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Using structure-from-motion for monitoring active lava flows and domes

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3-D reconstruction software based on structure-from-motion (SfM) algorithms can substantially reduce the requirements and learning curve for generating topographic data from photographs, and thus offers strong potential for data collection in many dynamic environments. Unfortunately, SfM-based software tends not to provide the rigorous metrics that are used to assess the quality of results in conventional photogrammetry software. Here, we use examples of repeat oblique airborne acquisitions from a volcanic dome (Volcán de Colima, Mexico) and terrestrial time-lapse stereo-photography (Mt. Etna, Sicily) to examine the sensitivity of results to imaging characteristics and SfM processing procedures. At Volcán de Colima, photographs were acquired with a relatively favourable convergent geometry, from an opened window in a light aircraft. However, hazards prevent the deployment of ground control, so the derived topographic shape relies entirely on the image tie points generated automatically by the software. In contrast, at Mt. Etna, control targets could be used but, with only two (mildly convergent) cameras, the image geometry is naturally weaker that at Colima. We use both of these cases to explore some of the challenges involved with understanding the error inherent in projects processed using SfM-based approaches. Results are compared with those achieved using a rigorous close-range photogrammetry package.