LANDSLIDE HYDROLOGY: FROM HYDROLOGY TO PORE WATER PRESSURE AND LANDSLIDE INITIATION

Thom A. Bogaard
Delft University of Technology, Department of Water Management, Delft, The Netherlands

ABSTRACT

The management of landslide risk and, more generally, natural risks is an essentially interdisciplinary task, as the contribution of many knowledge fields is required. In fact, a modern approach to landslide risk management involves the deployment of a layered strategy, including not only structural measures such as building defense structures or slope stabilization works, but also non-structural measures which require setting up on-site monitoring networks, remote sensing monitoring schemes, fast and reliable transmission of data and its quality control, development of models and decision support tools to assess the risk in real-time.

Rainfall-induced landslides is an interdisciplinary topic that requires knowledge from geomechanics, geomorphology, hydraulics and hydrology fields, to name a few. More specifically, the representation of hydrological processes in the models used for assessing the stability of slopes is often incomplete. Landslide hydrology, however, is not simply putting together hydrological calculations (modeling) with the knowledge coming from the above mentioned disciplines. In fact, the main challenge is embedding our increased understanding of hydrological processes in hillslopes and catchments in a physically correct but also parsimonious manner for landslide hazard assessment. The focus hereto, should be on inclusion of the non-linear behavior of hydrological response on precipitation due to complex water storage in soil layers as well as in the entire catchment. This boils down to an issue in matching processes occurring at very different time and space scales. Special attention should be given to the boundary conditions around the domain considered for slope stability analysis.

The small scale hydrological processes (e.g., infiltration and snowmelt) directly affect the stress state of soil (at pore scale), leading to landslide trigger. The catchment scale processes create the preconditions for the trigger to take place, so they are landslide causes but in our modelling domain often only visible as boundary condition. Uniquely and interestingly, the hillslope scale hydrological processes, developing in the same domain considered for slope stability assessment, make causes and triggers meet. Therefore, past and current research on landslide hydrology can be usefully regarded into this cause/large scale and trigger/small scale concept.

The lecture will address the work done in the field of landslide hydrology and shed light to important knowledge gaps that urgently need to be addressed in order to

arrive at improved landslide mitigation and early warning systems.

SHORT BIO

Thom Bogaard is Associate Professor hydrology at the department of Water management at TUDelft, The Netherlands, with over 25 years of experience in (applied) hydrological research and education. His focus is on multidisciplinary hydrology and specialized in hydrology and earth surface dynamics. In his research and education, he develops and tests innovative measurement technology and applies them with his students to solve hydrological problems. The combination of controlled experiments, field monitoring and modelling is central in his research. He co-authored ~ 125 international peer-reviewed papers (>75 international journal papers, > 50 peer-reviewed conference papers, 6 Book chapters). He is Executive Editor of Hess, the leading international hydrological journal, and Associate Editor of WIREs Water (an invitation only journal).

Thom is a well-structured and energetic teacher who loves to be in the field. He aims to bring across my own curiosity and excitement about research to students through education and supervision. He has been acknowledging three time for best lecturer at UU and TUDelft. Thom has ample experience in course development and curriculum management. Capacity building projects in developing countries and outreach activities are a key aspect in his professional life. His experience is mainly in Southeast Asia (Thailand, Indonesia, Vietnam and Nepal), but also in several African countries.