

AI-Powered Multi-Source Satellite Flood Mapping, Impact Assessment, and Real-Time Web Visualization

Jonathan Li

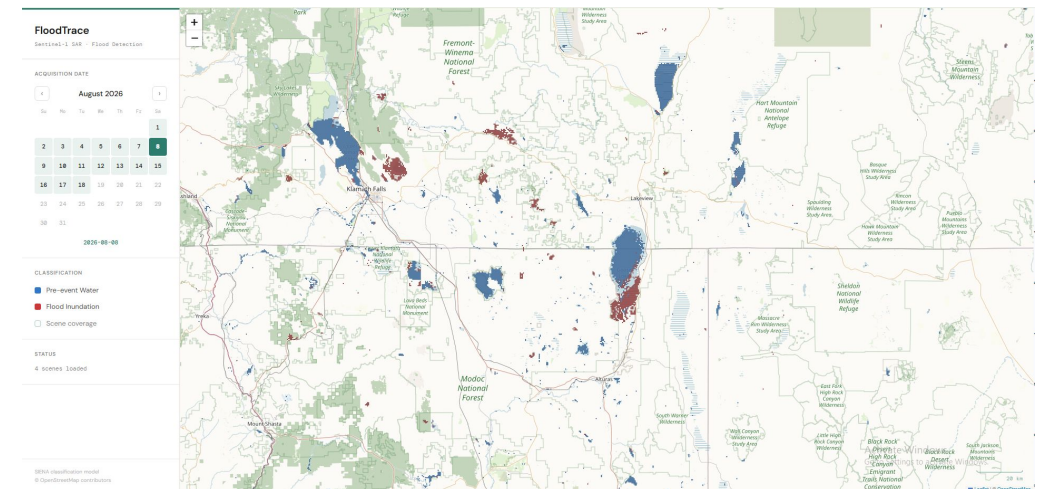
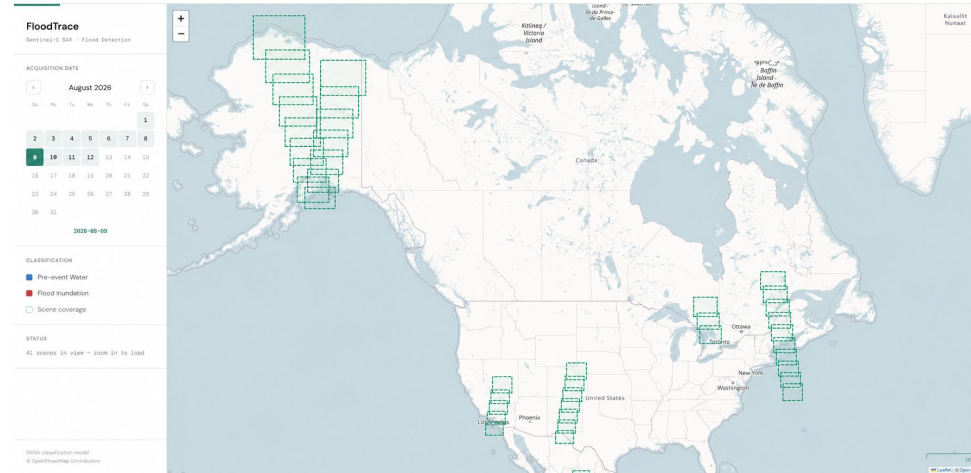
Mentors: Qing (Henry) Yang

Objectives

- Develop a full-stack app to visualize Sentinel-1 SAR flood maps over U.S in live stream.
- Build an automated HPC pipeline to process satellite products and update the platform.
- Explore deep learning models for flood depth prediction using a public dataset.

Results

- Developed and deployed FloodTrace, a secure web platform for interactive Sentinel-1 flood data visualization.
- Automated satellite data processing and updates through an HPC-to-AWS pipeline.
- Trained and evaluated three U-Net models, showing that direct 6-hour forecasting outperformed recursive forecasting.



Live flood maps over US:

<https://flood-trace.vercel.app/>

<https://jonathanqli2006.github.io/floodwarning/>

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How It Works

1. Website

Automates the ingestion of Sentinel-1 SAR satellite imagery, processes it into web-ready formats, and serves it to users through a secure interactive map

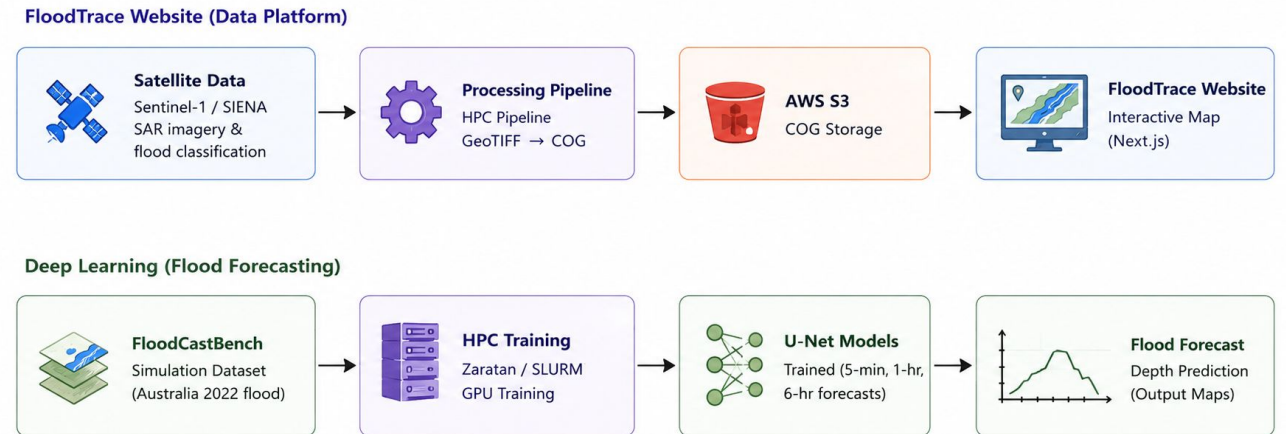
[Sentinel-1 / SIENA] → [HPC Pipeline] → [AWS S3] → [FloodTrace]

