S251: Tropical Cyclones in the NASA GEOS-5 Model and MERRA-2 Reanalysis

Studies of projected changes in tropical cyclones under anthropogenic climate change, as well as their modulation by internal climate modes, make use of global climate models. To this end, tropical cyclones can be tracked in the output of higher resolution models. Using climate models to make future projections of tropical cyclones relies upon having a baseline of the characteristics of model storms under the current climate. This study focuses on two high-resolution datasets – the NASA GEOS-5 Model (Goddard Earth Observing System Model, Version 5) and the MERRA-2 Reanalysis (Modern-Era Retrospective analysis for Research and Applications, Version 2). Both of these datasets were created using exactly the same atmospheric model during the same period. However, while GEOS-5 is a free-running atmospheric model forced only with sea surface temperature, MERRA-2 is a reanalysis product, i.e. the model assimilates data from a large variety of data sources. Thus, by comparing tropical cyclones tracked in these datasets to each other and global best track datasets in the period 1980-1999, this project aims to evaluate 1) the sensitivity of this model to how it is forced and 2) how well the storms tracked in GEOS-5 and MERRA-2 replicate observed tropical cyclones' characteristics.

We used two different tracking schemes on both datasets and found no significant difference in the performance of the model and the reanalysis in simulating tropical cyclones. Standard diagnostics for tropical cyclones, such as the mean number, intensity distribution, as well as their interannual variability are very similar in the free-running model and the reanalysis. Both GEOS-5 and MERRA-2 show a bias towards weaker tropical cyclones than observed and GEOS-5 has storms that occur closer to the equator than in the observed record. Neither GEOS-5 nor MERRA-2 accurately reproduce tropical cyclone modulation by ENSO. Additionally, comparison of MERRA-2 to other reanalysis datasets shows that MERRA-2 on average generates fewer total but also more intense storms than the European Centre for Medium-Range Weather Forecasts Interim Reanalysis (ERA-Interim) and Japanese 55-Year Reanalysis (JRA-55). Further research must be performed to understand why this data assimilation is failing to provide a positive impact on the tropical cyclone simulation in this model.

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