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Supporting Information for

Kinematic Rupture Scenarios and Synthetic Displacement Data: An Example Application to the Cascadia Subduction Zone

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Contents of this file

Figures S1 to S4

Additional Supporting Information

Dataset S1: Plots of the 1300 scenario ruptures
Dataset S2: Rupture files, static offset and PGD files, log files, and waveforms for the 1300 scenario ruptures

Both data sets are in the file "Cascadia.zip"

The fakequakes code is a module of the MudPy inversion and modeling code it can be obtained at http://github.com/dmelgarm/MudPy

Introduction

In Dataset S1 we provide plots of each one of the 1300 scenarios in the "plots" folder, in this file readers will find one plot for each scenario event, an example of such a plot is shown in Figure S1. The plots have the total slip from each scenario as well as the rise time at each subfault (column labeled "dura" in the .rupt file associated with each rupture) and the rupture onset time (column labeled "rupture time"). Those figures also include the distribution of stations used to synthesize the waveforms.

In Dataset S2 we also provide detailed information on each of the scenario ruptures as well as the synthesized waveforms at all stations. This data can be collectively found in the file "data", in that folder readers will find one subfolder for each scenario event, labeled Cascadia.000000, Cascadia.000001 and so on. Inside each folder there are three summary files that contain information on the scenario rupture, screenshots of these files are in Figures S2-S4. The files end in .log, .rupt, and .offsets. The .log files (Figure S2) contain summary information on the scenario rupture such as magnitude, hypocentral location, centroid location, etc. The .rupt files contain the description of the rupture in a subfault format. The .offsets file contain the static offsets and peak ground displacement (PGD) values at each station. Furthermore we include the waveforms at each station for each rupture in SAC format. Inside each folder there are SAC files for each station and component. For example the files bamf.LYE.sac, bamf.LYN.sac and bamf.LYZ.sac have the waveform data for station bamf and the north, east and up components. Station locations and coordinates are in the "station_info.txt" file

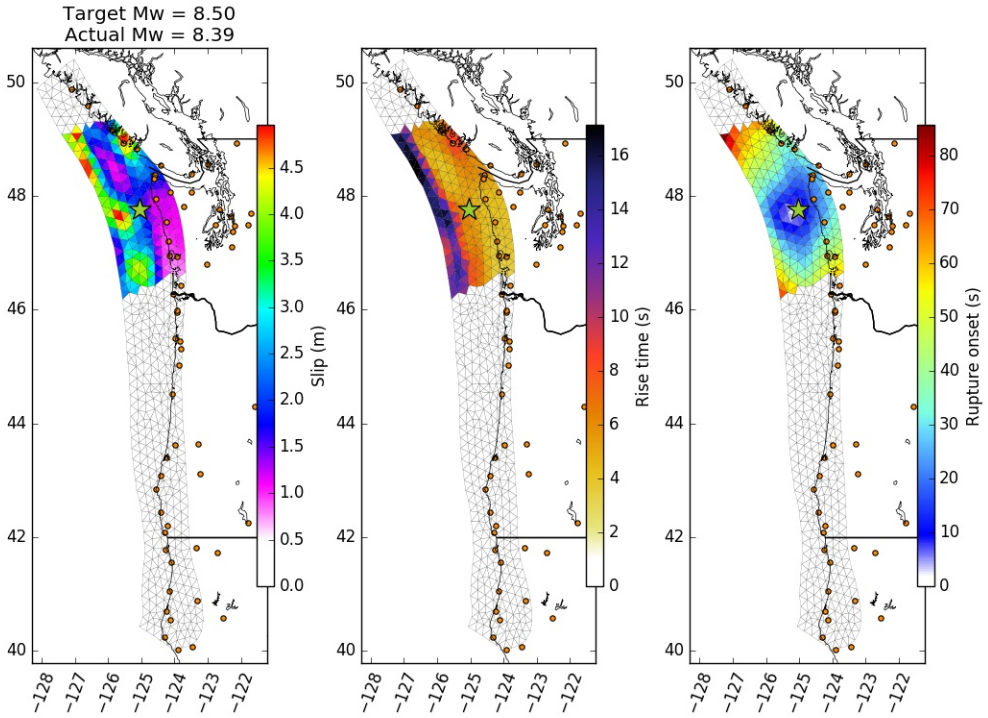

Figure S1. Example summary plot for scenario #531**.** Plotted are the total slip, rise time and rupture onset times at each subfault. The green star denotes the hypocenter and the orange squares are the GNSS station locations used to synthesize the waveforms. We provide a plot like this one for every one of the 1300 scenario ruptures in the supplementary file cascadia_plots.zip

