Machine Learning-aided Disaster Response

Multi$^3$Net: Segmenting Flooded Buildings via Fusion of Multiresolution, Multisensor, and Multitemporal Satellite Imagery

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Global Natural Disaster Event Occurrences

A rising tide
Natural disasters by cause

- Meteorological: Storms
- Hydrological: Floods, landslides and avalanches
- Climatological: Extreme temperatures, droughts, forest fires

Source: Munich Re
Economist.com
2016 and 2017 were one of the most impact-full hurricane seasons with Hurricanes Mathew, Harvey, Irma, and Maria devastating the Caribbean islands and causing subsequent floods.
First-responders are often restricted by lack of information about the location of affected communities and the level of damage.
After such disaster events, first responders initially prioritize access to information over map accuracy.
Case Studies

Houston
Floods
Aug. 2017

Ecuador
Earthquake
Apr. 2016
Our Approach: Multi$^3$Net

**Key idea**

Fast, high-accuracy **building** and **damage detection** by fusion of **multiresolution**, **multisensor**, and **multitemporal** satellite imagery in CNN.

**Input data sources:**
- Radar: Sentinel-1 (public)
- Optical: Sentinel-2 (public)
- Very high resolution (commercial)
Input data: Multiresolution satellite imagery

- 0.5m post-disaster
- 10m pre/post-disaster
- 10m pre/post-disaster

Very high-resolution optical
Medium-resolution optical
Medium-resolution radar
Input data: Multiresolution satellite imagery

0.5m post-disaster

10m pre/post-disaster

10m pre/post-disaster

Very high-resolution optical

Medium-resolution optical

Medium-resolution radar
Ground truth data: towards two objectives

Building footprints

Damaged sites

Open Street Map
Qualitative results: Houston—Flood Damage

RGB input  Target  Prediction
Qualitative results: Ecuador—Hurricane Damage

input
prediction
damaged

final prediction overlay
Publications

**NIPS Conference** *December 2–8, 2018 in Montreal, Canada*
Workshops on

- Modeling and Decision-making in the Spatiotemporal Domain
- AI for Social Good

**AAAI Conference** *January 27–February 1, 2019 in Honolulu, Hawaii, USA*

- Multi$^3$Net: Segmenting Flooded Buildings via Fusion of Multiresolution, Multisensor, and Multitemporal Satellite Imagery
Thank you!

If you’d like to learn more, come join us for our presentation today at 2:00pm at Φ-Lab.