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Testing a process-based model of groundwater/surface water interactions at the hillslope, subcatchment, and watershed scales

Claudio Paniconi (1), Mauro Sulis (2), Matteo Camporese (3), Stefano Orlandini (4), and Mario Putti (3)

(1) Institut National de la Recherche Scientifique - Centre Eau, Terre et Environnement (INRS-ETE), Université du Québec, Quebec City, Canada (claudio.paniconi@ete.inrs.ca), (2) INRS-ETE, Quebec City, Canada, (3) Università di Padova, Padua, Italy, (4) Università di Modena e Reggio Emilia, Modena, Italy

Hydrological models that can simulate in a dynamically consistent manner the interactions between the atmosphere, land surface, and subsurface over a range of scales are needed for improved climate prediction, environmental protection, and water resources management. Rigorous testing of available models is extremely important: the hypotheses underpinning model parameterizations need to be continually assessed and improved, in particular with regards to the coupling (or integration) of different processes (or process submodels). The coupling term for the model tested in this work is computed as the balance between atmospheric forcing (rainfall and potential evaporation) and the amount of water that can actually infiltrate or exfiltrate the soil. Sensitivity tests, intercomparison studies, and other model applications will be used to illustrate features and challenges for this particular model formulation, in relation to other approaches where relevant. The tests will examine processes and factors such as leakage, heterogeneity, grid resolution, hydrograph separation, rill and sheet flow paradigms, and boundary conditions, and will consider the influence of these factors on streamflow, soil water storage, groundwater recharge, evaporation, and other important determinants of a catchment's water balance. Challenges related to scale invariance, mass balance errors, and model bias will be addressed.