Floodplains representation in Land Surface Models

Toward higher resolution

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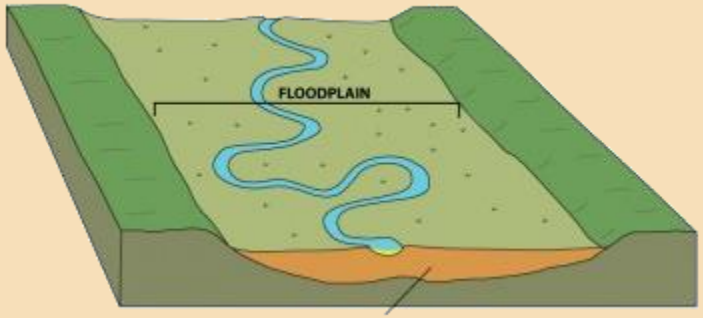
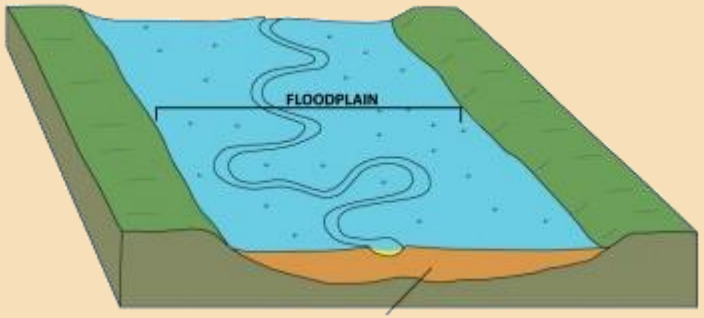
What are the floodplains and why representing them?

Junk et al. (1989) :

> “areas that are temporally or permanently flooded by the lateral overflow of rivers or lakes and/or by direct precipitation or groundwater.”





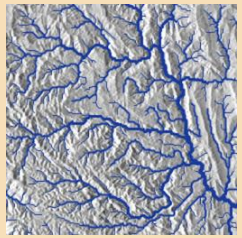
Large floodplains are considered as wetlands and their study is a pertinent subject due to :

- Their impact on the **regional water cycle** (local changes in *evapotranspiration and heat fluxes*)
- Their interaction with the **atmosphere** (changes in *precipitation patterns, discontinuity of surface temperature and heat fluxes)*, and even more for **tropical floodplains**
- Their **ecological richness** and **biodiversity**
- Their strong interaction with the **carbon cycle**

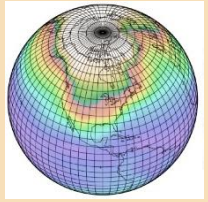
Using a high resolution river routing scheme

High resolution rouing allows to :

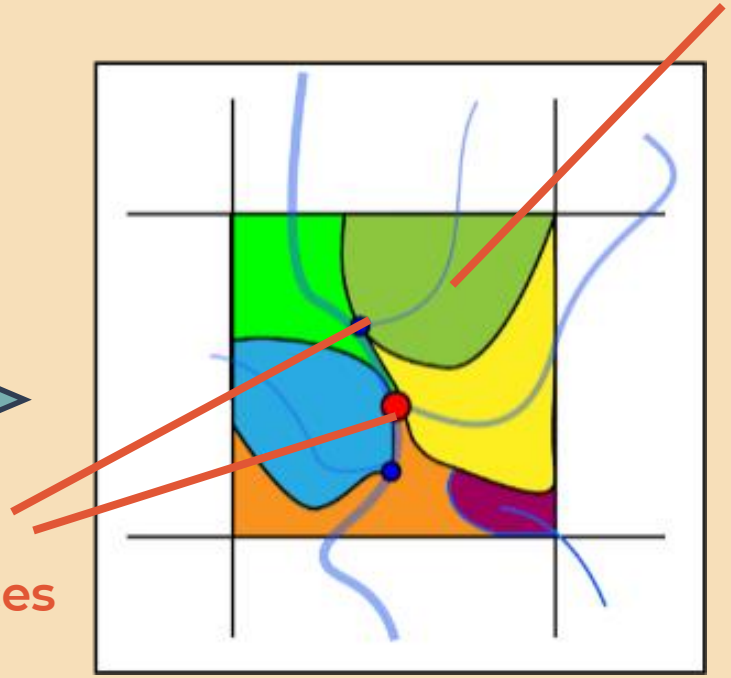
- Use the river routing with different type of grid and resolution (previously only with rectilinear at 0.5°)
- Improves the representation of the **river flow**
- Improves the representation of **subgrid processes**
- Facilitates the **comparison with observations**



