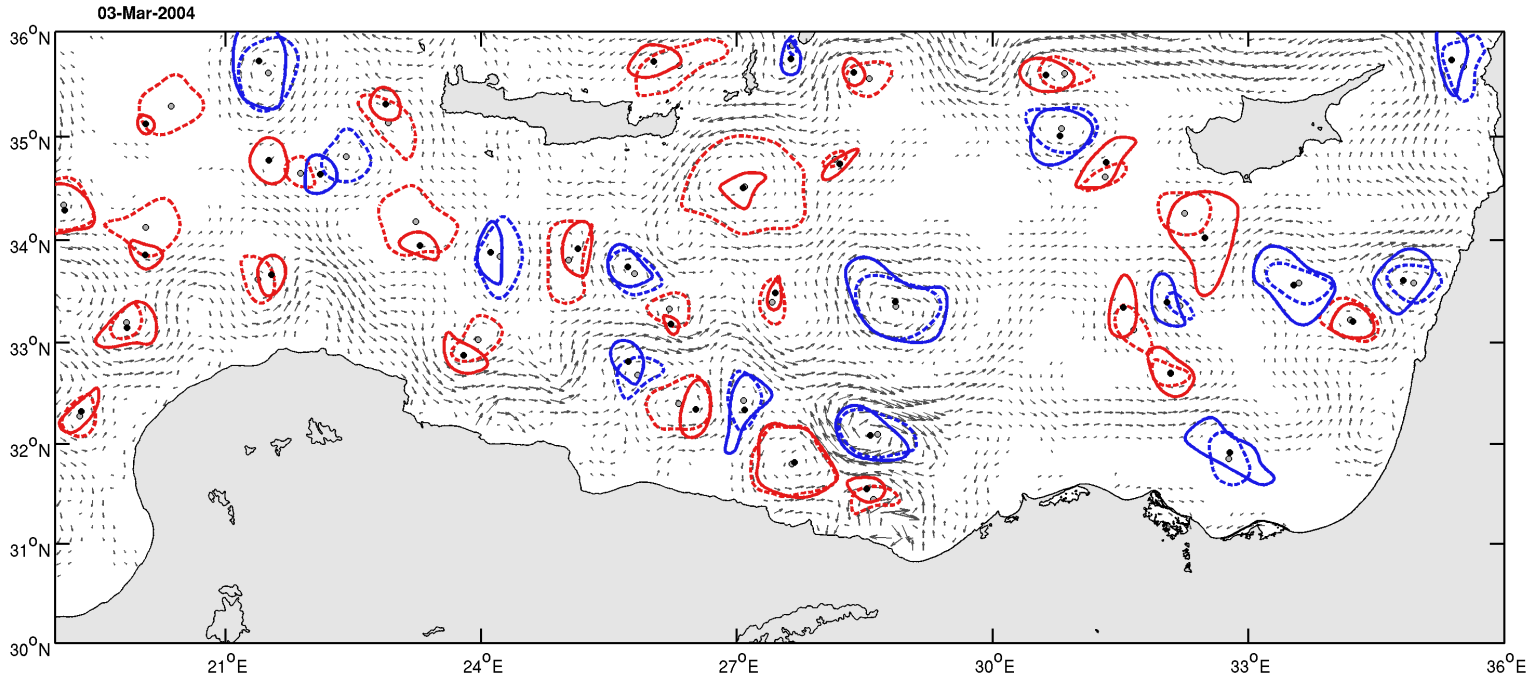
ANR DYNED &
Idea towards Deep/Machine Learning



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Collect Localisation Satellite (CLS), Toulouse, France.

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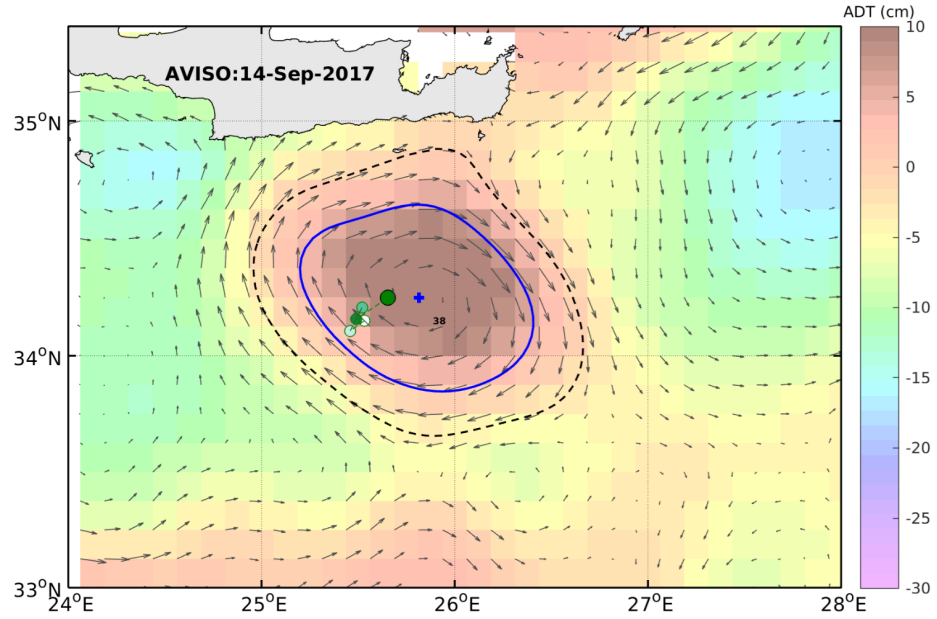
ANR: *DYNamical Eddies-Atlas (DYNED)*

