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Using exposed tree roots as a dating tool for erosion in mountain torrents

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In alpine areas, steep torrents are characterised by an intensive interaction between erosion and accumulation. Erosion of forested riverbanks frequently causes a potential destabilisation of adjoining trees. Fallen trees hold the potential to lead to a blockage of the fluvial system that potentially results in severe flooding. In addition, erosion on slopes and riverbanks in forested areas may cause landslides and debris flows.As a consequence, these geomorphic processes may lead to severe damage to infrastructure in the affected areas.

The work presented here aims at reconstructing the erosion dynamics and at evaluating the influence of riverbank erosion on the quantity of driftwood in two selected torrents of the Swiss Alpine area. Focus is set on the analysis of wood anatomical features of exposed roots of coniferous and deciduous trees so as (i) to date erosive events and (ii) to determine erosion rates. Dating the moment of root exposure along riverbanks in combination with traditional dendrogeomorphological techniques applied to tree trunks allows reconstruction of erosion dynamics, which often lead to a potential destabilisation of adjoining trees.

Dating the moment of root exposure is done by investigating wood anatomical features in the annual rings of exposed roots. Roots of coniferous trees show structural changes in the earlywood cells due to exposure. This anatomical feature in the xylem of exposed roots allows definition of the time of exposure at a resolution of one year.

In addition, detailed geomorphological mapping of the specific sites and precise documentation of the position of the exposed roots related to the recent soil surface is compiled. The resulting data allow determination of erosion rates on riverbanks and slopes. Consequently, a temporal and spatial quantification of erosion is possible. This

methodology, which was already established for conifer trees, is now also applied to European Ash (*Fraxinus excelsior* L.) and enabled us to determine a species-specific reaction to root exposure.

Our data show the potential of roots in general and in particular of deciduous trees for dendrogeomorphological research, especially concerning erosion studies.