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Deliverable D.B1: User needs and requirements

A deliverable of

Task B: User requirements and assessments

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Dissemination Level		
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)	
TN	Technical Note	X

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EXECUTIVE SUMMARY

The activities defined and performed in the Action B.1 named “Identification of user needs” are reported in this document, which represents the first official deliverable of Task B “User requirements and assessments”.

The starting point of this action is the definition of the list of products which are planned to be developed by the Safety project. The list is a key requirement in order to define credible user needs and specifications for each product.

To define the needs, the results of two activities are taken as input:

- the review of international and EU strategies and Directives as well as the results of previous projects on the landslides, subsidence and geohazard risks management;

- the analysis of the existing natural risks prevention procedures of the CPAs involved in the project (Italian Civil Protection Department – IDCP and Canarias Civil Protection - CDCP), with a specific focus on the hydraulic and geological risk management, for Italian civil protection, and including also the volcanic risk management for the Canarias authority.

The preliminary identification of two qualitative lists of user needs, based on each operative workflow of the two CPAs involved, has been done.

These two separated lists have been re-worked taking into account the international and EU strategies and Directives and the results of previous main developed EU projects.

The results is the final list of user requirements, not specific only for Spanish or Italian framework, but useful to support Civil protection authorities in increasing knowledge and ability to manage and reduce the geological risks.

Due to the fact that the user requirements are defined in the first stage of the project, this list, which plays the role of starting point and guidance for the development of the products, will be updated during the progresses of the project. This is because some useful input could derive from the close collaboration among users, scientists and technological partners during the next phase of the project. The updated list of the requirements list will be included in the second official deliverable of Task B foreseen for Month 12, to define the user assessment procedure.

REFERENCE DOCUMENTS

N°	Title
RD1	DoW Part B

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INTRODUCTION

The project Safety aims to provide to the Civil Protection Authorities (CPA) the capability of periodically monitor and assess the impact of geohazards (landslides and subsidence, volcanos, earthquakes) on urban areas. The project's objectives are to improve the ability to detect and map landslides, to assess and forecast the impact of triggered landslide events on vulnerable elements, and to model landscape changes caused by slope failures. Safety is mainly addressed to the CPAs at different administrative levels.

This document is the report which includes the definition of the user needs and the translation of these in requirements to support the activities of Safety and, in particular, to develop products really useful for the CPAs. The present document is organized in three main sections:

- **the first section** is dedicated to describe the methodology selected to define the user needs. First of all, it includes the list of requested Safety products in order to define the user needs focalised on each of them. The second relevant input, reported in this section, is a review of existing strategies and Directives existing at EU or international level, as well as the main results of previous projects performed on the similar topics;
- **the second section** includes the analysis of existing procedures of the CPAs involved in the project, for natural risks prevention and the two corresponding lists of the user needs for Safety products specific for Italian civil protection and for Canarias civil protection;
- **the third and final section** of the document contains the final list of the user needs translated in requirements for the products which will be developed in the project. This list is elaborated starting from the two qualitative lists of user needs for Italy and Spain, taking into account the information deriving from EU and international existing strategies and Directives, as well as the results of main projects and programme already developed for the same topic of the project.

1 METHODOLOGY TO COLLECT USER NEEDS

The identification and the definition of the user needs for Safety has been based on:

- the analysis of the Safety DOW, where all the proposed project activities are described;
- the interaction between the Safety project partners;
- the experience and specific expertise of the Safety partners and in particular of the users involved in the project consortium;
- a literature review about Directives, strategies, national and international activities and projects connected with Safety objectives from a user point of view.

For the user needs collection the procedure described below has been designed and followed (figure 1.1):

- for each CPA involved in the project have been taken into account the existing prevention procedures, in particular for the subsidence and landslides risks;
- taking into account the specific procedures of each CPA involved in the project, qualitative user needs, for the specific context and for each product of SAFETY, have been defined;
- starting from the two different qualitative user needs and taking into account the state of the art at EU and international level (in terms of existing Directives, results of specific projects about the same topics, etc.), a single list of user needs has been elaborated;
- the final list of user needs is reported as project/products requirements (using a specific rationale and coding), in order to support the activities of the project and make the products suitable to be integrated in the operative workflow of different CPAs and in different environmental contexts.

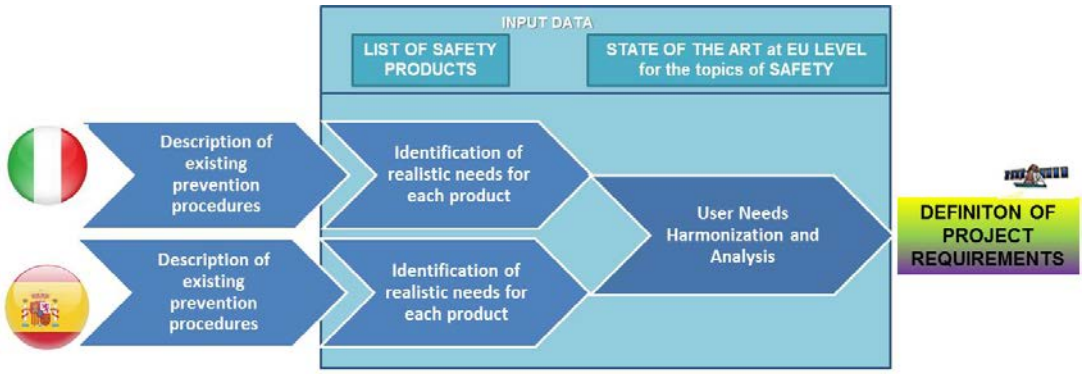


Figure 1-1 Procedure to collect user needs and define requirements.

Two main input data, to start the process of user need identification, have been used:

- The list of products foreseen for the project (see section 1.1).
- The existing state of the art in terms of strategies and directives at EU or international level for specific products (e.g. the Inspire Directive) and the results reached by the research activities conducted through other EU projects or initiatives on the same topics that have to be taken into account in order to avoid loss of effort already spent in previous initiative with similar goals (see section 1.2).

1.1 Safety products

The list of products is reported below with a short description of the type, the task in charge to provide it, and the test site in which the product is planned to be produced.

Product	Type of product	Short Description	Test site
Deformation activity map	Map	**(Task C.2)** The Deformation activity maps will consist on multi-layers map containing at each layer different levels of information related to the level of activity of each map cell.	Tenerife, Gomera and Gran Canaria Islands and Volterra
Geohazard Susceptibility and hazard map	Map	**(Task E.1)** Landslide susceptibility is the likelihood of a landslide occurring in an area based on local terrain conditions. Landslide hazard is the probability of occurrence in a specified period and within a given area of a potentially damaging landslide of a given magnitude.	Tenerife, Gomera and Gran Canaria Islands and Volterra
Geohazard activity map	Map	(**Task E.3**) The Geohazard activity map combines deformation map and geo-hazard inventories. In particular, it will consists in a map that integrates the PSI ground deformation data, the inventory of geohazard phenomena and the morphology of the area. As a result, the geo-hazard activity map will highlight hotspot areas with active instability phenomena. It will be updated according to the SAR data processing.	Volterra area and Canary Islands test sites
Impact assessment on structure and infrastructure map	Map	(Task E The impact assessment map will result in a evaluation of the impact of detected geohazards on vulnerable	

		structures and infrastructures, such as road networks and built-up areas. The impact assessment map will be based on susceptibility and geohazard activity maps combined, in a GIS environment, with the available geo-databases of elements at risk and occurred damage. This will be elaborated by deriving their vulnerability in terms of expected loss and impact degree. The final outcome will be a simplified colour scale map implemented with the level of impact expressed as the probability of suffering for a specific geo-hazard	
Radar interferometry software	Software	**(Task C.2)** Software tools to process the Sentinel-1 data in order to obtain deformation velocity maps.	

Table 1-1 List of Safety products

The list has been defined during the Kick off meeting of Safety project in agreement with all the partners.

Due to the fact that the production of the projects will start after the definition of requirements, and thanks to the fact that some users are also involved as project partners, the list of requirements will be re-worked at month 12, in order to update the needs taking into account the progresses reached by the project.

1.2 State of the art at EU level

The aim of this review was to collect useful information about the main existing activities performed in the same topics of the Safety project.

The necessity to summarize the existing state of the art concerning the research activities to support the management and understanding of geological risk is a preliminary step, which makes the project in the position to take advantage from the previous results.

The need to improve efforts for the development of prevention products and services is part of an innovative approach to shift from “disaster management” to “disaster risk management”. In this context, the Safety project activities have to be well positioned within the context of the European and international initiatives related to risk prevention and management, namely the EU civil protection mechanism and its legislation and the recently adopted Sendai Framework for Disaster Risk Reduction 2015-2030. In fact, the Sendai framework will aim to prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increasing the preparedness for response and recovery, and thus strengthening resilience.

The goals of the Safety project are close to the intention of EU and global action and policy that make attention on the evaluation of the data related to the disaster and the data related to the susceptibility and exposure in order to manage the risk in a different approach. In this way, the project is addressed to cope the Four Priorities for Action of Sendai framework for disaster risk reduction, and in particular with the Priority 1: Understanding disaster risk.

In addition, some strategies, programme and Directives have to be considered in order to make easier the integration of Safety products in the operative workflow of CPAs. For example, one of the goal of Safety is the development of cartographic products to support activities of risk evaluation; for this type of product the Inspire Directive is valid and already operative in EU Member States.

