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No.577 January 2010

土砂災害危機管理に関する日伊シンポジウム報告書

危機管理技術研究センター　砂防研究室

Report on Japan –Italy Symposium on Risk Management and Governance to Cope with Natural Disaster

Research Center for Disaster Risk Management
Erosion and Sediment Control Division

国土交通省　国土技術政策総合研究所

National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure, Transport and Tourism, Japan

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第 577 号　　2010 年 1 月

Technical Note of NILIM
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Research Center for Disaster Risk Management

概要

砂防研究室はイタリア共和国国家研究評議会（CNR）と共同で平成 16 年より「水文地質学的リスクに関する文献、研究及び研修のための日伊共同研究所に関する取極め」、平成 20 年より「土砂災害ハザード評価と対策」に関するプロジェクトを進めてきた。これらのプロジェクトの成果や土砂災害に関する最新の研究成果を公表し討論することを目的として「土砂災害危機管理に関する日伊シンポジム」を平成 21 年 10 月 27 日 13 時より三田共用会議所で開催した。このシンポジウムでは、平常時や地震等による大規模な土砂災害が発生した際の危機管理（リスク・ガバナンス）について発表と討論を行った。本報告はその概要と発表資料を取りまとめたものである。

キーワード：土砂災害、リスク　ガバナンス、地震

Synopsis

Erosion and Sediment Control Division has been implementing “A joint laboratory, named Geo-Risk Joint Lab (GRJL) on research training and documentation on hydro-geological risks” since 2002 and “Landslide hazard assessment and mitigation” since 2008 with National Research Council of Italy (CNR). In order to disseminate and discuss on the achievements of research activities and practices, The Japan-Italy Symposium “Risk Management and Governance to Cope with Natural Disaster” was held at the Mita Conference Hall in Tokyo on October 27, 2009. Presenters and participants discussed mainly on the risk governance for sediment-related disasters caused by earthquakes. This technical note reports the summery of discussions and presented materials in the symposium.

Keywords: Sediment-related disaster, Risk governance, Earthquake

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1　概要

-土砂災害危機管理に関する日伊シンポジウム-

１．はじめに

「土砂災害危機管理に関する日伊シンポジム」が平成 21 年 10 月 27 日 13 時より三田共用会議所において開催されました。本シンポジウムは平成 16 年に署名した「水文地質学的リスクに関する文献、研究及び研修のための日伊共同研究所に関する取極め」に基づく研究成果を公表するとともに、第 8 回日伊科学技術協力合同委員会（平成 19 年 12 月 28 日東京で開催）で合意されたエグゼキュティブ･プログラム「土砂災害ハザード評価と対策」(”Landslide hazard assessment and mitigation”）の一環として、また、現在開催されている「日本におけるイタリア２００９・秋」のイベントとして、国土技術政策総合研究所（以下、「国総研」と略す）の主催で実施しました。以下にその概要を報告いたします。

２．シンポジウムの概要

２．１　プログラム

寺川陽国総研研究総務官からの主催者側の挨拶（写真－１）に続いて、来賓の牧野裕至国土交通省砂防部長（写真－２）、在日イタリア大使代理のアルベルト・メンゴーニ科学技術担当参事官（写真－３）より挨拶を頂きました。それに続いて、日本国とイタリア共和国の両国から１題ずつ基調講演を行い、以下の３つの話題について両国から１題ずつ発表を行いました。

話題１：土砂災害に関する危機管理体制～法律体系と指揮命令関係～

話題２：危機管理体制の事例

話題３：危機管理体制とリスク評価に関する最近の研究成果

２．２　発表の概要

２．２．１　基調講演

寺田秀樹国総研危機管理技術研究センター長が「岩手宮城内陸地震における土砂災害と危機管理」と題して、15 個の主な天然ダムの特徴と対応、三迫川で発生した土石流、荒戸沢ダムで発生した地すべりについて概要を紹介しました。また、沼倉裏沢の天然ダムの決壊についても詳しく報告しました。さらに、今回の土砂災害で新しく開発され、採用された技術も紹介しました。

写真－１　寺川陽研究総務官による挨拶

アレッサンドロ・パスート国家研究評議会水文地質研究所パドバ研究所長が「山地災害リスク：予測から管理そしてガバナンスへ」と題して、欧州連合で行われているプロジェクト「山地災害リスクプロジェクト」を紹介しました。このプロジェクトは山地災害のリスクの分析、そのリスクの定量化、リスクを低減するための対策、そしてリスクガバメントといった４つの分野を取り

扱ったもので、南フランスアルプス、西ドロミテ（２地域)、北アペニン、東ピレネーの５か所で実施しています。

写真－２　牧野裕至砂防部長による挨拶

写真－３　アルベルト・メンゴーニ科学技術担当参事官による挨拶

２．２．２　話題１

岩男忠明内閣府参事官補佐が日本国における中央政府レベルでの応急対応の流れを法律と事例に基づいて紹介しました。特に、内閣府による-省庁間の調整について紹介しました。

マリアーノ・キャラッロベネト州政府市民保護局長が「ベネト州における危機管理体制について―地域機能センター―」と題して、イタリア共和国ベネト州での防災体制を紹介しました。同センターは法律に基づいて予測と監視の２つの段階で警報を発しています。警報は土砂災害と洪水に関するもので、危険性無、低危険度、中危険度、高危険度の４段階に分類されています。その情報と今後の気象条件の予測はインターネットを通じて住民に伝達されます。

２．２．３　話題２

マウロ・カーディナリ国家研究評議会水文地質災害研究所ペルージャ研究所研究員が「2009年ラクイナ地震のその後－緊急対応とその後の対応における技術的かつ学術的活動」と題して、ラクイナ地震に伴って生じた土砂災害の概要と、地震後の落石と地すべりのリスク評価の結果について紹介しました。特に今回の地震では、落石による被害が多かったことが報告されました。

小竹利明東北地方整備局河川部河川計画課建設専門官が「平成 20 年岩手宮城内陸地震における TEC-FORCE 活動について」と題して、地震直後から実施した土砂災害危険個所緊急点検や天然ダムの危険度評価・応急対策について紹介しました。

２．２．４　話題３

筆者が「平成 20 年岩手宮城内陸地震における危険度評価について」と題して、地震直後から実施した下流域への土砂・洪水の氾濫の危険性についての評価結果を紹介しました。また、湯浜地区の天然ダムが地震発生後 10 ヶ月間でどのように侵食されたかについても紹介しました。

ジャンパオロ・キャビナート国家研究評議会水文地質災害研究所ローマ研究所研究員が「ラクイナ地震 : 危機管理と地盤変動」と題して、地震後に行ったボーリング調査をはじめとする各種調査の結果から動的地盤図の作成結果について紹介しました。この図は街の復興対策に生かされるとともに、地理情報データベースとして公表すると説明されました。

３．おわりに

イタリア共和国代表団として６名の研究者（写真－４）が本シンポジウムに参加され、特に地震に着目して土砂災害対策について情報を交換いたしました。日本国とイタリア共和国では、豪雨だけでなく地震や火山といった誘因によって土砂災害が発生しています。今回のシンポジウムを通じて、特に地震による土砂災害について有意義な情報を交換でき、土砂災害対策の技術が一層向上することが期待されます。

写真－４　イタリア共和国代表団と発表者との記念撮影

最後になりましたが、本シンポジウムを開催するに当たり話題を提供していただいた発表者の方々、シンポジウムに参加された 57 名の方々、そして会場の手配・設営と資料の印刷等の事前準備を手伝っていただいた関係各位に感謝の意を表します。

引用文献

水野秀明：土砂災害危機管理に関する日伊シンポジウムを開催して 砂防と治水 Vol.42, NO.5, p50～51 2009.12

2 土砂災害危機管理に関する日伊シンポジウム

ポスター

土砂災害危機管理に関する日伊シンポジウム

開催のご案内

目的／ 本シンポジウム“Risk Management and Governance to Cope With Natural Disaster”は日伊科学技術協力合同委員会において合意された日伊土砂災害共同研究所（GRJL）プロジェクトでの研究活動を一般の方々を含めて広く公表するとともに、土砂災害への危機管理技術に関する情報を交換することを目的として実施します。

日時／ **平成21年10月27日**
13：00~17：30

場所／ 三田共用会議所
東京都港区三田2-1-8
TEL 03-3455-7591

●営団地下鉄　南北線　麻布十番駅下車
徒歩5分（2番出口）

都営地下鉄　大江戸線　麻布十番駅下車
徒歩7分（2番出口）

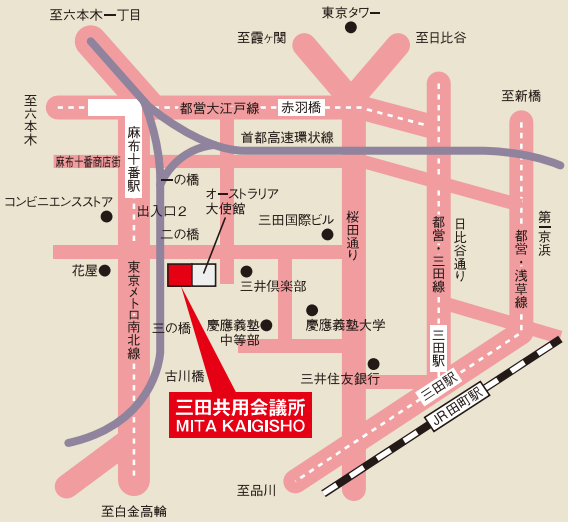
JR　田町駅下車
徒歩20分

都営地下鉄　三田　三田駅下
タクシー7分

都営地下鉄　浅草線　三田駅下車

●都営バス　二ノ橋バス停下車
徒歩2分

系統　[都06]新橋駅ー渋谷駅
[橋86]新橋駅ー目黒駅



平成20年岩手宮城内陸地震に伴って形成した天然ダム

マッサ・マルターナの斜面保全対策

1997年5月に大きな地震に見舞われたマッサ・マルターナ。マッサ・マルターナは台地の上にできた町であるため、街の周りは急な崖となっている。地震により崩れた斜面を補強している。

主催／ 国土交通省国土技術政策総合研究所

プログラム（予定）

12：00 ～ 13：00　**受付**
13：00 ～ 13：05　**主催者挨拶**
13：05 ～ 13：20　**来賓挨拶**
13：20 ～ 14：20　**基調講演**
- **アレッサンドロ・パスート 氏**
  イタリア共和国国家研究評議会水文地質災害研究所研究部長
- **寺田　秀樹 氏**
  国総研危機管理技術研究センター長

14：20 ～ 15：20　**話題１：土砂災害に関する危機管理体制～法律体系と指揮命令関係～**
15：20 ～ 15：30　**休憩**
15：30 ～ 16：30　**話題２：危機管理体制の事例**
16：30 ～ 17：30　**話題３：危機管理体制とリスク評価に関する最近の研究成果**

講演者（予定）

イタリア共和国側

アレッサンドロ・パスート 氏（イタリア共和国側団長）
国家研究評議会水文地質災害研究所研究部長

ファウグスト・グゼッティ 氏
同水文地質災害研究所所長補佐

マウロ・カーディナリ 氏
同水文地質災害研究所研究官

ジャンパオロ・キャビナート 氏
同水文地質災害研究所研究官

ジャンルカ・マルカート 氏
同水文地質災害研究所研究官

マリアーノ・キャラッロ 氏
ベネト州政府市民保護局長

日本国側

岩男　忠明 氏
内閣府政策統括官（防災担当）付災害応急対策担当参事官補佐

寺川　陽 氏
国総研研究総務官

寺田　秀樹 氏
国総研危機管理技術研究センター長

小山内　信智 氏
国総研危機管理技術研究センター砂防研究室長

水野　秀明 氏
国総研危機管理技術研究センター砂防研究室主任研究官

小竹　利明 氏
東北地方整備局河川部河川計画課建設専門官

言語　日本語とイタリア語の逐次通訳

お問い合わせ
〒300−0804 茨城県つくば市旭１
国土交通省国土技術政策総合研究所危機管理技術研究センター砂防研究室　担当：水野、植松
電話：029-864-4372　FAX：029-864-0903　電子メール：sabou@nilim.go.jp

お申し込み　**電子メールまたはFAXにて　▶お申し込み期限：平成２１年１０月２６日午後5時まで**

▶電子メール：sabou@nilim.go.jp（電子メールでお申し込みの場合は、氏名、住所をご記載ください）

▶FAX：下記にご記入の上、**FAX.029-864-0903** へ送信してください。

氏　　名	ふりがな
住　　所	〒　　－ TEL（　　）　　－ FAX（　　）　　－

3.1　基調講演「岩手内陸地震における土砂災害と危機管理」

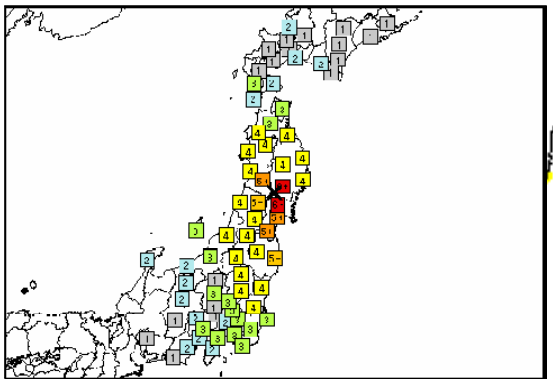
寺田　秀樹　国土技術政策総合研究所　危機管理技術センター長

Sediment-related Disaster and Crisis Management in the Iwate-Miyagi Nairiku Earthquake

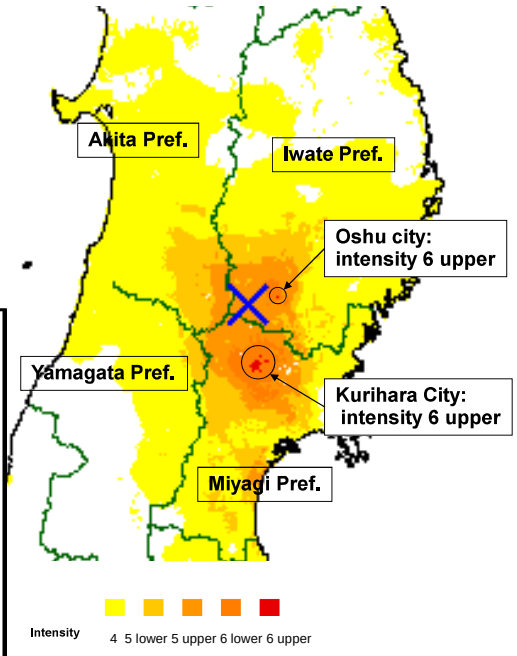
National Institute for Land and Infrastructure Management
Research Center for Disaster Risk Management
Hideki Terada

The Iwate-Miyagi Nairiku Earthquake

- Time of occurrence: 8:43 am, Jun. 14th, 2008
- Intensity : M7.2
- Focal depth: 8 km
- Maximum seismic intensity: Intensity 6 upper

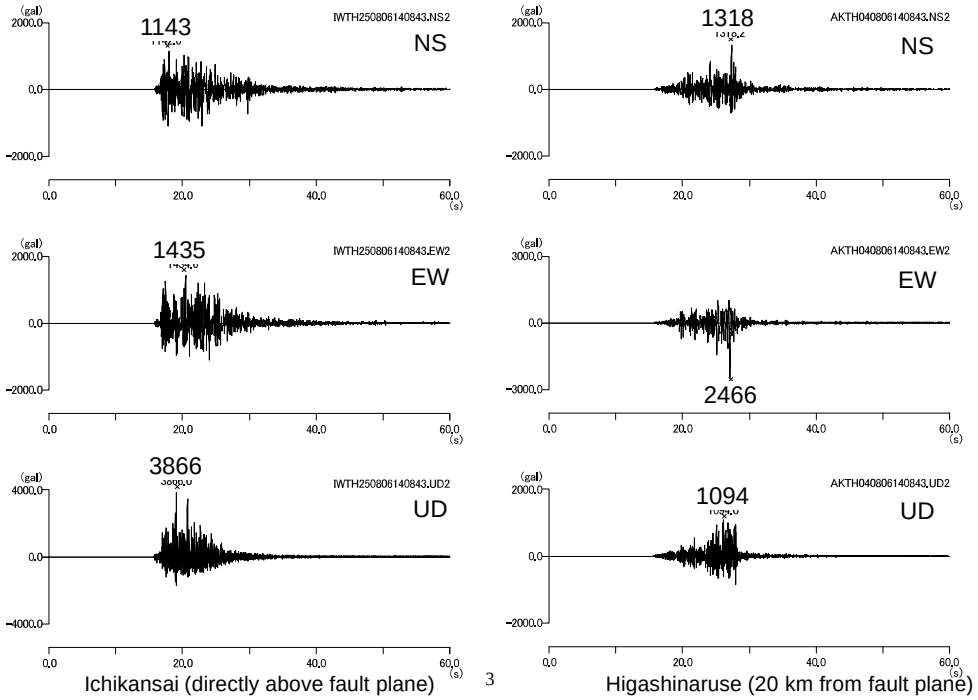


Seismic Intensity Map



Estimated Seismic Intensity Map (JMA)

Ground motion Characteristics - huge rate acceleration was observed



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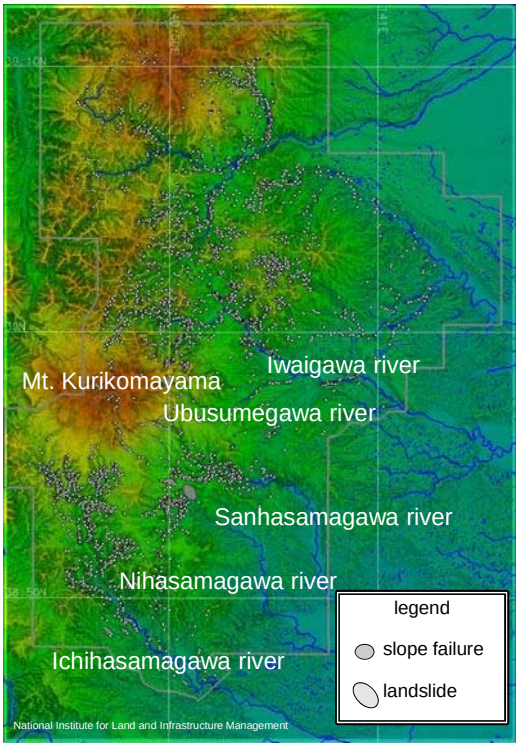
(Observations by National Research Institute for Earth Science and Disaster Prevention)

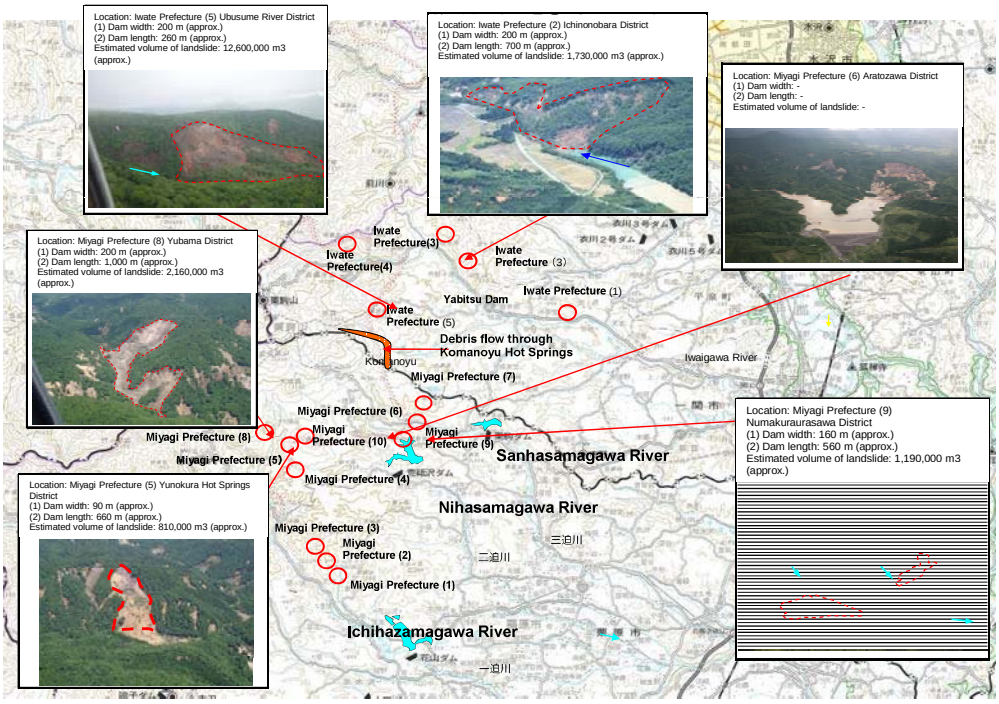
Outline of Sediment-related Disaster

- Over 3,500 slope failures.
- 15 river blockages (natural dams) (7 river blockage built upstream of Ichihasamagawa river).
- A large landslide occurred on the Nihasamagawa River (upstream of Aratozawa Dam).
- A debris flow on the Sanhasamagawa River caused serious damage to hotels at the Komanoyu Spa.
- Number of people missing or dead: 18

Background diagrams provided by Miyagi and Iwate Prefectures to show areas damaged by landslides are Geographical Survey Institute 50m mesh digital maps (height above sea level) and 1:25000 mesh digital maps (based on special data).



Occurrence of the Sediment-related Disaster – 15 river blockages



Debris Flow and Post-disaster Situation on Sanhasamagawa River

Landslide on eastern slope of Mt. Higashikurikomayama, forming a debris flow destroying the Komanoyu Hot Springs Hotel

7 fatalities

Photographed June 15th 2008

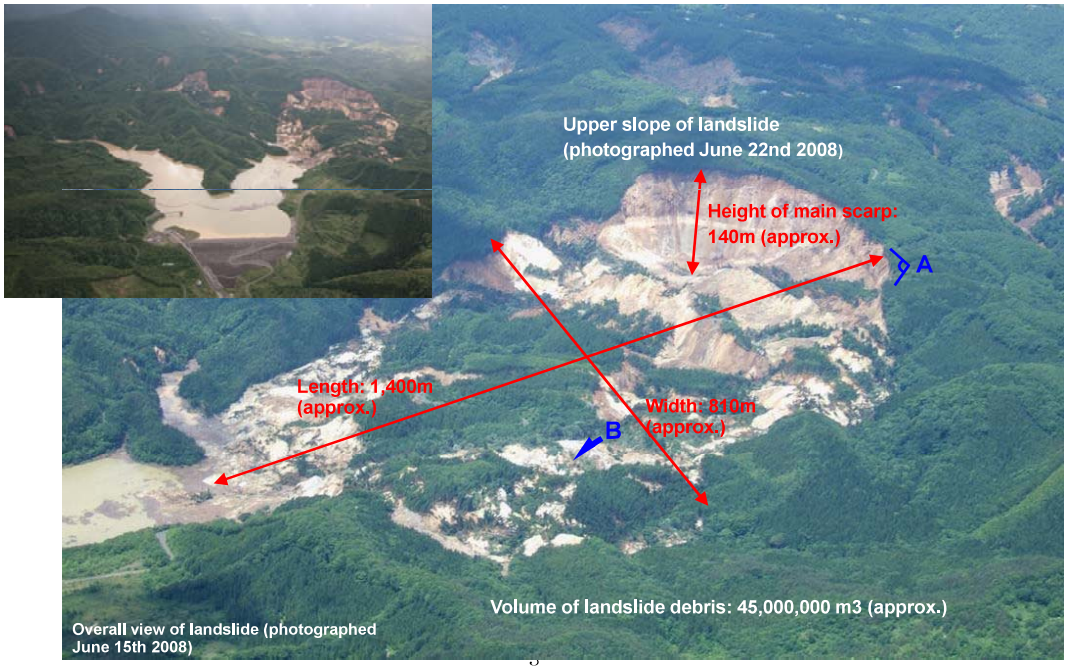
Photos: Ministry of Land, Infrastructure, Transport and Tourism, National Institute for Land and Infrastructure Management, Research Center for Disaster Risk Management, Erosion Sediment Control Division

Massive Landslide on Sanhasamagawa River

Downstream towards bottom, upstream towards top, of photo. Aratosawa Dam reservoir at center, with landslide occurring in its entire left upper tributary. The landslide has reached the reservoir. Multiple landslide areas apparent at left.