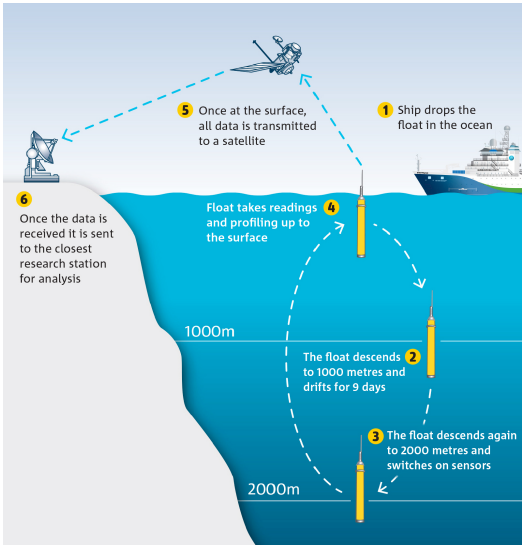
AVISO + Automatic eddy detection

Characterization of surface eddies



ARGO floats

Vertical density profiles

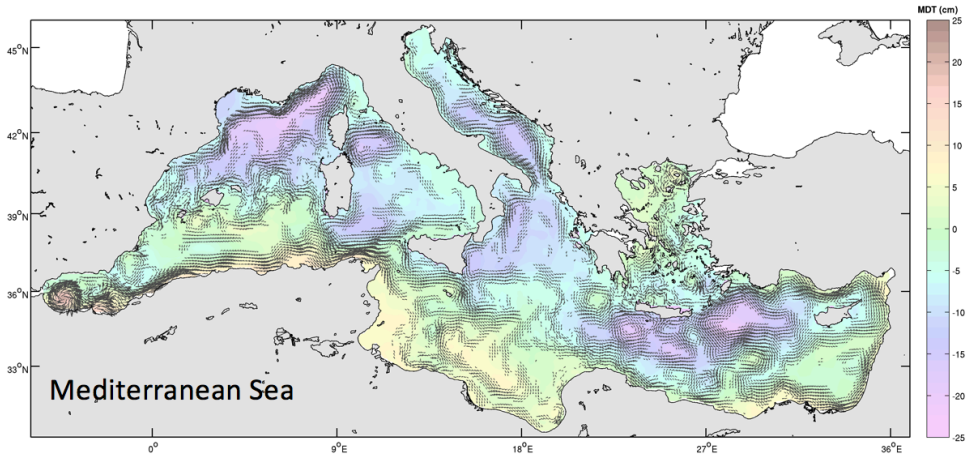


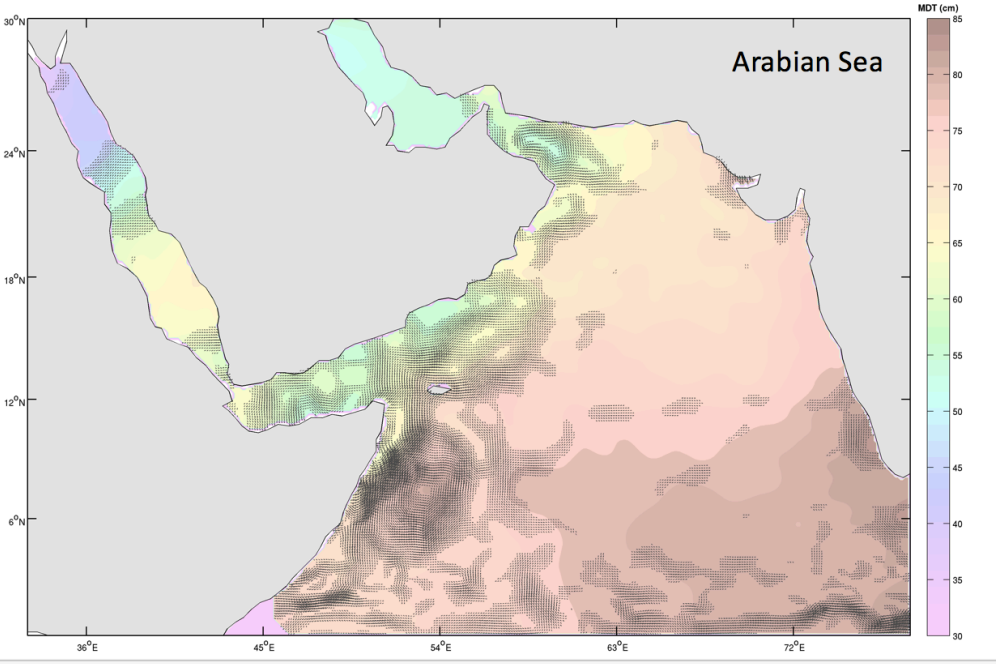
Chaigneau *et al.* (2011); Peglisaco *et al.* (2015); Laxenaire et al. submitted (2017)

*Estimation of the **3D structure** of the detected eddies*

ANR: *DYNamical Eddies-Atlas (DYNED)*

Dynamical eddy Atlas
from 2000 to 2015
in two specific areas



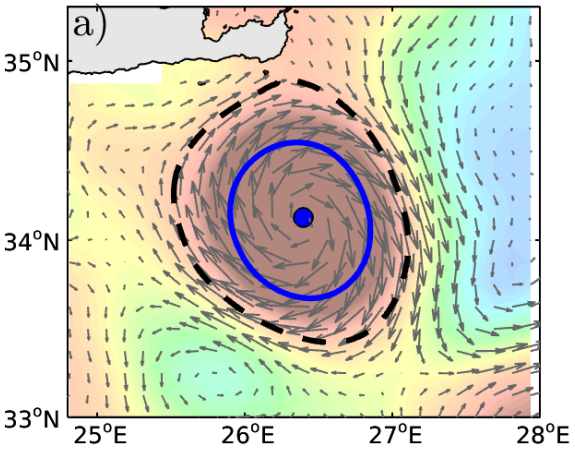


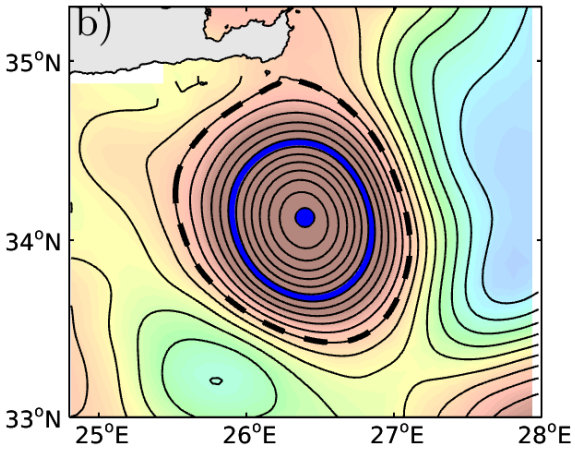
AMEDA: Angular Momentum Eddy Detection Algorithm

