

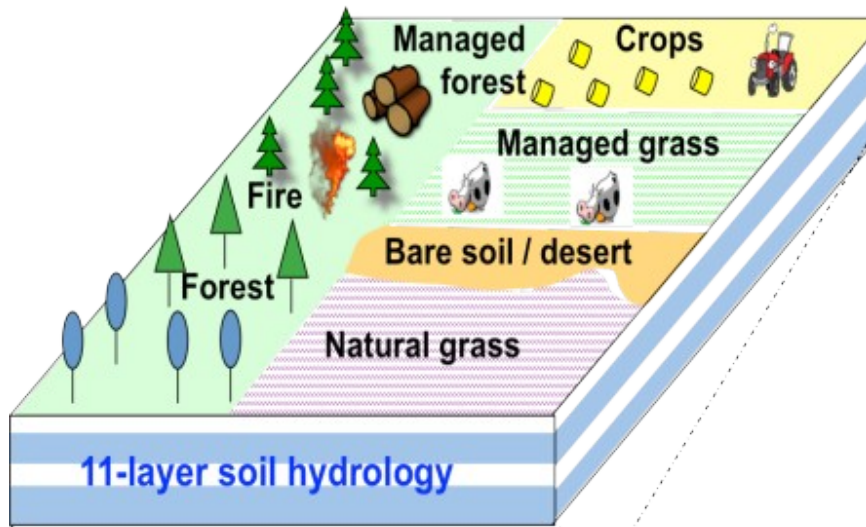
LSCCE contribution

C. Ottlé, J. Polcher, Z. Titus, M. Uchasara

Implementation of lakes in ORCHIDEE land surface model

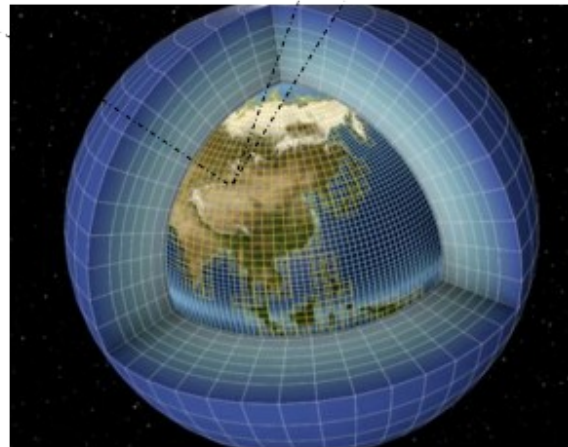


ORCHIDEE
LAND SURFACE MODEL



ORCHIDEE: land surface component of the French IPSL Earth System Model

ORCHIDEE recently coupled with Flake (*Mironov et al., 2010*) lake model (*Bernus and Ottlé, GMD, 2022*)



