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Emissions of Volatile Organic Compounds (VOCs) from soil to the atmosphere according to agricultural land-uses. Interrelationships between SOM, microbial diversity and VOCs fluxes

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Emissions of Volatile Organic Compounds (VOCs) from soil to the atmosphere according to agricultural land-uses.

Interrelationships between SOM, microbial diversity and VOCs fluxes

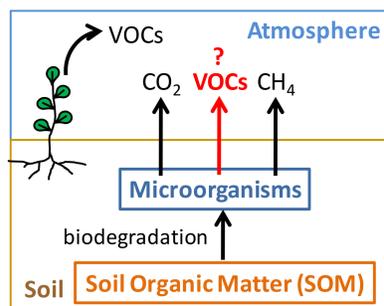
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CONTEXT

Soil microorganisms are key players in soil functioning. Indeed these organisms are responsible for the decomposition of Soil Organic Matters (SOM) and deliver nutrients readily accessible to plants. While the biodegradation of SOM releases CO₂ and CH₄ to the atmosphere, it has

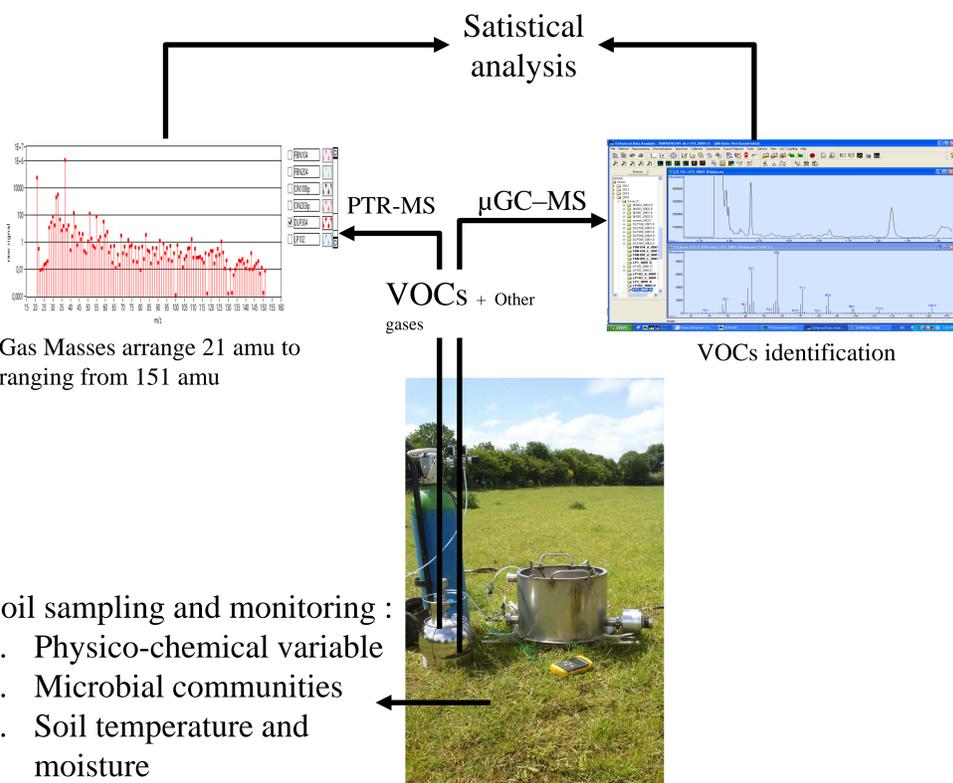


been recently shown that microbial SOM biodegradation generates Volatile Organic Compounds (VOCs) which take part in greenhouse gases and secondary organic aerosols production. The VOC emission rates from soil to atmosphere in agricultural landscapes are still poorly documented compared to CO₂ and CH₄ fluxes.

OBJECTIVES

- Determination of the VOC emission spectrum according to different agricultural land uses :**
 - Conventional cropping: Organic or Mineral Nitrogen fertilization
 - Meadows
- Understand the link between SOM, active soil microorganisms and VOCs and greenhouse gases (CO₂, N₂O, CH₄) emissions**

EXPERIMENTAL STRATEGY



Research in going

- Long term monitoring of *in situ* VOCs emission at the landscape scale
- Analysing the diversity of soil microbial communities (meta-barcoding)
- Analysing the reactive Soil Organic Matter (THM-GC-MS method)
- Explaining (SIP C¹³ RNA method) and predicting the VOCs emissions according to environmental and biological parameters (Multivariate analysis and lab incubations)

