Geophysical Research Abstracts
Vol. 19, EGU2017-11290, 2017
EGU General Assembly 2017

The impact of extratropical warming on the tropical precipitation

Masakazu Yoshimori (1), Ayako Abe-Ouchi (2), Hiroaki Tatebe (3), and Toru Nozawa (4)

(1) Faculty of Environmental Earth Science, GI-CoRE and ARC, Hokkaido University, Sapporo, Japan (myoshimo@ees.hokudai.ac.jp), (2) Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan, (3) Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan, (4) Okayama University, Okayama, Japan

From paleoclimate evidence to future climate projections, it has been reported that the asymmetric warming (or cooling) between the northern and southern hemisphere extratropics induces the meridional shift in the tropical precipitation. Such a shift is often understood by the energy-flux framework in that the extra energy is transported from more warming to less warming hemispheres through the change in the Hadley circulation. As the Hadley circulation transports energy in opposite direction to the moisture, the tropical precipitation tends to be intensified in the hemisphere of a larger warming. This framework is shown to be particularly useful for modelling results without ocean dynamical feedback. In the current study, a fully coupled atmosphere-ocean model is used to investigate the impact of extratropical warming on the tropical precipitation under the realistic RCP4.5 scenario. It is shown that the mid-high latitude warming alone in the poleward of 40° (56% global warming) can significantly affect the tropical precipitation change in the equatorward of 20° (38% hemispheric contrast) from late autumn to early winter. High-latitude warming alone affects much less. This meridional change in the tropical precipitation is largely explained by the circulation change, rather than the humidity change. The reduced northward eddy momentum and heat fluxes in the northern hemisphere induces anomalous Hadley circulation in the northern tropics. This change seems to weaken the equatorial upwelling in the Pacific, which leads to the equatorial SST rise. The equatorial sea surface warming induces the meridionally symmetric pattern of the anomalous Hadley circulation (though, asymmetric in strength), resulting in the northward migration of the tropical precipitation. The larger change in the ocean heat transport near the equator, relative to the atmosphere, requires a more refined theory than the conventional energy-flux framework.