International Research (Project No.: 2019W-02)

Project name: Effects of Climate Change and Human Activities on Flood Disasters of Loess Plateau in Northwestern China
Principal Investigator: Pingping Luo
Affiliation: School of Water and Environment, Chang'an University
Name of DPRI collaborative researcher: Takahiro Sayama
Research period: April 01, 2019 ~ March 31, 2021
Research location: Xi'an, China
Number of participants in the collaborative research: 8 (DPRI staff: 2, non-DPRI staff: 6)
- Number of graduate students: 4 (Master students: 3, Doctor students: 1) (Included number)
- Participation role of graduate students [Data analysis and field work]

Implementation status in FY2019

1. Conducted field observations in the study area, we used UAVs (DJI Spark Fly More Combo) to obtain high-precision terrain data and channel cross-section acquisition, and collected soil sampling and remote sensing data, soil physical data and river flow monitor.
2. Based on daily precipitation data from 1970 to 2016, we supplemented by climate analysis methods such as trend analysis, spatial analysis and wavelet coherence, and the characteristics of spatiotemporal changes of extreme precipitation in the Loess Plateau in northern Shaanxi were analyzed. The results show that: (1) from 1970 to 2016, the temperature fluctuations in northern Shaanxi are increased, and the precipitation in those areas is increased, and the semi-arid boundary obviously has been moved to the northwest; (2) from 1970 to 2016, the precipitation in northern Shaanxi showed some extremes. Specifically, the number of weak precipitation days is decreased, the number of heavy precipitation days is increased, and the duration of precipitation was fragmented. The maximum precipitation and the intensity of precipitation all showed a significant increasing trend.
3. Taking the typical watersheds of the Loess Plateau in northern Shaanxi, Wangmaogou River and Tuweihe River are considering as the examples, the applicability of the RRI model in these two rivers was verified, and the characteristics of the flood process and the spatial distribution of rainstorm in these two rivers were revealed. The typical rainstorm-flood process of the river basins was analyzed. The results show that: (1) The storm and flood conditions in the Tuweihe River Basin are complicated, and the spatial variability of the rainstorm is large. It is difficult to accurately record the precipitation process in the sparse site. The statistical results show that the grade of precipitation data at the observed rainfall stations is low and the error of the rainstorm condition is higher than that of the high-level rainstorm. (2) Under the premise of ensuring data availability, the RRI model has a good simulation test effect in the two representative watersheds of the Loess Plateau in northern Shaanxi, and can meet the simulation of the storm-flood process in this area. (3) The model has a large simulation error for the small-scale river basin with very few measured input data, which lead the observed peak discharge is higher than the simulated peak discharge and the coming time of simulated peak discharge is earlier than that of observed peak discharge.

Implementation plan in FY2020

On the basis of previous studies, combined with the newly acquired watershed data, the following studies were conducted on the Jinghe River Basin with more complete data on the Loess Plateau:

1. The accuracy of precipitation data observed by traditional ground rainfall stations is high, but due to the low density, the spatial estimation capacity is insufficient; satellite remote sensing precipitation data can reflect the spatial and temporal distribution characteristics of precipitation in the watershed, but there are certain data errors. We are going to carry out the research on the fusion correction of radar precipitation and ground station observation precipitation data, and further use the integrated precipitation data to drive the RRI model to simulate the storm and flood process to improve the accuracy of precipitation data and the applicability of hydrological process simulation.
2. We are planning to use the high-precision precipitation data for RRI model, modify the model structure, and recalibrate

the model parameters as well as simulate runoff and flood conditions under climate change and human activities to determine which factors have the greatest impact on flood disasters.

3. For the future plan, we will investigate and collect the construction status, the main parameters of the water conservancy projects under the historical process in the region, and the historical development data of regional population, economy, agriculture, forestry, animal husbandry and fishery. Using the remote sensing monitoring data of China's land use status as the main information source in the past 40 years, the land use transfer matrix method and statistical methods were used to analyze the impact of human activities on the underlying surface. And we will use CA-Markov model to predict the future land use pattern. Combined with the previous research on the calculation of the precipitation trend and distribution, the RRI model is used to predict the future storm-flood process changes under the combined influence of climate change and human activities. It will find out the maximum water depth and flooded area under future climatic conditions, and provide sustainable flood management recommendations for the major watersheds of the Loess Plateau.