

## Development and deployment of a water-crop-nutrient simulation model embedded in a web application

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It is long time by now that scientific research on environmental and agricultural issues spent large effort in the development and application of models for prediction and simulation in spatial and temporal domains. This is fulfilled by studying and observing natural processes (e.g. rainfall, water and chemicals transport in soils, crop growth) whose spatiotemporal behavior can be reproduced for instance to predict irrigation and fertilizer requirements and yield quantities/qualities. In this work a mechanistic model to simulate water flow and solute transport in the soil-plant-atmosphere continuum is presented. This desktop computer program was written according to the specific requirement of developing web applications. The model is capable to solve the following issues all together: (a) water balance and (b) solute transport; (c) crop modelling; (d) GIS-interoperability; (e) embedability in web-based geospatial Decision Support Systems (DSS); (f) adaptability at different scales of application; and (g) ease of code modification. We maintained the desktop characteristic in order to further develop (e.g. integrate novel features) and run the key program modules for testing and validation purposes, but we also developed a middleware component to allow the model run the simulations directly over the web, without software to be installed. The GIS capabilities allows the web application to make simulations in a user-defined region of interest (delimited over a geographical map) without the need to specify the proper combination of model parameters. It is possible since the geospatial database collects information on pedology, climate, crop parameters and soil hydraulic characteristics. Pedological attributes include the spatial distribution of key soil data such as soil profile horizons and texture. Further, hydrological parameters are selected according to the knowledge about the spatial distribution of soils. The availability and definition in the geospatial domain of these attributes allow the simulation outputs at a different spatial scale. Two different applications were implemented using the same framework but with different configurations of the software pieces making the physically based modelling chain: an irrigation tool simulating water requirements and their dates and a fertilization tool for optimizing in particular mineral nitrogen adds.