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Rainfall-runoff model calibration at an ungauged catchment using the map-correlation method

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The International Association of Hydrological Sciences ten-year Prediction in Ungauged Basins (PUB) initiative encourages the development of approaches to estimate streamflow at ungauged catchments. One such approach is to transpose calibrated rainfall-runoff model parameters from a gauged, reference catchment to an ungauged catchment. Central to this approach is the selection of the reference catchment from which to transpose the model parameters to the ungauged catchment. Previous studies have found the selection of the reference catchment to be problematic and different selection criteria have shown little success. We introduce the map-correlation method, which selects a reference catchment whose logarithms of daily streamflow are most correlated with the ungauged catchment. This is achieved by first kriging the cross-correlations, r, between the logarithms of daily streamflow at each reference catchment and all other reference catchments in the study area. Then, at an ungauged catchment, the map-correlation method yields an r value for each reference catchment. The reference catchment resulting in the highest r value is selected. To determine if r is related to model goodness-of-fit, 34 sets of simulation model parameters were obtained by calibrating rainfall-runoff models at 34 gauged catchments in the mid-Atlantic United States. At each of the 34 study catchments, the other 33 calibrated sets of model parameters were transposed to the study catchment, resulting in 33 goodness-of-fit values between the observed and estimated daily streamflows. These goodness-of-fit values were compared to the r values estimated from the observed, concurrent daily streamflow between each study catchment and the other 33 catchments. This comparison was repeated for each of the 34 catchments to obtain 1,122 (34 multiplied by 33) goodness-of-fit and r values. The relation between r and goodness-of-fit will be presented and contrasted with the use of other criteria to choose a reference catchment.