

VERTICAL AND TEMPORAL DISTRIBUTION OF OZONE IN THE LOWER TROPOSPHERE MEASURED WITH DIAL

G.C. Grabbe¹, J. Bösenberg¹ and T. Schaberl²

¹Max-Planck-Institut für Meteorologie

²Meteorologisches Institut der Universität Hamburg

Bundesstraße 55, 20146 Hamburg, Germany

Phone: +49 40 41173 256 Facsimile: +49 40 41173 298

E-mail: grabbe@dkrz.d400.de

Introduction

An UV-DIAL system, based on a KrF excimer laser and subsequent Raman shifting in H_2 or D_2 has been used over an extended period of time to perform routine observations of the ozone vertical distribution in the lower troposphere. The height range depends on details of the instrument setup and on atmospheric conditions. Usually it was either around 1 to 2.5 km or 0.2 to 1 km. These measurements have been used to study the diurnal cycle, annual variation, and dependence on meteorological parameters of the ozone content of the lower troposphere.

Annual Variations of Ozone

As can be seen in Figure 1, the ozone density in the lower part of the free troposphere (LFT) has an upward trend until May/June. From the second half of June on, already lower ozone values were observed there. The annual variation is rather small in the LFT. Even during the winter the minimal observed amount of ozone in the LFT was $60 \mu g/m^3$. The measurements from the adjacent layer below the LFT are obtained from the convective

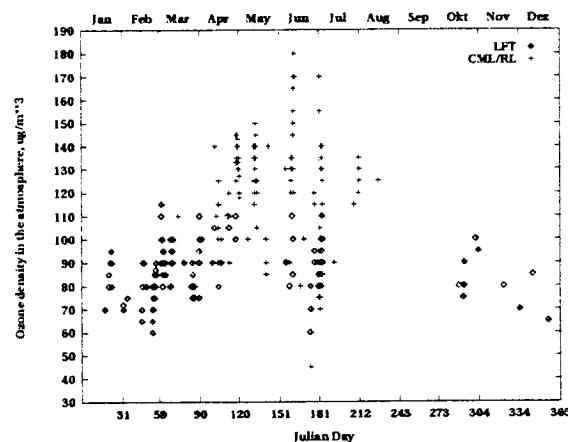


Figure 1: *Annual Variation of Ozone in the Troposphere*

tively mixed layer with sufficient turbulence during daytime. During the night, the measurements result from the so called residual layer (RL), which represents the former convective mixed layer (CML) of the day before. The RL is decoupled from the ground and so the dissipation of ozone during the night did not take place there as at the ground. Since there are a lot of measurements during June and beginning of July, these measurements are investigated in detail.

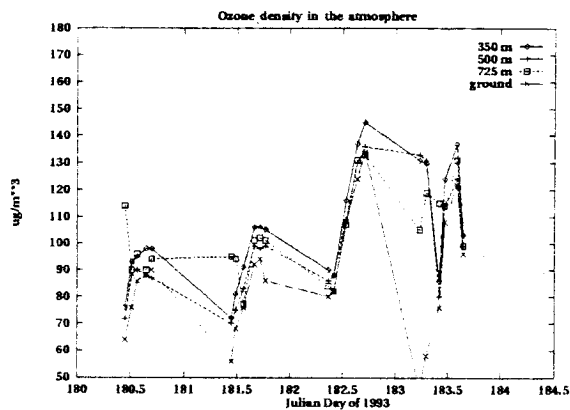


Figure 2: Diurnal variation of ozone in the heights of 350m, 500m, 725m and at the ground between 93/06/29 (Julian day 180) and 93/07/02 (Julian day 183)

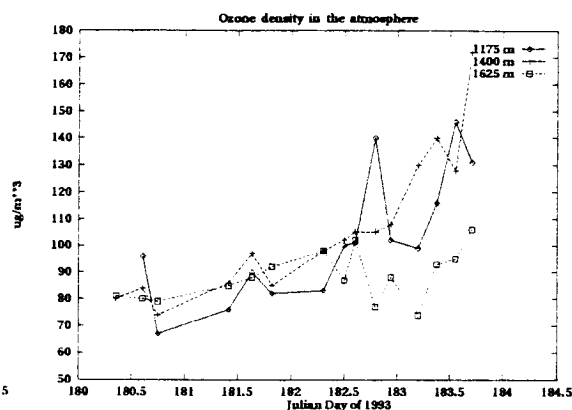


Figure 3: Diurnal variation of ozone in the heights of 1175m, 1400m and 1625m between 93/06/29 (Julian day 180) and 93/07/02 (Julian day 183)

Diurnal Variations of Ozone

The temporal evolution of the ozone distribution in the lower troposphere during summer episodes of high ozone has been studied in detail for two cases. In both cases a drastic increase of approximately $50 \mu\text{g}/\text{m}^3$ was observed in the CML as well as at the ground during the first three days. The nighttime measurements were made in the RL. So, the high ozone value in the heights of some hundred meters in the morning of day 183 in Figure 2 can be explained, while the ground value turned out to be low. Later on in the day, the measurements were made in the CML and had a similar value and lapse as the ground value. No clear diurnal variation showed up in the LFT, but an ozone increase of $10 \mu\text{g}/\text{m}^3$ per day was observed (Figure 3).

Correlation between Ozone and Meteorological Parameters

The extended set of data of ozone profiles is presently being used to study correlation between ozone concentration and simple meteorological parameters at various heights. For example, the already known positive correlation ozone - air temperature at ground level is confirmed. At elevated levels, in the lower free troposphere, a corresponding correlation still exists, but with less significance and with a considerably smaller slope. Correlation with other parameters is under investigation.