Hydroclimate variability in the Malay Peninsula over the past 3000 years recorded by stalagmites

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The Indian summer monsoon (ISM) has profound impacts on human societies in South and Southeast Asia through moisture and heat it carries. On orbital timescales, the ISM closely follows the Northern Hemisphere summer insolation [1, 2], while the ISM responds to ocean circulation changes in the North Atlantic on millennial timescales [e.g., 3, 4]. The solar activity, however, is suggested to have dominant influence on ISM variability on shorter timescales during the Holocene [5, 6]. To date, highly resolved proxy data from paleoclimate archives are sparse and scattered in the Southeast Asia, one of the "hot zones" for the ISM. Here we reconstruct decadal-resolution hydroclimate variations over the Malay Peninsula for the past ~3000 years, by using oxygen stable isotope ratios ($\delta^{18}O$) in speleothems. The mean value of $\delta^{18}O$ is consistent with the ones from southern Myanmar and Thailand [7] and central and northeast India [8]. It suggested that Malay Peninsula $\delta^{18}O$ data, which is characterized by strong multi-decadal to centennial oscillations, can be reliably regarded as an ISM precipitation record. Through examining the relationships between the $\delta^{18}O$ values, Northern Hemisphere temperature, and solar irradiation, we can answer the underline mechanism of ISM variability in the Holocene.

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