Global pattern of nitrogen limitation: Confronting two global biogeochemical models with observations

R. Quinn Thomas[1], Sönke Zaehle[2], Pamela H. Templer[3], & Christine L. Goodale[1]

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[3] Department of Biology, Boston University

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- Nitrogen deposition increasing carbon storage

  (Thomas *et al.* 2010 *Nature Geoscience*)

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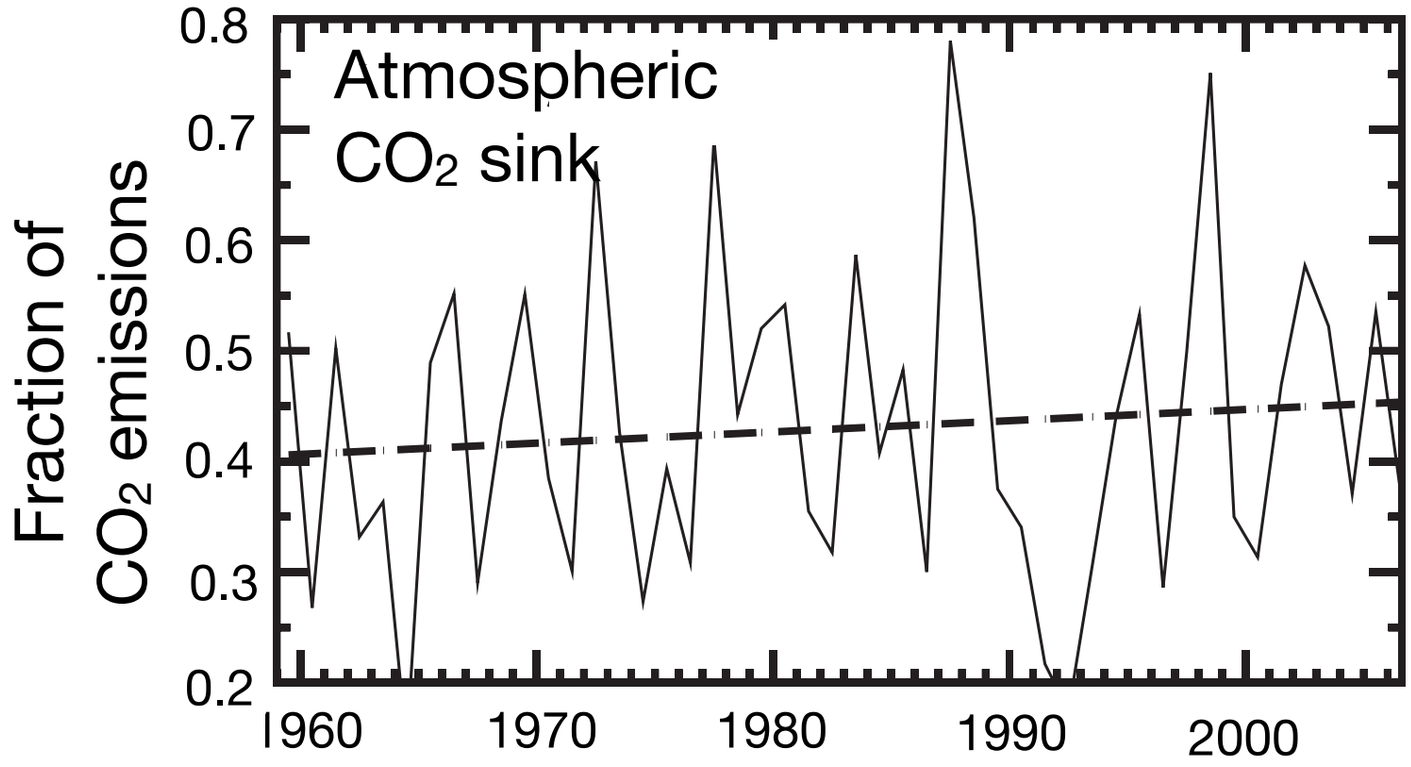

What are the patterns of nitrogen limitation in global biogeochemical models?

Test of nitrogen limitation in two global biogeochemical models

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CLM-CN 4.0

(Thornton *et al.* 2009 *Biogeosciences*)

O-CN

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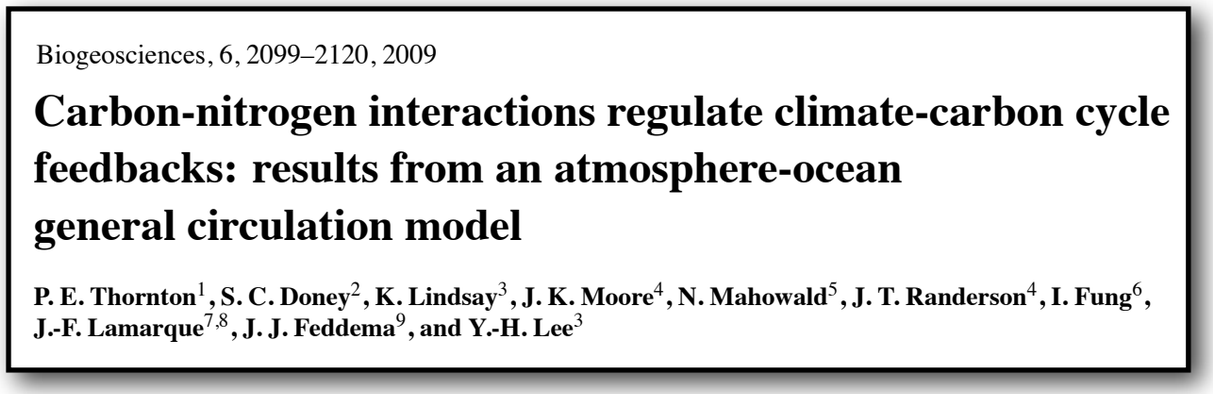

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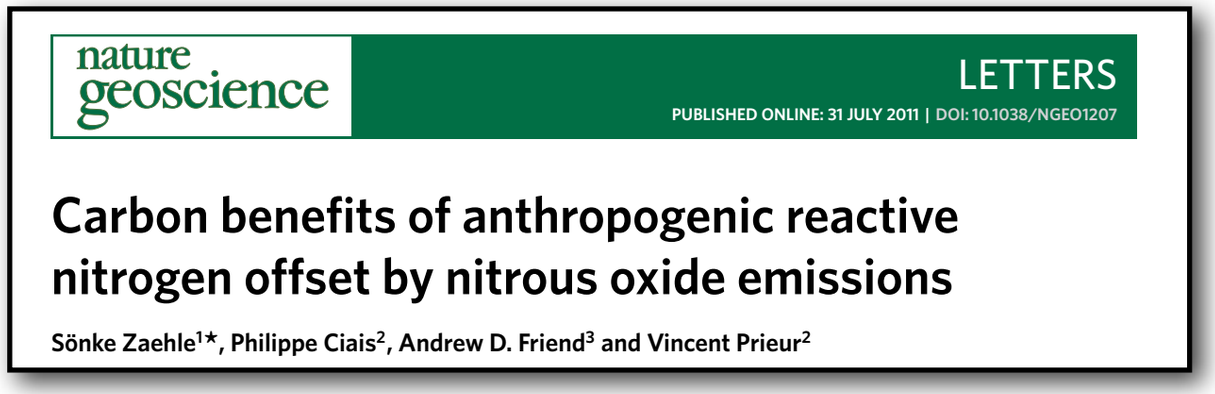

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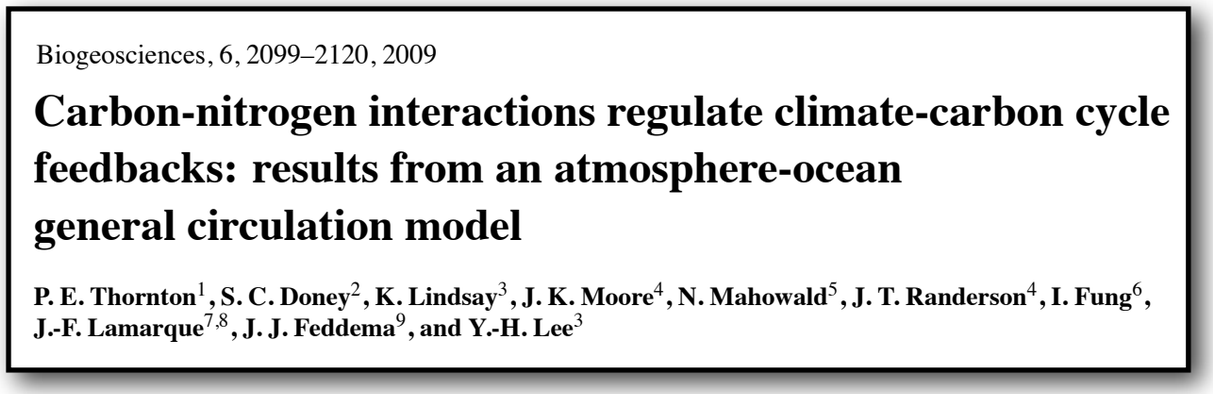

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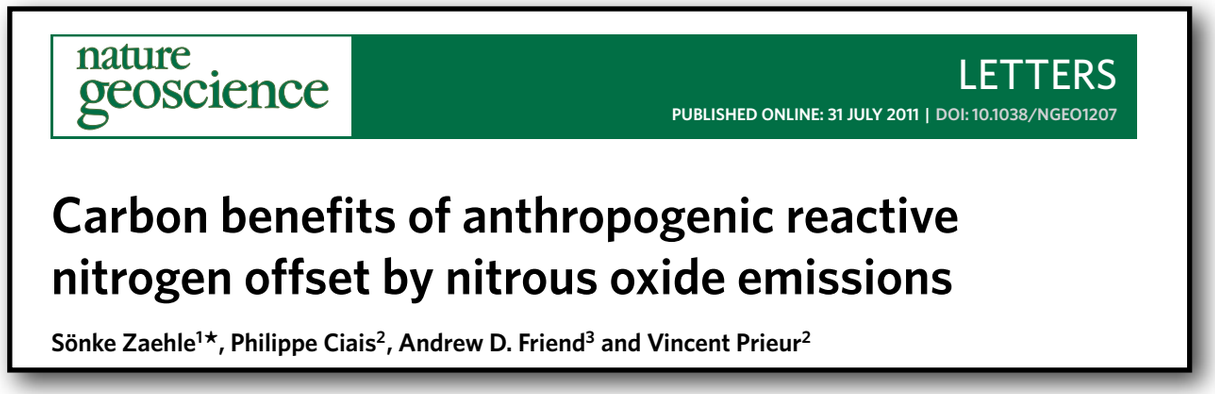

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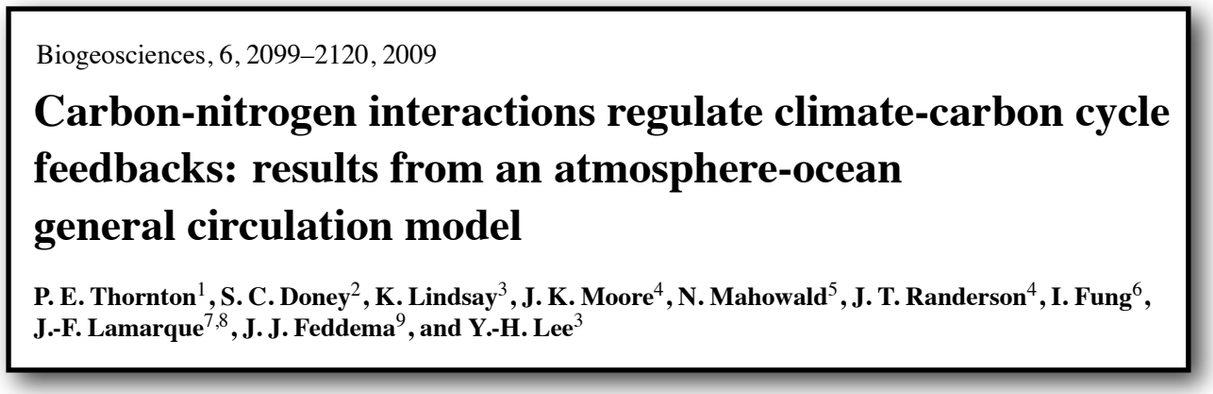

