http://www.rainwatch-africa.org

http://owc.enterprise.earthnetworks.com/OnlineWeatherCenter.aspx?aid=7144&stat=L2GAM&pid=3&layerID=Radar.Global&Units=1

Government of The Gambia
Department of Water Resources
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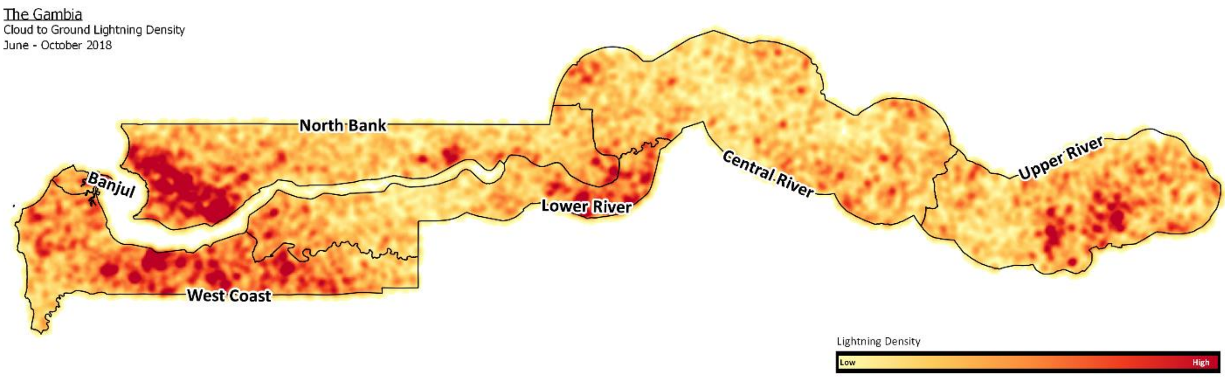
THE GAMBIA ANNUAL CLIMATE REPORT
2018



1.0 INTRODUCTION:

The Climate of a country or locality therein is the synthesis of the day to day evaluation of meteorological elements that had affected it.

Various methods are used to represent Climate such as diagrams, graphs, etc… including the frequency of weather types.

Climate data are usually expressed in terms of an individual calendar month, season, year and or determined over a period of at least 30 years enough to ensure that representative values are obtained.

The main elements treated in this report are temperature, rainfall and solar radiation; with spectacular weather phenomena such as Thunderstorms with its associated Cloud to Ground (CG) lightning activities.

The Climate of a country or locality therein is due to the following factors:-

- Latitude
- Altitude
- Aspect (slope) of the local terrain
- Position relative to continents and oceans
- Atmospheric and Oceanic circulation patterns.

Two of the most significant Meteorological signatures that are keenly observed over The Gambia are Thunderstorms and dust-haze/ duststorm. These Meteorological phenomena are generated due to the following:

1.1 THUNDERSTORM:

Thunderstorm is a series of sudden electrical discharges resulting from an atmospheric condition. These discharges result in sudden flashes of light commonly known as 'lightning' and trembling sound waves known as 'thunder'.

Thunder is the sharp rumbling sound produced after a lightning discharge heats the air in its path suddenly and intensely causing the sudden expansion of the air column*. The tops of the thunder cloud are mainly positively charge while the bottom parts are negatively charge with a few positive electrical charges. The ground is generally mostly negatively charged with a few positive charges. Hence, an electric discharge (lightning/ thunderbolt) will flash from the Cb cloud to the ground, or within the cloud top to near the base of the cloud or from one Cb cloud to another.*

Thunderstorms are associated with convective (cumulonimbus) clouds and are often accompanied by severe weather, such as hail, upper level icing, wind shear 'turbulence', downburst winds 'squalls', rain, and terrifying lightning flashes and roaring thunder claps.

They develop when warm, humid air near the ground receives an initial upward push from converging surface winds and rises rapidly in an unstable atmosphere. Thunderstorm can become severe when the atmosphere is particularly unstable with additional energy obtain from surrounding winds.

Thunderstorms with its related severe weather activities can create hazards and unsafe conditions such as injuries, deaths, damage to property and socio-economic disruptions and disadvantages.

In order for a Cumulonimbus cloud to develop into a Severe Storm there needs to be a mechanism to maintain the core of rising air and protect it from the effects of the cold falling precipitation.

1.1.1 SQUALL-LINE (Disturbance lines or Multi-cell lines):

A squall-line is a line of developing Cumulus clouds, usually accompanied by strong gusts of wind which may or may not be associated with a change in wind direction that last several minutes and then suddenly dies down. Over West Africa, they have a North-South orientation. The length of Squall-lines ranges between 300 to 500 km, with a width of approximately 50 km and have heights of 10 to 15 km.

They form during the Northern Hemisphere Summer. Their preferred time of formation is in the late afternoon hours, when insolation and turbulent eddy exchange are strongest. They depend on and are controlled by, the depth of the Southwest Monsoon.

The arrival of a Squall-line is associated with a rise in pressure and a drop in temperature.

They travel westwards and reach a speed varying between 60 to 120 kmh^{-1} or higher. They are faster over land than over the water bodies. They travel a distance of approximately 10° to 20° longitude before decaying and on some occasions can maintain their characteristics for over a day.

1.2 DUST HAZE & DUSTSTORM:

Dust Haze is due to high concentration of dust particles in the atmosphere which can be dangerous to transportation especially air navigation. Sometimes visibility is reduced to only a few kilometres or less.

Dust haze is observed during the Northern Hemisphere Winter months (Commonly known as the Harmattan over West Africa) onwards early summer. The origin of the dust is said to be the Sahara desert. Due to the north-easterly trade winds which are advected into our region during this season, dust or sand may be raised from the ground by the wind and carried upwards and transported windward. This eventually spreads over much of Western Sahel and onto the Tropical and Equatorial North Atlantic Ocean and goes far south as 05°N. The height to which the dust particles rise depends on their size and the prevailing condition and trajectory.

This phenomenon usually settles down under calm or very light winds. Abnormally, when unseasonal slight rains occurs during this period and if it persists for some time; it also help in the clearing of this dust.

Apart from the hazards on transportation, it has also effect on health. The presence in the atmosphere of fine dust particles serves as a blanket. The maximum temperatures are reduced while the minimum are usually higher than normal. This is due to the fact that these particles scatter both the in-coming and out-going radiation back; Thus, keeping the nights warmer than normal.

The presence of dust haze during northern hemisphere summer hampers the formation of low clouds. This is due to the high concentration of the dust particles. Even though these particles can serve as condensation nuclei, the high concentration makes competition for water vapour and hence, fewer water vapour for clouds to form.

When the visibility is reduced below 1 km, the phenomenon may be referred to either as a sandstorm or as a **duststorm**. Sandstorm consists of relatively coarse sand which is too heavy to be lifted far. The sand particles rarely extend to a height of more than 20 or 30 m, and they are not carried appreciable long distances from their source.

Duststorm consists of minute particles of fine dust, and may on occasions be distributed to heights of several kilometres above the Earth’s surface. For dust to be raised and to remain in the air, a number of conditions must be satisfied; viz:-

A strong High pressure system (Azores/ Saharan) extending its associated ridge over the Sahara desert.

The passage of a deep Mid-latitude frontal depression over North Africa. Particularly, when there is a cold air outbreaks over Western Europe extending onto the Maghreb.

The extent of these phenomena depends on the Pressure gradients and hence prevailing and or required wind force to lift or raise the dust at the lower levels over the Sahara into the Sahel region.

2.0 MAIN CHARACTERISTICS OF THE GAMBIA'S CLIMATE:

The country is largely semi-arid with two distinct seasons (i.e. wet and dry). The Wet (rainy) season is from June to October; whereas, the Dry season is from December to April while May and November are considered as transitional months.

As depicted on the plotted diagrams and maps, most regions within The Gambia are currently experiencing a slight increase in Surface Air Temperature while Rainfall patterns are irregular and highly variable.

During the dry season, the influencing factors are the Saharan anticyclone which causes subsidence and hence, surface warming with northeasterly and or easterly wind-flow. The passages of mid-level troughs from the Atlantic Ocean occasionally accompanied by the Sub-Tropical Westerly Jet brings along unusually breezy and cool northerly and or northwesterly wind-flow, at times cloudy conditions and even unseasonal rains.

With regards to the rainy season, the critical factors in development of a wet mode depends on: The development of a low-level equatorial southwesterly or southerly monsoonal flow, northward displacement of the Inter-Tropical Discontinuity / Inter-Tropical Convergence Zone (ITD/ITCZ) and the African Easterly Jet (AEJ) including Easterly wave activities.

2.1 TEMPERATURE:

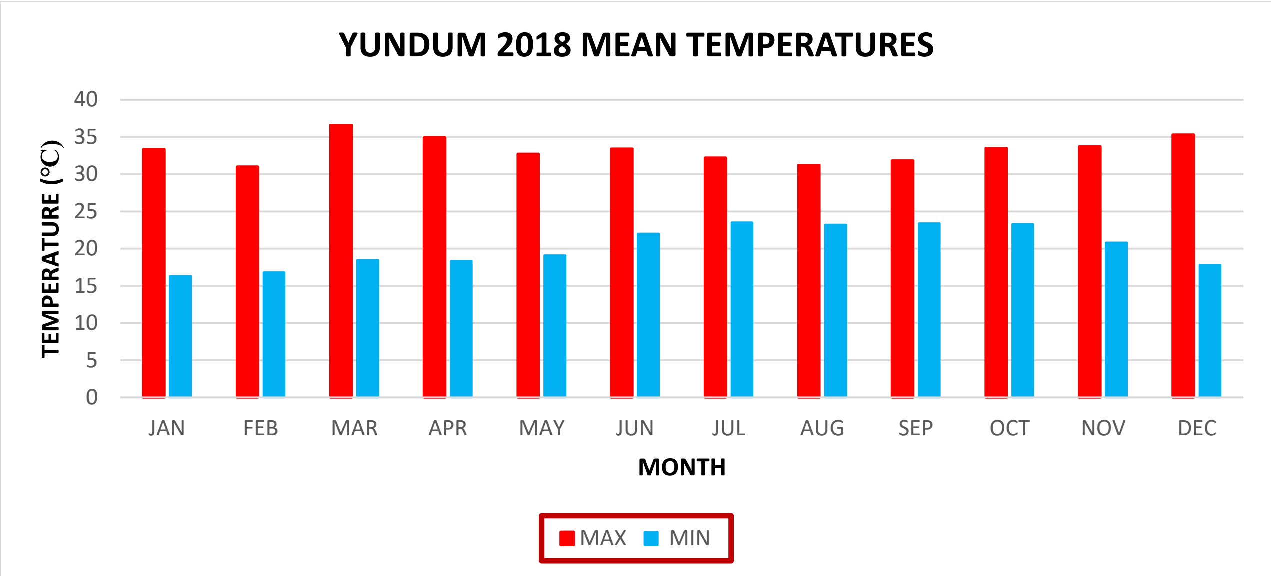
Temperature:- is the degree or intensity of heat present in a substance or object.

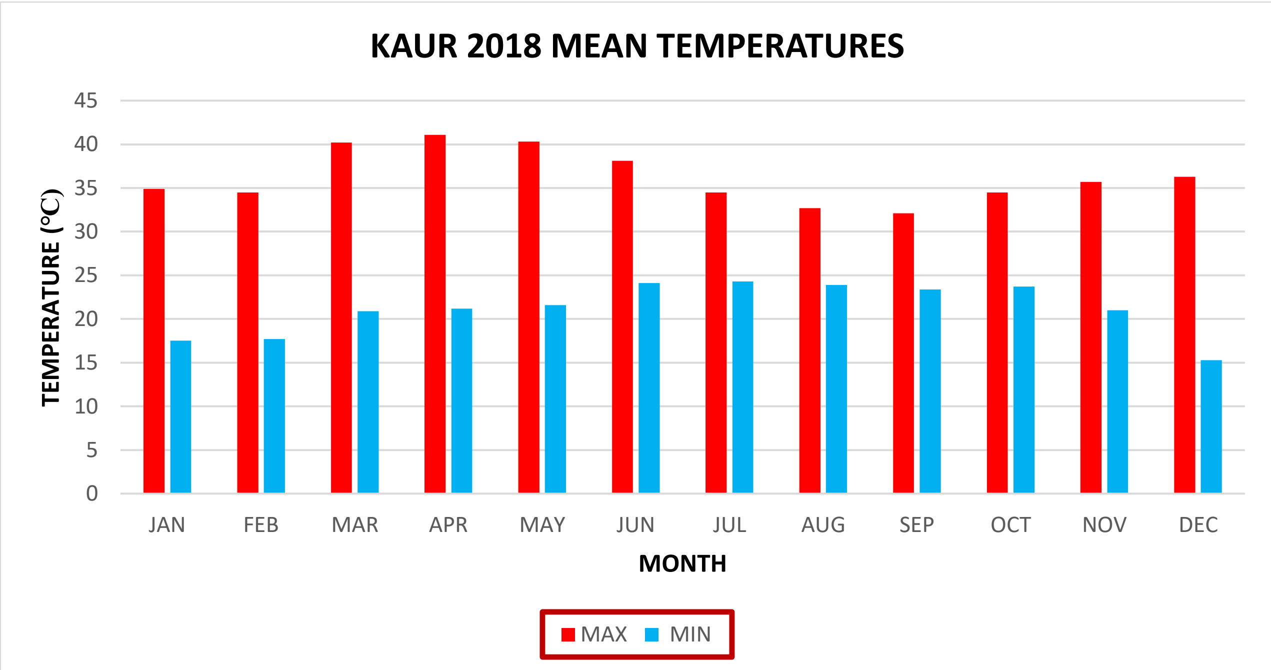
Measurements of Surface Air Temperature are made in a screen that shields the instrument from direct sunlight. The screen is positioned so that the thermometer bulb is 1.5m above the ground. Various Thermometers are used for different temperature measurements. However, the unit of measurement is the degree Celsius (℃).

