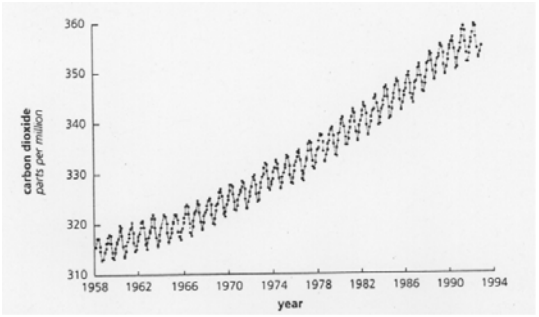
Elevated CO_2 and the global C cycle

I. Is atmospheric CO_2 increasing?
- Historic, millenial, and ice age patterns

II. Is it caused by humans?
- 3 lines of evidence

III. Consequences
A. Direct
B. Indirect

Rising atmospheric CO_2



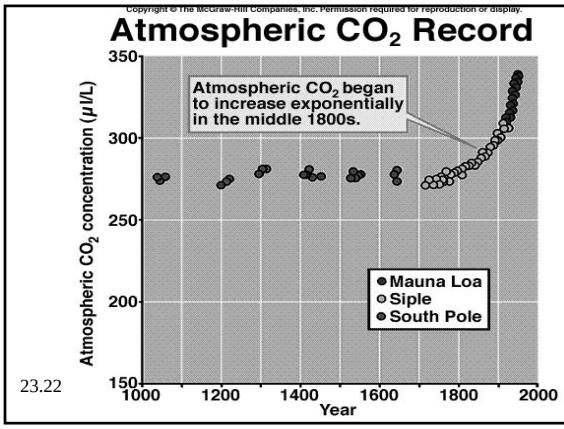
Schlesinger 1997

Questions

1. How does this fit into Earth's long-term history?

2. How do we know if recent changes are caused by human activities?

3. What might be the consequences?



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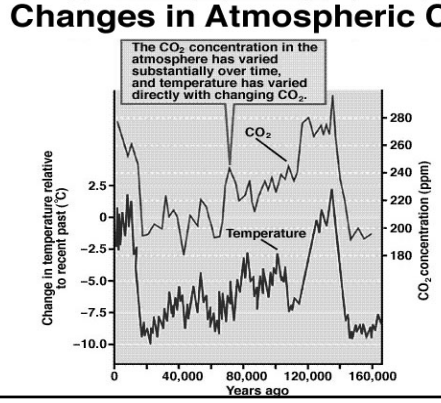

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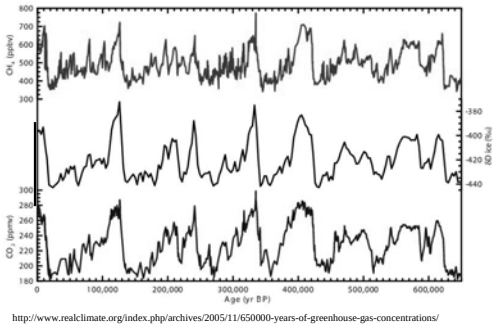


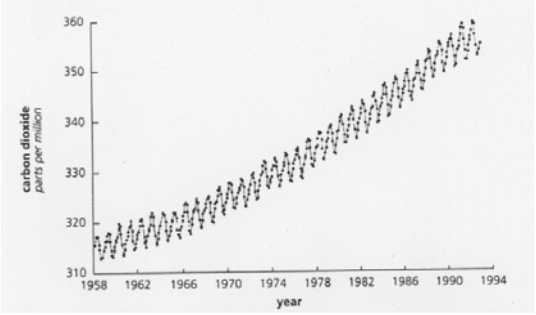
http://www.realclimate.org/index.php/archives/2005/11/650000-years-of-greenhouse-gas-concentrations/

Here's the more recent 650,000 year record from the EPICA ice core in Antarctica. The black line is the temperature proxy.

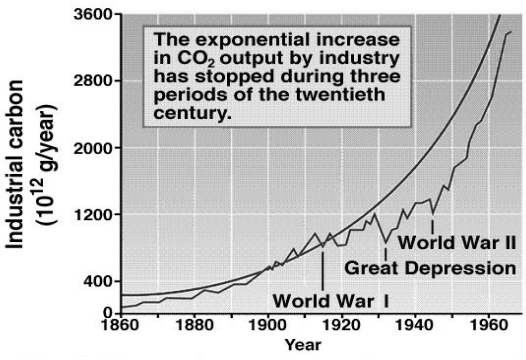
Questions

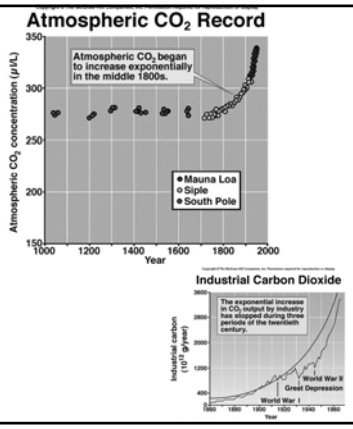
1. How does this fit into Earth's long-term history?
2. How do we know if recent changes are caused by human activities?
   a. Timing
   b. C budgeting
   c. C signatures – ^{14}C
3. What might be the consequences?

