



UNIVERSITÉ
DE GENÈVE

INSTITUTE FOR
ENVIRONMENTAL SCIENCES



Dr. Adrien Favillier

Post-doc

Climate Change Impacts and Risks in the
Anthropocene (C-CIA)

Dendrolab.ch

Adrien.Favillier@unige.ch

Boulevard Carl-Vogt, 66

1205 Genève

To **M. Ruedi Haller**

Parc Naziunal Svizzer

Direktor des Schweizerischen Nationalparks

Nationalparkzentrum

Urtatsch 2, 7530 Zernez

Object: Tree-ring analysis of eleven cross-sections

Dear Mr. Ruedi Haller,

We have crossdated the eleven cross-sections that you have given us on the October 2021. All cross-sections were sanded—using grit from 40 to 320—and then scanned at very high resolution (1200 dpi). Each section was digitized and then crossdated using Coorecorder and CDendro software, from Cybis.se. The first complete ring after the cork was set at 2020. Then the growth pace of each sample was synchronized, with a specific attention to Larch Budmoth outbreaks—a foliage feeding Lepidopteran insect responsible for 3- to 4-years growth reduction, during periodical outbreaks each 8- to 10-years. As a result, the oldest tree dates to 1823 (198), whereas the youngest one dates to 1954 (67). Numerated cross-sections were cross dated as follow:

- Cross-section n°1 is 181-year-old and dates to 1840.
- Cross-section n°2 is 192-year-old and dates to 1829.
- Cross-section n°3 is 182-year-old and dates to 1839.
- Cross-section n°4 is 191-year-old and dates to 1830.
- Cross-section n°5 is 180-year-old and dates to 1841.

The six-remaining cross-sections dates to 1823 (198), 1854 (157), 1889 (132), 1925 (96), 1942 (79) and 1954 (67). A total of 65 growth disturbances was retrieved in the tree-rings, including 27 in the five numerated cross-section. In details, 3 injuries were observed—including 2 in Cross-section n°2—and dated to 2002, 2015 and 2019, respectively. Additionally, we observed:

- 48 tangential row of traumatic resin ducts, appearing nearby a wound—13 strong, 18 medium and 17 weak intensities.
- 8 growth suppressions, occurring after the loss of the apex of the tree—4 strong and 4 medium intensities.
- 7 compression wood related to the tilting of the stem—3 strong and 4 medium intensities.

According to the cross dating of these growth disturbances and the 4-steps detection—summarized in Favillier et al., *CRST* 154 (2018)—, 7 debris flow events were reconstructed with a high confidence level in 2002, 1971, 1962, 1952, 1916, 1898 and 1874, respectively. For further details, all figures and data are listed in the appendix attached to this letter.

Best regards,

Dr. Adrien FAVILLIER

FAVILLIER



APPENDIX

Additional files and documents:

- SNP-DB.xlsx — This file resumes the event detection. It contains: the growth disturbances' database; the list of events, and the parameters computed for the event detection per year.
- SNP-Figs.pdf — This file contains all the computed figures, in vector format.

Figures

- Figure 1: Debris flow chronology.
- Figure 2: Shroder's It and sample size graph.
- Figure 3: Graph of the growth disturbances.
- Figure 4: Graph of Weighted It.



