National Science Foundation

University of California at San Diego NHERI Natural Hazards Engineering Research Infrastructure

UC San Diego JACOBS SCHOOL OF ENGINEERING Structural Engineering

DesignSafe Cyberinfrastructure for Research in Natural Hazards Engineering

Tim Cockerill, Ph.D.

Texas Advanced Computing Center

The University of Texas at Austin

Joint Researcher Workshop

UC San Diego, Lehigh & SimCenter

December 16-17, 2019

University of California, San Diego

LEHIGH NHERI Real-Time Multi-Directional Testing Facility

University of California at San Diego NHERI Natural Hazards Engineering Research Infrastructure

SIMCENTER COMPUTATIONAL MODELING AND SIMULATION CENTER

DESIGNSAFE-CI

NHERI: NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE

DesignSafe Cyberinfrastructure for Research in Natural Hazards Engineering

Tim Cockerill, Ph.D.

Deputy Project Director, DesignSafe
Director of User Services, TACC
Texas Advanced Computing Center (TACC)
University of Texas at Austin

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What is DesignSafe?

- A web-based research platform that provides tools to manage, analyze, and understand critical data for natural hazards research

DesignSafe Vision

- A cyberinfrastructure (CI) that is an integral part of research discovery
  - Provide a platform for data sharing/publishing
  - Enable research workflows and access to high performance computing (HPC)
  - Deliver cloud-based tools that support the analysis, visualization, and integration of diverse data types
- Amplify and link the capabilities of natural hazards researchers in the US and abroad

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NHERI Natural Hazards Engineering Research Infrastructure

- DesignSafe cyberinfrastructure
- Seven experimental facilities
- RAPID reconnaissance facility
- Computational modeling and simulation center (SimCenter)
- Coordinating Office (NCO)

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NHERI: A NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE

www.designsafe-ci.org

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

- Data Depot
- Workspace
- Recon Portal
- SimCenter Research Tools
- User Guides

D… …sed research pl… …twork that pr… …al tools needed to m… …derstand critical d… …research.

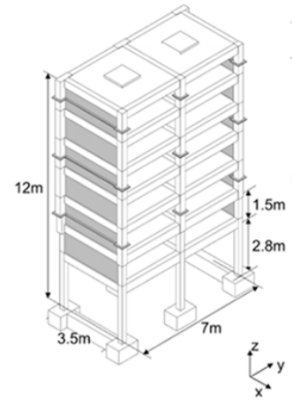
Learn how to
Start Using DesignSafe

Browse the Data Depot's
Published Data Sets

Join the conversation in
DesignSafe's Slack Channel

Learn more about
NHERI, the NCO & DesignSafe

NHERI Five-Year
Science Plan



QuakeCoRE

NCREE

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3-D and first storey plan view of test specimens

QuakeCoRE/NCREE Blind Prediction Competition

The QuakeCoRE center in New Zealand, in collaboration with the National Centre for Research on Earthquake Engineering (NCREE) in Taiwan and DesignSafe in the US, is excited to announce a competition to predict the response of reinforced concrete (RC) structures with torsional irregularities to earthquake shaking. Expressions of interest are due by 5 pm on May 01, 2019 (New Zealand time).

FIND MORE NEWS IN THE NEWSROOM

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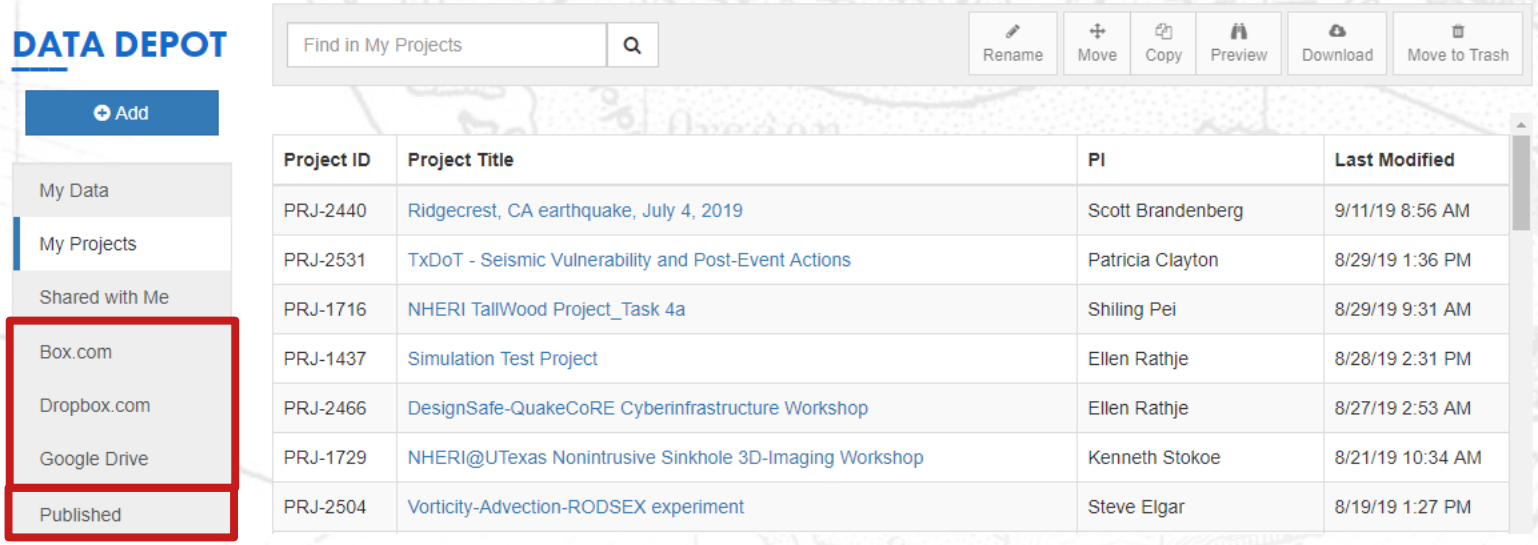
DesignSafe Research Workbench

