Proposal Submission Form

EUROPEAN COMMISSION
7th Framework Programme on Research, Technological Development and Demonstration

Collaborative Project

A1: Content

Proposal Number	000000	Proposal Acronym	MED-SUV

GENERAL INFORMATION ON THE PROPOSAL

Proposal Title	MEDiterranean SUpersite Volcanoes		
Duration in months	36	Call identifier	FP7-ENV-2012-two-stage

Topic code(s) most relevant to your proposal

ENV.2012.6.4-2	-	-

Free Keywords: Mt. Etna, Campi Flegrei/Vesuvius, volcanoes, hazard, risk, preparedness, awareness,

Abstract (max. 2000 char.)

This project will improve the consortium capacity of assessment of volcanic hazards in Supersites of Southern Italy by optimising and integrating existing and new observation/monitoring systems, by a breakthrough in understanding of volcanic processes and by increasing the effectiveness of the coordination between the scientific and end-user communities. More than 3 million of people are exposed to potential volcanic hazards in a large region in the Mediterranean Sea, where two among the largest European volcanic areas are located: Mt. Etna and Campi Flegrei/Vesuvius. This project will fully exploit the unique detailed long-term in-situ monitoring data sets available for these volcanoes and integrate with Earth Observation (EO) data, setting the basic tools for a significant step ahead in the discrimination of pre-, syn- and post-eruptive phases. The wide range of styles and intensities of volcanic phenomena observed on these volcanoes, which can be assumed as archetypes of 'closed conduit ' and 'open conduit' volcano, together with the long-term multidisciplinary data sets give an exceptional opportunity to improve the understanding of a very wide spectrum of geo-hazards, as well as implementing and testing a large variety of innovative models of ground deformation and motion. Important impacts on the European industrial sector are expected, arising from a partnership integrating the scientific community and SMEs to implement together new observation/monitoring sensors/systems. Specific experiments and studies will be carried out to improve our understanding of the volcanic internal structure and dynamics, as well as to recognise signals related to impending unrest or eruption. Hazard quantitative assessment will benefit by the outcomes of these studies and by their integration into the cutting edge monitoring approaches thus leading to a step-change in hazard awareness and preparedness and leveraging the close relationship between scientists, SMEs, and end-users.

Similar proposals or signed contracts?

a) Has this proposal (or a very similar one) been previously submitted to a call for proposals of the 7th EU RTD Framework Programme? — no

IF YES
- please give the call identifier: -
- please give the proposal or contract number (if known): -

b) Is this proposal (or a very similar one) currently being submitted to another call under FP7? — no

IF YES please give the call identifier: -

Proposal Submission Forms

EUROPEAN COMMISSION

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A3.2: Budget

			Estimated budget (whole duration of the project)									
Participant Nr	Organisation Short Name	Organisation country	RTD	Demonstration	Training	Coordination	Support	Management	Other	Total	Total receipts	Requested EU contributions
1	INGV	IT	1165577	0	0	0	0	420147	105619	1691343	0	1399950
2	CNR	IT	473333	0	0	0	0	0	5000	478333	0	360000
3	AMRA	IT	491333	0	0	0	0	4500	47000	542833	0	420000
4	DPC	IT	53333	0	0	0	0	0	0	53333	0	40000
5	DLR	DE	571944	0	0	0	0	0	11305	583249	0	440264
6	UHH	DE	106400	0	0	0	0	0	0	106400	0	79800
7	LMU	DE	280051	0	0	0	0	9960	0	290011	0	219999
8	GFZ	DE	229766	0	0	0	0	0	27565	257331	0	199890
9	UDUR	UK	127749	0	0	0	0	0	24189	151938	0	120000
10	UNIVBRIS	UK	156667	0	0	0	0	0	0	156667	0	120000
11	CNRS	FR	446331	0	0	0	0	0	15000	461331	0	349748
12	BRGM	FR	265800	0	0	0	0	0	149300	415100	0	348650
13	ESA	FR	105400	0	0	0	0	3000	17950	126350	0	100000
14	CSIC	ES	321333	0	0	0	0	0	9000	330333	0	250000
15	UGR	ES	570400	0	0	0	0	0	30400	600800	0	458200
16	UAC	PT	98667	0	0	0	0	0	16000	114667	0	90000
17	UoM	MT	56356	0	0	0	0	0	7733	64089	0	50000
18	IMoSS	CH	385008	0	0	0	0	0	11244	396252	0	300000
19	Surveylab	IT	240000	0	0	0	0	0	0	240000	0	180000
20	MATEC	IT	226667	0	0	0	0	0	10000	236667	0	180000
21	T2	UK	348200	0	0	0	0	0	31200	379400	0	292350
22	UWO	CA	28800	0	0	0	0	0	0	28800	0	0
23	JPL Caltech	US	2902	0	0	0	0	0	0	2902	0	0
24	USGS - HVO	US	7200	0	0	0	0	0	0	7200	0	0

Total	6759217	0	0	0	0	437607	518505	7715329	0	5998851

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR RESEARCH & INNOVATION

Directorate I - Environment

Brussels, 16/02/2012
ares(2011)546749

To: Giuseppe Puglisi
ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA
Sezione di Catania - Osservatorio Etneo
Via di Vigna Murata 605
00143 ROMA
Italy (IT)

7th Framework Programme – acknowledgement of receipt of proposal

Dear co-ordinator

Thank you for submitting your proposal MED-SUV
MEDiterranean SUpersite Volcanoes

under the call FP7-ENV-2012-two-stage
which has been recorded as having arrived on 15/02/2012 16:37:56
Your proposal has been given the following reference number:

Proposal reference number: **FP7- 308665-2**

Please make sure that you quote this reference number in all future correspondence related to this proposal. Also make sure that all of your partners are aware of this reference number.

Your proposal will be checked for eligibility, including confirmation of the time and date of arrival. All eligible proposals will go forward for evaluation. Guidance on when the Commission will decide on successful proposals for funding can be found in the original call for proposals. You will be notified as soon as possible after this of whether your proposal has been successful or not.

Disclaimer: Please note that this acknowledgement of receipt letter may in no way be taken to prejudge the Commission's check of eligibility criteria nor the outcome of the evaluation process related to this call for proposals.

On behalf of the Commission, I would like to thank you for your interest in the 7th Framework Programme.

Yours sincerely,

Avelino GONZALEZ GONZALEZ

Proposal full title: **MEDiterranean SUpersite Volcanoes**
Proposal acronym: **MED-SUV**
Type of funding scheme: **Collaborative Project**

Work programme topics addressed: ENV.2012.6.4-2 Long-term monitoring experiment in geologically active regions of Europe prone to natural hazards: the Supersite concept - FP7-ENV-2012-two-stage.

Name of the coordinating person: **Dr. Giuseppe PUGLISI**

List of participants:

Participant no.	Participant legal Name	Country
1 (Coordinator)	Istituto Nazionale di Geofisica e Vulcanologia (INGV)	IT
2	Consiglio Nazionale delle Ricerche (CNR)	IT
3	Analisi e Monitoraggio del Rschio Ambientale – (AMRA) S.C.A R.L	IT
4	Dipartimento di Protezione Civile (DPC)	IT
5	Deutsches Zentrum für Luft- und Raumfahrt (DLR)	DE
6	University of Hamburg (UHH)	DE
7	Ludwig-Maximilians-University Munich (LMU)	DE
8	Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum (GFZ)	DE
9	Durham University (UNIVDUR)	UK
10	University of Bristol (UNIBRIS)	UK
11	Centre national de la recherche scientifique (CNRS)	FR
12	Bureau de Recherches Géologiques et Minières (BRGM)	FR
13	European Space Agency (ESA)	FR
14	Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC)	ES
15	University of Granada (UGR)	ES
16	Universidade dos Açores (UAc)	PT
17	University of Malta (UoM)	MT
18	IMoSS AG	CH
19	Surveylab	IT
20	Marwan Technology (MATEC)	IT
21	Terradue (T2)	UK
22	University of Western Ontario (UNIWO)	CA
23	California Institute of Technology - Jet propulsion Laboratory (CALTEC-JPL)	US
24	United States Geological Survey – Hawaiian Volcano Observatory (USGS-HVO)	US

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1: Scientific and/or technical quality, relevant to the topics addressed by the call

1.1 Concept and objectives

The MED-SUV proposes the development and implementation of a state-of-the-art infrastructure for the volcanic risk management life-cycle, from the observation to people preparedness, in southern Italy. The infrastructure will rely upon the improvements of the understanding of geophysical processes underlying the volcanic systems of Vesuvius/Campi Flegrei and Mt. Etna. It will also achieve the integration of existing components, such as monitoring systems and data bases, novel sensors for the measurements of volcanic parameters, and tools for data analysis and process modelling.

1.1.1 Rationale

Threat of volcanic activity. Active volcanoes in densely populated areas represent a major natural hazard that influences and guides the territory management policy and requires a strong and effective interplay of the societal components (science, engineering, policy makers). This has led to the implementation of in-situ volcano monitoring systems worldwide, as well as an increasing interest of Earth Observation (EO) missions to acquire geophysical and geochemical parameters linked to the volcanic activity.

In Europe, the south of Italy is a clear example of such a situation, where various areas are threatened by virtually all types of volcanic hazards (from lava flows to tephra falls, pyroclastic flows, lahars, and widespread ash clouds affecting international air traffic). The metropolitan area of Naples (more than 2 million of inhabitants with a density > 2.600 inhabitants/km^2) has grown within the Campi Flegrei caldera and around Vesuvius volcano; both volcanoes have shown highly explosive volcanism throughout their geological histories and into historical time. A new eruption is expected to produce 10-30 km-high volcanic columns, ash cloud dispersal over substantial portions of Europe and beyond (depending on wind directions), and devastating pyroclastic flows. The area of Naples is one with the highest levels of volcanic risk worldwide also considering that, since the 1950s, a phase of unrest is under way in the Campi Flegrei caldera, whose macroscopic effects resemble those of phenomena that preceded its most recent eruption in 1538. Therefore, a volcanic eruption would have the potential to cause a crisis of European proportions.

The challenge from future eruptions in this densely populated area requires the most avant-garde monitoring methods and techniques to be applied, in order to capture and correctly interpret premonitory signs of unrest in time to permit an adequate response. This Task is rather delicate also because of the risk of a false alarm that could cause partial to total disruption of social, cultural, and economic life and bring hardship to an exceptionally large number of people. Conversely, late warning of an unusually rapid eruption onset can result in a rather chaotic response, with a high risk of economic and human losses.

Mt. Etna, Europe's most active volcano, is a formidable threat for the city of Catania and the surrounding region, with about 1 million inhabitants and important infrastructures, e.g., the Catania International Airport, one of the busiest in Italy. A clear example of the effects of the continuous risk in this area is the cumulative economic loss due to volcanic ash clouds, which amounted to 10-20 M€ in the last 10 years. Even though at Etna, eruptions generally develop in such a way as to permit timely evacuation, some events are known to have escalated extremely rapidly (e.g., the 1981 flank eruption), rendering a coordinated response difficult.

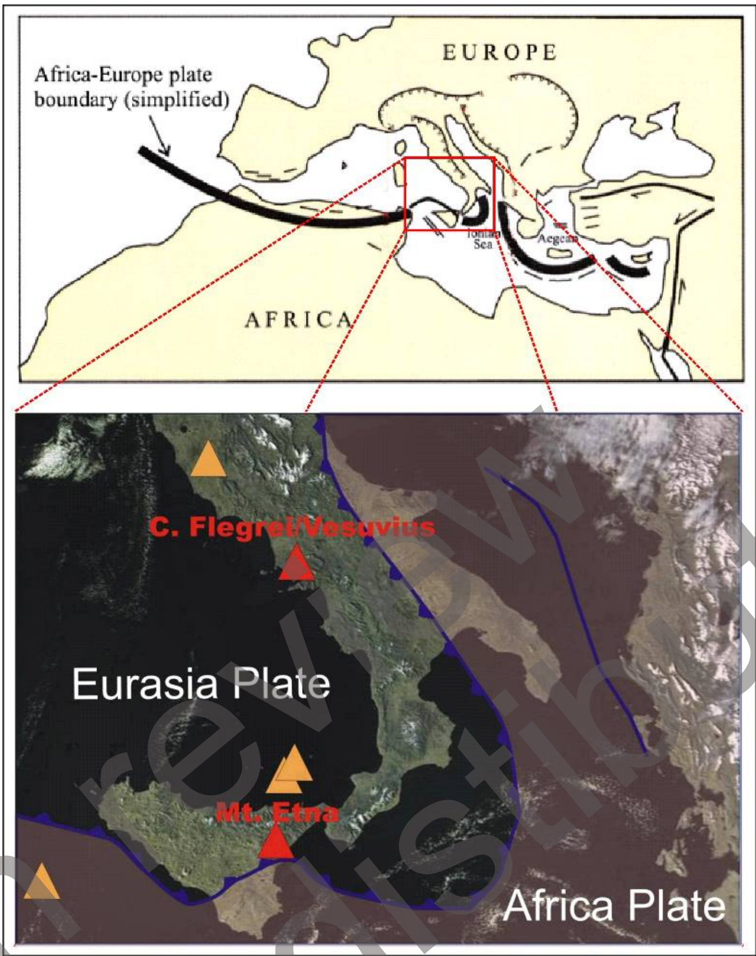


FIGURE 1: geodynamic setting

Volcanic Systems. Southern Italy is linked to the geodynamic context of the central Mediterranean area, characterized by active tectonics related to the diachronic convergence of the boundary between the Eurasian and African plates. The local tectonic setting of the Campanian and Sicilian regions produces very different magmas feeding Mt. Etna, Vesuvius and Campi Flegrei, which is reflected in different eruptive behaviours controlled by "open" or "closed" conduit conditions, and encompasses almost the entire spectrum of threatening, and possibly disruptive/destructive volcanic phenomena. Campi Flegrei and Somma Vesuvius, indeed, are currently in a state of quiescence characterized by hydrothermal activity, whereas Mt. Etna is a classical open-conduit volcanic system dominated by nearly persistent activity, generating both effusive and explosive eruptions.

Cluster of Supersites. Vesuvius is currently quiescent and not showing any signs of an imminent eruption in the near future; Campi Flegrei, however, is in a state of mild unrest and an acceleration of unrest also in a relatively brief time period cannot be excluded. Mt. Etna, on the other hand, is one of the most active volcanoes on Earth and, in the past few decades, has erupted virtually every year, including a powerful summit paroxysm on 5 January 2012. Eruptions at this volcano can be strongly explosive (e.g., 2002; 2011) and produce volcanic ash plumes likely to disrupt air traffic for hours to weeks (e.g., 5 January 2012); they can also produce lava flows capable of invading the populated sectors and thus representing a significant threat to human property and vital infrastructures. For this particular social and geodynamic situation, the south of Italy has often been called the "cradle" of Volcanology, where the oldest volcano observatories worldwide have been set up: the Osservatorio Vesuviano (OV) in Naples and the Osservatorio Etneo (OE) in Catania. The interest of the international volcanological community in the southern Italian volcanoes, as well as their growing role as laboratories for hazard assessment during the 20th century is also testified by the inclusion of Mt. Etna and Vesuvio in the list of "Decades Volcanoes", identified by the IAVCEI commission during the International Decade for the Natural Disaster Reduction of the UN, and by the large amount of scientific publications (e.g., more than 70 per year, on average, on Mt. Etna over the last ten years). Besides such recent studies, documentation of the activity at these volcanoes extends back to the classical period, i.e., more than 2500 years, and all have been the subject of extensive geological studies (resulting in updated geological maps for each volcano, such as the recent Geological Map of Mt. Etna, published in December 2011), so that their evolution, eruptive histories, and dynamics are very well understood.

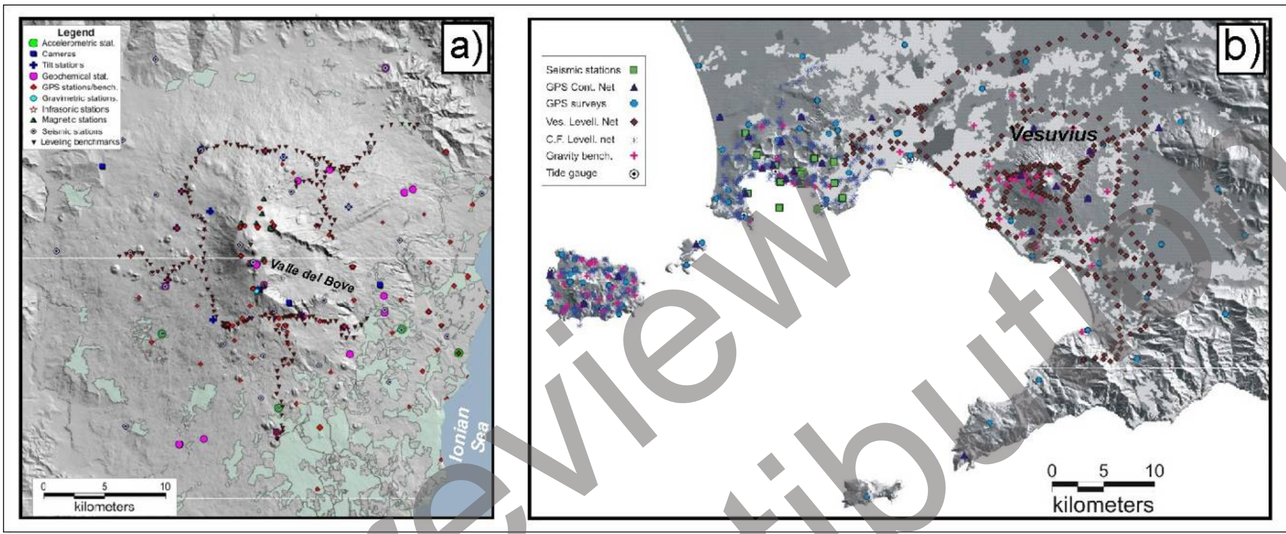


FIGURE 2: (a) monitoring system of Mt. Etna; (b) monitoring system of Neapolitan area

The Earth Observation (EO) community too considers the volcanoes of southern Italy particularly appealing. Space agencies, indeed, have run background missions for both Campi Flegrei/Vesuvio and Mt. Etna over a long time (since the 1980s), so that the current EO data base, for both Synthetic Aperture Radar (SAR) and optical data, is probably the largest in the world for active volcanoes, including EO time series starting from 1984 (LANDSAT) and 1992 (European Remote Sensing, ERS), respectively. All current EO missions comprise the collection of data on the southern Italian volcanoes among their qualified objectives, and there is a considerable confidence that future missions (e.g., Sentinel) will offer possibilities to increase the number of parameters measured with high accuracy from space (e.g., deformation, gas emissions, thermal structures).
For all the above reasons, the Campi Flegrei/Vesuvius and Mt. Etna volcanoes can be considered archetypes of active volcanoes (for the sake of simplicity labelled in the following as “closed” and “opened” conduit volcanoes, respectively) and have been included in the list of the Supersites from the geohazard scientific community inside the Group of Earth Observation (GEO) initiative. They can be considered, altogether, a *cluster of Supersites* in the centre of the Mediterranean area (see section 1.1.3). Synergic activities as well as complementary aspects of these areas, will guarantee that the outcomes of the project will be applicable to other European volcanic areas and elsewhere.

The MED-SUV Consortium proposes this project which will exploit the large, remarkable and unique data set on the Cluster of Supersites to gain new insight into the internal dynamics of the volcanoes and provide answers to the following questions.

- Are the current EO and in-situ observations detailed and accurate enough to capture signals which reflect the internal dynamics and/or eruptive phenomena? How is it possible to improve the quality of these signals?
- What are the expected effects of magma ascent on the stress/strain field (and vice versa)?
- How well can we forecast the place and time of an eruption or volcanic unrest?
- How may we optimize the functioning of the chain from observations to end-users during an eruptive event?
- How are the project outcomes “exportable” to other active volcanoes?

1.1.2. Scientific and Technical Objectives

The overall goal of the project is to apply the rationale of the Supersites GEO initiative to Campi Flegrei/Vesuvius and Mt. Etna to reduce the volcanic risk, by improving the understanding of the underlying geophysical processes, through the integration and sharing of the in-situ and Earth Observation (EO) data sets and the implementation of new instruments and monitoring systems.

The main specific objectives of the project are:
1. Development of the next generation of geo-hazard monitoring/observing systems.
2. Characterization of the volcanic processes through cutting-edge data analysis/modelling
3. Strategies for volcanic disaster preparedness and mitigation
4. Test and validation of the project outcomes
5. Dissemination

Ob. 1. Development of the next generation of geo-hazard monitoring/observing systems.
This objective will be achieved by integrating three parallel groups of activities aimed at: Ob.1.1.) developing new instruments/observation methods; Ob.1.2.) achieving the integration of EO and in-situ data; Ob.1.3.) implementing a digital infrastructure to guarantee the interoperability and sharing of the data sets.

Ob. 1.1. New instruments/observation methods.
The project will promote new monitoring methods and instrumentations, according to a gap analysis of the current monitoring systems and considering the end-user requirements. Specific attention will be devoted to the systematic acquisition of parameters up to now measured only occasionally (e.g., the 3D strain) or production of new deliverables (e.g., routine deformation maps), as well as to the improvement of the accuracy of the measurements. This objective envisages the involvement of SMEs, which may optimize their efforts by profiting from the wealth of volcanic and geophysical phenomena existing in the cluster of Supersites.

Ob. 1.2. Data integration.
The project will standardize the (pre)-processing procedures and develop algorithms able to generate integrated data from multiple EO data sets and in-situ monitoring systems. We intend to obtain new kinds of data by “merging” two or more different types of data, relevant to a specific phenomenon/parameter, rather than to simply “render” them together. Assessment of time series, resulting from the data integration, is planned.

Ob. 1.3. Digital infrastructure for data interoperability and sharing.
This objective addresses technical and management issues. An effective Supersite architecture must consider a service-oriented digital infrastructure (also referred to as cyber-infrastructure) fully interoperable with the existing and next GEOSS Common Infrastructure (CGI), and must also recognize components as, for instance, the Supersite (multi-disciplinary) catalogue and portal, the EO data, the in-situ data, etc. To achieve this aim, several levels of interoperability must be considered for a successful Supersite complying with the GEO/GEOSS principles and demands. Thanks to the wide spectrum of the available data, the project is an ideal forum to find worldwide applicable technical solutions and data policies aimed at facilitating open access to the EO and the in-situ data, and render them exportable to other Supersites. This aim will be achieved by considering the GEO Work Plan, the guidelines of the Supersites Consortium documents, as well as the indications of the World Organization of Volcano Observatory (WOVO), the links with ESFRI research infrastructures related to Earth Science (e.g., EPOS, EMSO) and the outcomes of recent projects aimed at exploiting the EO and in-situ data of Italian volcanic areas (e.g., PREVIEW, SAFER, ASI-SRV, etc.).

Ob. 2. Characterization of the volcanic processes through cutting-edge data analysis / modelling
This objective is aimed at improving the knowledge on the volcanic subsurface or surface processes during the pre-, syn- and post eruptive phases of the target volcanoes, by fully exploiting the complete (integrated) data set and by performing new specific experiments. By assuming that

Campi Flegrei/Vesuvius and Mt. Etna are archetypes of “closed” and “open conduit” volcanoes, respectively, this objective will be achieved by: Ob. 2.1.) identifying the spatial and/or temporal parameters relevant to internal process among the huge available data; Ob 2.2.) modelling of the subsurface processes; Ob. 2.3.) characterizing the surface volcanic processes, especially during eruptive phases.

Ob. 2.1. Identification of relevant parameters
The huge amount of in-situ and EO data sets, available today on the cluster of Supersites, requires specific analyses to rapidly detect and validate any signals related to possible unrests or changes in volcanic activity (e.g., anomalies in the time series of deformation measurements, seismic signals, thermal surveys, gas emissions, etc.). Recognition of these parameters is expected to have a tremendous impact both on the monitoring activity and on the modelling of internal processes. Emphasis will be put on unravelling the nature of the noise in physical and chemical signals. This aim will be achieved by applying massive data mining and by taking advantage of the published results of recent projects (e.g., PREVIEW, SAFER, ASI-SRV, INGV-DPC, etc.). Multiparameter approaches in implementing the analysis tools will be preferred.

Ob. 2.2. Modelling of the subsurface processes
The onset of an eruption as well as its evolution or waning phases are controlled by a complex equilibrium between the structural framework (stress field) and the forces controlling magma ascent in the volcano plumbing system. Changes in this equilibrium produce geophysical and geochemical signals that can be modelled to interpret various subsurface processes. Models are aimed at a quantitative evaluation of parameters related to any threatening event (e.g., volume changes, duration/magnitude of an eruption, increase in gas emission rate, conditions facilitating the flashing of a hydrothermal system and producing a phreatic burst, etc.). The reliability of models largely depends on the degree of knowledge of the structural setting, the physical and chemical properties of both the magma and the surrounding medium, and any other “boundary” condition. Therefore, this intrinsically complex objective needs to be addressed through multidisciplinary approaches aimed at: i) defining unclear, weak or approximate parameters and/or boundary conditions and/or structural setting to improve the implementation of the models, ii) modelling of parameters (e.g., ground deformation) sensitive to or – better – specific of the magma dynamics and its interaction with hydrothermal systems/faults/landslides. The models should also include sensitivity analyses of the critical parameters to be monitored for the hazard assessment and methodologies for solving inverse problem (interpretation), as well as inter-comparison and validation of models.

Ob. 2.3. Characterization of the surface processes.
Eruptions are associated with vast amounts of EO and in-situ data that currently provide critical parameters characterizing the surface volcanological processes, such as the spatial and temporal distribution of the volcanic products, the evaluation of the magma and gas emission rate, the atmospheric dispersal of the eruptive plume, etc.. This specific objective, thus, will be aimed at improving the exploitation of the integrated data sets for the evaluation of these parameters (crucial for the hazard assessment) by applying adequate models.

<u>Ob. 3. Strategies for volcanic disaster preparedness and mitigation</u>
Mitigation of the volcanic risk can only be achieved if the scientific and social preparedness is associated with an effective synergy between scientists and decision-makers. Thanks to the wide spectrum of the activity at the group of Supersite volcanoes, and the firm collaboration between the scientific community and Civil Protection authorities, the project will allow to implement adequate technical/scientific and operational solutions. The by-products could then be adapted and applied to other volcanic sites with similar threats. To fully achieve this objective, two specific action lines are foreseen: Ob. 3.1.) a quantitative multi-hazard assessment, based on the results of the monitoring, data analysis and modelling activities, and Ob. 3.2.) improved communication among scientists, decision-makers and end-users through shared protocols and awareness actions. We will achieve this objective by exploiting the expertise matured in previous and current projects (e.g.,

PREVIEW, MIAVITA, EDURISK and ASI-SRV) and operational systems already operating for specific threatening phenomena (e.g., ash clouds).

Ob. 3.1. Quantitative multi-hazard assessment.
The main goal is to further implement the current practice on short- and long-term volcanic hazard assessment for the Italian Supersite volcanoes, including earthquakes and mass-movements related to the volcanic activity. We plan to achieve this goal through the inclusion of the output of models and data analyses carried out in the project, the continuous streaming of multiparameter monitoring data, the databases already available in the INGV Observatories, and the cutting-edge monitoring systems already existing on the target volcanoes.

Ob. 3.2. Transfer of outcomes to the decision-makers and relationships with end-users
Any kind of risk/hazard assessment has no value if it is not related to an operative goal of risk reduction. For this reason, we plan to transfer the project outcomes to global/national/regional decision-making authorities. The final goal is to reinforce the relationship and cooperation between the scientific and risk-management communities and clarify the respective roles. Any unclear role, indeed, may hamper the management of volcanic crises and/or provoke a lack of confidence in the population living in the volcanic areas. This problem will be faced by cooperating with the decision makers (e.g., the Italian Department of Civil Protection and VAAC).

Ob. 4. Testing ,validation and transfer of the project outcomes [Pilot Phase]
The wide spectrum of the volcanic phenomena associated with the cluster of Supersites gives the opportunity to test the applicability of the project products (e.g., new monitoring systems and methods) in various volcanic areas. To achive this objective a monitoring Pilot Phase will be carried out on the cluster of Supersite, as well as on other volcanic systems with similar behaviours controlled by "open" or "closed" conduit conditions. (e.g. Piton de la Fournaise and Azores). Other European Volcano Observatories will be directly involved in the project, by sharing both the scientific/technical aspects and disaster management expertise. This link will facilitate the applicability of the outcomes of the project in the monitoring and study of other volcanic areas.

Ob. 5. Dissemination.
This objective is aimed at broadcasting the outcomes of the project to the scientific community and the general publicThis view of the dissemination activities concurs also to the achievement of the general objective (knowledge of the volcanic risk) addressing communities not necessary living close to active volcanic areas as well. Actions to accomplish an effective dissemination will include a project website, networking with on-going national and international ventures rooted in the volcanological community, the sustainability of the communication also after the end of the project to build new knowledge in volcanology that can be applied to less instrumented volcanoes.

1.1.3. Relevance of the topics addressed by the call

The objectives and work-plan of the MED-SUV project meet all the topics addressed by the call.

- The multidisciplinary consortium is formed by 24 leading academic and research institutions and SMEs from 10 countries, which will implement a **long-term monitoring experiment** aimed at **fitting the rationale of the "Supersite" initiative to a large geographical key region prone to hazards**, hosting a *cluster of Supersites* (Campi Flegrei/Vesuvio and Mt. Etna volcanoes), **where all building blocks of a value chain from observations to end-users can be linked together and applied to the phases of the risk management cycle**. Indeed, in this region a unique institution in charge of the monitoring system (INGV) and a unique decision maker in charge of the management of volcanic risks and interventions during volcanic crisis (DPC) operate together.
- The WPs will organize a logic structure of activities finalized at improving **the scientific understanding of occurrence of the volcanic hazards**, (WP4, WP5), by (i) implementing **novel monitoring systems and new instrumentation in collaboration with SME's** (WP2, WP3), (ii) **aggregating space and ground-based observations** (WP3) and (iii) **mitigating, and improving the preparedness to volcanic disasters** (WP6, WP8).

- Since the *cluster of Supersites* is in the centre of the Mediterranean Sea, MED-SUV is **coordinated with the existing monitoring marine systems** (WP3) such as the NEMO-SN1 observatory of EMSO (off east Sicily) and CUMAS multisensor station (offshore Campi Flegrei). The MED-SUV team will conduct the monitoring of the *cluster of Supersites* **through a fully integrated conceptual approach based on collaboration with existing monitoring networks** (INGV) **and international initiatives** (e.g., GEO, Space Agencies, EPOS, EMSO, ICDP, ESF-MEMVOLC) (WP1 and WP3).
- **Models of ground motion and deformation** (WP4, WP5) will be implemented by exploiting the available **multidisciplinary measurements prior to, during and following geohazard events** (e.g., eruptions, landslides) (WP3).
- MED-SUV will **run a Pilot Phase as a European supersite demonstrator** on a few selected volcanic areas (WP7) and, on the whole, will contribute **to demonstrate the next generation of geo-hazards monitoring/observing systems and to establish comprehensive natural hazards observatories through cross-cutting approaches**.

1.2 Progress beyond the state-of-the-art

1.2.1. State-of-the-art

The volcanoes of southern Italy pose enormous potential hazards, necessitating the development of world-class volcano monitoring solutions. The creation of INGV in Italy in 1999 allowed consolidation of all Italian volcano monitoring resources into a single national body, and over the last 13 years this has allowed a remarkable increase in the quality and depth of the monitoring systems used, allowing ground-breaking progress in the knowledge of magmatic/volcanic processes. Today, INGV manages what may be the most sophisticated volcano monitoring networks in the world, made up of 280 and 140 multi-parametric stations on Mt. Etna and Campi Flegrei/Vesuvius respectively, about 250 benchmarks periodically surveyed with GPS and more than 600 km of high-precision levelling lines covering both areas. The monitoring activity includes: geophysical monitoring (seismicity, ground deformation, gravity and magnetism changes), geochemical monitoring (soil, fumaroles and plume gas emissions, ground water chemistry changes), thermal and video surveillance, together with geological analysis (geological and structural surveys, mapping of lava and tephra distribution and petro-chemical laboratory analyses). (http://www.ct.ingv.it/; http://www.ov.ingv.it/OV/; http://cnt.rm.ingv.it/)

All this heterogeneous information is currently processed and interpreted with the aim to recognise the subsurface magma dynamics and precursory events that may announce forthcoming eruptions. As an example, to enable a swift and accurate response to a rapidly evolving volcanic crisis at Etna, new systems for the real-time electronic elaboration and automatic interpretation of instrumental monitoring data have been recently developed (e.g., the volcanic tremor classifier alert system applied in the operation room of the INGV-Osservatorio Etneo in Catania) (Messina and Langer, 2011).

The cutting-edge monitoring system has favoured the development of advanced research as, for instance, carried out in the European PREVIEW, SAFER, GLOBVOLCANO or National ASI-SRV, INGV-DPC projects.

The result of the research carried out on the southern Italian volcanoes is a wealth of international scientific publications presenting insights into the dynamics and hazards of these volcanoes, such as: high-resolution seismic tomography of Etna (Patanè et al., 2006); evidence on the geometry of the magmatic system of Vesuvius (Auger et al., 2001); the development of new systems of pattern classification applied to seismic radiations for early detection of volcanic unrest (Langer et al., 2011); modelling of hazardous volcanic processes and their impact on the human environment (Zuccaro et al., 2008).

Notwithstanding the modern and sophisticated monitoring system and the high-quality research, different categories of data (e.g., seismology, such as earthquakes and volcanic tremor, ground deformation, gas geochemistry, and petrology) have so far largely been treated separately. What has until now been rather neglected is a continuous multidisciplinary integration of these different types of data and their analysis systems. The few multidisciplinary studies carried out so far have indeed shown the enormous potential for gaining fundamental insights and obtaining a sound conceptual model of these volcanic areas and their dynamics (e.g. Longo et al., 2011; Neri et al., 2009; Aiuppa et al.,2010).

For example, Campi Flegrei caldera is a nested, complex, resurgent structure undergoing unrest usually dominated by magmatic-hydrothermal processes that can escalate toward an eruption. An intimate link, not completely revealed before, relates resurgence patterns and variations in the intense hydrothermal fluid circulation within the very heterogeneous caldera fill (Chiodini et al., 2011). Nearby Vesuvio is quiescent since 1944 and currently shows no signs of an imminent reawakening. This is the longest repose period at this volcano since the 17th century, and a future eruption is expected to be the most violent since the catastrophic, explosive reawakening of the volcano in 1631 after 500 years of repose. Numerous recent studies have been devoted to the probable impact of a strongly explosive eruption and Civil Defence issues, based on the deposits of past eruptions in human environments, and computer simulation of pyroclastic density currents, the most hazardous volcanic phenomenon to be expected in a new eruption (e.g., Spence et al., 2004; Cioni et al., 2008).

The dynamics of Mt.Etna are the result of a complex interaction between magma ascent in the rather complicated plumbing system and the tectonic regime controlled by flank instability, whose driving conditions (e.g., structural setting, tectonic forces) and cause-effect relationships are not yet completely understood (Acocella and Puglisi, 2010; Bonforte et al., 2008; Bonanno et al. 2011). The limit in the interpretation of Mt. Etna's dynamics is largely due to inadequate knowledge of its basement and shallow crust, mostly based on experiments carried out more than twenty years ago, with techniques and resolutions unsuitable for the potentiality of current modelling and the high quality of information provided by the EO and in-situ data sets.

1.2.2. Progress

The first category of progress, following the achievement of the Objective 1, will affect the monitoring system, which will provide better quality data, whilst maintaining its present configuration. The new monitoring/observation systems, designed and implemented in MED-SUV, will open new perspectives in volcano monitoring. The automation of monitoring ground deformation by SAR data, for instance, will reduce the time of latency (and costs) of such type of monitoring. MED-SUV will be the "incubator" of new instruments and systems able to extract new information from the actual monitoring systems (e.g. the tool for integrating and analysing thermal and visible images) and will collect parameters in a systematic way, more accurately. One of the main innovations of the project will be the implementation of the prototype of the digital infrastructure compliant with the GEO-GEOSS requirement. It will contribute to the achievement of the GEO 2012-2015 Work Plan, allowing significant progress in data sharing among scientific institutions and promoting an integrated and multidisciplinary approach to facilitate warning of, and response to, the volcanic risk. The integration of EO and in-situ data in the monitoring system will determine steps forward in the interpretation and modelling of the volcanic/magmatic processes as well.

The second category of progress concerns specific aspects of the geophysical and volcanological knowledge of the Supersites Volcanoes in southern Italy, conform to the Objective 2. On Mt. Etna we plan to carry out a new experiment of active seismic tomography in order to provide a new 3D seismic velocity model. The results of this experiment, integrated with previous geophysical surveys (e.g., gravity, magnetotellurics, etc.), will improve the current knowledge of the crust beneath this volcano and of the physical processes controlling magma ascent, through cutting-edge modelling. The modelling of ground deformation will benefit from the outcomes of the seismic experiment, as the improvement of knowledge of the physical and geometrical parameters of the internal structure of Mt. Etna and its basement will increase the accuracy and robustness of the cut-edge numerical models (e.g. Finite Element or Boundary Element Methods).

With respect to the Campi Flegrei, the project will be focused on the dynamics of the caldera, including phenomena such as the continuous gas emissions from the Solfatara and the bradyseism that caused the evacuation of the town of Pozzuoli twice in the last 40 years. The study of these processes can be successfully approached through the integration of in-situ and EO data and the development of models encompassing the dynamics of the geothermal and magmatic systems. This activity will benefit from the results of previous projects of seismic tomography and hazard evaluation, and of the results of the on-going deep drilling project inside the caldera (CFDP-ICDP). Moreover, the expected results of this project include the development of new tools for detecting volcanic anomalies and for assessing the hazard associated with the Campi Flegrei unrest.

The third category of progress is expected in the field of hazard assessment and risk mitigation, following the achievement of the Objective 3. The use of avant-garde short- and long-term hazard assessment approaches on two quite different volcanic areas like Campi Flegrei and Mt. Etna widens the possibility to extrapolate the results to many other volcanic systems all around the world. Moreover, it is expected that the outcomes of a hazard assessment based on multidisciplinary, cutting-edge knowledge and a strong link with decision-makers will allow us to define new paradigms in the risk awareness on populated areas. This is of particular relevance for scenarios that might either result in false alarms or involve an unexpectedly rapid escalation of a volcanic unrest crisis.

