

PhD Project

Affiliation	ECOSYS (INRA – Agroparitech) and SADAPT (INRA – AgroParitech)
Supervisors	Benjamin Loubet, Raia Silvia MASSAD, Francesco ACCATINO
Title	Optimizing land use allocation, energy and matter fluxes in Europe for minimizing environmental impacts of agriculture
Main Workplace	UMR ECOSYS Thiverval – Grignon 78850
Doctoral School	ED 129 Sciences de l'Environnement d'Ile de France
Funding	Institut de Convergence CLAND
Start Date	1st November 2019
How to apply	Send a CV, cover letter and the name and contacts of two professional references by mail before September 6th 2019
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Background

A growing world population will increase the demand for food, especially for animal-source products. The big challenge is to increase food production without harming other ecosystem services (e.g., carbon sequestration, biodiversity) and without increasing environmental impacts (e.g., greenhouse gas emissions, air pollutant emissions). Indeed the limitedness of available land causes severe tradeoffs between food production and other environment-related targets.

By modifying the land surface, land-use and land-cover (LULCCs) and land management changes (LMCs) alter the physical, chemical, and biological processes of the biosphere and therefore all land–atmosphere interactions, from local to global scales (Massad et al. 2019).

Since the Second World War, the use of synthetic nitrogen fertilizers largely increased, with half of the quantity ever used being applied in the last 20 years (Erisman et al., 2007). The growth of nitrogen fertilization threatens water sources (e.g. eutrophication of surface waters, pollution of groundwater, acid rains), soils (e.g. soil acidification), climate via greenhouse gas emissions, and air quality (Fowler et al. 2013). In addition, the transportation of feed between different regions has an environmental impact.

Optimization models are useful tools for exploring trade-offs and synergies among ecosystem services and environmental impacts (Accatino et al. 2019). These models consist in linking land use and land cover variables to the provision of ecosystem services or to environmental impacts.

In order to better study the environmental impacts of agriculture, it is important to better model the factor that influence the nitrogen cycle and the fluxes of nitrogen between different parts of Europe due to feed transportation.

Objectives

The objectives of the PhD is to propose a model of nitrogen fluxes (within and between European regions) influenced by land cover, land use, and livestock allocation. It will be possible to model agricultural production as well as different environmental impacts (e.g., GHG emissions, air pollutant emissions, NO₃⁻ leaching) and other ecosystem services (e.g., carbon sequestration). The model will be used for finding strategies to soften tradeoffs and enhancing synergies between agricultural production, ecosystem services and environmental impacts. Different climate scenarios will be considered.

Work Description

The PhD consists of using an optimization-modelling framework model for exploring different scenarios as well as the relationship between nitrogen management, environmental impacts and energy and matter fluxes between the different regions in Europe under different climate scenarios. More precisely the candidate will have to:

- Explore the different existing modeling frameworks and choose which elements of the nitrogen cycle to include in them;
- Build and calibrate a simple model (models for some ecosystem services are already produced by the research group; others are available in the literature). Concerning the N cycle, this will be implemented either from a simplification or metamodeling exercise of the CERES-EGC model (Gabrielle et al. 2006);
- Build a model for predicting possible feed fluxes
- Implement the simple model in an optimization framework;
- Explore the different results and interpret them.

References

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