

GSNL - Geohazard Supersites and Natural Laboratories

Biennial report for Candidate/Permanent Supersite - July 2016

Vesuvius/Campi Flegrei Supersite

Status	<i>Candidate Supersite</i>
Proposal documents	http://www.earthobservations.org/documents/gsnl/proposals/VesuviusCampiFlegrei_prposal.pdf
Acceptance letter(s)	http://medsuv_portal.ct.ingv.it/documents/acceptanceletter_vesuvius
Previous reviews	No previous report
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Science team issues

During the 2014-2016 first biennial period of the Vesuvius/Campi Flegrei Supersite, most of the scientists from the Science team were involved in the related MED-SUV (MEDiterranean SUPersite Volcanoes) project (<http://med-suv.eu>) funded by the 7th Framework Programme for Scientific Research of the European Commission.

MED-SUV was a project addressing the topic *"Long-term monitoring experiment in geologically active regions of Europe prone to natural hazards: the Supersite concept"* started in May 2013, with a duration of three years. The MED-SUV and Supersites concept implies the integration between space-borne and in-situ measurements for improving monitoring and knowledge of the areas of interest on the whole, with an open data policy.

The leading institution of the project was INGV and the existence of MED-SUV guaranteed, besides funding, the cooperation among the partners as well as the feed-back of scientific outcomes to the Supersite PoC (Point of Contact).

Moreover, **the e-Infrastructure issued in the framework of the project** (MEDSUV portal, <http://medsuv.portal.ct.ingv.it>) **is now in charge for both in-situ and space-borne data dissemination**, in the latter case following the access rules imposed by Space Agencies (with the exception of data directly distributed by some Agencies through their own portals).

Before setting up the MED-SUV portal, the PoC provided directly the data to the users upon their request, therefore the PoC reports no major obstacles in the organization of the research activities among the different teams.

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At present, the Science team mainly consists of Italian scientists, with only three foreign members, resulting in a lack of international participation to the initiative.

In this regard, during the first biennial period, the main concern of the PoC was focused on the quality of the results (see also *Scientific achievements*), guaranteed by some internationally known Italian teams, rather than the team internationality. Anyway the PoC is aware of this lack, therefore one of his tasks, to be carried out during the next biennial period, will be the enlargement of the team towards its international component. This will be done in close cooperation with the SAC members and the chair, improving data/results dissemination in order to involve more scientists.

In situ data

A general overview of the monitoring networks in the Neapolitan volcanic area is presented:

INGV-OV monitoring networks (Vesuvius)

Seismic	Permanent:	20 stations	Mobile:	7 stations
GPS	Permanent:	10 3D vertices		
Leveling	Discrete:	325 benchmarks		
Tide gauge	Permanent:	2 stations		
Tiltmetric (permanent)	Surface:	3 stations	Borehole:	4 stations
Gravimetric	Discrete:	35 benchmarks	Permanent:	1 station
Geochemical	Permanent:	4 stations		
Thermal Infrared Imagery	Permanent:	1 station		

INGV-OV monitoring networks (Campi Flegrei)

Seismic	Permanent:	22 stations	Mobile:	18 stations
GPS	Permanent:	18 3D vertices		
Leveling	Discrete:	370 benchmarks		
Tide gauge	Permanent:	4 stations		
Tiltmetric (permanent)	Surface:	4 stations	Borehole:	6 stations
Gravimetric	Discrete:	37 benchmarks	Permanent:	1 station
Dilatometric	Permanent:	4 stations		
Geochemical	Permanent:	5 stations		
Thermal Infrared Imagery	Permanent:	5 stations		

For Vesuvius/Campi Flegrei Supersite, in-situ data are now under implementation on the MED-SUV portal however, taking into account the e-Infrastructure was released only at the end of the project (May 31, 2016), this phase is still ongoing. Therefore, only the data currently available on the portal have been reported in the table below.

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Type of data	Data provider	How to access	Type of access
e.g. seismic waveforms, GPS time series, gas measurements, etc.	Link to data repository or description of procedure for data access	E.g. unregistered public, registered public, limited to GSNL scientists, etc.
Seismic waveform	INGV	Link to Network Italian Seismic Network Web Service through MED-SUV Portal Search	Limited to registered users
Seismic events	INGV	Link to Network Italian Seismic Network Web Service through MED-SUV Portal Search	Limited to registered users
GPS data	INGV	MED-SUV GSAC server	Limited to registered users

In situ data issues

The Vesuvius/Campi Flegrei in-situ data are provided by INGV, whose data policy is based on the open data paradigm. INGV is now going to implement the access rules for specific datasets by the early months of 2017, nevertheless the MED-SUV portal is now open to all the Scientific Community, by adopting the criteria to register the users. Indeed, the landing page (<http://medsuv.portal.ct.ingv.it/>) allows any interested scientist to ask for an account: the request is then evaluated and usually accepted, as the aim is only to trace the users, not to close the data. In this regard, it is worth noting that these access rules do not significantly differ from those of many Space Agencies.

