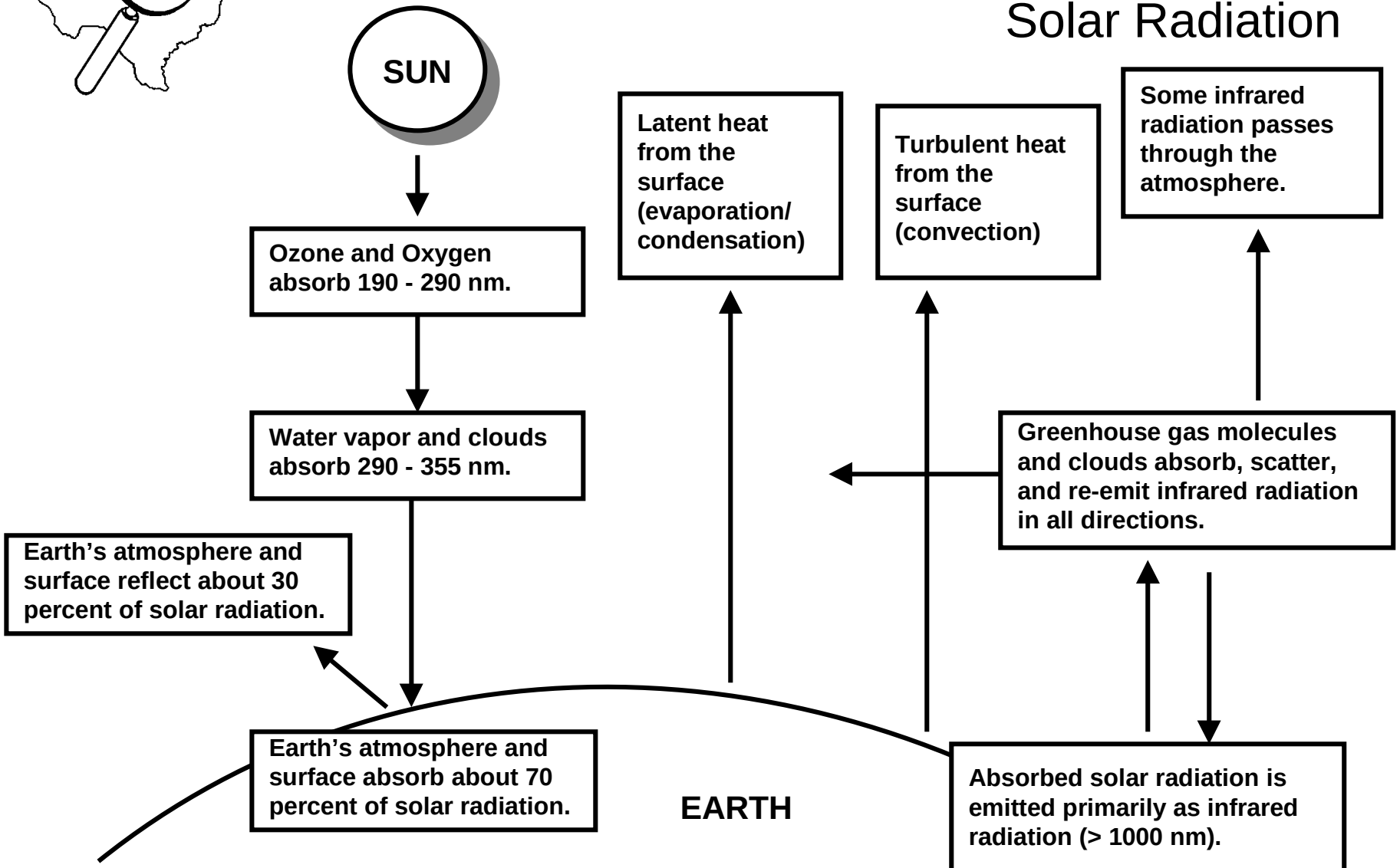
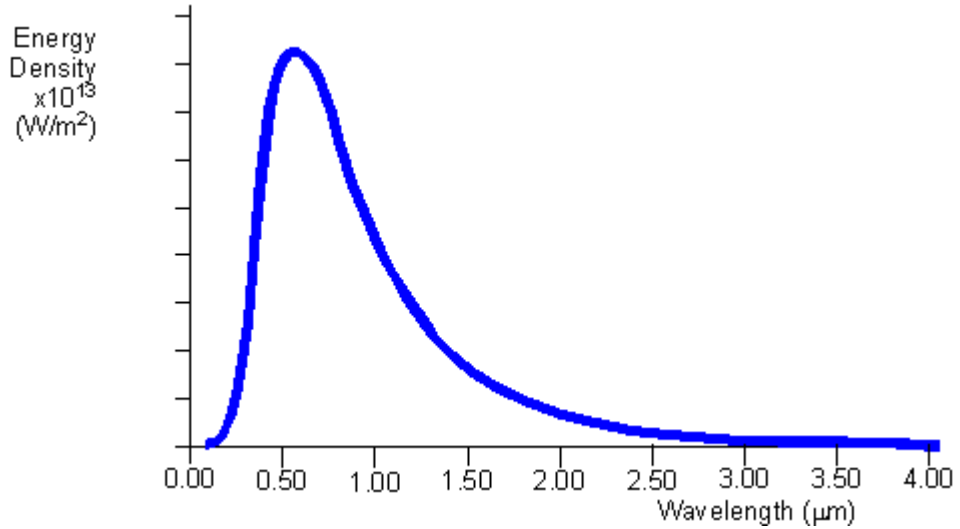
Global Warming Science
Solar Radiation



