Fig. 1. Atmospheric CO₂ has been increasing.

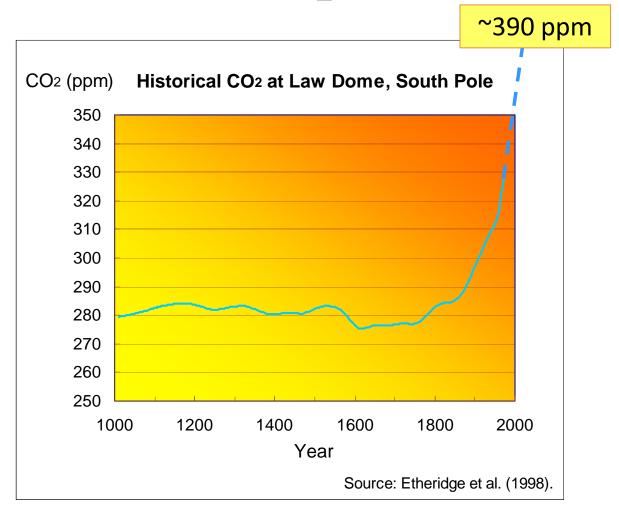
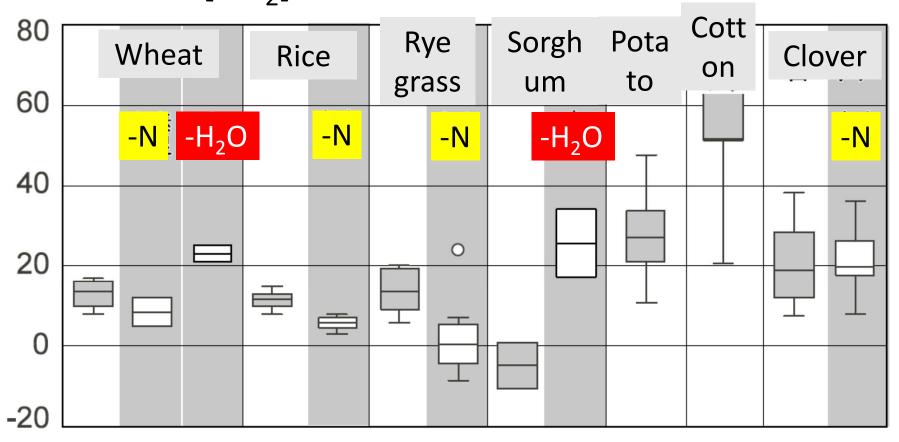
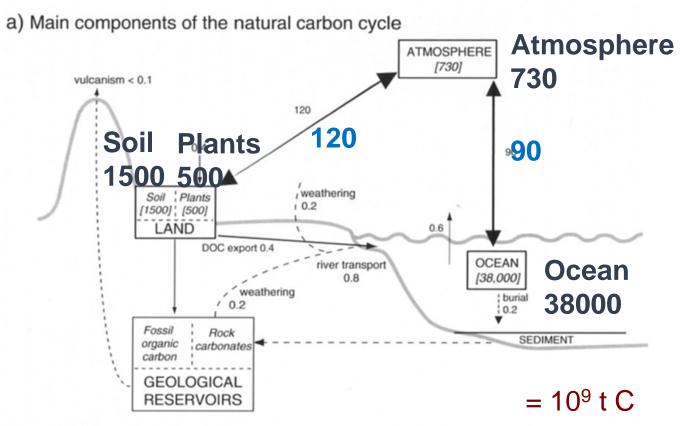


Fig. 2. Increase (%) of crop yields by a 200 ppm increase of $[CO_2]$.



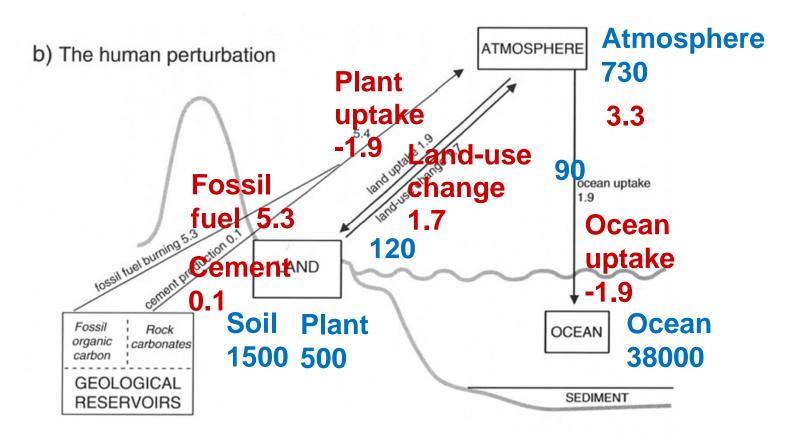
Source: B.A. Kimball et al. (2002) Advances in Agronomy 77, 293-368 and H.Y. Kim et al. (2003) Field Crops Research 83, 261-270.

Fig. 4a. The earth's carbon cycle: without human disturbances



Source: Climate Change 2001: The Scientific Basis. John Houghton et al. eds. CUP, Cambridge, UK. 2001.

Fig. 4b. The earth's carbon cycle: with human disturbances



Source: Climate Change 2001: The Scientific Basis. John Houghton et al. eds. CUP, Cambridge, UK. 2001.

Fig. 3. Predicted effects of temperature rise and CO₂ increase on rice yield: model estimates

TABLE 2

Mean Predicted Changes (%) in Potential Yields Under the 'Fixed' Temperature and CO₂

Scenarios. Temperature Increments are Above the Current Mean Temperatures at Each Site.