- Data Depot Data Repository
  - Private space (My Data)
  - Collaboration space (My Projects) for data sharing and ultimate publishing
  - Publicly accessible space (Published) for curated data from My Projects
  - Publicly accessible space (Community Data) for uncurated data
- Discovery Workspace
  - Apps/tools for computational simulation, data analysis, etc. with access to files in Data Depot
- Reconnaissance Portal: discover published reconnaissance data

Data Depot: My Projects



A space to share files/data/results with collaborators and to <u>eventually</u> publish for public use

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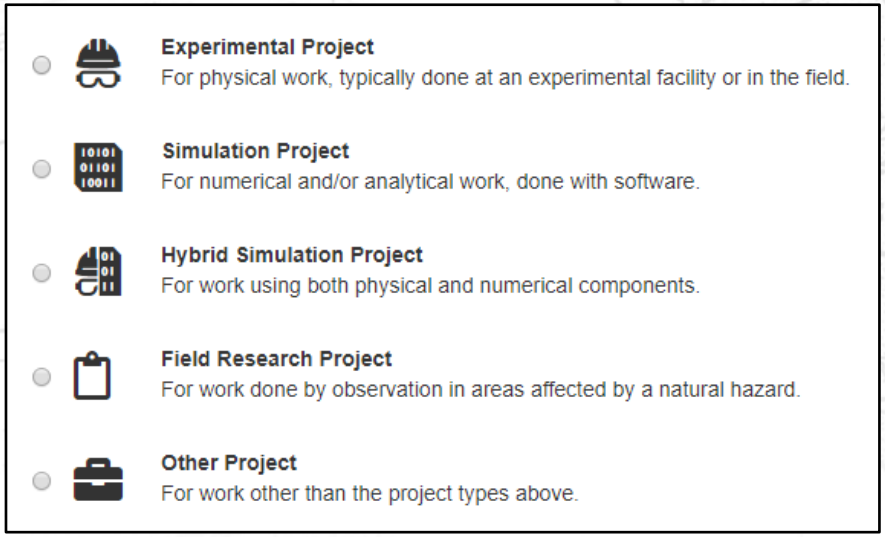
Data Curation Philosophy

- Allow users to easily store, share, document, and publish data throughout the life of a research project
- Flexible data models and interactive curation
  - Allows researchers to decide how to represent their research
  - Support different types of data
  - Consider what is needed for data to be understandable by others for data reuse

DesignSafe Data Models

Structured, yet flexible, data models for different types of research



Curation

- Define categories
- Categories assigned to files/folders
- Relate categories to organize data

