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Comparing the source mechanisms of long period (LP) volcano-seismic events recorded in 2009 and 2011 at Turrialba volcano, Costa Rica

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Shallow long-period (LP) seismic events have been recorded on Turrialba volcano, Costa Rica with energy concentrated between frequencies of 0.2 to 3Hz. This type of event has been recorded at many volcanoes across the world and, in some instances, swarms of LP events have signalled the onset of a volcanic eruption. Previous studies have shown that in order to reduce path effects and gain as accurate a source inversion as possible, seismometers should be located in a dense network across the summit of a volcano (close to the source). Turrialba volcano is therefore an ideal volcano on which to carry out source inversion due to the relatively easy and safe access to the volcano summit.

Activity at Turrialba volcano has increased dramatically in recent years with high levels of seismic and fumerolic activity. Two field experiments were instigated with broadband seismometers deployed on the summit and flanks of the volcano: one from March to September 2009 and the second (consisting of a denser network) from March to May 2011. Between these experiments a small phreatic eruption occurred in January 2010. The data from the field experiments have been analysed and over 5000 LP events identified. The frequency content and waveforms of the events are different for each dataset. Source locations have been calculated using a variety of methods including first arrivals, array analysis and a grid search implemented while carrying out moment tensor inversion. During both experiments the LP events are located below the active (western) summit crater at shallow depth. These locations were then used to carry out full-waveform moment tensor inversion to constrain the source mechanism, using 3D full-waveform simulations to calculate the Green's functions. The optimum source mechanism for the LP events is a sub-horizontally orientated tensile crack during both 2009 and 2011. Whilst the event locations and source mechanisms have been shown to be comparable between 2009 and 2011, which suggests that the source of the LP events is unchanged, the waveform shapes do change suggestive of subtle changes in the source process through time.