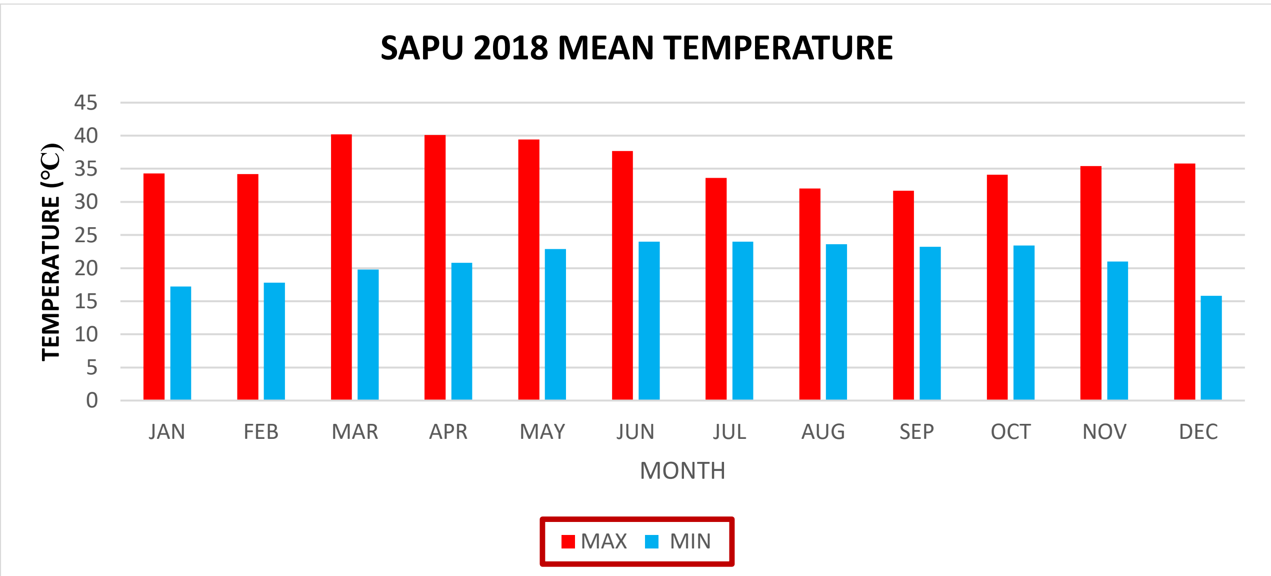
Temperatures are lower at night than by day, with the minimum temperature usually occurring by dawn and the maximum temperature occurring two to three hours after midday.

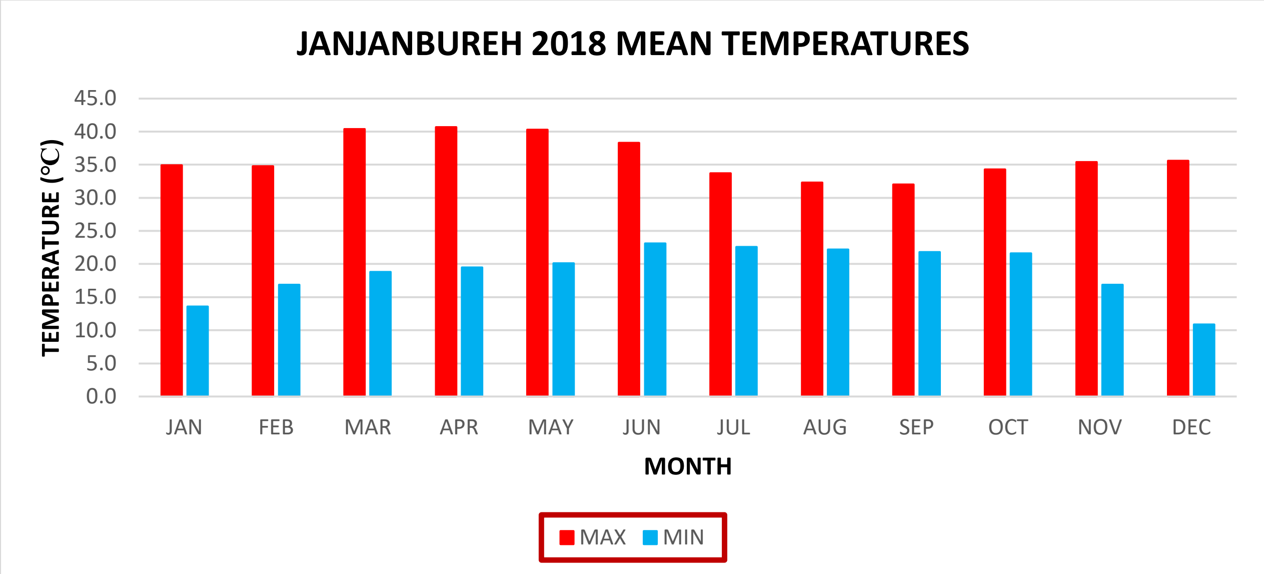
The cycle of temperature during a 12 month period is The ***Annual range of temperature,*** which is the difference between the average temperatures of the warmest and coldest months. The annual range of temperatures is greatest over the inland than over coastal or near-coastal areas. Due to the influence of the Atlantic ocean, temperatures are been modified such that coastal and near-coastal areas experiences mild to moderate temperatures as compared to the inland areas where the difference in annual temperature ranges are large during the hot and cold seasons.

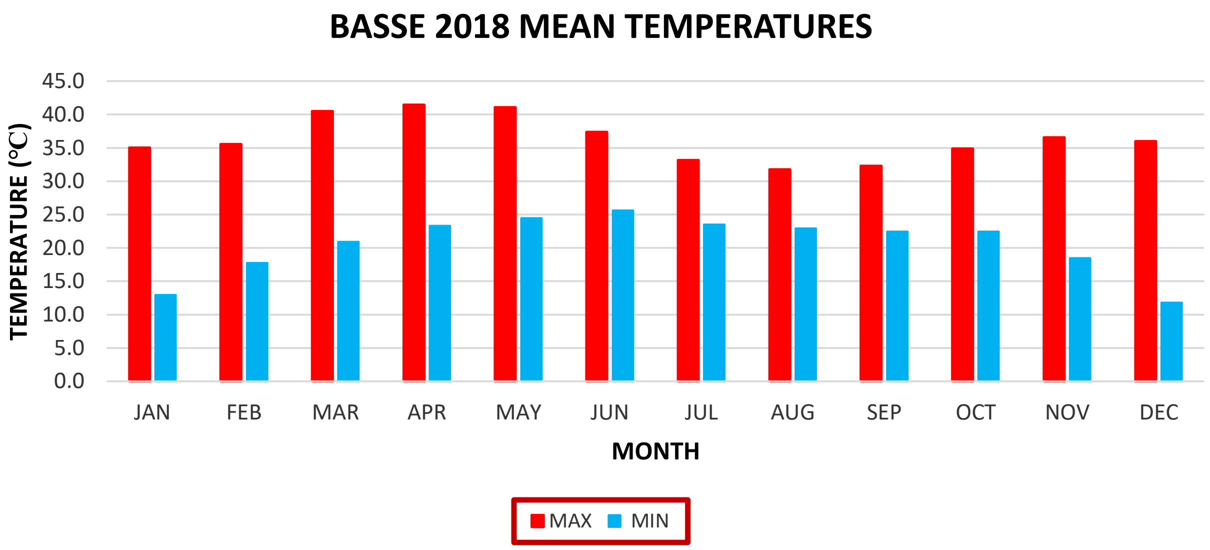
As indicate on the plots below, the 2018 Annual range of temperatures for selected locations are as follows …. ***Yundum- 20.3℃; Kaur- 25.8℃; Janjanbureh- 29.8℃ and Basse- 29.6℃……..***


YUNDUM 2018 MEAN TEMPERATURES
TEMPERATURE (°C)
0
5
10
15
20
25
30
35
40
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
MAX
MIN


KAUR 2018 MEAN TEMPERATURES
TEMPERATURE (°C)
0
5
10
15
20
25
30
35
40
45
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
MAX
MIN


SAPU 2018 MEAN TEMPERATURE
TEMPERATURE (°C)
0
5
10
15
20
25
30
35
40
45
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
MAX
MIN



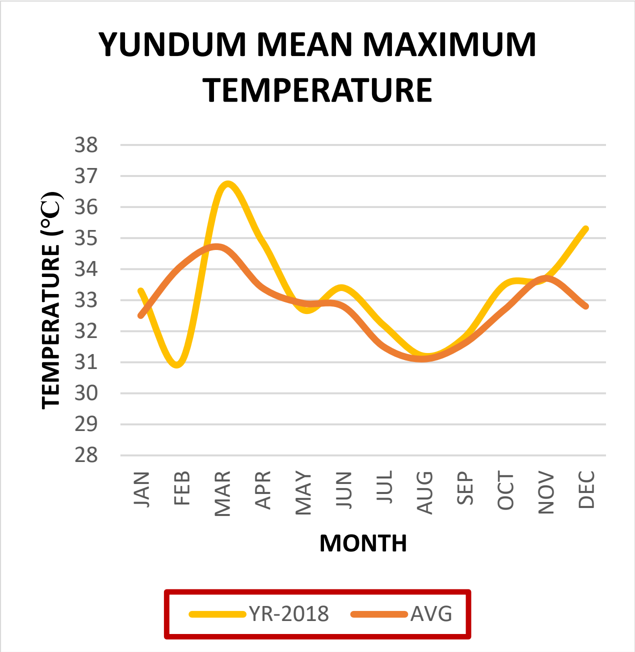


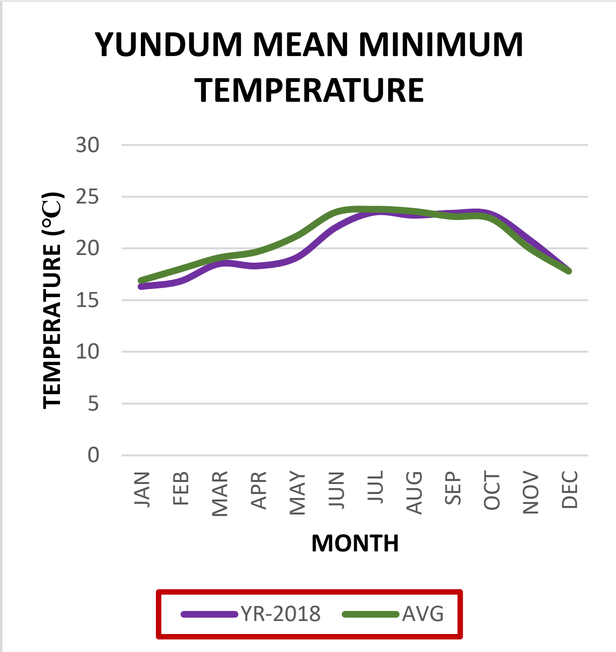
Apart from the coastal or near-coastal areas that experiences slight daytime warming episode as depicted on the Yundum Mean Maximum Temperature plots below, average temperature conditions prevailed over most places.

Pertaining to the Mean Minimum Temperature, the country experiences a general night time cooling with lowest values realised over the inland areas; such as Jenoi, Janjanbureh and Basse.

Mean Maximum Temperature: During February, Cooler than normal conditions prevail over Yundum; whereas, March, April June, July, October and December were warmer than normal with an annual departure of +0.5℃

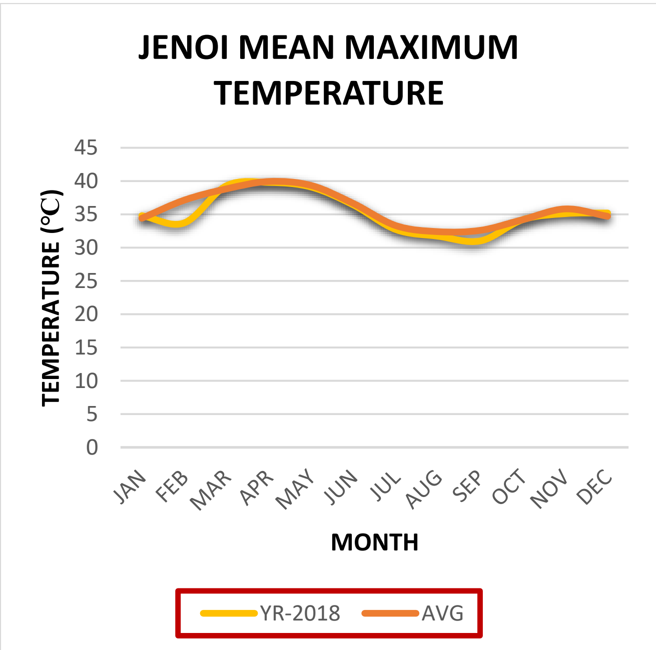
Mean Minimum Temperature: January to June was slightly warmer while the rest of the year was near Normal with an annual departure of -0.6℃.

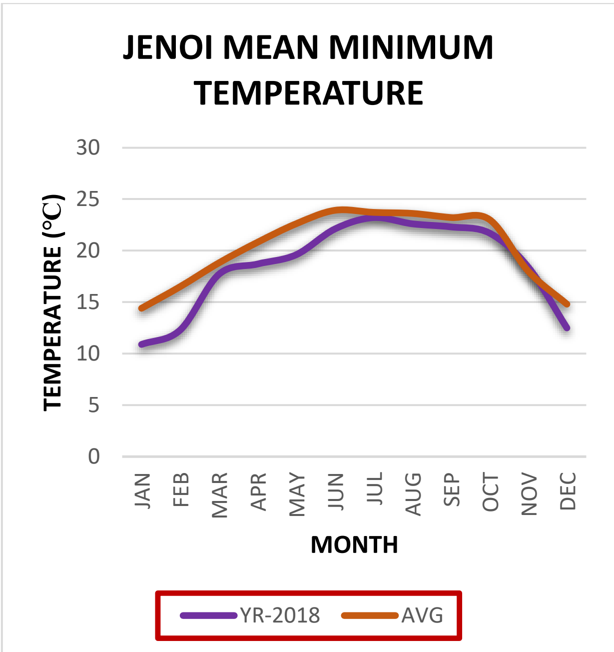




Mean Maximum Temperature: February and September were cooler than normal for Jenoi, the rest of the months had normal temperatures, with an annual departure of -0.5℃.

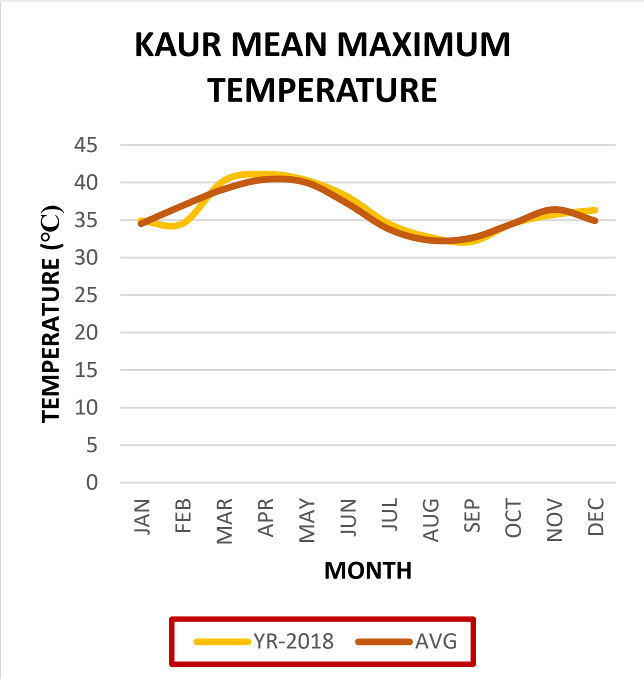
Mean Minimum Temperature: Apart from July and November that experienced a normal temperature condition, the rest of the months recorded below normal temperatures with an annual departure of -1.8℃.

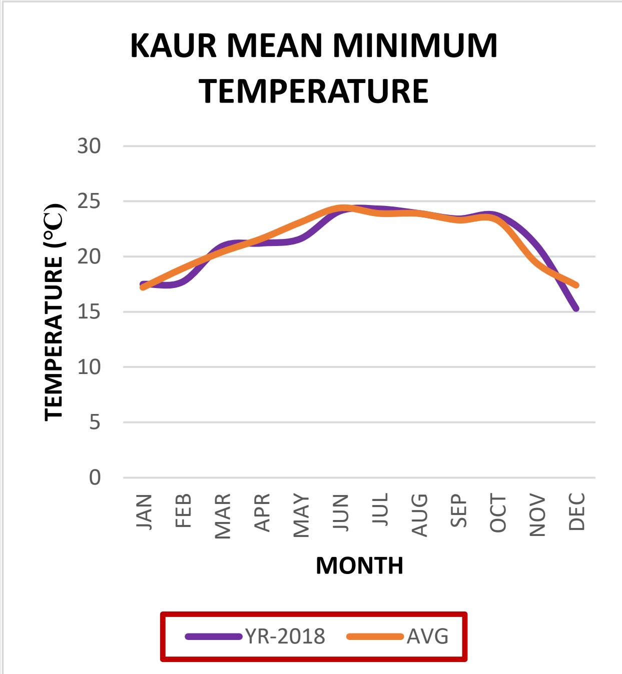


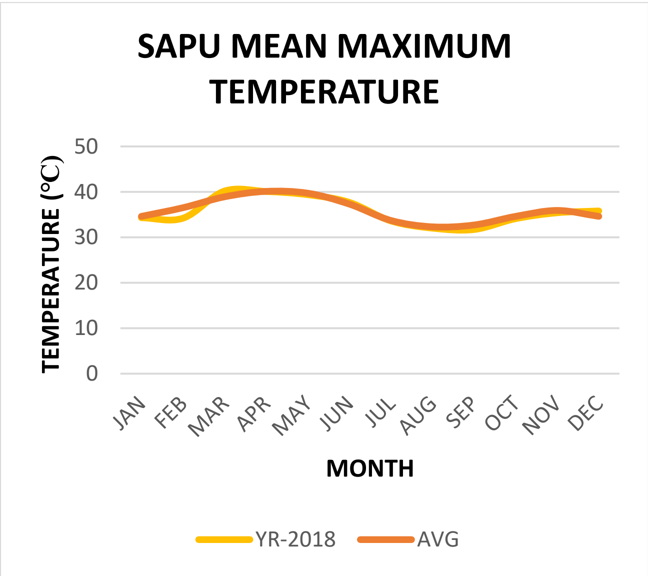


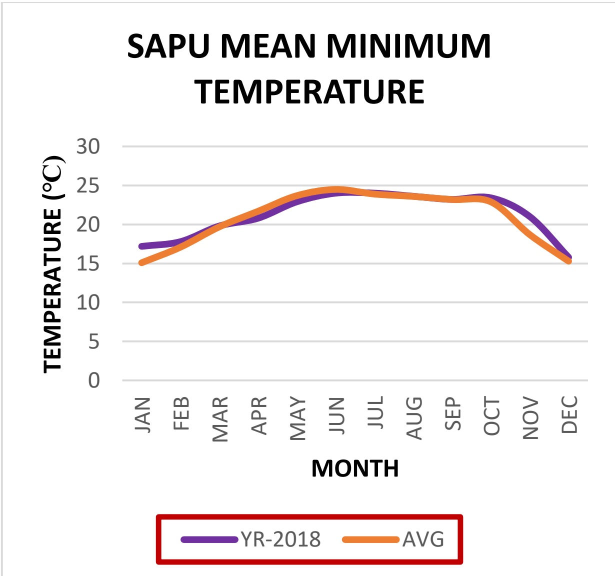
As for Kaur: March Mean Maximum Temperature was slightly warmer and February cooler than normal respectively while the rest of the months had near-normal temperatures.

Mean Minimum Temperature during February, May and December for Kaur were cooler than normal while November was warmer than normal with the rest of the months recording normal temperature conditions.



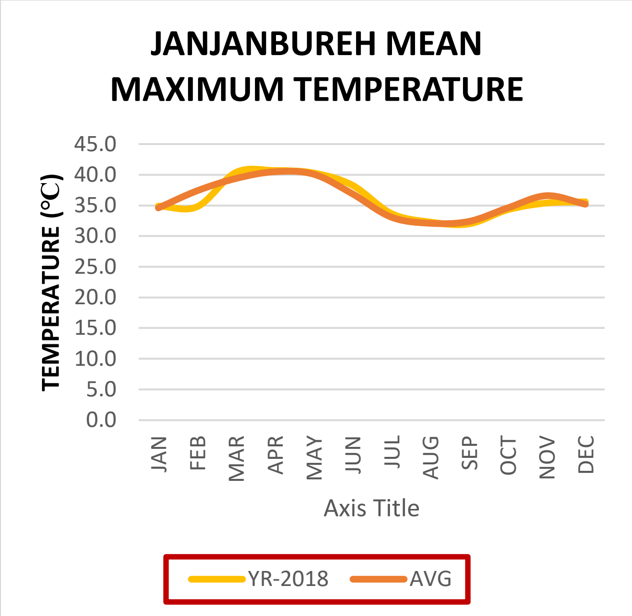


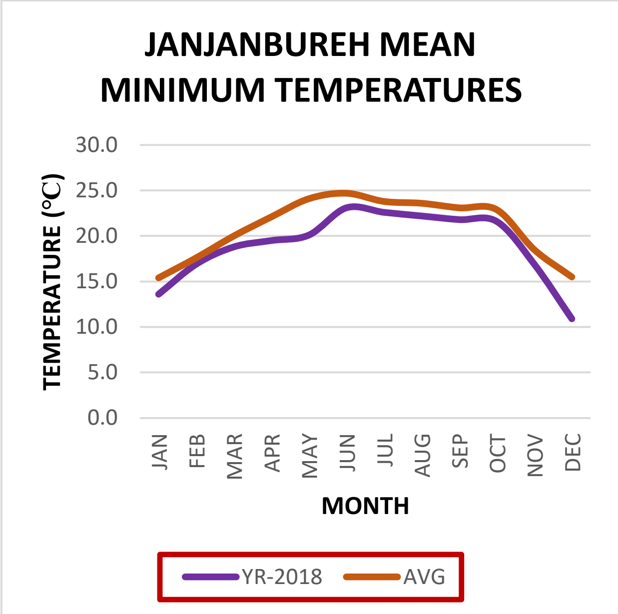




Sapu Mean Maximum temperature is quite similar to that of Kaur and Janjanbureh with the later having nil annual temperature departure (0.0℃).

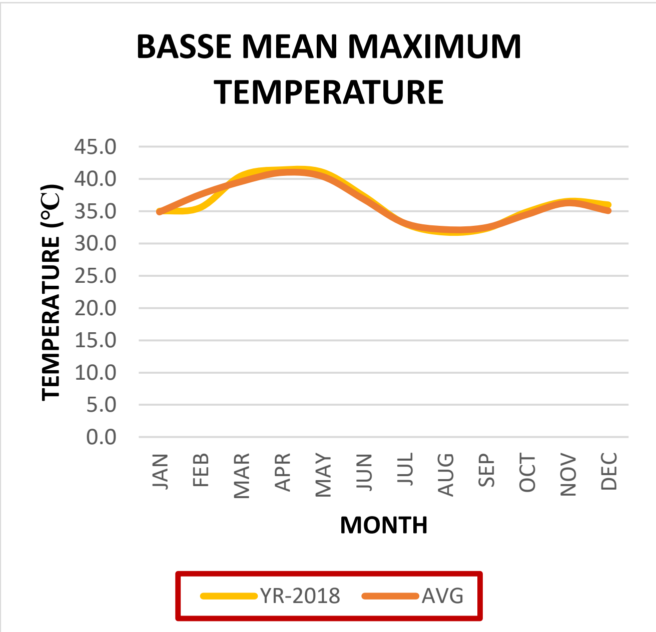
For the Mean Minimum Temperature, The months of January and November were warmer than usual and slightly cooler in April and May. Generally, cooler conditions prevail throughout the year over Janjanbureh with an annual departure of -1.9℃.

