

# Next Generation Liquefaction Database and Cloud Computing

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K.J. Ulmer, P. Zimmaro, S.J. Brandenberg, K.O. Cetin, K.W. Franke, R.E.S. Moss, G. Can, K. Hudson, and M. Ilgac

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# Outline

- Database Contents
  - Types of information
  - Database size
  - Earthquakes
- Database Access
  - Different ways to access database content
  - Tools and resources to help you connect

# Database Contents

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# Database Contents

- Events
- Sites
- In-situ Tests (SPT, CPT, invasive and non-invasive geophysical tests)
- Observations
- Laboratory Tests

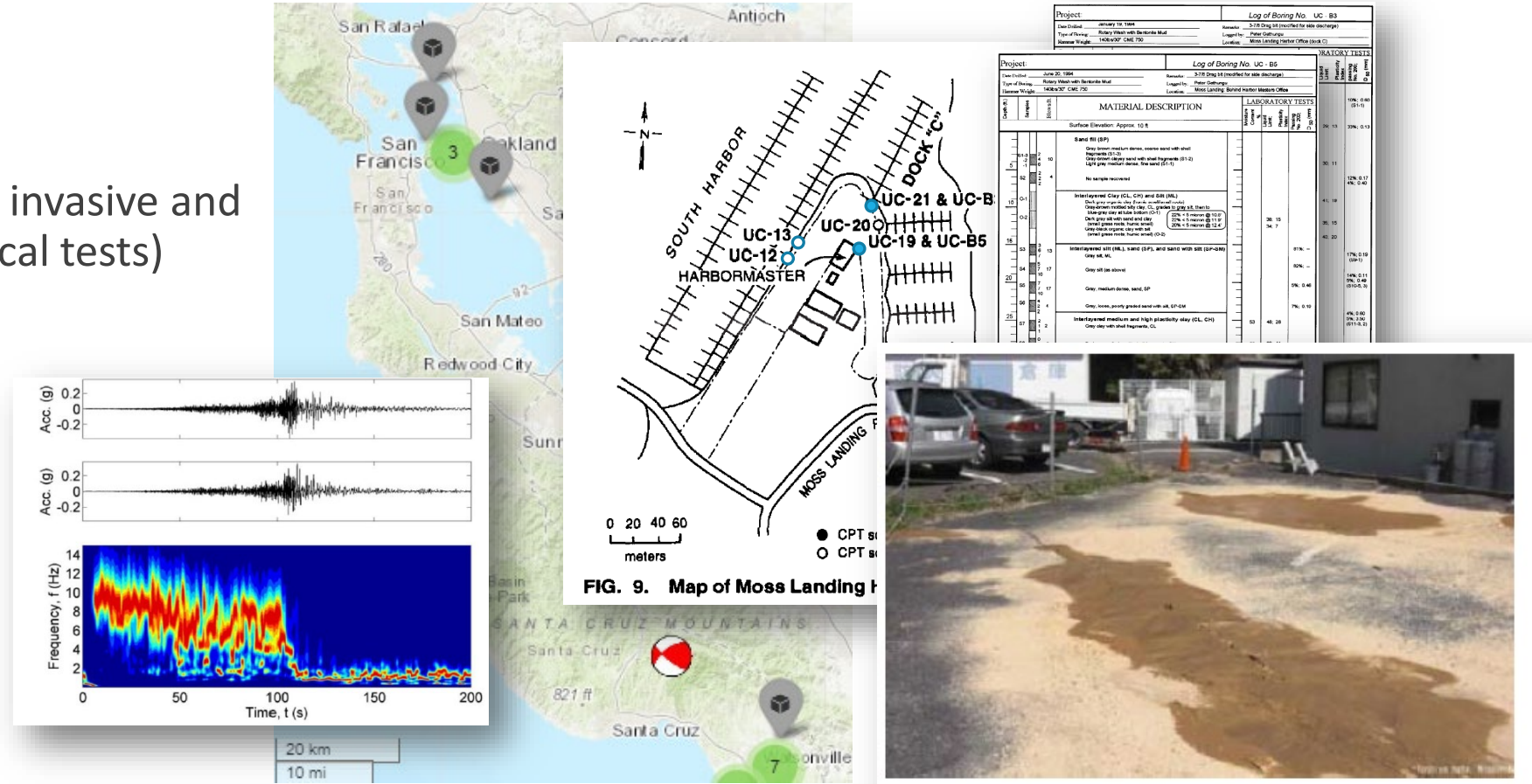
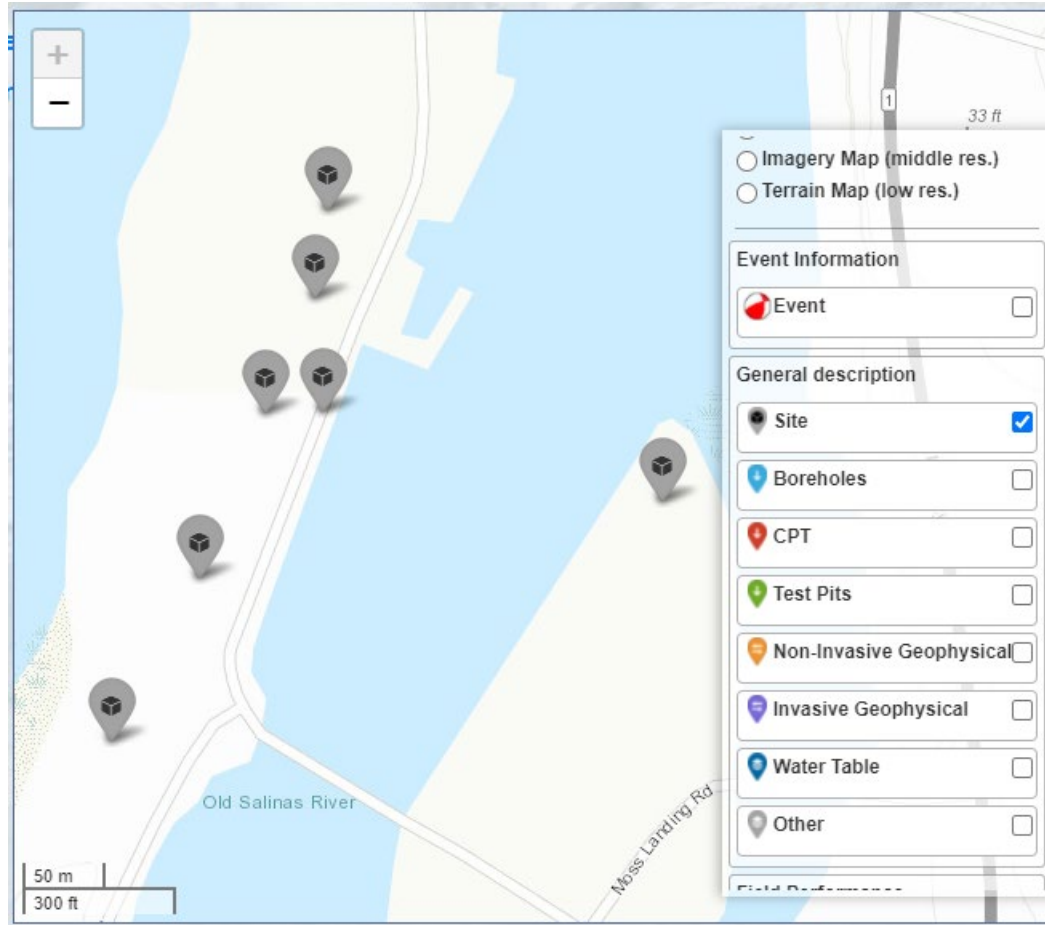
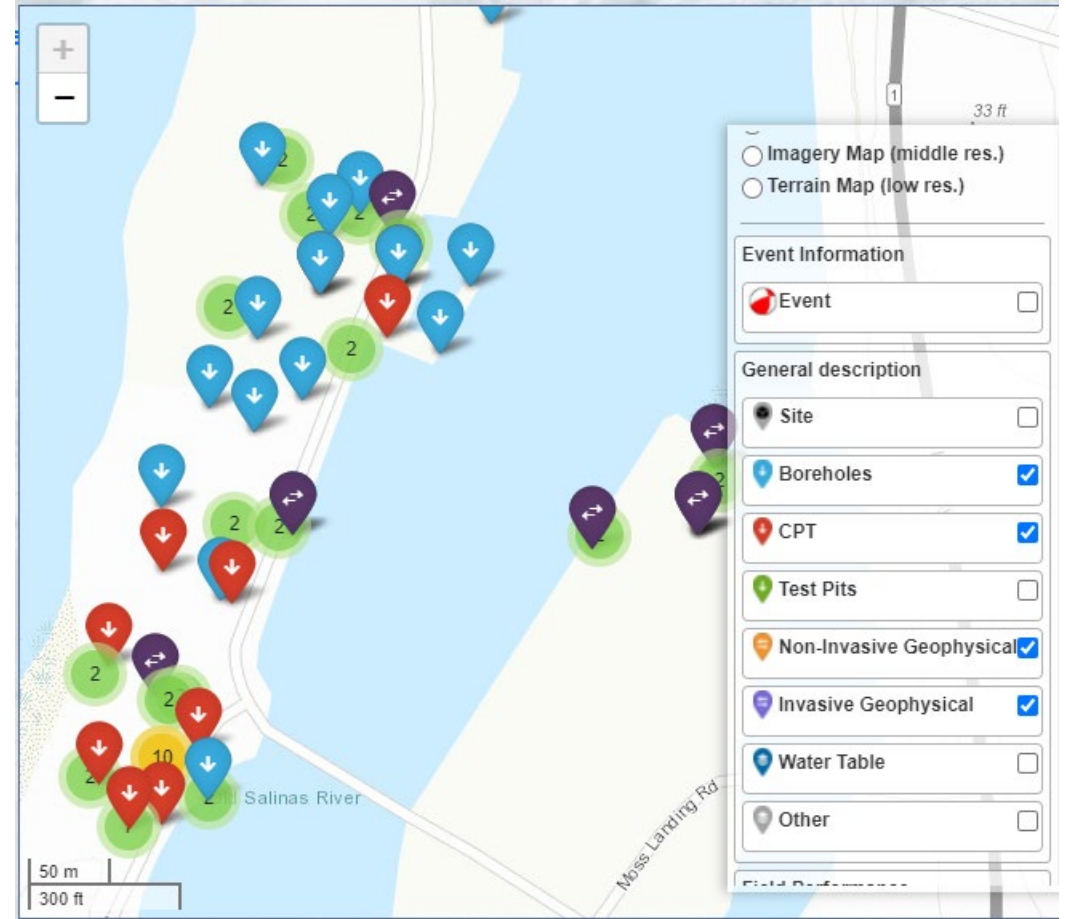


