Variable Effects of Nutrient Enrichment on Soil Respiration in Mangrove Forests

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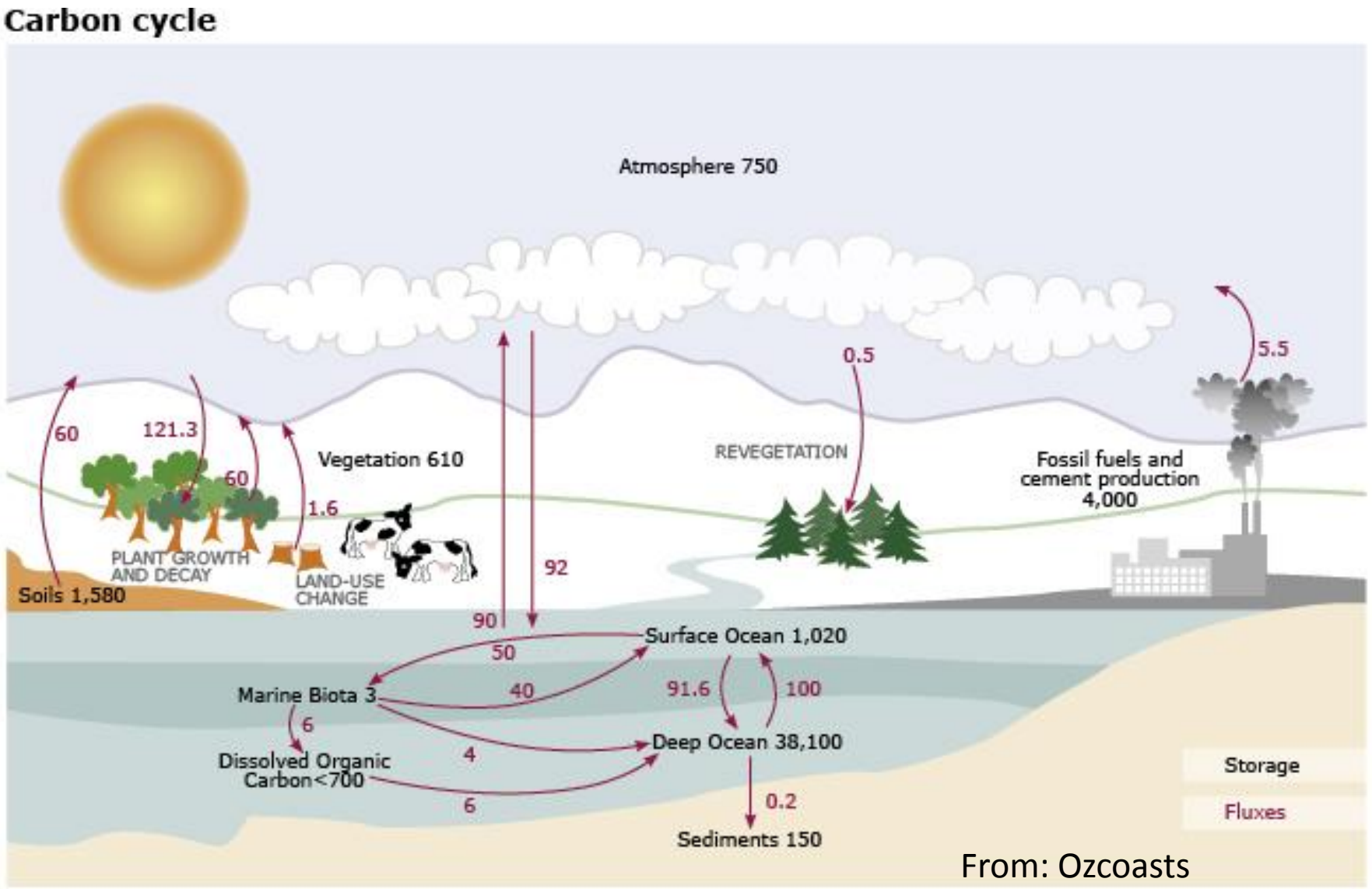
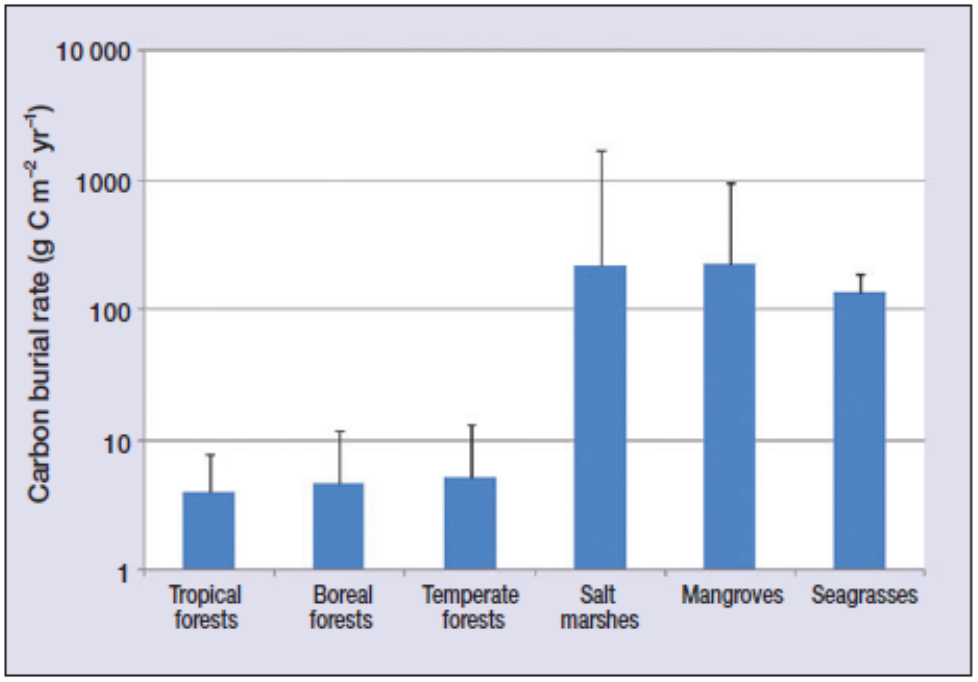
Soils are responsible for large C stocks and fluxes



