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The mistral wind from a Rossby-wave perspective: a climatological classification of RWB

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The Gulf of Genoa is one of the most cyclogenetic places on the globe, mostly due to Alpine lee-cyclogenesis. The mistral wind is an inherent feature in this process, known for its positive contribution to the deepening of the lee-cyclone. The mistral is recognized by many as one of the most dangerous weather regimes in the Mediterranean and has been associated to extreme weather events in the region. While extensive research has focused on the lower-tropospheric mistral and lee cyclogenesis, the features of the Rossby waves that drive the process are not generally known. Here, the isentropic potential vorticity (PV) structures governing the occurrence of the mistral wind are classified using a self-organizing map (SOM) clustering algorithm. A 36-year (1981–2016) climatological classification of Rossby waves generating a mistral wind is performed based on daily ERA-Interim isentropic PV data. 16 distinct mistral associated PV structures are identified, where each classified flow pattern corresponds to a different type or stage of the Rossby wave life cycle. From broad troughs to thin PV streamers to distinguished cutoffs, each of these PV patterns exhibits a distinct surface impact. A clear seasonal separation between the clusters is evident, and transitions between the clusters correspond to different Rossby wave-breaking processes. This analysis provides a new perspective on the surface impact of Rossby waves throughout their lifetimes, and their influence on extreme weather events.