IR - ILLICO *17 Nov 2022*

Observation à JULIO au large de Marseille

Anne Petrenko[1], J.L Fuda[1], N. Bhairy[1],
S. Barrillon[1], J. Bouffard[2], A. Bosse[1], F. Carlotti[1], A. Carret[4*],
D. Casella[3], C. Comby[1], A. Doglioli[1], C. Estournel[5], C. Grenz[1],
P.Marsaleix[5], M. Meloni[4] + collègues JULIO/BioSWOT

[1] AMU-MIO, France; [*] étudiant L3 AMU Parcours Mer; [2] ESA, Rome;
[3] ISAC- CNR, Rome; [4]Serco c/o ESA, Rome, Italy;
[4*]Serco c/o ESA, basée à Toulouse; [5] LEGOS, Toulouse

Institut Méditerranéen d'Océanologie

Aix*Marseille université

cnrs

IRD Institut de recherche pour le développement

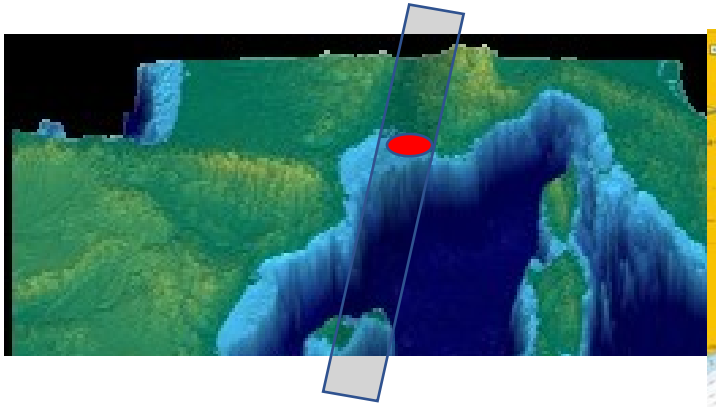
UNIVERSITÉ DU SUD TOULON VAR

JULIO - JUdiciously Located for Intrusion Observation (Petrenko et Fuda, MIO)

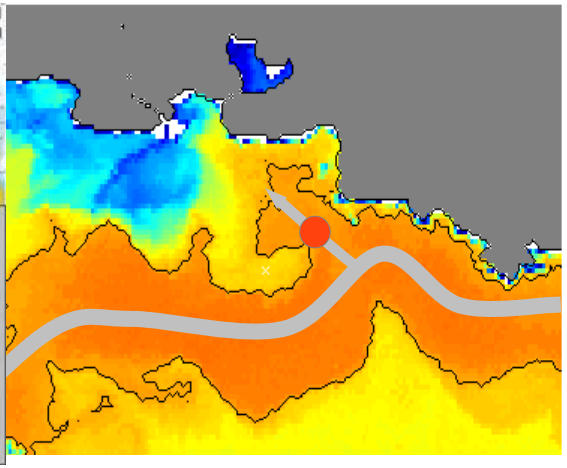
https://people.mio.osupytheas.fr/~petrenko/julio.htm

mouillage JULIO (5° 15' E – 43° 8' N, isobathe 100m)
ADCP (300 kHz)
tous les 5 m de la colonne d'eau, fréquence 1/2h

Raisons scientifiques : **- sous la trace futur SWOT**
- gradient côte-large
- localisé sur transect Minorque / Marseille de MOOSE GE
- détection des intrusions du Courant Nord dans le Golfe du Lion
- si observation long-terme : CN impacté par changement climatique ?

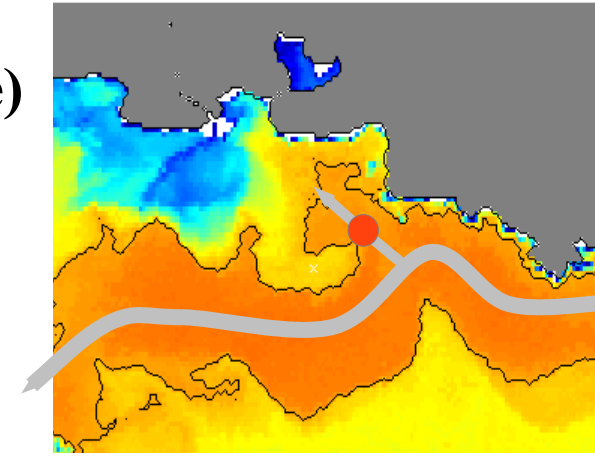


sous la trace futur SWOT



JULIO - Observation long terme à haute fréquence – MIO Observation

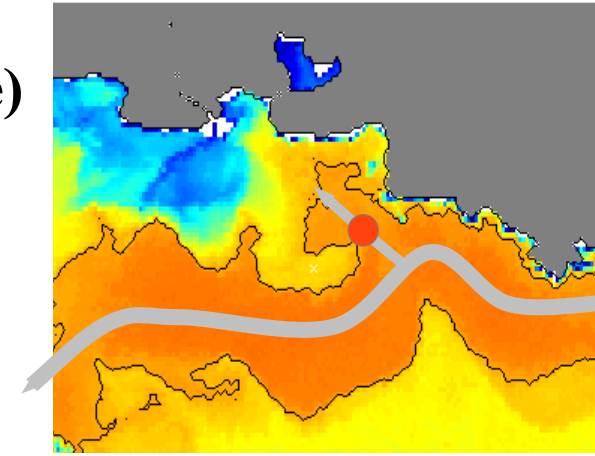
JULIO impliqué dans :



- projet international IDEAS 2017 – now (avec ESA, Rome)
  (Casella et al., 2020)
  finance 1 post-doc/an + instrumentation
- campagne MERITE – HIPPOCAMPE 2019
  (Tedetti et al., soumis)
- projet APREM 2016-18
  (Chen PhD 2019, Chen et al, to be submitted)
- projet ROMARIN 2012- 19
  (Feliu PhD 2021, échantillonnage mensuel 2017-19
  pour faire lien JULIO et MOOSE-Antares)
- observation MIO 2012 – now (équipe physique OPLC + SAM +autres équipes)
  (Barrier et al., 2016 ; + autres sur site web)
- projet SPECIMED 2010-2014 ...

JULIO - Observation long terme à haute fréquence – MIO Observation

JULIO impliqué dans :

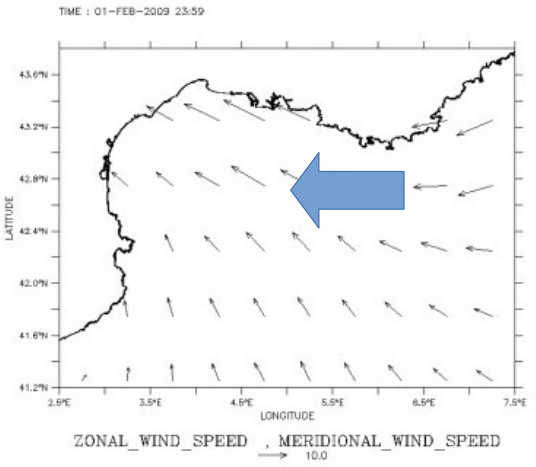


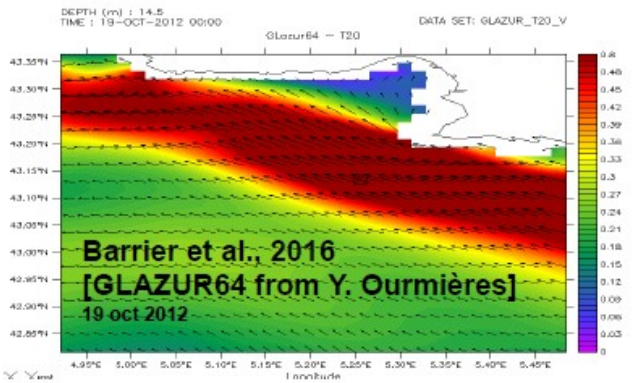
- projet international IDEAS 2017 – now (avec ESA, Rome)
  (Casella et al., 2020)
  finance 1 post-doc/an + instrumentation
- campagne MERITE – HIPPOCAMPE 2019
  (Tedetti et al., soumis)
- projet APREM 2016-18
  (Chen PhD 2019, Chen et al, to be submitted)
- projet ROMARIN 2012- 19
  (Feliu PhD 2021, échantillonnage mensuel 2017-19
  pour faire lien JULIO et MOOSE-Antares)
- observation MIO 2012 – now (équipe physique OPLC + SAM +autres équipes)
  (Barrier et al., 2016 ; + autres sur site web)
- projet SPECIMED 2010-2014 ...

JULIO - Etude des processus physiques

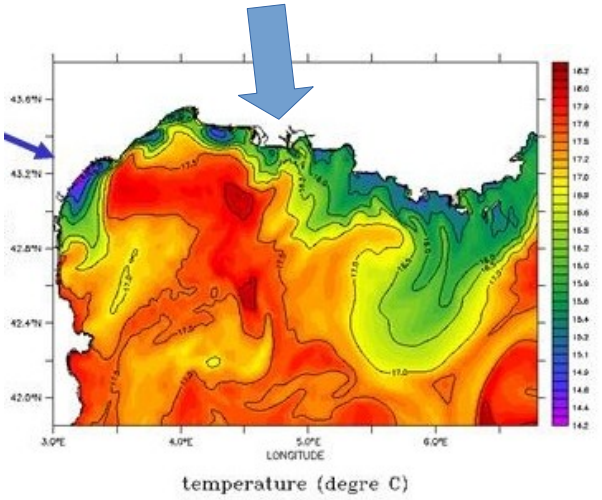
2 processus de génération des « méga-intrusions» les deux générés par le VENT

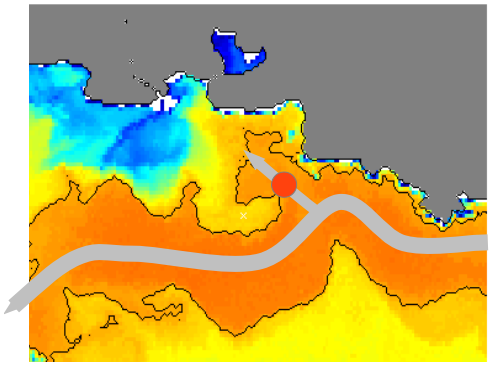
1) vent d'est empilant l'eau sur la côte, par géostrophie : mise en place d'une intrusion (indépendant de la stratification, simultané avec le vent)





2) Mistral, durant les conditions de stratification, due à la relaxation des upwellings du Var (l'intrusion arrive à peu près 1 jour après la relaxation du vent)

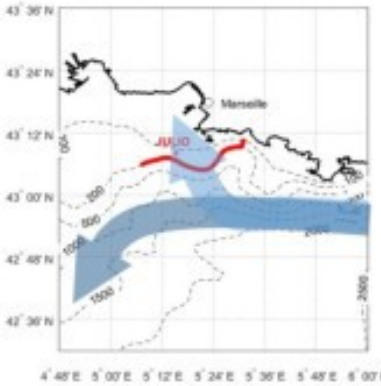




[Barrier N., Petrenko A.A., Ourmieres Y., (2016), Strong intrusions of the Northern Mediterranean Current …, Ocean Dynamics, 1-15. 10.1007/s10236-016-0921-7.]:

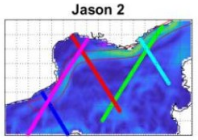
IA : a Random Forest Algorithm able to detect intrusions

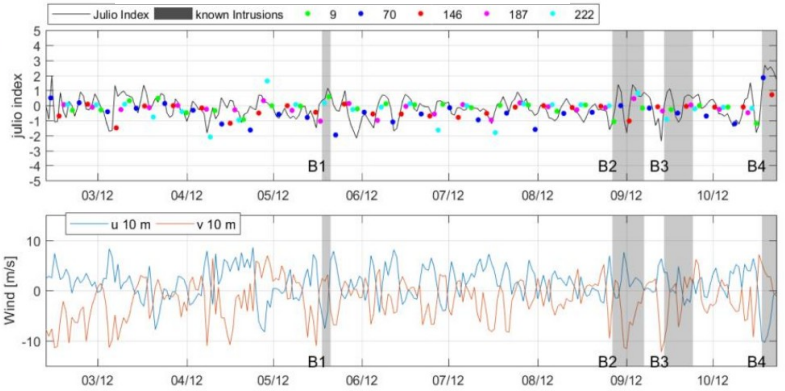
A **Random Forests Algorithm (RFA)** has been :
- trained with the SYMPHONIE model data, then
- applied to satellite data, and finally
- validated by JULIO in situ data.

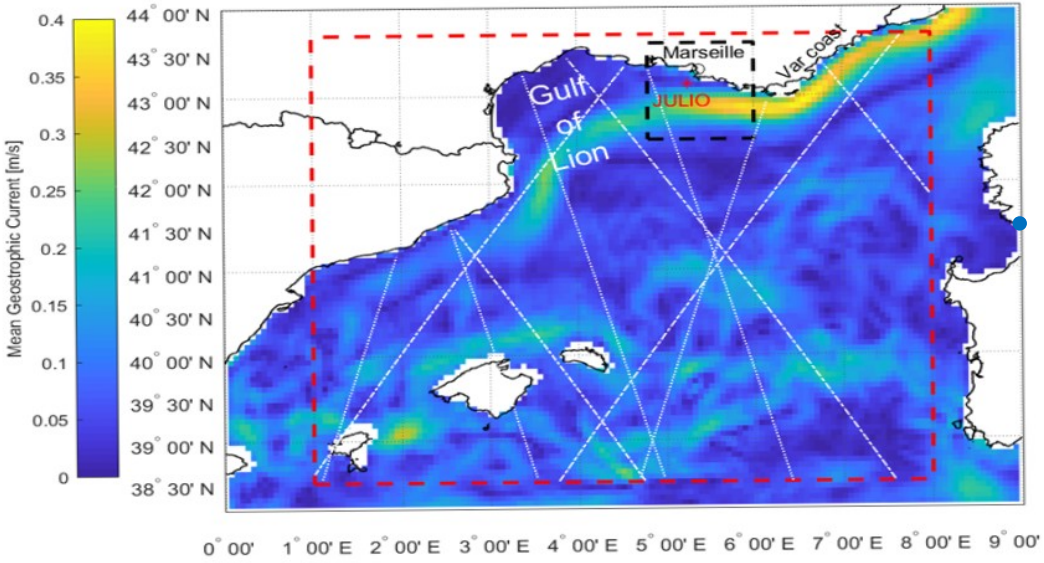


The algorithm identifies 93% of current intrusions.

[Casella et al., 2020]



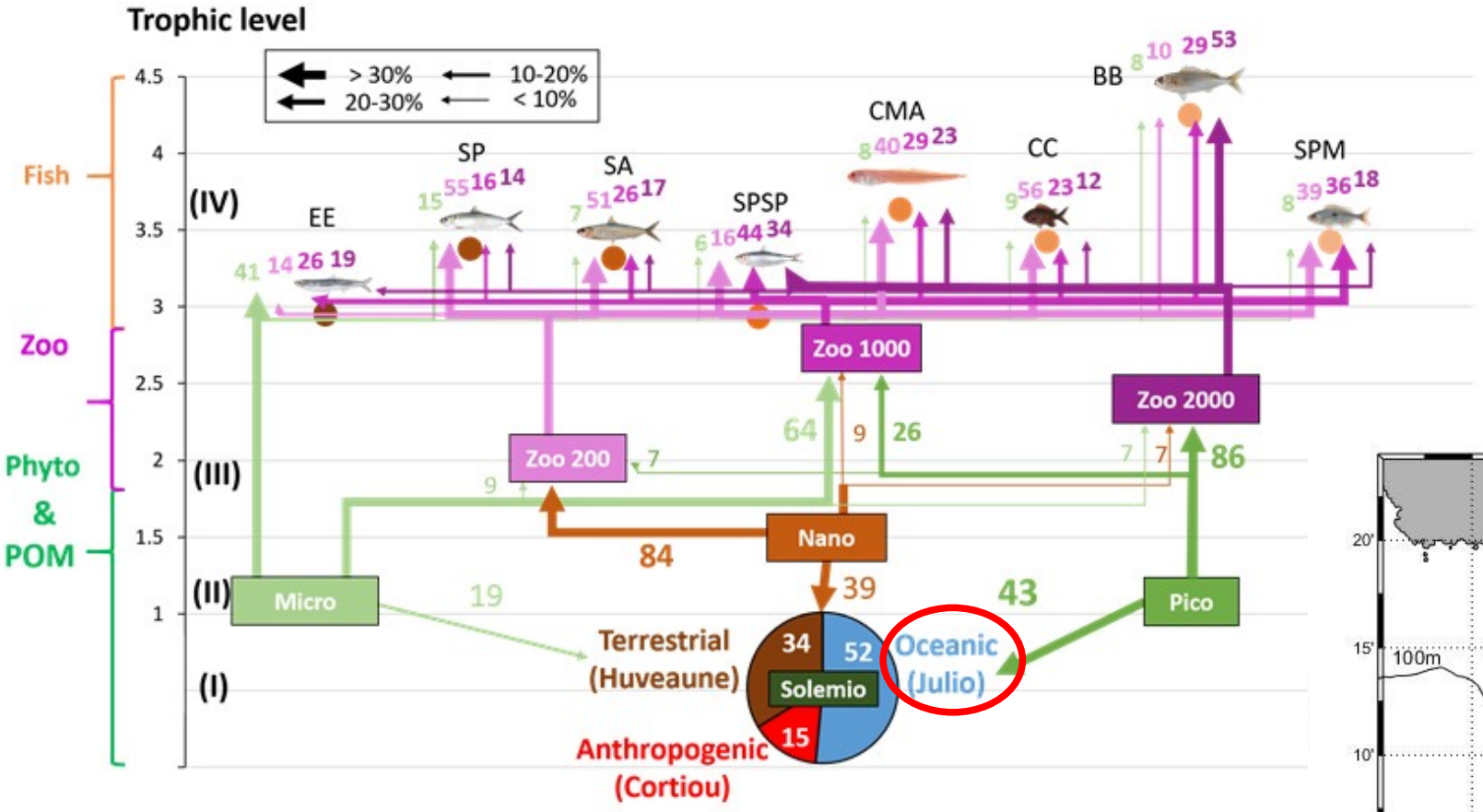


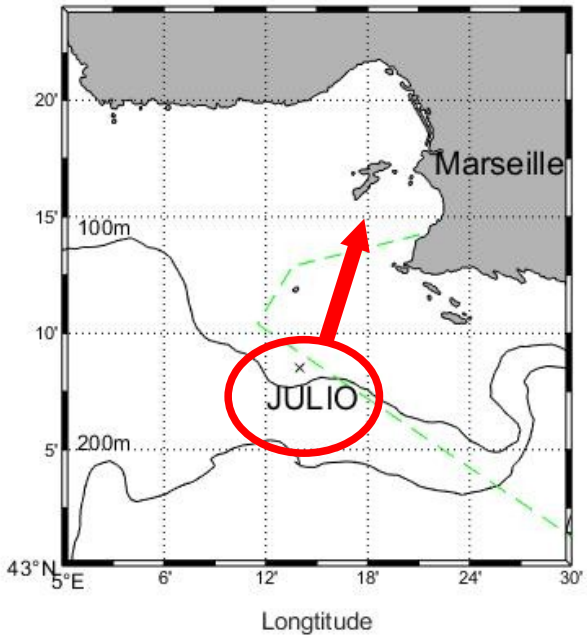


Perspectives:
- algorithm tests with other altimetric tracks (e.g. Cryosat)
- detection of fine scales
- test of vertical velocity w measurements

[Casella, D., Meloni, M., Petrenko, A.A., Doglioli, A.M., Bouffard, J. (2020). Coastal current intrusions from satellite altimetry. Remote Sens., 12(22), 3686; doi:10.3390/rs12223686. hal-02999636]