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Curation Process

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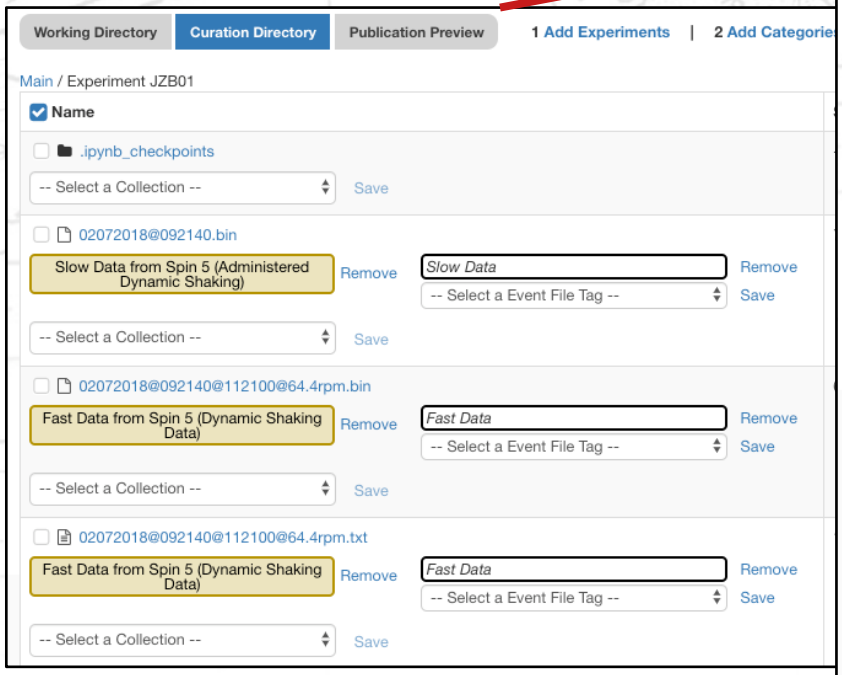
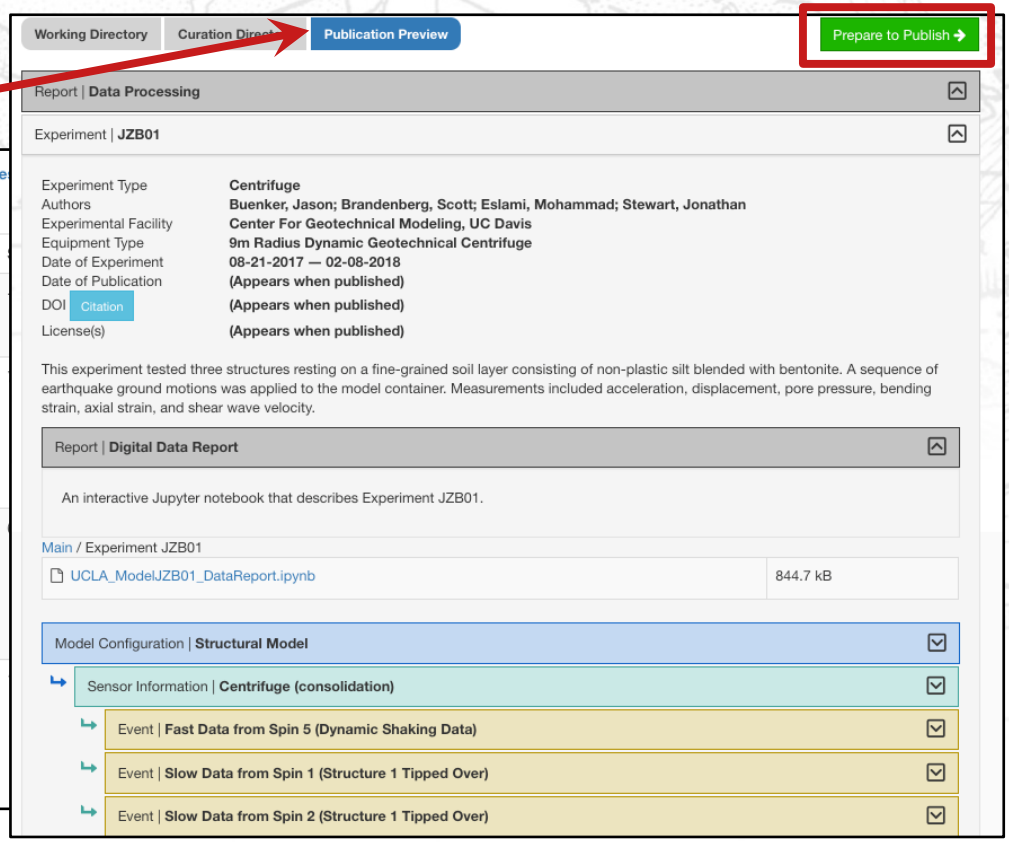
Curation Process





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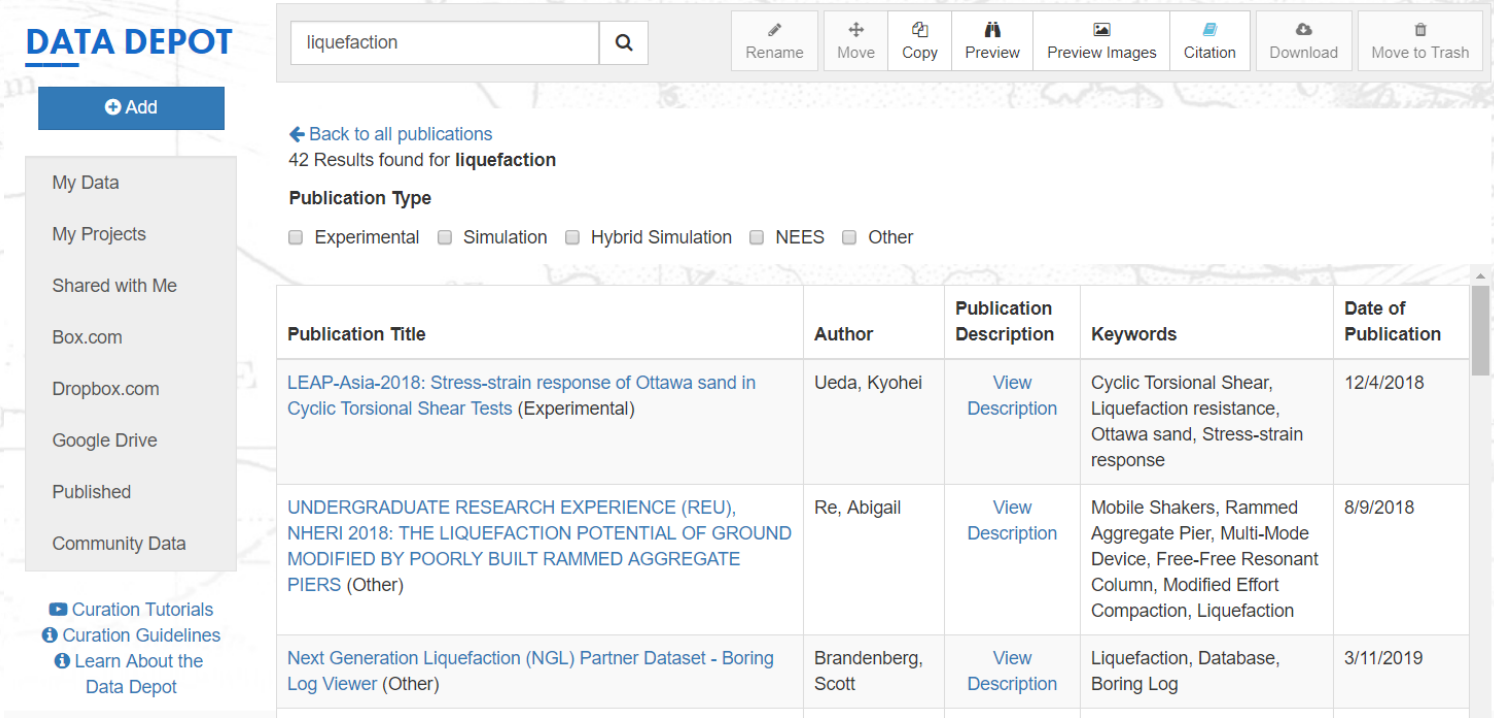
Data Depot Search