The list reported below includes a small description of all the main Directives, strategies and projects taken into account as input for the definition of Safety user needs:

- **Sendai Framework for Disaster Reduction 2015–2030**. Based on the following 4 pillars: priority 1, Understanding disaster risk as the base of other three priorities for Action; priority 2, Strengthening disaster risk governance to manage disaster risk; priority 3, Investing in disaster risk reduction for resilience; and priority 4, Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction.
- **ISDR-ICL (International Consortium on Landslides) Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk**, officially accepted in 2015 at the 3rd United Nations World Conference on Disaster Risk Reduction in Sendai, Japan. ICL is proposing the ISDR-ICL Sendai Partnerships 2015-2025 to promote the understanding and reducing landslide disaster risk to be adopted in WCDRR 2015 in Sendai.
- **COP21 and Sustainable Development Goals:** On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development — adopted by world leaders in September 2015 at an historic UN Summit — officially came into force. Over the next fifteen years, with these new Goals that universally apply to all, countries will mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind.
- **Soil thematic strategy**: Landslides are one of the soil threats considered in the EU Thematic Strategy for Soil Protection and the related Proposal for a Soil Framework Directive. The proposed Directive, in turn, will be the Strategy implementing tool. This will mainly require to identify landslide and other soil threat risk areas in the European Union, set risk reduction targets for those areas and establish programmes of measures by Member States to achieve them. On 13 February 2012 the European Commission published the report The implementation of the Soil Thematic Strategy and ongoing activities (COM(2012) 46). The report provides an overview of the actions undertaken by the Commission to implement the four pillars of the Strategy, namely awareness raising, research, integration, and legislation. It also presents current and future challenges to ensure soil protection. The report includes a preliminary landslide susceptibility map of the EU and neighbouring countries produced by the European Landslide Expert Group coordinated by the Joint Research Centre (http://esdac.jrc.ec.europa.eu/themes/landslides).
- **INSPIRE DIRECTIVE.** In November 2012 the Commission, in agreement with the Member States, has set up the INSPIRE Maintenance and Implementation Framework (MIF), to further optimize the performance of the INSPIRE infrastructure in order to meet its policy objectives. In the INSPIRE Committee meeting on 8 April 2013, it was agreed to set up a Commission expert group called INSPIRE Maintenance and Implementation Group (MIG), with representatives of the INSPIRE national contact points. The MIG is structured in two permanent sub-groups focusing on technical (MIG-T) and policy-related (MIG-P) aspects as well as a number of temporary sub-groups focusing on specific actions defined in the maintenance and implementation work programme (MIWP). The MIG was formally established and started its work in October 2013. The MIG has been complemented by a pool of experts drawn from the stakeholder community. The experts in this pool are called

upon when MIG sub-groups are formed to address specific implementation or maintenance issues, but will also provide the opportunity to reach out to experts involved or interested in particular aspects of INSPIRE implementation or maintenance. Another initiative of the Commission linked to the INSPIRE Maintenance and Implementation Framework, is the INSPIRE Thematic Clusters Platform with the objective of supporting INSPIRE implementation in the Member States. This Platform has clustered all the INSPIRE themes into nine thematic domains to facilitate sharing of experiences, best practices, raise questions and resolving issues. The "Earth science cluster" is relevant for Safety project because groups the INSPIRE themes of Energy Resources, Mineral Resources, Soil, Natural Risk Zones and Geology.

- **Copernicus programme.** (Land, Emergency…) Copernicus, previously known as GMES (Global Monitoring for Environment and Security), is the European Programme for the establishment of a European capacity for Earth Observation. The objective of the European Copernicus programme for land is to provide land cover information to users in the field of environmental and other terrestrial applications.
    - Copernicus land builds on the pre-cursor Copernicus-related FP7 project Geoland, which addressed amongst other both the local component (i.e. the Urban Atlas) and the continental component.
    - The Copernicus Emergency Management Service (EMS) is the first Copernicus service to become operational whit the aim to reinforce the European capacity to respond to emergency situations. The service has been defined and further refined in the past decade within a set of precursor Research & Development Projects such as: RESPOND (ESA GSE, 2004 – 2009), PREVIEW (FP6, 2005 – 2008) and RISK-EOS (ESA GSE, 2003 – 2008), defining and structuring the basic user requirements; SAFER (FP7, 2009 – 2011) and linkER (Service Contract, 2009 – 2011) together powered the pre-operational version of the GMES Emergency Response Service widening the user community accessing to the service.
    - The Copernicus EMS provides a cartographic service to authorized users involved in the management of humanitarian crises, natural disasters and man-made emergency situations, exploiting satellite information and data.
- **Intergovernmental Panel on Climate Change (IPCC)** is the international body for assessing the science related to climate change. The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

The results of the following projects have to be considered as starting point for SAFETY work:

- **LAMPRE** [2013-2015]: Landslide Modelling for Vulnerability Assessment, Preparedness and Recovery Effort. This two-years research project had the following goals: enhance landslide risk mitigation/preparedness efforts, post event-landslide recovery and reconstruction activities in highly vulnerable geographic and geologic regions, improve the ability to detect/map landslides, assess/forecast the impact of triggered landslide events on vulnerable elements, and model landscape changes caused by slope failures, exploit and develop existing Earth Observation imagery to prepare event, seasonal and multi-temporal landslide maps, improve the response capacity from Civil Protection Authorities through products for preparedness/mitigation & recovery reconstruction phases, assess the economic sustainability and facilitates the uptake of the LAMPRE downstream service.
  This project has been well developed also in terms of user requirements for the products which are similar to those of Safety, even if using different type of sensors. For this reason, the results of this project that is also one of the last developed in support of landslides risk management, have been well evaluated and used as input for Safety project.

- **DORIS** [2010-2013]: Ground Deformation Risk Scenarios: an Advanced Assessment Service. An advanced downstream service for the detection, mapping, monitoring and forecasting of ground deformations, that integrates traditional and innovative Earth Observation and Ground-Based data and technologies [19]. In the DORIS project different monitoring techniques with HR data have been used, including remote sensing (optical and SAR) and in situ (GBInSAR) data. In particular, for SAR monitoring the images have been acquired from different satellites (ERS1/2, Envisat, Radarsat, TerraSAR X and COSMOSKY MED).
- **SAFER** [2009-2012]: Services and Applications For Emergency Response.
- **TERRAFIRMA** [has been operating in three discrete stages: Stage 1 - the first two-year (ended in 2005) was concerned with consolidation of service providers and users; Stage 2 – started in November 2005, concerned with rolling-out the service across all Member States of the EC. ; Stage 3 - started in December of 2009 and ended on 2012]. This project was based upon the remote sensing technique of Persistent Scatter Interferometry (PSI). The service was focused on urban subsidence and landslides, but earthquake zones, coastlines and flood plains were also included.
- **SAFELAND** [2009-2012]: Living with landslide risk in Europe: Assessment, effects of global change, and risk management strategies) three main objectives:
  - provide policy-makers, public administrators, researchers, scientists, educators and other stakeholders with improved harmonized framework and methodology for the assessment and quantification of landslide risk in Europe's regions;
  - evaluate the changes in risk pattern caused by climate change, human activity and policy changes.
  - provide guidelines for choosing the most appropriate risk management strategies, including risk mitigation and prevention measures.

2 EXISTING NATURAL RISKS PREVENTION PROCEDURES

The direct involvement of Civil Protection Authorities, at different administrative levels (National and regional), in the SAFETY project is a good opportunity for strengthening the use of science and technology in policymaking and is also relevant in order to proceed in the direction of compliance with the prospective of Disasters Risk Reduction (DRR) and to develop services, procedures and products that can be easily integrated with other operative services at EU level and easily shared among EU Member State.

The countries directly involved, as Civil Protection, in Safety consortium are particularly affected by landslides and geological risk due to morphological condition as well as from activation of landslides due to other natural risks (e.g. Volcanic and seismic).

The following sections are dedicated to analyse the existing prevention activities and procedures for hydraulic and geological risk in both country, with a focus also concerning volcanic risk management for Canarias. The analyses result in an interesting overview of two organization, with a similar mandate, but different organization also due to the different administrative level. In addition, a list, in term of qualitative user needs for foreseen products of Safety, has been elaborated by both authorities and presented at the end of corresponding section.

2.1 Italian Civil Protection – prevention activities and procedures for hydraulic and geological risk

The Italian National Civil Protection service is organised as a complex system. Within the system, the responsibility in the activities of forecasting, prevention, relief and overcoming emergency situations are assigned to several Bodies and operative structures. The complexity of the domestic situation of risks actually requires the coordinated and synergic use of all the skills and resources available. In the section 2.1.1 a short description of the mandate of Italian Civil Protection and its organization is described, while, in the section 2.1.2, the prevision and prevention activities, procedures and organization, specific for the hydraulic and geological risk, are described.

In the section 2.1.3 a short list of specific user needs, tailored for the Italian territory and context, is reported in a qualitative manner for each product planned to be produced in the Safety project.

2.1.1 Italian Civil Protection system

The Italian Civil Protection Department (DPC) is a structure of the Presidency of the Council of Ministers established with Law no 225 /1992. It steers the National Service of Civil Protection, which includes local authorities, research institutes, private companies, volunteer associations and all Italian operational forces. During major emergencies, it ensures horizontal (line Ministries) and vertical (central-local) coordination. It has a guiding role, in cooperation with regional and local governments, for risk prevention, forecasting and monitoring activities as well as for emergency preparedness and for intervention procedures in cases of on-going or upcoming crisis events. To this purpose, it counts on a well-developed network of risk monitoring and forecasting centres (one in each region, plus the central one located in the DPC premises and with a coordination role) which work closely with the local branches of the National Service of Civil Protection and the scientific community as well as on a national inter-institutional operational room, where all the operational forces are present 24/7. It promotes drills, national and international training projects and activities that contribute to spreading the culture of civil protection based on prevention and preparedness rather than only response. The Italian Civil Protection Department operates also at the international level, in co-operation with similar institutions of other Countries in a context of European collaboration, and supports the European Civil Protection Mechanism interventions with its own capacities.

Being also the coordinator of the National Platform for Disaster Risk Reduction, DPC is fully involved in the development of a multi-level and inter-institutional coordination in the wider field of disaster risk reduction, in accordance with the Hyogo Framework for Action and now the Sendai framework. In the framework of its guiding role in the phase of emergency preparedness, DPC:

- develops and implements contingency plans for major events as well as awareness raising campaigns, jointly with local governments and volunteering associations throughout the country;
- provides technical support to local government for the elaboration/updating of contingency plans, including testing activities (such as simulations/field exercise);
- issues guidelines, standard operating procedures aimed at regions, provinces and municipalities, to prepare and implement prediction and prevention programmes based on risk scenarios;
- promote field exercise for testing multi-level co-ordination (international, national and local), including host nation support aspects.

The components and operational structures of the National Service are committed, depending to the different areas of competence and responsibility, in predicting and planning actions to prevent and mitigate risks.

Municipalities, provinces and prefectures are dedicated also to the update of emergency plans, indispensable tools of prevention, based on regional and national guidelines and addresses. The individual citizen, as a component of the National Service, plays an important role in the prevention of risks. The everyday activities of spreading knowledge and awareness of civil protection among the population have the main goal of simply just building a more and more aware and prepared citizen.

