Linking storm events and hypoxia dynamics. The case of the Black sea shelf.

Mathurin Choblet[1,2], Luc Vandenbulcke[1], Marcel Ricker[2], Joanna Staneva[2], Marilaure Grégoire[1]
[1] *MAST-FOCUS, University of Liège, Liège, Belgium*
[2] *Helmholtz-Zentrum Hereon, Geesthacht, Germany*

The northwestern Black Sea shelf, an extensive shallow area with intense primary production, is vulnerable to hypoxic events. Bottom hypoxia occurs seasonally in regions where the oxygen consumption by benthic respiration can not be compensated by ventilation. It intensifies at the end of summer due to stratification and organic matter accumulation, imposing significant stress on the ecosystem. This study models the impact of storms, strong waves, and sediment dynamics on hypoxia and biogeochemical cycling. Our investigation includes both biogenic and non-biogenic sediments, collectively forming suspended particulate matter (SPM), an underexplored aspect in Black Sea modeling.

To examine these phenomena, we employ a physical-biogeochemical wave model setup, utilizing the NEMO 4.2 ocean model at spatial resolutions of 15km and 2.5km from 2012 to 2022. NEMO is coupled online with the BiogeochemicAl Model for Hypoxic and Benthic Influenced area (BAMHBI) and the WAM wave model serves as forcing for calculating bottom shear stress induced by waves. Our study will be supported by remote-sensing SPM data for model validation and process understanding.

Focusing on compound interactions, we illustrate how alterations in benthic-pelagic coupling can potentially alleviate or exacerbate hypoxic conditions. In particular, we investigate the effect of waves, and their parameterization, on the dynamics of hypoxia (e.g. spatial extent, number of events). Our goal is to disentangle the physical and biogeochemical mechanisms driving observed changes, in particular configurations (e.g. calm period versus storms situation). Furthermore, we assess the scale of influence of storms events by assessing changes in the transport of water, sediment, and nutrients from the shelf to the open sea.

The investigation of sediment dynamics under atypical conditions, anticipated to become more frequent due to ongoing global warming, serves as a cornerstone for the comprehensive integration of sediments into physical-biogeochemical modeling of the Black Sea and contributes to a more robust understanding of the complex interactions shaping the region's ecosystem.