Responses of suspended sediment yield to topography and land use in the Yellow River Basin, China

*Ruiqi Zhang[1], Takashi Oguchi[2], Zhiguo Meng[3], Lele Hou[3]

1. The University of Tokyo, Graduate school of Frontier Sciences, 2. The University of Tokyo, Center for Spatial Information Science, 3. The University of Jilin, College of Geoexploration Science and Technology

The Yellow River (YR) is one of the most sediment-laden rivers in the world. Hyper-concentrated flows triggered by rainstorms are widely distributed during summer in the YR basin (YRB). Many previous studies examined suspended sediment yield using the product of water discharge (Q) and suspended sediment concentration (SSC) within a specific period, which may downplay the effect of hyper-concentrated flows. Besides, research on large watersheds was limited in the past when investigating the interactions among sediment yield and corresponding environmental factors in the YRB. This situation may hinder the understanding of determining factors of erosion and deposition for watersheds with different sizes.

Motivated by the scientific issues mentioned above, this study has utilized Q and SSC data independently for the YRB from 2008 to 2012 and investigated the effects of watershed size, topography and land use based on 94 gauged watersheds whose area ranges from 43.3 to 730036 km^2. For Q and SSC, we mainly analyzed daily mean and maximum values, respectively, during July to September. Data analysis indicated the following four characteristics of the watersheds: 1) Q increases with the watershed area (A) for small watersheds, while it almost stays constant for large watersheds. The latter observations could be caused by the limited ability of river channels to obtain baseflow as well as enhanced water infiltration and evapotranspiration in gentle downstream areas. 2) SSC is uncorrelated to A for tributary watersheds but tends to be positively correlated for mainstream watersheds; The latter observation may reflect the complex and highly variable characteristics of small watersheds and increase in SSC with increasing sediment supply for large watersheds encompassing the Loess Plateau. 3) Of the selected topographic variables, Q is more affected by slope-related variables, suggesting the effects of water infiltration and evaporation on water flow over different slopes. In contrast, SSC is more affected by elevation-related variables, and the associations may be due to stronger water flow and sediment transportability in higher areas when sediment availability is sufficiently high. 4) Compared with topography, the effects of land use on both Q and SSC are weak, and of the four land-use variables, Q is only correlated to the percentage of grassland; However, this correlation could be superficial without a cause-effect relationship since some watersheds with high percentage of grassland may be located in mountainous regions where rainfall infiltration is not significant, while some watersheds with low percentage of grassland may be located in downstream plains where water flow is less concentrated. The obtained results have revealed the major influence of topographic factors, which may help people understand the regularities of sediment yield under current environmental conditions in the YRB.

Keywords: The Yellow River Basin, water discharge, suspended sediment concentration, topography