During emergency, when an event affects a territory, the Mayor - the only authority of civil protection within the National Service - has the task of ensuring emergency assistance to the population, coordinating the local operational structures on the basis of the municipal emergency plans ("A" type event). If the means and resources available to the municipality are not sufficient to deal with the emergency, the Province, the Prefecture - Territorial Offices of the government, and the Region will intervene and activate the available resources on the territories under their jurisdiction ("B " type event). In more serious situations, upon request of the regional government, the national level takes over, with the declaration of a state of emergency ("C" type event): the President of the Council of Ministers is in charge of intervention coordination, operating through the Department of Civil Protection. It such cases the National Service is involved with all its components and operational structures.

2.1.2 Prevention activities and procedures for hydraulic and geological risk

The Department is committed to the development and implementation of the Early Warning Systems (EWSs), in close collaboration with Competence Centres, which daily support the activities to improve the performances of EWS as well as providing research products to be integrated in an operative framework. This close collaboration has been tested for a long time in the national hydraulic and hydro-geological EWS which is run by a network of Centres for Forecasting and Surveillance, one national, managed by Civil Protection Department, and one for each region managed by regional authorities. The national Early Warning System has been established by law (Directive of the Prime Minister Dir.P.C.M. 27/02/2004 and subsequent modifications and supplements). The Regional Centres for Forecasting and Surveillance, together with the National one (active on the territory 24 hours a day), are accountable in the monitoring events. The Regional authorities are in charge to issue warnings and alerts on the basis of the weather forecast and evaluation of the impacts made by the Centres for Forecasting and Surveillance network. These warnings are sent to the Mayors, who are responsible for their dissemination among the citizens. DPC is in close contact with regional level and support it in reducing the gap by:

- Coordinating the impact evaluation in terms of landslides and floods;
- Defining homogeneous format for the bulletins;
- Defining common alert levels;
- Promoting campaigns to inform and raise the population awareness;
- Supporting the local emergency planning providing guidelines;
- Prevision.

In the Civil Protection Department, the data arrives at a monitoring centre which has the job of collecting, checking and passing the information to the components and to the operative structures on a central and local level. The monitoring system is made up of:

- national centres of scientific research;
- technological systems of collecting and processing information on different types of risk and on the conditions that may increase the possibility of danger for the community;

- data processing centres capable of indicating the probability of catastrophic events as early as possible.

The technical-scientific activity ranges from collecting information on the territory to processing it, up to interpreting the collected data according to models and simulations of events. These data make it possible for the civil defence department to assess the situations of possible risk, to alert the intervention system in useful time and to provide the authorities with the necessary elements to make reasoned and timely decisions.

Knowledge of the territory and danger thresholds for the various risks establishes the basis, not only for the forecasting activity, but also for determining the directions and lines of the various types of possible prevention intervention.

The members of the Civil Protection Department are responsible, at the various levels, for determining and indicating the interventions useful for keeping down the probability of disastrous events occurring or at least to limiting the possible damage. It is just as important that they promote actions of making the local people aware of the risks, that is the first form of civil protection. The forecasting and prevention programmes are the instrument to determine the intervention priorities and the times with which the civil defence actions should be actuated, according to the danger of an event, to the vulnerability of the territory and to availability of funds.

2.1.3 User Needs Specific for Italian Civil Protection

In the following table the qualitative description of the Italian Civil Protection user needs for each Safety product is reported considering the existing procedure and operative workflow in which these products can be integrated.

Product	Short Description of Italia needs for specific product
Deformation activity map (DAM)	The deformation activity map (DAM) is a product useful to be elaborated in specific site where a deformation is already detected and could produce potential risk for settlements and or infrastructures. The deformation activity map has to be updated all the time that a new data is available for a period of time depending on the specific event under concern. The map has to be delivered with information about the methodology used to produce the products and with a metadata Inspire-compliant and easily integrated in the internal GIS. The list of data used for the production have to be clearly reported in the metadata together with the accuracy and the resolution of the map.
Geohazard Susceptibility map (GSM)	Geohazard susceptibility map (GSM) is a product that shows where Geohazard are expected to occur based on local conditions, including the morphological, geological, and land use settings. Different colours refer to the predicted levels of geohazard susceptibility in a region and have to be clearly reported in the map and corresponding legend. This product may be useful to be integrated both in the Copernicus Land at local and Pan-European levels as well as can be an input or a benchmark to be take into account in the Soil Thematic strategy and for producing products of Copernicus Emergency Management Service. In terms of importance the Susceptibility is a key element for improving the geological risk management and to focus on specific territory that have to be monitored and

	carefully managed. The map has to be delivered with information about the methodology used to produce the products and with a metadata Inspire-compliant and easily integrated in the internal GIS also considering the opportunity to provide web services. The list of data used for the production have to be clearly reported in the metadata together with the accuracy and the resolution of the map. For this type of map could be easy to implement also the database considering the Inspire Directive, in particular related to the Natural Risk Zone.
Geohazard activity map (GAM)	Similar to the GSM, this map can support the risk evaluation both in the emergency and in the preparedness and prevention phases. As for the other cartographic products the map has to be delivered with information about the methodology used to produce the products and with a metadata Inspire-compliant and easily integrated in the internal GIS also considering the opportunity to provide web services. The list of data used for the production has to be clearly reported in the metadata together with the accuracy and the resolution of the map. For this type of map too, as for the GAM, could be easy to implement also the database considering the Inspire Directive, in particular related to the Natural Risk Zone.
Impact assessment on structure and infrastructure map (IASI)	This is a good support to support the planning phase as well as evaluate the damages on structure and infrastructure due to an event giving good information to the on field activities and to plan the intervention to manage the emergency.
Radar interferometry software (RIS)	The software can be useful if compatible with windows operating system, GNU/Linux operating system and Mac OS operating system. It has to be deployed with a user manual and has to be easy to learn and user friendly.

2.2 Canarias Civil Protection Procedures

The Spanish National Civil Protection service is a complex system where the assistance and overcoming of emergency situations are assigned to several Bodies and operative structures. In particular, the responsibility related to the volcanic risk management and decision-making is shared between National and Canary Island (Autonomic) authorities, depending on the phase and situation of the declared emergency. Different emergency plans can be activated, from local to national level, depending on the increasing volcanic risk and situation. IGN declares the scientific alert with its own data or evaluating the available data from other institutions through the Scientific Committee of the corresponding Emergency Plan. The Volcanic Alert Level is established and changed by the Ministry or by requirement from the National Government in the Region or the Director of the Emergency Plan (National or Regional).

In the following sub-sections are shortly described the Spanish Civil Protection in 2.2.1 and the Canary Islands Civil Protection System 2.2.2.

2.2.1 The Spanish Civil Protection system

The Spanish Civil Protection and Emergency General Directory is a public service aimed to study and prevent collective high risk, disasters and public calamity situations that can suppose a risk for the citizens, as well as to protect the citizens and their properties when those situations arise.

The main **functions** include:

- Preparation of civil protection plans at national level or those whose competence will be assigned by the existing legal regulations.
- Preparation and management of exercises and simulations in the framework of the aforementioned plans.
- Development of studies related to risk analysis and preventive pilot projects to back up emergency and disaster prevention plan.
- Preparation and broadcast of warnings to civil protection organizations and, where appropriate, to citizens.
- Management of subsidies and aid set aside to meet needs derived from disasters or catastrophes and preparation of the corresponding regulations.
- Theoretical and practical training in the management of risks and emergencies, including the training of managers and personnel of the services and organizations involved in emergency actions, particularly fire and rescue services, health services and law enforcement authorities.
- Carrying out studies and information programs for the citizenship, promoting the self-protection of citizens and corporations and promoting social participation in activities of civil protection and emergencies and education programs for prevention in schools.
- Coordination of relations with the different Civil Protection Delegations and Sub-Delegations of Government and with the Regional Bodies and Local Administrations with competences in civil protection activities, as well as, the organization and maintenance of the Secretary of the Civil Protection National Commission, of its Permanent Commission and of its technical commission and working groups.
- Maintenance of technical relations with equivalent organizations from other countries, especially from the European Union, Mediterranean and Latin America .
- Request the intervention of the Military Emergency Unit in accordance with the Protocols on action that are set out for this.

The main **objectives** are**:**

a) To inform and prepare citizens through the self-protection.

b) To constitute an organization bringing together all public and private entities for the rescue of people and their goods, in cases of calamities or disasters.

c) Coordinated and effective intervention in situations of serious risk, catastrophe or public calamity.

The General Directorate acts mainly on various fields: floods, earthquakes, volcanoes, chemical plants, nuclear power plants and dangerous goods transport, and its basic functions in these fields are:

- Precautions: To analyse the assumptions of risk, its causes and effects, as well as the areas that might be affected (Risk Inventory).
- Prevention: To take the necessary measures to avoid or to reduce the hazards situations, with the means available.
- Planning: To develop emergency plans, and action lines to deal with serious risk situations, catastrophe or public calamity.
- Intervention: To coordinate and to direct the intervention of civil protection components for people and properties protection and rescue.

- Rehabilitation: To attend the relevant institutional bodies in planning and measures implementation to restore the essentials public services, socioeconomic and environmental conditions, essential to normalize the lives of the affected communities.

2.2.2 Canarias Civil Protection system

The Canary Islands Protection system (CDPC) is under the responsibility of the Directorate General of Security and Emergency, which belongs to the Ministry of Territorial Policy, Sustainability and Security of the regional government of the Canary Islands. Its main competences are: (1) security; (2) coordination of local polices; (3) Emergencies, Civil Protection and Marine Rescue; (4) potentially dangerous animals; (5) training. The 112 emergency coordination service alerts from specific emergencies, and evaluates and coordinates the necessary response.

Regional government in the Canary Islands is organized in nine different sections, called Consejerías, one of which is Land Policy, Sustainability and Security. One task area of this Consejería is the Environmental Policy, through which a General Management of Security and Emergencies is competent in the civil defence through a Civil Protection and Emergency Management Service.

This Service is also responsible of the Centre for Emergency and Security Coordination, CECOES 1-1-2, and the Emergency and Rescue Group (GES). CECOES 1-1-2 is a public service that no only gives the adequate response to any emergency call that happens in the Canary Islands, but also knows about all emergency means and resources in every moment for its implementation in any emergence situation that could take place in real time. CECOPIN and CECOPAL have the same functions at insular and local levels, respectively.

On the other hand, GES is an action group in charge of search and rescue missions for regional government. GES have the corresponding human and material resources to achieve their goals, including five helicopters based in different islands, and it is aimed to give a quick response to every unexpected situation that could take place in the autonomous community.

Besides, we can consider that civil service works, in the case of the Canary Islands, in four different stages: local, insular, regional and state governments and each of them manage their own civil defence services.

