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The role of the alluvial floodplain to modeling water discharge using SWAT model in the Amazon catchment

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www.cnrs.fr

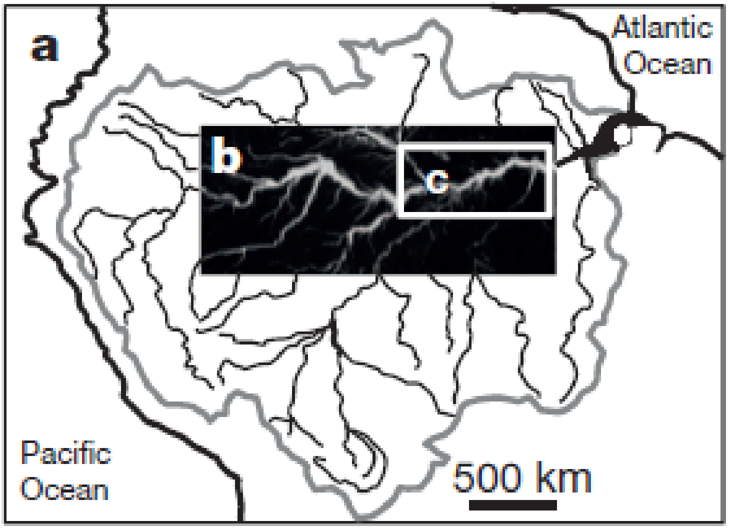
Amazon river is the biggest river in the world, around 6 100 000 km^2

The alluvial floodplain is the most important in the world (300 000 km^2, 5% of the total surface (Richey et al., 1989).)

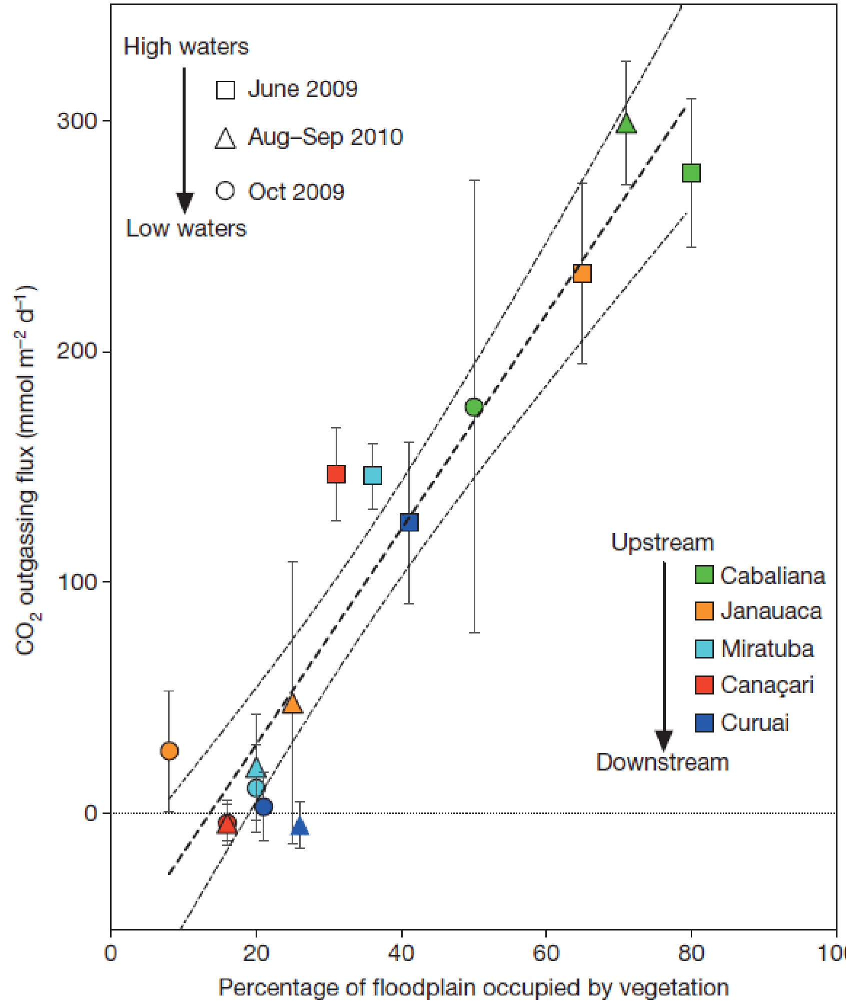
Alluvial floodplain provide **Environmental Services** : Biological processes (Respiration, biomass production, denitrification…)

- ***Carbon balance***

  210 Teragrams of carbon emitted per year as CO_2 from the central Amazon River and its floodplains (Richey et al., 2002, Nature).

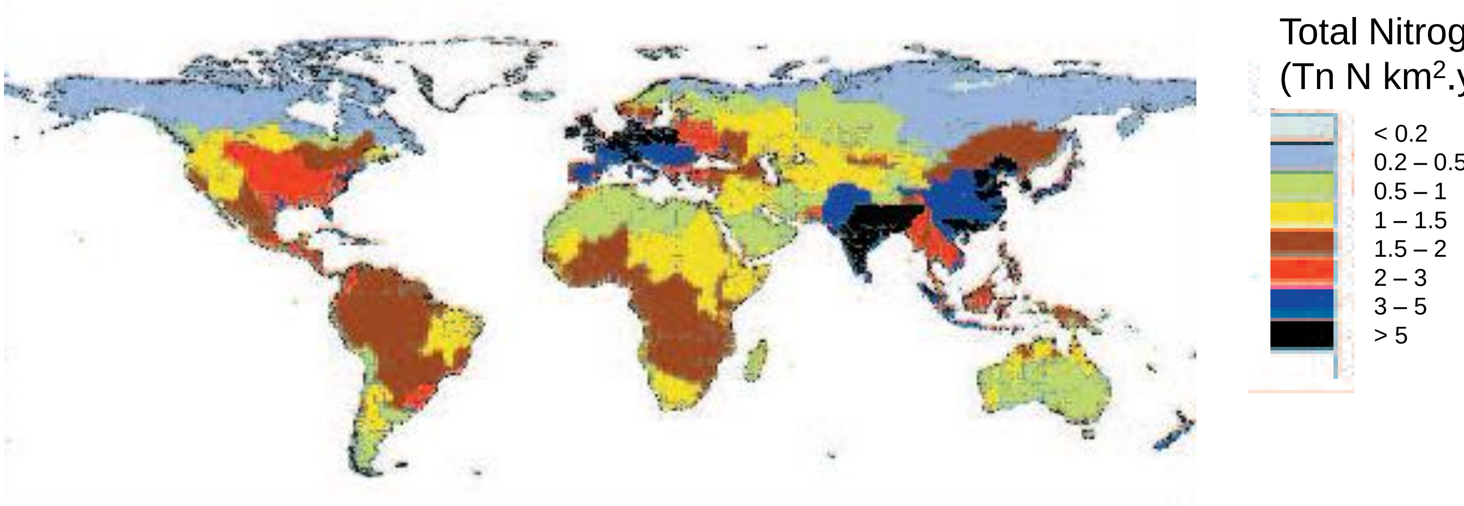


All land	Quadrant-b
Total area (km²)	1 770 000
Maximum flooded (km²)	243 000
Fraction of flooded land	14%



Vegetation-mediated control CO_2 outgrassing in amazon floodplain. (Abril et al., 2104, Nature).

A global overview of nitrogen pollution



Distribution of specific Nitrogen loading onto the continental landmass (Tons N km^2/year) at Basin-scale Vörösmarty et al. 2000).

<u>**Amazon Nitrogen fluxes**</u> (Martinelli et al., 2012).

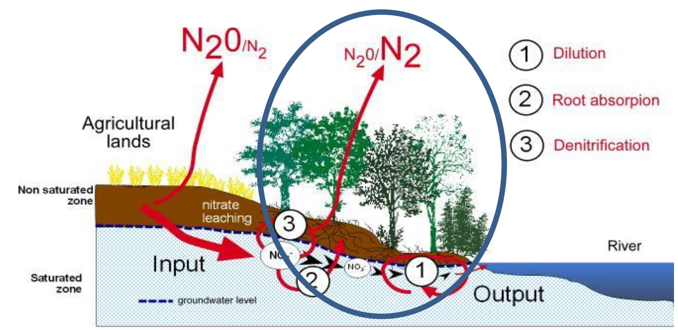
The main <u>inputs</u> of nitrogen to the region are biological nitrogen fixation occurring in tropical forests (7.7 Tg.yr^{-1}) and agricultural lands (1.7 Tg.yr^{-1}). N fertilizers (0.5 Tg.yr^{-1})

The main output flux is the riverine flux, equal to 2.80 Tg.yr^{-1} (10% of the global flux).

