GIS and DENDROCHRONOLOGICAL TECHNIQUES for AVALANCHE HAZARD MAPPING

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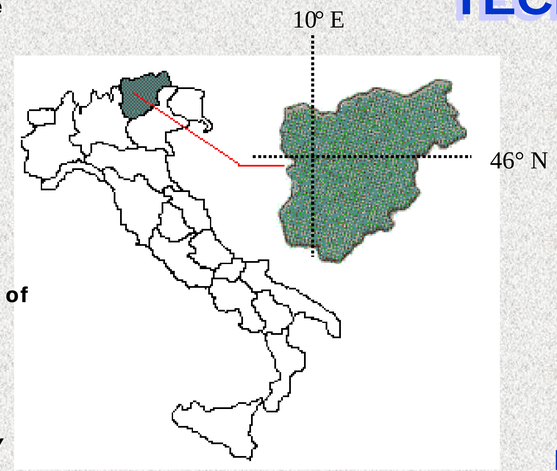
AIMS OF THE WORK:

- To map avalanche risk on the base of topographical and vegetational parameters, in order to get RISK MAPS
- To evaluate the protective role of the vegetation
- To understand the avalanche activity of a peculiar site
- To reconstruct spatial extent of past avalanches

Tools: GRASS GIS; DENDROCHRONOLOGY



STUDY AREAS:

Two avalanche tracks in Pejo Valley:

- "*Tof Larch*" track
- "*Val dei Spini*" track

"***Tof Larch***" track

"***Val dei Spini***" track

DETERMINATION OF POTENTIAL RISK INVOLVING FOREST AREAS WITH GRASS:

Definition of: "MORPHOLOGICAL AVALANCHE RISK" **dependent on:** TOPOGRAPHICAL FEATURES OF GROUND SURFACE

Definition of: "POTENTIAL RISK" **dependent on:** VEGETATION PATTERN (i.e. coverage and density, trees per ha.)

These information are overlayed to obtain the RISK MAP

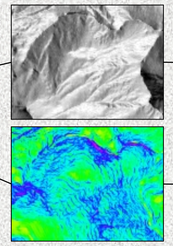
MORPHOLOGICAL RISK MAP

VEGETATION MAP

RISK MAP

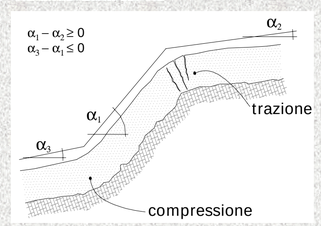
MORPHOLOGICAL RISK MAP

Digital Elevation Model → aspect map; slope map



TOPOGRAPHICAL CRITERIA

- slope: 28° < α < 55°
- minimum surfaces (625 m²)
- slope changes: Δα ≥ 10°

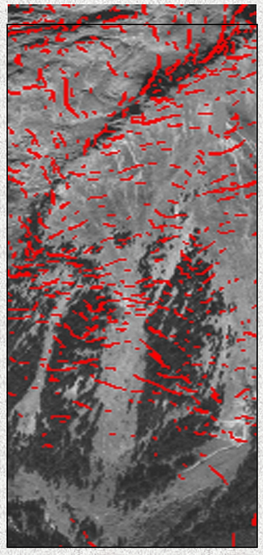


VEGETATION MAP

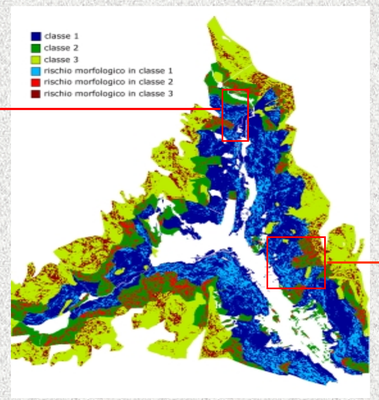
Forest Management Plan → categories of the vegetation; % species; density, coverage

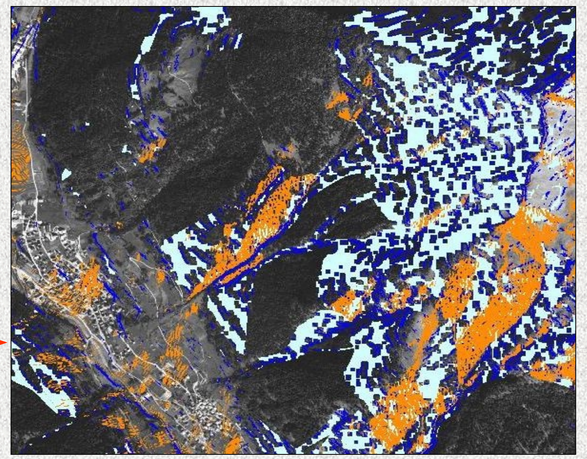
POTENTIAL RISK CLASSES

	DENSITY AND COVERAGE	
	coverage	mean number of trees per ha.
class 1	> 40 %	254 trees/ha
class 2	< 40 %	115 trees/ha
class 3	Pastures and naked ground	



"***Tof Larch***" track





"***Val dei Spini***" track

Slope changes (Δα ≥ 10°) **inside minimum surfaces** (625 m²)

Minimum surface (625 m²)
Slope change (Δα ≥ 10°)
South-East exposition

TREES IN STUDY AREA:

Visible signs due to avalanches: tilting, breakage, scarring,uprooting

Visible reactions of trees:

- new stem formation
- branch modification
- harp form
- suckers

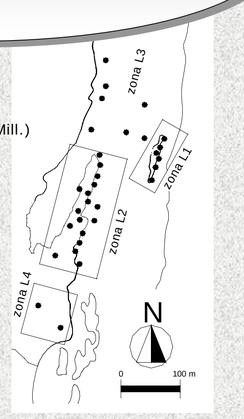
FIELD ACTIVITY:

SAMPLING "*Tof Larch*" track, Val di Pejo (ITALY)
October 1999 – January 2000

Sampling zones : **zone L1, L2, L3, L4**

Cored trees : **35 larches** (*Larix decidua* Mill.)

