Geophysical Research Abstracts
Vol. 14, EGU2012-11489, 2012
EGU General Assembly 2012

Continuous catchment-scale monitoring of geomorphic processes with a 2-D seismological array

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The monitoring of geomorphic processes during extreme climatic events is of a primary interest to estimate their impact on the landscape dynamics. However, available techniques to survey the surface activity do not provide a relevant time and/or space resolution. Furthermore, these methods hardly investigate the dynamics of the events since their detection are made *a posteriori*. To increase our knowledge of the landscape evolution and the influence of extreme climatic events on a catchment dynamics, we need to develop new tools and procedures. In many past works, it has been shown that seismic signals are relevant to detect and locate surface processes (landslides, debris flows). During the 2010 typhoon season, we deployed a network of 12 seismometers dedicated to monitor the surface processes of the Chenyoulan catchment in Taiwan. We test the ability of a two dimensional array and small inter-stations distances ($\sim$ 11 km) to map in continuous and at a catchment-scale the geomorphic activity. The spectral analysis of continuous records shows a high-frequency ($>$ 1 Hz) seismic energy that is coherent with the occurrence of hillslope and river processes. Using a basic detection algorithm and a location approach running on the analysis of seismic amplitudes, we manage to locate the catchment activity. We mainly observe short-time events ($>$ 300 occurrences) associated with debris falls and bank collapses during daily convective storms, where 69% of occurrences are coherent with the time distribution of precipitations. We also identify a couple of debris flows during a large tropical storm. In contrast, the FORMOSAT imagery does not detect any activity, which somehow reflects the lack of extreme climatic conditions during the experiment. However, high resolution pictures confirm the existence of links between most of geomorphic events and existing structures (landslide scars, gullies...). We thus conclude to an activity that is dominated by reactivation processes. It highlights the major interest of a seismic monitoring since it allows a detailed spatial and temporal survey of events that classic approaches are not able to observe. In the future, dense two dimensional seismological arrays will assess in real-time the landscape dynamics of an entire catchment, tracking sediments from slopes to rivers.