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Full Length Research Paper

Empirical Study of the Health Effects of Extreme Weather Conditions on Human and the Environment

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The changing temperatures which may result in heat waves and cold spell extreme conditions resulting in diseased climatic conditions; shift plant and change in animal and human habitat had been the subject of this study. The extreme weather conditions associated with the solar radiations and the terrestrial radiation based on tropical diurnal cycle are evident in the gradients of temperature which include the atmospheric, ambient, and hemispheric temperature activities. Also, from this study, it has been observed that the recurring temperature, pressure and wind patterns are termed modes of climate variability and the atmosphere and ocean interact to create a form of temperature cycle. However, the increase in the temperature of atmosphere results in hot spots and contributes to variability in the surface properties of our diurnal latent heat flux while cold spell are highly variable with symptoms of pneumonia, influenza and hypothermia.

Keywords: Heat waves, Cold spells, Climate variability, Temperature, Climate change

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BACKGROUND

Heat waves and cold spells have been at intense equilibrium about the interest in the time series studies of temperature and mortality. Viewing the extremes of temperatures provides a satisfactory means of quantifying the relationship between ambient temperatures and daily mortality. Observatory studies have shown that the effect of a hot day is apparent only for a few days in the mortality series while in the contrast, a cold day has an effect that lasts up to two weeks. (Curwen and Devis, 1988). Nonetheless, it is observed that different mechanisms are involved in heat and cold related mortality, cold related mortality in temperate countries is related in part to the occurrence of seasonal respiratory infections. High temperatures cause some well-described clinical syndromes such as heatstroke (Kilbourne, 1992) notwithstanding, very few deaths are reported as attributed directly to heat. Exposure to high temperatures increases blood viscosity and it is plausible that heat stress may trigger a vascular event such as heart attack or stroke (Keatinge et al., 1986). Studies have shown that elderly people have impaired temperature regulation (Kilbourne, 1992; Drinkwater and

Table 1. Showing the pathways by which climate change affects human health, including local modulating influences and the feedback influences of adaptation measures as reported by Patz et al (Patz et al., 2000)

Climate Changes	Modulating Influences	Health Effects
Heat waves	Transmission dynamics	Air pollution related health effect
Extreme weather	Agro- ecosystems	Extreme weather related health effects
Temperature	Socioeconomics, Demographics	Temperature related illness and death
Precipitations	Hydrology	Mental and nutritional infectious
Regional weather changes	Microbial contamination pathways	Water and food borne disease ,

Horvath, 1979). Physiological studies in the elderly indicate that low temperatures are associated with increased blood pressure and fibrinogen levels (Woodhouse et al., 1993; Woodhouse et al., 1994). Heat waves recorded reports of death cases, in July 1995 a heat wave in Chicago, USA, caused 514 heat- related deaths (12 per 100000 population) and 3300 excess emergency admissions (Whitman et al., 1997). Moreover, from 12 to 20 July, daily temperatures ranged from 34–40°C, with the highest temperatures on 13 July. The maximum number of deaths occurred on 15 July (Dematte et al., 1998). During heat waves, excess mortality is greatest in the elderly and those with pre-existing illness (Kilbourne, 1998). Much of this excess mortality is due to cardiovascular, cerebrovascular and respiratory disease. The mortality impact of a heat wave is uncertain in terms of the amount of life lost. A proportion of the deaths occur in susceptible persons who were likely to have died in the near future. Nevertheless, there is a high level of certainty that an increase in the frequency and intensity of heat waves would increase the numbers of additional deaths due to hot weather. There is no standard international definition of a heat wave. Operational definitions are needed for meteorological services.

Literature Review

The temporal climate variations are most clearly known as normal diurnal and seasonal variations. The amplitude of the diurnal temperature cycle at most locations, more importantly in the rainfall upland area is typically in the range of 5–15°C, (Burroughs et al., 1996). The amplitude of seasonal variability is generally larger than that of the diurnal cycle at high latitudes and smaller at low latitudes. With these characteristic interactions, it becomes inclusive that, there is a complex interplay between the strength of surface winds that blow along the equator and surface or air temperatures. The ocean and atmospheric conditions in the tropics fluctuate somewhat causing a form of cooling in the tropical region on the geographical location characterized with climate variation with weather variables subject to raising sun on most days. The climate index is typically described by the statistics of a set of atmospheric and surface variables such as: temperature, precipitation, wind, humidity, cloudiness, soil moisture.

