

# Quality of AM radio reception at night and daytime for future use in Natural Disaster situations

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## Abstract

Brazil has more than 10.500 radio stations, which broadcast live sports, music, services and entertainment. It is estimated that 86% of the Brazilian population listens to radio programming, making it, therefore, a more adaptable communication vehicle for use in different media and situations, such as the possibility of using it to transmit alerts and warnings in situations of natural disasters. The objective was to compare the propagation of AM radio transmissions at night and during the day with commercial receivers, also, to prove, with a simple methodology and at a reduced cost, problems and advantages that may occur in transmissions on the aforementioned frequencies, instigating research scientific research with students from an elementary school in Brazil. The receptions were carried out by the students during the day (9:00 and 12:00) and at night (7:00 and 00:00) using two receivers, one powered by batteries and the other by a battery (car receiver) and recorded for later group analysis adopting the SINPO code methodology. The results showed that several commercial AM radio stations were received at night, but during the day it was not possible to receive reception at any of the times analyzed. During the night, many distant stations could be captured, which negatively influenced the reception of the stations studied, but could be used to explain the propagation of the electromagnetic wave, the presence and performance of the Ionosphere and its characteristics. Due to the propagation behavior of the electromagnetic wave of AM radio stations, which has some peculiarities when compared to commercial FM stations, the use of this band in the region under study, in the case of alerts and warnings of natural disasters, must be better analyzed to ensure satisfactory results are obtained.

## Introduction

In Brazil, according to current law, radio stations are characterized by three broadcasting formats: commercial, educational and community or free (PERAZOLI, 2004). It is estimated that 86% of the Brazilian population listens to radio programs (KANTAR IBOPE MEDIA, 2018). In addition to being a more adaptable communication vehicle for use in different media and situations (CURADO, 2015), such as the possibility of using it to transmit alerts and warnings in emergency situations (KITAGAWA, 2015), as AM transmissions are received at a much greater distance than FM transmissions (APUKE, 2017), including mountainous regions, exceeding line-of-sight distances (SHOJI, 2023), because, according to Apuke (2017), when they reach the layer of the atmosphere called ionosphere, are reflected back to Earth. This feature of AM transmission can be a great ally in situations of natural disasters.

Comparing the propagation of AM radio transmissions at night and during the day with commercial receivers, also, proving, with a simple methodology and at a reduced cost, problems and advantages that can occur in transmissions on the aforementioned frequencies, instigating scientific research and the protagonism of student.

## Method/Experiment

The present study was carried out with 9th year students from a municipal elementary school in the city of Indaial (26°52'00"S 49°11'26"W), state of Santa Catarina - Brazil.

For reception tests, two receivers were used that had AM radio frequency coverage (535 to 1,650 kHz), one powered by batteries and the other by a battery (car receiver) which facilitated handling, however, reduced the possibility of interference from the electrical network (Figure 01).



The SINPO code methodology was adopted to quantify the reception of the stations listed below:

- Radio Bandeirantes 1350 kHz (ZYJ 760);
- Rádio Guarujá 1420 kHz (ZYJ 754);
- Rádio Difusora Itajaí 1530 kHz (ZYJ 761).

The receptions were carried out at six times of the day - a twenty-four hour interval, divided into three tests during the day (9:00 and 12:00) and three during the night (19:00 and 00:00) - Brasilia time.

The place for carrying out the daytime tests was in the school environment, in an external location away from electrical wiring, transformers or electronic equipment, with the aim of minimizing external disturbances. The night tests were carried out at the authors' residence, respecting the same criteria mentioned above.

The approximate distances between transmitting stations and receivers were between 55 and 100 km.

DAYTIME	S - signal	I - interference	N - noise	P - propagation	O - overall
1350 kHz	1	1	1	1	1
1420 kHz	1	1	1	1	1
1530 kHz	1	1	1	1	1
NIGHT	S - signal	I - interference	N - noise	P - propagation	O - overall
1350 kHz	2	2	3	3	1
1420 kHz	2	2	3	3	1
1530 kHz	2	2	2	3	1

## Results

The results showed that several commercial AM radio stations were received at night, but during the day it was not possible to detect them at any of the specific times due to interference from other stations and during the night, many distant stations could be received, including in Spanish, and these ended up influencing the specifications in the reception of scientific stations. This is mainly due to the fact that during the day the main path is the ground wave and, therefore, communication is local, while at night, the signals reach hundreds and, in some cases, thousands of kilometers away (CRILLY, 2020), because in this positioning the D layer of the ionosphere recombines and the signals in the AM band are reflected in the ionosphere, allowing the so-called sky-wave propagation. Crilly (2020), reports that in his tests, he showed no propagation effects of sky waves during the day at frequencies below 5 MHz, which is the range used in the present study.

It is known that every system that involves the transmission of electromagnetic waves is influenced by the propagation environment, which can cause disastrous results in the quality of the information transmitted (FERNANDES, 2012). The use of Medium Wave transmission in natural disasters can be used, however with caution, as in a study planned in Japan, a Medium Wave transmitter station with 5 kW of power covered a radius of approximately 15 km and depending on the area under study, reaching 80 km (SHOJI, 2023).

For disaster situations, the choice of frequency used and the transmission time must be taken into account so that they occur reliably to the locations where the receivers are located, making the best possible use of the layers of the ionosphere for refraction and reflection of signals (FISHER, 2018), destination distance and variations based on geographic and geological factors (SHOJI, 2023).

## Conclusion

It was noticed that the reception of the commercial AM stations studied had an extremely precarious quality at night, and during the day, reception was not possible.

Due to the propagation behavior of the electromagnetic wave of the AM radio station, which has some peculiarities when compared to commercial FM stations, the use of this band in the region under study must be better analyzed for the purpose of this study.

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