Revista Brasileira de Climatologia
ISSN: 1980-055x (Impressa) 2237-8642 (Eletrônica)

ASSOCIATION BETWEEN AEROSOLS AND HOSPITALIZATIONS FOR RESPIRATORY DISEASES

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ABSTRACT: The fires in Campo Grande have been a serious environmental problem. The objective is to study the trend of respiratory diseases (DAR), and correlates them with precipitation, wind speed, relative humidity, temperature, concentration of surface ozone, optical depth, number of outbreaks of fires and carbon monoxide. The records were obtained from the DAR Datasus; the outbreaks of fires and optical depth were obtained from the National Institute for Space Research and the concentration of ozone and carbon monoxide at the Institute of Physics of the UFMS. The mathematical correlation between the number of admissions for respiratory diseases and climatic indicators , indicated that the main source in order of significance are ozone, carbon monoxide, optical depth , fire outbreaks , wind speed , relative humidity , minimum temperature , rainfall . had two first principal components explained 91.48 % of the variance in the data studied, with a positive correlation between respiratory diseases, ozone, carbon monoxide, wind speed, optical depth and focus of fire and a negative correlation between rainfall, humidity and minimum air temperature, and the equation was determined with an error between the observed and estimated values of 2.29% and R- Sq = 89.1%.

KEYWORDS: Fires, Respiratory, climate, optical depth, clearness index.

ASSOCIAÇÃO ENTRE AEROSSÓIS E INTERNAÇÕES POR DOENÇAS RESPIRATÓRIAS

RESUMO: Os incêndios em Campo Grande têm sido um grave problema ambiental. O objetivo desse trabalho é estudar a tendência de doenças respiratórias (DAR), e correlaciona-las com precipitação, velocidade do vento, umidade relativa do ar, temperatura, concentração de ozono de superfície, profundidade óptica, número de focos de incêndios e monóxido de carbono. Os registros foram obtidos a partir do DAR Datasus; os focos de incêndios e profundidade óptica foram obtidos do Instituto Nacional de Pesquisas Espaciais e da concentração de ozono e monóxido de carbono no Instituto de Física da UFMS. A correlação matemática entre o número de internações por doenças respiratórias e indicadores climáticos, indicou que a principal fonte em ordem de importância são o ozônio, monóxido de carbono, profundidade óptica, focos de incêndio, velocidade do vento, umidade relativa, temperatura mínima, precipitação. tinha dois primeiros componentes principais explicou 91,48% da variância nos dados estudados, com uma correlação positiva entre doenças respiratórias, ozônio, monóxido de carbono, velocidade do vento, profundidade óptica e foco de incêndio e uma correlação negativa entre precipitação, umidade e temperatura mínima do ar , e a equação foi determinada com um erro entre os valores observados e estimados de 2,29% e R- quadrado = 89,1%.

PALAVRAS – CHAVE: Incêndios, respiração, clima, profundidade óptica, índice de claridade.

1. INTRODUCTION

Recent studies have shown that air pollution is responsible for several deleterious effects on human health, including increase in emergency room visits for respiratory diseases (NARDOCCI et al, 2013, SOUZA et al, 2013, MASCARENHAS et al, 2008; DENISE et al, 2013, SILVA et al, 2012; TRAMUTO et al, 2011; SETTE, D. M.; RIBEIRO, H, 2011), decrease in lung function (POPE et al, 1991;. HOEK; BRUNEKREEF, 1993 POPE&KANNER, 1993); increase in hospital admissions for respiratory diseases (IGNOTTI, et al, 2010; JASINSKI, PEREIRA, BRAGA, 2011; BUENO F et al, 2010), absence from work in adults and increased school absenteeism in children (Castro et al, 2009; OSTRO, 1990) and increase in mortality (PASTORELLO et al, 2012; HESS et al, 2009; AIDE et al, 2009; DOCKERY et al, 1992;. SALDIVA et al, 2007;.. ANDERSON et al, 1996; Michelozzi et al. 1998).

In recent decades, through technological advances, the catalysts of automobile exhausts and filters in industries for controlling pollutants emissions have been installed, which has helped to reduce the levels of particulate matter and other pollutants emitted into the atmosphere.