7.1 Tg.yr^{-1} plant uptake and denitrification

<u>N gaz emission</u>

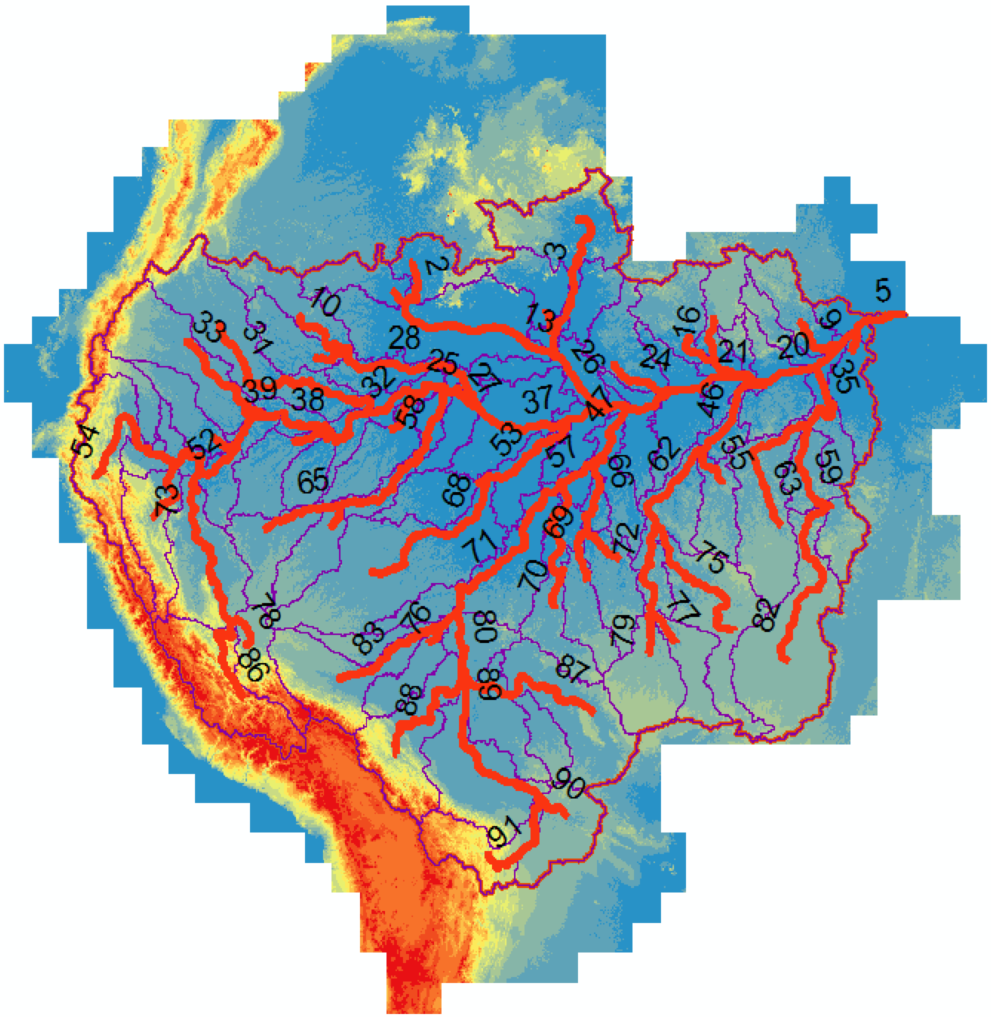
Denitrification (~130 Tg)



River flow to the sea (~36 Tg)

- **WEATHER:**

Global Weather Data from SWAT (http://globalweather.tamu.edu/)



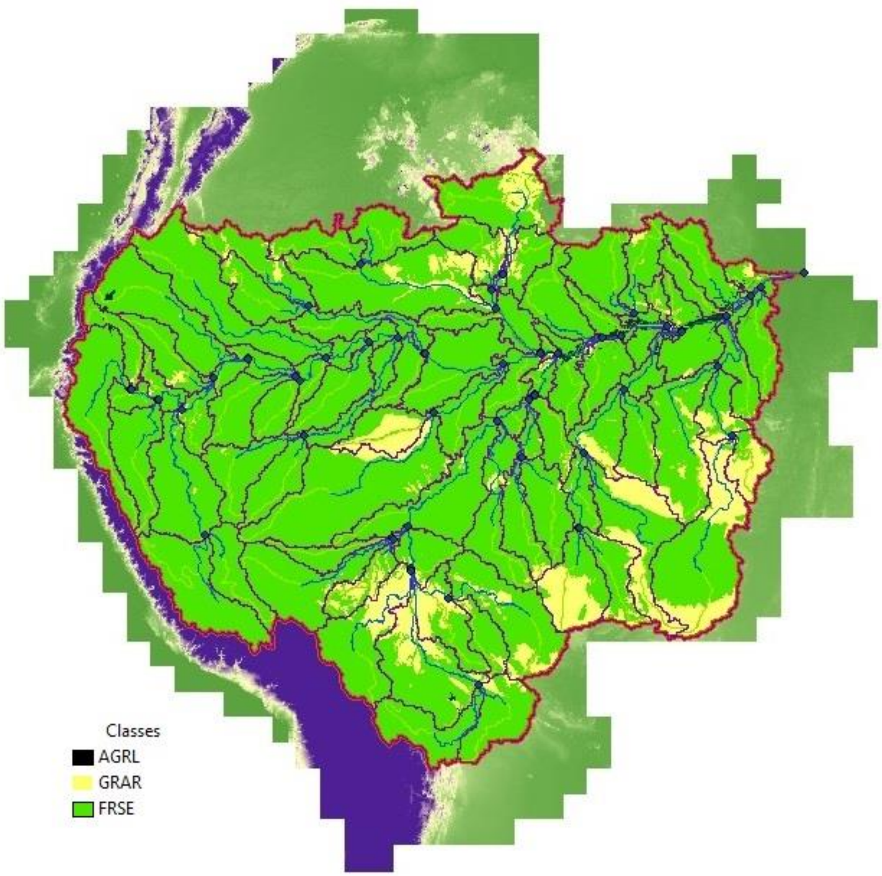
- **SUBBASSINS:**

- 91 subbassins (39 000 km² to 214 000 km²), 0.5 to 3.6 % total surface.
MNT SRTM (90m)
3 Land cover classes 89.4 %: Forest, 10.5 %, Grassland, 0.1 %, Agriculture.
17 soil classes (FAO).

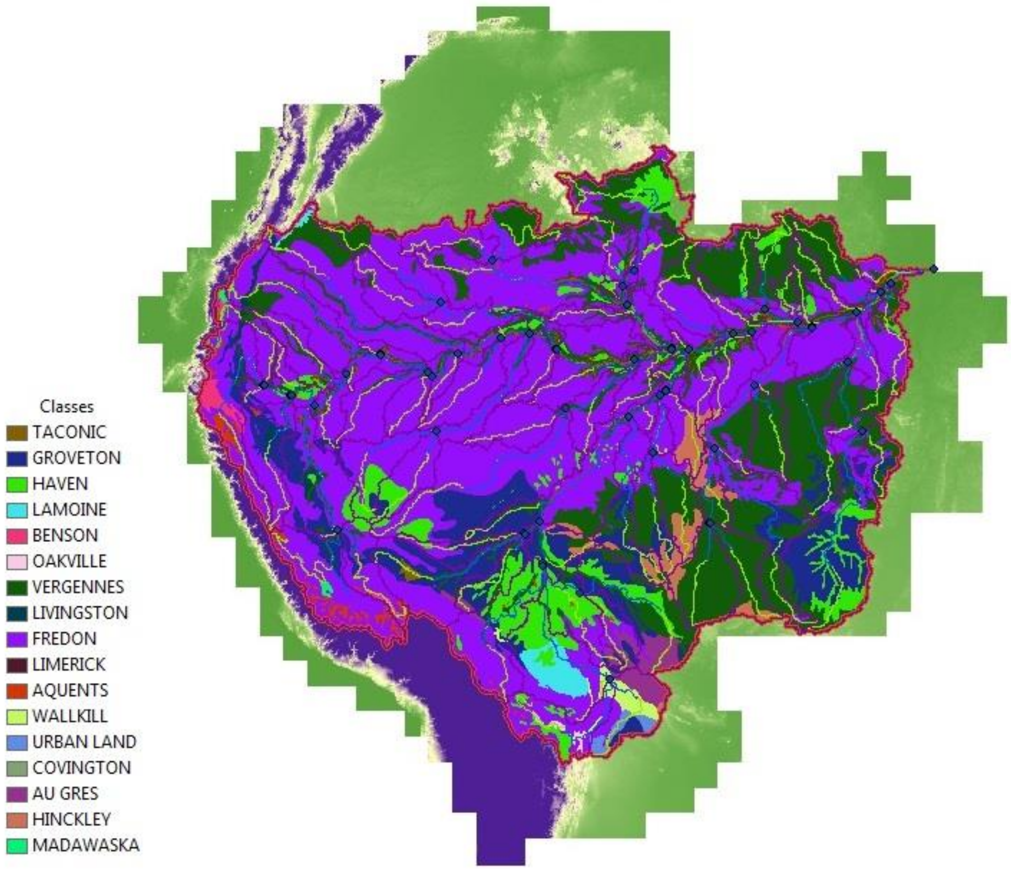
- 709 HRUs

Study area

Land cover (Global cover)



