Project: **954**
Project title: **Changes in the western Pacific Tropical Cyclones in a warming environment**
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One of the grand challenges of the WCRP is in understanding and predicting weather and climate extremes. To answer this grand challenge using a coordinated effort in providing ensembles of regional climate simulations over different regions, a WCRP Initiative on Coordinated Regional Downscaling Experiment (CORDEX) has been established. The Climate Service Center Germany (GERICS) is contributing to the said CORDEX ensemble of regional climate simulations over various domains including the Southeast Asia using the regional model REMO.

In this project, the general aim is on understanding the changes of tropical cyclones in a global warming scenario. GERICS is using ROM, a regional atmosphere coupled with a global ocean model, to simulate the climate change effects on tropical cyclones in the western Pacific region.

During the 2015 Computing Period, GERICS have performed hindcast simulations to study the influence of coupling a global ocean model to a regional atmosphere model for the 1980-2012 period. For this purpose, simulations have been calculated with the coupled version (ROM) and the uncoupled version (REMO). To evaluate the impacts of the coupling system, ROM is compared to REMO. The horizontal resolution of the model is 50 km with 27 hybrid vertical levels. Figure 1 shows the preliminary results of the mean summer precipitation biases of REMO and ROM simulations from the CRU (over land) and HOAPS (over sea) observational datasets. In the coupled version (Figure 1b), some regions of the precipitation biases over the ocean was reduced. However, precipitation biases over Indian Ocean and Indonesia still remain, which could be due to inadequate number of vertical levels. Some studies indicated that if the vertical resolution is increased, the air-sea interactions are better represented. In this regard, an additional simulation is currently ongoing to investigate the effects of increasing the model vertical levels from 27 to 40.

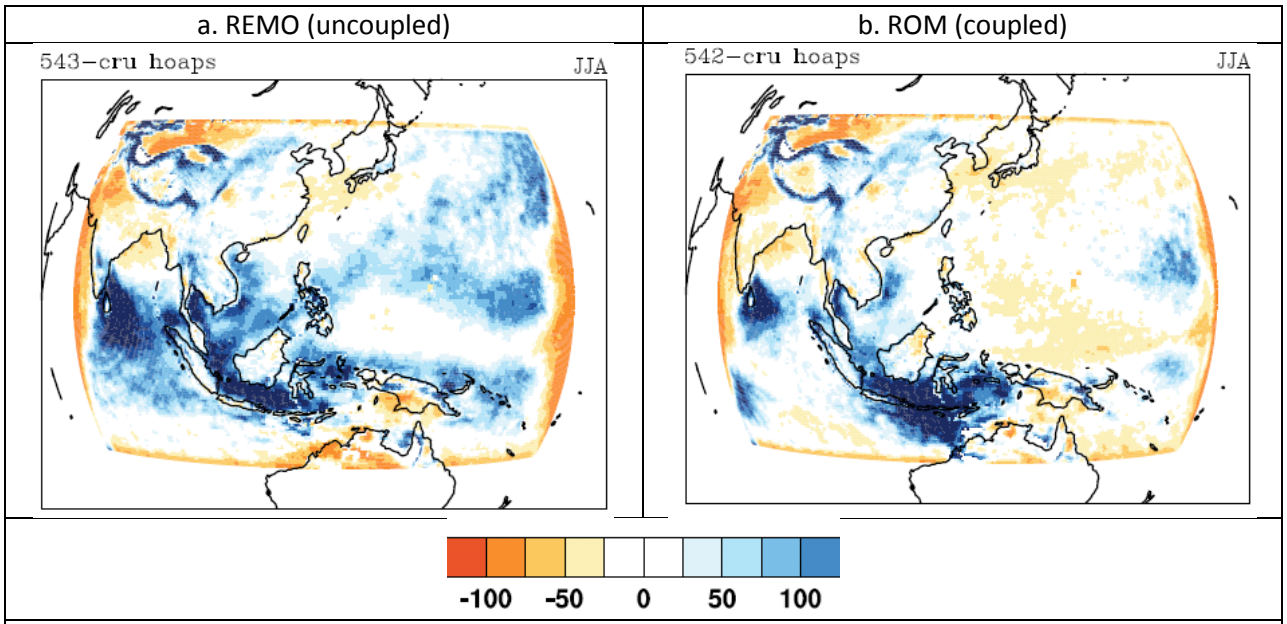

Figure 1. Mean precipitation biases of REMO (a) and ROM (b) from observational datasets for the JJA season from 1980 to 2012. Spatial resolution at 50 km.

In previous studies, atmosphere-only models have the tendency to overestimate the number of tropical cyclones due to the prescribed sea surface temperature. Figure 2 shows the initial results from tracking tropical cyclones using the TRACK algorithm of Kevin Hodges. In the coupled version (ROM), the number of tropical cyclones has decreased and it is closer to the observed

tracks than the uncoupled version (REMO). This result could be due to better representation of the air-sea fluxes.