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Published Dataset

DATA DEPOT

Add

Published

Community Data

Help

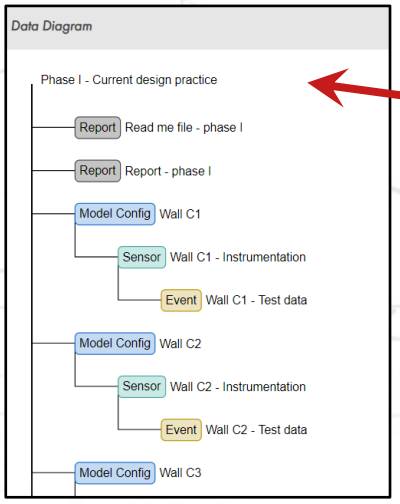
walls

Rename | Move | Copy | Preview | Download | Move to Trash

PRJ-1648 | **UNIVERSITY OF AUCKLAND LIGHTLY REINFORCED CONCRETE WALL TESTS**

PI	**Henry, Rick**
DOI Citation	**10.17603/ds2-tshe-kd83**
Project Type	**Experimental**
Keywords	**Reinforced Concrete, Wall, Seismic Design, Minimum Vertical Reinforcement, Plastic Hinge Region, Reinforcement Buckling, Reinforcement Fracture, Concrete Design Standards**

A series of experimental tests of large-scale lightly reinforced concrete walls were conducted at the University of Auckland. The test were used to investigate minimum vertical reinforcement provisions and formed the basis for revisions to the New Zealand Concrete Structures Standard (NZS 3101:2006 (A3)) and the US Building Code Requirements for Structural Concrete (ACI 318-19). This dataset summarizes the results from the 11 tested walls including all sensor data (load cell, LVDT, string-pot displacement gauge, displacement transducer and strain gauge). Detailed instrumentation plan, loading protocol, test sequences, test observations and photos that were taken throughout the testing are also provided. The dataset is intended to serve as a reference for future work, as well as an open resource to be used in future research.



View Data Diagram

Experiment | **Phase I - Current design practice**

Experiment Type	**Other**
Authors	**Lu, Yiqiu; Henry, Rick**
Experimental Facility	**Other**
Equipment Type	**Other**
Date of Experiment	**04-07-2014 — 09-01-2014**
Date of Publication	**10-07-2019**
DOI Citation	**10.17603/ds2-3v8q-7k69**
License(s)	**Open Data Commons Attribution**

Six reinforced concrete walls designed with minimum distributed vertical reinforcement in accordance with NZS 3101:2006 (Amendment 2)

Report | **Read me file - phase I**

Report | **Report - phase I**

Model Configuration | **Wall C1**

Sensor Information | **Wall C1 - Instrumentation**

Event | **Wall C1 - Test data**

Model Configuration | **Wall C2**

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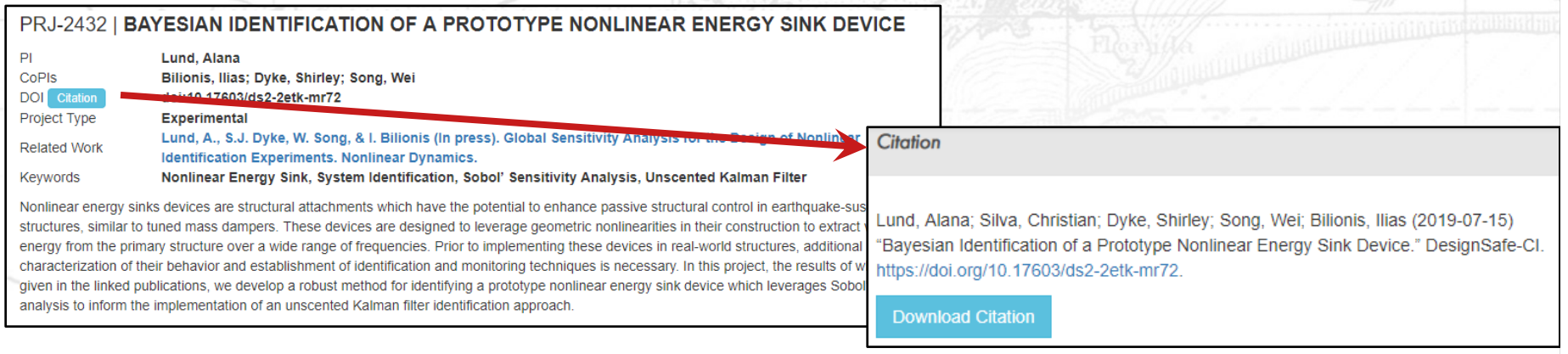
Make **your** data count!