IPSL Earth System Model

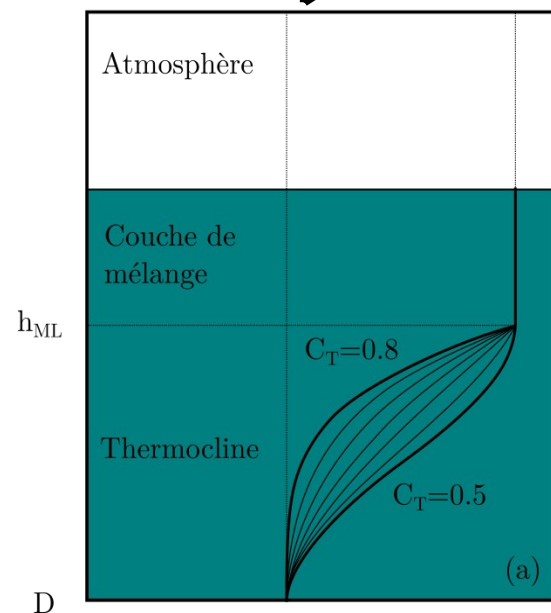
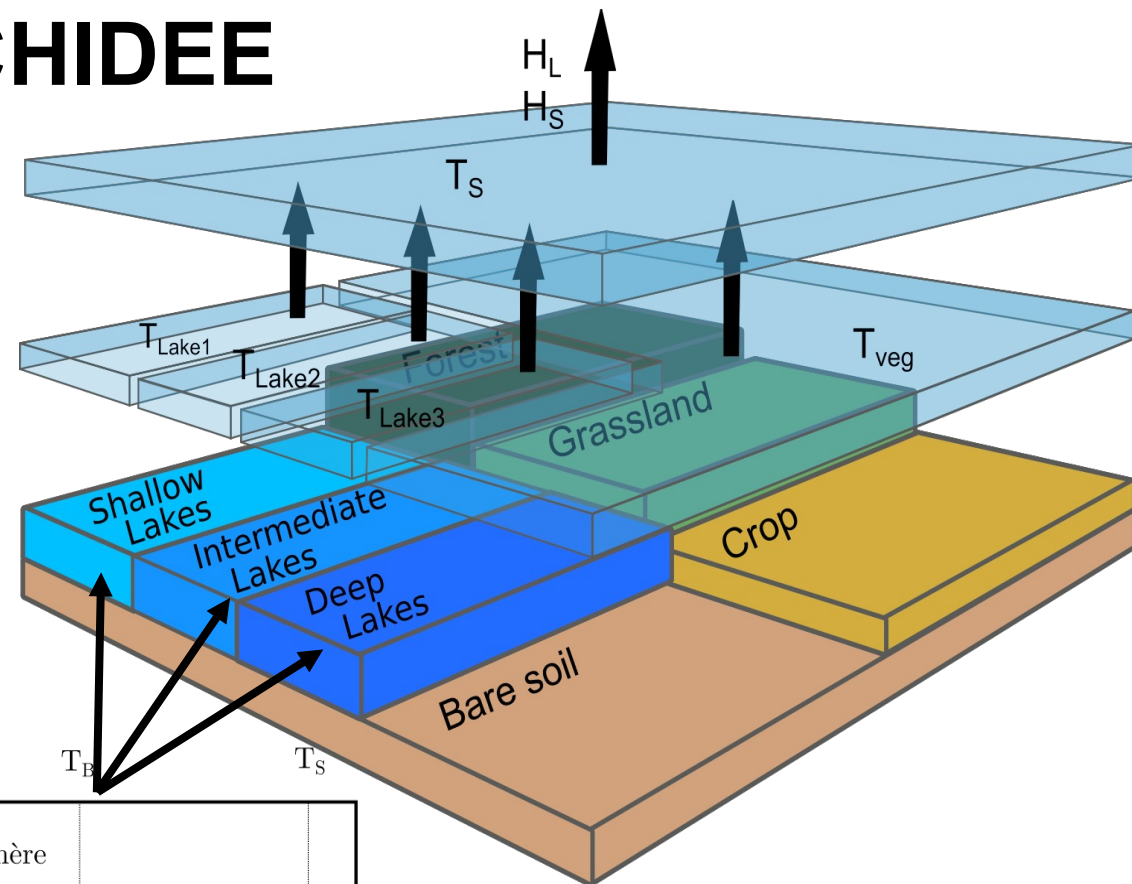
Implementation of lakes in ORCHIDEE

Flake module computes the lake energy balance for a number of predefined lake tiles with different properties.

As a first step, depth was chosen to discriminate the tiles.

