The Carbon Cycle
Antropogenic Carbon Emissions and Atmospheric Accumulation

Where is all the Carbon?  (2005)

- Atmosphere:
  - CO₂: 805 Gt
  - Methane: 1.7 Gt

- Oceans: 38,000 Gt
  - Surface, contact with atmosphere: 700-1000

- Terrestrial Systems:
  - terrestrial vegetation: 540 - 560 Gt
  - organic matter in soils: 1500 – 2000 Gt (in the top meter)

Note: 50% of dry (water removed) organic matter is carbon

- Fossil Fuels:
  - Recoverable reserves of coal, oil, and gas: 5000–10,000 Gt
Carbon Stocks & Flows

Units: 1 Pg
=10^{15} g = 1 Gt
=Billion tons

Budgeting the Anthropogenic Changes
How to find the ‘Missing Carbon’?

Last Friday (01/23/09) Japan’s Aerospace Exploration Agency launched “IBUKI” …not to search for little C’s in outer space, but to…
monitor the change in infrared radiation caused by the presence of CO₂

- “IBUKI”=GOSAT= Greenhouse Gases Observing Satellite
- Next month (02/23/09) NASA launches OCO from the Vandenberg Air Force Base in California (~Santa Barbara)

As we learned during the course of the lecture sleeps now in Antarctic Waters...
Hope to get more precise maps of sinks and sources

mean flux [gC/m² /yr]
for 2007-01-15 ± 15.0 days

The Carbon Tracker Project. Map depicts model based interpolation of changes in Carbon flux, watch the date!
Hope to get high resolution maps of sinks and sources

mean flux [gC/m²/yr]
for 2007-07-15 ± 15.0 days

The Carbon Tracker Project, Northern summer.
http://www.esrl.noaa.gov/gmd/ccgg/carbontracker/fluxmaps.php?type=global#imagetable
Seasonal pattern of CO₂ concentrations:

RECENT MONTHLY MEAN CO₂ AT MAUNA LOA

Source: Dr. Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/)
Finding the missing carbon

Why are we interested in these details?

- Natural Sinks and Sources can change over time, in particular, in response to climate change.
- To predict these changes we need to find and understand the sinks, sources, and mechanisms at work.
Carbon Cycle & Feedback Effects

• The current terrestrial carbon sink represents a subsidy that has kept the airborne fraction of total CO2 emissions between 40% and 50% for at least the past five decades.

• Most projections of future climate have been based on the assumption that the current terrestrial sink will not only continue but will grow in proportion to concentrations of CO2.

• Recent findings and feedback effects challenge this assumption.

For more: