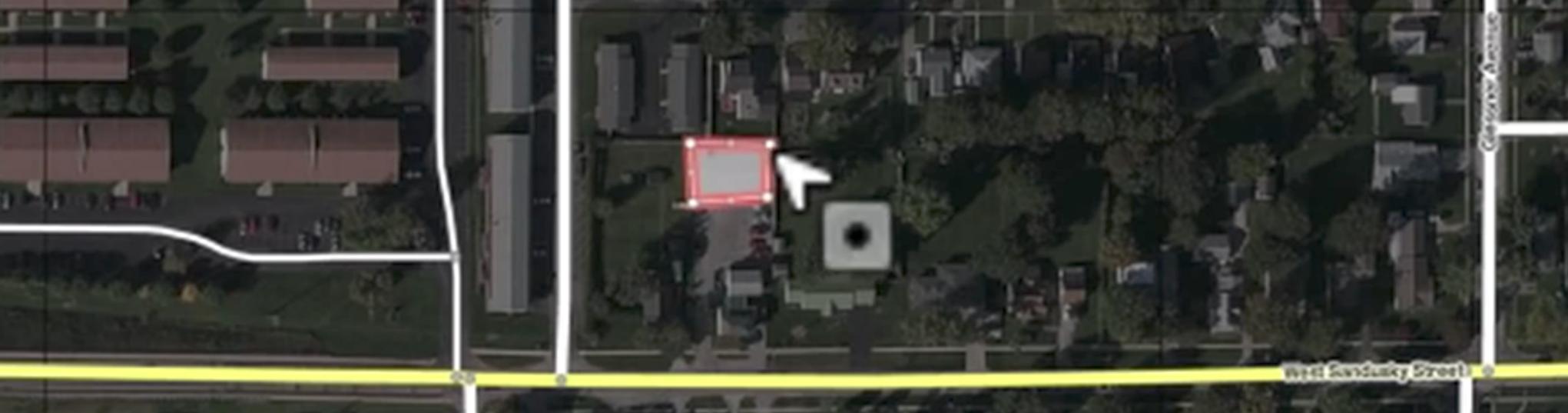




TARGETING DISASTER RELIEF FROM SPACE

EMILY MILLER



MOTIVATION

After natural disasters, Humanitarian Open Street Map volunteers identify damaged buildings by hand

- Labor intensive
- Time intensive
- Susceptible to error

The ability to detect hardest hit areas faster and more accurately enables better targeting of disaster relief



TYPHOON HAIYAN

NOVEMBER
2013

Hardest storm
ever to hit land

1.1 million homes
destroyed

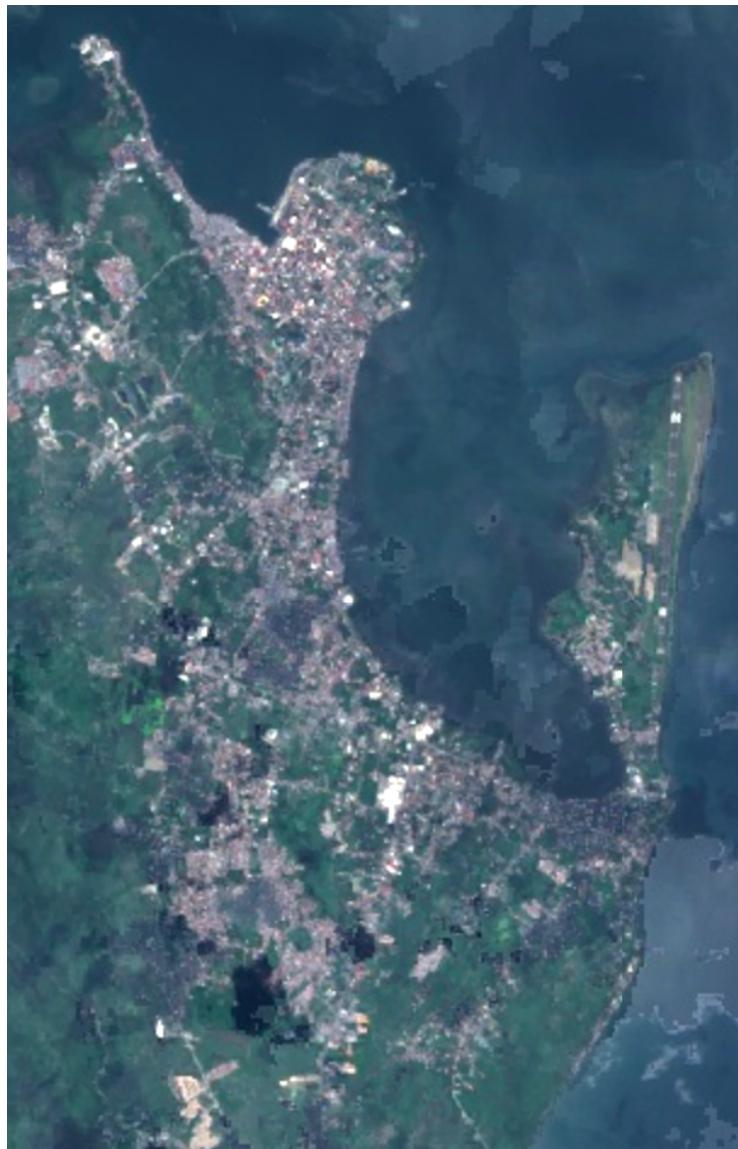
PROCESS

Data	Satellite imagery from Google Earth Engine Building damage data from Copernicus Emergency Management Service
Modeling	Random forest baseline U-Net neural net
Results	Density maps for hotspot analysis

