Climate Essentials:
Critical Greenhouse Gas Concentration Trends

We will review the essential fundamental historic raw data of Climate Change- Collections of Fundamental Climate Data and Mathcad Generated Plots:

Paleologicical Records - Temperature Proxies/Reconstructions
Co-Plot of Temperature Anomaly and CO2 from the past 420,000 years from Vostok Ice Core Data
Milleniual Temperature Reconstructions (Last 1000 yrs from several souces)

CO2 Records
The Keeling Curve: Mauna Loa Observation Hawaii Monthly CO2 Concentration Data (1958-2010)
CO2 - Neftel Siple Ice Station - 1847 to 1953
Vostok Ice Core Data: Barnola et al
Temp and CO2 Hadcrut data:1860 to 2010
CDIAC - Carbon Dioxide Information Analysis Center - Global Anthropogenic CO2 Emissions

The Miskolczi - Principle

Relative and Specific Humidity vs. Height - The Saturated Greenhouse Effect
**A fundamental assumption of global warming models is that
humidity is constant or increases.**
If Humidity has been decreasing with time, then
Warming cannot be caused by increased CO_2.

**In what follows, we will examine satelite data which
shows that humidity has been decreasing.**

See NOAA Earth System Research Laboratory Report:
"Stratospheric Water Vapor is a Global Warming Wild Card"

http://www.esrl.noaa.gov/news/2010/stratospheric_water_vapor_impacts_global_warming.html

Historical Isotopic Temperature Record from the Vostok Ice Core - 1999

http://www.heartland.org/publications/NIPCC%20report/PDFs/Chapter%203.1.pdf
http://en.wikipedia.org/wiki/Ice_core
Petit, "Climate and atmospheric history of the past 420,000 years from the Vostok ice core,
Antarctica", Nature 399: 429-436 CO2: Gas age CO2 (ppmv) File: co2vostokPetit.txt
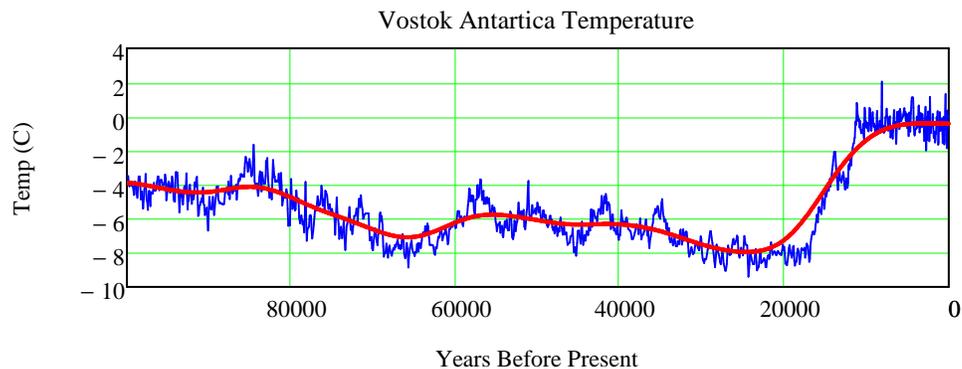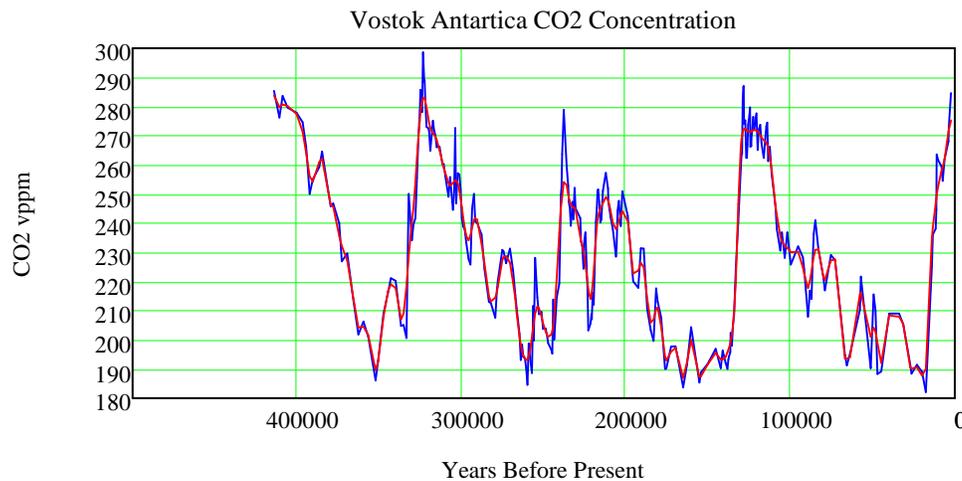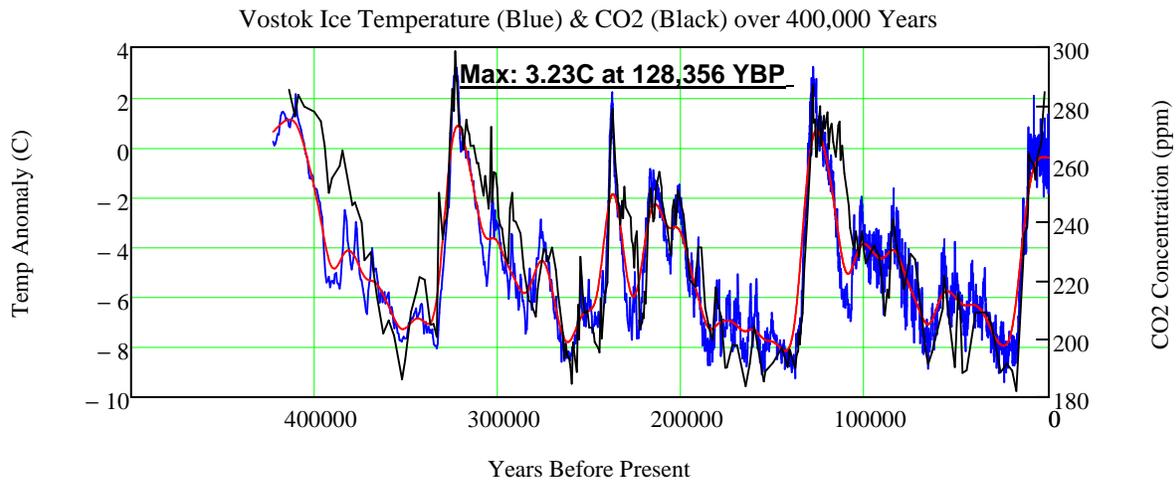Carbon Dioxide Information Analysis Center
http://cdiac.esd.ornl.gov/ftp/trends/temp/vostok/vostok.1999.temp.dat
Depth (m), Age of ice (yr BP),   Deuterium contentof the ice (D), Temperature Variation (deg C)

