Assessing modeled spatial and temporal variability in soil moisture using automated, multi-objective, step-wise calibration

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Abstract. The predictive capability of many environmental models is commonly hampered by a profuse set of parameters that are often physically ambiguous and costly to measure in the field. Furthermore, model parameter estimation is sometimes hindered by complex dynamical model feedbacks and interactions, resulting in the inability of many automated calibration procedures to identify optimal parameter sets. In the case of modeling and calibration endeavors for field-scale environmental models in agricultural settings, little work has been done in attempting to assess and correct model structure at different points in space based on parameter optimization. We attempt to remedy this situation by examining the performance of a vertically-distributed model used to estimate depth-dependent soil moisture variability in a dryland agricultural setting (the Root Zone Water Quality Model, RZWQM) in Colorado at different landscape positions within a cropped field using multiple-objective, step-wise calibration. This method employs a shuffled complex evolution algorithm which uses competitive evolution and complex shuffling to search for globally optimal parameter sets. In this exercise we examine the calibration of hydraulic parameters that govern the formulation of the Brooks and Corey description of the soil water retention curve. The incorporation of such parameter optimization and structural assessment techniques into the modeling "toolbox" of government agencies such as the Agricultural Research Service will aid the design and implementation of more accurate predictive tools to advise sound economic and environmental management of agricultural resources. Future work will examine model performance discretely in space by using spatial dynamic identifiability analysis to quantify the marginal probability distribution of a parameter in terms of spatial statistics such as contributing area, local slope, and partial contributing area.

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