

Workshop on the Next-Generation Liquefaction Database

September 24, 2018, University of California, Los Angeles

UCLA **Samueli**
School of Engineering

Recent case histories data collection and distillation

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Engineer Change.

Outline

Introduction

Liquefaction data distillation

Recent case histories, focus on:

Christchurch sequence (New Zealand) 2010-2011

Tohoku **M**9.0 earthquake (Japan) 2011

Emilia **M**5.8 earthquake (Italy) 2012

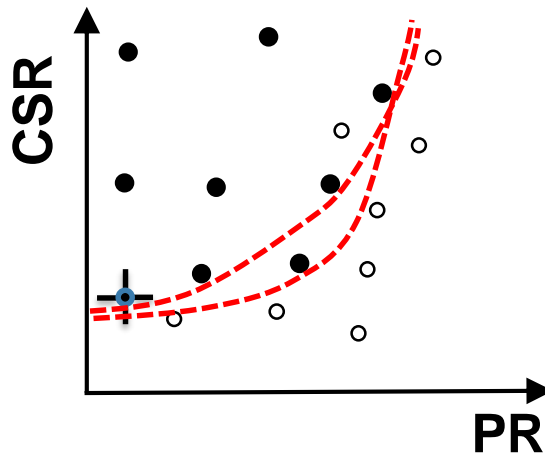
Conclusions

Recent case histories

Challenges and opportunities

Legacy case histories – **(main) sources of uncertainty:**

- Lack of high-quality characterization (uncertain capacity)
- Lack of information about susceptibility
- Uncertain magnitude (impact on magnitude scaling)
- Uncertain ground motions (lack of recordings, analogic data)
- Unclear observations (uncertain location, liquefaction or not?)



- Liquefaction
- No Ground Failure

Recent case histories

Challenges and opportunities

Recent case histories:

- High-quality characterization
- High quality magnitude estimation
- Large digital networks (good ground motion characterization)
- Unprecedented quantity/quality of observations

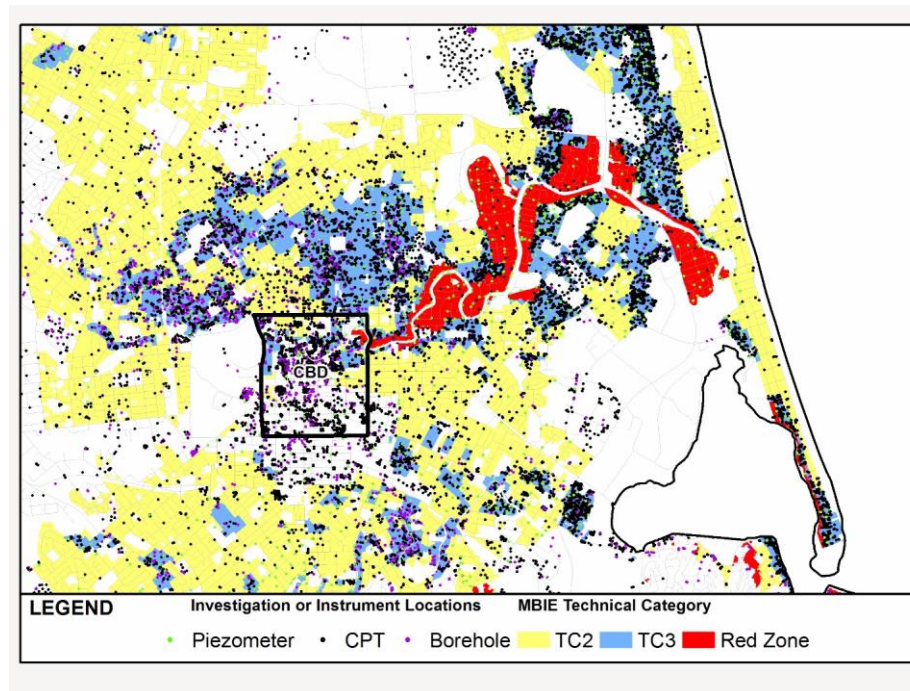
- Christchurch 2010-2011
- Tohoku 2011
- Emilia 2012

