Developing an algorithm for predicting stream dissolved organic carbon concentrations from UV-visible light absorbance

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The export of carbon from terrestrial ecosystems may constitute a significant and climate-responsive carbon loss from forests, impacting downstream aquatic ecosystems. However, the magnitude of terrestrial carbon mobilized from the landscape is difficult to accurately capture during typical sampling campaigns. Therefore, accurate and high-resolution determination of dissolved organic carbon (DOC), the major transport medium of carbon from terrestrial to aquatic ecosystems, is imperative.

To better determine DOC export from forests to headwater streams within Newfoundland and Labrador, we explored the relationship between light-absorbing chromophoric dissolved organic matter (CDOM) and bulk DOC. Such a relationship would allow for rapid prediction of DOC concentrations based on absorbance characteristics, and through usage of an in-situ spectrophotometer, high-resolution determination of exported DOC.

We modeled the CDOM-DOC relationship from 4 headwater stream catchments across the province, using ~240 discrete samples collected over 5 years. Due to the heterogeneous composition of DOC within headwaters, which can alter this relationship, we included samples representative of sources to our streams, including nearby soil and groundwater inputs. Parameters used in multiple regression models were varied in each iteration to capture potential spatial and/or temporal differences potentially affecting DOC prediction accuracy. The ability of each model to successfully predict future observations was assessed by calculating R^2Predicted , while validation sets were further used to confirm model accuracy.

The most robust model (R^2Predicted = 0.90, validation R^2 = 0.83) included a combination of all sample types (soil, stream and groundwater). However, prediction accuracy was reduced when the model was applied to samples from an additional forest catchment outside of the training sample set, suggesting a sensitivity of predicted DOC to catchment characteristics. Therefore, our results indicate the need for a catchment specific establishment of a CDOM-DOC algorithm before high-resolution estimates of carbon exports from terrestrial to aquatic environments can be accurately determined.

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