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Functional test of FOOTPRINT pedotransfer functions for the dual-permeability model MACRO

J. MOEYS (1), N.J. JARVIS (1), F. STENEMO (1,2), J.M. HOLLIS (3), I.G. DUBUS (4), M. LARSBO (1), C.D. BROWN (5), R. BROMILOW (6), Y. COQUET (7), and P. VACHIER (7)

(1) SLU, Department of Soil and Environment, Box 7014, 750 07 Uppsala, Sweden (Julien.Moeys@mark.slu.se), (2) SWECO Environment AB, Gjörwellsgatan 22, Box 340 44, 100 26 Stockholm, Sweden, (3) National Soil Resources Institute, Cranfield University, Cranfield, Beds., MK43 0AL, UK, (4) BRGM, Avenue C.Guillemin, BP6009, 45060 Orléans, Cedex 2, France, (5) Environment Department, University of York, Heslington, York, YO10 5DD, UK, (6) Rothamsted Research, Harpenden, Herts AL5 2JQ, UK, (7) INRA/AgroParisTech, UMR Environment and Arable Crops, BP01, 78850 Thiverval-Grignon, France

Our ability to assess and predict pollution risks for surface waters and groundwater across larger areas (e.g. catchment and regional scales) relies on our capacity to estimate soil physical and hydrological properties and crop characteristics that are generally required as model parameters. 'Pedotransfer' functions (PTF) can be used to estimate model parameters from more easily available soil survey data. The EU-FP6 European project FOOTPRINT (www.eu-footprint.org) has supported the development of a full set of PTF's to completely parameterise the pesticide fate model MACRO from only easily available site and soil data for a range of European agronomic, climatic and pedological scenarios The work presented here aimed at assessing the performance of the parameterisation procedures developed in the FOOTPRINT project for MACRO, from a functional point of view. We present a comparison of measured and simulated tracer leaching in medium- to long-term (2 months to 2 years) experiments driven by natural-transient rainfall conditions on 41 lysimeters, representing 15 soil types, located in Sweden, UK and France. For each experiment, the only information used to parameterize the model was a soil profile description, in which each horizon is characterized by its thickness, FAO master horizon type, texture class, organic carbon content and bulk density and knowledge of the tillage (till, no-till, harrowed) and cropping practices (crop type, and sowing dates). The average depth of the lysimeters was 1 meter, each profile containing an average of 4.6 horizons. The soil properties covered a large range of textures (1 to 78% clay), organic matter contents (0 to 29%) and bulk densities (550 to 1870 kg.m-3). Simulations were first conducted without any calibration of parameters. In a second step, we conducted simulations where two crop parameters were optimized (root depth and root water uptake efficiency), in order to estimate the impact of errors in the simulated water balance on solute leaching predictions. For each simulation, we computed a series of statistics (RMSE, model efficiency) to assess the quality of the prediction for water flow, tracer leaching and tracer concentrations in the outflow. The contribution of bias to the simulation errors was estimated. Both sorted and non-sorted results have been used to compare measured and simulated 'solute flow' time series and distribution (time-independent). Conclusions are drawn concerning strengths, weaknesses and biases of the set of PTF routines, on their supposed origins, and on potential future improvements.