Cloud to Street

MEMORY TO MAP

Improving Radar Flood Maps With Temporal Context and Semantic Segmentation

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NEED

Near Real Time Flood Mapping

Rising frequency and magnitude of flood disasters (UNDRR 2015)

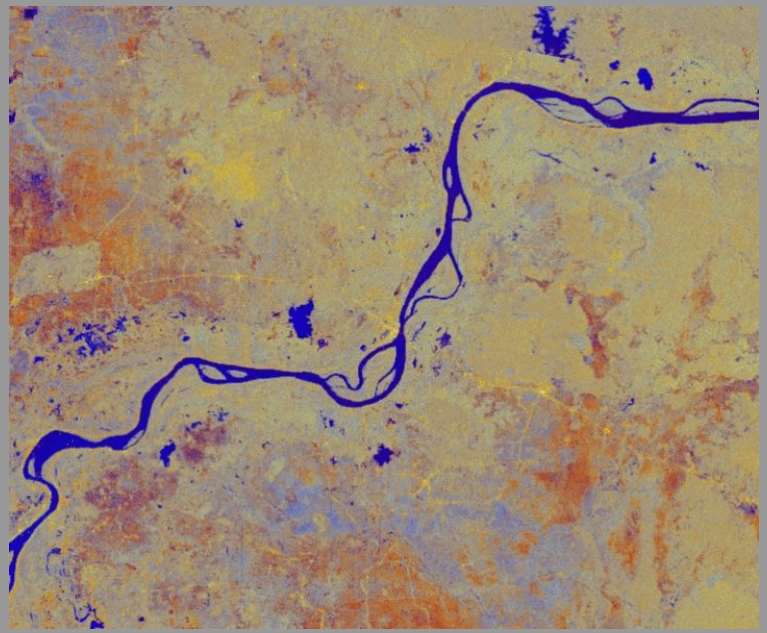
Growing populations affected, disproportionate impacts due to social vulnerability (Tellman et. al. 2020)

Milkmen wade through a flooded road after Cyclone Amphan, in North 24 Parganas district.
(Photo: PTI)

THE SCIENCE

Sentinel-1 Synthetic Aperture Radar (SAR) Imagery and ML

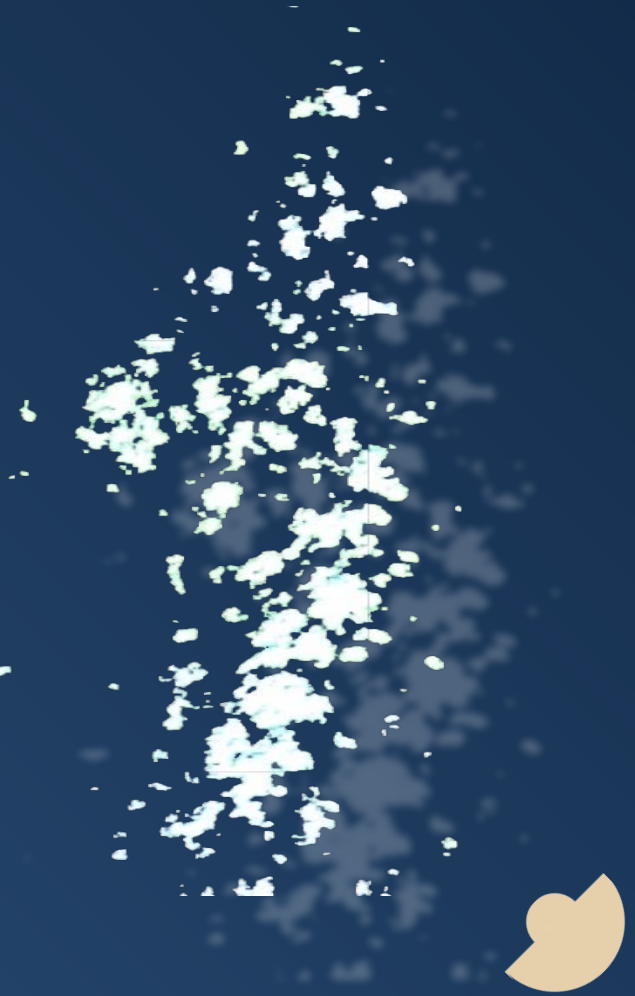
- SAR: active sensor (non-optical)
- Cloud penetrating
- Detects surface properties rather than reflected light → change in water signal



