MIA VITA

Final publishable summary report

Description of the project context and objectives

The Context

Volcanic eruptions are among the most dramatic agents of change on Earth. The emissions of gases and ash from larger eruptions can perturb global climate, affect human health and disrupt air-traffic. and adversely affect farming and agriculture. Volcanism therefore represents a multi-level threat to human societies and the environment. Assessing and managing multiple hazards and risks at volcanoes requires the combination and coordination of many capabilities and instrumental techniques, and involves expertise in volcanology, geology, physics, signal processing, data analysis, agriculture and social sciences. In EU countries, volcanic risk assessment and management are tackled through scientific knowledge and monitoring. For International Cooperation Partner Countries (ICPCs), risk management practices often have to deal with more limited availability of scientific information.

The Project Objectives

Following UN International Strategy for Disaster Reduction recommendations and starting from shared existing knowledge and practices, the MIAVITA project aims at **developing tools and integrated cost effective methodologies to mitigate risks from various hazards on active volcanoes** (prevention, crisis management and recovering).

Assessment and management of hazard risks constitutes a crucial requirement for many countries, especially ICPCs. Efficient management requires an integrated, seamless volcanic risk management methodology to be available for local authorities and scientists. In such an approach, there are three objectives to focus on:

(i) prevention tools based on risk assessment through risk mapping and realization of possible damage scenarios,

(ii) improvement of crisis management capabilities based on monitoring and early warning systems and secure communications, and

(iii) reduction of people's vulnerability and development of recovering capabilities after an event occurs (resilience) for both local communities and ecological systems.

These three objectives imply the design of an integrated information system with appropriate data organisation and transfers.

The Methodology

The methodology is designed for ICPC contexts but is expected to be valuable, also, for European stakeholders concerned with volcanic risk management. **The project's multidisciplinary team gathers civil defence agencies, national volcanological surveys, scientific teams (Earth sciences, social sciences, building, soil, agriculture, Information Technologies and telecommunications) and an IT private company**. The scientific work focuses on:

- the development of a risk assessment methodology that can be applied to any volcano, and adapted to existing and available knowledge

- the design of a WebGIS and data repository, as well as specifications and development of a scenario builder
- the identification and use of cost-efficient monitoring tools designed for poorly monitored volcanoes i.e. satellite & ground monitoring, especially for gas analysis and volcano seismology
- the improvement of vulnerability assessment for people and goods: buildings and biosphere
- socio-economic surveys to enhance community resilience
- the identification of good practices for volcano monitoring and emergency management in the field of telecommunications

Results have been achieved in partnership with local scientists and stakeholders in Cameroon, Cape Verde, Indonesia and Philippines. The objectives have been achieved through sharing/transfer of know-how, scientific and technological developments and dissemination/training, according to the Figure 1.

