CHARACTERISTICS OF RAPID FADINGS ON THE TROPOSPHERE PATHS IN EXTREME CLIMATIC CONDITIONS

D.D.Darizhapov, G.S.Zhamsuyeva, D.Z.Tsidipov,

N.B.Chimitdorzhiyev

(Institute of Natural Sciences, Ulan-Ude, USSR)

The report presents the results of a researsh of statistic characteristics of rapid fadings of a signal on two paths of troposcattering microwaves situated in the central Yakutia. The report considers such characteristics of a signal fluctuations as depth and duration of rapid fadings. In conditions of a sharply continental climate it has been revealed that in winter on the investigated paths the depth of rapid fadings is less and the duration of rapid fadings is greater than in other seasons of a year.

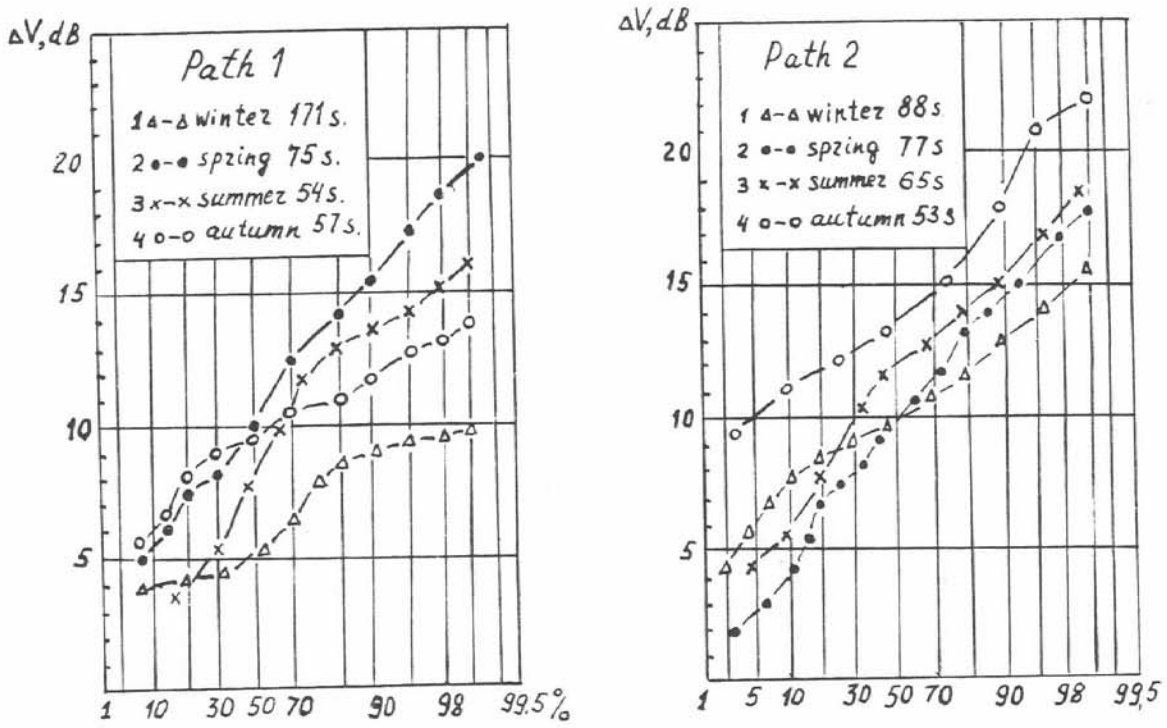
It is known that a phenomenon of troposcattering microwaves is characterized by rapid and slow fadings of signals. The division of fadings into rapid and slow ones is rather conditional and it is connected with the fact that a signal in troposcattering represent a nonstationary stochastic process. By rapid fadings are meant fluctuations of instant value of signal revels analysed for such periods of time, during which an average value of signals practically has no changes. Experimental study of characteristics of rapid fadings in different regions of the globe is of great interest both for finding out the mechanism of troposcattering far over the horizon and for engineering applications.

For this purpose the measurements of signal levels were made on two tropospheric radio paths with a general reception point located in the extreme climatic region with a charply continental climate /Central Yakutia/. The wave length of transmitters was equal to 36 cm. Equivalent length of path 1 is equal to 160 km, path 2 is equal to 290 km. Scattering angles within these intervals at a normal refraction are correspondingly equal to 19 milliradians and 34 milliradians. Both path run over poorly rugged forest - tundra. Profiles of the paths, the equipment used and methods of measuring signal levels were described in /1/. This work also describes seasonal and day and night variations of slow fadings of a signal. It was found out that in conditions of a sharply continental climate values of level signals of troposcatter, observed in winter, exceeded level signals in other seasons of a year. And a seasonal variation of signal levels as refractivity gradient of troposphere have two maximums in winter and in summer, and two minimums in spring and in autumn. Now let us consider characteristics of rapid fadings on these paths. The recording of instant values of a radio signal was made by sessions from 5 to 50 minutes, 8 times a day. The time interval of a session of recording rapid fading was taken accor-

ding to the character of fluctuations and it was enough to contain some dozens of autocorrelation radii. Time constant of recording a signal was 50 msec.

Characteristics of depth of rapid fadings

Figures 1a,b give distributions of depth of rapid fluctuations $V_{90\%}/V_{10\%}$, constructed separately according to the seasons of a year from the ensemble of distributions of the amplitudes of rapid fadings of every session of recording. The curves show that depth distributions of rapid fadings on the investigated paths are characterized by different seasonal dependencies.

