Geophysical Research Abstracts
Vol. 21, EGU2019-13793-1, 2019
EGU General Assembly 2019

The role of soil piping in gully development: A dendrogeomorphological approach

Anita Bernatek-Jakiel and Dominika Wrońska-Wałach

Institute of Geography and Spatial Management, Faculty of Geography and Geology, Jagiellonian University, Krakow, Poland

Gullies are complex geomorphic systems which are initiated and transformed not only by concentrated overland flow, but also by mass movements and subsurface erosion, such as soil piping. The role of piping in gully initiation and development especially in forested areas is often underestimated due to the difficulties in observing and studying this process. This study has tested dendrogeomorphological analyses to reconstruct the transformation of pipe collapses and gully bottom deepening by soil piping. Piping erosion affects both roots and tree rings because of the changes in water flow patterns and mechanical stress. Dendrogeomorphological analyses enable dating of pipe collapses.

The study was conducted in the Bieszczady Mts., SE Poland, built of flysch rocks (sandstones, shales and mudstones), where pipes develop in Cambisols at the soil–bedrock interface. The detailed analyses were conducted in the test area with two piping systems, which are located in grasslands, and they end at pipe outlets in the forest, in the head of a gully. Roots (8) and stems (19) samples were taken in the field and analysed in the laboratory. Vessel lumen area, fibre size, ring width and the appearance of tension wood were analysed using WinCELL Pro (Regent) and the LINTAB with TSAP-Win (RINNTECH) system.

Dendrogeomorphological analyses have revealed that the pipe roof initially collapsed in the lower position on the slope and the pipe develops up the slope. This implies that pipeflow concentrates along the slope and the erosion potential increases in the lowermost position of slope. The study has confirmed the role of piping in gully deepening which happened because of high precipitation events. In the forest, piping erosion occurred almost simultaneously with high precipitation, whereas the development of pipe collapses on grasslands were observed with the delay (i.e. 1–2 years later than the years with high precipitation), which shows the impact of vegetation on soil piping. Additionally, this study has demonstrated that neighbouring pipes may be of different age, which means that they develop with different dynamics. General assumptions on the age of pipe collapses should be made with caution.

The study is supported by the National Science Centre, Poland: the research was a part of the first author's project PRELUDIUM 3 (DEC-2012/05/N/ST10/03926), the first author was granted the ETIUDA 3 doctoral scholarship (DEC-2015/16/T/ST10/00505), whereas the participation in the conference was supported within the SONATINA 1 project (DEC-2017/24/C/ST10/00114).