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Global Warming and Heat Waves in West-Africa: Impacts on Electricity Consumption in Dakar (Senegal) and Niamey (Niger)

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Abstract: Global warming and related atmospheric temperature rises can impact the electricity sector. The aim of this study is to assess extreme temperatures and heat waves impacts on electricity consumption in West-Africa. To achieve this goal, observational climatic data and long period electricity consumption data collected from Dakar (Senegal) and Niamey (Niger) were used. Obtained results have shown that annual mean temperature enhancement trends during the study period, 1976 to 2011, are similar in both cities. The maximum variations between annual mean temperatures, during 35 years, are around 2.2±0.1°C. The surface temperature seasonal cycle has given two hot periods for each city. The number of hot days and heat waves has increased and their frequency is more pronounced in the last decades. Dakar, the extreme west coastal zone, presents more hot days, which reached 20 days in 2009, and shows greater frequency but has fewer heat waves compared to Niamey in the middle Sahel which has longer lasting heat waves. The electricity consumption trends in both cities match extreme temperatures evolution well. It is low during the cold season but rises during the hot periods. In Niamey, electricity consumption reaches its first peak during its hottest period, March to May. After that, there is a decrease during rainy and cold seasons, which is followed by an enhancement during the second hot period from September to November, with a prominent consumption peak in October. Similar trends were observed for Dakar. A positive correlation has been obtained between the surface temperature and the two cities' electricity consumption, confirming the extreme weather global impact.

Keywords: Global Warming, Extreme Temperature, Heat Wave, Electricity Consumption, West-Africa

1. Introduction

Human activities such as burning of fossil fuels for energy generation, industries, agriculture and other land uses have contributed to the release of significant quantities of greenhouse gases (carbon dioxide, methane, nitrogen oxide…) into the earth atmosphere [1]. The result is an increase of the earth's average atmospheric temperature which causes global warming and related changes in climate [2, 3, 4]. In recent decades, the changing climate has led to a discrepancy in the frequency, intensity, spatial extent, duration, and timing of extreme climate events like tornadoes, floods, droughts and heat waves [3, 4-7].

The intergovernmental panel on climate change in its Fourth Assessment Report has confirmed that Africa is one of the most vulnerable continents to climate change and

climate variability. The continent's vulnerability is exacerbated by endemic poverty, economic and institutional weaknesses and limited access to infrastructure, technology and energy [8]. Additionally, the Sub Saharan Africa has the most rapid population growth in the world, accompanied by an unprecedented extension of the cities [9].

Fossil energy (oil, gas, charcoal), nuclear energy (uranium) and renewable energy resources (solar, wind and hydro) are available to power Africa [10]. However, the continent is facing several critical challenges related to its energy sector such as energy access, energy security and sustainable use of biomass resources. In most West-African countries, 61-86% of used energy came from traditional uses of wood fuel [11].

Electricity, which is a powerful economic and social development engine, plays a vital role in human settlements and support economies, prosperity and well-being [12]. In Sub-Saharan Africa, almost 600 million people do not have access to electricity [10]. The electricity access rate exceeds 50 percent only in very few countries. The accessibility challenge is exacerbated by an extraordinary increase in demand due to rapid population growth on the one hand [9, 13], and ongoing climate change in acute events like extreme temperature, on the other [4, 8]. In fact, it was shown that ambient temperature increases have considerable impact on energy generation and consumption in the world [5, 12, 14]. Indeed, extreme temperatures and heat waves which can be defined by heat amount or degree (heat intensity), number of consecutive days of unusual hot weather (heat duration) and occurrence of hot period (heat frequency), can affect electricity production, storage, transportation and population demand [12, 15-17]. Thus, the rapid growth of West-African cities resulting from the considerable population explosion and cities' unprecedented extension will undoubtedly aggravate the continuous rises of electricity demand in this area [13]. The occurrence of extreme events during these last decades can increases electricity demand and will aggravate observed shortage due to recurrent blackouts. Indeed, extreme events such as flood, drought, sea level rises and especially heat waves may become more frequent and more severe and will have a greater number of negative impacts on human wellbeing in the coming years [6]. Extreme events which occurred for instance once in every two decades, are occurring nowadays two or three times for the same duration. This pattern will continue and will increase as long as global warming will persist [15, 18, 19]. One commonly anticipated impact of climate change includes a greater frequency of occurrence of periods of excessively high and low temperatures [4, 7, 8, 19]. Unfortunately, even if extreme temperature and/or heat waves impacts on the electricity sector seem to be obvious, there is a lack of data in this area. The temperature rises impacts on electricity sector are not deeply investigated [20, 21]. The first studies on adaptation to heat wave in the electricity sector are embryonic [12].

To reduce West-African countries' electricity sector vulnerability, this study examines temperature evolution, heat waves and their impact on electricity consumption. It was conducted in two West-African cities: Dakar (West Coast) and Niamey (Central Sahel). The main objectives are to assess the global warming in these cities and to evaluate temperature increases' impacts on the electricity sector.

2. Data and Methods

2.1. Data

Daily minimum and maximum temperature was collected from the national meteorological offices of Dakar (Senegal) and Niamey (Niger). In order to follow the evolution of the temperature trends and potential heat waves in the two cities, observational data of thirty-five recent years, ranging from 1976 to 2011, are used. These data are of good quality and have been processed using the method of homogenization [16]. The advantage of using daily data instead of monthly or weekly data is that it will allow successful identification and localization of hot days as well as heat waves. Electricity consumption data availability during the period 1976-2011 explained the choice of this period. Electricity data were obtained from the two national electricity offices, SENELEC (Senegal) and NIGELEC (Niger). Due to data availability, only annual domestic usage data from 1970 to 2000 are used for Dakar whereas for Niamey the global consumption data of low, medium and high voltage including consumption from domestic, industries and others, ranging from 1977 to 2012 will be used. To further the investigation, monthly available global consumption data from 2009 for Niamey and 2013 for Dakar were used. For the same years, monthly mean temperatures obtained from daily temperature data were used.