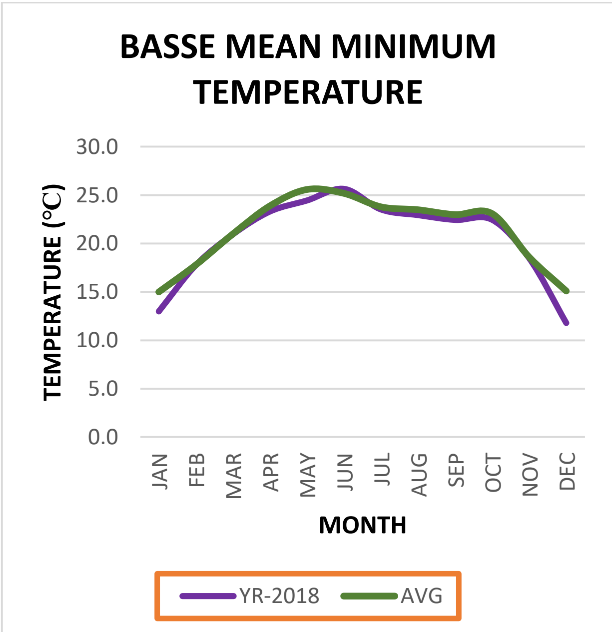




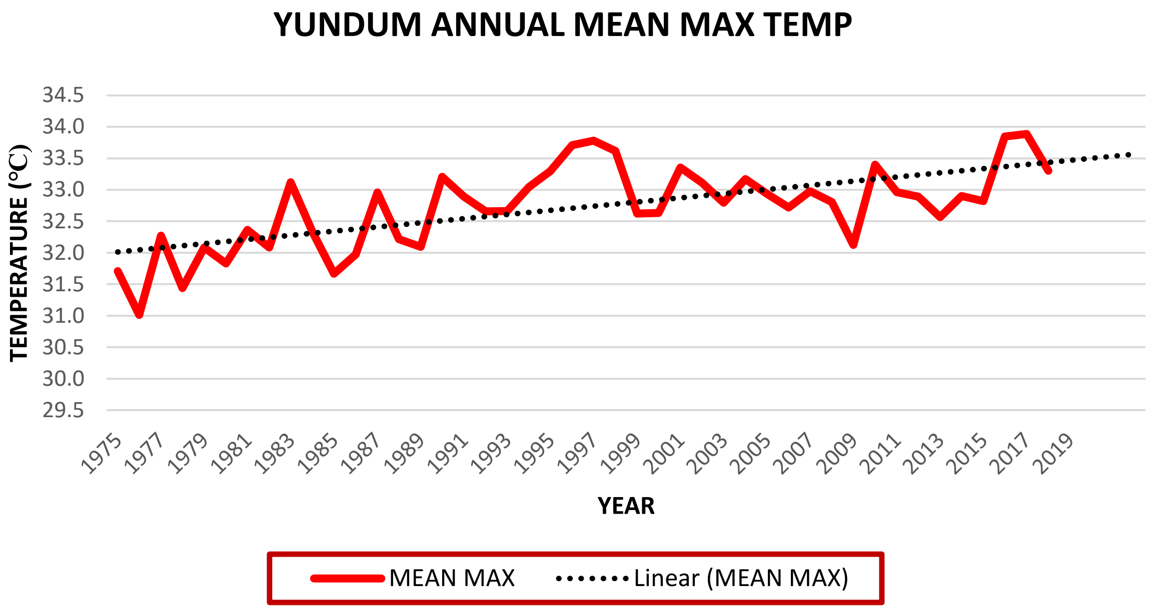
Apart from February which recorded a cooler than normal Mean Maximum temperature in Basse, the rest of the months had an near-normal temperatures with an annual departure of 0.1℃. However, a notable increase occurred between March and April.

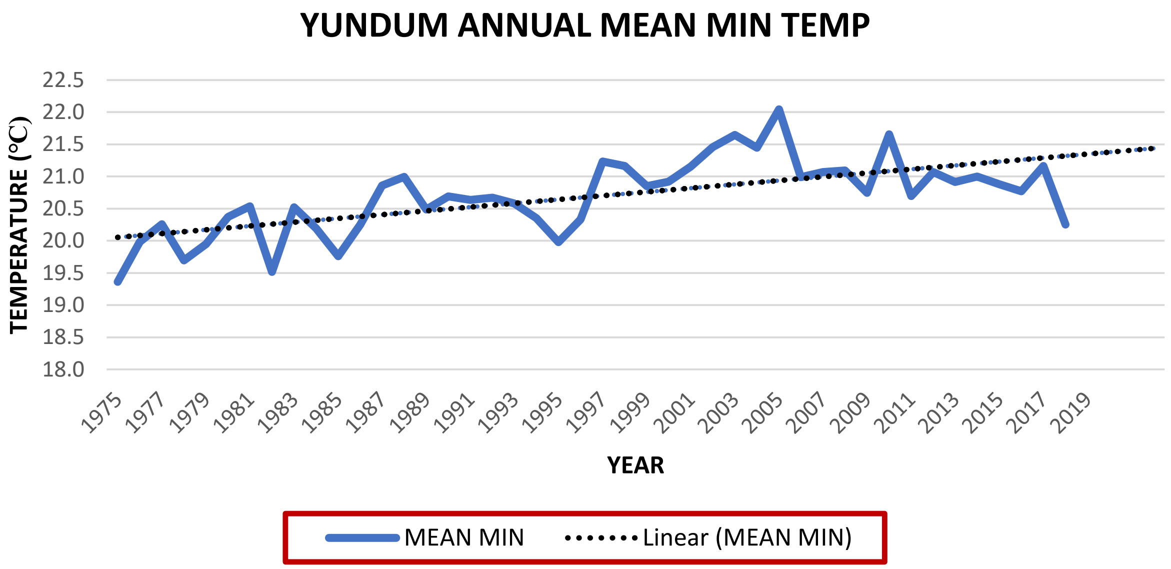
The Mean Minimum Temperatures for January, May and December were cooler than normal; while, the rest of the months had almost normal temperatures but with an annual departure of -0.7℃.





Finally, the time series plots below represent the annual fluctuations of the rising and falling of Surface Air Temperature events for a near-coastal and inland areas respectively from 1975 through 2018.

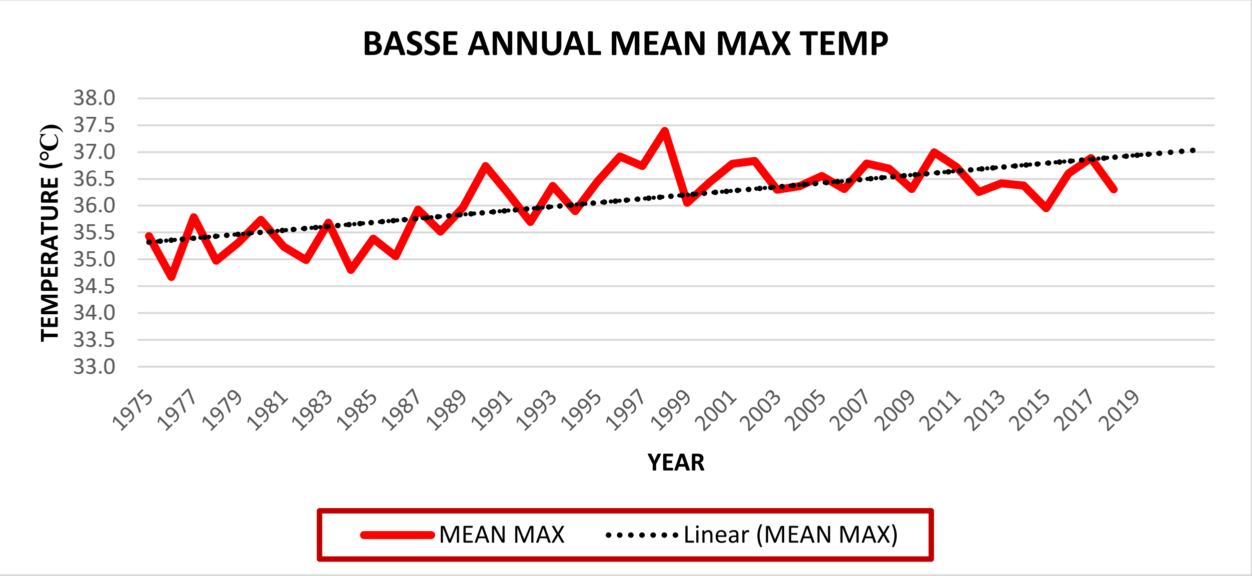


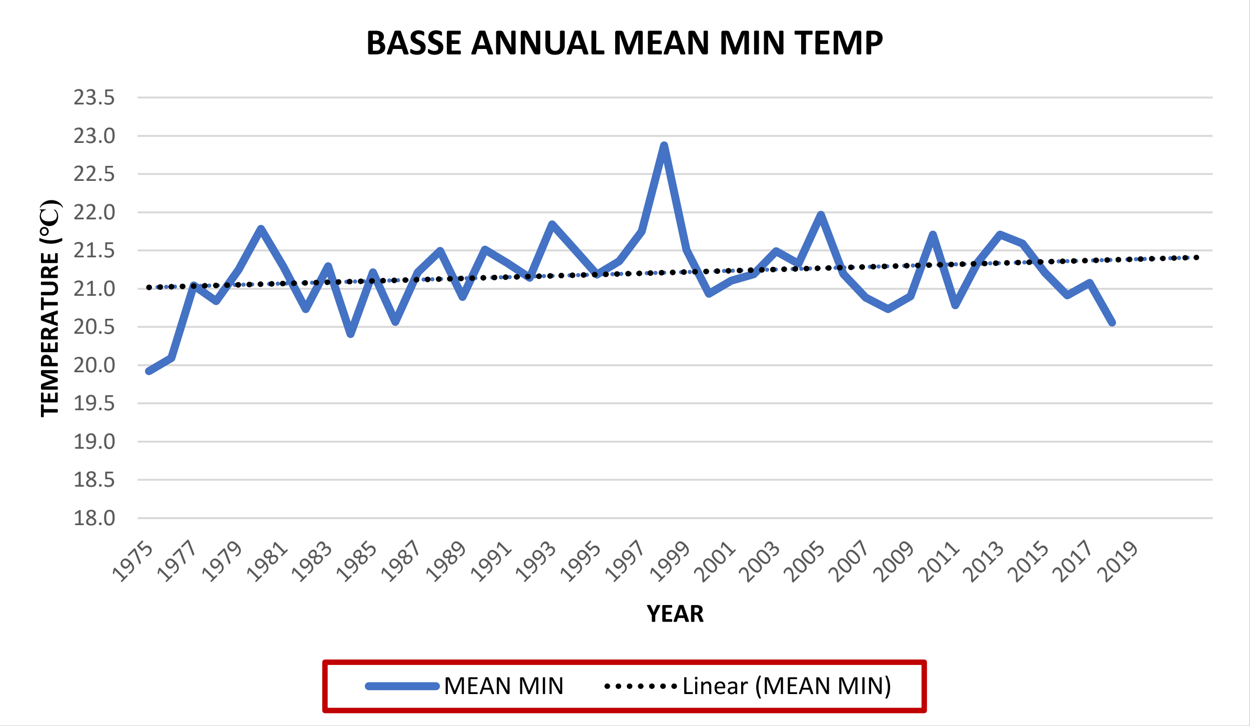


Inspite of the annual fluctuations as shown on the Long-term linear Temperature Trend plots above, during the 44years in question Mean Max Temperatures near-coastal areas had increase by 1.456℃ an equivalent of 0.0331℃ annually; whereas, the Mean Min Temp increases by 1.298℃ indicating an annual increase of 0.0295℃. On the contrary, the inland Mean Max temperatures had increased by 1.619℃ an annual increase of 0.0368℃; whereas the Mean Min temperatures increases only by 0.3796; hence, an annual increase of 0.0084℃.

In this regard, the average daytime warming over The Gambia therefore is about 1.54℃ with an annual increase of 0.035℃; whereas, night time warming is 0.84℃ an annual increase of 0.02℃.

However, it is worth noting that 2018 was generally a relatively cool year as depicted by the significant drop in temperatures.





2.2 RAINFALL:

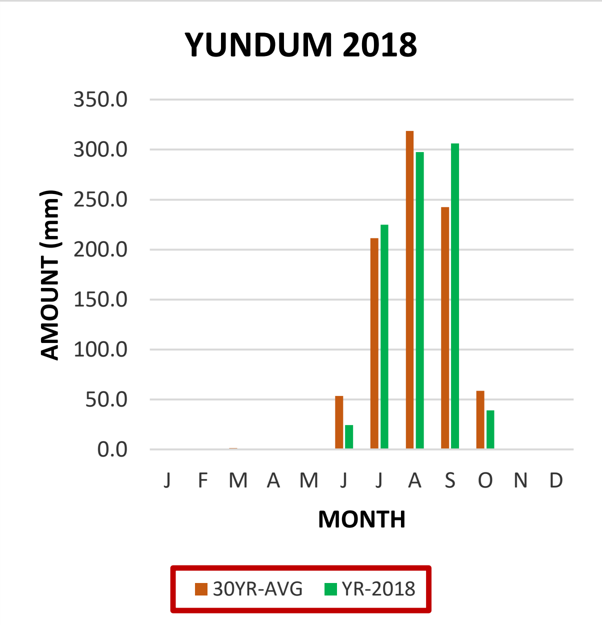
Measurements of rainfall amount often vary greatly from location to location because of the variable nature of the rain generating mechanism and their interaction with the different terrain.

