

Primarily some notes on the UCSC recording of the 1989 Loma Prieta earthquake at the Los Gatos Presentation Center

File: C:\peer_nga\database\lex_lgpc_comparison.pdf

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In response to my email of July 6, 2004, Walt Silva et al. recently sent newly processed data from UC Santa Cruz for the 1989 Loma Prieta earthquake. The new spectra now seem to be in better agreement with those I computed. Here is a direct comparison at the UCSC station:

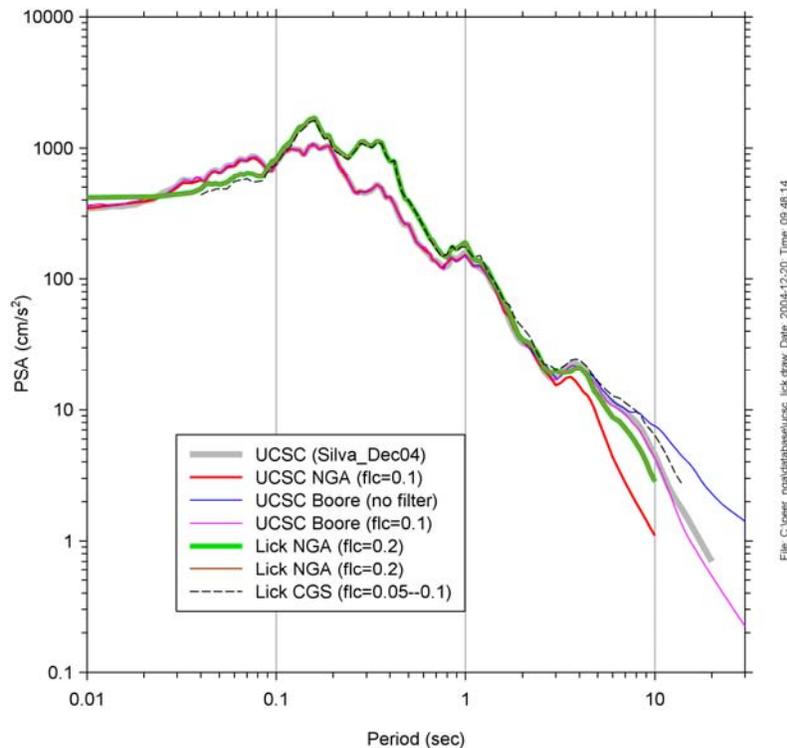


Figure 1. Spectra of data recorded on the UCSC campus. The new spectrum at UCSC (gray) is in good agreement with my spectrum of filtered motion (magenta). Note that the difference between the Lick and UCSC spectra is probably real.

The main topic of these notes is the Los Gatos Presentation Center (LGPC) data. I think that the data are so full of erroneous spikes (even after despiking and high-cut filtering by Silva et al.) and are so different from the relatively nearby Lexington Dam (LEXD, my code for this station) record that the motions from LGPC should not be used. As a side note, I also discovered that the coordinates of LEXD in the CGS data files and web site is

incorrect. Using the Topo! Program, I find that the proper coordinates are 37.20080 and -121.99032 (NAD27). This note is mainly a bunch of figures.

Here is a map of the locations of LGPC and LEXD, as well as the surface projection of the Loma Prieta mainshock that Bill Joyner and I used for distance calculations in our 1993 regression work (note that with our surface projections that the JB distance is not zero to the stations, as it is for LGPC in the NGA flatfile).