Impacts of Hot Weather

Hot weather conditions have been observed under study to show a more substantial impact than cold, and many heat stress indices have been developed to assess the degree of the impacts related different meteorological variables with total mortality and other more specific mortality classes which include cause of death and aging and identified high temperature as the most important causal mechanism. Many other studies support this relationship between temperature and mortality. On a particular note, literature observations have shown that majority of studies have found that most of the excess deaths that occurred during periods of intense heat were not attributed to causes traditionally considered to be weather-related, such as heat stroke. Consequently, many researchers continue to utilize total mortality figures in their analyses, as deaths from a surprisingly large number of causes appear to escalate with increasing temperature. Nonetheless, extreme episode of temperature exposure have recorded literature of data set that are revealing of the effects caused on human beings. (Kilbourne et al., 1982) conducted a case study in which a number of heat factors associated with heat stroke were identified and factors found to be associated with an increased risk of heat stroke included alcoholism, living on higher floors of buildings, and the use of tranquilizers. Possible factors that are found to be associated with the reduction of the risk and consequences caused by the extreme heat conditions include the use of air conditioning, frequent exercising, consumption of fluids, and living in a well-shaded residence.

Impacts of Cold Weather

The impact of cold on human well-being is highly variable. Not only is cold weather responsible for direct causes of death such as hypothermia, influenza, and pneumonia, it is also a factor in a number of indirect ways. Hypothermia occurs when the core body temperature falls below 35^{0}C and thus it is evident from studies that mortality rates increase during periods of cold weather. Health reported statistics have shown death or mortality is about 15% higher on an average cold day than on an average sunny day. However, increases in mortality during exceedingly cold periods are less dramatic than their hot weather counterparts. In becoming adapted to cold temperatures, it is evident by the facts of repeated exposure would work and thus been noted that bath made at about 15^0C water for a span of time (say 30 minutes) results in less signs of cold-induced stress.

DESCRIPTION OF STUDY AREA

Data Source and Experimentation

The primary instrument used in this study is an imetos paranometer, a weather radar station in an African tropic on the geographical compass of (Lat. 7.67^0N, Long. 5.31^0E) Afe Babalola University, Ado Ekiti, South West, Nigeria. The weather data recorded by the instrument were assessed in a computer model. The instrument been a sturdy, easy to mount and perfectly designed for a variety of different task in climate zones. It measures extreme weather conditions, the precipitation, soil moisture, wind speed and wind direction, atmospheric pressure, relative humidity. However, it is termed a field climate thermo-hygrometer instrument used to provide necessary data needed for climate activities and also to cater for most exotic micro- meteorological challenges which may have implications on health. The digital thermo hygrometer is the secondary climate instrument used in this study which measures both humidity of the air and temperature of the air. The thermo hygrometer measures different ranges of humidity and temperature depending on the model. The thermo hygrometer takes the measurements, store them to memory and transfer the data to the computer for further detailed analysis. The thermo hygrometer offers a contactless working which enables non-destructive measurements advantageous to this work. However, the experiential analysis of the records taken from the instruments involve the threshold ambient temperature of the day on the data model recorded with synchronizing expected maximum and minimum atmospheric temperatures and hence the average atmospheric temperatures were considered true atmospheric temperature values. Alongside on the model read the date, and the expected average precipitation, and the geographical rain spot. For harmonic reasons the atmospheric temperature and the felt (ambient) temperature were compared at different relative speeds in (m/s). The time series involved, enabled us to compare the precedence and expedience implications of terrestrial radiations, solar noon and solar radiations. Our variations however enable plot-grams for different spots climate induced conditions.

