Highly-coherent oceanic structures and their impact on the diatom dynamics

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Diatoms are known to thrive in high nutrient-high turbulent systems (e.g. polar, upwelling and coastal areas). However, they are not exclusive to these systems, and recent observations revealed that short-living spatially-restricted diatoms blooms may occur in oligotrophic, nutrient limited waters fueled by transient meso- and submesoscale dynamical structures such as eddies, fronts or filaments, questioning future projections based on models that cannot properly resolve these circulation structures. In this talk, I will present a novel framework to identify flow coherence simultaneously in space and time, and how it can be used to study what dynamical conditions are conductive to episodic diatom blooms in oligotrophic waters. We combine remote-sensed data from different platforms (satellite observations of dominant phytoplankton functional types) with Lagrangian techniques, including finite-time Lagrangian eddy kinetic energy and finite-time Lagrangian vorticity calculated from altimetry derived surface currents. This methodology has been applied to classify the flow structures according to their Lagrangian coherent rate (LCR) (i.e. a new objective measure of the range of dynamical coherence scales of the underlying flow features), and to identify the mesoscale eddies that effectively promote diatoms blooms. In particular, we observe that turbulent mesoscale structures with high LCR (40 days or longer) favor the sustained growth of diatoms. The integration of Eulerian kinematic variables into a Lagrangian frame represents a significant step forward towards quantifying new dynamical scales of geophysical turbulence that modulate the phytoplankton community structure, and offer a new, robust test for Earth System Models.