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assessment for urban areas”

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A deliverable of WP 1 (Activity 1.1): Identification of User needs

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PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
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Table of Content

EXECUTIVE SUMMARY	3
REFERENCE DOCUMENTS	4
1 INTRODUCTION	6
2 SLOPE HAZARDS IN THE VALLE D'AOSTA REGION	7
3 ITALIAN CIVIL PROTECTION SYSTEM	8
4 VALLE D'AOSTA REGION CIVIL PROTECTION SYSTEM	11
5 USER REQUIREMENTS	12
ANNEX A – INSPIRE FORMAT	15
ANNEX B – LAYOUT OF MAPS	17
REFERENCES	19

EXECUTIVE SUMMARY

This document resumes all the activities performed within the Action 1.1 "Identification of user needs" and represents the first deliverable of the WP1 "Tools to support the Early Warning for Landslides geohazard", led by UNIFI.

The main goal of this action is describing the existing prevention procedures implemented by the Italian Department of Civil Protection (DPC) and applied also at regional level by the Valle d'Aosta Region Civil Protection (VARCP). This task benefits of procedures and products already defined in the framework of the European ECHO project SAFETY, where DPC and UNIFI already collaborated to define specific user requirements for satellite-derived ground deformation and vulnerability products. The user needs will be defined considering Sendai Framework for Disaster Risk Reduction 2015–2030, identifying the most efficient and effective way to integrate U-Geohaz products and services into the CPA prevention mechanisms. These User Needs will be converted into Requirements for effective product and service developments.

The Activity 1.1 is led by the VARCP which is the final user of the developed products and hence it will assure the identification of realistic needs for all the products that will be generated and delivered in the framework of WP1.

This deliverable is a technical report describing the context in which the VARCP works (focusing on landslide geohazard) and its procedures for landslide risk management. Moreover, the deliverable will illustrate the specific user requirement for each product that will be delivered in the next two years of the project.

REFERENCE DOCUMENTS

N°	Title
RD1	DoW Part B

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1 INTRODUCTION

The hazards associated with landslides result in complex and changing landscapes whose evolution must be mapped and monitored in detail to forecast future behavior. Landslide and debris-flow disasters represent a major geological hazard that occurs more frequently worldwide than volcanic eruptions and floods and is nearly as common as earthquakes. Among natural hazards, landslides are one of the main causes of loss of life and property (Canuti et al. 2004), claiming fatalities and injuries and producing direct and indirect economic losses. The global impact of slope failures on structures, infrastructure, the economy and the environment remain largely undetermined (Schuster and Fleming 1986), and it is difficult to quantify at the European scale as well (Hervás 2013).

Italy is one of the European countries with the highest landslide hazard, and 13% of the territory is prone to landslides (Nadim et al., 2006). In Italy, detailed records of landslides do exist, such as the IFFI (Italian Landslide Inventory, *Inventario dei Fenomeni Franosi in Italia*), which mapped over 490,000 landslides covering an area of 21,200 km², equal to 7% of the total surface (Trigila et al. 2014). Approximately 9600 areas in Italy have been classified as “at extremely high landslide risk” according to Italian Law No. 267/1998. By exploiting catalogues of historical landslides in Italy, Guzzetti (2000) and Salvati et al. (2010) analyzed the related impact and assessed individual and societal risks at the national scale. Between 1990 and 1999, at least 263 people were killed by mass movements for an average of 26 deaths per year. In the twentieth century and the first decades of the twenty first century, several landslides injured or killed more than 8000 people, destroying public buildings and private houses and resulting in over 200,000 people homeless or evacuated (Salvati et al. 2015). The total cost of direct damage is estimated to range annually from 0.3 to 0.4% of the gross domestic product (Canuti et al. 2004), highlighting that the landslide problem in Italy is particularly relevant, and on a worldwide scale, it is second only to Japan among the technologically advanced countries.

In this framework, the Civil Protection Authorities (CPAs), who are appointed to prevent landslide hazards and to manage emergencies deriving from potentially damaging events, need a monitoring strategy that uses reliable data acquired in a short period of time over wide areas (at times covering entire regions) for use in forecasting, prevention and emergency phases. Earth Observation (EO) data and remote sensing play a key role in management of geohazard-related problems, leading to new levels of understanding of the complex solid Earth processes that often lead to disasters. In recent decades, satellite-based observations and the derived geospatial products have been successfully demonstrated to be highly valuable in measurement of land motion in a wide range of application fields (Tralli et al. 2005), including land motions related to landslides (Tofani et al. 2013). EO technologies have broadened their range of applications with the development of techniques based on exploitation of the phase and amplitude information contained in satellite SAR images. In particular, multi-interferogram approaches have proven their valuable contributions in different phases of landslide response (Canuti et al. 2007) and Civil Protection practices (Corsini et al. 2006; Farina et al. 2007).

