EFFECTIVE STRESS ANALYSIS TO DISCERN THE CHARACTERISTICS OF EJECTA

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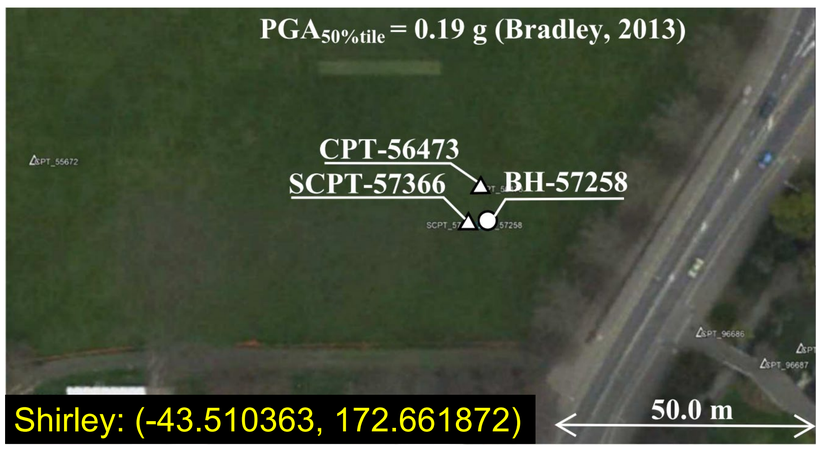
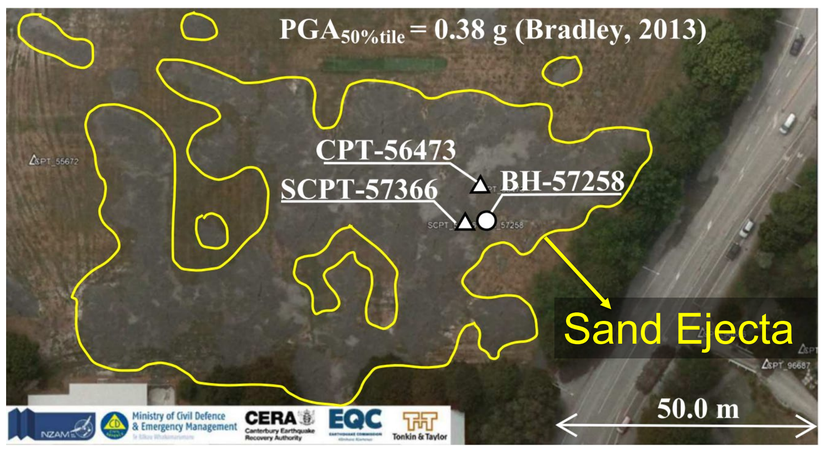
Overview

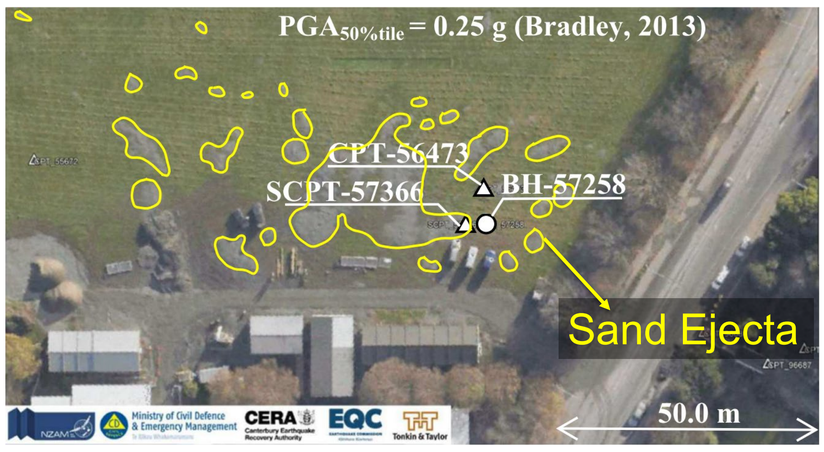
- Different amounts of sand ejecta were observed at a free-field site in Christchurch after shaken by 3 different earthquakes.
- Current liquefaction triggering procedures only provide a **YES** or **NO** response without providing the severity of ejecta.
- Effective stress analyses (ESA) are performed to develop a means for estimating the observed different amounts of ejecta.