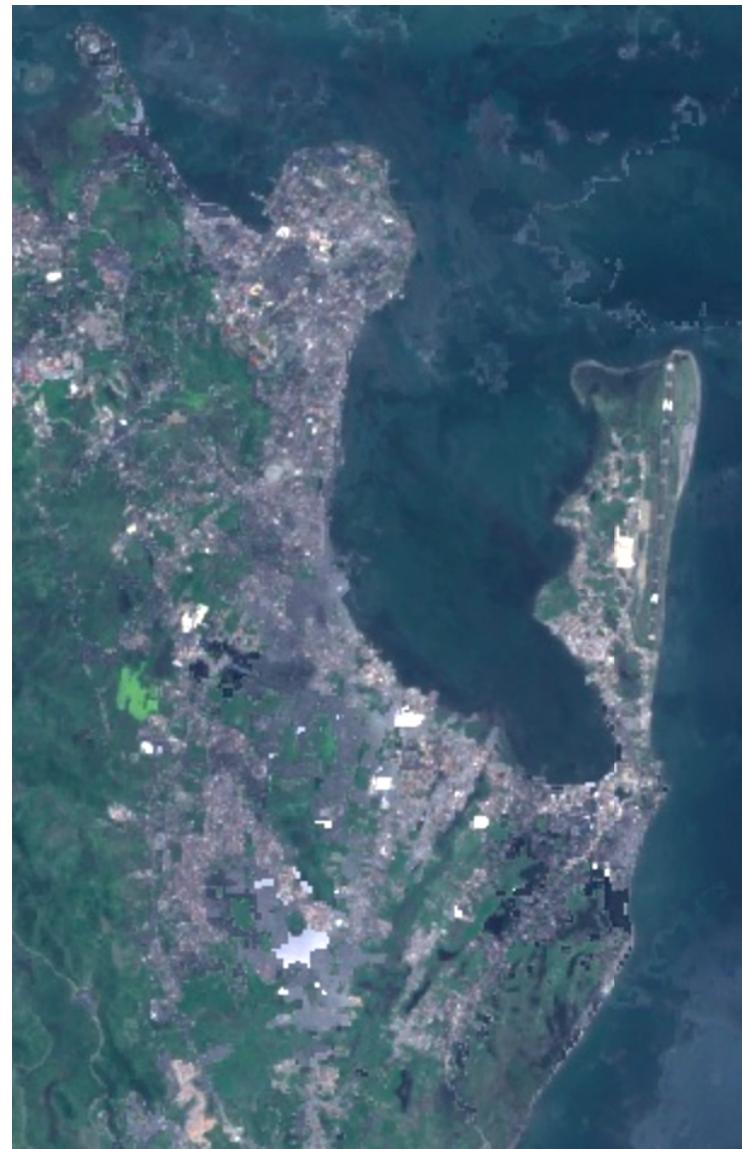
L a n d s a t 8

SATELLITE IMAGERY

PRE-TYphoon



POST-TYphoon



BUILDING DAMAGE

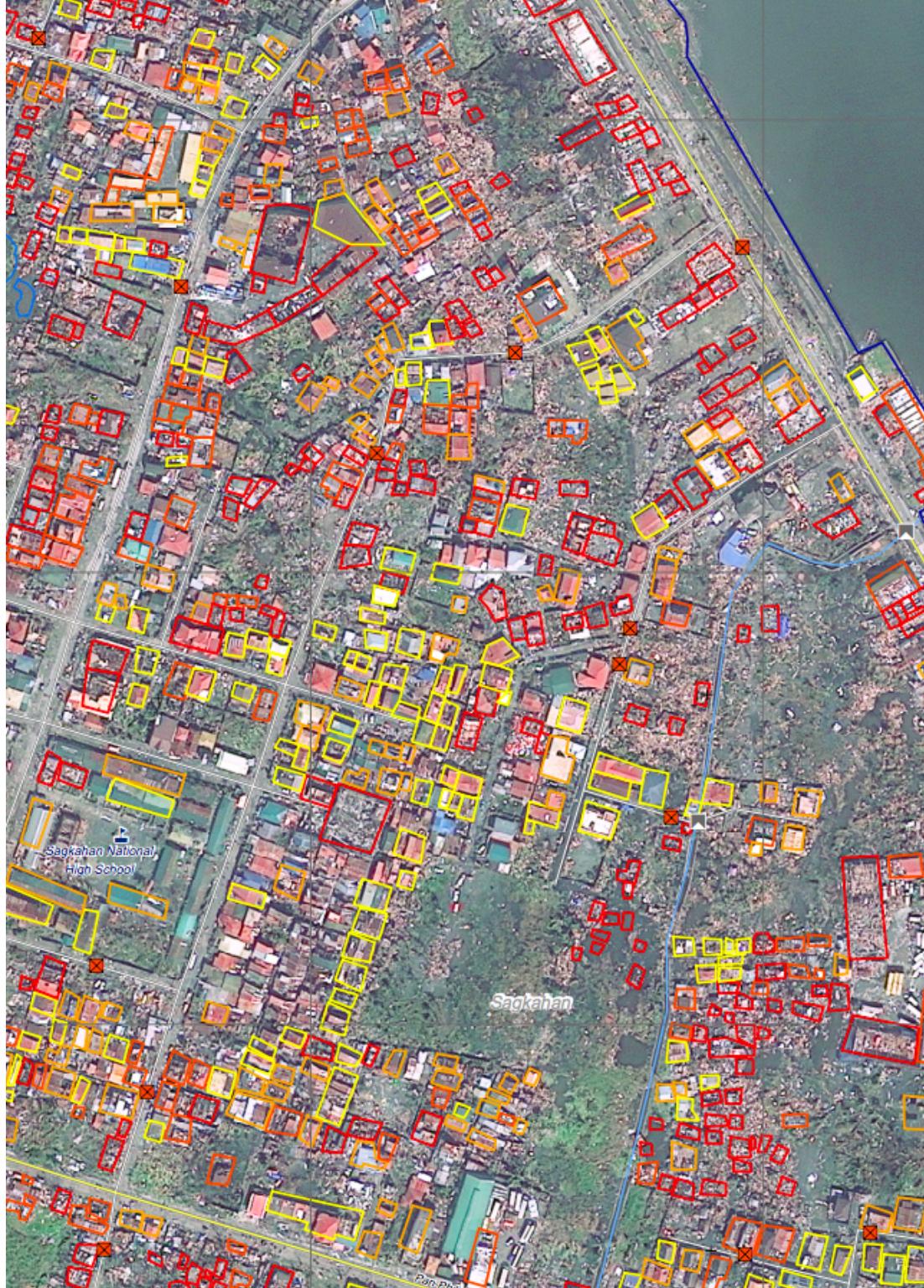
1

Polygons marking
damaged buildings

2

For each pixel:

- damaged
- not damaged



RANDOM FOREST MODEL

- Pixel-wise classification: damaged or not damaged
- Information for each pixel:

Red

Blue

Green

UV

Infrared

etc.

- Pre-typhoon
- Post-typhoon
- Subtraction

RANDOM FOREST MODEL

- Pixel-wise classification: damaged or not damaged
- Information for each pixel:

Red

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Green

UV

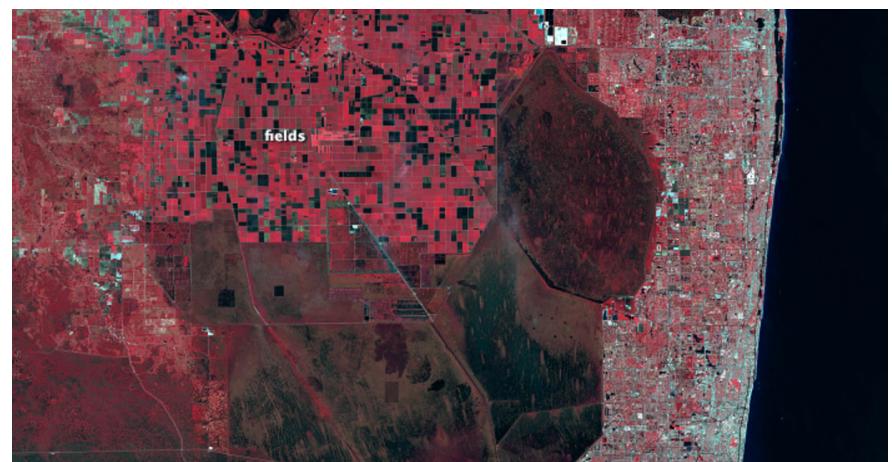
Infrared

etc.