FIG. 9. Map of Moss Landing Harbor

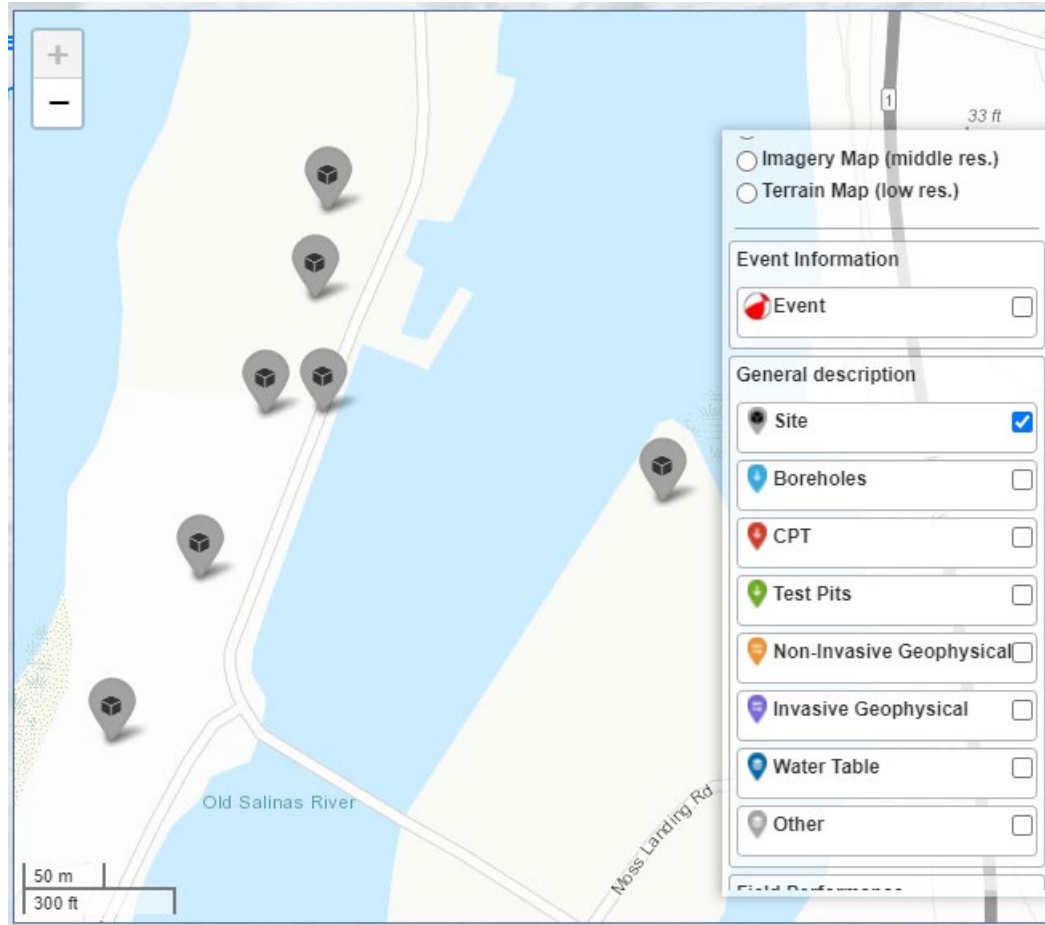
## Sites



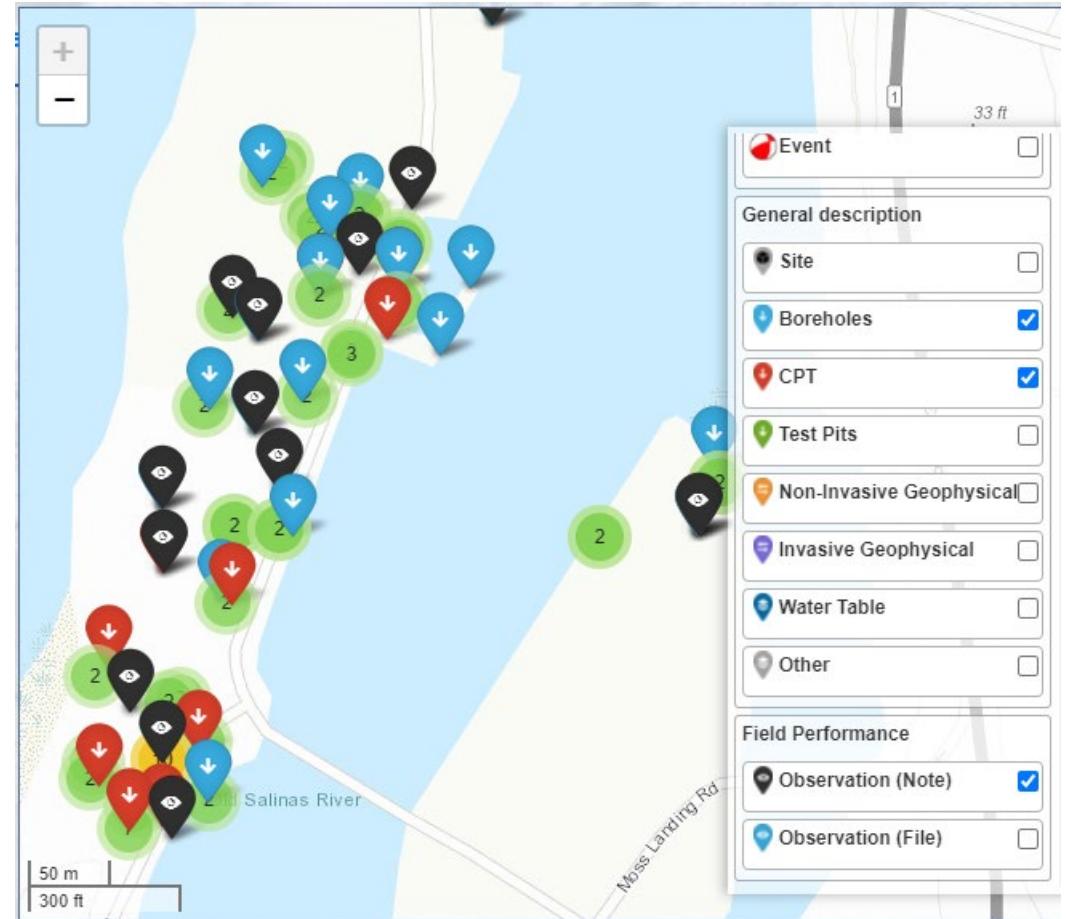
## In-Situ Tests



## Sites



## Observations and Tests



# Database Contents

Type	Total Number	In Preparation	Under Review		Reviewed (Two Reviews)
			(No Reviews)	(One Review)	
CPT Soundings	<b>935</b>	273	27	81	554
Boreholes	<b>910</b>	220	44	61	585
Surface Wave Measurements	<b>39</b>	13	7	0	19
Invasive Vs Profiles	<b>139</b>	0	14	1	124
Liquefaction Observations	<b>695</b>	131	32	51	481
Non-Liquefaction Observations	<b>494</b>	89	23	73	308

# Database Contents

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	Total Number
Index (Gs, wc, FC)	4641
Plasticity	1675
Grain Size	5376
Relative Density	77
Consolidation	9
Triaxial	64
Simple Shear	72