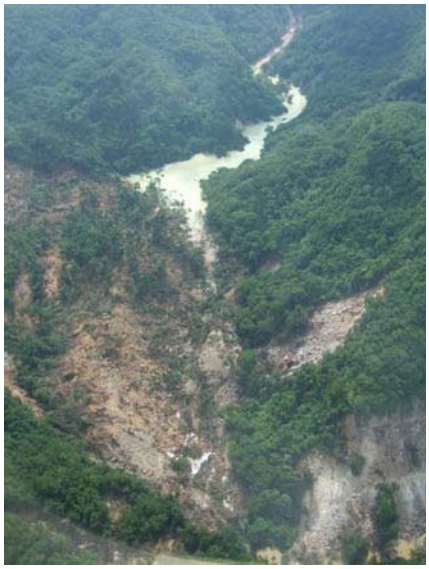
Photo: Aero Asahi Corporation

Landslide Occurring Upstream of Aratozawa Dam



Photos: Public Works Research Institute, Earth and Sand Management and Research Group, Landslide Unit

Natural dam blocking river flow at Numakuraurasawa, with overflow and erosion

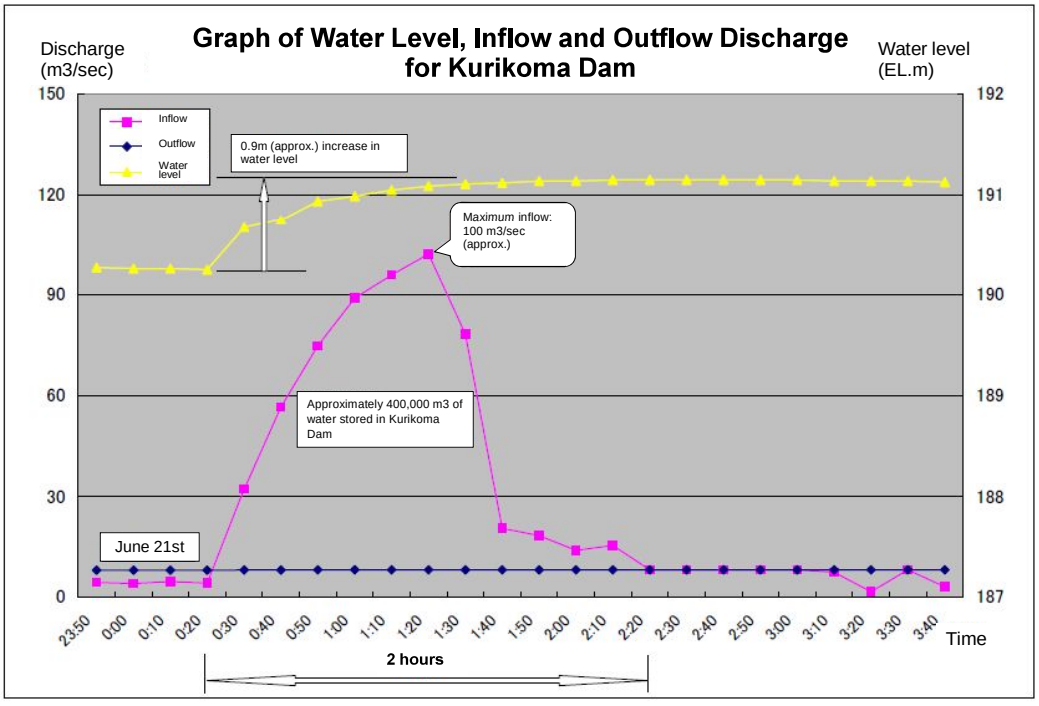


Photographed around 1:00 pm on June 20th 2008

Photographed around 12:00 pm on June 21st 2008

View upstream in vicinity of Numakuraurasawa District (Sanhasamagawa River), Kurihara City, Miyagi Prefecture

Photos: Ministry of Land, Infrastructure, Transport and Tourism, National Institute for Land and Infrastructure Management, Research Center for Disaster Risk Management, Erosion Sediment Control Division



Source: Ministry of Land, Infrastructure, Transport and Rivers Bureau, Erosion Control Section, Erosion Control Planning Unit (issued to media June 21st)

Emergency Measures for Sediment-related Disaster in Ichinonobara District (Ichinoseki City, Iwate Prefecture)

Natural Dam Blocking River Flow in Ichinonobara District

* Length of blockage: Estimated 700 m
* Width of blockage: Estimated 200 m
* Volume of sediment in blockage: Estimated 1,730,000 m3

Temporary drainage channel opened from12:30 pm on June 21st

Measures commenced on June 17th to relieve blockage (natural dam)

Digging of temporary drainage channel conducted 24hrs per day between June 18th and 26th

Forced drainage using drainage pump between June 19th and 22nd

Work to expand channel completed July 5th

Blockage of Ubusumegawa River (Ichinoseki City, Iwate Prefecture)

Emergency removal of sediment from existing check dam

Source: Ministry of Land, Infrastructure, Transport and Tourism, Rivers Bureau, Erosion and Sediment Control Department website

Observation and Measuring Equipment for Warning and Evacuation System

Wire sensor

Photo of equipment installed on Hasamagawa River (July 9th 2008)

CCTV

Ministry of Land, Infrastructure, Transport and Tourism, Tohoku Regional Development Bureau website

Photos: Ministry of Land, Infrastructure, Transport and Tourism, National Institute for Land and Infrastructure Management, Research Center for Disaster Risk Management, Erosion Sediment Control Division

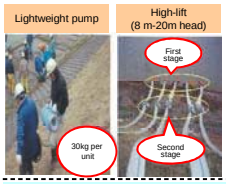
New Technology and Methodology Employed in Measures to Relieve River Blockage (natural dam)

Problem of blocked roads overcome by dismantling heavy equipment and transporting it to site by helicopter

Remotely controlled equipment to ensure safe working conditions in dangerous locations

Light, high-lift pump for ready drainage in difficult mountainous areas

Benefiting from the lessons for the 2004 Niigata - Chuetsu Earthquake, the Hokuriku Equipment Bureau developed a drainage pump able to be installed by personnel in areas where use of cranes and other equipment is not possible.
Pump capacity
* 5.5 m3/min per unit

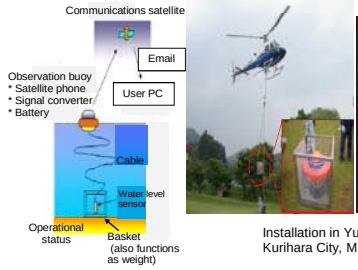


In Use Following the 2008 Iwate-Miyagi Nairiku Earthquake

Ichinonobara District (Ichinoseki City, Iwate Prefecture)

Yunokura Hot Springs District (Kurihara City, Miyagi Prefecture)

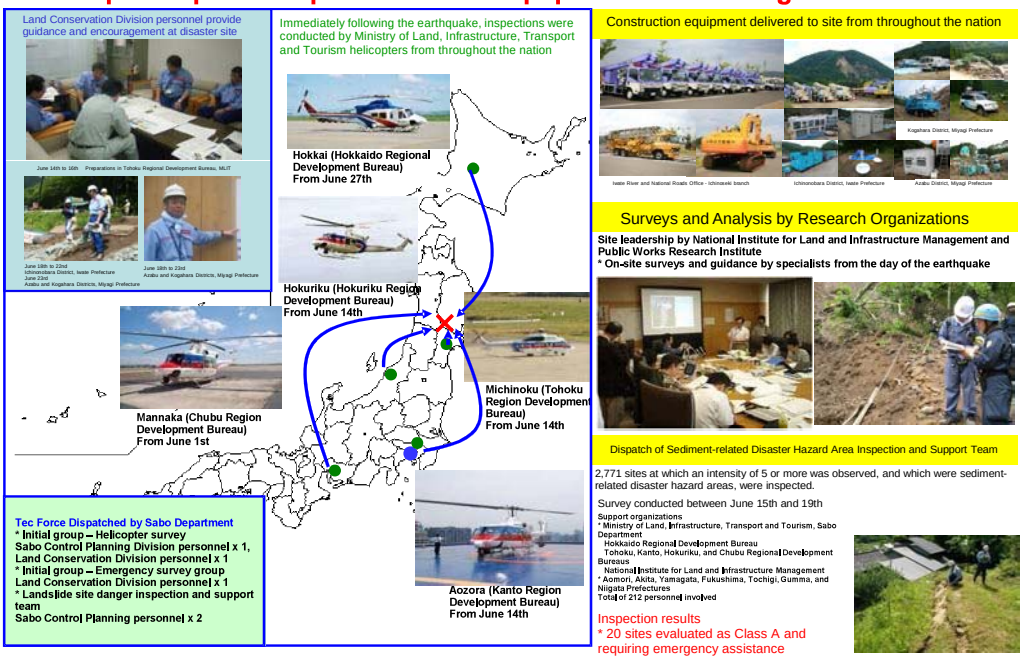
Doken-type water level observation buoy dropped directly from helicopter



Installation in Yubama District in Kurihara City, Miyagi Prefecture

Response and Assistance for Sediment-related Disasters in the 2008 Iwate-Miyagi Nairiku Earthquake

Rapid response in personnel and equipment from throughout the nation



Crisis Management for Catastrophic Sediment-related Disasters

(1) Rapid collection of information

(2) Emergency surveys and evaluation of danger

(3) Monitor situation and establish a system for warning and evacuation

(4) Emergency measures and rapid response

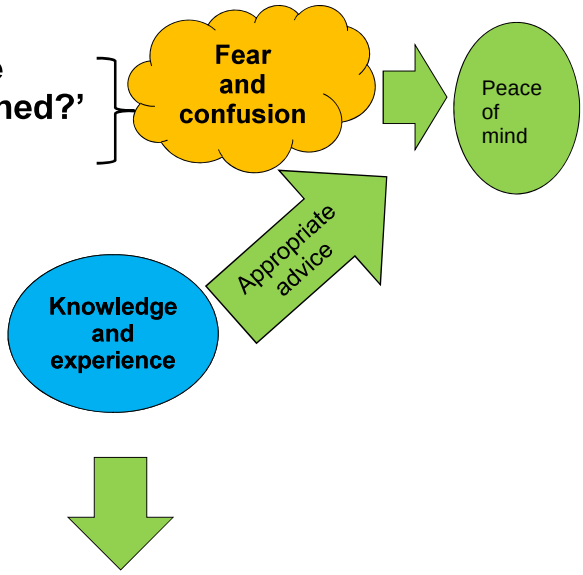
(5) Manage and ensure safety (works, search activity)

(6) Sharing of information between related organizations, and dissemination of information to the mass media and citizens

(7) Make preparations under normal circumstances (organization, training, equipment)

Crisis Management for Disasters

In the current situation, the questions are 'what happened?' and 'what to do?'



The Iwate-Miyagi Nairiku Earthquake
Ichinoseki Disaster Headquarters

Notice
Evacuation

The Iwaigawa River is blocked in the area of Genbicho in Ichinonobara District due to a landslide resulting from the Iwate-Miyagi Nairiku Earthquake. Flow in the river may increase rapidly.

Move to a location equivalent to FIVE FLOORS OR MORE ABOVE GROUND if an emergency evacuation instruction is issued.

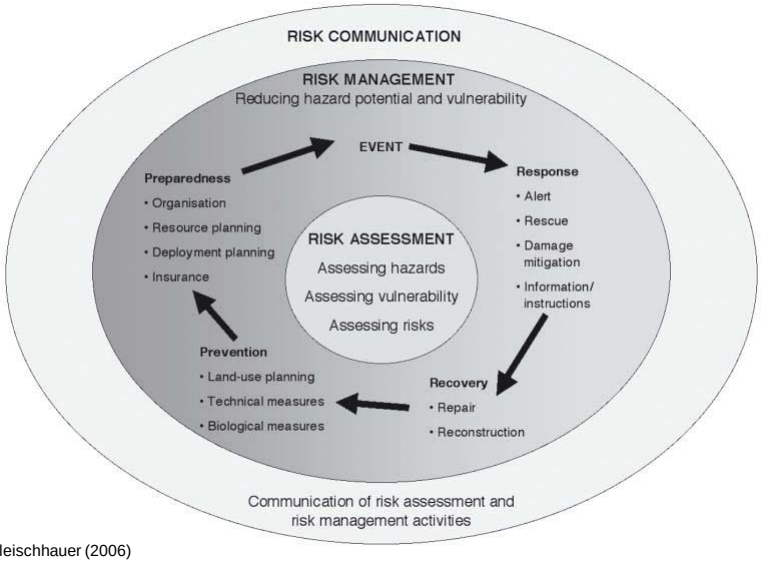
Ensure that the necessary activities are conducted smoothly and efficiently

3.2 基調講演「山地災害リスク：予測から管理そしてガバナンスへ」

アレッサンドロ・パスート（ イタリア共和国側団長）

国家研究評議会水文地質災害研究所研究部長

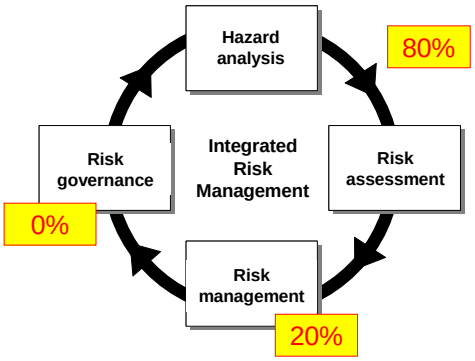
The Risk Governance Cycle



Fleischhauer (2006)

Lack of knowledge and case histories

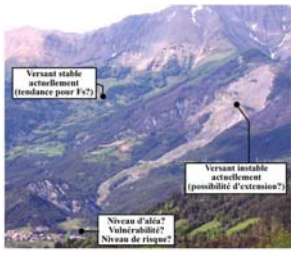
- A comprehensive bibliographical analysis have been carried out. The percentage of international publications in the domain of landslides, over the period 1980 - 2001 (n=350)



Vulliet & Dewarraz (2001)

Hazard Identification

- Identification and recognition of **mountain geomorphological processes**



landslide

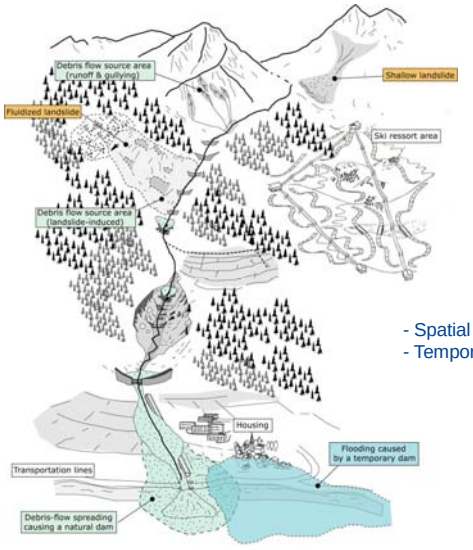
debris flow

snow avalanche

flooding

Hazard Identification

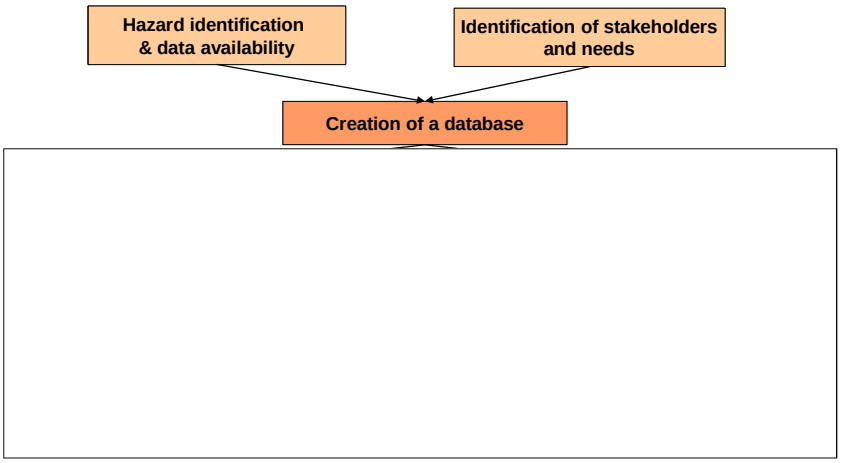
- Understanding of the interaction of mountain geomorphological processes, at a **catchment** scale



- Spatial interaction (e.g. domino effect)
- Temporal interaction

From hazard to risk

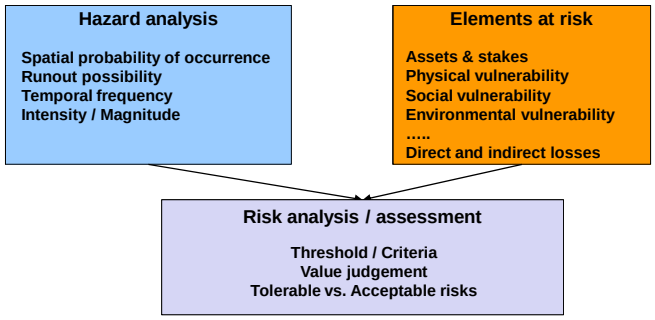
- Apply this understanding to living with the hazards by using a **multi-hazard/risk oriented analysis (MHRA)**



Kappes et al. (2009)

Risk analysis

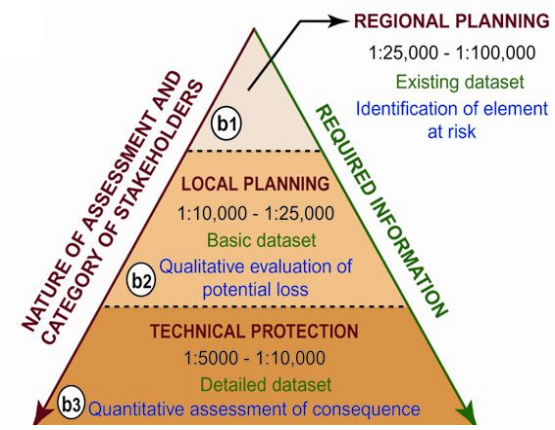
- Apply this understanding to living with the hazards by using a **quantitative risk analysis (QRA)**



Kappes et al. (2009)

Risk analysis

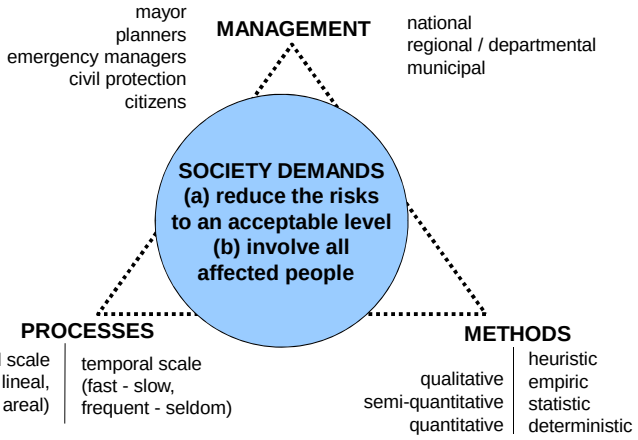
- Main issues to take into account:
  - Scale of the analysis



Puissant et al. (2006)

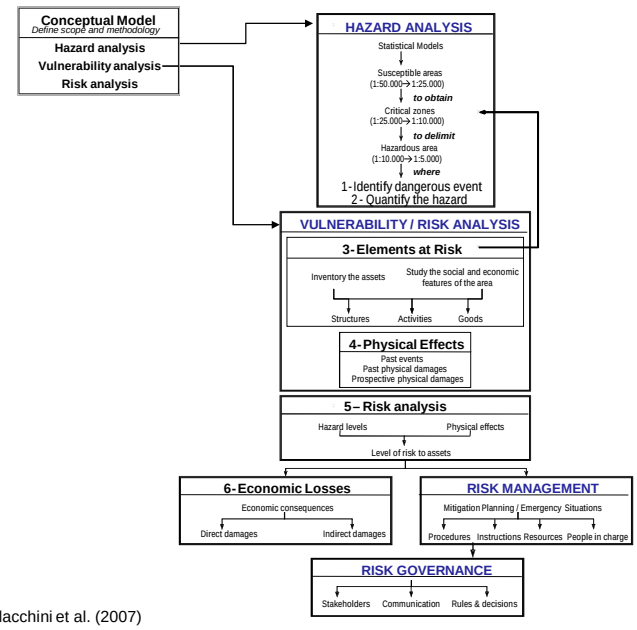
Risk analysis

- Main issues to take into account:
  - Data availability
  - Stakeholder needs
  - Country legislation ...



Kappes et al. (2009)

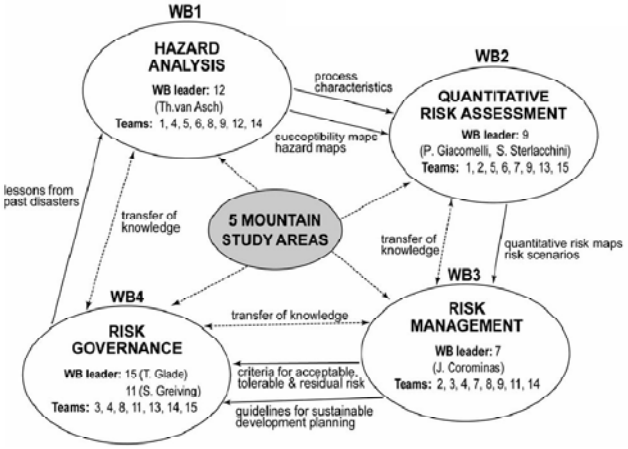
Conceptual Model



Sterlacchini et al. (2007)

Mountain Risk Project structure

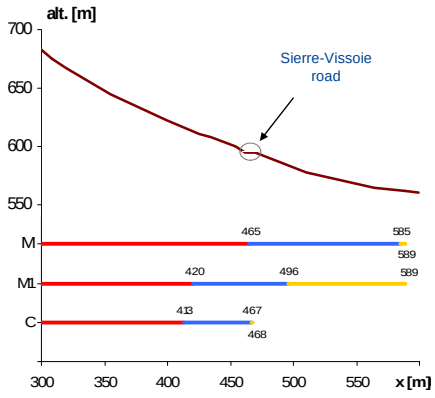
- **Research Activities – Training Activities – Transfer ok Knowledge Activities**
- **Several mountain study sites; e.g. 'field laboratories':**
  - 2 main investigation sites: South French Alps (Barcelonnette), Western Dolomites (Valtelina)
  - other areas of interest: Western Dolomites, Northern Apennines, Eastern Pyrenees
- 4 working blocks (**WBs**) and several topic actions (**TAs**) per working blocks

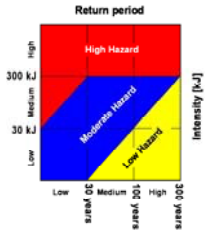


Hazard Analysis

TA-01: *Develop and harmonise procedures for the identification, location and quantification of the processes creating mountain risk*

- Comparing some existing approaches for rock fall hazard mapping used in Europe. Searching for the possibility of harmonising rock fall hazard mapping procedures (*Abbruzzese et al., EPFL*)



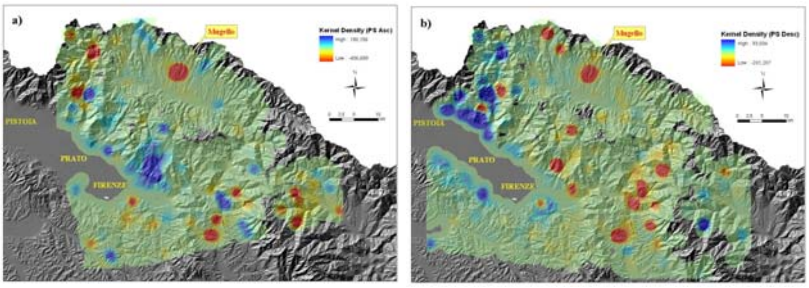


2D Rock fall hazard mapping performed with the Matterock (M), Modified Matterock (M1) and Cadanav (C) methodologies, according to the Swiss Guidelines (block size: 1m^3).
The mapping is shown only for the profile abscissas located between 300 and 600 m. From x=0 m to x=300 m the hazard level is "high" for all the methodologies).

Hazard Analysis

TA-01: *Develop and harmonise procedures for the identification, location and quantification of the processes creating mountain risk*

- Testing of different remote-sensing and ground geodesy techniques (different resolutions and accuracies) for usability identification and landslides analysis (*Kniess et al., UJF; Lu et al., UNIFI*)

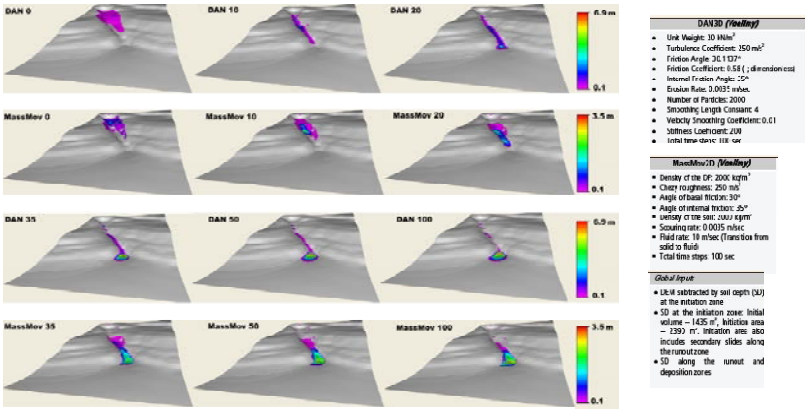


The hotspot map of the Arno river basin from one scene of the RADARSAT SAR image, including the Pistoia-Prato-Firenze and Mugello basin area: a) hotspot map derived from kernel density estimation using ascending RADARSAT PS; b) hotspot map derived from kernel density estimation using descending RADARSAT PS. Red Hotspot (low negative kernel density) indicates the clustering of high velocity PS moving away from LOS whereas blue hotspot (high positive kernel density) implies the clustering of high velocity PS moving towards LOS.

Hazard Analysis

TA-02: *Improve the prediction of the spatial extent and the velocity of extreme phenomena*

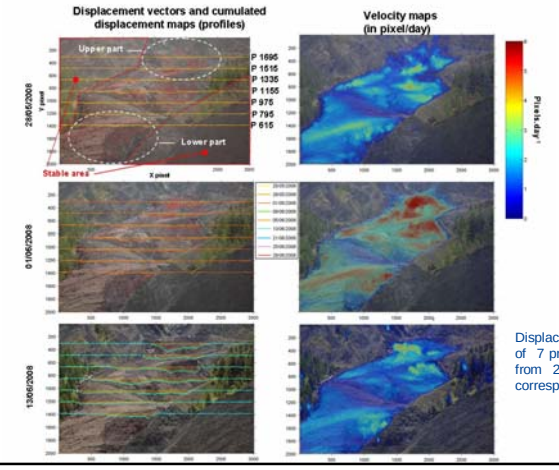
- Modelling the runout of debris flows comparing MASS-MOV2D & DAN3 (Quan Luna et al., ITC)



Hazard Analysis

TA-03: *Highlight critical factors involved in the short-term behaviour (crises) and long-term behaviour (climate and land use change) of the processes*

- New techniques for monitoring the kinematics of large landslides, such as the correlation of digital images (*Travelletti et al., EOST*)

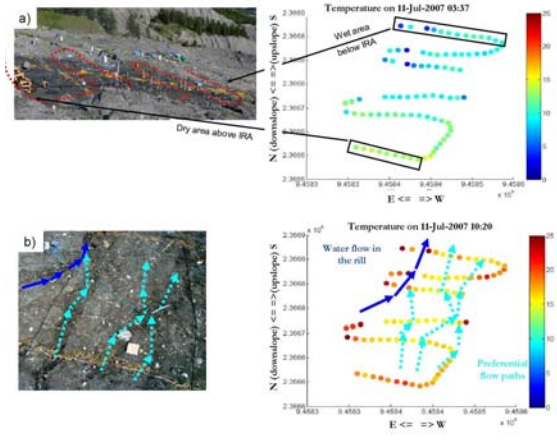


Displacement vectors and cumulated displacements of 7 profiles (P 615 to P 1695) in the image plane from 20th May to 29th June 2008 (Left) and corresponding velocity map (right).

Hazard Analysis

TA-03: *Highlight critical factors involved in the short-term behaviour (crises) and long-term behaviour (climate and land use change) of the processes*

- Distributed Temperature Sensing (DTS) with fibre optic cables to monitor soil temperature in order to identify preferential flow paths and define wet spots (*Krzeminska et al., TUD*)

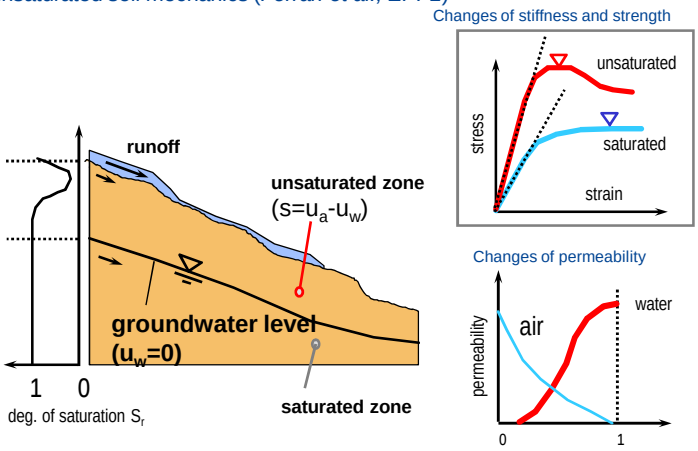


1 (a) Fibre Optic Cable installed within Infiltration Research Area (IRA) with temperature measurements and estimated preferential flow paths, (b) NESCAFE picture of IRA with marked preferential flow paths

Hazard Analysis

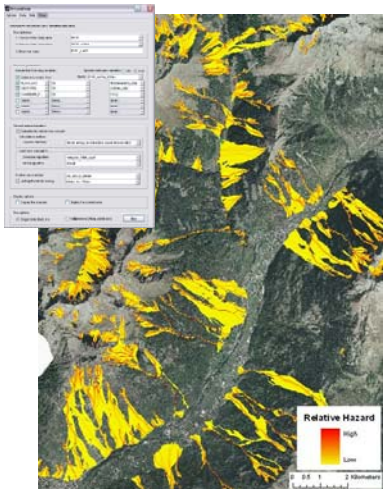
TA-03: *Highlight critical factors involved in the short-term behaviour (crises) and long-term behaviour (climate and land use change) of the processes*

- Advanced hydro-mechanical modelling of large landslides with introduction of unsaturated soil mechanics (*Ferrari et al., EPFL*)

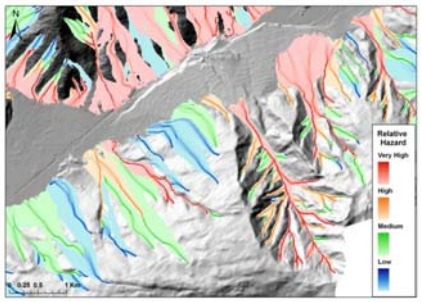


Hazard Analysis

TA-04: *Develop techniques for assessing the temporal probability and the magnitude of the hydro-geomorphological events, determine and map the hazard and validate these outputs.*



- A novel approach to combine susceptibility maps of debris flow source areas and runout zones (*Blahut et al., UNIMIB, with input of Quanterra*)



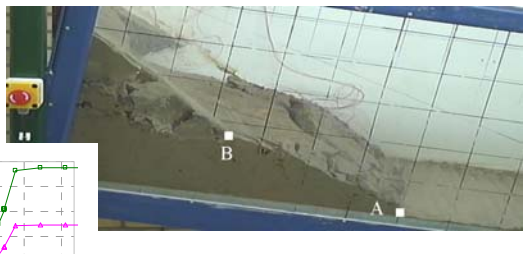
Application of the debris flow runout model DFGrid Prob developed at University of Lausanne (IGAR) to the study area of Valtellina di Tirano showing the probabilities of relative debris flow hazard.

