Geophysical Research Abstracts
Vol. 13, EGU2011-9101-1, 2011
EGU General Assembly 2011

The Influence of African Easterly Waves on the Generation of Atlantic Tropical Cyclones in WRF Tropical-Channel Simulations

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African Easterly Waves (AEW) have been shown to provide initial conditions for the generation of tropical cyclones in the so-called “marsupial” effect. A proper representation of tropical cyclones in climate simulations is thus essential for planning and mitigation. Here, we study how the link between AEW and tropical cyclone generation is represented under a combination of microphysical and cumulus parameterization schemes in the Weather Research and Forecasting (WRF) model.

We have used the WRF model version 3.2. It was run at 50 km resolution using a tropical channel set up. In this type of setup, the domain consists of the boundaries above and below certain latitude and no side boundaries. This process allows the interaction from the extra-tropics through the north-and-south boundaries. In addition to that, it allows the generated waves to propagate around the globe more naturally - as in the real world and in global models. The meridional boundary conditions were specified using six-hourly ERA Interim (0.5 degree resolution) data. The runs have meridional boundaries at 45S and 45N, with 37 vertical levels, ranging from the surface to pressure p = 10 hPa.

We tested four combinations of these: Hong-Dudhia-Chan’s and Hong-Lin’s microphysical schemes; and Kain-Fritsch’s and Betts-Miller-Janjic’s cumulus parameterization schemes. Each simulation was run for a two-year period - where the first year was discarded as the spin-up time

The storm-tracking algorithm TRACK was used to track the AEW. The AEW analyzes used was based on the Thorncroft-Hodges (TH) method: tracking statistics analyzed on the 600- and 850-mb relative vorticity data. The analysis, as well as following TH, will also follow Bengtsson et al (2007a, 2007b) for tropical cyclones, including their structure. The validation is compared against the ERA Interim and NCEP/NCAR Reanalyzes data.

Results from this study will form the basis for the selection of a setup to be used in downscaling of future climate runs.