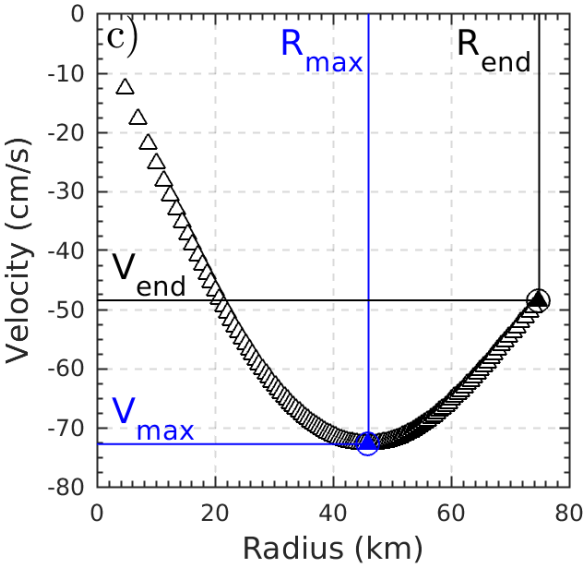
AVISO
Geostrophic Velocities
+ AMEDA

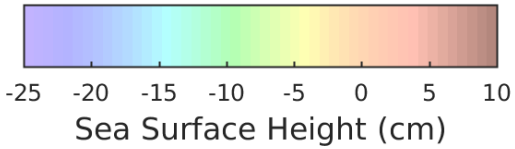
Characteristic contours

Dynamical parameters









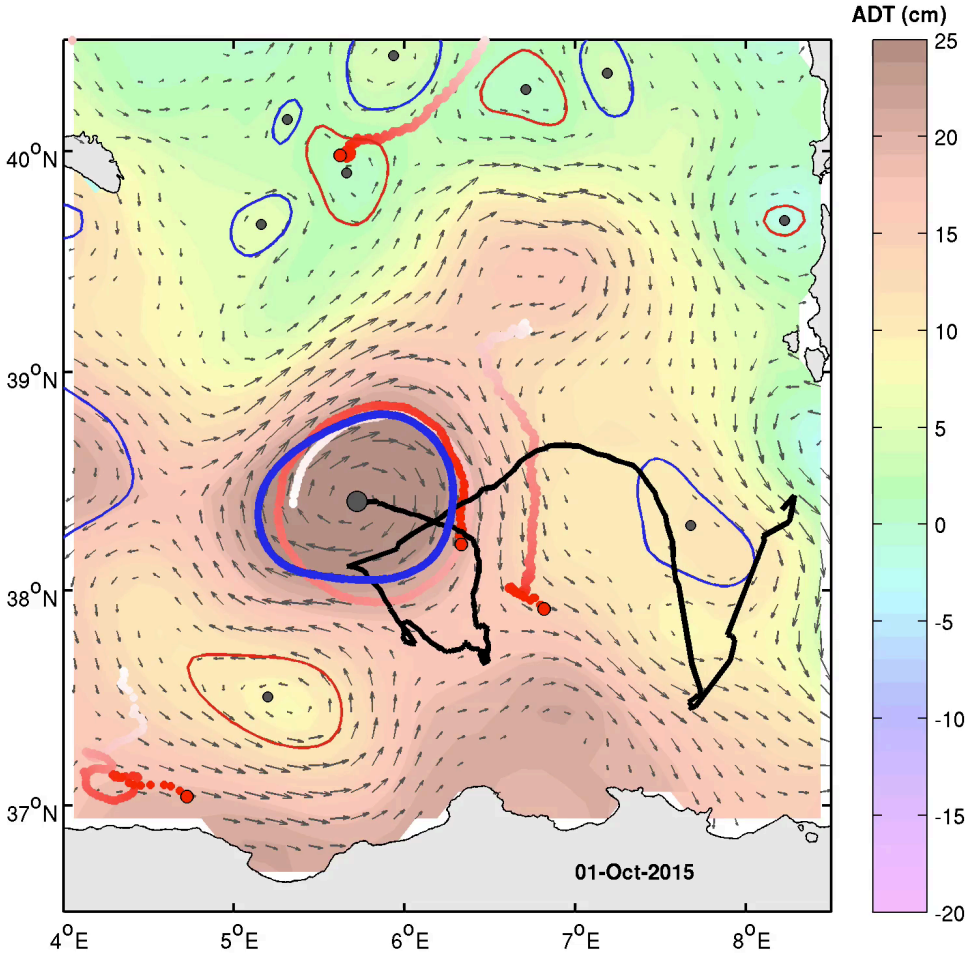
R_{max}, V_{max}, $Ro=V_{max}/(f\,R_{max})$

ζ/f (vorticity) ,ellipticity , α (shape parameter)

Le Vu et al., JOAST (2018)

AMEDA: Angular Momentum Eddy Detection Algorithm

Dynamical evolution of long-lived eddies



- Origin / formation processes
- Trajectory
- Merging / splitting events
- Dissipation / end of life

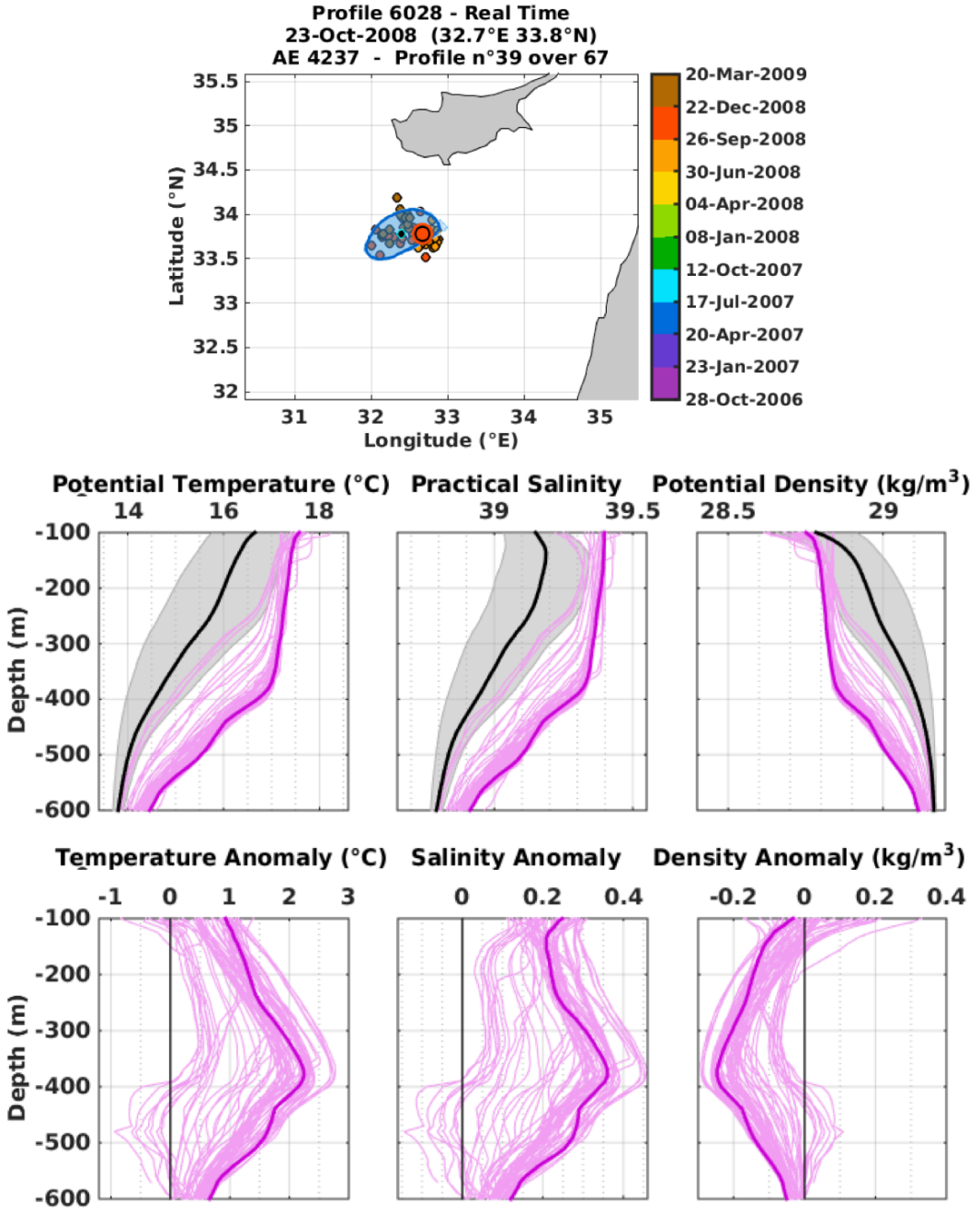
Garreau *et al.,* submitted to JGR (2017)

