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Changing impact of the large-scale atmospheric circulation on the regional climate variability of the Baltic Sea for the period 1950-2022

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A detailed assessment of climate variability of the Baltic Sea area for the period 1958-2009 (Lehmann et al. 2011) revealed that recent changes in the warming trend since the mid-1980s, were associated with changes in the large-scale atmospheric circulation over the North Atlantic. The analysis of winter sea level pressure (SLP) data highlighted considerable changes in intensification and location of storm tracks, in parallel with the eastward shift of the North Atlantic Oscillation (NAO) centres of action. Additionally, a seasonal shift of strong wind events from autumn to winter and early spring existed for the Baltic area. Lehmann et al. (2002) showed that different atmospheric circulation regimes force different circulation patterns in the Baltic Sea. Furthermore, as atmospheric circulation, to a large extent, controls patterns of water circulation and biophysical aspects relevant for biological production, such as the vertical distribution of temperature and salinity, alterations in weather regimes may severely impact the trophic structure and functioning of marine food webs (Hinrichsen et al. 2007). To understand the processes linking changes in the marine environment and climate variability, it is essential to investigate all components of the climate system which of course include also the large-scale atmospheric circulation. Here we focus on the link between changes/shifts in the large scale atmospheric conditions and their impact on the regional scale variability over the Baltic Sea area for the period 1950-2021. This work is mostly an extension of previous studies which focused on the response of the Baltic Sea circulation to climate variability for the period 1958-2008 (Lehmann et al. 2011, Lehmann et al. 2014). Now extended time series ECMWF ERA 5 reanalysis for 7 decades are available, highlighting recent changes in atmospheric conditions over the Baltic Sea. The main focus of this work is to identify predominant large scale atmospheric circulation patterns (climate regimes) on a monthly/seasonal time scale influencing the regional atmospheric circulation over the Baltic Sea area. Furthermore, long-term changes on the annual to decadal time scale will also be investigated.