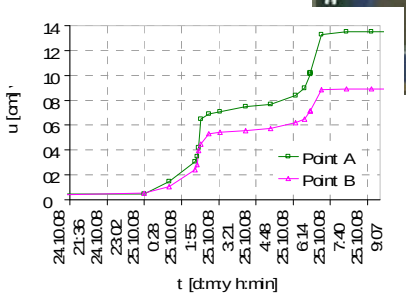
Hazard Analysis

TA-05: *Define criteria for establishing representative and reliable monitoring networks for early warning and for interpreting monitoring data.*

- For the design of landslide EWs, the analysis of failure modes are studied at the laboratory scale during the initial failure stage *(Spickermann et al., UU & EOST)*

Slope after failure, 26-10-2008, inclusive final positions of observed points A, B of the test on Zoelen clay.



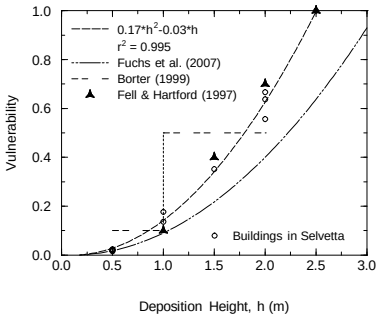


Time displacement curves of the last phase of failure in the test on Zoelen clay.

Quantitative Risk Assessment

TA-06: *Inventory of the elements at risk, and estimation of vulnerability functions*

- Relationships between the physical features of the damaging events and the induced damage *(Akbas et al., UNIMIB-CNR)*

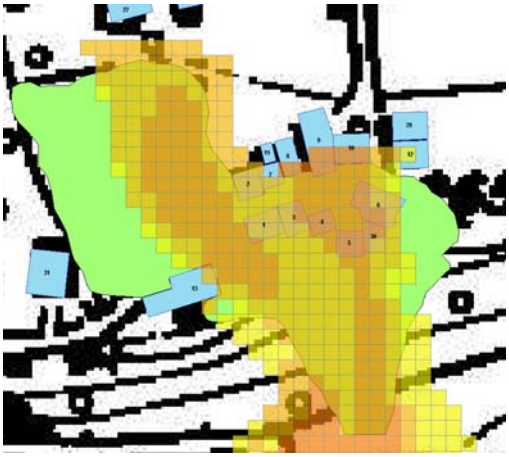


Empirical vulnerability function based on data from the 13 July 2008 mud-debris flow event in the village of Selvetta (Valtellina study site): a function of deposition height.

Quantitative Risk Assessment

TA-06: *Inventory of the elements at risk, and estimation of vulnerability functions*

- Empirical vulnerability functions for Selvetta event from Flo2D modelling (Akbas, *Blahut, Quan Luna et al., UNIMIB-CNR / ITC*)



Variables for vulnerability curves construction:

- Velocity
- Static pressure
- Impact force
- Flow depth
- Specific energy

Quantitative Risk Assessment

TA-07: *Quantification of the level of social, economic, and environmental losses of the damaging phenomenon*

- Relationships between the physical features of the damaging events and the induced damage *(Blahut et al., UNIMIB-CNR)*

Execution Timing

Price List

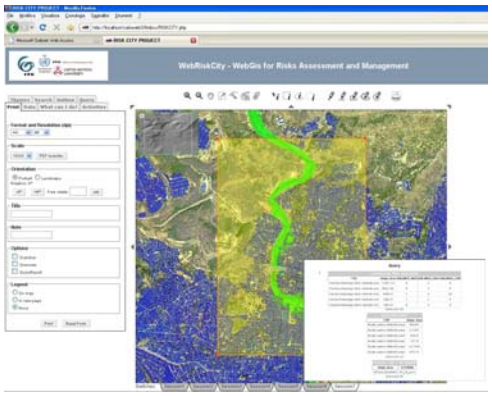
Assessment of Direct Damage

Example of Valtelina di Tirano case study

Quantitative Risk Assessment

TA-08: *Define a procedure to translate societal perception of risk into a QRA*

- Dissemination and analysis of **questionnaires** in the study areas to measure the societal perception of risk *(Angignard et al., TUDO; Garcia et al., UNIMIB-CNR)*

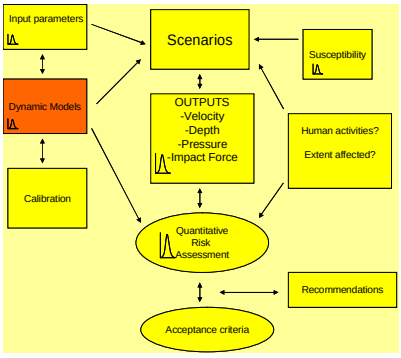


Through meetings, workshops, and public discussions in the study sites (during and after the element inventory and vulnerability function development phases), a two-way knowledge transfer has been created; it will be used both to improve the quantitative risk analysis tools, and to increase the awareness of the public.

Quantitative Risk Assessment

TA-09: *Identify and quantify the sources of uncertainty in the analyses*

- Development of a general framework for a quantitative risk assessment using a stochastic approach for dynamic models (Quan Luna et al., ITC)



Uncertainties result both from the probabilistic nature of events and from a real lack of knowledge of basic physics and damage fragilities associated with the events.

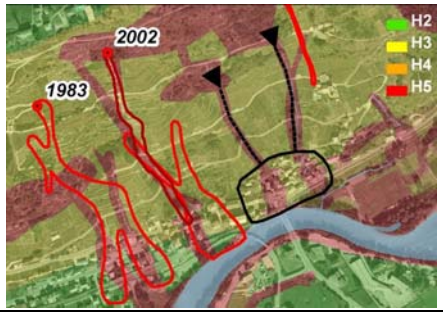
Empirical vulnerability function based on data from the 13 July 2008 mud-debris flow event in the village of Selvetta (Valtellina study site): a function of deposition height.

Quantitative Risk Assessment

TA-10: *Estimate a number of risk scenarios considering the status and evolution of the natural, economic and social systems.*

- Proposition of risk scenarios with assessment of direct damages (Akbas, *Blahut, Frigerio et al., UNIMIB-CNR*)

Estimation of future economic losses: example of Tresenda scenario



Elements at Risk	n.	Cost to remove debris (€)	Cost to restore walls (€)	Cost to restore electric plant (€)	Cost to restore furniture (€)	Cost to rebuild the houses (€)	Direct damage (€)
Houses (0,5 m debris)	46	208,434	178,086	119,375	371,600	-	877,495
Houses (1 m debris)	17	172,945	82,981	99,072	308,400	-	663,398
Houses (destroyed)	5	163,805	-	-	66,800	408,878	639,483
Roads	-	134,773	-	-	-	-	134,773
TOTAL DIRECT DAMAGE							2,315,149

Risk Management

Risk management takes the output from the risk assessment, and considers risk mitigation, which may include various alternatives: reducing the likelihood of an event, reducing the consequences e.g. by developing monitoring, warning and evacuation plans, and implementing regulatory controls. It may include monitoring of the risk outcomes, feedback and iteration when needed

Risk evaluation → **Risk acceptability**

Risk Management actions:

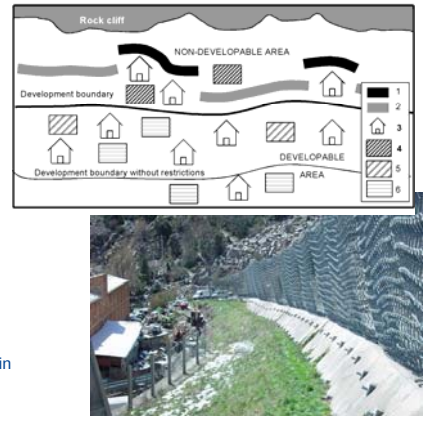
Hazard Prevention	Hazard Reduction	Risk Mitigation
Hazard level remains unchanged	Hazard level is lowered	Consequences are reduced
Land-use planning	Landslide Stabilization Measures	Emergency preparedness
Building codes	Protective measures	Emergency response
Mitigation plan		Recovery

Risk Management

TA-11: *Propose guidelines for sustainable development planning at both local and regional mapping scales, and for different end-users requirements.*

- Hazard prevention: governmental, administrative or regulatory actions, that can influence land planning and buildings construction, are developed.

Development of a rockfall mitigation plan in Andorra (Mavrouli et al., UPC)



Risk Management

TA-12: *Evaluate feasibility, effectiveness and performance of remedial (protective and preventive) measures , and assess the residual risks.*

- **Hazard reduction**

Stabilization measures

Before the event

Slope regrading

Slope reinforcement

Drainage

Protective measures

Structural measures

Fences, walls

Diversion dykes

Non-structural
Sustainable measures

Protection forest

Maintenance

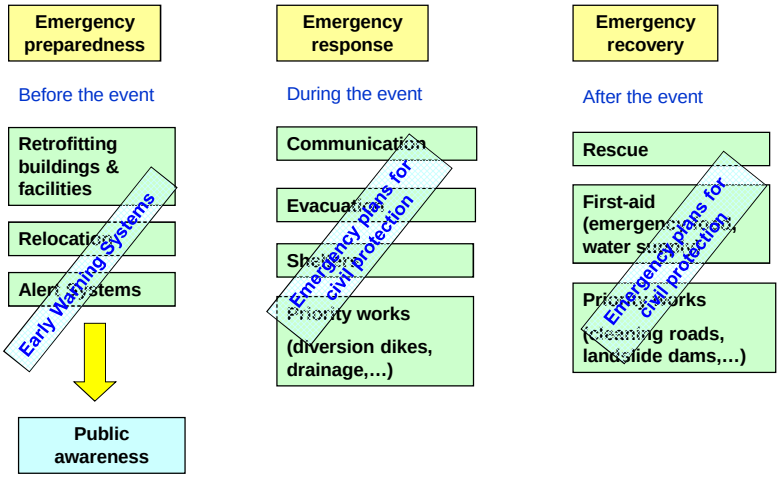
Cost-benefit analyses

Scenarios

Risk Management

TA-13: *Formulate criteria for establishing warning systems and evacuation plans.*

- **Risk mitigation: EW system and Emergency plan**



Risk Management

TA-14: *Provide a framework for cost-benefit analyses.*

event	Parameters: probability of failure	probability of reach	rebound height	threatened sector of a reference area	temporal (spatial) probability	Consequence of each scenario	Annual probability of occurrence of each scenario	Number of potential damages	Risk for a given scenario
	$P_{(L)}$	$P_{(T\|L)}$	P(h<h0)	Pt	$P_{(S\|T)}$				
1	37%	18%	60%	7%	11%				
bloc (ω)	0.63	0.82	0.4	0.93	0.89	No block departure	6.30E-01		
	0.37	0.18	0.6	0.07	0.11	No element at risk reached (no damage)	3.03E-01		
						height of rebound > height of object (no damage)	2.66E-02		
						Area not crossed by the block (no damage)	3.72E-02		
						Area crossed by the block, no person hit	2.49E-03		
						Damages to persons	3.08E-04	3	9.23E-04 [deaths/year]
						sum 1.00E+00		Total Risk	9.23E-04 [deaths/year]

Protective work

Example of event-tree analysis for evaluating the risk to persons in non-built areas (*Abbruzesse et al., EPFL*)

Risk Governance

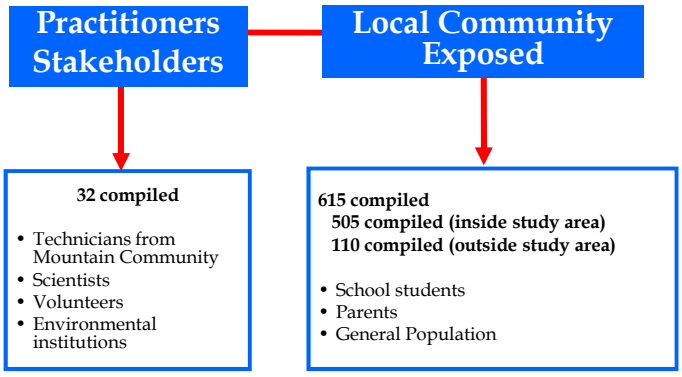
To adopt risk management and governance strategies the following principles will be carefully considered:

- using the same methodological techniques for QRA recognized as legitimate and fair by the stakeholders.
- empowering and involving stakeholders (the affected individuals and groups) appropriately and making decision-makers more accountable to them.
- creating the conditions for stakeholders to consider the relevant scientific evidence to meet their needs in an atmosphere of mutual respect and trust.
- producing practical decisions and strategies, flexible and open to revision with time.
- evaluating and monitoring the consequences of decisions, taking into account the stakeholders view to readjust decisions if necessary.
- evaluating the actual information needs (especially geo-information) in view of the decision-making process.

Risk Governance

TA-15: *Incorporate the lessons learnt from past disasters within the management.*

- **Social surveys to evaluate the present situation (questionnaire)**
  Risk Perception, Previous Experience, Preparation for a future emergency, Level of Trust, Needs, Concerns



Garcia et al. (UNIMIB-CNR)

Risk Governance

TA-15: *Incorporate the lessons learnt from past disasters within the management.*

- **Risk perception on mass-movement and floods**

How likely… **Mean = 2.205**

1. Not likely
2. Very unlikely
3. Likely
4. Very likely
5. Extremely likely

…will be a flood next year	… population will be adversely affected	…you or your family will be affected	…your home or property will be affected	…transport networks will suffer damage	…critical lifelines will suffer damage

- Previous Experience 82.4% (Direct experience, awareness)
- Triggering Factors (1. Rain; 2. Deforestation; 3. Modification of river bed)
- Hazard Ranking (1. Fire, 2. Flood, 3. Landslides)
- Received Information about Natural Hazards:
  - 24 % of population
  - Poor Quality (2.31)
  - 1. Family; 2. Press; 3. TV

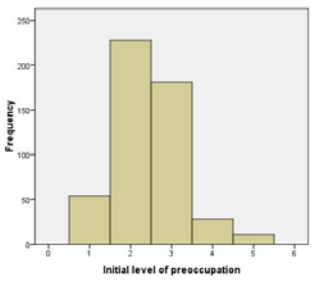
Garcia et al. (UNIMIB-CNR)

Risk Governance

TA-15: *Incorporate the lessons learnt from past disasters within the management.*

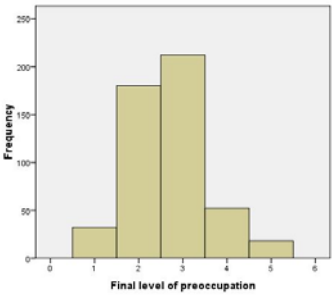
- **Level of concern of the inhabitants**

BEFORE SURVEY



1. Not at all
2. A little bit
3. Fairly
4. A lot
5. Completely

AFTER SURVEY (5% increase)



Garcia et al. (UNIMIB-CNR)

Risk Governance

TA-16: *Identify legal aspects, risk cultures and insurance possibilities.*

- **Analysis of legal framework** concerning of natural hazards (including Civil Protection) + **Social survey** (knowledge about legal aspects + risk culture in terms of trust and preparedness)

1. Strongly disagree
2. Disagree
3. Moderately
4. Agree
5. Strongly agree

	Agree in forcing institutions to inform about NH	Agree in forcing local institutions to provide an intervention plan in case of emergency	Agree be more restrictive about urbanization and land development	Agree be more severe with whoever carry out activities that increase the natural risk
Mean	**4.02**	4.19	**3.77**	4.03

• Preparedness
- 1. Civil Protection ; 2. Mountain Community; 3. Municipality (Moderately Prepared)
- Yourself (little prepared)
- Population (little prepared)

• Trust
- 1. Civil Protection ; 2. Mountain Community; 3. Municipality (Fairly)

Garcia et al. (UNIMIB-CNR)

Risk Governance

TA-17: *Communicate the information, educate the practitioners and the population, and involve all stakeholders in the decision-making process.*

- **Social survey:** Measure of actual participative levels and main interests and topics addressed on education campaigns about risks

	Could you take personal measures to reduce the consequences of NH		Know the emergency plan		Know the emergency procedures	
	Freq.	%	Freq.	%	Freq.	%
Yes	70	**13.9**	20	**4**	88	**17.4**

FUTURE INFORMATION

	Would you like to receive new info.?	
	Freq.	Valid %
Yes	**286**	**66.5**

• Preferred media to receive information
(1. TV; 2. Press; 3. Flyers)

• Who should provide the information
(1. Municipality; 2. Mountain Community; 3. Civil Protection)

Garcia et al. (UNIMIB-CNR)

Risk Governance

TA-18: *Provide a framework for the use of geo-information at all levels and define the potentiality of modern visualization tools.*

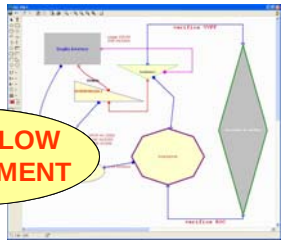
Risk Governance

PETer

Protezione Emergenza Territorio
(Protection and Emergency of the Territory)

GIS

WORK FLOW MANAGEMENT



INTEGRATED SYSTEM TO MANAGE PROCEDURES LINKED TO GEOGRAPHICAL FEATURES

PEOPLE

RESOURCES

PROCESSES

Considering the laws in charge
Providing a user-friendly instrument

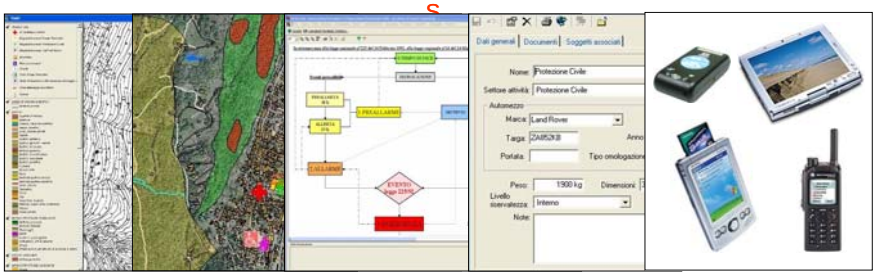
Risk Governance

Evolution from “static” to “dynamic” GIS

Ability in linking geographical features and processes to workflow management instruments

…INTEGRATION…

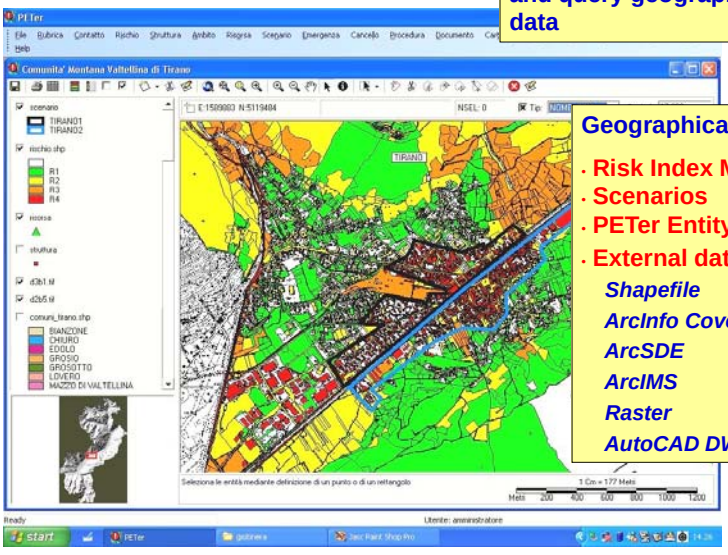
DATA PROCESSES PROCEDURES ACTIONS COMMUNICATION



Risk Governance

PETer Mapping

GIS tools **to manage, edit and query geographical data**

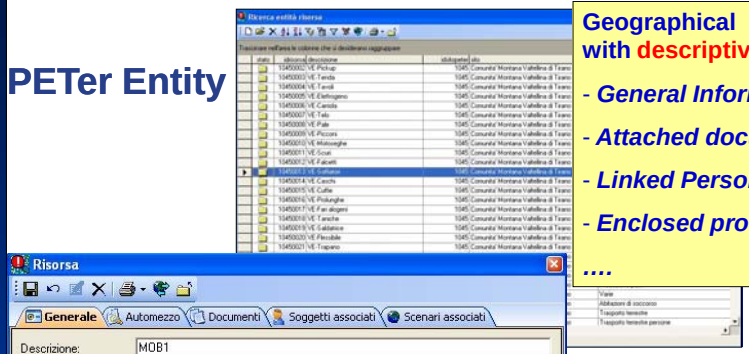


Geographical dataset:

- **Risk Index Map**
- **Scenarios**
- **PETer Entity**
- **External data:**
  - ***Shapefile***
  - ***ArcInfo Coverage***
  - ***ArcSDE***
  - ***ArcIMS***
  - ***Raster***
  - ***AutoCAD DWG e DXF***

Risk Governance

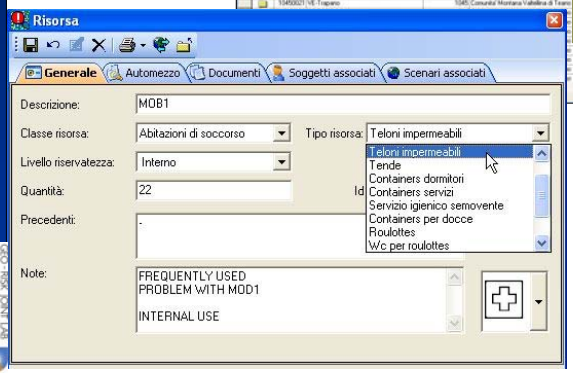
PETer Entity



Geographical feature with descriptive chart:

- *General Information*
- *Attached documents*
- *Linked Personnel*
- *Enclosed procedures*

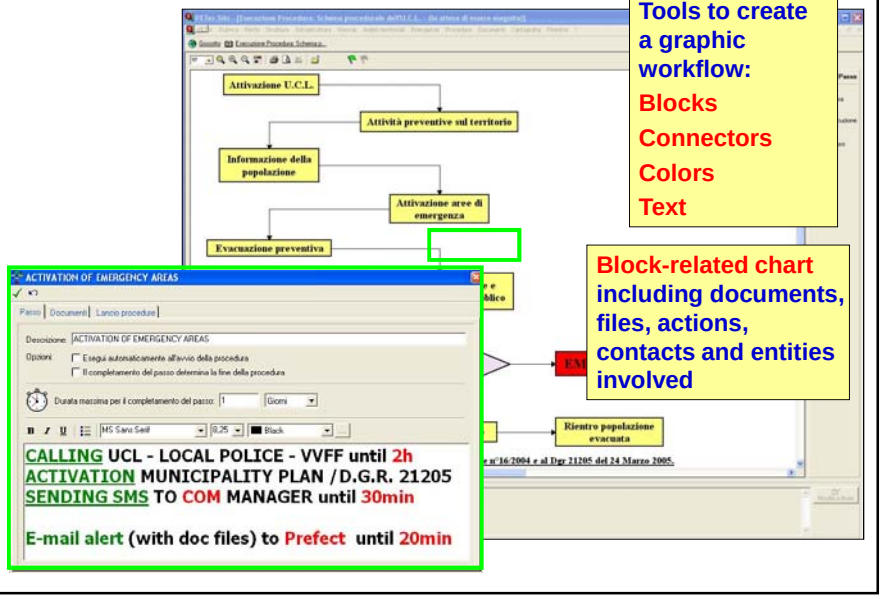
....



Customized menu *and* user-friendly quick form for data entry

Risk Governance

Models for DSS

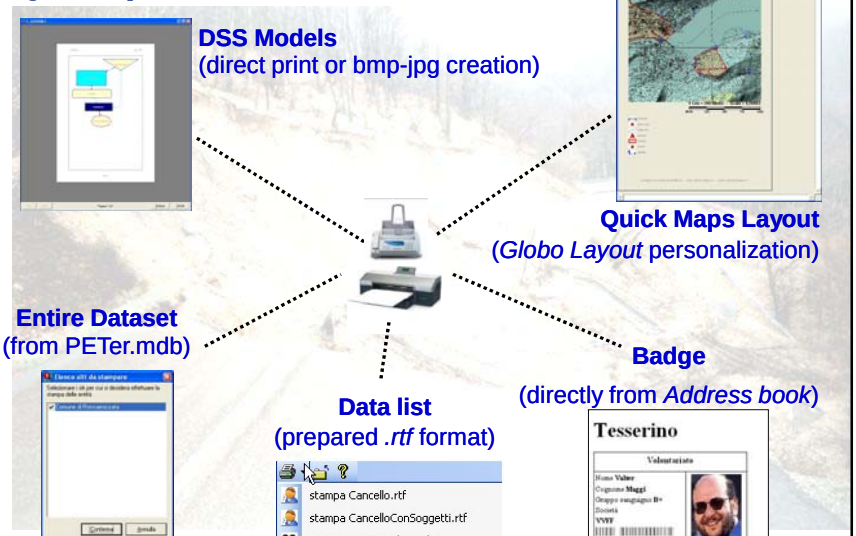


Tools to create a graphic workflow:
Blocks
Connectors
Colors
Text

Block-related chart including documents, files, actions, contacts and entities involved

Risk Governance

Quick prints



Risk Governance

Main conclusions

Risk governance aims to enhance the disaster resiliency of a society

It must includes the totality of actors, rules, conventions, processes and mechanisms concerned with how relevant risk information is collected, analyzed and communicated, and management decisions are taken

The 3 elements of Risk governance are: Risk assessment, risk management, risk communication process among scientists, politicians and public

Risk governance mainly derives from the integration of the elements of Risk Assessment (hazards, vulnerability and risks identification) and risk communication (communication of risk assessment and risk management activities)

An appropriate procedural framework for hazard and risk assessment is seen as indispensable to coordinate the several risk-related directives

More public participation into both, risk assessment and risk decision-making is needed for more legitimacy and public acceptance of the resulting decisions

ありがとうございます。

話題 1: 土砂災害に関する危機管理体制～法律体系と指揮命令関係

3.3 「日本国における危機管理体制と法律」

岩男　忠明　内閣府政策統括官（防災担当）付参事官

（災害応急対策担当）付参事官補佐（業務担当）

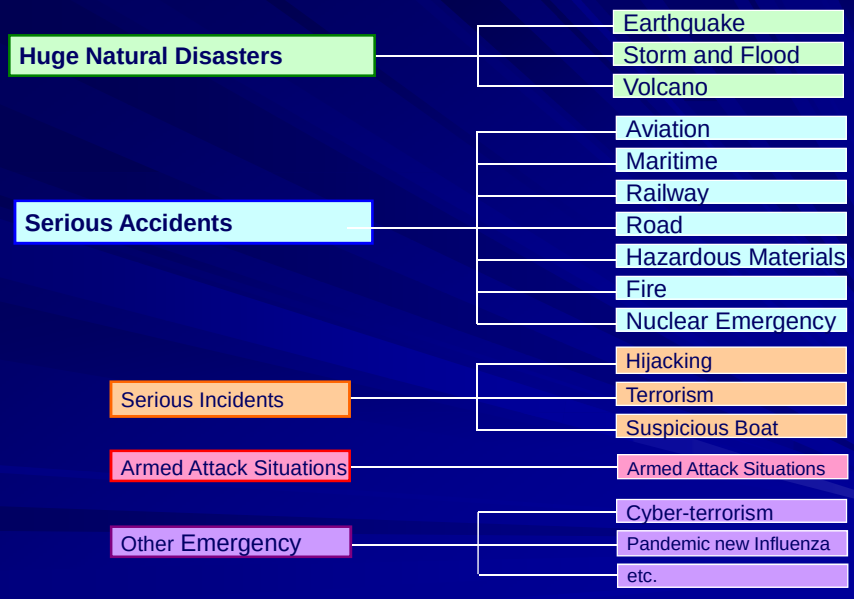
Emergency Management and Disaster Countermeasures Basic Act in Japan