$$\text{Temp}_{Vostok} := \text{READPRN}(\text{"vostok.1999.temp.txt"}) \quad \text{CO2Vostok} := \text{READPRN}(\text{"CO2vostokPetit.txt"})$$

$$\text{CO2VosS} := \text{ksmooth}\left(\text{CO2Vostok}^{\langle 0 \rangle}, \text{CO2Vostok}^{\langle 1 \rangle}, 5000\right)^{\blacksquare} \qquad \text{CO2VosS}_{norm} := \frac{\text{CO2VosS} - 260}{8}$$

$$\text{TS}_{vost} := \text{ksmooth}\left(\text{Years}_{vost}, \text{Temp}_{vost}, 10000\right)^{\blacksquare}$$

Note: The 100,000 Year Cycle, which corresponds the the Earth's Orbital Variation
CO2 actually lags temperature by around 1000 years.

Vostok Ice Temperature (Blue) & CO2 (Black) over 400,000 Years

Max: 3.23C at 128,356 YBP

Vostok Antartica CO2 Concentration

Vostok Antartica Temperature

CO2 Concentration Monthly Plot

The Keeling Curve: Mauna Loa Observation Hawaii Monthly CO2 Concentration Data

The carbon dioxide data, measured as the mole fraction in dry air, on Mauna Loa constitute the longest record of direct measurements of CO2 in the atmosphere. This data is the gold standard in climate research. They were started by C. David Keeling of the Scripps Institution of Oceanography in March of 1958 at a facility of the National Oceanic and Atmospheric Administration (Keeling, 1979). NOAA started its own CO2 measurements in May of 1974. The moving average is for seven adjacent seasonal cycles centered on the month to be corrected, except for the first and last three and one-half years of the record, where the seasonal cycle has been averaged over the first and last seven years, respectively. The estimated uncertainty in the Mauna Loa annual mean growth rate is 0.11 ppm/yr. This estimate is based on the standard deviation of the differences between monthly mean values.

