Next Generation Liquefaction: A Community Discussion

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Outline

Introduction and current needs

The Next-Generation Liquefaction (NGL) database

Laboratory component of the database

Cloud-based community access

Discussion points
NGL Database Contributors

- **NGL leadership**: Jonathan Stewart, Steven Kramer, Yousef Bozorgnia
- **Database working group**: Scott Brandenberg (chair), Robb E.S. Moss (Cal Poly), K. Onder Cetin (METU), Kevin Franke (BYU), Paolo Zimmardo (UCLA), and Dong Youp Kwak (Hanyang University)
- **Southwest Research Institute**: John Stamatakos, Miriam Juckett, Bis Dasgupta, Joey Mukherjee, Zackary Murphy, Steven Ybarra
- **Nuclear Regulatory Commission**: Thomas Weaver
- **Caltrans**: Tom Shantz
NGL Database Contributors

- **U. of Utah**: Steve Bartlett, Masoud Hosseinali
- **Virginia Tech**: Russell Green, Kristin Ulmer
- **UC Berkeley**: Jonathan Bray, Christine Beyzaei
- **Tonkin & Taylor**: Sjoerd Van Ballegooey, Mike Liu
- **BYU**: Heidi Dacayanan, Lila Lasson
- **METU**: Gizem Can, Makbule Ilgac
- **UCLA**: Omar Issa, Chris Nicas, Trini Inouye, Arielle Sanghvi, Tristan Buckreis, Naoto Inagaki, Wyatt Iwanaga, Michael Winders, Bryan Ong, Siddhant Jain, Allison Lee, Honor Fisher
- **Others**: Mike Greenfield, Teruo Nakai, Hideo Sekiguchi, …
Liquefaction effects on the built environment and the community

Liquefaction manifestation (Ridgecrest, 2019)

Effects on infrastructure and lifelines (Northridge, 1994)

and its effects (Kocaeli, 1999)

Regional scale impact (Christchurch, 2010-2011)
NGL Project Components

• Community **liquefaction and non-ground failure database**

• **Fully-vetted relational** database

• **Supporting studies** of critical effects poorly constrained by data

• **Model development**: team meetings, common resources, required parameter space
NGL Project Organization

**Joint Management Committee (JMC)**
Representatives of key organizations: PMC, SWRI, sponsors (Caltrans, NRC, BoR, etc.)

**Project Management Committee (PMC)**
PIs: Kramer, Stewart
Advisor: Bozorgnia

**Advisory Board**
Boulanger, Bray, Cubrinovski

**Database Development**
Brandenberg (Chair), Cetin, Franke, Moss, Zimmaro, students, IT support (SWRI)

**Focused Studies**
- Susceptibility criteria (UCLA)
- Critical layer (VT)
- Ageing (Clemson)

**Model Development**
Topical developer teams
The Next-Generation Liquefaction Database

www.nextgenerationliquefaction.org

DOI: 10.21222/C2J040
The NGL Database: Definition of a Site

- **Site**: high level entity into which NGL users organize their data.
- **Single point on map** for plotting purposes. It should not be interpreted as a single location in space.
- Geotechnical conditions and observations of liquefaction effects may vary spatially within a site.
- Users exercise **judgment** in assigning a point to a site. Add remarks on how the choice was made.
The NGL Database: Definition of a Site

- CBD-21, Green et al. (2014) (Canterbury earthquake sequence)
- Observed liquefaction manifestation
The NGL Database: Definition of a Site

- CBD-21, Green et al. (2014) (Canterbury earthquake sequence)
- Observed liquefaction manifestation
- One Cone Penetration Test
The NGL Database: Definition of a Site

- **Mihama-ward (M9.1 Tohoku event)**
- **Variable performance over a short length**
- **Potentially impactful for susceptibility studies**
The NGL Database: Definition of a Site

- **Site and its characteristics in NGL DB**
- **1 site location (but sites can encompass a wide area)**
The NGL Database: Definition of a Site

- Site and its characteristics in NGL DB
- 1 site location (but site encompass a wide area)
- Multiple observations across site
The NGL Database: Definition of a Site

- **Site and its characteristics in NGL DB**
- 1 site location (but site encompass a wide area)
- Multiple observations across site
- Multiple field/lab tests

- NGL database has flexibility to host both:

  *single-point sites*
  *geospatially distributed datasets*
The NGL Database: Current Status

www.nextgenerationliquefaction.org

- Quality control via formal review process
- Each piece of information needs to be reviewed by two reviewers
- Most sites currently under review
- More than 20% already reviewed

<table>
<thead>
<tr>
<th>Total Number</th>
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<tbody>
<tr>
<td>CPT Soundings</td>
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<td>Boreholes</td>
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<td>Invasive Vs Profiles</td>
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<tr>
<td>Liquefaction Observations</td>
<td>215</td>
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<tr>
<td>Non-Liquefaction Observations</td>
<td>288</td>
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</tbody>
</table>

Population and review process overseen by NGL Database Working Group (Chair S.J. Brandenberg)
Cloud-Based Community Access

- Database replicated daily onto DesignSafe servers
- Cloud-based tools
Cloud-Based Community Access

- *Database replicated daily onto DesignSafe servers*
- *Cloud-based tools*

NGL Partner Data App
Cloud-Based Community Access

NGL Jupyter notebooks are all available in DesignSafe Community Data

https://jupyter.designsafe-ci.org
Cloud-Based Community Access

Cone Penetration Test (CPT) visualization tool
Laboratory Component of the Database

- **New database tables to host laboratory test results**

- **Index tests**
- **Grain size distribution**
- **Triaxial**
- **Direct Simple Shear (1D-2D)**
- **Others...**

*From Hudson et al. (2020) – PEER Poster*
Laboratory Component of the Database Cloud-Based Community Access

Laboratory Component (New Tools – Available online soon!)

Slide K. Hudson (UCLA)
Laboratory Component of the Database
Cloud-Based Community Access

Laboratory Component (New Tools – Available online soon!)

Slide K. Hudson (UCLA)
Recent Geospatial Datasets

- Geospatial models (e.g. Zhu et al., 2017) require additional layers (e.g. geology maps, ground water table maps, etc.)

- Can be added to NGL via supplemental files or DOI (if data resides elsewhere – e.g. DesignSafe)
Geospatial Visualization Tools

From Brandenberg et al. (2020)
Geospatial Visualization Tools

From Brandenberg et al. (2020)
Recent Geospatial Datasets: NGL Vision

- **How to visualize additional layers in NGL? Coming soon**

Additional layers (or datasets) all unchecked by default
Discussion points

• **Geospatial models**
  what layers do we need to add?
  layer format (geojson, shapefile, etc.)?

• **Laboratory component:**
  Additional test types?
  Available lab test datasets?

• **Upcoming model development phase:**
  New tools (e.g. Artificial Intelligence)?
  Community needs/gaps?
Thank you!

Open Discussion

Relevant References


Project homepage: https://uclageo.com/NGL/
Database: DOI: 10.21222/C2J040
http://nextgenerationliquefaction.org