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The interaction between society changes and hydrological extremes: the case of Yangtze River Basin, before and after the 1931 flood

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As the longest river in Asia, the Yangtze River has shown its impact on human societies with floods recorded since 12th century. In 1931, the Yangtze River has manifested its force again with one of the deadliest floods ever recorded in Chinese history, causing 422,499 casualties, damages to more than 25.2 million people and 58.7 billion m² farmland. The impact of the 1931 flood, resulting in the increment of rice price, has remained till 1933. Researches on the 1931 flood damage has shown its direct causation including political corruption, technical backwardness, and meteorological abnormality. However, in a long-term period, it is still unclear if the change of society has intensified the vulnerability of flood or some hydrological extremes has accelerated the social transformations. Here we propose a conceptual socio-hydrological framework within which the mutual influence between society and water system is analyzed. To address the issue of data scarcity, we applied the Water and Energy Budget-based Distributed Hydrological Model (WEB-DHM) to reconstruct the hydrological conditions in the early 20th century of China, based on which the potential rice production was estimated. With the reconstructed data, we found that the change of the social structure of villages aggravated the vulnerability of agricultural production towards natural hazards, and hydrological extremes speeded-up such structure change. Our results demonstrate how reconstructed data is likely to help comprehend a socio-hydrology system under a conceptual framework, shedding light on the inner correlation of a pre-industrial society like the early 20th century of China. We anticipate our study to be a starting point for more sophisticated socio-hydrological models, which will likely to be applicable to many other regions and times.