LETTERS TO THE EDITOR

DAYTIME ATTENUATION RATES IN THE VLF AS A FUNCTION OF AZIMUTH USING ATMOSPHERICS

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The study of the propagation of very low frequency radio waves over distances lying between 1000 to 4000 km will provide valuable information regarding the propagation characteristics of such waves and physical properties of the reflecting walls of the earth-ionosphere waveguide. Many workers[1,2,3] have theoretically shown that non-reciprocity in attenuation exists in the east-west and west-east directions and reciprocity along north-south and south-north directions. The attentuation propagated from east is higher than that of west. Taylor[4] has experimentally determined the attentuation rates in east-west and west-east directions during daytime in the VLF band, using atmospherics by "two station method". Harth[3] extended the calculations of Wait and Spies[5] for evaluating the attenuation under dominant mode propagation conditions during daytime in the range 5-11 kHz as a function of Ω (earth's magnetic field parameter which depends upon the direction of propagation). The night time attenuation rates in the range 5-11 kHz have already been reported[6] by authors. In this communication the authors deduced the attenuation rates from the spectral study of atmospherics during daytime received from different azimuth angles and compared with the theoretical values of Harth.

The experimental techniques and method of calculations of various parameters of atmospherics were published elsewhere by the authors[6,7,8]. Four hundred wave forms of atmospherics used for the present analysis form a part of observation taken at daytime during March, 1976 to March, 1977 at Waltair.

Wait[9] has given the propagation equation of atmospherics as

$$E_a = \frac{E_0 \times 0\cdot4 \times 10^{\frac{-Ad}{2\times10^4}}}{\sqrt{d.f.}}\,; \quad 1000 \leq d \leq 8000 \text{ km}$$

where d is the distance in km, E_0 the effective radiated field at one mile from the source v/m, f the frequency in kHz and A the attenuation factor in db/1000 km.

From the spectral analysis of atmospheric wave forms during the daytime, the absolute attentuation rates have been determined by using equation (1). To evaluate the absolute values of attentuation factors, we must know the value of the frequency corresponding to maximum amplitude in the received, spectrum source spectrum at that particular frequency and the distance of origin of the atmospherics. By using the values[6] of the source spectrum and by trial and error method the attenuation rates during daytime have been determined.

The variation of attenuation factor with direction of arrival at different frequency is shown in Fig. 1. The attenuation rates in the frequency range 6–11 kHz obtained by authors as a function of azimuth are compared with the theoretical values at Waltair which are deduced from the theoretical values of Harth. The experimental and theoretical values have similar variation except for a slight deviation in the magnitude. This might be due to the conductivity of the earth. Attenuation rates during daytime are higher than

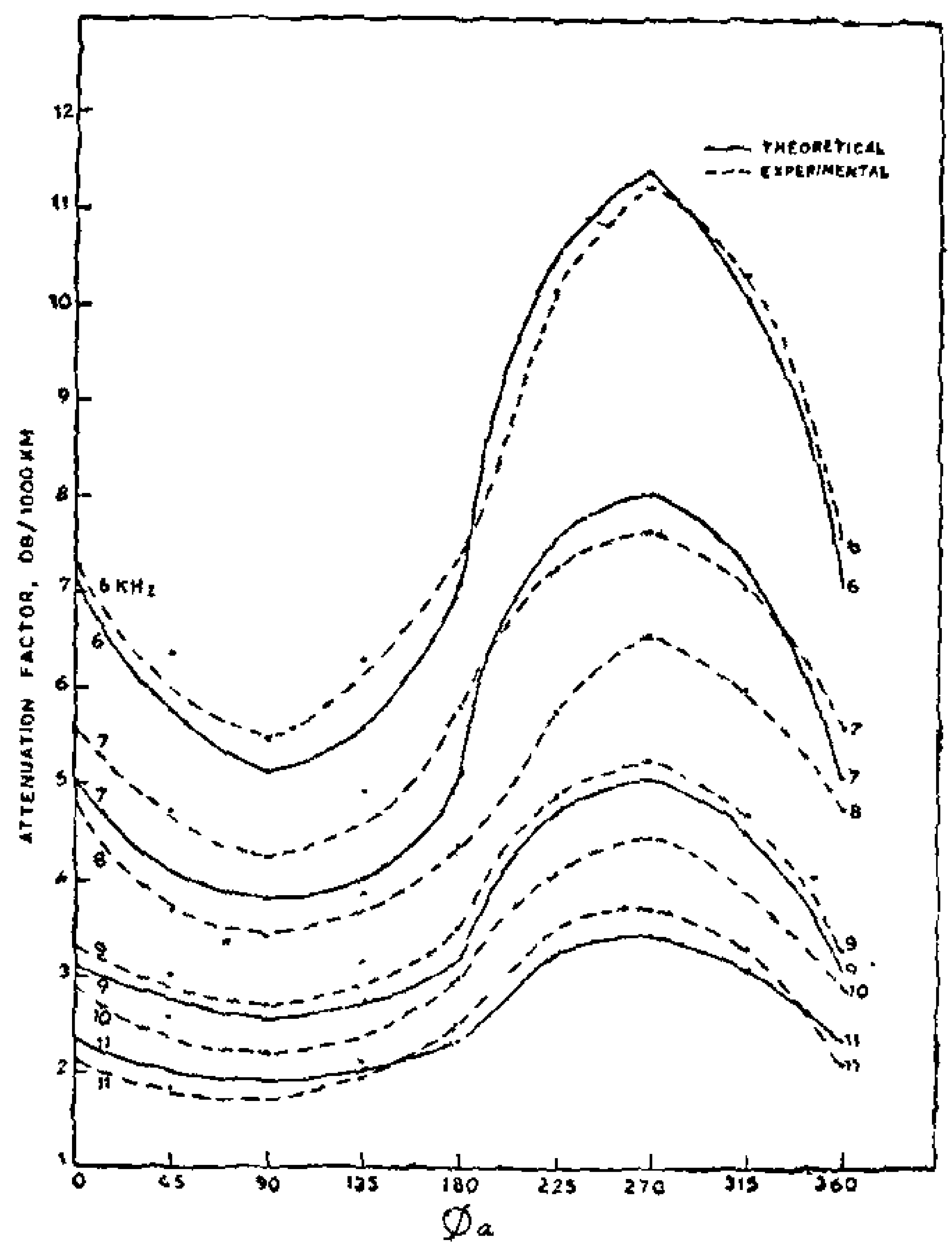

Fig. 1. Variation of attenuation factor with azimuth ϕ_a at different frequencies.