

FIELD MEASUREMENTS OF ATTENUATION
OF MICROWAVES BY DUSTSTORMS

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ABSTRACT

Observations of microwave signal level on 45Km, 6GHz and 6Km, 11GHz links in South of Iraq were made together with meteorological data using two meteorological stations and radio-Sonde data. The results indicate that attenuation due to duststorms with visibilities down to 600m is negligible compared with the deep fading due to multipath phenomena common in this area.

1. INTRODUCTION

The effects of duststorms on microwave propagation have been recently the subject of several investigations [1]. Most workers obtained attenuation in terms of permittivity, particle size distribution, particle size and shape. The general conclusion was that except for very dense and humid storms, attenuation by duststorms does not represent a serious problem for communication systems operating at frequencies below 10 GHz. However, an actual field measurement on a 45.5Km, 11 GHz link in Iraq was performed in 1979 by Al-Hafid et al [2]. They reported fading of 10-15 dB lasting 150 minutes and 26 dB lasting 40 minutes during duststorms of 6-10Km visibility. Such deep fading for a slight duststorm can not be accounted for. More recently, in 1987 Ghobrial et al [3] reported a field experiment in Sudan on 18Km, 2GHz and 20Km, 7.5GHz links. He observed negligible attenuation of less than 0.5 dB for less than 200m visibility. In this paper, a field experiment in the south of Iraq on a 45Km, 6GHz and 6Km, 11 GHz links is reported. The location of these links is near that of Al-Hafid et al [2]. Only small values of attenuation were observed during duststorms of visibilities down to 600m. Deep fadings due to multipath were a common occurrence.

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2. DESCRIPTION OF THE EXPERIMENT

The present experiment was made on two microwave links in the south of Iraq. The first one is between Basrah exchange and Nukhaila to the north. It operates at 6GHz and has a length of 45Km. It is mostly through desert except for few kilometers near Basrah city. The second link of 6Km 11GHz is in Basrah urban central area linking Basrah exchange to the T.V. transmitter station. Both links use linear polarization. Signal recordings were made using dual channel recorders with a sensitivity range 10-100mv. The recording equipment was calibrated as in Fig.1 to facilitate direct recording of instantaneous signal level in this range which is within the dynamic receiver range. Recording speed was set to 60mm/hour. Meteorological data were collected by two meteorological stations, the first is midway on the 6GHz link and the second is near T.V. transmitter station. Also, twice daily radio-sonde data were made available.

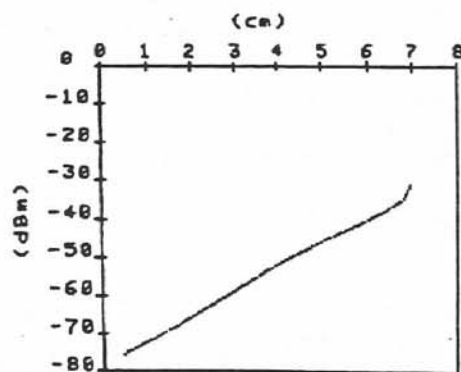


Fig.(1) Calibration Curve

3. RESULTS

The received signals were recorded continuously from 4th September up to 24th October 1988. Several duststorms with visibilities down to 600m occurred within the period of recording. Analysis of signal level recordings indicated the followings:-

- 1- The observation on the 11GHz link indicated conclusively that duststorms with visibilities more than 600m do not produce measureable attenuation. For example, Fig.2 shows signal level before and during a duststorm that occurred on 10th Sept. 1988. Minimum visibility recorded was 0.8Km at 1220.
- 2- Signal level recordings on the 6GHz link together with the meteorological data for the 50 days period indicated that several fading mechanisms are present. Surface ducts are common. Multipath due to sharp variations of refractive index with height is present most of the time. A typical signal recording before and during a duststorm is shown in Fig.3. It is seen that during the duststorm sharp fading of the signal is reduced. This may be due to better air-mixing accompanying the storm leading to less

favourable conditions for occurrence of multipath phenomena. Fig.4 shows the measured distribution of attenuation due to duststorms on the 6GHz link for the period of the recording.

4. DISCUSSION

Signal recordings of the 11GHz link during duststorms with visibilities down to 600m did not produce measurable attenuation. This is possibly due to the length of link being too short. The storm covers the entire path and the whole medium becomes homogeneous reducing multipath events to a minimum. The results of 50 days signal recordings on the 6GHz link shows that attenuation due to duststorms is generally in agreement with published results. This experiment performed in the same area as that of Al-Hafid et al [2] confirms that the deep fadings they reported were possibly not due to duststorms but due to multipath phenomena which is found to be very common in this area.

