Title : Characterization of eddies and frontal structures in the North-East Atlantic: towards the analysis of their impact on carbon fluxes.

Place : IUEM (LEMAR/LOPS), Technopole Brest Iroise, 29280 Plouzané, France
Duration : 6 months

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Increased resolution of spatial models and observations has revealed the prevalence of eddies and frontal structures throughout the world ocean (Chelton *et al*., 2011). These structures are responsible for the transport of heat and mass, as well as tracers and biogenic elements over long distances. They also induce changes in the characteristics of water masses, and control primary production and carbon export fluxes (Lévy *et al*., 2015). It is therefore essential to be able to describe them precisely (number, size, intensity, life time, rotation, etc.) in order to diagnose their impact. Within the framework of the APERO project, based on numerous international collaborations (UK, D, USA) within the JETZON consortium, this internship aims to carry out a preliminary study of the area covered by the campaign planned in the North East Atlantic in order to optimize the sampling strategy, an essential step for the project. More specifically, the work objectives are:

- Establish statistics on the characteristics of the eddy structures of the North-East Atlantic and their seasonal and interannual variability.
- Estimate their impact on the transport of tracers, including chlorophyll.
- Describe the intensity and stability of frontal structures associated with eddies, and the potential impact on carbon fluxes.

Several tools have been developed to describe the characteristics of the structures of the eddies and the impact of small scale on the circulation and distribution of tracers. Given its ability to be adapted to data of varying spatial resolution and to be used on both satellite observations and numerical model outputs, the software used is AMEDA (Le Vu *et al*., 2018), which is also capable of managing the gaps in the data, as well as the merging/dislocating of eddies. The study of the coherence of the identified structures, as well as the convergence/divergence lines of the fluid, will follow the approach by Finite Size Lyapunov Exponents (FSLE: Lehahn *et al*., 2018). The internship will be carried out in several stages.

- Seasonal and interannual variability of eddies and frontal structures using the outputs of a high-resolution (1/60°) simulation of the North Atlantic.
- Seasonal and interannual variability of eddies and frontal structures using satellite altimetry: statistical comparison with simulation outputs
- Impact of this variability on the distribution of tracers: surface temperature and chlorophyll (satellite data and model outputs).

This internship is at the frontier between fluid dynamics and marine biogeochemistry. All tools/software and numerical simulation outputs are available in the host laboratories.

Chelton, D. B., M. G. Schlax, and R. M. Samelson, 2011: Global observations of nonlinear mesoscale eddies. *Progress in Oceanography*, 91**,** 167-216 ; Le Vu, B., A. Stegner, and T. Arsouze, 2018: Angular Momentum Eddy Detection and Tracking Algorithm (AMEDA) and Its Application to Coastal Eddy Formation. *Journal of Atmospheric and Oceanic Technology*, 35**,** 739-762.; Lehahn, Y., F. d'Ovidio, and I. Koren, 2018: A Satellite-Based Lagrangian View on Phytoplankton Dynamics. *Annual Review of Marine Science*, 10**,** 99-119 ; Lévy, M., O. Jahn, S. Dutkiewicz, M. J. Follows, and F. d'Ovidio, 2015: The dynamical landscape of marine phytoplankton diversity. *Journal of the Royal Society Interface*, 12.