2.2. Method

2.2.1. Method Used for Hot Day Identification

The method used was the same for both Dakar and Niamey. It was based on the calculation of the 90th percentile of the temperature known as a threshold to identify hot day and heat wave. This method has been already successfully used [16, 17]. To identify a hot day which is defined in this approach as a day with a maximum temperature greater than the 90th percentile, the entire distribution of the daily maximum temperatures for the hot period was considered. The choice of the hot periods in the two cities was done based on the mean seasonal cycle of the temperature over the whole period. From each hot period, the number of hot days in the year was determined over the study period. For a chosen hot period of each year, over the study period, the 90th percentile was calculated as threshold to identify the hot days by using daily temperature maximal. All days with a maximum temperature greater than the 90th percentile were considered as hot days.

2.2.2. Method Used for Heat Wave Identification

In this study, a heat wave is observed if the mean of the minimal and maximal temperature is greater than the 90th percentile of the entire considered period, i.e., the mean between the maximum and minimum temperature greater than the 90th percentile threshold for at least three successive days over the hot period. For that, the percentile calculation

was carried out also per samples considering the same hot period as did with the hot days. For a chosen hot period of each year over the whole period 1976-2011, the 90th percentile of the mean temperature is calculated and all days that have mean temperature greater than the 90th percentile classified [16, 17, 22]. All three successive days with a mean temperature greater than the 90th percentile is considered as heat wave of type n3. After that, the heat wave evolution (duration) is determined by looking at heat wave with four (n4), five (n5) until six (n6) successive days.

3. Results

3.1. Global Warming and Heat Wave Assessment in West-Africa

3.1.1. Inter Annual Variability of Extreme Temperatures in Dakar and Niamey

The annual mean extreme surface temperature evolution in Dakar and Niamey are shown in Figure 1. For the two cities, the annual mean temperature maximal (Tmax), minimal (Tmin) and their mean (Tmean) trends were plotted. A lack of observed data is noted from Dakar compared to Niamey.
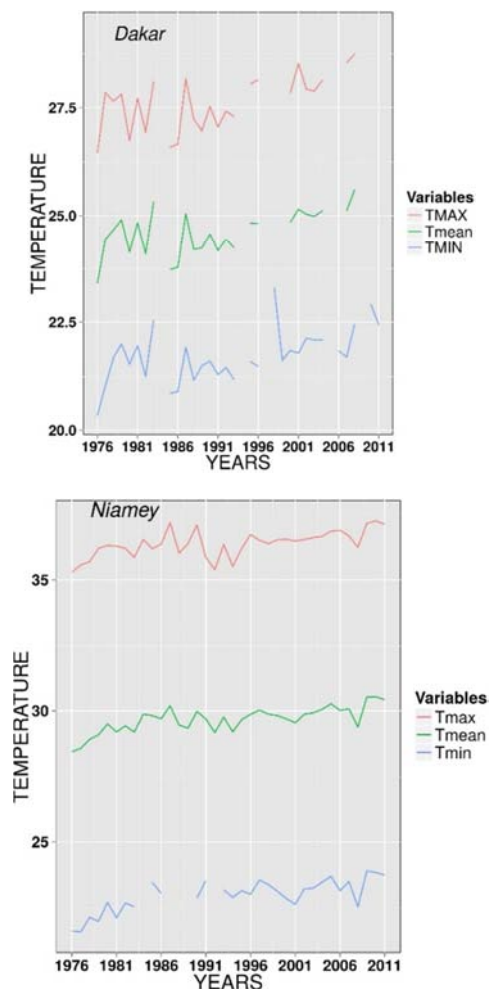

Figure 1. *Annual mean temperature of Dakar (top) and Niamey (bottom) over the period 1976-2011 for the maximum temperature (Tmax), the minimum (Tmin) and the mean (Tmean).*

In the two cities an increasing trend was found for the annual mean temperature maximum (Tmax), minimum (Tmin) and their mean (Tmean) over the considered period from 1976 to 2011.

For Dakar, one can see a slight increase accompanied by a significant fluctuation for the observed variables from 1976 to 1992, followed by an evident rise in measured temperatures from 1992 to 2011. The highest temperature value (Tmax graph) recorded during the study period is 28.8°C (seen in 2008) whereas, the lowest one is 26.5°C, measured in year 1976. Thus, the Tmax values reached a maximal difference of +2.3°C in Dakar (Senegal) in only 35 years. For Tmin, the lowest value (20.3°C) was recorded in 1976 and its highest value (22.5°C) is seen in 2008. The highest difference measured for Tmin varations is similar to Tmax during the same period. Otherwise, the Tmin has exactly the same general trend as Tmax. The global variation observed from 1976 to 2011 for Tmin, Tmax and calculated Tmean ranged from +2.1 to 2.3°C.

For Niamey, there is a slight increase for all recorded variables during the whole period. Here, annual mean Tmax and Tmin have their highest peaks in year 2010 and are respectively 37.5 and 23.8°C. Their lowest values, which are recorded in the year 1976, are respectively 35.30 and 21.6°C. For the studied variables the highest difference measured during 35 years is equal to 2.2°C for both Tmax and Tmin.

The greatest annual mean temperature increases in the two cities in 35 years are similar and are around 2.2±0.1°C. During the last decades, a significant rise in temperature increase is observed in Dakar and Niamey, two West African cities located in different climatic zones, Niamey in the center of Sahel and Dakar on the extreme western coast. This is mainly due to worldwide anthropogenic greenhouse gases effects and their related global warming. In both cities, there is evidence of global warming. Therefore, if nothing is done, anthropogenic greenhouse gases may continue to increase the earth's average atmospheric temperature and related extreme weather events like floods, hot days and heat waves in Africa [23].

