UZBEKISTAN

Ozone Monitoring

In Uzbekistan the monitoring of the total ozone content (TOC) and its surface concentrations is carried out by the Service of the Environment Monitoring at the Centre of Hydrometeorological Service at the Cabinet of Ministers of the Republic of Uzbekistan (Uzgidromet).

Currently, the regular daily observations of the total stratosphere ozone content are being conducted at two stations – Tashkent (37,1°N, 69,2°E, 478 m a.s.l.) and Termez (37,1°N, 67,2°E, 311m a.s.l.).

Both stations operate since 1989. At Kumbel and Abramov glacier stations the observations were ceased because of the equipment failure and absence of financing for its restoration.

The observations of the total ozone content are being made with the filtering ozone measuring M-124 device designed by Guschin P. (manufactured in Russian). Because of financial difficulties this device did not undergone calibration, but nevertheless, as it was confirmed by the Central Aerological Observatory (CAO) (Dolgoprudny town, Moscow region, Russia) the data on the stratospheric ozone content measured at Tashkent station, are highly compatible with satellite data.

Systematic observations on tropospheric ozone and other trace gases (CO_2, CO, NO, NO_2 and others) are being continued in all big cities of Uzbekistan. Samples are being taken 2 times a day – in the morning and midday, since April till October. The concentration of tropospheric ozone is made by photometric method based on the displacement of iodine by ozone when it is adsorbed by the solution of potassium iodide. The extracted iodine is estimated by the spectrophotometric measurement of the adsorption spectrum by the iodine ions with the wavelength of 352 nm.

According to the data of systematic observations the mean annual ozone concentration in surface layer in Tashkent in summer exceeds MAC (Maximum Admissible Concentration) from 1,3 to 3 times which corresponds 39-69 μg/m^3. The mean daily MAC for Uzbekistan is 30 μg/m^3. The highest tropospheric ozone content is recorded in Bekabad (2-3 MAC) and Chirchik (3-3,7 MAC) which is caused by the increased level of the atmospheric pollution with the ozone precursors. Every year the increase of the ozone concentration in surface layer is recorded since May to September, while in October the ozone content is slightly lower. The data of observations are being published in the yearly reviews on atmospheric pollution. In case of the increase ozone concentrations the information is being transferred to the relevant departments of the State Committee on Environment Protection following the pattern of the information exchange adopted in the Republic of Uzbekistan.

Information

The mean daily data on the stratospheric ozone content are transferred one time per month from Tashkent station to the Voeikov's Main Geophysical Observatory (MGO) (Saint-Petersburg, Russia) for the further generalization and transfer to the World Centre of Ozone Data in Toronto (Canada). The results of the regular daily measurements of TOC are being transferred to the Central Aerological Observatory (CAO) (Dolgoprudny town, Moscow region, Russia) for the inclusion of this information to the international framework of the data exchange.

During winter period (December – March) a similar information is transferred 3 times a week to the University in Tessaloniki (Greece).

Information received from Termez station is being used for scientific studies. All primary information is stored in archive of Uzgidromet of the Republic of Uzbekistan.

At present the data base on stratospheric and surface (tropospheric) ozone is built up. The daily 2-times a day measurements of the surface ozone content in Almalyk (1992-2000), Tashkent (1991-2000), Chirchik (1992-1999), Fergana (1994-2000) cities and measurements of TOC over Tashkent measured by the surface methods and from satellites put the basis for such data base. The concentration of the surface ozone content was measured at 07am and 13pm of the local solar time by the known method and is expressed in $\mu g/m^3$. As it is known the concentration of TOC is measured daily in Dobson units.

The values of ozone (O_3) measured in stratosphere and in surface layer are presented in PC readable form. The software designed for the archive data manipulation are written and debugged.

Scientific studies on the stratospheric and tropospheric ozone

Scientific and experimental studies related to the investigation of the current state of stratospheric and atmospheric ozone in the Republic of Uzbekistan are carried out at the Research Hydrometeorological Institute of Uzgidromet at the Laboratory of Ozonosphere and Ionosphere Studies and at the Department of Studies and Forecasting of the Environment Pollution.

The conducted studies are aimed to the solution of the following tasks:

- to analyze the available information by the results of parallel measurements of stratospheric and tropospheric ozone to reveal their relationship, evaluation of the stratospheric ozone effect on the surface ozone concentration;
- to study the possible mechanisms of the ozone transfer from stratosphere to troposphere;
- to find out the main mechanisms of the ozone formation in the polluted atmosphere of the urbanized territories and the role of precursors;
- to develop regional models of the ozone formation, of its spatial-time distribution, flow in the conditions of rough orography and arid climate;
- to analyze the state of the measuring network of tropospheric and stratospheric ozone, work out a programme for the measuring network updating;
- to work out a methodology for the evaluation of the zone effect on the surface vegetation; to carry out experimental studies of the surface ozone concentrations on the localities between the settlements; elaboration of standard for the atmospheric pollution by ozone for the surface vegetation.

