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## Synergies between SWOT and L-Band sensors over wetlands

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## Introduction

Monitoring of inland water surfaces via remote sensing over tropical areas is a challenging task because of impact of vegetation and cloud cover. Surface Water & Ocean Topography (SWOT) mission will provide global monitoring of inland waters height and extent with high spatial resolution and a 21 days cycle. Several microwave based products have been elaborated to monitor these surfaces (Papa et al. 2010). Based on results during CAL/VAL of SMOS (Al Bitar et al., 2012), new studies at CESBIO showed the potential of L-Band SMOS (Soil Moisture and Ocean Salinity) mission to monitor water surfaces in tropical areas under the vegetation at relatively high temporal scale (3-7days) but low spatial resolution (25km). In this project we aim at studying the synergistic potential of the use of SWOT futur data over wetlands with L-Band data from radiometers namely SMOS (ESA/CNES) and SMAP (Soil Moisture Active Passive – NASA).

## Motivations



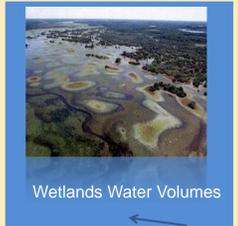
Water height / surfaces from SWOT

&



Water surfaces from SMOS/ SMAP

→



Wetlands Water Volumes

SWOT will provide unprecedented information over wetlands via its interferometric capabilities. SWOT mission is expected to provide water extent and height over wetland areas but at a low temporal resolution/

We recently showed the capabilities of L-Band radiometers to monitor water surfaces over large extents at a relatively high temporal resolution in all weather and under vegetation.

The combination of the two previous products will provide unprecedented monitoring at 3 days and kilometer over densely vegetated wetlands

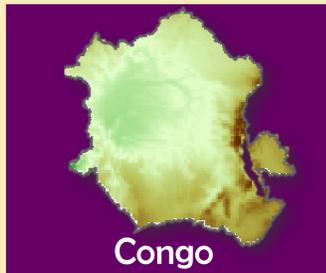
## Regions of interest

Three major tropical basins are considered :



Amazon

Well documented basin with a fair amount of validation information.



Congo

Poor amount of validation information and difficult accessibility so space hydrology is crucial here.



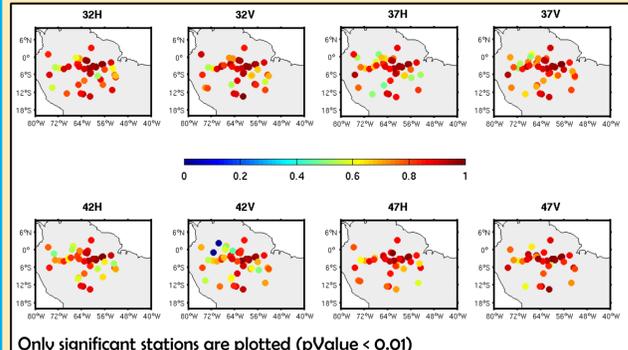
Gange-BH

More challenging for L-Band microwave (RFI: Radio frequency interferences). It is a major transboundaries basin (Hussein et al.)

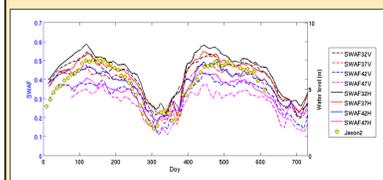
## First Results over Amazon

### Altimetry and water fraction

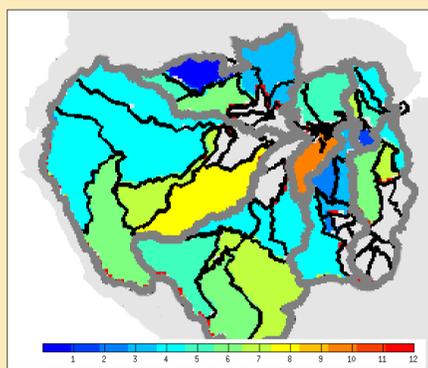
Correlation coefficient (r) between SWAF and Jason-2 (2010-2012)



