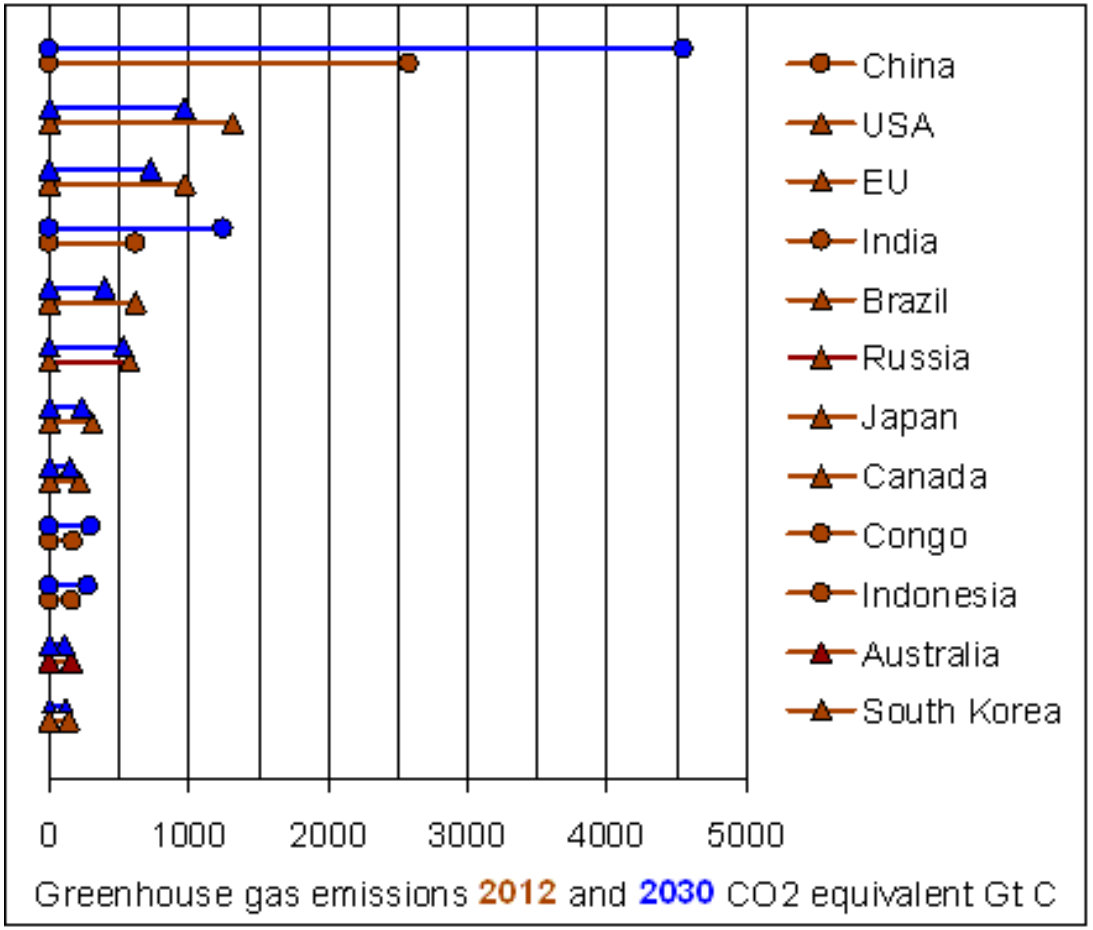
The Uncertain Climate

Talk given to the Old Codgers

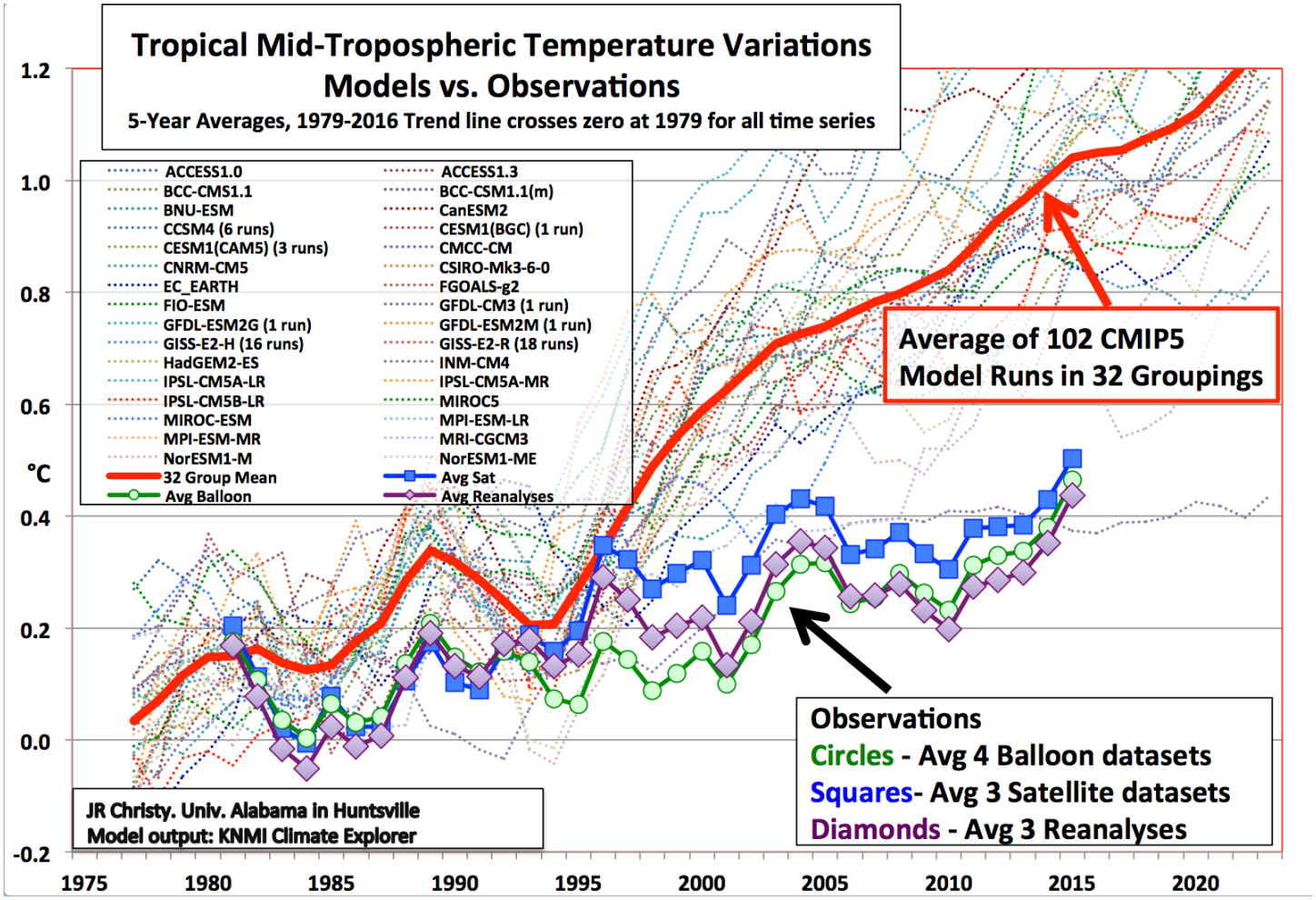
Tom Quirk

1 November 2017

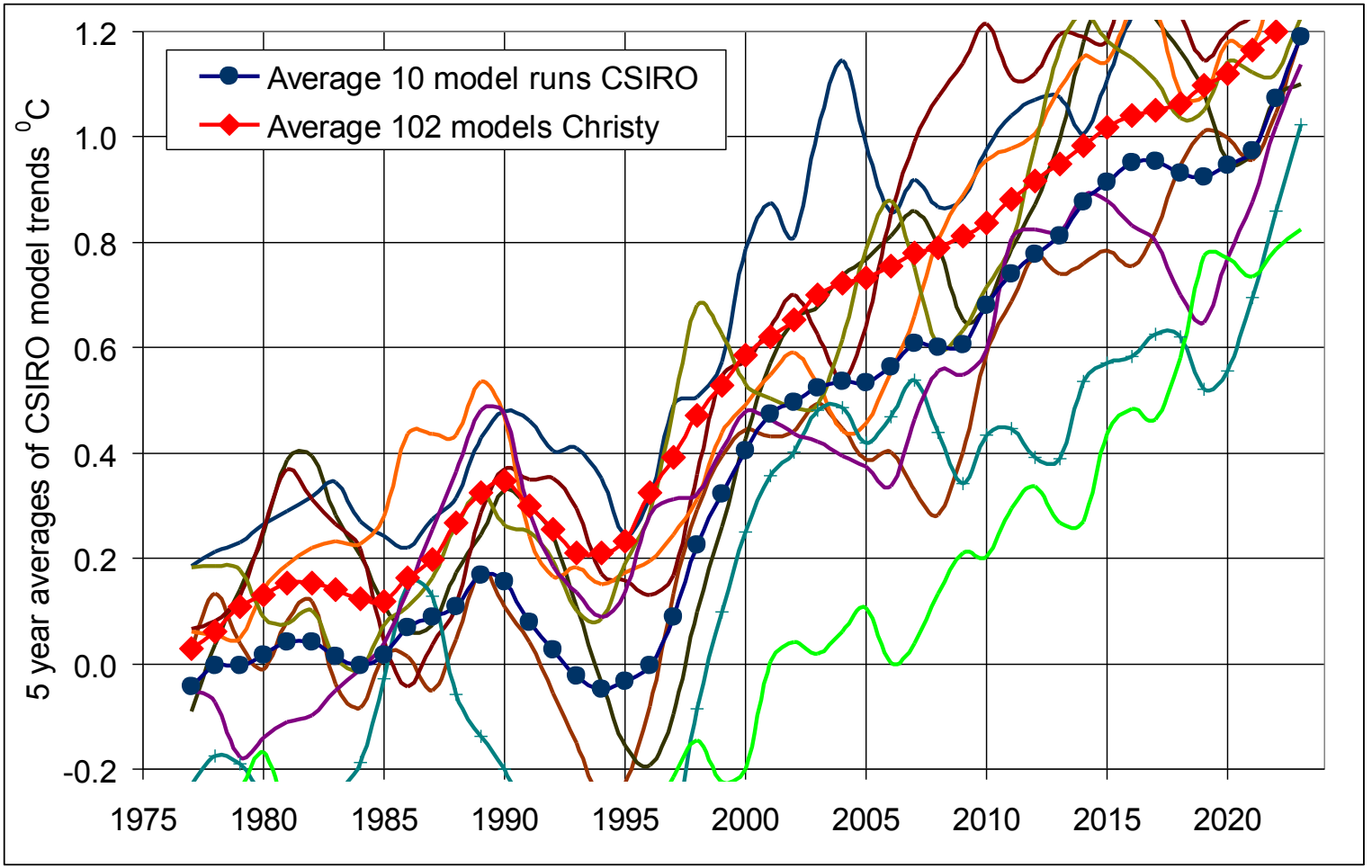


Greenhouse gas emissions in 2012 and promises for 2030. There is a 23% increase from 7.83 Gt C to 9.59 Gt C for 72% of global emissions China is a major uncertainty

