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Diurnal Variation of Tropical Ice Cloud Microphysics: Evidence from Satellite-borne Polarimetric Microwave Measurements

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The diurnal variation of tropical ice clouds has been well observed and examined in terms of the occurring frequency and total mass but rarely from the viewpoint of ice microphysical parameters, but the latter accounts for a large portion of uncertainties in evaluating ice clouds' role on global radiation and hydrological budgets. Owing to the advantage of precession orbit design and paired polarized observations at a high-frequency microwave band that is particularly sensitive to ice particle microphysical properties, 3 years of polarimetric difference (PD) measurements using the 166 GHz channel of Global Precipitation Measurement Microwave Imager (GPM-GMI) are compiled to reveal a strong diurnal cycle over tropical land
(30°S–30°N) with peak amplitude varying up to 38%. Since the PD signal is dominantly determined by ice crystal orientation, size and shape, the diurnal cycle observed by GMI can be used to infer changes in ice crystal properties. Moreover, PD change is found to lead the diurnal changes of ice cloud occurring frequency and total ice mass by about 2 h in opposite phase, which strongly implies that understanding ice microphysics is critical to predict, infer, and model ice cloud evolution and precipitation processes.