Parc Naziunal Svizzer — Debris flow chronology

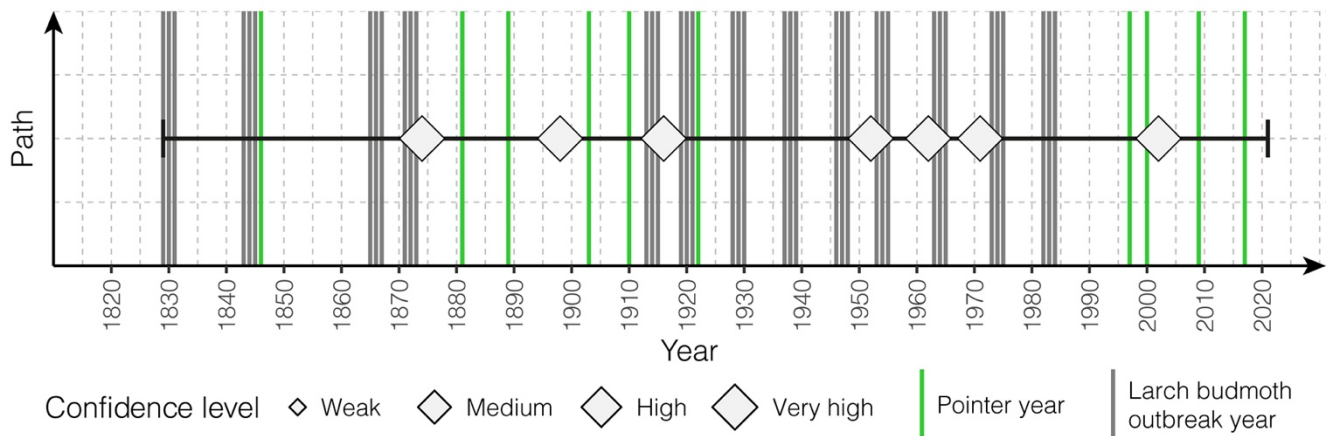


Figure 1: Debris flow events reconstructed for the period 1829–2021. Symbol sizes are proportional to the level of confidence. Grey bands represent triplets of years associated to LBM outbreaks. Vertical green lines highlight the pointer years which are characterized by an anormal narrow ring.



Parc Naziunal Svizzer — Shroder's It and sample size

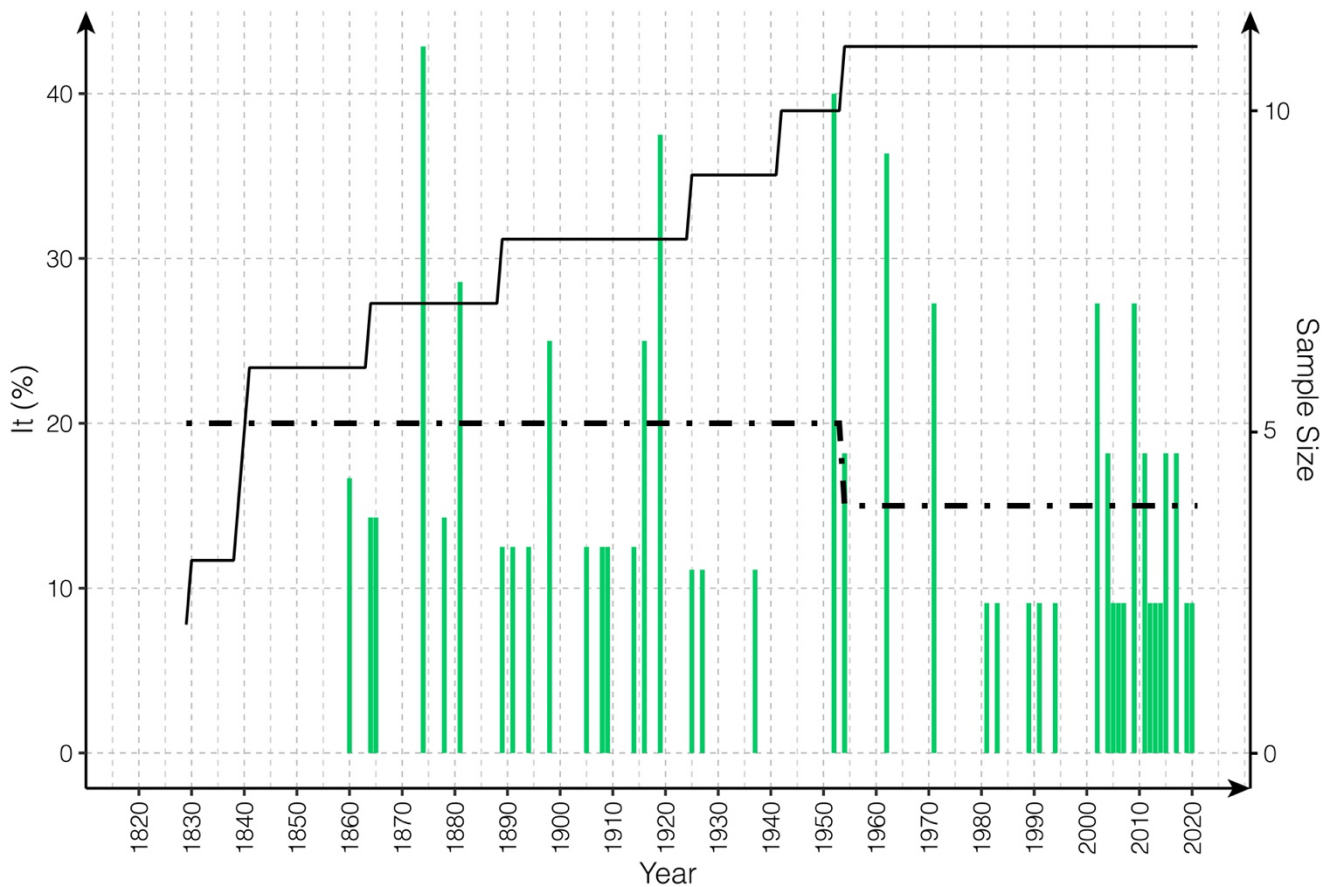


Figure 2: Histogram of the Shroder's It. Green bars represent the annual value of the Shroder's It—the percentage of trees with a growth disturbance per year. The dashed line is the It threshold to detect a debris flow event. The solid line denotes the sample size.



