MONITORING SOIL CONDITION IN LA PLATA BASIN ECOSYSTEMS USING AMSR-E DATA

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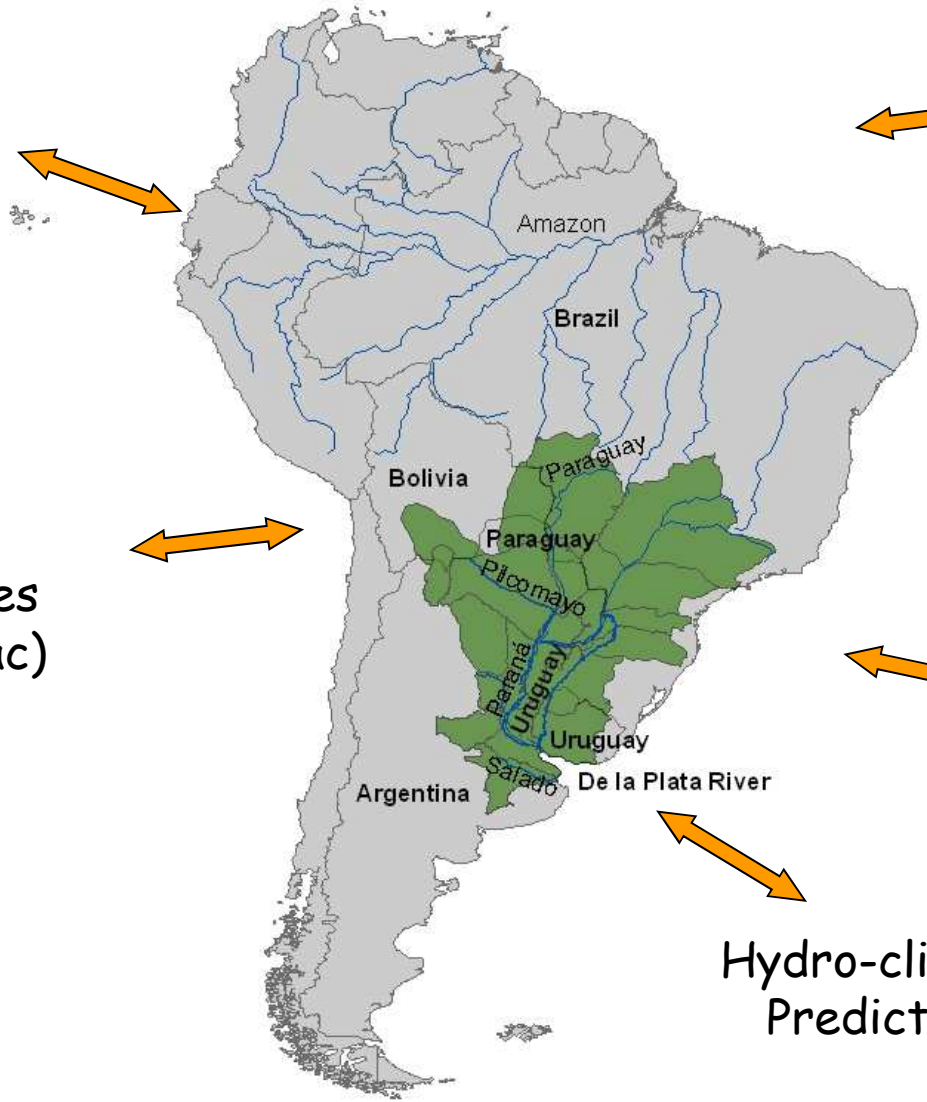
La Plata Basin Priority areas

Land surface effects

SST Anomalies (Atl & Pac)



Hydro-climate Prediction

- Extension

  Aprox 3.200.000 km2

- 5 Countries

  Argentina (downstream)
  Bolivia
  Brazil (upstream)
  Paraguay
  Uruguay

- Main rivers

  Paraná, Paraguay
  Uruguay, Iguazú
  Pilcomayo,
  Bermejo

- 100.000.000 inhabitants
- 80% of the GNP of the 5 countries is produced in the basin

