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A METHOD TO ESTIMATE WHOLE REACH MEASURES OF ANTIBIOTIC UPTAKE [OR RELEASE] IN STREAMS RECEIVING EFFLUENT DISCHARGE

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ABSTRACT: Recently, multiple regional and national studies have highlighted the occurrence of antibiotics and various degradation products in water resources, particularly streams. However, few studies have attempted to evaluate the transport of antibiotics through streams, although several studies have evaluated specific mechanisms of antibiotic uptake and transformation, such as physico-chemical adsorption to soils and sediments. This study will present a method to calculate whole-reach measures of antibiotic uptake [or release] using the solute spiraling theory. This study uses the continuous input of a wastewater treatment plant (WWTP) effluent discharge into a stream (Mud Creek at Fayetteville, Arkansas) as the antibiotic source, because a previous study identified eight antibiotics and associated degradation products downstream from the WWTP outfall in this stream. We selected one sampling site upstream of the effluent discharge and four sampling sites downstream, and water samples (one per site) were collected sequentially from upstream to the most downstream site over one day during daylight. At each site, we also collected physico-chemical data, including discharge, wetted width, transect depth, pH, conductivity, temperature and dissolved oxygen. The water samples were filtered on site and then analyzed for several antibiotics (49 different chemicals) at the USGS Organic Geochemistry Research Lab in Lawrence, Kansas and for Cl^- and or F^- (used in dilution correction) using an IC in Fayetteville, Arkansas. This study used a novel application of the mathematical equations contained within the solute spiraling theory; this innovative approach has been applied to the uptake and transport of nitrogen, phosphorus and carbon in effluent dominated streams. We used downstream declines in antibiotic concentrations to estimate a whole–reach measure of antibiotic retention or release in streams. However, the observed longitudinal pattern in antibiotic concentrations downstream from continuous WWTP inputs was the net result of antibiotic uptake and release processes within the stream reach. Therefore, we will use downstream declines in antibiotic concentrations to estimate the net nutrient uptake length (S_{net}), net mass transfer coefficient ($v_{f\text{-}net}$) and the net antibiotic uptake rate (U_{net}).

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