Study Sediment Dynamics Using Gliders

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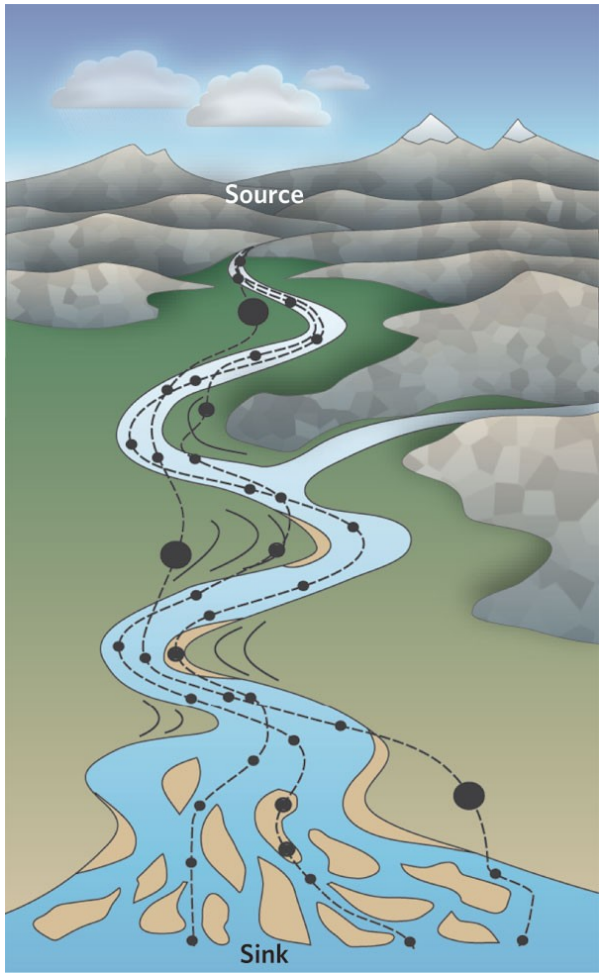
Why study Sediment Dynamics ?

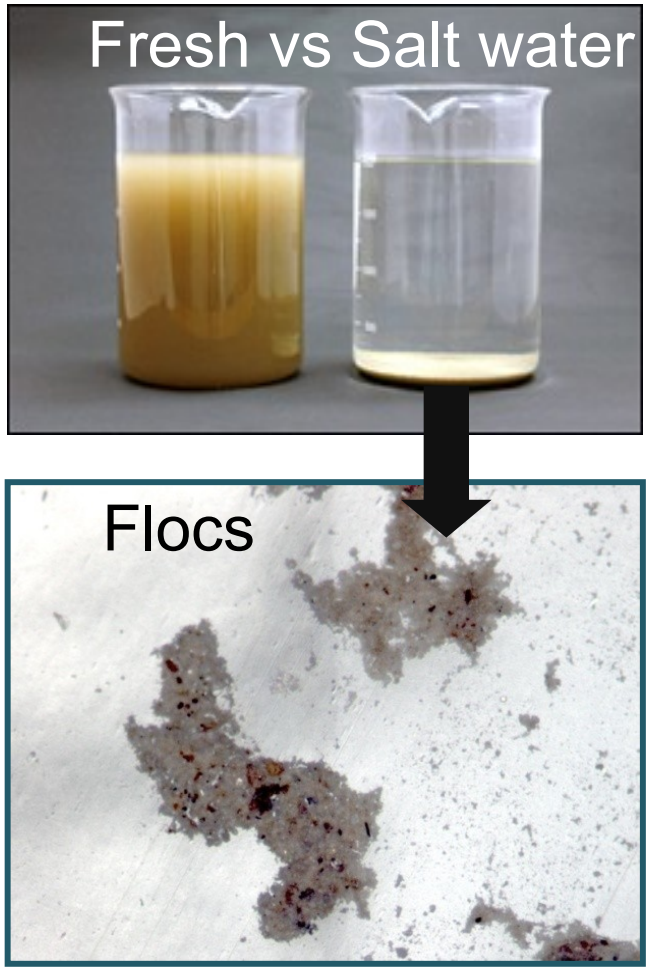
- Sediments ~ Particles: complex with organics & contaminants
- Land to sea transfer of particulate matter, carbon sequestration and sedimentation on continental shelves vs transfer to deep-sea
- Sediment records natural & anthropogenic processes at various timescales



Nature, 451 , 2008

How to study Sediment dynamics?

