



GlobVolcano pre-operational services for global monitoring active volcanoes

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The GlobVolcano project (2007-2010) is part of the Data User Element programme of the European Space Agency (ESA). The project aims at demonstrating Earth Observation (EO) based integrated services to support the Volcano Observatories and other mandate users (e.g. Civil Protection) in their monitoring activities. The information services are assessed in close cooperation with the user organizations for different types of volcano, from various geographical areas in various climatic zones.

In a first phase, a complete information system has been designed, implemented and validated, involving a limited number of test areas and respective user organizations. In the currently on-going second phase, GlobVolcano is delivering pre-operational services over 15 volcanic sites located in three continents and as many user organizations are involved and cooperating with the project team.

The set of GlobVolcano offered EO based information products is composed as follows:

- **Deformation Mapping**

DInSAR (Differential Synthetic Aperture Radar Interferometry) has been used to study a wide range of surface displacements related to different phenomena (e.g. seismic faults, volcanoes, landslides) at a spatial resolution of less than 100 m and cm-level precision. Permanent Scatterers SAR Interferometry method (PSInSARTM) has been introduced by Politecnico of Milano as an advanced InSAR technique capable of measuring millimetre scale displacements of individual radar targets on the ground by using multi-temporal data-sets, estimating and removing the atmospheric components. Other techniques (e.g. CTM) have followed similar strategies and have shown promising results in different scenarios.

Different processing approaches have been adopted, according to data availability, characteristic of the area and dynamic characteristics of the volcano.

- Conventional DInSAR: Colima (Mexico), Nyiragongo (Congo), Pico (Azores), Arenal (Costa Rica)
- PSInSARTM: Piton de la Fournaise (La Reunion Island), Stromboli and Volcano (Italy), Hilo (Hawaii), Mt. St. Helens (United States),
- CTM (Coherent Target Monitoring): Cumbre Vieja (La Palma)

To generate products either Envisat ASAR, Radarsat 1 or ALOS PALSAR data have been used.

- **Surface Thermal Anomalies**

Volcanic hot-spots detection, radiant flux and effusion rate (where applicable) calculation of high temperature surface thermal anomalies such as active lava flow, strombolian activity, lava dome, pyroclastic flow and lava lake can be performed through MODIS (Terra / Aqua) MIR and TIR channels, or ASTER (Terra), HRVIR/HRGT (SPOT4/5) and Landsat family SWIR channels analysis. ASTER and Landsat TIR channels allow relative radiant flux calculation of low temperature anomalies such as lava and pyroclastic flow cooling, crater lake and low temperature fumarolic fields.

MODIS, ASTER and SPOT data are processed to detect and measure the following volcanic surface phenomena:

- Effusive activity Piton de la Fournaise (Reunion Island); Mt Etna (Italy).
- Lava dome growths, collapses and related pyroclastic flows Soufrière Hills (Montserrat); Arenal – (Costa Rica).
- Permanent crater lake and ephemeral lava lake Karthala (Comores Islands).
- Strombolian activity Stromboli (Italy).
- Low temperature fumarolic fields Nisyros (Greece), Vulcano (Italy), Mauna Loa (Hawaii).

- **Volcanic Emission**

The Volcanic Emission Service is provided to the users by a link to GSE-PROMOTE – Support to Aviation Control Service (SACS).

The aim of the service is to deliver in near-real-time data derived from satellite measurements regarding SO₂ emissions (SO₂ vertical column density - Dobson Unit [DU]) possibly related to volcanic eruptions and to track the ash injected into the atmosphere during a volcanic eruption.

SO₂ measurements are derived from different satellite instruments, such as SCIAMACHY, OMI and GOME-2. The tracking of volcanic ash is accomplished by using SEVIRI-MSG data and, in particular, the following channels VIS 0.6 and IR 3.9, and along with IR8.7, IR 10.8 and IR 12.0.

The GlobVolcano information system and its current experimentation represent a significant step ahead towards the implementation of an operational, global observatory of volcanoes by the synergetic use of data from available Earth Observation satellites.