Acocella, V. and G. Puglisi (2010), Hazard Mitigation of Unstable Volcanic Edifices, Eos Trans. AGU, 91(40), 357, doi:10.1029/2010EO400002

Aiuppa, A., et al. (2010), Patterns in the recent 2007–2008 activity of Mount Etna volcano investigated by integrated geophysical and geochemical observations, Geochem. Geophys. Geosyst., 11, Q09008, doi:10.1029/2010GC003168

Auger, E., Gasparini, P., Virieux, J. & Zollo, A. (2001). Seismic evidence of an extended magmatic sill under Mt. Vesuvius. Science, 294, 1510–1512.Cioni, R., Bertagnini, A., Santacroce, R., Andronico, D. (2008) Explosive activity and eruption scenarios at Somma-Vesuvius (Italy): Towards a new classification scheme. J. Volcanol. Geotherm. Res., 178: 331-346, doi: 10-1016/j.jvolgeores.2008.04.024.

Bonanno, A., Palano, M., Privitera, E., Gresta, S., Puglisi, G. (2011) Magma intrusion mechanisms and redistribution of seismogenic stress at Mt. Etna volcano (1997–1998). Terra Nova, Volume 23, Issue 5, pages 339–348, DOI: 10.1111/j.1365-3121.2011.01019.x

Bonforte, A., A. Bonaccorso, F. Guglielmino, M. Palano, and G. Puglisi (2008), Feeding system and magma storage beneath Mt. Etna as revealed by recent inflation/deflation cycles, J. Geophys. Res., 113, B05406, doi:10.1029/2007JB005334

Chiodini, G., S. Caliro, C. Cardellini, D. Granieri, R. Avino, A. Baldini, M. Donnini, and C. Minopoli (2010). Long-term variations of the Campi Flegrei, Italy, volcanic system as revealed by the monitoring of hydrothermal activity, J. Geophys. Res., 115, B03205, doi:10.1029/2008JB006258.

Langer, H., Falsaperla, S., Messina, A., Spampinato, S., Behncke, B. (2011). Detecting imminent eruptive activity at Mt Etna, Italy, in 2007-2008 through pattern classification of volcanic tremor data. J. Volcanol. Geotherm. Res., 200: 1-17.

Longo A., Papale P., Vassalli M., Saccorotti G., Montagna C.P., Cassioli A., Giudice D., Boschi E. (2011). Magma convention and mixing dynamics as a source of Ultra-Long-Period oscillations. Bull. Volcanol., doi: 10.1007/s00445-011-0570-0.

Messina, A., Langer, H., (2011). Pattern Recognition of Volcanic Tremor Data on Mt Etna (Italy) with KKAnalysis - a software for Unsupervised Classification. In press on Computer & Geosciences, doi:10.1016/j.cageo.2011.03.015

Neri, M., Casu, F., Acocella, V., Solaro, G., Pepe, S., Berardino, P., Sansosti, E., Caltabiano, T., Lundgren, P., Lanari, R. (2009). Deformation and eruptions at Mt. Etna (Italy): A lesson from 15 years of observations. Geophys. Res. Lett., 36, L02309, doi: 10.1029/2008GL036151.

Patanè, D., Barberi, G., Cocina, O., De Gori, P., Chiarabba, C. (2006). Time-resolved seismic tomography detects magma intrusions at Mount Etna. Science, 313: 821-823.

Spence, R.J.S., Baxter, P.J., Zuccaro, G. (2004). Building vulnerability and human casualty estimation for a pyroclastic flow: a model and its application to Vesuvius. J. Volcanol. Geotherm. Res., 133: 321-343, doi: 10.1016/S0377-0273(03)00405-0.

Zuccaro, G., Cacace, F., Spence, R., Baxter, P., (2008). Impact of explosive eruption scenarios at Vesuvius, J. Volcanol. Geotherm. Res., 178 (3), pp 416-453.

1.3 S/T methodology and associated work plan

1.3.1. Overall strategy of the work plan.

We adopt a method to organize the work plan that in general consists of four phases: a) in-depth analysis of the state-of-the-art in the various aspects addressed in the project (e.g., monitoring infrastructures, available measurements and data bases, methodologies for data analysis and elaboration), aimed at identifying gaps and defining requirements, b) design of the approaches/ instruments/systems/models/procedures that will be developed in the project, c) implementation of the previous step design and d) test and validation. The end of each phase is a milestone of the project and deliverables relevant to the activities of each phase will be issued. This general method will be applied to the different activities of the project.
The project will be organized in Work Packages (WP) and Tasks in order to ensure the achievement of the objectives. We will adopt a teamwork approach, although for specific cases (e.g., to implement some new instruments or measurement systems) the deliverables will be implemented by single participants, coordinated within specific Work-Packages or Tasks.

The Work Plan is structured in the Project management (WP1), New monitoring and Observing systems (WP2); Data Sharing, Integration and Interoperability (WP3); Closed-conduit volcanoes laboratory (WP4); Etna volcano laboratory (open-conduit) (WP5); Volcanic hazard assessment, disaster preparedness, and mitigation (WP6); Pilot Phase - Validation and transfer of project outcomes (WP7); Dissemination and Outreach (WP8). Each WP is organized in Tasks, each aimed at the achievement of specific objectives and the productions of specific deliverables.
Referring to the numbers of the General Objectives in Section 1.1.2, the WPs 2 and 3, will focus on Objective 1, the WPs 4, 5 on Objective 2, while the WPs 6, 7 and 8 will have in charge Objectives 3, 4 and 5 respectively. Across the WPs 4-5, we will organize Working Groups (WG), each one being aimed at addressing a specific methodological theme (e.g., numerical modelling approaches) in common between the different volcanic areas.
Here below is an overview of the different WPs together with the guidelines for the definition of Tasks.

1.3.2. Timing of the WPs.

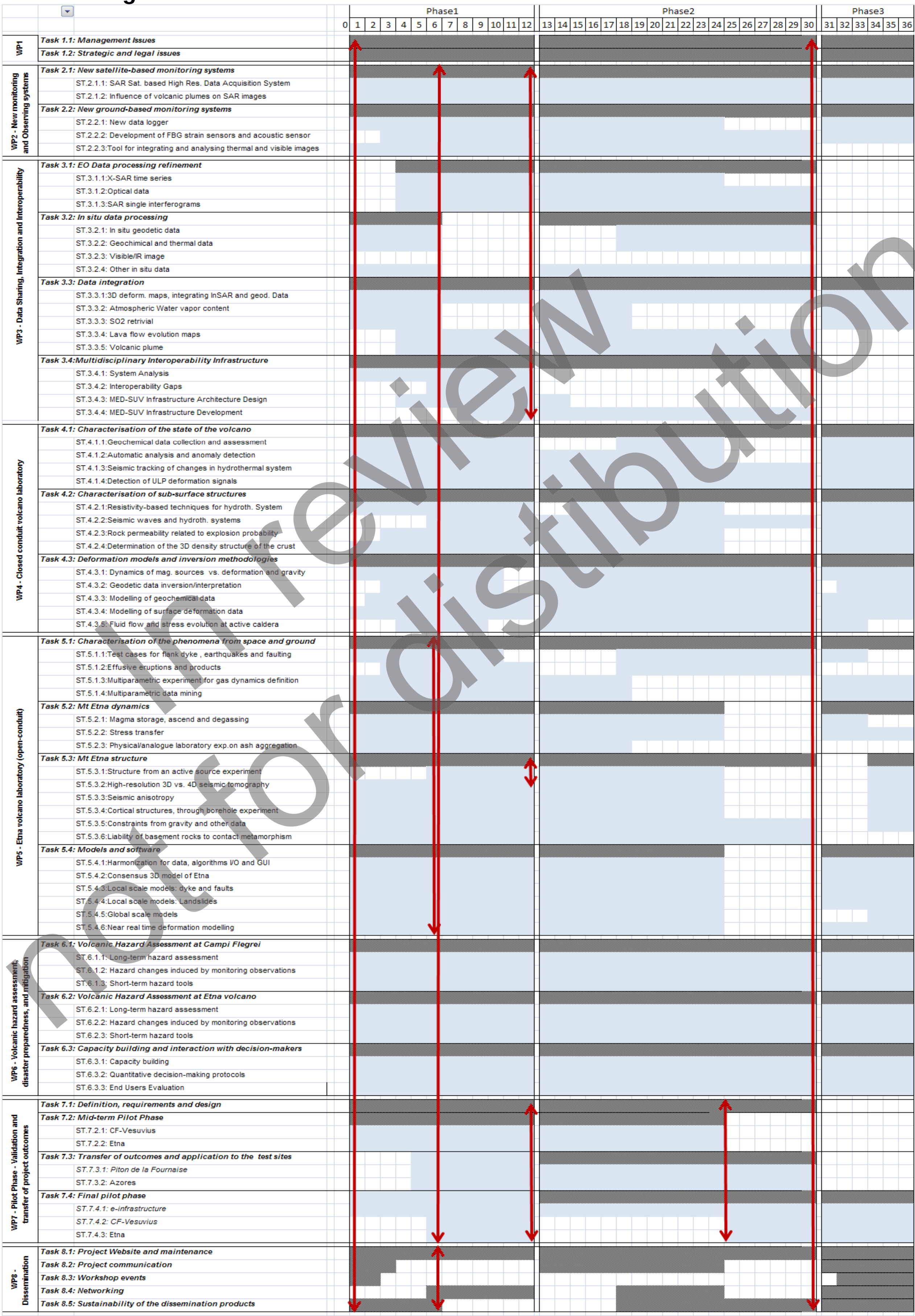


Table 1.3.3 a: Work package list

Work package No[1]	Work package title	Type of activity[2]	Lead participant No[3]	Lead participant short name	Person-months[4]	Start month[5]	End month
1	Project management	MGT	1	INGV *(Puglisi)*	39.8	0	36
2	New monitoring and Observing systems	RTD	5	DLR *(Minet)*	118.8	0	36
3	Data Sharing, Integration and Interoperability	RTD	1	INGV *(Martini)*	222.74	0	36
4	Closed conduit volcano laboratory	RTD	7	LMU *(Dingwell)*	187.45	0	36
5	Etna volcano laboratory (open-conduit)	RTD	11	CNRS *(Briole)*	174.2	0	36
6	Volcanic hazard assessment, disaster preparedness, and mitigation	RTD	1	INGV *(Marzocchi)*	82.7	0	36
7	Pilot Phase - Validation and transfer of project outcomes	RTD	11	CNRS *(Allard)*	81.85	0	36
8	Dissemination and Outreach	OTHER	12	BRGM *(Modaressi)*	54.81	0	36
	TOTAL				972.35		

1 Work package number: WP 1 – WP n.

2 Please indicate one activity per work package:

RTD = Research and technological development (; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable in this call including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities) According to the description of the funding scheme given previously.

3 Number of the participant leading the work in this work package.

4 The total number of person-months allocated to each work package.

5 Measured in months from the project start date (month 1).

Table 1.3.3 b: Deliverables List

Del. no. [1]	Deliverable name	WP no.	Nature[2]	Dissemination level [3]	Delivery date[4]
1.1	Consortium Agreement	1	O	PP	1
8.1	Workshops	8	O	PU	1
8.2	Project website	8	P	PP	2
5.1	Report on dyke injections, earthquakes, creep events with their characteristics and a set documented sample events and data to be used in the other Tasks and WP	5	R	PP	3
8.3	Communication plan	8	R	PP	3
1.2	Periodical reports 1/5	1	R	PU	6
1.7	Data policy guidelines 1	1	O	PP	6
2.1	Report on Automated TerraSAR-X High Resolution Data Acquisition and Processing System: Requirement Analysis	2	R	PP	6
2.2	Report on Network performance evaluation & image processing tool design	2	R	PP	6
3.9	Report describing the data fusion environment project, the data integration processing principles and algorithms, the users requirements and the system requirements for interoperability (with particular attention to the GCI)	3	R	PP	6
4.1	Report on monitoring campaigns of Campi Flegrei and Vesuvius volcanoes (1/6).	4	R	PP	6
5.19	Report on all standards to be used in the shared models	5	R	PP	6
3.13	MED-SUV System and interoperability Gaps Analysis	3	R	PP	8
3.1	Input and Processing SW module Final Design	3	R	RE	10
1.3	Periodical reports 2/5	1	R	PU	12
2.3	Development of a new functionality for local	2	P	PP	12

1 Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.

2 Please indicate the nature of the deliverable using one of the following codes:
R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

3 Please indicate the dissemination level using one of the following codes:
PU = Public
PP = Restricted to other programme participants (including the Commission Services).
RE = Restricted to a group specified by the consortium (including the Commission Services).
CO = Confidential, only for members of the consortium (including the Commission Services).

4 Measured in months from the project start date (month 1).

	data recording				
4.11	3D resistivity model in the area Solfatara-Pisciarelli-Agnano.	4	O	PP	12
4.2	Report on monitoring campaigns of Campi Flegrei and Vesuvius volcanoes (2/6).	4	R	PP	12
5.16	Bibliographic report of the inputs from the other observations for the building of a global structural model of Etna	5	R	PP	12
5.2	Report on explosive events with overall characteristics and a set of documented sample events and data to be used in the other Tasks and WP (including a series of explosive events like those of 2011)	5	R	PP	12
5.2	Structural model of Etna compliant with the new and previous seismic data (including bibliographic report on the constraints from previous seismic work) and all other data. The definition of this model will include the definition of a grid or boundary elements structure used in the Task 4 models.	5	O	PP	12
7.1	Report on the planning of the Test and validation activities	7	R	PP	12
3.1	Reports describing the products and their requirements (including parameter, format, protocols and way to access) needed for the data fusion and sharing; and the design of the interoperability architecture	3	R	PP	14
3.14	MED-SUV Infrastructure Architecture Design	3	R	PP	14
3.2	Input and Processing SW module beta version (prototype)	3	P	RE	16
1.4	Periodical reports 3/5	1	R	PU	18
2.4	Executable Software Development for decoding of locally stored data	2	P	PP	18
2.5	Image Processing tools for quantitative data extraction	2	P	PP	18
2.6	Network establishment/optimization	2	O	PP	18
4.14	Development of a method for the inversion of in situ and EO geodetic data (First versions).	4	O	PU	18
4.3	Report on monitoring campaigns of Campi Flegrei and Vesuvius volcanoes (3/6).	4	R	PP	18
4.7	Development of an algorithm for geophysical anomalies discovery by using Neural Network analysis	4	P	PP	18
4.8	Development of an algorithm for detection and location of seismo-volcanic sources	4	P	PP	18
5.21	Shared local 2D and 3D models including	5	O	PP	18

	realistic rheological parameters and structure, algorithm, elements of computer code, comparisons and benchmarks, demonstator				
5.4	Report on the experiment and gathered data and results, including new sound velocity method	5	R	PP	18
5.5	Report on the software tools developed for data mining and on- and off-line available tools (restricted during the time of the project, then open)	5	R	PP	18
7.2	Report on the outcomes of the first Pilot phase	7	R	PP	18
3.3	Input and Processing SW module final release	3	P	PP	19
3.5	Complete SW (with interface module) final design	3	R	RE	19
4.13	Technical report about the performance of the BubbleLab (experiment design, tests).	4	R	PU	20
8.4	Action plan for the sustainability of the dissemination	8	R	PP	20
1.5	Periodical reports 4/5	1	R	PU	24
2.7	Design Report and field setup of FBG sensors	2	P	PP	24
2.8	Hardware and software upgrades to allow a further reduction of power consumption	2	D	PP	24
3.6	Complete SW (with interface module) beta version (prototype)	3	P	PP	24
4.12	3D model of Vesuvius hydrothermal system.	4	O	PP	24
4.4	Report on monitoring campaigns of Campi Flegrei and Vesuvius volcanoes (4/6).	4	R	PP	24
4.9	Tests of real time CICA implementation	4	D	PP	24
5.1	Report on ash aggregation experiments	5	R	PP	24
5.11	Report on ash and ash aggregate settling experiments	5	R	PP	24
5.12	Report of the TOMO-Etna marine and land experiment, data and results	5	R	PP	24
5.13	Report on the high resolution tomography	5	R	PP	24
5.14	Report of the seismic anisotropy investigation	5	R	PP	24
5.15	Report of the borehole experiment, data and results	5	R	PP	24
5.17	Report on experiments on the thermal weakening of Etna basement rocks and the related decarbonation	5	R	PP	24
5.22	Report on the survey and quantification of landslides	5	R	PP	24
5.23	Shared global scale model: algorithm, elements of computer code	5	P	PP	24

5.24	Demonstrator of a near-real time deformation modelling tool handling the various available data, structure & theoretical background	5	O	PP	24
5.3	Report on effusive events with discharge rate and lava flow expansion trends and a set of documented sample events and data to be used in the other tasks and WP	5	R	PP	24
5.6	Report on experiments on the thermal weakening of Etna basement rocks and the related decarbonation	5	R	PP	24
5.7	Report on experiments constraining the effect of microlite growth and/or crystal content on the rheological properties of lava flows.	5	R	PP	24
5.8	Report on the theoretical background applicable to the characteristic events delivered in Sub-Task 5.1.1 and Sub-Task 5.1.2	5	R	PP	24
5.9	Report on stress transfert, interaction between the magmatic and the tectonic system, identification of test cases for modelling	5	R	PP	24
7.3	Test of preliminary version of SAR algorithm for isolating volcanic plume signal in SAR data (test against ground truth)	7	O	PP	24
7.5	Report (guidelines) on the feed-backs to the other WPs and on the two volcanic test sites	7	R	PP	24
1.6	Periodical reports 5/5	1	R	PU	30
2.1	Report on Automated Image acquisition and processing on test cases	2	R	PP	30
2.9	Automated TerraSAR-X High Resolution Data Acquisition and Processing System: Prototype	2	P	RE	30
3.11	Software products of the digital infrastructure for the data fusion, sharing and interoperability.	3	P	PP	30
3.12	Report with the software products description, their implementation and usage.	3	R	PP	30
3.15	MED-SUV Infrastructure (software)	3	P	PP	30
4.1	Software package for removing noise from nanosensitivity deformation signals and detection of ULP signals at supersite volcanoes.	4	P	PP	30
4.5	Report on monitoring campaigns of Campi Flegrei and Vesuvius volcanoes (5/6).	4	R	PP	30
6.1	Short-term hazard assessment tool for Etna	6	P	PP	30
6.2	Short-term hazard assessment tool for Campi Flegrei.	6	P	PP	30
7.4	Improved retrieval procedures for volcanic plume signal extraction from SAR data –	7	O	PU	30

	comparison with Numericcal models and ground data				
3.4	Input and Processing SW module as built design and user manual	3	D	RE	33
3.7	Complete SW (with interface module) final release and user manual	3	D	RE	33
8.5	Workshops	8	O	PU	35
1.1	Exploitation Agreement	1	O	RE	36
1.11	Final project report	1	R	PU	36
1.8	Data policy guidelines 2/2	1	O	PP	36
1.9	Memorandum of Understanding	1	O	PP	36
2.11	Report on Characterization of SAR Signal Propagation delays caused by volcanic plumes	2	R	RE	36
2.12	Field Test of two stations	2	O	PP	36
2.13	Installation and operation of the FBG strain sensor in the summit zone of Etna	2	O	PU	36
3.8	Integrated 3D ground deformation and 3D strain maps for selected test cases (DEMO of SW)	3	P	PU	36
4.15	Development of a method for the inversion of in situ and EO geodetic data (Final versions).	4	O	PU	36
4.16	Generic integrated fluid flow and rock mechanics model for activity at a collapse caldera.	4	O	PP	36
4.6	Report on monitoring campaigns of Campi Flegrei and Vesuvius volcanoes (6/6).	4	R	PP	36
5.18	Report on the rock mechanical strength analysis of basement rocks	5	R	PP	36
6.3	Preparedness and awareness Guidelines	6	R	PU	36
7.6	Final report on the Pilot Phase	7	R	PP	36
7.7	Prototype of new generation monitoring system	7	P	PP	36

Table 1.3.3 c: List of milestones

Milestone number	Milestone name	Work package(s) involved	Expected date [1]	Means of verification[2]
1	Kick-off meeting	WP1,WP2,WP3,WP4,WP5,WP6,WP7,WP8	M0	
2	State of the art, gap analysis and requirement	WP2,WP3,WP4,WP5,WP6,WP7	(M6)	Validated by ExC
3	Planning of seismic experiment	WP5	(M6)	Validated by ExC
4	Web site	WP8	(M6)	Validated by a user group
5	Planning of activity and design of new system	WP2, WP3, WP7	(M12)	Validated by ExC, and AB
6	Seismic experiment	WP5	(M12)	Validated by ExC
7	End of 1°Pilot phase	WP7	(M24)	Validated by ExC
8	End of implementation of new system	WP1,WP2,WP3,WP4,WP5,WP6,WP7,WP8	(M30)	Validated by ExC

[1] Measured in months from the project start date (month 1).

[2] Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype completed and running flawlessly; software released and validated by a user group; field survey complete and data quality validated.

Table 1.3.3 d: Work package description

Work package number	1	**Start date or starting event:**	Start of project (T0)		
Work package title	Project management				
Activity Type[1]	MGT				
Participant number	**1**				
Participant short name	**INGV**				
Person-months per participant:	39.8				

Objectives

The WP1 is in charge of the overall management of the project, the preparation of the documents for the EC, the definition and the achievement of a consensus on strategic and political issues related to the use and exploitation of the project products, (e.g., Intellectual Property Regulations - IPR), the relationships with the stakeholders and the Advisory Board. The WP1 will also deal with the legal issues, considering the technical results achieved in the other WPs.

A general valued objective will be to guarantee a smooth decision making process which foresees the involvement of the partners of the project, through the following management bodies:the Executive Committee (ExC) and the General Assembly (GA).

Description of work

[Note; please see sections 2.1 and 3.2 for further information regarding the Management Structure. Only the Tasks and deliverables are outlined below]

Task 1.1 Management Issues

Management of the contacts with the governing bodies (ExC, AB, GA), contract obligations (reporting), adoption of the Consortium Agreement. As MED-SUV will address very sensitive applications (e.g. for Civil Defence purposes) and include industrial partners, particular care will be devoted to identify any potential issues related to Intellectual Property and use of foreground and background knowledge.

Task 1.2 : Strategic and legal issues

This Task will outline strategic guidelines, basic principles and term of reference for some crucial issues such as

Data policy. One of the main aims of the project is the sharing of the data to achieve the GEO objective. Apart from the technical aspects of the data sharing, which will be coped in the WP3, legal issues will be discussed in the GA. Thanks to the wide spectrum of the kinds both of the available data and participants (data providers and data users), indeed, the project as whole is the ideal forum to find worldwide enforceable data policies aimed at promoting retrieval and systematic

[1] Please indicate one activity per work package:
RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities).

access to the EO and the in-situ data. This Task deals with the definition of such a data policy, by organizing a specific work group which study and propose a data policy, which will be discussed through the governing bodies and will be adopted by the GA. The first version of this data policy will be adopted in and tested the project activities (within first 6 months).

Intellectual Property Rights As MED-SUV will address very sensitive applications (e.g. for Civil Defence purposes) and include industrial partners, particular care will be devoted to identify any potential issues related to Intellectual Property and use of foreground and background knowledge, which will be defined in the Consortium Agreement and Exploitation Agreement respectively

Memorandum of Understanding (MoU) at the end of the project a MoU will be agreed among the partners to identify those components of the developed monitoring systems and infrastructure to be maintained in operation in the frame of GEO.

Deliverables

- D1.1. Consortium Agreement (M1)
- D1.2. Periodical reports 1 (M6)
- D1.3. Periodical reports 2 (M12)
- D1.4. Periodical reports 3 (M18)
- D1.5. Periodical reports 4 (M24)
- D1.6. Periodical reports 5 (M30)
- D1.7. Data policy guidelines 1 (M6)
- D1.8. Data policy guidelines 2 (M36)
- D1.9. Memorandum of Understanding (M36)
- D1.10. Exploitation Agreement (M36)
- D1.11. Final project report (M36)

Work package number	2	**Start date or starting event:**		Start of project (T0)	
Work package title	New monitoring and Observing systems				
Activity Type[1]	RTD				
Participant number	1	**5**	12	19	20
Participant short name	INGV	**DLR**	BRGM	SurveyLab	MATEC
Person-months per participant:	5.8	**49**	7	30	27

Objectives

The WP2 is aimed at developing new instruments/monitoring systems devoted to measure new parameters, increase measurement accuracy and precision, increment the spatial/temporal data sampling and reduce the costs of collection of the informations.

Thanks to the wide spectrum of volcanic phenomena on the cluster of Supersites we will have the opportunity to develop and test the systems in different operative conditions.

The WP is divided in a Remote Sensing Task and one In-Situ Task.

In the framework of the Remote Sensing Task we envisage to implement: (i) a new EO system based on X-band Synthetic Aperture Radar (SAR) sensors designed for automatic monitoring ground deformations over active volcanoes and (ii) a methodology to explore the potential use of C-band SAR systems in the characterization of volcanic plumes in terms of geophysical parameters.

The In-Situ Task will focus on new, low power consuming and low priced data loggers (GILDA), new in-situ low-costs, high-resolution sensors based on optical Fiber Bragg Grating systems for systematically measuring tri-axial strains and new instruments and sensors to measure the physical and chemical parameters of volcanic emissions (volcanic plumes and fumaroles) and to monitor the lava flows thermal and spatial evolution.

Description of work

Task 2.1: New satellite-based monitoring systems (DLR)

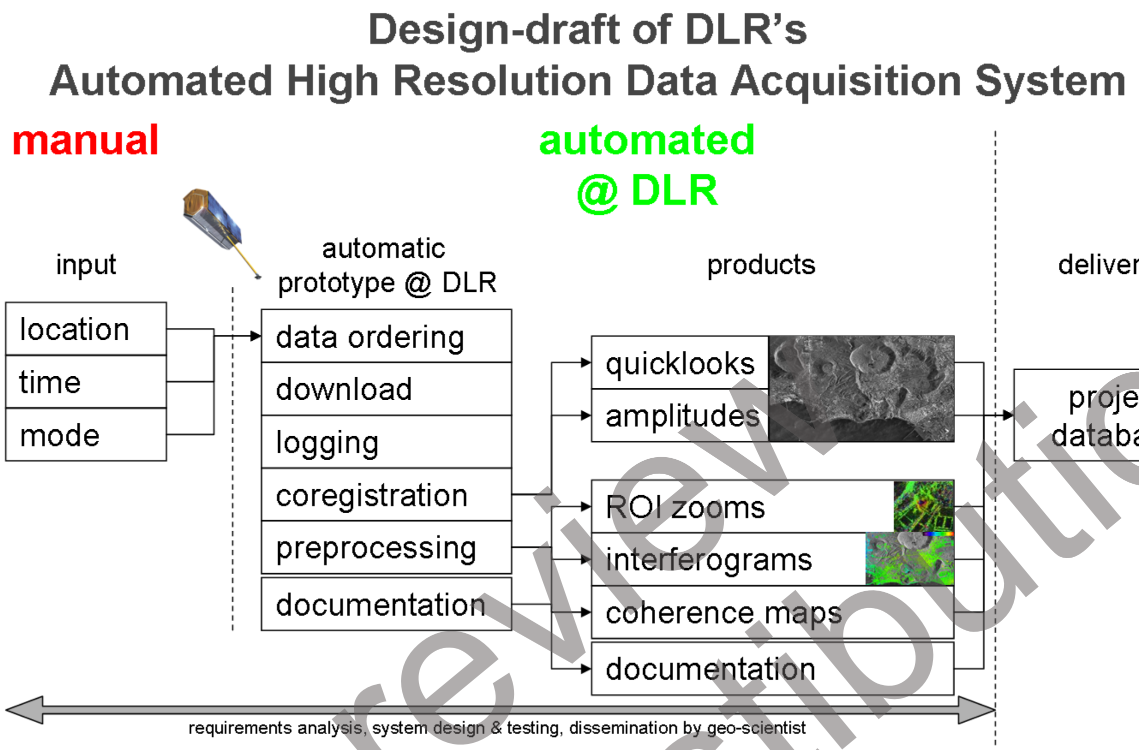
Sub-Task 2.1.1: SAR Satellite based High Resolution Data Acquisition System

Monitoring volcanoes and volcanic areas using SAR-data is a well established method of risk assessment. However, acquisition planning, ordering, downloading and importing data is a time and work intensive, but inevitable process. It has to be done not only once before the actual processing, but for continuous monitoring, it poses a consecutive and iterative process.

These preparations will be taken over by an Acquisition and Processing System, which will be developed at DLR. The required input for running this system will be narrowed to only a few essential inputs, like coordinates, monitoring period and acquisition mode. Using this core input, the system will automatically check for possible acquisition scenarios and present the feasible solutions to the user. Applying the selected scenario, the system will order, download the data and thus creating a local data base of SAR data. With every newly acquired scene, an automated InSAR processing will be started, resulting in products like amplitude images, interferograms (deformation maps) and coherence maps. Additionally to the derived products, the original satellite data will be delivered to a central data sharing point, enabling all participants to validate, use and

[1] Please indicate one activity per work package:
RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities).

fuse the data. The whole process will be logged for complete traceability. (Team: DLR)



Sub-Task 2.1.2: Quantifying the influence of volcanic plumes on SAR images

We propose to use Synthetic Aperture Radar (SAR) systems to characterize volcanic plumes as a complement to other in-situ and remote sensing techniques. While it is known that the SAR signal is delayed as it passes through heterogeneous layers of the atmosphere, this delay typically affects the SAR signal to a fraction of the phase cycle or few centimeters depending on the radar wavelength employed by the system. We propose to investigate the source of anomalous (metric) SAR signal delay that has recently been observed on targeted volcanic areas. The method would allow us to reasonably assert whether the SAR signal is perturbed by the volcanic plume during the actual process of SAR image focusing. If yes, the SAR wave delay can then be used to characterize the plume in terms of geophysical parameters.

We propose to develop a methodology that could be applied systematically both on C band SAR data from archives and on newly acquired C band data from future satellite missions such as the European Space Agency SENTINEL. (Team: BRGM)

Task 2.2: New ground-based monitoring systems (INGV)

Sub-Task 2.2.1: New data logger

The main purpose of this Task is to improve the characteristics of the digital recorder called GILDA (Geophysical Instrumentation for Low power Data Acquisition), to realize an instrument that provides excellent data quality with low power consumption and low production cost. Such an instrument will facilitate the development of advanced monitoring systems, allowing to create dense geophysical instrument networks at low budget. Moreover it will be profitably used in cooperation projects with developing countries.

A data logger for recording of multiparametric geophysical data was designed and developed at INGV-Osservatorio Vesuviano. This data logger, called GILDA (Geophysical Instrumentation for Low power Data Acquisition), is characterized by low power consumption and low internal electronic noise. This instrument is designed to meet the needs of installations in remote areas, not supplied by an electrical power network. Most of the seismic digital stations of the monitoring network of Vesuvius and Campi Flegrei are equipped with GILDA. This instrument is routinely used with velocimeters, accelerometers, infrasonic sensors, hydrophones, and electrometers. The casing and connections are easily customized to suit the installation needs and production costs are low compared with available commercial instrumentation. A GILDA is also installed in an OBS in the Gulf of Pozzuoli. This Task aims to achieve further optimization of power consumption and improve the acquisition system firmware adding new functionality. The new functionality will focus on control of environmental parameters of the instrument (temperature, power supply and consumption) and to implement a flexible and friendly user interface in order to facilitate the use of the instrument and to improve the remote management of the data logger. (Team: INGV-OV)

Sub-Task 2.2.2: Development of FBG strain sensors and acoustic sensor

Stress and strain changes at volcanic areas are recognized among the best indicators of changes in the activity of the system, and its possible evolution towards critical stages. Depending on their time evolution, stress and strain changes have traditionally been the focus of either geodetic (static changes) or seismological (dynamical changes) studies.

In volcano geodesy, encouraging results have been obtained though borehole strain-meters. However, they are not easy to install, especially in the harsh conditions usually encountered in the summit zone of an active volcano, and involve high costs.

Therefore, the near future of stress–strain monitoring depends on the development of broad-band sensors which are low-cost and easy to install, even in the form of dense arrays.

Another promising method for volcano monitoring is the detection of acoustic waves in the infrasonic frequency range (between ~100 mHz and a few tens of Hz). Commonly, infrasonic volcano monitoring is achieved through networks and/or arrays of microphones. Noise from wind represents the main limitation for such devices.

Advancements in opto-electronics have allowed the development of low-cost fiber optic sensors, reliable, rugged and compact, which are particularly suitable for on-field application. In particular, strain and acoustic sensors based on optical Fiber Bragg Grating (FBG) seem to be the most promising to monitor active volcanoes.

In the framework of MED-SUV we plan to (a) develop a prototype of "smart" FBG strain sensor and (b) study the feasibility of an infrasonic sensor based on the same technology. In comparison with previous implementation of the FBG technology to study rock deformations, the system that will be developed within MED-SUV is expected to offer a significantly higher resolution and accuracy in static measurements, in the order of 0.5 microstrain. Moreover, a careful study will be carried out in order to obtain a smooth dynamic response up to 100 Hz, thus allowing the observation of seismic waves. Finally, strategies to implement a tri-axial configuration will be studied.

As for the infrasonic FBG sensor, while some works exist in the literature concerning the use of FBGs for acoustic detection, an infrasonic sensor for geophysical applications represents a completely novel implementation. An advantage of using FBGs for infrasonic sensing is the possible implementation of distributed FBG arrays to separate the wind-induced noise from the acoustic signal through interferometric schemes.

The performances of the proposed systems will be tailored to suit the requirements of volcano monitoring, with special attention to the trade-off between resolution and cost. (Team: MATEC, INGV-CT)

Sub-Task 2.2.3: Implementation of a tool for integrating and analysing thermal and visible images

The permanent ground NEtwork of Thermal and VIsible and Sensors located on Mt. Etna (Etna_NETVIS) will be optimized and extended to observe the most active areas and to monitor surface sin-eruptive processes. A dedicated tool for automatically pre-processing high frequency data to extract geometrical and thermal parameters and track the evolution of the lava field will be developed and tested both in simulated and real scenarios. Survey Lab srl will develop the low-level algorithms and the graphical interfaces on the basis of the requirements provided by the INGV team which will also lead and support the testing activity in the fields.

The activity includes the following steps:

- Design and optimization of the permanent network (including the requirements for additional observations sites to be set up during emergency phases)
- Design and realization of GCP network (both artificial and natural targets) to be adopted for calibrating the system and data georeferencing (extracting the external orientation parameters, data quality assessment, etc.)
- Development of the interface for data selection and pre-processing to obtain a coherent multi-temporal dataset of orthophotos (a-priori orientation parameters and DEM are required)
- Implementation of algorithms for extraction of 2D and 3D (in case of stereo and multiview acquisition) features, compilation of evolutions maps of the flow propagation, active areas and Implementation of algorithms to evaluate active flow area and to estimate effusion rates

(Team:SurveyLab, INGV-CT)

Deliverables

D2.1 Report on Automated TerraSAR-X High Resolution Data Acquisition and Processing System: Requirement Analysis - (M6)

D2.2 Report on Network performance evaluation & image processing tool design - (M6)

D2.3 Development of a new functionality for local data recording - (M12)

D2.4 Executable Software Development for decoding of locally stored data - (M18)

D2.5 Image Processing tools for quantitative data extraction - (M18)

D2.6 Network establishment/optimization - (M18)

D2.7 Design Report and field setup of FBG sensors - (M24)

D2.8 Hardware and software upgrades to allow a further reduction of power consumption - (M24)

D2.9 Prototype of Automated TerraSAR-X High Resolution Data Acquisition and Processing System - (M30)

D2.10 Report on Automated Image acquisition and processing on test cases - (M30)

D2.11 Report on Characterization of SAR Signal Propagation delays caused by volcanic plumes - (M36)

D2.12 Field Test of two stations - (M36)

D2.13 Installation and operation of the FBG strain sensor in the summit zone of Etna - (M36)

Work package number	3		**Start date or starting event:**					Start of project (T0)		
Work package title	Data Sharing, Integration and Interoperability									
Activity Type[1]	RTD									
Participant number	1	2	3	11	13	14	18	19	21	22
Participant short name	INGV	CNR	AMRA	CNRS	ESA	CSIC	IMoSS AG	SurveyLab	T2	UNIWO
Person-months per participant:	58.3	60.19	12	11.5	8	10	22.75	14	25	1.

Objectives

This WP has three main objectives:

a) to refine the processing chains of the existing monitoring systems, both EO (Task 3.1) and in-situ (Task 3.2). These activities will be aimed at introducing the existing monitoring systems into the digital infrastructures .

b) to integrate the EO and in-situ data to obtain a “new truly integrated data set” (Task 3.3). Rather than a combination of two or more different data sets produced by EO and in-situ observations, we expect to augment the capability of observing new parameters or improve the measurement spatial and temporal resolutions.For example, the integration of scalar LOS areal continuous InSAR information with the 3D punctual GPS displacement vectors will allow to obtain a continuous 3D displacement field.

c) To implement a new digital infrastructure to allow data interoperability and sharing (Task 3.4). To this aim the supersite digital infrastructure will consider concepts and solutions introduced and adopted by the GEOSS Common Infrastructure (GCI), as well as the standards recognized by the GEO Standard and Interoperability Forum (SIFINSPIRE and GMES. Theactivities of GEOWOW project will be taken into account through the partners involved in this WP. For data archiving and sharing, the supersite digital infrastructure will also consider the experience and best practices developed by previous relevant projects (e.g., DIVO, ASI-SRV, PREVIEWS). The infrastructure will be developed using a Service-oriented approach. The analysis and design phases will address the required services including for instance: Discovery; Semantic expansion/navigation; Access; Visualization/Portrayal/Map, and Processing/Analysis. In this context, added value processing services for exploiting the information contained in low level ESA satellite data will be implemented. The added value products will include integrated parameters and maps obtained merging satellite and in situ data.

Description of work

Task 3.1: EO Data processing refinement (CNR - IREA)

In this Task we will design and implement specific interfaces to process and transfer the EO data into the integration and interoperability environments (Task 3.3 and Task 3.4). The EO will be

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made available directly from the databases already implemented, based on the existing monitoring systems.