METHODOLOGY

Factors and Formulations

The most essential formula relevant to this study are the Wind Chill formulation that will relate the surface temperature recorded by our climate instrument with the sensational temperature on the human body called the wind chill equivalent temperature, this caters for the implication that may arise from extreme temperature conditions. However, the empirical formulation for the relationship between surface sensation temperature on human being is defined as the equivalent temperature called the wind Chill equivalent temperature (Osczevski and Bluestein, 2005). The is given by the relation

$$WCT = 35.74 + 0.6215T - (35.75 - 0.4275T)V^{0.16} \quad (4.1)$$

Where: WCT is referred to as wind chill temperature

T Is the calculated temperature by empirical model taking in degree Fahrenheit

V is the wind speed measure in meters per second (m/s)

The simplified formula that bridges the relationship between the relative humidity, empirically calculated temperature and the dew point is shown in equation (4.2). This is referred to as Heat index factor (HI) used in the effect of relative humidity on the human sensation of temperature (Schoen, 2005) given thus:

$$HI = T - 0.9971\, exp^{0.02086\, T}\left[1 - exp^{0.0445\, (D-57.2)}\right] \quad (4.2)$$

Where: HI is referred to as heat index factor

T Surface temperature recorded by the field climate instrument

D Is the empirically recorded dew point

RESULTS AND ANALYSES

The result synopses and analyses concerning different variables include transects and fitted graph being descriptive autistics of the climate study. This latest study however evaluates the daily temperature variation as an important factor of the solar energy. In this study, our observation includes that when the hour of the day are directed by the solar noon, the clouds are clear and during this hours, equilibrium is usually reached when the solar radiation exceeds the terrestrial radiation. However, our evaluation has inferred that when the relative humidity is high we have high resulting tendencies for precipitations and on the other hand with low relative humidity conditions, clouds are clear and temperature is relatively high.

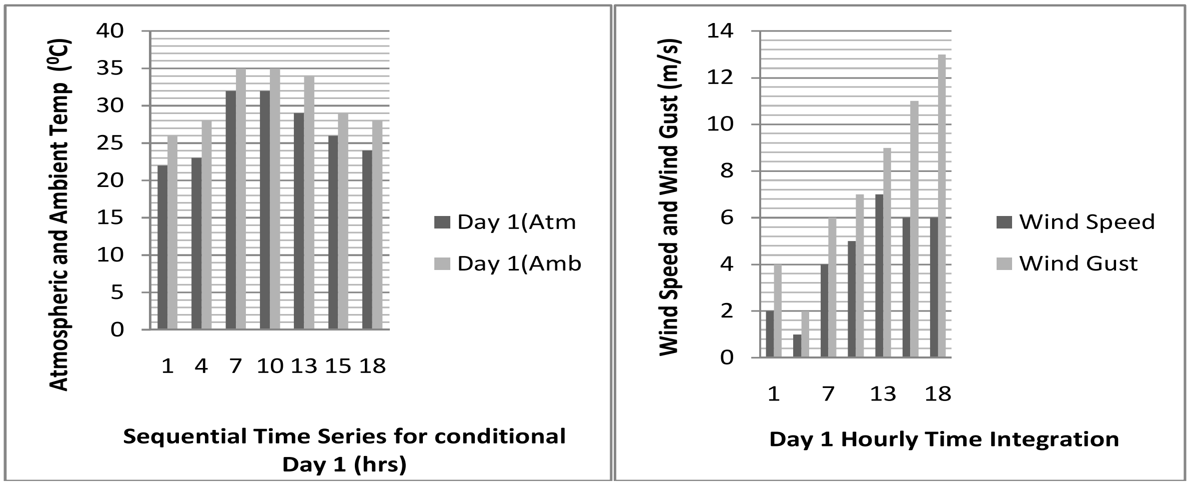

Figure 1. Fitted Variation of Temperature – Wind Speed For precipitation possibilities Day 1 (April 24, 2013)

