OpenFLUID

a Software Environment for Modelling Fluxes in Landscapes

Applications on distributed hydrological modelling on farmed catchments

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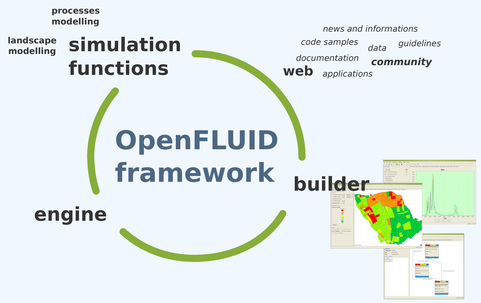
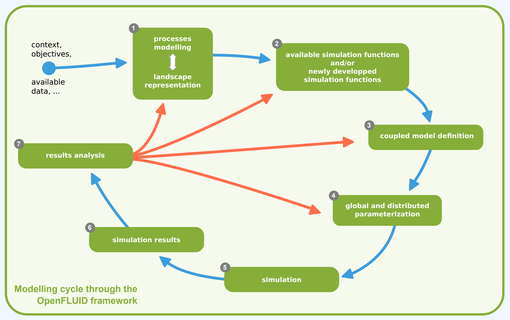
Overview

OpenFLUID is a software framework and an operational platform for integrative modelling and simulation of landscapes functionning, developped by the Laboratory of Interactions between Soil, Agrosystem and Hydrosystem (LISAH). The platform can simulate different spatial processes, over different landscapes representations, using processes models and space definition models.
The processes and landscapes models are developped or integrated (if they already exists) into simulation functions. These simulation functions are dynamically plugged to the OpenFLUID framework in order to build coupled models adapted to context and objectives, and are used by OpenFLUID applications to run simulations.



Features

The OpenFLUID framework proposes a formalism to encapsulate spatial models as software plugins (simulation functions), that can be used and reused in order to build coupled models. The landscape is represented as a connected graph where nodes are spatial units and edges are relationships between these spatial units. This representation can be defined in a static way through input dataset or dynamically built by simulation functions at runtime. An OpenFLUID simulation consists in data exchanges between models over time and space.
The simulations functions contain only scientific knowledge (the models), whereas the framework manages the simulation execution (data structuration and exchanges, consistency checkings, inputs/outputs, ...)



Detailed features
- scalar or vector variables for spatial data exchanges
- distributed input data for spatial parameterization
- spatial discrete events for non-continuous information
- coupling consistency checking through data exchanges
- fixed time step for common coupling, internal time steps of simulation functions are independant
- "buddies" tools for related tasks such as generation of scientific documentation from the source code of simulation functions
- standard file formats for inputs and ouputs (XML-based)
- adapted memory management for large simulations (optional)

A Source Development Kit (SDK) is provided in addition to the framework, allowing to develop models as software plug-ins. This SDK includes the full documentation of the API and an Integrated Development Environment (IDE) based on the Eclipse IDE.

OpenFLUID community

The OpenFLUID project is inspired by open-source approaches promoting interoperability, openness, and transparency. The development is based on collaborative work between software engineers and scientists from different disciplines related to landscape modelling. The OpenFLUID community gathers users, software developers and scientists, allowing to mutually improves knowledge and skills, to share productions, and to improve software features and quality. The OpenFLUID community web site (http://www.umr-lisah.fr/openfluid/community/) shares information about the project.

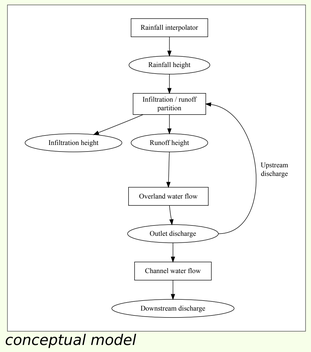
Application examples

Runoff pathways and hydraulic properties at field scale

Objectives: 1) studying the effect of intra-field variability of hydraulic properties and of row crop on the runoff generation and flow pathways. 2) comparing different implementation of the same hydrological process.

Methods: a 1200 m² vineyard field was divided into more than 1000 surface units for accounting for row and interrow vine structure.
MHYDAS model was run with either Morel-Seytoux, Diskin, or horton representation for infiltration/ runoff partition - with either Hayami solution or finite difference scheme (Crank Nicholson) for the diffusive wave transfer.

spatial representation

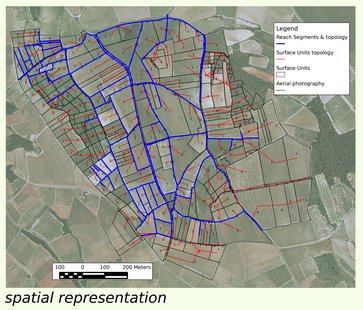


conceptual model

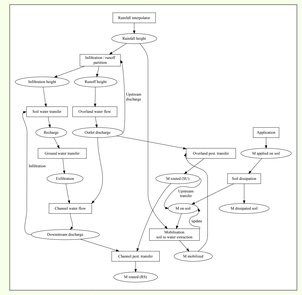
Surface and ground water contamination in agricultural catchment

Objectives: studying the effect of agricultural practices and man-made structures (ditches, terraces ...) on water and pesticides fluxes (surface and ground water contamination).

Methods: The Roujan catchment (91 ha - South France) was divided into 354 surface units, 252 reach segments and 1080 groundwater units.
MHYDAS model was run with a full surface and groundwater water module and a full fate and transfer



spatial representation

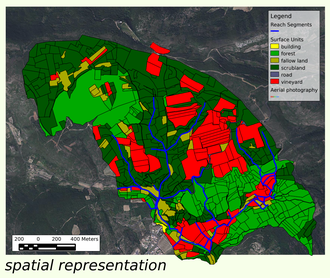


conceptual model

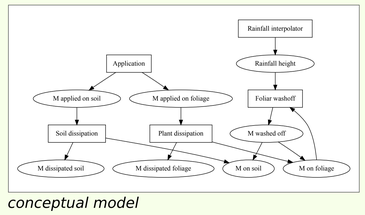
Pulverization techniques and long-term fate of pesticides

Objectives: studying the long-term effect (4 years) of pesticide pulverization techniques and adjustments on fate of different fungicides on soil and surface water contamination.

Methods: The Neffiès catchment (400 ha -South France) was divided into 720 surface units and 80 reach segments.
In this example, the MHYDAS model was run with a fate of pesticide on both plant and soil compartments.



spatial representation



conceptual model

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