


# Use of the Short Wave Radio to prove the ionosphere with students from a public school in Brazil

Use of the Short Wave Radio to prove the ionosphere with students from a public school in Brazil  
 KITAGAWA, Alexandre Takio<sup>1</sup>  
 1 - Department of Education of Indaial, Santa Catarina, Brazil (Secretaria de Educação de Indaial)



**INTRODUCTION**

The ionosphere is a part of the terrestrial atmosphere ranging from about 50 km to more than 1000km height (DA SILVA, 2001; MAGFORS & SCHLICKEL, 2001), consisting of plasma produced by ionization of the upper atmospheric gases by ultraviolet (UV) rays and particles of short wavelength from the sun, and the

**METHODOLOGY**

For reaching the layers of the atmosphere, in Brazil, public schools rely on textbooks, pictures and videos, however, a practical experiment is not often carried out. To remedy this gap, using low-cost materials, an experiment was carried out, well known for radio amateurs using two receivers, one portable short-wave 9.500 to 6.200 MHz and 7.100 to 7.200

**RESULTS AND DISCUSSION**

The students were surprised to hear broadcasts in other languages, from other distant countries, Japanese, Chinese and English, and not so late to relatively close FM radio stations. Short-wave equipment was also used in studies by Pachter (2009), taking advantage of the ionosphere's characteristic. A summary of the experiment is in:


**CONCLUSION**

We conclude that the low-cost experiment using short wave radio can prove the existence of the ionosphere and the use of this layer.

**REFERENCES**

BORA, Sarah. Ionosphere and radio communication. *Encyclopedia*, v. 22, n. 2, p. 222-232, 2017.

BRUSCATO, G. C. O ensino de física através das atividades práticas realizadas na instalação, operação e manutenção de uma estação radioamadora. 2011. 177 p.



**Acknowledgment**

We are very grateful to the organizers of HamSci for the opportunity granted. We would also like to thank the Department of Education of Indaial, the Santa Teresa Middle School and its collaborators and students.

[AUTHOR INFORMATION](#) [ABSTRACT](#) [CONTACT AUTHOR](#) [WEB](#) [PDF FULLTEXT](#)

KITAGAWA, Alexandre Takio<sup>1</sup>

1 - Department of Education of Indaial, Santa Catarina, Brazil (Secretaria de Educação de Indaial)



PRESENTED AT:



## INTRODUCTION

The ionosphere is a part of the terrestrial atmosphere ranging from about 80 km to more than 1000 km height (DA SILVA, 2001; HAGFORS & SCHLEGEL, 2001), consisting of plasma produced by the photoionization of thin upper atmospheric gases by ultraviolet (UV) rays and photons of short wavelength from the sun, and the upper ionosphere is used for radio communication and navigation as it reflects long, medium, as well as short radio waves (BORA, 2017). Therefore, the same author states that the ionosphere has been studied extensively because of its great importance in radio communication by reflecting the radio signals back to the receivers. However, its effectiveness depends on the frequency of the transmitted signal. For example, Xiong (2018), affirms that high frequencies (HF, defined as 3 - 30 MHz) radio waves can travel long distances through multiple reflections of the ionosphere and the Earth (from one point on the Earth's surface to another far point on the Earth's surface). As an advantage of broadcasting in HF, we can mention the reach in several areas of the planet, where the internet does not reach, the low cost of equipment in relation to those using satellite communications, the portability and miniaturization of this equipment and the possibility of breaking issues of government censorship (MARTINS, 2015). Several stations can be tuned around the world: BBC, Voice of America, Deutsche Welle, Radio France Internationale, China Radio International, among others.

## METHODOLOGY

For teaching the layers of the atmosphere, in Brazil, public schools rely on textbooks, pictures and videos, however, a practical experiment is not often carried out. To remedy this gap, using low-cost materials, an experiment was carried out, well known for radio amateurs using two receivers, one portable short-wave (5,950 to 6,200 MHz and 7,100 to 7,300 MHz) and the other to FM (88 to 108 MHz ), where shortwave radio stations with foreign language broadcasts were randomly tuned, in order to characterize broadcasts from abroad. It was compared with some FM radio broadcasts from neighboring municipalities, previously researched on the internet and it was noticed that it was not possible to receive these stations.

