# C-7-4 RADIOMETRIC ATTENUATION MEASUREMENTS AT WAVELENGTH OF 4,1 MM IN THE EARTH'S ATMOSPHERE BY EMISSION

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There are much enough experimental works on millimtre wave vertical molecular absorption in the earth's atmosphere [1] . There are also several measurements of attenuation in clouds and rains at wavelengths of $\lambda$=8,2 mm [2-4] , 4,1 mm [2-3] , 3,2 mm [4-8] and 1,3 mm [9] .

We had carried out vertical attenuation in clouds and precipitation by emission of the atmosphere at $\lambda$= 4,1 mm in Gorki district in different seasous of 1976-1977 during about 90 days.

The observations were made by using the superheterodyne radiometer with bandwidth 30 MHz and sensitivity 4 K for integration time 1 s. The rectangular horn of sizes 54x540 mm$^2$ served as receiving antenna. The zenith angle scanning was made by rotating plane metal reflector of sizes 2x2 m$^2$ placed at distance 6 m and covering all the antenna pattern. The black bodies at temperatures of liquid nitrogen and room air were used for calibration. The measurement aqquracy about 10%.

In the case of continuous cloudness the vertical attenua tion was measured by the well known zenith scanning method. The attenuation in clouds was determined by retraction the vertical molecular absorption from the total measured attenua tion. The molecular absorption was calculated according to relation (7) of work [10] .

In the case of discontinous cloudness the attenuation was determined by expression:

$$\Gamma(dB) = 4,34\ \ln \frac{T_0 - T_b^{(1)}}{T_0 - T_b^{(2)}} ,$$

where $T_b^{(2)}$ and $T_b^{(1)}$ - brightness temperatures of clear sky and cloud respectively for the tame zenith angle. Such method was applied also for the measurements of attenuation in rains and snowfalls.

Type and power of clouds were fixed by the eye and the cloud classification atlas. The rainfall rate was measured by altered standard pluviograph P-2 with higher rainfall rate and time resolutions.

Influence of scattering on measured rain attenuation was taken into consideration according to the results of calculations made in work [11] .

The results of cloud attenuation measurements at $\lambda$=4,1 mm are given in Fig.1.

The vertical maximum attenuation in clouds in summer reached 3÷5 dB only in the cases of cumulus congestus and stratus cumulus clouds. In winter attenuation was considerably lower and did not exceed 1 dB. It can be explained by absence of power developed clouds and by cloud ice particles in winter time. Simultaneously measured attenuation in cumulus clouds at $\lambda$=1,3 mm was 3÷4 times higher than at

$\lambda$=4,1 mm and reached 10÷12 dB.

The experimental dependence of the vertical rain attenuation $\Gamma_{\tau}$ (dB) on rainfall rate $J$ is given in Fig.2. The dotted line is the result of calculations for the effective thickness of rain layer 1 km. The snowfall attenuation reached some times the same values about 3 dB as in rain.

The cumulative probability distributions of the vertical attenuation at $\lambda$=4,1 mm for all attenuation effects are given in Fig.3 for the total abservation time of 680 h in all seasous of year (solid curve) and for the winter observation time 320 h (dotted curve). The values on ordinate axis correspond to time in percents when the vertical attenuation is equal or exeeds the value determined by abscissa axis. One can see from Fig.3 that the maximum attenuation 9 dB was observed during 0,01% of time and that in winter the attenuation is smaller and its probability is lower.

## REFERENCES


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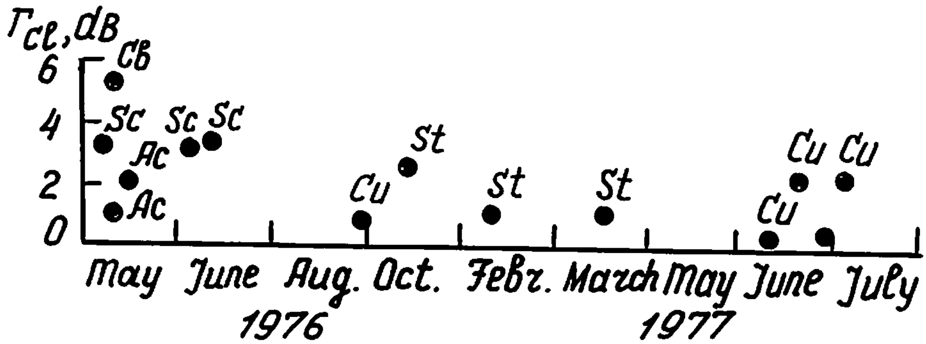


Fig.1..

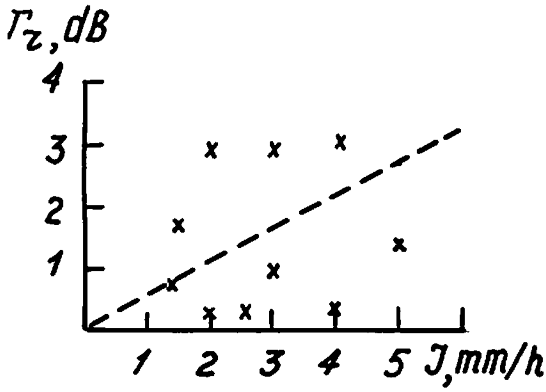


Fig.2.

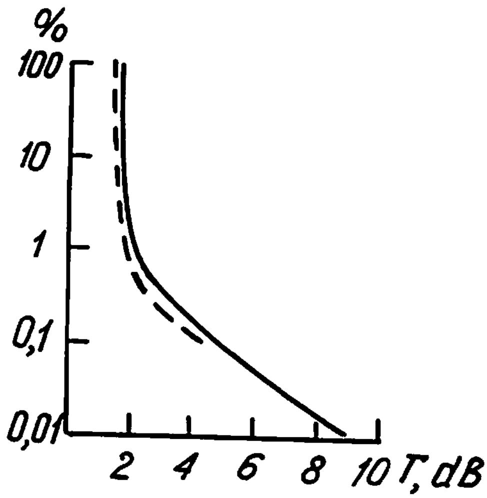


Fig.3.