APPENDIX F: COMMENTS ON S AND S_0

In describing attenuation of all peak amplitudes versus distance, we used "representative" source to station distance Δ, defined by

$$\Delta = S\left(\ln\frac{R^2+H^2+S^2}{R^2+H^2+S_0^2}\right)^{-1/2} \qquad (A.1)$$

where R is epicentral distance (in km), H is focal depth (in km), S is source dimension (see eqn (III.1.6))

$$S = \begin{cases} -25.34 + 8.51M & \text{for} \quad 3 \le M \le 7.25 \\ 0.2 & \text{for} \quad M < 3 \end{cases} \qquad (A.2)$$

and S_0 is the correlation radius (Trifunac and Lee, 1985a), approximated by

$$S_0 \sim \beta T/2 \qquad (A.3)$$

where β is velocity of shear waves in the source region, and T is the period of wave motion. We choose T to be in the period range near the largest spectral amplitudes of the Fourier amplitude spectra of the function whose peaks are being determined. For attenuation equation describing amplitudes of peak accelerations, we take $S_0 \sim 0.1$ km. For peak velocities, we assume $S_0 \sim 1$ km and $T \sim 1$ sec.

For peak displacements, the shape of the corresponding Fourier amplitude spectrum depends on the proximity of the source to the recording station and on the values of the corner frequencies f_1 and f_2, which are related to fault length L and width W (Trifunac, 1993b). For unilateral faulting, statistical studies of strong ground motion suggest that the total duration of faulting $\tau_1 \sim 1/f_1 = L/2.2 + W/6$ (Trifunac and Novikova, 1995). The time required for the dislocation to spread over the entire fault width is $\tau_2 \sim 1/f_2 = W/6$. In this work we assume that T in eqn (A.3) is approximately 1/2 to 1/3 of τ_1. Then, for $\beta \sim 3$ km/sec, we define

$$S_0 = \min(S_f, S)/2 \qquad (A.4)$$

where $S = S(M)$ is given by eqn (A.2) and S_f can be approximated by

$$S_f = \begin{cases} L(M) & M < 3.5 \\ L(M)/2.2 + W(M)/6 & 3.5 \le M \le 7 \\ L(M_{\max})/2.2 + W(M_{\max})/6 & M > M_{\max} = 7 \end{cases} \tag{A.5}$$

with $L(M)$ and $W(M)$ defined by

$$L(M) = a10^{bM} \tag{A.6}$$

and

$$W(M) = c10^{dM} \tag{A.7}$$

where $a = 0.01$, $b = 0.5$, $c = 0.1$ and $d = 0.25$ (Trifunac, 1993b).

Near the source, for $M < 4.5$, as $R \to 0$ and $H \to 0$,

$$\Delta \to S\left(\ln\left(\frac{S}{S_0}\right)^2\right)^{-1/2} \tag{A.8}$$

showing that Δ becomes sensitive to the ratio S/S_0. At present, the available strong motion data is not sufficient to control selection of functional forms and of amplitudes of functions describing S and S_0, and the rough approximation $S = 0.2$ km for $M < 3$ in eqn (A.2) will result in overestimates of $d_{\max}$ (and $\overline{u}$). For those applications when $d_{\max}$ and $\overline{u}$ need to be estimated for $R < 5$ km, and only for small magnitudes ($M < 4.5$), we replace S as defined by eqn (A.2) by

$$S = \begin{cases} -25.34 + 8.51M & \text{for} \quad 4.5 \le M \le 7.25 \\ 0.0729(5.5 - M)10^{0.5M} & \text{for} \quad M < 4.5. \end{cases} \tag{A.9}$$

With this approximation for S in eqn (A.9), the regression equations for $d_{\max}$ and for $\overline{u}$ can be used even at $R \to 0$ and $H \to 0$, and since $\overline{u} = 2d_{\max}$, the same equations can be used to describe $\overline{u}$ versus M at the fault surface. (Trifunac, 1993b).