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Holocene temperature changes in southeastern China reconstructed from stalagmite fluid inclusions

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The long-term trends of Holocene temperature obtained from reconstructions and simulations are inconsistent and have been controversial. Paleoclimate reconstructions suggest a gradual cooling after the Holocene climatic optimum, while model simulationss show continued warming. This is the long-standing Holocene conundrum. It is argued that some Holocene temperature reconstructions may be influenced by summer temperature bias. Therefore, finding proxy indicators less influenced by temperature seasonality is crucial in resolving the conundrum. Additionally, temperature reconstruction records in Southeast China are not yet comprehensive, the sensitivity of various proxies, uncertainties in chronology, and the uneven distribution of proxy records have led to significant differences in temperature reconstruction results. Stalagmites inside cave are in a relatively stable environment, and cave monitoring shows that the cave temperature is usually stable and represents the local annual mean temperature. Therefore, utilizing the water stable isotopes from stalagmite fluid inclusions can more accurately reconstruct local annual mean temperatures. This study used hydrogen and oxygen isotopes of three stalagmite samples (SN35, SN38, and SN42) from the Shennong Cave in Southeast China to reconstruct a temperature record for the Holocene (9 ka-0.8 ka). By employing a conversion function between calcite fluid inclusion water isotopes and annual mean temperature, we found the reconstructed cave temperature is ~19.1°C from 2-0.8 ka BP, consistent with the modern local annual mean temperature of 19.1°C, indicating these stalagmites could precisely record the local annual temperature changes. The reconstructed Holocene record shows a slight overall upward trend during the period of 9-0.8 ka BP, in agreement with model simulation results. The records also show a significant drop in temperature around 5.2 ka BP and a further abrupt change in temperature around 4.2ka BP, which may have had an important impact on the origin and decline of Liangzhu, a well-developed neolithic culture in the lower reaches of the Yangtze River.Our new record provides new evidence to resolve the Holocene temperature conundrum.