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Oxygen conditions and biogeochemical responses in Black Sea ecosystems: Investigations by the EU-Project HYPOX

Felix Janssen (1), Jan Fischer (1), Jana Friedrich (2), Moritz Holtappels (1), Gaute Lavik (1), Anna Lichtschlag (1), Nelli Sergeeva (3), Christoph Waldmann (4), Frank Wenzhoefer (1,2), Antje Boetius (1,2)

(1) Max Planck Institute for Marine Microbiology, Bremen, Germany, (2) Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, (3) A.O. Kovalevskiy Institute of Biology of Southern Seas, Sevastopol, Ukraine, (4) MARUM, University Bremen, Germany

Eutrophication and global warming promote the occurrence of hypoxic (low oxygen) conditions in aquatic systems. The EU-funded project HYPOX (www.hypox.net) is set up to improve our understanding of hypoxia formation and to develop capacities and knowhow for hypoxia monitoring. The oxygen deficient Black Sea is selected as one of the project's target sites as a natural laboratory to investigate causes and consequences of hypoxia formation as well as ecosystem recovery from previous hypoxia. HYPOX Black Sea investigations focus on three contrasting sites: the Crimean Shelf, the Bosporus outlet area, and the Romanian Shelf. Different oxygen observation methods were used to cope with differences in oceanographic settings (physical vs. biological hypoxia drivers) and infrastructure (accessibility, ship traffic). The presented work gives an overview of the applied methods and the results obtained so far.

Investigation at the Crimean Shelf focused on the monitoring of temporal changes in oxygen concentrations and their effect on benthic communities and processes. Fluctuations in oxygen availability were found to be pronounced and to have negative effects on the abundance of benthic fauna and the metabolic activity of microorganisms. In the Bosporus outlet area the main task was to monitor injections of oxygenated Marmara Sea water and their effect on the biogeochemistry of the anoxic Black Sea water column. Water intrusions through the Bosporus were found to vary largely over time. The temporary supply of oxygen to the anoxic water body showed strong effects on microbial conversion of nitrogen in these layers. The Romanian Shelf was selected as a site that recovers from severe eutrophication-driven hypoxia. After twenty years of reduced nutrient input following the collapse of the eastern European economies, monitoring of oxygen dynamics show that summer stratification and high benthic oxygen uptake rates still cause summer hypoxia.

In summary the HYPOX Black Sea investigations reveal the existence of so far unexplored but substantial and often site-specific dynamics in hydrography and oxygenation. These variations have an extensive impact on Black Sea ecosystems on the level of faunal and microbial communities as well as biogeochemical processes. Consequently these hydrographic dynamics with temporal scales down to hours or days can cause large dead zones on the Black Sea shelf and need to be studied further by long-term observation.