The "Vsoil" modeling platform

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Human actions and climate change induce modifications in soils and hydrosystems that must be predicted and evaluated. The soil is a fragile component of the ecosystem and it plays an essential role for primary production and water quality. Modeling is a powerful tool to simulate physical, chemical and biological modifications of the soil. Comparing model outputs to long term experiments is absolutely necessary to evaluate our understanding of the soil plant atmosphere system functioning and thus our ability to predict its evolutions.

The "VSoil modeling framework" was developed to provide the scientific community with a tool easing the development and the share of modeling tools and knowledge.

The platform is composed of four softwares, "VSoil Processes", "VSoil Modules", "VSoil Models" and "VSoil Player". "VSoil Processes" allows to capitalize the knowledge on the processes and their interactions; "VSoil Modules" is an application to develop modules; "VSoil Models" offers a framework to easily build or modify models by assembling modules; "VSoil Player" is a place to run the models, to compare their outputs, to compare with observations, to carry out sensitivity analysis.

Using "VSoil Processes" does not require any skill in programing. The software is dedicated to the definition of the variables and the processes. A process is characterized by its name, what it does and two lists of variables for its inputs and outputs. Variables have a definition, a unit chosen in the international unit system, and some informations on its spatial extend and its content. These informations are later used by the "VSoil Module" software. The platform user can add processes and variables to those already available. The platform automatically detects the links between the processes using their respective inputs and outputs. It creates graphs that will be the backbones of the models. The software displays the graphs, and allows to visualize the exchanged variables.

The "VSoil Modules" software is dedicated to the development of modules. Modules are numerical representations of the processes. A module uses its inputs to calculate its outputs at times required by a main program. A module is made up of declarative, initialization and compute parts. The software allows editing, compiling and testing the codes. The software automatically generates most of the declarations so that the user can concentrate on the coding of the calculation part. A coding assistance is available. Admitted languages are Fortran and C++. Existing numerical codes can be easily embedded in the platform provided the structure is respected. This is the only part of the platform that requires programing efforts.

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One can create a model with "VSoil Model" either from scratch or modifying a model already available. An existing model can be easily modified by adding modules to account for new processes and/or by changing existing modules by new ones. From scratch, the user chooses a process and from there is helped choosing the modules for all the processes that will be automatically activated by the platform or by the user. When no module is available for providing a variable required by another one, the user knows what is missing and which process is implied. When all the modules receive the variables they need, the model is considered as viable and the software automatically creates a main program. A graphical user interface through which parameters and initial situations can be given is also automatically generated. The set of parameters can be saved for reuse. The model can be run and all the output variables can be displayed or exported.

With the "VSoil Player" the user can run existing models, and compare models outputs. Sensitivity analysis can be easily carried out. It is based on the R-sensitivity package. The user simply selects a method and its parameters, the model parameters to be tested, and the model outputs on which sensitivity will be evaluated. The platform generates the R script, runs the model and displays the results. Development are being done to offer parameters estimation, and easy connection to some data bases (climate, soil properties) to either provide parameters or access to observations.

The platform is a collaborative tool. Users can easily exchange platform objects (variables, processes, modules, models) by means of import and export procedures using either the mail or any other file storage systems. Our wish is that platform users share their developments and cite each others when using available numerical codes. A license and a chart are available and must be signed.

The platform can be freely downloaded from the web site: www6.inra.fr/vsoil. More informations and news on ongoing projects, PhD, and new developments can be found on the web site.

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