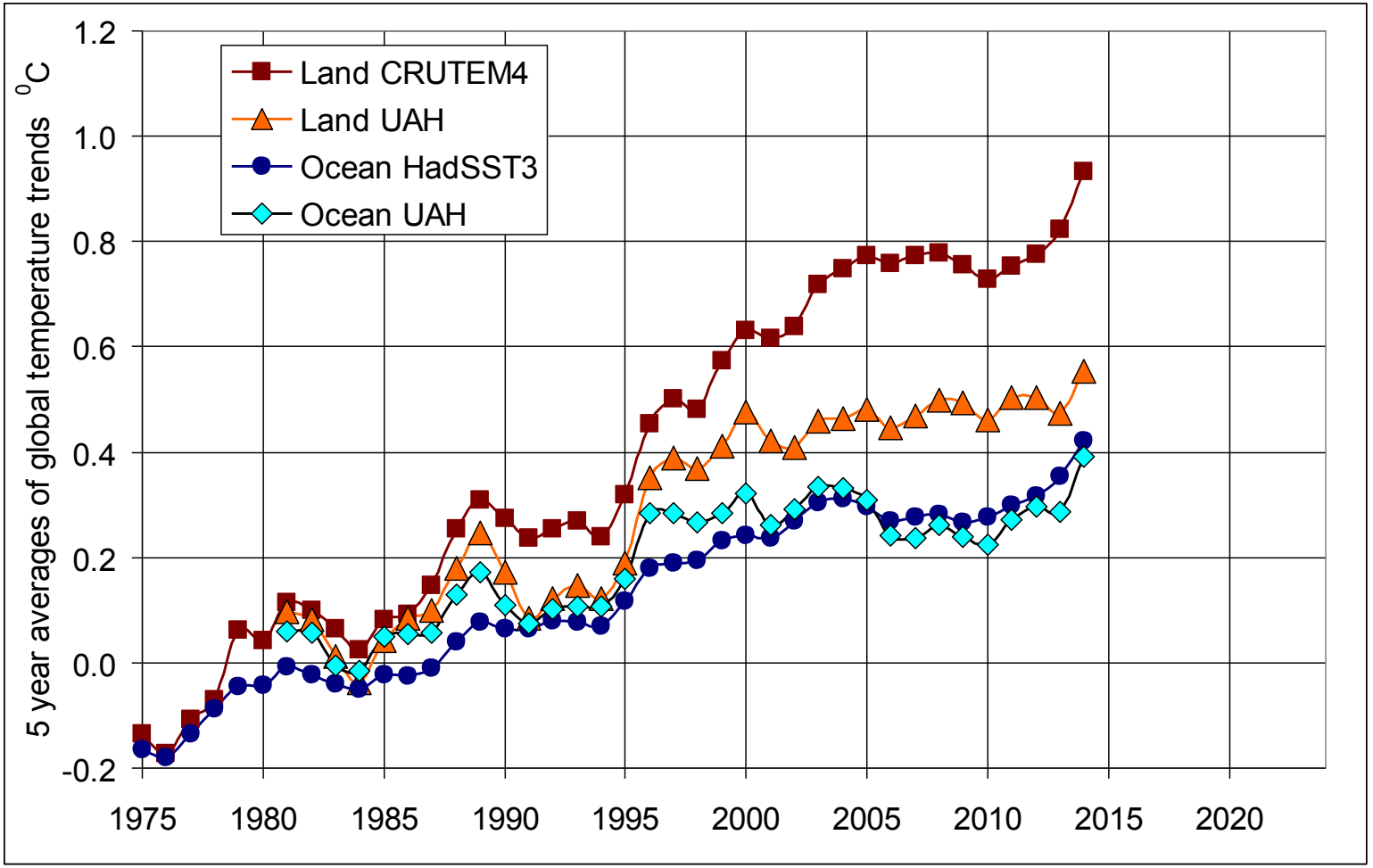
The annual increases in greenhouse gas emissions from China are roughly equal to the total annual greenhouse gas emissions from Australia



John Christy from the University of Alabama at Huntsville (UAH)
U.S. House Committee on Science, Space & Technology
29 March 2017



10 CSIRO model runs are included in the Christy analysis and these model runs are shown here along with the 5 year average and the Christy 102 model average



5 year averages of lower troposphere global temperatures from UAH and surface temperatures from the UK Met Office for land, CRUTEM4 and for the ocean HadSST3. The yearly trend measurements are adjusted to cross zero in 1979 before the 5 year averaging (as is the case for the Christy figure)..

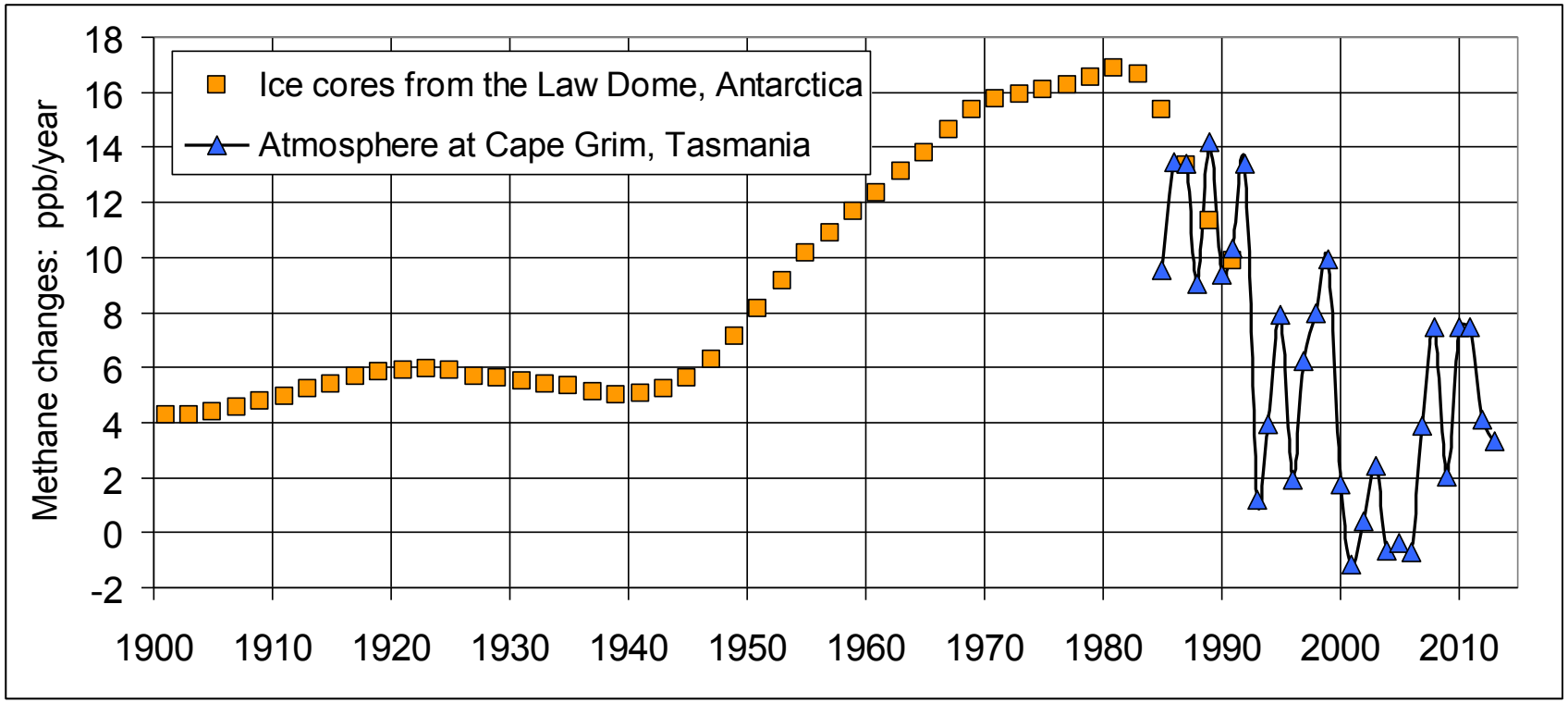
- There are major problems with both the prediction of future global temperatures and the construction of present global temperatures.
- Regional projections of climate are even less useful
- Policy development is based on predictions and not measurements.

