Some notes on programs and files for evaluating the AB06 GMPEs

David M. Boore

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The accompanying zip file ("files_for_verification_of_ab06_gmpe_evaluations.zip") contains a number of files that will be useful in using the AB06 ground-motion prediction equations (GMPEs):

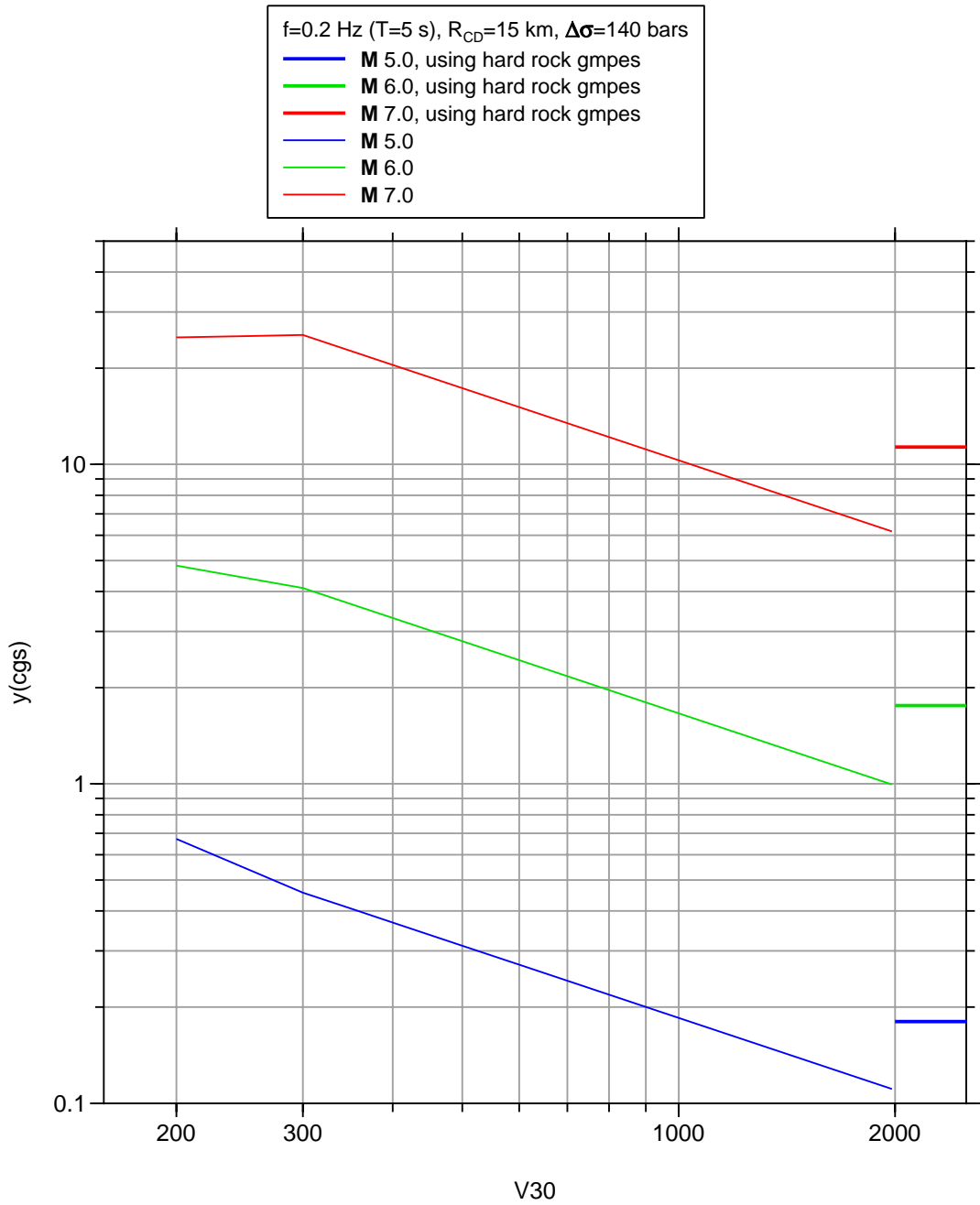| File	Description
ab06_gm_fmrvs.exe	Executable of program for evaluating the AB06 GMPEs
ab06_gm_fmrvs.for	The source code for the main program
ab06_fmrvs_evaluate_gmpes.for	The source code for the subroutine that does the GMPE evaluations
ab06_gm_fmrvs_utility_subs.for	The source code for various utility subprograms
AB05eqn_Rcd.par	Table of hard rock coefficients to four significant digits
AB05eqnBC_Rcd.par	Table of B/C coefficients to four significant digits
ab06_table_7.txt	Table 7 of AB06
ab06_gm_fmrvs_ctl_file_prepare.xls	An Excel spreadsheet that might be useful in preparing the control file
ab06_gm_fmrvs.ctl	The control file used for the comparison tables below (the entries above the first "stop" row are for the soil motions; entries for other runs are given below)
ab06_output_for_comparisons_hr.out	Hard rock motions for a set of input parameters
ab06_output_for_comparisons_soil.out	Soil motions for a set of input parameters

