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Impacts of Bottom Trawling on Organic Matter Fate: A Baltic Sea Modeling Study

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Beyond the detrimental effects of bottom-trawling on sediment fauna, there is increasing interest in its biogeochemical consequences. Sediment disturbances have been shown to enhance organic matter (OM) mineralization, particularly by exposing OM from anoxic layers to oxygen [1]. Trawling resuspends large volumes of sediment into the water column. However, field studies examining the effects of bottom trawling on organic matter mineralization and storage have reported contrasting results, with many showing no significant effect [2]. Although a kinetic rate formulation mechanistically linking oxygen exposure to enhanced mineralization has not yet been established, biogeochemical effects of bottom trawling have been incorporated into ecosystem models and extrapolated to global scales, commonly assuming oxic enhancement of mineralization [3-5]. Here, we investigate how trawling-induced resuspension interacts with OM dynamics in a shallow, eutrophied coastal sea where natural hydrodynamics, bioturbation, and spatial variability in bottom-water oxygen, including widespread oxygen deficiency, strongly influence OM cycling.

Starting from the ERGOM ecosystem model calibrated for the Baltic Sea, which simulates OM resuspension driven by bottom shear stress and bio-resuspension and the settling of suspended material, we implemented an additional trawling-induced resuspension term. Bottom-trawling activity was quantified by combining AIS data from Global Fishing Watch with ICES reports on fishing activity.

We compared simulations with and without additional bottom-trawling induced resuspension. The results show that bottom-trawling can have a significant effect on the distribution of OM, depending on the trawling activity, bathymetric slopes, and OM reactivity, whereas effects on the areal extent of hypoxic bottom waters appear negligible. Our setup also tracks the residence time of OM in the water column and sediment. In shallower areas, which are most intensely trawled, OM spends considerable time in the water column due to frequent natural resuspension before being removed through burial or mineralization. These findings imply that the extent to which bottom-trawling enhances oxygen exposure of OM depends strongly on regional hydrodynamic and biogeochemical conditions.

[1]Dauwe et al., Mar Ecol Prog Ser. 2001;215:13-22.
[2]Epstein et al., Glob Change Biol. 2022;28:2875–2894.
[3]Sala et al., Nat. 2021;592:397–402.
[4]Hiddink et al., Nat. 2023;617:E1–E2.
[5]Zhang et al., Nat Geosci. 2024;17:1268-1276.