Due to the volcanic origin of the Canary Islands, one of the basic pillars in the forecast of geological hazards is PEVOLCA, the Special Plan for Volcanic Emergency. This plan provides an inventory of means and resources, both human and materials, and lays down action protocols to apply in the case that a volcanic or a geological risk come true.

The declaration for a volcanic emergency usually comes from the National IGN, the institution in charge of volcanic surveillance in Spain. Here, we must consider that volcanic crisis came preceded by announcing phenomena, as earthquakes, subterranean noises or land deformations. In the case of volcanic unrest, the Scientific Committee of PEVOLCA Plan decides the level and origin of the volcanic activity informing to the Plan Director that can activate the Plan.

PEVOLCA contemplates the following **situations**:

- Pre-alarm situation. Green light
- Alarm situation. Yellow light
- Maximum alarm situation. Orange light
- Emergency situation. Red light

The PEVOLCA Director, according to the information provided by the Technical Director can activate different **emergency operational levels**:

Levels 0 and 1, insular level

This level corresponds to a situation in which, even existing a volcanic activity, occurs without important risks for people, infrastructures or environment.

Level 2, regional level

Level 2 reflects an increase in the gravity of the situation, with strong impact and serious hazard for the population. Scientific Committee will be constantly in contact with Plan's Direction, with the aim of informing any change or increase in the volcanic activity. In this level, forest fires or ash fall can occur and interfere with electricity, communications, forcing roofs to collapse, polluting the water, etc. This stage implies informing the population about recommendations and planned actions; this phase can last from a few days up to some weeks or months. The PEVOLCA emergency level 2 implies that emergency will be managed by regional authorities; the coordination of the whole actions linked with the Plan will correspond to CECOES 1-1-2, if required.

***Level 3,* state level**

The establishment of an emergency in level 3 implies the existence of an extremely high hazard situation, affecting large areas where the life of people can not be guaranteed with the resources foretold in the Plan. In this level, high energetic or explosive eruptions can be expected or the situation can be difficult to forecast. Therefore, it implies to pay attention to zones larger than those expected in a usual eruptive episode. Scientific Committee will be in permanent communication with Plan's Direction. In this level, emergency will be managed according with that established in the State Plan.2.2.2.1 Rockfall and Landlides Hazards in the Canary Islands

In Canary Islands, according to historical data and morphology of the terrain, with steep slopes present in some enclaves of it, different types of risk dynamics slopes (rockfalls, landslides, collapses) are given, being the rains the main cause of almost all rockfalls and landslides occurring inside the islands. Historically, we have documented a number of gravitational giant landslides in the geologic history of the islands, which have generated tsunamis and mega-tsunamis (with waves over 30 meters high). These giant landslides are caused by the rapid growth of large volcanic edifices of the islands causing serious imbalances. When a volcano has grown so much that exceeds the critical level of stability, form a critical system, in which any additional process (trigger), as a new intrusion, an eruption, an earthquake or saturation of the soil, can cause the collapse part of the volcano. Thus the balance is restored and the building can continue to grow.

There are studies that support that have occurred at least 10 historical events corresponding to large landslides into the sea in the Canary Islands, which have generated mega-tsunamis. The most representative are:

- Tenerife. Caldera de Las Canadas (several slides: Icod), the valleys of El Palmar, La Orotava, Güimar and northern arc of Anaga.
- El Hierro. El Golfo, El Julan and Las Playas.
- La Palma. Aridane Valley.
- Fuerteventura. The arc of Jandía.
- Gran Canaria. The arc of Andén Verde.

In addition, there is also evidence that there have been a special type of landslides, consisting in a landslide and mudslide mixture. Although the volume of materials displaced is much lower

than the previous, its origin is mainly due to the saturation of the ground. Regarding collapses, corresponding Canary Islands to volcanic terrain, there are areas where ground collapses occur; they are associated with volcanic tubes. The volcanic tubes are not easily identifiable, using as criteria the lava flow type and age. The largest number of volcanic tubes of the Canaries are in fluid cast of "pahoehoe" type of recent ages (younger than 100,000 years).

In the case of rockfall emergency, when a rockfall event hits one of the islands, the 112 collects the alert from the citizens. From this alert an approximate geolocation (± 500 m) is provided to the insular government. Civil Department from insular government are in charge of the reparation of the damage and the municipality ensures the emergency assistance to the population if necessary. Road maintenance services and reparation works are carried out by private companies supporting the insular Civil Department.

2.2.3 Prevention activities and procedures for geological risk

2.2.3.1 National School of Civil Protection

Most of the prevention activities for geological risk are carried out by the National School of Civil Protection. The National School of Civil Protection, established by Royal Decree 901/1990, 13th of June, is a body of the Directorate General of Civil Protection and Emergencies that plays, in accordance with the established in the Royal Decree 1181/2008 of the 11th of July, the following functions:

- To train theoretical and practically the staff of the different services and organizations involved in people and goods protection in emergency case
- To serve as a technicians and specialists forum in the matters related to the risks and emergencies management
- To promote the development of the prevention social culture and the citizen self-protection

From a strategic point of view, the National School of Civil Protection mission is to implement training policies approved by the responsible of the civil protection national system in order to train and maintain in its members' the level of competence required in their role, within a training public system for national civil protection. In order to delimit the National School action field, it is understood that human resources that form the civil protection national system are made up of all professionals and/or volunteers who operate from their respective organizations for citizen protection in catastrophic events. The training public system for civil protection has as a mission to train and maintain the professional skills that these people need to play their role effectively. However, initial training for professionals should be the responsibility of each organization, although the training public system of civil protection should homogenise it; the volunteers training should be planned, programmed and delivered by the mentioned public system, as well as the training devoted to the updating of those ones. The National School of Civil Protection mission, within training public system for civil protection, is given strategies to structure the National School activities and these are: To leader cooperatively the national public system of training, so that the effort developed by all training centres for civil protection is coordinated and aimed at common objectives previously established.

2.2.3.2 Canary Islands Government Tests and Simulations

The Canary Islands Government organizes different simulations in order to test and to verify the capability and the level of preparation for emergency response. That is, the efficiency with which the different organizations involved carry out their actions. Its aim is to check:

- Functioning and effectiveness of warning systems for the population and communications.
- Time of response from Action Groups and for the application of protective measures.
- Operation (in fictitious conditions) of Action Groups and a first evaluation of its effectiveness.

However, there are points that can not be tested by tests, such as the ability of the organization to cope with unforeseen events. Tests start from a predetermined emergency situation, and check the internal and functional mechanisms of the Plan. The Director of PEVOLCA (Volcanic Emergency Plan) shall propose an annual plan of simulacra, while an official of the Directorate General of Security and Emergencies will coordinate exercises in different islands gather along the year the maximum possible diversity of experiences.

In 2014, during the Congress in Transnational Cooperation in Security and Emergency (EMERNET), the Canary Islands Government organized simulations of an eruption and earthquake, with a series of practical exercises in emergency, to study action measures in event of an earthquake-volcanic phenomenon, with an earthquake of magnitude 5.1, 2 kilometres deep. The first part of the exercise took place with the convening of the PEVOLCA Scientific Committee, which analysed the likely scenarios and assumptions where there is a risk-volcanic earthquake on the island of Tenerife. Once these assumptions, the Direction Committee met to consider which possible measures in Civil Protection had to be taken before a possible volcanic eruption. Plans for an evacuation were made, including escape routes, possible failures of electrical and telephone supplies were addressed, possible shelters where located, and roadblock, incidents in air traffic, communication plan, etc. were foreseen. In these meetings were present technical and scientific personnel from Azores, Cape Verde, Madeira, the UK and Italy, which also acted as observers, in addition to those from state government, Canary Islands (regional) Government, Cabildo de Tenerife (insular government) and the municipalities affected. The occurrence of an earthquake of 5.1 that hit the Candelaria area, causing structural collapse and subsequent rescue of people trapped in Punta Larga quarry was simulated. Also, a dangerous goods accident caused by the explosion of a fuel tank due to the earthquake, and the evacuation of a school were simulated. After receiving the call alerting at the CECOES 1-1-2 (emergency phone number room), and once he analyzed the situation, the. Advanced Command Post moved to the area, and the Crisis Room which commands the PEVOLCA was activated. Both they were also activated the Emergency Plan for Tenerife Island (depending on the insular government) as the Municipal Emergency Plan for Candelaria (the municipality involved in the drill).

In this simulation participated the Firefighters from Tenerife; AEA (volunteers association); UME (a military unit specialized in emergencies); Red Cross; SUC (emergency sanitary aid); GES (regional search and rescue service); Guardia Civil (police), Candelaria municipality; Civil Protection from La Laguna (a neighbour municipality); Canary Islands Police; Cabildo Insular de Tenerife (insular government); Civil Protection from Azores; Civil Protection from Cape Verde; and Consejería Ministry of Education of the Government of the Canary Islands. In 2015, and under the First International Conference on Volcanic Emergencies, an initiative within the Transnational Cooperation Programme Madeira-Azores-Canary Bomber 2.0 of the European Union, organized by the Consortium of Security and Emergency of Lanzarote, the Consortium for Firefight of Tenerife, the Civil Protection organizations of Madeira and Cape Verde, Bomber 2.0, the MAC 2007-2013 program for Transnational Cooperation and the European Union through the ERDF Community program, was held in Lanzarote an emergency drill produced because of a volcanic eruption. The drill included the evacuation of Ye village, and the establishment of a crisis cabinet.

2.2.3.3 *Landslide Hazards Maps by Canary Islands Government and GRAFCAN*

There is not a system of hazard identification associated to dynamics slopes (landslides) in the Canary Islands. We can emphasize that the landslides (mudslides, landslides, flows) can be generated as a result of other risks because the equilibrium condition of a landmass is altered by other natural process. Therefore, we can say that both the Seismic Monitoring Network, as the Volcanic Surveillance Net and METEOALERTA, can serve as identification systems and surveillance of dangerousness by landslides. The hazard will be characterized by the soil conditions, soil type, rainfall, and various anthropic sources.

• Intrinsic factors. Include the elements considered inherent instability of the slope, ie, existing on the hillside itself and can cause their movement, such as slope and lithology. The slope, which is a factor that determines the stability of existing buildings and volcanic slopes on the islands of the archipelago.

The methodology used to calculate the hazard includes the analysis of the percentage of slope from the DEM. To determine the degree of fragility of the different lithologies have used the Continuous Digital Geological Map of the Canary Islands (GRAFCAN) and its lithologic groups that conform the islands. So, in each island have been distinguished 5 different types of land: - Clays - Sedimentary deposits - Rocky Massif with low resistance - Pyroclasts - Volcanic rock with high resistance.

