Geophysical Research Abstracts
Vol. 12, EGU2010-10533-1, 2010
EGU General Assembly 2010

On a fully coupled numerical methods for a 2D surface and subsurface flow hydrological model

Emanuele Cordano, Giuseppe Formetta, and Riccardo Rigon
University of Trento, CUDAM/Department of Civil and Environmental Engineering, Trento, Italy (ecor@ing.unitn.it)

The core of hydrological and land surface models is the budget of extensive quantities like mass (of water, soil, sediment particles or other chemical component), momentum and energy in a representative finite volume which usually derives from discretization of the appropriate partial differential equations.
In this contribution some mathematical characteristics of these equations are emphasized and a method for the integration of this type of equation based on a new numerical scheme which evolves from Brugnano and Casulli, 2008 and Casulli, 2009, is shown.
In this work we present a catchment-scale, coupled, surface-water/groundwater model with structured or unstructured grid. The surface water flow and overland runoff are solved by integrating the shallow water equation in 2D, whereas Boussinesq equation (BEq), based on Darcy's law, is solved for groundwater flow. Both equations are derivations of the fluid flow Navier-Stokes Equation and thus they are solved in a similar way. The equations are discretized in a coarse grid which, however, accounts for sub-grid variations of topography and soil properties. Wetting and drying of both the subsurface and surface are obviously modeled. The model can also take into account the presence of unsaturated zones above water table (e.g. Cordano and Rigon, 2008, Hilberts et al, 2005).
The methods used fall under the theorem demonstrated by Brugnano and Casulli, 2008, and Casulli, 2009, and thus, their convergence to the exact solution are guaranteed. However, implementation problems can occur in case of steep hillslopes or complex topography, and these problems are discussed and solved with applications to Alpine catchments.
The models are implemented as a Free Software and coupled with a Geographical Information System (GIS). Further details of this work are available on http://www.geotop.org/cgi-bin/moin.cgi/Boussinesq#preview.