La Plata Basin floods and droughts: Contribution of microwave remote sensing in monitoring and prediction

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Contents

- Chracteristics of the region: Del Plata Basin

- Evidences about how useful satellite microwave radiometry (AMSR-E, SMOS, AQUARIUS, MWR) is and could be for the region hydrological issues

- Overview of project objectives and methodology and work in progress

Del Plata Basin

Extreme Hydrological events (EHE)

(Floods and drougth)

❖**Extension**

Aprox 3.200.000 km2

❖**5 Countries**

Argentina (downstream)
Bolivia
Brazil (upstream)
Paraguay
Uruguay

❖**Main rivers**

Paraná, Paraguay
Uruguay, Iguazú
Pilcomayo,
Bermejo

❖**Population**: 100.000.000 inhabitants

❖**Economy**: 80% of the GNP of the 5 countries is produced in the basin

Del Plata Basin: Sub-basins

- The Paraná river has a 900 km alluvial plain.
- The flood plain total surface area is about 33000 km2.

Del Plata Basin: Main rivers – Typical hydrographs

Selected gauging stations:

1-2. Pilcomayo – Bermejo (550 m3 sec-1)

3. Paraguay (Pto Pilcomayo) (3200 m3 sec-1) (headwaters in Pantanal)

4. Iguazu (1800 m3 sec-1)

5. Paraguay (Pto Bermejo)

6. Paraná (Posadas)(headwaters in Brasil)

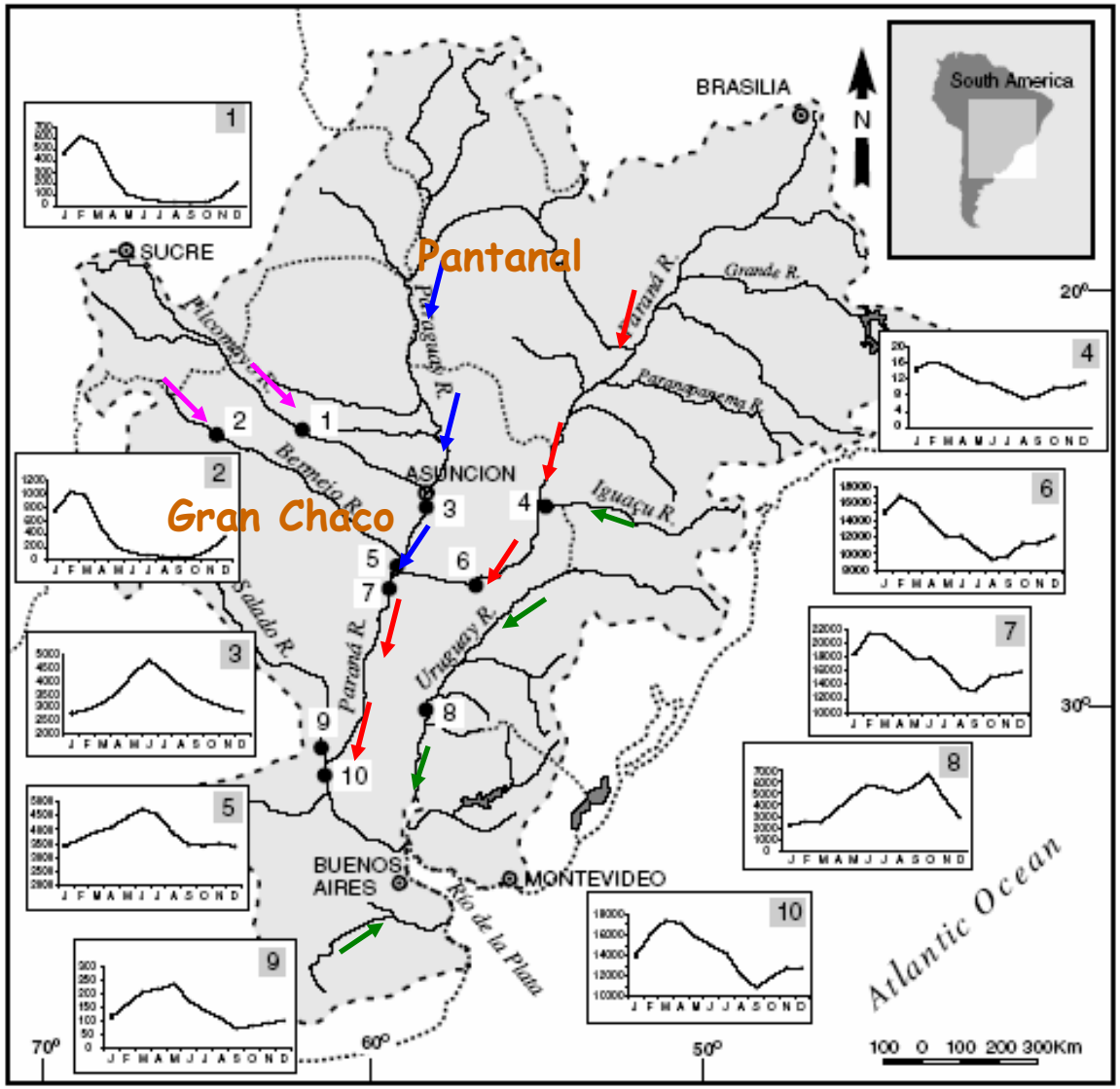
7. Paraná (Corrientes)

