

Use of multiple in situ instruments and remote sensed satellite data for calibration tests at Solfatara (Campi Flegrei volcanic area)

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Monitoring natural hazards such as active volcanoes requires specific instruments to measure many parameters (gas emissions, surface temperatures, surface deformation etc.) to determine the activity level of a volcano. Volcanoes in most cases present difficult and dangerous environment for scientists who need to take in situ measurements. Remote Sensing systems on board of satellite permit to measure a large number of parameters especially during the eruptive events but still show large limits to monitor volcanic precursors and phenomena at local scale (gas species emitted by fumarole or summit craters degassing plumes and surface thermal changes of few degrees) for their specific risk. For such reason unmanned aircraft systems (UAS) mounting a variety of multi-gas sensors instruments (such as miniature mass spectrometer) or single specie sensors (such as electrochemical and IR sensors) allow a safe monitoring of volcanic activities.

With this technology, it is possible to perform monitoring measurements of volcanic activity without risking the lives of scientists and personnel performing analysis during the field campaigns in areas of high volcanic activity and supporting the calibration and validation of satellite data measurements. These systems allowed the acquisition of real-time information such as temperature, pressure, relative humidity, SO₂, H₂S, CO₂ contained in degassing plume and fumaroles, with GPS geolocation. The acquired data are both stored in the sensor and transmitted to a computer for real time viewing information. Information in the form of 3D concentration maps can be returned.

The equipment used during the campaigns at Solfatara Volcano (in 2014, 2015 and 2016) was miniaturized instruments allowed measurements conducted either by flying drones over the fumarolic sites and by hand carrying into the fumaroles.

We present the results of the field campaign held in different years at the Solfatara of Pozzuoli, near Naples, concerning measurements of CO₂, H₂S and SO₂. The campaigns were carried out in collaboration with the University of Costa Rica and Jet Propulsion Laboratory of the California Institute of Technology (Pasadena, California) and has allowed the acquisition of a number of measures through scientific miniaturized multi-gas, thermal cameras and spectro-radiometer.

The acquired measurements have also permitted the calibration and validation of satellite data as ASTER and LANDSAT8 (in collaboration with USGS). We believe that the rapid increasing of technology developments will permit the use UAS to integrate geophysical measurements and contribute to the necessary calibration and validation of current and future satellite missions dedicated to the measurements of surface temperatures and gas emissions in volcanic areas.