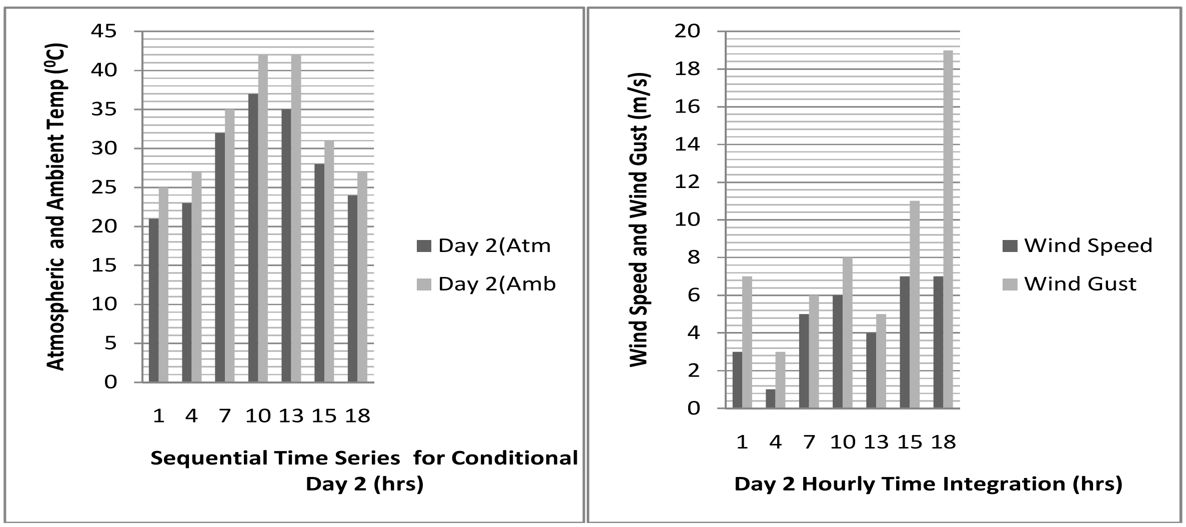

Figure 2. Fitted Variation of Temperature – Wind Speed For precipitation possibilities Day 2 (May 6, 2013)

DISCUSSIONS I

The plots of the atmospheric-ambient temperatures against sequential time series reveals an uneven pattern in temperature exponents or changes over the period coved, with aurora behavioral trends with the relative wind speed resulting in most precipitations, it can be visualized from Figure 1 and figure 2, that there is a lead in most histogram for the ambient indices with deviance of about $\pm 4^0C$ even when the wind speed are relatively low, however precipitation event or cold clouds are visible to wind gust ranging from 6m/s to 18m/s as can be observed for the precedence of the terrestrial radiations by the solar radiations just after the solar noon, precipitations were convective. These agree with the fact that the weather system have well defined cycles and structural features that governed by the law of heat and motion (Heristchi and Mouradian, 2000) . It can also be deduced from the graph that the series maintain a trend that are responsive to instantaneous seasonal components such as large bodies of water and wind cloud that are common phenomenon with rainfall upland climate. These become a factor contributing to rain fall indices in April 2013 and are validated by the fact that sun emits its energy at almost a constant rate but a region receives more heat when sun is higher in the sky and when there are more hours of sunlight in the day (Henney and Harvey, 1998). The patterns on the fitted graphs (see figure 1 and figure 2) have similar trend but different seasonal variability, this attests a realistic fact that solar radiation exceeds terrestrial radiation during the day and the surface becomes warmer. This also confirms that the amount of solar energy received by any region varies with time of the day, with season, with latitude (Watson et al., 2011).

