Estimation of daily streamflow time series at ungauged basins using the map correlation method

Stacey Archfield (1), Richard Vogel (2), Riddhi Singh (3), and Thorsten Wagener (4)

(1) U.S. Geological Survey, Massachusetts-Rhode Island Water Science Center, Northborough, MA, United States
(sarch@usgs.gov, +1.508.490.5072), (2) Department of Civil and Environmental Engineering, Tufts University, Medford, MA,
United States (richard.vogel@tufts.edu, +1.617.627.4260), (3) Department of Civil and Environmental Engineering,
Pennsylvania State University, University Park, PA, United States (rus197@psu.edu), (4) Department of Civil and
Environmental Engineering, Pennsylvania State University, University Park, PA, United States
(thorsten@engr.psu.edu,+1.814.865.5673)

Daily streamflow information is critical for solving any number of hydrologic problems. Because most of the world's stream reaches are ungauged, this data is commonly needed for rivers that have no readily available measurements of streamflow. Approaches to estimating daily streamflow time series at ungauged catchments typically require the transfer of some set of hydrological or physical properties of a gauged catchment (or set of gauged catchments) to an ungauged site of interest. Central to these approaches is the selection of the appropriate gauged catchment from which to transfer information to the ungauged catchment. The map-correlation method, a new application of geostatistics, selects a gauged catchment whose daily streamflow time series is estimated to be most correlated with the ungauged catchment. This is achieved by first developing spatial models of the cross-correlations, r, between the time series of concurrent daily streamflow at each gauged catchment and the other gauged catchments in the study region. Then, through kriging, the map-correlation method yields estimates of r at the ungauged catchment from each of the spatial models. By comparing the estimates of r, the map-correlation method selects the gauged catchment that had the spatial model with the highest r value at the ungauged catchment. The utility of the map-correlation method for estimating daily streamflow time series at ungauged catchments was applied to two transfer methods: 1) the drainage-area-ratio method, which transfers and scales the streamflows at the gauged catchment to the ungauged catchments by the drainage area of the ungauged catchment, and 2) the transfer of calibrated rainfall-runoff model parameters from a gauged to an ungauged catchment. We applied this method to two study areas in the eastern United States and compared it with the selection of the nearest gauged catchment. We found that the map-correlation method improved estimates of daily streamflow time series for both transfer methods.