

ERRATUM: EMPIRICAL GROUND-MOTION RELATIONS FOR SUBDUCTION ZONE EARTHQUAKES AND THEIR APPLICATION TO CASCADIA AND OTHER REGIONS

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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 Hz 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 unaffected, as is the interface database at lower and higher frequencies, and 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 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. In Figure 1, the actual residuals of the data (after corrections to the database were made) at 2.5 Hz 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 $M \geq 7.5$ at 2.5 Hz, and 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 a $M 8.5$ 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 PSA predictions:

$$\log \text{PSA}(2.5\text{Hz})_{\text{corrected}} = 0.333 \log (\text{PSA}(2.5\text{Hz}))_{\text{AB03}} + 0.667 \log (\text{PSA}(5\text{Hz}))_{\text{AB03}}$$

$$\log \text{PSA}(5\text{Hz})_{\text{corrected}} = 0.333 \log (\text{PSA}(5\text{Hz}))_{\text{AB03}} + 0.667 \log (\text{PSA}(2.5\text{Hz}))_{\text{AB03}}$$

where $(\text{PSA}(2.5\text{Hz}))_{\text{AB03}}$ denotes the PSA value predicted for 2.5 Hz from the Atkinson and Boore (2003) 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 on Figure 2. If this correction is applied, then the average residual for $M \geq 7.5$ events for both 2.5 Hz 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.

We considered repeating the 2003 regressions for interface events at these two frequencies with the corrected database. However it is overdue to revise these prediction equations in a much more comprehensive way. 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 are 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-related error. Hence an approximate correction is more appropriate in the interim.

Acknowledgements

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References

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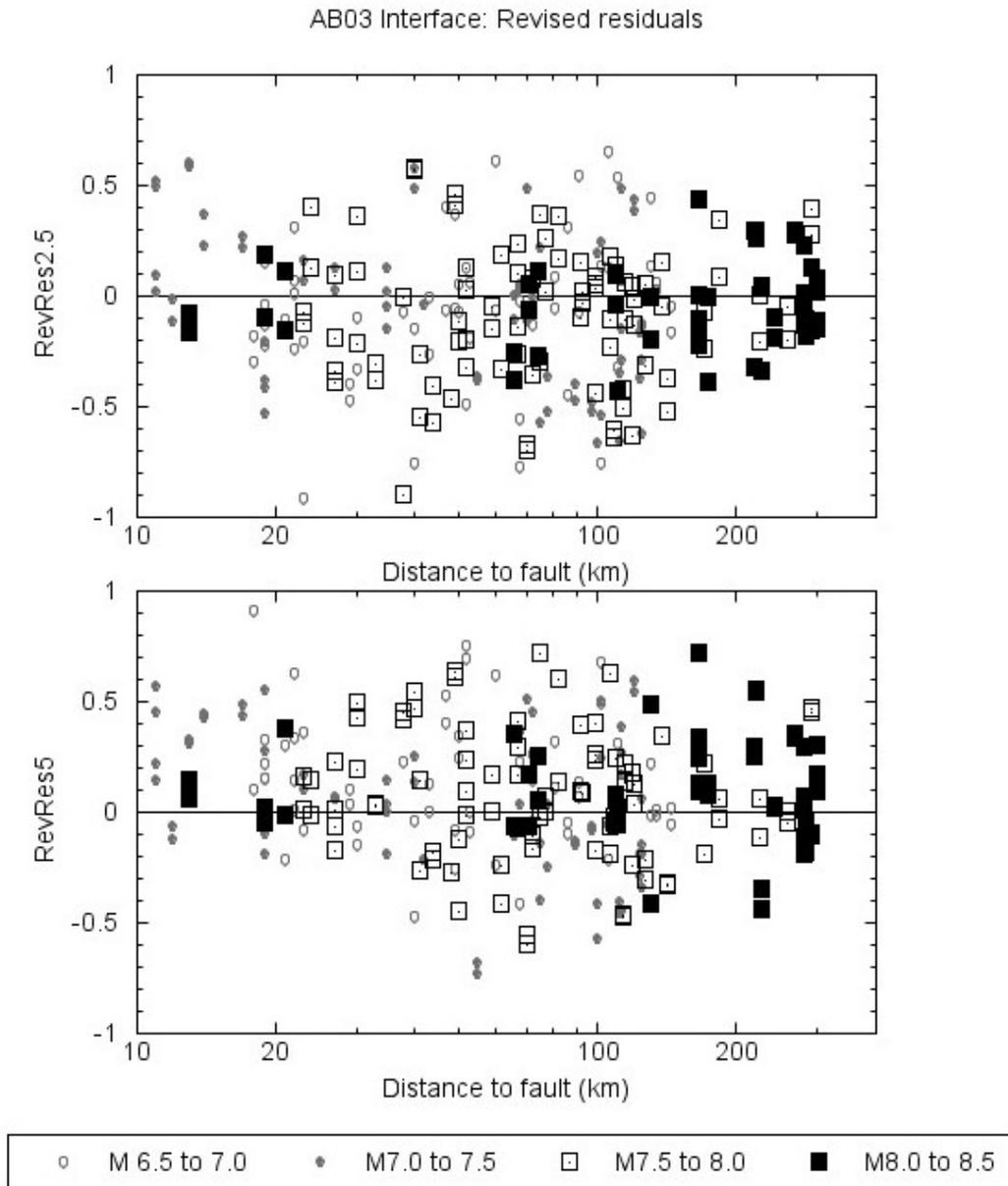


Figure 1 – Residuals in log(10) units for the corrected AB03 database relative to the AB03 equations for interface events, as published.