Parc Naziunal Svizzer — Growth disturbances

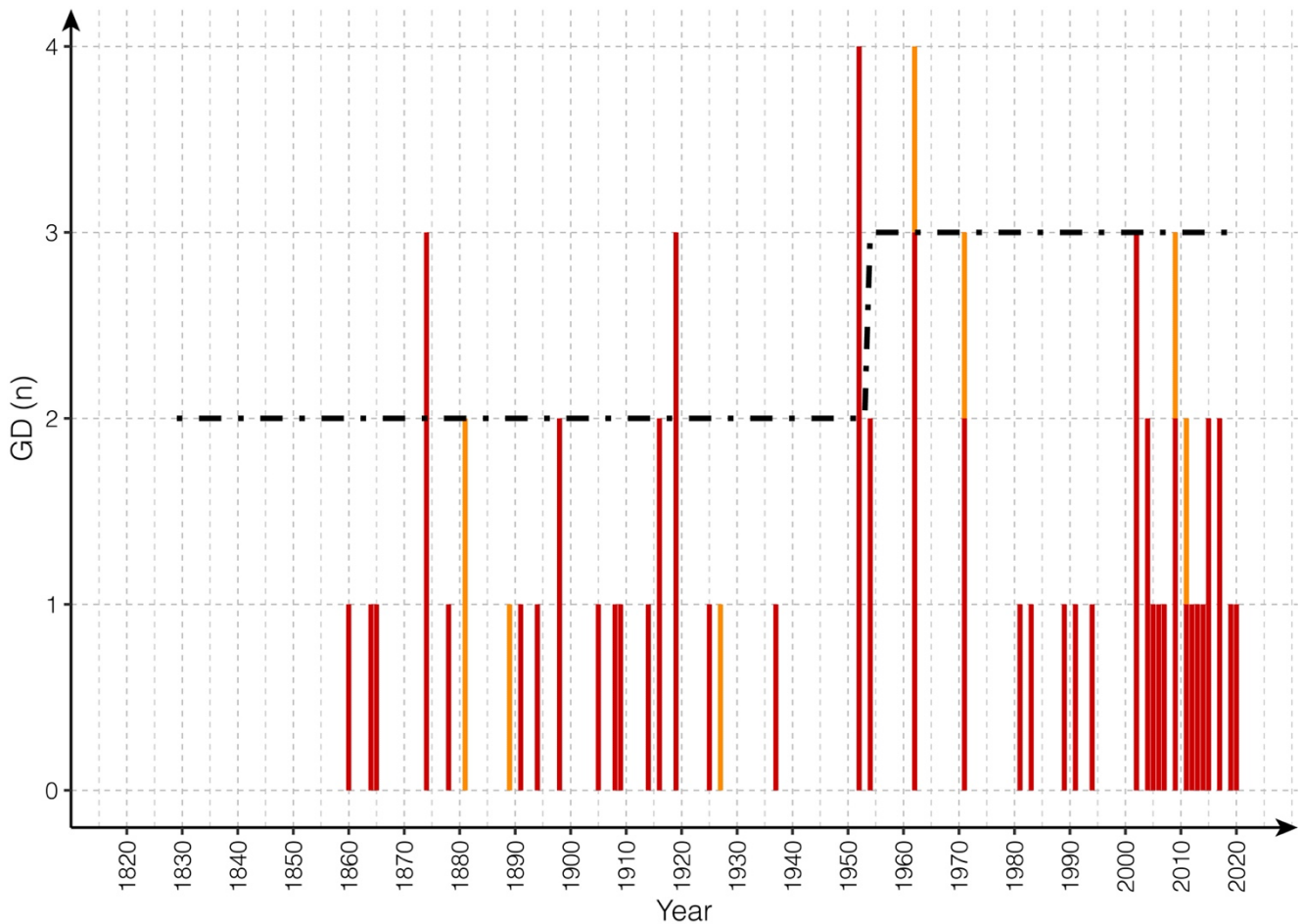


Figure 3: Histogram of the growth disturbances. Orange bars show the total number of growth reductions while red bars represent the number of mechanical disturbances, such as tangential rows of Traumatic Resin Ducts. The dashed line denotes the growth disturbance threshold to detect a debris flow event.