- ***Formally publish*** data sets in stable data repositories
  - Include data processing scripts, visualizations, etc.
- Data needs a permanent, ***digital location (DOI)*** not just a URL
  - List curated data sets on your CV
- Formally cite data ***in your reference list*** of your paper using DOI, citation language as indicated in DesignSafe

MAKE DATA COUNT



Reconnaissance Portal

Identifying Archived Datasets from Recon Events

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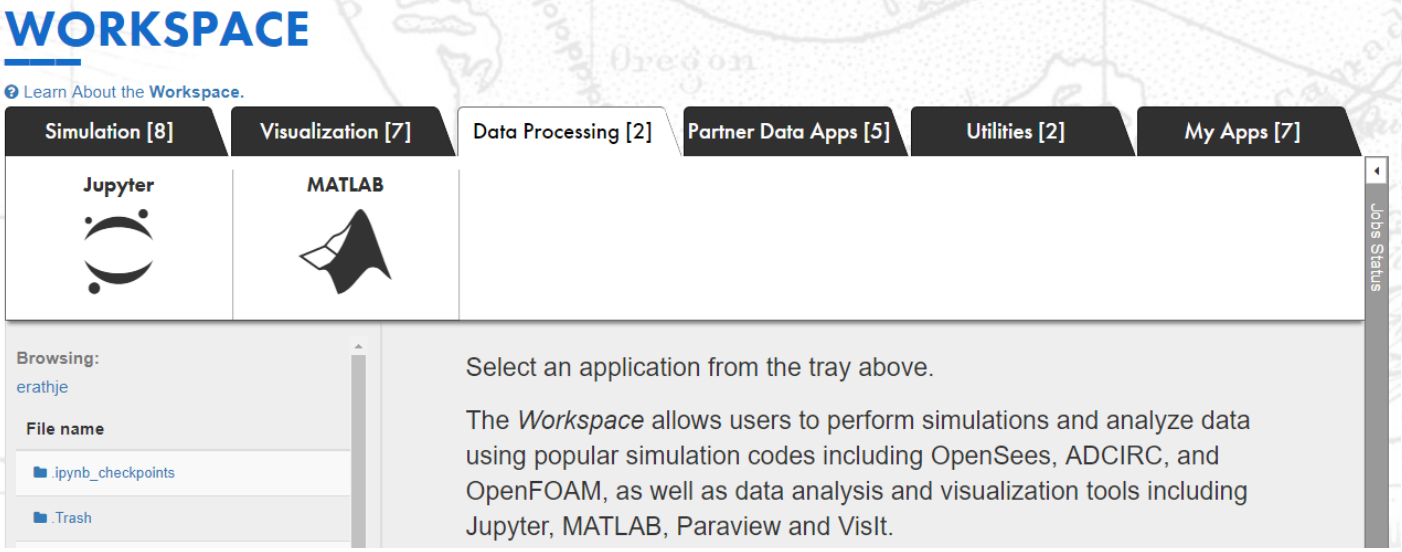
Discovery Workspace

- Cloud-based tools and HPC enabled codes (Stampede2)
- Access to files in the Data Depot