Sub-Task 3.1.1 – X-SAR time series

This Task is focused on the generation of surface deformation time series and mean deformation velocity maps, relevant to the two selected Supersite zones of Mt. Etna volcano and the Campi Flegrei volcanic system. To achieve this Task, the well-established DInSAR technique known as Small BAseline Subset (SBAS) approach will be applied to archives of SAR images collected by the second-generation radar sensors of the Italian Space Agency Cosmo-Skymed (CSK) constellation, over the two Supersite areas. In particular, the DInSAR deformation products will be retrieved at the regional scale, characterized by a spatial resolution on the ground of about (50 x 50 m). The retrieved results will be eventually adapted to be exploited for the subsequent EO Data Integration step (Task 3.3). (Team: CNR-IREA)

Sub-Task 3.1.2 – Optical data

Optical data(AVHRR, MODIS) real time acquisition by INGV antennas able to receive data from various satellites different times of the day.The acquisitions in real-time multi-mission satellite images are automatically processed to produce a systematic measurements of brightness temperature at sensor both on Etna, Campi Flegrei and Vesuvio, which could be integrated in the Supersites information layers. (Team: INGV)

Sub-Task 3.1.3 – SAR single interferograms

This Sub-Task is focused to optimize the processing chain of the production of single interferograms to be exploited in the activities of the Task 3.3 or WPs 4 and 5. Data from all the previous and current SAR missions (C-bans, X-band and L-band) suitable for the project will be considered in this Task. Processing chains are based on the existing commercial or no-commercial (copyrighted) software. The processing chains will be revised and optimized in order to produce interferograms suitable for the integration with other geodetic/optical data (Sub-Task 3.3.1), for the comparison/integration with the results of the atmospheric water vapour content (Sub-Task 3.3.2) or for the modelling activities (WP4 and WP5). (Team: INGV)

Task 3.2: In situ data processing (INGV)

Activities:

Design and implementation of specific interfaces to transfer the in situ data into the integration and interoperability environments (Task 2.3 and Task 2.4). The in situ data to be integrated with the EO will be made available directly from the databases already implemented

Sub.Task 3.2.1 In situ geodetic data

The subtask will provide the ground deformation data acquired during the periodic surveys and by the permanent networks operating at the Supersite test areas that will be integrated with the information derived for the EO InSAR processing. Starting from the the existing databases, the subtask will provide support to the data integration environment following the standards defined by the task 3.3 Data will be collected by the INGV ground deformation monitoring activity (GPS, Tilt, Levelling, Tide Gauges) and by the AMRA borehole strainmeter networks.

Sub.Task 3.2.2 Geochemical and thermal data

The subTask will provide the geochemical and thermal data acquired by the periodic surveys and by the permanent instrumentation operating in the selected Supersite zones, in order to be integrated with the EO Optical data, for the development of the systems for the analysis and data fusion. Based on the existing data and databases, the subTask will provide their interfacing to the data integration environment following the standards defined by the Task 3.3. Data will include SO_2 and CO2 gas emission and thermal IR images.(Team: INGV)

Sub.Task 3.2.3 Visible/IR image (INGV, SurveyLab)

The subtask will provide the data extracted from the image collected during periodic surveys and by the permanent networks operating at Mt. Etna zones, in order to be integrated with data extracted from EO data. Starting from the the existing databases, the subtask will provide support to the data integration environment following the standards defined by the Task 3.3

Sub.Task 3.2.4 Other in situ data

Based on the requirements of the data integration process and the development of the data integration environment defined by the Task 3.3, this subtask will provide additional in situ data: seismic volcanologic data and environmental data are already available in the neighbouring areas of Vesuvius-Campi Flegrei and Mt. Etna. In particular data belonging to marine monitoring systems such as NEMO-SN1 observatory (part of ESFRI EMSO) and CUMAS, deployed off-shore Catania and in the Gulf of Pozzuoli respectively, will be included. These data will contribute to test the data fusion methodologies.(Team: INGV,AMRA).

Task 3.3: Data integration (CSIC)

The integration will concern three aspects of the volcano monitoring: the ground deformation (by integrating InSAR and geodetic data), the thermal data and the gas emissions (by integrating EO optical and geochemical/geophysical in-situ measurements). This integration, optimizing the processing chains, will face the problem of the atmospheric effects of the EO.

Activities:

- Development of the data integration environment, designed to create a new database populated by the parameters obtained from the integration process.
- Development of the systems for the analysis and data fusion, defining standards for connecting the modules for interfacing to EO and in situ databases (Task 1 and Task 2), in order to reach a technical interoperability
- Improved data fusion methodologies including procedures for quality assessment Extension of data fusion application to new datasets to extract combined information (optical, micro-gravity, DInSAR time series data).
-

Sub-Task 3.3.1 – 3D deformation maps, derived from integration between InSAR and geodetic data.

The purpose of the activity of this Task is to integrate ground deformation data coming from remote sensing (SAR) and geodetic (spatial and terrestrial) techniques into a unique solution that takes all the advantages of each single methodology. This means exploiting the high spatial resolution but 1D DInSAR displacement maps and the 3D but sparse ground motion data coming from GPS stations and so on with other classical geodetic techniques, such as leveling, EDM, tilt, etc.. Techniques aimed at obtaining a 3D deformation field by means of the integration of DInSAR displacement data with GPS and ground geodetic measurements will be implemented. At the Campi Flegrei site this approach will be aided by the availability of a dense leveling which include 350 benchmarks regularly surveyed. Special emphasis will be given to the data quality assessment and accuracy estimation of the integrated dataset.. (Team: CSIC, INGV, IMoSS AG, UNIWO)

Sub-Task 3.3.2 – Atmospheric Water vapour content

In this Sub-Task techniques to estimate the effects of water content in the atmosphere that affects SAR signal will be developed by combining EO data measurements, GPS and atmospheric modelling. The EO data used will regards ENVISAT-MERIS, EO1-HYPERION and possibly future SENTINEL-3 data. The GPS data acquired trough the INGV permanent GPS geodetic network will be analyzed to investigate tropospheric anomalies. The model assumes neutral atmosphere as no-dispersive medium with respect to radio waves up to frequencies of 15 GHz, and thus the reproduction of the wave propagation is caused by density anisotropy.

The output of the integration of EO water vapour maps and GPS is to reproduce the delay that tropospheric anomalies causes in the synthetic aperture radar (SAR) satellite signals (phase of the back-scattered radar wave) that should be removed from the deformation signals. (Team: INGV, CNRS)

Sub-Task 3.3.3 – SO_2 retrivial

The feasibility to use satellite data to reconstruct quantitative time series of SO2 flux from Mt. Etna was recently demonstrated in a pilot study by Merucci et al. [2011]. SO2 fluxes are important in volcanology because they reflect magma dynamics at shallow depths, <3km below the surface. Ascending, depressurizing magmas exsolve and release SO2 in proportion to the mass of the input magma, allowing quantitative constraints to be placed on the volume of magma in play. This allows direct comparison with ground deformation signals measured with GPS network and InSAR, producing a comprehensive picture of the magma dynamics driving eruptive activity. Building upon the initial studies of Merucci et al. [2011] we will produce systematic analyses of the SO2 flux time series from satellite data, focussing first on MODIS data and then extending to other platforms. These data will be integrated with the automatic network of SO2 flux analysers installed around Etna, allowing validation. A critical component of the work will be the use of innovative ground-based ultraviolet and infrared camera technologies to accurately derive plume velocities, resolving the largest source of error in the reconstruction of SO2 time series from satellite data. With the combined technologies of satellite imaging, UV/IR camera imaging and UV network validation applied to Etna we will be able to establish SO2 time series reconstruction from satellite data as a well-validated and robust tool for investigation of volcanoes world-wide. (Team: INGV)

Sub-Task 3.3.4 Lava flow evolution maps

Ground based techniques permit to carry out direct observations characterized by higher accuracy than remote sensing data. These data can be used to downscalethe information derived from satellite data and/or to integrate the satellite datasets in case of incomplete coverage or missing acquisitions (both due to low revisiting time or bad geometrical conditions).Lava flows evolution maps and instantaneous effusion rate values (if available, trends extrapolated over a defined observation period) derived from visible and radar satellite data available within the project will be compared and, eventually, combined with the maps obtained using Etna_NETVIS (WP2-Sub-Task 2.2.3) .

The analysis will permit to assess the capability of a specific sensor, or of a combination of them, to monitor the evolution of fast evolving lava flows propagating along the volcano slope contributing to hazard assessment evaluation..Survey Lab srl will define standards for obtaining comparable datasets from both EO and in-situ sensors and will develop a procedure for merging both spatial and discharge rate data. The procedure will take into account the discrepancy among the different datasets in terms of accurary and resolution and will attempt to provide a combined approach (based on error analysis and data weighting) to evaluate the reliability final results reliability. The procedure will be tested on simulated and historical test cases in collaboration with the INGV teams in charge of satellite data processing (INGV-RM) and map compilation (mapping lab at INGV-CT). The procedure will be also tested during the frequent active eruptive phases of Etna..(Team: Survey Lab - INGV)

Sub-Task 3.3.5 – Volcanic plume

The integration of satellite data (e.g. METEOSAT, MODIS) and ground-based measurements of the Etna volcanic plumes will be useful to quantify with a major precision the mass eruption rate and its grain-size distribution at the source, and the optical depth and the ash cloud dispersal in atmosphere in order to reduce drastically their uncertainty. Concerning the ground-based system, we propose to use: one Lidar system already located in a station only 7 km far from the volcanic vent (Scollo et al., 2011), two sun-photometers, one located at Nicolosi and one which will be very soon installed in Malta (Project Vamos Seguro, leader INGV) located in the far field of Mt. Etna, and sounding balloons which are used to measure atmospheric parameters on the Mt. Etna region (Coltelli et al., 2011). The Doppler radar continuously operated at La Montagnola will be used to assess mass fluxes using constraints on the particle size distribution obtained by field studies combined to disdrometer (X-band microwave and laser) measurements of the tephra fallout. (Team: INGV, CNRS)

Task 3.4: Multidisciplinary Interoperability Infrastructure (CNR-IIA)

The main objective is to design and develop the MED-SUV multidisciplinary interoperability infrastructure applying the GEOSS principles and contributing to the GCI -as well as to other European initiative, like INSPIRE and GMES.

This Task will design and develop the MED-SUV multi-disciplinary infrastructure implementing the necessary interoperability arrangements to interface the MED-SUV systems and resource (e.g. see the data integration environment of Task 3.3) and the GCI (GEOSS Common Infrastructure).

The MED-SUV multi-disciplinary infrastructure will build on the existing multidisciplinary infrastructures and capacities recognized and developed by the other WPs. It will apply the GEOSS principles -with particular reference to the GEOSS Data Core principles. Besides, the MED-SUV infrastructure will implement interoperability with other relevant European initiatives (e.g. INSPIRE, GMES, EPOS) and not only (e.g. NSF EarthCube, DataOne). It will be designed and developed considering its sustainability and operation beyond the project lifetime.

The MED-SUV multidisciplinary infrastructure will achieve technological and semantic data interoperability by considering the experience and the best practices developed by previous relevant projects. Activities will include: (a) the design and development of a system for metadata modelling and data search; (b) the design and development of application and services for data and information publishing and sharing (e.g. MED-SUV portal, discovery service(s), access service(s), processing & workflow service(s), semantic functionalities, etc.).

Building on the data integration environment of Task 3.3, this Task will design and implement the MED-SUV platform for data sharing, establishing the procedure for the integrated data porting and the automatic processing to verify data consistency. The new platform will consider international standards, including: WOVOdat, GEOSS Supersites formats and rules, WMO, ISO and OGC specifications.

The platform will help scientists to make the full use of various types of data across communities. In particular, the platform will provide harmonized access to ESA EO data (e.g. ESA archive and new generation of Explorers such as GOCE) and tailored products (e.g. generated by ESA toolboxes or scientists).

Sub-Task 3.4.1 - System Analysis

The main objective of this Sub-Task is to recognize the necessary resources to be interconnected by the MED-SUV infrastructure. Main inputs will come from the MED-SUV User requirements activities, from the Task 3, and from an analysis of the main initiatives and programmes to be considered for the interoperability sake (e.g. INSPIRE, GMES, NSF EarthCube, etc.). This activity will include an analysis of the GCI and its interoperability principles to be applied. The outcome of this activity is a System requirement document. (Team: CRN-IIA, INGV, ESA)

Sub-Task 3.4.2 - Interoperability Gaps

Based on the 4.1 System Analysis, the main objective of this Sub-Task is to recognize the existing interoperability gaps by consider system requirements, whit particular attention to the GCI interoperability needs. The outcome of this activity is an analysis of existing interoperability gaps and proposed solutions to minimize the MED-SUV Community effort, as far as interoperability is concerned. (Team: CRN-IIA, INGV, ESA)

Sub-Task 3.4.3 - MED-SUV Infrastructure Architecture Design

Filling the identified interoperability gaps, the main objective of this Sub-Task is to design the architecture of the MED-SUV Infrastructure for achieving interoperability inside the MED-SUV Community, with the GCI, and with other relevant infrastructures (e.g. INSPIRE, GMES, NSF EarthCube, etc.). Such a design must lower the present entry barriers for both Users and Data Producers, as far as data sharing and usability are concerned. The architectural design will . provide the MED-SUV specification for: metadata, controlled vocabulary (thesaurus), discovery, access, and processing protocols supported by the infrastructure. Besides, important challenges as data quality, Quality of Services, and Data Policy, will be addressed. The GCI interoperability principles must be introduced and applied in the architecture (e.g. the GCI brokering philosophy). A MED-SUV Web portal will be one of the architectural components. The outcome of this activity is a formal design document, in terms of separate but interrelated viewpoints, as in the Reference Model for Open Distributed Processing “methodology”.(Team: CRN-IIA, INGV, ESA, Terradue)

Sub-Task 3.4.4 - MED-SUV Infrastructure Development

The main objective of this Sub-Task is to implement the architecture of the MED-SUV Infrastructure. This implementation provides the MED-SUV infrastructure services to publish and share data and information (i.e. resources). The MED-SUV infrastructure will provide services for resources: publishing, discovery, access, download, visualization, processing, etc. The developed infrastructure will provide a complete interoperability with the GCI by conforming to its brokering approach. The MED-SUV Web Portal will be developed by INGV. Through the portal, Users requests processed by the system will produce outputs represented by table of data, data plots, thematic maps, data access (including compressed data files for a simple download), etc. The outcome of this activity is the MED-SUV software infrastructure. (Team: INGV, CRN-IIA, Terradue, ESA)

Deliverables

D3.1 Input and Processing SW module Final Design - (M10)

D3.2 Input and Processing SW module beta version (prototype) - (M16)

D3.3 Input and Processing SW module final release - (M19)

D3.4 Input and Processing SW module as built design and user manual - (M33)

D3.5 Complete SW (with interface module) final design - (M19)

D3.6 Complete SW (with interface module) beta version (prototype) - (M24)

D3.7 Complete SW (with interface module) final release and user manual - (M33)

D3.8 Integrated 3D ground deformation and 3D strain maps for selected test cases (DEMO of SW) - (M36)

D3.9 Report describing the data fusion environment project, the data integration processing principles and algorithms, the users requirements and the system requirements for interoperability (with particular attention to the GCI) - (M6)

D3.10 Reports describing the products and their requirements (including parameter, format, protocols and way to access) needed for the data fusion and sharing; and the design of the interoperability architecture - (M14)

D3.11 Software products of the digital infrastructure for the data fusion, sharing and interoperability. - (M30)

D3.12 Report with the software products description, their implementation and usage. - (M30)

D3.13 MED-SUV System and interoperability Gaps Analysis. - (M8)

D3.14 MED-SUV Infrastructure Architecture Design - (M14)

D3.15 MED-SUV Infrastructure (software) - (M30)

Work package number	4	**Start date or starting event: T0**							
Work package title		Closed-conduit volcanoes laboratory							
Activity Type[1]		RTD							
Participant number	1	2	3	7	8	10	11	14	22
Participant short name	INGV	CNR	AMRA	LMU	GFZ	UNIBRIS	CNRS BRGM	CSIC	UNIWO
Person-months per participant:	31.9	5.55	56	12	18	35	12.	13	4

Objectives

WP4 includes field activities, lab-scale experiments and processing and modelling issues in order to determine the internal structure of the supersite volcanoes **Campi Flegrei and Somma-Vesuvius** and reveal the way they behave. This will be achieved by assessing the large variety of non-linear thermo-mechanical and chemical processes that involve hydrothermal systems and precede and accompany unrest episodes by fully exploit the EO and in situ data base existing in the area and by carries out by specific experiment. Hydrothermal systems shall be studied because they are strongly affected by sub-surface changes and may be excellent early warning systems. WP4 activities represent an innovative, cross-cutting 4D (i.e. in space and time) geophysical and geochemical monitoring of the hydrothermal reservoir to 1) characterize background signals ("noise"), 2) detect geophysical and geochemical anomalies. 3) model reservoir changes in time, especially in virtue of renewed inputs of magmatic fluids and 4) furnish deterministic indicators for a robust assessment of the short- to medium-term volcanic risk, including occurrence of phreatic eruptions. We will "record the heartbeat of volcanoes" by detecting geophysical and geochemical transients related to sub-surface processes, both with ground-based and satellite-based techniques. Both volcanic systems are characterized by hydrothermal activity that is however manifested differently at each system. Campi Flegrei hosts a volumetrically huge and highly convective hydrothermal system, Somma-Vesuvius a smaller but more saline and hotter hydrothermal system, surrounding the crater axis. As hydrothermal systems can either enhance or screen the signals related to magma and its volatiles and/or tectonic activity, the proposed Tasks will contribute to unravelling the nature of subtle physical and chemical signals (usually referred to as "noise").

The ultimate goal of WP4 is a refined understanding of the interaction of magmatic and hydrothermal reservoirs, with a focus on the threatening phenomena as, for instance, (1) the surface effects of resurgence, (2) the switch from non-eruptive to eruptive unrest at Campi Flegrei or (3) the possible transition from obstructed to open-conduit conditions at Somma-Vesuvius.

Description of work

WP4 is subdivided in three main Tasks and several Sub-Tasks: (1) Characterisation of the state of the target volcanoes, (2) Characterisation of the sub-surface structure and (3) Modelling of volcanic processes.

Task 4.1: Characterisation of the state of the volcano (AMRA)

Sub-Task 4.1.1: Geochemical data collection and assessment of geochemical baselines and anomalies

[1] Please indicate one activity per work package:
RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities).

It will include (1) the systematic sampling and analysis of the main fumaroles; (2) CO_2 flux surveys and (3) periodic deployment of a Multigas-type station (e.g., Aiuppa et al., 2007) based on electrochemical sensors ± Infrared detectors ± Portable Flame-Ionisation-Detector. The latter serves for a detailed real-time acquisition of significant gas ratios at fumarolic plumes. The results will be validated with laboratory analysis on discrete gas samples). Periodic acquisitions are planned in conjunction with other geophysical experiments in this WP. We will also select samples of fumarolic condensates (both available and newly collected) for S-isotopes. The implementation of the geochemical time series from fumaroles will be essential for the recognition and interpretation of unrest phases, improving our evaluation of the short-term volcanic hazard. (Team: AMRA, INGV*)*

Sub-Task 4.1.2: Automatic analysis and anomaly detection
This Task is aimed to the development of algorithms for detecting and characterising geophysical and geochemical signals in real time in order to highlight anomalies and to provide meaningful information to decision-makers (as e.g. Civil Protection). We aim to develop procedures for the type- and spatial analysis of seismo-volcanic sources in the Campi Flegrei, including volcano-tectonic and long-period events and volcanic tremor. We will discover anomalies by using Neural Network analysis of multi-parametric data sets. When needed, these techniques will be based on parallel computing, with special reference to low cost GPU technologies. (Team: INGV*)*

Sub-Task 4.1.3 Seismic detection, location and tracking of medium changes in the shallow hydrothermal system beneath a volcano
We will implement and test innovative methodologies for 4D (i.e. in space and time) geophysical investigations of the shallow fluid migration and state changes by combining and integrating innovative seismic techniques (repeated 3D active/passive seismic surveys) and by detecting, locating and tracking seismic transients. During the experiment, both active sources and continuous ambient noise recordings will be used. The waveform signals generated by a large number of mini-vibroseis sources will be collected at a dense three-component seismic array installed within the pilot sites (Solfatara and Agnano craters). In addition, the contemporary acquisition of ambient noise allows for the determination of the Green's function representing the impulsive elastic response of the medium (Shapiro and Campillo, 2004). Combining the information provided by Green's function acquired from different station couples, location of the hydrothermal noise sources and images of the subsoil structure are achievable through ambient noise tomography even at a very small scale (Cros et al., 2011). We will investigate the feasibility of using ambient noise to track temporal changes of the seismic velocity in the medium possibly induced by the hydrothermal activity. We will also pursue a novel approach to analyse continuous seismic signal and separate the sources from background noise. The main objective is to improve the standard procedures of picking the emergent onset arrivals of the seismic signals by exploiting the ICA-based approach for the BSS (Blind Source Separation) of convolute mixtures in a frequency domain (CICA) [Ciaramella et al., 2006; 2011]. (Team: AMRA, CNRS, GFZ, INGV-OV*)*

Sub-Task 4.1.4 Detection of ULP deformation signals
The search of Ultra Long Period deformation signals is relevant to study magma transport mechanism and to obtain reliable medium- and short-term precursors of volcanic eruptions. This will be performed by using the high-sensitivity borehole and underground strainmeters and tiltmeters arrays for geophysical monitoring of CF/Vesuvius (see WP2). The detection of ULP deformation signals is a not simple matter due to the environment noise, atmospheric disturbances and other oscillations due to ocean loading effects. A specific tool will be developed, based on the algorithm developed by Amoruso et al. (1999) which proved to be effective for understanding the signals observed on Hekla during the 1991 eruption. This tool will be fundamental to search deformation transients to be linked to magma convection and mixing dynamics as recently modelled by Longo et al. (2011) or to hydrothermal processes. (Team: AMRA*)*

Task 4.2: Characterisation of sub-surface processes and structures (CNRS)
Sub-Task 4.2.1: Resistivity-based techniques for Campi Flegrei and Somma-Vesuvius

hydrothermal systems

An integrated electrical and electromagnetic survey is proposed for the Campi Flegrei area. This way, we will define a high-resolution 3D resistivity structure both at shallow and intermediate depths in a box area centred on the alignment WSW-ENE Solfatara-Pisciarelli-Agnano fumarole fields. Deep electrical resistivity tomography (ERT) and audio-magnetotelluric (AMT) survey will be performed in order to investigate structural link between the distinct fumarolic areas and to depict the water layer and the structure of the hydrothermal field. A quantitative correlation based on multivariate analyses between monitored electrical, geochemical and also seismic signals will give further constraints for a dynamical model of the investigated area.

Similarly, a 3D high-resolution multi-electrodes DC electric resistivity tomography is planned on **Vesuvius** cone coupled with temperature, self-potential and soil diffuse degassing. The aims of this survey are to (1) obtain the inner structure of Vesuvius cone through the study of permeability contrasts inside the edifice, to (2) image the hydrothermal system of Vesuvius cone by 3D inversion in high resolution and (3) to use joint-inversion to improve the 3D model of Vesuvius hydrothermal system. The depth of the model will be improved in collaboration with colleagues who acquired MT, CS-EM measurements. Improvements of the 3D model will be also obtained by joint-inversion with other available parameters (seismic tomography / gravimetric measurements). All these tomography data will be used through thermo-hydro-mechanic codes (such CSP++) to model the fluid flow, including the change of phases associated with the hydrothermal system. (Team: AMRA, CNRS, INGV, UNIBRIS)

Sub-Task 4.2.2: Laboratory assessment of dynamic interaction between seismic waves and the pressure of the hydrothermal systems

Pressure transients in fluid reservoirs will be studied using a combination of laboratory experiments and continuous pressure monitoring at geothermal wells in the Campi Flegrei (CF) area. To test the hypothesis that bubbles are involved in observed pressure transients triggered by seismic waves, we will employ the GFZ BubbleLab. This will allow us to (1) simulate earthquake ground motions with a shaking table, (2) track the size and velocity of rising bubbles via a camera system, (3) quantify transients with a set of pressure sensors (up to 400 Hz) and (4) trace the position of bubbles in sediments using ultrasound. The field monitoring will involve water level/pressure and temperature (PT) sensors to be installed in the geothermal wells. During the first field campaign water level and temperature will be mapped. Depending on logistic and budgetary constraints, we will then select suitable wells for continuous long-term monitoring (up to 100 Hz). The aim is to monitor the temporal development of the geothermal “plume” in comparison to the situation described by Bruno et al. (2007). We will apply classical time-series analysis as well as new wavelet-based approaches (Woith et al. 2011) to detect and remove external meteorological effects from the time series. The resulting PT changes in space and time can then be used either as input or as constraints for the thermo-hydro-mechanical modelling (see Task 4.2.1 and Task 4.3.5). (Team:GFZ)

Sub-Task 4.2.3: Assessment of rock permeability and its relation to explosion probability

Changes in gas & vapour permeability may be responsible for shifting the regime from permeable flow to steam explosions. We will quantify the permeability of natural rocks as a function of several conditions (P, T, strength of country rock). The experiments will be performed in a newly designed and unique setup based on rapid decompression of natural samples. Varying natural conditions likely to cause steam flashing (constant P & increasing T or constant T & decreasing P) will be analysed. Changes in porosity and permeability as well as mechanical properties of rocks may result from (1) compaction or (2) alteration or mineralization from aqueous magmatic-hydrothermal fluids. The permeability evolution plays a key role in modulating the ability of a closed volcanic system to loose volatiles and its ability to build-up overpressure. As a direct consequence, knowledge of these properties is integral to understanding the onset of phreatic and magmatic eruptions as well as ground deformation, gravity changes, volatile flux and seismicity. We aim to compact magma samples with differently permeable network structures at magmatic conditions (up to 1000 °C & 75 MPa) and quantify the effect of compaction on permeability. Understanding these changes will help to constrain the degassing vs. over-pressurisation budget of Campi Flegrei and

Somma-Vesuvius volcanoes. Team: (LMU)

Sub-Task 4.2.4: Determination of the 3D density structure of the crust

Knowledge of crustal structure is very important for realistic interpretation of geodetic and geophysical observations. Gravity data (with precise positioning data) permit us, by means of solving the inverse problem [e.g. Camacho et al., 2001], to obtain conclusions about the 3D distribution of anomalous density. Both Campi Flegrei and Somma-Vesuvius volcanoes are characterized by hydrothermal activity. The anomalous density models can produce valuable information about porosity and location and shape of the active structural components. The analysis and further 3D inversion of a gravity anomaly coming from a dense gravity survey (precise gravity and positioning) can produce a very valuable information about the presence and distribution of subsurface anomalous mass structures in the survey zone. Non-subjective 3D inversion techniques will be used (ranging from adjustment of isolated anomalous 3D structures with free geometry, to adjustment of sub-horizontal layers and sedimentary basins) [Camacho et al., 1997, 2000, 2001, 2002, 2007, 2009, 2011a, 2011b]. Gravity data will come from existing compilations, but additional, complementary observations for particular locations could be carried out to complete the model. Seismic models, if available, can be used as additional information to constrain the gravimetric model. (Team: CSIC, INGV-OV)

Task 4.3: Theoretical deformation models and inversion/interpretation methodologies (INGV)

This Task is aimed at implementing and testing new deformation models relevant to the Campi Flegrei area, in order to fully exploit the wide EO (SAR interferometry) and ground-based (GPS, levelling, gravity, tilt etc.) data set available for this area.

Sub-Task 4.3.1: Modelling of internal dynamics of magmatic sources and their effect on surface deformation and gravity field

The study will consider the internal dynamics (magma movements, mass and heat transfer) of the magmatic sources and plumbing systems, the effects on the surrounding rocks and the characterization of the changes in physical/chemical characteristics of the magma that yield physico-chemical observables detected at surface.

In order to characterize the vigorous heat and mass supply to the overlying hydrothermal systems, we will explore the consequence of the early exsolution of CO_2-rich gases in well-characterized magmas from the eruptive history of CF/SV. All collected data will allow assessing magmatic variables in space and time, such as composition, pressure, temperature, redox state, proportions of phases or density. These data will allow formulating hypotheses about thermo-barometric conditions of magma as (1) the gas/(melt+crystal) ratio (mass and volume), (2) role of CO_2-rich fluids on the magma evolution processes, (3) role of the crystallization rate and crystallization stages in relation to magma outgassing, (4) budget of volatiles in relation to the erupted magma volume. Moreover, we intend to employ advanced numerical modelling of multiphase, multi-component gas-bearing magma dynamics in magmatic systems with complex geometries and km-size, and couple them to modelling of the elastic rock response, in order to identify signals diagnostic of magma recharge at active volcanoes.

The simulations will be performed by employing numerical codes developed at INGV-Pisa (Longo et al., 2006, 2007, 2011). The quantitative information allowed includes the followings: (1) space-time distribution of flow variables and magma properties associated with convection/mixing dynamics in the magmatic system; (2) space-time distribution of the associated gravity anomaly (corresponding to the free-air corrected anomaly); (3) space-time distribution of ground displacement, over a range of frequencies from 10^{-3} (period of hours) to 10 (tenths of s). This encompasses the quasi-static to volcanoseismic frequency bands.

This Task will also shed light on the budget between the magma actually present at shallow depth and the measures of CO_2 fluxes at surface. For the determination of the displacements, surface deformation, variations of gravity and stress produced by magmatic intrusions and activity in associated faults, analytical and semi-analytical models and inversion methods will be improved and new ones will be developed. The results of these methods will be compared and validated using available data. (Team: AMRA, CSIC, INGV-Pisa, UNIBRIS, UNIWO)

Sub-Task 4.3.2: Geodetic data inversion/interpretation

Aim of this Task is to get unified tools for data inversion according to the following conditions: (1) Ability to integrate different types of deformation data (EO and ground-based deformation data and gravity variation data), (2) Ability to work with complex deformation models [e.g., different kind of sources (magmatic intrusions and faults)], (3) Provide computer codes with an interface system that can be operated by a general non-expert user working for geological and anthropogenic hazards, (4) Ability to produce results within a reasonable computational time (near real time), (5) To provide tested, validated and inter-compared computer codes and (6) Implementation of a near real time interpretation system for early-warning.

The availability of deformation data will allow for the joint inversion of gravity and deformation, likely using genetic algorithms or other nonlinear inversion techniques (e.g., random search). We will use the forward models developed in the frame of this research project. Computation run time will be a crucial aspect, considering the programs have to be used for interpretation even during crisis situations. Potential applications to increase speed to near real-time will be examined, including streaming software and cloud computing algorithms. They will be applicable to integrated space and terrestrial data of different kind and capable of interpreting displacements and gravity data simultaneously. (Team: CSIC, INGV, UNIWO)

Sub-Task 4.3.3: Modelling of geochemical data

Previous physical numerical simulations of the hydrothermal system indicated that magma degassing episodes triggered the bradyseismic crises occurred at Campi Flegrei from 1982-1984 to 2000 (Chiodini et al., 2003). New simulations will be aimed to understand what is happened at Campi Flegrei after the year 2000. The new simulations will be performed with TOUGH2 (Pruess, 1991), a code which has capabilities for the modelling of multi-dimensional fluid and heat flows of multi-phase (gas and liquid) and multi-component (water and carbon dioxide) fluid mixtures, such as they occur in the system feeding Solfatara fumaroles. The model will be constrained by the compositions of Solfatara fumaroles as well as by the measured emission of hydrothermal CO2. A main aim is to derive the variation in the time of the input of magmatic fluids into the hydrothermal system of Campi Flegrei, and understand the multiple contributions to final degassing at surface. A deterministic interpretation of the geochemical time series from fumaroles and its indicators will be essential for the recognition and interpretation of unrest phases, improving our evaluation of the short-term volcanic hazard. (Team: AMRA, INGV-OV)

Sub-Task 4.3.4: Modelling of surface deformation data

This Sub-Task is aimed at developing models of ground deformation (thermo-fluids-dynamic approach) to understand the movement of fluids in the subsurface and their relations with the seismicity. The models obtained with different approaches will be integrated to better characterize and quantify the deep processes occurring in the caldera and produce an integrated framework for interpreting the monitoring signals from the high-risk volcanic area of Campi Flegrei. We propose a CNR-IREA/ING-OV joint activity based on developing modelling approaches for the inversion of surface deformation data working both at low- (deformation time-series) and high- (single deformation events) time frequencies. In particular, we will perform a study based on the availability of in situ deformation data and the temporal variation of deformation field, as obtained through SAR interferometry analyses. We expect to retrieve time-dependent thermo-fluid dynamic inverse numerical models of the volcano system by means of finite element (FEM) methods that, together with seismological and geochemical measurements, will eventually allow an early detection of possible shallow magmatic intrusions. (Team: CNR-IREA, INGV-OV)

Sub-Task 4.3.5: Coupled fluid flow and stress evolution at active collapse caldera

The twenty years which followed the volcanic unrest of 1982-1984 at the Campi Flegrei caldera, were characterized by a general subsidence interrupted by 3 minor uplift episodes (1989, 1995 and 2000). These crises were interpreted as the result of repeated injections of magmatic fluids into the hydrothermal system (Chiodini et al., 2003; D'Auria et al., 2011). Since 2000, the main fumarolic fields enlarged, new vents formed, the concentration of the magmatic component increased, swarms of earthquakes became more frequent and, after a decrease in the subsidence rate, the ground started a general trend of uplifting in 2005. The investigation of Campi Flegrei caldera unrest dynamics links to activities in VUELCO project with focus on an intercontinental consensus of mechanics and management of caldera unrest.

Using a set of computational modelling techniques, the aim of this Task is to simulate the interaction of shallow fluid flow and encasing rocks beneath collapse calderas with a documented history of hydrothermal unrest in order to obtain insights on (1) the effect of shallow fluid flow on subsurface stress variations and vice versa in a mechanically heterogeneous crust and (2) resultant stress and mass redistribution patterns and associated ground deformation and gravity changes. At collapse calderas in particular fluid flow modelling has focused on the long-term evolution of fluid and gas release from a magma chamber. Here, our focus lies on the simulation and evaluation of coupled fluid flow and mechanical modelling on the short-term (minutes to months) in a mechanically heterogeneous crust in view of providing a knowledge base for operational purposes. This activity will focus on the investigation and sensitivity testing of the intricate permeability vs. porosity relationship in encasing rocks via a concerted modelling approach. We will use a set of commercial simulation software TOUGH2, a numerical simulator for non-isothermal multiphase flow in fractured porous media and COMSOL Multiphysics, a finite-element numerical solver with capabilities for coupling fluid mechanics with structural mechanics problems. The investigation will be modular starting with a simple and generic concept of fluid flow through a mechanically homogenous crust. In a step-like approach more complexities will be added to the simulations to achieve more realistic modelling scenarios. The models will be parameterised by findings from other activities in this project.(Team: INGV-OV, UNIVBRIS).

Deliverables

D4.1. Report on monitoring campaigns of CF and Vesuvius volcanoes 1/6 - (M6)

D4.2. Report on monitoring campaigns of CF and Vesuvius volcanoes 2/6 - (M12)

D4.3. Report on monitoring campaigns of CF and Vesuvius volcanoes 3/6 - (M18)

D4.4. Report on monitoring campaigns of CF and Vesuvius volcanoes 4/6 - (M24)

D4.5. Report on monitoring campaigns of CF and Vesuvius volcanoes 5/6 - (M30)

D4.6. Report on monitoring campaigns of CF and Vesuvius volcanoes 6/6 - (M36)

D4.7. Develop.of an algorithm for detection and location of seismo-volcanic sources (M18)

D4.8. Develop.of an algorithm for geophysical anomalies discovery by using Neural Network analysis - (M18)

D4.9. Tests of real time CICA implementation - (M24)

D4.10. Software package for removing noise from nanosensitivity deformation signals and detection of ULP signals at supersite volcanoes - (M30)

D4.11. 3D resistivity model in the area Solfatara-Pisciarelli-Agnano - (M12).

D4.12. Data processing (3D inversion) and publication. 3D model of Vesuvius hydrothermal system - (M24)

D4.13. Technical report about the performance of the BubbleLab and the continuous fluid monitoring system (experiment design, tests) - (M20)

D4.14. Development of a method for the inversion of in situ and EO geodetic data (First versions) - (M18)

D4.15. Development of a method for the inversion of in situ and EO geodetic data (Final versions) - (M36)

D4.16. Generic integrated fluid flow and rock mechanics model for activity at a collapse caldera - (M36)

Work package number	5		**Start date or starting event:**				T0					
Work package title	Etna volcano laboratory (open-conduit)											
Activity Type[1]	RTD											
Participant number	1	6	7	9	11	12	14	15	17	22	23	24
Participant short name	INGV	UHH	LMU	UNIV DUR	CNR S	BRG M	CSIC	UGR	UoM	UNI WO	JPL	HVO
Person-months per participant:	25.1	11	29	13	**24**	5	13	41	10	2	0.1	1

Objectives

This WP is devoted to improve the knowledge of the processes occurring at Mt. Etna. . It aims at providing a scientific and modelling framework to forecasting the short-term evolution of future eruptive events, estimating the volume of magma feeding an eruption, the temporal trends in magma and gas emission rates, the spatial/temporal evolution and volume of lava flows; the physical characteristics (dispersal, grain-size distribution and optical depth in atmosphere) of the eruptive plumes and the total mass of pyroclastic fall deposits. Questions addressed will be: storage, evolution, dynamics of the magma in the plumbing system; interaction between the magmatism and tectonics; quantification and modelling of subsurface and surface processes. We will focus on the major threatening phenomena: the violent short-lived or long-lasting explosive events (lava fountains), both producing consistent volcanic plumes, the opening of mid- and low-altitude eruptive fissures, the surface faulting and the reactivation of landslides. Test cases well monitored by EO and in-situ data in recent years (*e.g.*, the 2001 or 2002-03 eruptions, 2011 explosives events at the SE crater) will be used to cross-calibrate studies on earlier devastating eruptions (e.g., 122 B.C., 1669 ad) that may represent "end-members" of the hazard at Mt. Etna. We will use data mining methods to rapidly detect anomalies on the huge multiparametric data set. Specific laboratory and field experiments will be performed to constrain the physical and chemical parameters of rocks/magma in complement to the seismic tomography.which will be partly performed through a marine experiment supported by UGR during a cruise of the R/V Sarmiento de Gamboa. Mt. Etna has a nearly continuous activity, with eruptions that strongly impacts its surroundings and require near real-time updating and assessment. We will quantitatively characterize eruptions by improving the performance and extending the monitoring capability with improved ground systems and the systematic use of EO data (SAR and optical imagery) and ground based imagery (HD, high-speed, and TIR cameras, DOAS and FTIR spectrometers) including active sensors (LIDAR and Doppler Radar). Ash aggregation/settling experiments will help constraining plume dispersal simulations. Results of the ongoing "Vamos Seguro" project on volcano plume monitoring in the central Mediterranean area will also be used.