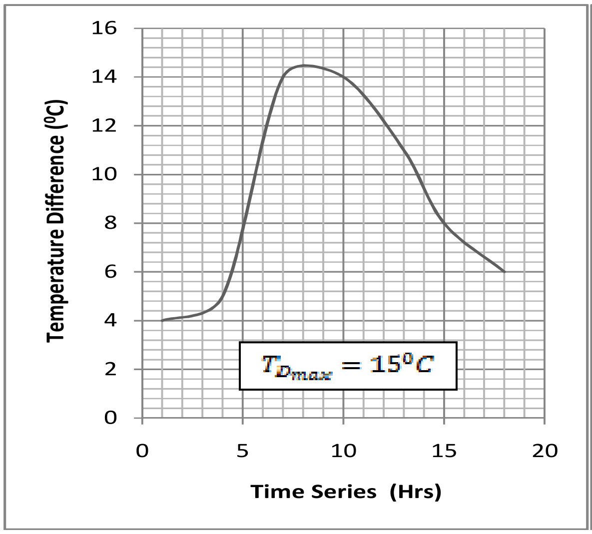

Figure 3. Variations for April 24, 2013

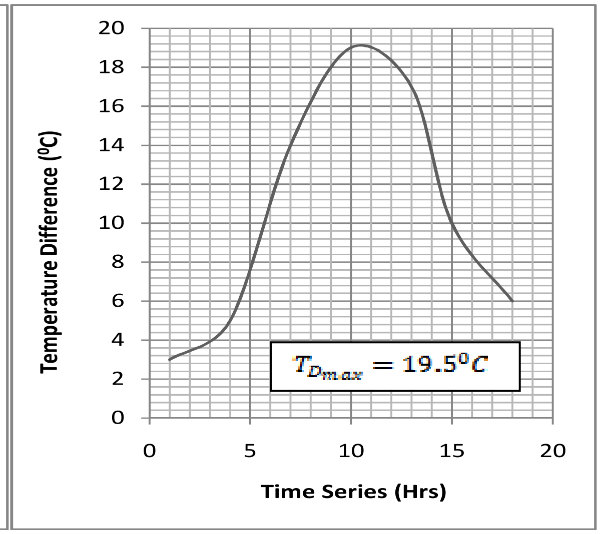

Figure 4. Variations For May 6, 2013

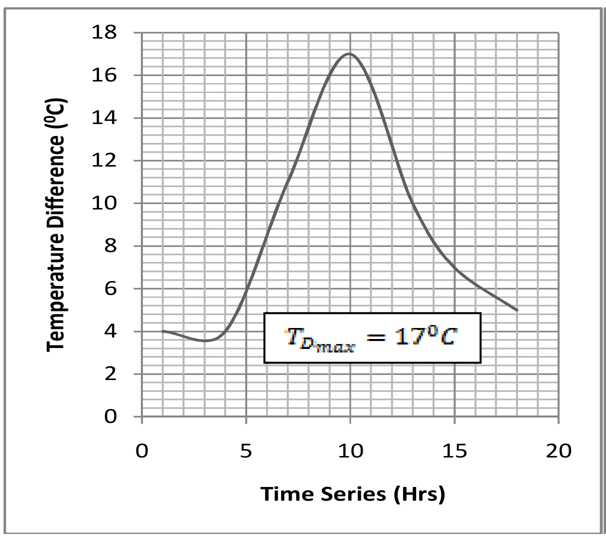

Figure 5. Variations for May 30, 2013

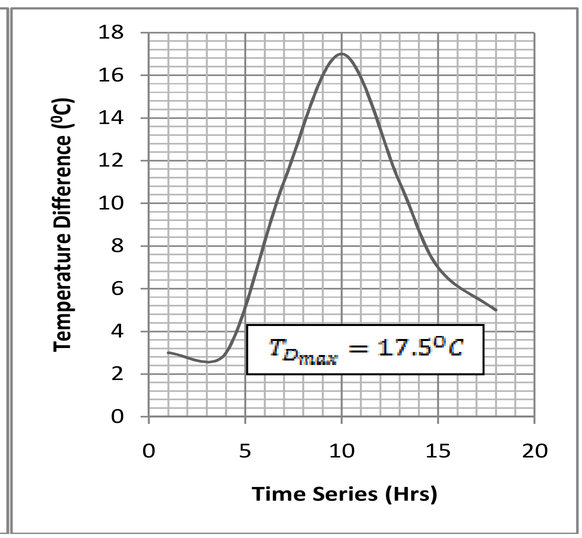

Figure 6. Variations for June 10, 2013

Figure 3 – Figure 6. Fitted Amplitude Pattern Time – sequenced Tropical Temperature Differentials on High Relative Humidity Days from April – June, 2013

