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Investigating the predictability of Mediteranean cyclones and their severity

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Cyclones are essential elements of the climate and of the water cycle in the Mediterranean. The most intense of them lead to natural disasters because of their violent winds and extreme rainfall, which can cause significant damage to the territories bordering the Mediterranean (coast and mountain ranges). Reliable forecasts of cyclones are therefore essential to better anticipate and prevent their societal impact. However, their predictability is often limited by their particularities: smaller cyclones with a shorter life cycle than in the North Atlantic, complex topography, interactions with the relatively warm sea and air masses laden with dust from the Sahara.

We investigate the predictability of Mediterranean cyclones in a systematic framework using an ensemble prediction system. A reference dataset was first obtained by tracking cyclones in the ERA5 reanalysis (1979-2021), using an algorithm developped for the North Atlantic and adapted for the Mediterranean region. We then investigated the predictability using ARPEGE ensemble reforecasts in a homogeneous configuration over 22 years (2000-2021).

We restricted the study on 500 cases, which were selected using a storm severity index based on wind gusts and adapted for the Mediterranean region. The cases were then divided in several categories following their dynamical context, their intensity and their geographical origin. The predictability of the reforecasts was finally quantified on each of those categories, using probabilistic scores on cyclone trajectories (along and cross track error) and on intensities (mean sea level pressure and storm severity index).

While past studies have been limited by the fact that regular updates of operational forecasting systems do not allow the predictability of cases to be compared with each other, the homogeneous configuration of the ARPEGE ensemble reforecasts makes it possible to systematically identify the limitation to the predictability of Mediterranean cyclones.