Paraná River Delta flood as seen by Aquarius, SMOS, AMSR2 and SAR systems

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Paraná - Paraguay Basin.

- Part of the Plata Basin (biggest sub-basin)
- Covers 1.7 million Km$^2$ in 4 Countries
- Densely populated (70 million)
- One of the richest agricultural regions in SA
- Its floodplains provide irreplaceable ecological/hydrological functions:
  - mitigating large floods and droughts
  - recharging aquifers
  - supplying high quality fresh water.
Flooding is of major concern in the Plata Basin.

Extended floodplains, settled and cultivated.


Providing information on the current state of the basin hydrologic system on a systematic basis is critical to the regional economies and society.

Any improvement in monitoring or prediction will have significant societal benefits.
Paraná River Delta.

- Located at the final 300 Km of Paraná River.
- Covers 17,000 Km²
- Mostly herbaceous vegetation (less than 20 % forest)

- From April to June 2013: strong rains over Brazilian part of Paraná Basin.
- This created a weak to moderate flood wave that reached Paraná River Delta on July 2013.
## Available Data

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Data used</th>
<th>Dates</th>
<th>Data obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquarius (L Band)</td>
<td>L2 V2 Tb</td>
<td>2013/01 – 2013/09</td>
<td>PI</td>
</tr>
<tr>
<td>SMOS (L Band)</td>
<td>SCLF1C Tb</td>
<td>2013/05 – 2013/09</td>
<td>PI (35 to 45° average)</td>
</tr>
<tr>
<td>AMSR2 (C, X and Ka Bands)</td>
<td>L1B Tb</td>
<td>2013/01 – 2013/11</td>
<td>PI</td>
</tr>
<tr>
<td>Cosmo Skymed (X Band)</td>
<td>HH σ₀</td>
<td>2013/07/05, 2013/07/25, 2013/08/10, 2013/08/30, 2013/09/15</td>
<td>Flooded area maps</td>
</tr>
<tr>
<td>Auxiliary data</td>
<td>Water level in Rosario Port, Land cover map, emission model results</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
PI = \frac{2*(Tb_V - Tb_H)}{(Tb_V + Tb_H)}
\]
- AMSR2 derived PI shows a good agreement with flooded area fraction estimations from Cosmo Skymed higher resolution SAR images
- Ka band data are noisier than X and C band data
Even though SMOS data are much noisier than AMSR2, we can still see some agreement between PI and flooded area fraction estimated from Cosmo Skymed data, especially in the case of Ascending passes of SMOS.

Descending passes are noisier than ascending passes (although this could be an effect of the different amount of available data.
Aquarius data show low sensitivity to flooded area fraction from Cosmo Skymed data.

This could be due to footprint size, that causes used PI to include a range of continent/wetland area ratio.

Descending passes are noisier than ascending passes.
Methods.

Algorithm (Hamilton et al., 2002)

\[ PI = \frac{2(Tb_v - Tb_H)}{(Tb_v + Tb_H)} \]

\[ 1 = f_w + f_{nf} + f_f \]

\[ PI_{obs} = f_w PI_w + f_{nf} PI_{nf} + f_f PI_f \]

\[ f_f = \frac{PI_{obs} - f_w PI_w - (1 - f_w) PI_{nf}}{PI_f - PI_{nf}} \]

Methods.

Algorithm hypothesis (Hamilton et al., 2002)

\[ f_f = \frac{PI_{obs} - f_w PI_w - (1 - f_w) PI_{nf}}{PI_f - PI_{nf}} \]

**H.1.** \( PI_w \), is known (estimated from model simulations).

**H.2.** \( f_w \) is constant and known (0.197).

**H.3.** \( PI_{nf} \), must be a constant value and can be estimated, in our case, from model simulations.

**H.4.** \( PI_f \), must be a constant value, have a negligible dependence on flood condition and can be estimated from images.

**H.4 is not true in our study area (Salvia et al., 2010), since the increase of water level reduces the emerged vegetation, causing a decrease in emission but an increase in \( PI \)**
Flow chart of proposed algorithm

Adapted from Salvia et al., 2011.

AMSAR2 shows good results, both PI data and flooded area fraction estimations follow the trend of Cosmo Skymed derived fraction of flooded area.

PI from SMOS showed less sensitivity to flooding, which makes flooded area fraction estimations much noisier.

In addition, Aquarius shows much lower values of estimated flooded area fraction.
We think the fact that the studied event is a weak flooding may be responsible for the low sensitivity of Aquarius data, since it is the sensor with larger footprints.

We hope to get better results when studying a stronger flooding event.
Thank you!