

Millennial-scale variability of East Asian summer monsoon precipitation during the last 6 kys is caused by N-S oscillation of precipitation front associated with westerly jet movement

*Ryuji Tada¹, Ke WANG¹, Keita Saito¹, Hongbo Zheng⁶, Yoshiaki Suzuki¹, Saiko Sugisaki², Kana Nagashima⁵, Masao Uchida⁷, Tomohisa Irino⁴, Takeshi Nakagawa⁸, Yoshimi Kubota³, Katsunori Kimoto⁵, Takuya Itaki²

1. Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, 2. Geological Survey of Japan, AIST, 3. National Museum of Nature and Science, 4. Hokkaido University, 5. JAMSTEC, 6. Yunnan University, 7. National Institute for Environmental Studies, 8. Ritsumeikan University

Precipitation by East Asian summer monsoon (EASM) plays a dominant role in the hydrological cycle of the area and exerts significant impact on lives of people living there. Thus, it is important to understand time-scale and magnitude of the variability and their controlling factors. Centennial- to millennial-scale variability of EASM precipitation could have been especially significant judging from Chinese historical records, but its magnitude, spatial distribution, and controlling factor(s) are largely unknown.

In this study, we estimated movement of EASM (precipitation) front in Yangtze River drainage basin during the last ~6 kys based on reconstruction of provenance changes of fine silt fraction of the sediments, representing suspended particulate (SPM) from Yangtze River, using cores from Yangtze Delta and the Mud Belt along the South China coast. The results show centennial- to millennial-scale NW-SE oscillation of EASM front with NW ward penetration during 6-5.1, 3.5-1.8, and 0.2-0 ka, and SE ward retreat during 5.1-3.5 and 1.8-0.2 ka, respectively.

We compared the result with N-S oscillation of westerly jet over the Japan Sea during the Holocene by Nagashima et al. (2013). The result suggests the oscillation of EASM front is in parallel with oscillation of the westerly jet, supporting the idea that subtropical westerly jet bounds the northern limit of EASM precipitation.

We also reconstructed flood and heavy precipitation record in SW Japan during the last 6 kyrs using SG-12 cores from Lake Suigetsu, and compared the record with the provenance changes of SPM discharged from Yangtze River. The comparison revealed a striking similarity between temporal changes in flood and heavy rain frequencies in Lake Suigetsu, SW Japan and temporal changes in provenance of SPM discharged from Yangtze River.

The observed relationships suggest that N-S movement of westerly jet has been controlling millennial-scale changes in EASM intensity through modulating the position of EASM front, and southward shifts of westerly jet and EASM front have caused more rain and frequent floods in SE part of South China and SW Japan.

Keywords: East Asian summer monsoon, precipitation front, westerly jet, Yangtze River, Lake Suigetsu, Holocene