Reducing Agricultural N_2O Emissions and Sustaining Productivity

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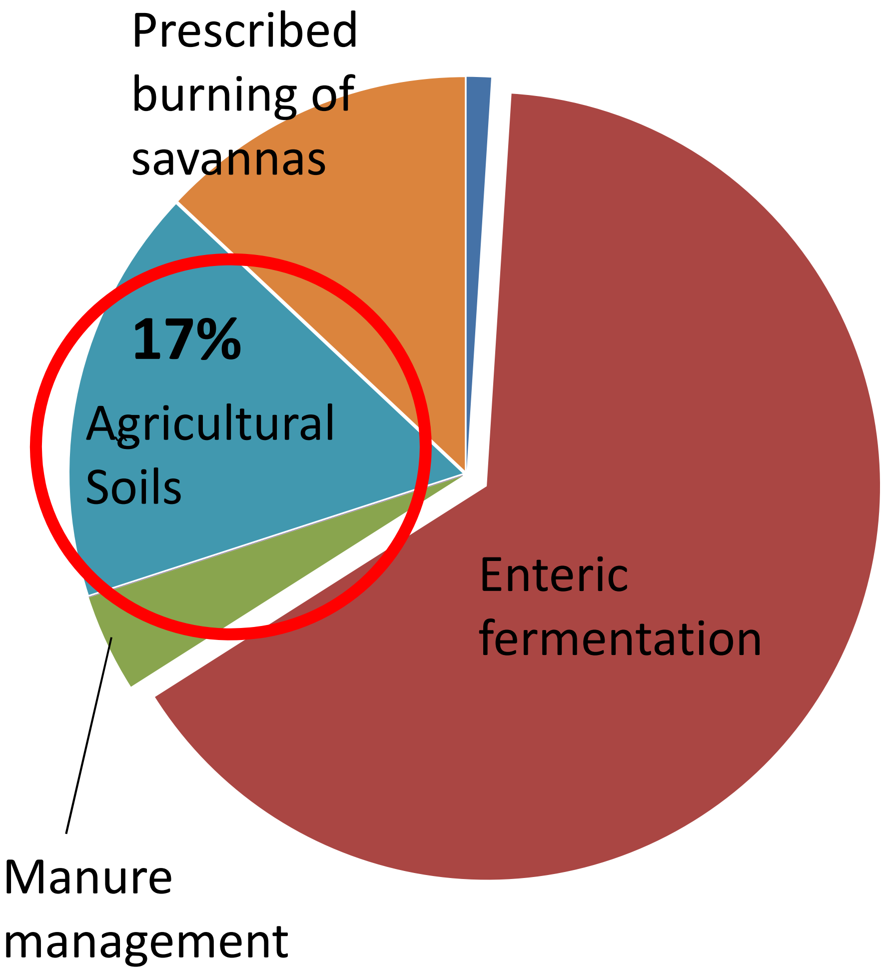
n2o.net.au

Australian Government
Department of Agriculture, Fisheries and Forestry

GRDC
Grains Research & Development Corporation

Australian Agriculture & GHGs



- Agriculture
  - 16% of Australia's GHGs
  - 59% of all CH_4
  - 86% of all N_2O
- N_2O from soils
  - 3% of national GHGs
  - 17% of agricultural GHGs

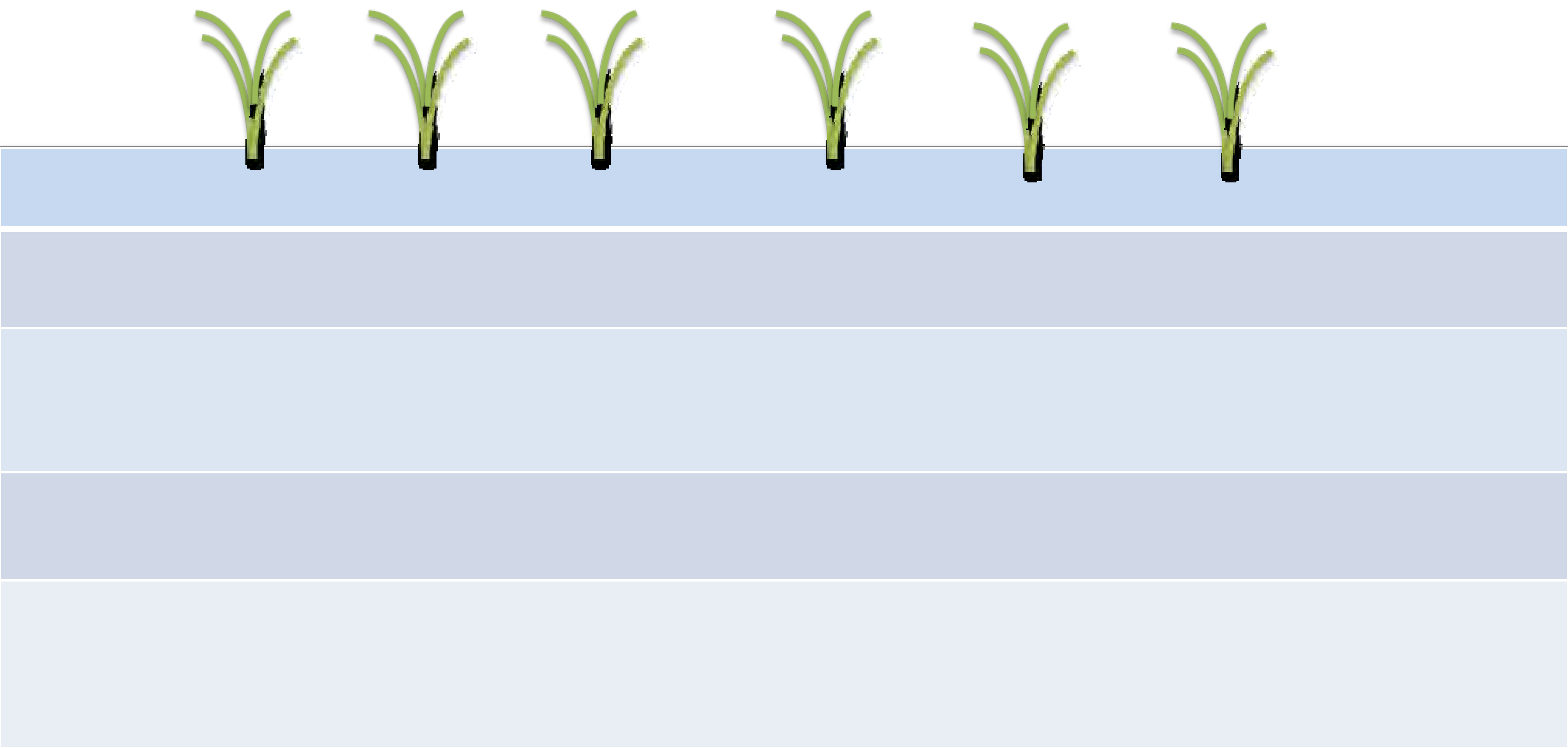
Why is N_2O important?

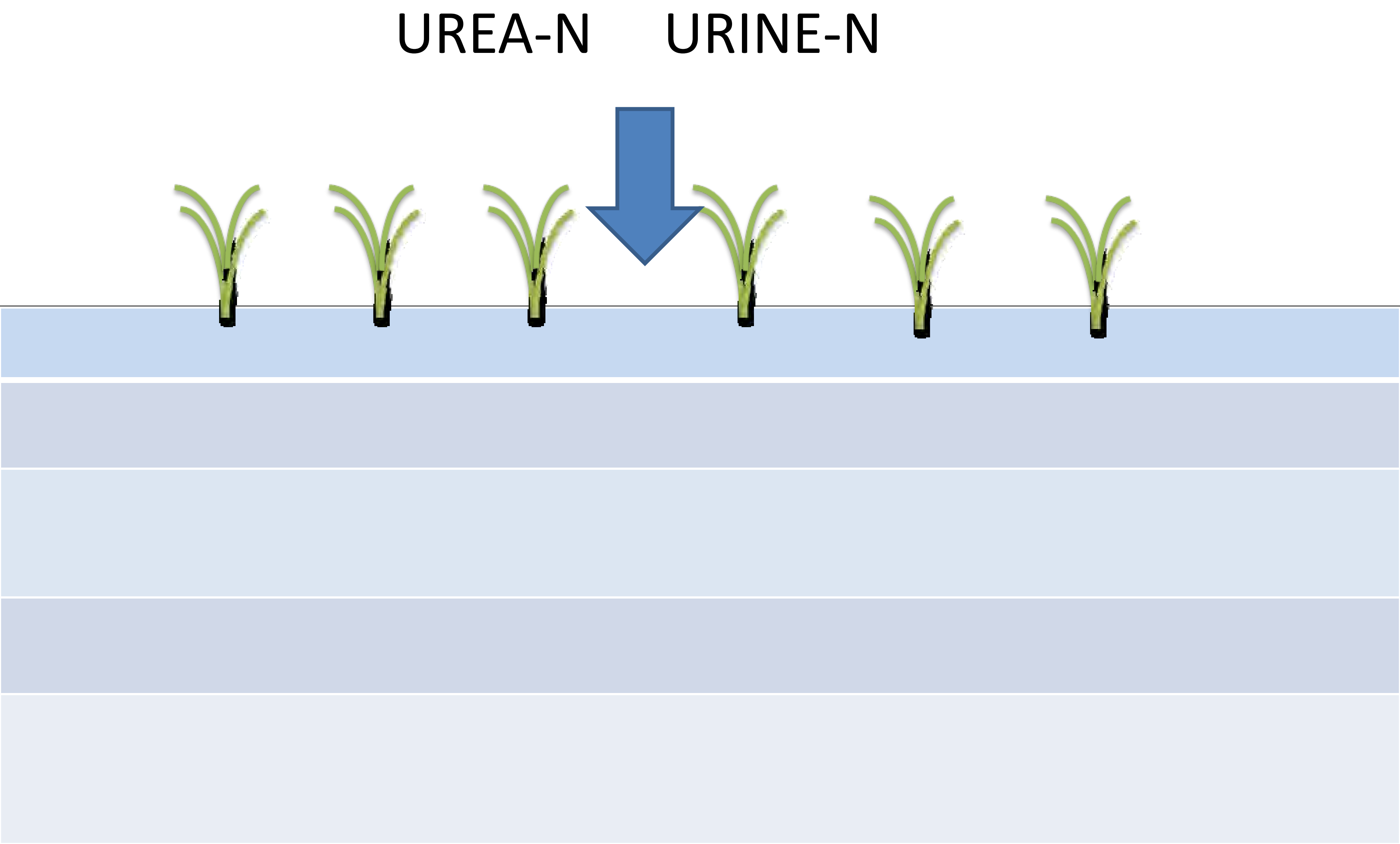
- Global warming potential is 300 x CO_2
- Principally from N sources applied to soils - Emission Factors: 0.3 - 2.1%
- Indicator of other gaseous N losses: 1 - 70%
- Intimately linked to crop & pasture productivity
- Mitigation is a permanent, avoided emission