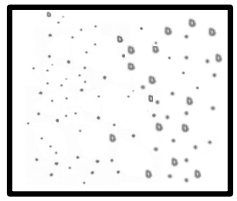
- Characterisation of Sediments (concentration, nature, size, shape, density => Ws)
- Dynamics: estimate fluxes for sediments, organics, contaminants
- Implementation in hydro-sedimentary models (sediment sizes, densities and Ws): regionalisation at larger scale

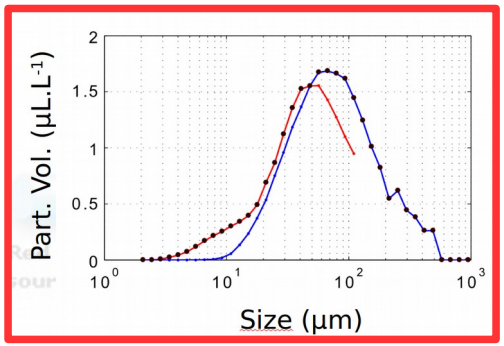


How to study Sediment dynamics: need sensors

- Optical sensors (more sensitive to fines):
  - Turbidimeters, BB meters (1): concentration
  - LISST: size spectra (2)
  - Holography: size & shape (3)
- Acoustic sensors (4):
  - Concentration
  - Motion

(1)





(2)

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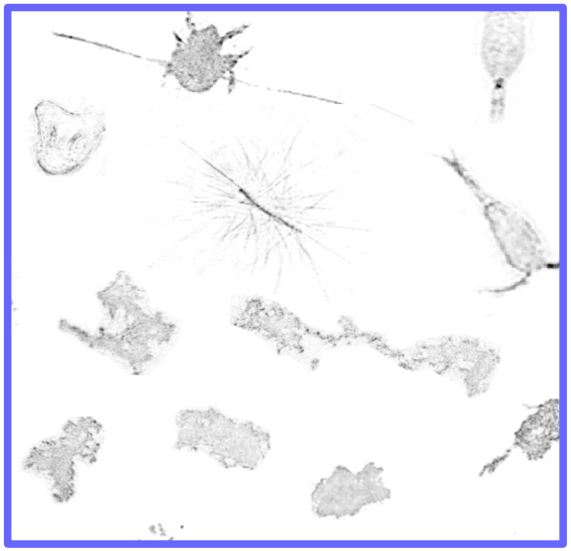
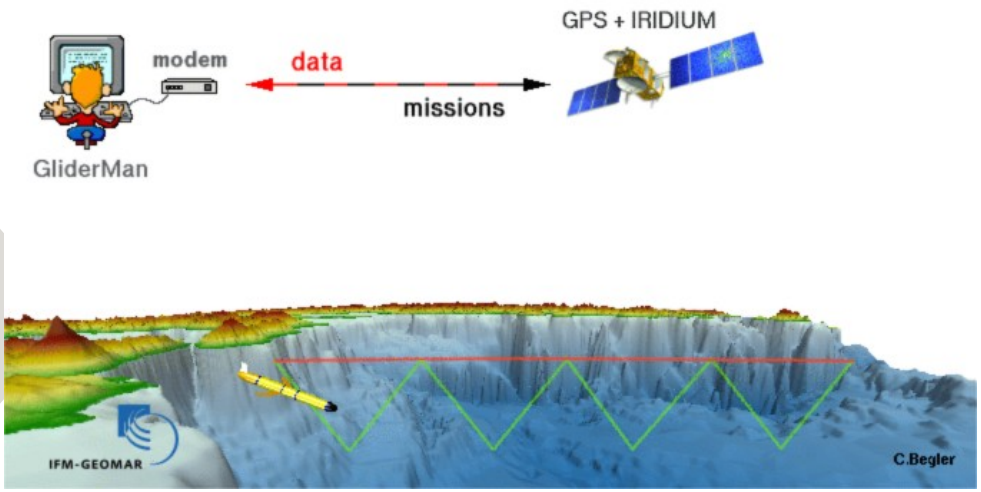
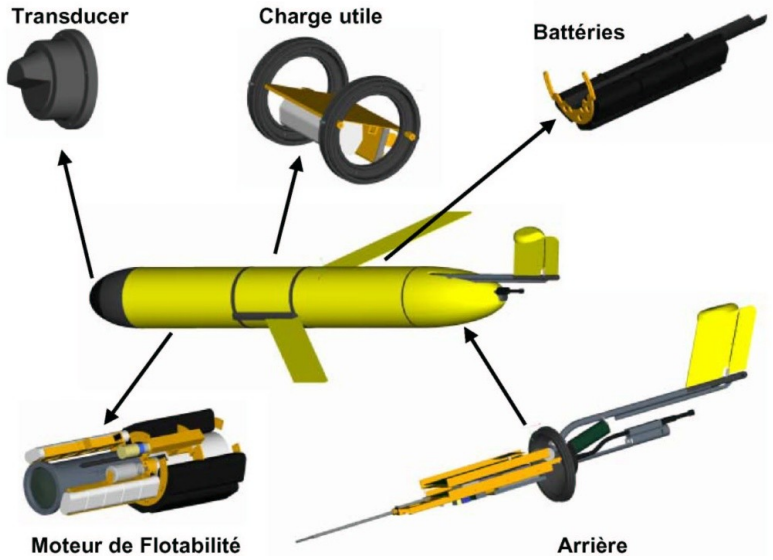


(4)

Why using glider?



