

# **Elevated atmospheric CO<sub>2</sub> concentrations and the effects on net nitrogen mineralization rates in a CO<sub>2</sub> enriched sweetgum forest**

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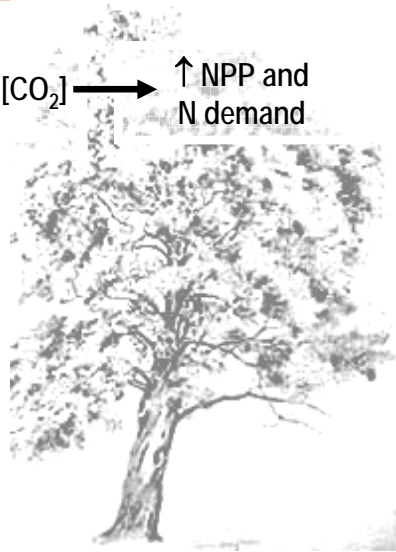


## Rising [CO<sub>2</sub>] and Nitrogen Cycling

- [CO<sub>2</sub>] = 280 ppm before 1750 → 379 ppm in 2005
- Models predict ↑ [CO<sub>2</sub>] → ↑ C stored in terrestrial biosphere
- C accumulation may be constrained by unavailability of inorganic N

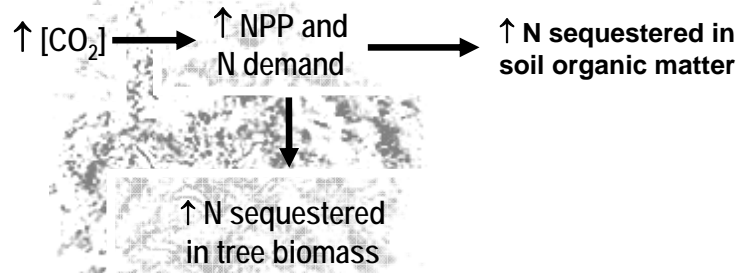
# Progressive N Limitation

↑ [CO<sub>2</sub>] → ↑ NPP and  
N demand



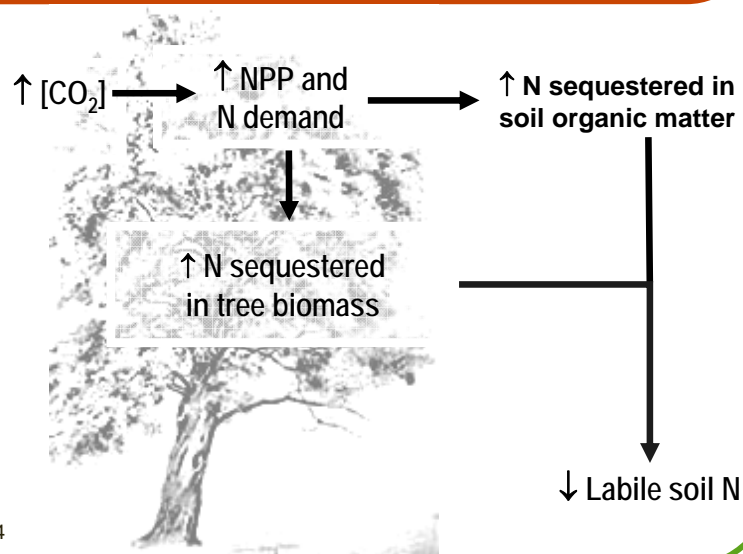
Modified from  
Luo et al. 2004

# Progressive N Limitation



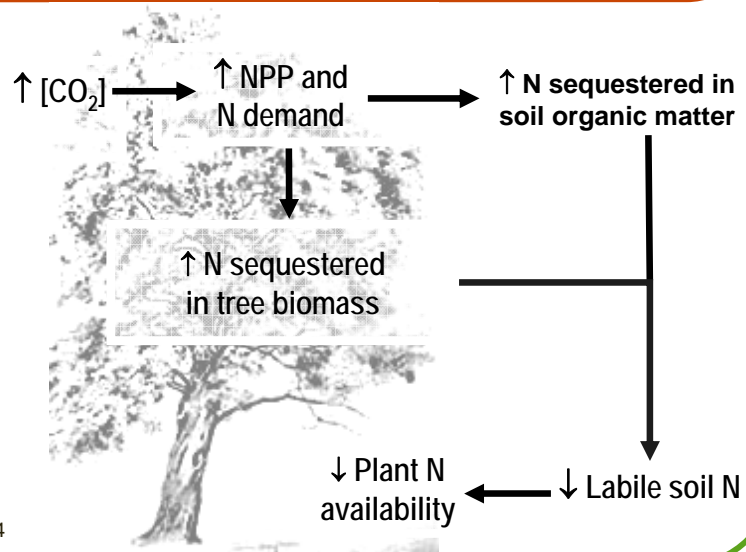
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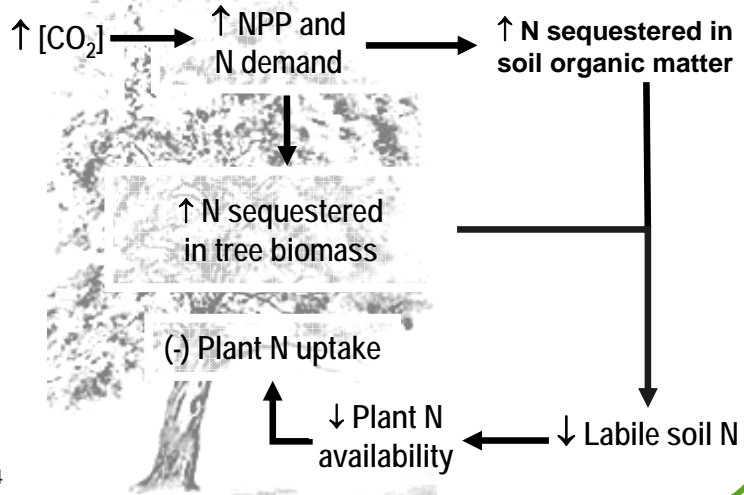


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Luo et al. 2004

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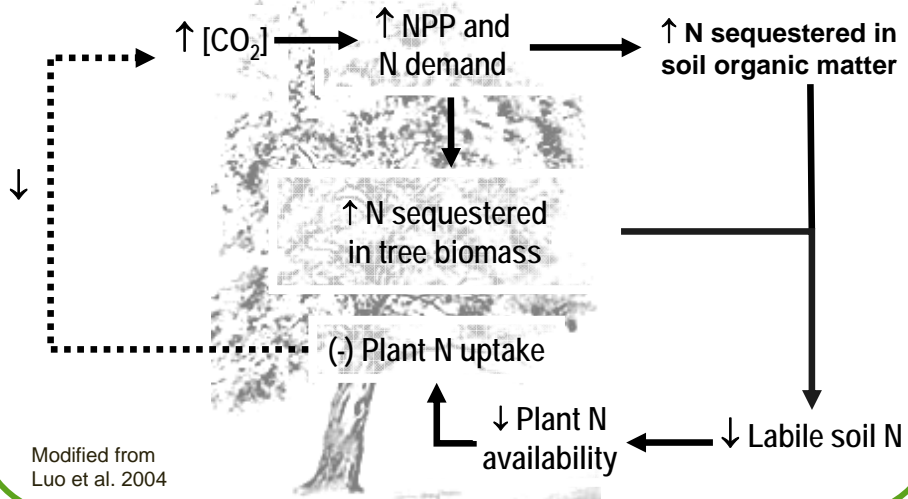