3 depth classes were chosen (0 – 5m, 5 – 25m, above 25m)

Prior maps based on HydroLakes (Messenger et al., 2016) were generated for different grid resolutions (1° , 0.5° , 0.25°) to map tile parameters such as grid fraction, median depth, average radiative (albedo, extinction coefficient) and fetch parameters



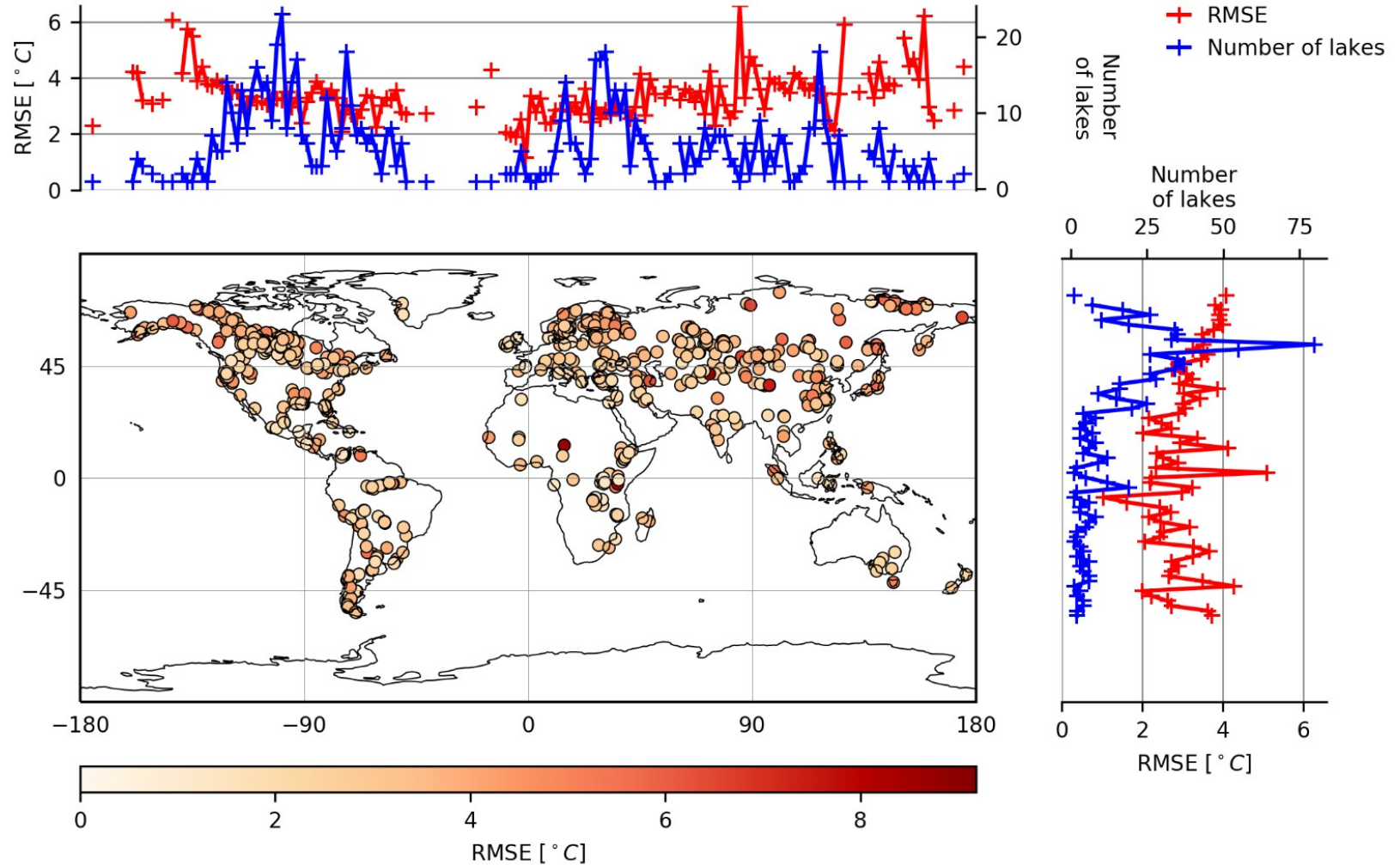
1D Flake lake model

ORCHIDEE – FLake model evaluation using 5 different atmospheric forcings

ERA5, WFDEI-CRU, CRU-JRA, CRUNCEP, ERA5, E2OFD

Evaluation of surface temperature with GloboLakes product (~1000 lakes)