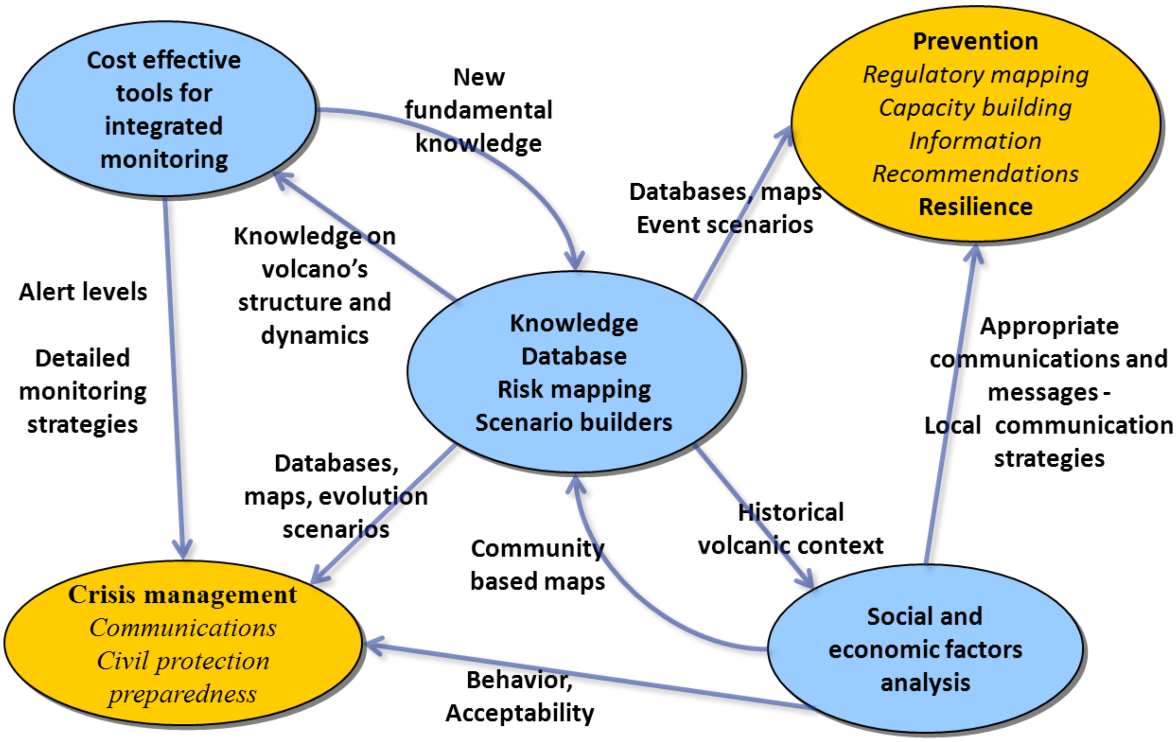

Figure 1 - MIAVITA conceptual frame

The work is divided into 8 work-packages :

Work-package No	Work package title	Type of activity	Lead Participant No
WP 1	Project management	MGT	1 (BRGM)
WP 2	Knowledge database and Web-GIS design	RTD	1 (BRGM)
WP 3	Cost effective monitoring	RTD	2 (INGV)
WP 4	Fragility curves and ecological vulnerability assessment	RTD	8 (UHOH)
WP 5	Socio-economic vulnerability and resilience	RTD	4 (CNRS)
WP 6	Communication strategies for crisis management	RTD	3 (IST)
WP 7	Users' needs and volcanic threat management	RTD	10 (DSC)
WP 8	Validation, dissemination of results and users' training	RTD	11 (DPC)

Beside this, the project is organised at two levels:

- Acquisition of data, development of new tools and methodologies (WP2 – WP6)
- Involvement of end users and stakeholders and dissemination (WP7 – WP8)

Data acquisition and analysis:

- WP2, dedicated to risk assessment, built on a knowledge database, hazard and risk mapping and scenario builders. The knowledge database and GIS including: the geological and morphological context, historical known events and their characterisation, integrated hazard map taking into account the various possible phenomena, the identification of elements at risk and their values, risk mapping methodology, etc. This knowledge database must be completed by:
    a. software enabling realisation of damage scenarios;
    b. schematic model of events and activities (volcano dynamics);
- WP3: Monitoring of targeted active volcanoes, using cost-effective techniques (satellite data, gas analysis and volcano-seismology). The objective is to identify parameters indicating a change of volcanic activity and to help defining alert levels. The setting up and adaptation of "easy tools" for monitoring the volcano (i.e. mainly remote sensing techniques) will be coupled with the above mentioned schematic model of dynamics and already defined accurate monitoring strategies.
- WP4: Vulnerability assessment. To assess risk, two components must be taken into account, hazards and damages. Knowledge on vulnerability of buildings, soil and agriculture make it possible to quantify the risk.
- WP5: Social and economic factors analysis. Effective disaster risk management must encompass the social and economic dimension of risks and disasters. It basically includes people's vulnerability and community resilience. This WP aims to assessing and reducing people's vulnerability facing volcanic risk. It also intends to enhance community resilience to foster disaster recovery. It shall further provide local authorities with decision-making information on people's behaviour and risk tolerance. These will help in designing effective prevention and mitigation strategies from both bottom-up and top-down perspectives;
- WP6: communication and data transfers. This key point will specify and set up infrastructures to ensure smooth and effective communication in crisis management.

