ORCHIDEE :

Toward an high resolution floodplains scheme

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I. Introduction

Issues

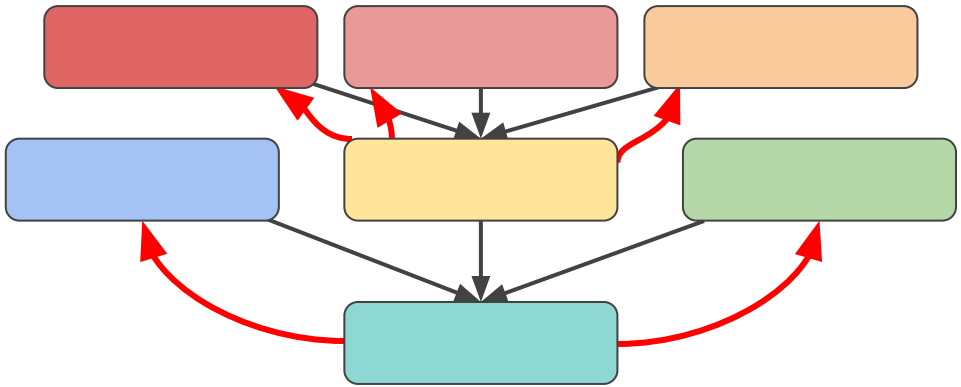
1. Floodplains are important for land-atmosphere interactions
2. Floodplains may have an impact on local and regional rainfall and should be integrated to improve high resolution simulations
3. Actual floodplains scheme is not adapted to the high resolution routing

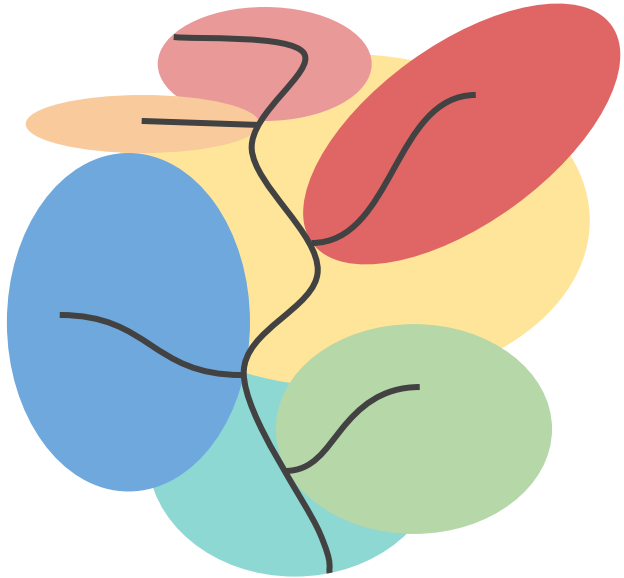
Focus on Pantanal region, the World Largest Floodplains, located in Central South America in the Upper Paraguay River Basin

I. Introduction

Diverging routing and HTUs

HTU hierarchy





- River are connected by a converging routing
- Horizontal scale of HTUs can be smaller than the horizontal propagation of floodplains
- Floodplains need a routing to transfer water between neighbours HTUs

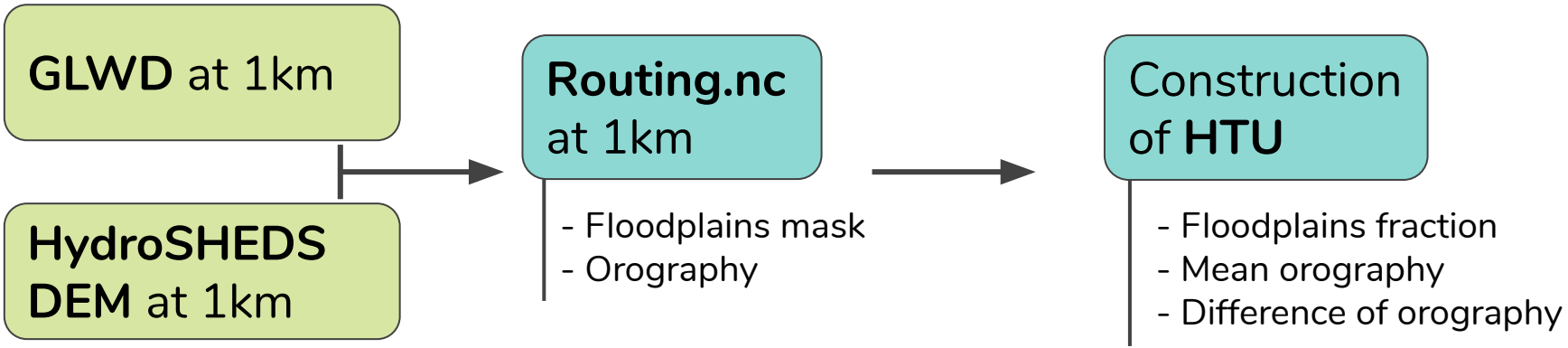
Converging routing

Possible Connection via floodplains

I. Introduction

Integrating the floodplains information

An high resolution flooodplains scheme needs additional information such as the orography and the surface that can be flooded for each HTUs.