JULIO - Biogéochimie et biologie



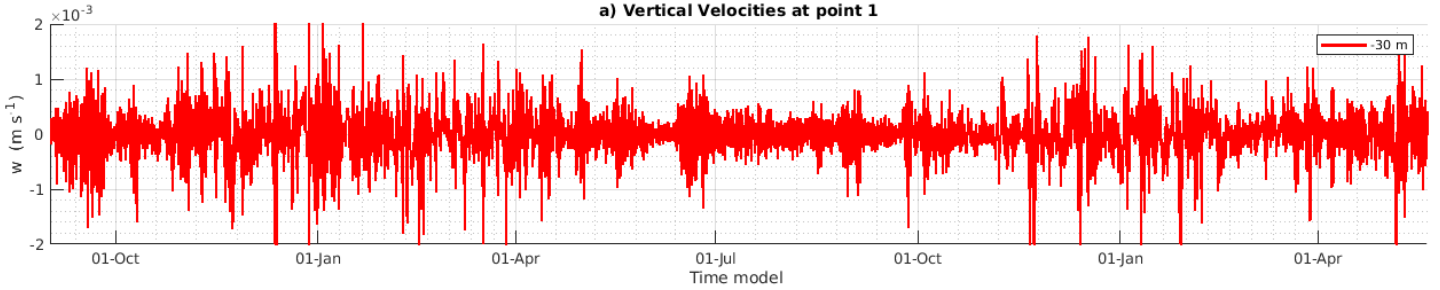


> 50 % de la MOP (Somlit Marseille) vient de Julio

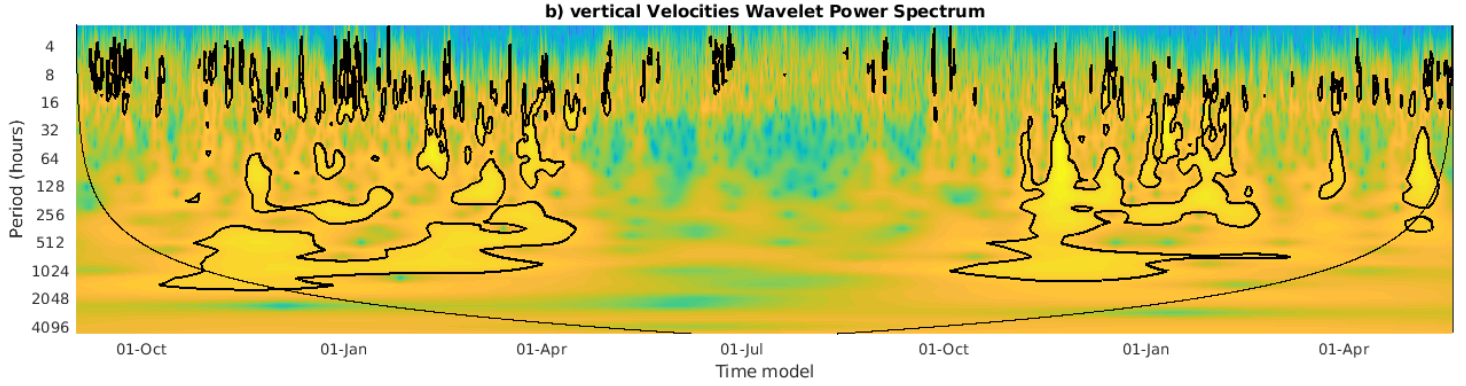
essentiellement pico et nano phytoplancton, base du réseau trophique planctonique de la baie de Marseille (Chen, thèse 2019 ; Chen et al., to be submitted)

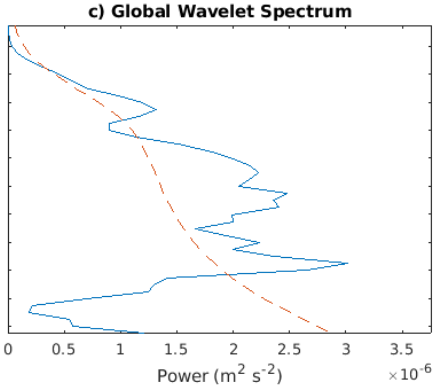
JULIO - Modélisation Symphonie (Estournel, Marsaleix, Comby)

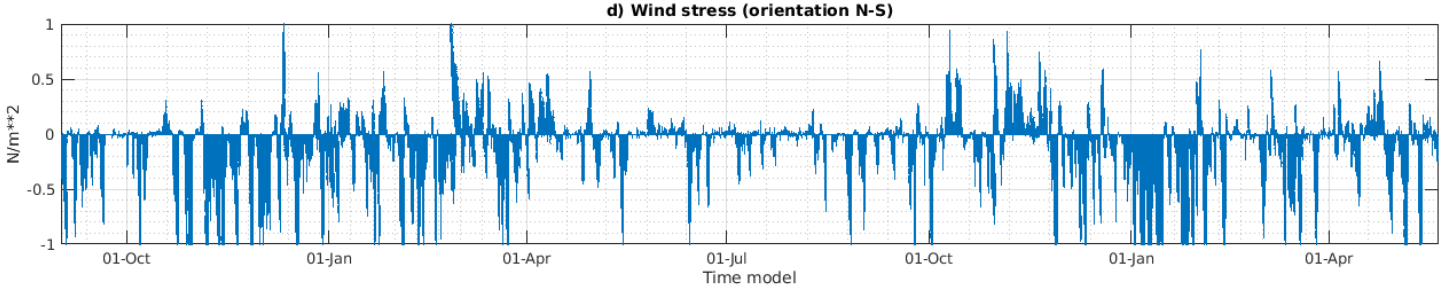
Analyse des vitesses verticales (en cours) au point JULIO dans le cadre de FUMSECK-vv (LEFE, PIs S. Barrillon et A. Petrenko) & de la collaboration avec C. Estournel et P. Marsaleix modélisation Symphonie HR



Forte variabilité des w
En lien avec le forçage météorologique

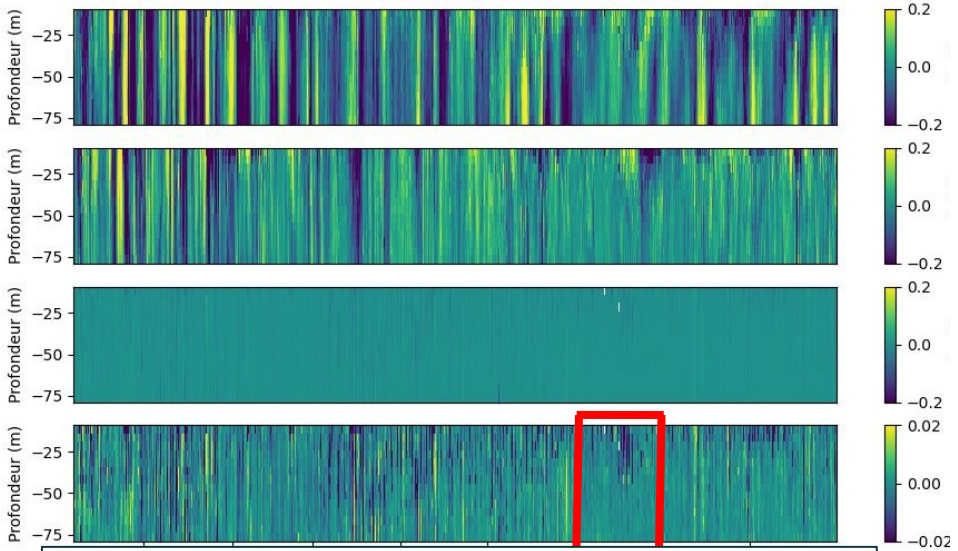






Analyse en ondelettes
Oct 2018 à Mai 2019
(C. Comby)

JULIO - Courantologie - Vitesses horizontales et verticales



décembre 2020 - août 2021

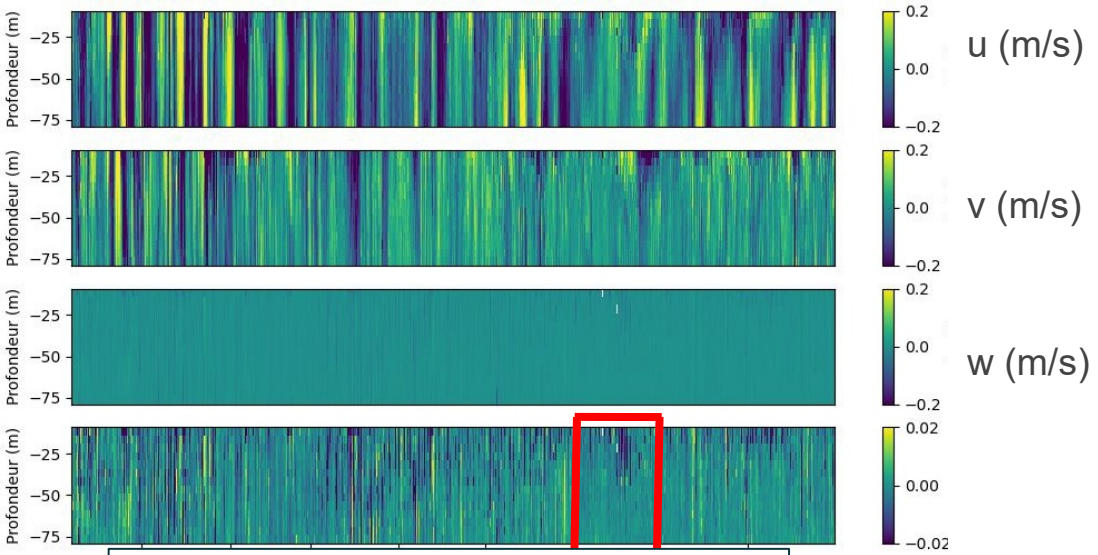
-0,2 à 0,2 m/s

W - 0,02 à 0,02 m/s

- 2 à 2 cm/s

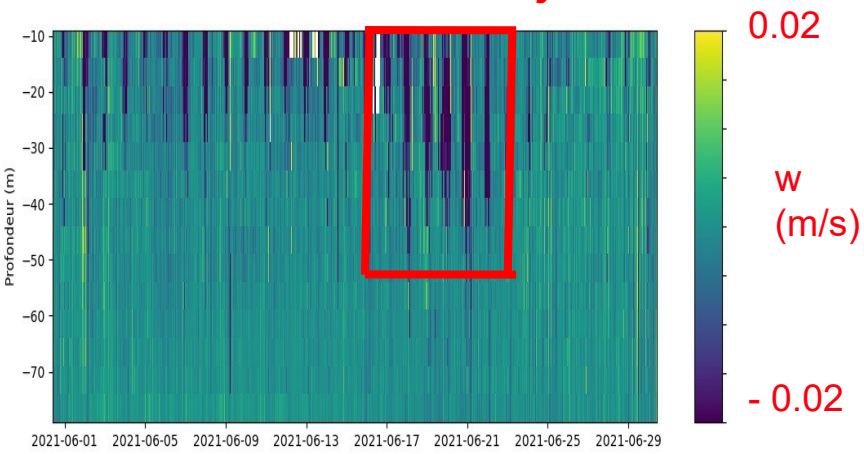
[stage L3 vitesse verticale à JULIO (T Bellayer, 2022 ; dir A. Petrenko)]