Keeling had perfected the measurement techniques and observed strong diurnal behaviour with steady values of about 310 ppm in the afternoon at three locations (Big Sur near Monterey, the rain forests of Olympic Peninsula and high mountain forests in Arizona). By measuring the ratio of two isotopes of carbon, Keeling attributed the diurnal change to respiration from local plants and soils, with afternoon values representative of the "free atmosphere". By 1960, Keeling and his group established the measurement record that was long enough to see not just the diurnal and seasonal variations, but also a year-on-year increase that roughly matched the amount of fossil fuels burned per year.
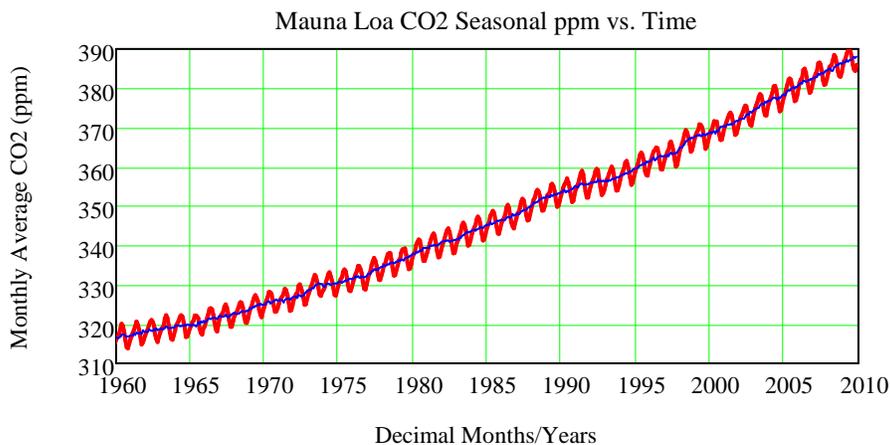
The Keeling Curve also shows a cyclic variation of about 5 ppmv in each year corresponding to the seasonal change in uptake of CO2 by the world's land vegetation. Most of this vegetation is in the Northern hemisphere, since this is where most of the land is located. The level **decreases from northern spring** (May) onwards as new plant growth takes carbon dioxide out of the atmosphere through photosynthesis and rises again in the northern fall as plants and leaves die off and decay to release the gas back into the atmosphere.
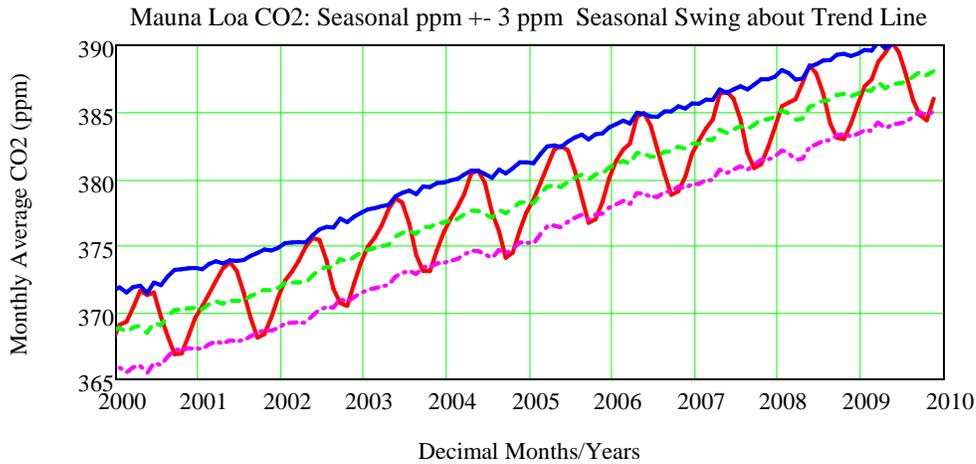Read data from http://www.esrl.noaa.gov/gmd/ccgg/trends/co2_data_mlo.

