

Project Newsletter

Autumn 2024

Project updates and activities
Meet more partners



Welcome to the 4th newsletter!

This newsletter contains a summary of the special session held at the 14th International Conference on Air Quality, other conference presentations and we introduce the remaining members of the consortium.

Date for the diary:

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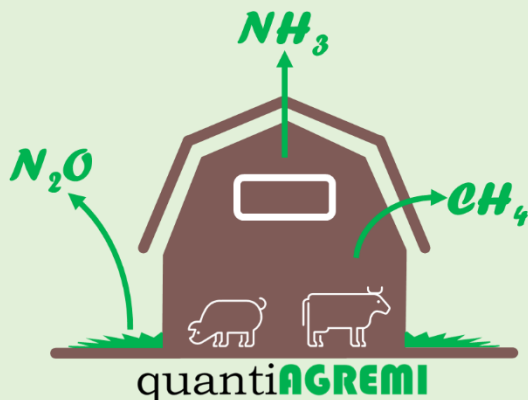
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The project has received funding from the European Partnership on Metrology, co-financed from the European Union's Horizon Europe Research and Innovation Programme and by the Participating States.

METROLOGY
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Project updates and activities

Special session at the 14th International Conference on Air Quality (14th to 17th May 2024, Kumpula, Helsinki)

A special session concerning the **quantiAGREMI** project was held during the International Conference on Air Quality in May 2024. The session included eight presentations from a number of project partners across the technical work packages.

PTB presented on an optical gas standard (OGS) for ammonia amount fraction measurements consisting of a laser spectrometer that can provide amount of substance fractions (i.e. concentrations) that are directly traceable to the SI. Their results showed that the NH₃-OGS spectrometer could measure high concentrations (>400 ppb) and had good linearity up to about 25 ppm, concentrations expected within livestock housing.

Ammonia detection was also the focus of the presentation from Picarro who demonstrated the performance of their new PI2103 NH₃ analyzer based on cavity ring-down spectroscopy (CRDS) for single-species measurements as well as their G2509 analyzer that can also measure other greenhouse gases including CO₂, CH₄ and N₂O.

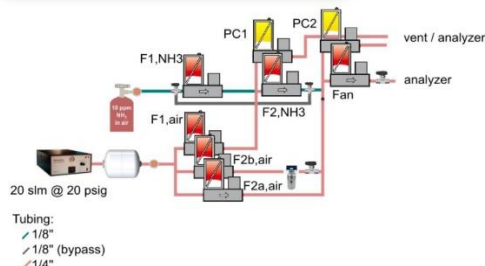
The final presentation from WP1 was from METAS who showed the three SI-traceable ammonia reference gas generators developed within the project:



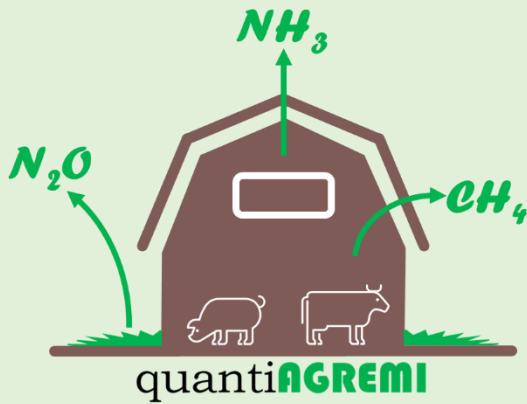
VTT's dynamic gas generator that uses liquid evaporation to generate wet reference gases;



METAS's ReGaS-3 permeation-based generator



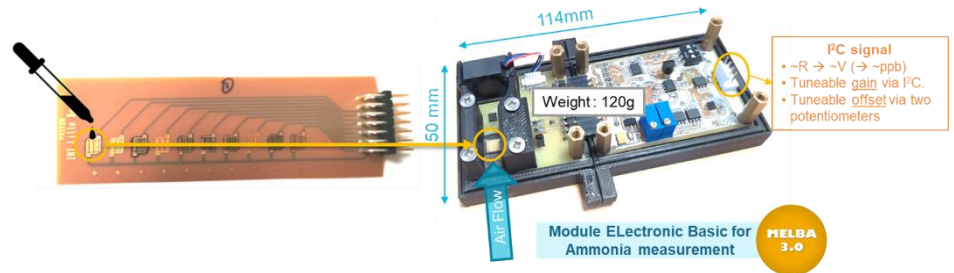
VSL's dynamic dilution system.