Soil (FA0)



AMAZON RIVER PROJECT : Data

…and a well known and monitored catchment

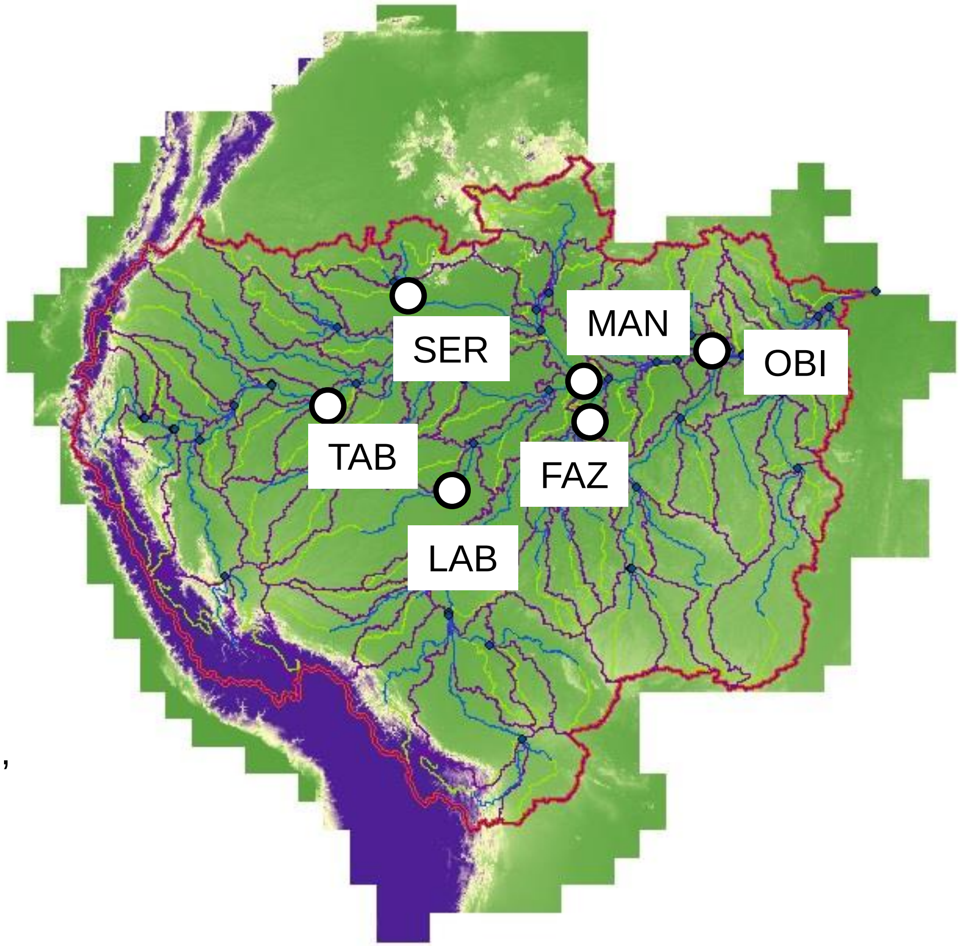
- **HYDROLOGY:**(Daily, Monthly)

247 stations with water discharge data
794 stations with water level data
Period : 1968 to today

