# The NHERI RAPID Facility:
# Enabling the Next-Generation of Natural Hazards Reconnaissance

Natural Hazards Engineering Research Infrastructure (NHERI) Program of the National Science Foundation (NSF)

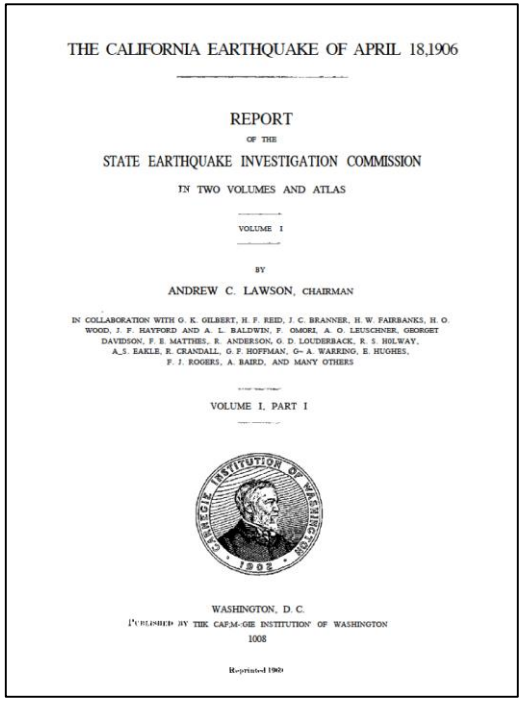
RAPID NHERI
Natural Hazards Reconnaissance Facility

Hurricane Katrina

UNIVERSITY OF WASHINGTON  APL  OSU Oregon State University  VT  UF University of Florida

**RAPID Leadership Team:** Joseph Wartman (UW), Jeffrey Berman (UW), Michael Olsen, (OSU), Jake Dafni (UW), Troy Tanner (UW; APL), Jennifer Irish (VT), Scott Miles (UW), Kurtis Gurley, (UF), Ann Bostrom (UW), and Laura Lowes (UW)

# 1906 Earthquake: The Dawn of Natural Hazard Reconnaissance in the U.S.



THE CALIFORNIA EARTHQUAKE OF APRIL 18,1906

REPORT
OF THE
STATE EARTHQUAKE INVESTIGATION COMMISSION
IN TWO VOLUMES AND ATLAS

VOLUME I

BY

ANDREW C. LAWSON, CHAIRMAN

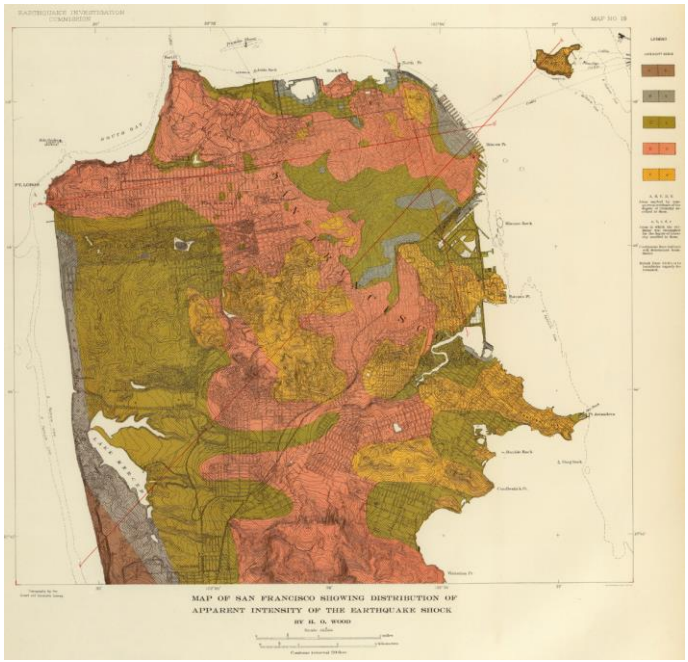
IN COLLABORATION WITH G. K. GILBERT, H. F. REID, J. C. BRANNER, H. W. FAIRBANKS, H. O. WOOD, J. F. HAYFORD AND A. L. BALDWIN, F. OMORI, A. O. LEUSCHNER, GEORGE DAVIDSON, F. E. MATTHES, R. ANDERSON, G. D. LOUDERBACK, R. S. HOLWAY, A. S. EAKLE, R. CRANDALL, G. F. HOFFMAN, G. A. WARING, E. HUGHES, F. J. ROGERS, A. BAIRD, AND MANY OTHERS

VOLUME I, PART I

WASHINGTON, D. C.
PUBLISHED BY THE CARNEGIE INSTITUTION OF WASHINGTON
1908

Reprinted 1969

Inspired new, fundamental understanding of earthquakes: e.g. ground movement surveys leads H. F. Ried to introduce the landmark *"theory of elastic rebound"*

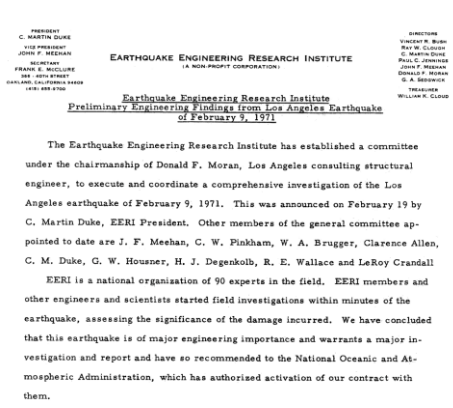



Post-event mapping across the city begins to provide a coherent story that explains damage concentrations: the notion of *"site effects"*

Source: USGS (https://earthquake.usgs.gov/earthquakes/events/1906calif/18april/revolution.php)

# Reconnaissance Research Organizations


EXTRA
Los Angeles Times
24 QUAKE DEAD
50 Missing; Bridges Collapse
Dam Badly Cracked; 2 Hospitals Wrecked
Apollo Makes Pinpoint Landing in Pacific to Cheers of Sailors


EARTHQUAKE ENGINEERING RESEARCH INSTITUTE
(A NON-PROFIT CORPORATION)

Earthquake Engineering Research Institute
Preliminary Engineering Findings from Los Angeles Earthquake of February 9, 1971

The Earthquake Engineering Research Institute has established a committee under the chairmanship of Donald F. Moran, Los Angeles consulting structural engineer, to execute and coordinate a comprehensive investigation of the Los Angeles earthquake of February 9, 1971. This was announced on February 19 by C. Martin Duke, EERI President. Other members of the general committee appointed to date are J. F. Meehan, C. W. Pinkham, W. A. Brugger, Clarence Allen, C. M. Duke, G. W. Housner, H. J. Degenkolb, R. E. Wallace and LeRoy Crandall

EERI is a national organization of 90 experts in the field. EERI members and other engineers and scientists started field investigations within minutes of the earthquake, assessing the significance of the damage incurred. We have concluded that this earthquake is of major engineering importance and warrants a major investigation and report and have so recommended to the National Oceanic and Atmospheric Administration, which has authorized activation of our contract with them.

EERI

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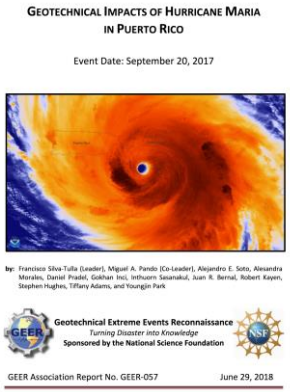
GEOTECHNICAL IMPACTS OF HURRICANE MARIA IN PUERTO RICO

Event Date: September 20, 2017

by: Francisco Silva-Tulla (Leader), Miguel A. Pando (Co-Leader), Alejandro E. Soto, Alexandra Morales, Daniel Pradel, Gokhan Inci, Irthuorn Sasanakul, Juan R. Bernal, Robert Kayen, Stephen Hughes, Tiffany Adams, and Youngjin Park

Geotechnical Extreme Events Reconnaissance
Turning Disaster into Knowledge
Sponsored by the National Science Foundation

GEER Association Report No. GEER-057 June 29, 2018


GEER

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SSEER
SOCIAL SCIENCE EXTREME EVENTS RECONNAISSANCE

ISEEER
INTERDISCIPLINARY SCIENCE & ENGINEERING EXTREME EVENTS RECONNAISSANCE

+ StEER + Near Shore (*coastal*) EER

**EER**s: "A humanitarian mission in the broadest sense" (*Los Angeles Times*)

# *Recent Reconnaissance Example:* Perceptions of Mexico's Earthquake Early Warning

- Issue: How do Mexico City residents perceive SASMEX (earthquake early warning system)? How did they respond to warnings for the September 2017 earthquakes relative to the system's performance?

- Approach: Interdisciplinary team of seismologists, sociologist, psychologist, and urban geographer. In-depth interviews. Convenience sample of the public, government officials, academics, business, & NGOs.

- Outcome: Recommendations for earthquake early warning system development in the United States published in *Science*.