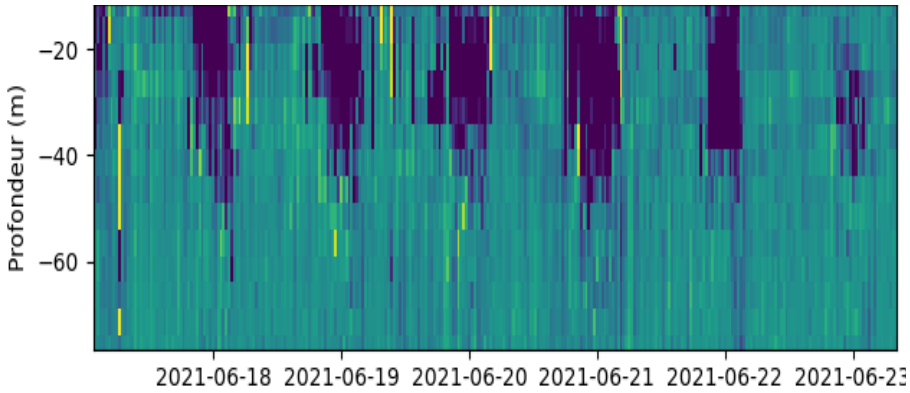
JULIO - Courantologie - Vitesses horizontales et verticales



décembre 2020 - août 2021

→ **Zoom sur le mois de juin 2021 :**





→ **En courantologie, déconvolution à effectuer entre vitesses verticales dues à des processus physiques et celles dues à des processus biologiques**

→ **Zoom du 17 au 23 juin 2021**

W<0 $\overline{w}$ = -3 cm/s max -10 cm/s

Durée 7 à 10 h autour de minuit en période de pleine lune

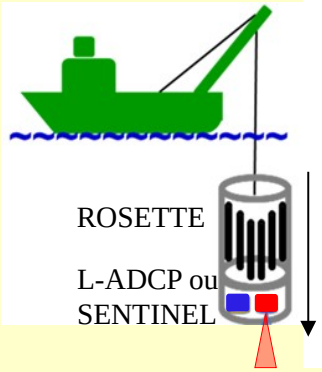
Satiation sinking ? (Tarling et al., 2017)

[stage L3 vitesse verticale à JULIO (T Bellayer, 2022 ; dir A. Petrenko)]

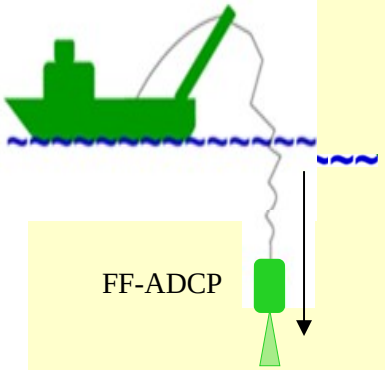
Vitesses verticales (OPLC – MIO + projet LEFE FUMSECK-VV)

Direct *in situ* (ADCP)

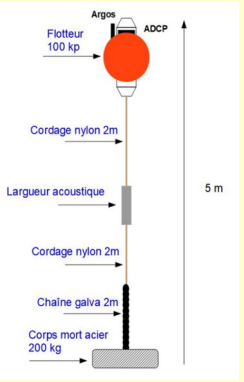
CTD package



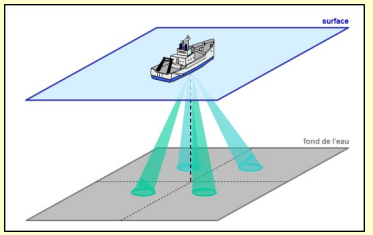
Free-Fall



Mooring



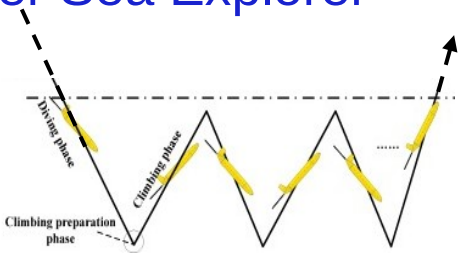
Vessel-mounted



Direct *in situ* with flight model

VVP
(*Vertical Velocity Profiler*)

Glider Sea Explorer



Indirect :

ω equation

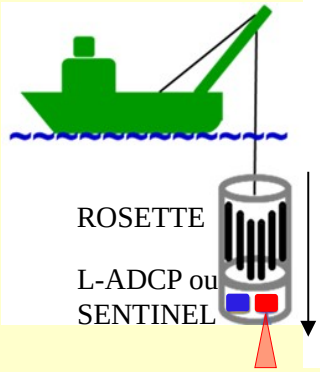
in situ 3D gridded density & currents

Modelling (hydrostatic)

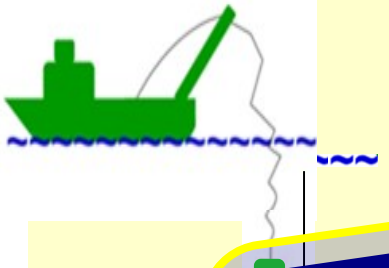
Vitesses verticales (OPLC – MIO + projet LEFE FUMSECK-VV)

Direct *in situ* (ADCP)

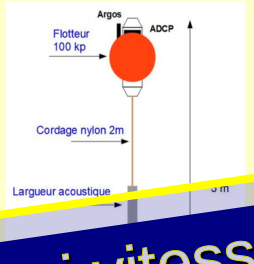
CTD package



Free-Fall



Mooring



Vessel-mounted

Pourquoi vitesses verticales ?
- processus physiques
- apports de sels nutritifs
- export de carbone ?

Direct *in situ* with flight model

VVP
(*Vertical Velocity Profiler*)

Glider Sea Explorer

Indirect :

ω equation

in situ 3D gridded density & currents

Modelling (hydrostatic)

JULIO - Observation long terme à haute fréquence – MIO Observation

Conclusions :

- étude de processus physiques
courants de pente
intrusions dans golfe/rade/fjord

- impacts sur biogéochimie/biologie

- IA : RFA sur produits altimétriques
intrusions du CN dans le golfe du Lion

Perspectives :

- étude de processus physiques
de fine échelle, des vitesses verticales

- impacts sur biogéochimie/biologie

- IA : RFA sur produits altimétriques
sera testé avec/étendu à SWOT
et avec autres processus de fine échelle:
méandres, tourbillons…

- lien avec données MOOSE, SOMLIT, HTMNet, COAST-HF, ...

- à moyen et long terme : impact changement climatique

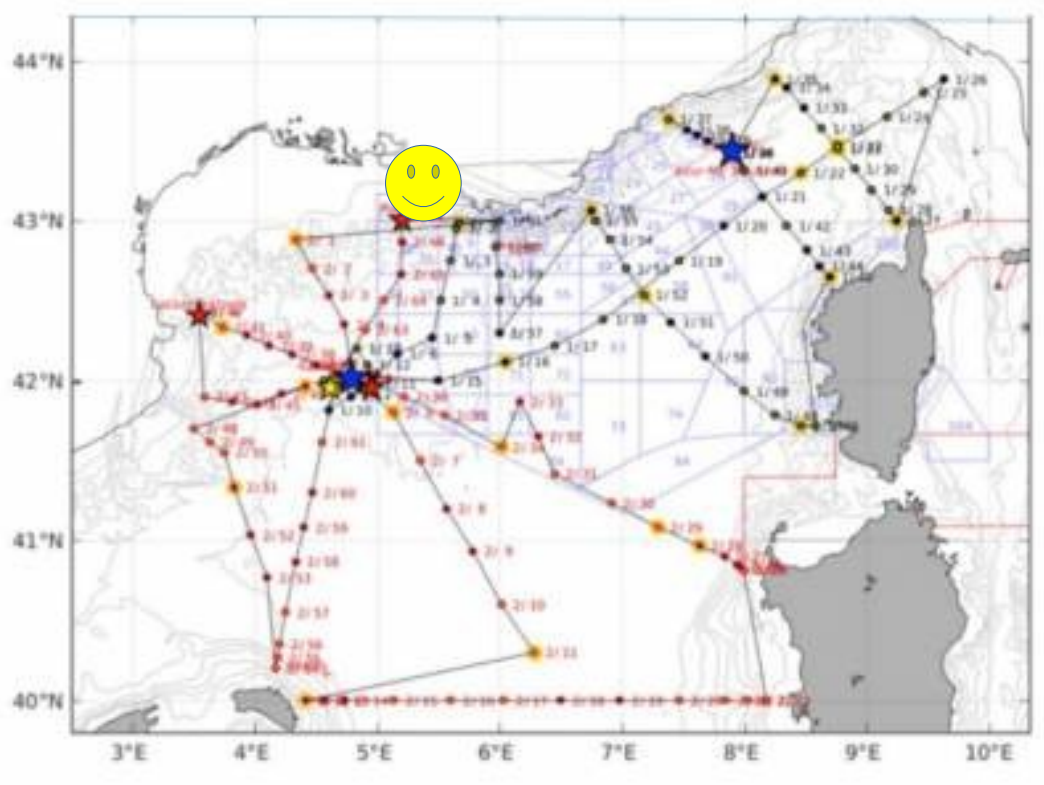
JULIO - Observation long terme à haute fréquence – MIO Observation

Conclusions :

- étude de process physiques
courants de pente itesses verticales
intrusions dans gc

- impacts sur biog chimie/biologie

- IA : RFA sur prc its altimétriques
intrusions du CN u à SWOT
Lion sus de fine échelle:
s…



JULIO ⊂ Observation régionale intégrée et multidisciplinaire inclus dans la prochaine labelisation MOOSE ?

- lien avec données MOOSE, SOMLIT, HTMNet, COAST-HF, ...

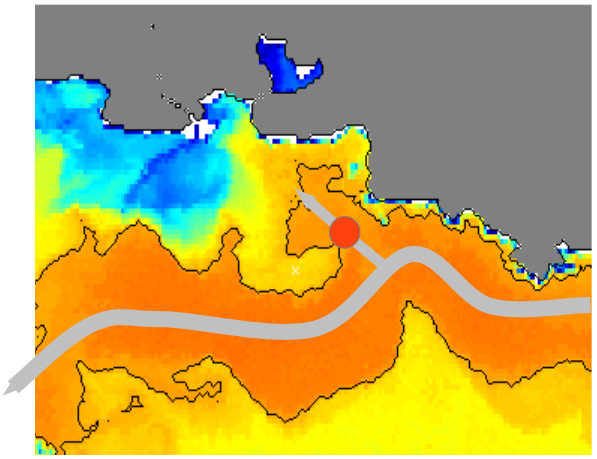
- à moyen et long terme : impact changement climatique

JULIO - Observation long terme à haute fréquence – MIO Observation

Pourquoi maintenir la série long terme à JULIO ?