Global Warming Science
Black Body Radiation

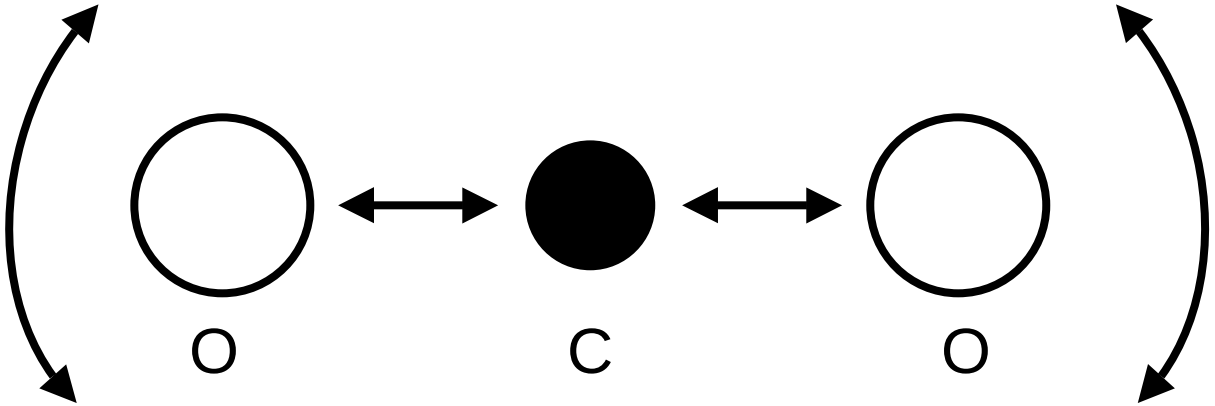


$$f_{max} = xT$$

(Wein's displacement law)

