The Use of Sentinel 2 to extract the Digital Elevation Model and the velocity of the volcanic ash cloud: comparison with multi sensors analysis on Etna volcano.

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In this study, we demonstrate the use of Copernicus Sentinel 2 to extract the velocity and the Digital Elevation Model of a volcanic ash cloud. The elevation of the ash cloud is an important parameter in volcanology, for manifold reasons. Firstly, the injection height controls the ash dispersion in the atmosphere. Secondly, the injection height is controlled by the pressure in the magmatic chamber, thus this parameters gives indirect access to a solid Earth physical parameter. Thirdly, the roughness of the ash plume is an essential parameter to understand turbulences and plume cinematics/dynamics.

With the exception of dedicated spaceborne missions, such as Multi-angle Imaging Spectro Radiometer (MISR), most of the conventional stereo photogrammetric methods from satellite do not hold for the retrieval of the DEM of a volcanic ash cloud. This is because the volcanic cloud moves between the stereo images acquisitions (with time lag from tens to 60 seconds). This motion yields an offset that adds up to the offset due to stereoscopic parallax. Therefore, height estimation with these methods is biased. In a previous study, de Michele et al. (2016) showed that conventional multispectral push broom satellites, such as Landsat 8, present a small lag between the panchromatic and multispectral bands that can be used to extract both velocity and elevation of the ash plume at high spatial resolution. Here, we show that the methodology can be applied to Copernicus Sentinel 2, that present an improved repetition frequency of 5 days. In this study, we apply the method to two Mount Etna eruptive clouds on 29 December 2018 and 27 July 2019. Then, in a future work, we will compare the results with independent measurements from Sentinel 3, MODIS and SEVIRI.