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

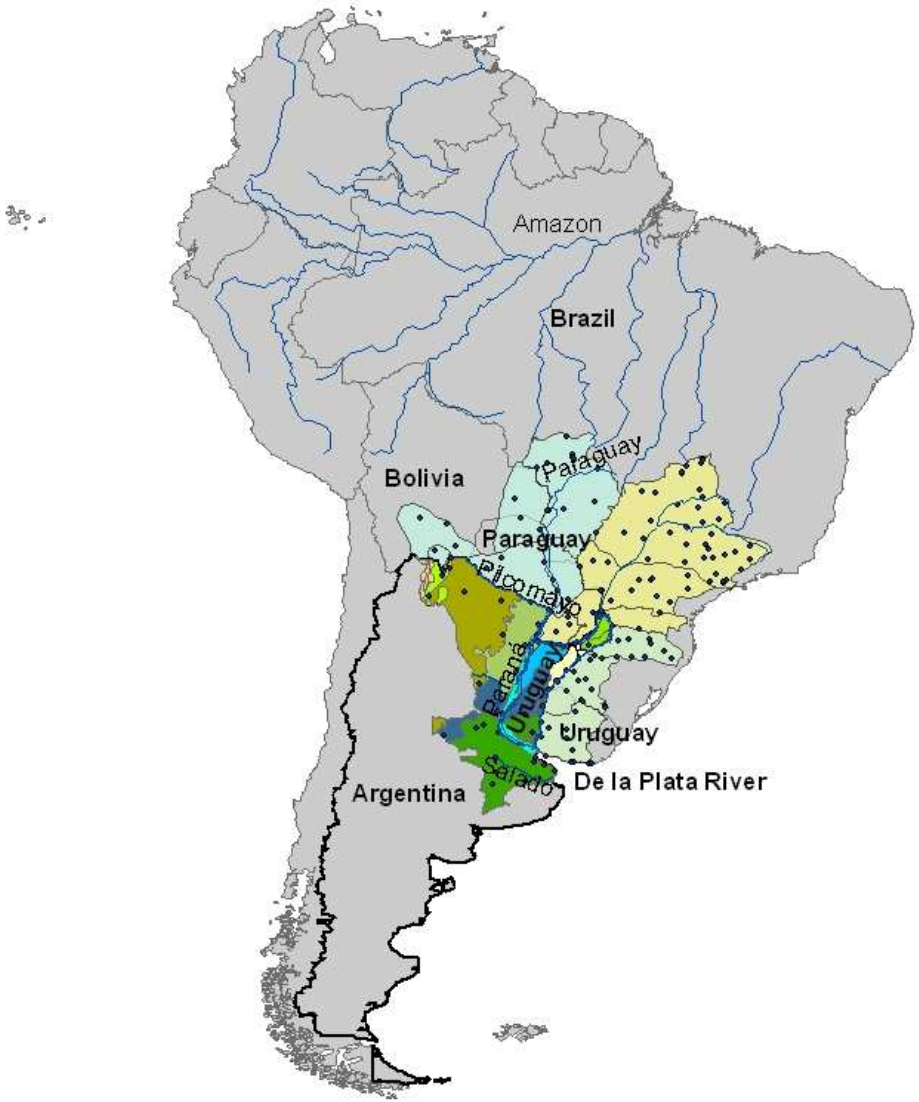
Specific:

- 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

La Plata Basin Characteristics: Sub-basins

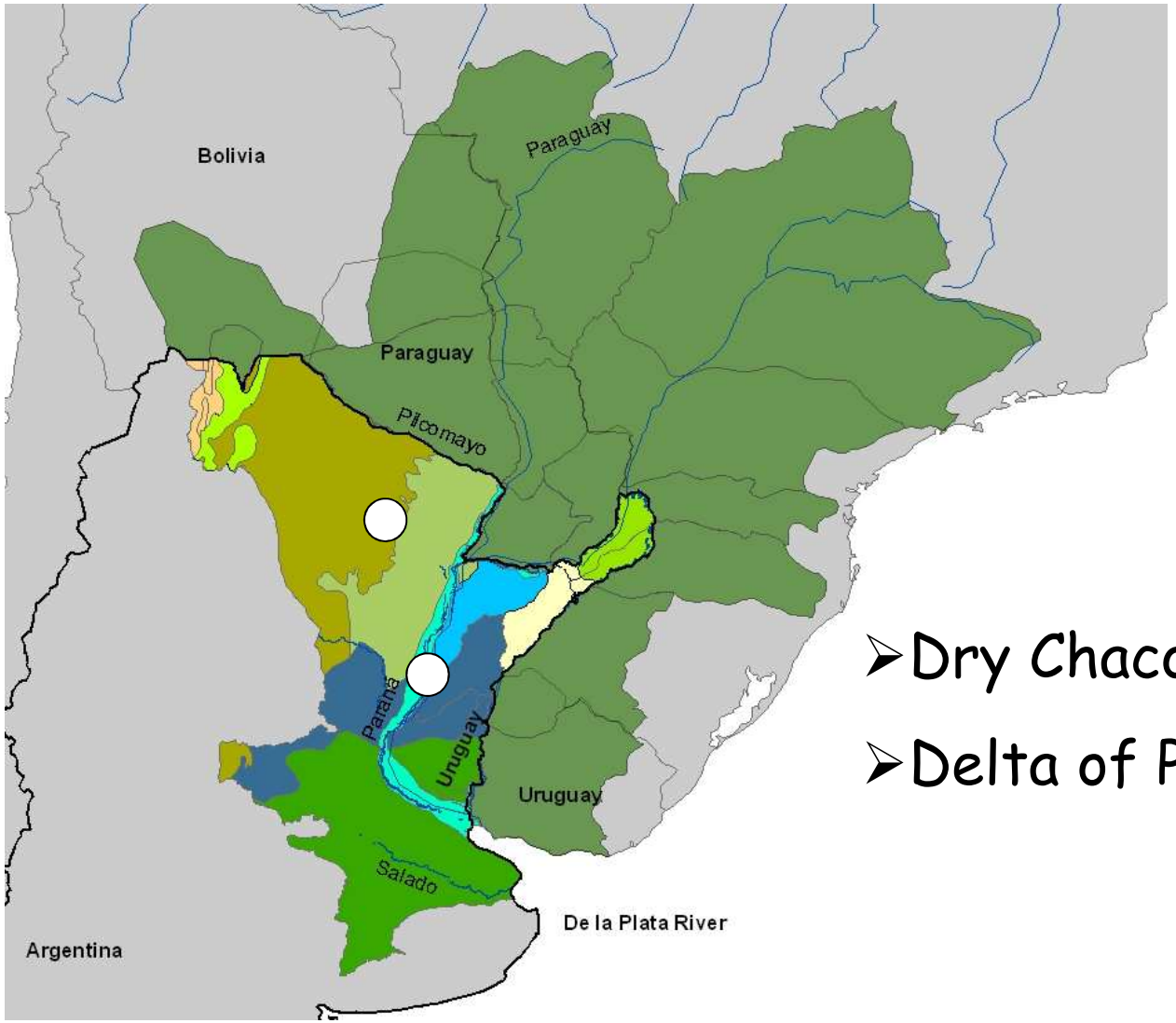
La Plata Basin Characteristics: ecosystems