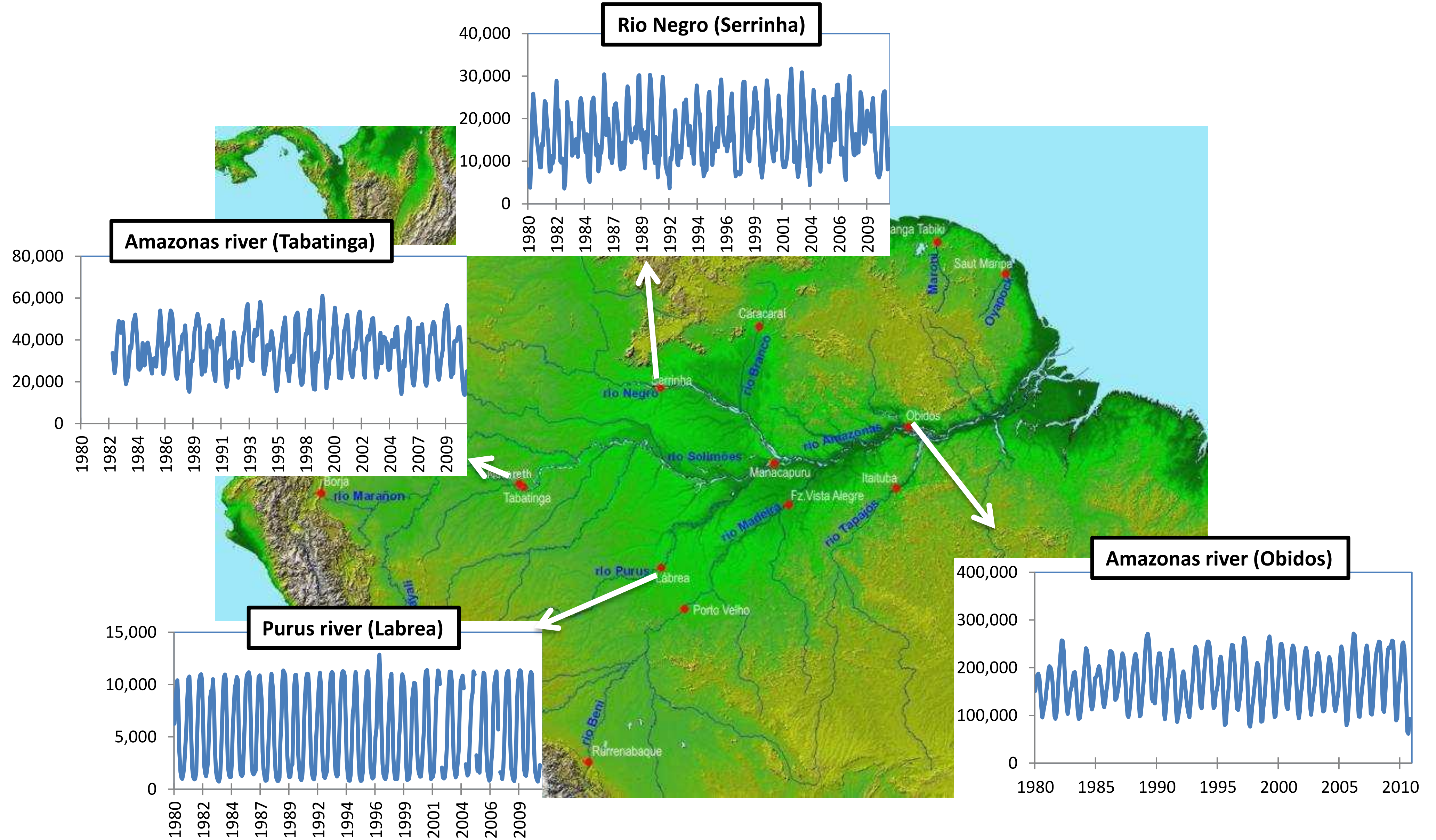
http://www.ore-hybam.org/index.php/eng

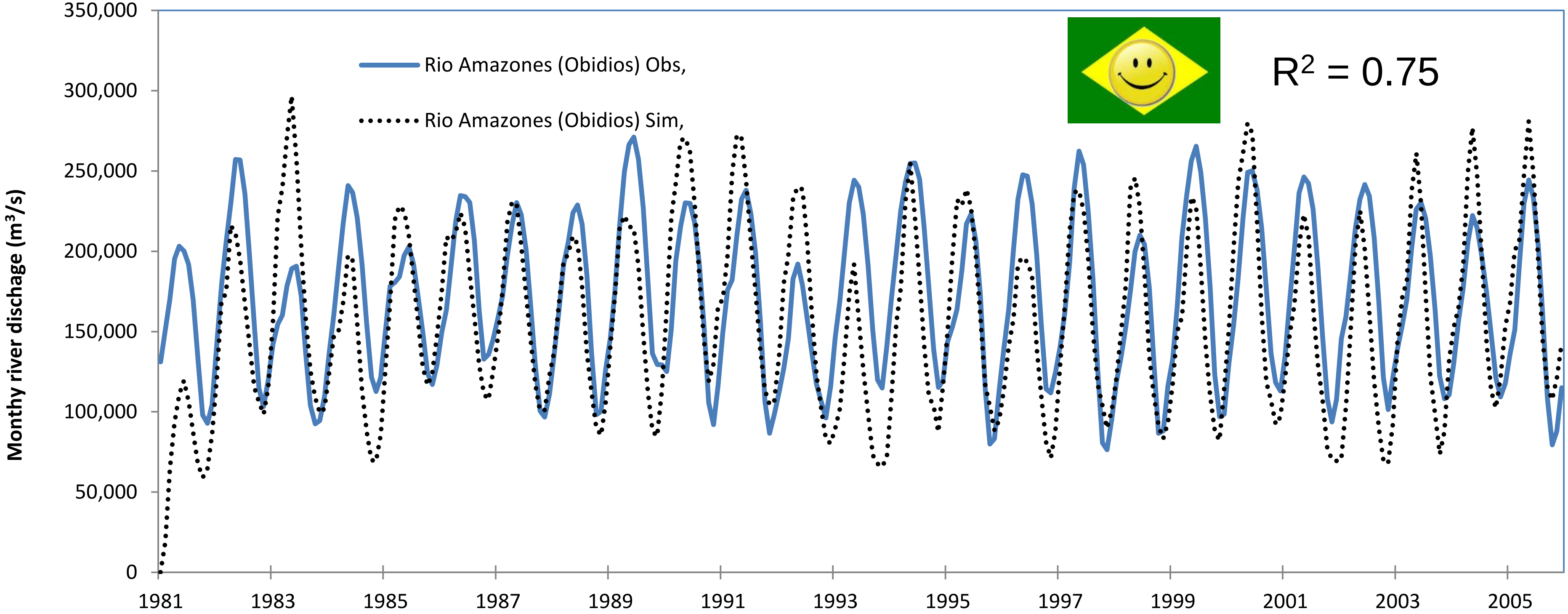
ORE HYBAM Observatoire de Recherche en Environnement
Geodynamical, hydrological and biogeochemical control of erosion/ alteration and material transport in the Amazon basin

- ORE HYBAM network stations (15 stations of the ORE HYBAM stricto sensu);
-a network to monitor suspended material concentration : twenty stations complementary to that of the ORE HYBAM, managed by the joint research programs IRD-SENAMHI-UMSA in Bolivia, IRD-SENAMHI-UNALM Peru, IRD-INAMHI Ecuador, IRD-ANA-UnB-UFF-UEA in Brazil (data reserved for participants of the ongoing projects);



Modelling - Monthly river dischage (m^3/s)





PRECIP = 2355.7 mm

SURFACE RUNOFF = 570.14 mm

LATERAL SOIL = 88.84 mm

GROUNDWATER = 536.83 mm

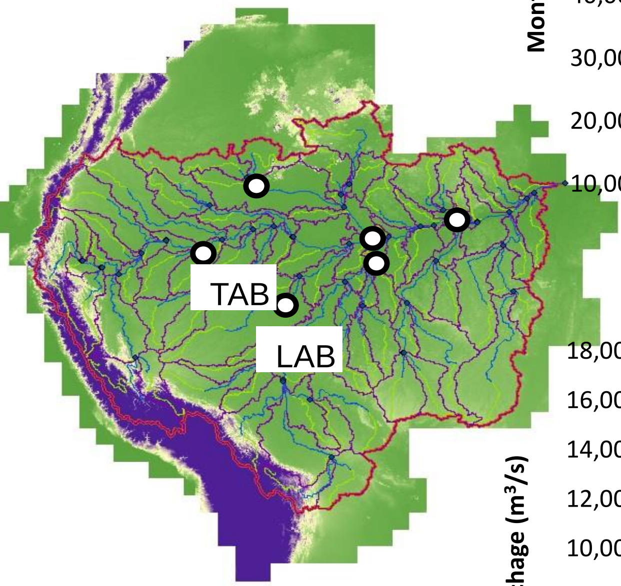
TOTAL WATER YLD = 1192.92 mm (Observed = 1193 mm)

