Temporal and spatial variability of oxygen and sulfide in the Black Sea

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The upper ocean hydrochemistry in the Black Sea is analyzed using data originating from profiling floats as well as from coupled three-dimensional circulation biogeochemical model. Major focus is on the dynamics of suboxic zone which is the interface separating oxygenated and anoxic waters. The scatter of oxygen and sulfide data is indicative of vigorous biogeochemical reactions in the suboxic zone, which acts as a boundary layer or internal sink for oxygen. This internal sink affects the mixing patterns of oxygen compared to the ones of conservative tracers. Two different regimes of ventilation of pycnocline were clearly identified: a gyre-dominated (cyclonic) regime in winter and a coastal boundary layer (anticyclonic eddy)-dominated regime in summer. These contrasting states are characterized by very different pathways of oxygen intrusions along the isopycnals and vertical oxygen conveyor belt organized in multiple-layered cells formed in each gyre. The contribution of the three-dimensional modelling to the understanding of the Black Sea hydro-chemistry, and in particular the coast-to-open-sea mixing, is also demonstrated. Evidence is given that the formation of oxic waters and of cold intermediate waters, although triggered by the same physical process, each follow a different evolution. The difference in the depths of the temperature minimum and the oxygen maximum indicates that the variability of oxygen is not only just a response to physical forcing and changes in the surface conditions, but undergoes its own evolution.