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Erratum to

Empirical Ground-Motion Relations for Subduction Zone Earthquakes and Their Application to Cascadia and Other Regions

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Online Material: Horizontal-component data for subduction zone earthquakes.

It has come to our attention that the ground-motion database used in the Atkinson and Boore (2003) prediction equations (AB03) for interface earthquakes contains errors.

The response spectral values at 2.5 and 5 Hz for interface events were inadvertently switched in the database for nearly 2/3 of the interface records. The in-slab database is unaf-
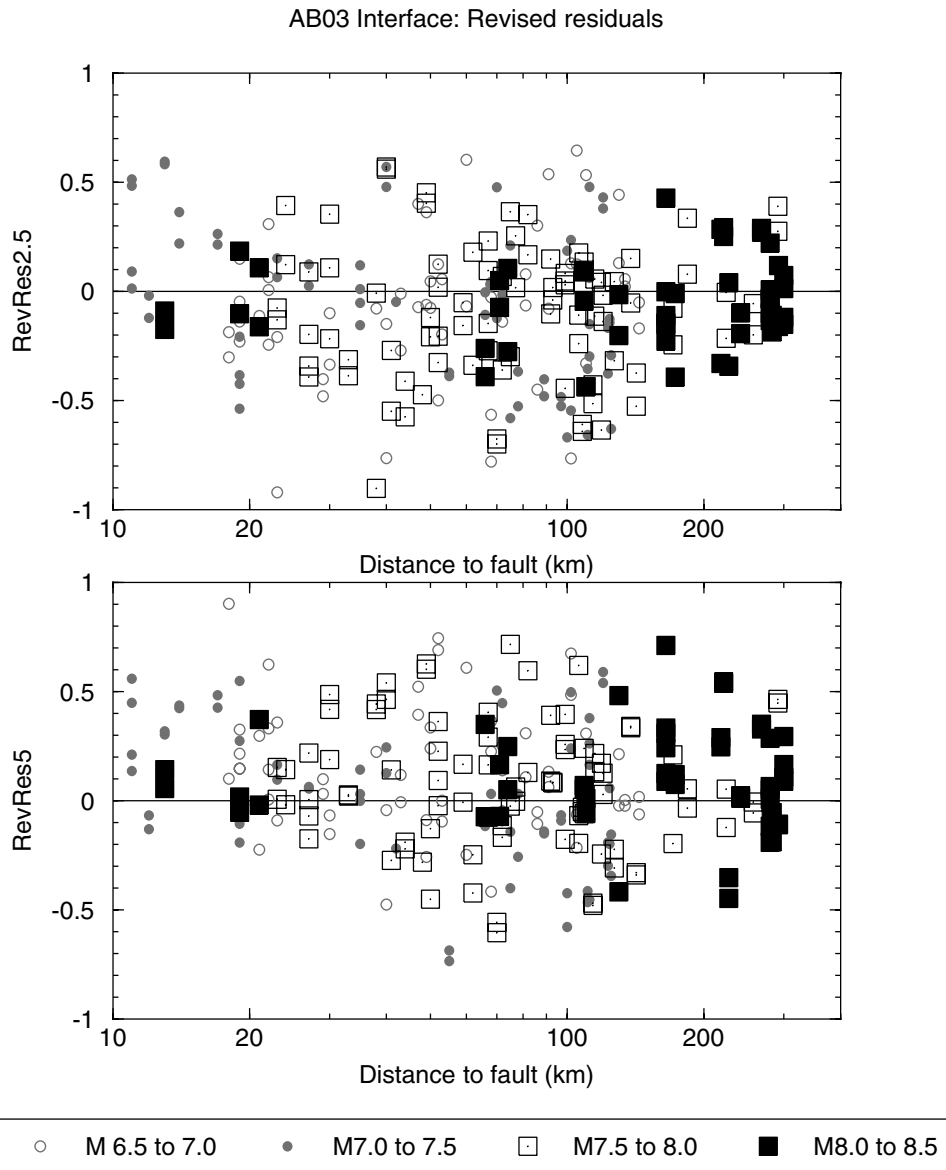
Figure 1. Residuals in log(10) units for the corrected AB03 database relative to the AB03 equations for interface events, as published.

fected as is the interface database at lower and higher frequencies and peak ground acceleration (PGA). The error appears to have occurred while importing the Youngs *et al.* (1997) database into our database (the original Youngs *et al.* database was correct; the switch occurred when we imported their data and combined it with other data). The main impact is a distortion in the shape of the response spectrum with frequency. Our interface spectra are too peaked (too high) near 2.5 Hz and are too attenuated (too low) near 5 Hz.