Possibility to exchange information between scientists and civil defence authorities. Furthermore, there is a need for permanent links between laboratories and field observatories.

Involvement of stakeholders is a key point for success. They have to define actions to be taken according to the data analysed for:

a. Prevention. Based on a better risk assessment (risk mapping and realization of possible damage scenarios). This includes improvement of damage functions assessment for a number of hazards (like ash fall on roofs, effects of lahars, etc.) defined by the targeted volcanoes on various elements at risk, like buildings, infrastructures and crops. Definition of regulatory land-use recommendations, guidance for appropriate building techniques and agriculture, population awareness and information;
b. Crisis management. Protocols and tools for efficient communication between civil protection stakeholders, scientists and the population during a crisis. Improvement of crisis management capabilities (focused on early warning systems and secure communications). When the crisis starts, it is important to communicate as much as possible to reduce further problems due to the disruptions of human activities. Communication strategies are to be defined, especially using systems able to communicate through ashy atmospheres.

These actions will be achieved at all stage of the project through two work-packages.

- WP7: Users needs and volcanic threat management
- WP8: Validation and dissemination of results and users training.

Description of the main S&T results/foregrounds

WP2 - Knowledge database and Web-GIS Design

In essence, WP2 proposes tools that are based on heterogeneous knowledge and data, in order to provide a number of users with synthetic information about volcanic hazard and risk. The general objectives of this task are:

- Developing a generic GIS and web-GIS Database Architecture decision tool for volcanic threat management, using datasets already existing in Mount Cameroon.
- Setting up a risk assessment GIS (hazard maps, elements at risk maps, element at risk values and vulnerability database, risk maps) and a schematic model of events activities (volcanic dynamics) based on most probable scenarios on Philippines, Indonesia and Cape Verde target sites
- Developing an automatic or semi-automatic scenario builder software (integrating error assessment) initially based on Mount Cameroun already existing database and adapted to other target sites

These general objectives have been fulfilled as follow.

Generic methodology design – Hazard and Risk mapping methodologies

The user requirements information collected in WP7 into engineering and scientific requirements have been collected and used to define the wished features of the GIS and the data base. In addition, generics methods for hazard and risk mapping have been developed and shared.

Fundamental geological data on target volcanoes have been acquired and shared. This has enabled establishing basic knowledge on the targeted volcanoes, i.e., geological and geophysical volcano dynamics assessment. This has resulted in establishing new hazard mapping, in particular in Kanlaon.

A specific task has enabled to classify hierarchically exposed elements. While surveys had already been acquired in Mount Cameroun, a focus in the poorly known Kanlaon has been chosen for improving knowledge on exposed assets in this area.

Then a last task aimed at setting up the method to evaluate and map the 3 risk components (hazard, vulnerability, risk elements). An approach developed by BPPTK/CVGHM and applied in Merapi has been used for mapping risk at Mount Cameroon. The method has the advantage over other approaches (e.g. mapping exposed assets on a hazard map) of enabling risk assessment in a holistic way for facilitating mitigation, prevention and preparedness.

Scenario builder software

Scenarios have been defined for Kanlaon and Mount Cameroun with the support of local partners. Following specifications for scenario builders established in the previous phases, the software that was developed within the FP7 SYNER-G project for systemic risk scenario analysis has been adapted to address the issue of volcanic risk. These developments have been tested on eruptive scenarios on Mount Cameroon. This work has shown that the different functions of existing damage can actually be ordered as part of such a tool, and that the usual limits of such scenario-tools, namely the fact that they cannot assess potential indirect damages, are here especially exacerbated because of the temporal dimension of the hazardous event. Because of this, we think that scenario builders are most useful for preparedness exercises or at the earliest stage of abrupt disasters. For longer term recovery, the assessment of human vulnerability factors remains the most important action to undertake.

WebGIS database Architecture

This task has consisted in framing and developing a WebGIS and associated data architecture for Mount Cameroun. The tool has been transported in the Ministry of Mines of Cameroun in 2013 for testing use by stakeholders in charge of prevention and preparedness.

