Global Advanced Research Journal of Physical and Applied Sciences Vol. 4 (1) pp. 051-056, September, 2015
Available online http://www.garj.org/garjpas/index.htm

Full Length Research Paper

Empirical study of the temporal variation of a tropical surface temperature on hourly time integration

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Accepted 11 September, 2015

This work investigates the daily temperature variation as an important factor of the solar energy striking the earth's surface each morning. Literature records that a shallow layer of air directly above the ground is heated by conduction and heat exchange between this shallow layer of warm air and cooler above is not sufficient enough. On regular days when the clouds are clear, air temperature vary by 77^0F (25^0C) from just above the ground to waist height. Incoming solar radiation exceed outgoing heat energy for many hours after noon and equilibrium is usually reached at mostly 91.4^0F (33^0C), observed as unusually very high. These characteristics are inferred by variety of different factors such as large bodies of water, soil type and cover, wind cloud cover/ water vapor, and moisture on the ground. The temperature variations are greatest very near the earth's surface which was represented by time aided characteristics in this region of study. However, sunny days are found to typically have high records of diurnal temperature variations. Nonetheless, low lying humid area in the vicinity of study have the least of variations. This explains why the tropics used in this study have high temperatures of up to 100^0F (38^0C) by 1.00pm on bright sunny days and have lows of 69.8^0F – 82.4^0F (21^0C – 28^0C) under raining situations.

Keywords: Geo – Spatiotemporal, Temperature, Temporal, Time integration

INTRODUCTION

The geographical spatiotemporal factors are generally the elements of weather which include temperature, humidity, cloudiness, precipitation, wind and pressure. These elements are organized into various weather systems, such as area of high pressure, low pressure and thunderstorm. Weather differs from climate, which is the weather that a particular region experiences over a long period of time. Nonetheless, climate includes the averages and variations of all the weather elements. All weather is due to heating from the sun and the differences in solar energy create temperature variations. Temperatures also vary with differences in topographical surface and with altitude. These temperature variations create forces that drive the atmosphere in its endless motions. During the day, solar radiation exceeds

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terrestrial radiation and the surface becomes warmer. At night, solar radiation ceases, but terrestrial radiation continue and cool the surface. Cooling continues after sunrise until solar radiation again exceeds terrestrial radiation. Minimum temperature usually occurs after sunrise, sometimes as much as one hour after. The continued cooling after sunrise is one reason that fog sometimes forms shortly after the sun is above the horizon.

LITERATURE REVIEW

All weather systems have well defined cycles and structural features that are governed by the laws of heat and motion (D. Heristchi and Z. Mouradian, 2000). The sun emits energy at almost constant rate, but a region receives more heat when the sun is higher in the sky and when there are more hours of sunlight in the day (C.J Henney and J.W Harvey, 1998). The amount of solar energy received by any region varies with time of day, with seasons, and with latitude (F.T Watson et al, 2011). Topographical surfaces and altitude are also determinant of varying temperature or temperature differences (C. Partha, B.N Dirivadi, 2011)

Study Area and Description

The 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^{0}N, Long. 5.31^{0}E) Afe Babalola University, Ado Ekiti, South West, Nigeria. The weather data recorded by the instrument were assessed in a computer model. The instrument is a sturdy, easy to mount and perfectly designed for a variety of different task in climate zones. It measures the precipitation, soil moisture, wind speed and wind direction, atmospheric pressure, humidity and senses the leaf wetness. However, it is termed an agro-tronic instrument used to provide necessary data needed for cultivation of plants and also to cater for most exotic micro- meteorological challenges. The research diagnostics and modeling in these recent studies are:

- Agro - meteorology
- Rainfall activities/ Events
- Flood forecast
- Check the transportation of green house gases
- Control of green house effects
- Climate diagnosis
- Precipitation predictions
- Cloudiness characteristics : cold cloud, warm cloud and clear air

DATA ANALYSIS

Sample Data Table of Precipitation Probability (%) at Different temperature on daily time integration

METHODOLOGY

Step 1

- Observe the threshold ambient temperature of the day on the data model
- Record the Expected maximum and minimum atmospheric temperatures and determine the average atm. temp.
- Record the date, and the expected average precipitation, and the geographical rainspot.