Raisons autres que scientifiques :

- **près de Marseille (1h sur Antédon)**
- **pas chère (max 600 euros par an), peu contraignant en man/woman power**
- **exploitée en papier et conférences internationales**
- **collaboration internationale (SERCO/ESA Rome 1 postdoc/an + instrumention ADCP 5 faisceaux)**
- **lien avec équipe physique Toulon (ex dans ANR Barrillon 2023)**



(+ historique était censé faire partie de MOOSE dès le début 2008/10)

Coastal Current Intrusions from Satellite Altimetry

by Daniele Casella [1,*], Marco Meloni [2,3], Anne A. Petrenko [4], Andrea M. Doglioli [4] and Jerome Bouffard [5]

1 Consiglio Nazionale delle Ricerche, Istituto di Scienze dell'Atmosfera e del Clima (CNR-ISAC), C
2 Serco c/o ESA, European Space Agency ESA-ESRIN, 00044 Frascati, Italy
3 EUMETSAT, Eumetsat Allee 1, 64295 Darmstadt, Germany
4 Aix Marseille Université, Université de Toulon, CNRS, IRD, MIO, 13288 Marseille, France
Space Agency, Directorate of Earth Observation Programmes, 00040 Frascati, Italy
should be addressed.

Strong intrusions of the northern mediterranean current on the eastern gulf of lion: insights from in-situ observations and high resolution numerical modelling

Nicolas Barrier[1] · Anne A. Petrenko[1] · Yann Ourmières[2,3]

10 November 2020

Merci de votre attention, au cas biblio JULIO (disponible sur site web Petrenko) :

- Barrier N., Petrenko A.A., Ourmieres Y., (2016), Strong intrusions of the Northern Mediterranean Current on the eastern Gulf of Lion: insights from in-situ observations and high resolution numerical modelling, Ocean Dynamics, 1-15. 10.1007/s10236-016-0921-7.
- Bouffard, M. Meloni, Multi-Platform validations of altimetry for monitoring the variability of Coastal fronts: Status and Updates, IDEAS+ Cal/Val Workshop#5, 12-13 December 2017, ESA/ESRIN, Frascati, Italy
- Casella, D., Meloni, M., Petrenko, A.A., Doglioli, A.M., Bouffard, J. (2020). Coastal current intrusions from satellite altimetry. Remote Sens., 12(22), 3686; doi:10.3390/rs12223686. hal-02999636
- Casella D., Meloni M., Bouffard J., Doglioli A., Petrenko A., Multi-Platform validations of altimetry for monitoring the variability of Coastal fronts, IDEAS+ Cal/Val Workshop#6, 11-12 October 2018, PMOD/WRC, Davos Dorf, Switzerland
- Declerck A., Ourmieres Y. and Molcard A. (2016), Assessment of the coastal dynamics in a nested zoom and feedback on the boundary current: the North-Western Mediterranean case. Ocean Dynamics, final revision
- Fraysse, M., Pinazo, C., Faure, V.M., Fuchs, R., Lazzari, P., Raimbault, P. Pairaud, I (2013), Development of a 3D coupled physical - biogeochemical model development around Marseille coastal area (NW Mediterranean Sea): What complexity is required in coastal zone?, PlosOne, doi: 10.1371/journal.pone.0080012
- Gatti, J., Intrusions du Courant Nord sur la partie Est du plateau continental du golfe du Lion, thesis, June 2008, 156 pp.
- Meloni, M., Bouffard, J., Doglioli, A.M., Petrenko, A.A., Valladeau, G. (2019). *Toward science-oriented validations of coastal altimetry: application to the Ligurian Sea*. Remote Sens.Envir., 224, 275-288, doi:10.1016/j.rse.2019.01.028
- Meloni M., Doglioli A., Petrenko A., Bouffard J., Valladeau G., Toward new validation concept for high-resolution altimetry Era: application to the Coastal Ligurian Sea, International Review Workshop On Satellite Altimetry Cal/Val Activities and Applications", 23-26 April 2018, Chania, Crete, Greece.
- Meloni M., Bouffard J., Doglioli A., Petrenko A., Valladeau G. and Casella D., Toward new validation concept for high-resolution and coastal altimetry, 25 years of progress in radar altimetry symposium, 24-29 September 2018, Ponta Delgada, Portugal
- Meloni M., Doglioli A., Petrenko A., Bouffard J., Valladeau G.,Multi-Scale Analysis and Applications of Coastal Altimetry Observations Over the Ligurian Sea, 11th Coastal Altimetry Workshop, 12 - 15 June 2018, ESA-ESRIN, Frascati;
- Meloni M., Doglioli A., Petrenko A., Bouffard J., Valladeau G.,Multi-Scale Analysis Of Coastal Altimetry data, multi sensor observations and numerical modelling over the NWMed sea, 10th Coastal Altimetry Workshop, 21 - 24 February 2017, Florence, Italy
- Meloni M., Doglioli A., Petrenko A., Bouffard J.,, Multi-Scale Analysis Of Coastal Altimetry data, multi sensor observations and numerical modelling over the NWMed sea, 2017 Ocean Surface Topography Science Team (OSTST), Miami, Florida, October 23-27 2017.
- Millet B, Pinazo C, Banaru D, Pagès R, Guiart P, et al. (2018) Unexpected spatial impact of treatment plant discharges induced by episodic hydrodynamic events: Modelling Lagrangian transport of fine particles by Northern Current intrusions in the bays of Marseille (France). PLOS ONE 13(4): e0195257. https://doi.org/10.1371/journal.pone.0195257
- Petrenko, A.A., , Kersale, M., Nencioli, F., Gatti, J., Doglioli, A. M., Dekeyser, I. (2013), Coastal circulation in the Gulf of Lion, the influence of mesoscale processes on interregional exchanges, Proceedings, 40th CIESM Congress, 28 October - 1 November 2013, Marseille, France
- Petrenko A., Y. Leredde, and P. Marsaleix (2005), Circulation in a stratified and wind-forced Gulf of Lions, NW Mediterranean Sea: in-situ and modeling data. Continental Shelf Res., 25, 5-27, doi:10.1016/j.csr.2004.09.004
- Ross O.N., M. Fraysse, C. Pinazo, I. Pairaud (2016), Impact of an intrusion by the Northern Current on the biogeochemistry in the eastern Gulf of Lion, NW Mediterranean. Estuarine, Coastal and Shelf Science 170(1–9). doi:10.1016/j.ecss.2015.12.022

Merci de votre attention, + autres refs plus bio :

Papiers plus biologiques :

- M. Tedetti, J. Tronczynski, F. Carlotti, M. Pagano, S. Ben Ismail, C. Sammari, M. Bel Hassen, K. Desboeufs, C. Poindron, S. Chifflet, A. Bellaaj Zouari, M. Abdennadher, S. Amri, D. Bănaru, L. Ben Abdallah, N. Bhairy, I. Boudriga, A. Bourin, C. Brach-Papa, N. Briant, L. Cabrol, C. Chevalier, L. Chouba, S. Coudray, M.N. Daly Yahia, T. de Garidel-Thoron, A. Dufour, J.-C. Dutay, B. Espinasse, P. Fierro-González, M. Fornier, N. Garcia, F. Giner, C. Guigue, L. Guilloux, A. Hamza, L.-E. Heimbürger-Boavida, S. Jacquet, J. Knoery, R. Lajnef, N. Makhlouf Belkahia, D. Malengros, P.L. Martinot, A. Bosse, J.-C. Mazur, M. Meddeb, B. Misson, O. Pringault, M. Quéméneur, O. Radakovitch, P. Raimbault, C. Ravel, V. Rossi, C. Rwawi, A. Sakka Hlaili, J.A. Tesán Onrubia, B. Thomas, M. Thyssen, N. Zaaboub, C. Garnier. Contamination of planktonic food webs in the Mediterranean Sea: Setting the frame for the MERITE-HIPPOCAMPE oceanographic cruise (spring 2019). Marine Pollution Bulletin (submitted)

- Chen et al.,

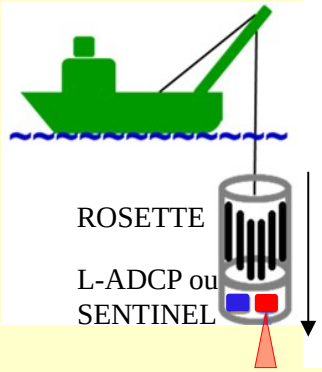
Stages :

+ 2 stages M2 en zooplancton à JULIO (AC Lafarge 2022, M. Péraud, 2021 ; dir F. Carlotti)
+ 1 stage analyse LISST & LOPC (M. Pinson, 2015 ; dir F. Carlotti et L. Berline)
+ 1 stage L3 vitesse verticale à JULIO (T Bellayer, 2022 ; dir A. Petrenko)

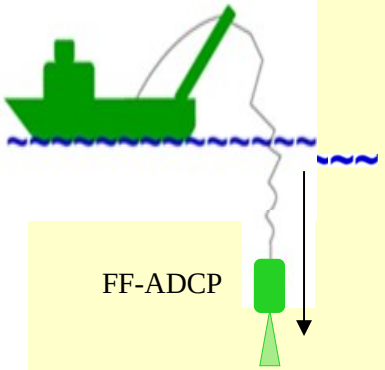
Vitesses verticales (OPLC – MIO + projet LEFE FUMSECK-VV)

Direct *in situ* (ADCP)

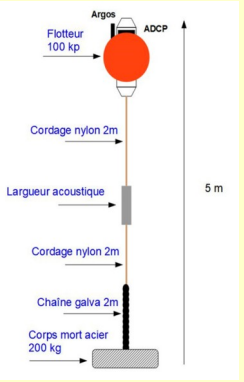
CTD package



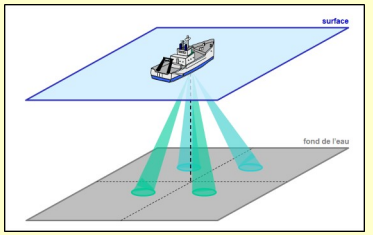
Free-Fall



Mooring



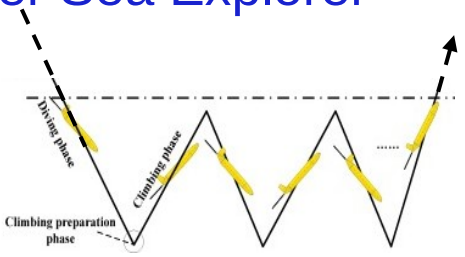
Vessel-mounted



Direct *in situ* with flight model

VVP
(*Vertical Velocity Profiler*)

