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Combined geological and UAS aerial photogrammetric surveys for a better understanding of volcanic phenomena: the Ischia island (Italy) case study.

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Integrating geological field with drone remote sensing surveys is becoming a common methodology to estimate some volcanological parameters. For example, knowing the volumes of domes and lava flows in volcanic areas is important to infer the magnitude of an eruption and the potential volcanic hazards in a defined area. It is not always possible to define the correct geometry of these bodies only from field surveys, as they often occur in remote and inaccessible areas.

One possible way to overcome these difficulties is to use drone aerophotogrammetric surveys, with a drone equipped with a high-resolution camera, and then processing the images with digital photogrammetric techniques to create a three-dimensional model of the terrain. At the same time, UAS aerophotogrammetric surveys alone are not sufficient to fully characterize the volume of domes and lava flows, as they do not provide information on their basal surface geometry.

Therefore, it is necessary to combine geological and drone aerophotogrammetric surveys. Integrating data from both methods allows to obtain a more comprehensive and reliable estimation of the volume of domes and lava flows, as well as a better understanding of their formation and evolution processes.

A similar integrated approach is being carried out on the island of Ischia where, in the last period of activity (13/10 ka – 1302 CE), at least 22 effusive eruptions produced lava flows and domes. A first attempt to estimate the volume of the erupted lavas was made some years ago superimposing a mask representative of the extension of the lava bodies on a Digital Elevation Model and then calculating the difference with respect to a set of flat theoretical base surfaces. A detailed geological survey, combined with geomorphological analysis, has been performed on some selected lava bodies obtaining a better definition of their base surfaces geometry.

Aerial photogrammetric surveys, obtained from aerial photographs taken with the use of UAS equipped with a visible-range camera, was used to obtain the geomorphological features. It was

possible to produce the points cloud of the areas of interest and orthorectify and georefer the data.

Later the different constituent elements of the points cloud were classified separately, distinguishing anthropogenic vs. natural elements.

Volumes of the lava bodies were determined by operating profiles and sections along crossed directions, defined on the basis of the assessment of the underground pattern of the volcanic deposits. A high-resolution digital terrain model of the entire volcanic body was obtained this way.

This result was achieved through the use of specific software (Pix4D and Agisoft).

The methodology was verified by overlaying the DTM (5m) and DSM (1m) of the Campania Region and the Metropolitan City of Naples respectively.

Previous estimations revealed a widespread volume underestimation especially where basal geometry differs significantly from that of a horizontal or simply tilted plane. This led to a recalculation of the volumes and suggests to apply the tested methodology to all lava bodies of the last period of volcanic activity at Ischia.