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OBSERVATIONS AND PARAMETERIZATION OF BOUNDARY LAYER STRUCTURES AND CLOUDS AT THE ARM TWP NAURU SITE

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ABSTRACT

Marine boundary layer clouds are fundamental in regulating the vertical structure of water vapor and entropy in the lowest 2 km of the Earth's atmosphere. The observations from the ARM TWP-Nauru site provide a unique opportunity to study these clouds and the associated boundary layer structure. In this study we consider the climatology of night-time boundary layer clouds observed at the Nauru site from January 1999-2001 within the context of a simple atmospheric mixed layer representation of the subcloud layer. This period for the analysis is chosen since the night-time winds observed at Nauru are very steady from the East during the entire observing period. An excellent correlation between the observed cloud base heights and the LCLs calculated from the surface meteorological data supports a model closure assumption that links the mixed layer depth to the LCL. Using this closure, the subcloud layer model is forced with monthly-averaged sea surface temperatures (upwind of the island) from satellite estimates and the temperature, moisture, and wind observations from the Nauru site to calculate the sub-cloud longwave cooling rates as a residual. The magnitudes of the advective terms in the temperature and moisture budgets are estimated using NCEP reanalyses. The average residual cooling rate for this two-year study is 1.0 ± 0.2 oC day. A climatology of nighttime boundary layer clouds is developed using the ARSCL cloud properties. Statistics on cloud thickness, fractional coverage, and cloud radar reflectivity are estimated for different classes of fair weather cumuli. The relationship between the observed cloud properties and the month-to-month variability in the longwave cooling residual will be examined. Although the initial evaluation of the model was made using monthly averages, the applicability of the model using daily values will be evaluated.

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