The EuroDendro project -Snow-avalanche frequency and 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.

Tree species

The EuroDendro project is very interested in:

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

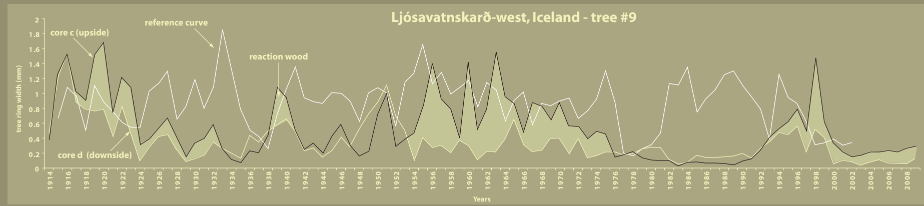
- birch (*Betula pubescens*) in N Iceland
- birch (*Betula pubescens*) & alder (*Alnus*) in W Norway
- beech (*Fagus sylvatica*) in NE Cantal - France

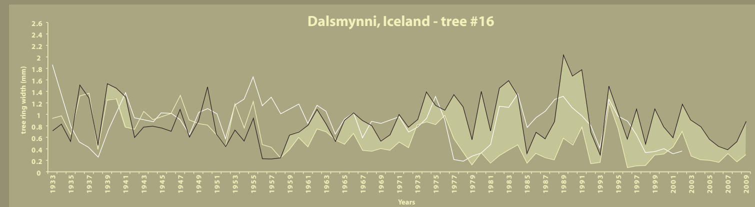
(ii) coniferous trees in little explored areas where broad-leaved trees are unavailable:

- spruce (*Picea abies*) in Central Romania

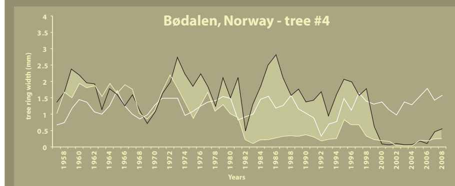
The dendrochronological approach

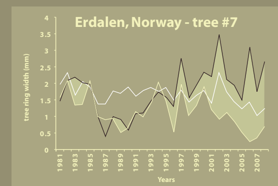
- Core extractions in c & d directions, i.e. parallel to the main flux lines, on both the uphill & the downhill sides of the tree
- Core analyses on a Lintab measurement table, enabling tree-rings counting, location & dating of growth disturbances (narrow & large rings) & reaction wood formation.



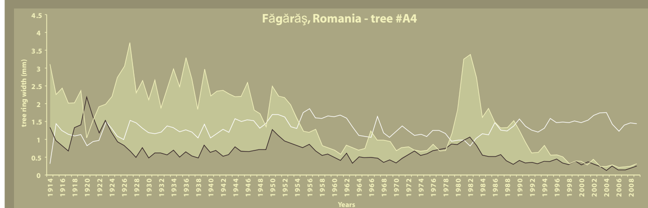


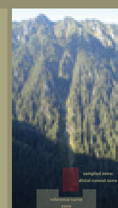
- Slow growth
- Samples from the lower track & upper runout zones
- Broad-leaved trees => tension wood on the strained side of the trunk => asymmetrical growth
- Reference growth from outside the snow-avalanche influence area isolate the role of climatic accident & insect attacks
- Location of the reaction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





- 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
- Bødalen: 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.

Investigated areas

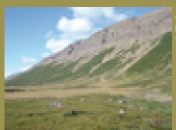
The EuroDendro project investigates four main areas, some of them in connection with other scientific frameworks.

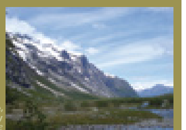
Study sites location © GoogleEarth

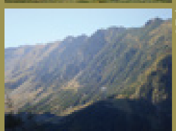
The investigated areas are located in:

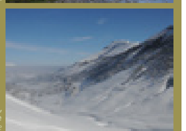
(A) Northern Iceland, in the Dalsmynni valley, the Ljósavatnskarð pass & the southern Fnjóskadalur valley,
(B) Western Norway, at the bottom of Nordfjord, in Erdalen & Bødalen,
(C) Central Romania, in the Southern Carpathians, in the Bâlea valley, Făgărăş massif,
(D) Central France, in the Northeastern valleys of the Cantal massif.

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


The Fjnóskadalur site, Iceland © Armelle Decaulne


The Erdalen site, Norway © Armelle Decaulne


The Bâlea site, Romania © Armelle Decaulne


The Cantal site, France © Emmanuelle Defive

The dendromorphological approach

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

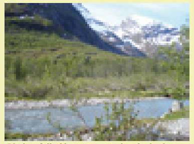
- tilting of the trunk,
- presence of scars on the trunk,
- topped trees.

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

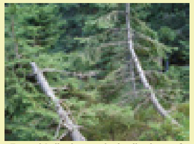
- locate the maximum potential damages
- estimate the runout distances
- appreciate the lateral dispersion of the events



Recurrent snow avalanches strongly influence the growth of the birches that develop typical tilted trunks (Ljósavatnskarð, Iceland). *© Armelle Decaulne*


Birches felled by a snow avalanche in the Bødalen valley, Norway. *© Armelle Decaulne*

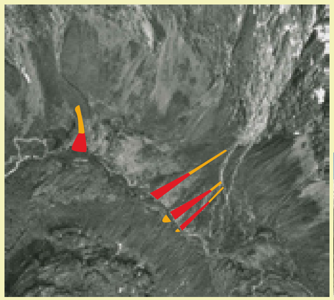

Scars on the trunk & main branches in the snow-avalanche path. *© Armelle Decaulne*


Topped & tilted spruce in the distal part of the path, Romania. *© Armelle Decaulne*


Asymetric branch distribution on a spruce in Romania. *© Armelle Decaulne*

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

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


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

Main areas of felled trees
Main areas of damaged shrubs

Main dendrogeomorphological investigated paths in the Bødalen valley, Norway.
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