SPOT4 (Take5) Experiment: simulation of Sentinel-2 time-series to monitor the maximum turbidity zone of tidal estuaries

SPOT 4 / Take 5 User Workshop

19/11/2014 – CNES Toulouse

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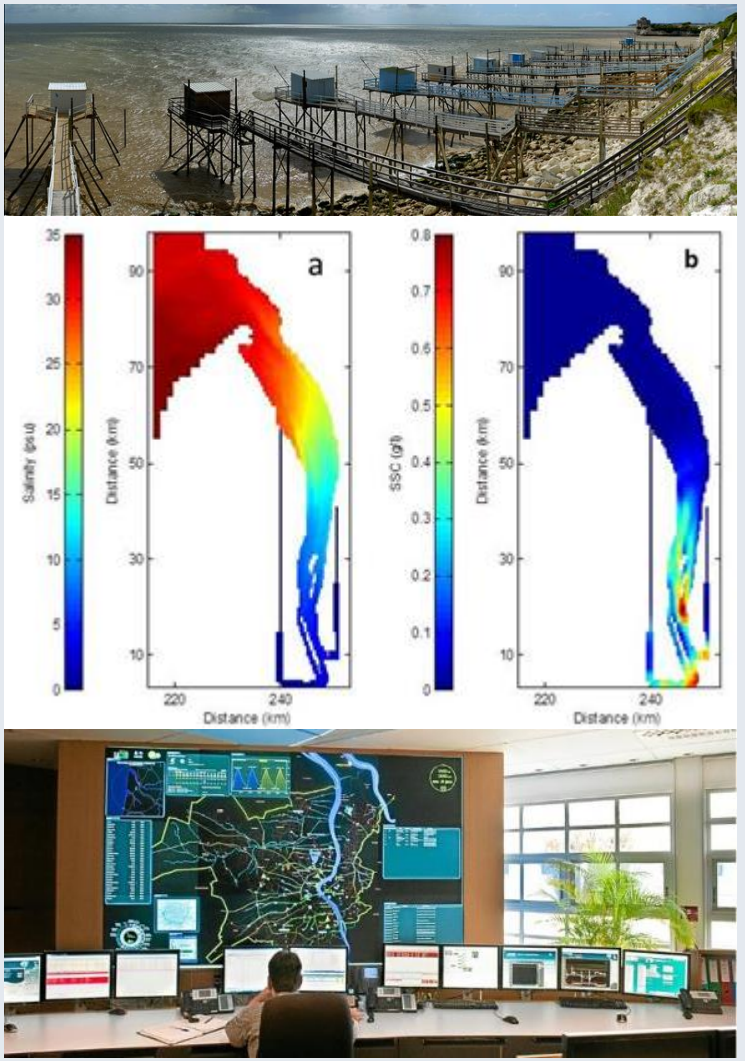
Main issues in very turbid estuarine environments

- Scientific issues
  - Understanding MTZ dynamics (2D / 3D): high SPMs, low O2.
  - Hydro-sedimentary processes understanding and modeling
- Conservation issues
  - Natural heritage protection
  - Water quality (WFD)
- Industrial and socio-economic issues
  - Fisheries & aquaculture
  - Navigation & harbour activity
- Management issues
  - Waste water discharge
  - Nuclear power station cooling



Existing image products

Gironde: the widest estuary in western Europe

MTZ caracteristics in the Gironde:

- several tens of km long;
- magnitude of mouvement: about 100 km

- Downstream section (2 to 12 km width): medium resolution imagery, MODIS HR wavebands
  - Level 1A
  - Level 2 SR (surface reflectance) - http://reverb.echo.nasa.gov/reverb

