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Stagnation periods in the Baltic Sea since 1500

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The Baltic Sea in northern Europe is one of the largest brackish water bodies in the world and has a long tradition of monitoring dating back to the late 19^{th} century. During the 20^{th} century, inflow events large and dense enough to replace the deeper bottom waters have taken place irregularly, typically every 3-5 years. Though smaller and intermediate inflow events have occurred frequently, only three so called major inflows took place between 1983 and 2003 (1983, 1993 and 2003). As a result, large bottom areas became stagnant, with severe oxygen conditions as a consequence. At the same time, the nutrient load coming from anthropogenic sources was high resulting in increased primary production in the water masses. The high primary production further increased the oxygen consumption in the Baltic Sea deep water resulting in even larger areas with anoxic conditions.

We model the salinity and oxygen conditions in the Baltic Sea over the past 500 years to be able to investigate the frequency and severity of the stagnation since 1500. By doing so, we can investigate whether or not the present period with little inflow events and deteriorating oxygen conditions are anomalous or unprecedented in historical context. Modeling is done by using the process oriented coupled basin model PROBE-Baltic with meteorological forcing derived from multi-proxy reconstructions.

The preliminary results show that stagnation periods prior to the 20^{th} century are comparable in length to those in the late the 20^{th} century and are therefore not an uncommon situation in the Baltic Sea. This indicates that the present scarcity of major inflow events and prolonged stagnation periods is within natural range of variability. The stagnation periods are probably more related to changes in the atmospheric large scale circulation pattern, which changes over time. While the oxygen conditions prior

to the 20^{th} century occasionally were bad due to long stagnation periods, they have deteriorated considerably during the last 50 years. This is most likely an effect of increased anthropogenic influence by increased nutrient load from land.