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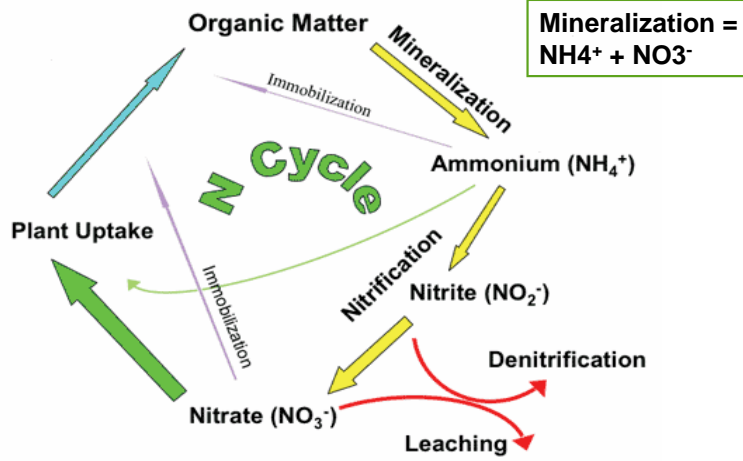
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# Progressive N Limitation



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# The Nitrogen Cycle



Adapted from: <http://www.ipm.iastate.edu/ipm/icm/node/2415/print>

## Research Predictions

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- **Elevated [CO<sub>2</sub>] will not affect N leaching losses.**

# Oak Ridge FACE Site



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FACE = Free Air CO<sub>2</sub>  
Enrichment