La Plata Basin Characteristics: meteorological stations



La Plata Basin Characteristics: hydroelectric plants

Areas observed and analyzed by AMSR-E system



- Dry Chaco Forest
- Delta of Paraná river

This presentation

- AMSR-E radiometer
- Use of Polarization Index (PI) and Frequency Index (FI).
- Chaco Forest
  - Rain events monitoring
  - Sensitivity to forest biomass
- Paraná sub-basin
  - Monitoring flood condition

AMSR-E instrument and the data set

1. Operating frequencies bands: 6.925 GHz (C),10.65 GHz (X), 18.7 GHz (Ku), 23.8 GHz, 36.5 GHz (Ka), and 89.0 GHz.

2. Lower frequencies are more suitable for terrestrial applications, while higher frequencies, i.e 23.8 GHz, 36.5 GHz and 89.0 GHz, are influenced by atmospheric water vapor and clouds.

3. A conical scanning is used, to observe the terrestrial surface with an angle of 55°. The IFOV is equal to 43 X 75 km at 6.925 GHz, is reduced to 29 X 51 km at 10.65 GHz, and is narrower at the higher frequencies.

4. In this study, we have used L1b data, which contain values of brightness temperature, at vertical (V) and horizontal (H) polarization, corrected and calibrated. Each file, is 80 Mb, contains brightness temperature values along a 1450 km strip. The data have been downloaded from NASA site http://nsidc.org/ims-bin/pub/nph-ims.cgi/u885372. Low resolution data have been used at all frequencies.

The use of radiometric indexes

Polarization Index

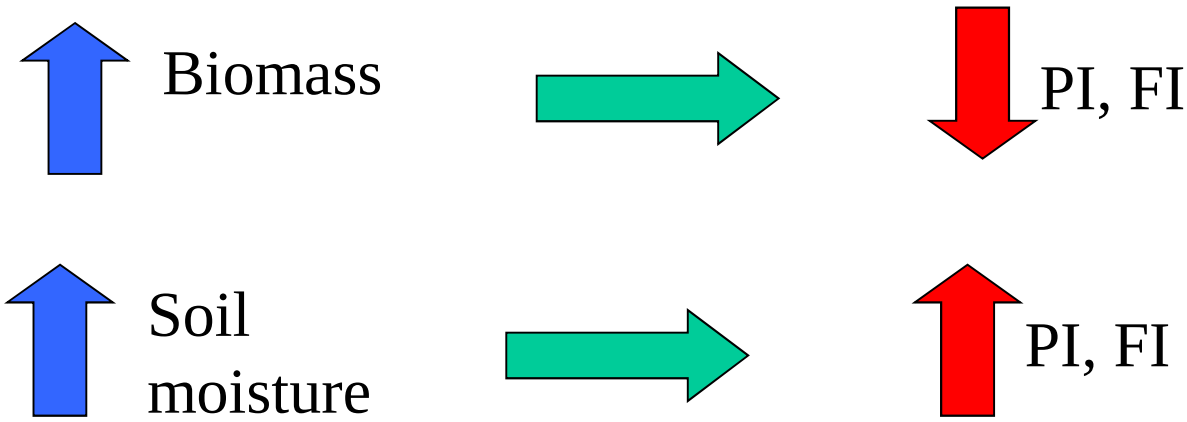
$$PI = 2\frac{Tb_{6.9GHzV} - Tb_{6.9GHzH}}{Tb_{6.9GHzV} + Tb_{6.9GHzH}}$$

Frequency Index

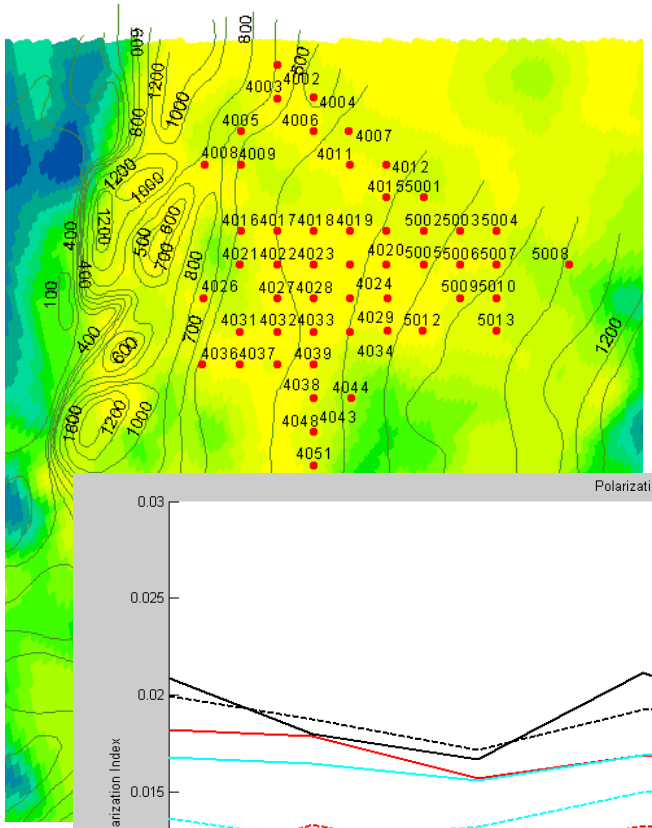
$$FI = 2\frac{Tb_{36GHzH} - Tb_{6.9GHzH}}{Tb_{36GHzH} + Tb_{6.9GHzH}}$$

