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Modeling the influence of hydrodynamic processes on anchovy distribution and connectivity in the Black Sea

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Dispersal in many fish species occurs during early life through advection by currents.
The connectivity between anchovy stocks found in different areas in the Black Sea due to larval transport via currents is studied with a Lagrangian model. In this study drifters representing anchovy larvae are released in three consecutive years (2001-2003) coinciding with very warm mean summer temp (2001) and cold mean summer temperatures in the Black Sea (2001). Drifters are released in known spawning regions in mid-June (15th), mid-July and mid-August of each of the three years at nodes where the water temperature is above 20°C. Individuals are advected and dispersed by daily current fields calculated from AVISO sea surface height data for 36 days, assuming this time span covers the time it takes for anchovy eggs to develop into early larvae and larvae stages before becoming a juvenile and acquiring the ability to swim. The present version of the model set up includes neither active swimming of juvenile and adults, nor fishing mortality. These simplifications are introduced to isolate the effect of life cycle characteristics as well as environmental influences on anchovy dynamics.

Model results indicate that anchovy larval dispersal is strongly controlled by advection through the two cyclonic gyres of the Black Sea and the Rim Current around the periphery of the basin. Locally, dispersal is controlled by mesoscale eddies spinning off this rim current. Currents may advect larvae as far as xx km in the 36 days of transport and therefore all coastal regions of the Black Sea where anchovy spawning can occur are interconnected. Specifically, the spawning area on the north-western shelf is connected to the spawning region on the south-western shelf of the Bosphorus, while the spawning area on the southern shelf off Samsun (Turkey) is connected to the north-east spawning region off the Azov Sea. However, the south-western shelf and the north-east spawning areas are more isolated. Interannual variability in the dispersal and survival of larvae is considerable, especially when comparing warm years (e.g. 2001) to cold years (e.g. 2003).