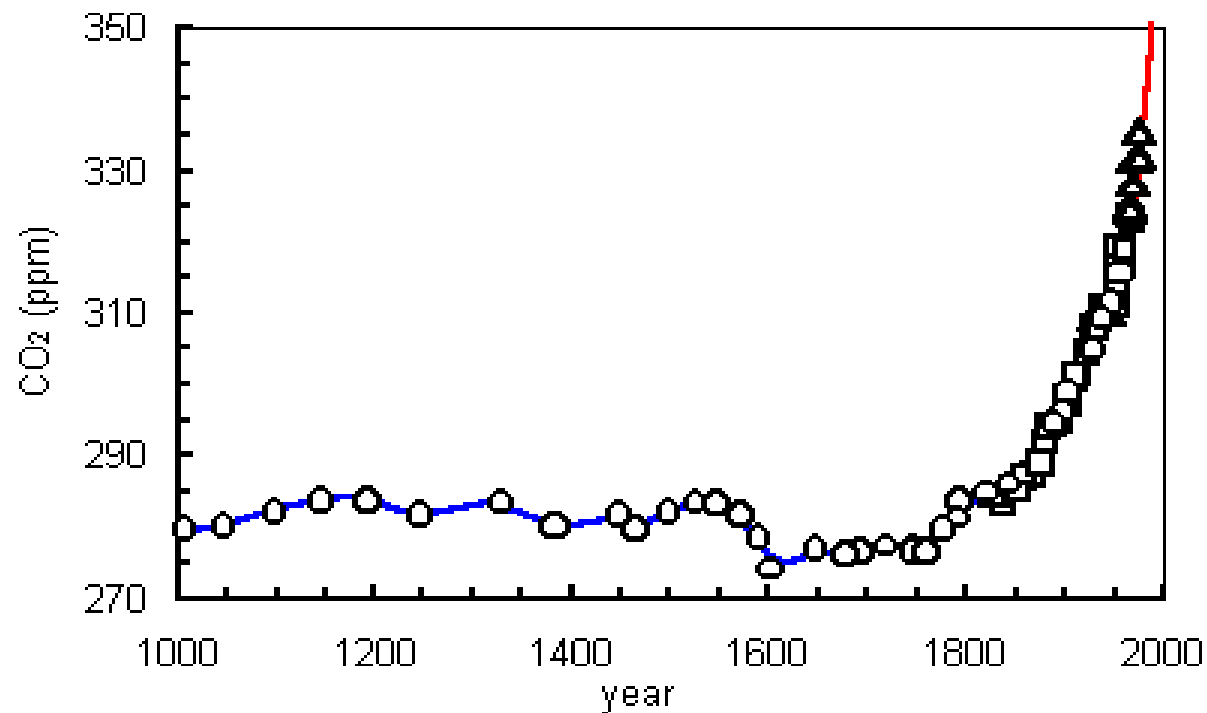


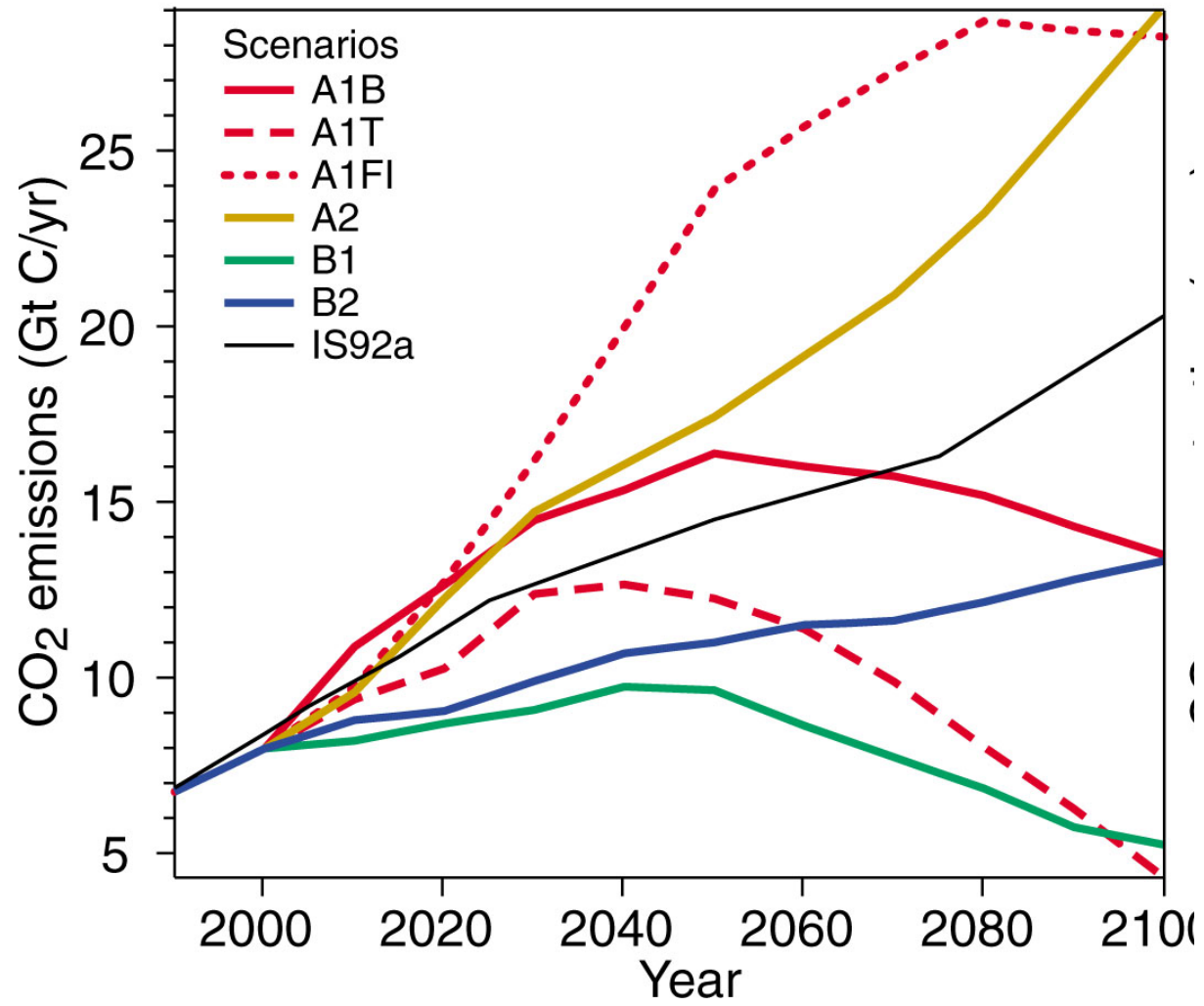
Will the rising concentration of
CO₂ in the atmosphere mean
more productive forests?

