RETINA

Realistic Evaluation of Temporal Interaction of Natural hazards

User Requirement Document
Deliverable N° D13

Version 1.2

30 September 2002

	Name	Institution	Signature	Date
Prepared by	Olivia Lesne Philippe Bardey	ACRI-ST ACRI		
Verified by	Antoine Mangin Kurt Feigl	ACRI-ST CNRS Toulouse		
Distributed to: (mark all applicable boxes)				
		X RETINA Coordinator		
		X RETINA Consortium Suppliers		
		X RETINA Consortium End Users		
		X European Commission		
		External, for publication		

TABLE OF CONTENTS

1 Introduction

1.1 Context and general objectives

This document concerns the mechanical coupling and temporal interaction between earthquakes, volcano, landslides and hydrology. It contributes to natural hazard assessment and mitigation by promoting validated methods exploiting available. It seeks to provide a prototype framework for implementation in a European context.

Decision-making agencies in communities at risk require multi-risk.. Current management schemes in the RETINA laboratories (Iceland, Alps, and Azores) consider each risk separately. For example, the possibility that an earthquake can trigger a landslide, is currently neglected in land-use planning. This lack can seriously underestimate the actual risk to the population.

According to the current legislation, local agencies should take into account the information provided in **available** seismic hazard maps for land use planning, permitting processes, and information to the communities.

In such a general context, the document defines a methodology for a future proposed service to provide seismic hazard maps. Accordingly, the following requirements aim at improving quantitatively and qualitatively hazard maps for triggered earthquake, landslide and volcanic events.

This report is open for minor modifications prior to M12.

1.2 Purpose

The purpose of this document is to refine and specify the user requirements for constraining "Elevated Risk Situations".

The high level requirements specified in this document have been established in co-ordination with local authorities. They result from the compilation and analysis of the relevant literature on the subject, mainly [RD1], [RD2], [RD3], [RD12], [RD13], [RD20], [RD23], [RD24], [RD35]. The main objective is to provide inputs for research and to define clear and measurable goals.

1.3 Terminology – Structure of the presentation

Each item bears a unique identification number which will be used for cross-reference in the following steps of the RETINA project life cycle.

- The term "hazard" shall take the conventional meaning of " to be completed by Niels….", as defined by the UNESCO handbook [RD 36].
- The term "risk" shall take the conventional meaning of " to be completed by Niels…." as defined by the UNESCO handbook [RD 36].

- Requirements which are considered as mandatory are stated with a **"shall"**.
- Requirements which are considered as desirable are stated with a **"should"**. In the present context, desirable means that this requirement is either felt technically out of the scope of RETINA or not explicitly expressed but reasonably supposed to be useful. The latter will be confirmed during the course of the pilot experiments project and are herein flagged with a TBCE (to be confirmed by experiment).

1.4 Reference Documents

[RD1] R.W. Jibson et al., A method for producing digital probabilistic seismic landslide hazard map
Engineering Geology 58 (2000) 271-289

[RD2] A. Prestininzi, R. Romeo, Earthquake-induced ground failures in Italy
Engineering Geology 58 (2000) 387-397

[RD3] Natural Disaster Reduction
Proceedings of the Conference Sponsored by the American Society of Civil Engineers – Washington, D.C. – December 3-5, 1996

[RD4] Carter W., Shrestha R., Tuell G., Bloomquist D. and Sartori M.
Airborne Laser Swath Mapping Shines New Light on Earth's Topography
EOS, Vol.82, N°46, November 13,2001

[RD5] Faye J., Lakhdar Y. – Ministère de l'Aménagement du Territoire et de l'Environnement
Dossier d'information – Mouvements de terrain (15/12/00)

[RD6] Faye J., Lakhdar Y. – Ministère de l'Aménagement du Territoire et de l'Environnement
Dossier d'information – Séisme (15/12/00)

[RD7] Obligations et responsabilités des maires en matière de prévention des risques naturels (Novembre 2001)
http://www.carrefourlocal.org/vie_locale/cas_pratiques/securite/preventionrisquesnaturels.html

[RD8] http://www.prim.net/cgi_bin/citoyen/macommune/23_face_au_risque.html

[RD9] Les mouvements de terrain – Risque d'éboulement des « Ruines » de Séchilienne (Isère).
Fiche technique IFFO-RME