3.1.2. Evolution of the Surface Temperature Seasonal Cycle in Dakar and Niamey

The two cities differ in terms of climate and can be seen as "relatively cold" and "very hot" climatic zones. The mean annual temperature maximum ranged from 20 to 29°C in Dakar while, in Niamey, it ranged from 22 to 37.5°C over the study period, 1976 to 2011. Thus, the main objective of the mean seasonal cycle's determination is to differentiate in each city the yearly cold months from the hot ones. Indeed, it was seen that the seasonal temperature fluctuation can have a large impact on the city's electricity generation and consumption. For each city, the study period monthly mean temperature maximum, minimum, and their mean values for Dakar and Niamey are plotted in Figure 2.
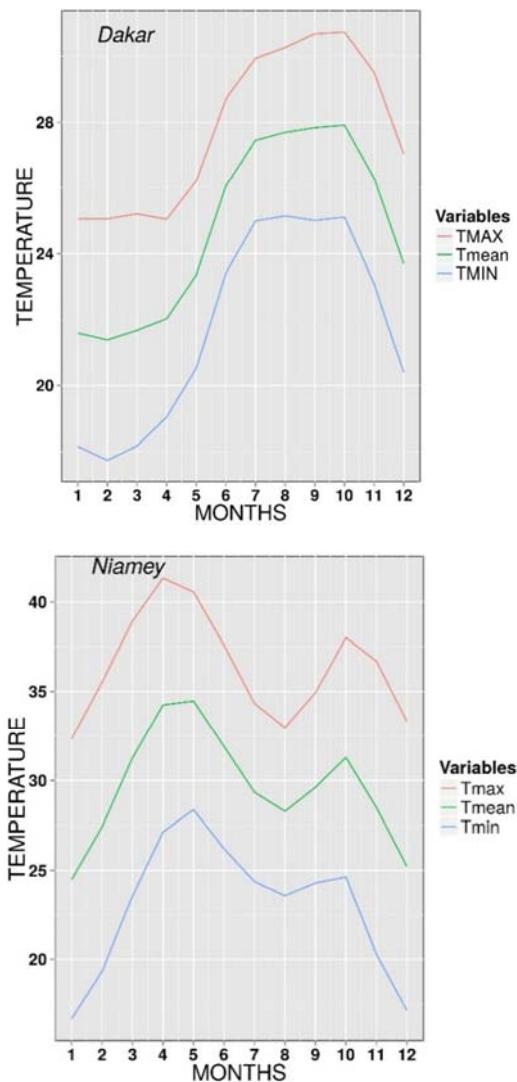
Figure 2. Mean seasonal cycle of the surface temperature (Tmax, Tmin, Tmean) over the period 1976-2011 for Dakar (top) and Niamey (bottom) from month 1 (January) to 12 (December).

The Tmax, Tmin and Tmean are relatively low in Dakar compared to Niamey during all the year. The three surface temperature (Tmax, Tmin, Tmean) trends have shown in Dakar a slight decrease during the two first months (January and February), which are the coldest. The temperature minimum and maximal have their lowest value, respectively around 17.8 and 25°C during this period. After that, there is a substancial increase of recorded temperature from March to July, which is followed by a very slight increase from July to October. The greatest increase is observed from April to July which coincides with the beginning of the rainy season. The graphs show that the maximum temperature reaches its peak (30.8°C) in October, the end of the rainy season. After the month of October, it was seen an important drop of all variables from October to December.

For Niamey, the temperature patterns are slightly different from Dakar even if the yearly general trend is similar. The Tmax, Tmin, Tmean lowest temperatures are in the Harmattan season (December and January) and also during the rainy season (July to September). All the remaining

months are characterized by a steep rise in temperature. Here, there is an increase of the measured temperature from January to May. After that, the decreases observed for the temperature maximum may be explained by the beginning of the rainy season in the area. The rise of the diurnal temperature (Temperature minimum) during the same period confirms the previous assertion. As in the case of Dakar, after the month of October, one observes a drop of the surface temperature until December. The measured decrease is more pronounced in Niamey compared to Dakar.

For the study period and according to the seasons, Niamey temperature maximal (41.5°C) and minimal (29°C) peaks are recorded respectively in April and May, during the dry season and before the installation of the rainy season. The lowest value of minimal and maximal temperature is 17°C and 32.4°C respectively, and was recorded in the month of January, during the Harmattan season.

In the two cities, a broad temperature peak period was seen from July to October for Dakar while in Niamey two distinct peak periods form April to June and during the month of October was observed. In order to take into account the electricity consumption during the peak periods (peak months and surrounding ones), the following division is adopted for hot period identification. For Dakar, the hot periods are June-July-August (JJA) and September-October-November (SON) while they are March-April-May (MAM) and September-October-November (SON) for Niamey.

According to the fact that temperature variation (increase and decrease) is one of the most influential climatic factors that have an effect on energy consumption in the world [20, 24], one would expect to have a significant increase in electricity consumption in the two cities during their corresponding extreme temperature periods. Here, only the hot period will be deeply investigated because temperature decreases in the two cities (cold period) offer acceptable temperature conditions. Moreover, the coldest observed periods, without other climatic extreme events, will probably result in a decrease of electricity consumption in the two cities.

3.2. Identification and Evolution of Hot Days and Heat Waves in Dakar and Niamey

The identification of the hot days and heat waves was achieved by adopting the definition given in the methods section. For both hot days and heat waves, their evolution was determined by considering the previously obtained hot periods JJA and SON for Dakar and MAM and SON for Niamey based on the mean seasonal cycle graph.