[Bonafilia, et. al. 2020]

CHALLENGES WITH SAR IMAGERY

- Surface water generally has low SAR backscatter (dark)
- Other surfaces can also have low backscatter
    - E.g. arid landscapes (deserts), paved surfaces, recently cleared fields
- Need to differentiate in order to achieve low false positive rate

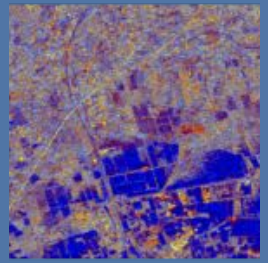


SOLUTION: SCENE MEMORY

annual permanent water boundaries, pre flood images

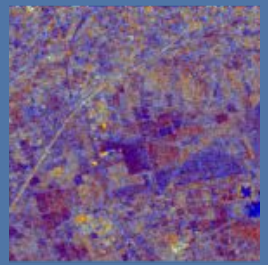
METHODOLOGY: Data

1. **Flood Chips:** Hand-labeled 512x512 images of flood events
(2250 chips from 125 global flood events)

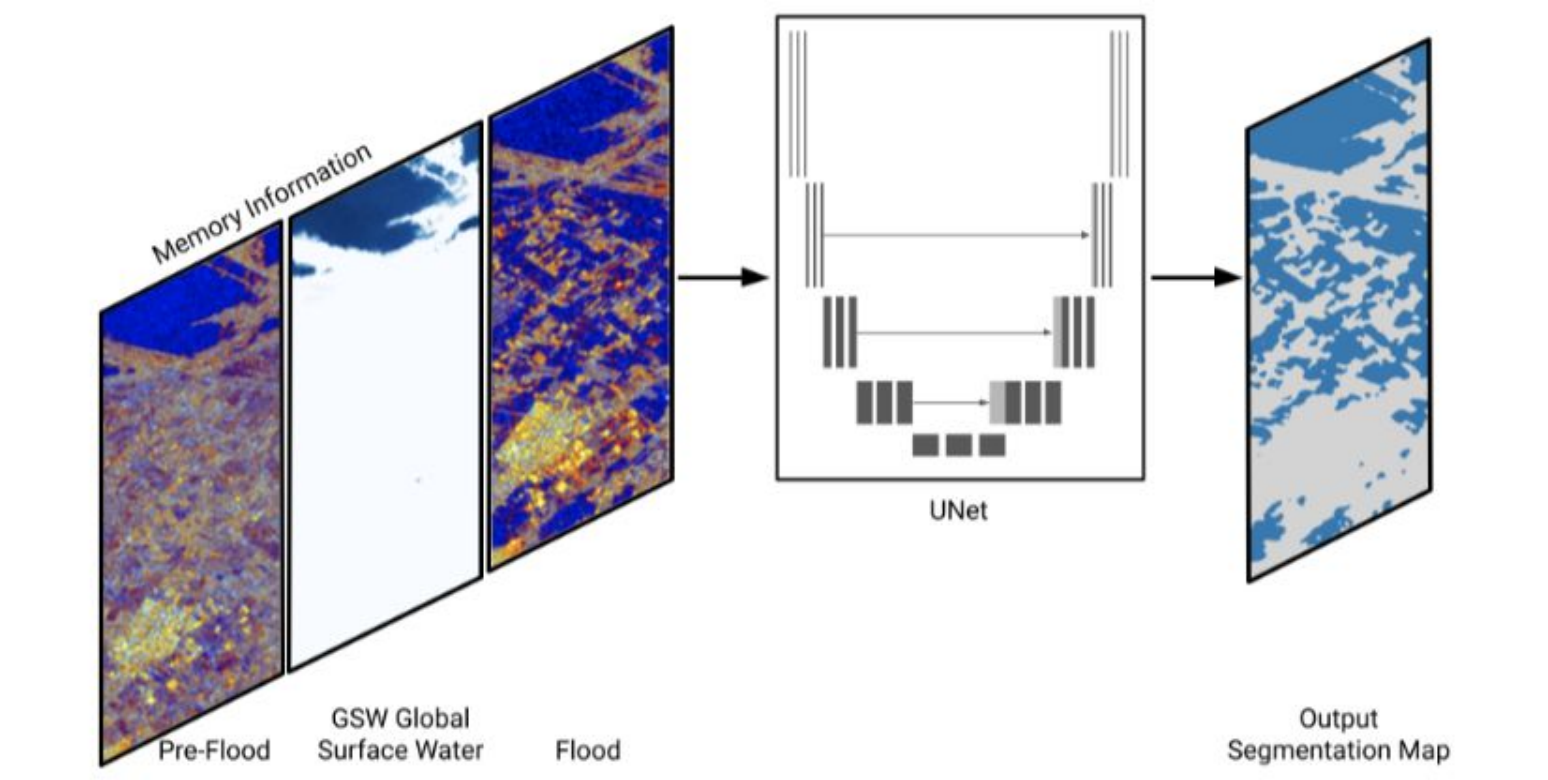


2. **Permanent Water:** Global Surface Water (GSW) occurrence data

3. **Pre-Flood Chips:** images corresponding to each 512x512 flooded chip
(acquired 14-35 days before the flood)



