EMS Annual Meeting Abstracts
Vol. 11, EMS2014-659, 2014
14th EMS / 10th ECAC

Variability of Atmospheric Circulation Patterns associated with major inflows to the Baltic Sea

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The salinity stratification in the deep basins of the Baltic Sea is 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.

Strong inflows are associated with the certain sequences of atmospheric forcing, and it could be assumed that changes in atmospheric circulation patterns impact on the Baltic Sea inflow regime. Therefore, our aim was to characterize the variability of sequences of atmospheric circulation patterns at the time of MBIs, to use this knowledge for studying their recurrence in different time periods.

We defined patterns of air flow over the Danish Straits by using the Jenkinson-Collison types (JCT) of atmospheric circulation. JCT could be called also synoptic weather types, which describe the positions of cyclones and anticyclones that determine the airflow. The 12 GMT gridded dataset of sea level pressures from NCEP/NCAR Reanalysis has been classified into 26 circulation patterns over the period 1948-2013.

The main conclusion is that the variability of circulation patterns during inflow periods is very high: there is not only one sequence of patterns that will result in high inflow. In agreement with previous studies the most regular part of the inflow period is the 20-day pre-inflow period, which is dominated by anticyclonic patterns. During the main inflow period (the next 20-day period) the dominant patterns are CW and CNW. During the last 20-day post-inflow period there are no large deviations from the average pattern distribution. The anomalies from the mean situation are better pronounced during MBIs compared to all other non-saline inflows.