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Driving mechanisms of South Atlantic storm track changes in an extreme climate scenario according to HadGEM2-ES and WRF downscaling

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This work aims to assess the future projected changes in the cyclones originated in the South Atlantic, focusing on their genesis and intensifying mechanisms. The TRACK program was used to identify and track cyclones based on the relative vorticity from winds at 850 hPa. Spatial distribution maps of the atmospheric environment at the time of genesis were built using information sampled from individual features, e.g., mean upper-level jet speed, low-level moisture transport. First, we evaluated the HadGEM2-ES ability to reproduce the main characteristics of the South Atlantic cyclones and access their future projected changes using the RCP8.5 scenario. Then, we performed a dynamical downscaling using the WRF model to improve the resolution of the climate model in the historical (ExpHad-HIST) and RCP8.5 (ExpHad-RCP85) scenarios. Our results showed that HadGEM2-ES were able to reproduce the South Atlantic storm track pattern and its four main cyclogenesis regions: (1) Southern Brazilian coast (SE-BR, 30ºS); (2) Northern Argentina, Uruguay, and Southern Brazil (LA PLATA, 35ºS); (3) central coast of Argentina (ARG, 40ºS-55º) and; (4) Southeastern South Atlantic (SE-SAO, 55ºS and 10ºW). However, HadGEM-ES presented less intense cyclones and a negative density bias on the subtropical storm track, as a consequence of an underestimated genesis in the LA PLATA and SE-BR regions. The ExpHad-HIST provided a better representation of these two genesis regions, where the effects of an improved orography, mesoscale processes and strong and more organized low-level jet seem to reduce the static stability and support cyclone development. HadGEM2-ES RCP8.5 future projection showed a decrease of 10% in the number of cyclones over South Atlantic and a poleward shift of the main storm track, linked to the larger reduction of systems in mid than high latitudes. This increase in the cyclone activity at 30ºS led to the high track density in the South Atlantic subtropical storm track, both in the summer and winter. The ExpHad-RCP85 also showed a poleward shift of the main storm track, but mainly in the summer. The reduction and southward displacement of the cyclone occurrences can be addressed to the increase in the static stability at mid-latitudes. However, the increase in the moisture content at low levels seems to balance the effect of the static stability as long as there is an increase in the genesis in the equatorward genesis regions. In fact, the ExpHad-RCP85 simulated growth in the genesis in the northern edge of SE-BR (20ºS, 50ºW) and ARG (45ºS) regions, in the summer, and the LA PLATA region in the winter - being the last change also observed in HadGEM2-ES RCP8.5. The large increase in the low-level moisture and

a strengthening of the equatorward flank of the upper-level jet could justify more genesis at these locations, competing with the increase in static stability. Moreover, the large content of low-level moisture available in the future simulation may also be connected to the observed intensification of the cyclones over the Uruguayan and Brazilian coast.