Main results

As it was mentioned before, for I, II point the data base was built up by the results of measurements of stratospheric and tropospheric ozone and precursors of the ozone formation. Statistical analysis of the obtained information allowed revealing the relationships between the surface and stratospheric ozone and Wolf numbers. The reference days when stratospheric ozone has undergone the extreme variations were found out. The method of the epoch's superposition in relation to the reference dates was applied to the Wolf' numbers. Thus, the situation on the Sun when stratospheric ozone has undergone an extreme sudden increase or decrease of concentrations was defined. On Figure 1 the upper curve corresponds to the positive sudden increase of TOC, while the lower one – to the extreme sudden decrease of TOC values. Table 1 presents the statistical parameters of the both groups along the columns. Despite the substantial discrepancy of statistic data the positive extreme increase of TOC values follow the enhancement of the solar activity while the minimum value of the ozone layer density in stratosphere

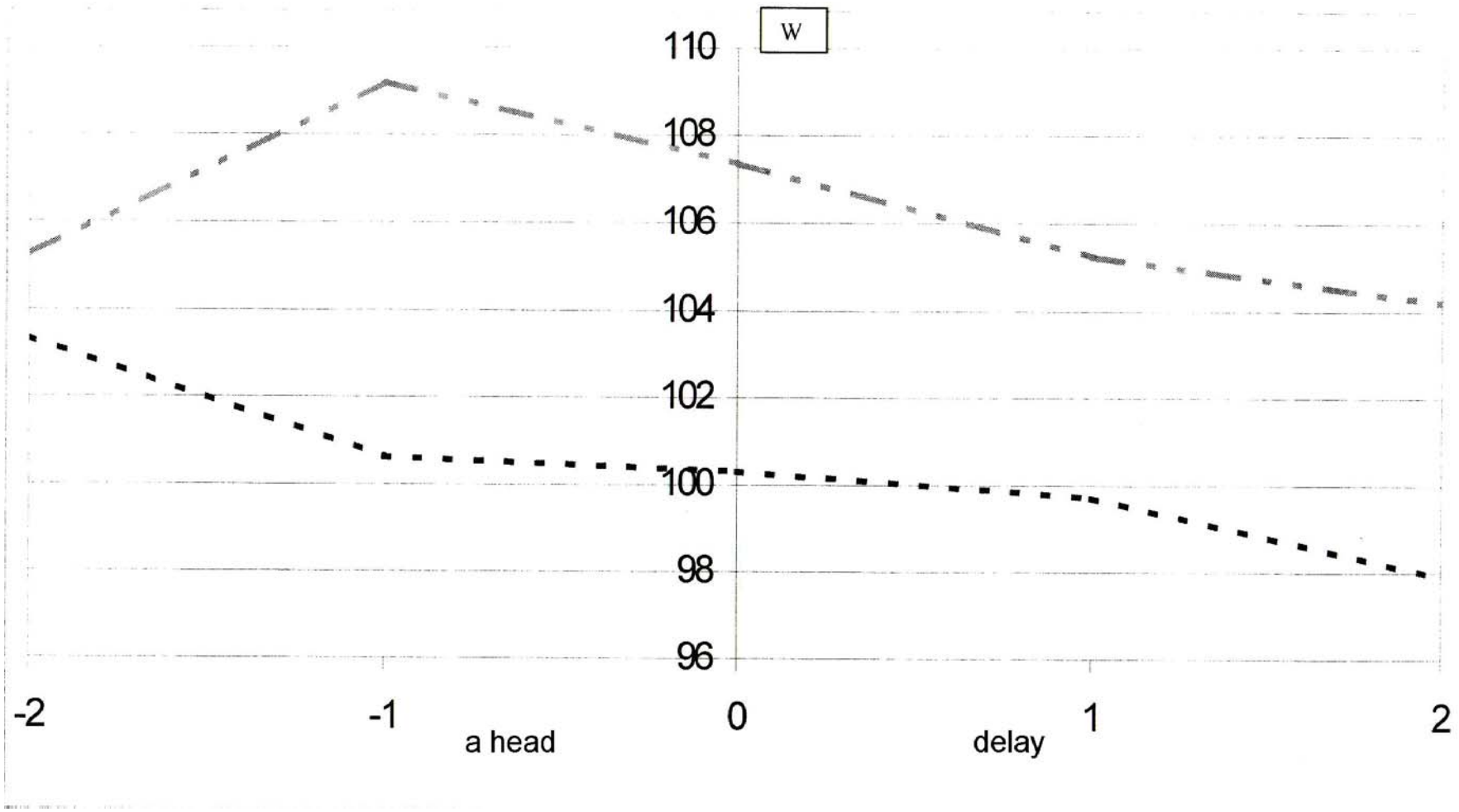
corresponds the lower spot number on the Solar disk. The both processes are about 24 h ahead the phenomena in stratosphere. The obtained result does not contradict the theoretical outlook on the nature of stratospheric ozone formation.

