Cities on Volcanoes 9
November 20-25, 2016
Puerto Varas, Chile
'Understanding volcanoes and society: the key for risk mitigation'

UAV-based remote sensing surveys and Structure from Motion technique for generating a very-high-resolution DEM of 1974 Mount Etna Lava flow

Massimiliano Favalli [1], Alessandro Fornaciai [1,2], Luca Nannipieri[1], Andrew Harris [3], Charline Lormand [3], Sonia Calvari [4]

[1]Istituto Nazionale di Geofisica e Vulcanologia, Pisa, Italy

[2]Dipartimento di Fisica e Astronomia, Alma Mater Studiorum, Università di Bologna, Bologna, Italy

[3]LMV

[4]Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, Italy

Keywords: Unmanned Aerial Vehicle (UAV), high resolution Digital Elevation Model, Etna 1974 eruption, Structure from Motion (SfM)

Modeling lava flow morphology is an essential step in defining the flow system and the associated flow dynamics. For this reasons since 1990s more and more effort has been focused in the generation of Digital Elevation Models (DEMs) of volcanic landform. Nowadays LIDAR technologies, both airborne and terrestrial, are consolidated for the production of high-resolution DEM, although data acquisition is still costly, often not easy and point density over poorly reflective, basaltic surfaces or in the shadow zones sometimes prevents the production of an acceptable DEM. The development of Structure-from-Motion (SfM) computer vision technique has given to the researchers a low-cost and user-friendly tool for generating high-resolution topography starting from consumer grade camera images. The SfM method solves the camera pose and scene geometry simultaneously and automatically, using a highly redundant bundle adjustment based on matching features in multiple overlapping, offset images. The recent explosion of Unmanned Aerial Vehicle (UAV) technology has presented a new, flexible, low-cost platform option for volcano remote sensing, and it represents an ideal platform to make the best use of the SfM method. In this contribution we used an hexacopter F550 equipped with a consumer-grade camera (Sony NEX5) to carry out a photogrammetric survey over the 1974 Mount Etna lava flow field. Using photogrammetric data collected in May and September 2015, we generate a 20 cm resolution DEM, derivative maps and RGB orthophoto of the studied lava flow. The very high resolution photogrammetry-derived DEM patches have been merged and georeferenced thought surface-surface distance minimization taking the 2005 1-meter-resolution LIDAR derived DEM of Mount Etna as reference surface. Finally, the photogrammetric and LIDAR DEMs derived products are compared in order to assess the relevance of increasing the topographic resolution beyond 1 meter for analyzing and quantifying lava flow morphologies.