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Dynamical patterns and regime shifts in the nonlinear model of soil microorganisms growth

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Dynamical model of soil microorganisms growth and turnover is formulated as a system of nonlinear partial differential equations of reaction-diffusion type. We consider spatial distributions of concentrations of several substrates and microorganisms. Biochemical reactions are modelled by chemical kinetic equations. Transport is modelled by simple linear diffusion for all chemical substances, while for microorganisms we use different transport functions, e.g. some of them can actively move along gradient of substrate concentration, while others cannot move. We solve our model in two dimensions, starting from uniform state with small initial perturbations for various parameters and find parameter range, where small initial perturbations grow and evolve. We search for bifurcation points and critical regime shifts in our model and analyze time-space profile and phase portraits of these solutions approaching critical regime shifts in the system, exploring possibility to detect such shifts in advance.
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