Some important notes:

1. Equation 6 should have no curly bracket before "max"
2. The coefficient tables in AB06 (Tables 6 and 9) were not given to enough precision, and thus PSA vs T can show oscillations due to the rounded coefficients. For this reason, the program AB06_gm_fmrvs ("GM" = "Ground Motion" and "FMRVS" = "Frequency", "Magnitude", "Distance", "Velocity", and "Stress") uses more precise tables than the published tables.
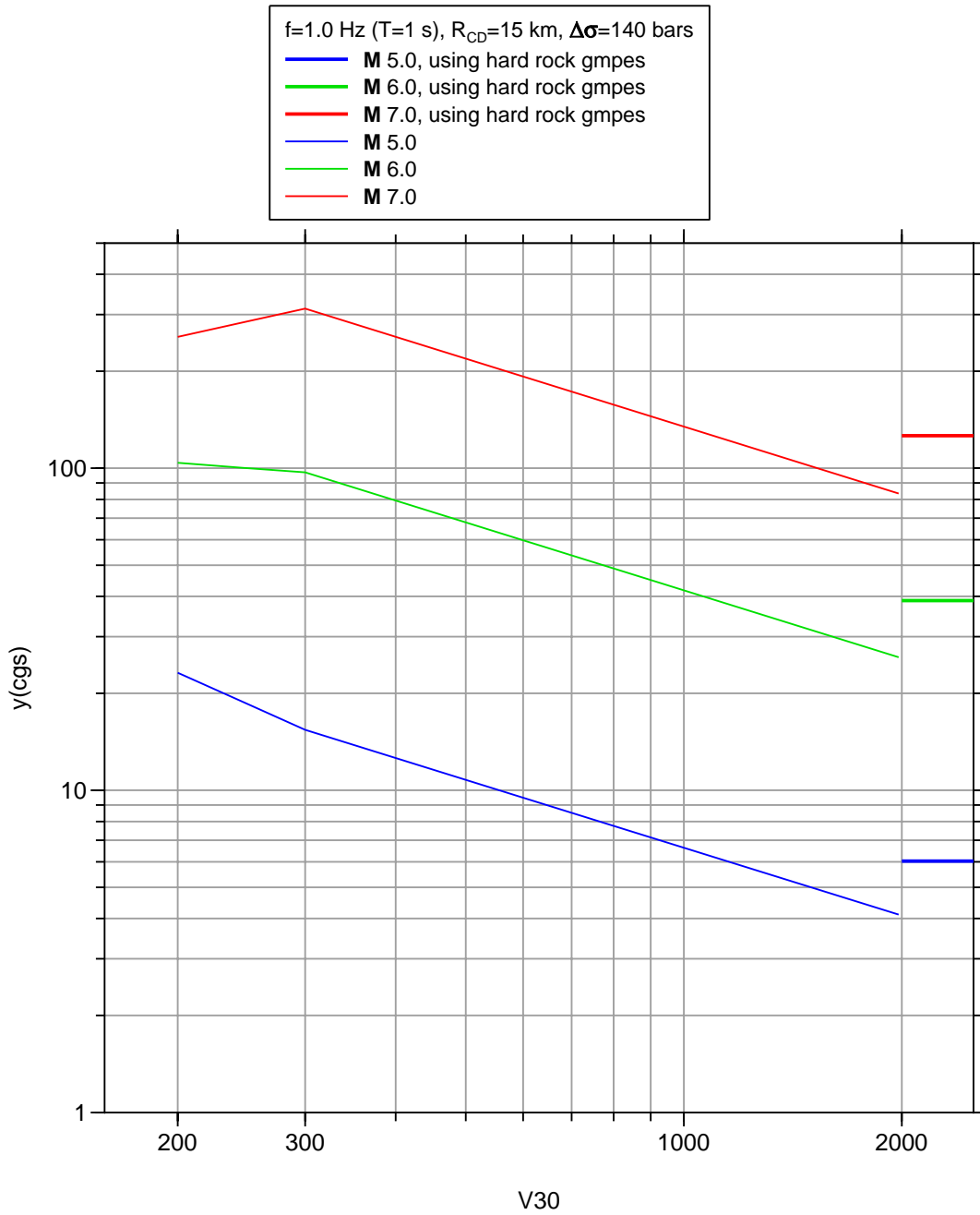
3. The program AB06_gm_fmrvs can use either with the hard rock or the B/C coefficient table; if the hard rock table is used, the input value of V30 (which is required, because of the free format used in reading the control file) is reset to 2500.0 (provisionally, the hard rock values can be used for V30>=2000); if the B/C table is used, any value of V30 can be used, but the name of the output file should be changed if necessary, and we recommend that V30 be less than 760 m/s; values of ground motion for V30 between 800 m/s and 2000 m/s can be obtained by interpolating between the B/C value of 760 m/s and the hard rock value, assuming it to represent motions for V30=2000 m/s (we may revisit this in the future).
4. The site amplifications used in AB06 are for an early version of the Boore and Atkinson PEER NGA GMPEs; I use the published version (Boore and Atkinson, 2008) in AB06_gm_fmrvs).

