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La energía radiada por los grandes terremotos superficiales
The radiated energy of large shallow earthquakes

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ABSTRACT

Despite its fundamental importance in seismology, accurate estimation of radiated energy remains challenging. The interaction of the elastic field with the near-source structure, especially the free surface, makes the radiation field very complex. Here we address this problem using the normal-mode theory. Radiated energy estimations require a detailed finite source model for the spatial and temporal slip distribution. We use the slip models for recent great earthquakes provided by various investigators. We place a slip model in a spherically symmetric Earth (PREM), and compute the radiated energy by modal summation. For each mode, the volume integral of the energy density over the Earth's volume can be obtained analytically. The final expression involves a sum over the source patches nested in the modal summation itself. In practice we perform modal summation up to 80 mHz. We explore the effect of several factors such as the focal mechanism, the source depth and the source duration. Not surprisingly, the source depth plays a key role. The effect can be very significant for events presenting large slip at shallow depths. Deep earthquakes and strike-slip earthquakes are essentially unaffected by the free surface. Similar to the situation in moment tensor determinations, shallow dipping reverse or normal focal mechanisms can be heavily affected. Estimates of the radiated energy for the frequency band $f \leq 80$ mHz for some large earthquakes such as 1995 Bolivia, 2004 Sumatra, 2010 Maule, 2010 Mentawai, and 2011 Tohoku are provided. To obtain the total radiated energy, the radiated energy for frequency > 80 mHz estimated with other methods (e.g., integration of squared velocity records) needs to be added.