• Triggers. Including the elements considered as triggers of the movements of the slope, those that are external and that through its application can lead to instability of the slope (vertical and horizontal rainfall, seismicity, land use and road infrastructure). Currently the main source of slope instability is the saturation of the soil, being necessary to carry out an analysis of both vertical and horizontal precipitation in the Canary Islands. To define vertical precipitation the main tool is the database rain gauges managed by the National Institute of Meteorology, which has been completed with the rain gauges of the Canarian Institute of Agricultural Research

(ICIA) of the Ministry of Agriculture, Livestock, Fisheries and Food, in the Canary Islands Government.

The methodology used is similar to that developed on the basis of hydrological data of the danger of floods. From the data of meteorological stations, will be developed in raster format, isohyets (daily maximum precipitation) for a return period of 2, 5, 10, 25, 50, 100, 200 and 500 years for each of the islands. These isohyets possible to estimate the average rainfall for each area of the island. As mentioned, currently the main source of slope instability is the saturation of the soil, being necessary to carry out an analysis of horizontal precipitation, since in the Canary Islands, this phenomenon represents a very high water intake. The layer of horizontal rainfall will take place defining those areas of the islands where there is no evidence that horizontal precipitation. Regarding the seismicity is necessary to analyze the existing seismic events in the Canary Islands since it involves a trigger landslides element. Catalogues of seismic events, both from the CSIC and the IGN, following the methodology developed in the seismic hazard, will be used. While in seismic hazard analysis only took into account the events of more than 2.9 magnitude, as were felt by the population, its application to landslide hazard involves considering all events registered, ie those of magnitude greater than 1.5, since although they are not felt by the population, can cause some kind of movement hillside. The structure of the layer will be similar to seismicity developed in the study of seismic hazard in the database of seismic events. Land uses directly affect their erodibility depending on the degree of protection that provides coverage. To use the parameter land use, existing information will be used. Gathering different classes in categories, since the danger of rockfall and landslides varies itself, depending on its coverage by vegetation areas, urban areas or bare soil. This is part of different databases included in others projects, which certain coverage for the purpose of this application can be grouped. Those infrastructures that can destabilize slopes and cause movements will be considered. Specifically, existing road infrastructure on the islands will be used, since they are elements that alter the profile of the relief. These infrastructures have already been used in estimating the danger of forest fires and therefore the same layer and the same methodology as the one developed in this section, will be used.

2.2.4 User needs specific for Canarias Civil Protection

Product	Short Description of Canarias needs for Safety products
Deformation activity map	A mapping of ground deformation in places where a high risk of volcanic activity in the future can be foreseen must be performed. The chosen places are Las Cañadas Caldera, the northern slopes of Teide-Pico Viejo volcanic system, and Tenerife NW ridge, in Tenerife; the whole island of El Hierro and the southern ridge of La Palma island. The object is to detect, in a time scale as accurate as possible, any ground deformation that may be indicating the start of a volcanic activity, especially that with expected explosive features. The map should be updated at each Sentinel pass, and would have to be associated with a database that allows to compares at every time all the strain which could be detected, by comparison with a regular situation of tectonic rest. It shall be compatible with the GIS from Canary Islands Civil Protection agency, and accompanied by a methodological explanation related to their process of realization.

Geohazard Susceptibility map	Mapping of selected locations in the Canary Islands must be performed. Different locations have been chosen because of current impact of infrastructures on the slope movements, such as the Anaga mountains, on the island of Tenerife, and the area of Andén Verde in Gran Canaria. This mapping should work in a time scale so accurate as possible, that is to be updated at every pass of sentinel, allowing detect the existence of deformations in the ground that could be identified as the early stages of a landslide. The map should allow interactivity with other GIS layers available in the Canary Islands Civil Protection agency, and referred both to those elements likely to create local conditions for movement on the ground (topography -through the digital elevation model (DEM), lithology, vegetation, land use, etc.) and to those elements that can act as triggers for landslides (road infrastructure, foreseeable intense rainfalls, air and soil moisture, seismic risk , etc). The product should allow a proper assessment of the slope movement phenomena before they can be triggered. The maps will be accompanied by an explanation of the methodology used, and a database that allows analysing the phenomena not only from a spatial perspective, but also from the internal dynamic of geomorphological processes. All maps must be compatible with the GIS from the Canary Islands Civil Protection agency.
Geohazard activity map	This product is a software that have to allows develop a simulation, from the data available in the previous GSM, of the final surface shape, in case a sliding process could be finally triggered by some local factor. The result must be displayed on a topographic map. In order to implement this tool, a detailed mapping of the existing road network in mountain areas of study, as triggers to start the slopes processes, will be available through Canary Islands Civil Protection agency GIS. A historical account of registered landslides in this area will be also provided by insular government, through Canary Island Civil Protection agency. This data will be integrated in the system, in order to allow accuracy. As with other products, methodology used and the corresponding database have to be delivered, an all the tools must be fully compatible with Canary Islands Civil Protection agency GIS, allowing its integration with the rest of the Civil Protection GIS partners.
Impact assessment on structure and infrastructure map	
Radar interferometry software.	This software can be useful, and should be fully

	compatible with other tools from Canary Islands Civil Protection agency. It has to be deployed with a user manual, has to be easy to learn, and used friendly.

3 USER NEEDS AND REQUIREMENTS FOR SAFETY PRODUCTS

In the Section 2, considering the existing procedures in each involved country (Spain and Italy) a series of qualitative needs have been elaborated separately by the two countries and for each products foreseen in the project.

Starting from this two preliminary lists, and taking into account that the Safety project is designed to set up useful products for Civil Protection user community at EU level (operating at different administrative and organizational levels, from local to continental), an further effort has been spent to define one list of realistic user need for each product, to make the Safety products suitable to be integrated also in a different national context (it means different administrative procedures, different morphology, etc.).

This result has been also reached integrating the input derived from the results of section 1.2. Due to the fact that these user requirements are set up at an initial stage of Safety, where all the activities are starting the requirements will be re-worked and enhanced, if possible, producing the final requirements list, which will be presented in the Deliverable D.B2.1, User Assessment Procedure, together with the procedure to assess the compliance between products and user needs.

3.1 RATIONALE AND CODING OF THE REQUIREMENTS

The Safety user needs are here reported as specific and realistic User Requirements (UR), which can support the development phase of the project. In addition, SAFETY requirements are further subdivided in two sub-categories, including:

- Capacity Requirement (CAP), defining what type of information the individual products shall deliver, including requests of performance;
- Project Requirements (PRR), defining constraints imposed by the project or that the project has to follow considering the state of the art on the same topic.

A specific coding scheme has been adopted to number uniquely the Safety user needs. This is a lesson learned from several other EU projects developed with similar purposes (e.g. Doris, Lampre, etc.). Each single need is coded adopting the following labelling scheme:

SAF-UR-CAP-1

Where:

- SAF identifies the SAFETY project (for compatibility with other similar projects);
- UR identifies the SAFETY project the User Requirement (UR);
- CAP defines the function of the requirement, including a Capacity Requirement (CAP) and a Project Requirement (PRR);
- NUM is the progressive number of the requirement.

3.2 USER NEEDS AND REQUIREMENTS

For each product, defined by the project team, a series of specific user needs are established in order to cope the main necessity of CPAs that represent the users of the project. The needs identified as relevant to make the project results really useful to be integrated in support of CP authorities are here listed as requirements.

DEFORMATION ACTIVITY MAP (DAM)					
Capacity Requirement			**Project Requirement**		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**	**Requirement CODE**	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-1	SAFETY shall provide DAM in the following format: - vector: shp - raster: geotif, geojpg, geopdf and ASCII		**SAF-UR-PRR-1**	SAFETY shall provide GSM by Inspire spatial data services (wms, ogc, wfs….) (view, download…)	
SAF-UR-CAP-2	SAFETY shall provide DAM with a description of input data used (type, resolution, source, etc.)	It can be included in the metadata or in a specific section or layout	**SAF-UR-PRR-2**	SAFETY shall provide DAM completed with metadata INSPIRE compliant	
SAF-UR-CAP-3	SAFETY shall provide DAM whit an evaluation of the quality and uncertainty of the map	It can be included in the metadata or in a specific section or layout	**SAF-UR-PRR-3**	SAFETY shall provide DAM in a specific layout ready to be printed for in the field activity and using the format already used by the Copernicus operative service, or a new one optimised for the project	see Annex A for a proposal for the layout
SAF-UR-CAP-4	SAFETY shall provide DAM at the best scale possible considering the input data				
SAF-UR-CAP-5	SAFETY shall provide DAM at the best possible resolution considering the input data				

DEFORMATION ACTIVITY MAP (DAM)					
Capacity Requirement			**Project Requirement**		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**	**Requirement CODE**	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-6	SAFETY shall provide DAM as values or deformation and as category class if possible defined on the basis of specific thresholds	The thresholds and category classes have to be clearly reported in the legend of the map in the specific section of the layout			

GEOHAZARD SUSCEPTIBILITY MAP (GSM)					
Capacity Requirement			**Project Requirement**		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**	**Requirement CODE**	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-7	SAFETY shall provide DAM in the following format: - vector: shp - raster: geotif, geojpg, geopdf and ASCII		**SAF-UR-PRR-4**	SAFETY shall provide GSM by Inspire spatial data services (wms, ogc, wfs….) (view, download…)	

GEOHAZARD SUSCEPTIBILITY MAP (GSM)					
Capacity Requirement			**Project Requirement**		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**	**Requirement CODE**	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-8	SAFETY shall provide GSM with a description of the modelling approach for preparing a GSM	It can be included in flayer developed for the product	**SAF-UR-PRR-5**	SAFETY shall provide GSM completed with a database INSPIRE-compliant	See Annex B for a proposal for the database compilation following the INSPIRE Directive
SAF-UR-CAP-9	SAFETY shall provide GSM with a description of input data used for the production	It can be included in the metadata or in a specific section or layout	**SAF-UR-PRR-6**	SAFETY shall provide GSM completed with metadata INSPIRE-compliant	See Annex B for a proposal for the layout
SAF-UR-CAP-10	SAFETY shall provide GSM with an evaluation of the quality and uncertainty	It can be included in the metadata or in a specific section or layout	**SAF-UR-PRR-7**	SAFETY shall provide GSM in a specific layout ready to be printed for in field activity and using the format already used by the Copernicus operative service, or a new one optimised for the project	See Annex A for a proposal for the layout
SAF-UR-CAP-11	SAFETY shall provide GSM at the best scale possible depending on input data				
SAF-UR-CAP-12	SAFETY shall provide GSM at the best resolution depending on input data or extension of area of interest				
SAF-UR-CAP-13	SAFETY shall provide GSM represented as values (e.g. probability value as %) and category class (e.g. n. classes...)				