3.2.1. Identification and Evolution of Hot Days

From each hot period, the number of hot days in the year was determined over the study period. For example, for Dakar hot period JJA of each year, over the 35 years, the number of hot days is obtained by using daily temperature maximal (around 3312 values), and then their 90th percentile is calculated. All days with a maximum greater than the 90th percentile were considered as hot days of the JJA period. The

same approach is applied to the remaining hot periods for Dakar and Niamey. In the following figures, the number of hot days for Dakar (Figure 3) and Niamey (figure 4) is presented for the different hot periods.
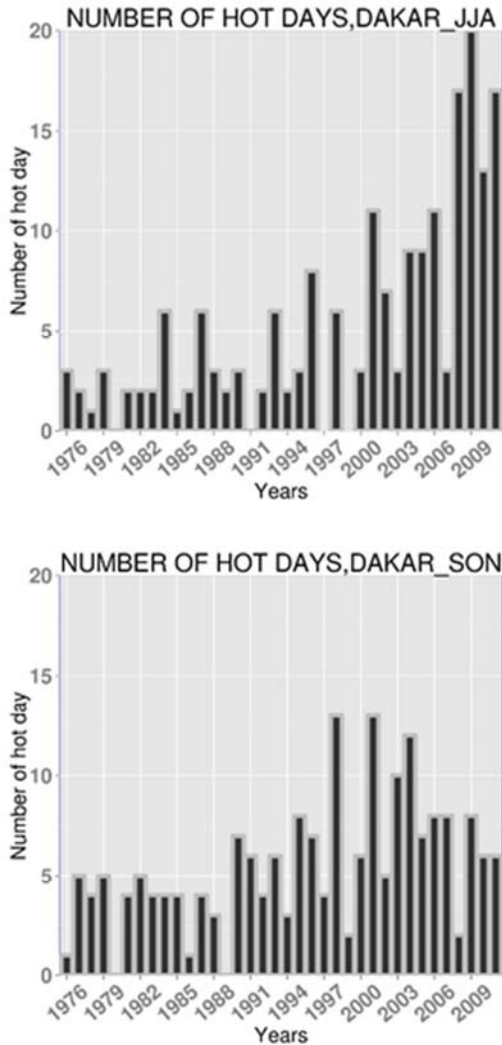

Figure 3. Number of hot days over 1976-2011 in Dakar for hot periods JJA (top) and SON (bottom).
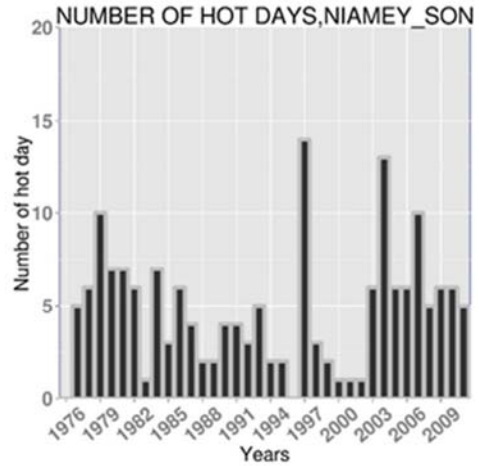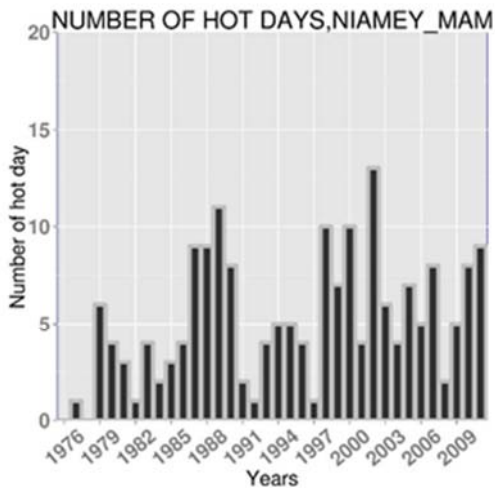

Figure 4. Number of hot days over 1976-2011 in Niamey for hot periods MMA and SON.

In Dakar, for the hot period with the highest temperature (JJA), the observed increase is more visible with a significant number of hot days in the last two decades. The number of hot days reaches 20 days in 2009. The same trend is also observed for the Dakar SON hot period where the number of hot days during the 2000's is multiplied by approximately 2.5 to 3 times compared to the 80's.

For Niamey, the number of hot days' general pattern is similar to Dakar, with a more pronounced fluctuation between the years. During Niamey's hottest period (MAM), the greatest number of hot days and the long lasting ones are recorded mainly in the years 1988, 1998 and 2002. For its SON hot period, the number of hot day's fluctuation is prominent. Its hottest years in terms of number of hot days are 1979, 1999, 2004 and 2006.

A significant increase in the number and frequency of hot days, over the study period has been observed. During the last decades, Dakar presents more hot days in number and frequency compared to Niamey. However, the hot day becomes more consistently long, the closer one gets to the current date.

