ADAPTING SYST'N® FOR MODELING ALFALFA GROWTH

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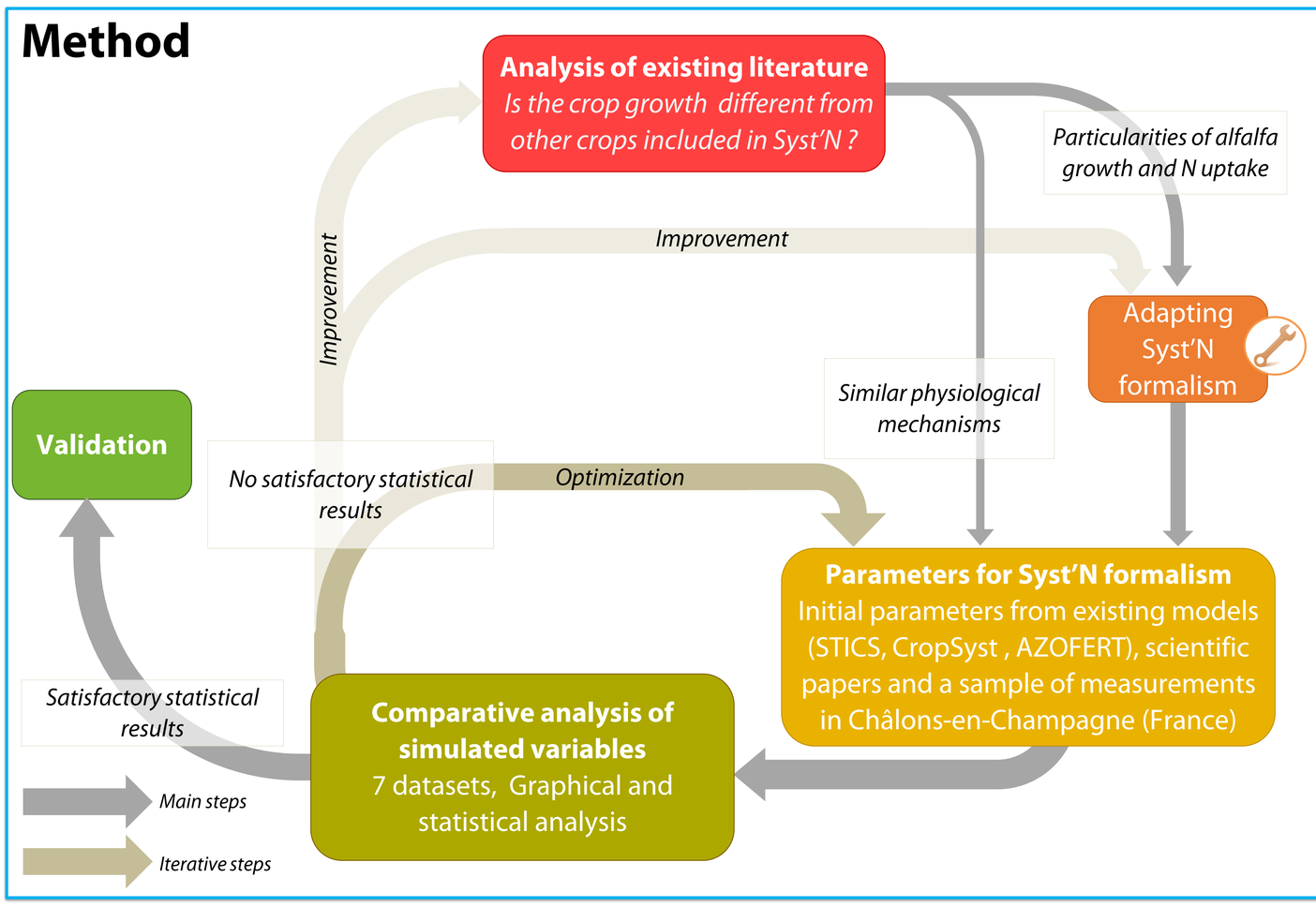
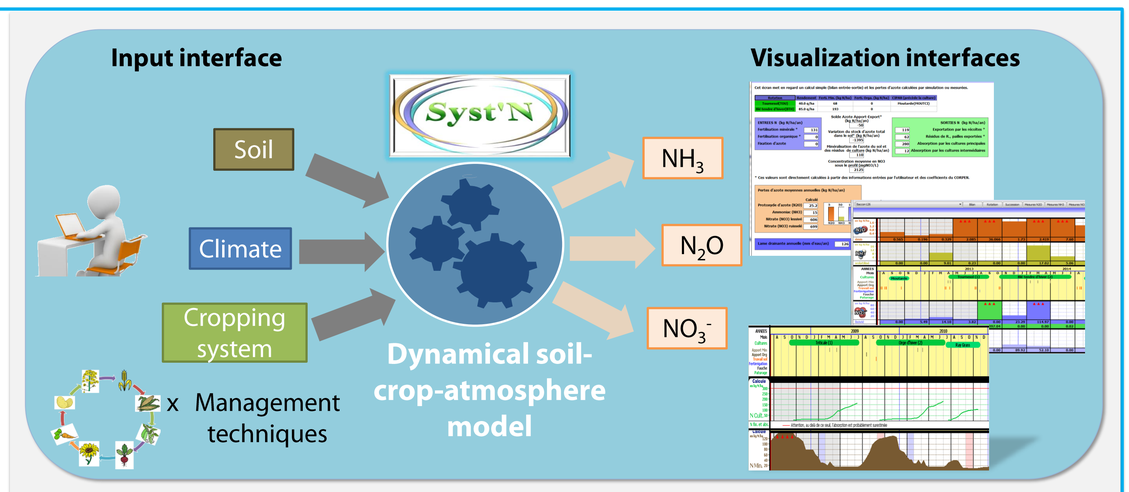
Introduction

