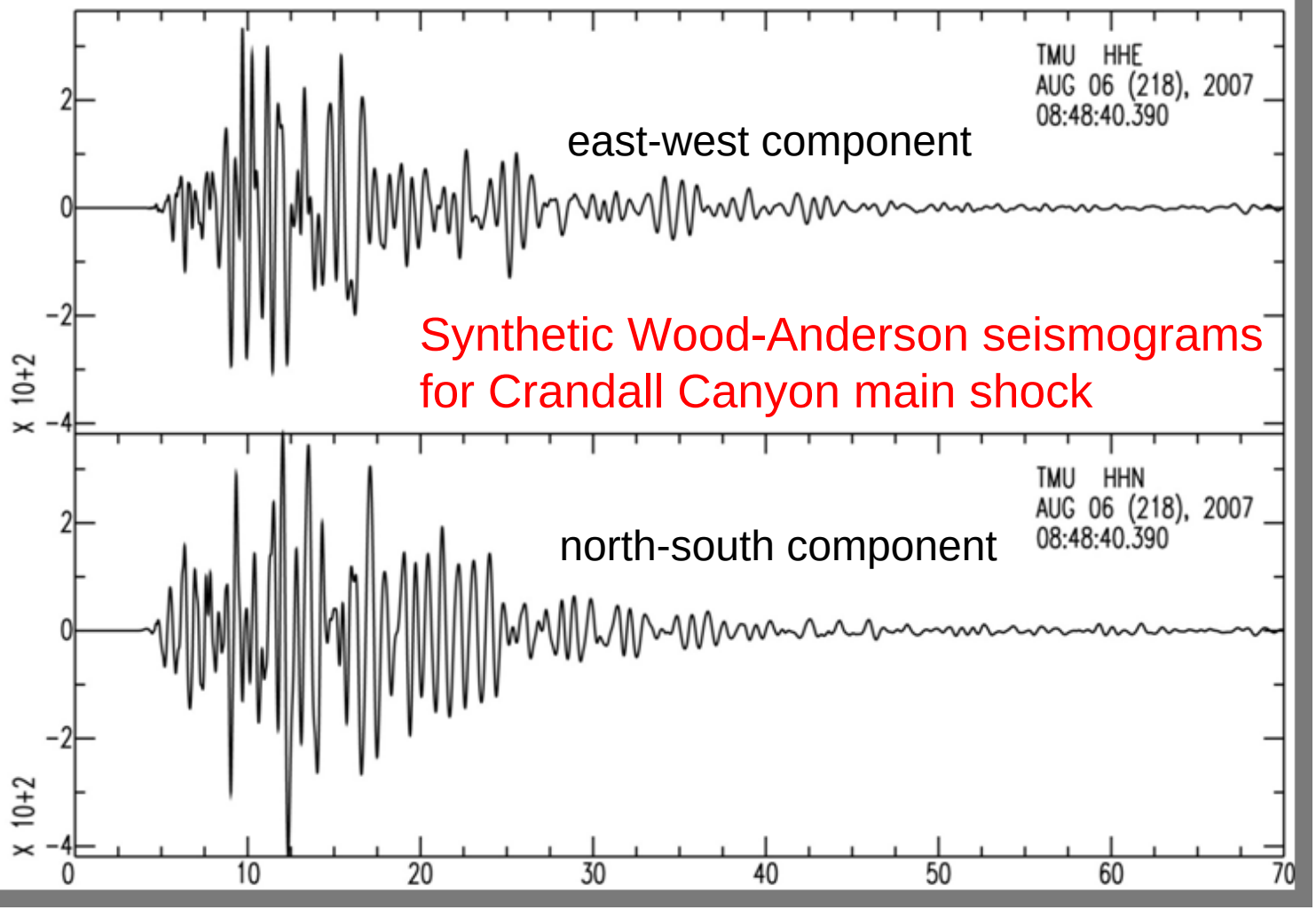
Magnitudes in the University of Utah Instrumental Earthquake Catalog: July 1962 - present

