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Transplanting and Analyzing the Extreme Rainfall Event of Zhengzhou “7.20” Heavy Rainstorm: A Study in Rizhao City

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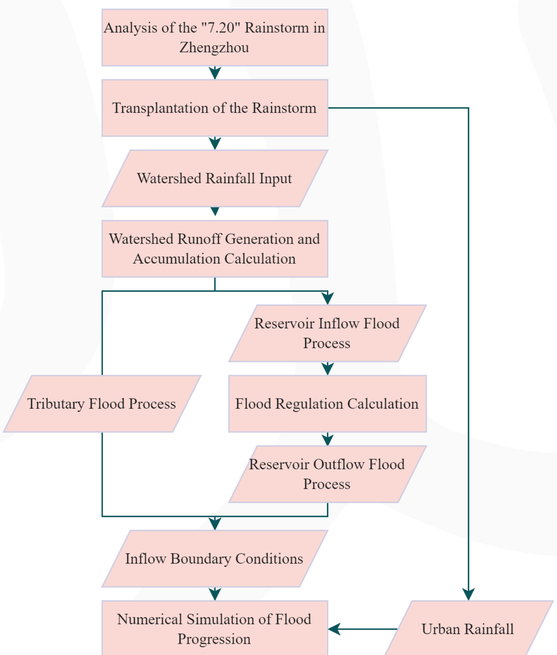
Objectives

For the purpose of profoundly assimilating lessons from the catastrophic “7.20” rainstorm disaster in Zhengzhou, Henan Province, and effectively enhancing the extreme flood prevention and response capabilities of Rizhao City, this study transplants the extraordinary rainstorm event to the Futuan-river Basin in Rizhao. Simulative calculations are performed to assess the potential floods triggered by this rainstorm pattern. Building upon the existing engineering conditions, flood defense strategies and dispatch plans, the study extrapolates and analyzes the potential impacts on reservoirs, river channels, and flood detention areas. This foundational work is aimed at ensuring preparedness for extreme rainstorm disasters. It encompasses the formulation of emergency response plans, pre-disaster drills, and flood season rehearsals. Through these efforts, the study seeks to enhance Rizhao City‘s capacity to effectively address extreme rainfall events and mitigate flood disasters.

Methods

The technical methodologies employed in this study comprise two main components: the transplantation analysis of the "7.20" rainstorm event in Zhengzhou and watershed flood simulation analysis.

- The transplantation analysis of the rainstorm event involves the utilization of overlay analysis and proportional amplification methods.
- The watershed flood simulation analysis is conducted through the integration of hydrological and hydrodynamic methods. The flood processes within tributaries located in hilly areas and the inflow flood processes of reservoirs are determined by hydrological analysis. Reservoir operation strategies are simulated to derive the outflow flood processes. The flood progression simulation was performed using the finite volume method on an unstructured grid.



Results and discussion

Two computational scenarios are established to analyze the impact of the rainstorm center's position on the flood process:

- Scenario 1: located upstream of the Rizhao Reservoir
- Scenario 2: located within the Rizhao urban area

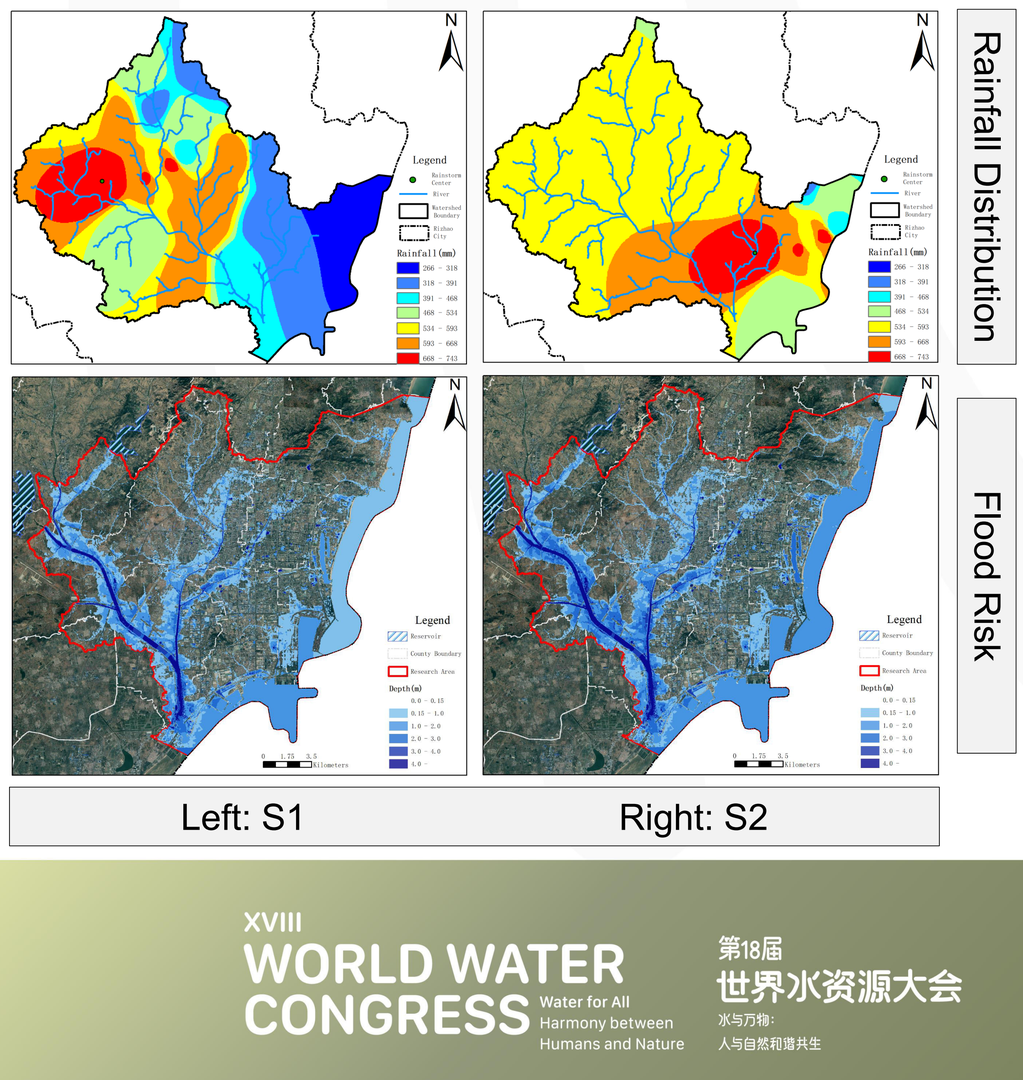
The following table presents the inundation situation in the urban area for both scenarios.

Scenario	Urban area rainfall (mm)	Inundated area (km^2)	Average water depth （m）
S1	419	151.89	0.46
S2	610	166.02	0.73
Rate	**45.6%**	**9.3%**	**58.7%**

The urban area experiences a significant uptick in precipitation in S2. Moreover, in conjunction with the flood regulation and storage impact of the Rizhao Reservoir, the simulated inundation in S2 proves to be notably graver in comparison to S1.

The concentration of rainfall in the northwestern mountainous region results in heightened flood peaks, affecting both the Nanhu River and the inflow into the Rizhao Reservoir, surpassing those observed in S2. Nevertheless, the disparity in downstream discharge following regulation by the Rizhao Reservoir remains modest.

Overview of research area



Rainfall Distribution

Flood Risk

Left: S1 Right: S2