Rising atmospheric CO_2

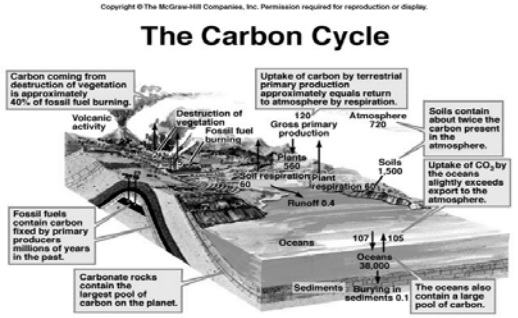


Schlesinger 1997



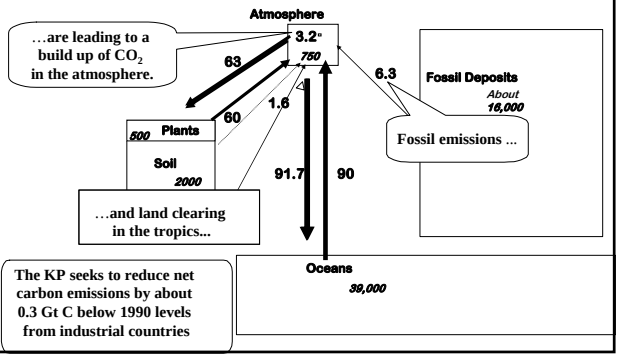


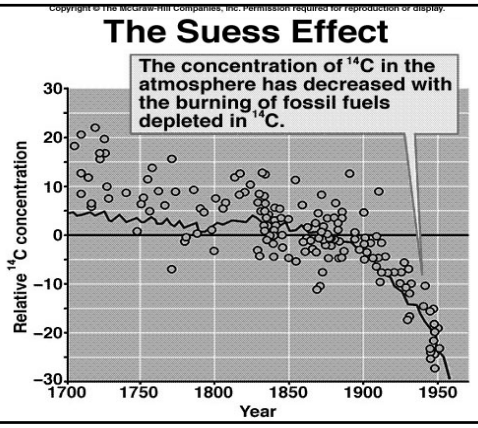
Global carbon budgeting



The Global Carbon Cycle - 1990s

Units Gt C and Gt C y^{-1}





Questions

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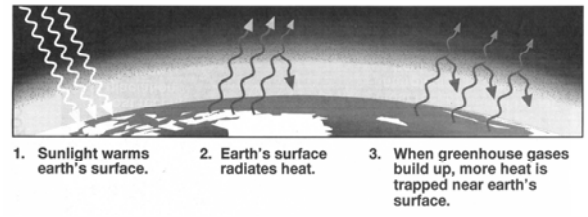
Consequences of Elevated CO_2

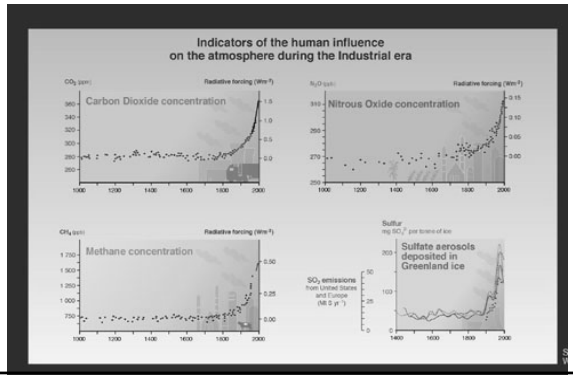
1. Direct effects – more on these later
   a. On plant growth
   b. On decomposition
2. Indirect effects
   a. Warming
   b. Effects of warming
      i. Sea level rise
      ii. Changes in precipitation
      iii. Storm frequency and intensity?
      iv. Biological changes: species range shifts, diseases?

