

# Isotopes dans IPSL-CM

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# LMDZiso : news

- Disponible dans la configuration IPSLCM7ISO\_work
  - LMDZ-ISO installation/compilation/simulation amip

## Chantiers

- Mise en Place d'une simulation de référence (fournie par C. Agosta et N. Dutrievoz) :
  - LMDZ-ISO amip (+ nudging)
  - scripts python pour analyse des sorties
- Convergence physique de phylmdiso avec phylmd
- Fusion du répertoire phylmdiso dans phylmd
  - Utilisation du tableau QX à la place des t\_seri xt\_seri
  - changement de l'ordre des boucles sur les isotopes
  - suppression des #ifdef ISO
- Remplacement de isoverif par les routines génériques de David Cugnet
- Correction de bugs : explosion de OVAPH218O et OVAPHDO au pôle nord

# icoLMDZiso: news

## Done:

- Initialization of water isotopes in the ico driver
- Exchanges of isotopes dyn $\leftrightarrow$ phy in the ico driver  
Conversion kg/kg  $\leftrightarrow$  ratio = children / parent
- Advection of isotopic ratios (as for other tracers)

... and some other refactoring later ...

## It runs and good results! (global nbp40)

But... explosion of H<sub>2</sub><sup>18</sup>O and HDO after a few month

→ it comes from the physics, debug ongoing.

## Needed for:

- icoLMDZiso LAM, e.g. Antarctica (AWACA, ice core interpretation)
- IPSL-CMiso for paleoclimate studies



# Integration of water isotopes into ORCHIDEE

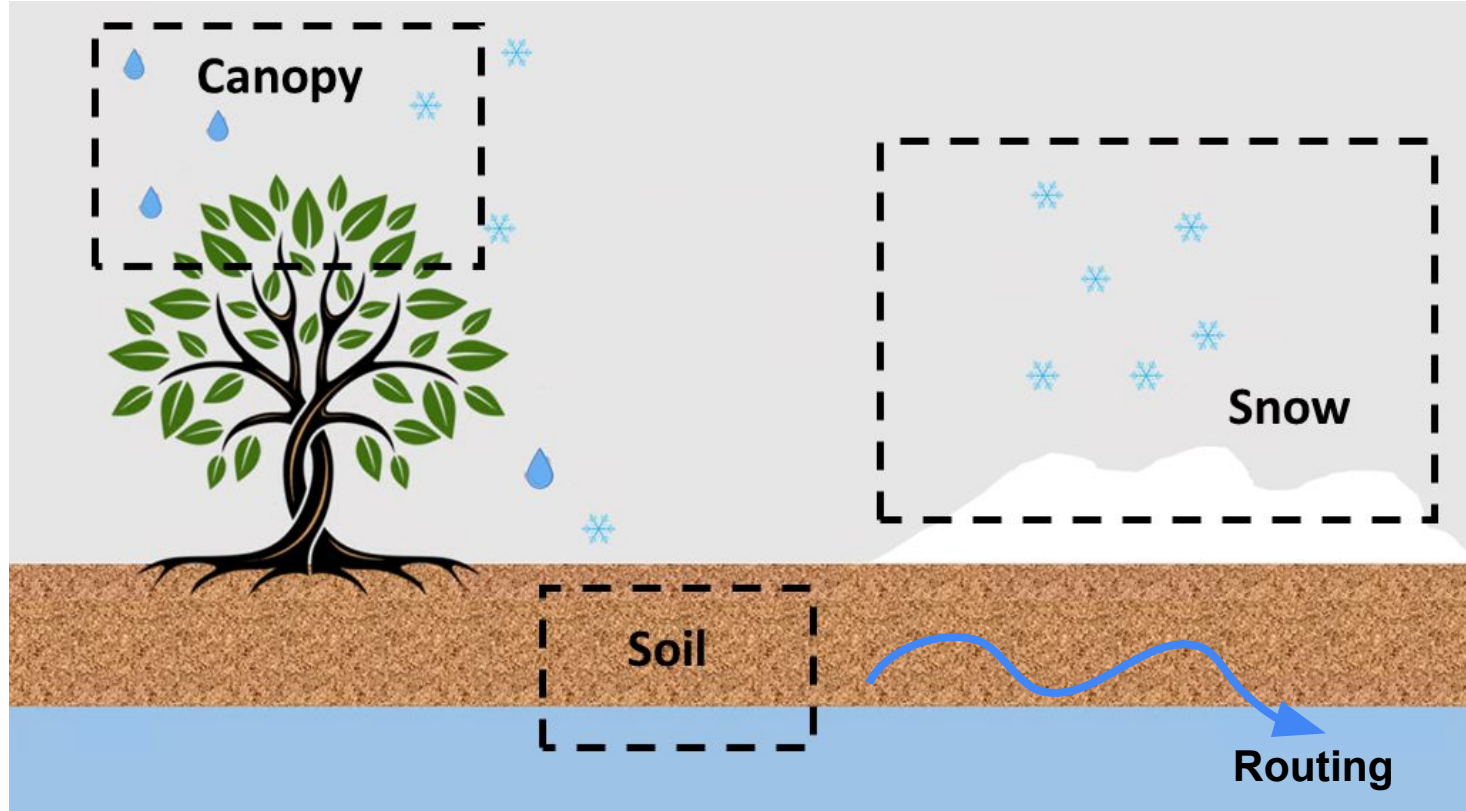
*By ~~401~~ doctoral researcher Aya BAH*

