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Representation of marine boundary layer cloud diurnal cycle in the CanAM4

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The diurnal cycle represents a fundamental mode of system variability, linked to the periodic, daily variability of solar insolation. Many atmospheric variables including precipitation, clouds, and radiation have been shown to exhibit significant variability on the diurnal time scale. Recent work suggests that monthly mean diurnal cycle variations can explain more than 30% of monthly anomalies in high clouds and precipitation in certain regions and seasons. This result suggests that there are pathways and feedbacks through which diurnal cycle variations can influence longer-term variability, making it critical for climate models to represent these important processes. Diurnal variability has also been shown to be important for explaining the monthly variability in marine boundary layer cloud regimes that are critical to determining climate sensitivity. This study investigates the representation of cloud, precipitation, and radiation diurnal cycles in a simulation spanning 2000-2009 by the fourth version of the Canadian Centre for Modelling and Analysis Atmospheric GCM (CanAM4) using a suite of satellite observations in climatologically important regions: Amazon, Peruvian and Namibian stratocumulus, and the tropical western Pacific. Clouds and Earth's Radiant Energy System (CERES) Synoptic (SYN) data product provides 3-hourly TOA longwave and shortwave fluxes and cloud fractions on a 1-deg x 1-deg grid. CERES SYN cloud information is obtained by combining MODIS and geostationary satellite cloud retrievals. TRMM 3B42 merged precipitation product is used to provide 3-hourly precipitation rates, averaged onto the CERES grid. Finally, this study investigates relationships between simulated monthly-mean diurnal cycles and monthly-mean cloud, precipitation, and radiation variability to determine if CanAM4 exhibits links between diurnal cycle and longer-term variability previously found in observational investigations.