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Climate change and Mediterranean storm tracks: present and future climate simulations of a high-resolution Mediterranean model

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A number of studies suggest that cyclone activity over both hemispheres has changed over the second half of the 20th century. General features include a reduction in the number of cyclones but with an increase in the number of more intense cyclones; as well as a poleward shift in the tracks. Moreover, these features are expected to be projected in the future under global warming conditions.
The assessment of the future changes of the cyclonic activity as imposed by global warming conditions is very important since these cyclones can be associated with extreme precipitation conditions, severe storms and floods. This is more important for the Mediterranean that has been found to be more vulnerable to climate change.
The main objective of the current study is to better understand and assess future changes in the main characteristics of cyclonic tracks in the Mediterranean. The climatology of the cyclonic tracks includes temporal and spatial variations of frequency, and dynamic and kinematic parameters, such as intensity, size, propagation velocity, as well as trend analysis.
For this purpose, the ENEA high resolution model is employed, based on PROTHEUS system composed of the RegCM atmospheric regional model and the MITgcm ocean model, coupled through the OASIS3 flux coupler. These model data became available through the EU Project CIRCE which aims to perform, for the first time, climate change projections with a realistic representation of the Mediterranean Sea. Two experiments are employed; a) the EH5OM_20C3M present climate simulation, where the lateral boundary conditions for the atmosphere (1951-2000) are taken from the ECHAM5-MPIOM 20c3m global simulation (run3) included in the IPCC-AR4, and b) the EH5OM_A1B scenario simulation, where the IPCC-AR4 ECHAM5-MPIOM SRESA1B global simulation (run3) has been used for the period 2001-2050.
The identification and tracking of cyclones is performed with the aid of the Melbourne University algorithm (MS algorithm), according to the Lagrangian perspective. MS algorithm characterizes a cyclone only if a vorticity maximum could be connected with a local pressure minimum. This approach is considered to be crucial, since open lows are also incorporated into the storm life-cycle, preventing possible inappropriate time series breaks, if a temporary weakening to an open-low state occurs.
According to the results, a decrease of the storm number and a tendency towards deeper cyclones is expected in the future, in general agreement with the results of previous studies. However, new findings reveal with respect to the dynamic/kinematic characteristics of the cyclonic tracks.

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