Geopotential oscillations and rainfall cycle in the Mediterranean Region

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In the context of regional climate change, the Mediterranean climate variability constitutes an issue of particular concern because in the last decades the number of cyclones has declined, the total rainfall reduced, while the temperature has increased, which can finally lead to a subregional desertification process.

The Mediterranean sea is bounded by the European sub-continent and by the North African continent, and it is located in the southern band of the westerly winds, which places the Mediterranean downwind of the Atlantic ocean and upwind of the Asian continent. Most of the Atlantic perturbations travel on the north side of the Mediterranean basin (MB), since this sea is protected by mountains with the exceptions of few gaps: Gibraltar, the Rhone valley, the north Adriatic sea, and the eastern Libyan desert. The few perturbations which enter into MB are generated by the southern tail of a parent Atlantic cyclone, therefore, they are usually smaller than their parent, but they are locally strengthened by the orography and by the evaporation. Because of its morphology, in the MB, the precipitation is rather localized, as shown by the analysis done by several Authors for the three sub-basins: Western (WMB), Central (CMB), Eastern (EMB), respectively. In fall and winter, the rainfall is strongly related to the North Atlantic oscillation (NAO): when the NAO is weak (strong) a larger (smaller) number of Atlantic perturbations reaches the Mediterranean, and it rains more (less). While, in summer, the influence of NAO on the precipitation is less evident.

In the present work we correlate the rainfall distribution with the geopotential and the dynamical fields. Results show that the rainfall in the Mediterranean basin is in phase with the geopotential difference between the Central Asia and the Azores, both oscillate with an annual periodicity with a minimum in mid-summer and a maximum in late fall.

While, the rainfall difference between the WMB and the EMB is in phase with geopotential difference between the EMB and the WMB, both oscillate with a semiannual period with two maxima (May and October) and two minima (February and July). This periodicity is due to the combined action of the cyclonic-anticyclonic vortex over Turkey and of the Libyan anticyclone.

The rainfall in the CMB has an annual periodicity, which is in phase with the geopotential difference between the Central Asia and the Azores as the precipitation in the MB. However in the CMB, the rainfall is more and the rainy season is longer than in

the MB. This precipitation enhancement is induced by the Libyan anticyclone.