_cascadia.000413.log

```
Scenario calculated at 2016-05-03 00:40:40 GMT
Project name: Cascadia_final1
Run name: cascadia
Run number: 000413
Velocity model: cascadia.mod
Hurst exponent: 0.75
Corr. length used Lstrike: 54.68 km
Corr. length used Ldip: 40.01 km
Slip std. dev.: 0.900 km
Maximum length Lmax: 185.91 km
Maximum width Wmax: 117.02 km
Effective length Leff: 158.03 km
Effective width Weff: 90.11 km
Target magnitude: Mw 8.4000
Actual magnitude: Mw 8.1142
Hypocenter (lon,lat,z[km]): (-126.784215,48.887891,11.17)
Hypocenter time: 2016-09-07T14:42:26.000000Z
Centroid (lon,lat,z[km]): (-126.832184,49.517934,20.07)
Source time function type: dreger
```

Figure S2. Example of a rupture summary .log file.

_cascadia.000483.rupt

```
# No,lon,lat,z(km),strike,dip,rise,dura,ss-slip(m),ds-slip(m),ss_len(m),ds_len(m),rupt_time(s),rigidity(Pa)
1   -125.237101  46.418952   10.8050    353.00   10.00  0.5    0.00    0.00    0.00    16926.90   16926.90   0.00   3.577392e+10
2   -124.977971  46.528374   14.6990    352.00   10.00  0.5    0.00    0.00    0.00    14578.41   14578.41   0.00   4.043200e+10
3   -125.143248  46.527428   12.4190    352.00   10.00  0.5    0.00    0.00    0.00    14850.93   14850.93   0.00   4.043200e+10
4   -127.501597  49.733148   14.0040    332.00   14.00  0.5    0.00    0.00    0.00    16004.69   16004.69   0.00   4.043200e+10
5   -125.172806  46.330382   11.4000    351.00    9.00  0.5    0.00    0.00    0.00    13751.73   13751.73   0.00   3.577392e+10
6   -125.221520  46.639212   11.7340    351.00   10.00  0.5    0.00    0.00    0.00    14830.37   14830.37   0.00   4.043200e+10
7   -124.233695  45.721955   22.6470    358.00   10.00  0.5    0.00    0.00    0.00     7566.37    7566.37   0.00   4.547664e+10
8   -124.025577  40.213135   24.4000     77.00   10.00  0.5    0.00    0.00    0.00    15379.21   15379.21   0.00   4.547664e+10
9   -124.771840  47.442103   20.7890    343.00    9.00  0.5    0.00    0.00    0.00    13483.69   13483.69   0.00   4.547664e+10
10  -125.348033  46.655639   10.1220    350.00    9.00  0.5    0.00    0.00    0.00    13209.84   13209.84   0.00   3.577392e+10
```

Figure S3. Example of a rupture description .rupt file. The description of each column is in the file header. The coordinates are for the geometric centroid of each subfault triangle. The column labeled "rise" has dummy values of 0.5, the column labeled "dura" contains the actual rise times of each subfault in seconds. "ss_slip and "ds_slip" contain the values of slip in the strike-slip and dip-slip directions. Positive dip-slip is thrust. The columns "ss_len" and "ds_len" when multiplied together give the correct area for each triangular element.

_cascadia.000799.offsets

```
# Station, lon, lat, N[m], E[m], Up[m], PGD[m]
albh     -123.4875     48.3898   -0.015031   -0.016407   -0.020941    0.193686
bamf     -125.1351     48.8353    0.001259    0.001806   -0.019200    0.201823
bend     -121.3151     44.0571    0.005473   -0.385272    0.014002    1.079888
bils     -124.2523     47.5391   -0.017917   -0.021724   -0.041035    0.268774
cabl     -124.5600     42.8400   -0.967608   -3.512802    1.079165    4.035741
chzz     -123.9800     45.4900   -0.089306   -3.230153   -0.562092    4.414892
cski     -122.2355     47.3803   -0.068736   -0.098875   -0.016262    0.422539
ddsn     -123.2400     43.1200    0.267554   -2.225357   -0.649884    2.803025
eliz     -127.1226     49.8730    0.000082    0.007204   -0.010102    0.165059
elsr     -122.7605     47.4975   -0.068328   -0.080913   -0.023908    0.340516
grmd     -123.0226     46.7954   -0.221718   -0.340729   -0.079243    0.811138
```

Figure S4. Example of a static offsets and PGD summary .offsets file. PGD is calculated on the three components of motion as noted in Melgar et al. [2015] equation 1.

References

Melgar et al. (2015), Earthquake magnitude calculation without saturation from the scaling of peak ground displacement, *Geophys. Res. Lett.*, doi:10.1002/2015GL064278