**Natural Hazards
and Earth
System Sciences**

Book Review of
"Tree Rings and Natural Hazards: A State-of-the-Art"

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TREE RINGS AND NATURAL HAZARDS: A STATE-OF-THE-ART, BY: MARKUS STOFFEL, MICHELLE BOLLSCHWEILER, DAVID R. BUTLER, AND BRIAN H. LUCKMAN (EDS.), SPRINGER, DORDRECHT, THE NETHERLANDS, 505 PAGES, ISBN 978-90-481-8735-5 (HARDCOVER), ISBN 978-90-481-8736-2 (E-BOOK), PRICE: 160,45 €

This book organizes 47 articles into eleven parts. Written by the editors, Part I is the introduction and Part XI the overall conclusion and outlook. In between, the nine parts has four to six articles each. Each part begins with an introductory overview, followed by several case studies conducted primarily in Europe and North America. Some of the articles are two or three pages in length, while others are like full-length journal articles. Some appear to have been completed earlier, but many others appear to have been written for this edited volume.

Readers who are not familiar with dendrogeomorphology or dendrochronology are recommended to start with Part I. The introduction explains how tree growth can be affected by natural hazards, how these effects are preserved in tree rings, and how tree rings are sampled and processed in laboratory analysis. It also covers the frequency, magnitude, and return period of a natural hazard, which are closely associated with tree-ring applications.

Part II focuses on snow avalanche. Evidence of past avalanche activity can be gathered by analyzing impact scars, reaction wood, suppression rings, and, more recently, traumatic resin ducts in tree rings. Relying on such evidence, Germain et al. were able to estimate the return interval and annual probability of high-magnitude avalanches at the local and regional scales in the Gaspé Peninsula, Québec (Canada). Other case studies used tree-ring analysis to vali-

date numerical simulations of snow avalanches and to derive the avalanche climatology on the regional scale. Part III on landslides starts with an overview that suggests three general strategies to date landslides: date the oldest tree living on the landslide deposit, date trees affected but not killed by landslides, and date trees killed by landslides. In practice, tree-ring analysis helped to determine the temporal sequence of landslides from 1820 to 1994 in Lago, Calabria (Italy) and to provide the exact date and season of recent landslides and the climatic context responsible for their inception for the eastern coast of Hudson Bay, Québec (Canada). One other study used tree-ring widths to examine the relationship between landslide occurrence and precipitation variability. Rockfall is covered in Part IV. The normally small volume of rockfall fragments makes it difficult to capture enough tree-ring samples. Also, it is difficult to distinguish in tree-ring analysis single events with multiple rocks or multiple events at different times within a year. Thus, according to Stoffel et al., tree rings have been used only rarely for the reconstruction of rockfall activity. Three case studies from Swiss Alps and Eastern Pyrenees illustrated tree-ring applications for rockfall modeling and hazard analysis.

Part V focuses on debris flows. In the overview, Jakob claims that dendrochronology has played a crucial part in reconstructing debris flow activity in the past. Trees damaged by the debris have visible growth defects such as tilted stems, trunk burial, and root damage, and they also have impact scars in tree rings for dating and analysis. Based on such evidence, the debris-flow chronology was constructed in two separate case studies. The third study analyzed debris-flow dynamics and growth disturbances in century-old trees on a forested cone, and the fourth combined a wood formation model and tree-ring analysis for high-precision dating of debris-flow events. Flooding is covered in Part VI. Paleoflood research uses scarring caused by abrasion or impact as evidence: the number of tree rings between the scar and the outside ring determines the timing of the flood, and the

height of the scar suggests the minimum elevation of high water. In one case study, the frequency of flood events was estimated to be 4.5 years along a small stream in the Polish Tatra Mountains. The other case studies examined the effects of hydroelectric flooding and the frequency and magnitude of spring floods. Tropical cyclones (hurricanes) and tornadoes are included in Part VII under meteorological hazards. Tree-ring width and wood density are data that can provide climatic information. A case study of dendrochronological responses to a tornado reported the presence of growth release, reaction wood, suppressed growth, and reduced latewood in tree rings. The other two case studies analyzed the oxygen isotope composition in tree-ring samples to isolate the years of landfalling hurricanes.

Part VIII covers the use of fire scars in tree rings for tracking wildfires in the past. One case study used fire-scar chronologies with other regionally synchronized data such as drought indices and insect outbreak to study decadal climatic variability during the past 400 years in the American Southwest. Another study performed tree-ring analysis to reconstruct fire regimes and to measure changes in forest and fire structure, before applying the information for forest management. Two other studies discussed wildfire risk, and wildfire risk and ecological restoration. Part IX focuses on tree rings and earthquakes. Earthquakes can produce a variety of responses in trees such as physical breakages of trunks and roots, changes in the growth rings, and tilting. Earthquake-

induced elevation changes, landslides, and liquefaction can also produce additional evidence for studies of paleoseismology. Case studies in Part IX include seismic events in Fuyun (China), southwestern Montana (USA), and Olympic and Yellowstone National Parks (USA). Volcanic activity is covered in Part X. Volcanic eruptions can have global and local effect. Salzer and Hughes established a temporal association between ring-width reductions in subalpine pines and globally-effective volcanic eruptions as recorded in polar ice cores and the historical volcano record over the past 5000 years. In contrast, two case studies relied on the presence of narrow growth rings and damaged or killed trees to study the local impacts of past volcanic eruptions. The fourth study used carbonized logs buried in a pyroclastic flow deposit to date a volcanic eruption used to be unknown, and the fifth tested the dendrochemical evidence of a 1781 volcanic eruption in tree rings.

In Part XI, the editors conclude the book by suggesting areas of research needs and possible tree-ring applications for studies of natural hazards.

This book offers a comprehensive coverage of tree rings and natural hazards, aided with many tables and figures. It is an excellent book for readers who want to learn what is dendrogeomorphology and how tree-ring analysis can be used, either alone or with other data, to estimate the frequency and magnitude of natural hazards.