Engineering and Technology Journal e-ISSN: 2456-3358
Volume 07 Issue 12 December-2022, Page No.-1755-1768
DOI: 10.47191/etj/v7i12.01, I.F. – 6.484

Analysis Model for Non-predictive Patterns of Non-Ionizing Radiations

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ABSTRACT: Non-ionizing radiations have been, and still are, a problem whose approach arouses great social interest, due to its controversial implications for human health and the interest of telecommunications companies in the development and implementation of technologies wireless networks based on the propagation of electromagnetic waves. The recurring question generated from society is related to the possibility that said radiation affects healthin some way. The present study is based on the hypothesis that, if there is any degree of affectation, it could be due to an effect found regarding non-predictive patterns of propagation of electromagnetic waves and punctual concentration of radiation in very small areas, generating differentials in the level of density of immission. A field work has been carried out looking for the elements of the urban and suburban environment that facilitate and/or enhance the concentration of radiation at a point and were analyzed with qualitative statistical models with binary logistic regression and association analysis, to develop a prediction pattern. possibility of existence of a point of high density of electromagneticimmersion depending on elements of the environment.

1 INTRODUCTION

1.1 Non-ionizing radiation

Non-ionizing radiation is produced from interaction mechanisms between the electric and magnetic wave fields on the molecules of living beings that give rise to the displacement of ions that are in undisturbed positions, this generates vibrations of the same and evenrotation of bipolar molecules, in particular the water molecule. Although these disturbances exclusively produce random thermal agitation, which gives rise to a heating effect known as SAR (Specific Absorption Rate). It is assumed that they must be fast enough for the effectsto occur in the time of the interaction, therefore there is a minimum level and frequency threshold for the response to be considerable.

Regarding the value of public exposure for NIRs, the Argentine telecommunications governing body ENACOM (National Communications Entity) explains that "Several studies have investigated the effects of radiofrequency fields on brain electrical activity, cognitive function, sleep, heart rate, and blood pressure in volunteers. To date, these studies seem to indicate that there is no conclusive evidence that exposure to radiofrequency fields below the level that causes tissue heating has harmful effects on health.

1.2 Effects on Human Health

At the international level, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) treats RNI by defining that "direct effects are the result of direct interaction of the fields with the body, indirect effects involve interaction with an object at a different electrical potential of the body."

In the treatment of these radiations, the assumptions that are explicit for what is called the far field must be taken into account, that is, the space in which the radiation propagates and where the wave is considered to have a flat front:

- Wave fronts They have a flat geometry.
- Vectors E and H and the direction of propagation are mutually perpendicular.
- The phase of the E and H fields are the same, and the ratio of the E/H amplitudes isconstant through space.
- In free space, the E/H ratio = 377 ohms which is the free space characteristicimpedance.

The power density is called S, that is, the power per unit area, normal to the direction of propagation. It is related to electric and magnetic fields by the expression:

$$S = \frac{E}{H} = \frac{E^2}{377} = \frac{H^2}{377}$$

Under these conditions, electromagnetic fields interact with the human body producing a certain level of internal currents, whose dependence is related to the coupling mechanisms and with the frequency that is considered. Ohm's law is applied to establish the current density, which will be the product of the electrical conductivity of the medium, multiplied by the electric field. This will generate a dosimetry which entails recommendations which are related to the current density in the frequency range up to 10 MHz and the specific rate of absorption in the frequency range from 100 KHz to 10 GHz.

The power density also appears in the range of specified frequencies, between 10 and 300 GHz, which is precisely what measures the magnitude called electromagnetic immission, which is specified in $\frac{W}{m^2}$ or $\frac{uW}{cm^2}$, while the specific energy absorption rate SAR is measured in will be measured in $\frac{W}{kg}$.

Taking this characterization into account, it is necessary to state that the recommendations that are made to limit exposure to non-ionizing radiation are not particularly related to the possibility of inducing cancer, but to immediate health effects from short-term exposures. , such as stimulation of peripheral nerves and muscles, electric shocks and burns caused by contact with conductive objects, also the generation of elevated temperatures in tissues as a result of the absorption of energy during exposure to electromagnetic radiation.

