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An assessment of the Atlantic and Mediterranean cyclones simulated by CMIP5 models

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The atmosphere only and coupled climate models that participate in the CMIP5 project are analysed for assessing their performance in simulating the extratropical cyclones in the Atlantic and Mediterranean regions. By considering the six hourly model output, cyclones are identified as relative maxima in the 850mb vorticity, and tracked using an objective feature tracking algorithm. Stormtrack statistics are then computed by aggregating properties of the ensemble of tracks, so that the spatial distribution and the intensity of the cyclone activity can be separately quantified. The focus on the Atlantic and Mediterranean region is motivated by the socio-economic importance of the area, its susceptibility to changes in cyclone activity and the large spread in the mean climates simulated by the models participating into the CMIP3 dataset. Performing an intercomparison study of the cyclone dynamics in CMIP5 will allow an assessment of the model uncertainties of cyclone behavior over the region. The Atlantic and Mediterranean stormtracks are analysed using thirty years long AMIP (1979-2008) and coupled (1976-2005) historical CMIP5 runs focused on properties such as the average cyclone intensity, the track, genesis and lysis densities. The presence of systematic errors is evaluated with respect to four recent reanalyses datasets, namely ERA-INTERIM, NASA-MERRA, NCEP-CFS and JRA-25. A detailed investigation is performed to determine whether the errors in the spatial distribution of the cyclones and of their intensity can be systematically related, across a variety of models, to the errors in the simulated large scale circulation and in the variability of the Atlantic eddy driven jet stream. The intensity distribution of the ensemble of cyclones in the two stormtracks is further investigated by examining the probability density function (PDF) of the maximum along-track cyclone wind speed and precipitation rate. Estimations of the average and of extreme cyclone intensities are both extracted from the PDF, and are compared between the models and the reanalyses. The differences between the coupled and the AMIP runs are evaluated for understanding the fraction of error of the coupled runs which can be directly attributed to bias in the simulated sea surface temperature. The four seasons are separately investigated, but results for the winter and summer seasons are preferentially presented.