The direct involvement of Civil Protection Authorities, at different administrative levels (National and regional), in the U-Geohaz project is a good opportunity for strengthening the use of satellite-based technologies 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 and shared with other operative services at EU level and among EU Member States.

2 SLOPE HAZARDS IN THE VALLE D'AOSTA REGION

The Valle d'Aosta (VdA) Region is located in the Northwestern Italian Alps and more than 50% of the its territory has an elevation above 2000 m a.s.l., though topographic relief is highly variable, ranging from 300 m a.s.l. to peaks higher than 4000 m a.s.l.

The slopes of VdA are characterized by high density of mass movements, which can be synthetically grouped in glaciers, rock glaciers, and landslides (Cignetti et al., 2016).

One third of the Italian glaciers are hosted by the VdA Region. Their evolution is strictly connected with the current climatic regime and are characterize by different deformation rates, passing from tens of meters/years for glacier flows to centimeter/years in the case of permafrost-related creep (Fallourd et al., 2011).

Rock glaciers are a periglacial landform composed of lobate frozen rock debris with steep fronts and side slopes, directly connected to permafrost conditions. Depending on their ice content can be defined as active, inactive, or relict (Barsch, 1996). If active, they can move downslope with a velocity ranging between centimeter to meter years; if inactive or relict, they basically do not move (Haeberli et al., 2006). In VdA, rock glaciers occupy the 2% of the regional territory, mainly being relict landforms; active rock glaciers are detected only at the highest altitudes (Guglielmin & Smiraglia, 1998).

Landslides affect the 18% of the entire territory of the Valle d'Aosta Region (Trigila et al., 2010); 4400 phenomena are already mapped, leading to a high landslide density equal to 134 landslides over 100 km². Shallow landslides (soil slips, planar, and rotational sliding), rockslides and large slope instabilities are present. Deep seated gravitational slope deformations (DSGSD) affect the 13% of the VdA territory for a total of 280 known phenomena. DGSD commonly show very slow to slow annual deformation rates, involving entire high-relief flank valleys (Agliardi et al., 2009). These phenomena are directly connected to the Late-glacial evolution of VdA mountain valleys and mainly triggered by glacial debuttressing. Their evolution is controlled by geological/lithological, climatic, post-glacial and seismic factors (Crosta et al., 2013).