**Current Database size: 1.56 GB**



# Earthquake Events

Year	Event	M	Yes	No	CPT	SPT	Vs
1944	Tohnankai	8.2	3	0	0	3	0
1948	Fukui	6.84	2	1	0	3	0
1964	Niigata	7.6	17	5	5	38	0
1968	Inangahua, New Zealand	7.1	0	1	1	0	0
1968	Tokachi-oki - off the east coast of Honshu	8.2	6	4	0	16	1
1971	San Fernando	6.61	13	0	12	6	0
1975	Haicheng (Liaoning), China	7	5	2	9	5	7
1976	Tangshan	7.6	12	7	21	19	15
1976	Guatemala	7.5	1	4	0	4	0
1977	San Juan (Caucete), Argentina	7.4	16	4	0	6	0
1978	Miyagiken-Oki 2	7.7	22	10	0	27	0
1978	Miyagiken-Oki 1	6.5	1	16	0	27	0
1979	Imperial Valley-06	6.53	8	4	30	22	7
1980	Victoria, Mexico	6.33	4	1	13	5	0
1980	Mid-Chiba, Japan	6	0	1	1	1	0
1981	Westmorland	5.9	3	2	44	16	3
1983	Nihonkai-Chubu Aftershock	6.8	1	0	0	1	0
1983	Nihonkai-Chubu - near the west coast of Honshu	7.7	33	14	3	38	3
1987	Superstition Hills-02	6.54	1	7	48	23	7
1987	New Zealand-02 (Edgecumbe)	6.6	20	7	53	5	0
1987	Superstition Hills-01	6.22	0	3	28	8	3
1989	Loma Prieta	6.93	154	56	214	109	43
1990	Luzon, Philippines	7.7	38	6	0	15	0
1993	Kushiro-oki - Hokkaido	7.6	6	2	0	7	3

Year	Event	M	Yes	No	CPT	SPT	Vs
1994	Toho-oki - Hokkaido (Kuril Islands)	8.3	2	1	0	5	3
1994	Northridge-01	6.69	11	0	63	31	5
1995	Kobe, Japan	6.9	51	37	36	73	3
1999	Hokkaido	6.2	0	1	0	1	1
1999	Kocaeli, Turkey	7.51	17	2	70	41	22
1999	Chi-Chi, Taiwan	7.62	58	175	53	53	22
2000	Tottori, Japan	6.61	1	0	0	1	1
2002	Au Sable Forks NY	4.99	1	1	0	18	0
2003	Tokachi	8.3	3	1	3	8	6
2007	Chuetsu-oki	6.8	1	0	0	1	1
2010	El Mayor-Cucapah	7.2	6	2	29	7	5
2010	Darfield, New Zealand	7	46	16	184	27	1
2010	Maule, Chile	8.8	11	1	9	10	4
2011	Tohoku-oki	9.1	23	19	22	36	32
2011	Lyttleton Earthquake, New Zealand	5.9	12	10	159	28	0
2011	Lyttleton Foreshock, New Zealand	5.8	1	0	11	2	0
2011	Christchurch SE Earthquake 0613, New Zealand	6	14	14	185	36	0
2011	Christchurch SE Foreshock 0613, New Zealand	5.2	3	5	49	6	0
2011	Christchurch 20110416, New Zealand	5	6	2	29	0	0
2011	Christchurch, New Zealand	6.2	55	14	251	45	1
2012	Emilia, Italy	5.8	1	0	1	0	0
2013	Obihiro - Hokkaido	6.9	0	1	0	1	1
2021	Near East Coast of Honshu	6	0	12	10	7	5
<b>TOTAL</b>		<b>47</b>	<b>689</b>	<b>471</b>	<b>1646</b>	<b>841</b>	<b>205</b>

Yes = A latitude/longitude coordinate where surficial evidence of liquefaction was observed (e.g., sand boil, lateral spread, settlement, structural damage, etc.)

No = A latitude/longitude coordinate where no surficial evidence of liquefaction was observed

# Database Access

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# Tools and Resources

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- Graphical User Interface (GUI) <https://nextgenerationliquefaction.org/>
- Connect to the NGL database through Jupyter Notebooks on DesignSafe <https://www.designsafe-ci.org/>
- Schema website <https://nextgenerationliquefaction.org/schema/index.html>
- NGL Tools Documentation
  - Use case documentation on DesignSafe (<https://www.designsafe-ci.org/rw/use-cases/>)
  - <https://ngl-tools.readthedocs.io/en/latest/>
- NGL YouTube Channel
  - Webinars on case histories and related topics
  - October DesignSafe Workshop: creating Jupyter Notebooks

Sites ▾

Field Performance ▾

Field Investigation ▾

Earthquake ▾

Type event name

Magnitude:

min

max

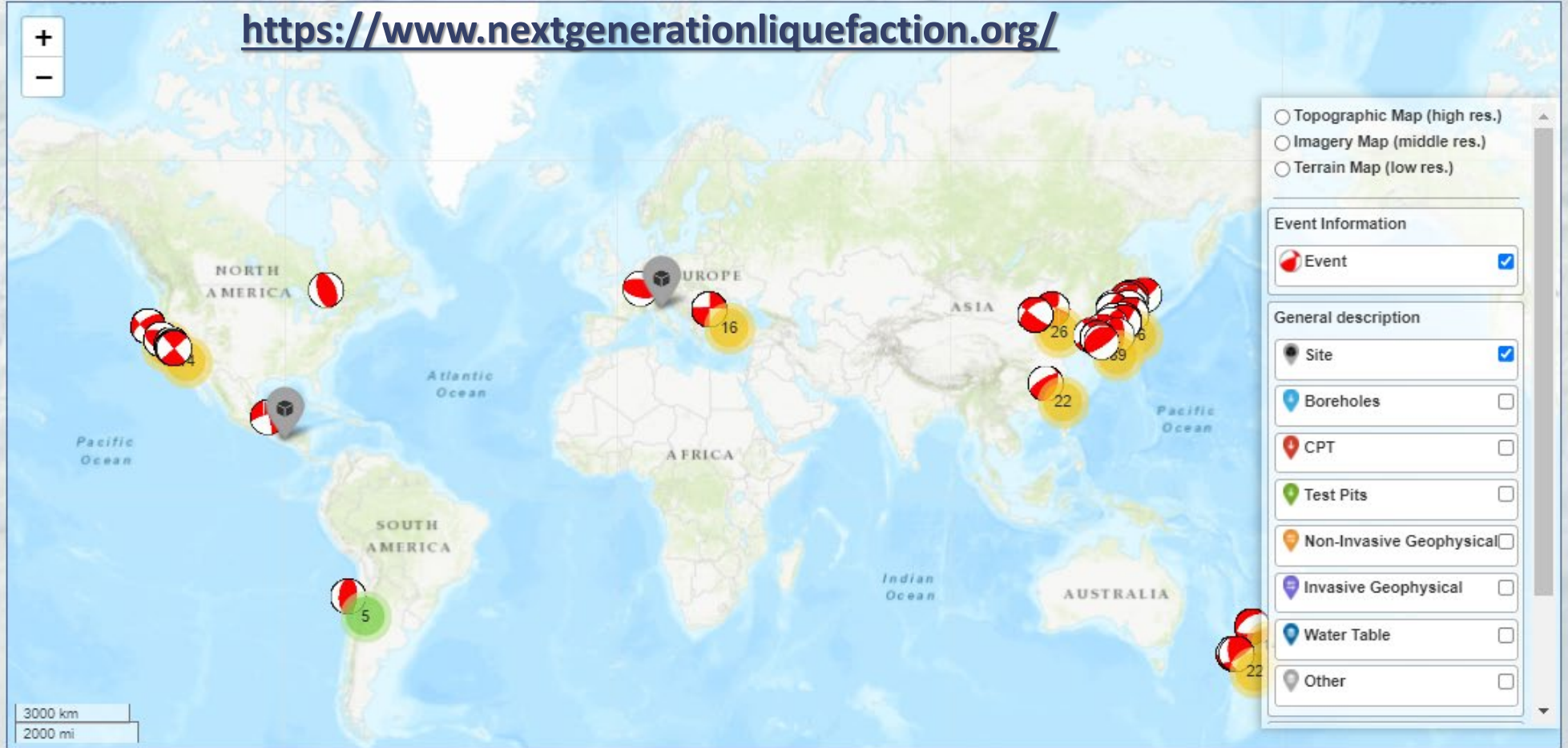
(choose one or type ▾)

Submit

Reset

Statistics ▾

<https://www.nextgenerationliquefaction.org/>





Latitude 37.82411  
Longitude -122.31489  
Observations: Surface Evidence / Settlement / Structural Damage  
Note: Figure 7: settlement on the east side of the administrative building at the SFOBB toll plaza (Kayen et al. 1998). Location approximated using description and satellite imagery from the year 1993.

### SFOBB-1 - SPT

Type Borehole  
Latitude (deg) 37.824811  
Longitude (deg) -122.309862  
Note: Test information from Mitchell et al. (1994). Location estimated from Figure 5 of Mitchell et al. (1992).  
Reviewed?   
[Plot](#)

### SFOBB-4

Type CPT  
Latitude (deg) 37.823796  
Longitude (deg) -122.314986  
Note: Digitized from Figure 6.11 in Kayen (1993). Sleeve friction approximated from (Penetration Resistance) x (Friction Ratio / 100%). Location estimated from Figure 5 of Mitchell et al. (1992).  
Reviewed?   
[Plot](#)

#### Information

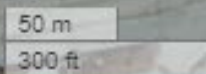
nt

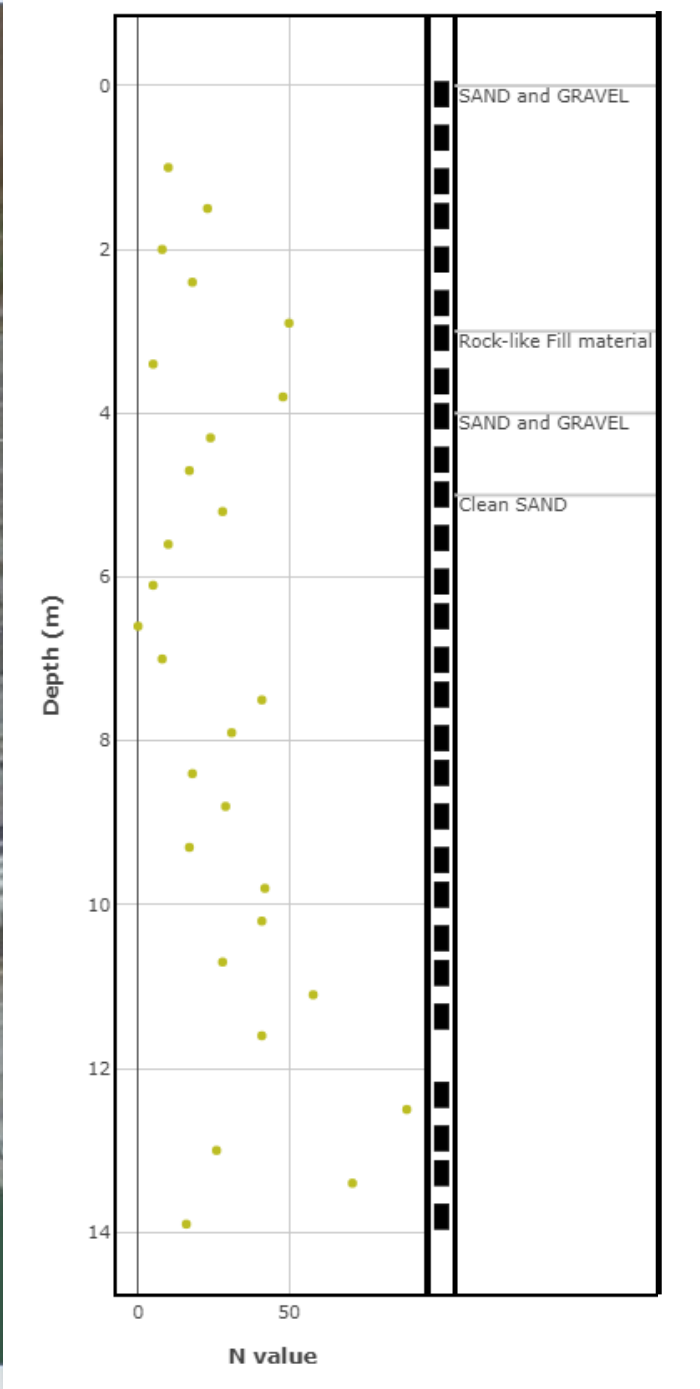
#### General description

- Site
- Boreholes
- CPT
- Test Pits
- Non-Invasive Geophysical
- Invasive Geophysical
- Water Table
- Other