Summary

WP2 concludes with generic recommendations to conduct risk assessment, which are provided in the Handbook for volcanic risk management, in the reports and in scientific articles being prepared for a special issue on volcanic risk management presently scheduled in Natural Hazards and Earth System Sciences. First, Hazard mapping is the most important tool to develop and it can only be based on intensive field surveys together with the interpretation of geologists. It is also a prerequisite for land use planning and for risk mapping. In addition, for the same eruption, various adverse events will have different extension and consequences, so that they have to be processed separately. This distinction between adverse events and their potential physical impacts is particularly important for hazard mapping in volcanic areas, since these areas can be affected by multiple adverse events, each one associated with several possible physical impacts. Scenario-based risk assessments are useful, but they must be considered with caution, since they cannot account for all damages due to an event and because the focus on a single type of event may lead to over-adaptation to this event and maladaptation to others. WebGIS has been considered as a useful tool to communicate with authorities in charge of prevention, mitigation and preparedness. Finally, method in risk mapping have considerably been exchanged between partners during the project and the initial physical risk assessments have moved to more complete assessment of risks, including of the societal vulnerability component. As a summary, WP2 has achieved its research objectives to provide insight on how volcanic risk management can be improved through adapted knowledge management on hazard, vulnerability, and risk.

WP3 - Cost effective monitoring

The review of the existing monitoring systems has been completed and was followed by the set-up of new instrumentations on the targeted volcanoes

Ground monitoring network activities

MIAVITA purchased and installed the following equipments for monitoring at Kanlaon: 3 broadband seismometers CMG-40T (Güralp), 3 digitizers Malaku (Kinemetrics), 3 wifi telemetry system (Leverage), 1 tiltmeter (Applied Geomechanics), 1 digital audio level (Rope Systems), 3 personal computers for data processing

Five broadband seismological stations have been installed on Merapi, three stations purchased from MIAVITA (Güralp CMG-40TD and data logger Güralp DCM) and two come from the BRGM seismological stations pool (Güralp CMG-40TD and data logger Güralp DCM).

On Fogo Volcano, four Guralp broadband seismometers CMG-3ESPC equipped with CMG-DM24 were installed and are currently working, one CMG-EAM and a Seiscomp Embedded PC were purchased and working. The telemetry system was installed and four additional seismic stations, acquired thanks to funds from Government of Cape Verde, are installed and working.

A small network of corner reflectors, needed for SAR data calibration and analysis has been successfully set up on Fogo volcano.

Two new imaging cameras have been developed and tested during the 1st year of MIAVITA project:

- an Infrared camera (IR) for ash and SO2 monitoring
- an Ultra Violet (UV) camera for SO2 gas emission estimation, during the daytime

A new Wireless Sensors Network has been designed and a prototype has been realized and tested.

All the instruments worked (and are still working) for all the duration of the project. Data concerning levelling, deformation and seismicity have been processed and analysed. Many field campaigns for additional measurements and instruments maintenance have also been carried out.

Remote Sensing activities

A new product has been developed specifically for the MIAVITA targeted volcanoes. This is based on OMI SO_2 data and is intended as a monitoring product to be used on a daily basis.

A new DEM, at 10 m resolution, extracted by ALOS-PRISM optical data has been released, together with an ortho-rectified PRISM @ 2.5 m per pixel, panchromatic image for Kanlaon volcano.

A pre 2010 eruption high resolution DEM of Merapi has been delivered. The DEM is based on airborne SAR data at 10 m resolution per pixel.

Two additional DEMs extracted by means of SAR interferometry applied on ALOS-PALSAR images have been delivered for Merapi and Kanlaon.

The SAR time series of ENVISAT satellite data has been done for Fogo and Mount Cameroon volcanoes.

Merapi 2010 eruption

SAR data analysis – with very high resolution images from COSMO-SkyMed - has been performed in order to monitor the evolution of changes of volcano crater. Moreover, the analysis allowed an evaluation of the pyroclastic deposits coverage and volume estimation.

The link between gas and seismicity has been clearly pointed out. From observations it is clear that the amount of gas released from Merapi is directly linked to the seismicity, as seen by RSAM.

