Influence of stratospheric dynamics on tropical convection and equatorial waves

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Previous studies based on satellite observational data and model simulation found an enhancement of tropical convection in association with an abrupt change in tropical circulation during a Stratospheric Sudden Warming (SSW) event. The principal process of the stratospheric impact on the tropospheric variability could be a decrease of the static stability in the Tropical Tropopause Layer (TTL) by intensified upwelling in ascending branch of the Brewer-Dobson circulation [Eguchi and Kodera, 2007; 2010; Kodera et al., 2011, 2015; Eguchi et al., 2015]. The present study focused on enhanced deep convection and tropical cyclones over the southwestern Indian Ocean and the southwestern Pacific Ocean during the SSW event in January 2010 simulated in a global nonhydrostatic model, NICAM (Nonhydrostatic ICosahedral Atmospheric Model) [Satoh, et al., 2014] which explicitly calculates moist physics at a cloud-system-resolving resolution.
The upwelling in the lower stratosphere associated with the SSW event started around 5 January 2010, and the deep convection was formed from 8 to 14 January along 10 south degree latitude in the whole tropics (except for South American sector in the simulation) due to the negative static stability at the upper layers at TTL. In particular, the precipitation was extended longitudinally over the Indian Ocean after 8 January, which developed over high SST region across the Indian Ocean. A tropical cyclone developed within this region on 11 January. It is noted that deep convection was enhanced over the equatorial Africa on 8 and 9 January before enhancement of the longitudinally extended precipitation over the Indian Ocean. Eastward propagation of a convective coupled Kelvin waves from the Africa to the Maritime continent, might excite the longitudinally extended precipitation through a reduction of the static stability in the TTL. The convection over the Maritime continent was enhanced around 15 January when the Kelvin wave arrived there. Difference in responses of convective activity over the equatorial Africa and that over the Maritime Continent could be arose from a difference in convective characteristic in two regions such as higher cloud top altitude over Africa than that over the Maritime Continent.

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