Antarctic Ice Sheet Is Melting Rapidly, New Study Warns Of Rising Sea Levels

Washington Post, 3/3/06

The Antarctic ice sheet is losing as much as 36 cubic miles of ice a year in a trend that scientists link to global warming, according to a new paper that provides the first evidence that the sheet's total mass is shrinking significantly.

The new findings, which are being published today in the journal Science, suggest that global sea level could rise substantially over the next several centuries.

It is one of a slew of scientific papers in recent weeks that have sought to gauge the impact of climate change on the world's oceans and lakes. Just last month two researchers reported that Greenland's glaciers are melting into the sea twice as fast as previously believed, and a separate paper in Science today predicts that by the end of this century lakes and streams on one-fourth of the African continent could be drying up because of higher temperatures.

The new Antarctic measurements, using data from two NASA satellites called the Gravity Recovery and Climate Experiment (GRACE), found that the amount of water pouring annually from the ice sheet into the ocean -- equivalent to the amount of water the United States uses in three months -- is causing global sea level to rise by 0.4 millimeters a year. The continent holds 90 percent of the world's ice, and the disappearance of even its smaller West Antarctic ice sheet could raise worldwide sea levels by an estimated 20 feet.

"The ice sheet is losing mass at a significant rate," said Isabella Velicogna, the study's lead author and a research scientist at Colorado University at Boulder's Cooperative Institute for Research in Environmental Sciences. "It's a good indicator of how the climate is changing. It tells us we have to pay attention."

Richard Alley, a Pennsylvania State University glaciologist who has studied the Antarctic ice sheet but was not involved in the new research, said more research is needed to determine if the shrinkage is a long-term trend, because the new report is based on just three years of data. "One person's trend is another person's fluctuation," he said.

But Alley called the study significant and "a bit surprising" because a major international scientific panel predicted five years ago that the Antarctic ice sheet would gain mass this century as higher temperatures led to increased snowfall.

"It looks like the ice sheets are ahead of schedule" in terms of melting, Alley said. "That's a wake-up call. We better figure out what's going on." .... *More of this article online ...*

Announcement

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rebecca.matichuk@lasp.colorado.edu

The Carbon Cycle

Sean Davis

Which of the components of the Earth System are part of the Carbon cycle?

A. Rice Paddies

B. Cows

C. Mountain Uplift

D. Oceanic Phytoplankton

E. All of the above

Carbon Cycle - Definition

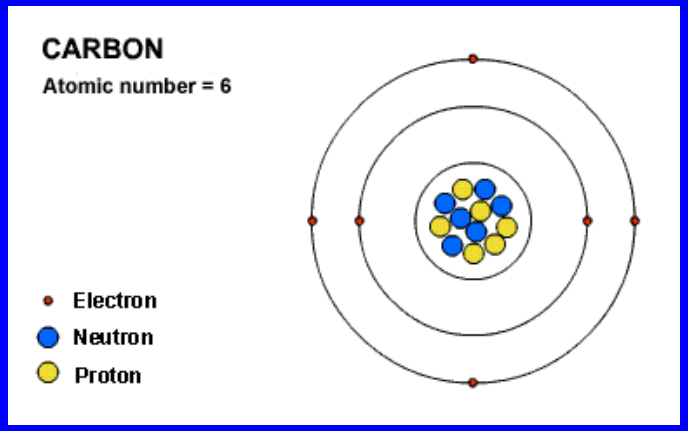
Carbon Cycle – A biogeochemical cycle in which carbon is transferred among various locations and forms within the Earth System, operating on both “short” and “long” time scales…

Carbon Cycle – Who Cares?

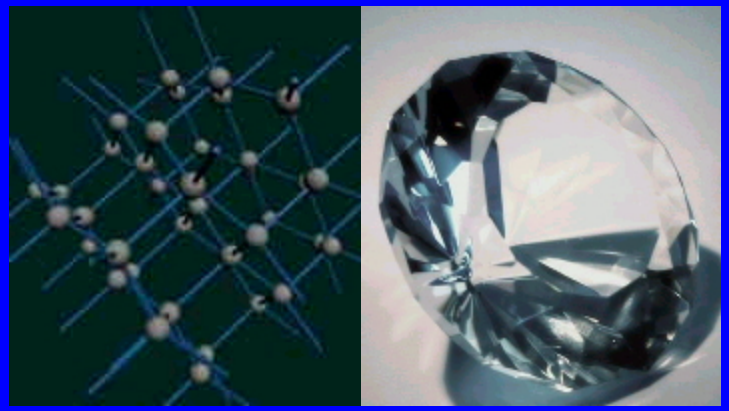
- All life based on carbon
  - Carbon is both “input” and “ouput” of life processes
- Carbon affects..
  - Earth’s temperature
  - Maintenance of oxygen in the atmosphere
  - Distribution of organisms on Earth
- Goal of understanding how system responds to perturbations

Carbon – Oh so Many Forms!

