Formation of Tropospheric Ozone in Hungary

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Summary

In 2001-2002 three ozone monitoring sites were operated in Hungary including TOR Station no. 15 (K-puszta). As the monitoring activity did not receive support during the period more emphasis was given to the numerical modelling of ozone formation in urban plumes and on a regional scale. For this purpose the adaptive grid model of Hart *et al*. (1998) was adapted and further developed. Test calculations were performed for the Carpathian Basin and for the urban plume of Budapest. The results correlate well with the ozone mixing ratios measured at K-puszta.

Objectives

Subproject TOR-1 showed a northwest-southeast gradient in the summer surface level ozone concentration. As a result of the long range transport of pollutants the highest concentrations in the TOR/EMEP networks were measured in Hungary and at the Hungarian-Austrian border. Unfortunately, there was no longer a monitoring station in this region east of central Hungary which could help the work of the modellers. In the framework of TOR-2, in addition to TOR Station 15 (K-puszta), two new ozone monitoring sites were planned to be established in Eastern Hungary. The monitoring programme of K-puszta had to include as many ozone related substances as funding allowed (e.g., non-methane hydrocarbons, carbonyl compounds, nitrogen oxides). In the region of Budapest traffic was the main contributor to the emissions of ozone precursors. In the framework of TOR-2 the NO_x-VOC emission of the "average Hungarian car" was planned to be determined on the basis of a tunnel experiment. Distribution of the primary and secondary pollutants within and around the city can be determined by means of a suitable mathematical model.

Main results

In addition to K-puszta (TOR Station 15 - 48°58'N, 19°33'E, 125 m) two more ozone monitoring sites were operated in Hungary in 2001-2002. Hortobágy (47°29'N, 20°56'E, 91 m) is located in the strictly protected part of the Hortobágy National Park (Eastern Hungary, Hungarian Great Plain) on a wide, open plain, as far from any anthropogenic pollution sources as it is possible in Central Europe. The other station (Nyírjes - 47°52'N, 19°57'E, 702 m) is located in the Mátra Hills in north-eastern Hungary. Under certain meteorological conditions the station may be above the boundary layer which should be taken into account in the evaluation of the data.

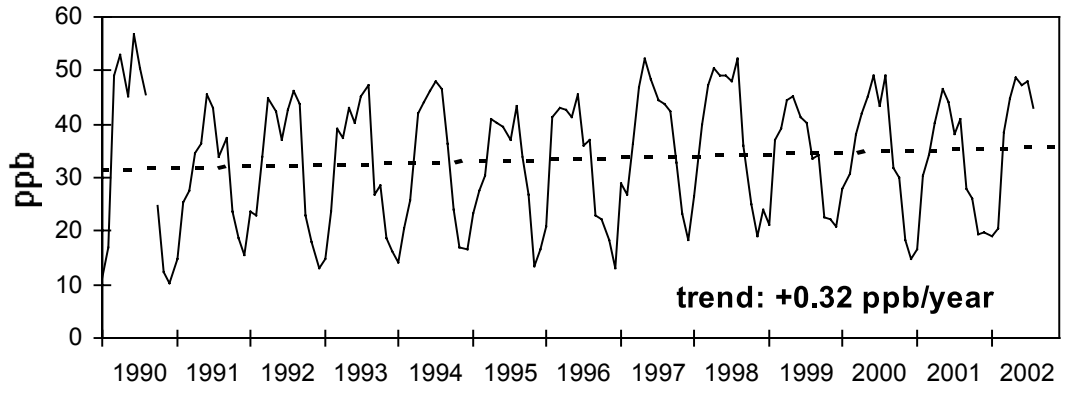

Figure 1. Trend in the mixing ratio of surface level ozone at K-puszta, Hungary.

