Geophysical Research Abstracts
Vol. 13, EGU2011-8817, 2011
EGU General Assembly 2011

Estimating the hydrological domain validity of a boundary condition-based surface–subsurface flow model using a mass balance sensitivity analysis.

Cecile Dages (1), Claudio Paniconi (2), and Mauro Sulis (2)

(1) INRA Montpellier, LISAH, Montpellier cedex1, France (dages@supagro.inra.fr), (2) INRS-ETE, Université du Québec, 490 rue de la Couronne, G1K 9A9, Québec, Canada

Catchment modeling has long referred to surface flow modeling. Nevertheless, such modeling approaches fail when surface and subsurface interactions are a key component of the hydrological cycle. These cases require the modeling of both surface and subsurface flow. Several models that couple surface and subsurface flow have recently been developed using quite different coupling approaches. Broadly speaking, we can consider coupling schemes to be of three different types: sequential and noniterative; sequential and iterative; and first-order coupled. The sequential iterative and the first-order coupled approaches are presumed to be more accurate, whereas the sequential noniterative approach is easier to implement and should be more efficient on a per time step basis. On the other hand, the simpler approaches may be more sensitive to mass balance errors, while first-order coupling raises parameterization concerns (new exchange terms are introduced). There is thus a need to assess in detail the advantages and disadvantages of different coupling approaches. In this work we begin to address some of these important issues using the CATHY (CATchment HYdrology) model that features elements of both the sequential noniterative and sequential iterative coupling schemes. CATHY is a physically-based hydrological model where the surface module resolves the one-dimensional (1D) diffusion wave equation and the subsurface module solves the 3D Richards equation. Coupling between these two equations is based on an extension of the boundary condition switching procedure used in some subsurface models for the handling of atmospheric inputs on the land surface boundary of the catchment. The main aim of this work is to assess, via sensitivity analysis, the accuracy and mass balance limitations for the CATHY model over a range of temporal and spatial discretizations and for a variety of hydrological configurations. Particular attention is paid to the case of high exchange fluxes under Dirichlet boundary conditions. This type of boundary condition is not flux-limited and may lead to a poor estimation of exchange fluxes and consequently to poor overall mass balance.

Keywords— surface-subsurface modeling, mass balance