Modeling the dynamics of agricultural landuse and practice changes with GENLU2 - a SWAT application

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Motivation

1- Localisation of the area

2- Methods & Tools

3- Results

Conclusion and perspectives
Motivation

Concern:
Implementing complex agricultural practices for heterogeneous cropping systems through the SWAT interface is very tedious and time consuming.

Objective:
To develop a tool, GENLU2, that can make it possible to feed the agronomical management database with complex practices representative of the Charente’ s watershed. GENLU2 is able to build the mgt1 & mgt2 tables in a read-in SWAT format.
The Charente’s river basin
The Charente’s river basin

MODELING SUB-WATERSHEDS

Coupling test SWAT-hydro geological model for ground waters on the Boutonne river basin (1300 km²)

Sources: DB Geofla (IGN) / MNT (IGN) / AEAG
The Charente’s river basin

MODELING SUB-WATERSHEDS

**Coupling test SWAT-hydro geological model for ground waters on the Boutonne river basin (1300 km²)**

**Hydrological delineation of the Aume-Couture watershed (465 km²)**
The Charente’s river basin

MODELING SUB-WATERSHEDS

Coupling test SWAT-hydro geological model for ground waters on the Boutonne river basin (1300 km²)

LandUse with GENLU2
Validation of soil and crop rotation typologies on the Né river basin (700 km²)

Hydrological delineation of the Aume-Couture watershed (465 km²)

GENLU2: Technical validation on Ruiné watershed (6 km²)

Sources: DB Geofla (IGN) / MNT (IGN) / AEAG
The Charente’s river basin:

A ZONE OF INTEREST FOR WATER QUALITY IN REDUCING NON POINT SOURCE POLLUTION

Zones of interest for Best Management Practices

Sources: DB GeoFla (IGN) / MNT (IGN) / AEAG / ASP
The tool GENLU2 is part of the implementation process to SWAT projects. In a read-in Access files it implements new tables of managements directly into the database of the SWAT2009 project.
Implementation of scenarios and land management practices

From a base line scenario that is representative of the actual agricultural system, GENLU2 enables to generate efficiently alternative scenarios like the intensification of the agricultural practices, the lengthening of rotations, implementation of BMP, introduction of new crops, organic farming, etc.
GENLU2 process

- Reading of the features at the HRU scale (crop rotation, usersoil, etc)
- Look up with the soil typology/rotation/ landuse management operation
- For each HRU: allocation of management schedules/ crop within each rotation/scenario.
- For each HRU: pseudo-randomization of crop succession into the sequence of the rotation
- Building up of MGT read-in SWAT format files = input data for simulation
- Operation schedule by HRU
Crop succession modelised by GENLU2
FROM 2001 TO 2011 : ILLUSTRATION WITH S0

% of Utilised Agricultural Land

Arable Land with crop rotations

Perennial landcover

- Irrigated winter wheat
- Winter wheat
- Irrigated winter barley
- Winter canola
- Corn silage
- Corn
- Winter canola
- Sunflower
- Natural meadow
- Permanent meadow
- Temporary pasture
- Vineyards
- Forests
- Urban zones

Results

-> GENLU2 enables a good distribution of the crops through the years.

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Crop succession modelised by GENLU2

From a static typology of rotations to dynamical crop rotations
An example of an alternative scenario

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</table>
Thank you for your attention!

Questions?
Global methodology

Typology of agricultural systems
Scenarios

- GAMS model
- SWAT agro-hydrological model
  - Estimation of concentrations at the sub-basin scale

Stakeholders

- Agro-environmental indicators
  - Pressure/intensity/potential risk
  - Group of plots/sub-basin scales

Cost-effectiveness
- For each scenario
- HRU/sub-basin scale

Distributive effectiveness
- At the sub-basin scale

Optimisation of the localisation of BMPs

Environmental effectiveness
- Of each scenario/reference scenario
Calibration and validation on the water outflows

Calibration (2001 to 2005)

- $R^2$: 0.80
- Nash–Sutcliffe: 0.69

Validation (2008 to 2011)

- $R^2$: 0.72
- Nash–Sutcliffe: 0.63

Mean daily flows (2001 to 2005)

- Measured data: 1.83 m$^3$/s
- Simulated (SWAT) data: 1.7 m$^3$/s
Calibration on the water flows

CALIBRATION AT THE GAUGING STATION OF SALLES D’ANGLES - $R^2 = 0.778$

The model has been calibrated and validated on the available continuous daily data, that is on the flows from respectively 2001 to 2005 and from 2008 to 2011 at the gauging stations of Salles d’Angles (R4122521).

As input data, the model incorporates daily precipitations at weather stations of Cognac & La Couronne. Daily measured water flows.
Variabilités des valeurs de paramètres des sols

Valeurs des paramètres de sols