Recent case histories

Challenges and opportunities

Recent case histories:

- High-quality characterization



The Canterbury Geotechnical Database
From: www.tonkintaylor.co.nz

Recent case histories

Challenges and opportunities

Recent case histories:

- High quality magnitude estimation
- Large digital networks (good ground motion characterization)

The screenshot shows the USGS Earthquake Hazards Program website for the 2016 Kaikoura earthquake. The header features the USGS logo and the text "science for a changing world" above a green seismic waveform. Below the header, the event is identified as "M 7.8 - 54km NNE of Amberley, New Zealand" with a timestamp of "2016-11-13 11:02:56 UTC" and coordinates "42.737°S 173.054°E" at a depth of "15.1 km depth". A left-hand navigation menu includes "Overview", "Interactive Map", "Regional Information", "Impact", "Felt Report - Tell Us!", "Did You Feel It?", "ShakeMap", and "PAGER". The main content area is divided into several sections: "Interactive Map" showing a map of New Zealand with a red circle around the epicenter; "Regional Information" showing a map of New Zealand with a red circle around the epicenter; "Felt Report - Tell Us!" with a "Responses" counter showing "0 0 0 7 1 0" and a call to action to contribute to citizen science; "Did You Feel It?" with a red "IX" indicator and a map of New Zealand showing the earthquake's impact; and "ShakeMap" with a red "IX" indicator and a map of New Zealand showing the earthquake's impact.

Event page for the 2016 Kaikoura earthquake (New Zealand)
From earthquake.usgs.gov

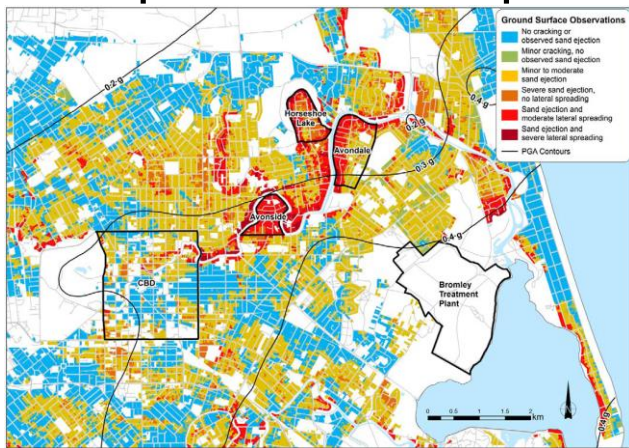
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Recent case histories

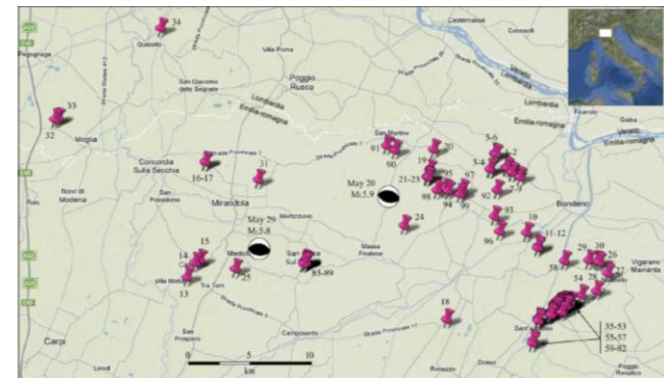
Challenges and opportunities

Recent case histories:

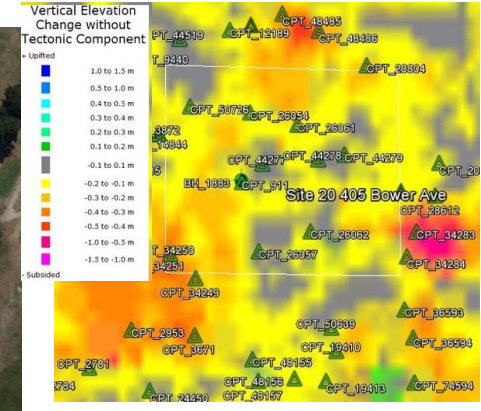
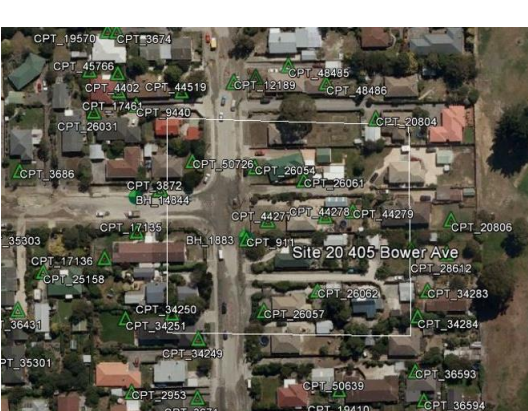
- Unprecedented quantity/quality of observations



From Van Ballegooy et al. (2014)



From Emergeo (2012)



Recent case histories

Challenges and opportunities

Recent case histories – Abundance may also create challenges

Data distillation

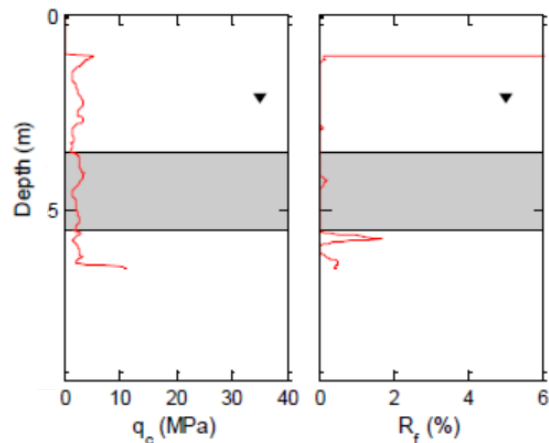
(Definition of priority sites based on):

- Availability of all three elements:
 - Geotechnical information
 - Ground motion at the site
 - Observations/measurements
- Level of importance (extension of parameter space)

- Christchurch 2010-2011
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Recent case histories

Christchurch sequence (New Zealand) 2010-2011



Geotechnical characterization (CPT)

From Green et al. (2014)

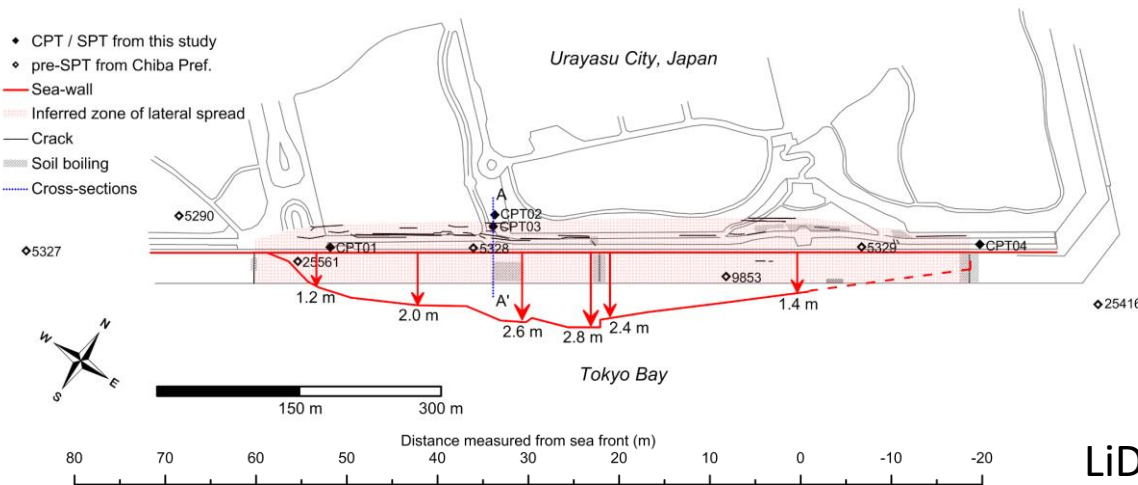


25 sites, 50 case histories
(Complete - under review)

