# A Framework for Harnessing Citizen Scientists and Journalist Networks for Post-disaster Reconnaissance

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Rice University (NHERI REU)

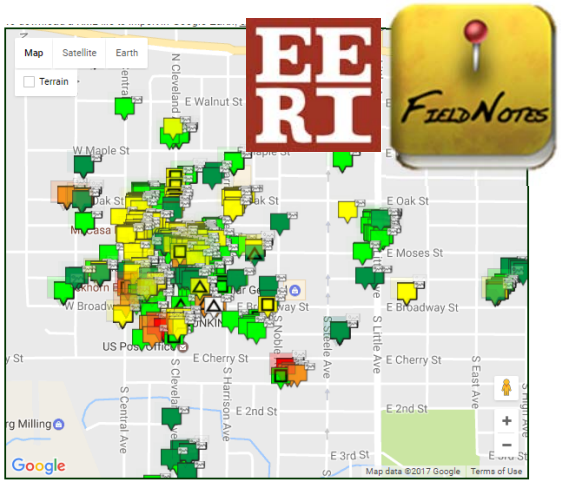
# Current Engineering Reconnaissance Practice

StEER
STRUCTURAL EXTREME EVENTS RECONNAISSANCE

GEER

EERI


More recently




EERI FieldNotes

DESIGN SAFE-CI

Recon Portal

**2019 Ridgecrest, CA Earthquake Sequence**

Southern California

2019-07-04 earthquake

**Available datasets:**

- USGS Ridgecrest EQ OnePager
- Ridgecrest RED-ACT Report
- Quake Insights Blog
- EERI Virtual Clearinghouse
- Christmas Canyon China Lake Record from M6.4 event
- EERI VERT Searles Valley Earthquake Phase 1 Report
- GEER Field Observations
- StEER: Preliminary Virtual Reconnaissance Report (PVRR)

# Challenges

- Time & money to mobilize
  - Highly skilled team members (engineers)
  - Only mobilize if a severe event
  - Focus only on areas of most severe damage
- Difficult to locate damaged areas
  - Especially in rural areas or moderate events
  - Locals can help with this
- Need more data to improve probabilistic damage models
  - Including less severe events
  - Including minor and non-damage

# Motivation: Case Study

## M5.8 Pawnee, OK (September 2016)

- GEER team of 5 people deployed
- Documenting evidence ground failure (e.g. liquefaction)
- Very rural area, ranches
- Recon team did not find any evidence of liquefaction


Source: Facebook (from Beverley Day, Pawnee County Commissioner Office)

# Motivation: Case Study

## M5.8 Pawnee, OK (September 2016)

- Other social media damage documentation

**Nathan Tifft**
@ntifft

Follow

Earthquake damage in Stillwater, OK. #Earthquake @kfor @jamesaydelott

8:03 AM - 3 Sep 2016

316 176

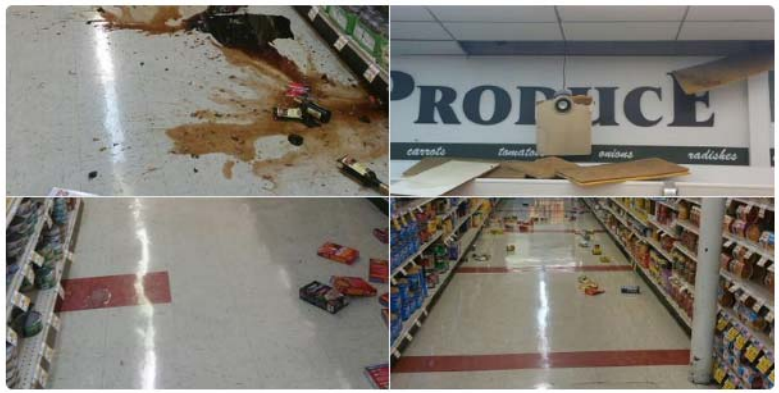
**Marc Dillard** @F5Video 3 Sep
Please send in any damage pics/reports to @kfor #earthquake

**Mary Beth Carver**
@maryelisabethe

Follow

@F5Video @kfor pic.twitter.com/GWBL5III5o

9:19 AM - 3 Sep 2016




1 1

**Marc Dillard** @F5Video · Sep 3
@maryelisabethe what the location of the photos? Thank You

2 1

**KFOR** @kfor · Sep 3
@F5Video @maryelisabethe did you take these pics? Where?

1

**Mary Beth Carver** @maryelisabethe · Sep 3
@kfor @F5Video my husband took them At Spencer's Grocery in Chickasha.

3

Source: Bustle (linked to from EERI)

# Motivation: Case Study

## M5.8 Pawnee, OK (September 2016)

- Things to beware of…

# Cultivate New Damage Data Streamlines

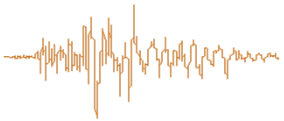
Journalist Networks

Citizens

Social Media

# Proposed Framework

Natural Hazard Event



Activate Journalist & Citizen Scientist Networks

Requires outreach

- What data do we want?
- How to contribute?