CO₂ concentrations are rising

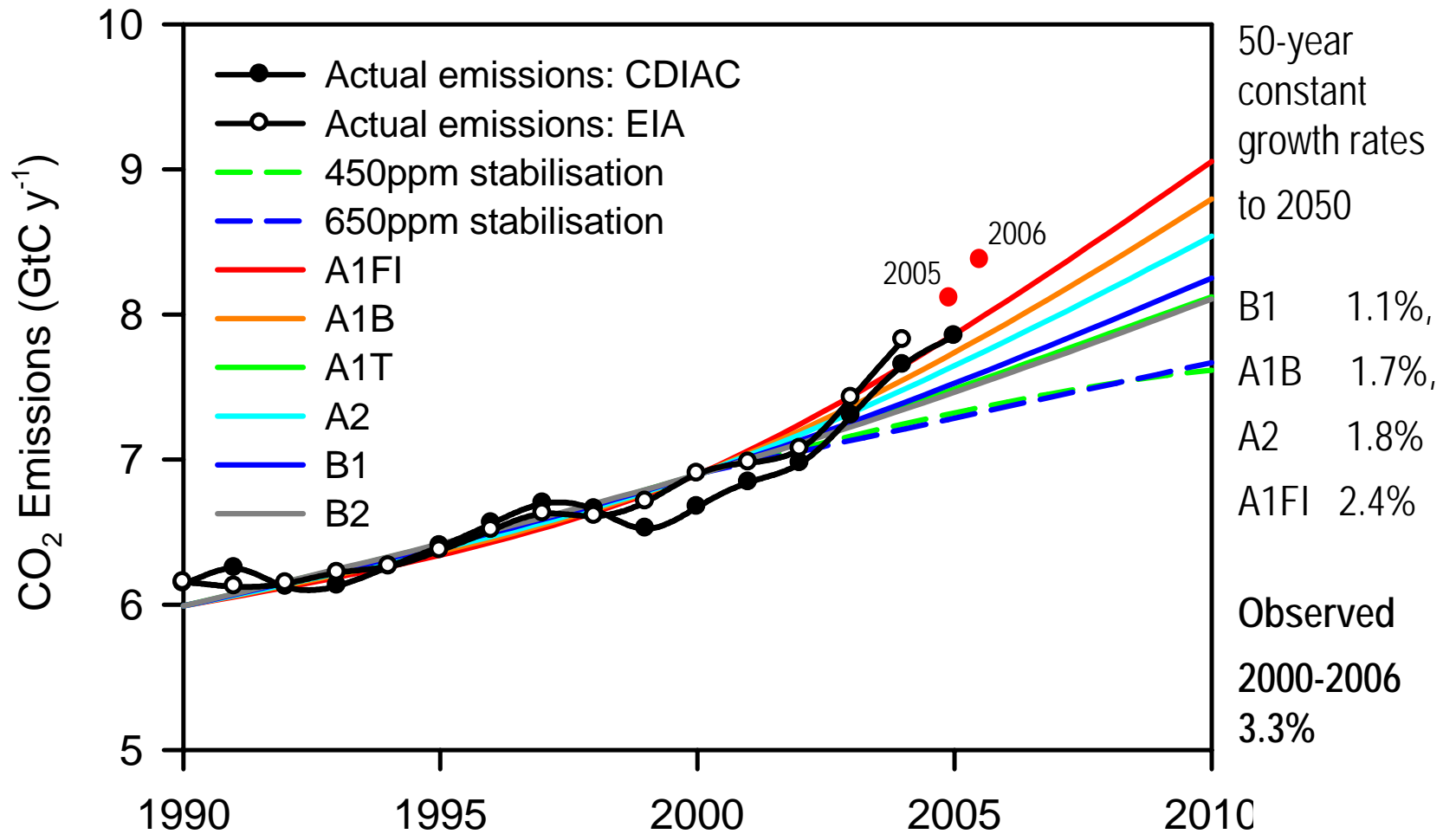


[CO₂] over time
(combining many sources)

