



Comparative Analysis of the Effects of Some Atmospheric Components on Signal Strength Level of Digital Terrestrial TV in Abuja and Plateau State, Nigeria

Abdullahi Ayegba^{a,c}, Ale Felix^{a,b}, John Momoh^{a,b}, Ikpaya D. Ikpaya^{a,b}, Joseph Sunday Ojo^d, Adekunle Titus Adediji^d, and Iruemi Olohimai Juliet^{a,b},

^aDepartment of Systems Engineering, African University of Science and Technology, Km. 10, Airport Rd, P.M.B 681, Garki, Abuja, 900107, Nigeria,

^bNational Space Research and Development Agency, Obasanjo Space Centre, Umar Musa Yar'adua Express way, P.M.B 437, Garki, Abuja, 900108, Nigeria,

^cManagement of Information Technology Department, African University of Science and Technology, Km. 10, Airport Rd, P.M.B 681, Garki, Abuja, Nigeria,

^dPhysics Department, Federal University of Technology, Akure, Nigeria,

*Correspondence: mathsongroup@gmail.com

Abstract

The study aims to compare the influence of some components of the atmosphere like wind speed, rainfall, temperature, atmospheric pressure and relative humidity on the strength of the signal received (SSR) via digital terrestrial television reception in Abuja, the Federal Capital Territory, and Jos, Plateau State. The parameters of the atmosphere were obtained using automatic weather logger, and a CATV signal strength meter, in two selected locations (Jos, Plateau State and Abuja, Federal Capital Territory) between 2019 and 2020. The results show that the SSR of both AIT and Unity TV fails to correlate with atmospheric pressure, temperature, rainfall as well as wind speed, but are strongly influenced by relative humidity for the period of study. The implication is that, when the rainfall, atmospheric temperature, wind speed and atmospheric pressure increase, the SSR of the two televisions stations decreases, and vice versa. On the other hand, the greater the relative humidity, the greater the SSR of the television stations; since the humidity or water moisture in the atmosphere would reduce the temperature of the atmosphere which should have caused signal attenuations. The percentage of relationship between the SSR of AIT with atmospheric temperature is 90.4%, pressure is 10.4%, relative humidity is 88.5%, wind speed is 96.0% and rainfall is 31.5% based on the coefficients of correlation, while percentage of relationship between the SSR of Unity TV by atmospheric temperature is 94.0%, pressure is 6.3%, relative humidity is 91.5%, wind speed is 50.4% and rainfall is 33.5% based on the coefficients of correlation. Although, the percentage of relationship of temperature in Jos is higher than in Abuja, the effect is less significant on SSR in Jos compared to AIT, Abuja, probably due to the low annual temperature of Jos as well as the higher altitude of Jos compared to Abuja. It could be as a result of the short distance (10 km) between the transmitter and receiver in Jos compared to the distance (18 km) between the transmitter and receiver in Abuja. The results will find usefulness to Nigeria Broadcasting Commission (NBC) being a regulatory body would ensure compliance with well-developed operational guidelines for improving quality of signal performances. It will also serve as benchmarks for digital link budgeting in other parts of Nigeria.

Keywords: Cointegration; Atmospheric Components; Signal strength; Digital Terrestrial TV; Tropical Location.

1. Introduction

A digital terrestrial television broadcasting is the television broadcasting whereby the signal retransmitted by the spacecraft in space is first of all received by a terrestrial television transceiver before it is being retransmitted to homes and offices for reception using Yagi antenna [1]. Ideally, the strength of the UHF or VHF signal is influenced by the shape of the earth and weather variables such as wind, humidity, temperature, and the contact of the signal with trees, mountains, buildings, water bodies and valleys [2]. The change of these weather parameters may also be determined by the seasons of the year [3], and this affects the standard or level of signal received at any destination.

© The Author(s) 2025

I. Adimula et al. (eds.), *Proceedings of the 8th URSI-NG Annual Conference (URSI-NG 2024)*, Advances in Physics Research 12,

https://doi.org/10.2991/978-94-6463-644-4_2

Generally, the status of the signal strength received from a terrestrial television at any location is of paramount interest to the various sectors in the broadcasting industry [4] as signal quality can also be influenced by the interactions of different forms of noise [5]. Some other factors especially the external ones such as weather elements, when interacted with the signals can cause signal attenuation [6-7] in addition to variation in the radio signal horizon [8-9].

