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Improving process understanding in a data-scarce catchment by modelling at different spatial scales and different levels of complexity

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The comparison of calibrated and uncalibrated models and their ability to reproduce or predict time series of discharge as well as the comparison of their shortcomings can yield important information. This type of comparison can give us insights in catchment functioning and allows us to test the validity of our perceptions and assumptions.

The hydrology of a small data-scarce catchment in the southern Chilean Andes was investigated with a number of field campaigns. The catchment is dominated by young volcanic ash soils which are little understood in their hydrological functioning. Due to difficult accessibility most of the experimental work was carried out on a hillslope in the lower part of the catchment. This dataset was then used to parameterize the physically based model Catflow. The model was applied at the hillslope scale to test hypotheses which were developed from the experimental data. This includes hypotheses concerning lateral and vertical preferential flow as well as the importance of rainfall redistribution in the forest canopy. Results were compared to the process oriented model Wasim-ETH, which was used to model rainfall-runoff response at the catchment scale. While in Catflow the water movement in the unsaturated zone is modelled explicitly with the mixed form of the Richards equation, Wasim-ETH does not model soil water movement but uses a system of storages and thus needs to be calibrated. Due to the difference in scale and approach the two models also contain different inherent assumptions. The comparison of the models and their performance thus allows us to evaluate the validity of these assumptions. It was found that while both models were

able to reproduce the overall dynamics of the system quite well, they both failed in reproducing the fast event recessions observed in the field. This indicates the possible importance of threshold processes so far not included in the models.