ICNIRP does not include a the risks of contracting cancer, expressing that the available information is insufficient to provide a basis for the establishment of restrictions on exposure and, delving into the subject, expressing that the epidemiological investigation provides evidence, which, although it is classified as suggestive, is not convincing enough to associate carcinogenic effects at 50 or 60 Hz magnetic flux density exposure levels, which are substantially lower than those recommended. It takes into account the effects obtained from short-term exposures to electromagnetic radiation without having obtained a clear relationship between this exposure and the response obtained.
When considering the epidemiological studies, the results are usually inconclusive in relationto the laboratory study. The vast majority of them are related to the increase in temperature caused by increased exposure to high frequencies, however the increase in that temperature does not produce a localized increase, according to the work of Chatterjee et al. 1986; Chen and Gandhi 1988; Hoque and Gandhi 1988

Referring to the studies by which microwave fields could be mutagenic, ICNIRP indicatesthat it was determined that there is a low probability.
As can be seen, there are different types of studies, some focused on the effects of warming and others that emphasize some conditions whose symptoms suggest greater risks.
These studies are collected annually by SSM (Scientific Council on Electromagnetic Fields) which gives relevance to the evaluation of risks to health from electromagnetic fields (EMF). They can be divided into broad sectors, such as:

- epidemiological
- studies experimental studies in humans
- experimental studies in animals
- in vitro studies.
- studies on biophysical mechanisms
- dosimetry
- evaluation of exposure.

In the latest edition, which corresponds to the year 2020, it is specified once again, as in previous editions, that it has not been possible to establish new causal relationships between exposure to electromagnetic radiation and health risks. Although, in any case, it leaves the door open to new studies. It is interesting, in this edition, the mention in this regard that some attempts have been made to discriminate the exposure to radio waves from other possible sources of impact. From the study, there is some indication of a weak impact of radio wave exposure, although it indicates that other similar studies are needed before solid conclusions can be drawn.

In conclusion none of the four human experimental studies on the effects of RF-EMF, which were published in the reporting period and which addressed various outcome parameters (electrodermal activity, heart rate, variability, thermal pain threshold, and symptoms) observed exposure effects. This adds evidence to the conclusion that there are no short- term adverse effects from RF-EMF exposure.

It is worth specifying here what the studies that SSM does, differentiate in three frequency ranges: those of an extreme low frequency, doing epidemiological studies, in humans, in animals and cell phones. In the same way, in intermediate frequency fields, he makes epidemiological studies in humans, animals and cells. Finally, radiofrequency investigations are also analyzed from the epidemiological point of view, for example: cancer in adults, hypersensitivity and symptoms in the presence of electromagnetic waves. In the particular case of human studies, the nervous system and the pain threshold are analyzed. In animal symptomatology, genotoxicity and oxidation stress, fertility and physiology are also studied, cell studies are carried out, how the adaptation response, genotoxicity and other points that have to do with conditions in cells

1.3 The Study of Electromagnetic Propagation

Although propagation research is carried out primarily with the Friis equation, this onlyanalyzes the attenuation in free space, as a consequence of the increase in the radius of a circular surface, with the gain and loss factors of the components of the transmission system, the transmitted power, the received power, the losses that exist both in transmission and reception and the consequent attenuation in free space. The attenuation factors are exclusively considered to be frequency and distance.

$$Lp(dB) = 20\ Log\ d + 20\ Log\ f - 10\ Log\ Gt - 10\ Log\ Gr - 147.55\ dB$$

However, two important aspects have been analyzed in more detail for some time: on the one hand, the consideration of the effect of reflection, as an analysis of two incident rays towards any location, what will cause a constructive or destructive interference, according to a geometric analysis and phases involved. In these cases the height of the antennas has a great incidence, being the power received:

$Pr = Pt\ Gt\ Gr\ ht^2 hr^2\ _D 2$

Which indicates that at short distances the reflection effect is more noticeable. Long ago, the effect of reflection was taken as detrimental to propagation, since it produced adverseeffects due to destructive interference, or, depending on the distance, beneficial effects due to constructive interference. At present, when using the multiple input multiple output (MIMO)system, reflection has been taken as beneficial in the propagation of systems that make use of MIMO systems, to such an extent that cellular telephone companies have massively adapted their facilities to make extensive use of reflection propagation.

It is more interesting to take into account the two propagation models initiated from Okumura's research, who devised a graphic method based on experimental measurements in Japan. Later, Masaharu Hata defined, through mathematical equations, indicating that radiofrequency waves behave logarithmically. This is how the first Hata-Okumura propagation model arises, in which a differentiation in frequency ranges is taken for the first time, but also in environments, differentiating urban, suburban and rural areas and applying different coefficients for the logarithmic functions. This modelis expressed as:

$L50(dB) = LF + Amu\ (f, d) - G(hte) - G(hre)$ - $GAREA$

Where:
L50 (dB): Median path attenuation
LF: Free space attenuation
Amu (f, d): Average relative attenuation (curves) G (htx): Height gain of the Tx antenna.
G (hrx): Rx antenna height gain.
GAREA: Gain due to the type of environment

This model was improved by the European Cooperative for Scientific and Technical Research (EURO COST) which developed the COST 231 model, it itself introduces a correction factor to adapt the Hata-Okumura model to a range of frequencies higher than the UHF band, introducing a correction factor in decibels. It differentiates medium-sized and suburban cities from large metropolitan centers. These corrections provide the consideration of dispersion losses in the frequency range of the previous model and extending up to 2 GHz.

