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How much process understanding can be gained with limited experimental investigations, and how can we translate that into catchments models?

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The vast majority of catchments worldwide are poorly gauged or ungauged. Classical data sets as hydrological modelers normally need, i.e. discharge records and climate parameters, groundwater levels etc., are often incomplete, uncertain or just wrong. However, short records of some variables (e.g. observations of a few events, groundwater table fluctuations during snow melt, extent of saturated areas etc.) or data sets that are often hardly used in classical hydrological modeling (e.g. tracer data, observations of locals etc.) can help enormously to unpuzzle the functioning of dominant hydrological processes. During short intensive monitoring campaigns using a variety of methods including classical hydrometry, tracers and geophysics, the major runoff source areas can be mapped. It can not be emphasized enough, that knowledge of the dominating processes, including water flow pathways and residence times, are essential for understanding and predicting the hydrological response of a catchment in particular during extreme situations or during changed circumstances (e.g. land use change, climate change). In this paper, the use of short intensive monitoring campaigns to develop a conceptual understanding of the catchment functioning is illustrated with some case studies from small and meso-scale catchments in Germany, South Africa and Tanzania. It is also discussed how this understanding can be transferred into a process-based conceptual catchment model.