Year Month decimal average interpolated trend #days
              date   ppm   ppm   (season corr)

$MLCO2 := READPRN("NOA\_Mauna\_Loa\_Monthly\_CO2.TXT")$

$Date := MLCO2^{\langle 2 \rangle}$ $CO2_{ML} := MLCO2^{\langle 4 \rangle}$ $TrendCO2 := MLCO2^{\langle 5 \rangle}$

Mauna Loa CO2 Seasonal ppm vs. Time

Mauna Loa CO2: Seasonal ppm +- 3 ppm Seasonal Swing about Trend Line

Decimal Months/Years

Neftel Siple Ice Station - 1847 to 1953
http://cdiac.ornl.gov/ftp/trends/co2/siple2.013
 Avg depth   Gas   concentration
   (m)   (yr AD)   (ppmv)

Increase per year (%)

$$\frac{(390 - 372)\cdot 100}{10\cdot 372} = 0.48387$$

$SipleCO2 := READPRN("Friedli \ Siple \ CO2 \ 1986.TXT")$ $IceCO2 := READPRN("CO2 \ Ice \ Core \ Data.txt")$

http://www.wasserplanet.becsoft.de/180CO2/CO2tot1812-2007.txt
Column C: CO2 total 1812-1961 corrected. annual averages from raw data.
$BeckCO2 := READPRN("Beck \ CO2 \ Corrected.TXT")$
$BeckSmth := ksmooth\left(BeckCO2^{\langle 0 \rangle}, BeckCO2^{\langle 1 \rangle}, 10\right)$

See: "CO2: The Greatest Scientific Scandal of our Time", Zbigniew Jaworowski
This applies to all the CO2 Ice Core data shown in this worksheet

Ice Core, ML, and Beck CO2 Yearly ppm

Beck Smith Historical Direct Instrument Records

Years
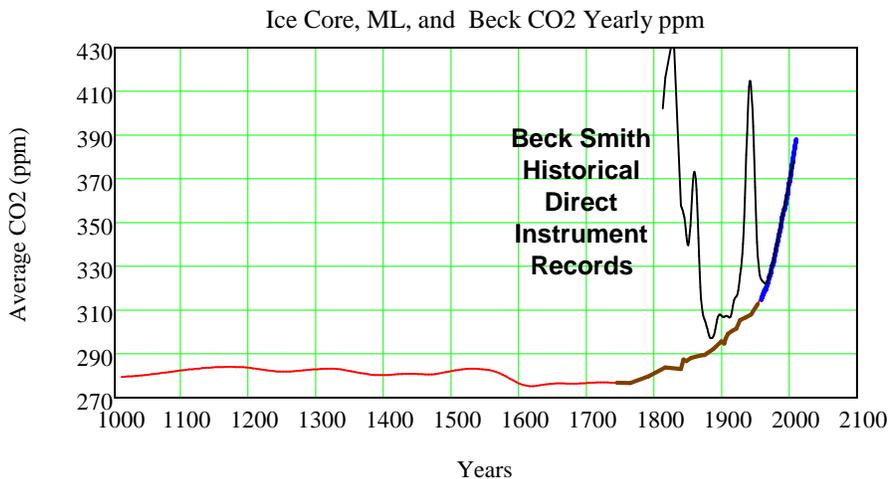
www.soest.hawaii.edu/GG/FACULTY/POPP/Lecture15.ppt
Measurements of CO2 concentration - Core from rapidly accumulating ice
Merge well with instrumental data1763 - major improvements to the steam engine by the

 Scottish engineer James Watt
1769 – first self-powered road vehicle, built by French inventor Nicholas Cugnot
1780 - formulation of the Law of Combustion by the French scientist Antoine Lavoisier
1790 - invention of the electrical battery by the Italian scientist Luigi Galvani
1807 - development of commercial steamboats by the American inventor Robert Fulton
1816 – first U.S. energy utility company and natural gas is used to light streets of Baltimore
1851 - height of the New England whaling industry
1886 – German mechanical engineer Karl Benz first patent for gasoline-powered ICE car
1903 – first sustained powered air flight, at Kill Devil Hills, North Carolina
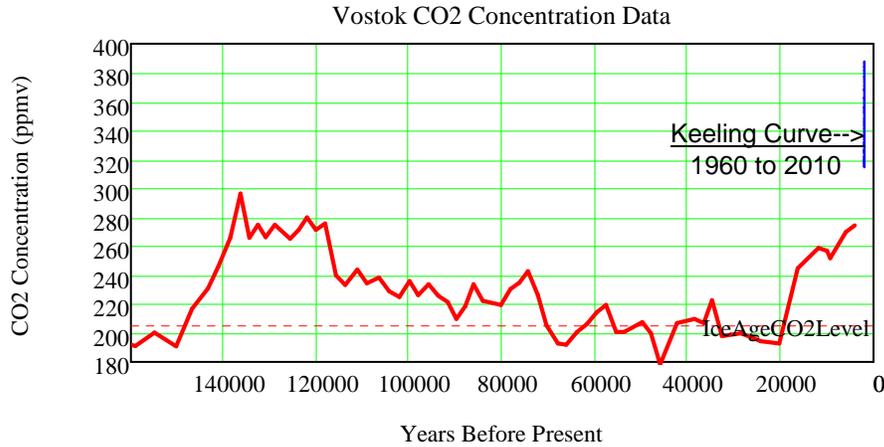
Depth (m), Ice Age(yrs), Gaz age (Yrs), CO2 (ppmv), mimimum, maximum