[RD10] Dangers naturels et accidents majeurs – L'environnement en Suisse
Office fédéral de la statistique/Office fédéral de l'environnement, des forêts et du paysage (pp.115-126)

[RD11] Seismic hazard zone report for the San Juan Capistrano 7.5-minute quadrangle, Orange county, California
Seismic Hazard Zone Report 053
Department of Conservation / Division of Mines and Geology (2001)

[RD12] Seismic Hazard Zones in California
http://www.conservation.ca.gov/dmg/shezp/zoneguid/index.htm *(last updated: 11/07/01)*

[RD13] Romeo R.
Seismically induced landslide displacements: a predictive model
Engineering Geology, Vol.58 N°3-4 (special issue), pp. 337-351 - December 2000

[RD14] Esposito E. et al.
Landslides and other surface effects induced by the 1997 Umbria-Marche seismic sequence
Engineering Geology, Vol.58 N°3-4 (special issue), pp. 353-376 - December 2000

[RD15] Papadopoulos G.A., Plessa A.
Magnitude-distance relations for earthquake-induced landslides in Greece.
Engineering Geology, Vol.58 N°3-4 (special issue), pp. 377-386 - December 2000

[RD16] Seismic Hazards Mapping – California Public Resources Code
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/codes/prc/chap-7-8.htm

[RD17] Currently Available Hazard Zone Maps and Planned Release Dates
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/shezp/schedule.htm

[RD18] Official Map of Seismic Hazard Zones
Seismic Hazard Zones: Beverly Hills Quadrangle
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/shezp/maps/m_bevh.htm

[RD19] Official Map of Seismic Hazard Zones
Seismic Hazard Zones: Point Mugu Quadrangle
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/shezp/maps/m_poim.htm

[RD20] Guidelines for evaluating and mitigating seismic hazard in California
Special Publication 117
California Conservation / Mines and Geology
http://www.conservation.ca.gov/dmg/pubs/sp/117/index.htm

[RD21] Seismic hazard mapping program fact sheet
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/shezp/shzmpf.htm

[RD22] Seismic Hazards Mapping (Article 10)
California Code of Regulations – Title 14
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/codes/ccr/t_14/3720.htm

[RD23] Plans de prévention des risques naturels prévisibles (PPR)
Guide Général
Ministère de l'Aménagement du Territoire et de l'Environnement / Ministère de l'Equipement, des Transports et du Logement

[RD24] Plans de prévention des risques naturels (PPR) – Risques de mouvements de terrain
Guide Méthodologique
Ministère de l'Aménagement du Territoire et de l'Environnement / Ministère de l'Equipement, des Transports et du Logement

[RD25] Bruneau M., Tierney K.
Market-Focused and Open-Systems Approaches to Earthquake Loss-Reduction : Contextualizing Role of Engineering Research.
Natural Hazard Review, Vol.3, N°2, pp. 48-54 (May 2002)

[RD26] Turner L.
What's Shaking ? Earthquake Trials. Test Networked RTK
GPS World, pp.16-22, April 2002

[RD27] Les risques majeurs dans les Alpes de Haute-Provence.
Action Publique – Lettre des services de l'Etat dans le département des Alpes de Haute-Provence. N° Spécial

[RD28] Venet C.
Construction parasismique : point réglementaire
CSTB Magazine 134, pp. 49-52, mars-avril 2001

[RD29] Les plans de prévention des risques (P.P.R.)
PROCERISQ (Procédures et réglementation applicables aux risques technologiques et naturels majeurs)
Ministère de l'Aménagement du Territoire et de l'Environnement.

[RD30] Rapport annuel du délégué aux risques majeurs – Année 2000
Ministère de l'Aménagement du Territoire et de l'Environnement.

[RD31] La surveillance sismologique en France (2001)
http://www.prim.net/citoyen/moi_face_au_risque/surveillance_sismo.html

[RD32] Index to Seismic Hazard Zone Maps – Showing locations of official and preliminary maps.
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/shezp/maps.htm

[RD33] Watersheds Mapping
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/ws/index.htm

[RD34] Landslide Maps Available from the California Department of Conservation's Division of Mines and Geology
California Conservation / Mines and Geology
http://www.consrv.ca.gov/dmg/geohaz/ls_maps.htm

[RD35] Kert C.
Rapport sur les techniques de prévision et de prévention des risques naturels: séismes et mouvements de terrain. (1995)
Tome 1 : Conclusions du Rapporteur
Rapports de l'Office Parlementaire d'évaluation des choix scientifiques et technologiques
http://assemblee-nat.fr/rap-oecst/risque95/somseism.asp

[RD36] UNESCO
Report… URL….

