3D EARTH SURFACE MODELS

Topographic reconstruction of digital volcanic surfaces through very high spatial resolution of optical satellite imagery.

Active volcanic areas are frequently affected by surface changes due to effusive and explosive activities such as lava flows, lava fountaining, fall out deposits and pyroclastic flows. An updated and accurate topography of these areas is necessary for the correct hazard assessment to mitigate the eruptive event. From the very high resolution Pleiades acquisitions it is possible to measure such surface changes by reconstructing the 3D model.

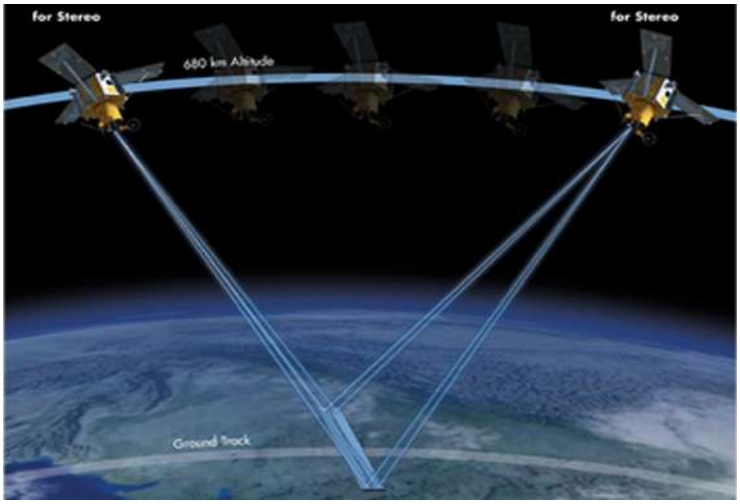
COMPANY: **Airbus Defence and Space**
LAUNCH: **Pléiades 1A (16 Dic 11), Pléiades 1B (2 Dic 12)**
SITE: **Kourou (Guiana Francese)**
REVISIT INTERVAL: **1 day**
Sun-synchronous orbit
LIFE TIME: **5 years**
INTENSITY: **11 bits per pixel (2048 levels)**
SWATH: **20 km a nadir**
STRIP MAPPING (MOSAIC): **100 x 100 km**
STEREO IMAGING: **20 x 280 km**

TECHNIQUES

Two Stereo Satellite Photogrammetry Techniques has been developed and used to generate the 3D models: the NASA-ASP and MicMac. Both using Stereo or Tristereo Images by Multispectral sensor.

- **AMES STEREO PIPELINE** (ASP), a suite of open source automated geodesy and stereo - photogrammetry tools intended to process stereo imagery with or without accurate camera pose information.

- **MICMAC** is a free open-source photogrammetric suite developed by the French IGN (Institut Géographique National) that can be used in a variety of 3D reconstruction scenarios.



