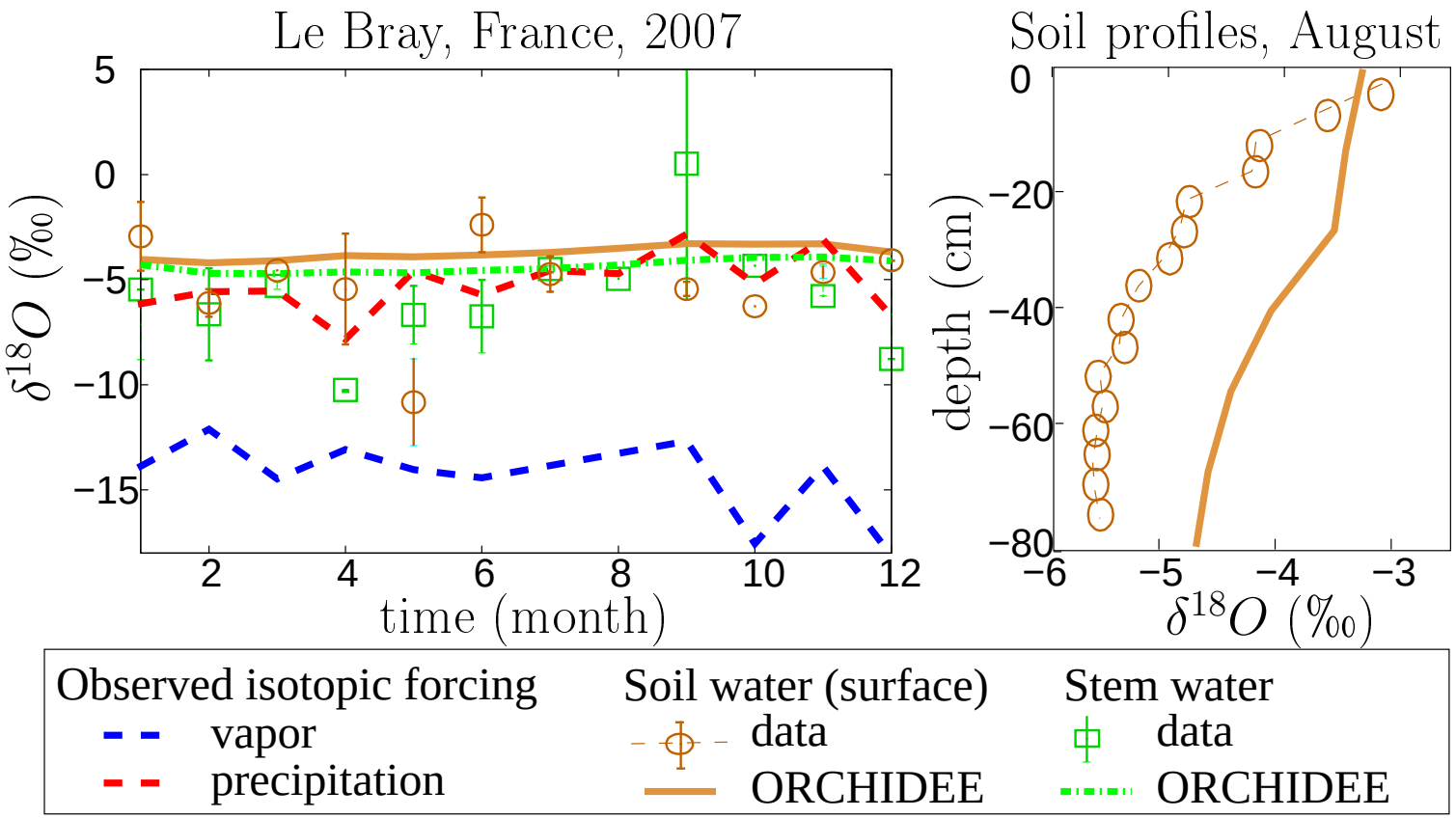
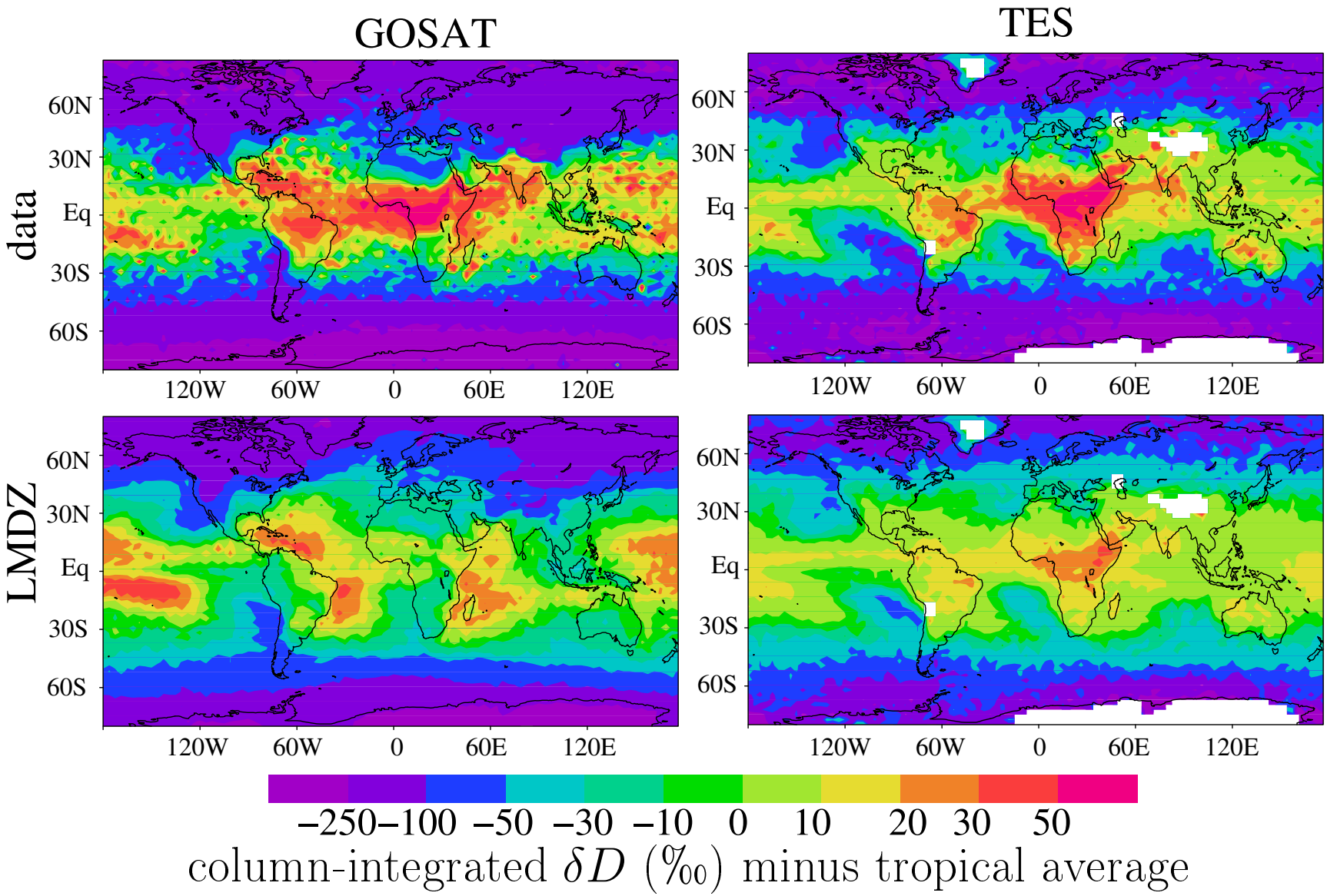
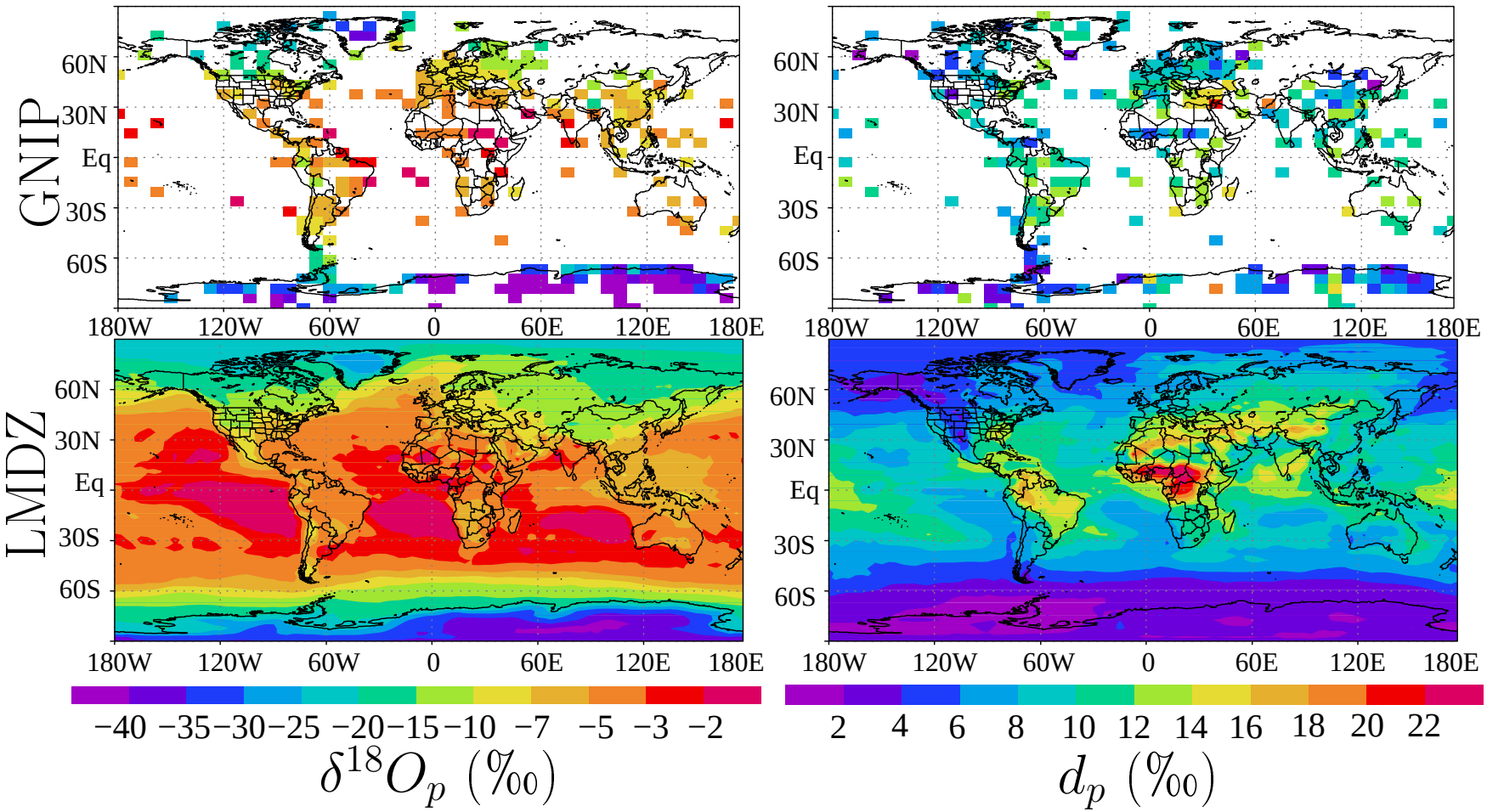