## **Supervisors**

- Camille Risi (SU-LMD)
- Jean Baptiste Ladant (LSCE-CLIM)
- Philippe Peylin (LSCE-MOSAIC)

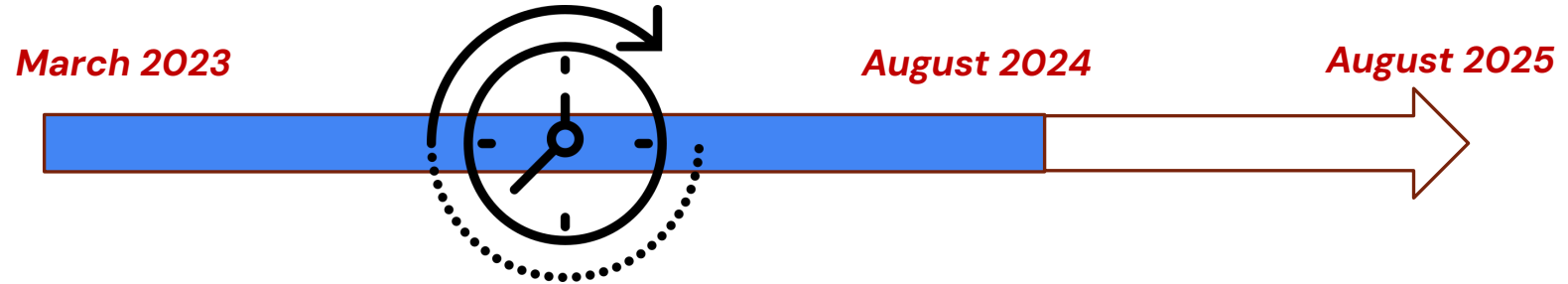
## **Contributors**

- Josefine Ghattas
- Jerome Ogee
- Matthias Cuntz
- Catherine Ottele



**Figure 1:** The hydrologic components of ORCHIDEE involved in the water isotopes integration

## *Post-doctoral contract*



- To run a simulation on site and compute the isotopic composition of soil water
- To add the frozen fraction of the soil water
- Write a paper about a scientific application/Add isotopes to the snow compartment

# Modeling water isotopes with the NEMO Watiso package

The isotopic ratio is transported

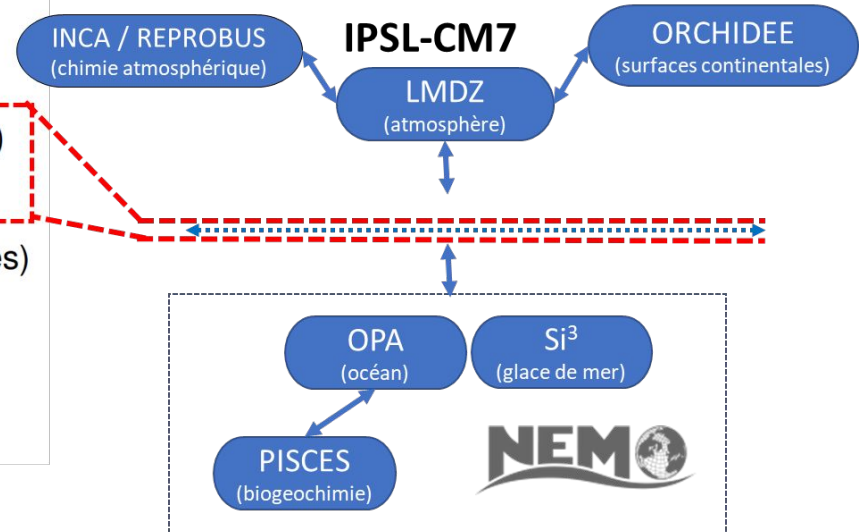
- ▶  $^{18}\text{R} = ^{18}\text{O}/\text{O}$  (rel. to the total of all isotopic forms)
- ▶ Boundary condition at the sea surface ( $z = \eta$ )

