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Assessing the effectiveness of BMPs with the SWAT-GENLU modeling framework

Environmental performance of production activities, Spatial and dynamic territorial organization, Public policy analysis, Territories

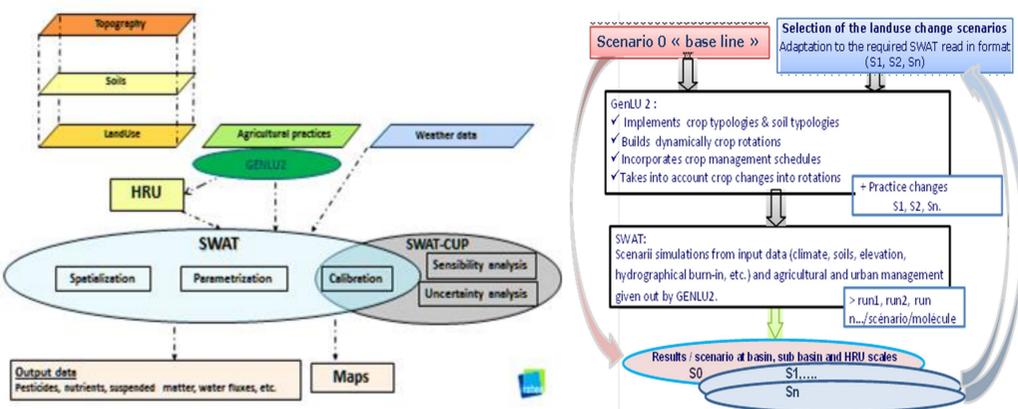
The GENERator of LandUse (GenLU1 and GenLU2) applications make it possible to feed complex actions at HRU level into SWAT agronomical management files

Motivations - Concerns - Objectives

- ✓ Simulate long-term BMP scenarios with complex cropping systems (long crop rotations, heterogeneous practices) (GenLU1 & GenLU2)
- ✓ Include sensible temporal variability in management operation schedules (GenLU1 & GenLU2)
- ✓ Need for automatic implementation into SWAT mitigation measure scenarios
- ✓ Need to adapt to different spatial scales at a daily time step (GenLU1 & GenLU2)
- ✓ Need to spatialize Agricultural Census and generate land use cover (GenLU1)
- ✓ Need to spatialize a typology of practices linked to soils and generate land use cover (GenLU2)
- ✓ Need to adapt to different methodologies (integrated assessment, standalone environmental modeling, or environmental modeling coupled with bio-economic modeling)
- ✓ Need to account for the impact of climate on management application dates (GenLU1 & GenLU2)

Modeling framework

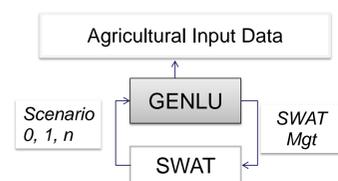
- The GenLU applications are an interface between land use data and the SWAT project input files



Source : Odile Leccia – Paul Bordenave (2008)

GenLU global methodology

- The GenLU applications are adapted for each BMP scenario
- They sequentially process BMP scenarios at HRU scale