BarnolaCO2 := READPRN("Barnola Vostok CO2 1987.TXT")   IceAgeCO2Level := 205

Vostok cores show that CO2 concentrations are at the highest level in 160,000 years.

Vostok CO2 Concentration Data

An imperative for climate change planning: tracking Earth's global energy
Kevin E Trenberth
http://www.cgd.ucar.edu/cas/Trenberth/trenberth.papers/EnergyDiagnostics09final2.pdf

Plot data from above article for Fig 1
http://www.cru.uea.ac.uk/cru/data/temperature/hadcrut3vgl.txt

HadCrut := READPRN("hadcrut3vgl.txt")   rows(HadCrut) = 320   cols(HadCrut) = 14   n := 0 .. 159

HadCrutx := READPRN("hadcrut3glx.txt") rows(HadCrutx) = 160 cols(HadCrutx) = 14   n := 0 .. 159

$$TCrut_n := \sum_{m=1}^{12} \left(HadCrut_{2 \cdot n, m} \cdot \frac{1}{12} \right) \quad KT_{CO2} := \frac{TrendCO2 - 330}{100} \quad Time_{crut_n} := HadCrut_{2 \cdot n, 0}$$

$$TCrut_n := HadCrutx_{n, 13} \qquad\qquad IceCoreCO2 := \frac{IceCO2^{\langle 1 \rangle} - 330}{100} \quad TCrutPlus := \overrightarrow{(\Phi(TCrut) \cdot TCrut)}$$

Global Temp (Bars) & CO2 Levels (Black Line) vs. Time
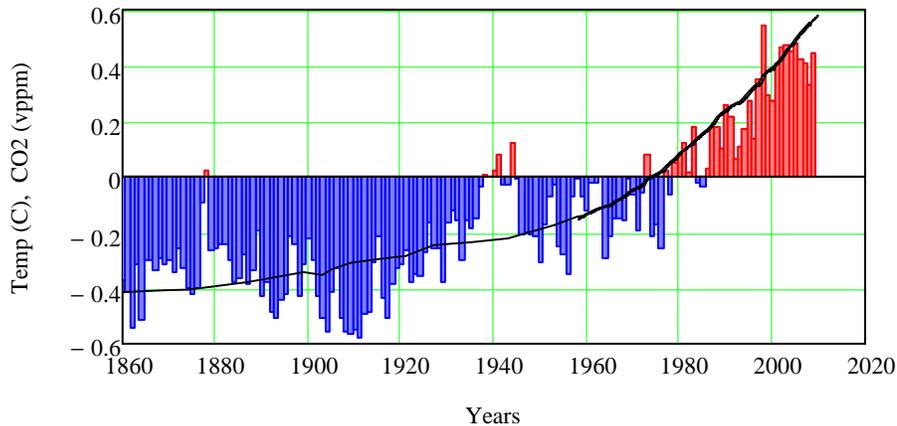
Use Ice Core and NOA _Mauna_Loa_Trend_CO2.txt versus hadcrut3glx.txt in file
Correlation_Yr_CO2_Temp.TXT.

