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

Project name: Effects of Climate Change and Human Activities on Flood Disasters of Loess Plateau in Northwestern China（中国北西部の黄土高原における洪水災害に対する気候変動と人間活動の影響）

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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 of graduate students:

It is helpful to improve the practical ability and scientific research quality of graduate students. Graduate students have basic practical experience and scientific research experience, and are basically familiar with and understand the professional technology and discipline frontier in this subject field. Graduate students participating in the project can better discover, analyze and solve detailed problems in time, and ensure the real-time progress of the project.

- Impact on research and education:

The project-based learning model emphasizes that students develop skills and abilities in the process of trying to solve problems, and focuses on cultivating students' comprehensive quality capabilities. Feedback on the project from the students' perspective, starting from both perspectives, using hydrological numerical models to provide scientific and reasonable theoretical support for the formulation of flood control policies in the context of the times, so as to solve problems related to the analysis of the effects of flood control measures.

Research Report

(1) Research purpose

In the context of the frequent occurrence of extreme rainstorms and the rapid increase in the probability of floods and related disasters, China's regional development is facing a huge threat. As an advanced method, the hydrological numerical model can provide scientific and reasonable theoretical support for the formulation of flood control policies. This study uses the distributed rainfall runoff flood model (RRI model) developed by the International Centre for Water Hazard and Risk Management (ICHARM) to analyze the application characteristics of the model in the river flood process, riparian flood process, and plain waterlogging process in the river basin. This research aims to solve the problems related to the analysis of the effects of flood control measures, and expand the research on data calibration and land use changes in the later period.

(2) Summary of the research process

First of all, we conducted field observation in the study area, using unmanned aerial vehicle (DJI spark flight) to obtain high-precision terrain data and river cross-section collection, and collected soil sampling and remote sensing data. At the same time, we use the soil physical data of ultrasonic liquid level meter and river flow monitoring, based on the daily precipitation data from 1970 to 2016, supplemented by climate analysis methods such as trend analysis, spatial analysis and wavelet coherence, to analyze the temporal and spatial variation characteristics of extreme precipitation in Northern Shaanxi Loess Plateau.

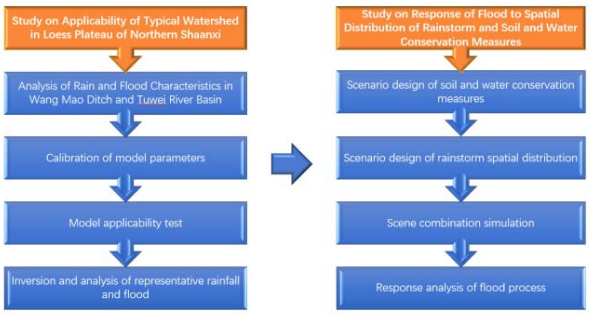

Figure 1 Technical flow chart

Figure 2 Meteorological data collection system

After that, the Wangmaogou and Tuwei river basins in the Loess Plateau of northern Shaanxi were taken as examples to verify the applicability of the RRI model in these two rivers, revealing the spatial distribution characteristics of the flood process and heavy rainfall of the two rivers. On the basis of previous research, combined with newly obtained watershed data, the Jinghe River Basin was studied. We carry out research on the fusion and correction of radar precipitation and ground station observation precipitation data, and further use the comprehensive precipitation data to drive the RRI model to simulate the storm and flood process, so as to improve the accuracy of precipitation data and the applicability of hydrological process simulation. At the same time, we use the high-precision precipitation data of the RRI model to modify the model structure and recalibrate the model parameters to simulate runoff and flood conditions under climate change and human activities to determine which factors have the greatest impact on flood disasters. Finally, combined with the remote sensing monitoring data of China's land use status in the past 40 years, the land use transfer matrix method and statistical methods are used to analyze the impact of human activities on the underlying surface.

