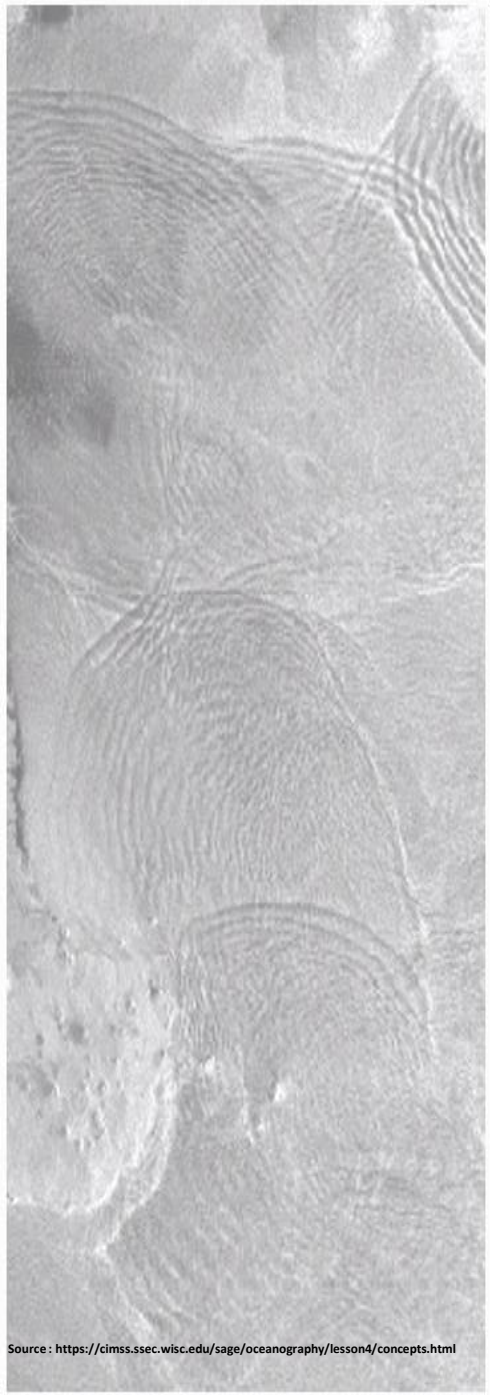
Source : https://cimss.ssec.wisc.edu/sage/oceanography/lesson4/concepts.html

Coastal current estimates from Glider mounted ADCP (Acoustic Doppler Current Profiler)

Centre of Education and Research on the Mediterranean Environments (CEFREM)

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8th EGO Meeting And International Glider Workshop
May, 2019

UNIVERSITÉ PERPIGNAN VIA DOMITIA

La Région Occitanie Pyrénées - Méditerranée

CEFREM

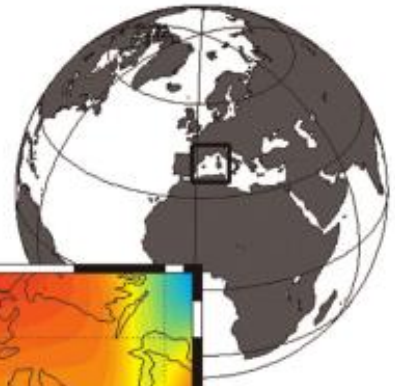
Background

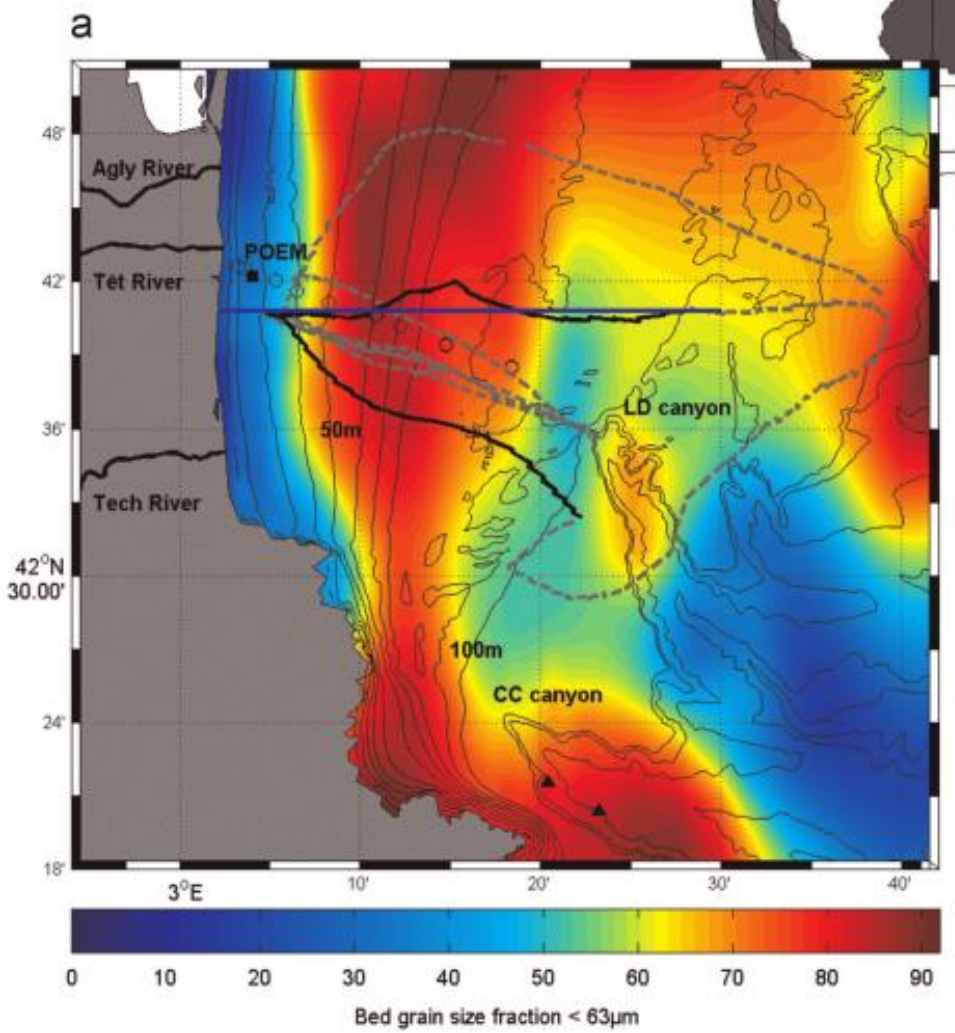
Aim :