- **Preferred magnitude is local magnitude, M_L , determined from maximum peak-to-peak amplitudes on Wood-Anderson seismograms--originally real ones, now synthetic ones from broadband and strong-motion instruments. Cannot always be determined (even now).**
- **The vast majority of the magnitudes are coda magnitudes, M_C , (duration magnitudes, M_d) determined from signal durations on short-period vertical records**
- **Calculations of earthquake rates are very sensitive to the minimum magnitude used and the accuracy of the magnitudes. Homogeneity is important!**

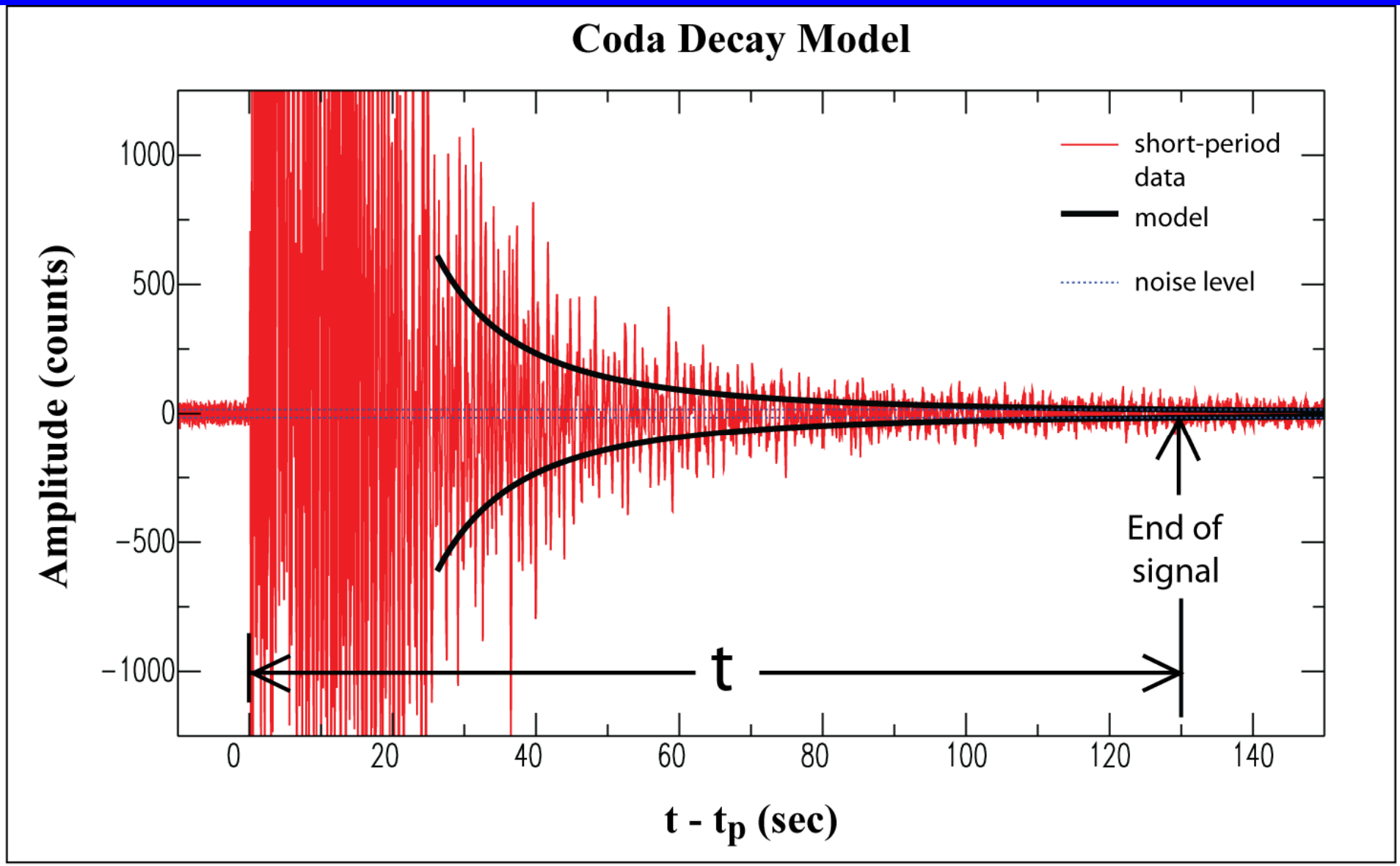
Measuring size

(Richter, coda, and moment magnitudes)