- Elemental Carbon –The atom, or combined with itself



Diamond



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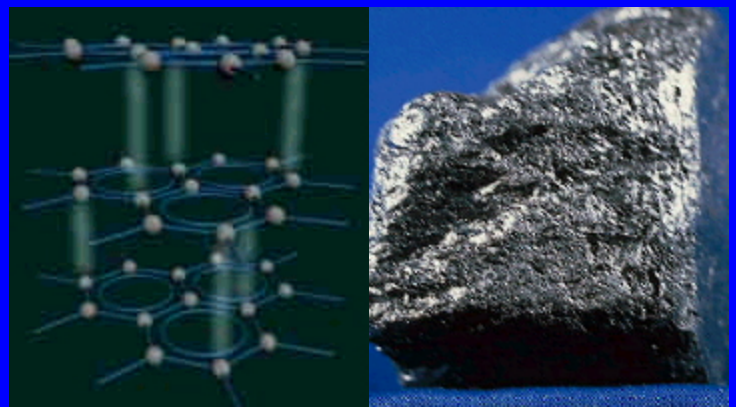
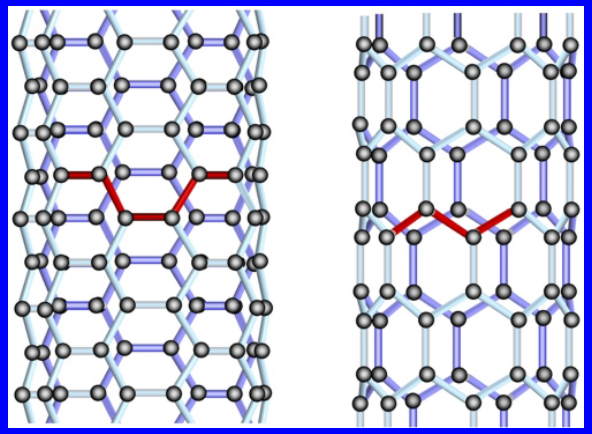
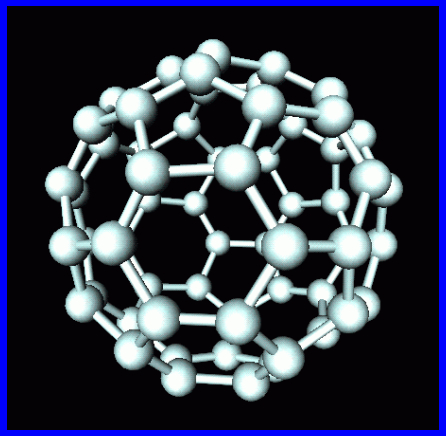


"Exotic" Carbon



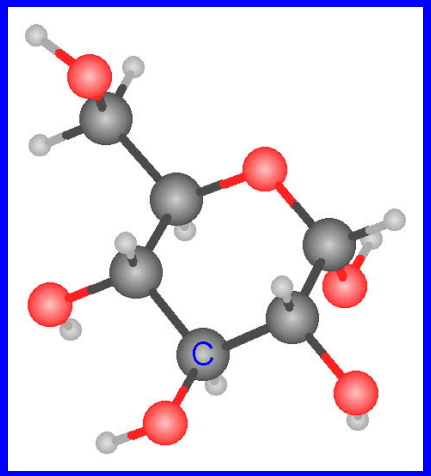
Nanotubes



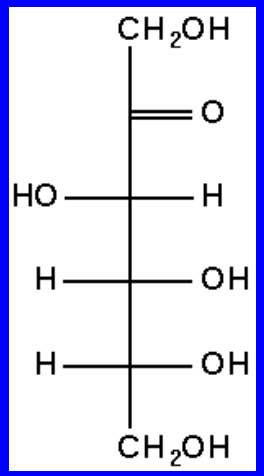
"Buckyball" –
1996 Nobel Prize

Carbon – Organic vs. Inorganic

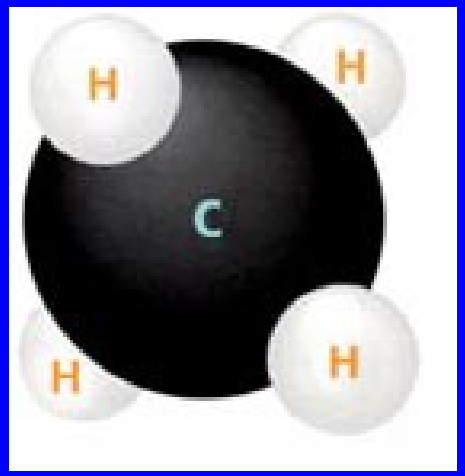
- Organic carbon – combined with hydrogen, nitrogen, oxygen, carbon – associated with life



