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Effects Of Tropospheric Turbulence On Radio Signal Data Passing Atmospheric Communication Links

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In this work, we analyze the effects of turbulent structures - small, moderate, and large, on the parameter of the refractive index and, via this parameter, on the index of scintillation of the radio wave passing atmospheric channels with fading [1]. Relations between these parameters are analyzed and discussed for conditions of weak turbulences, as well for experimentally observed cases of moderate and strong turbulences occurring in the middle latitude troposphere [2, 3]. By using relation between the scintillation index of signal intensity and the well-known Rician K-parameter of fast fading, and by obtaining the relations between signal data stream parameters, i.e., capacity, spectral efficiency, bit-error-rate (BER), and K-factor of fast fading, we numerically analyze various situations of data sent via tropospheric communication links with fading accounting for various effects of weak, moderate and strong turbulences on quality of transmitting various data within such communication links.

We determine the functional relationship between the scintillation index σ_I^2 and the K-parameter of fading, considered strong turbulences, and determine and present data parameters [4] for small, medium, and strong turbulence. We consider the HF-band (for long-range ionospheric propagation) and UHF-band (for satellite communications), identify and compare the influence of the atmosphere on wave's propagation in such frequency bands. As the result, we show the dependence of data parameters on the carrier frequency and compare these parameters for the HF and UHF bands. We conclude that fading phenomena caused by atmospheric turbulence on radio wave propagation is not less important than the influence of precipitation in predicting of operational parameters of atmospheric links.

References

[1] S.R. Saunders, *Antennas and Propagation for Wireless Communication Systems*, Chichester, Wiley, 2001.

[2] [2] S. Bendersky, S., N. Kopeika and N. Blaustein, "Prediction and modeling of line-of-sight bending near ground level for long atmospheric paths," *Proc. of SPIE Int. Conf.*, San Dieg, August 3-8, 2004, pp. **512-522**.

[3] N. Blaunstein and C. Christodoulou, *Radio Propagation and Adaptive Antennas for Wireless Communication Networks: Terrestrial, Atmospheric and Ionospheric*, Wiley InterScience, NJ, 2014.

[4] N. Blaunstein and Y. Ben-Shimol, *Advanced Technologies and Wireless Networks Beyond 4G*, Wiley, Hoboken, NJ, 2020.