Description of work

WP5 includes four tasks. Task 1 concerns the observations of the threatening phenomena (explosive and effusive events, dyke injection, earthquakes). Task 2 focuses on the theoretical frame for the volcano dynamics. Task 3 is on the structural frame gathering the various observations with emphasis on new seismic experiments. Task 4 focuses on shared model,

[1] Please indicate <u>one</u> activity per work package:
RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities).

software and input/output and visualization conventions that will boost communication between teams

Task 5.1: Characterisation of the threatening phenomena from space and ground (INGV)
This Task includes four different Sub-Tasks: one is related to the three hazards that we want to tackle at Etna: the explosive events at the summit, the dyke injection on the volcano flanks, and the earthquakes, the other is related to the data mining with procedures that will be common to the three hazards and compliant with the specifications of the WP3. For each hazard the team will focus on the following questions: (a) definition of the hazard, typical characteristic temporal (duration, repeat time, precursors) and spatial dimensions, past well-documented events, available models for those events. The main output of this activity will be to select characteristic events with a well-documented and available data set. The activity will be divided as follows:

Sub-Task 5.1.1 - Test cases for flank dyke injections, earthquakes and faulting
We will select a set of recent and well document dyke injections that can be used as reference events for the modelling. We will select a set of well document recent earthquakes and a set of recent well document creep events on shallow faults on flanks (Pernicana, Mascalucia) and in the Timpe. (Team: INGV)

Sub-Task 5.1.2 - Effusive eruptions and products
We will analyse the result of the mapping of the eruptive products obtained with NETVIS as developed in WP2 integrated with satellite data in WP3. The high-frequency dataset on the geometry of lava flows and strombolian fallout will permit to improve interpretation and modelling of the mechanisms of cone-forming explosive activity and lava flow emplacement. Observations of time-evolution of the discharge rate trend for eruptions having different styles represent an important objective of this sub-task that will contribute to understand lava flow expansion patterns in function of both lava flux and cooling rate of the lava surface.
(Team: INGV, SurveyLab)

Sub-Task 5.1.3 - Multiparametric experiment for gas dynamics definition
We will set-up a temporary multiparametric monitoring system (infrasound, seismic, gravimetric, gas, thermal and visible video cameras) that will be deployed at the Mt. Etna NE Crater (continuously degassing from several years). By the means of a vertical linear infrasound array that will be introduced in the crater, we will measure the sound velocity in the plume. At the same time, the multiparametric monitoring system will records the “fingerprint” of the degassing process with the aim of the gas escaping process modelling. In addition we will try to explain the difference found in the estimation of gas volume made by means of infrasound modelling and independent estimates. Finally, the same dataset will be used to give detailed information about the NE Crater structure. We will repeat the experiment several time in order to sample different degassing conditions.(Team: INGV)

Sub-Task 5.1.4 - Multiparametric data mining.
We will integrate seismic data and data originating from other scientific fields (such as volcano imagery, geochemical analyses, deformation, gravity and magneto-telluric), in order to facilitate the cross-check of the findings encountered from the single data streams, in particular allowing their immediate verification with respect to ground truth. In particular, part of the research will be focused on the management and integration of a large dataset of measurements. Team: INGV.

Task 5.2 Mt Etna dynamics (CNRS)
This tasks aims to gather various physicists of the volcanoes, expert in various fields (seismology, deformations, geochemistry, thermodynamics, petrology, mineralogy, atmosphere) in order to produce an jointly-agreed theoretical framework for the geochemical and physical phenomena occurring during the three hazards under investigation. The objective of this task is to deliver a practical/theoretical background that can be converted into software in the task 5.4.

Sub-Task 5.2.1 - Magma storage, ascend and degassing
The main planned actions are: (1) To determine the pre-eruptive magma conditions, with emphasis on magma composition, pressure, temperature, volatile solubility, redox and fluid composition (C-O-H-S-F-Cl) prevailing in the reservoir(s). (2) To assess experimentally the importance of magma-crust interactions and sediment ingestion (specifically carbonate and sulphate-rich lithologies), and their potential influence on the volatile budget and hence the eruptive dynamics of Mt. Etna. (3) To investigate the effect of magma ascent rate on the amount and the composition of the gas phase, the extent of magma dehydration by CO_2 flushing, and therefore the magma dynamics and gas release at the surface. (4) To investigate radioactive disequilibria among short-lived U-series isotopes (222Rn, 210Pb, 210Bi, 210Po) in both volcanic gases and solid products, in order to additionally discriminate between deep gas accumulation processes and shallow degassing. (5) To perform conductivity experiments aimed at retrieving the most likely electrical signature of the present plumbing system, focusing on the influence of the gas phase on conductive properties of typical Etna basaltic magmas. (6) Finally, by combining the above results with geophysical data bases and signals recorded by the local monitoring networks, to provide a quantitative, numerical modelling of the dynamics of magma ascent, degassing and eruption at Mount Etna.(Team: CNRS, INGV, LMU).

Sub-Task 5.2.2 - Stress transfer and interaction between faults and the magmatic/hydrothermal system
This task aims at studying the rheology and stress transfer inside Mt Etna, the interaction between slow-slipping faults and propagating dikes, the correlations between induced seismic events and deformation, the effect of the structural discontinuities. Seismic data and field measurements from the Pernicana will be used to validate the models of Task 5.4 and infer information on the physical links between structures, deformation and seismicity. Observations from Etna and other areas around the world show that the moment tensor of dike-induced earthquakes is poorly understood. The expected moment tensor will be estimated by calculating the changes that the fault induces on the dike geometry. We will select a set of recent and well-document dyke injections that can be used as reference events for the modelling. We will select a set of well document recent earthquakes and a set of recent well document creep events on shallow faults on flanks (Pernicana, Mascalucia) and in the Timpe. (Team:CNRS, UHH, INGV, CSIC, UNIWO

Sub-Task 5.2.3 – Physical and analogue laboratory experiments on ash aggregation
Volcanic plume dynamics and the extent of their impacts are strongly controlled by particle aggregation and settling. We will experimentally (in laboratory and in the field) define the physical parameters controlling the formation and settling of ash aggregates and particles by varying ambient conditions (humidity, air flow and temperature, droplet size and composition) and volcanic parameters (size and shape distribution and chemical composition of ash particles) in order to define the time scales and efficiency of aggregation. Complementary field-emission scanning electron microscope and neutron computed tomography analyses will provide the physical characteristics of ash aggregates. Settling velocities and aerodynamics will be quantified using a high-speed camera. Systematic and controlled large-scale settling experiments will provide the full characterisation of particle settling using two synchronized high-speed cameras, providing a 3D view to be analyses by particle image velocimetry. These innovative experiments aim to describe the cycle of ash aggregation and destruction during transport and deposition. The will serve as input parameters for numerical models of ash dispersion forecast (in WP6).(Team:LMU, INGV)

Task 5.3 Mt Etna structure (UGR)
The main activity and the first four sub-tasks will be around passive and active seismic experiments. The last two sub-task will be on the constraints from gravity and other geophysical data and on constraints from laboratory experiments.

Sub-Task 5.3.1 Investigation of the Etna structure by an active source experiment (TOMO_ETNA)
We plan during 2013 an active seismic tomography experiment by mean of active

refraction/reflection seismic investigations, carried out both on-land (explosion in deep boreholes), and offshore, by airgun shots registered onshore too. During the experiment the integration of a land temporary seismic network and of Ocean Bottom Seismometers/Hydrophones (OBS/H) will improve, even over limited time duration, the land-based permanent network geometry. The experiment consists of long (50-70 km), inland and submarine, 2D seismic profiles recording inland deep boreholes explosions and air gun shots at dense inland stations and OBS/H streams. Firstly, 2D velocity and attenuation tomography along the best sampled profile will be performed. In particular, the 2D attenuation tomography will be obtained inverting both Qi and Qs values. Following, the data of the active experiment will be integrated with the passive seismic ones, derived by local earthquake recorded in the last 10 years, into a unique three-dimensional structural-volcanological model of the volcano. This structural model will be compared in integrated with the results from Sub-Task 5.3.5.(Team: UGR, UDUR, INGV)

Sub-Task 5.3.2 High-resolution 3D vs. 4D seismic velocity and attenuation tomography
This Task is aimed in applying standard and advanced tomographic techniques in order to model seismic data recorded during the last 10 years (several thousands of local earthquakes) together with those acquired in occasion of the active seismic experiment (Sub-Task 5.3.1). The main goal is to better define the Mt. Etna's plumbing system and to locate crustal magma reservoirs and other crustal and upper mantle relevant discontinuities.(Team: INGV, UDUR).

Sub-Task 5.3.3 Seismic anisotropy.
The main objective of this Task is to create a benchmark of spatial variations in shear wave anisotropy around Mount Etna, against which to measure future temporal changes, also comparing these findings with those derived through the coda wave interferometry and the GF studies.(Team: INGV)

Sub-Task 5.3.4 Investigation of cortical structures, through borehole experiment
The Osservatorio Etneo and the Osservatorio Vesuviano (INGV) will conduct a joint deployment of a small aperture array close to the dawnhole seismic station called "Pozzo Pitarrone", installed since 2006 by Osservatorio Etneo at a depth of 120 meters. The results of this Task will be also useful to the work of the other Task group of this WP (seismic tomography experiments, Patanè activity). Furthermore, the knowledge of some physical parameters could be helpful for a 3D numeric model of Etna volcano (Task 5.4). (Team: INGV)

Sub-Task 5.3.5 - Constraints from gravity and other data
The determination of a density model will provide information about tectonic and volcanic structures below Mt. Etna and sorrounding area that are necessary to model variations in both magmatic and hydrothermal reservoirs and stress regime giverning fluid ascent along the main geological structures. The methodology will be the same as used in WP4. This knowledge will be merged with the konwledge on the geology of the volcano. The gravity structure is also variable in response of the volcanic activity and thus a useful basic data in Task 5.1.(Team: CSIC, INGV).

Sub-Task 5.3.6 - Liability of basement rocks to contact metamorphism
The liability of carbonate rocks to decarbonate (<45 vol.%) during contact metamorphism has direct impacts on the development of magmatic reservoirs (within such lithologies) as well as on the stability of overburden volcanic edifice and volcanic degassing. Thermochemical analysis will be performed to chemically assess the onset, kinetic and magnitude (OKM) of decarbonation of calc-silicate materials with a range of purities (i.e., carbonate/silicate ratios). The compressive and tensional strength of thermally stressed calc-silicates will be tested in situ using a high-temperature uniaxial press and failure of the material will be monitored by an array of acoustic emission sensors (Figure b). The efficiency of decarbonation during heating at a different rate will be tested against the strength of the materials to elaborate a deterioration threshold for failure in order to assess changes in deformation mechanisms associated ground deformation. (Team: LMU).

Task 5.4 Models and software (CSIC)

This Task is devoted to sharing data formats, computer and modelling tools (from the algorithm to be implemented to the computer codes). Agreement will be needed in various computational questions: the variables of the overall problem, the format of the input/output data and parameters vectors, the way to handle the uncertainties, the computer code (or codes) that will be used (C, Fortran, Python), the visualization tools, the interconnection with existing computer codes (commercial or already developed in the partner laboratories).

Sub-Task 5.4.1 – Harmonization for data, algorithms I/O and visualisation
There is a need in this project of talking exactly the same language for all space and ground data and all products. Various codes will be developed in the project or adapted to allow joint work between all teams. The gecoding of all data, georegistration of all images must also be done within a unique reference frame. The same need for harmonisation exists for the visualisations. (Team: All WP5 partners).

Sub-Task 5.4.2 - Consensus 3D model of Etna
This Task aims at developing a 3D model of Etna volcano, which includes realistic geological structures derived from the integration of surface and subsurface data. A computational mesh that includes realistic surfaces (topography, faults and discontinuities structures) will be designed for the use in numerical modelling.
(Team:INGV, CNRS, CSIC)

Sub-Task 5.4.3 - Local scale models: dyke and faults
This Task aims at developing local scale models to fit multi- parameter observations related to magma ascend and dyke injections, earthquake and creep events interactions between faults and between fault and dyke (and opposite). Various modelling approaches exist in the consortium and the models predictions will be compared for the test cases selected in Task 1, improvements of the models and validation of the simulation is expected from this competitive simulation. A full interaction between dikes and faults will be achieved by modeling them by means of 2D and 3D mechanical boundary-element codes, based on plane-strain elementary dislocations and on rectangular elementary dislocations. We will study the development and extension of faults due to the dike-induced stress. The seismicity on faults will be modelled by means of rate-and-state theory and by using effective media theories. The role of exsolving gas in influencing propagation, stress levels and seismicity will be included if possible. (Team:UHH, INGV, CNRS, CSIC, UNIWO)

Sub-Task 5.4.4 - Local scale models: Landslides
This Task is aimed at studying the effect of the volcano dynamic on local landslides; as test case wil be considered the landslide close to the Presa village, which activity is strictly related to the Pernicana Fault. The large EO and in situ data available will constrain and model of the landslide.(Team: INGV)

Sub-Task 5.4.5 – Global scale models
This Task aims at modelling the large-scale deformation and evolution of the volcano in relation with deep magma chamber feeding and release, flank instabilities, regional tectonics of the Ionian margin. We will combine the data of magma storage, ascend and degassing with the geophysical data recorded by the monitoring networks. The question of time scale of magma and regime change over years, decades or centuries will be part of this Task. (Team: INGV, CNRS, JPL, CSIC, HVO,UNIWO).

Sub-Task 5.4.6 – Near real time deformation modelling
We will work towards improving approaches developed in the last years (e.g. the SISTEM approach developed at INGV-CT) and implementing a more global and near real-time deformation model able to fully exploit the large input of EO and in-situ ground deformation data available for this volcano. This result will be useful to constrain the tools for the hazard assessment developed in the WP6. (Team: INGV, CSIC, CNRS)

Deliverables

There will be one deliverable for each main Task defined above plus one additional deliverable for the unified structural model of Etna. In Task 5.4 the software will be in a demonstrator stage, the duration and level of funding of the project, and also the complexity do not allow us to go further this stage of sharing the same physics, volcano structure, input and output parameters and visualization tools. We are not aware about any example of such an achievement of any volcano worldwide and we think that this harmonization will constitute a very significant step forward

- D5.1. Report on dyke injections, earthquakes, creep events with their characteristics and a set documented sample events and data to be used in the other Tasks and WP - (M3)
- D5.2. Report on explosive events with overall characteristics and a set of documented sample events and data to be used in the other Tasks and WP (including a series of explosive events like those of 2011) - (M12)
- D5.3. Report on effusive events with discharge rate and lava flow expansion trends and a set of documented sample events and data to be used in the other tasks and WP - (M24)
- D5.4. Report on the experiment and gathered data and results, including new sound velocity method - (M18)
- D5.5. Report on the software tools developed for data mining and on- and off-line available tools (restricted during the time of the project, then open) - (M18)
- D5.6. Report on experiments on the thermal weakening of Etna basement rocks and the related decarbonation - (M24)
- D5.7. Report on experiments constraining the effect of microlite growth and/or crystal content on the rheological properties of lava flows - (M24).
- D5.8. Report on the theoretical background applicable to the characteristic events delivered in Sub-Task 5.1.1 and Sub-Task 5.1.2 - (M24)
- D5.9. (Report on stress transfert, interaction between the magmatic and the tectonic system, identification of test cases for modelling – (M24)
- D5.10. Report on ash aggregation experiments - (M24)
- D5.11. Report on ash and ash aggregate settling experiments - (M24)
- D5.12. Report of the TOMO-Etna marine and land experiment, data and results - (M24)
- D5.13. Report on the high resolution tomography - (M24)
- D5.14. Report of the seismic anisotropy investigation - (M24)
- D5.15. Report of the borehole experiment, data and results - (M24)
- D5.16. Bibliographic report of the inputs from the other observations for the building of a global structural model of Etna - (M12)
- D5.17. Report on experiments on the thermal weakening of Etna basement rocks and the related decarbonation - (M24)
- D5.18. Report on the rock mechanical strength analysis of basement rocks - (M36).
- D5.19. Report on all standards to be used in the shared models - (M6)
- D5.20. Structural model of Etna compliant with the new and previous seismic data (including bibliographic report on the constraints from previous seismic work) and all other data. The definition of this model will include the definition of a grid or boundary elements structure used in the Task 4 models. Improved at TO+24 with outputs or Task 5.3 - (M12)
- D5.21. Shared local 2D and 3D models including realistic rheological parameters and structure, algorithm, elements of computer code, comparisons and benchmarks, demonstator - (M18)
- D5.22. Report on the survey and quantification of landslides - (M24)
- D5.23. Shared global scale model: algorithm, elements of computer code, comparisons and benchmarks, demonstrator - (M18)
- D5.24. Demonstrator of a near-real time deformation modelling tool handling the various available data, structure & theoretical background - (M24)

Work package number	6	**Start date or starting event:**		T0+1	
Work package title	Volcanic hazard assessment, disaster preparedness, and mitigation				
Activity Type1	RTD				
Participant number	1	3	4	12	16
Participant short name	**INGV**	AMRA	DPC	BRGM	UAc
Person-months per participant:	52	12	4.5	7	7

Objectives

The main purpose of WP6 is to show how the improvement of the monitoring system in the Italian Supersite volcanoes may contribute to a better hazard assessment and to bridge the gap between science and the mitigation and preparedness of volcanic disasters. During a phase of unrest, the data collected at the supersite are interpreted in terms of the models developed in WP4 and WP5, and in WP6 they are used to update the short-term hazard assessment. The format of the scientific output is shaped taking into account the needs of the different stakeholders. The outcomes of this WP will be validated through some joint activities with WP7

Specific objectives are:
- development and validation of innovative tools to track the evolution of the hazards (ash fall, pyroclastic and lava flows) during a phase of unrest or immediately after the eruption, at Etna and Campi Flegrei.
- development of innovative procedures to calibrate hazard models with real-time data collected during an eruption.
- development of probabilistic framework to integrate high-quality monitoring data in a probabilistic hazard assessment before the eruption.
- development of Evaluation/Validation process for hazard maps and procedures addressed to end-users, for enhancing risk mitigation strategies and decision-making process.
- development of guidelines to establish the specific role of scientists and decision-makers during a volcanic emergency
- development of feasible communication protocols between scientists and decision-makers

Description of work

In WP6, we plan to develop innovative probabilistic tools for the short-term (days to few months) hazard assessment before and during an eruption. To this purpose we will consider the threat posed by ash fall and lava and pyroclastic flows, and will calculate how the hazard assessment varies through time depending on the monitoring observation. The probabilistic assessment will be made through Bayesian probabilistic procedures incorporating the results of the physical-based models carried out in WP4 and WP5, expert judgment, ash fall and lava flow modeling, real-time monitoring observations, and data of past phases of unrest. The tools will be aimed at transferring the project outcomes to regional/national/global communities involved in risk reduction, by implementing prototypal tools and procedures for the scientific management of volcanic-related hazards at the supersite (e.g., decision support systems, plans for scientific interventions, etc). Methodolgies for improving awareness and preparedness of volcanic risks will be carried out. Specific working groups involving both the scientific community and the end-users will be established to ensure tools development clearly linked back to user needs. An exercise will allow testing project data products (e.g thematic maps, probabilistic hazard scenarios), in order to have

1 Please indicate one activity per work package:
RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities).

an overview of how these information are used and any possible problems in decision-making processes. Guidelines for the application of the results of the project to the entire volcanic disaster management cycle (mitigation, preparedness, warning, response and recovery) will be issued with the final goal of improving the mitigation of volcanic risk. Starting points are the results of the recent and ongoing projects (e.g. INGV-DPC; PREVIEW, EXPLORIS, ASI-SRV, MIA VITA, MATRIX, VUELCO, EDURISK, etc.).
The activities of WP6 are broken out in 3 Tasks; the first two are related to the short-term hazard assessment at Etna and Campi Flegrei that present specific peculiarities, and the third task aims at building a clear and efficient links between Science and decision-makers..

Task 6.1: Volcanic Hazard Assessment at Campi Flegrei (INGV, AMRA, BRGM)
This task aims at providing quantitative tools to track probabilistically the evolution of volcanic unrest and eruptive phases for Campi Flegrei accounting for the evolution of the monitoring observations. This initiative is planned in strong synergy with the ongoing FP7 project VUELCO. Specifically, we will consider hazards posed by ash, and pyroclastic flow.

Sub-Task 6.1.1: Long-term hazard assessment
The long-term hazard assessment represents the background model for the short-term hazard model. In the case of Campi Flegrei, the background hazard assessment is of particular importance, because the monitoring observation may be very helpful to forecast the time of onset of the eruption, but they have less importance in forecasting the vent and it may be not important at all to forecast the size of the next eruption that is probably the largest unknown. The only way to forecast the size of the impending eruption and to make a reliable forecast of the location of the vent is to rely one the behavior of the volcano in the past. To this purpose, we intend to consolidate and improve the long-term hazard assessment in these two specific topics.
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Sub-Task 6.1.2: Hazard changes induced by monitoring observations
Standard and new generation of monitoring observations provides in almost real-time important information about the evolution of the volcanic system. In this sub-task we aim at exploring how these observations can be transformed into a probabilistic assessment. We adopt a Bayesian approach applied to the BET code that allows us to merge different kinds of input (outcome of physical models, expert opinion, and data of past phases of unrest) and to assess epistemic and aleatory uncertainties. A key aspect for this purpose is to adequately structure and incorporate experts' knowledge i.e. to handle qualitative and vague interpretation of real-time observations, possible ignorance or disagreements (conflicting views). This will be investigated using different procedures, such as Dempster-Shafer Theory of Evidence, and the Delfi method. Moreover, we develop an innovative procedure to forecast the duration of the eruption accounting for the real-time gas flux and ground deformation data..

Sub-Task 6.1.3: Short-term hazard tools
The short-term hazard tools are physics-based models that are able to simulate the impact on the ground of a specific hazard. These models are important for the short-term hazard assessment made before the eruption and also when the eruption is ongoing. In particular, simulation of volcanic ash dispersal scenarios and probabilistic hazard maps based on volcano history and meteorological data will be performed at Vesuvius and Campi Flegrei. Moreover, automatic procedures and a web-based interface to models for the generation of daily hazard maps for volcanic ash dispersal will be developed. These tools will be useful for the short-term ash fall hazard assessment during a phase of unrest and during an eruption.

Task 6.2: Volcanic Hazard Assessment at Etna volcano (INGV, BRGM)
This task aims at providing quantitative tools to track probabilistically the time and spatial evolution of ash fall and lava flow hazards at Etna, before and during an eruption. Before an eruption, short-term hazard is built on top of the background hazard (the long-term assessment) taking into account how the monitoring observations modify the hazards through time. During an eruption, the ash fall and lava flow hazards is updated in real time feeding cutting-edge simulation models with

real-time satellite and ground observations. Moreover, we plan to provide an innovative procedure based on monitoring observation that forecasts the duration of an eruption; this issue is particularly important for Etna, perhaps more than forecasting the onset of the eruption.

Sub-Task 6.2.1: Long-term hazard assessment
Long-term hazard assessment represents the background hazard at which we have to refer when the hazards changes through time before an eruption depending on the evolution of the monitoring observation. For Etna, we plan to consolidate the knowledge acquired in other projects about long-term ash fall and lava flows hazard assessment..

Sub-Task 6.2.2: Hazard changes induced by monitoring observations
This task has the same goal of task 1.2 and it requires a similar general approach, mostly based on the Bayesian statistics, the BET code, and the Bayesian Belief Network. Also in this case, the target is how to translate monitoring observations into probabilities.

Sub-Task 6.2.3: Short-term hazard tools
As for subtask 1.3, the short-term hazard tools are physics-based models that are able to simulate the impact on the ground of a specific hazard. Here, we plan to implement innovative procedures to: i) improve the accuracy of existing ash fall dispersion models and lava flow models used at Etna with innovative procedures to calibrate them in real-time integrating data from ground-based and satellite systems; ii) develop and validate, in cooperation with colleagues in Catania, the short-term multi-model forecasting system developed by INGV and operational at the Osservatorio Etneo of Catania, incorporating epistemic and aleatory uncertainties..

Task 3: Capacity building and interaction with decision-makers (INGV, DPC)
The goal of this task is ambitious and aims at establishing more quantitative and transparent scientific and communication protocols to bridge the gap between scientists and decision-makers. Recent natural disasters have clearly showed that scientific information is not directly and straightforwardly used by decision-makers to take mitigation actions. A crucial issue is also how scientists and decision makers have to share information and communicate among them in order to define efficient risk mitigation strategies. On the other hand, decision-makers, to be credible and to minimize a posteriori critics, have to establish clear and transparent decision-making protocols. These protocols clarify role and responsibilities of each partner involved in the crisis management, starting from scientists. Moreover, we think that these protocols may be an extraordinary tool of education and awareness for the society that may be affected by the eruption. In this WP, scientists and decision makers (DPC) will be engaged in order to facilitate the communication and use of the hazard assessment made by scientists during a phase of unrest. This task has a strong synergy with the ongoing FP7 EU project VUELCO where both INGV and DPC are involved.

Sub-Task 6.3.1: Capacity building
An efficient volcanic risk mitigation strategy requires a complex interplay among scientists, decision-makers and society. Required input are, first of all, well-calibrated and tested hazard models. However, because of the involved time scales for testing, the inherent uncertainties, lack of knowledge and range of expert opinions, and given the high societal importance, an additional step of structured consensus building in the informed technical community and beyond is needed before such models can be used widely as input for short-term risk assessment and to eventually issue public warnings. The objectives of this Sub-Task are: i) to promote good science in the domain of short-term hazard assessment contributing to define best practice standards (in strong collaboration with FP7 EU project VUELCO); ii) to involve stakeholders and scientists in defining shared guidelines for decision-making protocols

Sub-Task 6.3.2: Quantitative decision-making protocols
Decision-making under uncertainty means that is impossible to plan mitigation actions that result to be the optimal ones also a posteriori. For this reason, it is of crucial importance to define quantitative rules to translate the hazard assessment and the probabilistic information into rationale mitigation actions. The goal of this Sub-Task is to implement further quantitative decision-making

based on cost-benefit analysis applied to the supersites considered here and to check its feasibility in real cases. This aim is coordinated with past and ongoing initiatives on the same topic.

Sub-Task 6.3.3: End Users Evaluation

This subtask aims at developing tools and procedures that are able to improve communication and coordination between scientific, local communities, and decision-makers at the supersites and at other volcanoes like Azores. To this purpose, we plan to: 1) train local Civil Protection operators at Campi Flegrei test area, on the scientific output of the project MED-SUV; 2) evaluate the Civil Protection operators' response to the project tools; 3) collect the Civil Protection requirements; 4) final test exercise with involving operators and a sample of general population..

Deliverables

D6.1: Short-term hazard assessment tool for Etna - (M30)

D6.2: Short-term hazard assessment tool for Campi Flegrei - (M30)

D6.3: Preparedness and awareness Guidelines. These guidelines aim at: 1) clarifying the role of during a volcanic crisis, 2) improving the link between scientists and decision-makers, 3) Best guidelines for efficient hazard tools communication and dissemination about volcanic risks - (M36).

Work package number	7	**Start date or starting event:**									
Work package title	Pilot Phase - Validation and transfer of project outcomes										
Activity Type[1]	RTD										
Participant number	1	2	3	5	**11**	12	14	16	18	19	20	21
Participant short name	INGV	CNR	AMRA	DLR	**CNRS**	BRGM	CSIC	UAc	IMoSS AG	Surveylab	MATEC	T2
Person-months per participant:	5.7	7.3	2	2	**6**	**2**	3	46	4.25	0.6	5	8

Objectives

The WP7 will be in charge of the Pilot Phase for demonstrating and validating the applicability of the WP2, WP3, WP4 and WP5 project outcomes to other European volcanoes and Observatories. Besides Italy, several European countries (France, Greece, Portugal, Spain, plus Iceland) do have to face the threat of active volcanoes and eruptions. Here the project will run the monitoring Pilot Phase as a "European Supersite Demonstrator", first on the two target volcano laboratories (Etna, C.F./Vesuvius), then on two test sites - Piton de la Fournaise and the Azores volcanic archipelago - which were selected for their high level of risk and the availability of monitoring networks. Like Etna, Piton de la Fournaise (Reunion Island) is as an "open vent" erupting volcano, while the Azores archipelago hosts several caldera-bearing (CF/Vesuvius-type) dormant volcanoes.

In this WP, the new generation of geo-hazards monitoring/observing systems produced in the previous WPs will be validated for transfer and application. Reciprocally, and for further improvement of the project outcomes, the WP will be in charge to incorporate previous or/and contemporaneous experiences in volcano monitoring and crisis management conducted in other European countries.

Demonstration and Transfer by WP7 will typically concern all the results/products of general relevance, such as databases format and web access, existing and innovative technological products, integrated systems for ground-based and satellite monitoring, calibrations of sensors/networks, developed numerical models. Such a scientific transfer will also impact the strategies for hazard assessment and communication between volcanologists, authorities and populations.

By the end, these combined activities are aimed at the definition and built up of a new generation of volcanic hazard monitoring/observing systems in Europe.

WP7 will thus have three major goals:

(i) Contribute to defining the operational scenario for the test and validation activities and follow their realization;

(ii) Feed the project with experiences on volcano monitoring and disaster managements carried out in other European countries;

(iii) Demonstrate the applicability of the project results on other European volcanoes.

The WP activities will be organized in four Tasks, with the collaboration of other WPs, and will be

[1] Please indicate one activity per work package:
RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities).

coordinated by CNRS.

Description of work

The activity will be developed in four phases, each one corresponding to one of the Tasks below:

(1) Requirements/design of the operational scenarios and experiments, and feed-back with experiences from other European volcanic countries;

(2) Experiments and tests of results/outcomes of single components of the monitoring system (first pilot phase);

(3) Transfer of the outcomes to other WPs and application to the two volcano test sites (Fournaise and Azores);

(4) Validation and feed-back of the integrated monitoring components into the new generation monitoring system, including the e-infrastructure (final pilot phase).

Periodic meetings (at the end of each phase) will allow assessing the feed-back of WP7 activities into the other WPs.

Task 7.1: Requirement and design of the operational scenario and experiments, and feed-back with experiences from other European volcanic countries

During this first part of the WP7, the Task 1 will plan the test and validation activities that will be carried out in the project, in close connection with other WPs. This will concern the requirements, operational scenarios and design of experiments. In Task 7.1 the activities of the two Pilot Phases, which will be developed in Task 7.2 and Task 7.4, will be defined. We will focus the planning on the expected advancements of the various project activities devoted to either the implementation of new observing systems or new methods allowing to increment our knowledge of volcanic processes (e.g. modeling tools). In the same time, WP7 will feed the project with experiences in volcano monitoring and crisis management gathered in other European countries.

Task 7.2. Mid-term Pilot Phase - Experiment and test of results of single components of the monitoring system

In this Task WP7 will experiment, test and validate the products or outcomes (either preliminary or definitive) issued from the first half of the project. Testing activities will be aimed at validating the project's advancement and the architecture of the new monitoring system, by considering the advance of single components such as: integrated systems for ground-based (GPS) and space-borne sensing of ground deformations, landslides, and volcanic gas emissions; new instrumental approaches; calibration procedures; data loggers; and algorithms.

Sub-Task 7.2.1 [CF-Vesuvius]

In this Sub-Task we plan to carry out experiment to test the preliminary version of the following systems/products:

- the GILDA data-logger
- the test on the preliminary version of the algorithms to integrate SAR, geodetic and optical data
- test of correlated geophysical and geochemical soundings of CF hydrothermal system

Sub-Task 7.2.2 [Etna]

In this Sub-Task we plan to carry out experiment to test the preliminary version of the following systems/products:

- test of new strain-sensors, in particular the FBG strain sensor prototype, for either (i) shallow borehole installations or (ii) long-baseline surface deployments, aimed at measuring length changes between pre-defined benchmarks.
- test of the preliminary version of the algorithms of the automatic extraction of 2D and 3D features from ETNAVis
- test of the preliminary version of algorithms to integrate SAR, geodetic and optical data.
- test of integrated measurements and modeling of dissolved and exsolved volatiles in Etna magmas

- test of cross-correlations between remote sensing measurements of eruptive gas emissions and geophysical signals

Task 7.3: Transfer of outcomes to the other WPs and application to the two volcano test sites (Fournaise and Azores)

In this Task, the WP7 will transfer the outcomes of the tests to the other WPs and will identify all potential feed-backs for the different activities on the two laboratory volcanoes, Etna and CF/Vesuvius. Furthermore, the WP7 will simultaneously conduct a first validation test of the applicability of the project outreaches on the two other selected volcano targets, Piton de la Fournaise and the Azores archipelago. Such an activity will allow direct inter-comparison between the project outcomes and the existing local monitoring systems, promote improvements of the latter, and make the project benefiting from experiences of the respective volcano Observatories. Joint meetings but also field demonstration and joint experiments will be organized for that purpose. The products concerned by this validation test will be selected in close coordination between the project partners and the local volcano Observatories.

Sub-Task 7.3.1 [Piton de la Fournaise]

In this Sub-Task we plan to carry out experiments to test the preliminary version of the following systems/products:

- New method to invert ground deformation models form EO and geodetic data
- Seismic noise correlation system
- Comparison of calibration procedures for tiltmeters
- Models for the dynamics of dyke propagation, degassing and eruption
- Improved retrieval procedures for the continuous survey of SO_2 fluxes using UV remote sensing
- Improvements in automated geochemical monitoring of persistent crater gas emissions

Sub-Task 7.3.2 [Azores]

In this Sub-Task we plan to carry out experiments to test the preliminary version of the following systems/products:

- New method to invert ground deformation models form EO and geodetic data
- Automated geochemical monitoring
- Quantification of dissolved volatiles in Azorean magmas
- New models for the dynamics of dyke propagation, degassing and eruption

Task 7.4: Final Pilot Phase

During this ultimate part of the Pilot Phase, WP7 will validate all the products or outcomes generated during the project, as components of the new monitoring system. WP7 will then promote their transfer to the other European volcanic countries. This will concern all the products of general relevance or/and selected products of specific interest, such as databases format and web access, existing and innovative technological products, integrated systems for ground-based and satellite monitoring, calibrations of sensors/networks, algorithms and developed numerical models. Such a scientific transfer will be organized under the form of reports, workshops, publications, and presentations at international meetings. It should also impact the strategies for hazard assessment and communication between volcanologists, authorities and populations in European countries dealing with the risks from volcanic hazards. During this phase the WP will consider the opportunity of building up an European volcanological Task Force.. This Task Force should be aimed at bringing assistance and knowhow to volcano Observatories and governments in case of volcano emergency in Europe and, elsewhere.

Sub-Task 7.4.1 [e-infrastructure].

In this Sub-Task we plan to carry out a test of the final version of the e-infrastructure to verify the possibility to share the data and interoperate the various archives. Strictly according to the deliverables presented in Task 3.4 the MED-SUV platform, deployed for data sharing, will be tested using experiments data within the project as case histories. The proposed goal of this Task is to organize data format considering international standard (WOVOdat, GEOSS Supersites formats and rules, WMO, ISO and OGC specifications). This phase is particular important because it must address important aspects such as: scalability and sustainability --i.e. (non-functional) requirements. Naturally, these requirements have been also considered in the previous design and implementation phases. Stress and interoperability tests will be conducted and reported.This new phase validate the architecture also for selected datasets relevant to Piton de la Fournaise and Azores sites. Porting procedures will be able to create adaptive the data sharing process and the new proposed e-infrastructure will be ready to be used in different international contest. Only a fine tuning phase is necessary in order to adapt the requirements to the system response in respect to new data input.

Sub-Task 7.4.2 [CF-Vesuvius]
In this Sub-Task we plan to carry out experiment to test the final version of the following systems/products:

- the GILDA data-logger
- the algorithms to integrate SAR, geodetic and optical data
- Numerical models for the dynamics of dyke propagation, degassing and eruption
- Improved automated geochemical monitoring of persistent crater gas emissions
- The automated TerraSAR-X High resolution Data Acquisition and Processing system will be run on the Europeas Supersites in a joint and coordinated experiment. The test will cover all the stage, namely data-acquisition, data processing and product validation. A final validation report will be filed to summarize the whole experiment,describe all steps and results and validate the final results.

Sub-Task 7.4.3 [Etna]
In this Sub-Task we plan to carry out the test of the final version of the following systems/products:

- Installation of the final version of the FBG strain sensor prototype in the summit zone, and test of the FBG infrasonic sensor in field, in order to validate the interferometric methods for the reduction of uncorrelated acoustic noise through the use of FBG sensor arrays
- the test on the preliminary version of the algorithms of the automatic extraction of 2D and 3D features from ETNAVis
- the test on the preliminary version of the algorithms to integrate SAR, geodetic and optical data.
- Numerical models for the dynamics of dyke propagation, degassing and eruption
- Innovative sensors for the remote analysis of eruptive gases
- Improved automated geochemical monitoring of persistent crater gas emissions
- Improved retrieval procedures for the continuous survey of SO_2 fluxes
- The automated TerraSAR-X High resolution Data Acquisition and Processing system will be run on the Europeas Supersites in a joint and coordinated experiment. The test will cover all the stage, namely data-acquisition, data processing and product validation. A final validation report will be filed to summarize the whole experiment,describe all steps and results and validate the final results

Deliverables

D7.1. Report on the planning of the Test and validation activities - (M12)

D7.2. Report on the outcomes of the first Pilot phase - (M18)

D7.3. Test of preliminary version of SAR algorithm for isolating volcanic plume signal in SAR data (test against ground truth) - (M24)

D7.4 Improved retrieval procedures for volcanic plume signal extraction from SAR data – comparison with Numericcal models and ground data - (M30).