As inferred from the work of [10] and [11], topography and geographical locations where a radio receiver is sited may also influence the level of the signal it can receive, thus, the receiver at a higher location receives better signal strength than the one at a lower location.

Attenuation is the reduction in radio signal strength transmitted or received and, may be caused by signal transmission over a long distance. The decrease in the level of signal in the troposphere or atmosphere in general as a result of noise from electrical networks and influenced by some atmospheric elements is a major concern when one propagates radio signal through the atmosphere [7]. In the atmosphere, there could be precipitations and gases, when microwaves pass through such an atmosphere, the signal level will be decreased by scattering and absorption. However, this scattering of radio signal is more pronounced at higher frequencies [12].

As at the time of the research (2019 -2020), the only territories in the entire Nigeria operating on fully digital broadcasting of terrestrial television are Jos-Plateau state and Abuja-the Federal Capital Territory, as no television signal can be received without a decoder or setup boxes. According to the former minister of Information, Alh Lai Muhammed as reported by premiumtimes newspaper on March 11, 2021, "the second phase of digital switchover will be in Lagos, Rivers, Yobe, Kano and Gombe", and this research had already been concluded then. Due to relationship of some atmospheric conditions with radio or television signal strength as noted in some previous works [6,7 & 12], and which vary across Nigeria, there is need to compare the effects of the parameters of the atmosphere on the received signal level in these two geographical locations (Jos and Abuja). The objective of this research was to compare the effects of some parameters of the atmosphere like rainfall, relative humidity, temperature, wind speed and pressure on the signal strength received (SSR) of digital terrestrial television in Abuja, the Federal Capital Territory, and Jos, Plateau state. This will help government Agency like the Nigeria Broadcasting Commission (NBC) in ensuring good quality signal transmission especially in the area of Digital terrestrial television in Nigeria being a regulatory body would ensure compliance with well-developed operational guidelines.

2. Materials and Method

Jos is a town and is the capital of Plateau State. Plateau State is located in North-Central geographical zone of Nigeria. The state is in the tropical zone. Jos is situated at the altitude of around 1,400 m between lat. 8.92° to 10.18° N, and long. 8.35° to 9.50° E. The rainy season of Jos is between April and September, while the dry season is between October and March. Jos Plateau covers an area of about 8600 km² with the mean annual rainfall of about 1,280 mm, while its average monthly temperature is about 21 – 25 °C and sometimes between 15.5 °C to 18.5 °C during the coolest months. The highest rainfall is recorded during the wet season months of July and August.

Abuja is the capital of Nigeria. The city also has two seasons- rainy and dry. The rainy season in Abuja begins in April and ends in September, while the dry season begins in October and ends in March. Abuja is located at the altitude of around 470 m, and between lat. 8.25° to 9.20° N, and long. 6.45° to 7.39° E. The mean rainfall of Abuja annually is around 1,389 mm, while its mean monthly temperature is between 23.9 – 25.7 °C [1]. The effect of climate change is also experienced in Abuja, and this makes the temperature to soar sometimes above this range. The two territories (Jos and Abuja) chosen in this work was because Abuja and Jos, are the only cities that presently operate on fully digital terrestrial television transmission in Nigeria.

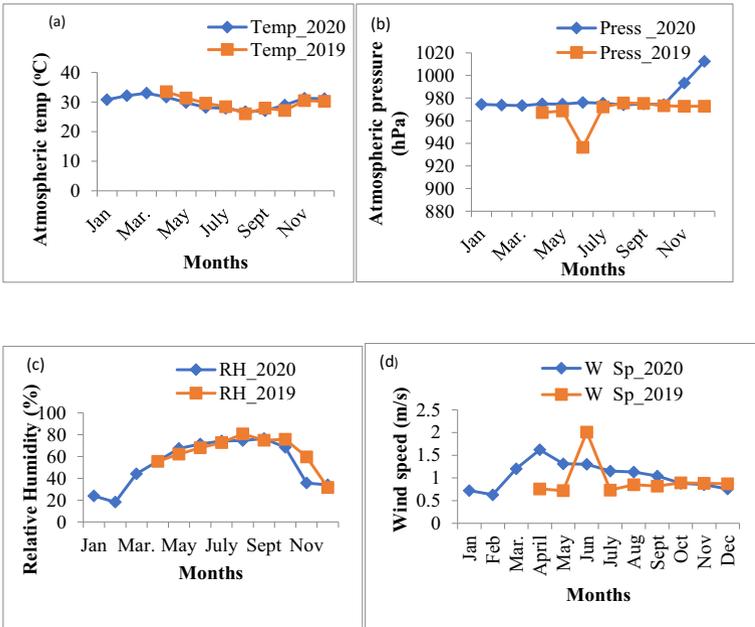
The instrumentation for the measurement in the two locations- Jos and Abuja, comprises the Yagi-Uda antennas, automatic weather station, co-axial cable, and Digital Community Access Television (CATV) signal meters. Automatic weather gauges were used for the measurement of the atmospheric parameters, while the CATV signal meters were used to measure the SSR of African Independent Television (AIT) (535.2 MHz) and Unity TV (786 MHz). The readings were carried out from 5:00 am to 9:00 pm daily in Rayfield, Jos and Karshi Abuja, respectively. The readings were taken at an interval of 30 minutes from April 2019 to December 2020. Throughout the study period, the direction of the antennas in study areas remained unchanged even during routine cleaning of the instrumentation. The daily and monthly averages of the measured parameters were computed and used for further analysis.

