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Diurnal cycle of surface-flux probability distributions in regional climate models

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Clouds, water vapor, precipitation, and temperature advection create large day-to-day variations in the diurnal cycle of surface sensible and latent heat fluxes. A single precipitation event during a long dry period, for instance, produces an "outlier" for the probability distribution of latent heat fluxes for any particular hour of the diurnal cycle. Similarly, nocturnal cold-air advection over a warm surface reverses the nocturnal downward sensible heat flux that usually is observed. A few such events create a highly non-normal distribution for, say, the midnight sensible heat flux. By examining only mean or median of modeled and observed values of the climatological diurnal cycle of sensible and latent heat flux we fail to evaluate a model's ability to capture important components of the climate. Furthermore, success in simulating diurnal means in one climate may not provide confidence in simulating the full range of variability in another climate. We use box and whisker plots to examine the eight probability distributions of three-hourly surface sensible and latent heat fluxes produced by five regional climate models (RSM, RegCM3, CLM, RCA-3, and GEM-LAM) used to simulate two domains (Continental US and Baltex region). Surface observations from two GEWEX Continental-Scale Experiment reference sites (Bondville, IL USA and Cabauw, the Netherlands) in the CEOP-1 archive were compared with results of models for which 3-hourly values were available. Results show that all models capture the observed large increase in variability from nighttime to daytime, and some models even are able to capture small numbers of large nocturnal "outliers" that are observed.