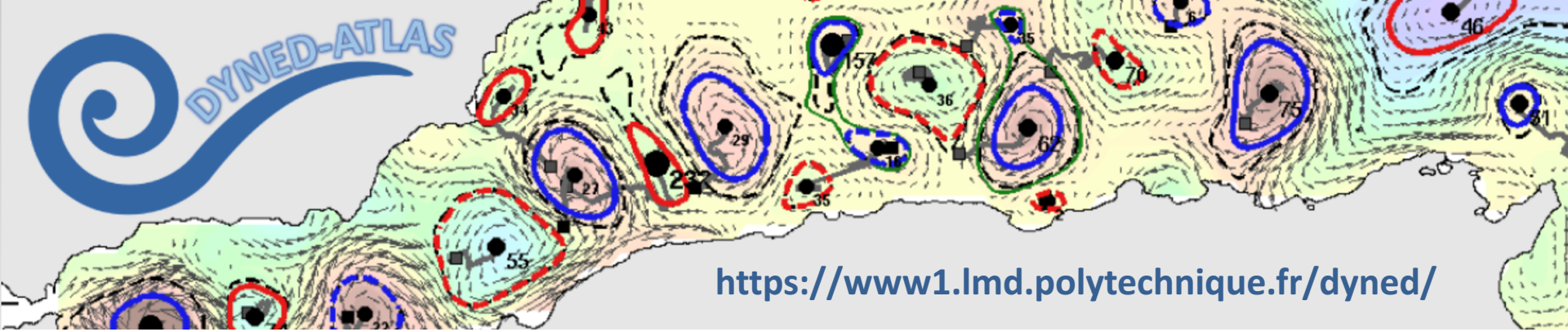
ANR: *DYNamical Eddies-Atlas*

Estimation of the
3D structure
of individual eddies

Mean climatological profile outside all eddies

Argo profile inside the selected eddy





Goals

- Provide a dynamical data-base of long-lived eddies (2000-2015)
- Mediterranean Sea / Arabian Sea
- Estimation of the 3D structure of the eddies: few characteristic proxys
- Comparisons with various in-situ campaigns
- An user friendly GUI to access and use the DYNED-Atlas data-base
- A new methodology (eddies distribution) to validate regional numerical models

Understand

formation processes / decay and dissipation of coherent eddies

Wind / eddy interactions

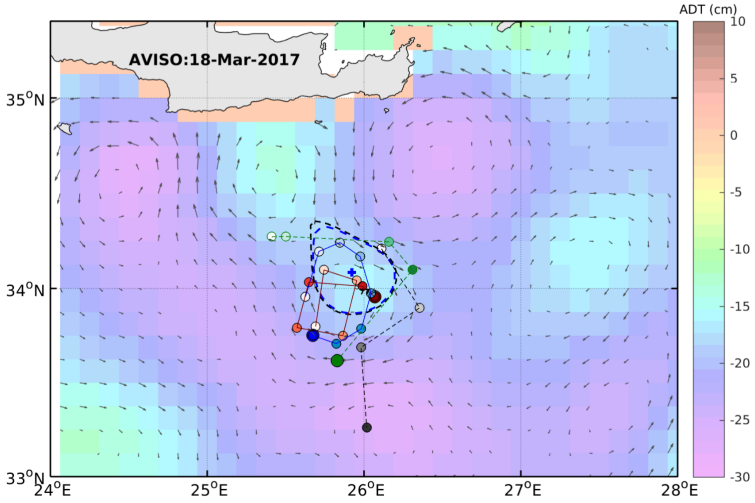
Impact on subsurface transport (-200m, -600m…) of heat, salt, ...

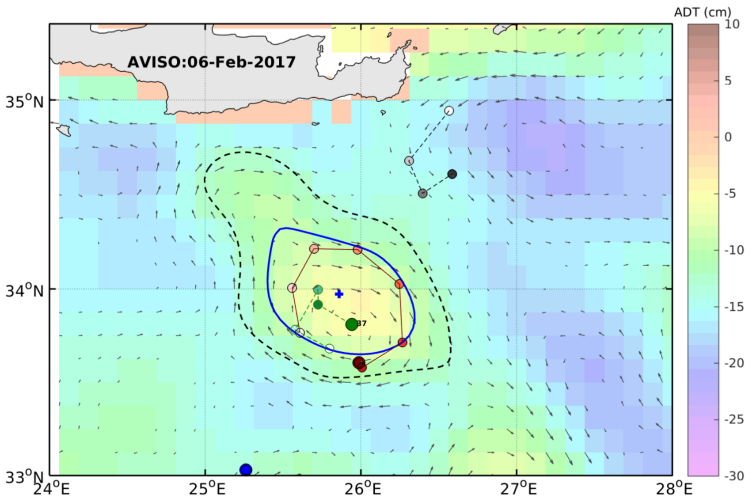
Impact on biogeochemical cycles

Projet CNES (eddy reliability index)

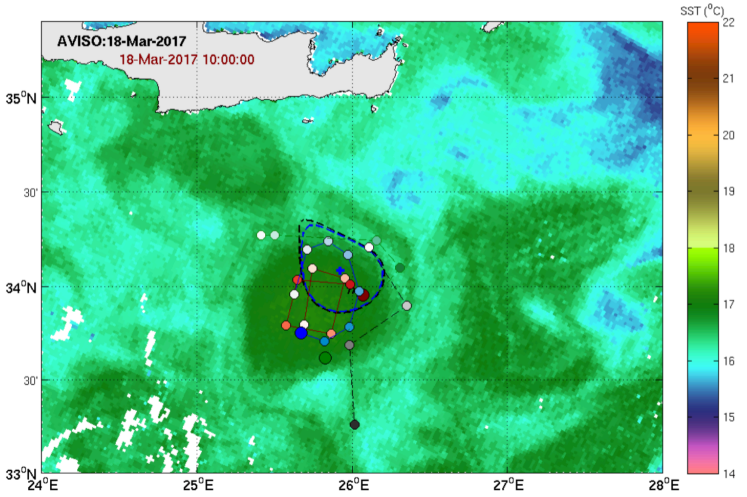
How reliable is the eddy detection from altimetric data-set ?