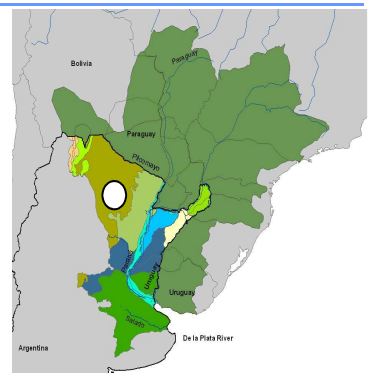
The **indexes** do not depend on **surface temperature**, and keep the dependence on surface variables, such as **vegetation biomass and soil moisture**

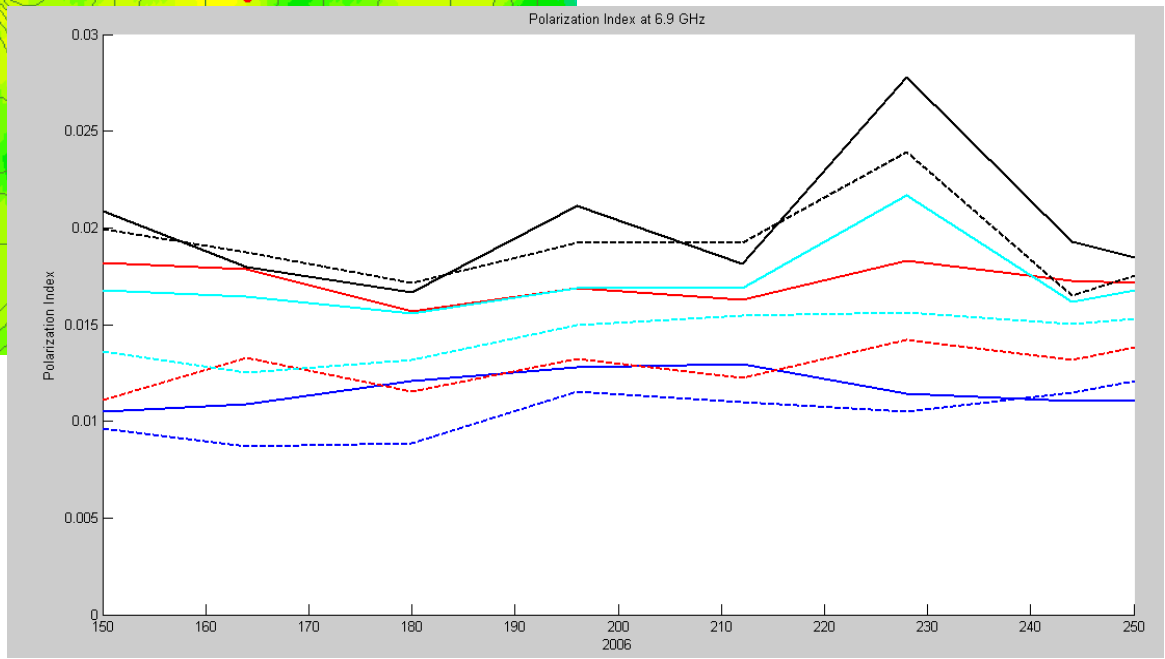
(Ferrazzoli et al., 1992, Paloscia et al., 1988, 2001)