Sweetgum  
(*Liquidambar  
styraciflua* L.)  
plantation: est. 1988



Ambient rings: avg.  
at 391 ppm CO<sub>2</sub>

Enriched rings: 544  
ppm CO<sub>2</sub>

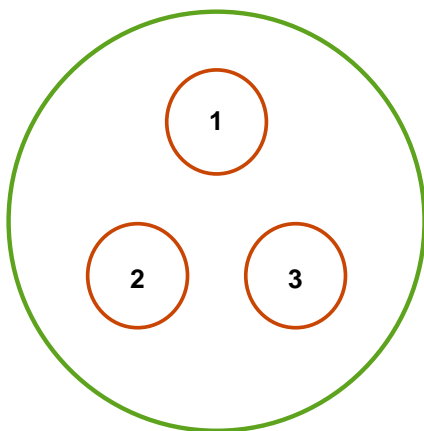


The site consists of  
five, 25 m diameter  
rings

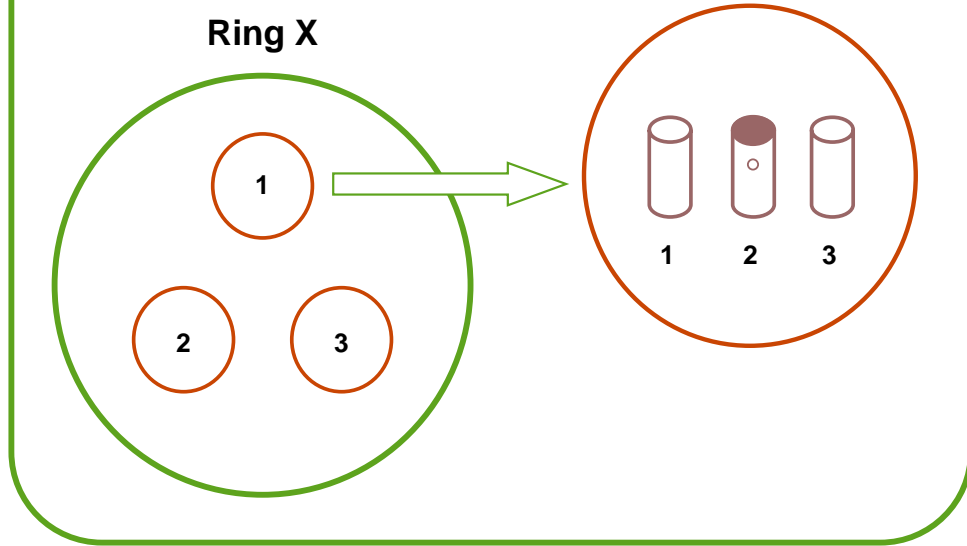


# Experimental Design

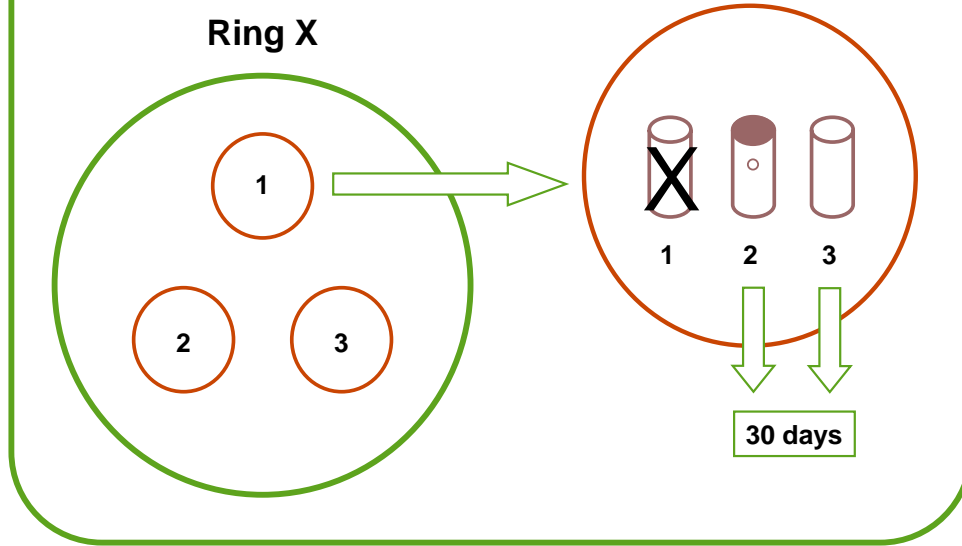