- other sites : Indiana, Florida, Alaska (2), Portugal, Czech Rep (2), Germany (2)

Evaluation of water vapor isotopes

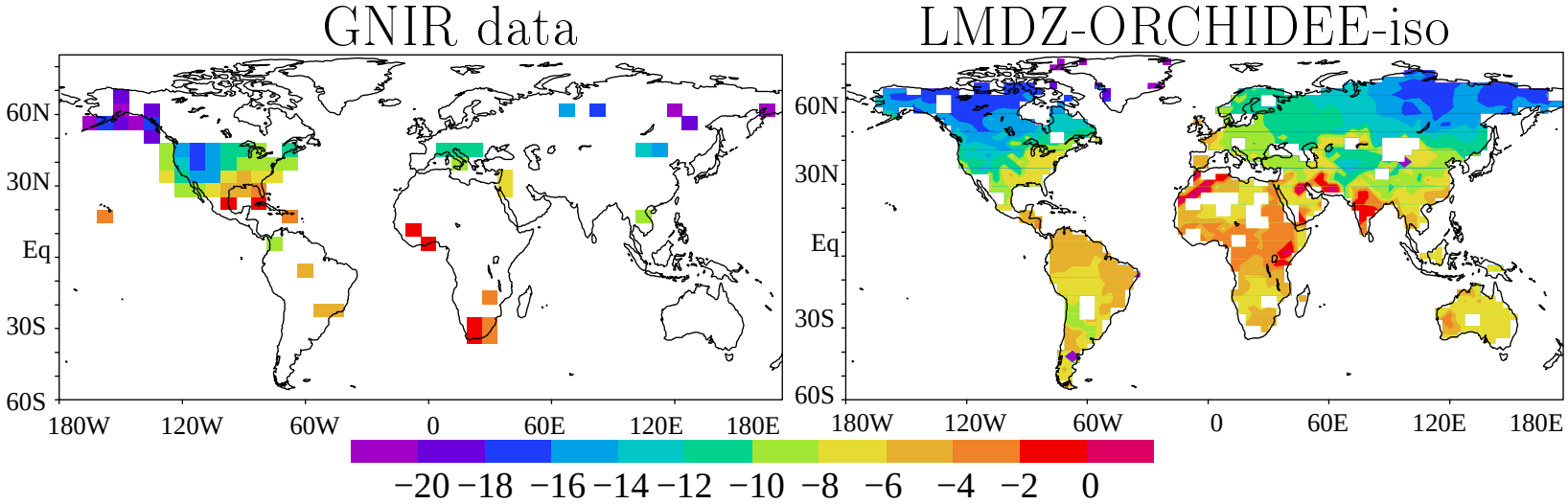


Evaluation of precipitation isotopes



Evaluation of rivers isotopes

annual mean $\delta^{18}O_r$ (‰)