Chaco forest: *Effects of biomass and average rainfall*

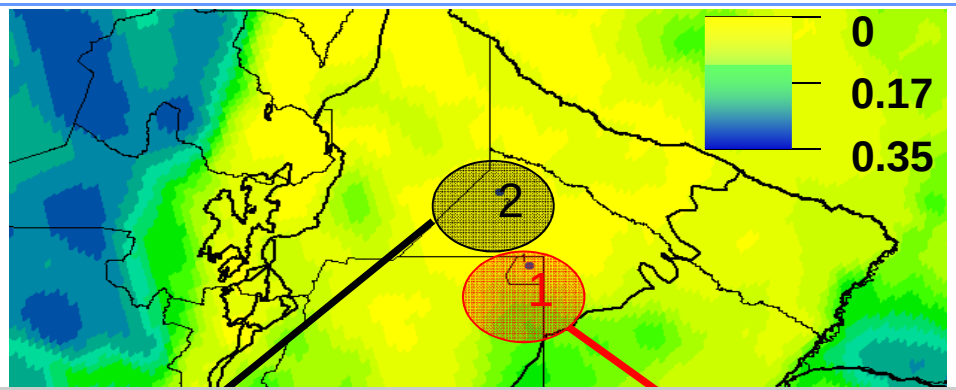


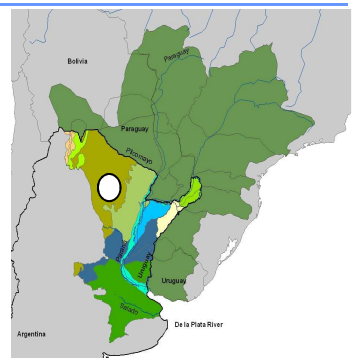


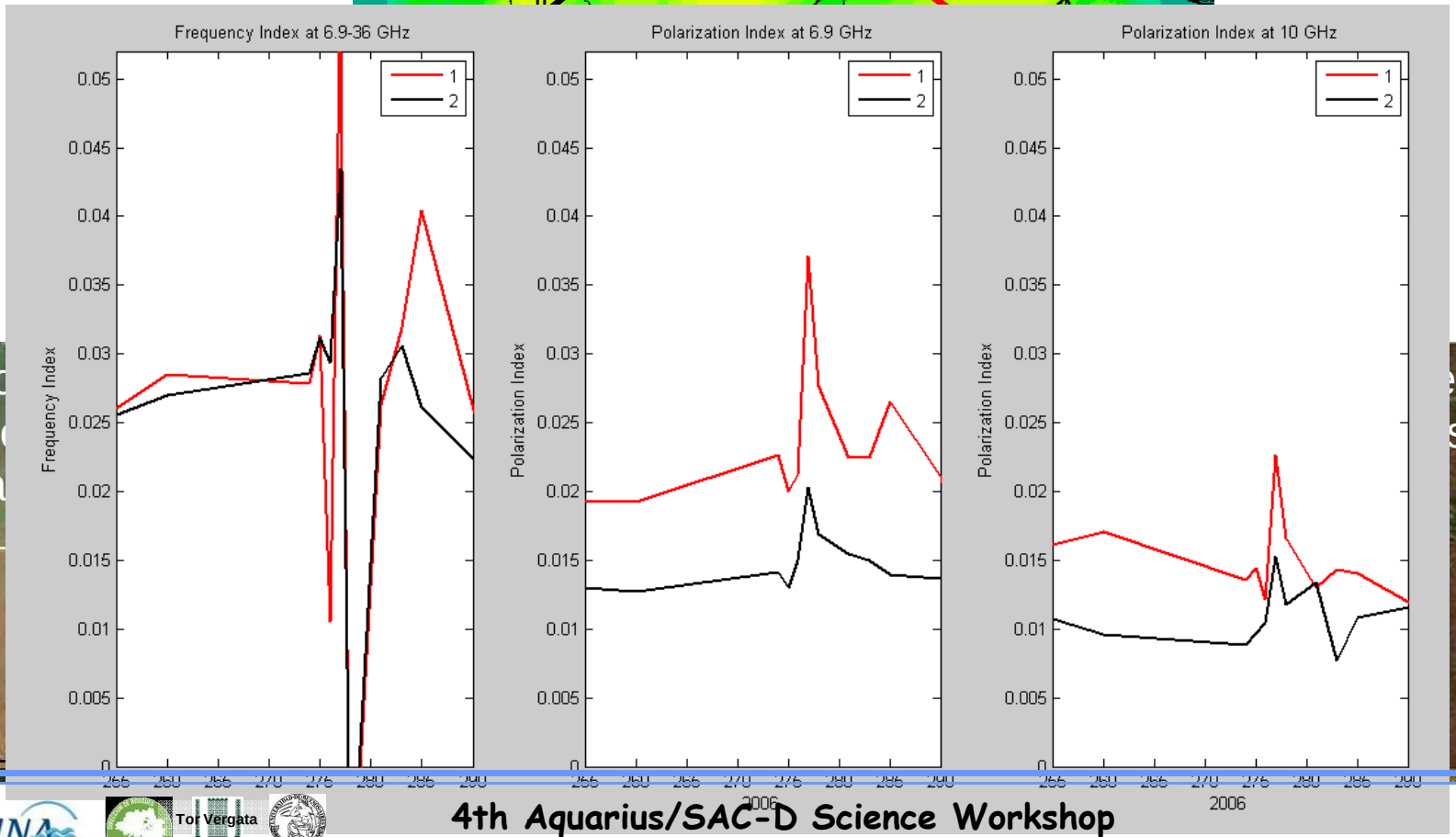


----- **900** mm/y (54.7 Tn/ha)
---- **800** mm/y (94.8 Tn/ha)
---- **700** mm/y (54.6 Tn/ha)
---- **600** mm/y (54.7 Tn/ha)
- - - **900** mm/y (111.7 Tn/ha)
- - - **800** mm/y (122.6 Tn/ha)
- - - **700** mm/y (146.5 Tn/ha)
- - - **600** mm/y (164.5 Tn/ha)

Chaco forest: *Effects of a heavy rainstorm*







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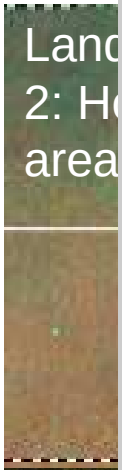
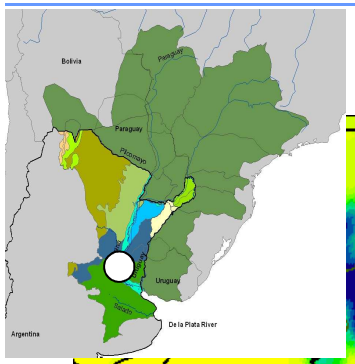
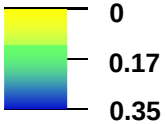
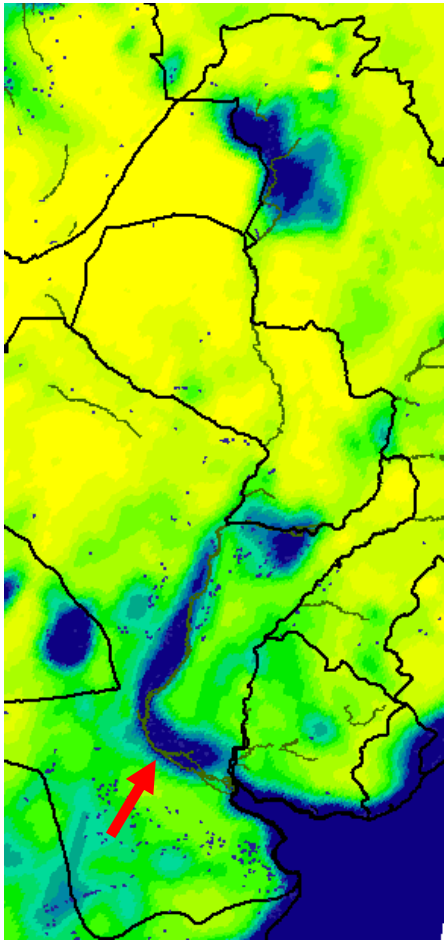


