PREFERENTIAL FLOW THROUGH THE RIPARIAN VADOSE ZONE: LIGHT TRANSMISSION EXPERIMENTS AND MODELING FRAMEWORK

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Excess agrochemical and fertilizers are transported towards surface water bodies during overland runoff events. This periodic non-point source contamination input leads to progressive regime shifts on aquatic ecosystems (e.g. eutrophication). Pollution control practices, such as riparian buffers, are focused on surface runoff, with little attention given to subsurface transport. Nonetheless, field evidence suggests that riparian vadose zones are particularly rich in macropores (i.e. structured openings allowing fast movement of infiltrating water). Macropores lead to preferential flow, PF, bypassing soil matrix filtering capability, and rapidly driving contaminants to the shallow water table, typical of riparian zones. Current modeling frameworks allow to capture PF non-sequential patterns, such as the source-responsive model. However, the physical interpretation and identifiability of some PF parameters remain unclear due to data scarcity. We hypothesize that, PF can be quantified and related to different morphologies and soil textures by setting some influencing factors through laboratory experiments; and, if connectivity is not required for PF to have a significant impact on the overall transport process, then PF impact is largely underestimated. Therefore, the objective of this study is to develop, characterize, and model, PF laboratory experiments in a two-dimensional flow chamber through light transmission experiments. A fully physical light transmission model is proposed based on Beer-Lambert and Fresnel´s law, capturing soil moisture variations with excellent test efficiencies throughout the profile (NSE>0.95). PF experiments, carried out using 3D printed macropores, show that the fast increase on macropore hydraulic conductivity during infiltration leads to unstable flow at the pore-end (i.e. fingering). Hence, source-responsive model is parameterized; and a recession component is included, absent in the original framework. A comprehensive PF mechanistic model is proposed, describing heterogeneous infiltration through the riparian vadose zone. This PF model shall be integrated in decision-support tools to enhance riparian buffers efficiency on contaminant removal.

PRESENTER BIO: Enrique Orozco-Lopez is a Chemical Engineer from Murcia, Spain. Enrique is a PhD candidate in hydrologic modeling and water quality at ABE, working with Dr. Rafael Muñoz-Carpena and Dr. Bin Gao in modeling the impact of preferential flow on contaminant transport through riparian buffers. Enrique's research interest is in water quality engineering, from treatment plants to treatment wetlands.