8. Uruguay

9. Salado

10. Paraná (Paraná) (17000 m3 sec -1)

Río de la Plata mean total discharge: 21500 m3 sec-1



Pasquini & Depetris, J. of Hydrology, 2007

Del Plata Basin : hydroelectric plants

- 130 reservoir dams (Upper Paraná) that modulate the discharge
- Land use

Del Plata basin: Paraguay_Paraná wetlands corridor – Recent floods and droughts

Flood wave

Bolivia

Paraguay

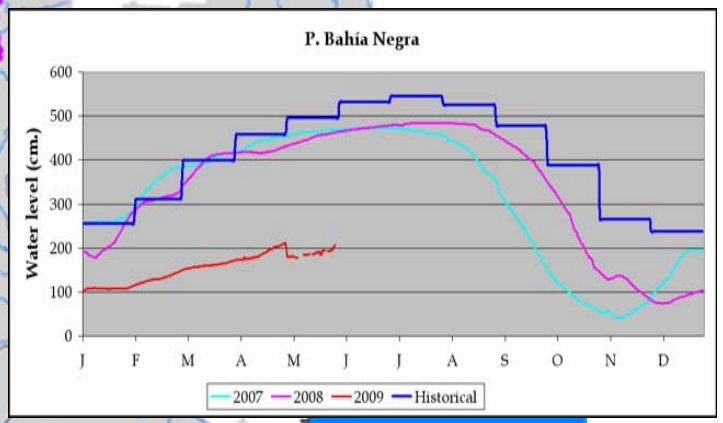
Uruguay

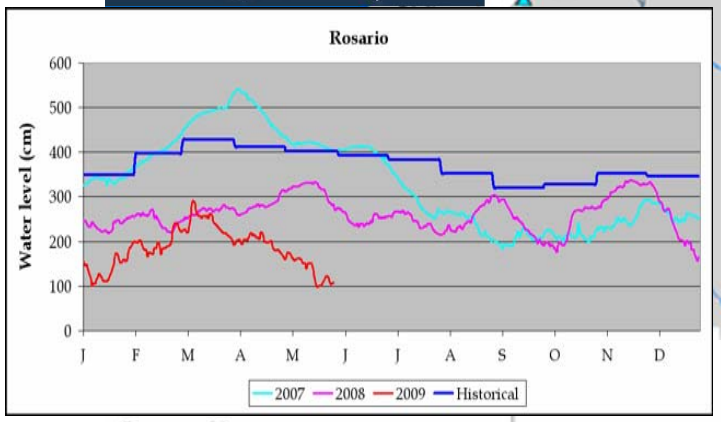
Atlantic Ocean

Bahia Negra

Pilcomayo

Paraná



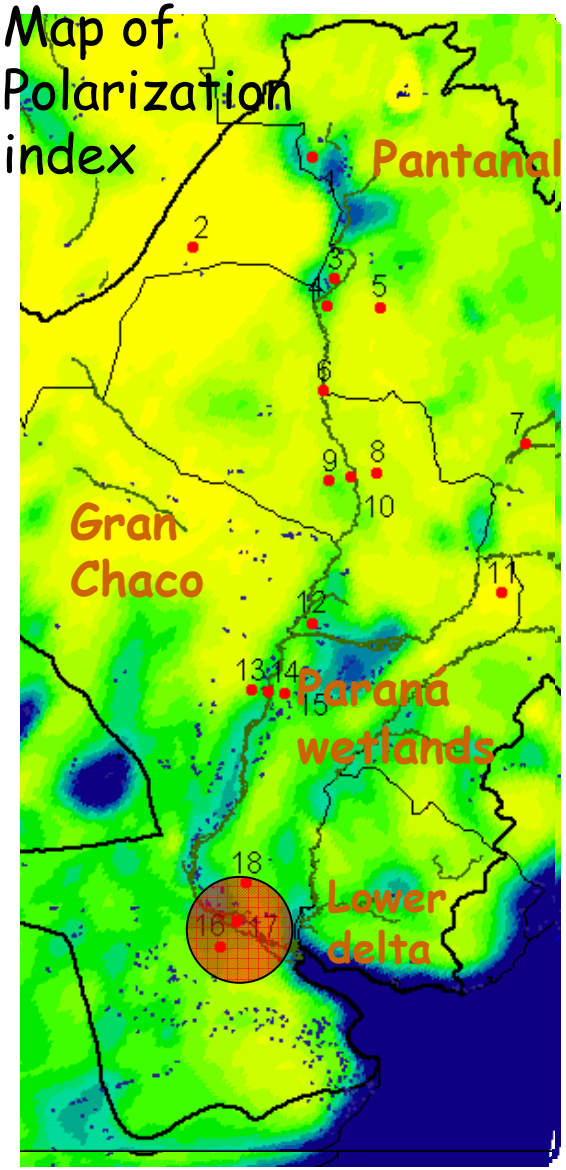


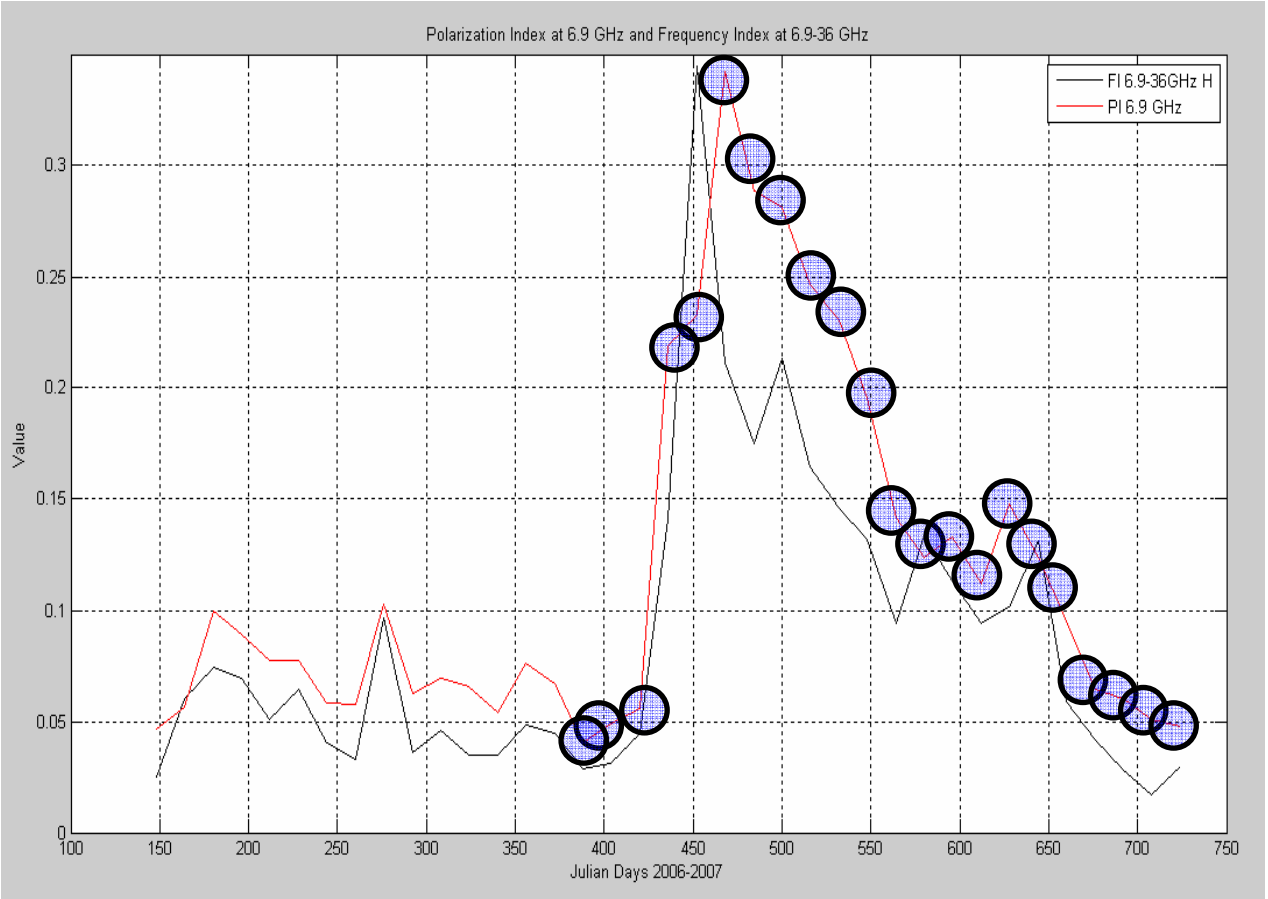
Ramsar Sites:
- Presence of Animal Invasive Species
- Presence of Plant Invasive Species
- Presence of Both Plant and Animal Invasive Species
- No Invasive Species Reported