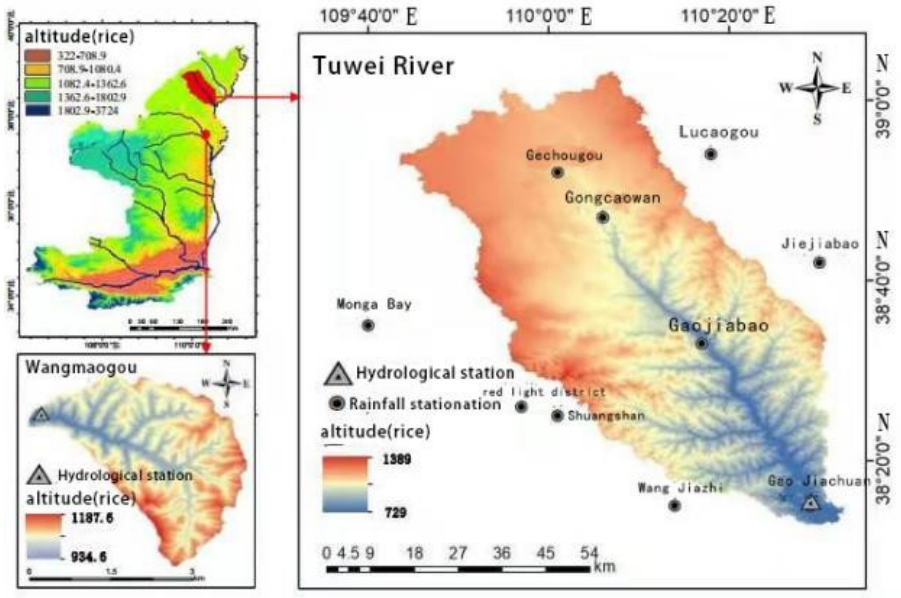

Figure 3 Regional status map

(3) Summary of research results

1. Application of RRI model in Wangmaogou and Tuwei River Basins in the Loess Plateau of Northern Shaanxi

The conditions of rainstorm and flood in the basin are complex, and the spatial variability of rainstorm is large. The simulation results of the model show that the precipitation data of the observation station is low. Under the premise of ensuring the availability of data, the RRI model has a good simulation test effect in the two representative watersheds of the Loess Plateau in northern Shaanxi, and can simulate the storm flood process in the region ; This model has a large simulation error for small watersheds with very few measured input data, which results in the measured peak flow rate being higher than the simulated peak flow rate, and the arrival time of the simulated peak flow rate is earlier than the measured peak flow rate. A scenario design of water and soil conservation measures and the spatial distribution of rainstorms is carried out for the Tuwei River Basin. Under the arrangement of water and soil conservation measures with different combinations of biology and engineering, we use the RRI model to simulate the rainfall-runoff-flood flooding of the three design rainstorm processes. The results show that the spatial distribution of the rainstorm has a significant impact on the flood process, and the peak discharge time is the earliest when the rainstorm center is downstream. We found that soil and water conservation measures can effectively delay the peak present time, reduce part of the peak flow, and alleviate the degree of regional flooding. Among them, ecological measures have the best effect on delaying low-peak floods, and engineering measures have the best effect on reducing peak floods.