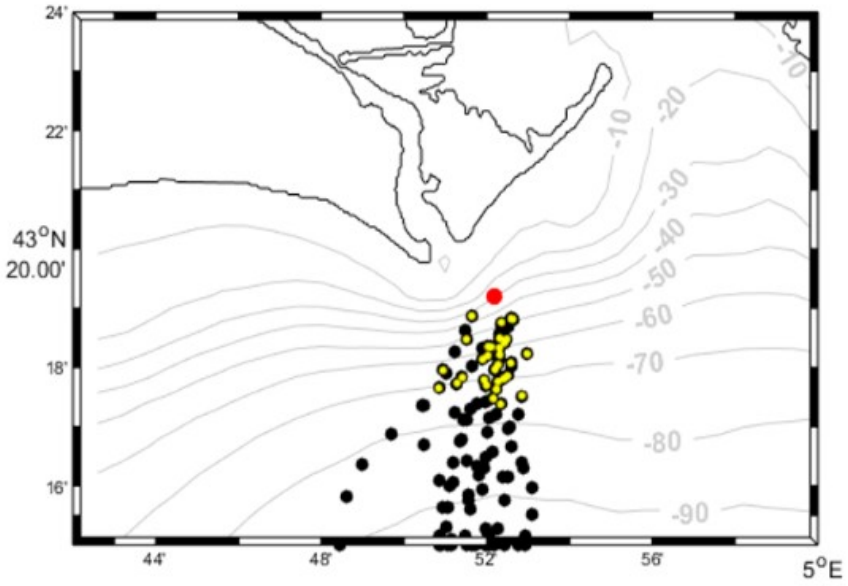


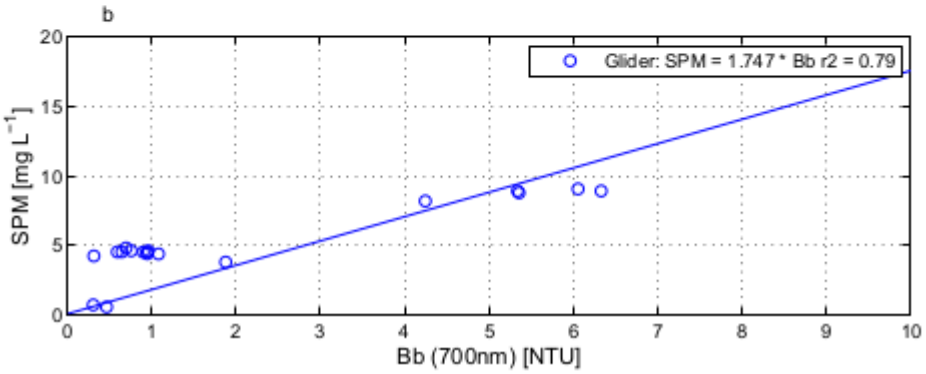
- Long-term (1 - 3 months), high-frequency measurements, deployment during intense events (floods & storms)
- Scientific payload: BB (various wavelengths), ADCP
- Typical mission from coast to offshore (20 to 200 m depth)
- , 1 mab (sediment resuspension) to surface (river plumes)

Sensor calibration: an important step!

- Difficult to calibrate the sensor alone
- Calibration using both sensor and platform
- Compare with other instruments (rosette CTD, same sensors, water samples for further analysis)
- Tricky in rough sea! And need of a large boat

Sensor calibration: an important step!