Wetlands
Rivers
Political Boundaries (Intl.)
Political Boundaries (Natl.)
Paraná Basin

200 0 200 400 Kilometers

Paraná sub-basin: *monitoring "**flood condition** " using **AMSR-E C** band data*





Monitoring from 28/03/2007 to 31/12/2007

Why passive microwave sensors?

-The problems addressed

-The size of the basin

Objectives of our research

General:

To examine the impact of soil moisture estimates, made available from current and future systems such as SMOS, and Aquarius, in land surface hydrology applications

Specific:
To investigate the capability of radiometry at L band and higher frequencies to predict and monitor flooding events in the basin
To use electromagnetic models to understand and interpret observations in forest and agricultural areas
To develop inversion methods for soil moisture determination

This project: methodology

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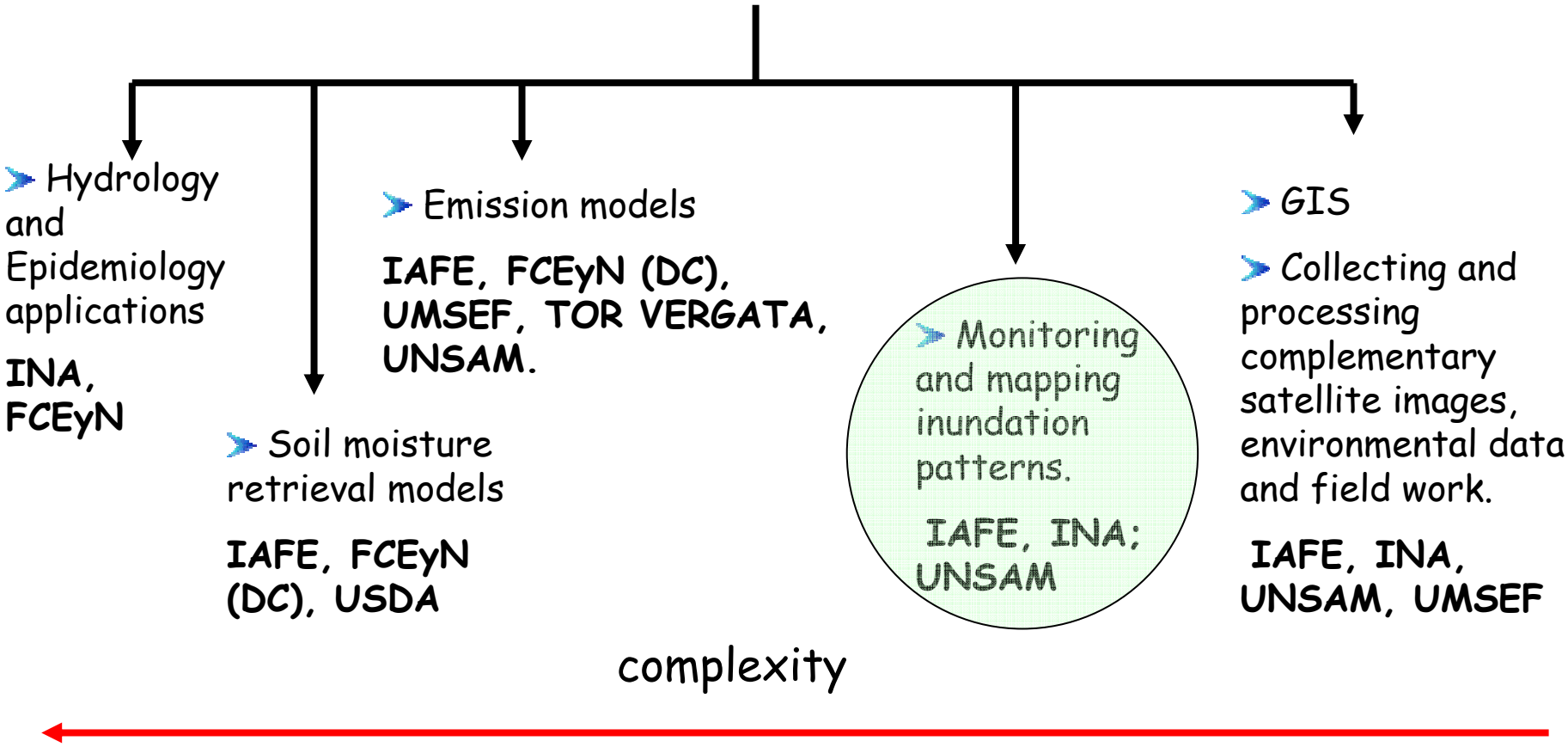

1. Almost all pixels in passive systems are **heterogeneous**.

2. The observed Tb can be modelled as the sum of the Tb of the different ladncover weighted by their relative area. For the case of a flooded area, the observed PI can be modelled as:

$$PI_{obs,\lambda} = f_w PI_{w,\lambda} + f_{nf} PI_{nf,\lambda} + f_f PI_{f,\lambda}$$

Where PI_w, PI_{nf} y PI_f corresponds to the PI of **open water, nonflooded and flooded land** f_w, f_{nf} y f_f corresponds to threir relative area in the pixel.
By definition:

$$1 = f_w + f_{nf} + f_f$$

Therefore, the **flooded area** can be estimated as:

$$f_f = \frac{PI_{obs,\lambda} - f_w PI_w - PI_{nf,\lambda} + f_w PI_{nf,\lambda}}{PI_{f,\lambda} - PI_{nf,\lambda}}$$

