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Modularity in integrated catchment modeling covering different time-scales

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The majority of exiting catchments models are either designed to be used as basin management tools or as event based models. Models of the first type usually use lumped approaches to characterize the processes occurring in catchments and work over hydrological response units or similar structures. Models of the second type are called physical based distributed models (PBDM). Due to limitation of available computer power and due to internal time stepping PBDM are usually not suitable to be used for long term simulations. Mediterranean catchments provide further challenges in terms of simulations: (i) long dry periods without runoff; (ii) extreme first-flush events; (iii) formation of pools and flow interruption; (iv) water quality and sediment quality processes influenced by expansion and contraction dynamics in the channel bed.

TempQsim project is dedicated to solving these difficulties, improving and creating tools that increase the efficiency of integrated water management in semiarid river catchments. As a contribution to this project the Technical University of Lisbon started developing MOHID Land. This paper describes the methodology adopted in the development of the integrated catchment model MOHID Land, integrated into the Water Modeling System MOHID (WMS - MOHID). WMS - MOHID is developed using ANSI FORTRAN 95, following object oriented programming rules. Objects are created by creating instances of modules. The object oriented design of the WMS- MOHID was the base for the development of MOHID Land. Many existing features could easily be used (e.g. modules for atmosphere, condition, modules for IO), other very easy to add (e.g. as in stream hydrodynamic the user has the options to use the CASCADE, water quality dynamics can be simulated using the biogeochemical reactions of CE-QUAL-W2). In order to solve all the above mentioned challenges and keep at

the same time the model suitable to carry out long term simulations the model must be able to solve efficiently events of short duration and long periods where the system is rather “un-dynamic”. For this MOHID Land uses a dynamic time stepping. MOHID Land computes water, sediments and properties transport in a watershed. The core modules of MOHID Land which simulate the hydrological cycle are: (i) a module for 2D overland flow, (ii) a module for 1D river flow (kinematic wave, or the complete St. Venant equation), (iii) a module for 3D unsaturated flow by solving Richards equation and (iv) a module for 2D saturated flow. Evapotranspiration is considered in the model as a dynamic boundary condition and is computed as a function of the potential evapotranspiration. The in stream water quality can be simulated using different water quality modules: (i) a WASP like module, (ii) the CE-QUAL-W2 module or (iii) a module based on the model ERSEM. Current applications include four different catchments in the scope of three European projects, TempQSim, ICReW and Ecoriver. In this communication the MOHID modeling system will be presented, highlighting the interface between all processes, physical domains and time scales simulated. Preliminary results for current models applications will also be announced.