The Walfish and Bertoni propagation model models the loss in three factors: that in free space, a level signal factor of the roofs and the most important is that of losses by diffraction in the signal that goes from the roofs to the level of the pavement.

These models derive from the COST 231-Walfisch-Ikegami model, where the characteristics of an urban environment are introduced, such as: heights of buildings, width of streets, separation between buildings and orientation of streets with respect to the direct radio path between a base station and a subscriber. Its main characteristic is that this model is not deterministic but statistical and considers the characteristic values of the environment. Among which it is worth noting what is taken into account: the number of floors of the buildings, the width of the streets and even the presence of trees. In all cases the calculations are oriented towards obtaining the total losses of a signal emitted by an antennaat a height between 50 and 70 m. This model does not consider multipath propagation and its reliability decreases if the terrain is not flat. A combination that allows incorporating these parameters is the Longley-Rice model, which incorporates the two-ray terrestrial reflection model. This model has also been object of alterations and one of them is the introduction of the so-called urban factor.

Although there are also other iterative models that use databases based on the topography of a terrain, it is clear that they can make estimates of the signal level from a transmitting antenna to a given point. Other software recently appears, which based on all these models, effectively allow the signal intensity to be calculated for certain frequency ranges.

1.4 Immission

When total density measurements of the total power registered at a point are made, without discriminating its origin, and in turn taking a broadband spectrum, it is when we are talking about electromagnetic pollution by immission . The regulations aim at measuring the sum of the radiation sources to which the population is exposed. Based on these definitions, the immission analysis cannot be performed with a predictive model, since the variety of radiation sources exceeds a model based on diffraction, reflection and propagation formats in the field. free space, even combined. This opens a field of investigation, where the aspects of the environment should be taken as specified in the predictive models, but considering, not a point source with a specific frequency or specific frequency range, but the interaction of all types of radiation at a point, considering the surrounding environment as a whole, but discriminating in its factors.

Ordóñez et al (2010) conclude that although the intensity of the electromagnetic field radiated by telephone stations and other radiation emitters can be theoretically predicted, the real environment always deviates from the ideal model, and therefore, they indicate that the only way to obtain this real value by making measurements.

Luján et al (2013) carried out experimental measurement work with a NARDA EMR 300 Electromagnetic Field Meter instrument, 100 KHz to 3 GHz. For the measurements, they used a methodology based on taking radiation from different models of cell phones, as well as a variety of equipment. and every day electronic devices. Their conclusions are revealing:

- Cell phones are not the only source of microwave radiation present in everyday environments.
- A low consumption lamp can cause fields 140 times more intense than a digital cell phone on a call.
- The radiations of cell phones are very far from the range of ionizing frequencies that excite electronic of molecules.
- Talking on a cell phone inside metallic structures multiplies radiation exposure several times and doing so from cars moving away from cell phone masts also increases their radiation levels, subjecting vehicle occupants to higher levels of exposure.

The first and the last two are consistent with the working hypothesis of this work.

2 WORK HYPOTHESIS

From the work of Breslin (2019) it can be seen that there are non-predictive patterns in the immission measurements of non-ionizing radiation, however, the same work indicates that, from the measurement campaigns, points have been found of radiation that not only are not predictive, but have levels much higher than those of their adjacencies, which have been called "*concentration points of non-ionizing radiation*", it is thus necessary to delve into these points since epidemiological investigations take areas of work, but no explicit points. Under this perspective, a field of research is opened in the area of health, taking the possibility that a person may be exposed to a much higher level of radiation than another, even in the vicinity. The measurement campaign mentioned in the work of Breslin (2019), indicates that these concentration points do not have large diameters, but rather areas, with diameters between 2 and 3 meters, and that the radiation differentials between the point of high concentration and those of normal radiation, can be higher by an order of magnitude.

The challenge is to predict which are the conditions that favor the high concentration of radiations and to model them.

3 METHODOLOGY

Based on the experiences of previous research work, a series of environment elements were raised. The working hypothesis is that certain elements of the environment could be established as determining factors for the existence of RNI concentration points, namely: Massive metallic structures located at ground level and metallic structures at the level of a second floor, that is, heights of 2 4 to 5 meters of considerable sizes (not less than 10 meters wide), correspond to metal gates and bars, public signage at level and height.