Glider Sea Explorer



Indirect :

ω equation

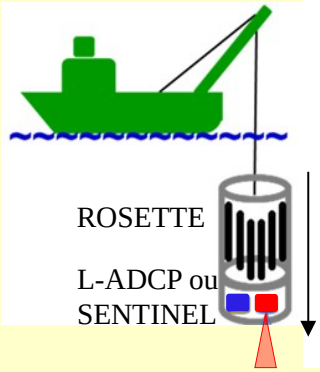
in situ 3D gridded density & currents

Modelling (hydrostatic)

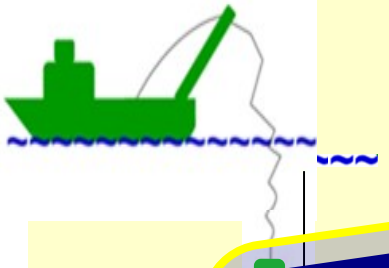
Vitesses verticales (OPLC – MIO + projet LEFE FUMSECK-VV)

Direct *in situ* (ADCP)

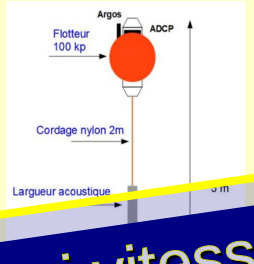
CTD package



Free-Fall



Mooring



Vessel-mounted

Pourquoi vitesses verticales ?
- processus physiques
- apports de sels nutritifs
- export de carbone ?

Direct *in situ* with flight model

VVP
(*Vertical Velocity Profiler*)

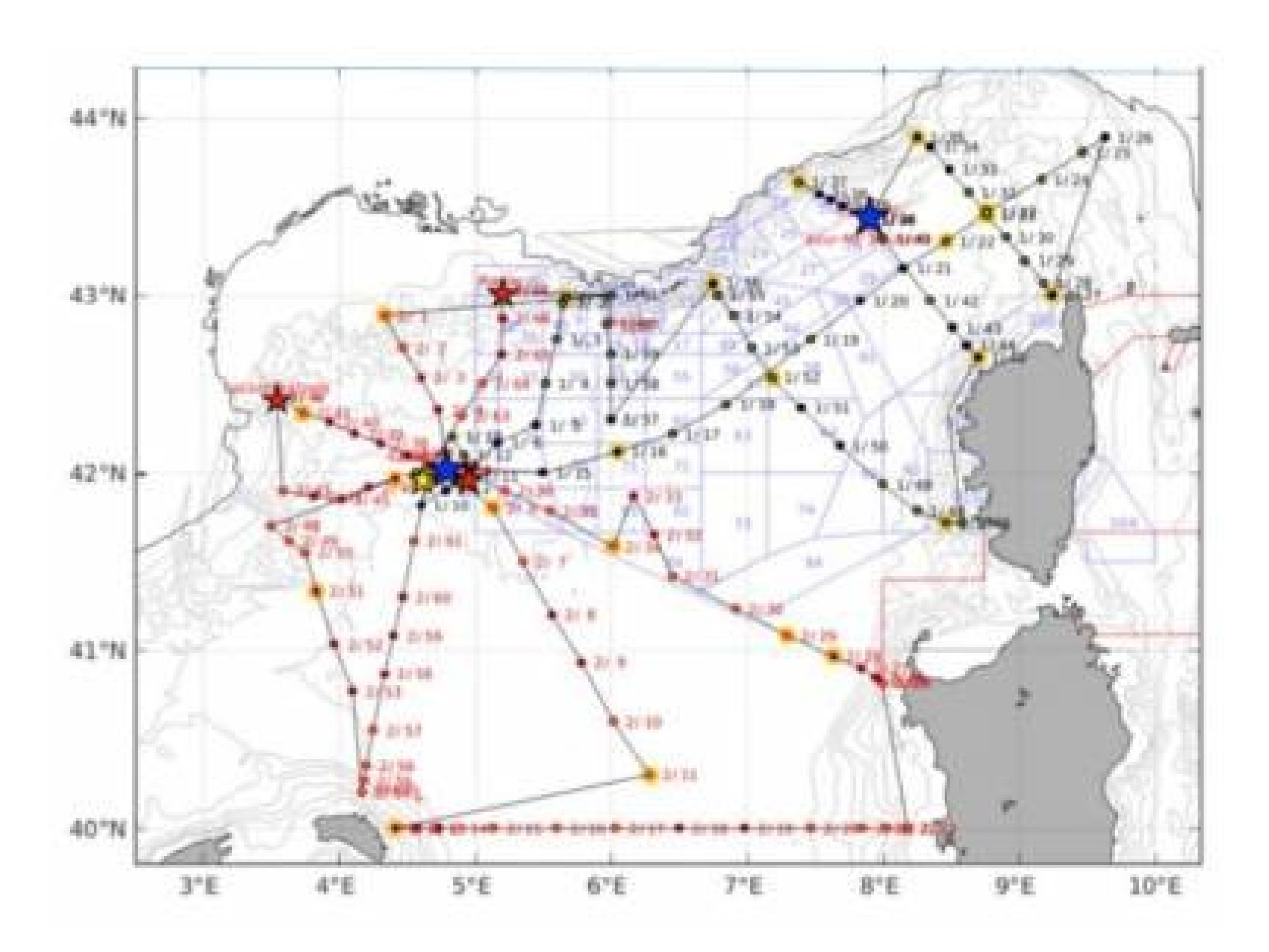
Glider Sea Explorer

Indirect :

ω equation

in situ 3D gridded density & currents

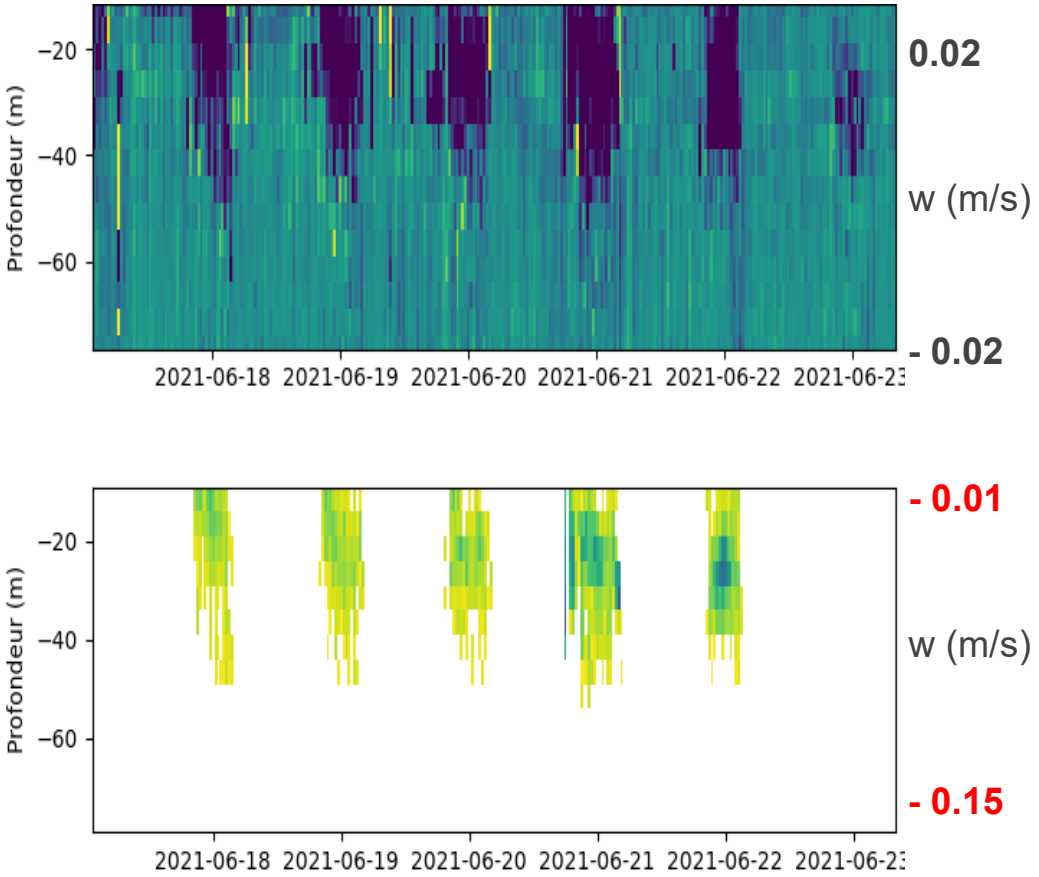
Modelling (hydrostatic)


44°N
43°N
42°N
41°N
40°N
3°E
4°E
5°E
6°E
7°E
8°E
9°E
10°E


Rhone SORA
Planier
Antarès
Dyfamed/Boussole/
ODAS Cote d'Azur
Têt
MOLA/Lacaze
42N5E/HC/
ODAS Golfe du Lion
Suivi des apports des fleuves
Suivi des dépôts atmosphériques
Radars HF
Suivis hauturiers mensuels
Bouées Météo-France
Lignes de mouillage
Pièges à particules
Radiales gliders
Flotteurs BioArgo

JULIO - Vitesses verticales (stage T. Bellayer, L3 - 2022)

Période particulière : du 17 au 23 juin 2021



Application de la méthode de sélection des anomalies avec w< -0.à1 m/s durant la période du 17 au 23 juin. .