2. Deep Learning Model

Trains U-Net neural networks on flood simulation data to predict flood depth maps up to 6 hours ahead

[FloodCastBench] → [Zaratan / SLURM] → [U-Net Models] → [Flood Forecast]

Figure(s)



Architecture diagram of the automated data pipeline from HPC processing to web display.

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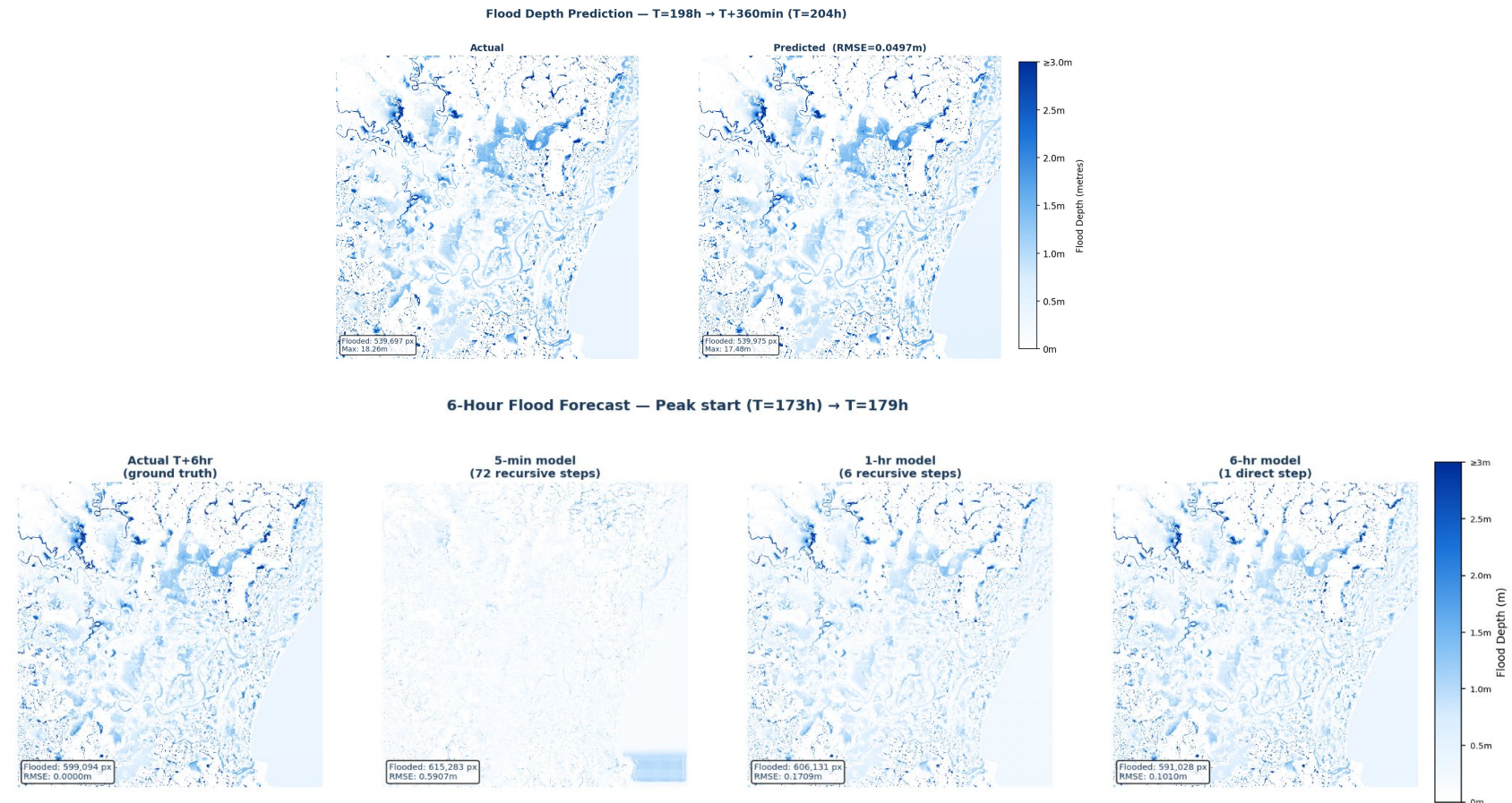
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Figure(s)

Models

- Trained 3 U-Net models to predict flood depth 5 minutes, 1 hour, and 6 hours ahead.
- Models used terrain, land use, rainfall, and previous flood depths as inputs.
- Models performed well for single-step predictions.
- Recursive predictions are closer to a real operational setup, but errors accumulated over steps. The direct 6-hour model avoided this and performed better.
- The 1-hour model could be a practical choice for flood inundation forecasting with 1 to 3 hours of lead time.



6-hour recursive forecast comparison starting at flood peak (T=173h). The actual flood extent remains near 600,000 pixels throughout the 6-hour window. Both recursive models collapse rapidly while the direct 6-hour model provides a single-step prediction.