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Model structural error and the curse of the errors in variables problem

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Our models are in error and so are the observations (measurements) we use as input forcing data to drive model simulations, to assess modelling performance, and to define initial and boundary conditions. All measurements have two components associated with the error term, 1) the precision of the instrument and 2) the errors in variables problem. The 'errors in variables' problem is essentially an unknown error quantity, reflecting the mismatch between the values of the variables required to run and evaluate a model and the values of the data that are actually measured. This difference arises as a result of scale, heterogeneity and incommensurability effects, both at the local point scale (e.g. a recording well measurement compared to the predicted water table elevation predicted at the effective model gridscale) or at the catchment scale (e.g. the true variability of the rainfall field used to drive the model simulation). It could only be properly assessed if we could measure the quantity we are interested in everywhere at the scale required by our model simulations. Otherwise, the estimation of errors in variables is a poorly posed problem even in simple statistical cases. It is also an important constraint on the identification and understanding of model structural errors. In this paper we investigate what techniques can be employed to consider such errors further in the modelling process.