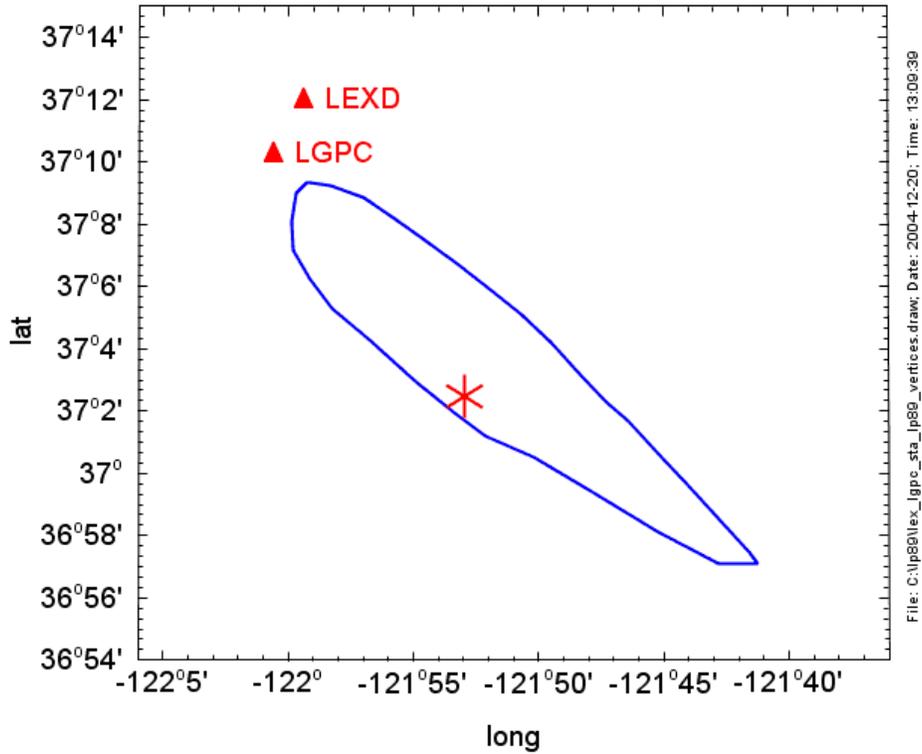


Figure 2. Map of surface projection of the fault, the epicenter (asterisk), and stations.

Here is a more detailed map:



Figure 3. Map showing locations of LGPC and Lexington Dam stations (the stations are 3.6 km apart).

The accelerations at LGPC before despiking are shown below:

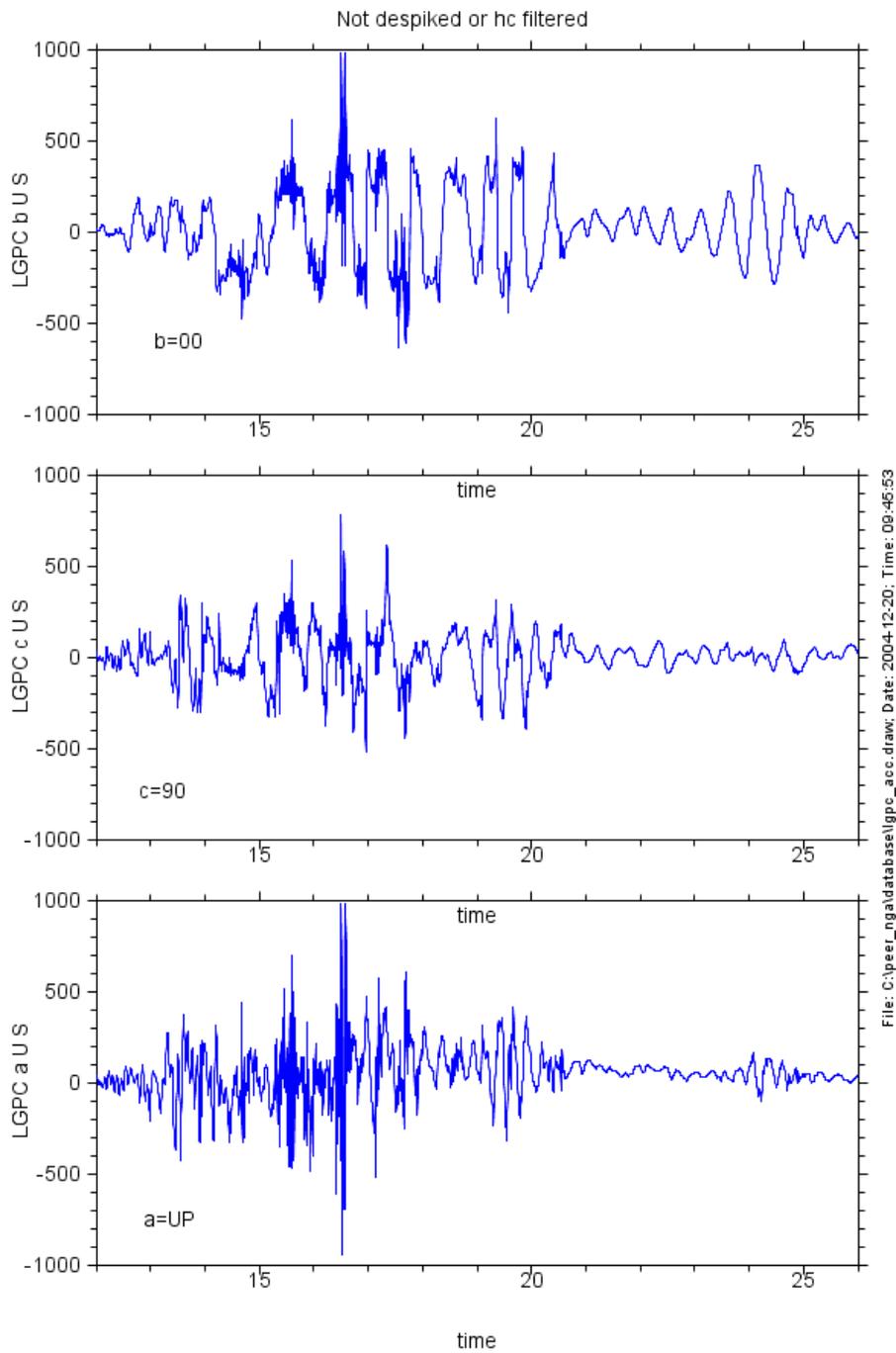


Figure 4. The accelerations at LGPC, before despiking.