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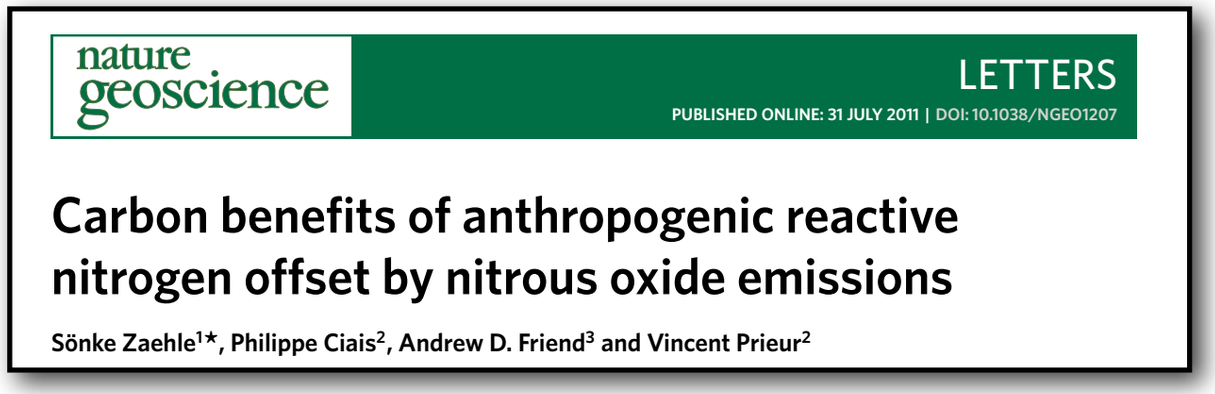

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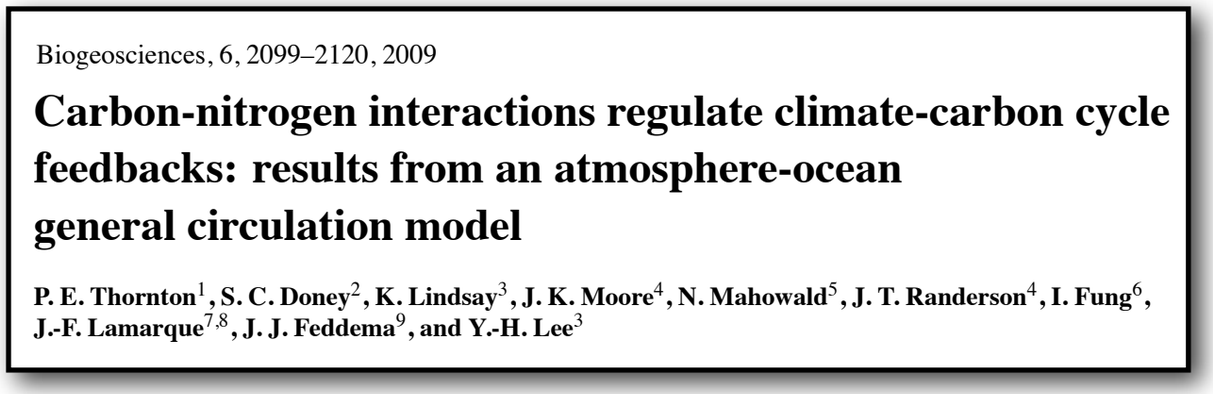

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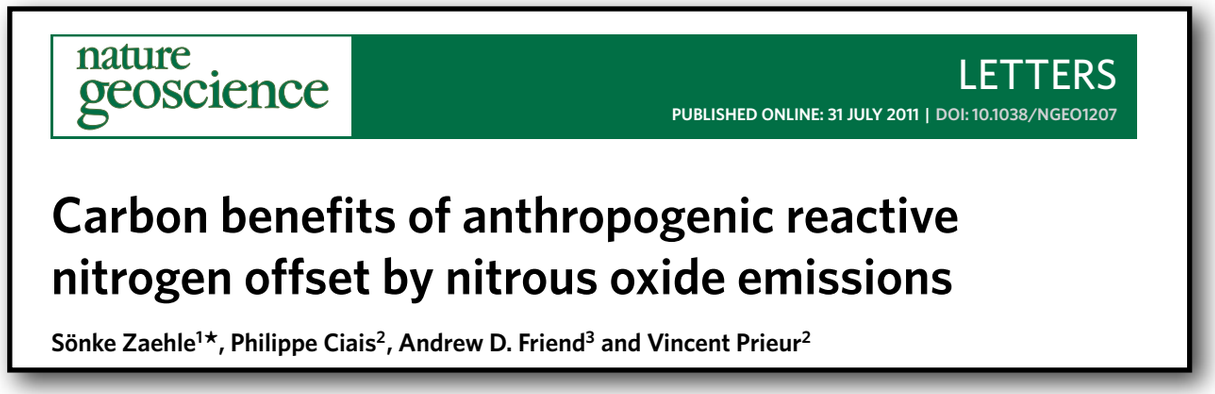

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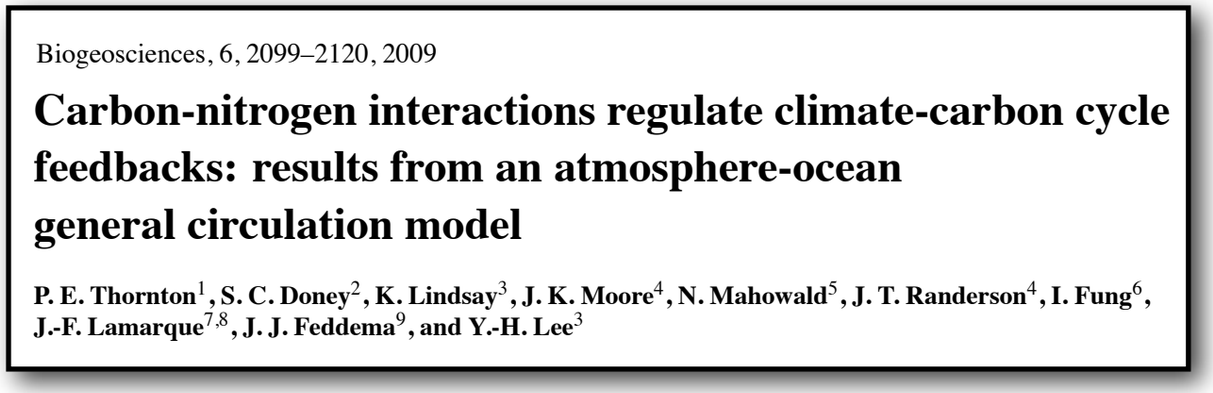

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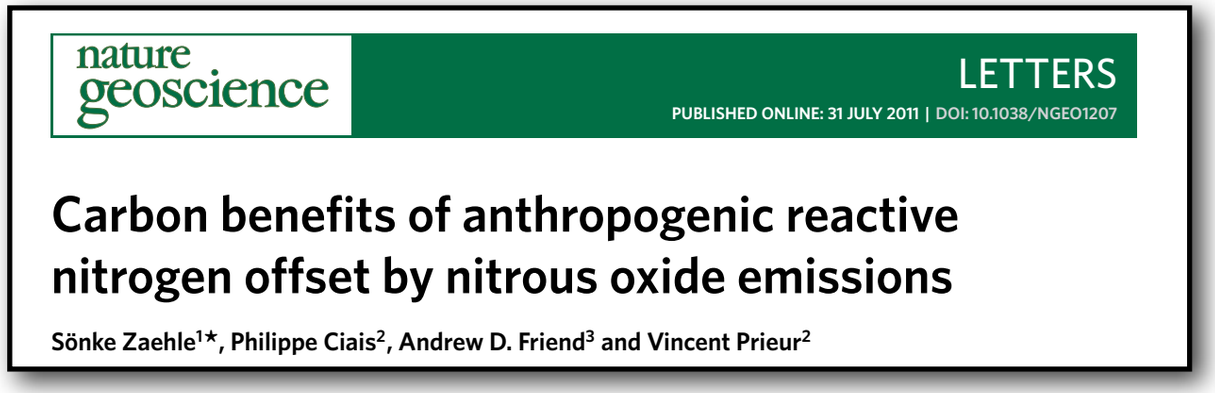

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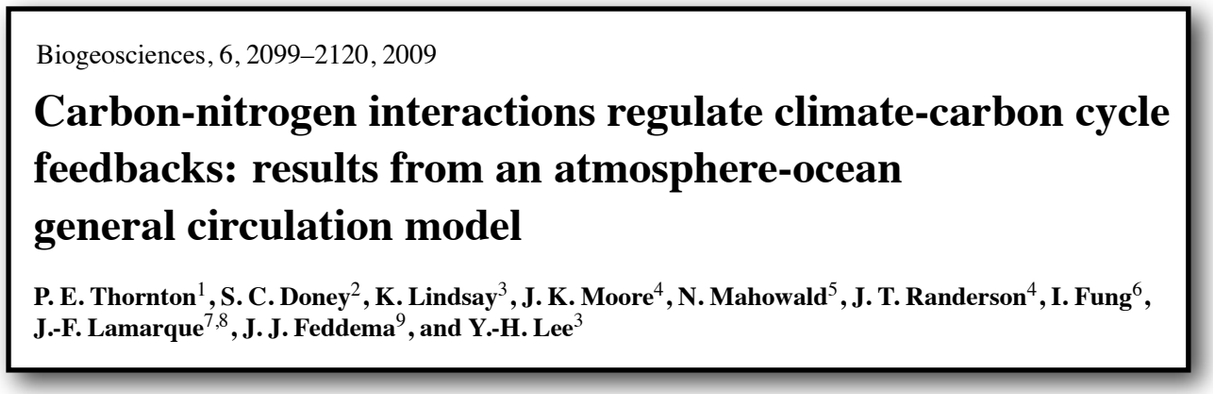

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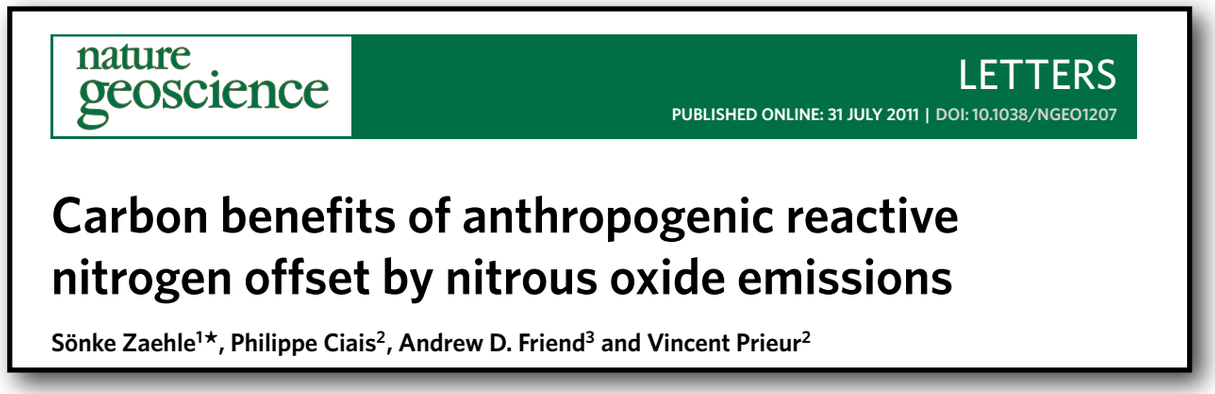

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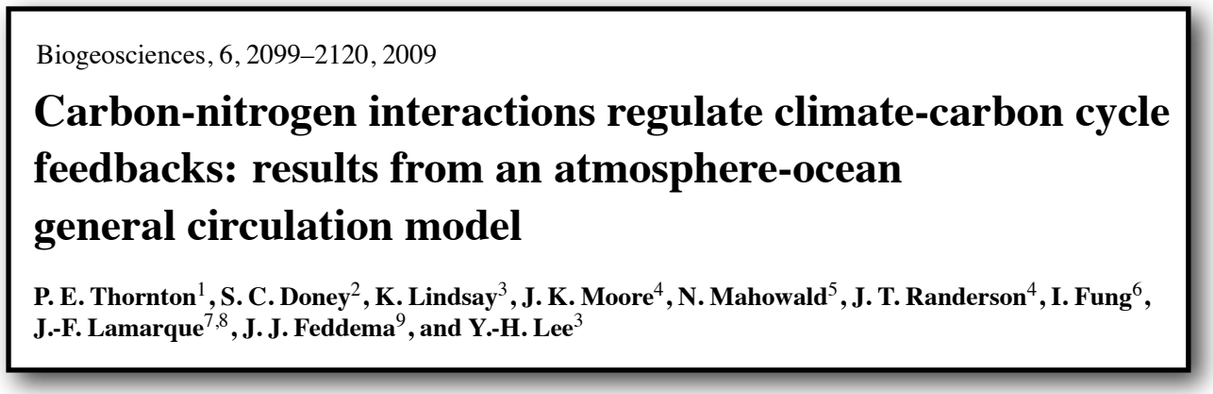