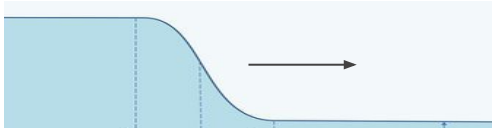


I. Introduction

Development steps

1. Understand the process at the higher resolution scale (with HydroSHEDS)
2. Find the physical equations to describe it
3. Adapt the method to the HTUs system

II. First Experiment
Sequential diffusion



Propagation of a flood wave over the Paraguay river :

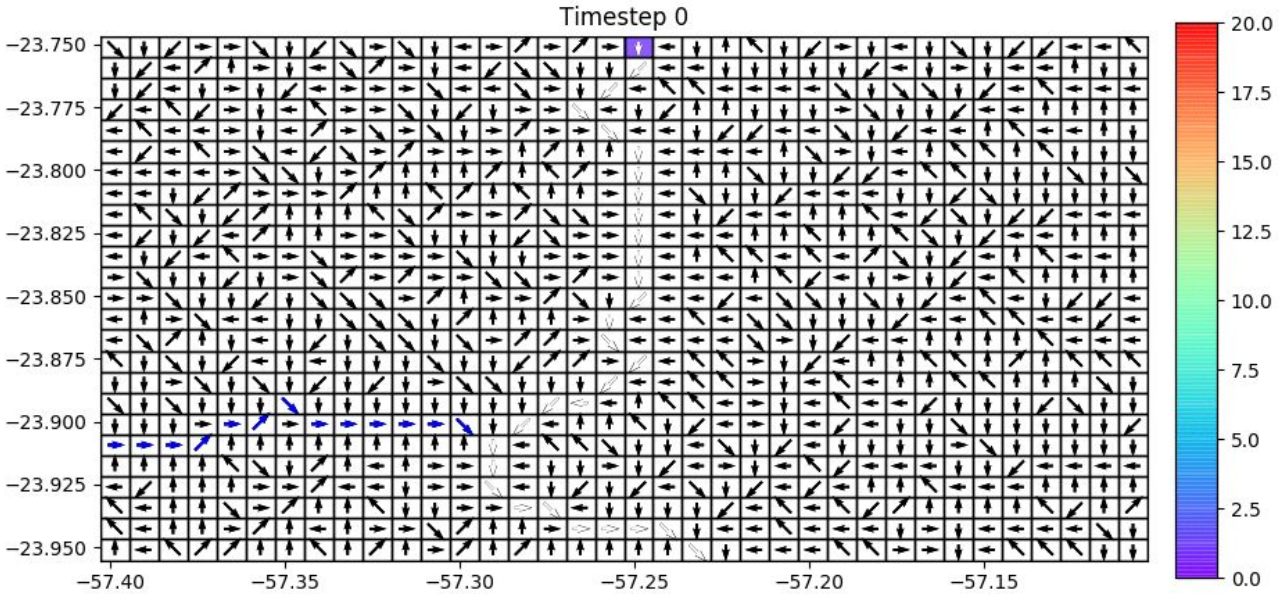
1. Propagation of the flood wave over the main Paraguay river : one grid cell per time step (total of 30 grid points)
2. Each flooded gridpoint of the main Paraguay river floods progressively the grid points in its upstream area, one grid points per time step and flooding the gridpoint with lower orography

Grid points of the main Paraguay flood their upstream grid points :

- One grid cell can be flooded at each time step.
- The grid cell that will be flooded can only be among the upstream neighbours (following ‘trip’) of the already flooded one and must be considered as floodplains by GFPLAINS250m.
- Among these potentially flooded grid points, the grid point flooded is the one with the lowest orography (i.e. grid points are consecutively flooded by sorting orography increments).

II. First Experiment

Results



Number of time it has been flooded (*number of main Paraguay river grid points flooding it*)

https://drive.google.com/open?id=1GvpF80UhYvRhJttSqmRvYszZRheKDkEJ

III. Toy model

Integrating more physic to the diffusion

Forcing :
Qin

Main river

- stream flow
- floodplains reservoirs

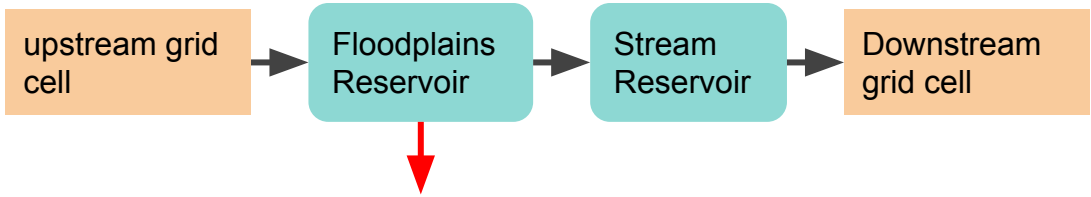
2 reservoirs of 1 dimension:
- ❏ Stream reservoir (stream)
- ❏ Main Floodplains reservoir (flo)

All the basin

- Synchronization with floodplains reservoir of the streamflow points
- Diffusion of the floodplains water

1 reservoirs of 2 dimension:
- ❏ Floodplains reservoir (Vfp)

Vfp and flo are synchronised



III. Toy Model

Main river

(like ORCHIDEE)

Main floodplains reservoir → Stream reservoir

$$Q_{fp->str} = \frac{1}{g*k} V_{floodplains} * dt/day$$

Stream reservoir → Downstream grid cell

$$Q_{str->fp} = \frac{1}{g*k} V_{streamflow} * dt/day$$

Diffusion of main floodplains reservoir → upstream cells

To upstream grid cell **i** , if $V_{floodplains}$ > threeshold :

$$Q_i = \frac{1}{m*n_i} V_{floodplains} * dt/day$$

Time coefficient (day/m) g

Topo index (m) $k = \sqrt{\frac{d^3}{\Delta z}}$

Constant (day) m

Flood diffusion (-) $n_i = \sqrt{\frac{\Delta z_i}{d_i}}$

$$V_{fp}^{t+1} = V_{fp}^{t} - \sum_i^{neighbours} Q_i + Q_{str->fp} - Q_{fp->str} - Fp2SM$$

Open questions

- Is there another way to propagate the wave over the floodplains?

- How to define the floodplains transfer between HTUs ?