2.5 A COMPARISON OF MODELLED OZONE GROUND CONCENTRATION WITH MEASUREMENT

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1. INTRODUCTION

In 2001 a new four-year complex project officially called "Transformation of air-pollution with respect to negative anthropogenic processes and their impact on the human population, landscape receptors and to modelling of their transport in the atmosphere" financed by the Czech Ministry of Environment has started. In the framework of this project several field campaigns occurred and in these campaigns extensive measurement of photochemical smog (tropospheric ozone) took place. For the same time periods a model complex consisting of the ETA model, Mesinger et al. (1988) and chemical transport model (hereinafter CTM) SMOG Bednar et al. (2001a, 2001b) has been used for modelling an ozone ground concentration distributions in the same area. In this contribution a comparison of model results and measured values is presented for data from June 2000, as for this period all the necessary information for the modelling activity were available and also there occurred field campaign before the above mentioned project started. .

2. FIELD CAMPAIGN AREA

Area where field campaign of extensive measurement took place is schematically shown in fig.1.

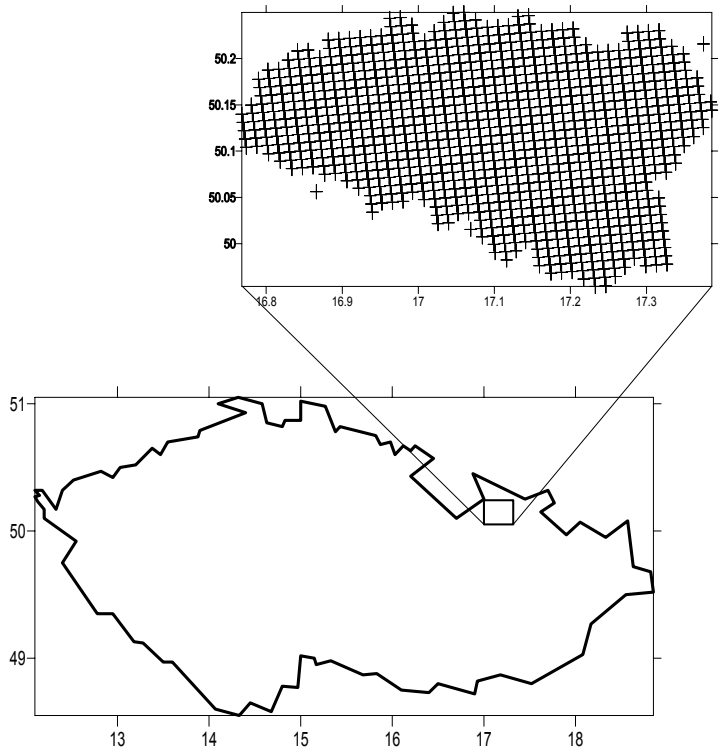

Fig.1 Area where the field campaign occurred. Longitude and latitude in geographical degrees.

Area of interest is located in the Jeseniky Mountains in the Northern Moravia close to the Czech – Polish border. The geographical pattern of the area can be seen from the fig.2. The highest mountain peak has height 1491 meters above the mean sea level. The average height of

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this area is approximately 1000 – 1200 meters above the mean sea level. This mountain area belongs to the group of the protected areas in the Czech Republic and it has been also a reason, why the measurement took place there.

Fig.2 Geographical map of the Jeseniky Mountains area.

Passive samplers together with permanently exposed monitors created relatively dense network and thanks to that fact it was possible also to construct a map showing the spatial distribution of monthly mean values of O_3 ground concentration.

3. MODELLING ACTIVITY

At the Department of Meteorology and Environment Protection, Faculty of Mathematics and Physics, Charles University in Prague a CTM called SMOG has been developed in the second half of the last decade of the last century. Description of this model can be found in Bednar et al. (2001a or 2001b). CTM SMOG is of a puff model type that can be used for computing the daily hours means in a given point or area of interest, for example. This model needs meteorological data that have to be prepared by some meteorological prognostic model. As there is an ETA model available and run in a semi-operational mode at the above mentioned department the output data from this model were used for the reconstruction of meteorological conditions in June 2000.

Emission data used contained all main point sources located at the area of the Czech Republic, from the neighbourhood of the domain of interest also information about medium point sources were taken into account. These point sources were placed in the model orography exactly where they are located. Information about the rest of the emission sources, i.e. traffic sources, small point sources, local heating etc. was used in a gridded form with a grid 5×5 km. The problem dealt with Polish, Slovak and for some cases also Hungarian sources. For these emission sources there were no information available and because the area is close to Czech –Polish border and also the Czech – Slovak border is not too far from the area of interest, the model results should be underestimated. But we supposed that time series tendencies could be well computed and monthly mean value of ozone concentration should display a right pattern.

Using all the above mentioned information, mean daily values that correspond only to hours with daylight, were computed. As the information about the background ozone concentration was not available for this period the boundary values have been taken constant and equal to 80 $\mu g\ m^{-}$. From the daily results a monthly mean value of concentration has been also estimated.

4. RESULTS

In the following sequence of figures computed result are shown together with those constructed from the measured data.