2 Guidelines – Methodology

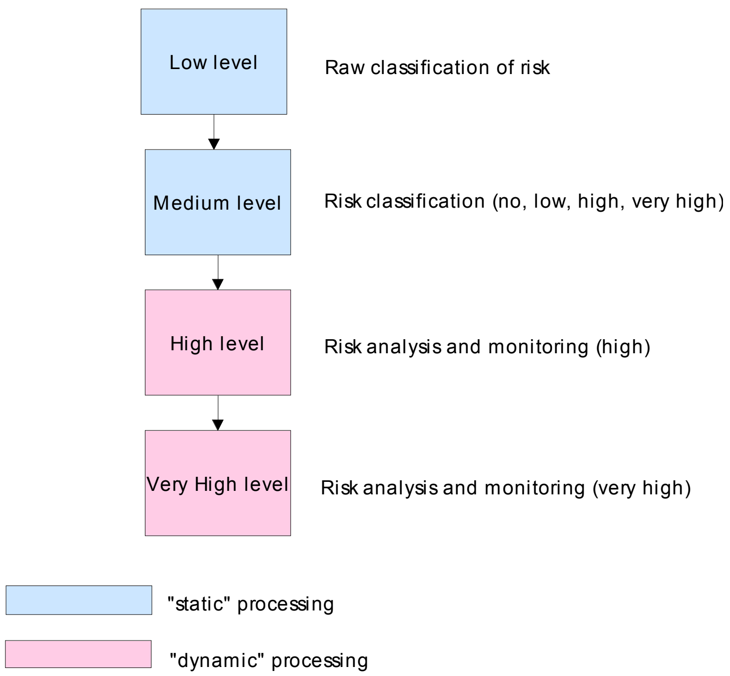
This section provides the requirements for the methodology based on the following rationale: optimise resources without compromising efficiency while permanently adapting resources to the level of predictable risk. In short, it means increasing efforts in modelling and data acquisition when and where increased risk occurs.

2.1 Overview

URD.2.1-1 The goal shall be to derive a standardized method of hazard assessment to consistently evaluate hazard potential, making extensive use of :

- Latest geotechnical data
- A uniform Geographic Information System (GIS) with standard map layer characteristics (e.g., San 25 IGN in France)
- standard format for exchange of geographical data with Meta Data structure, sharing standard technical terms and definition (e.g. DCS@net project is one tentative in France)

URD.2.1-2 The process shall be incremental as illustrated on the diagram below. The approach will vary from rough, low-level for under “safe” stress conditions to highly refined, high-level methodologies where and when the state of stress approaches failure. The performance requirements increase toward the “high” end of the scale. The highest levels will use simulation tools to assimilate available data with appropriate spatial and temporal resolution.



Low:
use archived data and existing map, no need to update except after unpredictable events
Medium:
updated data, simple models, and standard update.

High:
integration of complex models using regularly refreshed data sets.
Very High:
assimilation of near or real time data into sophisticated modelling system and integration into operational alert system.

2.2 High-level requirements for high level products

URD.2.2-1 RETINA mission shall fulfil the needs for a methodology to derive synthetic maps with the purpose to establish a diagnostic (pre or post event).

URD.2.2-2 Concerning the environmental risk itself, priorities for mapping hazard zones should be: i. population affected by the hazard, ii. probability of public health and safety threat, iii. willingness of lead agencies to share cost of mapping within their jurisdiction, iv. availability of existing information.

2.3 Diagnostic

URD.2.3-1 The diagnostic shall address expertise of areas for a hazard classification.

URD.2.3-2 The diagnostic shall be driven by legislation at European level

URD.2.3-3 The diagnostic should make use of harmonised data and means (GIS) to allow interconnection with other field of expertise (Civil defence, Health, urbanisation …)

URD.2.3-4 There should be an agreement on hazard index definition based on intrinsic reliability.

URD.2.3-5 There should be an agreement on state of the art recognized information to delineate geographical zone concerned by RETINA. The information shall comprise :

- set of reference books,
- charts,
- tables,
- equations,
- others (TBCE)

URD.2.3-6 A conservative approach shall be applied to rank zones according to the treatment they require.

