Dynamics of the Amazonian mud bank system through spatial observation and hydro-sedimentary modeling: the case of French Guiana

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OVERVIEW

General context of French Guiana coast:

The coastal waters influenced by the Amazon river outputs are characterised by the presence of huge mud banks migrating along the coastline. This original mobile morphodynamical system is a source of real issues in terms of coastal management (e.g. access to Cayenne and Kourou harbours). Numerous uncertainties currently remain on the subtidal morphology of the mud banks as well as on the factors driving their migrating patterns.

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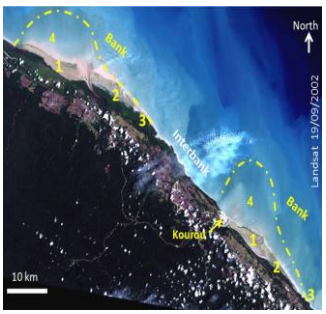


Gensac, 2012

The improvement of the quality of the recent **high spatial resolution s**atellite sensors (**Landsat 8 OLI, Sentinel-2**) can provide new insights into the understanding of the hydro-sedimentary processes related with the amazonian mud bank system through the quantitative assessment of the bio-optical products distribution such as SPM, for example. A better comprehension of the migration of the mud banks system needs the developpment of a hydro-sedimentary model that will be able to reproduce the local characteristics. This activity will be realised thanks to the adaptation of an existing **hydro sedimentary model** (**TELEMAC,** Coll, CEREMA) already tested in French Guiana coast.

Objectives of the PhD:

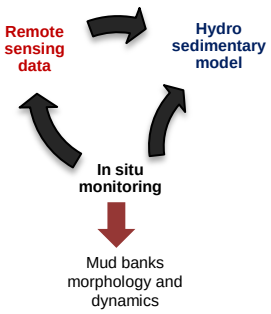
✓ Marine extension of the mud banks in FG

✓ Impact of environmental forcings on mud banks characteristics and migrating rates

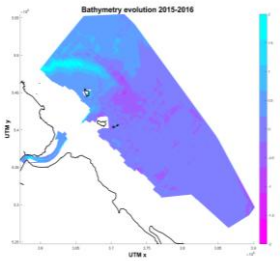
✓ Develop tools from high resolution remote sensing data to quantify SPM, mud bank position and other products (e.g. CDOM)

✓ Contribute to build the first hydrosedimentary model (TELEMAC) that could help for forecasting

METHODOLOGY



In situ monitoring



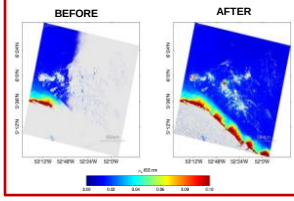
• Calibration and validation of the hydrodynvamic model: measurements of turbidity, salinity, current velocity, tide, bathymetry,etc
• Development and validation of the remote sensing observation and interpretation of the RS data (e.g. link surface/bottom)

Remote Sensing Data

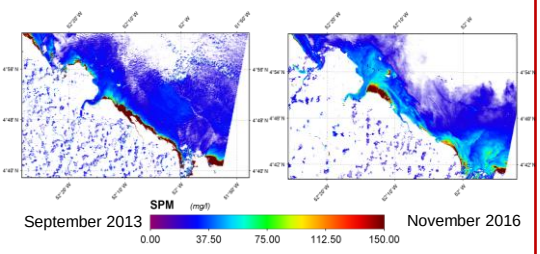
Remote sensing data allows to have better insights of the mud banks systema through the quantitative assessment of:
- **SPM distribution** (mud bank subtidal extension, migration rates)
- **CDOM distribution** (local river plume extension)

→ *Valuable data for developing and validating a first local hydro-sedimentary model*

→ **Development of a Sun Glint correction algorithm** for high resolution data satellites: preservation of the reflectance over non glinted areas:

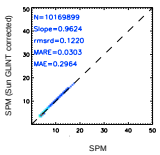


Kaw mud bank evolution:



September 2013 — November 2016

SPM derived from the R_{rs} (665) (Han et al, 2015)

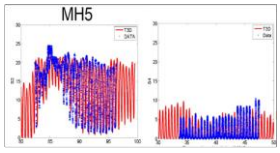


No modification of the SPM restitution after application of the sun glint correction method developped

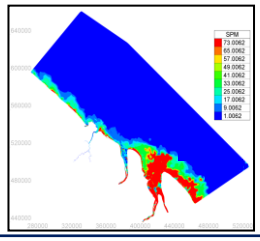
Hydro sedimentary model

The hydrosedimentary model (TELEMAC) allows to:
• Have a better understanding of the interaction between mud banks and the different dynamic forces (tide, waves, Guiana current, etc)
• Have a better knowledge of the mud banks migration

Modelling processing chain:
• 2D Hydrodynamic model
• 3d Hydrodynamic with salinity transport
• 3D Hydrodynamic model with waves and sedimentary transport



-Example of in-situ salinity values used for the calibration and the validation of the TELEMAC hydro model: level and general trend → correct, but still uncertainties
→ Sensitivity of the offshore boundary



Integration of the SPM (mg/l) data coming from high resolution satellite data into the mesh of the TELEMAC model used as SPM **initial condition** at the surface of the model

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ON GOING WORK AND PERSPECTIVES

- Hydrosedimentary model:
  - Incorporation of a local consolidation model
  - Adaptation of Gratiot settling velocity to the TELEMAC model
  - Comparison of the results of the TELEMAC friction law with the KUL friction law
  - Comparison between the results obtained with the model and the HR SPM satellite data
- Remote sensing data:
  - Valorisation of the sunglint correction method & automated procedure (Abascal Zorrilla et al., in prep.)
  - Evaluation of atmospheric correction schemes (more match-ups exercises)
  - Comparison of the developped local algorithms to estimate the bio-optical products with the general ones
  - Analysis of the seasonality of SPM data
  - Comparison of MR data with HR data to better characterise mud banks migration