TOTAL OZONE VALUES AND SULFUR DIOXIDE CONTENT IN MURMANSK

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The monthly average total ozone values in Murmansk are compared with the dioxide sulfur content in the air of the same city for the period 1974-1989. The comparison was made for 7 months from March till September when the number of the ozone observations was enough representative. The correlation coefficients for all months are positive from 0.16 to 0.54, and the connection between both 'independent' variables is seen. This result is in a full agreement with the investigation of De Muer and De Backer on the interference by SO_2 on total ozone measurements at Uccle (Belgium). The ozone data in Murmansk were obtained with the Soviet M-124 ozonometer. It uses the glass filter with 20 nm bandwidth on 300 nm just on the maximum of the most intensive SO_2 adsorption band.

As a rule a determination of the total ozone content includes measurements of the light intensity near 300 nm. Just on this wavelength the very strong absorption band of sulfur dioxide is situated. A second spectral region is taken with more longer wavelength where the ozone absorption is less. So the total ozone measurements in the atmosphere with a significant SO_2 content can give heightened values of the ozone.

De Muer and De Baker [1] have accomplished the very careful correction of the total ozone data from Uccle, Belgium for the period 1971-1991 on SO_2. In the calculations they used the SO_2 content data in the air near their observatory and found that the input of SO_2 in ozone values has an order of 10 Dobson units. After excluding of this error the long-term negative ozone trend over Uccle disappeared, the ozone layer over Belgium was found very stable after that procedure.

The comparison between the total ozone measurements over Murmansk and the content of SO_2 in the air on the streets of the city was made with the idea of [1] in mind. The monthly ozone values were taken from ozone volumes edited by Gushchin [2]. The device in Murmansk is the soviet ozonometer M-124 with glass filters.

The monthly SO_2 data were published in the special year-books [3] with materials on industrial pollution in cities at Kola peninsula. We may turn to account only data for the time interval 1974-1989 with exception of 1983. In 1988 the monthly data were absent. In 1986 a device and method of measurement were changed, instead of an aspirator an absorptive tube was installed. In 1986 and 1987 the data of both methods were published in parallel, and the new method have given the value by three times less than the old one. In 1989 only the data of absorption tubes were published. We have used the aspirator data, and the data for 1989 were multiplied by corresponding coefficient. So there were data only for 14 years to compare.

As the ozone as SO_2 have very strong season variations, so the comparison was made for separate months, from March till September. There were too few ozone observations in Murmansk outside of this period.

The correlation coefficients between the contents of the ozone in the stratosphere and SO_2 on the streets of Murmansk for all 7 months were calculated. They are given in the Table. All of them are positive, and the random probability of such event is 2^{-7}. The values of the coefficients are scattered between 0.16 and 0.53.

Table

Month	Correlation coefficient
MARCH	+0.50
APRIL	+0.26
MAY	+0.16
JUNE	+0.53
JULY	+0.48
AUGUST	+0.51
SEPTEMBER	+0.42

The year variations of the total ozone and SO_2 amounts for March and August are shown in Fig.1. There is some correspondence between variations of both kind data, and there is a difference between the curves for different months as for ozone as for SO_2. The same data are shown in Fig.2 also as the scattered diagrams with the regression lines. It is seen enough well that although SO_2 variations do not determine the ozone variations completely, the influence of SO_2 amount on the results of the ozone measurements is appreciable.
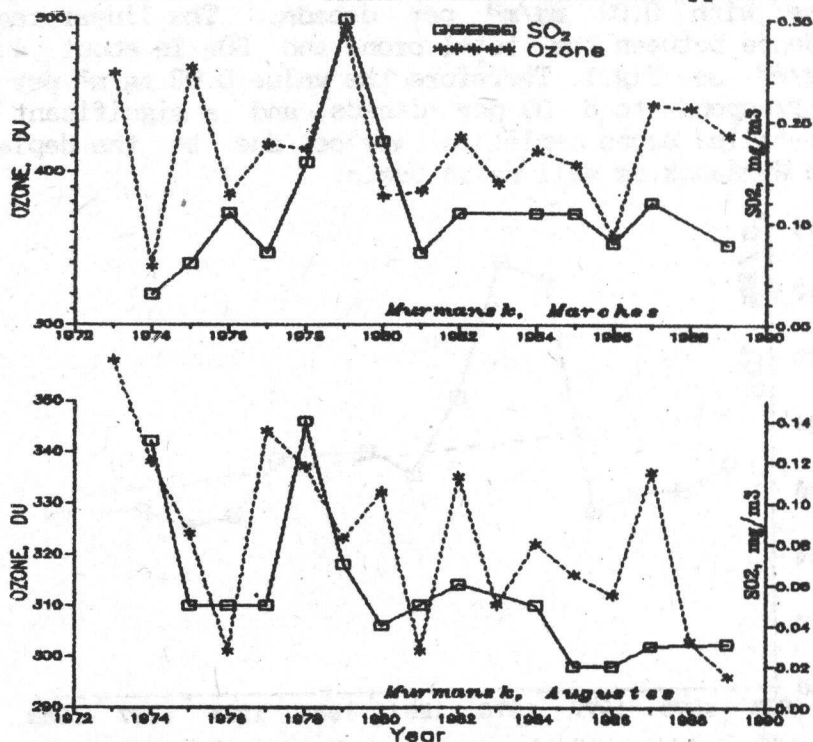