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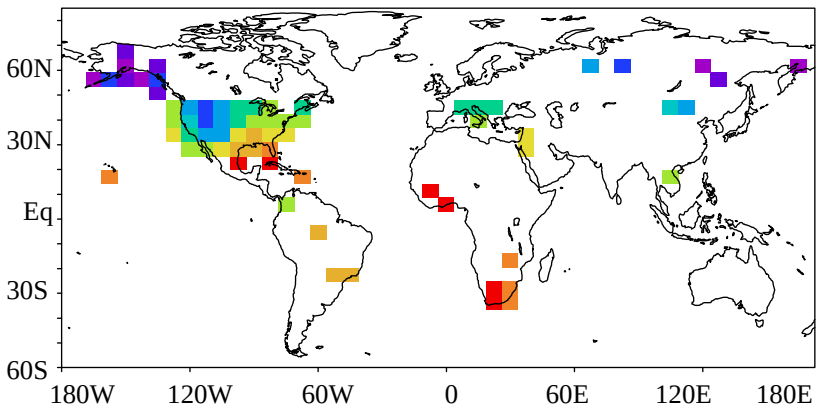
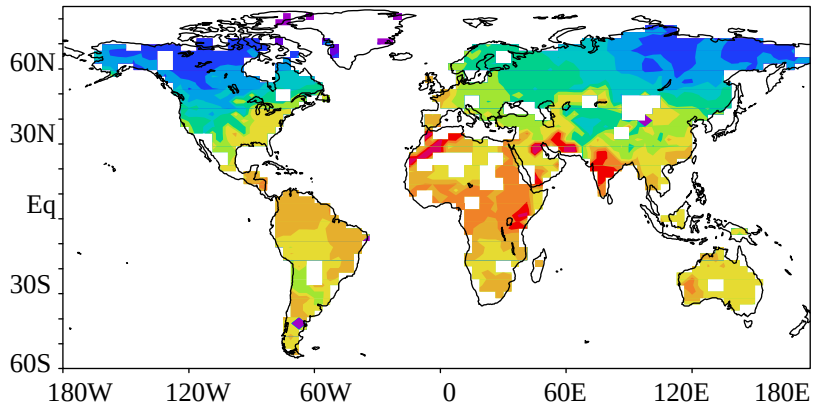
GNIR data

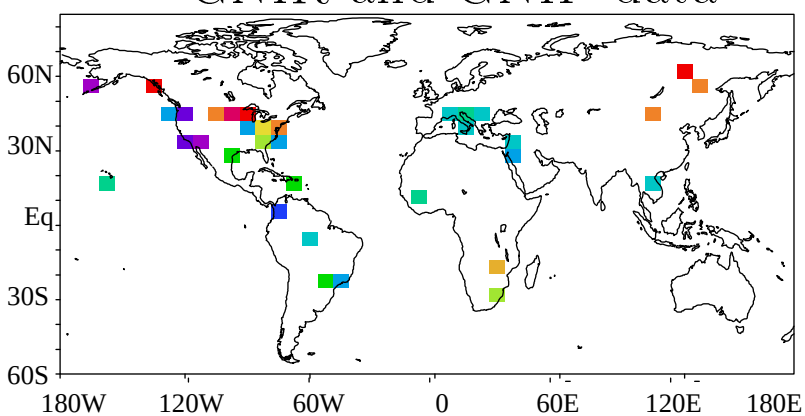


LMDZ-ORCHIDEE-iso



annual mean $\delta^{18}O_r - \delta^{18}O_p$ (‰)

