Geophysical Research Abstracts
Vol. 15, EGU2013-3113, 2013
EGU General Assembly 2013

Using bias aware EnKF to account for model errors caused by unresolved subsurface structure

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An always present issue when modeling flow in the unsaturated zone is to what level any subsurface structure is resolved within the model. In the work presented here we use the Ensemble Kalman Filter to assimilate local soil water content observations from a synthetic lysimeter test case in an unsaturated water flow model. We investigate the use of colored noise bias corrections to account for unresolved subsurface layering in a homogeneous model and compare this approach with using a heterogeneous, fully resolved, flow model. In both flow models we use a simplified model parameterization to ensure that none of the models can be a perfect match to the synthetic reality. Three bias correction setups are tested, applying the bias either on the observations, on the model states (here pressure head) or on the observations with a feedback to the model states. The results show that the use of bias corrections can increase the predictive capability of the homogeneous flow model if the bias corrections are interacting with the model states. If correct knowledge of layering structure is available, the fully resolved heterogeneous model performs best. However, if no, or erroneous, layering is used in the model, the use of a homogeneous model with bias corrections can be the better choice for modeling the average behavior of the system.