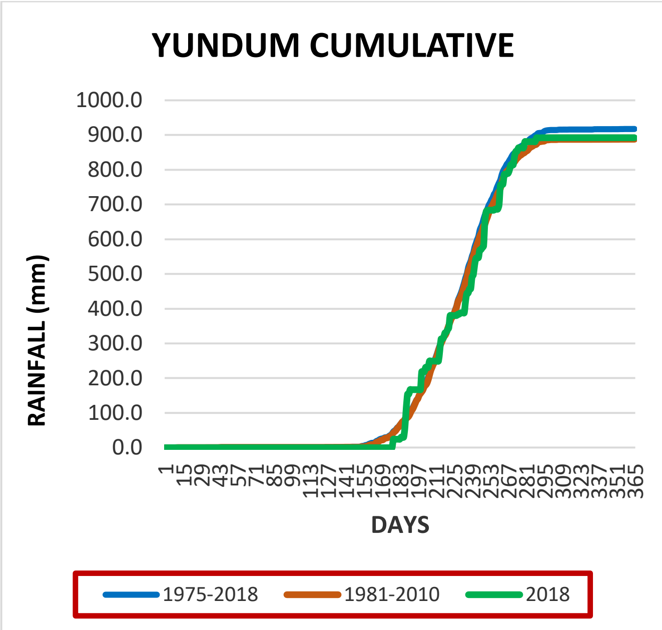
The storage rain-gauge used has a sharp brass rim diameter of either 5inch (12.7cm) or 8inch (20.3cm) sited 50cm above ground level with a funnel that collects rain in a narrow necked bottle placed in a removable can.

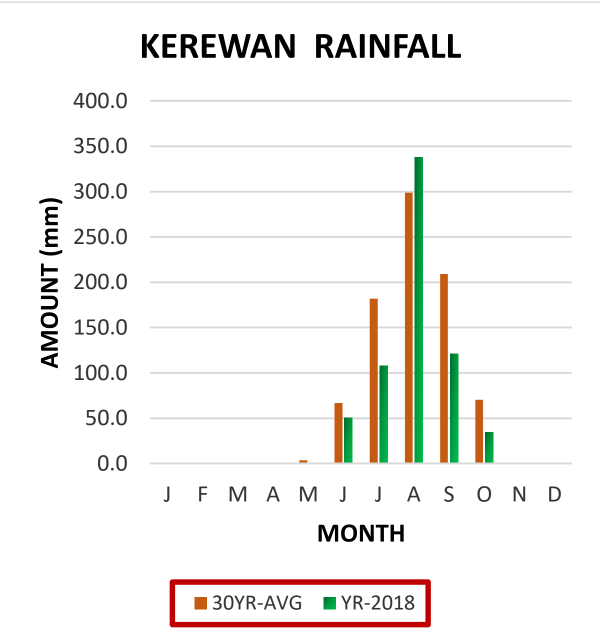
To measure the rainfall amount an Observer empties the collected rain into a graduated glass measuring cylinder. The unit of measurement is the millimetre (mm).

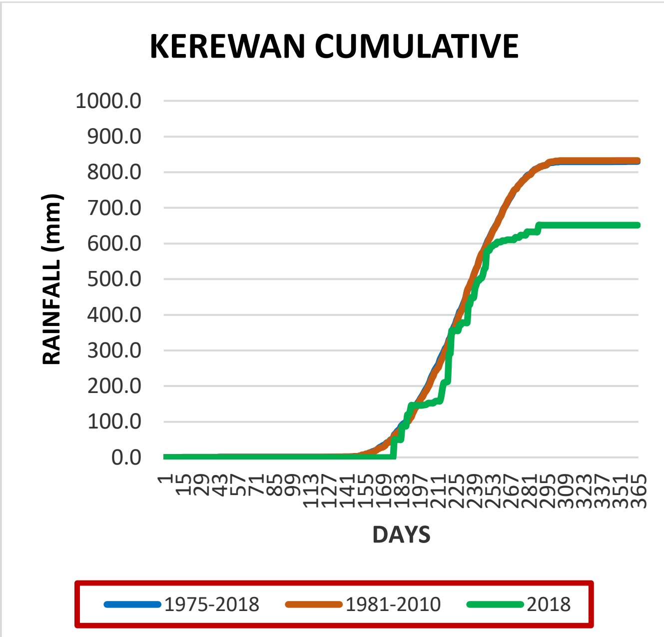
Generally, It is evident on most of the plotted diagrams on the subsequent pages that rainfall peak varied between the month of August and September depending on the region. Hence, indicating the high variability and erratic nature of precipitation. Without reasonable doubt there is about 2 weeks shift from the normal commencement dates of rain in different regions of The Gambia.

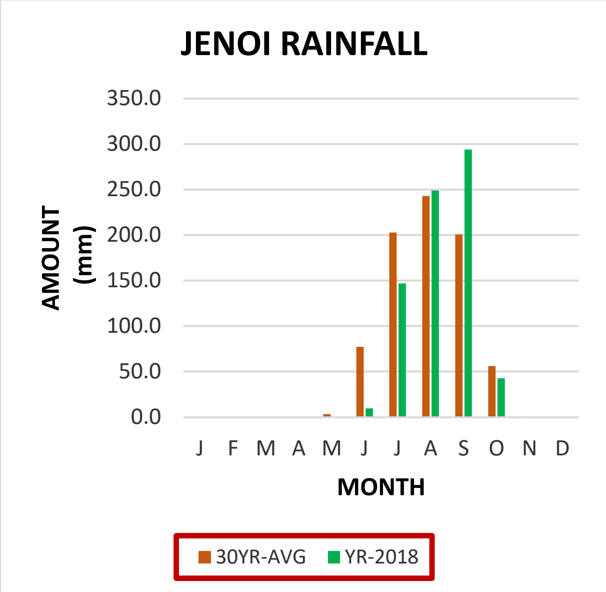
Although, over 80% of our seasonal rain occurs in July, August and September; albeit, on an agro-ecological point of view, June being the sowing/planting month was very critical in the sense that below average rainfall was recorded across the country as revealed on the rainfall histograms. Despite the late onset (i.e. turning point at base of plots) from the normal scenario as depicted on the Cumulative frequency – Ogive curves below; September and October performed very well as compared to year 2017. Hence, we had witnessed a see saw pattern, that is a good start and poor ending for 2017 and a reversal in 2018; depicting the high variability in inter-annual and annual rainfall variability.

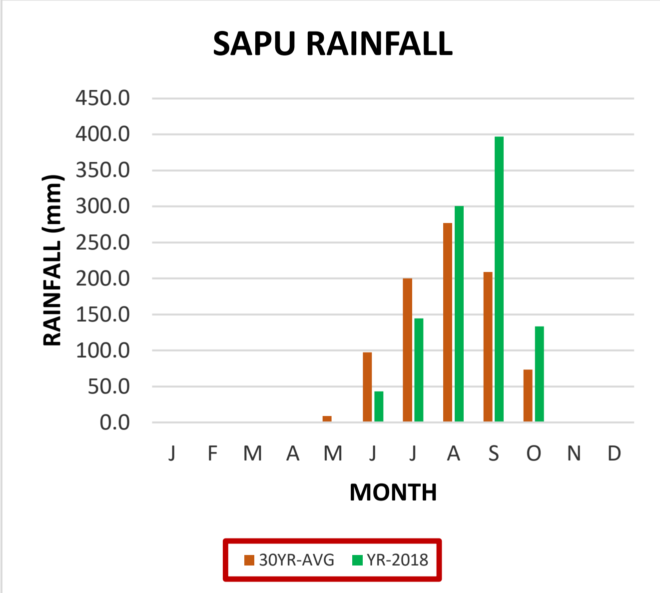


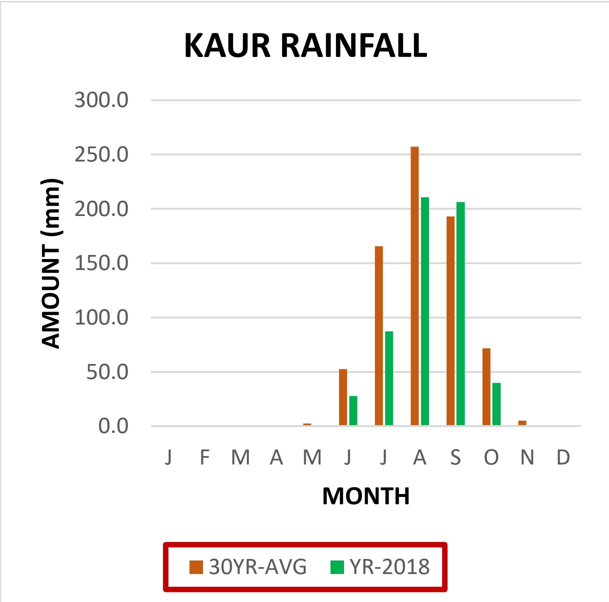


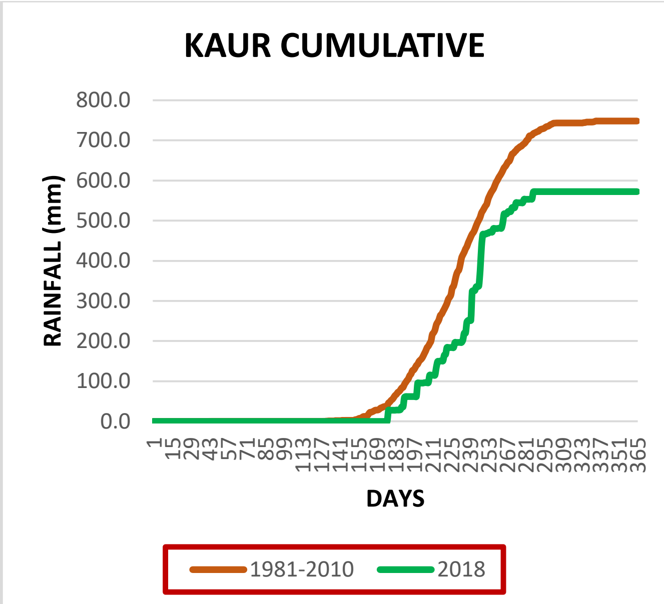


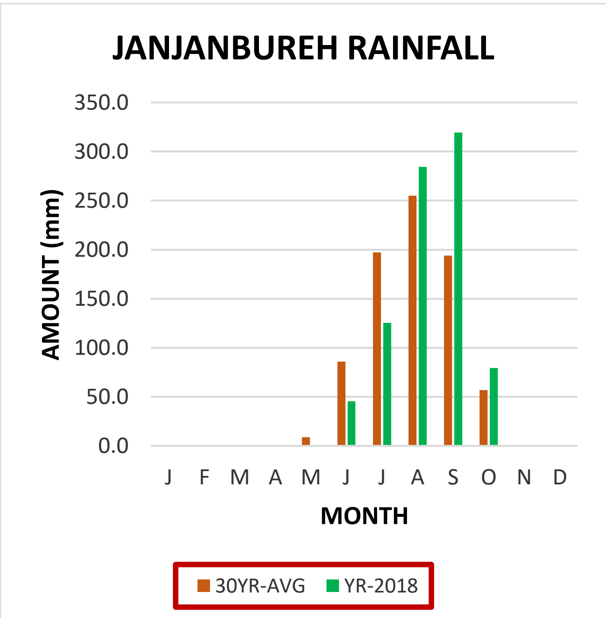


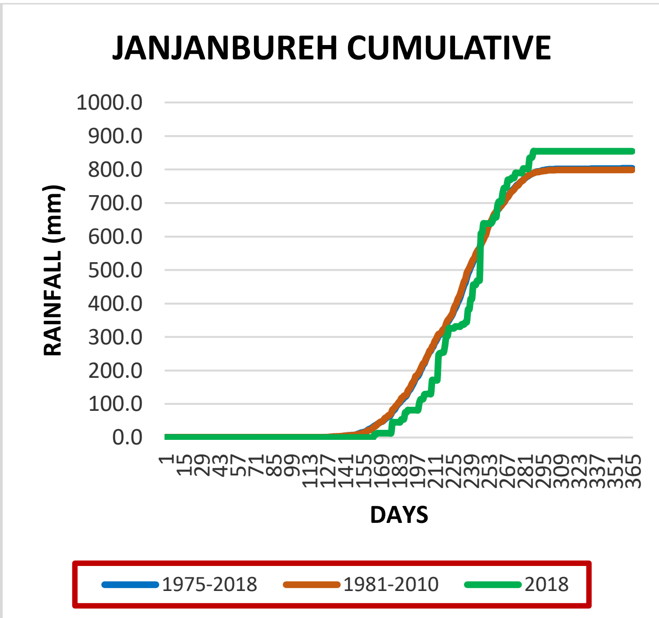

JENOI RAINFALL
AMOUNT (mm)
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
J F M A M J J A S O N D
MONTH
30YR-AVG
YR-2018

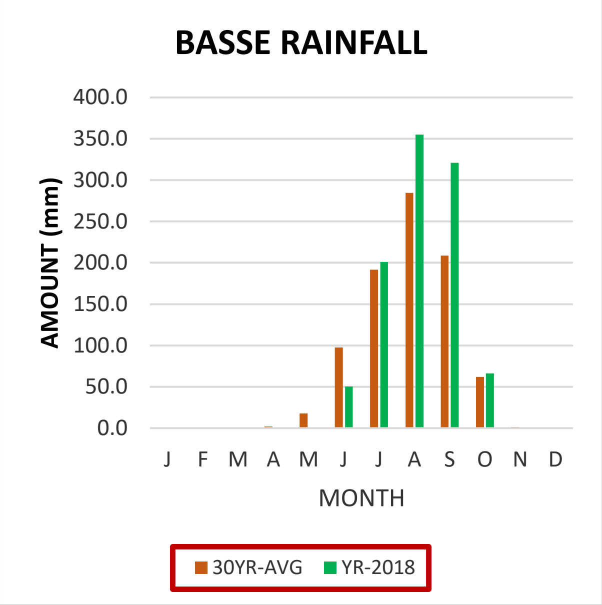

SAPU RAINFALL
RAINFALL (mm)
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
J F M A M J J A S O N D
MONTH
30YR-AVG
YR-2018