Step 2

- Read data table, Thus : www.fieldclimate.com
- Compare the temperature harmonics (Atm. temp & Felt. temp) with relative speeds

Step 3

- Group the data table as in time integration, early hours of the day (4:00am) and late hour of the day (10:00pm)

Step 4

- Plot the data table:
- 2D- variation of temp-temp with time intervals.
- 2D - variation of the wind speed (normal and gust) with daily time integration
- Spot our maximum for the atmospheric and the environmental ambient temperature, wind speed and wind gust.

Step 5

- Compare the temperature variations with time for the season (as in this study; after mid April to late June, 2013)
- Interpret and discuss the results.

First Temperature Harmonic

GMT Time 24th April, 2013	Atmospheric temperature (℃)	Air felt temperature (℃)	Wind Speed (km/hr)	Wind Gust (km /hr)	Precipitation Probability (%)
4 .00am	22	26	2	4	0
7. 00am	23	28	1	2	0
10.00am	32	35	4	6	31
1. 00pm	32	35	5	7	73
4.00pm	29	34	7	9	86
7. 00am	26	29	6	11	84
10.00pm	24	28	6	13	43

Second Temperature Harmonic

GMT Time 6th May, 2013	Atmospheric temperature (℃)	Air felt temperature (℃)	Wind Speed (km/hr)	Wind Gust (km /hr)	Precipitation Probability (%)
4 .00am	21	25	3	7	0
7. 00am	23	27	1	3	0
10.00am	32	35	5	6	3
1. 00pm	37	42	6	8	7
4.00pm	35	42	4	4	34
7. 00am	28	31	7	11	50
10.00pm	24	27	7	19	53

Third Temperature Harmonic

GMT Time 30th May, 2013	Atmospheric temperature (℃)	Air felt temperature (℃)	Wind Speed (km/hr)	Wind Gust (km /hr)	Precipitation Probability (%)
4 .00am	22	25	5	8	0
7. 00am	22	25	5	8	0
10.00am	29	32	8	14	4
1. 00pm	35	39	8	8	8
4.00pm	28	33	11	16	55
7. 00am	25	29	7	21	100
10.00pm	23	27	6	19	42

Fourth Temperature Harmonic

GMT Time 10th June, 2013	Atmospheric temperature (℃)	Air felt temperature (℃)	Wind Speed (km/hr)	Wind Gust (km /hr)	Precipitation Probability (%)
4 .00am	21	24	4	7	0
7. 00am	21	24	5	7	0
10.00am	29	31	6	11	0
1. 00pm	35	38	8	9	0
4.00pm	29	34	10	14	46
7. 00am	25	29	7	20	79
10.00pm	23	27	8	28	51

Time	**Atm. temp**(℃)	**Felt temp.**(℃)	Wind Speed (km/hr)	Wind Gust (km /hr)	Probability (%)

RESULTS AND DISCUSSIONS

Our variation is short term based since it is diurnal and daily records were taken on hourly time integration. The comparison was however made with solar variations since it is temperature dependent and that the characteristics of the spectral distribution of solar radiations compares with our study diurnal temperature - temperature temporal characteristics. Observations shows that solar radiation usually termed in rise and fall in seasonal temperature have similar pattern with this present study. (See figure 1.0a - Figure 1.0 g). This is

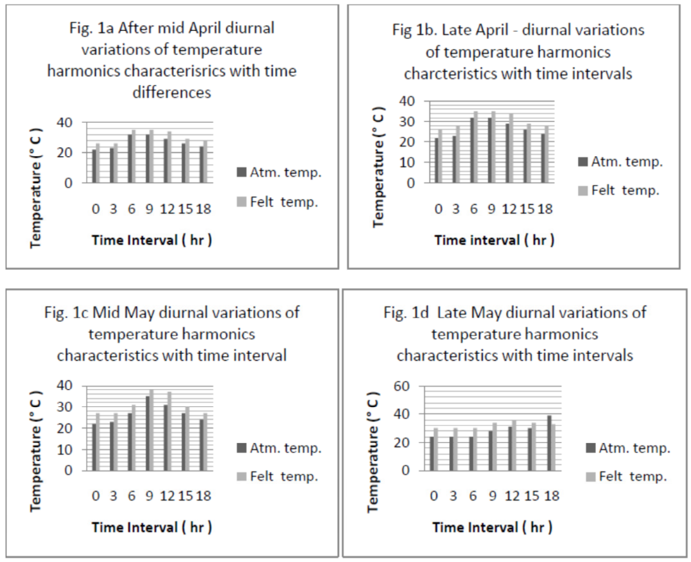

Fig. 1.0a - Fig. 1.0d : Diurnal cycle of harmonic analysis characterized for atmospheric temperature and air felt temperature for specified days between April and June, 2013