M_L M_C M_W

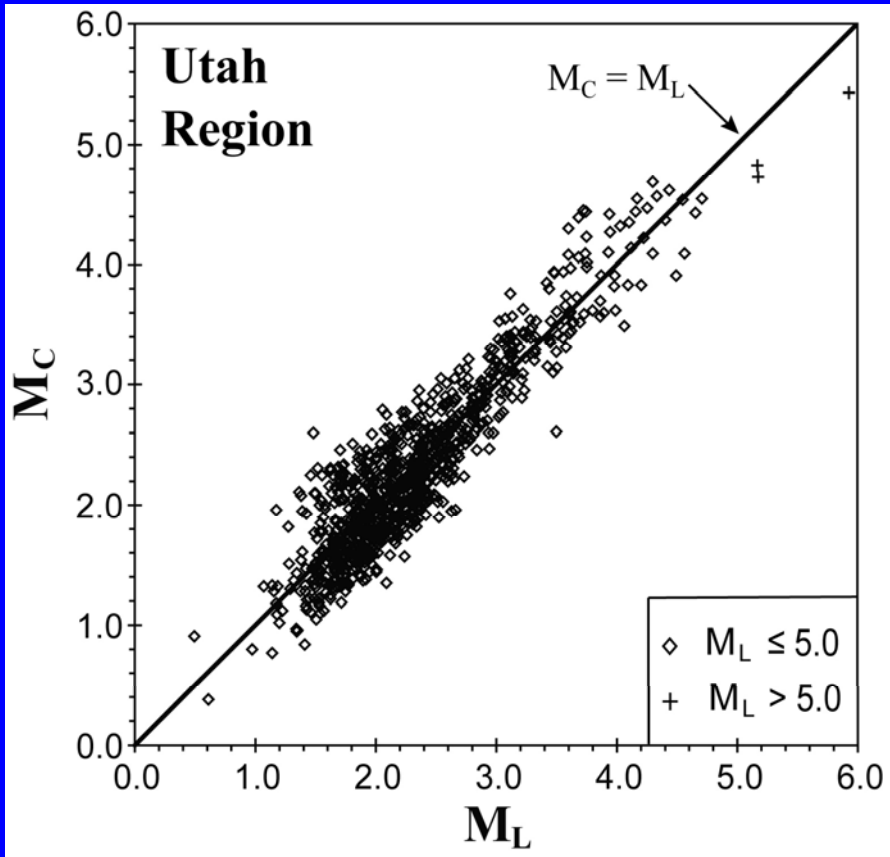


Short-Period Vertical-Component Record
Station MLI, ML 3.8 Utah Earthquake, 6/28/1990