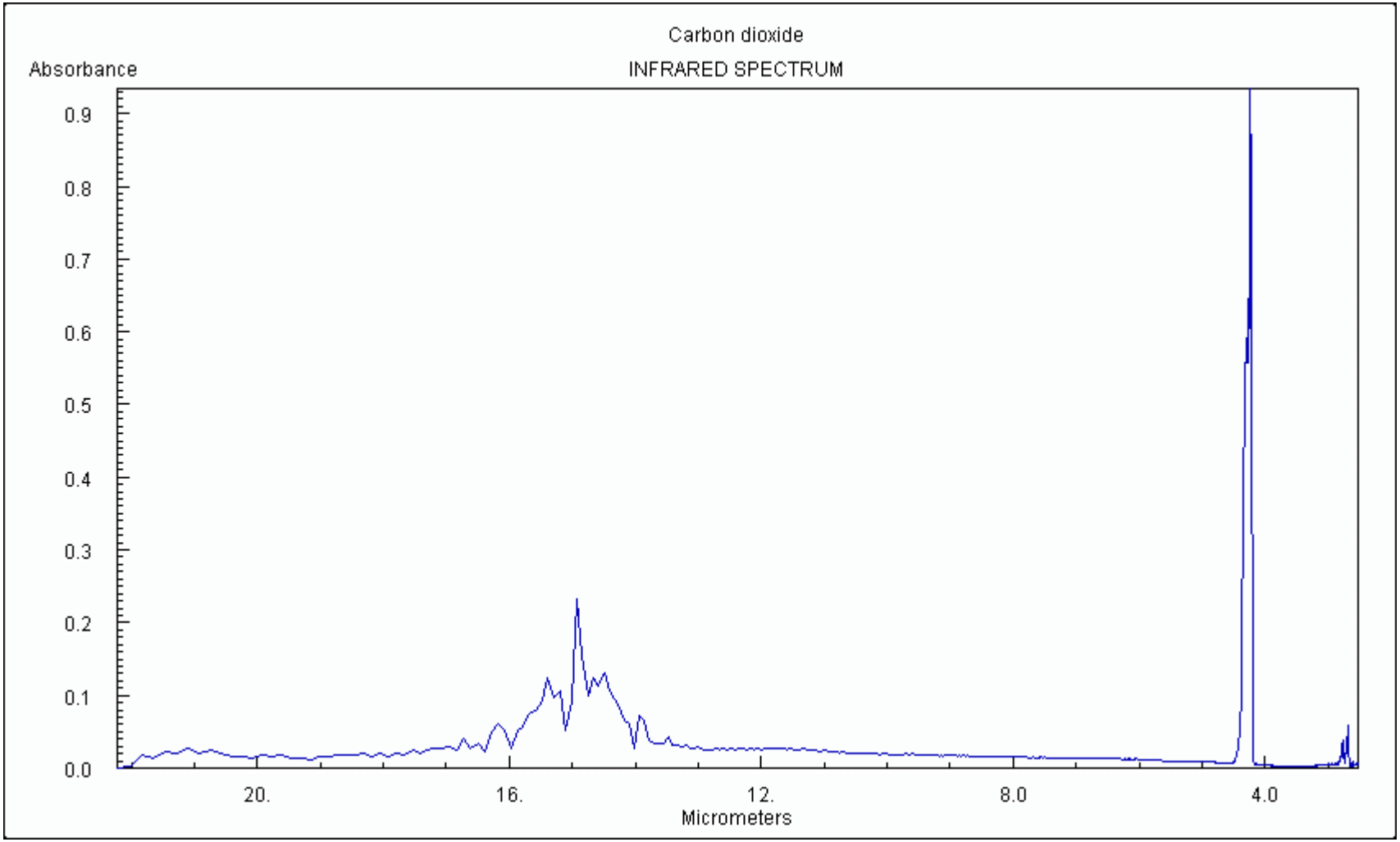
http://www.egglescliffe.org.uk/physics/astronomy/blackbody/bbody.html

Global Warming Science
CO_2 Quantum Mechanics



Global Warming Science
CO_2 Absorption Spectrum

http://webbook.nist.gov/cgi/cbook.cgi?ID=C124389&Units=SI/&Mask=80

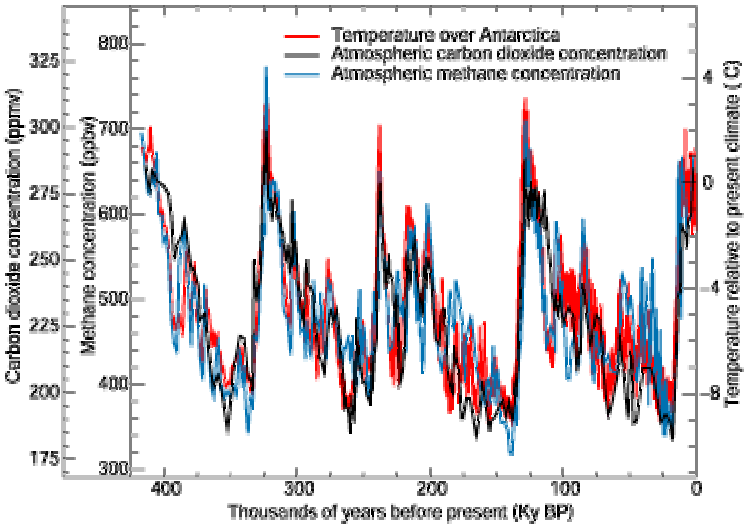


Global Warming Science
Global Warming Potential

Gas	*GWP*
Carbon dioxide (CO2)	**1**
Methane (CH4)*	**21**
Nitrous oxide (N2O)	**310**
HFC-23	**11,700**
HFC-32	**2,800**
HFC-125	**1,300**
HFC-134a	**3,800**
HFC-143a	**140**
HFC-152a	**2,900**
HFC-227ea	**2,900**
HFC-236fa	**6,300**
HFC-4310mee	**1,300**
CF4	**6,500**
C2F6	**9,200**
C4F10	**7,000**
C6F14	**7,400**
SF6	**23,900**

http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsNationalGlobalWarmingPotentials.html

Global Warming Science
GW Gasses and Temperature—History



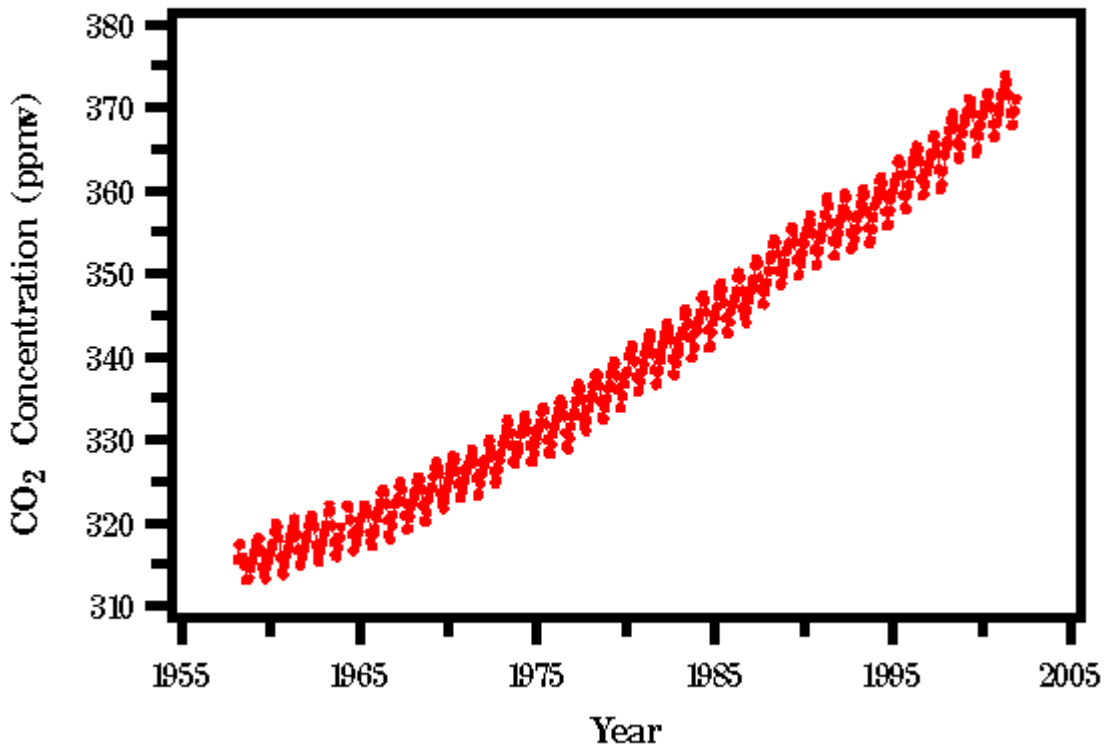
This graph shows the increase in the atmospheric concentration of Carbon dioxide (CO2), methane (CH4) and Antarctic temperature from 420,000 years ago until prior to the industrial revolution.

The grey color represents CO2 concentrations, and the scale on the far left refers to the CO2 values. As can be seen in the graph to the left, pre-industrial levels (~280 ppmv) were similar to previous interglacials (times which were not considered an 'ice-age' - as now). The present, post-industrial atmospheric level of CO2 concentration is around 370ppmv, which on this graph would be off the scale.