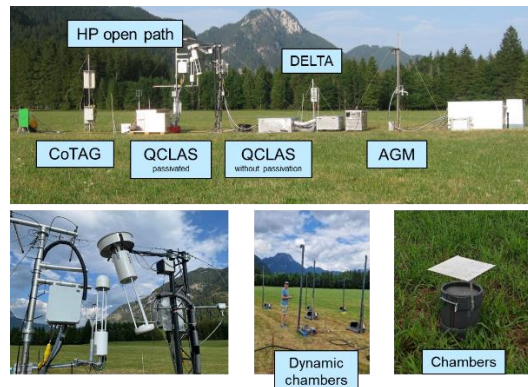
There were two presentations from WP2, the first from Sensair describing their highly compact NDIR gas sensor prototype, so called K96, offering the multi-gas capability and the sub-ppm resolution as main breakthrough features. Targeting the GHG monitoring and designed for mass production, the K96 addresses the need for low-cost, robust, and reliable sensing solutions to monitor CO_2 , CH_4 and N_2O concentrations, to detect hot spot and hot moment emissions, and eventually to facilitate a comprehensive assessment of specific GHG emitters from the industry (O&G, waste sectors) and from the agriculture (livestock).

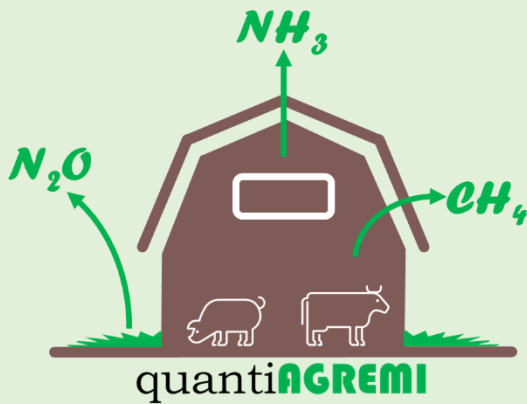


IMT also presented on their sensitive surface that reacts with NH_3 to induce a change in conductivity inside the material and consequent change in resistance that can be measured when ammonia is present. Under controlled laboratory conditions, this sensor achieved good linearity and accuracy.



From WP3, TI presented the results of the ammonia flux measurements highlighted in the last newsletter. A number of different sensors and analytical techniques were compared to measure fluxes from both ammonia release experiments and the application of slurry. A strong diurnal variability and the influence of wind direction were uncovered; methods based on eddy covariance (EC) appeared to underestimate the flux; massive emission peaks were found after slurry application, with low-level emission fluxes in EC methods still visible after 5 to 6 days; and fluxes by dynamic chambers are underestimated and affected by temperature fluctuations, but match well with EC fluxes after correction.





The final talk in the special session was from EMPA concerning the characterisation and validation of N_2O isotope ratio measurements using CRDS. While the calibration and correction strategy has been fully established, there are still on-going field experiments to complete.

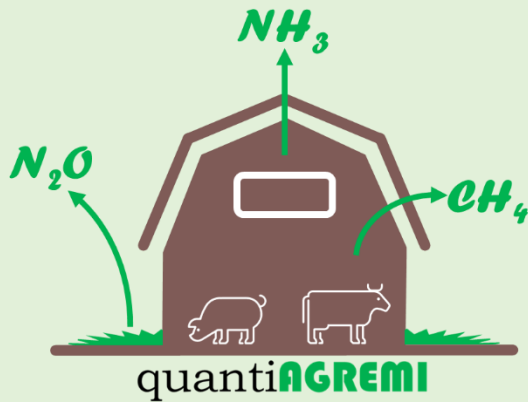
International Symposium on Gas and Dust Emissions from Livestock (EmLi, 24th to 26th September 2024, Valencia, Spain)

INRAE presented a poster concerning improvements to the “simplified method” for estimation of greenhouse gas and ammonia emissions in open livestock buildings. In this so-called “Simplified Method”, the CO_2 and other target gas concentrations are measured to calculate the gas gradients (between indoor and outdoor). The mass balance approach based on a farm questionnaire is used to track the organic carbon entering and leaving the barn. The results of the questionnaire are also used to characterize the farm diversity and for data quality assessments. Control quality is the first step of this method: a screening protocol based on indicators evaluate the reliability level of gas measurements and possible inconsistencies during data collection.