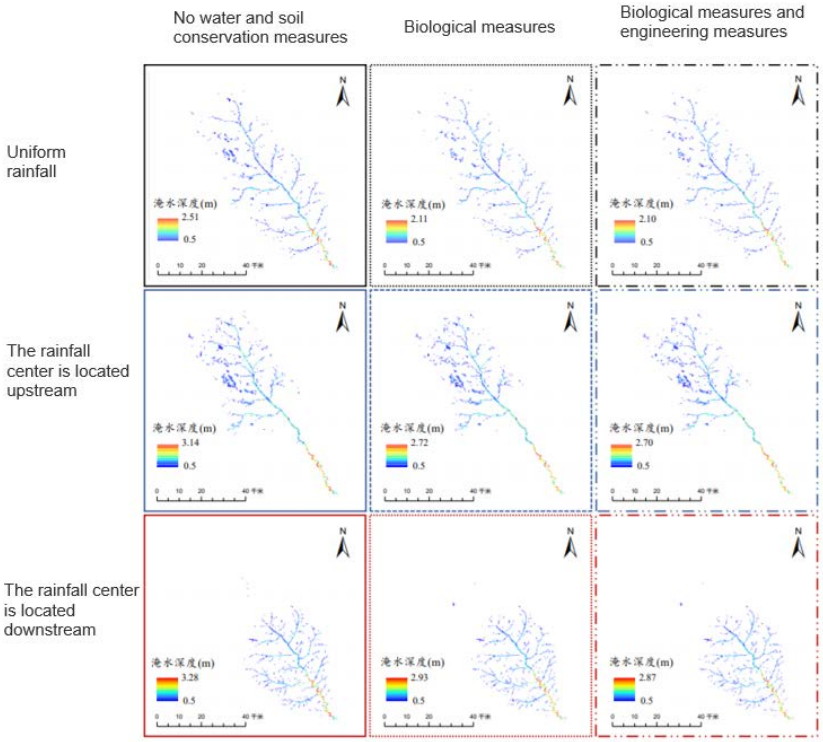

Figure 4 Effect of soil and water conservation measures

2. Research on the fusion correction of radar precipitation and ground station observation precipitation data

We use a self-developed ultrasonic level gauge to measure rainfall and flow data in the study area. (In the measurement, the pulsed ultrasonic wave is emitted by the sensor, and the sound wave is reflected by the surface of the object and then received by the same sensor and converted into an electrical signal. The distance between the sensor and the measured object is calculated from the time between the emission and reception of the sound wave.)

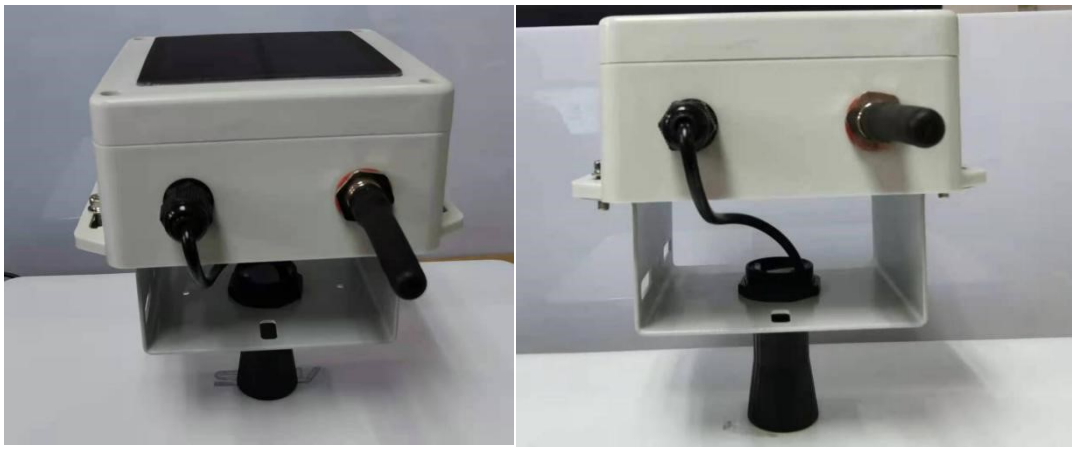

Figure 5 Ultrasonic level gauge

At the same time, we have set up several monitoring points in Yanta campus and Qingyang area, and set up weather stations and flow meters in these places.