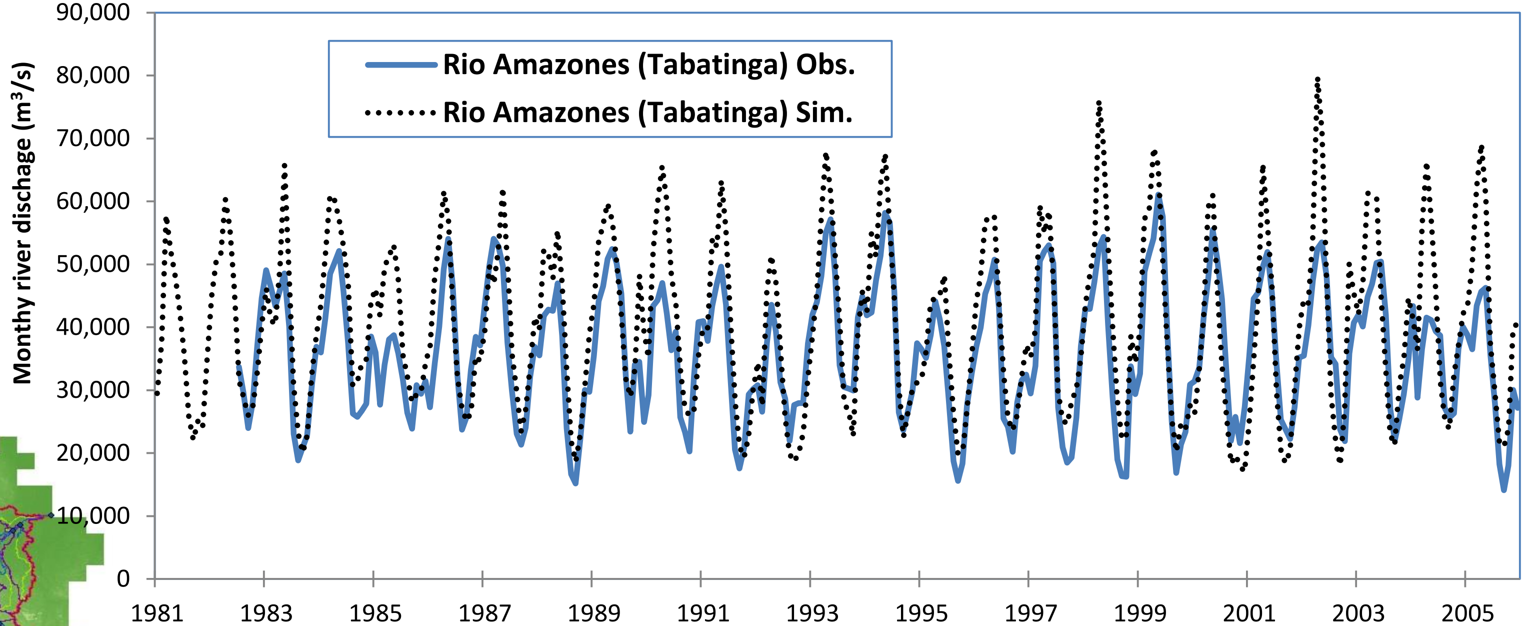
ET = 801.6 mm

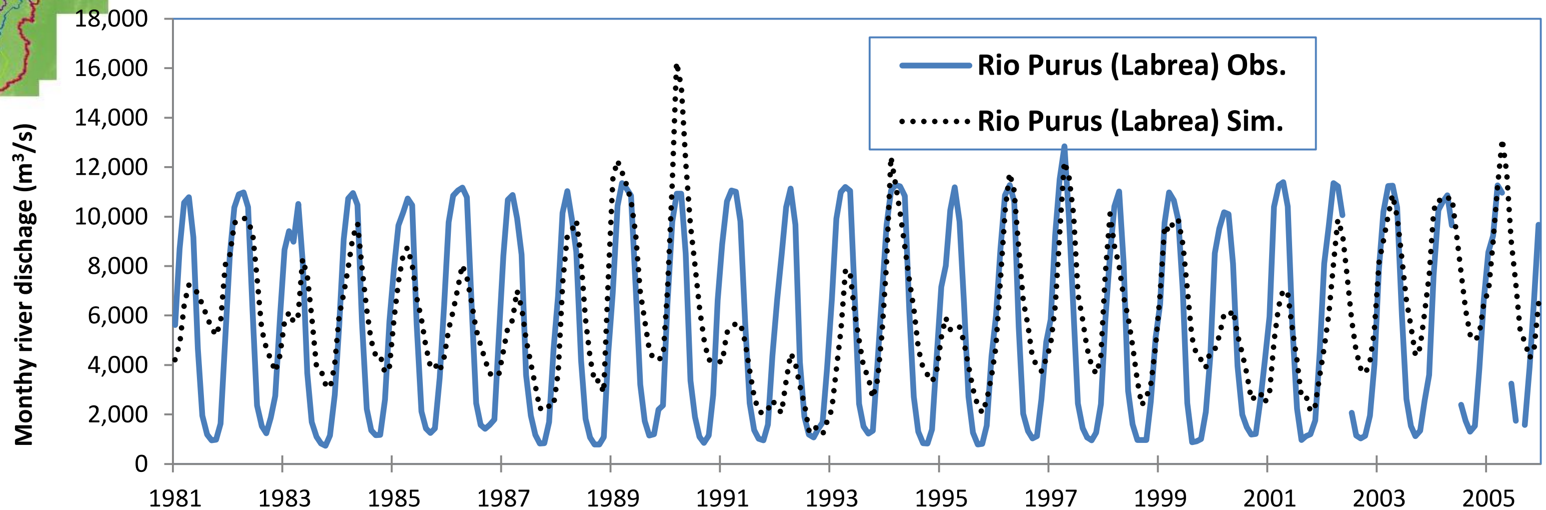
PET = 1273.8 mm

River hydrology - Monthly river dischage (m^3/s)

$R^2 = 0.76$



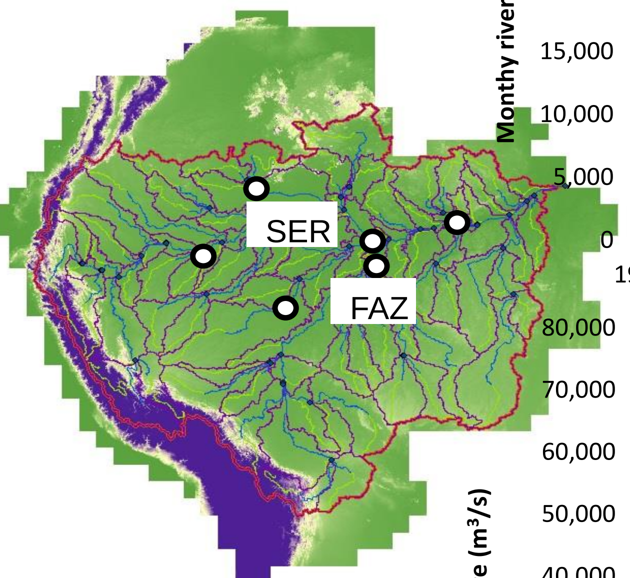


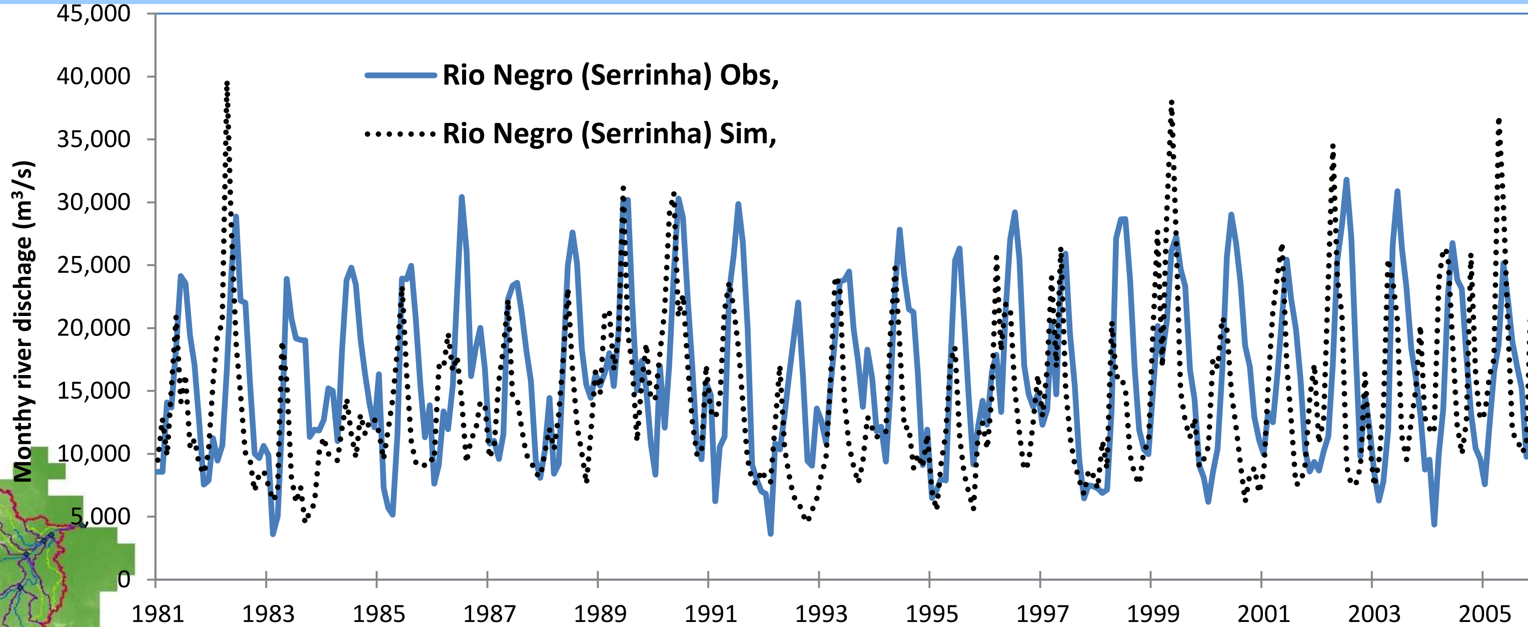


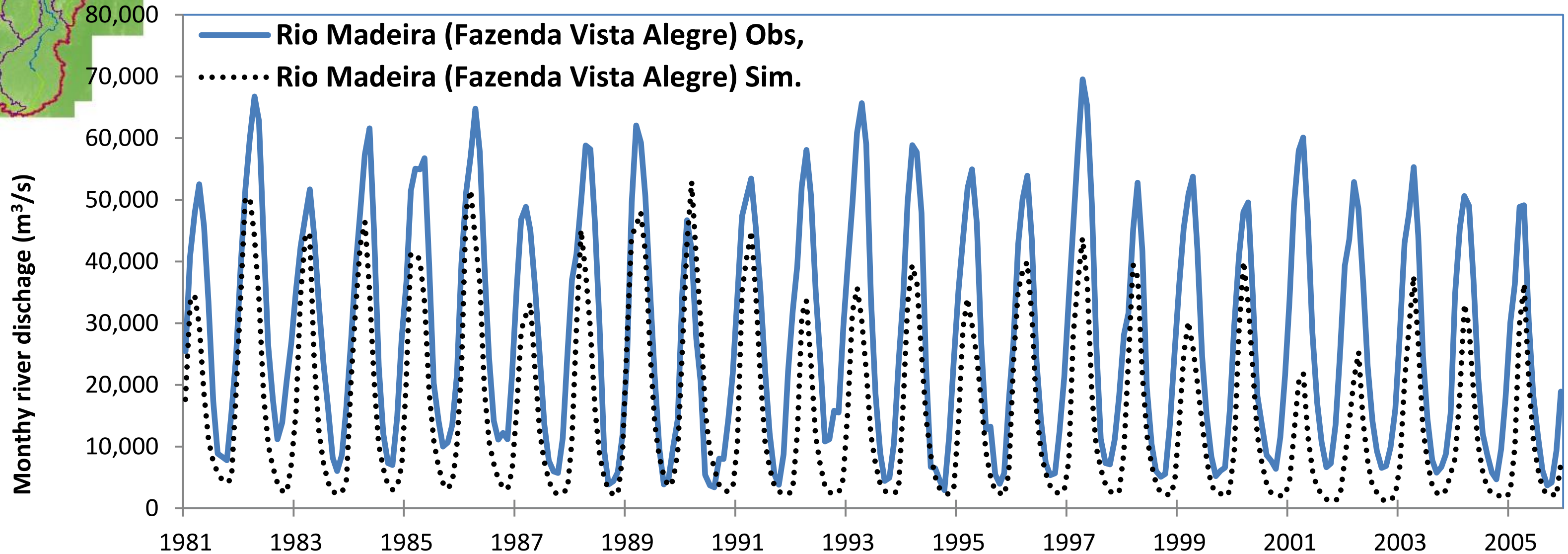
$R^2 = 0.48$

River hydrology - Monthly river dischage (m^3/s)