Fig.1. Dioxide sulphur amount in Murmansk and total ozone content over Murmansk during 1973-89 for March and August.
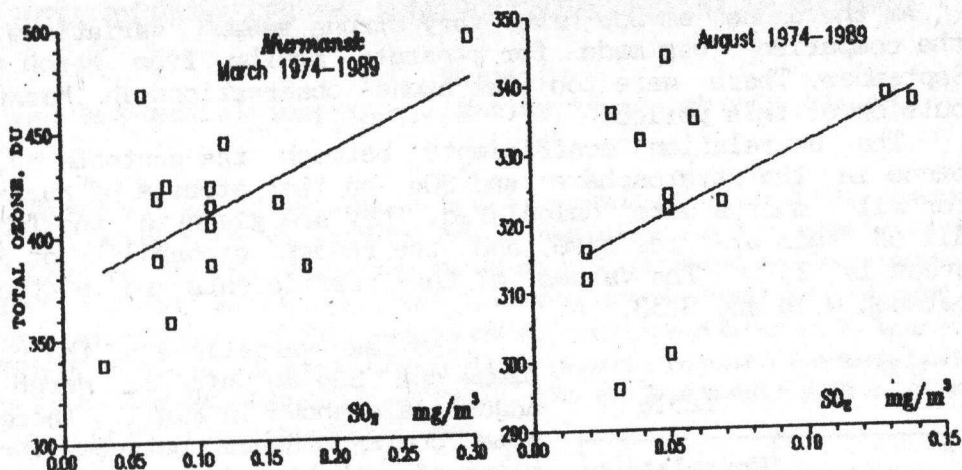
Fig.2. Total ozone values versus SO₂ amounts and the regression lines.

The statistical trend analysis of the ozone values in Murmansk for 1973-1987 was executed in [4] and the all-year trend coefficient was found as -5.88 ± 4.8 %/decade what corresponds to the decrease of 20 DU/decade. In Fig.3 the annual average values of SO_2 in Murmansk for the March-September period are presented. The regression line is overplotted at the Figure and the general tendency is negative decline with 0.02 mg/m³ per decade. The linear regression dependence between the total ozone and SO_2 is about 40 DU per 0.1 mg/m³, see Fig.1. Therefore the value 0.02 mg/m³ per decade may correspond to 8 DU per decade, and a significant part of the so-called ozone depletion may be due to the depletion of SO_2 in Murmansk as well as in Uccle.
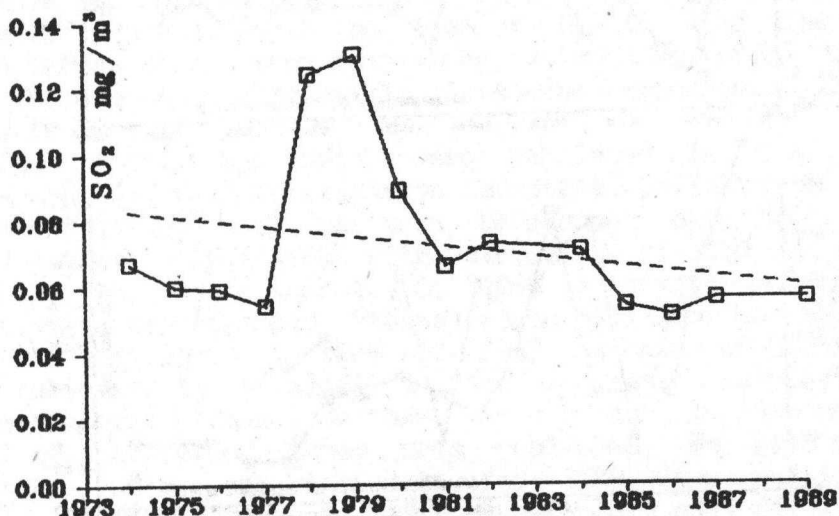

Fig.3. Variations of the averaged for March-September values of SO_2 in Murmansk and the regression line.

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