Greenhouse gases

Methane

CO2

Methane

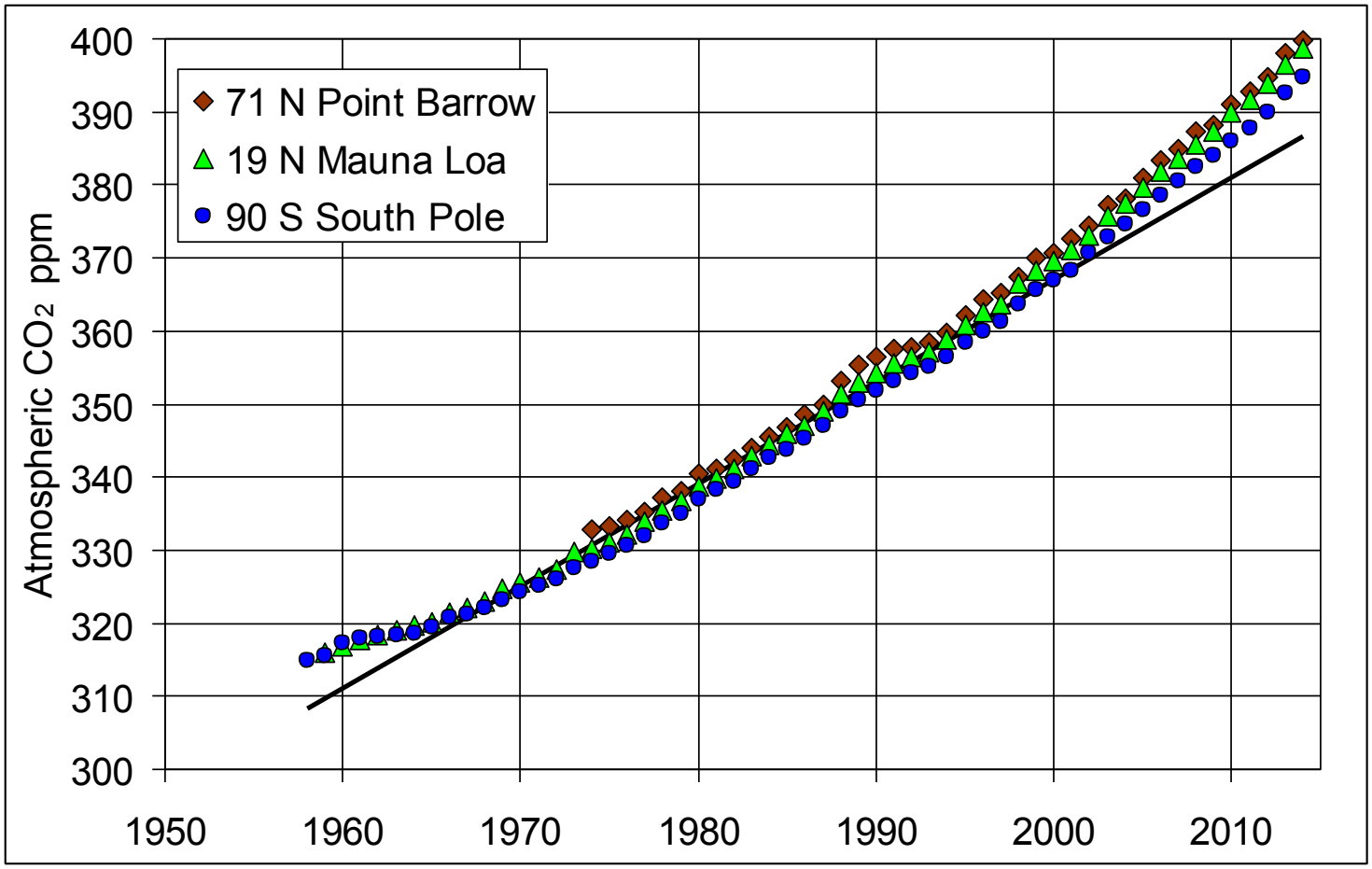


Ice core and direct measurements of atmospheric methane from 1900. The peaks in the direct measurements correspond to El Ninos with the exception of 1992 which is an indirect result of the Mt Pinatubo eruption. Data source CSIRO

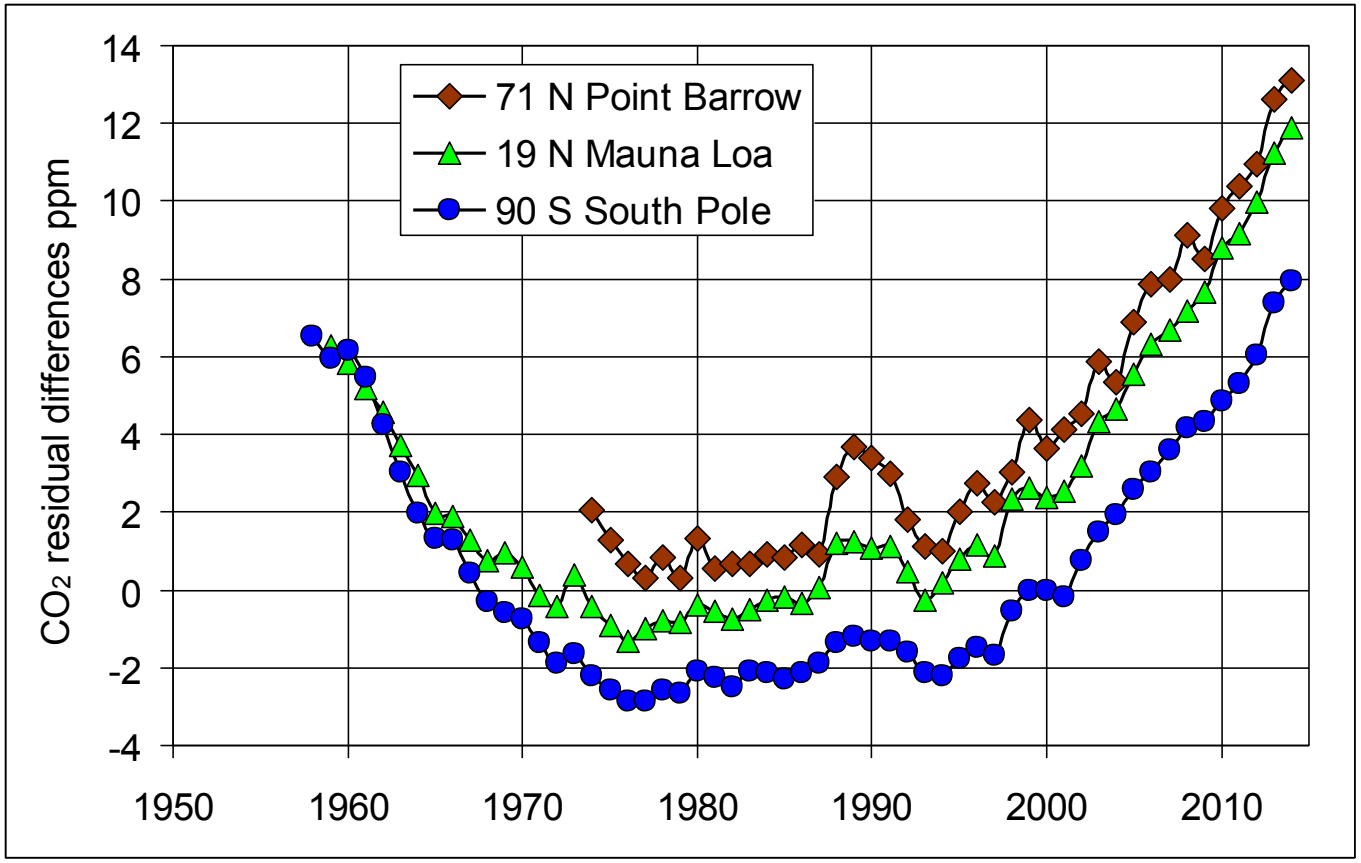
Tom Quirk, Twentieth Century Sources of Methane in the Atmosphere ENERGY & ENVIRONMENT VOL 21 p 251-266,

- The rise in atmospheric methane during the latter part of the twentieth century was due to leaking natural gas pipelines, particularly in the Soviet Union
- When gas was sold to the Europeans in the 1980s the Trans Siberian pipeline was found to be a source of substantial leakage which was then stopped.
- Annual changes in methane now reflect El Ninos where droughts cause the escape of marsh gas.

CO2



Average yearly CO2 concentrations at the South Pole, Mauna Loa and Point Barrow from Scripps measurements. The straight line is a best fit to the South Pole data with an annual increase of 1.5 ppm per year.

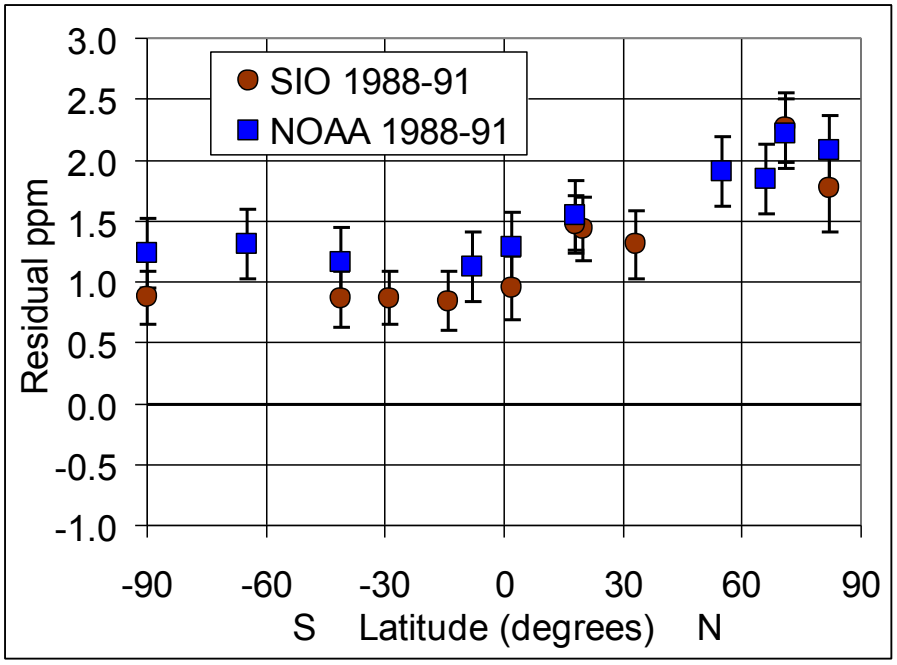


Residual differences from a straight line fit to average yearly CO2 concentrations at the South Pole (see Figure 1 above) and also similar residuals for Mauna Loa and Point Barrow. Note the break in the trends in 1977 and 1995 at the times of phase changes in the Pacific and Atlantic Decadal Oscillations.*

*Tom Quirk, Did the Global Temperature Trend Change at the End of the 1990s? Asia-Pacific J. Atmos. Sci., 48(4), 339-344, 2012

Regime Shifts* - changes in residual trends in

1965 Atlantic Decadel Oscillation
1976 Pacific Decadel Oscillation **Regime shift 1977**
1995 Atlantic Decadel Oscillation
2001 ?? Pacific Decadel Oscillation



*S.R. Hare, N.J. Mantua: Empirical evidence for North Pacific regime shifts in 1977 and 1989.