Hamilton et al, 2002

This project: methodology

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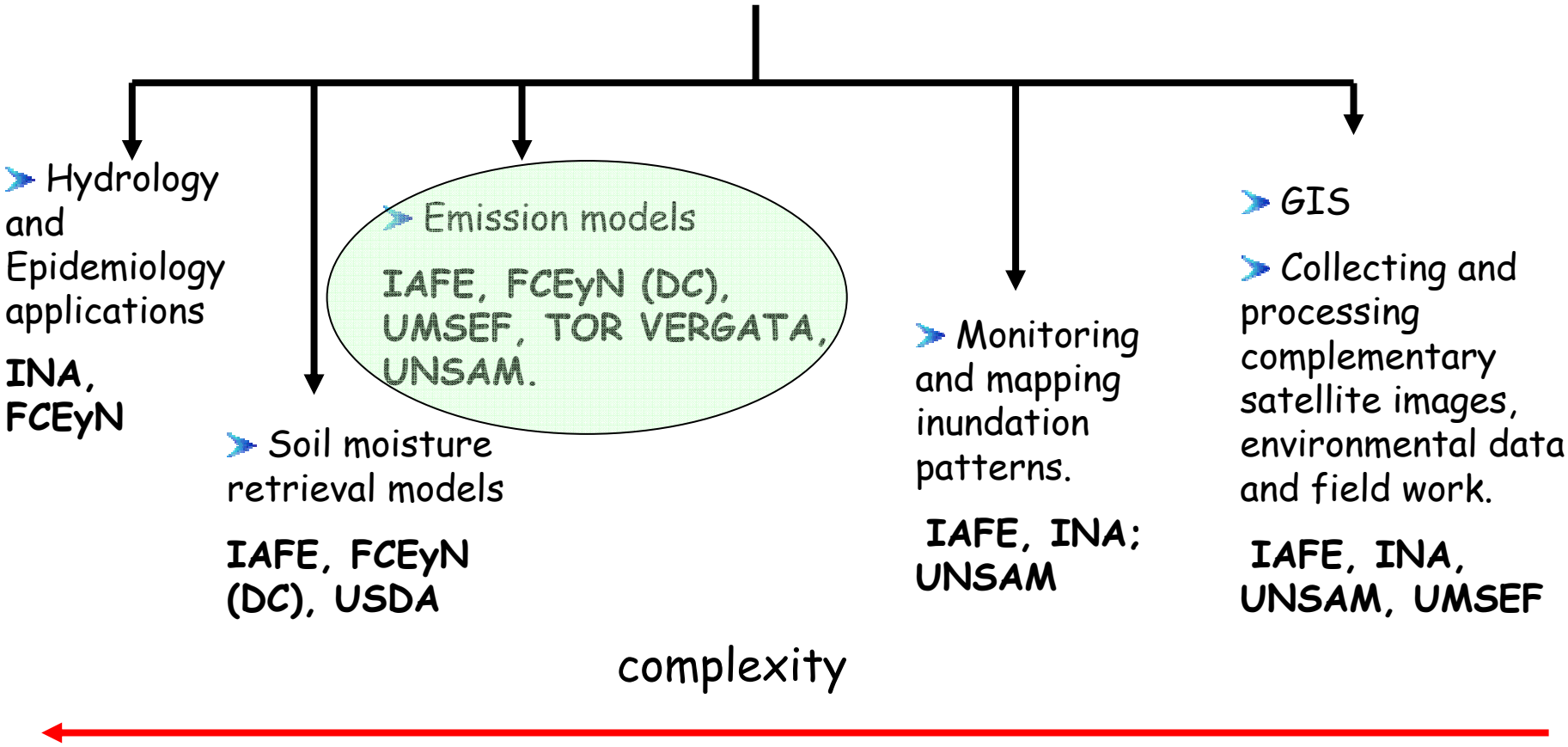
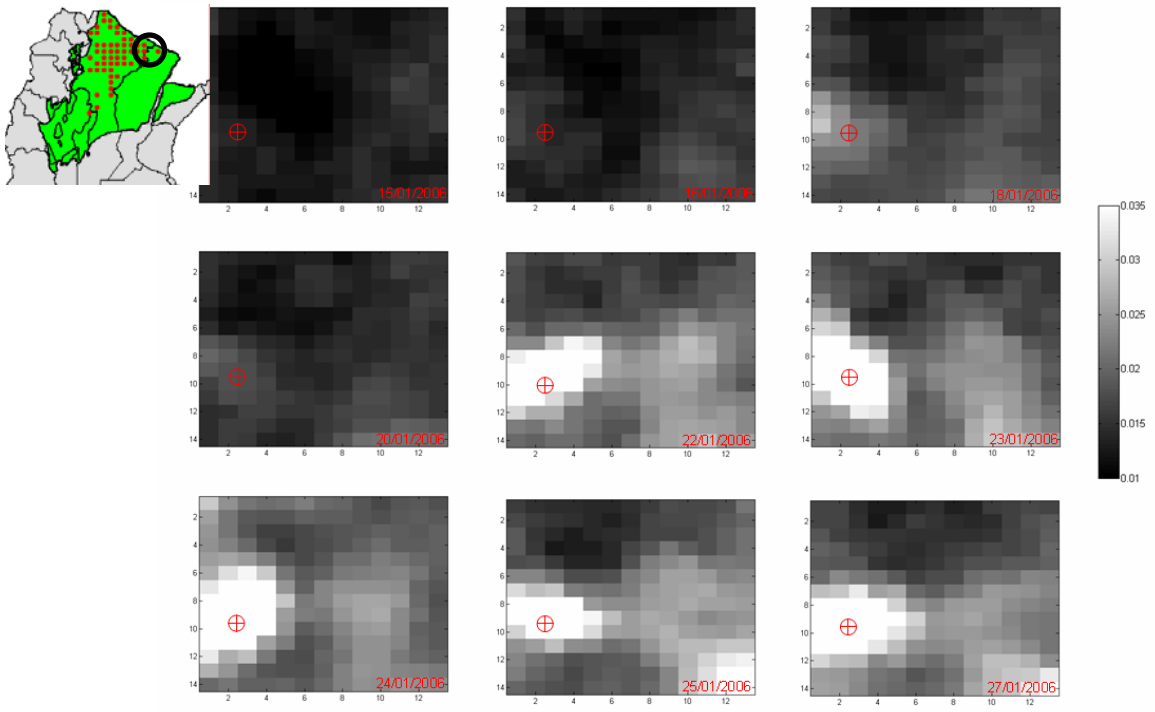
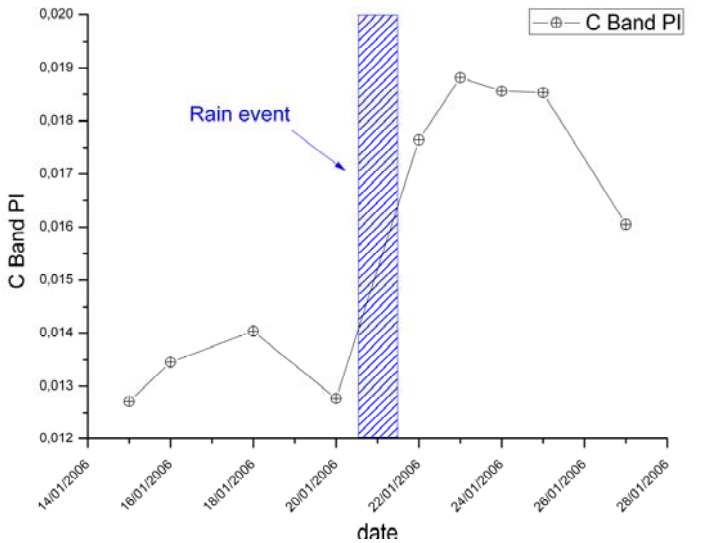


