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Testing of a coupled soil water and heat model under a vegetated surface in Emilia-Romagna (Italy)

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Criteria3D is a numerical model that solves equations of surface and subsurface water flow in a three-dimensional domain. Surface flow is described by the two-dimensional parabolic approximation of the St. Venant equation, using Manning's equation of motion; subsurface flow is described by the Richards' equation for the unsaturated zone and by Darcy's law for the saturated zone. Surface and subsurface domain are coupled by means of the continuity of pressure head so that all governing equations of water flow are simultaneously solved in a single global matrix. We are currently working on model extensions in order to simulate heat and solutes transfer to achieve a complete three-dimensional model of water, heat and solutes flow. In this work the heat flow governing equations are introduced in the model and coupled with the water flow equations. The soil temperature changes are driven mainly by three mechanisms of heat transfer: conduction, advection, and latent heat transport. All of these are taken into account explicitely in the model. Isothermal and thermally driven vapor flow is simulated and incorporated as latent heat flow. Both water and heat equations are solved using an integrated finite difference formulation. A Criteria3D water flow test on a small catchment is already reported in literature. In this work the coupled model of water and heat flow is tested, for a one dimensional case study, on a grass field with sandy loam soil with transitional silty clay loam and silt loam horizons, located in the plain of Bologna (Italy). The experimental data are collected using water and temperature probes installed at seven different depths.