- Christchurch 2010-2011
- Tohoku 2011
- Emilia 2012

Recent case histories

Tohoku M9.0 (Japan) 2011

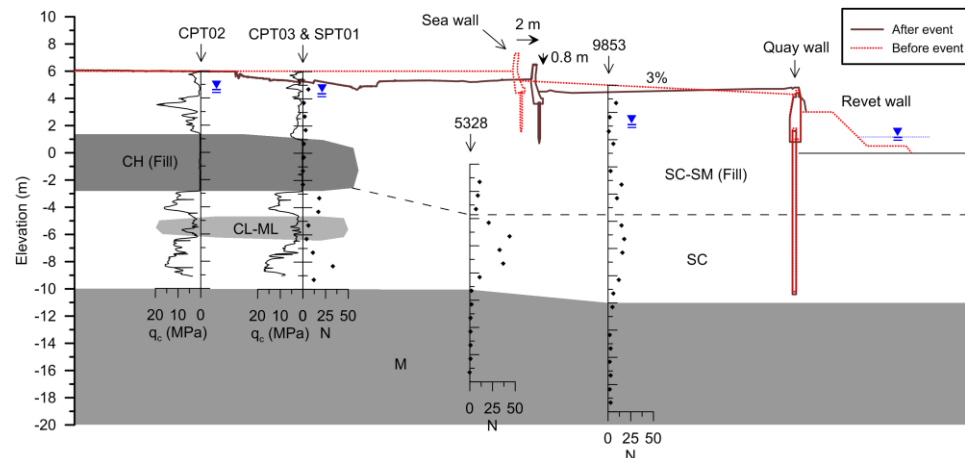


Urayasu sea front

LiDAR + on site measurements

CPT/SPT/VS profiles

Detailed cross sections



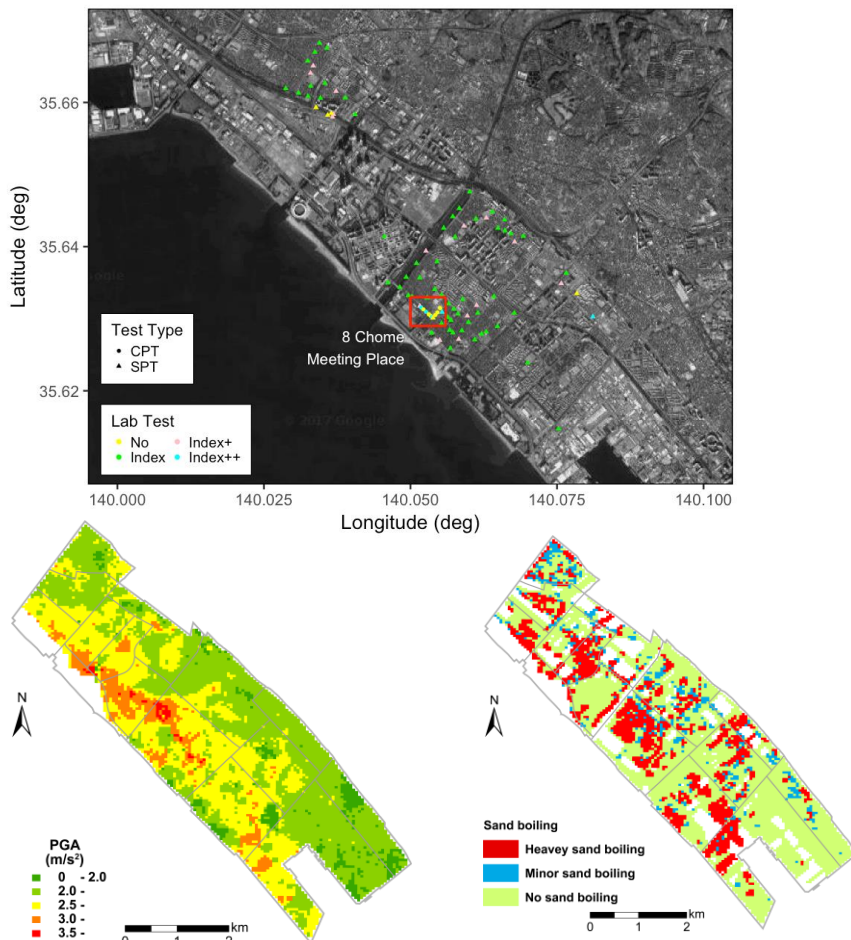
1 case history
(Complete – will be under review soon)