DISCUSSIONS II

As can be observed from figures 3 to figure 6, the amplitude patterns of the time series temperature differences are regular only that, maximum temperature differences are reached at particular relative humidity for either the possibilities of zero precipitations or precipitations, nonetheless, the relative humidity for days under study are $\geq 50\%$ but characteristically become not only elements for the formation of clouds (cold, warm, mixed clouds, or clear air). It becomes evidently clear that the temperature differential gradients would not be the same for our time series data (See figure 3 – figure 6) specified days from April to June, 2013, these were cold cloud days. Observations shown from our comparisons, that during the solar noon in all the days under study, when the atmospheric temperature are about $33^0C \pm 4^0C$, saturated cloud for precipitations are visible, under these view, the maximum temperature $T_{D_{max}}$ determining features for precipitations about 19.5^0C and 17.5^0C in May and June respectively. (Figure 4 and Figure 6 shown the pattern). Clear air days with about $33^0C \pm 0^0C$, possible precipitation were stratified or widespread when maximum temperature

$T_{D_{max}}$ reached after the noon are about 15.0^0C and 17.0^0C in April and May 2013 (Figure 3 and Figure 5 shown the pattern). It is however fair to justify from our study that solar variation becomes the major determinant for precipitation possibilities irrespective of other weather elements such as wind, pressure, cloudiness and relative humidity.

CONCLUSIONS AND RECOMMENDATIONS

This study has concluded some facts about climate studies which include a check to the effect of extreme high temperature and extreme low temperature on our habitat of study. Identification of the impact of climate change on wetlands and biodiversity and critically observe the possibilities of human activities under temperature changes during the day and night hours. Environmental advantage of warm cloud, cold cloud, mixed phased cloud and clear air and the possibilities of cloud formations for the prediction for precipitation and other climate activities. It is however recommended that for research on the health impacts of climate variability and change aims to increase human understanding of the potential risks in the climate and to identify effective adaptation options. The climate system has become an integral part of the complex life supporting processes which by the increasing weight of human numbers and economic activities became a part of natural systems that are now coming under pressure that should be given an up to date studies for the reasons of health implications. Research on the potential health effects of weather, climate variability and climate change requires an understanding of the exposure of interest. Although often the terms weather and climate are used interchangeably, they actually represent different parts of the same spectrum. The long term good health of human beings depends on the continued stability and functioning between the weather system, the biosphere's ecological system and physical systems. The development of an empirical knowledge of the understanding of the potential health consequences of climate change has provided us with the basic information to understand weather, climate, climate variability and climate change, and thus discussed some analytical methods used to address the unique challenges as had been observed and addressed in this study.

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Appendix

Tabular Analyses for Surface Temperature Harmonics Used for the Study

Data Set Dates & Time	Temperature Observations				
24th April, 2013 Local Time	**Atmospheric Temperature (^{0}C)**	**Ambient Temperature (^{0}C)**	**Tropical Surface Temperature Difference (^{0}C)**	**Air Felt Temperature Difference (^{0}C)**	**Operating Temperature (Atm – Amb.) (^{0}C)**
4.00am	22	26	4	4	-4
7.00am	23	28	5	10	-5
10.00am	32	35	14	17	-3
1.00pm	32	25	14	7	7
4.00pm	29	34	11	16	-5
7.00pm	26	29	8	11	-3
10.00pm	24	28	6	10	-4
6th May, 2013 Local Time					
4.00am	21	25	3	7	-4
7.00am	23	27	5	9	-4
10.00am	32	35	14	17	-3
1.00pm	37	42	19	24	-5
4.00pm	35	42	17	24	-7
7.00pm	28	31	10	13	-3
10.00pm	24	27	6	9	-3
30th May, 2013 Local Time					
4.00am	22	25	4	7	-3
7.00am	22	25	4	7	-3
10.00am	29	32	11	14	-3
1.00pm	35	39	17	21	-4
4.00pm	28	33	10	15	-5
7.00pm	25	29	7	11	-4
10.00pm	23	27	5	9	-4
10th June, 2013 Local Time					
4.00am	21	24	3	6	-3
7.00am	21	24	3	6	-3
10.00am	29	31	11	13	-2
1.00pm	35	38	17	20	-3
4.00pm	29	34	11	16	-5
7.00pm	25	29	7	11	-4
10.00pm	23	27	5	9	-4