Glucose



Fructose

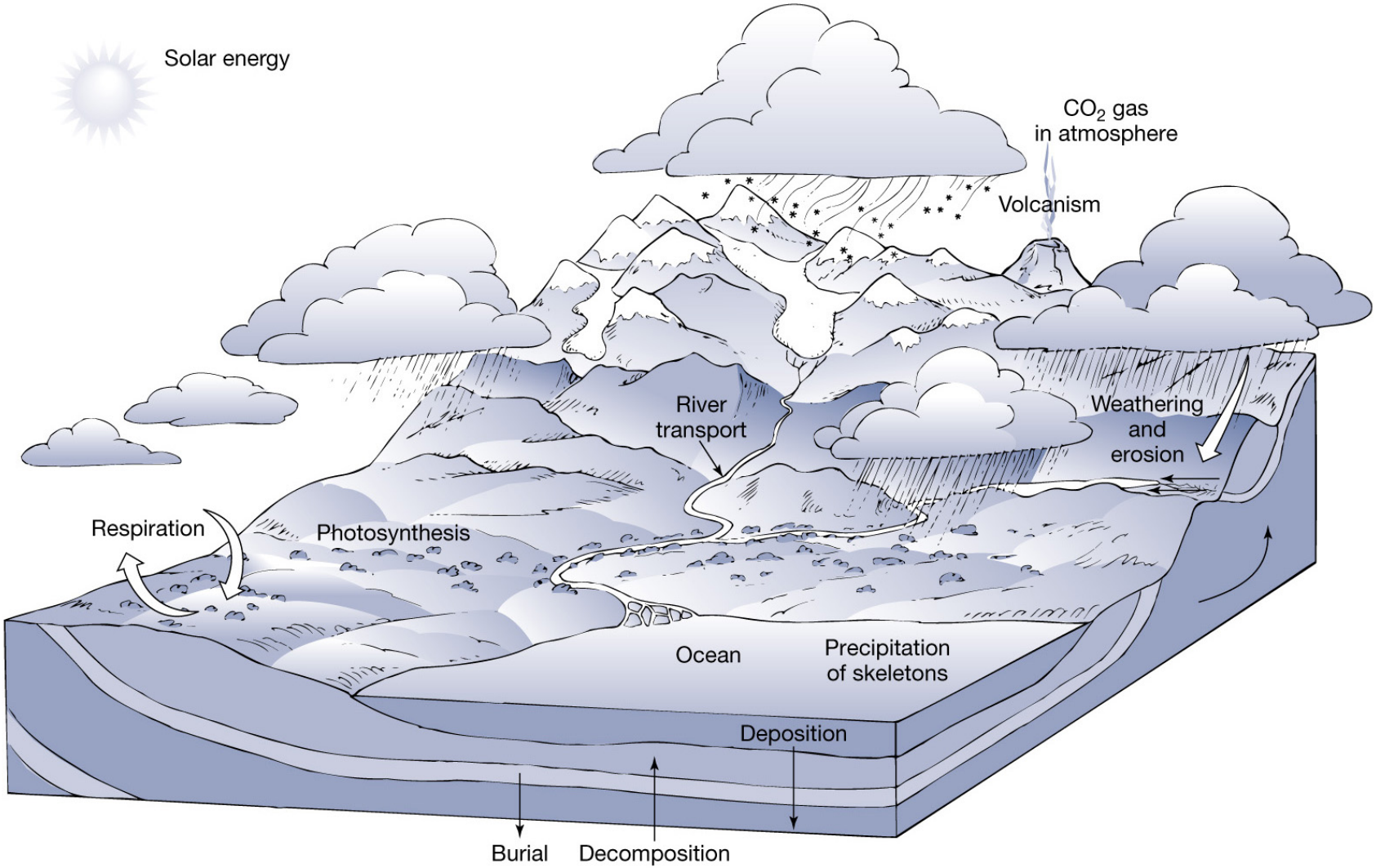


Methane

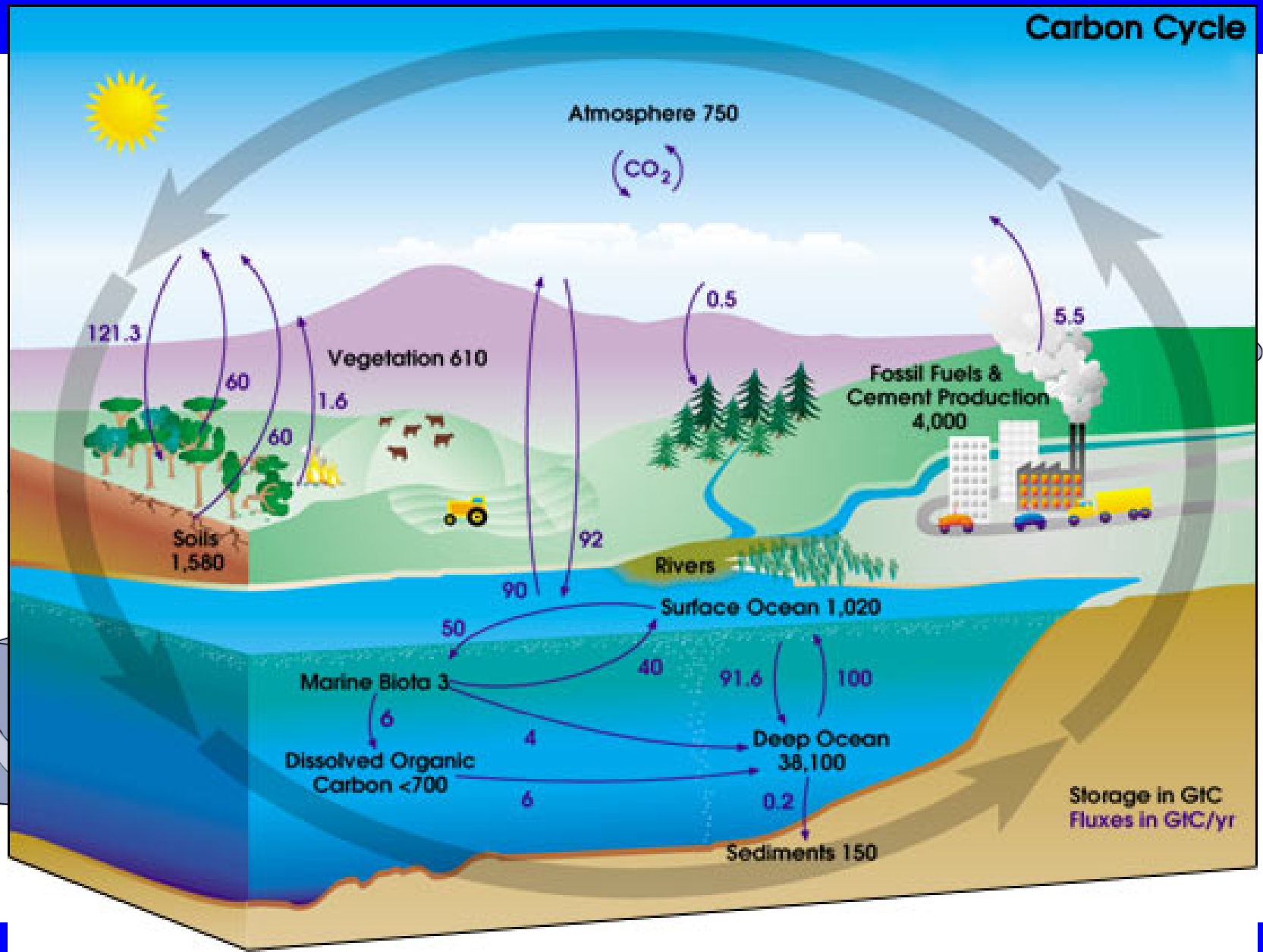
… and **LOTS** of others !!!!!