3.2.2. Identification and Evolution of Heat Waves

From each hot period, the heat waves (types and number) were determined over the study period. For example, over the whole period 1976-2011, for the hot period JJA of each year, the 90th percentile of the mean of the minimum and maximum temperature was calculated and all the days that have their mean temperature greater than the 90th percentile were classified. All the periods with three successive days with a mean temperature greater than the 90th percentile were considered a heat wave. The heat wave types (duration) were also investigated by looking at heat waves with four, five and six successive hot days. Investigation was stopped at six days because heat waves with seven successive days were rare in all the studied cities (Figure 5 & Figure 6).
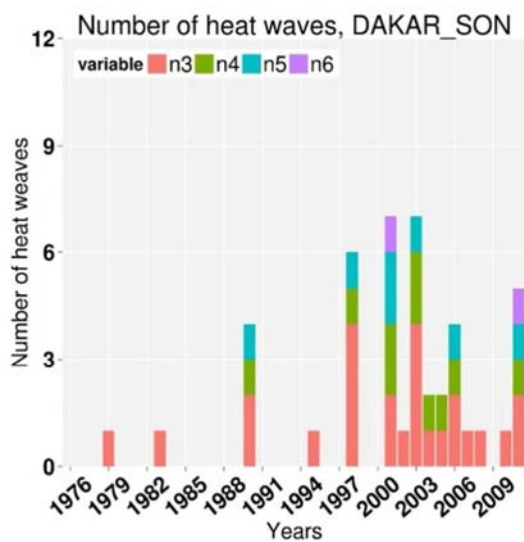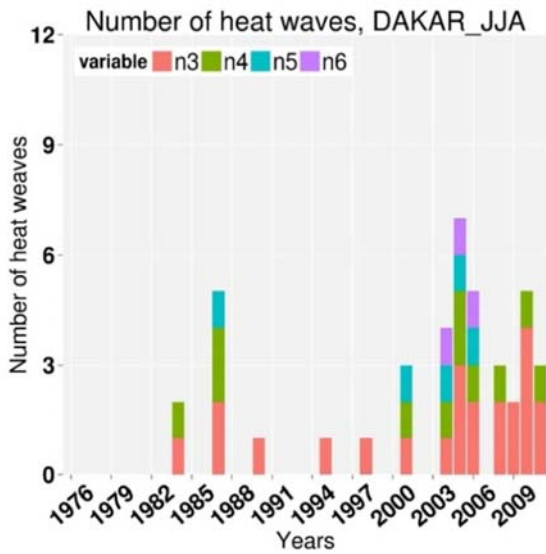
Figure 5. *Evolution of the number of heat waves for Dakar considering the hot period JJA and SON. n3 represents three successive hot days where the mean temperature was greater than the 90th percentile, n4 represents four successive days and so on.*
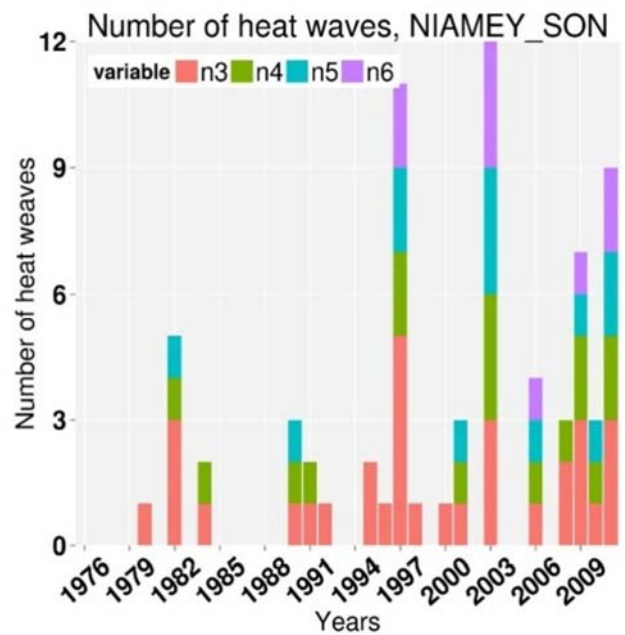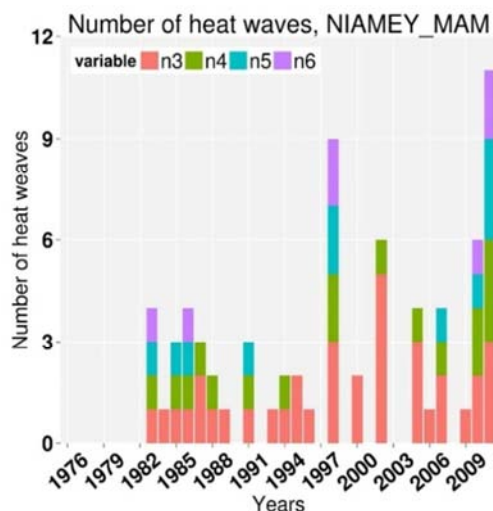

Figure 6. *Evolution of the number of heat waves for Niamey considering the hot period MAM and SON. n3 represents three successive days where the mean temperature greater than the 90th percentile, n4 represents four successive days and so on.*

In both cities, during the study period (1976 to 2011), the number of heat waves increased in the last decade (2000-2011) compared to the previous ones. The most heat waves observed are for three days (n3) followed respectively by heat wave of four days (n4), then heat waves of five days (n5) and heat wave of six days (n6). The hot periods of Niamey (MAM and SON) present a significant number of heat waves with longer duration (n5 and n6) compared to Dakar hot periods (JJA and SON).

3.2.3. Evidence of Global Warming in the Two West African Cities

In both cities (Dakar and Niamey), evidence of global warming has been noted with an increase in the annual extreme temperatures trend in the studied decades. In fact, the obtained results have shown a clear trend of temperature increase not only in minimal and maximal temperatures but also in the mean temperature. Moreover, an increase in number, frequency and duration of hot days and heat waves has also been observed during the different hottest periods. Furthermore, an increase in heat wave duration and frequency, with more heat waves in recent decades, is also observed. Thus, the period 1976 to 1990 presents fewer heat waves compared to the periods 1990-2000 and 2000-2011, where most of the heat waves cases are concentrated. The obtained results issued from observational data confirm the worldwide scientists' warnings on the global warming impacts for decades from now. The observed temperature enhancement recorded in the two West African cities seems to be more significant than the IPCC 4th Assessment Report's (AR4) estimation for recent 100 years (1906-2005). The temperature trend shows an average warming of 0.74°C

± 0.18°C. According to obtained results issued from observed data, the inter-annual temperature evolution in the arid area (Niamey), from 1977 to 2000, have shown about a 1°C increase in both maximal and minimal (Tmax and Tmin). From 2001 to 2011, about 0.7°C increase in the Tmax and about a 1.4°C increase in the Tmin were obseved. Therefore, the total maximum increase for the whole period (35years) offered a 1.7°C increase for Tmax and 2.4°C for Tmin. Thus, the West-Africa ambient temperature is becoming warmer and warmer resulting in more extreme climatic events.