- Sheet metal roofs or parabolic-type metal structures
- Buildings with two floors
- Buildings with three or more floors
- Presence of electrical distribution transformers
- High density of low voltage
- electrical wiring Presence of medium voltage electrical wiring
- Plants with flat sheets with diameters less than the length wave of 0.4283 meters(700 MHZ)

An action protocol was proposed before the detection of points called "*radiation concentration points* ", this protocol includes the determination of the diameter in which the point of high radiation is verified, the determination of the surrounding normal radiation and the maximum radiation in the concentration area, the verification of the presence in the environment of 50 meters of the elements of the environment and the taking of photographs for registration. Each point was georeferenced in a spreadsheet that includes the item and additional observations.

4 ANALYSIS OF THE FIELD WORK

A total of 300 measurements were made, of which 100 were selected that meet the condition of being points where the radiation differential, with respect to a normalized value, is greater than an order of magnitude, following the specified action protocol.

The predominant areas for the study coincided with the area of the previous work and belong to the northern sector of the city of Salta Capital

4.1 Analysis of Statistical Data of Measurements

For the analysis of the values taken, the IBM SPSS software has been chosen, since the study tends to be qualitative. This software provides tools that allow you to quickly query data and formulate hypotheses, run procedures to clarify relationships between variables, identify trends, and make predictions.

4.1.1 Descriptive Statistics

The first analysis that is carried out is related to descriptive statistics and focuses on the differential value of radiation density between what has been called normal radiation, with respect to radiation at the point of concentration

4.1.1.1 High and low values

Descriptive Statistics

Table N°1: values of classical descriptive statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
normal real difference	50	6.44	1.17	7.61	2.9976	1.66565 2.774	Valid
N (listwise)	50						

these values, it allows establishing the value of the radiation differential that configures a discrimination, between what is considered a high value and a low radiation value.

4.1.1.2 Mean Value

A second level of analysis is that of normal values which, as can be seen, is situated at 0.23

$$\frac{uW}{cm^2}$$

Descriptive Statistics

Table N°2: statistical values for the normal level of radiation

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
normal value of radiation	50	.84	.02	.2390	.20315	.86	.041
Valid N (listwise)	50						

4.1.1.3 Pearson Correlation Between Amount and Level

The third analysis tends to obtain a possible correlation between the amount of construction elements present in a high radiation point, and the radiation level, under the hypothesis that the sum of elements that favor radiation concentration could positively affect the existence of radiation concentration points.

The Pearson correlation coefficient measures the degree of linear relationship between two variables and assumes a value between −1 and +1. If one variable tends to increase while the other decreases, the correlation coefficient is negative. On the other hand, if the two variables tend to increase at the same time, the correlation coefficient is positive

Where:

$$\rho = \frac{\sum_{i=1}^{n} (X_i - X)(Y_i - Y)}{(n-1)\, SxSy}$$

X is the sample mean for the first variable Y sample mean for the second variable

n is the number of observations

Sx is the simple standard deviation for the first variable

Sy is the simple standard deviation for the second variable

CORRELATIONS

Table N°3: Correlation of Pearson

		sum of positive variables	real difference normal
sum of positive variables	Pearson Correlation	1	-.023
	Sig. (2-tailed)		.872
	N	50	50
normal real difference	Pearson Correlation	-.023	1
	Sig. (2-tailed)	.872	
	N	50	50

From the analysis of the Pearson correlation, it can be noted that since it is a negative value, although not very high, there is no correlation between the number of significant construction elements and the value of the radiation differential. Therefore, not with the total value of radiation either.

Regarding the existence of a point of high radiation, it cannot be correlated with the number of construction elements, since the existence or absence is a constant

Correlations

Table N°4: correlation with the sum of the variables

		sum of positive variables	existence of point of high radiation
sum of positive variables	Pearson Correlation	1	.to
	Next (2-tailed)		.
	N	50	0
existence of high radiation point	Pearson Correlation	.to	.to
	Next (2-tailed)	.	
	N	0	0

It cannot be calculated because at least one of the variables is constant

4.1.2 Inferential Statistics

Taking into account the nature of the independent variable, insofar as it can be analyzed, either by its absolute differential value between normal radiation and punctual radiation, or, taking into account the median, it will be transformed into a binary dichotomous variable, for which a high radiation differential value will be established, above 2.99 $\frac{uW}{cm^2}$ and low differential at lower values, therefore it can only take two values. These are complementary and will not be comparable, as happens in a linear regression, therefore, by applying the logistic regression model, it will be possible to predict the probability of high radiation occurring or not, what is the object of study.

By doing this analysis, it is possible to study the impact that each of the predictors has on the occurrence of the event subject to analysis, with the advantage that it is a very flexible tool in terms of the nature of the predictors, since they can be scale or categorical.

