The use of long-term modelling in analysing N_2O abatement strategies in dairy pastures

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Introduction Concerns about the environmental impact of nitrogen (N) losses in Australia, in particular, nitrous oxide emissions are related to the rapid increase in N application on dairy pastures. Computer modelling is the most suitable method available to assess the potential of best management practices (BMP) to reduce field losses, as direct field measurements are frequently limited by the short term nature of many field trials.

Materials and methods DairyMod is a biophysical model (Johnson *et al*., *2003)* focussing on pasture and cropping systems, and associated greenhouse gas emissions. The model incorporates the principal rotational grazing management strategies that are used in Australia, including modules for pasture growth and utilisation by grazing animals, animal metabolism including milk production, water and nutrient dynamics, and management strategies for fertiliser, irrigation and grazing. The output includes daily and annual estimates for all the principal fluxes in the system, including methane and nitrous oxide. DairyMod was parameterised using data from an experimental site where N losses were measured for 3 years from grass/clover pastures grazed by dairy cows, receiving either 0 (0N) or 200 kg N/ha (200N) as urea (Eckard *et al.,* 2003). A 42 year historical simulation was conducted using long-term climate data for the location.

Results Mean measured N_2O emissions for the 3 years of the field experiment were 4.6 and 7.2 kg N_2O/ha for the 0N and 200N rates, respectively, close to the 42-year modelled means of 2.9 and 7.5 kg N_2O/ha. However, over the 42-year simulation, predicted N_2O emissions ranged between 0.1 and 7.4 kg N_2O/ha for the 0N rate, and 1.5 to 14.4 kg N_2O/ha for the 200N rate (Figure 1). If the field experiments were run from 1959 to 1961 mean N_2O emissions could have been 0.2 (0N) or 1.9 (200N) kg N_2O/ha.y; perhaps insufficient to justify a targeted abatement strategy. However, mean N_2O emissions between 1978 and 1980 were 3.5 (0N) or 9.6 (200N) kg N_2O/ha, justifying the development of BMPs aimed at reducing annual N inputs.

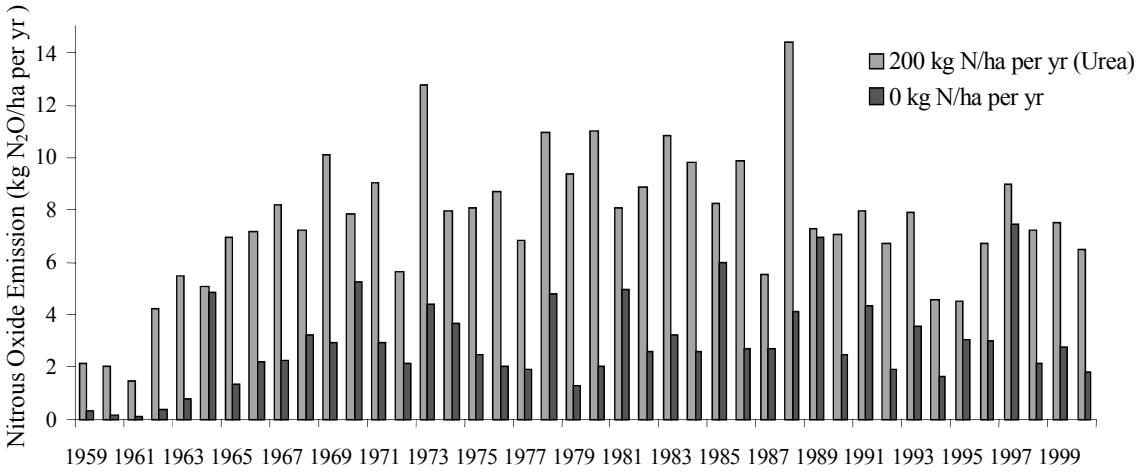

Figure 3 Annual total of N_2O emissions from a grazed dairy pasture with or without 200 kg N/ha

Conclusions Simulation modelling is an essential tool in evaluating the longer-term impacts of BMPs developed from short-term field experiments, particularly for highly variable processes like N_2O emissions.

References

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