Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09033, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09033
EGU General Assembly 2008

ASI-Volcanic Risk System (SRV): a pilot project to develop EO data processing modules and products for volcanic activity monitoring

Maria Fabrizia Buongiornoa, Simona Zoffolib ,Eugenio Sansostic, Sergio Pugnaghid, Sergio Teggid, Stefano Vignolie, Angelo Amodiof, ,Pierluigi Soddug, ASI-SRV Scientific Team

aIstituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, 00143 Roma, Italy; bAgenzia Spaziale Italiana, Viale Liegi 26, 00198 Roma, Italy; cCNR- Istituto per il Rilevamento Elettromagnetico dell'Ambiente, Via Diocleziano 328, I-80124 Napoli, Italy; dUniversità di Modena e Reggio Emilia,Via Vignolese 905, I-41100 Modena, Italy; eAdvanced Computer Systems S.p.A.Via della Bufalotta , 378, I, 00139 Roma Italy; fGalileian Plus S.r.L. Via Tiburtina 755, I-00159 Roma, Italy; g Dipartimento della Protezione Civile, Via Vitorchiano 2, 00189 Roma, Italy

Text of Abstract

The pilot project "Volcanic Risk System (SRV)" funded by the Italian Space Agency (ASI) aims at defining, developing and demonstrating (at a pre-operational stage) a set of functionalities in support of a decisional system for volcanic risk management based on the use of Earth Observation (EO) data. Moreover, the pilot project supports research activities to fill in the gaps between the user needs and the available technology. The selected user is the Italian Department for Civil Protection (DPC).

A very important issue regarding the product implementation of SRV is the achievement of End-User requirements, which will guarantee the compliance between the system modules and out-puts with the operative request of the End-User during the different volcanic risk phases: 1)Knowledge and Prevention,2) Crisis 3)Post Crisis

The different products will be developed on three test sites (Etna, Vesuvio and Campi Flegrei) and they will be delivered via WEB-GIS interface. The selected test sites

are characterized by a noticeable ground deformation activity, by the availability of geodetic "ground-based" measurements and, regarding Etna, characterized by an almost persistent volcanic activity, allowing the generation of products related to the sin-eruptive and post-eruptive phase.

The decisional system is based on the synergic use of several EO data, such as: DInSAR deformation maps, flux of sulphur dioxide (SO2) [1] water vapour and volcanic aerosol optical thickness [2] by means of ASTER, MODIS and HYPERION data on Etna test site. Experimental algorithms will be tested in the system processing chain for carbon dioxide (CO2) by means of hyperspectral sensors on airborne and spaceborne platforms (eg. Hyperion. AVIRIS). The analysis of ash clouds will be made by means of already consolidated procedures [3, 4, 5] which uses low spatial resolution sensors with an high revisit time (eg. AVHRR, MSG, MODIS). Moreover the thermal analysis, directed to the identification of temperature variation on volcanic structure indicating a change in the volcanic activity state is performed [6].

As far as the ground deformation map generation, the selected approach is the Small Baseline Subset (SBAS) method [7], a Differential SAR Interferometry (DInSAR) technique implementing an appropriate combination of differential interferograms generated from SAR data pairs characterized by short spatial and temporal separation (baseline) between the two acquisition orbits. We recall that this method can work both at the full sensor resolution [8] and with averaged (multilook) interferograms.

An important step of the project development regarded the technical and scientific feasibility of the selected products. In fact the technical feasibility depends from the data availability, in the required spectral channel, from satellite revisit time and by the accuracy algorithms and models used in the processing.

The deformation maps retrieved by SAR interferometry are based on consolidated techniques [9], which accuracy has been analysed in the past years. Moreover the selected test sites have well developed GPS network that ensure a suitable validation for the SAR maps produced by the system. Nevertheless the usability of the deformation maps in the Crisis Phase (Sin-eruptive) is restricted by the low revisit time of the current systems. Since the availability of new mission (eg. COSMO-SKYMED) in the next years should improve the revisit time as well as the ground resolution of SAR systems, within the SRV project, prototype procedures for new SAR sensor in X and L band will be developed and tested .