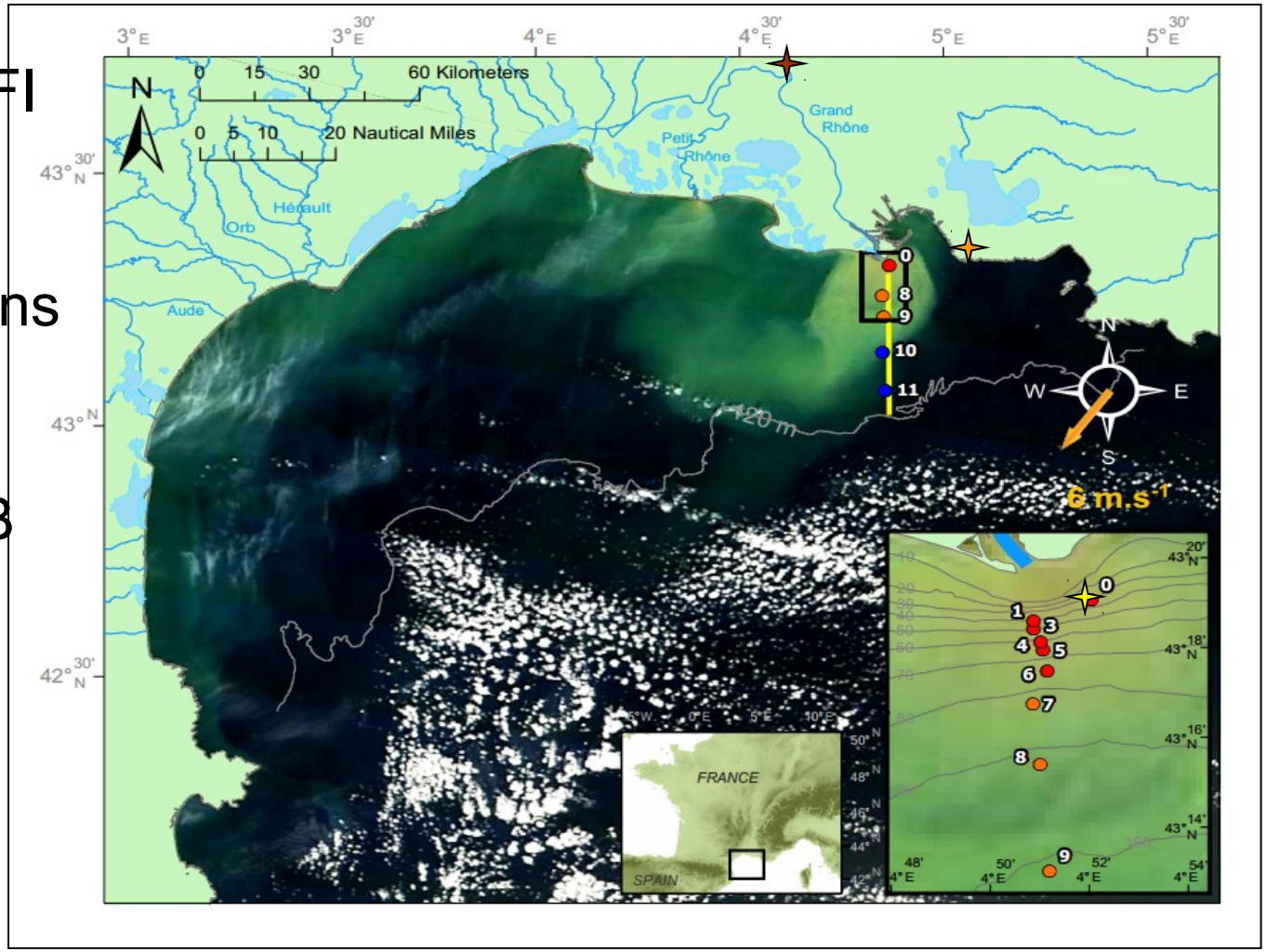
- Calibration with nearby buoys (and satellites)
- Optimize glider trajectory close to buoys
- Need to have same sensors on both platforms (each sensor is unique...)

Characterisation of particles during flooding conditions

Rhône River ROFI
February 2014

Flooding conditions
(4000 m^3/s)

Glider survey (BB 3 λ) & field campaign (CTD, LISSTs)