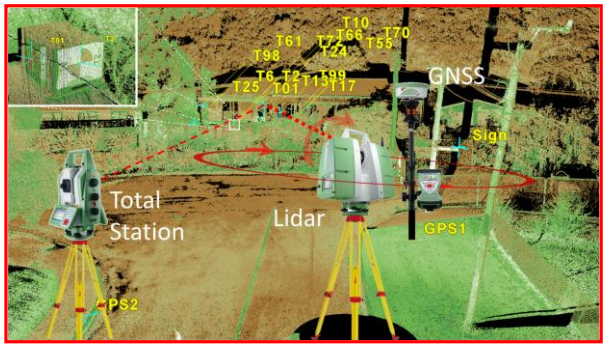
Allen, R.M., et al. (2017) "Quake warnings, seismic culture", *Science*



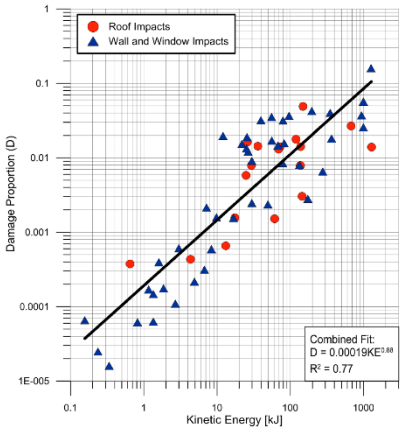

# *Recent Reconnaissance Example:* Impact of Co-Seismic Rockfall on Buildings

- Issue: landslide risk practices require that the vulnerability of communities to landslides be known, but information was not available to support such assessment.

- Approach: lidar-scan ~30 homes/sites damaged by rockfall during the Christchurch earthquake , and relate impact energy to building damage indices; geotechnical-structural collaboration




- Outcome: A series of rigorous, data-driven fragility relationships to support risk assessment and land-use policy




Grant et al. (2017) *Landslides*

# Value of Natural Hazard Reconnaissance Data

- Data generated by an extreme event is often "perishable" —and thus, must be collected quickly

- Disaster data sets include the real-world complexities (e.g., interplay between natural, human, and built systems) that allow us to better understand and to quantify the socio-technical dimensions related to damage, restoration, and resiliency of the built environment

- Such data is difficult to duplicate in the laboratory

- Once collected, these data can be used to:
  - develop new fundamental discoveries and insights
  - test and verify simulation models
  - reduce uncertainties in probabilistic models


*"Because of limitations in resources and training...reconnaissance is often cursory and anecdotal" (2011)*

# RAPID Mission and Strategic Activities

**The RAPID facility provides investigators with the equipment, software, and support services needed to collect, process, and analyze perishable data from natural hazard events**

- Acquire, maintain, and operate state-of-the-art data collection equipment
- Develop and support mobile applications to support interdisciplinary field reconnaissance
- Provide advisory services and basic logistics support for research investigations
- Facilitate the systematic archiving, processing and visualization of acquired data in DesignSafe-CI
- Train a broad user base through workshops and other activities
- Engage the public through citizen science, as well as through community outreach and education

# RAPID Timeline

## Year 1
Community Input and Resource Requirement Development

## Year 2
Acquisition, Commissioning and Training

## Years 3-5
User Service, Field Operations, Continued Training

**September 2016-September 2017**

- Developing facility headquarters
- Hiring staff
- Workshop
- Science plan revision
- Specification development
- Trial equipment deployment and testing
- Coordination with DesignSafe
- Facility operating documents
- Advertising
- Mobile app development

**September 2017-September 2018**

- Procurement and commissioning
- Staff training
- Facility operating plan and site users manual
- User training workshops (4)
- REU program
- IT cyber security
- RApp development and testing
- Fiscal operating plan
- Proposal support

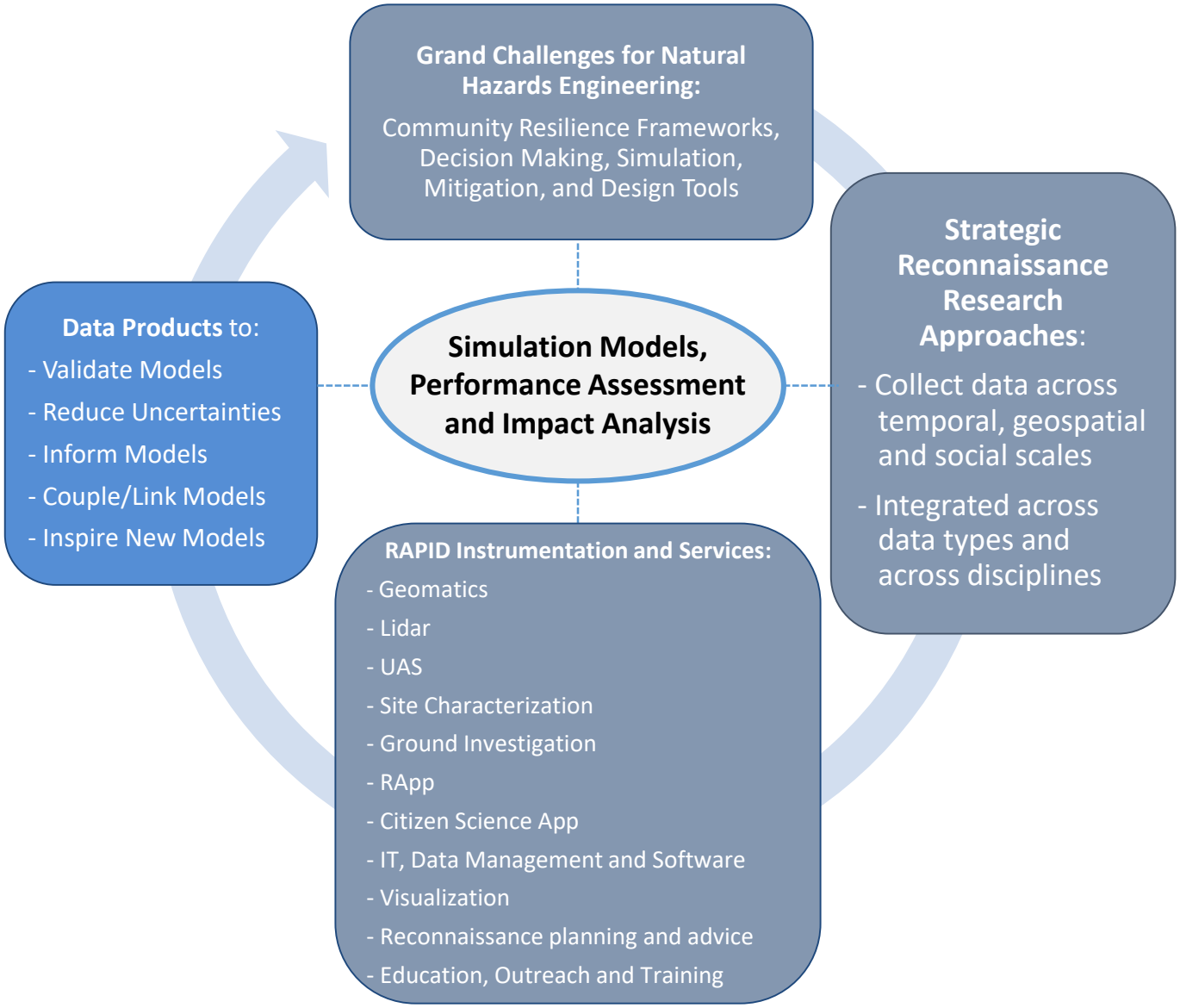
**September 2018 and beyond**

- Supporting field missions and data use/reuse
- Training
- Maintenance
- Updating

# RAPID Science Plan

The principal scientific goal of the RAPID is

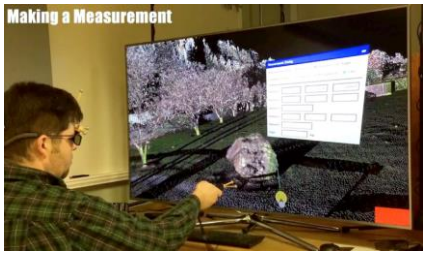
to *inform natural hazards computational simulation models, infrastructure performance assessment, and socioeconomic impact analysis by supporting the collection, development, and assessment of high-quality disaster data sets*



# Instrumentation Highlights

5 laser scanners
(up to 2.4 km range)