Interface predictions on rock: M8.5 at 50, 125 km

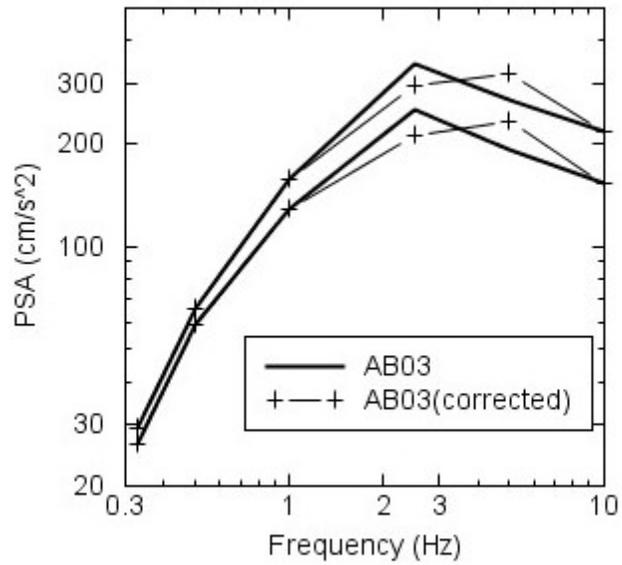


Figure 2 – Predicted response spectra for M8.5 interface events on rock, at 50 km (upper curves) and 125 km (lower curves) for AB03 as published, and after the recommended correction.

AB03 Interface: Revised residuals (after approximate error correction to AB03)

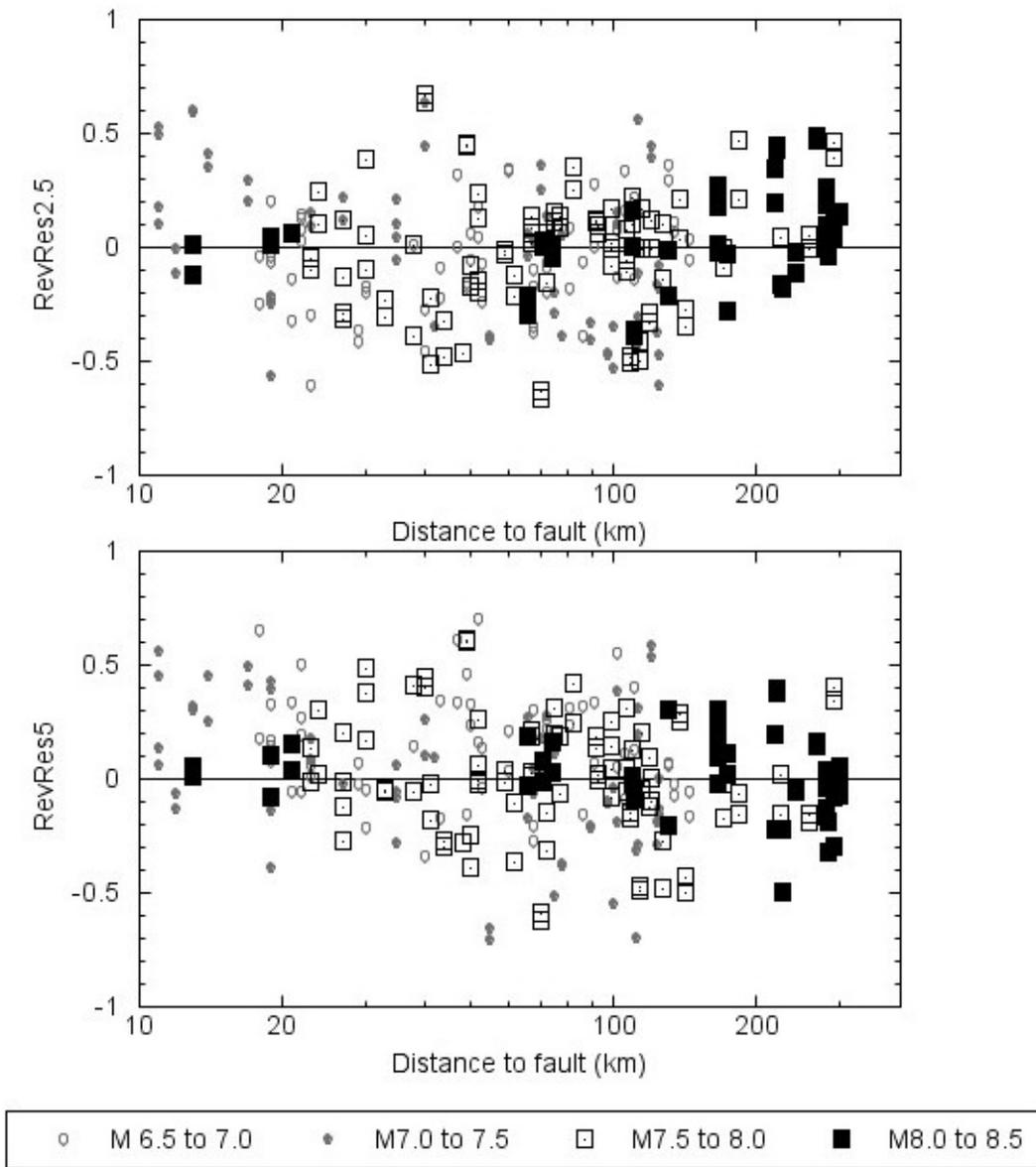


Figure 3 – Residuals in log(10) units for the corrected AB03 database relative to the AB03 equations for interface events, after applying the recommended approximate correction..