MINISTERIUM
FÜR EIN
LEBENSWERTES
ÖSTERREICH

WILDBACH- UND LAWINENVERBAUUNG

LANDSLIDE MONITORING AND EARLY WARNING SYSTEMS IN AUSTRIA

Oslo, October 2016
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ALPINE HAZARDS IN AUSTRIA

- Austria is exposed to heavy precipitation, hails, thunderstorms and avalnches in winter
- 100.000 km rivers and torrents, 9.000 lakes
- 67 % of the area is part of a torrent or avalnche catchment
- 12.000 torrent and 5.000 avalanche catchments
- High potential for landslides and rockfall due to topography

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LIVING SPACE VS. ENDANGERED AREAS

Percentage of area suitable for settlements:

Austria	**37 %**
Tyrol	**12 %**

Increase settled areas per second:

Austria	**1,9 m²**
Switzerland	**1,0 m²**

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Avalanche disaster 1999

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DEBRIS FLOWS 2012, 2013
ST. LORENZEN, VIRGEN, HÜTTAU

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WLV ORGANISATION

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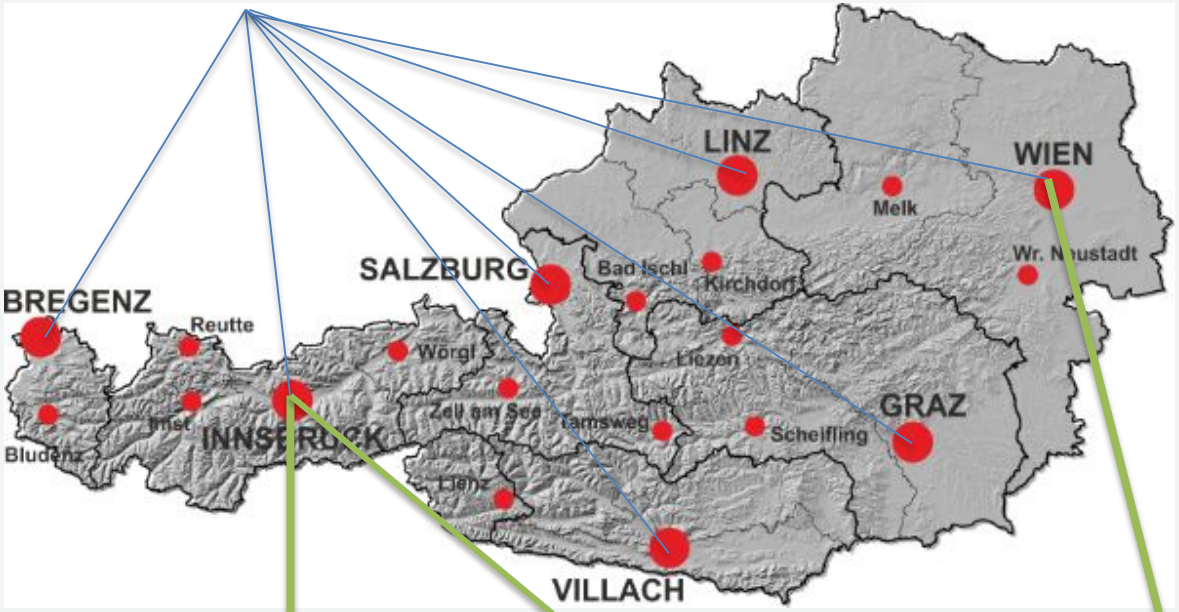
21 local/construction offices

app. 300 employees

800 construction workers

- 7 district offices



- 3 Staff units (geology, avalanche simulation, geoinformation)

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TASKS OF THE WLV

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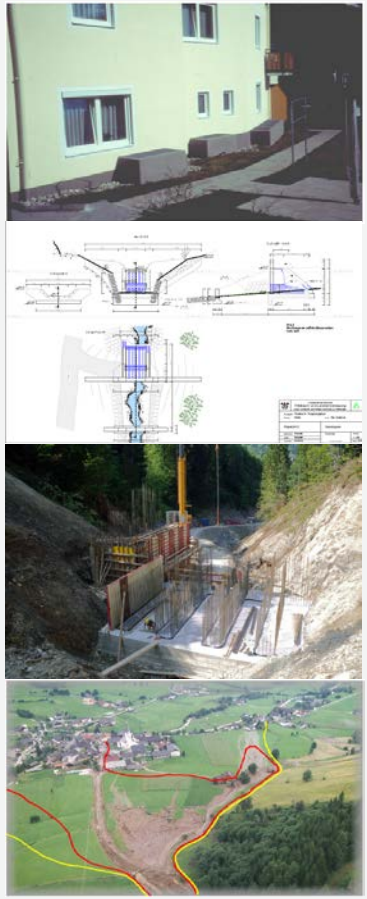
- Expertise
- Planning construction measures
- Carrying out construction meas.
- Hazard zone mapping



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APPLICATION WARNING

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- Support of conventional protective measures
- Automatic protection of less sensitive traffic routes
- Protection of construction sites

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ADVANTAGES WARNING

- Rapid deployment
- Fairly cheap
- Sometimes the only option
- Preservation of evidence

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DISADVANTAGES

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- Technically sensitive
- Maintanance-intensive
- Necessity of a good organisation
- In development

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MAIN DIFFICULTIES

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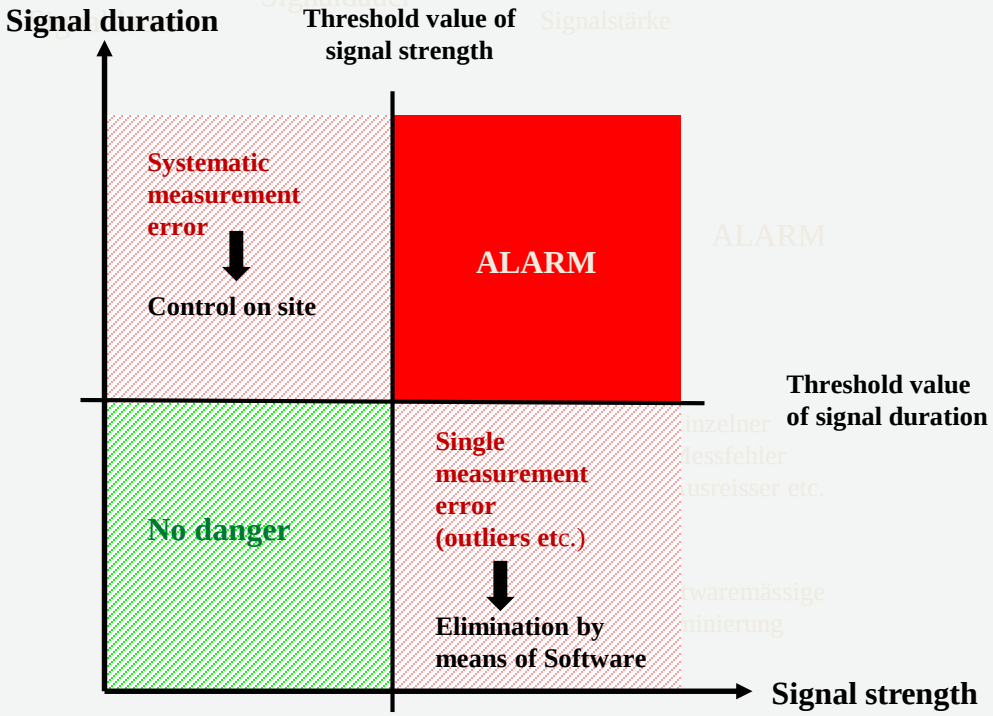
- Definition of reliable threshold values
- Achievement of a sufficient warning time