Suite of drones with high resolution cameras and lidar




Virtual environment for data visualization and analysis


"Applied Streetview" mobile imaging


Survey and geomatics control

Autonomous boat with hydrographic survey


Seismographic arrays and shear wave velocity profiling

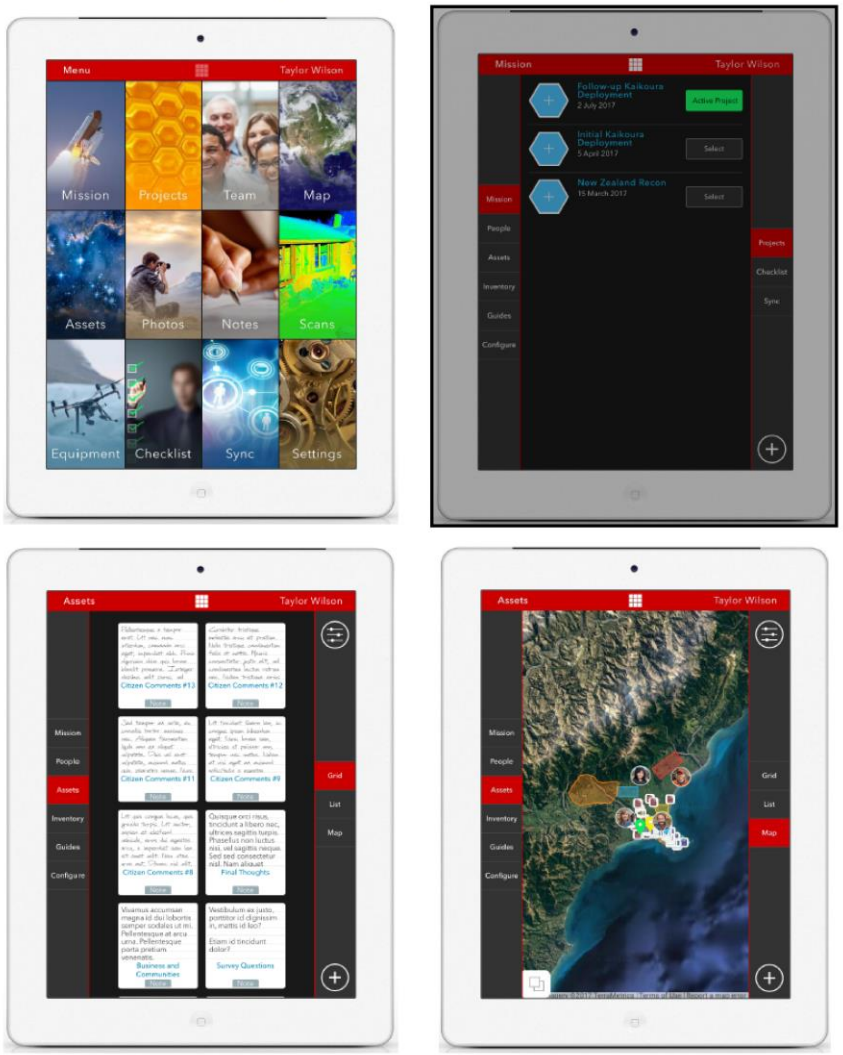
Mobile EEG
(electroencephalography)

And workflows (standardization and ease of use) and much more….

# RAPID App or "*RApp*"

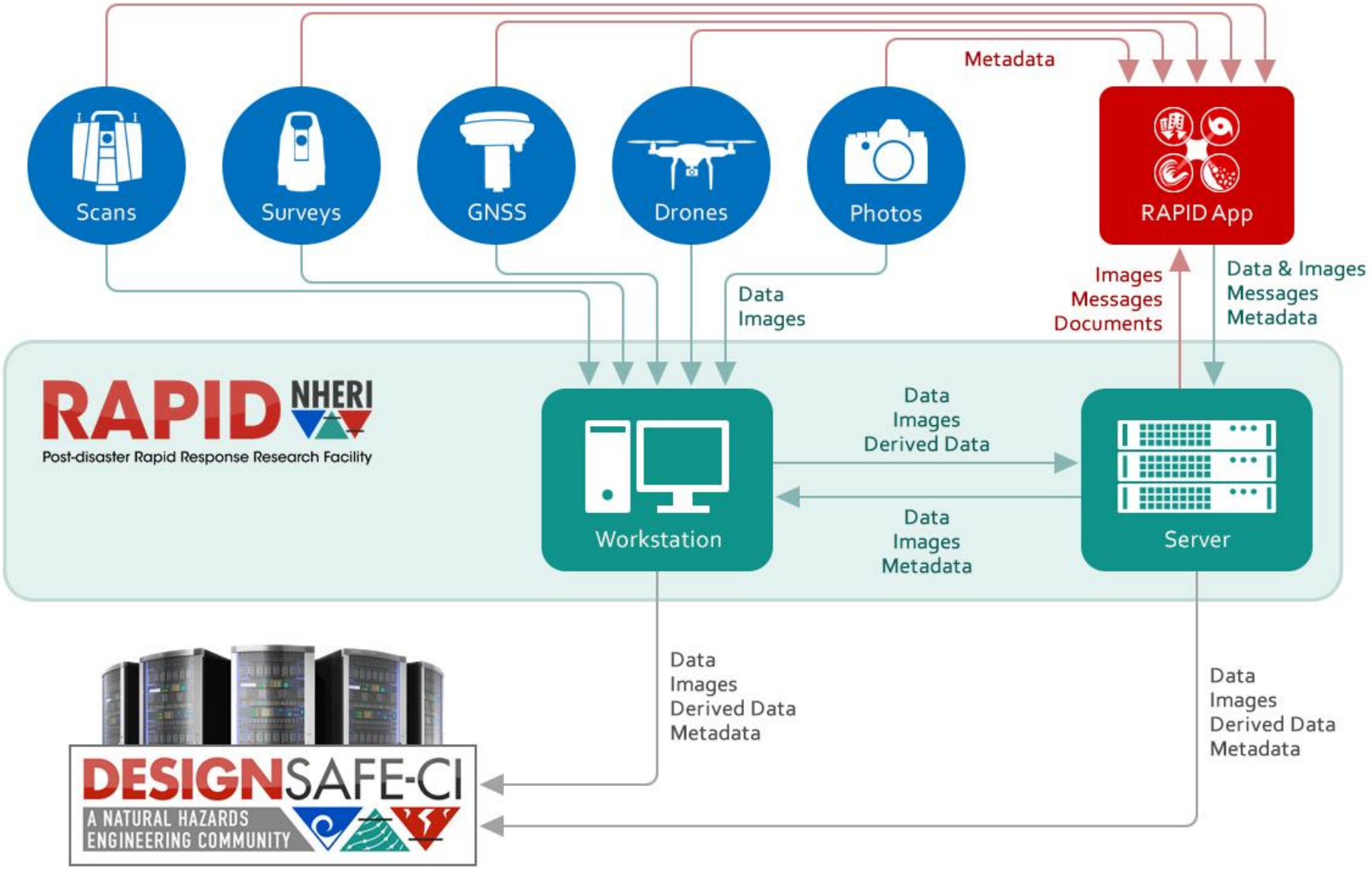
RApp integrates mission planning and coordination, data collection, and data management into a single, unified package

*RAPID App graphical user interface prototype.*




- Afford users the ability to identify, capture, aggregate, organize, store, and manage social science, engineering, and natural science reconnaissance data
- Disseminate, analyze, and visualize those data
- Facilitates communication, coordination, and collaboration among researchers across disciplines
- Designed with a human-centered approach that includes user research, prototyping, and iteration.

# (Open) Data Workflow



# **Science Plan: Strategic Approaches** – Acquire and integrate data over a range of temporal and spatial scales, and across disciplines

*EARTHQUAKE EXAMPLE* ILLUSTRATING LINKS BETWEEN STRATEGIC APPROACHES, INSTRUMENTATION, AND DATA COLLECTION PRODUCTS

*Overarching Strategic Reconnaissance Research Approaches*

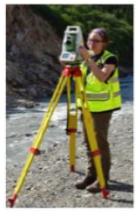
1. Collect data across temporal scales, e.g. evolution of co-seismic landslide with time, recovery and return to home for affected persons
2. Collect data across geospatial scales, e.g. community-level and site-specific damage mapping, regional geology trends and site period
3. Collect data and integrate across disciplines, e.g. collect building damage and socio-economic data in identical effected communities

**UAS lidar**: Aerial mapping of ground failure to obtain high-resolution, bare-earth DEM

**UAS camera**: Aerial mapping of building damage patterns to obtain orthophotos and DEM

**Seismometer**: measure natural period and aftershocks to obtain site characteristics

**Camera and geomatics control**: SfM survey to map building damage to obtain 3D model for interrogation



**iPad App**: interview affected persons to obtain social science data

**Terrestrial lidar:** map ground failure and affected structures to obtain high-resolution DEM

**AUV/single beam**: submarine mapping to obtain bathometry

# **Science Plan: Strategic Approaches** – Acquire and integrate data over a range of temporal and spatial scales, and across disciplines

*WIND (HURRICANE) EXAMPLE* ILLUSTRATING LINKS BETWEEN STRATEGIC APPROACHES, INSTRUMENTATION, AND DATA COLLECTION PRODUCTS

