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Diurnal Signature of Cloud Fraction Using Kalpana1 Satellite Dataset over Indian Summer Monsoon Region

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Cloud fraction (CF) has been recognized as an important parameter to understand the cloud feedback in the context of climate sensitivity. However, the numerical models continue to struggle replicating the observed cloud field over the Indian monsoon region. Examining diurnal variability of CF is key to understanding cloud processes. Although there are many studies on diurnal variation of precipitation (e.g. Sahany et al. 2010, BK Basu 2007, Singh et al. 2009) in the Indian monsoon region, a comprehensive climatology of CF diurnal variability is missing. Since polar orbiting satellites are not suitable for the task, we analyze Indian Space Research Organization's (ISRO) geostationary satellite Kalpana1 (Shukla et al. 2012) cloud product to address this issue. CF data from Kalpana1 satellite are available every 30-mins at a spatial resolution of 25 km. Kalpana1 CF was found to agree quite well with MODIS cloud product (Verma et al., 2018). Here, we have analyzed ten years (2009-2017) of Kalpana1 data for the summer monsoon (Jun-Sep) season to establish climatology of CF at 30-mins interval. The diurnal amplitude and phase for the monsoon season are examined.
Our analysis reveals two distinct modes of CF over Arabian Sea (AS) and Bay of Bengal (BOB). For example, over most part of the AS, CF is maximum at 2330 IST but CF is highest at 1730-2030 IST over the southern part of the AS. In case of BOB, CF peaks at the same time (1730-2030 IST) in the northern part but in the southern part, it peaks at 0530 IST. On the contrary, late afternoon-early evening (1730-2030 IST) peak is observed over the land. The maximum ($\pm 1\sigma$) and minimum ($\pm 1\sigma$) CF over the AS (0-20N,58-73E), BOB (0-20N,86-94N) and core monsoon region (20-25N,70-88E) are 0.41 ± 0.12 and 0.22 ± 0.10, 0.67 ± 0.07 and 0.38 ± 0.07, and 0.62 ± 0.11 and 0.25 ± 0.03, respectively. We present the first decadal climatology of CF diurnal variation over the Indian monsoon region using Kalpana1 satellite data. Our results highlight the spatial heterogeneity in CF diurnal variation that the models must represent in order to accurately simulate the monsoon precipitation.