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PROBLEMS WLV

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- complex monitoring architecture due to great variety of parameters
  - Landslides
  - Rockfalls
  - Hydrological parameters

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PROBLEMS WLV

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WILDBACH- UND LAWINENVERBAUUNG

- Data transfer
  - Decentralized stations
  - GSM/GPRS Data transfer
  - Radio transfer at remote/peripher stations
  - Central database needed
- Power supply
  - Mostly solar supplied
  - Heated cameras, videos ???
- Data management
  - Running costs
  - Station administration
  - Database, archivation, visualization
  - Data validation

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PROCEDURE WLV

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WILDBACH- UND LAWINENVERBAUUNG

1. Strategic decision 2015 – no installation of own hydrographic service within wlv
2. Setting up and financing stations
3. Handing over to owner of structure (e.g. retention basin) – community, cooperative
   - operates station in collaboration with manufactorer of station and/or civil engineer → costs !!!
   - operates station in collaboration with existing hydrographic services (which province based organised) → minimal costs

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BREITENBERG

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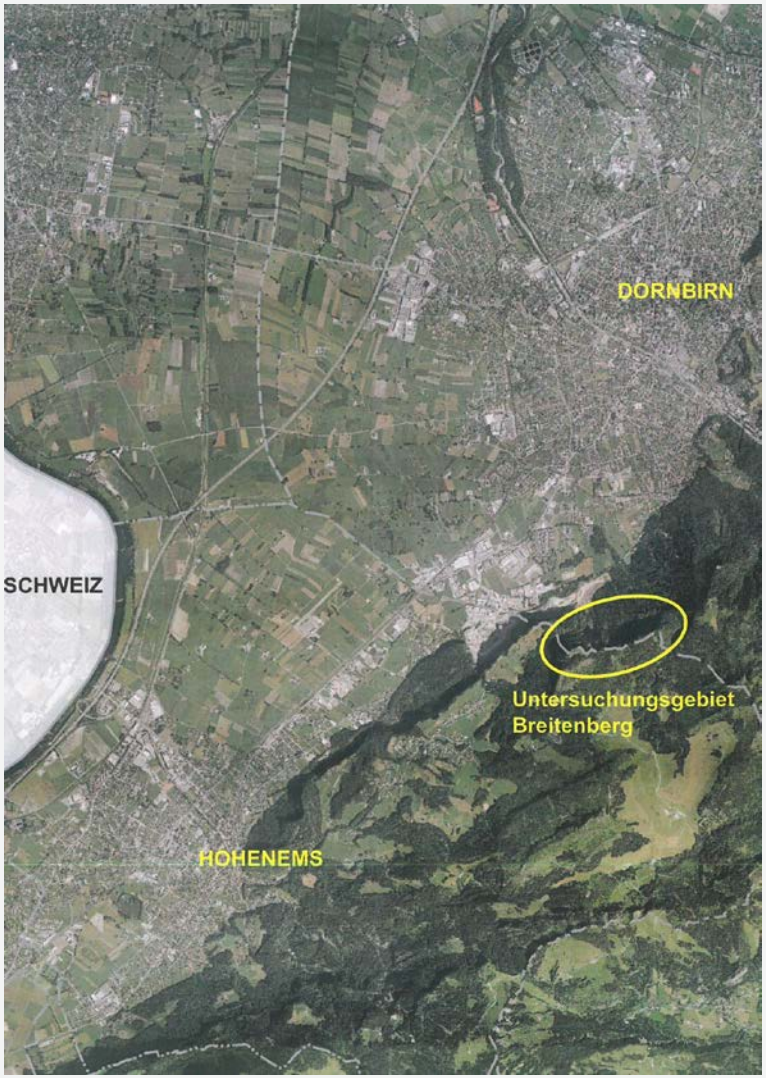
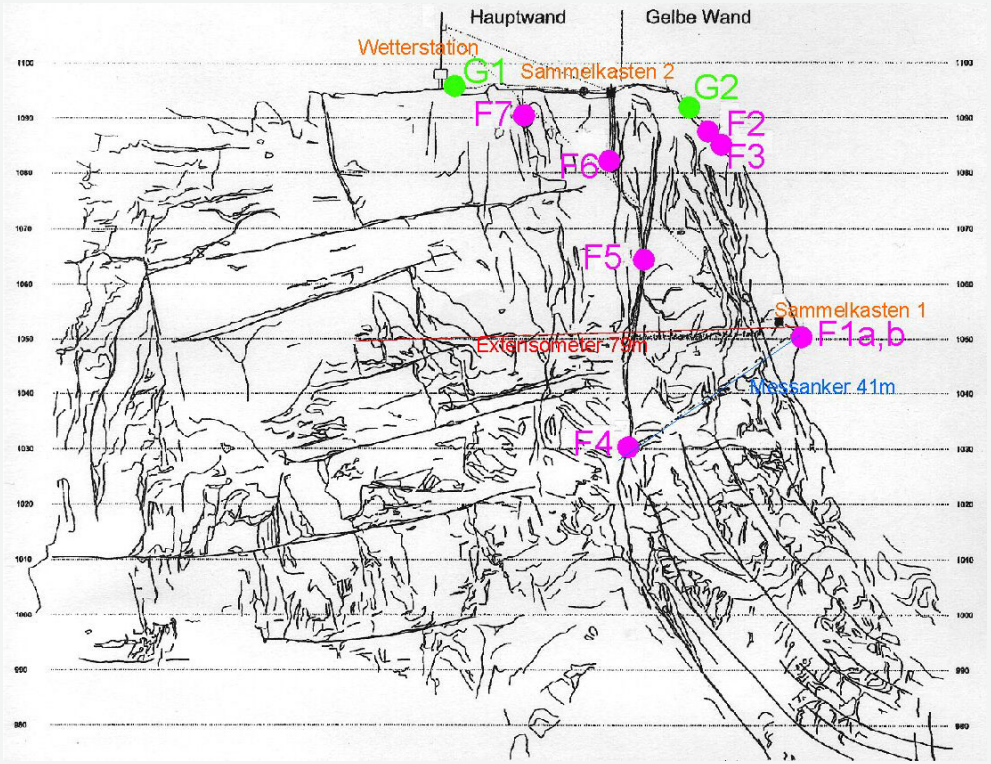


Toppling of a rock pillar (180.000 m³) would cause base failure in the Rhine valley and subsequent destruction of houses.