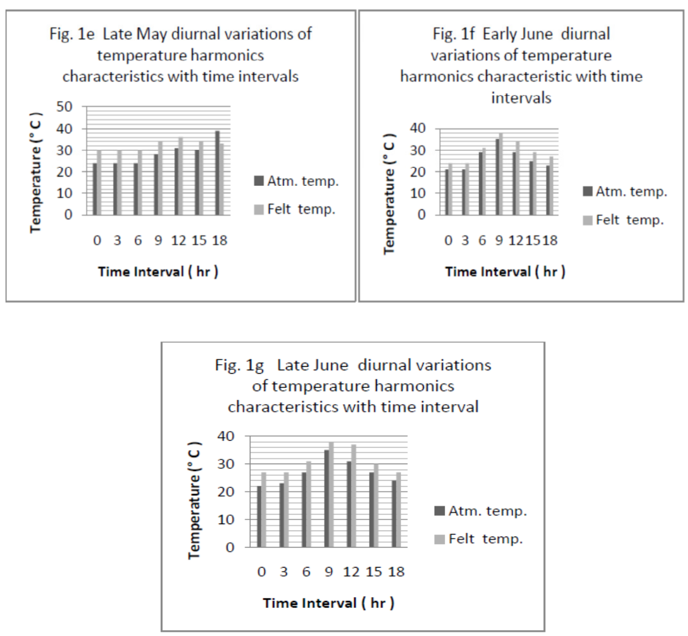

Fig. 1.0 e - Fig. 1.0g : Diurnal cycle of harmonic analysis characterized for atmospheric temperature and air felt temperature for specified days between April and June, 2013

proved pragmatic that solar radiation exceeds terrestrial radiation during the day and the surface becomes warmer. This fact agrees that the amount of solar energy received by any region varies with time of the day, with season, with latitude (F.T Watson et al, 2011). This present study has also shown that during the night season solar radiation ceases, but terrestrial radiation continues and cools the surface, cooling continues after sunrise until solar radiation again exceeds terrestrial radiation.

Observations 1

Figure 1.0a - Figure 1.0g show a component for the diurnal cycle of the harmonic analysis characterized for

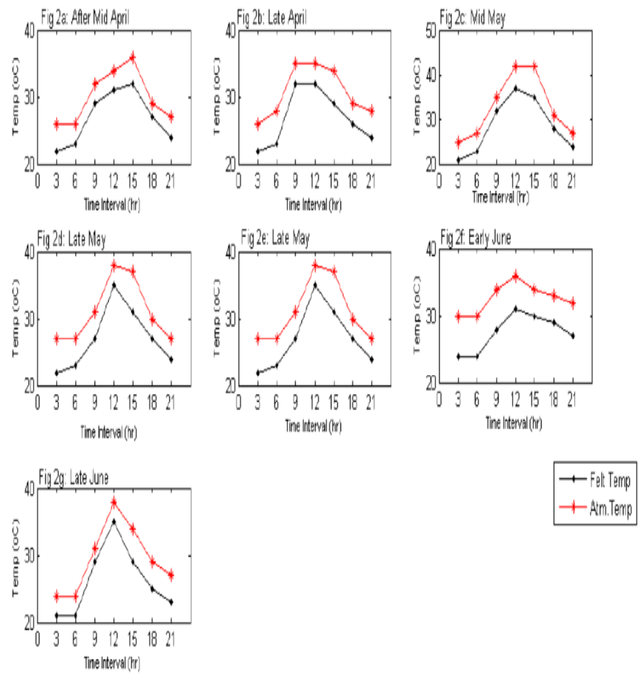

Fig.2.0a - Fig. 2.0g : 2D - Variations atmospheric temperature and air felt temperature with daily time integrations for specified days between April and June, 2013.