Thus, despite the introduction of air quality Standards with lower overall pollutants levels in recent years, several studies have suggested that even with the pollutants below the recommended levels, deleterious effects on human health are observed (HABERMANN, M.; Gouveia, N, 2012; HABERMANN, M.; MEDEIROS, APP; Gouveia, N, 2011). These studies confirm the difficulty in setting air quality Standards adequate for protection of the population, especially for individuals at risk, such as those with pre-existing disease. These studies were conducted in developed urban areas where air pollution is related to the burning of fossil fuels; however, where the effects severity and extent on human health caused by pollution from the burning of biomass in rural areas of developing countries.

The objective of this study is to investigate the application of Multivariate Analysis methodologies, through Principal Component Analysis (PCA) to identify correlations of respiratory diseases with climatic indicators.

2. MATERIALS AND METHODS

Databases related to the Hospital Information System of SUS, which were coded according to the International Classification of Diseases (ICD) 10th Revision (ICD10 J10 and J18) were used. The data analyzed refer to Chapter X of ICD 10, which covers the respiratory diseases (ARD) in the period from 2004 to 2009, making a historic run of six years. Records data on hotspots / fires were obtained from online database publicly available at the website of INPE, captured by the following sensors: AVHRR aboard the NOAA series satellites orbital; MODIS aboard TERRA and AQUA satellites orbital; geostationary satellite GOES.

Were considered as dependent variable (Y) the coefficients for respiratory diseases and as an independent variable (X), the years of study. The transformation of the variable year on year-centralized variable (year minus the midpoint of the study period) was required, as in polynomial regression models, the terms of the equation are often highly correlated, and express the independent variable as an deviation from its mean substantially reduces the auto-correlation between them.

Trend analysis of the time series was performed using a multiple linear regression model that best described the relationship between the independent variable X (ozone concentration, number of fires, precipitation, minimum, maximum and average temperature, relative humidity , wind speed and optical depth) and the dependent variable Y (coefficients of hospitalization for DAR) according to the equation: Y = β0 + + β1X1 β2X2 ++ βkXk + ... + ε; where, k: number of variables; Xj: regressors; βj: estimators; ε: standard error. As a measure of precision, the coefficient of determination (R2) were used. Residual analysis confirmed the assumption of homoscedasticity of the model (LATORRE MRDO; CARDOSO, MRA, 2001).

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The daily records of the concentration of O_3 and CO in the atmosphere during the years 2004 to 2009 were provided by the Federal University of Mato Grosso do Sul, in which campus was located at the monitoring station. The meteorological data used in this study were obtained from the meteorological station of the Brazilian Company of Beef Cattle - EMBRAPA. Geographically, it is situated at latitude 23° 39'S and 46° 37'W longitude.

The optical depth data were obtained from the Aerosol Robotic Network - AERONET, a network monitoring via remote sensing of aerosols operationalized by NASA and LOA-Photons. In Brazil, the program has nine stations operated by the INPE and the IAG / USP. The program provides a bank of continuous data and long-term radiometric and microphysical properties of aerosols in research related to aerosols, corrections of satellite images and links with other databases (Holben, 1998).

Measures of solar radiation at the surface is performed using an electronic sun photometer Cimel 318 that performs measurements of direct and diffuse radiation at 340, 380, 440, 500, 675, 870 and 1020nm channels in various angular directions in 15 minutes intervals and in certain zenithal and azimuthal preset positions. It has two collimators, one for measurement and one for direct radiation diffuse radiation coupled to the sensor head which is positioned a wheel which accommodates the sensor filters for various wavelengths measuring. The sensor head is attached to an zenithal and other azimuthal motor which direct the collimatorsto predetermined positions relative to the positioning of the Sun.

From the data of direct solar radiation at the surface and the known values of solar radiation at the top of the atmosphere. The term u is related to the path of the radiation in the atmosphere and depends on the zenithal angle of measure in the plane of the solar trajectory. Known these three terms can indirectly establish the optical depth parameter $\tau\lambda$ (SOUZA AND SCHUSH, 2001).

