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Estimation of Daily Streamflow Series at Ungaged Sites in the Semi-arid Volta Basin of West Africa

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Time series of streamflow are needed for flood management, sizing of on-stream reservoirs, environmental flow assessment and other applications. In the semi-arid Volta Basin of West Africa, such streamflow data are limited due to lack of long-term, continuous gaging stations. Thus, methods to estimate streamflow at ungauged locations are essential for management of water resources in this basin.

A new method, which first estimates a flow-duration curve at an ungaged site and then transforms the curve to a time series of streamflows using a nearby index gage, was developed for the northeastern United States. First a daily flow-duration curve at an ungaged site is estimated using regional regression methods. A time series of daily flows is then created by transferring the timing of the daily flows at an index gage to the ungaged site at equivalent exceedance probabilities. The selection of the index gage is based on a geostatistical analysis which we term correlation maps implemented using a Geographic Information System. This method offers improvement over traditional approaches such as the drainage-ratio method. Initial results show the method produces goodness-of-fit values comparable to those achieved from calibrated rainfall-runoff models developed for this region. To test the applicability of this method to other areas, this methodology is applied to ungaged locations in Ghana and Burkina Faso and a jack-knife cross-validation experiment is conducted to evaluate the agreement between observed and estimated flow series.