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Deterministic Continuum Models for Spatially Heterogeneous Biofilm Communities

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Abstract. Biofilms are dense aggregations of microbial cells encased in a slimy extracellular matrix that form on surfaces in moist environments. Such multicellular communities are a very successful life form and are able to tolerate harmful environmental impacts that would eradicate free floating individual cells. Biofilms play an important role in various natural and industrial systems and mathematical models for their growth have been developed for several decades. We focus on deterministic continuum models for spatially heterogeneous biofilm communities that are formulated as quasilinear reaction-diffusion-systems. The equations for the biomass fractions exhibit two non-linear diffusion effects: a power-law degeneracy (like the porous medium equation) and super diffusion. The prototype growth model is discussed as well as several more recent multi-species extensions that take further biofilm processes into account. Analytical results are shown and numerical simulations presented to illustrate the model behavior. This is joint work with Messoud Efendiev (HelmholtzCenter Munich), Hermann Eberl, Blessing Emerenini, Maryam Ghasemi and Kazi Rahman (University of Guelph).