PhD studentship with INRA and IRSTEA in Montpellier (France) in Pesticide Fate Modelling Modelling in Air, Soil and Water

Background

The contamination of ecosystems by pesticides used in agriculture concerns all ecological compartments (atmosphere, soil, aquifers, water bodies) (Aubertot et al., 2005). It has proven and suspected consequences in terms of public health (INSERM, 2013) and preservation of ecosystem quality and biodiversity (Hallman et al., 2017). The identification of pesticide dispersal routes, their determinisms and their relative contributions, according to the local environmental characteristics, to the cultivation and application practices and to the compound properties, is a prerequisite for diagnosing the risks of contamination and exposure and for seeking approaches to reduce contamination.

While the potential pathways of contamination are fairly well known, their relative importance is only very partially known. Their diversity (leaching, runoff, atmospheric drift, volatilization, atmospheric deposits, etc.), their complex interactions and the fact that they occur during and after the spreading of the compounds on the ground or vegetation has so far led to a series of research works, by contamination pathway or by main environmental compartments (air, water, soil). Finally, atmospheric dispersion has only recently been the subject of studies due to a growing concern about population exposure by air, as shown by ANSES (2013) and an expert report in 2017 on the strategy for monitoring pesticides in the atmosphere in order to assess the exposure of the general population to these compounds (Anses, 2017) or by the European BROWSE project on the exposure of local residents and passers-by to locally applied pesticides (Butler Ellis et al. 2017).

However, a good understanding of processes and an assessment of exposure risks requires an understanding of all transfer pathways and their interactions. Accordingly, the landscape scale becomes a relevant scale to study (Boivin and Poulsen, 2017; Topping et al., 2015), since it is at this scale that the different transfer paths, hydrological and atmospheric, converge. It is also at this scale that it is possible and desirable i) to estimate the ecotoxicological and toxicological impacts of pesticides, ii) to evaluate the expected positive impacts of new cropping systems and their spatial and temporal distribution, in order to limit the use of pesticides or their dispersion, iii) to study the value of ecological infrastructures (networks of ditches or hedges, wetlands, untreated areas, grass strips) in order to mitigate pesticide dispersion. The organisation of the landscape thus constitutes a new lever for action that can be mobilised in addition to the levers at plot level.

To do this, models simulating the fate of pesticides at the agricultural plot scale (e.g. PRZM, MACRO, Pearl cited in EC, 2014), those at the watershed scale (Mottes et al. (2014)) or models describing different types of atmospheric transfers and deposition (Guiral et al., 2016; Scholtz et al., 2002 ; Bedos et al. 2009, 2013) provide the first bricks for landscape-scale modelling. However, to date, no systemic modelling is available to represent at the landscape scale the risks of ecosystem contamination in the air, soil and water compartments, linked to the conjunction of hydrological and atmospheric transfer pathways. The need to develop this type of modelling tools at territorial scales was clearly identified by the work of the Anses (2017) for the atmospheric component. It corresponds to a scientific lock recognized because of the complexity to represent the temporal and spatial interaction of the mechanisms involved.

Objectives of the PhD

The PhD project thus aims to develop and evaluate an integrated modelling of the fate of pesticides at the landscape scale in order to be able to:
1) identify and prioritize the major processes contributing to the contamination of the different environmental compartments according to the landscape systems studied (organization of cropping practices and cropping systems, environmental characteristics, landscaping and ecological infrastructures),
2) simulate the influence of new pest control strategies at a landscape scale, and
3) to contribute to assessing the exposure levels of organisms in environmental compartments and populations living near agricultural areas.
The modelling developed will be implemented, tested and evaluated on a typical Mediterranean wine-growing landscape.

Organization and progress of the thesis

The PhD project must take place over 3 years and is part of a collaborative project, MIPP-V, funded by Montpellier University of Excellence. It is based i) on the OMERE Environment Research Observatory, including the Roujan wine catchment area, ii) on the OpenFLUID platform for modelling landscape flows managed by LISAH, iii) on the UMR ITAP ReducPol Technological Research platform and iv) on a set of process models and emission databases already set up (emission by volatilization (Garcia et al, 2014; Lichiheb et al., 2016); atmospheric dispersion / FIDES model (Bedos et al., 2013); hydrological fluxes / MHYDAS model (Bouvet et al., 2011)) within the collaborative project.

The following tasks are foreseen:

i) Implementation of the integrated model on a dedicated modelling platform, based on a conceptual diagram proposed by the partner laboratories;

ii) Contribution to the development of an ad hoc database on the dynamics of air, soil and water contamination in a Mediterranean wine-growing landscape;

iii) Sensitivity analysis, calibration and comparison of modelling to experimental test situations;

iv) Evaluation of the relative contributions of the different transfer routes to soil and surface water resource contamination and exposure of local residents in the case of a vineyard landscape.

Employment conditions:

The PhD student will have his main office at UMR LISAH in Montpellier in collaboration with UMR ITAP and ECOSYS, and will make stays at UMR Ecosys in the Paris region. He will be in charge of the modelling work and will contribute to the field experiments conducted by the 3 laboratories involved in the PhD project. Position to be filled from September or October 2018 for a period of 3 years.

Gross monthly salary: 1580 €

Expected profile of the candidate:

Master 2 or equivalent level in Environmental Sciences with training preferably in at least two of the following 3 themes: hydrology-hydrodynamics, atmospheric processes, pesticide geochemistry and fate. In particular, we are looking for a PhD student with numerical modelling skills in the hydrological and/or atmospheric transfer of pollutant compounds as well as an ability to work in a team and with rigour. Programming skills are desirable and communication and writing skills in English are essential.

Further enquiries

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Application :

Consideration of application will begin on 8 July 2018 and continue until the position is filled. Please send to Dr Marc Voltz (marc.voltz@inra.fr) a detailed CV, a letter of motivation, a transcript of marks for the last 2 years of the degree prepared (Master level), a copy of the Master's report (if available). Interview are scheduled to take place in July 2018 for the candidates selected following the examination phase of the applications.

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