## Modelling the emission of volatile organic compounds (VOCs) from agricultural land
### Young scientist position

INRAE is looking for a motivated postdoc / young scientist for a project focused on **quantifying the emissions of VOCs** between agricultural land and the atmosphere via **the analysis of existing datasets** and their **integration into soil-surface exchange models**. Work will be performed in collaboration with researchers of the French agronomic institute (INRAE) UMR ECOSYS in Grignon (soon Saclay) (near Paris) and Lyon (southern France), and the University of Irvine, California (USA).

### Background

While anthropogenic sources of VOCs are relatively well-known, natural sources are more complex and known only for a limited number of natural ecosystems, with estimates still subject to significant uncertainties. VOC emissions from living plants have been widely studied in the literature. However, there has been much less attention focused on VOC emissions from soil and litter, although they can also be important terrestrial sources[1]. Agricultural land whose annual rotation generates periods of bare soil (ploughing) and which has high levels of organic matter in the surface horizon (crop residues, litter, fertilizer inputs) is therefore a less well characterized and potentially important surface type in the VOC balance.

By modelling, it is possible to quantify the contribution of VOCb emissions to aerosol formation. However, the utility of these atmospheric models depends on the quality of the input parameters and, in particular, on the reliability of qualitative and quantitative data on the sources of primary pollutants introduced into the atmosphere. At the national level, some rare emission estimates have been made for Spain[2], the United Kingdom[3], Greece[4] and Switzerland[5]. For France, only Simpson et al.[6] (1995) estimated the isoprene and ACOV emission and total VOC emission (Simpson et al. 1999) in studies of European biogenic inventories. The lack of a reliable inventory of biogenic emissions prevents the use of air quality prediction models, which would allow a better understanding of these complex tropospheric processes and the anticipation of peak pollution days.

### Overall aim

The successful candidate will work on assembling, analyzing and combining experimental results with a modelling approach. Several laboratory and field experiments measuring VOC exchanges have been carried out recently with different types of agricultural soils combined with varying temperature and soil moisture as well as different types of fertilization (exogenous organic matter, crop residues, etc.).

As a first step, he/she will focus on deriving emission factors for most emitted VOCs based on different soil types, physico-chemical parameters, organic matter content, management practices or other pertinent variables to be determined. He/she will use these emissions factors as well as functions describing their variability with temperature, soil moisture, pH etc. to construct a model allowing to predict VOC emissions from agricultural soils.

[1] Tang, J., Schurgers, G., & Rinnan, R. (2019). Process understanding of soil BVOC fluxes in natural ecosystems: a review. Reviews of Geophysics, 57(3), 966-986. https://doi.org/10.1029/2018RG000634

[2] Ortiz, A., Dory, M.; The estimation of non-methane VOC emissions from nature in Spain for CORINAR inventory. In: Proceedings of Workshop on International Emission Inventories, Regensburg, Norwegian Institute for Air Research, EMEP/CCC-Report 7/90, 1990.

[3] Anastasi, C., Hopkinson, L. and Simpson, V. J.: Natural hydrocarbon emissions in the United Kingdom, Atmospheric Environment. Part A. General Topics, 25(7), 1403–1408, doi:10.1016/0960-1686(91)90249-7, 1991.)

[4] (Pistikopoulos, P., Moussiopoulos, N. and Tsilingiridis, G.: Spatial Distribution and Temporal Variation of Biogenic Volatile Organic Compounds (VOC) from Greek Forests., pp. 179–88., 1993.

[5] Andreani-aksoyoglu, S. and Keller, J.: Estimates of monoterpene and isoprene emissions from the forests in Switzerland, Journal of Atmospheric Chemistry, 20(1), 71–87, doi:10.1007/BF01099919, 1995.

[6] Simpson, D., Guenther, A., Hewitt, C. N. and Steinbrecher, R.: Biogenic emissions in Europe: 1. Estimates and uncertainties, Journal of Geophysical Research, 100(D11), 22875, doi:10.1029/95JD02368, 1995.

As a second step, he/she will implement these formalisms within the MEGAN[7] model in collaboration with A. Guenther from the University of California – Irvine. The model will then be used with detailed and spatially explicit input data at the French scale to derive VOC emission maps for France.

A trip to Irvine - USA) (1-2 months) will be necessary to interact with project partners.

## Skills

Good knowledge in surface-atmosphere exchange of gases and/ or soil science, knowledge of agronomy, understanding of climate and impact sciences, interest and motivation in programming, demonstrated experience working with models.

- Dynamic and collaborative team player, autonomous, proactive and rigorous.
- Ability to effectively communicate with colleagues and with staff from the partners of a project
- Good English oral and written communication

## Working Environment

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, in plant and animal sciences, and is 11th in the world in ecology and environment.

ECOSYS Unit (Écologie fonctionnelle et écotoxicologie des agroécosystèmes) studies the mass, energy and pollutant exchange between the soil the plant and the atmosphere, using micrometeorological measurements techniques. The lab also develops research and applied models of soil emissions, turbulent transfer, stomatal exchange and surface interaction of pollutants. The lab is particularly interested in nitrogen compounds (ammonia, nitrogen oxides), ozone, VOCs and pesticides. The lab is strongly involved in European projects and has many links with other European laboratories. ECOSYS is located in the south of Paris with regular train connections to the center of Paris.

## Practical Information

Location: UMR ECOSYS - Université Paris-Saclay, located about 30 km from the heart of Paris

Contract duration: 14 months

Starting date: The position is available from September 2022 and will remain open until filled

Salary: 2100€ net/month 1 year after PhD completion (increasing with experience according to INRAE salary grid) with full social and health benefits

How to apply: Applicants should submit a complete application package by email. The application package should include (1) a curriculum vitae including the publications, (2) statement of motivation, (3) names, addresses, phone numbers, and email addresses of at least two references.

Contacts: Raia Silvia Massad (raia-silvia.massad@inrae.fr), Raluca Ciuraru (raluca.ciuraru@inrae.fr) and Benjamin Loubet (benjamin.loubet@inrae.fr).

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[7] Guenther, A. B., Jiang, X., Heald, C. L., Sakulyanontvittaya, T., Duhl, T., Emmons, L. K. and Wang, X.: The Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2.1): an extended and updated framework for modeling biogenic emissions, Geoscientific Model Development, 5(6), 1471–1492, doi:10.5194/gmd-5-1471-2012, 2012.