XVIII International Conference on Water Resources
CMWR 2010
J. Carrera (Ed)
CIMNE, Barcelona 2010

HILLSLOPE CONTROLS ON THE HYDROLOGIC RESPONSE FROM A COUPLED SURFACE/SUBSURFACE MODEL

Marta Altissimo[*], Marco Marani[*], Sylvain Weill[†], Giorgio Cassiani[‡], Rita Deiana[‡], Matteo Rossi[‡] and Mario Putti[†]

[*] Dept. IMAGE, University of Padova
via Loredan 20, I 35131 Padova, Italy
e-mail: {altissimo/marani}@idra.unipd.it, web page: www.image.unipd.it

[†] Dept. DMMSA, University of Padova
via Trieste 63, I 35121 Padova, Italy
e-mail:{weill/putti}@dmsa.unipd.it, web page: www.dmsa.unipd.it

[‡]Dept. of Geosciences, University of Padova
via Giotto 1, I 35137 Padova, Italy
e-mail: {giorgio.cassiani/rita.deiana/matteo.rossi}@unipd.it, web page: www.geoscienze.unipd.it

Summary. One of the crucial themes in hydrological processes is how much of the observed hillslope-scale complexity and heterogeneity needs to be included in any predictive hydrological model at the watershed scale. The detailed understanding of hillslope dynamics is of fundamental theoretical and practical importance in hydrology, and has been investigated by use of analytical and theoretical approaches, numerical models with various degrees of simplification, and field experiments. Here we apply a coupled surface/subsurface model to an instrumented study basin located in Northern Italy, where detailed observations of streamflow, atmospheric forcing, water table levels, soil moisture, as well as a characterization of hydrogeological properties exist. The model is based on a three-dimensional Richards equation solver describing variably saturated flow in porous media and is used to test the extent to which a Richards-like unsaturated flow dynamics can explain the observed hillslope response. Simulations show the model ability, for validation periods distinct from calibration ones, to satisfactorily capture discharge hydrographs over long time scales and across different seasons. Numerical experiments under different scenarios highlight the relative role and importance of the superficial vegetated layer and of the riparian vegetation zone, as well as the importance of incorporating a detailed description of the basin geophysical structure in order to reproduce the observed response of the system.