Alteration of Critical Zone chemistry due to addition of rapidly dissolving rock salt

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Application rates of rock salt, primarily halite (NaCl), to roads and other impervious surfaces have increased over the last several decades in North America, Europe, and elsewhere with the growth in car ownership and the percentage of the landscape covered by impervious surfaces. Rapid rates of dissolution, which makes rock salt effective for melting frozen precipitation, result in significant additions of Na^+ and Cl^- to the Critical Zone, consequently altering geochemical fluxes to soils, surface water, and groundwater. Na^+ and Cl^- in surface water and groundwater, even in rural areas, show a trend of increasing concentrations over the last 50 years with implications for ecosystem health and drinking water quality.

An understudied aspect of the rock (or road) salt problem is the effect of management practice changes, *e.g.*, stormwater basins, on the timing and magnitude of Na^+, Cl^-, and other elemental fluxes through the Critical Zone. We are studying the fluxes using grab sampling and a sensor network in stormwater basins receiving direct runoff from impervious surfaces, groundwater, and surface water. The continuous record from sensor data allows quantification of episodic fluxes, which are common in a stormflow-dominated system, and utilization of spatio-temporal data mining techniques to elucidate patterns in the data.

After road salt runoff enters the stormwater basins, some fraction is exported rapidly to surface waters and the remainder to groundwater. Addition of large amounts of Na^+ and Cl^- to groundwater results in salinization. Baseflow from salinized groundwater increases surface water fluxes of Na^+, Cl^-, and other elements during non-winter seasons. Analytical and geochemical modeling results demonstrate that addition of water with high Na^+ and Cl^- concentrations alters cation exchange composition, which affects the capacity of soils to support vegetation and changes groundwater and surface water chemistry for years. Thus stormwater basins increase road salt impacts on the Critical Zone.