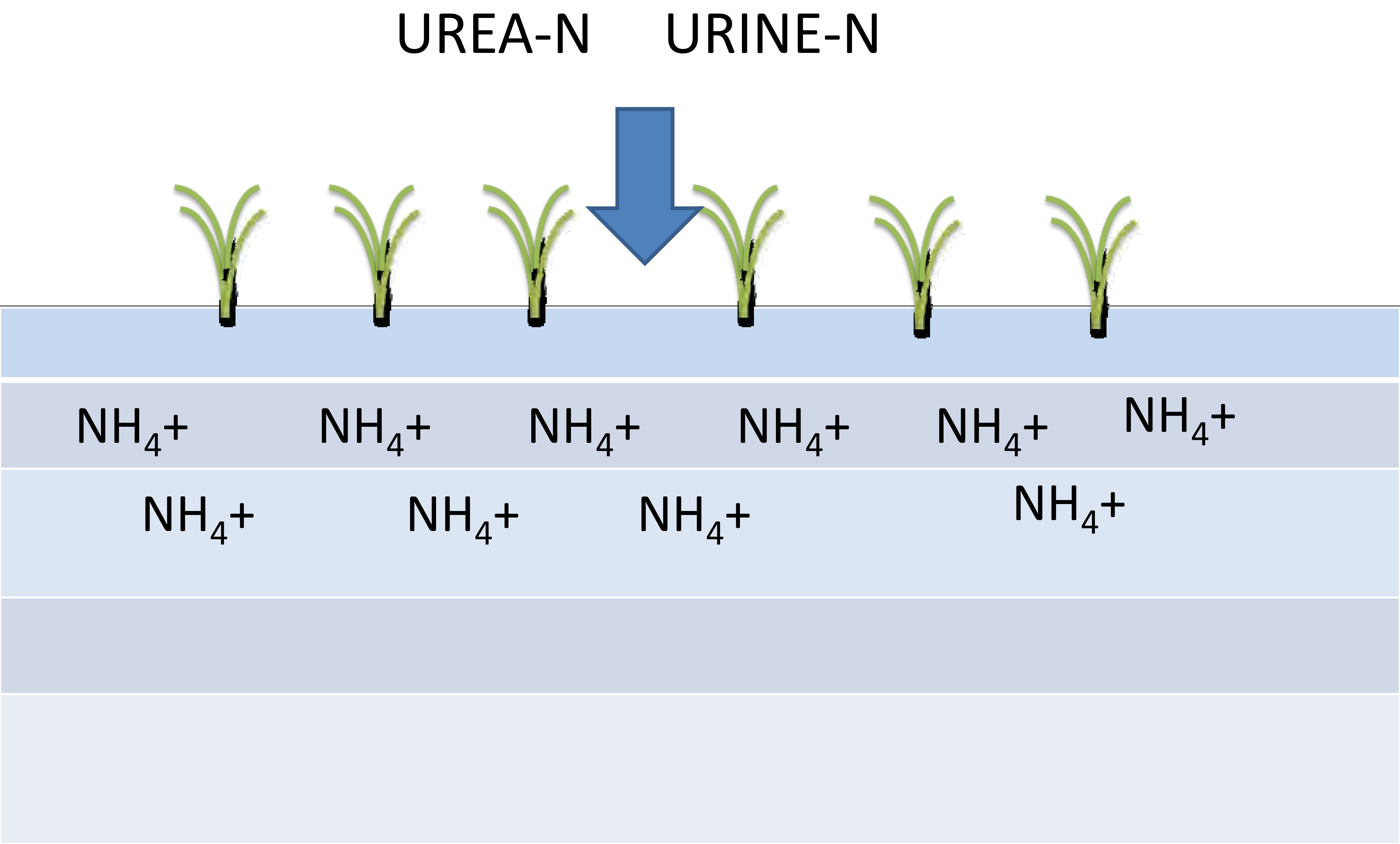
The Global Agricultural Intensification Imperative

- 6 billion to 9 billion people by 2050
- Less arable land, less water, climate change
- Higher energy costs
- Increased fertiliser prices
- Economic and environmental solutions
- Adaptation and mitigation nexus
- More soil organic matter & increased nitrogen use efficiency

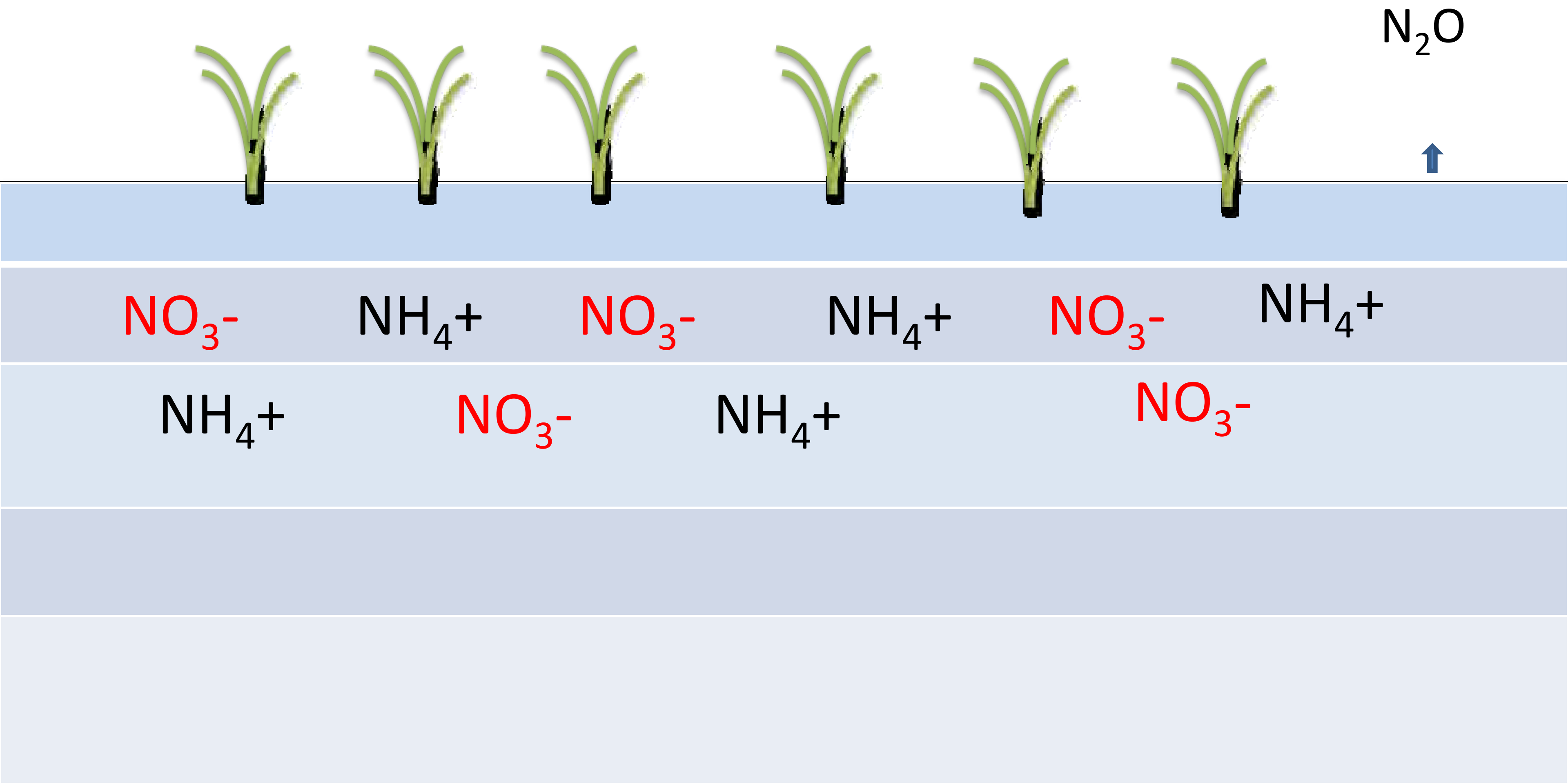
How is N_2O emitted?