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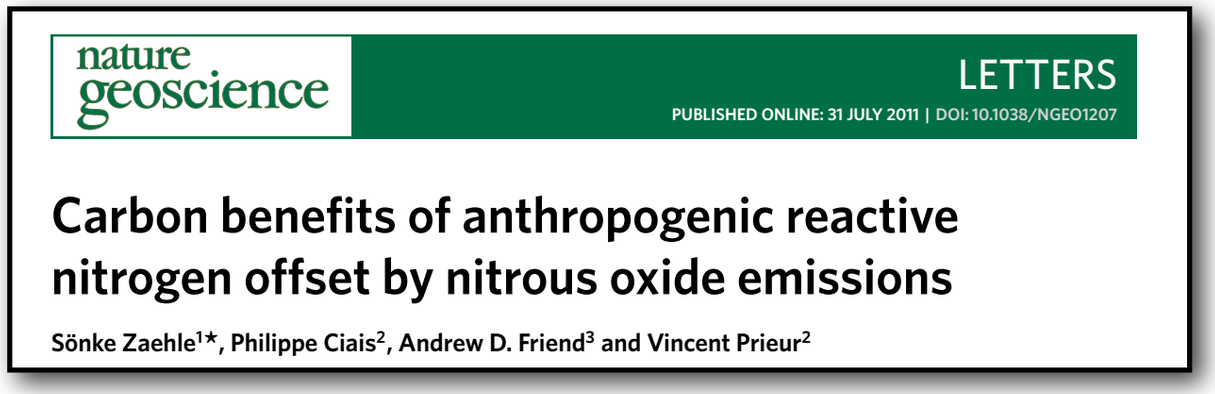

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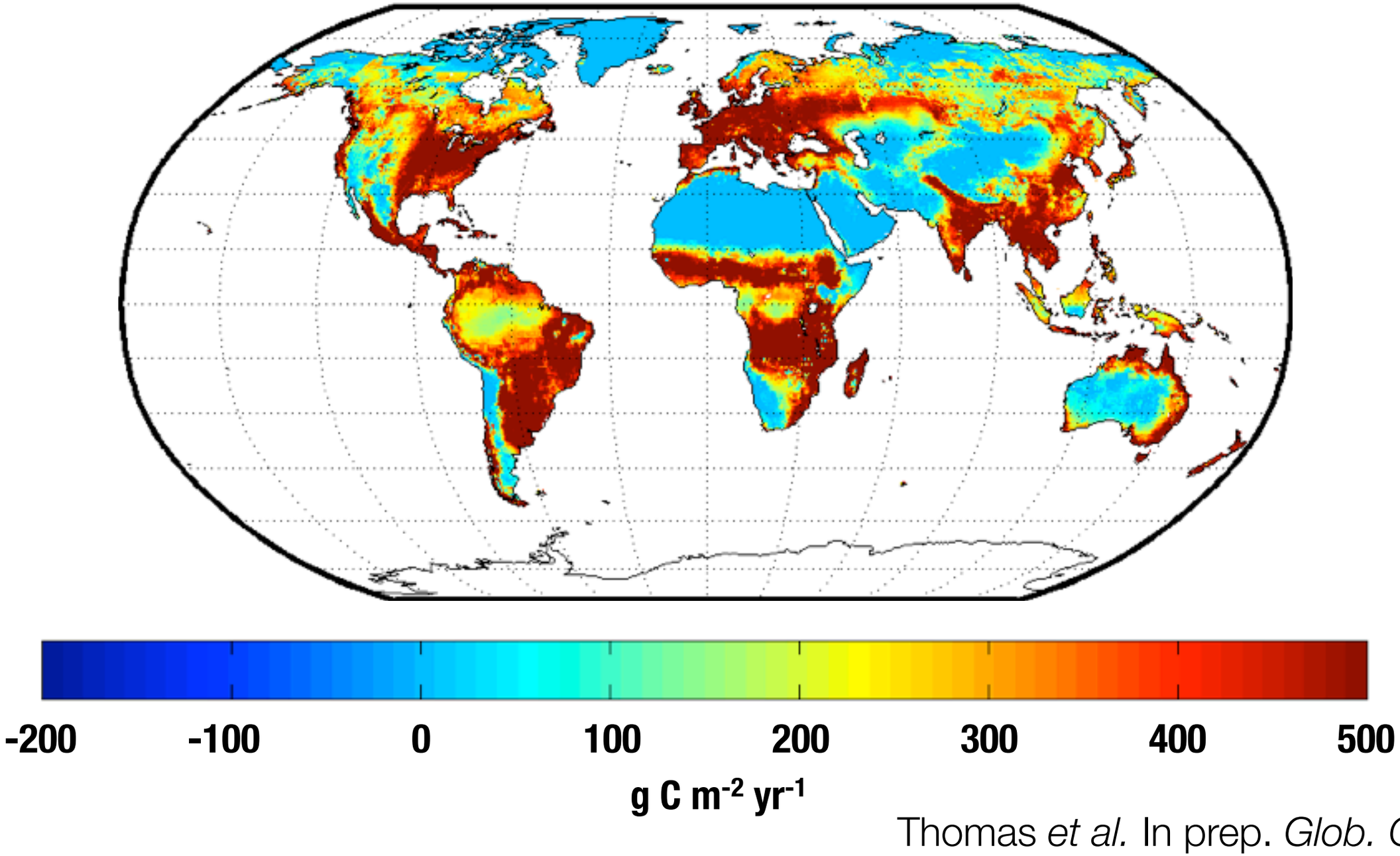
Differing mechanisms governing N loss

Global nitrogen fertilization experiment

- 25 year simulations (1985-2009)
- Nitrogen applied globally at five levels continuously
  - Low application to parallel plausible changes in nitrogen deposition (0.5 g N m^{-2} yr^{-1})
  - Higher applications to parallel field experimental additions of nitrogen fertilizer to terrestrial ecosystems (2.0, 4.0, 10.0 g N m^{-2} yr^{-1})
  - High application to test nitrogen saturation (30.0 g N m^{-2} yr^{-1})
- Same climate inputs and land-use history

Global nitrogen fertilization response: High addition (30.0 g N m^{-2} yr^{-1})

ΔNet Primary Productivity (CLM-CN)



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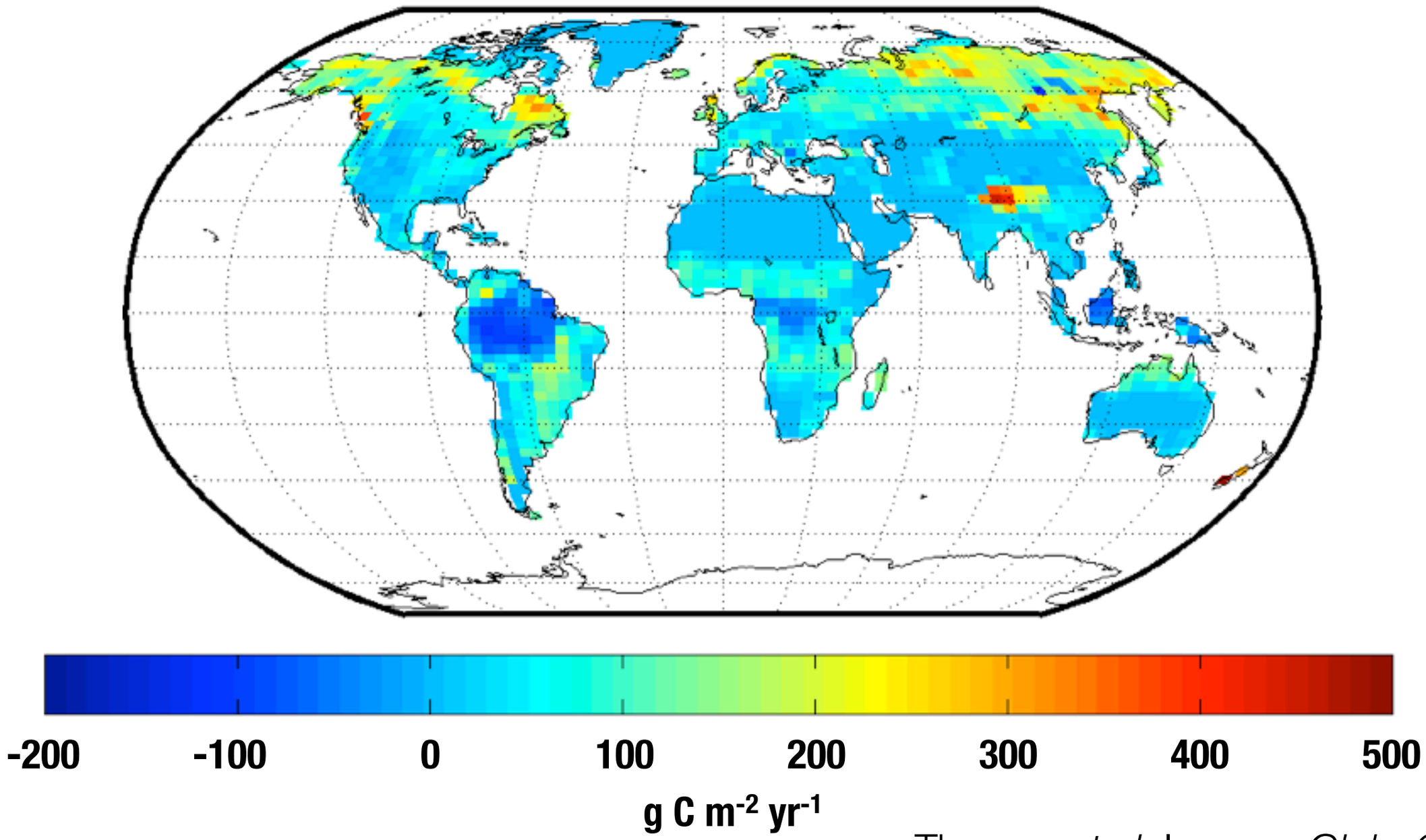

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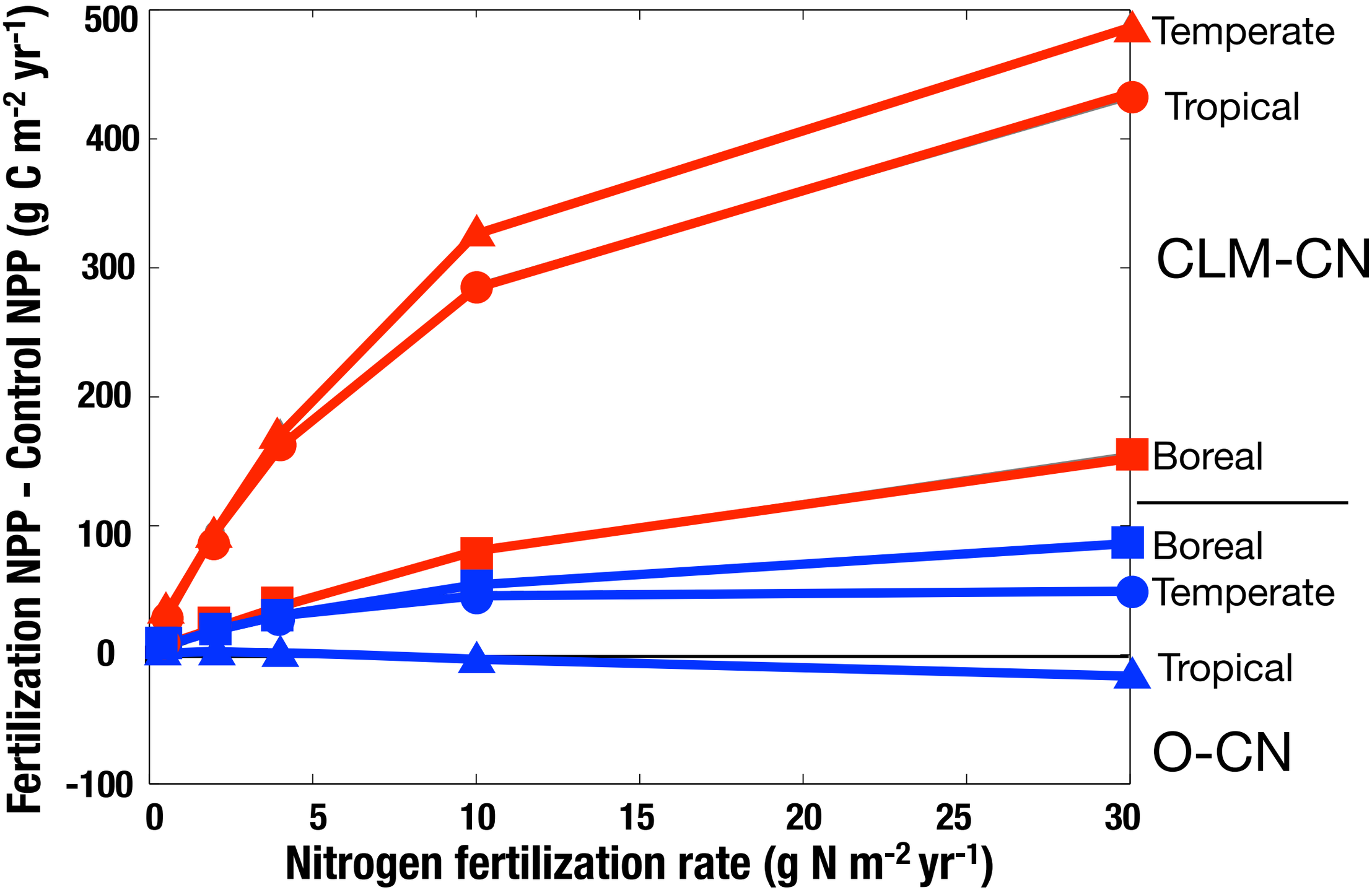
CLM-CN more responsive to nitrogen than O-CN