Timeseries of water surface and height at Rio Negro

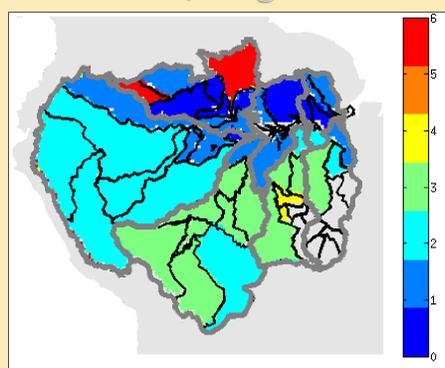


### Link with TRMM rainfall



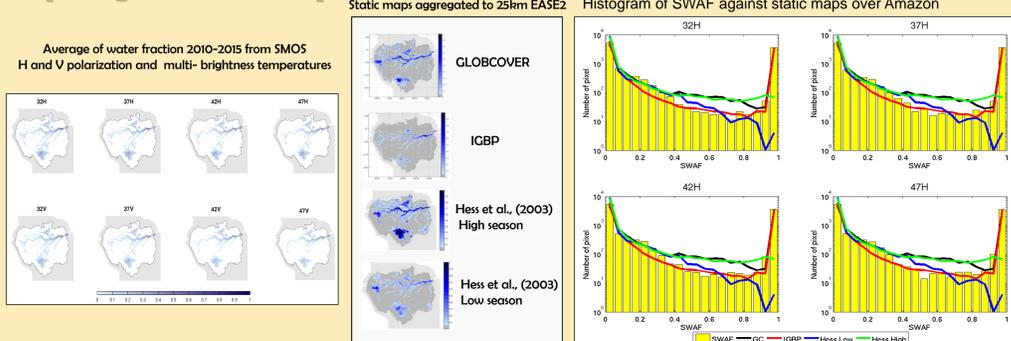
Lag in weeks between water surface and rainfall

### Link with discharge at outlet



Lag in months between water surface and discharge

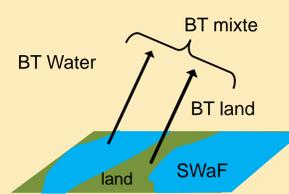
### Comparing with static maps



## Methods

### Phase 1 : water fraction & altmetric data comparison

Water fractions from SMOS and SMAP is computed for the respective mission durations using a simple double component radiative transfert modeling.



$$BT_{p,mixte}(t, \theta) = SWaF_p(t, \theta) BT_{p,water}(t, \theta) + (1 - SWaF_p(t, \theta)) BT_{p,forest,veg,soil}(t, \theta)$$

- BT water:** - Computed following Klein & Swift, 1977
- BT forest:** - Extracted over one pixel composed by tropical forest only
- BT mixte:** - SMOS/CATDS BT L3 data (then SMAP L1 BT)

The product is compared with the altmetric data from Jason-2, Sentinel-3, SARAL - AltiKa. A time series analysis between the different component of the water budget observed via remote sensing is done to depict the contribution of wetlands into the hydrologic cycle as observed with this new product.

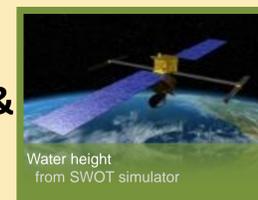
### Phase 2 : water volumes by use of altimeters and water fractions

Based on Frappart et al. (2012), we combine the Jason-2 and the SMOS/SMAP water fractions to obtain water volumes of wetlands. A **SWOT-like** product will also be produced using the hydrology simulator.



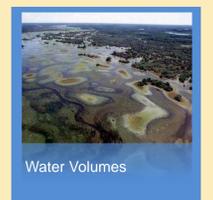
Water surfaces from SMOS/SMAP

&



Water height from SWOT simulator

→



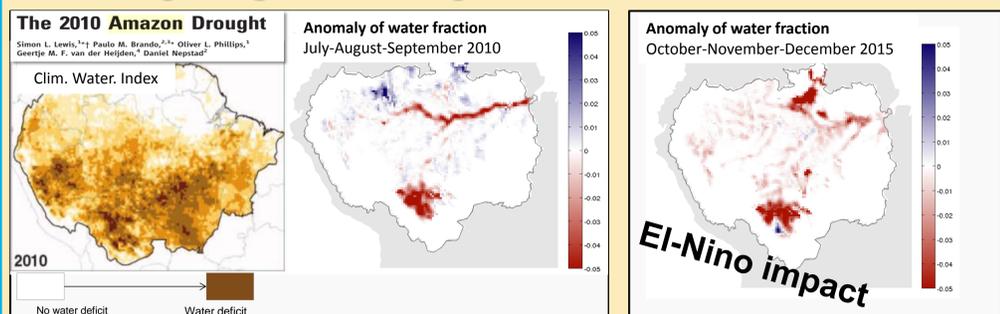
Water Volumes

### Phase 3 : Assimilation of products into hydrodynamic models

- Assimilation of wetland water heights (SWOT base line) in IPH-MGB model
- Assimilation of water surface fraction in IPH-MGB model
- Assimilation of wetlands reservoir volumes in IPH-MGB model

## Applications

### - Enhancing drought monitoring



### - Enhancing stream flow modelling

The project aims at answering the question on how will the merging of SWOT and L-Band data help in improving stream flow estimation over Tropical basins.

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 This work is financed via the TOSCA-SOLE CNES SWOT Science Team grant and CNES post-doc program. We thank CNES/IFremer for SMOS CATDS data and Legos/CNES for Hydroweb data.