*Overarching Strategic Reconnaissance Research Approaches*

1. Collect data across temporal scales, e.g. evolution of co-seismic landslide with time, recovery and return to home for affected persons
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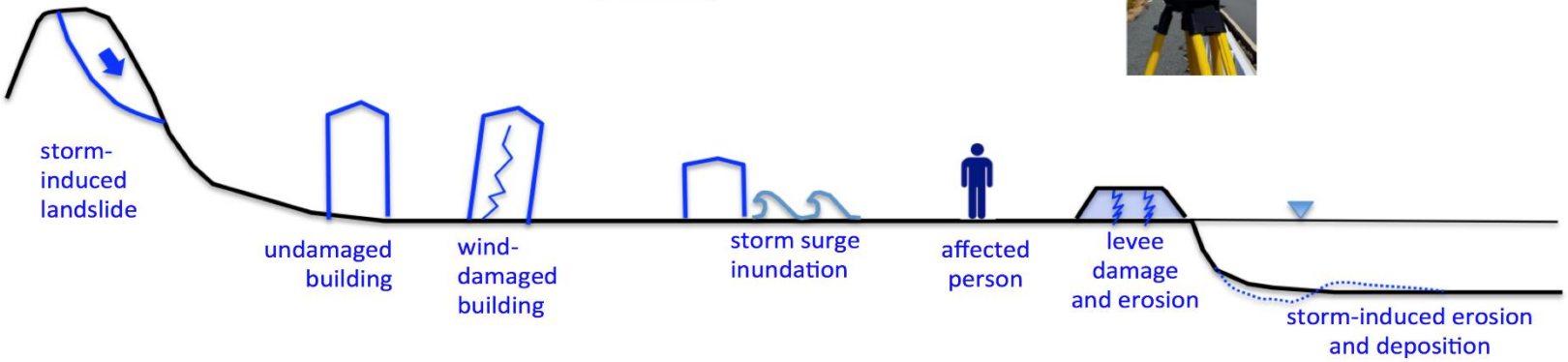
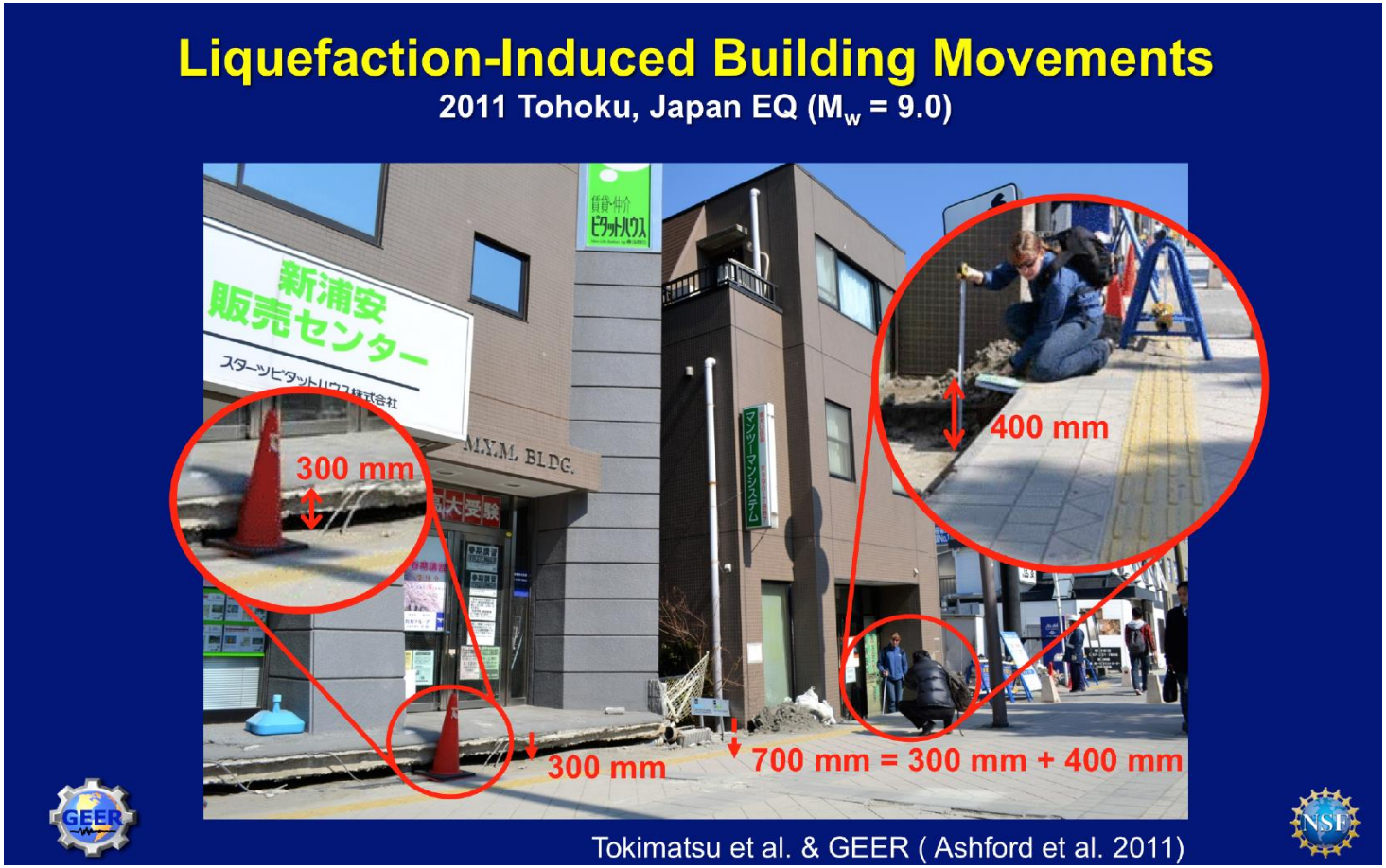
**AUV/single beam**: submarine mapping to obtain bathymetry



# Enabling the Next Generation of Natural Hazards Reconnaissance




Courtesy of J. Bray (2017) Ishihara Lecture, Simplified procedure for estimating liquefaction-induced building settlement

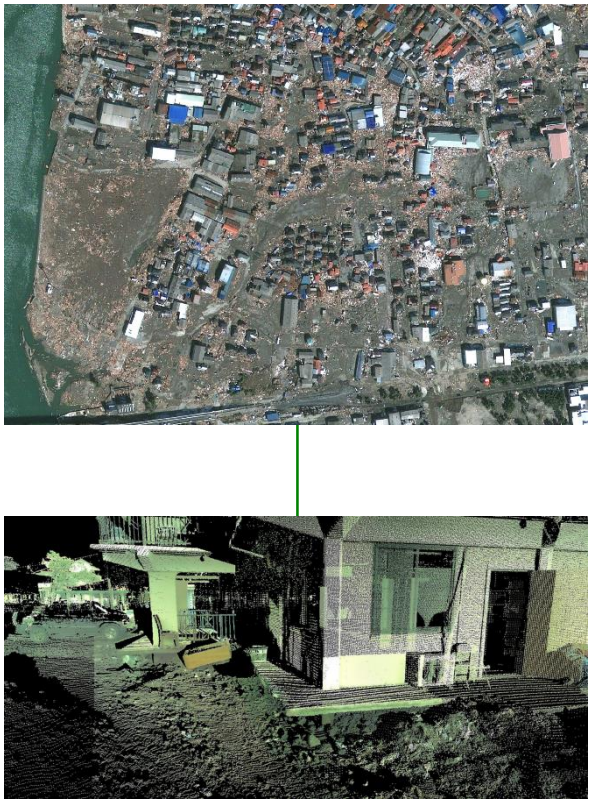
- 2D sparse “point" data
- Manual measurements
- 10 cm resolution

# Next Generation Natural Hazards Reconnaissance

- Large amount of high-quality data
- High-resolution (<1 cm), systematic data collection
- 3D (and 4D)
- Automation

Tsunami Inundation

# Next Generation Natural Hazards Reconnaissance



Tsunami Inundation

# Next Generation Natural Hazards Reconnaissance

Amanda South, reporter, Newstalk ZB, 8-5-12.

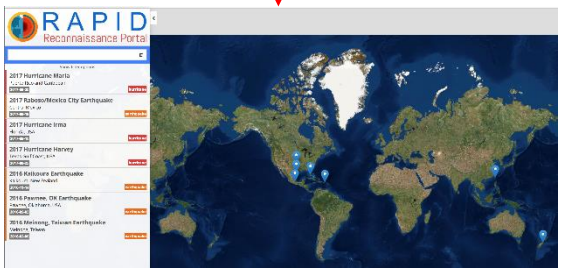
I: Right, let's start with February 22, can you describe your key experiences on that day?

IP: I was actually at home, ironically, because the Christchurch City Council was having its first dedicated earthquake recovery meeting so I would have started work at 1, so I was always haunted by that, but I was in Angus' bedroom getting him off for a nap and I guess the rest is history. The house started to explode around us. I just took him in by body in the middle of the room and things just fell around us. We were in this little bubble in the middle and it was horrific because everyone has that internal counter and you thought `Oh my god this is going to on too long, it's supposed to stop'. It got angrier and stuff was just erupting in the hallway. I can just remember knowing it was horrific and trying to think about my kid and I can remember my

