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Prediction of stream water quality in a forested catchment using the topographic riparian flow-concentration integration model (TRIM): A parsimonious modeling concept based on topographic scaling laws

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The sheer number of processes with a potential influence on stream water quality poses a considerable challenge for anyone who wants to avoid unnecessarily complex models. Several studies have highlighted near-stream riparian zones (RZs) as considerable controls on short-term water quality dynamics. Where this assumption holds true, it is possible to vastly reduce model complexity by focusing on the representation of the interactions between hydrological flow pathways and biogeochemical characteristics in RZs. The topographic riparian flow-concentration integration model (TRIM) uses simple scaling laws derived from high-resolution elevation data to predict spatially distributed solute exports from RZs to streams. We applied the TRIM concept to an extensive set of hydrometric data and DOC concentrations measured at the boreal Krycklan catchment in Northern Sweden. DOC samples were collected from about 100 stream locations as well as from 130 suction lysimeters installed at different RZs. Observed temporally variable riparian groundwater tables and flow pathways at different RZs could be well predicted by linking discharge measured at the outlet of a nested catchment to the topographic wetness index (TWI). The TWI was further useful to estimate riparian soil water DOC concentrations at different depths. By combining scaling relations for flow pathways and riparian DOC concentrations we derived a scalable power-law relation to predict DOC exports from RZs to streams. Based on our results we suggest that the TRIM concept is also applicable in catchments were detailed information of RZ characteristics is not available.