Time series of oxygen concentrations in the Baltic Sea

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One of the most profound effects on the health of the Baltic Sea is the increase of hypoxia over the last century. Bottom water oxygen concentrations are strongly influenced by the inflow of saltier, denser water governed by meteorological forcing. Salt water inflows bring new supplies of oxygen to bottom waters, but at the same time enhances stratification creating larger bottom areas that experience hypoxia. However, it is the increased flux of organic material due to nutrient enrichment, which has disrupted the balance between oxygen supply through physical processes and oxygen consumption from decomposition. It is believed that the extent of hypoxia has increased with discharges of nutrients from land and atmosphere over the last century, although there are only few studies quantitatively supporting this. Oxygen monitoring data from the beginning of the 1900s suggest that hypoxia was confined to the very deep parts of the Baltic, but the scarcity and heterogeneity of data complicates the assessment of hypoxia. After 1970, when more frequent monitoring was initiated, the extent of hypoxia has fluctuated in response to variations in inflows, but there has been no overall trend. We have re-analyzed the historical monitoring data using statistical models to deliver estimates for the change in oxygen conditions. Our results show that hypoxia started developing already in the 1920s with a strong increase after WWII, consistent with estimates of nutrient export. Hypoxia is also present in the coastal zone of the Baltic and we have identified 115 sites that have experienced hypoxia during the period 1955-2009 increasing the global total to ca. 500 sites, with the Baltic coastal zone thus containing over 20% of all known sites world-wide. The Baltic Sea displays alarming trends with hypoxia steadily increasing with time effecting nutrient biogeochemical processes, ecosystem services and coastal habitat.