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An application of field-based photogrammetry as a virtual outcrop building target: a key example from Santorini's northern caldera wall, Greece

Fabio Luca Bonali[1], Luca Fallati[2], Varvara Antoniou[3], Kyriaki Drymoni[4], Federico Pasquaré Mariotto[5], Noemi Corti[2], Alessandro Tibaldi[1], Agust Gudmundsson[4], and Paraskevi Nomikou[3]

[1]Department of Earth and Environmental Sciences, University of Milano-Bicocca, Piazza della Scienza 4 – Ed. U04, 20126, Milan, Italy; CRUST- Interuniversity Center for 3D Seismotectonics with Territorial Applications, Italy

[2]Department of Earth and Environmental Sciences, University of Milano-Bicocca, Piazza della Scienza 4 – Ed. U04, 20126, Milan, Italy

[3]Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Panepistimioupoli Zografou, 15784 Athens, Greece

[4]Department of Earth Sciences, Queen's Building, Royal Holloway University of London, Egham, Surrey TW20 0EX, UK

[5]Department of Human and Innovation Sciences, Insubria University, Via S. Abbondio 12, 22100 Como, Italy

The application of photogrammetry to volcanic areas is usually made using UAVs for collecting pictures aimed at producing high-resolution orthomosaic and digital surface models. In the present work, instead, we use a boat-camera-based photogrammetry approach, as a tool for orthomosaic, digital surface modelling and virtual outcrop production at an almost vertical 300-m-high geological feature: the northern caldera wall of Santorini. This is a geological structure of great interest, where many tens of dykes crop out within a heterogeneous host rock made of sequences of effusive and explosive volcanic deposits. Some active and inactive faults also dissect the caldera wall. Thus, the study area is almost inaccessible for classic field surveys due to challenging logistic conditions and landslide hazard.

We used a 20 MPX camera run by an operator who collected a total of 887 pictures almost continuously, orthogonal to the ground and opposite to the target, during a 5.5-km-long boat survey. We performed the study along the northern caldera wall, at a constant boat velocity and at a distance from the coast/caldera wall that varied between 35.8 m and 296.5 m. The outcomes of the photogrammetry application include: 1) a high-resolution 3D model of the study area, 2) a high-resolution virtual outcrop for two selected parts of the caldera, 3) qualitative and quantitative structural data (dyke attitude, thickness, cross-cutting relationships, host rock lithology) along the vertical caldera cliff. Our method represents a new approach for 3D outcrop building for research under extreme logistic conditions.