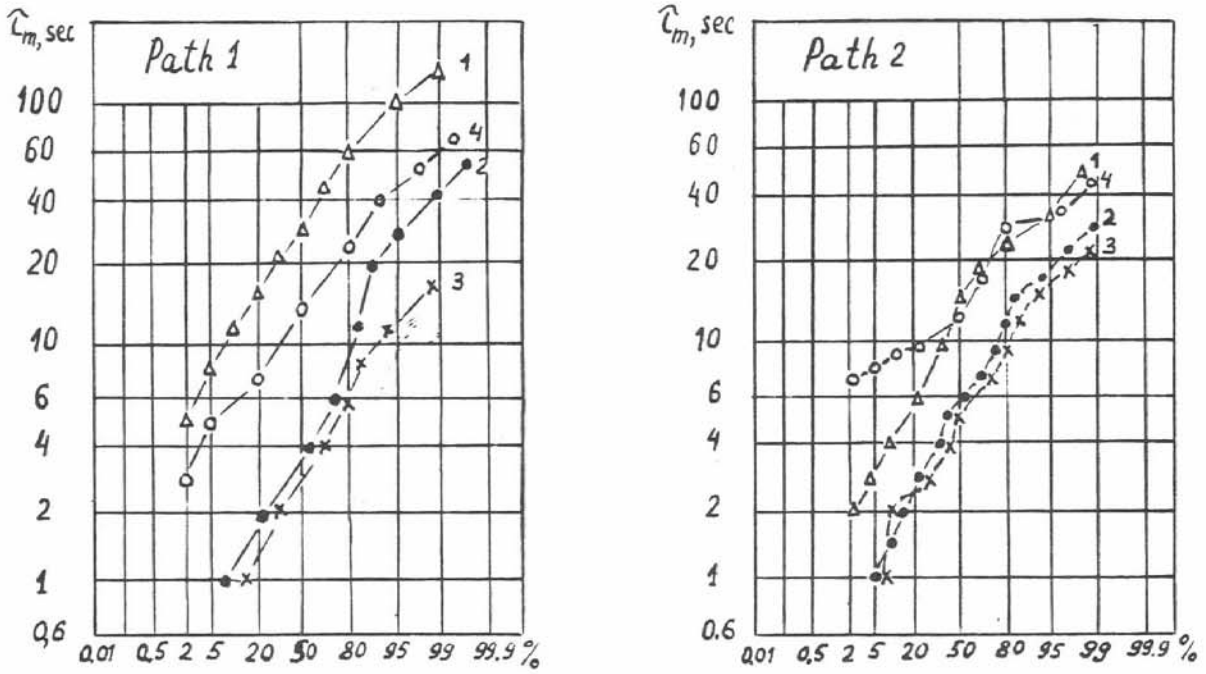


On path 1 the amplitude of seasonal variations of the depth of rapid fadings on the median level exceeds noticeably the amplitude of seasonal variations of the depth on path 2. In the same accordance is a dispersion σ of distributions for every season, i.e. σ on path I exceeds σ on path 2. Marked peculiarities are due to the difference of paths in length. On shorter path I a radio signal fluctuations are formed at the expense of troposphere volume, in which inhomogeneities according to intensity and scale are more variable due to closer location to the land surface.
Figures 1a,b also show that on the investigated paths in winter the depth of rapid fadings on the median level is the least one in other seasons of a year. For comparison let us mark that the depth of rapid fadings in winter is slightly more than in summer on analogous troposcatter lines in moderate climatic regions /2/.

The comparison of experimental distributions with Rayleigh law showed that signal fadings were observed mainly in winter. The range of these signal fadings was less than 13,4dB. That value was typical of Rayleigh law. At that time of a year increased the coherent component of a signal.
In other seasons of a year we could frequently observe signal fadings, the depth of which exceeded the depth of Rayleigh law of fadings. Such situation arises when there is an interference of two or three waves, having approximately equal amplitudes and regularly distributed phases in the interval $0 + 2\pi$.

Characteristics of duration of rapid fadings

Figures 2a,b presented integral distributions of median values of duration of rapid fadings determined from every recording session of instant values of a signal on the investigated paths of troposphere.



These distributions were constructed separately for every season of a year. Figures 2a,b show that in winter the duration of rapid fadings (τ_m) considerably exceeds τ_m in other seasons of a year. The amplitude of seasonal variations of a median durations on path I considerably exceeds the amplitude of seasonal variations on path 2. The increase of fading durations in winter on both paths is due to the effect of anticyclone conditions as well as in sharply continental conditions of middle latitudes. At that period atmosphere masses of the air are characterized by weak mobility and inertness of the processes /3/. In conditions of a moderate climate one can find out a small tendency of increasing duration of fadings in summer.
The analysis of day and night variations of duration of rapid

fadings shows that τ takes the greatest values at night and morning hours. It is connected with the fact that at that hours increase refraction and reflection from stratified inhomogeneities. In the daytime duration of rapid fluctuations decreases due to the destruction of stratified inhomogenieties. At that time fadings were due to the interference of waves, scattered on turbulent inhomogeneities.

Conclusion

In conclusion we mark that in winter on the paths located in the regions with a sharply continental climate, the depth of rapid fadings is less and the duration of rapid fadings is greater than in other seasons of a year. In conditions of a moderate climate a contrary picture is found out /2/.

Literature

1. Troposcatter of microwaves in extreme climatic conditions /In the book 8th International symposium on EMC, Wroclaw, 1986, part II, p.309-316.
2. A.A.Shur Characteristics of a signal on troposphere radiolines. - Moscow, Svyaz, 1972.
3. A.A.Borisov Climates of the USSR. Moscow, Prosveschenie, 1967.