An extensive analysis of Merapi seismicity before and during eruption has been performed.

During the crisis phase of Merapi 2010 eruption, many remote sensing data have been processed in order to retrieve SO2 (AIRS and IASI sensors) and ash (MODIS and MTSAT)

WP4 - Fragility curves and ecological vulnerability assessment

The major objective of this work package was to evaluate the vulnerability of buildings and infrastructure as well as agricultural systems and soils to volcanic hazards though the establishment of fragility curves. The vulnerability to volcanic hazard and the disaster resilience inherited in the current agricultural systems have been investigated together with the associated vulnerability of human settlements. Finally, mitigation strategies to improve community resilience have been proposed in the face of future volcanic hazards. The target volcano was from the beginning Mount Kanlaon in the Philippines. This is a subduction volcano, which was reported to be active and has the form of a typical stratovolcano. Locally the specific situation was that there are some little cities around the volcano which may be reached by volcanic events. Also an interesting point was that four different ethnicities are living around the volcano. And two political departments are sharing the volcanic cone. During the work, the major problem was the impossibility to reconstruct the volcanic history properly. Due to societal problems and the remote place of the volcano, Philippinian colleagues were not able to collect sufficient basic data. Therefore during the progress of WP4 data from Merapi (Indonesia), Fogo (Cape Verde Islands) and finally Etna (Italy) have been incorporated in the data to be used also.

The different types of volcanic events could be stratified according to its effects on agriculture and buildings. Lava flows led to complete loss of vegetation and arable land and buildings and its rehabilitation needs centuries or more. Second, pyroclastic density currents and lahars cause immediate and complete destruction of arable land, buildings and infrastructure.

However, rehabilitation may be possible with high efforts after several years or decades. Ash fall may be the most far reaching and sometimes also the most destructive agent to agriculture infrastructure and buildings. However, the impact is mainly depending on the amount of ash.

Reducing the vulnerability of buildings was a special focus in our study. It was found that community buildings generally are built with modern materials. However, these buildings are frequently built with poor standards. Relevant codes of practice for design and construction have to be employed, which are suitable for the volcanic area. Agricultural homes are often built with timberframe and poor quality shed roofs. Those buildings cannot be expected to survive a significantly level of ash fall or a pyroclastic flow. This point underlines the need to build specific community shelters, which can be used in a sudden emergency. And general buildings for crop storage should be made with materials possible to resist volcanic hazards.

Well-developed soils from volcanic materials (Haplic Andosols) can be highly productive, with a pH around 6.5 when they are rich in organic matter and well supplied with mineral nutrients. While any amount of ash fall may affect growing vegetation, it remains difficult to predict the long-term effects on soils. The highly productive Andosols may buffer ash fallout of up to around 10 cm very well. Leached tropical soils may even benefit from ash fallout of less than 5 cm in thickness. Unproductive and rocky poorly-developed soils may have little influence. Generally restoration of agriculture with ash fall thicknesses up to 10 cm is feasible. In the range of 10 to 30 cm of fallout, it is already very difficult but feasible with specific cultivation practices such as growing nitrogen fixing legumes. Thicknesses greater than 50 cm will require a completely new agricultural system. With the available data, some chronofunctions of soil properties in relation to volcanic events have been derived as well as vulnerability curves for plant and crop systems. A soil suitability index was developed instead of modelling scenarios. This index could be used for different crops and many different volcanic events. This establishment replaced the attempt of using an agronomic crop production model and was applied in the case of sugar, cane and maize, which are most important crops at the target volcanos.

Further research in this domain requires selection of volcanoes with a well-established history of volcanic events Ii.e., well-dated or readily-datable events). This would be a prerequisite to improve the prediction of volcanic impacts on agriculture infrastructure and buildings.

WP5 – Socio-economic vulnerability and resilience

Assessing people's vulnerability and coping capacity at Mount Cameroon

In the south-west region of Mount Cameroon, both community leaders and the general population have pointed out that their livelihoods are endangered by the destruction of animals, forests, water and soil by various threats. The main reactions to natural hazards include: people run out of their houses and relocate temporarily; some stay back to protect property; people protect their nostrils from ash and gas using common material found in the environment; traditional medicine is used to prevent the inhaling of gas; women protect and provide food and equally take care of children; and men assist in rescue operations, perform rituals to appease the gods and prayers for divine intervention.