http://lwf.ncdc.noaa.gov/oa/climate/carbdiox.html

Global Warming Science
CO_2 History

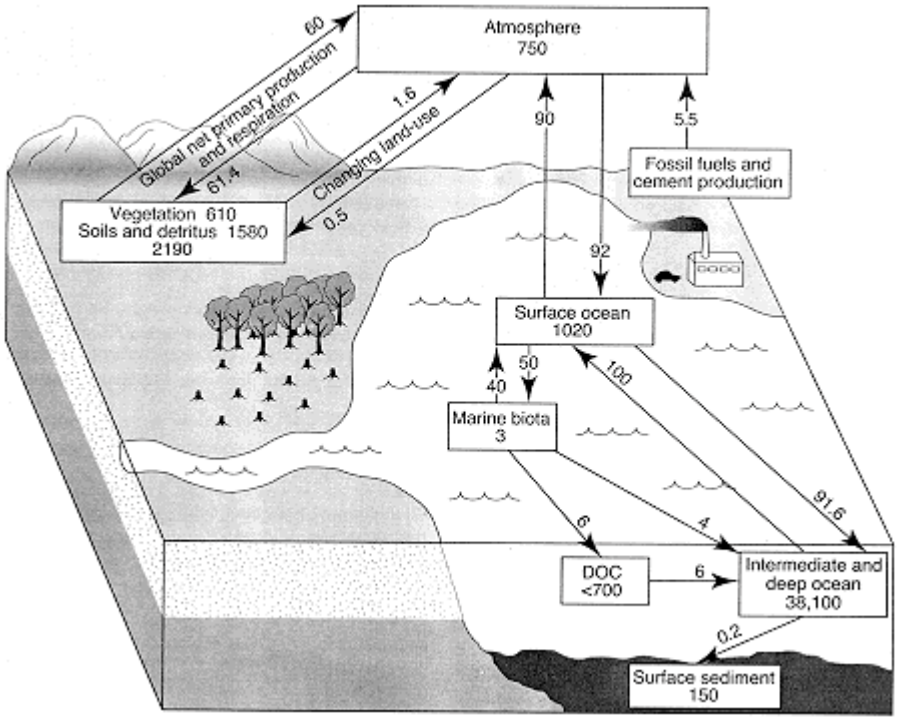
Carbon dioxide concentration as measured at Mauna Loa, Hawaii. These measurements represent the globally mixed concentration.

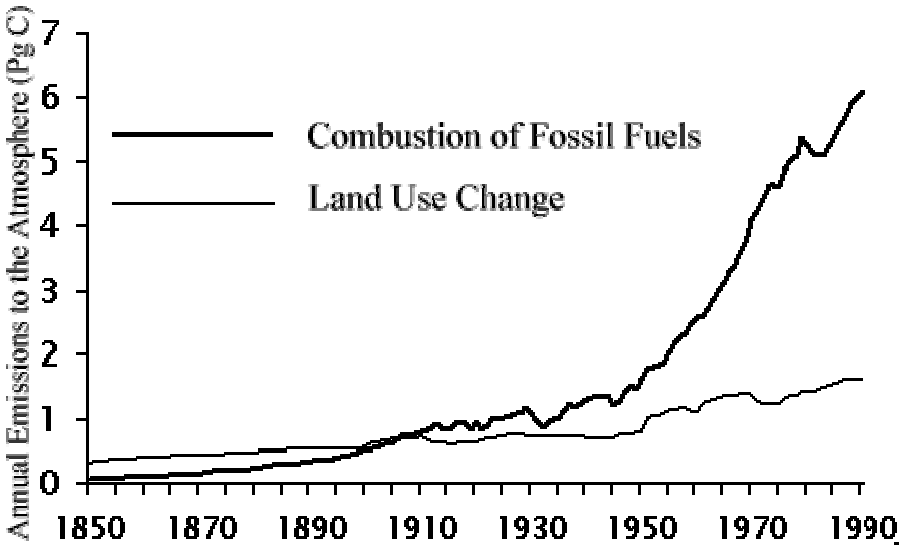


Source: Dave Keeling and Tim Whorf (Scripps Institution of Oceanography)

http://lwf.ncdc.noaa.gov/img/climate/globalwarming/sio-mlgr.gif

Global Warming Science
The Carbon Cycle





http://www.whrc.org/science/carbon/carbon.htm

Global Warming Science
Quantified Carbon Cycle

Atmospheric increase = Emissions from Fossil fuels + Net emissions from changes in land use - Oceanic uptake - Missing carbon sink

