MASTER INTERSHIP PROPOSAL

Title: *Deep learning applied on high-resolution visible images boost oceanic eddy detection.*

Location

AMPHITRITE (Start-Up, X Tech program)
DRAHI-X-Novation Center, Route de Saclay, Ecole Polytechnique.

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Goals and contexts:

There is today a strong growth of ocean data, satellite and in-situ data. Nevertheless, it is still difficult to characterize, in real time and with a high accuracy, the state of the ocean at local or regional scales (10-200km). The value of AMPHITRITE is to merge satellite data and to use artificial intelligence to provide reliable information tailored to the needs of the maritime stakeholders.

Our technological innovation, which constitutes a strong competitive advantage, is the result of our research work carried out in recent years at the CNRS and the Ecole Polytechnique, by the founders of AMPHITRITE. It is now based on the fusion of several satellite data (AVISO/DUACS altimetry and high-resolution SST L3S images) to locate and characterize the shape of oceanic eddies at the ocean surface. The technology development project we propose consists in extending our Deep-Eddy-Scan detection tool, which is currently operational on SST images, to other very high-resolution satellite images (Figure 1): water color channels (WC) and Synthetic Apertur Radar (SAR) images. The aim here is to extend the scope of an existing methodology. This will increase the reliability and robustness of the real-time Deep-Eddy-Scan algorithm especially when visible images are corrupted by strong cloud coverage.

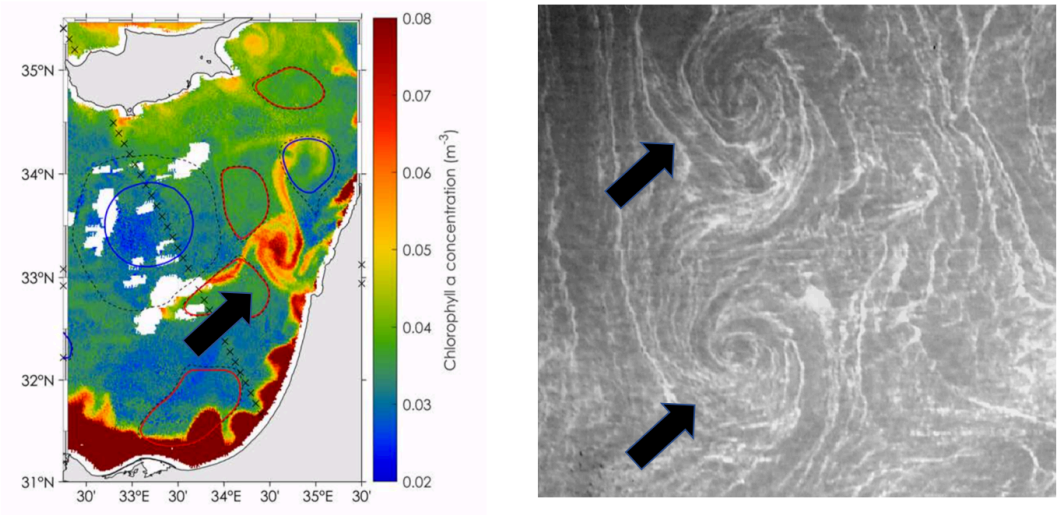

Figure 1 *Examples of eddy signature indicated with the black arrows on a seawater color image (left) and synthetic apertur radar (SAR) (right).*

Tools and methodology:

1- The first phase consists in building a training data-set (on WC and SAR images) containing eddies images validated by our Deep-Eddy-Valid tool. This tool computes the geometric match between the characteristic contour of an eddy detected on AVISO/DUACS altimetry data and the contour of the same eddy detected on SST images. When the Intersection Over Union between these two independent detections is higher than 50% the eddy is considered as validated (Figure 2).

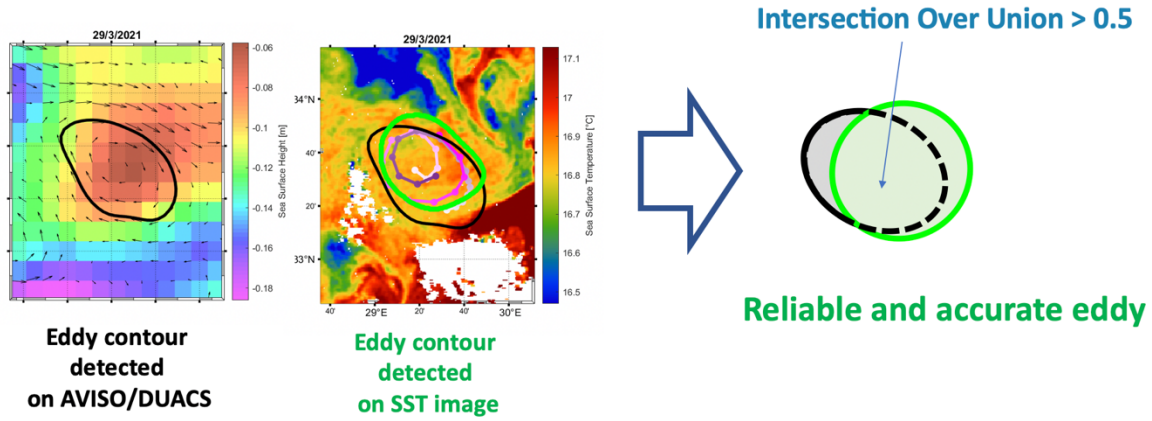

Figure 2: Principle of Deep-Eddy-Scan

2- In a second step we will train a specific convolutional neural networks of the UNET type to provide, by segmentation, the characteristic contours of eddies visible on WC images and optimize the model performance adding synthetic cloud coverage.

3- In a third step we will train a specific convolutional neural networks of the UNET type to provide, by segmentation, the characteristic contours of eddies visible on SAR images.

4- The final task is to combine analyses of independent SST, WC and SAR images, when they are not too noisy, with AVISO/DUACS altimetry fields to build the most accurate eddy map in a given area. This requires quantifying the coherence of the four detection channels to identify reliable detections (coherence between two independent physical signatures) and probable detections (a single physical signature but with a high reliability rate).

Candidate Skills:

This project will suits an highly motivated student willing to gain experience within an ocean tech start-up. The master student should have at least one of the following expertise:

- Familiriaty with computer vision (CV) methods (semantic segmentation, object detection) and corresponding deep learning architectures.
- Know-how on machine learning (ML) libraries in Python. Pytorch expertise is a plus.
- A past CV/ML project. Experience or strong interest on remote sensing/ocean data is a plus.

Internship allowance: 1200€/month