$R^2 = 0.34$



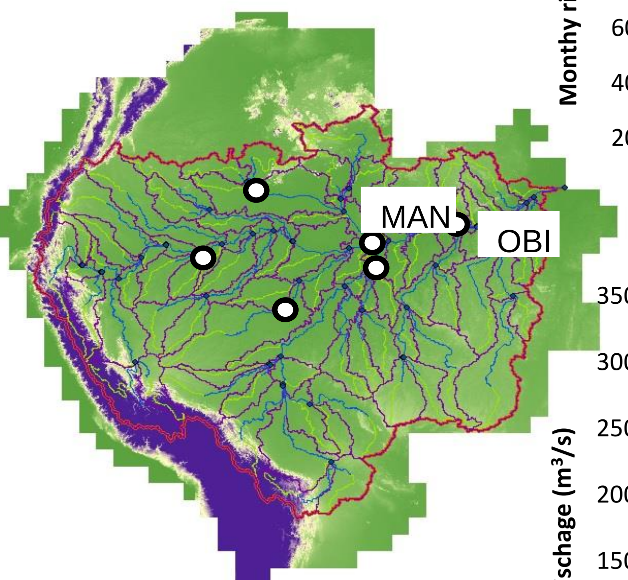


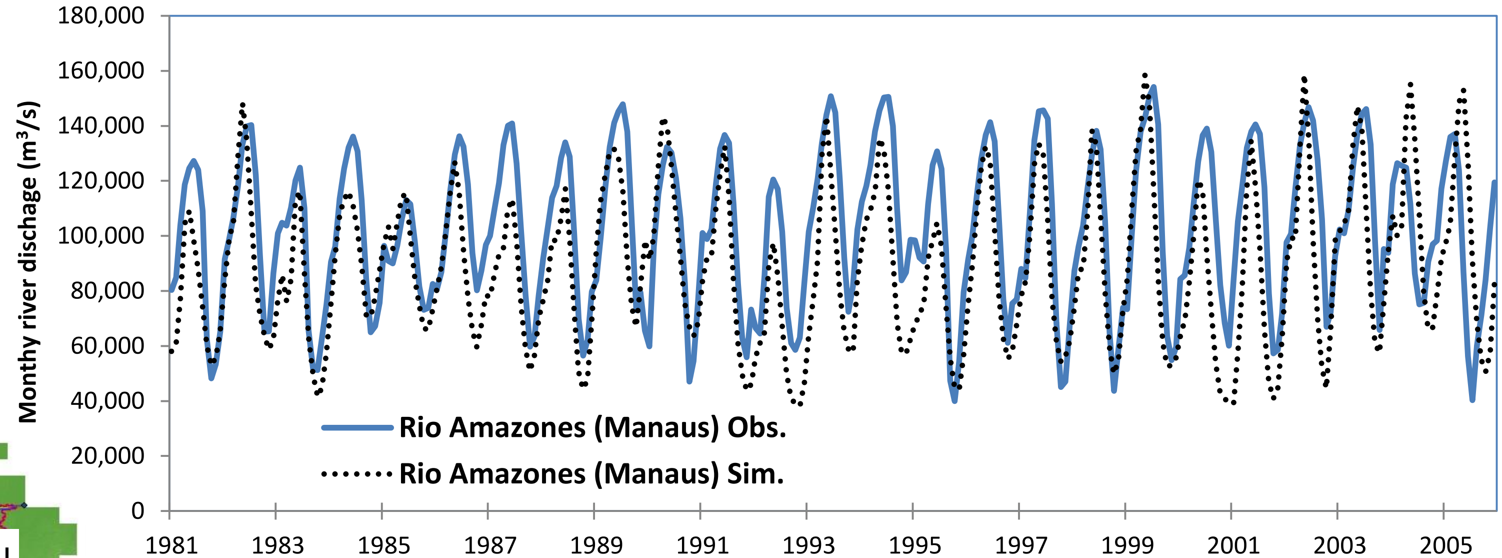


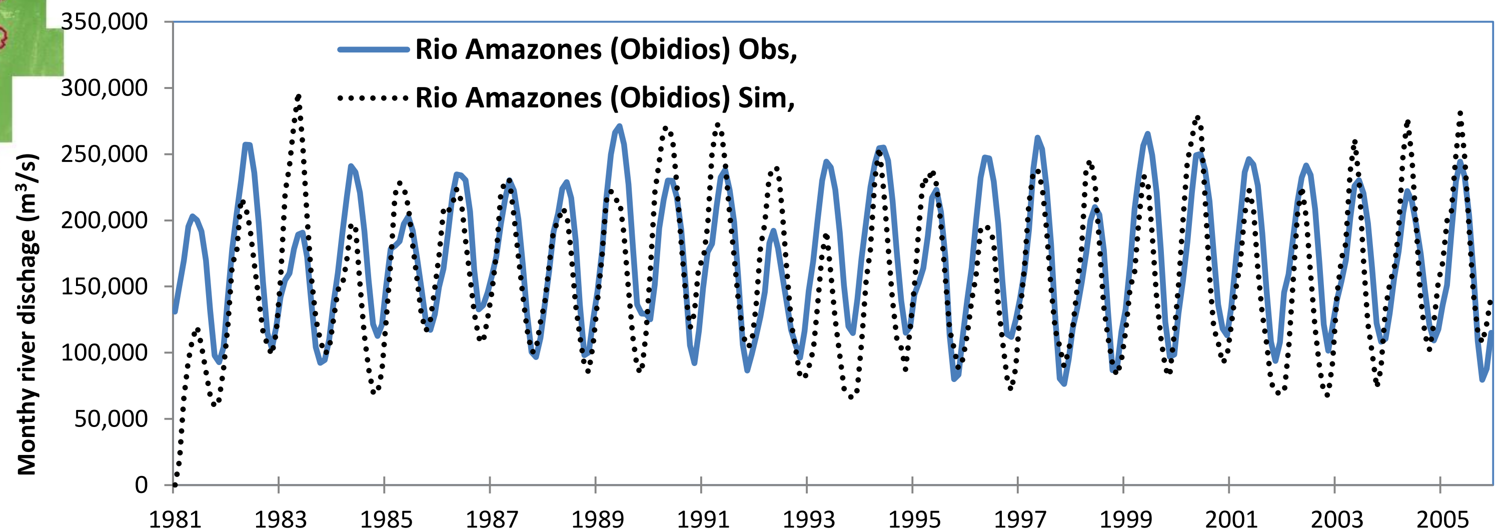
$R^2 = 0.76$

River hydrology - Monthly river dischage (m^3/s)