Many et al., 2016, JMS

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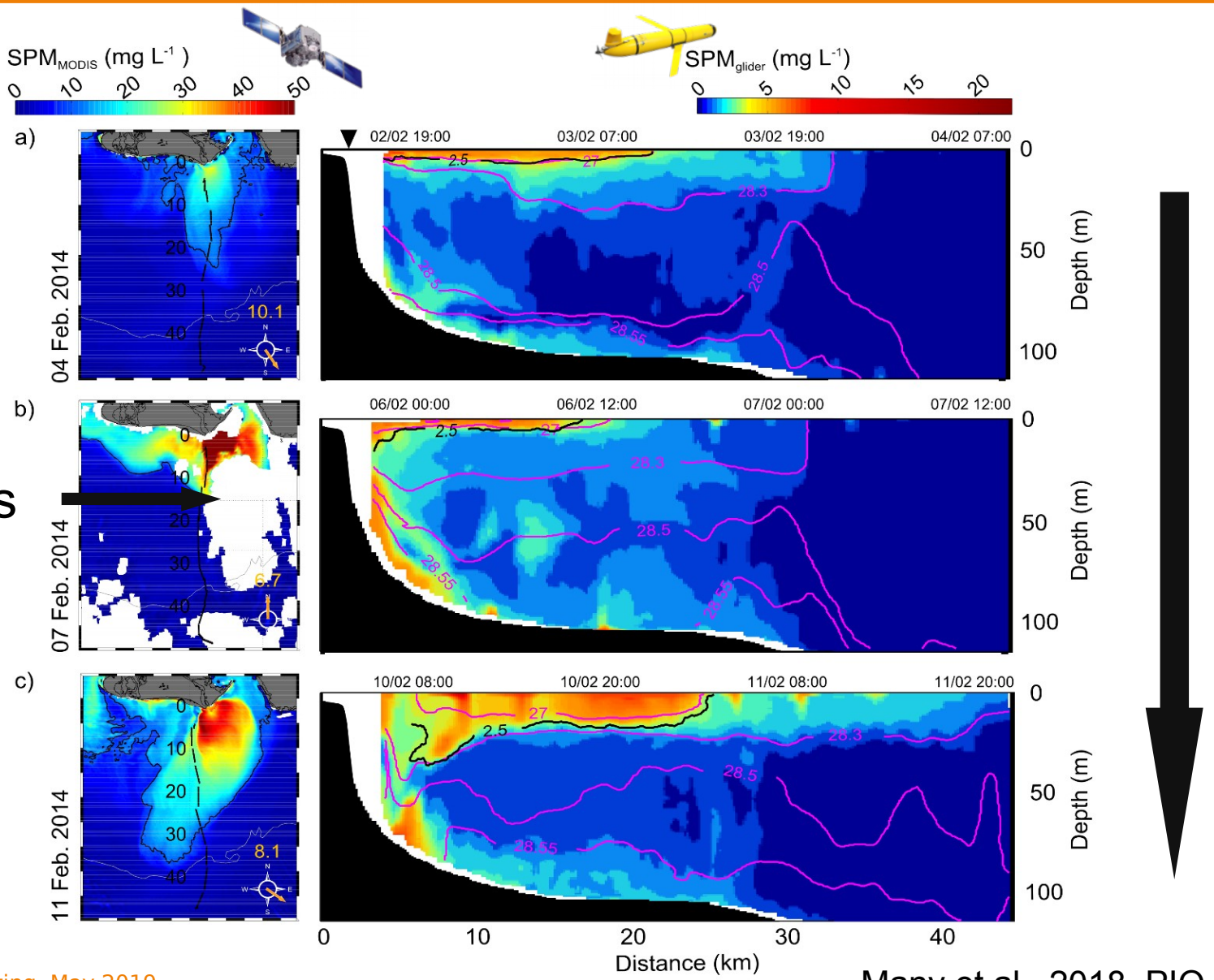
Match-up glider vs satellites for 3D Turbidity