D7.5. Report (guidelines) on the feed-backs to the other WPs and on the two volcanic test sites (M24)
D7.6. Final report on the Pilot Phase - (M36)
D7.7. Prototype of new generation monitoring system - (M36)

Work package number	8	**Start date or starting event:**	
Work package title	Dissemination and Outreach		
Activity Type[1]	OTHER		

Participant number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Participant short name	INGV	CNR	AMRA	DPC	DLR	UHH	LMU	GFZ	UNIVDUR	UNIBRIS	CNRS	BRGM	ESA	CSIC	UGR	UAc	UoM	GEOMOS	Surveylab	MATEC	T2	UNIWO	JPL	USGS-
Person-months per participant:	4.8	0.5	8	2	1.31	1	1	1	1	3	0.1	10	1.2	2	4	6	2	1.5	0.4		3	1		

Objectives

1. To ensure a scientific visibility towards end-users beyond the project area
2. To promote effective and widespread application of results in practice by supporting end-users uptake and implementation.
3. To link MED-SUV supersite to other data sharing initiatives
4. To provide a continuing resource for end-users of supersite beyond MED-SUV

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Description of work

Task 8.1: Project Website (BRGM, INGV)
A project website will be set up and maintained by the consortium. It will serve within project partners as an access point to the project shared documents and a link to the digital data infrastructure for a better team efficiency; it will provide a public visibility beyond the project framework through newsletters and articles. This website will also be linked to other web-based initiatives for supersites such as GEO.
Following the example of the Soil Technology websites cluster, the project could be clustered with the other European supersite initiatives to propose one entry portal under the European Community framework

Task 8.2 Project communication (BRGM, All)
The communication plan includes several actions taking place throughout the duration of the project. The proposed actions are :

- Production of project brochure(s), leaflet(s) and poster(s)
- Production of periodic newsletters via email and of a social media campaign
- Production of proceedings, papers, reports etc. and CD ROMS following workshops and conferences
- Promotion of project aims, objectives and specific research activities at relevant events (conferences etc).
- Identification and contact of local and international TV networks (i.e. Euronews) to the opening workshop, in order to bring a large media coverage to the supersites and the

[1] Please indicate one activity per work package:
RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium; OTHER = Other specific activities, if applicable (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities).

underlying scientific challenges.

The first communication action can be done during the final MIA-VITA event, International Conference on Integrated Approaches for Volcanic Risk Management that will be held on 11-12th September 2012, to present MED-SUV and its goals. Another communication action will take place at the IAVCEI general assembly at Kagoshima in September 2013.

Task 8.3: Workshop events (INGV, DPC, BRGM)

Workshop will be held as follows, in order to directly promote the project :

- One Kick-off workshop (including field trips on both sites of the Supersite project) that will define and then review the scope of project work and expectations, and pinpoint the needs of end-users
- The final project event (conference/workshop) will disseminate the project findings to targeted audiences (including scientific community, authorities, policy makers, private sector). It will be broken down into two parts : one final workshop open to scientific community, and meetings with public representatives for risk management

Another objective is to get end users involved during the first meeting, and then for the entire duration of the project through personal contacts generated by the first event and specific WP meetings.

Task 8.4 Networking (All)

We will identify ongoing national, EC (including MIA-VITA,VUELCO, MATRIX, EDURISK) and international initiatives (including GEO, UNAVCO supersites, IAVCEI, WOVO, etc.) and other actions in the area of geohazard risk management and data sharing, and we will collate links to them on the project website. Informal networking will include attendance at relevant conferences and meetings, participation on request in events organised by the Commission, discussion with other initiatives, and seeking opportunities for inter-institute researcher exchanges.

Project website (and data server entry point) address will be transmitted to relevant network, research institutes and observatory sites for a better reference.

Task 8.5 Sustainability of the dissemination products (All)

We will in this Task coordinate with other WPs and the European Community with the aim to make the dissemination products sustainable. The project website and its content will be transferred if necessary to the digital infrastructure. Discussions will be opened in order to maintain a high level of communication around the supersite even after the end of the project, in order to find sustainable solutions (for example through the GEO initiative).

Deliverables

D8.1: Workshops - (M1)

D8.2: Project website - (M2)

D8.3: Communication plan - (M3)

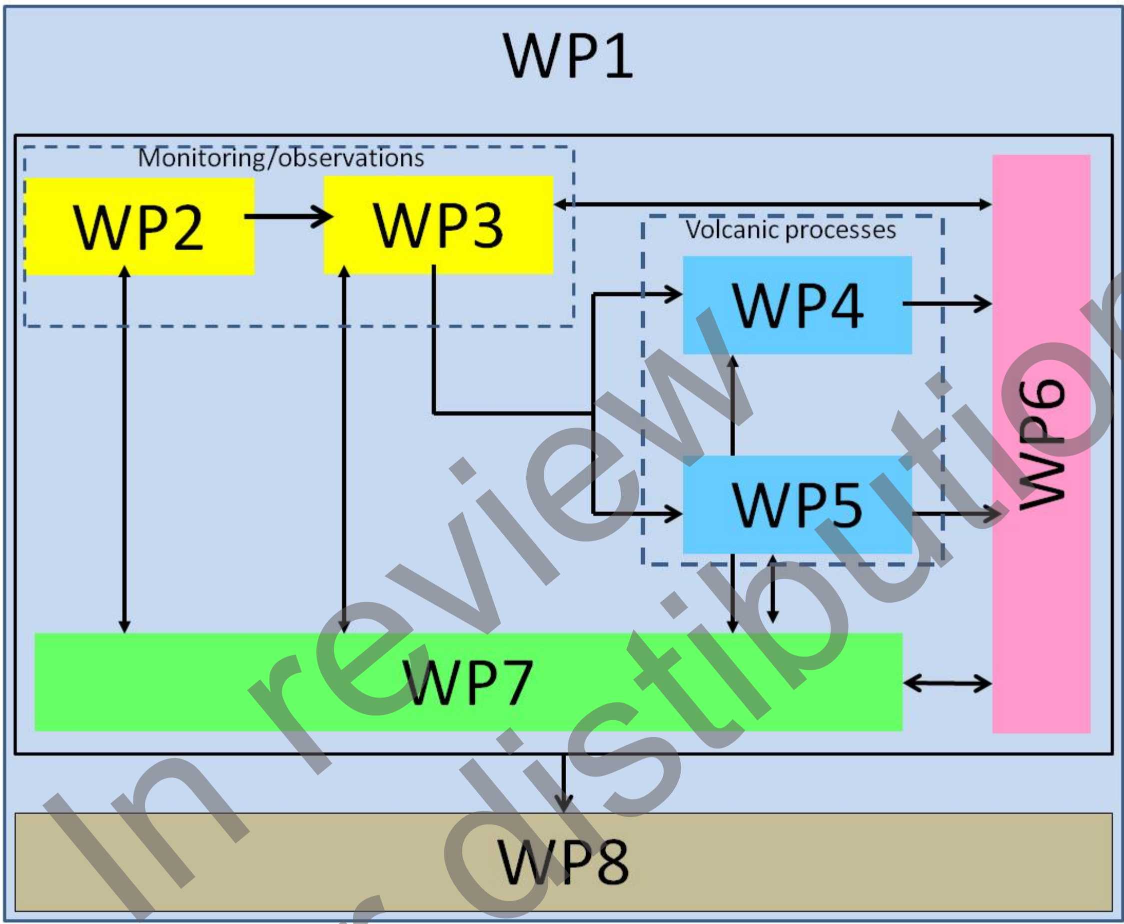
D8.4 : action plan for the sustainability of the dissemination - (M20)

D8.5: Workshops - (M35)

Table 1.3.3 e: Summary of staff effort

Participant no./short name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total person months
1/(INGV)	**39.8**	5.8	**58.3**	31.9	25.1	**52.2**	5.7	4.8	**223.6**
2/(CNR)			60.19	5.55			7.3	0.5	**73.54**
3/(AMRA)			12	56		12	2	8	**90**
4/(DPC)						4.5		2	**6.5**
5/(DLR)		**49**					2	1.31	**52.31**
6/(UHH)					11			1	**12**
7/(LMU)				**12**	29			1	**42**
8/(GFZ)				18				1	**19**
9/(UNIVDUR)					13			1	**14**
10/(UNIVBRIS)				35				3	**38**
11/(CNRS)			11.5	12	**24**		**6**	0.1	**53.6**
12/(BRGM)		7			5	7	2	**10**	**31**
13/(ESA)			8					1.2	**9.2**
14/(CSIC)			10	13	13		3	2	**41**
15/(UGR)					41			4	**45**
16/(UAc)						7	46	6	**59**
17(UoM)					10			2	**12**
18/(IMoSS AG)			22.75				4.25	1.5	**28.5**
19/(Surveylab)		30	14				0.6	0.4	**45**
20/(MATEC)		27					5		**32**
21/(T2)			25				8	3	**36**
22/(UNIWO)			1	4	2			1	**8**
23/(CALTEC-JPL)					0.1				**0.1**
24/(USGS-HVO)					1				**1**
Total	**39.8**	**118.8**	**222.74**	**187.45**	**174.2**	**82.7**	**91.85**	**54.81**	**972.35**

Table 1.3.3 f: Interdependencies among project's components



1.3.4 Significant risks and associated contingency plans.

Risks are an inherent element of ambitious RTD projects. However, unmanaged risks may have a detrimental impact on the project schedule and results and eventually give rise to contractual litigation. Appropriate management procedures shall identify and monitor risks and shall take appropriate measures to suppress or mitigate their effects. While some risks (technological bottlenecks, poor integration of competencies...) can be identified before the development phase of the project and prevented by strategies devised within the Work Plan, others either internal (major equipment failure, defaulting partner,...) or external to the project (technical developments outside the project, ...) may appear during project implementation and will require timely management decisions. A risk management method comprising risks identification, evaluation and ranking, mitigation, contingency planning and residual risks follow-up, will be applied by all WP leaders, and coordinated by the Project Coordinator also according to the decision making process outlined in the section 2.

At the base of the Risk Management there is the **Quality Plan**, that the ExC will produce at the start of the project and will govern the quality procedures for the whole project. This document will define a set of rules for the organisation of the day-to-day work, including the procedures to be used, the reporting mechanisms, the organisation of meetings, and the preparation of documentation for submission to the Commission. It will include a set of product descriptions for each of the project deliverables, which will include the definition of the quality criteria against which the deliverable will be assessed for fitness for purpose, and the quality method that will be used to test this compliance. The Quality Plan will set out the on-going evaluation and assessment requirements and these will be “built in” to the procedures of each WP to ensure that the progress towards the attainment of the projects objectives is properly monitored and clear.

2. Implementation

2.1 Management structure and procedures

Creation and management of an efficient governance structure is important for the success of the project.
The objectives of project management are as follows:
i. meeting the objectives of the project within the agreed budget and timeframe,
ii. ensuring project compliance with EC rules,
iii. coordinating project activities and ensuring effective internal communication
iv. monitoring of the scientific and technical progress of the entire project, by means of the supervision of the achieved milestones and other non technical aspects,
v. carrying out quality control of the work performed and of deliverables,
vi. identifying risks or conflict situations and resolving them
vii. setting up an organisation to support the above objectives.

A Consortium Agreement setting the principles of Consortium management will be prepared and signed by all participating members prior to finalising contract negotiations with the Commission

Governance structure
The project steering and management is assured by

- the Coordinator,
- the Executive Committee,
- the WP Leaders
- the General Assembly.

The Coordinator
The Coordinator is the legal entity acting as the intermediary between the consortium of the project partners and the EC.
The Coordinator:

- acts as the intermediary between the consortium of the partners and the EC,
- transmits financial and technical reports and all necessary information to the EC,
- receives project funds by the EC,
- transfer project funds to the partner institutions according to the budget break-down,
- Monitor the project spending

The individual representing the Coordinator is the Project Coordinator and is supported by a Management Team (MT) with administrative and financial competences properly set up by the Coordinator. The Project Coordinator implements the administrative and financial decisions of the Executive Committee, and the General Assembly also within the framework of rules set by the European Commission. The Project Coordinator will be responsible for day-to-day MED-SUV management, including all administrative, financial, legal and technical aspects of the project. The Project Coordinator is also responsible of the Executive Committee and General Assembly meetings arrangement.
A further Task will be coordinating activities such as reporting to the European Commission.
Clear communication (including regular email updates) will be vital to ensure appropriate integration between the workflow of each partner.
The Project Coordinator shall, in addition to its responsibilities as a Participant, perform the Tasks assigned to him as described in the Grant Agreement and the Consortium Agreement .

The Executive Committee

The Executive Committee (ExC) is the highest decision-making body of the Consortium and includes the Project Coordinator and the WP Leaders. The Project Coordinator shall chair the meetings of the ExC. The ExC takes care of the regular monitoring of the project activities according to the agreed time-line (milestones and deliverables fulfilment in due time). ExC shall support the coordinator in the adoption of the corrective measurements eventually needed for the re-alignment of the project WP development to the original plan .
The ExC will cope with the strategic planning and direction of the project. The decision-making about high-level management issues, including mainly technical, financial, exploitation, dissemination, planning and control are under the responsibility of the ExC. The ExC will coordinate the communication and feedback between the different WPs and participants.
Administrative and financial Tasks are to evaluate periodic technical reports and financial reports, to monitor and implement any change necessary in the Consortium Agreement, and to adopt the exploitation and overall dissemination plan of the project.
ExC strategic and political Tasks will include the elaboration,with the involvement of the General Assembly, of guidelines for a data policy, the set-up of a shared frame for Intellectual property Rignts regulations, and the achievement of a Memorandum of Understanding to favour the prosecution of some of the activities beyond the project duration.

The ExC takes care of the contacts with the Advisory Board, board of experts periodically revising the project progress, and convey the comments and suggestions eventually expressed by the AB to the partners. Meetings of the Executive Committee shall take place every 6 months or upon request by any of its members. The meetings can be either physical meetings or audio- or video-conferences using internet facilities.

The WP Leaders
The WP leaders (WPLs) constitute the operational level of the governance and are responsible for monitoring the performance of the WP and ensuring the timely delivery of the WP deliverables. The WPLs will provide the interface between the scientific work done by their partners in the respective WPs and the ExC
The role of the WPL comprises the following:
1. To coordinate and supervise the developments in the WP.
2. To enforce, in a timely fashion, the implementation and development of the proposed research Tasks as scheduled in the corresponding WP.
3. To monitor the achievement of S&T objectives, deliverables and milestones of the respective WP, and if changes and/or critical events arise, notificate and recommend remedial actions to the ExC and the Coordinator in a timely fashion.

The General Assembly
The General Assembly (GA) is includes the representatives of all the partner institutions, who meet once per year upon call of the Project Coordinator. The GA has to be regularly updated through meetings or mails by the Project Coordinator about the development of the project (e.g., status of deliverables, deviations and corrective actions).
The GA in case expresses its decision on any major technical, administrative and financial decision of the project and has to be compulsory consulted whenever amendments of the Description of Work (DoW) are proposed by any of the parties. The GA decision can be expressed by voting and each partner institution can rely on one vote only.

In particular, the GA shall evaluate the proposals submitted by the Project Coordinator and the ExC and related to strategic and legal issues (WP1, Task 2) and will provide amendments and give further recommendations . The GA will be involved in the definition of the guidelines for the use of the data within the project and for the data policy after the end of the project.

The Advisory Board
The Advisory Board (AB) consists of experts proposed by the partner institutions. Its composition will be approved by the General Assembly. Representatives from GEO, WoVo, UNAVCO, ESFRI relevant to the topics of the project will be called to participate to the AB. The AB is regularly

updated about the project development and gives recommendations to the Executive Committee in order to improve the scientific, strategic and social impact of the project activities. The AB will review the project's work and outcomes. Particular care will be devoted to evaluate the extent of compliance of the project results with the objectives of the GEO and the Supersites initiative (e.g., it will take care of the open access to an effective use of the scientific data).

Decision Making process

The decision making process will be developed according to the following scheme:

- ExC starts the process upon request of any of the partners including the Coordinator.

- The ExC according to the nature of the risen request can alternatively
  A. decide to discuss and take decision internally to the ExC (very non-specific an non-strategic issues with little impact on the workplan)
  B. give assignment to the Project Coordinator to convene the GA to reach a shared decision (very specific and strategic issues and matters with high impact on the workplan) .

- If the ExC deal with the risen request internally (A), the Project Coordinator is charged of the communication of the ExC decision to the GA by circulating the related documentation (minutes of the ExC meetings)

- If the GA has to be involved in the decision (B), the Project Coordinator, upon ExC assignment, convenes the GA and jointly provides the GA member with the documentation prepared by ExC and related to the risen request. The outcome of the GA consultation on the risen request is acquired by the Project Coordinator, transferred to ExC and put in force.

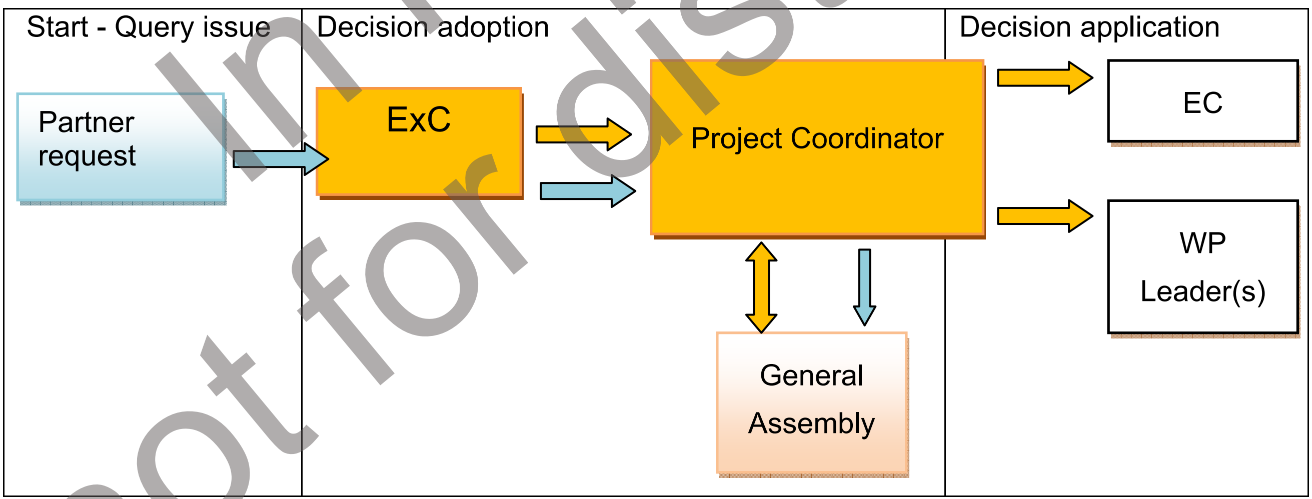


FIGURE 3– the phases of the Decision Making process: cyan arrow stay for information flux (case A, decision inside the ExC), and orange arrows stay for decision flux (case B, GA involved in the decision).

Risk management

The risk management method will comprise risks identification, evaluation and ranking, mitigation, contingency planning and residual risks follow-up.

At the start of the project The Project Coordinator and the ExC will define the risk management method based on a **Quality Plan** (QP) which will govern the quality procedures for the whole project.

The QP will include a revision of all the deliverables internally to the consortium and in particular

- The identification of check times during the project for the risk evaluation

- The definition of the procedure for the internal revision of the deliverables before the ExC acceptance and the transmission to the EC
- A procedure for the development of remedial actions in case of occurrence of event that can put at risk the achievement of one or some results of the project.
- The definition of a template for those deliverables which consist of reports.
- The definition of a presentation/submission mode deliverables which are hardware devices and software ensuring the undisclosure of those deliverables which can be subject to IPR.

A draft of QP will be presented at the kick-off meeting to the GA by the ExC for amendements according to the decision making process outlined in the section 2. The final approval shall be reached by month 2 of the project.

Internal Communication flows and methods
The communication flow will be both bottom-up and top-down, through standard communication methods, such as: meetings, e-mail, phone, etc. In particular, a cooperative working method, using a partner reserved area in the the project website and Virtual Agora will be established.

Meetings
Meetings for the different entities in the project have been planned for the entire project, on the following basis:
1. General Assembly of the partner representatives organised by the Project Coordinator or by one of the member of the ExC and attended by all Participants

- Kick-off meeting to be held in Project Month 1.
- Interim meeting to be held in Project Month 12 and 24.
- Final meeting to be held in Project Month 36.

2. ExC meetings organised by the Project Coordinator and attended by all ExC members

- 7 meetings will take place during the course of the project on average on a semester base.
- In order to reduce travel costs ExC meetings will be held together with General Assembly meetings

2.2 Individual participants

2.2.a Participant 1: Istituto Nazionale di Geofisica e Vulcanologia (INGV)

Brief description: INGV is the largest Italian research institutions in Earth Sciences with headquarters in Rome and basis in numerous cities all over Italy (Milan, Pisa, Bologna, Naples, Palermo and Catania) and about 1000 personnel units. Its main mission is the monitoring and study of geophysical phenomena in both the solid and fluid components of the Earth. INGV manages monitoring networks and collects, inspects and disseminates data in the field of seismology, volcanology, geodesy, geochemistry and marine sciences. It is the reference scientific institutions for Italian governmental bodies especially in the field of geo-hazards. INGV operates in close coordination with civil protection authorities at national (DPC) and local level. INGV manages 24/7 nationwide seismic surveillance service and early warning based on the monitoring infrastructures. Numerous laboratories, observatories and monitoring stations in marine areas enrich its research infrastructures. The INGV seismic and volcanic monitoring networks and the labs fit into the European Plate Observing System (EPOS), one of the European Research Infrastructure listed in the Roadmap of the European Strategy Forum on Research Infrastructures (ESFRI), also included in the Italian Research Infrastructures Roadmap.
INGV has a relevant experience in the coordination of research activities and has been engaged in national projects funded by the Ministry of Education, University and Research and by other national agencies such as the Italian Space Agency (e.g., project SRD). Thanks to multi-year agreements, INGV coordinates research activities on order of DPC addressed to seismic and volcanic hazard assessment and mitigation. INGV has participated both as coordinator and partner to several past and on-going projects funded by international bodies such as EU (e.g., EC projects EXPLORIS, ERC StG CO2Volc, MAMMA, ITN NEMOH, SHARE, MIAVITA, PREVIEW, SAFER, NERIES, NERA, UPStrat-MAFA). INGV leads the Preparatory Phase (PP) projects of two ESFRI research Infrastructures of the environmental sector, namely EPOS-PP and EMSO-PP (EMSO - European Multidisciplinary Seafloor Observatory).

Main tasks: Project management (WP1); Data Sharing, Integration and Interoperability (WP3), Volcanic hazard assessment, disaster preparedness, and mitigation (WP6); participation in WP 2, W4, W5, W7, and W8.

***Key personnel involved*:**
Giuseppe Puglisi Director of Research, Head of the unit “Ground Deformation” of the INGV Section of Catania, Osservatorio Etneo. His research activity concerns the dynamic of the volcanoes and surrounding areas investigated by using geodetic techniques, mainly GPS and SAR interferometry. He also deals with researches concerning ground deformation data inversion problems, mainly using numerical optimisation techniques. He is the coordinator of MED-SUV project and the leader of WP1.
Marcello Martini, Director of Research, head of the INGV Section Osservatorio Vesuviano. Main scientific interests concern the use of seismology to investigate the dynamic of active volcanic areas and the implementation of innovative technologies. He is also involved in committees for the management of the hazard assessment in the Neapolitan area. He is coordinator of WP3.
Warner Marzocchi is Director of Research with main scientific interest in natural hazard assessment with particular focus on the definition of probabilistic tools to merge any kind of available information and to deal with aleatory and epistemic uncertainties; the development of probabilistic tool for multi-risk assessment; the seismic hazard assessment at different time scales; the volcanic hazard assessment. He was past co-chair of WOVO. He is the coordinator of MED-SUV WP6.

Recent relevant publications:
Arienzo, I., R. Moretti, L. Civetta, G. Orsi, P. Papale (2010) The feeding system of Agnano-Monte Spina eruption (Campi Flegrei, Italy): Dragging the past into present activity and future scenarios. Chemical Geology 270, 135-147, doi: 10.1016/j.chemgeo.2009.11.012.

Barsotti, S., D. Andronico, A. Neri, P. Del Carlo, P.J. Baxter, W.P. Aspinall, T. Hincks (2010). Quantitative assessment of volcanic ash hazards for health and infrastructure at Mt. Etna (Italy) by numerical simulation, Journal of Volcanology and Geothermal Research, 192, 1/2, 85-96, doi:10.1016/j.jvolgeores.2010.02.011.

Chiodini, G. (2009). CO2/CH4 ratio in fumaroles a powerful tool to detect magma degassing episodes at quiescent volcanoes. GEOPHYSICAL RESEARCH LETTERS, ISSN: 0094-8276, doi: 10.1029/2008GL036347.

Guglielmino G., Nunnari G., Puglisi G., Spata A. (2011). Simultaneous and Integrated Strain Tensor Estimation from geodetic and satellite deformation Measurements (SISTEM) to obtain three-dimensional displacements maps. IEEE Trans. Geosc. Rem. Sens., vol. 49, 1815-1826, doi: 10.1109/TGRS.2010.2103078.

Patanè, D., Barberi, G., Cocina, O., De Gori, P., Chiarabba, C. (2006) Time-resolved seismic tomography detects magma intrusions at Mount Etna. Science, 313: 821-823.

Sandri L, Jolly G, Lindsay, J, Howe T, and Marzocchi W (2011). Combining long- and short-term probabilistic volcanic hazard assessment with cost-benefit analysis to support decision making in a volcanic crisis from the Auckland Volcanic Field, New Zealand. Bulletin of Volcanology, doi:10.1007/s00445-011-056-y.

Taddeucci, J., Scarlato P., Montanaro C., Cimarelli C., Del Bello E., Freda C., Andronico D., Gudmunsson M.T. (2011). Aggregation-dominated ash settling from the Eyjafjallajökull volcanic cloud illuminated by field and laboratory high-speed imaging. GEOLOGY, 39, 891–894.

2.2.b Participant 2: Consiglio Nazionale delle Ricerche (CNR) [IIA, IREA]

The **Consiglio Nazionale delle Ricerche** (**CNR**) is the main public research entity in Italy with more than 100 Institutes grouped in 11 Departments..
In particular, within the project activities the IREA and IIA institutes will be involved.
The **Institute for Electromagnetic Sensing of the Environment** (**IREA**), a CNR institute, incorporates a Microwave Remote Sensing Group that is active since 1987. Their main research interest is Differential SAR interferometry (DInSAR), with two main aims: (1) development of effective tools for detecting and monitoring of Earth surface deformations; (2) demonstration of applicability of the proposed techniques in real scenarios. IREA-CNR is the initiator of the well known Small Baseline Subset (SBAS) processing technique for generating deformation time series starting from SAR data. IREA-CNR has a high level expertise in scientific SAR and DInSAR algorithm development. It has a large experience in scientific software development, since it built up a complete, semiautomatic DInSAR processing chain that, starting form satellites raw data, produces geocoded SBAS deformation time series. IREA-CNR has implemented its SBAS-DInSAR processing chain in the G-POD and GENESI-DEC framework of ESA, permitting to process in an automatic way satellite data. IREA-CNR has been involved in a number of National and International Project in the SAR related field, as coordinator or participant.

Main tasks:The CNR-IREA group will be involved within WP3 and WP4 activities.

Key personnel involved:
Antonio Pepe is a Research Scientist with CNR-IREA. His main research interests are in the SBASDInSAR field, with particolar emphasys on the development of advanced phase unwrapping codes to be applied for processing 3D-stacks of differential interferograms. He has also been responsible or collaborator in several National and European projects on DInSAR.
Mariarosaria Manzo is a Research Scientist with CNR-IREA. Her research interests include DInSAR data processing and applications for the monitoring of surface displacements produced by subsidence, volcano activity and earthquakes.
Giuseppe Solaro is a Research Scientist with CNR-IREA. His main research interests are relevant to the SBAS-DInSAR data processing, recently concentrated on novel generation satellites (COSMO-SkyMed, TerraSAR-X), and to the geophysical modelling of seismic sources by inverting DInSAR and geodetic data.
Pietro Tizzani is a Research Scientist with CNR-IREA. His main research interests include processing of SAR data acquired by the C- and X- band sensors, and integrated geophysical numerical modelling of volcanic sources by inverting DInSAR, geodetic and geothermal data.

Recent relevant publications:
P. Tizzani, A. Manconi, G. Zeni, A. Pepe, M. Manzo, A. Camacho, and J. Fernández (2010), Long-term versus short-term deformation processes at Tenerife (Canary Islands), Journal of Geophysical Research, vol. 115, B12412, doi:10.1029/2010JB007735.
G. Solaro, Acocella V., Pepe S., Ruch J., Neri M., Sansosti E. (2010) Anatomy of an unstable volcano from InSAR: multiple processes affecting flank instability at Mt. Etna, 1994-2008. Journal of Geophysical Research, VOL. 115, B10405, 2010.
Ruch J., Acocella V., Storti F., Neri M., Pepe S., Solaro G., Sansosti E. (2010) Detachment depth revealed by rollover deformation: An integreted approach at Mount Etna. Geophys. Res. Lett., VOL. 37, doi:10.1029/2010GL044131, 2010.
Manconi, A., T. R. Walter, M. Manzo, G. Zeni, P. Tizzani, E. Sansosti, and R. Lanari (2010), On the effects of 3-D mechanical heterogeneities at Campi Flegrei caldera, southern Italy, J. Geophys. Res., 115, B08405, doi: 10.1029/2009JB007099.

2.2.c Participant 3: ANALISI E MONITORAGGIO DEL RISCHIO AMBIENTALE – AMRA S.C.A R.L Napoli

Brief description: AMRA S.c.a r.l. is an entirely public, non-profit Company. It was formed in 2005, as a result of an EU funded project. The leading partner of AMRA Scarl is the University of Naples "Federico II", the other partners being four public Universities, CNR, INGV, the Zoological Station "Anton Dohrn". AMRA operates in the fields of natural and anthropogenic risk assessment and mitigation. AMRA owns the ISNET EEW network installed in Irpinia. Early warning methods for natural hazards and quantitative probabilistic multi-risk assessment are his core activities. AMRA operates in close partnership with the National Department of Civil Protection. AMRA has been involved in several EU FP6 projects. It was coordinator of the NARAS (Natural Risk Assessment) Project,. It was promoter and member of the management team of the SAFER (Seismic Early Warning For Europe) Project. AMRA is currently involved in several FP7 Projects. It is coordinating the REAKT (Towards real-time earthquake risk reduction) project and the CLUVA (CLimate change and Urban Vulnerability in Africa). Among the others, it is partner of the following projects: SYNER-G (Systemic Seismic Vulnerability and Risk Analysis for Buildings, Lifeline Networks and Infrastructures Safety Gain); SAFELAND (Living with Landslide Risk in Europe); GEISER (Geothermal Engineering Integrating Mitigation of Induced Seismicity in Reservoirs); MATRIX (New Multi-HAzard and MulTi-RIsK Assessment MethodS for Europe); NERA (Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation).

*Main tasks:*Active involvement in WP 3, 4, 6, 7, 8 and leader of task 4.1

Key personnel involved

Roberto Moretti is Associate Professor at the Dep. Of Civil Engineering of the Second University of Napoli and holds an associate research position at INGV Napoli. He served as Secretary for Geochemistry of European Geoscience Union (EGU).
Lucia Civetta is Full Professor of Geophysics University of Naples "Federico II", and a former Director of Osservatorio Vesuviano, Napoli. Since 2001 she holds an associate research position at INGV Napoli. She is member of the "Great Risks Commission" of the Italian Civil Defense Agency. She has been the coordinator of the last volcanology project on Campi Flegrei "Unrest" funded by the Italian Civil Defense Agency.
Giovanni Orsi is Full Professor of Volcanology and Head of the "Volcanology and Petrology" unit at INGV Napoli.
Roberto Scarpa is Full Professor of Earth Physics and Director of the Environment Research Center of the University of Salerno
Aldo Zollo is Full Professor of Seismology and Solid Earth Physics at University of Naples "Federico II".. Member of the National Commission "Grandi Rischi" and of the (ANVUR) of the Italian Ministry of Research.
Paolo Capuano is Associate Professor of Geophysics at the University of Salerno and holds an associate research position at INGV (Napoli) and at INFN (Salerno).
Agata Siniscalchi is an associate professor at University of Bari expert in methodological and applicative problems concerning the electrical and electromagnetic methods.
Mariarosaria Falanga is a researcher at the University of Salerno. She has expertise in nonlinear methodology devoted to the identification of volcanic seismic signals from background noise.

Recent relevant Publications

Baker D.R., Moretti R. (2011) Modeling the solubility of sulfur in magmas: a 50-year old geochemical challenge. Reviews in Mineralogy and Geochemistry, 58, 167-213.

Battaglia J; Zollo A, Got J-L .(2011) Rates of similar micro-earthquakes: Comparison between Campi Flegrei (Southern Italy) and other volcanic areas J. Volcanol. Geotherm. Res. 200, 62-74

Ciaramella A; De Lauro E; Falanga M; Petrosino S (2011) Automatic detection of long-period events at Campi Flegrei Caldera (Italy)Geophys. Res. Lett., 38, L18302

2.2.d Participant 4: Dipartimento di Protezione Civile (DPC)

Brief description The Civil Protection Department of the Presidency of the Council of Ministers (http://www.protezionecivile.it) is the focal point of the Civil Protection National System, which includes Research Institutes, Private Companies, Volunteers and all Italian operative Forces. The main activities are: forecasting, in order to analyse causes of disaster events, to identify risks and detect risky areas; prevention, to reduce disaster damages; assistance, to ensure elementary aid to the population; management and overcoming of the emergency situations. DPC is involved in many National and International activities related to the evaluation and mitigation of natural risks and crises management (i.e. volcanic, earthquake, landslide).

Main Tasks: DPC will be involved mainly in WP6 an WP8 Activities.

Key personnel involved:
Dr. Vittorio Bosi (DPC team Leader): PhD geologist with experience in geological risk (seismic and volcanic), and remote sensing analysis. He is an expert in seismotectonics, seismic and volcanic hazard evaluations and mapping. He has joined the DPC since 1996 and he has been involved in several projects aimed to volcanic risk in Italy and Fogo (Cape Verde), and to seismic hazard in Italy and Portugal. He worked in projects aimed to volcanic risk at national level (ASI Project) and European level (Eurorisk-Preview). At present he is the referent for the activities related to Eolie Islands, to the diffuse degassing in Italy, to the satellite interferometry on volcanoes. In particular he is the team leader for WP8 in the European Project called MIA-VITA, and he is the scientific DPC responsible for the project.
Dr. Chiara Cardaci: geologist, experience as geophysical researcher on volcanoes and expert in volcanic risk. She works on volcanic monitoring systems, volcanic surveillance, volcanic hazard evaluations and mapping, real time evaluation of the impending risk and crisis scenarios to support civil protection decision-making. She joined the DPC in 2000, where her current role as deputy manager is to coordinate the Volcanic Risk Service. She is in charge of the national commission for the Emergency Plan of Vesuvius and Campi Flegrei Volcanic Caldera.. She is currently involved in projects regarding to volcanic risk at national level (ASI Project) and European level (GMES - ERS: Eurorisk-Preview, Linker and Safer Projects). At present she is the DPC referent for the activities related to Campi Flegrei and Vesuvius.
Dr. Stefano Ciolli: geologist.. He has joined the DPC in 1998, where he works in the Volcanic Risk Service. He is involved in projects aimed at volcanic hazard evaluation and risk management . He was in charge of the National Functional Centre for volcanic risk, to support decision-making and the development of procedures for the national alert system. He represents the DPC in matters related to air traffic management during volcanic eruptions. At present he is the DPC referent for the activities related to Etna volcano
Dott.sa. Arianna Minicocci: Engineer, with 6 years experience in volcanic risk management. She is involved in the DPC's Volcanic Risk Service activities and in the CFSE (Centre for Forecasting and Surveillance of Effects) activities, for the Volcanic Risk Service. She is participate in activities related to the volcanic and national emergency management (Lipari, L'Aquila) and exercises at the national level on the volcanic risk (Mesimex). She joined DPC in 2005, as voluntary civil servant and in 2007 she has been in charged of DPC's contribution to European project BOSS4 GMES.

Recent relevant publications:
D. Ridente, A. Bosman, A. Sposato, D. Casalbore, A. Scalzo, C.Cristiani, V. Bosi, F.L. Chiocci, 2011. Submarine Geohazard Assessment Based on Regional Seafloor Mapping. Example from the Italian ProjectMAGIC (Marine Geohazards along the Italian Coasts). Marine Research at COR - 2011

Bertolaso G., De Bernardinis B., Bosi V., Cardaci C., Ciolli S., Colozza R., Cristiani C., Mangione D., Ricciardi A., Rosi M., Scalzo A., Soddu P. 2007. Civil protection preparedness and response to the 2007 eruptive crisis of Stromboli volcano, Italy;

2.2.e Participant 5: Deutsches Zentrum für Luft- und Raumfahrt (DLR)

Brief description: DLR is Germany's national research center for aeronautics and space. Its extensive research and development work in Aeronautics, Space, Transportation and Energy is integrated into national and international cooperative ventures. The Earth Observation Center (EOC) at DLR consists of the German Remote Sensing Data Center (DFD) and the Remote Sensing Technology Institute (IMF) and is the center of competence for earth observation in Germany. The IMF is focused mainly on developing sensor-specific algorithms and methodologies, whereas DFD concentrates on developing user-oriented products and services. IMF scientists have been involved in SAR data processing since the early days of SEASAT, the first SAR satellite launched by NASA in 1978. They have had and continue to play leading roles in all civil German SAR missions (SIR-C/X-SAR 1994, SRTM 2000, TerraSAR-X 2007, TanDEM-X 2010) and they accompanied ESA in all European SAR missions. The SAR Signal Processing Department (IMF-SV) at IMF is involved in this project. They carry out research on data from spaceborne and airborne SAR instruments and specialise in developing algorithms and software for the focusing and interferometric processing of SAR signals. In addition, new methods and products are developed for geophysical applications. They develop and operate generic, interferometric and D-InSAR processors for purposes such as deriving digital elevation models and determining the rates of ground subsidence.