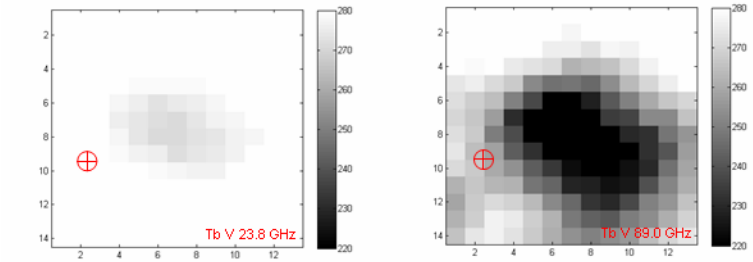
Chaco forest: AMSR-E PI evidences of rain events



C Band PI map of the area near Las Lomitas site. Las Lomitas is marked in red.



C Band PI trend of a forest pixel (100 % cover, 100 Tn/ha) near Las Lomitas site. The rain event (150 mm) is marked in blue.



23.8 GHz Tbv (left) and 89.0 GHz Tbv (right) of the area near Las Lomitas site indicating the rain event. Las Lomitas is marked in red.

This project: work in progress

✓4 years of AMSR-E data 2006-2009 under analysis using environmental data and emission models.

✓Emission models for Chaco Forest

✓Specific studies in Chaco region addressing the sensitiviy of PI to rain events. Biomass measurements, tree characteristics and 10 years of precipitation data are available.

✓A submitted project for a posdoc fellowship that addresses the Paraguay-Paraná wetland corridor and the determination of fractions of flooded area within each pixel.

Thanks for this opportunity!!!!