Paraná sub-basin: *Effects of flood*





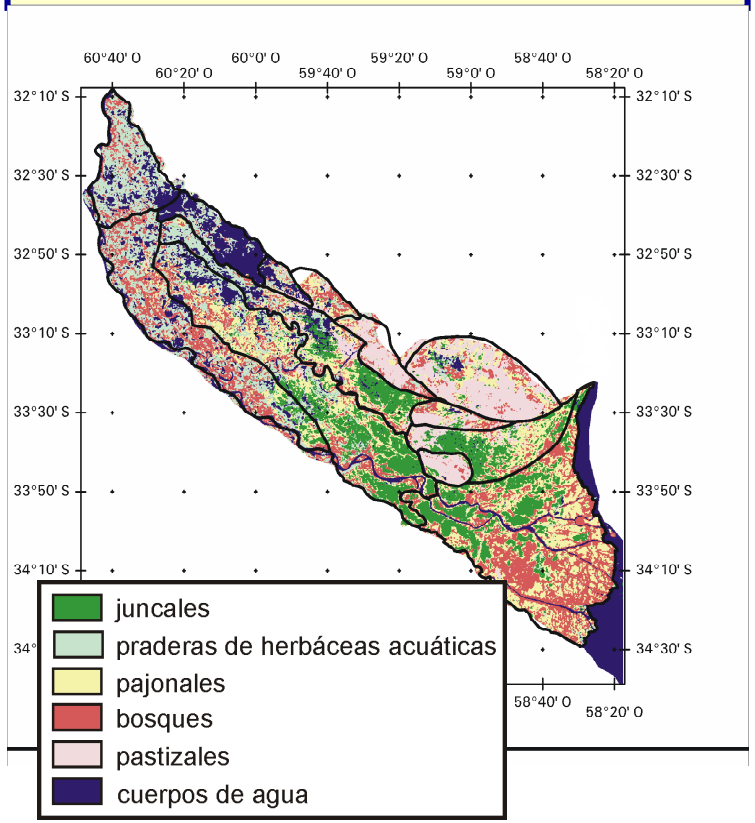


before

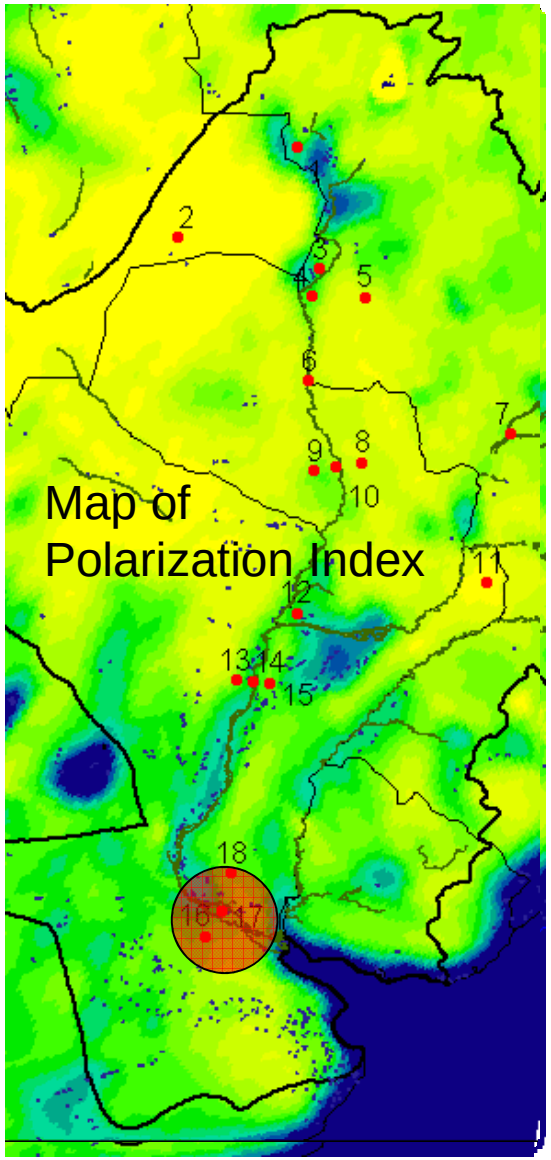
after

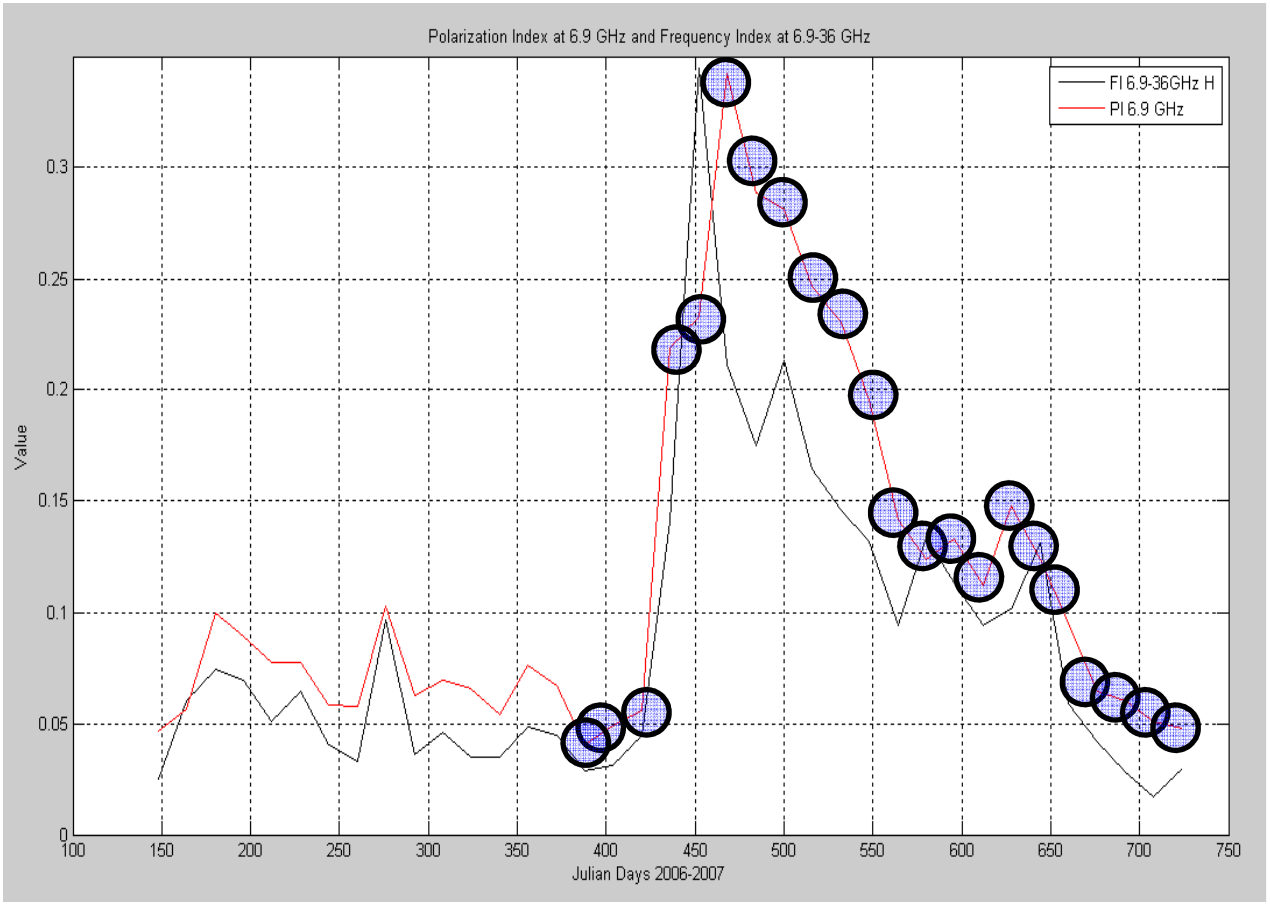
