



Anthropogenic roles in changing patterns of floods in China over the last century: characteristics and explanations

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China is a natural disaster prone country, and floods exhibit a high frequency with large losses. Statistics indicate that there are more than 1000 floods in the history of China, including the 1887 Yellow River floods with a death toll of 0.9–2 million, the 1931 floods with a death toll of 3–4 million and the 1998 Yangtze River floods with a death toll of 3704. This study described the changes in flood trends and anthropogenic roles in the changing patterns using a combination of geographic information system (GIS), remote sensing and statistical methods, and elucidate the potential causes for the changing patterns. Over the last century, the statistical analysis displayed that the floods in most Chinese large river basins mainly occurred in May to August. Floods were most common in the Yangtze River basin (27.2 % of all floods), followed by the Huaihe River (12.7 %), Pearl River (12.2%) and Liaohe (12.2%) basins. The inter-annual variation of highest flood stages and duration showed a long-term increasing linear trend. At the decadal scale, the flood situations were most severe in 1990s while gentle after that in terms of the occurrence frequency and average duration. Climate change was the primary influence factor for changing of flood characteristics, however, some anthropogenic activities caused increasing in floods for the period 1960 – 1990: first, destruction of vegetation has led to soil erosion in the upper reaches. In the period 1960-1990, the forest cover had been reduced to half, while the area exposed to severe erosion doubled in size, which led to increasing in floods. Second, land reclamation and siltation has reduced lake sizes. This has resulted in decrease of the flood storage capacity. Third, the construction of levees has caused flood levels to rise due to restricted flood discharge capacity. For example, establishment of the Great Jinjiang levee caused silting up of the riverbed and valley in the mid-reaches of Yangtze. On the other hand, the “return land to lake” policy, intensive sand mining in the lake and, especially, dam construction, played an key role in mitigation of flood frequency and severity. In the Liaohe, Haihe, Yellow River, Huaihe river basins, the total reservoir storage capacity can regulate more 100% of river runoff, which can significant mitigate flood frequency and severity, in the Yangtze and Pearl river basins, the reservoirs can regulate around 30% of river runoff; the mega dams (e.g., Three Gorges Dam) constructed on the mainstem play a key role in flood control. Results obtained from this study reveal trends and distributions of floods and associated anthropogenic roles in changing patterns of floods in China, which can help to fully understand floods variation.