Figure 6 Construction process and effect

The land use data is obtained from the corrected land satellite data after interpretation, and the elevation data uses the SRTMDEMUYTM90 data set with a spatial resolution of 90m. Based on the constructed temporary rainfall runoff database, the programming program dynamically searches the main location of the flood process based on the flow data, and the programming program dynamically searches the main location of the flood process based on the flow data. The purpose is to ensure the integrity of catching rainfall in the early stage of a flood event and

returning water later. The results show that under the improved RRI model simulation with a grid accuracy of 10m and a time scale of 1 hour, the simulation results are more consistent with the measured flow process, and the peak time and flow have a high degree of accura

4. List of research results

Title of work or paper	Publication name	Author	Publish time	Category	Impact factor
Historical Assessment and Future Sustainability Challenges of Egyptian Water Resources Management	Journal of Cleaner Production	**Luo Pingping**; Sun Yutong* ; Wang Shuangtao* ; Wang Simeng; Lyu Jiqiang*; Zhou Meimei*; Nakagami Kenichi; Takara Kaoru;Nover Daniel	2020	SCI Highly Cited Papers	7.2462
Impact of temporal rainfall patterns on flash floods in Hue City,Vietnam	Journal of Flood Risk Management	Mu Dengrui ; **Luo Pingping*** ; Lyu Jiqiang; Zhou Meimei; Huo Aidi; Duan Weili; Nover Daniel; He Bin; Zhao Xiaoli	2020	SCI	2.438
Control and remediation methods for eutrophic lakes in the past 30 years	Water Science and Technology	Zhang, Yuan; Luo Pingping*; Zhao Shuangfeng; Kang Shuxin; Wang Pengbo; Zhou Meimei; Lyu Jiqiang	2020	SCI	1.247
Deposition of MOFs on Polydopamine-Modified Electrospun Polyvinyl Alcohol/Silica Nanofibers Mats for Chloramphenicol Adsorption in Water	Nano	Li Aowen; Zhou, Meimei*;**Luo Pingping***; Shang Jiaxin;Wang Pengbo; Lyu Luxue	2020	SCI	1.5661
Spatiotemporal Analysis of Hydrological Variations and Their Impacts on Vegetation in Semiarid Areas from Multiple Satellite Data	Remote Sensing	Zhu, Yonghua; **Luo Pingping***; Zhang Sheng; Sun Biao	2020	SCI	4.5093

Title of work or paper	Publication name	Author	Publish time	Category	Impact factor
Water quality trend assessment in Jakarta: A rapidly growing Asian megacity	PLos One	**Luo, Pingping**; Kang, Shuxin*; Apip; Zhou, Meimei*; Lyu, Jiqiang*; Aisyah, Siti; Binaya, Mishra; Regmi Ram Krishna; Nover, Daniel	2019	SCI	2.7399
Study on the Temporal and Spatial Variation of Snow Cover in the Mountainous Area of Hotan River Basin	China Rural Water Conservancy and Hydropower	Xue Qiang Lu Jiqiang* Luo Pingping Liu Jun Nie Qiyang Shen Bing Han Bo	2020	Core journal	0.442
Temporal and spatial variation characteristics of potential non-point source pollution risks in the Bahe River Basin affected by land use changes	Journal of Water Resources and Water Engineering	Nie Qiyang Lu Jiqiang* Sun Xiali Luo Pingping Shi Didi Xue Qiang Shen Bing	2019	Core journal	0.588
Research on the Influence of Human Activity Disturbance on the Design Flood of the Bahe River Basin	Journal of Water Resources and Water Engineering	Dengrui Yuan Weining Lu Jiqiang* Luo Pingping Fan Lei	2019	Core journal	0.588
The application prospect of super absorbent resin in sponge city	Flood Control and Drought Relief in China	Luo Pingping* Liu Liming Zhou Meimei Liao Lei Zhang Feilong	2019	National Journal	0.342
The application prospect of roof greening in sponge city	Pearl River	Luo Pingping* Liu Jiaxin Su Mengfei Cai Haohan Jie Yuhan Li Lingyu Zhou Meimei Lu Jiqiang Shi Wenhai	2020	National Journal	0.392