In logistic regression, it is assumed that the data follow the following model

$$l_n\left(\frac{p}{1-p}\right) = b_0 + b_1 * x_1 + b_2 * x_2 + \ldots + b_k * x_k + u = x * b + u$$

if we take what:

$$z = b_0 + b_1 * x_1 + b_2 * x_2 + \ldots + b_k * x_k$$

this leads to:

$$p = \frac{e^z}{1 + e^z}$$

This expression indicates that the logistic regression model is a non-linear regression model but, applying a logarithmic scale, it has a linear form.

Applying logarithm and operand we arrive at what:

$$l_n(p) - l_n(1 - p) = b_0 + b_1 * x_1 + b_2 * x_2 + \ldots + b_k * x_k$$

This expression indicates that the difference between the probability that an event occurs with respect to that it does not occur, is linear on a logarithmic scale.

The solution to find the coefficients b must be done from any point called b_0, for which reason an initial estimate of the value of the real parameters is made and a recursive procedure is used with the Newton-Raphson algorithm.

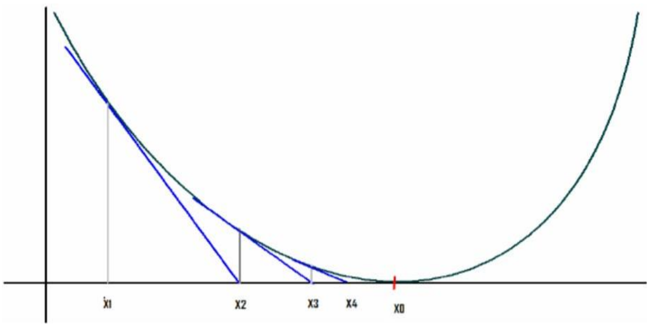

Figure No. 1: obtaining values from recursion

Taking into account what was stated above, the values are processed in SPSS with the following results for a logistic regression.

Variables en la ecuación

		B	Error estándar	Wald	gl	Sig.	Exp(B)
Paso 1[a]	cartalta(1)	1,334	1,626	,673	1	,412	3,795
	portones(1)	1,594	,759	4,415	1	,036	4,925
	cercas(1)	,790	,767	1,061	1	,303	2,204
	edif2(1)	1,692	,577	8,595	1	,003	5,429
	edif3(1)	1,690	,954	3,141	1	,076	5,421
	techosm(1)	,654	1,154	,322	1	,571	1,924
	cantidad	-1,429	,533	7,193	1	,007	,240
	Constante	,805	,571	1,992	1	,158	2,238
Paso 2[a]	cartalta(1)	1,453	1,557	,870	1	,351	4,275
	portones(1)	1,506	,740	4,144	1	,042	4,510
	cercas(1)	,655	,725	,816	1	,366	1,926
	edif2(1)	1,654	,571	8,385	1	,004	5,228
	edif3(1)	1,609	,942	2,918	1	,088	4,997
	cantidad	-1,357	,513	6,991	1	,008	,258
	Constante	,844	,570	2,193	1	,139	2,325
Paso 3[a]	portones(1)	1,257	,682	3,398	1	,065	3,515
	cercas(1)	,405	,668	,368	1	,544	1,500
	edif2(1)	1,558	,561	7,708	1	,005	4,749
	edif3(1)	1,435	,920	2,431	1	,119	4,199
	cantidad	-1,129	,443	6,506	1	,011	,323
	Constante	,774	,560	1,915	1	,166	2,169
Paso 4[a]	portones(1)	,980	,502	3,811	1	,051	2,665
	edif2(1)	1,493	,550	7,363	1	,007	4,450
	edif3(1)	1,299	,899	2,086	1	,149	3,665
	cantidad	-,958	,336	8,123	1	,004	,384
	Constante	,879	,538	2,674	1	,102	2,408
Paso 5[a]	portones(1)	,937	,494	3,599	1	,058	2,554
	edif2(1)	1,445	,544	7,061	1	,008	4,241
	cantidad	-,886	,327	7,320	1	,007	,413
	Constante	,871	,534	2,660	1	,103	2,389

a. Variables especificadas en el paso 1: cartalta, portones, cercas, edif2, edif3, techosm, cantidad.

Table N°5: summary of the application of the variables to the analysis model

The last analysis is the most relevant since it is where the b coefficients of the variables appear in the second column. We focus exclusively on the first step, since it is where all the variables are, both the continuous ones, which in this case is represented only by the number of predictors present, and the discrete ones that represent the existence or not of the predictor.

The third column is the standard deviation of the estimator.

