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# Quality Control for Next-Generation Liquefaction Case Histories

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# Outline

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- Introduction and project needs
- The Next-Generation Liquefaction (NGL) database
- NGL quality control and review process
- Vision for community access
- Final remarks



# NGL Project Directors

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# NGL Project Contributors

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**Database working group:** Scott Brandenberg (chair), Robb E.S. Moss (Cal Poly), K. Onder Cetin (METU), Kevin Franke (BYU), Paolo Zimmaro (UCLA), and Dong Youp Kwak (Hanyang University)

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**Nuclear Regulatory Commission:** Thomas Weaver

**Caltrans:** Tom Shantz

**Jupyter Notebook Tools:** Honor Fisher, Allison Lee (UCLA undergrads)

**Lateral Spread Project:** Steve Bartlett, Masoud Hosseinali



U.S. NRC



# NGL Project Contributors

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***Others:*** Mike Greenfield, Teruo Nakai, Hideo Sekiguchi



# What is a database?

Event Name	Magnitude	Epicentral Latitude	Epicentral Longitude
Westwood Hills	6.3	34.0689	118.4452
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Hollywood Valley	7.2	34.1027	118.3404
Hollywood Valley	7.2	34.1027	118.3404

Station Name	$V_{S30}$ (m/s)
Factor Building	380
Santa Monica Courthouse	215
Factor Building	380
Santa Monica Courthouse	215

$R_{jb}$ (km)	PGA (g)
2	0.84
14	0.28
20	0.61
30	0.32

Event



Station



Ground Motion



# Example database

Event Table



Event_id	Event Name	Magnitude	Epicentral Latitude	Epicentral Longitude
1	Westwood Hills	6.3	34.0689	118.4452
2	Hollywood Valley	7.2	34.1027	118.3404

 Primary Key

 Foreign Key

Station Table



Station_id	Station Name	$V_{S30}$ (m/s)
1	Factor Building	380
2	Santa Monica Courthouse	215

Motion Table



Motion_id	Event_id	Station_id	$R_{jb}$ (km)	PGA (g)
1	1	1	2	0.84
2	1	2	14	0.28
3	2	1	20	0.61
4	2	2	30	0.32

# NGL Project Activities

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1. Develop a publicly available database of liquefaction case histories.
2. Provide a coordinated framework for supporting studies to augment case history data for conditions that are poorly constrained by empirical data.
3. Provide an open, collaborative process for model development in which developer teams have access to common resources and share ideas during development.

# The NGL Database

[www.nextgenerationliquefaction.org](http://www.nextgenerationliquefaction.org)

View Data ▾ Interact With Data ▾ Actions ▾

Current Mode: User ▾ Log Out

Sites ▾

Field Performance ▾

Field Investigation ▾

Earthquake

Type event name

Magnitude

Mmin Mmax

M6.6 New Zealand-02  
M6.9 Loma Prieta  
M7.0 Darfield, New Zealand  
M6.2 Christchurch, New Zealand  
M5.8 Emilia, Italy  
M9.1 Tohoku-oki  
M7.0 Haicheng (Liaoning), China

Reset Submit

Statistics ▾

Topographic Map (high res.)  
Imagery Map (middle res.)  
Terrain Map (low res.)

Event Information

Event

General description

Site

Boreholes

CPT

Test Pits

Non-Invasive Geophysical

Invasive Geophysical

Water Table

Stratigraphic Units

Detailed Soil Description

3000 km  
2000 mi

SwRI PEER Caltrans U.S. NRC MPC UDOT Keeping Utah Moving

# Database quality control

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The NGL database working group oversees the database population activities and coordinates the formal process of reviewing NGL case histories.