In relation to resilience, there is no significant difference in the perception of threat several years after the occurrence of a disaster. Gas and acid rain were pointed out as the main cause of crop destruction years after eruption. Several years after the 1999 eruption, the population complained of reduction in food production, increasing poverty, unemployment, and in people settling continuously in disaster prone areas. The high fertility of the soil around Mount Cameroon which favours the development of small or large scale farming, the proximity of the sea that enhances fishing activities, natural resources like petrol, mineral water, and quarry sites are all natural potential factors which help the population to recover from a disaster. The major findings of this study were used to develop a community-based disaster risk management scheme, which can be used to develop a model to reduce people’s vulnerability and enhance community resilience. Parts of these results were used as inputs to apply the risk mapping method to Mount Cameroon in WP2.

Socio-economic influence on people’s risk awareness: a view from Fogo Volcano

At Chã das Caldeiras, a village located in the 9 km-wide caldera of Fogo, the population permanently exposed to volcanic hazards is around 710. The community of Chã has both weaknesses and strengths in facing volcanic hazard. Socio-economic factors have been identified as more important compared to hazard-related factors, in explaining risk behaviours during an eruption. People have a good knowledge of volcanic hazard. Based on the MIAVITA database, 77% of people who experienced the last eruption in 1995 fled from danger. Others waited until the last moment to leave the caldera (12.5%), while some stayed in the village. Cultural factors may explain the strong attachment of people living in the caldera with the volcano, which is considered as a friend despite the absence of local beliefs.

People’s response is more likely due to economical assets and constraints, and lack of alternatives for access to livelihoods outside the caldera. The volcanic soils within the caldera are fertile, the climate conditions are better than in the lowlands, and the volcano is a source of additional income since 1995 with the development of geotourism. However, livelihoods are fragile for many reasons: climate-dependent farming, absence of land registration, limited alternative resources, growing dependence on volatile national and international economies, lack of communication facilities and of public services, etc. Economic pressure can also explain people’s behaviour during crisis, since they first refused to evacuate in order to cultivate their crops, take care of their animals and protect their goods.

Community-Based Disaster Risk Reduction activities at Kanlaon Volcano

50 000 people, from three major ethnic groups, live on the verge of poverty with numerous social problems on the slopes of Kanlaon Volcano. Most are marginalized people who had to escape the everyday risk of livelihood insecurity. People decided to face volcanic hazards in order to plant food sustenance needed for daily living. The long history of poverty and political upheaval among mountain communities has created an atmosphere of mistrust between locals and the government. Being marginalized, the resources at the household and community levels which are necessary to protect themselves from hazards are limited. Livelihood and other daily survival strategies are more urgent matters making disaster preparedness the least priority even if they are capable of doing it. In addition, being far, literally and politically from the city centre, the mountain communities are usually the lowest priorities of the government when conducting a Disaster Risk Reduction (DRR) program.

In the frame of the MIAVITA project, recent DRR activities conducted around Kanlaon Volcano in collaboration with local stakeholders such as NGOs, authorities and local communities tried to integrate bottom-up and top-down strategies. Community Based DRR (CBDRR) activities were implemented in four local communities considered as most vulnerable and most exposed to volcanic hazards. Participatory methods have allowed local people to express their knowledge. Livelihood issues were tackled and included. Local authorities and outside scientists had the opportunity to share and integrate, not substitute, their knowledge. The project fostered local ownership and sustainability. In the MIAVITA study, outputs such as the results of action planning, 3-dimensional maps, and other important documents produced by the people were left in the communities and are accessible to everyone.

