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NOCTURNAL URBAN OZONE MAXIMUM IN SUMMER 1994 – DATA FROM GÖTEBORG, SWEDEN

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1. INTRODUCTION

Nocturnal secondary maximum of atmospheric ozone in urban areas during stable atmospheric weather conditions has been reported by several authors (Chung 1977, Samson 1978, Steinberger and Ganor 1979, Liu et al. 1990, Corsmeier et al. 1997, Strassburger and Kuttler 1998, Baumbach and Vogt 1999, Helbig 1999). As no O_3 is produced during the night the nocturnal ozone maximum is explained as an effect of vertical mixing of high concentrations of ozone from higher levels or horizontal transport from rural areas through local wind systems.

In this study, nocturnal urban ozone maximum during a summer with high frequency of clear and calm weather was investigated together with meteorological data in order to describe

- the magnitude, frequency and timing of nocturnal ozone maximum
- the relative importance of local wind systems and vertical mixing

2. STUDY AREA

The Göteborg urban district, is with it's 500 000 inhabitants, the second largest city in Sweden. The city is located on the Swedish westcoast at 57° 42´ N, 11°58´E. The climate is a marine West Coast climate associated with alternating low pressure westerly flows, blocking highs in the eastern Atlantic and high pressures over Russia. In contrast to many other parts of Europe the pollution pattern in Scandinavia is influenced by long-transported pollutants from the continent brought to Scandinavia by the dominating regional south-westerly winds.

3. METHODS

The analysis of ozone concentrations and meteorological data was focused on four summer months, May, June, July and August in 1994. During this period the maximum ozone concentrations in central Göteborg reached 170 μg m^{-3} (Figure 1). Ozone data was collected from one urban and one rural meteorological station and meteorological data was gathered from another eight meteorological stations within the area. From the database all nights with a mean wind speed of maximum 2 ms^{-1} and maximum cloud cover of 2 octas was selected. Altogether 34 such clear and calm nights were identified. The diurnal ozone concentrations for a 24 hour period during these nights were analysed and those with an ozone increase of 10 μgm^{-3} or higher were selected (Table 1). Meteorological data for these 34 nights were analysed with focus on the horizontal (and vertical) wind field, and air stability.

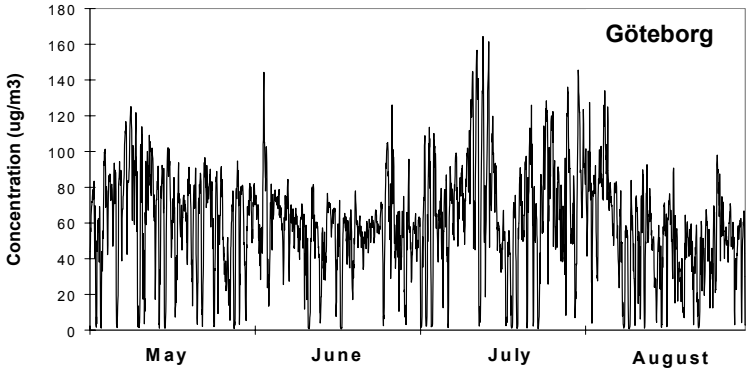

FIGURE 1. Diurnal ozone concentrations in the Göteborg city centre during May-August 1994

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4. RESULTS

During 19 of the 34 selected nights ozone peaks larger than 10 ugm^{-3} occurred (Table 1). The secondary ozone maximum appeared either early or late during the night, sometimes even two peaks occurred. Most of the nocturnal peaks were found in the early night (62 %), i.e. the ozone increase was observed during the first three hour after sunset (Table 1). Figure 2a shows an example of a single peak occurring in May 1st and 2nd 1994 and Figure 2b shows a double peak occurring in August 11th and12th 1994. The preliminary results indicate that the timing of the nocturnal ozone maximum is related to the air stability and the interpretation is that both horizontal and vertical transport of ozone are important.

TABLE 1

MEASUREMENT PERIOD	**MAY – AUGUST 1994**
Number of clear and calm nights	34
Number of nights with nocturnal maximum, (threshold > 10μgm^{-3})	19
Number nights with early peak (ozone increase during the first three hours after sunset)	16
Number of nights with late peak	10

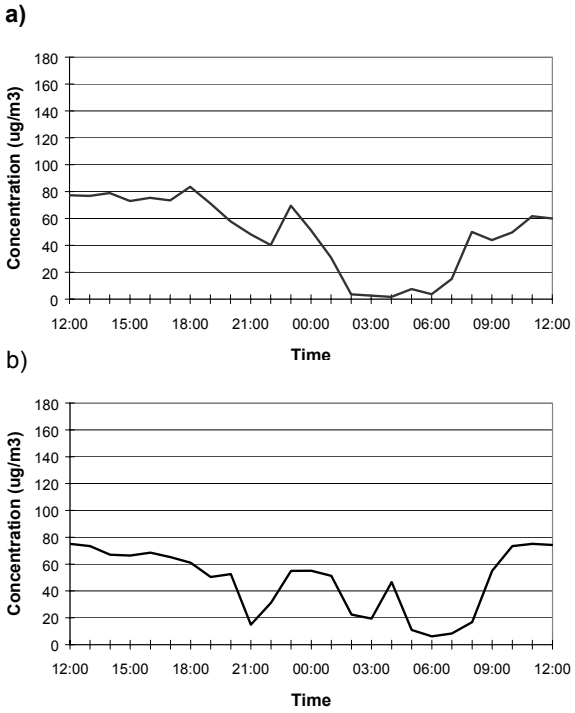

FIGURE 2. Nocturnal ozone maximum at the Göteborg urban station. A. Single peak, May 1-2, 1994 B. Double peak, August 11-12, 1994

5. ACKNOWLEDGEMENT

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