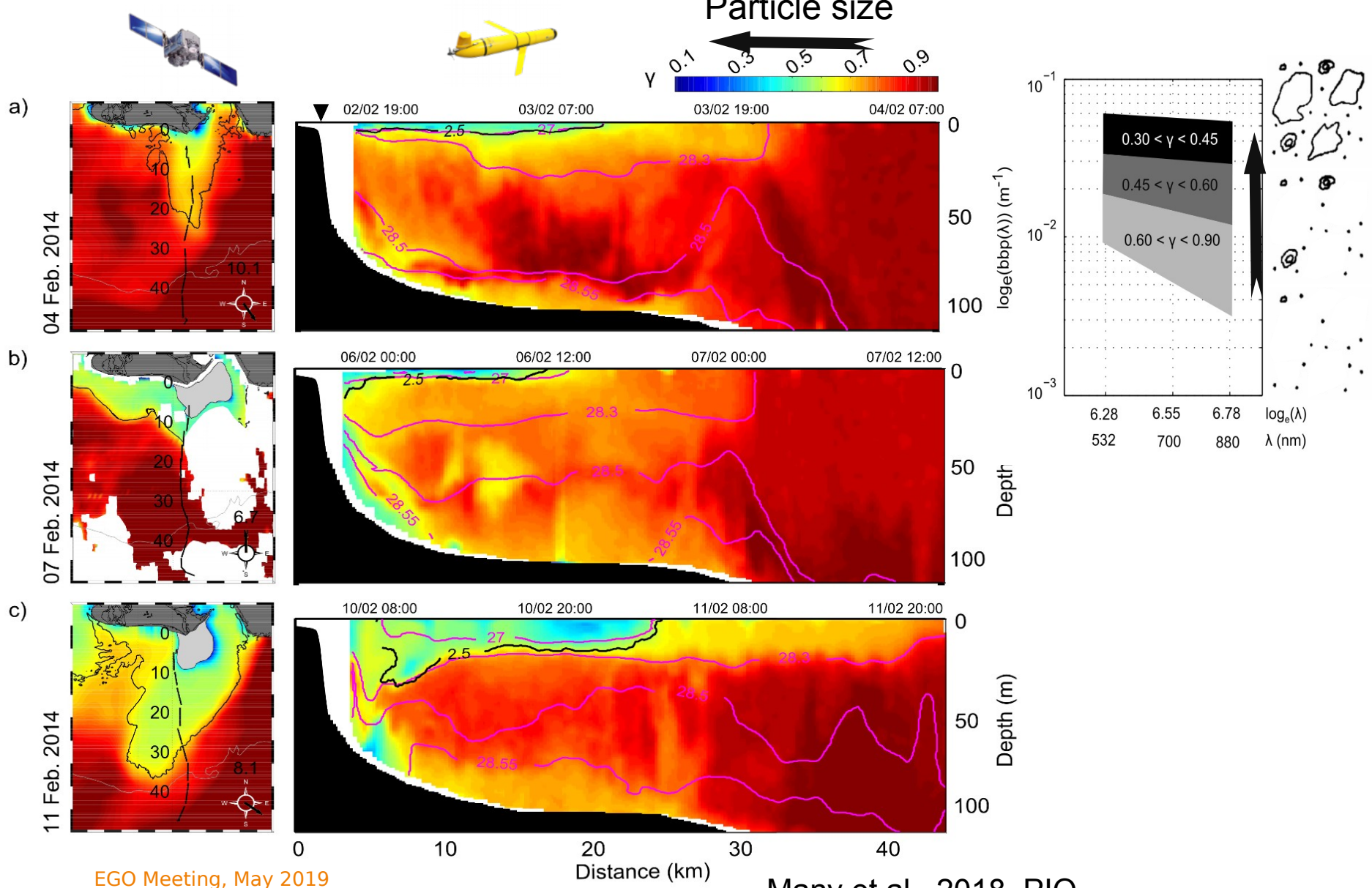


Clouds

Flooding discharge

Many et al., 2018, PIO

Match-up glider vs satellites for particle size index



Many et al., 2018, PIO

Estimation of Sediment Fluxes from Glider

- Measure both [SPM] and current velocity to estimate sediment fluxes [talk M. Gentil]
- Coastal Slocum Glider
- Optical: Wetlabs (@700nm) & Acoustic: DVL Explorer RDI 600 kHz (BB, 0.1 Hz, BT)

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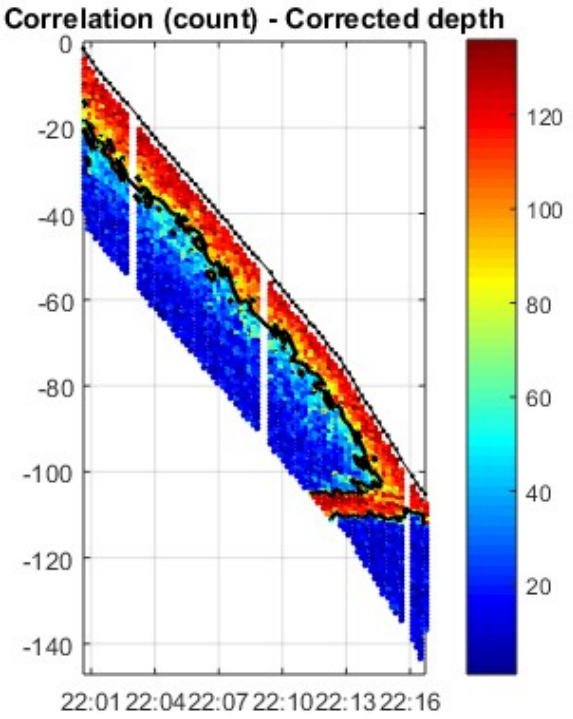
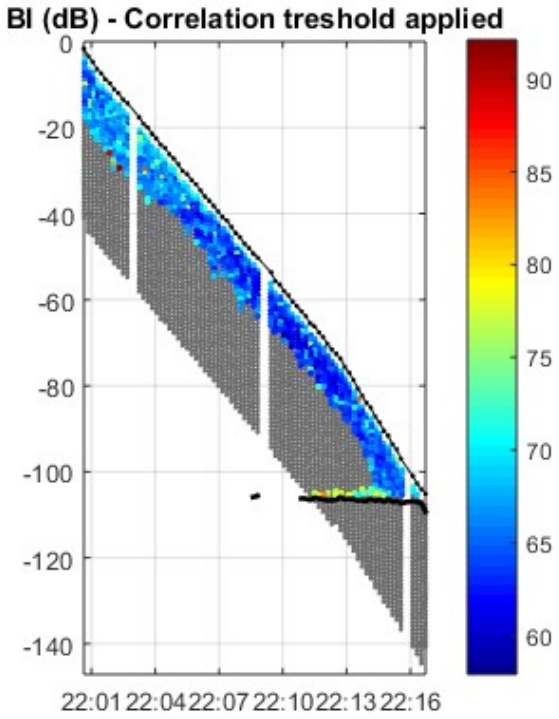
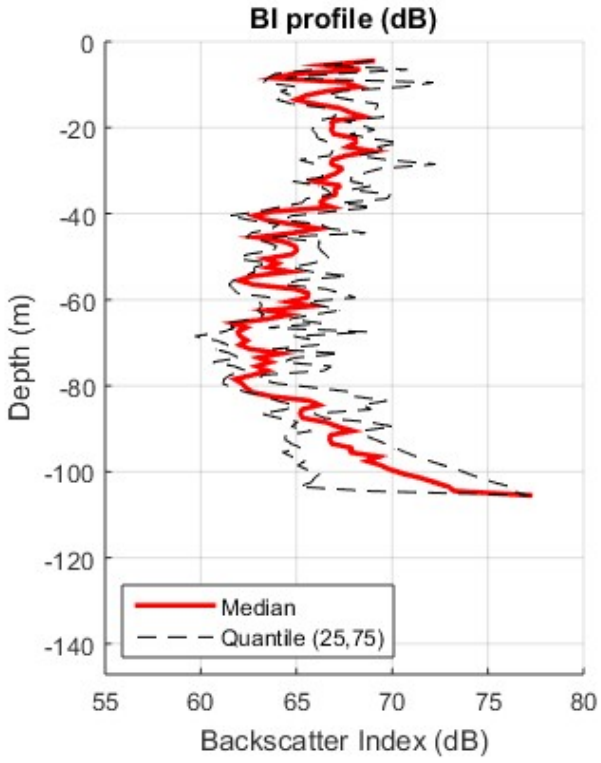
Backscatter index as a proxy of SPM





