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気候変動下における洪水ハザードおよびリスク評価のための全球洪水モデリングへの堤防システムの統合

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Integrating Levee Systems into Global Flood Modelling for Flood Hazard and Risk Assessment under Climate Change

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研究概要

Flooding is one of the most severe natural hazards worldwide, causing substantial economic losses and catastrophic societal impacts. Although levees are widely implemented for flood mitigation, few global flood models incorporate their influence on flood routing. Consequently, current assessments often assume "natural" river conditions, leading to significant inaccuracies in estimating actual flood hazard and risks in protected regions.

In a previous study (Zhao et al., 2025), we developed a levee module for the CaMa-Flood model and generated levee parameters for global ungauged rivers. Building on this foundation, the current project aims to analyze changes in flood hazards and risks while accounting for levee effects under a changing climate. Specifically, the project consists of three main steps:(1)We will employ the CaMa-Flood Global Flood Model (GFM) with the newly developed levee module to simulate historical flood dynamics. By comparing simulations with and without levees, we will explicitly quantify the protective benefits of existing infrastructure. (2) We will use projections from CMIP6/7 climate models to drive the GFM and estimate future changes in flood hazards through 2100. To ensure reliability, we will adopt advanced bias-correction methods to reduce uncertainties that typically propagate from raw climate model outputs to flood simulations. (3) We will integrate dynamic population and GDP data to analyze how flood exposure and risk evolve. We will focus on identifying global "hotspot" regions where levee overtopping may become more frequent. This work provides new insights into global flood modeling, supporting improved flood management and decision-making in levee-protected areas.