3 Results and Discussion

Figures 1 (a - e) represent the variations of the average monthly atmospheric parameters of Abuja for 2019 and 2020. The results shows that the monthly temperature in both 2019 and 2020 attains higher values from around January to April, and from around October to December. It also shows that the average monthly temperature was lower in the

period of study from around May to September. In 2019, the maximum and minimum average monthly temperatures were 33.49 °C and 26.07 °C, and this occurred in April and August respectively. In 2020, the maximum and minimum average monthly temperatures were 33.00 °C and 26.74 °C, and this occurred April and August respectively. The lowest average temperature recorded in August in Abuja could be a result of much rainfall in August in Abuja during the study period.

The atmospheric pressure in the two years did not show much variation monthly except a sudden decrease that occurred in June in 2019. The maximum and minimum average monthly pressure in 2019 and 2020 are 975.69 hPa (August) and 936.51 hPa (June), and 1012.55 hPa (December) and 974.70 hPa (May), respectively. The relative humidity in the two years was higher from April to October, and from then it started decreasing. The maximum and minimum average monthly relative humidity in 2019 and 2020 are 80.60 % (August) and 31.54 % (December), and 76.41 % (September) and 18.13 % (February), respectively. The wind speed and rainfall show same trend in monthly variation as the two were higher between April and October, with the maximum rainfall of 384.40 mm and 544.19 mm occurring in August in both 2019 and 2020. This maximum rainfall occurring in August might be the reason why minimum average temperature and relative humidity occurred in August too because rainfall introduces moisture (relative humidity) in the atmosphere, thereby making the atmosphere cooler, hence the reduction in atmospheric temperature.



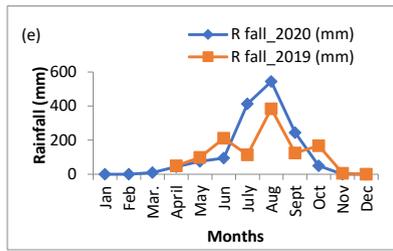
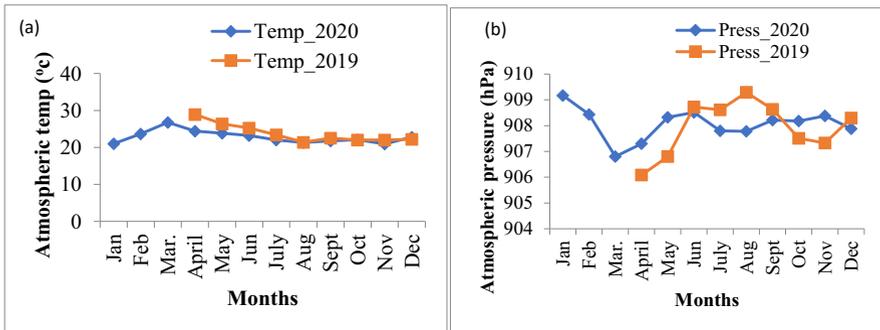
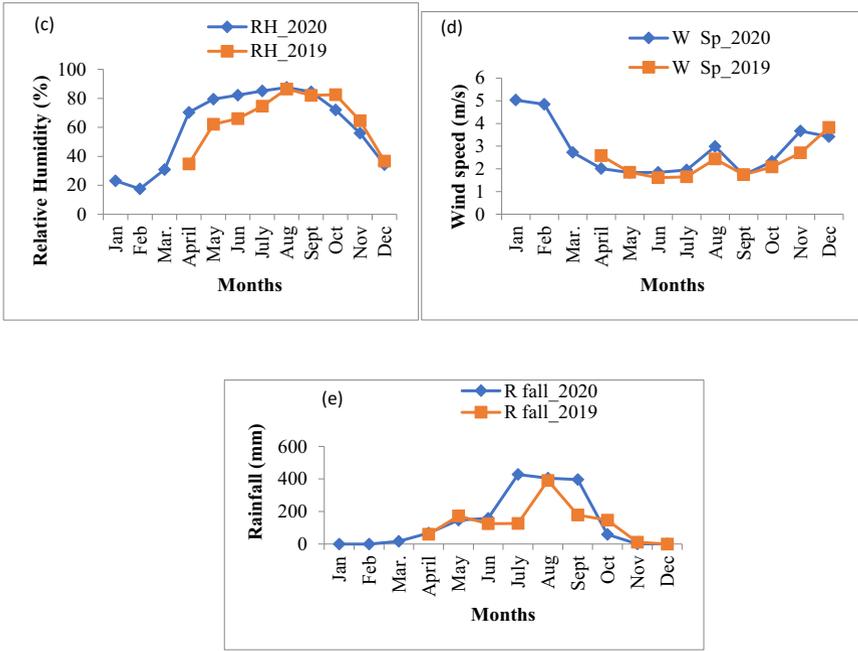


Fig. 1(a – e): Average monthly atmospheric parameters of Abuja for 2019 and 2020

Figures 2(a – e) shows the average monthly atmospheric parameters of Jos for 2019 and 2020. In Jos, Plateau State, similar behavior of the atmospheric parameters was observed though with different average maximum and minimum values of the atmospheric components. While the average maximum and minimum temperature were 28.93 °C (April) and 21.20 °C (August) in 2019, and 26.76 °C (March) and 20.93 °C (November) in 2020; the average maximum and minimum atmospheric pressure were 909.29 hPa (August) and 906.08 hPa (April) in 2019, and 909.17 hPa (January) and 906.80 hPa (March) in 2020; the average maximum and minimum relative humidity were 86.47 % (August) and 34.83 % (April) in 2019, and 87.51 % (August) and 17.55 % (February) in 2020; the average maximum and minimum wind speed were 3.82 m/s² (December) and 1.61 m/s² (June) in 2019, and 5.03 m/s² (January) and 1.73 m/s² (September) in 2020; the average maximum and minimum rainfall were 391.22 mm (August) and 0.00 mm (December) in 2019, and 427.43 mm (July) and 0.00 mm (January) in 2020.





Figures 2(a – e): Average monthly atmospheric parameters of Jos for 2019 and 2020

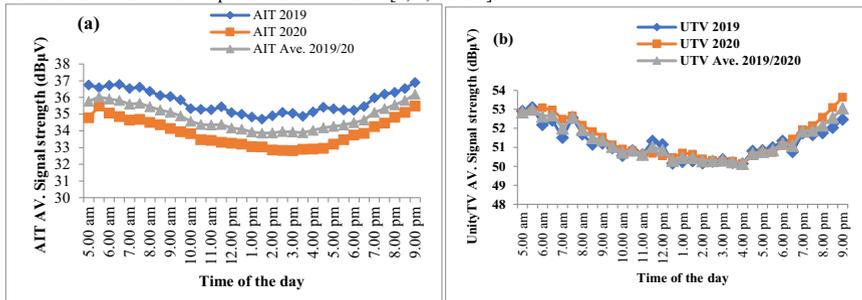
Figures 3(a and b) shows the half hourly received signal strength of AIT, Abuja and Unity TV, Jos, in 2019, 2020 and the average of the two years. From figure 3.0a, it was shown that the half hourly SSR of AIT in the two years (2019 and 2020) was higher in the morning period from around 5.00 am to around 11.00 am, and in the evening from around 5.00 pm to 9.00 pm. It was shown that the level of the signal strength received was lower in the noon period from around 12.00 pm to 4.00 pm. This similar trend of half hourly variations was observed in the SSR of Unity TV Jos as the half hourly SSR was higher from around 5.00 am to around 11.00 am, and from around 5.00 pm to 9.00 pm (figure 3.0b). The results also show that the peak signal level of AIT was around 37 dBμV, while that of Unity TV was around 54 dBμV (Figures 3 (a-b)). This implies that the average SSR of AIT, Abuja, is lower than that of Unity TV, Jos.

