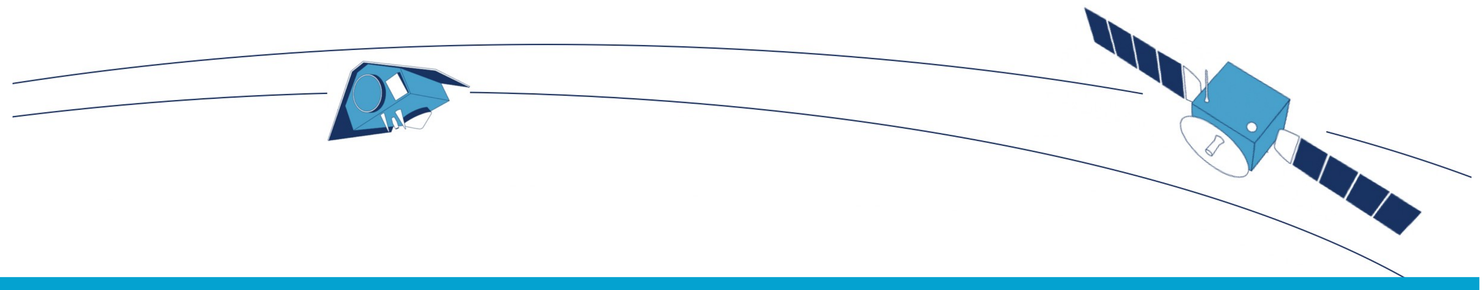
AMPHITRITE
OCEAN DATA INTELLIGENCE



DEEP-EDDY-SCAN
a new tool for real-time eddy detection based on the fusion of SST and altimetry satellite data

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ÉCOLE POLYTECHNIQUE

Abstract

We developed a processing-chain and associated tools to detect and track eddies in Near Real Time (NRT) over the Mediterranean Sea every day (**DEEP-EDDY-SCAN**).

The chain analyses **Altimetry** imagery (Fig.2a) thanks to objectives methods such as **AMEDA** (Fig.1). In the same time a detection of eddies is performed on the **SST** (Fig.2b) thanks to a **neural network**. The fusion between these detection aim to determine their **reliability** (Fig.3).

The viewer can pop-up the eddies past trajectory and we use **ARGO profiles** to provide an estimate of their **vertical structure** (Fig. 4) and their surrounding.

The **SEAScope** viewer allows to explore the result of DEEP-EDDY-SCAN and compare with detection perform on different **Operational Oceanic Models** (Fig.5).

Eddy Detection Methods

On Altimetry and Numerical Models

The **A**ngular **M**omentum **E**ddy **D**etection **A**lgorithm (**AMEDA**, Le Vu *et al*. 2018) is an automated eddy detection and tracking algorithm based on the surface velocity. That allows to detect and quantify the size (R_{max} on Fig 1) and the intensity of eddies during their all life from many different data set (altimetry, *in-situ* measurements or numerical models).

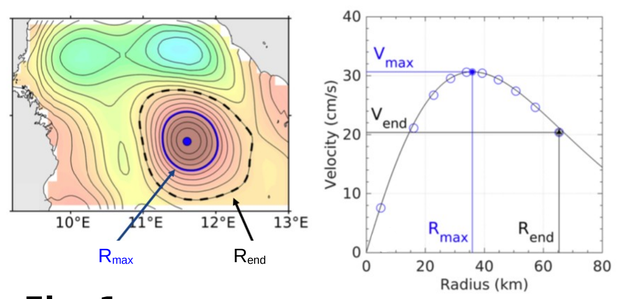


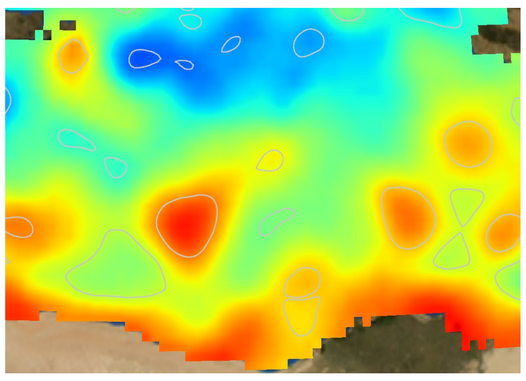
Fig. 1

Ioannou & al. JGR 2019

On Sea Surface Temperature

Neural netwok trained on segmentation task to detect contour of maximum velocity (R_{max}) thanks to an OSSE (Observing System Simulation Experiment) – for more details see Stegner *et al*. **Poster 105**