The second step is to merge all on-farm data (gas measurements and farm questionnaire) using a three tiers approach:

- Level 1: only gas concentrations are used. Calculation of the mass budget is based on a generic dataset (reference data relevant for the cattle farm category) with a maximal uncertainty.
- Level 2: in addition to gas concentrations observed during several seasons, specific data from the questionnaire are considered reliable and used to decrease uncertainty in estimated house emission factors.
- Level 3: using measured input-output data (quantities and qualities of feed, litter, milk and manure) and repeated gas concentration measurements, a confirmed distribution of emission factors can be calculated. This level of detail can be found with complementary studies or with work done in experimental farms requiring to spend more time.

In the last step, results are displayed as a “signature of the farm” showing the distribution of emission factors in classes around the national emission factors, for the specific housing and compared to all observed farms serving as a “reference distribution”



Meet the Consortium

In this newsletter, we introduce the last of the project partners within the **quantiAGREMI** project.

INRAE

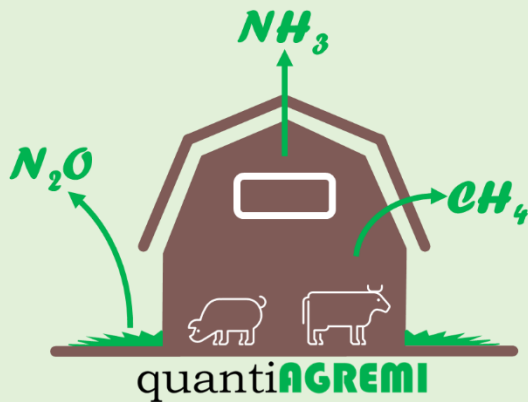
The National Research Institute for Agriculture, Food and Environment is a French national public scientific research institution under the dual aegis of the Ministry of Research and the Ministry of Agriculture. This institute is a community of 13,000 people allocated in 250 laboratories including 45 experimental units. The Joint Research Unit Soil, Agro- and Hydro-systems, spatialization (INRA UMR SAS in Rennes) includes scientists of INRAE, professors and assistant professors of AGROCAMPUS OUEST which is a public university-level college, for life and environmental sciences and technologies. They study together the interactions between agriculture and the environment using an integrative and spatialized approach of rural areas and transfer knowledge to MSc and PhD students, professionals in agriculture and stakeholders .

Within **quantiAGREMI** WP1, INRAE have been providing a fit-for-purpose bench to generate gas mixtures with a controlled level of moisture and dry gas mixtures containing CH_4 , NH_3 , CO_2 and N_2O from cylinders. The device has been characterized and SI-traceability ensured. A number of experiments have also been taking place at INRAE's experimental facility within WP1. INRAE are also participating in WP2 by helping plan and interpret experiments and in particular, testing a simplified method for the assessment of emission factors in a dairy barn.

LUKE

Luke, Natural Resources Institute Finland is the leading research organization for agriculture, forestry, game, and fisheries in Finland. It operates under the Ministry of Agriculture and Forestry in 12 different research locations across Finland. Luke develops solutions for sustainable food production, bioeconomy, and emission mitigation. It operates own research farms with one of those currently building a new state-of-the-art dairy barn which can be used as a base for emission measurements in this project. Luke has in-depth expertise in livestock production including the entire production chain from plants and animals to housing technologies, manure management, and nutrient and carbon-recycling solutions back to field soil. Luke is also nationally responsible for the agricultural GHG inventory and provides the necessary background data for gaseous nitrogen emission inventory (air quality).

In this project, Luke serves as an expert on livestock production, housing technologies, manure management, and emission measurement, mitigation and modelling within **quantiAGREMI** WP2.



Thünen Institute

The Johann Heinrich von Thünen Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries under the auspices of the German Ministry of Food and Agriculture (BMEL) – Thünen Institute in brief – consists of 14 specialized institutes that carry out research and provide policy advice in the fields of economy, ecology and technology.

They develop scientific basics through their own research to facilitate decision-making processes for the German government. The institute carries out long-term monitoring activities allowing for robust statistical data series and represents German interests in international scientific commissions and bodies. Results flow into guidelines and standards as well as into regulations and legislation. Their work contributes to securing the sustainable use of natural resources, serves economic development, and ensures the quality of life for our society.