The optical depth determined from direct radiation considers all attenuators elements from the atmosphere and can be broken down into three components:

$$\tau_{total} = \tau_{aerossol} + \tau_{rayleigh} + \tau_{ozônio}$$

Components related to the action of ozone and constituents of uncontaminated atmosphere gases (N_2, O_2, H_2O, Ar, CO_2, among others) are modeled and discounted. The precipitable water is evaluated from the 940nm channel with strong absorption. Is still considered the attenuation due to pollutant gases such as CO, CO_2, CH_4, among others.

The data go through a qualification process that classifies them into three levels:

- Level 1.0 - raw data without any treatment;

- Level 1.5 - data only periods with no clouds.

The procedure for measuring the direct radiation is done three times within 30 seconds. If the measures exhibit pronounced difference, it is considered that there is the presence of clouds between the sun and the photometer;

- Level 2.0 - data quality and accuracy evaluated (equipment performance, anomalies in temperature sensors, filters degradation, data consistency compared to satellite images and climatological consistency). This procedure is performed when the equipment is sent to NASA for calibration. In this work, we used only data levels 2.0.

According VERMOTE AND VERMEULEN (1999), the role of aerosols in the attenuation of solar radiation is more significant in the 500nm channel. This fact justifies the use of the optical depth at this wavelength when seeking consider the action of aerosols on radiative transfer models. Considering this aspect, this work will use the aerosol optical depth at 500nm τ500nm channel as indicative of polluted atmosphere aerosols.

2.1 - Statistical Analysis

In this study a descriptive analysis of the variables will be made and, subsequently, the hypotheses will be tested using Multiple Regression Models.

Using the Mean Square Error (EQM) to verify the model skill.

$$\text{EQM} = \sqrt{\frac{1}{n}}\left(\sum_{i=1}^{n}(Pi - Oi)^2\right)$$

where: Pi is the estimated value and the observed value Hi.

In all analyzes we considered the significance level of 5%.

For analysis of the variables was carried out to standardize the data to apply the statistical technique, considering the method of Principal Component Analysis (PCA).

3. RESULTS AND DISCUSSION

Average temperatures in the region are considered elevated in spring-summer, being September and October the hottest months (average above 23 ° C) and mild in autumn-winter, but are rarely lower than 18 ° C, on average, and the months June and July at lower temperature regimes between 18 ° C and 21 ° C, the average height reached by precipitation during presents a distribution of 1330 mm.

The values of the averages temperature recorded monthly and annual lead to the understanding of the spatial and seasonal variations in the climate variable follows the characteristics of the region, the highest temperature regimes are observed between the months from October to March, corresponding to summer in the field of climate tropical in the southern hemisphere, and the month of October has the highest average since this is characterized by the transition between the dry and rainy season. Thus, changes in atmospheric circulation patterns, high rates of evapotranspiration, the low average wind speeds and incipient precipitation, such as low humidity favor the rising of the temperatures, which indicate the beginning of summer. Another analysis which may be made from the temperatures is that the temperature variation observed between the months with higher and lower temperatures is very low, ranging 4.0 ° C on average, between the month of June (lower thermal averages) and the month of October (the hottest month).

The rainy season (October to March / April) concentrates more than 85% of annual rainfall, while December and January are contributing more than 35% of the annual precipitation. Already the dry season, which in some years begins in April and extends until the beginning of October, is characterized by a significant reduction in rainfall and, in the driest quarter (June to August), rainfall represent, on average, less than 2% of the annual total.

During the dry season it is possible to observe long periods without rain and/or insignificant rainfall, well below the evapotranspiration (Etp) daily and that does not change the condition of dryness of the environment. These periods often come to exceed 100 days. During the analysis, the amount of years and the average followed days when occurred such prolonged dry periods, with reference to those superior to 75 consecutive days.

It is also observed that the average days in years when long dry periods above the minimum of the research occurred were 105 days and the median days without significant rainfall (less than 2.5 mm) is 110 days, and that almost half of the years shows a long period without rain exceeding 75 continuous days. This period coincides with the time of year the dry season, being most commonly occur in the months of June, July and August.

