A Rationale for Studying the Cycling of Carbon on Planet Earth

From the Mauna Loa record (the "Keeling Curve"), we can determine the annual rate of increase of CO_2 in the atmosphere to be about 1.5 ppmv (parts per million by volume)

But:

Human activities (fossil fuel burning, deforestation principally) are releasing 6 Gt of C per year mostly as CO_2. [1 Gigaton or Gt equals 1000 trillion grams (i.e. 10^{15} g), or 1 trillion kg; a gigaton is sometimes called a petagram, "peta" indicating 10^{15})

By direct measurement of the CO_2 concentration and estimates of the volume of the atmosphere, it has been determined that Earth's atmosphere contains about 760 Gt of C, almost all as CO_2.

Hence, the rate of increase in CO_2 concentration in the atmosphere should be [(6 Gt/year)/760 Gt] x 370 ppmv (the current average concentration). This equals 3 ppmv per year, twice what is observed in the Mauna Loa record. So, half of the added CO_2 is going somewhere other than the atmosphere!

A major (and important!) challenge then is to determine where the CO_2 is going.

What are the likely sinks? There are two leading culprits:

- The ocean, which is reckoned by some to take up roughly half of the 'missing' CO_2 via biological, chemical and physical processes
- Terrestrial vegetation (the so-called carbon sinks on land, which caused so much grief at the COP VI conference in the Hague last year, when countries squabbled over the size of the sinks in various locations (like the boreal forests of northern Canada).

Our focus in EOSC 112 will be on the oceanic side – we will be exploring the various controls on carbon cycling as well as sinks.