Moutain Risks
Stakeholder Workshop
Dortmund   24-25/09/2007

Study area southern Alps
(France)

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Pôle Grenoblois Risques Naturels

• Risk management in France / french partners
• Hydrogeological hazards affecting southern alps
• Landslide risk management in Trieves
• Landslide risk management in Barcelonette basin
Risk management in France

- **RM circle**: cf Climchalp project (www.climchalp.org)

- **Role of the institutions**
  - State: regulation, information, financial support
  - Regional councils: incentive financial support
  - Departmental councils: road and rescue service management, financial support
  - Communes: first responsibility level, land use planning
  - Citizens: right to be informed, civil protection partners (?)

- **Public / private engineering**
  - RTM, BRGM, CETE…: strong field/technical capacities, various status and dynamics
  - Engineering companies
  - Universities / research centers
French partners Mountain risks
• University Caen
• Univ Joseph Fourier Grenoble
• Cemagref Grenoble

Pôle Grenoblois Risques Naturels : NGO
www.risknat.org
• Members : research and technical institutes of R-Alpes
• Interface Research / public authorities and institutions
• Impulse and coordinate applied research / natural hazards
• Supported by Conseil Général Isère / Région R-Alpes
Earthquakes
Torrents floods and debris flows
River floods
Rockfall, rock avalanches
Landslides and deep slope movements
(Avalanches)
Southern Alps: moderate sismicity but high vulnerabilities

Moderate sismicity
Intensity VIII-IX

High vulnerability
Hi-Tech Industries
Chemical and nuclear plants
Southern Alps: moderate sismicity but high vulnerabilities.

Annecy 1996
Intensity VII

Corrençon 1962
Intensity VI - VII

Lambesc 1909
Intensité VIII à IX

Sismalp – 1990-2000
GRENOBLE : alpine glacial valley filled with clay sediments

Bedrock depth: up to 800 m

Vallon, 1999
SITE EFFECT: SEISMIC AMPLIFICATION

Observations $M_I=3.5$ – SO de Modane (73)

Simulation $M=5.5$ Laffrey

Station Parc P. Mistral

bâtiments

- : sol de classe B
- : sol de classe C
- : sol de classe A (rocher)

Séisme du 25 mai 2003, $M_I=3.5$, SW Modane (73)
Torrents

Urbanisation
Slopes, forest and protection works management / RTM service fragilized
Lack of meteorological monitoring in mountain areas
Rivers : enough space?

Embankment / flooding areas

Social acceptation / risk dialog?

Isère:
• Flood Prevention Plans
• Project upstream Grenoble
Rivers: transit capacity?

Biological management of river beds
Upstream / downstream sediments management
(+ / - : Drôme river lack of sediments / reforestation)

Drac à Jarie 1907

Drac à Jarie 1997

doc: Patrick Blanc, Sylvie Perrard, "Grenoble; un siècle de photographies", Didier-Richard, 1998
Rockfall – rockavalanche risks near Grenoble

- Limestone Cliffs
- Granier
- 140 km
Rockavalanche risks in alpine valleys near Grenoble

Strategical study / landuse planification

Chartreuse east : 57 km cliff
- 9 unstable sites
- 19 to be qualified

Rockfall : every day management
Rockavalanches : out of scope of Prevention Plans
Historical catastrophe: Mont Granier

1248: huge mudflow (300-500 Mm³) triggered by rockavalanche (10-50 Mm³)

XX°: several rockfall $10^4 – 10^5$ m³
Sechilienne : major slope instability

- Massifs subalpins sédimentaires
- Massifs cristallins
- Accident médian de Belledonne

0 10 20 km

N

Annecy
Sillon Subalpin

Chambéry

Vercors

Chartreuse

Isère

Belledonne

Pelvoux

Vallée du Grésivaudan

Séchilienne

Sillon

Subalpin

Séchilienne : major slope instability

Grenoble

Switl }

Limestone

Micaschists

Clays
Narrow valley: risk of natural damming

- Interruption of main road transit to southern Alps / Italy: 1-2 M€/day
- Upstream slow flooding risk: impact on local development
- Downstream wave flooding risk / urban zones and chemical plants
Decisions:

- Intense monitoring (State: CETE Lyon)
- Alert system / Civil Protection Plan downstream
- Paper factory and 50 houses preventive expropriation (Loi Barnier, 1°)
- Road uplift on opposite slope (project 2009)
- Hydraulic tunnel: investigation gallery done, studies going on… funding?
Mouvements de terrain dans la région de Grenoble

Trièves slides

- Massifs subalpins sédimentaires
- Massifs cristallins
- Accident médian de Belledonne

Grenoble

Limestone
Micaschistes
Clay
Trièves landslides

MR partner: LGIT – Univ Joseph Fourier
Trièves landslides

Larmalierres

EDF hydropower dam: risk evaluated as low, no specific monitoring
Avignonnet landslide management

Avignonnet

Le Mas village:
• damages to houses, danger to habitants
• limited monitoring (RTM – CG 38)
• expropriation procedure going on
• Social risk dialog: …?
Set up of the MOUVARGI observatory

- Creation of a geotechnical database (2005-2006; funds Conseil Général Isère / State)
- Permanent geotechnical and geophysical measurements on Avignonnet landslide (funds Région Rhône-Alpes)
- Scientific projects, open data access

National label with 3 other sites
(Séchilienne, La Clapière, Super-Sauze)
Trieves: geotechnical database
Avignonnet: permanent measurements

**Futur (short term):**
- 1 station GPS
- 1 station météo
- Deep and shallow piezometers

**Going on:**
- 2 sismological stations
- 1 GPS station

**Avignonnet**
Avignonnet landslide

Permanent équipements

Station GPS

Stations sismologiques

Stations GPS
Understanding Avignonnet landslide

Displacement

Water table

Vibration

Temps

GPS Station

Piezometer

Sismological station
Ex: These G. Bievre (UJF-LGIT)

Investigation of hectometrical extension cracks
Investigation of hectometrical extension cracks
LANDSLIDE RISK MANAGEMENT IN THE BARCELONNETTE BASIN

J-P Mallet, O. Maquaire, University of Caen
HAZARD TYPE: LARGE MUDSLIDES

La Valette mudslide

Several ‘Slide2Flow’ risk catchments
HAZARD TYPE: DEBRIS FLOWS – 26 active torrents
HAZARD TYPE: SHALLOW SLIDES

- **Translational slide**

  - Bois Noir
  - Depth (m) $\mu = 7$  $\delta = 4.7$
  - Length (m) $\mu = 207$  $\delta = 146.5$
  - Width (m) $\mu = 76$  $\delta = 69$
  - $\alpha$ (°) $\mu = 20$  $\delta = 7$

- **Shallow translational slide**

  - Abries torrent
  - Depth (m) $\mu = 3.5$  $\delta = 1.35$
  - Length (m) $\mu = 112$  $\delta = 76$
  - Width (m) $\mu = 38$  $\delta = 25$
  - $\alpha$ (°) $\mu = 25$  $\delta = 8$

- **Rotational slide**

  - Poche torrent
  - Depth (m) $\mu = 6$  $\delta = 2.9$
  - Length (m) $\mu = 128$  $\delta = 116$
  - Width (m) $\mu = 146$  $\delta = 138.5$
  - $\alpha$ (°) $\mu = 20.4$  $\delta = 8.9$
Tasks of RTM – ‘Restauration des Terrains en Montagne’

- **Large landslides**: setup of monitoring systems and mitigation works (drainage, etc)

Monitoring of La Valette mudslide
HAZARD & RISK MANAGEMENT

Tasks of RTM – ‘Restauration des Terrains en Montagne’

- **Large landslides**: setup of monitoring systems and mitigation works (drainage, etc)

Debris flow alert system

Sediment trap & storage dam
HAZARD & RISK MANAGEMENT

Tasks of RTM – ‘Restauration des Terrains en Montagne’

- **Debris flow activity**: Setup and maintenance of torrent check dams, eco-engineering, risk mapping

Reforestation

Torrent mitigation works
HAZARD & RISK MANAGEMENT

- Hazard & risk mapping: Plan de Prévention des Risques (PPR), Building authorization

Tasks of State (contracts with RTM, BRGM or private companies)