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Frequencies and pathways of deep cyclones forcing major inflows to the Baltic Sea

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The salt budget of the Baltic Sea is determined by a balance between saline inflow from the Kattegat and brackish water outflow from the Baltic through the Danish Straits. River runoff and precipitation cause dilution while evaporation acts in the opposite direction. Ice formation and melting act as evaporation and precipitation, respectively, but have no influence on an annual timescale. Generally, during dry periods the mean salinity of the Baltic Sea increases while during wet periods a decrease will happen. These long-term changes are overlaid by the atmospheric-driven water exchange between North Sea and Baltic Sea. The salinity and the stratification in the deep basins are linked to the occurrence of Major Baltic Inflows (MBIs) of higher saline water of North Sea origin, which occur sporadically and transport higher saline and oxygenated water to deeper layers. These major inflows are often followed by stagnation periods with no strong saline inflows, during which the permanent halocline weakens, even disappears in some basins, and extended areas of oxygen deficiency develop in those regions where the salinity stratification remains. Since the mid-1970s, the frequency and intensity of major inflows have decreased. They were completely absent between February 1983 and January 1993. However, in spite of the decreasing frequency of MBIs, there was no obvious decrease in the frequency of larger Baltic Sea volume changes. Generally, strong inflows to the Baltic Sea are driven by strong to very strong westerly winds. For most effective inflows the frequency and pathways of deep cyclones are important. Furthermore, Atlantic cyclone frequencies and associated storm tracks are highly correlated with the NAO. Based on NCEP/NCAR and ERA Interim SLP reanalysis data for the period 1950-2013, deep cyclones variability over the northern North Atlantic, North Sea and Baltic Sea region has been analyzed, and cyclones frequencies and characteristic pathways have been related to large Baltic Sea volume changes.
The work is a contribution to the recently launched Earth system research network for the Baltic region ”Baltic Earth”.