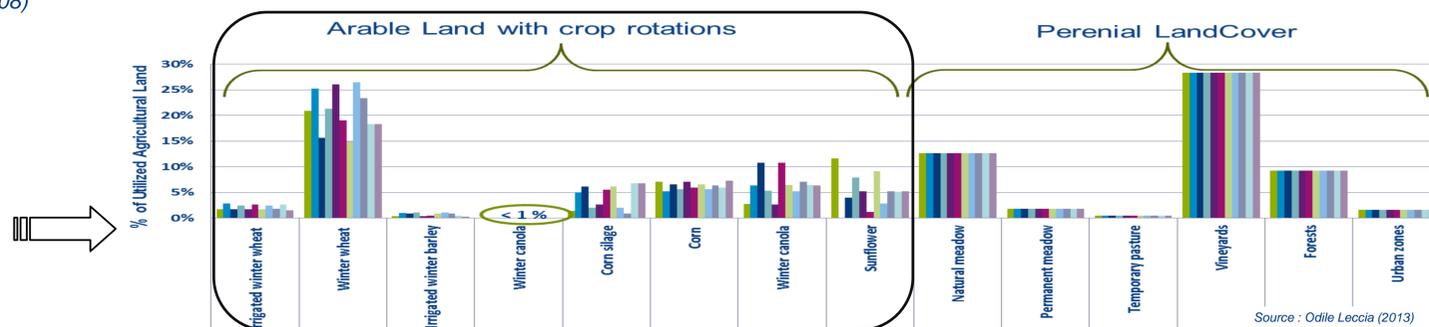


Code	Cropping systems of SO (baseline scenario)	Code	Mitigation scenario's cropping system (example)
S	Corn silage	S	Corn silage
FTB	Corn silage (*2) - Sunflower - Winter wheat	LLFTB	Alfa (*3) - Corn silage (*2) - Sunflower - Winter wheat
TB	Sunflower - Winter wheat	PB	Sunflower - Field Peas - Winter wheat
TBB	Sunflower - Winter wheat (*2)	BPB	Sunflower - Winter wheat - Field peas - Winter wheat
TBCB	Sunflower - Winter wheat - Winter canola - Winter wheat	BPCB	Sunflower - Winter wheat - Field peas - Winter canola - Winter wheat
TBO	Sunflower - Winter wheat - Winter barley	TBO	Sunflower - Winter wheat - Field peas - Winter barley
MMMW	Irrigated corn (*3) - Irrigated winter wheat	LLMMW	Alfa (*3) - Irrigated corn (*3) - Irrigated winter wheat
M	Irrigated winter wheat	M	Irrigated corn
MMMQ	Irrigated corn (*3) - Irrigated winter barley	LLMMQ	Alfa (*3) - Irrigated corn (*3) - Irrigated winter barley
MW	Irrigated corn - Irrigated winter wheat	LLMW	Alfa (*3) - Irrigated corn - Irrigated winter barley

Reading of the features at the HRU scale (crop rotation, usersoil, etc)
 Look up with the soil typology/rotation/ landuse management operations
 For each HRU: allocation of management schedules/crop within each rotation/scenario & of sensible temporal variability in the op. dates
 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
 Writing of management operation schedule of each cropping system allocated to each HRU

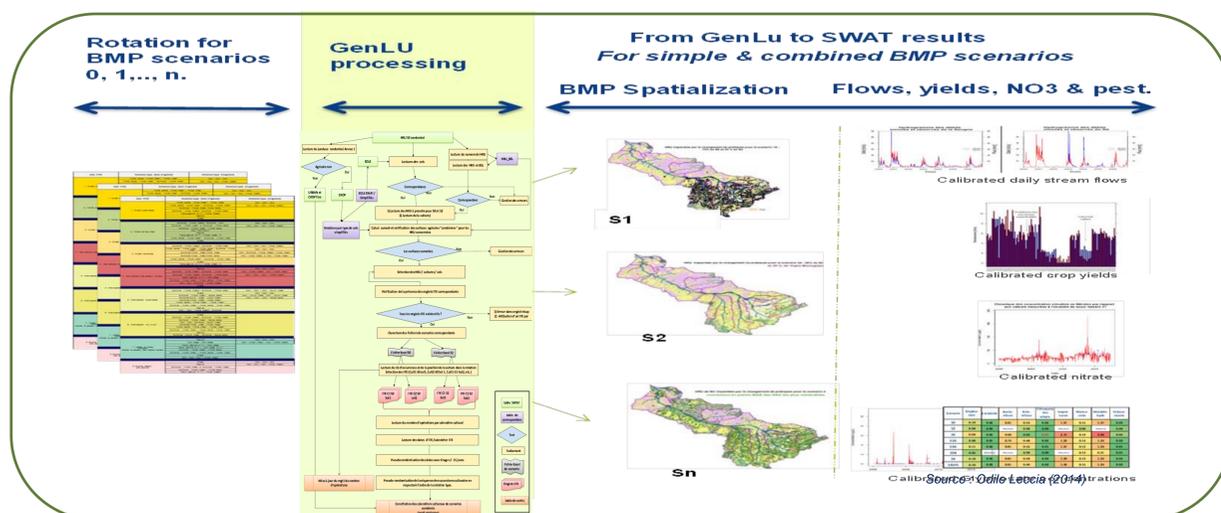
Results

- Statistical post-process GenLU cropping system to compare modeled and real surfaces



Source : Odile Leccia (2013)

- The GenLU applications make it possible to feed complex practices into SWAT-compatible input files



Thanks to its ability to build SWAT-compatible alternative scenarios, GenLU is a highly useful tool to automatically implement complex land use and agricultural systems into the SWAT model

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Abstract

Diffuse pollution from agriculture has become a major concern for **water managers**. To improve the water quality, agricultural mitigation measures **are widely used but not easy to evaluate on large territories**. We proposed an **integrated assessment method for public decision makers including the modeling of scenarios at the watershed scale**. We chose the SWAT model for its capacity to represent urban and agricultural practices. Implementing these practices at the HRU level through the standard interface can be tedious: thus 6 year crop rotation require circa 60 to be duplicated for all the agricultural HRUs and all scenarios.

We developed a program in order to facilitate the modeling of these mitigation measures: **GENLU1 (2007) for environmental modeling** and **GENLU2 (2012) for integrated assessment modeling**. Both versions enable building the SWAT management operation schedule and **targeting BMPs wholly or in part of the area**. It allows to implementing changes in molecules or crop management sequences or widths of filter strips. It manages a **temporal variability in dates of application**.

GENLU1 generates the landcover raster by spatializing data from the French Agricultural Census at the commune scale and spatial non-agricultural landuse. The associated management operation schedules are built from field studies and regional knowledge. **GENLU2** is dedicated to **integrated assessment modeling in which** agricultural practices are finely described at the group-of-plots scale using typologies (crop rotations * types of soil).

This ability to build up read-in SWAT alternative scenarios makes GENLU an appropriate tool for implementing the SWAT model with complex landuse and agricultural systems.

Keywords

SWAT, GENLU, BMPs, NPS, integrated assessment modeling, agricultural practices, NPS, water quality, mitigation measures, scenarios, cropping systems,