The fourth column is the Wald estimator in which all coefficients > 4 will be significant.

The sixth column is the p-value of the coefficient, which is the probability that a calculated statistical value is possible given a true null hypothesis.

The seventh column is the exponential of the coefficient that is important in the impact of the qualitative variables.

As an example, assuming the probability, calculated for 2-story buildings:

$$\frac{p}{1-p} = e^{Z} = k.\, e^{1,692*edif2}$$

The result of the exponential is 5.43, which indicates that the probability of a high radiation point is multiplied by 5.43 if there are buildings two floors.

With the estimated coefficients, the probability of existence of a high radiation point can be predicted by building its probability function.

$P(node = \frac{1}{\ }) = {}^{1} x\ 1{+}e^{-z}$

Where:

$$z = 0{,}805 + 1{,}334 * cartalta + 1{,}59 * portones + 0{,}79 * cercas + 1{,}692 * edif2 + 1{,}690 * edif3 + 0{,}654 * techosm - 1{,}429 * cantidad$$

It is clear that the greater the number obtained in z, the probability approaches 100%, also that the greater the number of predictors combined in a area, the probability decreases.

The model requires 5 steps to achieve that the change in likelihood is minimal. At this point, only three variables have remained, which are the gates, the two-story buildings and the number of elements present.

By making an analysis of the results obtained from the logistic regression, and in particular, in the last step, where the model eliminates the variables to make the expression more precise, we came to the conclusion that the variable what has a real incidence on the presence of high radiation points, are the two-story buildings, in second place are the three- story buildings, in a third place the metal fences and wire fences, in a fourth place the high billboards and finally the metal roofs. It should be noted that the transformers and plantshave been discarded because there is only one unit in all the analyses.

5- TEST OF THE MODEL IN PLACES WITH HIGH BILLBOARDS

Based on the probability equation, and taking into account that the probability that there is a point of concentration of non-ionizing radiations would be explained by 33% by the high billboards, and the existence of two-story buildings, which is assimilable to mostly urban environments, a new measurement campaign was carried out taking into account only tall signage (heights of the lower edge greater than 3 meters) in different parts of the city, in urban environments and suburban (with the absence of two-story buildings). The probable distance to the antenna with the highest incidence was also taken into account

5.1 - Existence of High Radiation Points in the Presence of High Billboards

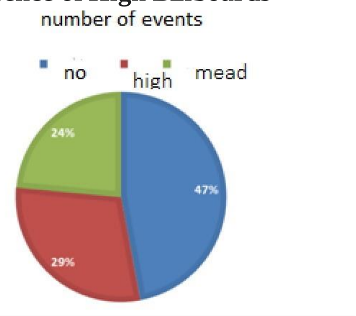

Figure N°2: assertiveness graph of the probabilistic model

From the result of the measurement campaign, it can be seen that in 53% of the sites where there are tall billboards there is a point of concentration of RNI

5.2 - Location Analysis

Focusing the analysis on the urban/suburban environment, it is observed that in 78% of the cases high or medium high values radiation levels are found in urban environments, while in suburban environments only 33% of the sites have high or medium levels, while that in the remaining 66% there are only normal levels of radiation.

5.3 - Incidence of the Distance with Respect to the Antenna and RNI Level

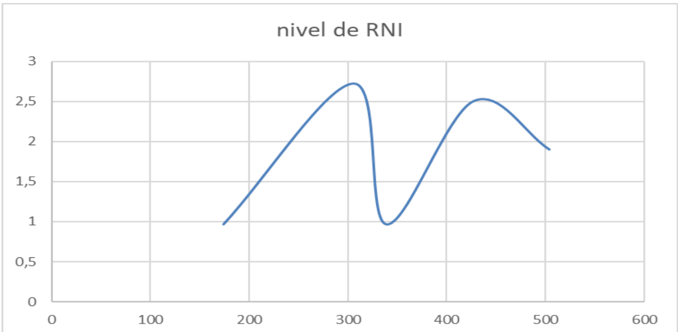

Figure N°3: Incidence of the distance with respect to the antenna and RNI level

From the curve it can be seen that high levels of radiation cannot be correlated with the distance to the antenna.

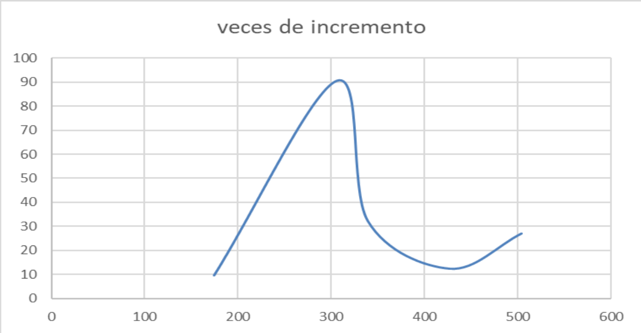

Figure N° 4: the distance with the times of increase with respect to the normal value in each site

From the curve it can be seen that high levels of radiation cannot be correlated with the distance to the antenna.

