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# How can we calibrate a physically-based hydrologic model to maximise its value for understanding catchment function?

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Characterising the functional behaviour of catchments is a main scientific question in hydrology. Typically the amount of data available is insufficient to characterise the dynamics of catchments, such as the variability in storage or the release of moisture. We therefore require numerical models to interpolate (e.g. to understand internal states) or extrapolate (e.g. to a new catchment altogether) existing observations. Spatially distributed and physically-based models have been especially promising in this regard, but have, so far, suffered from at least two problems. Firstly, they do not perform well in an uncalibrated state when parameters are simply estimated from information about soils or vegetation. Secondly, calibration to specific variables, mainly streamflow, generally does not sufficiently constrain other parts of the model domain that are important for understanding catchment function, e.g. internal variability of storage behaviour. And there are of course more issues such as overparameterisation, model structural error or the noncommensurability of modelled and observed state variables. In this presentation we would like to revisit the topic of model calibration for physically-based models. Our premise is that the direct calibration to observations almost always leads to an overfitting of the model to this type of information, while other aspects of model behaviour get ignored. Here we propose to use the observations (and any other available information) only to guide the development of an explicit perceptual model, which contains information about what behaviour we believe can be expected from the catchment or not. Our efforts are then focused on making the perceptual and the numerical model consistent with each other. We believe that this strategy is more likely to yield numerical models that are hydrologically acceptable than traditional calibration strategies.