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Volcano eruption monitoring by thermal image correlation: pixel offsets show episodic dome growth at Colima volcano

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To quantify the magnitude of eruptions or explosions is one of the main problems in volcano monitoring programs. Whilst modern monitoring data such as derived from seismicity allow depicting the location, type and occurrence of volcanic activity, the scale of eruptions commonly remained to be estimated visually or in the aftermath based on eruptive products. Quantifying deformation and eruption occurrence is of high value not only for early warning, but also for physical understanding of explosive volcanoes as this study demonstrates for one of the most active volcanoes of Mexico. Volcán de Colima is currently experiencing a phase of viscous dome growth, associated with daily episodic Vulcanian eruptions and rock falls. Little is known about the dynamics of dome growth accompanied by explosion scales. We present results from a nighttime time-lapse infrared camera shooting, compared to local seismic amplitude recordings. As detected by tracking features in correlated images before and after the explosions, the location of the high-temperature field is subject to significant and systematic lateral pixel offsets during eruptions. Dome growth is shown to occur intermittently, with lateral displacements exceeding 1 m within less than 120 seconds. Only the thermally elevated regions of the dome are displaced and are often, but not always, associated to seismic amplitude peaks. Therefore our analysis of infrared image correlation suggests the occurrence of silent or aseismic dome growth episodes, challenging current understanding of volcano physics as well as applied methods in volcano surveillance.