



Multiscale deformation monitoring at Colima Volcano using TerraSAR-X interferometry and camera observations

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Colima is one of the most active volcanoes in Mexico. Since the beginning of the most recent eruptive period in 1998, its activity has been characterised by repeated episodes of dome growth and collapse, leading to pyroclastic flows. The current dome at Colima began growing in 2007, but the steep slopes and explosive nature of the volcano limit the possibilities for monitoring it directly. However, measuring deformation in the region of the crater is important to determine the rate of the ongoing eruption and the stability of the dome. Since June 2011, the seismic and magmatic activity at Colima has decreased significantly and remained low ever since.

The activity in the summit region has been recorded by a video monitoring system installed by the University of Colima volcano observatory. We have analysed the optical camera data obtained between February and June 2011 using spatial digital image correlation techniques. We show that the velocity of dome extrusion varies strongly on a daily basis, reaching up to 3m/day, and then systematically decreased over the following months. Deformation was barely above the detection threshold of 30cm/day in the weeks prior to June 21st, when a significant explosion occurred, removing part of the dome. Camera data recorded after this event does not show any displacements, possibly due to the low spatial resolution of the camera data.

In order to analyse slower deformation processes, we have acquired TerraSAR-X data in spotlight mode for ascending and descending tracks over Colima, obtaining a high spatial resolution of up to 2 m, and a temporal resolution of up to 11 days. In combination with a high resolution digital elevation model, the InSAR data allow the detection of modifications of the dome at a resolution that is two orders of magnitude below the detection threshold of the cameras.

The different temporal and spatial scales of deformation detectable by camera and radar monitoring (metre to centimetre, respectively), highlight the benefit of combining these methods to observe the full range of activities at Colima. The results reveal that explosions may occur suddenly after a period of declined dome growth.