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Evolution of the rates of mass wasting and fluvial sediment transfer from the epicentral area of the 1999, Mw 7.6 earthquake

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The 1999 Chichi earthquake (Mw=7.6) triggered more than 20,000 landslides in the epicentral area in central west Taiwan, and subsequent typhoons have caused an even larger number of slope failures. As a result, the suspended sediment load of the epicentral Choshui River has increased dramatically. Measurements of suspended sediment at a downstream gauging station indicate that the unit sediment concentration increased about six times due to the earthquake, and decreased exponentially due to flushing by subsequent typhoons. The e-folding time scale of the seismic perturbation of sediment transfer in the Choshui River is 3-5 years. Based on this estimate of the decay of the erosional response to the earthquake, a mass balance can be calculated for the earthquake, including co-seismic uplift and subsidence, post-seismic relaxation, and erosion. This mass balance shows that the Chi-Chi earthquake has acted to build ridge topography in the hanging wall of the fault, but in the far field, some destruction of topography has occurred. However, our estimate of seismically-driven erosion may be incomplete. A detailed analysis of landsliding in the Chenyoulan tributary of the Choshui River indicates that most co-and post seismic landslide debris remains on hillslopes within the catchment. Recent typhoons have continued to cause high rates of landsliding high in the landscape, but rates of mass wasting near the stream network have decreased. The full geomorphic response to the Chi-Chi earthquake may be much larger, and more protracted than indicated by river gauging data.