As mentioned above also data from passive samplers exposed for the whole one month lasting period were used together with data from the monitors permanently exposed in this area. Thanks to that a dense network of monitors covers the whole area of interest. The monthly mean O_3 ground concentration for June 2000 is shown in fig.3. In this figure the result obtained from the measured information is shown.

Maximum values (about 140 $\mu g\ m^{-3}$) are met in the centre of the domain of interest. Concentrations are decreasing when going inland ward (to the Moravian territory) but also the lowest values of ground concentration exceed the level of 110 $\mu g\ m^{-3}$. This pattern may be caused by the fact that main emission sources that can affect the pattern of ground concentration distribution are located eastward form this area (Ostrava city territory) and northward and north-western ward where Polish industrial sources are located. Also long range transport from the main Czech emission sources occurs when the flow is from the western part of the wind rose (west or south-west wind). Prevailing winds in this period (June 2000) were those from west or north-west and there were relatively quite a lot of cases when wind blew from south-east sector of wind rose.

Model results show the following pattern of O_3 ground concentration distribution that can be seen in fig. 4. Maximum values of ground concentration in the centre of the area exceed the value of 90 μgm^{-3} and concentrations also decrease when going outside from the centre but the lowermost values are met in the northwester part of the domain. This is probably due to missing information about Polish emission

sources. The same fact (mentioned above) results probably in the underestimated values of the O_3 ground concentration in the area of interest and in a location of maximum values that is more southward when comparing with measurement.

Approximately in the centre of the investigated domain there is a permanently measuring monitor Cervenohorske sedlo located approximately in the centre of the enlarged area in fig.1. One result of the presented modeling activity was a computation of the time series of daily values of O_3 concentrations in the point corresponding to the position of monitor. Comparison of daily mean values based on measured data (for measured values they have been obtained by averaging the 30 minutes values from 10 AM to 6 PM) with the model results can be seen in the fig.5.

The surprisingly good correspondence in time tendencies is seen both for measured and modeled data. The underestimation of model results is also evident but times when the extreme values occurred are identical.

5. CONCLUDING REMARKS

In this contribution a comparison of model SMOG results with O_3 ground concentration measurement and also comparison of spatial distribution of O_3 ground concentration obtained as a model result and constructed from the measured data are shown. Model results underestimate the concentration values, but one of the objective reasons for this is the fact that the set of emission sources data has been limited and contains only information about the Czech emission sources. It is a great limitation especially in those meteorological situations when wind directions were from the western and north-western sectors of wind rose or from south-eastern or eastern ones.

This comparison also shovs that model can be successfully applied for such task when characteristic daily values of O_3 ground concentration are to be provided. Also the parametrization of the chemical reaction cycle used in this model seems to give realistic results.

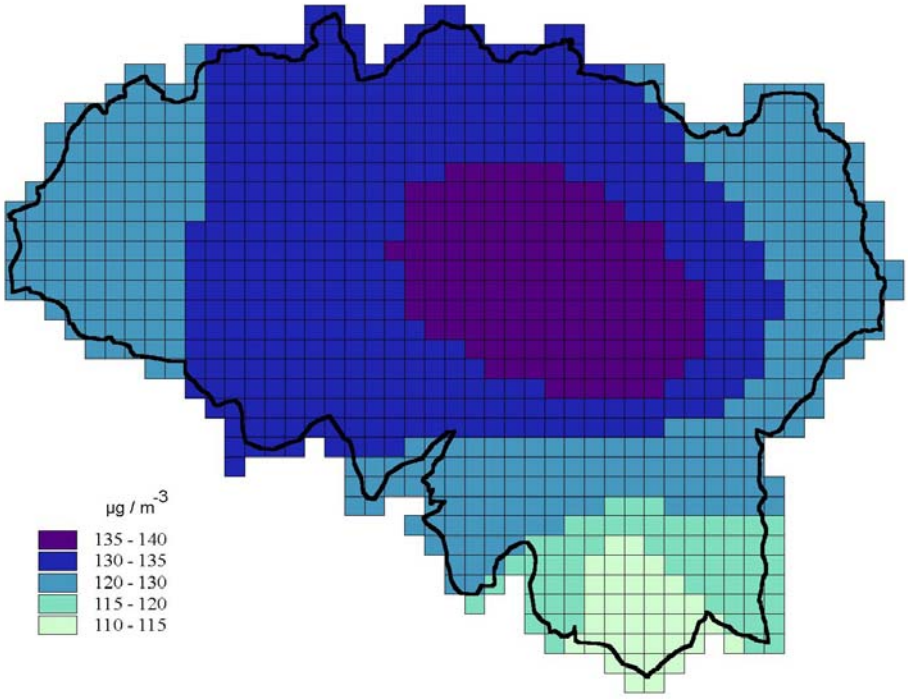

Fig.3 Monthly mean ground concentration of O_3 in $\mu g\ m^{-3}$ – measurement.

