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Comparison of different parameterisations and conceptualisations of the MIKE SHE model using multi-objective calibration

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Calibration of a distributed and integrated hydrological model potentially includes a huge number of parameters and model structures to be analysed. Thus, to make the calibration problem tractable a rigorous model parameterisation and conceptualization is required. Furthermore, for making reliable distributed predictions of different state variables calibration should be performed using multiple sources of information from different sites in the modelling domain. This calls for formulation of the calibration problem in a general multi-objective context. Multi-objective calibration allows a comprehensive evaluation of the trade-offs between different calibration objectives that highlights possible model structural deficiencies. In addition, it offers an elaborate framework for comparison of different model structures and model conceptualisations by considering several performance criteria in a consistent manner. For instance, one model structure may be better in simulating groundwater heads than river runoff as compared to another model structure.

In this paper multi-objective calibration is applied for comparison of different model parameterisations and conceptualisations of the MIKE SHE modelling system. MIKE SHE offers an elaborate modelling framework that allows choosing between different process descriptions within the same modelling system. For the various modelling components several model descriptions are available ranging from complex, physically-based descriptions that solve the governing partial differential equations to more simple, conceptual models. The proposed methodology is applied for calibration

of a MIKE SHE model setup of the Danish Karup catchment. The available data consist of groundwater level measurements at several locations within the catchment as well as runoff measurements at the catchment outlet and at three internal stations. The analysed models include different parameterisations of the saturated and unsaturated zones to investigate the effect of distribution of key hydraulic parameters and geological conceptualisation. In addition, the effect of using different process descriptions for the unsaturated zone component is analysed.