Mean Values

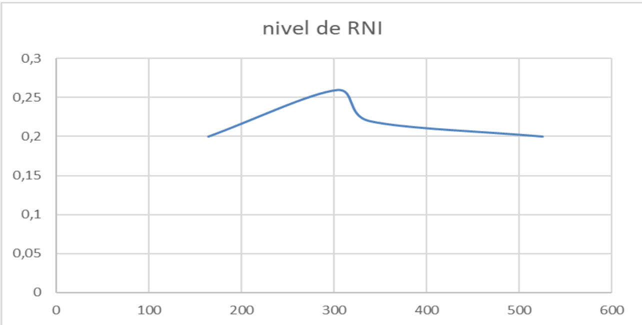

Figure N° 5: average levels with respect to distance to the antenna

In the average values, a correlation between level and distance to the antenna is notobserved either; in fact it tends to be a constant

Figure N°6: relationship between distance to antenna and times of increase

Nor is there a correlation between distance and times of increase, but rather a certain correlation between level and times of increase.

6 - CONCLUSIONS

The present work starts from an initial condition, which implies the recognition that the constructive and destructive interferences of the different frequencies of non-ionizing radiations must be analyzed with the concept of electromagnetic immission. Under this paradigm, the traditional model of the transmission equation, even with all its evolutions, considering the diffraction and reflection factors, cannot explain a phenomenon that is verified when making measurements in mostly urban areas, which is the existence of of what has been called in this work “radiation concentration points”. It has been hypothesized that these points could be related to the construction environment, which generates an influence such as to verify this condition that cannot be predicated with the traditional model, which is why a common pattern of the surrounding environment has been sought, finding a certain amount of construction elements, what are common. Based on a measurement campaign carried out under a specific protocol, it has been possible to detect 100 points where a differential appears between the normal radiation in the area and the radiation level of a certain point.

Strictly using the measurement protocol, the existence or absence of these common construction elements was determined for subsequent statistical analysis.

Given the binary characteristics of the analysis and taking into account what is being worked with qualitative elements, a consistent qualitative study was carried out.

Descriptive statistics were used to consider what is the average radiation level by which the differential of radiation in high level and low level is going to be characterized.

Pearson's correlation was applied to determine if any of the construction elements has a linear correlation with respect to the radiation differential, finding no evidence.

Finally, given the binary nature of the data, logistic regression was used, which allows taking quality values and quantitative values in a single operation.

A model based on logistic regression was obtained, which can predict, based on the construction environments, the probability of existence of a "radiation concentration point" with coefficients applied to each of them.

Applying this model to one of these construction elements, which is the metal signage located at a level above the ground greater than 2.4 m, a level of assertiveness of 53% was achieved in the prediction.

Measurements were also made at specific points, which confirm the hypothesis that the radiation concentration points are not closely related to the distance from the most probable source of radiation, and do so with the construction environment, that is, what can be reasonably predicted, what is the urban environment, the presence of any of these construction elements with certain application coefficients given by the model, who are more likely to generate a radiation concentration point than in a suburban or rural environment .

7 - REFERENCES

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8 - ANNEXES

Resumen de procesamiento de casos

Casos sin ponderar[a]		N	Porcentaje
Casos seleccionados	Incluido en el análisis	99	100,0
	Casos perdidos	0	,0
	Total	99	100,0
Casos no seleccionados		0	,0
Total		99	100,0

a. Si la ponderación está en vigor, consulte la tabla de clasificación para el número total de casos.

Codificación de variable dependiente

Valor original	Valor interno
alta	0
baja	1

Codificaciones de variables categóricas

		Frecuencia	Codificación de parámetro (1)
techosm	hay	4	1,000
	no hay	95	,000
portones	hay	40	1,000
	no hay	59	,000
cercas	hay	65	1,000
	no hay	34	,000
edif2	hay	26	1,000
	no hay	73	,000
edif3	hay	7	1,000
	no hay	92	,000
cartalta	hay	3	1,000
	no hay	96	,000

Tabla de clasificación[a,b]

Observado			Pronosticado: existencia alta	Pronosticado: existencia baja	Porcentaje correcto
Paso 0	existencia	alta	0	49	,0
		baja	0	50	100,0
	Porcentaje global				50,5

a. La constante se incluye en el modelo.