From the correlation analysis presented in Table 1, it is shown that the correlation coefficients of the AIT and Unity TV SSR with the atmospheric temperature are negative. This means that the SSR is inversely proportional with the atmospheric temperature. In the same way, atmospheric pressure, wind speed and rainfall indirectly vary with the received signal level, whereas the relative humidity varies directly with signal level or strength of the Unity TV and AIT. In other words, as the pressure of the atmosphere, wind speed, rainfall and temperature increase, the level of the SSR reduces, while the decrease in the values of these components of the atmosphere will lead to an increase signal level. In the case of relative humidity, the rise in relative humidity will lead to the rise in the received signal level. This could be as a result of the ability of relative humidity or water moisture in the atmosphere to reduce the temperature which on its own is inversely proportional with the SSR.

Although all the atmospheric parameters affected the SSR in the same way, the average SSR of Unity TV (Jos) is higher than the average SSR of AIT measured in Abuja. The higher signal strength recorded in Jos compared to Abuja could be as a result of lower average temperature of Jos (22.8 °C) compared to that of Abuja (25.7 °C) since lower temperature is in favour of the signal strength. Also, it could be that the higher altitude of Jos (1400 m) compared to Abuja (470 m) was one of the factors which contributed to increased SSR in Jos compared to Abuja, because in the troposphere (from the surface of the earth to about 10 km altitude), the higher you go, the cooler it becomes, hence

the higher SSR Also, as the altitude increases, the amount or volume of air over a given or unit area will decrease [14]. Thus, the atmospheric pressure will decrease due to lower air molecules. This decrease in atmospheric pressure will lead to increase in SSR since the two (signal strength and pressure) are inversely related to each other. Also, in Abuja, while the distance between the startimes transmitter (9.05° North 7.50° East) and the receiver in Mathson Space School in Karshi, Abuja (8.83° North 7.57° East) is 18km, in Jos, Plateau state, the distance between the startimes transmitter (9.88° North 8.88° East) and the receiver in Rayfield, Jos (9.84° North 8.89° East) is 10km. This also contributed to the higher SSR in Jos compared to that in Abuja.

The percentage of relationship between the SSR of AIT with atmospheric temperature is 90.4%, pressure is 10.4%, relative humidity is 88.5%, wind speed is 96.0% and rainfall is 31.5% based on the coefficients of correlation, while percentage of relationship between the SSR of Unity TV by atmospheric temperature is 94.0%, pressure is 6.3%, relative humidity is 91.5%, wind speed is 50.4% and rainfall is 33.5% based on the coefficients of correlation. This result is line with results reported in the work of [1, 9, 11- 13].



Figures 3(a and b): The half hourly received signal strength of the television stations (AIT and Unity TV Jos) in 2019, 2020 and their average.

Table 1. Result of correlation analysis of half hourly data

Station	Temp. (°C)	Pressure (hPa)	Rel. Humidity. (%)	Wind speed (m/s)	Rainfall (mm)
AIT (dBμV)	-0.904	-0.104	0.885	-0.960	-0.315
Unity TV (dBμV)	-0.940	-0.063	0.915	-0.504	-0.335

3.2 Analysis of the Cointegration

The cointegration analysis shows the presence of a long-term relationship between the SSR and the components of the atmosphere or not. With the critical value set at 5% level, there will be cointegration if the probability value of any of the hypothesized cointegration equations is 0.05 or less. In this case, the statement of no cointegration or the null hypothesis (H_0) would not be accepted, but rejected. H_0 is the hypothesis that no long-term relationship is existing between them while H_1 is the alternative. In addition, when the trace statistics value is higher than the critical value, or the value Max-Eigen statistics is higher than the critical value, the statement of no cointegration is rejected. From Table 2, at the probability of 0.004 (first row), there is a cointegration since the value meets the condition of “equal to or less than 0.05”. Also, on the same row, the trace statistics value of 140.67 is higher than the critical value of 125.61. This also confirms that there is a cointegration, and the null hypothesis which means no cointegration will be rejected. From the Maximum Eigen value method (Table 3), the value of the probability of 0.002 is less than 0.05, and the Max-Eigen Statistic (57.246) is higher than the critical value (46.231), hence the null hypothesis of no cointegration will be rejected. In other words, there is a long-term relationship between the atmospheric components and the SSR of AIT.