•Inorganic carbon – not associated with life – graphite, diamond, rocks, CO_2

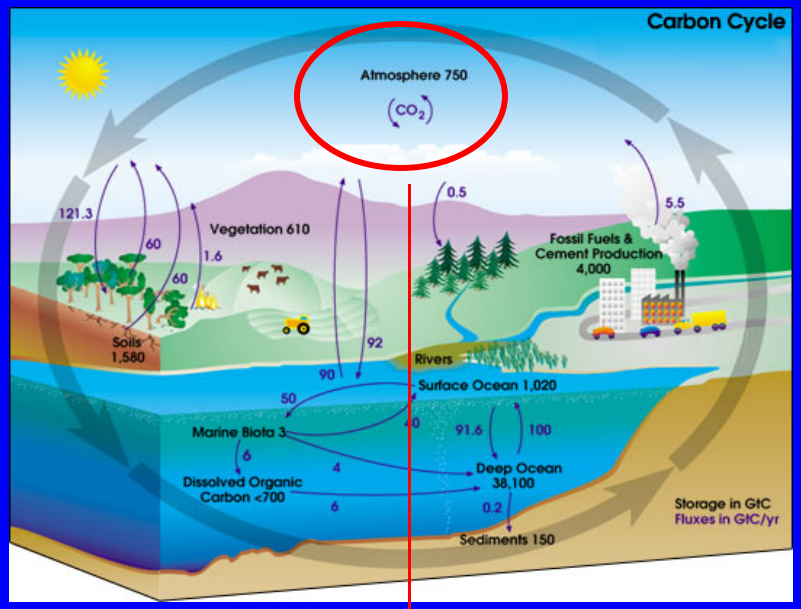
Carbon Cycle Overview

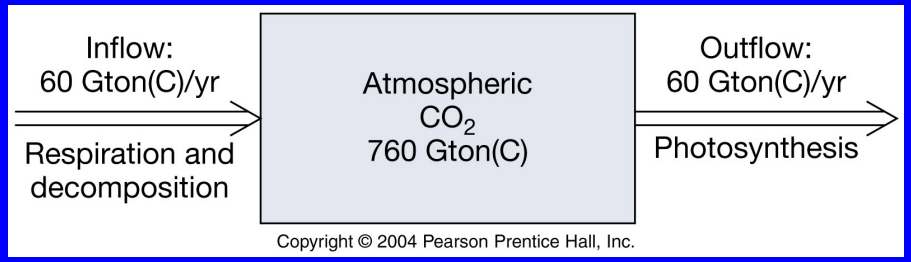


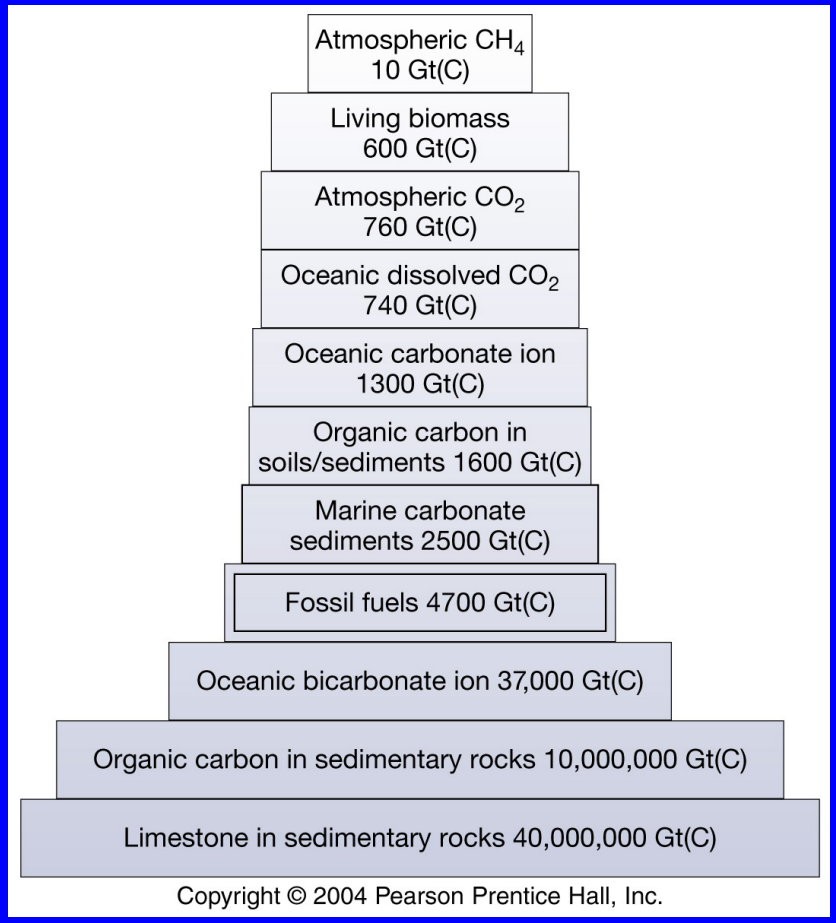
Carbon Cycle Overview



Carbon Resevoirs

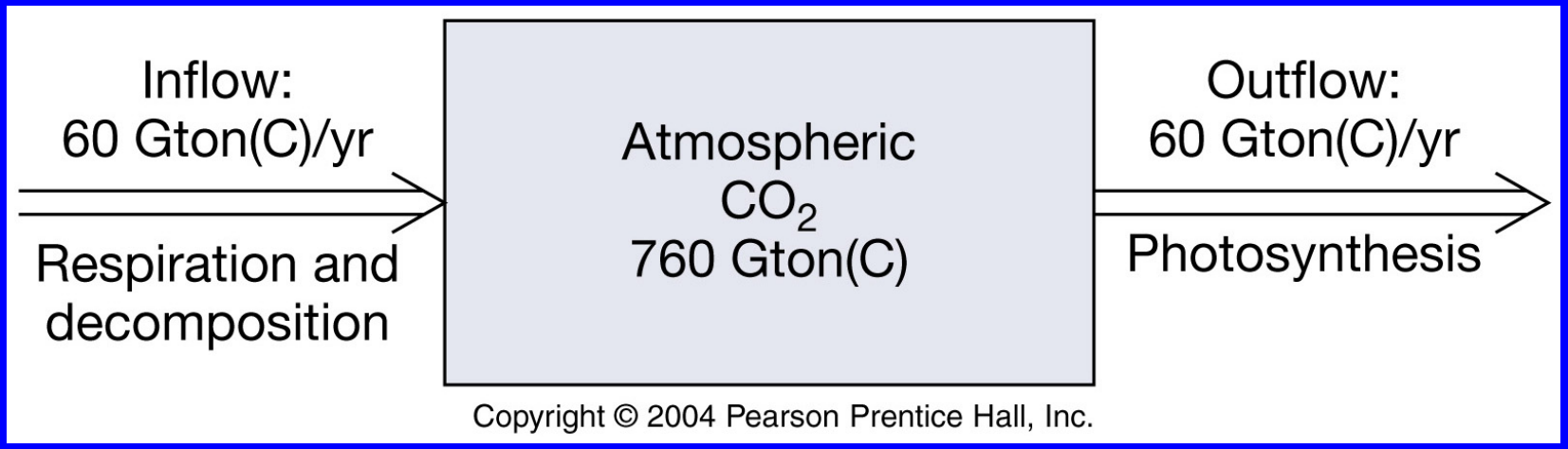






Resevoirs and Steady State

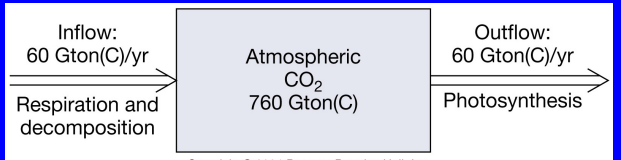
- Steady state – component is steady with time
  - No input AND no output
  - Input = Output

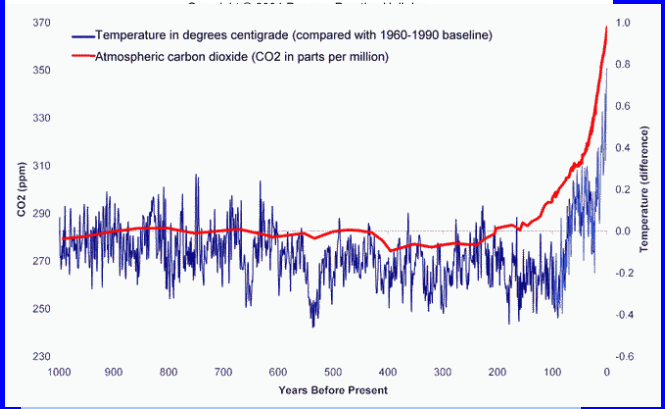