3.3(±0.2) = 5.5(±0.5) + 1.6(±0.7) - 2.0(±0.8) - 1.8(±1.2)

http://www.whrc.org/science/carbon/carbon.htm

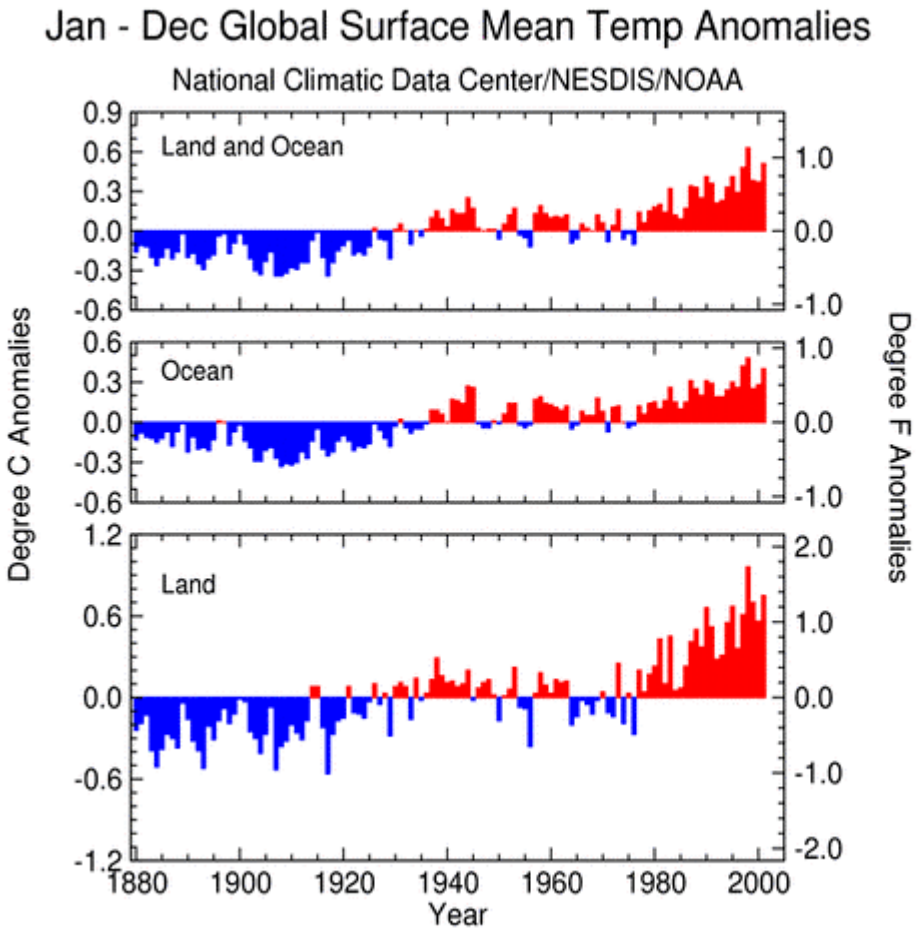
Global Warming Science
Human Contribution

The natural production and absorption of carbon dioxide (CO_2) is achieved through the terrestrial biosphere and the ocean. However, humankind has altered the natural carbon cycle by burning coal, oil, natural gas and wood and since the industrial revolution began in the mid 1700s, each of these activities has increased in scale and distribution. Carbon dioxide was the first greenhouse gas demonstrated to be increasing in atmospheric concentration with the first conclusive measurements being made in the last half of the 20th century. Prior to the industrial revolution, concentrations were fairly stable at 280ppm. Today, they are around 370ppm, an increase of well over 30%. The atmospheric concentration has a marked seasonal oscillation that is mostly due to the greater extent of landmass in the northern hemisphere (NH) and its vegetation. A greater draw down of CO_2 occurs in the NH spring and summer as plants convert CO_2 to plant material through photosynthesis. It is then released again in the fall and winter as the plants decompose.

http://lwf.ncdc.noaa.gov/oa/climate/gases.html#cd

Global Warming Science
Global Temperature History

This graph shows annual mean global temperature anomalies over the period 1880-2001.
The zero line represents the long term mean temperature from 1880-2001, and the red and blue bars are showing annual departures from that mean.
As is evident in the graph, 2001 was second only to 1998 in terms of global temperature, and the trend has been toward increasing temperatures at least since the beginning of the 20th century.
Land temperatures have greater anomalies than the ocean, which is to be expected since land heats up and cools down faster than water.



http://lwf.ncdc.noaa.gov/oa/climate/globtemp.html