REMOTE SENSING APPROACH FOR MONITORING THE FLOOD EXTENT IN THE AMAZON RIVER FLOODPLAIN

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1. INTRODUCTION

The **Lower Amazon River** floodplain is subject to large seasonal variations in water level due to the dimensions of the basin. Such amplitude, associated with its flat topography, results in **significant variation in flood extent throughout the year**.

Remote sensing data, especially Synthetic Aperture Radar (SAR) data, represents a good alternative for mapping the total flood extent of these wetlands, because of its ability to provide timely and continuous information, since they are less affected by atmospheric conditions than optical data. Nevertheless, mapping the total flood extent is not an easy task, as the Amazon River floodplain is composed of different types of land cover with backscattering properties that change in time and space. Therefore, before the application of techniques for land cover classification, it is necessary to characterize this backscattering on SAR images.

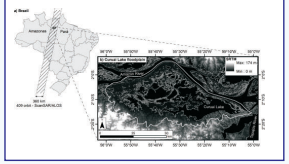
The present study has two **objectives**:

1) **Characterize the backscattering of the main Amazon floodplain cover types in PALSAR/ALOS (ScanSAR mode) images**; and

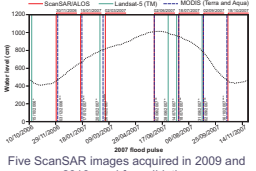
2) **Use the SAR images to map inundated area at multiple dates along the hydrological cycle**.

2. METHODS

Study Area: **Curuai Lake Floodplain**
Lower Amazon River



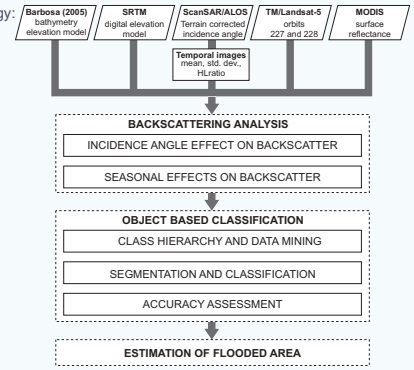
Remote sensing data



Five ScanSAR images acquired in 2009 and 2010 used for validation

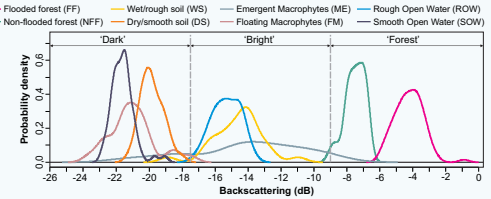
Field campaign: **April/2011**

Methodology:

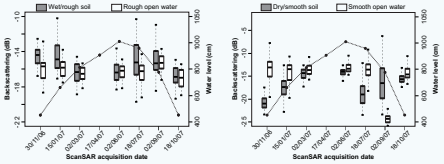


3. RESULTS

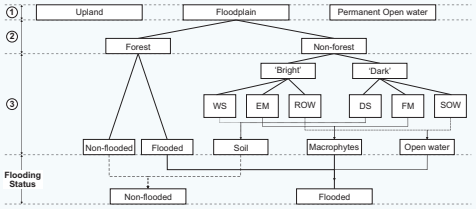
Backscattering analysis



Seasonal analysis



Class hierarchy



Segmentation, data mining and classification rules

- Weka data mining: decision tree algorithm (J4.8)
- Multiresolution segmentation algorithm (e-Cognition 8)
- Classification rules: Level 1 and 2 (one result for entire time series):

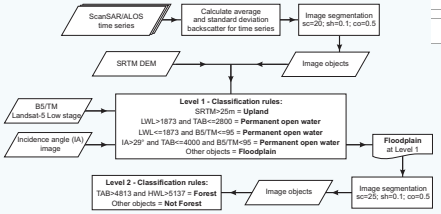
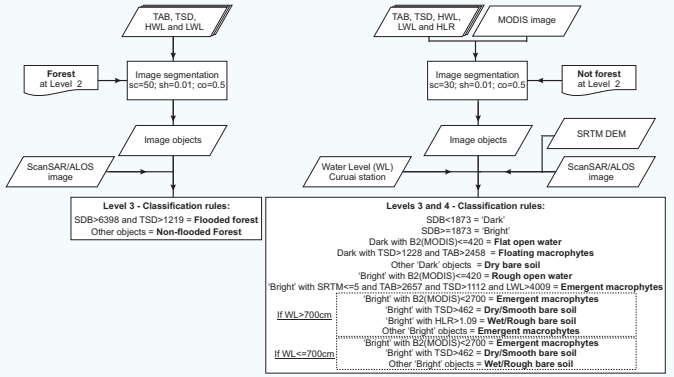


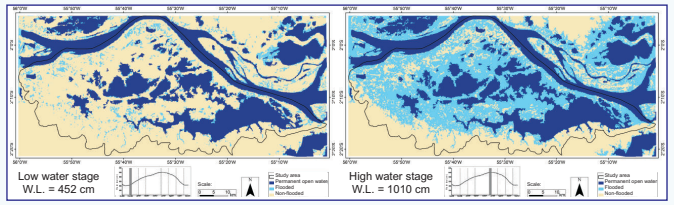
Image / attribute	Description	Classification Hierarchy
TAB	Temporal Average Backscattering	Levels 1, 2 and 3
TSD	Temporal Standard Deviation backscattering	Levels 1, 2 and 3
HWL	Highest Water Level backscattering	Levels 1 and 3
LWL	Lowest Water Level backscattering	Levels 1 and 3
HLR	Highest/Lowest water level backscattering Ratio	Level 1
SRTM	Digital Elevation Model	Level 1
B5/TM	Landsat-5/TM Infrared band of the low water stage (15/10/2006)	Level 1

- Classification rules: Level 3 (one result for each ScanSAR date):



Accuracy assessment:

- Levels 1 and 2 had overall accuracies of 90% and 83%, respectively;
- For the third level, accuracy was of 78% and 80% for low and high water stage, respectively;
- Flooding status was mapped with 88% and 90% accuracies for the low and high water stages, respectively.



Estimation of flooded area:

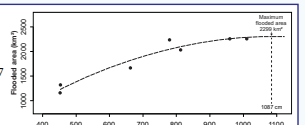
- For WL ≤ 1087 cm:

$$FA = (-2{,}67 \times 10^{-3} \pm 0{,}001) \times WL^2 + (5{,}81 \pm 2) \times WL - 858{,}7 \pm 757$$

- For WL > 1087 cm:

$$FA = 2299\ km^2$$

RMSE of 202 km² (10% of the observed values average)



2. CONCLUSION

OBIA allowed: 1) the integration of optical and SAR data; 2) exploration of the spatial and temporal variation of PALSAR ScanSAR backscattering observed for the Amazon floodplain; and 3) supported the monitoring of flooding extent during 2007, while reducing the effect of image speckle and incidence angle variability on the SAR data classification.
Wide swath SAR data has great potential for monitoring large wetlands areas, such as the Amazon river floodplain. Future studies can use the concepts of this developed methodology for monitoring the flood extent in the entire Amazon basin.