- Measurement of currents and turbidity in coastal area
- Assess the impact of flood and storms events

Glider survey characteristic :

- Gulf of Lions
- February 2011 - April 2011
- Deployment of Slocum Glider (G2)
- Equipped with :
  - CTD sensor *(currents)*
  - Optical sensor *(turbidity)*





Bourrin et al., 2015

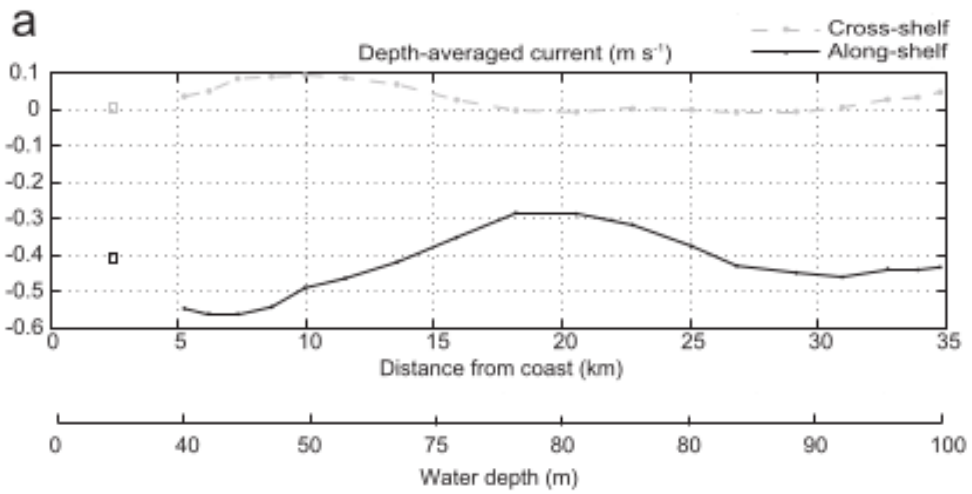
Background

Indirect current measurement from CTD sensor :

- Drift of glider between two surfacing (DAC)
- Geostrophic current estimation from (u):
  - gravity field
  - density gradient
  - Coriolis effect