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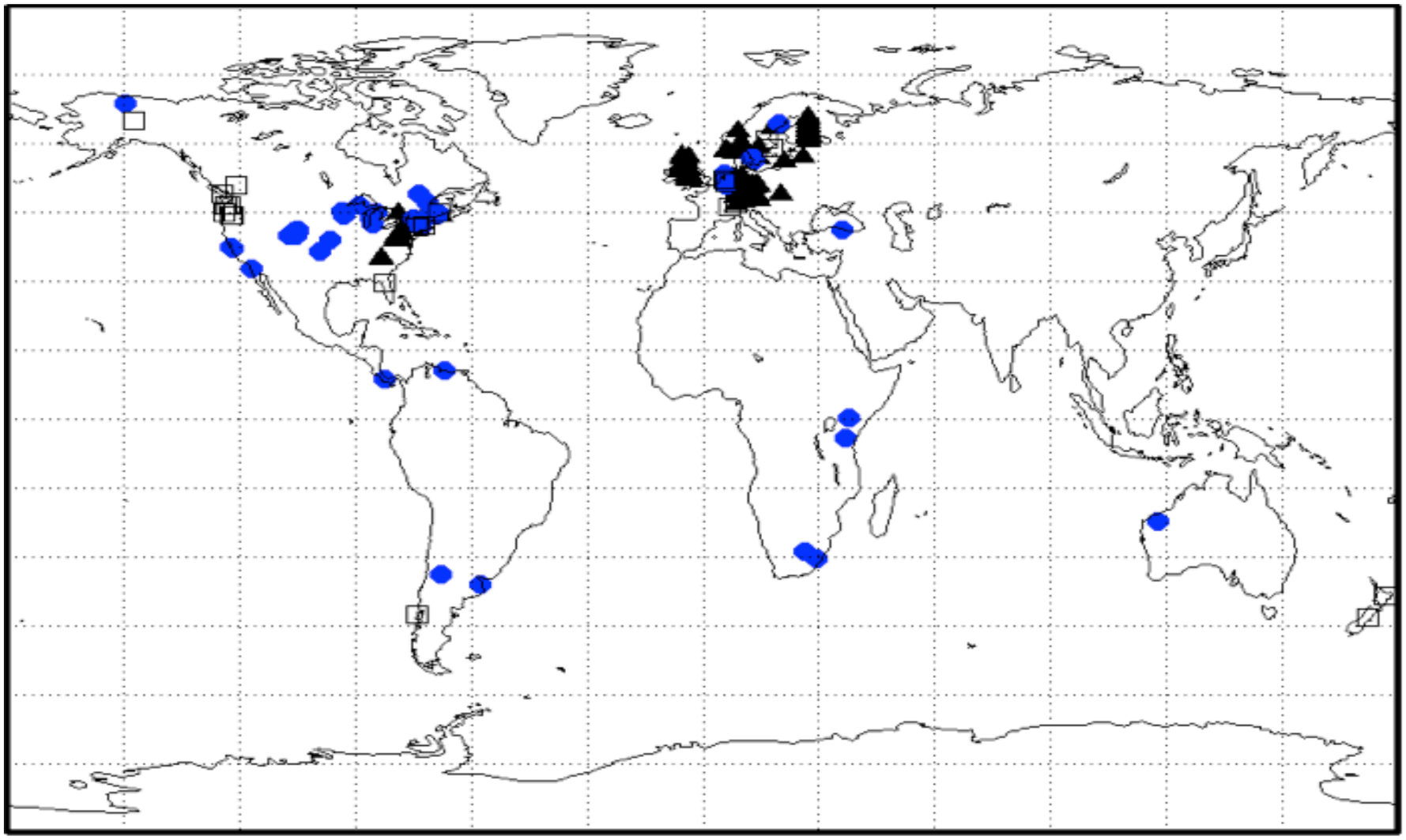
Model comparison to data:
Model response compared to observations



● Nitrogen fertilization experiments

□ ^{15}N tracer studies

▲ Plot/small catchment nitrogen budgets

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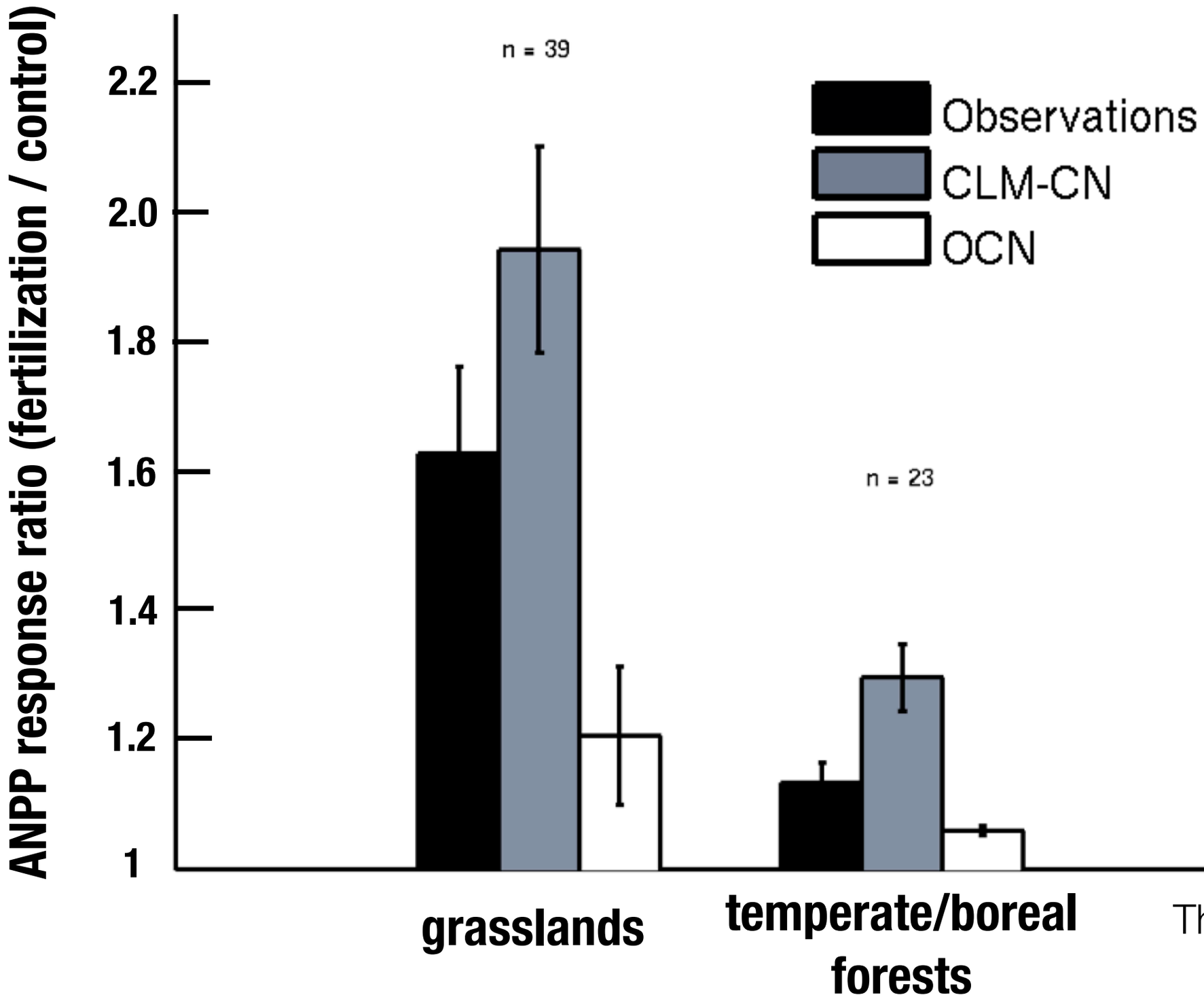
Model comparison to data:
NPP response to N fertilization



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Model comparison to data:
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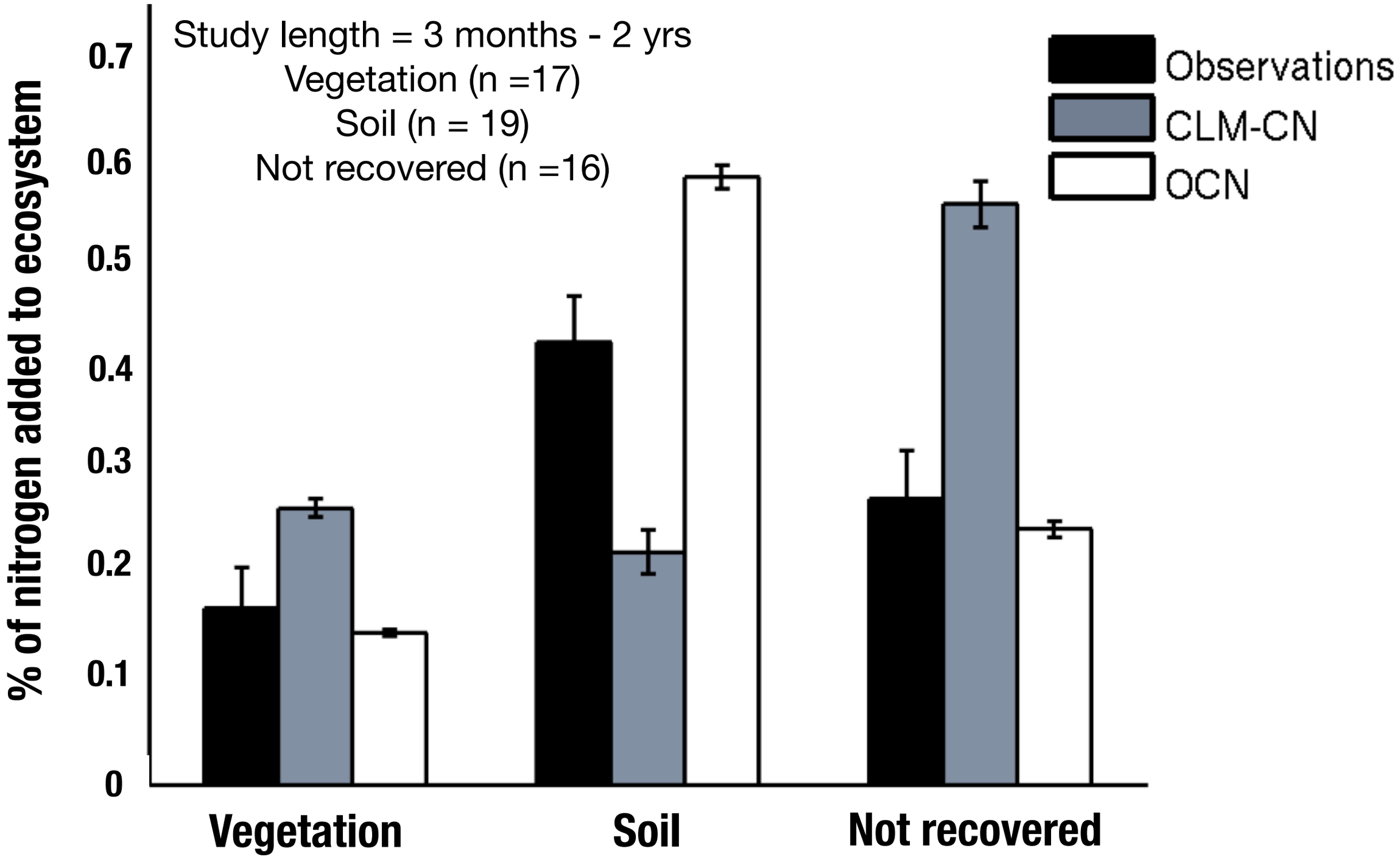