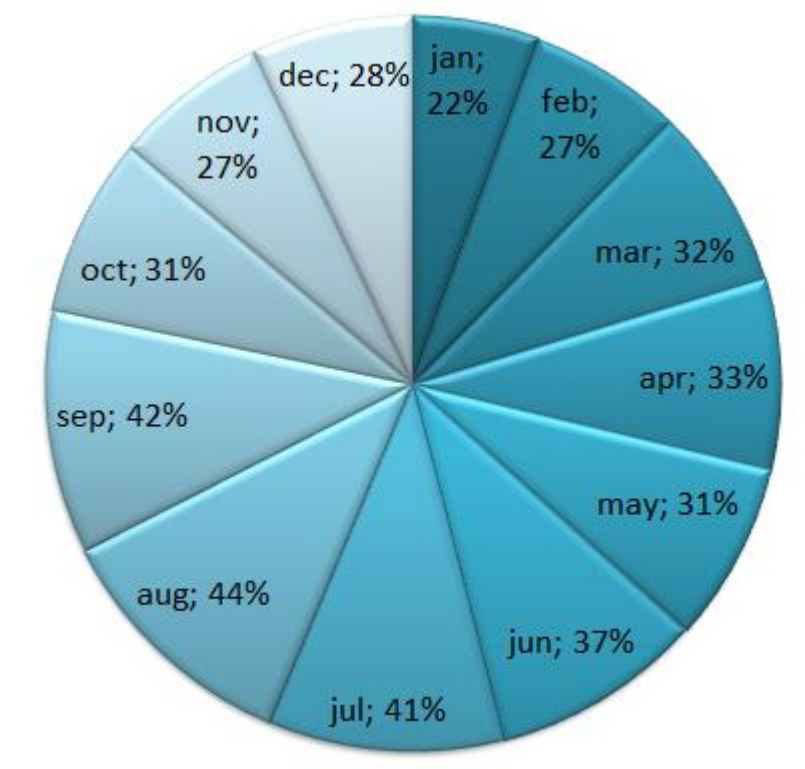
  ➡ Sentinel 3

- Upstream section (<100 m to 2 km): high resolution imagery
  - Landsat imagery
  - SPOT4 (Take5 experiment)
  - Rrs Products (TOSCA Landsat, Theia Pole - http://www.ptsc.fr/)

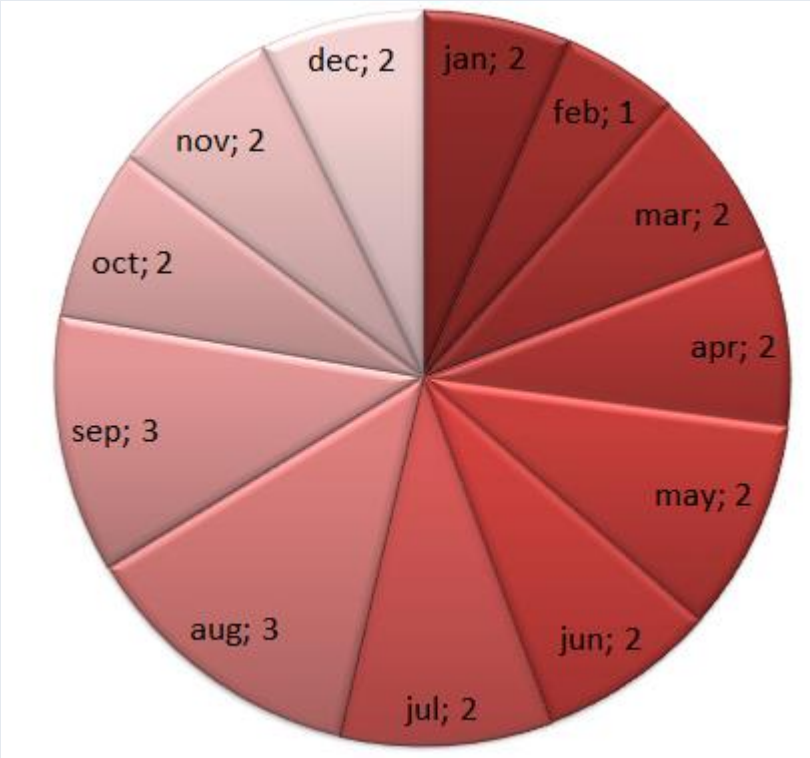
  ➡ Sentinel 2

Future S2 observation database of the Gironde estuary simulated from MODIS observations

