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# Numerical modeling of biochemical transport processes with heterogeneous source terms. Dimensionless analysis with the Activated Sludge Model ASM1

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## ABSTRACT

Subsurface flow constructed wetlands are one of the different types of wastewater treatments used nowadays. There, water is treated by physical, biological and chemical processes while flowing through a porous media. Many aspects of detailed processes which take place there are not well-known. In fact, a key point of their behavior is that simultaneously aerobic and anaerobic conditions take place in different parts of the domain.

Mathematically the problem is a convection – diffusion – reaction system of equations, highly coupled because of the nonlinear reaction term that models the biochemical processes. The Activated Sludge Model No.1 (ASM1) and a simplified six–equations model based on it are used here as examples of complex reaction models. An stabilized Galerkin formulation is used for spatial discretization, and the Runge-Kutta-Fehlberg 4-5 scheme is used for time integration.

Homogeneous examples with and without oxygen entrance throughout all domain have been used to check the numerical performance of the approach. Two dimensionless examples with oxygen entrance in just upper part of the domain have also been computed with both models. It has been found that under horizontal low–velocity conditions a discontinuity in oxygen vertical profile is found, even if a continuous transition in oxygen entrance is imposed (see figure 1). Sensitivity of this limit behavior to the angle between flow and source term change is analyzed.

In the limit situation, classical convection–focused stabilization schemes are not able to smooth properly discontinuities produced by continuous source terms. Numerical improvements needed to manage it are

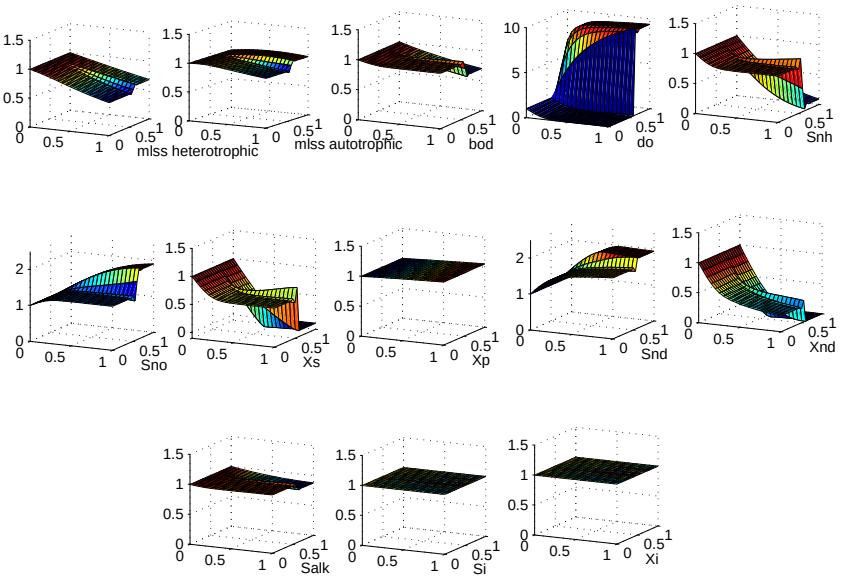


Figure 1: Evolution when oxygen entrance has continuous transition. Discontinuities may be seen in some profiles.

indicated, as well as an extension to more realistic biochemical models for subsurface flow constructed wetlands.

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