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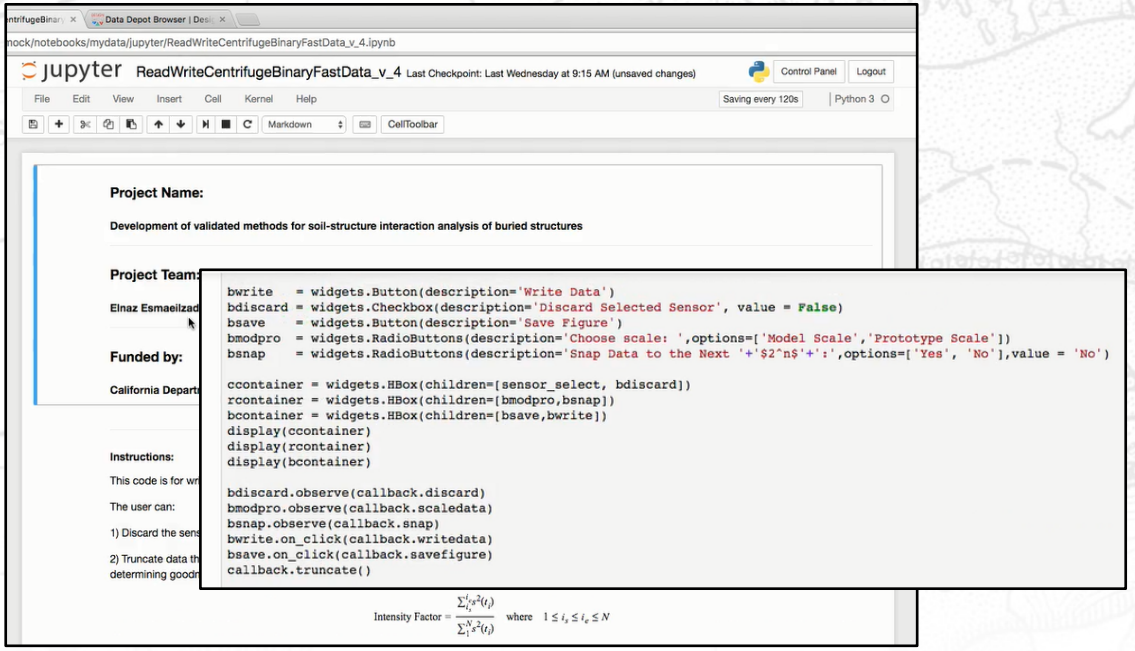
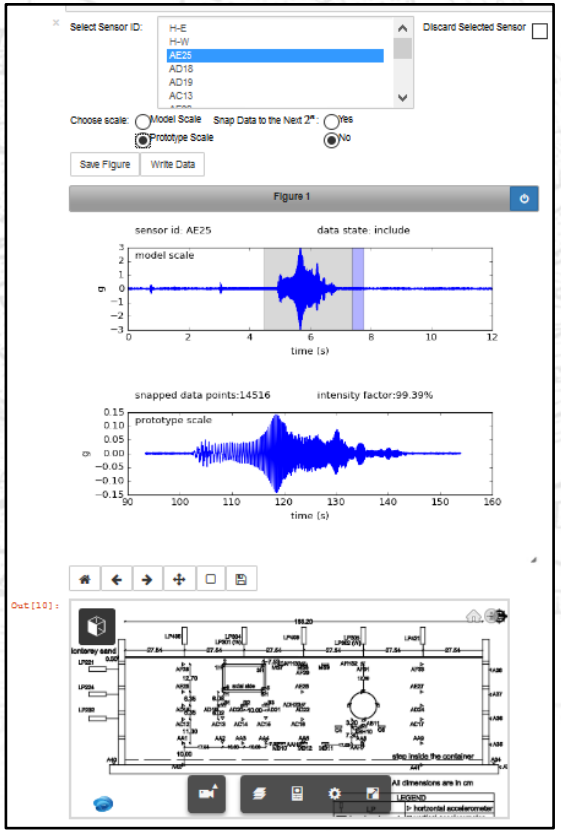
DesignSafe Discovery Workspace

- Data analysis in the cloud
  - Matlab: data analysis and plots, batch processing
  - Jupyter: electronic notebook that supports Python and R analysis
- Visualization
  - HazMapper: DesignSafe version of “Google Maps”
  - Potree: Create, view, and analyze point cloud data
  - QGIS: geospatial data analysis

Electronic Notebook





From Prof. S. Brandenberg, UCLA

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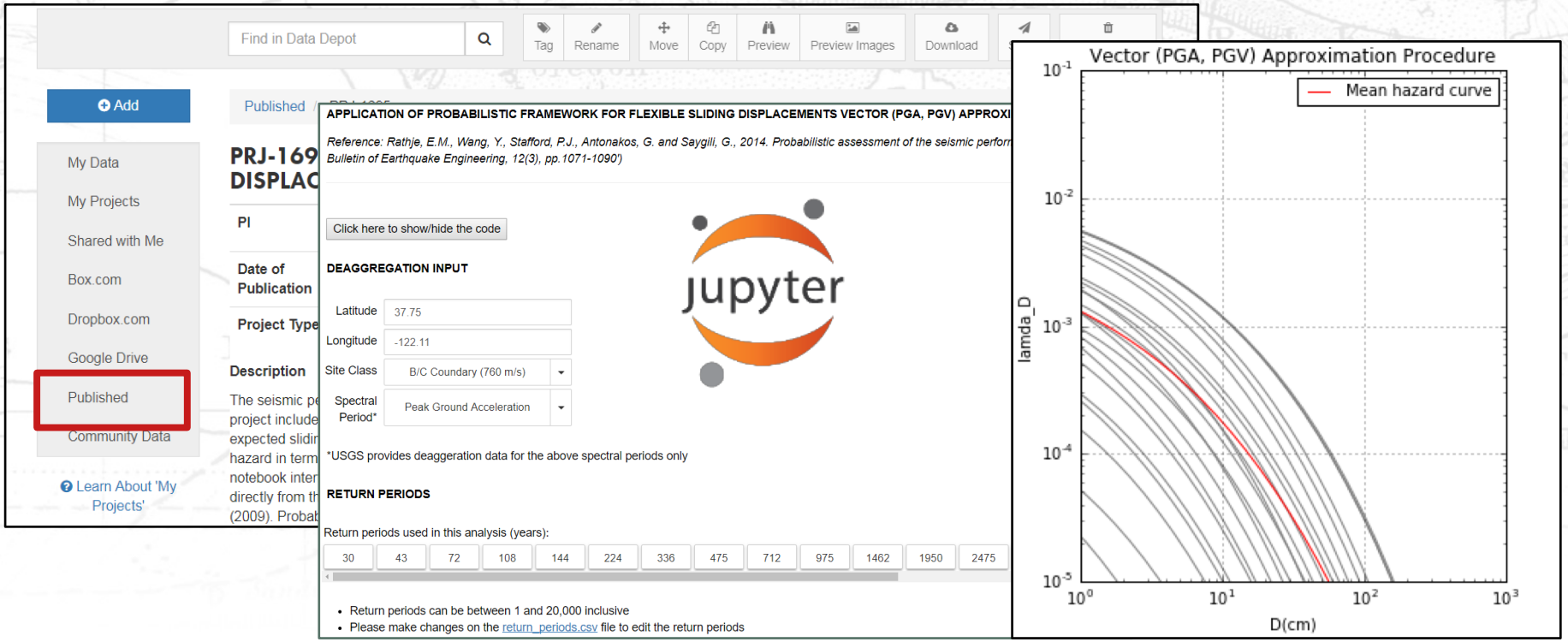
Published Scripts to Aid Research to Practice