Let's consider now the surface ozone and try to derive the relationship between the surface ozone and, consequently, the flow of the solar UV-rays. The mean annual values of the Wolf's numbers and the averaged O_3 values measured at Tashkent, Chirchik, Almalyk, Angren, Bekabad and Fergana stations were used. Figure 2 presents the correlation of these parameters. The density of the average monthly ozone values over the region is inversely proportional to the Wolf's numbers and, consequently, to the flow of UV-rays. If this is right, then it is rather difficult to suppose that the surface ozone component is formed, mainly due to photochemical reactions in the polluted atmosphere.

In the course of investigation of the assessment of the tropospheric ozone effect onto the surface vegetation the important results were obtained.

The results of the conducted studies have revealed the possible negative effect of the nitrogen and ozone oxides on physiology of the vegetative cell. The existence of the manifested inverse relationship between the concentration of photosynthesis pigments and NO_3^- content in vegetation fibers was detected. In this case NO_3^- is the precursor of the ozone formation in the polluted atmosphere.

The studies on the ozone effect on the surface vegetation carried out at the Department of Investigations and forecasting of the Environment Pollution of NIGMI enabled to set up the ecological standard for annual plants - EcoMAC мр = 0,061 μg/m^3, MACad (average daily)= 0,029 μg/m^3 at departmental level.



Upper curve – reference values were selected by maximum TOC.
Lower curve - reference values were selected by mimimum TOC.
Averaging period 1992-2002 y.

Figure 1: Averaged variations of the Wolf`s numbers in relation to reference dates.

Table 1: Main statistics of the Wolf`s number groups.

	W-grouping in relation to TOC maximum values					**W-grouping in relation to TOC minimum values**				
	-2	-1	0	1	2	-2	-1	0	1	2
Mean value	105,2439	109,1852	107,35	105,2375	104,1829	103,3387	100,6452	100,3175	99,70968	97,8871
Statistic error	8,829128	9,085569	9,298481	8,977296	8,610847	9,477992	9,587226	9,601769	9,603685	9,532518
Median	85,5	99	94	89	87,5	85	86	83	95	88,5
Mode	0	0	0	0	0	73	11	79	41	11
Statistic deviation	79,95115	81,77012	83,16814	80,29538	77,97453	74,62978	75,4899	76,21168	75,61949	75,05913
Dispersion	6392,187	6686,353	6916,939	6447,348	6080,028	5569,605	5698,724	5808,22	5718,308	5633,872
Excess	-0,62463	-0,702	-0,45132	-0,56785	-0,4001	-0,54635	-0,08934	0,034573	0,243303	-0,3959
Asymmetry	0,56543	0,525671	0,608251	0,592944	0,642886	0,661969	0,856455	0,810723	0,77459	0,677018
Interval	320	315	320	288	289	277	291	298	342	297
Minimum	0	0	0	0	0	11	11	0	0	0
Maximum	320	315	320	288	289	288	302	298	342	297
Sun	8630	8844	8588	8419	8543	6407	6240	6320	6182	6069
Calculation	82	81	80	80	82	62	62	63	62	62
	Ahead in days		Reference data	Delay in days		Ahead in days		Reference data	Delay in days	