October 2009

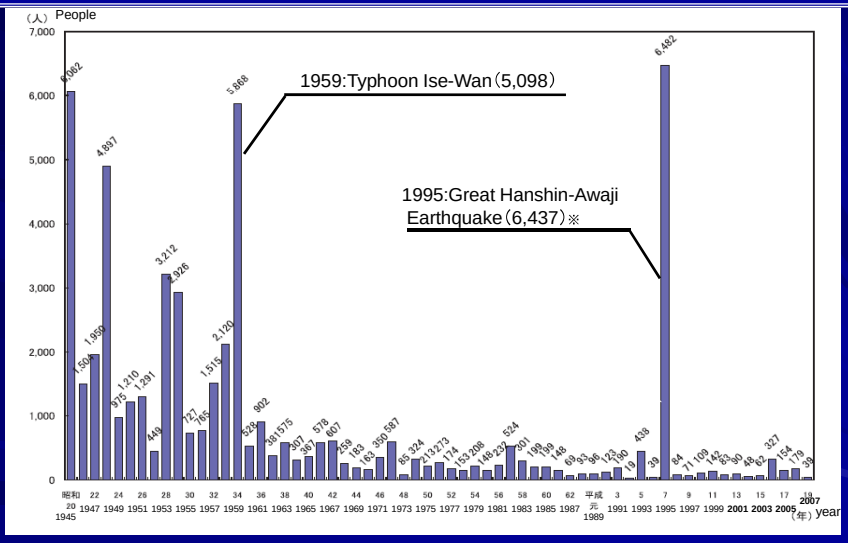
IWAO Tadaaki

Cabinet Office, Government of Japan

Types of Emergency

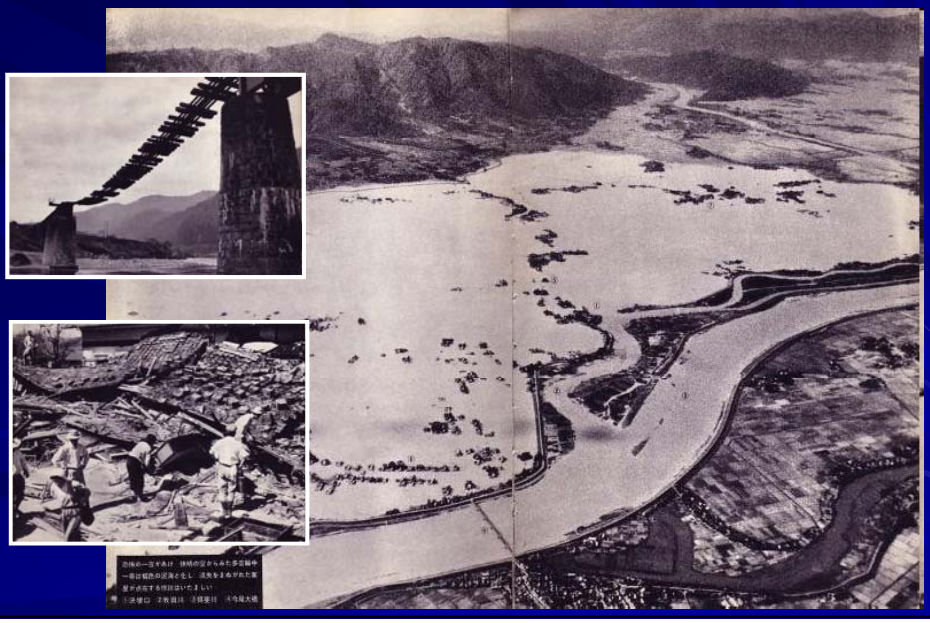


The number of Death and Missing Persons in Natural Disasters



（※）The number of Deaths in Great Hanshin-Awaji Earthquake include 912 relative deaths

1959 Ise-wan Typhoon



Disaster Countermeasures Basic Act 1961

1. Planning

- Disaster Management Plan at both National and Local level

2. Administrative Organization

- Central Disaster Management Council chaired by the Prime Minister (Ordinary Time)
- Major Disaster Management Headquarter, Extreme DM HQ (Emergency Situations)

3. Basic Policy for Disaster Prevention and Recovery

- Training, Public Investment, Finance

1995 Kobe Earthquake

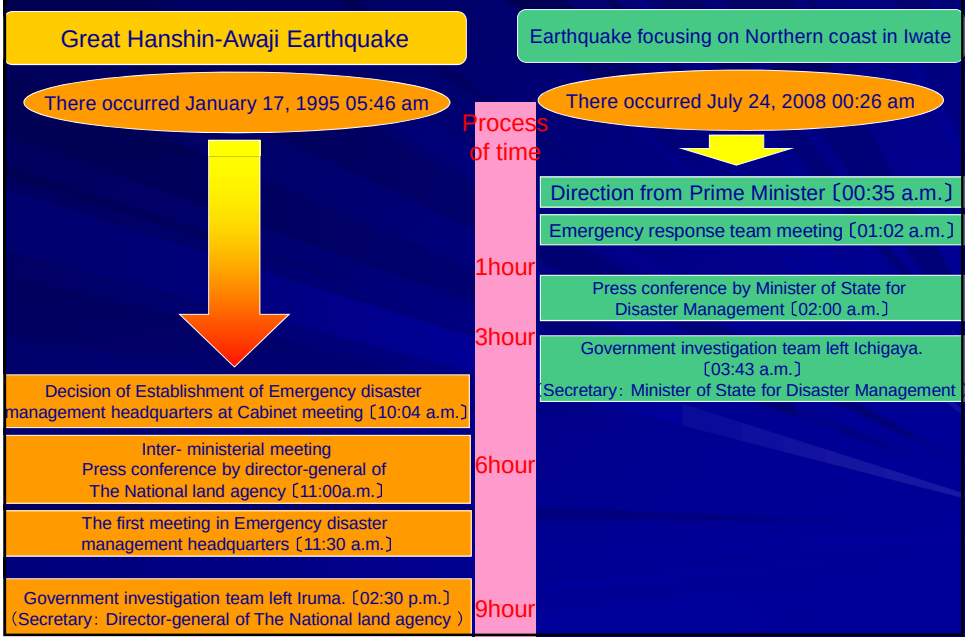
Lessons of the Earthquake
Lack of Information
Caused Delayed First Response

- Damaged Headquarters
- Local Government Command initially paralyzed
- Destroyed almost all traffic system
- Telecommunication, even satellite telecommunication system were cut off due to power failure

⇒ It took three days to grasp the entire picture of damage

Comparison of Emergency Response

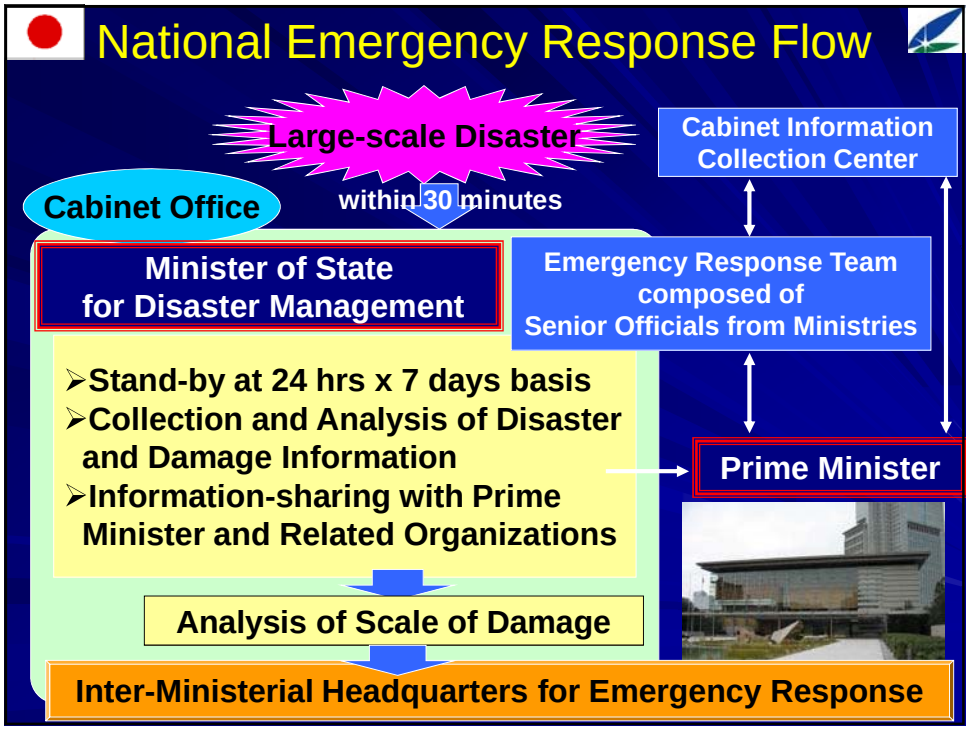
～Between Great Hanshin-Awaji Earthquake and Earthquake focusing on Northern coast in Iwate～



National Countermeasures

- **Establishment of the Cabinet Information Collection Center**
- **Enhanced Governmental System**
  - -Minister of State for Disaster Management
  - -Chief Cabinet Secretary for Crisis Management
- **Development of Disaster Information System (DIS)**
  - -Early Estimation System
  - -Emergency Measure Support System

National Emergency Response Flow



Emergency Response

3 hours

➢Dispatch of an emergency survey team to the affected areas

➢Mobilization of Search and Rescue Teams
- ◆ Police , Firefighting, Self-Defense Forces

➢Full-scale search & rescue activities

➢Nationwide emergency assistance
- ◆ Emergency medical evacuation
- ◆ Food & Water
- ◆ Blankets & Clothes
- ◆ Prevention of secondary disasters such as landslides
- ◆ Temporary repairs of infrastructure & lifeline

24 hours

From Response to Recovery & Rehabilitation Phase

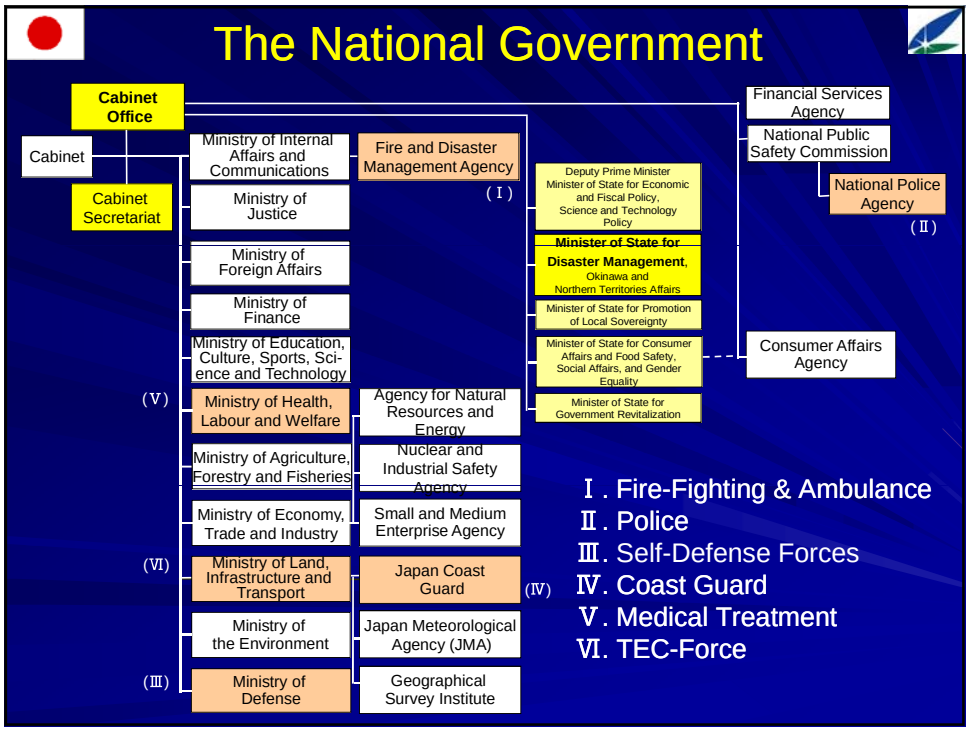
1-3 weeks

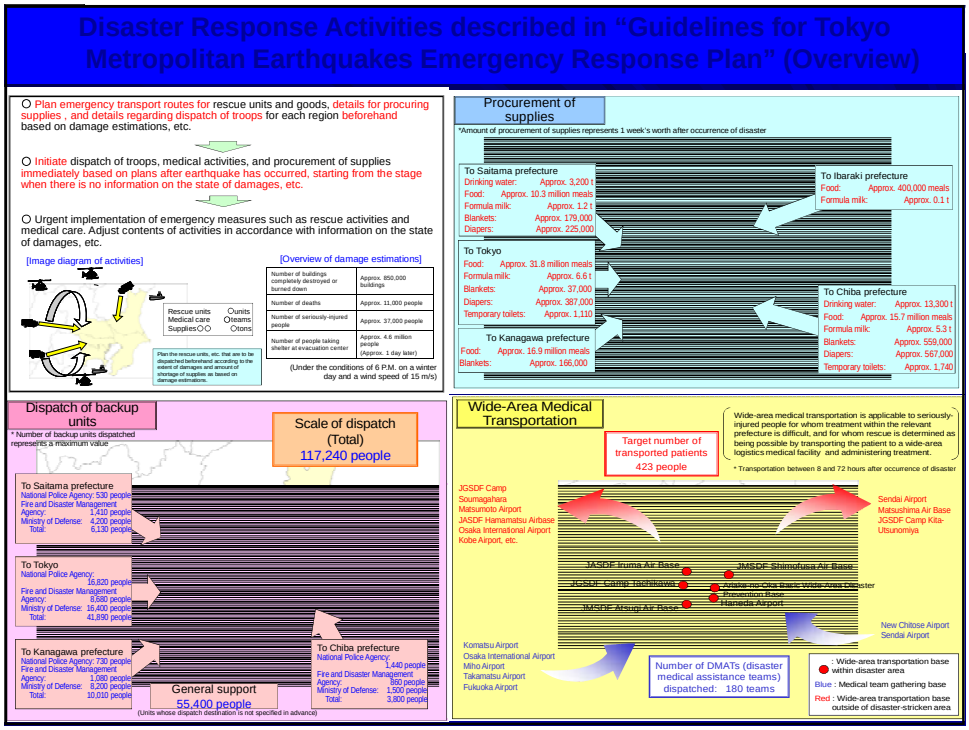
➢Improving of the quality of life of evacuees
- ◆ Hot meals with variety
- ◆ Public bath service
- ◆ Mental care against PTSD
- ◆ Evacuation of elderly & handicapped to tourist hotels

➢Full-scale recovery of infrastructure & lifeline

1 months & thereafter

➢Smooth transition to recovery & rehabilitation phase
- ◆ Ensuring of housing
- ◆ Preparations for the coming winter & snow
- ◆ Recovery of the local economy
- ◆ Support to isolated and devastated areas


The National Government
Cabinet Office
Cabinet
Cabinet Secretariat
Ministry of Internal Affairs and Communications
Ministry of Justice
Ministry of Foreign Affairs
Ministry of Finance
Ministry of Education, Culture, Sports, Science and Technology
Ministry of Health, Labour and Welfare
Ministry of Agriculture, Forestry and Fisheries
Ministry of Economy, Trade and Industry
Ministry of Land, Infrastructure and Transport
Ministry of the Environment
Ministry of Defense
Fire and Disaster Management Agency
Agency for Natural Resources and Energy
Nuclear and Industrial Safety Agency
Small and Medium Enterprise Agency
Japan Coast Guard
Japan Meteorological Agency (JMA)
Geographical Survey Institute
Deputy Prime Minister
Minister of State for Economic and Fiscal Policy, Science and Technology Policy
Minister of State for Disaster Management, Okinawa and Northern Territories Affairs
Minister of State for Promotion of Local Sovereignty
Minister of State for Consumer Affairs and Food Safety, Social Affairs, and Gender Equality
Minister of State for Government Revitalization
Financial Services Agency
National Public Safety Commission
National Police Agency
Consumer Affairs Agency
Ⅰ. Fire-Fighting & Ambulance
Ⅱ. Police
Ⅲ. Self-Defense Forces
Ⅳ. Coast Guard
Ⅴ. Medical Treatment
Ⅵ. TEC-Force


Disaster Response Activities described in "Guidelines for Tokyo Metropolitan Earthquakes Emergency Response Plan" (Overview)
Procurement of supplies
Dispatch of backup units
Wide-Area Medical Transportation
Scale of dispatch (Total) 117,240 people
General support 55,400 people
Target number of transported patients 423 people
Number of DMATs (disaster medical assistance teams) dispatched: 180 teams

話題 1: 土砂災害に関する危機管理体制～法律体系と指揮命令関係

3.4　「ベネト州における危機管理体制について

-地域機能センター-」

マリアーノ・キャラッロ　ベネト州政府市民保護局長

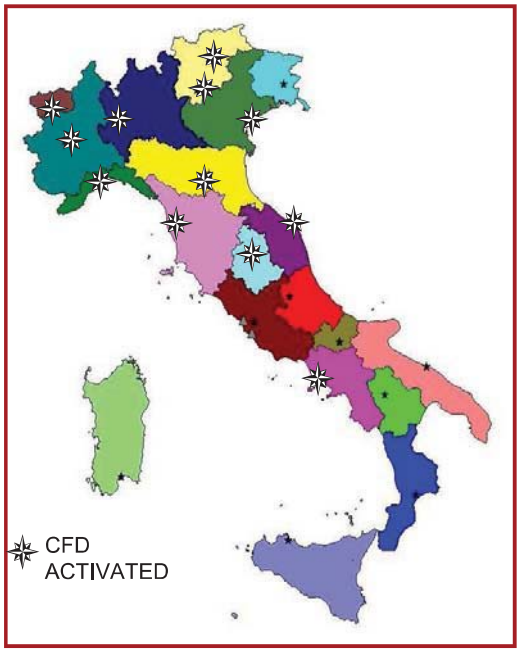
Regional Civil Protection

the emergency management in Veneto: Decentralized Functional Center (CFD)

Eng. Mariano Carraro

secretary of public works and civil protection

What is the CFD?



Regional organization delegated to ***assess and manage hydraulic and hydrogeological alerts*** *on Italian Regions.*

MAIN AIM:

- ✓ ***prediction of events;***
- ✓ ***monitoring the events and the consequent impact on the territory;***
- ✓ ***support to the emergency management***

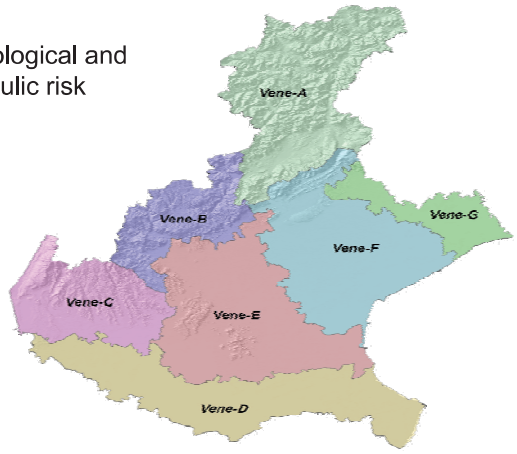
The C.F.D. of Veneto Region actually assess the following risks:

Hydrogeological and hydraulic

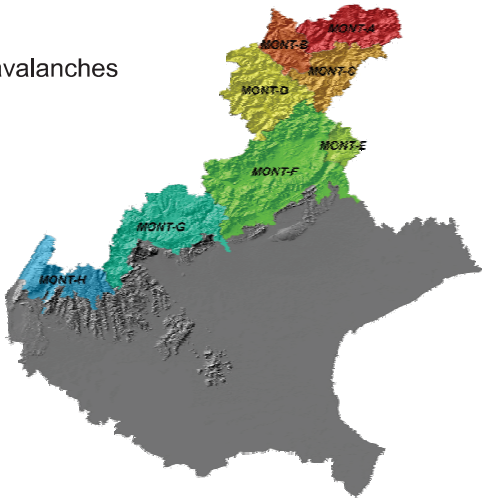
Avalanche *(starting from November 2009)*

Alert areas

Hydrological and hydraulic risk



avalanches



Alert Management

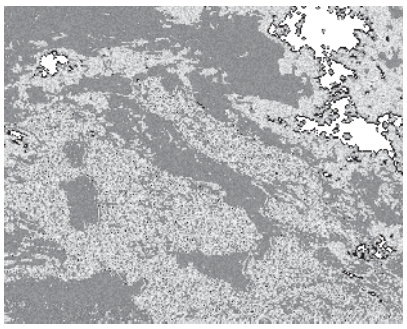
The Italian national law provides that the alerts are managed into 2 different steps

- ✓ ***Forecast step:*** *forecasting of the meteorological, hydrological, Hydraulic and snowpack conditions expected. Evaluation of possible effects on the integrity of life, property, settlements and the environment*

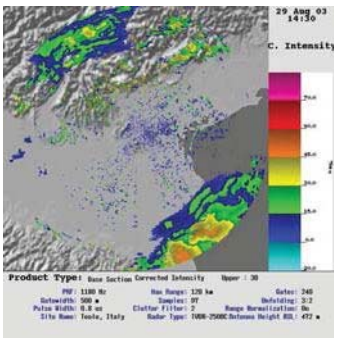
- ✓ ***Monitoring step:*** *qualitative and quantitative observation of the meteorological event and its relative effects in terms of rising of hydrometric levels, landslides and avalanches. Support to end users through* ***nowcasting*** *service.*

Forecast step: THE WEATHER

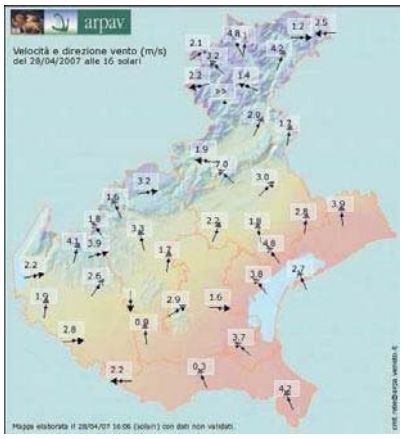
Satellite



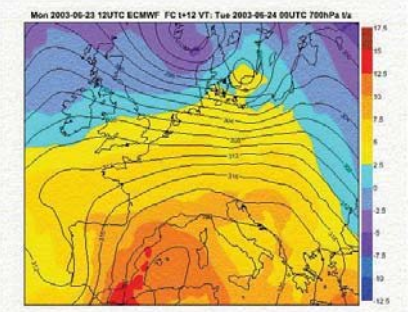
Radar



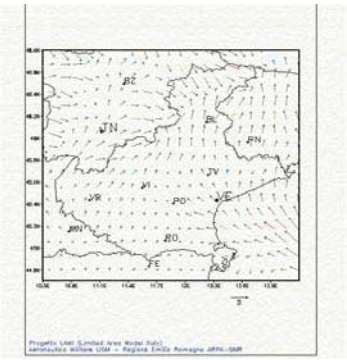
Weather stations



Global models



Local models



Expert knowledge

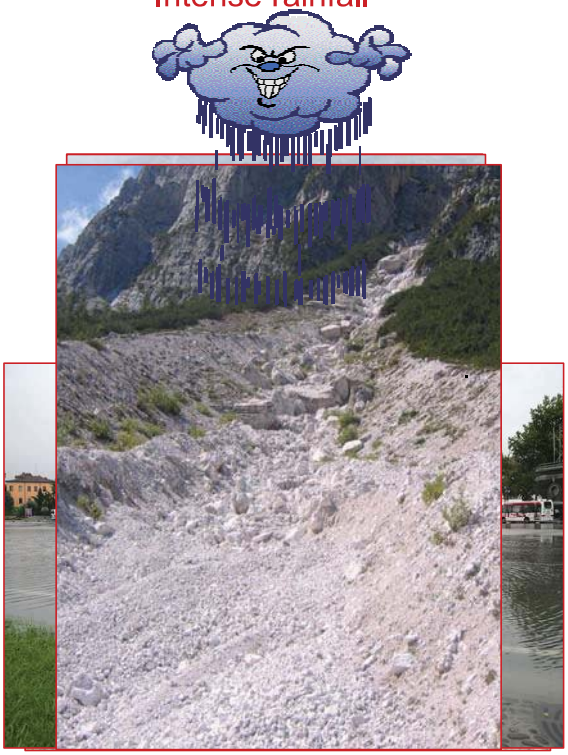
- ***Instruments reliability***
- ***Synthesis of the informations***
- ***Evaluation of the local orographic effect***

Forecast step: HYDROLOGICAL BASIN RESPONSE

Depending on type of the meteorological event it is possible to forecast the type of risk to assess and get the correct information to the end users

Persistent perturbation

Intense rainfall



CRITICALITY NOTICE

The CFD classifies an event through 4 different critical levels: ***absent, low, moderate and high****.*

CRITICALITY	SCENARIO	Civil protection counter-measures
Absent	No forecasted phenomena	No counter-measures
Low	Possibility of hydrogeologic and hydraulic phenomena that should not affect directly population and primary infrastructures.	WARNING Requires the availability of peoples involved in civil protection actions and a continuos monitoring of the pohenomenas
Moderate	Possibility of damages on infrastructures	PRE-ALARM Requires an enhanced availability of all the peoples involved in civil protection actions and the prearrangement of all the tools necessary to handle the crisis.
High	High possibility to have extended damages on primary infrastructures, population and diffuse hazard on the territory affected by the event	ALARM Activation of all available forces in the manner provided by the plans or according to directives of Civil Protection.

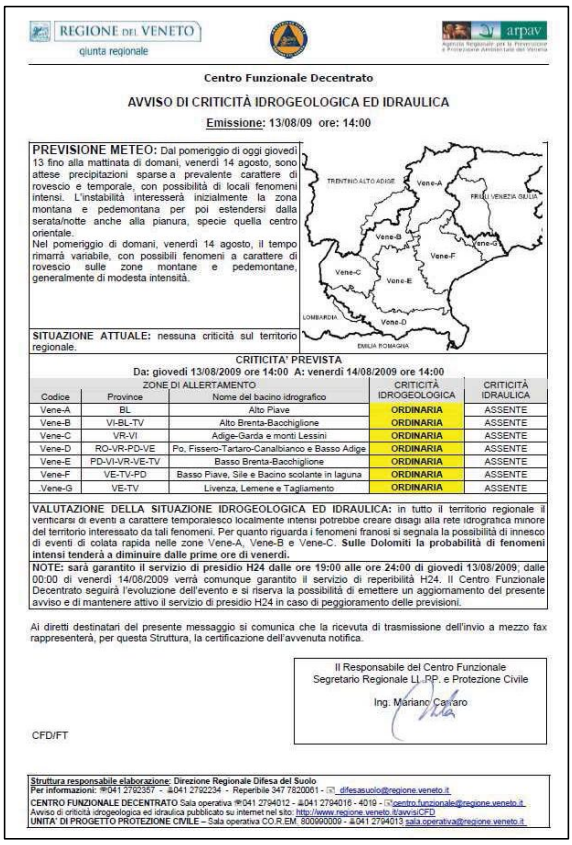
The criticality announcement:

Brief summary of the expected weather conditions →

Criticality levels on different alert areas →

Description of the hydrogeologic and hydraulic expected conditions →

How to contact the CFD →



REGIONE DEL VENETO
giunta regionale

arpav

Centro Funzionale Decentrato

AVVISO DI CRITICITÀ IDROGEOLOGICA ED IDRAULICA

Emissione: 13/08/09 ore: 14:00

PREVISIONE METEO: Dal pomeriggio di oggi giovedì 13 fino alla mattinata di domani, venerdì 14 agosto, sono attese precipitazioni sparse a prevalente carattere di rovescio e temporale, con possibilità di locali fenomeni intensi. L'instabilità interesserà inizialmente la zona montana e pedemontana per poi estendersi dalla serata/notte anche alla pianura, specie quella centro orientale.
Nel pomeriggio di domani, venerdì 14 agosto, il tempo rimarrà variabile, con possibili fenomeni a carattere di rovescio sulle zone montane e pedemontane, generalmente di modesta intensità.

SITUAZIONE ATTUALE: nessuna criticità sul territorio regionale.