URD.2.3-7 Criteria for zoning shall be:

- already known zones
- dedicated to specific coupled hazard
- dedicated for testing relevant research outcomes
- Others (TBCE)

2.4 Detailed methodology

URD.2.4-1 The methodology shall comprise five phases :

- Phase 1: geo-characterisation of the site
- Phase 2: single hazard model
- Phase 3: coupled hazard model
- Phase 4: coupled hazard mapping
- Phase 5: consideration of social/economical for risk quantification

2.4.1 Phase 1 : Geo-characterisation of the site

1. *Requirements in* ***physiography***

URD.2.4.1-1 Digital terrain model (DTM) shall have vertical accuracy better than 5m, potentially finer for active zones of high risk.

URD.2.4.1-2 Slope map layer in GIS should be calculated at a scale of 1:25000 using a standard accepted method .

2. *Requirements in* ***geology***

URD.2.4.1-3 Bedrock geologic maps should be merged with surface geologic maps.

URD.2.4.1-4 Structural geology maps showing faults and blocks should be available.

URD.2.4.1-5 Landslides inventory at scale (1:25000) with attributes (activity, thickness, associated geologic unit) should be available.

3. *Requirements in* ***volcanology***

URD.2.4.1-6 All existing reports or events should be available.

4. *Requirements in* ***Engineering geology***

URD.2.4.1-7 Material shear strength data should be available

URD.2.4.1-8 Bedding condition (dip direction and magnitude) shall be available

URD.2.4.1-9 Existing landslide strength characteristic shall be available

5. Requirements in **hydro-chemistry –geology**

URD.2.4.1-10 Hydrology data shall be available

URD.2.4.1-11 Hydrochemistry data shall be available

URD.2.4.1-12 Aquifer information shall be available

2.4.2 Phase 2 : Earthquake hazard model

URD.2.4.2-1 there should be availability of a consensus within scientific community for fault sources for long-term slip rate, maximum earthquake magnitude and rupture geometry.

URD.2.4.2-2 depending on the seismic source used, a seismic source model shall be used for each source and using appropriate attenuation relation (depending on type of fault rupture) to obtain ground shaking levels including the hazard of exceeding peak horizontal ground acceleration, PGA).

URD.2.4.2-3 The seismic hazard map shall be produced by calculating hazard at site on a 5 km spatial grid.

URD.2.4.2-4 Grid value (not to be interpolated) shall give earthquake magnitude and distance that contributes most to the hazard at 10% probability of exceedance in 50 years.

2.4.3 Phase 3 : Earthquake-induced landslide model

A selection will be performed of the recorded motion close to the required parameter in terms of modal magnitude, modal distance, PGA. For this selected record, a relationship between landslide displacement and yield acceleration will be developed. This relationship provides the required link covering all combination of soil material and slope.

URD.2.4.3-1 The process for zoning earthquake induced landslides should include:

- earthquake loading
- existing landslide feature maps
- slope gradient
- rock and soil mechanical properties
- Watertable levels

URD.2.4.3-2 Displacements of 5, 15, 30 cm should be the criteria for rating the level of landslide hazard potential between Very low and low (5cm) , low and moderate (10 cm) , moderate to high (30 cm) (TBCE)

URD.2.4.3-3 Common assumptions and limitations shall be used for factor of safety analysis as for instance :

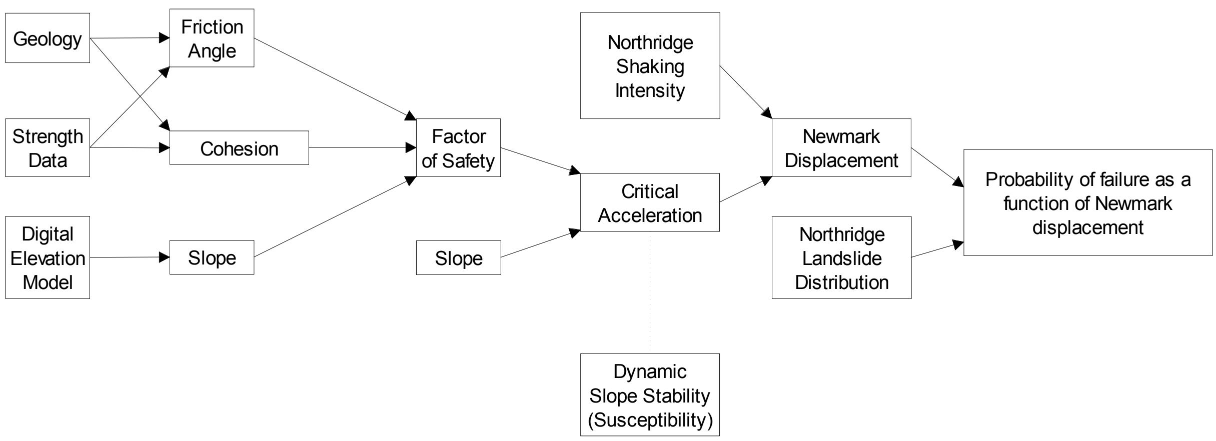
- sliding mass assumed to be rigid
- no permanent displacement for acceleration below critical acceleration.
- plastic deformation on the sliding surface for acceleration above critical acceleration.
- critical acceleration is strain independent.
- constant dynamic strength equal to static strength.
- no pore-water pressure increment.