$$u = -\frac{1}{f\rho}\frac{\partial p}{\partial y}; \qquad \textit{(1)}$$

During a storm and flood event



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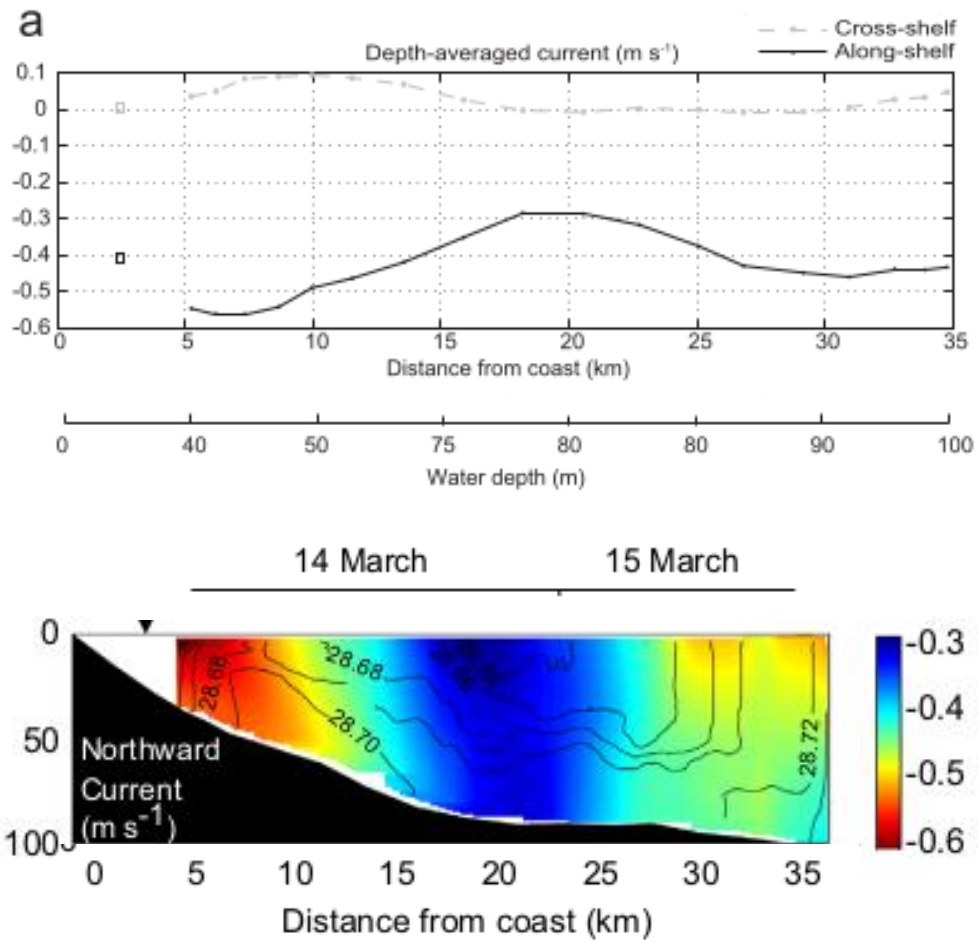
- Absolute currents :
  - Adjustment of geostrophic velocities

Uabs = u + DAC ***(2)***

During a storm and flood event



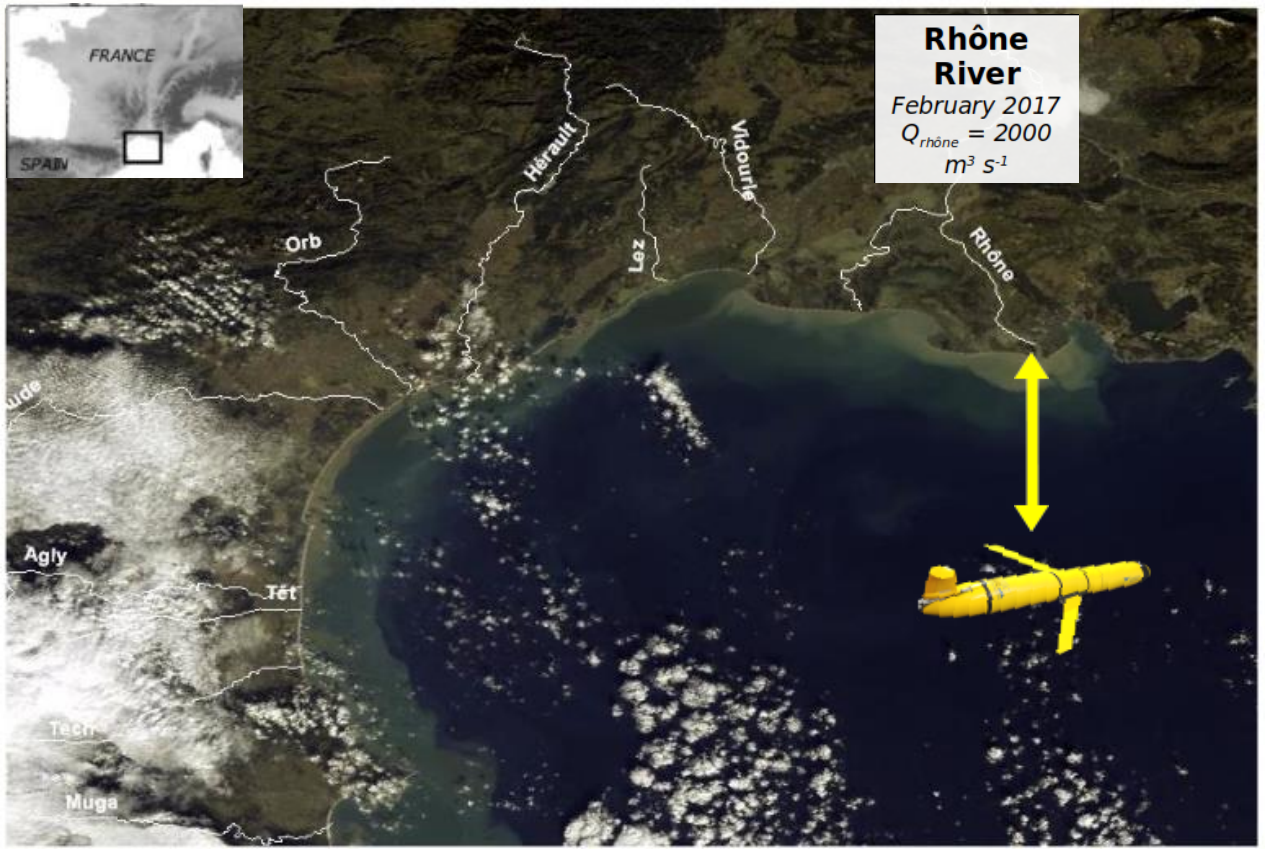
An adcp is used to improve the estimation of the vertical structure of currents