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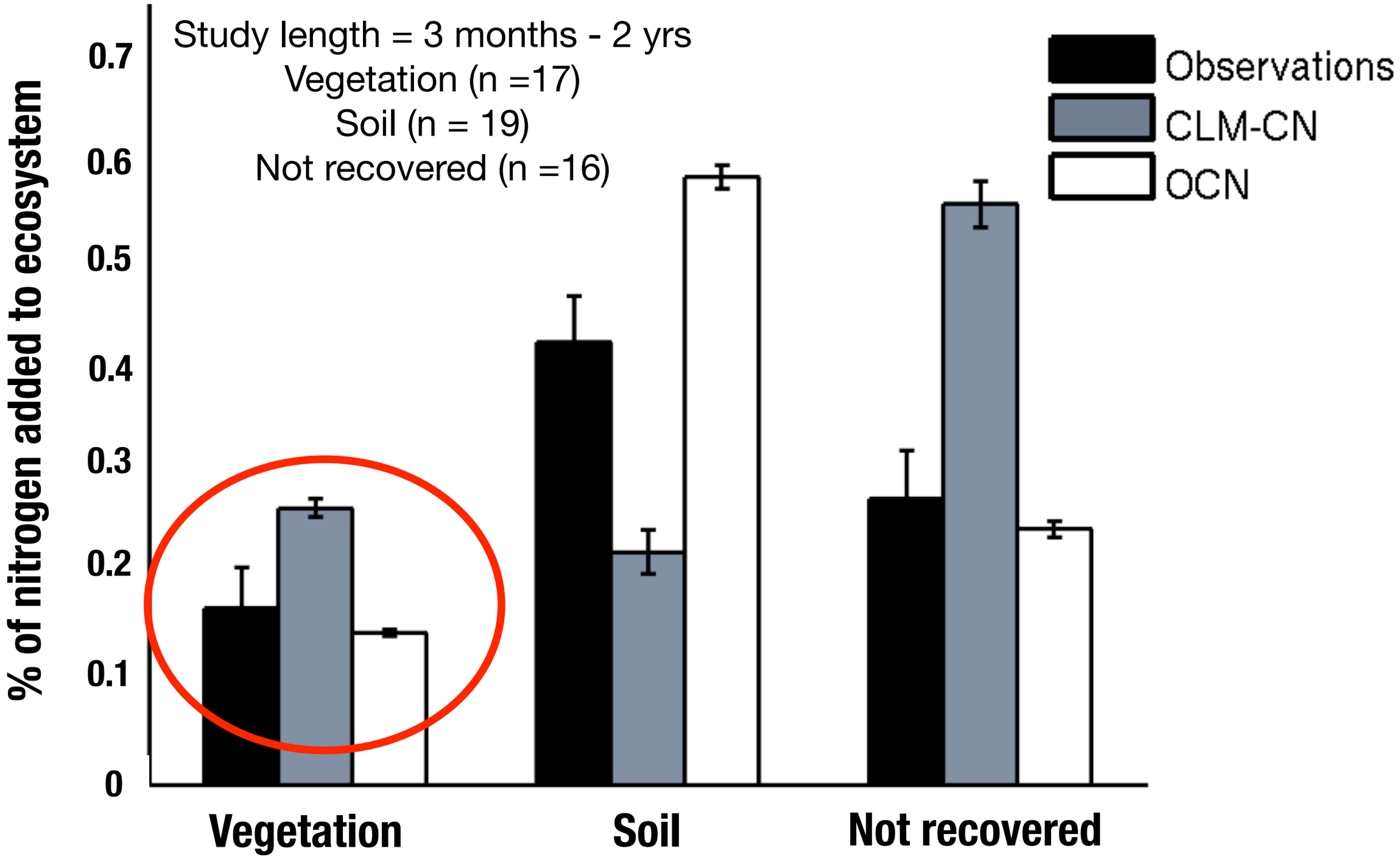

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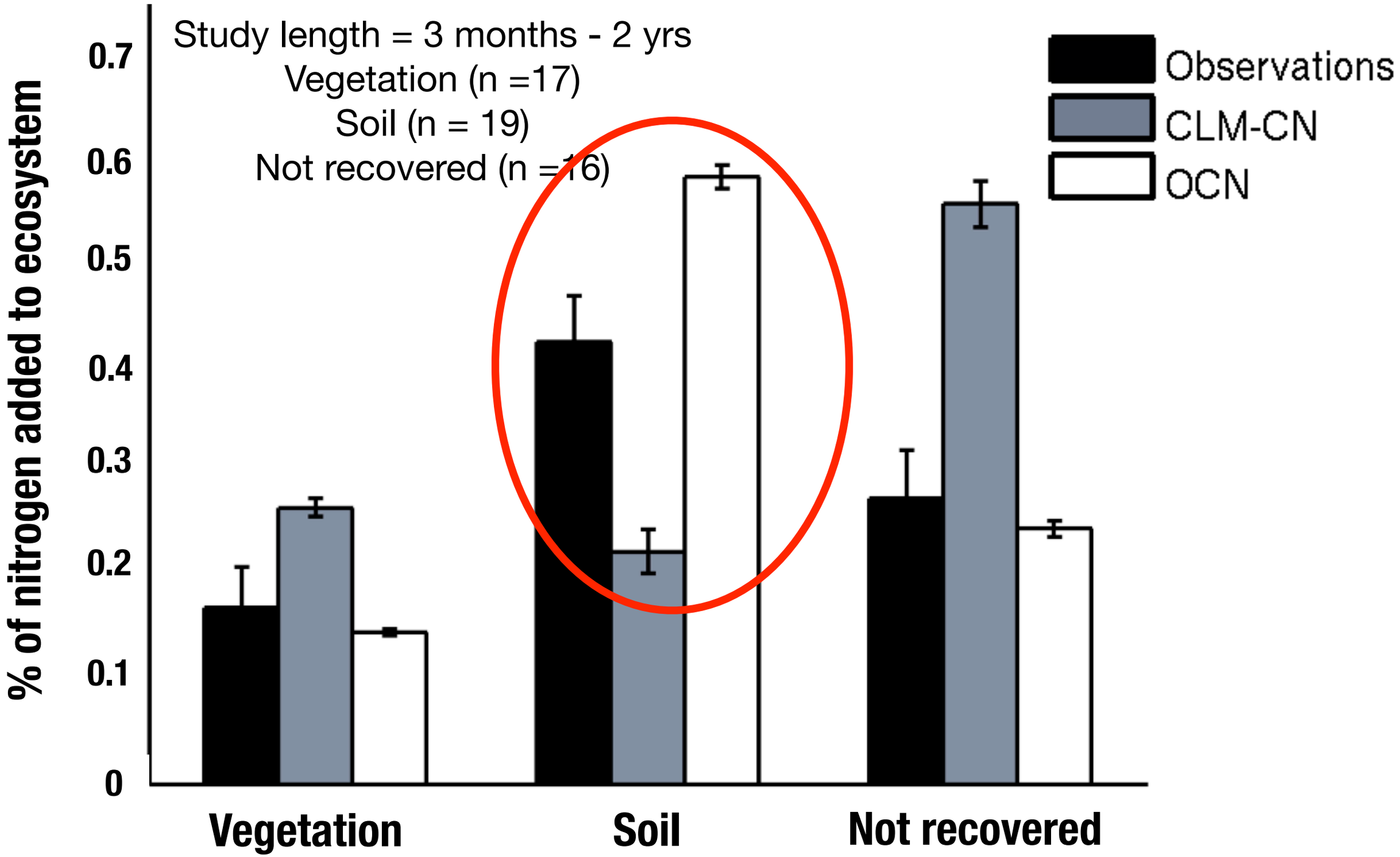

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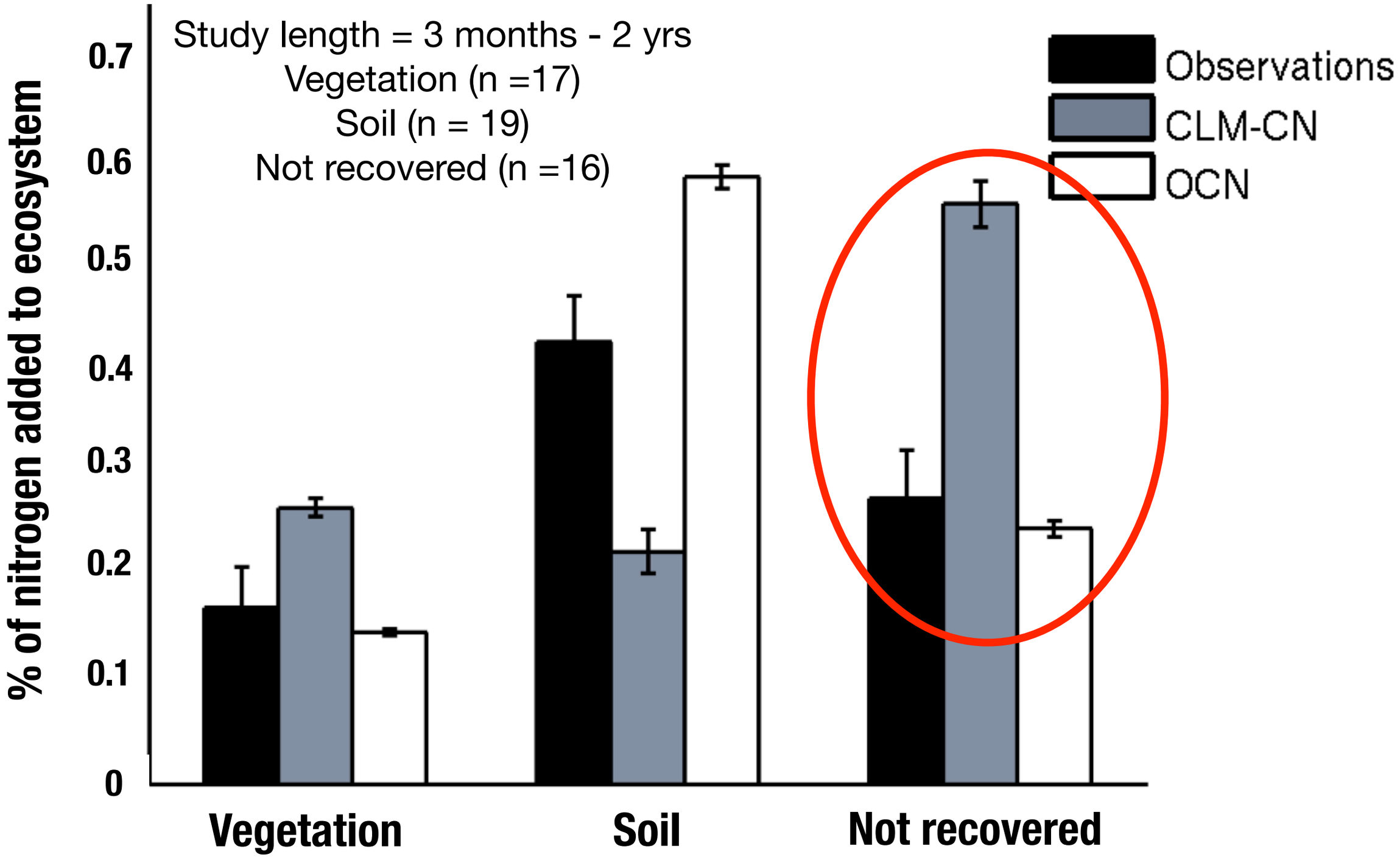

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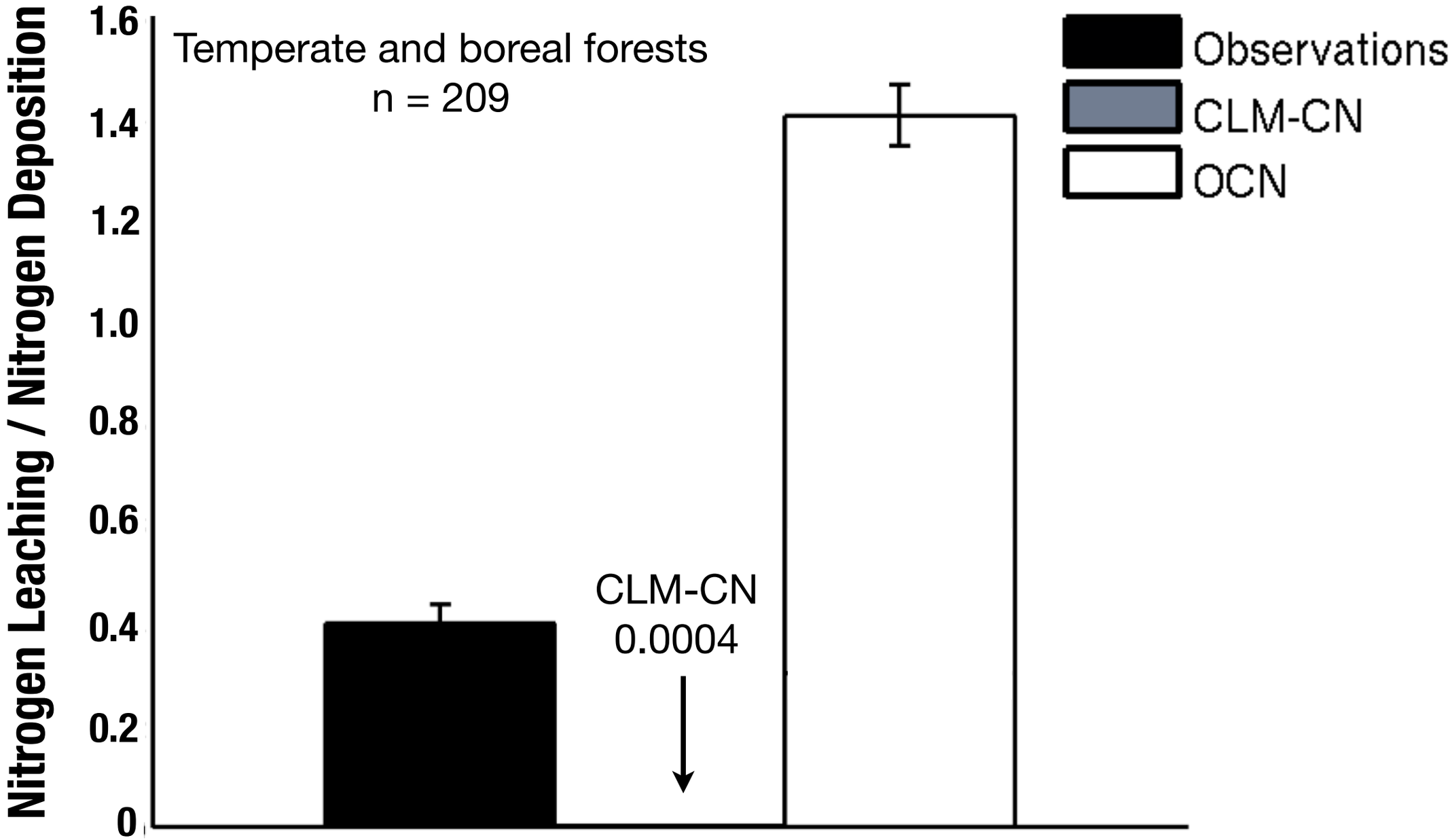

