

Phytolith reveals seasonal drought conditions of tropical East Asia during the last 60,000 years

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Whether or not millennium-scale climate events had occurred in the tropical continent of East Asia during the last glacial period has been a

long-term puzzle. In addition, whether those events were affected by the high-latitude atmospheric conditions in the northern hemisphere, or driven by low-latitude oceanic conditions, remains uncertain.

A research team led by Prof. Lu Houyuan from the Institute of Geology and Geophysics of the Chinese Academy of Sciences identified seven millennial-scale seasonal drought events occurring during warm interstadial periods based on the analysis of phytolith and pollen obtained from sediment cores of Huguangyan Maar Lake in Zhanjiang, Guangdong Province, China. The study was published in *PNAS* on Nov. 23.

"These events had been mainly driven by changes in both zonal and meridional atmospheric-[ocean](#) circulations, which were considered to be major determinants of the hydrological changes in tropical East Asia," said Prof. Lu.

Tropical regions are the "engines" of global hydrological cycles. Therefore, revealing the characteristics and mechanisms of hydrological changes in [tropical regions](#) in long-term scales are crucial to thoroughly understanding the evolution of global hydrological patterns, as well as predicting occurrences of extreme climatic events which may be caused by such changes.

In this study, the researchers found that seven millennial-scale seasonal drought events could be identified, which were indicated by the high percentages in the bilobate phytolith. These findings had contradicted the previously accepted mechanism in which the Intertropical Convergence Zone (ITCZ) had moved southward during the cold period that cause the drought events.

They also found that by comparing the reconstruction results of several long-scale tropical Pacific sea surface temperatures (SSTs), the bilobate

peaks were consistent with the increases in the zonal SST gradients from west to east over the tropical Pacific Ocean.

"The results suggested that the rises in the SST in the western tropical Pacific Ocean had strengthened the Walker circulation process and weakened the atmospheric convection processes in the eastern Pacific Ocean, thereby forming anticyclone conditions in the North Pacific Ocean region," said Prof. LU.

This may have contributed to the westward extension of West Pacific Subtropical High (WPSH). Meanwhile, the warming of the western tropical Pacific Ocean strengthened the Hadley circulation in the East Asia region, which further strengthened the WPSH and suppressed the East Asian summer monsoons.

Consequently, the northward movement of the WPSH was delayed, and the water vapor from the ocean became weakened. Modern climate records have revealed that during the years when the WPSH moves westward, the precipitation during spring and summer seasons in the Huguangyan area tends to be significantly lower than that observed during the years when the WPSH moves eastward.

The study results revealed the process of the millennium scale hydrological changes in tropical East Asia during the last glacial period under the joint control of the zonal and meridional ocean-atmospheric circulation conditions.

More information: Jianping Zhang et al. Seasonal drought events in tropical East Asia over the last 60,000 y, *Proceedings of the National Academy of Sciences* (2020). [DOI: 10.1073/pnas.2013802117](https://doi.org/10.1073/pnas.2013802117)

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