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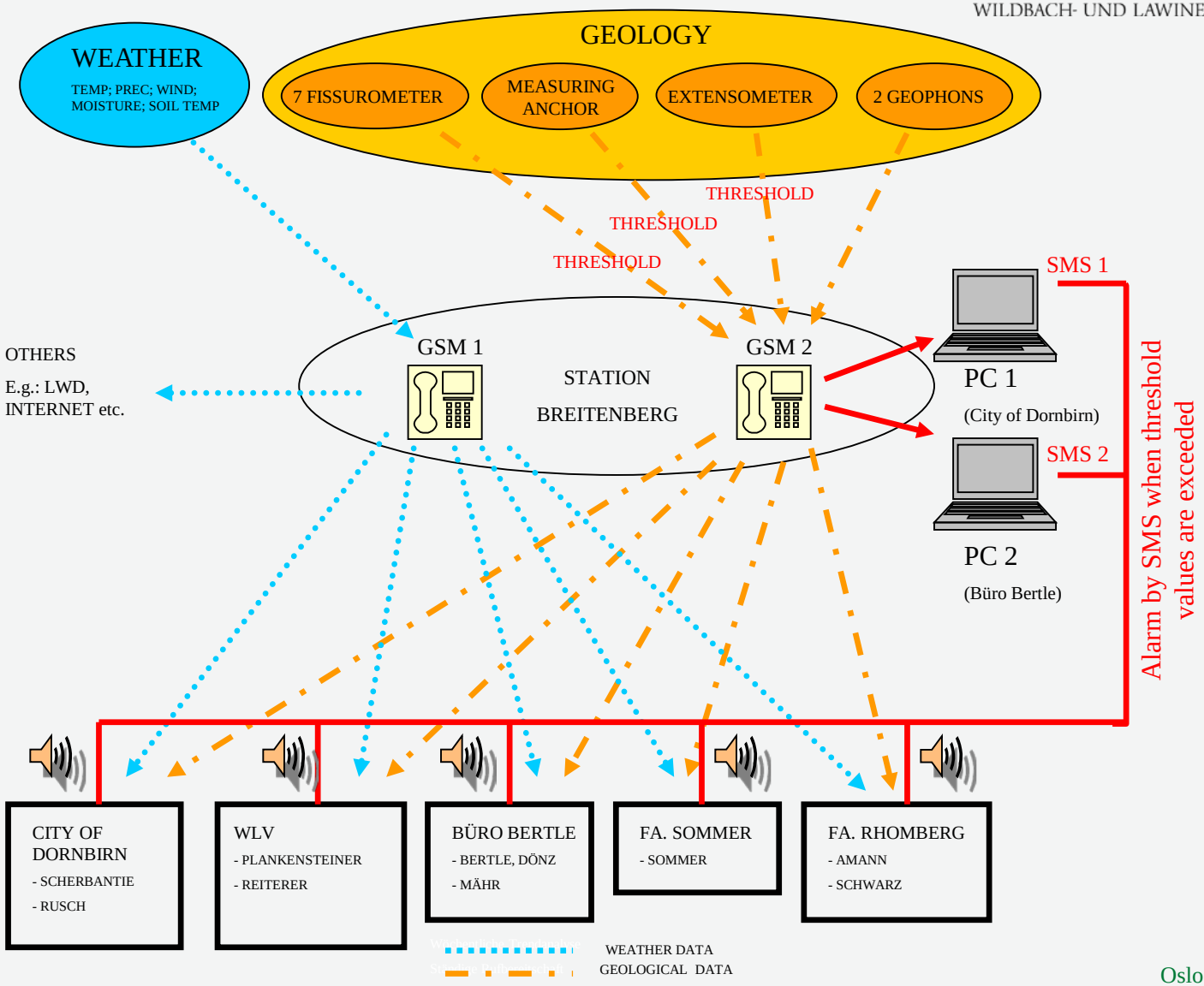

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MÄSSTOBEL

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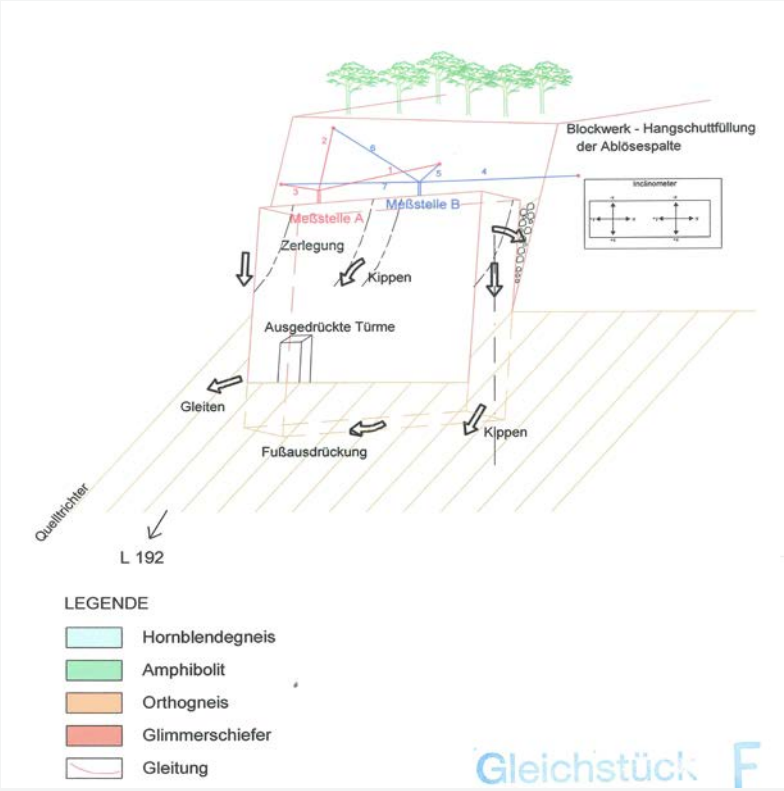
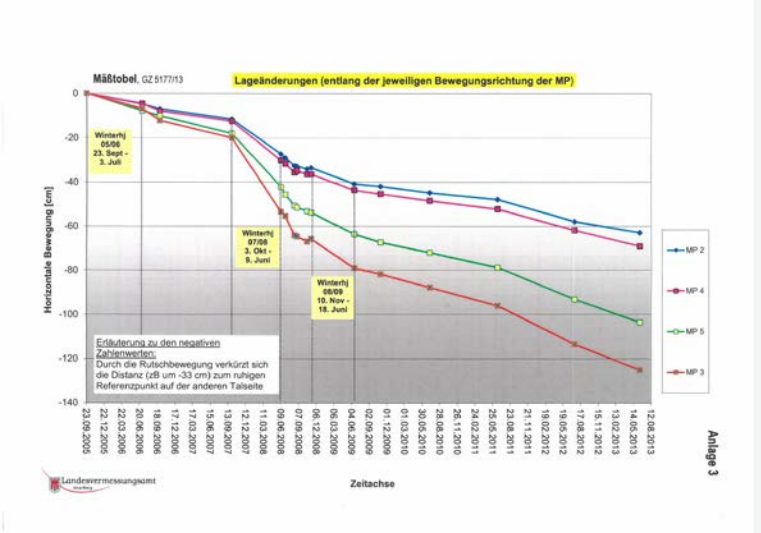
WILDBACH- UND LAWINENVERBAUUNG

