Measurement of Western U.S. Baseline Ozone from the Surface to the Tropopause and Assessment of Downwind Impact Regions

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Monitoring of the full tropospheric baseline ozone flowing into the western USA from the Pacific Ocean has been limited to the weekly ozonesondes from Trinidad Head. To explore whether or not Trinidad Head is representative of baseline ozone at different latitudes, an ozonesonde network was implemented during May 10 – June 19, 2010, with four launch sites along 960 km of California's coastline. Three other sites were positioned inland to indicate the impact of ozone production downwind of the baseline sites. Modeling showed that the transport of North America pollution plumes over the California coast occurred primarily below 3 km. Removing ozone measurements impacted by these plumes resulted in no statistically significant change in the median baseline ozone. We found a high degree of vertical and latitudinal variation in free tropospheric baseline ozone with an enhancement at 6-10 km in the north sloping downwards to 2-4 km in the south. Polluted air masses and stratospheric intrusions that descend isentropically along the west coast likely explain this feature. Above 3 km, ozone precursor emissions (< 20 days old) most likely to impact ozone along the California coast originated in China or from international shipping. Below 2 km, international shipping is the greatest source of ozone precursors, but inefficient ozone production in the marine boundary layer results in much lower ozone values compared to the mid- and upper troposphere. Approximately 8-10% of the baseline ozone that enters California in the 0-6 km range goes on to impact the surface of the USA, but very little reaches the surface of the eastern USA. Focusing just on California, the major impact of baseline ozone that enters the state above 2 km is on the high elevation terrain of eastern California. Baseline ozone below 2 km has its strongest impact on the low elevation sites throughout the state. Compared to baseline sites, we found no increase in lower tropospheric ozone in the northern Central Valley, while ozone increases of 12-24% were found over the rest of the Central Valley. Enhancements above Joshua Tree were similar, 16-21%, while the greatest ozone enhancements occurred over the LA Basin, 29-60%.

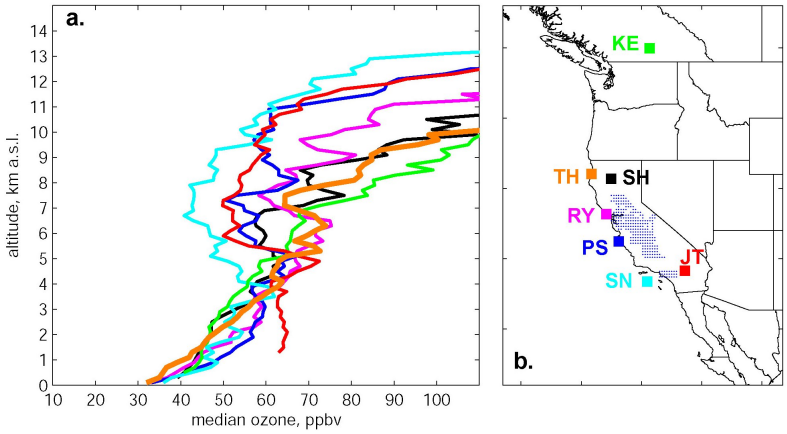

Figure 1. a) Median ozone profiles during May-June 2010, with colors corresponding to the ozonesonde launch locations shown in b) Locations of the seven IONS-2010 ozonesonde sites. Also shown are the NOAA P3 sampling locations (blue dots) of the measurements used in the Central Valley and LA Basin ozone composite profiles.