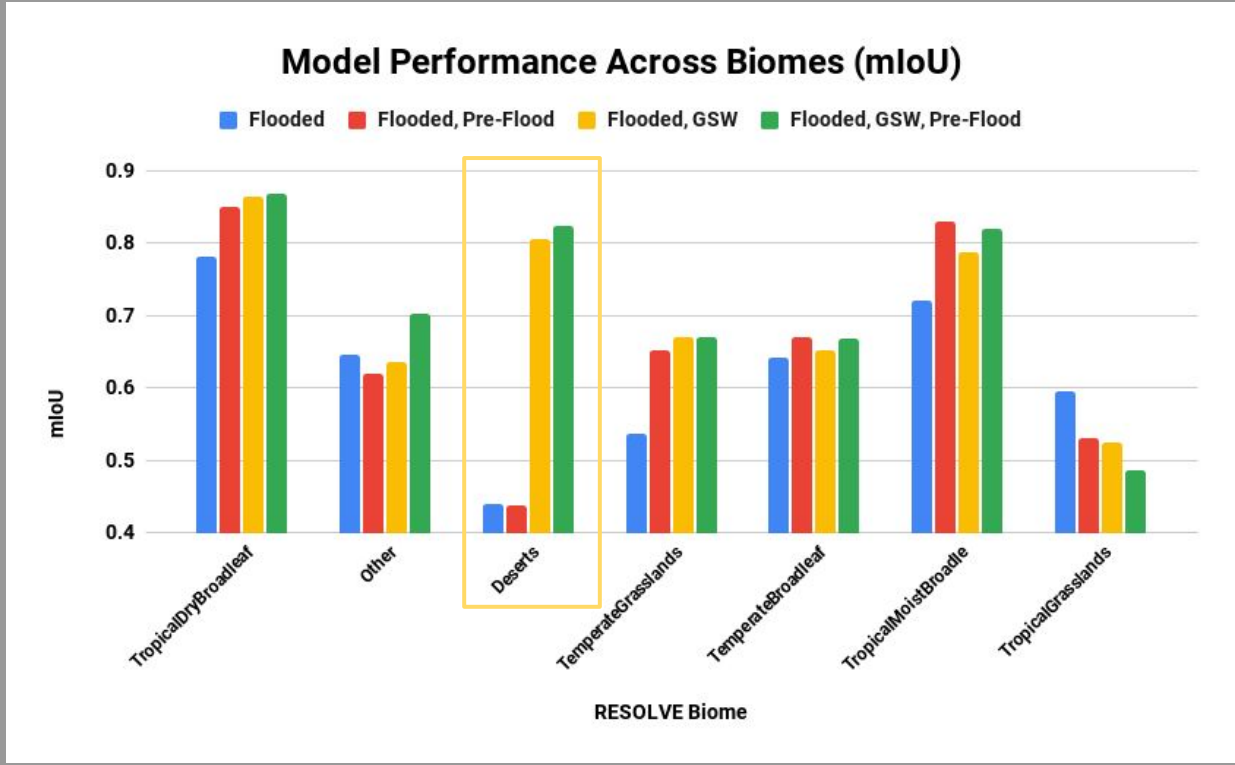
METHODOLOGY: TRAINING



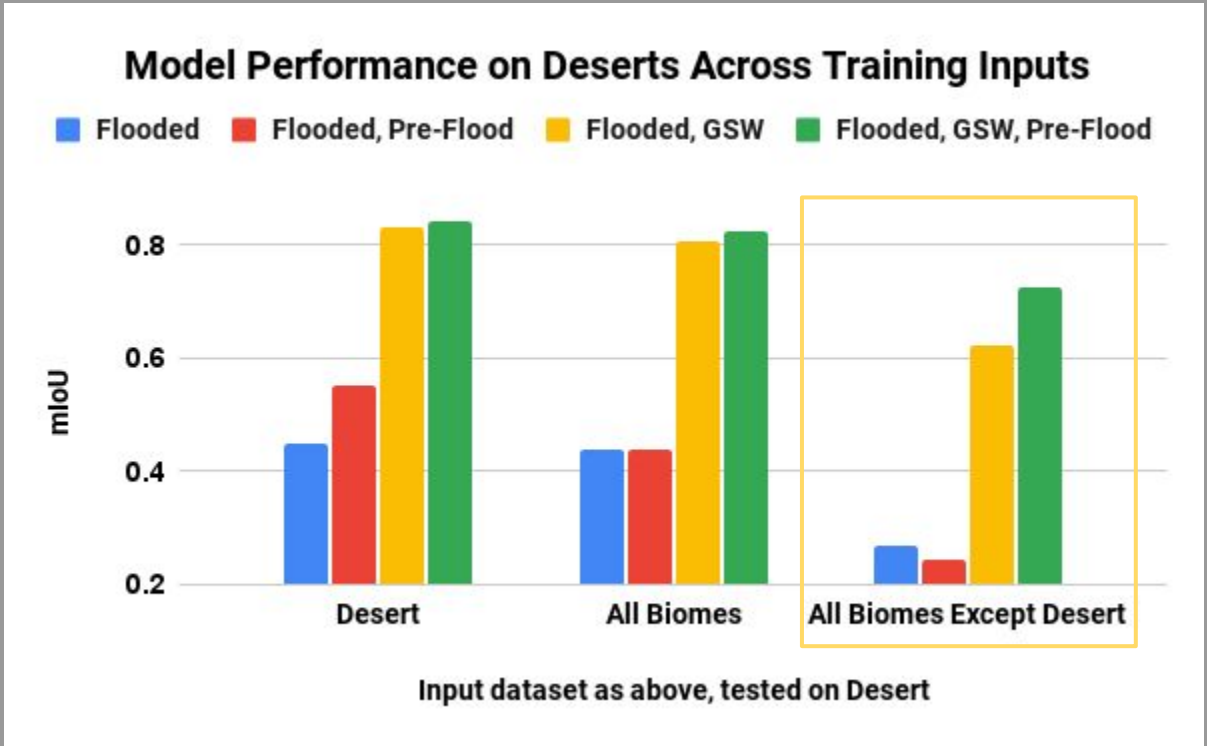
RESULTS: Overall Performance

Model Inputs	Flooded	Flooded Pre-Flood	Flooded GSW	**Flooded GSW Pre-Flood**
mIoU	0.62	0.66	0.72	**0.75**
F1 Score	0.77	0.80	0.84	**0.87**

RESULTS: Global Biome Validation



RESULTS: Desert Validation



FUTURE WORK: Alternative Contextual Inputs

- Alternative constructions of pre-flood images
  - E.g. annual means of backscatter
- Static local conditions
  - Biome, land cover, and population density
- Topographic information → water drainage and movement patterns over time.

HIGH-RESOLUTION IMAGERY OF MAKOTIPOKO, SKYSAT SATELLITE 2019, PLANET LABS

Thank you.

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Questions? Contact veda@cloudtostreet.info