GNIR and GNIP data



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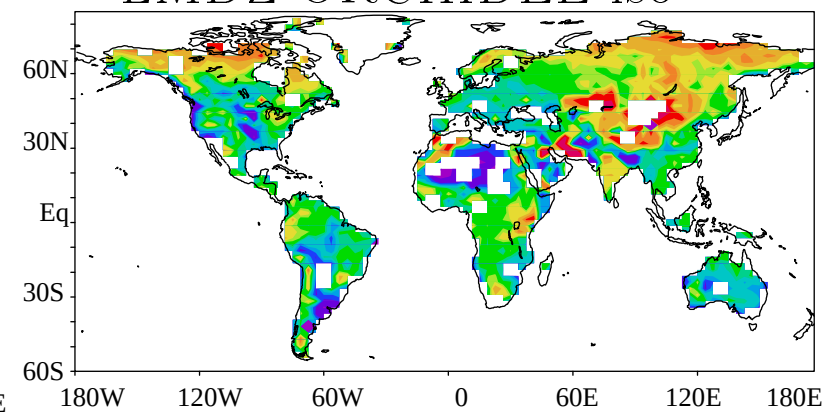
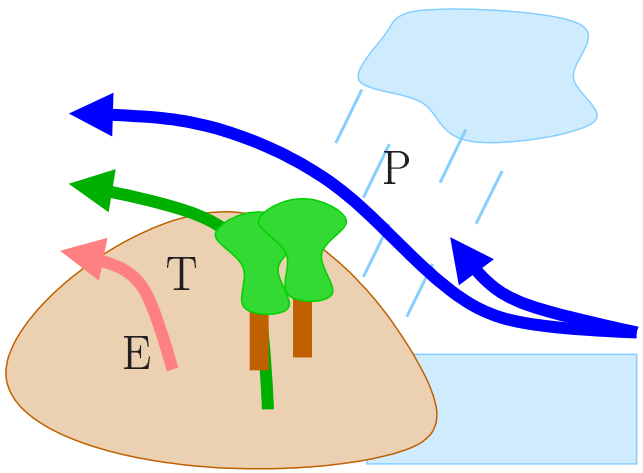
