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Verification and intercomparison of reactive transport codes to describe root-uptake

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Several mathematical models have been developed to simulate processes and interactions in the plant rhizosphere. Most of these models are based on a rather simplified description of the soil chemistry and interactions of plant roots in the rhizosphere. In particular the feedback loops between exudation, water and solute uptake are mostly not considered. The aim of this work was to evaluate some existing coupled speciation-transport tools to model rhizosphere processes. We implemented and tested a simple rhizosphere model with three geochemical computational tools (ORCHESTRA, MIN3P, PHREEQC). The first step was an accuracy analysis of the different solution strategies by comparing the numerical results to the analytical solution of solute uptake (K or Ca) by a single cylindrical root. All models are able to reproduce the concentration profiles as well as the uptake flux. The relative error increases with decreasing distance to the root. The strength of the codes presented in this paper is that they can also be used to investigate more complex and coupled biogeochemical processes in rhizosphere models.