Dome contraction at Colima Volcano in 2012 as constrained by TerraSAR-X interferometry

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Colima is one of the most active volcanoes in Mexico. It has been proposed that its activity is marked by 100-year cycles which terminate in a large Plinian eruption, and that we could be approaching the end of the current cycle. Since the beginning of the most recent eruptive period in 1998, the type of activity has been varying between smaller explosions, dome growth and dome collapse, some of these 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 this region is important to determine the rate of the ongoing eruption and the stability of the dome. In June 2011, the seismic and magmatic activity at Colima decreased significantly and remained low until January 2013, when a series of four significant explosions took place, preceeded by seismic premonitors ranging from significant to almost none.

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. We generated interferograms using DORIS and subsequently analysed the time series of the deformation pattern with the small baseline approach implemented in the StaMPS software, also applying a linear atmospheric correction for each small baseline interferogram. In combination with a high resolution LIDAR digital elevation model the spotlight data allows the detection and quantification of slow deformation in the region of the dome in an unprecedented spatial and temporal resolution, considerably higher than those achieved by other methods.

Here we present the time series of the dome deformation between February and December 2012. The velocities in either look direction reaches up to 10cm/year in line of sight, the maximum subsidence being directed towards the centre of the dome, but very low velocities at its borders. The data suggests that the strong explosion in January 2013 occurred after months of dome contraction. We present a model to explain the pattern of dome contraction rates in an attempt to explore how localisation and geometry of the deeper conduit might be inferred from the space geodetic data.