Influence of Synoptic Factors on Rainfall During the Impacts of Cyclone “Kirsty” in the Central Parts of Latvia

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In late July 2024, cyclone “Kirsty” caused exceptionally intense rainfall in central Latvia, resulting in severe flooding and record-breaking precipitation totals for Latvia. This study investigates which synoptic-scale factors contributed to the extreme rainfall and evaluates their influence during the cyclone’s development and passage over the Baltic region. Synoptic weather charts (prepared by national weather agency), reanalysis data (ERA5), and meteorological observations (geostationary satellite data, doppler radar data, SYNOP station data) were analysed along the track of cyclone “Kirsty”, with particular attention given to the cyclone’s structural evolution, frontal configuration, moisture transport, and sea surface temperature anomalies in the Baltic Sea and the Gulf of Riga during 28-29 July. Precipitation and hydrometeorological data from observation stations operated by the Latvian Environmental, Geology and Meteorology Centre were used to quantify rainfall intensity and spatial distribution. The analysis indicated that cyclone “Kirsty” followed a Shapiro-Keyser type development, characterised by frontal fracture and enhanced low-level convergence, which prolonged moisture advection over central Latvia. Anomalously high sea surface temperatures in the Gulf of Riga increased atmospheric moisture availability and intensified precipitation within the cyclone’s frontal zones. The combined effect of these factors contributed to extreme rainfall totals, including a maximum observed accumulation of 198,7 mm. The results highlighted the importance of cyclone structure and regional air-sea interactions in amplifying extreme precipitation events in the Baltic region and demonstrated the relevance of synoptic analysis for improving flood-risk assessment.

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