Adapting the measurement methods to the different purposes

Paul Robin, Mélynda Hassouna

► To cite this version:

Paul Robin, Mélynda Hassouna. Adapting the measurement methods to the different purposes. ACS Fall 2020 Virtual Meeting - Symposium on Animal agriculture emission measurement technologies, Kyoung S Ro (USDA); Mélynda Hassouna (INRAE), Aug 2020, San Fransisco, United States. 10.1021/scimeetings.0c07421 . hal-03324203

HAL Id: hal-03324203

<https://hal.inrae.fr/hal-03324203>

Submitted on 23 Aug 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

➤ Adapting the measurement methods to the different purposes

Mélynda Hassouna, Paul Robin
INRAe-UMR SAS-FRANCE

➤ GHG emissions in animal systems

Different gases from various sources

➤ Specificities of agricultural emissions

≠

FUGITIVE
Diffuse

CHANELED

Animal species, genetics, climate,
manure management, farmers
practices....

HIGH DIVERSITY

INRAE

Adapting the measurement methods to the different
ACS Fall 2020 Virtual Meeting & Expo, August 17-19

> Why quantifying agricultural emissions?

-> **MITIGATION**

Certification of mitigation techniques and emission levels (regulation)

Environmental assessment

Emission Factors (GHG, NH₃, PM)

Inventories

Scientific needs

Figure 1. Ammonia emissions, EU-28, 2013 (% of total ammonia emissions).

Source: European Environment Agency

INRAE

Adapting the measurement methods to the different purposes
ACS Fall 2020 Virtual Meeting & Expo, August 17-20, 2020/ Hassouna

➤ Different methods adapted to the emission source

➤ Different kind of measurement objectives with various constraints

R

❑ Scientific research → Continuous and accurate

e

I

❑ Pollution abatement → Adapted level of accuracy with standard protocol

i

❑ Policy-making : national inventories, certification of mitigation techniques → Easy to implement, low cost

a

b

I

e

➤ Different kinds of objectives with many possible constraints

➤ 3 kinds of measurement methodology

Reference methods

Continuous measurement

Studies of emitting processes

Scientists

Simplified Methods

Intermittent measurement + models

Low-cost methods

Efficiency of mitigation options and environmental certification

Emission-factor acquisition

Scientists, agricultural engineers, monitoring and certification offices

Control methods

Intermittent measurement

Low-cost methods

Emission levels checking

Agricultural engineers, monitoring and certification offices and livestock technicians, farmers

Accuracy, Cost

➤ Reference methods

Gas concentrations : NH_3 , N_2O , CO_2 , CH_4 , SF_6

$\text{SF}_6 \rightarrow$ Air flow rate

Gas emissions

INRAE

Adapting the measurement methods to the different purposes
ACS Fall 2020 Virtual Meeting & Expo, August 17-20, 2020/ Hassouna

➤ Reference methods

Continuous measurement of ER

Implementation in experimental facilities

Implementation in commercial conditions

Accuracy

INRAE

Adapting the measurement methods to the different purposes
ACS Fall 2020 Virtual Meeting & Expo, August 17-20, 2020/ Hassouna

➤ Simplified methods

➤ Example : Ratio of concentration gradients and Carbon mass balance

Spot
measurement of
gas
concentrations

Convective transport ➡

$$\frac{E_{C-CO_2}}{E_{C-CH_4}} = \frac{\text{grad}_{C-CO_2}}{\text{grad}_{C-CH_4}}$$
$$\frac{E_{N-NH_3}}{E_{C-CO_2}} = \frac{\text{grad}_{N-NH_3}}{\text{grad}_{C-CO_2}}$$

Livestock Data

Mass budget ➡

$$E_{C-CO_2} + E_{C-CH_4} = C_{\text{Loss}}$$

$$C_{\text{Loss}} = C_{\text{inputs}} (\text{feed, pigs}) - C_{\text{outputs}} (\text{manure, pigs})$$

Emission
estimates

$$\rightarrow E_{C-CO_2} = C_{\text{Loss}} / [1 + (\text{grad}_{C-CH_4} / \text{grad}_{C-CO_2})]$$

$$\rightarrow E_{C-CH_4} = E_{C-CO_2} * (\text{grad}_{C-CH_4} / \text{grad}_{C-CO_2})$$

$$\rightarrow E_{N-NH_3} = E_{C-CO_2} * (\text{grad}_{N-NH_3} / \text{grad}_{C-CO_2})$$

$$\rightarrow E_{N-N_2O} = E_{C-CO_2} * (\text{grad}_{N-N_2O} / \text{grad}_{C-CO_2})$$

➤ Simplified method

+ Zootechnical data

Implemented in 40 commercial pig houses to quantify EF
Still goes on

Measurement methods to the different purposes
Annual Meeting & Expo, August 17-20, 2020/ Hassouna

➤ Simplified method

Dairy barns

Solid
Manure
Slurry

Time spent in the barn

➤ Control method

- broiler batch, December 2008, France
- CO₂ and NH₃ $\pm$ proportional per period
- CO₂ and NH₃ depend on growth, stocking density, manure management

➡ grad CO₂ / grad NH₃ characterizes one period

➤ What are the future challenges

- Keep on working on the validation of simplified methods and control methods
- Standard protocols for measurement but also for uncertainty assessment and sensors calibration
- Guidelines for data reporting

To be more efficient, we should join our forces in an international network on measurement of agricultural gas emissions

INRAE

Adapting the measurement methods to the different purposes
ACS Fall 2020 Virtual Meeting & Expo, August 17-20, 2020/ Hassouna

More information

Protocols :

https://www6.inra.fr/animal_emissions/ADEME-Metrologie

Book Free download

https://www6.inra.fr/animal_emissions_eng/News/Measuring-gaseous-emissions-from-animal-farms

INRAE

Adapting the measurement methods to the different purposes
ACS Fall 2020 Virtual Meeting & Expo, August 17-20, 2020/ Hassouna

Thanks for your attention
and your questions !

Contact :

melynda.hassouna@inrae.fr

[Paul. robin@inrae.fr](mailto:Paul.robin@inrae.fr)

INRAE

Adapting the measurement methods to the different pu
ACS Fall 2020 Virtual Meeting & Expo, August 17-20, 2020/ Hassouna