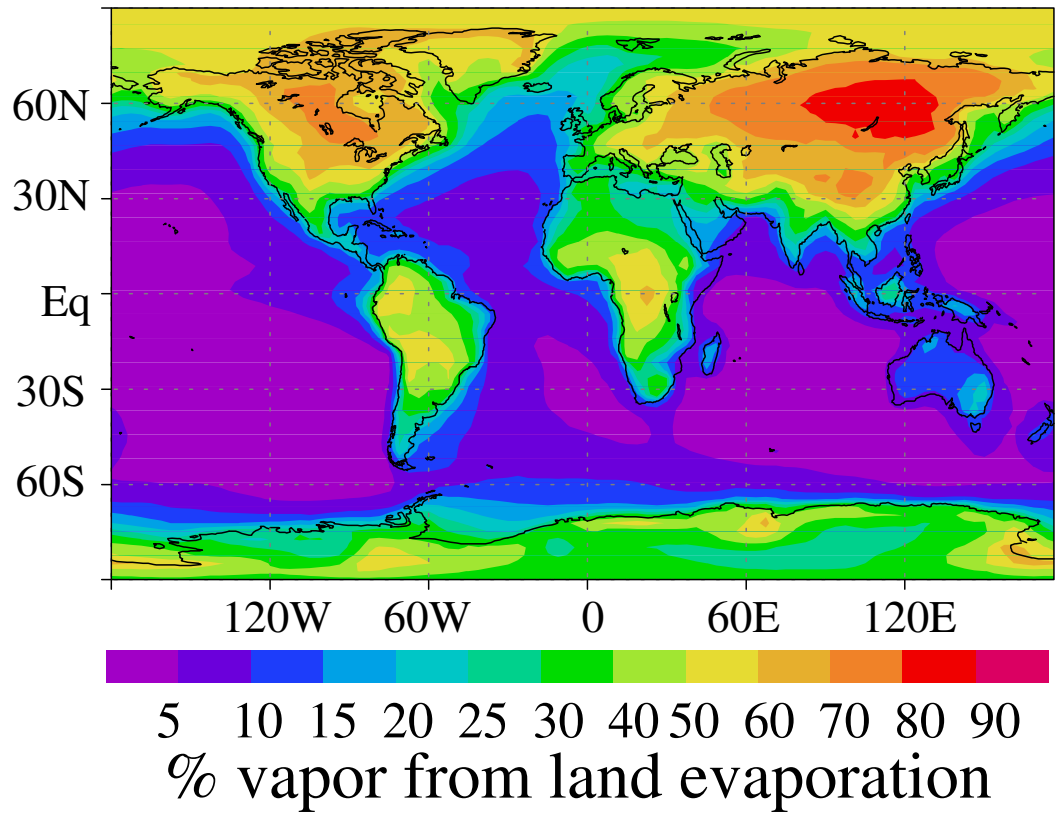
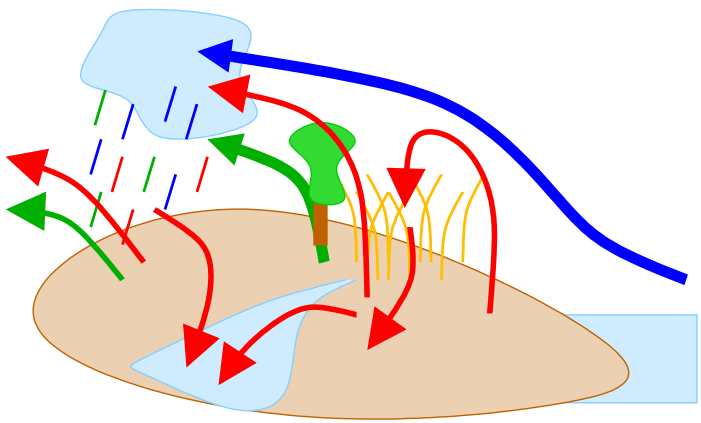


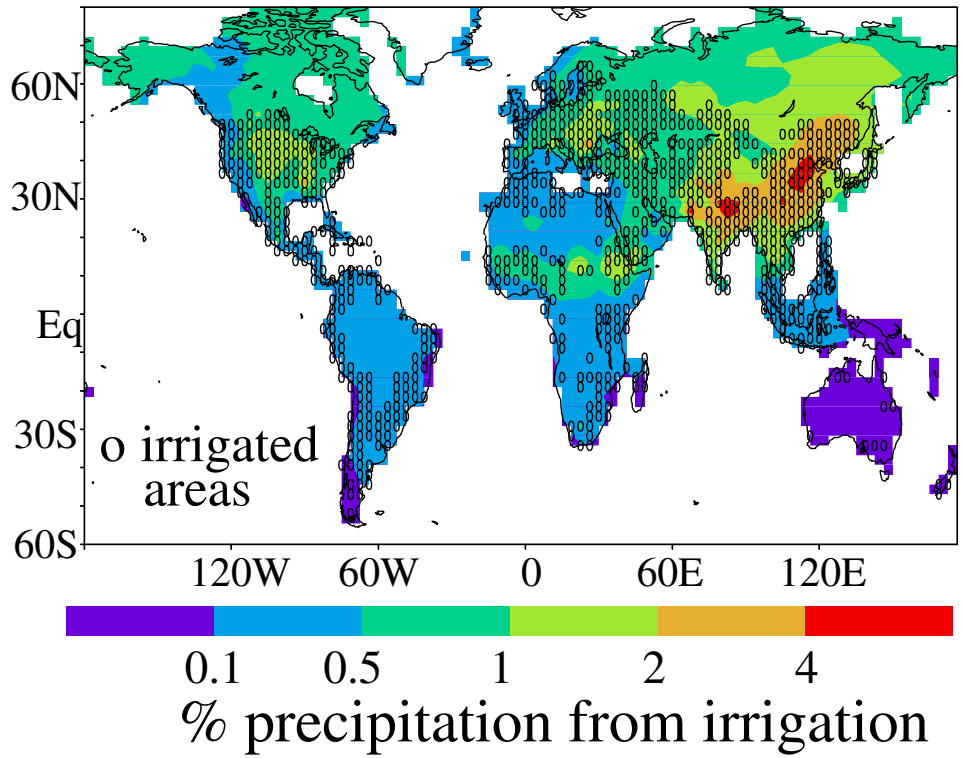
Applications : quantifying continental recycling