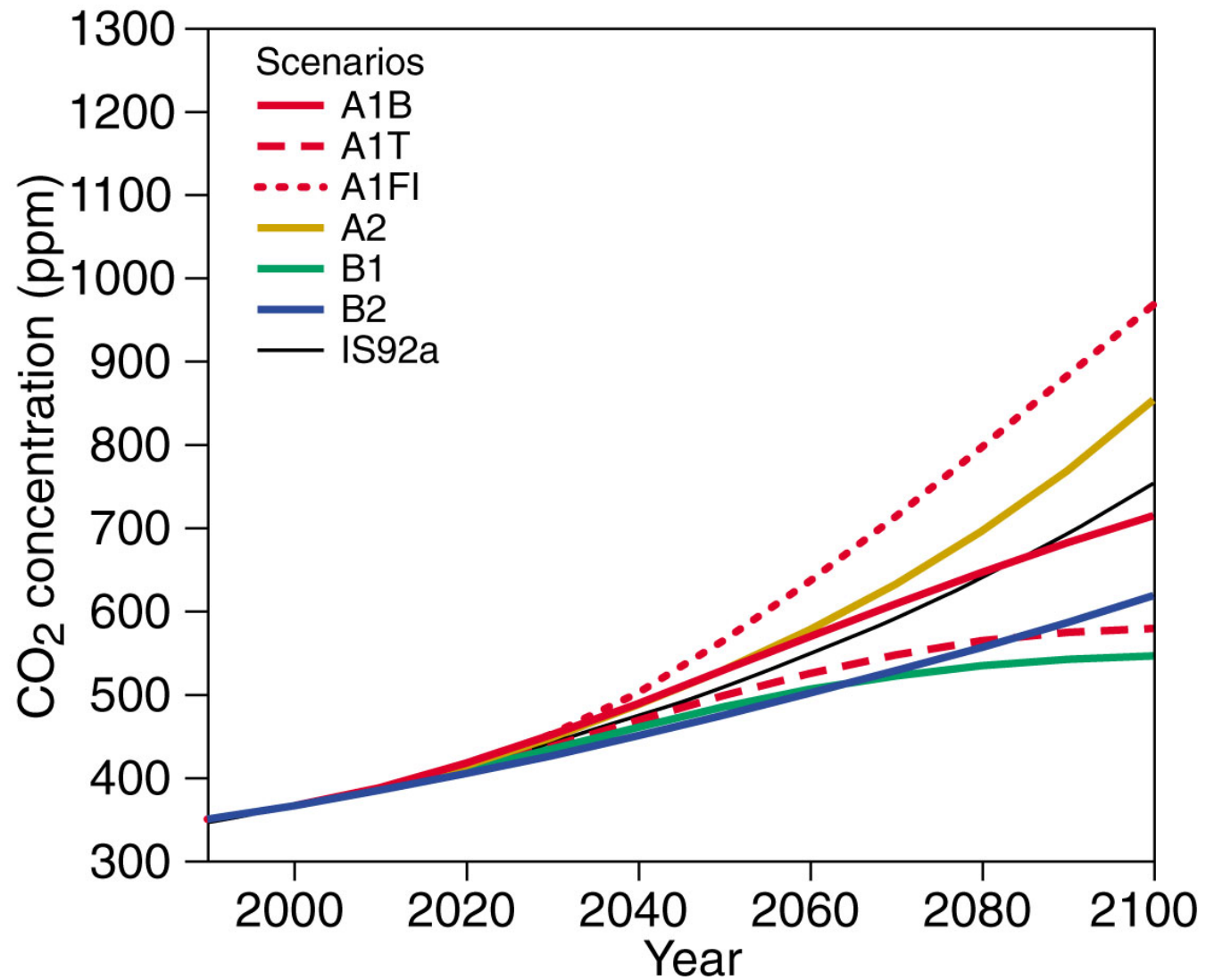
(a) CO₂ emissions



How well are we doing?



