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Beyond Streamflow: Improvement of Distributed Parameters for Continental-Extent Hydrologic Modeling Using Alternative Data Products

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Abstract: The traditional approach to hydrologic model calibration and evaluation—comparing observed and simulated streamflow—is not sufficient. Intermediate process variables computed by the model could be characterized by parameter values that do not necessarily replicate those hydrological processes in the physical system. To better replicate these intermediate processes, in addition to streamflow, intermediate process variables can be examined when there is an associated "observed" variable that can be used as a baseline dataset. This study presents a CONUS-scale parameter estimation technique for the USGS National Hydrologic Model application of the Precipitation-Runoff Modeling System (NHM-PRMS) using five 'baseline' data sets (runoff, actual evapotranspiration, recharge, soil moisture, and snow covered area). These baseline datasets, with error bounds, were derived from multiple sources for each of the NHM-PRMS's 109,951 hydrologic response units (HRUs) on time scales from annual to daily. Sensitivity analysis was used to identify the (1) calibration parameters and (2) relative sensitivity of each baseline dataset to the calibration parameters, for each HRU. A multiple-objective, step-wise, automated calibration procedure was used to identify the 'optimal' set of parameter values for each HRU. Using a variety of baseline data sets for calibration of the intermediate process variables alleviates the equifinality problem and "getting the right answer for the wrong reason." Through a community effort we should strive to improve our understanding of this baseline information, making it available to the modeling communities to help calibrate and evaluate hydrologic models using more than streamflow.

***Keywords**:* Calibration, hydrologic modeling, PRMS, streamflow