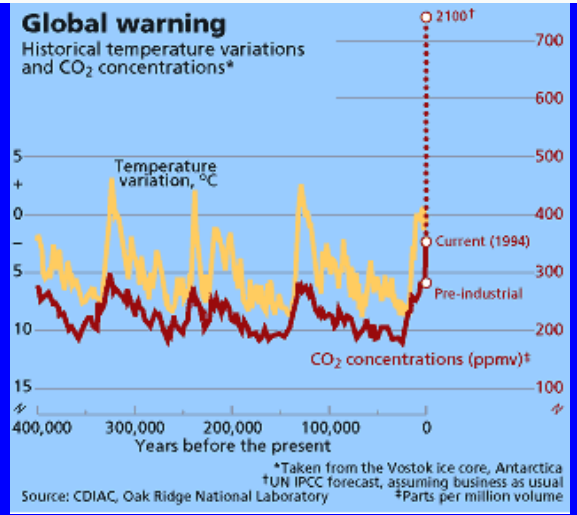
Is atmospheric CO_2 in steady state?

Is atmospheric CO_2 in steady state?

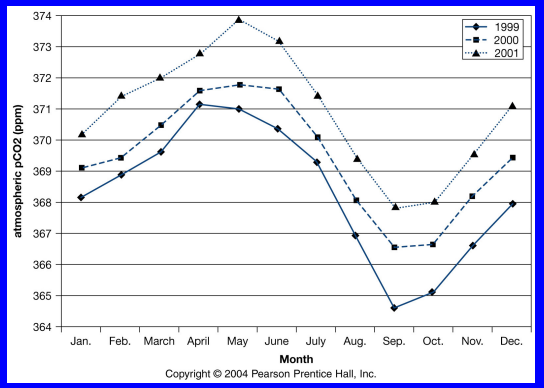
Yes

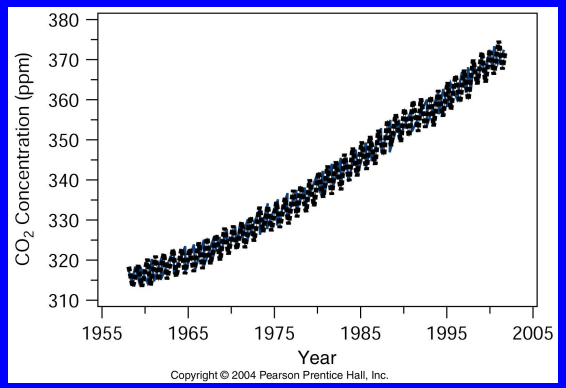






… and No!





Steady state a matter of time-scale

Seasonal time scale -> No

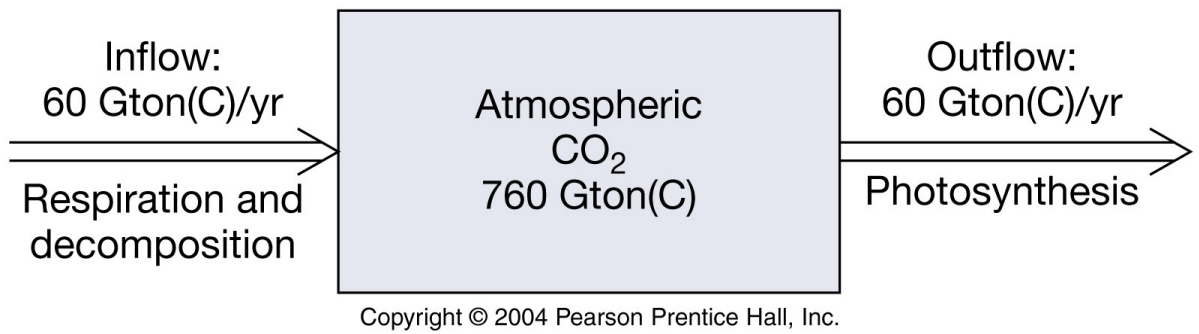
Annual time scale -> Steady state

100 year scale -> No

Natural Cycle -> Yes

Steady State and Residence Time

Residence Time – average amount of time spent in a reservoir that is in steady state.