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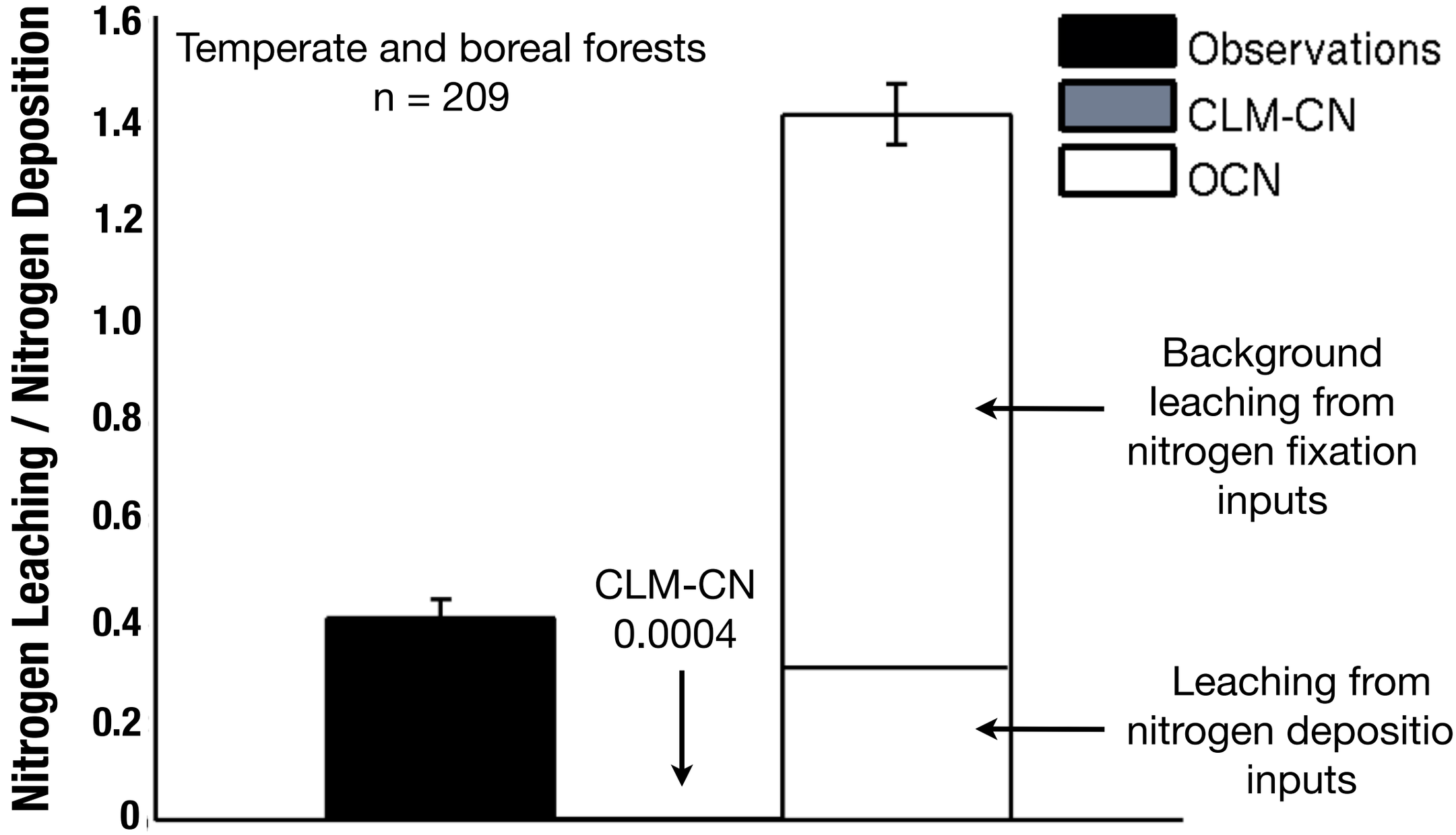

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Conclusions and Implications (cont'd)

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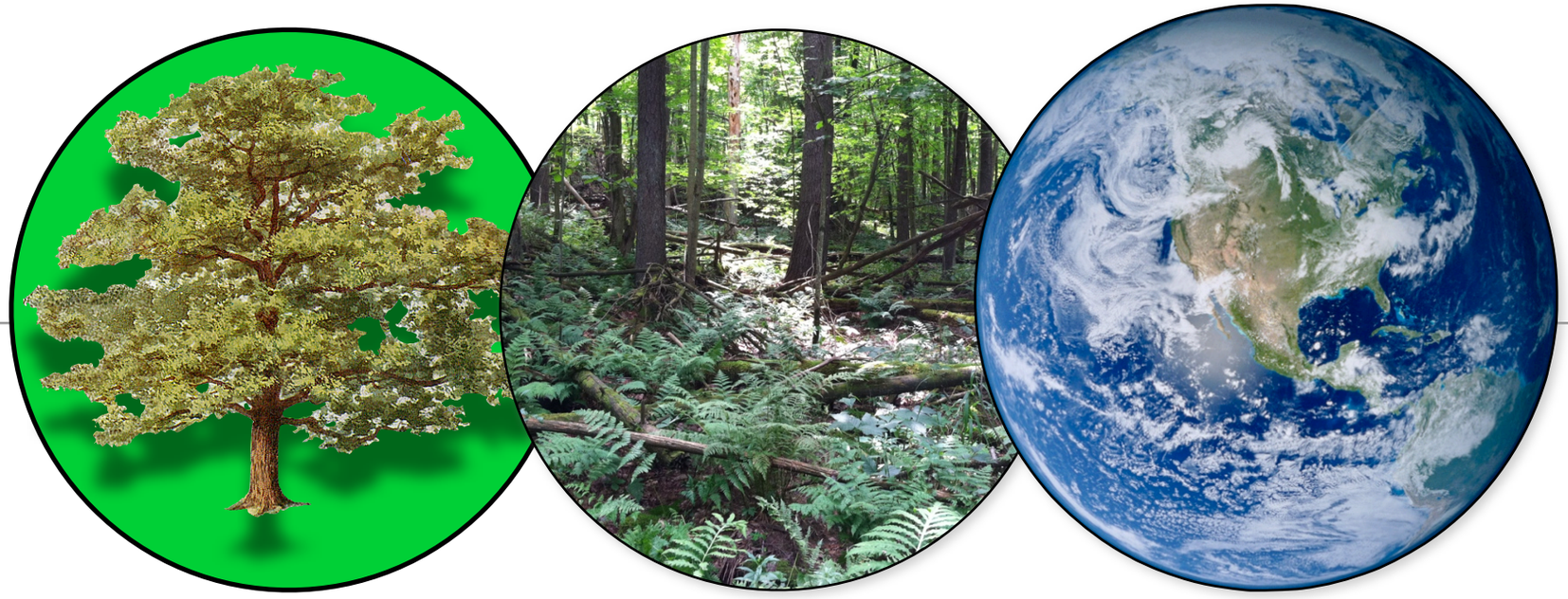
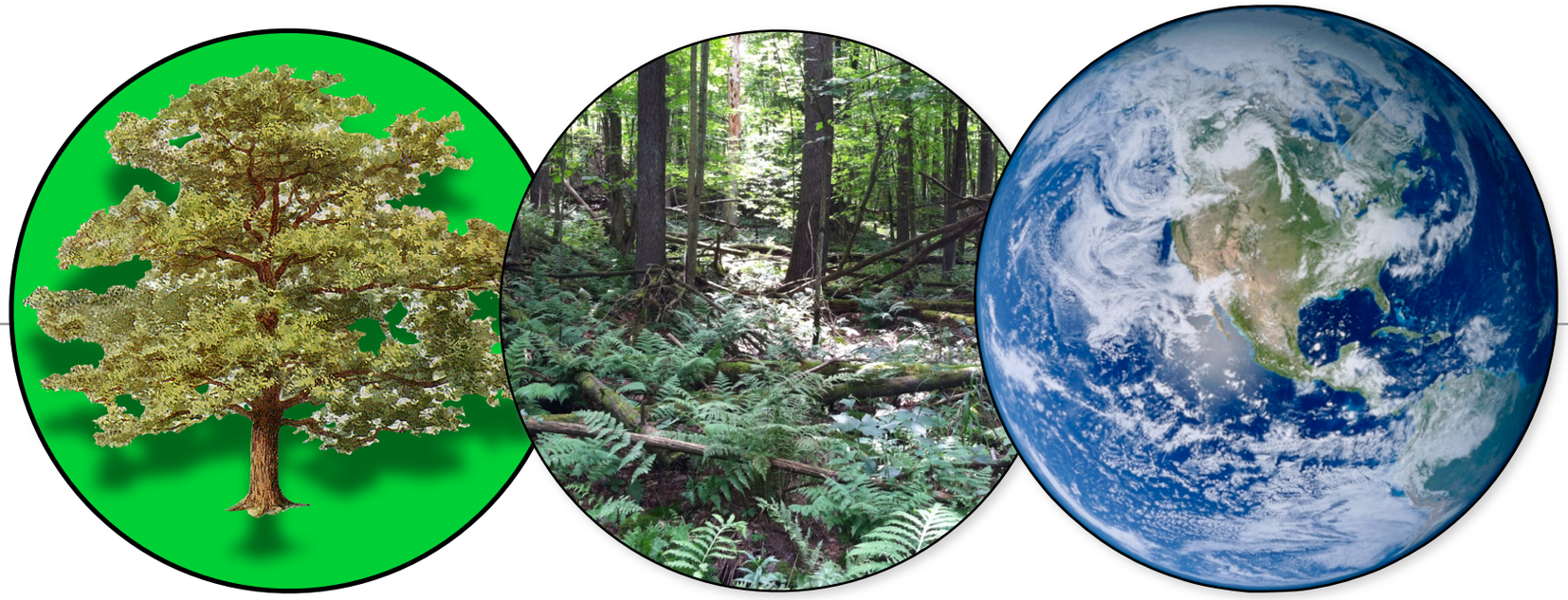
- Future research will focus on testing additional models and expanding the observational data set

Questions?



