THE RAMON MARGALEF SUMMER COLLOQUIA
A view of the ocean from Barcelona

## Conference Title:

Ocean mesoscale eddies: frontal forcing and their impact on the marine ecosystem.

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## Abstract:

Mesoscale eddies are nearly ubiquitous features of the World Ocean. They occupy the 25 % of the ocean surface at any time. They may be viewed as frontal structures with nearly circular shape. Therefore they isolate physical and biogeochemical properties at their interior an introduce gradients of those properties at their periphery while they are advected. Their radius varies with the first baroclinic Rossby radius of deformation which is O(100-50 km) for low and mid latitudes and O(10 km) for high latitudes. There are mainly three eddy types: cyclones, anticyclones and intrathermocline eddies. Due to the geostrophic adjustment cyclonic eddies are recognizable by the upward doming of the isopycnals while anticyclones by their downward displacement. Intrathermocline eddies, also often referred as mode-water eddies, are a particular type of anticyclonic eddies being their most remarkable feature the associated dome shape of the isopycnals in the shallower layers and bowl shape in the deeper layers forming thus lens-like structures overall.

There are growing evidences that eddies may have a great impact on the marine ecosystem and on modulating biogeochemical fluxes. In particular eddies may influence phytoplankton through three primary processes: horizontal advection, vertical fluxes of nutrients and mixing. Recently a special attention has been paid on the influence of eddy-wind interaction on vertical fluxes of nutrients. Some studies proposed that such interaction leads to an upwelling/downwelling at the centers of anticyclones/cyclones that will enhance/decrease primary production in anticyclones/cyclones. Other studies point out that this interaction takes place at the eddy periphery. It any case both mechanisms will enhance primary production in anticyclones which is contrary to classical view that anticyclones are oligotrophic structures being cyclones more productive. The secondary circulation inside a mesoscale eddy which drives nutrient fluxes can be much more complex than those related with eddy-wind interactions and involves also the occurrence of Vortex Rossby Waves (VRW) and the deformation and advection of the potential vorticity field.

Moreover it has been observed that eddies evolves pulsating switching thus between upwelling and downwelling modes

Recent observations in a mid ocean mode-water eddy (eddy PUMP) suggest that the physical forcing of the marine ecosystem system inside a mesoscale eddy is complex. Although it was observed a clear enhancement of microphytoplankton at the eddy periphery the distribution of the different phytoplankton groups varies which suggest a different response of those groups to vertical mixing and secondary circulation. Coinciding with microphytoplancton enhancement vertical upwelling/downwelling cells where observed at the eddy periphery. Those cells are most likely the result of VRWs and the advection of potential vorticity than of eddy-wind interaction. In addition an upward entrainment velocity related with mixing was observed all along the eddy that can reinforce/suppress the effects of the upwelling/downwelling cells.