The number of admissions from respiratory diseases in the period 2004-2009 showed an average number of 1314 admissions / year in this period, we find that the months that have a higher percentage of admissions are the months of July, August and September with 29%, followed months of April, May, June with 27.3%; October, November and December with 24.4% and finally the months of January, February and March that have a value of 19.2% (Figure 1).

The variation of aerosol concentrations in the atmosphere of Campo Grande - MS is strongly influenced by biomass burning. The practice of burning biomass is related to weather conditions prevailing in Campo Grande during the second half of winter and the first half of spring. The long period without rainfall and very low relative humidity are meteorological factors that contribute to the seasonality of biomass burning (Figure 1 - Spotlights burned).

The seasonality with the atmosphere of Campo Grande / MS is contaminated by aerosols is verified. The critical periods occur between August and October coinciding with the dry season. The values of the monthly averages of optical thickness at 500nm channel (τ500nm) begin to rise from the month of August with (τ500nm ~ 0.1). The maximum values typically occur in September (τ500nm ~ 0.5 to 1.0) and decreased from October to the beginning of the rainy season. The effect of reduction of aerosols in the atmosphere with the beginning of the rainy season varies from year to year. The analysis of the major events of intense attenuation of radiation by aerosols with the number of hotspots detected by the AVHRR / NOAA and the movement of the plumes by MODIS / TERRA sensor indicated some regions as the main contributors to the atmosphere of Campo Grande / MS (Figure 1 optical-depth).

An analysis of mathematical correlation between the number of admissions for respiratory diseases with the concentration of surface ozone, carbon monoxide, hot spots detected monthly by AVHRR / NOAA, precipitation, relative humidity, wind speed, minimum temperature, and average values τ500nm was performed. The values of "R" are shown in Table 1.

Table 1 - Pearson correlation coefficient as a function of environmental indicators

Ozone	CO	Rainfall	minT	RH	speed	Optical Depth	Fire Outbreaks
0.76	0.74	-0.63	-0.60	-0.78	0.84	0.52	0.65

Table 1 presents the Pearson correlation coefficients of respiratory diseases (ARD) in relation to climate variables. Observed an inversely proportional relation between precipitation, air temperature and relative humidity. For the respiratory diseases there is a positive and statistically significant correlation between the wind speed, optical depth, carbon monoxide and ozone.

Analysis of the data by principal components resulted in two components with own values, which explain 91.48% of the variance observed in the study area. Thus, the first component explains 67.33% of the variance. The second component explains 24.15% of the total variance (Table 2).

That is, most of the variability and components can be used as an indicator of causes of respiratory disease without significant loss of characteristics. The factors are: group 1; ozone, carbon monoxide, fire outbreaks and optical depth, wind speed. Component 2: temperature, relative humidity, and precipitation.

Table 2 - Sequence of eigenvalues in descending order and the contribution of the data total variance, ozone, carbon monoxide, wind speed, optical depth, fire outbreaks, rainfall, humidity and temperature.

Eigenvalues	%total variance	Eigenvalue acumulated	% acumulated
6.06	67.33%	6.06	67.33%
2.17	24.15%	8.23	91.48%

In a dendrogram (Figure 2), which corresponds to the figure with the coefficients of overcrowding rescaled where the lower coefficient corresponds to 1 and greater than 0.25, it is clear that the optimal cutoff value is the distance from just above 0 25, after the formation of the two groups.

The similarity between the groups defined by cut-off point in the dendrogram may be better analyzed and interpreted through Table 3.

Table 3 - Average standard deviation, maximum and minimum of the investigated parameters, defined by cluster analysis and risk values.

