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A comprehensive study of mesoscale dynamics and horizontal transports in the North Western part of the Black Sea

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Due to its enclosed nature, the Black Sea is confronted with many environmental problems. Via agricultural and industrial runoff, large European rivers discharge excessive amounts of nutrients into shallow areas of the North West shelf. This leads to over-eutrophication of shelf waters and degradation of marine habitats and communities. The balance of nutrients on the shelf is governed not only by the supply of nutrients by rivers but also by the rate with which nutrient rich shelf waters are replaced by relatively clean deep sea waters. There are significant gaps and uncertainties in understanding and quantifying the exchanges across the shelf break. Mesoscale dynamics, such as formation and propagation of mesoscale eddies, fronts and filaments, is thought to be an important contributing mechanism of exchanges across the shelf break. Despite numerous previous studies, there are obvious gaps in understanding the roles of mesoscale dynamics in horizontal mixing and vertical exchanges through the thermocline.

This study has been carried out on 8-19 May 2004 as part of the Black Sea Ecosystem Recovery Project, and is based on a high resolution grid of in-situ measurements (with spacing of 5 to 15 miles between stations) and supporting satellite and drifting buoys information. The field phase was designed using a Lagrangean philosophy in mind, and the grid of stations (62 in total) followed an anticyclonic eddy, which was induced by the Rim current and moved SW along the shelf break. A mesoscale eddy was identified using satellite SST data and then surveyed using a “butterfly wing” set of cross

sections that allowed to identify precisely the centre and the internal structure of the eddy. Data included standard CTD measurements, continuous velocity profiling with a lowered ADCP probe, biochemical sampling with 2 litre bottles, launch of 6 surface SVP-B ARGOS tracked drifters, chlorophyll measurements with fast repetition rate fluorimeter, measurements of turbulence, water transparency, and wind speed and direction. The eddy broke down a few weeks afterwards, so that the embedded drifters (simulated pollution) travelled very different trajectories. Eddy trajectories were compared with that ones for the period May- September 2003-2004 inferred from AVHRR thermal images. The trajectory and the parameters of the observed eddy are found to be similar to the numerical simulations of the Black Sea circulation carried out using a POLCOMS code. Further analysis revealed a 3D velocity structure, in some cases the eddy induced horizontal movement penetrated as deep as 500m.