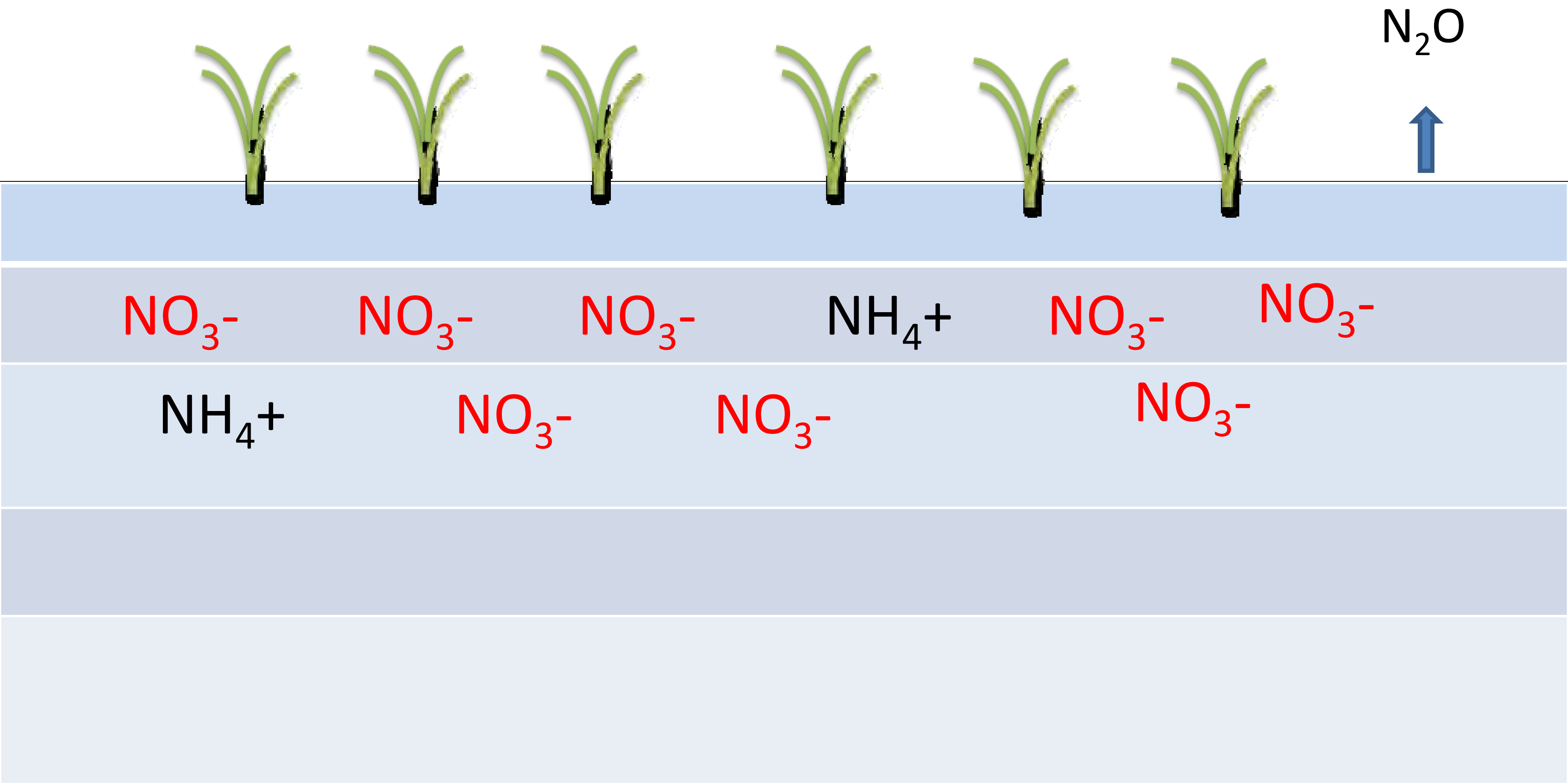

UREA-N
URINE-N

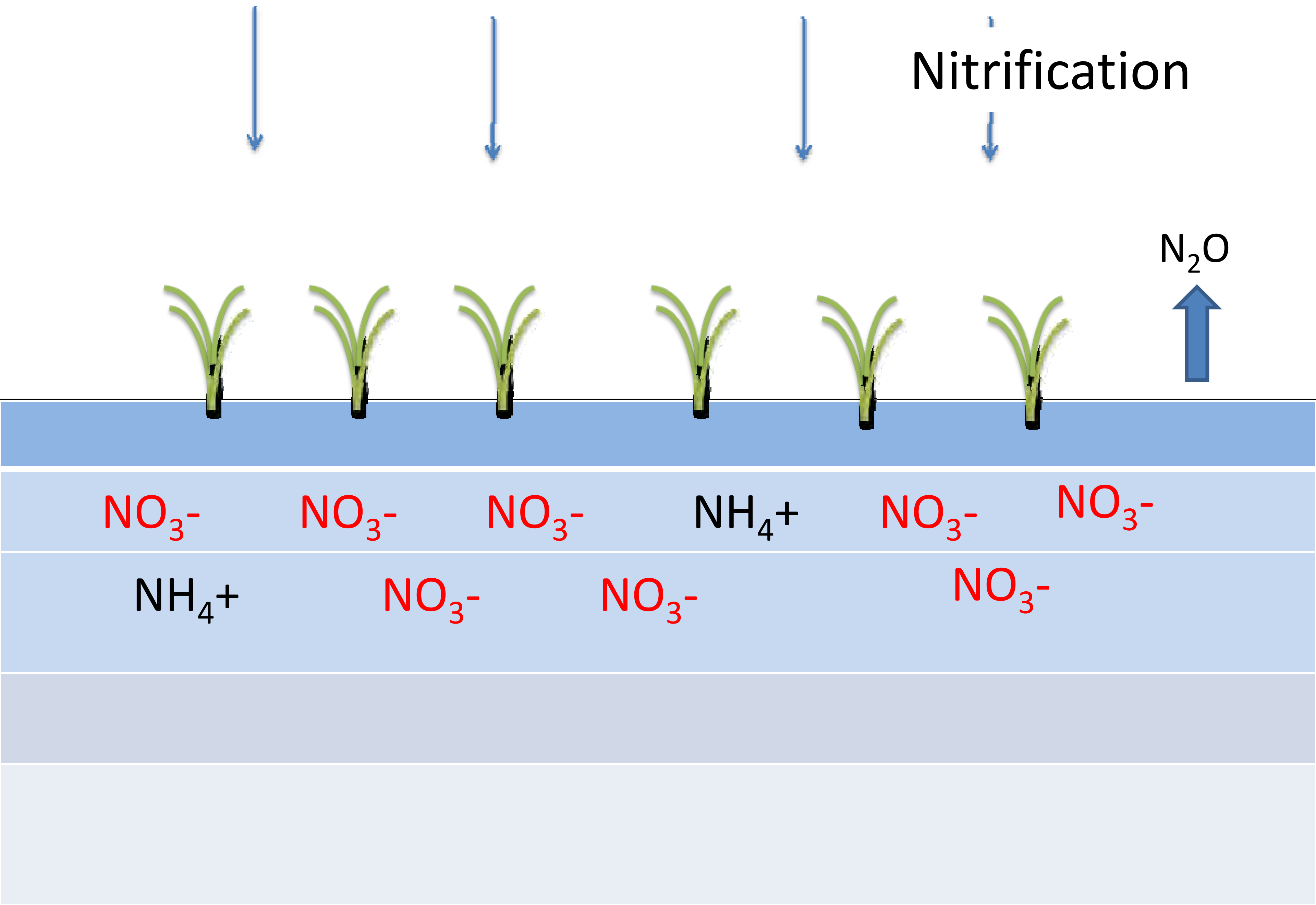

UREA-N
URINE-N
NH4+
NH4+
NH4+
NH4+
NH4+
NH4+
NH4+
NH4+
NH4+
NH4+

Nitrification

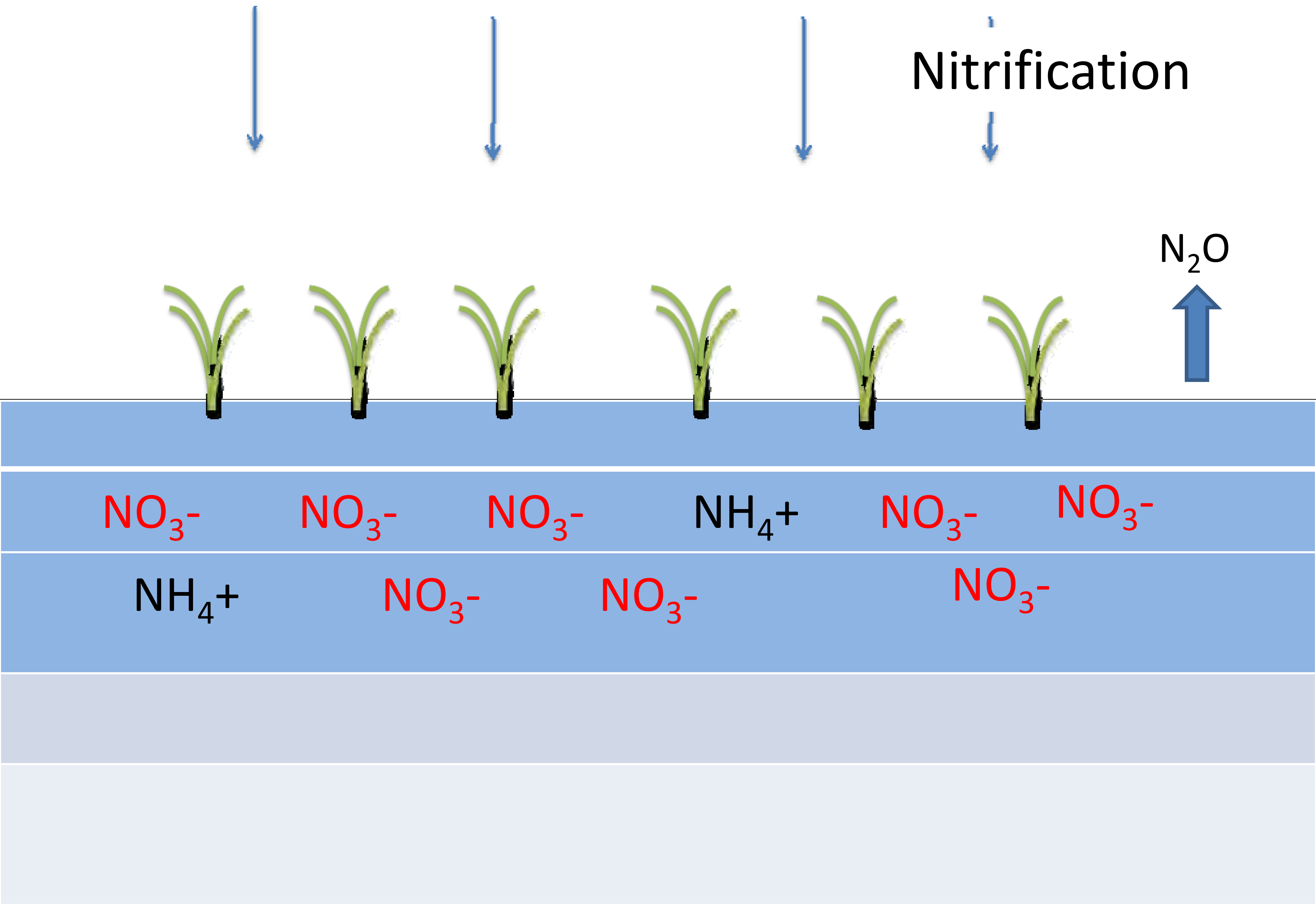


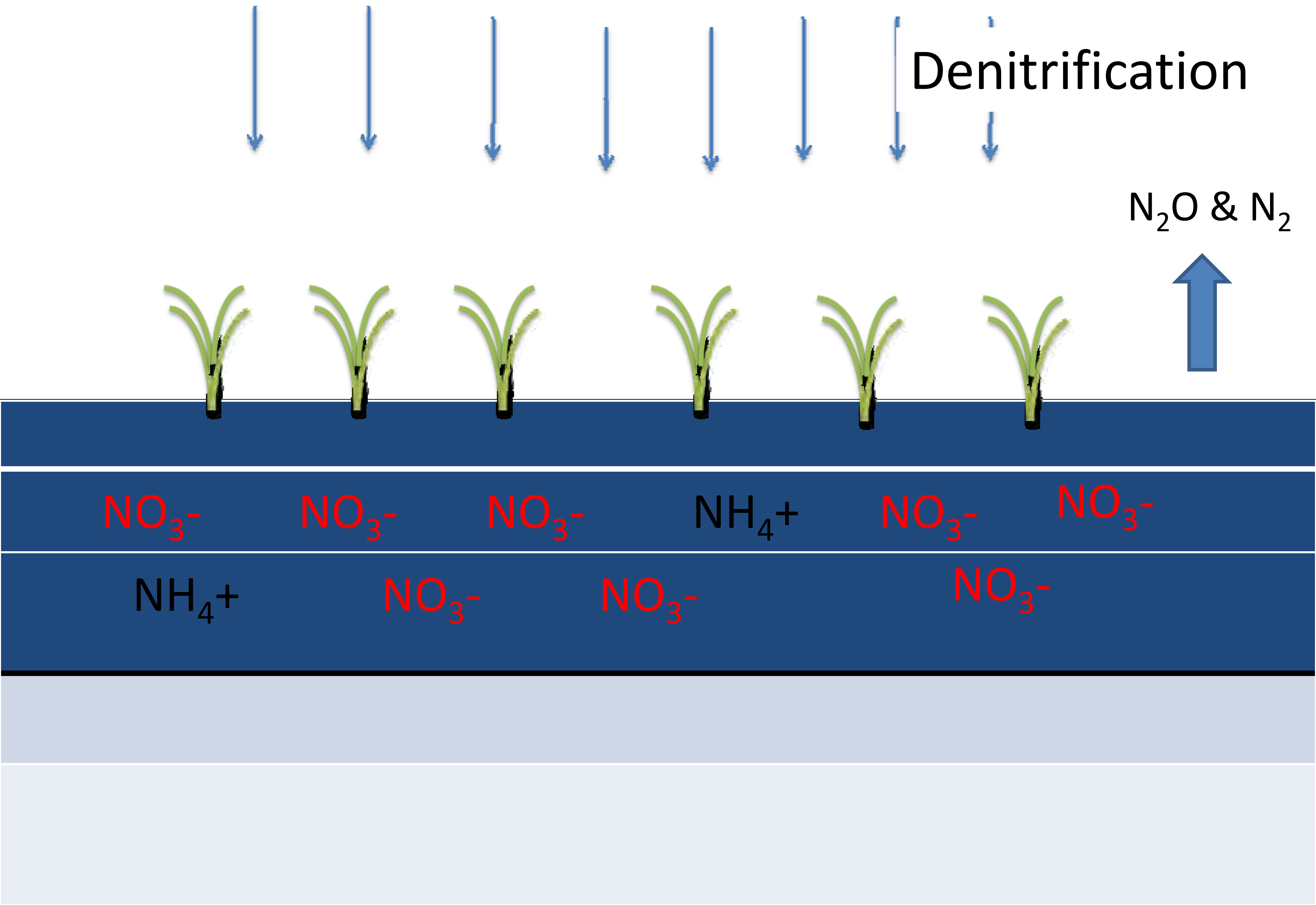
Nitrification

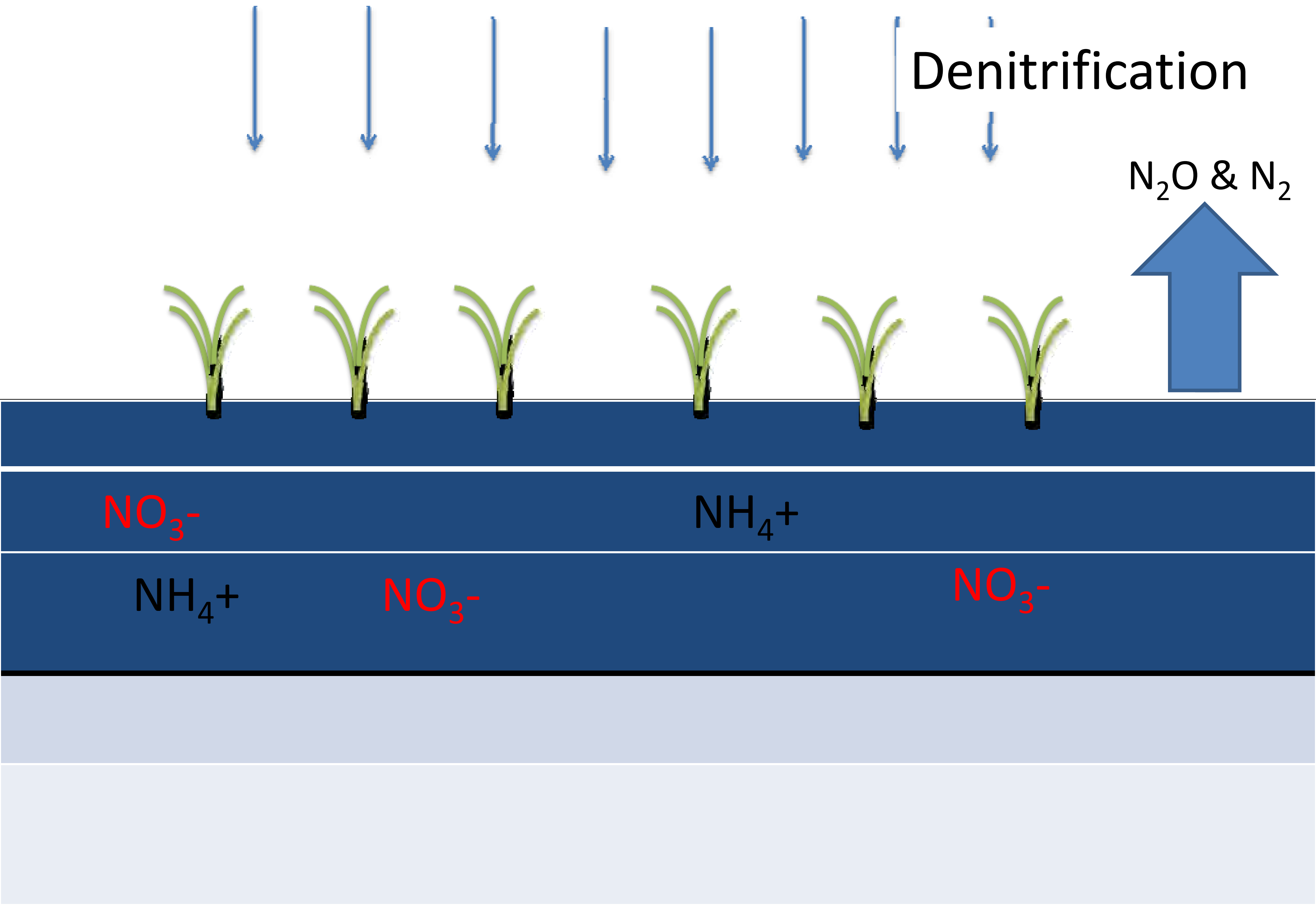


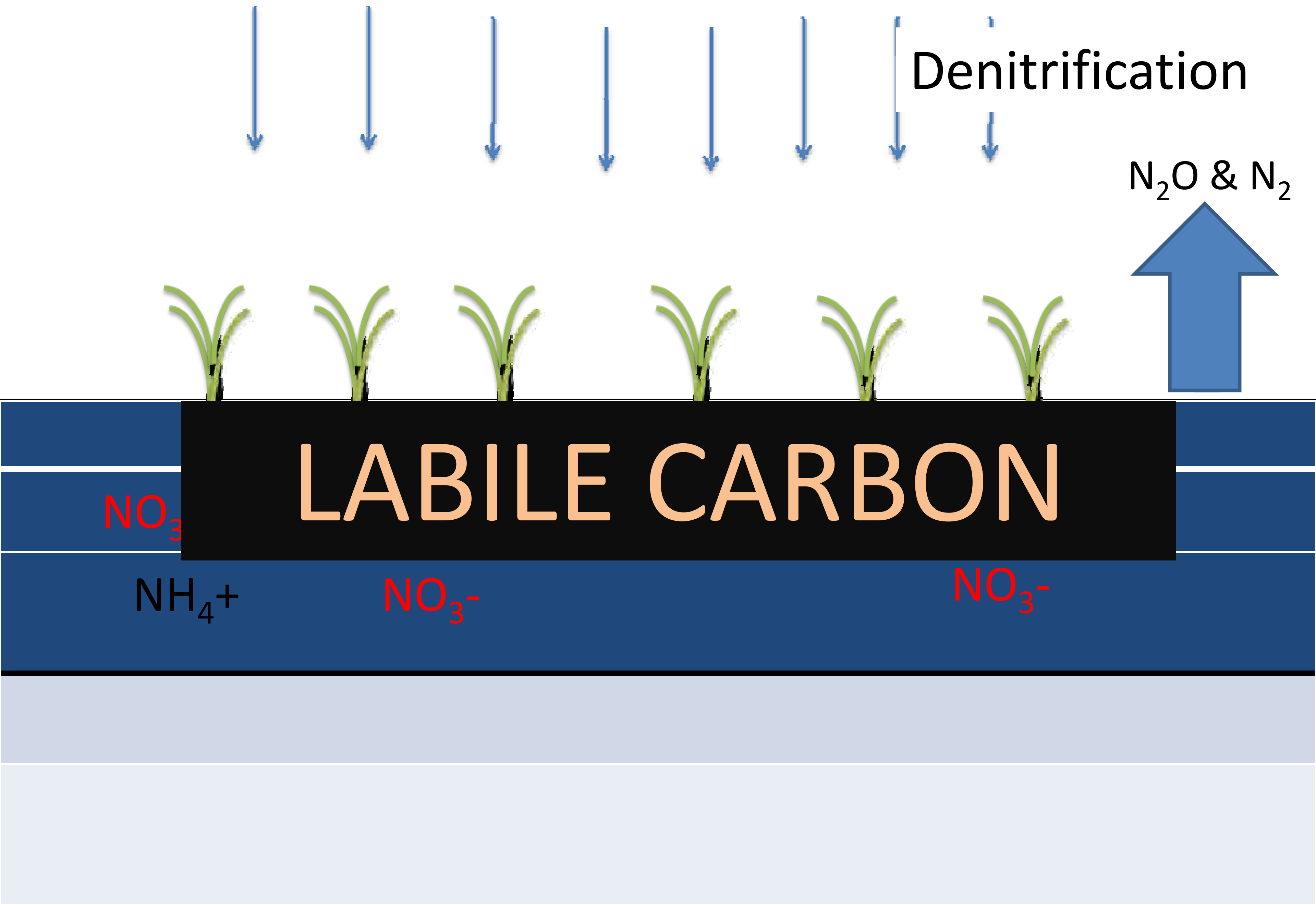


Nitrification
N_2O
NO_3-
NO_3-
NO_3-
NH_4+