b. El valor de corte es ,500

Variables en la ecuación

		B	Error estándar	Wald	gl	Sig.	Exp(B)
Paso 0	Constante	,020	,201	,010	1	,920	1,020

Modelo si el término se ha eliminado

Variable		Logaritmo de la verosimilitud de modelo	Cambio en el logaritmo de la verosimilitud -2	gl	Sig. del cambio
Paso 1	cartalta	-61,058	,615	1	,433
	portones	-63,079	4,656	1	,031
	cercas	-61,291	1,081	1	,298
	edif2	-65,442	9,383	1	,002
	edif3	-62,479	3,455	1	,063
	techosm	-60,909	,317	1	,573
	cantidad	-64,703	7,905	1	,005
Paso 2	cartalta	-61,308	,796	1	,372
	portones	-63,086	4,354	1	,037
	cercas	-61,323	,828	1	,363
	edif2	-65,467	9,116	1	,003
	edif3	-62,514	3,209	1	,073
	cantidad	-64,708	7,597	1	,006
Paso 3	portones	-63,090	3,565	1	,059
	cercas	-61,494	,373	1	,542
	edif2	-65,507	8,399	1	,004
	edif3	-62,644	2,672	1	,102
	cantidad	-64,912	7,210	1	,007
Paso 4	portones	-63,507	4,027	1	,045
	edif2	-65,508	8,028	1	,005
	edif3	-62,656	2,325	1	,127
	cantidad	-66,071	9,155	1	,002
Paso 5	portones	-64,550	3,787	1	,052
	edif2	-66,493	7,674	1	,006
	cantidad	-66,721	8,130	1	,004

Pruebas ómnibus de coeficientes de modelo

		Chi-cuadrado	gl	Sig.
Paso 1	Paso	15,731	7	,028
	Bloque	15,731	7	,028
	Modelo	15,731	7	,028
Paso 2[a]	Paso	-,317	1	,573
	Bloque	15,414	6	,017
	Modelo	15,414	6	,017
Paso 3[a]	Paso	-,796	1	,372
	Bloque	14,618	5	,012
	Modelo	14,618	5	,012
Paso 4[a]	Paso	-,373	1	,542
	Bloque	14,246	4	,007
	Modelo	14,246	4	,007
Paso 5[a]	Paso	-2,325	1	,127
	Bloque	11,921	3	,008
	Modelo	11,921	3	,008

a. Un valor negativo de chi-cuadrados indica que el valor de chi-cuadrados ha disminuido del paso anterior.

Resumen del modelo

Paso	Logaritmo de la verosimilitud -2	R cuadrado de Cox y Snell	R cuadrado de Nagelkerke
1	121,502[a]	,147	,196
2	121,819[a]	,144	,192
3	122,615[a]	,137	,183
4	122,988[a]	,134	,179
5	125,312[a]	,113	,151

a. La estimación ha terminado en el número de iteración 4 porque las estimaciones de parámetro han cambiado en menos de ,001.

Tabla de clasificación[a]

			Pronosticado		
			existencia		Porcentaje correcto
Observado			alta	baja	
Paso 1	existencia	alta	25	24	51,0
		baja	10	40	80,0
	Porcentaje global				65,7
Paso 2	existencia	alta	27	22	55,1
		baja	10	40	80,0
	Porcentaje global				67,7
Paso 3	existencia	alta	27	22	55,1
		baja	11	39	78,0
	Porcentaje global				66,7
Paso 4	existencia	alta	33	16	67,3
		baja	23	27	54,0
	Porcentaje global				60,6
Paso 5	existencia	alta	27	22	55,1
		baja	19	31	62,0
	Porcentaje global				58,6

a. El valor de corte es ,500

Las variables no están en la ecuación

			Puntuación	gl	Sig.
Paso 2[a]	Variables	techosm(1)	,328	1	,567
	Estadísticos globales		,328	1	,567
Paso 3[b]	Variables	cartalta(1)	,928	1	,335
		techosm(1)	,517	1	,472
	Estadísticos globales		1,215	2	,545
Paso 4[c]	Variables	cartalta(1)	,374	1	,541
		cercas(1)	,370	1	,543
		techosm(1)	,176	1	,675
	Estadísticos globales		1,492	3	,684
Paso 5[d]	Variables	cartalta(1)	,192	1	,661
		cercas(1)	,025	1	,875
		edif3(1)	2,283	1	,131
		techosm(1)	,086	1	,770
	Estadísticos globales		3,805	4	,433

a. Variables eliminadas en el paso 2: techosm.

b. Variables eliminadas en el paso 3: cartalta.

c. Variables eliminadas en el paso 4: cercas.

d. Variables eliminadas en el paso 5: edif3.