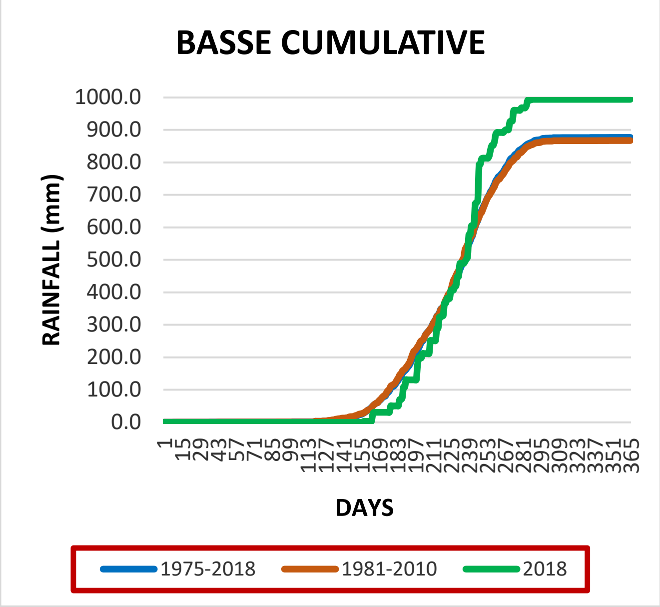

KAUR RAINFALL
AMOUNT (mm)
300.0
250.0
200.0
150.0
100.0
50.0
0.0
J F M A M J J A S O N D
MONTH
30YR-AVG
YR-2018


KAUR CUMULATIVE
RAINFALL (mm)
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
DAYS
1981-2010
2018


JANJANBUREH RAINFALL
AMOUNT (mm)
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
J F M A M J J A S O N D
MONTH
30YR-AVG
YR-2018


JANJANBUREH CUMULATIVE
RAINFALL (mm)
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
DAYS
1975-2018
1981-2010
2018





From the plots above it is evident that the eastern parts of the country i.e. Upper River Region (URR) and Central River Region (CRR) South registered above normal rainfall, CRR North and North Bank Region (NBR) recorded below normal rainfall; whereas, Lower River and West Coast Regions (LRR &WCR) had a normal rainfall scenario despite the late onset. A critical point to note is the evidence of dry spells which are the long horizontal/ flat steps as depicted on the middle of the rainy season most especially on the Kerewan and Janjanbureh Ogive plots.

2.3 SOLAR RADIATION:

INSOLATION Stands for: **IN**coming **SOL**ar Radi**ATION**. Is the rate at which Solar radiation is receive by a unit horizontal surface at any point on or above the Earth's surface. Various components of Earth's atmosphere absorb ultraviolet and infrared Solar radiation before it penetrates to the surface, but the atmosphere is quite transparent to visible light **(*Sunshine*)**.

The visible light 'sunshine' received and absorbed at the surface is transformed into heat and re-radiates in the form of invisible infrared radiation.

However, note that the SOLAR RADIATION RECEIVED at any given instance is influenced by the following factors;

1. Solar Output (Solar Constant)
2. Sun-Earth distance (Earth's Orbital parameters)
3. Latitudinal distribution/difference (Length of day, Inclination of Sun's rays)
4. The Atmosphere's Optical Depth (The amount of insolation depleted while passing through the atmosphere)
5. Albedo (Reflectivity).

including:

i. Altitude (and or Elevation) and Aspect (Terrain slope).
ii. Land-Water contrast (difference in ***Specific Heat)***.
iii. Ocean Currents.

The pyranometer mounted 2m above ground level is used for measuring Global radiation which in effect is the total downwelling shortwave radiation "SOLRAD" measured on a unit horizontal surface. The unit of "SOLRAD" measurement is "Watts per meter square" (Watts/m^2) or Mega-Joules per meter square (MJ/m^2).

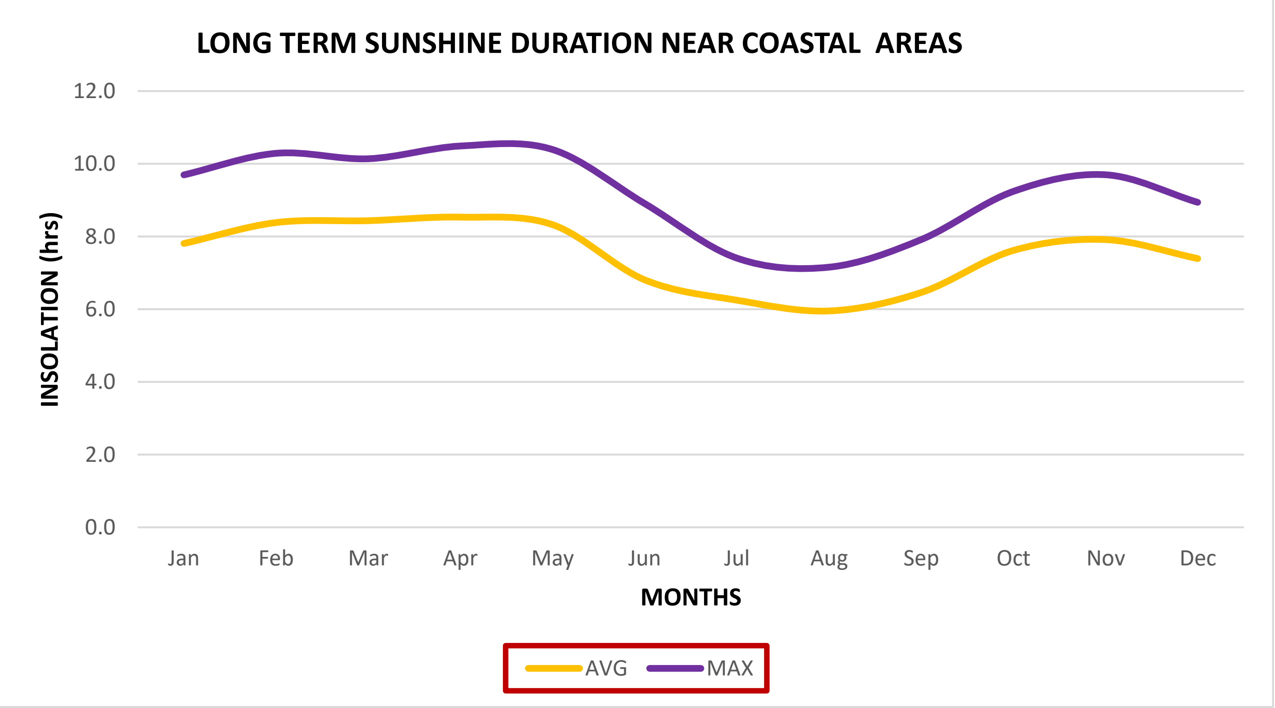
However, from our historical records, the only instrument for measuring sunshine duration is the Campbell-Stokes Sunshine recorder. A glass sphere mounted 2m above ground level focuses the sun's direct radiation on a graduated card and the length of a burn trace on the card corresponds to the duration of sunshine. The unit of measurement is in hours.

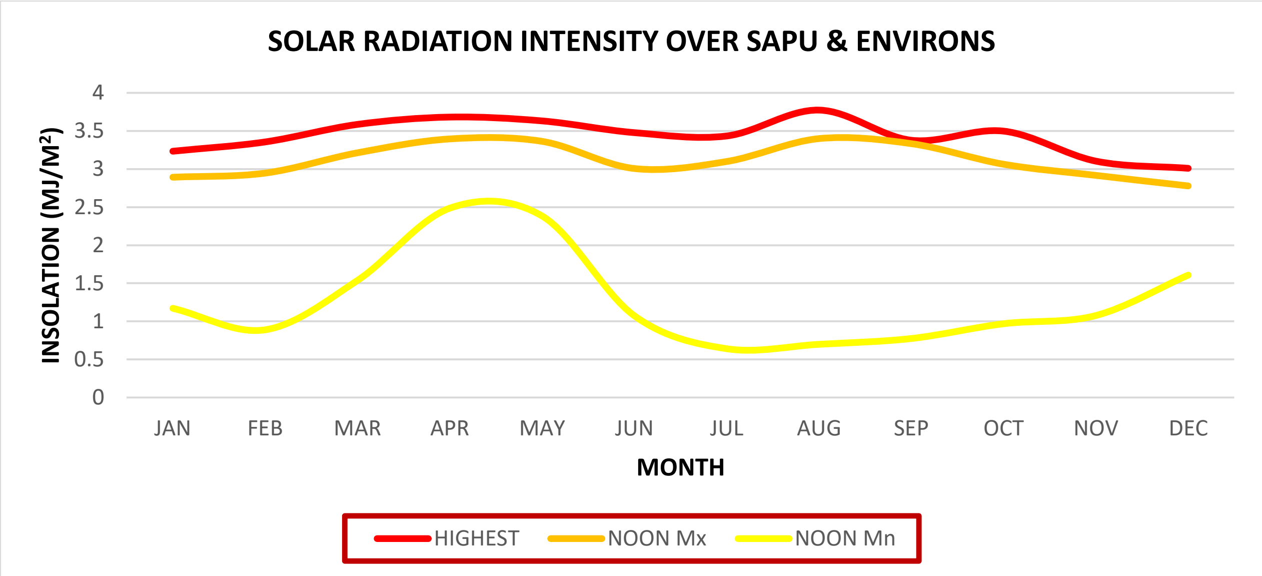
Because of the variation in the length of day from winter to summer, the duration of Sunshine shows a marked seasonal variation. As a consequence, April-May is on average the Sunniest month while August is with least sunshine duration.

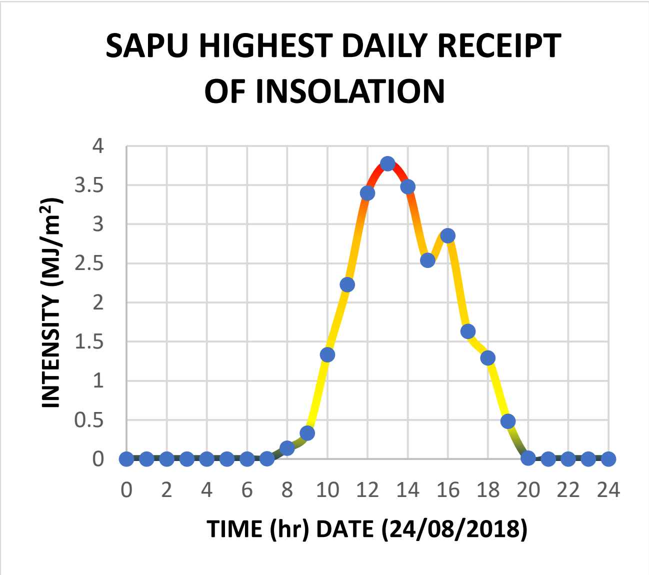
During the annual cycle of SOLRAD receipt, The Gambia experiences two maxima which occurs in April-May and August-Sept with the maximum receipt in April-May coinciding with the highest temperature. However, the high temperatures recorded in November, occurs sometime after the presence of the passage of the Sun onto the southern hemisphere.

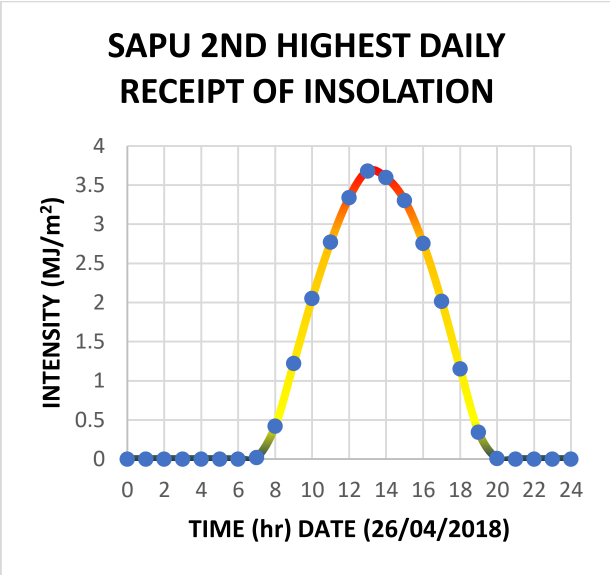
Furthermore, despite the sun been overhead the Northern Hemisphere during Summer, the Earth's point in orbit is moving farther away from the sun. Hence, the high temperatures registered in MARCH-APRIL-MAY (Northern Hemisphere Spring) may be due to the 23.5-degree tilt of our planet's spin axis and the sun shining down on the vast land in the Northern Hemisphere which assist in the heating process.