Residence time = Reservoir size / inflow (outflow) rate

Residence time related to response time

Long residence time → Long response time

Short residence time → Short response time

What is the residence time of CO_2 in the atmosphere, if the input is 60 Gton/year, and the atmosphere holds 600 Gton ?

c. 100 Gton
d. 10 Gton
e. 100 years
f. 10 years

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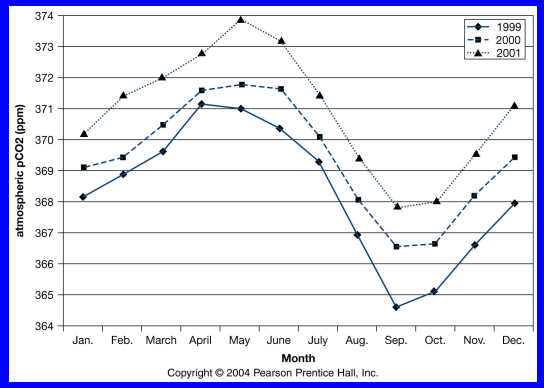
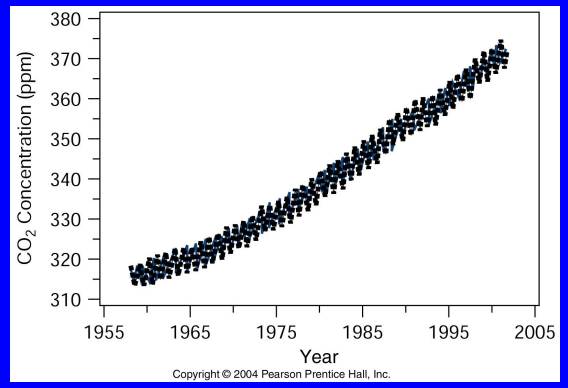
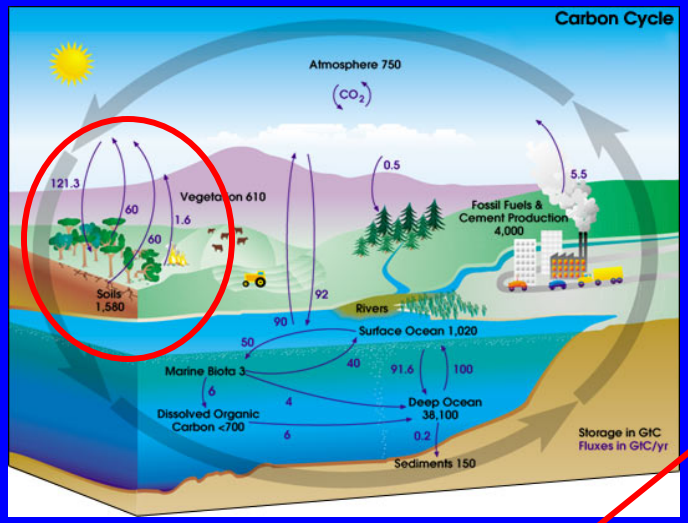


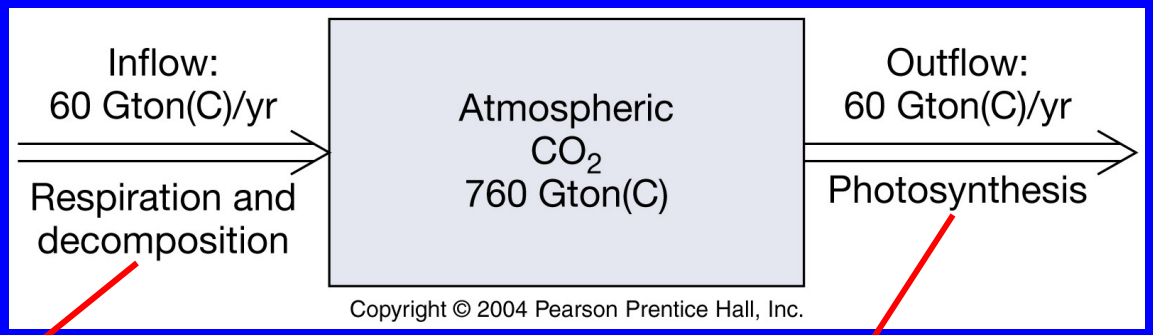


Residence/Response time of atmospheric CO_2 is relatively short!

→ Changes in inflow/outflow of CO_2 to atmosphere will make the reservoir respond quickly

Land/Atmosphere Short-term Organic Carbon Cycle





Respiration:

$CH_2O + O_2 \rightarrow CO_2 + H_2O$

Decomposition:

$2CH_2O \rightarrow CO_2 + CH_4$

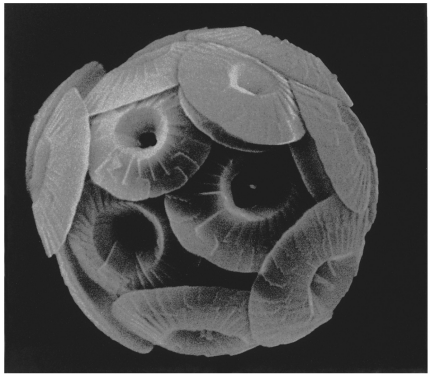
Photosynthesis --

$CO_2 + H_2O \rightarrow CH_2O + O_2$

Marine Short-term Organic Carbon Cycle

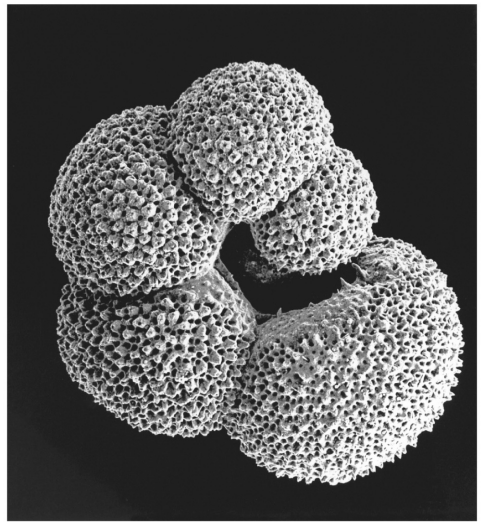
Phytoplankton

(a)

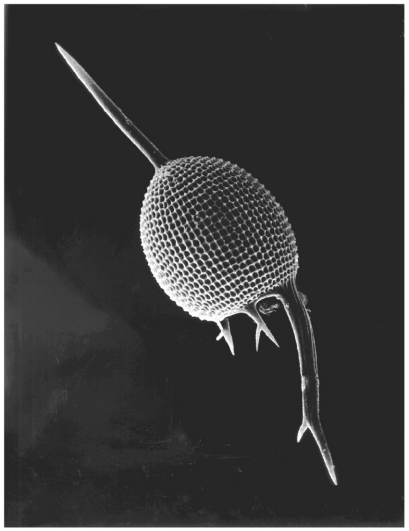


(b)

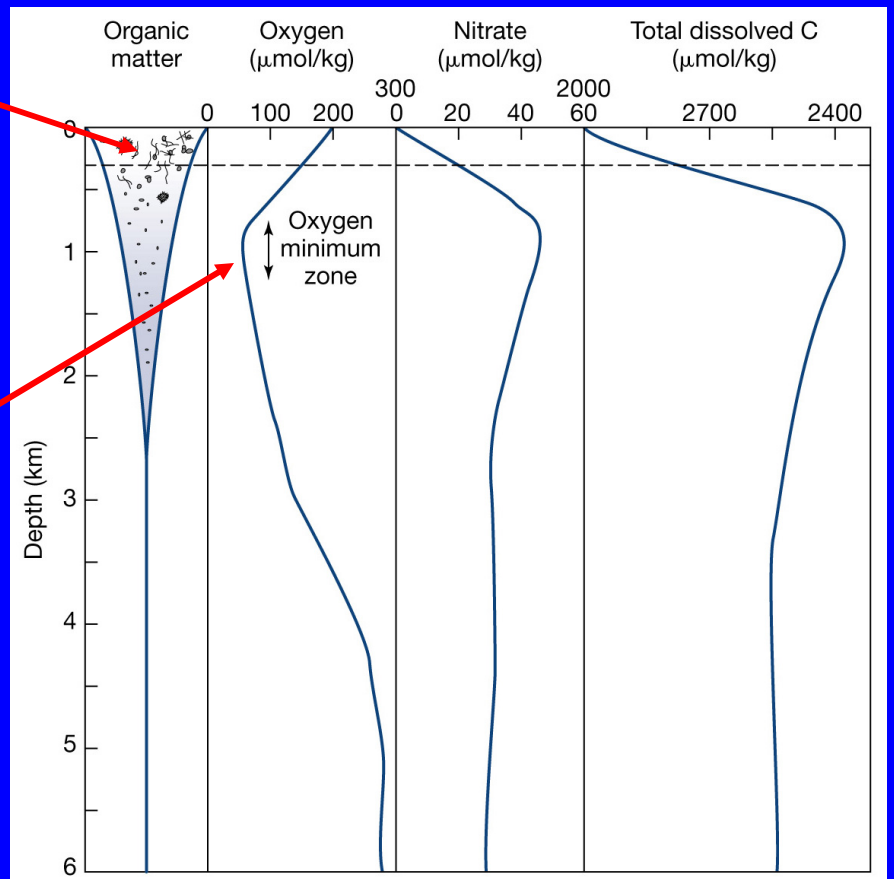
Zooplankton



(c)