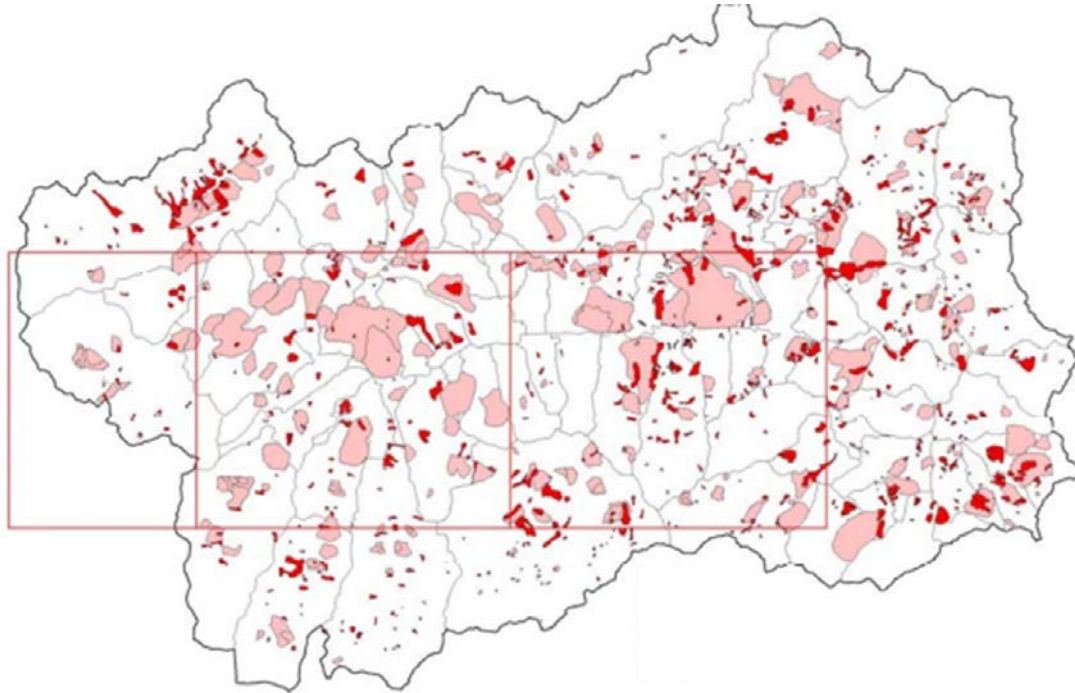


Figure 1 – Landslide inventory for the Valle d'Aosta Region, In red the landslides boundaries and in pink the DSGSD boundaries. From Giardino & Ratto, 2007.

3 ITALIAN CIVIL PROTECTION SYSTEM

The Italian National Civil Protection service is organized as a complex system. Within the system, the responsibility in the activities of forecasting, prevention, relief and overcoming emergency situations are assigned to several operative structures. The risk complexity of the Italian situation actually requires the coordinated and synergic use of all the skills and resources available.

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 centers (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. It promotes conferences, national and international training projects and dissemination 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 and Sendai Frameworks. 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 programs 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, fundamental tools of prevention, based on regional and national guidelines. 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 a hydrogeological emergency, the Mayor - the only authority of civil protection within the National Service – must ensure emergency assistance to the population, coordinating the local operational structures on the basis of the municipal emergency plans ("A" type event). If the municipal resources, in terms of structures and people, available are not sufficient to deal with the emergency, Province, Prefecture, Territorial Offices of the government and Region will activate all the available resources to support the local municipality 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. In such cases the National Service is directly involved with all its components and operational structures.

The Department is committed to the development and implementation of the Early Warning Systems (EWSs), in close collaboration with Competence Centers, 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 Centers 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 27/02/2004 and subsequent modifications and supplements). The Regional Centers 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 Centers 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 center 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 centers 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 centers 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 defense 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 programs are the instrument to determine the intervention priorities and the times with which the civil defense actions should be actuated, according to the danger of an event, to the vulnerability of the territory and to availability of funds.

4 VALLE D'AOSTA REGION CIVIL PROTECTION SYSTEM

The Valle d'Aosta Civil Protection (VARCP) is structured according to the Italian laws and it is based on the first response to the emergencies by the municipalities. The regional administration coordinates the response to the emergencies either in the case the Municipalities cannot give an effective response to local emergencies, or in the case of complex and extended events. In addition, the regional administration oversees the forecast and prevention activities, issuing civil protection warnings (e.g. in the case of meteorological or avalanche hazards).

Geohazard management is a particularly well-developed activity and it is managed by the distributed regional civil protection system adopting the “support function” organizational framework. Regarding landslide management, the civil protection system relies on the support provided by the Regional Geological survey (one of the administrative and technical structures of the RAVA – Regione Autonoma Valle d'Aosta), which is in charge of the monitoring of active geohazards, being mainly landslides. The other fundamental support is provided by the meteorological and rainfall forecasts issued by the Regional Functional center which takes also care of landslides and rockfalls inventories.

The warning and early warning procedures are codified and approved by the regional government Resolution n. 26/2014, according to the Directive of the Prime Minister 27/02/2004. According to the above-mentioned Resolution and to the regional organization, the Geological survey is in charge of the follow up of the active landslides and of the technical reports in case of new instabilities.

In this framework, when a new slope instability occurs the civil protection operation center dispatches an alert to the Geological survey, activating, where required, a survey aimed at evaluating the level of the residual risk. If the risk level is still high, civil protection measures, i.e. evacuation procedures or road closing, will be undertaken. In the case of an acceleration registered by an instrumented landslide, the Geological survey will issue a warning to the VARCP operative center, alerting at the same time the municipalities involved who are in charge of the activation of the civil protection plans.

In both cases, it's self-evident that the interferometry radar technology is a great opportunity for the operational services of VdA, greatly improving the monitoring capabilities of the territory, thanks to the wide area coverage and, in the case of the Sentinel-1 constellation, to the high temporal resolution available. Furthermore, the capability to penetrate the cloud cover is another outstanding feature which allows a quick evaluation of the slope displacements even during the rainfall events.

5 USER REQUIREMENTS

In this section, considering the existing procedures at national (Italian DPC) and regional (VARCP) scale, a series of qualitative user needs for each product of WP1 will be presented.

