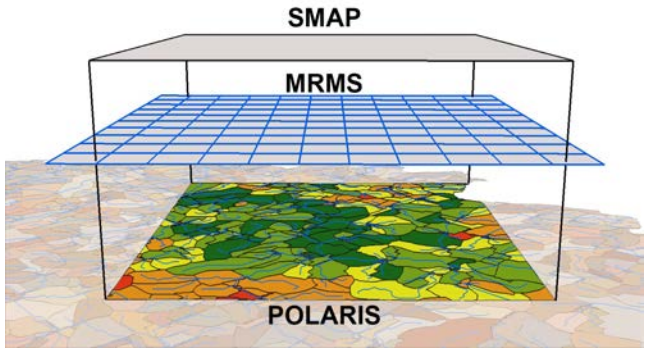
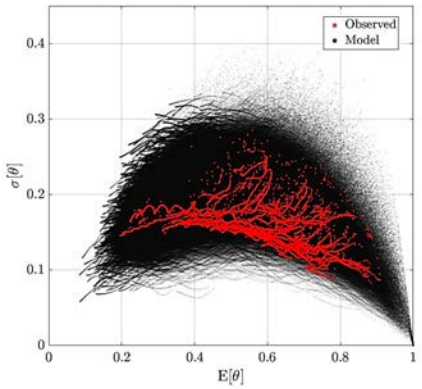
Exploring Sub-grid Variability of SMAP Satellite-based Soil Moisture

Problem: Mismatch between spatial resolutions of soil moisture from hydrologic models and satellite-based estimations.

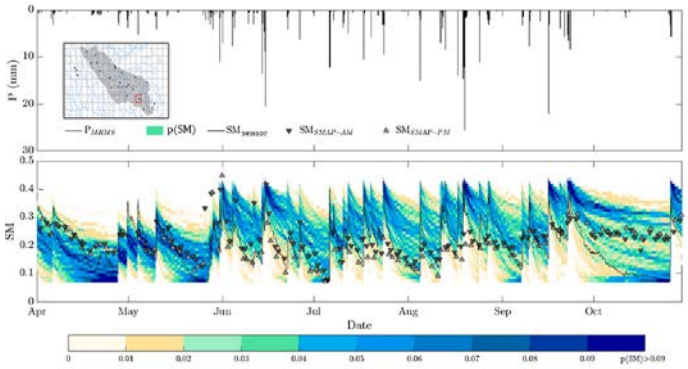
Findings: Highest variability and therefore uncertainty corresponds to intermediate ranges of soil moisture mean. We developed a data-driven model to provide quantitative estimates of this uncertainty.



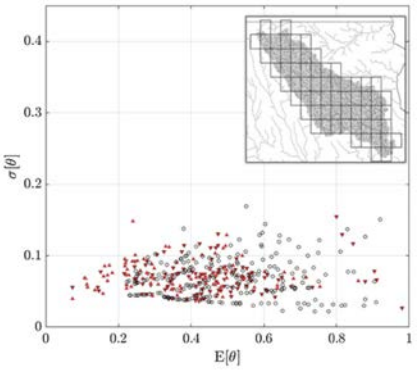
High resolution rainfall and soil properties are used



Soil moisture mean vs standard deviation



Probabilistic soil moisture time-series for a SMAP pixel within Turkey River basin from April to November 2016.



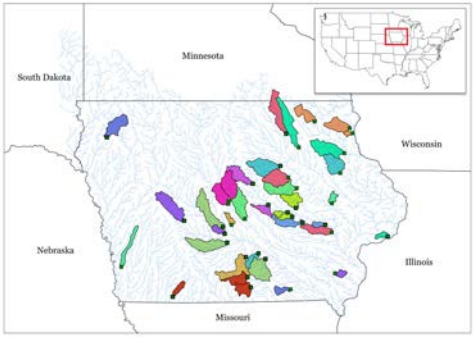
Standard deviation of the up-scaled model (circles) and SMAP soil moisture (triangles)

Impact: Confidence in satellite-based soil moisture is higher for wet and dry conditions.

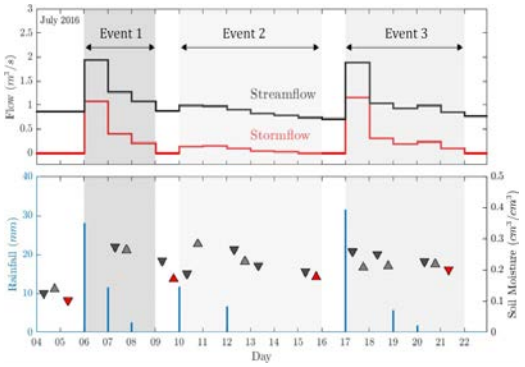
Jadidoleslam, Mantilla, Krajewski, Cosh, 2019: Data-driven stochastic model for basin and sub-grid variability of SMAP satellite soil moisture. *Journal of Hydrology*

Investigating the Potential of SMAP Soil Moisture for Runoff Prediction

Problem: SMAP products have limited temporal and spatial resolution and subject to uncertainty. Therefore, are they relevant for streamflow prediction?