2010 Darfield EQ (image 09/04/2010)
M_w7.1, R_{rup}18.3 km (**NONE**)



2011 Christchurch EQ (image 02/24/2011)
M_w6.2, R_{rup} 4.6 km (**EXTREME**)



2011 June EQ (image 06/14/2011)
M_w6.0, R_{rup} 5.9 km (**SEVERE**)

Shirley Site

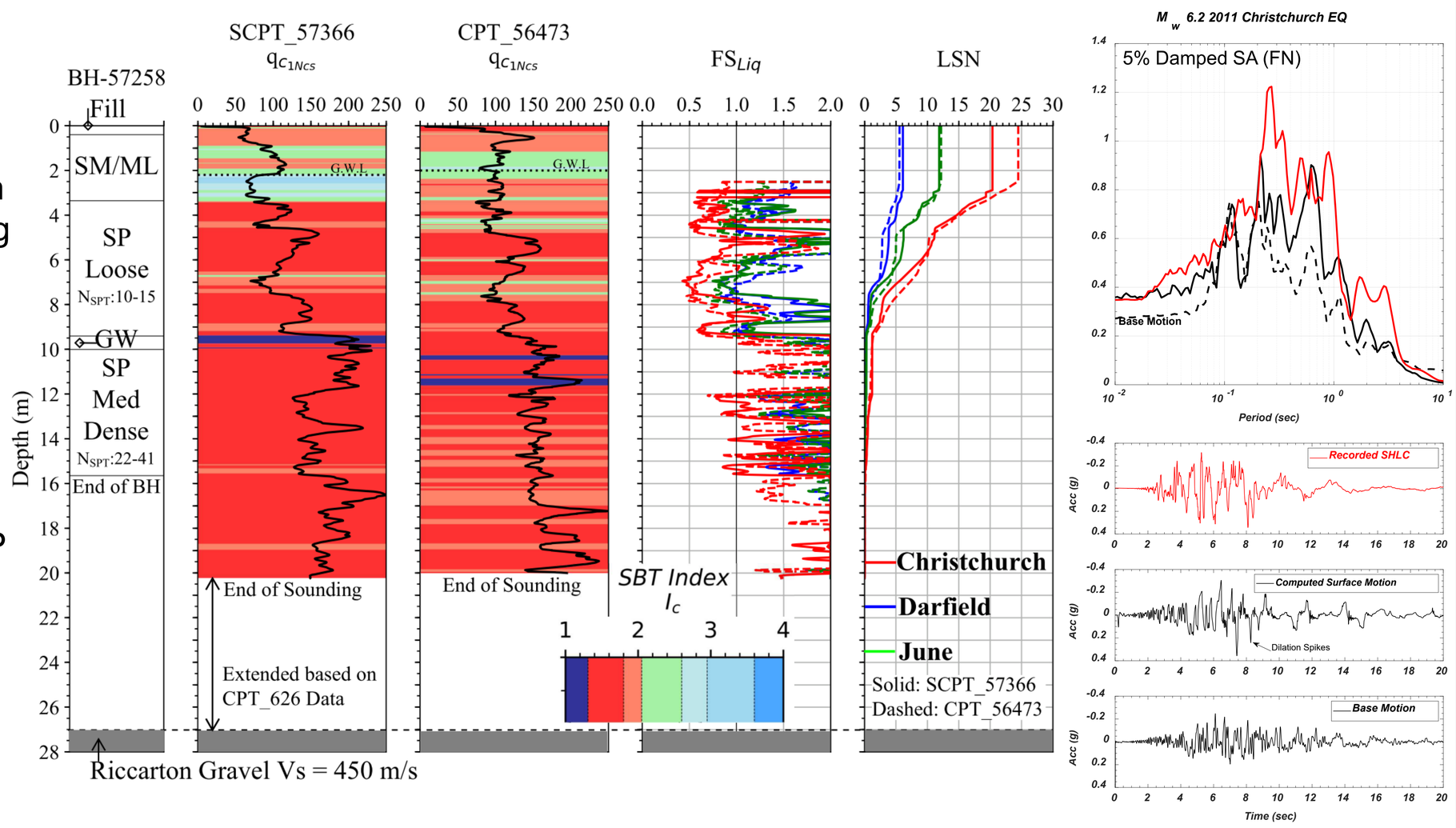
- Thick continuous clean sand, liquefiable deposit
- 600 m away from strong motion site (SHLC) that liquefied during February & June 2011 events

Simulation

- 1D FE-ESA (OpenSees v3.0)
- PM4Sand & PM4Silt
- Deconvolved input motion
- Fully-coupled, 4 node quadSSP element, Biot's u-p formulation
- Elastic base & outcrop motion