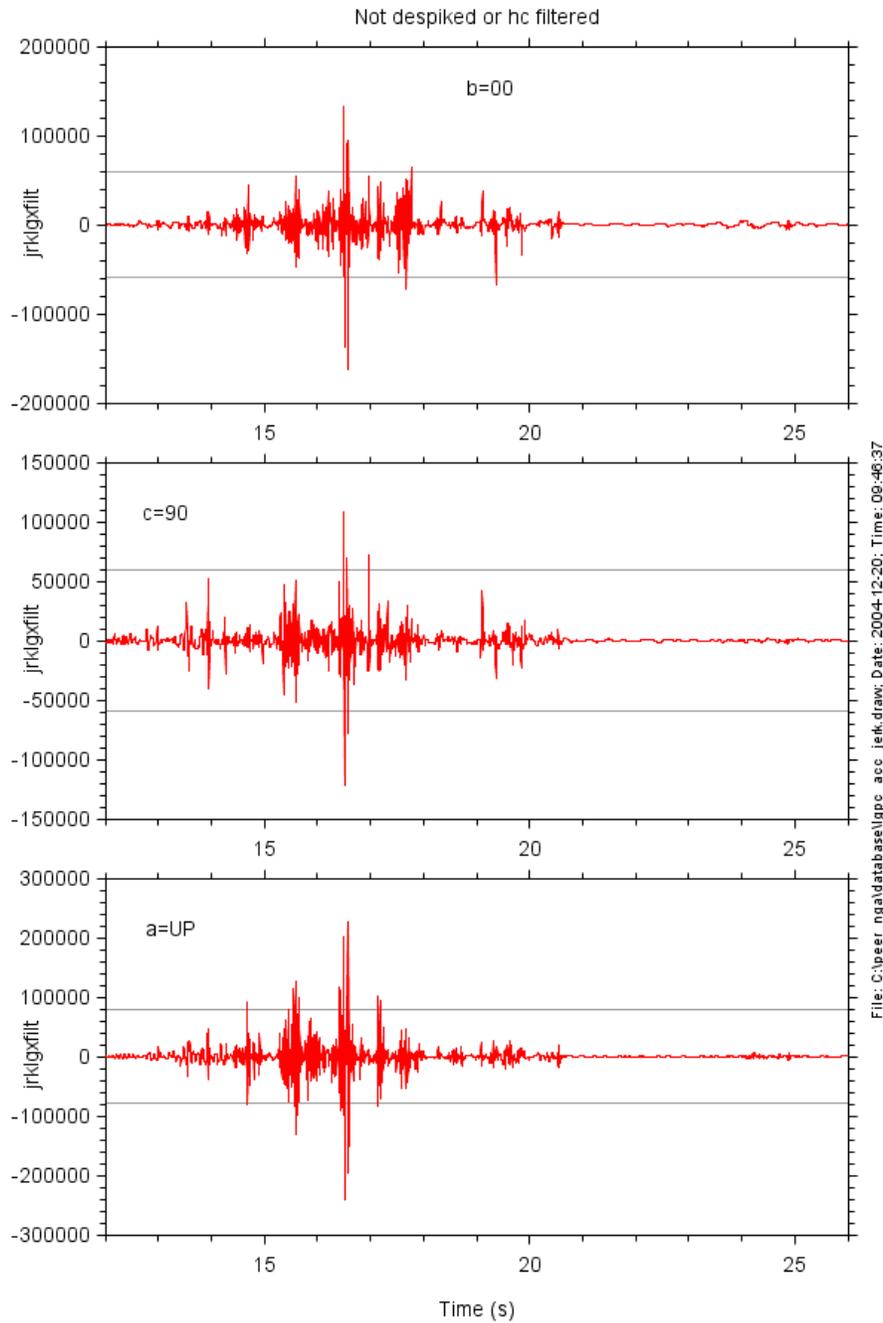


Figure 5. “Jerk” (first difference of acceleration) at LGPC, using the original record (not despiked). The horizontal gray lines correspond to the jerk level used by Silva et al. in despiking the record (the first difference would be $981 \cdot 0.3 / 0.005 = 58,860$ for the horizontal components and $981 \cdot 0.4 / 0.005 = 78,480$ for the vertical component). Recalling that spikes in acceleration show up as double sided pulses in jerk, the plot above suggests that there are many more spikes on the records than identified by Silva et al.

To see the effect of the Silva et al. despiking (and 80 Hz high-cut filtering), I show the same two figures as before, but using the data recently sent by Silva et al.