- MODIS : July 2002 – april 2014



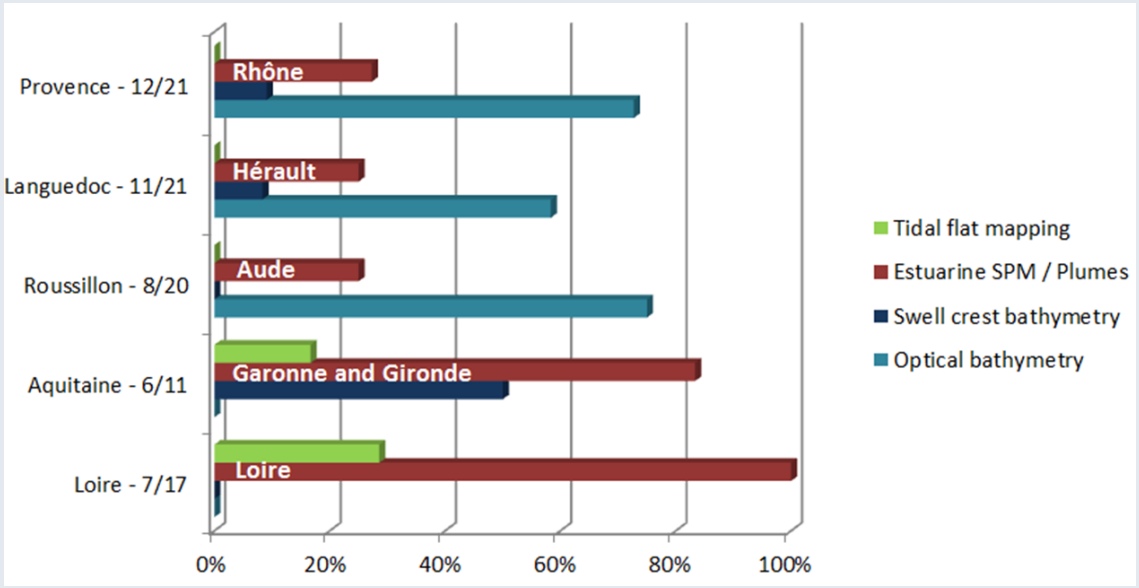
- Simulation S2 - HR

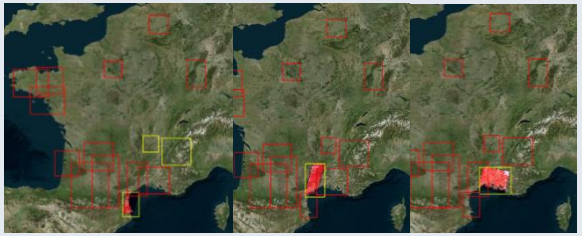


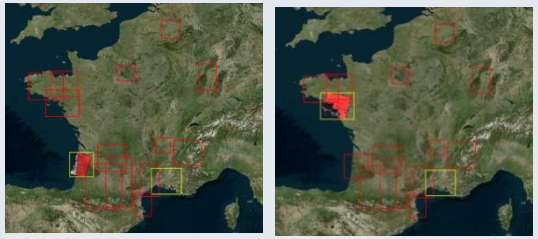
Copernicus constellation : a major data provider for coastal observatories

- **Observations at regional scales**
- **Frequent update**
- **SAR and/or MR/HR colour acquisitions**

