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From hillslope to catchment scale hydrologic prediction in a semi-arid region with in-situ observations, satellite soil moisture products, and a distributed catchment model

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The water-limited region frequently experiences extreme climate variability. This region, however, has relatively little hydrological information to characterize the catchment dynamics and its feedback to the climate system. This study assesses the relative benefits of using remotely sensed soil moisture, in addition to sparsely available in-situ soil moisture and stream flow observations, to improve the hydrologic understanding and prediction. We propose a multi-variable approach to calibrate a hydrologic model, Soil and Water Assessment Tool (SWAT), a semi-distributed, continuous catchment model, with observed streamflow and in-situ soil moisture. The satellite soil moisture products (~ 5 cm top soil) from the Soil Moisture and Ocean Salinity (SMOS) and the Soil Moisture Active Passive (SMAP) are then used to evaluate the model estimates of soil moisture over the spatial scales through time. The results show the model calibrated against streamflow only could provide misleading prediction for soil moisture. Long term in-situ soil moisture observations, albeit limited availability, are crucial to constrain model parameters leading to improved soil moisture prediction at the given site. Satellite soil moisture products provide useful information to assess simulated soil moisture results across the spatial domains, filling the gap on the soil moisture information at landscape scales. The preliminary results from this study suggest the potential to produce robust soil moisture and streamflow estimates across scales for a semi-arid region, using a distributed catchment model with in-situ soil network and remotely sensed observations and enhance the overall water budget estimations for multiple hydrologic variables across scales. This research is conducted on Merriwa catchment, a semi-arid region located in the Upper Hunter Region of NSW, Australia.