Spatio-temporal Characteristics of Vegetation Dynamics and Its Interaction with Sediment Yields in the Yellow River Basin, China

R. Zhang[1] and T. Oguchi[2]
[1]Department of Natural Environmental Science, The University of Tokyo
[2]Center for Spatial Information Science, The University of Tokyo
Contact: [1]<zhangruiqi@csis.u-tokyo.ac.jp> [2]<oguchi@csis.u-tokyo.ac.jp >

(1) Motivation: Vegetation influences sediment yields through the surface hydrological cycle. Since vegetation is characterized by inter-annual and seasonal dynamics, its effect on hydrological cycle may also vary with time. Thus, research on vegetation dynamics can deepen our understanding of runoff and sediment regulation, especially for areas where water erosion is severe, such as the Yellow River Basin (YRB) in China (Fig. 1). However, previous studies suffered from some limitations. For example, traditional methods for computing the Normalized Difference Vegetation Index (NDVI) are ineffective against contaminated atmospheric haze, cloud and snow, leading to missing data. They also often fail to detect existing locally low NDVI values during the harvest period. Moreover, the number of examined watersheds in each previous study is usually limited because only spatially independent watersheds are considered. Considering the large spatial disparities in the YRB, whether obtained results are representative of the whole region is debatable. In this research, we adopted possible methods to address the problems mentioned above, and investigated relations between vegetation and sediment yields.

(2) Methodology: This study applied a new noise-reduction algorithm called the Spatial-Temporal Savitzky-Golay method (Cao et al., 2018) to reconstruct the NDVI time series. It can address the problem of missing data in NDVI datasets, and can also better preserve the low NDVI values during the harvest period. In addition, this study investigates both main watersheds and sub-watersheds to increase the number of data for statistical analyses.

(3) Results: We have analyzed data collected from 70 gauged watersheds and sub-watersheds for the years from 2008 to 2012. Our main findings are: 1) the value of monthly mean NDVI calculated from the obtained NDVI maps is positively correlated to monthly mean water discharge (Q), although the correlation coefficient (R) varies spatially; 2) the responses of monthly mean NDVI to Q have time lag, and its length also differs spatially; 3) Higher values of the maximum suspended sediment concentration (SSC) are negatively correlated to the mean annual NDVI (Fig. 2), reflecting the role of vegetation in retaining soil. However, the correlation is insignificant if the maximum SSC is small.

(4) Reference:

Cao, R., Chen, Y., Shen, M., Chen, J., Zhou, J., Wang, C., Yang, W. A simple method to improve the quality of NDVI time-series data by integrating spatiotemporal information with the Savitzky-Golay filter. Remote Sens. Environ. 2018, 217, 244-257.

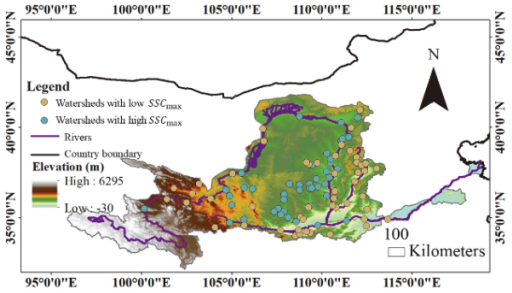

Figure 1: Elevation distribution of the YRB and location of watershed outlets (dots)

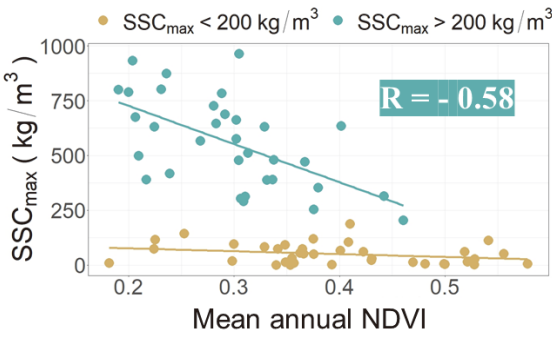

Figure 2: Maximum SSC versus mean annual NDVI. Their relation differs according to maximum SSC values.