- **SP4 – Tk5: Sentinel 2 simulation for MTZ monitoring**



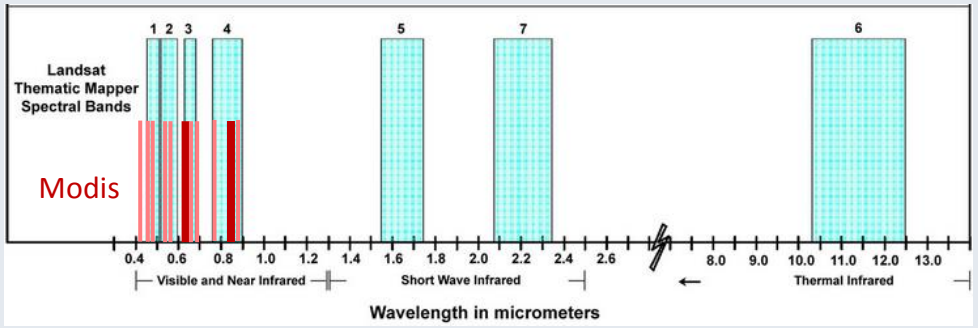


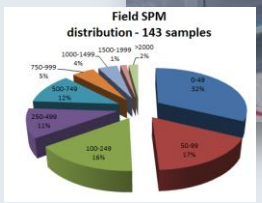


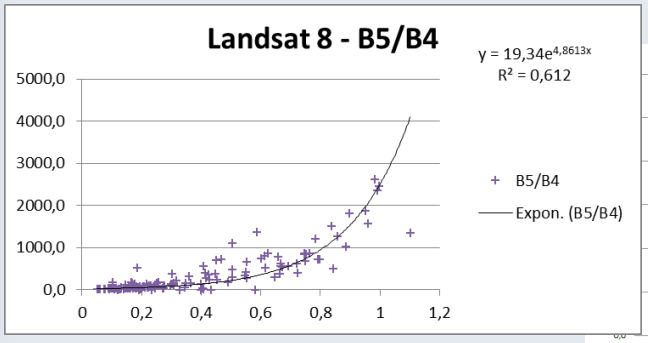
Conception and validation of the SPM algorithms

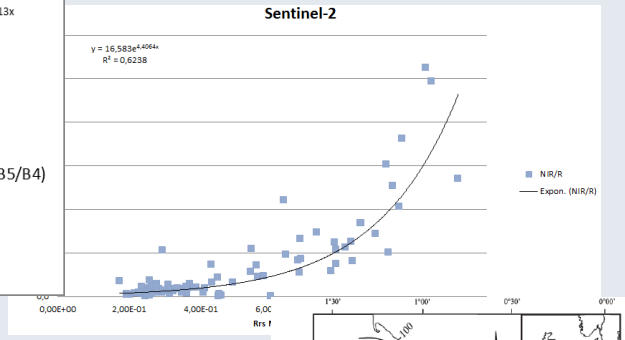
MODIS (*Doxaran et al., 2009*):

SPM=12,996*exp((Rrs_859 ou SR_859/Rrs_645 ou SR_645)/0,189)

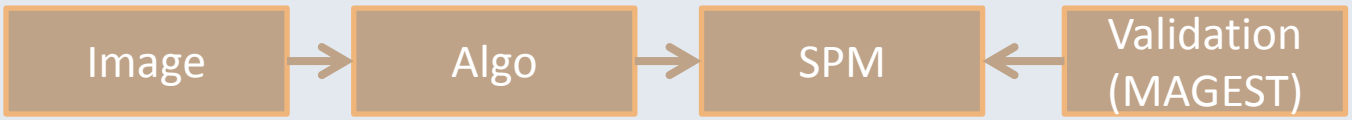


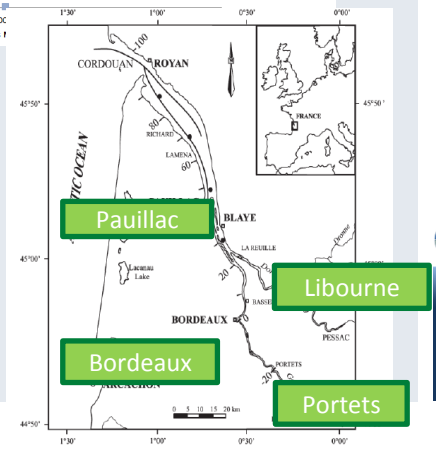






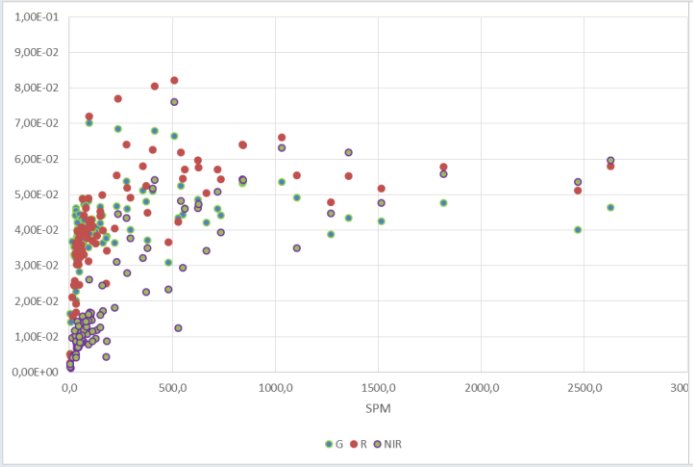
$R_{rs} = (L_w - \rho * L_{sky})/E_d$ *(ρ : réflectance de Fresnel à l'interface air-mer)*

