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Obtaining soil hydraulic parameters from data assimilation and calibration under different climatic/soil conditions

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Obtaining trustful soil hydraulic properties is essential to correctly simulate soil water content (swc), which is a key step for countless applications (agricultural management, soil remediation, aquifer protection...). Laboratory procedures to quantify soil hydraulic properties are expensive and tedious, and may differ from those obtained in field conditions. Alternatively, soil hydraulic properties can be derived from soil water content monitoring data in conjunction with soil water flow modeling. The present study aims to compare the estimation of soil hydraulic properties by standard calibration based in inverse modelling, SC, versus joint soil water state – parameter data assimilation based in the Ensemble Kalman filter method, DA. This study is made for eight different scenarios considering two soil types and four climatic conditions. Overall, we demonstrate the usefulness of DA, and particularly the dual-state-parameters approach of the Ensemble Kalman Filter to be applied with real atmospheric field conditions in unsaturated Richard's equation soil models. When observed swc did not show a broad range of values, both methodologies were able to get a set of properties that reports reasonably good and similar statistics ((RMSE below 0.1 and/or r2 above 0.8 after a period of 100 days). Nevertheless, goodness-of-fit statistics from DA methodology were clearly better than SC when dealing with humid climates and especially with medium soils: r2 was higher with DA methodology in more than 95 percent of times as compared to r2 obtained with SC. On average, we conclude that DA is better than SC. From the present study, we can also consider that 1 year is a period long enough to obtain trustful soil hydraulic properties when DA methodology is applied. In case of SC methodology, 1 year is enough with some easy-to-be-reproduced situations. Statistics for both methodologies did not improve significantly when new additional data are considered.