Assessing risk perception at Merapi before and during the 2010 eruption

In the framework of the MIAVITA project, people's behaviour, hazard knowledge and risk perception were assessed before and after the 2010 major eruption of Mount Merapi. The volcanic activity of Merapi has been totally integrated into people's daily lives. In Javanese perspective, Mount Merapi is personified: "Mbah Merapi" (Mbah means grandparent) belongs to the human world. Instead of being considered as a source of danger, the volcano embodies the common patriarch respected by all the villagers. Local people put their trust in the spiritual guardian of the volcano appointed by Yogyakarta Palace, namely Mbah Marijan. The presence of the Juru Kunci's house at Kinarhejo partly explains the refusal of the inhabitants there to evacuate before the 2006 eruption of Mount Merapi, although the evacuation had been ordered by the authorities. The feeling of safety is enhanced with the presence of concrete structures like Sabo dams, and by the distance of the village from the crater. This feeling of safety from the local communities living further than 15 km from the Merapi crater was enhanced by the extent of the pyroclastic flow hazardous areas delineated by CVGHM, which did not take into account the possibility of a major explosive eruption. Since 2006, several programs on volcano-related disaster management were conducted in villages located close to the summit, e.g., participative volcanic hazard mapping, community evacuation simulations, and compulsory training programs for hazard mitigation. However, there was a lack of community awareness and education for villages located between 10 and 20 km from the summit, where the evacuations were unplanned.

More than 80% of the victims of the November 4th 2010 eruption were living in villages located outside the 15 km radius. Most of the villagers decided to evacuate by themselves just after the first explosion on 26 October, when the pyroclastic flows reached Kinahrejo. Twenty five people were killed, including Mbah Maridjan who refused to evacuate. People opted to evacuate when they felt imminently threatened by pyroclastic flow or ash fall, as exemplified during the night of 4 to 5th November 2010. 72% of the interviewed people in the refugee camps have returned to their village during the evacuation period, some of them at a daily frequency, mainly in order to feed the livestock or to see the condition of their house.

Summary

At the local level, Participatory 3-Dimensional Models (P3DM) have been built in 3 villages at Fogo, Merapi, and Kanlaon in order to raise local awareness of territories, to provide stakeholders with powerful mediums for land-use management and to serve as effective community-organizing tools.

As an output of our results on the four studied volcanoes, we have proposed a series of good practice in order to reduce the gap between risk managers and the population. The efficiency of volcanic risk management depends on several factors related to: hazard knowledge and public awareness, communication (sharing of information, language, and dissemination of information), integration of the local people in DRR process, cultural factors in people's awareness and risk perception, and socioeconomic environment in people's awareness and behavior, etc.

WP6 – Communication strategies for crisis management

The overall objective of MIAVITA WP6 was a) the assessment of the potential of modern communications technology to improve the standards of volcano monitoring and emergency management; b) the upgrade of the telecommunications infrastructure in Fogo Volcano through the testing and implementation of innovative solutions and c) the drafting of recommendations concerning best practices for volcanic data transmission for routine monitoring as well as emergency management.

As a starting point, a general telecommunications functional architecture for volcanic monitoring and crisis management was developed, through the identification and characterization of relevant actor entities (volcanic sensors, local and remote volcanological laboratories, civil protection centre, local forces, population), information entities (sensor data, expert reports, management commands, public reports, field data), and definition of the workflow process. The functional architecture was characterized both in terms of the present systems and the required communications links, on the basis of information's gathered from ICPC partners through a questionnaire. This task produced deliverable D6.a. An update of the deliverable, including instantiation to the participating ICPC volcanoes based on the analysis of the replies to questionnaires, was part of deliverable D6.f.

The upgrade of telecommunications infrastructure in Fogo Volcano started with a reconnaissance survey of Fogo island in December 2008, to assess the situation of equipments deployed in previous projects. This assessment led to the organization of an extra MIAVITA workshop in Fogo island in June 2009. In parallel, the requirements for new equipment to be purchased under MIAVITA were discussed with INMG, and the procurement and purchase processes were initiated. This is described in deliverable D6.b. The new equipments were procured and ordered, and duly installed and tested, reaching full operational status by mid-2011.