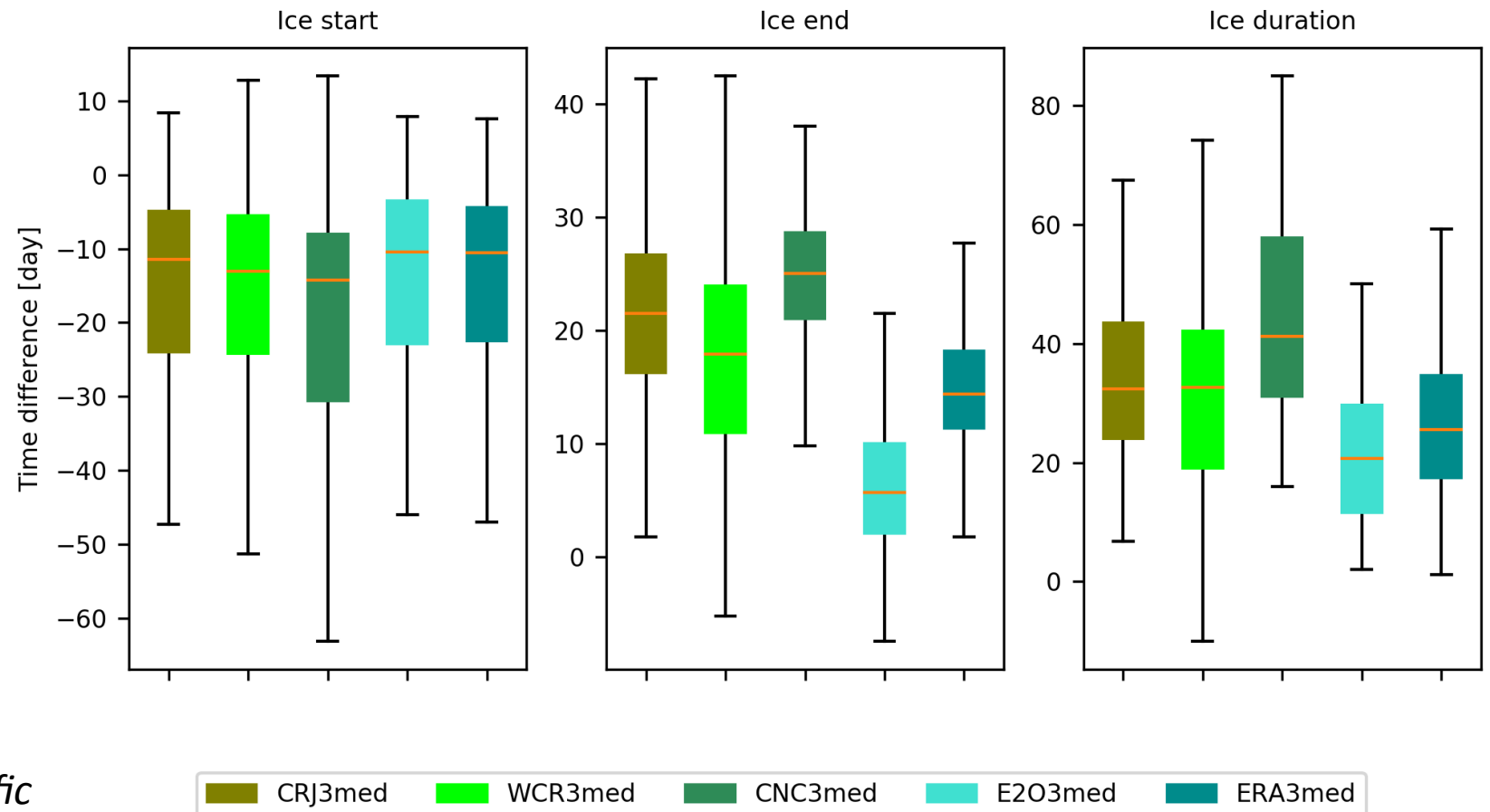
Errors on LWST = 2.7 K with ERA5 atmospheric forcing