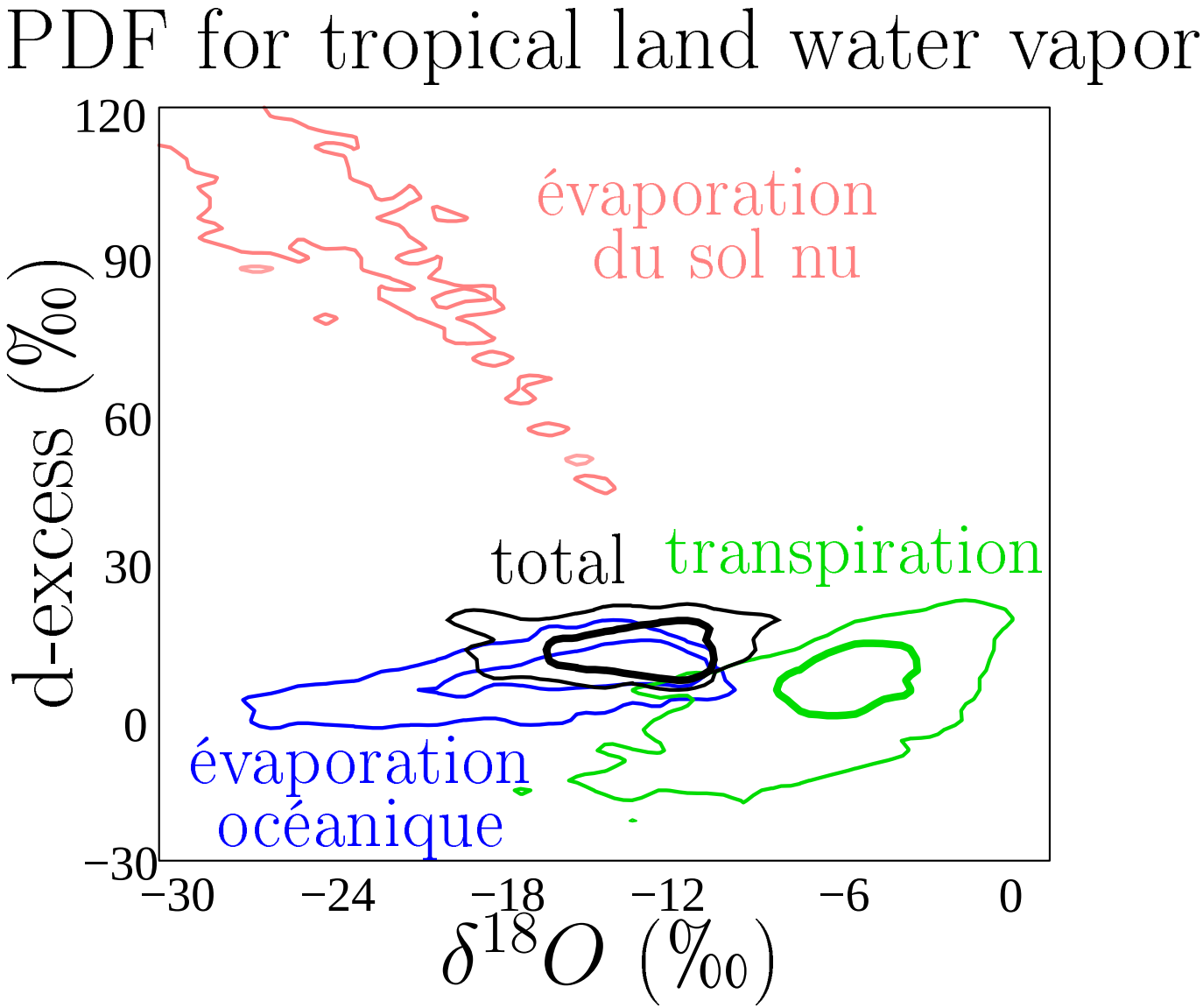


Quantifying the role of irrigation

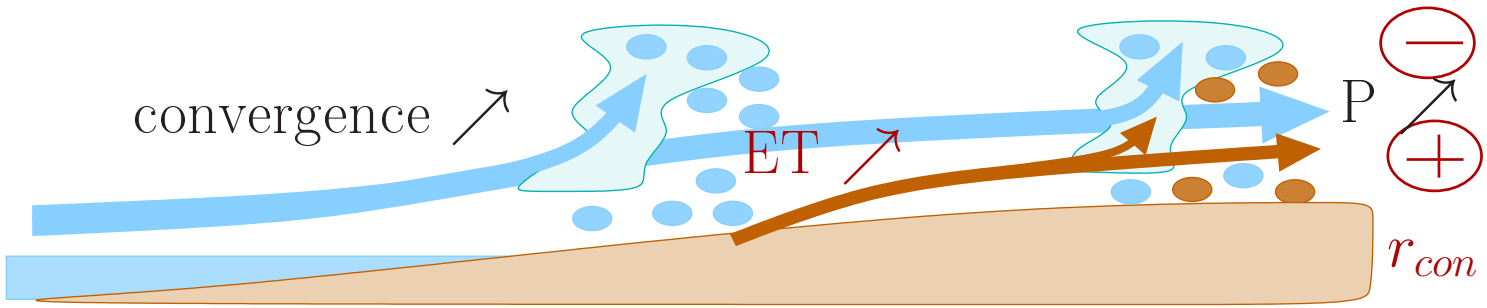




Isotopic signature of continental recycling



Isotopic proxy for role of continental recycling for intra-seasonal moisture variability



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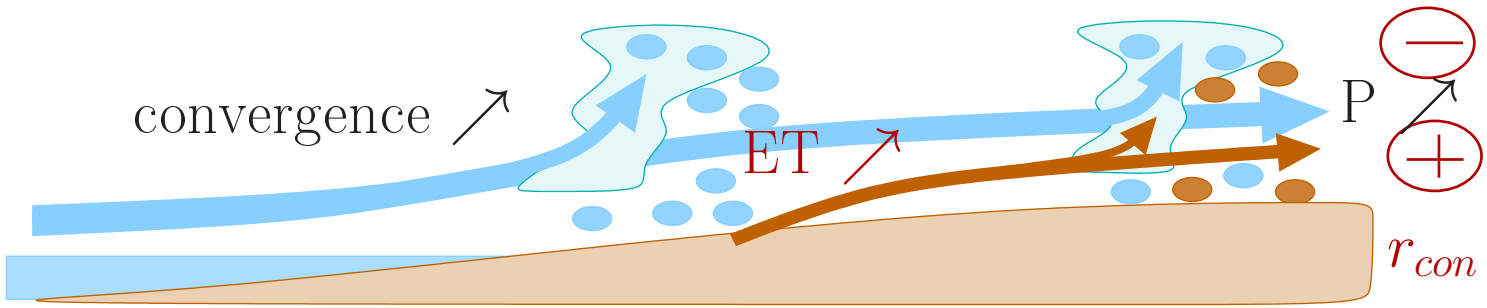