- Pre-typhoon
- Post-typhoon
- Subtraction

Vegetation

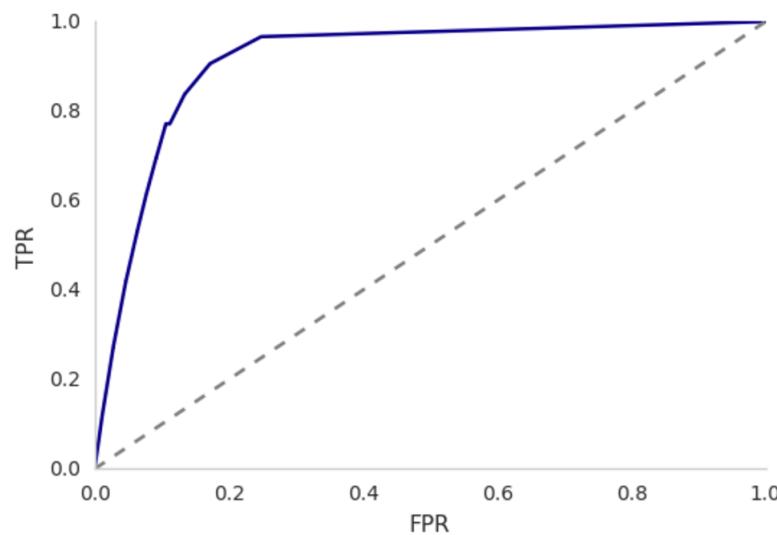
City



RANDOM FOREST

- Create balanced sample to deal with class imbalance

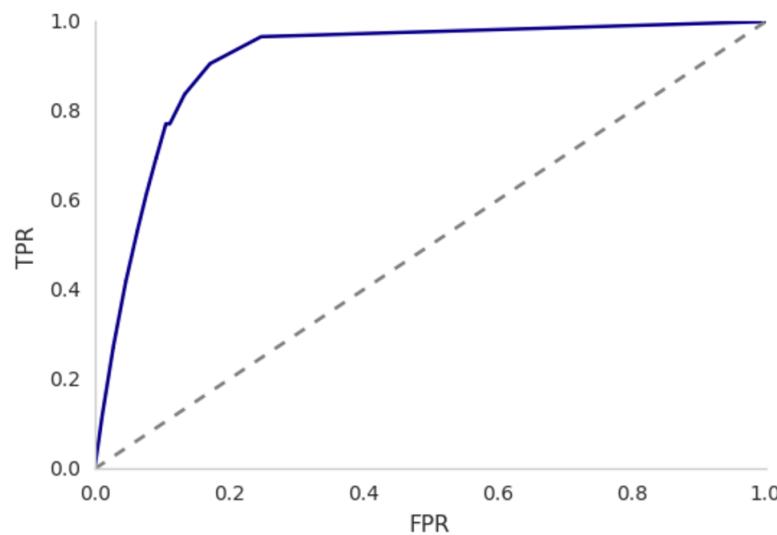
Train on top of 3 images →
predict bottom half of 3 images