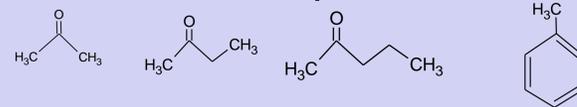
Reference

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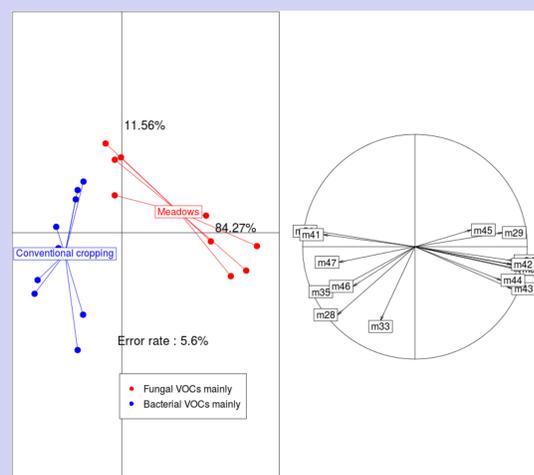
RESULTS: the main VOCs emitted by soil

Four main VOCs identified using μGC/MS and produced by soil :

Acetone, 2-butanone, 2-pentanone, toluene and Methanol



RESULTS: Effect of land uses on VOCs spectra



• Soil VOCs emissions **differed** between **meadows and conventional cropping**

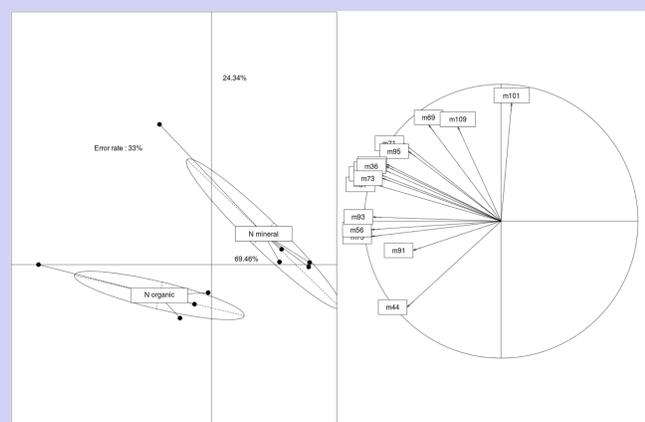
• Soil VOCs discriminants :

• **Meadows** : m73 (2-Butanone), m45 (acetaldehyde), m63 (dimethylsulfide) m77 (Carbon disulfide), m87 (alkane)
• **Mainly from Fungal**

• **Conventional cropping** : m28, m42, m109 (2,5 dimethylpyrazine)
• **Mainly from Bacterial**

Representation of the different land uses on the first two axes of the PLS-DA models based on VOCs spectra. Data obtained during April 2015.

Effect of Nitrogen fertilization on cropped soils

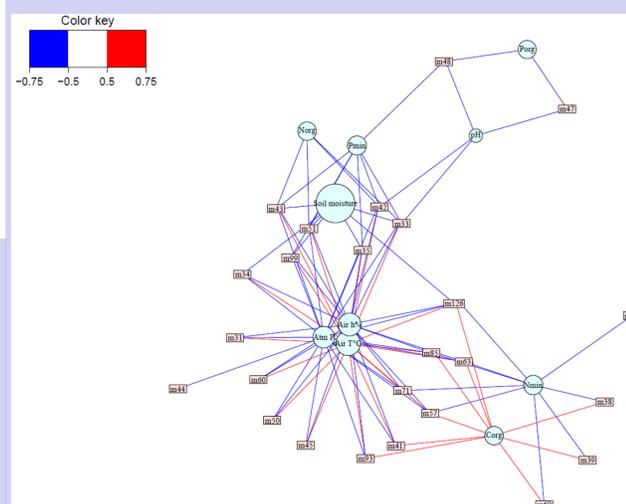


• **Different** VOCs emissions according to **Nitrogen Fertilization (Organic vs Mineral)**

• Soil VOCs discriminant: m56 (Propanenitrile), m93 (Toluene), m75 (1 or 2-butanol), m57

Representation of the different Nitrogen fertilization on the first two axes of the PLS-DA models based on VOCs spectra from soil. Data obtained during April 2015.

Interrelationships between soil VOCs emissions and Environmental parameters



• **Atmospheric parameters** (P, T, RH) drive **firstly** the emission of VOCs by **soil under cropped condition**

• **Soil moisture** is the **second main factor** related to soil VOCs emissions

• **Nutrients** are **less important factor** in this analyse to explain the VOCs emissions

Network of Soil VOCs emissions and Environmental parameters after a PLS 2. Data obtained during March 2015.