$\text{CorrCO2Temp} := \text{READPRN}(\text{"Correlation\_Yr\_CO2\_Temp.TXT"})$

$\text{RSquare} := \text{corr}\left(\text{CorrCO2Temp}^{\langle 1 \rangle}, \text{CorrCO2Temp}^{\langle 2 \rangle}\right)^2$ RSquare = 0.80882

$\text{s} := \text{slope}\left(\text{CorrCO2Temp}^{\langle 1 \rangle}, \text{CorrCO2Temp}^{\langle 2 \rangle}\right) = 0.00847$

$\text{int} := \text{intercept}\left(\text{CorrCO2Temp}^{\langle 1 \rangle}, \text{CorrCO2Temp}^{\langle 2 \rangle}\right) = -2.82393$ $\qquad \delta T := \text{int} + \text{s} \cdot \text{CorrCO2Temp}^{\langle 1 \rangle}$

Correlation Does Not Necessarily Mean Causation

Correlation between CO2 ppm and Temp Anomaly (1854-2009)

CO2 (ppm)
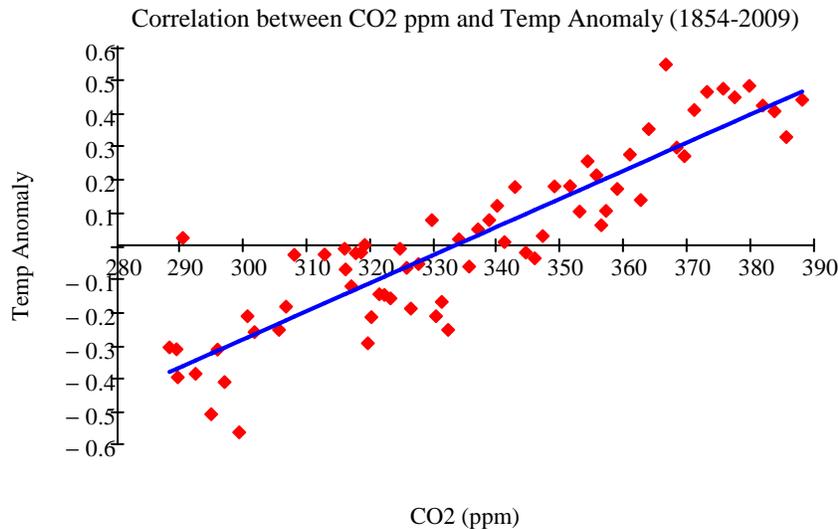
Covariation Between CO2 and δD
If the δD change reflects a proportional T drop, then more than ½ of the interglacial-to-glacial change occurred before significant removal of atmospheric CO2

Values shown normalized to their mean values during the mid-Holocene (5–7 kya BP) and the last glacial (18–60 kya BP) Clearly visible are the disproportionately low deuterium values during the mid-glacial (60–80 Kya BP), the glacial inception (95–125 KyaBP), and the penultimate glacial maximum (140–150 Kya BP)
Covariation of carbon dioxide and temperature from the Vostok ice core after deuterium-excess correction" Kurt M. Cuffey & Françoise Vimeux

Miskolczi Saturated Humidity Model:
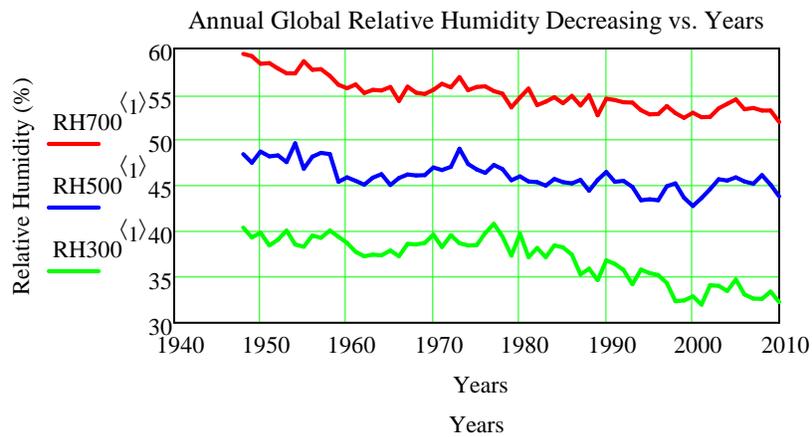## Total infrared optical depth is a constant ~1.87