ORCHIDEE – FLake model evaluation

Evaluation of ice phenology with Global Lake&RiverIce phenology database (857 lakes)

Errors on ice start, end, duration period show systematic biases whatever the forcing used : **too early onset and late offset** leading to **overestimation of the freezing period up to 40 days**

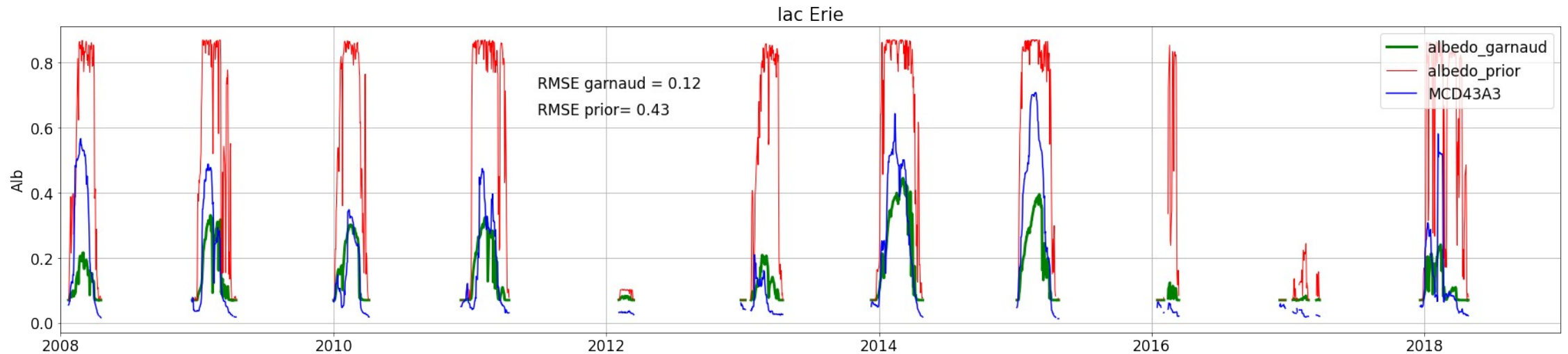


ORCHIDEE – FLake model on-going developments

Accounting for partial ice cover in FLake

Ice Fraction = with $H_{crit} = f(fetch)$

First approach based on Garnaud et al., 2022, calibrate with satellite albedo product (MODIS MCD43A3)



Preliminary results on Canadian Great lakes show encouraging results (Albedo RMSE improved, ice duration and phenology better captured,

