A Report on 75 m Band Radio Wave Propagation During a Solar Eclipse in Equatorial Area

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1. INTRODUCTION

The 75 m broadcasting band (frequency 3.9 ~ 4.5 MHz) is commonly used by many local, regional, and international broadcasting radio stations to transmit their programs, which are aimed to the close and medium distance (up to hundred kilometers) listeners. This frequency band has a unique characteristic because the electromagnetic wave is reflected by an ionospheric layer in a such way so that the propagation distance is limited into several hundred kilometers.

The radio wave propagation always changes in accordance with the sun's position. In the equatorial areas, the variation has a specific pattern which is different than that in sub-equatorial areas (or more over in polar areas). The reflection effect meet it's maximum value in the night time, and meet it's minimum in the day time as the ionosphere layer's change. The radio stations working in this frequency band should be reckon this phenomenon to predict their broadcasting distance both in the night and day times, so that the number of expected listener can be reached. It is also important to know the propagation characteristic during wet and dry seasons in the equatorial area.

During a solar eclipse (part or total eclipse), a climate change like effect in the reception of radio signal can be performed. It is interested to see a rapid variation of received signal strength during the eclipse as a study of radio wave propagation in the high frequency. This paper describes a report on a 75 m band radio wave propagation during a ring solar eclipse in an equatorial area (Indonesia) which has been occurred on August 22, 1998 at 07:00 AM local time.

2. MEASUREMENT CONDITION

The measurement of received signal strength is performed in Satya Wacana Christian University, Salatiga, Indonesia, which is located in 110.5^{o}E 7.4^{o}S (Central Java Island). The radio wave source (broadcasting station) is located in Pontianak, West Kalimantan Island (109^{o}E 0^{o}), and the working frequency is 3,976 kHz. This station has been selected since it's location is precisely in the equator line and almost in the same time line with the measurement site location (see Fig. 1). The distance of both locations is about 780 km.

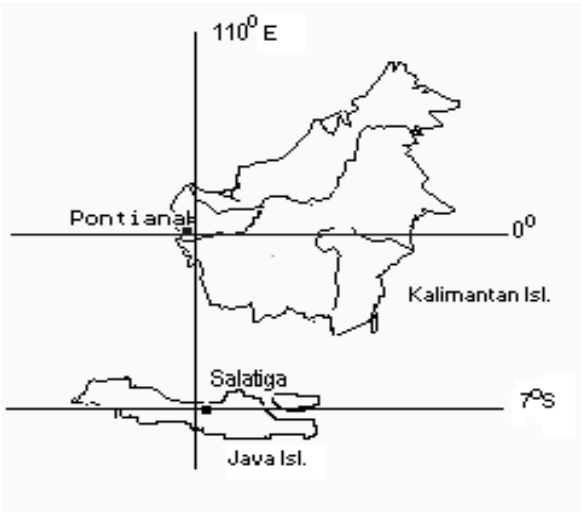


Fig. 1. Location of Pontianak and Salatiga.

Measurement of received signal strength is performed automatically using a communication receiver and a personal computer. Outside temperature, relative sunlight intensity, and relative humidity also measured simultaneously. The measurement system block diagram is shown in Fig. 2.

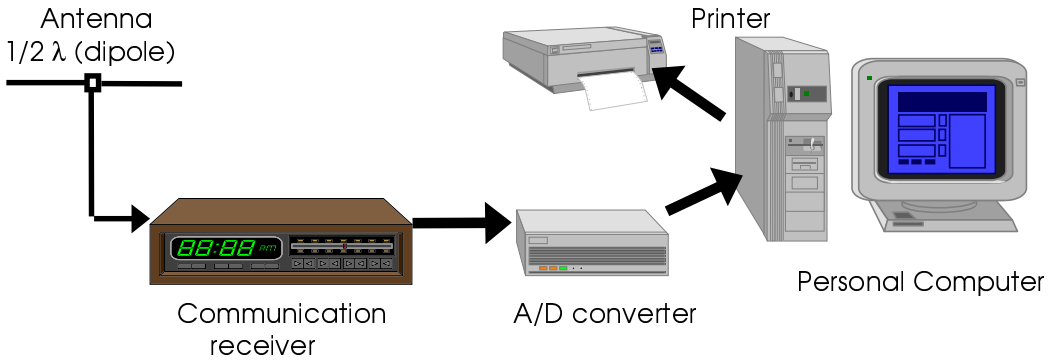


Fig. 2. Measurement system block diagram.

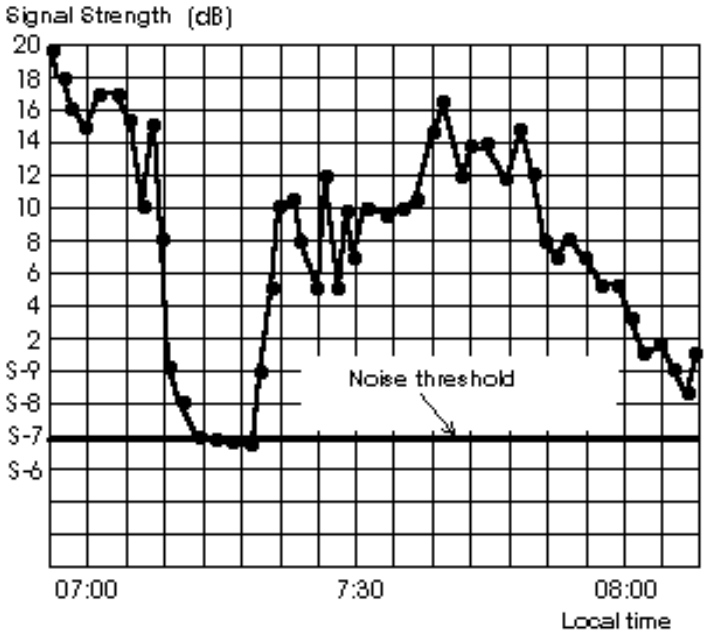
The measurement condition is shown in Table 1.