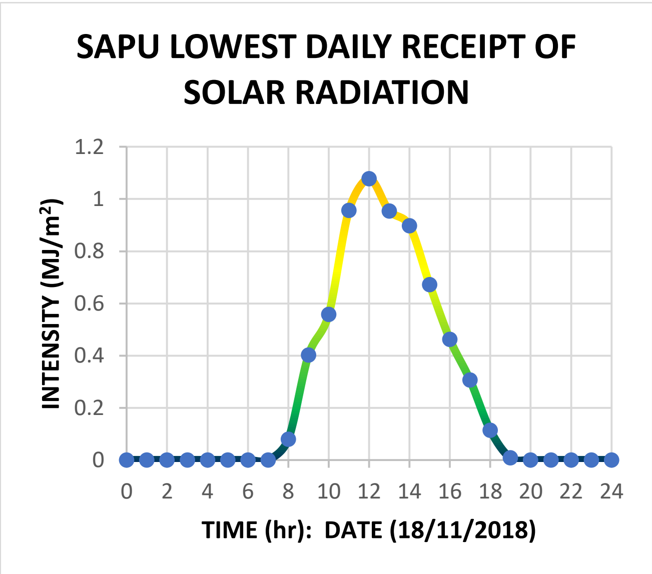
The daily cycle similarly, has its max receipt of insolation intensity shortly after the passage of the overhead Sun on the zenith around **13UTC** with max temperatures and heating occurring one to two hours later (**14 - 15UTC**) depending on the season. This scenario is manifested on the Daily INSOLATION and Temperature cycle plots for Yundum below. On the contrary, as also depicted by the plots below, Sunshine duration is high from January to May with an average of above 8hours of Sunlight dropping gradually from June to September reaching an average minima of 6hours in August as a result of cloud coverage.

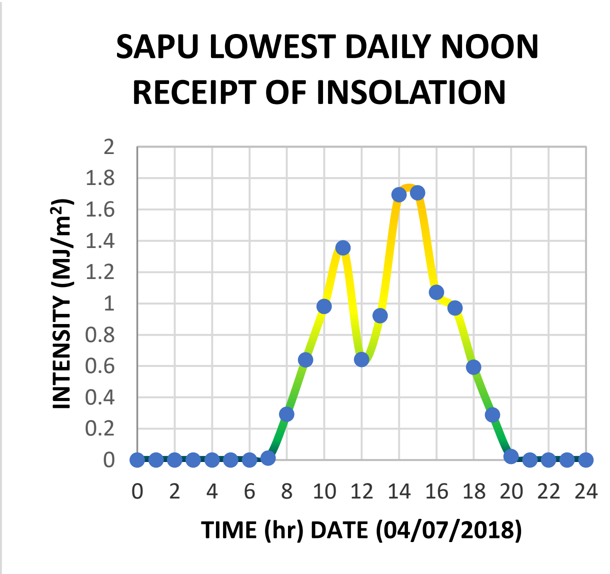






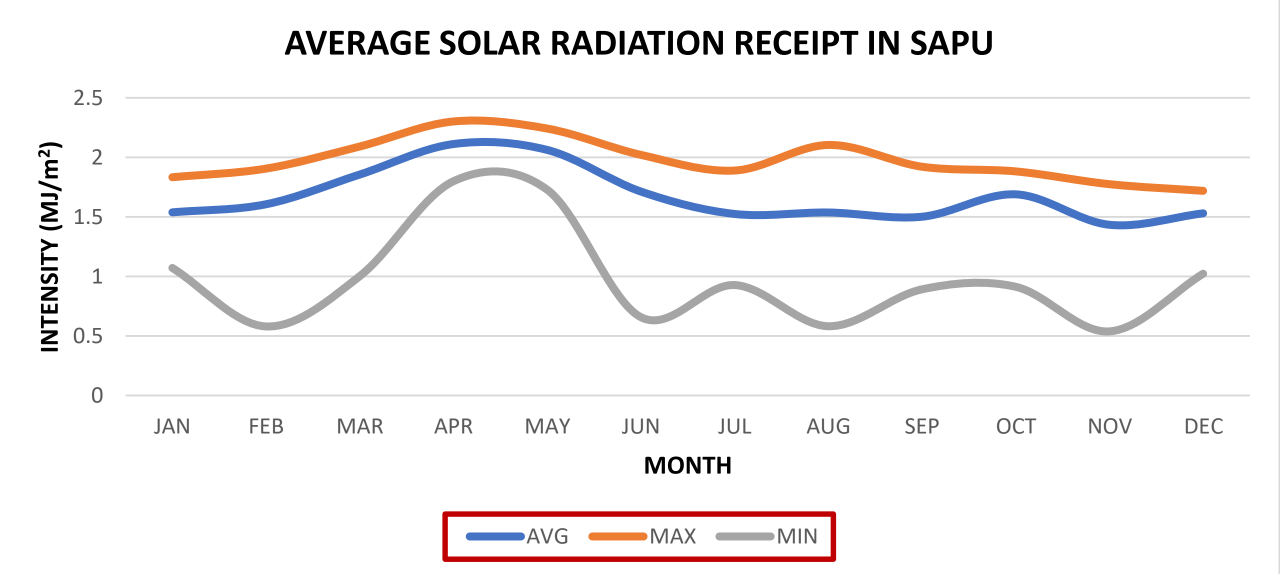






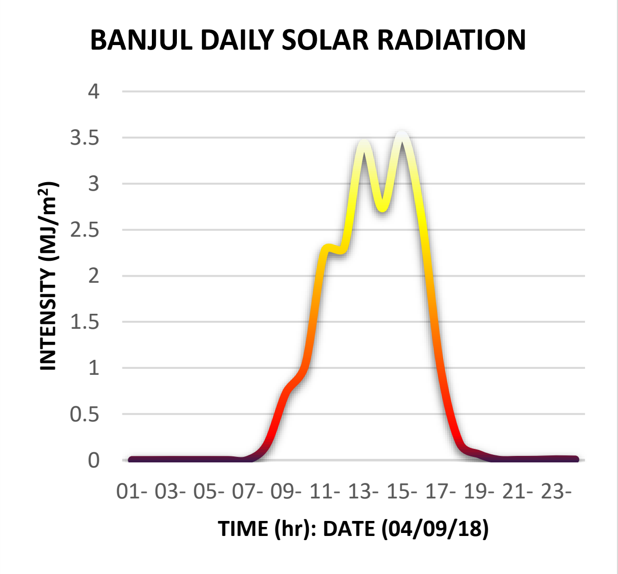
As indicate on the plots, 2018 April & August are the months of max receipt of SOLRAD with July recording the least. The two Noon max receipt of SOLRAD also coincides with the highest insolation in April and August. Hence, this marks the annual march of the overhead Sun crossing The Gambia

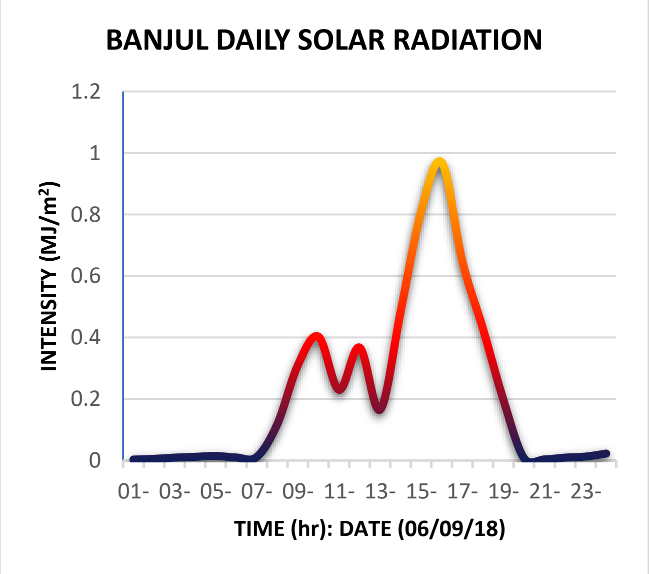
Northwards reaching the Tropics of Cancer on 21st/22nd July and its Southwards movement reaching the Equator by the 21st /22nd September respectively. The reason for July, August receiving occasional least insolation during Northern Hemisphere Summer and not in December when the overhead Sun is at its Southern most position (Tropic of Capricorn) is because of the frequent prevalence of Cloudiness at this time of the year, when most of the insolation is depleted by reflection and absorption, as well as scattering due to the huge amount of water vapour molecules in the atmosphere.

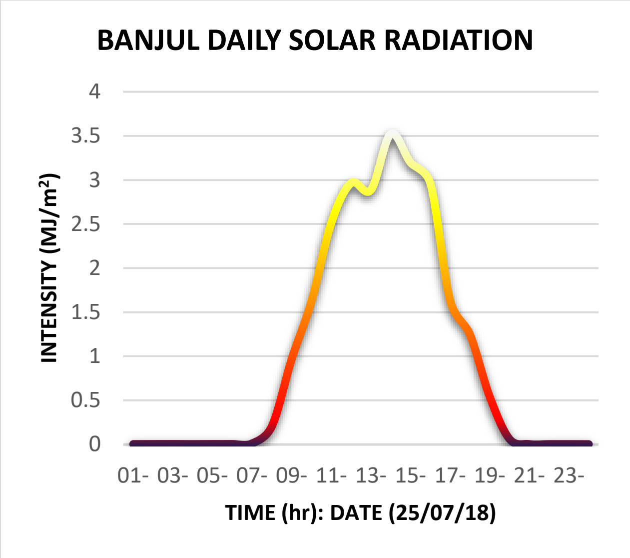


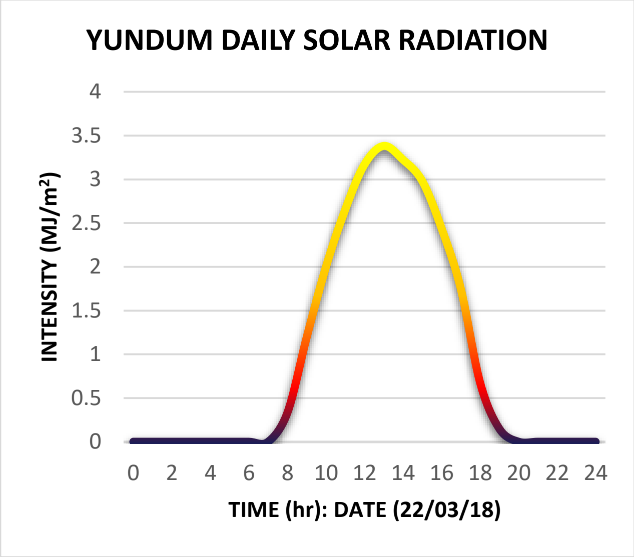
The average amount of Solar energy flow during 2018 as shortwave irradiance reaching the surface (2meters above ground level) as recorded in Sapu, Central River Region is 0.47 KWhm^{-2}. Mean Maximum and Mean Minimum values are 0.64 and 0.15 KWhm^{-2} respectively; Whereas, ***the highest value recorded is 1.05 KWhm^{-2}***.

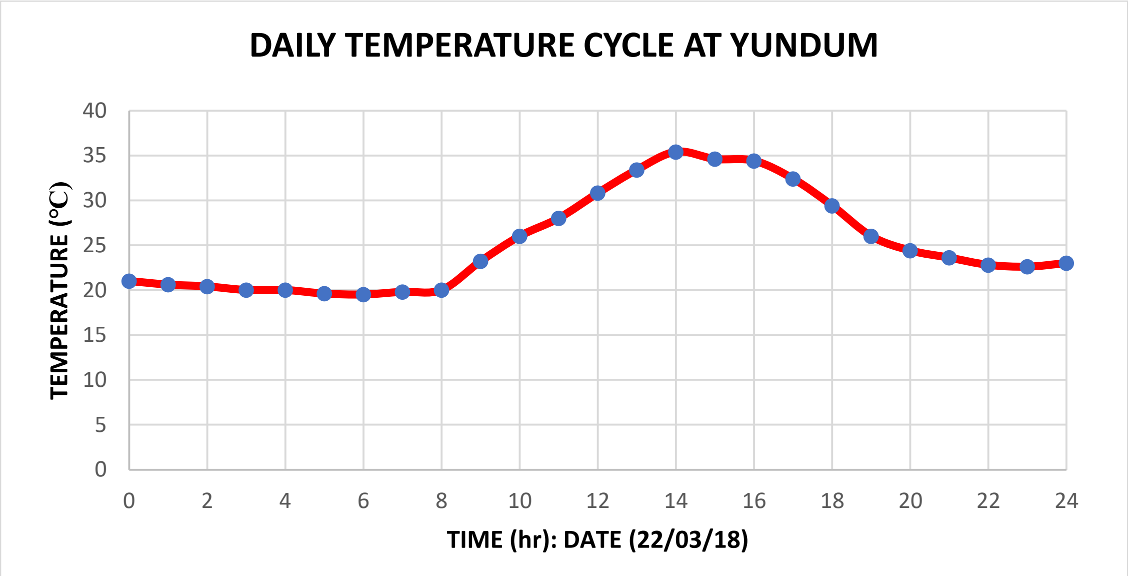
Selected stations in the western sectors of the country (west of Longitude 16.08°W) were also evaluated such as Banjul, Yundum, Jambanjalley, Sibanor including Kerewan. Despite the differences in elevation, altitude and time of maximum receipt of insolation intensity, ***the highest average amount recorded in 2018 is approximately 1.0 KWhm^{-2}***.