3.3. Annual Impact of the Temperatures on the Electricity Consumption

In the global warming evidence in West-Africa, it was shown that there is an increase in extreme temperatures and related extreme weather events. A significant increase in hot days and heat waves' number, duration and frequency was seen during recent decades compared to the past. Additionally, to increase in electricity demand due to cities large extension and the population's rapid growth, the West-African electricity companies will face ongoing global warming and related climate change impacts. In order to assess the temperature increase impacts, annual data on the electricity consumption collected from the electricity company of Dakar (SENELEC) and that of Niamey (NIGELEC) have been plotted over the study period (Figure 7). This approach will allow electricity consumption trends in both cities over the study period to be determined. The comparison of electricity consumption trends to the temperatures (Tmax, Tmin and Tmean) over the study period will help in the evaluation of the temperature impact on the electricity sector. In the two cities, a general increase trend has been observed. Due to electricity consumption data availability, the whole study period hasn't been covered. Here, Dakar domestic electricity consumption data from 1970 to 2000 and Niamey global consumption data from 1977 to 2012 has been plotted in Figure 7.
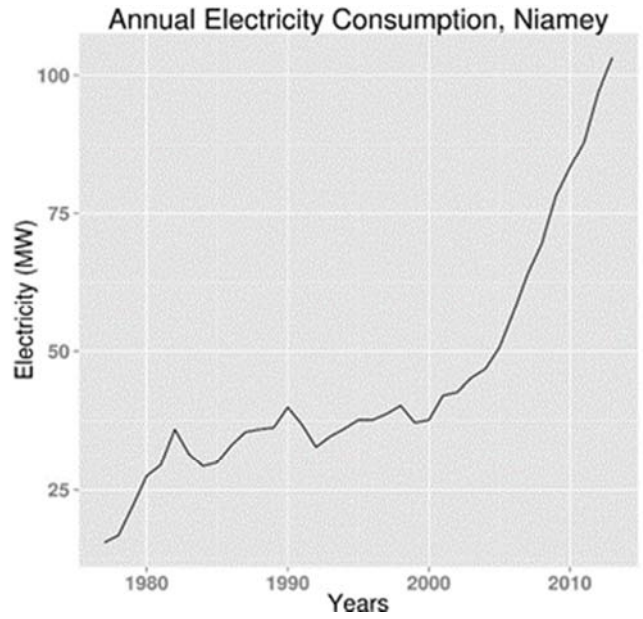

Figure 7. Annual electricity consumption of domestic usage for Dakar ranging from 1970-2000 and global consumption for Niamey ranging from 1977-2012.

In Dakar, a significant increase is seen between 1970 and 1980. The sizeable fluctuations during the period 1980-1992 follow a similar pattern to the temperatures' (Tmax, Tmin and Tmean) evolution during the same period. The significant crisis in the Senegal electricity sector during the same period has probably contributed to the observed pronounced fluctuations. From 1992 to 2000. There is a significant increase in the city's domestic electricity consumption rate which passed from 86 KWh to more than 115 KWh per inhabitant. For the Senegal national electricity company (SENELEC) the observed evolution of the consumption depends mostly on the increase of the customers with the extension of the grid. Nonetheless, the comparison of Dakar electricity consumption with the temperature evolution during the same period allows observation that temperature seems to affects the electricity consumption in the city. The two parameters graphs show the same trends, they mostly increase, decrease and fluctuate during the same hot and cold periods.

In Niamey, the electricity global consumption is also characterized by a relative increase before 1980 followed by a fluctuation during the period 1980 to 2000, like Dakar. The last decades are characterized by an important and rapid increase, from 37.5 MW in 2000; it increase considerably to more than 100 MW in only ten years. The observed increase for electricity consumption in Niamey is more pronounced than the enhancement measured for the temperature evolution during the same period. According to Niger national electricity company (NIGELEC), the sector experienced a large investment during the same period which has reduced blackout number and duration, boosting the consumption rate.

The inter-annual temperature evolution in the arid area (Niamey), +1.7°C for Tmax and +2.4°C for Tmin during the
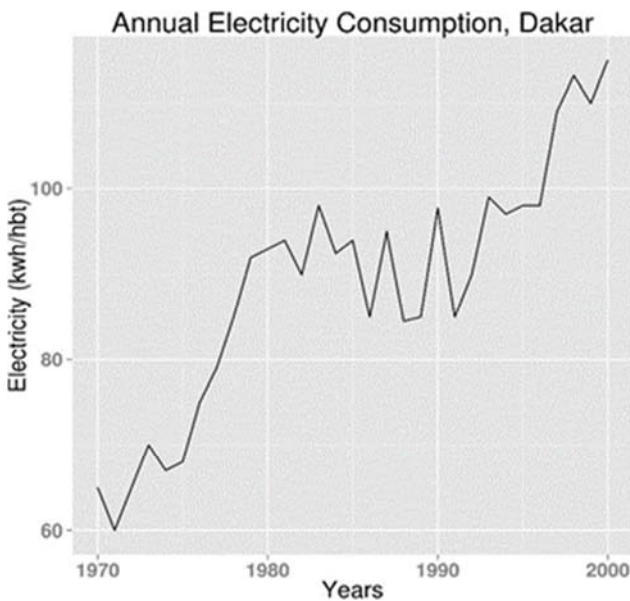
study period (1976 to 2011) can be linked to the electricity consumption increase which passes to more than 10 times the baseline. However, the population growth during the same period, the grid extension and the lack of long term daily data make difficult to determine clearly the overall temperature increase effects on the two cities' electricity consumption. Elsewhere, the annual temperature evolution's effects on the electricity generation, storage and transportation are not also well known.

