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Water quality in riparian boreal forest: a multi-method approach to scale biogeochemical drivers from groundwater hotspots to catchment outlets.

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Stream chemistry in boreal regions is for a large degree defined by the riparian zone. Within the riparian zone, groundwater hotspots represent a very small area, but likely play a major role in controlling stream water quality. Hotspots have shown to be unique in their plant species richness, soil texture and biogeochemistry. Also in terms of stream metabolism, hotspots show different responses, either due to local biotic or abiotic conditions. Readily available hydrological mapping tools, combined with biogeochemical data (stream temperature and stable water isotopes) show that there is great potential in predicting groundwater hotspots using terrain-based approaches. However, the role of individual hotspots varies in time. Presumably their hydrological regime is highly dependent on landscape properties of the upstream area. To improve the predictability of hotspots in space and time, a mechanistic understanding is needed. We achieve this by a combined approach including a damming experiment, high resolution optic fiber stream temperature measurements (DTS), a dense groundwater well network, stream and groundwater trace element analysis, frost monitoring and infrared (IR) imagery. This field-based strategy sheds light on the underlying drivers of groundwater hotspots and links them to landscape characteristics. This allows to move away from highly monitored reaches, and evaluate the relation between upland landscape features and the temporal variability of groundwater exfiltration rates on a catchment scale.