CRITICITA' PREVISTA
Da: giovedì 13/08/2009 ore 14:00 A: venerdì 14/08/2009 ore 14:00

ZONE DI ALLERTAMENTO			CRITICITÀ IDROGEOLOGICA	CRITICITÀ IDRAULICA
Codice	Province	Nome del bacino idrografico		
Vene-A	BL	Alto Piave	ORDINARIA	ASSENTE
Vene-B	VI-BL-TV	Alto Brenta-Bacchiglione	ORDINARIA	ASSENTE
Vene-C	VR-VI	Adige-Garda e monti Lessini	ORDINARIA	ASSENTE
Vene-D	RO-VR-PD-VE	Po, Fissero-Tartaro-Canalbianco e Basso Adige	ORDINARIA	ASSENTE
Vene-E	PD-VI-VR-VE-TV	Basso Brenta-Bacchiglione	ORDINARIA	ASSENTE
Vene-F	VE-TV-PD	Basso Piave, Sile e Bacino scolante in laguna	ORDINARIA	ASSENTE
Vene-G	VE-TV	Livenza, Lemene e Tagliamento	ORDINARIA	ASSENTE

VALUTAZIONE DELLA SITUAZIONE IDROGEOLOGICA ED IDRAULICA: in tutto il territorio regionale il verificarsi di eventi a carattere temporalesco localmente intensi potrebbe creare disagi alla rete idrografica minore del territorio interessato da tali fenomeni. Per quanto riguarda i fenomeni franosi si segnala la possibilità di innesco di eventi di colata rapida nelle zone Vene-A, Vene-B e Vene-C. **Sulle Dolomiti la probabilità di fenomeni intensi tenderà a diminuire dalle prime ore di venerdì.**

NOTE: sarà garantito il servizio di presidio H24 dalle ore 19:00 alle ore 24:00 di giovedì 13/08/2009, dalle 00:00 di venerdì 14/08/2009 verrà comunque garantito il servizio di reperibilità H24. Il Centro Funzionale Decentrato seguirà l'evoluzione dell'evento e si riserva la possibilità di emettere un aggiornamento del presente avviso e di mantenere attivo il servizio di presidio H24 in caso di peggioramento delle previsioni.

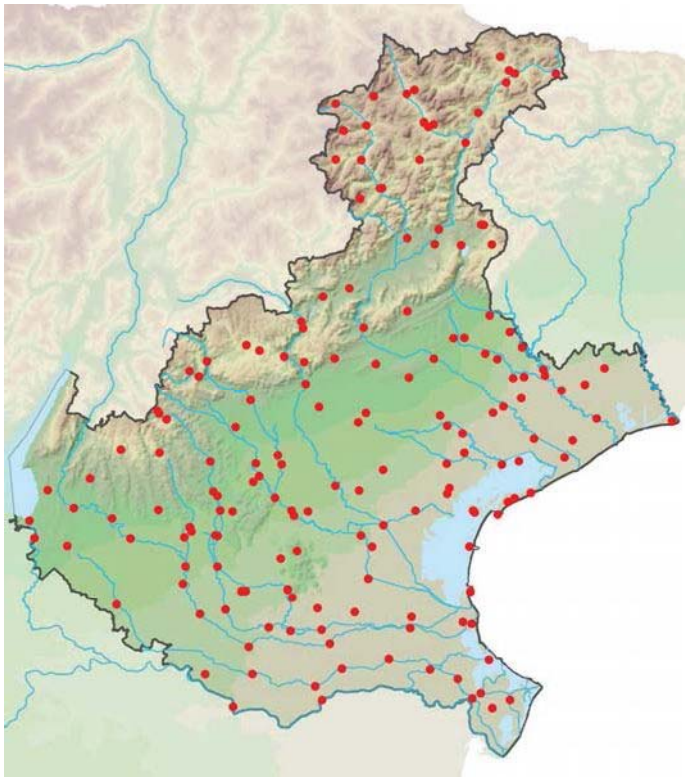
Ai diretti destinatari del presente messaggio si comunica che la ricevuta di trasmissione dell'invio a mezzo fax rappresenterà, per questa Struttura, la certificazione dell'avvenuta notifica.

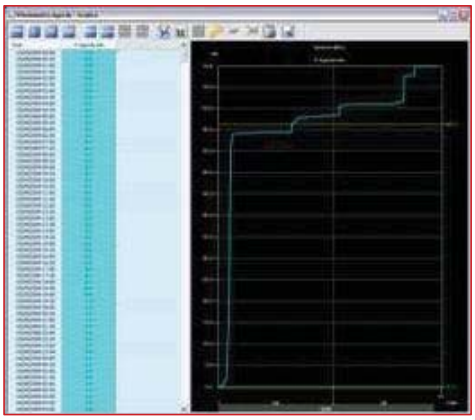
Il Responsabile del Centro Funzionale
Segretario Regionale LL.PP. e Protezione Civile
Ing. Mariano Carraro

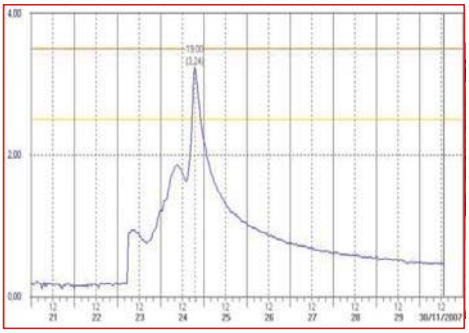
CFD/FT

Struttura responsabile elaborazione: Direzione Regionale Difesa del Suolo
Per informazioni: ☎041 2792357 - 🖷041 2792234 - Reperibile 347 7620061 - difesasuolo@regione.veneto.it
CENTRO FUNZIONALE DECENTRATO Sala operativa ☎041 2794012 - 🖷041 2794016 - 4019 - centro.funzionale@regione.veneto.it
Avviso di criticità idrogeologica ed idraulica pubblicato su internet nel sito: http://www.regione.veneto.it/avvisiCFD
UNITA' DI PROGETTO PROTEZIONE CIVILE – Sala operativa CO.R.EM. 800990009 - 🖷041 2794013 sala.operativa@regione.veneto.it

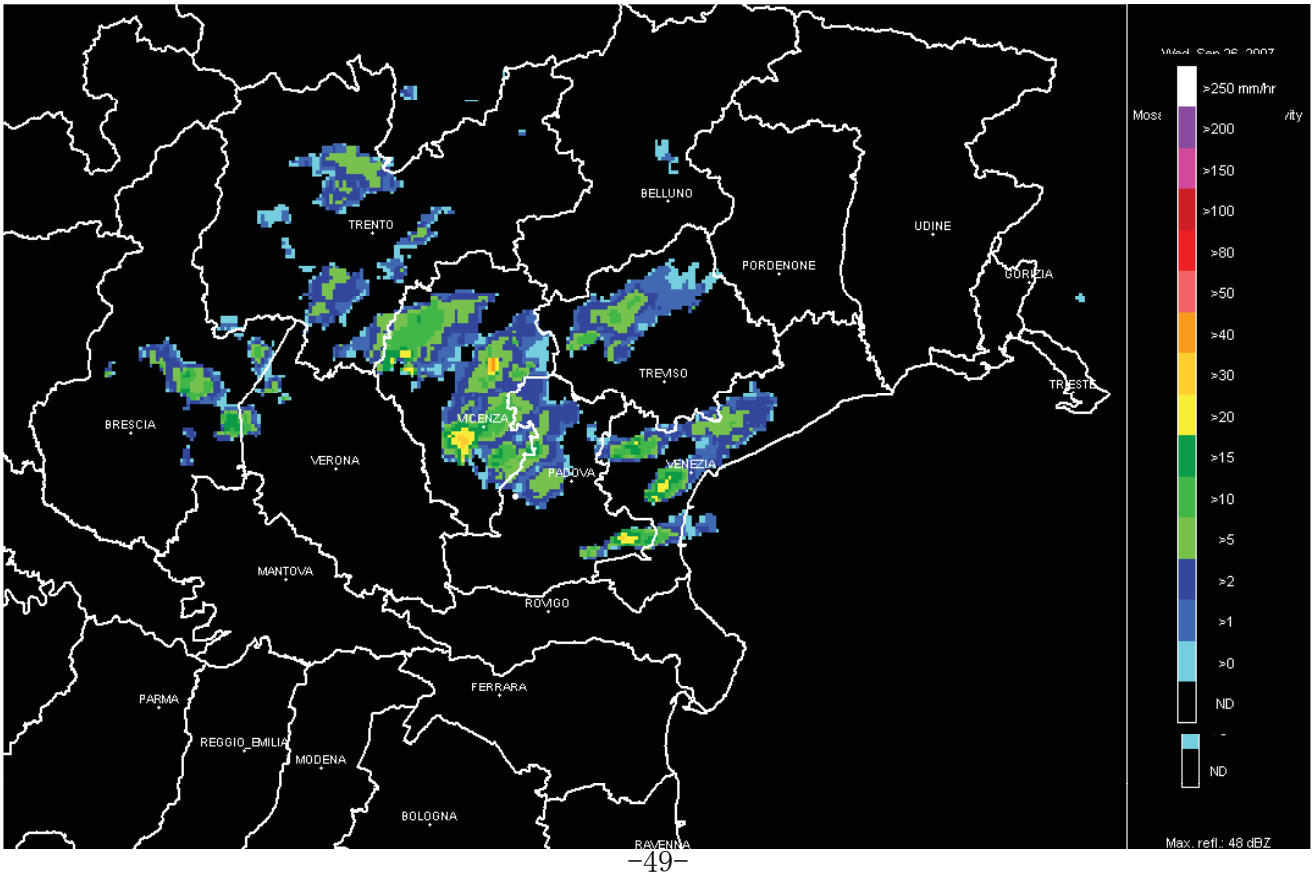
Monitoring system: the hydro-thermo-pluviometric network of CFD







Monitoring system: metheo-radar



Examples:
April, 28th-30th 2009

Expected criticality →

REGIONE DEL VENETO **Centro Funzionale Decentrato**

AGGIORNAMENTO N. 4 DELL'AVVISO DI CRITICITÀ IDROGEOLOGICA ED IDRAULICA
Emissione: 29 /04 /09 ore: 14 : 00   Validità: 29 /04 /09 ore: 14 : 00 – 30 04 /09 ore: 14 : 00

PREVISIONE METEO: per la seconda parte della giornata odierna è prevista una fase di instabilità con precipitazioni sparse a prevalente carattere di rovescio e temporale, localmente anche intensi, soprattutto su Prealpi e pianura. Limite della neve intorno ai 1400-1700 m, in temporaneo abbassamento in corrispondenza dei fenomeni più intensi. Tendenza a diradamento e attenuazione dei fenomeni dalla serata. Nei giorni successivi ulteriore miglioramento: non sono previsti fenomeni significativi. Sulla base della citata evoluzione meteorologica **a partire dalle ore 24 del 29/04/2009 si considerano cessate le condizioni meteorologiche avverse.**

SITUAZIONE ATTUALE: I livelli idrometrici permangono elevati su tutto il territorio regionale: si osservano livelli particolarmente elevati nei fiumi Fratta-Gorzone e Bacchiglione. Nei fiumi principali (Adige, Brenta, Piave) si osservano livelli ancora sostenuti, ma attualmente non particolarmente critici. Nel sistema Livenza-Meduna sono in corso aumenti dei livelli, in particolare sul fiume Monticano. Fenomeni franosi localizzati si sono verificati nelle zone Vene-A, Vene-B e Vene-C.

CRITICITA' PREVISTA
DA: mercoledì 29/04/2009 ore: 14:00 A giovedì 30/04/2009 ore 24:00

ZONE DI ALLERTAMENTO			CRITICITÀ IDROGEOLOGICA	CRITICITÀ IDRAULICA
Codice	Province	Nome del bacino idrografico		
Vene-A	BL	Alto Piave	MODERATA	ORDINARIA
Vene-B	VI-BL-TV	Alto Brenta-Bacchiglione	MODERATA	ORDINARIA
Vene-C	VR-VI	Adige-Garda e monti Lessini	MODERATA	ORDINARIA
Vene-D	RO-VR-PD-VE	Po, Fissero-Tartaro-Canalbianco e Basso Adige	ORDINARIA	ORDINARIA
Vene-E	PD-VI-VR-VE-TV	Basso Brenta-Bacchiglione	MODERATA	MODERATA
Vene-F	VE-TV-PD	Basso Piave, Sile e Bacino scolante in laguna	ORDINARIA	ORDINARIA
Vene-G	VE-TV	Livenza, Lemene e Tagliamento	ORDINARIA	ORDINARIA

VALUTAZIONE DELLA SITUAZIONE IDROGEOLOGICA ED IDRAULICA: gli eventi meteorologici previsti possono causare ancora situazioni di moderata criticità idrogeologica nelle zone Vene-A-B-C-E a seguito di possibili fenomeni localizzati che interesseranno principalmente i bacini idrografici di piccole-medie dimensioni. In alcuni settori delle zone Vene-B e Vene-C si ritiene possibile l'attivazione e la riattivazione di fenomeni franosi anche in riferimento agli eventi meteo del novembre-dicembre 2008; per la zona Vene-A (in particolare la zona dell'Alpago) è possibile il verificarsi di fenomeni di instabilità. Si prevede una situazione di criticità ordinaria per la zona Vene-D, Vene-F e Vene-G. Relativamente al rischio idraulico sono previste condizioni di ordinaria criticità sulle aste fluviali principali ricadenti nell'intero territorio regionale ad eccezione del nodo idraulico Fratta-Gorzone e del fiume Bacchiglione dove permangono elevati livelli idrometrici. Sono possibili incrementi idrometrici in conseguenza di precipitazioni anche di moderata intensità, soprattutto nei bacini di piccole medie dimensioni della zona pedemontana e prealpina.

NOTE: Domani 30/04/09 verrà emesso un aggiornamento del presente Avviso di Criticità. E' in corso il servizio di nowcasting attivato lunedì 27/04/09 a partire dalle ore 9.00. E' garantito il servizio di presidio H24 a partire dalle 7 di lunedì 27/04/2009.

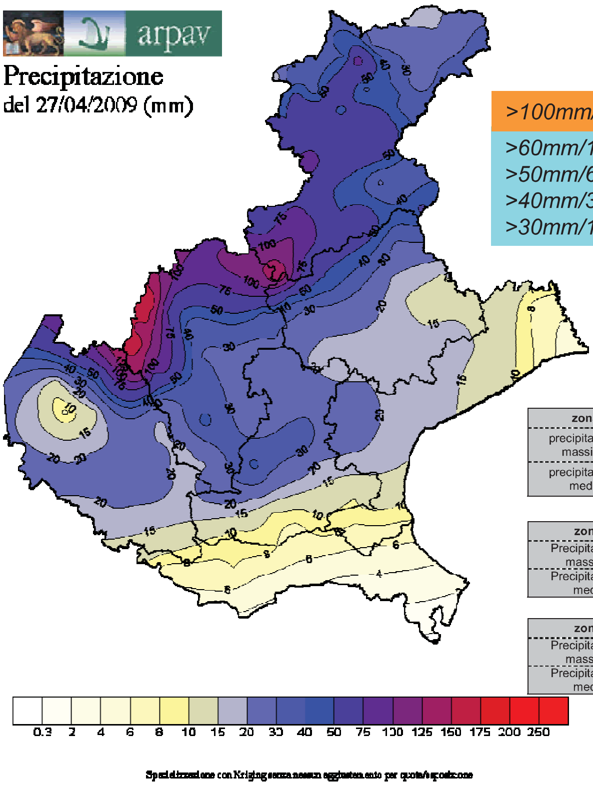
Ai diretti destinatari del presente messaggio si comunica che la ricevuta di trasmissione dell'invio a mezzo fax rappresenterà, per questa Struttura, la certificazione dell'avvenuta notifica.

D'ordine del Responsabile del Centro Funzionale
Segretario Regionale LL.PP. e Protezione Civile
Ing. Mariano Carraro
Matteo Cesca

Struttura responsabile elaborazione: Direzione Regionale Difesa del Suolo
Per informazioni: ☎041 2792357 - 041 2792234 - Reperibile 348 3630015 ✉ difesasuolo@regione.veneto.it
CENTRO FUNZIONALE DECENTRATO Sala operativa ☎041 2794012 - 041 2794016 - 4019 - ✉centro.funzionale@regione.veneto.it
Aggiornamento dell'avviso di criticità idrogeologica ed idraulica pubblicato su internet nel sito: http://www.regione.veneto.it/avvisiCFD

Example: April, 28th-30th 2009

Recorded rainfall



>100mm/24h

>60mm/12 h
>50mm/6 h
>40mm/3 h
>30mm/1 h

Nome stazione	Prov	1 ora	3 ore	6 ore	12 ore	24 ore	1 giorno	2 giorni	3 giorni	4 giorni
Turcati Recoaro	VI	22.2	50.4	81.2	138.2	243.2	174	313.8	361.8	401.4
Valpore (Valle di Seren)	BL	19	44.8	79.8	148.6	208.6	150.8	291.6	335.8	377
Rifugio la Guardia (Recoaro)	VI	20.6	47.4	68.8	129.6	227.4	168.6	288.2	326.8	363.6
Passo Xomo Posina	VI	17.2	43	77.4	135.2	204.2	158.2	257.2	308	335.8
Molini Laghi	VI	17.4	48.2	83.4	138.2	216.8	174	266	306.2	334
Contra' Doppio Posina	VI	19.4	51	84.8	142.6	201.8	159.2	254.4	297.8	323.4
Recoaro 1000	VI	12	32.4	60.2	108.2	170.2	129.2	222.4	272.2	311.8
Crespadoro	VI	18.8	54.6	98.6	170	222.4	130.6	253	283.6	308.4
Valli del Pasubio	VI	14.6	38.8	68	115.8	186.2	135.8	237.2	276.4	304.6
San Bortolo	VR	16	39.2	68.6	136.8	201.4	116.6	232.8	266	294.4
Castana (Arsiero)	VI	22	55.2	92	125	162.8	104.8	204	239.2	267.4
Marcesina	VI	10.6	29	52.2	91.8	145.4	111.2	182.2	207.8	230
Valdagno	VI	14.6	33.6	57.8	105	140.6	84.4	166	196.2	222.6
Col Indes (Tambre)	BL	18.6	52.4	88.6	126.2	146.6	116.4	165.4	206.8	221.8
Brustole' Velo d'Astico	VI	17	44	74.4	97.8	119.8	84.4	146.4	181.8	208
Cansiglio loc. Tramedere	BL	16.8	39	64.6	91.4	116.4	91	142.4	183	202.4
S. Antonio di Tortal	BL	13.4	36	54.8	88.6	118.8	70.2	140.2	183.6	199.4
Feltre	BL	12.8	25	45.2	60.8	117.2	99	139.4	176.2	193.6
Monte Avena	BL	12.4	33	59.2	98	132.6	93	153	178.6	190.4
Passo Santa Caterina Valdagno	VI	13.8	28.8	49.4	82	109.4	74.2	134.4	164.4	190.2
S. Andrea (Gosaldo)	BL	9	22.6	40.8	79.4	118.6	81.6	138	167.2	179.4
Astico a Pedescala	VI	14	37	60.8	82.6	102.2	70.2	120.4	153	175
Asiago (aeroporto)	VI	9	24.4	43.2	73	104.6	77.2	124	152	168.2

27 April 2009

zona	Veneto A	Veneto B	Veneto C	Veneto D	Veneto E	Veneto F	Veneto G
precipitazione massima	151	174	131	23	44	50	20
precipitazione media	48	95	40	11	24	22	12

28 April 2009

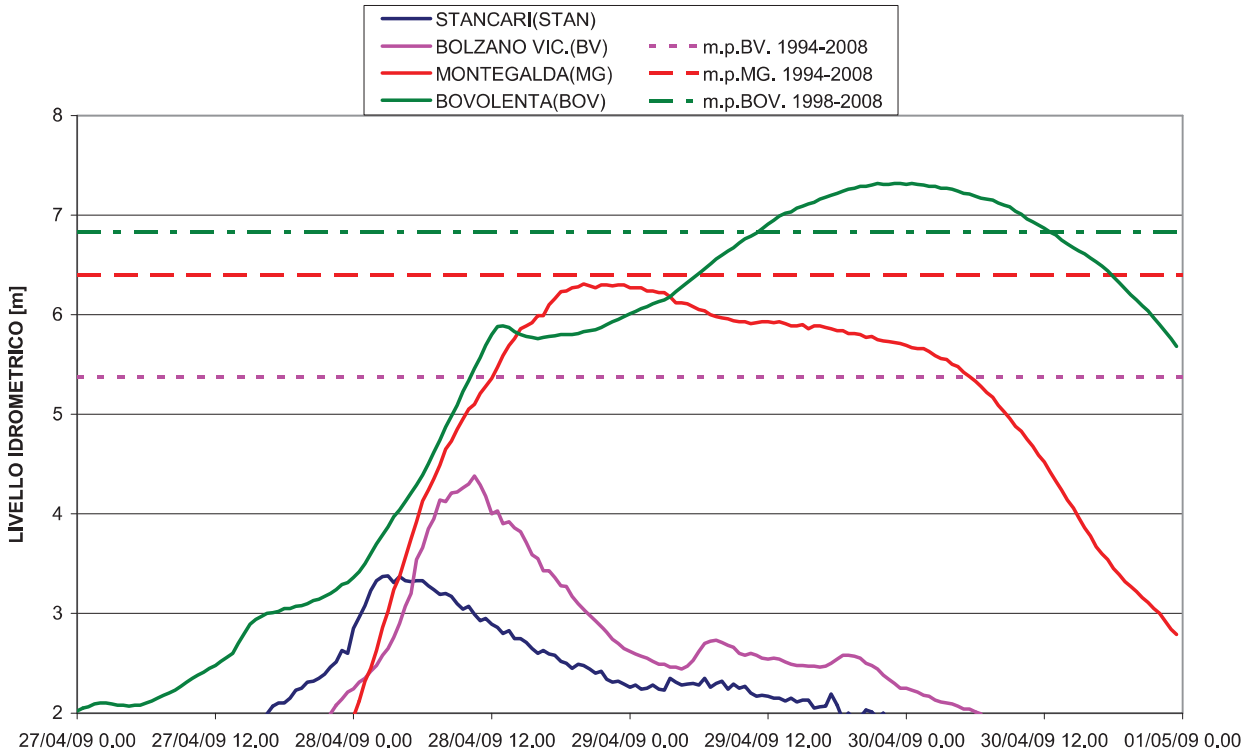
zona	Veneto A	Veneto B	Veneto C	Veneto D	Veneto E	Veneto F	Veneto G
Precipitazione massima	140.8	139.8	122.4	13.2	50	41.4	37.4
Precipitazione media	34.5	68.2	31.6	7.1	22.0	30.0	30.0

29 April 2009

zona	Veneto A	Veneto B	Veneto C	Veneto d	Veneto e	Veneto f	Veneto F
Precipitazione massima	44.2	59.8	30.6	26	40.6	42.6	25.8
Precipitazione media	23.6	33.8	20.3	11.0	22.4	19.9	17.4

Example: April, 28th-30th 2009

Hydrometric response recorded from the hydrometers of the CFD network



Example: April, 28th-30th 2009

Some important rivers in Veneto

Example: April, 28th-30th 2009

THE ROTOLON LANDSLIDE (RECOARO TERME)

Examples:

June, 5th-6th 2009

notice of adverse weather conditions →

REGIONE DEL VENETO **Centro Funzionale Decentrato**

AVVISO DI CONDIZIONI METEOROLOGICHE AVVERSE

Emissione: 5 giugno 2009 ore: 13 : 00 Validità: 05/06/2009 ore: 12.00 – 07/06/2009 ore: 18.00

SINTESI

Tipologia di fenomeni: precipitazioni diffuse su zone montane e pedemontane + attività temporalesca (anche sulla pianura)

Durata evento: da pomeriggio/sera di venerdì 05 fino a pomeriggio/sera di domenica 07. **Fase più intensa sabato 6**

Zone più interessate: zone montane e pedemontane e pianura nord orientale

DESCRIZIONE

Situazione meteo: l'arrivo di una perturbazione di origine atlantica determina un flusso instabile sud occidentale fino a sabato, con passaggio domenica della saccatura in quota associata ad una seconda fase di instabilità ma di minore entità

Fenomeni previsti:
nel pomeriggio sera di venerdì 5 precipitazioni locali in pianura, da sparse a diffuse in serata su zone montane e pedemontane, anche a carattere di rovescio o temporale.
Sabato 6 precipitazioni anche a carattere di rovescio e temporale, diffuse e localmente abbondanti su zone montane e pedemontane e pianura nord orientale, più sparse e di entità complessivamente minore sul resto della pianura (in particolare sulle zone meridionali). Localmente saranno possibili fenomeni temporaleschi intensi.
Tendenza a diradamento dei fenomeni dalla serata a partire da sud ovest.
Domenica ancora precipitazioni sparse, a prevalente carattere di rovescio o temporale, ma di entità complessivamente inferiore rispetto a sabato. Miglioramento in serata
Da Venerdì a Sabato sera venti forti in quota da sudovest. In pianura venti in genere moderati meridionali, a tratti anche sostenuti sulle zone meridionali.

Osservazioni: specie sabato sulle zone montane e pedemontane saranno presenti sia precipitazioni diffuse, anche persistenti, sia fenomeni a carattere di rovescio o temporale.

QUANTITATIVI DI PRECIPITAZIONE

Dalle ore 00 alle 24 del 05 giugno	Dalle ore 00 alle 24 del 06 giugno	Dalle ore 00 alle24 del 07 giugno
Generalmente scarsi (0-20 mm/24h), localmente moderati (20-60 mm/24h) sulle zone montane e pedemontane.	- contenuti (20-60 mm/24h) sulle zone montane, pedemontane e pianura nord orientale, solo localmente abbondanti (60-100 mm/24h) su zone montane e pedemontane. - generalmente scarsi (0-20 mm/24h) sul resto della pianura, localmente contenuti (20-60 mm/24h).	Generalmente scarsi (0-20 mm/24h), solo localmente contenuti (20-60 mm/24h) in corrispondenza dei rovesci o temporali più intensi.
Note: precipitazioni più probabili dal tardo pomeriggio/sera.		

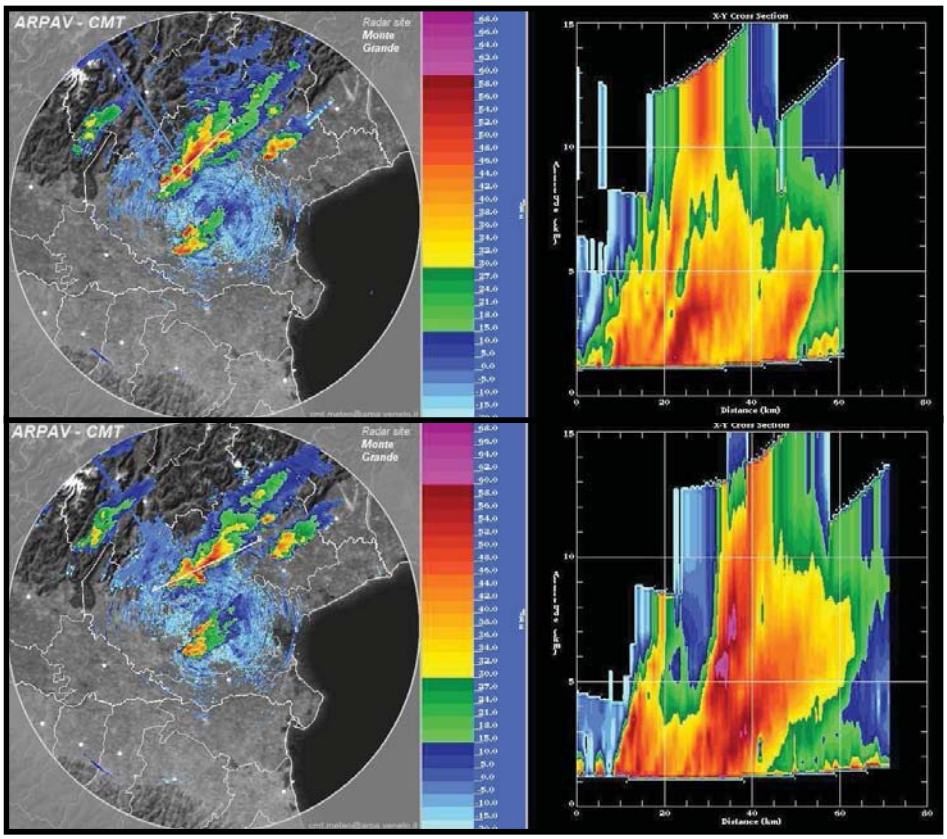
Classi di precipitazione in 24h (mm): scarsa (0-20), contenuta (20-60), abbondante (60-100), molto abbondante (100-150), molto elevata (>150mm).