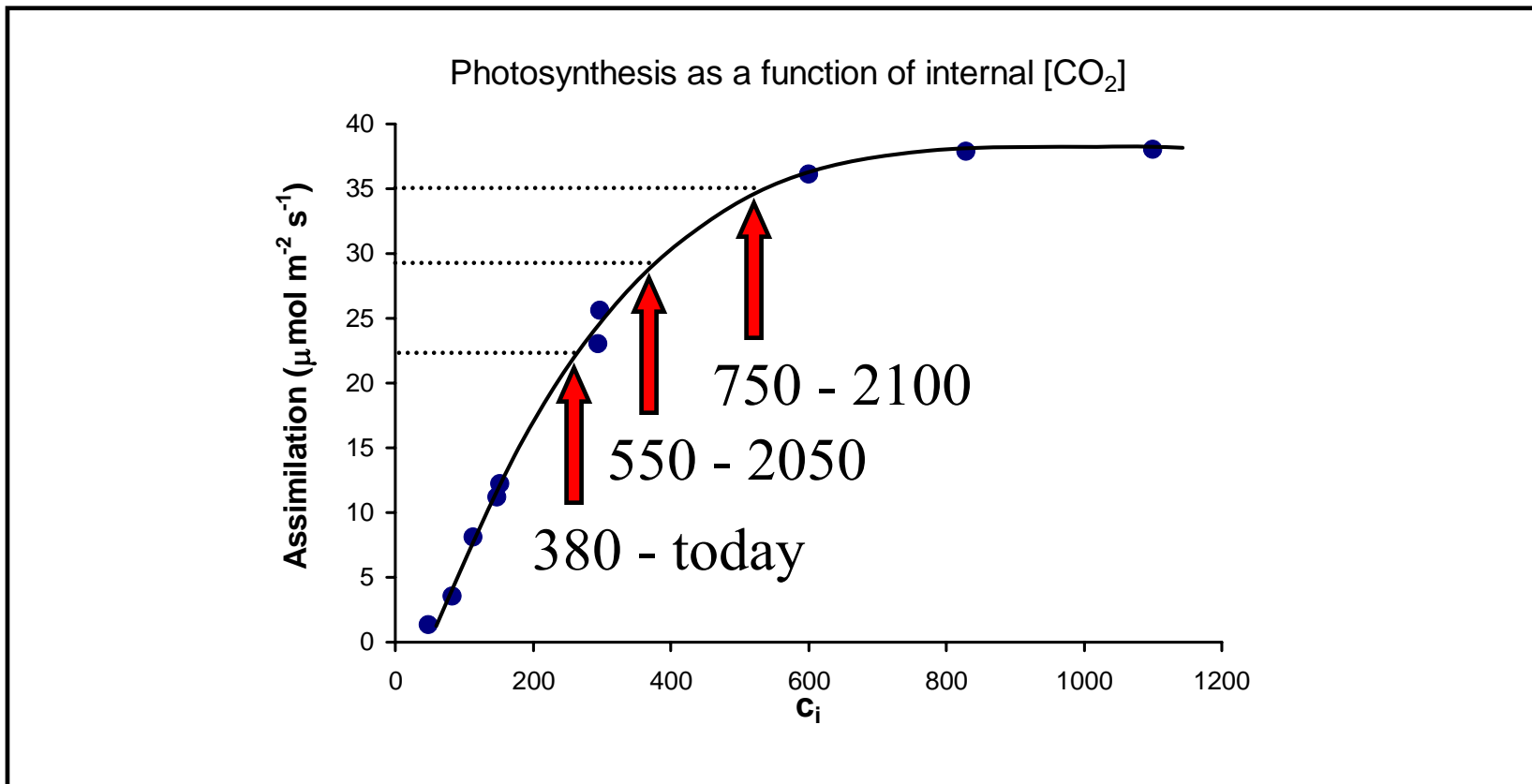
(b) CO₂ concentrations



So, what will this mean?

- CO_2 is one of the most important molecules for living things
- Photosynthesis
- $\text{CO}_2 + \text{light} + \text{water} \rightarrow \text{all living matter}$
- Photosynthetic rates are not saturated at current $[\text{CO}_2]$

Photosynthesis vs [CO₂]



Since photosynthesis is related to
growth...

