EGU21-5587, updated on 27 Oct 2021
https://doi.org/10.5194/egusphere-egu21-5587
EGU General Assembly 2021

Employing Legacy Road Salt and Soil Electrical Conductivity as Tracers to Unlock Glyphosate Transport Processes in a Variable Source Area

Emma Payne, Steven Pacenka, Brian Richards, Naaran Brindt, Anna Schatz, and Tammo Steenhuis
Department of Biological and Environmental Engineering, Cornell University, Ithaca, NY 14853, United States of America

Glyphosate is the most widely used herbicide active ingredient in the world, with 1.35 Tg used globally in 2017. Despite a strong affinity for binding to soil and rapid microbial degradation, in recent studies glyphosate has been detected in agricultural runoff at significant concentrations. This unexplained phenomenon necessitates further study into the mechanism of glyphosate transport from agricultural fields. This study was an investigation into the internal hydrology at a 4.9 ha agricultural catchment and the hydrological processes driving glyphosate transport at this site. Chloride is introduced to this standalone watershed via a point source of sodium chloride road de-icer salt at the top edge of the catchment. The goal of this project was to employ chloride as a tracer to unlock how water moves in the catchment. Since 2015, we have been undertaking annual extensive field sampling campaigns to monitor runoff for glyphosate at an outlet weir. In this project, we used archived samples from the 2018, 2019 and 2020 field campaigns and analyzed over 700 samples for electrical conductivity, over 400 samples for chloride and over 500 samples for glyphosate. During storms, chloride concentration and electrical conductivity decreased as the baseflow component carrying dissolved ions was diluted by the fast response overland flow. During the peak flow of a storm, chloride makes up a consistent fraction of electrical conductivity as the entire catchment contributes to flow at the outlet. We also found that the ratio of glyphosate concentration to electrical conductivity increased linearly with flow rate. The rate of increase (ie., the slope of glyphosate to conductivity ratio versus flow rate) decreases between sequential storms as glyphosate adsorbs and microbially degrades, and from this we extrapolated an empirical degradation half-life of less than 10 days. Cumulatively, the observations of chloride and electrical conductivity suggest that the catchment behaves as a series of connected reservoirs, each with a slow-moving subsurface component and a fast-response overland component. By exploiting the existence of a road salt chloride tracer and soil electrical conductivity in a variable source area, we were able to unlock the hydrological processes at play in areas where surface runoff is generated.