Ring X



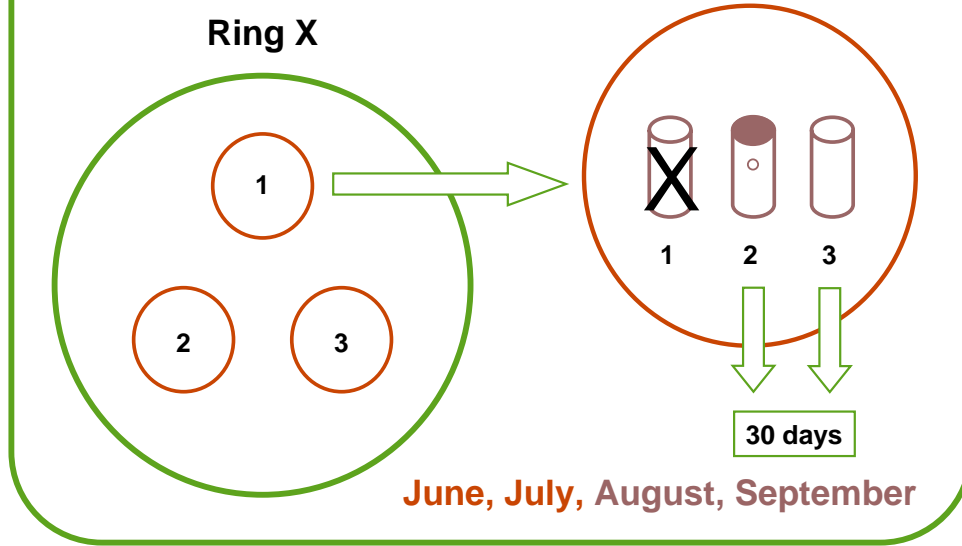
# Experimental Design



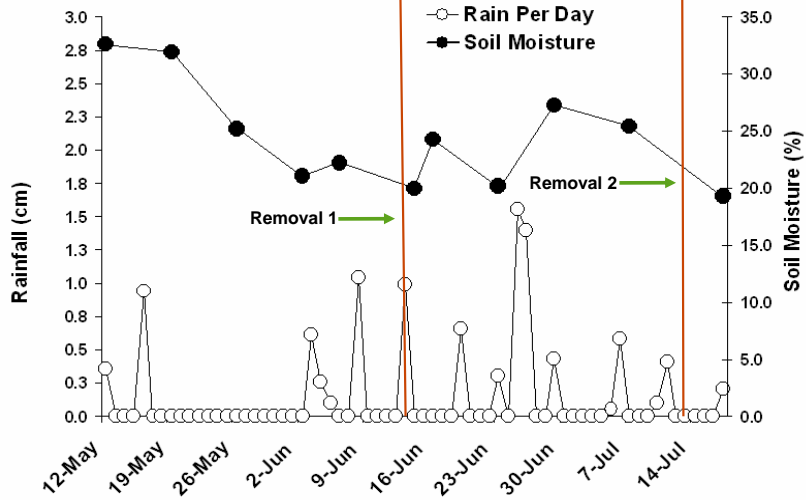
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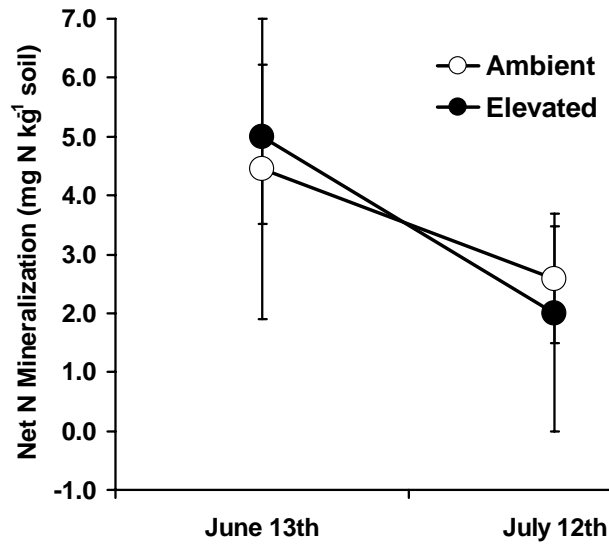
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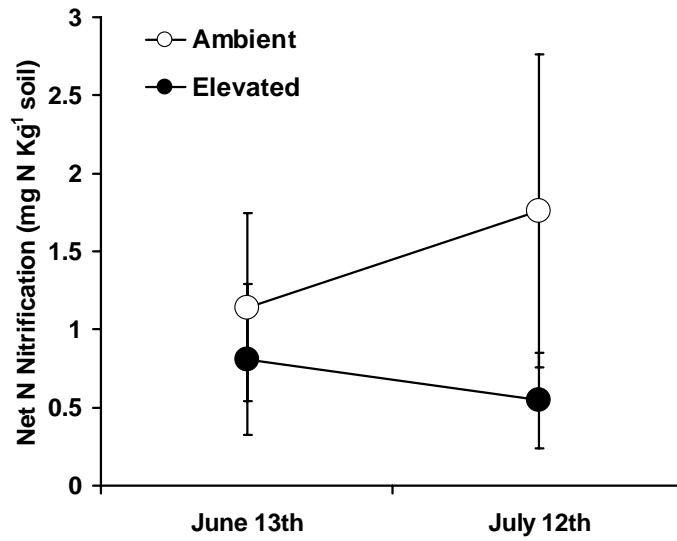
# Precipitation in Drought Conditions



