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Sediment type and benthic fauna control the nutrient release in a coastal bay

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Eutrophication of coastal seas is still a major problem that may even increase in the near future according to recent model studies. The catchment of the Baltic Sea with nine highly industrialized riparian countries is intensively used and only few major rivers are responsible for more than half of the riverine nutrient input to the coastal zones. It is hypothesized that these nutrient are the main drivers for large anoxic bottom waters in the central Baltic Sea and an increasing hypoxia problem in coastal waters. The sequestration of nutrients was therefore intensively studied in the Baltic Sea, however either in the water column or in the sediments. The role of the benthic pelagic coupling for the nutrient turnover was much less investigated especially due to technical challenges.
We therefore used a lander system to quantify the nutrient release from sediments in a river impacted coastal Bay of Gdansk in the framework of the BONUS-COCOA project. Lander deployments and sediment coring were done simultaneously to measure nutrient fluxes over time and to characterize grain size, permeability, organic matter content, and benthic fauna. The benthic communities were analyzed to identify potential linkages between nutrient release and the species composition. Our study revealed close linkages between types/grain-size of sediment and the nutrient release. The activity of the animals in the sediment seems responsible for significant release of nutrients which is more pronounced than the diffusive nutrient release back to the water column. Rates from nineteen stations were used to draw a conclusive picture of the overall nutrient release from sediments and were set into a framework of a nutrient budget for the Bay of Gdansk considering the role of fauna. Moreover, we are able to identify a depth of roughly 50m as a border that separates the dominance of benthic recycling from deeper stations where mainly deposition or organic material takes place. Changes in properties of sediments are discernible from 50 m downwards to deeper waters. A storm encountered during one cruise was used to evaluate effects of strong wave action on the release and leaching of nutrient from sediments. Overall, the importance of oxygenated coastal waters to allow benthic life is therefore crucial for nutrient turnover and nutrient removal in coastal zones.