- Rock slide (800.000 m³)
- Debris jam in the Suggadin torrent
- Dam failure with floodwave endangers the settlement area of St. Gallenkirch and access road to Gargellen





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RINDBERG

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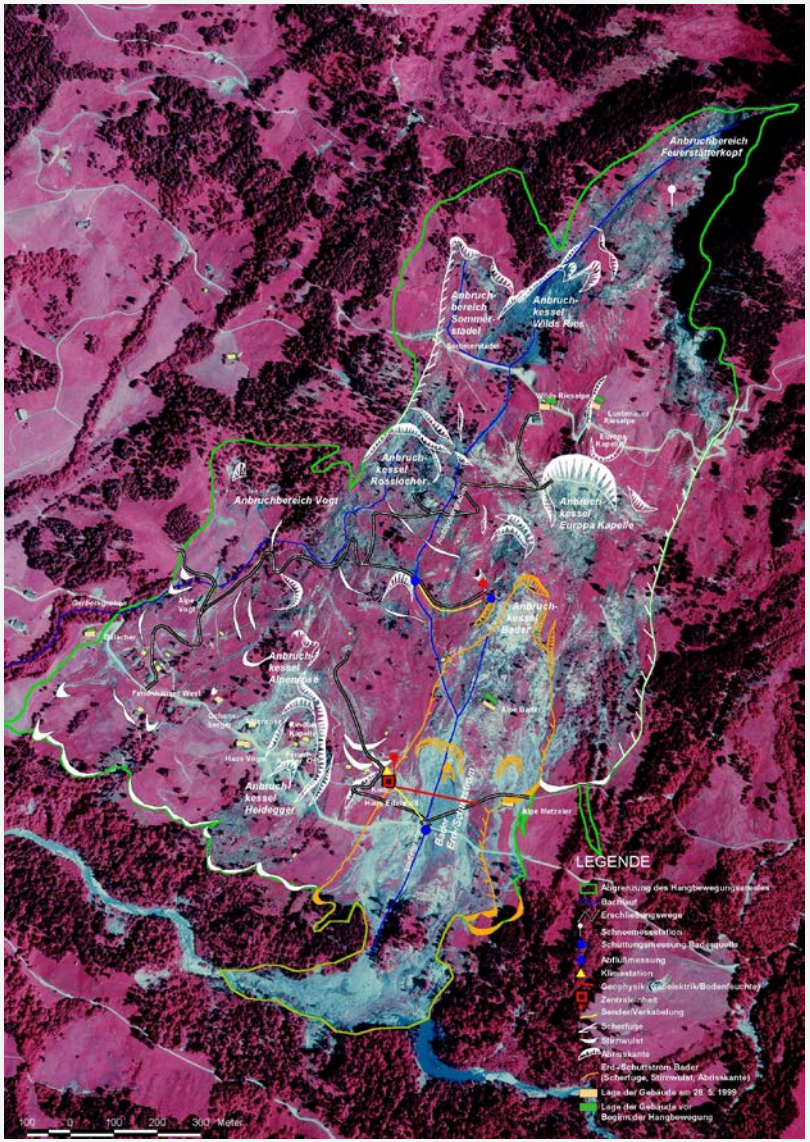

