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Seasonal seafloor oxygen dynamics on the Romanian Black Sea Shelf

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The Black Sea suffers from the combined effects of anthropogenic eutrophication, overfishing and climate forcing. As a result, its broad and shallow western shelf in particular has a history of ecosystem collapse during the 1970s to the mid-1990s, which followed a slow recovery since the late 1990s due to reduction in anthropogenic pressures. Because of eutrophication, increased oxygen consumption caused recurrent widespread seasonal seafloor hypoxia in a system that is already naturally prone to decrease in bottom water oxygen during summer. On the shelf, reduced bottom water ventilation is a strong natural driver for seafloor hypoxia, due to strong seasonal thermohaline stratification as a result of freshwater inflow from the large rivers Danube, Dniester and Dniepro.
To understand the present seasonal dynamics of seafloor oxygen on the Romanian shelf, a seafloor mooring was deployed in 2010 and 2016 during summer and autumn, for three and six months, respectively. The mooring, consisting of an Aanderaa SEAGUARD sensor package attached to an acoustic release, was deployed in 30 m water depth in the Portita region – north of Constanta and south of the Danube River Mouths. The in-situ time series of seafloor oxygen, temperature, turbidity, salinity, and current velocities and directions, combined with CTD profiles, benthic oxygen consumption rates based on ex-situ incubations of sediment cores, and pelagic oxygen respiration rates provide a set of information that allows biological and hydrophysical controls on seafloor oxygen to be identified.
We observed the built-up of the thermohaline stratification during late spring and early summer, accompanied by steady decrease in bottom water oxygen. Superimposed settling of particles to the seafloor eventually led to the formation of seafloor hypoxia in late summer. Anticyclonic currents resemble diurnal tidal cycles, albeit low in magnitude. The effects of a strong rainstorm and a Danube flood event in late September were visible in a short-term increase in bottom water oxygen. The autumn storm events over the Black Sea led to seafloor ventilation and stepwise increase of bottom water oxygen on the shelf, which continues during the stormy winter season.