Geophysical Research Abstracts
Vol. 14, EGU2012-9520, 2012
EGU General Assembly 2012

Improving convergence and mass balance in Richards equation-based solvers

C. Paniconi (1), M. Putti (2), and M. Islam (2)
(1) INRS-ETE, Université du Québec, Canada (claudio.paniconi@ete.inrs.ca), (2) Università di Padova, Italy

As hydrological models become increasingly sophisticated (e.g., coupling with various meteorological, ecological, or biogeochemical components) and are applied in ever more computationally demanding contexts (e.g., the many realizations that are typically generated in parameter estimation, uncertainty analysis, data assimilation, or scenario studies), the need for robust, accurate, and efficient codes is greater than ever. The Richards equation for subsurface flow is highly nonlinear and requires iterative schemes for its solution. These schemes have been the subject of much research over the past two decades, but an effective all-purpose algorithm has thus far proven elusive. Ideally, rapid (quadratic as opposed to linear) and global (insensitive to initial guess) convergence is sought, in addition to applicability over a range of conditions (dry soils, storm-interstorm simulations, geological heterogeneity, 3D domains with complex boundary conditions, etc). Richards' equation can be mathematically formulated and numerically discretized in a variety of manners, and the specific form and scheme chosen will affect the mass balance behavior of the model. This is a second thread that has been much addressed over the years, and it too remains very relevant because of the expansion in model development and application mentioned above. In this presentation we test a promising nested Newton-type algorithm for solving Richards' equation, and we discuss some of the new computational challenges faced when subsurface codes are coupled with other models and used in highly CPU-intensive settings.