Have you seen the economic recession in the atmospheric CO$_2$ record?

Accounting for emissions and the resulting radiative forcing of climate.

*Pieter P. Tans*

Earth System Research Laboratory

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interannual variation 1991–2009

slope $-0.048$ permil/ppm

$\delta^{13}C$ (permil per year)

CO2 (ppm per year)

permil per year

1995  2000  2005
Response to global temperature anomalies

CO₂ GROWTH RATE (ppm/year²/deg K)

YEAR

0.0
0.5
1.0
1.5
2.0
response fn amplifies temperature anomalies

CO2 amplitude (ppm/year per degree C)
frequency (cycles/year)
Response to monthly mean precip anom

CO₂ growthrate (ppm/year² per mm/day)

YEAR

0.0 0.5 1.0 1.5 2.0

0 0 0 0 0

-15 -10 -5 0 5 10 15

-15 -10 -5 0 5 10 15
CO2 growthrate anomalies (5yr-trend removed)

ppm/year

observed

-- calculated

unexplained variations

ppm/year


Mass balance:
\[ FF + \text{net terrestrial} = \text{atmos} + \text{ocean} \]

fossil emissions + (land use emissions minus ecosystem uptake) = atmospheric increase + oceanic increase

\[
C_{atm}(t) = \int_{-\infty}^{t} dt' E(t') \left[ x_0 + \sum_{i=1}^{3} x_i \exp[a_i(t'-t)] \right] \quad \text{with} \quad \sum x_i = 1
\]

\[
C_{oce}(t) = \int_{-\infty}^{t} dt' E(t') \left[ 1 - x_0 - \sum_{i=1}^{3} x_i \exp[a_i(t'-t)] \right]
\]

The coefficients \( x_i \) and time constants \( a_i \) are subject to two independent constraints:
2. Observed average rate of uptake by the oceans during 1993-2002 (2.2±0.6 GtonC/year, Manning and Keeling, Tellus 2006)
fossil emissions + (land use emissions minus ecosystem uptake) = atmospheric increase + oceanic increase
atmospheric CO2 increase since pre-industrial

climate forcing by CO2 since pre-industrial
Conclusions:

On a **decadal** time scale *mankind* has a dominant influence on the carbon cycle.

On **sub-decadal** time scales the response of *terrestrial ecosystems* to climate variations is the dominant influence on atmospheric carbon.

Current globally averaged climate forcing by historical U.S. CO2 emissions up to 2010 equals 0.451 W m^{-2}, and time-integrated forcing until **2010** equals 22.5 Watt-years m^{-2}. For PR China these numbers are 0.192 W m^{-2} and 3.5 Watt-years m^{-2}.

Historical U.S. emissions until 2010 have already committed the global climate system until the year **2300** to time-integrated forcing of 101 Watt-years m^{-2}. For PR China the same measure is 32 Watt-years m^{-2}.

The concept of a 100-year atmospheric time horizon for CO2 is misleading to the public and to most scientists. It should be abandoned.