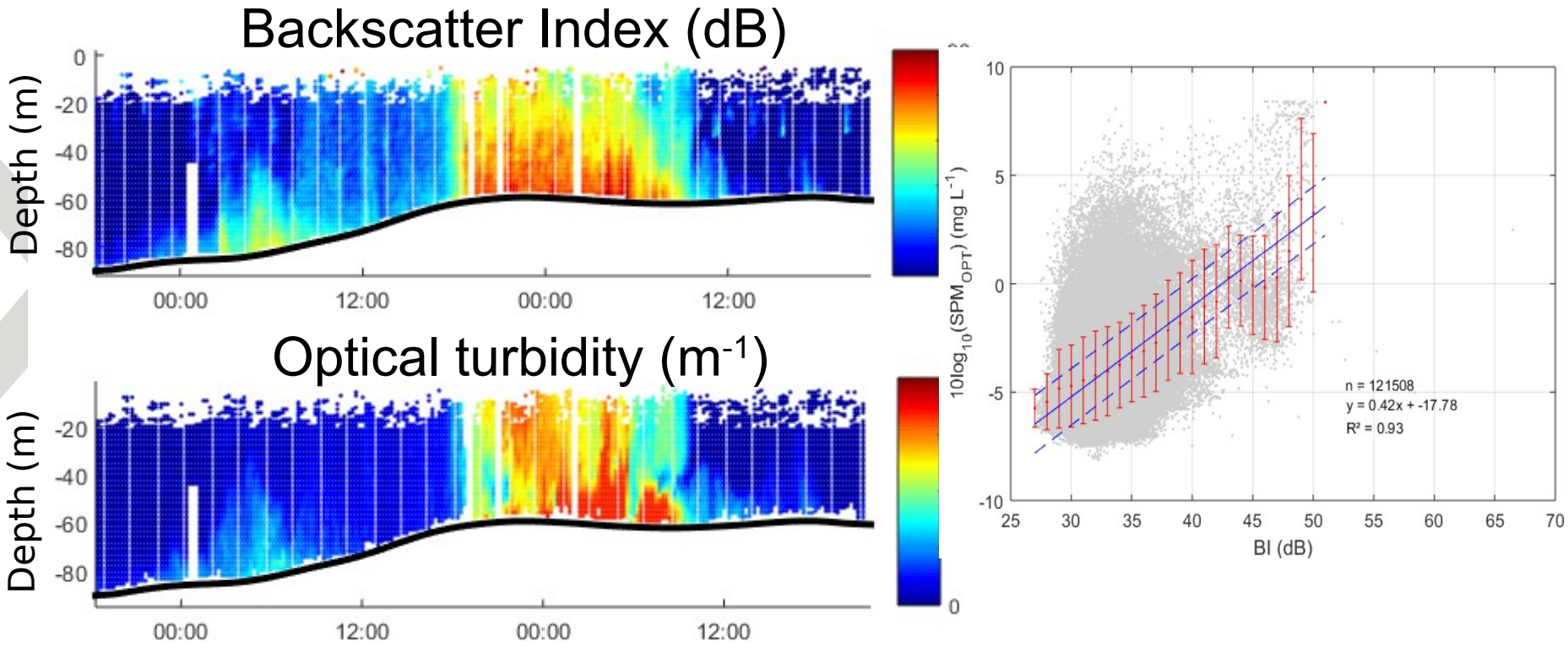


Backscatter estimate (*Mullison, 2017*):

$BI = 10 \log_{10}(10^{(Kc*(RL-Er)/10)} - 1) + TL_w + Tl_g$ (RL = raw signal from DVL Explorer)

