Hydrology and Earth System Sciences
An Interactive Open Access Journal of the European Geosciences Union

Hydrol. Earth Syst. Sci., 13, 1-16, 2009
www.hydrol-earth-syst-sci.net/13/1/2009/

A new data assimilation approach for improving runoff prediction using remotely-sensed soil moisture retrievals

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Abstract. A number of recent studies have focused on enhancing runoff prediction via the assimilation of remotely-sensed surface soil moisture retrievals into a hydrologic model. The majority of these approaches have viewed the problem from purely a state or parameter estimation perspective in which remotely-sensed soil moisture estimates are assimilated to improve the characterization of pre-storm soil moisture conditions in a hydrologic model, and consequently, its simulation of runoff response to subsequent rainfall. However, recent work has demonstrated that soil moisture retrievals can also be used to filter errors present in satellite-based rainfall accumulation products. This result implies that soil moisture retrievals have potential benefit for characterizing both antecedent moisture conditions (required to estimate sub-surface flow intensities and subsequent surface runoff efficiencies) and storm-scale rainfall totals (required to estimate the total surface runoff volume). In response, this work presents a new sequential data assimilation system that exploits remotely-sensed surface soil moisture retrievals to simultaneously improve estimates of both pre-storm soil moisture conditions and storm-scale rainfall accumulations. Preliminary testing of the system, via a synthetic twin data assimilation experiment based on the Sacramento hydrologic model and data collected from the Model Parameterization Experiment, suggests that the new approach is more efficient at improving stream flow predictions than data assimilation techniques focusing solely on the constraint of antecedent soil moisture conditions.

Final Revised Paper (PDF, 1446 KB) | Discussion Paper (HESSD)

Citation: Crow, W. T. and Ryu, D.: A new data assimilation approach for improving runoff prediction using remotely-sensed soil moisture retrievals, Hydrol. Earth Syst. Sci., 13, 1-16, 2009. Bibtex | EndNote | Reference Manager