From: Ozcoasts

Coastal wetlands are important in the global C cycle

- C stocks are globally important
- Understanding soil respiration gives insight into other components of carbon budget

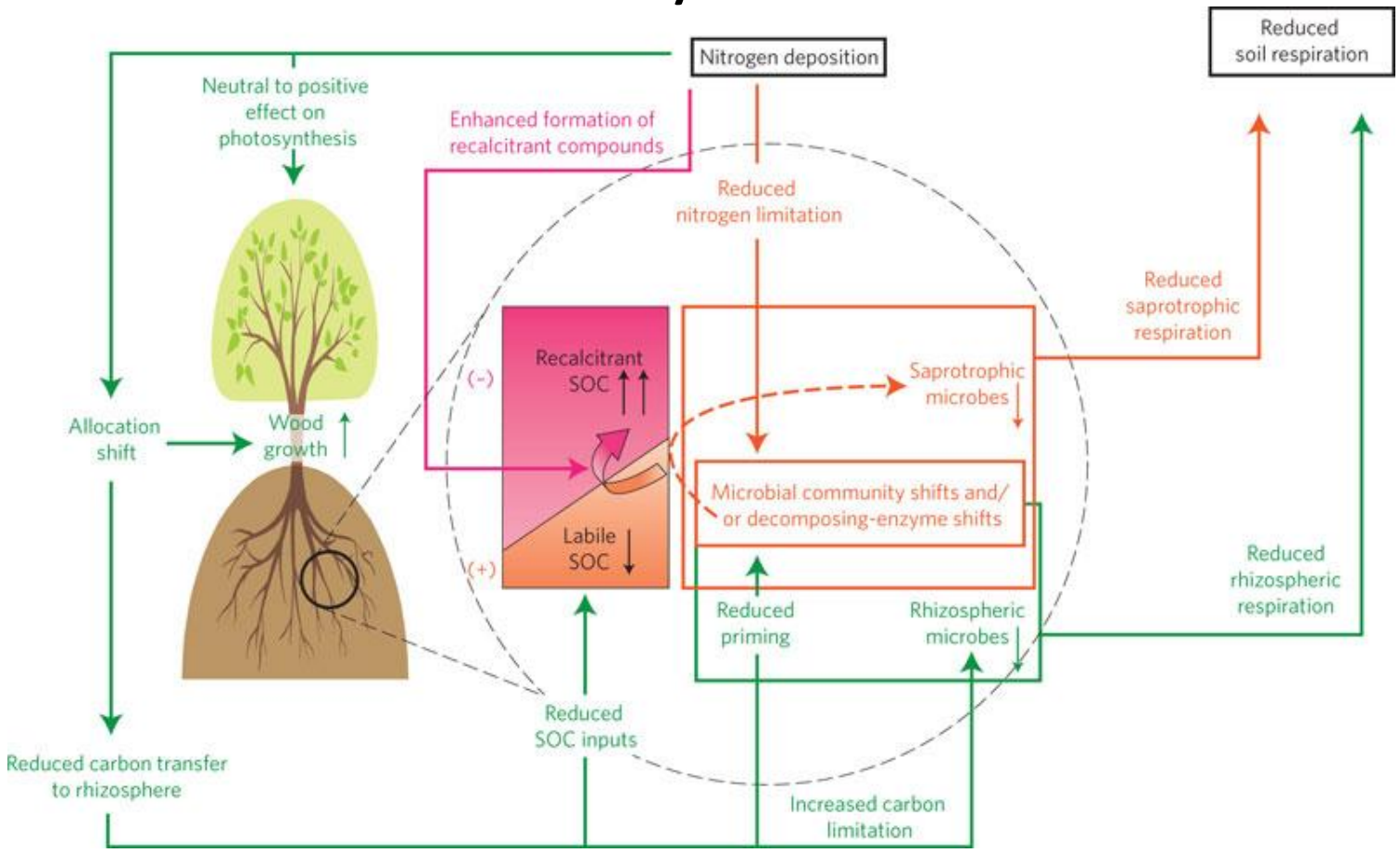


Mcleod et al. 2011

Millenium Ecosystem Assessment

Meta analysis of terrestrial systems

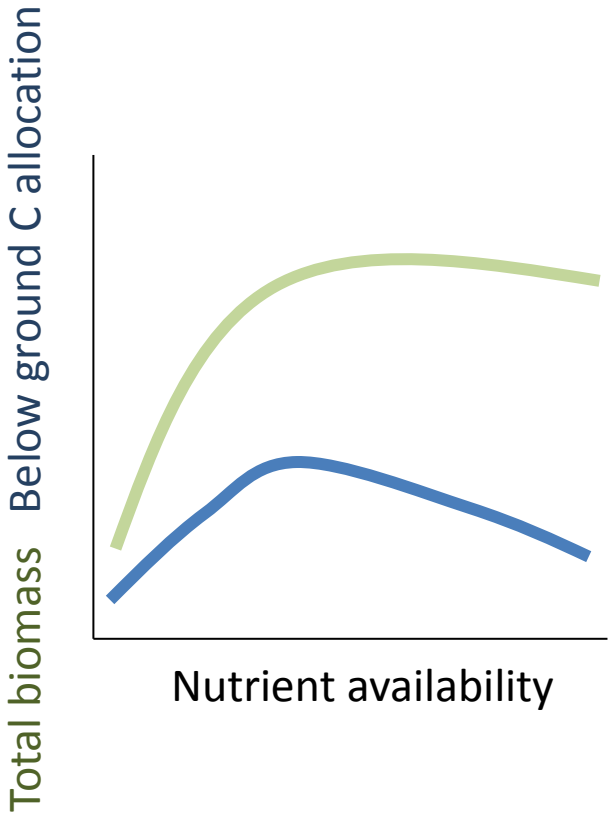
