Text Supplement for ScholarWorks@UA collection "Seismic moment tensor catalog for Minto Flats fault zone (2000–2014)"

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Attribution: If you use these files, please cite *Tape et al.* (2015).

Description of files

The files here are part of the PhD thesis work by Vipul Silwal. The materials were included as part of the supplement to *Tape et al.* (2015).

A seismic moment tensor catalog of 15 earthquakes was generated using body waves and surface waves. The best solution (M_0) was obtained through a grid-search in the double-couple moment tensor space using the "cut-and-paste" (CAP) approach of *Zhu and Helmberger* (1996). The waveform fits for the 15 events in the catalog are shown in Figure A, with the best-fitting depth plots in Figure B.

Among the 15 earthquakes, 11 were within the Minto Flats fault zone, while 4 were outside the fault zone and within the 'northwest subregion' of *Tape et al.* (2015).

Figure A: Waveform fits [`Fig_S2_mffz_waveforms.pdf`]

Waveform fits for 15 moment tensor inversions. Black are observed waveforms; red are synthetic waveforms computed using a frequency-wavenumber method (*Zhu and Rivera*, 2002) that assumes a (1D) layered model. We use the 1D model `tactmod` (*Beaudoin et al.*, 1992; *Ratchkovski and Hansen*, 2002). The waveforms are fit separately within five time windows: P wave vertical component (PV), P wave radial component (PR), Rayleigh wave vertical component (SurfV), Rayleigh wave horizontal component (SurfR), and Love wave transverse component (SurfT). At far left in each row is the station name, source-station distance in km, and station azimuth in degrees. Below each pair of waveforms are four numbers: the cross-correlation time shift between data and synthetics, the cross-correlation value, the percent of the misfit function represented by the waveform pair, and the amplitude ratio between waveforms, $\ln(A_{\text{obs}}/A_{\text{syn}})$, where A is the max value of the waveform within the time window.

The beachball represents the best solution M_0 (i.e., the global minimum of the misfit function). The beachball is plotted as a lower-hemisphere projection (standard seismological convention) of the moment tensor. The surrounding black dots denote the azimuthal location of the stations used, and the red crosses denote the lower hemisphere piercing points of the ray paths to the stations.

Here is a description of the four header lines:

1. `Event 20001129103547240 Model and Depth tactmod_019`
   The event ID is derived from the origin time of 2000-11-29 10:35:47.240.
   The 1D model used is `tactmod`, and the event depth is 19 km.

2. `FM 10 82 0 Mw 5.70 ISO 0 CLVD 0 rms 3.877e-05 VR 66.0`
   The orientation of the moment tensor solution M_0 is strike 10°, dip 82°, rake 0°. The estimated magnitude is M_w 5.7. The ISOtropic coordinate is $\delta = 0°$ and the CLVD coordinate is $\gamma = 0°$, because all events in this study are modeled as double couple moment tensors. The waveform difference between data and synthetics is 3.88×10^{-5}, and the variance reduction is $VR = 66.0\%$.

3. `Filter periods (seconds): Body:2.00-4.00. Surf:20.00-40.00`
   The body waves were filtered 2.0–4.0 s, the surface waves were filtered 20–40 s.

4. `# norm L1 # Pwin 15 Swin 110 # N 21 Np 40 Ns 38`
   An L1 norm was used for the misfit function. The (reference) P-window is 15 s long, the surface wave window is 120 s long, there are 21 stations with at least one waveform, 40 is the number of P windows used, and 38 is the number of surface wave windows used.

The numbers below each station are

1. source–station epicentral distance, km
2. station azimuth, in degrees

The four numbers below each pair of waveforms are

1. the cross-correlation time shift $\Delta T = T_{\rm obs} - T_{\rm syn}$ required for matching the synthetics $s(t)$ with the data $u(t)$ (a positive time-shift means that the synthetics arrive earlier than the data)
2. the maximum cross-correlation percentage between $u(t)$ and $s(t - \Delta T)$
3. the percentage of the total misfit
4. the amplitude ratio $\ln(A_{\rm obs}/A_{\rm syn})$ in each time window

Figure B: Depth plots [`Fig_S3_mffz_dep.pdf`]

Best-fitting depth grid search for 15 events. The depth increment for the grid search is 2 km. The red arrow marks the Alaska Earthquake Center catalog depth, and the white arrow marks the depth obtained from the moment tensor inversion. The long tick marks on the x-axis mark the layer boundaries in the 1D model used in the moment tensor inversions. The plot shows the variance reduction (gray curve) with scale on the right. On the left is the variance reduction relative to the minimum variance reduction. The depth uncertainty is calculated based on the depth at which the variance reduction is 0.10 worse than at the best solution. Note that the earthquake magnitude is free to change for each depth, and it generally increases with increasing depth for the best-fitting solution, as we might expect.

Text file table for moment tensor catalog [`mffz_vipul_mech.txt`]

Seismic moment tensor catalog of 15 events. Details can be found within the header lines, which also refer to *Kanamori* (1977); *Silver and Jordan* (1982); *Tape and Tape* (2012)

Input text files used in the moment tensor inversion [input_weight_files.zip]

We provide a text file for each of the 15 events in this study. These files show which stations and which time windows were used (or not) in each moment tensor inversion. It also shows the first-motion polarity observations that were used.

References

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