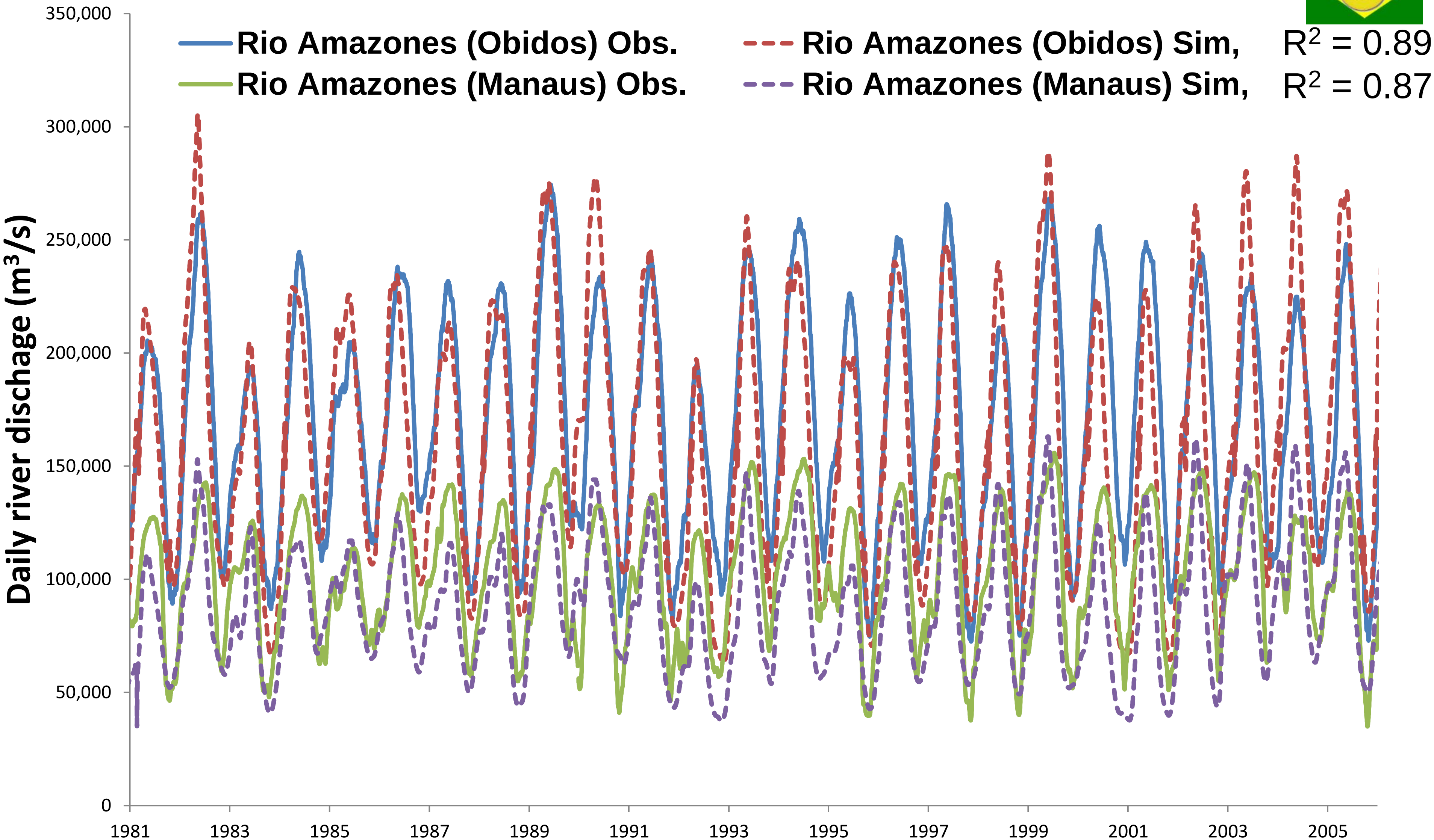
$R^2 = 0.60$



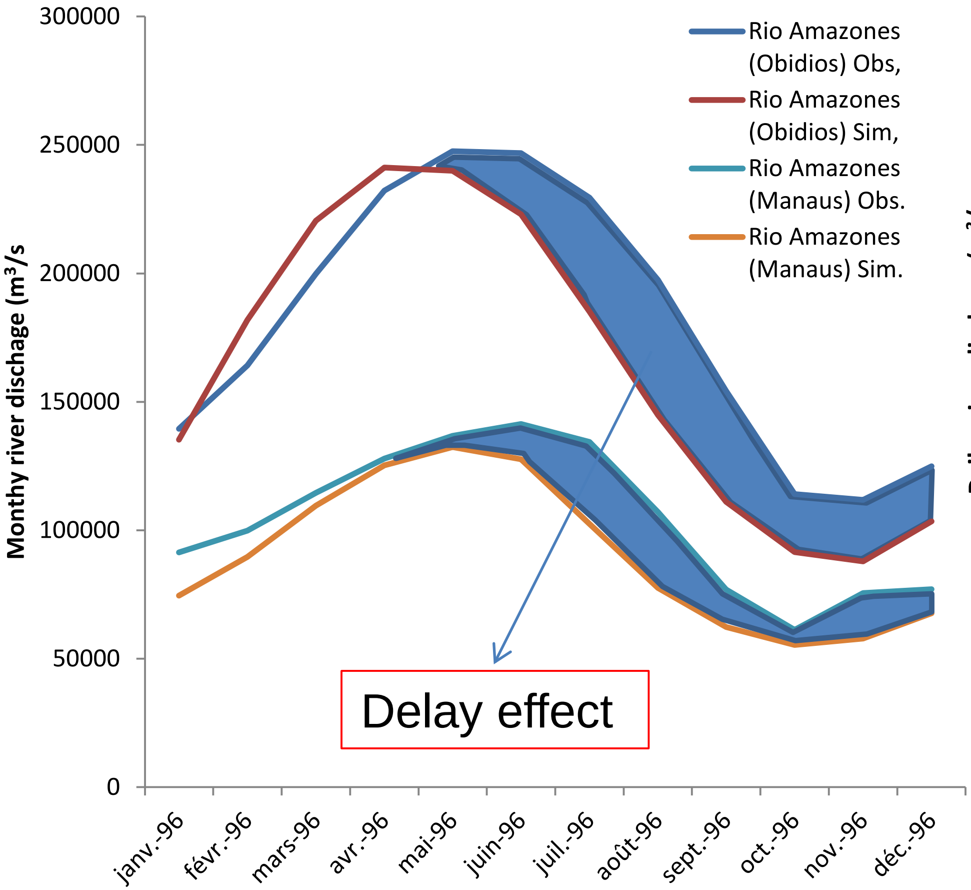




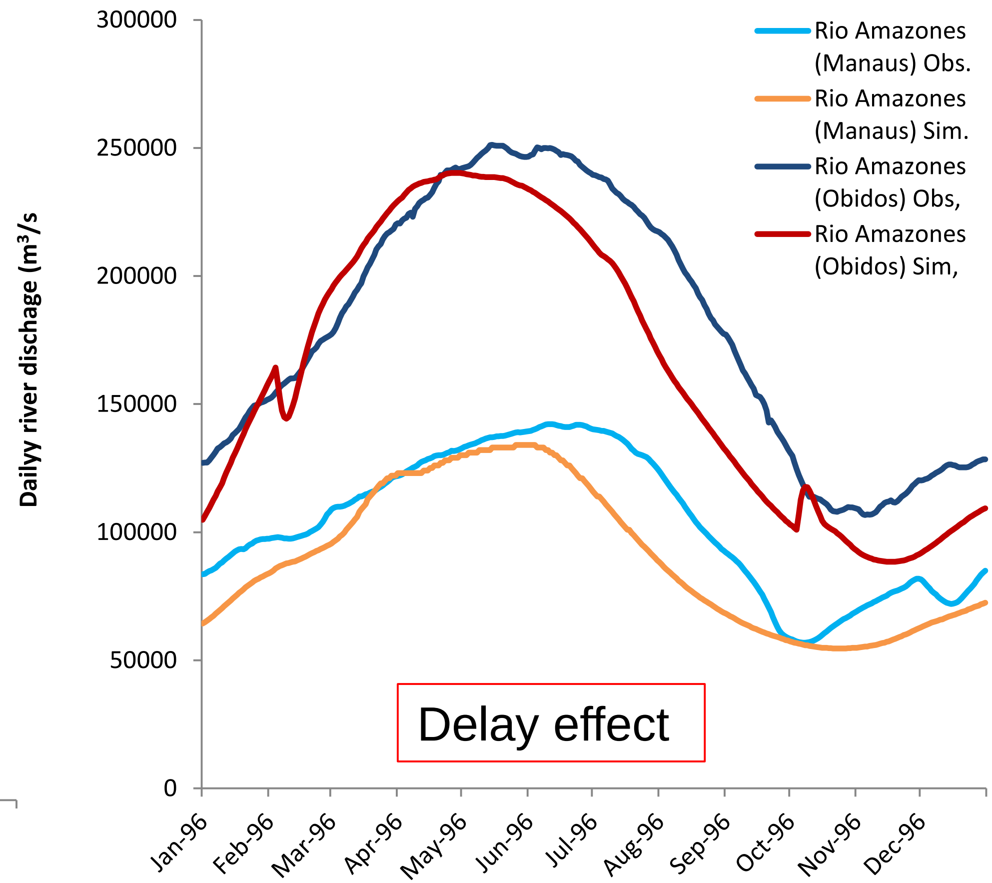
$R^2 = 0.76$


Rio Amazones (Obidos) Obs.
Rio Amazones (Obidos) Sim, $R^2 = 0.89$
Rio Amazones (Manaus) Obs.
Rio Amazones (Manaus) Sim, $R^2 = 0.87$
Daily river dischage (m^3/s)
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

