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Late Holocene anti-phase change in the East Asian summer and winter monsoons

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Changes in East Asian summer and winter monsoon intensity have played a pivotal role in the prosperity and decline of society in the past, and will be important for future climate scenarios. However, the phasing of changes in the intensity of East Asian summer and winter monsoons on millennial and centennial timescales during the Holocene is unclear, limiting our ability to understand the factors driving past and future changes in the monsoon system. Here, we present a high resolution (up to multidecadal) loess record for the last 3300 years from the southern Chinese Loess Plateau that clearly demonstrates the relationship between changes in the intensity of the East Asian summer and winter monsoons, particularly at multicentennial scales. At multimillennial scales, the summer monsoon shows a steady weakening, while the winter monsoon intensifies continuously. At multicentennial scales, a prominent ~700-800 yr cycle in the summer and winter monsoon intensity is observed, and here too the two monsoons are anti-phase. We conclude that multimillennial changes are driven by Northern Hemisphere summer insolation, while multicentennial changes can be correlated with solar activity and changing strength of the Atlantic meridional overturning circulation.