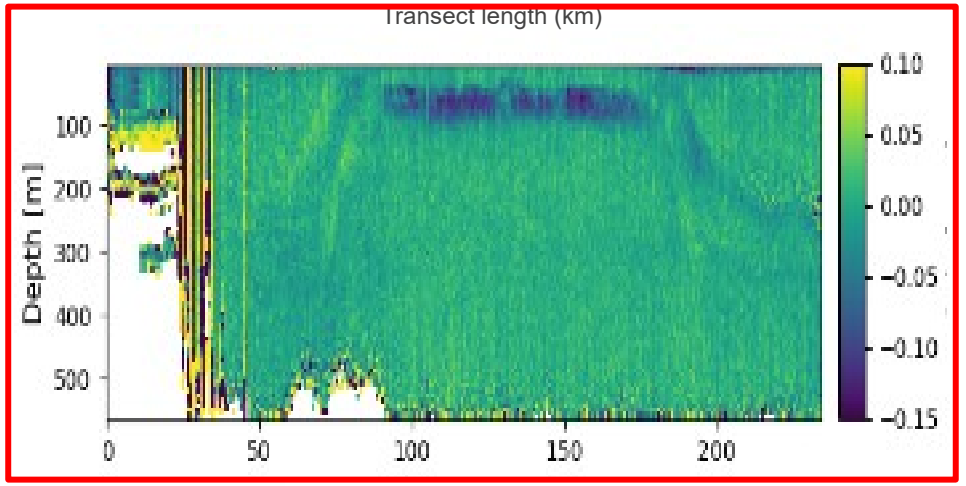
Tableau 1 : Caractéristiques des épisodes d'anomalie détectés entre le 17 et le 23 juin.

Anomalie	Début	Fin	Durée	Prof. Max (m)	Vitesse Moyenne (m/s)	Vitesse Négative Maximale (m/s)
1	2021-06-17, 20:15	2021-06-18, 03:45	7 h 30 min	51,5	-0,029	-0,109
2	2021-06-18, 19:45	2021-06-19, 04:15	8 h 30 min	51,5		
3	2021-06-19, 19:45	2021-06-20, 04:15	8 h 30 min	51,5		
4	2021-06-20, 18:45	2021-06-21, 04:45	10 h 00 min	56,5		
5	202-06-21, 20:15	2021-06-22, 03:15	7 h 00 min	51,5		
Moyenne	Début à 19:45	Fin à 04:03	8 h 18 min	52,5		

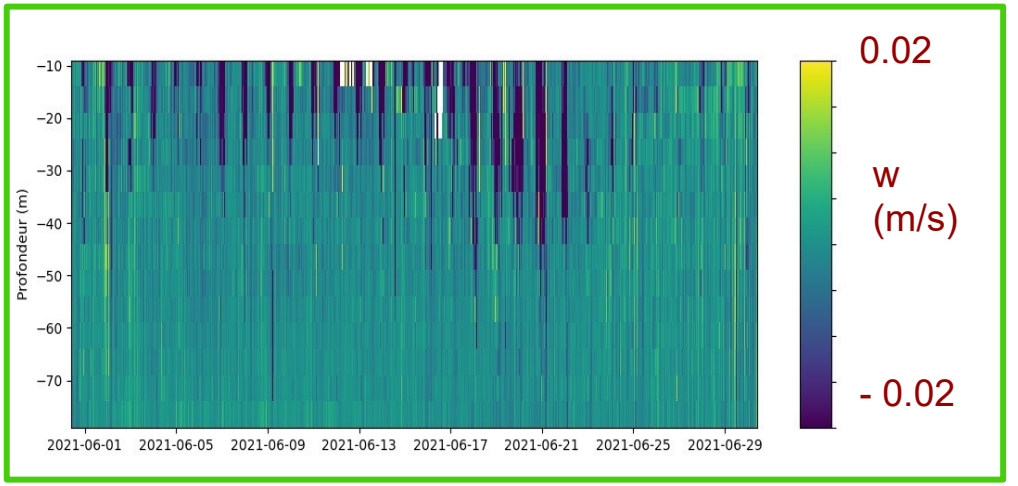
- Durée des épisodes : de 7 à 10h
- S'étendent sur une couche plus profonde que lors d'autres périodes

JULIO - Vitesses verticales (stage T. Bellayer, L3 - 2022)

Comparaison avec le premier transect de la campagne FUMSECK



FUMSECK à gauche (C. Cunci ; L3 – 2021)



JULIO à droite (T. Bellayer ; L3 - 2022)

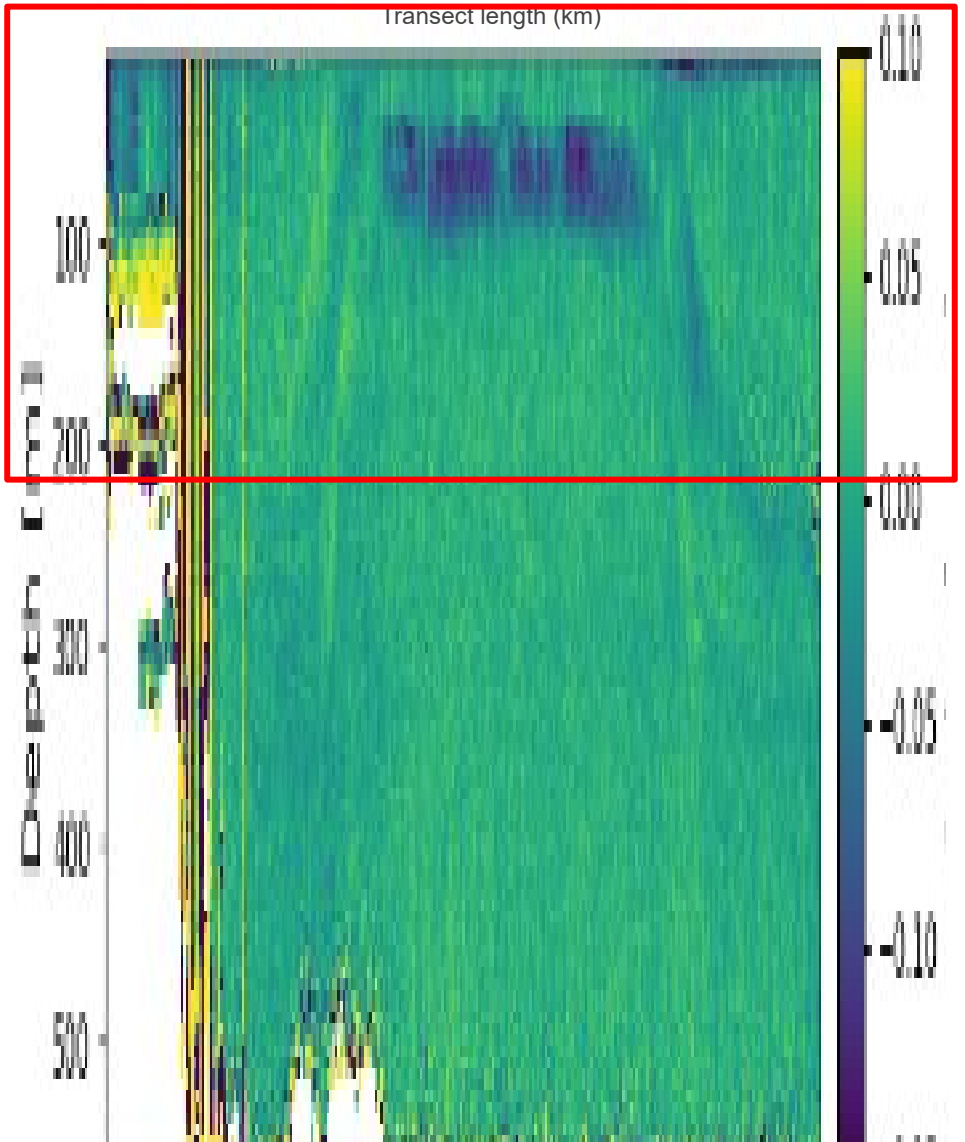
- Profondeur de mesure : **500 m** / **95 m**
- Fréquence d'émission : **75 kHz** / **300 kHz**
- Taille minimale détectée : **4 cm** / **0,5 – 1 cm**
- Vitesse moyenne mesurée : **- 6,5 cm/s** / **- 2,9 cm/s**

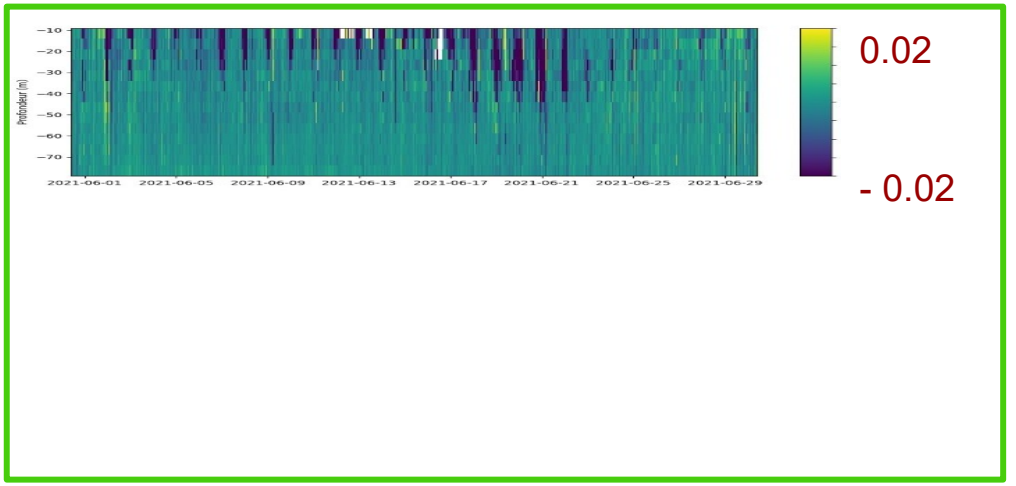
→ **Phases de montée / descente invisibles sur la série temporelle JULIO (car sur un fond < 100 mètres)**

→ **Anomalies plus proches de la surface que durant FUMSECK**

JULIO - Vitesses verticales (stage T. Bellayer, L3 - 2022)