We have corrected the electronic supplement that contains the database, adding a column to the database to show which records contained the error (Ⓔ see the data in the electronic edition of *BSSA*). In Figure 1, the actual residuals of the data (after corrections to the database were made) at 2.5 and 5 Hz are plotted, relative to our published prediction equations (where residual = log observed − log predicted). We find that our equations have a mean bias of −0.08 log units for events of $\mathbf{M} \geq 7.5$ at 2.5 Hz and have a mean bias of +0.08 log units at 5 Hz. Thus, the AB03 equations are about 20% too high at 2.5 Hz and 20% too low at 5 Hz. Figure 2 shows the effect of the error on spectral shape. We plot the AB03 spectra for an $\mathbf{M}$ 8.5 interface event, on rock, at distances of 50 and 125 km (the magnitude-distance range of most interest to applications in the Cascadia region). If we make an approximate correction to the AB03 predictions based on the relative amount of data that were switched (as discussed in the following), the effect of the error on spectral shape can be clearly seen.

An approximate correction to account for the database error is to use a weighted average of the 2.5 and 5 Hz pseudoacceleration (PSA) predictions:

$$\log \text{PSA}(2.5 \text{ Hz})_{\text{corrected}} = 0.333 \log[\text{PSA}(2.5 \text{ Hz})]_{\text{AB 03}}$$
$$+ 0.667 \log[\text{PSA}(5 \text{ Hz})]_{\text{AB 03}},$$
$$\log \text{PSA}(5 \text{ Hz})_{\text{corrected}} = 0.333 \log[\text{PSA}(5 \text{ Hz})]_{\text{AB 03}}$$
$$+ 0.667 \log[\text{PSA}(2.5 \text{ Hz})]_{\text{AB 03}},$$

where $[\text{PSA}(2.5 \text{ Hz})]_{\text{AB 03}}$ denotes the PSA value predicted for 2.5 Hz from the AB03 interface equations, as published. This correction is based on the fact that approximately 2/3 of the records in the interface database for 2.5 and 5 Hz were switched. The approximate correction was used to plot the AB03(corrected) curve in Figure 2. If this correction is applied, then the average residual for $\mathbf{M} \geq 7.5$ events for both 2.5 and 5 Hz (for the corrected predictions) is zero. We stress that this correction applies only to interface events. Figure 3 shows the interface residuals for the database relative to the AB03(corrected) approximation.

An important and potentially confusing caveat regarding this correction is in order. In AB03, we also included regional correction factors that could be applied to make the AB03 equations more specific to particular regions. The correction factors for interface events (the only type of events affected) for Cascadia were based on data from the Cape

Interface predictions on rock: M8.5 at 50, 125 km
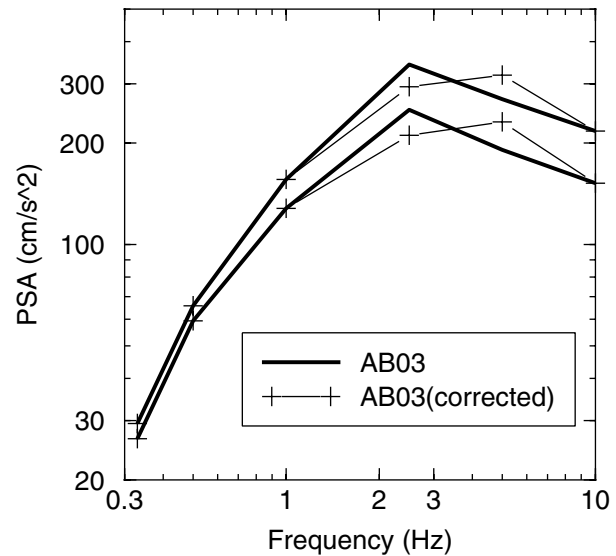
Figure 2.   Predicted response spectra for *M* 8.5 interface events, on rock, at 50 km (upper curves) and 125 km (lower curves) for AB03 as published and after the recommended correction.

Mendocino earthquake. None of these data contained the database swap error. Consequently, the AB03 interface equations when applied with the Cascadia regional factors (as provided in AB03) are actually correct for the Cascadia region (though limited by the fact that they were based on one event); thus, they should not be further corrected using the aforementioned weighting scheme. However, the swap error affects the generic equations (non-region-specific), and by implication it affects the application of the equations to all regions other than Cascadia. For those cases we recommend using the aforementioned weighting scheme. We checked the Japan-specific correction factors that were recommended in table 3 of AB03 against the residuals computed after correcting the swap error using the recommended weighting scheme; the correction factors given in table 3 of AB03 for Japan are unchanged (within 0.01 log units of those printed). Thus, if the region-specific equations for Japan are used, the swap error should be corrected when computing the generic ground motions, plus the region factors given in table 3 AB03 for Japan should be applied to the generic motions (the order of these operations does not matter).