Bourrin et al., 2015

Glider Survey of the Rhône river mouth

Characteristic :

- February 2017 - March 2017
- Deployment of Slocum Glider (G2)
- Equipped with :
  - DVL : 600 kHz
  - Optical sensor : 2 wavelength (532/880 nm)
  - CTD sensor

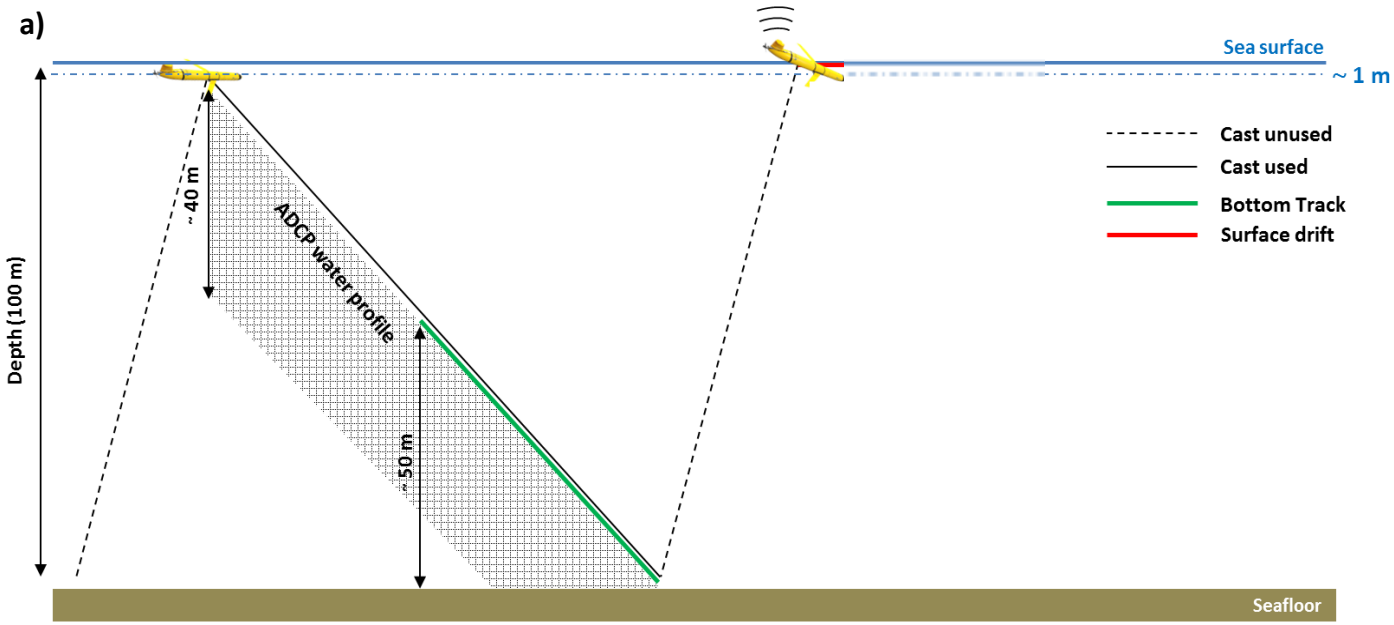


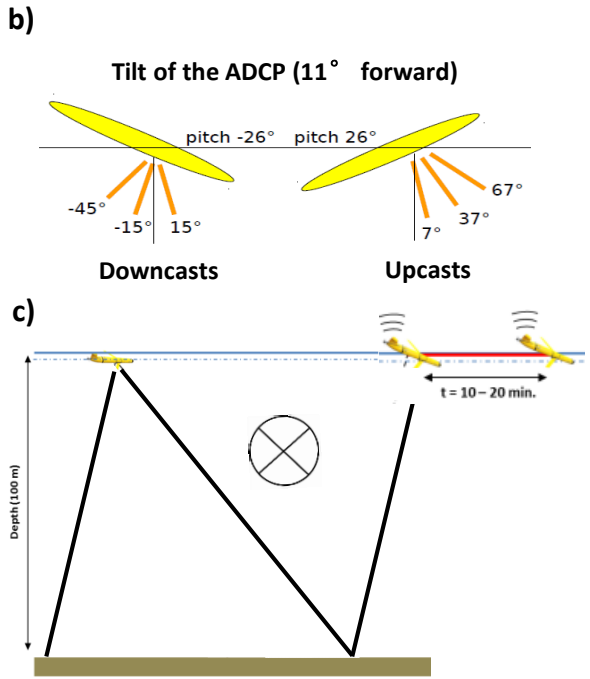
RDI DVL (Dopler Velocity Log) Explorer

Wetlab ECO puck

Un-pumped CTD SBE-41CP

Glider operation





ADCP data (a and b) :

