



Towards an improved mechanistic understanding of major saltwater inflows into the Baltic Sea

Katharina Höflich (1), Andreas Lehmann (1), and Kai Myrberg (2)

(1) GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (khoeflich@geomar.de), (2) SYKE Finnish Environment Institute / Marine Research Centre, Helsinki, Finland

The Baltic Sea is a semi-enclosed water body connected to the North Sea only via the shallow and narrow Danish Straits. Of special importance to the salinity and oxygen dynamics of the Baltic Sea are major Baltic inflows (or highly saline barotropic inflows), that are the only process to effectively ventilate water masses below the permanent halocline. Their occurrence is typically explained by a sequence of easterly winds over a period of several weeks followed by westerly gales during which the highly saline Kattegat water is pushed over the entrance sills. While this explanation is accurate in a descriptive sense, it does not necessarily serve as sufficient explanation for the occurrence of major Baltic inflows. Recently, attempts were made to understand major Baltic inflows in the context of large barotropic inflows and it was found that a sequence of easterly and westerly circulation types forces not only major Baltic inflows but large barotropic inflows in general. Thus, clarification on the factors that are exclusive to the formation of major Baltic inflows is needed. Based on a realistic numerical ocean model setup of the Baltic Sea system and for the period 1979-2015 we investigate on the important ingredients to the occurrence of major Baltic inflows. The analysis is based on the complete set of large barotropic inflows, and both atmospheric and oceanic factors are covered. We find that both, the salinity in the transition area between the North Sea and Baltic Sea, as well as details in the atmospheric circulation during the event, are of importance to the occurrence of major Baltic inflows. Even though excess river runoff is often held responsible for the occurrence of stagnation periods (i.e. extended periods without the occurrence of major Baltic inflows), attempts to classify its role were not made. Therefore, sensitivity experiments with the strong major Baltic inflow of December 2014 were performed, where river runoff and salinity in the transition area are investigated in more detail. Finally, insights into the ingredients to effective major Baltic inflows are synthesized into a flow-chart diagram in which an improved mechanistic understanding of major Baltic inflows is outlined.