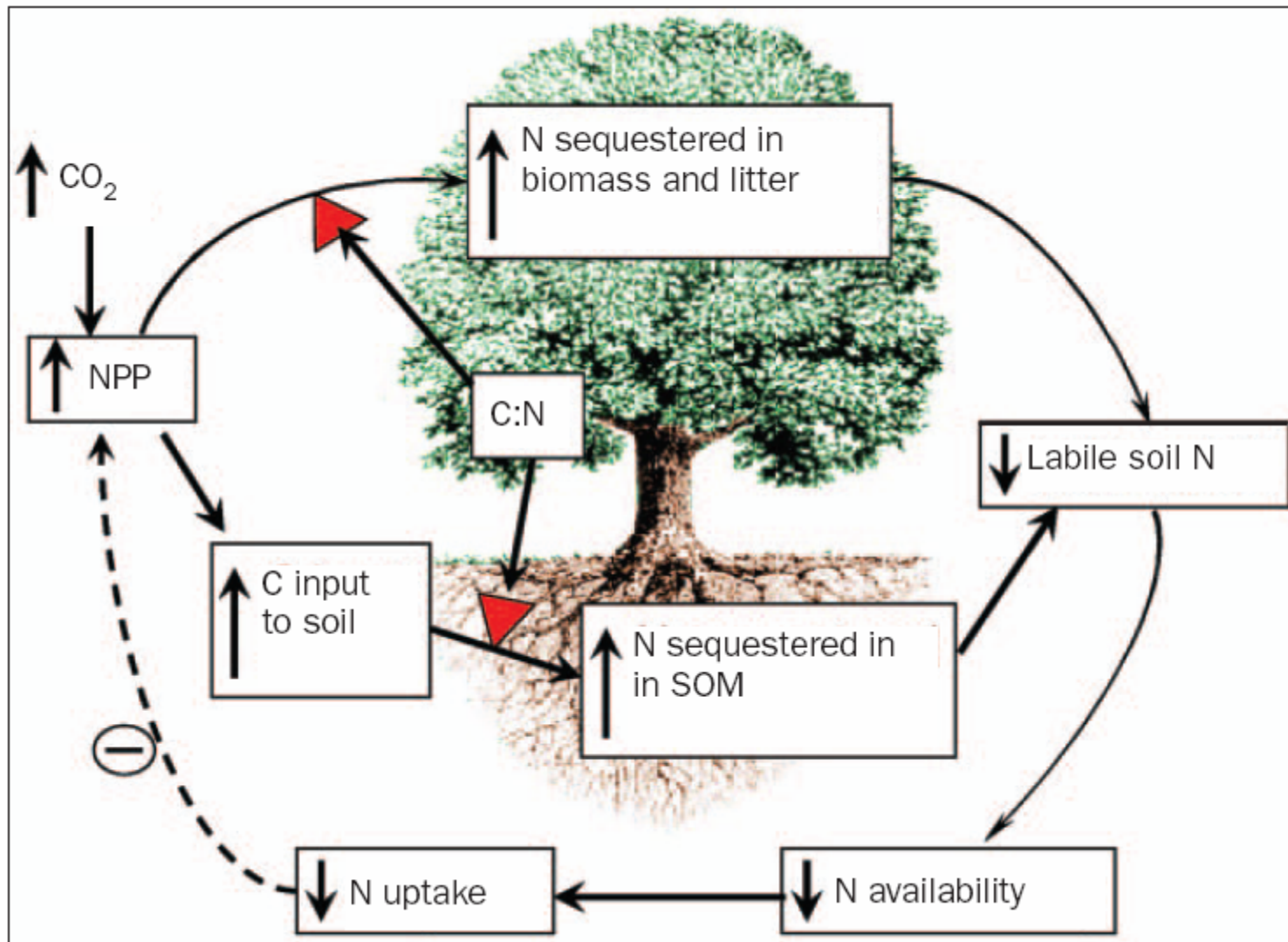
Does this mean that increasing CO₂ levels will
return faster growing trees?

You would think so...

