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Assessment of long time series of atmospheric circulation patterns forcing inflows of saline water to the Baltic Sea

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Sporadic inflows of saline waters are very important to maintain the salt balance and favorable conditions for life in the entire Baltic Sea. At other times the Baltic Sea water exchange with the North Sea through two narrow and shallow straits is highly restricted and due to the high fresh water runoff from the catchment area, outflow conditions are generally dominating. Inflow events, which carry enough saline water into the Baltic to reach the bottom of the central basins, are called major Baltic inflows (MBI). During the last 4 decades, the number of MBI-s per decade has gone down from 4-5 to only one, what has generated hypoxia in large volumes of the Baltic deeps. There are no significant changes in the time-series of the general number of inflows, the decrease is only in MBI-s.

The trigger of a Baltic inflows lies in the atmosphere and the direct atmospheric forcing consists of two phases: at first high pressure with easterly winds lasts over the Baltic Sea region, what is followed by strong westerlies. The intensity of the event depends on the persistence and strength of both phases and how closely these come after each other. There are also some anomalies in the atmospheric circulation during the whole season with the event compared to mean situation, but these results are not so distinct. At the same time for prediction of MBI-s longer term factors that favor the MBI-s are very important. The other source of predictability lies in the upper atmospheric levels as the signal of transformation in the atmospheric circulation starts from up. That means that if we want to detect or even predict MBI-s from atmospheric forcing side we should be flexible and capable to describe atmospheric circulation in the whole atmospheric column with varying resolution in time and space. This sounds as a classical synoptic climatological task.

Availability of more than century-long reanalysed time series gives us opportunity to study the variability of atmospheric forcing of MBI-s and other inflows during the whole period of their detection. Our main task could be summed up as: what is the scale of the atmospheric forcing of MBI-s and inflows in general in time and space? To answer this question we perform a number of sensitivity studies with various atmospheric circulation classifications, varying the size of the area of that is classified, the altitude of pressure field, the period that is classified. This all helps us to get a better understanding why the occurrence of the events is so variable and brings us towards detection of the events from the atmospheric parameters.