URD.2.4.3-4 A hazard potential matrix should be derived by group of strength materials and slope categories.

2.4.4 Phase 4: Earthquake-induced landslide hazard mapping

URD.2.4.4-1 In addition to already active areas, the hazard mapping shall focus on areas where analyses make appear earthquake displacement larger than 5 cm

URD.2.4.4-2 There is a strong monitoring requirements to rank the hazard level (therefore driving to a deeper analysis and specialization). This shall be analysed the RETINA scientific team.



Flow chart showing steps involved in producing a seismic landslide hazard map.
From RD1 - Data requested from phases 1 to 4

2.4.5 Phase 5: Consideration of social/economical for hazard quantification

URD.2.4.5-1 The hazard map issued in phase 4 should be cartographically compatible for overlaying with other mapping (population density, urbanisation …).

URD.2.4.5-2 The hazard map should include overlays indicating the location of emergency facilities.

For other scientific themes (volcanology/earthquakes), the requirements shall be in accordance with the philosophy of the axes derived from landslides.

3 Products

Natural hazards can be seen in a cycle:

- *The first phase is the quiet period following an event, the build-up period for the next event and before any observable activities occur for the next event*
- *Second is when observable activities start to occur, though it is not known whether it is a precursor or whether it is a false start.*
- *The third is when the activities are reaching a level that indicate a very strong likelihood that a pending event will occur "soon".*
- *The fourth and final phase is when the event actually has occurred and AVRIK is battling with the consequences, which eventually leads back into the first phase and the area is quiet again.*

The corresponding phases in terms of civil defence are:

- *Risk Analysis Phase;*
- *Alert Phase;*
- *Hazard Phase;*
- *Emergency Phase,*

which can be seen as one research phase and three activation phases.

Hereafter, we classify the products according to the period or phase during which they are realized. We will distinguish static products from the ***risk analysis phase or research phase*** *corresponding to the quiet period, and dynamic products from the* ***activation phase****, which correspond to data production, analysis and information delivery, necessary during the three phases of activation, from the event precursors to the event occurrence.*

3.1 Static products

3.1.1 EQ-LS-HY hazard information requirements for communities at risk

What EQ-LS-HY mission is designed to do :

1. Concerning the general long-term mission objectives :

URD.3.1.1-1 EQ-LS-HY mission shall be to provide value added decision system tools for analysis, mitigation and management of earthquake induced landslide hazards (strong common approach with liquefaction induced by earthquake).

URD.3.1.1-2 EQ-LS-HY mission shall be based on state of the art approved methodology using the appropriate data with adequate models scientifically validated within their domain of application to produce exportable results at the right time.

URD.3.1.1-3 EQ-LS-HY global mission shall fulfil the following dedicated missions :
- **Operational** mission
- **Research** mission

URD.3.1.1-4 The main focus of the EQ-LS-HY **operational** mission shall be the production and distribution of **synthetic maps** (geographic information layers) directly exploitable and compatible with standard software, for import before controlled exploitation and processing for specific needs (technical, economic, legal, and social).

URD.3.1.1-5 The **research** mission of EQ-LS-HY should provide demonstration of assimilation of near or real time data into sophisticated modeling system as well as off-line analysis for the derivation of relevant thresholds for quantitative risk assessments.

2. Concerning the geographical extent :

URD.3.1.1-6 The EQ-LS-HY **operational** mission should cover the European area.