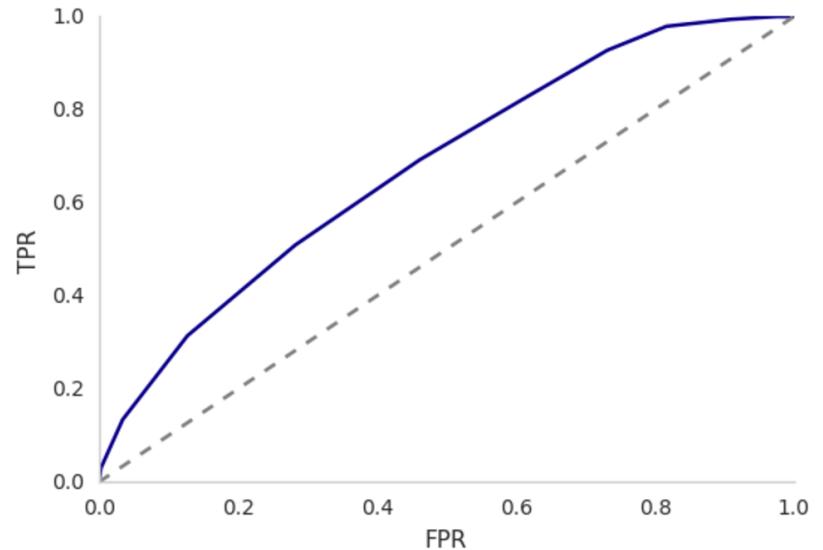
RANDOM FOREST

- Create balanced sample to deal with class imbalance

Train on top of 3 images →
predict bottom half of 3 images



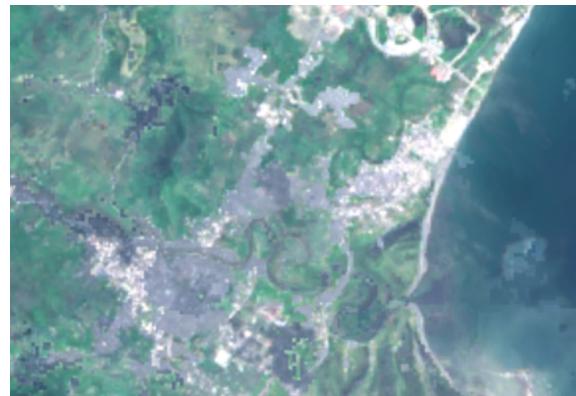
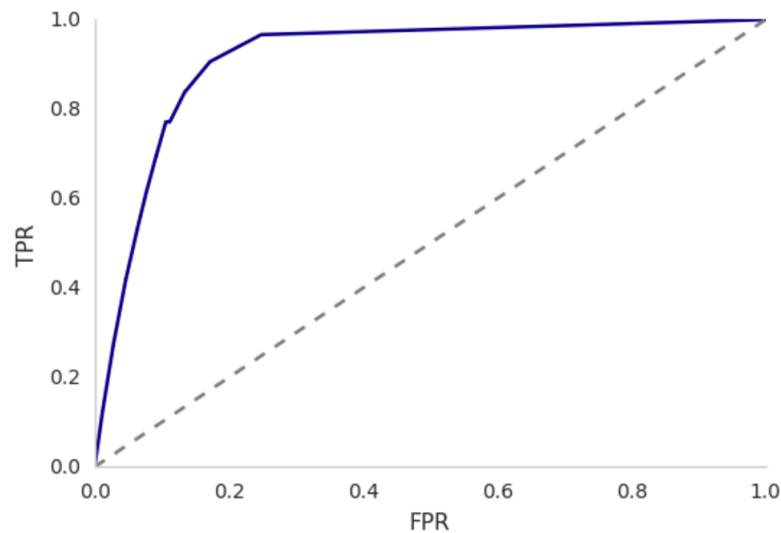
Retrain on 3 full images →
predict on new 4th image