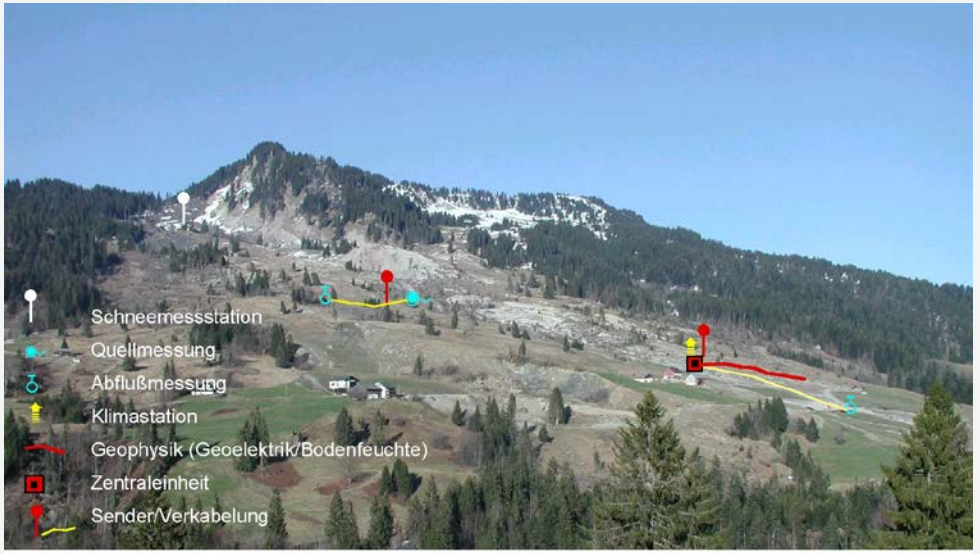

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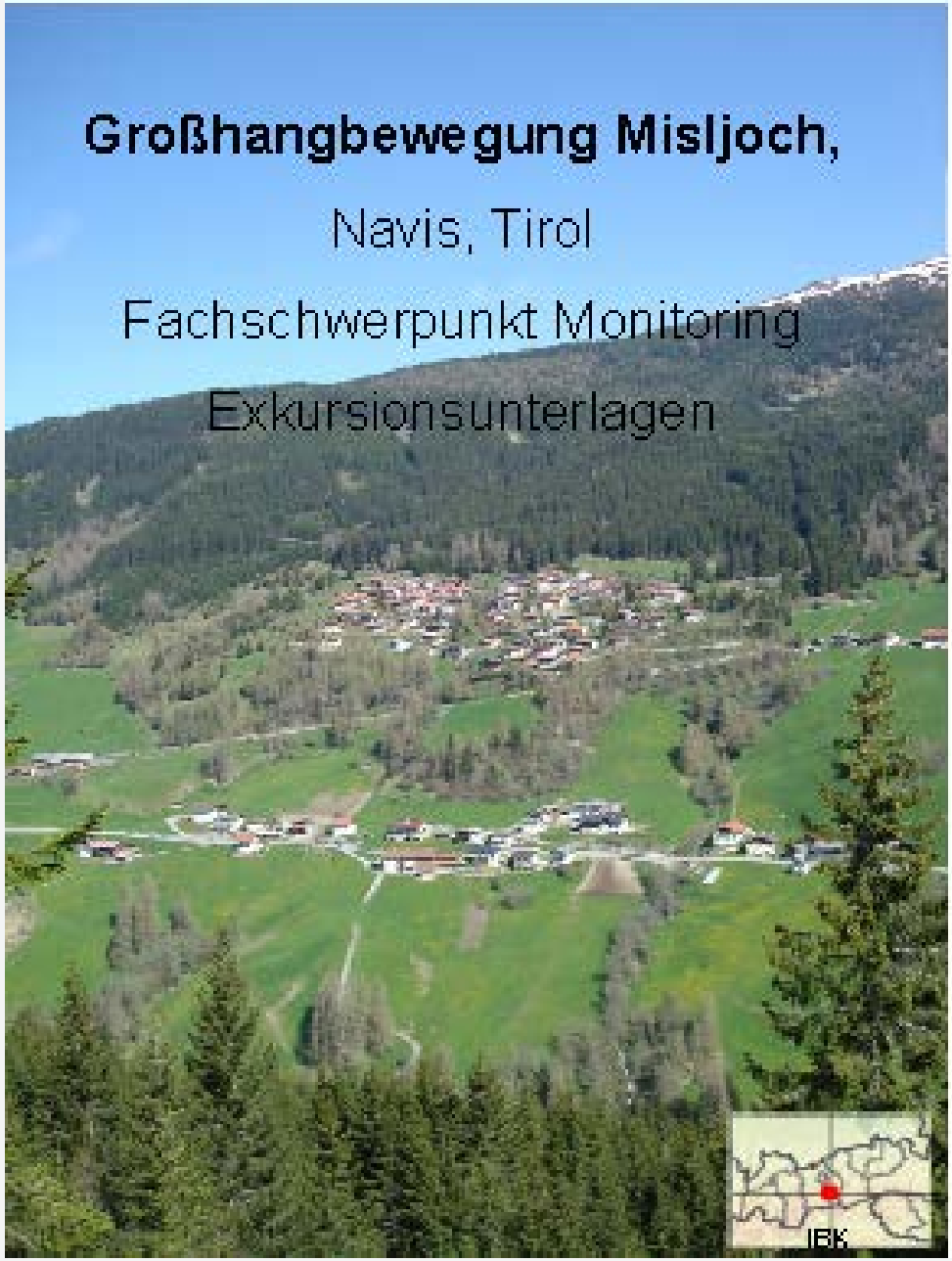
Großhangbewegung Misljoch,

Navis, Tirol

Fachschwerpunkt Monitoring

Exkursionsunterlagen



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- control of water pipes
- Gauges
- Site control
- Surface movement control
- Depth movement control
- Conservation of evidence

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GSCHLIEFGRABEN

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WILDBACH- UND LAWINENVERBAUUNG

- 3,8 Million m³ of material involved in an earth flow
- presumably triggered by a rock fall in April 2006
- Deposition height at the fan up to 8 m
- dislocation velocity up to 4,7 m per day
- 37 estates with 55 buildings were endangered
- 55 houses with 100 people were evacuated by a crisis committee

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GSCHLIEFGRABEN

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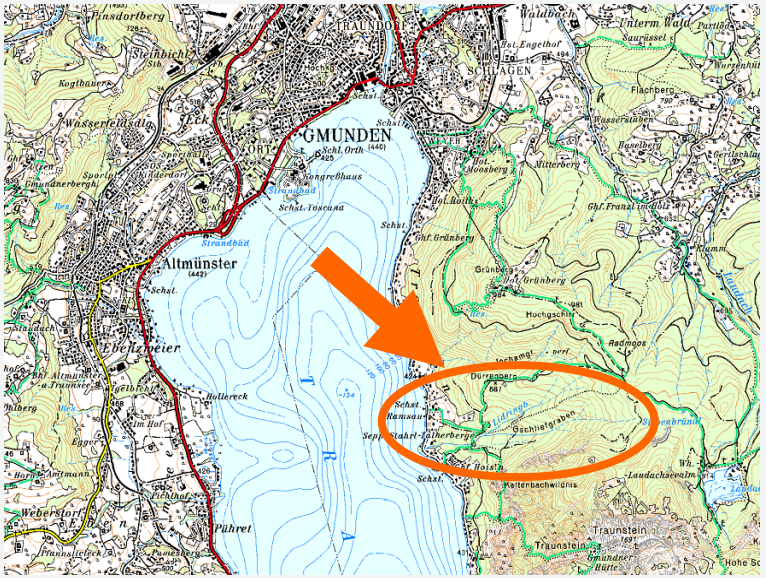
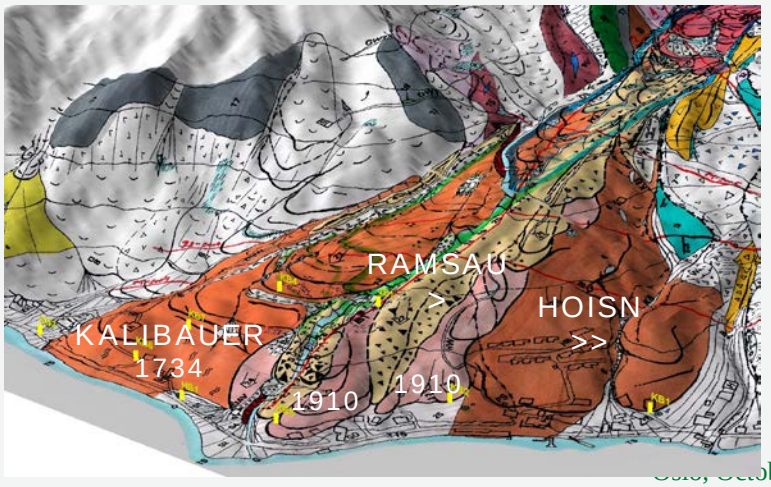
Remote sensing	Airborne Laserscanning
	Aerial Photographs
	Echo Sounding
Surface - surveying	Survey of drafts
	Observation of ranging-poles
	Monitoring of drafts
	Monitoring of anchors
	Webcam
	Terrestrial survey
	dGPS survey
Depth - surveying	Borehole logs
	Inclinometer
	Well gauges and piezometer
	TDR
	Seismic and geophysics
	Soil mechanics
Hydrology	Precipitation, temperature, barometric pressure
	Discharge in pipes and open channels