URD.3.1.1-7 The EQ-LS-HY **research** mission shall be at regional and local scale (1:5000 to 1:10000) on dedicated area.

URD.3.1.1-8 All EQ-LS-HY operational products shall be made available on specific geographical areas identified as critical areas at a 1:25000 scale consistent with the spatial representativeness of the input data products.

URD.3.1.1-9 Two zones in the Alps shall be used as pilot experiment sites, namely: La Clapière and Sauze.

3. Concerning the temporal extent :

URD.3.1.1-10 The **operational** mission of EQ-LS-HY should provide a long-term monitoring, modulated by seasonal and other climatological variations, over all the sites having been identified as critical areas (on a weekly/monthly/yearly routine basis).

URD.3.1.1-11 The **operational** mission of EQ-LS-HY should provide near real-time monitoring on all sites having been identified as highly critical areas (on a three hour basis – TBCE).

URD.3.1.1-12 The **research** mission of EQ-LS-HY should provide near real-time observations to the highly critical areas monitoring system of the **operational** mission.

4. *Concerning the specific EQ-LS-HY RETINA mission objectives :*

URD.3.1.1-13 EQ-LS-HY RETINA mission shall be to define the appropriate methodology to achieve the general long-term objectives defined in 2.1. above.

URD.3.1.1-14 More specifically, EQ-LS-HY RETINA mission should aim at answering the following questions with emphasis on harmonisation across physics fields:

- What data for what model?
- What model for what zone?
- What zone for what risk ?

URD.3.1.1-15 EQ-LS-HY RETINA mission should identify and specify the following key elements:

- Models: domain of application, ease of use, validation process, cost, delay.
- Data collection, calibration, validation, distribution, archiving, access.
- Zoning: scale, geophysical, administrative or geometric boundaries, temporal evolution
- Questions: vulnerability, Factor of safety assessment, affected zone of equal risk,
- Maps: SIG layers, control, security, confidentiality

URD.3.1.1-16 For each element and as appropriate, EQ-LS-HY RETINA mission should define the following characteristics :

- Accuracy requirements
- Validation requirements
- Spatial and temporal requirements
- Others (TBCE)

3.1.2 EQ-VO-LS hazard information requirements for land planning

URD.3.1.2-1 EQ-VO-LS RETINA mission shall identify for each geological hazard the following elements:

- The geological conditioning factors
- The geological critical values
- The minimum security distance

3.2 Dynamic products

To go beyond the traditional hazard maps of earthquakes, landslides, and volcanos, RETINA seeks to understand the mechanical coupling between these three phenomena. They are linked to and by the stress field in the crust, as represented by the sides of the triangle. If the stress increases enough, the material will fail catastrophically. For example, magma injection in the plumbing beneath Hengill volcano in Iceland often triggers swarms of micro-seismicity. We hypothesize that this process tends to release the stress, thereby retarding a larger earthquake. Detailed modeling of such stress transfer is one of the primary objectives of RETINA.

Increasing shear stress on unconsolidated materials on steep slopes can trigger landslides. Such stress change triggers may also be tectonic (from plate driving forces), hydrological (from heavy rain), or volcanic (magmatic injection). Any of these events can perturb the stress field enough to trigger another event. Indeed, stress changes as small as 0.1 bar (0.01 MPa) suffice to trigger an earthquake. This change increases the Coulomb stress beyond the failure threshold, breaking the material. This quantity is the primary means we will use for describing mechanical coupling. The primary observational of the stress changes is the deformation they produce, whether dynamic (micro-seismicity recorded by seismometers) or static (strains measured by GPS, INSAR or other geodetic techniques).

This emphasis on stress changes implies that the hazard maps can change dynamically as a function of time. To calculate such stresses changes requires all of the GIS layers used to produce the individual, static hazard maps, as listed above. In addition, it will require updates to the stress field, such as heavy precipitation, new volcanic unrest, or an earthquake sequence.

4 Civil defence information need

RETINA objectives incorporate the approach between the scientific community and the civil protection agencies. The civil defence community (CDC) requires hazard information from the scientific community (SC) about existing risks, for emergency planning, and up to date information about condition, for emergency plans commencement. The SC shall provide informations during the risk analysis phase (research phase) and the three activation phases (operational phase) described in the products paragraph. The CDC is not expecting the SC to have all the answers to all the questions, but share the knowledge that is available in a formatted system.