- N deposition decreased soil respiration
- Reduced allocation to roots
- Microbial community becomes carbon limited



Janssens et al. 2010

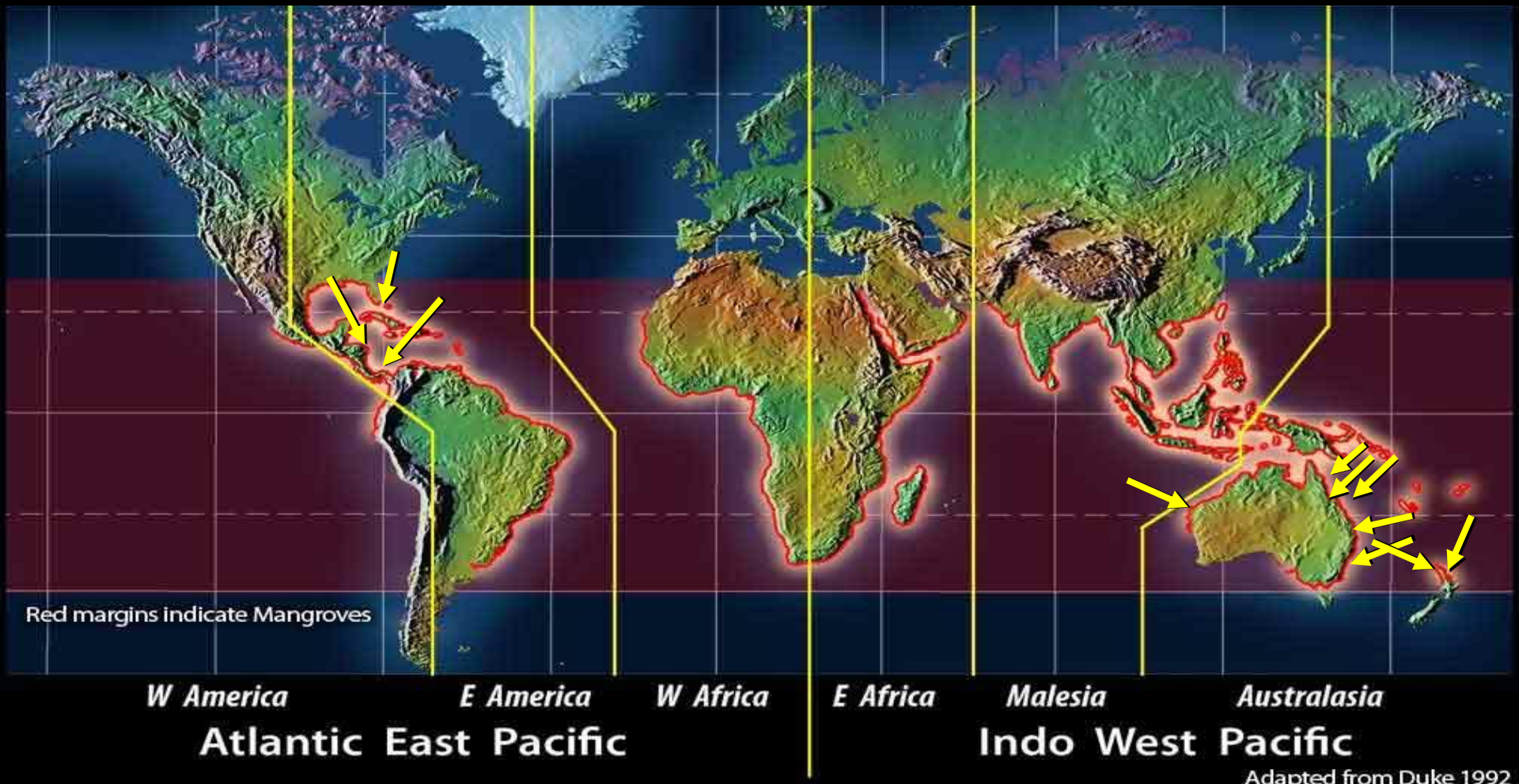
Hypothesis

- Soil respiration will decrease with fertilization



Field sites

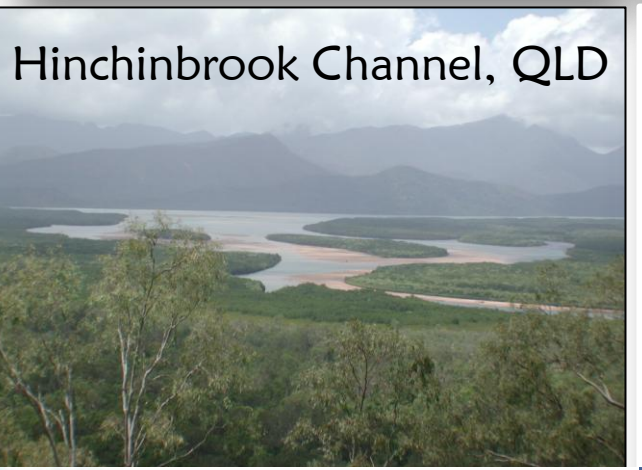
Broad geographic approach – natural gradients and variation