Main Tasks: DLR's Task is the development, implementation, testing and demonstration of a new satellite based volcano monitoring system. It will automatically order and process SAR data acquired by the TerraSAR-X mission and provide interferometric evaluations for certain regions of interest. DLR will also act as coordinator for WP 2

Key personnel involved:
Michael Eineder received the Diploma in electrical engineering from the University of Munich in 1990 and the Dr. rer. nat. in Radar Remote Sensing from the University of Innsbruck in 2004. He has been with DLR since 1990 and is head of the SAR Signal Processing Department at IMF. He has contributed to radar processing and calibration work for the satellites SIR-C/X-SAR, ERS, ENVISAT, SRTM, TerraSAR-X, TanDEM-X, RADARSAT and ALOS. He was responsible for the SRTM interferometric processor development and calibration and the TerraSAR-X processor design.
Christian Minet received his Diploma in Geology from the Technical University Munich in 2006. He is with DLR since 2006, working in the SAR Signal Processing Department at IMF. His work focuses on monitoring deformations of the Earth's surface using the different methods of exploiting SAR data (InSAR, PS-InSAR, Incoherent Cross-Correlation, SBAS).

Recent relevant publications:
M. Eineder, N. Adam, R. Bamler, N. Yague-Martinez, H. Breit, Helko, "Spaceborne Spotlight SAR Interferometry With TerraSAR-X," IEEE Transactions on Geoscience and Remote Sensing, Vol. 47 (Issue 5), pp. 1524-1535, 2009.
M. Eineder, C. Minet, P. Steigenberger, X. Cong, T. Fritz, "Imaging Geodesy – Toward Centimeter-Level Ranging Accuracy With TerraSAR-X," IEEE Transactions on Geoscience and Remote Sensing, Vol. 49 (Issue 2), pp. 661-671, 2011.
C. Minet, M. Eineder, N. Yague-Martinez, "Haiti Earthquake (12.01.2010) Surface Shift Estimation Using TerraSAR-X Data," Proc. IGARSS 2011, Vancouver, pp. 2488-2491 , 2011.
K. Goel, N. Adam, C. Minet, "Long term analysis of strong non-linear deformations induced by coal mining using the SBAS technique," ESA FRINGE 2011 Workshop, 19.-23. Sept. 2011, Frascati, Italy, 2011.
M. Eineder, A. Roth, C. Minet, F. Amelung, "DLR's Activities to Support the GEO Supersite Initiative with TerraSAR-X Data," ESA FRINGE 2011 Workshop, 19.-23. Sept. 2011, Frascati, Italy, 2011.

2.2.f Participant 6: University of Hamburg (UHH)

Brief description: With about 38,000 students, Universität Hamburg is one of Germany's largest universities. Approximately 650 of the 4,100 academic staff are full professors. These are supported by about 5,800 employees working in technical support, libraries, laboratories, health care and administration. The Institute of Geophysics of the University of Hamburg is committed to studying the interplay between Earth processes like earthquakes, volcanism, tectonics and neotectonics, basin formation, and sediment-ocean interaction.

Main Tasks: Universität Hamburg's Task is the development of numerical models for the interaction of fluid-filled structures (magma-filled dikes and other cracks filled with hydrothermal fluids and gases) with faulting.

Key personnel involved:

Dr. Eleonora Rivalta: expertise in physical modelling of magma-filled dikes and hydrofractures, and in general physical modelling of volcanic processes.

Prof. Torsten Dahm: Volcano seismologist, expert in moment tensor inversion and on the physics of fluids in the Earth's crust.

Dr. Francesco Maccaferri: expertise in boundary element numerical modelling, main author of a code for the modelling of the trajectories of magma-filled dikes under the effects of external factors such as layering or external stress field.

Recent relevant publications:

Rivalta, E., and Dahm, T., 2004. Dyke emplacement in fractured media: application to the 2000 intrusion at Izu islands, Japan , Geophys. J. Int., vol. 157, pag.283-292, doi:10.1111/j.1365-246X.2004.02193.x

Rivalta E., and Segall, P., 2008. , Geophys. Res. Lett., 35, L04306,Magma compressibility and the missing source for some dike intrusions doi:10.1029/2007GL032521.

Maccaferri F., Bonafede M. and Rivalta E., 2010. A numerical model of dyke propagation in layered elastic media , Geophys. J. Int., Vol. 180 N. 3, Pag. 1107 - 1123, doi:10.1111/j.1365-246X.2009.04495.x.

Rivalta E., 2010. Evidence that coupling to magma chambers controls the volume history and velocity of laterally propagating intrusions, J. Geophys. Res., 115, B07203, doi:10.1029/2009JB006922.

Maccaferri, F., Bonafede, M. and Rivalta, E., 2011. A quantitative study of the mechanisms governing dike propagation, dike arrest and sill formation. JVGR, 208, 39-50.

2.2.g Participant 7: Ludwig-Maximilians-University Munich (LMU)

Brief description: Ludwig-Maximilians-University is one of only three universities that achieved elite status in the first round of the German Excellence Initiative. The volcanology group, led by Prof. Dingwell, has 6 permanent staff members, 2 junior professors, 5 PostDocs and 9 PhD students. It has a strong background in Field and Experimental Volcanology. Instrumentation includes shock tubes for decompression experiments, rock characterisation and grain-size analysis, rheology, thermal analysis, geochemistry, petrology, high-speed filming, high-performance computer facilities. LMU involvement in EU-projects: ITN participation (FP6: 12 RTNs, 5 as coordinator); (FP7: 9 ITNs, 2 as coordinator). The volcanology group was involved in EXPLODE, MULTIMO and Volcano Dynamics and is part of the on-going networks MeMoVolc, NEMOH (both FP7 ITNs) and VUELCO (FP7 Cooperation).

Main Tasks: Laboratory experiments and data/sample collection for Sub-Tasks 4.2.3; 5.1.2, 5.2.1, 5.2.3 and 5.3.6

Key personnel involved:

Dingwell, Donald B (Leader of WP4) He is chair of Mineralogy and Petrology, Research Professor of Experimental Volcanology and currently Director of Earth and Environment. His interests are in the understanding of mechanistic sources of unrest signals in volcanic systems. He has been a leader in the field of experimental determination of magma properties and processes for 25 years. He is president of the European Geosciences Union, Chair of Earth and Cosmic Sciences of the Academia Europaea and General Secretary of the ERC.

Hess, Kai-Uwe He is an applied mineralogist with over 15 years of experience in high-temperature and high-pressure experiments in the field of melt rheology, such as for instance viscosity measurements and advanced dilatometry. His further interests comprise neutron and x-ray tomography.

Kueppers, Ulrich He is a geologist specialised in experimental and physical volcanology. He extensively worked on several active volcanoes and performed thorough investigations of particle size and shape and ash generation with respect to fragmentation efficiency.

Lavallée, Yan He is a geologist/petrologist include with expertise in complex rheology, rock deformation and acoustic emission with application to volcanic unrest and eruption forecasting.

Scheu, Bettina She is an experimental geophysicist. She is in charge of the fragmentation laboratory and involved in other sections of the experimental volcanology labs. Her research topics comprise fragmentation dynamics of natural and analogue material, permeability and degassing properties, elastic properties of magmas and magma textures in order to understand and model volcanic processes.

Recent relevant publications:

Heap MJ, Mollo S, Vinciguerra S, Lavallée Y, Hess KU, Dingwell DB, Baud P, Iezzi G (2012). Calcination-driven deterioration of the carbonate basement under Mt. Etna volcano (Italy): implications for volcano instability. Accepted in Journal of Volcanology and Geothermal Research.

Kueppers U, Auer B, Cimarelli C, Scolamacchia T, Dingwell DB (2011) Experimentally constraining the boundary conditions for volcanic ash aggregation. Geophysical Research Abstracts Vol. 13, EGU2011-11999.

Lavallée Y, Heap M, Dingwell DB, Calcination-driven collapse at volcanoes. In review in Solid Earth.

Mueller S, Scheu B, Spieler O, Dingwell DB (2008) Permeability control on magma fragmentation, Geology, v.36 (5), 339-402, doi: 10.1130/G24605A.1.

Scheu B, Kueppers U, Mueller S, Spieler O, Dingwell DB (2008) Experimental volcanology on eruptive products of Unzen volcano. Journal of Volcanology and Geothermal Research, 175 (1-2), 110-119.

2.2.h Participant 8: Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum (GFZ)

Brief description:: GFZ was founded in 1992 as the national research institution for geosciences in Germany and is *ab initio* member of the Helmholtz Association of National Research Centres. With currently more than 1100 staff GFZ combines all solid earth science fields including geodesy, geology, geophysics, mineralogy, palaeontology and geochemistry, in a multidisciplinary scientific and technical environment. Research is accomplished using a broad spectrum of methods, such as in-situ monitoring and observations, satellite geodesy and remote sensing, deep geophysical sounding, scientific drilling, and the experimental and numerical modeling of geo-processes. In order to furnish its operations around the globe and in space, GFZ maintains massive scientific infrastructure and platforms, including observatories, a modular Earth science infrastructure, the home base of the International Continental Scientific Drilling Programme (ICDP) with the Operational Support Group, the novel drilling InnovaRig, and the Centre for GeoInformation Technology CEGIT, to name the most relevant for this project. In 2012 a BubbleLab will start its operation allowing the simulation of earthquake waves and their effect on various types of fluid reservoirs. GFZ has a relevant experience in coordinating and participating to international projects, e.g. TRIDEC, Collaborative, Complex and Critical Decision-Support in Evolving Crises (FP7-ICT-2009); GEISER, Geothermal Energy Integrating Mitigation of Induced Seismicity in Reservoirs (FP7-ENERGY-2009); CO2CARE, CO2 Site Closure Assessment Research (FP7-ENERGY-2010); GITEWS German Indonesian Tsunami Early Warning System Project;; SAFER, Seismic Early Warning for Europe (FP6: ENV 6.3.IV.2.3); SHARE, Seismic hazard harmonization in Europe (FP7-ENV-2008); MATRIX, New Multi-Hazard and Multi-Risk Assessment Methods for Europe (FP7-ENV-2010); REAKT, Strategies and Tools for Real Earthquake Risk Reduction (FP7-ENV-2011).

Main tasks: GFZ will focus on pressure transients in fluid reservoirs including the dynamic interaction between seismic waves from local and distant earthquakes and the pressure of hydrothermal systems through a combination of (i) experiments under lab conditions focusing on the role of bubbles (BubbleLab), and (ii) continuous pressure monitoring at geothermal wells in the Campi Flegrei area. Additionally, GFZ will contribute to seismic noise measurements.

Key personnel involved:
Jochen Zschau: Head of the Section "Earthquake Risk and Early Warning";
Heiko Woith: Earthquake hydrogeology with many years of experience in long-term monitoring of thermal waters;
Thomas R. Walter: InSAR crustal deformation modelling and signal decomposition; Woith and Walter are the responsible PIs for the operation of the BubbleLab at GFZ;
Rongjiang Wang: Numerical modelling of dynamic interactions between seismic waves and reservoirs; Stefano Parolai: Seismological site effects and amplification.

Recent relevant publications:

Picozzi, M., Parolai, S., Bindi, D., 2010. Deblurring of frequency-wavenumber images from small-scale seismic arrays. Geophysical Journal International, 181, 1: 357-368.
Wang, R., Woith, H., Milkereit, C., Zschau, J., 2004. Modelling of hydrogeochemical anomalies induced by distant earthquakes. Geophysical Journal International 157: 717-726.
Walter, T.R., Wang, R., Acocella, V., Neri, M., Grosser, H., Zschau, J., 2009. Simultaneous magma and gas eruptions at three volanoes in southern Italy: an earthquake trigger? Geology, 37, 3: 251-254.
Woith, H., Barbosa, S., Gajewski, C., Steinitz, G., Piatibratov, O., Malik, U., Zschau, J., 2011. Periodic and transient radon variations at the Tiberias hot spring, Israel during 2000-2005. Geochemical Journal 45: 473-482.

2.2.i Participant 9: Durham University (UNIVDUR)

Brief description: The University of Durham, in the United Kingdom, was founded in 1832. It has over 15,000 undergraduate and postgraduate students (of whom 3,500 are postgraduates and 1,900 international students from over 120 countries) and employs over 3,000 staff. Its academic teaching and research programmes are delivered through departments organised within three faculties: Arts and Humanities, Science, and Social Sciences and Health. Durham University is one of the UK's leading research universities and has been successfully involved, both as partner and co-ordinator, in a large number of Framework Programme projects and networks. The University is engaged in several aspects of activity such as high-quality teaching and learning, advanced research and partnership with business, and regional and community partnerships and initiatives. The University's strategy is directed at creating the future through internationally recognised research, scholarship and learning within a distinctive collegiate environment.

Main Tasks: Analyze data to provide 3D seismic tomography model of Mt. Etna. Liaise with other team members to improve methodologies to optimize them for the Etna case. Integrate the results with other analyses. Disseminate results via meetings, conference presentations, public outreach and the media.

Key personnel involved:

Gillian R. Foulger and her co-workers have worked in seismic tomography on various scales for over 20 years, studying 5 active volcanic and geothermal areas, and the whole mantle beneath Iceland. Her group is currently developing a new, improved tomography program that can obtain structure deeper than local sources sample, by including rays from regional earthquakes. This code will be available for the Etna experiment.

Recent relevant publications

Julian, B.R. and G.R. Foulger, Time-dependent tomography, Geophys. J. Int., 182, 1327-1338, 2010.

Julian, B.R., G.R. Foulger and F. Monastero, Time-dependent seismic tomography and its application to the Coso geothermal area, 1996-2006, Proceedings, Thirty-Third Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, January 28-30, SGP-TR-185, 387-390, 2008.

Foulger, G.R., Towards Supervolcano technology, Science, 313, 768-769, 2006.

Foulger, G.R. and B.R. Julian, A powerful tool – Use of time-dependent MEQ tomography for monitoring producing geothermal reservoirs, Geotherm. Res. Council Bull., 33, 120-126, 2004.

Gunasekera, R.C, G.R. Foulger and B.R. Julian, Reservoir depletion at The Geysers geothermal area, California, shown by four-dimensional seismic tomography, J. Geophys. Res., 108, B3, 10.1029/2001JB000638, 2003.

Foulger, G.R., M.J. Pritchard, B.R. Julian, J.R. Evans, R.M. Allen, G. Nolet, W.J. Morgan, B. Bergsson, P. Erlendsson, S. Jakobsdottir, S. Ragnarsson, R. Stefansson and K. Vogfjord, Seismic tomography shows that upwelling beneath Iceland is confined to the upper mantle, Geophys. J. Int., 146, 504-530, 2001

2.2.j Participant 10: University of Bristol (UNIBRIS)

Brief description: With about 16000 full-time students and more than 5000 staff, the University organises its academic affairs in some 34 departments and 15 research centres which are arranged in six faculties. League tables generally place Bristol within the top ten universities in the United Kingdom and within the top 30 in the world. The School of Earth Sciences was ranked in the top 5 UK Earth and Environmental Sciences for research by the HEFCE in 2008. The school encompasses five research groups covering the spread of Earth Sciences topics. The Volcanology group is a global leader in the area of field and laboratory investigations of active and young volcanoes, theory development and modeling. All group members are associated with the Cabot Institute a world-class multidisciplinary institute for research on all aspects of global environmental change, from basic science and social science to technological and policy solutions. It brings together some of Bristol's most outstanding research – in natural hazards and risk, Bayesian statistics, uncertainty and decision-making, climate modeling, poverty, global insecurities and governance, and systems engineering.

Main Tasks: 4.2, 4.3 and WP8, with active involvement in WP 2, 5, 6.

Key personnel involved:

Dr. Joachim Gottsmann currently holds a Royal Society University Research Fellowship (2005-2013) and is proleptic senior lecturer at the School of Earth Sciences. He has broad interests in the geology and geophysics of active volcanic systems including multiparametric geophysical analyses with a particular focus on integrated geodetic timeseries investigations and mathematical modeling of volcanic systems undergoing unrest. He also has interests in the analysis of volcanic threat and perception of volcanic risk in areas affected by unrest activity. He has been officer for Volcanic Hazards of EGU's Natural Hazards sections, leader of the IAVCEI Commission on Collapse Calderas (2005-9) and is recipient of the 2008 IAVCEI Wager Medal. He currently holds a number of research grants with relevance to the project from the Royal Society, the National Environmental Research Council, and the European Commission. He is the scientific coordinator of the VUELCO collaborative project (282759) financed under theme ENV.2011.1.3.3-1 by the EC's 7th framework programme.

Recent relevant publications:

Hautmann, S., Gottsmann, J., Sparks, R. S. J., Mattioli, G. S., Sacks, I. S., and Strutt, M. H., 2010, Effect of mechanical heterogeneity in arc crust on volcano deformation with application to Soufriere Hills Volcano, Montserrat, West Indies: Journal of Geophysical Research-Solid Earth, v. 115, B09203

Geyer, A., and Gottsmann, J., 2010, The influence of mechanical stiffness on caldera deformation and implications for the 1971-1984 Rabaul uplift (Papua New Guinea): Tectonophysics, v. 483, no. 3-4, p. 399-412.

Kinvig, H. S., Geyer, A., and Gottsmann, J., 2009, On the effect of crustal layering on ring-fault initiation and the formation of collapse calderas: Journal of Volcanology and Geothermal Research, v. 186, no. 3-4, p. 293-304.

Gottsmann, J., Carniel, R., Coppo, N., Wooller, L., Hautmann, S., and Rymer, H., 2007, Oscillations in hydrothermal systems as a source of periodic unrest at caldera volcanoes: Multiparameter insights from Nisyros, Greece: Geophysical Research Letters, v. 34, no. L07307, p. doi:10.1029/2007GL029594.

Gottsmann, J., Berrino, G., Rymer, H., and Williams-Jones, G., 2003, Hazard assessment during caldera unrest at the Campi Flegrei, Italy: a contribution from gravity-height gradients: Earth and Planetary Science Letters, v. 211, no. 3-4, p. 295-309.

2.2.k Participant 11: Centre national de la recherche scientifique (CNRS) [IPGP, ISTO, ISTERRE, LMV, ENS]

Brief description: CNRS partner groups 5 French research Institutes (see below). CNRS will coordinate both WP5 and WP7 and, through its team components, will contribute to WP3, WP4, WP5 and WP7 RDT activities.

General description of the partner institution

Institut de Physique du Globe de Paris (IPGP)
IPGP will be leader of the French consortium. IPGP is a mixed research Unit (UMR7154) of CNRS and Paris Diderot University. It hosts 330 permanent researchers, engineers and technicians, 65 on contracts, and 90 doctorate students. Scientists are grouped in 13 research teams working in various fields of Earth and Planetary Sciences. Three of those teams have strong international expertise in geophysics, field and physical volcanology, gas geochemistry and remote sensing, magma petrology and geochemistry, and numerical/ analogue modelling of geological fluid dynamics. IPGP is the Institute responsible for the monitoring of French active volcanoes and shares the management of Montserrat Volcano Observatory.

Main Tasks: IPGP participants will contribute to WP3, WP4 and WP5. IPGP researcher P. Allard will coordinate the WP7.

Key personnel involved:

Patrick Allard, is Director of research in French CNRS, attached to IPGP. He has been specialized in studies of volcanic gas emissions and magma degassing processes.. He is coordinator of the IPGP transverse research programme in Volcanology, co-Leader of the IAVCEI Commission on Volcanic Gases, President of Section 3 (Volcanology) of French CNFGG, and member of several steering or evaluating committees. He has coordinated or be PI several research contracts at national, European (ETNA's VOLATILES; FURNAS VOLCLAB; MVRRS; AGMV) and international levels. He has stayed in volcano observatories (Soufrière of Guadeloupe; Vesuvius; Etna), and has been secretary of the French governmental Committee for the Evaluation of Volcanic Risks (CSERV, 1983-85). He is author or co-author of more than 80 publications in A-ranked journals, plus a dozen of papers in books or special volumes, and has a current h-index of 27. He will coordinate the WP7 and the sub-task 5.2.1 of WP5.
Nicole Métrich, is Director of research in French CNRS and attached to IPGP. She is specialized in the study of dissolved volatiles in magmas and magma petrogenesis using sophisticated micro-beam tools. She has coordinated several research contracts at European levels and his associate researcher of INGV-Pisa. She is author or co-author of more than 70 publications in A-ranked journals, plus a tenth of papers in books or special volumes, and has a current h-index of 26.

Recent relevant publications:

Allard P. (2010) A CO2-rich gas trigger of explosive paroxysms at Stromboli basaltic volcano. J. Volcan. Geotherm. Res., 189, 363–374.

Métrich N., Allard P., Bertagnini A., Di Muro A. (2011) Comment on 'Conduit convection, magmamixing, and melt inclusion trends at persistent degassing volcanoes' by Fred Witham, published in Earth Planetary Science Letters (2011) 301, 345–352. Earth Plan. Sci. Letters, 306, 3−4, 306−308.

Métrich N. , Allard P., Aiuppa A., Bani P., Bertagnini A., Belhadj O., Di Muro A., Garaebiti E.,Massare D., Parello F., Shinohara H. (2011) Magma and volatile supply to post−collapse volcanism and block resurgence in Siwi caldera (Tanna island, Vanuatu arc). J. of Petrology, 52, 1077−1105, doi:10.1093/petrology/egr019.

Pino A., Moretti R., Allard P., Boschi E. (2011) Seismic precursors of a basaltic paroxysmal explosion track deep gas accumulation and slug upraise. J. Geophys. Res.-Solid Earth, B02312, 1-13, doi:10.1029/2009JB000826.

Institut des Sciences de la terre d'Orléans (ISTO)

ISTO is a mixed research Unit (UMR7327) of CNRS, Orléans University and BRGM. It hosts 70 permanent researchers, engineers and technicians, and 35 doctorate students, and 15 postdoc. Scientists are grouped in 4 research teams working in various fields of Earth and Planetary Sciences. One of those teams is involved in volcanology studies, with strong international expertise in experimental petrology aimed at defining pre-eruptive conditions, volatile solubilities, physical properties of magmas.

Main Tasks: ISTO participants will contribute to WP5

Key personnel involved:

Bruno Scaillet, 49, is Director of research in French CNRS. He has over 20 years of experience in experimental studies aimed at unravelling magmatic and volcanic processes, including on several Italian volcanoes (Vesuvius, Pantelleria, Etna, Stromboli). He is author or co-author of more than 85 publications in A-ranked journals with a current h-index of 28.
Giada Iacono Marziano, 33, is research scientist in French CNRS. She is specialized in the study of experimental simulations of magma contamination, the determination of solubilities of key species such as CO2, or of noble gases. She is author or co-author of 15 publications in A-ranked journals,
Michel Pichavant, 56, is Director of Research at French CNRS. He has over 30 years of experience in experimental petrology, with special emphasis on fluid-related processes, phase equilibria, and volatile solubilities, including on several Italian volcanoes (Stromboli, Vesuvius). He is author or co-author of more than 130 papers in A-ranked journals, with an h-index of 36.
Fabrice Gaillard, 37, is Research Scientist at French CNRS. He has 12 years of of experience in experiments with special emphasis on the determination of electrical properties of magmas at high pressure and high temperature. He is author of 26 papers in A-ranked journals with and H-index of 11.

Recent relevant publications:

Gaillard Fabrice; Scaillet Bruno; Arndt Nicholas T. 2011. Atmospheric oxygenation caused by a change in volcanic degassing pressure. Nature 478, 229-232
Lesne Priscille; Scaillet Bruno; Pichavant Michel; et al. (2011) The H2O solubility of alkali basalt: an experimental study. Contrib. Mineral. Petrol 162, 133-151
Lesne Priscille; Scaillet Bruno; Pichavant Michel; et al. (2011). The carbon dioxide solubility in alkali basalts: an experimental study. Contrib. Mineral. Petrol 162, 153-168
Iacono-Marziano Giada; Paonita Antonio; Rizzo Andrea; et al. (2011). Noble gas solubilities in silicate melts: new experimental results and a comprehensive model for the effects of liquid composition, temperature and pressure. Chemical Geology 279, 145-157
Di Carlo Ida; Rotolo Silvio G.; Scaillet Bruno; et al. (2010). Phase equilibrium constraints on pre-eruptive conditions of recent felsic explosive volcanism at Pantelleria Island, Italy. Journal of Petrology 51, 2245-2276.
Pichavant Michel; Di Carlo Ida; Le Gac Yann; et al. (2009). Experimental constraints on the deep magma feeding system at Stromboli volcano, Italy. Journal of Petrology 50, 601-624.
Iacono-Marziano Giada; Gaillard Fabrice; Scaillet Bruno; et al. (2009). Role of non-mantle CO2 in the dynamics of volcano degassing: the Vesuvius example. Geology 37, 319-322.

Ecole Normale Supérieure (ENS)

The Laboratoire de Géologie (http://www.geologie.ens.fr) is specialized in the study of the Earth deformation at all ranges of timescale, from second (seismology) to million years (mantle rheology). One of its research axes is Earth dynamics and earthquakes. The laboratory has worked or is working on the several large earthquakes that occurred in the last decades and in particular the three giant earthquakes of Sumatra (2004), Chile (2010) and Japan (2011), with particular focus on the ground deformations observed with GPS and SAR interferometry. The laboratory is involved in field GPS monitoring with campaign and permanent GPS in Chile, Indonesia, Greece, Bulgaria, Guatemala. It occupies a leading position in two observatories, the Laboratoire International Associé "Montessus de Ballore" (https://www.lia-mb.net/) in Chile and the Corinth Rift Laboratory (http://crlab.eu) in Greece. It is also one of the leading institutions in the GPSCOPE project (http://gpscope.fr and https://gpscope.dt.insu.cnrs.fr) which is a national initiative gathering various CNRS laboratories involved in Geophysical GPS. Pierre Briole has a long experience in measuring and modelling surface deformation induced by seismic activity (seismology, GPS and Insar). ENS participates in various national and international R&D projects, in collaboration with several research institutions, in particular in the countries where it has installed sensors in the field. ENS has participated and currently participates to several EU projects relevant to the hazard theme (EU projects CORSEIS, AEGIS, ASSEM, 3HAZ, SISCOR, REAKT for Greece, ANR projects for Chile and Indonesia).

Main Tasks: ENS participants will contribute to WP3, WP5. P. Briole is the Leader of the WP5

Key personnel involved:

P. Briole, senior CNRS researcher, is expert in geodesy and remote sensing applied to volcanoes and seismic zones. He has been measuring and modelling since twenty years the ground deformation of several volcanoes in the Italy (Etna, Campi Flegrei, Vulcano), France (Piton de la Fournaise), Greece (Nisyros), Japan (Sakurajima, Myakejima), Portugal (Sao Miguel island). He has been also involved in the study of seismic areas in Greece (Gulf of Corinth), Chile (Atacama), Djibouti (Asal Rift), Algeria (Algiers region). He has been involved in fast post-seismic response, involving both field GPS campaigns and InSAR studies, after the 1992 earthquake of Galaxidi (Greece) the 1995 earthquakes of Grevena and Aigion (Greece), the 1995 earthquake of Antofagasta (Chile), the 1997 earthquakes of Umbria (Italy), the 1999 earthquake of Athens (Greece), the 2003 earthquake of Boumerdes (Algeria), the 2003 earthquake of Bam (Iran), the 2005 earthquake of Mushafarabad (Pakistan). P Briole has been involved in several EU and ESA project concerning the monitoring on volcanoes in the last decade (TEKVOLC, MADVIEWS, EMPEDOCLE, ROBOVOLC, EMEWS, see http://briole.iterre.fr/spip/Projets.html).

Recent relevant publications:

Cavalie, O., M. P. Doin, C. Lasserre, and P. Briole, Ground motion measurement in the Lake Mead area, Nevada, by differential synthetic aperture radar interferometry time series analysis : Probing the lithosphere rheological structure J. Geophys. Res., 112, 2007

Mahsas A., K Lammali, K Yelles, E Calais, AM Freed, P Briole, Shallow afterslip following the 2003 May 21, M-w=6.9 Boumerdes earthquake, Algeria. Geophys. J. Int., v. 172, p. 155-166, 2008.

Briole P, Willis P, Dubois J, Charade O Potential volcanological applications of the DORIS system. A geodetic study of the Socorro Island (Mexico) coordinate time series Geophys. J. Int. 178, 1, 581−590, 2009.

Floyd M.A., Billiris H., Paradissis D., Veis G., Avallone A., Briole P., McClusky S., Nocquet J.M., Palamartchouk K., Parsons B., England P.C. A new velocity field for Greece: Implications for the kinematics and dynamics of the Aegean, J. Geophys. Res., 115, B10403, 2010.

F. Guglielmino, C. Bignami, A. Bonforte, P. Briole, F. Obrizzo, G. Puglisi, S. Stramondo, U. Wegmuller, Analysis of satellite and in situ ground deformation data integrated by the SISTEM approach: The April 3, 2010 earthquake along the Pernicana fault (Mt. Etna - Italy) case study, Earth Planet. Sci. Lett., 2011.

<u>ISTerre (Institut des Sciences de la Terre)</u>

It is a laboratory dedicated to Earth and Environmental Sciences. It was created in 2010 by merging the LGIT and the LGCA. It belongs to the CNRS (National Centre for Scientific Research), University Joseph Fourier in Grenoble (UJF), Université de Savoie in Chambery (UdS), IRD and LCPC. It hosts about 250 persons, including 92 academics, 50 technical and administration staffs, 19 postdocs and 90 Ph.D. students. The annual budget is 4.9 M€ (without salaries for permanent staff and academics). 55% of this budget comes from contracts, and 16% from the CNRS. 10% of the budget is dedicated to observation activities.

ISTerre hosts 9 research groups covering the major fields in this discipline: Seismic cycle and transitory movements, Geochemistry 4D, Geodynamo, Volcanos geophysics, Faults mechanics, Mineralogy and environments, Waves and structures, Tectonics reliefs and basins, and Seismic Risks. The laboratory has produced 836 articles in international journals between 2005 and 2009 (162 per year on average), including 24 in journals with Impact Factor > 5.

As a member of the OSUG (Observatoire des Sciences de l'Univers de Grenoble), ISTerre is responsible for a number of national facilities for permanent (OMIV, RAP, RENAG, RENASS, RLBP) and mobile (SISMOB) observations in geophysics, and data centers (FOSFORE, RAP). It is involved in research infrastructures for European seismology (NERIES, RESIF which is part of EPOS). ISTerre scientists have close connections with beamlines at synchrotron and neutron facilities in Grenoble (ESRF and ILL), Paris (SOLEIL) and abroad.

With 41 professors and assistant professors, ISTerre is strongly involved in teaching programs : Licence and Master programs in earth sciences, seismology, physics, hydrology and geochemistry at the UJF and UdS, Master in applied material sciences at Polytech Grenoble", and bachelor in mechanics and physics at the IUT.

2.2.l Participant 12: Bureau de Recherches Géologiques et Minières (BRGM)

<u>*Brief description*</u>: BRGM is a French public institution providing R&D and expertise for public policies, decision making and citizen information in different fields of the Earth Sciences. Activities at BRGM cover areas such as observation, mapping and databases, development and modeling for surface and subsurface processes, natural risks evaluation, management and mitigation and the protection of the environment. BRGM also provides support for EU policies in partnership with other geological surveys (EuroGeoSurveys). The Risks (RIS) division, which will be involved in the MED-SUV project, features teams of renowned international experience in the fields of geotechnical, earthquake, landslide, coastal and structural engineering, emergency management with activities related to geophysical monitoring, numerical modeling, natural hazards evaluation, vulnerability assessment and risk mitigation. BRGM has coordinated or contributed to many EC research projects in risk and vulnerability evaluation fields, including MIAVITA on the volcanic risk management, and many others like: RISK-BASE, LESSLOSS, ORCHESTRA (FP6); ENSURE, SHARE, SAFELAND, PERPETUATE, SYNER-G, MATRIX, ENVISION, REAKT, EuroGEOSS (FP7).

<u>*Main Tasks*</u>: BRGM will lead WP8 on Dissemination and will participate in WP2, WP5 and WP6

<u>*Key personnel involved*</u>:
Hormoz Modaressi, (PhD Ecole Centrale Paris,1987). Head of the RNSC division of BRGM since 1999 and professor at the Polytech School of Engineering of Pierre and Marie Curie University (Paris VI) since 1996. He was an expert evaluator for the 5th, 6th and 7th EC Framework Programmes. He is author of more than 100 scientific publications.
Mickael Delatre, PhD in seismology, is currently involved in the modeling of strong earthquake with hybrid methods, and the use of microseismicity and seismic noise to monitor underground objects (CO_2 or geothermal reservoirs with FP7 CO2CARE and GEISER)
Marcello De Michele is a researcher in remote sensing. "Laurea" in Geological Sciences, M.Sc. in remote-sensing and PhD in seismo-tectonics, Marcello de Michele's research focuses on InSAR processing and Sub Pixel offset techniques for ground displacement measurements. His main interests are remote sensing applications to seismotectonics and natural hazards.
Daniel Raucoules is a researcher at the French Geological Survey (BRGM). PhD in Physics he is specialised in remote sensing techniques applied to ground displacement studies. In particular, he focuses on processing of InSAR and optical satellite imagery to natural risks monitoring.
Jeremy Rohmer (Paris School of Mines, major in geotechnical sciences, 2005), his research focuses on uncertainty analysis within risk assessments (seismic, landslide, CO_2 geological storage), more specifically for experts' information treatment and epistemic uncertainty reduction through global sensitivity analysis.
Amélie Vagner (SUPELEC, 2006) Specialist in Systems and Automation Engineering, she is currently involved as Project manager of FP7 MIAVITA and works on technical activities related to vulnerability assessment (ENSURE, SYNER-G).

<u>*Recent relevant publications*</u>:
Rohmer J., Baudrit, C., (2011) The use of the possibility theory to investigate the epistemic uncertainties within scenario-based earthquake risk assessments. Natural Hazards, Vol. 56, Issue 3, 613-632.
de Michele M., Raucoules D., Salichon J., Lemoine A., Aochi H., Spatiotemporal evolution of surface creep in the Parkfield region of the San Andreas Fault (1993- 2004) from Synthetic Aperture Radar, Earth and Planetary Science Letters, 308, 141-150 (2011).
Raucoules D., de Michele M., Assessing ionospheric influence on L-band SAR data: Implications on co-seismic displacement measurements of the 2008 Sichuan Earthquake, IEEE Geoscience and Remote Sensing Letters, 7, 2, 286-290 (2010).

2.2.m Participant 13: European Space Agency (ESA)

Brief description: ESRIN, the ESA EO centre located in Italy, is responsible for collecting, storing and distributing EO satellite data. Major EO activities today are related to the exploitation of the ERS missions (ERS-1: '91 - 2000, ERS-2: launched in '96) and Envisat (launched early '02). ESA actively supports projects aimed at optimising the accessibility and use of these data. Examples of relevant ESA-funded EO Programmes are the Data User, the Marked Development and the GMES (Global Monitoring for Environment and Security) Service Element Programme. Through these programmes and via participation to EC-funded projects, ESA has obtained excellent contacts with the EU Earth science and EO user community. ESA is also active in promotion of relevant technology (Grid, digital libraries, portals, web-services) for various space-related applications, including Earth science & EO.

Main Tasks: Involved in WP3 activities.

Key personnel involved:
Dr. Pierre-Philippe Mathieu, is an Earth Observation Applications Engineer in the Earth Observation Science & Applications Department of the European Space Agency in ESRIN (Frascati, Italy) since 2003. For the last 15 years, he has been working in the field of environmental modelling, Earth System Science, Weather Risk Management and remote sensing applications. He is quite experienced in managing R&D and industrial projects. And in working with a variety of users, including public & private organisations, development banks, policy makers and scientists. He has a degree in mechanical engineering and M.Sc from University of Liege (Belgium), a Ph.D. in oceanography from the University of Louvain (Belgium), and a Management degree from the University of Reading Business School (Uk).
Dr Roberto Cossu, working in ESA since 2005, has been working in several projects dealing with different aspects of EO applications and related innovation technologies. For the last few years, he has been contributed to the ESA participation in the development and utilization of Grid, Open GIS, emerging Web-based and e-collaboration technologies for EO and environmental applications throughout ESA and EC-funded projects. In the ESA participation to EC FP6 and FP7 activities, he has been in charge of the ESA contribution (as work package and Task leader) to: the Grid support action for Earth Science – DEGREE; Collaborative Working Environment - Collaboration@Rural, GENESI-DR. He is currently Project Director Project GENESI-DEC (Ground European Network for Earth Science Interoperations - Digital Earth Communities). He has published many papers in various international journals and conferences.

Previous experiences:
ESA - eoPortal aims to provide a single access point for EO information and services including satellite imagery, a directory to locate data and resources, direct access to EO-satellite data as well as map servers and cartographic resources - http://www.eoportal.org/.
ESA internal Earth Science Grid on Demand, develops a framework for EO investigators to easily deploy their algorithms or processing modules using Grid and providing fast access to Envisat and other ESA data - http://giserver.esrin.esa.int/grid2004.
EU - DEGREE, Dissemination and Exploitation of GRids in Earth sciencE promotes the Grid culture within different areas of Earth Science and the use of Grid as platform for e-collaboration.
EU – GENESI-DR, Ground European Network for Earth Science Interoperations – Digital Repositories
EU – GENESI-DEC, Ground European Network for Earth Science Interoperations- Digital Earth Communities
EU – ENVRI, Environmental Research Infrastructure
EU – GEOWOW- GEOSS interoperability for Weather, Ocean, and Water
GEO – GEO WebPortal.

2.2.n Participant 14: Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC)

Brief description: The Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC) is the largest public multidisciplinary research organisation in Spain. CSIC collaborates with national and International universities, public RTD organisations, SMEs, companies and other institutions of a scientific/technological nature. It has a staff of more than 13,500 employees, among these about 3,500 are permanent researchers and more than 4,000 are pre- and post-doctoral researchers. The CSIC has 135 institutes or centres distributed throughout Spain, including 51 Joint Research Units with universities or other research institutions. There is also a delegation in Brussels. It has considerable experience in both participating and managing RTD projects and training of research personnel. Under the 6th Framework Programme CSIC has signed 404 actions (of which 37 coordinated by CSIC). CSIC has been the 5th organisation in Europe in project execution and funding in the 6th FP. Under the 7th FP CSIC has signed as of today more than 459 projects (including 51 coordinated by CSIC as well as 22 ERC).
The Institute of Geosciences (IGEO) is the largest Earth Sciences Institute in Spain. The participant team have a great experience in geodetic research, applying ground and space-based geodetic techniques to the monitoring of volcanic hazards, data integration (GPS, InSAR, optical,…) to obtain 3D displacement field, as well as theoretical modelling (direct and inverse problem), being able to do simultaneous interpretation of terrestrial and space data of deformation and gravity changes. This team has taken part in a wide range of national and international projects, including several EU and ESA projects, in which the members have been involved actively.