Taking into account that the U-Geohaz 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), a further effort has been spent to define one list of realistic user need for WP1 products, to make this products suitable to be integrated also in a different national contexts, i.e. in different natural and social environments.

Due to the fact that these user requirements are set up at an initial stage of U-Geohaz, where all the activities are starting, the requirements will be further re-worked and enhanced in the ongoing project. The cross-comparison between initial user needs and final outputs of the project will be assessed at the end of U-Geohaz (M23) with a specific deliverable of the user assessment deliverable (D1.2.2).

The U-Geohaz user needs are here reported as specific and realistic User Requirements (UR), which can support the development phase of the project. For each product, defined by the project team, a series of specific user needs are established in order to cope the main necessity of the Civil Protection authority involved, i.e. the final users of the project.

Work Package 1 is subdivided into 6 activities, of these, 4 will only produce technical reports, thus not requiring a specific evaluation of user needs. Activity 1.3 (Landslide activity maps) and Activity 1.4 (Vulnerable elements at risk map generation) will produce shapefiles, software tools and maps, thus requiring specific user needs.

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

WPX_DC_Y

where:

X is the number of WP

DC is the deliverable code (e.g. 1.4 or 1.3.2)

Y is the progressive number of the requirement

WORK PACKAGE 1: TOOLS TO SUPPORT EARLY WARNING FOR LANDSLIDE			
Activity 1.3 Landslide activity map			
Short Description	Requirement	Product	User Requirements
The main goal of this activity will be the generation of Active Deformation Areas (ADA) that represents a fast way to obtain reliable information about location and intensity of ground deformation. Within this action, open-source software tools to generate the ADA will be provided.	WP1_1.3.2_1	Active Deformation Areas map (ADA)	U-Geohaz shall provide ADA in shapefile or raster format.
	WP1_1.3.2_2	Active Deformation Areas map (ADA)	U-Geohaz shall provide ADA with a description of input data used.
	WP1_1.3.2_3	Active Deformation Areas map (ADA)	U-Geohaz shall provide ADA with an evaluation of the quality and uncertainties of the product.
	WP1_1.3.2_4	Active Deformation Areas map (ADA)	U-Geohaz shall provide ADA results in a specific layout ready to be printed for field activities.
	WP1_1.3.3_5	Software tools to produce the 6-day ADA map and User manual	U-Geohaz shall provide a free prototype software for ADA generation compatible with common operating systems (Windows, MacOS or GNU/Linux)
	WP1_1.3.3_6	Software tools to produce the 6-day ADA map and User manual	U-Geohaz shall provide guidelines for software tools use
	WP1_1.3.3_7	Software tools to produce the 6-day ADA map and User manual	U-Geohaz shall foresee practical training sessions about the use of software tools

WORK PACKAGE 1: TOOLS TO SUPPORT EARLY WARNING FOR LANDSLIDE			
Activity 1.4 Vulnerable elements at risk map generation			
Short Description	Requirement	Products	User Requirements
The aim of this task is assessing the impact of detected and/or assessed geohazard on roads and built up areas. This task will exploit previously defined ADA to evaluate their impact level on infrastructures and thus on the population.	WP1_1.4_1	Vulnerable elements at risk map (VEAM)	U-Geohaz shall provide VEAM in shapefile or raster format.
	WP1_1.4_2	Vulnerable elements at risk map (VEAM)	U-Geohaz shall provide VEAM with a description of input data used.
	WP1_1.4_3	Vulnerable elements at risk map (VEAM)	U-Geohaz shall provide the methodology used to derive the VEAM.
	WP1_1.4_4	Vulnerable elements at risk map (VEAM)	U-Geohaz shall provide VEAM represented as values or category classes
	WP1_1.4_5	Vulnerable elements at risk map (VEAM)	U-Geohaz shall provide VEAM results in a specific layout ready to be printed for field activities.

ANNEX A – INSPIRE FORMAT

U-Geohaz project is focused on monitoring geohazard-associated ground deformations specifically addressed to urban areas and critical infrastructures. Several work packages consider the production of different kind of maps to assess the potential of geohazard activity. Analyzing INSPIRE directive these products can be included in Natural Risk Zones theme of Annex III.