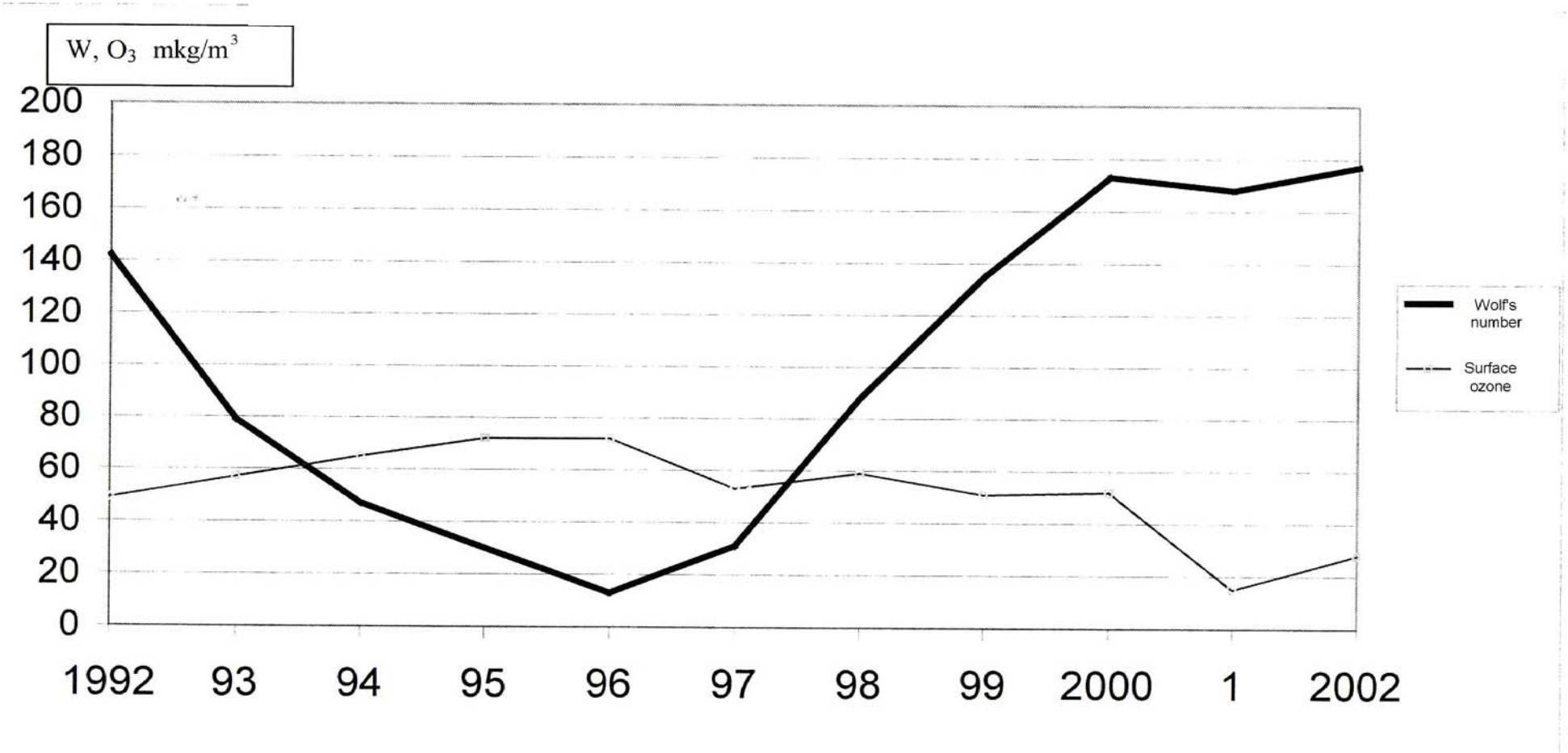


Figure 2: Comparison of the average annual Wolf`s number with the average of average monthly values by 6 stations of the region in 1992-2000 y.

Problems and needs of the ozone monitoring

The current level of scientific investigations implies the availability of the update equipment and instrumentation. However, under the present circumstances the instrumentation base does not meet the current needs. The filter ozone meters M-124 which are in use at the ozone monitoring stations of Uzbekistan are obsolete and out of date, besides they were not calibrated during many years and need to be calibrated. The last calibration of instruments was made in 1993. It is needed to have at least one Dobbson or Bruger spectrophotometer for the calibration of the network ozone meters.

For getting more comprehensive and reliable information on TOC it is required to extend the network of the regular daily observations which can be fulfilled with the relevant equipping of stations with the modern equipment and instrumentation and with the provision of financial support of international organizations.

Unfortunately, because of the absence of the relevant instruments we could not start the monitoring of solar UV-B radiation in parallel with TOC measurement as well as the cycle of activities designed at the experimental estimation of the reduction of the crop capacity of agricultural crops in relation to the increase of UV-B radiation.

Since January 2001 the station for satellite information receiving from NOAA satellites is in operation at Uzgidromet. It was supplied by USAID agency as humanitarian aid.

The problem urgent necessity is to carry out the training courses for the young specialists of the republic with the aim of practicing new technical means for the measurement of ozone and flow of UV-B rays, measurement of traces of halloid-hydrocarbons, studying of the new mathematical models linking the atmospheric chemistry and climate as well as training related to the issues of the forecasting of the ozone layer behaviour.

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