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Cyclonic activity in the Mediterranean: tele-connections and their linkage to large-scale circulations

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The spatial distribution and time evolution of winter (DJF) Mediterranean cyclones are studies. The study covers 30 seasons, 1972/3 – 2001/2 and is based on the ECMWF sea-level pressure with a 2.5[U+F0B0]×2.5[U+F0B0] resolution. The cyclones were identified objectively following Raible and Blender (2004), based on daily sea level pressure. The tele-connecting regions were identified through correlations maps of cyclone occurrences, derived for selected cyclogenetic regions. Pairs of regions that showed significant correlation were further analyzed and correlated with large-scale circulations.

Significant positive correlations were found between cyclone occurrence in North Europe and the Black Sea, Italy and the Black Sea and Italy and Europe. A positive correlation between two regions is interpreted as an indication for cyclone track connecting them or a tendency of a secondary cyclone formation in one of them under the influence of a 'parent' one at the other. Positive correlation was also found between remote regions, the eastern Mediterranean and the Canaries Islands, pointing at the role of Rossby waves, which wavelength is equal to the distance between them. Negative correlation was found between the cyclone occurrence in Italy and the Middle East, implying that cyclone activity around Italy is on the account of that in the eastern Mediterranean, and that the cyclones tend to move from Italy toward the Black Sea rather than toward the eastern Mediterranean.

The correlations were studied separately for each season and some of them were found to change magnitude and even to reverse their sign for limited periods. In order to find the external forcings that may explain these changes, we correlated the time variations of the 500-hPa circulation patterns, as reflected by the leading EOFs, with cyclone occurrences in individual regions. The results point at the direct influence of the upper-level circulations on cyclogenesis. In addition, the time evolution of the amplitude and phase of the 500-hPa EOFs were correlated with the time evolution of the ratio of number of cyclones between pairs of tele-connecting regions. The latter shows how the upper-level circulations modulate the tele-connection as expressed by cyclone occurrence. This analysis was done for both the intra-seasonal course and the inter-seasonal time-scale.