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Predicting Hydromodification in Streams Using Nonlinear Memory-Based Algorithms in Southern California Streams

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ABSTRACT

Hydromodification is a serious management concern in semiarid regions and is expected to become worse with land use and climate change. Potential stream channel responses range from increased or decreased sediment loads, incision, and dramatic nonequilibrated channel enlargements. The prevalence of hydromodification, particularly in semiarid regions, creates a need for new predictive tools that can support decisions aimed at reducing or mitigating hydromodification effects in a large geographical region. Existing models to screen and predict hydromodification are limited in terms of performance and require time and data. This paper examines three nonlinear learning algorithms—support vector machines, artificial neural networks, and random forests—for predicting changes in stream channel morphology as an indicator of hydromodification. The authors explore the ability of each algorithm to rank the important variables that explain the degree of channel response for streams located in Southern California. Results suggest that variables pertaining to the stream bank morphology, such as bank angle, maximum bank height, and bottom widths, rank high in their ability to predict hydromodification. Among the three algorithms, random forest performance is robust compared to artificial neural networks and support vector machines, given its ability to accommodate small data sample sizes and minimal data preprocessing. The study shows that for complex responses, such as hydromodification of stream channels, preprocessing will continue to be a necessary step for nonlinear algorithms. With proper guidance, there is potential for using nonlinear algorithms to assess stream reaches vulnerable to hydromodification and inform management decisions to manage streamflow and runoff in Southern California.

Full Text

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