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Identification of runoff processes in a small catchment in the Chilean Andes - Testing our perception with physically based models

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Extensive land use changes in Southern Chile have the potential to increase risk of floods, erosion, nutrient loss and eutrophication. In order to estimate this risk detailed knowledge and understanding of rainfall-runoff response mechanisms in disturbed as well as undisturbed catchments is mandatory. The primary focus of this study lies on data collection and experimental investigation in order to enhance our process understanding. In a second step hypotheses concerning hydrologically dominant structures and processes are tested by implementing physically based hydrological models. Field investigations concentrate on a catchment without anthropogenic intervention in order to understand the system in its natural state. The research area is situated in the Reserva Nacional Malalcahuello in the Precordillera de los Andes (Región de la Araucanía). The catchment is located on the southern slope of the Volcán Lonquimay. Important characteristics of the catchment include native forest with a dense understory of bamboo, steep slopes and young, little developed volcanic ash soils with high hydraulic conductivities. Measurements of discharge, soil moisture and ground water dynamics, rainfall, throughfall and soil physical parameters are carried out to determine the relevant runoff processes. Tracer studies add valuable information to these more 'classical' data sets. Tracer techniques employed in this investigation include qualitative and quantitative methods. Dye tracer experiments were used to visualize flow paths in the unsaturated zone. For the purpose of hydrograph separation major cations and anions as well as stable isotopes, electrical conductivity and water temperature were used as environmental tracers. For a better characterization of the subsurface intrusive methods (augering/soil pits/core sampling) as well as non-intrusive methods (electrical resistivity) were employed. Preliminary results suggest the importance of fast processes

for rainfall runoff response on the one hand as well as of considerable dampening effects of a large storage on the other hand. There is evidence of preferential flowpaths resulting from the textural differences between different layers of volcanic ash (from gravel fraction to silty sand). However, connectivity of these gravel layers along the hillslope is necessary in order to make them hydrologically relevant on catchment or even hill slope scale. In the near-stream zone, flow reversal between groundwater and surface water has been observed under certain conditions. With the help of physically based models it is possible to test these perceptions gained from point data for their importance on hill slope and catchment scale.