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On the Origins of Cyclones Entering the Baltic Sea Region

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Changes in cyclonality are one of the major reasons for the climate warming tendencies in the Baltic region during the last decades (Sepp et al. 2005). The aim of present study was to investigate how the properties of the cyclones that transport air to the Baltic Sea region have changed in recent decades. We mean here the number of cyclones generated in various areas, the characteristics of their age and air pressure.
For the analysis, from a database of cyclones (Gulev et al. 2001), lows with the following characteristics were chosen: average air pressure below 1000 hPa, formed outside of and entered to 1000 km radius circle centred at 58.75°N 25.5°E. We assumed that these lows were the most important baric formations influencing the Baltic weather as they brought additional energy from the Atlantic, the Northern Sea, or the Mediterranean. The total number of such cyclones during 1948−2010 was 2185.
First, using ArcGIS, the areas of most intensive cyclogenesis were identified. The period was divided into three 21-year periods, and the changes in the areas of formation were compared visually. Next, the clusterisation of the cyclogenesis points was carried out using the k-means method. The cyclogenesis points were first divided into 3, then into 12 clusters. Changes in the frequency and duration of cyclones, as well changes in the air pressure at the cyclogenesis points, and in the minimal and mean air pressure of cyclones were studied using the linear trend analysis ($p<0.05$). Trends were searched for the year and for the cold/warm half-year (respectively Nov−Mar and Apr-Oct). Strong cyclones (MSLP<981.1 hPa) were analysed separately.
Despite the changes observable in the density maps of the cyclogenesis points, there were no statistically reliable trends in the number of cyclones entering the 1000 km radius circle. There were no changes in any of the analysed clusters or in the half-year periods. Changes in the duration of cyclones and the air pressure at the points of formation were also rare. However, the mean and the minimum air pressure of the cyclones decreased considerably – especially in the case of lows that formed above the British Isles and west of them. The air pressure statistics of several clusters, however, is influenced by strong cyclones. The number of strong cyclones has not changed, but their mean and minimum air pressures have decreased significantly.
It may be concluded that the changes in cyclonality were not caused by changes in the cyclogenesis points, but probably by changes in the other parameters of the life cycle of cyclones.

References

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