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Use of resistograph for dendrogeomorphological analysis of avalanche impacts (massif de l'Oisans, France)

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Dendrogeomorphology is based on identification of particular tree rings with abnormal density. Wood density is traditionally determined by a volumetric or a X-Ray method that is accurate but expensive for largescale sampling. Several new methods and instruments, including the Pilodyn wood tester, torsiometer and electronic microdensitometry, have been suggested to replace the standard method. Among these methods, the Pilodyn is commonly used but it has drawbacks. It only estimates relative density of living trees. It is not recommended for through-the-bark measurements because of variation in bark thickness among trees. Because the tool only penetrates into the first few rings of the tree (from 7 to 20 mm), it does not measure the juvenile wood near the center of the tree. The resistograph device offers an alternative method. Invented in the purpose of detecting wood cavity, with low or null density in standing trees or construction wood, it measures the drill resistance of a fine needle as it penetrates wood. It was investigated for rapid assessment of relative wood density of particular tree-rings used in dendrogeomorphology.

We used samples from a dendrogeomorphological study achieved during summer 2004 on the Pierres Jean-Jeanne talus slope (Oisans massif, Northern Alps, France; 45.03 N, 06.25 E). 170 discs were taken from dead or impacted trees with poor survival or which were no longer of forestry quality. Resistographic profiles were processed on 15 discs from this study. 11 stems showed visible signs of past avalanches impacts; 4, no obvious avalanche damage. Resistographic and micrometric measurements were processed on an identical axis to determine width and density parameters of 613 tree rings. Resistograph « IML Resi F400 » composed of an electronic unit and a drilling unit was used to process resistographic measurements. The tool is based on measuring the drilling resistance along a small needle path when a needle is driven into a tree with a constant force. The power consumption of the drilling device is measured electronically as well as the amplitude of drilling resistance. The amplitude readings are recorded, each 1/10 mm, in relation to the penetration depth of the needle (from bark to bark). This reveals the variation in the density of earlywood, latewood, and tree rings. Numeric measurements are stocked in the drilling unit and can be processed with software FTools (© Instrumenta Mechanik Labor GmbH).

To reach our goal, each tree ring must be delimited on the resistographic profile using software F.Tools. To avoid counting errors, a correlation coefficient was measured between ring width chronologies obtained from micrometric measurements and ring width chronologies obtained from resitographic profiles. Next, for each tree ring, we determined width (L), averaged width (MMP3) maximum density (MXD) and variation of density (VARD). The data set was simplified using a clustering analysis and a Principal Component Analysis (PCA). A simplified assessment grid was derived from this PCA. It provides probability benchmarks to identify disturbances in a densitometric signal. The combined utilization of grid and resistograph offers prospects for spatialization and cartography of avalanche hazards.