The data series of the new ozone monitoring sites are too short yet for detailed statistical evaluation. At K-puszta, operating since 1990, the overall linear trend for the whole period of the measurements is 0.32 ppb/year (Fig. 1). Hourly mixing ratios did not exceed the 100 ppb limit in 2001-2002. In 2001-2002 the maximum values were 98 ppb (1 August, 2001) and 91 ppb (22 June, 2002), respectively, similar to those in the previous two years, but significantly lower than in the late 1990s (1996: 137 ppb, 1997: 122 ppb, 1998: 128 ppb).

Regular sampling for non-methane hydrocarbon species ceased at the end of 1999 due to lack of support. Preliminary analysis of the trends was presented at the EUROTRAC 2000 Symposium (Haszpra *et al*., 2001c). Publication of a more detailed study is still in preparation.

For the assessment of the traffic originated hydrocarbon species, a one-day tunnel experiment was performed in summer 2000. Results of the experiment were published in Haszpra *et al.* (2001b). Comparison with the previous measurements (1990 and 1997) (Haszpra and Szilágyi, 1994; Haszpra *et al.*, 1998) is in progress. During that decade the emission factors got closer to the Western European standards. Significant changes could also be observed in the relative composition of the hydrocarbon speciation. Preliminary analysis of the trends were presented in Haszpra *et al.* (2001a).

Because of the lack of funding for the monitoring activity in 2001-2002 more emphasis was given to the modelling work. For the description of the ozone formation in the urban plume of Budapest, and in the Carpathian Basin in general, the adaptive grid model developed by Hart *et al.* (1998) was chosen. The model was further developed and adapted to the available input data by Lagzi *et al.* (2001, 2002). For Hungary and Budapest the emission inventories were provided by the local authorities, while for the model domain outside of the country the EMEP emission inventories were used. The meteorological information was obtained from the limited area numerical weather forecast model (ALADIN - Horányi *et al.*, 1996) of the Hungarian Meteorological Service. In the test calculations, K-puszta, located about 70 km to the southeast of Budapest, was used as a reference point. Figure 2 shows the measured and calculated mixing ratios for the period of 2-5 August, 1998. The calculated and

the measured values correlate well except for a part of 4 August when the model overestimates the mixing ratio. It might be the consequence of the too coarse resolution (20 x 20 km^2) of the emission grid.

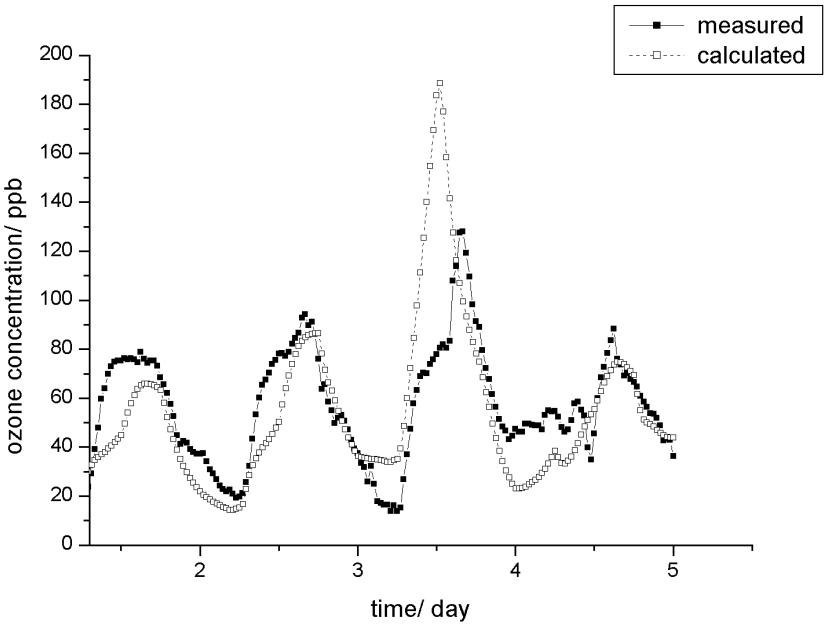

Figure 2. The measured and calculated ozone mixing ratios at K-puszta on 2-5 August, 1998.

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