URD.4-1 A systematic approach shall be come up to bridge the gap between those that know and understand the natural hazard cycle and those that have to act upon the information, *i.e.*, the scientist and civil defence workers.

URD.4-2 The SC should provide hazard information to the CDC during all natural hazard phases.

4.1 Risk analysis phase

The idea here is that the SC develop a set of answers to the following list for each area of interest. That way a procedure is developed that can be followed in any European country. It also enables an easy exchange of information between countries in Europe if all countries present information in the same format. It is highly likely that the scientific community will not be able to fulfil the requirements of civil defence for all cases. However, knowing that the scientific community does not have answers to questions is also an important part of the collaboration. The civil defence is used to working in an atmosphere that is full of uncertainty and unknowns, that is in fact part of the definition for a disaster.

URD.4.1-1 The **operational** mission of the multi-hazard should provide two kinds of information to the civil authorities users, thus contributing to induce adequate protective measures:

- **before events**, maps of Safety Factor or critical acceleration associated with maps of risk with maximum estimated delay between seismic shaking and significant landslide (Hours to days in over consolidated clays and dense sands);
- **after events**, local maps of possible damage extent and re-mapping.

URD.4.1-2 Specific data i.e. digital maps that show earthquake faults, rift zones, landslides, volcanoes and craters and extents of lava flows from individual eruptions in active volcanoes (historic and prehistoric) shall be provided to the National Civil Defence.

URD.4.1-3 High level products shall be generated and made available to users.

URD.4.1-4 After an event, civil defence should be immediately informed of what happened, when and where; existing indicators, like future possible occurrences and respective duration.

URD.4.1-5 The following requirements for the multi hazard coupling for disaster response should be fulfilled, to the extent possible, during the risk analysis phase for a specific place/area/event:

Past history:

1. A general history of the area
   a. Geologic maps
   b. Seismic fault maps (active faults, level of activity)
   c. Seismic hazard maps (landslides, liquefaction)
   d. Volcanic hazard maps (lava flows, pyroclastic flows, lateral blasts, landslides, lahares, tephra volume, tephra distribution, volcanic gases, harmful substances [i.e. *fluoride* F_2, *Hydrogen sulphide* H_2S, *Sulphur dioxide* O_2S])
   e. Records of local observations
2. Where to look for information – who knows what
3. Information distributed with the CD system
4. Information distributed to the public
5. Determine long term risk
6. Determine risk within historical context
7. Compiling and manipulating scientific data into a format useable for the CDC

Modeling processes:

1. A general description of what is possible and what is probable
2. A description of how an event starts
3. A description of how the event will unfold and subsequent events
4. A description of how an event ends
5. Expected duration
6. A list of parameters obtainable as a function of time before the event (months, weeks, days, minutes)
7. A list of parameters obtainable as a function of how reliable they are as warning indexes

Monitoring – interpretation of data:

1. What is the accessibility to scientists? 24 hours/day – 7 days/week – 365 days/year
2. Monitoring systems currently in place
3. Monitoring systems located abroad
4. Monitoring systems available, but have not been set up, for instance due to cost
5. Warning systems currently in place
6. Warning systems located abroad
7. Warning systems available, but have not been set up, for instance due to cost
8. Indexes (specific or general) for the alert phase
9. Indexes (specific or general) for the hazard phase
10. Indexes (specific or general) for the emergency phase
11. The difference of what is happening and what will and what does this mean

4.2 Activation phase

URD.4.2-1 The user requirements should be divided into two basic categories. The first category should characterize general requirements in the event of natural hazards and the second requirements that are specific to individual events:

- general requirements should develop procedures for identifying signals that an earthquake of a significant magnitude or a volcanic eruption is about to take place and the means by which that information is conveyed to National Civil Defence.
- specific requirements should be geared to identifying precursors or index values which may be used to determine whether to mobilize the Civil Defence System at one of its three phases of activation, the **alert phase**, the **hazard phase** or the **emergency phase**.

URD.4.2-2 The **operational** mission of the SC shall contribute to the dissemination of meaningful and standardised Safety Factor maps easily understood and accessible by the civil authorities.

4.2.1 Alert phase

URD.4.2.1-1 During the alert phase, civil defence shall know what are the existing risks and what are the type of hazards (earthquake/volcano/landslide) related to those risks.

URD.4.2.1-2 The requirement of the CDC from the SC should now become a notification that a parameter has reached an alert phase level and that appropriate action should be taken, which is predefined to some extent. Depending on how the CDC is wired into the monitoring system, the CDC may be self-alerted through the system.