## RESULTS AND DISCUSSION

The students were surprised to hear broadcasts in other languages (from other distant countries - Japanese, Chinese and English) and not to listen to relatively close FM radio stations.

Short wave equipment was also used in studies by Fischer (2019) taking advantage of the ionosphere's characteristic. Amateur radio equipment in HF has also been used in other studies to prove the ionosphere and studies on electromagnetic waves (BRUSCATO, 2011; BRUSCATO & MORS, 2014).

In Brazil, the teaching-learning process with the discipline of Physics may be related to the methodologies applied by teachers in the classroom, where they are often not easy to understand, as they focus only on theoretical classes (DOS SANTOS, *et al.*, 2019) and the lack of resources such as laboratory equipment to obtain greater use in teaching in practical classes (SILVA *et al.*, 2018) makes the content uninteresting for the student. Therefore, it becomes necessary to think of a strategy to overcome these obstacles.

## CONCLUSION

We conclude that this low-cost experiment using short wave radio can prove the existence of the ionosphere and the use of this layer.

## REFERENCES

BORA, Saradi. Ionosphere and radio communication. *Resonance*, v. 22, n. 2, p. 123-133, 2017.

BRUSCATO, G. C. O ensino de física através das atividades práticas realizadas na instalação, operação e manutenção de uma estação radioamadora. 2011. 177 p. Dissertação de mestrado (Programa de Pós-graduação em Ensino de Física) Instituto de Física, Universidade Federal do Rio Grande do Sul, Porto Alegre, 2011.

BRUSCATO, Gentil César; MORS, Paulo Machado. Ensinando física através do radioamadorismo. *Rev. Bras. Ensino Fís.*, São Paulo, v. 36, n. 1, p. 1-8, Mar. 2014.

BRUSCATO, Gentil César; MORS, Paulo Machado. Ensinando física através do radioamadorismo. *Revista brasileira de ensino de física*, v. 36, n. 1, p. 1-8, 2014.

DA SILVA, Henrique José Almeida. Onda Ionosférica. Propagação na Atmosfera. 1.<sup>a</sup> edição, 2001.

DOS SANTOS, Francisco Willan Costa *et al.* Identificação de dificuldades no processo de ensino-aprendizagem por meio do programa PIBID (Programa Institucional de Bolsa a Iniciação à Docência): um estudo de caso sobre as dificuldades encontradas no ensino da disciplina de física de uma escola pública na cidade de Parnaíba. *Research, Society and Development*, v. 8, n. 8, p. e34881234-e34881234, 2019.

FISCHER, William. Transmissão de sinais em radiofrequência via ondas curtas. 2019. Trabalho de Conclusão de Curso.

GASPARELO, Ulisses Antonio Coa *et al.* Estudos Estatísticos de ocorrência das bolhas ionosféricas sobre a região equatorial brasileira durante 2000-2005. In: 10th International Congress of the Brazilian Geophysical Society & EXPOGEF 2007, Rio de Janeiro, Brazil, 19-23 November 2007. Society of Exploration Geophysicists and Brazilian Geophysical Society, 2007. p. 2162-2165.

HAGFORS, Tor; SCHLEGEL, Kristian. Earth's ionosphere. In: *The Century of Space Science*. Springer, Dordrecht, 2001. p. 1559-1584.