Satellite data

Type of data	Data provider	How to access	Type of access
ERS-1/ERS-2	ESA	http://eo-virtual-archive4.esa.int/?q=Vesuvius	Registered public
ENVISAT	ESA	http://eo-virtual-archive4.esa.int/?q=Vesuvius	Registered public
Sentinel	ESA	https://scihub.copernicus.eu	Registered public
TerraSAR-X	DLR	https://supersites.eoc.dlr.de	Registered public
COSMO-SkyMed	ASI	PoC requests access to ASI for individual users, data then accessible via the MED-SUV Portal	Authorized GSNL scientists
RADARSAT-2	CSA	PoC requests access to CSA for individual users; a specific CSA server is under implementation on the MED-SUV Portal	Authorized GSNL scientists
Landsat 8	USGS	http://earthexplorer.usgs.gov or through the MED-SUV Portal	Registered public

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AVHRR	NOAA	http://earthexplorer.usgs.gov or a sub-set is available through the MED-SUV Portal File Manager	Registered public
MODIS	NASA	http://modis.gsfc.nasa.gov/data/ or a sub-set is available through the MED-SUV Portal File Manager	Open

Current availability of InSAR data provided through the Vesuvius/Campi Flegrei Supersites initiative:

X-band data:

COSMO-SkyMed (CSK, StripMap, SLC: SCS_B)

Ascending: 275 scenes in the time-span 2012.03.31 to 2016.06.21;

Descending: 10 scenes in the time-span 2011.11.25 to 2013.05.13.

TerraSAR-X & TanDEM-X - monostatic (TSX/TDX, StripMap, SLC: SSC)

Ascending (Vesuvius): 41 scenes in the time-span 2008.02.15 to 2016.06.30;

Descending (Vesuvius): 79 scenes in the time-span 2012.04.04 to 2016.06.11;

Ascending (Campi Flegrei): 87 scenes in the time-span 2009.03.11 to 2016.06.24;

Descending (Campi Flegrei): 7 scenes in the time-span 2010.07.12 to 2015.03.13.

C-band data:

RADARSAT-2 (RS-2, StripMap, SLC, Fine-Beam)

Ascending: 14 scenes in the time-span 2013.06.18 to 2014.05.20.

ERS1/2 & ENVISAT archive data available through the ESA Virtual Archive.

Sentinel-1 archive and current data available through the Sentinels Scientific Data Hub.

Satellite data issues

Although satellite data provision by Space Agencies represents an added value to the Supersites initiative, some issues arose - from the PoC point of view - in the first biennial period, which will be summarized here:

1. The availability of the ESA space-borne data (ERS1/2, ENVISAT and Sentinel) through the respective web-sites for any registered user, although represents a great improvement compared to the past, with free-of-charge data for everyone, does not allow to trace scientists downloading the data, resulting in two related drawbacks: a) scientists are not aware of the Supersites initiative, as they could be potentially interested in collaborating with the Supersites teams, to get better results for their own work and on the whole and b) the Supersites PoCs are not aware of the activities carried out by colleagues outside

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their teams, whose work not only could contribute to a better knowledge of the areas of interest, but it could be also an additional contribution to be reported to CEOS. A suggestion could be to highlight on the web-sites disseminating satellite data, the Supersites initiative and the opportunity of a collaboration among interested scientists, with links to the GEO-GSNL portal to get in touch with the PoCs.

2. Also for TSX/TDX data, available through the DLR Supersites web-page, there is no means to trace users downloading data, although the service is very fast in uploading data on the web-page after the order of the PoC.
3. Ordering RS-2 data seems to be neither fast nor user-friendly: the task is accomplished through the APT dedicated tool, which is quite complex and slow when searching through the archives. Moreover, it only works on Windows operating system, but not on Mac or Linux, the latter widely used by the Scientific Community. A web-based ordering solution would represent a great improvement.
4. ALOS 2 L-band SAR data have not been used to generate products for Vesuvius/Campi Flegrei Supersite. In many other volcanic areas with moderate to strong vegetation cover the ALOS 2 data have provided very good results, reducing the temporal decorrelation effects with respect to the X- and C-band data.
We expect that the joint integration of the multiband imagery dataset will greatly improve the ground deformation mapping over the area, strongly benefiting the Supersite research results.
A quota of about 100 ALOS 2 images per year would be sufficient for this purpose.
5. A great improvement in the Supersites initiative and related studies would be the opportunity to get from Space Agencies not only the *routine* satellite data (namely StripMap) but also high or very high resolution data, like the Enhanced Spotlight mode for CSK and the Staring Spotlight mode for TSX, to carry out detailed studies and monitoring over some *critical* areas as in the case, for instance, of the Solfatara-Pisciarelli zone in Campi Flegrei, now marked by a very strong (renewed) fumarolic activity. This area is also the site of many ground-based instruments (geodetical: GPS/tillimeter/leveling) geochemical and thermal cameras. Again, such a comparison between in-situ and space-borne data, would be an added value for the Supersites initiative on the whole, pointing out the possibility to get very valuable results on a local/very local scale from satellite data, in spite of the preconception that such data are addressed to the use on large/wide areas.

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Research results

Relevant results for the Vesuvius/Campi Flegrei Supersite were obtained **inside and outside the MED-SUV project** activities.

The e-Infrastructure is one of the main achievements of the MED-SUV project; a report on scientific activities by the Science team will be presented as well.

MED-SUV e-Infrastructure

We consider a noteworthy outcome the implementation of the e-Infrastructure in the framework of the EC-FP7 MED-SUV project, for two reasons. The first one is mainly technical: the implementation of the e-Infrastructure fosters the Community to deal with two main technical drawbacks well known at the beginning of the project and thoroughly connected each other, i.e. the standardization of the in-situ datasets and the interoperability among databases (both EO and in-situ). The second reason is typically strategic: the implementation of the MED-SUV e-Infrastructure is a key element for implementing the European Plate Observing System (EPOS) platform (EPOS is one of the GEO Participating Organizations), in which MED-SUV is considered as a pilot for the provision of the volcano observations.