NO_3-
NO_3-
NH_4+
NO_3-
NO_3-
NO_3-

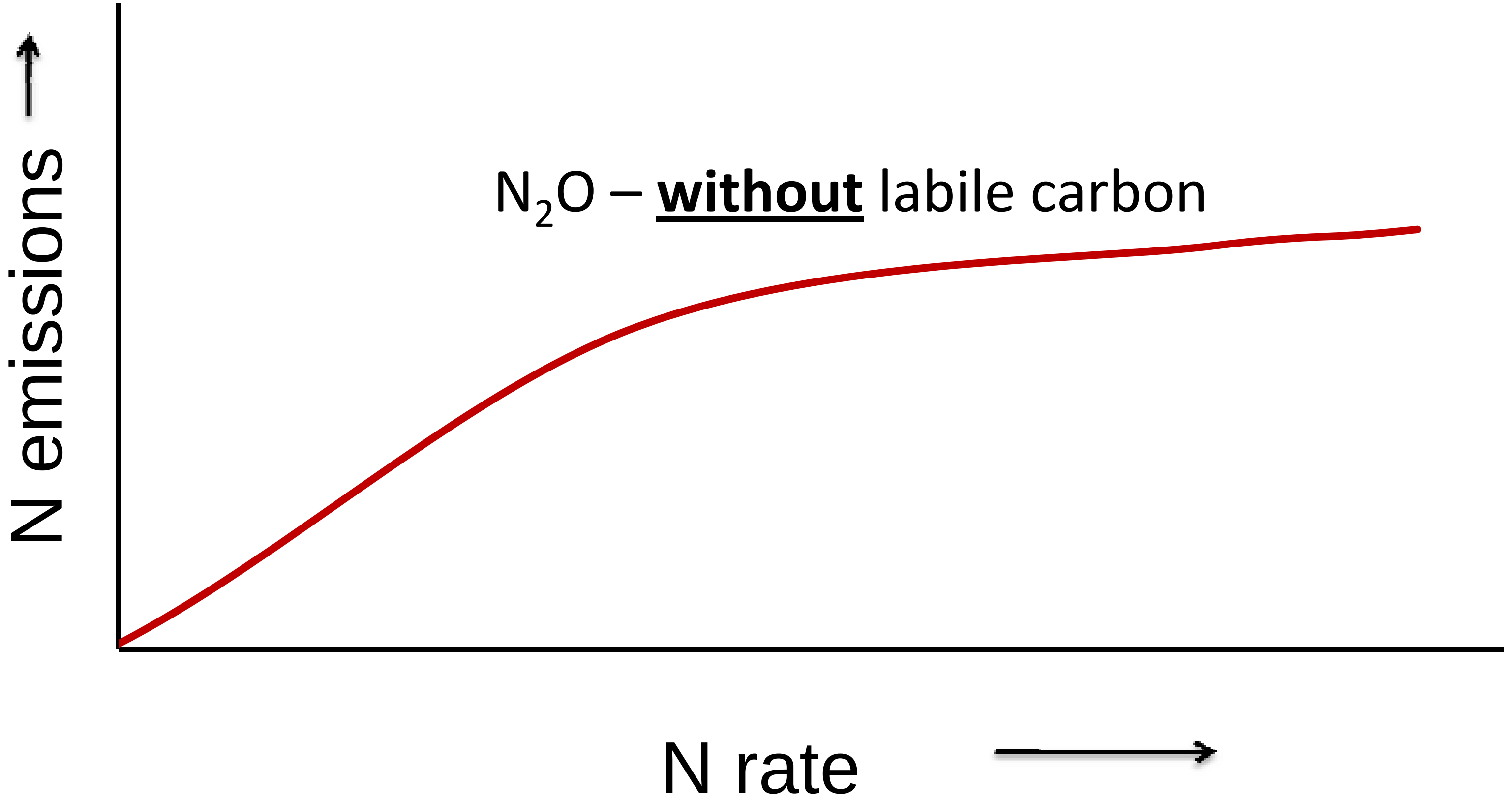

Nitrification
N_2O
NO_3-
NO_3-
NO_3-
NH_4+
NO_3-
NO_3-
NH_4+
NO_3-
NO_3-
NO_3-


Denitrification
N_2O & N_2
NO_3-
NO_3-
NO_3-
NH_4+
NO_3-
NO_3-
NH_4+
NO_3-
NO_3-
NO_3-

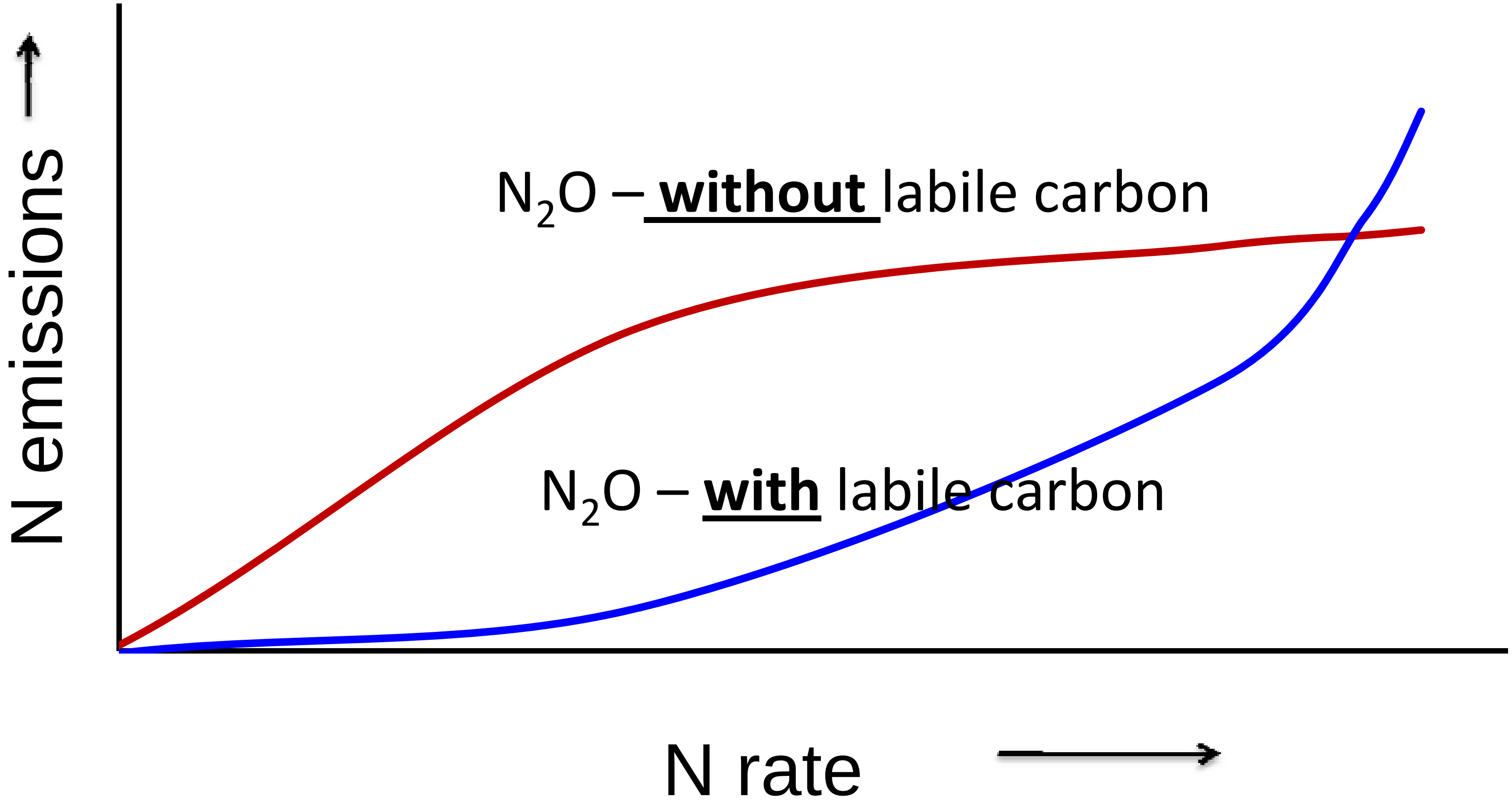

Denitrification
N2O & N2
NO3-
NH4+
NH4+
NO3-
NO3-


Denitrification
N_2O & N_2
LABILE CARBON
NO_3
NH_4+
NO_3-
NO_3-

Labile Carbon and N_2O Emissions



Labile Carbon and N_2O Emissions



Nitrous Oxide Research Program (NORP)

- Reduce uncertainty re the magnitude of N_2O, CH_4 and CO_2 emissions in response to management.
- Evidence based, cost-effective mitigation
- Nitrogen management (fertiliser and legumes), inhibitors and irrigation.
- Links to the National Adaptation and Mitigation Initiative (NAMI) – on-farm demos.

