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INVESTIGATIONS OF CLOUDS OF THE SIBERIAN REGION AS PART OF THE ECLIPS PROGRAM

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The ECLIPS experiment has been performed for serial years aimed at subsatellite support of the International Satellite Cloud Climatology Program. We performed an independent experiment in the ECLIPS data format to ensure our readiness to future synchronous experiment with lidars that will be used onboard ENDEAVOR and MIR. In Addition, ALMAZ pilotless space station with onboard lidar will be launched in Russia.

In our experiments we employed MAKREL'-2 and M2M airborne lidars[1,2]. Their design allow us to perform ground-based measurements as well. Identical lasers operating at a wavelength of 532 nm with pulse energy up to 30- 50mJ are used in these lidars. The first lidar has a receiving telescope 0.15m in diameter and is capable of simultaneous measuring two polarization components of lidar return signal. The second lidar is capable of measuring the polarization components in series. The diameter of the objective of its receiving telescope is equal to 0.2 m. Data recording systems are identical and include 7-bit ADC with data sampling frequency up to 100 MHz. When the ECLIPS program will be implemented, standard radiometers of optical range and an all-sky camera[3] , being capable of operating 24 hours a day, will operate simultaneously with the lidar.

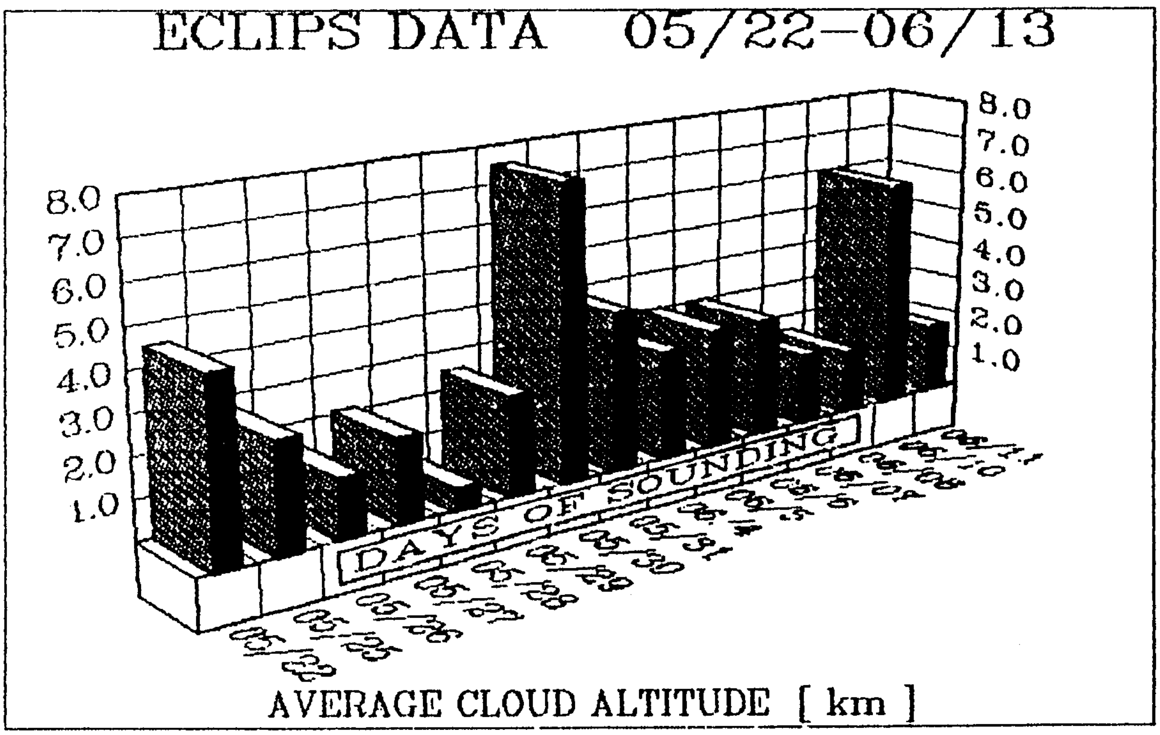

Fig. 1

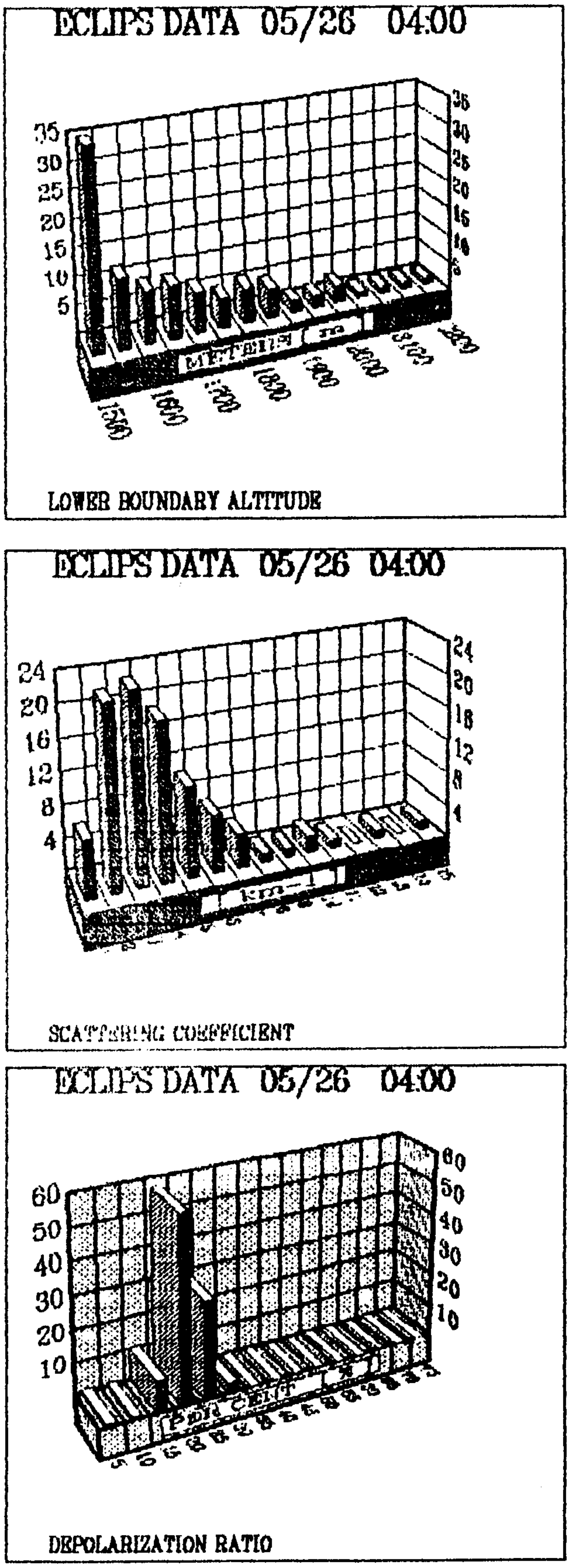
ECLIPS DATA 05/26 04:00
35 30 25 20 15 10 5
METERS
1500 1600 1700 1800 1900 2000
LOWER BOUNDARY ALTITUDE
ECLIPS DATA 05/26 04:00
24 20 16 12 8 4
km-1
SCATTERING COEFFICIENT
ECLIPS DATA 05/26 04:00
60 50 40 30 20 10
PER CENT
DEPOLARIZATION RATIO

Fig.2

The degree of linear depolarization $\delta(r)$ was defined as the ratio of the cross polarized component $F(r)$ to the polarized component $F(r)$ of lidar return. In accordance with Ref.4, the scattering coefficient $\sigma(r)$ was defined by the formula

$$\sigma(r) = F_1(r) / 2 \int_{r}^{r_{max}} F_1(x) x^2 \, dx . \qquad (1)$$

Here r_{max} is the maximum range from which we recorde the signal. In the present paper we calculated the average scattering coefficient to analyze a cloud state. The average scattering coefficient was derived from Eq.(1) by averaging $\sigma(r)$ over the cloud depth from the time of signal arrival to the time at which the signal reached its peak value. The latter was taken as a lower cloud boundary altitude, although it was calculated with the use of the other criteria[4].

As expected, the cloud characteristics are widely varied. They can hardly be predicted and therefore must be measured *in situ* in the subsatellite experiments. As an example, Fig.1 shows the altitudes of the lower cloud boundary (ALCB) observed over the period of 21 summer days. Each measurement was daily averaged.

From this figure it can be seen that the ALCB increases above 4 km for three days. Moreover, the process of increase is periodic in character. Most likely such a behavior is occasional.

Figure 2 illustrates the behavior of the ALCB in more datail on May 26 at 4 a.m. The altitude of the LCB was 1500 m and had asymmetric distribution . The scattering coefficient $\sigma = 4$ km^{-1} in 22 % of all cases, and had asymmetric distribution up to $\sigma = 18$ km^{-1}. The depolarization ratio $\delta = 0.25$ in 50% of all cases but it had a narrow distribution.

We restrict our consideration with the above figures. It can be only mentioned that at 9 a.m. of the same day the ACLB was 600 m and remained practically constant. The distribution of σ had two maxima of 3 and 9 km^{-1}, while $\delta = 0.06$ and had asymmetric distribution up to $\delta = 0.2$.

At 1 p.m. the ACLB was uniformly distributed within the 900-1400 m altitude range, the values of σ and δ were almost constant and equal to 2 km^{-1} and 0.05, respectively. In winter we observed long cyclonic periods in Western Siberia ,and the ACLB did not reveal such sharp changes .

In conclusion an important contribution of the ECLIPS experiment to the development of routine cloud sounding should be declared, even degressing on its subsatellite application.

REFERENCES

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