MED-SUV e-Infrastructure adopted a distributed architecture managed through a brokering approach; it is built by four main elements: the data nodes, the data broker, the authorization components, the WEB APIs and the Portal. The distributed data nodes provide both EO and in-situ data; they are located in the ESA (for ERS 1-2, ENVISAT, Sentinel 1-2 data) and DLR (for TSX/TDX data) portals, the IRIS node (for seismic data) and INGV data centers (for ASI-CSK data, GPS, Hydrophone/OBS waveform, thermal cameras and tilt data). The data broker is able to connect different data systems exposing a single common and standard interface; its main components are (a) the discovery broker, (b) the access broker, (c) the semantic enhancement module. The authorization components implement the MED-SUV data policy assessed at the beginning of the project (Deliverable 1.2), which adopts the open access paradigm, by identifying the users as registered and authorized. Currently registered users are all those MED-SUV partners that asked to have an account to the e-Infrastructure, which today number is 58. Authorized users are allowed to access the in-situ data sub-sets, referring to experiments carried out during the project by specific teams. The WEB-APIs functionalities allow developing client applications for facilitating integration with overarching systems. The portal (http://medsuv_portal.ct.ingv.it/) is the user's access to the e-Infrastructure.

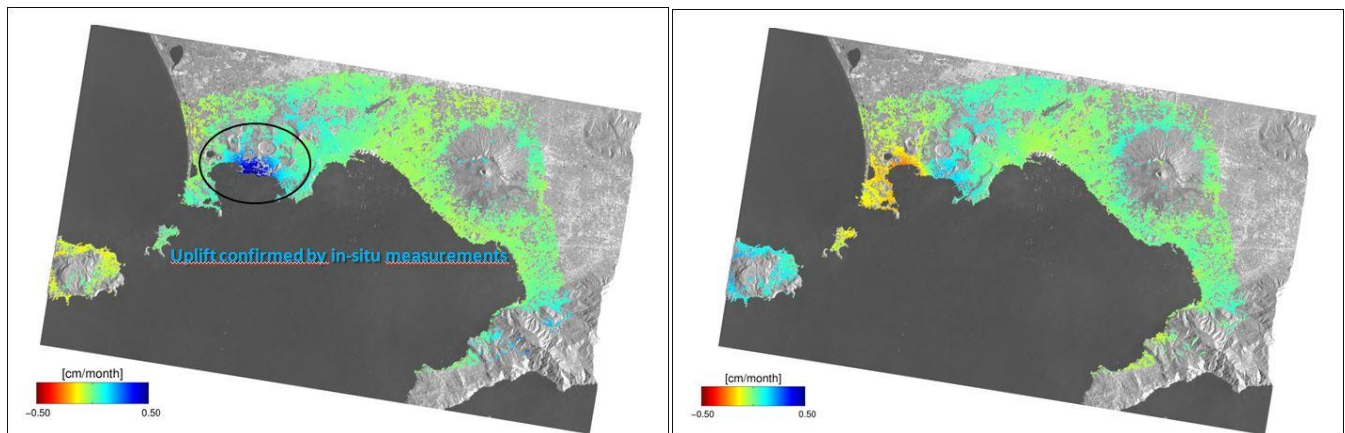
Scientific achievements

Although all the members of the Science team are actively involved, relevant results were carried out in the 2014-2016 biennial period mainly by three teams - apart from the outcomes of the ESA-SEOM INSARAP project presented in the following - namely INGV-OV (Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Napoli *Osservatorio Vesuviano*), INGV-CNT (Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Roma *Centro Nazionale Terremoti*) and IREA-CNR (Istituto per il Rilevamento Elettromagnetico dell'Ambiente - Consiglio Nazionale delle Ricerche).

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INGV-OV team (*S. Borgstrom, V. Siniscalchi*)

Many interferometric products were generated by the team, exploiting all the InSAR data available for the Vesuvius/Campi Flegrei Supersite, namely CSK, TSX/TDX (monostatic), RS-2 and S1-A data. Validation and assessment of the latter has been the task of the INGV-OV team in the framework of the above mentioned INSARAP (Sentinel-1 - INSAR Performance Study with TOPS data, http://seom.esa.int/page_project006.php) project funded by ESA in the framework of the ESA-SEOM (Scientific Exploitation of Operational Missions) activities. The project was focused on processing, validation and assessment of S1-A data on some test-areas in the World, with Vesuvius and Campi Flegrei as a volcanic test-site, taking into account the considerable availability of geodetic data (mainly GPS and leveling) from the INGV-OV monitoring networks. Results (Fig.1,2,3,4) were very encouraging, therefore the project has been recently extended by ESA, with INGV-OV still as a science team member, for data validation and assessment of the recently launched Sentinel1-B satellite.