NORP Core Field Sites

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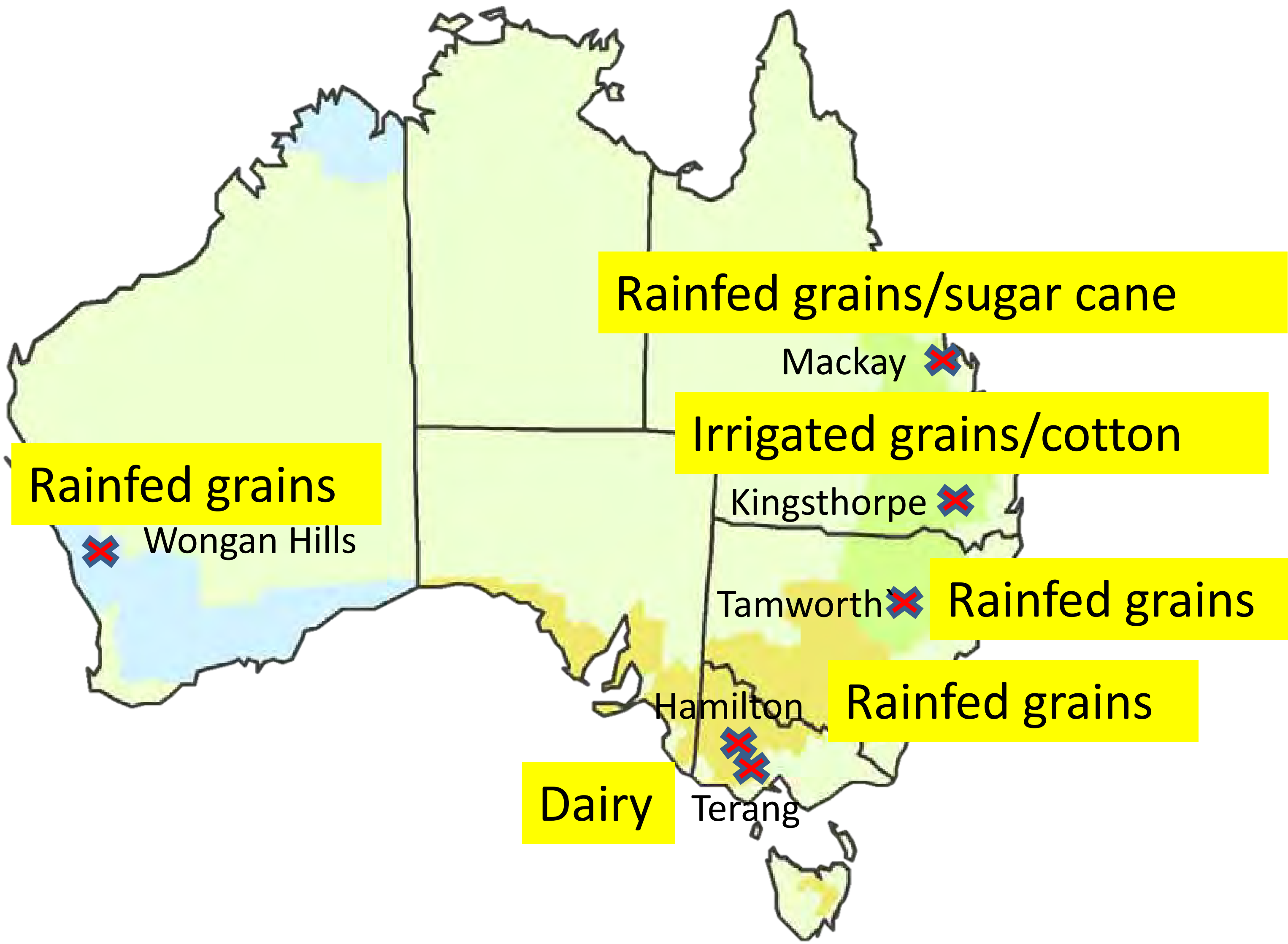
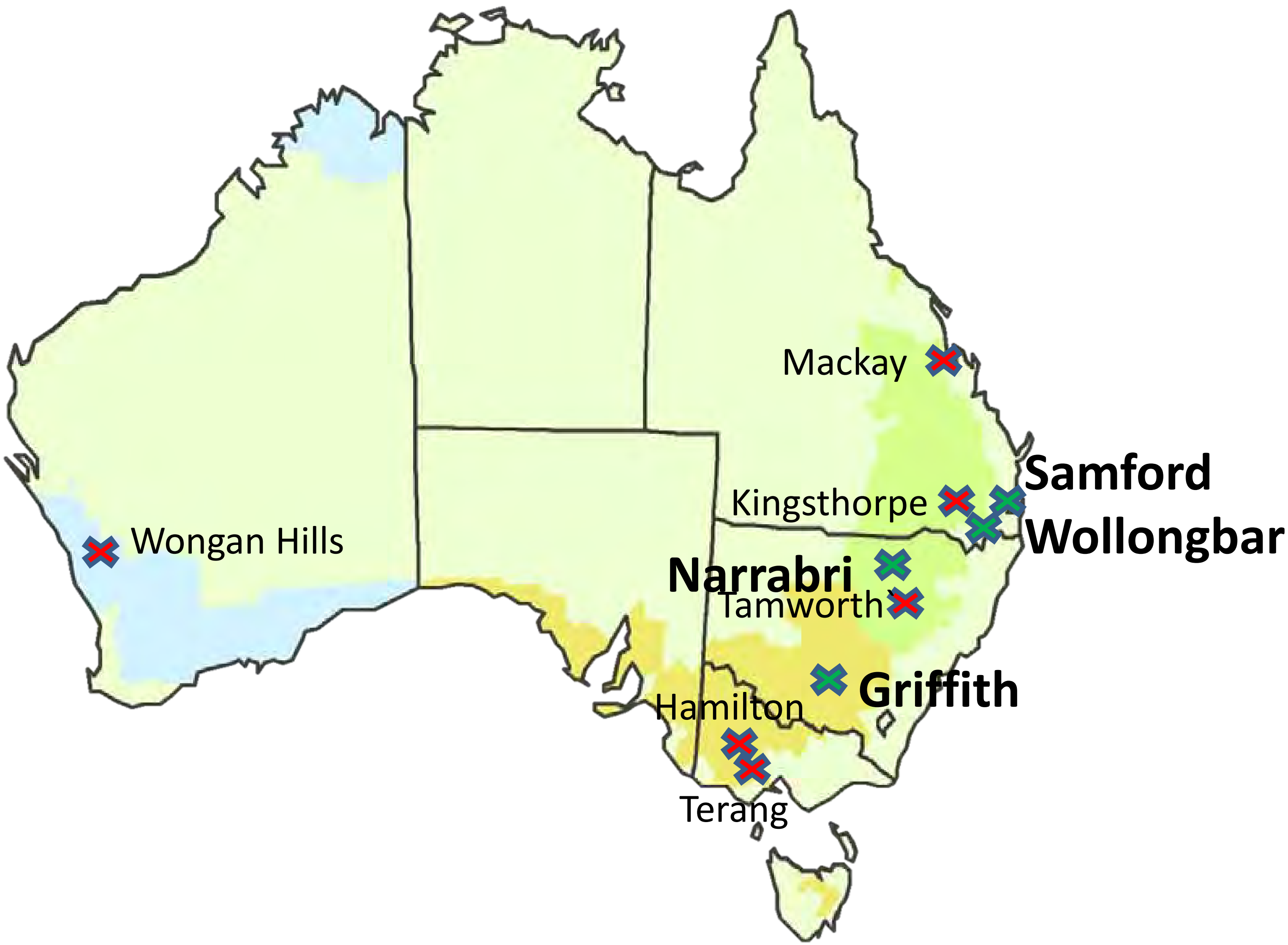