From Kwak et al. (2018)

- Christchurch 2010-2011
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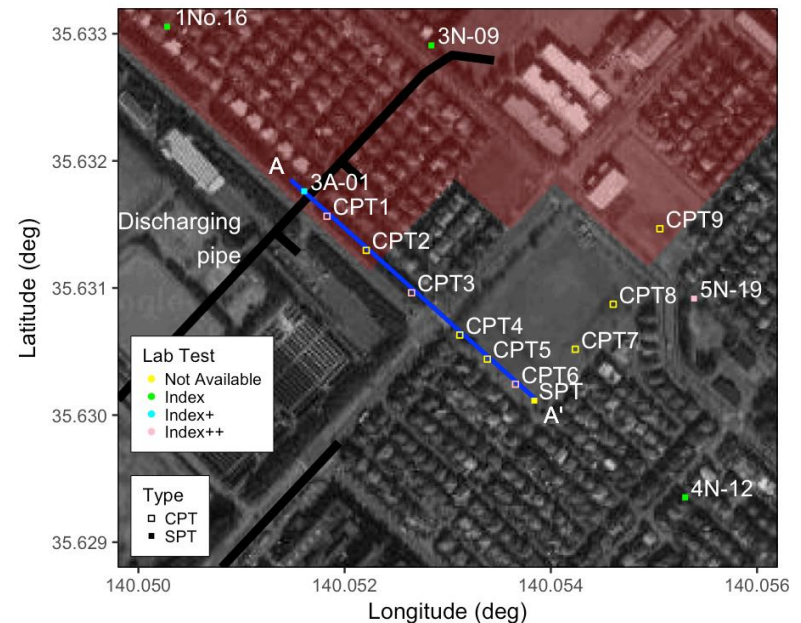
Recent case histories

Tohoku M9.0 (Japan) 2011



From Kwak et al. (2018)