In the case of Unity TV, there is also a long-term relationship as indicated in the Maximum Eigenvalue test and Trace test (Tables 4 and 5). From the Trace test method; there exists four cointegrations as the probabilities in the first four rows were 0.000, 0.003, 0.016 and 0.048 are all less than 0.05, a condition for cointegration, and H_0 will be rejected. From the Maximum Eigenvalue test, on the first row, the probability is 0.0000. In addition, the values of the Trace statistics in the first four rows in the Trace test table are higher compared to the critical values. Similarly, the value of the Max-Eigen Statistic in the first row of Max-Eigen (Table 5) is higher than the critical value. At the Trace statistics values of 191.932, 110.866, 75.774, and 48.032, the critical values are 125.620, 95.750, 69.820 and 47.860 respectively. This implies that there exists a long-term relationship between the signal level of Unity TV and the studied components of atmosphere [15].

Table 2: Result of Trace test Cointegration for AIT

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.861	140.677	125.615	0.004
At most 1	0.737	83.431	95.754	0.259
At most 2	0.460	44.657	69.819	0.842
At most 3	0.371	26.760	47.856	0.863
At most 4	0.315	13.294	29.797	0.877
At most 5	0.075	2.318	15.495	0.989

Table 3: Result of Maximum Eigen test Cointegration for AIT

Unrestricted Cointegration Rank Test (Maximum Eigen value)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.848	57.246	46.2314	0.0023
At most 1	0.700	38.775	40.078	0.069
At most 2	0.504	17.897	33.877	0.883
At most 3	0.436	13.466	27.584	0.858
At most 4	0.324	10.976	21.132	0.650
At most 5	0.293	2.261	14.265	0.983

Table 4: Result of Trace test Cointegration for Unity TV

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.939	191.932	125.620	0.000
At most 1 *	0.702	110.866	95.750	0.003
At most 2 *	0.616	75.774	69.820	0.016
At most 3 *	0.576	48.032	47.860	0.048
At most 4	0.395	23.145	29.800	0.239
At most 5	0.188	8.5870	15.500	0.405

Table 5: Result of Maximum Eigen test Cointegration for Unity TV

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.939	81.066	46.232	0.000
At most 1	0.702	35.092	40.078	0.164
At most 2	0.616	27.742	33.877	0.226
At most 3	0.576	24.889	27.584	0.107
At most 4	0.395	14.556	21.132	0.321
At most 5	0.188	6.039	14.265	0.608

4. Conclusion

The comparative study of how atmospheric components influence the signal strength of terrestrial television in Abuja and Jos, Plateau state, has been carried out. The data of the parameters of the atmosphere (temperature, rainfall, atmospheric pressure, wind speed and relative humidity) measured with weather stations in Abuja and Jos, and the AIT signal strength measured in Abuja and Unity TV signal strength measured in Jos, were used for the analysis. The results show that there were monthly and hourly variations in the atmospheric parameters in both Abuja and Jos, and there was a variation in the signal strength of the two television stations too. From the results, it was observed that the SSR of the two stations- AIT measured in Abuja, and Unity TV measured in Jos were higher in the morning and evening periods and lower in the afternoon period. It was also shown that the SSR of Unity TV, Jos, was greater than that of AIT Abuja in the two years of study. The result further showed that wind speed, atmospheric pressure, temperature, and rainfall are indirectly related with the received signal level of the AIT and Unity TV, and that both are directly proportional with the received signal level of the two stations. It could be inferred that the lower signal level in the noon period is as a result of the inverse relationship with atmospheric temperature as temperature will be higher in the noon compared to morning and evening period. The higher SSR in Jos compared to Abuja could probably be as a result of the lower temperature of Jos compared to that of Abuja, hence, a favourable condition for increase in signal strength. From the results of the cointegration analysis, we can therefore, conclude that there is a long-term relationship between the SSR of the two television stations and the atmospheric components. Though the effects of these components of the atmosphere were felt in both Abuja and Jos, it is likely that the effect felt in Jos was not as strong as that felt in Abuja due to altitude, and the average temperature differences of the two locations, hence the higher signal strength in Jos than in Abuja. It could be as a result of the short distance (10 km) between the transmitter and receiver in Jos compared to the distance (18 km) between the transmitter and receiver in Abuja. The results will find usefulness to Nigeria Broadcasting Commission (NBC) being a regulatory body would ensure compliance with well-developed operational guidelines for improving quality of signal performances. It will also serve as benchmarks for digital link budgeting in other parts of Nigeria.

