

# Accepted Manuscript

Research papers

Unsupervised Ensemble Kalman Filtering with an Uncertain Constraint for Land Hydrological Data Assimilation

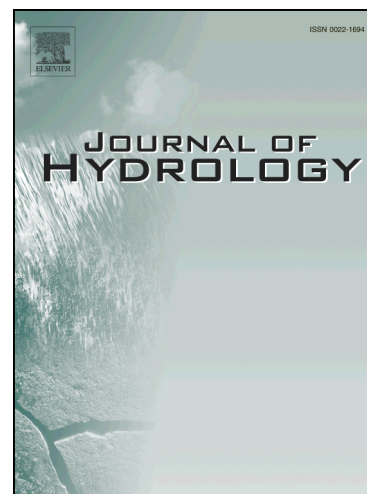
M. Khaki, B. Ait-El-Fquih, I. Hoteit, E. Forootan, J. Awange, M. Kuhn

PII: S0022-1694(18)30502-X

DOI: <https://doi.org/10.1016/j.jhydrol.2018.06.080>

Reference: HYDROL 22929

To appear in: *Journal of Hydrology*



Please cite this article as: Khaki, M., Ait-El-Fquih, B., Hoteit, I., Forootan, E., Awange, J., Kuhn, M., Unsupervised Ensemble Kalman Filtering with an Uncertain Constraint for Land Hydrological Data Assimilation, *Journal of Hydrology* (2018), doi: <https://doi.org/10.1016/j.jhydrol.2018.06.080>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

# Unsupervised Ensemble Kalman Filtering with an Uncertain Constraint for Land Hydrological Data Assimilation

M. Khaki<sup>a,1</sup>, B. Ait-El-Fquih<sup>b</sup>, I. Hoteit<sup>b</sup>, E. Forootan<sup>c</sup>, J. Awange<sup>a</sup>, M. Kuhn<sup>a</sup>

<sup>a</sup>*School of Earth and Planetary Sciences, Discipline of Spatial Sciences, Curtin University, Perth, Australia.*

<sup>b</sup>*King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia.*

<sup>c</sup>*School of Earth and Ocean Sciences, Cardiff University, Cardiff, UK.*

---

## Abstract

1 The standard ensemble data assimilation schemes often violate the dynamical balances of hydro-  
 2 logical models, in particular, the fundamental water balance equation, which relates water storage  
 3 and water flux changes. The present study aims at extending the recently introduced Weak Con-  
 4 strained Ensemble Kalman Filter (WCEnKF) to a more general framework, namely unsupervised  
 5 WCEnKF (UWCEnKF), in which the covariance of the water balance model is no longer known,  
 6 thus requiring its estimation along with the model state variables. This extension is introduced  
 7 because WCEnKF was found to be strongly sensitive to the (manual) choice of this covariance. The  
 8 proposed UWCEnKF, on the other hand, provides a more general unsupervised framework that  
 9 does not impose any (manual, thus heuristic) value of this covariance, but suggests an estimation  
 10 of it, from the observations, along with the state. The new approach is tested based on numerical  
 11 experiments of assimilating Terrestrial Water Storage (TWS) from Gravity Recovery and Climate  
 12 Experiment (GRACE) and remotely sensed soil moisture data into a hydrological model. The  
 13 experiments are conducted over different river basins, comparing WCEnKF, UWCEnKF, and the  
 14 standard EnKF. In this setup, the UWCEnKF constrains the system state variables with TWS  
 15 changes, precipitation, evaporation, and discharge data to balance the summation of water storage  
 16 simulations. In-situ groundwater and soil moisture measurements are used to validate the results of  
 17 the UWCEnKF and to evaluate its performances against the EnKF. Our numerical results clearly  
 18 suggest that the proposed framework provides more accurate estimates of groundwater storage  
 19 changes and soil moisture than WCEnKF and EnKF over the different studied basins.

*Keywords:* Constrained data assimilation, Ensemble Kalman Filter (EnKF), Unsupervised Weak  
 Constrained Ensemble Kalman Filter (UWCEnKF), Water budget closure, Hydrological modeling.

---

*Email address:* Mehdi.Khaki@postgrad.curtin.edu.au (M. Khaki)

<sup>1</sup>Contact details: Department of Spatial Sciences, Curtin University, Perth, Australia, Email: Mehdi.Khaki@postgrad.curtin.edu.au, Tel: 0061410620379

Download English Version:

<https://daneshyari.com/en/article/8894464>

Download Persian Version:

<https://daneshyari.com/article/8894464>

[Daneshyari.com](https://daneshyari.com)