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Testing a dual-scale semi-distributed hydrological modelling approach in a small Mediterranean mountain catchment

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Middle mountain areas in the Mediterranean have undergone a long lasting history of land use which frequently resulted in a patchy land cover. The complex land cover patterns and the marked seasonality of the climate are the major challenges for the hydrological modelling of Mediterranean mountain areas, which generate most of the water resources for the lowland populated areas.
Research in the Vallcebre catchments (NE Spain, 42º 12'N, 1º 49'E) started over 20 years ago with the objective of better understanding the hydrological functioning of Mediterranean mountains. During this period, climatic data and hydrometric records at the outlet of the catchments have been complemented with the monitoring of distributed catchment internal fluxes and states, such as depth to the water table, soil moisture, forest rainfall interception and tree transpiration.
Along with several exercises made with hydrological models of diverse degrees of complexity, the semi-distributed TOPBAL model has been implemented at the Can Vila catchment. TOPBAL has been developed within the semi-distributed structure of TOPMODEL on the basis of two drivers of hydrological similarity: topography and vegetation type. The model explicitly considers rainfall interception by vegetation, the control of semi-distributed soil moisture on evapotranspiration, and the two-way exchanges between the root-unsaturated semi-distributed stores and the phreatic store, which is unique for all the catchment as in TOPMODEL. Although the parameter parsimony of TOPMODEL has been followed as much as possible, the wealth of processes and, as a consequence, of parameters, has made convenient the development of a sub-model. PLOTBAL, a plot-scale MATLAB SIMULINK model, makes easier the interactive testing of diverse vegetation and soil parameters, the validation of model simulations with local data, and the simulation of plot-scale vegetation changes.
First model results indicate that this modelling approach is adequate to cope with most of the difficulties associated to the modelling of Mediterranean mountain areas within the limitations of uncertainty in the observations.