IRL


Twin Cays


Bocas del Toro


Hinchinbrook Channel, QLD


Whangapuoua, NZ


Giralia, WA

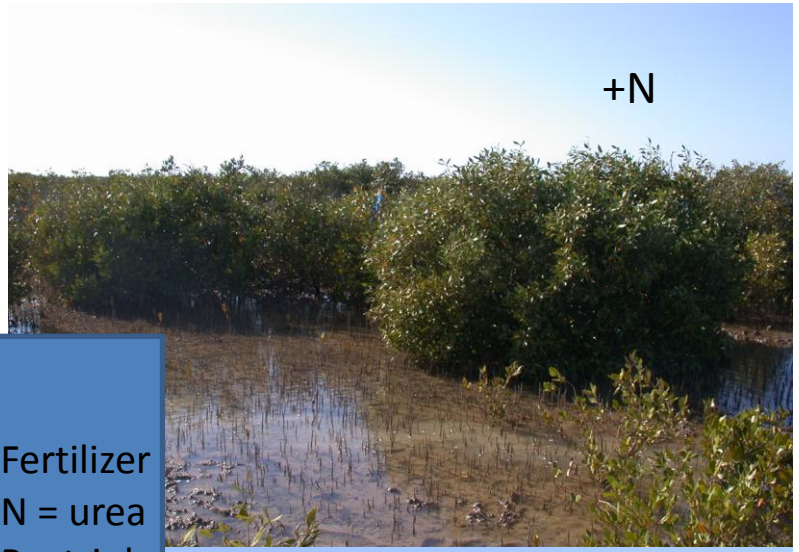

Townsville, QLD

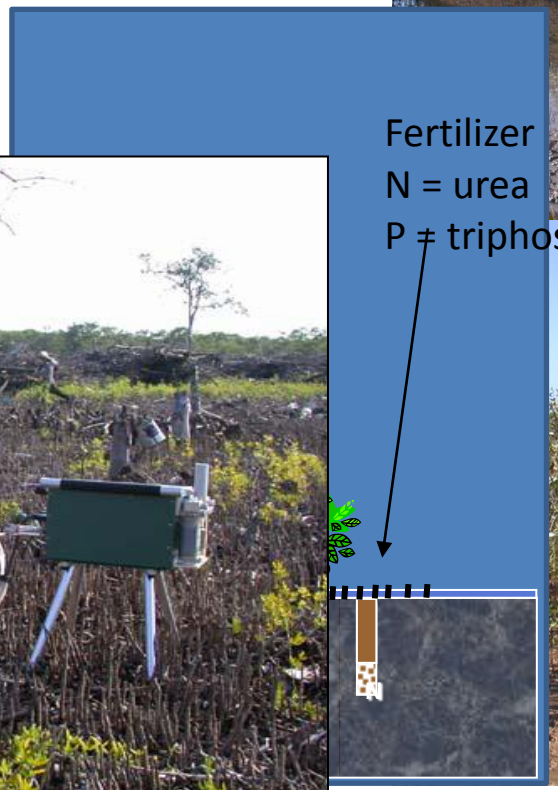

Port Douglas, QLD

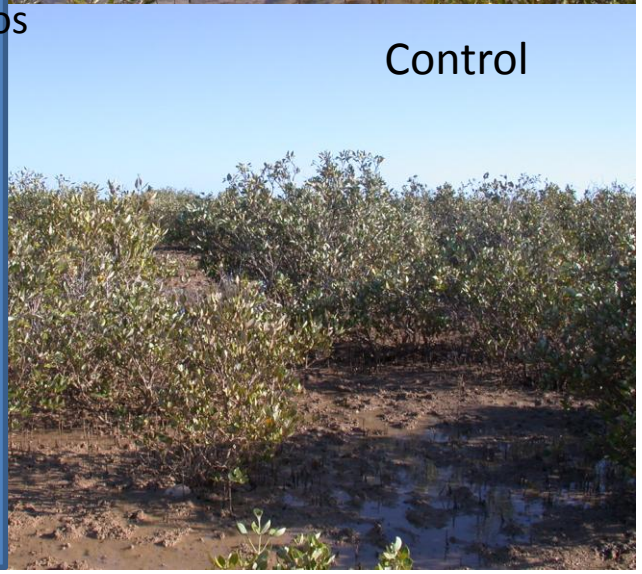

Exmouth, WA

Methods

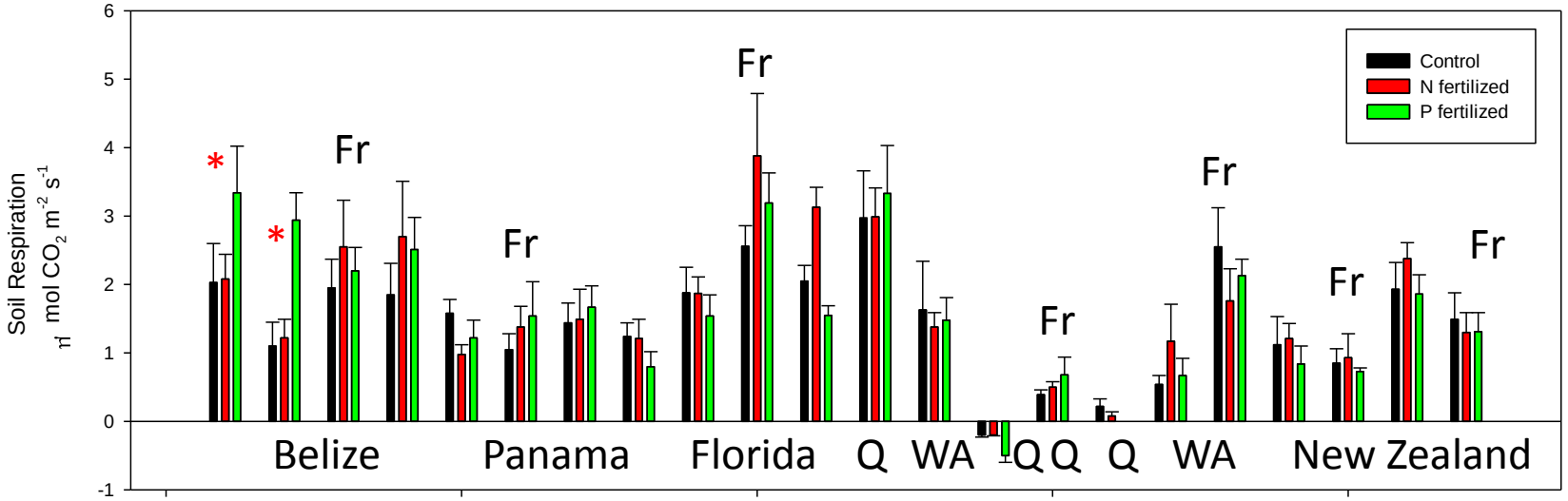
- Fertilized (> 2 years)
- Growth (stem extension)
- Soil respiration





