

Interannual Variation in the Atmospheric CO₂ Growth Rate

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One of the key results arising from global measurements of atmospheric CO₂ is the relatively large interannual variation of the CO₂ growth rate. The red curve in Figure 1 shows the CO₂ growth rate for 1979-2002 determined from samples collected at the remote marine boundary layer sites of the CMDL Cooperative Global Air Sampling Network. The average growth rate over this period is 1.5 ppm yr⁻¹ (dashed line), while the growth rate ranges from ~0.6 ppm yr⁻¹ to over 3 ppm yr⁻¹. The CO₂ global annual average increased by 2.1 ppm from 2001 to 2002.

Variations in the CO₂ emissions from fossil fuel combustion are too small to explain all of the observed variation. Relatively small changes in the net balance of large gross carbon fluxes between the atmosphere and the oceans and the atmosphere and the terrestrial biosphere add up to relatively large changes in the global CO₂ sinks. These changes appear to be driven, in turn, by short-term climate fluctuations.

One particularly important climate phenomenon is El Niño/Southern Oscillation (ENSO). Monthly values of the Multivariate ENSO Index (MEI) [K. Wolter and M.S. Timlin, Proc., 17th Climate Diagnostics Workshop, University of Oklahoma, 1993; *Weather*, 53, 315-324, 1998] are plotted as the blue curve in Figure 1. MEI includes sea level pressure, zonal and meridional winds, sea surface temperature, air temperature, and cloudiness. It is clear that the positive CO₂ growth rate anomalies tend to occur, with a lag of several months, during times of positive MEI, that is, El Niños. An exception to this is 1991-1992 when low CO₂ growth rates prevailed during most of the 1991-1994 El Niño period. This period was complicated by the widespread cooling that followed the eruption of Mt. Pinatubo in 1991. The recent higher-than-average CO₂ growth rate may be related to the moderate El Niño of 2002.

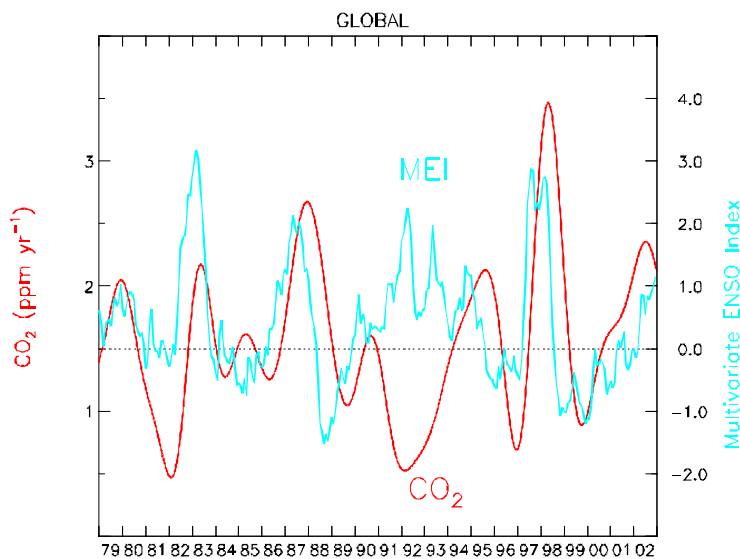


Figure 1. The globally averaged CO₂ growth rate (red curve) and the Multivariate ENSO Index (blue curve).