Il Responsabile del Centro Funzionale
Segretario Regionale LL.PP. e Protezione Civile
Ing. Mariano Carraro

Struttura responsabile elaborazione: ARPAV - Dipartimento per la Sicurezza del Territorio - Centro Meteorologico di Teolo
Per informazioni: Sala operativa ☎049 9999128 (Centralino ☎049 9998111) - 🖷049 9999136 - Reperibile 335 7081730/36
✉ cmteo@arpa.veneto.it
CENTRO FUNZIONALE DECENTRATO Sala operativa ☎041 2794012 - 🖷041 2794016 - 4019 - ✉centro.funzionale@regione.veneto.it
Avviso di condizioni meteorologiche avverse pubblicato su internet nel sito: http://www.regione.veneto.it/avvisiCFD

Example: April, 5th- 6th 2009

Radar images of the tornado in Riese Pio X



Example: June, 5th- 6th 2009

Damages caused by the tornado in Riese Pio X

Examples:

18 of July 2009

Expected criticality ⟶

REGIONE DEL VENETO
giunta regionale

arpav

Centro Funzionale Decentrato

AVVISO DI CRITICITÀ IDROGEOLOGICA ED IDRAULICA

Emissione: 16/07/09 ore: 14:00

PREVISIONE METEO: dalla mattinata del 17 crescente probabilità di rovesci/temporali a partire dai settori montani/pedemontani occidentali in successiva estensione verso nord-est; dalla sera fenomeni sparsi anche su pianura centro-settentrionale.
Fase più intensa tra la sera del 17 e il mattino del 18 con probabili temporali di forte intensità (grandinate, forti raffiche di vento, rovesci intensi).
Miglioramento dal pomeriggio di sabato a partire dai settori occidentali.

SITUAZIONE ATTUALE: nessuna criticità sul territorio regionale.

CRITICITA' PREVISTA
Da: venerdì 17/07/2009 ore 14:00 A: sabato 18/07/2009 ore 14:00

ZONE DI ALLERTAMENTO			CRITICITÀ IDROGEOLOGICA	CRITICITÀ IDRAULICA
Codice	Province	Nome del bacino idrografico		
Vene-A	BL	Alto Piave	ORDINARIA	ASSENTE
Vene-B	VI-BL-TV	Alto Brenta-Bacchiglione	ORDINARIA	ASSENTE
Vene-C	VR-VI	Adige-Garda e monti Lessini	ORDINARIA	ASSENTE
Vene-D	RO-VR-PD-VE	Po, Fissero-Tartaro-Canalbianco e Basso Adige	ORDINARIA	ASSENTE
Vene-E	PD-VI-VR-VE-TV	Basso Brenta-Bacchiglione	ORDINARIA	ASSENTE
Vene-F	VE-TV-PD	Basso Piave, Sile e Bacino scolante in laguna	ORDINARIA	ASSENTE
Vene-G	VE-TV	Livenza, Lemene e Tagliamento	ORDINARIA	ASSENTE

VALUTAZIONE DELLA SITUAZIONE IDROGEOLOGICA ED IDRAULICA: Il verificarsi di eventi a carattere temporalesco localmente intensi potrebbe creare disagi alla rete idrografica minore del territorio interessato da tali fenomeni. Per quanto riguarda i fenomeni franosi si segnala la possibilità d'innesco di eventi di colata rapida nelle zone di allertamento VENE-A, VENE-B, VENE-C.

NOTE: E' garantito il servizio di reperibilità H24. Il Centro Funzionale Decentrato seguirà l'evoluzione dell'evento e si riserva la possibilità di emettere un aggiornamento del presente avviso in caso di peggioramento delle previsioni.

Ai diretti destinatari del presente messaggio si comunica che la ricevuta di trasmissione dell'invio a mezzo fax rappresenterà, per questa Struttura, la certificazione dell'avvenuta notifica.

CFD/MC

D'ordine del
Responsabile del Centro Funzionale
Segretario Regionale LL.PP. e Protezione Civile

Ing. Mariano Carraro

Roberto Tarabbia

Struttura responsabile elaborazione: Direzione Regionale Difesa del Suolo
Per informazioni: ☎041 2792357 - 🖷041 2792234 - Reperibile 347 7822150 - ✉ difesasuolo@regione.veneto.it
CENTRO FUNZIONALE DECENTRATO Sala operativa ☎041 2794012 - 🖷041 2794016 - 4019 - ✉centro.funzionale@regione.veneto.it
Aggiornamento dell'avviso di criticità idrogeologica ed idraulica pubblicato su internet nel sito: http://www.regione.veneto.it/avvisiCFD
UNITA' DI PROGETTO PROTEZIONE CIVILE – Sala operativa CO.R.EM. 800990009 - 🖷041 2794013 sala.operativa@regione.veneto.it

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Example: 18th of July 2009

THE DEBRIS FLOW OF "BORCA DI CADORE"

Conclusions

- ***The main goal of the CFD is to use prevention as a fundamental tool for a correct emergency assessment;***

- ***It is essential to constantly inform the addressees of CFD messages about how to interpret the notices and what actions must correspond to different levels of criticality;***

- ***The CFD operates a regional early warning function that alerts to a particular hazard/risk, therefore becomes essential that all municipalities adopt as soon as possible appropriate Municipal Civil Protection Plans;***

- ***The CFD of Veneto Region in ending its start-up period and will spend parts of the near future to improve the service given to the end users.***

Thanks for the attention

FOR MORE INFORMATIONS:
mariano.carraro@regione.veneto.it
centro.funzionale@regione.veneto.it

話題 2: 危機管理体制の事例

3.5　「2009 年ラクイナ地震のその後－緊急対応とその後の対応における技術的かつ学術的活動」

マウロ・カーディナリ

国家研究評議会水文地質災害研究所研究員

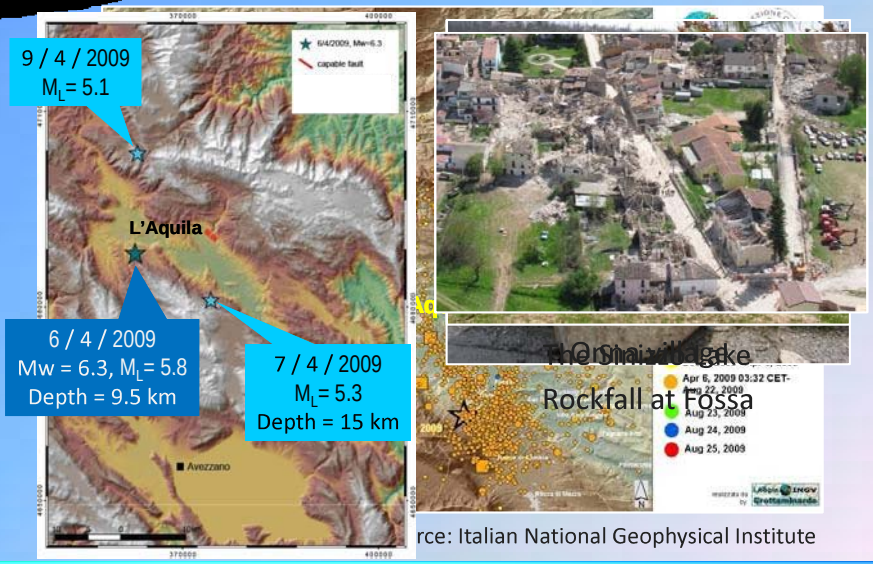
International Symposium on
"Risk Management and Governance to Cope with Natural Disasters"
Tokyo, 27th October 2009

The 2009 l'Aquila Earthquake Sequence

Technical and Scientific Activities in the Emergency and Post-Emergency Phases

Mauro Cardinali
Research Institute for Geo-Hydrological Protection
(CNR-IRPI, Perugia, Italy)
Mauro.Cardinali@irpi.cnr.it

THE 2009 L'AQUILA EARTHQUAKE SEQUENCE



rce: Italian National Geophysical Institute

MAIN ACTIVITIES

- Mapping of earthquake' ground effects
- Site evaluation for new settlements
- Rock fall hazard assessment
- Forecast of rainfall induced landslides

MAPPING OF GROUND EFFECTS

Quickbird taken on 8 April 2009
Panchromatic, 0.6 m × 0.6 m

MAPPING OF GROUND EFFECTS

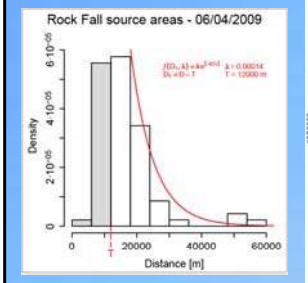


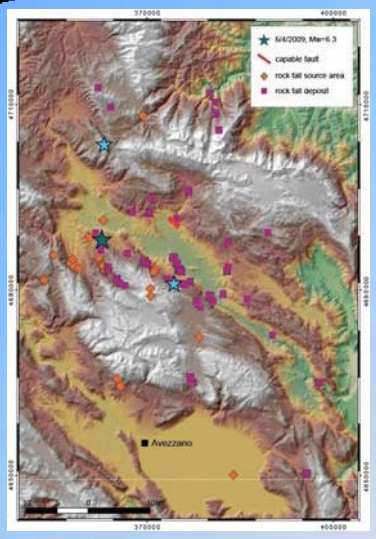


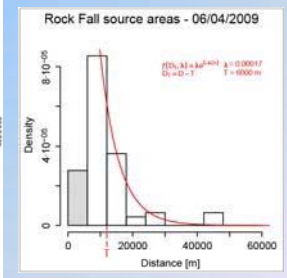
Area investigated	1260 km²
Number of landslides	> 150
Landslide type	Rockfall
Other types	Topple



MAPPING OF GROUND EFFECTS



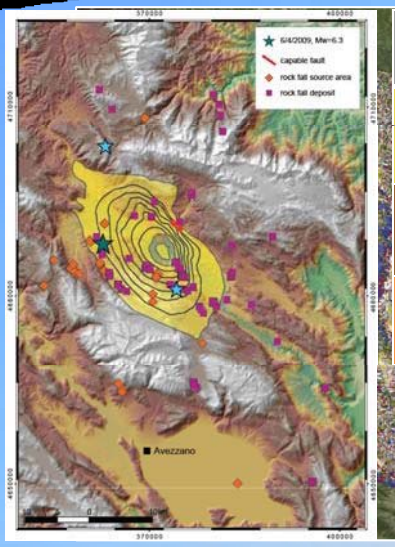




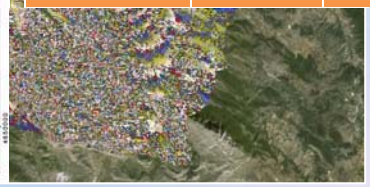
Max. Distance	25 km

MAPPING OF GROUND EFFECTS

Interferometric analysis by



	Area [km²]	*Rock falls [#]*
Within the fringes	*384 (30%)*	*88 (72%)*
External to the fringes	*883 (70%)*	*34 (28%)*
Total area	*1267*	*122*



SITE EVALUATION FOR NEW SETTLEMENTS









HOMELESS	
April	67.500
September	32.900

SITE EVALUATION FOR NEW SETTLEMENTS

PROCEDURE		
1	Town planners	Proposed areas
2	IRPI	Photo-interpretation and field survey
		Geomorphological mapping
		Mapping of suitable areas
3	IRPI	Formal assessment and report to the Civil Protection Dept.

SITE EVALUATION FOR NEW SETTLEMENTS

PROPOSED SITES

GEOMORPHOLOGICAL SUITABLE SITES

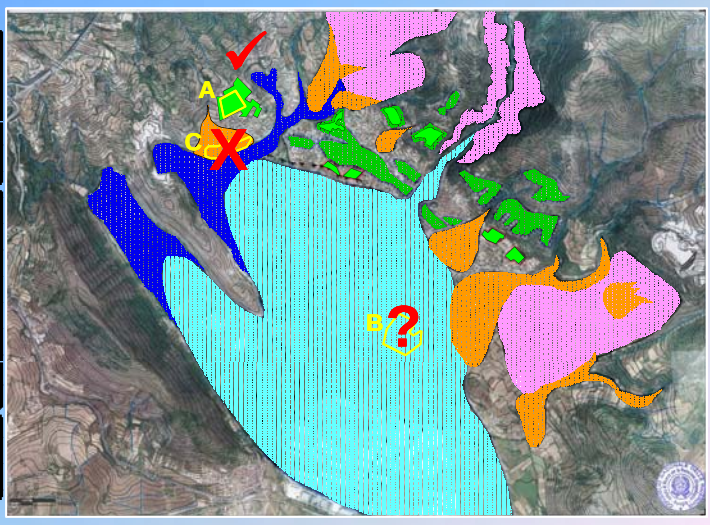
LANDSLIDE

DEBRIS CONE

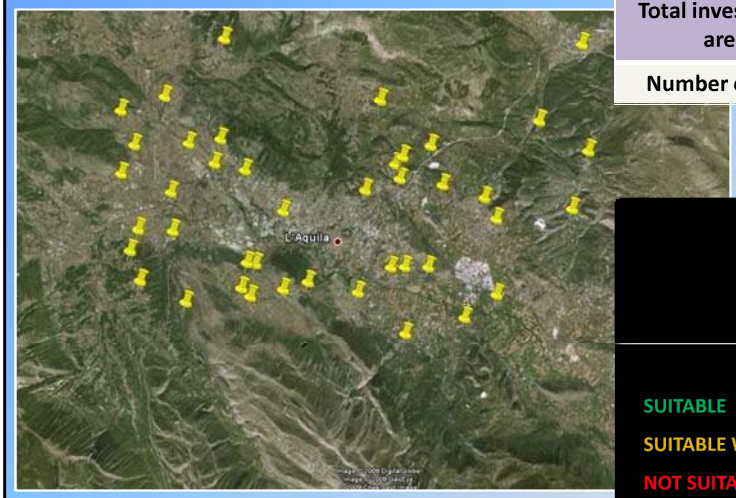
ALLUVIAL FAN

ALLUVIAL PLAIN

TERRACE



SITE EVALUATION FOR NEW SETTLEMENTS



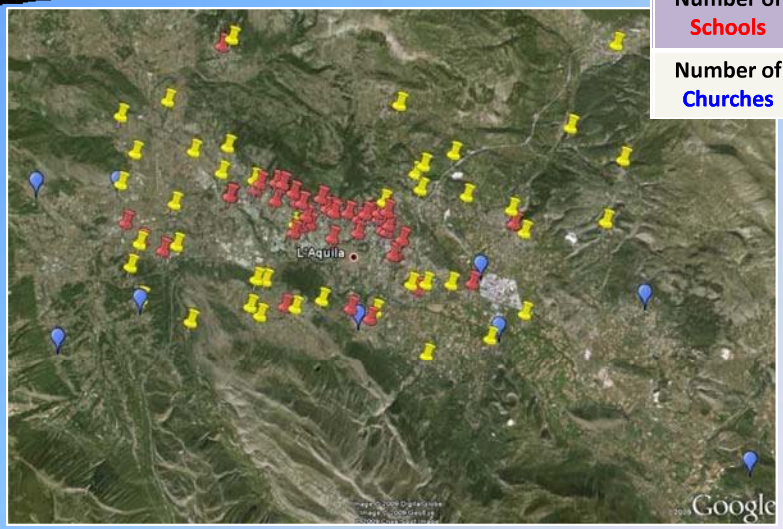
Total investigated area	150 km²
Number of sites	61

SUITABLE

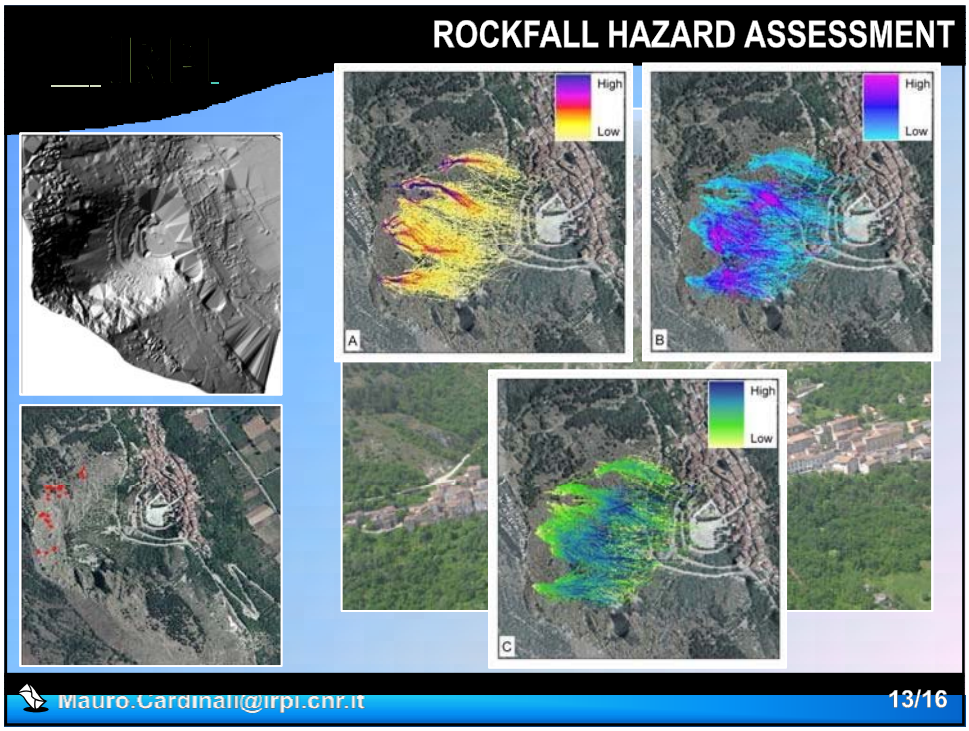
SUITABLE WITH PRESCRIPTIONS

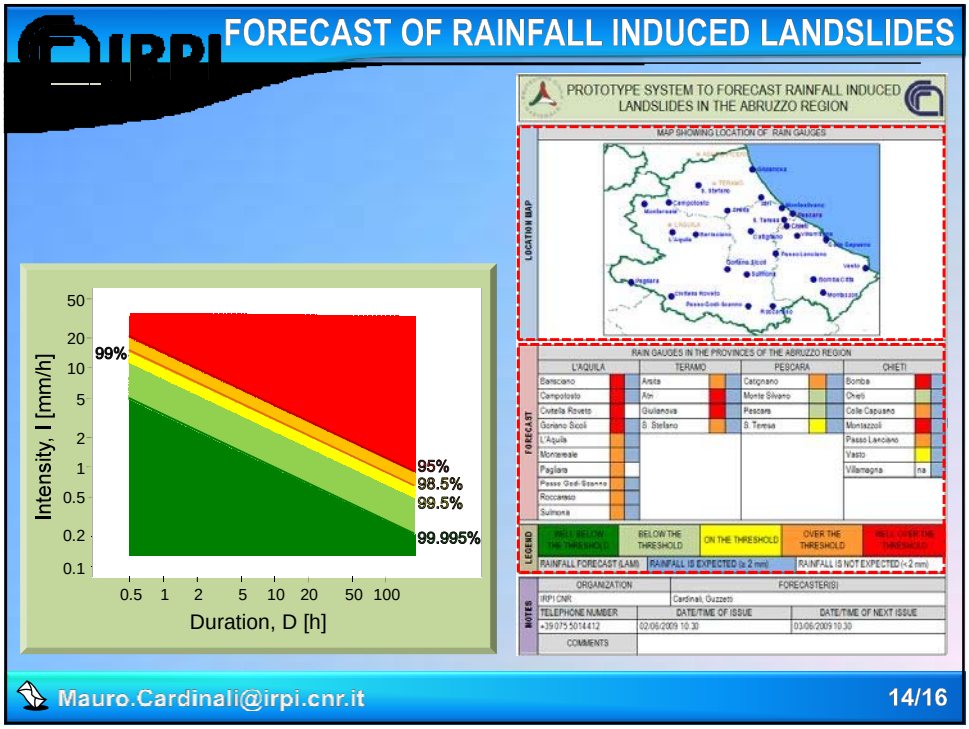
NOT SUITABLE

SCHOOL & CHURCH SITES



Number of Schools	51
Number of Churches	9/30


ROCKFALL HAZARD ASSESSMENT
High
Low
A
B
C
Mauro.Cardinali@irpi.cnr.it
13/16


FORECAST OF RAINFALL INDUCED LANDSLIDES
PROTOTYPE SYSTEM TO FORECAST RAINFALL INDUCED LANDSLIDES IN THE ABRUZZO REGION
MAP SHOWING LOCATION OF RAIN GAUGES
LOCATION MAP
RAIN GAUGES IN THE PROVINCES OF THE ABRUZZO REGION
FORECAST
L'AQUILA
TERAMO
PESCARA
CHIETI
LEGEND
RAINFALL FORECAST (LAM)
RAINFALL IS EXPECTED (≥ 2 mm)
RAINFALL IS NOT EXPECTED (< 2 mm)
NOTES
ORGANIZATION
FORECASTER(S)
IRPI CNR
Cardinali, Guzzetti
TELEPHONE NUMBER
DATE/TIME OF ISSUE
DATE/TIME OF NEXT ISSUE
COMMENTS
Intensity, I [mm/h]
Duration, D [h]
99%
95%
98.5%
99.5%
99.995%
Mauro.Cardinali@irpi.cnr.it
14/16

CONCLUSIONS

- The l'Aquila 2009 earthquake sequence triggered primarily rock falls.
- The density of slope failures decreases away from the epicenters following exponential laws that is compatible with previous studies
- The majority of the slope failures occurred where surface deformation measured by DIn-SAR was largest.
- The procedure for the site evaluation for new settlements is effective and operative
- Rock fall hazard assessment and bulletins for the possible occurrence of landslides turn out to be useful in the post-emergency phase
- We believe that these techniques can be applied with success in other Natural Disasters, in Italy and elsewhere.

Thank you for your attention

P. Allasia, L. Antronico, F. Ardizzone, M. Bado, V. Balducci,

L. Borselli, M.T. Brunetti, F. Fiorucci, D. Giordan, F. Godone,

F. Guzzetti, G. Iovine, G. Lollino, P. Lollino, F. Luino, A.Mondini,

M.Parise, M. Rossi, P. Reichenbach, M. delle Rose, S. Silvano

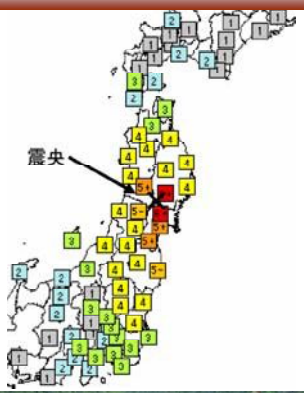
話題 2: 危機管理体制の事例

3.6 「平成 20 年岩手宮城内陸地震における TEC-FORCE 活動について」

小竹 利明　東北地方整備局河川部河川計画課　建設専門官

岩手・宮城内陸地震の概要

【発生日時】平成20年6月14日　8時43分
【場　　所】岩手県内陸南部の深さ8km
【規　　模】M7.2
【最大震度】6強（宮城県栗原市、岩手県奥州市）
【被害の特徴】
○中山間地における土砂災害の被害が甚大
（大規模な河道閉塞（天然ダム）が15箇所で形成）
○一方、震度の割には住宅被害は少なかった。




▲土石流の直撃を受けた旅館


▲大規模な地すべりが発生


▲大規模な河道閉塞（天然ダム）

1

地震発生直後の国土交通省の災害対策

6月14日（土）
8：43　地震発生（M7.2）
10：00　防災ヘリコプター（みちのく号）飛行開始
13：20　**TEC-FORCE（先遣隊）調査開始**
6月15日（日）
7：00　**土研、国総研による現地調査開始**
10：00　**TEC-FORCE（土砂災害対策班）が調査開始**
11：00　迫川、磐井川にて11箇所の河道閉塞確認
6月16日（月）　岩手・宮城県が国交省へ河道閉塞緊急対策を要請
7：00　**TEC-FORCE（道路調査班）が調査開始**
TEC-FORCE（被災建築物調査班）が調査開始
6月17日（火）　直轄砂防災害関連緊急事業実施
（約25億円　磐井川1箇所、迫川2箇所）
6月21日（土）　直轄砂防災害関連緊急事業実施
（約18億円　磐井川1箇所、迫川2箇所）
6月24日（火）　直轄砂防災害関連緊急事業実施
（約1億円　迫川1箇所）
7月　9日（水）　直轄砂防災害関連緊急事業実施
（約18億円　迫川2箇所）


ヘリ調査


専門家の天然ダム調査

2

緊急災害派遣隊（TEC-FORCE）

Technical Emergency Control Force

●地震、水害・土砂災害等から**国民の生命と財産を守ることは国の基本的責務**
●**人員・資機材の派遣体制等の充実**を図り、危機管理体制を強化

⇨ 平成20年度に創設

活動内容

- **被災状況の迅速な把握**
- **社会基盤施設の早期復旧**
  - ・初動対応の迅速化
  - ・専門チームによる集中対応
  - ・復旧対策に関する技術指導の充実・強化
- **二次災害の防止**
  - ・被災箇所に対する高度な技術指導
  - ・応急対策（立案・実施）
  - ・災害危険度予測（避難判断）
- **その他災害応急対策**