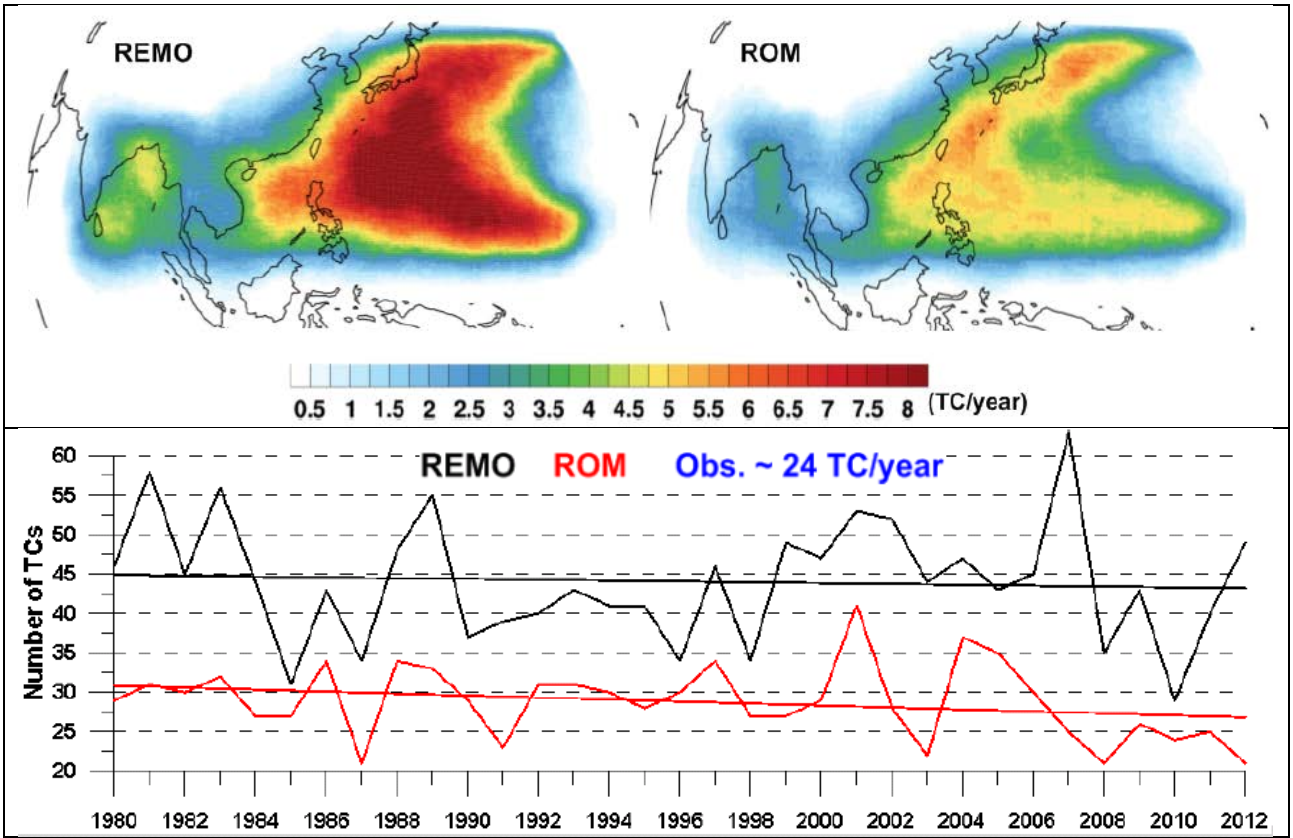

Figure 2. Track density distribution (top) and number of tropical cyclones detected (bottom) in the western Pacific ocean basin using TRACK during the active tropical cyclones season for the period of 1980-2012.

Based on the preliminary results, the coupled model have improved some regions where precipitation bias over the ocean compared to REMO during summer. The simulated frequency of tropical cyclones in the coupled model is approximately closer to the observed values than in the uncoupled model. These initial results indicate a potential for ROM in investigating the changes in tropical cyclones in a global warming scenario.

For the present computing period, the simulations on the coupled and uncoupled model at 50 and 25 km. resolutions for the ERA-Interim period have been done. Ongoing simulations include the experiments with increased vertical levels for both coupled and uncoupled model setup at 25 km. The climate change simulations will be requested for the next computing period.

The preliminary results have been presented in several workshops and conferences such as the CORDEX-Southeast Asia in Manila, Philippines, SPARC Storm Track Workshop in Grunewald, Switzerland, and in the 10. Deutsche Klimatagung in Hamburg, Germany. A paper is in preparation and we hope to finish writing it within the year to enable us to apply for funding for this study.