Parc Naziunal Svizzer — Confidence level

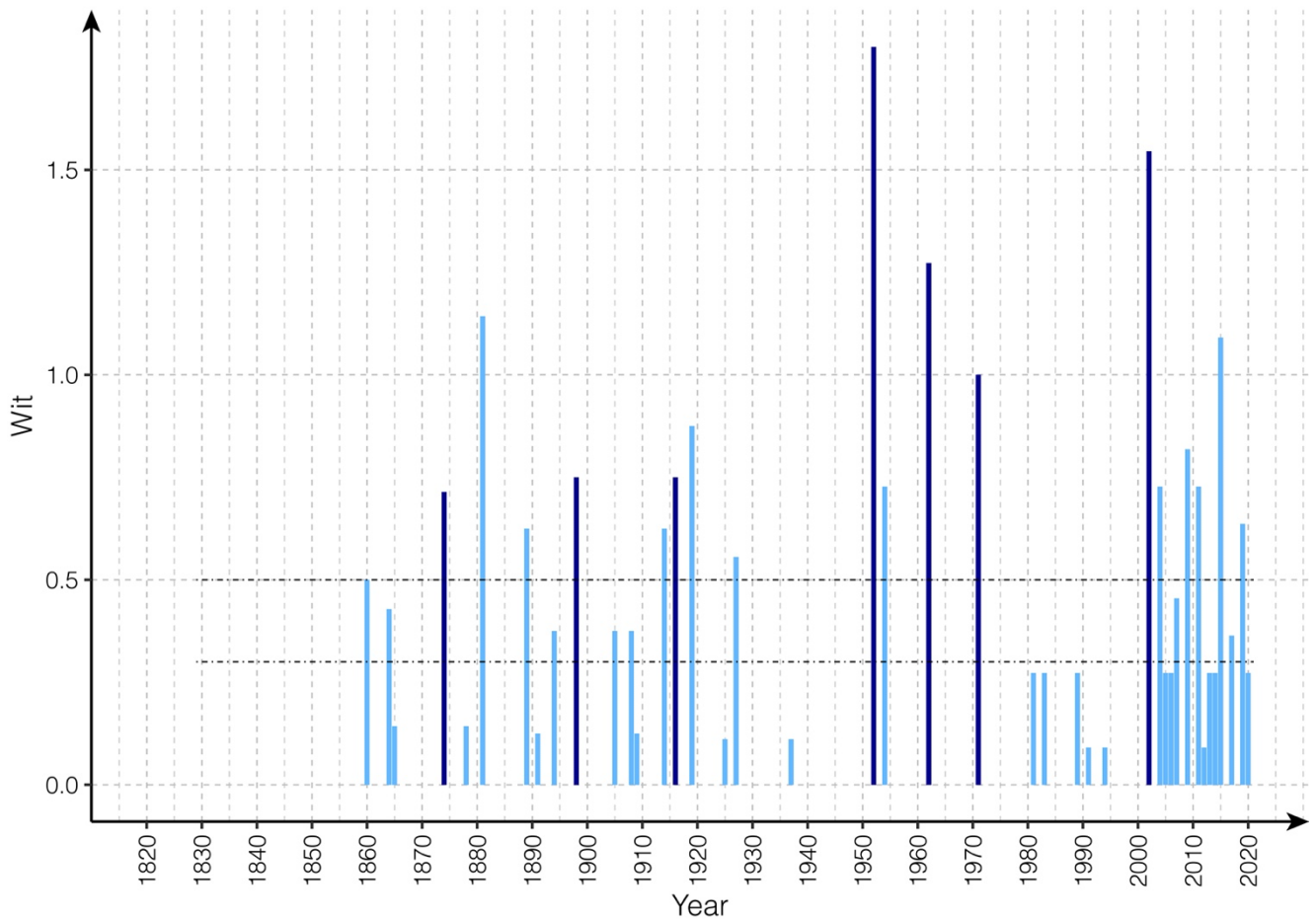


Figure 4: Histogram of the Weighted It (Wit)—which consider the intensity of each growth disturbance to compute the confidence level of the event. Dark blue bars represent successfully detected event while light blue bar represent non-event years. Dashed lines represent the threshold to consider a very high confidence level ($Wit \geq 0.5$); a high confidence level ($0.2 \geq Wit < 0.5$); or a medium confidence level ($Wit < 0.2$).