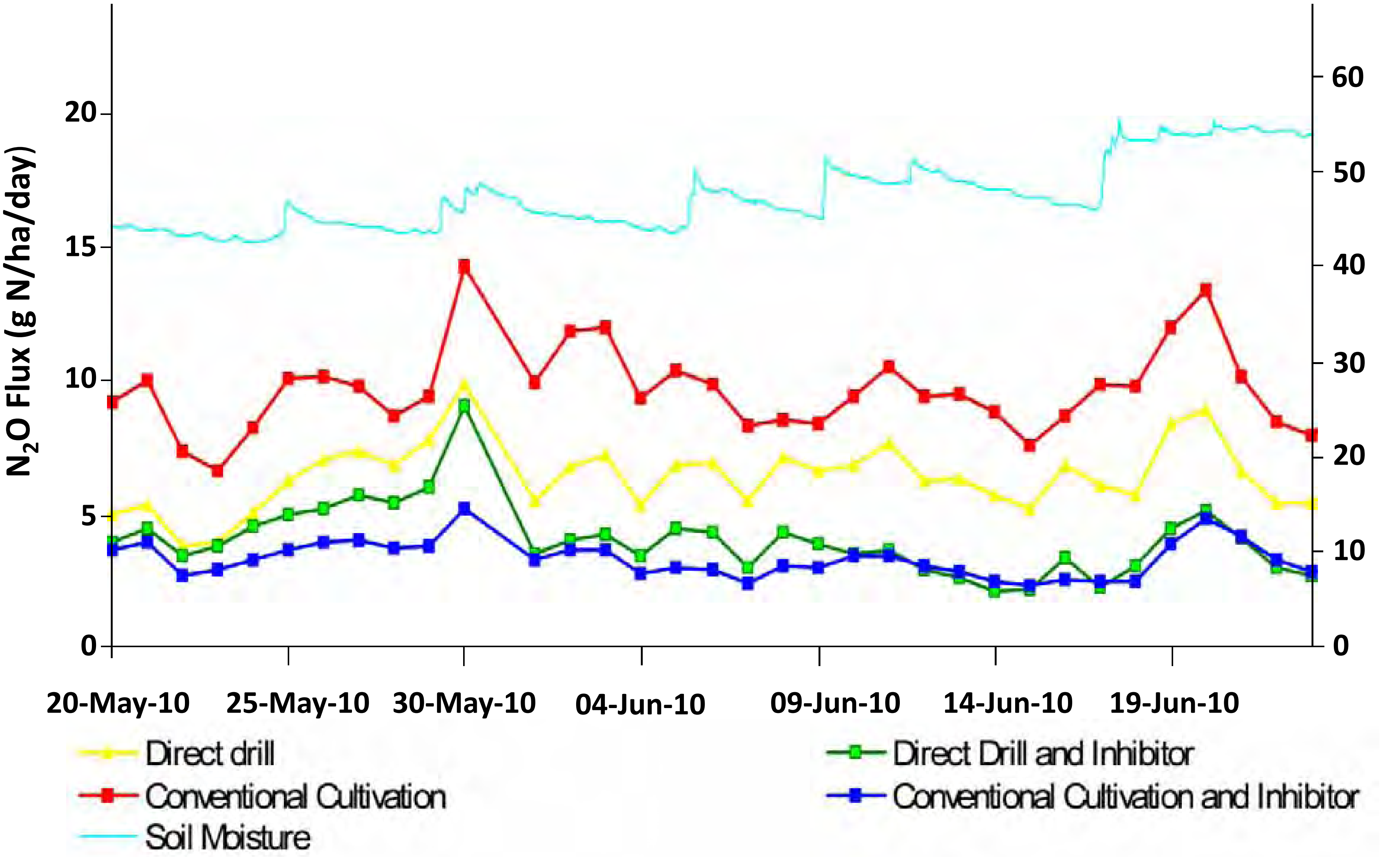
NORP Core Field Sites +




GMC

Inhibitors (DCD) and N_2O

HRZ Wheat (after pasture) - Hamilton



Inhibitors (DCD) and N_2O
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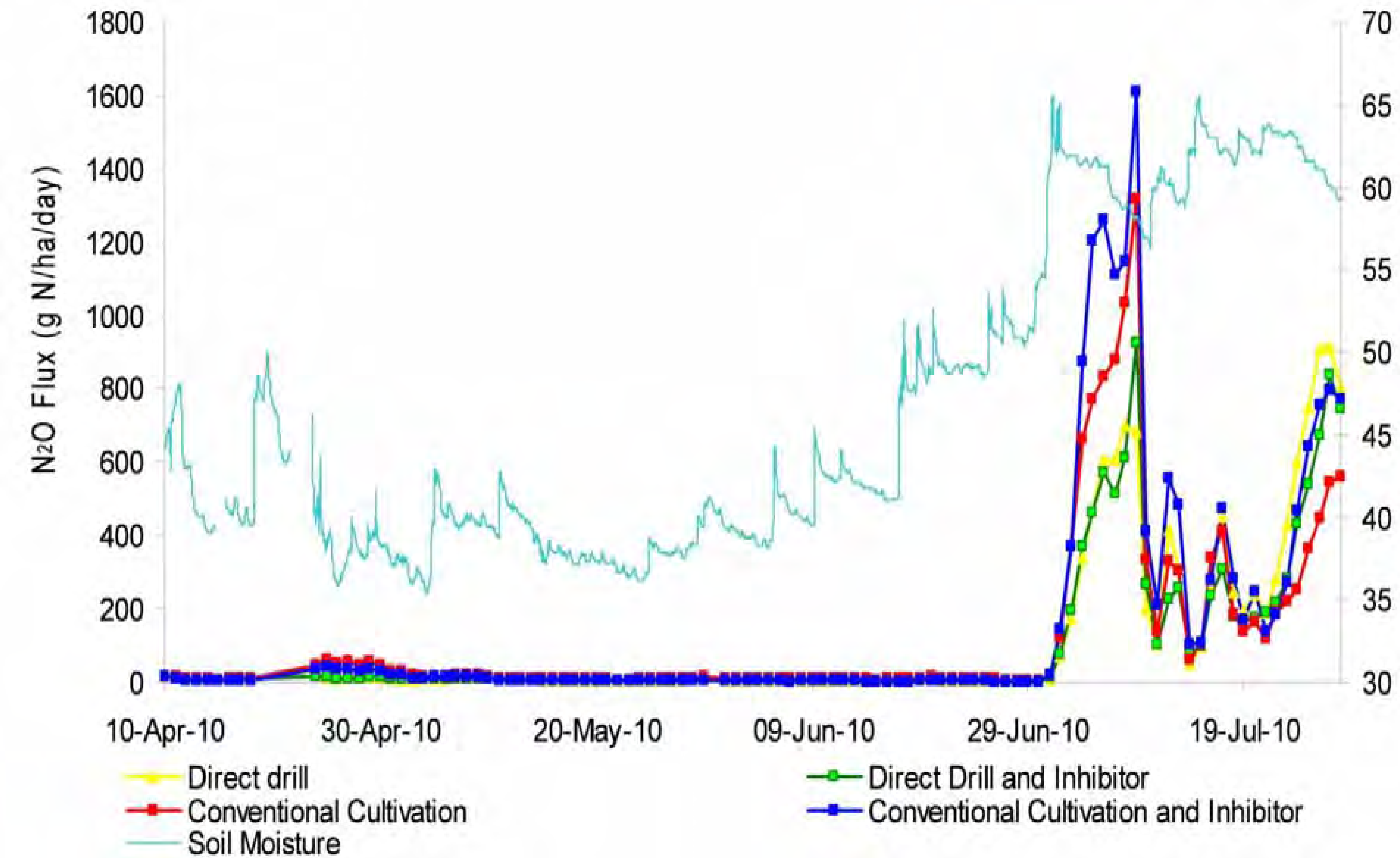

Irrigation and N_2O
Wheat (after cotton) – Kingsthorpe, Qld

Treatment	Full	Opt.	Dry
Seasonal Flux [kg N_2O-N/ha]	0.75	0.43	0.45
Emission Factor [%]	0.38	0.22	**0.23**
Irrigation/rain amount [mm]	417	315	219
Yield [t/ha]	3.1	1.9	1.6
GHG intensity [kg N_2O-N/ t yield]	0.25	0.27	0.33

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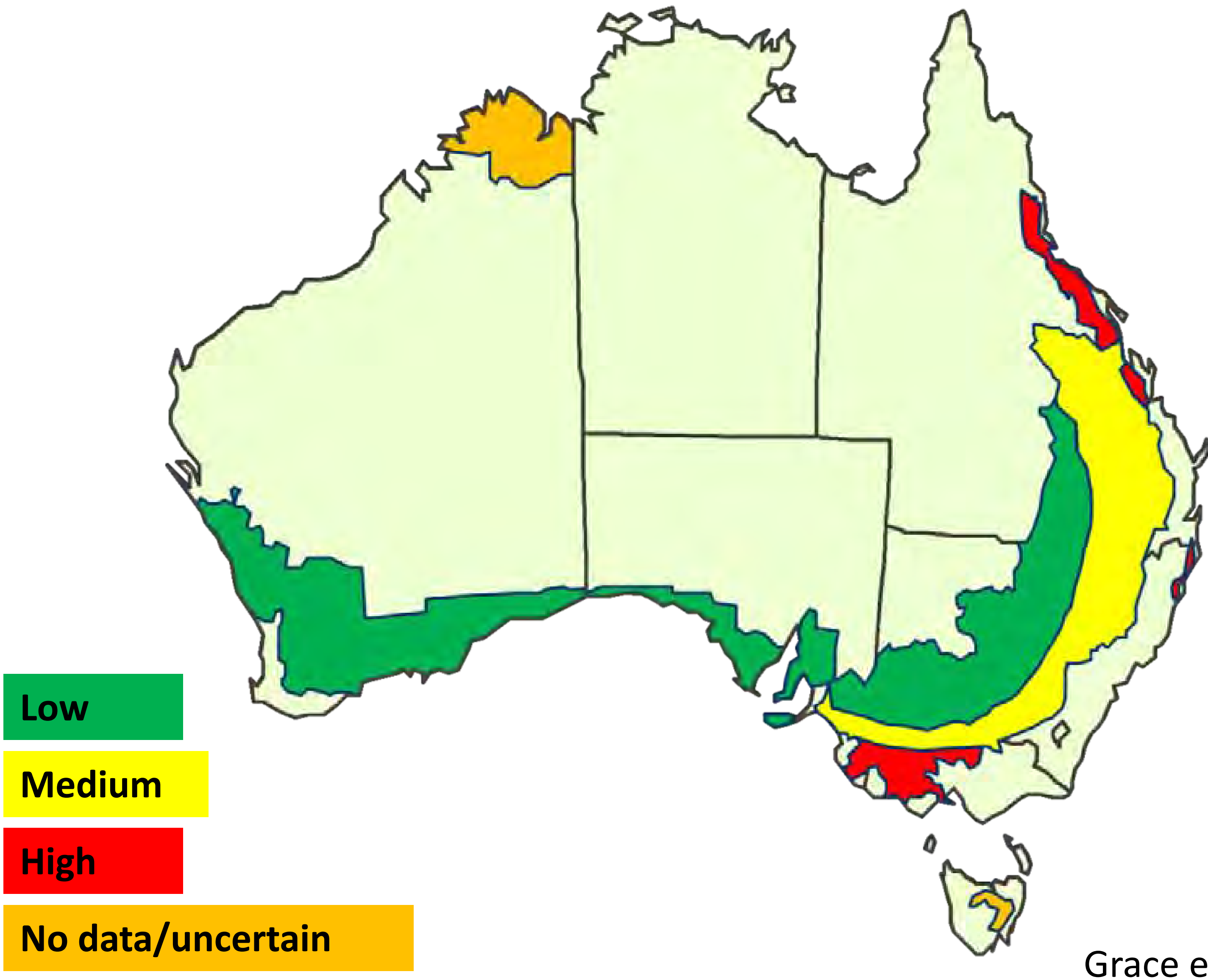
What has NORP found......

