Inner-core Lightning and Vertical Structures associated with Tropical Cyclone Intensity Change

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Abstract

Previous studies suggested that lightning activity could be an indicator of Tropical Cyclone (TC) intensity change but their relationships vary greatly and at times appear contradictory. The importance of total lightning for TC intensification study and forecasting applications has also been pinpointed by several studies. Recently,we revisited this problem using 16 years of TRMM Lightning Imaging Sensor (LIS) measurements and found that reduced (elevated) inner-core total lightning marked rapidly intensifying (weakening) TCs, whereas outer rainband total lightning had opposite trends. These findings are identical to those reported by DeMaria et al. (2012) based on ground-based lightning network observations. It is also shown that the reduced lightning activity in rapidly intensifying storms was coincident with reduced volumes of 30-dBZ radar reflectivity in the mixed-phase cloud region (-5 to -40 ºC), suggesting the lack of large ice particles (e.g., graupel) in the inner cores of rapidly intensifying TCs (which is considered to be important for cloud electrification). In order to further investigate the physical process responsible for these results, we have examined the vertical profiles of radar reflectivity, distribution of precipitation/convection, overshooting radar echo tops (CloudSat), and microwave ice scattering signatures provided by GPM and CloudSat overpasses. This data fusion exercise uniquely provide a more complete understanding of storm electrification, convective intensity, ensemble precipitation microphysics, and storm dynamics in relation to TC intensity change. For example, we have distinguished the convective and microphysical structures between rapidly intensifying (RI) TCs with and without enhanced lightning activity, RI and steady-state TCs, and RI and rapidly weakening TCs.

Topic Areas

Lightning and Weather, Lightning Climatology

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