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The EuroDendro project - Snow-avalanche frequency & magnitude in European Middle Mountain unravelled by dendrogeomorphological analyses

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Objectives

The EuroDendro project aims to detect the signal of recent snow-avalanche activity within the analyses of tree rings.

In mountain areas, even middle mountains, snow avalanches are a common process & pose serious hazards & risks in recently occupied sectors, either for residence or recreation purposes.

Where (i) geomorphological evidence of snow-avalanche occurrence are scarce, (ii) historical records are poor & (iii) trees are colonizing part of the slopes, tree-ring analyses appear as a good alternative to reveal the recent snow-avalanche history.

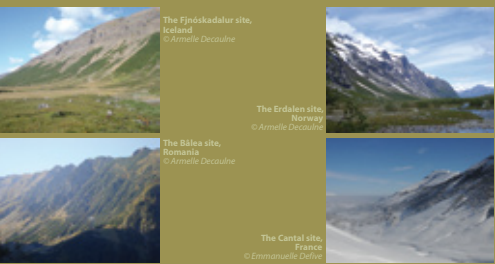
Investigated areas

The EuroDendro project investigates four main areas, some of them in connection with other scientific frameworks.

The investigated areas are located in:

- (A) Northern Iceland, in the Dalsmyrni valley, the Ljósavatn-skarð pass & the southern Fnjóskadalur valley,
- (B) Western Norway, at the bottom of Nordfjord, in Erdalen & Bødalén,
- (C) Central Romania, in the Southern Carpathians, in the Bălea valley, Făgăraș massif,
- (D) Central France, in the Northeastern valleys of the Cantal massif.

All these areas are characterised by steep slopes, harsh wintry conditions, known frequent snow-avalanche activity, a relative remoteness & a tree-cover on talus & cones.



Tree species

The EuroDendro project is very interested in:

(i) broad-leaved trees, which attracted seldom attention in dendrogeomorphology related to snow-avalanche activity:

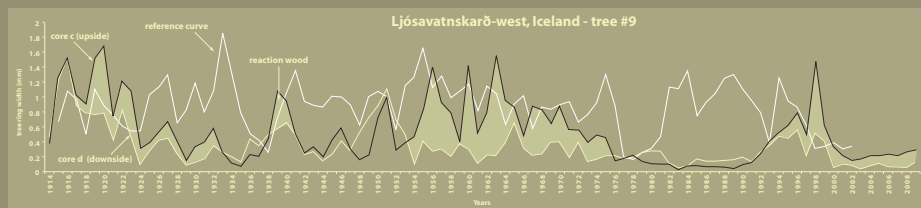
- ◆ birch (*Betula pubescens*) in N Iceland
- ◆ birch (*Betula pubescens*) & alder (*Alnus*) in W Norway
- ◆ beech (*Fagus sylvatica*) in NE Cantal - France

(ii) coniferous trees in little explored areas where broad-leaved trees are unavailable:

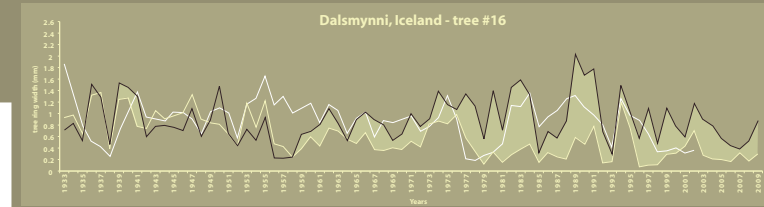
- ◆ spruce (*Picea abies*) in Central Romania

The dendrochronological approach

◆ Core extractions in c & d directions, i.e. parallel to the main flux lines, on both the uphill & the downhill sides of the tree



◆ Core analyses on a Lintab measurement table, enabling tree-rings counting, location & dating of growth disturbances (narrow & large rings) & reaction wood formation.



- ◆ Slow growth
- ◆ Samples from the lower track & upper runout zones
- ◆ Broad-leaved trees => tension wood on the strained side of the trunk => asymmetrical growth
- ◆ Reference growth from outside the snow-avalanche influence area isolate the role of climatic accident & insect attacks
- ◆ Location of the reaction wood date recurrent events over the last 80 years, with a different distribution

The dendromorphological approach

The dendromorphological approach consists in a survey of the investigated areas to inventory damages that affect the morphology of the tree:

- ◆ tilting of the trunk,
- ◆ presence of scars on the trunk,
- ◆ topped trees.



Such a survey enables mapping the most frequent snow-avalanche paths, helping to:

- ◆ locate the maximum potential damages
- ◆ estimate the runout distances
- ◆ appreciate the lateral dispersion of the events

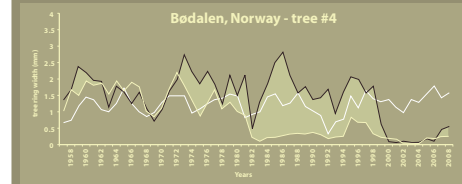
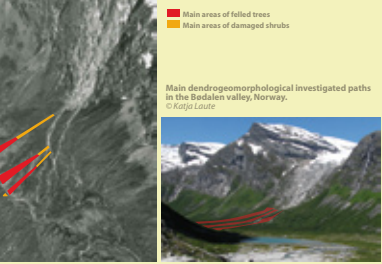
Map of the tree morphology, reflecting damages due to snow-avalanche occurrence on a colluvial cone in the Ljósavatn-skarð pass, Iceland. Background images are © Mikulajg.



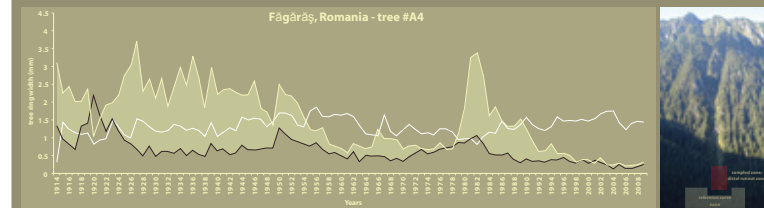
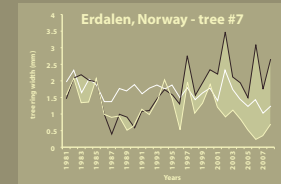
Map of the tree morphology, reflecting damages due to snow-avalanche occurrence on a colluvial cone in the Dalsmyrni valley, Iceland. Background images are © Mikulajg.



Spatial distribution of major impact areas affecting trees in the Bødalén valley, Norway. Background image is © Norwegian land survey.



- ◆ Young trees could indicate: (i) recent snow-avalanche activity drop at valley level (ii) change in grazing zones
- ◆ Well-defined areas of felled trees = recent major snow-avalanche events
- ◆ Reference growth = average of all cores extracted in c-d directions
- ◆ Samples from the lower runout zones
- ◆ Bødalén: sudden drop of tree growth in 2000 = major avalanche felled the tree
- ◆ Erdalen: recurrent avalanchy winters post-1995, severe from 2000 & especially in 2002 & 2006



- ◆ Reference curve built from straight spruces sampled below the path
- ◆ Narrow path with poor tree cover, even in the distal runout zone
- ◆ Most of the trees are very young (+/- 30 years)
- ◆ Reaction wood formation on the downhill side = recurrent stress due to snow-avalanche activity.
- ◆ Oldest trees signal several avalanchy periods, especially from 1920s to early 1950s again during the 1980s.