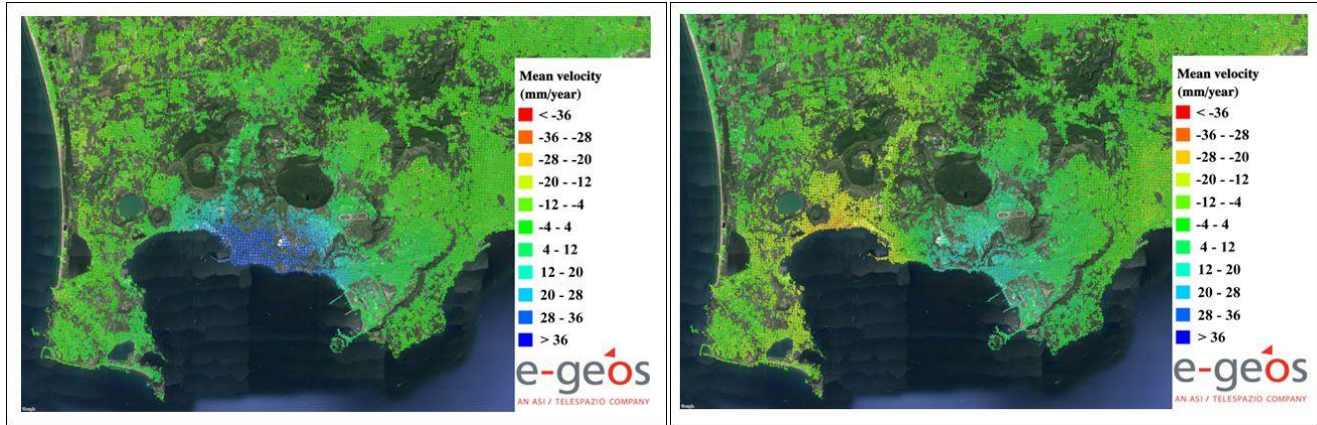


a)

b)

Fig.1- a) Campi Flegrei and Vesuvius - Up (Oct.2014-Oct.2015); b) Campi Flegrei and Vesuvius - Easting (Oct.2014-Oct.2015)
Credits ESA/DLR/E-geos/INGV/GFZ - S1-A data processing by DLR - Microwaves and Radar Institute

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a)

b)

Fig.2 a) Campi Flegrei, detail - Up (Oct.2014-Oct.2015); b) Campi Flegrei, detail - Easting (Oct.2014-Oct.2015)
Credits ESA/DLR/E-geos/INGV/GFZ - S1-A PSI data processing by E-geos

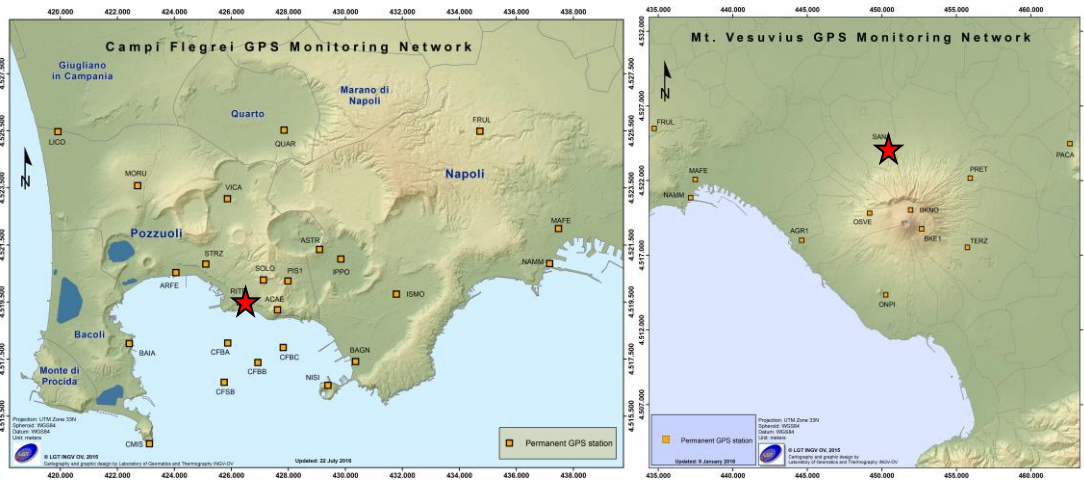


Fig.3 - The Campi Flegrei (left) and Vesuvius (right) continuous GPS (cGPS) monitoring networks
Red stars represent the cGPS stations of RITE (Campi Flegrei) and SANA (Vesuvius)

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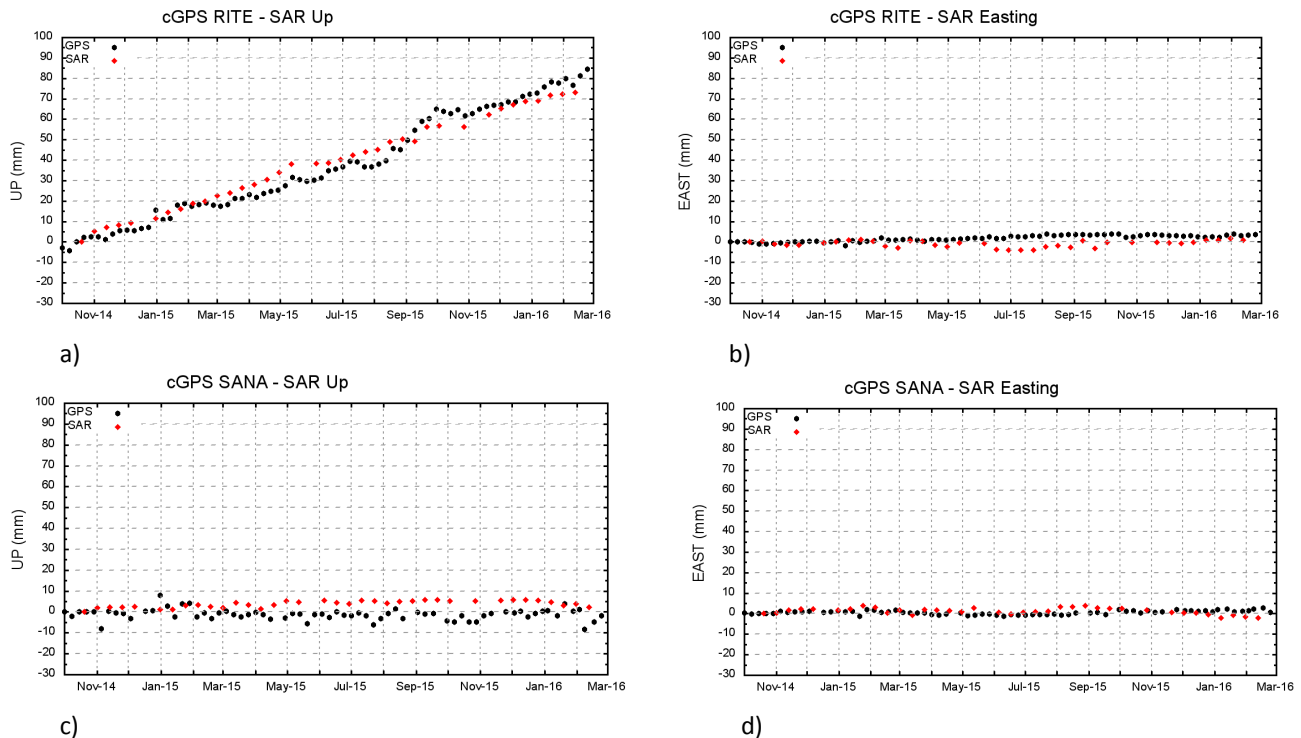