Delta del Río Paraná Region

17,000 Km²



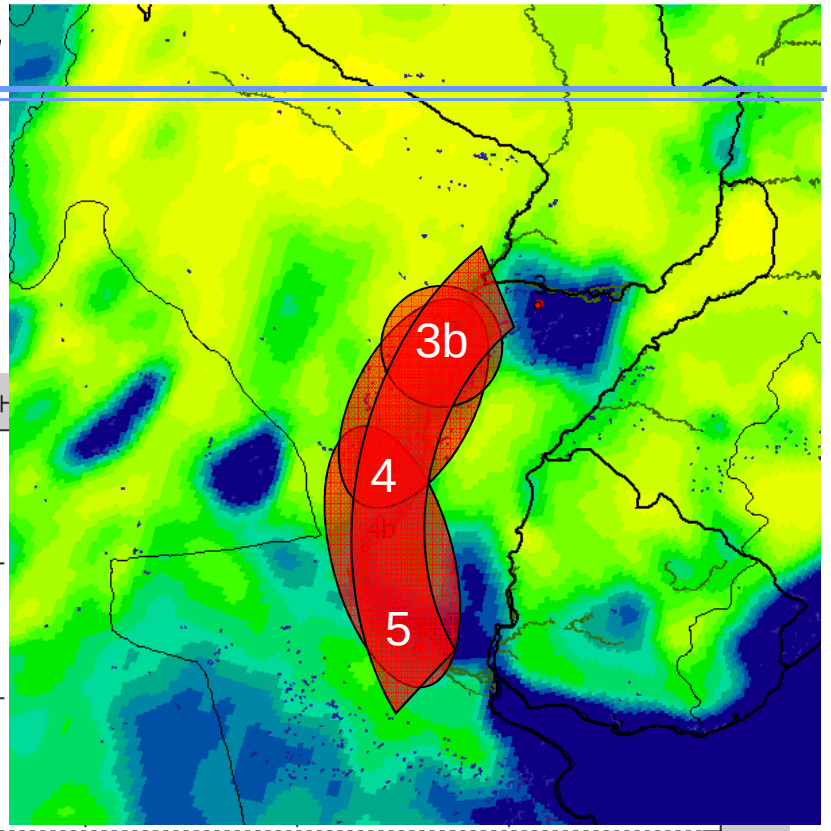
Paraná sub-basin lower delta: *monitoring water level*