River description (MERIT, HydroSHEDS..)



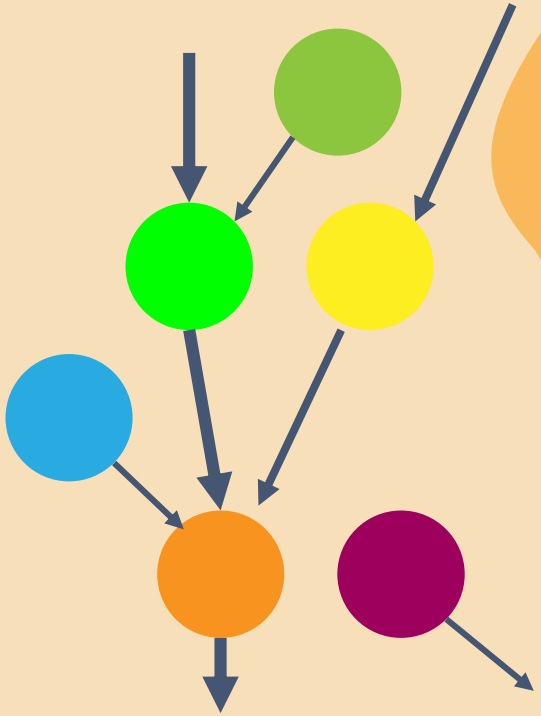
Atmospheric grid



Confluences

High resolution river routing

Hydrological Transfer Unit (HTU)



Floodplains description

Floodplains are described in the HTUs with:

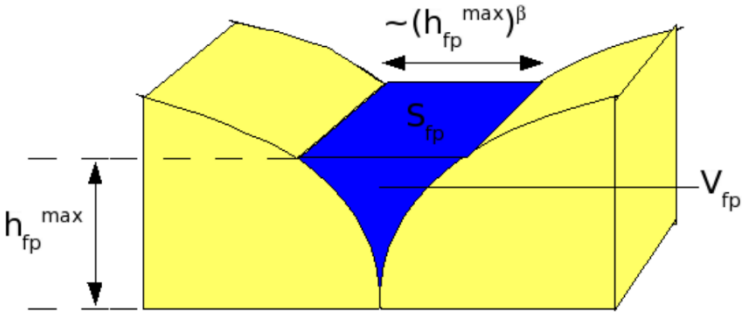
- the **Maximal fraction of floodplains** defined from Global Lake and Wetland Dataset (GLWD - Lehner and Döll, 2004).

- the **Difference of altitude** two consecutive HTUs (from the altitude at the outflow).

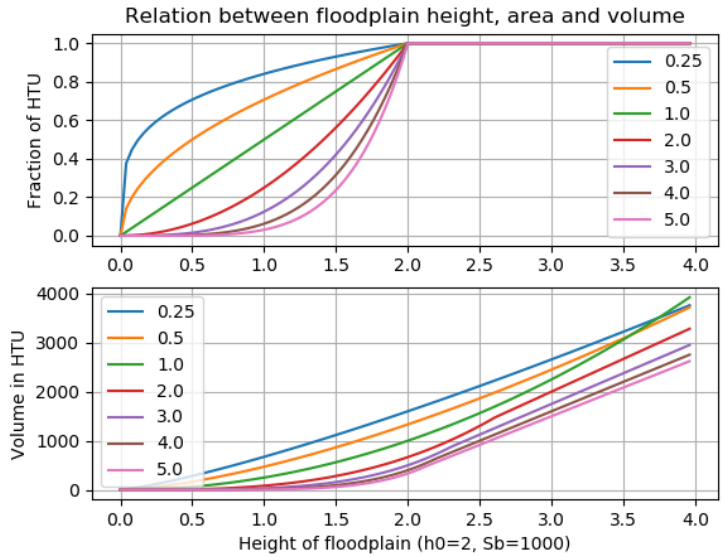
- the **Shape of the floodplains** is described with :
  - β_0 : shape of the floodplains assumed from the distribution of altitude of the HTUs' hydrological pixels,
  - h_0 : height at which the HTU is flooded.