The tests on the use of VSAT for data transmission in Fogo island started with the selection of a site to install a satellite antenna in Fogo island, in December 2008. The construction of the infrastructure – equipment shelter, solar panel structure, radio mast, platform for VSAT antenna - took place during the second trimester of 2009 (no telecom equipment was purchased by the project for this purpose). Tests of possible network configurations were conducted using VSAT equipment in South Morocco, in similar satellite coverage conditions. A solution combining VSAT "residential-type" Internet service (ISP Skylogic, Italy) with mediated Virtual Private Network service (QNV Solutions, Spain) was validated and selected for testing in Fogo Island (deliverable D6.c). The attempt to implement this solution in Fogo volcano led to a negative result, and several market-driven barriers were identified in the process. Finally, the VSAT option was abandoned and an alternative Inmarsat-based solution was adopted and implemented to back-up the data transmission links put in place in the scope of the project.

Two tasks were built on the information gathered through the questionnaires in order to make recommendations concerning:

a) adequate architecture and best practices for communications between laboratories (local, i.e., in the vicinity of the volcano, and remote, either at national or international level) for emergency management, through the identification of critical points and fragilities; (D6.e)

b) local telecommunications infrastructure from the viewpoints of monitoring of crisis management (D6.f).

Summary

In Fogo island, a very significant improvement of the standards of volcanic monitoring was achieved, through the upgrade of the data transmission infrastructure, which secures real-time access to a substantial volume of monitoring data for analysis at INMG headquarters in Mindelo.

Given the overall low level of awareness to the critical nature of data transmission and communications reliability for volcanic emergency management, the two deliverables containing recommendations for good practices in what concerns communications can be expected to raise the awareness to this particular problem and help promote corrective measures, thus reducing the vulnerability of the communities exposed.

WP7 – Users' needs and volcanic threat management

This WP has been developed using a combination of studies, missions, workshops conducted in the ICPCs during the whole duration of the project. Workshops have been held in Cape Verde (June 2009), Indonesia (July 2009) and Philippines (August 2009). In the Philippines as well as in Indonesia, local closure workshops have been organized too in August and September 2012, respectively. Initially, the information taken during these workshops from participants belonging to the scientific community and from civil protection and disaster management agencies, indicated the main user requirements and needs, and served as good preliminary assessments for volcanic crisis prevention, mitigation and preparedness for each of the target volcanoes. For Cameroon, the preliminary assessment was done using previous project (GRINP project - Gestion des Risques Naturels et Protection Civil), which involved both BRGM and MINIMIDT.

The results obtained through these workshops have been integrated with the information taken during MIAVITA missions, studies and analyses. Representatives of Italian and French Civil protection visited the four countries, taking information in each specific socio-cultural and volcanic context through meetings with the main civil protection stakeholders and scientists. A special mission has been arranged during the 2010 Merapi volcanic crisis. At this occasion a group of scientists of MIAVITA group, worked with CVGHM and the local civil protection during the eruption, producing a daily report to MIAVITA team, which included scientific analysis and civil protection actions. These reports have been relevant to deeply understand the civil protection system in Indonesia. Many missions have been performed also by CNRS through its involvement in WP5 sociological aspects. CNRS collected a lot of information about the civil protection system and the related needs for all the ICPCs involved in MIAVITA project. This work has been particularly useful since it enabled partners to get information from local authorities and local people during the exercises conducted. This work was possible thanks to the strong support of local scientists (CVGHM, PHIVOLC, MINIMIDT and INMG).

Hence the users involved in volcanic crisis management have been mapped for each target volcano. When possible, their needs have been collected. And the basic land-use recommendations, alert levels and procedures in case of crisis have been identified.

Furthermore the main strengths and weakness of the civil protection systems have been drawn. On this basis, some suggestions and recommendations has been given to the local authorities in order to support them in developing the system, when needed.

In Cape Verde, MIAVITA team organized and run a final exercise (Table-Top) in June 2012 with the support of the local civil protection, taking into account MIAVITA guidelines and recommendations as a mainstream.

All this data are reported in WP7 integrated deliverable (D7.a-d).

Finally, these information were used as major contributions to the "*Handbook for Volcanic risk Management - Prevention, Crisis management, Resilience*" which was published and distributed to MIAVITA partners, and many other organizations worldwide. This volume is freely downloadable on internet.