3.4. Monthly Cross Analysis Between Temperature Increase and Electricity Consumption

In the monthly cross analysis, available monthly data for the two cities were used. The data are global, *i.e* total domestic, industry and others sectors consumption. For Dakar, the global consumption data for 2013 were plotted with the same year's monthly temperature evolution (Figure 8) while for Niamey, the data used are from 2009 (Figure 9). Global electricity consumption data availability and data quality explained the choise of these years.
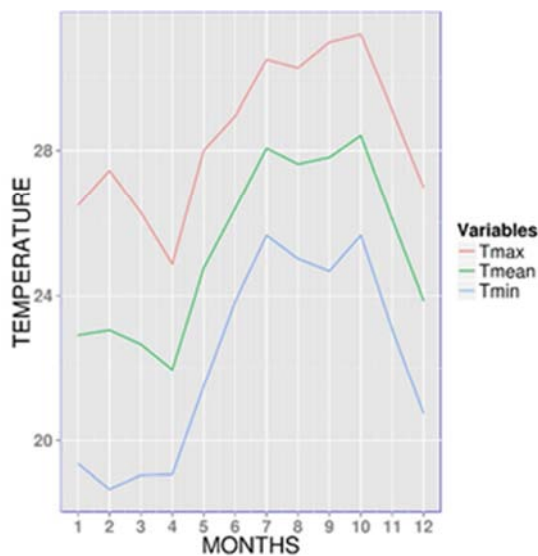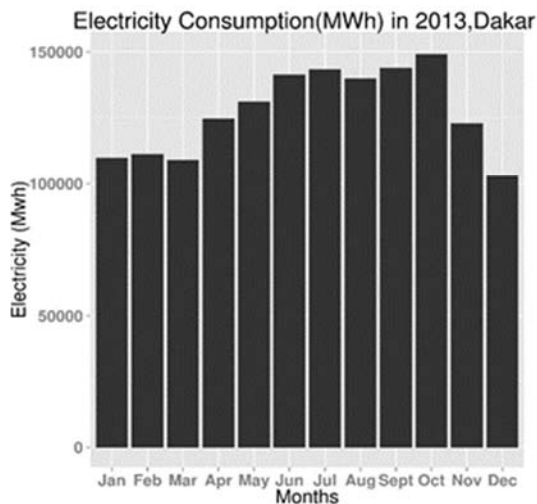

Figure 8. Monthly electricity consumption vs monthly mean temperature for 2013 (Dakar).
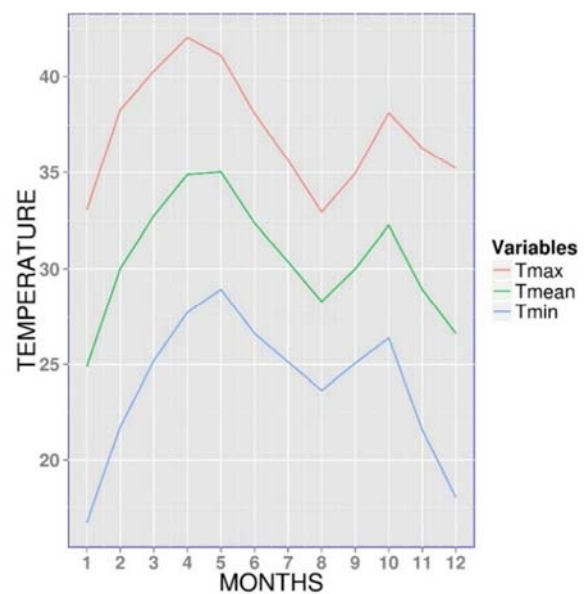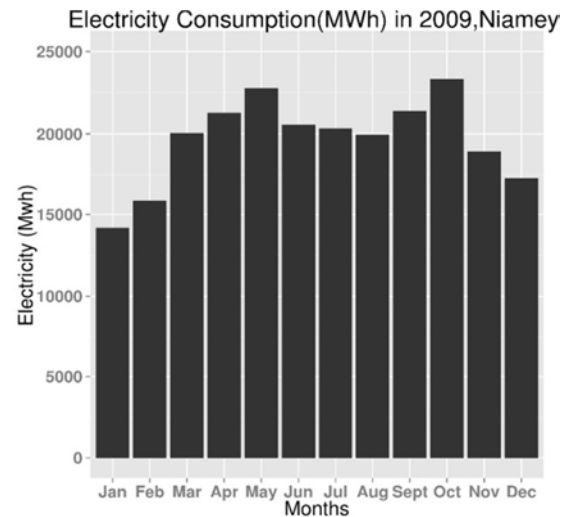

Figure 9. Monthly electricity consumption vs monthly mean temperature for 2009 (Niamey).

In both cities, the electricity consumption is low during the cold season (December, January and February). It starts increasing in March-April and reaches its first peaks in May and July, which coincide respectively with the first peak of the minimal temperature during the same month for hottest period determined for Niamey (MAM) and Dakar (JJA).

The second peaks of electricity consumption coincide with the second peaks in temperature in the two cities. In Niamey, the greatest electricity consumption was expected in April and May months when the highest temperatures are recorded in the area. April is characterized by higher Tmax than May, but the latter has a higher Tmin and Tmean and they both have greater temperatures than October. Therefore, in the electricity consumption graph, the first peak (May) was expected to be greater than the second (October) and not the observed reverse. Indeed, the significant consumption peak in October, with the highest consumption of 23,500 MWh in 2009, compared to the hottest period months (MAM), can be explained by the availability of sufficient electricity to cover

the population's electricity demand in October. Indeed, substantial part of Nigelec energy (85%) comes from the hydropower source issued from Nigeria electricity generation systems installed on the river Niger, which high water period is around October [24]. Thus, imported electricity is more available in October allowing coverage of the maximum demand of the corresponding hot period (SON). Nevertheless, the demand is also high in the hottest period MAM but the limitation of the imported electricity added to the limited thermal electricity capacity of the country explain why the global electricity demand is not well satisfied during this period, attering the hottest period impacts on electricity consumption. According to the company, if electricity is available to satisfy the important demand, the consumption rate during this period will be higher and its peak will be the highest one compared to October.