The river routing in ORCHIDEE uses three reservoirs: one for the river flow crossing the HTU (**the stream**), one for the runoff and one for the drainage.

The floodplains are represented as an **extra-reservoir** in serie with the stream reservoir.



From d'Orgeval et al., 2008



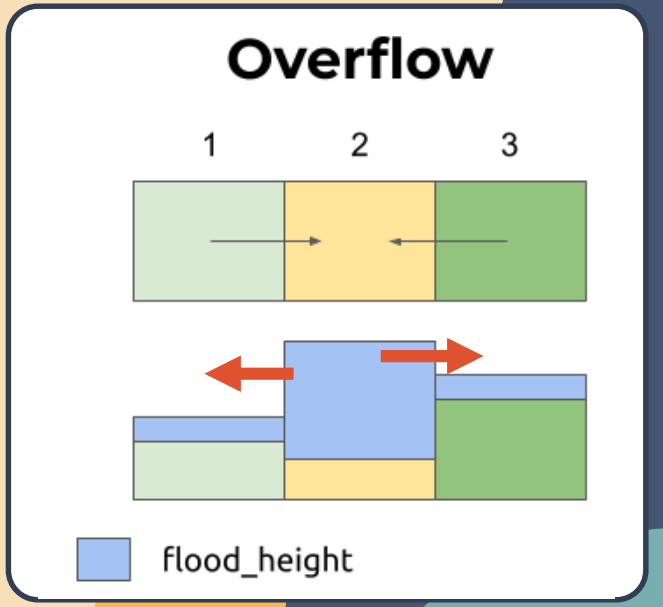
Floodplains at high resolution

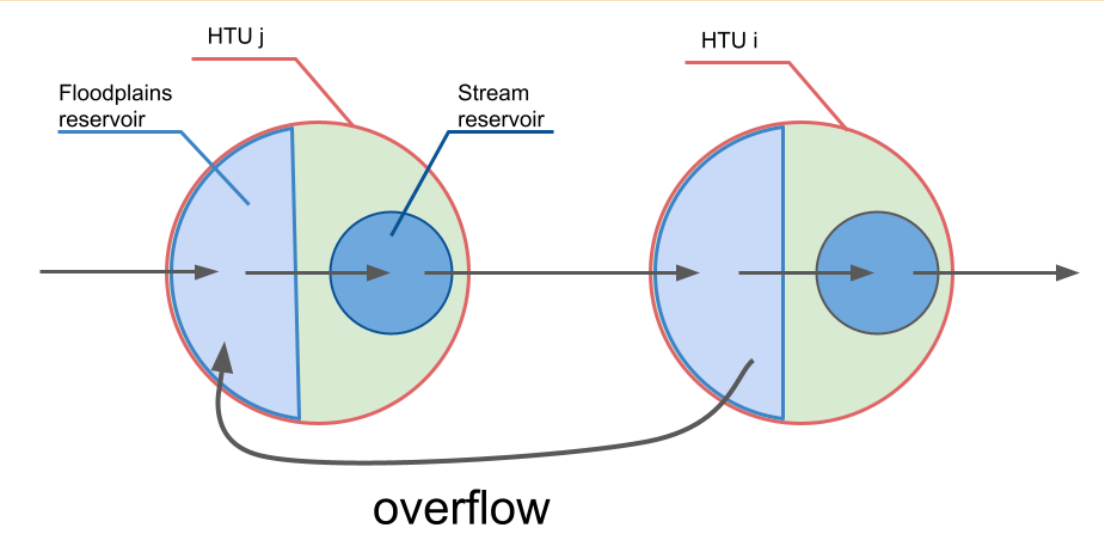
The water in the floodplains reservoir the water can have extra movements:

- **Overflow** : the water moves upstream when the height of the floodplains is higher than the difference of altitude with the upstream HTUs

- **Infiltration** : of the water which then goes to the soil humidity of the grid point (shared by all the HTUs in the grid point)

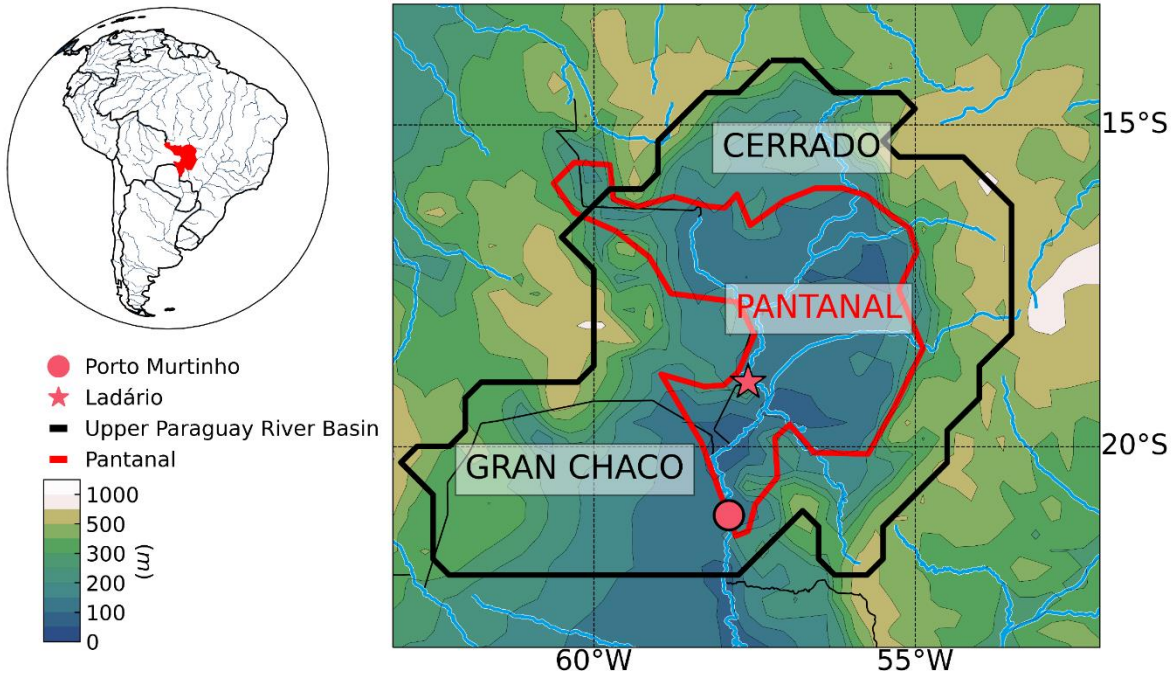
- **Evaporation** : at almost potential rate over the flooded surfaces

