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Shift of soil moisture-temperature coupling exacerbated 2022 compound hot-dry event in eastern China

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Compound hot-dry events (CHDEs) are among the deadliest climate hazards and are occurring with increasing frequency under global warming. The Yangtze River Basin in China experienced a record-breaking CHDE in the summer of 2022, causing severe damage to human societies and ecosystems. Recent studies have emphasized the role of atmospheric circulation anomalies in driving this event. However, the contribution of land–atmosphere feedback to the development of this event remains unclear. Here, we investigated the impacts of soil moisture-temperature coupling on the development of this concurrent heatwave and drought. We showed that large amounts of surface net radiation were partitioned to sensible heat instead of latent heat as the soil moisture-temperature coupling pattern shifted from energy-limited to water-limited under low soil moisture conditions, forming positive land–atmosphere feedback and leading to unprecedented hot extremes in August. The spatial heterogeneity of hot extremes was also largely modulated by the land–atmosphere coupling strength. Furthermore, enhanced land–atmosphere feedback has played an important role in intensifying CHDEs in this traditional humid region. This study improves the understanding of the development of CHDEs from three aspects, including timing, intensity, and spatial distribution, and enables more effective early warning of CHDEs.