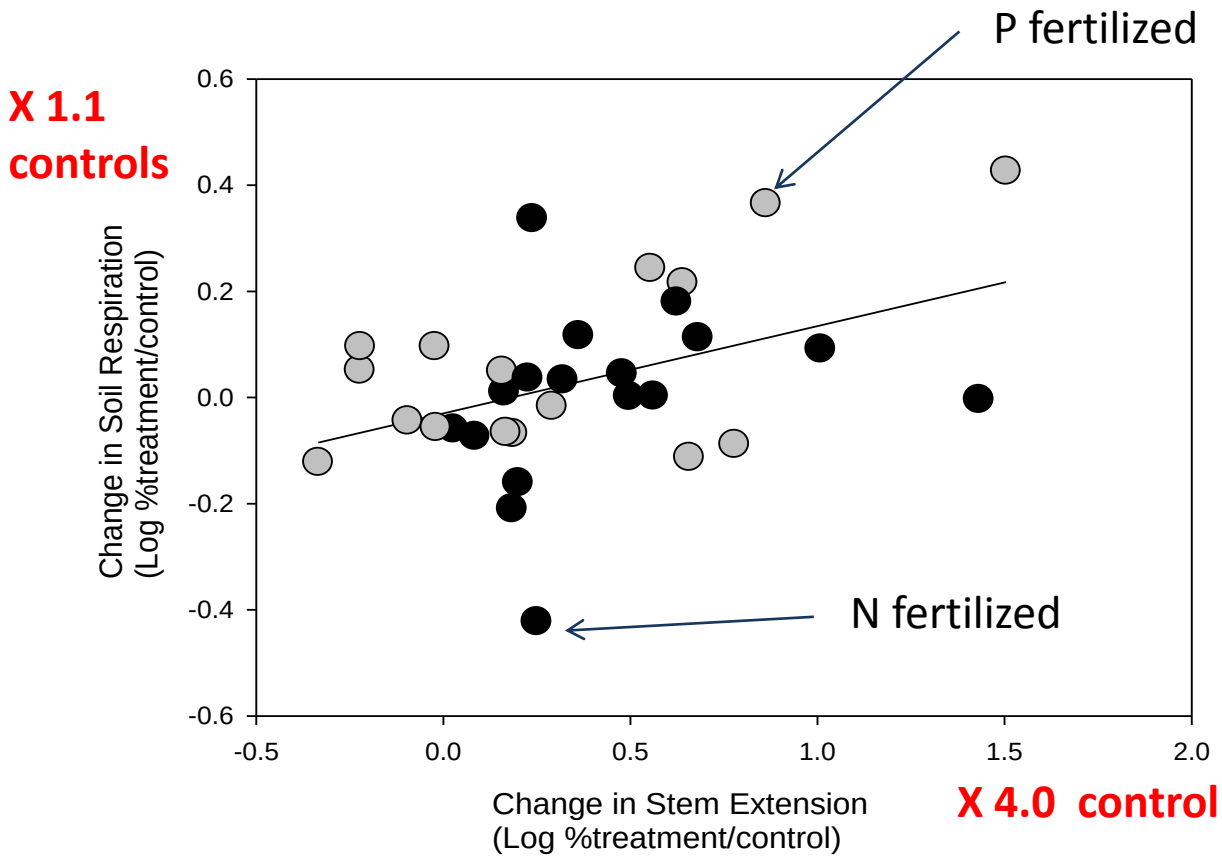


Soil respiration with fertilization



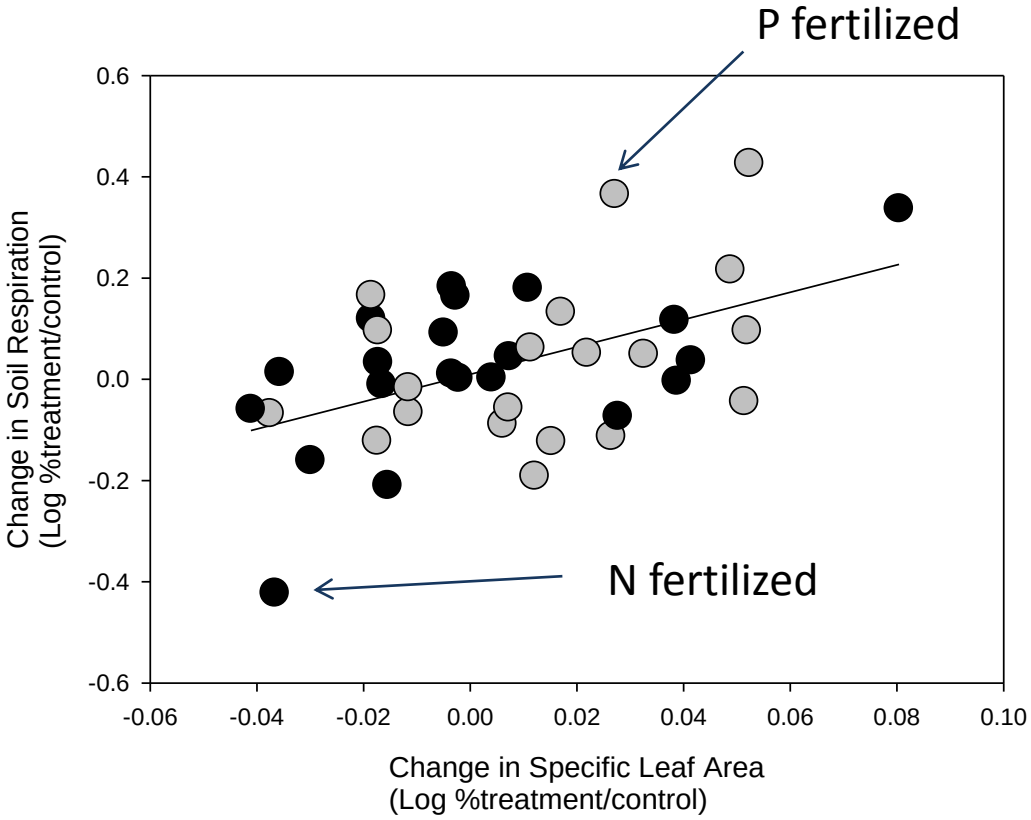
- Scrub forests 8/14 significantly increased
- Fringe forests 1/7 increased
- Phosphorus 3 increased; Nitrogen 5 increased

Why would soil respiration increase?



- Enhancement in soil respiration correlates with above-ground growth (but weak, less sensitive)