Area extent : **4 ha**



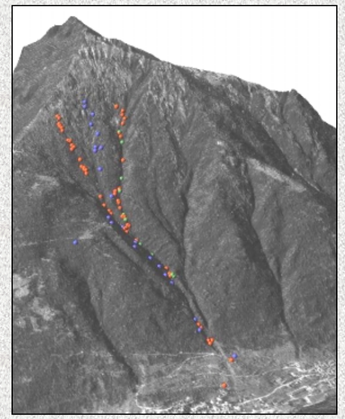
SAMPLING "*Val dei Spini*" track, Val di Pejo (ITALY)
October 2000 – December 2001

Sampling zones : **two avalanche paths along the "val dei Spini" avalanch area.**

Cored trees : **86 larches** (*Larix decidua* Mill.)
11 alnus (*Alnus viridis* (Chaix) DC.)

Area extent : **18 ha**

GPS localization of cored trees:
- *Larix decidua*
- *Larix decidua*
- *Alnus viridis*



WORK PROCEDURE:

GRASS GIS ANALYSIS

DEFINE THE EXTENSION OF POTENTIAL RISK → **SPATIAL CHARACTERIZATION**

- Determination of the extension of potential risk areas and tracks
- Location of old paths and new potential paths inside the track

DENDROCHRONOLOGY

AVALANCHE → **GEOMORPHOLOGICAL AGENT** → **Tree shape, Tree-ring features** / **land and vegetation disturbance**

→ **TEMPORAL CHARACTERIZATION** → reconstruct

- Frequence of events
- Lacking historical data
- Stages of disturbance in different areas

RESULTS AND VERIFICATION:

Tof Larch track

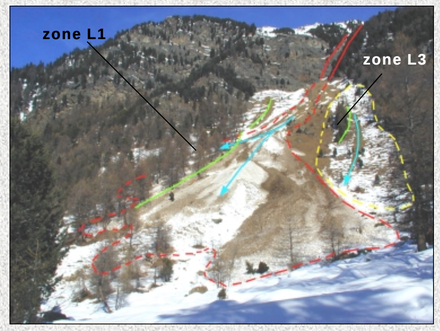
spatial distribution of dendroecologic indicators

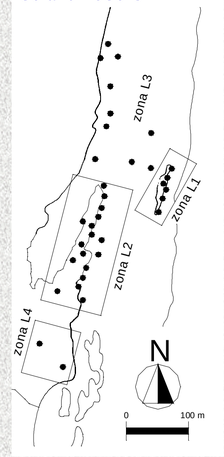
delimitation of avalanche tracks having significant activity

confirmation of *in situ* pre-observations

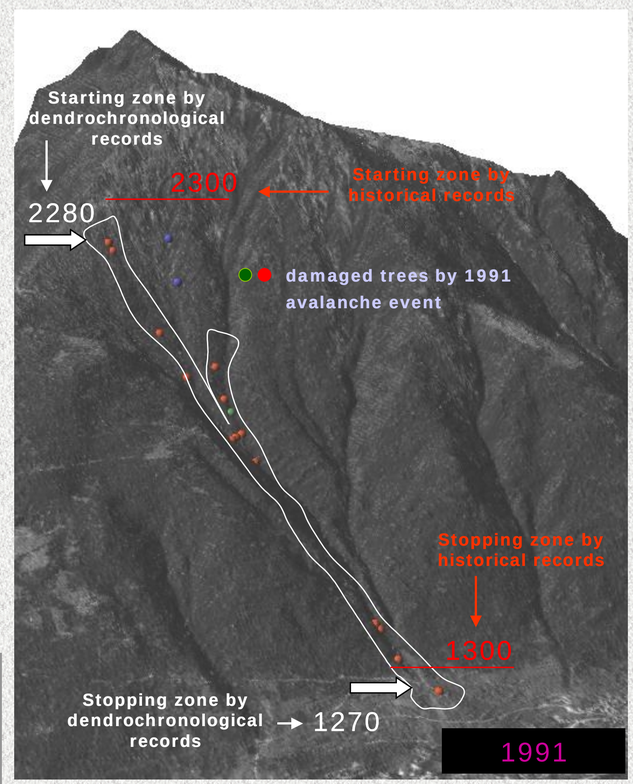
avalanches *Tof Larch* dated with this work: **1950-51, 1976-77, 1981-82, 1986-87**

Recorded in Val di Pejo
- avalanche register: **1951, 1972, 1977**
- Historical notes: **Winter seasons 1985-86 and 1986-87**





Val dei Spini track



CONCLUSIONS:

It is possible to define the avalanche areas in forest zones, by means of morphological criteria and vegetational features recognition

It is possible to update existing avalanche location maps (CLPV) and to create new risk map where informations are lacking

GRASS GIS has proved to be effective to produce risk maps, to locate new avalanche risk areas and paths and to represent the results of dendrochronological investigations

FUTURE DEVELOPMENTS

Refine the GIS model, providing more accurate input data at the moment not available (local snow conditions, terrain characteristics...)