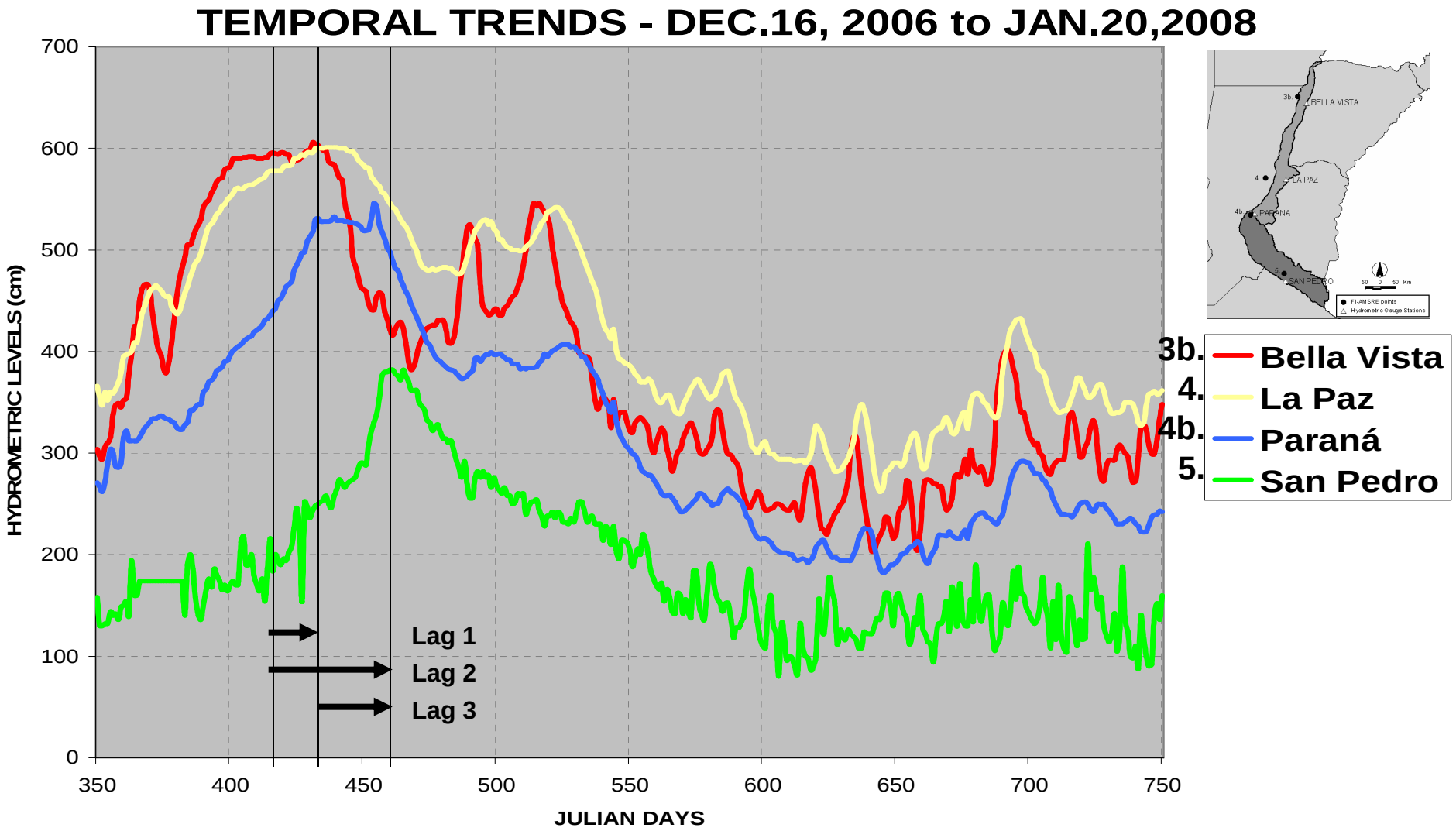


Monitoring from 28/03/2007 to 31/12/2007

Paraná sub-basin: *temporal trends*



Comparison: 2007 year



AMSRE FI vs HYDROMETRIC LEVELS TRENDS

2007 YEAR					
FI POINTS	HYDROMETRIC STATIONS	maximum JULIAN DAY	LAG 1: 3b to 4b	LAG 2: 3b to 5	LAG 3: 4 to 5
3b	BELLA VISTA	433			
4	LA PAZ	436			
4b	PARANÁ	441	8		
5	SAN PEDRO	458		25	22

LAGS (DAYS)				
LAGS	AMSRE FI	1990 YEAR	1997 YEAR	2007 YEAR
LAG 1	11	13	14	8
LAG 2	31	28	19	25
LAG 3	20	18	29	22

DIFFERENCES OF LAGS (DAYS)			
LAGS	DIF AMSRE-FI vs 1990 YEAR	DIF AMSRE-FI vs 1997 YEAR	DIF AMSRE-FI vs 2007 YEAR
LAG 1	-2	-3	3
LAG 2	3	12	6
LAG 3	2	-9	-2

Conclusions

- The results of **Chaco Forest** indicate that AMSR-E data at C band is **sensitive** to rain events and average yearly precipitation, **even under homogeneous dry forests** (50 – 150 Tn/ha). This could be important, since there are different opinions regarding this subject in the scientific community.

- In **Paraná sub-basin** the trends of PI and FI as a function of time, for points located along the river at its end, **show a maximum**. The **temporal location** of these **maxima is shifted in time**, going downwards the watershed. The **trends of water level data**, measured at close stations, are in good agreement and show **similar lag times**. The absolute values of PI and FI depend on land cover, and need further investigations.

- These results are promising in view of future exploitation of SMOS and Aquarius data in La Plata basin. **Better sensitivities** are expected at L band.