Changes in soil respiration correlate with specific leaf area

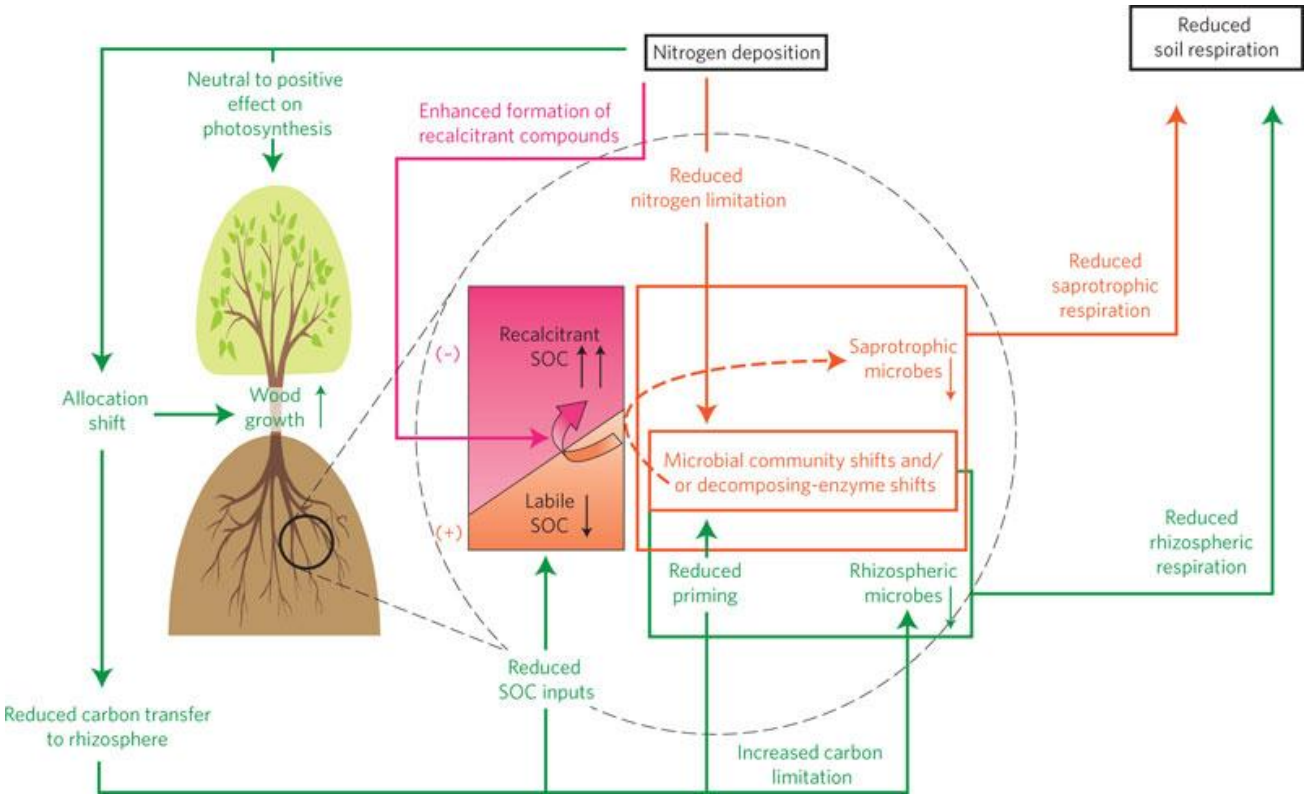


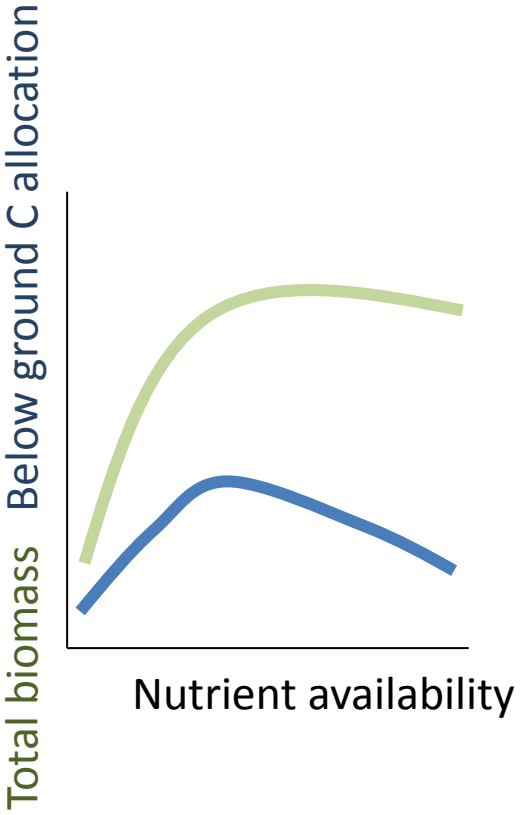
- Specific leaf area is correlated with specific root length
- Change in structure of roots? (more, finer roots)

Conclusion 1.

- Reduced allocation belowground with fertilization

  ⇧ aboveground growth ≠ ⇧ soil respiration
- Some evidence fertilization does alter roots
- Why no decrease in soil respiration with fertilization (as observed in terrestrial ecoystems)?
  - Mangrove below ground production is nutrient limited in some sites (e.g. scrub forests – McKee et al. 2007)





- Work for the future: increases in nutrient availability gives rise to enhanced stored carbon?

Conclusion 2

So what about my methods?