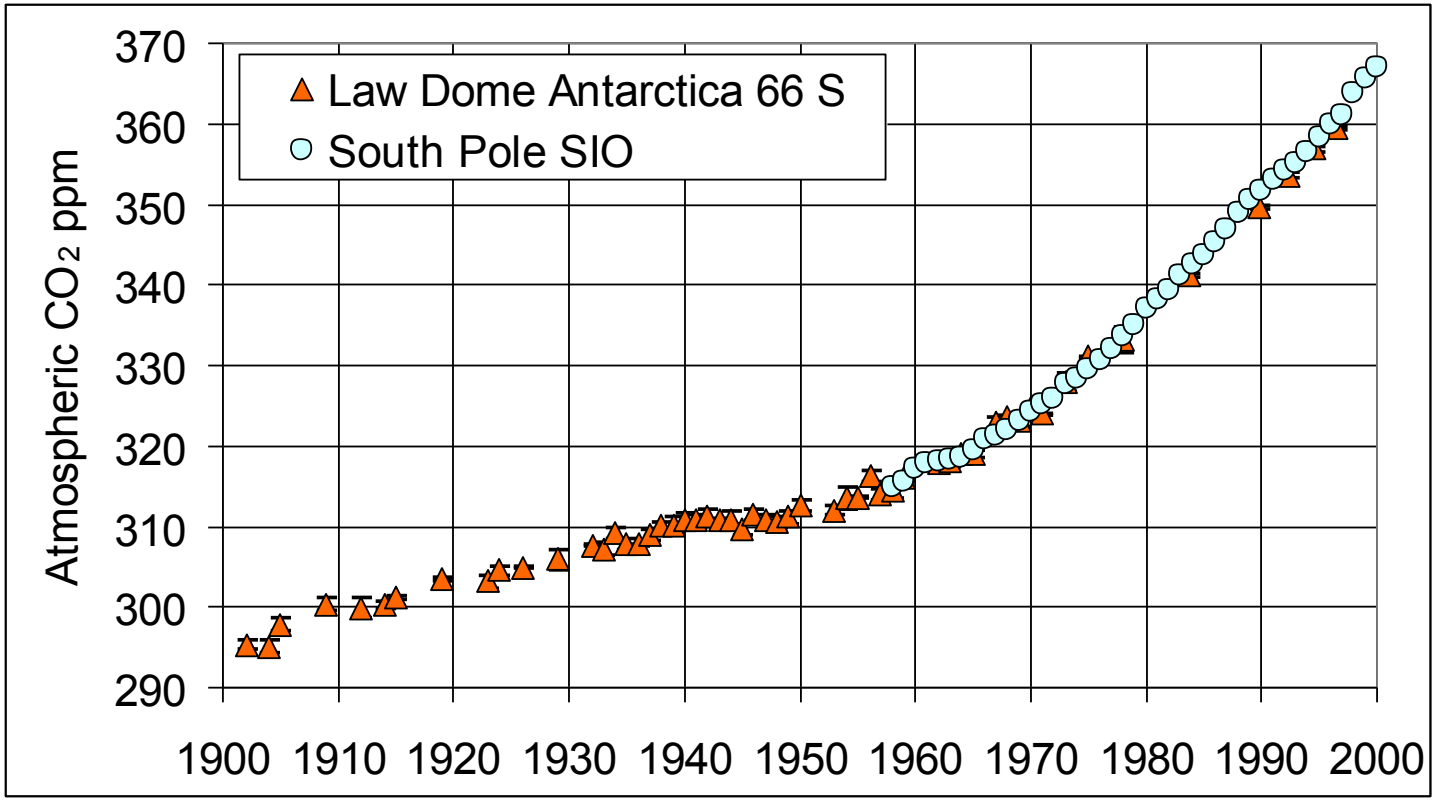
Progress in Oceanography 47 (2000) 103–145

Regime shift 1989

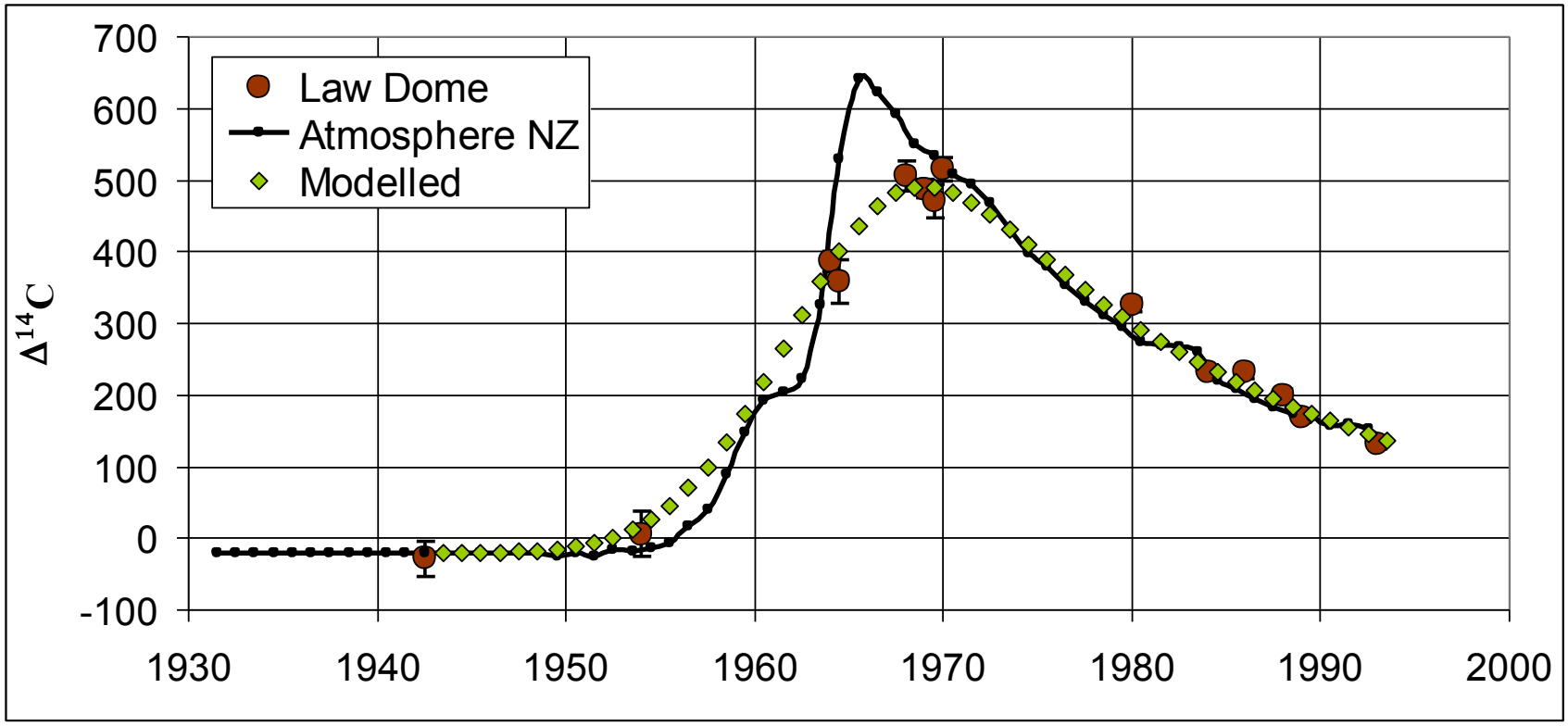
Average residual differences in the annual value of the CO2 anomaly by latitude for SIO and NOAA measurement stations at the peak years of 1988 to 1991

2.7 +/- 0.4 GtC of CO2 entering and leaving the atmosphere with the carbon isotopic composition found in plants

- Ocean Regime shifts of 1977 and 1989 were identified by looking at mainly biological measures such as size of fish and yields from fish catches.
- The basis of the 1989 event lies at the bottom of the ocean food chain with less than normal growth of phytoplankton.
- The 1988 - 91 CO2 bubble has the isotopic composition of plant (fossil fuel) derived carbon
- http://joannenova.com.au/2015/11/the-mystery-of-a-massive-2-5gt-of-co2-that-came-and-went-could-it-be-phytoplankton/

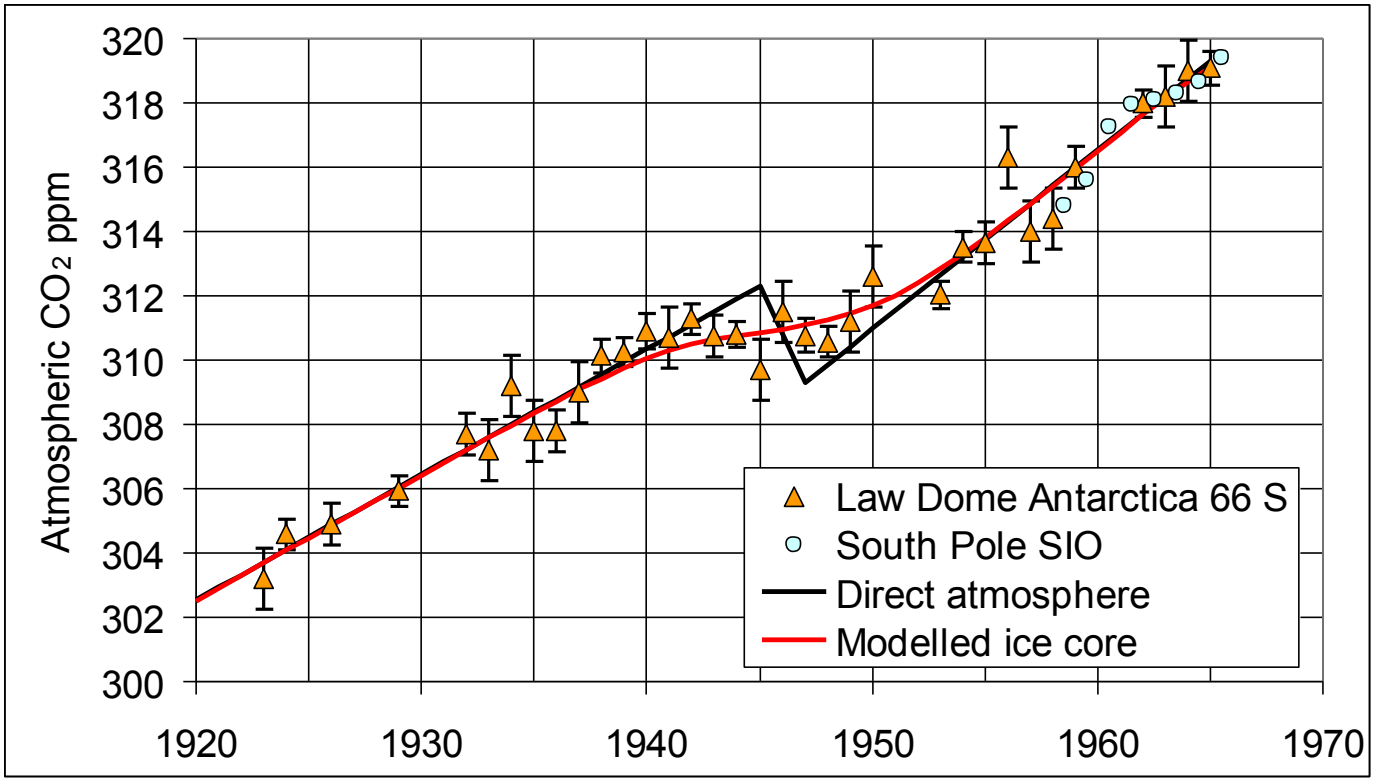


Law Dome ice core and South Pole direct measurements of atmospheric CO2 from CSIRO and SIO datasets.

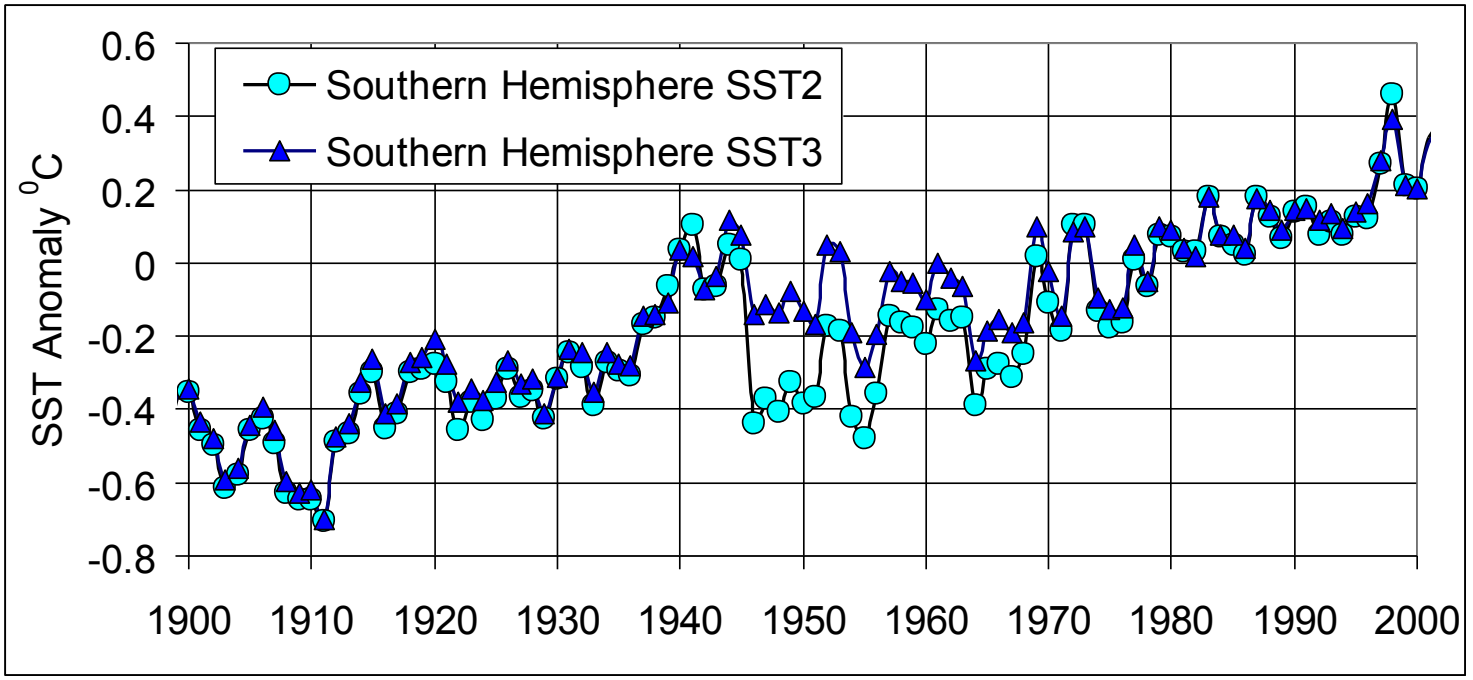


Direct atmospheric measurements in New Zealand and ice core measurement of C-14 labelled atmospheric CO2. The continuous green diamonds are a modelled ice core simulation from redistributing the direct measurements using a normal distribution with a standard deviation of 4.2 years.

Levchenko, V. A. et al. (1996) The 14C "bomb spike" determines the age spread and age of CO2 in Law Dome firn and ice Geophysical Research Letters. ***23****. 3345*



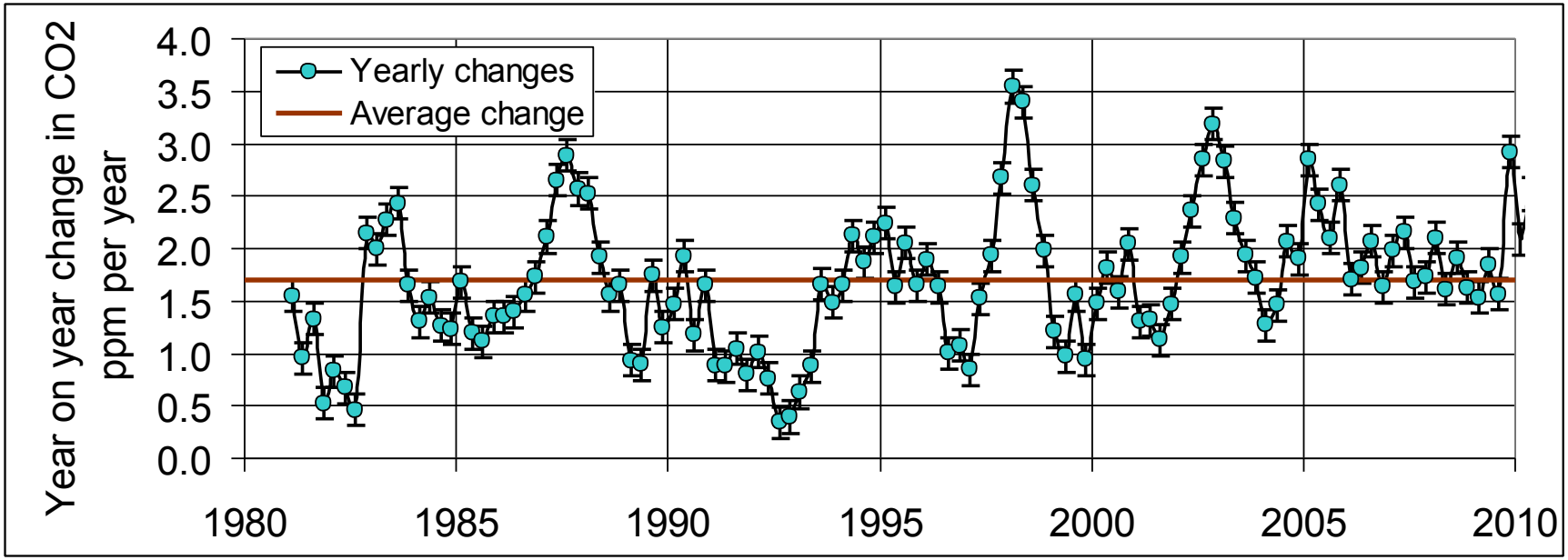
Law Dome ice core and direct South Pole measurements of atmospheric CO2. Solid line - modelled direct atmospheric CO2 concentrations increasing at 0.389 ppm per year before 1946 and 0.556 ppm per year after 1948. The continuous red line is the simulated ice core measurements assuming a 4.2 year standard deviation for atmospheric mixing in the ice core air bubbles.



Average yearly sea surface temperature (SST) anomalies for the Southern Hemisphere from the HadSST2 and HadSST3 data sets.