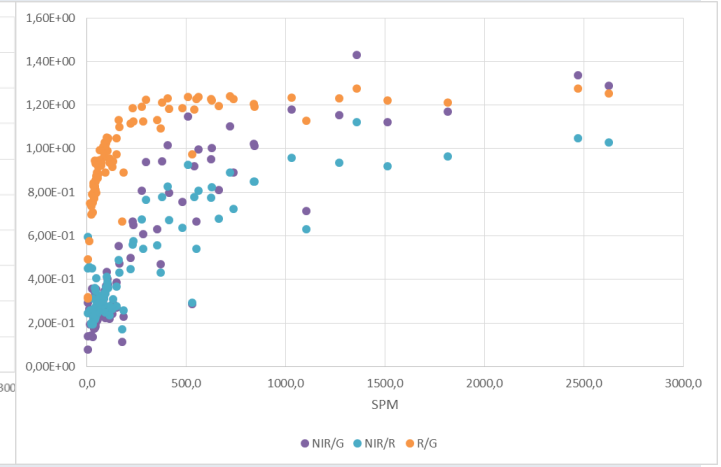




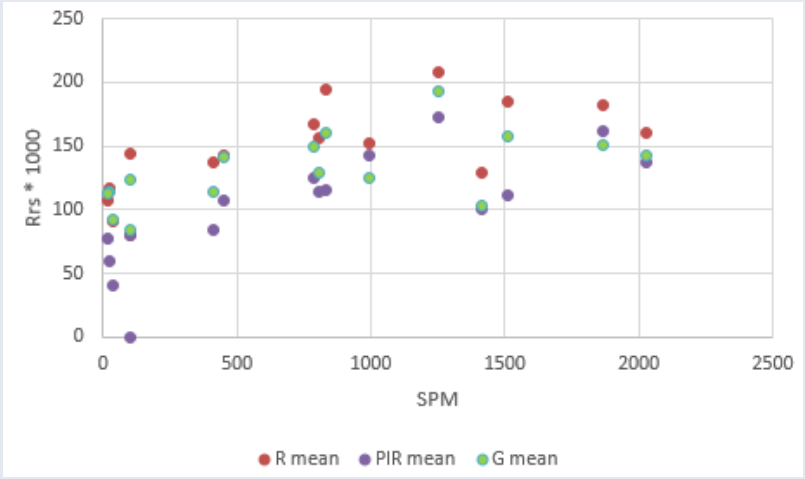
Sensitivity analysis

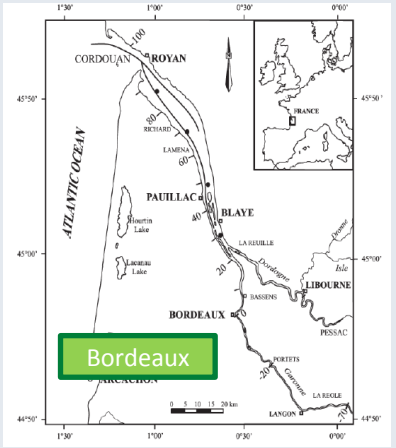
- Field data





- HR products

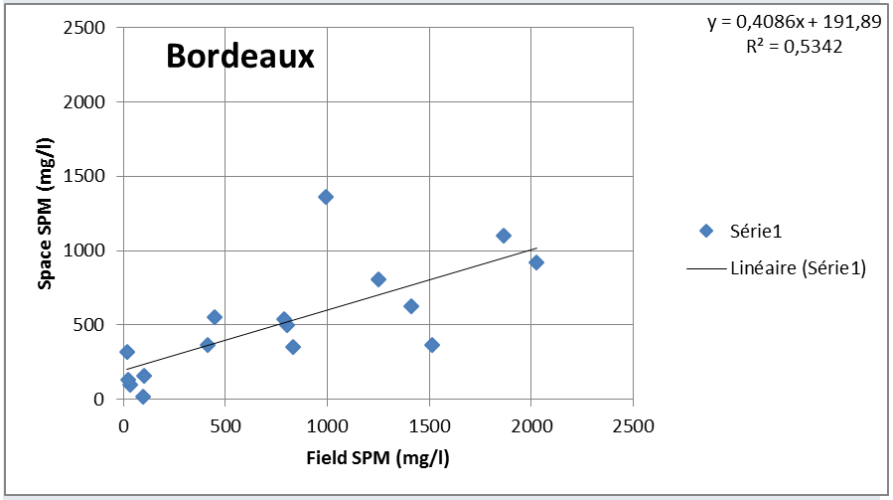




Accuracy of space SPMs

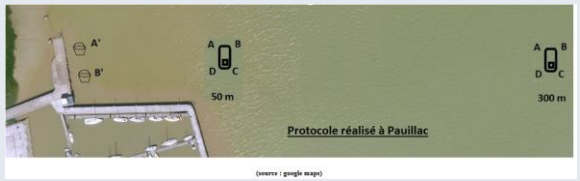
Results

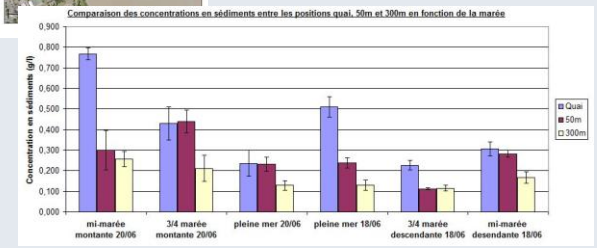
- NIR/R as proxy
- TOC derived with slope correction
- L5 + L7 + L8 + SP4/Tk5
- 2011 & 2013



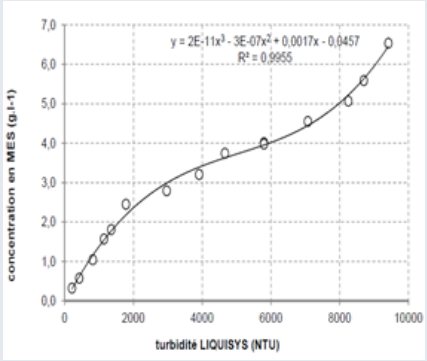
Expected improvements

- Database growth
- MAGEST vs pixel location



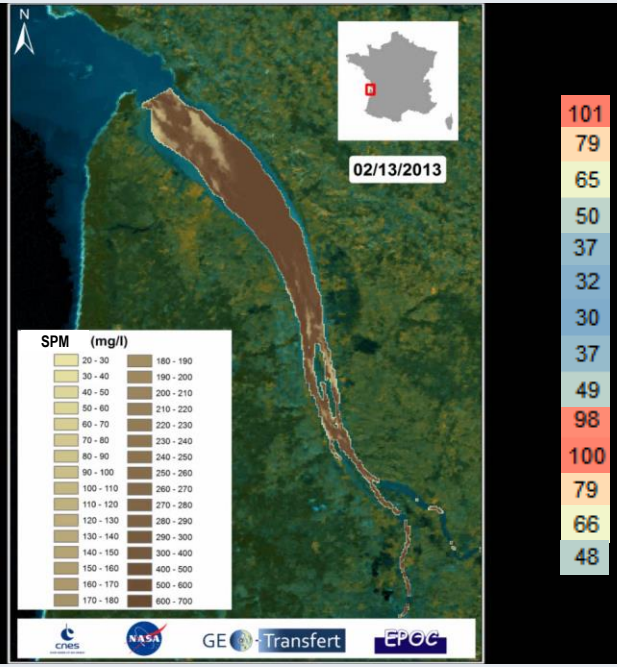


- NTU vs SPM
- Consideration of Bidirectional effects

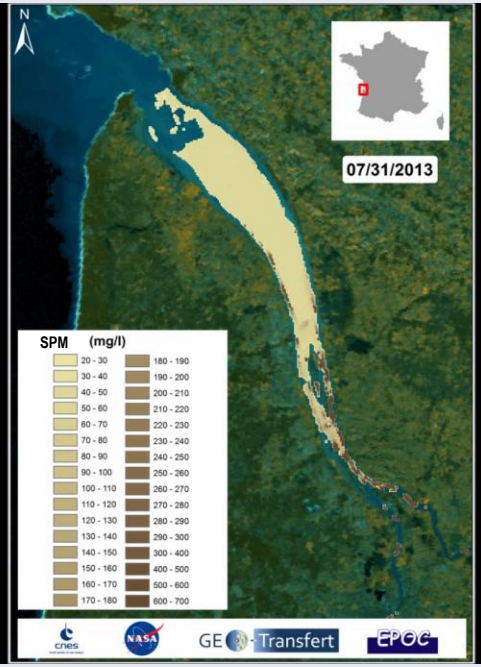


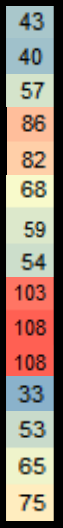
Temporal series production

Flood