Fig.4 - S1-A/cGPS comparison (Up and Easting) for RITE [Campi Flegrei a), b)] and SANA [Vesuvius c), d)] stations
The comparison refers to the time-span October 2014 - March 2016

Credits ESA/DLR/E-geos/INGV/GFZ - S1-A data processing by DLR; cGPS data processing by INGV-OV

With regard to Fig.4, it is important to underline that the comparison (Oct.2014-Mar.2016) was carried out on all the cGPS stations of the Campi Flegrei and Vesuvius areas.

Some TSX/TDX data provided in the framework of Supersites were also presented as simple interferograms (fig.5) and deformation maps on the Surveillance Reports (*Rapporti di Sorveglianza*, in Italian) for the Italian Civil Protection Department (ICPD) as a result of monitoring activities in the Neapolitan volcanic area. Note that CSK data processing and results are provided on a regular basis by the IREA-CNR team to the ICPD, according to a formal agreement among ASI (Agenzia Spaziale Italiana), ICPD and IREA-CNR, the latter appointed as a *Centre of Expertise* (Centro di Competenza).

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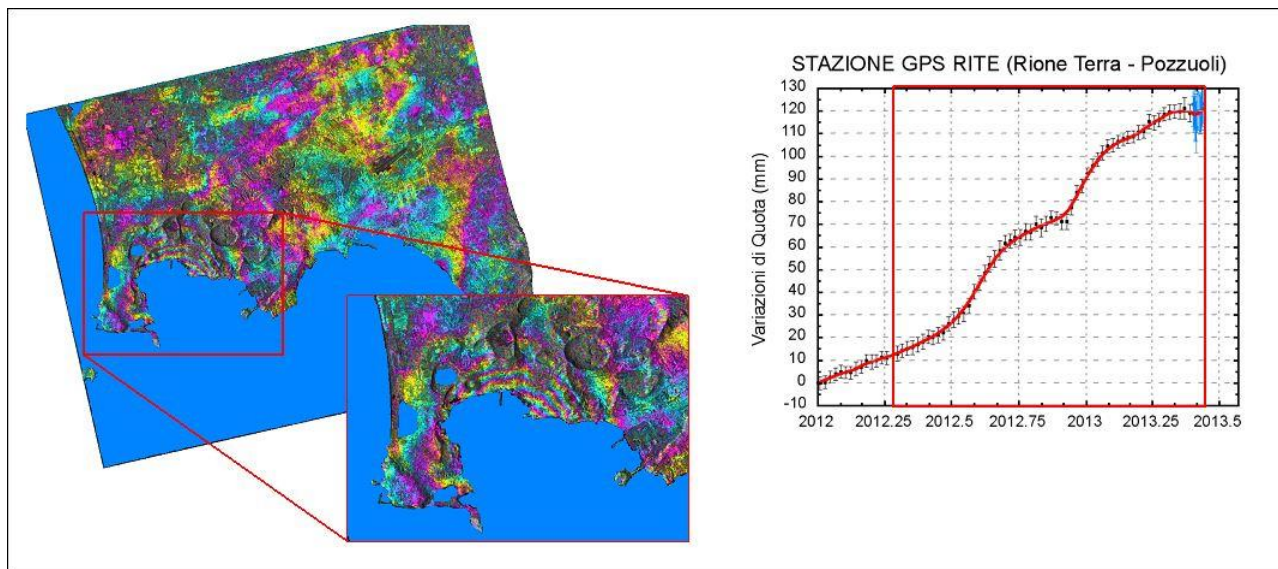


Fig.5 - Left: TSX interferogram (17/04/2012-09/06/2013, ascending); **TSX data processing by INGV-OV**
Right: Time-series of the height variations for RITE (01/01/2012-09/06/2013); **cGPS data processing by INGV-OV**
(the red box refers to the time-span of the interferogram) - from *Rapporto di Sorveglianza 2013*, INGV-OV

INGV-CNT team

The *Centro Nazionale Terremoti* branch of INGV in Rome has two teams working on space-borne data for Supersite: the first one on InSAR and the second one on Optical/Infrared data processing.

