Outline

NGA-Sub database

Status of NGA-Sub ground motion models

Summary
Acknowledgements

Supports of the following agencies are gratefully appreciated:

- FM Global
- USGS
- Caltrans
- PG&E
Acknowlegements:

31 researchers and practitioners who worked hard on various pieces of the project

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
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<tbody>
<tr>
<td>1</td>
<td>Tadahiro Kishida</td>
<td>16</td>
<td>Ronnie Kamai</td>
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<td>2</td>
<td>Norman A. Abrahamson</td>
<td>17</td>
<td>Nicolas Kuehn</td>
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<td>3</td>
<td>Sean K. Ahdi</td>
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<td>Dong Youp Kwak</td>
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<td>4</td>
<td>Timothy D. Ancheta</td>
<td>19</td>
<td>Annie Kwok</td>
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<td>5</td>
<td>Ralph J. Archuleta</td>
<td>20</td>
<td>Po-Shen Lin</td>
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<td>6</td>
<td>Gail Atkinson</td>
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<td>Harold Magistrale</td>
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<td>7</td>
<td>David Boore</td>
<td>22</td>
<td>Silvia Mazzoni</td>
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<td>Ken Campbell</td>
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<td>Sifat Muin</td>
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<td>9</td>
<td>Brian Chiou</td>
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<td>Saburoh Midorikawa</td>
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<td>10</td>
<td>Victor Contreras</td>
<td>25</td>
<td>Grace Parker</td>
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<td>Robert Darragh</td>
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<td>Hongjun Si</td>
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<td>Nick Gregor</td>
<td>27</td>
<td>Walter Silva</td>
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<td>13</td>
<td>Zeynep Gulerce</td>
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<td>Jonathan P. Stewart</td>
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<td>14</td>
<td>I.M. Idriss</td>
<td>29</td>
<td>Melanie Walling</td>
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<td>15</td>
<td>Chen Ji</td>
<td>30</td>
<td>Katie E. Wooddell</td>
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<td>16</td>
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<td>Bob Youngs</td>
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NGA-Sub database

The database spans:

- 71,343 three-component recordings
- Over 210,000 records
- 1,880 worldwide earthquakes
- Magnitudes from 4 to 9
- Interface, Intraslab (“slab”) classifications
NGA-Sub database

The database includes:

- Acceleration, Velocity & Displacement Records
- Pseudo-spectral acceleration response spectra (PSA) for periods: 0.01-10 sec
- For 11 damping values between 0.5% and 30%
- Fourier amplitude spectra (FAS) for frequencies from 0.1 to 100 Hz
- Significant durations based on Arias Intensity
NGA-Sub database: Event distribution

Database includes events and ground motions recorded since early 1970s to present, including recent significant earthquakes:

- 2010 Maule, Chile (M8.8)
- 2011 Tohoku, Japan (M9.1)
- 2017 (September) Mexico, EQs (M7.1 and M8.1) are also being investigated

Database includes more data than all previously compiled databases (e.g. BCHydro 2016)
NGA-Sub database: Event distribution

BCHydro data
NGA-Sub database: Event distribution

- 2011 Tohoku, Japan
- 2010 Maule, Chile
- Alaska
- Taiwan
- Pacific Northwest
NGA-Sub database: Event distribution

- Hypocenters
- Strong motion stations
Recordings & Events Distribution

(a) Recordings
- South/Central America (3.8%)
- Alaska (5.6%)
- Pacific Northwest (3.3%)
- Taiwan (21%)
- Japan (67%)

(b) Events
- Japan (22%)
- Alaska (19%)
- Pacific Northwest (4.6%)
- Taiwan (10%)
NGA-Sub: Relational Database

**Metadata:**
- Source
- Site
- Path
- Event Class

**Data:**
- Peak GM values
- PSA
- Duration
- FAS
NGA-Sub flatfile and timeseries

- In the tradition of NGA program, the flatfile used in the development of ground motion models will be released along with the models.

- NGA-Subduction Database:
  - All data is being stored & managed in a relational database.
  - Relational database will improve update and expansion.
  - Relational database can be queried by other databases, such as NGA-liquefaction.

- Time series of NGA-Sub:
  - About 500 motions were selected and will be released to the public.
  - Online tools will have to be developed for release of other time series. This will be developed later.
Example of Time Series and Durations

2011 M9.1
Tohoku,
Japan

1989 M6.9
Loma Prieta
(crustal EQ)
At least four teams of ground-motion modelers have been working in development of models.

There will be “Global” model and Regionalized models.

Heavy focus on regionalization (or lack of regionalization) on terms, including:

- Vs30 scaling
- Anelastic attenuation
- Regional effects of amplification (constant term)
- Regionalized magnitude scaling for slab events
NGA-Sub Ground Motion Models

- Special attention on Cascadia:
  - No recorded large magnitude interface event in the region
  - Few in-slab events. Most of them (except Nisqually EQ) have lower motions than global (international) model

- Investigation by UC Santa Barbara researchers for NGA-Sub team:
  - Break point in magnitude scaling for in-slab events is a function of the slab thickness. This feature is being incorporated into ground motion models
### Break in Magnitude Scaling for In-Slab Events (UCSB)

<table>
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<th>Subduction Zone</th>
<th>Saturation Magnitude</th>
<th>Fault Maximum Width</th>
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<td>Aleutian</td>
<td>7.95</td>
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<tr>
<td>Alaska</td>
<td>7.2</td>
<td>22.5</td>
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<tr>
<td>Cascadia</td>
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<td>22</td>
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<tr>
<td>Central America South</td>
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<td>Central America North</td>
<td>7.4</td>
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<td>South America North</td>
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<tr>
<td>Taiwan</td>
<td>7.7</td>
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</table>
Ground Motion Models

- For the USGS National Seismic Hazard Maps, the plan is to:
  - Submit an updated BCHydro model (based on the NGA-Sub database)
  - It will be shared with the public (PEER Report)
  - By June 30, 2018

- Followed by individual ground motion models, to be finalized and documented by individual modeling teams by September 2018
Summary

- The database is in the final stages of QA

- In the tradition of all NGA projects, data and models are checked, and checked, and checked,…

- Ground motion simulations for deep slab events have been carried out and revealed interesting findings that are being incorporated in the models

- Ground motion models by different teams are being finalized

- Updated BCHydro model will be released for USGS National Seismic Hazard Maps, followed by individual models developed by individual teams
THANK YOU!