FACULTY OF SCIENCE
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Fate of increased nitrogen deposition in humid sub-tropical forests in Southern China

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Introduction

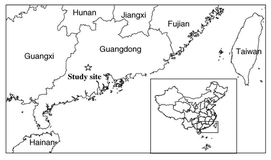
- Increased N deposition can result in N saturation when the biotic demand for N is exceeded, leading to increased rates of N cycling and losses of nitrate (NO_3), soil and surface water acidification, plant nutrient imbalances, even forest decline.
- But, these effects depend on the fate of deposited N
- The fate of increased N deposition is less understood in humid tropical forests, which in China recieves among the highest N depositions in the world

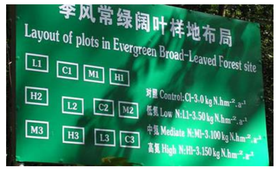
Objectives

- investigate the fate of deposition N in tropical forest ecosystems and especially to understand the N retention mechanisms in these forest using isotopic labelling techniques (^{15}N)
- to compare the fate of N in the humid tropics with that found in similar experiments in temperate forests

Study site

- Sub-tropical mixed broadleaved forest, regional climax (~400 yrs old),
- Precipitation 1927 mm.
- High nitrogen deposition of 30 -73 kg N ha^{-1} yr^{-1}





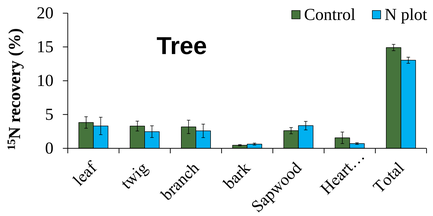
Experimental design and sampling

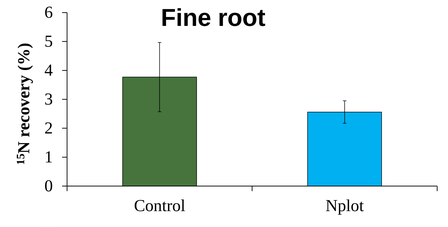
- A nitrogen addition experiment established in 2004
- Two levels of N deposition: Ambient and 50 kgNha^{-1}yr^{-1}
- Stable isotope technique: $^{15}NH_4{}^{15}NO_3$-tracer addition over 1 year
- Sampling of major ecosystem pool i.e. all plant component and soils, fluxes.
- Quantifying the recovery (fate) of the added tracer using the following equation:

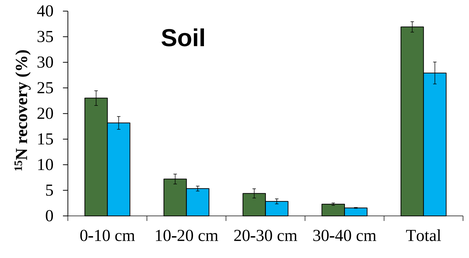
$$^{15}N_{rec}\% = m_f\,(\text{atom }\%\ ^{15}N_f - \text{atom }\%\ ^{15}N_i) \,/\, m_t(\text{atom }\%\ ^{15}N_t - \text{atom }\%\ ^{15}N_i)$$

where $^{15}N_{rec}$ = Percent of ^{15}N tracer recovered in the labeled N pool; m_f, = N pool of each ecosystem compartment (kg N/ha); atom% $^{15}N_f$ = atom percent ^{15}N in the labeled N pool; atom% $^{15}N_i$ = atom percent ^{15}N in the reference N pool (i.e. natural ^{15}N abundance); and atom% $^{15}N_t$ = atom percent ^{15}N of added tracer

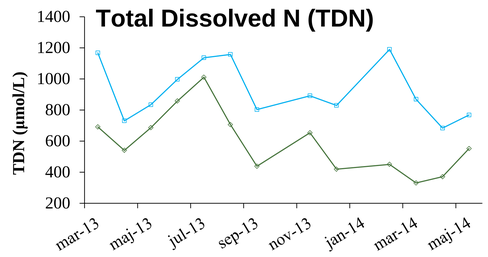
Results-preliminary
Percent ^{15}N recovery in ecosystem component

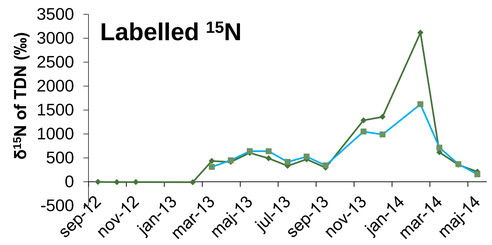


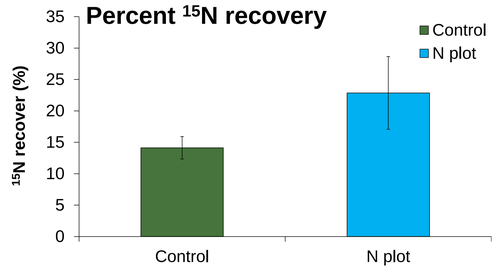




Leaching loss of ^{15}N (0-20 cm mineral soil)







Summary of the N fate

Pool/flux	Percent ^{15}N recovery	
	Control	N plot
Plant	34.9	23.7
Soil	36.9	27.9
0-20 cm soil solution	14.1	22.9
Total recovery	**85.9**	**74.5**

Discussion and conclusion

Percent ^{15}N recovery

- Plant uptake and soil immoblization of added N is reduced under increased N deposition (N plot) possibly due to soil acidification and leaching loss of added N
  - N addition was found to cause higher N leaching and soil acidification in the forest
  - More ^{15}N in soil solution was recovered in N plots than in control plot indicating of leaching of added N
- Plants and soils retained similar amount of added ^{15}N which is different from temperate forests where soil tended to retain more

Incomplete ^{15}N tracer recovered

- Incomplete recovery of the added ^{15}N could be realted to:
  - Missing pools (not sampled) such as big roots, few undestory vegetation species and deeper soil layers
  - Losses through leaching below 20 cm, surface runoff, and denitrification

Future perspective

- Long term fate of added N
- Full quantification of losses from the system including **denitrification**

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