Evaluating the effect of improved snow and soil representation in physically based, distributed hydrologic models

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Abstract

The National Weather Service uses the Sacramento Soil Moisture Accounting (SAC-SMA) model to generate river forecasts. SAC-SMA is a conceptually based model with spatially lumped parameters. Although this model performs well when calibrated properly, like other lumped parameter models, it suffers from an inability to respond to changes in land use or climatic conditions, and is not generally transferable to ungauged basins. Consequently, there is considerable interest in bringing physically based distributed (PBD) models into operation. However, despite the intellectual appeal of PBD models, recent studies have shown that lumped models outperform PBD models. A potential cause of the failings of PBD models is that they require considerable amounts of site specific information that is often unavailable at appropriate scales. Representing the inherent spatial variability of climatic drivers and landscape properties is challenging, particularly in complex terrain where subgrid variability can be quite large. A solution is to identify the processes and properties that require explicit and detailed representations and those for which detail can be sacrificed. We suggest that the poor performance of PBD models is generally due to incorrect application of simplifying assumptions. The goal of this project is to establish the minimum level of detail in snow and soil complexity necessary to meet performance needs of physically based distributed hydrologic models in semi-arid, snow dominated watersheds by conducting integrated field and modeling studies in well-characterized watersheds.