**Institute of Atmospheric Physics, National Central University**

Date：2019/05/03

Location：S1-713

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**Changes of Tropical Precipitation and Convection**

**under Global Warming Projected from HiRAM Simulations**

**Abstract**

 From regional perspectives, rainfall changes do not all follow the “wet-get-wetter” or “dry-get-drier” hypothesis proposed in previous studies. In this study, high-resolution atmospheric model HiRAM is used to investigate the changes of precipitation in the tropical region under the RCP8.5 warming scenario, and to further understand the physical mechanism affecting the precipitation changes.

The results show that the equatorial Pacific is most sensitive region in precipitation increase under the influence of global warming, while the precipitation reduction exhibits a hook-like distribution. For the tropical atmosphere above oceans, only about 1/2 of the area follows the “wet-get-wetter” theory. From the moisture budget, we find that the thermodynamic effect, ($-\left⟨\overbar{ω}∂\_{p}q^{'}\right⟩$), generally follows the “wet-get-wetter” or “dry-get-drier” hypothesis. In regions disobeying the “wet-get-wetter” or “dry-get-drier” hypothesis, the dynamic effect, ($-\left⟨ω^{'}∂\_{p}\overbar{q}\right⟩$), dominates the moisture budget and shows opposite signs to the thermodynamic effect.

Besides, the distribution of tropical precipitation changes is similar to the change of sea surface temperature (SST) and cloud radiation effect (CRE). The results show that the warmer SST induce warmer air temperature, which increase more water vapor and convection in the atmosphere, generate more convective clouds and CRE, and further affecting the air temperature. This positive SST-CRE feedback mechanism promotes precipitation to increase in tropical regions under global warming.

In addition, the difference of precipitation change mechanism in target domain is compared, and the atmospheric stability index “NGMS” and convective vertical variation are analyzed. The results show that there is an enhanced bottom heavy structure of convection in the mean descending region and an enhanced top heavy structure of convection in the ascending region. The NGMS change associated with the former is negative, which tends to decrease the atmospheric stability; while the NGMS change associated with the latter is positive, which tends to increase the stability of the atmosphere. This may explain why the precipitation change in the mean descending region can have a similar size of precipitation changes as the mean ascending region under global warming.

**Keyword**

Normalized Gross Moist Stability (NGMS)