InSAR data processing (*S. Stramondo, C. Bignami, M. Polcari, E. Trasatti*)

With regard to Campi Flegrei, two different CSK datasets were processed for both ascending and descending tracks, for the 2011-2015 time-span (fig.6). In this period, the area underwent an uplift of more than 25 cm, where the InSAR analysis has pointed out a semicircular deformation pattern centered on the Solfatara crater, with velocity peaks of about 4.0, 4.5 cm/year in Rione Terra, in the maximum deformation area close to the coast.

Ascending data, in particular, show an optimal temporal coverage, allowing a detailed analysis until October 2015 and pointing out a good agreement with GPS results from the Campi Flegrei continuous GPS network.

CSK data analysis was carried out through the *multi-baseline* approach implemented in the IPTA (Interferometric Point Target Analysis) tool by GAMMA software©, with results provided in terms of trend and time-series of ground deformation.

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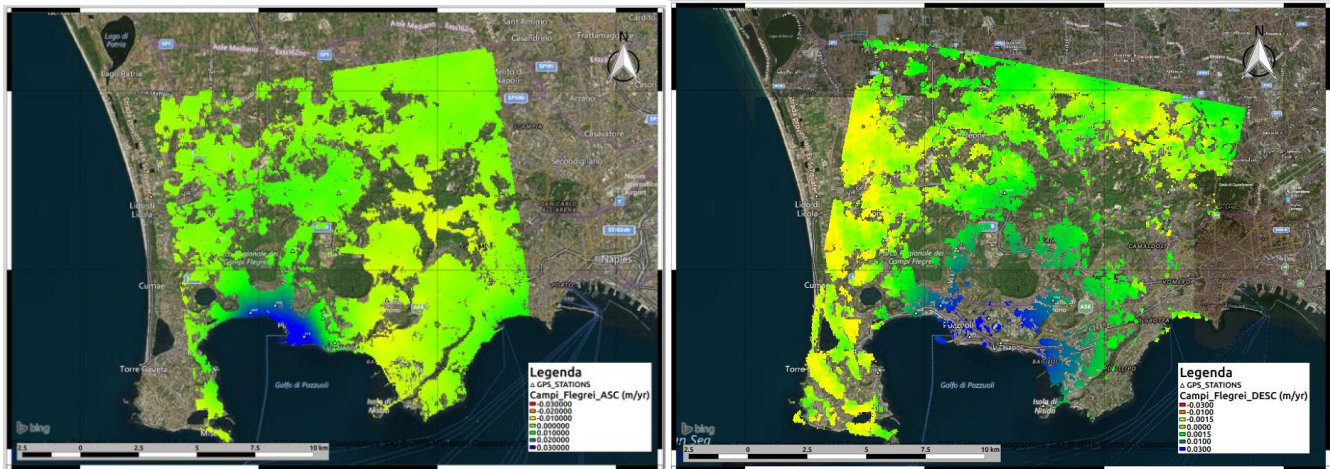


Fig.6 - Left: CSK mean deformation velocity map (01/2011-10/2015, Ascending)
Right: CSK mean deformation velocity map (01/2011-03/2015, Descending)

Credits INGV-CNT

Optical/Infrared data processing (*M.F. Buongiorno, M. Silvestri*)

The main activities in the biennial period on the use of Optical/Infrared data concerned the archiving of real-time data directly acquired by MEOS Multi-mission Antenna (for MODIS data) and AVHRR-TERRASCAN (for AVHRR data), both installed on the roof of the INGV building in Rome. By using these data the radiance and the brightness temperatures have been stored in the INGV storages. These satellite systems currently operative have the capability to acquire radiances either in the mid-infrared spectral region and in the thermal infrared. This allows to acquire information considering the type of source and allows all these systems to be potentially used for thermal monitoring. Moreover, the capability to ensure high frequency revisiting times can be used during emergency situations and can be therefore potentially used in operational contexts. Currently the main disadvantage of this type of sensors is represented by the interference of weather clouds, with data completely unusable.

The temporal coverage of Vesuvius and Campi Flegrei is at least four passes per day for the AVHRR sensor, with a daily repeat cycle corresponding to 1460 images per year.

Also MODIS covers Vesuvius and Campi Flegrei with two Terra frames (at 10.30 and 21.30 UTC) and two Aqua frames (at 00.00 and 12.00 UTC), with a daily repeat cycle corresponding to 1460 images per year (each polar satellite: 730 images/yr).

In order to reach more accuracy on the thermal state of volcanic areas, it is necessary to use TIR (Thermal Infra-Red) sensors with high spatial resolution, obtaining detailed information on the areas where significant changes can occur. ASTER and Landsat 8 TIR sensors, nominally, collect data on the whole Earth every 16 days. Vesuvius and Campi Flegrei are currently covered by two frames each 16 days (1 frame in daytime and 1 in nighttime), corresponding to about 44 images per year (each frame: 22 images/yr) per sensor.

During 2014 and 2015 two field campaigns for CAL/VAL activities were organized, with results reported in Silvestri et al., 2015 (see also *Publications*).

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As a result, no anomalous surface temperature behavior relevant to Vesuvius and Campi Flegrei has been detected.

IREA-CNR team (A. Pepe, S. Pepe, G. Solaro, P. Tizzani)

The team has detected the spatial and temporal evolution of the ongoing unrest phenomena by using the Differential SAR Interferometry (DInSAR) approach. In particular, the availability of the CSK images catalogue acquired along the ascending satellite orbit from 2009 to date (fig.7), has allowed to analyze both the background behavior and the uplift event occurred between January 2012 and June 2014.