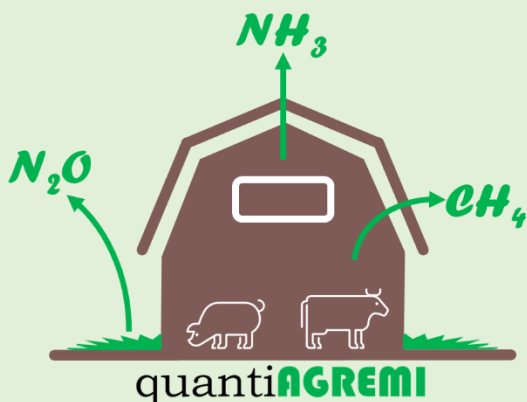
The main scope of the Institute of Climate-Smart Agriculture is on the annual calculation of the national emission inventory of greenhouse gases and air pollutants from agriculture. The inventory constitutes a scientific stock-taking where sources and sinks are quantified together with an identification of critical hot spot regions and an analysis of underlying processes. Further fields of activities are the measurement and modelling of greenhouse gases that are produced and released from agriculture, soil organic carbon studies, ammonia emissions, climate relevance of production systems, and climate change mitigation measures.

Thünen Institute will provide equipment to carry out NH_3 flux work in **quantiAGREMI** WP3.

UKCEH

The UK Centre for Ecology & Hydrology is a leading independent research institute dedicated to understanding and transforming how we interact with the natural world. They have over 600 researchers and tackle urgent environmental challenges such as climate change, pollution, and biodiversity loss. For over 60 years, UKCEH and its predecessor institutes have been at the forefront of environmental monitoring and modelling. They have been actively involved in the development and application of flux measurements of NH_3 and greenhouse gases including N_2O .

UKCEH have provided equipment to carry out NH_3 flux work in **quantiAGREMI** WP3. UKCEH have also led the use of low cost sensors, alongside the high temporal resolution flux measurements, to determine the NH_3 deposition footprint around a naturally ventilated livestock housing. This activity is being carried out at the livestock housing during the emission comparison study, where emissions will have been quantified.



Agroscope

Agroscope is the Swiss centre of excellence for agricultural research, and is affiliated with the Federal Office for Agriculture (FOAG). Agroscope and FOAG are subordinate to the Eidgenoessisches Departement fuer Wirtschaft, Bildung und Forschung WBF. Agroscope makes an important contribution to a sustainable agriculture and food sector as well as to an intact environment, thereby contributing to an improved quality of life. Agroscope researches along the entire value chain of the agriculture and the food sector. Its goals are a competitive and multifunctional agricultural sector, high-quality food for a healthy diet, and an intact environment. Agroscope is characterised by its combination of research, policy advice, enforcement, knowledge exchange and technology transfer, as well as by its coupling of application-oriented basic research and practical relevance.

The Ruminant Research Unit has longstanding experience in emission measurements from naturally ventilated livestock housings using an external tracer ratio method (entire housing level) as well as from individual cow level using GreenFeed systems. Agroscope's experimental dairy housing for emissions measurements allows comparable emissions measurements in two identical but separate compartments.

Within the **quantiAGREMI** project, Agroscope are involved in WP1 where they have been providing experimental facilities where livestock emissions measurement can be compared between devices.

EMPA

The Swiss Federal Laboratories for Materials Science and Technology (EMPA) is an interdisciplinary research institute of the ETH Domain, conducting cutting-edge materials and technology research. The Emissions and Isotopes group, have experience in developing and applying advanced sample preparation and analytical techniques for the analysis and interpretation of gaseous emissions from diverse, point or diffuse, natural or anthropogenic source processes. They were the first to develop an OIRS technique to analyse nitrous oxide and methane isotopic species with high precision and accuracy. In recent years, the group extended the activities towards the analysis of very rare, doubly substituted, so-called clumped isotopic species of nitrous oxide and methane.

EMPA will contribute to WP1 and WP2 of **quantiAGREMI** with its experience in emission quantification for diffuse sources. A particular focus will be given to WP3, where EMPA will develop an OIRS technique for N_2O isotope analysis and apply it to differentiate source processes and validate a biogeochemical soil model in collaboration with KIT.