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Land surface and atmospheric conditions associated with heat waves in the South Central United States

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Exposure to extreme heat was reconstructed based on regional land-atmosphere processes from 1979 to 2010 in the South Central U.S. The study region surrounds the Chickasaw Nation (CN), a predominantly Native American population with a highly prevalent burden of climate-sensitive chronic diseases. Land surface and atmospheric conditions for summer heat waves were analyzed during spring (March-April-May, MAM) and summer (June-July-August, JJA) based on the Climate and Ocean: Variability, Predictability, and Change maximum temperature definition for heat wave frequency (HWF). The spatial-temporal pattern of HWF was determined using empirical orthogonal function (EOF) analysis and the corresponding principle component time series of the first EOF of HWF. Statistically significant analyses of observed conditions indicated that sensible heat increased and latent heat fluxes decreased with high HWF in the South Central U.S. The largest positive correlations of sensible heat flux to HWF and the largest negative correlations of latent heat flux to HWF were specifically observed over the CN. This is a significantly different energy transfer regime due to less available soil moisture during the antecedent MAM and JJA. The higher sensible heat from dry soil could cause significant warming from the near surface (> 2.0ºC) to the lower troposphere (> 1.5ºC), and accumulated boundary layer heat could induce the significant patterns of higher geopotential height and enhance anticyclonic circulations (negative vorticity anomaly) at the midtroposphere. Results suggested a positive land-atmosphere feedback associated with heat waves and called attention to the need for region-specific climate adaptation planning.