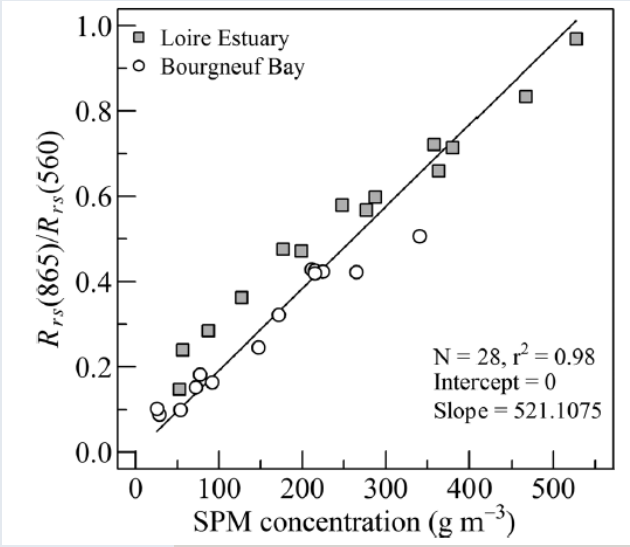
Low water



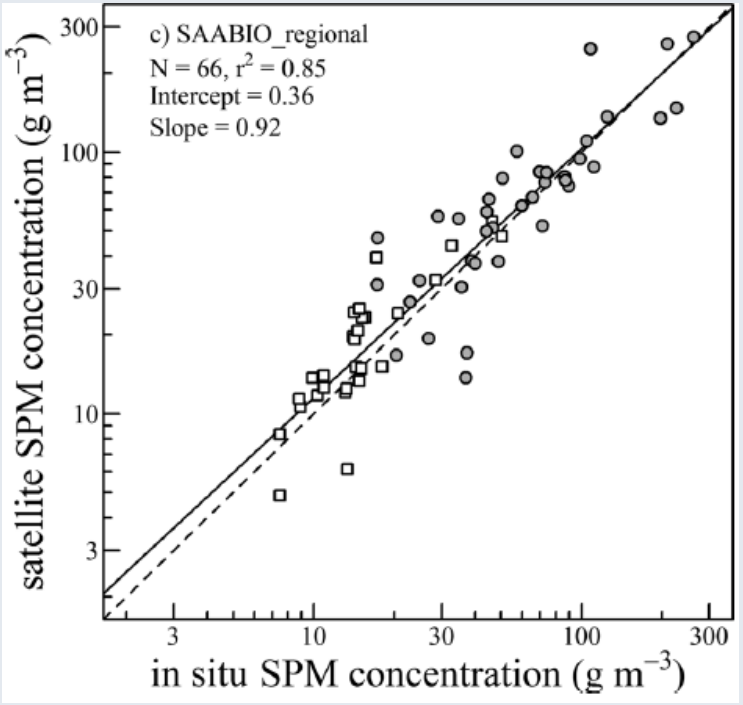


Loire experiment (MR)

- MERIS FR algorithms



- Validation in the Loire estuary and Bourgneuf Bay



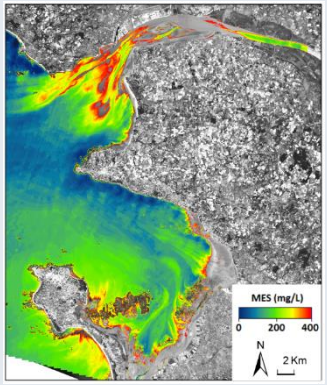
Journal of Geophysical Research: Oceans

Remote sensing of suspended particulate matter in turbid oyster-farming ecosystems