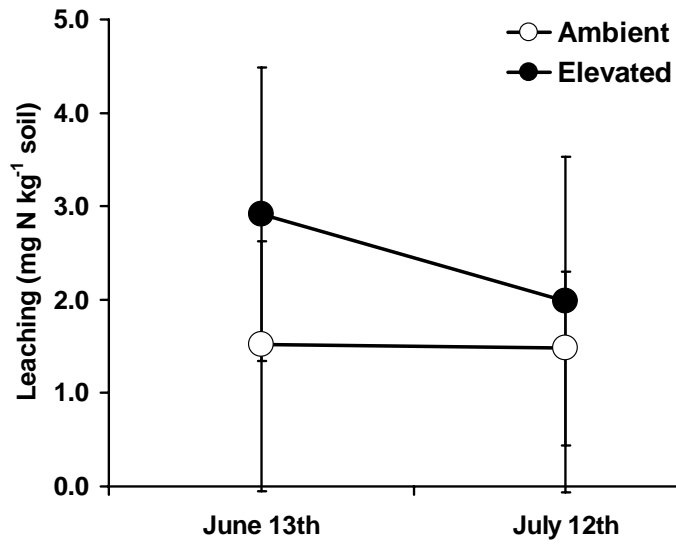
# Net N Mineralization Decreases Over Time



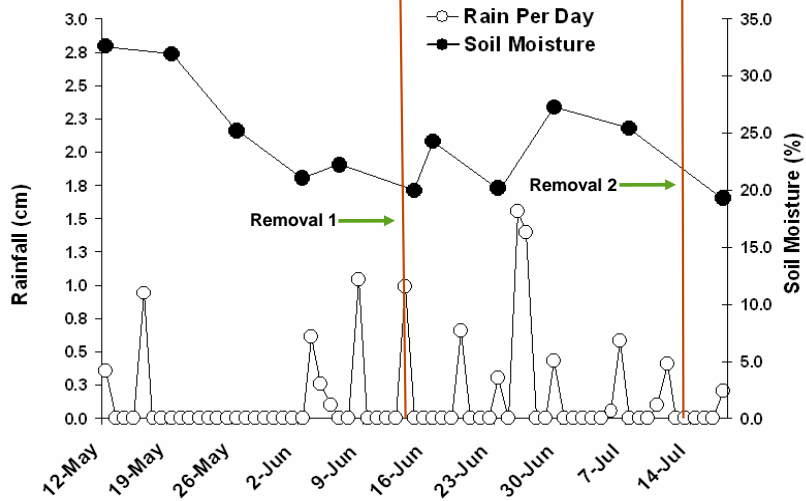
# Net N Nitrification Levels



# Leaching Levels Similar Over Time



# Soil Moisture and Daily Rainfall



## Take Home Message

- **At Oak Ridge FACE, net N mineralization was not affected by elevated [CO<sub>2</sub>], however, it decreases between the months.**

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  - **Possible cause 1: atypical drought → ↓ microbial activity → ↓ uptake of inorganic N.**

## Take Home Message

- **At Oak Ridge FACE, net N mineralization was not affected by elevated  $[\text{CO}_2]$ , however, it decreases between the months.**
  - Possible cause 1: atypical drought  $\rightarrow$   $\downarrow$  microbial activity  $\rightarrow$   $\downarrow$  uptake of inorganic N.
  - Possible cause 2:  $\uparrow$  Microbial activity under elevated  $[\text{CO}_2]$  does not alter net N available for uptake.

## Take Home Message

- **In order to predict future carbon sequestration options and understand terrestrial nutrient cycling, it is necessary to understand net N mineralization under enriched [CO<sub>2</sub>].**

## Future Directions

- **Collect August and September data, to finish my experiment!**

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- **Long term studies on net N mineralization at CO<sub>2</sub> enriched sites with mature forests are important.**

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- More work is needed to illuminate the effects of elevated [CO<sub>2</sub>] on soil N cycling and its effects on forest production.
- Long term studies on net N mineralization at CO<sub>2</sub> enriched sites with mature forests are important.
- **We must integrate net N mineralization data into global climate change models in order to accurately predict ecosystem responses.**

# Acknowledgements: Thank You!



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