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Improving Curve Number storm runoff estimates using passive microwave satellite observations

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This study investigated the potential for improvement of Soil Conservation Service (SCS) Curve Number (CN) storm runoff estimates with the implementation of satellite-derived soil moisture. A large data-set (1980-2007) of daily measurements of precipitation and streamflow for 135 Australian catchments ranging in size from 53 to 471 km^2 was used. The observed CN, a measure of the soil's maximum potential retention, was calculated using the SCS-CN model from measured precipitation and stormflow data. The observed CN was compared to a soil wetness index (SWI) based on AMSR-E satellite surface moisture and an antecedent precipitation index (API) based on field observations. Significant correlations ($p<0.001$) between SWI and observed CN were found for only 17% of the catchments, with an average correlation coefficient (r) of 0.57. Incorporating SWI in the model increased the correlation between observed and modeled storm runoff amounts on average from r=0.47 (basic SCS-CN without SWI) to 0.68. Significant correlations ($p<0.001$) between API and observed CN were found for 81% of the catchments, with an average r of 0.62. Incorporating API in the model increased the correlation between observed and modeled runoff on average from r=0.55 (basic SCS-CN without API) to 0.72. Our results demonstrate that although there is useful information in coarse resolution remotely sensed surface soil moisture for modelling rainfall-runoff in small to medium-sized catchments, the use of API is likely to give better results. The limited improvement in storm runoff estimates with the introduction of a satellite-based SWI may be due to the different spatial scales of the catchments and the remotely sensed data, inaccuracies in the remotely sensed data or the simplification implied by the SWI approach.