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A dual porosity model for the uptake of nutrients by root hairs

Root hairs are thought to play an important role in mediating nutrient uptake by plants. In this talk we develop a mathematical model for the nutrient transport and uptake on the scale of a single root. We treat soil as a double porous material, since nutrients are assumed to diffuse both in the soil fluid phase and within the soil particles, while they can also bind to the soil particle surfaces by reversible reactions. Using homogenization techniques we derive a macroscopic model for nutrient diffusion and reaction in the soil which includes the effect of all root hair surfaces. Various numerical simulations of a simplified version of the macroscopic model highlight the importance of root hairs for the uptake of nutrients by the plant in a variety of different soil moisture scenarios.