Data processing, based on the use of the Small BAseline Subset (SBAS) algorithm (Berardino et al., 2002), has produced a dense spatial mean deformation velocity map and the corresponding time-series relevant to each coherent pixel of the SAR scene. The IREA-CNR team imaged that the source responsible of ground deformation is due to the emplacement of a magmatic sill beneath the town of Pozzuoli, on the coast, during the 2012-2013 crisis episode.

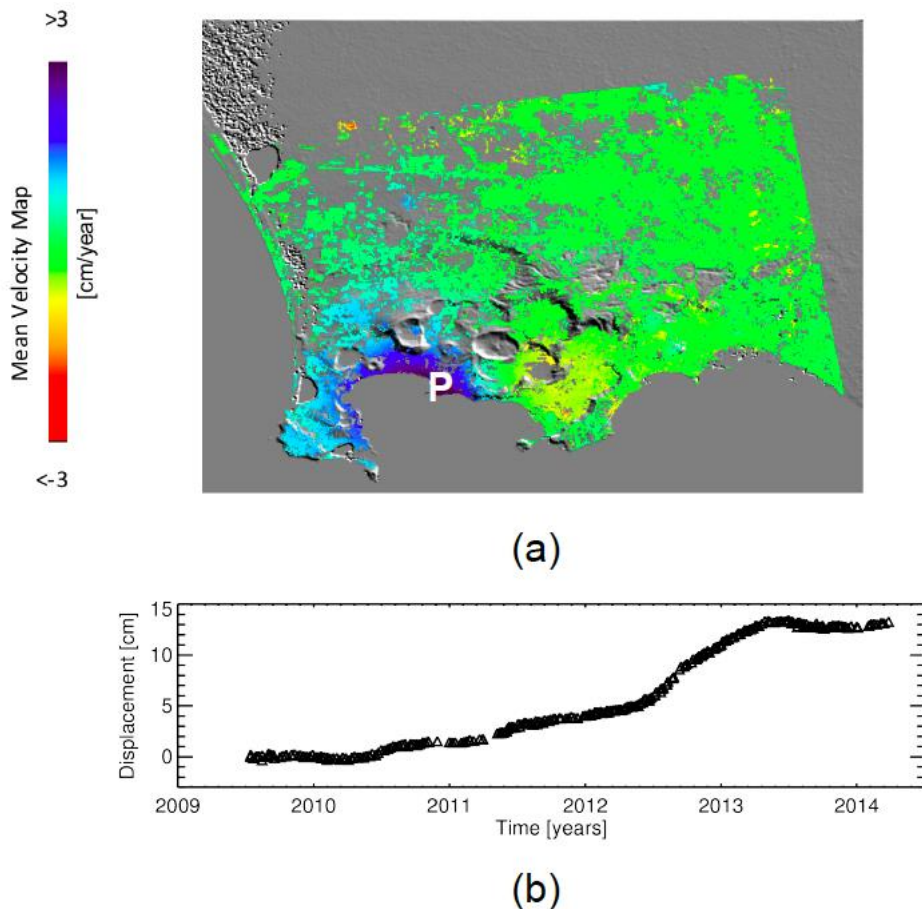


Fig.7 - (a) Mean deformation velocity map of Campi Flegrei caldera as retrieved using CSK ascending SAR dataset
(b) Time-series of deformation related to the pixel labeled as P in (a) located nearby the Pozzuoli harbor

Credits IREA-CNR

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A new study from the **University of Naples team (D. Calcaterra, D. Di Martire)** will start in a short time, with the aim of investigating mainly the upper part of the Vesuvius volcanic edifice, with no vegetation and therefore good coherence. The focus of this study is to characterize the area of interest, marked by a slow although continuous subsidence in recent years, from the engineering geology point of view. This will contribute also to fill the gap of the recent scientific literature on the exploitation of InSAR data on this peculiar volcano, one with the highest volcanic risk worldwide due to the strong urbanization of the surrounding areas.

Publications (see also http://medsuv_portal.ct.ingv.it/documents/)

Peer reviewed journal articles/not peer reviewed journal articles

Samsonov S.V., Tiampo K.F., Camacho A.G., Fernandez J., Gonzales P.J. (2014). Spatiotemporal analysis and interpretation of 1993-2013 ground deformation at Campi Flegrei, Italy, observed by advanced DInSAR. *Geophysical Research Letters*, 10.1002/2014GL060595.

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Research products

There are no formally complete, publically available research products; therefore, the table below has been left intentionally blank. Supersites data have been used to make a variety of non-publically-available products and have aided with some software development (e.g. the SISTEM tool from Guglielmino et al., 2011).

Type of product	Product provider	How to access	Type of access
e.g. ground deformation time series, source model, etc.	Name of scientist(s)	Link to publication, research product repository or description of procedure for access	E.g. public, registered, limited to GSNL scientists, etc.
...
...

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Research products issues

As no products are reported, this subsection has been left intentionally blank.

Dissemination and outreach (see also http://medsuv_portal.ct.ingv.it/documents/)

Besides publications addressed to the Scientific Community, relevant results from the Supersite activities are reported to the main stakeholder, the Italian Civil Protection Department (see also *Societal Benefits*), in the form of six-months and annual Surveillance Reports. In particular, they show regular updates on the ongoing ground deformation in Campi Flegrei, which underwent an overall inflation of about 34 centimeters from 2011 to date.