Syst'N® (Parnaudeau et al. 2012) is a pluriannual diagnosis tool of nitrogen emissions at plot scale, that enables to assess agri-environmental performance of cropping systems according to the soil-climate context. This tool is intended for a broad range of stakeholders in air and water quality management (agricultural consultant, facilitators in water catchment …). It consists of a dynamic model to simulate daily nitrogen atmosphere-biosphere fluxes and of ergonomic graphical interfaces to describe the cropping system and the soil-climate context of the field but also to visualize N emissions changes (in ammoniacal, nitrate or nitrous oxide form) during the rotation.
The model is based on existing models (STICS, AZODYN, NOE, AZOFERT…), and parameters of some twenty crops have already been integrated in the tool. However the range of parametrized crops is limited compared to the diversity encountered on the field. A new project is now to adapt Syst'N to alfalfa, a perennial forage legume emerging in cropping systems.

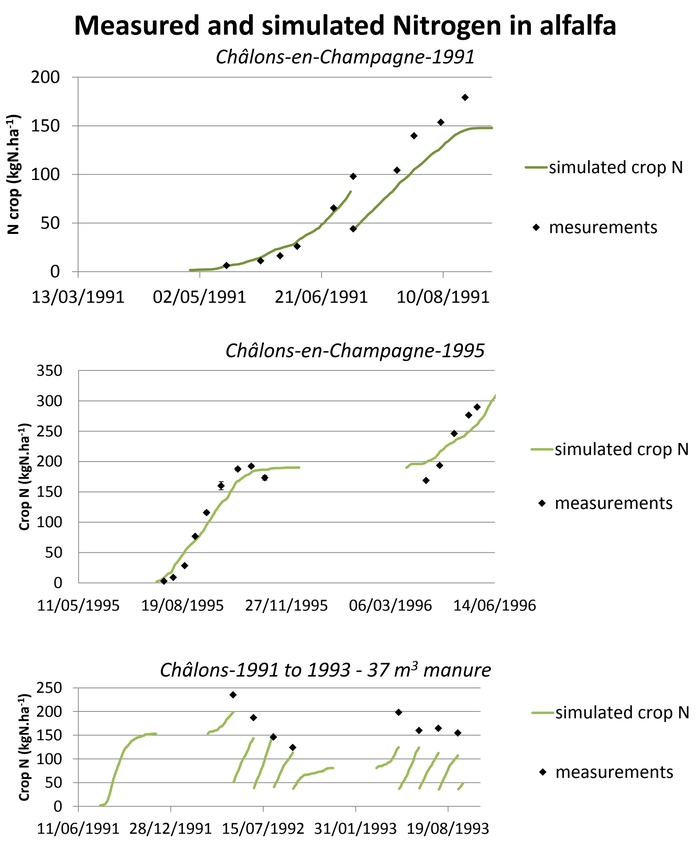
Method





Particularities of alfalfa growth	Adapting Syst'N formalism
Perennial legumes	Adapted formalism and database architecture : different growth dynamics and nitrogen uptake after emergence and after a cut (Thiébeau et al, 2011) due to the ability of alfalfa to store and release nitrogen at different stages.
Dormant crop	Dormancy formalism based on CropSyst model (Confalonieri and Bechini 2004).

Results for simulated crop nitrogen content



Experimental sites	Crop N (kgN.ha^{-1})	
		RRMSE (%)
Châlons-en-C. *Parametrization set*	Seedling *(28 data)*	22%
	Regrowth crop *(41 data)*	21%
Châlons-en-C *Validation set*	Seedling *(101 data)*	35%
	Regrowth crop *(46 data)*	38%
	After dormancy *(46 data)*	39%
Mirecourt	All stages *(106 data)*	80%
Elsenheim	All stages *(7 data)*	47%
Châlons-en-C *with manure*	All stages *(48 data)*	27%

No data available for crop nitrogen conten in Grignon, Lusignan and La Minière. Only LAI and aerial biomass were compared

Complementary results

Overestimation of dry matter and, to a lesser extent, crop nitrogen content (when available) was observed for 4 datasets especially during summer. The most likely hypothesis is that the **inhibition formalism under water stress conditions** in Syst'N do not enough constrain fixation and growth of alfalfa.

The simulated **proportion of fixed nitrogen** was consistent with the literature. Variations **from 70% to 50%** nitrogen derived from atmosphere were observed with fertilized alfalfa.

After alfalfa destruction, cumulated **N mineralized from residues** after two years reached 331 and 368 kgN.ha^{-1} (depending on the last cut date), which fits with experimental results from Justes et al, 2001 (3% and 7% error)

Conclusion

Using datasets and litterature, we obtained satisfactory results for crop N with most datasets but Syst'N overestimates the aerial biomass especially during summer. New formalisms are currently tested to improve simulated water stress in the whole model, that should lead to an other testing phase and parameters validation or optimization.

References

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