

Temporal Variations in CO₂ in Air in Pasadena, California

S. Newman and E. Stolper

California Institute of Technology, Pasadena, CA 91125; 626-395-6474, E-mail: sally@gps.caltech.edu

How does an urban environment modify the global cycle of observed atmospheric CO₂? To address this question, we have studied CO₂ since 1998 on the Caltech campus and compared the observed temporal variations with relatively local clean air data from La Jolla (<http://scrippsco2.ucsd.edu/data/ljo.html>). Time series analysis of daily [CO₂] and isotopic composition Caltech data reveal periodicities at 1 and 0.5 year and 7 days. This last period is not observed in La Jolla. In addition, the δ¹³C pattern is inverted in Pasadena relative to that at La Jolla, and there is no well-defined seasonal variation in CO₂ mixing ratio in Pasadena, in contrast to the La Jolla pattern (Figure 1). The seasonal variations in Pasadena reflect the superposition of local contributions of CO₂ in Pasadena on global clean air temporal variations. The local contributions are significant: e.g., the total CO₂ concentration in Pasadena is ~25 ppm higher than in clean air. Although the typical diurnal variation in CO₂ mixing ratio consists of a low [CO₂] plateau at about ~10 AM-4 PM PST and a high [CO₂] plateau at ~9 PM-3 AM, there are significant variations with season and day of the week (Figure 2). The amplitude of the diurnal variation in Pasadena varies from ~20 ppm in June to ~80 ppm in December. We typically observe a maximum in [CO₂] at ~5-9 AM on weekday mornings, which is smaller on weekends and coincides with increased traffic on surface streets in Los Angeles due to weekday morning rush hour. There is no corresponding peak that can be associated with afternoon rush hour.

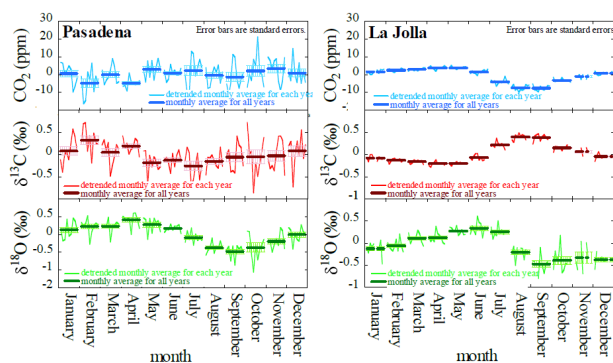


Figure 1. Annual cycles of [CO₂], δ¹³C, and δ¹⁸O for mid-day flask samples for Pasadena and La Jolla from 2001-2008. Long-term linear trends have been subtracted from all analyses. The darker line segments indicate the averages for each month for all years, whereas the lighter time series indicate the averages for each month for individual years.

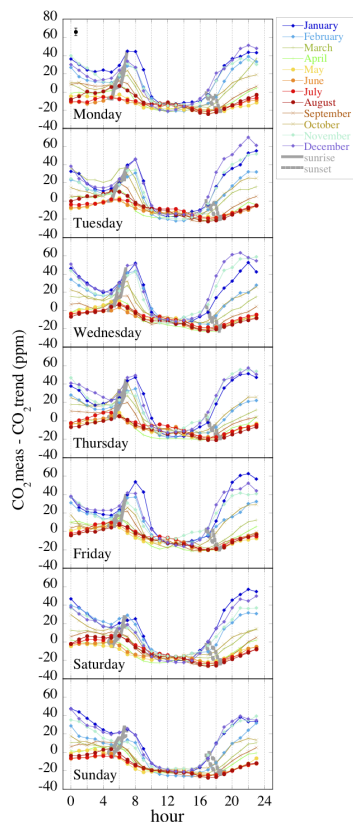


Figure 2. Changes in diurnal variations in [CO₂] with day of the week and month of the year. Summer months are in red and winter months in blue. [CO₂] is given as the difference from the long-term linear trend. The error bar in the Monday panel indicates the average standard error.