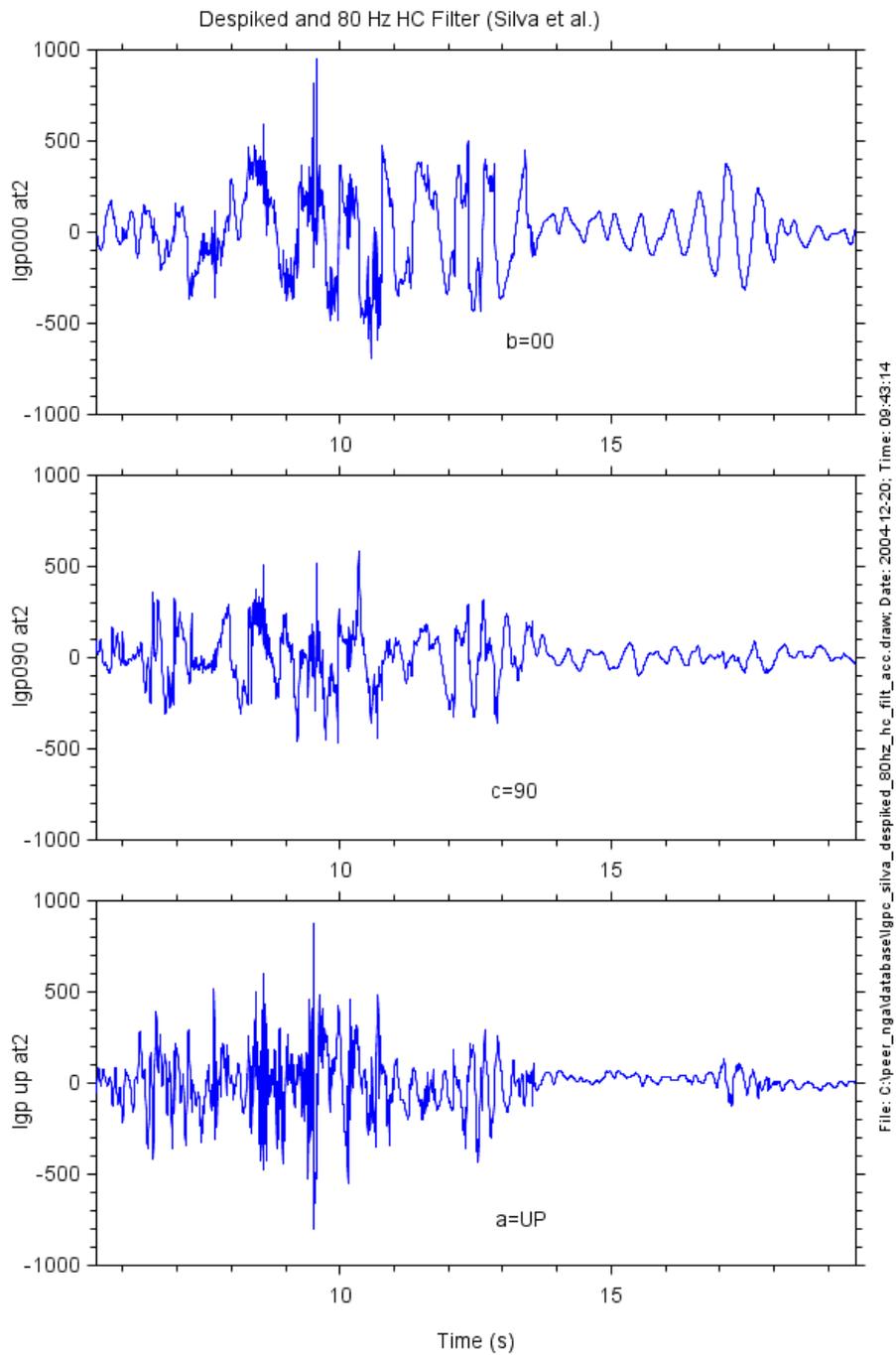


Figure 6. Despiked and high-cut filtered by Silva et al.