Example Eyewitness Interview Transcript

# Next Generation Natural Hazards Reconnaissance

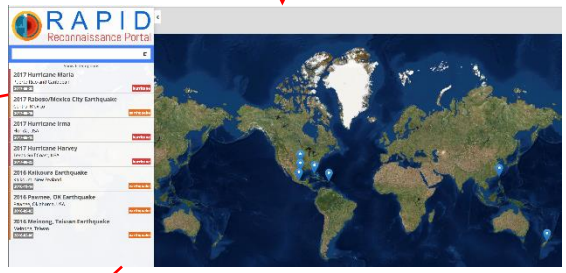
DESIGNSAFE-CI
A NATURAL HAZARDS ENGINEERING COMMUNITY




# Next Generation Natural Hazards Reconnaissance

DESIGNSAFE-CI
A NATURAL HAZARDS ENGINEERING COMMUNITY

QGIS

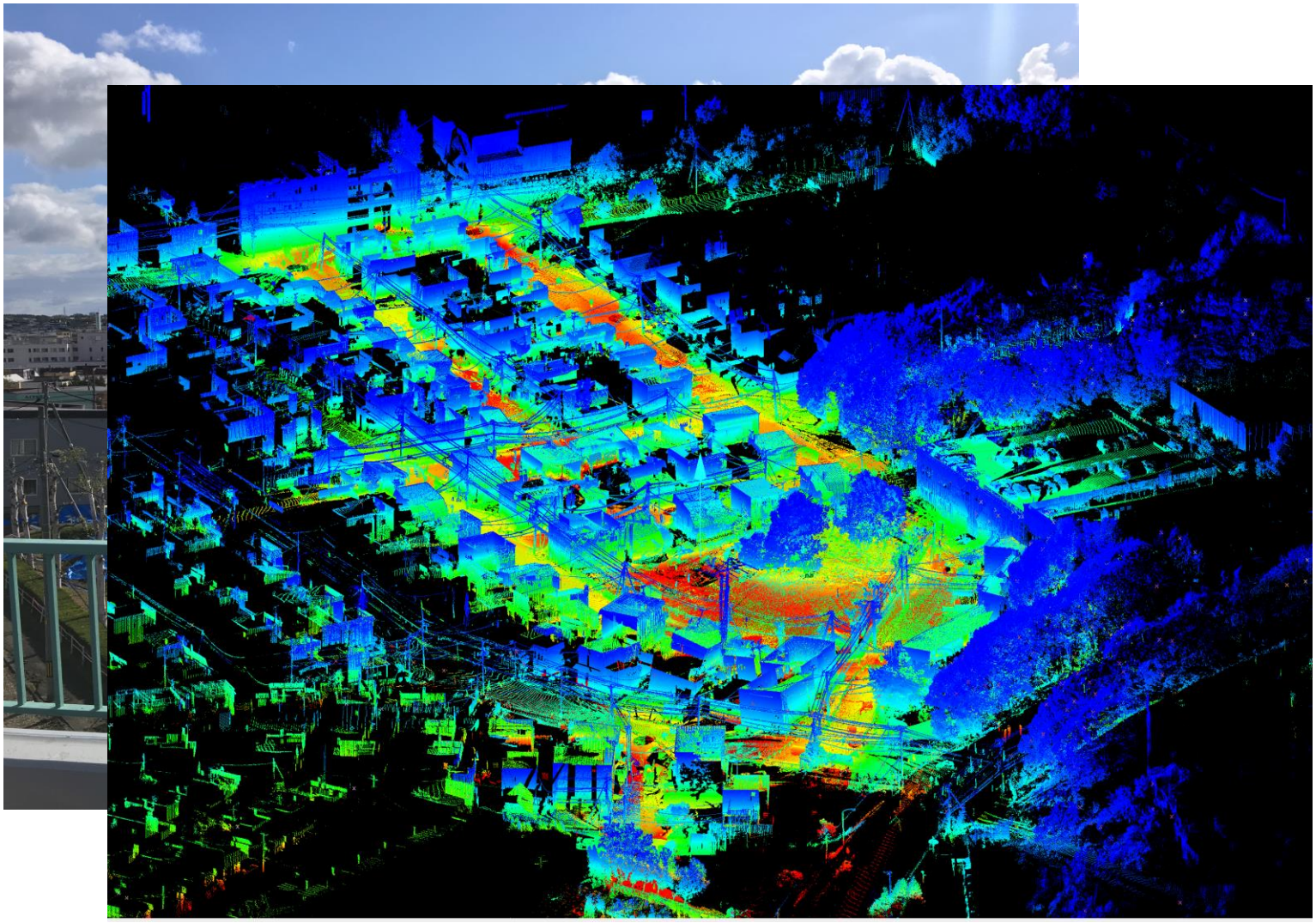



# Recent Missions

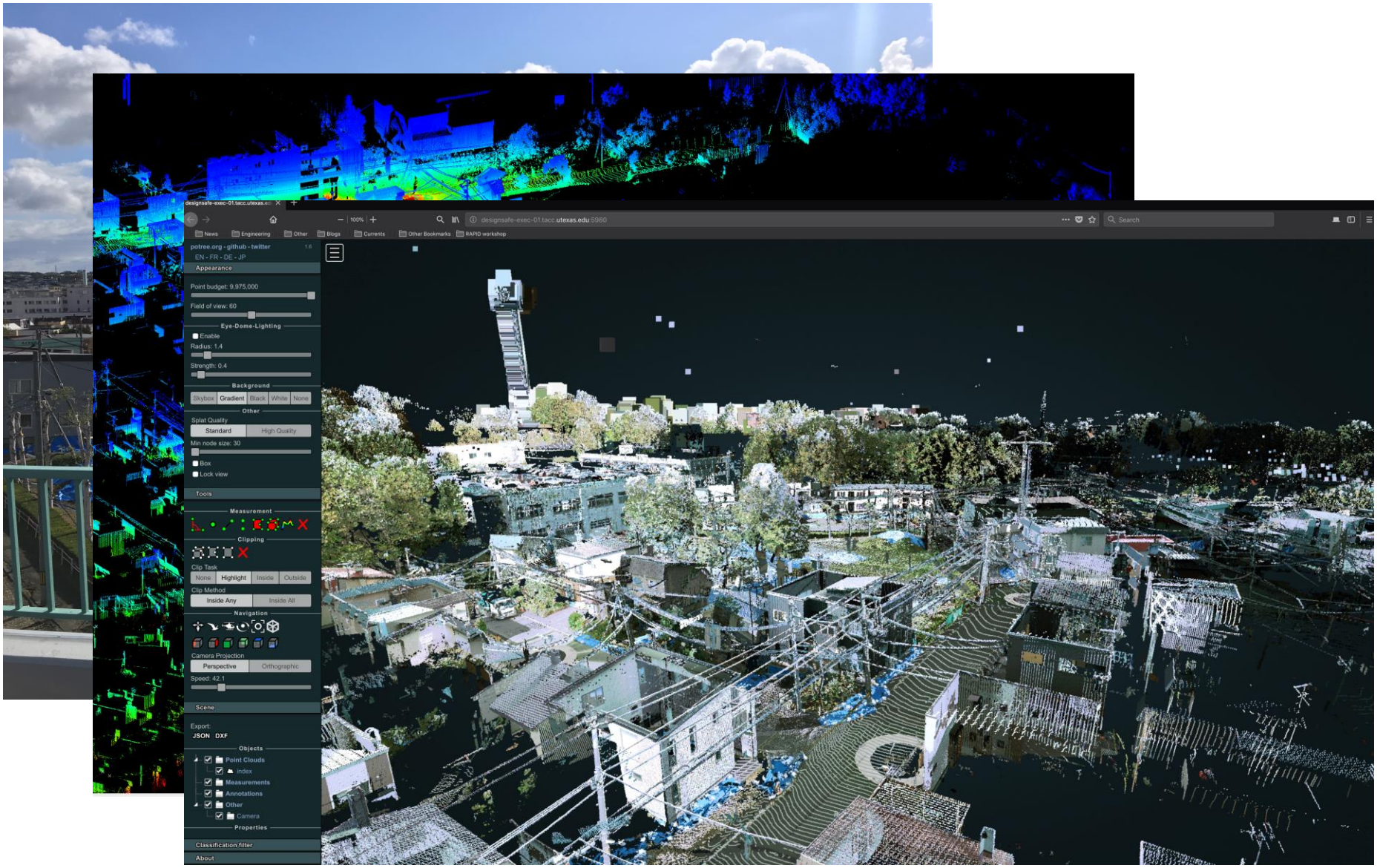
## Hokkaido, Japan Earthquake response in support of GEER

# Recent Missions

# Recent Missions

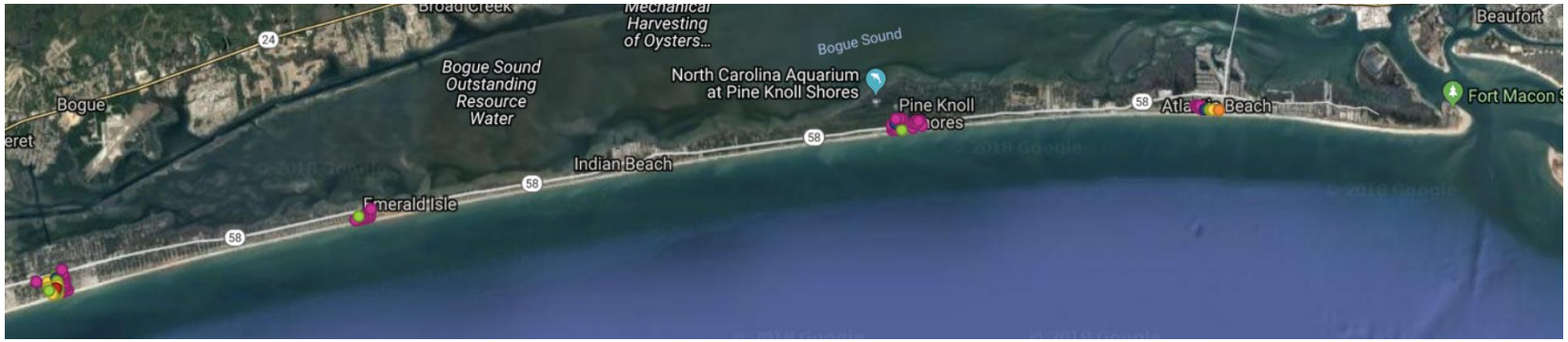


# Recent Missions



# 2018 Hurricane Florence response in support of StEER and GEER

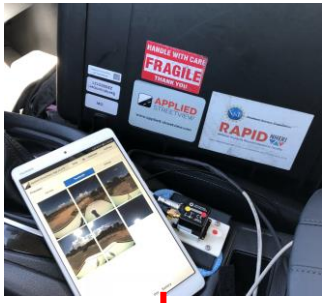
- Friday 9/14: Landfall
- Wednesday 9/19: 1st StEER team reaches affected area for preliminary assessment
- 9/18-9/22: StEER and RAPID coordination via slack:
  - What equipment, who gets it, how do they get it
- 9/18-9/22: GEER and RAPID coordination via email:
  - Will they send a team, what equipment, who gets it and how
- 9/20: RAPID ships equipment to GEER team member Navid Jafari (LSU):
  - BLK360, Structure Sensor, iPad, Flir, Insta360
- 9/21: StEER Team 2 Lead Daniel Smith (UF) picks up Streetview at RAPID HQ
- 9/21: StEER and RAPID decide to deploy Dafni and Yeung and with StEER team 2
  - Depart on 9/24
  - Equipment: Matrice 210 (UAV), Mavic Air (UAV), BLK360