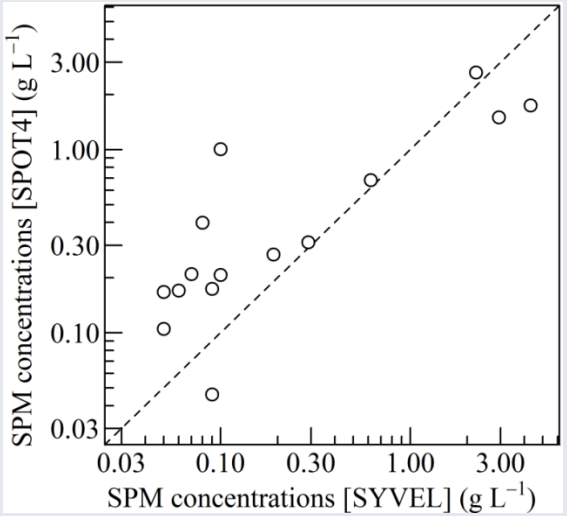
Pierre Gernez[1], Laurent Barillé[1], Astrid Lerouxel[1], Constant Mazeran[2], Axel Lucas[3], and David Doxaran[3]

Loire Experiment (SP4 – Tk5)

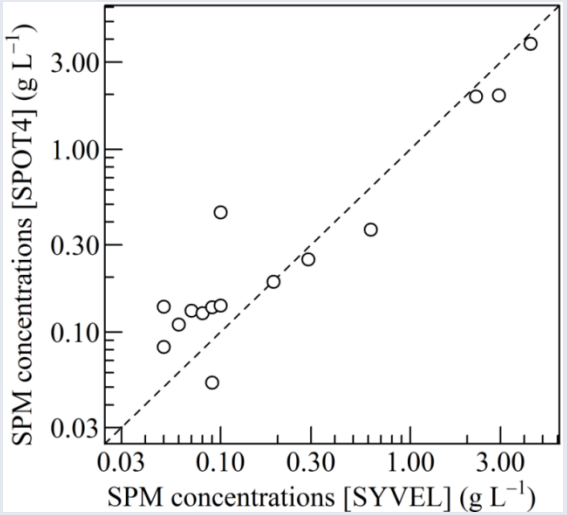
- SPM derived from SPOT4 data using XS3/XS1 R_{rs} band ratio (Doxaran et al., 2003).
- Field SPM data acquired by SYVEL automated turbidity network SYVEL (GIP Loire Estuaire).



- Nearest pixel



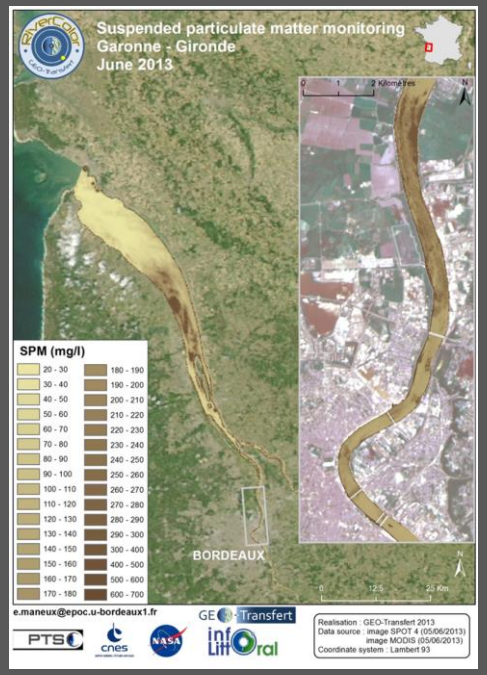
- Average or five pixels excluding the nearest one



Conclusions & Perspectives

- Success of the SPOT4 / Take 5 experiment (data delivery and data processing by CNES) to analyze the water turbidity changes from inland water body inlets upstream the rivers
- Paper will be prepared gathering the results of the HR experiment in the Loire and the Gironde (Doxaran, Gernez, Lafon, Lubac)
- ETM observatory:
  - RIVERCOLOR observatory of the MTZ in the Gironde is realized
  - MODIS and SPOT/LANDSAT integration to prepare S2 + S3 use in the ETM monitoring
  - Validation of the product is still undergoing
- OC measurement in estuaries must be compared to derive standard measurement procedures of SPM based on coupled MR and HR
  - AOPs field database obtained in the Gironde, Loire, Adour and Seine
- Multi-sensor Chlor *a* & POC algorithms are still under development

Many thanks!



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