We considered repeating the 2003 regressions for interface events at these two frequencies with the corrected database. However, a comprehensive revision of these prediction equations is overdue. There is an order of magnitude more data than was available in 2001 (when the database was compiled), and new knowledge suggests that other factors, such as whether recordings in a fore-arc or back-arc region, should be considered in the prediction equations (Macias *et al.*, 2008). We plan to pursue a more complete update to the AB03 equations rather than simply correct the database-

AB03 Interface: Revised residuals (after approximate error correction to AB03)
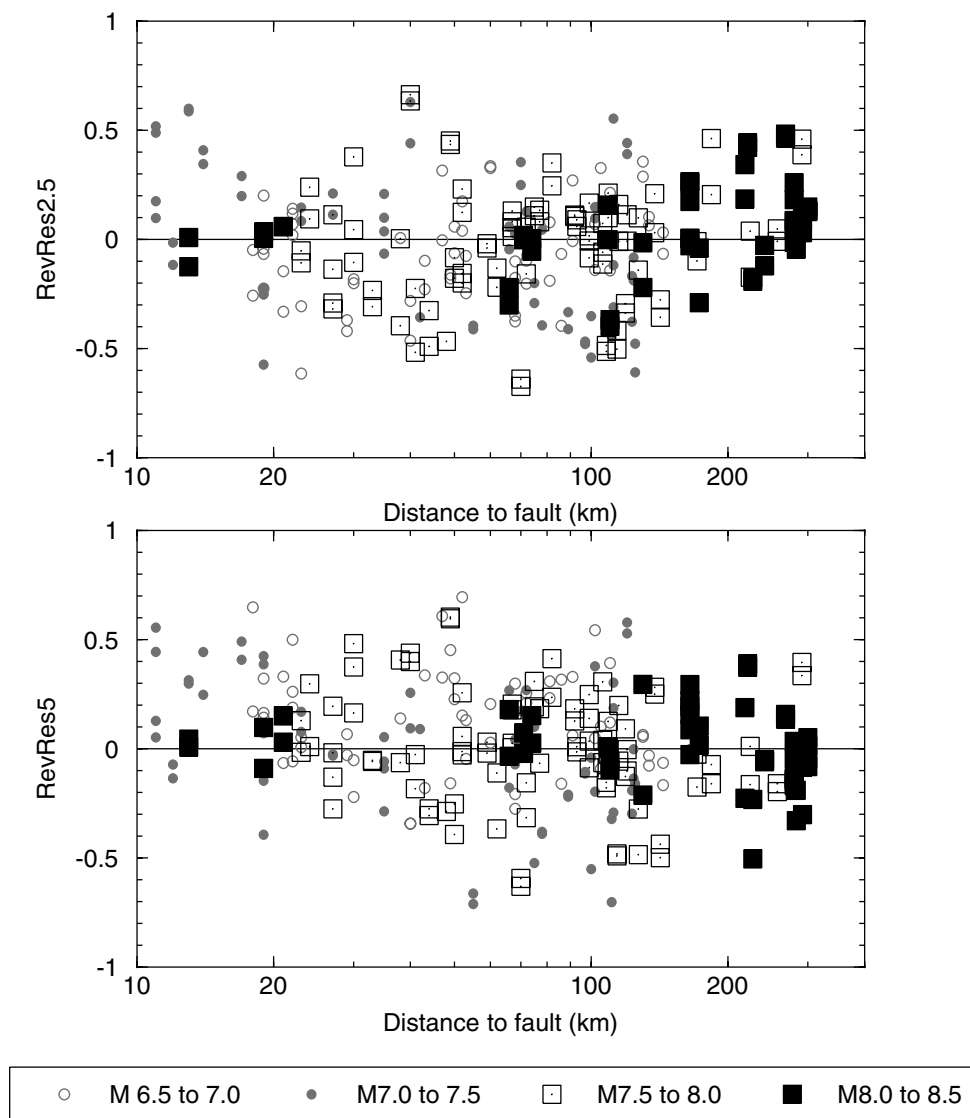
Figure 3. Residuals in log(10) units for the corrected AB03 database relative to the AB03 equations for interface events, after applying the recommended approximate correction.

related error. Hence, an approximate correction is more appropriate in the interim.

References

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