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Detection of trends in baseflow in New Jersey streams using different metrics and timeframes

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Abstract Text:

Annual baseflow in streams across the four physiographic provinces of New Jersey (with streamflow records ranging from 25 to 95 years) has been analyzed to identify possible trends in baseflow. Different timeframes and baseflow metrics were assessed for their utility in identifying trends.
We analyzed three measures of annual baseflow (baseflow per unit drainage area, BF; ratio of BF to precipitation, BF/P; BF fraction of total flow, BF/TF) and the minimum annual daily average flow per unit drainage area (MADAF, included as a potential surrogate of baseflow) using the non-parametric Mann Kendal statistical test and the Sen slope estimator. For the 29 unregulated streams, the percentage with significant (95% confidence) increasing trend vs. with decreasing trend was 24% vs 17% for BF/P, 21% vs 7% for BF, 17% vs. 11% for BF/TF and 12% vs. 14% for MADAF. The sizeable differences among metrics indicates the need to carefully choose the metric when analyzing for trends.

Consistency of the results for the four metrics was further investigated by calculating the rate of "disagreement", i. e., trend at a specific gage in one metric but not in another. BF to BF/P had the lowest rate, disagreeing in only 3% of cases in which a trend in BF was detected. The other disagreement rates ranged from 14% to 28%. These sizeable rates reinforce the need for care in choosing the metric and cast doubt on MADAF's appropriateness as a surrogate.
BF/TF had the lowest coefficient of variation (CV) of the four metrics. By the criterion of low variability, BF/TF is therefore judged the most reliable indicator of baseflow trends.

The metrics were examined in series of 10-year blocks to compare trends in partial records to those in full records. Stream that showed long-term trends were likely to have one or more 10- year period(s) in which there was no trend. This finding underscores the need for long-term records if trends are to be detected.

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Impact Statement:

This project can help managers of existing or proposed water supply reservoirs assess whether stream baseflow entering the reservoir will be increasing or decreasing in the future.