In both West-African cities, Dakar (Senegal) and Niamey (Niger), the observed temperature changes match well electricity consumption trends. The high similarity of the electricity consumption pattern in the two cities with the temperature evolution confirms significance of this climatic parameter on energy consumption in the area. During Dakar's hottest period (JJA), the electricity consumption in this city is high whereas during the same period a slight decrease is observed in Niamey. This is probably due to the rainy season where the ambient temperature is supportable. The second peak of electricity consumption in October, the highest in both cities, coincides with the second hot period (SON) for Dakar and Niamey. Additional investigations on other available data have shown that the monthly electricity consumption *vs* monthly mean temperature for years 2006 and 2011 respectively for Niamey and Dakar (not shown) have given similar results confirming the above observation for the different hot periods in the two cities.

3.5. Correlation Study Between Temperature Increase and Electricity Consumption

In order to measure the exact weight of observed temperature variation impacts on the two cities electricity consumption during the study period, a correlation study between annualy temperature minimum and maximum *vs* electricity consumption is conducted. In the Figure 10 are plotted the correlation between the annual mean temperature and the consumption in Dakar and Niamey over the study period, 1976 - 2011.
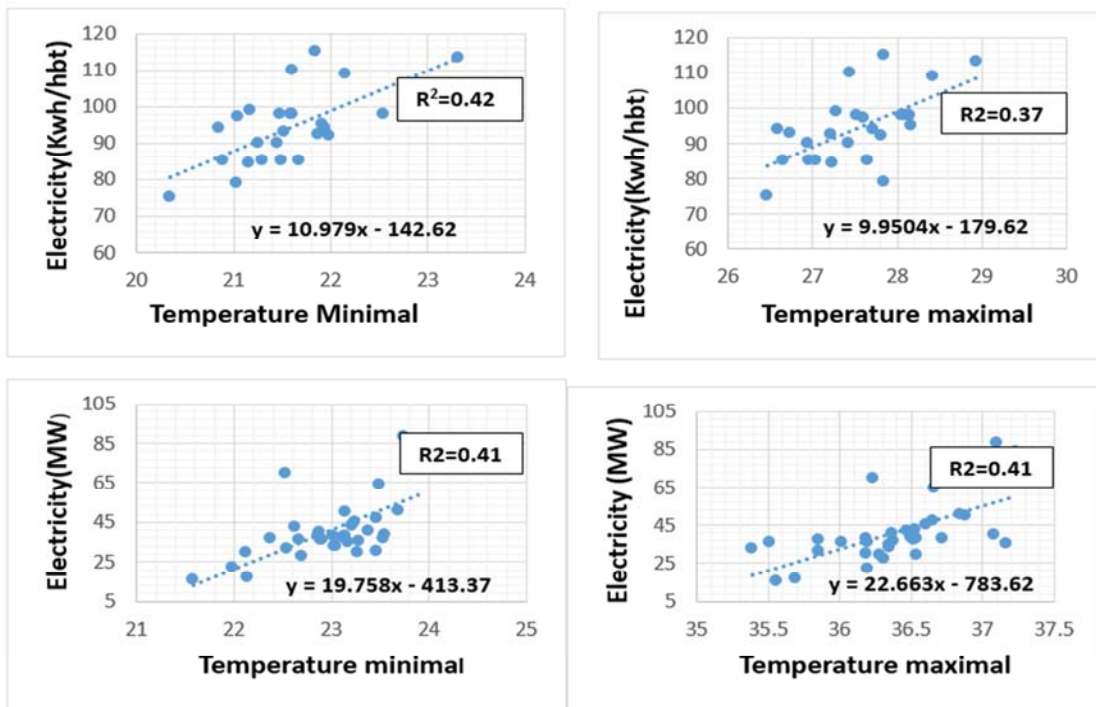

Figure 10. *Correlation between the annual mean temperatures and the annual electricity consumption. On top for Dakar (KWh/hbt) and at the bottom for Niamey (MW).*

For both cities, a positive correlation is obtained for annual temperature minimal or maximal showing the presence of a dependance on the electricity consumption. In Dakar, the temperature minimal seems to link more with the electricity consumption ($R^2 = 0.42$) compared to the temperature maximal ($R^2 = 0.37$). In Niamey, their correlation coefficient is similar ($R^2 = 0.41$) for both minimal and maximal temperature.

The obtained results has shown that temperature remains an important parameter impacting the electricity consumption in these cities. However, in order to improve the correlation coefficient value it will be necessary to have additional information factors such as electricity availability, extent of the grid, population growth and economic potentials which can influence the annual electricity consumption in these cities.

4. Conclusion

Significant rises in surface temperature and extreme climatic events in West-Africa are observed during the study period, 1976 - 2011. The investigation conducted in Dakar (Senegal) and Niamey (Niger), two West-African cities, has shown increases in recorded ambient temperature. Extreme events like hot days and heat waves have drastically increased during the last decades provoking a significant impact on the electricity sector in both cities. The number of hot days is greatest in Dakar compared to Niamey, where heat waves' occurrence and duration dominated. The observed extreme weather has aggravated electricity demand and consumption. In the two cities, a steep rise in domestic and global electricity consumption has been observed during their corresponding hot periods. Unfortunately, adaptation measures have not yet been taken by most West African electricity companies and the research is nascent. Therefore, this study urges companies to seek adjustment measures to face current and expected temperature effects in order to reduce recurrent shortage in electricity provision due to hot period's frequent blackouts. An international collaborative investigation on temperature evolution in ongoing climate change context and a forecast on how they may impact West-African electricity sector are needed. There is also a great necessity to gather more precise information on extreme temperatures, heat waves, electricity consumption, energy demand and equipment safety in order to find appropriate adaptation measures.

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