- Typically low emissions EXCEPT where sufficient LABILE CARBON is available e.g. dairy, high rainfall grains (moreso after pasture), sugar cane – trash retained.
- Strong interaction between C management and N inputs

Regional N_2O Emission Potential



Grace et al. unpublished

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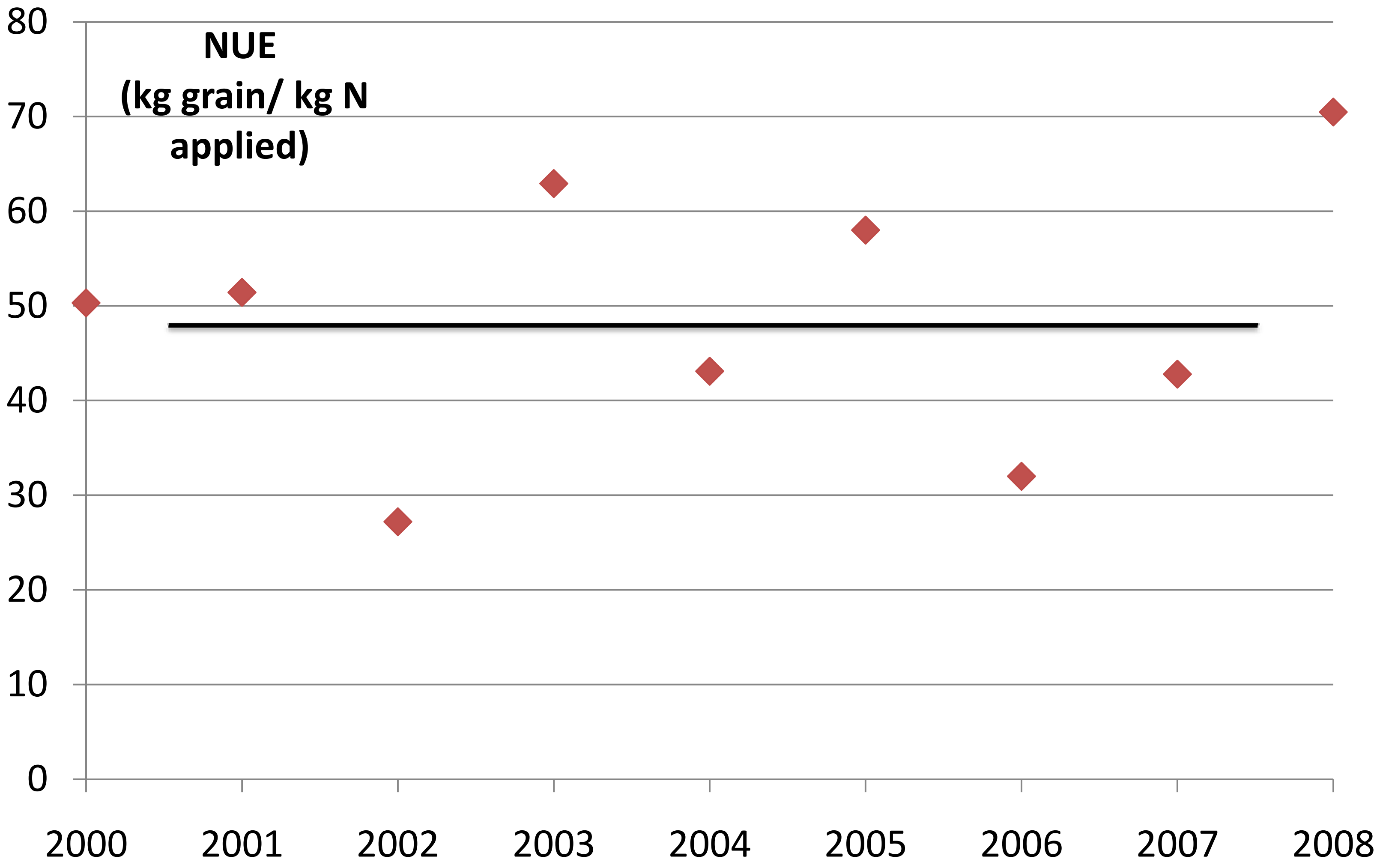
- Strong interaction between C management and N inputs
- Nitrification inhibitors show promise but are temperature and time dependent.
- Increasing nitrogen use efficiency is critical.

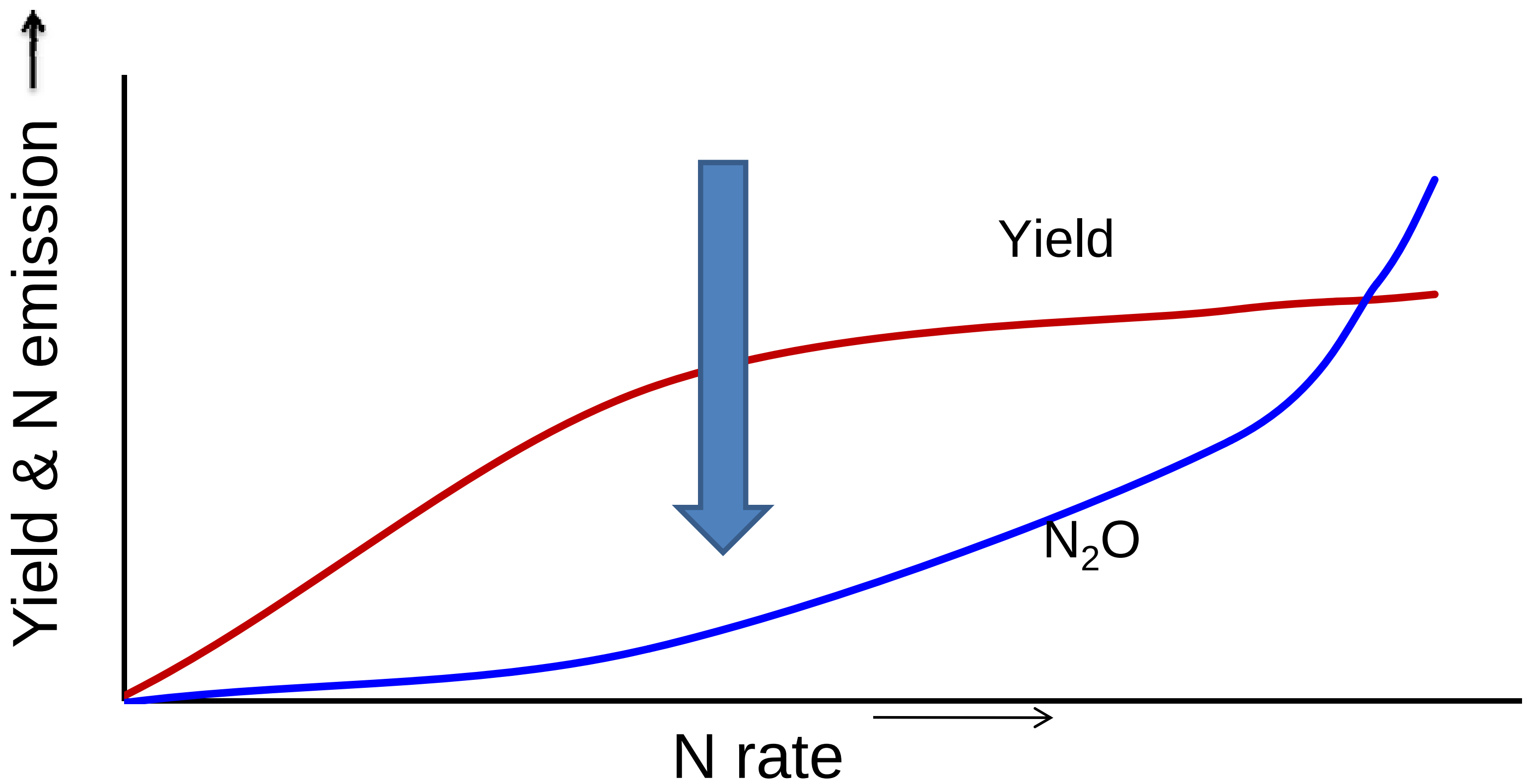
Nitrogen Use Efficiency (Cereals)*



*FAOSTAT

Nitrogen Reduction Protocol*

- Fertiliser N vs Yield vs N_2O – profitability incentive



*Millar, Robertson, Grace, MASGC, 2010

Acknowledgements

- Graeme Schwenke (NSW I&I)
- Louie Barton (UWA)
- Clemens Scheer (QUT)
- Sally Officer, Kevin Kelly (Vic DPI)
- Weijin Wang (Qld DERM)
- Deli Chen, Helen Suter, Rich Eckard (Uni Melb.)

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