



## **From cause-effect-analysis to adaptation to hydrological change: Impacts of environmental change on catchment hydrology and water management**

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The water cycle of catchments is influenced by different forcings and boundary conditions causing an observed or a possible future hydrological change. Regional climate is variable or even changing, land use is altered due socioeconomic drivers, and humans are taking actions directly in rivers or in the natural groundwater storage in order to regulate the water flows in a catchment. In those cases where hydrological change is observed, very often focus is set on single cause-effect-relationships, first. Sometimes, satisfying correlation is found, and a single cause-effect-relationship can be derived. But just as often correlations cannot sufficiently explain the hydrological change. Integrative approaches are required in order to consider that different changes occur simultaneously. However, interactions between the different causes of hydrological change are complex, and the differentiation of their individual share of hydrological change is difficult.

This presentation points out that different strategies are required to investigate the effects of historical and future changes on catchment hydrological behaviour. These differences are due to limitations in data availability and model validity under changing environmental conditions. Examples on the value and the limitation of the analysis of individual cause-effect-relationships between environmental change (land use and climate change) and hydrological change are provided. Despite their limited consideration of the 'complexity' of environmental change they can contribute to analyse the system. The problem of model validity for future environmental conditions is discussed, which can be reduced by applying multi-model-ensembles. Finally, it will be illustrated that scenario analysis is a valuable tool to quantify possible future hydrological change. Knowing reliable 'numbers' of change is a prerequisite for a successful adaptation to changing environmental conditions, i.e. of the regional water management to climate change, which can be a successful strategy to reduce future hydrological risks.