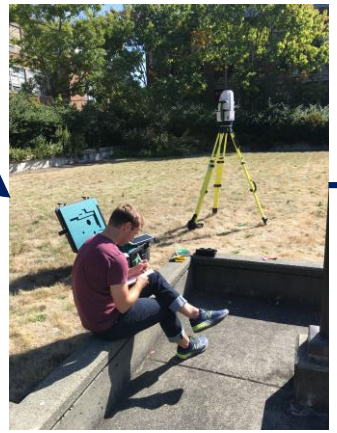
# September Disaster "Season"

Site operations specialist

Outside users




Hands-on summer workshop attendees: Navid Jafari and Alex Grant



Pre-deployment refresher and eqpt. pick-up, Sept. 2018

# Other Non-Disaster Natural Hazard Missions

NSF Research Project "*A Platform for Regional-Scale Landslide Risk Assessment*" (NSF Grant 1548552)

Landslide hazards

Challenging (helicopter) access

Tech director/director in-field collaboration

Equipment capabilities in adverse weather

# Complementing Laboratory Instrumentation


Obtain 3D high- resolution point cloud models for NHERI experiments

- Record damage
- Determine precise instrument locations
- Benchmark experiments to field observations
- Develop damage detection and load history determination methods

# The RAPID's Roles

- Maintain and calibrate equipment for you to use
- Provide staff assistance for use when necessary
- Assist with proposal preparation:
  - Advice
  - Integration with science plan
  - Provide budget information for RAPID equipment and staff
- Logistical support:
  - Arrange and assist with equipment delivery
  - RApp to help with team organization/coordination

- ***Outside our scope**:*
  - *Coordinating reconnaissance missions*
  - *Setting the scientific objectives for reconnaissance missions*
  - *Providing funding for reconnaissance*

# Overview of Using the RAPID

## Before Deployment

**Before Requesting Equipment:**
- Read RAPID Site User Manual
- Review equipment list and specifications
- Review User Agreement
- Review user rates and fees
- Verify liability insurance
- Verify reconnaissance funding source
- Complete user training (recommended)

**Request Equipment (Preferred 2 Weeks Prior to Deployment):**
- Check current status of equipment
- Complete the RAPID Equipment Request Form

**Discussion Between RAPID And User (Within 2 Business Days of Equipment Request):**
- Equipment needs
- Schedule
- Rates
- Shipping logistics
- Complete RAPID User Agreement

**Setup RApp (if Needed):**
- User setup of RApp via Mission Control
- RAPID prepares field tablets
- Verify DesignSafe account is active

**Receive Equipment:**
- Options: At home, in field, from RAPID HQ, carried by RAPID staff, handoff from another team

## Deployment

**Collect Data:**
- Use manufacturer or RAPID developed equipment manuals (loaded on RApp or otherwise provided)
- RAPID remote support as needed
- RAPID staff in-field (if needed)

**Return Equipment:**
- Options: Shipping, returned by hand, returned by RAPID staff, handed off to another team
- RAPID will inspect and verify equipment condition

## After Deployment

**Data Archival:**
- Raw data uploaded to DesignSafe by RAPID staff
- Good practice to back up data during deployment as well on backup devices or computers

**Data Processing:**
- If needed RAPID HQ has processing capabilities
- Can setup as part of initial user agreement or arrange afterwards
- Processed data uploaded to DesignSafe by user

**Pay User Rates:**
- RAPID invoices per the user agreement
- Payment expected within 30 days

# Who can use the RAPID? (anyone…)

- Open to anyone:
  - Academics, government agencies, private industry, etc.
  - Different rates for NSF vs. non-NSF (RAPID equipment is subsidized by NSF)
  - Different priority for equipment requests
  - We aim to accommodate all requests
- NSF Grants:
  - RAPID equipment can be requested for any NSF research
  - Reconnaissance possibilities:
    - RAPID grants
    - NSF supported reconnaissance organizations (GEER http://www.geerassociation.org/ , ISEER (https://hazards.colorado.edu/news/center-news/102)
    - Other NSF proposals

# RAPID Priorities for Equipment Requests

- The RAPID will make every effort to accommodate all requests
- When we can't, this table sets our priorities
- We have and continue to establish MOU's with other organizations that have similar equipment to help handle intensive drawdowns

| User | Data Collection Activity | | | | |
|---|---|---|---|---|---|
| | Near-Term Response to a Priority Natural Hazard[1] | Recovery Phase for a Priority Natural Hazard[1] | Experiments at NHERI Facilities | Other Natural Hazards | Other Applications |
| NSF Supported | 1 | 2 | 2 | 3 | 3 |
| Non –NSF Federal Agency | 4 | 5 | 5 | 5 | 5 |
| Other | 5 | 6 | 6 | 6 | 6 |

[1] Priority Natural Hazards: Hurricanes, Tornados, Other Windstorms, Storm Surge, Earthquakes, Tsunamis, and Landslides

# Where can the RAPID Equipment be Deployed?

- Locations following natural hazards:
  - Priorities are wind events, earthquakes, and tsunamis
  - Both immediate response and recovery monitoring possible, as are "pre-event" missions
- To supplement instrumentation at large-scale experimental facilities
  - Priorities are tests at other NHERI facilities
- Focus on short term deployments:
  - Longer term deployments possible but we need to talk
  - Deployments more than two weeks will require a user agreement to ensure equipment can be returned for high priority use if it is needed

# Equipment Delivery

- The RAPID will organize the shipping of equipment
  - It may meet you in the field
  - You may retrieve from the UW
  - Our staff may meet you with it
  - You may receive a hand-off from another reconnaissance team
- You will be responsible for some of the delivery costs
- The site user manual (coming to the RAPID website) will have detailed requirements
- The RAPID will help with import/export controls
  - Instrument specific
  - Limitations on certain countries

# Rates

Rates and their calculation reviewed and approved by UW Management Accounting and Analysis and the UW College of Engineering