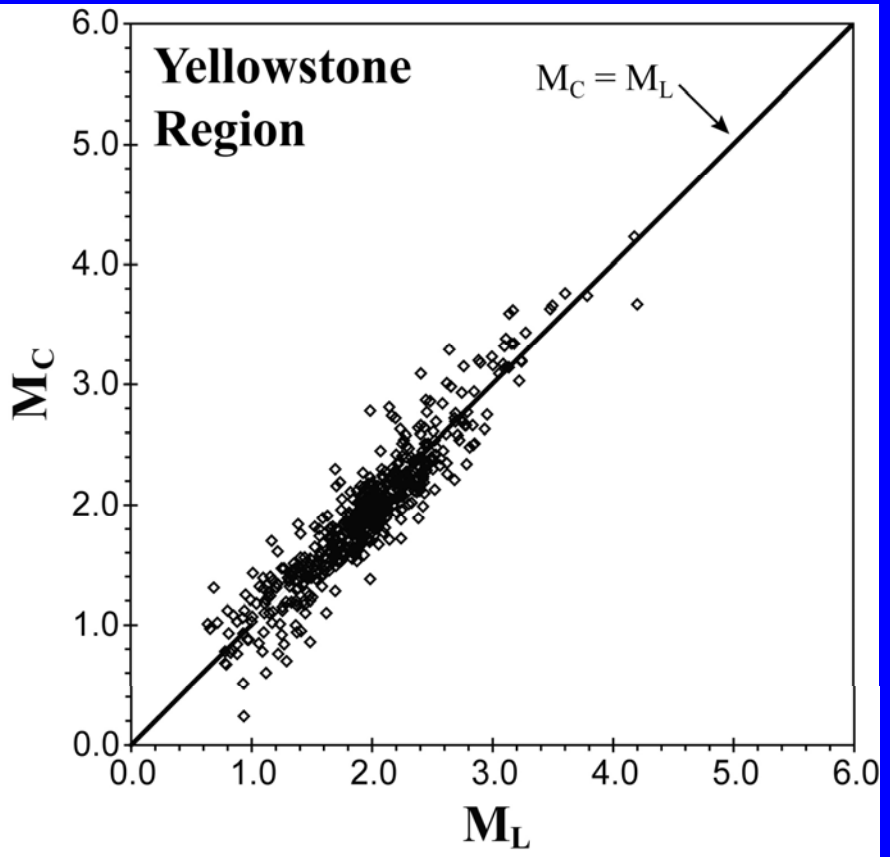


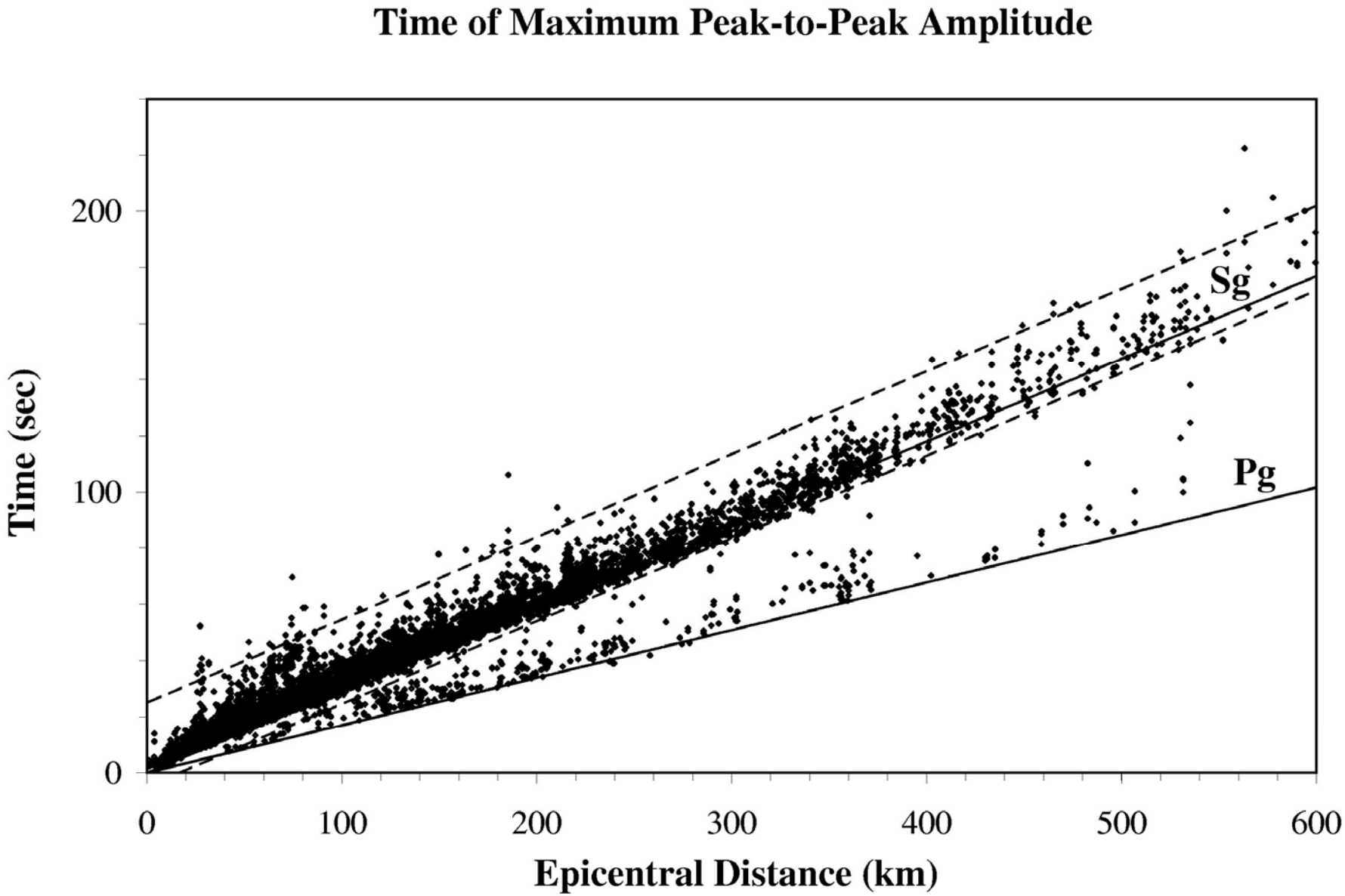
M_C Calibrations

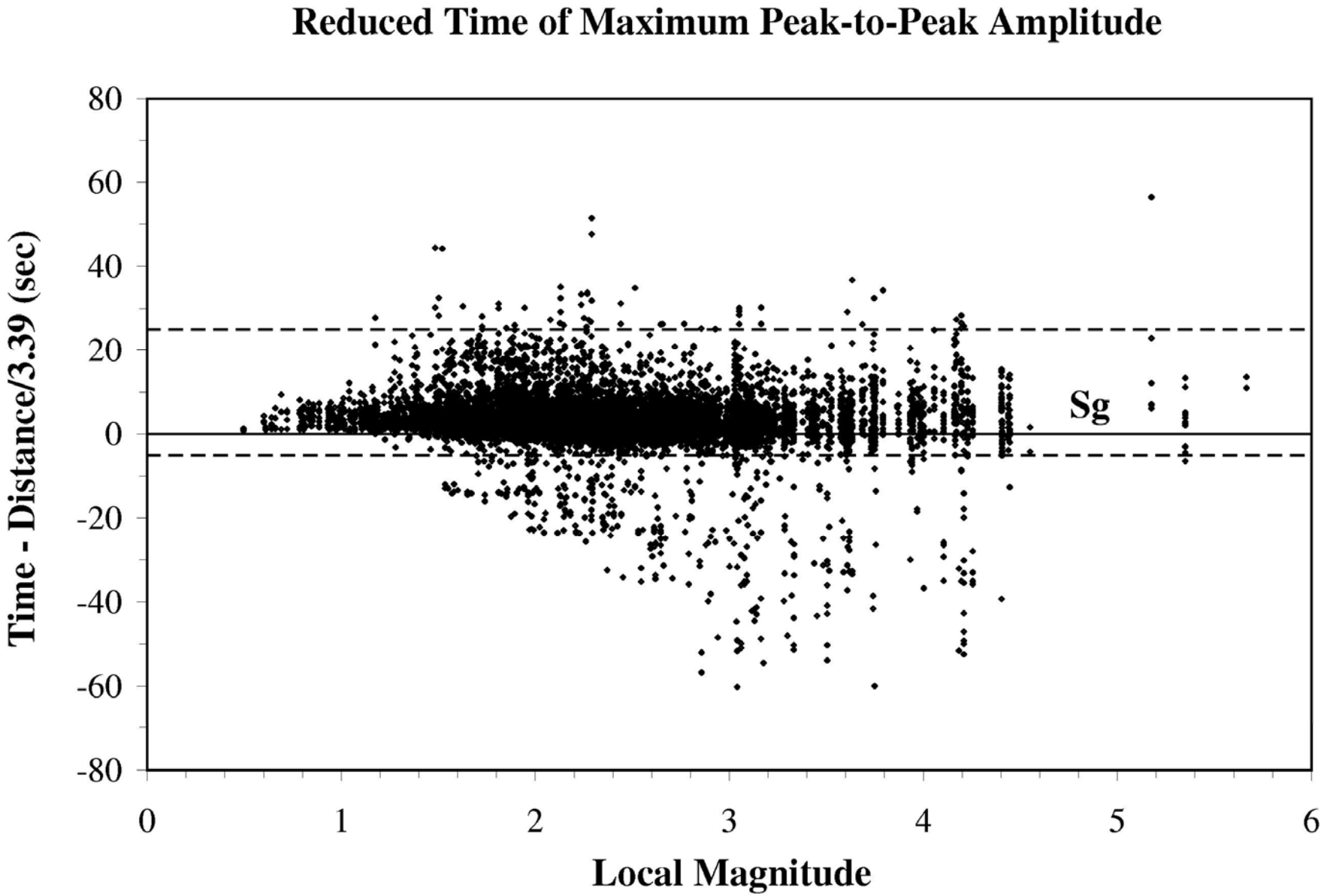
Data: 1981 - 2001



Data: 1995 - 2001




Time of Maximum Peak-to-Peak Amplitude
Time (sec)
0
100
200
0
100
200
300
400
500
600
Epicentral Distance (km)
Sg
Pg


Reduced Time of Maximum Peak-to-Peak Amplitude
Time - Distance/3.39 (sec)
80
60
40
20
0
-20
-40
-60
-80
Sg
0
1
2
3
4
5
6
Local Magnitude

Overview of AQMS Magnitude Determinations

(I) Automatic Near-Real-Time Magnitudes

(1) ***Automatic M_Ls (and M_Es) from rad2 and trimag.***
Feature continuous calculation of synthetic Wood Anderson (SWA) maximum 0-p amplitudes (etc.) using recursive time domain filter approximation (Kanamori et al., 1999)

(2) ***Automatic M_Cs (M_ds) from pick_ew and eqcoda.***
Widely used modules straight from earthworm

(3) These programs are reasonably well documented

Overview of AQMS Magnitude Determinations

(III) Automatic Magnitudes with Options for Review and Revision