GEOHAZARD ACTIVITY MAP (GAM)					
Capacity Requirement			**Project Requirement**		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**	**Requirement CODE**	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-14	SAFETY shall provide GAM in the following format: - vector: shp - raster: geotif, geojpg, geopdf and ASCII		**SAF-UR-PRR-8**	SAFETY shall provide GAM by Inspire spatial data services (wms, ogc, wfs….) (view, download…)	
SAF-UR-CAP-15	SAFETY shall provide GAM with a description of the modelling approach for preparing a GAM	It can be included in flayer related to the project	**SAF-UR-PRR-9**	SAFETY shall provide GAM completed of database INSPIRE-compliant	see Annex B for a proposal for the database compilation following the INSPIRE Directive
SAF-UR-CAP-16	SAFETY shall provide GAM with a description of input data used for the production	It can be included in the metadata or in a specific section or layout	**SAF-UR-PRR-10**	SAFETY shall provide GAM completed of metadata INSPIRE-compliant	see Annex B for a proposal for the layout
SAF-UR-CAP-17	SAFETY shall provide GAM whit an evaluation of the quality and uncertainty	It can be included in the metadata or in a specific section or layout	**SAF-UR-PRR-11**	SAFETY shall provide GAM in a specific layout ready to be printed for in field activity and using the format already used by the Copernicus operative service, or a new one optimised for the project	see Annex A for a proposal for the layout
SAF-UR-CAP-18	SAFETY shall provide GAM at the best scale possible depending on input data				

GEOHAZARD ACTIVITY MAP (GAM)					
Capacity Requirement			**Project Requirement**		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**	**Requirement CODE**	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-19	SAFETY shall provide GAM at the best resolution depending on input data or extension of area of interest				
SAF-UR-CAP-20	SAFETY shall provide GAM represented as values (e.g. probability value as %) and category classes (e.g. n. classes...)				

IMPACT ASSESSMENT ON STRUCTURE AND INFRASTRUCTURE MAP (IASI)		
Capacity Requirement		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-21	SAFETY shall provide the methodology used to perform the IASI	It can be included in flayer developed for the product
SAF-UR-CAP-22	SAFETY shall provide the IASI in a geolocalised manner (eg. Shp file of structure and infrastructure and related level of impact)	It can be included in flayer developed for the product
SAF-UR-CAP-23	SAFETY shall provide IASI represented as values or category class if possible defined on the basis of specific thresholds	It can be included in flayer developed for the product or in a metadata if a .shp can be produced

RADAR INTERFEROMETRY SOFTWARE (RIS).		
Capacity Requirement		
Requirement CODE	**Description of corresponding User Need**	**Comment/suggestion for implementation and compliance**
SAF-UR-CAP-24	Safety shall provide a free prototype of RIS and foreseen training session to deploy the SW on the CPA involved in the project	
SAF-UR-CAP-25	Safety shall provide a prototype software compatible with windows operating system, GNU/Linux operating system and Mac OS operating system.	
SAF-UR-CAP-25	Safety shall provide a prototype software for regional landslide susceptibility modelling and zonation with on-line help, tutorial and user manual	

ANNEX A

GEOHAZARD MAPS (GHMs) DATABASE PROPOSAL

In terms of database organised for the GHMs (which include Geohazard Activity Map –GAM and Geohazard Susceptibility Map - GSM) in SAFETY project, and analysing the INSPIRE Directive, it is possible to propose, for this product, a schema to harmonise the database. In particular, in Figure A-1 has been reported the application schema for Natural risk zone. In this schema analysing in particular the attributes of “Hazard Area feature Type” some good opportunities to build a proposal for the database for the GHM have been defined.

The attribute of Hazard Area feature type, in addition to the geometry of hazard area, are:

- Likelihood of occurrence: in NRZ Data Specification Likelihood of occurrence data type is a set of 3 (voidable) attributes;
- assessment Method, which refers to the method used to express the likelihood of a hazard event;
- qualitative Likelihood, which enables to describe in narrative form the assessment of the likelihood of occurrence of a hazard event;
- quantitative Likelihood, which is either a probability of occurrence, or a return period.
- (Either the qualitative likelihood or the quantitative likelihood shall be complete);
- Magnitude, or intensity: in NRZ Data Specification level of intensity data type is a set of 3 (voidable) attributes:
    - Reference to a model;
    - Qualitative value;
    - Quantitative value;
    - (Either the qualitative value or the quantitative value shall be complete).

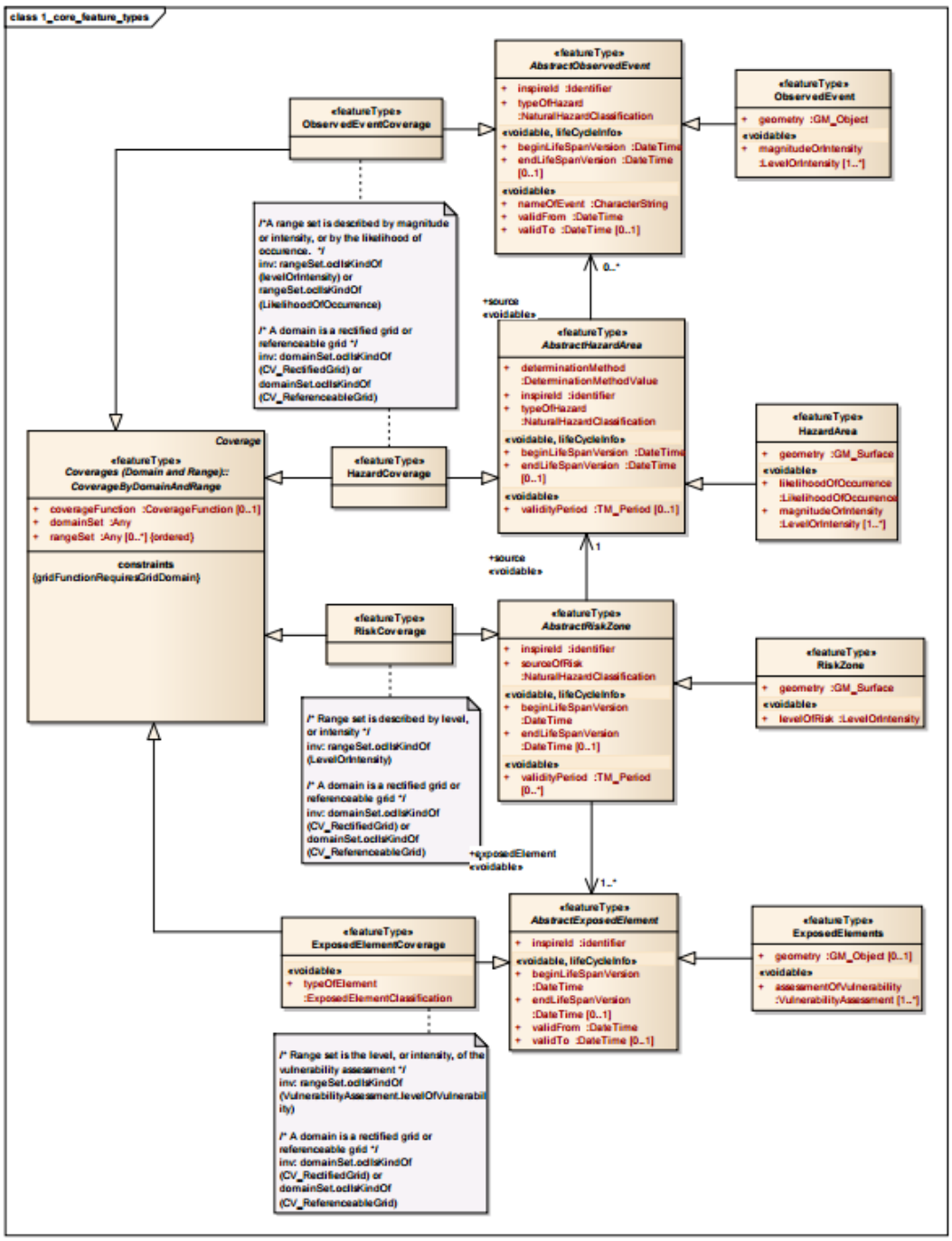


Figure A-1 focus on the Natural Risk Zones application schema; the GREEN box indicates the Susceptibility application contest (http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_NZ_v3.0.pdf page 25)

According to these indications, the following match between NRZ Data Specifications and the GHM Database fields can be proposed:

Quantitative likelihood: with the percentage related to susceptibility classes with values from 0 to 1.

Qualitative value of intensity: with the level of susceptibility reported in terms of qualitative classes e.g. low, medium high very high.

For the full compliance with the INSPIRE Natural Risk Zone Application Schema, it is also needed to take into account the following additional attributes of the feature Type Abstract Hazard Area:

- Identifier
- Method of determination
- Type of hazard

The INSPIRE Natural Risk Zone application schema, finally, also provides the possibility of establishing a relationship between the observed events and the hazard areas.