TABLE 2: Monitoring methods applied during the Gschliefgraben landslide remediation.





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PECHGRABEN

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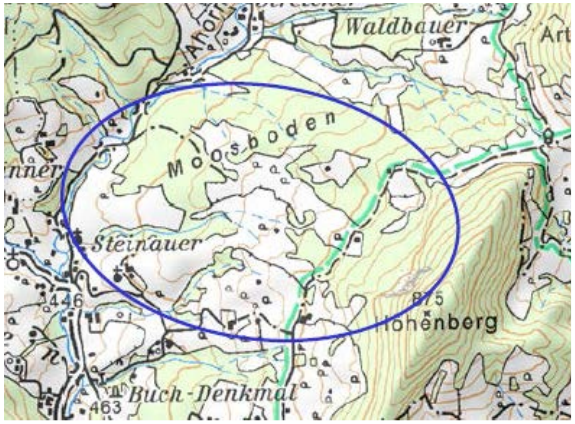

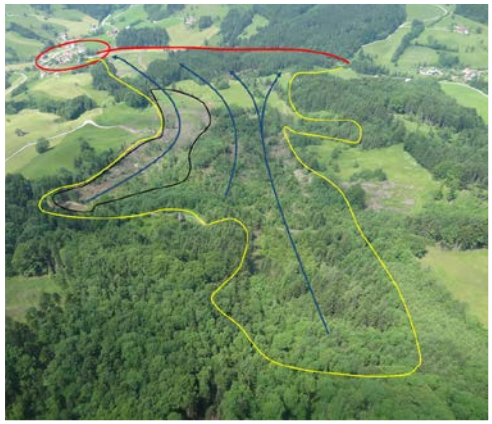

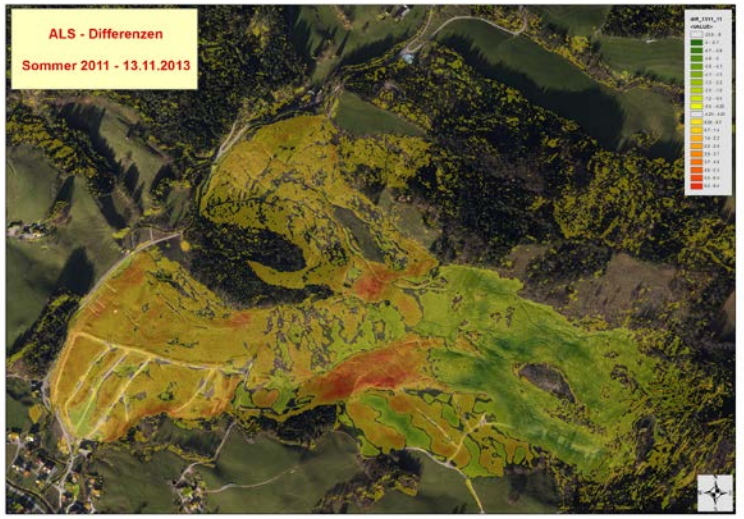

Remote sensing	ALS (Airborne Laserscan)
	UAV (unmanned aerial vehicle)
Surface surveying	of fissures
	direct measurement of movements
	photomonitoring (webcam)
	GPS-measurements
Depth surveying	borholes
	inclinometer
	well gauges and piezometer
	soil moisture
	geoelectrics
Meteorology	precipitation
	temperature

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ROCKFALL INGELSBERG

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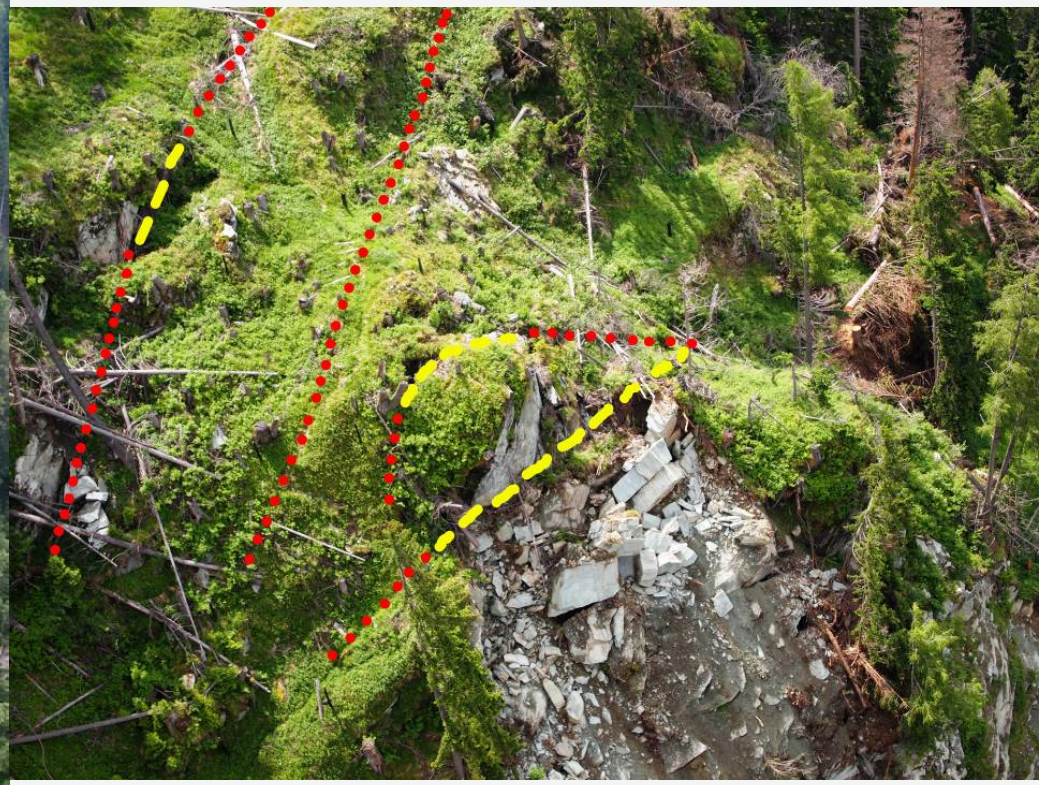

