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INFORMATION TECHNOLOGY

Enhancing Flood Segmentation with Multi-Source Satellite Data: Toward Robust and Generalizable Deep Learning Models

ABSTRACT

Floods are among the most destructive natural disasters, with widespread and lasting impacts on society and the environment. Traditional satellite-based flood detection approaches commonly rely on optical imagery, which is limited by cloud cover and a lack of data diversity, often resulting in overfitting and poor generalization. This project proposes a generalizable multi-modal deep learning framework for flood detection in satellite imagery to directly address these challenges. The proposed system integrates both optical and Synthetic Aperture Radar (SAR) data, enabling reliable flood detection regardless of weather or lighting conditions. By utilizing diverse datasets from multiple satellite sensors and geographic regions, including various flood types, the framework overcomes the constraints of single-source, single-context models. It employs advanced segmentation architectures and incorporates temporal sequence analysis for tracking flood progression when available. Extensive experiments on heterogeneous datasets demonstrate that the multi-modal approach not only improves detection accuracy in challenging scenarios but also reduces overfitting and enhances the model's ability to generalize across different flood events and regions. This system advances the potential for robust, scalable flood monitoring and supports timely emergency response and disaster management in real-world situations.

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