

## **3-yr PhD Position**

### **Modelling and Monitoring of Ammonia and Greenhouse Gas Fluxes in Grazed Grasslands**

*The French National Research Institute for Agriculture, Food, and the Environment (INRAE) is a public research establishment. It is a community of 12,000 people with more than 200 research units and 42 experimental units located throughout France. The institute is among the world leaders in agricultural and food sciences, plant and animal sciences, and is ranked 11<sup>th</sup> in ecology and environmental sciences. INRAE's main goal is to be a key player in the transitions needed to address major global challenges. In the face of global increase in population, climate change, scarcity of resources and decline in biodiversity, the institute develops solutions for multiperformance agriculture, high quality food and sustainable management of resources and ecosystems.*

#### **PROJECT DESCRIPTION**

- Grazed grasslands worldwide may represent a net carbon (C) sink for atmospheric CO<sub>2</sub>, but depending on climate and management (livestock density, fertilization), their net greenhouse gas (GHG) budget may be significantly offset by emissions of nitrous oxide (N<sub>2</sub>O) and methane (CH<sub>4</sub>). Another important environmental impact is the emission of gaseous ammonia (NH<sub>3</sub>), a major atmospheric pollutant responsible for ecosystem eutrophication, plant biodiversity loss, indirect N<sub>2</sub>O emissions, and a chemical precursor of fine particulate matter (PM<sub>2.5</sub>).
- The magnitude of NH<sub>3</sub> emissions by pastures remains uncertain owing to a relative scarcity of field-scale micrometeorological flux measurements, compared with e.g. CO<sub>2</sub> and N<sub>2</sub>O. The mechanisms underlying NH<sub>3</sub> emissions from animal urine and excreta are well known qualitatively, but their interactions with the soil-plant system and the mineral and organic nitrogen pools in grazed grasslands need to be better accounted for in deterministic ecosystem models.
- This PhD project aims to improve models to simulate and predict field-scale NH<sub>3</sub> emissions, as well as carbon and nitrogen cycling and net GHG budgets of grazed grasslands, by coupling a biogeochemical grassland ecosystem model (BASGRA\_N) to a physical-chemical model (GAG) of the NH<sub>3</sub> emission process from herbivore-deposited nitrogen (especially ureic forms). The explicit coupling of the C, N and H<sub>2</sub>O cycles in the complex soil-plant-animal-atmosphere modelling system should also help address potential pollution swapping issues within the nitrogen cascade and their response to management and climate change forcings.

#### **WORK ENVIRONMENT AND ACTIVITIES**

- Your research will be mainly carried out at the INRAE-Institut Agro UMR SAS lab in Rennes, NW France, in close collaboration with – and with some time spent at – the UK Centre for Ecology and Hydrology, Edinburgh, Scotland, for model training and advanced simulations.
- You will work within a multi-disciplinary team, with scientists, engineers and technicians specialized in environmental science, atmospheric science, agro-ecosystem biogeochemical modelling, eddy covariance and chamber flux measurements, animal science, soil science, landscape ecology.
- Your work will contribute to gaining a better understanding of NH<sub>3</sub> and GHG fluxes over grazed grassland. The core of the work will be modelling and programming, but a significant part will be devoted to environmental data analysis and assimilation by models (e.g. parameter optimization, Bayesian calibration). Flux and ecosystem data from ICOS/FLUXNET monitoring stations will be used to develop, test and calibrate the coupled model. You will also assist in data collection in the field during intensive flux measurement campaigns.

■ Special terms and conditions of activity:

- French or English will be the working language;
- The work will involve some experimental activities in outdoor conditions.

## QUALITY OF LIFE AT INRAE

By joining our team, you will benefit from (depending on the type of contract):

- 30 days of annual leave + 15 days "Reduction of Working Time" (for a full time equivalent);
- [parenting support](#): CESU childcare allowance, leisure services;
- skills development schemes: [training](#), [career advice](#);
- [social support](#): advice and counselling, social assistance and loans;
- [holiday and leisure services](#): holiday vouchers, accommodation at preferential rates;
- [sports and cultural activities](#);
- collective catering.

## TRAINING AND SKILLS REQUIRED

- **Recommended training**: Master's degree in environmental science, ecophysiology, biogeochemistry, environmental physics, biology or chemistry
- **Knowledge required**: Advanced understanding of the carbon, nitrogen and water cycles in terrestrial ecosystems; ecosystem biogeochemical modelling; surface-atmosphere exchange processes; elemental fluxes in agro-ecosystems
- **Skills required**: Programming skills (R, Fortran, Matlab, ...); experience with trace gas flux measurements.

### ↘ Reception modalities

- Address: INRAE-UMR SAS, 65 rue de St-Brieuc
- Postal code + City: 35042 RENNES, France
- Type of contract: PhD studentship
- Duration of the contract: 3 years (36 months)
- Starting date: Autumn 2022
- Salary: EUR 23700/year (gross)

### ↘ How to apply

- Send by mail to [christophe.flechard@inrae.fr](mailto:christophe.flechard@inrae.fr):
  - a 1-page cover letter explaining your motivation for applying for this PhD position;
  - a CV, including a description of relevant skills;
  - a description of your MSc work (or MSc thesis if available).