Here are some plots of ground motions vs V30, showing that there is sometimes a mismatch for values of V30 near 2000 m/s for motions from the hard rock table of coefficients and the B/C table of coefficients, adjusted for other V30 values using the amplifications of Boore and Atkinson (2008). These mismatches are what motivated us to recommend extrapolation to obtain PSA values for V30 between 760 and 2000 m/s:
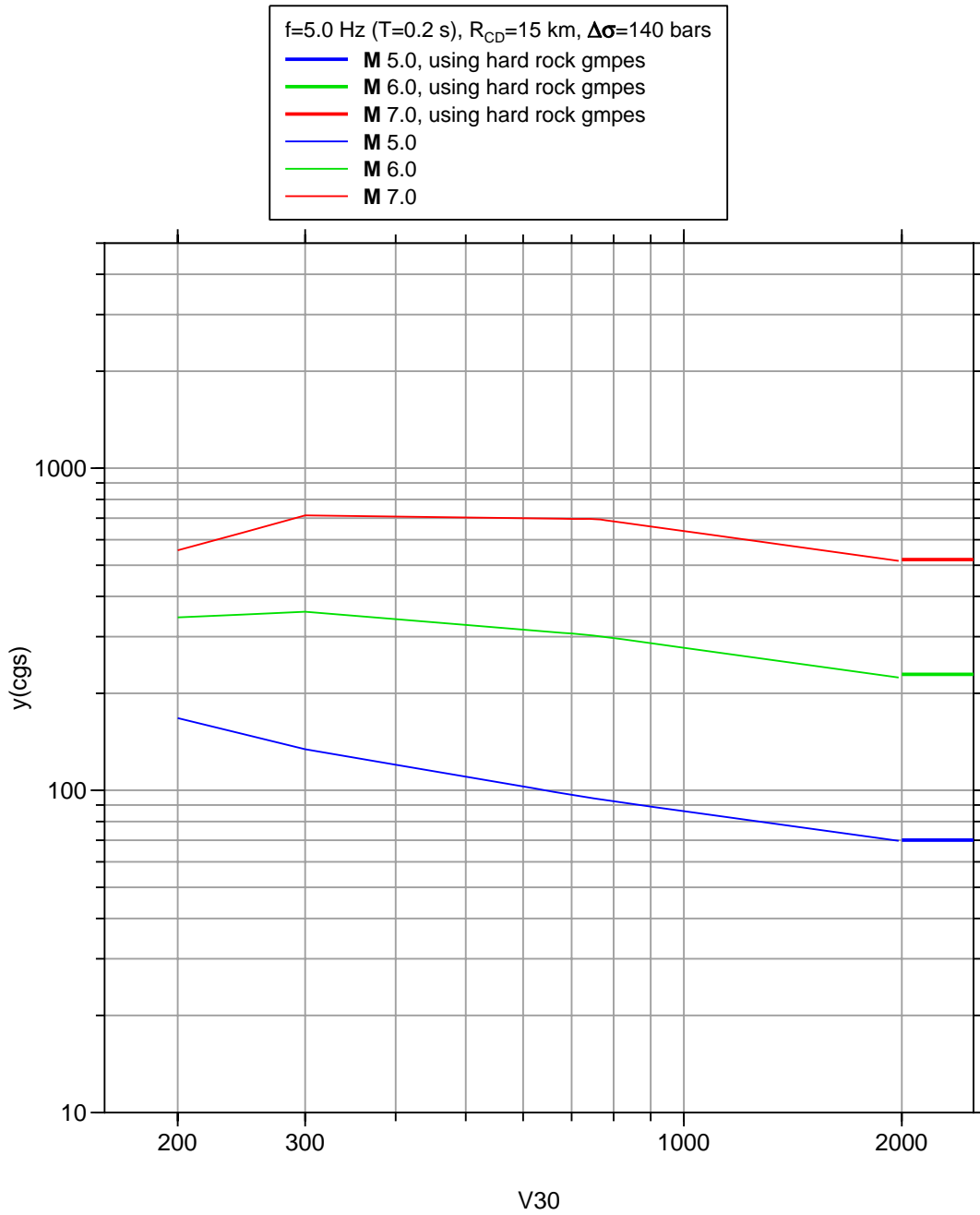
The figures are for f=0.2, 1.0, and 5.0 Hz. Each figure shows *PSA* vs *V30*, for **M**=5, 6, and 7. $R_{CD} = 15 \text{ km}$, $\Delta\sigma = 140 \text{ bars}$. The results should be self explanatory.