Comparaison avec le premier transect de la campagne FUMSECK





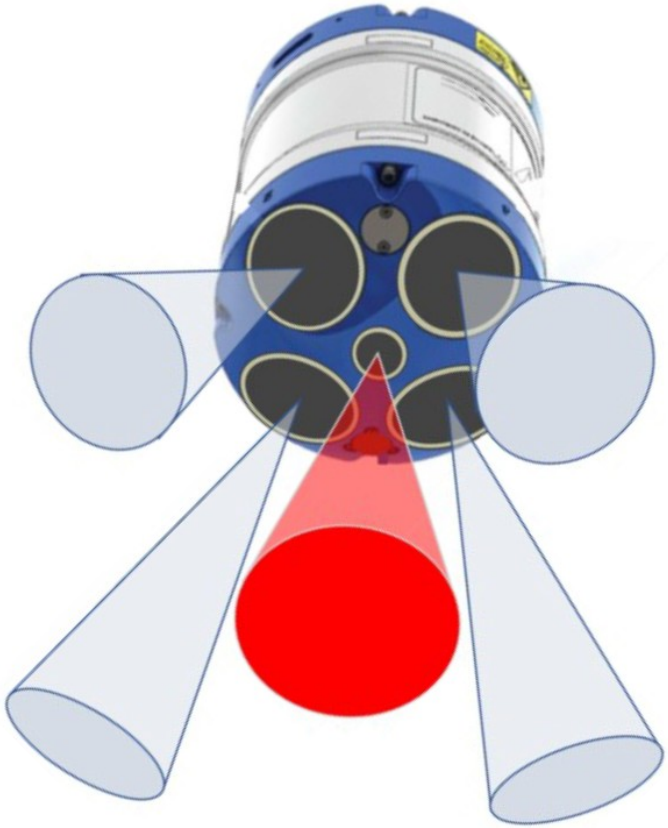
→ Phases de montée / descente invisibles sur la série temporelle JULIO (car sur un fond < 100 mètres)

→ Anomalies plus proches de la surface que durant FUMSECK

On going work (supported by collaboration with SERCO/ESA ; project IDEAS-QA4EO)

SENTINEL arrival at
MIO – Feb 21, 2022

A new current profiler



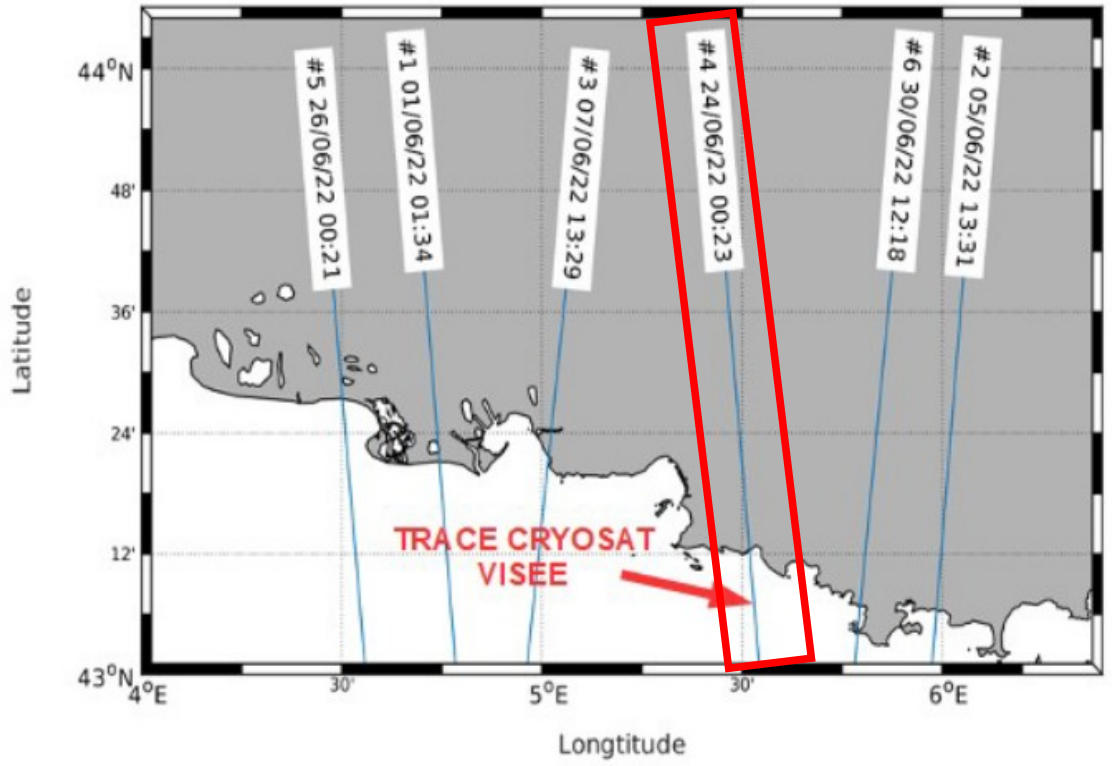
5 beams for an improved detection of the vertical component

On going work (supported by collaboration with SERCO/ESA ; project IDEAS-QA4EO)

June 2022 VVPtest cruise

Maintenance of the JULIO mooring...

...and..



… first deployment at sea of the SENTINEL as an FF-ADCP (see C. Comby talk) and if possible, colocated with a Cryosat passage

JULIO - Observation long terme à haute fréquence – MIO Observation

Séries temporelles : JULIO

* from June 24, 2022 on going

* from Sept 1st, 2021 to June 23, 2022, every 30', every 4 m

* from Dec 7, 2020 to August 31, 2021; every 30', every 5 m

* from July 17, 2014 to April 10, 2015

[Sept 23, 2016 launch. Dragged probably 3 days after, but stayed at the bottom. ADCP found mid-April 2017 by fishermen. ADCP ok but cage not responding to acoustic communication tests.]

* from Sep. 26, 2013 to March 28, 2014

* from Feb. 12 to Oct 23, 2012

JULIO - Observation long terme à haute fréquence – MIO Observation

* piles ADCP 150€

* piles largueurs 80€

* lest ~ 200€

* bout et autres ~150€

TOTAL : 600 euros/mise à l'eau

JULIO - Observation long terme à haute fréquence – MIO Observation

Séries temporelles : JULIO SOMLIT

6) from June 24, 2022 on going

5) from Sept 1st, 2021 to June 23, 2022, every 30', every 4 m

4) from Dec 7, 2020 to August 31, 2021; every 30', every 5 m

2) from 16/03/2017 to 19/12/2017

1) from 25/08/2016 tp 01/10/2016

3) from July 17, 2014 to April 10, 2015

[Sept 23, 2016 launch. Dragged probably 3 days after, but stayed at the bottom. ADCP found mid-April 2017 by fishermen. ADCP ok but cage not responding to acoustic communication tests.]

2) from Sep. 26, 2013 to March 28, 2014

1) from Feb. 12 to Oct 23, 2012

JULIO - Observation long terme à haute fréquence – MIO Observation

dans la collaboration avec SERCO (Italie) - projet ESA – QA4EO

2 post-docs:

2017 - 2018 M. MELONI
altimétrie et OSCAHR

Meloni, M., Bouffard, J., Doglioli, A.M., Petrenko, A.A., Valladeau, G. (2019). Toward science-oriented validations of coastal altimetry: application to the Ligurian Sea. Remote Sens.Envir., 224, 275-288

2019 - 2020 D. CASELLA
altimétrie et JULIO

Casella, D., Meloni, M., Petrenko, A.A., Doglioli, A.M., Bouffard, J. (2020). Coastal current intrusions from satellite altimetry. Remote Sens., 12(22), 3686

3e collaboration en cours:

2021- 2022 A. Carret (CDI)
altimétrie (*CryoSat-2, IceSat-2, Sentinel 3 et 6*) et Bio-SWOT Med

Casella et al., 2020 : New algorithm (Random Forests Algorithm, RFA) able to detect intrusion events using satellite altimetry.C

Available: a) ECMWF wind b) 10 years Symphonie 3D oceanic circulation numerical outputs
c) X-Track altimetry data (Saral, Jason 2) d) JULIO time-series

***FORWARD** ("physically based" training)*

INPUTS → *OUTPUTS*

ECMWF wind (a)

SLA anomalies from SYMPHONIE (b)

→ SLA anomalies

→ 200 m isobath JULIO flux

93% success

Once the training of the RFA algorithm is done:

BACKWARD – INVERSE PBM

INPUTS → *OUTPUTS*

SLA anomalies from altimetry (c)

→ 200 m isobath JULIO flux

compared to the **in situ JULIO Fluxes (d)**

Minus: the algorithm is prone to the assumptions made in the model

Advantage: does not contain uncertainties of real data

Note: XTrack : JASON2 has a 10 days repeat period and SARAL 35 days

Casella et al., 2020 : New algorithm (Random Forests Algorithm, RFA) able to detect intrusion events using satellite altimetry.

$$J\,ind = \frac{Ujul - \left(\overline{Ujul}\right)}{std\left(Ujul\right)}$$

(adapted Barrier et al., 2017)

U jul courant orthogonal à la section JULIO – côte
moyenné sur la verticale
et moyenné sur la journée

Puis moyenné (et std)
sur la série temporelle étudiée $\left(\overline{Ujul}\right)$

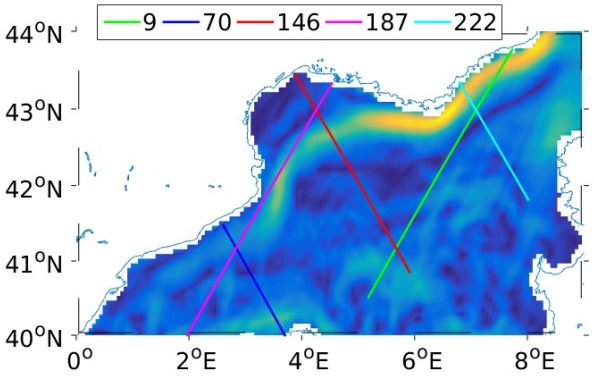
X- TRACK Level 2 ALES (Adaptative Leading Edge Subwaveform)
state of the art altimetric corrections
20 Hz Level 3 product available, here 1 Hz used

All Jason 2 (10 days repetition) and Saral/Altika (SA) (35 days repetition)

RFA combines 'bootstrap aggregating (bagging)' and 'random subspace method'
final predictions are made by averaging the predictions of each individual tree
important to determine the predictor variables :
here the wind 1 to 2 days before and distance to the coast/JULIO
For regression type pbm (predicting continuous dependant variables), criteria to measure 'impurity' based on residual sum of square algorithm

JULIO - Observation long terme à haute fréquence – MIO Observation

New algorithm (Random Forests Algorithm, RFA) able to detect intrusion events using satellite altimetry (Casella et al., 2020).



Exemple pour des traces
Jason 2 (Février-Octobre 2012)

[Casella, D., Meloni, M., Petrenko, A.A., Doglioli, A.M., Bouffard, J. (2020). Coastal current intrusions from satellite altimetry. Remote Sens., 12(22), 3686; doi:10.3390/rs12223686.]