#### Field Performance

- Observation (Note)
- Observation (File)





nt Information

Event

eral description

Site

Boreholes

CPT

Test Pits

Non-Invasive Geophysical

Invasive Geophysical

Water Table

Other

d Performance

Observation (Note)

Observation (File)

# Connecting to the NGL Database through DesignSafe

The screenshot displays the DesignSafe website interface. At the top, the NGL logo (Next Generation Liquefaction) is visible, along with navigation links for 'View Data', 'Interact With Data', and 'About'. The 'Interact With Data' dropdown menu is open, showing options: 'Schema', 'New DesignSafe User', 'Existing DesignSafe User', and 'NGL Tools Documentation'. The 'Existing DesignSafe User' option is highlighted with a yellow box. Below the navigation bar, the 'DESIGNSAFE' logo and 'NSF' logo are present. The main content area features a 'TOOLS & APPLICATIONS' section with a sub-link 'Learn About Tools & Applications.' and a tray of application cards. The 'SimCenter Tools' card is highlighted with a yellow box and contains the NGL logo. Other cards include 'Hurricane Data Analysis' (H), 'SCEC BBP Ground-Motion Portal' (S), 'SWbatch' (S), and 'TPU V'. A 'My Data' link is also visible. At the bottom of the tray, it says 'Select an application from the tray above.'

Select items to perform actions on them.

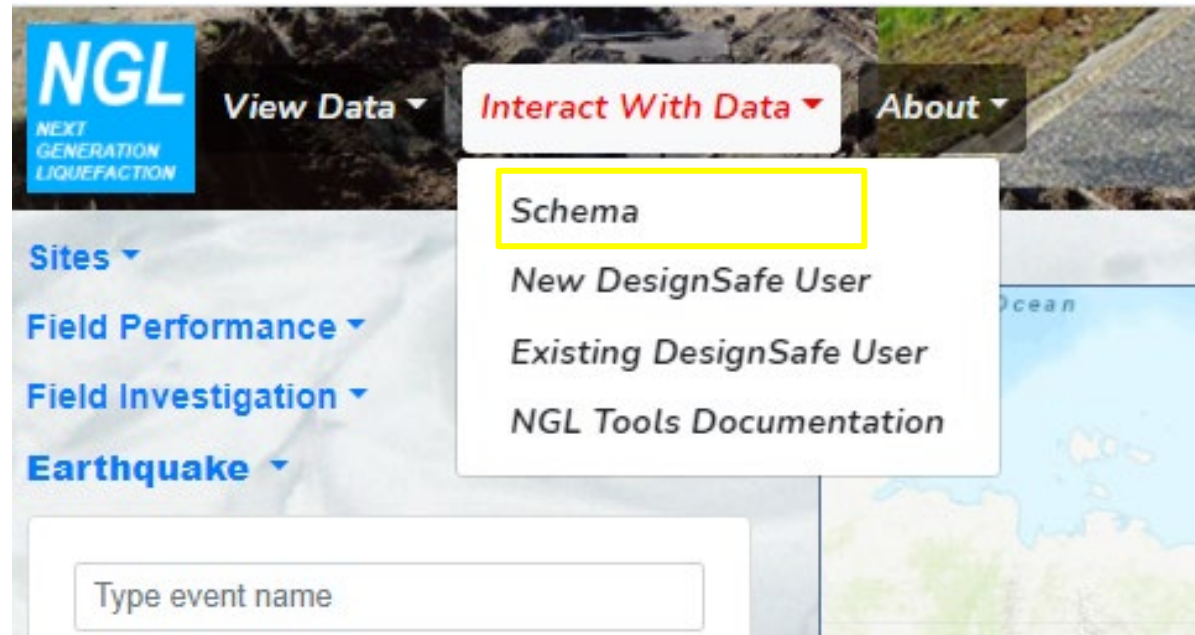
Upload New ↕

<input type="checkbox"/> 0 ▾ / CommunityData / NGL		Name ↓	Last Modified	File size
<input type="checkbox"/> ..			seconds ago	
<input type="checkbox"/>	 CPT_viewer.ipynb		2 months ago	91.1 kB
<input type="checkbox"/>	 ExampleQueries.ipynb		2 months ago	53.3 kB
<input type="checkbox"/>	 SPT_Viewer.ipynb		17 hours ago	27.1 kB
<input type="checkbox"/>	 SPT_Viewer_old.ipynb		a month ago	17.3 kB
<input type="checkbox"/>	 VS_Invasive_viewer.ipynb		17 hours ago	71.4 kB
<input type="checkbox"/>	 VS_Invasive_viewer_old.ipynb		2 years ago	96.9 kB
<input type="checkbox"/>	 VS_non_Invasive_viewer.ipynb		2 years ago	109 kB
<input type="checkbox"/>	 footer.png		2 years ago	61.7 kB
<input type="checkbox"/>	 NGLlogo-italic.png		2 years ago	20.8 kB
<input type="checkbox"/>	 README.html		2 months ago	90 B



# NGL Schema

- <https://nextgenerationliquefaction.org/schema/index.html>



## Tables

## SchemaSpy Analysis of sjbrande\_ngl\_db

Generated on Sun Jul 11 17:23 CEST 2021

XML Representation

Insertion Order Deletion Order

TABLES  
77VIEWS  
0

## Database Properties

Database Type: MySQL - 5.6.41-84.1

## Tables

All Tables Views Comments

Table / View	Children	Parents	Co
BORH	0	1	

## BORH

662 rows

Description [↗](#)

General information for boreholes

Columns [↗](#)