References

- [1]. Ojo JS, Ayegba A, and Adediji AT. Modeling digital terrestrial television signal strength with atmospheric parameters and noise temperature: A case study of North-Central Nigeria". *Journal of Physics: Conference Series*, 2021;1 – 9. doi:10.1088/1742-6596/2034/1/012002
- [2]. Obiegbu UA, and Anene CR. Experimental Study On The Impact Of Meteorological Variables On Ultra High Frequency Radio Signal Generated By Anambra Broadcasting Corporation (Abs) For Sustainable Development In Awka, Anambra State Metropolis, Nigeria. 2023;1 – 20. Available at <https://www.researchgate.net/publication/372100981>
- [3] Ukhurebor KE, Azi SO, Abiodun I C and Ojiemudia SE. Influence of Weather Variables on Atmospheric Refractivity over Auchu Town, Edo State, Nigeria. *Journal of Applied Science and Environmental Management*. 2018;22 (4): 471 – 475.

- [4]. Ajewole MO, Akinbolati A, Adediji AT and Ojo JS. Precipitation Effect on the Coverage Areas of Terrestrial UHF Television Stations in Ondo State, Nigeria". *International Journal of Engineering and Technology*. 2014;4(9):525-535
- [5]. Haykin S. *Sistemas de Comunicação Analógicos e Digitais*. 4 th ed. Porto Alegre, Brazil: Bookman, 2004.
- [6]. Amajama J. Impact of Atmospheric Temperature on (UHF) Radio Signal". *International Journal of Engineering Research and General Science*. 2016; 4(2); 619-622
- [7]. D. Yabwa, O. M. Kanu, M. I. Dawaki. Determination Of The Effects of Radio Signal Strength And Attenuation As A Function Of Linear Distance And Some Atmospheric Conditions on TSBS, Jalingo, Taraba State. *FUDMA Journal of Sciences (FJS)*. 2023, 1. 7(3); 207-214.
- [8]. Mat R, Shafie MM, Ahmad M, Umar R, Seok YB, Sabri NH. Temperature Effect on The Tropospheric Radio Signal Strength for UHF Band at Terengganu, Malaysia. *International Journal on Advanced science, Engineering and information technology*, 2021; 16(5); 770 – 774
- [9]. Ojo JS, Ajewole MO and Sarkar SK. "Rain rate and rain attenuation prediction for satellite communication in Ku and Ka bands over Nigeria". *Progress in Electromagnetics Research B*. 2008.
- [10]. Akinbolati A, Akinsanmi O, and Ekundayo K R. Signal strength variation and Propagation profiles of UHF Radio wave Channel in Ondo state, Nigeria. *International Journal of wireless and microwave technology*. 2016; 6: 12 – 28.
- [11] Akinsanmi A, Ajewole MO, Adediji AT, Ojo JS. The Influences of Meteorological Parameters on Digital Terrestrial Television (DTT) Signal in the Tropics. *International Journal of Digital Information and Wireless Communications (IJDWC)*. 2017; 7(3): 161-172.
- [12]. Orji PO, Chiemeka IU, Obiegbona D C and Eze C M. Estimation of rain attenuation effect on radio wave propagation for broadband communication over northern Nigeria. *IOP Conf. Series: Earth and Environmental Science* 1178. IOP Publishing doi:10.1088/1755-1315/1178/1/012027. 2023; 012027 1 - 10
- [13]. Ale F, Ayegba A, Agboola O, Olatunji PJ. Effects of some weather variables on the signal strength of Maloney FM radio, Nasarawa State, Nigeria. *Heliyon*. 2024; e25978: 1 – 9.
- [14]. Boyle R. *A Defence of the Doctrine of touching the spring and weight of air*, London: Thomas Roycroft, 1662. (Section: The Law of Gases)
- [15]. Emmanuel AA, Akeem AT, Adetomiwa K. Liberation vis-à-vis non-liberalisation trade policy: Exploring the impact of price volatility on producer share price and cocoa supply response in Nigerias and Ghana. *Heliyon*. 2024; e32741: 1 – 20.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