f=0.2 Hz (T=5 s), R_{CD}=15 km, $\Delta\sigma$=140 bars

- ▬▬ **M** 5.0, using hard rock gmpes
- ▬▬ **M** 6.0, using hard rock gmpes
- ▬▬ **M** 7.0, using hard rock gmpes
- ── **M** 5.0
- ── **M** 6.0
- ── **M** 7.0

y(cgs)

V30

File: C:\gm_predictions\working\ab06_gm_fmrvs_psa_vs_v30_m5.0_r15_140b.draw; Date: 2010-02-06; Time: 21:20:05

f=1.0 Hz (T=1 s), R_{CD}=15 km, $\Delta\sigma$=140 bars

- **M** 5.0, using hard rock gmpes
- **M** 6.0, using hard rock gmpes
- **M** 7.0, using hard rock gmpes
- **M** 5.0
- **M** 6.0
- **M** 7.0

y(cgs)

100

10

1

200   300   1000   2000

V30

File: C:\gm_predictions\working\ab06_gm_fmrvs_psa_vs_v30_m5.0_6.0_7.0_f_1.0_r15_140b.draw; Date: 2010-02-06; Time: 21:22:06

f=5.0 Hz (T=0.2 s), R_{CD}=15 km, $\Delta\sigma$=140 bars
- **M** 5.0, using hard rock gmpes
- **M** 6.0, using hard rock gmpes
- **M** 7.0, using hard rock gmpes
- **M** 5.0
- **M** 6.0
- **M** 7.0

y(cgs)

V30

File: C:\gm_predictions\working\ab06_gm_fmrvs_psa_vs_v30_m5.0_6.0_7.0_f_5.0_r15_140b.draw; Date: 2010-02-06; Time: 21:24:13

References

Atkinson, G.M. and D.M. Boore (2006). Earthquake ground-motion prediction equations for eastern North America, *Bull. Seismol. Soc. Am.* **96**, 2181—2205.

Boore, D. M. and G. M. Atkinson (2008). Ground-motion prediction equations for the average horizontal component of PGA, PGV, and 5%-damped PSA at spectral periods between 0.01 s and 10.0 s, *Earthquake Spectra* **24**, 99--138.