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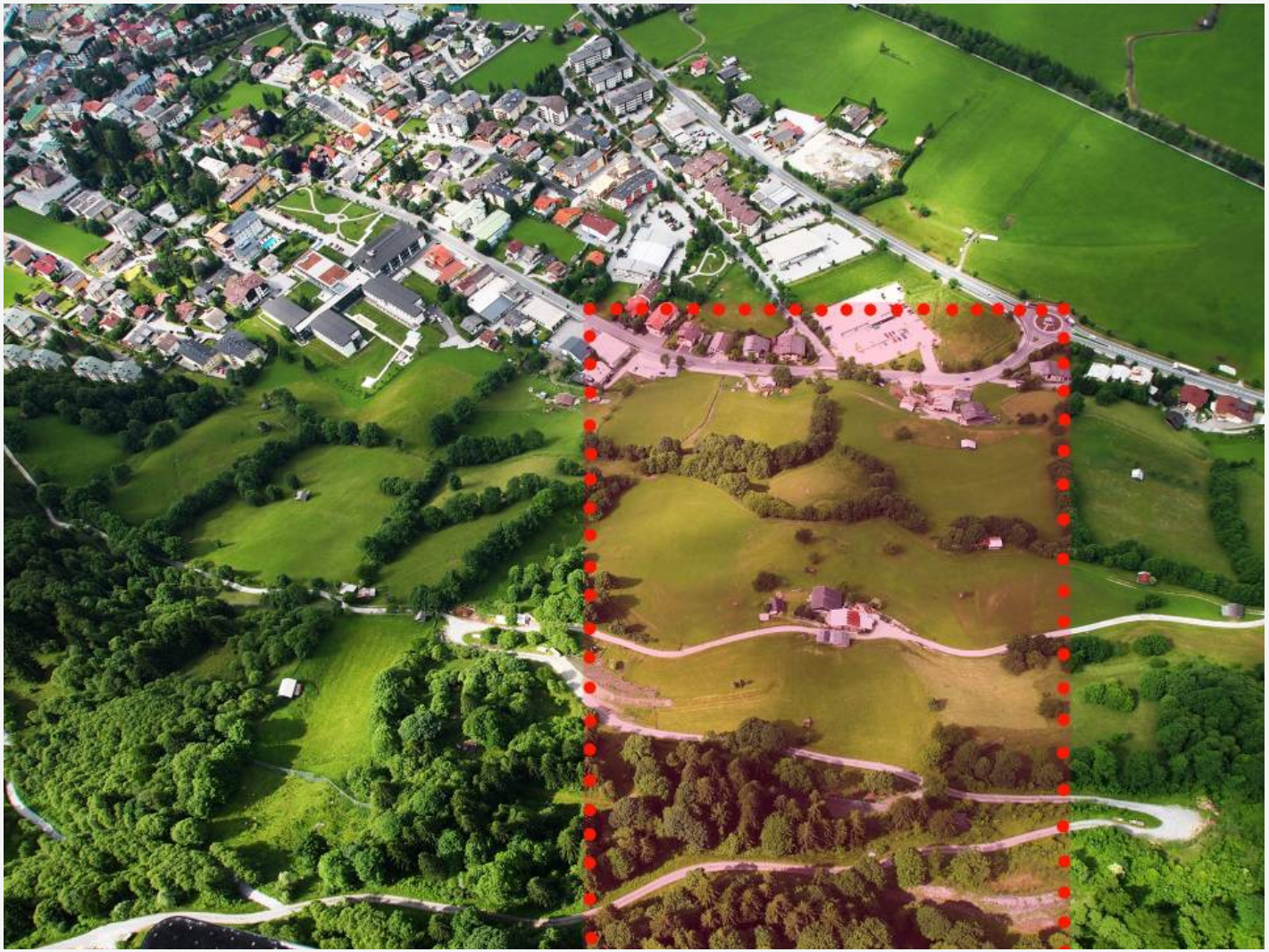

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ROCKFALL INGELSBERG MONITORING

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- 5 Fissurometer
- 13 survey points
- 3 cameras
- 1 thermometer

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IN-SAR – INTERFEROMETRIC SYNTHETIC APERTURE RADAR

+ Distance up to 4 km
+ whole area covered resolution below 1mm
+ Continous measuring (24/7) independent of weather
– Dense Vegetation and snow hinder accurate measuring

