“The diurnal cycle of water and energy over the Continental United States from three reanalyses”

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The Continental United States summertime diurnal behavior of surface and column-integrated atmospheric water and energy components is compared among three reanalyses. The strength of the diurnal solar forcing leads to consistent phases among surface energy components across the continent and all reanalyses, but the amplitudes vary widely. This forcing has a particularly strong and direct impact on the surface energy cycle, but interacts with many aspects of the surface and column-integrated water cycle through dynamical convergence, leading to large diurnal fluctuations in the atmospheric reservoir of water vapor. The North American Regional Reanalysis (NARR) displays a diurnal circulation centered over Northern Texas that leads to regional patterns in the diurnal cycles of assimilated precipitation. Constructed vapor flux convergences from the National Centers for Environmental Prediction / Department of Energy (NCEP/DOE) Reanalysis-2 Global Spectral Model and the Experimental Climate Prediction Center’s reanalysis using an updated Seasonal Forecast Model reproduce many of the observed regional circulation and convergence patterns, but fail to generate the appropriate diurnal precipitation, presumably due to inadequate convective parameterizations. Diurnal variations in atmospheric energy respond not only to the direct solar forcing, but also to the resulting dynamically-forced semidiurnal thermal tide. Although they are negligible on timescales greater than a year, the tendency terms of the water and energy budgets at the surface and in the atmosphere are important in the diurnal cycle.