

Reconstructing 1931 flood in Yangtze River basin and its application to Chinese economic history

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Historical floods are receiving increased attention in flood research and in applied flood protection. One of the reasons is that they can be taken into account for the improvement of long-term data series and their statistical validation as well as for the analysis of return periods. Apart from that, analyzing the interaction between historical floods and socio-economic activities has attracted more and more interests as well. Previous research has focused on rebuilding temperature, precipitation, discharge and water level of historical floods, however, more detailed information like inundation depth and area is still required for more advanced analysis. In this research, we reconstructed the inundation condition and flood propagation process of 1931 flood in Yangtze River basin using Rainfall-Runoff-Inundation (RRI) model and carried out some primary analysis on Chinese economic history. Although the 1931 flood in Yangtze River basin is recognized as the deadliest flood ever recorded for its damage to more than 25.2 million people and 58.7 billion m² farmland, it is considered to be simulated by a distributed hydrological model for the first time because of data scarcity in 1930s and document loss afterwards. However, with the help from many historians, lots of valuable historical documents were found and collected, which makes the model simulation possible. For the preparation of input data of RRI model, a) 24 stations' daily precipitation data from Jan 1st to Dec 31st were digitized from *Monthly Meteorological Bulletin* and *Hydrological Data of Yangtze River Basin*, b) land use classification data of 2015, 2005, 1995, 1985, 1975 were collected and land use classification data of 1955, 1935 and 1915 were simulated using Artificial-Neural-Network-based-Cellular-Automata (ANN-CA) scheme. Dataset b) is further validated by military map with similarity over 60%. The model was calibrated for the discharge at Chongqing gauge station by varying the land use, soil, geometry and precipitation related parameters and then evaluated using flood investigation map. We expect that the simulation result from RRI model is especially suitable for economic history study, because the inundation depth & area were generated daily for the whole year by a 2D diffusive scheme, with which historians can analyze flood impact in more detailed time and space scale. To demonstrate this point, some primary studies were also carried out: a) validation of the number of farmers influenced by 1931 flood with inundation severity, b) analysis of the rice price fluctuation in Hunan province with the inundation time and depth. From study b), one interesting finding is that places where navigation channel was limited and blocked tended to have higher rice price, which indicated the transportation mainly to be shipping in 1930s.

Keywords: Yangtze River basin, historical flood, hydrological modeling