Better

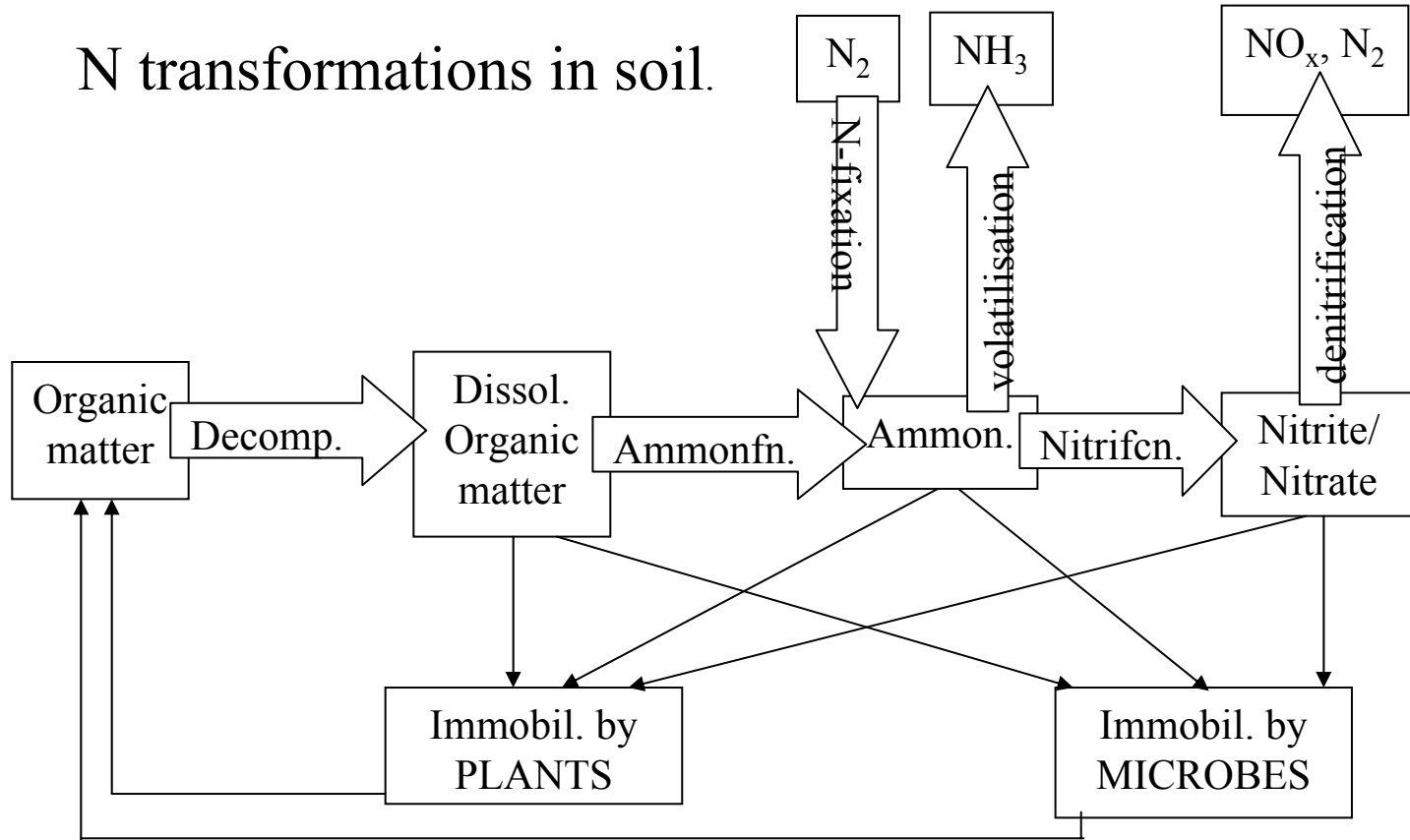
WUE, NUE

BUT



Luo *et al.* 2004 *BioScience* 54, p. 733

N transformations in soil.



Progressive Nitrogen Limitation of Ecosystem Responses to Rising Atmospheric Carbon Dioxide

August 2004 **BioScience** Vol. 54 No. 8, 731-9

YIQI LUO, BO SU, WILLIAM S. CURRIE, JEFFREY S. DUKES, ADRIEN FINZI, UELI HARTWIG, BRUCE HUNGATE, ROSS E. McMURTRIE, RAM OREN, WILLIAM J. PARTON, DIANE E. PATAKI, M. REBECCA SHAW, DONALD R. ZAK, AND CHRISTOPHER B. FIELD

A highly controversial issue in global biogeochemistry is the regulation of terrestrial carbon (C) sequestration by soil nitrogen (N) availability. This controversy translates into great uncertainty in predicting future global terrestrial C sequestration. We propose a new framework that centers on the concept of progressive N limitation (PNL) for studying the interactions between C and N in terrestrial ecosystems. In PNL, available soil N becomes increasingly limiting as C and N are sequestered in long-lived plant biomass and soil organic matter. Our analysis focuses on the role of PNL in regulating ecosystem responses to rising atmospheric carbon dioxide concentration, but the concept applies to any perturbation that initially causes C and N to accumulate in organic forms. This article examines conditions under which PNL may or may not constrain net primary production and C sequestration in terrestrial ecosystems. While the PNL-centered framework has the potential to explain diverse experimental results and to help researchers integrate models and data, direct tests of the PNL hypothesis remain a great challenge to the research community.