	Variables	Average	dp	Mínimum	Maximum	Risc	I.C 95%	
	Ozone	17.74	16.48	10.37	29.97	1.00118	0.97818	1.02417
	CO	170.81	170.98	133.59	241.08	0.9996	0.97660	1.02259
Group 1	Speed	3.68	3.54	3.02	4.41	1.08177	1.05877	1.10476
	Opt. depth	0.15	0.15	0.06	0.33	1.39654	1.37354	1.41953
	F. outbreaks	513	690.33	114	1705	1.00001	0.97702	1.02301
	Rainfall	3.6	2.71	0.6	7.1	0.98235	0.95936	1.00535
Group 2	Min T	18.85	17.76	15.5	21.37	0.99590	0.97291	1.01890
	RH	65.7	57	47.32	78.48	1.00370	0.98071	1.02670

The cluster analysis generated a variables significant classification, identifying how influence the incidence of respiratory diseases. Therefore, it is attested that the seasonality was instrumental in defining the clusters. Several studies confirm the relationship between climate and respiratory diseases, with mild temperatures (or sudden drops) and long periods of drought, which corroborate the injury on the respiratory system, increasing cases of hospitalization. It was observed that the highest number of admissions for respiratory diseases occurred in the early months of autumn and late winter (April to September) (Figure 1), during which the minimum temperature decreased and the drought and the absence of precipitation increased. In the same period, the highest monthly concentrations of fire outbreaks occur recorded by satellite, may be from different causes, both natural as anthropogenic.

As a worsening of these conditions in winter (dry) add up massive amounts of particulate matter in the air - emitted particulate matter - mainly by the burning, worsen symptoms of hospitalization for respiratory diseases (Table 2, Figure 1). With deforestation expanded agricultural fields, which, in time to prepare for planting, increase the amount of suspended particulate matter in the air. The analysis of climatological data, as hospitalizations for respiratory and concentration indices of ozone and carbon monoxide demonstrated correlations. Periods of prolonged drought, oscillations and drops in temperature and relative humidity, in most cases lower than 60%, were present at times when there was an increase in the number of cases of hospitalization for respiratory diseases (Table 1).

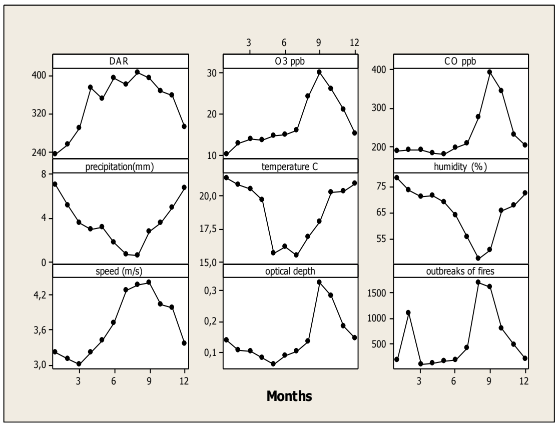

Figure 1 Seasonal variation in respiratory disease (ARD), concentration of ozone (O_3) ppb, Carbon Monoxide (CO) ppbv, rainfall (mm), minimum temperature (0C), relative humidity (%), wind speed (m / s), optical depth, fire outbreaks to Campo Grande.

If the data are correlated, one must adjust the model taking into account these self correlations. This correction is made by inserting the residue in the model. All considerations of time trends should be observed when performing a study, for example, on the impact of a given pollutant in population health. Other factors that are generally considered in these studies are the effects of temperature, precipitation and humidity. After considering the factors mentioned, we find the values of the coefficients β's. of the equation: intercept = - 0.022; βozone = 0.0118; βCO = -0.00040; Brainfall = - 0.0178; βmintemp = - 0.0041; βrh = 0.00371; βwind speed = 0.0786; βopticaldepth = - 0.334; βfireoutbreaks = - 0.000018; with a mean square error = 2.29% and R-Sq = 89.1%.

4. DISCUSSION

Environmental degradation is a major problem of modern society. Technological development, population growth (and their concentration in urban areas), industrialization and the use of new methods and techniques in agriculture are some of the contributing factors for the introduction of different chemical, synthetic and even natural substances in the environment that generate adverse effects on the environment and living beings.

The composition and structure of the atmosphere are undergoing significant changes due to changes in land use in some areas. Important changes in the concentration of aerosol particles and the concentration of several trace gases occur as a result of emissions from fires. These changes occur from the local scale up to thousands of miles away from the regions of emission. The water cycle may be changing due to the emission of large amounts of particles that act as cloud condensation nuclei, and properties of micro-physics of clouds are changing. Changes in land use are also affecting emissions of biogenic gases that participate in the processes of particle formation and clouds. Strong changes in the atmospheric radiative balance may be affecting the assimilation of carbon by the ecosystem, with changes in the primary productivity of forests in large areas. Still, it is assumed that the changes of the cycles of water, energy, carbon, nitrogen and nutrients, resulting from use change and land cover can cause climatic and environmental consequences at local, regional and global scales. All these strong changes in atmospheric processes critical to ecosystem health indicates that changes in land use go beyond just the exchange of forests for pasture and cultivation, but point to deeper environmental changes with effects on the ecosystem.

One of the main ways to study and evaluate respiratory deseases induced by emissions _ and other human interventions is through future projections of atmospheric state including these disorders. Thus, to obtain results that are physically consistent atmospheric models must properly incorporate the aerosol emissions and appropriately handle the transmission and the interaction of these emissions to the environment. However, knowledge about the properties of the aerosol particles and their role in changing the atmospheric scenario is relatively recent. Only in the last decade have been assumed the relevance of the inclusion of their effects on atmospheric for weather forecasting, climate and air quality numerical models. This change in position brought a extraordinary increase not only the complexity, but mainly, uncertainties, changes to the climate scenario (ANDREAE et al., 2004). The inclusion of aerosols in atmospheric models brings new challenges to the development of new parameterizations that appropriately represent the various processes by which aerosols interact with other atmospheric elements. And before that, grows in importance the need for inventories of emissions of aerosols with better temporal and spatial resolution measurements and characterization of increasingly accurate particle.

The incremental environmental changes of the process of land occupation with emissions from burning is also a major focus. The forest interacts strongly with the atmosphere, emitting and absorbing gases and particles, and thus altering the physical, chemical and biological environment of the ecosystem. Aerosol particles are emitted naturally by vegetation, and these mechanisms are critical in the production of clouds in the balance of solar radiation and the cycling of nutrients, among other processes. Understand the natural processes that regulate the composition of the atmosphere is critical so that we can develop a strategy for sustainable development in the region. As a result of emissions from fires, atmospheric concentrations of aerosol particles and trace gases increase by 2-8 factors in large areas, which alters the radiation balance, with the absorption of up to 70% of photosynthetically active radiation. This reduction in radiative flux affects the photosynthetic rate, surface temperature, and latent andsensible heat fluxes. The nutrient deposition is strongly affected by human activities, with significant increases in nitrogen deposition in disturbed areas (ARTAXO et al, 2006).

If the air quality around the patient undergoing the hospitalizationsis not good, there is a high possibility of airborne bacterial infection. In addition, several studies have described the correlation between airborne aerosol and respiratory disease.(Kleinjans JC, 2013; Jenerowicz D, Silny W, Danczak-Pazdrowska A, et al, 2012; Andrade Filho VS, Artaxo P, Hacon S, et al.,2013)

During burning, the combustion is incomplete, with the formation of compounds are not completely oxidized irritating to the respiratory system, and in some cases carcinogenic, fine particulate matter reach the alveoli and in large concentrations into the bloodstream or is in the lungs, resulting in diseases as chronic emphysema. Toxic organic vapors such as PAHs are possibly carcinogenic. The carbon monoxide can cause hypoxia, to prevent the blood to carry adequate oxygen. Fetuses are especially susceptible because they can not compensate for the reduction in oxyhemoglobin without sustained increase in heart rate. The aldehydes are irritating the mucosa and some, such as formaldehyde, can be carcinogenic. Volatile organic compounds can irritate the skin and eyes, causing dizziness, coughing and wheezing, and some are carcinogenic. Ozone in high concentrations, can affect lung function, at low, cause coughing, choking, shortness of breath, mucus, itching and burning in the throat, nausea and decreased lung function, when exercising (Malilay 1999), we can see Figure 1, Table 1 and 2 a strong correlation between respiratory diseases and climatic variables.

The effects of air pollution can produce impacts on human health in different ways. On the one hand impacts directly, as in the case of heat waves, or deaths from other extreme events. But often, this impact is indirect, being mediated by environmental changes such as changing ecosystems and biogeochemical cycles and shifting the balance by ozone, which can increase the incidence of infectious diseases (Barcellos, C. et al, 2009).

Air quality worsens in relation to the parameter of concentration of ozone and carbon monoxide during the winter months, reaching triple, when weather conditions are more favorable to the dispersion of pollutants, times when there is more stability. In relation to the formation of ozone, the pollutant has higher concentrations in spring and summer due to the higher intensity of sunlight (Figure 1). The interaction between sources of pollution and the atmosphere will set the level of air quality, which determines, in turn, the emergence of adverse effects of air pollution on the receivers.

Ozone near the surface of the earth is the result of photochemical reactions of pollutants with solar radiation and acts aggressively. Photochemical oxidants produce strong eye irritation. Other reactions at high ozone concentrations are effects on lung function in children and adults, increased frequency of asthma attacks, reduced athletic performance, additional stress in patients with chronic obstructive pulmonary disease, inflammation of the lungs. Not sure about constant exposure to ozone cause irreversible damage to the lungs. Studies to assess the effects of repeated and intermittent exposures to ozone in the indices of lung injury, inflammation and fibrosis (Commitee of the Environmental ..., 1996) are being developed.

Some measurements during episodes of fires in Campo Grande, referring to the chemical characterization of mist spread over a wide area, indicated ozone concentrations of 91.3 ppb (parts per billion), which is usually around 15 ppb (parts per billion) in the period where there is no occurrence of fires, it is good to note that CONAMA Resolution 03/90 establishes the limit of ozone concentration of up to 81.2 ppb during the period of 1 hour.

In general, the concentrations of CO remain with acceptable values over the year, with the only concern the months of August, September and October whose values near surface are far greater than the limits established by CONAMA Resolution 03/90. This change greatly increases the health risks of the population in relation to respiratory diseases. The stable weather conditions are unfavorable to the dispersion of pollutants in the atmosphere, as light winds and calms, low relative humidity and the absence of precipitation. Instead, the kinds of unstable weather as the front systems, enable an environment with ventilation and precipitation facilitating the dispersion of pollutants.

It is observed that the largest number of admissions for respiratory illnesses occurred from early fall and late winter (April to September) (Figure 1), during which the minimum temperature decreases, as the greatest drought and lack of rainfall periods occur. As a worsening of these conditions in winter (dry) add up massive amounts of particulate matter in the air, both from the burning of fossil fuels, caused by the movement of vehicles, as the burning of cane sugar in the production of alcohol - one of the main bases of the economy. Thus, the particulate material emitted mainly by the combustion of burning practiced by the vast majority of farmers, accentuates the clinical picture of hospitalization for respiratory diseases.

It is possible to observe a big difference between seasons of summer and winter, which are opposite as their climatic characteristics; fact that, with regard to winter, potentiates the cases of respiratory tract morbidity.The performance of the coefficients of respiratory diseases, adjusted in the period, show a trend of increase for the population studied. The same applies to the number of outbreaks, to Campo Grande. However, even though the analysis of trends and components evaluate changes in health status of the population, understanding that the coefficients represent indirect measures and constitute subsidies in the quantitative evaluation for the creation of health policies is required (TOME, E.A, LATORRE, M.R.D.O. 2001).

5. CONCLUSION

The variability of aerosol optical depth at 500nm channel checked on the atmosphere of Campo Grande/MS shows strong seasonality related to prevailing weather conditions and the numerous fire outbreaks[1] recorded in aerosol source regions. On the months with the greatest influence of fires, τ500nm averages are verified around 0.6 to 1.0, while the months with cleaner air, τ500nm values were observed around 0.1. The mathematical correlation between the number of admissions for respiratory diseases and climatic indicators, indicated that the main source, in significance order, are ozone, carbon monoxide, optical depth, fire outbreaks, wind speed, relative humidity, minimum temperature and rainfall.

The first two principal components accounted for 91.48% of the variance of the data studied, with a positive correlation between respiratory diseases, ozone, carbon monoxide, wind speed, optical depth and focus of fire and a negative correlation between rainfall, humidity and minimum air temperature, and the equation was determined with an error between the observed and estimated values of 2.29% and R-Sq = 89.1%.

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Texto submetido à RBClima em 04/02/2016