

Surface ozone levels at Table Mountain during STOIC 1989

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Abstract. As a part of the routine operations of the Jet Propulsion Laboratory atmospheric measurements program at the Table Mountain Facility, the surface ozone concentration is continuously monitored using a Dasibi photometer. The influence of the Los Angeles basin to the southwest of the facility and the height of the inversion layer cause large fluctuations in the ozone concentration. Peaks as high as 200 parts per billion by volume (ppbv) were observed during the Stratospheric Ozone Intercomparison Campaign (STOIC) compared to a normal background level near 50 ppbv. These measurements, made during STOIC, were important in assessing the impact of the surface ozone concentration on the various instruments participating in the campaign.

Introduction

The Stratospheric Ozone Intercomparison Campaign (STOIC) brought together a number of different type of instruments for measurements of both the ozone concentration profile and the ozone column content [Margitan *et al.*, this issue]. Large fluctuations in the concentration of ozone near the Earth surface, as a consequence of urban pollution, has the potential to affect the measurements made by these instruments. This is especially true for the column measurements which were made with Dobson and Brewer spectrophotometers during STOIC [Komhyr *et al.*, this issue; Kerr and McElroy, this issue, McElroy and Kerr, this issue]. The results from the Jet Propulsion Laboratory-Table Mountain Facility (JPL-TMF) Dasibi were therefore provided as an integral part of the STOIC data set in order that the impact of local pollution on the different measurement techniques could be evaluated [McDermid and Walsh, 1991].

Experiment

Air was sampled from the atmosphere at a point ~3 m above the ground and flowed to the Dasibi, model 1008-PC, ozone photometer through a Teflon tube that was ~5 m long. The reference ("zero air") input was provided by scrubbing air sampled from the same environment by passage through a manganese dioxide (MnO₂) filter. The Dasibi updated its measurement every 10 s. Using a personal computer, a snapshot of these measurements was automatically taken once every 5 min and was stored on disk. The specified accuracy of the Dasibi is the greater of ± 3 parts per billion by volume (ppbv) or 2% of the reading.

Results and Discussion

Figures 1 and 2 show the ozone level at 5-min intervals for the 14 days of STOIC. The occasional breaks in the data were caused when the automatic logging was interrupted for some reason. The timescale used on these plots is Pacific

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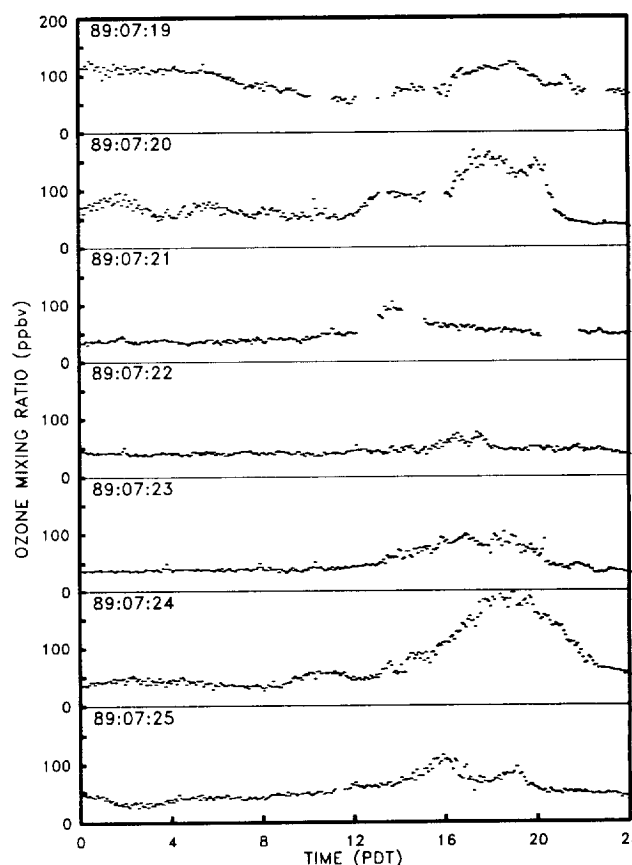


Figure 1. Variations in the surface ozone level on a daily basis, July 19-25, 1989. Each dash represents one measurement at 5-min intervals.

daylight time (PDT) which can be converted to universal time (UT) by adding 7 hours.

