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Response of winter North Atlantic storm track to climate change in the CNRM-CM5 simulations

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Climate variability in Europe in winter is largely controlled by North Atlantic storm tracks. These are associated with transport of energy, momentum, and water vapour, between the equator and mid latitudes. Extratropical cyclones have caused severe damages over some regions in north-western Europe, since they can combine extreme precipitation and strong winds. This is why it is relevant to study the impact of climate change on the extratropical cyclones, principally on their intensity, position or lifespan. Indeed, several recent studies have focused on this subject by using atmospheric reanalysis and general circulation models (GCMs). The main conclusions from the CMIP3 simulations showed a decreasing of the total number of cyclones and a poleward shift of their tracks in response to global warming. In the recent CMIP5 exercise, the consensus is not so clear, probably due to more complex feedbacks acting in the different models. Thus, the question of changes in North Atlantic storm-tracks with warming remains open.
The main goal of this work is to explore the changes in the North Atlantic storm-tracks in the past and future decades and to analyze the contributions of the different external forcings (natural and anthropogenic) versus the internal variability. On this purpose, we use the Detection and Attribution (D&A) simulations performed with the coupled model CNRM-CM5. To characterize the extratropical cyclones and their tracks, a tracking scheme based on the detection of maximum of relative vorticity at 850 hPa is conducted.
We show that the coupled model fairly well reproduces the storm genesis locations as well as the tracks pathways comparing to several atmospheric reanalysis products. In the recent historical period (1950-2005), the model shows a decrease in the number of storms in the southern North-Atlantic, when all the forcings (anthropogenic and natural) are prescribed. Even if the role of internal variability is important in the last decades (the inter-members spread is very large), and the signals rarely emerge from the noise, analysis based on the Eady Growth Rate parameter has lead to quantify the respective roles of baroclinicity and meridional temperature gradients. Finally, in the scenario (RCP8.5), the tendency seen in the all-forcings historical run is confirmed and reinforced.