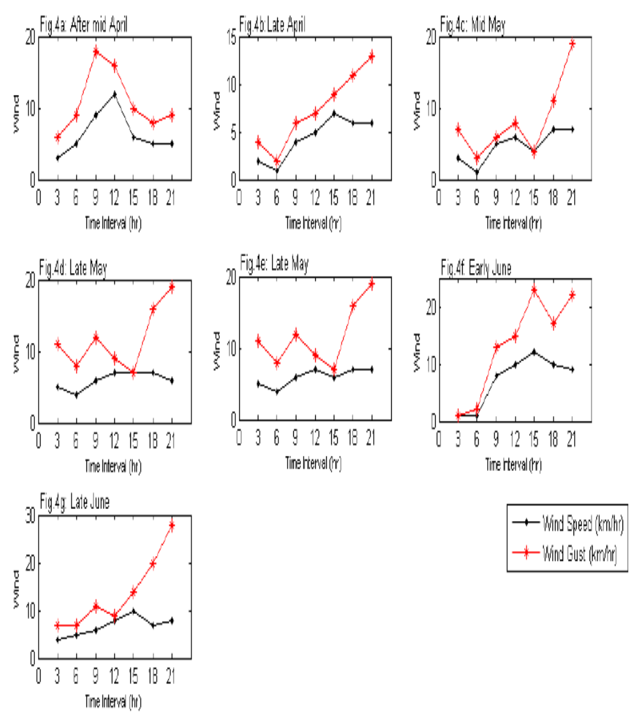

Fig.3.0a - 3.0g: 2D - Variations of Wind Speed and wind gust with daily time integrations for specified days between April and June, 2013.

the atmospheric temperature and the ambient temperature showing that the temperature - temperature temporal activity has been relatively been constant throughout the days of the month with the variation set range of three hourly time change or integration. Nonetheless, precipitation events have been observed between 28^{0}C and 36^{0}C for precipitation events with significantly high probability. This time of the day was symbolic of cold clouds.

Observations 2

Figure 2.0a - figure 2.0g feature 2D - Variations of the atmospheric temperature and air felt temperature with daily time integrations for specified days between April and June, 2013 showing that the short term variation of the diurnal cycle is elliptic in oscillations; the warm and cold cloud events were considered with green house factors for the solar radiation greater than the terrestrial radiation. Our observation from this present study show that high temperature accompanied the green house gases and also the depletion in the layer of ozone layer is an aided factor.

Observation 3

Figures 3.0a - 3.0g featured 2D - Varying plots of the comparisons of wind speed and wind gust with daily time interval for specified days in April to June, 2013 showing that the short term variation of the diurnal cycle is asymmetrical in progression indicative of aurora characteristic of our observation from latest study (Kaka and Alao, 2013) .The velocity in air are greatest very near the earth's surface termed to be symbolic of time aided in characteristics of near 20km/h for wind gust mostly resulting in rain or cold clouds as observed in this present of study.

CONCLUSION

The temperature variations are greatest very near the earth's surface which was temporal aided characteristics in this region of study. The observatory study critically considered some environmental factors such as large bodies of water and wind drifts, these are considered some fluctuation phenomena of the asymmetrical properties as may be observed from our plots (Fig.3.0a - Fig 3.0g). However, sunny days are found to typically have the greatest daily temperature variations. The warm clouds or clear air are the features on high sunny days known to be unusually very high around 1:00pm during the day. Nonetheless, on regular days when the clouds are clear, air temperature vary by 77^{0}F (25^{0}C) from just above the ground to waist height. Incoming solar radiation exceed outgoing heat energy for many hours after noon and equilibrium is usually reached at mostly 100^{0}F (33.4^{0}C), as observed as unusually very high. These characteristics are however inferred by variety of different factors such as large bodies of water, soil type and cover, wind cloud cover/ water vapor, and moisture on the earth.

APPENDIX

GMT - Greenwich Meridian Time

ACKNOWLEDGMENT

Our sincere appreciation to the management of Afe Babalola University for making available the site instrument, imetos paranometer used for this study. We acknowledged the staff for Physics Programs at Afe Babalola University, Ado Ekiti, Ekiti State, Nigeria for their moral encouragement given to us and also, the Department of Physics, Adekunle Ajasin University, Akungba Akoko, Ondo state, Nigeria for their scholastic contribution to this work. With no reservation, we thank the World Academy of Science and Technology (WASET) for their peer reviewed of this paper and its inclusion in the conference proceedings of the International Conference on Applied Science, Technology and Environmental Engineering, ICASTEE 2014.

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