"*The future is certain, only the past is unpredictable" thought to be from a Polish radio station during Soviet times.*

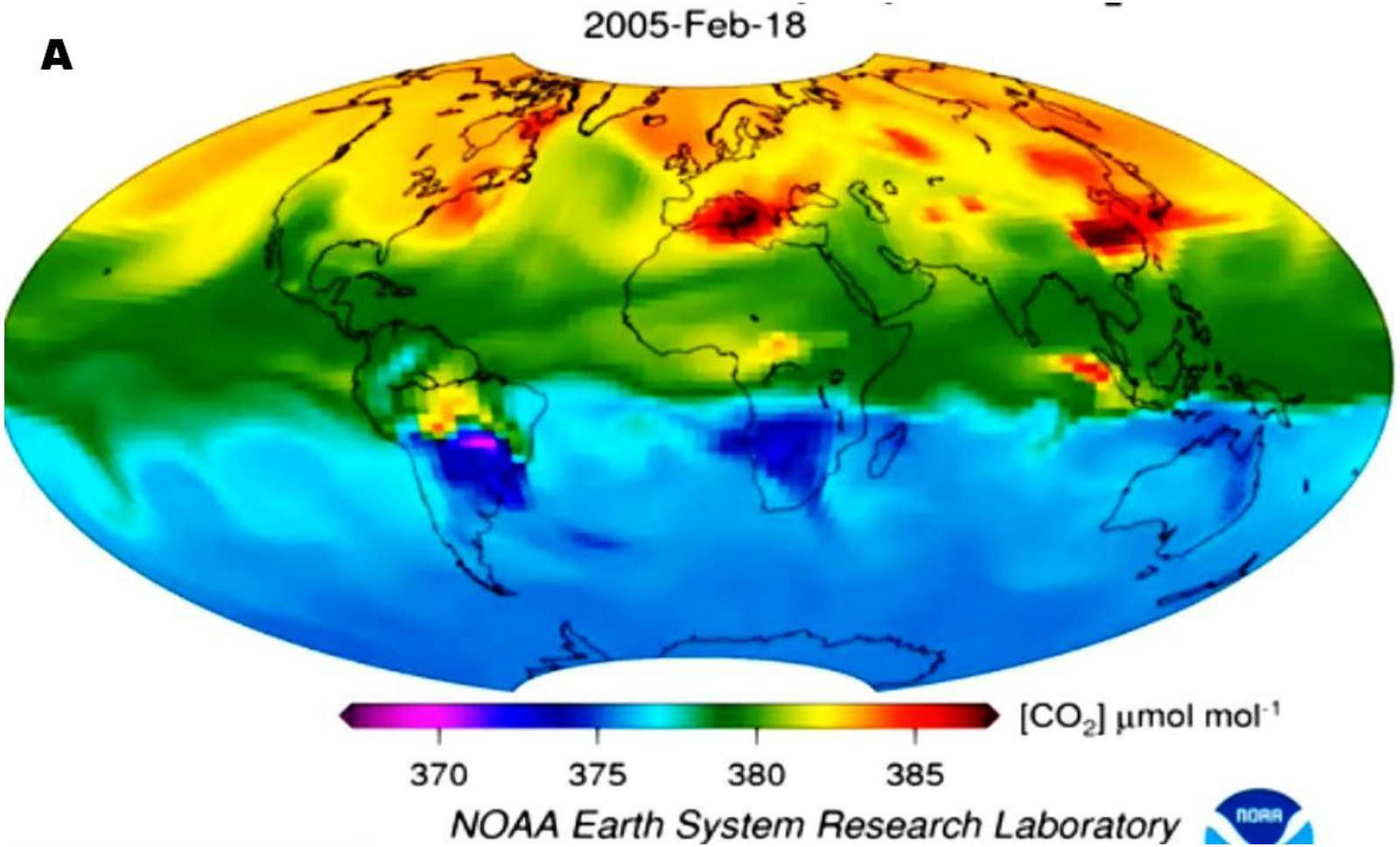
- The observed plateau in atmospheric CO2 in the Antarctic is a consequence of the way the atmosphere is trapped as snow falls and the air is finally trapped as the ice is formed.
- Unfolding the measurements shows a fall in atmospheric CO2 in the mid 1940s.
- The CO2 fall coincides with a fall in the southern ocean surface temperature with the ocean taking in more CO2 or emitting less CO2.



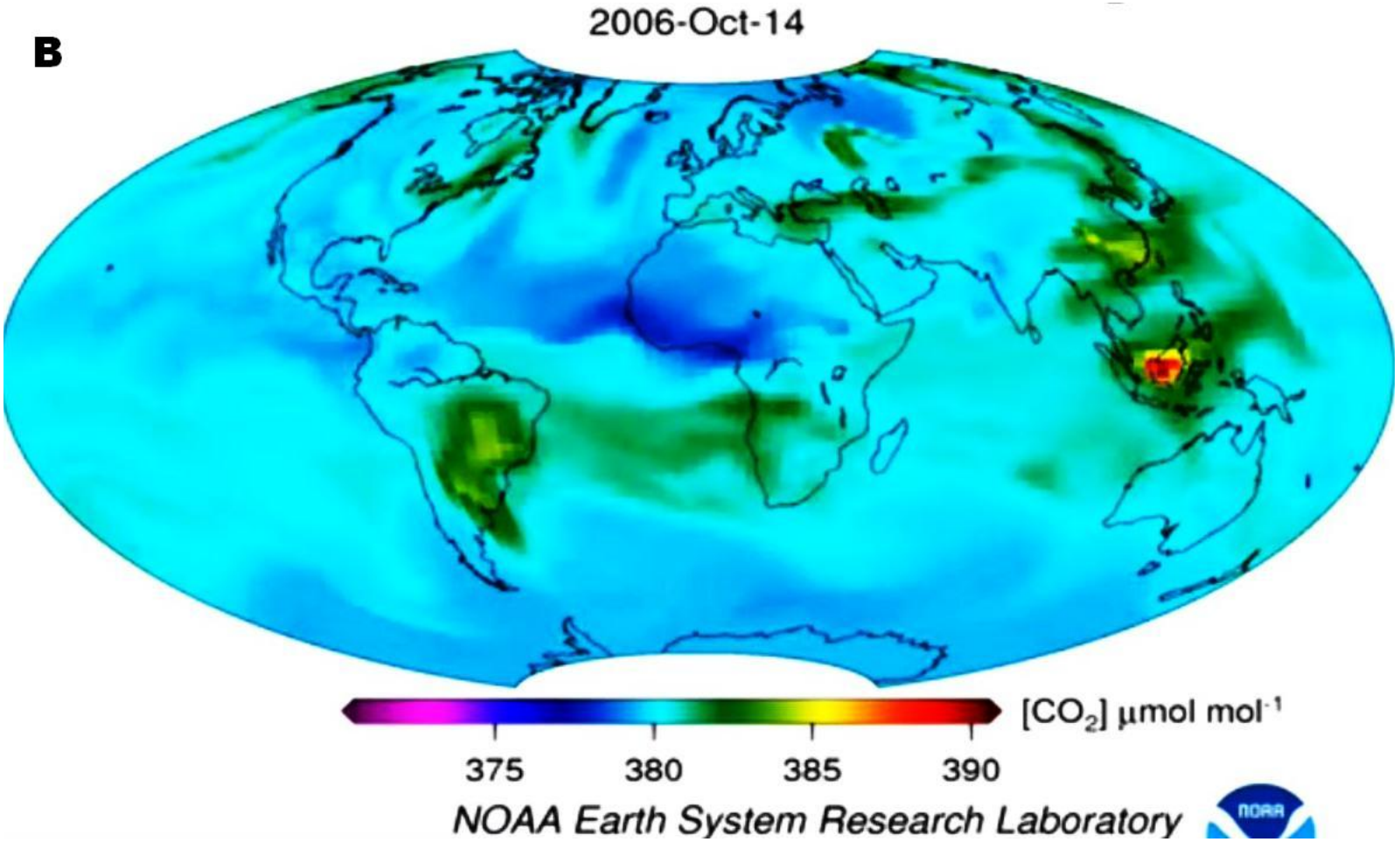
Year on year changes in atmospheric CO2 at Mauna Loa. The yearly average increase is 1.69 ppm. The CO2 peaks are at the time of El Nino's.

- The CO2 El Nino peaks in the annual increase of atmospheric CO2 are thought to be the result of reduced mixing of the atmosphere with the ocean surface as wave action is reduced during an El Nino.
- The peaks carry a strong isotopic signal that they are the result of reduced removal from the atmosphere of CO2 from fossil fuels.
- BUT there may be another explanation