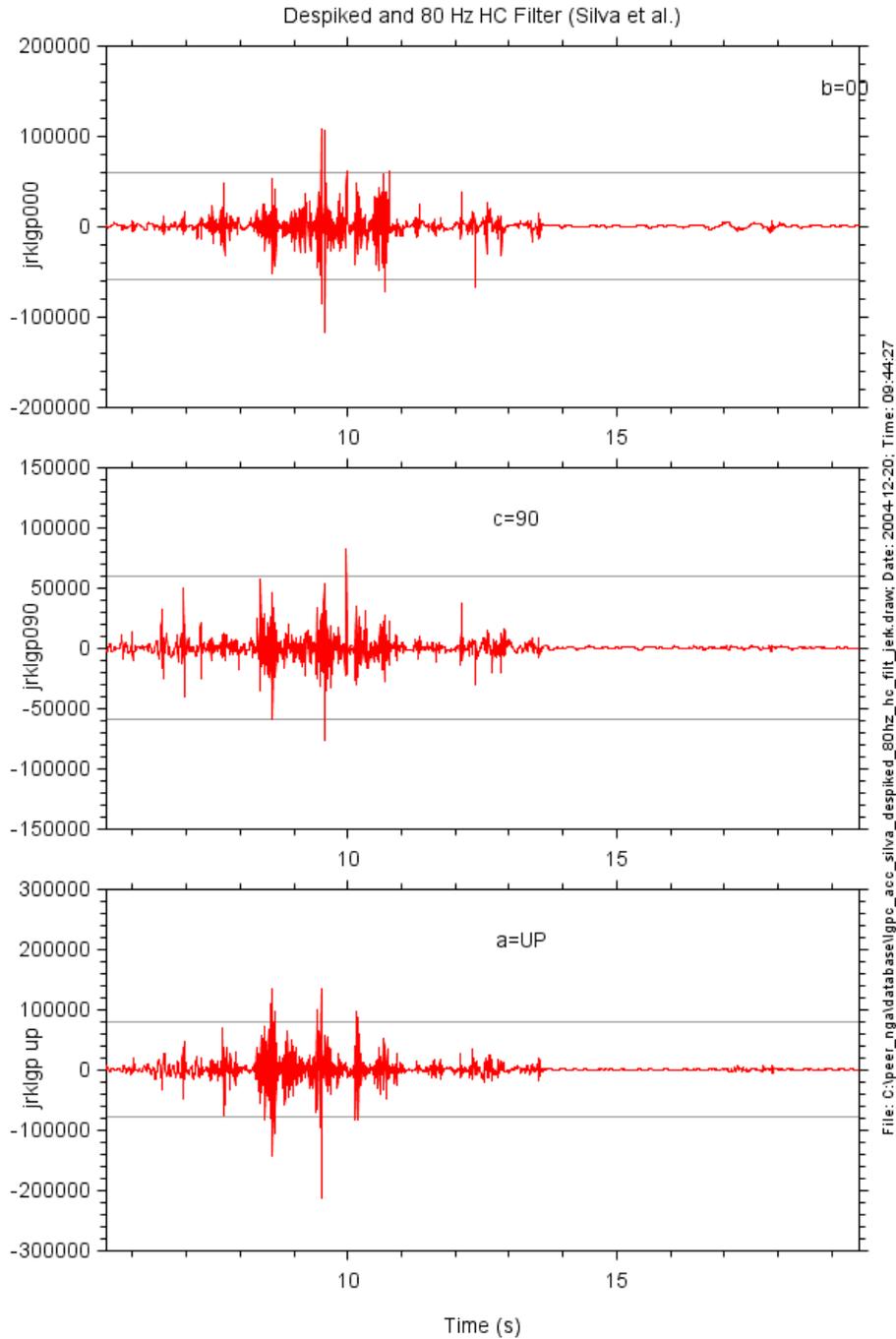


Figure 7. Jerk for the despiked records.

It seems to me that much of the high-frequency chatter remains. Notice that some of the spikes in the jerk trace are single sided, implying steps in the acceleration. It is not clear to me that the despiked record (Figs 6, 7) is that much better than the original record (Figs. 4 and 5). Did Walt send the proper time series in his recent email? I plotted lgp000.at2, lgp090.at2, and lgp-up.at2.

The waveforms at LEXD and LGPC are quite different, event though the stations are only 3.6 km from one another. This is shown in the next figure.