The proposed logical and shape file models are reported in the following image (Figure A-2), in order to support the future development of the database for this type of product

INSPIRE TWG-NZ Data Specification on Natural Risk Zones D2.8.III.12_v3.0 rc3																	
HazardArea							AbstractHazardArea										
geometry	**likelihood Of Occurence**			**magnitude or intensity**			**begin Life Span Version**	**determination Method**	**end Life Span Version**	**inspire Id**			**type Of Hazard**		**validity Period**	**source**
geometric representation of spatial extent covered by the hazard area	general concept relating to the chance of an event occurring			quantitative or qualitative assessment of either risk, hazard or vulnerability			Date and time at which this version of the spatial object was inserted or changed in the spatial data set.	Specifies if the hazard area result is delineated after modelling or determined after interpretation.	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.	External object identifier of the hazard area.			A generic classification and a specific classification of the type of natural hazard		Future finite time frame where the hazard applies	Abstract Observed Event
	qualitative likelihood	**quantitative likelihood**	**assessment method**	**qualitative value**	**quantitative value**	**assessment method**				Local ID	Name space	Version ID	Natural hazard category value	Specific hazard type value		
	a qualitative assessment of the likelihood of occurrence of a hazard	a frequency of occurence or return period of a hazard phenomenon	a citation to a method used to express the likelihood	a qualitative assessment of the level or intensity	a quantitative assessment of the level or intensity	a citation to a method used to express the level or intensity										
<GM_Object>	*<string>*	*<number>*	*<citation>*	*<string>*	*<number>*	*<citation>*	*<date>*	*<enum>*	*<date>*	*<string>*	*<string>*	*<string>*	*<string>*	*<string>*	*TM_Period*	

optional
conditional
mandatory

SHAPEFILE PHYSICAL MODEL

HazardArea											
ID Hazard Area	**Natural hazard category value**	**Specific hazard type value**	**Begin life span version**	**source**	**Valid from**	**Shape**	**ShapeArea**	**determination Method**	**qualitative value**	**quantitative likelihood**	**ID Observed Event**
1.IT.CNRIRPI	Landslide	shallow	30/1/13	Messina 2009	30/10/10	polygon	288,342	modelling	high	0,705547	9.IT.CNRIRPI

Figure A-2 Draft Model for GHM database structure and shapefile physical model proposal

METADATA COMPLIANCE

The metadata INSPIRE compliance requirements has not been totally satisfied in the Safety project. The metadata elements contain the main information about a spatial dataset, as Responsible organization, Spatial Resolution or Metadata Date. This information is useful to use the product and essential to record the detail of the dataset for future applications.

The INSPIRE Metadata for Safety products are composed by "INSPIRE Implementing Rules on the Interoperability of Spatial Datasets" and "INSPIRE Data Specification on Natural Risk Zone" In Tab. A-1 and A-2 INSPIRE implementing rules for metadata are shown, in particular providing an example about the GHM product.

Table A-1 –INSPIRE Implementing Rules on metadata

Metadata elements required by the INSPIRE Implementing Rules on the Interoperability of Spatial Datasets				
Regulation Part/Section	**Metadata Element**	**INSPIRE Condition**	**Detail**	**Example**
B 1.1	Resource Title	Mandatory	Name by which the cited resource is known	GeoHazard Map
B 1.2	Resource abstract	Mandatory	Brief narrative summary of the content of the resource	The GeoHazard Map represents the ….
B 1.3	Resource Type	Mandatory	Scope to which metadata apply	dataset
B 1.4	Resource Locator	Conditional	Location (address) for on-line access using a Uniform Resource Locator address or similar addressing scheme.	http://www.safety-project.eu
B 1.5	Unique resource identifier	Mandatory	value uniquely identifying an object within a namespace.	(unique identifier with code + codespace)
B 1.6	Lineage	Mandatory	General explanation of the data producer's knowledge about the lineage of a dataset	Landslide hazard is the probability of occurrence in a specified period and within a given area of a potentially damaging landslide of a given magnitude….
B 1.7	Resource language	Conditional	Language(s) used within the datasets	English
B 2.1	Topic	Mandatory	Main theme(s) of the	Geoscientific

Metadata elements required by the INSPIRE Implementing Rules on the Interoperability of Spatial Datasets				
Regulation Part/Section	**Metadata Element**	**INSPIRE Condition**	**Detail**	**Example**
	category		dataset defined in B.5.27 of ISO 19115	Information
B 3	Keyword	Mandatory	Inspire theme name and commonly used word(s) or formalized word(s) or phrase(s) used to describe the subject.	Natural Risk Zone GeoHazard Map
B 4.1	Geographic bounding box	Mandatory	-	47.09 18.52 35.49 6.56
B 5	Temporal Reference	Mandatory	Temporal extent: defines the time period covered by the content of the resource. This time period may be expressed as: - an individual date- an interval of dates (starting date and ending date) a mix of individual dates and intervals of dates. Single date: - date of publication - date of last revision - date of creation	2016-10-06
B 6.2	Spatial resolution	Mandatory	-	20000
B 7	Conformity	Mandatory	Information on the degree of conformity with the implementing rules on interoperability of spatial data sets and services (degree + specification title + specification data type + specification date)	Conformant – COMMISSION REGULATION (EU) Nob 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services – publication -

Metadata elements required by the INSPIRE Implementing Rules on the Interoperability of Spatial Datasets				
Regulation Part/Section	**Metadata Element**	**INSPIRE Condition**	**Detail**	**Example**
				2010-12-08
B 8.1	Condition for access and use	Mandatory	Descriptions of terms and conditions, including where applicable, the corresponding fees shall be provided through this element or a link (URL) where these terms and conditions are described.	No condition apply
B 8.2	Limitation on public access	Conditional	This metadata element shall provide information on the limitations and the reasons for them. Limitations on public access shall be represented by at least one of these metadata elements: - access Constraints - other Constraints - classification	No limitation Intellectual property rights
B 9	Responsible organization	Mandatory	name of the organization and contact email address	CNR – Istituto Ricerca per la Protezione Idrogeologica mario.rossi@safety.com
B 10.1	Metadata Point of Contact	Mandatory	name of the organization and contact email address	CNR – Istituto Ricerca per la Protezione Idrogeologica mario.rossi@safety.com
B 10.2	Metadata date	Mandatory	-	2016-10-06
B 10.3	Metadata Language	Mandatory	-	English

Table A-2 INSPIRE Implementing rules on the Interoperability of Spatial Datasets

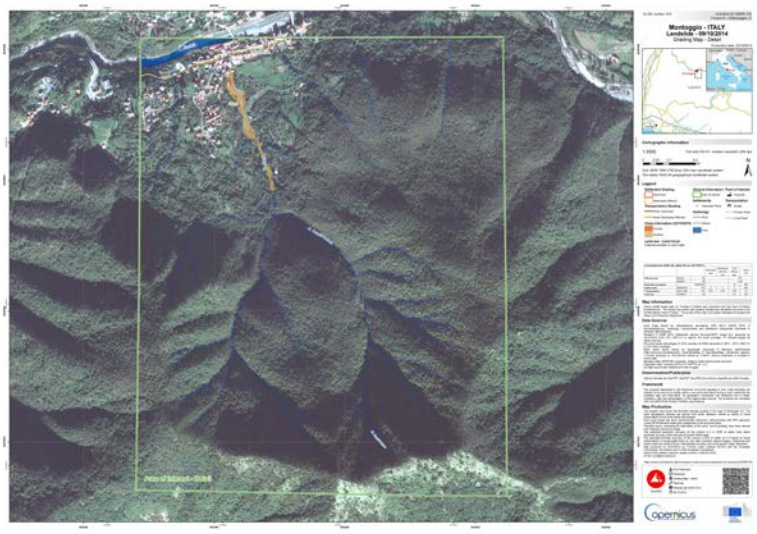
Metadata elements required by the INSPIRE Data Specification on Natural Risk Zone				
Metadata Natural Risk Zones Section	**Metadata Element**	**INSPIRE Condition**	**Detail**	**Example**
8.1.1	Coordinate Reference System	Mandatory	Description of the coordinate reference system(s) used in thedata set.	ETRS89
8.1.1	Temporal Reference System	Conditional	Description of the temporal reference systems used in the Dataset (code – code space)	
8.1.3	Encoding	Mandatory	Description of the computer language construct(s) specifying the representation of data objects in a record, file, message, storage device or transmission channel (name, version, specification)	GML application schema - Version 3.0 - D2.8.III.12 Data Specification on Natural Risk Zones –Technical Guidelines
8.1.4	Character Encoding	Conditional	The character encoding used in the data set	
8.1.5	Data Quality – Logical Consistency – Topological Consistency	Conditional	Correctness of the explicitly encoded topological characteristics of the Data set as described by the scope.	
	Spatial representation type	Mandatory	The method used to spatially represent geographic information.	vector

ANNEX B

LAYOUT OF MAPS

The purpose of this chapter is to provide references related to the graphic return and content for the maps foreseen to be produced in the Safety project. These references are inspired and mainly based on the maps currently provided by the Copernicus EMS service (Figure. B-1 including some useful input gathered from the INCREO project (Increasing Resilience through Earth Observation- a collaborative project under the call FP7-SPACE-2012- whose objective is to provide EO-based solutions to actors responsible for civil protection and disaster management http://www.increo-fp7.eu/).

A)



B)

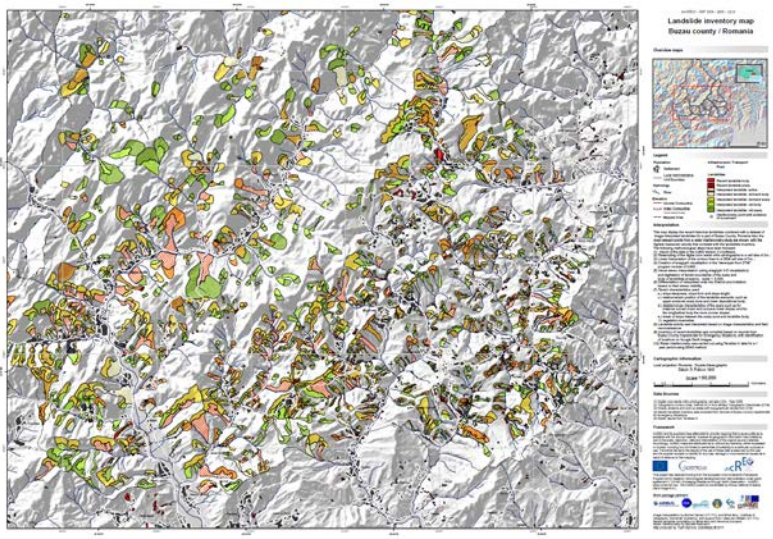


Figure B-1. Maps of the operational service Copernicus EMS rush (A) and the Landslide Inventory map product edited in the Project INCREO environment (B).

The chance to obtain a map in a raster format is absolutely appreciable by the final user and it makes the product suitable to be printed and used during the in field activities.

In Figure B-2 an overall schema, developed as result of LAMPRE project and which can be adopted for the maps of Safety is shown. Different sections that match different kinds of information are identified through a letter on the schema. The content of these sections is explained following with close connection with the same field of Copernicus EMS and INCREO as shown in (Figure B-3).