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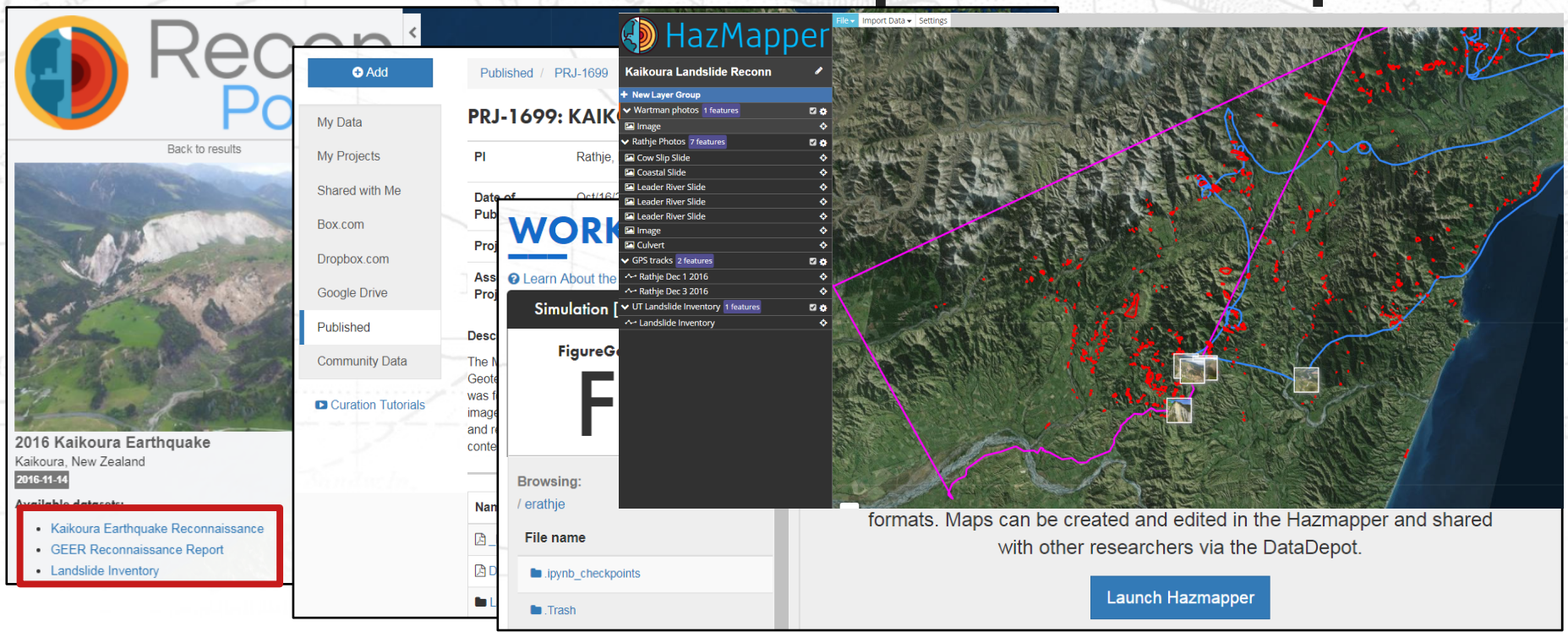
Recon Portal → Data Depot → Workspace