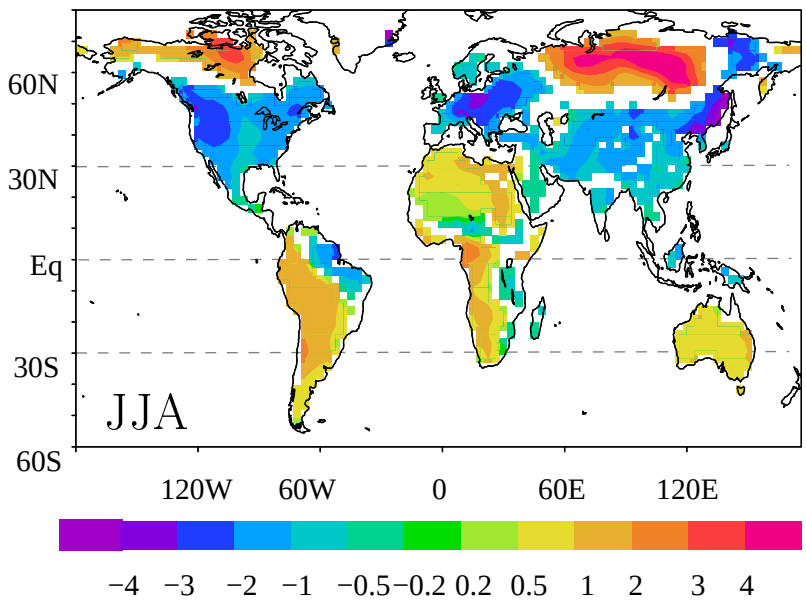

dr_{con}/dW $(\%/W.m^2)$
model diagnostic

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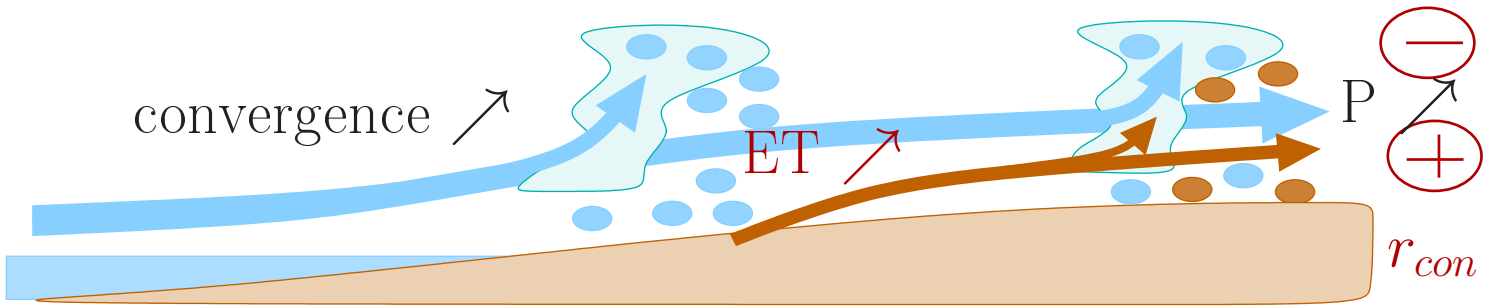

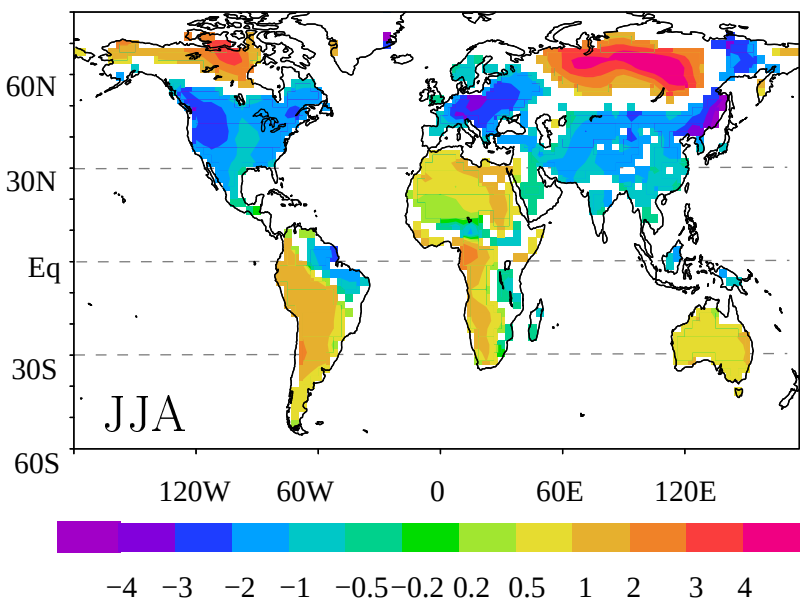

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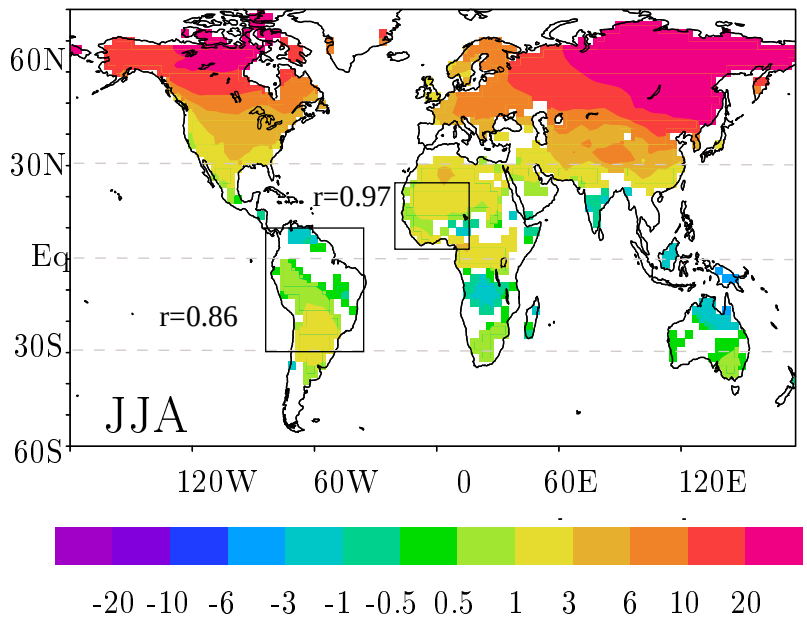

$d\delta D/dW$ $(‰/kg.m^2)$
observable diagnostic

Towards generic tracers

- At stake : long-term survival of water isotopes and tracers
- isotopes are voluminous in the code
- Add dimension to all variables
- different kinds of tracers : origin tracer, isotope, solute, organic matter... -> controlled by flags
- Plug to LMDZ and driver : tracers internal to ORCHIDEE and/or shared with LDMZ.
- Issues
  - order of loops

Road map

- Post-doc Francesca Guglielmo : isotopes in 11-layers and in high latitude addiditives
  -> will use the trunk with MergeHydro
- Myself :
  - prepare the version Francesca will use : easy to add Isabelle's and Tao's additives ?
  - resubmit reference paper
- With Didier Solyga : towards generic tracers ?