Detection on Satellite Data



AMEDA on Altimetry

R_{max} Contour
AE and CE

Neural Netwok on SST

Anticyclones
R_{max} Contours

Cyclones
R_{max} Contours

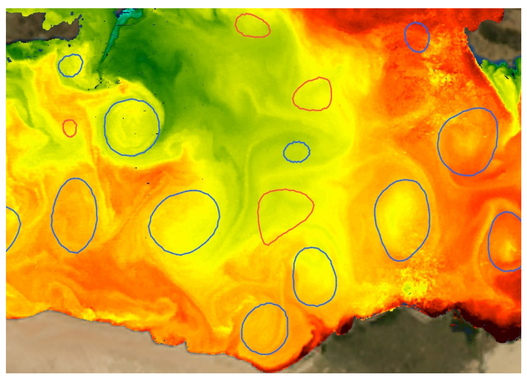


Fig. 2a: Example of AMEDA detection on a L4 SSALTO/DUACS Altimetry image (SEALEVEL_EUR_PHY_L4_NRT_OBSERVATIONS_008_060 from CMEMS. https://doi.org/10.48670/moi-00171)

Fig. 2b: Example of Neural Network eddy detection on a L3S SST image (SST_MED_SST_L3S_NRT_OBSERVATIONS_010_012 from CMEMS. https://doi.org/10.48670/moi-00142)

Reliability and Trajectory

Altimetry contours

Medium reliability

Good reliability

Strong reliability

Strong centers

Anticyclones R_{max}
ContourS from **SST**

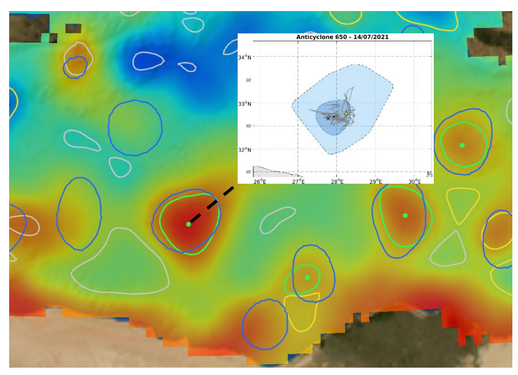
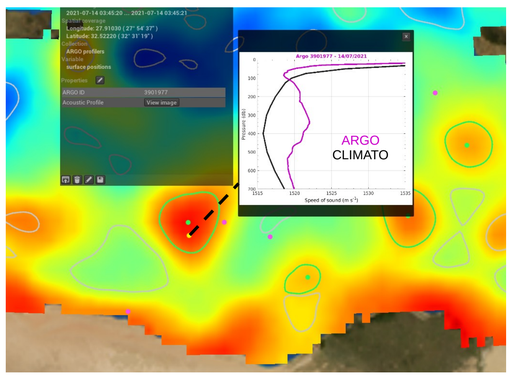


Fig. 3: Example of an AMEDA **tracking history** of a strongly reliable anticyclone based on a good superposition of 2 independent detections: Altimetry and SST (Fig.2).

Vertical Structure



AMEDA contours

Medium reliability

Good reliability

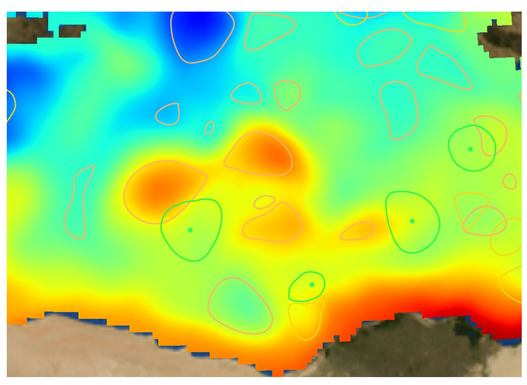
Strong reliability

Strong centers

ARGO profilers position

Fig. 4: Case of an ARGO float caught in a Mersa Matruh eddy in July 2021. The vertical profile of the temperature confirms that this eddy produces an important impact on the structure of the water density anomaly.

Models Comparaison



Altimetry contours

Good reliability

Strong reliability

Strong centers

MERCATOR
Contours

MFS
Contours

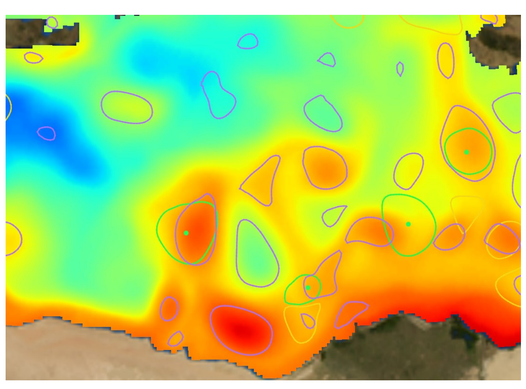


Fig. 5a: Comparison between reliable altimetry contours and AMEDA contours from **MERCATOR** NRT product with few concomitance.

Fig. 5b: Comparison between reliable altimetry contours and AMEDA contours from **MFS** NRT product with some good concomitance.

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Reference

- B. Le Vu *et al*., 2018. Journal of Atmospheric and Oceanic Technology, vol. 35, no. 4, pp. 739–762.
- A. Ioannou *et al*.,2017. Journal of Geophysical Research. Oceans, Wiley-Blackwell, 122 (11), pp.9276 - 9298.

Acknowledgement

- CMEMS https://marine.copernicus.eu and Ocean Data Lab https://www.oceandatalab.com