A NOVEL PLATFORM PROVIDING SERVICES IN THE MEASUREMENT OF AMMONIA VOLATILISATION FROM MULTIPLE AGRONOMIC PLOTS

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NITROGEN IS LOST THROUGH AMMONIA VOLATILISATION

- Tropospheric ammonia (NH_3) is a threat to the environment and human health
- NH_3 is mainly emitted by agriculture
- NH_3 volatilisation following application > 40% of the total NH_3 emissions in France
- NH_3 volatilisation is a major loss of nitrogen use efficiency
- Measuring ammonia emissions in agricultural fields is however a challenge for scientists
- A novel INRA-Transfer platform proposes a service for quantifying ammonia volatilisation in the field

A SERVICE TO EVALUATE AMMONIA VOLATILISATION IN THE FIELD

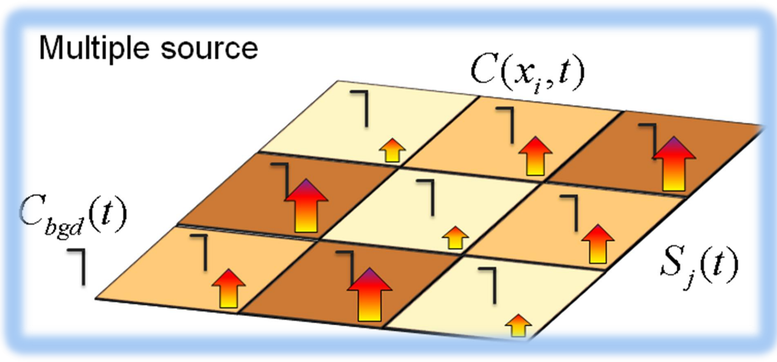
The methodology is based on well established inverse dispersion inference methodology (Flesch et al. 1995).
Our approach uses an Eulerian dispersion model (FIDES) validated for large fields with high frequency ammonia concentration measurements (Loubet et al., 2010).
The method was further developed to use low-cost ammonia diffusion samplers (ALPHA badges) and infer emissions from multiple agronomic plots.
The method was evaluated *in silico* (Loubet et al., 2018).

$$\overline{C(x_i)}^{\tau} = \overline{D_{i,j}}^{\tau} \times \overline{S_j}^{\tau} + \overline{C_{bgd}}^{\tau} + \overline{D'_{i,j} \times S'_j}^{\tau}$$

The equation used relates the concentration *C* at a location x_i to all the surrounding sources S_j using a transfer coefficient $D_{i,j}$ which is modelled with a dispersion model. C_{bgd} is the background concentration . The last term is a bias term accounting for the variability in time of the sources and transfer term.

PRACTICAL IMPLEMENTATION

ALPHA badges are placed on a mast in the middle of each plot.
Masts are placed at around 300 m away from the trial to capture background ammonia.
Geometry of plots is mapped using high precision GPS.
An ultrasonic anemometer is placed near the trial to characterise the turbulence
ALPHA badges are exposed with increasing durations up to few weeks to measure averaged NH_3 concentrations.



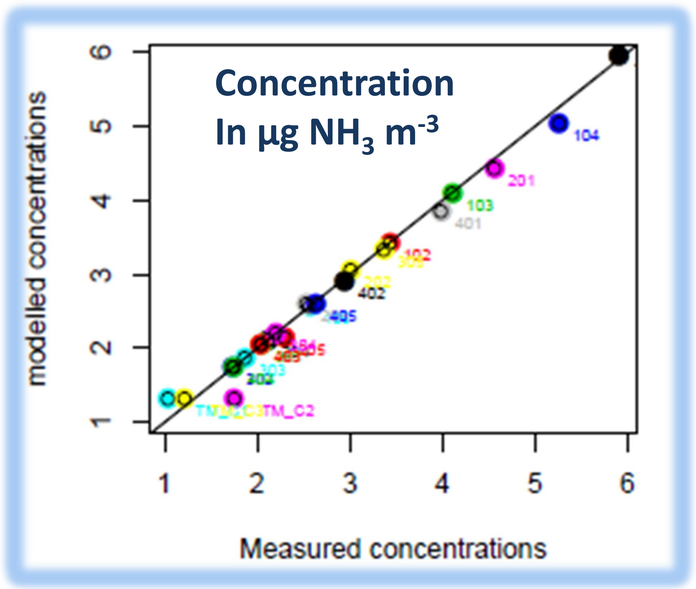
An example set up with 3 blocks x 3 repetitions and a background mast. C stands for concentration and S for source

Three ALPHA badges set up in the field under a rainshed

A ROBUST METHOD

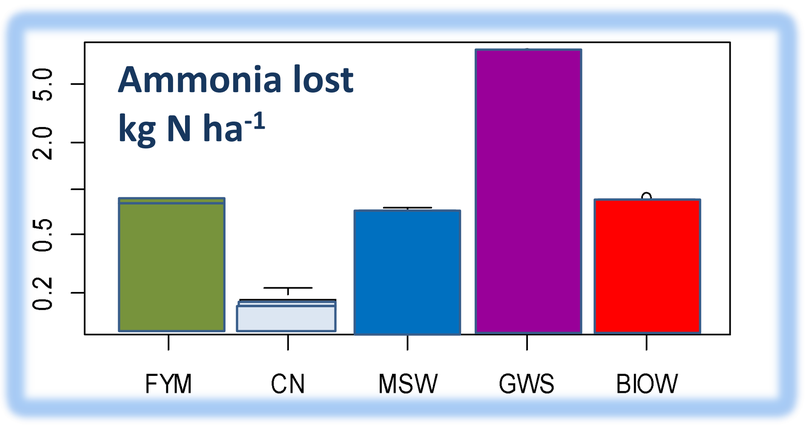
Method evaluation for single fields showed biases lower than 10% (Loubet et al. 2010).
For multiple fields, the method has a good reproducibility and a low bias (Loubet et al. 2018).

The emissions are inferred by optimising the difference between the measured concentration and the concentration modelled as in the above equation. The background concentration is also inferred. This graph shows the good quality of the modelled concentration over 20 plots following organic mater application in the SOERE PRO "Qualiagro"



The example result below shows a remarkable reproducibility of the inferred emission with confidence intervals (CI) lower than 5% of the median flux except for the control
6% to 30% of the N-NH_4^+ applied, and between 0.5% and 4% of the total N applied was lost

Map of the 20 plots (10 x 45 m)



Nitrogen lost as ammonia for FYM: farmyard manure, CN: control without organic inputs, MSW: Municipal solid waste, GWS: Green waste and sludge and BIOW: Bio-waste.

References

Flesch, T. K., Wilson, J. D., and Yee, E.: Backward-Time Lagrangian Stochastic Dispersion Models and Their Application to Estimate Gaseous Emissions, J. Appl. Meteorol., 34, 1320-1332, 1995.
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A NEW SERVICE OPEN FOR OPTIMISING PRACTICES AND FERTILISERS USE

This new service from INRA-Transfer will help designing your experiments, set up and make the measurements, analyse the results and provide a full report For any information please contact Marco.Carozzi@inra.fr

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