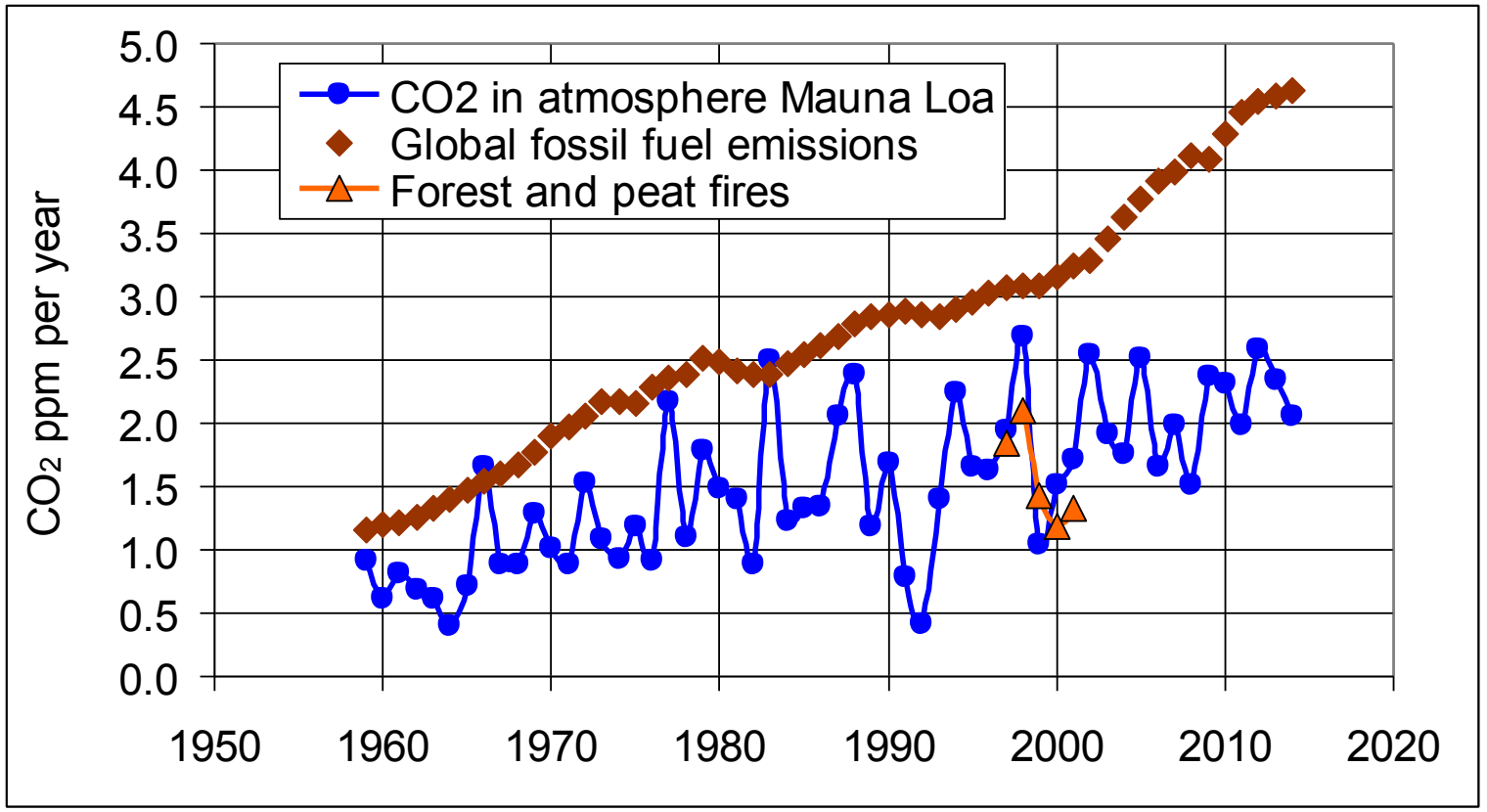
An example of CO2 concentrations in winter for the Northern Hemisphere with high concentrations of CO2. Note the fires in the tropics



An example of CO2 concentrations in summer for the Northern Hemisphere as plants remove CO2 from the atmosphere. Note the fires in the tropics

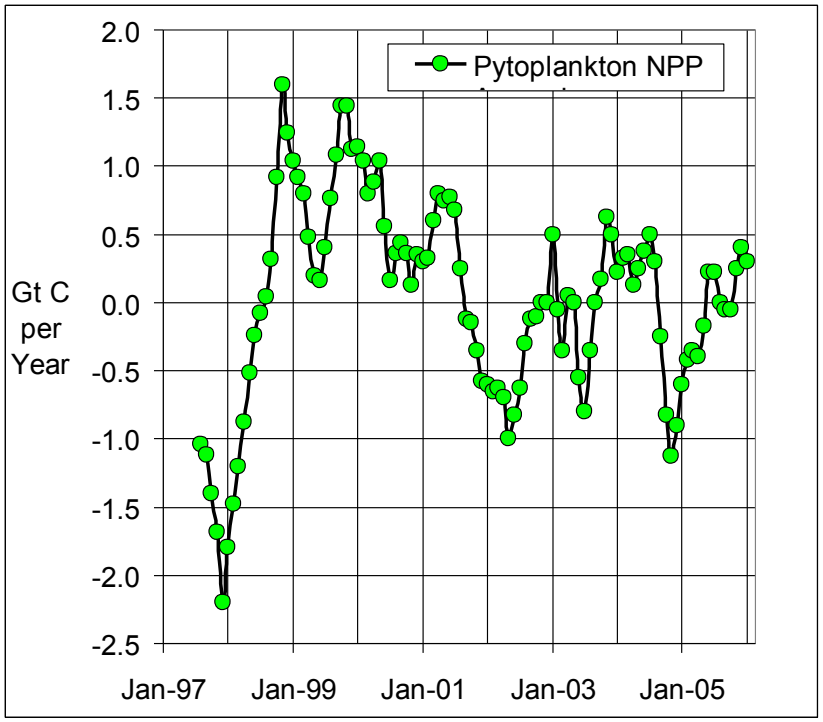


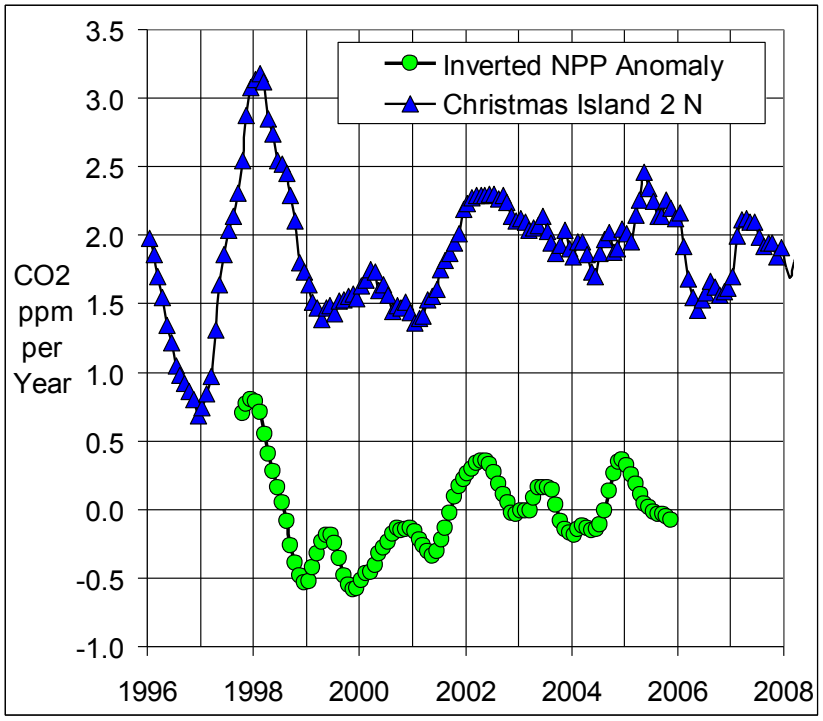
- *Tropical peatlands are one of the largest near-surface reserves of terrestrial organic carbon*
- *the occurrence of widespread fires throughout the forested peatlands of Indonesia during the 1997 El Niño event*
- *using satellite images of a 2.5 million hectare study area in Central Kalimantan, Borneo, from before and after the 1997 fires, we calculate that 32% (0.79 Mha) of the area had burned, of which peatland accounted for 91.5%*
- *Extrapolating these estimates to Indonesia as a whole, we estimate that between 0.81 and 2.57 Gt of carbon were released to the atmosphere in 1997 as a result of burning peat and vegetation in Indonesia*
- ***This is equivalent to 13–40% of the mean annual global carbon emissions from fossil fuels***
- Susan E. Page, et al. The amount of carbon released from peat and forest fires in Indonesia during 1997. *Nature* 420, 61-65 (7 November 2002)



Annual emission of CO2 from fossil fuels, estimated global CO2 emissions from forest and peat fires and atmospheric CO2 at Mauna Loa.*

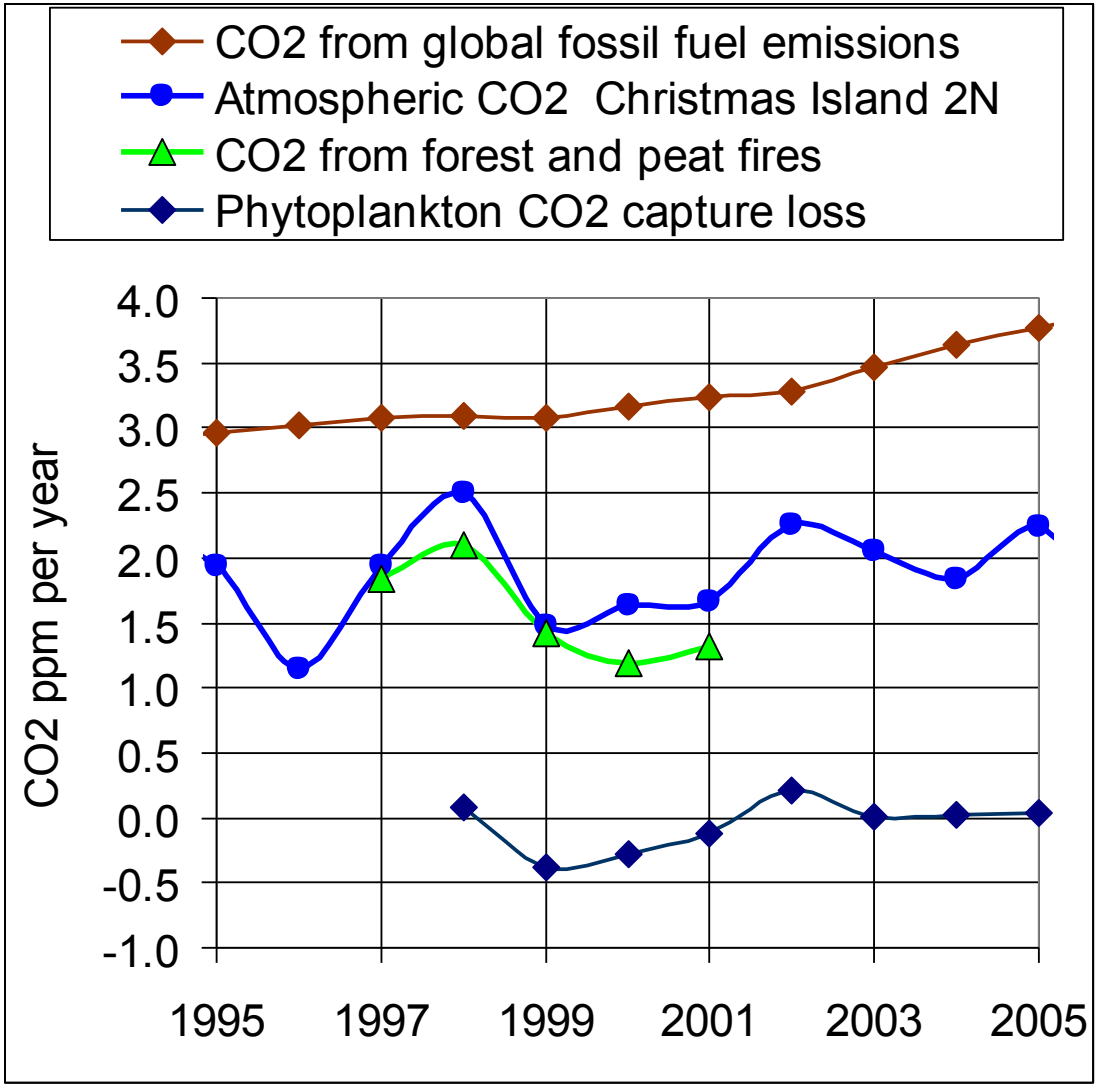
**Guido R. van der Werf et al. Continental-Scale Partitioning of Fire Emissions During the 1997 to 2001 El Niño/La Niña Period: Science 303, 73 (2004);*





