High-frequency observations reveal acute chloride pulses and chloride legacy effects in an urbanizing watershed impacted by road salting

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In watersheds impacted by urban growth and road salt usage, increasing stream chloride (Cl⁻) concentrations are well-documented. Peaks in stream Cl⁻ concentrations that exceed chronic and/or acute water quality guidelines are typical in the winter salting season when Cl⁻ (from Cl⁻-based de-icers) is flushed from the landscape but are not easily measured with grab samples. In some cases, chronic Cl⁻ conditions persist into the summer growing season due to a build-up of Cl⁻ in the subsurface. Estimating the proportion of Cl⁻ loads transported in the salting and non-salting seasons is of interest for tracking the relative role of subsurface Cl⁻ pools to the annual load, as well as the influence of runoff events on loads across the two periods. In this study, we made use of a 6-year record of high-frequency stream Cl⁻ concentrations from an urbanizing watershed in southern Ontario, Canada. High-frequency measurements revealed that the acute and chronic water quality guidelines for Cl⁻ were exceeded for 7 and 97 % of the study period, respectively. Salting season Cl⁻ loads were 2 to 5 times higher than in the non-salting season, but surprisingly, inter-event periods contributed 21 to 56 % of the annual load across years. The results of this study illustrate the utility of high-frequency sensors for identifying water quality extremes that negatively impact aquatic ecosystems, identifying Cl⁻ transport pathways, and tracking the build-up of legacy Cl⁻ in the subsurface.