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Dynamical downscaling of CMIP6 scenarios with ENEA-REG: an impact oriented application for the MED-CORDEX region

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In the framework of the coordinated regional modeling initiative Med-CORDEX (Coordinated Regional Climate Downscaling Experiment), we present an updated version of the regional Earth System Model ENEA-REG designed to downscale, over the Mediterranean basin, the models used in the Coupled Model Intercomparison Project (CMIP6). The regional ESM includes coupled atmosphere (WRF), ocean (MITgcm), land (Noah-MP, embedded within WRF), and river (HD) components with spatial resolution of 12 km for the atmosphere, 1/12° for the ocean and 0.5° for the river rooting model.

For the present climate, we performed a hindcast (i.e. reanalysis-driven) and a historical simulation (GCM-driven) over the 1980-2014 temporal period. The evaluation shows that the regional ESM reliably reproduces the mean state, spatial and temporal variability of the relevant atmospheric and ocean variables.

In addition, we analyze the future evolution (2015-2100) of the Euro-Mediterranean climate under three different scenarios (SSP1-2.6, SSP2-4.5, SSP5-8.5), focusing on several relevant essential climate variables and climate indicators for impacts. Among others, results highlight how, for the scenarios SSP2-4.5 and SSP5-8.5, the intensity, frequency and duration of marine heat waves continue to increase until the end of the century and anomalies of up to 2°C, which are considered extreme at the beginning of this century, will become the new normal condition of the Mediterranean Sea in less than a hundred years under the SSP5-8.5 scenario.

Overall, our results demonstrate the improvement due to the high-resolution air-sea coupling for the representation of high impact events, such as marine heat waves, and sea-level height.