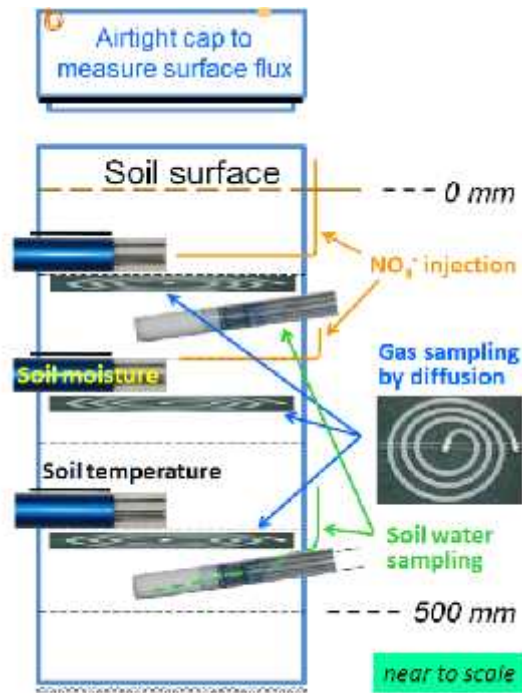


Drainage losses of N_2O and NO_3^-
in Ferralsol
is a major N-loss pathway

by

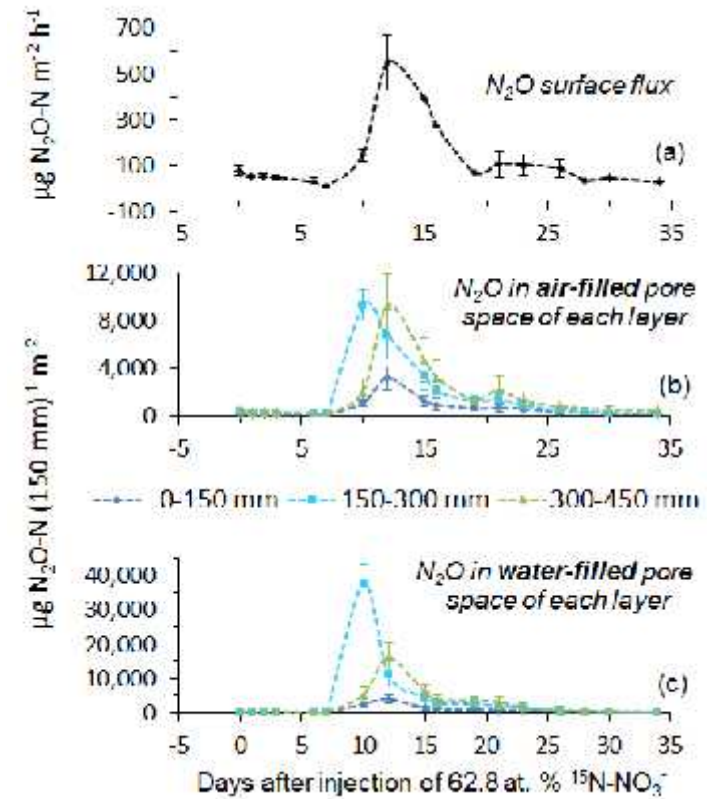
Peter Quin, Lukas van Zwieten, Peter Grace,
Lynne Macdonald, Annette Cowie, Dirk Erler,
Iain Young and Stephen Kimber

N₂O from denitrification



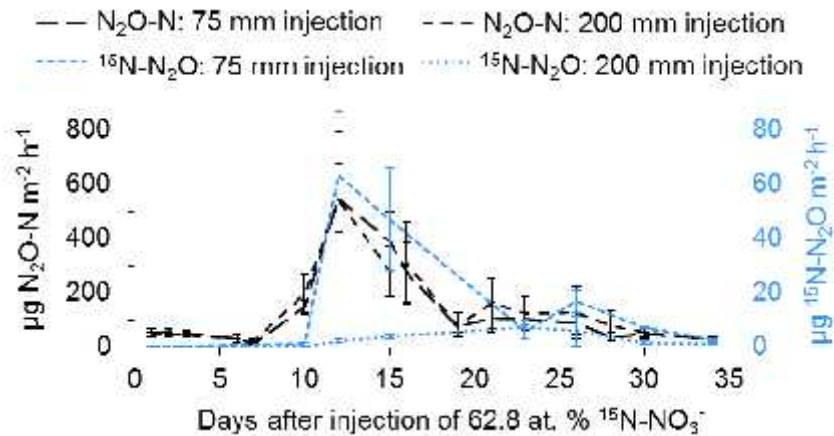
- Applied 62.8 at. % ¹⁵N-NO₃⁻ at 75 mm or 200 mm on Day 0.
- 9 days before application:
 - negligible NH₄⁺ in soil water
 - 2.2 – 120 mg L⁻¹ of NO₃⁻
 - so N₂O from denitrification.
- N₂O very soluble in water: 2.88 × 10⁻² mol L⁻¹ atm⁻¹ at 20 °C

Repacked columns: 14 weeks to settle



Leaching of dissolved N_2O and NO_3^-

Surface flux



Declining ^{15}N in soil water

Depth in soil	NO_3^- injection at 75 mm		NO_3^- injection at 200 mm	
	160 mm	460 mm	160 mm	460 mm
Day	At. % ^{15}N			
13	7.0	32.7	0.4	22.4
23	1.3	12.5	0.4	3.4
40	0.6	2.2	0.4	0.6

- Total direct emissions (Days 1–23) of excess $^{15}N_2O$:
 - From 75 mm depth = 0.50 % of total NO_3^- injected
 - From 200 mm depth = 0.065 %
 - below IPCC default of 1 %.
 - No emitted $^{15}N_2$ detected
- High hydraulic conductivity at time of highest in-soil N_2O and $^{15}N_2O$
- Potentially leaching $^{15}N_2O$ from 75 mm ($\times 155$) and 200 mm ($\times 125$) respective surface fluxes at the time
- IPCC default indirect emissions by leaching and runoff of 0.225 % of applied N – does **not** include dissolved N_2O
- ‘Top-down’ estimate¹ of 3-5 % of applied N emitted as N_2O , compared with default ‘bottom-up’ total emissions² of 1.3 %

¹ Smith et al. (2012) *Philos. Trans. R. Soc. Lond., B, Biol. Sci.* **367**(1593): 1169-1174.

² IPCC (2006) *2006 IPCC Guidelines for National Greenhouse Gas Inventories - Volume 4: Agriculture, Forestry and Other Land Use*. Chapter 11.



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