Ferenc M. Miskolczi, "Greenhouse effect in semi-transparent planetary atmospheres", Quarterly
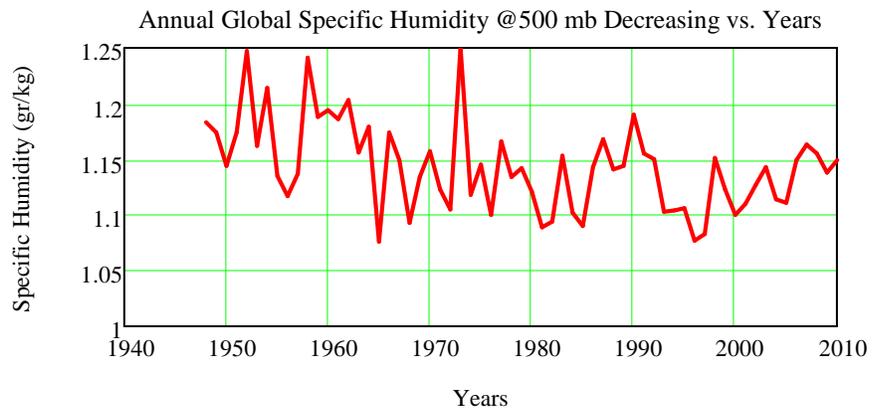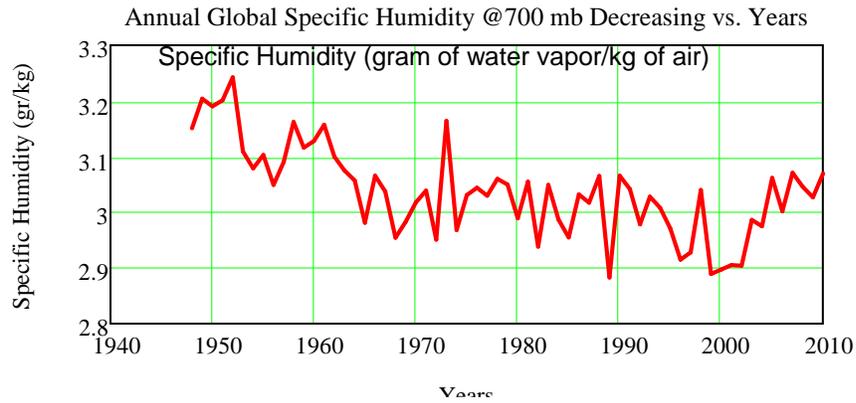Journal of the Hungarian Meteorological Journal,Vol. 111, No. 1, January - March 2007
Miskolczi predicts that RH must decrease as CO2 increases.   The ESRL RH data supports th
General Circulation Climate Models assume that RH is constant. The RH data shows this is fal
Evidence Reveals that Relative Humidity has been decreasing as CO2 has been rising
Data: http://www.esrl.noaa.gov/psd/cgi-bin/data/timeseries/timeseries1.pl

RH700 := READPRN("ESRL-NOAA-RH-GlobalAnnual700mb-1948-2010.txt")   Years := RH700$^{\langle 0 \rangle}$
RH500 := READPRN("ESRL-NOAA-RH-GlobalAnnual500mb-1948-2010.txt")
RH300 := READPRN("ESRL-NOAA-RH-GlobalAnnual300mb-1948-2010.txt")
SH700 := READPRN("ESRL-NOAA-SH-GlobalAnnual700mb-1948-2010.txt")
SH500 := READPRN("ESRL-NOAA-SH-GlobalAnnual500mb-1948-2010.txt")
SH300 := READPRN("ESRL-NOAA-SH-GlobalAnnual300mb-1948-2010.txt")

Higher Surface Levels (Decreasing Pressure): 700, 500, and 300 mb

Annual Global Relative Humidity Decreasing vs. Years

Years

Years

Annual Global Specific Humidity @700 mb Decreasing vs. Years

Specific Humidity (gram of water vapor/kg of air)

Annual Global Specific Humidity @500 mb Decreasing vs. Years

Years

Miskolczi Saturated Humidity Model:
Total infrared optical depth is a constant ~1.87

The cumulative greenhouse effect of all atmospheric greenhouse gases has not been changed, that is, the atmospheric TIOD is constant.

http://miskolczi.webs.com/

The Miskolczi - Principle

 Earth-type planetary atmospheres, having partial cloud cover and unlimited reservoirs of water vapor, maintain a energetically maximized (constant, 'saturated') greenhouse effect that cannot be increased by emissions.