Nitrogen cycling and N_2O emissions in FullCAM

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Introduction

FullCAM is used to construct Australia's national greenhouse gas (GHG) account for the land sector (Richards 2001). FullCAM integrates a suite of models to estimate and predict biomass, litter and soil carbon pools in forest and agricultural systems. An 'N cycling and N_2O emissions module' is being assembled for FullCAM with the goal of improving on the current emissions factor methodology.

Module description

- When FullCAM was constructed a limited N cycling capability was included. By maintaining the C/N ratios of the component pools of soil organic matter, rates of N mineralisation and immobilisation could be predicted. However, an inability to selectively track ammonium and nitrate N made predictions of N_2O emission difficult.
- In the new module, ammonium and nitrate N dynamics are modeled using functions based on NGAS from the Century model (Parton et al. 1996; 2001). This allows rates of nitrification and denitrification and associated emissions of N_2O to be estimated (red items in Figure 1).
- Modifications to the top soil moisture deficit in FullCAM were required to track nitrate leaching and drive existing nitrification and denitrification functions using a parameter similar to water filled pore space.
- Plant N uptake will be derived from dry matter production algorithms that are the subject of ongoing development.
- FullCAM will be moved to a daily time-step due to the dynamic nature of N cycling.

Table 1: Description of inputs for the N cycling and N_2O emissions module.

Input	Description
Temp	Soil temperature at depth (function of air temperature)
W	Soil water (modified top soil moisture deficit)
pH	Soil pH
CO2	Soil C mineralisation from FullCAM (proxy for available C and biological oxygen demand)
Net_{Min}	Net N mineralisation from FullCAM
K1	Proportion of net mineralised N that is immediately nitrified
Kmax	Maximum amount of NH_4 that can be nitrified in one day
K2	Proportion of nitrified N emitted as N_2O

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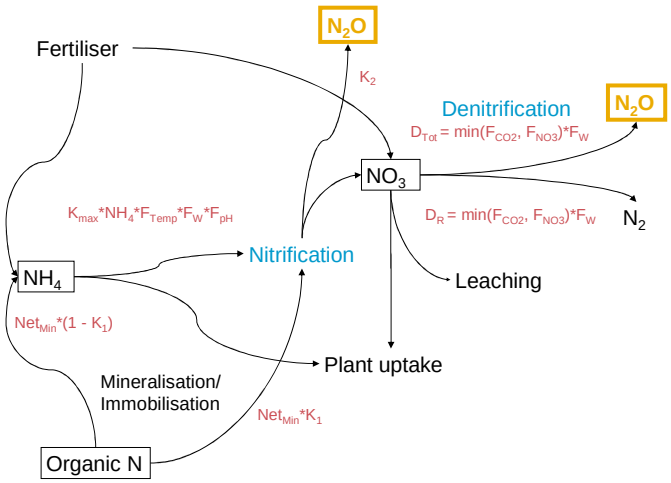

Figure 1: Processes and products in the N cycling and N_2O module.

Current and future activities

- Preliminary testing of an uncalibrated version of the new 'N-cycling and N_2O emissions module' (parameterised with default values from the literature) indicated that the module provides reasonable estimates soil nitrate and nitrous oxide emissions (Figure 2).
- A sensitivity analysis followed by systematic calibration is currently being completed. Applicability to different production systems will be defined using the Australian field data.

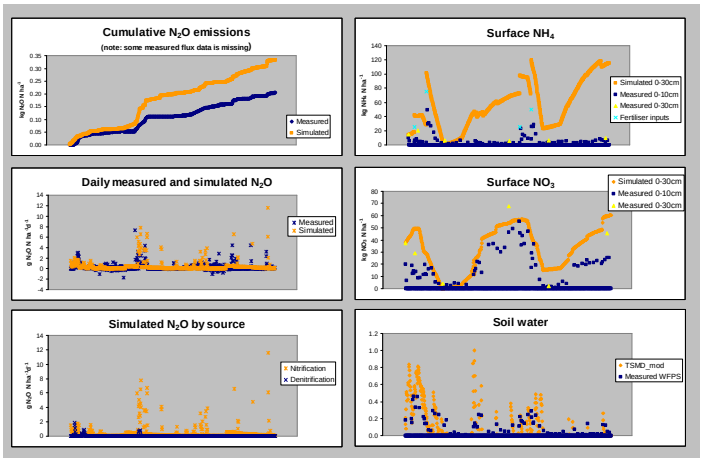

Figure 2: Preliminary simulation (uncalibrated using default values from the literature) of N_2O emissions from wheat at Cunderdin, Western Australia. (Barton *et al*. 2008).

References

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