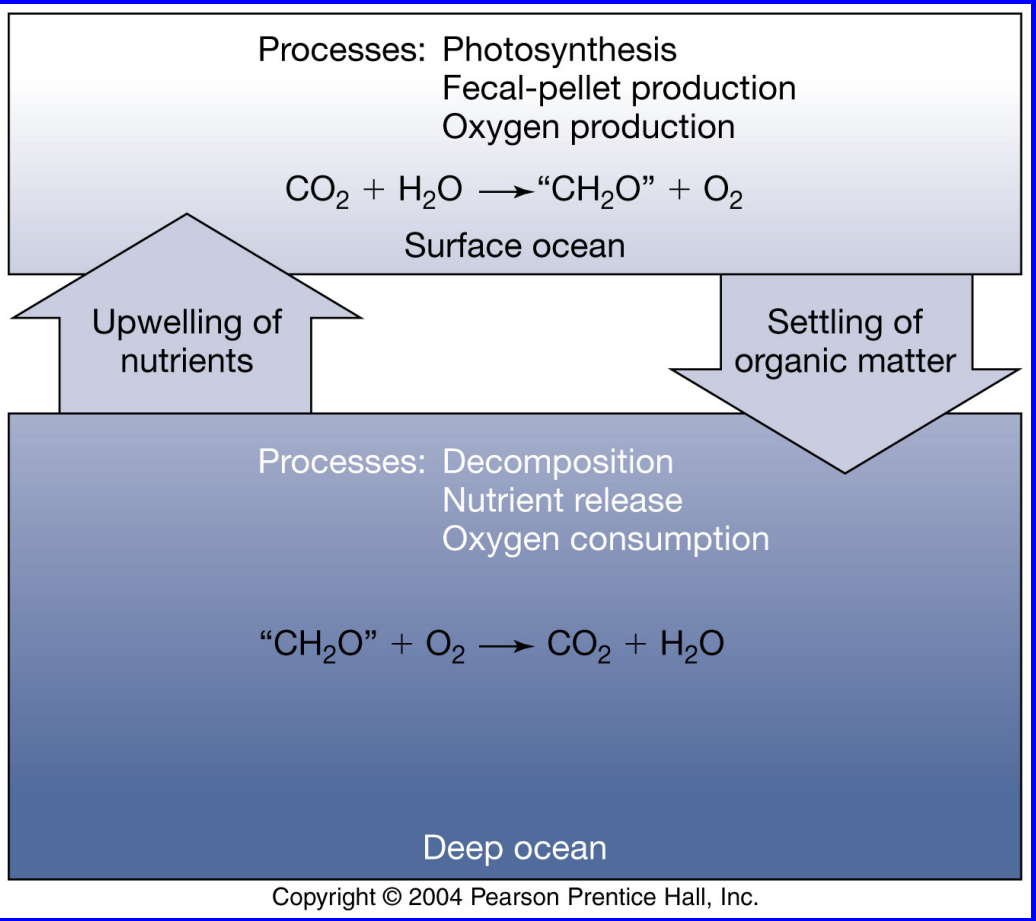


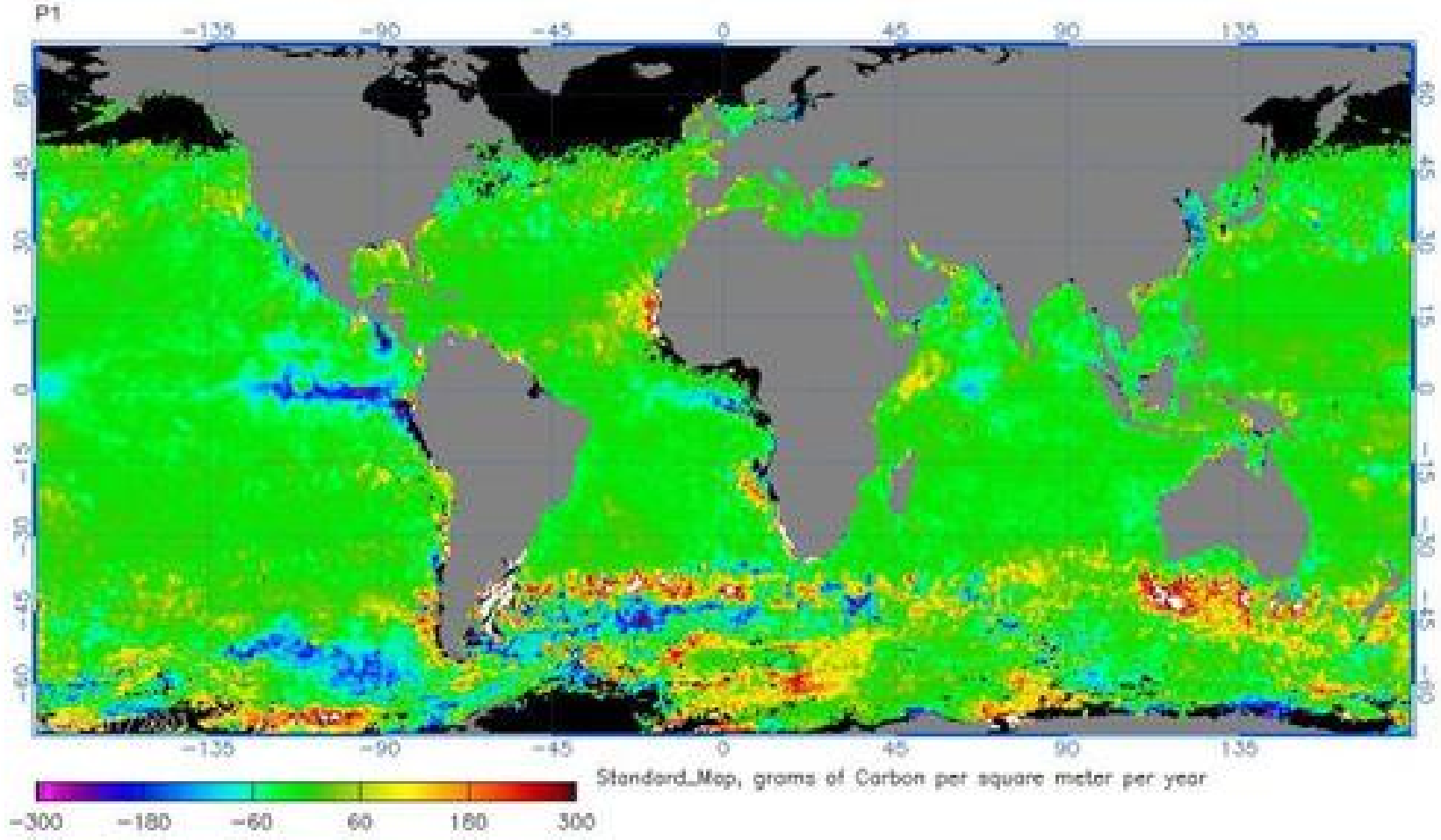
(d)



Marine Short-term Organic Carbon Cycle

The Biological Pump




P1
-135
-90
-45
0
45
90
135
60
45
30
15
0
-15
-30
-45
-60
Standard_Map, grams of Carbon per square meter per year
-300
-180
-60
60
180
300

Question

What do you think will happen to photosynthesis with increasing atmospheric CO_2/temperature, and what kind of feedback would this represent?

b. More photosynthesis -- Positive feedback

c. More photosynthesis --Negative feedback

d. Less photosynthesis – Positive feedback

e. Less photosynthesis – Negative feedback

Question

What do you think will happen to photosynthesis with increasing atmospheric CO_2/temperature, and what kind of feedback would this represent?

b. More photosynthesis -- Positive feedback

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