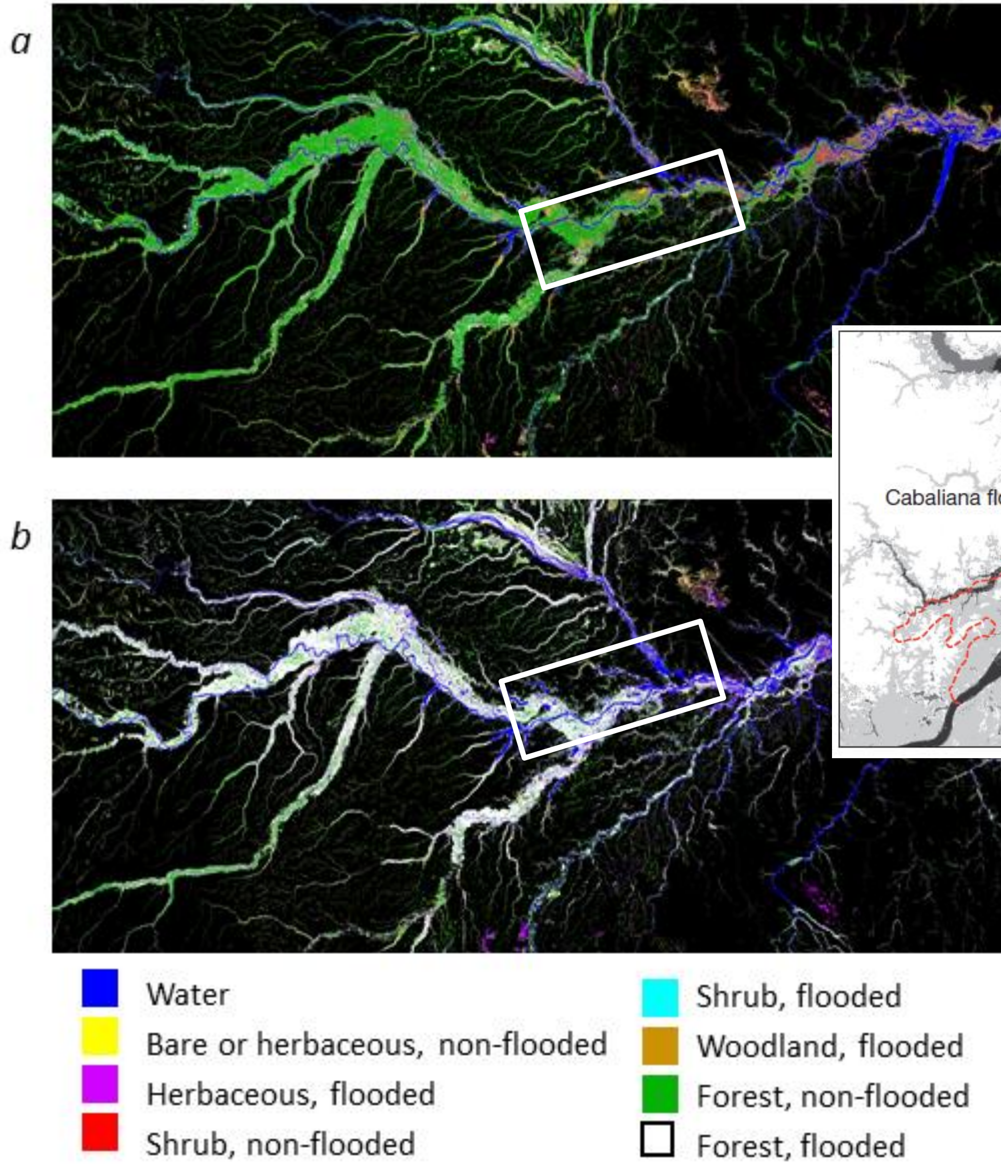
Monthly scale

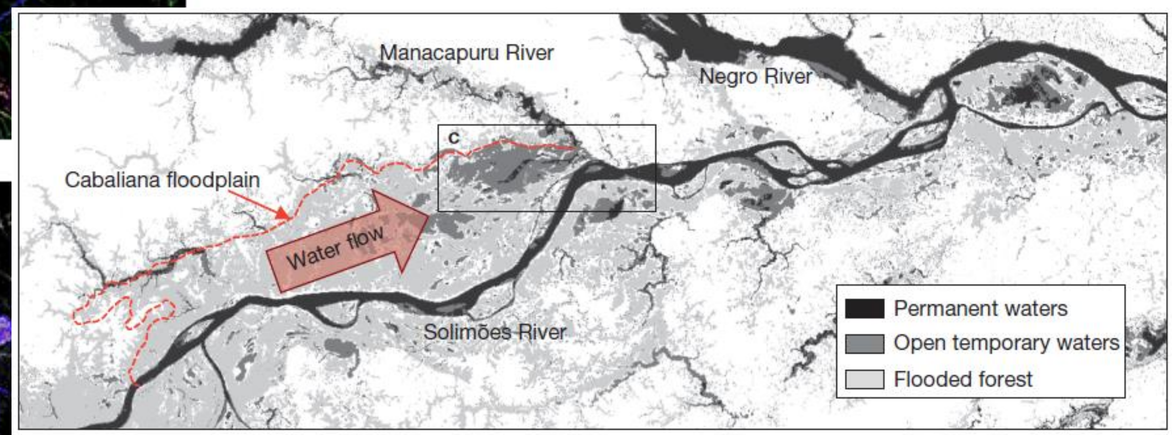


Daily scale



http://daac.ornl.gov/LBA/guides/LC07_SAR_Wetlands_Mask.html



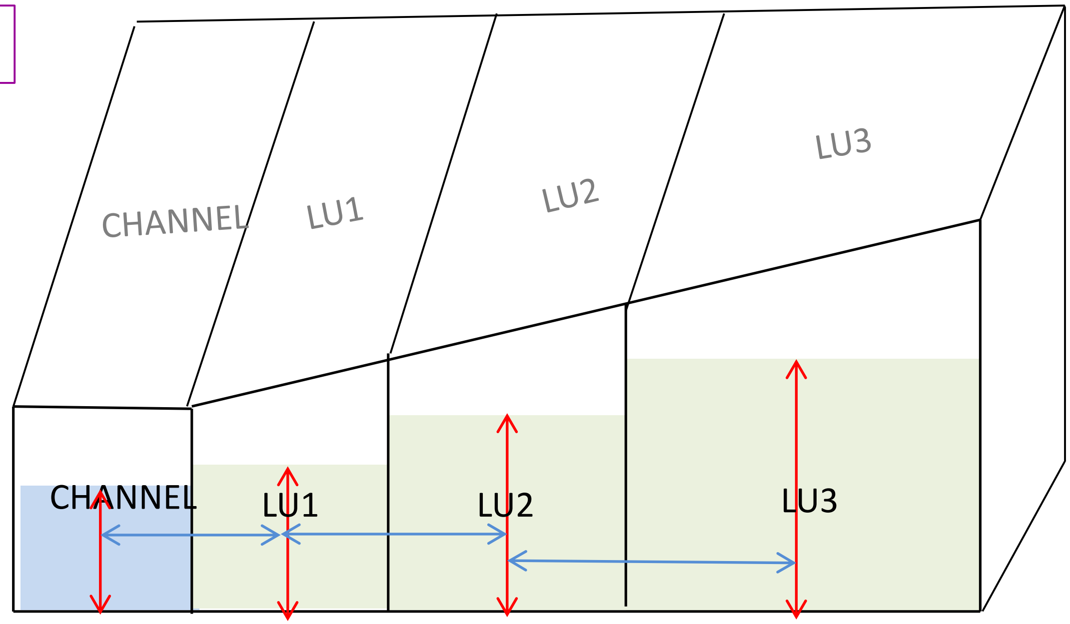


Abril et al., 2013

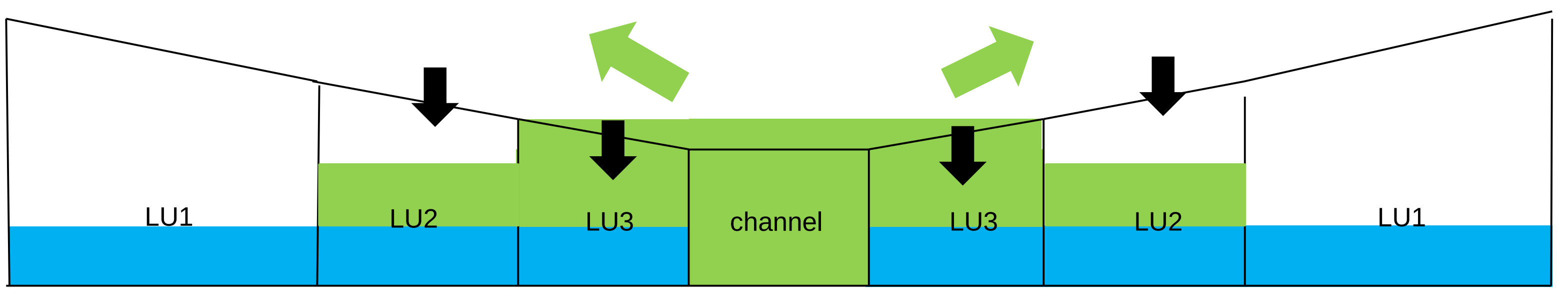
Mapping of wetlands vegetation and inundation cover classes at (a) low-water stage (September –October 1995), and (b) high-water stage (May–June 1996).

Aquifer – river exchanges

$$Q = K \times A \times \frac{\Delta H}{L}$$



Flooded water volume



NEXT STEPS

1. Improve input data : soils, land cover and meteo.

2. Integrate SWAT – LUD to quantify alluvial storage.

3. Compare simulation with remote sensing data.

4. Modelling sediment, Carbon and nitrogen transport.

5. Quantify carbon and nitrogen removal at floodplain scale.

We are open to collaborate with you!!!

Obrigado!!!