Related columns Constraint Comments

Column	Type	Size	Nulls	Auto	Default	Children	Parents	Comments
BORH_ID	INT UNSIGNED	10		√	null			Unique ID (primary key) for entries in the BORH table
TEST_ID	INT UNSIGNED	10	√		null		TEST	
BORH_TYPE	VARCHAR	50	√		null			Type of boring (e.g., Rotary wash, Hand auger)
BORH_RIG	VARCHAR	50	√		null			Boring rig information
BORH_DIA	FLOAT	12	√		null			Borehole diameter in m
BORH_CREW	VARCHAR	100	√		null			Name of logger / organization
BORH_MECH	VARCHAR	100	√		null			Hammer drop system (e.g., Rope-cathead Trip, Semi-automatic, Automatic)

# NGL Tools Documentation

The screenshot shows the NGL Tools website interface. At the top left is the NGL logo (Next Generation Liquefaction). Navigation links include 'View Data', 'Interact With Data', and 'About'. A dropdown menu is open under 'Interact With Data', listing 'Schema', 'New DesignSafe User', 'Existing DesignSafe User', and 'NGL Tools Documentation' (which is highlighted with a yellow box). Below the menu is a search bar labeled 'Type event name'. At the bottom, there is a promotional banner for '[Book a Demo]' with the text 'Get control of your code to ship fast, reduce risk, & reclaim your nights & weekends.' and 'Sponsored • Ads served ethically'.

» ngl\_tools documentation

[Edit on GitHub](#)

## ngl\_tools documentation

ngl\_tools is a collection of Jupyter notebooks developed to interact with the NGL database in DesignSafe. The Next Generation Liquefaction (NGL) Project is advancing the state of the art in liquefaction research and working toward providing end users with a consensus approach to assess liquefaction potential within a probabilistic and risk-informed framework. Specifically, NGL's goal is to first collect and organize liquefaction information in a common and comprehensive database to provide all researchers with a substantially larger, more consistent, and more reliable source of liquefaction data than existed previously. Based on this database, we will create probabilistic models that provide hazard- and risk-consistent bases for assessing liquefaction susceptibility, the potential for liquefaction to be triggered in susceptible soils, and the likely consequences. NGL is committed to an open and objective evaluation and integration of data, models and methods, as recommended in a 2016 National Academies [report](#). The evaluation and integration of the data into new models and methods will be clear and transparent. Following these principles will ensure that the resulting liquefaction susceptibility, triggering, and consequence models are reliable, robust and vetted by the scientific community, providing a solid foundation for designing, constructing and overseeing critical infrastructure projects.

The NGL database is populated through a web GUI at [www.nextgenerationliquefaction.org/](http://www.nextgenerationliquefaction.org/). The web interface provides limited capabilities for users to interact with data. Users are able to view and download data, but they cannot use the GUI to develop an end-to-end workflow to make scientific inferences and draw conclusions from the data. To facilitate end-to-end workflows, the NGL database is replicated daily to [DesignSafe](#), where users can interact with it using Jupyter notebooks.



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# Next Generation Liquefaction

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CHANNELS

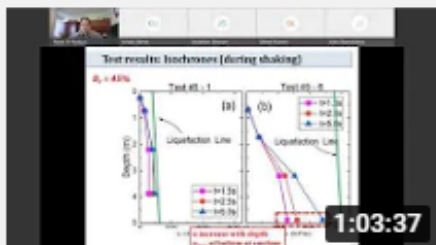
DISCUSSION

ABOUT



Uploads

▶ PLAY ALL



NGL Webinar Series (05)  
Tarek Abdoun, Effect of...

21 views • 2 months ago



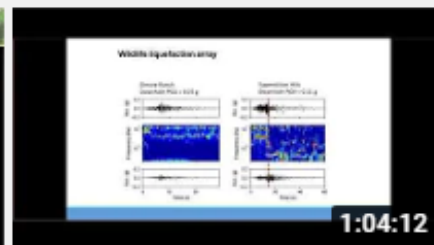
NGL Webinar Series (04)  
Monica Bucci, "What can w...

57 views • 3 months ago



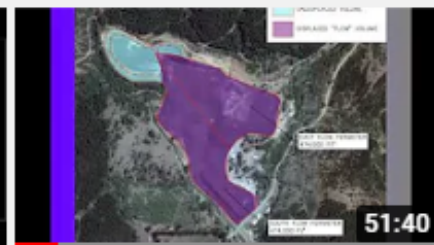
NGL Webinar Series (03)  
Christine Beyzaei, "Silty So...

53 views • 6 months ago



NGL Webinar Series (02)  
Mike Greenfield, "Ground...

67 views • 7 months ago



NGL Webinar Series (01)  
Robb Moss, "Las Palmas...

56 views • 8 months ago

<https://www.youtube.com/channel/UCtcbOIVb3soaJ5X60vdgKkw>

# Jupyter Notebooks

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- Jupyter notebooks allow us to do more
  - Import sophisticated analysis packages
  - Directly query the NGL database
  - Incorporate other publicly available information (e.g., spatial data)
- Example: visualizing individual case histories

Figure 8



SITE: Wufeng Site A, TEST: WAC-2,  
 EVNT: Chi-Chi, Taiwan,  
 FLDM: 1010 = No, 0.0m away

- Interbedding
- Deep Liq
- Strong Crust
- Partial Drainage

- Critical Layer w/ High  $I_c$

Comments:

Case #: 206

Layer: 7

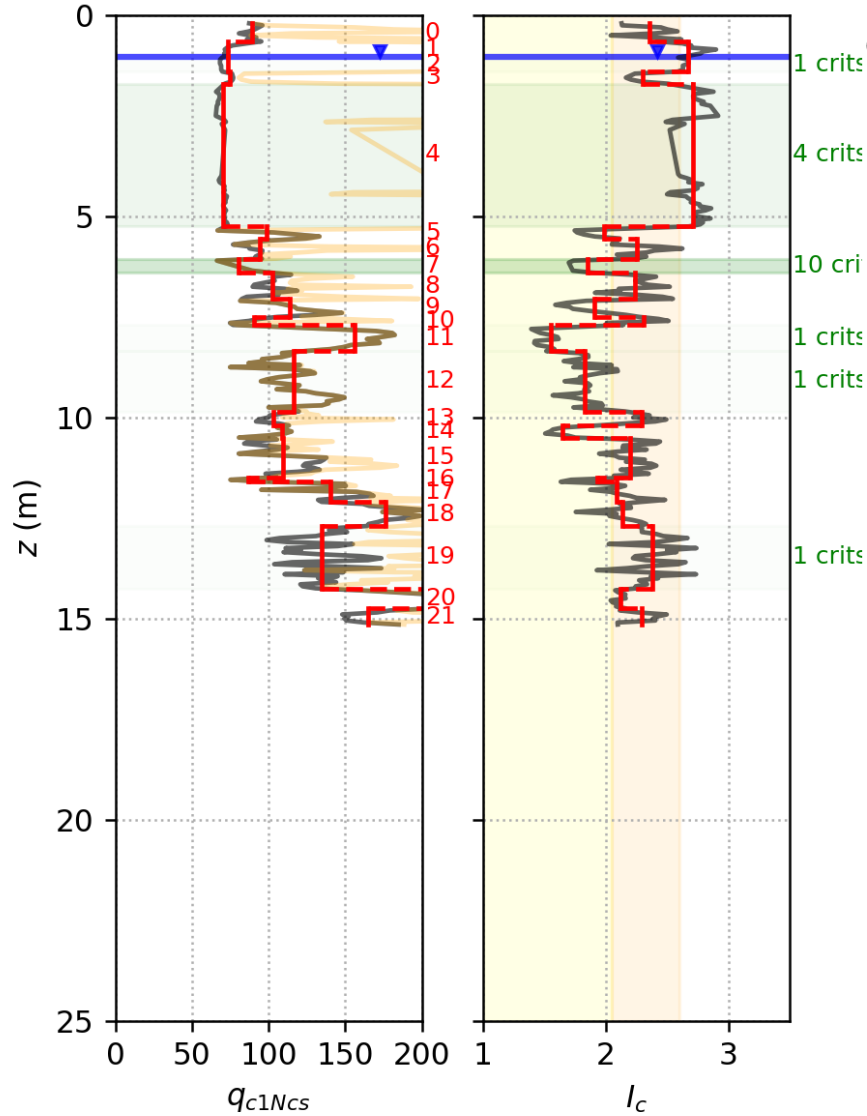
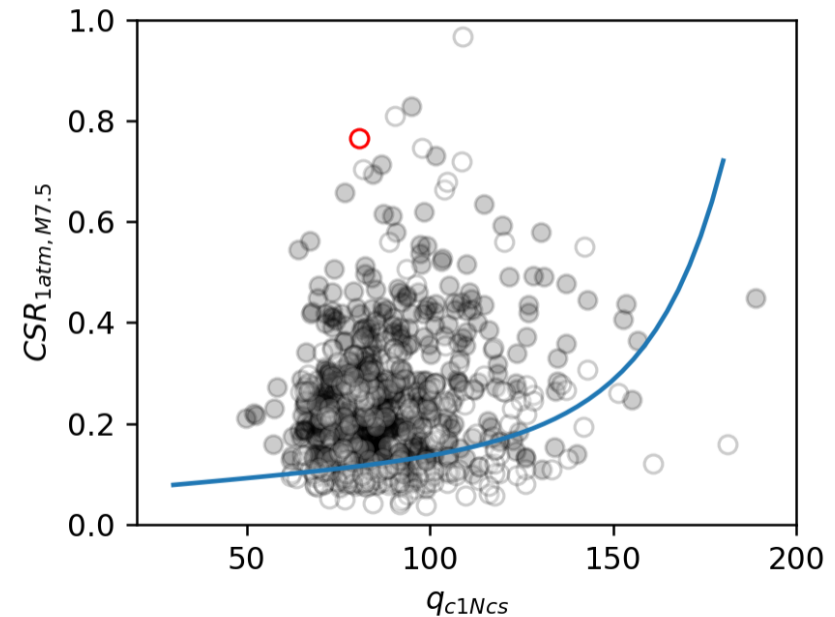


Figure 10



Layer No 7  
 (Criteria 1, 2, 3, 4, 5, 6, 7, 8, 17, 18)



# Conclusions

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- The NGL Database is populated with data to support your research
- Connecting to the database is facilitated through the GUI and Jupyter notebooks in DesignSafe
- Getting involved with NGL:
  - Have a case history to share? Contact us!
  - Want to use the database? The database itself and links to resources are available: <https://nextgenerationliquefaction.org>
  - Want to support the NGL project? Contact us!

# Questions

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## Contact Information

NGL Admin [admin@nextgenerationliquefaction.org](mailto:admin@nextgenerationliquefaction.org)

Scott Brandenburg [sjbrandenberg@g.ucla.edu](mailto:sjbrandenberg@g.ucla.edu)

Paolo Zimmaro [paolo.zimmaro@unical.it](mailto:paolo.zimmaro@unical.it)

Kristin Ulmer [kulmer@swri.org](mailto:kulmer@swri.org)

## References

Brandenberg, S. J., Zimmaro, P., Stewart, J. P., Kwak, D. Y., Franke, K. W., Moss, R. E., Cetin, K.O., Can, G., Gligac, M., Stamatakos, J., Weaver, T., & Kramer, S. L. (2020). Next-generation liquefaction database. *Earthquake Spectra*, 36(2), 939-959.

Next Generation Liquefaction (NGL) database. <https://nextgenerationliquefaction.org> (DOI: 10.21222/C2J040)

Rathje, E., Dawson, C. Padgett, J.E., Pinelli, J.-P., Stanzione, D., Adair, A., Arduino, P., Brandenburg, S.J., Cockerill, T., Dey, C., Esteva, M., Haan, Jr., F.L., Hanlon, M., Kareem, A., Lowes, L., Mock, S., and Mosqueda, G. 2017. "DesignSafe: A New Cyberinfrastructure for Natural Hazards Engineering," *ASCE Natural Hazards Review*, doi:10.1061/(ASCE)NH.1527-6996.0000246. <https://www.designsafe-ci.org/>