

Meteorological Controls on the Diurnal Variability of Carbon Monoxide at Pinnacles, an East Coast Mountaintop Site in the CarbonTracker Observational Network

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Trace gases such as Carbon Monoxide (CO) are affected by site-specific meteorological conditions that are particularly complicated in mountainous terrain. Knowledge of these site-specific meteorological conditions and their effect on trace gas variability is required to know how best to assimilate mountaintop trace gas measurements in applications requiring regionally-representative measurements. In the present study, we investigate the meteorological and CO characteristics at Pinnacles, a mountaintop monitoring site in the Appalachian Mountains and part of the CarbonTracker Observational Network, over the period 1 January 2009 to 31 December 2012. CO increases from a minimum at 0800 Local Sidereal Time (LST) minimum to a maximum around 1900 LST. There is large day-to-day variability, although the smallest amplitudes typically occur on fair weather days which we investigated further in this study. On fair weather days, many of the day-to-day differences in the diurnal CO cycle are explained by the presence or absence of a wind shift (Figure 1). On fair weather days with steady northwesterly winds, there is a daytime CO decrease which is in contrast to the mean diurnal CO cycle at Pinnacles, but is consistent with findings at tall towers in flat terrain. On fair weather days with a wind shift from the northwest to the south, the CO cycle is more typical of the mean CO cycle at Pinnacles and at other mountaintops worldwide and caused by the vertical transport of polluted air from adjacent valleys.

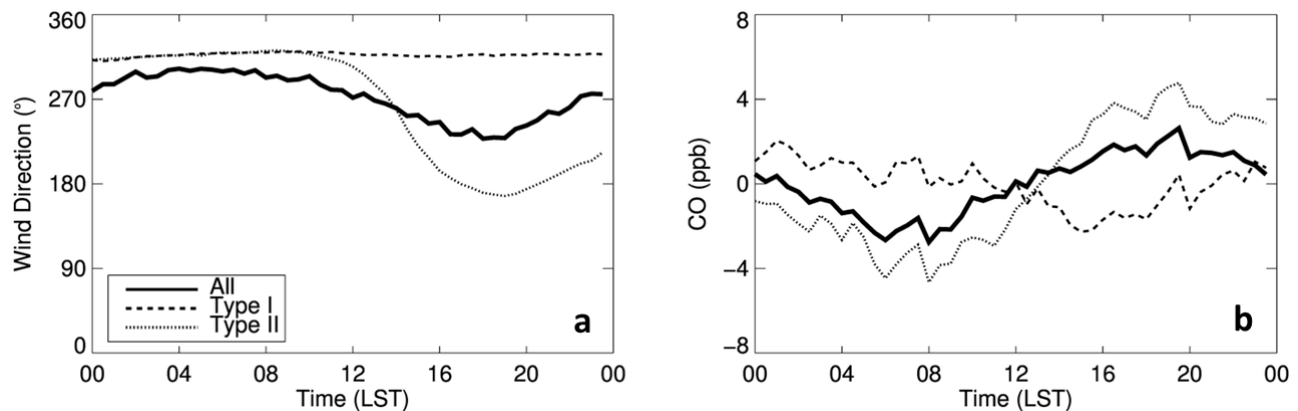


Figure 1. (a) Mean wind direction on all days (1 Jan 2009 – 31 Dec 2012) (black line, N=1126), fair weather days without a wind shift (Type I, dashed line, N=187), and fair weather days with a wind shift from northwesterly to southerly (Type II, dotted line, N=126) (panel a). Same for panel (b) but for CO measured 17 m above ground level with daily means removed.