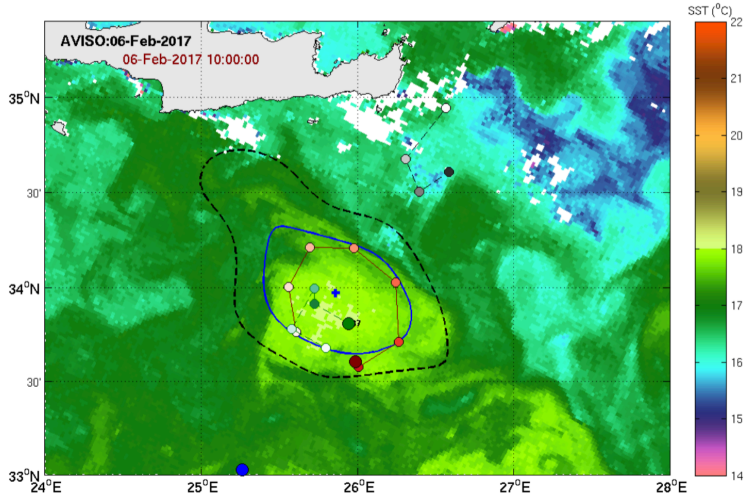
ADT
+
AMEDA
eddy contours
+
Argo floats





SST
+
AMEDA
eddy contours
+
Argo floats





Projet CNES (eddy reliability index)

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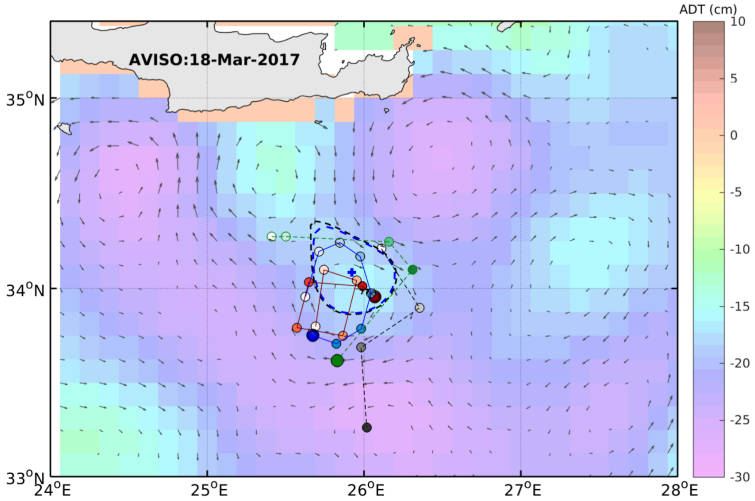
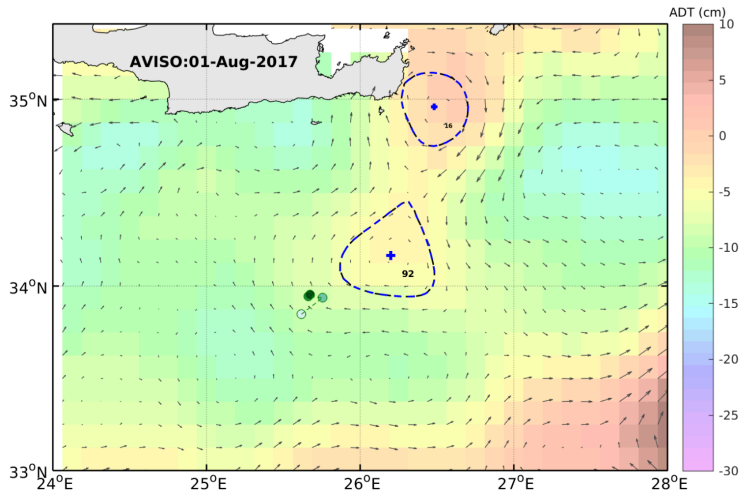
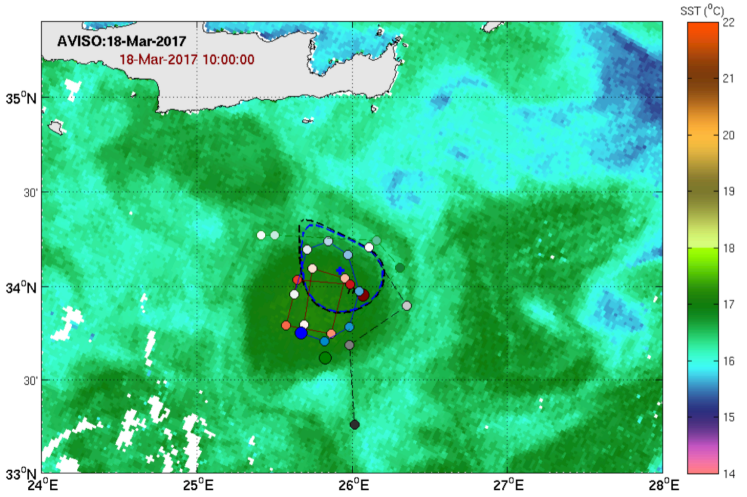
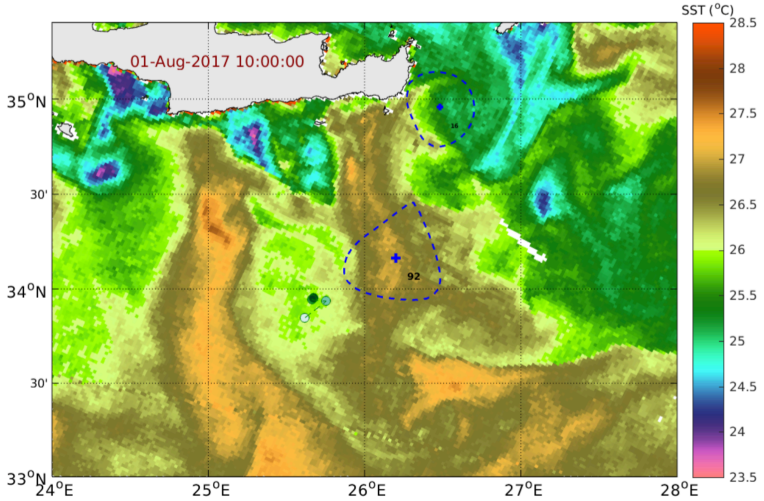




