

Responses of suspended sediment yield to precipitation, topography and dam control in the Yellow River Basin, China

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Soil erosion has long been a serious problem in the Yellow River Basin in China. The high sediment load carried by the Yellow River results in deposition along its path, raising the riverbed and increasing the flood risk in the lower reaches. To mitigate this situation, large-scale soil conservation measures have been put into practice such as the construction of dams to effectively trap fluvial sediments. Previous studies on this topic focused on the interannual fluctuation of sediment yield caused by dams and reservoirs. However, few studies focused on their effects on the seasonal variation of sediment yield. In 2002, the Yellow River Conservancy Committee began to implement the water-sediment regulation (WSR) scheme to regulate the river water, which further strengthen the impact of dam control on the seasonality of sediment yield. Therefore, this research aims to integrate natural contributing factors such as topography and precipitation with the WSR-based dam control to analyze the seasonal and spatial variations of sediment yield in the Yellow River, for the years 2008 to 2012. Data of daily suspended sediment concentration, water discharge, and precipitation were downloaded from the Chinese Data Sharing Infrastructure of Earth System Science, and the ASTER GLOBAL DEMs with a resolution of 1 arc-second were downloaded from the U.S. Geological Survey web site. ArcGIS and R software packages are used to analyze the obtained data. Inspection of data quality revealed that consecutive sediment yield and precipitation data for 97 watersheds are usable.

Data analysis indicated the following four basic hydrological characteristics of the watersheds. 1) Water discharge within each watershed is not stable both interannually and seasonally, because it has been affected by the implementation of dam regulation as well as low discharge conditions mostly in spring and winter especially in some small watersheds. 2) The variation of sediment yield in some natural watersheds reflects change in precipitation, leading to sediment yield peaks in summer. 3) In other watersheds, the variation of sediment yield tends to be independent of precipitation. Instead, some artificial conservation measures such as dam control effectively intercept sediments from the upstream area. 4) The correlation between suspended sediment yield and water discharge varies among watersheds, and the correlation coefficient can be used as a parameter representing hydrological characteristics. The DEMs have been also analyzed to relate hydrology and climate with geomorphology. The obtained results may help the policy makers better understand the erosion situations in the Yellow River Basin and regulate the soil conservation measures.

Keywords: Suspended sediment yield, the Yellow River basin, seasonality, precipitation, topography, dam control