



OUR PLANET FROM SPACE

UAS Based CAL/VAL ACTIVITIES

Thermal camera equipped UAS are used to perform flights at the same time of nightly satellite passages, in order to carry out calibration and validation of satellite data. Thermal ground targets are also positioned during the flight missions and ground thermal measurements are performed with hand held camera or permanent infrared stations to execute additional calibration of the infrared images acquired by UAS. A set of thermal gradiometers can also be used to evaluate the evolution of ground temperatures in a target area. A thermal gradiometer consists of a series of N temperature sensors arranged along a sensitive rod that can be inserted into the ground and to acquire a vertical thermal profile of one site. In addition, the drones equipped with a camera integrated with RTK system and ground base station, make it possible to develop morphological models with high detail and resolution (DTM and DSM). Furthermore, UAS equipped with volcanic gas sensors are in development and design phase in order to calibrate satellites data.



Main thematic area for **UAS Based CAL/VAL** activities

1. Flights with thermal camera equipped UAS, to be performed together with nightly satellite passages.
2. Flights with RTK positioned UAS and high-resolution visible camera.
3. Flights with UAS equipped with gas sensors to characterize the volcanic plume and degassing on active volcanoes.

METODOLOGY AND PRODUCTS

1. THERMAL MAPS

Overflights are carried out with multirotor drones equipped with a high resolution (640x512 pixel) thermal imaging camera (FLIR VUE PRO), programmed in conjunction with night thermal satellite passages, which allow to obtain thermal maps useful for validating and calibrating the satellite data.

2. HIGH RESOLUTIONS DTMS AS AID FOR SATELLITE ACQUISITIONS

Overflights are carried out with a drone equipped with a camera equipped with an RTK system and base station on the ground, with which it is possible to develop morphological models of high detail and resolution (DTM and DSM).
The high resolutions DTMs as aid for satellite acquisitions.

3. FLIGHTS WITH UAS EQUIPPED WITH GAS SENSORS

Use of different payloads of gas analysers on the volcanic summit area for geochemical measurements in order to carried out:

- i) reconstruction of the composition of the plume and its vertical gas distribution;
- ii) reconstruction of the gas concentration of the plume in time and space;
- iii) calibration/validation of satellite data.



SOME RESULTS

The figure on the left shows a comparison between thermal maps obtained by drone in the volcanic area of Pisciarelli (Campi Flegrei) and those obtained by satellite. For several years, at the same time as the drone acquisitions, on the same days, the thermal images from satellite (ASTER and Landsat 8/9) were analyzed and compared with those from the ground. The "calibration" experiments show results appear to be encouraging.

The central figure shows an extremely detailed morphological reconstruction of the S. Bartolo flow in Stromboli which will be useful for satellite acquisitions.

The figure on the right shows the geochemical composition of the Stromboli plume obtained using a miniGas sensor integrated in a UAS quadcopter. The flight was carried out at different heights in the plume. The gases measured were CO₂, SO₂, H₂S and H₂O with GPS georeferencing. Preliminary results show the presence of CO₂ (maximum measured concentration 635ppm) and SO₂ (maximum measured concentration 43ppm) in the active plume.



All the space-related INGV flyers are here!

REFERENCES

- Silvestri M., Marotta E., Buongiorno M.F., Avvisati G., Belviso P., Bellucci Sessa E., Caputo T., Longo V., De Leo V., Teggi S., 2020. Monitoring of Surface Temperature on Parco delle Biancane (Italian Geothermal Area) Using Optical Satellite Data, UAV and Field Campaigns. Remote Sensing, Technical Note, doi: 10.3390/rs12122018.
- Silvestri M., Diaz J.A., Marotta E., Musacchio M., Buongiorno M.F., Sansivero F., Cardellini C., Pieri D., Amici S., Bagnato E., Beddini, G., Belviso P., Carandente A., Colini L., Dumaz F., Peluso R., Spinetti C., 2015. Use of Multiple in situ and remote sensing instruments and techniques at Solfatara field campaign for measurements of CO₂, H₂S and SO₂ emissions: special demonstration on unmanned aerial system. Quaderni di Geofisica, 129, ISSN 1590-2595.