SST
+
AMEDA
eddy contours
+
Argo floats



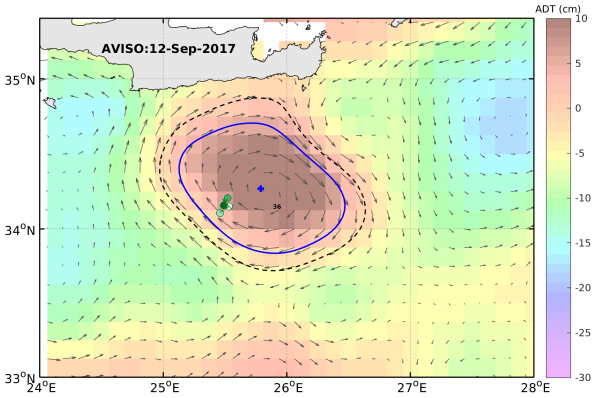


ANR PROJECT To be sumbitted in 2018

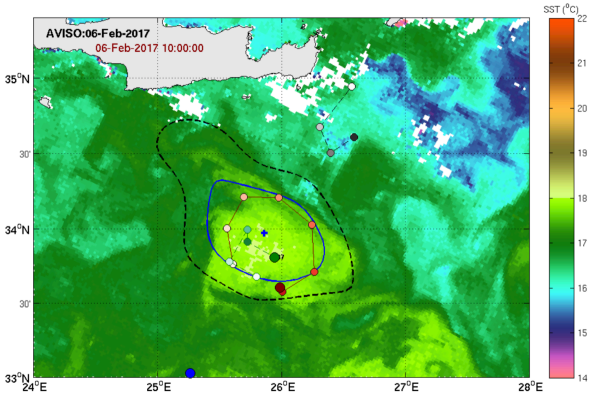
DEEP LEARNING METHODOLOGY FOR OCEANIC EDDY DETECTION FROM MULTISOURCE REMOTELY SENSED DATA & applied to Biologcal cycle ?

Eddy signature could appears on distinct data-sets

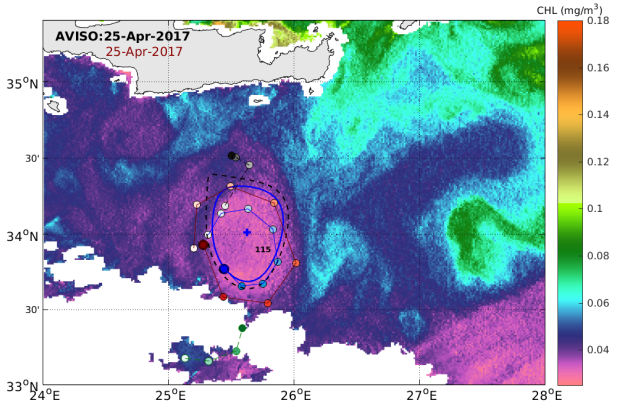
SSH
&
derived velocities



SST



Sea color (CHL)



But they are not all good proxies at the same time !

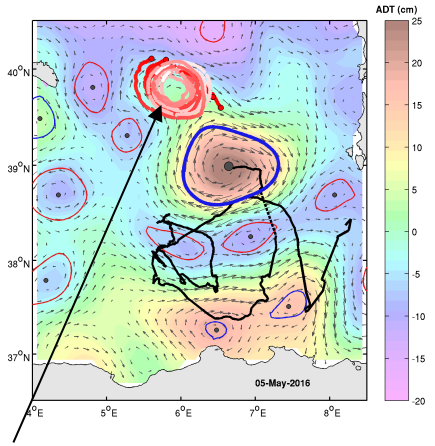
ADVANTAGES

- not sensitive to cloud coverage
- several satellites allow daily maps of SSH & surface velocities

DRAWBACKS

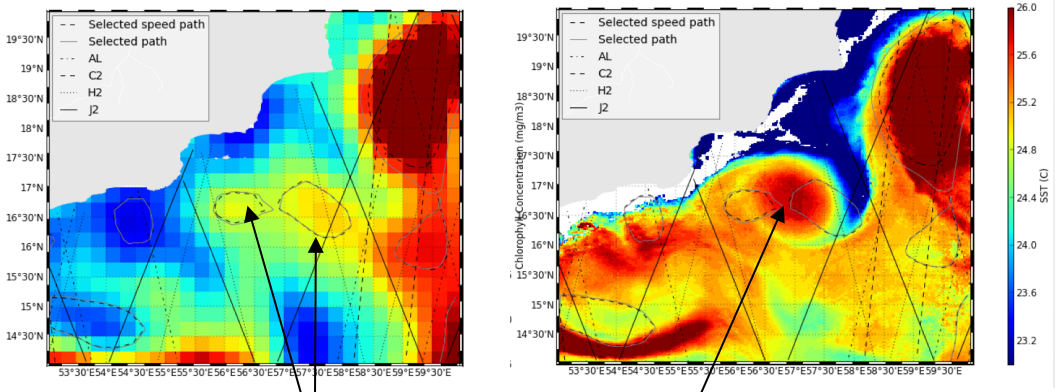
- Coarse gridded products 1/4° (global) or 1/8° (regional)
- « Holes » in the altimetric tracks

missed eddies



Not detected

Erroneous detection



Two eddies instead of one !

Sea Surface Temperature (SST) IMAGES

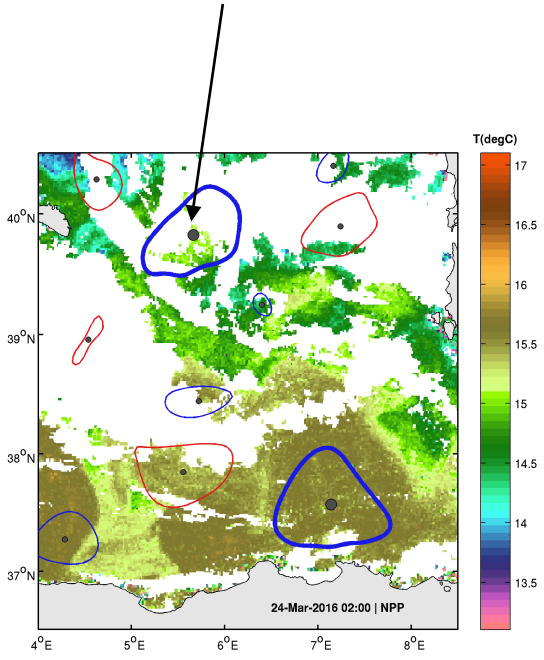
ADVANTAGES

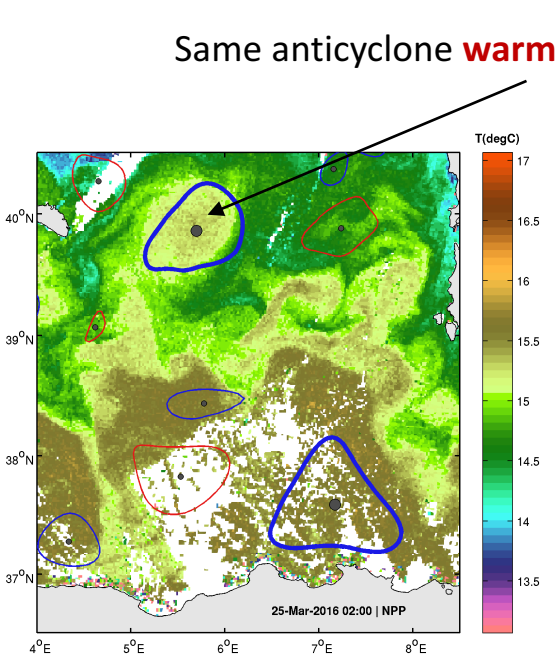
- High resolution (km grid)
- Up to five images per day could be available

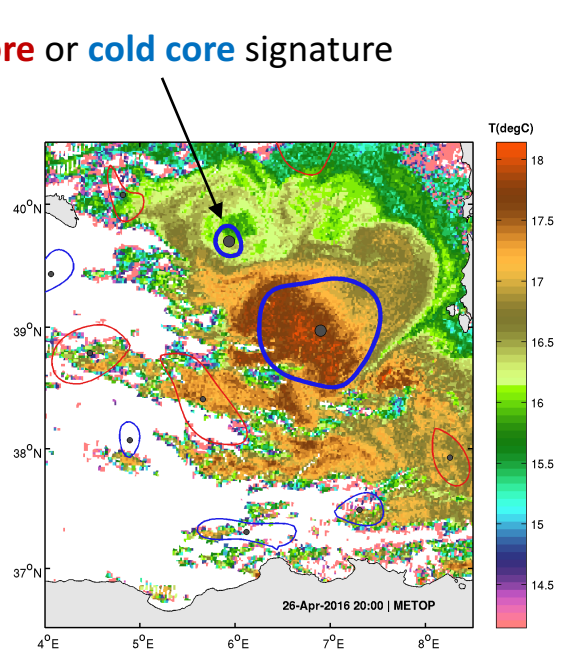
DRAWBACKS

- Cloud coverage
- Sensitive to air-sea interactions

Same anticyclone **warm core** or **cold core** signature







Not visible but detected by altimetry

HOW TO COMBINE ALL THESE DATA SETS TO IMPROVE THE EDDY DETECTION ?

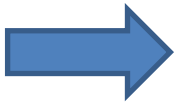
AND PROVIDES NEW ANALYSIS ON EDDY DYNAMICS AND BIOLOGICAL IMPACTS ?

OBJECTIVES METHODS

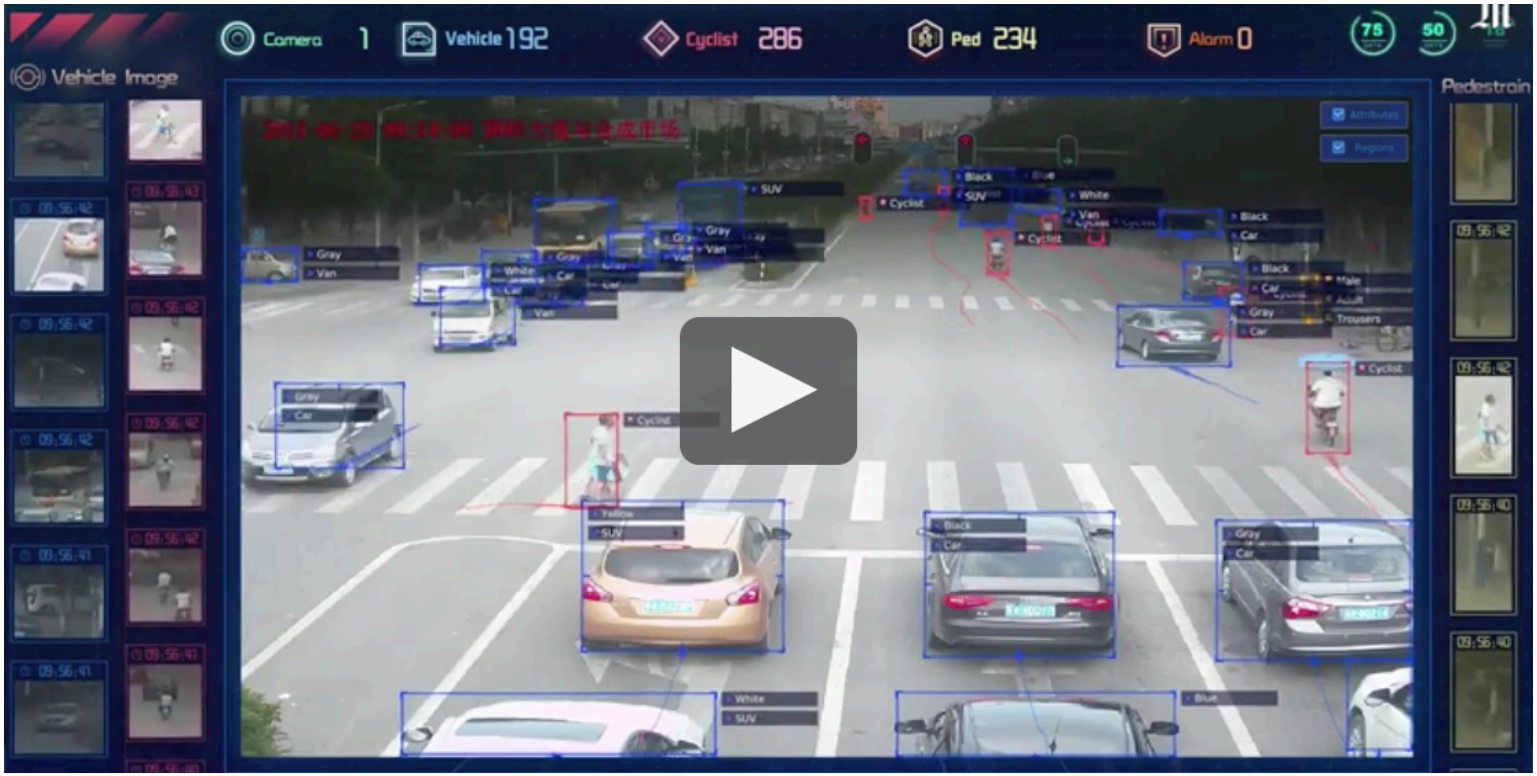
WORKS ON ALTIMETRIC DATA-SETS (eddy detection algorithm)
BUT THE DATA SETS NOT ALWAYS RELIABLE

