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Predicting thermal regimes of stream networks across the northeast United States: Natural and anthropogenic influences.

The ability to assess and manage impacts on stream temperature is critical for protection of aquatic communities. Managers are challenged by the need for predictive temperature models with both sufficient accuracy and geographic breadth for practical use. We described thermal regimes of New England rivers and streams based on a several water temperature metrics (July/August median temperature, daily rate of change, and magnitude and timing of growing season maximum). We used STARS (Spatial Tools for the Analysis of River Systems), an ArcGIS geoprocessing toolbox, to create spatial stream networks. We then developed and assessed spatial statistical models for each of these metrics, incorporating spatial autocorrelation based on both distance along the flow network and Euclidean distance using the SSN (spatial stream network) package for R. We used ArcGIS 10.2.2 along with GME (Geospatial Modelling Environment) and NHDPlus data to summarize the landscape and anthropogenic variables used as input to the models. These variables included median air temperature, estimated urban heat island effect, shaded solar radiation, main channel slope, watershed storage, surficial deposits, and presence or maximum depth of a lake immediately upstream. Using these variables, we predicted monthly median July or August temperatures with an overall root-mean-square prediction error of 1.4 and 1.5° C, respectively. Growing season maximum varied as a function of air temperature, local channel slope, shaded August solar radiation, imperviousness, and watershed storage. Predictive models for July or August daily range, maximum daily rate of change, and timing of growing season maximum were statistically significant but explained a much lower proportion of variance than the above models. We are extending this New England modelling approach to the Chesapeake Bay Watershed.

Keywords: stream network, temperature, spatial statistical model