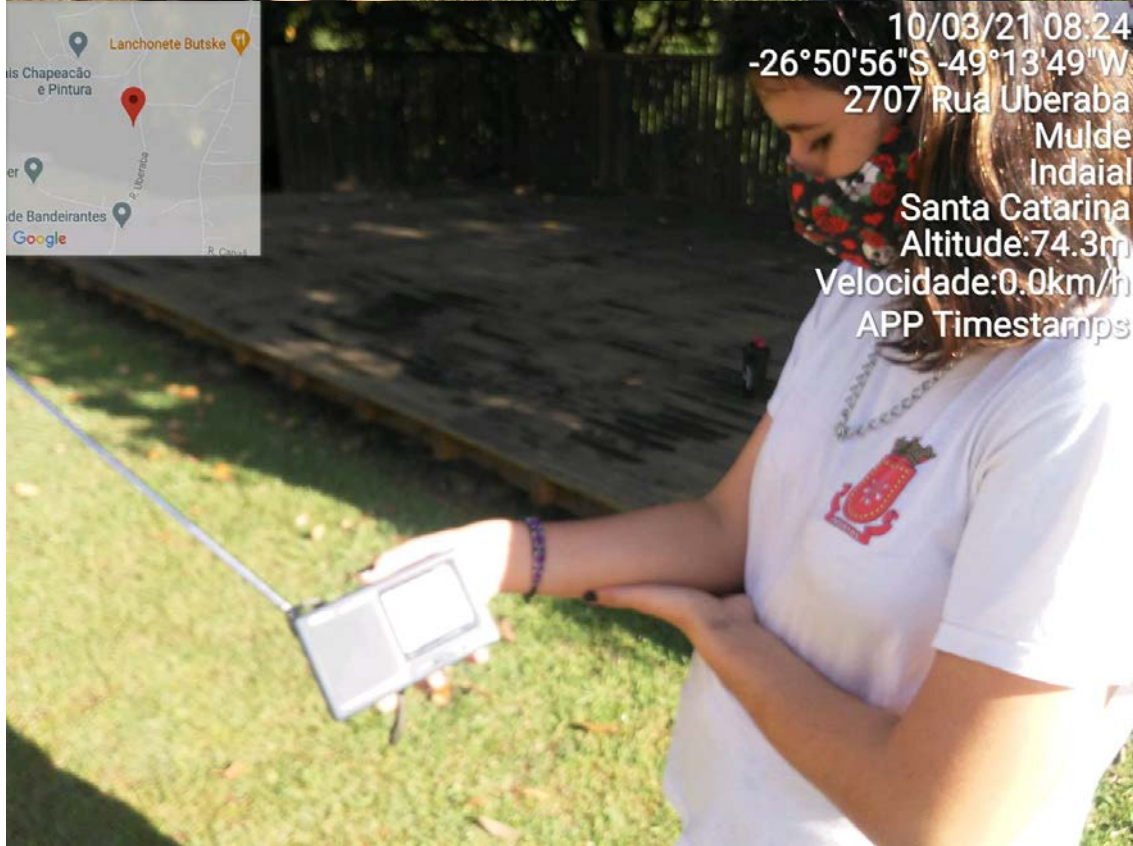
MARTINS, Ramon Mayor. Estudo das características ionosféricas para ondas curtas utilizando Rádio Definido por Software. In: IX FEPEG - Fórum de Ensino, Pesquisa, Extensão e Gestão, 2015, Montes Claros. *A Humanização na ciência, tecnologia e inovação*, 2015.

SILVA, Patrick Oliveira da *et al.* Os desafios no ensino e aprendizagem da Física no Ensino Médio. *Rev Cient da Faema*. V. 9, n. 2, p. 829-834, 2018.