Objective review:

- check that all required data fields are provided
- information provided is clear
- that the data are consistent with the original source

	Number
CPT Soundings	130
Boreholes	144
Surface Wave Measurements	9
Invasive Vs Profiles	33
Liquefaction Observations	133
Non-Liquefaction Observations	211



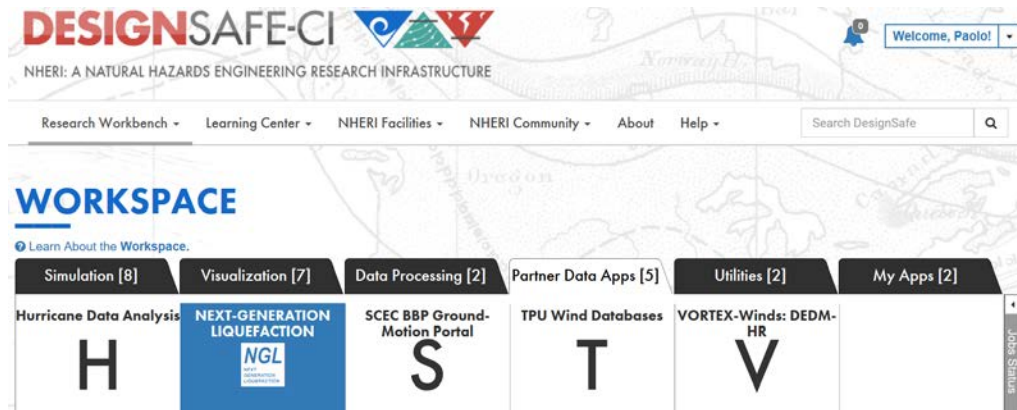
# Database quality control – NGL GUI

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# Vision for community access to cloud or not to cloud?

- Due to large amount of data, downloading data and processing them on a laptop is inefficient and undesirable (still possible).
- The database is mirrored onto DesignSafe ([www.designsafe-ci.org](http://www.designsafe-ci.org)). Users will be able to process data on the cloud using SQL queries in Jupyter notebook Python scripts (*off-the-shelf* libraries).



The screenshot shows the DesignSafe-CI workspace interface. At the top, the logo for DESIGNSAFE-CI is displayed, along with the text "NHERI: A NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE". A navigation bar includes links for "Research Workbench", "Learning Center", "NHERI Facilities", "NHERI Community", "About", and "Help". A search bar is located on the right. Below the navigation bar, the "WORKSPACE" section is visible, featuring a grid of application tiles. The tiles are categorized by type and count: Simulation [8], Visualization [7], Data Processing [2], Partner Data Apps [5], Utilities [2], and My Apps [2]. The tiles themselves are labeled with large letters: "H" for Hurricane Data Analysis, "S" for SCEC BBP Ground-Motion Portal, "T" for TPU Wind Databases, and "V" for VORTEX-Winds: DEDM-HR. A vertical sidebar on the right indicates the user's name, "John Stanton".