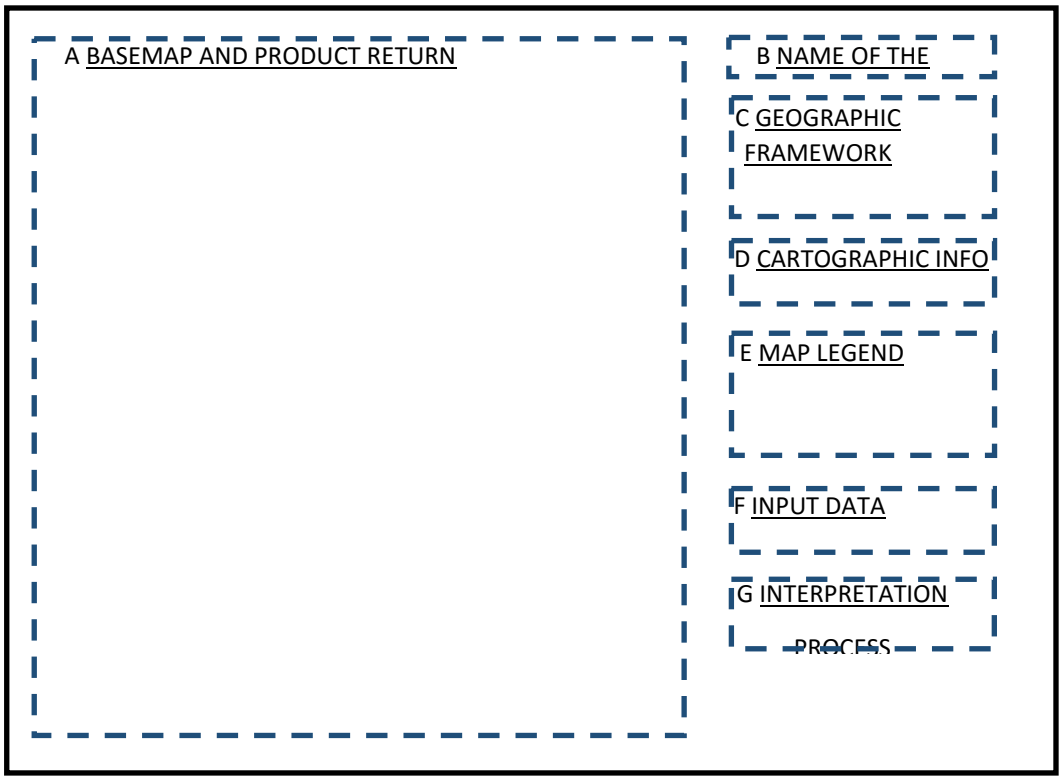


Figure B-2 Layout of the map in a raster format.

Section A BASEMAP AND PRODUCT RETURN (cfr Copernicus EMS)

Section A must contain the basic image that preferentially must be made up of the satellite image acquisition used for processing. On this basic map, hydrographic features of the part of the investigated area (trenches, rivers, lakes), and anthropic features (streets, residential areas, and landmarks) must be highlighted. Place names must be as accurate and rich as possible (maintaining the readability of the map). Finally, product specific information must be projected. This section has to consider the grid of the reference system within the extremes of associated coordinates.

Section B – NAME OF THE MAP (cfr Copernicus EMS)

Section B hosts the name of the map that has to allow to identify geographically the investigated area.

Section C – GEOGRAPHIC FRAMEWORK (cfr Copernicus EMS)

In section C it can reported the geographic framework both in national and regional scale. On this framework map the main morphological and hydrographic features of the area, the presence of infrastructure such as streets, railways and the analysed area must be indicated. As a useful reference for comparison with other cartographies, the presence of very rich place names is considered as a very useful option by the user (except for the scale readability and representativeness). The scale 1: 90.000 can be considered a useful reference.

Section D – CARTOGRAPHIC INFO (cfr Copernicus EMS

Section D collects the cartographic information such as scale (graphic and cartographic), the cardinal orientation, reference system and printing features (ISO format and quality).

Section E – MAP LEGEND (cfr Copernicus EMS

Section E is the map legend. The legend has to enable the identification of the general information described in section A (subject area of the study) as well as the urbanised areas. It has to indicate the landmarks (institutional places, industrial plants), the transport lines and everything that is shown on the map. Also hydrography has to be identified as well as the specific sources related to the type of product. It is already possible to foresee the user's requests for a section where one can describe statistical data regarding the potentially involved population, the infrastructures possibly divided by the purpose of use and degree of interest in the landslides.

Section F – INPUT DATA (cfr Copernicus EMS)

Section G contains information strictly connected to the input data both in terms of the base map (features of the satellite image, resolution, date of acquisition, sensor), technical data of other data used, e.g. DEM, etc. In the same section one has to include eventual bibliographical references relative to the source of the input data. Valid elaboration as well as data of the producer and the date of realization should be indicated.

Section G – INTERPRETATION (cfr INCREO)

References needed by the user to carry out a back analysis have to be indicated in this section. In this part the procedure and the method used for the arrangement of the product has to be described synthetically and schematically. Obviously the description will be related above all to the product it refers to. The description of the interpretative process will have to be preferably divided into consecutive phases and the progress of works will be indicated (data imported into the software, linear interpolation, etc.) Looking at the INCREO products and in particular at the landslide inventory maps (ex. the one edited for Buzau County in Romania - http://www.increo-fp7.eu/) the raster map shows a section where the methodological steps followed by the production are explained. This format could be used in Safety product.

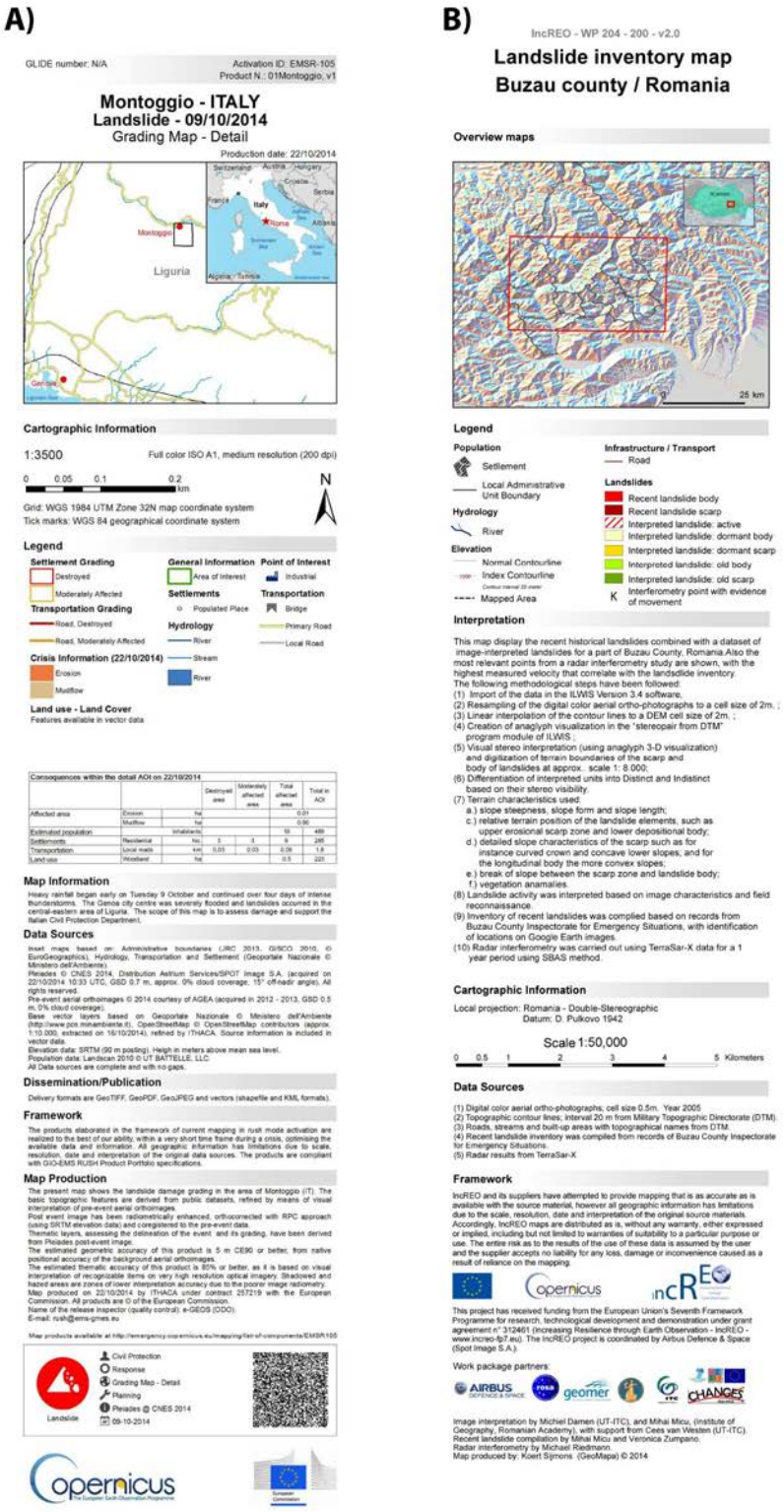


Figure B-3. Title block of the maps of the operational service GIO EMS rush and the Landslide Inventory map product edited in the Project INCREO environment

REFERENCES

- European Commission Factsheet Third UN World Conference on Disaster Risk Reduction 2015
- ECHO Factsheet – Disaster Risk Management – 2015
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- ECHO Factsheet – Disaster Risk Reduction – April 2014
- DG ECHO Thematic Policy Document n°5 Disaster Risk Reduction Increasing resilience by reducing disaster risk in humanitarian action - September 2013
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- http://ec.europa.eu/echo/
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- Van-Camp. L., Bujarrabal, B., Gentile, A-R., Jones, R.J.A., Montanarella, L., Olazabal, C. and Selvaradjou, S-K. (2004). Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection. EUR 21319 EN/6, 872 pp. Office for Official Publications of the European Communities, Luxembour
- "The State of Soil in Europe – a contribution of the JRC to the European Environ Agency 's Environment State and Outlook Report – SOER 2010" – 2012 contribution of JRC, EEA, EC-DG Environment
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- GMES Terrafirma -Review Of The Terrafirma Products 16th March 2009 Final version – Issue 3 M. Crosetto, F. Martín (IG)
- Core User Needs and User Standards Dossier U1 10th May 2011 Version 5.2 Pauline Kruiver, Marco Kleuskens, Rogier Westerhoff Deltare;
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- Safeland - Living with landslide risk in Europe; Assessment, effects of global change, and risk management strategies. Summary report.
- http://copernicus.eu/
- http://www.eea.europa.eu/themes/landuse;
- http://www.doris-project.eu/
- http://www.lampre-project.eu/