Mihama ward



Accurate on-site measurements
CPT/SPT profiles
Variable performance

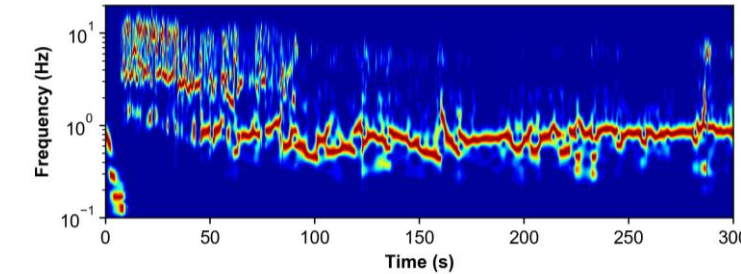
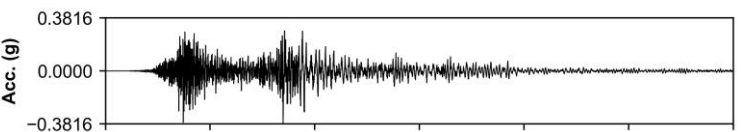
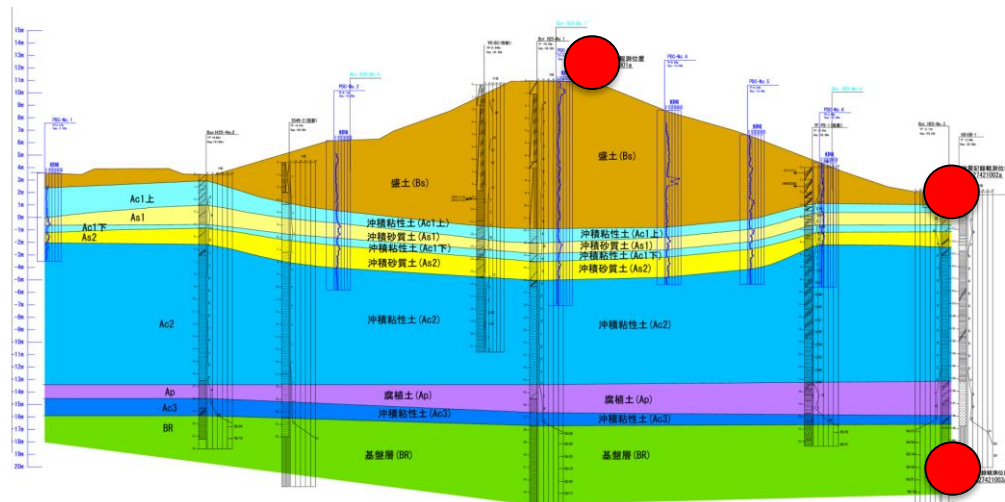
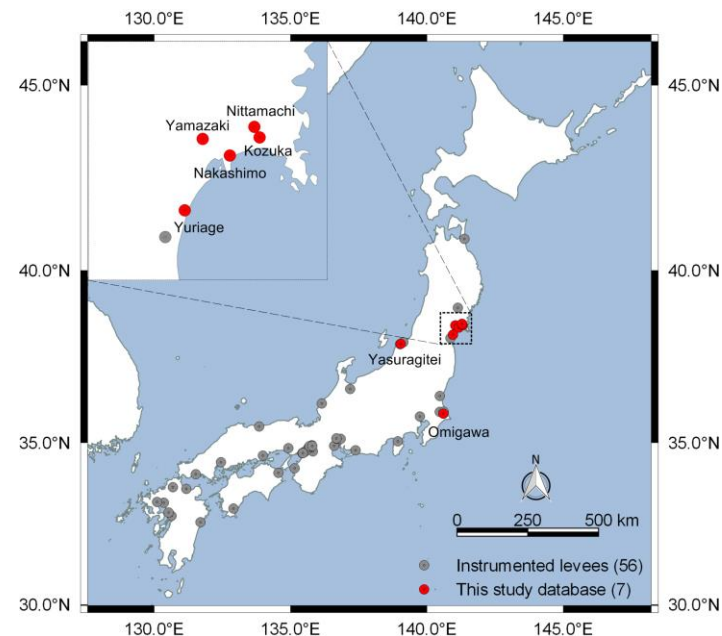
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Recent case histories

Tohoku M9.0 (Japan) 2011

Instrumented levee arrays



SPT profiles
Recording arrays

3 case histories
(Complete – will be under review soon)