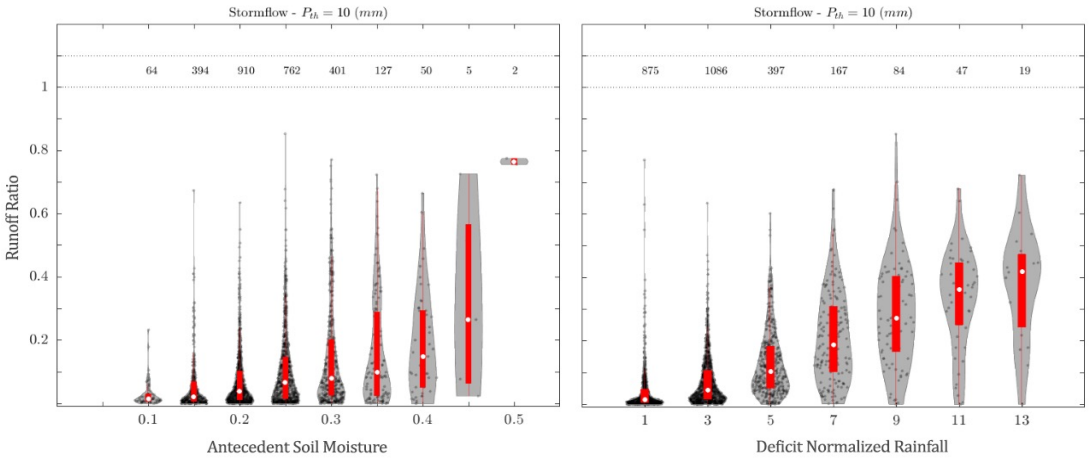


Study basins and USGS gages



Rainfall-runoff event definition for estimating runoff ratio and antecedent SMAP soil moisture (red triangles)

Findings: Our observation-based study confirms:
(1) Antecedent SMAP soil moisture (SM) has a significant relationship with runoff ratio;
(2) SM-deficit-normalized rainfall has a better predictive power than SM and rainfall.



Relationship between antecedent SMAP soil moisture and soil moisture deficit-normalized rainfall

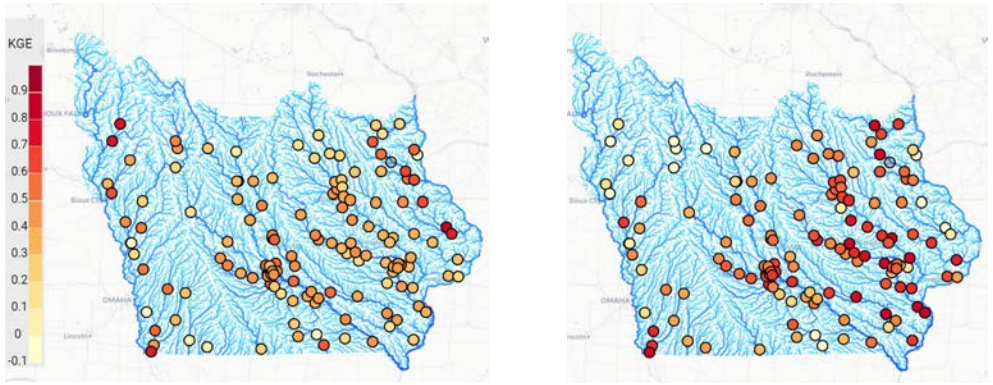
Impact: SMAP satellite-based product should be assimilated into streamflow prediction models.

Jadidoleslam, Mantilla, Krajewski, Goska, 2019: Investigating the role of antecedent SMAP satellite soil moisture, radar rainfall and MODIS vegetation on runoff production in an agricultural region. *Journal of Hydrology*.

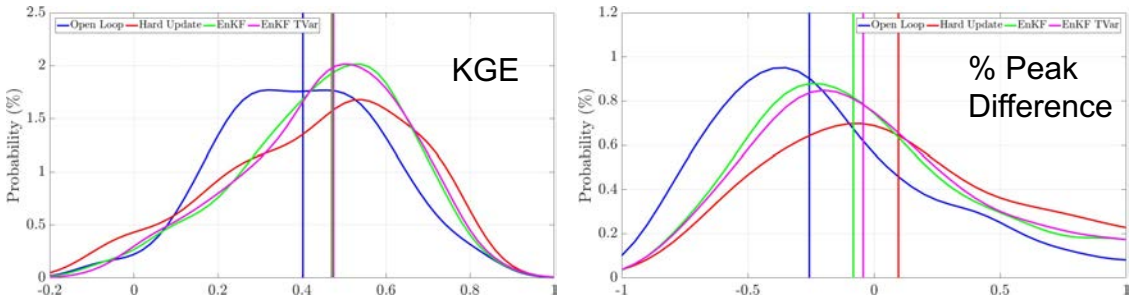
SMAP Soil Moisture Data Assimilation Improves Streamflow Prediction Performance

Problem: Model-based soil moisture states depend on model structure, assumptions, and data included. SMAP products provide reality-based estimates. What is an effective way for combining these two?

Findings: SMAP soil moisture data assimilation using Ensemble Kalman Filter with accounting for time-dependent errors in satellite-based soil moisture in a distributed hydrologic model increases model performance.



Streamflow prediction performance (Kling-Gupta Efficiency) for 2015 with open-loop (left) and SMAP soil moisture assimilated (right) model using Ensemble Kalman Filter



Distributions and median value for annual streamflow prediction performance in terms of KGE (left) and percent peak difference (right) for 4 years (2015-2018)

Impact: Improvements in real-time streamflow (flood) predictions

Jadidoleslam, Mantilla, Krajewski, 2020: Exploring satellite-based soil moisture data assimilation approaches for improved streamflow predictions. *(in preparation for submission to Water Resources Research)*.