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Interactive comment on "On the uncertainty of initial condition and initialization approaches in variably saturated flow modeling" *by* D. Yu et al.

Anonymous Referee #2

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This study investigates the temporal change of the uncertainty of initial condition in variably saturated flow model and assesses the impacts of several commonly-used initializing methods on results within various data assimilation frameworks. The topic is interesting and relevant to the topics of the Hydrology and Earth System Sciences. The manuscript is well-organized and easy to understand, although some of language, may be further refined and improved. The results and discussion are adequate to reach very instructive conclusions for variably saturated flow modeling. Several highlights for this manuscript: compared to previous researches on UIC issue, this study focuses on soil water modeling and makes a comparison between Monte Carlo (preferred by groundwater hydrologist) and Spinning up methods (preferred by surface water hydrologist). The investigation of warm-up time with different soil textures and depths is quite

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Discussion paper

interesting. The study of UIC propagation with data-model interaction is another merit. Therefore, I recommend this paper for publication in the Hydrology and Earth System Sciences, with a few comments. Major comments: 1) Authors have compared the difference of model outputs with various data assimilation framework (i.e., EnKF and IES). As the authors correctly point out, the ensemble size is an important factor for these two algorithms, which need to be discussed further. I encourage the authors to explore the effects of ensemble size on EnKF and IES with multiple test so that a suitable ensemble size for these two assimilation framework can be determined. 2) The synthetic case study present the proper warm-up time t[wu] versus different soil texture, soil depth, and meteorological conditions. While the relationship between t[wu] and meteorological conditions may be commonsense, the reveal of quantitative relationship between t[wu] and soil texture and soil depth is surprising and interesting, due to the fact that t[wu] changes abruptly from sand to finer texture, and it increases nonlinearly with the increase of soil depths. However, the soil is seldom homogeneous in natural conditions, especially for very long soil profile. The authors should at least present one simulating result of t[wu] for layered soil, which is more applicable for real-world case. I believe this should take too much work since it is one-dimensional model. Minor comments: Line 12: various initial condition »> various initial conditions Line 16: model initializing »> model initializing methods Line 28: delete in Line 48: a space between approaches and comma Line 61: hereafter referred »> hereafter referred to Line 77: delete the last the Line 81: initial ensemble are »> initial ensemble is Line 83: Currenlty »> Currently Line 110: Richards's »> Richards' Lines 129-130: as state-dependent, atmospeheric boundary condition (try to be more concise here and some other statements) Line 135: detemined »> determined Line 141: use UIC instead Eqs. (9-10): try to use one equation instead and shorten the description of the equation. Line 172: assimilation + approach Line 210: which lamta values you use in the simulations? Line 222: perscribe »> prescribe Line 223: availablitity »> availability Line 256: be consistent using itatic or not for PC. Line 256: why 3%? Line 335: warms »> warm Line 356: delete both Line 358-359: thus »> and thus Line 372: multiple spaces

between runs and are Line 392: Change “than” to that Line 405: Which evapotranspiration model are you using? Line 427: needs a space after “part.” Lines 443-444: “soil moisture profile has large variation, e.g., discontinuous soil moisture in layered soils.” — it would be interesting to see an additional case for heterogeneous soils, and this also leads to another interesting question — what will happen if pressure head profile, which is continuous in heterogeneous soil, is used as initial condition. Please add some discussion on this topic. Line 452: atmospheric condition »> atmospheric boundary condition Conclusion 2: Please include more details and add quantitative conclusions for this. Errors in references: Line 566, Line 673, Line 610, Line 639.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-557, 2018.