- Acoustically derived relative velocities (u,v,w,BT)
- Acoustically derived suspended particle matter (SPM)

Downcasts only

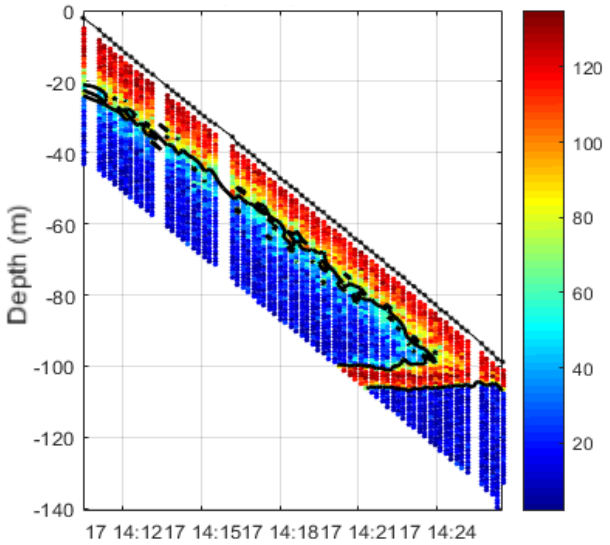
CTD, ECO Puck and Navigation data (c) :

- Depth average Current
- Surface Drift
- Geostrophic component
- Optically derived SPM (BB, CHL)

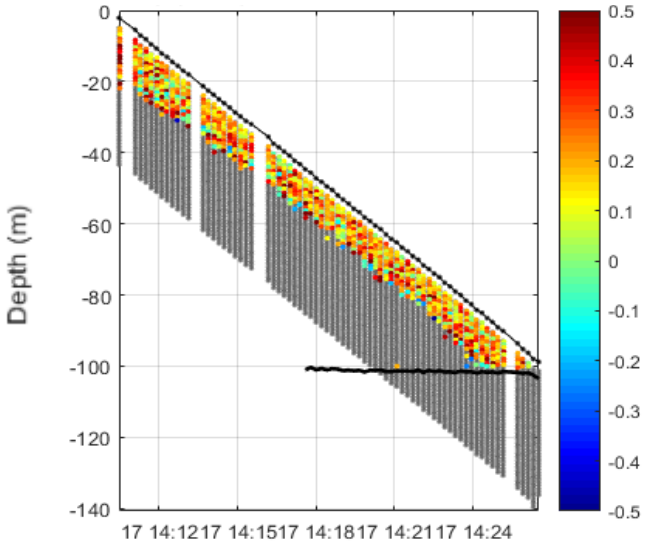
Downcasts/Upcasts

Reconstruction of relative velocity profiles

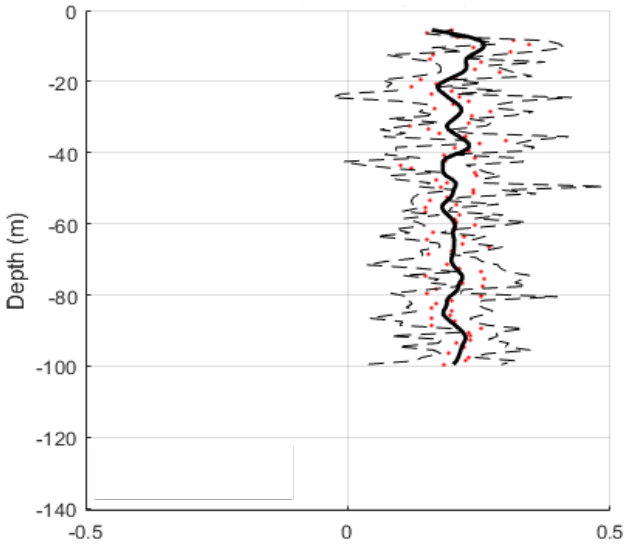
Correlation threshold (64 counts)



Filtered northward velocity (m.s^{-1})



Northward relative velocity (m.s^{-1})



in black solide line is the median
in dotted red line : quantile (25)
in dotted black line : quantile (75)

Application of a quality threshold:

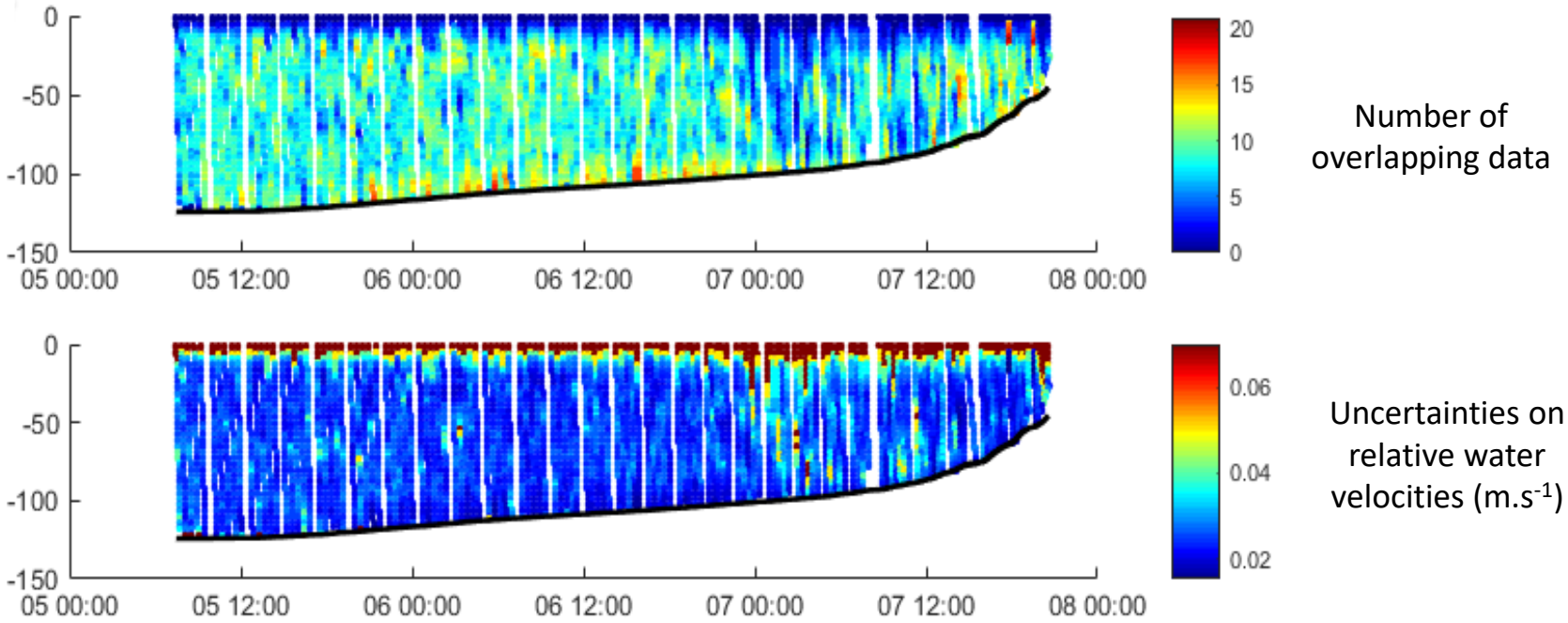
- Reduce the range of ADCP by 2

Stack of data (Fisher and Visbeck., 1992):

- Using a median on overlapping profiles

Many et al., in progress

Uncertainties on relative velocity profiles



Configuration:

- 1 ping = 1 profile ~ 10s
- Cell size : 1m
- Instrument error : 0.07 m s^{-1}

- **Uncertainties** is : 0.07/sqrt(N)

with N : number of overlapping data

Many et al., in progress

Glider Underwater Motion (GuwM)

Components of velocities :

$$Uadcp^{(z,t)} = Uglider^{(z,t)} + Uocean^{(z,t)} \quad (3)$$

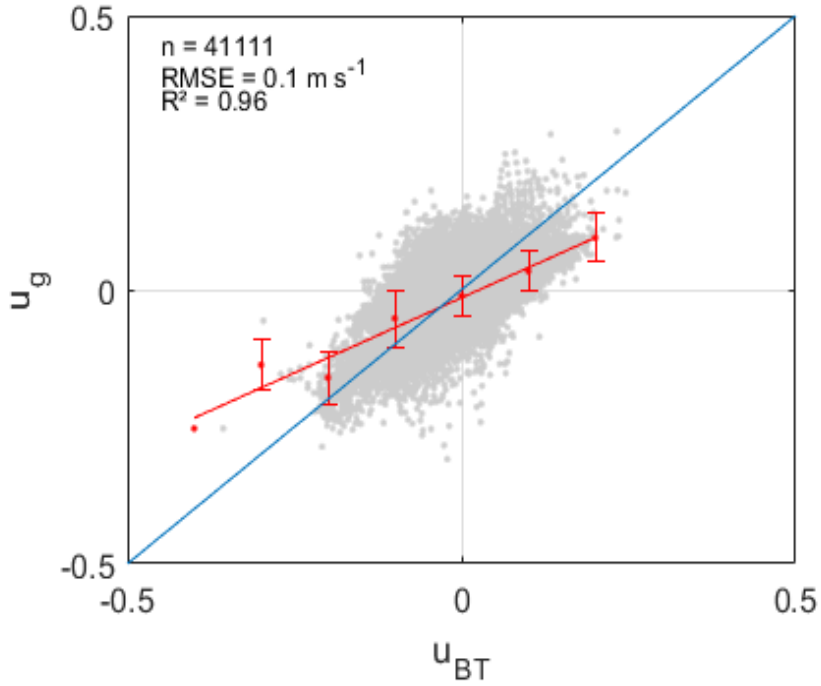
- GuwM : Using Dead reckoning (using Woithe et al., 2011 method) and Bottom track