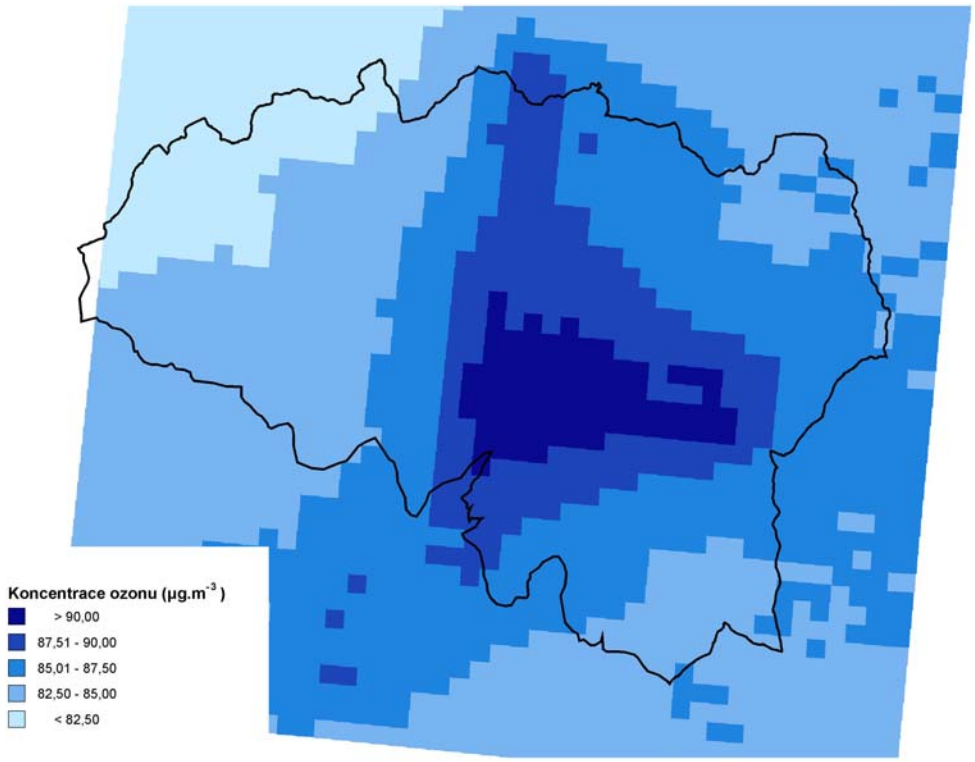

Fig.4 The same as in fig.3 but computed values.

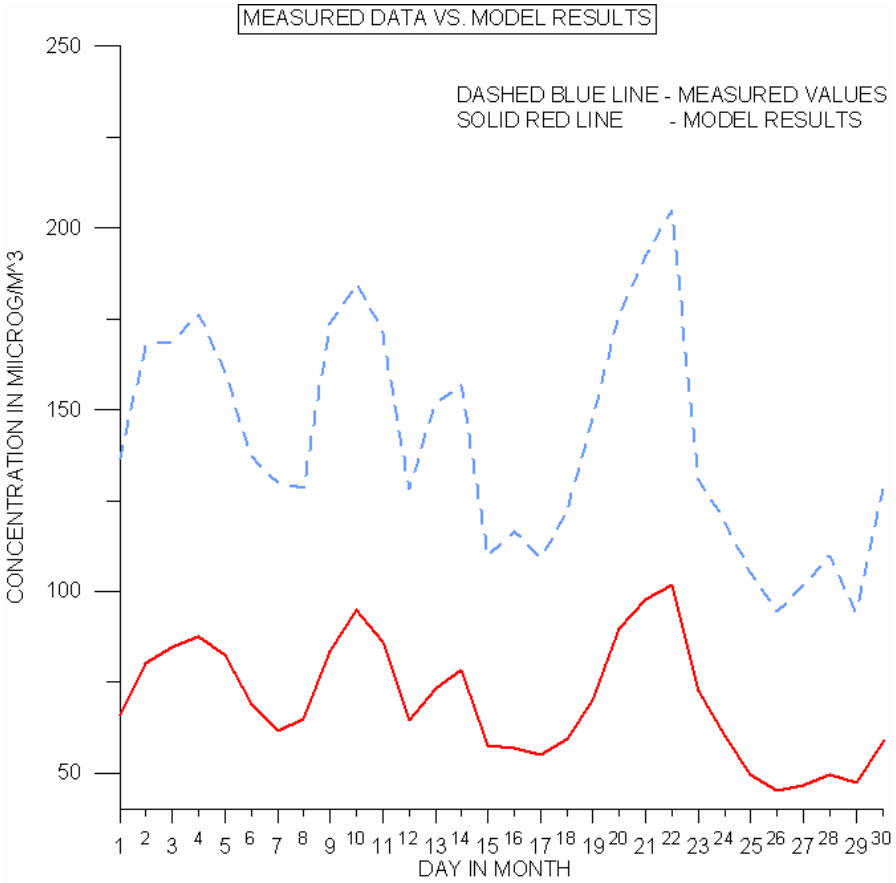

Fig.5 Daily mean values – comparison of model results and measurement.

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ACKNOWLEDGEMENT

This work has been performed in the framework of the project VaV/740/2/01 financed by the Ministry of Environment of the Czech Republic.