Harvest Social Media Data

Data Analytics & Computer Vision

- Relevance?
- Geo-location

Human-in-the-loop

Engineering Assessment

- Level of damage
- Deploy teams to interesting cases

Disseminate Data

DESIGN SAFE-CI

- Privacy concerns?
- Ease of reuse?

# Proposed Framework

Natural Hazard Event

Hurricane Florence

Activate Journalist & Citizen Scientist Networks

Requires outreach

- What data do we want?
- How to contribute?

**Ongoing work:**

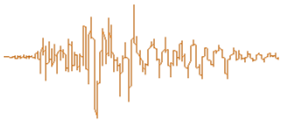
- Identify journalists from Hurricane Florence tweets
  - Automated text analysis of user profile

**Future work:**

- Connect with journalists in hazard-prone areas before events
- Pre-prepare outreach media
  - Explain purpose of collecting damage pics
  - Show example photos

# Proposed Framework

Natural Hazard Event



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## Ongoing work:

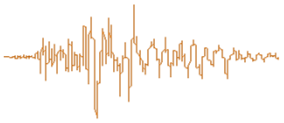
- Extract images
- Identify relevant images
  - Does it show infrastructure? What type?
  - Does it show damage?
  - Cause of damage? (flood, wind, soil effects)
- Use Google AutoML Vision
  - Trained & tested using Florence dataset

## Future work:

- Geo-location of images
  - Geo-tag data
  - User profile info
  - Info in text or image

# Proposed Framework

Natural Hazard Event



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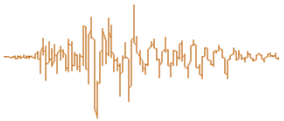
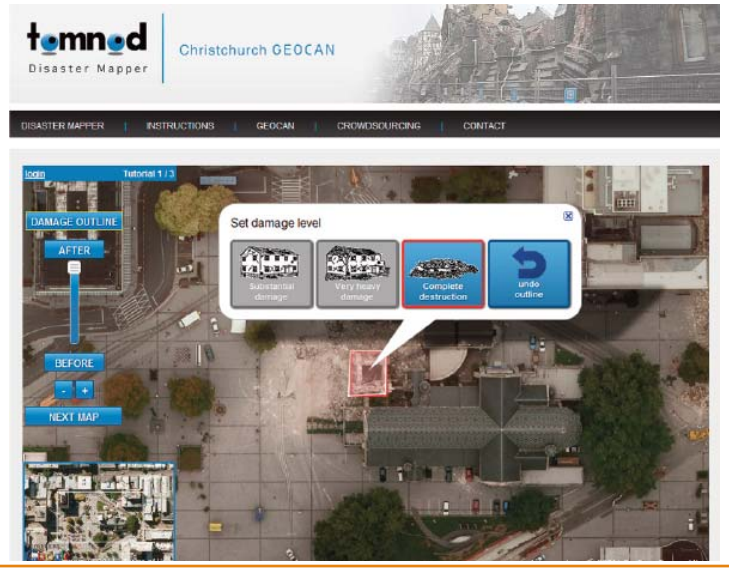


## Future work:

- Engineers scan pre-labeled images
  - Confirm relevance
  - Indicate level of damage
- Crowd sourcing
  - e.g. a “Mechanical Turk” approach

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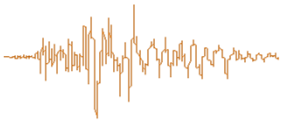

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Natural Hazard Event

Hurricane Florence

**Ongoing work:**

- DesignSafe Dataset
  - Tweet database
  - Jupyter Notebooks for processing
- Questions & Concerns
  - What to publish?
    - Full dataset vs. Tweet IDs only
    - Legal issues if data purchased from Twitter
    - Are there community standards?

Disseminate Data

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# Final Thoughts…

Work requires **interdisciplinary** collaboration

- Engineers
- Social Scientists
- Computer Scientists
- Citizens
- Journalists

Need to evaluate biases in datasets

- To develop robust probabilistic damage models

ACKNOWLEDGEMENTS:


“RAPID: Rural Loss Estimates of Hurricane Florence Enabled by Citizen Scientists” (Award HDBE-1902460)

NHERI REU Program (through NHERI NCO Award CMMI-1612144)

# Thank you

QUESTIONS?