Table 1. Measurement condition.

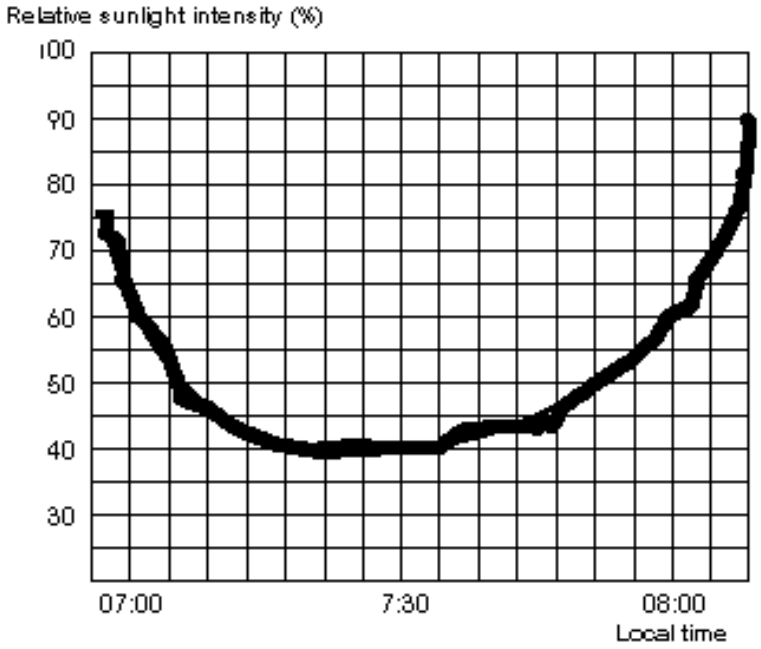
Measurement location	110.5°E 7.4°S (Salatiga, Indonesia)
Radio wave source location	109°E 0° (Pontianak, Indonesia)
Receiving antenna type	Half wave dipole
Receiving antenna height	20 meter above ground
Working frequency	3,976 kHz

3. MEASUREMENT RESULTS

Measurement has been performed on August 22, 1998, started at 06:00 AM and finished at 08:00 AM local time. The measurement results during eclipse is shown in Fig.3, and measurement results during a normal condition (performed August 23, 1998), as a comparison, is shown in Fig. 4.



a. Signal strength measurement result during solar eclipse.



b. Relative sunlight intensity during solar eclipse

Fig. 3. Measurement results.

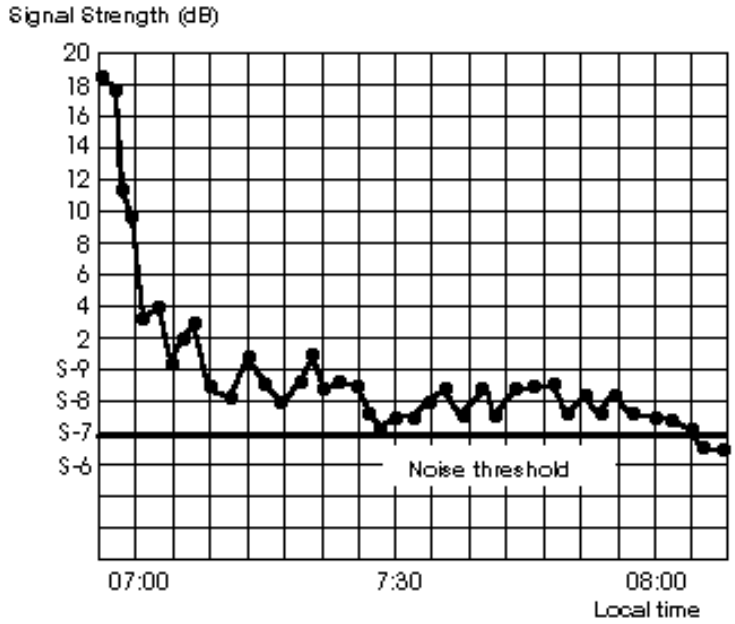


Fig. 4. Received signal strength during a normal condition.

4. ANALYSIS

From the measurement results it can be shown that during the eclipse the signal strength has been increased significantly. Compared to the normal condition (almost in the same time on the next day), the increment can be more than 10 dB. It also can be shown that the rapid change of signal strength is performed as soon as the eclipse come. It is supposed that in that time the F_2 layer of ionosphere has been combined down with the other ionospheric layers due to the temperature drop caused by eclipse. The effect is, a specific wave reflection in this layer caused a signal strength increment in the receiving site. After the eclipse, the signal strength has been dropped as low as in a normal condition.

5. CONCLUDING REMARKS

A 75 m band radio wave propagation during a solar eclipse in an equatorial area has been reported. A specific propagation effect has been detected. This phenomenon is important as a study of medium distance propagation in the high frequency band, especially in the equatorial zone.

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