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Mediterranean cyclones and wind storms in a changing climate

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This study examines cyclones and related wind storms affecting the Mediterranean region under present-day and future climate scenario conditions. The analysis is based on seven coupled ocean atmosphere GCM simulations: one simulation with the high resolution INGV CMCC GCM which was especially designed for Mediterranean applications, covering the period from 1950 to 2050 and was driven by observed and SRES A1B greenhouse gas concentrations; and six simulations with the ECHAM5/MPI-OM GCM encompassing the period from 1960-2100 following historic and SRES A1B (3 simulations) or SRES A2 (3 simulations) greenhouse gas levels.
Cyclones are detected using an objective cyclone identification and tracking algorithm. The intensity of cyclones is determined based on their Laplacian of pressure. Wind storms are detected by identifying clusters with wind speeds exceeding the local 98th percentile, which are than tracked in time using a nearest neighbour approach. The strength of a wind storm event is expressed via a storm severity index, which takes both area and duration of its extreme wind speeds into account.
In all climate change integrations, the total number of cyclones over the Mediterranean region significantly decreases in future decades. The decrease is especially high for intense cyclones (Laplacian of pressure >1.5; i.e. strongest 5%). However, for the most extreme cyclones, with return periods greater than a year and values of the Laplacian of pressure above 2 (corresponding to the strongest 0.1%), no statistically significant change in the frequency can be detected. In terms of wind storms, their number exhibits a statistically significant decrease over most of the Mediterranean Basin. Again, the frequency of the most extreme wind tracks does not change significantly.
It is shown that the majority of these most extreme cyclones are not of local origin but move into the Mediterranean region from the Atlantic Ocean. This is also true for extreme wind storms, which are mostly associated with cyclones that pass outside of the Mediterranean region. Most affected areas by these events are the Bay of Biscay and the Northern Mediterranean region.