During the FRINGE Workshop in 2015, a web-article was published on the ESA web-site at [http://www.esa.int/Our_Activities/Observing_the_Earth/Slight_surface_movements_on_the_radar/\(print\)](http://www.esa.int/Our_Activities/Observing_the_Earth/Slight_surface_movements_on_the_radar/(print)) reporting the InSAR results over the Neapolitan Volcanic area obtained in the framework of the ESA-SEOM activities (see *Scientific achievements*, INGV-OV team) exploiting Sentinel-1 data. See also the related international and local press review (e.g. ANSA, the Italian leading press agency, *Stern* (in German), *il Corriere del Mezzogiorno* and *il Giornale di Napoli* (both in Italian) and *FOCUS*, an Italian journal of scientific information).

Funding

Supersite has benefitted in this biennial period from the financial support of the MED-SUV project, funded by the EC from May 2013 to May 2016 for a total amount of ~ 6 M€.

Besides a certain amount of funding now guaranteed by the EVER-EST (European Virtual Environment for Research-Earth Science Themes) Virtual Research Environment, funded by the EC H2020 program and managed by ESA, the sustainability of Vesuvius/Campi Flegrei Supersite is foreseen in the framework of INGV and EPOS work plans. Specifically, INGV will guarantee the provision of the in-situ data produced by the day-to-day operational activity of the INGV monitoring system, which is funded by Italian Civil Protection Department through specific agreements. The current agreement is based on a framework program valid until 2021, which will reasonably be extended beyond this date. Access and share of data is agreed and sustained through the EPOS Implementation Phase project, in which the MED-SUV e-Infrastructure is one of the pilot for the volcanological community, and the national initiatives aimed at implementing the EPOS infrastructure in Italy. Furthermore, one of the MED-SUV deliverables was a strategic document including a proposal for a Memorandum of Understanding (MoU) among the institutes involved in the implementation of the MED-SUV web-site and data portal for their technical maintenance and improvement. The MoU is currently under negotiation.

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Societal benefits

The stakeholders other than the Scientific Community benefitting from the activities of Supersite are mainly the ICPD (Italian Civil Protection Department) and, on a local scale, the Regional Civil Protection of the *Campania* Region, besides the different Municipalities.

In this regard, the Campania Region demonstrated its sensibility to volcanic risk problems through a dedicated regional project funded by the EC (Progetto SISTEMA: *Sistema Integrato di Sorveglianza del Territorio con Metodologie Aero-spaziali*. POR FESR Regione Campania, 2007-2013). The area of interest of the project was Campi Flegrei, with a focus on ground deformation monitoring exploiting different geodetic techniques, in particular InSAR and continuous GPS. Besides the acquisition of new geodetic stations, a network of CRs (Corner Reflectors, 10 pairs), still to be completed, was established in the area.

This is an example of a fruitful interaction between Supersite and other institutional projects/activities: funding from the Campania Region project gave us the opportunity to project, realize and install the CRs network while Supersite allowed to get InSAR (namely CSK) data to accomplish the final goal of studying and monitoring the area.

A new funding on the same topic is foreseen by the Campania Region starting from 2017.

On a mid-term scale, the social benefits to be achieved through the Vesuvius/Campi Flegrei Supersite initiative and related outcomes, can be summarized in technical contributions to ICPD in setting up the updates of the National Emergency Plans for Vesuvius and Campi Flegrei areas.

The Emergency Plans are continuously evolving, depending on the contributions from the reference Scientific Community, in terms of new scientific knowledge for both areas.

In this regard, the National Commission established in 2003 by the ICPD in charge for these updates, has released in 2015 a new version of the Vesuvius Emergency Plan, extending the areas potentially interested by ash fall (Yellow Zone). A new update of the Campi Flegrei Plan was released in 2015 as well, indicating also in this case the boundaries of the Yellow Zone.

Ultimately, the possibility from remotely sensed data to extend the investigations on large/wide areas, far beyond the measurements on single ground-based stations, is an added value in this case, where ground deformation and thermal patterns on large areas have to be considered.

Conclusive remarks and suggestions for improvement

The Supersites initiative fits into a particularly favorable period for the Scientific Community. The opportunity offered by ESA to get free-of-charge satellite data for any registered user, represents a great improvement compared to the past. On the other hand, Supersites further contributed to make immediately available satellite data also from other Space Agencies (e.g. the DLR Supersites website), with the possibility to download in-situ data as well from the MED-SUV portal, just implemented and to be further updated in the next months.

Moreover, the recent development of some cloud services-on-demand for data processing allows to carry out the whole process, from data acquisition to final processing.

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This will result in the future in real advantages not only for the Scientific Community but also for *experienced* stakeholders.

As already mentioned, relevant scientific results were achieved by the Science team and future activities are planned as well.

The next two year period will be challenging after the end of the MED-SUV project, which gave support to Supersites in very different ways. In spite of this, the PoC vision for the future is positive, because some valued outcomes were gathered **also from researchers/activities outside MED-SUV**.

Also continuous data provision from Space Agencies will be critical for a successful next two year period: in this regard the PoC asks also, if possible, for high/very high resolution data, whose exploitation - in addition to in-situ data - can result in relevant progresses in the knowledge of the areas of interest.

In the light of what just said, besides considering the strategic importance for INGV to deepen the knowledge of the Italian volcanoes (not only for scientific research purposes but also for civil protection issues) the PoCs of the two Italian Supersite volcanoes jointly ask for the continuation of Vesuvius/Campi Flegrei and Mt. Etna Supersite initiatives, also on behalf of their Science teams.