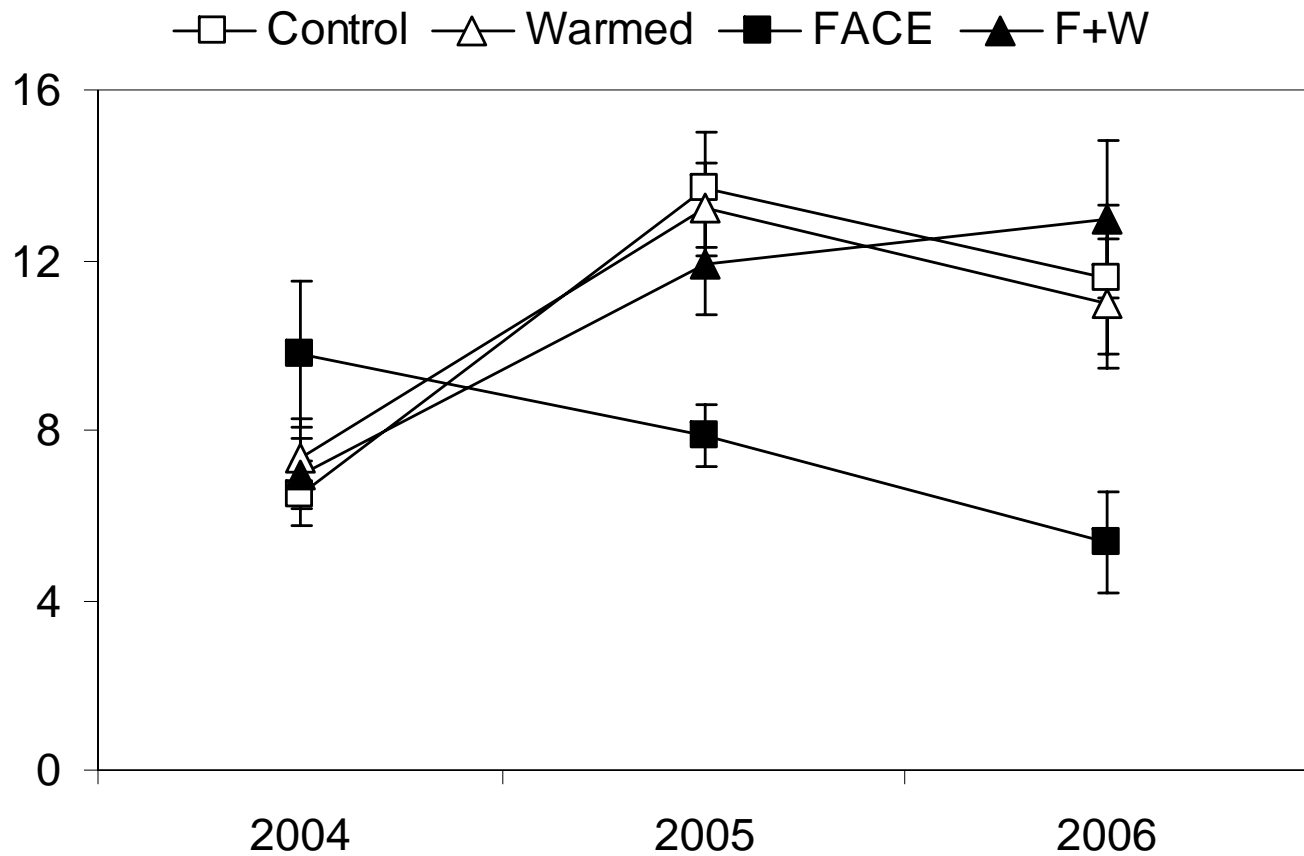
Is there experimental evidence for
this?

Yes, from a few forest [CO₂] experiments

YES, from several other ecosystems

(Maybe not from some)

Lots of evidence from other systems



So what are the important questions?

- Does elevated CO₂ cause a sustained stimulation of growth in forest species?
- Does N availability limit this response?
- What about other essential elements?
- What species/varieties/genotypes are most/least susceptible?

More questions...

- Can fertilisation offset N limitation indefinitely?
- Could beneficial microbes/mycorrhizae help alleviate these problems?
- Shouldn't we know more about what happens underground?