Data Specification on Natural Risk Zones - Technical Guidelines establish the practical implementation of these data according to INSPIRE Directive. This document establishes:

- Data content and structure
- Reference System, units of measure and grids
- Data quality
- Data-level metadata
- Delivery
- Data capture
- Portrayal

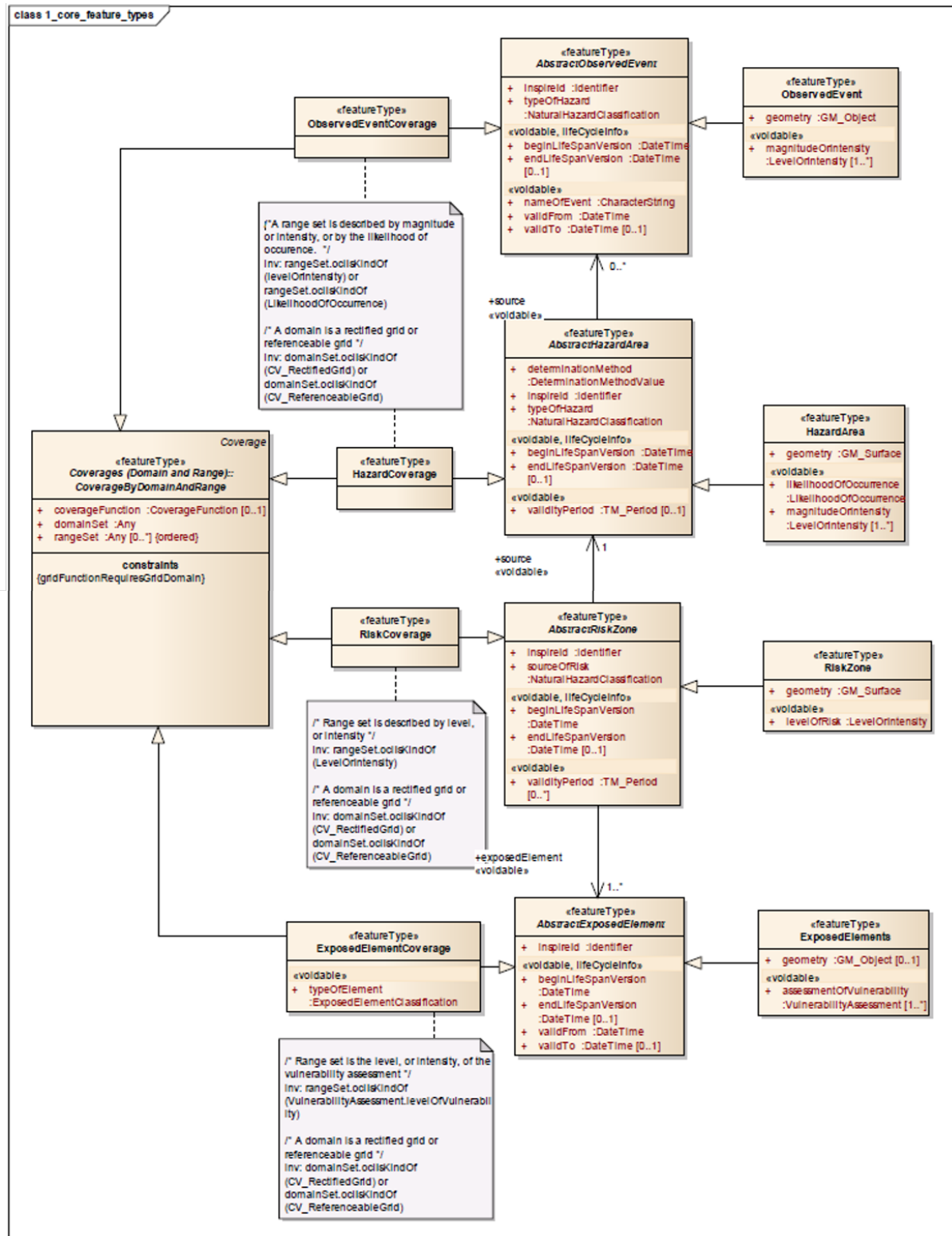


Figure 2 - Overview on the INSPIRE Natural Risks Zones application schema.

ANNEX B – LAYOUT OF MAPS

The purpose of this annex is to provide a reference scheme for the graphical return of the U-Geohaz products. The scheme is inspired by the outputs obtained at the end of the SAFETY project and based on the maps currently delivered by the Copernicus EMS service (<http://www.copernicus.eu/main/services>).

Delivering a map in a standardized raster format is extremely useful for end users, especially for Civil Protection actors, because of the possibility of having available a printable and ready-to-use product.

