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Satellite-derived evapotranspiration and soil moisture estimates can improve streamflow estimation for Australian catchments

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The predictive performance of catchment models usually decreases considerably when streamflow records are not used to calibrate model parameters (the 'ungauged catchment' problem). A solution is to use additional observations of internal model variables to constrain the model. Remote sensing data is particularly valuable for several reasons (e.g. coverage, frequency and consistency) but requires observational models with uncertainties of its own. We used satellite-derived estimates of actual evapotranspiration (AET) and near surface soil moisture to constrain a hydrological model for a variety of catchments in Australia. AET estimates were derived by scaling Priestley-Taylor reference ET based on MODIS land surface greenness and wetness indices. Near surface soil moisture estimates were derived from AMSR-E passive microwave observations using the VUA algorithm. Rather than attempting direct assimilation of remote sensing observations into an existing hydrological model, the greatest benefit was achieved when they were involved in model structure development. Resulting streamflow estimates were often better than those using existing model and regionalisation strategies. Remaining mismatches could often be attributed to uncertainty in rainfall estimates and distribution. We conclude that use of remote sensing observations can achieve greater consistency and accuracy in streamflow estimation.