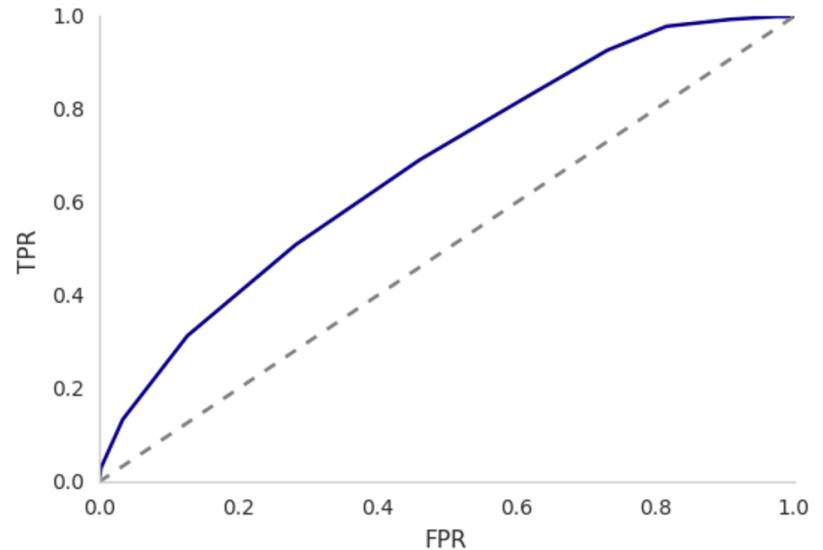
RANDOM FOREST

- Create balanced sample to deal with class imbalance

Train on top of 3 images →
predict bottom half of 3 images

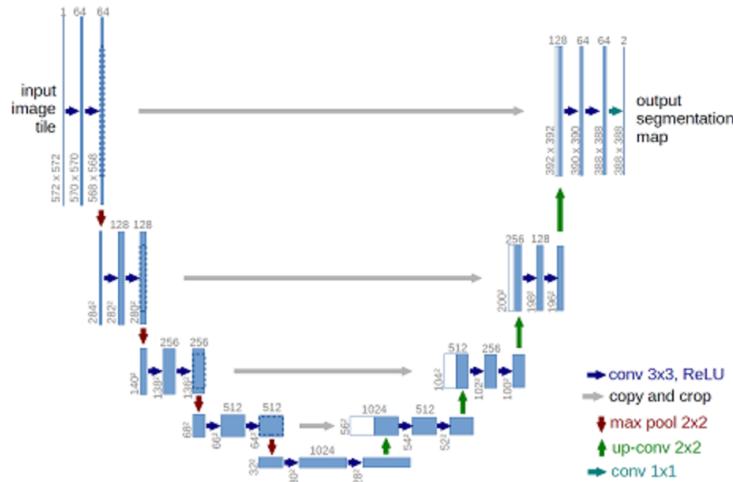


Retrain on 3 full images →
predict on new 4th image



U-NET

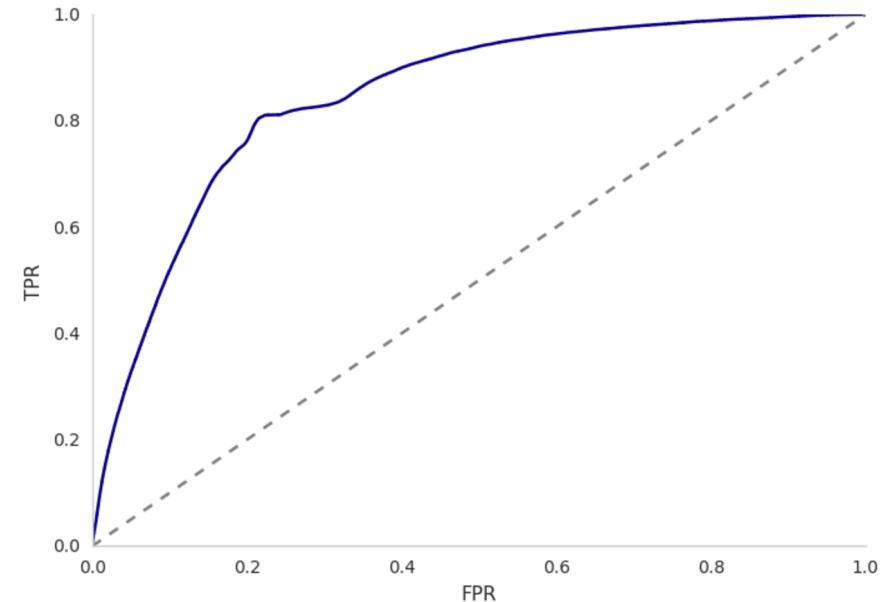
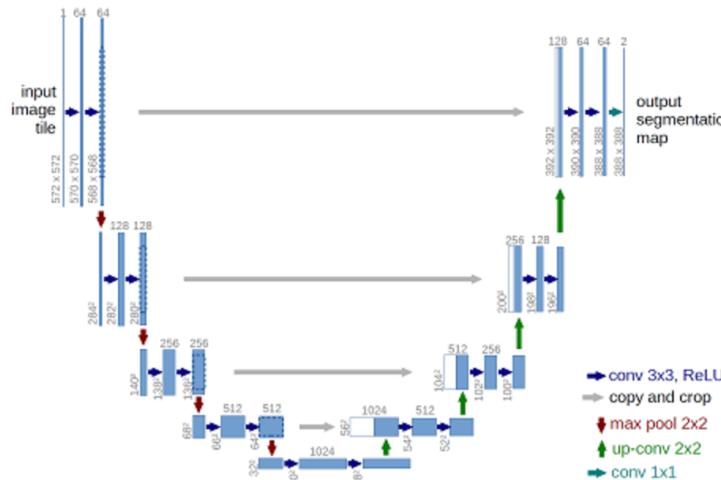
- Neural net known to be good for segmentation (object detection)