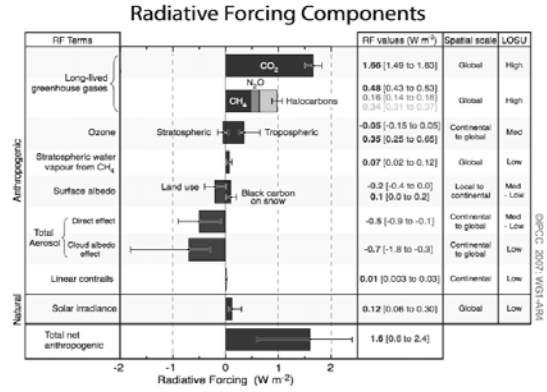
Enhanced greenhouse effect

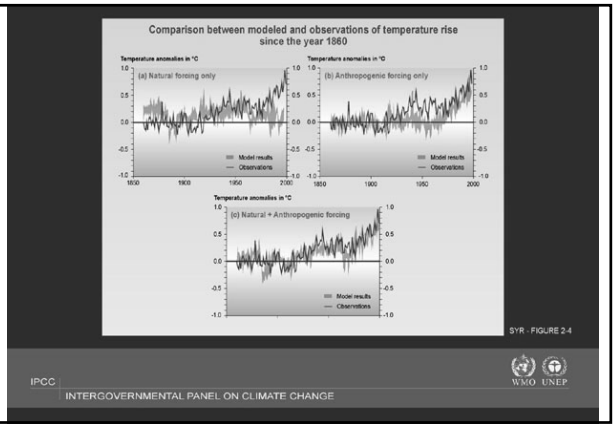


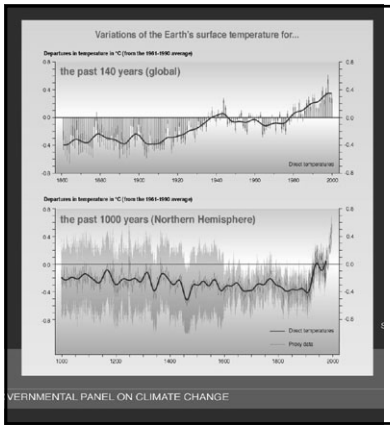
Starr&Taggart Fig. 37.12

And other greenhouse gases…



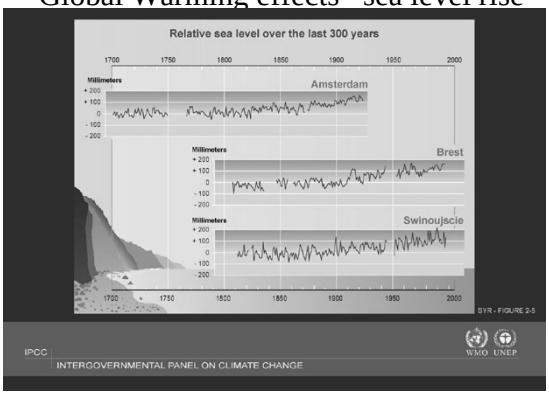




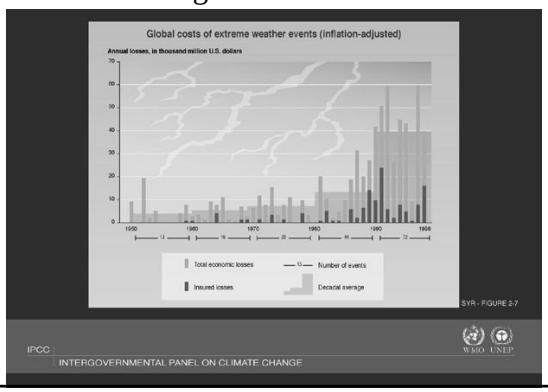


Elevated CO_2 effects: increased temperature

Global Warming effects –sea level rise



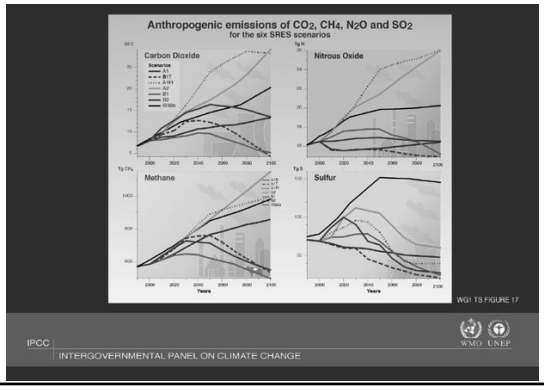
Global Warming effects – extreme weather



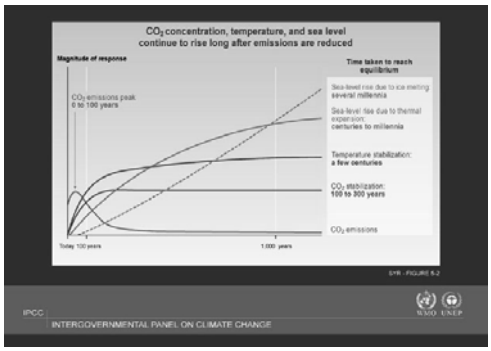
Remaining questions:

How much warming will occur?
How distributed?
Consequences?
What can be done? (Adaptation, mitigation)

Greenhouse gas emission scenarios



Global Warming effects – long-term



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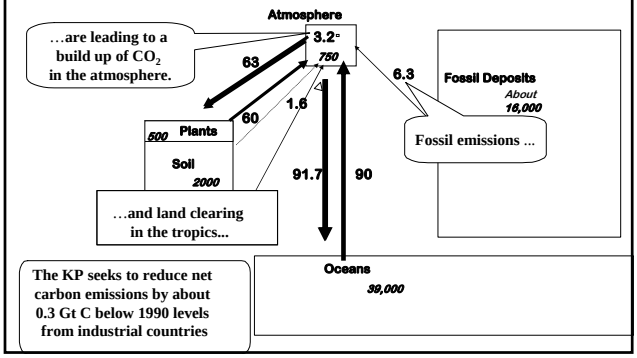

Questions

What causes uptake by natural systems?

How much capacity to continue absorbing CO_2?

What might limit their uptake capacity?

What can we do to enhance ecosystem uptake and thereby slow the atmospheric increase?

The End