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Glacio-isostatic control on hypoxia: the Baltic Sea as a case study for high-latitude shelf basins

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In high-latitude continental shelf environments, late-Pleistocene glacial overdeepening and early Holocene eustatic sea-level rise combined to create restricted marine basins with a high vulnerability to oxygen depletion. Here we show that ongoing glacio-isostatic rebound during the Holocene may have played an important role in determining the distribution of past hypoxia in these environments by controlling the physical exchange of water masses and the distribution of large-scale phosphorus (P) sinks. We focus on the Baltic Sea, where sediment records from a large, presently oxic sub-basin show evidence for intense hypoxia and cyanobacteria blooms during the Holocene Thermal Maximum (HTM). Using paleobathymetric modeling, we show that this period was characterized by enhanced deep-water exchange, allowing widespread phosphorus regeneration until $\sim$4ka. Intra-basin sills then shoaled to a critical depth, enhancing P burial in one of the sub-basins and terminating hypoxic conditions. Similar rearrangements of physical and chemical processes likely occurred in response to glacio-isostatic rebound in other high-latitude shelf basins during the Holocene.