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A model of degradation and production of three pools of dissolved organic matter in an alpine lake

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We investigated the transport and production of DOM in an alpine lake in the Colorado Front Range during snowmelt and the summer ice-free season by employing a new approach for distinguishing between three pools of DOM based on fractionation and spectroscopic characterization. Reactive transport modeling results confirm that terrestrially-derived sources of humic DOM are dominant during snowmelt and that microbially-derived humic and non-humic DOM are produced in the lake in the summer season when rates of primary productivity are highest. DOM separation and modeling results support the interpretation that losses of terrestrially-derived humic DOM are strongly dependent on photochemistry and indicate that the decay of non-humic and microbially-derived humic DOM is more influenced by heterotrophic degradation. Results suggest that production of non-humic DOM can be directly related to chlorophyll a concentrations and that microbially-derived humic DOM can be produced through condensation reactions. Furthermore, fluorescence and parallel factor (PARAFAC) analysis of humic DOM suggests that the rate of decay of microbially-derived humic DOM decreases as the redox state of quinone-like moieties of the humic DOM become more oxidized. This study quantifies the influence of DOM source on the chemical and biological reactivity of DOM in lakes. The methods presented in this study provide a framework for testing hypotheses related to the effects of a changing climate on lake ecosystem structure and function.