TEC-FORCE出発式


TEC-FORCE調査

3

TEC-FORCE（先遣隊・ヘリ調査）活動内容

6／14（土）

TEC-FORCE（先遣隊） ヘリ調査開始

6／15（日）

前日からのヘリ調査を基に、下流保全施設（家屋等）に影響のあると思われる規模の河道閉塞（天然ダム）箇所を11箇所選定

6／16（月）

河道閉塞3箇所が、直轄災害関連事業に採択

6／17以降

その後もヘリ調査を続け、合計15箇所の危険な河道閉塞を発見し、そのうち9箇所が直轄災害関連事業に採択

4

ヘリ調査で見つかった河道閉塞（天然ダム）

5

TEC-FORCE（地上調査）活動内容

・土木技術等に精通し、即戦力となる職員354名を派遣
・土砂災害危険箇所緊急点検、道路・橋梁点検等を迅速に実施

土砂災害

道路・橋梁

被災建物・下水道
（応急危険度判定）

6

TEC-FORCE　土砂災害危険箇所緊急点検

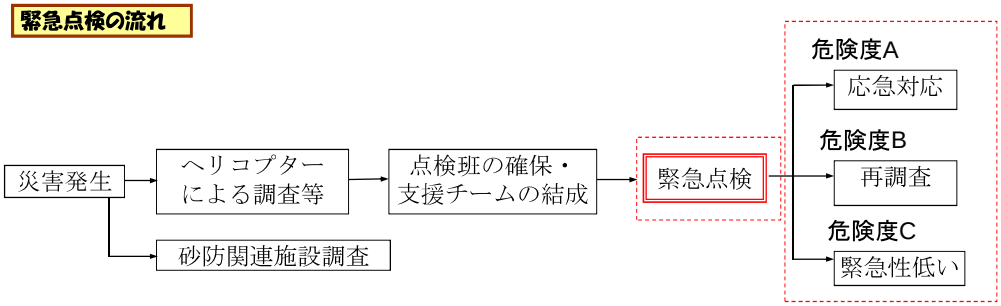
緊急点検とは

目的：災害発生後の降雨等により土砂災害発生の危険性が懸念されることから、２次災害防止に役立てることを目的として実施するもの

点検範囲：土砂災害危険箇所とその周辺箇所

点検主体：国土交通省地方整備局、事務所、都道府県

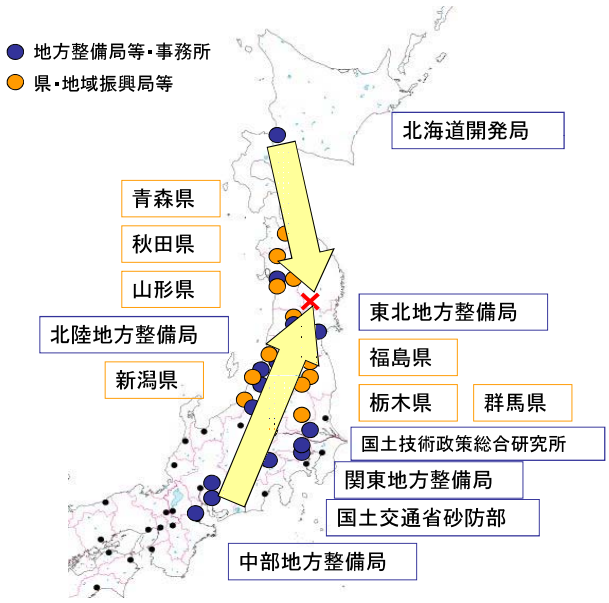
緊急点検の流れ



7

TEC-FORCE 土砂災害危険箇所緊急点検 チーム体制

平成20年岩手・宮城内陸地震

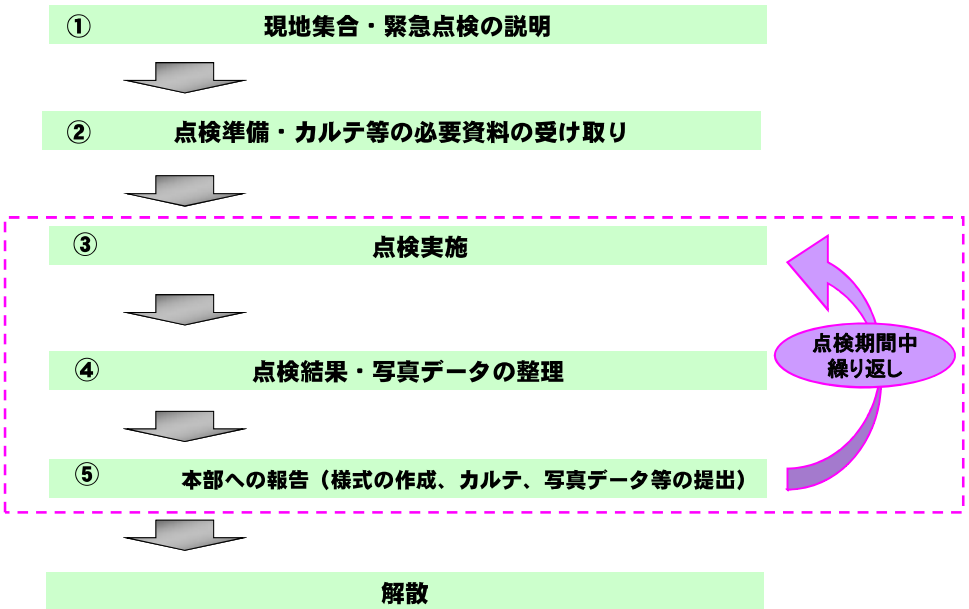


【現地点検班】

部署名	班数
開発局	1
東北地整	4
関東地整	3
北陸地整	5
中部地整	4
青森県	2
秋田県	2
山形県	2
福島県	2
栃木県	2
群馬県	1
新潟県	2
宮城県	1
計	31

8

TEC-FORCE 土砂災害危険箇所緊急点検 作業手順



9

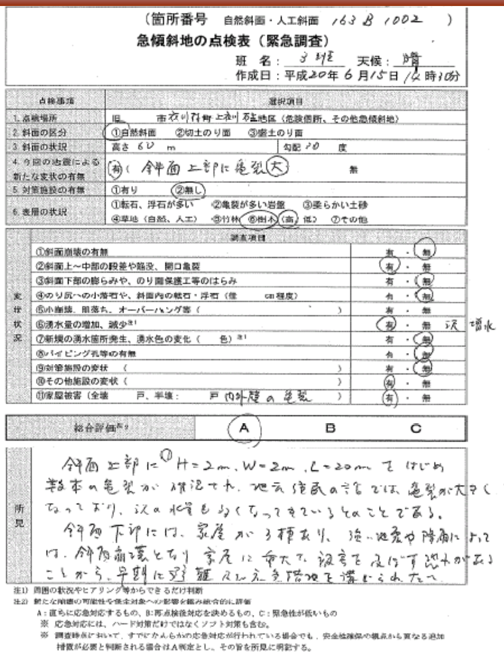
点検事項(急傾斜地崩壊危険箇所の例

危険箇所の諸元

危険箇所の状況

判定結果

所見



（箇所番号　自然斜面・人工斜面　163 B 1002　）

急傾斜地の点検表（緊急調査）

班　名：3班　天候：晴

作成日：平成20年6月15日14時10分

点検事項	選択項目
1. 点検場所	旧　市衣川村衣川 地区（危険箇所、その他急傾斜地）
2. 斜面の区分	①自然斜面　②切土のり面　③盛土のり面
3. 斜面の状況	高さ 60 m　勾配 20 度
4. 今回の地震による新たな変状の有無	有（斜面上部に亀裂（大）　無
5. 対策施設の有無	①有り　②無し
6. 表層の状況	①転石、浮石が多い　②亀裂が多い岩盤　③柔らかい土砂　④草地（自然、人工）　⑤竹林　⑥樹木（高、低）　⑦その他

調査項目	
①斜面崩壊の有無	有・無
②斜面上～中部の段差や陥没、開口亀裂	有・無
③斜面下部の膨らみや、のり面保護工等のはらみ	有・無
④のり尻への小落石や、斜面内の転石・浮石（径　cm程度）	有・無
⑤小崩壊、肌落ち、オーバーハング等（　）	有・無
⑥湧水量の増加、減少※1	有・無　沢　増水
⑦新規の湧水箇所発生、湧水色の変化（　色）※1	有・無
⑧パイピング孔等の有無	有・無
⑨対策施設の変状（　）	有・無
⑩その他施設の変状（　）	有・無
⑪家屋被害（全壊　戸、半壊：　戸 内外壁の亀裂）	有・無

総合評価※2	A	B	C

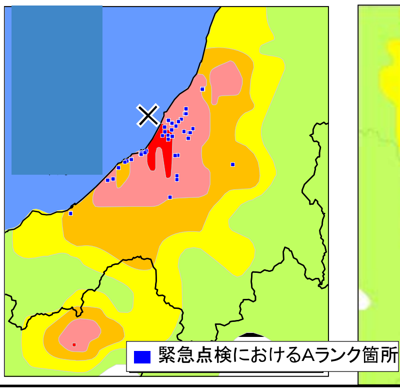
所見：斜面上部に①H=2m、W=2m、L=20mをはじめ数本の亀裂が確認され、地元住民の話では、亀裂が大きくなっており、沢の水量も多くなってきているとのことである。斜面下部には、家屋が3棟あり、強い地震や降雨によっては、斜面崩壊となり家屋に重大な被害を及ぼす恐れがあることから、早期に避難などの措置を講じられたい。

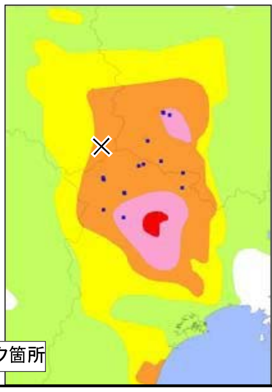
判定結果がAの場合の対応

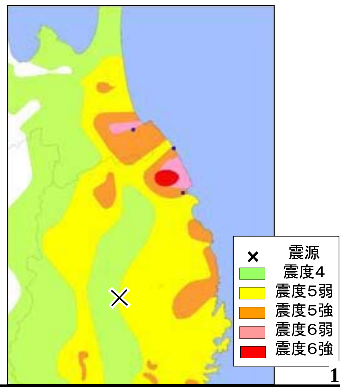
Aランク箇所発見後、直ちに情報伝達

点検班 → 点検本部 → 都道府県 → 市町村 → 住民

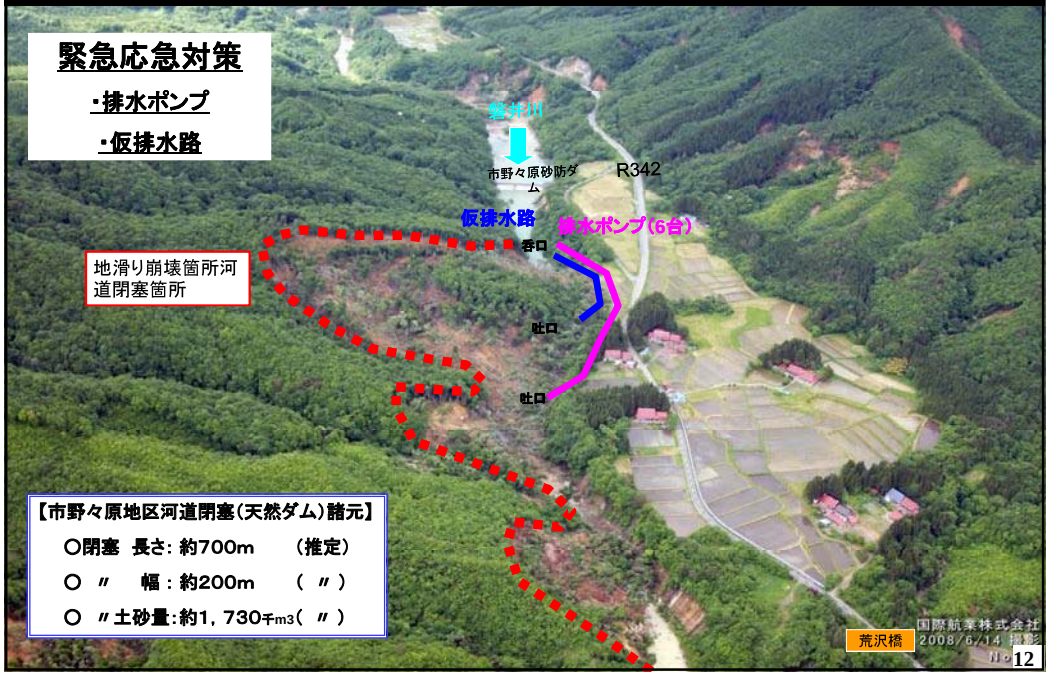
- 点検本部：・携帯電話による状況報告、写メール送信
- 都道府県：・崩壊状況の確認　・応急対応の検討
- 市町村：・警戒避難体制の検討
- 住民：・警戒避難







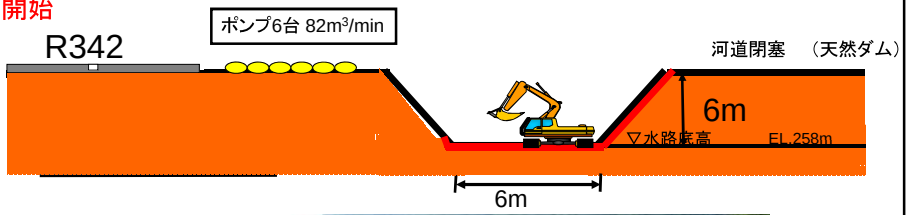
市野々原地区河道閉塞の緊急対応＜排水ポンプ・仮排水路の緊急整備＞



12

仮排水路の開削（発災７日後に完成・通水開始）

6月19日
ポンプ排水開始



6月21日
排水路通水開始

排水ポンプを実施しながらの仮排水路掘削状況

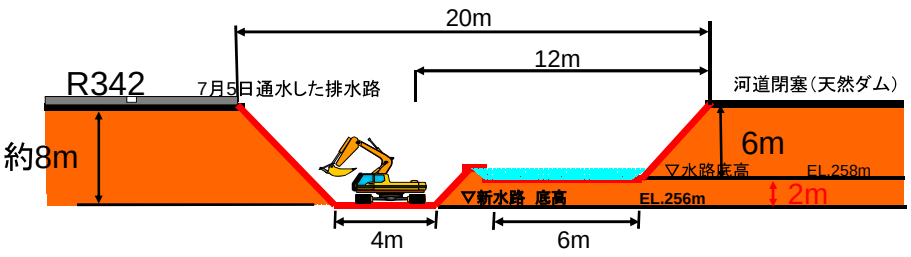
13

排水ポンプ・仮排水路の作業状況




14

仮排水路の拡幅（発災後２１日後に完成・通水開始）



断面拡幅掘削をしながら、仮排水路を流下する磐井川

完成した断面拡幅部を流下する磐井川

15

仮排水路拡幅の作業状況




16

まとめ

・TEC-FORCEは平成20年度に創設され、
岩手宮城内陸地震が初めての派遣

・TEC-FORCE活動により、迅速な被災箇所の把握が可能

・被災箇所把握後の迅速な応急対策により、
河道閉塞の決壊等の二次災害は発生せず

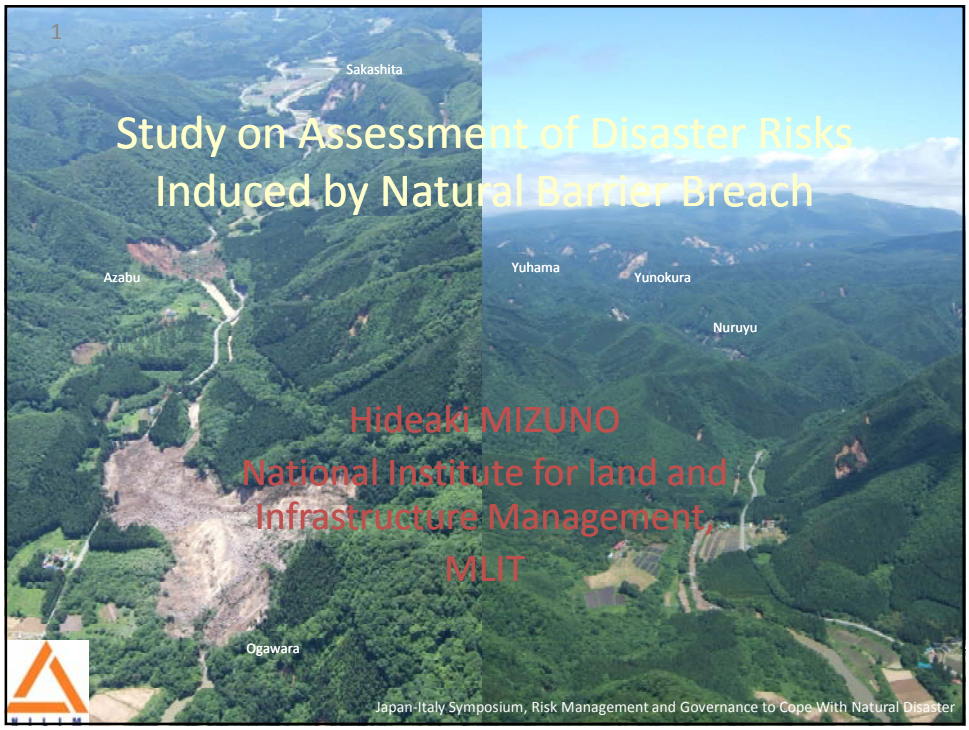
17

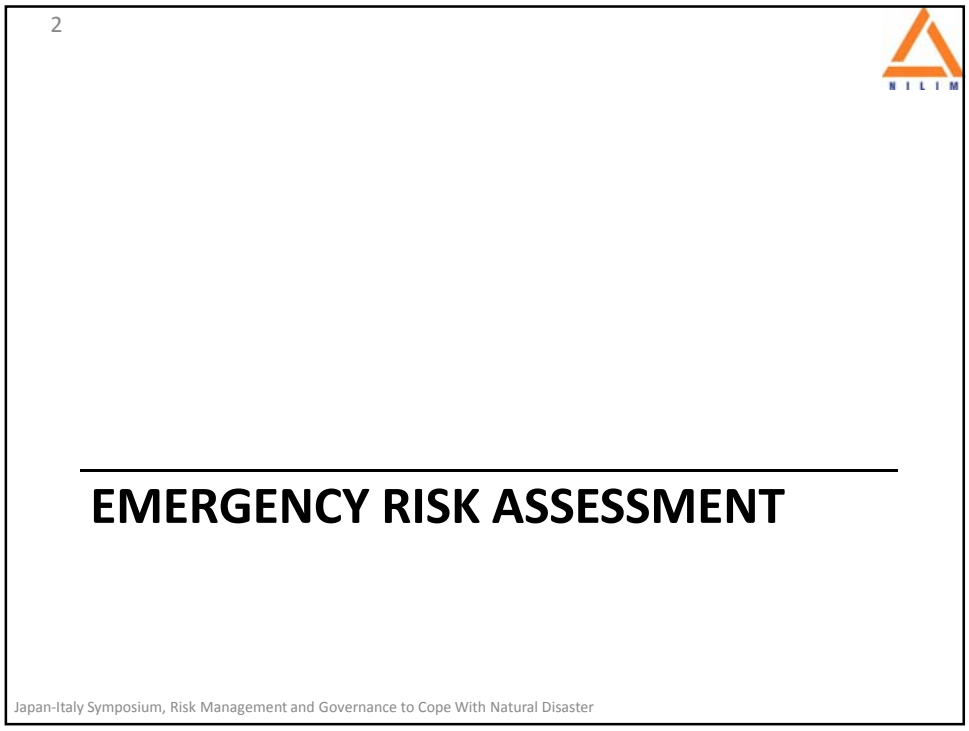
話題 3: 危機管理体制とリスク評価に関する最近の研究成果

3.7　「平成 20 年岩手宮城内陸地震における危険度評価について」

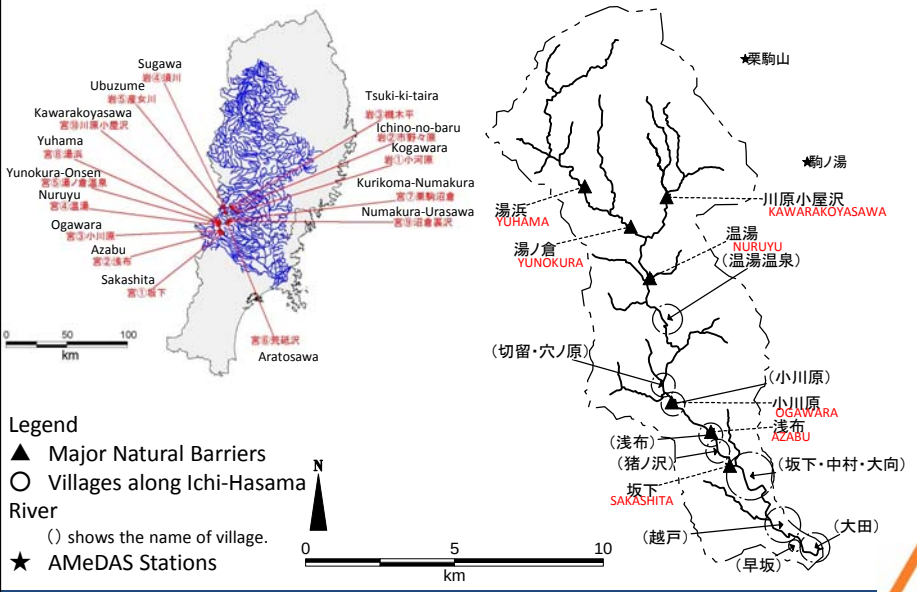
水野　秀明　国土技術政策総合研究所

危機管理技術研究センター砂防研究室　主任研究官


1
Sakashita
Study on Assessment of Disaster Risks Induced by Natural Barrier Breach
Azabu
Yuhama
Yunokura
Nuruyu
Hideaki MIZUNO
National Institute for land and Infrastructure Management, MLIT
Ogawara
Japan-Italy Symposium, Risk Management and Governance to Cope With Natural Disaster


2
EMERGENCY RISK ASSESSMENT
Japan-Italy Symposium, Risk Management and Governance to Cope With Natural Disaster

3 Location of Natural Barriers



4 Location and Position of Natural Barriers

Place	Position		Dimension		
	Longitude [deg.]	Latitude [deg.]	Height [m]	Width [m]	Long [m]
Yuhama	140.7458500	38.9044833	45	50	1200
Yunokura	140.7636167	38.8923167	20	52.5	630
Kawarakoyasawa	140.7774833	38.9011833	30	50	600
Nuruyu	140.7709833	38.8767667	6	40	820
Ogawara	140.7794333	38.8393333	10	30	580
Azabu	140.7946833	38.8304667	8	40	210
Sakashita	140.8020333	38.8202667	2.9	12.6	80

As of June 25, 2008

5 Assumed Process of Breach

- Following processes are assumed in case of the emergency risk assessment:
  1. Over-topping – Quick erosion type
  2. Seepage – Sliding type

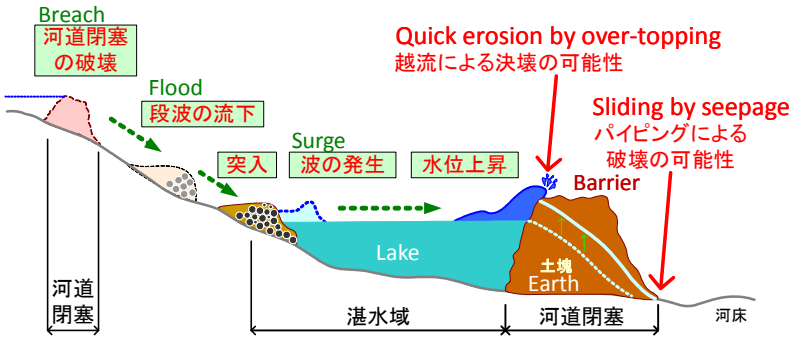


Fig. Conceptual diagram of the process of natural barrier breach

6 Results of the Emergency Risk Assessment -1-

Place	Dimension			Process of breach			Estimated peak discharge [m^3/s]	
				Days for breach				
	H[m]	W[m]	L[m]	Over-topping	Piping		Based on the monitored incoming flow rate	Based on the past record of maximum 24 hours rainfall
Yuhama	45	50	1200	39.2	1716	Overtopping	15～838	273～838
Yunokura	20	52.5	630	3.4	1081	Overtopping	10～471	187～528
Kawarakoyasawa	30	50	600	—	—	Overtopping	15～572	123～572
Nuruyu	6	40	820	—	—	Overtopping	1～34	34～85
Ogawara	10	30	580	—	—	Overtopping	4～103	103～161
Azabu	8	40	210	—	—	Overtopping	3～61	61～144
Sakashita	2.9	12.6	80	—	—	Overtopping	1～33	33～57

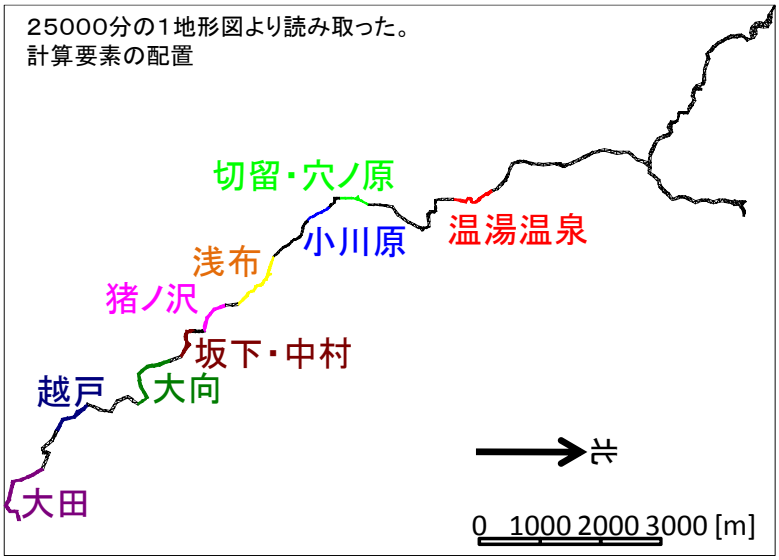
7 Results of the Emergency Risk Assessment -2-

- Water and sediment will be flooded in the Nuruyu-onsen village, Inonosawa village and Ohta village if the largest natural barrier, Yunokura, breaches.

Village	Capacity of flood [m^3/s]
Nuruyu-onsen	230～1200
Ogawara	1850～3021
Azabu	1194～8201
Inonosawa	260～4900
Hayasaka	1110～1150
Ohta	180～4900

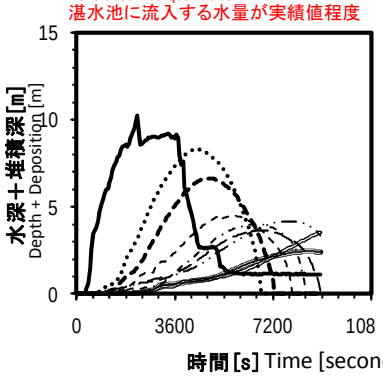
8 Results of the 2nd Risk Assessment -1-

- A series of natural barriers will be breached.

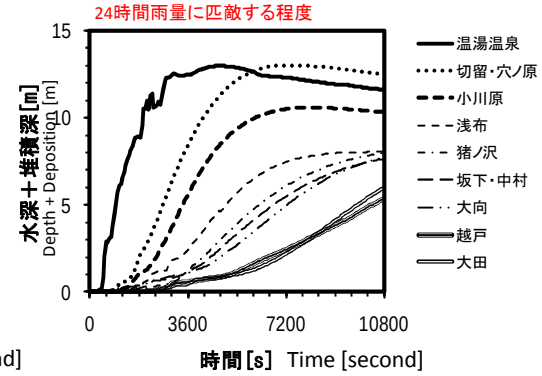


9 Results of the 2nd Risk Assessment -2-

The incoming flow into each lake are equal to the observed quantities.
湛水池に流入する水量が実績値程度



Rainfall equaled to the past record will occur
湛水池に流入する水量が既往最大24時間雨量に匹敵する程度



Difference between river bed and house

a.	Nuruyu-onsen	4m
b.	Ananohara	8m
c.	Inonosawa	6m
d.	Sakashita	5m
e.	Koedo	5m
f.	Ohta	11m

① If the incoming flow into each lake are equal to the observed quantities, Nuruyu-pnsen village will be flooded.
② If rainfall equaled to the past record will occur, all village except for Ohta will be flooded.

10

CHANGE OF NATURAL BARRIERS

11 Natural Barrier at Yuhama -1-

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✓After about one month, water in the lake formed by the natural barrier had been flowing on the surface of the barrier.
✓The surface of the barrier had been gradually eroded, so that the flood is not occurred at this moment.

①水が侵食していない箇所

②水が侵食した箇所(澪筋内)

12 Natural Barrier at Yuhama -2-

October 15, 2008

November 7, 2008

May 18, 2009

Big scale flood occurred on October 24, 2008, and many rocks deposited on the gully were moved. After this event, surface flow has been observed.

Left: Enlarged photo
The rock is marked by red circle.
Diameter is about 3m.

13 Natural Barrier at Yuhama -3-

- Process of erosion

June 30, 2008 April 28, 2009

Red : Rocks、Yellow: Trees Orange dot line: gully

The surface covered with sand had been eroded, however other area covered with rocks had not been eroded.

14 Current Situation as of April 28, 2009

Sakashita Azabu Ogawara

Nuruyu Kawarakoya-sawa Yunokura

Lakes formed by natural barrires have been disappeared or open channels have

15

SUMMARY

16 Conclusion

- Emergency Risk Assessment
  - Water and sediment will be flooded in the Nuruyu-onsen village, Inonosawa village and Ohta village if the largest natural barrier, Yunokura, breaches.
  - If a series of natural barriers – Yuhama, Yunokura and Kawarakoyasawa- have been breaching, Nuruyu village will be flooded.
- Current Situation as of Apr. 28, 2009
  - It is low probability that natural barriers except for Yuhama will be breach.
  - However the natural barrier at Yuhama is stable because the surface is covered with a lot of big rocks.

