

Research Collaborations on Stratosphere-Troposphere Dynamical Coupling in the Tropics in Association with the Project of Years of the Maritime Continent (YMC) for 2017-2019

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Stratosphere-troposphere (S-T) dynamical coupling has been studied over decades, mostly focusing in mid- and high- latitudes (e.g., annular mode variability in both hemispheres, impacts of the ozone hole on surface climate, and so on). However, there are not so many studies on S-T dynamical coupling (i.e., two-way interactions) in the tropics, even though influence of the troposphere on the stratosphere by upward propagating tropical waves is quite clear and has been studied extensively.

S-T dynamical coupling in the tropics is a scientifically interesting and challenging subject, because the dynamics of the coupling processes is largely different from those in the extratropics. In the tropics, Coriolis parameter is so small that quasi-geostrophic constraint is not very strong. Small-scale moist convection is the predominant source to drive the atmospheric motions in contrast to synoptic-scale baroclinic instability in the extratropics. Multiscale interactions of moist convections produce a wide variety of coherent motions and structures of the tropical atmosphere. However, the scale separation is not very straightforward because the moist convection and larger scales are so tightly coupled, and it is hard to extract causality in the interactions. On the other hand, the stratospheric influence on the tropospheric variations is weak, but it is clearly external. S-T coupling process in each time scale could be studied to know how large-scale stratospheric variations, influence on moist convection, and thus to understand how stratospheric variations influence on the tropospheric variations in weather and climate continuum.

There are some recent observational studies on such downward influence in association with stratospheric sudden warming (e.g., Kodera et al. 2011), quasi-biennial oscillation (e.g., Camargo and Sobel 2010, Liess and Geller 2012), and anthropogenic cooling trend (e.g., Emanuel et al. 2013, Vecchi et al. 2013). Numerical model studies with idealized experimental framework also made to study such a possible downward influence, including influence of QBO-like oscillation on convective organizations (Yoden et al. 2014) and that of the tropopause temperature trend on the intensity of tropical cyclones (Wang et al. 2014).

Stratosphere-troposphere interaction is one of the five main themes of the international research project “Years of the Maritime Continent” (YMC) planned for a two-year period from 2017 to 2019. Its objective is to improve understanding of processes governing the dynamical coupling of the stratosphere and troposphere and their mass exchanges over the MC. Possible SPARC-related activity on the S-T dynamical coupling in the tropics associated with the YMC project is proposed.

References

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