$$\rho_0 K \nabla ^{18}\text{R}|_{z=\eta} = \underbrace{(\mathcal{E} - \mathcal{P} - \mathcal{R})^{18}\text{R}}_{\text{Context-dependent}} - ({}^{18}\mathcal{E} - {}^{18}\mathcal{P} - {}^{18}\mathcal{R})$$

$\mathcal{E}, \mathcal{P}, \mathcal{R}$  = evaporation, precipitation, run-off ( $\ni$  ice-shelves)

${}^{18}\mathcal{E}, {}^{18}\mathcal{P}, {}^{18}\mathcal{R}$  = associated isotope fluxes

- ▶ Assumption:  ${}^{18}\text{R}_{\text{sea-ice}} = {}^{18}\text{R}|_{z=\eta}$
- ▶ No-flux condition on solid boundaries



# Implementation

## Two cases implemented

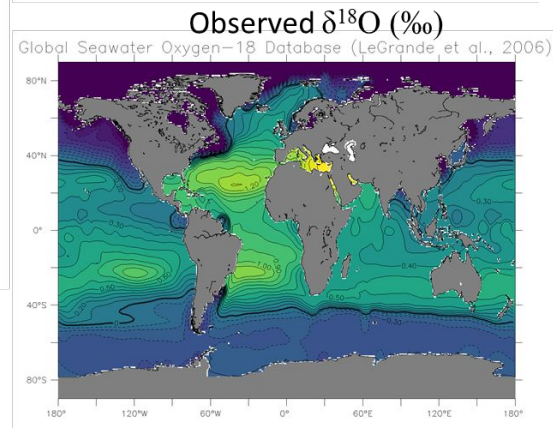
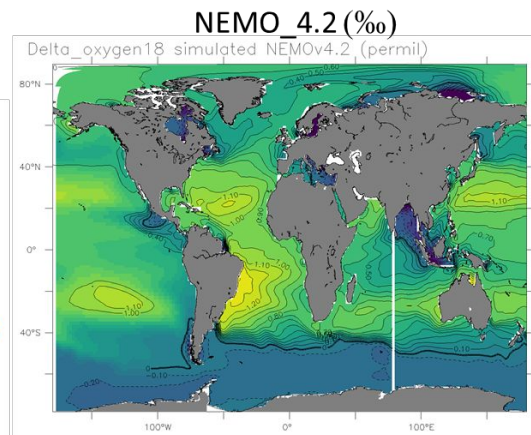
### 1. *In\_linssh=.false.*

- ▶ on-line or coupled
- ▶ full consistency between salinity and isotopic ratios

### 2. OFF-line

- ▶ additional tracer  $S_w$
- ▶ *In\_linssh=.true.*
- ▶ equilibrium state

Cases *In\_linssh=.false.* in on-line or coupled modes theoretically possible; but adds complexity





# Implementation and Next Steps

## Current Status:

### •Package Implementation:

- Code writing and compilation: **Completed**

### •OFFLINE Coupling:

- Implemented and tested with **long runs** using ORCA2 grid
- Experiments prepared:
  - **Control, Mid-Holocene**, and **LGM** simulations
- External forcing:
  - Fluxes from **LMDZiso bucket** model
  - No impact of **sea ice** on the isotopic composition of seawater

## Next Steps:

### •Asynchronous Coupling:

- Test asynchronous coupling (LMDZiso-NEMOv4.2), M2 internship (P. Sepulchre)

### •Toward Fully Coupled Model:

- Integration of water isotopes into the IPSL-CM coupled model ...

M2 internship funded by EUR-IPSL (Sepulchre/Nguyen/Risi et al.)

- Target : Asynchronous coupling LMDZiso - NEMOiso global
- Preindustrial validation and warm paleoclimate simulation
- PhD project submitted to CEA. Results in January '25

Example of validation with iCESM (Brady et al., JAMES, 2019)