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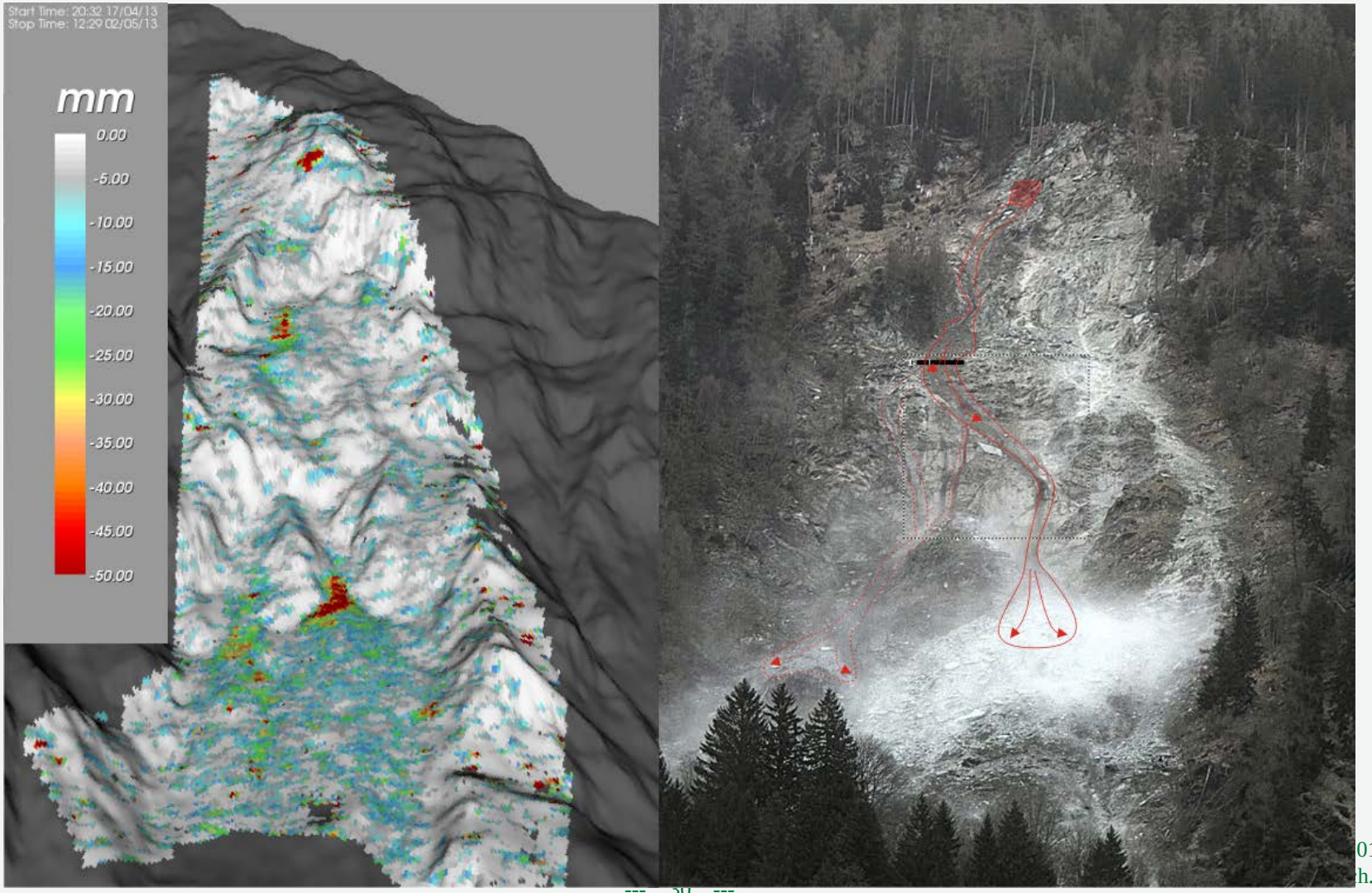
EVENT 29.4.2013



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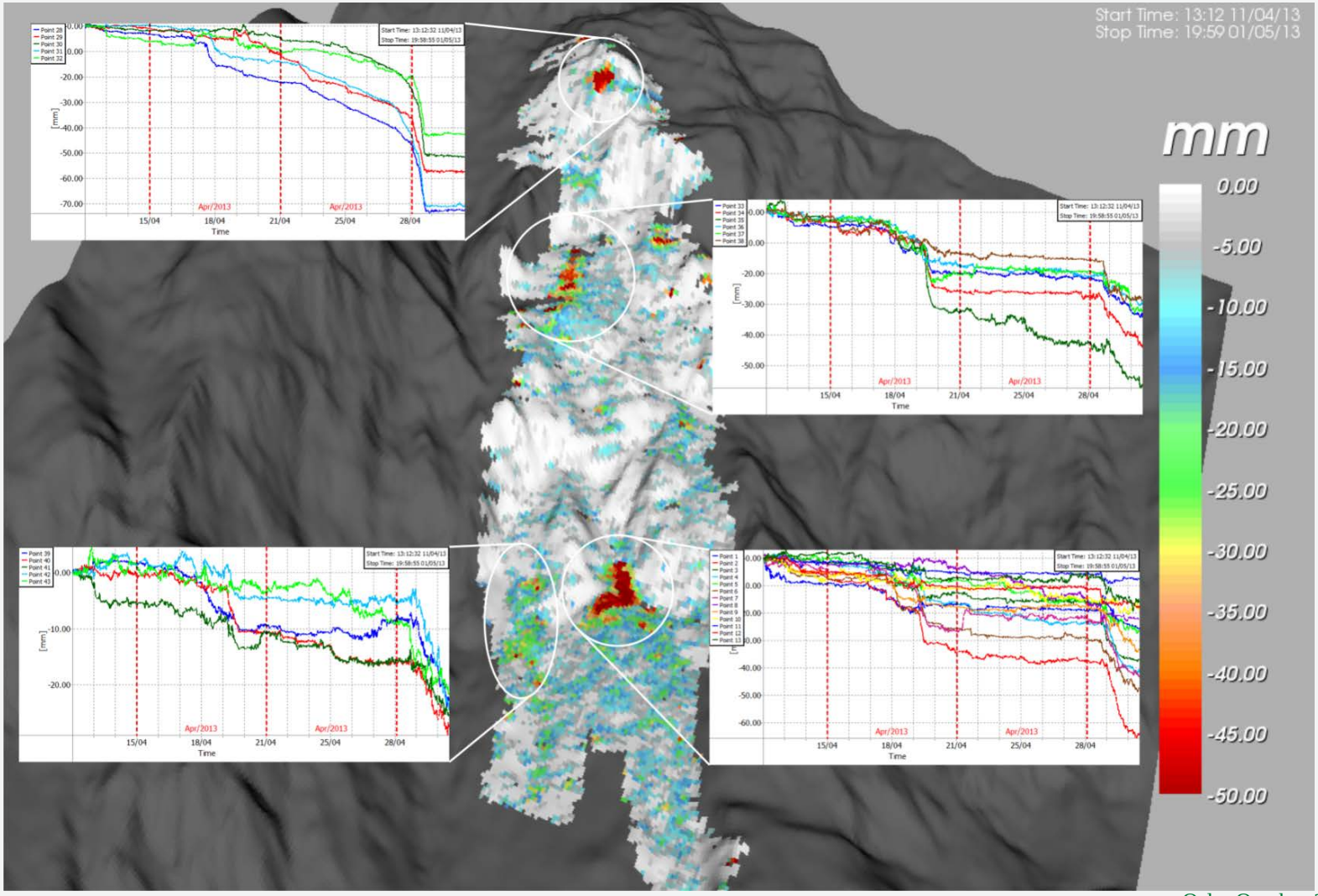

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MOSES

(MOBILE SAFETY AND EMERGENCY SYSTEM)

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„IT‘S NOT ENOUGH TO UNDERSTAND HOW TO PUT THUMBSCREWS ON NATURE, ONE NEEDS TO UNDERSTAND NATURE WHEN SHE TESTIFIES.“ (ARTHUR SCHOPENHAUER-GERMAN PHILOSOPHER)

FOR MORE INFORMATION

HTTPS://WWW.BMLFUW.GV.AT/EN/FORESTRY/NATURALHAZARDS.HTML

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