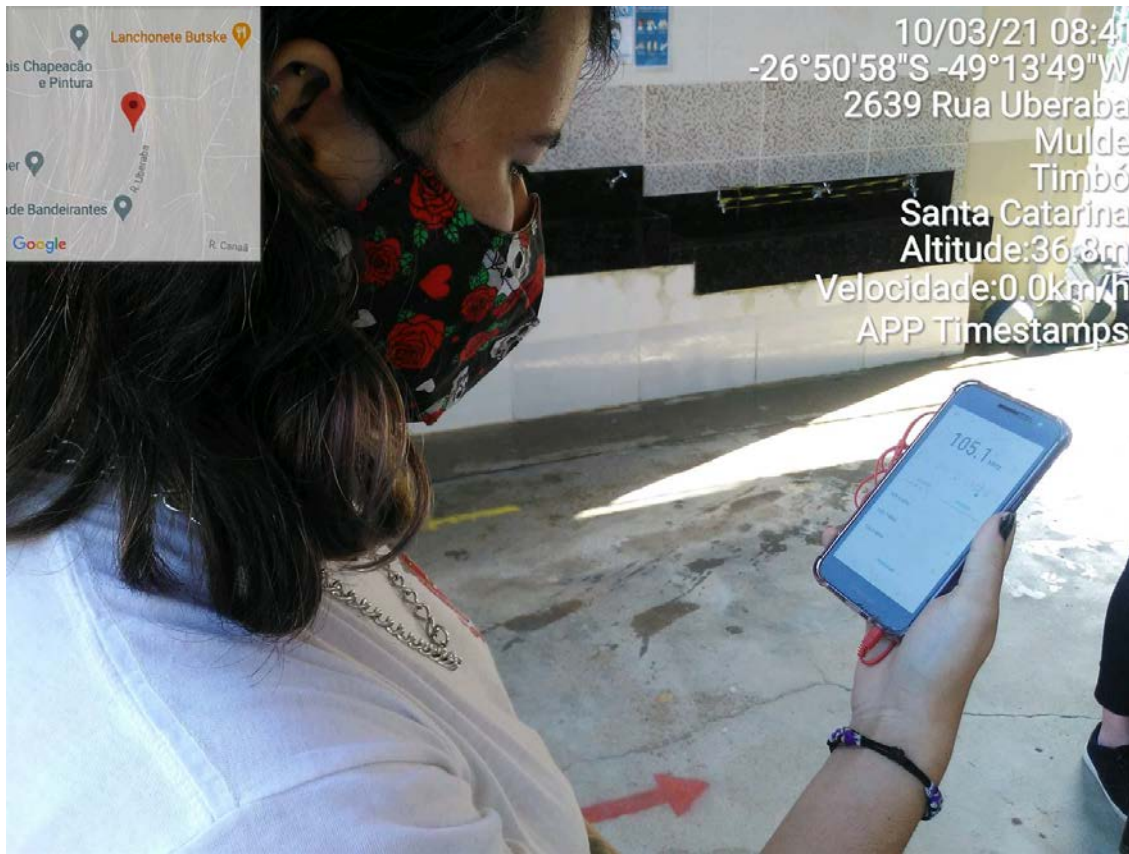
XIONG, Fuzhi. HF radio waves propagation model based on sky wave. In: *AIP Conference Proceedings*. AIP Publishing LLC, 2018. p. 030053.



10/03/21 08:23  
-26°50'56"S -49°13'49"W  
2707 Rua Uberaba  
Mulde  
Indaial  
Santa Catarina  
Altitude:71.1m  
Velocidade:2.3km/h  
APP Timestamps



10/03/21 08:24  
-26°50'56"S -49°13'49"W  
2707 Rua Uberaba  
Mulde  
Indaial  
Santa Catarina  
Altitude:74.3m  
Velocidade:0.0km/h  
APP Timestamps





## ACKNOWLEDGMENT

We are very grateful to the organizers of HamSCI for the opportunity granted. We would also like to thank the Department of Education of Indaial, the Escola Básica Mulde Baixa and its collaborators and students.

## AUTHOR INFORMATION

The author is a biologist, a middle school teacher in the Department of Education of Indaial, state of Santa Catarina, Brazil.

It is Amateur Radio Operator (PU1KTA) and Citizen Band Operator (PX1Y1858).

## ABSTRACT

### **Use of the Short Wave Radio to prove the ionosphere with students from a public school in Brazil**

Knowledge of the characteristics of the ionosphere is largely based on its effects on electromagnetic waves. For the teaching of the atmosphere layers, in Brazil, as public schools have textbooks, pictures and videos, however, a practical experiment is not often performed. To remedy this gap, using low-cost materials, an experiment was carried out, well known for radio amateurs using two receivers, one portable shortwave (5.950 to 6.200 MHz and 7.100 to 7.300 MHz) and the other to FM (88 to 108 MHz), where shortwave radio stations with foreign language broadcasts were randomly tuned to characterize broadcasts from abroad. It was compared with some FM radio broadcasts from neighboring municipalities, previously researched on the internet and it is reckoned that it was not possible to receive these stations. There was a surprise from the students when they heard transmissions in other languages (from other distant countries) and did not listen to FM radio stations relatively close, thus proving the existence and application of the ionosphere during science classes.