話題 3: 危機管理体制とリスク評価に関する最近の研究成果

3.8「ラクイラ地震―
危機管理とサイズミック　マイクロゾネーション」

ジャンパオロ・キャビナート

国家研究評議会水文地質災害研究所研究員

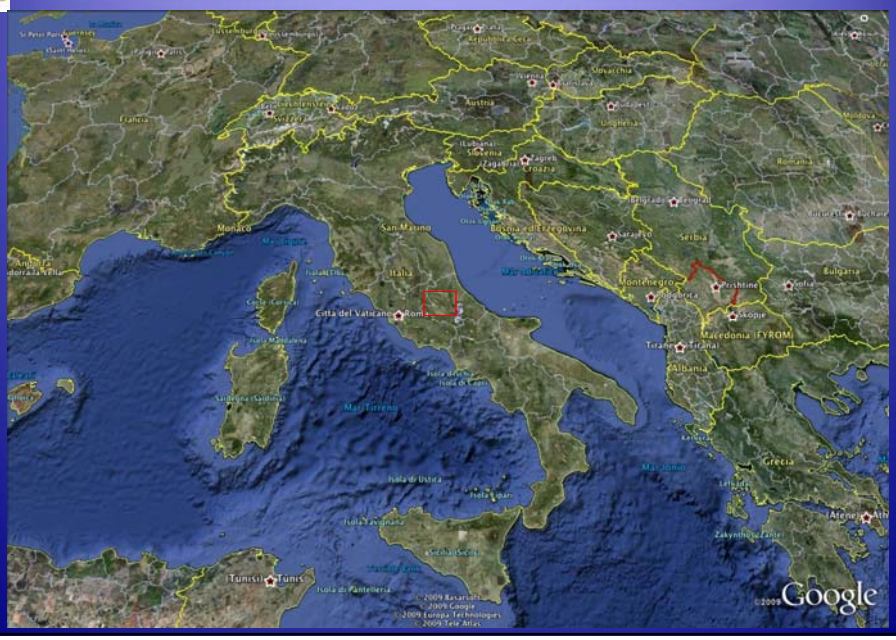
International Symposyum on
"Risk Management and Governance to Cope with Natural Disasters"
Mita Kaikan (Tokyo)

L'Aquila Earthquake: Managing Emergency and Seismic Microzonation

Gian Paolo Cavinato
CNR- Istituto Geologia Ambientale e Geoingegneria, Rome, Italy

TOKYO October 2009

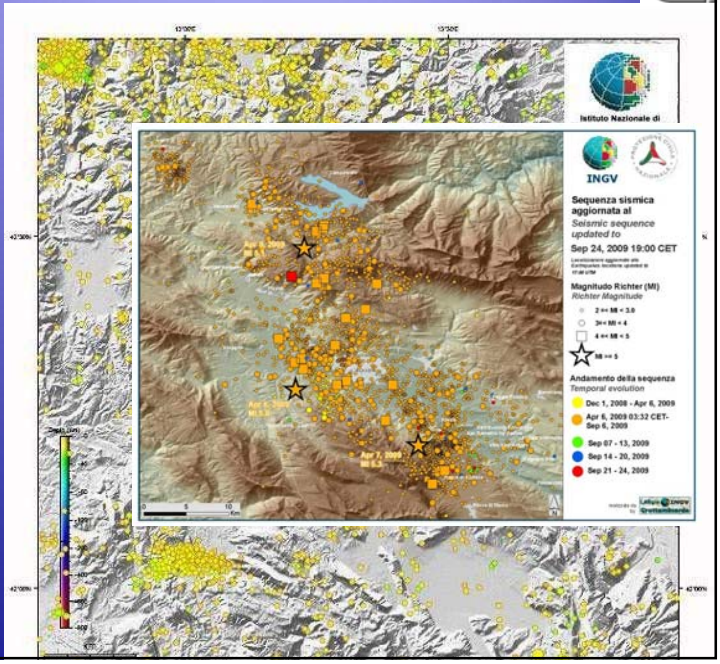
The 6th April 2009: L'Aquila earthquake



The 6th April 2009: L'Aquila Earthquake

The 6th April 2009 L'Aquila earthquake

2005-08 Historical instrumental sesimicity (2005-2008)



Managing Emergency Activities of the CNR (IRPI, IGAG, IAMC, IREA, ISMAR) for the Italian Department Civil Protection

- ACQUISITION OF GEOLOGICAL MAPS AND SUBSURFACE DATA
- FIELD MAPPING OF COSEISMIC DEFORMATIONS
- GEOLOGICAL SURVEY OF THE SITES IDENTIFIED FOR REBUILDING
- HYDROGEOLOGICAL, GEOMORPHOLOICAL, AND GEOPHYSICAL CHARACTERIZATION OF THE SITES CHOSEN FOR REBUILDING
- SEISMIC MICROZONATION

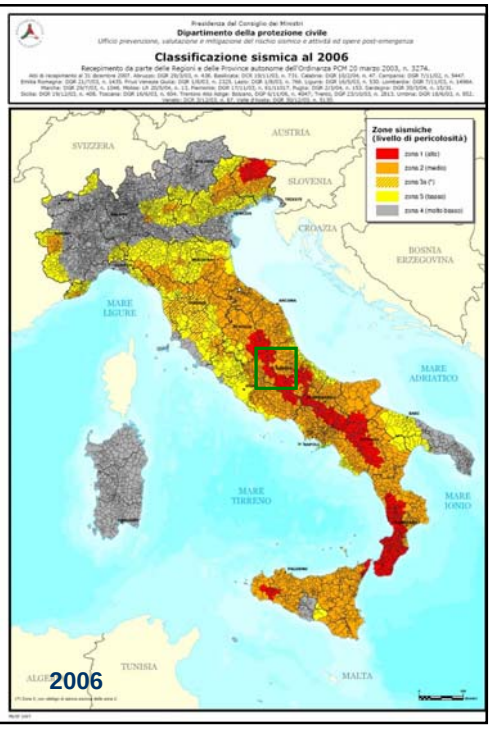
http://www.protezionecivile.it/

New criteria for seismic microzonation

Seismic microzonation in Italy

• Two different technical – scientific approaches for the mitigation of seismic risk:
  - Built new infrastructure knowing seismic hazard (reduce uncertainty on geohazard)
  -Built new infrastructures following earthquake proof methodologies (reduce the vulnerability)

➢Microzonation follows the first approach



Seismic Microzonation

LEVEL I
Output:
Map of the previous surveys
Map of Homogeneous zones for seismic microzonation

LIVEL II
Actions:
New data acquisition
Simplified numerical modeling
Output:
Map of the zones with no-co seismic effects expected
Map of zones prone to co seismic effects (Liquefaction, Active faults, Differential settlements)

LIVEL III
Actions:
New data acquisition
Output:
Map of Seismic Microzonation

Seismic Microzonation

Goals of Seismic Microzonation:

- Identify and edge areas with different level of seismic hazard
- Evaluate the seismic response of the terrains identified in the microzones for the riduction of the seismic risk

MICROZONES

The Microzones are classified in three categories:

- Stable Zones, with no seismic amplification compared to the seismic bedrock
- Stable Zones, with seismic amplification related to geological features
- Unstable Zones, (landslides, liquefaction, compaction of granular soils, consolidation of fine soils, differential settlement, outcropping active faults, etc.)

SEISMIC MICROZONATION IN THE L'AQUILA AREA

- The Italian National Civil Protection and the Abruzzo Region make the coordination of the working group
- The work start at the beginnig of May, and finish the 30th september, six month after the earthquake
- The budget of the operation is of 400.000 Euro

(All the Research Institute, the University, the Region and Province don't have any economic contributions)

SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE PROJECT

- More than 15 Municipalities are analyzed that have a macroseismics intensity at least 7° of MCS Scale
- The Task Force is compose by:

10 University: L'Aquila, Chieti-Pescara, Genova, Politecnico Torino, Politecnico Milano, Firenze, Basilicata, Roma1, Roma 3, Siena

7 Research Institute: CNR, INGV, AGI, RELUIS, ISPRA, ENEA Frascati, OGS Trieste

3 Regions and 2 Province: Lazio, Emilia-Romagna, Toscana, Provincia di Trento, Provincia di Perugia

The Task Force are compose up to 200 people

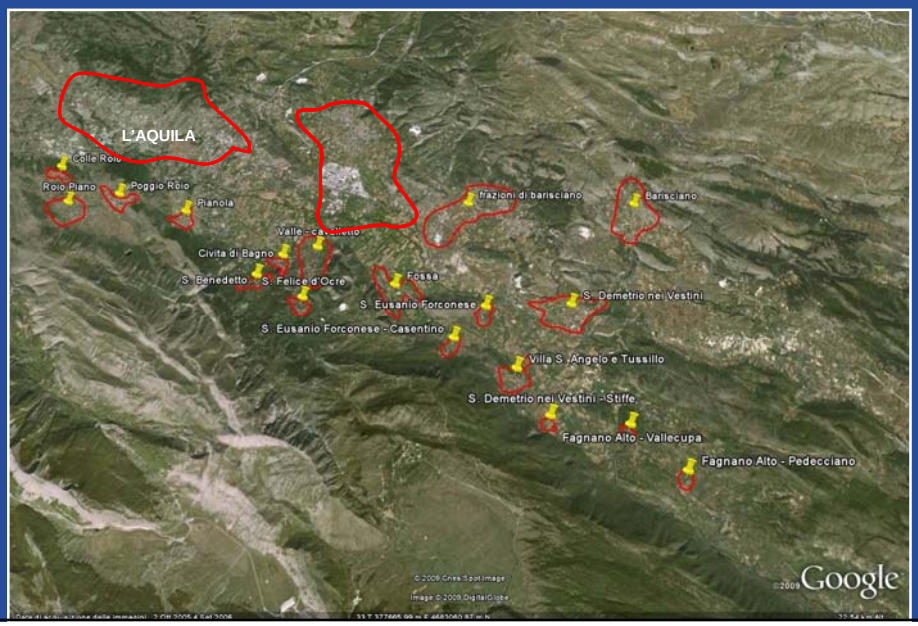
SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE TASK PROJECT

- Task 1: Finding, archivage and GIS Georeferencing of the previuos data
- Task 2: Geological and geotechnical Models geologico-tecnico (Geologists)
- Task 3: Geothecnical Analysis of the terrains (Geotechnics)
- Task 4: Geophysical Analysis of the terrains (Geophysics)
- Task 5: Instrumental Analyses: H/V Spectral rapport, strong / weak motion and microtremors (seismologist)
- Task 6: Numeric Simulation for Earthquake Reference (Geologists and statististics)
- Task 7: Numeric Simulation (Geologists and Engineer Geotechnicals)
- Task 8: Damage Analysis (Structural Engineers)
- Task 9: Urban planning and Building Technical Norm (Architects and Engineers)
- Task 10: Final Report, GIS cartographic output, and publication

SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE TASK PROJECT ACTIVITY

1) L'Aquila Center
2) L'Aquila Ovest (Cansatessa-Pettino), Coppito
3) L'Aquila Est (Tempera, Paganica, San Gregorio, Bazzano, S.Elia)
4) Poggio Picenze, San Pio delle Camere (Castelnuovo), Barisciano
5) Onna
6) Villa S.Angelo (Tussillo), S.Eusanio Forconese (Casentino), Fossa
7) S.Demetrio nei Vestini (Stiffe), Fagnano Alto (Vallecupa, Pedicciano), Arischia
8) Poggio Roio, Colle Roio, Roio Piano, Santa Rufina, Contrada Cavalli
9) Bagno Grande, Bagno Piccolo, Civita di Bagno, Pianola, San Benedetto, San Felice d'Ocre
10) Camarda, Collebrincioni
11) Castelvecchio Subequo, Goriano Sicoli

SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE TASK PROJECT ACTIVITY



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I LEVEL

II LEVEL

III LEVEL

BUDGET

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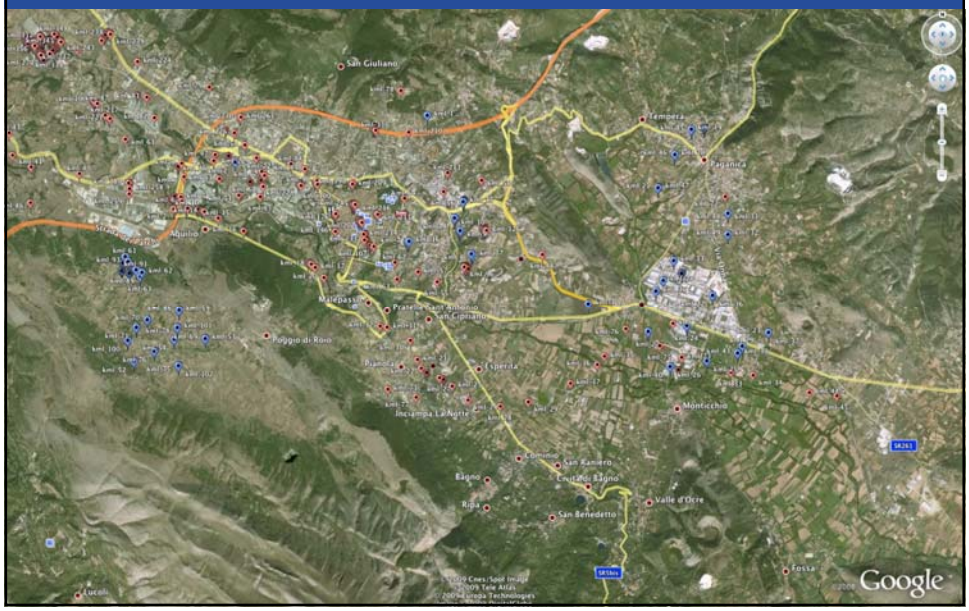
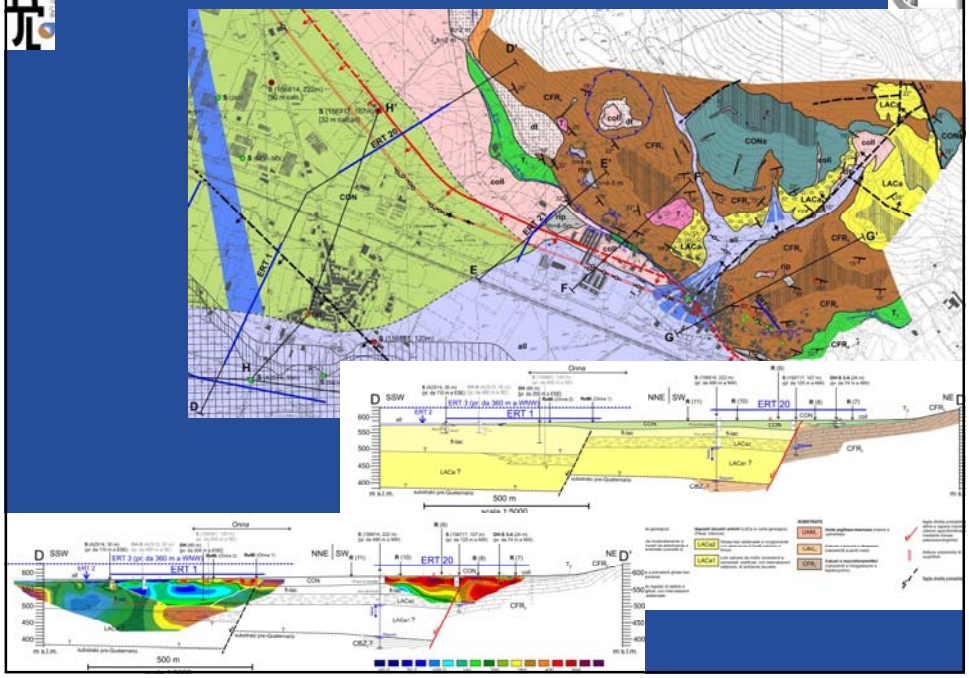
I LEVEL **Geological Field Work**

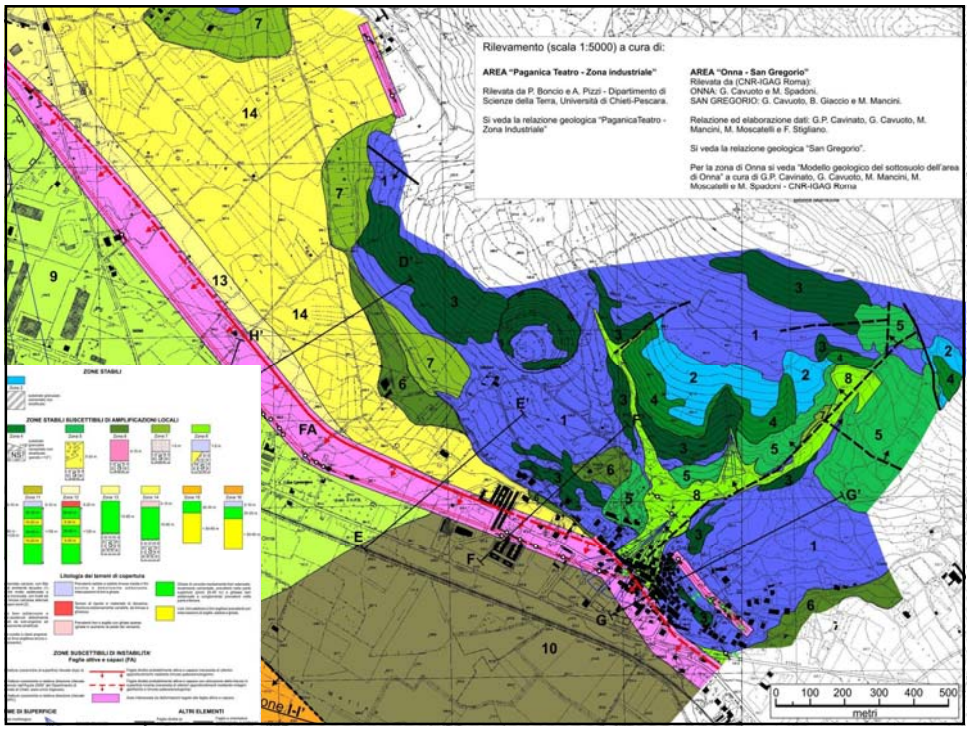
Co-Seismic deformation In the Paganica Area

SURVEYS POSITION OF GEOLOGICAL (RED) AND GEOPHISICAL DATA (BLUE) OF THE L'AQUILA AREA



GEOLOGICAL MAP





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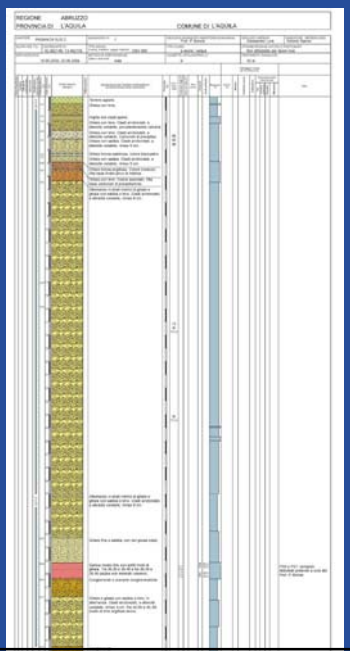
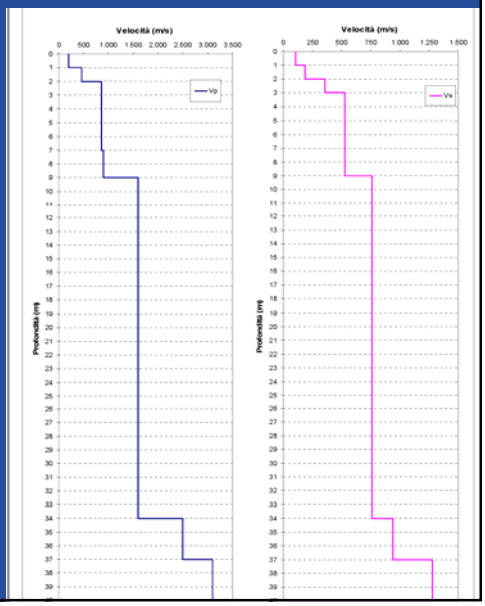
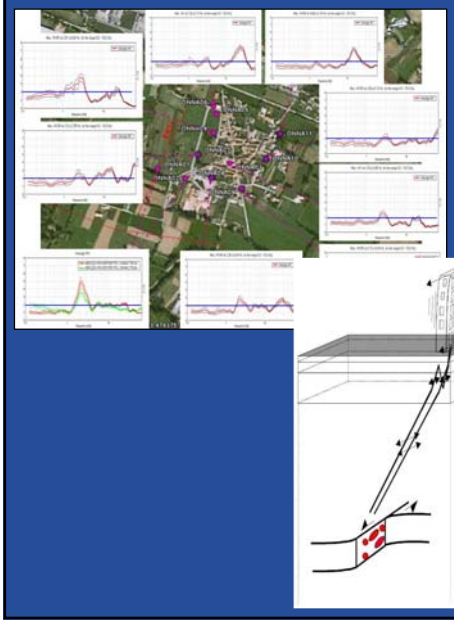
BORE-HOLE AND GEOTECHINCAL SAMPLING

BORE-HOLE AND DOWN-HOLE ANALYSES

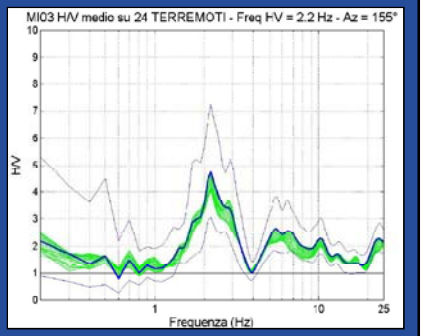




SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE TASK PROJECT ACTIVITY

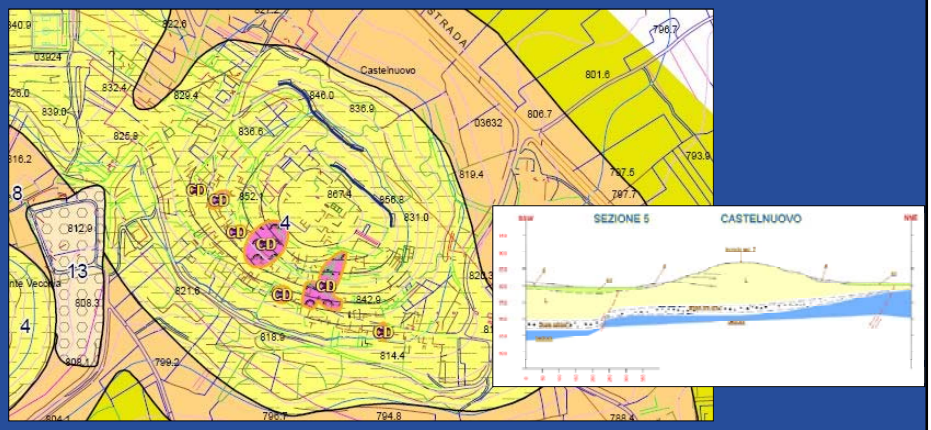


Microtremors analyis at Onna Town:
Terrain Vibration frequence



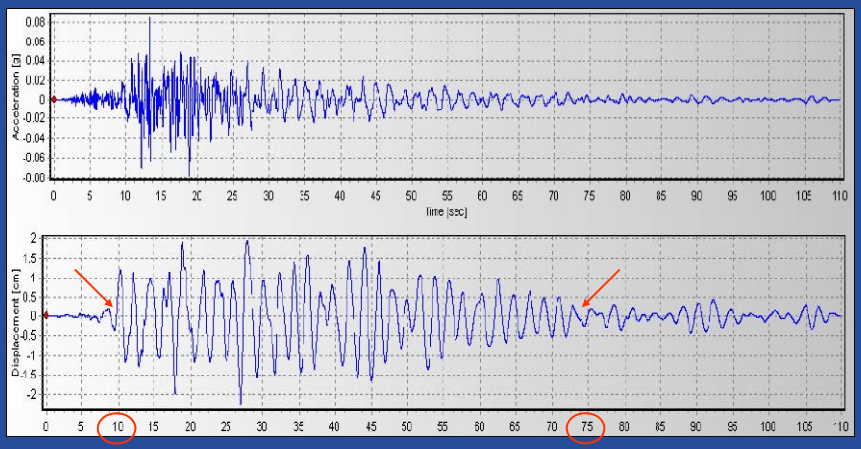
Weak motion terrain frequence in the Onna town (INGV Milano)

SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE TASK PROJECT ACTIVITY



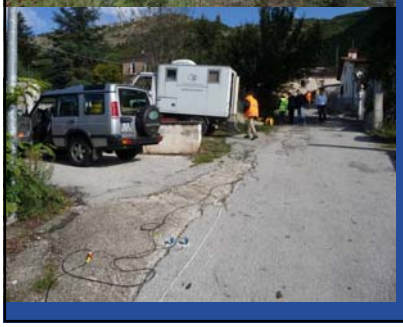
Output of the Geological map of Level I in the Castelnuovo town and Geological cross-sections. The pink area (CD) are interested by collapse during the earthquake for the presence of caves (Emilia-Romagna Region Field work).

SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE TASK PROJECT ACTIVITY

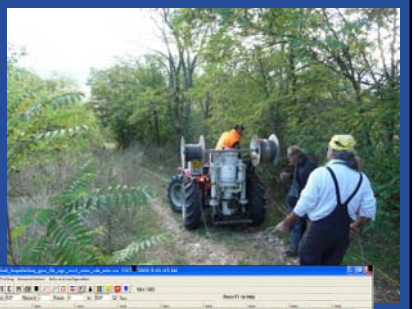


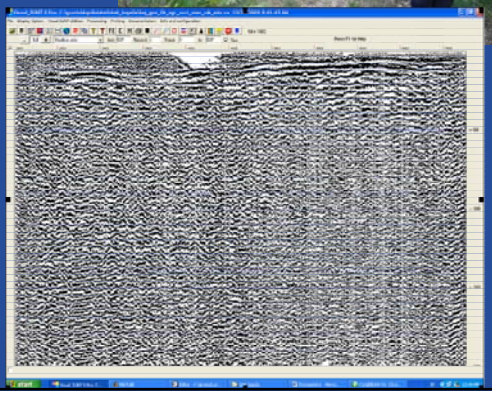
Time history recorded at Casteluovo (15 Km from the epicenter) related 04/09/2009 earthquake alle 00:52:59 con Ml=5.1 (Univ. della Basilicata, INGV Milano, GFZ, CNR IMAA).

SEISMIC MICROZONATION IN THE L'AQUILA AREA: THE TASK PROJECT ACTIVITY



Acquisition of reflection Seismic Profile Across The L'Aquila Basin





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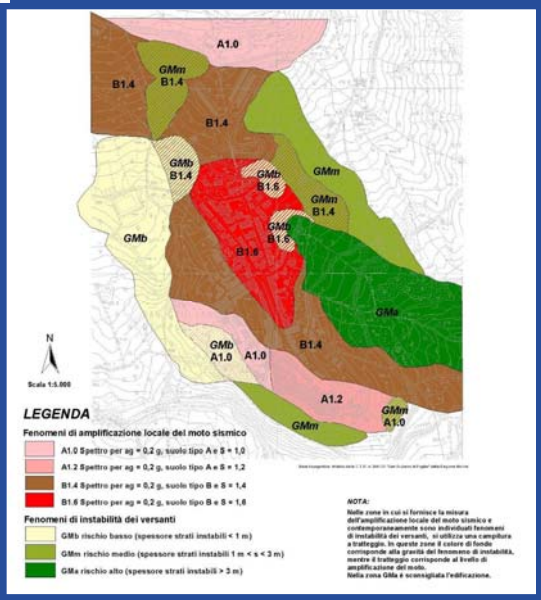
III LEVEL

Level III – MICROZONATION MAP



Examples of Microzonation Map of the San Giuliano di Puglia (CB) after the 2002 earthquake

EMERGENCY:REBUILDING ACTUAL SITUATION.....

Conclusions

- The CNR has an important role for the mananig activity during the Emergency time and for the prevenction activities
- The Seismic Microzonation is the tool for the mitigation of the seismic risk and for the land planning
- The Seismic Microzonation of the L'Aquila area is finalized for the post-earthquake event rebuilding and an important tool for the seismic proof of the new building and for the control of the ancient building and monuments
- All the data and the result of the Seismic Microzonation will be published and insert in a GIS Data-Base on line

国土技術政策総合研究所資料
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