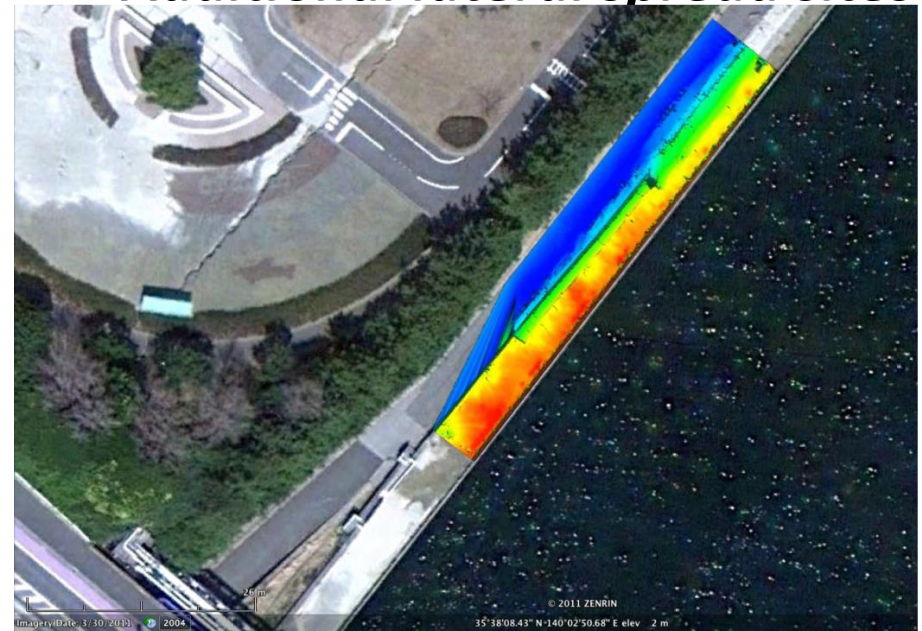
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Recent case histories

Tohoku M9.0 (Japan) 2011



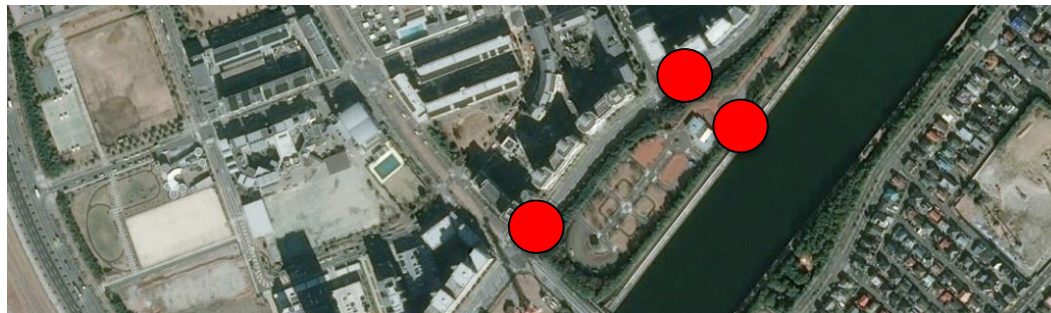
Additional lateral spread sites



3 SPT profiles

LiDAR

Accurate on-site measurements



3 case histories
(work in progress
UCLA-BYU)

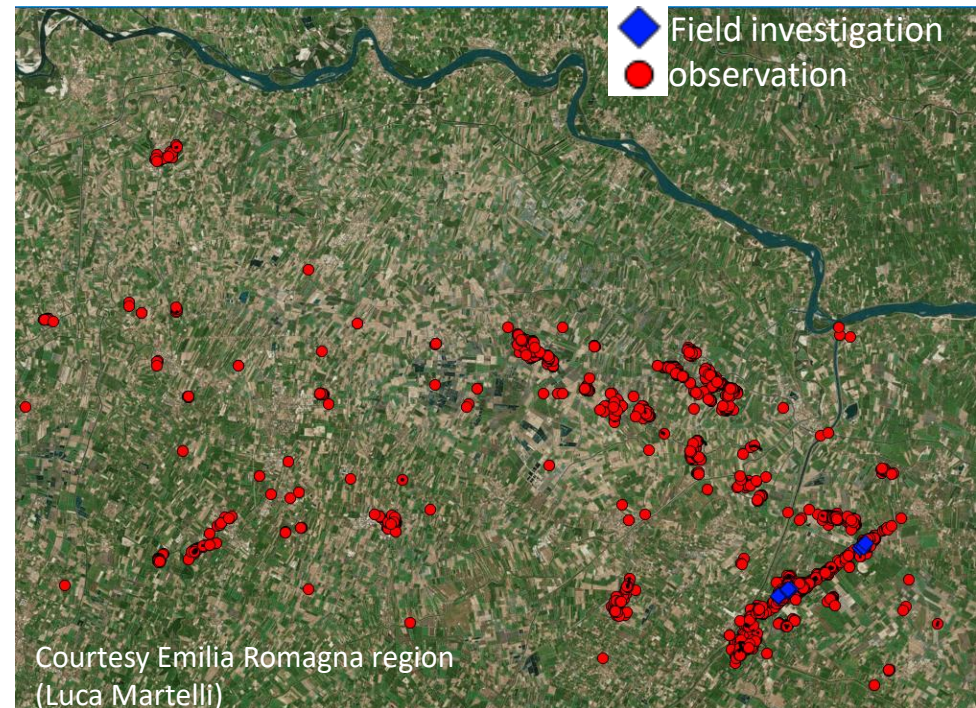
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Recent case histories

