Study reveals spatial and temporal evolution of precipitation in Indo-Pacific region over the last 40,000 years

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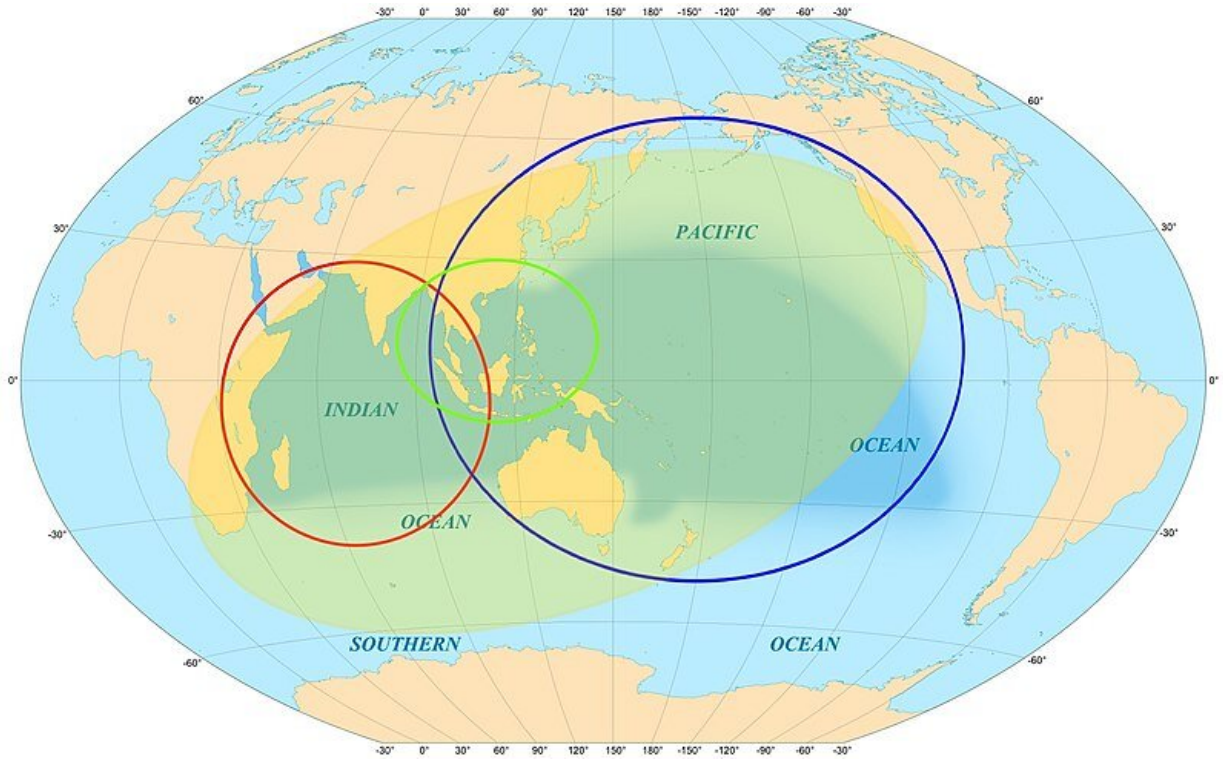

Red circle/oval roughly depicts the Indian Ocean region. Blue circle/oval covers the Pacific region. Green oval covers ASEAN. Yellow overlay covers the Indo Pacific. Credit: Eric Gaba/Wikimedia Commons, CC BY-SA

The Indo-Pacific warm pool is the warmest ocean in the world and is

known as "the global heat engine," which plays an important role in the climate system.

However, the actual observation records are generally short, which limits the understanding of climate evolution in the region in the context of global warming.

Using deep-sea sediment cores from the warm pool core area, a research team led by Prof. Wan Shiming from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) reported a continuous weathering record spanning the past 40,000 years with a temporal resolution of 80 years for the first time.

The study was published in *Geophysical Research Letters* on Dec. 14.

The continental weathering record is mainly influenced by changes in precipitation and temperature, while no significant millennial time-scale fluctuations in temperature changes have been observed in the Indo-Pacific region during the last 40,000 years.

Therefore, the researchers concluded that the millennial time-scale fluctuations in the reconstructed weathering record were mainly controlled by local changes in precipitation intensity. In turn, the variation of precipitation intensity in the region was directly related to the intensity evolution of deep atmospheric convection in the Indo-Pacific warm pool.

The results also showed that the evolution of atmospheric deep convection in the Indo-Pacific warm pool over the last 40,000 years was very consistent with the variation of the intensity of the El Nino Southern Oscillation (ENSO)-like system and the Pacific Walker Circulation.

On this basis, the researchers further summarized the reconstructed precipitation records of the region by various indicators and found that the western side of the Indo-Pacific region (East Indian Ocean) was mainly affected by the migration of the Intertropical Convergence Zone (ITCZ) and had an inverse precipitation distribution on the millennial time scale, while the eastern side (West Pacific) had a "sandwich" precipitation structure, which was mainly controlled by ENSO-like system.

The above results were also well reproduced in the Transient Climate Evolution (TraCE)-21 model driven by the single factor of North Atlantic meltwater, suggesting that the North Atlantic meltwater drive may be the causal factor for the differential precipitation distribution in the Indo-Pacific region at millennial time scales.

This study reveals the spatial and temporal distribution characteristics of precipitation in the Indo-Pacific region over the last 40,000 years. "It shows the differential distribution characteristics of precipitation between its east and west sides, distinguishing the different impacts of ITCZ and ENSO systems in the region," said Yu Zhaojie, first and corresponding author of the study.

The results can provide a boundary framework and result validation for high-resolution precipitation and warm pool atmospheric deep convection models. "Based on the inference of 'wetter getting wetter' in the context of global warming, the differential distribution of local precipitation in the Indo-Pacific region is likely to intensify in the future," said Prof. Wan.

More information: Zhaojie Yu et al, Millennial-scale precipitation variability in the Indo-Pacific region over the last 40 kyr, *Geophysical Research Letters* (2022). DOI: 10.1029/2022GL101646

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