Geophysical Research Abstracts
Vol. 19, EGU2017-13109, 2017
EGU General Assembly 2017


# Hydrologic system state at debris flow initiation in the Pitztal catchment, Austria

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Debris flows represent a severe hazard in mountain regions. Though significant effort has been made to forecast such events, the trigger conditions as well as the hydrologic disposition of a watershed at the time of debris flow occurrence are not well understood. To improve our knowledge on the connection between debris flow initiation and the hydrologic system, this study applies a semi-distributed conceptual rainfall-runoff model, linking different system state variables such as soil moisture, snowmelt, or runoff with documented debris flow events in the Pitztal watershed, western Austria. The hydrologic modelling was performed on a daily basis between 1953 and 2012. High-intensity rainfall could be identified as the dominant trigger (31 out of 43 debris flows), while triggering exclusively by low-intensity, long-lasting rainfall was only observed in one single case. The remaining events were related to snowmelt; whether all of these events where triggered by rain-on-snow, or whether some of these events were actually triggered by snowmelt only, remains unclear since the occurrence of un- resp. underrecorded rainfall was detected frequently. The usage of a conceptual hydrological model for investigating debris flow initiation constitutes a novel approach in debris flow research and was assessed as very valuable. For future studies, it is recommended to evaluate also sub-daily information. As antecedent snowmelt was found to be much more important to debris flow initiation than antecedent rainfall, it might prove beneficial to include snowmelt in the commonly used rainfall intensity-duration thresholds.