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Effect of Temporal Variability on Persistence Conditions in Rivers

Most recent modeling approaches assume that flow speed of the river is constant. In reality, however, flow speeds in rivers vary significantly on various temporal scales due to seasonality, weather conditions, or human generated disturbance. In this talk, I present persistence conditions by deriving the upstream invasion speed in simple reaction-advection-diffusion (single-compartment and two-compartment) models with coefficients chosen to be periodic step functions. The key idea to derive the minimum traveling wave speed is to take the exponential transform to obtain a moment generating function. In a temporally periodic environment, the averages of each coefficient function determine the minimal propagation speeds for a single-compartment model. For a two-compartment model, the temporal variability can promote population persistence in rivers when average conditions would lead to washout.