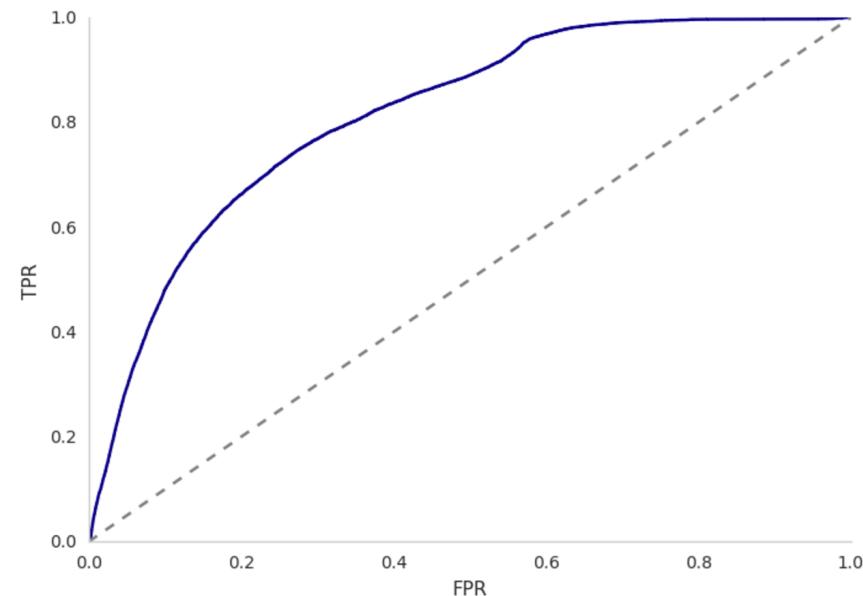
VALIDATION

U-NET

- Neural net known to be good for segmentation (object detection)

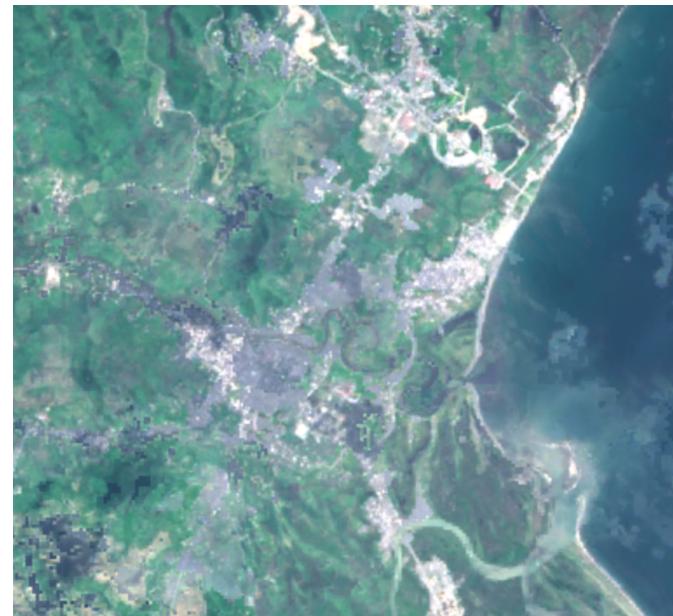


HOLDOUT



HOTSPOT ANALYSIS

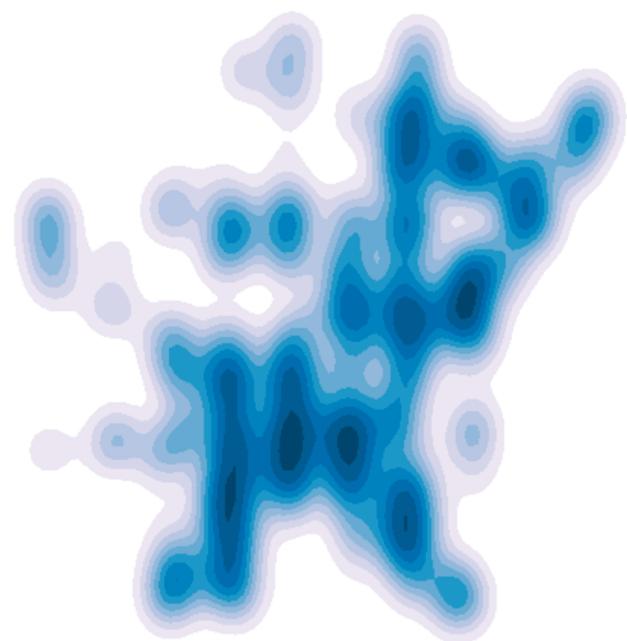
Identify areas with the greatest building damage



