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Detection, classification and physical analysis of Explosive Cyclones in the Mediterranean Region: a full exploitation of ERA5 dataset

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In the Mediterranean region, a wide variety of cyclogenesis mechanisms are known to develop, including baroclinic waves from the Atlantic, baroclinic wave cut-off and Warm Seclusions. These mechanisms have been shown sometimes to produce Tropical-Like Cyclones (TLC), Intense Mediterranean Cyclones (IMC) and Explosive-Cyclogenesis (EC). Depending on the cyclone's class, the characteristic frequency of appearance can vary, ranging from tens per month to around 1-1.5 per year, as in the TLC case. ECs are among the rarest and probably the most intense and destructive cyclone events that can develop; they usually originate at high latitudes during wintertime, mainly over the sea, preferring areas with relatively strong Sea Surface Temperature (SST) gradients. These events are characterized by a relatively fast drop of pressure at the centre of the cyclone, approximately more than 1hPa/hr in a time window of 24hr, or 12 in other milestone works. Several recent studies investigated the formation of ECs over the Mediterranean Basin (MB). EC formation is an extremely complex process, mostly driven in the MB by dry air intrusions from the stratosphere and by Atmospheric Rivers. Here, by using ERA5 reanalysis dataset, we first conducted a physical and dynamic analysis of the most intense cyclone events that occurred in the Mediterranean basin in the period 1979-2020, identifying factors that triggered and contributed to the intensification of such events. According to Sanders' and Gyakum's definition of Bergeron–a parameter that describes ECs' deepening rate and varies from 28mb/(24h) at the pole to 12 mb/(24h) at latitude 25°N–, and its mid-latitude 12 hours adaptation introduced by Zhang, we were able to classify them in the three aforementioned categories. Moreover, by using EOFs, we outlined synoptic configurations that are more likely to drive the phenomena, highlighting the role of the SCAND index and NAO-. We further investigated the deepening with a new promising approach involving the use of 6-hour timespans in order to single out all those systems with the strongest pressure gradients and quickest evolution, highlighting the differences between cyclones developing on the sea and others undergoing evolution related to semidiurnal atmospherical tides in northern Africa. Further analysis is being undertaken to determine the cyclones' phases and their main morphological characteristics, as well as their

correlation with atmospheric rivers and SST anomalies in the Central Mediterranean Basin.