Changes are Averaged Across all Sites and all Available Years

	Temperature increments			
Prese	ent) +0°C	+ 1°C	+ 2° C	+4°C
ORYZA1				
340 ppm	0.0	-7.3	-14.2	-31.0
$1.5 \times CO_2$	23.3	14.3	5.6	-15.7
$2 \times CO_2$	36.4	26.4	16.8	-7.0
SIMRIW				
340 ppm	0.0	-4.6	-9.8	-26.2
$1.5 \times CO_2$	13.0	7.8	1.9	-16.6
$2 \times CO_2$	23.9	18.2	11.7	-8.5

Fig. 5. Photosynthesis: energy capture and CO₂ fixation

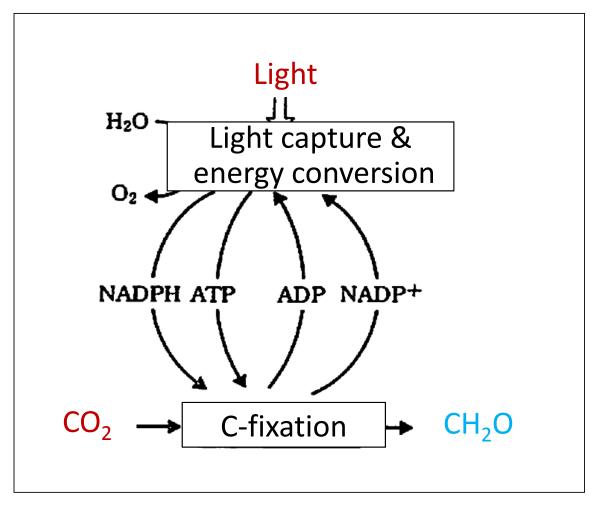


Fig. 6. Transport of CO₂ into plant interior and chloroplasts

Chloroplast Cell membrane Cell wall Inter-cellular space Source: Ref. 4. Stoma

Fig. 7. Calvin-Benson Cycle.

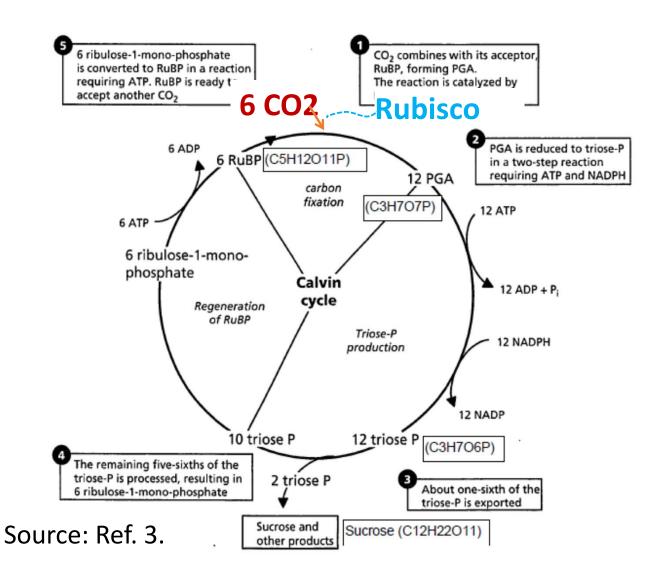


Fig. 8. A 'cartoon' of photosynthesis.

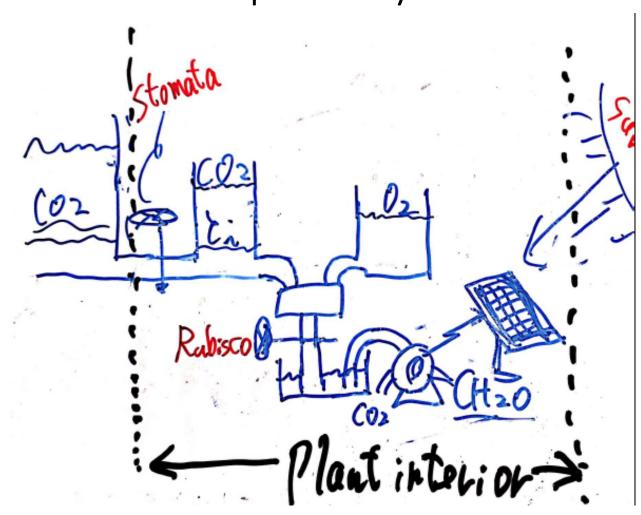


Fig. 9. **Fxtra** pathways for higher efficiency of carbon fixation by Rubisco.

Source: Ref. 2.

Rubisco oxygenates 2 out of 10 molecules of RuBP, a process called photorespiration, which lowers the already low efficiency of carbon fixation by Rubisco and spends extra. To fix this shortcoming of Rubisco, some plant species have invented extra pathways to condense CO₂ concentration at Rubisco. Rubisco PEP carboxylase $CO_1 \longrightarrow C_4$ acids $- \cdot \cdot \cdot + C_4$ acids $- \cdot \cdot \cdot + C_4$ acids $- \cdot \cdot \cdot + C_4$ $-+CO_2 \rightarrow PGA \rightarrow (CH_2O)$ Calvin RuBP cycle C₃ acids C3 (PGA) MESOPHYLL **C4** MESOPHYLL **BUNDLE SHEATH** CAM DARK LIGHT

Spatial or temporal separation

Fig. 10. A 'cartoon' of C₄ photosynthesis.

