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Using a H-infinty filter assimilation procedure to estimate root zone soil water content

Haishen LU

Hohai University, State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Nanjin, China (haishen2001@yahoo.com.cn)

Root zone soil water content impacts plant water availability and land energy and water balances. Due to an unknown hydrological model error, observation errors and the statistical characteristics of the errors, the most widely used Kalman filter (KF) and its extensions are challenged to retrieve the root zone soil water content using the surface soil water content. If the soil hydraulic parameters are poorly estimated, the KF and its extensions fail to accurately estimate the root zone soil water. The H-infinity filter (HF) represents a robust version of the KF. The HF is widely used in data assimilation and is superior to the KF, especially when the performance of the model is not well understood. The objective of this study is to determine the impact of soil hydraulic parameter uncertainty on the ability of HF assimilation to predict in situ soil water. The results show that the soil hydraulic parameters hold a critical role in the course of assimilation. When the soil hydraulic parameters are poorly estimated, the accurate estimation of root soil water content cannot be retrieved by the HF assimilation approach. When the estimated soil hydraulic parameters are similar to actual values, the soil water content at various depths can be accurately retrieved by the HF assimilation. The HF assimilation is not very sensitive to the initial soil water content, and the impact of the initial soil water on the assimilation scheme can be eliminated after about 5-7 days. The observation interval is important for soil water profile retrieval with the HF, and the shorter the observation interval, the shorter the time required to achieve actual soil water. However, the retrieval results are not very accurate at a depth of 100 cm. Also it is complex to determine the weighting coefficient and the error attenuation parameter in the HF assimilation. In this paper, the trial-and error method was employed to determine the weighting coefficient and the error attenuation parameter. After first establishing a limited range of the parameters, "the best parameter set" is selected from the range of values. For the soil conditions investigated, the HF assimilation results are better than the open-loop results.