Contribution of mesoscale eddies to Black Sea ventilation

Context
1. The Black Sea vertical structure induces permanent anoxia over a large part of the water column (~2000 m).
2. Recent study revealed that the limit of oxygen penetration has shoaled substantively during the past decades [1].
3. Oxygen penetration depth (on a density vertical scale) suggest the occurrence of diapycnal ventilation along the basin periphery. This area is known to be populated with recurrent and semi-permanent eddies [2].

Approach
▶ Our objective is to characterize the role of persistent and semi-permanent meso-scale structures in the diapycnal transport of biogeochemical tracers, in particular oxygen.
▶ First, we characterize the vertical anomalies recurrently associated with meso-scale eddies.
▶ The eddy identification is based on sea-level anomaly [3].
▶ This methodology is applied on satellite altimetry, and outputs from the GHER-BHAMBI model.
▶ For satellite-derived eddies, we evaluate the potential to use Argo profiles to characterize a corresponding recurrent vertical anomaly.
▶ For model-derived eddies, we use the outputs of the biogeochemical model to identify recurrent anomalies associated with meso-scale eddies [3].

References

Results: Composite Eddies from model outputs
Anticyclonic (red) and cyclonic (blue) eddies, detected on the basis of model outputs.
▶ High anticyclonic activities occurs over the shelf break separating the northwestern shelf from the open basin.

Persistent anomalies associated with anticyclonic eddies along the northwestern shelf break.
▶ Salinity mean field shows the iso-haline curvature.
▶ Chlorophyll anomaly evidence the meso-scale eddies structuring of biogeochemical processes.
▶ Oxygen anomaly, visible down to 150 m, suggests associated ventilation.

Results: Composite Eddies from observations
Anticyclonic (red) and cyclonic (blue) eddies, detected on the basis of satellite altimetry.
▶ Anticyclonic eddies along the northwestern depicts longer tracks than in the current model results.
▶ Basin-wide cover might be due to noise in the altimetry gridded products or over-smoothed model results.

Matches between ARGO (blue) and Bio-Argo (red) tracks and detected eddies, in the eddy-centered cylindrical reference frame (2010-2016).
▶ There is potential for composite analysis merging satellite and Argo data.
▶ This approach will benefit from for enhanced coastal altimetry products (SWOT).