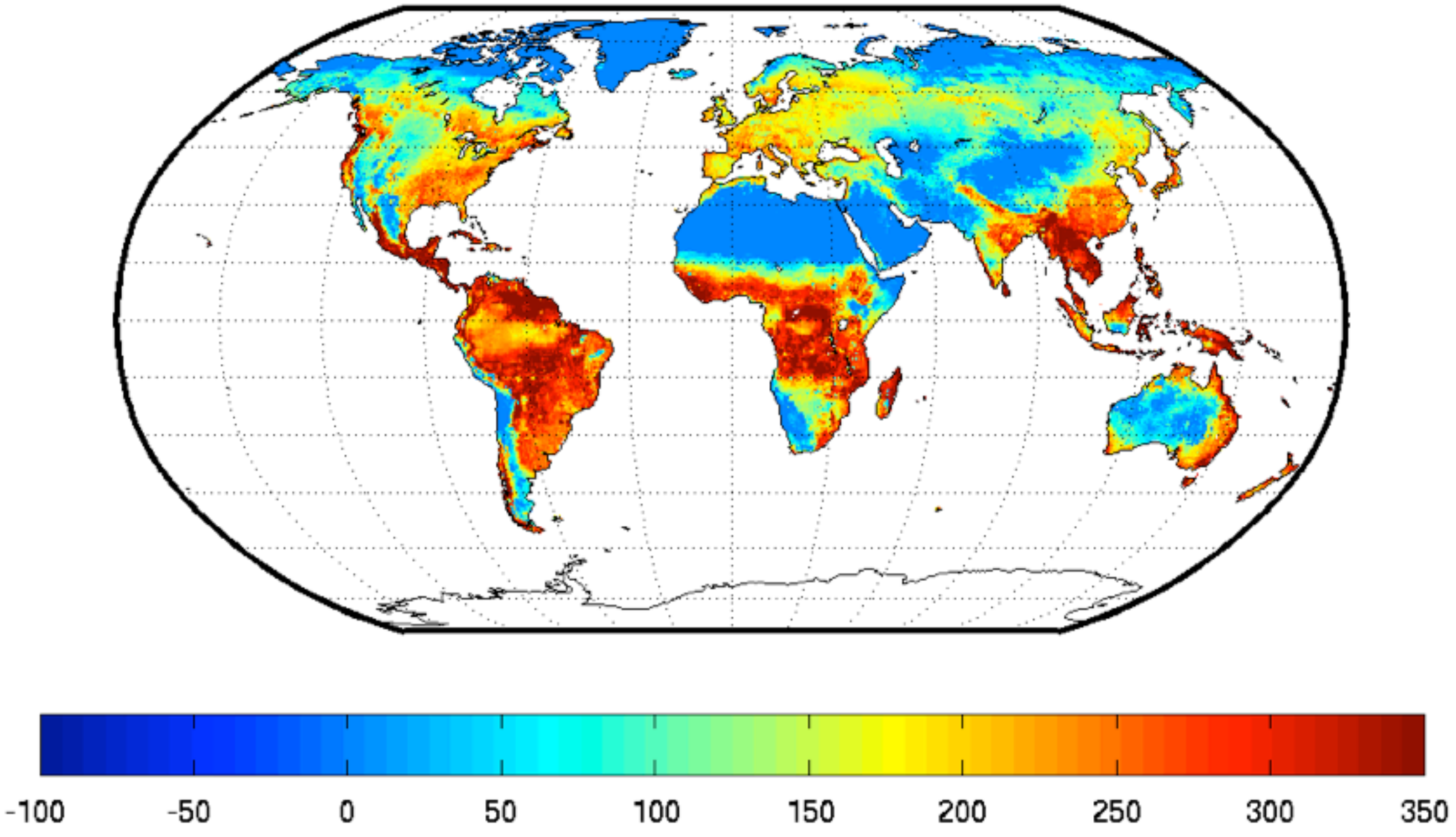
Questions?



- National Science Foundation
- Cornell Biogeochemistry and Environmental Biocomplexity Program
- Discussion with participants at the 2011 INTERFACE Research Coordination Network meeting in Florida
- Sam Levis and Gordon Bonan at the National Center for Atmospheric Research

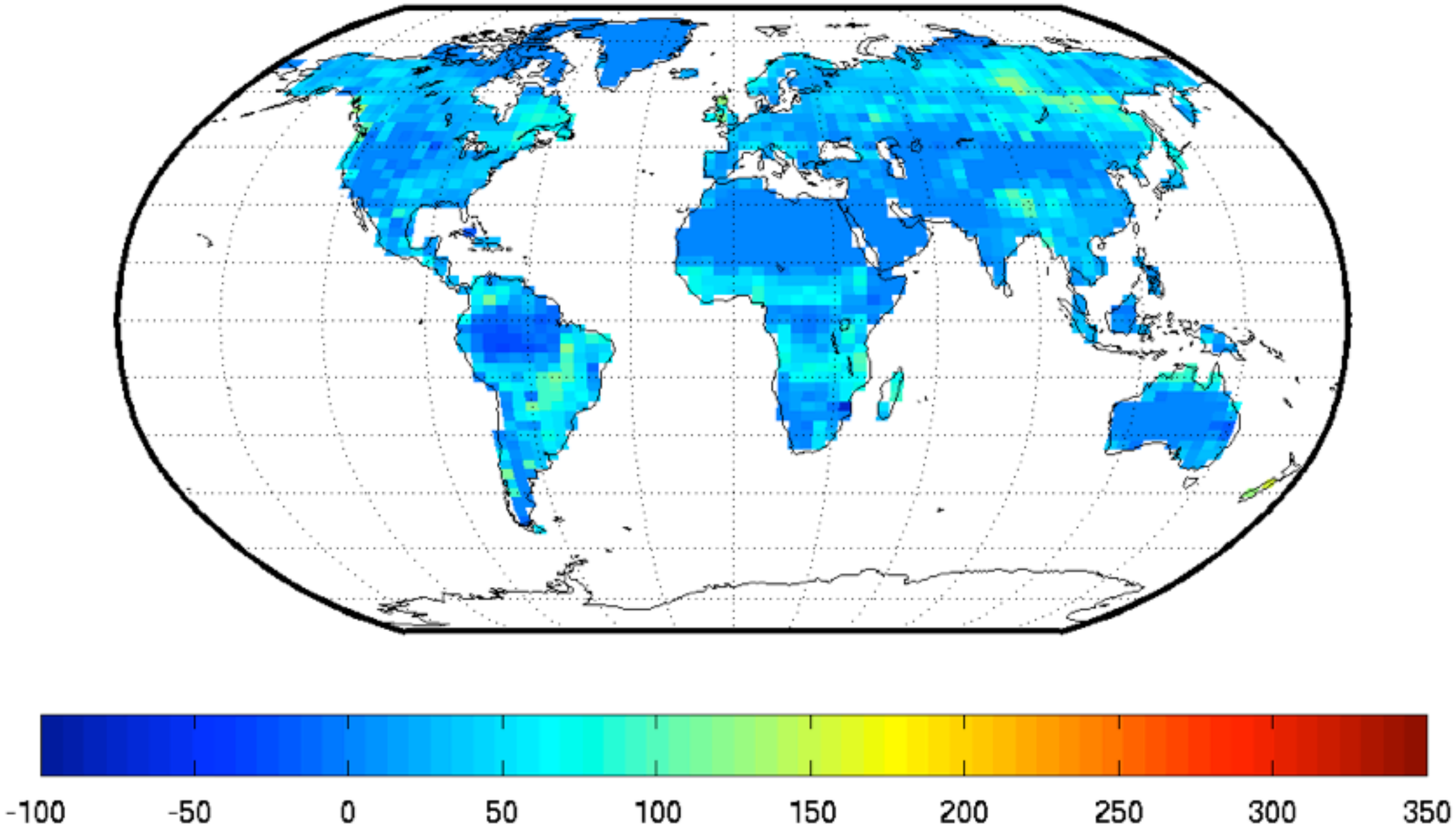
Global nitrogen fertilization response (5 yr): High addition (10.0 g N m^{-2} yr^{-1})

ΔNet Primary Productivity (CLM-CN)



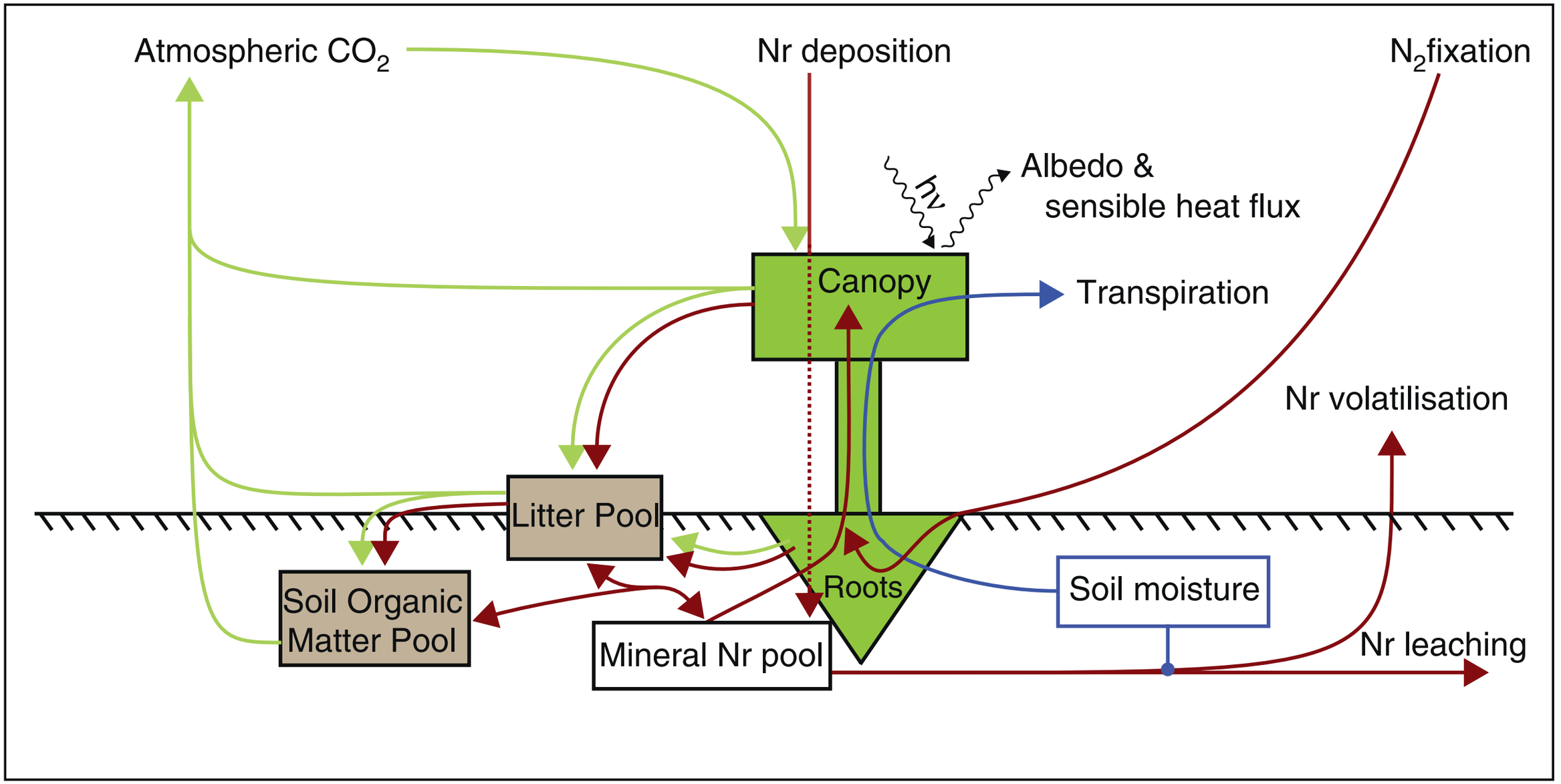
Global nitrogen fertilization response (5 yr): High addition (10.0 g N m^{-2} yr^{-1})

ΔNet Primary Productivity (O-CN)



Thomas *et al.* In prep. *Glob. Ch. Biol.*

Global biogeochemical models coupled to climate models: overview



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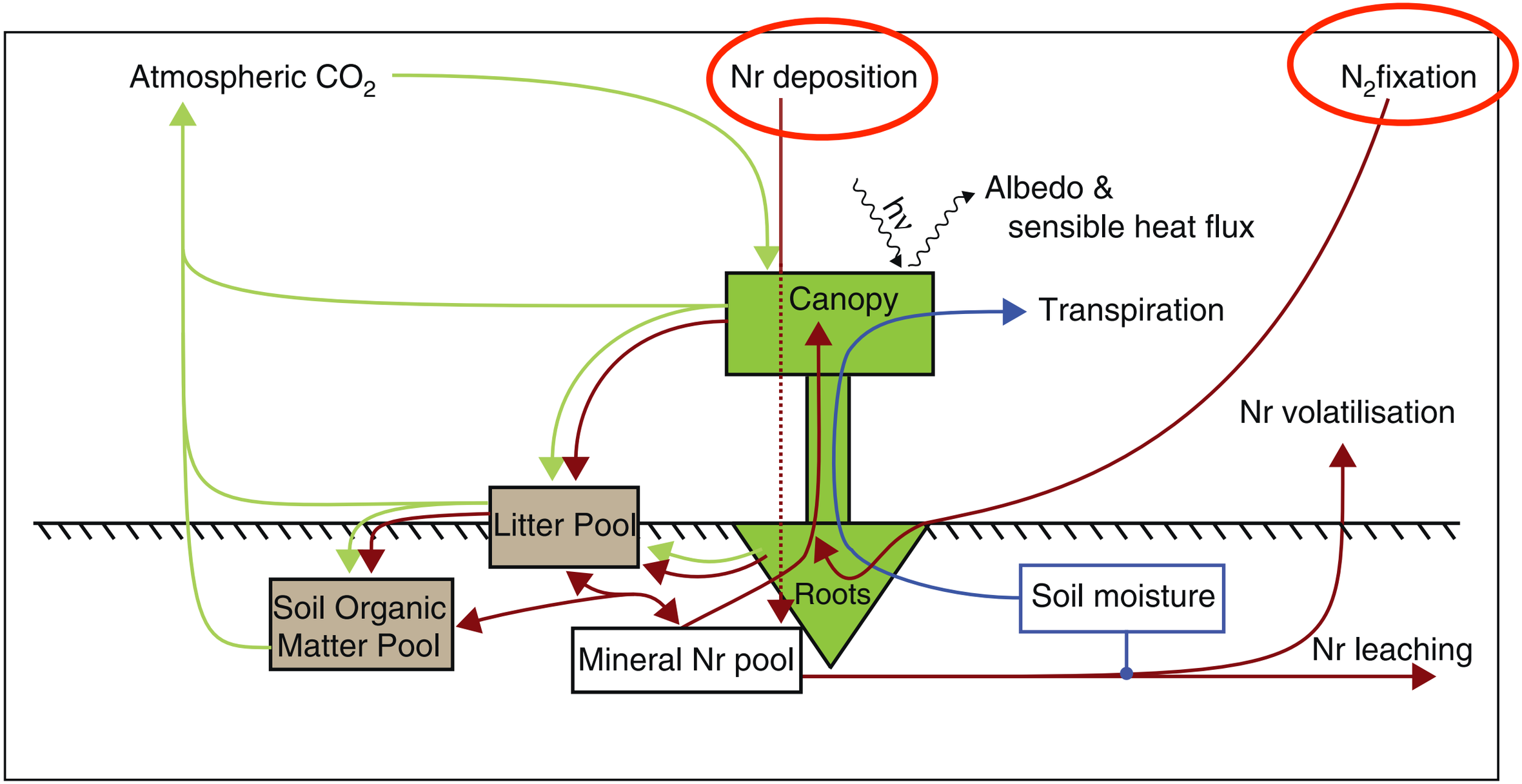
Global biogeochemical models coupled to climate models: overview