Main Tasks: Data integration (WP3, WP7), deformation modelling, structural studies using gravity data, inverse problem solution for interpretation of geodetic and gravity data (WP4, WP5, WP7).

Key personnel involved:
José Fernández, Research Scientist, born in 1963, is expert in Geodesy applied to natural and anthropogenic hazards, including ground and space base techniques, the combination of both kind of data to obtain 3D displacement field and deformation modelling, having developed and implemented techniques for joint interpretation of displacement and gravity changes. He has more than 170 reviewed papers published in journals and books (81 in SCI journals) with more than 940 citations. He has participated in 56 research projects and contracts (34 as PI or Co-PI).
Antonio G. Camacho, Tenured Scientist, born in 1958, is expert in direct modelling and inverse problem for simultaneous interpretation of displacement and gravity changes measured using ground and space base techniques, and structural and monitoring studies using gravity data.

Recent relevant publications:
Camacho, A.G., J. Fernández and J. Gottsmann, 2011. A new gravity inversion method for multiple sub-horizontal discontinuity interfaces and shallow basins. J. Geoph. Res., 116, B02413, doi:10.1029/2010JB008023.
Camacho, A.G., González, P.J., Fernández, J., Berrino, G., 2011. Simultaneous inversion of surface deformation and gravity changes by means of extended bodies with free geometry. An application to deforming calderas. J. Geoph. Res., 116, B10401, doi:10.1029/2010JB008165.
González, P.J., Fernández, J., 2011. Error estimation in multitemporal InSAR deformation time series, with application to Lanzarote, Canary Islands. J. Geoph. Res., 116, B10404, doi:10.1029/2011JB008412.
González, P.J., Samsonov, S., Manzo, M., Prieto, J.F., Tiampo, K.F., Tizzani, P., Casu, F., Pepe, A., Berardino, P., Camacho, A.G., Lanari, R., and Fernández, J., 2010. 3D volcanic deformation fields at Tenerife Island: integration of GPS and Time Series of DInSAR (SBAS). Cahiers du Centre Europ. Géodyn. Séism., 29, 44-50. ISBN: 978-2-91989-708-7.s

2.2.o Participant 15: University of Granada (UGR)

Brief description: The UGR research group is leader by Prof. Jesús Ibáñez, full professor in Physic of the Earth, and it is composed by professors and researchers of the research group of the UGR from the Andalusian Institute of Geophysics. This group has broad experience in analysis of seismic signals in different volcanoes as: Etna, Stromboli, Vesuvius, Campi Flegrei, Teide, Azores, Colima, Popocatepelt, Arenal, Telica, San Cristóbal, Copahue, Kilauea or Deception Island. Among different research lines, array analysis, seismic tomography, volcanic signal source location and analysis or automatic signal recognition are the most productive from the scientific point of view. The group has participated in several European and National research projects, and it has managed, in the last 10 years, a few millions of Euros. In the last 5 years the group has published more than 35 high quality scientific papers, presented more than 60 communications in international meetings, presented more than 10 doctoral thesis, and other scientific products. The group is the responsible of the use and management of a broad portable seismic network, focused in the study of volcanic seismicity. It is composed by 10 modules of 12 channels seismic array, and 15 broad band seismometers. Some of the seismic arrays are, at the present, deployed in active volcanoes as Colima, Copahue or Deception island. Many of the results of the group are directly applied to the early warning alert of different volcanoes, and some of the members of the group are permanent advisors of different Civil Protection organizations of Spain, Italy, Mexico or Argentina. The group has a large experience in active seismic experiments in volcanoes, being responsible of two of them, one developed in the Antarctica (Deception Island) and the second one in Tenerife Island (Canary Island, Spain) using a very similar structure proposed in the present project

Main Tasks: Seismic experiment in WP5.

Key personnel involved:
Prof. Jesús Ibañez, Director of Instituto Andaluz de Geofisica, Campus de Cartuja s/n, Universidad de Granadal.

Recent relevant publications:
Carmona, E., Almendros, J., Peña, J.A. and Ibáñez, J.M. Characterization of fracture systems using precise array locations of earthquake multiplets: An example at Deception Island volcano, Antarctica. J. Geoph. Res., 115. Doi: 10.1029/2009JB006865, 2010.

Dawson, P.B., Benitez, C., Chouet, B., Wilson, D. and Okubo, P.G., Monitoring very-long-period seismicity at Kilauea Volcano, Hawaii. Geoph. Res. Lett., 37, L18306, doi:10.1029/2010GL044418, 2010

Ibáñez, J. M., Benítez C., Gutiérrez, L. A., Cortés, G., García-Yeguas A.and Alguacil, G. Discrimination between different volcanic signals using Hidden Markov Model: an example of Stromboli and Etna volcanoes. Journ. Vol. Geotherm. Res., 187, 218-226. Doi 10.1016/j.jvolgeores. 2009.09.002.

Palo, M., Ibáñez, J.M., Cisneros, M., Bretón, M., Del Pezzo, E., Ocaña, E. and Posadas, A. (2009). Analysis of the wavefield properties of the volcanic explosions at Volcán de Colima, México: insight of the source mechanism. Geophy. Journ. Int., 177, 1383-1398.

Zandomeneghi, D., Barclay, A., Almendros, J., Ibáñez, J.M., William S. D. Wilcock, W.S.D and Ben-Zvi, T. The Crustal Structure of Deception Island Volcano from P-wave Seismic Tomography: Tectonic and Volcanic Implications. Journ. Geophys. Res 114, B06310, doi:10.1029/2008JB006119

García-Yeguas, A., Almendros, J., Abella, R. and Ibáñez, J.M. Quantitative analysis of seismic wave propagation anomalies in azimuth and apparent slowness at Deception Island volcano (Antarctica) using seismic arrays. Geophy. Journ. Int., Volume 184, Issue 2, pages 801–815, February 2011. DOI: 10.1111/j.1365-246X.2010.04864.x

Petrosino, S., Cusano, P., La Rocca, M., Galluzzo, D., Orozco-Rojas, J., Bretón, M., Ibáñez, J.M. and Del Pezzo, E. Source location of long period and low frequency seismicity at Colima volcano. Bull. Of Volcanology. DOI: 10.1007/s00445-011-0447-2.

2.2.p Participant 16: Universidade dos Açores (UAc)

Brief description: CVARG (Centre for Volcanology and Geological Risk Assessment) is a multidisciplinary research unit of the Azores University (UAc) belonging to the portuguese national research system. The CVARG activities are developed in the Earth Sciences branch and are mainly directed to the prevention and forecast of natural catastrophes. It develops its main activities in the Volcanology domain and associated phenomena, including among others, volcanic activity, earthquakes, ground deformation, landslides and tsunamis. In the research component, CVARG integrates various national and international networks and consortia and its research team has a considerable experience in international UE funded projects from the FP5, FP6 and FP7, namely, RETINA, FORESIGHT, EXPLORIS, VOLUME, ESONET, EMSO and EPOS among others. In a more operational component CVARG gives a strong emphasis to multi-parametric monitoring of geological hazards in the Azores region running in association with CIVISA (Centre for Information and Seismovolcanic Surveillance of the Azores) seismic, geodetic, geochemical and meteorological networks for seismovolcanic, landslide and environmental surveillance. It makes part of the Volcano Observatoty and provides scientific advice to the Azorean Civil defense

Main Tasks: Involved in WP6, WP7 (test site for validation and transfer) and WP8 activities

Key personnel involved:

João Gaspar. Assistant Professor with Habilitation. PhD in Geology (Volcanology) in 1996. He has been involved in several R&D projects directed to the study of volcanoes and to the multi-risk analysis in the Azores region. The domains of specialization include the eruptive history of volcanoes; explosive volcanism, caldera forming processes, seismovolcanic monitoring of the Azorean active volcanoes and response mechanisms and natural disaster management . He is responsible for the development of a GIS database for the integrated analysis of geological risks, namely volcanic eruptions, earthquakes, and landslides in the Azores. He was responsible for the implementation of the INSPIRE directive for the Azores Government.

Teresa Ferreira. Assistant Professor. PhD in Geology (Volcanology) in 2000. Since 2000 she has been involved in the upgrade and growth of the seismovolcanic monitoring network of the Azores for real time data acquisition. In 2008 she became head of the board of directors of the CIVISA (Centre for Information and Seismovolcanic Surveillance of the Azores). The research activities are focused in the study and monitoring of active volcanoes and other geological hazards. The domains of specialization are essentially volcanic gases, basaltic volcanism, eruptive history of volcanoes and volcano-tectonic systems.

Recent relevant publications:

Silva, R., Havskov, J., Bean, C. and Wallenstein, N. (2012) - Seismic swarms, fault plane solutions and stress tensors for São Miguel Island central region (Azores). accepted for publication in J Seismol. doi:10.1007/s10950-012-9275-x

Viveiros, F., Cardellini, C., Ferreira, T., Caliro, S., Chiodini, G. and Silva, C. (2010) - Soil CO2 emissions at Furnas volcano, São Miguel Island, Azores archipelago: Volcano monitoring perspectives, geomorphologic studies, and land use planning application, J. Geophys. Res., 115, B12208, doi:10.1029/2010JB007555.

Martini, F., Bean, C., Saccorotti, G., Viveiros, F., Wallenstein, N. (2009) - Seasonal cycles of seismic velocity variations detected using coda wave interferometry at Fogo volcano, São Miguel, Azores, during 2003-2004. Journal of Volcanology and Geothermal Research, 181, 3-4, 231-246. doi:10.1016/j.jvolgeores.2009.01.015

Viveiros, F., Ferreira, T., Silva, C., Gaspar, J.L. (2009) - Meteorological factors controlling soil gases and indoor CO2 concentration: A permanent risk in degassing areas. Science of the Total Environment, 407, 1362-1372. DOI:10.1016/j.scitotenv.2008.10.009

2.2.q Participant 17: University of Malta (UoM)

Brief description: The University of Malta is a University of 10,000 students. The Atmospheric research unit is in the Physics department in the Faculty of Science and comprises 5 full time employees. This Atmospheric Research Unit has instruments based at Giordan Lighthouse on Gozo. These instruments serve to monitor trace gases and Climate change in the Mediterranean. Both Shipping and Volcanic emissions are detectable and work is underway to install further equipoment specific to Volcanic emissions. Partecipation to the VOMOS-SEGURO project

Main Tasks: Partecipation to WP5, in studing and modelling volcanic plume

Key personnel involved:

Raymond Ellul – Project leader with 30 years experience in trace gas monitoring.
Martin Saliba – Technical Officer III who is responsible for maintaining the equipment.
Alexander Smyth – Research Officer II who works on Aerosol emissions.
Francelle Azzopardi – Research Officer I who works mostly on trace gases evaluation.
Miriam Azzopardi who handles shipping data and administrative work.

Recent relevant publications

R Ellul and M Saliba. Contribution of 2008 data set for Ozone and CO to WMO, WDCGG Data summary..WDCGG No 33. GAW Data Volume IV Greenhouse Gases and other Atmospheric Gases. Published by Japan Meteorological Agency/ World Meteorological Organization March 2009.

R Ellul. Summary of a 12 Year Study of Atmospheric Pollution in the Central Mediterranean. Proceedings of WMO Workshop held at WMO, Geneva, Switzerland 5 – 7th May 2009. Published by WMO Secretariat.

R Ellul and M Saliba. Contribution of 2009 data set for Ozone and CO to WMO, WDCGG Data summary. WDCGG No 34. GAW Data Volume IV Greenhouse Gases and other Atmospheric Gases. Published by Japan Meteorological Agency/ World Meteorological Organization March 2010.

R Ellul ,Giordan Lighthouse – Summary of a study of Atmospheric Pollution in the Central Mediterranean.Proceedings of World Meteorological Organization, Scientific Advisory Group on Reactive gases, Meeting, Gozo, Malta, 29-30th March 2011, Published by WMO Secretariat.

F Farrugia, M Saliba and R Ellul .A 12 years study of atmospheric pollution in the Central Mediterranean- latest results and future researchprospects. EMEP – TFMM Meeting. Zurich, Switzerland, 11-13 May 2011. Proceedings published by WMO.

R Ellul and M Saliba. Contribution of 2010 data set for Ozone and CO to WMO, WDCGG Data summary. WDCGG No 35, GAW Data Volume IV Greenhouse Gases and other Atmospheric Gases. Published by Japan Meteorological Agency/ World Meteorological Organization March 2011.

2.2.r Participant 18: IMoSS AG

Brief description: IMoSS AG is a monitoring services business based in Heerbrugg, Switzerland. IMoSS AG is part of the Swedish Hexagon Group, that amongst others, also includes Leica Geosystems AG, Intergraph Corporation and Novatel Inc. Building on over 20 years experience within the group companies, IMoSS AG is committed to providing complete solutions and services in terms of feasibility studies, system proposals, design and consultancy services, delivery, installation, training, support, operation, computation services and maintenance to the geodetic and geotechnical deformation monitoring market. IMoSS AG is a small, but growing business, currently with more than ten professionals based in Europe, Middle East and South America.

Main Tasks: IMoSS AG, through its experience in multiple 'Competence' areas are able to act as consultants, advisors and as service providers for designing, delivering and installing technologically advanced large scale or wide area deformation monitoring projects in ground motion studies of landslides and seismic movements. IMoSS AG staff have experience in working on similar projects in Europe regarding volcanoes and seismic movement monitoring.

As monitoring engineers, IMoSS AG has experience in preparing preliminary studies and project design and management, along with providing advice on specifications and instrumentation. As contractors, IMoSS AG has experience in delivering complete large scale deformation monitoring projects solely or in joint venture partnerships.

Key personnel involved:

Carlo Bonanno, involved as a project coordinator for IMoSS AG, is actually the responsible for IMoSS AG business development in region south of EMEA. He worked for 30 years in geodetic instrumentation market and he is managing the monitoring segment for Leica Geosystems in Italy since 15 years. He has a huge experience in monitoring systems and monitoring applications for geodetic sensors and data integration with different measuring technologies. He is the Leica Geosystems team leader for the monitoring early warning system in Ancona where a network of robotic total stations, GPS/GNSS receivers, tiltmeters and geotechnical multi-parameters columns are installed for permanent control of buildings inside the still active landslide area. He worked, as Leica Geosystems responsible for monitoring applications, on the Theodoros monitoring system of the Stromboli Volcano.

Marco Di Mauro, involved as project manager, actually is Competence manager for Infrastructure for IMoSS AG. Involved in Monitoring and Early warning systems since years starting with Geotechnical and ending up with Geodetic he is also an inventor (European patent) of a profile measurement system based on elettrolitic tilt sensor. The system, using elettrolitic tilt sensors, is used to measure the deformation of profiles of railways, of bridges, and of every structure witch develops itself in one prevalent direction. He has been for years project manager for AGISCo srl, Italy and LEICA GEOSYSTEMS AG, Switzerland, here is a list of the main projects he led:Dams (Cantoniera on Tirso river, Cumbidanovu, Maccheronis, UHE large Dams project), Railways (CAVET – high speed rail, Cagliari-Golfo Aranci line, Urban line Cadorna-Bovisa in Milan), Landslides (Recoaro 2000 loc. Fantoni, Raticosa sud, Intermesoli after L'Aquila earthquake, Grohovo in Croatia), Tunnels (High speed rail, New "Strada dei marmi" in Carrara), Bridges (Trieste, Viadotto Cattinara, dynamic and static load test)

2.2.s Participant 19: SURVEY LAB - Spinoff of Università di Roma La Sapienza

Brief description: Surveylab s.r.l is a spinoff funded in 2008 by researchers of the Geomatic section of the Department of Civil and Environmental Engineering. It is focused on the development of geomatic monitoring systems by means of advanced surveying and mapping technologies. It develops applications in many field of civil and environmental engineering including infrastructure control and monitoring..

Main Tasks: Surveylab s.r.l will be involved in the project in the activities of WP2, WP3 and WP5.

Key personnel involved:

Maria Marsella - Associate Professor at the Civil and Industrial Engineering Faculty - University of Roma “La Sapienza”. Research activities: satellite geodesy, airborne and satellite surveying applied to land management and natural hazards monitoring. Her role in the project will be on the coordination of the activity on the evaluation of the performances of in-situ ground networks in comparison with EO data.

Carla Nardinocchi - Assistant professor at the University of Roma “La Sapienza”.. Since 1998 the main research field of investigation has been the automatic data segmentation, building detection and reconstruction and (DTM) generation through the processing of airborne laser scanner data. Since 2004 started research work in the field of High Resolution Satellite Imagery (HRSI) and change detection analysis. Her role in the project is focused on defining photogrammetric algorithms into the tool for automatic ground image processing.

Alberico Sonnessa – Graduate student in Environmental Engineering. Phd in Geophysics – University of Bologna. Field of investigation focused on the processing and analysis of data acquired by means of terrestrial geomatic sensors (total station, terrestrial laser scanner, digital level GP) and airborne sensors (airborne laser scanner).

Silvia Scifoni – Graduate student in Environmental Engineering. Phd in Geophysics – Univ. of Bologna. Field of investigation focused on lava diversion barrier design for lava flow risk mitigation. She is expert in GIS and 3D vector data modelling.

Leonardo Daga, Graduate in Electronic Engineering at Sapienza Univ. Since 2002 collaborates to R&D projects coordinated by DICEA and Survey Lab. Senior consultant on robotics and remote control systems. His role in the projects will be that of image processing tool.

Recent relevant publications:

Coltelli C., Marsella M., Proietti C., Scifoni S.(2012). The case of the 1981 eruption of Mount Etna: An example of very fast moving lava flows. Geochemistry Geophysics Geosystems, VOL. 13, Q01004, 14 PP.,doi:10.1029/2011GC003876Vicari A., Herault A., Del Negro C., Coltelli M., Marsella M., Proietti C. (2007). Modeling of the 2001 lava flow at etna volcano by a cellular automata approach. Environmental Modelling & Software, 22, 1465-1471,doi:10.1016/j.envsoft.2006.10.005, ISSN: 1364-8152.

Marsella M, C. Proietti, A. Sonnessa, M. Coltelli, P. Tommasi, E. Bernardo (2009). The evolution of the Sciara del Fuoco subaerial slope during the 2007 Stromboli eruption: Relation between deformation processes and effusive activity. Journal of Volcanology and Geothermal Research, 182 (3-4), 201-213 doi:10.1016/j.jvolgeores.2009.02.002

Proietti C., M. Coltelli, M. Marsella, E. Fujita (2009). A quantitative approach for evaluating lava flow simulation reliability: the LavaSIM code applied to the 2001 Etna eruption. Geochemistry Geophysics Geosystems, 10 (9), doi:10.1029/2009GC002426

Scifoni S, M. Coltelli , M. Marsella, C. Proietti, Napoleoni, A. Vicari, C. Del Negro (2010). Mitigation of lava flow invasion hazard through optimized barrier configuration aided by numerical simulation: The case of the 2001 Etna eruption. Journal of Volcanology and Geothermal Research 192, 16–26 doi:10.1016/j.jvolgeores.2010.02.002,2010

2.2.t Participant 20: Marwan Technology (MATEC)

Brief description: Marwan Technology is a Spin-off of Pisa University, mainly dealing with laser sensors for industry and research. The company was founded by six people experienced in laser physics and electronics, it was born to build control electronics for scientific seismic isolators and custom position sensors for industrial automation. The company was spinned off after a long period of collaboration between a research group and the high-technology industry for advising and prototyping of measurement instruments. The group has already developed collaborations with several international research institutions. Marwan Technology acts as a coordinator for several R&D projects at regional level; among these we mention: SIRF project (Interferometric Rail Roughness Sensor), Regione Toscana DOCUP 2006; Portable sensor for real-time chemical analysis with LIBS technique, Regione Toscana Aiuti allo sviluppo precompetitivo Bando 2008; ALMA project (Laser Analysis of precious Metals and Ambers), Regione Toscana PORCREO 1.5, 2009. In addition Marwan participates to several other R&D projects at regional, national and European level; among these we mention: MONDI, project (MONitoring and DIagnostics of frescoes at the "Camposanto Monumentale" in Pisa), Regione Toscana POR-FSE asse IV, 2009. SSOA project (Development of Advanced Optical Sensors), Regione Toscana PORCREO 1.6, 2009.

Main Tasks: Development of a tri-axial strain sensor and an infrasonic sensor array based on FBG technology (WP2); test and validation of strain sensor on volcano laboratory (WP7).

Key personnel involved:

Fiodor Sorrentino- Researcher, experienced in optics, quantum electronics, spectroscopy – especially high resolution spectroscopy for metrological applications, - spectrometry, atom optics, atom interferometry, precision electronics, vacuum technologies, control theory, ultrastable lasers, computer simulation of atomic systems. Development and commercialization of mobile LIBS instruments. Coordination of integrated R&D projects at regional level, for overall 1 Million euro budget.

Giorgio Carelli - Researcher, expert in Design and prototyping of IR laser sources, drivers, and detectors; treatment of optical components; microwave control systems; interface programming for scientific instrumentation; managment of R&D projects. Renzo Grassi, - Technician, expert in optics, quantum electronics, spectroscopy, electronics, laser sensors, imaging sensors, LIBS.

Recent relevant publications:

P. E. Bagnoli, N. Beverini, E. Castorina, E. Falchini, R. Falciai, V. Flaminio, E. Maccioni, M. Morganti, F. Sorrentino, F. Stefani, C. Trono, Fiber laser hydrophones as pressure sensors, Int. J. Mod. Phys. A **21**, 102 (2006)

P. E. Bagnoli, N. Beverini, R. Falciai, E. Maccioni, M. Morganti, F. Sorrentino, F. Stefani and C. Trono, Development of an erbium-doped fibre laser as a deep-sea hydrophone, J. Opt. A: Pure Appl. Opt. **8** S535 (2006)

P. E. Bagnoli, N. Beverini, E. Castorina, E. Falchini, R. Falciai, V. Flaminio, E. Maccioni, M. Morganti, F. Sorrentino, F. Stefani, C. Trono, Fiber laser hydrophones as pressure sensors, Int. J. Mod. Phys. A **21**, 102 (2006)

P. E. Bagnoli, N. Beverini, B. Bouhadef, E. Castorina, E. Falchini, R. Falciai, V. Flaminio, E. Maccioni, M. Morganti, F. Sorrentino, F. Stefani, C. Trono, Erbium-doped fiber lasers as deep-sea hydrophones, Nucl. Instr. Met. Phys. Res. A **567**, 515 (2006)

N. Beverini, R. Falciai, E. Maccioni, M. Morganti, F. Sorrentino, C. Trono, Developing fiber lasers with Bragg reflectors as deep sea hydrophones, Annals of Geophysics 49, 1157 (2006)

2.2.u Participant 21: Terradue (T2)

Brief description: Terradue UK Ltd is the UK subsidiary of Terradue Srl, an SME operating mainly in the geospatial and space sectors, whose offices are in Rome. Terradue Srl owns the complete set of Terradue UK Ltd shares.

The UK subsidiary was created in June 2011 with the objective of exploiting the growing number of opportunities in the Climate Change Initiative where the products, solutions and experience of Terradue can bring several benefits and allow its subsidiary to grow in the next coming years.

Terradue's core business is Grid/Cloud based distributed computing (infrastructure and platform) and distributed data discovery and access. From global environmental analysis using massive amounts of Earth Observation data, to regional land change detection with complex 3rd party algorithms, Terradue offers a specialist service for the management and distribution of very large spatial data sets complemented with data inventory, query and processing systems, carried out collaboratively with open source projects.

Terradue UK Ltd has its offices in the Harwell Science & Innovation Campus within the Innovations Technology Access Centre initiative supported by the STFC (Science & Technology Facilities Council). The physical location of Terradue UK Ltd allows it to establish partnerships and consortiums to bid on UK co-funded projects and sees ESA projects as a complementary opportunity to staff the subsidiary in the Harwell Science & Innovation Campus where the European Space Agency has recently open a centre. The proximity to universities such as the University of Reading is seen as an opportunity to identify future Terradue UK Ltd staffs. The goal is to have 4-6 permanent staffs by the end of 2012.

Main Tasks: Terradue will participate in WP3, WP7 and WP8.

Key personnel involved:

Dr Pedro Gonçalves - Terradue founder, he is an Environmental Engineer with a PhD on 'Scale Invariance of Forest Fires Spatial Patterns -Environmental Modelling in a Global Distributed Data Access Architecture'. Pedro did a post-doc in ESA-ESRIN where he lead the development and transfer to operations of Grid Processing on-Demand (G-POD) a Grid based Web Services infrastructure for EO applications development using Globus Software and LCG (CERN) software. Pedro is the Chief Technical Officer and one of the two founders of Terradue Srl. Pedro deals with the OGC related activities and he is currently the editor of the OpenGIS® Catalogue Service Implementation Specification, Version 3.0 - Part 4: OpenSearch Query Interface (10-032). Pedro Gonçalves is also member of the GEOSS Architecture and Data Committee. GEO is the Group on Earth Observations and is coordinating efforts to build a Global Earth Observation System of Systems (GEOSS). The Architecture and Data Committee supports GEO in all architecture and data management aspects of its design, coordination, and implementation for comprehensive, coordinated, and sustained Earth observations.

Mr. Hervé Caumont is an Information Technology engineer with a Masters degree in Remote Sensing & Image Processing. Hervé has served the GEOSS Architecture Implementation Pilot through a multi-year involvement, and gained a consistent experience of OGC and CEOS standards application in different thematic environments; from the Enterprise systems design and data model harmonization issues, to the applications components deployment and configuration phases, through the standards and interfaces selection, profiling and interoperability testing for evolvable, scalable system architectures. Hervé is Terradue's Products and Solutions Program Manager, in charge of cross-projects coordination for corporate innovation and business development.

2.2.v Participant 22: University of Western Ontario (UWO)

Brief description: The University of Western Ontario (UWO) is one of the top 10 leading research universities in Canada, with annual research funding in excess of $225 million.

Main tasks: *WP3, WP4, WP5, WP8; Data assimilation, inversion modelling*

Key personnel involved:
Dr. Pablo J. González is a postdoctoral research assistant at Department of Earth Sciences at UWO. His research activity concerns the development of geodetic methods to measure ground displacements to better evaluate natural hazards (correlation of optical images and radar interferometric techniques). His efforts have been concentrated in develop realistic error estimation methods and implementation of statistically robust methods. Since 2007, he has been PI of similar proposals for the ESA CAT-1 projects (x2) and the DLR-TDX, which accounts for ~1000 SAR images, and an internationally funded project for the development of time series of SCANSAR interferometry to study large crustal deformations in East Africa. He is the author or co-author of more than 15 papers published in international scientific journals.
Dr. Kristy Tiampo is a Professor in Earth Sciences at UWO and has extensive experience in the modelling and inversion of geodetic data. For the past ten years she has been involved in geodetic applications for both volcanic and seismic sources worldwide and in Canada. She has more than 80 papers in peer-reviewed journals and conference proceedings. Currently, she operates seven continuous GPS instrumentation in southern Ontario and northwestern Québec. Her InSAR research includes joint development of a method for integrating GPS and ERS data, as well as several ESA Cat I projects using ERS and ENVISAT data and three SOAR grants. She has participated in twenty other research projects, PI on twelve.

Recent relevant publications:
González, P.J., Tiampo, K.F., Palano, M., Cannavó, F., Fernández, J. Fault slip nucleation, propagation and arrest controlled by groundwater-extraction crustal unloading stress changes, Nature Geosciences, submitted.
Tiampo, K.F., Mazzotti, S., James, T. Analysis of GPS measurements in eastern Canada using principal component analysis, PAGEOPH, doi:10.1007/s00024-011-0420-1, 2011.
Samsonov, S., Beavan, J, González, P., Tiampo, K., Fernández, J., Ground deformation in the Taupo Volcanic Zone, New Zealand observed by ALOS PALSAR interferometry, GJI, doi:10.1111/j.1365-246X.2011.05129.x, 187, 1, 2011
Samsonov, S. and Tiampo, K. Polarization phase difference analysis for selection of persistent scatterers in SAR interferometry, IEEE GRSL, doi:10.1109/LGRS.2010.2072904, 8, 2011.
Samsonov, S., Tiampo, K.F., González, P.J., Manville, V., Jolly, G. Ground deformation occurring in the city of Auckland, New Zealand and observed by ENVISAT Interferometric Synthetic Aperture Radar during 2003-2007, JGR, doi:10.1029/2009JB006806, 2010.
González, P.J., Tiampo, K.F., Camacho A.G., Fernández, J., Shallow flank deformation at Cumbre Vieja volcano (Canary Islands): Implications on the stability of steep-side volcano flanks at oceanic islands, EPSL, doi:10.1016/j.epsl.2010.07.006, 2010.
Perlock, P., González, P., Tiampo, K.F., Rodríguez-Velasco, G., Fernández, J., Samsonov, S. Time evolution of deformation using time series of differential interferograms: Application to La Palma Island (Canary Islands), PAGEOPH, 165, doi:10.1007/s00024-004-0388-7, 2008.
Tiampo, K.F., Fernández, J., Hayes, T., Jentzsch, G. Modeling of stress changes at Mayon volcano, Philippines. PAGEOPH, 164, doi:10.1007/s00024-007-0189-4, 2007.
Tiampo, K.F., Fernández, J., Jentzsch, G., Charco, M., Rundle, J.B. Inverting for the parameters of a volcanic source using a genetic algorithm and a model for magmatic intrusion in elastic-gravitational layered earth models. Comp. and Geosc., 30, 2004.

2.2.w Participant 23: California Institute of Technology - Jet propulsion Laboratory (CALTEC-JPL)

Brief description: The Jet Propulsion Laboratory (JPL), California Institute of Technology (Caltech), is managed by Caltech for the U.S. National Aeronautics and Space Administration (NASA). It is the lead NASA institution for the robotic exploration of the solar system and a leading institution for a large number of Earth satellites related to climate change and other geoscience objectives. JPL was the original developer of synthetic aperture radar (SAR) interferometry (InSAR) during the 1980's and continues to develop and apply InSAR techniques to scientific problems using both international SAR satellite data and the JPL/NASA developed airborne InSAR, the UAVSAR project.

Main Tasks: JPL will be involved in the geodetic data processing and modelling analysis for volcano deformation sources. This will include both interferogram-based modelling and InSAR time series (TS) analyses. The main focus will be on Mt. Etna, however the JPL participant will potentially be involved in analysis of Campi Flegrei as well, depending on data and volcanic activity/deformation.

Key personnel involved:

Paul Lundgren: Geodetic continuum mechanical modelling of both volcanoes and fault/earthquake processes for the past 20 years. Since 1997 has been active in modelling InSAR deformation observations to constrain volcanic source processes on Mt. Etna volcano, Campi Flegrei caldera, Italy; Uzon caldera, Karymsky volcano, Kamchatka; Kilauea volcano, Hawaii; as well as projects targeting volcanoes in the Pacific Rim with both satellite and UAVSAR radar. In each of these volcanoes InSAR interferogram and InSAR-TS analyses have been used (along with in-situ geodetic data such as GPS) to constrain volcano source models.

Recent relevant publications:

Lundgren, P., M. Poland, A. Miklius, S.-H. Yun, E. Fielding, Z. Liu, A. Tanaka, W. Szeliga, and S. Hensley (2011), Source models for the March 5-9, 2011 Kamoamoa fissure eruption, Kilauea Volcano, Hawaii, constrained by InSAR and in-situ observations, in preparation.

Lundgren, P., and Z. Lu (2006), Inflation model of Uzon caldera, Kamchatka, constrained by satellite radar interferometry observations, Geophys. Res. Lett., 33, L063012, doi:10.1029/2005GL025181.

Lundgren, P., F. Casu, M. Manzo, A. Pepe, P. Berardino, E. Sansosti, and R. Lanari, Gravity and magma spreading of Mount Etna volcano revealed by radar interferometry, Geophys. Res. Lett, L04602, doi:10.1029/2003GL018736, 2004.

Lundgren, P., and P. A. Rosen, Source model for the 2001 flank eruption of Mt. Etna volcano, Geophys. Res. Lett., 30(7), 1388, doi:10.1029/2002GL016774, 2003.

Lundgren, P., P. Berardino, M. Coltelli, G, Fornaro, R. Lanari, G. Puglisi, E. Sansosti, and M. Tesauro, Coupled magma chamber inflation and sector collapse slip observed with syntheic aperture radar interferometry on Mt. Etna volcano, J. Geophys. Res., 108(B5), 2247, doi:10.1029/2001JB000657, 2003.

Lundgren, P., S. Usai, E. Sansosti, R. Lanari, M. Tesauro, G, Fornaro, and P. Berardino, Modeling surface deformation observed with synthetic aperture radar interferometry at Campi Flegrei caldera, J. Geophys. Res., 106,19,355-19,366, 2001.

Lanari, R., P. Lundgren, and E. Sansosti, Dynamic deformation of Etna volcano observed by satellite radar interferometry, Geophys. Res. Lett., 25, 1541-1544, 1998.

2.2.y Participant 24: United States Geological Survey – Hawaiian Volcano Observatory (USGS-HVO)

Brief description: The Hawaiian Volcano Observatory (HVO) was established on the rim of Kilauea caldera in Hawaii in 1912. The Observatories mission is to monitor the activity of Hawaiian volcanoes as a means of assessing and forecasting volcano and earthquake hazards, as well as to gain insights into volcanic and earthquake processes that will help to better understand such hazardous phenomena.

Main Tasks: HVO will supply perspectives on Kilauea Volcano, which is often cited as an analogue for Mt. Etna. This includes data and interpretations related to flank instability and magmatic activity, and particularly the feedback between magmatic and tectonic processes.

Key personnel involved:

Dr. Michael Poland will represent HVO in the current proposal. Dr. Poland has been stationed at HVO since 2005 and is an expert in deformation monitoring, particularly radar interferometry, inferring magma plumbing system geometry, and monitoring flank instability.

Recent relevant publications:

Poland, M.P., Mikius, A., Sutton, A.J., and Thornber, C.R., in review, A mantle-driven surge in magma supply to Kīlauea Volcano during 2003–2007: Nature Geoscience, revision submitted November 24, 2011.
Montgomery-Brown, E.K., Sinnett, D.K., Larson, K.M., Poland, M.P., Segall, P., and Miklius, A., 2011, Spatiotemporal evolution of dike opening and décollement slip at Kīlauea Volcano, Hawai'i: Journal of Geophysical Research, v. 116, B03401, doi:10.1029/2010JB007762.
Johnson, D.J., Eggers, A.A., Bagnardi, M., Battaglia, M., Poland, M.P., and Miklius, A., 2010, Shallow magma accumulation at Kīlauea Volcano, Hawai’i, revealed by microgravity surveys: Geology. v. 38, no. 12, p. 1139-1142.
Montgomery-Brown, E.K., Sinnett, D.K., Poland, M., Segall, P., Orr, T., Zebker, H., and Miklius, A., 2010, Geodetic evidence for en echelon dike emplacement and concurrent slow-slip during the June 2007 intrusion and eruption at Kīlauea volcano, Hawaii: Journal of Geophysical Research, v. 115, B07405, doi:10.1029/2009JB006658.
Larson, K.M., Poland, M., and Miklius, A., 2010, Volcano monitoring using GPS: developing data analysis strategies based on the June 2007 Kilauea Volcano intrusion and eruption: Journal of Geophysical Research, v. 115, B07405, doi:10.1029/2009JB006658.
Poland, M.P., 2010, Localized surface disruptions observed by InSAR during strong earthquakes in Java and Hawaiʻi: Bulletin of the Seismological Society of America, v. 100, no. 2, p. 532-540.
Poland, M.P., Miklius, A., Wilson, D., Okubo, P., Montgomery-Brown, E., Segall, P., Brooks, B., Foster, J., Wolfe, C., Syracuse, E., and Thurber, C., 2010, Slow slip event at Kīlauea Volcano: EOS, Transactions, American Geophysical Union, v. 91, no. 13, p. 118-119.
Poland, M., 2010, Learning to recognize volcanic non-eruptions: Geology, v. 38, no. 3, p. 287-288.

2.3 Consortium as a whole

The MED-SUV consortium brings together institutions and companies having the needed experiences and expertise for the achievement of the project objectives, organized in a synergetic way. Together, these scientific and industrial partners as well as public agencies with long and well-assessed experiences form a consortium able to cover the whole volcanic risk management cycle, from observations to public communication. In addition to the remarkable human resources that make up the consortium, the partners also bring critical infrastructure into play, with world class monitoring networks, laboratories, computer facilities, etc..

INGV (Coordinator) is a high-level European scientific institution of Earth Science at the top of the ISI-Thompson rank in Volcanology made up of more than one thousand staff including S&T researchers, PhD students, technicians and administration staff. Beside the implementation and management of the geophysical, geochemical and volcanological monitoring networks (e.g. seismic, geodetic, geochemical, magnetic, video, satellite data, etc.) the skills of INGV include geological and structural surveys, the modelling of volcanic phenomena (e.g., lava and pyroclastic flows, volcanic plumes, ground deformation and the dynamics of internal magmatic sources, etc.) and the experimental characterization of rocks in chemical or physical laboratories. By law, INGV is responsible for the monitoring and surveillance activities of volcanic areas in Italy and works closely with the National Civil protection authorities, within specific official agreements, on issues including the hazard assessment in Italy and management of seismic and volcanic crises. During the last decade INGV has been deeply involved in the scientific surveillance of the 2001, 2002-03, 2005, 2007, 2008-09 eruptions of Mt. Etna and 2002-03 and 2007 eruptions of Stromboli volcano, as well as in the monitoring of recent bradyseism events in Campi Flegrei.
The wide range of the skills in Earth Sciences of the INGV has favoured close cooperation with almost all the partners of the MED-SUV consortium in the last decades. These long-standing collaborations will significantly facilitate the development of the project activities.

In MED-SUV, INGV leads the WP1 (Management) as well as two more RTD WPs (3 and 6) aimed at implementing, respectively, systems for the data integration/interoperability/sharing and strategies for volcanic disaster preparedness and mitigation. Furthermore, it works together with the participants to the consortium almost in all Tasks of the project, profiting from the long cooperation with many of them. Qualified activities are the implementation of new monitoring instruments/systems (WP2), the development of methods and algorithm to integrate EO and in-situ data and to allow the interoperability and sharing of the monitoring system data (WP3), the modelling of volcanic processes (WP4 and WP5) and the implementation of new models and procedures for the hazard assessment and preparedness (WP6).

CNRS groups a team of French Universities and scientific institutions having skills ranging as large as INGV and fully complementing among them and with the INGV. CNRS will lead the activities on WP5 and WP7, due to its valued experiences on studying the Mt. Etna volcanic processes and monitoring of both European and non-European (from the geographic point of view) volcanic areas. In MED-SUV, this team is also involved in integrating observation systems in WP3 (ENS), carrying out geophysical and geochemical experiments and modelling in WP4 and WP5 (IPGP, ISTO, ISTER, ENS, LMU) and supporting test and validation activities in WP7 (IPGP Volcano Observatories at Piton de la Fournaise).
UAc brings into the project the experiences of another Volcano Observatory (Azores), involved in the test and validation activities in WP7. Due to its experience in volcano hazard assessment and preparedness activities, UAc will contribute also on WP6.

Two main Space Agencies (ESA and DLR), scientific institutions (CNR-IIA and CNR-IREA) and industrial partner (T2) bring in the project the experiences of the Earth Observation community and the active role into international initiatives aimed at building systems for an improved use of the EO and in-situ data. DLR, which has an unquestionable expertise on the implementation and exploitation of EO systems, will implement a new system that automate all the monitoring process on the selected volcanoes based on the Terra-SAR-X satellite, from data ordering to the productions of interferograms (WP2). In Task 3.1 CNR-IREA will apply the SBAS approach to the second generation X-band SAR sensors to obtain surface deformation time series. One of the strategic issues of MED-SUV is to apply the GEOSS principle concerning the data interoperability and sharing, by design and developing the new European Supersites e-infrastructure. CNR-IIA, ESA and T2 form the team, leaded by the CNR-IIA, in charge to implement the e-infrastructure from the system requirements and gap analysis through a specific design. The assured expertise of the team is based on the long cooperation among the participants in international projects and initiatives aimed at implementing the principle of the sharing and interoperability of geophysical data, as GeoWOW, GENESI-DEC, etc.

CSIC will lead the team in charge of the integration between EO and in-situ geodetic data for assessing continuous 3D ground deformations map (Task 3.3). Furthermore, it applies its experience on the use of EO and in-situ data for investigating internal structures of active volcanoes and modelling ground deformations on Campi Flegrei/ Vesuvius and on Mt. Etna, where it leads the Task 5.4.
A qualified partnership from American countries (UNWO, CALTEC_JPL, USGS-HVO) will bring into MED-SUV the experiences acquired in studying the dynamics of other Supersites volcanic areas (e.g. Hawaii) by using EO and in-situ geodetic data. These participants will complement the expertise of CSIC and INGV in studying volcano dynamics by using EO and in-situ geodetic data.

MED-SUV will facilitate the cooperation among Universities and scientific institutions having proved skills in studying threatening volcanic phenomena and relevant processes, by using geophysical or geochemical techniques and data modelling. UHH will model the ground deformations acquired by the monitoring systems on Mt. Etna to study the process of the interaction between magmatic and structural systems. LMU, which leads the WP4, will investigate the physical conditions controlling the shift regime from permeable flow to steam explosions in the hydrothermal systems of the Campi Flegrei, by carrying out cutting-edge laboratory experiments. GFZ will carry out laboratory experiments, calibrated by field measurements, to define the physical and chemical characteristics of the processes that relate the dynamics of the fluids with stress field changes in Campi Flegrei. AMRA and UNIBRIS will apply their well-developed expertise in identify the anomalies in the geophysical and geochemical signals related to the dynamics of the shallow hydrothermal system of Campi Flegrei and Vesuvius. This team will carry out geophysical surveys (e.g. electrical, geo-electromagnetic or gravity surveys) on Vesuvius and Campi Flegrei to define the geometry of the inner structures and fix some constraints on the dynamic of these volcanoes. Together with INGV they will also investigate the internal dynamics of magmatic sources and its measurable effects on the surrounding rocks and surface of the Campi Flegrei (e.g. seismicity, gravity variations, deformations etc.) by implementing appropriate numerical models. UOM will apply in MED-SUV the outcomes and know-how on volcanic plume detection, developed in the framework of VAMOS-SEGURO project.

BRGM will lead the WP8 (Dissemination), so it is responsible of the implementation of the MED-SUV web portal and other activities driven by the dissemination plan. Furthermore it will develop innovative techniques to identify the effects of volcanic plumes in SAR data and implement probabilistic approaches for hazard assessment.
Together with BRGM, INGV and AMRA the DPC will define the strategies for volcanic disaster preparedness and mitigation. DPC will bring into the project the experience in managing the volcanic hazard and crisis, as well as the relevant preparedness and mitigation activities in Italian volcanic areas.

A well coordinated team formed by UGR, UniDUR and INGV will carry out the seismic experiment on Mt. Etna (WP5). They will apply surveying strategies and techniques of analysis of the seismic signals already adopted to carry out similar experiments on other volcanic islands (e.g., Deception and Tenerife).

The participation of industrial partners (IMOSS AG, SurveyLab, MATEC, T2) in the activities of MED-SUV guarantees the transfer toward the European industrial sector of the technical know-how related to the equipment and tools used in volcanological monitoring.

2.3.1. Subcontracting.

INGV will subcontract a specific activity of WP5 to the Milan University (Earth Sc. Dept). The subcontracted work consists in the application of geotechnical models (limit equilibrium methods and finite difference geomechanical simulation codes) to explore the instability factors, identify the critical conditions necessary to generate slope instability, as well as the geometry of the failure surfaces, volumes involved and kinematics, under different instability factors. The peculiar expertise required to carry out this work, quite different from the volcanological and geophysical skill characterizing the consortium, is at the base of the motivation of the subcontract. The subcontractor has large experiences in modelling landslides in volcanic areas (e.g. Stromboli) and will be request to study of an active landslide on the eastern flank of Mt. Etna (Presa).
IMOss AG will subcontract to external consultants the development and implementation of part of the software in the frame of the WP3.
UoM will subcontract the maintenance of equipment .
DPC will subcontract part of the work (graphic design) related to the preparation of leaflets in the framework of the activity of WP6.
Finally, INGV, AMRA, ESA and LMU will subcontract external auditors to certificates the financial statements.

2.3.2. Other countries.
Not available.

2.3.3. Additional partners.
Not available.

2.4 Resources to be committed

Non-management (WP1) resources are focussed on the first two Objectives (WP2, WP3, WP4 and WP5) which equally divide about 80% of the project budget, while the other three objectives (WP6, WP7 and WP8) approximately equally divide the remaining 20%. Indeed, because the first two Objectives contain the most R&D intensive activities there is a large human effort (about 75% of all the human resources in the project) as well as significant funds for hardware/devices/components and consumables (about 1/3 of the total "Other" costs) to implement new monitoring systems and carry out experiments on the "volcano laboratories". Conversely, the definition of strategies for volcanic disaster and preparedness, the tests, validations, pilot phase and dissemination are Objectives that clearly require fewer financial resources than the first two because they include activities that will make full possible use of the available infrastructure (e.g., monitoring networks, informatics facilities, etc.), such that the main costs here are associated with human resource allocation.

Coherent integration among the activities and corresponding resources can be seen through the overall project structure and Pert diagram (see Table 1.3.3 f) that show the uppermost importance of the first two Objectives, which directly address the main issues of the call (implementation of the development of the next generation of geo-hazard monitoring/observing systems and improvement of the scientific understanding of the occurrence of volcanic hazard). The work package structures and teams of groups working within each WP have been carefully designed to utilise resources efficiently in order to produce distinct deliverables which will systematically build towards the Objectives in an integrated fashion. Costs associated with each deliverable have been carefully assessed to ensure that the requested resources are adequate to produce the required products.

The broad, experienced scientific community and observatory facilities that make up our project consortium allow us to bring to bear significant complimentary resources in addition to the EU contribution. These resources can be divided between internal and external resources.

Internal resources consist of world-leading geophysical and geochemical monitoring networks, 24-hour operation rooms, instruments for geophysical and geochemical surveys, physical and chemical laboratories as well as powerful computing facilities. In order to meet the ambitious goals set in our project it is these unique internal resources which gives us the key to success, as they are fundamental to allow participants to produce the planned deliverables. For instance, the availability of HPC resources to perform cutting-edge numerical modelling or GPS or seismic stations to carry out the surveys planned in the project are fundamental pre-conditions to attain the goals of the various activities. All the participants bring into the project internal resources able to support the specific activities in which they are involved.
INGV scientific infrastructures will support significantly the project. All monitoring and observational systems on the volcanoes, including the geophysical and geochemical networks, the chemical and physical laboratories (e.g., the HP-HT Laboratory for Experimental Geophysics and Volcanology) etc., are entirely managed by INGV together. HPC resources are routinely used to produce daily models of dispersion of the volcanic plume for surveillance purposes. Furthermore computational resources will take benefit from the participation to or agreement with parallel and cloud consortium (e.g. COMETA, CASPUR). DLR will contribute its efficient, versatile and adaptable InSAR processing chain (GENESIS) and the experience of a team of specialists in signal processing, InSAR processing and interpretation. GFZ maintains massive scientific infrastructure. Relevant for MED-SUV is a new laboratory and a geophysical instrument pool. In 2012 a BubbleLab will start its operation allowing the simulation of earthquake waves and their effect on various types of fluid reservoirs. GFZ recently developed an ultra-compact recorder called CUBE, which opens the horizon to a new experiment style. CUBE meets the following demands: extreme low power consumption, ultra compact size, low price, accurate time base, and easy to handle in the field. GFZ may provide these CUBEs at no costs for experiments in the frame of MED-SUV upon formal application to the "Geophysical Instrument Pool Potsdam (GIPP)". The application needs a

recommendation by the Steering Board for the GIPP, and the final decision is made by the Executive Board of the GFZ. The Steering Board meets twice a year (April and October). The deadline for applications is four weeks before the Steering Board meeting (http://www.gfz-potsdam.de/portal/gfz/Struktur/Departments/Department+2/sec22/gipp).
Other internal resources are databases. INGV will provide to MED-SUV the database of the Italian active volcanoes containing the data of the multiparametric monitoring systems (geodetic, seismic, gravity data, images for video cameras, data on the geochemistry of volcanic plumes, water and soils). The infrastructure of this data base will be strengthened in the next two years in the framework of a national project aimed at improving the Italian scientific infrastructures (PON3; VULCAMED; 18 M€), funded by the Italian Ministry of University and Research, which started on January 2012.
CNRS will complement MED-SUV by providing the need data sets relevant to the testing and validation activities that will be carried out on Piton de la Fournaise (WP7).
Space Agencies will provide EO data. ESA data policy allows a free open access to the data on Supersites, while DLR will provide SLC data through specific agreement (TSX Science Proposal). Other EO data base will me made accessible according the general CEOS rules for the Supersites.

External resources come from ancillary supports or complementary activities carried out in other projects, currently in progress, such as VULCAMED. UniGRA will support the extension of the seismic experiment on Mt. Etna to the near marine sector with by providing the ship (Sarmiento de Gamboa) and the OBS within an agreement between the Spanish Ministry of Research and Innovation and the consortium COCSABO (see attachment 1: letter of interest). The implementation of the e-infrastructure and the tools for interoperability will benefit significantly from the involvement of CNR-IIA, ESA and T2 into GEOWOW, whose objective is to contribute to the GCI interoperability, develop innovative methods for harmonized access and use of heterogeneous data, services, and models and propose and validate a distributed architectural model federating Earth observation and other Earth Science data holdings. Finally, our studies on volcanic processes and hazard assessment on Campi Flegrei will fully utilise synergistic outcomes from the FP7 VUELCO project, which involves UniBRIS, INGV, LMU, DPC and CNRS.

3. Impact

This project addresses all links in the chain from observation to the end-users by implementing a conceptually new monitoring system, improving the knowledge of the studied volcanic areas, strengthening the link with the end-users and by optimising the transfer of information to the decision makers and the awareness actions. Accordingly, the impact is foreseen as described below.

3.1 Expected impacts listed in the work programme

1) ***A new digital infrastructure for data access: towards better efficiency in R&D and communication/coordination***
   The implementation within this project of a cyber digital-infrastructure prototype, facilitating access to observations and data (both in-situ and EO) is one of the most important and effective contributions to the GEO 2012-2015 work-plan. To guarantee the full achievement of this objective, the e-infrastructure will be compliant with the GEO/GEOSS interoperability principles and expectations. Specific user-friendly tools for an effective use of the information derived from the analysis of the data will also be implemented.
   The digital infrastructure will set a new milestone for research on closed-conduit (Campi Flegrei/Vesuvius) and open-conduit (Etna) volcanoes, providing a unique dataset combining many geophysical and geochemical parameters that will accelerate scientific progress and guarantee that maximum value is extracted from both ground-based and EO data. Furthermore, the digital-infrastructure is an essential prerequisite to achieving an effective and mature warning and response system to specific natural hazards, by involving all the scientific community and decision-makers participating to the project. The availability of the whole data set will facilitate the role of the decision-makers in the activities relevant to recover the effects of volcanic disasters (e.g., by acquiring a detailed map of the distribution of volcanic products or the effects of seismic activity associated with the eruptions). This database will therefore significantly contribute to the effectiveness of the communication and coordination between the scientific and decision-makers communities, which are already involved in the volcanic risk management chain.

2) ***Increased European technical know-how for the monitoring hazardous volcanoes***
   Technical and scientific actions of the project foresee the development of new monitoring sensors able to improve the accuracy and precision of measurements as well as data quality. Improvements will also include new ways of data acquisition and processing.
   Through new monitoring systems and new field campaigns, the use of different kinds of geophysical and geochemical data and their integration in cutting-edge models, this project will achieve a step-change in our understanding of both Etna and Campi Flegrei/Vesuvius. This will: i) increase the capability to interpret the clues of a volcanic unrest, ii) deepen the knowledge of volcanic processes, iii) lead to more accurate evaluations of the effects of an impending eruption and, in general, better assess the hazard of a specific volcanic area over both the short- and long-term.

3) ***Contribution to the development of the relevant European industrial sector***
   The project will implement cutting-edge solutions in volcano monitoring by profiting of both the wide spectrum of volcanic phenomena that is possible to analyze in the Supersite volcanoes of southern Italy and the qualified European scientific community and industrial components of the consortium. Significant aspects of the conceptually new monitoring system are the design and implementation of prototypes of cutting-edge systems or instruments for: measuring new in-situ parameters, reducing the costs, increasing the accuracy of measurements, integrating the EO and in-situ data. SMEs will be fully involved in all these activities, from the design to the implementation phases.

4) ***Improved use of observations and related information to inform policies, decisions and actions associated with disaster prevention, preparedness and mitigation.***
Protecting citizens living in or near volcanic areas from volcanic threats is a challenge that requires a strict cooperation between scientists, decision-makers and end-users. In the project, we plan to adopt specific activities to define pilot actions for an effective approach to increase the risk awareness of people living close to the volcanic threats, namely in the Campi Flegrei, one of the areas with the highest volcanic risk and population density worldwide. Aspects relevant to the now-casting of volcanic plumes and lava flows will be also addressed, based on the cutting-edge scientific know-how developed for Mt. Etna and currently used in the surveillance activity of this volcano.
One of the characterizing and qualified aspects of this consortium is that the scientific community and the decision-makers (DPC) work together to set up optimal procedures which will improve the quality of the information of the scientific community to the decision-makers in terms of both long- and short-term hazard assessment. In so doing, the consortium will contribute to the "Information for Social Benefit" part of the GEO 2012-2015 work plan by providing timely and adequate information relevant to the warning, response, mitigation and preparedness of volcanic risks and by adopting a multi-hazard approach ensuring that the decision-makers and citizen will be reached by the information and observations relevant to the volcanic hazard. Accordingly, the project will have a deep impact on the adoption of proper measures for the prevention, preparedness and mitigation of the volcanic disaster in southern Italy.

5) ***Increased communication and coordination between national, regional and global communities in support of disaster risk reduction***
An objective analysis of the management of past volcanic crisis, both in Italy and in other countries, will be an important starting point of the project. This analysis will also consider both the coordination between local and international scientific communities in case of volcanic crisis, and management aspects such as the respective roles and responsibilities of the scientific and decision-maker communities. The results obtained will drive the implementation of actions devoted to the volcanic risk preparedness, for instance, procedures for the management of the volcanic crisis, activities improving the awareness of communities living in the volcanic areas, etc. A global outcome of the project, thus, will be an optimal exploitation of the scientific, social and economical resources for the management of the volcanic risk.

3.2 Dissemination and/or exploitation of project results

The Dissemination is in charge of WP8, and will be developed according to the Dissemination Plan, which strategies and actions are blow detailed.

3.2.1 Overall dissemination strategy

The dissemination plan will support two main goals of this project: i) to build new knowledge in volcanology that can be applied to the Supersites as well as less instrumented volcanoes and ii) to provide to the end-user community an easy to use data infrastructure which will live even after the end of the project.

In order to effectively support these goals, the project will:

- disseminate the results within the scientific and, more in general, end-user communities, both in Europe and worldwide
- promote and link the activities (e.g., the data infrastructure, outcomes of experiments, models, etc.) to other initiatives
- ensure the sustainability of the communication after the end of the project according to the Memorandum of Understanding agreed with the participants of the Consortium.

Our dissemination strategy will pursue calibrated actions to reach the potential end-users, who will benefit of the results of the Supersite project. In the following, three groups of end-users are identified (3.2.2) and a plan of actions is designed to achieve the afore-mentioned goals (3.2.3).

3.2.2 Potential end-users of the Supersite project

The Supersite project identifies three groups of end-users that will be reached by the dissemination plan:

- **Scientific community**: the Supersite project aims to build an infrastructure that will ease the access to the huge library of data available on Etna and Campi Flegrei/Vesuvius volcanoes. This library, which will encompass as many geological, geophysical and geochemical methods as possible, will allow scientists to conduct in-depth analyses and build new models. A wide research community centred on the Supersite can also be created, and may allow breakthroughs in volcano science. The information to the scientific community on the wealth of this database and its potential benefits, which will be documented through the studies carried out within the MED-SUV project and the demonstrations of the database capacities, is therefore essential to enhance the potential of the Supersites and to contribute in capacity building.
- **Policy and decision makers**: the project database will be used as a time hazard assessment reference during volcanic crisis; coupled with a flexible risk evaluation using a two-layer approach (background long-term risk and quick short-term risk). It will offer an advanced tool for crisis management to decision makers. In this light, the project also plans to gather scientists and decision makers to improve their relationships and thus the reaction time in case of a volcanic crisis. The dissemination plan should therefore aim to reach them and associate them with the various WP of the project
- **General public**: the frequent Internet site slowdowns due to massive traffic from curious visitors after a natural disaster are the best testimony of the great interest of the general public in earth sciences. This genuine interest allows strengthening the bond between scientists and citizens, and it is a lever for risk management dissemination. Several studies have begun to use the feedback generated by these users to bolster research on critical areas, such as seismic damage assessment. The dissemination plan should therefore aim to attract the attention of the general public through several means to ensure the popularity of the Supersite webpage, and thus allow new and exciting interactions with scientists.

3.2.3 Implementation of the plan of actions

To disseminate the project's advancements and results:

- ❖ At the beginning of the project, launch dissemination actions will be aimed at attracting interest from the end-users, getting the project known. The following actions are planned:
  - Project brochures and leaflets will be edited and distributed during relevant scientific events. For example, MED-SUV promotion will be done during the final workshop organised by MIA-VITA "Integrated Approaches for Volcanic Risk Management", September 11th-12th
  - An opening workshop will be held, with end-user representatives invited. Local and international TV networks (for example, Euronews) will be invited for a press release.
  - A website will be set up, which will serve later as a support for dissemination actions
  - MED-SUV will be fully integrated to the GEO initiative and thus will make its beginning known through this network
- ❖ After the launch of the project, the plan aims to provide regular news to end-users through several channels:
  - The project results will be published in scientific publications and promoted during scientific meetings and workshops; MED-SUV will also set up a final open workshop to regroup and disseminate the results among scientific community. Dissemination towards the future researchers in volcanology will also be ensured by the participants through the use of cutting-edge data and results in relevant training courses

- The website will be regularly updated
- A periodic newsletter will be edited and distributed through the website (with possible Feed RSS), webmail and associated networks
- Social networks, such as Facebook and Twitter

For the promotion and link to other projects and initiatives, MED-SUV will share findings with other projects integrated to the GEO platform; cooperation will be also set out with networks more specifically rooted in the volcanological community, such as IAVCEI, VHub, WOVO, and MeMoVolc. With other Supersite and running FP7 projects, it will be explored the possibility to make a cluster of project websites under the European Union banner.
To ensure the sustainability of the project, the cooperation with GEO initiative offers interesting perspectives about the dissemination of results even after the end of the MED-SUV project, in agreement with the Memorandum of Understanding of the Consortium. Indeed, the mere existence of a permanent computer infrastructure with Internet features integrated in a web cluster offers us new opportunities to bolster not only the project research, but also future studies in volcanology through the access to the MED-SUV dataset. Several trails can be followed: creating a “job” space for the exchange of students working on volcanological themes, maintaining a citation database, using Facebook and Twitter accounts as relays for announcements (for example during a volcanic crisis), etc.

3.3 Management of the knowledge plan

The consortium will take a pro-active role to ensure that the results of the project are disseminated in an appropriate and useful manner. The protection and management of the knowledge will be handled through the Consortium Agreement (CA), which will defined the sensitive background knowledge and the associated access rights at the beginning of the project. Each participant has to declare the background sensitive knowledge (e.g., previously patented knowledge) in the CA. Each SME partner has exclusive ownership of the background during and after the project. The terms of use for non-sensitive background knowledge will be also specified on a fair use basis (e.g., right to free use with mention of the original owner and the MED-SUV project).
The CA will also set the rules driving foreground knowledge generated by the project. The ownership of the foreground knowledge will be with the partner who has generated the sensitive knowledge, whilst non-sensitive data will be disseminated using the fair use agreement aforementioned. If the foreground knowledge is capable of industrial or commercial exploitation, its owner must provide adequate and effective protection of it by patents, copyright or (registered) trademarks. Possible licensing of components will be treated on a case-by-case basis. In the case of SMEs, it is accepted in the CA that each SME Exploitation Manager, in cooperation with the Coordinator, will be assigned to take the necessary steps so as to protect the knowledge.
The Steering Committee will be in charge of the enforcement of the knowledge plan as defined by the CA, and will make the decision should a particular case arise. At the end of the project, the Steering Committee will prepare an Exploitation Agreement about the management of the knowledge and intellectual property issues effective from the end of the project on. The Exploitation Agreement will be discussed and approved by the General Assembly.

4. Ethics Issues

ETHICS ISSUES TABLE

Areas Excluded From Funding Under FP7 *(Art. 6)*

(i) Research activity aiming at human cloning for reproductive purposes;

(ii) Research activity intended to modify the genetic heritage of human beings which could make such changes heritable (Research relating to cancer treatment of the gonads can be financed);

(iii) Research activities intended to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer;

All FP7 funded research must comply with the relevant national, EU and international ethics-related rules and professional codes of conduct.

Where necessary, the beneficiary(ies) shall provide the responsible Commission services with a written confirmation that (a) favourable opinion(s) of the relevant ethics committee(s) has (have) been received and, if applicable, the regulatory approval(s) of the competent national or local authority(ies) in the country in which the research is to be carried out, before beginning any Commission approved research requiring such opinions or approvals.

In addition to ethics committees, national competent authorities on issues such as Data protection, Clinical trials, Animal welfare, Human tissue and cells, have been established in all EU Member States.

Guidance notes on informed consent, dual use, animal welfare, data protection and cooperation with non-EU countries are available at :
http://cordis.europa.eu/fp7/ethics_en.html#ethics_sd

	Research on Human Embryo/ Foetus	YES	Page
	Does the proposed research involve human Embryos?		
	Does the proposed research involve human Foetal Tissues/ Cells?		
	Does the proposed research involve human Embryonic Stem Cells (hESCs)?		
	Does the proposed research on human Embryonic Stem Cells involve cells in culture?		
	Does the proposed research on Human Embryonic Stem Cells involve the derivation of cells from Embryos?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research on Humans	YES	Page
	Does the proposed research involve children?		
	Does the proposed research involve patients?		
	Does the proposed research involve persons not able to give consent?		
	Does the proposed research involve adult healthy volunteers?		
	Does the proposed research involve Human genetic material?		
	Does the proposed research involve Human biological samples?		

	Does the proposed research involve Human data collection?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Privacy	YES	Page
	Does the proposed research involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?		
	Does the proposed research involve tracking the location or observation of people?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research on Animals[1]	YES	Page
	Does the proposed research involve research on animals?		
	Are those animals transgenic small laboratory animals?		
	Are those animals transgenic farm animals?		
	Are those animals non-human primates?		
	Are those animals cloned farm animals?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research Involving non-EU Countries (ICPC Countries[2])	YES	Page
	Is any material used in the research (e.g. personal data, animal and/or human tissue samples, genetic material, live animals, etc) : a) Collected and processed in any of the ICPC countries?		
	b) Exported to any other country (including ICPC and EU Member States)?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Dual Use[3]	YES	Page
	Research having direct military use		
	Research having the potential for terrorist abuse		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

[1] The type of animals involved in the research that fall under the scope of the Commission's Ethical Scrutiny procedures are defined in the Council Directive 86/609/EEC of 24 November 1986 on the approximation of laws, regulations and administrative provisions of the Member States regarding the protection of animals used for experimental and other scientific purposes Official Journal L 358 , 18/12/1986 p. 0001 - 0028

[2] In accordance with Article 12(1) of the Rules for Participation in FP7, 'International Cooperation Partner Country (ICPC) means a third country which the Commission classifies as a low-income (L), lower-middle-income (LM) or upper-middle-income (UM) country. Countries associated to the Seventh EC Framework Programme do not qualify as ICP Countries and therefore do not appear in this list.

[3] Dual-use items' mean items, including software and technology, which can be used for both civil and military purposes (Ref: Article 3**,** Council Regulation (EC) No 428/2009 of 5 May 2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items

5. Consideration of gender aspects

Traditionally, senior academic positions in the Earth sciences are predominantly held by men, in European countries less than 10% of full-time professors in the Earth sciences are women (Okay, N., et al., 2004. Current Status of women in Geosciences: A case study from Turkey. 32nd Int'l Geol. Cong., Florence, Italy (226-6): 1030.). Although only 10% of our Consortium partner groups are led by women, 27% of the key personnel carrying out significant roles in the project (see section 2.2 for each group). These positions include professors, senior academic (non-professorial level), senior researchers and technical support. This is higher than the average 24.3% of women at the postdoctoral research stage of a career in general science (Source: German Federal Statistical Office, Destatis, 2008e and 2009.).

Several European and international programmes have been undertaken to promote the participation of woman in research. Each partner will be encouraged to promote any institutional or national programme currently in place that promotes the participant of women in Earth sciences and the availability of support structures in their institute (e.g. crèches, schools etc. for researchers with families) according to the EC guidelines (The European Charter for Researchers, The Code of Conduct for the Recruitment of Researchers etc.). To encourage the participation of women in the MED-SUV project, research positions (postdoctoral and PhD level) will be advertised stating that the project promotes equal opportunities employment. We will request that our partners make available all regulations regarding family/maternity leave etc. at the time of advertising.

On the MED-SUV Project website, we will include links to EU services for human resources and mobility (e.g. Euraxess).

Attachment 1: letter of interest COCSABO

DECLARACIÓN DE INTERÉS

PARA ACCESO A BUQUES OCEANOGRÁFICOS DEL MICINN EN EL ÁMBITO DE LA COCSABO

Los buques oceanográficos constituyen la herramienta fundamental en la investigación de los océanos y sus recursos. Cuentan con un complejo y sofisticado equipamiento que es gestionado por personal experto. El amplio interés de la comunidad científica nacional así como la diversidad y distribución de las aguas y mares de interés, hacen que la asignación de campañas, dados los buques existentes, su equipamiento y su apoyo, sea una tarea compleja que exige un alto grado de coordinación de todos los agentes implicados.

Los buques asignados a la COCSABO prestan servicio a las campañas que se desarrollan en el marco del Plan Nacional de I+D+i, así como las del programa marco de la Unión Europea y las propias responsabilidades asignadas a los diferentes OPIs del MICINN. Sin embargo existen otras campañas que eventualmente pueden desarrollarse en estos buques en virtud de iniciativas auspiciadas desde otros estamentos del Estado, incluyendo las del Ministerio de Asuntos Exteriores en el programa de Extensión de Límites, iniciativas relacionadas con el Proyecto LIFE del Ministerio de Medio Ambiente, de la AECID o también de las Comunidades Autónomas.

En este sentido, se ha diseñado esta ficha de "**Declaración de Interés**" para todas aquellas campañas que no se desarrollan en el marco de Plan Nacional de I+D+i con el objetivo de conseguir una mejor planificación y coordinación de la utilización de los buques asignados a la COCSABO. De manera que esta ficha permitirá conocer las iniciativas que se están preparando y ello favorecerá su posterior toma en consideración en la elaboración de los calendarios de los buques.

La **Declaración de Interés** debe ser remitida a la Secretaría de la COCSABO (secretaria.COCSABO@micinn.es) tan pronto como la iniciativa sea presentada por el investigador o tecnólogo responsable para evaluación y eventual financiación ante el Organismo o Estamento competente.

Esta Declaración de Interés es meramente informativa y no implica obligación alguna por la COCSABO, ya sea en cuanto a asignación de tiempos o en relación con los términos en que se presenta la campaña. Adicionalmente esta Declaración no exime de la posterior elaboración de una propuesta completa si eventualmente la campaña fuera aprobada e incorporada a los calendarios de buques de la COCSABO.

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

COCSABO
FECHA: 18-NOVIEMBRE-2011
Nº REGISTRO: COC-DI-2011-08

INFORMACIÓN PRELIMINAR SOBRE LA CAMPAÑA[1]

1. Investigador principal

Datos de contacto incluyendo la Institución a la que pertenece

Prof. Jesús M. Ibáñez Godoy
INSTITUTO ANDALUZ DE GEOFÍSICA
Campus Universitario de Cartuja.
Calle Profesor Clavera, nº 12
UNIVERSIDAD DE GRANADA
18071 Granada. Spain.
Tlf 958 241761
629571353
Fax 958 160907
e-mail: jibanez@ugr.es

2. Nombre del proyecto

MEDiterranean SUpersite Volcanoes. MED-SUV. EU. FP7 – 308665-1

3. Principal disciplina científica

Geofísica, Geofísica Volcánica, Sismología, tomografía sísmica, estructura interna de la Tierra. Sísmica activa.

4. Descripción del proyecto o campaña

Esta campaña se encuadra dentro de las actividades programadas en el proyecto europeo MEDiterranean SUpersite Volcanoes. MED-SUV. EU. FP7 – 308665-1. El proyecto tiene como principales objetivos: a) Desarrollo de una nueva generación de sistemas de observación y control de geo-peligros; b) caracterización de los procesos volcánicos a través del modelado y análisis con nuevas técnicas de datos geofísicos de regiones volcánicas; c) desarrollo de estrategias para la preparación y mitigación de desastres volcánicos; d) desarrollo de diferentes test para la validación de las hipótesis y modelos. Para ello se han elegido dos regiones volcánicas del Mediterráneo como laboratorios, Etna y Campi/Flegrei-Vesuvio en Italia.

Para la realización de estos objetivos, uno de los planes de trabajo incluye el desarrollo de metodologías que permitan conocer los procesos volcánicos profundos durante las fases, pre- durante y post eruptivas. Entre estas metodologías se incluye la realización de una campaña de sísmica activa para el volcán Etna. Esta campaña ya se realizó en el pasado para Campi Flegrei y Vesuvio y ahora se pretende hacer un estudio similar para el Etna, en base de la experiencia del equipo también en otras regiones como Tenerife o Decepción en la Antártida.

[1] Cuando **NO** corresponden a proyectos del Plan Nacional, pero **SI** en el caso de proyectos europeos.

En esta campaña se ha previsto la combinación de fuentes artificiales en tierra y mar, así como el uso de la sismicidad natural de la región. Para las señales de tierra se cuenta con poder realizar explosiones usando material de la autoridad local de minas, y hacer al menos unas 30 explosiones de unos 100 kg cada una en pozos de unos 20 m. Las señales marinas se generarán usando cañones de aire comprimido emplazados en un buque oceanográfico. En este caso se desea utilizar el equipamiento que el BIO Sarmiento de Gamboa tiene, sobre todo su especial potencia y versatilidad. Para ello se realizarán explosiones siguiendo una malla densa en las costas de Sicilia frente al volcán en el lado Este y en el Norte, al lado del estrecho de Messina y entre las islas Eolias. Se calcula poder realizar no menos de 6000 disparos que cubran la zona. Estos disparos se realizarán usando dos fases de manera que se puedan duplicar los emplazamientos en tierra y tener una mayor cobertura.

Para el registro de las señales se usarán estaciones sísmicas permanentes y portátiles en tierra, y el despliegue de OBS en el mar. Para los OBSs se solicitarán los 17 que en este momento están disponibles por parte del CSIC para este objetivo. Adicionalmente está previsto solicitar a otras instituciones complementar dicha instrumentación, como AVI o IFM-Geomar. Debido a limitaciones logísticas la instrumentación de fondo marino sólo estará desplegada durante el tiempo de disparos, aproximadamente un mes.

El objetivo final será la tomografía de velocidad y atenuación sísmica de la zona. Nuestro grupo de trabajo tiene dilatada experiencia en este campo, resaltando las ya realizadas en Vesuvio, Campi Flegrei, Decepción y Tenerife, todas ellas publicadas en revistas de alto impacto y con la realización de tesis doctorales.

5. Centros involucrados en la campaña/proyecto

Participant no.	Participant legal Name	Country	Organisation type*
1 (Coordinator)	Istituto Nazionale di Geofisica e Vulcanologia (INGV)	IT	No-profit public body
2	Consiglio Nazionale delle Ricerche (CNR)	IT	No-profit public body
3	AMRA Scarl, Napoli	IT	No profit research organization
4	Dipartimento di Protezione Civile (DPC)	IT	No-profit public body, end user
5	Deutsches Zentrum für Luft- und Raumfahrt (DLR)	DE	No-profit public body
6	University of Hamburg (UHH)	DE	University
7	Ludwig-Maximilians-University Munich (LMU)	DE	University
8	Deutsches GeoForschungsZentrum (GFZ)	DE	No-profit public body
9	Durham University (UNIVDUR)	UK	University
10	University of Bristol (UNIVBRIS)	UK	University
11	Centre national de la recherche scientifique (CNRS)	FR	No-profit public body
12	Bureau de Recherches Géologiques et Minières (BRGM)	FR	No-profit public body

13	European Space Agency (ESA)	FR	No-profit public body
14	Consejo Superior de Invesigaciones Cientìficas (CSIC)	ES	No-profit public body
15	University of Granada (UGR)	ES	University
16	Universidade dos Açores (UAc)	PT	University
17	University of Malta (UoM)	MT	University
18	GEOMOS	CH	SME
19	Surveylab	IT	SME
20	Marwan Technology (MATEC)	IT	SME
21	Terradue (T2)	UK	SME
22	University of Western Ontario (UNIWO)	CA	University
23	Jet propulsion Laboratory (JPL)	US	No-profit public body
24	United States Geological Survey – Hawaiian Volcano Observatory (USGS-HVO)	US	No-profit public body

6. Organismo o Institución[2] al que se remite la propuesta

UE, FP7, y el buque se locita a la Unidad de Tecnología Marina, CSIC

INFORMACIÓN LOGÍSTICA

7. Buque (el nombre del buque será siempre orientativo)

BIO. Sarmiento de Gamboa

8. Área de trabajo
(Incluir croquis o mapa)

El estudio se realizará sobre el volcán Etna en la isla de Sicilia, Italia. Las explosiones con aire comprimido se harán en las costas Este y Norte de la Isla, hasta una distancia de unas 15 millas marinas, cubriendo una extensión de unos 40 km lineales. En la costa norte se cubrirá parte del espacio de las islas Eolias, como Vulcano o Strombli. Las zonas que se cubrirán con la malla densa de explosiones se refleja en la zona coloreada.

[2] Entidad que financiará el proyecto, la actividad o la campaña referida en esta Declaración de Interés

9. Días de trabajo (días completos de tiempo de buque necesarios para la campaña sin tránsitos)

Días:25/30

10. Número de Plazas

Personas: 12-16 científicos más 6-8 técnicos

11. Fechas previsibles de campaña
(Época preferida del año)

Julio-Octubre 2013

12. Equipamiento a bordo necesario

Sonda multihaz, EA-600; sonda paramétrica. Cañones de aire comprimido con la máxima potencia. OBSs de corto periodo. Gravímetro y magnetómetro. Programas de adquisición y control de los datos sísmicos.

13. Equipamiento portátil del buque necesario

14. Equipamiento propio aportado por el personal implicado

Sistemas informáticos portátiles, de almacenamiento de datos, de procesado de imágenes. Será posible incluir una dotación adicional de OBSs según acuerdos que se lleguen.

15. Comentarios

Este proyecto es una solicitud a la UE, FP7, para la realización de estas tareas, no incluyendo costes para el alquiler del barco, pero si para la gestión y uso de los OBSs, incluido el fungible necesario para tal fin. El Coordinador del proyecto es el INGV de Italia, Sezzione di Catania, pero es la UGR la responsable del experimento coordinando todas las tareas y costes económicos del mimos

Nota Adicional.- El solicitante de tiempo de buque se obliga a:

- Colaborar con la COCSABO y los organismos implicados en la preparación de la campaña
- Hacer constar la financiación del MICINN en los resultados del proyecto o informe (publicaciones etc.) y en cualesquiera acciones de difusión y divulgación relacionadas con el mismo.
- Entregar al MICINN, inmediatamente tras la realización de la campaña, un informe de campaña (secretaria.COCSABO@micinn.es) así como un listado con los metadatos obtenidos en ella.
- Entregar al MICINN, en un plazo de dos años desde la realización de la campaña, los datos obtenidos en ella.