In Figure 2 a layout proposal for U-Geohaz product is reported. This schema is composed of different sections containing different levels of information. The content of every section is explained below.

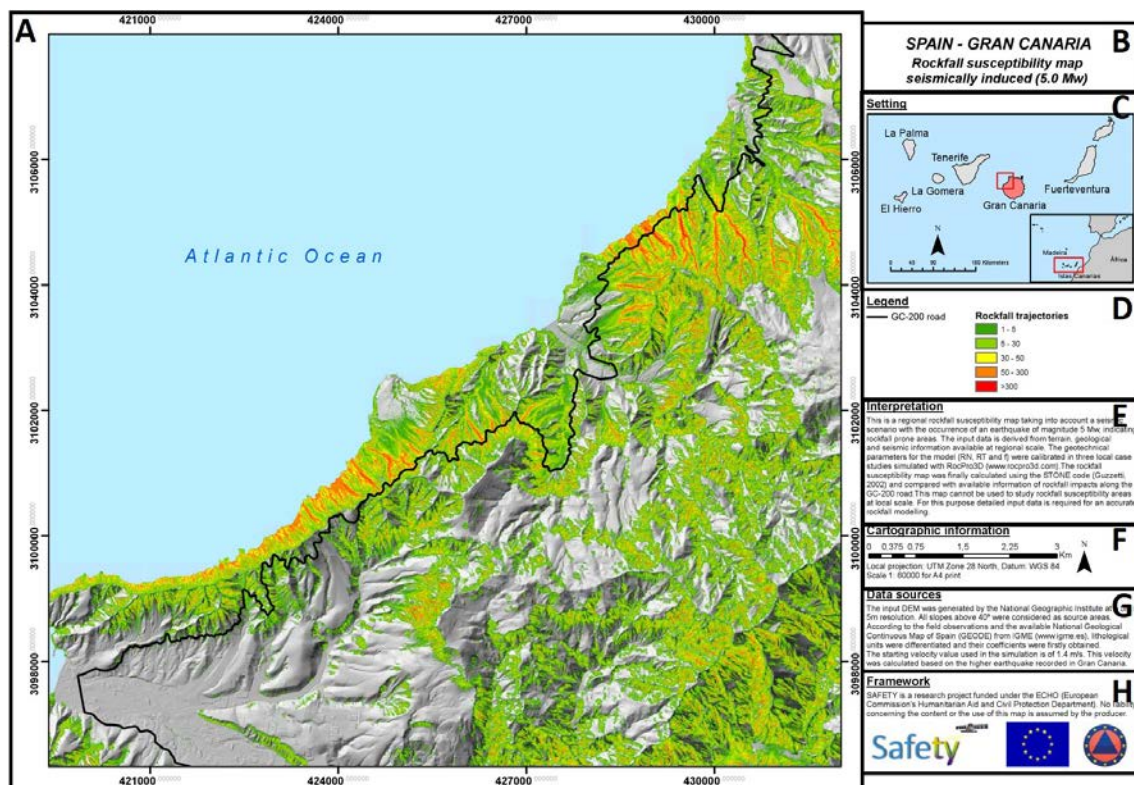


Figure 3 – Layout proposal for U-Geohaz products. The background image comes from one of the deliverables of the SAFETY project.

Section A: is the core of the layout and contains the results of an Action. Satellite images, aerial orthophotos, digital elevation models or shaded reliefs can be used as background image. The map must highlight political boundary (municipalities, regions, etc...), main roads and place names guaranteeing the readability of the map and depending on its scale. A reference grid has to be drawn outside the image border. The scale of the image has to be selected depending on the type of output and of the information to be deliver to the end users; images with different scale can be prepared.

Section B: is the name of the map and its location.

Section C: represents the geographical location of the site. Both national and regional geographical frameworks shall be shown.

Section D: is the legend of the map. The legend has to enable the identification of the general information described in Section A.

Section E: contains a brief interpretation of the map. In this section simple and effective information about what can be seen in the image have to be proposed. A small review about the main outcomes connected to this map can be added.

Section F: is the cartographic reference of the map. This section contains the scale bar and north direction referred to the image of Section A. Moreover, the reference cartographic system is shown.

Section G: describes the data source. In this section, the input data are briefly described.

Section H: describes the framework of the map. Simple information about U-Geohaz and the position of the product in the framework of the project are given. All the necessary logos can be added at the end of this section.

All the maps produced within U-Geohaz should be delivered in .pdf or in other standard image formats (.jpeg, .tiff, etc...).

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