OBJECTIVES METHODS

ARE NOT RELIABLE ON SST OR CHLOROPHYLL IMAGES
IMAGES NOT ALWAYS AVAILABLE OR CORRUPTED



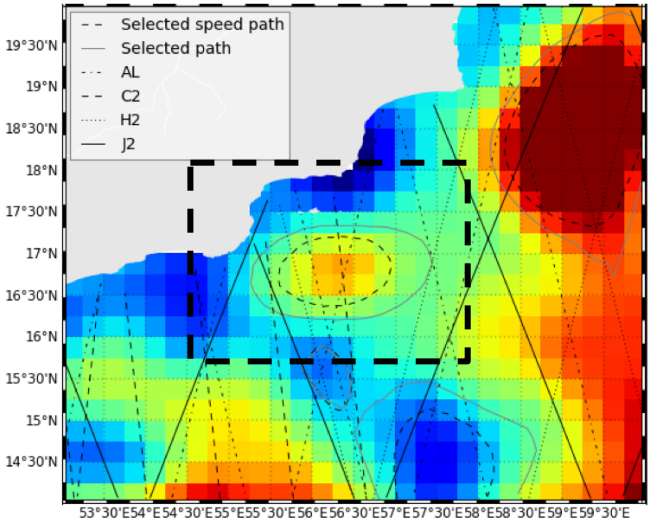
DEEP LEARNING STRATEGY
MIGHT BE SOLUTION
TO COMBINE ALL THESE DATA



Exemple of moving object classification and identification with deep learning methodology

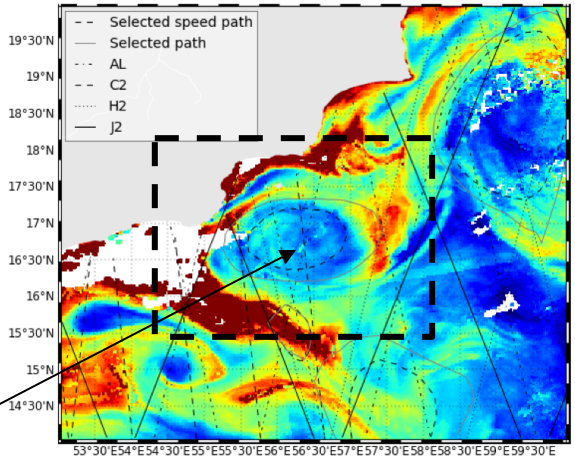
MAIN ISSUE : PROVIDE AN ACCURATE DATA SET FOR LEARNING STAGE

Use objective method
(eddy tracking algorithm)
on altimetric products
to locate eddies (center & size)



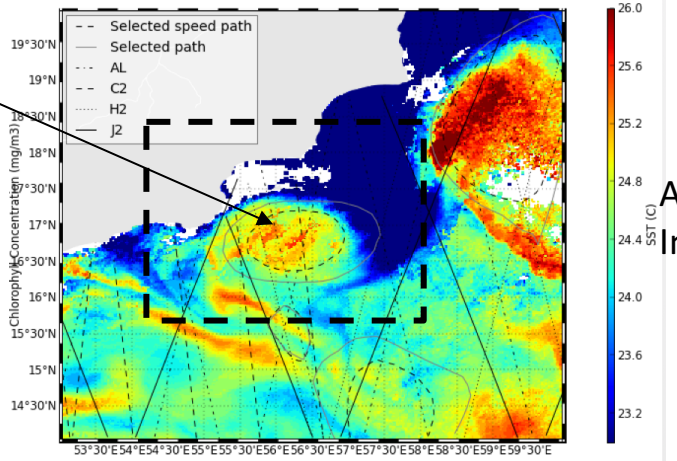
Only when the fiability index is good !

several tracks inside eddy contours



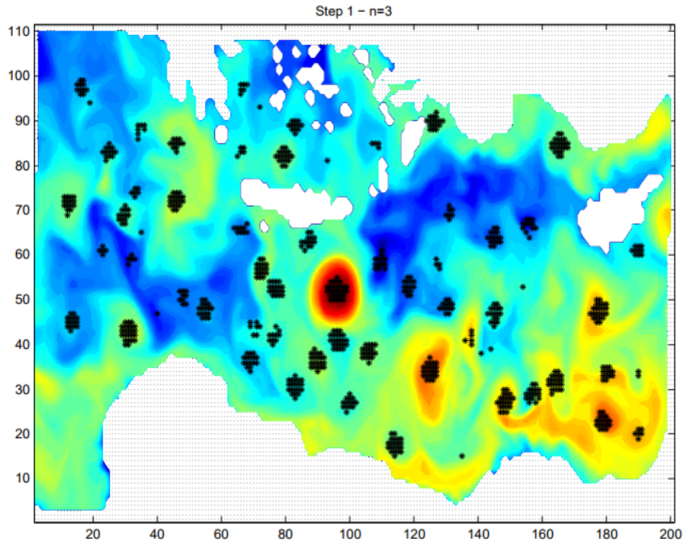
If image OK

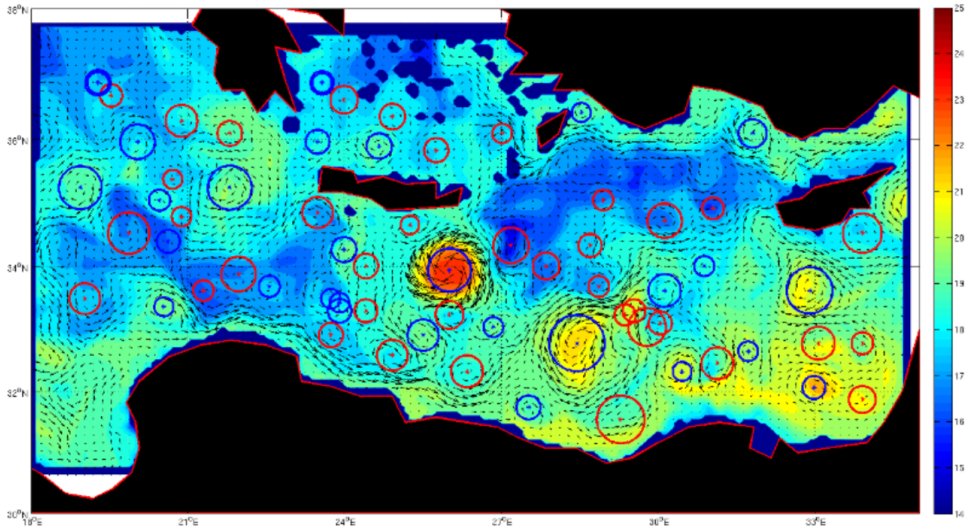
Add local SST
In learning data base



Add local CHL
In learning data base

Eddy –localisation: Deep learing methodology tested on MEDRYSV2 should works…





Sub-classification inside the main « standard » classification (eddy (A/C) , WC/CC, ….)

- Chlorophyl concentration / biogeochemical cycles ?