The plots indicate that the normal, clean, background ozone level was 50-60 ppbv. The topography of the region is such that TMF, which is at an altitude of 2300 m, is separated from the Los Angeles basin to the southwest by a ridge of mountains averaging 2500- to 3000-m elevation. When the height of the inversion is below this ridge, the Los

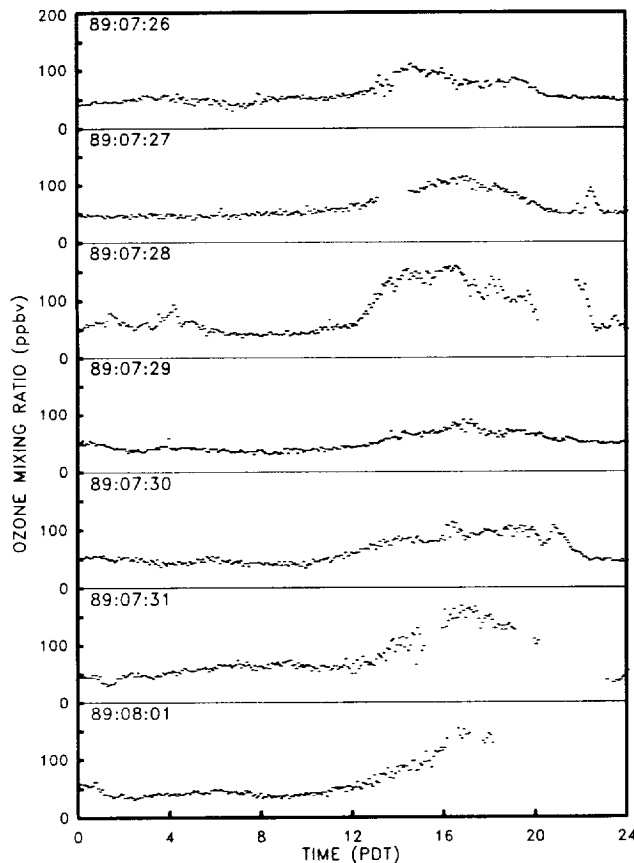


Figure 2. As Figure 1, July 26–August 1, 1989.

Angeles pollution (smog) does not encroach on the site even though the prevailing winds are from the southwest. The pattern shown in Figures 1 and 2 is typical of the summer months in this region. During the night the inversion is below the altitude of TMF and the surface ozone levels are normally at or near the background level of 50–60 ppbv. During the day the Sun heats up the boundary layer increasing the height of the inversion. Typically, by middle to late afternoon in the summer the height of the inversion is higher than the ridge and smog is carried over which causes the sharp increase in the ozone level at JPL-TMF. Similarly, after

sunset the boundary layer cools and the height of the inversion falls taking the ozone levels back to the background values. For almost every day of STOIC the afternoon surface ozone levels reached 100 ppbv and on one occasion, July 24, even exceeded 200 ppbv for a short time. Although they were not monitored during STOIC, the levels of other pollutants such as CO and NO_x are expected to follow a similar pattern.

Since the majority of the STOIC measurements were made near to local midnight, the surface ozone pollution did not seriously affect most of the instruments. However, there was a significant impact on the ozone column measurements made during the day with the Dobson and Brewer instruments and it was possible to develop a correction to the diurnal changes in the total column using the Dasibi measurements [Kerr and McElroy, this issue].

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References

- Kerr, J. B., and C. T. McElroy, Total ozone measurements made with the Brewer ozone spectrophotometer during STOIC 1989, *J. Geophys. Res.*, this issue.
- Komhyr, W. D., B. J. Connor, I. S. McDermid, T. J. McGee, A. D. Parrish, and J. J. Margitan, Comparison of STOIC 1989 ground-based lidar, microwave spectrometer, and Dobson spectrophotometer Umkehr ozone profiles with ozone profiles from balloon-borne electrochemical concentration cell ozonesondes, *J. Geophys. Res.*, this issue.
- Margitan, J. J., et al., Stratospheric Ozone Intercomparison Campaign (STOIC) 1989: Overview, *J. Geophys. Res.*, this issue.
- McDermid, I. S., and T. D. Walsh, Surface ozone concentrations at Table Mountain Facility (34.4° N, 117.7° W) during 1989 and 1990, *JPL Doc., JPL D-8354*, Jet Propul. Lab., Pasadena, Calif., March 1991.
- McElroy, C. T., and J. B. Kerr, Table Mountain ozone intercomparison: Brewer ozone spectrophotometer Umkehr observations, *J. Geophys. Res.*, this issue.

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