

STSM Report

Improving the estimation of methane emissions and mitigation potentials

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Introduction

The body of peer-reviewed papers on enteric methane mitigation strategies in ruminants is rapidly growing and allows for better estimation of the true effect of each strategy through the use of meta-analysis methods. However, the great diversity in methane measurement techniques makes meta-analysis of published results challenging. There is therefore a need to find strategies to harmonise these measurements across studies and across animal and production systems in order to better understand the potential effectiveness of different mitigation options. The collection of data on methane, feed nutrient and animal production is requested in order to evaluate the relationship between methane and mitigating strategies, as well as the effect of moderators (e.g.: level of intake, nature or type of the basal diet etc...) on the previous relationship.

At Aberystwyth University, we have recently developed the MitiGate on-line database (<http://mitigate.ibers.aber.ac.uk/>) as a tool for quantitative estimation of mitigation potentials under varying animal production systems. Colleagues at INRA UMRH have been working on similar issues, using different meta-analysis approaches. The focus of the METHAGENE network includes harmonisation and improvements of protocols for future collection of data on methane emissions in ruminants, sharing of the data and is particularly relevant for the accurate quantification of methane mitigation potentials. In particular, the METHAGENE COST action aims to discuss and agree on 1) protocols to harmonise large-scale methane measurements using different techniques; 2) easy to record and inexpensive proxies for methane emissions to be used for genetic evaluations; and 3) approaches for incorporating methane emissions into national breeding strategies. An important aspect of this work will be to merge data from very different techniques and measurement strategies, develop systems for database management and strategies for data analysis. The STSM will address these issues with particular focus on the measurement and quantification of methane mitigation strategies.

The aims of this visit/exchange are to initiate a longer term collaboration which will

1. expand the available data by merging our existing databases
2. improve methods for evaluation of mitigation potentials to include aspects of productivity
3. address challenges of scaling up studies from animal to farm scale and
4. develop methods for quantification of uncertainties at different scales

Progress made

The five day STSM visit to INRA has been a great success for both partners, with interesting discussions around methodology and data availability with several relevant colleagues at INRA (Diego Morgavi, Pierre Nozière, Cécile Martin and Maguy Eugène). This visit forms the start of a longer term collaboration, which will continue over the next 12 months.

The visit gave us an opportunity to discuss in detail the two methods used for meta-analysis at INRA and Aberystwyth, and to explore the differences and similarities in approach. It is clear that the statistical models used are not very different in principle, however, the analysis is based on different input data to explore different questions. At Aberystwyth, we use the ratio of means and its variance for each study to explore the average mean effect of a treatment across all relevant studies. INRA, on the other hand, uses generalized linear models on the original data (control and treatment means) to explore relationships between continuous variables. In both methods, residual heterogeneity is explored through the identification of explanatory variables or moderators. We would like to explore these differences further by using a joint database for model comparison. This model comparison, initiated during the STSM exchange, will be the focus of a collaboration to continue over the next 12 months.

The contents of the available databases at the two institutes were compared to clarify the complementarity of available information. There is much overlap between them, as both institutes use available published data as the primary input. Differences exist in the level of detail included in the databases, and this is an area where further cooperation can be very useful for both partners. The MitiGate database hosted at IBERS has been more recently updated, and contains a wider range of mitigation options. The INRA databases, on the other hand, include more detail on production outcomes and feed characteristics which can be very useful in exploring potential explanatory variables or moderators. The next step in the collaboration will therefore be to explore mechanisms for bringing the two databases together, to form a new and much more complete database for our model comparison exercise and for future meta-analysis efforts.

Future plans

Finally, the week afforded an opportunity to plan the next steps in our continued collaboration and prepare a more detailed work plan for the next 12 months. The first step will be to form a consortium agreement between the two partners, where we agree on the accessibility of data for the shared database. Also within the next month, we will advertise for 3 studentships. These students will be engaged to complete the meta-analysis and uncertainty analysis, with one student based at INRA using the INRA method and one student based at Aberystwyth using the Aberystwyth method. A third student will work with informaticians at INRA to develop the on-line stakeholder tool. The attached chart illustrates the intended tasks and work-plan for the project.

Agenda for next exchange – January 2015

The partner based at INRA, Dr. Maguy Eugène, will visit Aberystwyth for one week in January 2015. During this second exchange, we intend to discuss two topics in particular:

1. Methods of uncertainty analysis: We will discuss methods appropriate for the two meta-analysis approaches used. The intention is to develop a method which conforms to the recommendations set out by the IPCC.
2. Identification of stakeholders for the web-tool: This discussion will be used to inform the development of the on-line stakeholder tool and the visual illustration of meta-analysis and uncertainty analysis outcomes.