PhD offer

Simulating the fate of pesticides at catchment scale by a mixed mechanistic-statistical approach

UMR LISAH, University of Montpellier, INRAE, IRD, Institut Agro, Montpellier, France

Background and general objectives

The contamination of the air, soil and water resources by pesticides used in agriculture has been largely observed in many regions. To remedy this situation, pressure-impact diagnostic methods are needed both to identify risk situations and to evaluate new agronomic and landscaping strategies that limit the use and dispersion of pesticides. Accordingly, mechanistic modelling approaches have been developed for several years to simulate the impact of cropping systems and the implementation of buffer zones (grass strips, ditches, hedges) on pesticide dispersion and contamination of air, soil and water resources at different scales (plot, catchment, territory). These approaches complement indicator approaches by allowing a more in-depth analysis of the pressure-impact relationship (quantification of contamination levels and temporal dynamics, consideration of threshold effects and complex interactions between dispersion processes, explicit approach to the different impacts of cropping systems). They also allow an analysis of their accuracy by comparison with observations from reference situations. However, these advantages have their counterparts: complexity of modelling, strong data requirements, difficulty of parameterization and calculation time. As a result, the applications of these models for real case studies are still relatively few. This situation is quite general for pesticide transfer models on a landscape scale, and in particular for hydrological models. A general challenge is therefore to develop modelling approaches that can be parameterized with the limited data currently available in agricultural watersheds and that are computation time efficient. This is of importance for consultancy agencies carrying out pressure-impact relationship diagnostics and for agronomists seeking territorial agricultural management strategies that limit the impacts of pesticide applications.

To answer this general challenge, the PhD project aims (i) at assessing the performance of application of a mechanistic landscape model of pesticide transfer in catchments with limited data and (ii) at developing a simplified mathematical form of the mechanistic model by a meta-modelling approach.

Specific objectives

The PhD project aims to

(i) evaluate a hydrological model of pesticide transfer, MHYDAS-Pesticides, developed within the LISAH laboratory, under optimal conditions, using long-term data from a long term observatory (OMERE),

(ii) to evaluate the potential use of MHYDAS-Pesticides in the context of reduced data, according to different modelling objectives, and

(iii) to build and test a simplified numerical format of the MHYDAS-Pesticides model for different landscape and pedoclimatic configurations using metamodelling techniques.

Organization of the PhD thesis

The PhD project is expected to last 3 years. It will take advantage (i) of the database of the OMERE environmental research observatory, including the catchments of Roujan (Hérault) and Kamech (Cap Bon, Tunisia), and of (ii) of the OpenFLUID platform for modelling landscape flows, both managed by the LISAH, and (iii) of computing resources at the Meso@LR intensive computing mesocenter. The project is also part of a scientific and industrial partnership for the development of operational approaches to diagnose the pressure-impact relationship on the scale of watersheds through collaboration with the Envilys company (http://www.envilys.com).

The responsabilities of the PhD student during this project will be to:

- operate mechanistic modelling of hydrological pesticide and apply numerical methods for sensitivity analysis, model calibration and meta-modelling

- disseminate results via peer-review publications and attendance of international conferences
- collaborate with other researchers and PhD students of his working team and develop national or international partnerships.

Terms and conditions of employment and management :
The PhD position is funded for 3 years by the INRAE AgroEcoSystem division and by the Occitanie region. It will be geographically based in Montpellier. The PHD student will be part of the "Contaminants in Soil and Water" team at UMR LISAH and will be supervised by Prof. Dr. Jean-Stéphane Bailly (AgroparisTech), Dr Cécile Dagès (INRAE) and Prof. Dr. Marc Voltz (INRAE-Institut Agro).
The start of the PhD thesis is planned between October and December 2020 depending on the availability of the candidate for a period of 3 years.
The PhD student will have to register at the GAIA (Biodiversity, Agriculture, Food, Environment, Earth, Water) doctoral school on the Montpellier university site.
Half of the funding for the thesis is provided by the INRAE AgroEcoSystem department and the other half by the Occitanie region.
The expected amount of the doctoral salary is 1770 € gross per month.
The PhD student will be encouraged to enroll in a course labeled EIR-A (International Research School - Agreenium) in order to benefit from an international opening.

Expected profile of the candidate:
Msc in Environmental sciences and/or Agronomy with background and interest in hydrology, soil hydrodynamics, pesticide geochemistry. We are looking for a motivated and creative PhD student with a capacity in numerical modelling and skills in statistics (parametric estimation, multivariate models) and basic programming. Ability to work both independently and with a team is essential as well as communication and writing skills in English.

Contacts
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Application :
Please send to cecile.dages@inrae.fr a detailed CV, a cover letter, a transcript of the grades obtained during the Msc degree, a copy of the master report (if available). Applications are expected before the end of June and will be evaluated as they are received.
An audition may be scheduled for candidates selected following the file review phase.