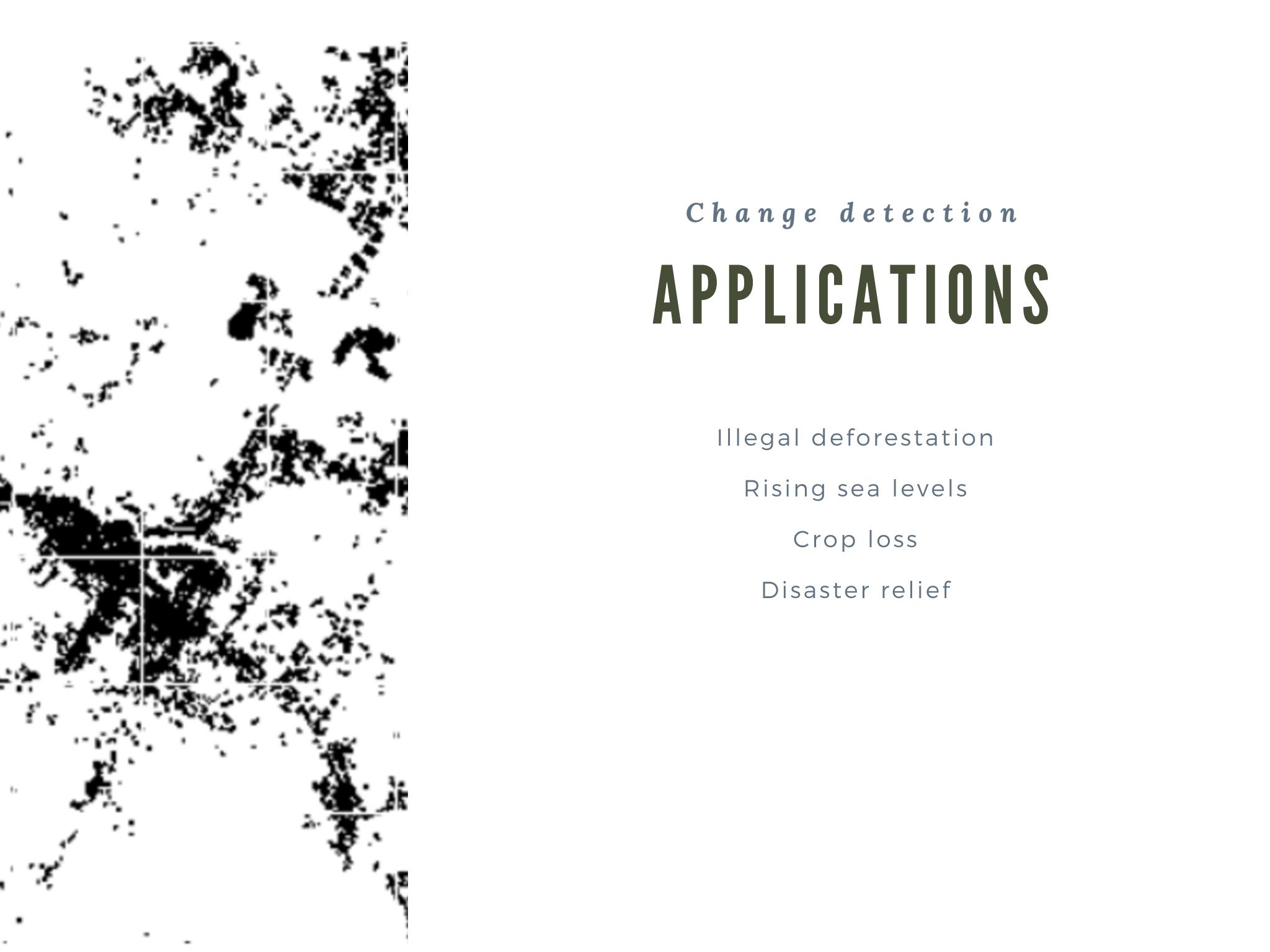
POST-TYphoon SATELLITE



GROUND TRUTH



PREDICTION



Change detection

APPLICATIONS

Illegal deforestation

Rising sea levels

Crop loss

Disaster relief



A large, semi-transparent rectangular overlay covers the right side of the slide. In the bottom-left corner of this overlay, there is a smaller, rounded rectangular inset containing a portrait photo of a smiling woman with short brown hair, wearing a teal scarf and a dark jacket. The main text area of the overlay contains the word "THANK YOU" in large, bold, white capital letters.

THANK YOU

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<https://emilyjanemiller.wordpress.com/>