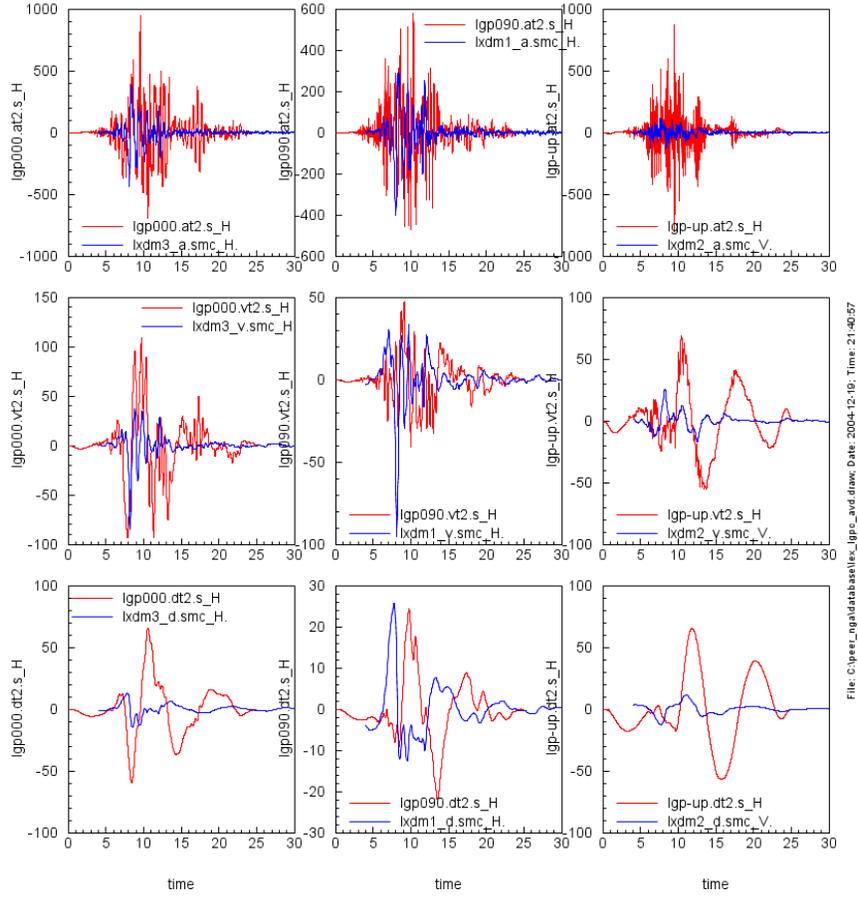


Figure 8. Comparison of acceleration, velocity, and displacement traces at Lexington Dam and LGPC. The Lexington Dam record was low-cut filtered between 0.05 and 0.10 Hz. The LGPC record was low-cut filtered with a causal 0.1 Hz filter. The time alignment is arbitrary; all Lexington Dam components were shifted by the same amount to produce general coincidence of the acceleration traces.

The spectra of all but the EW component for $T > 1$ sec are also very different in general, as shown in the next figure.

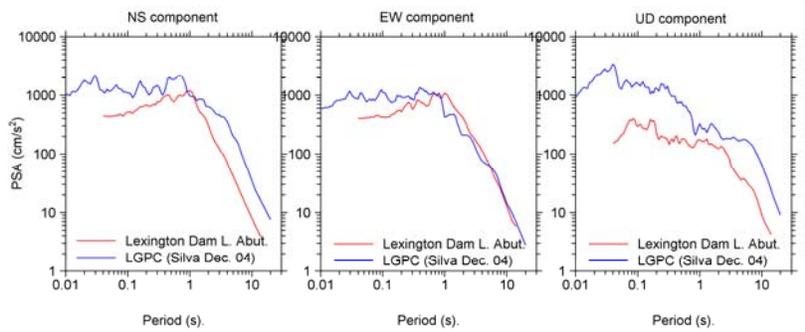


Figure 9. Spectra at LEXD and LGPC.

Unless someone can convince me otherwise, I think that the recordings at LGPC should not be used for any analyses. The acceleration record at LGPC is very strange looking, with numerous spikes that have not been removed by despiking and high-cut filtering. In contrast, the LEXD does not seem at all strange. (Maury Power is sending us some information that may bear on the possible influence of the dam on the record at LEXD, which was situated on the left abutment --- see Fig. 3. Reading Maury's latest email carefully, I am not sure if the material he included in a previous email and that he is sending will conclude that the dam did or did not have a substantial influence on the record at LEXD). If I knew what produced the spikes on the LGPC record and could be assured that the spikes only affect high frequencies, I could see using a high-cut filtered version of the record. But the comparisons of velocity and displacement waveforms at LEXD and LGPC does not give me much confidence that the problems on the LGPC record are restricted to high frequencies (with the possible exception of the EW component record).