Cluster analysis of explicitly and downscaled simulated North Atlantic tropical cyclone tracks

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Resume

The response of tropical cyclone (TC) activity to climate change is a question of major interest. In order to address this crucial issue, several types of models have been developed in the past such as Global Climate Models (GCMs). However, the horizontal resolution of those models usually leads to some difficulties in resolving the inner core of TCs and then to properly simulate TC activity. In order to avoid this problem, an alternative tool has been developed by Emanuel (2005). This downscaling technique uses tracks that are initiated by randomly seeding large areas of the tropics with weak vortices. Then the survival of the tracks is based on large-scale environmental conditions produced by, GCMs in our case. Here we compare the statistics of TC tracks simulated explicitly in four GCMs to the results of the downscaling technique driven by the four same GCMs in the present and future climates. The US CLIVAR hurricane-working group has realized all the simulations.

Simulated tracks are objectively separated into four groups using a cluster technique (Kossin et al. 2010). The four clusters form zonal and meridional separations of tracks as shown in Figure 1. The meridional separation largely captures the separation between more baroclinic (clusters 1 and 2) and more tropical systems (clusters 3 and 4), while the zonal separation segregates Gulf of Mexico and Cape Verde storms.

The downscaled simulations well capture most of the characteristics of the clusters such as the mean duration of the storms, the intensity or the Power Dissipation Index (PDI) compared with the observed clusters from Kossin et al. (2010). On the other hand, most of the explicit simulations present strong biases due to different reasons depending on the models examined.

In the future climate, we use three different scenarios to examine the possible future changes of TC clusters. We explored the role of a warming of the SST, the increase in carbon dioxide and a combination of the two previous variations. The results show that the response to each scenario is highly varying depending on the simulation examined.

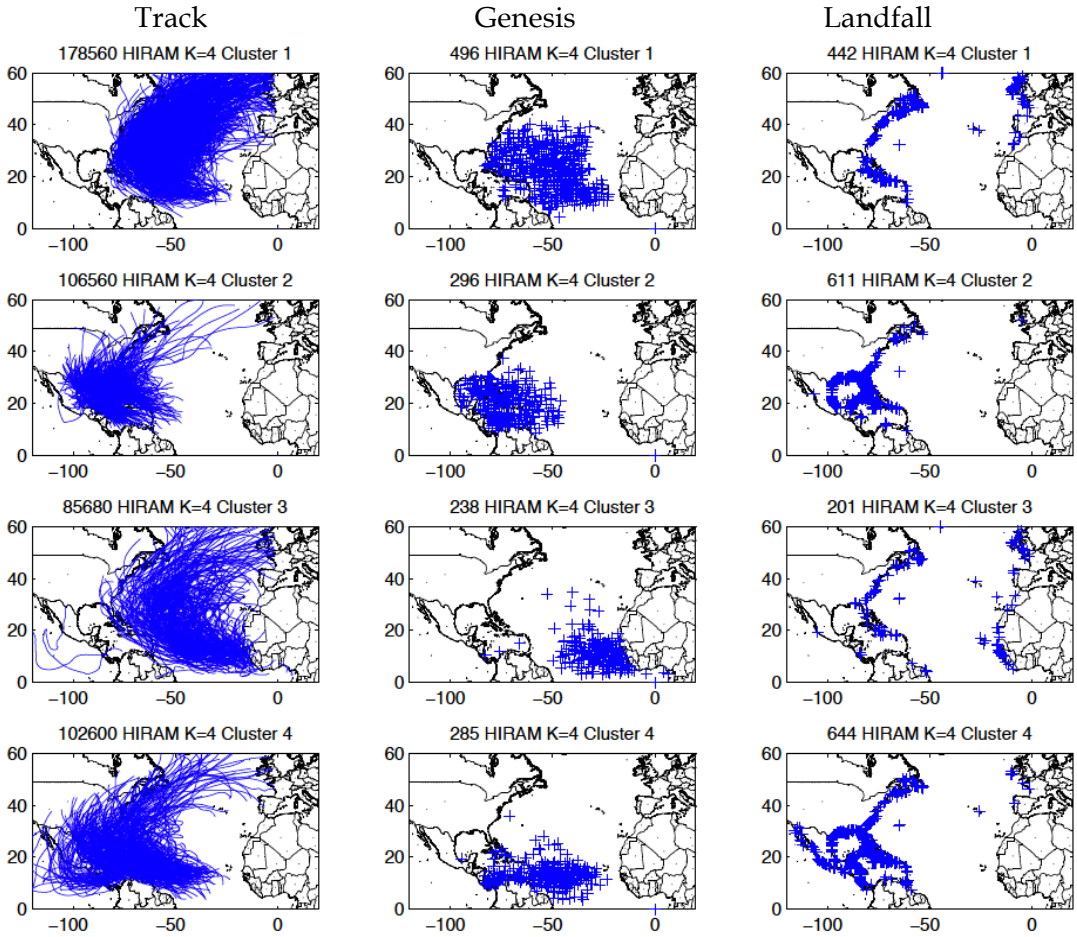

Figure 1: North Atlantic tropical storm and tropical cyclone tracks, genesis locations, and landfall locations for the downscaled simulation with le large-scale conditions from the GCM GFDL climatology.

References

- Kossin, J. P., S. J. Camargo, and M. Sitkowski, 2010: Climate modulation of North Atlantic hurricane tracks. Journal of Climate, 23, 3057-3076, DOI: 10.1175/2010JCLI3497.1.
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