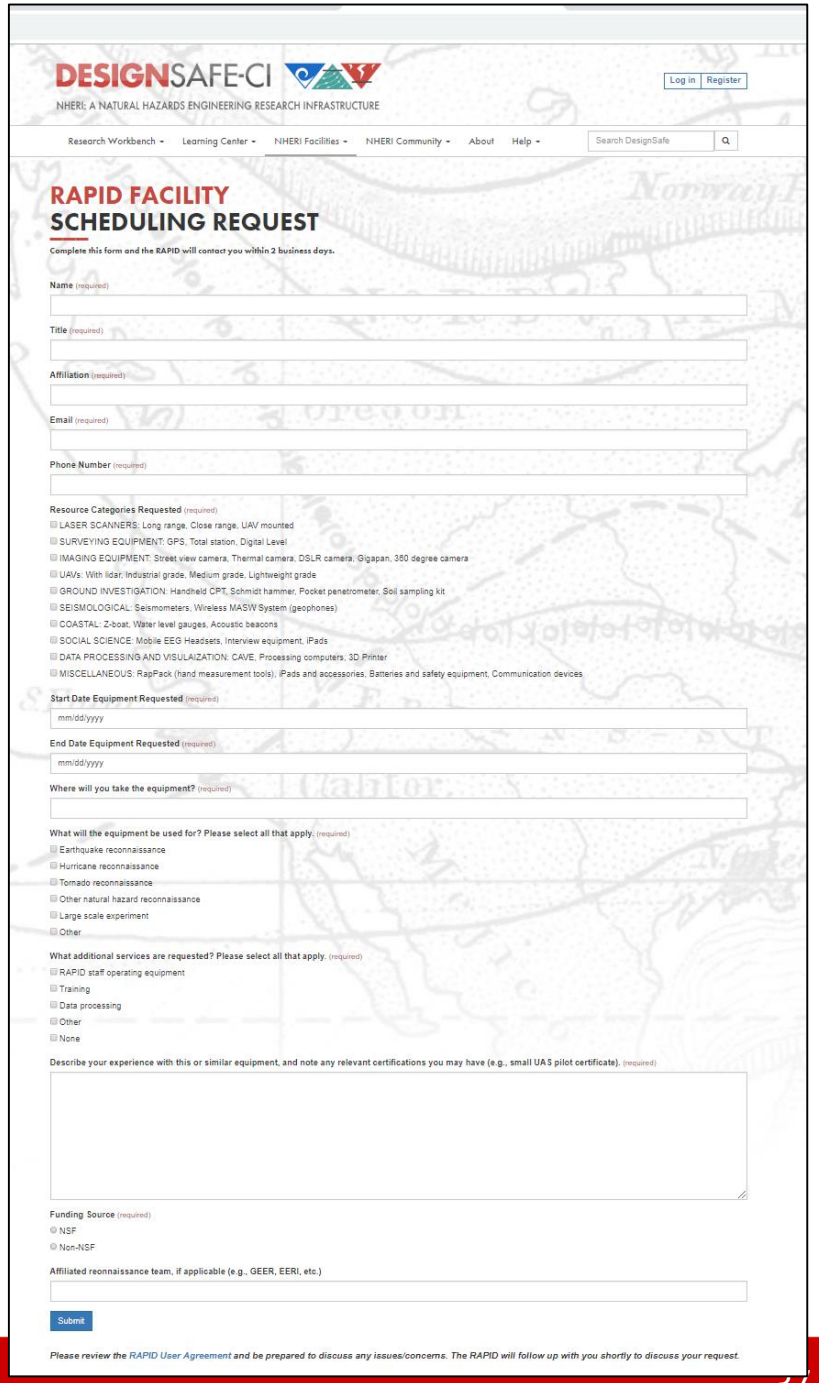
| Rate Number | Equipment/Staff | NSF Supported User Rate ($/Day) | Non-NSF Supported User Rate ($/Day) |
|---|---|---|---|
| **Rate 1** | iPad Pro 10.5 plus accessories | 5.48 | 9.18 |
| **Rate 2** | Field Laptop | 18.13 | 30.02 |
| **Rate 3** | 2TB Backup Device | 3.73 | 5.53 |
| **Rate 4** | Leica BLK360 | 67.38 | 113.87 |
| **Rate 5** | Maptek I-Site XR3 | 516.58 | 874.60 |
| **Rate 6** | Maptek I-Site LR3 | 429.66 | 727.75 |
| **Rate 7** | Leica Nova TS16I | 131.98 | 219.57 |
| **Rate 8** | Leica LS15 | 46.94 | 75.89 |
| **Rate 9** | Leica GS18T | 94.35 | 158.77 |
| **Rate 10** | Structure Sensor | 9.94 | 14.85 |
| **Rate 11** | DJI Mavic Pro | 22.94 | 35.80 |
| **Rate 12** | DJI Mavic Air | 21.70 | 33.72 |
| **Rate 13** | DJI Phantom 4 Pro+ | 28.36 | 46.27 |
| **Rate 14** | DJI Inspire2 with X4S Camera | 34.72 | 57.48 |
| **Rate 15** | DJI Matrice 210 with X4S Camera | 40.24 | 68.54 |
| **Rate 16** | Skyshot Hybrid HeliKite | 27.16 | 43.55 |
| **Rate 17** | Parrot Disco Adventurer | 14.67 | 19.61 |
| **Rate 18** | MiniRanger | 537.15 | 921.10 |
| **Rate 19** | Canon 7D Mark II with fixed and zoom lense | 18.12 | 28.98 |
| **Rate 20** | GigaPan Epic Pro V with tripod | 16.04 | 21.93 |
| **Rate 21** | DJI Osmo 3-axis Gimbal and 4K Camera | 7.90 | 12.49 |
| **Rate 22** | Insta360 One for Apple Products | 4.79 | 7.59 |
| **Rate 23** | Brinno BCC200 Construction Bundle Pro Time-Lapse Camera | 7.33 | 9.79 |
| **Rate 24** | Applied Streetview | 113.42 | 201.30 |
| **Rate 25** | Flir C3 Thermal Camera | 4.98 | 7.90 |
| **Rate 26** | Seismometers | 49.55 | 84.02 |
| **Rate 27** | ATOM Wireless Seismic Data Acquisition System | 157.97 | 265.65 |
| **Rate 28** | Hand Operated Dynamic Cone Penetrometer System | 36.93 | 60.76 |
| **Rate 29** | Geotester Pocket Penetrometer | 7.75 | 10.51 |
| **Rate 30** | SilverSchmidt and RockSchmidt Hammers | 16.67 | 26.88 |
| **Rate 31** | AMS 3-1/4-inch Basic Soil Sampling Kit (Hand Augers) | 24.23 | 38.08 |
| **Rate 32** | Z-Boat 1800 with Single Beam Echo Sounder | 352.43 | 615.42 |
| **Rate 33** | ULB 350/37 Underwater Acoustic Beacons and pinger | 43.77 | 70.08 |
| **Rate 34** | TruBlue 255 Water Level Gauge | 7.07 | 13.29 |
| **Rate 35** | Emotiv 14-Channel EEG Headset | 7.63 | 12.61 |
| **Rate 36** | Suaoki 222 Wh Portable Generator | 11.52 | 13.38 |
| **Rate 37** | Suaoki 400 Wh Portable Generator | 12.03 | 14.23 |
| **Rate 38** | RapPack | 7.53 | 12.34 |
| **Rate 39** | RAPID Staff In Field: Tech | 763.45 | 1429.89 |
| **Rate 40** | Processing Computers | 70.86 | 79.71 |
| **Rate 41** | CAVE | 99.72 | 146.08 |
| **Rate 42** | 3D Printer | 27.38 | 43.12 |

# Example Fee Scenarios

- 5 Day Hurricane Deployment (GEER)
  - Close range lidar ($67)
  - Structure sensor ($10)
  - iPad ($5)
  - Thermal camera ($5)
  - Insta 360 ($5)
  - Field laptop ($18)
  - Shipping: ~$500
  - **Total cost to user: $980**
  - **Equipment value: $24,400**
- 5 Day Hurricane Deployment (StEER)
  - Applied streetview ($113)
  - Matrice 210 (UAS) ($40)
  - GS18 GPS , 2 ($94)
  - Field Tech, 2 ($763)
  - Tech travel ($2500)
  - Shipping: ~$100 (checked bag fees)
  - **Total cost to user: $7,650**
  - **Equipment value: $94,900**
  - **Staff annual salaries ~$140,000 total**
- 5 Day Earthquake Deployment (GEER)
  - Close range lidar ($67)
  - Long range lidar ($516)
  - iPad ($5)
  - Field laptop ($18)
  - International insurance surcharge: $250
  - **Total cost to user: $3,280**
  - **Equipment value: $204,135**

# RAPID Equipment Availability: Via RAPID Website

- Basic information requested:
  - Equipment category
  - Dates
  - Locations
  - Use
  - Additional services
  - User experience with equipment
  - Funding source
  - Reconnaissance team (GEER/StEER, etc.)



DESIGNSAFE-CI

NHERI: A NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE

Log in | Register

Research Workbench | Learning Center | NHERI Facilities | NHERI Community | About | Help | Search DesignSafe

**RAPID FACILITY SCHEDULING REQUEST**

Complete this form and the RAPID will contact you within 2 business days.

Name (required)

Title (required)

Affiliation (required)

Email (required)

Phone Number (required)

Resource Categories Requested (required)

- LASER SCANNERS: Long range, Close range, UAV mounted
- SURVEYING EQUIPMENT: GPS, Total station, Digital Level
- IMAGING EQUIPMENT: Street view camera, Thermal camera, DSLR camera, Gigapan, 360 degree camera
- UAVs: With lidar, Industrial grade, Medium grade, Lightweight grade
- GROUND INVESTIGATION: Handheld CPT, Schmidt hammer, Pocket penetrometer, Soil sampling kit
- SEISMOLOGICAL: Seismometers, Wireless MASW System (geophones)
- COASTAL: Z-boat, Water level gauges, Acoustic beacons
- SOCIAL SCIENCE: Mobile EEG Headsets, Interview equipment, iPads
- DATA PROCESSING AND VISULAIZATION: CAVE, Processing computers, 3D Printer
- MISCELLANEOUS: RapPack (hand measurement tools), iPads and accessories, Batteries and safety equipment, Communication devices

Start Date Equipment Requested (required) mm/dd/yyyy

End Date Equipment Requested (required) mm/dd/yyyy

Where will you take the equipment? (required)

What will the equipment be used for? Please select all that apply. (required)

- Earthquake reconnaissance
- Hurricane reconnaissance
- Tornado reconnaissance
- Other natural hazard reconnaissance
- Large scale experiment
- Other

What additional services are requested? Please select all that apply. (required)

- RAPID staff operating equipment
- Training
- Data processing
- Other
- None

Describe your experience with this or similar equipment, and note any relevant certifications you may have (e.g., small UAS pilot certificate). (required)

Funding Source (required)