# Vision for community access

## NGL Jupyter notebooks on DesignSafe

**NGL Jupyter notebooks are all available in Community Data**

**<https://jupyter.designsafe-ci.org>**



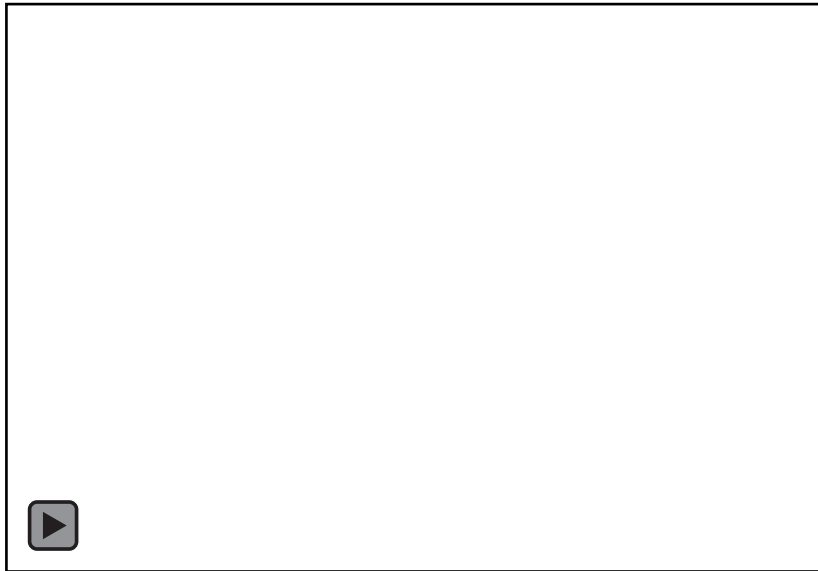
CommunityData / NGL		Name ↓	Last Modified
..			seconds ago
InverseFilteredCPT			5 hours ago
Connection.ipynb			a month ago
CPT_viewer.ipynb			5 hours ago
ExampleQueries.ipynb			5 hours ago
SPT_Viewer.ipynb			21 hours ago
VS_Invasive_Plots_and_Widgets.ipynb			seconds ago
VS_Invasive_viewer.ipynb			a month ago
VS_non_Invasive_viewer.ipynb			21 hours ago
CPT_thin_layer.py			15 days ago
footer.png			a month ago
NGLlogo-italic.png			a month ago

# Vision for community access – CPT viewer

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**NGL Jupyter notebooks are all available in Community Data**

**<https://jupyter.designsafe-ci.org>**



# Need more details about the database?

Understand the NGL schema

Schema online dictionary: <http://nextgenerationliquefaction.org/schema/index.html>

NGL Database Home Schema index Tables Columns Constraints Relationships Orphan Tables Anomalies Routines

Tables

SchemaSpy Analysis of NGL\_11\_19\_2018  
Generated on Tue Nov 27 12:08 PST 2018.

SQL Representation: Insertion Order Deletion Order

TABLES 55 VIEWS 0 COLUMNS 475 CONSTRAINTS 63 ANOMALIES 0 ROUTINES 0

Tables

All Tables Views Comments

Table / View	Children	Parents	Columns	Rows	Type	Comments
BORH	0	1	11	0	Table	General information for boreholes

# Conclusion

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- NGL database ([www.nextgenerationliquefaction.org](http://www.nextgenerationliquefaction.org)): more than 300 case histories and counting
- Database working group is supervising a formal case history vetting process
- NGL database mirrored onto DesignSafe
- Big-data analytics capability via Jupyter notebooks and other tools

# Thank you!

## Questions?

### Relevant References

- Brandenberg S.J., Kwak D.Y., Zimmaro P., Bozorgnia Y., Kramer S.L., Stewart J.P. (2018). Next-Generation Liquefaction (NGL) Case History Database Structure. Fifth decennial Geotechnical Earthquake Engineering and Soil Dynamics Conference, Earthquake Engineering and Soil Dynamics Committee of the Geo-Institute. Austin, TX (USA), June 10-13.
- Zimmaro P., Brandenberg S.J., Stewart J.P., Kwak D.Y., Franke K.W., Moss R.E.S., Cetin K.O., Can G., Ilgac M., Stamatakos J., Juckett M., Mukherjee J., Murphy Z., Ybarra S., Weaver T., Bozorgnia Y., Kramer S.L. (2019). Next-Generation Liquefaction Database. Next-Generation Liquefaction Consortium. DOI: 10.21222/C2J040.
- Stewart J.P., Kramer S.L., Kwak D.Y., Greenfield M.W., Kayen R.E., Tokimatsu K., Bray J.D., Beyzaei C.Z., Cubrinovski M., Sekiguchi T., Nakai S., Bozorgnia Y. (2016). PEER-NGL project: Open source global database and model development for the next-generation of liquefaction assessment procedures. Soil Dyn. Earthquake Eng., 91, 317–328.



Project homepage:

<https://uclageo.com/NGL/>

Database:

DOI: 10.21222/C2J040

<http://nextgenerationliquefaction.org>

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**Thank you!**  
**Questions?**

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