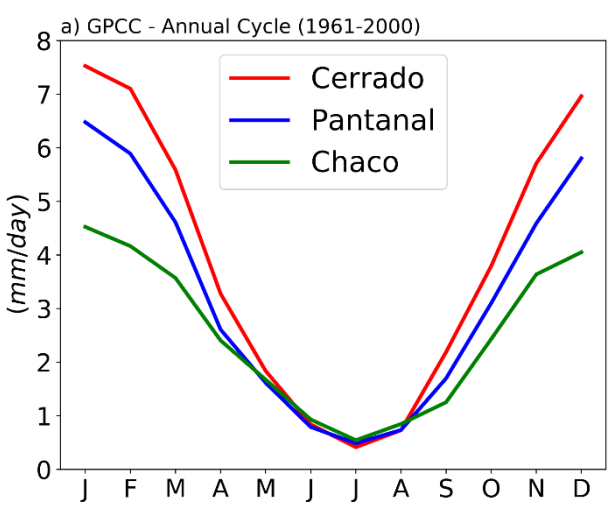


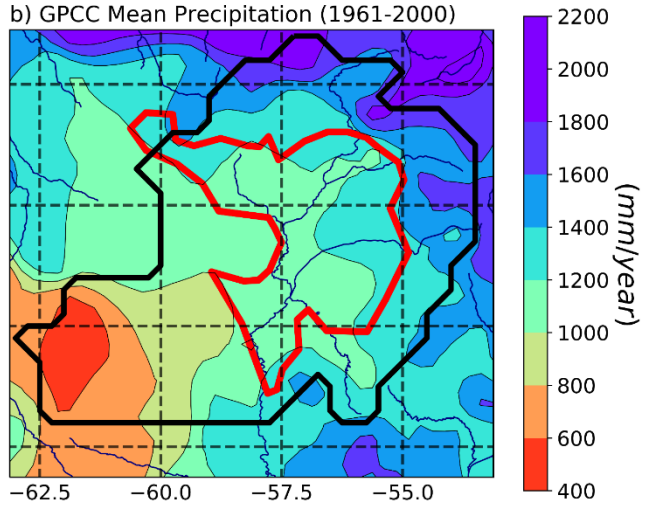


The Pantanal

Focus on the world's most extensive floodplains

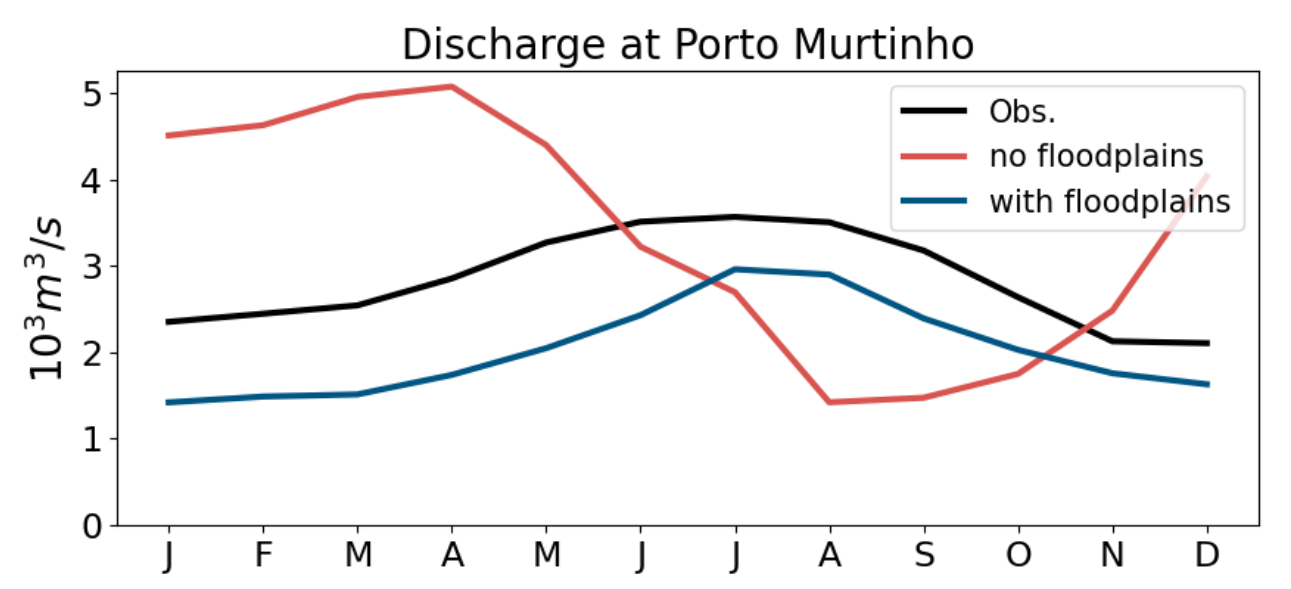


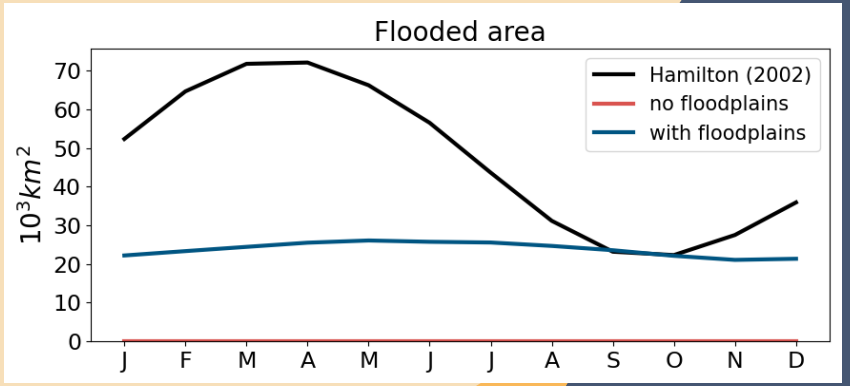


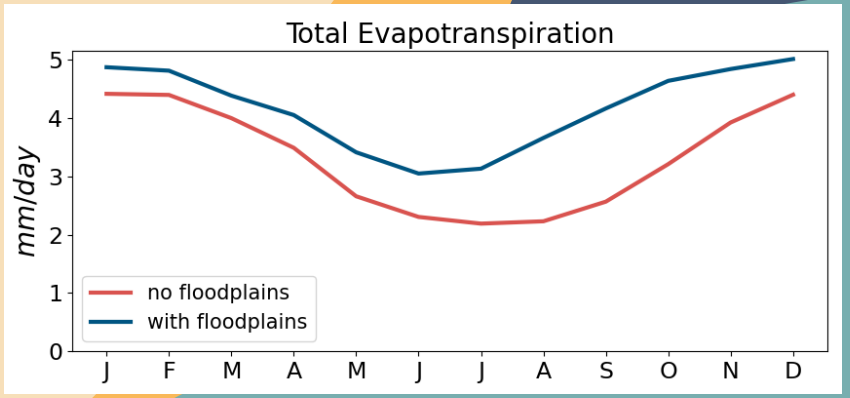


Results

Offline simulation over the Pantanal, the world's largest floodplains, forced by WFDEI CRU (Weedon et al., 2014)





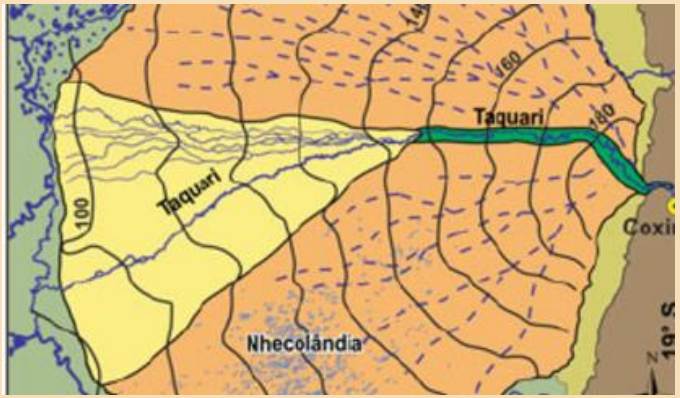


- Improvement of the river discharge at the outflow when activating the floodplains scheme
- The annual cycle of the flooded area seems correct but its variability is underestimated.
- The evapotranspiration increases due to direct evaporation and to transpiration.

Conclusion and perspectives

The reprentation of the floodplains at high resolution in a Land Surface Model :

- Improved the representation of the water cycle
- Increases the evapotranspiration and changed the vegetation.
- Underestimates the flooded area, partly due to the Taquari Megafan (*because it's a divergent flow*)



Taquari Megafan
(Assine et al. 2016)

The following step is to evaluate the impact of the floodplains in a land-atmosphere coupled simulation over South America.

Thank you for your attention

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