

4.2 - Improved N₂O Component Modelling

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Most models of soil C and N cycling include process descriptions or equations representing denitrification and some of those process descriptions include the partitioning of denitrification between N₂O and N₂. All of the models have strengths and weaknesses in different areas:

- some are highly explanatory but suffer from the inclusion of processes that are impossible to model quantitatively in a robust manner;
- some have empirical partitioning between N₂O and N₂ that might not hold for all the required physical and chemical conditions that the model is to be applied in but have well developed and tested descriptions for the supporting soil processes; and
- most of the models do not account for the spatially heterogeneous return of urine to pastures or for the effects of the urine patches on denitrification.

This theme of work will:

- review the component models in the literature and chose the best candidate(s) for further development and testing (Milestone 4.2.1);
- source published datasets for model development and validation and seek collaboration with concurrent work funded by the NZAGRC to ensure that the improved model will represent the best emerging knowledge (Milestone 4.2.2);
- improve the N₂O components of the model(s) chosen and test the improvements using the identified datasets (Milestone 4.2.3); and
- link the N₂O and CH₄ components into farm system model(s) to test mitigation opportunities at a systems level (Milestone 4.2.4).

4.2 – Progress in 2009/2010

Val Snow was invited to attend a planning meeting for the N₂O programme organised by Drs de Klein and Di. The purpose of this invitation was to ensure good coordination between the experimental and process understanding work in the N₂O programme and the model development and testing work in Theme 4. Particularly interesting prospects for leveraging the two programmes were identified and collaborative work will be planned as the work streams progress.

Val Snow and Cecile de Klein visited Peter Thorburn and Jodi Biggs, CSIRO Sustainable Ecosystems in Brisbane, to discuss collaboration possibilities. Common interests were identified. CSIRO will make available a recent adaptation to the soil C-N module in APSIM that has adapted and incorporated the

denitrification process descriptions in DayCent that allows the prediction of both total and N₂O denitrification. A return visit is planned for July 2010.

Rogério Cichota began updating the Tussock Creek modelling database (developed as part of the P21 Environment programme but included data relevant to leaching only) with N₂O data in anticipation that this will provide an important dataset for model testing.

Iris Vogeler and Val Snow met with Donna Giltrap to plan the model review and to discuss the N₂O database that Donna has been developing. Preliminary work on the review has been completed by identifying existing reviews focussing on denitrification, soil nutrient modelling and farm systems modelling.

4.2 – Progress in 2010/2011

A dataset of 150 different combinations of measurements from a range of NZ climates, soils and soil drainage classes, periods, from dairying and sheep and beef on flat and hill country has been compiled. Existing datasets for N₂O model development and testing model review have been compiled. The database will regularly be updated to include new data when available. A report on the “Datasets for N₂O modelling” has been written.

A number of different N₂O component models, identified in the internal report on “N₂O model review and selection of appropriate models” have been integrated into the APSIM modelling framework and are currently being tested against the experimental dataset for their ability to simulate N cycling of the soil, which is essential for accurate predictions of N₂O emissions.

A comparison of two different modelling approaches for simulating N cycling in soils, DNDC and APSIM, has been undertaken in detail and the results will be presented at the Modsim conference in Perth, Dec 2011.

DISCLAIMER: This report has not been peer reviewed and reports interim results only. Therefore, it may be subject to change.