(1) M_L and M_d are both calculated within Jiggle using different codes than for the automatic magnitudes.

(2) Hypoinverse calls from Jiggle are only used for calculating locations.

(3) Recalculation of M_L or M_d the first time initiates a complete automatic redetermination starting with the original waveforms.

(4) Configuration of programs all done through Jiggle properties settings—88 of them!

(5) *Insufficient documentation*—property definitions only.

Overview of AQMS Magnitude Determinations

(III) Negative Magnitudes are Supported

Rad2/Trimag: Produce automatic M_Ls

- **Pros**

--Very fast M_L determinations

--No sudden system load when a seismic event occurs

- **Cons**

--M_Ls reported in UU system are off by up to 0.3 unit

--Search windows cannot be configured to exclude the P-wave window

--Relatively high false alarm rate, at least in the northern California network

Pick_ew/Eqcoda: Produce automatic M_Cs

- **Pros**

--Robust size estimates

--Sum of weights from eqcoda coda fits is a useful noise discriminant

- **Cons**

--Time delay of ~3 minutes for all but the smallest events

Jiggle M_L Program

- **Pros**

--Highly configurable, with lots of options

--Convenient method for repicking 0-p amplitudes

--Easy switch between M_L table and waveforms

--Filtering options to enable M_Ls for small events

- **Cons**

--No option for using p-p amplitude instead of 0-p

--"Richter" M_L distance corrections don't match those used in rad2/trimag

--Any way to prevent p-p amplitude picks on non-SWA records?

Jiggle M_d Program

- **Pros**

--Highly configurable, with lots of options

--Shows plots of coda decay fits superimposed on the waveforms

--Easy switch between M_d table and waveforms

--Handles gain corrections via time-dependent end-of-coda thresholds stored in the database

--Is it possible to update coda termination values automatically whenever simple responses are updated?

- **Cons**

--Poor documentation—no description of what it does