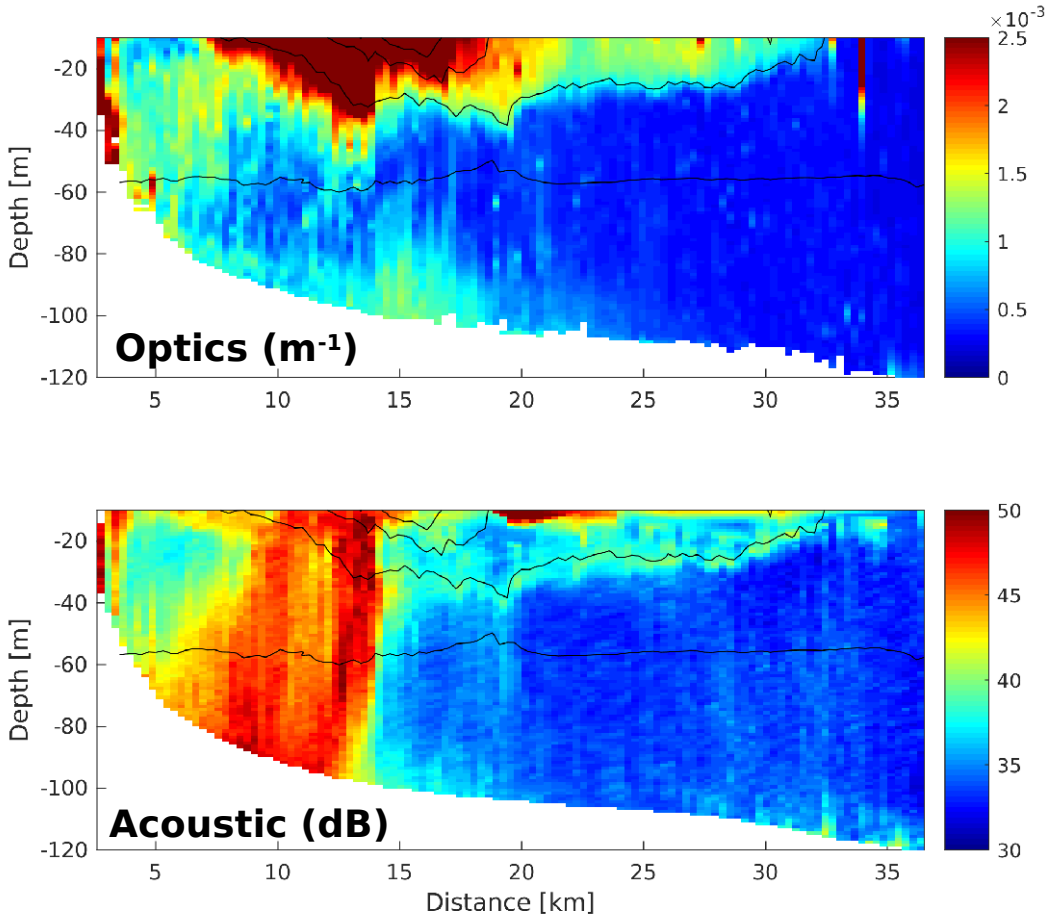
$10 \log_{10}(SPM) = a\ BI + b$

Optics vs Acoutic to estimate SPM



Rhône River shelf – November 2016

Optical vs Acoustic to estimate SPM

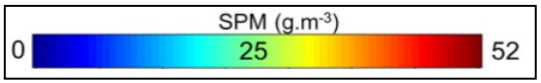


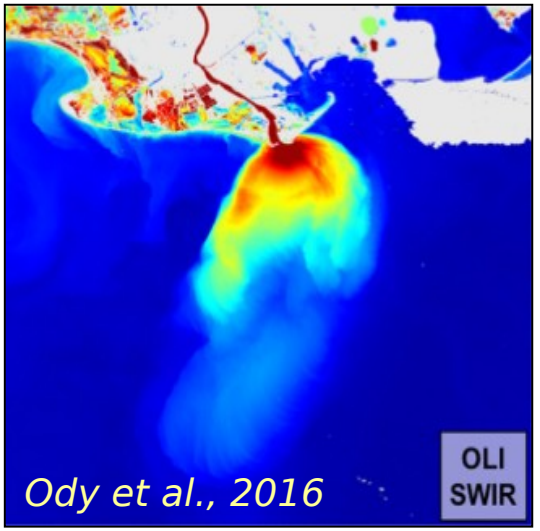
- Different signals = Different population of particles?
- Fines vs Small?
- Need in-situ grain size measurements to conclude

Rhône River shelf – February 2017

Summary

- Study particle dynamics need various sensors (optical, acoustics) and platforms to understand processes at various spatio-temporal scales
- Gliders are interesting tools for coastal oceanography (storms, flood events)
- Future: implementation of new sensors on glider (LISST, HOLO?, …) for particle size estimation





On-going collaboration with RU

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Thanks for your attention!

Questions?