URD.4.2.1-3 The SC should go into an interpretation mode of the data being collected to inform the CDC on:

- What is happening
- Where
- Possible developments
- Possible duration
- Side effects
- Time factor/urgency.

URD.4.2.1-4 Both the CDC and the SC should have a general plan on how to proceed in the event of an activation of an alert phase.

4.2.2 Hazard phase

URD.4.2.2-1 Civil defence shall know which is the scientific alert level to establish priorities and the needs in human and natural resources.

URD.4.2.2-2 This phase shall be reached both due to a prior alert during the alert phase, or a sudden occurrence of activities. The same issues should apply here as applied for the alert phase.

URD.4.2.2-3 The indexes should have already been defined, and if unique activities occur that give rise to the activation of an hazard phase, the SC shall notify the CDC.

URD.4.2.2-4 Again, the SC goes into interpretation mode and answers the questions:

- What is happening
- Where
- Possible developments
- Possible duration
- Side effects
- Time factor/urgency.

It is very important that the SC give an explanation to the CDC when informing about an activity and an interpretation of possible development in order to give the CDC a basis on which to act.

URD.4.2.2-5 Both the CDC and the SC should have a general plan on how to proceed in the event of an activation of an hazard phase.

4.2.3 Emergency phase

URD.4.2.3-1 During an emergency situation, the following aspects should be identified:

- type of event (seismic activity, volcanic activity or landslides);
- localization and existing indicators;
- historical of the event, that will be of assistance in the planning phase;
- which is the scientific alert level determined to the response of the civil protection structure.

URD.4.2.3-2 The role of the national civil defence during the emergency phase shall be to provide and coordinate assistance to the stricken area.

URD.4.2.3-3 The scientists shall still try and focus on the six basic questions, i.e.:

- What happened and when
- Where
- Possible developments
- Possible duration
- Side effects
- Time factor/urgency for possible related events.

URD.4.2.3-4 Once the initial emergency phase has died down, the CDC shall require information from the SC about likely developments:

- Is this a typical event that is likely to develop in a certain way?
- Is this an atypical event that is very unpredictable?
- or does the answer lie somewhere in between?

URD.4.2.3-5 SC needs to interpret the event regarding possible duration and end of event.

5 Information delivery means

URD.5-1 All multi-hazard long-term monitoring operational products shall be made available via a Web server updated according to the appropriate time scale of refreshment for timeliness civil authorities applications (weekly/monthly/ yearly).

URD.5-2 Near-real time information on highly critical areas should be provided via fax, telephone, mail, radio... (TBCE)

URD.5-3 A permanent telecommunications network between risk managers should be set up with a view to assisting decision-making and co-operation.

URD.5-4 The network shall act as a warning system in an emergency by transmitting relevant information on the regions concerned in order to facilitate co-operation.

6 Civil defence organisation and procedures

6.1 Risk analysis phase

URD.6.1-1 At this phase, civil defence shall be gathering general informations from earth scientist.

URD.6.1-2 Each committee shall have an emergency plan to work in prevision of an alert, based on the three phases of activation.

URD.6.1-3 Civil protection shall have planning actions, exercises and a regular structure maintenance.

URD.6.1-4 Exercises should be carried out at municipal or at regional level. The exercises are geared towards giving those who take on the responsibilities of national and local organisation and command, as well as those who will be involved in rescue and relief work experience in dealing with “real” situations. These exercises are orchestrated by personnel with vast experience in the field of civil defence and in planning the exercises they build on their own experience from real situations. These exercises shall be based on simulations of damage caused by disasters and on the identification of the material and human resources needed to provide an adequate response.

URD.6.1-5 After an event, civil defence shall be immediately informed of what happened, when and where; existing indicators, like future possible occurrences and respective duration.

6.2 Activation phase

URD.6.2-1 The system shall be activated at the three different activation phases with the following activities:

- **Alert phase**, ***i.e.* an event is probable**: information gathering and data collection and sharing, monitoring of the active area;
- **Hazard phase, *i.e.* an event is highly likely and action needs to be taken that affect the public:** preventive actions i.e. traffic control, (road blocks increased monitoring, preparation of emergency coordination center), evacuation;
- **Emergency phase, *i.e.* an event has occurred:** immediate activation of emergency plans, rescue and relief operations.