Combining Observed Water-Quality Variables for Trend Analysis

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Abstract

Water-quality trend analysis is being used increasingly as a scientific and public policy analysis tool. The seasonal Kendall technique is a common water-quality trend analysis procedure. When conducting trend analyses of water-quality data prepared for other purposes, it can be advantageous to aggregate observed variables so as to construct and analyze for trend a combined variable that has not been observed directly. Such analyses are hindered when one or more (but not all) of the observed variables being combined are censored (reported as being below an analytical detection limit); when the data series being combined include variations in censoring levels; and/or the variables being combined have been analyzed and recorded at differing levels of precision.

A method for combining observed values and analyzing the resultant aggregated value for trend using the seasonal Kendall technique, which accommodates these data characteristics, is described and demonstrated through application to Virginia water quality nitrogen data collected from 157 locations by Virginia Department of Environmental Quality over the 1978 – 95 time period. Variables of interest were nitrate-nitrite N (NN), total Kjeldahl N (TKN), and total N (TN) concentrations. TN was not measured directly, but was calculated by combining the NN and TKN forms. NN was calculated by combining measured values of nitrate-N and nitrite-N, where both components were available but NN was not measured directly. Seasonal and overall TN medians were calculated and allocated among NN and TKN components, and analyzed statistically for differences among ecoregions. NN, TKN, and TN trends were analyzed for each location using seasonal Kendall analysis, by ecoregion and for the state as a whole. The distribution of N among NN and TKN forms varies both seasonally and regionally. TN concentrations were found to be increasing in 6 of the state’s 7 ecoregions over the study period, with the strongest increases occurring as TKN and in the state’s eastern portions.