- NSF
- Non-NSF

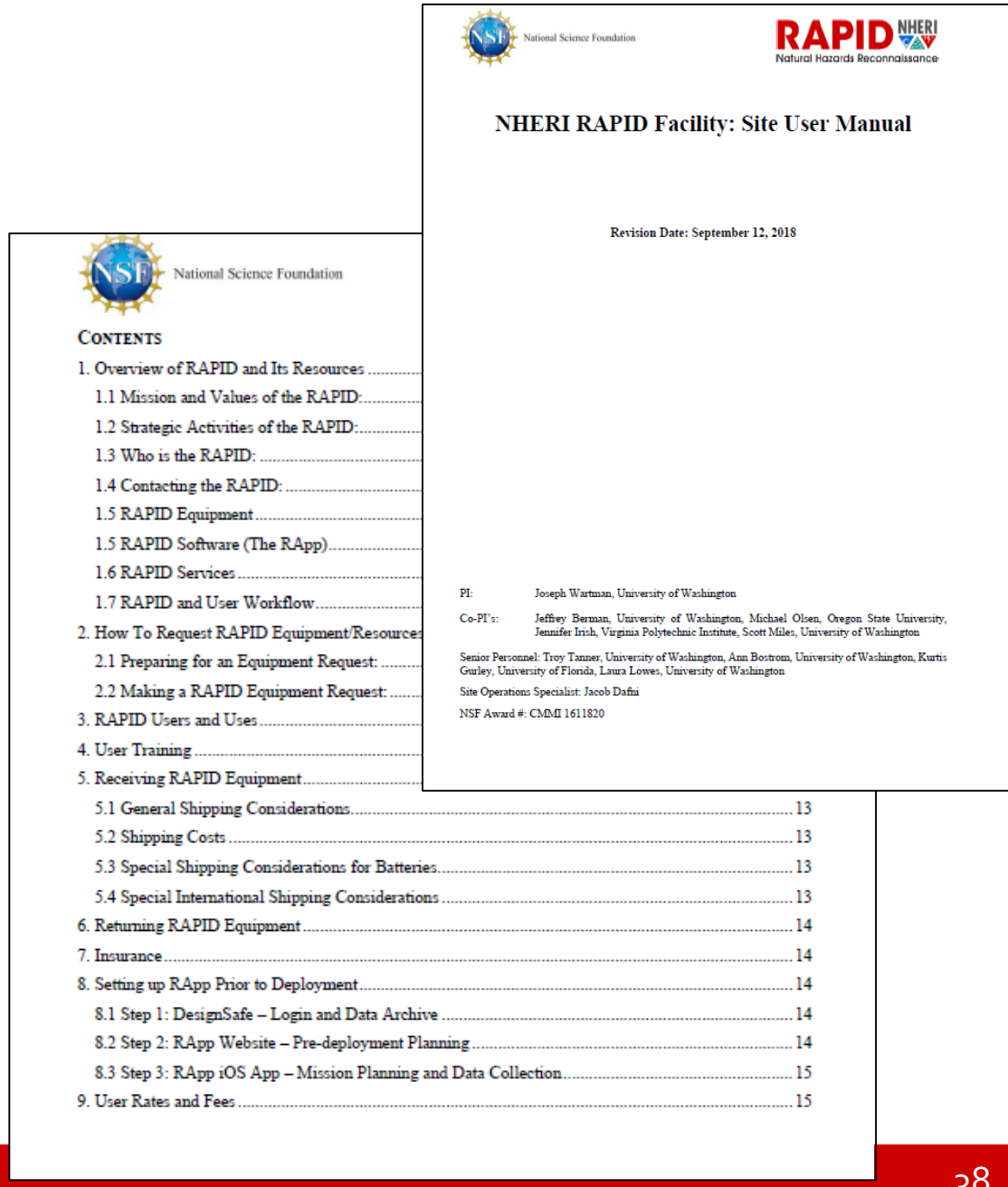
Affiliated reconnaissance team, if applicable (e.g., GEER, EERI, etc.)

Submit

*Please review the RAPID User Agreement and be prepared to discuss any issues/concerns. The RAPID will follow up with you shortly to discuss your request.*

# Site User Manual

- Available on RAPID website
- Has all pertinent information for using the RAPID Facility
  - Initial contact
  - Scheduling
  - Receiving and returning equipment
  - RApp setup
  - Rates and fees



National Science Foundation

RAPID NHERI Natural Hazards Reconnaissance

**NHERI RAPID Facility: Site User Manual**

**Revision Date: September 12, 2018**

PI: Joseph Wartman, University of Washington

Co-PI's: Jeffrey Berman, University of Washington, Michael Olsen, Oregon State University, Jennifer Irish, Virginia Polytechnic Institute, Scott Miles, University of Washington

Senior Personnel: Troy Tanner, University of Washington, Ann Bostrom, University of Washington, Kurtis Gurley, University of Florida, Laura Lowes, University of Washington

Site Operations Specialist: Jacob Dafni

NSF Award #: CMMI 1611820

National Science Foundation

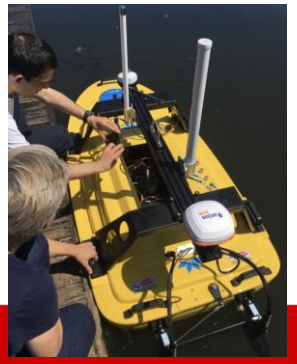
CONTENTS

# User Training and Site User Manual

- User training:
  - Recommended but not required
  - 1-Day overview workshops (example from 2018)
    - Wind-focused training in collaboration with NHERI WOW, Miami, May 17-18
    - Earthquake-focused training at the NCEE in Los Angeles, June 25
    - Joint GEER-RAPID training in San Francisco, week of September 17
  - 4-Day intensive hands-on workshops (at RAPID headquarters in Seattle)
    - Creates cadre of RAPID equipment experts
    - List of participants and expertise will be maintained on https://rapid.designsafe-ci.org/

# July 2018 Hands-On 4-Day Workshop

- July 24-27, 2018; Seattle UW campus and environs (Lake Washington)
- Over 90 applicants
- First year class of 24 advanced-trained potential users
- Provided travel support via a NSF supplement
- Primary objective: comprehensive, hands-on training on RAPID equipment data acquisition and post-processing



# rapid.designsafe-ci.org/

## UNIVERSITY OF WASHINGTON
RAPID EXPERIMENTAL FACILITY

DESIGNSAFE-CI
A NATURAL HAZARDS ENGINEERING COMMUNITY

Facility Overview | Equipment Portfolio | Resources | Workshops | Contact

### FACILITY OVERVIEW

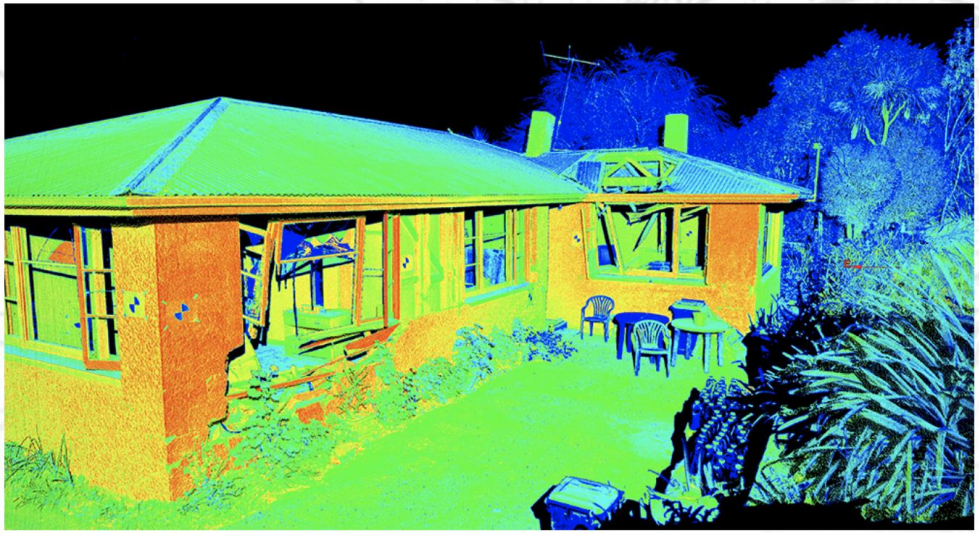
The NHERI Natural Hazards Reconnaissance Facility (referred to as the "RAPID Facility"), headquartered at the University of Washington (UW), is a collaboration between UW, Oregon State University, Virginia Tech, and the University of Florida. The facility will enable the natural hazards and disaster research communities to conduct next-generation rapid response investigations to characterize civil infrastructure performance and community response to natural hazards, evaluate the effectiveness of design methodologies, calibrate simulation models, and develop solutions for resilient communities. The facility engages in a range of activities including (1) acquiring, maintaining, and operating state-of-the-art data collection equipment, (2) developing and supporting mobile applications for interdisciplinary field reconnaissance, (3) providing advisory services and basic equipment logistics support for research investigations, (4) facilitating the systematic archiving, processing and visualization of acquired data in DesignSafe-CI, (5) training a broad user base through workshops and other activities, and (6) engaging the public by facilitating citizen science initiatives, as well as through community outreach and education.

The RAPID facility is currently commissioning and procuring instrumentation and will begin supporting field deployments in September 2018. The facility will be holding a series of 1-day user training workshops during Spring 2018 and offering a 1-week comprehensive hands-on instrumentation training in the late Summer 2018. This website will be evolving during the development of the NHERI RAPID facility and will host information on the community and user workshops, site user manuals and contact information, user rates, and scheduling protocols.

Request RAPID Equipment

See Where RAPID Equipment Is Deployed

How To Use The RAPID



RAPID NHERI