Dynamic Strains at Regional and Teleseismic Distances: Results from Longbase Laser Strainmeters

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There are increasing amounts of data for, and interest in, the ability of large earthquakes to trigger different kinds of seismicity – both conventional earthquakes and non-volcanic tremor – at distances such that largest stress changes are caused by radiated seismic waves. Because direct measurements of deformation are rarely available, the amplitudes of these stresses are almost always inferred from ground motions, thenselves either recorded or inferred. The three surface-mounted longbase laser strainmeters at Pĩnon Flat Observatory (PFO) provide a unique, well-calibrated measure of changes of the complete strain tensor, including those from seismic waves. We have examined strain data from 89 earthquakes between 1977 and the present, with magnitudes from 6.5 through 9.0; and at distances from 500 to 16,000 km, from these we develop expressins that use the distance and source magnitude to predict the peak strain, maximum dissipated power, and total dissipated energy. There is considerable scatter in the data, but these predictions usually fit to within a factor between one-third and three. For example, peak strain in the direction to the earthquake is given by $\log_{10}(E) = 0.95M - 1.65\log_{10}(Delta) - 2.8$, with distance Δ in degrees and strain in nanostrain. Theory predicts zero extensional strain perpendicular to the back-azimuth, but this is not observed. Instead, the peak (and rms) transverse strain is at least 20% of the radial, and for some events can be larger than radial strain, even allowing the back-azimuth to vary to allow for wave refraction. The strains seem to be least isotropic for paths through relatively uniform structure (from the SW Pacific) and most for paths along the plate boundary, suggesting a possible effect from multipathing. Both areal and fault-parallel shear are systematically larger at the PBO laser strainmeter sites in the Salton Trough (SCS and DHL) than at PFO.