25PB2 LIDAR SENSING OF AEROSOL OPTICAL PARAMETERS IN LOWER TROPOSPHERE

Yu.S.Balin and I.A.Razenkov
Institute of Atmospheric Optics, Siberian Branch, Russian Academy of Sciences
1, Academichesky Ave., 634055, Tomsk, Russia
Tel.: (382 2) 258 607
E-mail (via RELCOM): zuev@iao.tomsk.su

The paper reports results obtained from ongoing lidar profiling of total scattering coefficients in the lower troposphere in April-June, 1993. The measurements were performed by means of the LOZA-3 aerosol scanning lidar complex.

LOZA-3 belongs in tracking system and provides spatial and angular resolutions of 7,5 m and 10 ang.min. The lidar was placed on a hill at the eastern boundary of Tomsk, so that sensing could be carried out both in the townward direction and counter - currently over forest tracts, which enabled us to assess the effect of industrial pollutants on the optical condition of the atmosphere. The measurements were made every two hours round the clock in the following manner. First the atmosphere was probed in the townward direction at elevation angles of 2, 15, 45 and 80 °. Then the measurement cycle was reiterated but in the opposite direction. Coordinates of the origin and subsequent measurements over all the atmospheric paths were controlled by the IBM PC AT.

In that way we recorded a total of 12 scattering coefficient profiles at altitudes between 0,05 and 2 km within 24 hours every 2 hours apart.

The lidar ceiling tended to increase up to an altitude of 5-7 km if clouds occurred. The resulting diurnal realizations were thereafter used to generate data arrays for monthly cycles. An aggregate of 700 vertical profiles of the total scattering coefficient were measured during the period under review.

Figure 1 illustrates a general trend of behavior of the scattering coefficient as derived from the measurement cycle in May, 1993. A special computer code designed for data processing and filing makes it possible to obtain information on the vertical profile of the scattering coefficient for any date of interest (the right-hand side of Figure 1) and its time distribution at any altitude, day after day within a month. This is achieved by moving the cursor in the horizontal and vertical directions.

By way of example, at the bottom of Figure 1 we present time variation of the scattering coefficient at an altitude of 210 m. The vertical profile corresponds to the measurements made on May 2, 1993, 19:00 hours local time. The average monthly variation of vertical distributions up to 1000 m in May, 1993 is shown in Figure 2. The curves demonstrate distinct division of the atmosphere into altitude regions, each characterized by its own vertical profile of the scattering coefficient. The highest gradient is observed in the lowermost atmospheric layer 150 m thick, as expected. Farther, up to an altitude of ~300m the scattering coefficient is virtually invariable with height. Then it exhibits a smooth fall down to minimal values.

Analysis of the general time history of the monthly averaged diurnal variation of the scattering coefficient shows that it is at a minimum in the morning, generally around 5 a.m.. The atmospheric turbidity peaks as early as 11 a.m. and persists till 9 p.m.. The same conclusion can be arrived at by analyzing evidence from concurrent ground - based photometric measurements. The dynamic variation of the scattering properties of the boundary atmospheric layer is generally observed at altitudes ranging from 400-600 m.

The results obtained from statistical spectral analysis are reported. They provide characteristic scales of the time variation of the optical properties of the atmosphere, starting with diurnal cycles, as functions of the type of atmospheric circulation and present weather conditions.

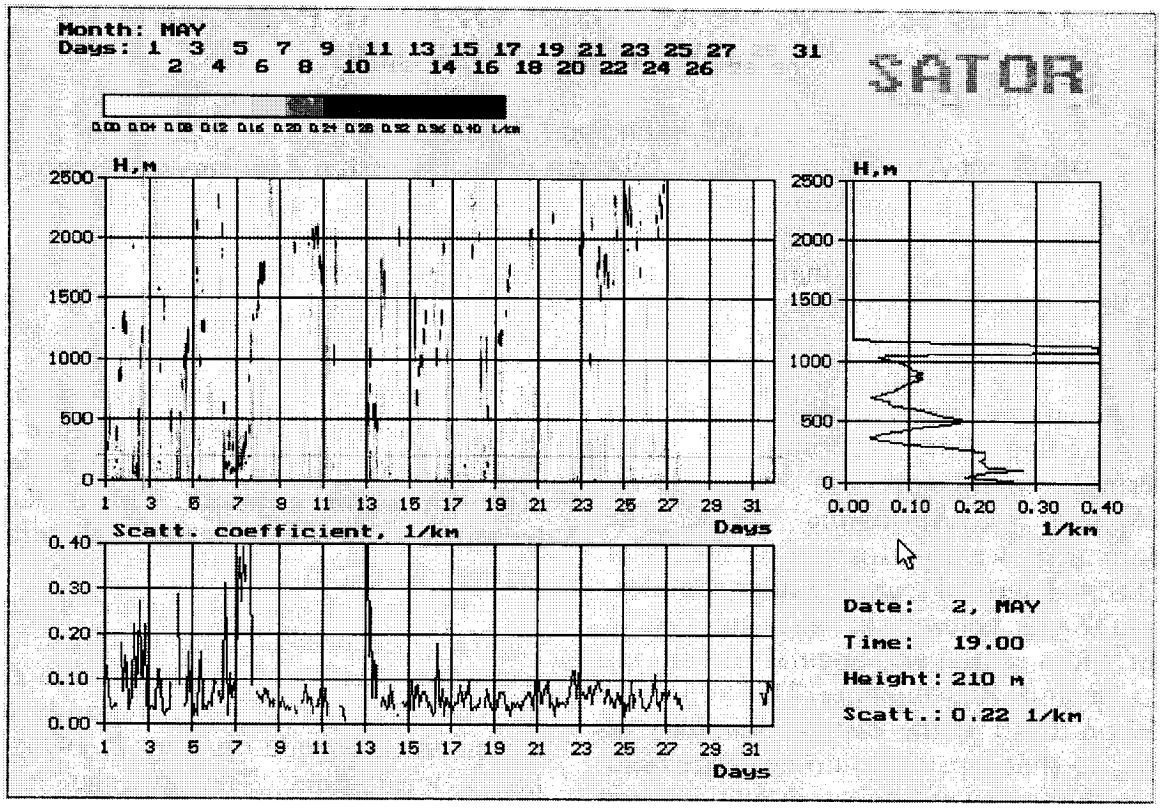
Month: MAY
Days: 1 3 5 7 9 11 13 15 17 19 21 23 25 27 31
2 4 6 8 10 14 16 18 20 22 24 26
SATOR
H,m
Scatt. coefficient, 1/km
Days
1/km
Date: 2, MAY
Time: 19.00
Height: 210 m
Scatt.: 0.22 1/km

Fig. 1

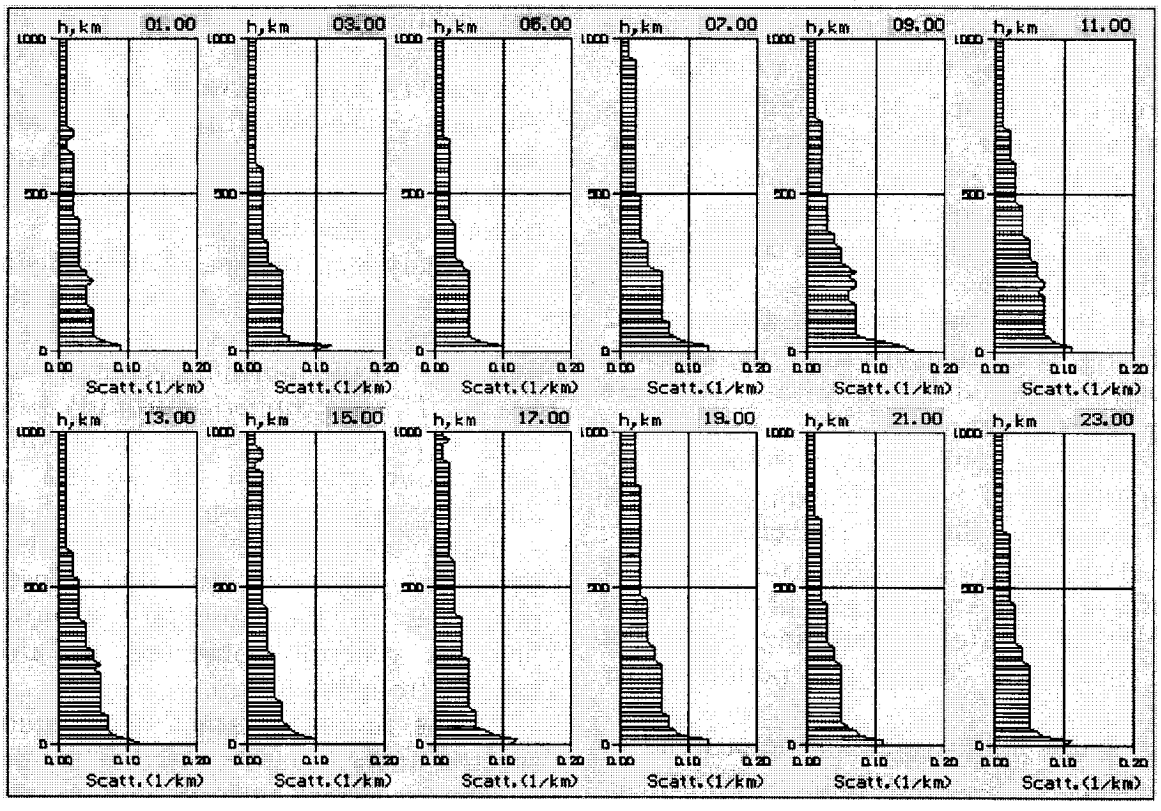
h,km
01.00
03.00
05.00
07.00
09.00
11.00
13.00
15.00
17.00
19.00
21.00
23.00
Scatt.(1/km)

Fig. 2