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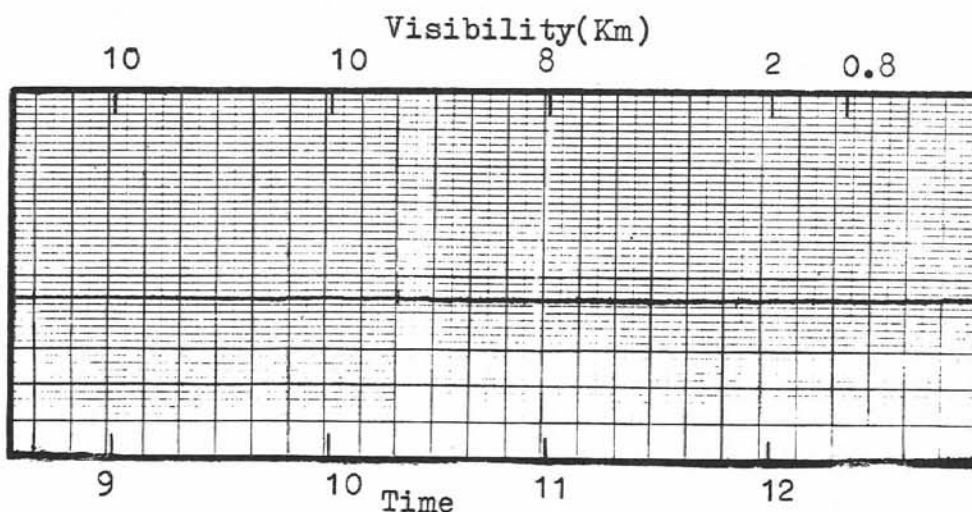
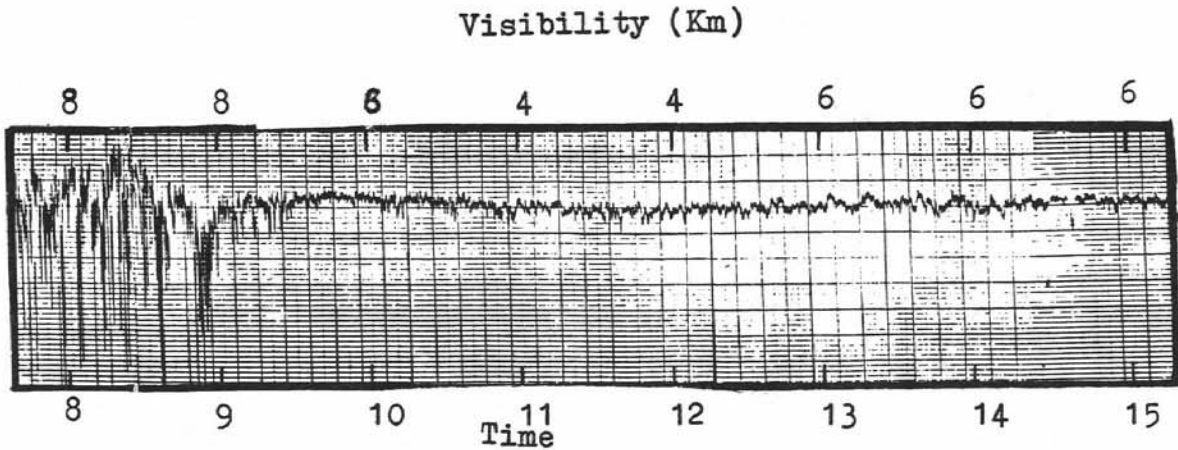
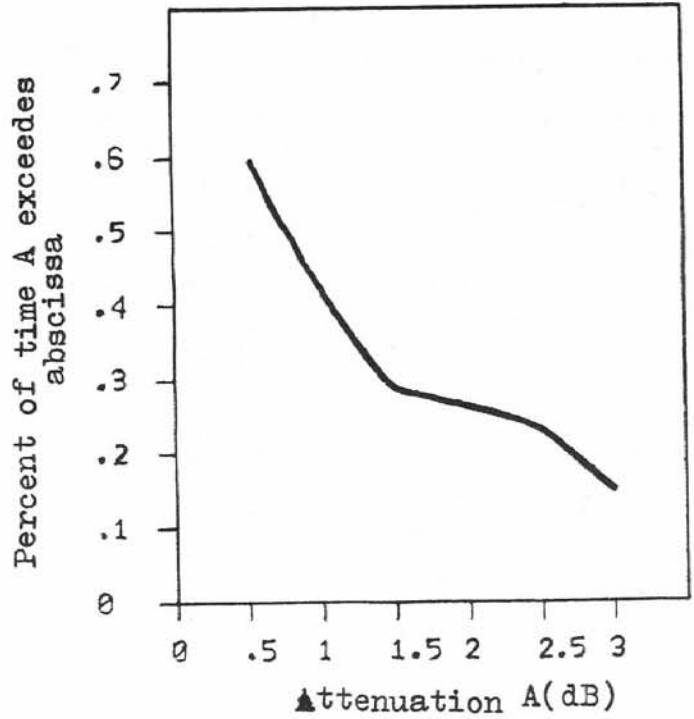


Fig.(2)signal level variations on the 11GHz Basrah.Ex-T.V link on 10th Sept.1988.



Fig(3) Signal level variations on the 6GHz Basrah.Ex-NKL link on the 12th Oct.1988.



Fig(4) Percentage of time attenuation A(dB) was exceeded due to dust storm at 6GHz for 45Km link. For the period 4/9-24/10/1986 in south of Iraq.