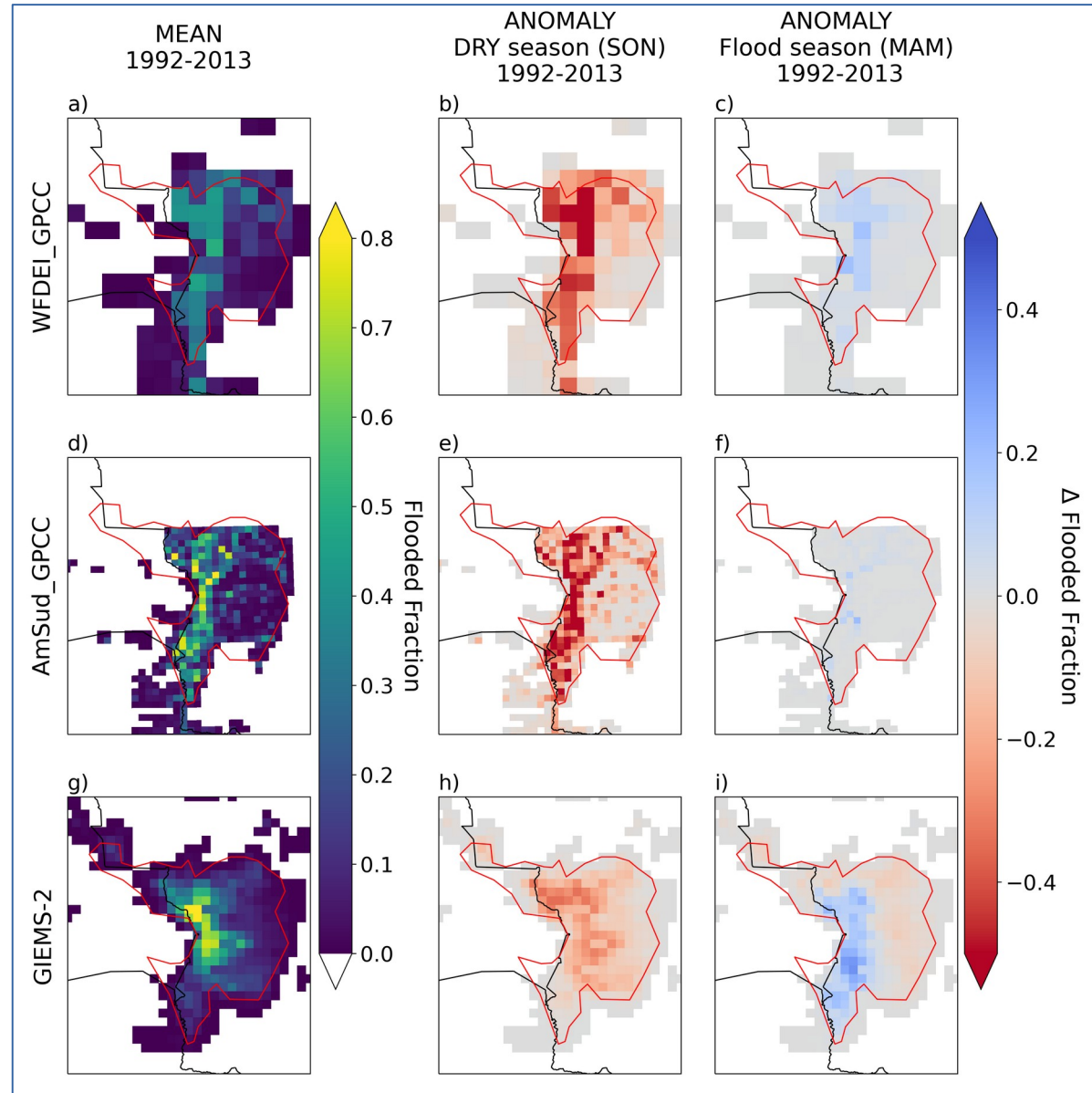
Calibration at the global scale is on-going ...

Lake	Erie	Huron	Michigan	Ontario	Superior
RMSE prior	0.43	0.36	0.32	0.22	0.57
RMSE post	0.12	0.08	0.05	0.06	0.13



Floodplains in ORCHIDEE

- Within ORCHIDEE the horizontal water transport interacts with the other components of the Land System Model.
- The convergence of rivers within the Pantanal allows to simulate the floodplain fraction and height at different resolutions.
- The comparison is done with a remote sensed estimate of inundation fraction (GIEMS-2).
- The enhanced evaporation modifies the vegetation cover and the atmospheric structure.
- The same methodology will be applied to lakes and reservoirs.



Next steps:

- Radiative parameters global optimization (albedo and extinction coeff.)
- Finalisation of lake mass budget implementation
- Evaluation on specific instrumented lakes
- Use of SWOT first products to evaluate the model (seasonal variations of WSE and water area products)
- Identify most uncertain parameters, perform sensitivity experiments and DA twin experiments
- Use of SWOT products to calibrate the most sensitive model parameters