- Good for covering a whole range of sites (portable*, flexible, rapid)

Portable*

Flexible

Conclusion 2 cont.

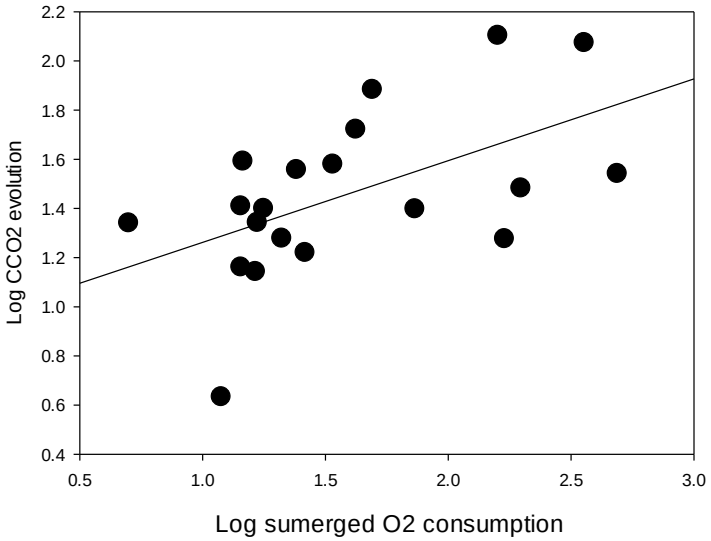
So what about my methods?

- Good for covering a whole range of sites (portable*, flexible, rapid)
- Surface films
- Missing what happens in water
- Scaling – e.g. annual rates

Surface films

Tide

- Can’t measure when sites are under water
- Rates of metabolism in air and water correlate (Alongi et al. 2000, Alongi et al. 2001), but variable.
- Issues of scaling



Acknowledgements

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- Giralia Pastoral Station, WA
- Australian Institute of Marine Science
- National Institute of Water and Atmospheric Sciences (NIWA) New Zealand
- Australian Research Council

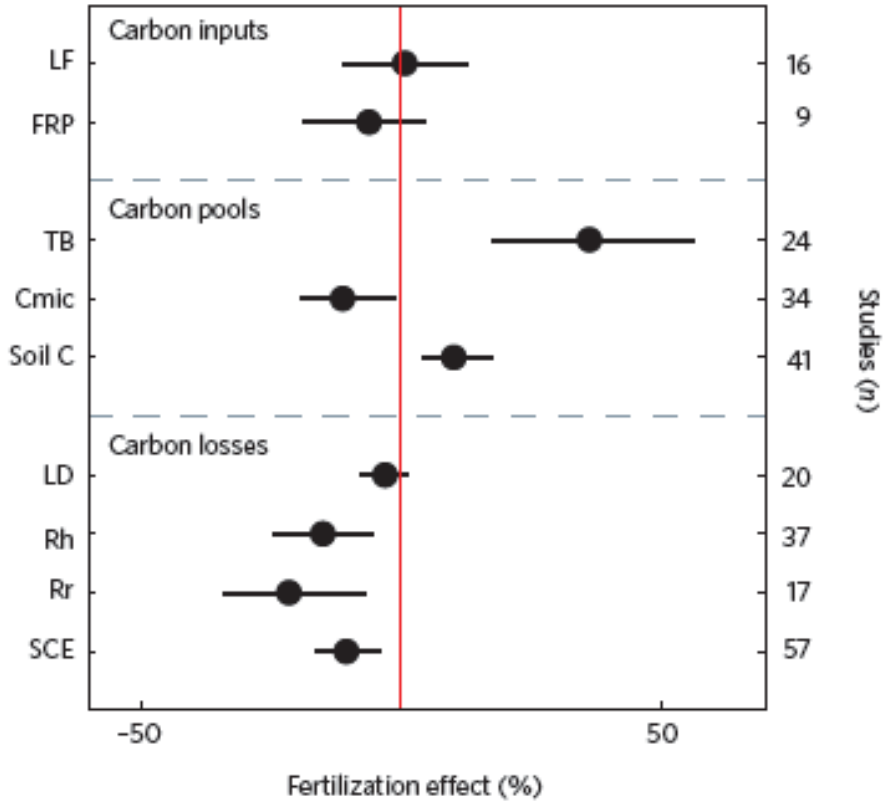
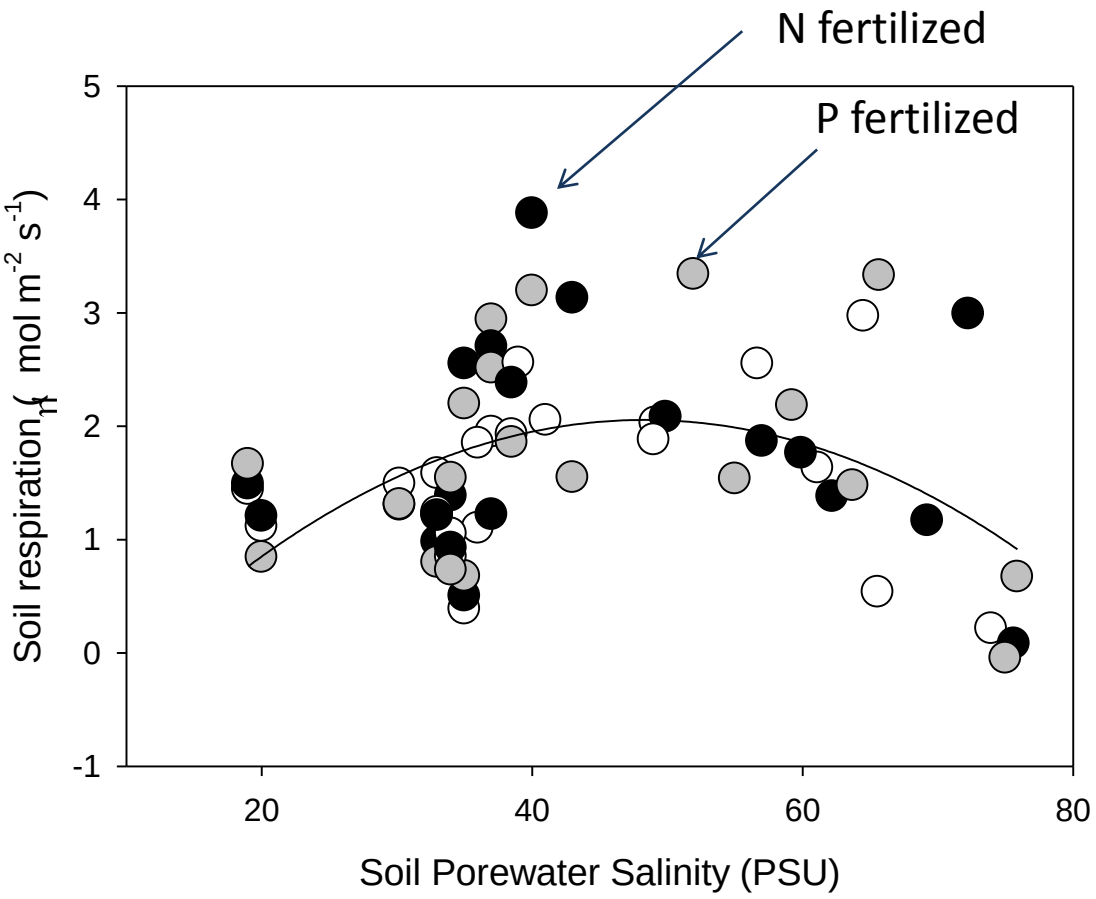


Figure 1 | Effect of experimental nitrogen addition on various forest carbon pools and fluxes as calculated by meta-analysis. Positive values indicate that nitrogen addition had a positive effect, negative values indicate a decrease. Error bars indicate the 95% confidence interval. Data are the weighted means for n data points (right axis). Parameters listed are carbon inputs (left axis): litter fall (LF) and fine-root production (FRP); carbon pools: total tree biomass (TB), microbial biomass (Cmic) and soil carbon content (Soil C); and carbon losses: litter decomposition (LD), heterotrophic respiration (Rh), root respiration (Rr) and soil carbon dioxide efflux (SCE). Exact numbers can be found in Supplementary Table S1.

Abiotic conditions are important



- Soil respiration declines with increasing salinity
- No interaction with fertilization