Modelling of long-term and short-term total ozone variability at Poprad-Gánovce, Slovakia

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A b s t r a c t : The purpose of this study was the construction of the daily total ozone model for Poprad-Gánovce (49.03°N, 20.32°E, 710 m a.s.l.), Slovakia, utilizing the local upper-air measurements performed there since 1961. The model of daily total ozone was created as a sum of two independent models: (1) model of the monthly total ozone values, (2) model of daily total ozone deviations from the monthly average. The long-term variability of the total ozone was modelled using multilinear regression of the monthly total ozone data measured with the Dobson spectrophotometer at the closest observatory Hradec Králové (50.18°N, 15.83°E, 285 m a.s.l.). The differences between the total ozone monthly averages from Hradec Králové and Poprad-Gánovce were negligible (in the range of ±2%), and no systematic bias was detected between both data series during the period of comparison 1993–2004. The content of the ozone-depleting substances concentration in the stratosphere expressed by the equivalent effective stratospheric chlorine (EESC), stratospheric aerosol, index of quasi-biennial oscillations (QBO), index of North Atlantic oscillation (NAO), solar activity expressed by sun spot number (SSN), and upper-air data (height of tropopause for January – February, temperature at 700 hPa level for December and difference between heights of 100 hPa and 250 hPa isobaric levels for the other months) were the parameters tested before inclusion into the monthly total ozone model. Analysis of the Hradec Králové monthly total ozone shows that concentration of ozone-depleting substances in the stratosphere, NAO-index and upper-air parameter belong to the best proxies of the monthly total ozone nearly during the whole year. Aerosols play a significant role in the long-term total ozone variability in December -

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January. Solar activity variations affect the total ozone values in April - July. The QBO index does not affect the total ozone variability significantly during any month, except of February. The comparison of monthly total ozone trends determined from the modelled and measured 1971–2000 time series shows a descending trend of the total ozone during all months. The largest total ozone decrease was detected in April and June, but the most significant linear decrease of total ozone was determined in January and in October. The difference between modelled and measured total ozone trends was below 0.3%. The short-term total column ozone variability was modelled using upper-air proxies only. The error of the final model of daily total ozone was 6%. The coefficient of the determination between the measured and modelled 1993–2004 total ozone was 0.86 at Poprad-Gánovce. The daily total ozone reconstruction has been performed since 1961, but there were large gaps in the upper-air data, and consequently in the modelled daily total ozone in the 60-ties.

Key words: total ozone, Brewer spectrophotometer, Dobson spectrophotometer, upper-air data, NAO-index, QBO-index, SSN-index, EESC, stratospheric aerosol, modelling