



Spatial-temporal variability of Monsoon Asia streamflow over the past four centuries

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The Asian Monsoon region is home to a quarter of the world's population, most of whom relies on rivers for water supply. Water management in this region would benefit from an improved understanding of long-term hydrologic variability, made possible with streamflow reconstruction studies. Yet, few such studies have been conducted here. In this work, we produce the first large-scale streamflow reconstruction over the last four centuries for various gauges in five large river basins (Mekong, Yangtze, Chao Phraya, Ganges and Brahmaputra) using a Linear Dynamical Systems approach and the Monsoon Asia Drought Atlas (MADA) as the paleoclimate proxy. We complement this gauge-based reconstruction by applying the same methodology to the outputs of a global hydrological model (FLO1K), which enables spatial analyses that are otherwise difficult with the limited gauge network. The gridded reconstruction also indicates potential skills for future reconstruction works. Both reconstructions reveal a history of regime shifts with prolonged droughts exceeding the lengths of those found in instrumental records and show the spatial footprints of the Asian megadroughts. Analyses of the dominant modes of variability suggest that relationships between streamflow in Asia and climate drivers (ENSO and IOD) vary significantly through space and time. Overall, the findings presented advance understanding of regional hydrologic variability and can help improve water resource management practice in many countries.