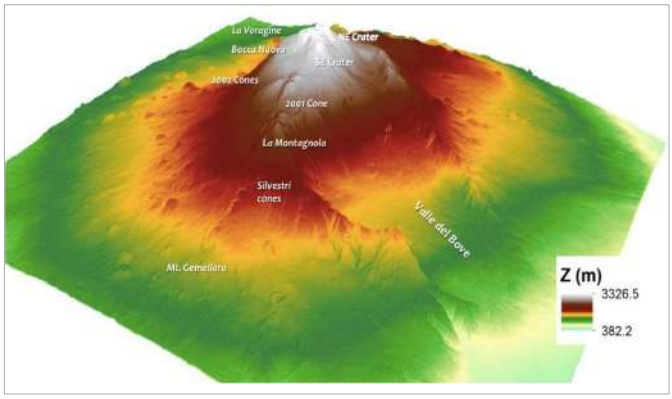
3D models results

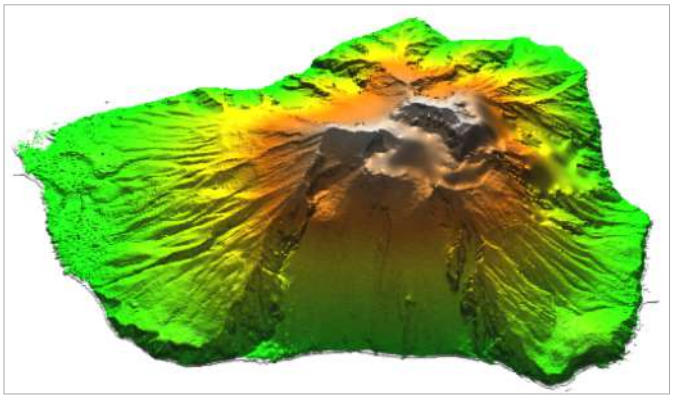
MT. ETNA

Geo-referenced and orthometric DSM
stored in raster format: ascii; geotif; esri grid
spatial resolution: 2 m
planimetric accuracy: 2 m
vertical accuracy: +/- 0.8 m

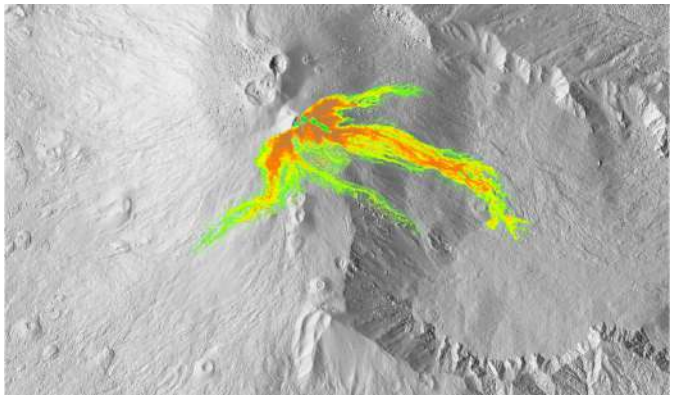
STROMBOLI

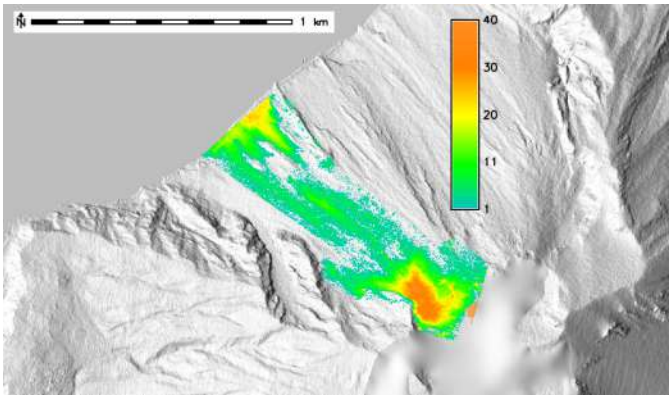
Geo-referenced DSM in raster format: geotiff
Ortho-images in raster format: geotiff
spatial resolution: 1 m
planimetric accuracy:1-2 m
vertical accuracy: +/- 1.6 m





From the digital surface models it's possible to make the difference of two topography acquired at different times in order to obtain the morphological changes occurred at the volcanic surfaces and measure the thickness and volumes of eruptive deposits, as lava flows, pyroclastic flows, cones growing and collapses.





Acknowledgements
GSNL iniziative Mt. Etna volcano Supersite
http://geo-gsnl.org/supersites/permanent-supersites/mt-etna-volcano-supersite-new/

All the space-related INGV flyers are here!

References
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Bisson M., C. Spinetti, D. Andronico, M. Palaseanu-Lovejoy, M.F. Buongiorno, O. Alexandrov, T. Cecere (2021). Ten years of volcanic activity at Mt Etna: High-resolution mapping and accurate quantification of the morphological changes by Pleiades and Lidar data. International Journal of Applied Earth Observation and Geoinformation, Volume 102, 2021, 102369, ISSN 0303-2434, https://doi.org/10.1016/j.jag.2021.102369.