Moreover, the project will make use of L-band data form the ALOS satellite and X-band SAR data from the recently launched COSMO-SkyMed satellites. We remark that a key limitation to the exploitation of the DInSAR technology is represented by the temporal decorrelation phenomena; accordingly, the relatively short revisit times of the COSMO-SkyMed constellation (from 8 days with the already available 2 satellites, up to 4 days when the full constellation is deployed) will represent a significant improvement with respect to the existing C-band systems, counterbalancing the decorrelation noise increase due to the wavelength shortening.

Clearly, the successful exploitation of these X-band systems will maintain strong limitations in eruptive crisis scenarios where hourly acquisitions would be required. However, for what concerns the COSMO-SkyMed system, the fully developed four sensors constellation will allow us to build up effective volcano monitoring scenarios also for early warning applications. In this context, an appropriate definition of the system planning has to be foreseen.

When successfully implemented, the system represents a unique tool for volcano monitoring that uses C- and L-band SAR data, along with X-band SAR data provided by ASI. The simultaneous generation of ground deformation time series in these three bands over a selected test-site has never been performed before, as well as their intercomparison.

REFERENCES

1. Realmuto V.J. , Abrams M.J. Buongiorno M.F., Pieri C.D. “The use of multispectral thermal infrared image data to estimate the sulfur dioxide flux from volcanoes: A case study from Mount Etna, Sicily, July 29, 1986”. *Journal of Geophysical Research*, Vol. 99, N˚ B1, pp 481-488, 1994

2. Spinetti C., M.F. Buongiorno, V. Lombardo, and L. Merucci. “Aerosol optical thickness of Mt. Etna volcanic plume retrieved by means of the Airborne Multispectral Imaging Spectrometer MIVIS”. *Annals of Geophysics* Vol. 46 N.2, 2003

3. Searcy C., Dean K., Stringer B., “PUFF: A Volcanic Ash Tracking and Prediction Model”. *J. Volc. and Geoth. Res.*, 80 (1-2), 1-16, 1998

4. Corradini S**.**, Cervino M., “Aerosol extinction coefficient profile retrieval in the Oxygen A-band considering multiple scattering atmosphere. Test case: SCIAMACHY nadir simulated measurements”, Journal of Quantitative Spectroscopy and Radiative Transfer, Vol. 97, pp. 354-380, 2006.

5. Realmuto V.J,. “Separating the effects of temperature and emissivity: emissivity spectrum normalization”, in *Proc. 2^{nd} TIMS Workshop*. Pasadena, CA: Jet Propul.Lab., JPL Publication 90-55, 1990

6. Constantine, EK, GJS Bluth, and WI Rose (1999, in review) TOMS and AVHRR sensors applied to drifting volcanic clouds from the August 1991 eruptions of Cerro Hudson, AGU Monograph on Remote Sensing of Active Volcanism

7. P. Berardino, G. Fornaro, R. Lanari and E. Sansosti, "A new Algorithm for Surface Deformation Monitoring based on Small Baseline Differential SAR Interferograms," IEEE Trans. Geosci. Remote Sens , vol. 40, pp. 2375-2383, November 2002.

8.Pepe, A., Sansosti, E., Berardino, P., and Lanari, R. (2005). On the Generation of ERS/ENVISAT DinSAR Time-Series via the SBAS technique. IEEE Geoscience and Remote Sensing Letters, 2, 3, pp. 265-269.

9.R. Lanari, O. Mora, M. Manunta, J.J. Mallorqui, P. Berardino and E. Sansosti, "A Small-Baseline Approach for Investigating Deformations on Full-Resolution Differential SAR Interferograms", IEEE Trans. Geosci. Remote Sens , vol. 42, pp. 1377 – 1386, July 2004.