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Monthly variations in outgoing longwave radiation in the tropics

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The amount of longwave radiative energy leaving the earth system is a critical component of global climate. Small changes in this energy flux, on the order of a few W m̂-2, can lead to large changes in the global mean temperature. It is therefore necessary to understand both natural variations and anthropogenic influences on the outgoing longwave radiation (OLR). One such natural variability is the diurnal cycle. This paper investigates the monthly variability of the OLR first diurnal cycle harmonic amplitude and phase by applying Fourier decomposition to the CERES 3-hourly Synoptic flux products. The results demonstrate a rich spatial structure of amplitude and phase monthly variability characterized by a significant land-ocean contrast: variability is typically two times larger over land than ocean. The strongest monthly variations are observed over dry, land regions (northern Africa, central Australia, and Chile) and exceed 6 W m̂-2 owing to variability in the surface temperature diurnal cycle. A unique spatial distribution is found over the ocean where monthly variations are twice as large in regions of climatological deep convection versus regions of marine stratocumulus clouds. Such a gradient in the OLR diurnal cycle monthly variability in regions of frequent and infrequent convection is not evident over land, which indicates a compensation between cloud and clear-sky contributions to the total variability not found over ocean. Using ERA-Interim reanalysis, the sensitivity of OLR monthly first harmonic amplitude and phase variations are investigated. Results reveal a significant sensitivity to the monthly mean dynamic and thermodynamic atmospheric conditions mainly over desert regions. Lastly, the results indicate significant covariation between anomalies in the OLR diurnal cycle first harmonic amplitude and monthly OLR anomalies. Implications of OLR diurnal cycle variability to mean OLR are discussed.