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The Holocene East Asian monsoon

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Tropical monsoons are key mechanisms for transfer of heat and moisture to higher latitudes. The north African and southwest Asian monsoons intensified during the early and mid-Holocene, then weakened dramatically from the mid to late-Holocene onwards, changes linked with precessional solar forcing and North Atlantic climate events. Here is presented a high-resolution, terrestrial proxy summer monsoon record, based on a rainfall/soil magnetism transfer function, for the southeast Asian monsoon, from a loess/soil sequence (at Duowa) in northern China, covering the past $\sim$ 12,500 yr. Holocene rainfall values vary from $\sim$ 70 mm/yr to $\sim$ 375 mm/yr, with rapid changes over cyclical millennial and multimillennial periods. As with the northwest African/southwest Asian monsoon records, a short arid interval at $\sim$ 12.5 to 11.5 ky B.P. (the Younger Dryas) and subsequent summer monsoon intensification are recorded. However, at 6 ky B.P., the southeast Asian summer monsoon weakened, when the northwest African/southwest Asian monsoons strengthened, and then, from $\sim$ 5 ky B.P., intensified, when northwest Africa/southwest Asia became dry. These antiphase monsoonal relationships may reflect competition between sea surface temperature changes and solar forcing. The sequence of monsoon events recorded at Duowa extends and agrees with loess/palaeosol records from the central Loess Plateau ($\sim$800 km east) and from the sedimentary record of Lake Hurleg, Tibetan Plateau ($\sim$500 km west). These records do not match the Holocene precipitation records inferred from oxygen isotope analyses of well-dated speleothem records from Dongge or Hulu caves. Modern isotopic analyses of precipitation in a range of Chinese sites indicate that oxygen isotope composition and precipitation amount are not highly correlated, suggesting that the Holocene cave records reflect other climate and regional factors.