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Explosive Cyclones in the Mediterranean Sea exploiting ERA5 dataset: detection, classification, statistical and synoptic analysis of their occurrance

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In the semi-enclosed basin of the Mediterranean Sea, a wide variety of cyclone mechanisms are known to develop, including baroclinic waves coming from the Atlantic, Mediterranean cyclones originating from the cut-off of baroclinic waves, Warm Seclusions, Tropical-Like Cyclones (TLC), Rapid-Cyclogeneses (RC) and Intense Mediterranean Cyclones (IMC). Depending on the cyclone's type, the characteristic frequency of appearance can vary, ranging from tens per month to around 1-1.5 per year, as in the TLC case. RCs are among the rarest and probably most intense and destructive cyclone events that can develop in nature; they usually originate at high latitudes, during wintertime, and mainly over the sea, preferring areas with high Sea Surface Temperature (SST) gradients. It is generally accepted that these events are described by quick drop of pressure, close to 1hPa/hr for 24 hours, within the eye of the cyclone. Several recent studies investigated the formation of RC's over Mediterranean Basin (MB). RCs formation is an extremely complicated process, and in the MB it is mostly driven by dry air intrusions from the stratosphere and by the trigger of Atmospheric Rivers.

Using ERA5 dataset, we firstly conducted a physical and dynamical analysis of the most intense cyclone events occurred in the Mediterranean basin in the period 1979-2020, identifying factors which triggered, generated and contributed to the intensification of such events. According to Sanders' and Gyakum's definition of Bergeron, a parameter which describes RCs' deepening rate and varies from 28mb/(24h) at the pole to 12 mb/(24h) at latitude 25°N, we were able to classify them in the three aforementioned categories. With the help of EOF analysis, we outlined synoptic configuration more likely to drive the phenomena, highlighting the role of SCAND index and NAO-. Moreover, we have investigated the deepening with a new promising approach involving the use of 6 hours timespans, in order to single out the cyclones with higher gradients of pressure and faster evolution in semi enclosed basins. Further analysis is being undertaken to determine the cyclones' phase and their main morphological characteristics, as well as their correlation with atmospheric rivers and SST anomalies exhibited by the Central Mediterranean Basin.