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## Validation of coupled speciation-transport models to describe root-uptake

B. Nowack (1), D. Jacques (2), S. Oswald (3), T. Roose (4), A. Schnepf (5), P.
Seuntjens (6), W. Van-Beinum (7), C.A.J. Appelo (8), F. Gérard (9), U. Mayer (10),
G. Kirk (11), H. Nietfeld (12), B. Jaillard (13)

(1) Institute of Terrestrial Ecology (ITOe), Swiss Federal Institute of Technology (ETH), CH-8952 Schlieren, Switzerland, (2) Performance Assessment Section, Waste & Disposal Department, SCK\*CEN, Boeretang 200, B-2400 Mol, Belgium, (3) Hydrogeology Department, UFZ Centre for Environmental Research, D-06120 Halle/Saale, Germany, (4) Centre for Mathematical Biology, Mathematical Institute, 24-29 St Giles, Oxford OX1 3LB, UK, (5) BOKU Vienna, Department of Forest and Soil Sciences, A-1180 Vienna, Austria, (6) Vito, Flemish Institute for Technological Research, Boeretang 200, B-2400 Mol, Belgium, (7) Cranfield Centre for EcoChemistry, Cranfield University, Silsoe, Beds MK45 4DT, United Kingdom, (8) INRA, Unit Biogéochimie des Ecosystèmes Forestiers, F-54280 Champenoux, France, (9) Hydrochemical Consultant, Amsterdam, The Netherlands, (10) Department of Earth and Ocean Sciences, The University of British Columbia, Vancouver, British Columbia V6T 1Z4, Canada, (11) National Soil Resources Institute, Cranfield University, Silsoe, Beds MK45 4DT, UK, (12) Institute of Soil Science and Forest Nutrition, University of Goettingen, D-37077 Goettingen, Germany, (13) Ecole Nationale Supérieure Agronomique de Montpellier, UMR INRA-ENSA.M Rhizosphère & Symbiose (R&S), 34060 Montpellier cedex 2, France

The classical model for root uptake of solutes from the soil supposes a cylindrical root surrounded by soil through which the solute diffuses and is taken up in a Michaelis-Menten process. The conventional modeling of solute uptake does not consider biogeochemical interactions, e.g. root-induced chemical changes in the rhizosphere. These changes can be for example acidification or exudation of organic anions which interact with the solute ions. These processes change the chemical characteristics in the rhizosphere and therefore affect the uptake. Some more sophisticated modeling approaches are needed to incorporate multiple interactions between plant roots and the surrounding soil. Therefore, available coupled speciation-transport codes that include the interactions between multiple components in the rhizosphere, can be used. Examples of such codes are ORCHESTRA, PHREEQC, MIN3P, or HP1. The aim of this work was to validate different approaches that can be used to implement a cylindrical root in these coupled speciation-transport models using the analytical solution of the solute uptake by a single root as reference. The uptake of K and Ca into the roots was implemented in the different models and calculated for a defined set of parameters. The results were then compared to the analytical solution. The validation results together with the description of the implementation of root uptake will be very useful for researchers working on rhizosphere-soil interactions and help to ease modeling of chemical processes in the rhizosphere.