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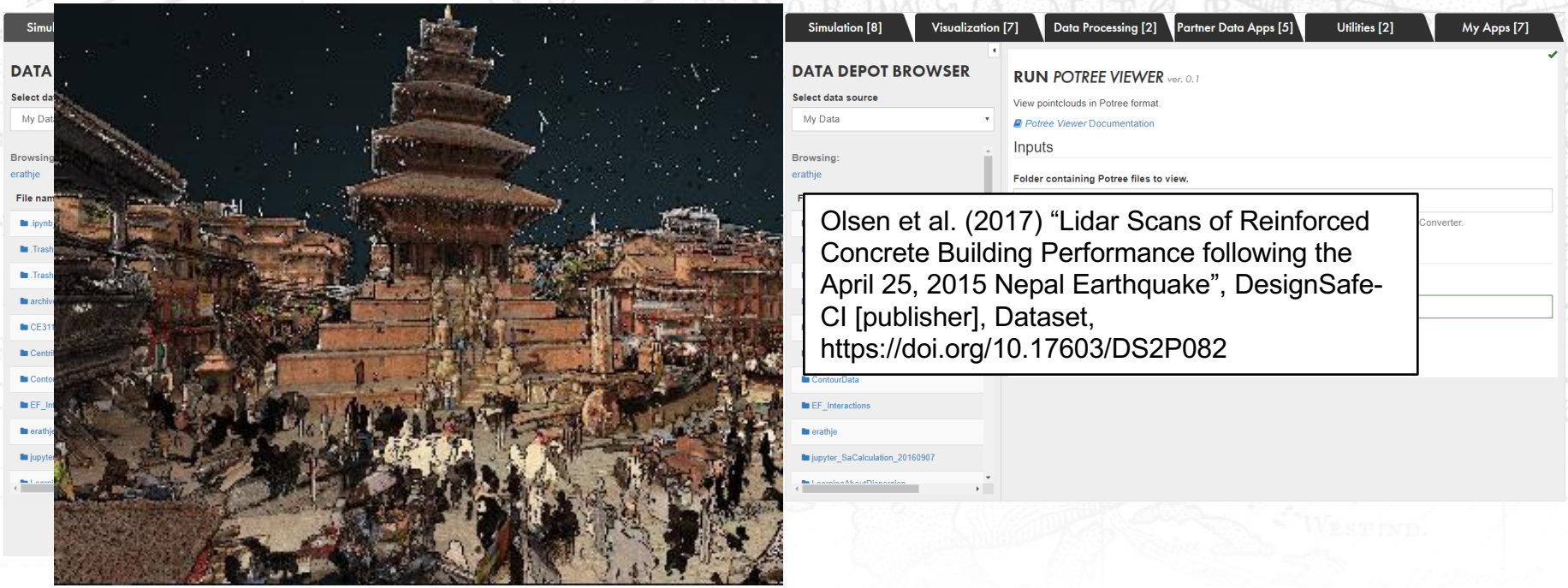
Potree Point Cloud Viewer



Olsen et al. (2017) “Lidar Scans of Reinforced Concrete Building Performance following the April 25, 2015 Nepal Earthquake”, DesignSafe-CI [publisher], Dataset, https://doi.org/10.17603/DS2P082

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Computational Simulation Codes

- OpenSees: FE code for seismic analysis of structures and soil
  - OpenSees Express: runs on a virtual machine
  - OpenSees MP and SP: run on Stampede2 supercomputer
  - Python interpreter OpenSeesPY available through Jupyter
  - STKO (Scientific Tool Kit for OpenSees) and GID: OpenSees pre/post processing
- LS-Dyna: Commercial FE code for structures and soil
  - “Bring Your Own License”, Runs on Stampede2

Computational Simulation Codes

- ADCIRC: storm surge modeling
  - ADCIRC: serial version
  - PADCIRC: parallel version on Stampede2 and Lonestar5
  - PADCIRC + SWAN: includes near shore waves
  - Kalpana available to convert NetCDF to Shapefiles
  - FigureGen available to create images of ADCIRC output
- OpenFOAM: computational fluid dynamics
- Clawpack/GeoClaw: PDE solver for storm surge modeling

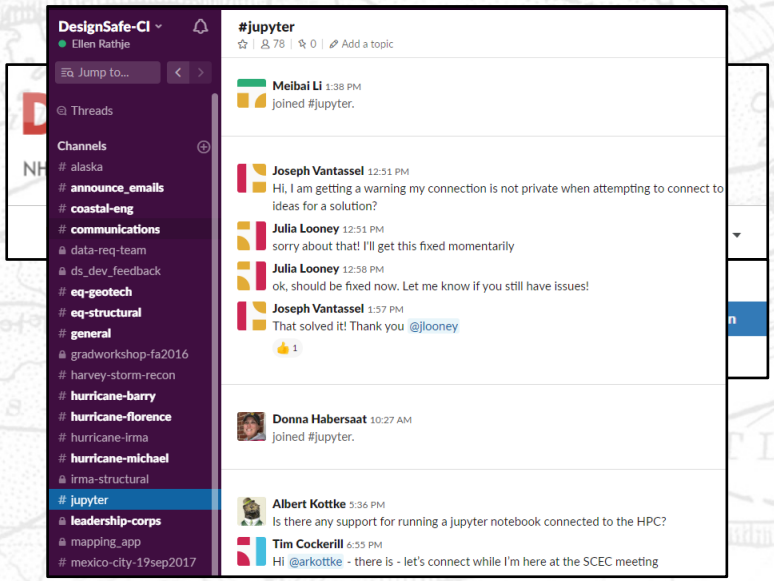
Direct Supercomputer Access

- Are you using an application not available on the portal?
- Are you running jobs that require more nodes?
- You can request a DesignSafe HPC allocation
  https://www.designsafe-ci.org/rw/user-guides/allocations-policy/

DesignSafe: Open for Business

Available to the Global Natural Hazards Research Community

- Interact with us and the community using the DesignSafe Slack team
- Cite data using DOIs!
- Cite DesignSafe marker paper (Rathje et al. 2017, *Natural Hazards Review*) if you use DesignSafe in your research



Please share your feedback, ideas, experiences!

Tim Cockerill cockerill@tacc.utexas.edu

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