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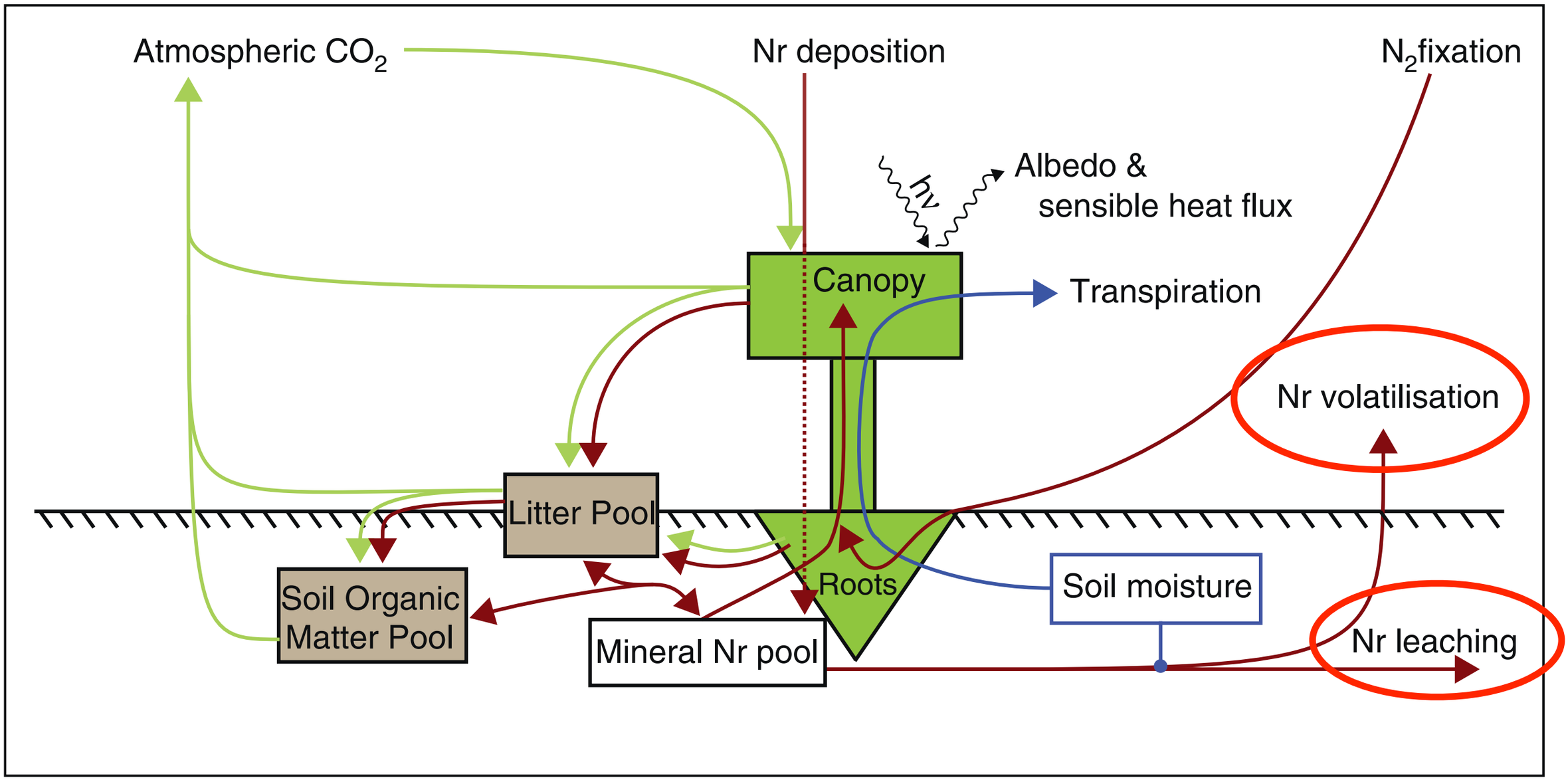
Global biogeochemical models coupled to climate models: overview



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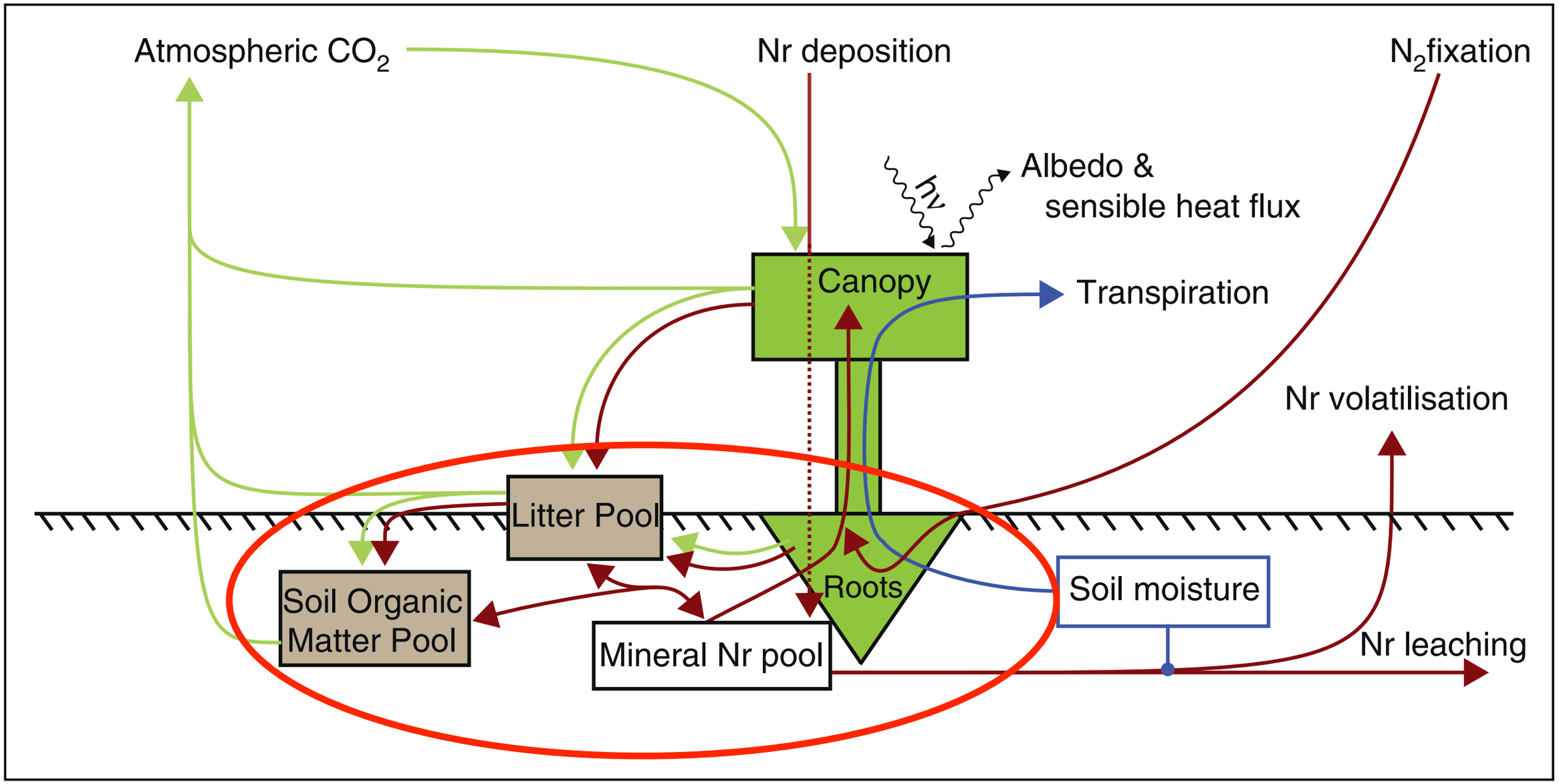
Global biogeochemical models coupled to climate models: overview



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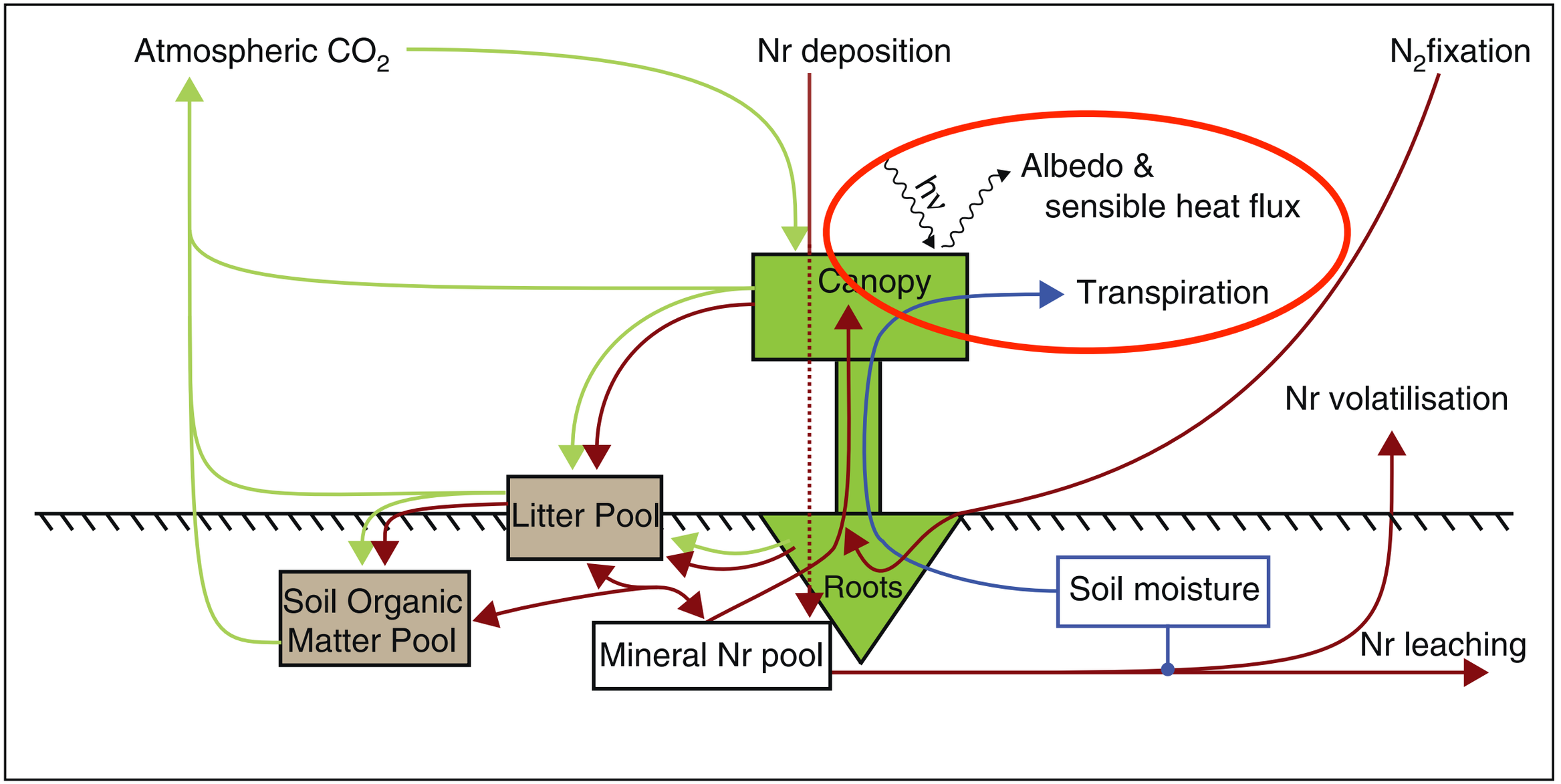
Global biogeochemical models coupled to climate models: overview



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