Left: *Phytoplankton NPP (Net Primary Productivity)*, a measure of the removal and storage of CO2 contained in the oceans. .**Right:** 3 month running average annual changes in atmospheric CO2 at Christmas Island (2 N) and the NPP for phytoplankton inverted and converted at 1 ppm = 2.13 GtC.*

**Michael J. Behrenfeld, et al: Climate-driven trends in contemporary ocean productivity Nature Vol. 444 7 December 2006*

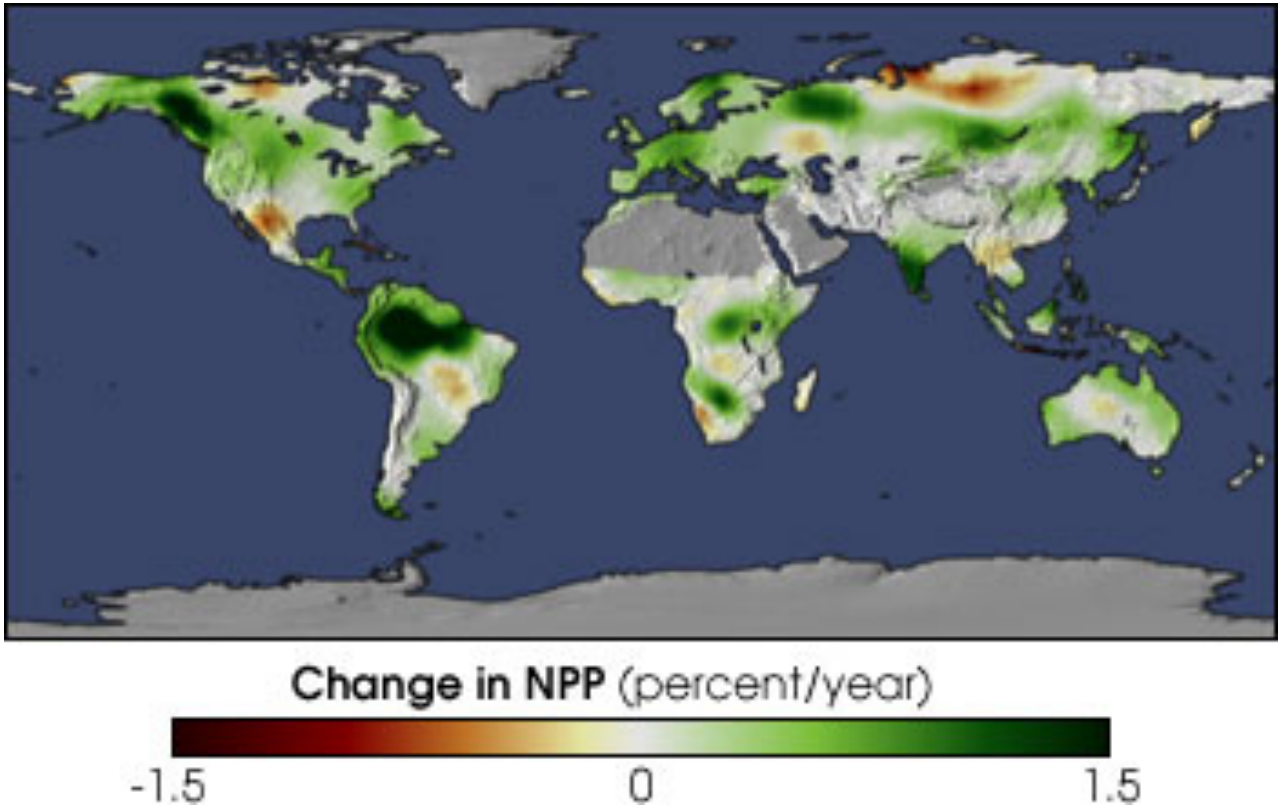


Annual emission of CO2 from fossil fuels, atmospheric CO2 at Christmas Island (2N), estimated global CO2 emissions from forest and peat fires and estimated phytoplankton CO2 capture loss,

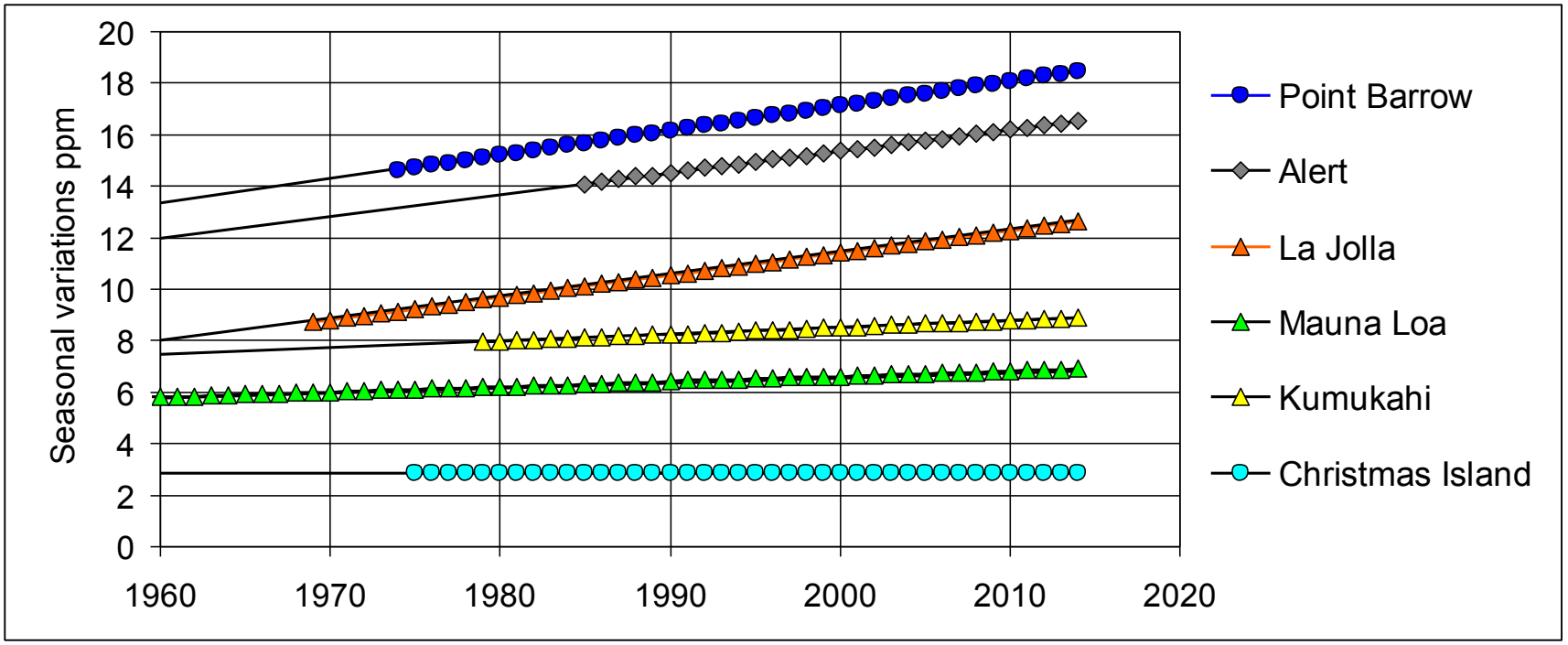
The peaking of CO2 from land and ocean trends matches the rise in atmospheric CO2 during the 1997-98 El Nino.

In this example 41% of fossil fuel emission are captured by CO2 sinks but if the fires are added then 62% of fire and fossil fuel emissions are captured.

- **BUT**
- For the land, there are studies that suggest that the peaks in annual changes in CO2 are a result of contributions from peat and forest fires.
- For the oceans, satellite studies show major reductions in phytoplankton numbers during El Nino's. The Regime Shift of 1989 may be an example of the same fall off in numbers of phytoplankton.
- Phytoplankton remove CO2 in the oceans just as land plants remove CO2 from the atmosphere. So they too contribute to the CO2 El Nino peaks.
- This contributes to the annual variability of atmospheric CO2. This variability is not present in CO2 fossil fuel emissions.



Satellite analysis of forest growth over 20 years. Net Primary Productivity (NPP) is a measure of carbon storage



Amplitude of seasonal variations of CO2 for selected locations extracted from SIO measurements. The increase in the northern latitudes is due to forest growth

Conclusion

- The sources and sinks of atmospheric CO2 are not well understood.
- The occurence of decadel ocean oscillations cannot be predicted
- The oceans have variable performance with El Nino La Nina events
- Forest and peat fires have been ignored compared to CO2 from fossil fuels
- The expanding forest sink for CO2 needs further exploration

Ultimate Conclusion

The whole aim of practical politics is to keep the populace alarmed (and hence clamorous to be led to safety) by menacing it with an endless series of hobgoblins, all of them imaginary

H L Mencken