Emilia M5.8 (Italy) 2012



San Carlo



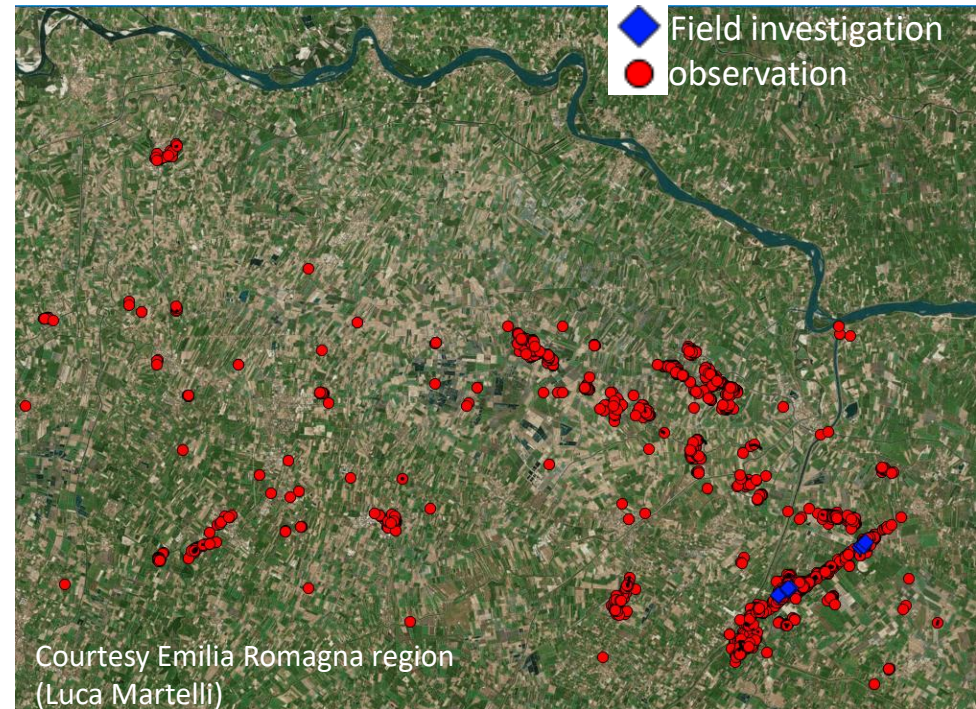
**4 case histories
(Complete – will be under
review soon)**

- Christchurch 2010-2011
- Tohoku 2011
- Emilia 2012

Recent case histories

Emilia M5.8 (Italy) 2012

San Felice



**4 case histories
(Complete – will be under
review soon)**

From Crespellani et al. (2012)
and Durante pers. Comm.

Final Remarks

- In recent years unprecedented amount of post-earthquake data
- Need of defining priority (high-quality and consequential case histories)
- Opportunity for spatial/regional analysis in combination with traditional geotechnical approaches
- Larger parameter space – opportunity for focused studies

Thank you!

Questions?



Project homepage:

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

Database:

<http://nextgenerationliquefaction.org>

Engineer Change.