$$w_g = \frac{-\Delta z}{\Delta t} \quad (4)$$

$$h_g = \frac{w_g}{\tan(\theta)} \quad (5)$$

$$u_g = h_g \times \sin(\alpha) - \acute{u} \quad (6)$$

$$ugcorr^{(z,t)} = a\, ug^{(z,t)} + b \quad (7)$$



Many et al., in progress

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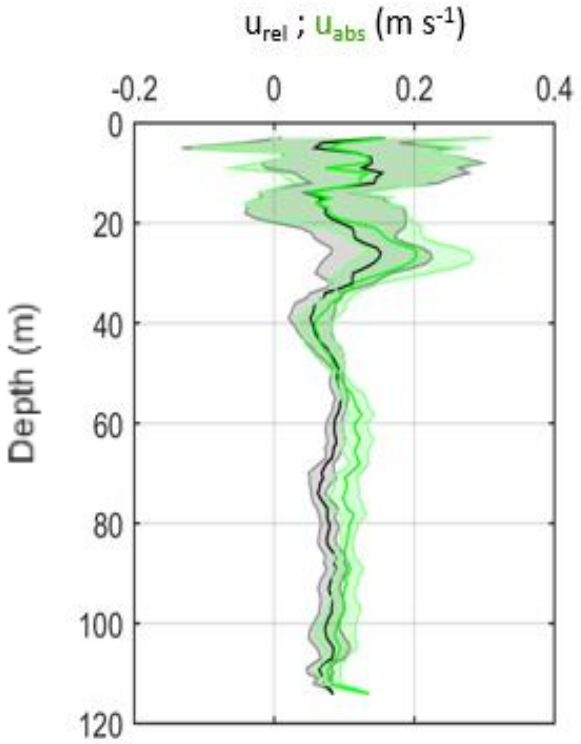
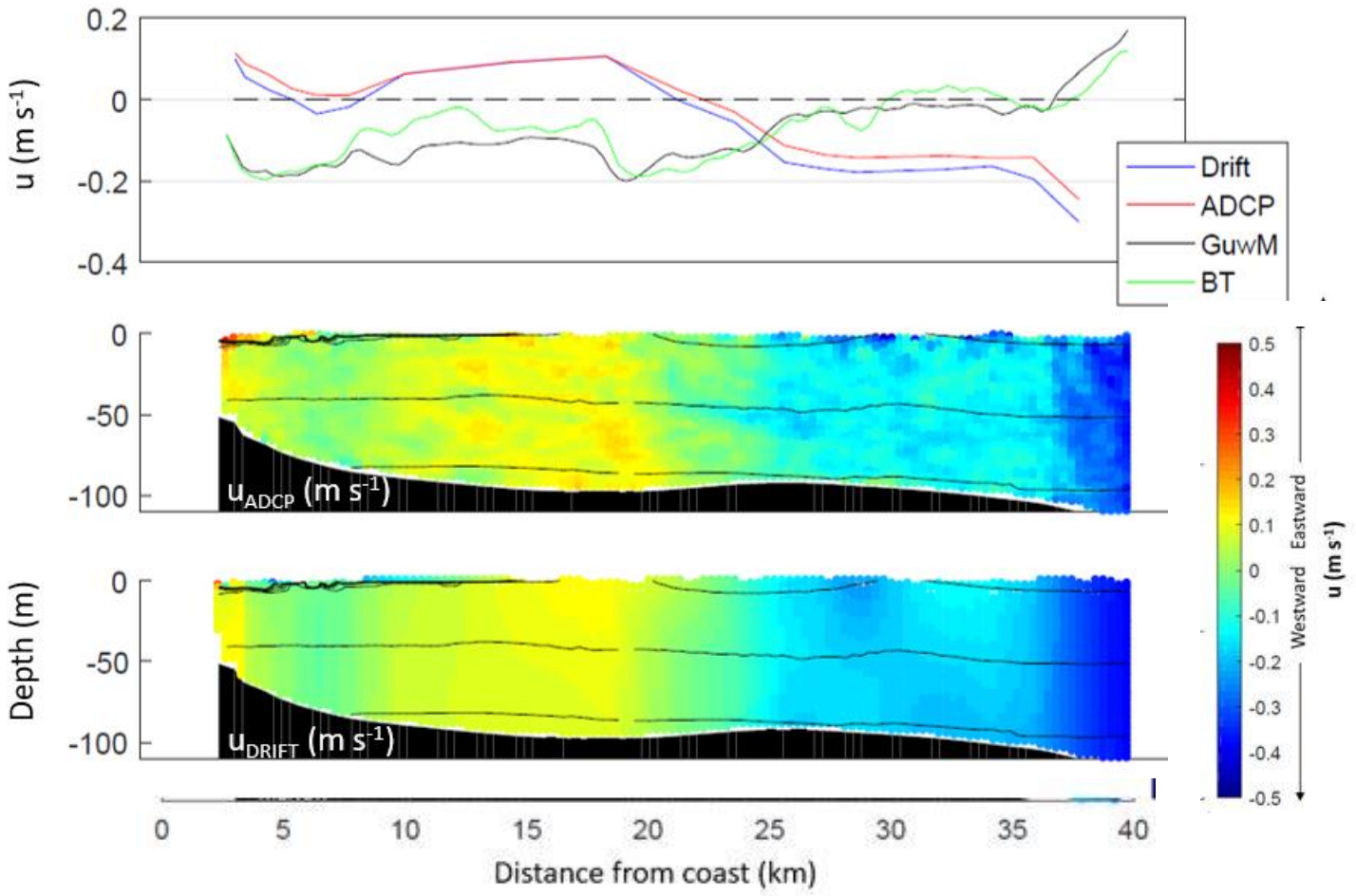
Absolute velocities of currents:

$$\boldsymbol{uocean^{(z,t)} = uadcp^{(z,t)} - ugcorr^{(z,t)}} \qquad \textbf{(8)}$$



Many et al., in progress

Absolute Water Velocities Method Comparison



Many et al., in progress

Conclusion and outlook

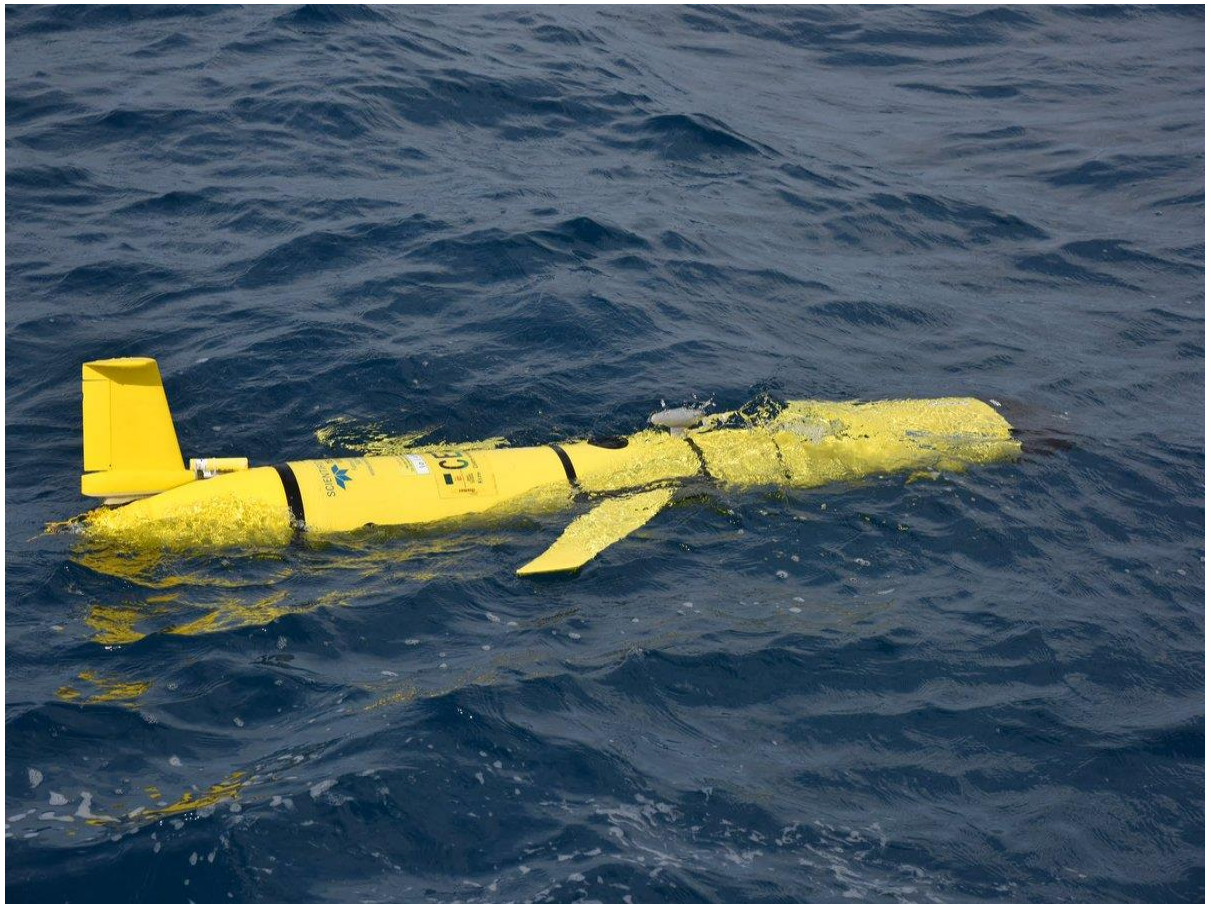
- Estimation of currents with an uncertainty about 0.04 $m.s^{-1}$ and 0.1 $m.s^{-1}$ with a simple flight plan

  → This can represent until 50% of the absolute velocities in some cases

- Ongoing :
  - Comparison with a flight model more complex *(Merckelbach et al,. 2010)*
  - Contribution of inverse solution *(Visbeck,. 2002)*

- Comparison with other fixed platforms and model
- Coupling with turbidity estimation (ADCP) for fluxes calculation

Thank you



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