

## **Enhanced solar activity influence on the summer temperature variability of the southeast margin of the Qinghai-Tibetan Plateau in the late Holocene**

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We present two quantitative chironomid-based Holocene summer temperature records from the southeast margin of the Qinghai-Tibetan Plateau (QTP). The records are from two alpine lakes (Tiancai and Heihai) located at the elevation of close to 4000 m above sea level from Yunnan Province. The mean July temperatures were quantified by applying a transfer function model ( $r^2 = 0.63$ , RMSEP = 2.3 °C) developed based on a 100-lake modern calibration dataset of south-west China. The results were validated using standard reconstruction diagnostics. Both records show that the total summer temperature variation is within 2.5 °C. The records also show that the overall pattern broadly matches the declining trend of the summer insolation at 30°N and the Asian Summer Monsoon records. The general declining trend is punctuated by a few warm and cool intervals on the centennial scale. We observed a periodicity pattern in the mean July temperature variability and these fluctuations are possibly related to both the solar irradiance and the summer monsoon changes. Solar activity may have played an enhanced role on the highland summer temperature changes in the late Holocene when the monsoon influence to south-western China is generally weakened. More comprehensive investigations are needed to clarify the relationship between solar activity, the East Asian and Indian Ocean summer monsoons and the response of alpine climate in order to disentangle these or the combined effects on the climate change in the broad region of south-western China.