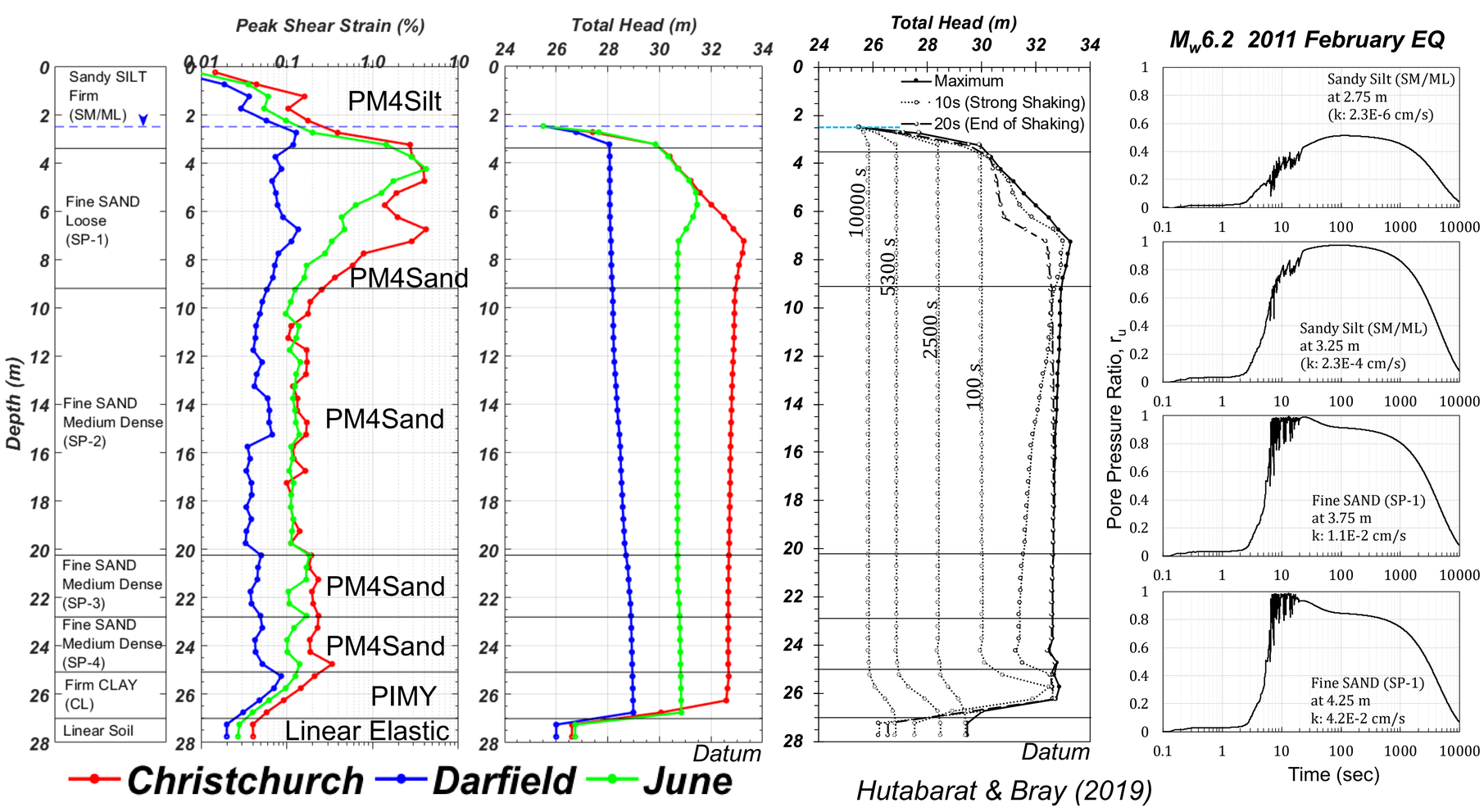
Limitations:

Not consider multidirectional shaking and cracking process of crust layer.



Findings

- Reasonable agreement between computed & SHLC recorded surface motion
- 1D ESA is able to capture the hydro-mechanical response of liquefied site
- Liquefaction of thick unit produces more and longer dissipation of u_{excess}, more water volume, & more severe ejecta
- Total head quantifies severity in the form of total unbalanced energy that must be dissipated through high pressure vertical water flow which produces ejecta



Hutabarat & Bray (2019)

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