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Multiple Regression and Inverse Moments Improve the Characterization of the Spatial Scaling of Daily Streamflows

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Understanding daily streamflow is essential for managing freshwater resources. Spatial scaling assumptions are common in flow frequency analysis (e.g. index-flood method) at ungaged sites, where simple scaling by drainage area is perhaps the most common assumption. Experiments at 173 streamgages in the Southeast US resulted in two important findings: First, traditional moments (positive moment orders) of streamflow tend to capture the spatial scaling behavior of flows above the median, whereas inverse moments (negative moment orders) are more informative for lower streamflows. Second, simple scaling by drainage area alone often leads to misleading estimates of the scaling factor because of omitted-variable bias, masking the true spatial scaling behavior. Multiple-regression can mitigate this bias by controlling for regional heterogeneity of basin attributes. Thus previous bivariate scaling analyses have failed to accurately capture the scaling of low-flow events and misrepresented the scaling factors on drainage area. Multiple-regression analysis shows that low flows scale with spatial scaling factors greater than one, while high flows scale with factors less than one. It is hypothesized that the relationship between scaling factors and exceedance probabilities is a unique signature of streamflow and can be used to understand the physical processes generating streamflow within a region.