

Observing changes at Santiaguito Volcano, Guatemala with an Unmanned Aerial Vehicle (UAV)

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Santiaguito Volcano (Guatemala) is one of the most active volcanoes in Central America, producing several ash venting explosions per day for almost 100 years. Lahars, lava flows and dome and flank collapses that produce major pyroclastic density currents also present a major hazard to nearby farms and communities. Optical observations of both the vent as well as the lava flow fronts can provide scientists and local monitoring staff with important information on the current state of volcanic activity and hazard. Due to the strong activity, and difficult terrain, unmanned aerial vehicles can help to provide valuable data on the activities of the volcano at a safe distance.

We collected a series of images and video footage of A.) The active vent of Caliente and B.) The flow front of the active lava flow and its associated lahar channels, both in May 2015 and in December 2015- January 2016.

Images of the crater and the lava flows were used for the reconstruction of 3D terrain models using structure-from-motion. These were supported by still frames from the video recording. Video footage of the summit crater (during two separate ash venting episodes) and the lava flow fronts indicate the following differences in activity during those two field campaigns:

A.)

- A new breach opened on the east side of the crater rim, possibly during the collapse in November 2015.
- The active lava dome is now almost completely covered with ash, only leaving the largest blocks and faults exposed in times without gas venting
- A recorded explosive event in December 2015 initiates at subparallel linear faults near the centre of the dome, rather than arcuate or ring faults, with a later, separate, and more ash-laden burst occurring from an off-centre fracture, however, other explosions during the observation period were seen to persist along the ring fault system observed on the lava dome since at least 2007 – suggesting a diversification of explosive activity.

B.)

- The lava flow fronts did not advance more than a few metres between May and December 2015 .
- The width and thickness of the lava flows can be estimated by relative comparison of the 3D models.
- Damming of river valleys by the lava flows has established new stream channels that have modified established pathways for the recurring lahars, one of the major hazards of Santiaguito volcano.

The preliminary results of this study from two fieldtrips to Santiaguito Volcano are exemplary for the plethora of applications of UAVs in the field of volcano monitoring, and we urge funding agencies and legislative bodies to consider the value of these scientific instruments in future decisions and allocation of funding.