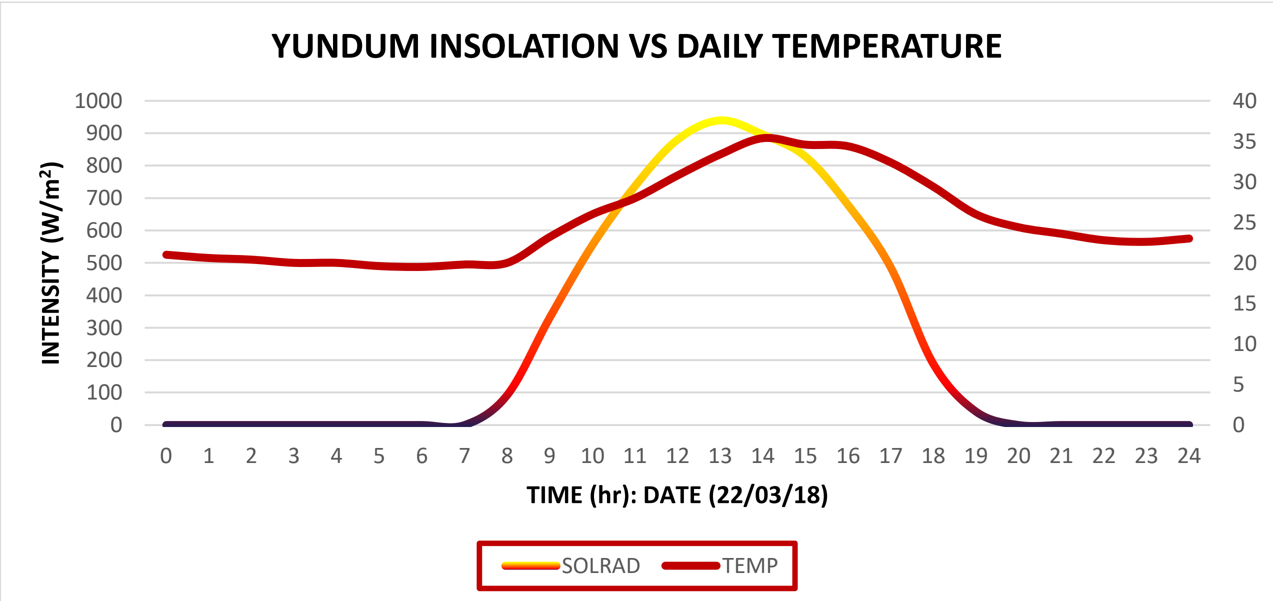




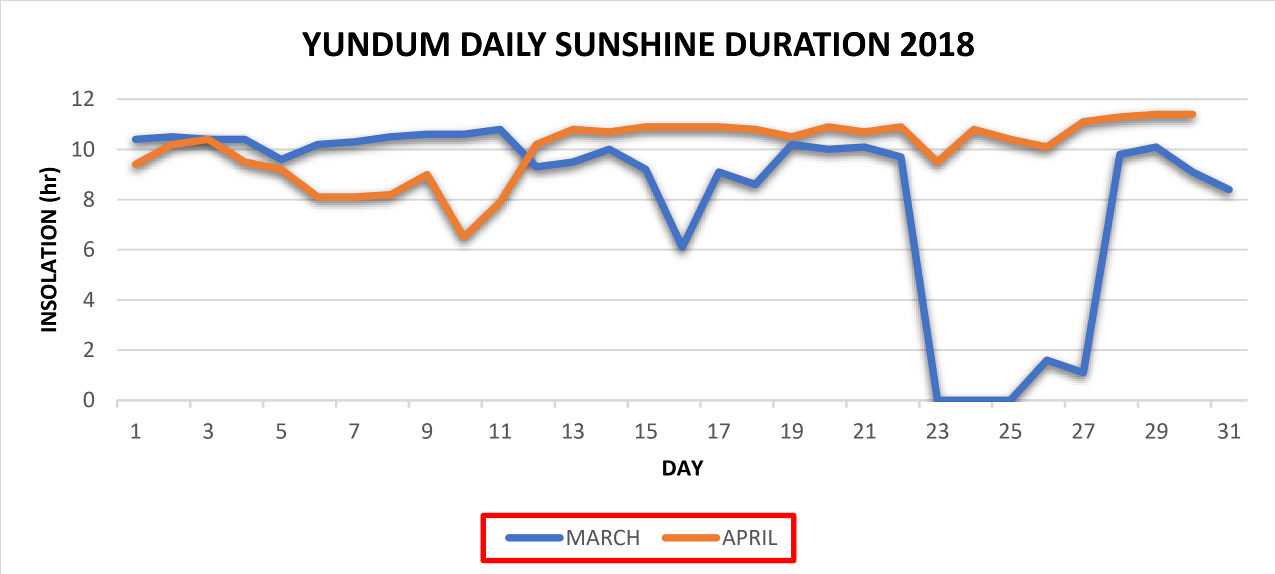


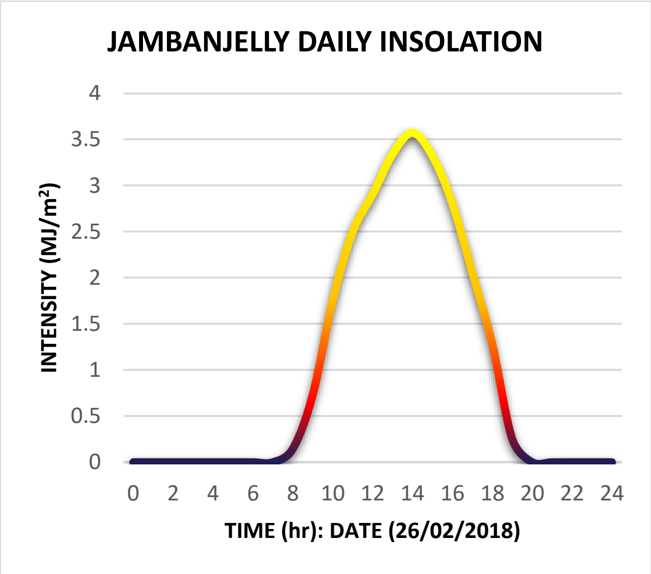


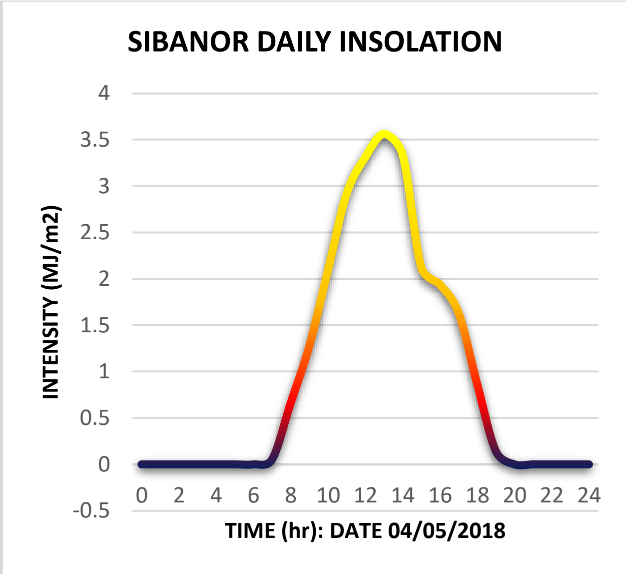
The behaviour of the daily Temperature cycle for Yundum was plotted during the Northern Hemisphere Spring equinox of 2018 and it is evident that maximum temperature occurs 1-2 hours after the daily highest receipt of SOLRAD.

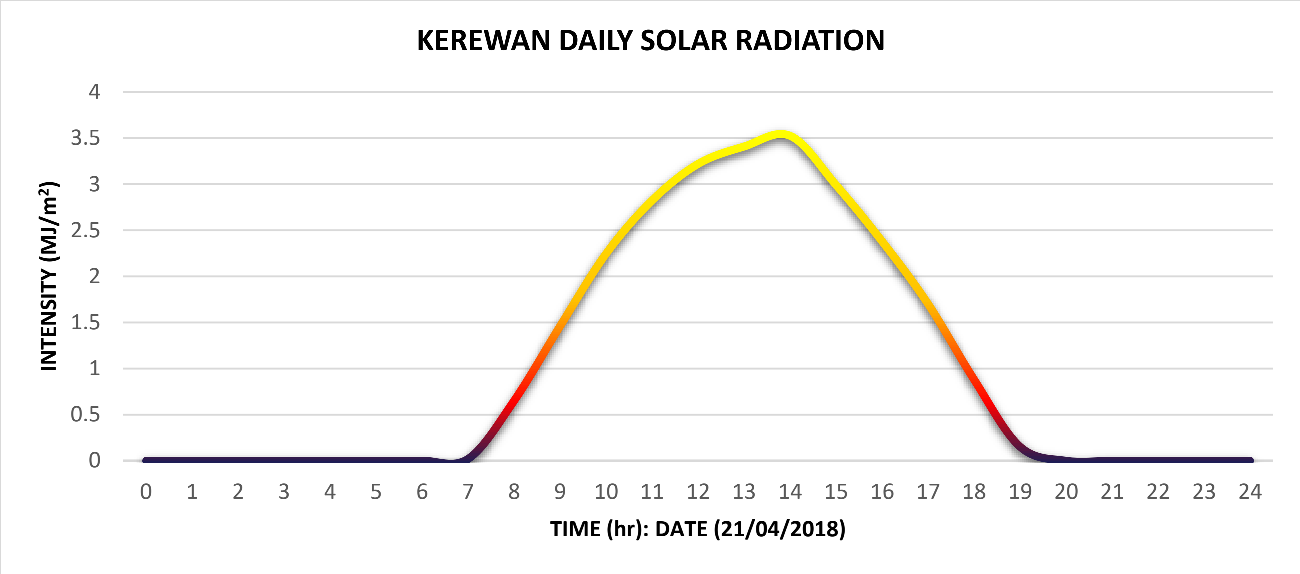


The diurnal variation of Surface Air Temperature trend for Yundum was plotted against the insolation intensity. Whereas, insolation commences at Sunrise, peaks after noon (13:00UTC) and shuts off at Sunset. Temperature on the other hand during this particular day reaches its minimum around dawn; while, it attains its maximum about 14:00 hours. Hence, not coincident with the incoming radiation peak; This lag is termed ***the lag of maximum,*** which is as the result of several factors, most important of which is the effects of thermal uplifting and winds that carry heat upwards and slow down the surface temperature rise until mixing in mid-afternoon produces the hottest time of the day. From the plot it could be deduced that Surface warming occurred between 08:00 to 15:00UTC and cools thereafter. Most important aspect to note is the net heat gained between 11:00-15:00UTC which balances the radiation heat lost from 20:00-07:00UTC.





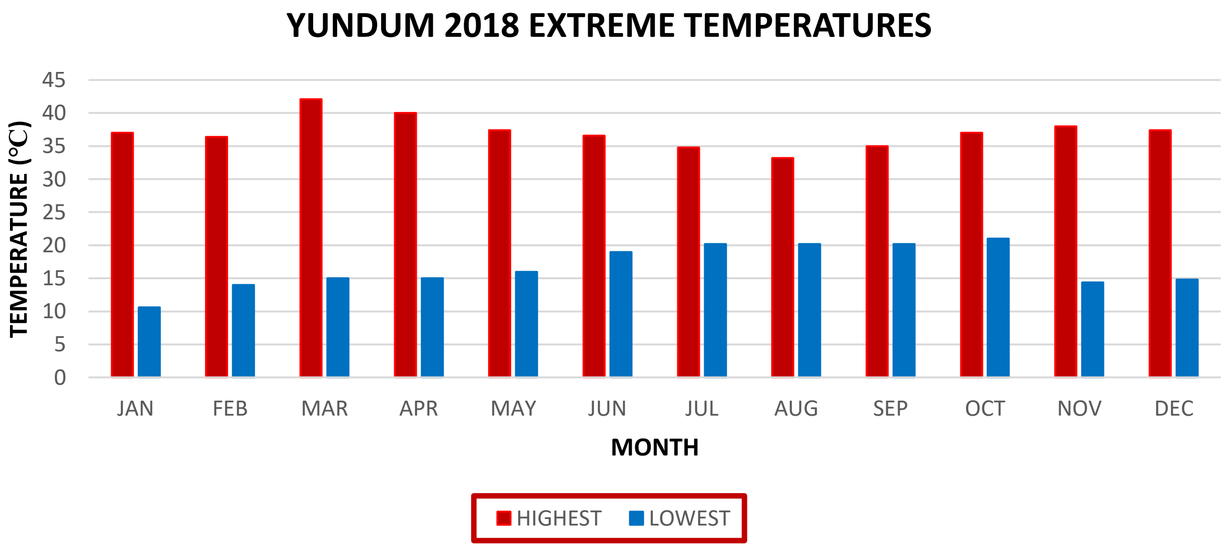


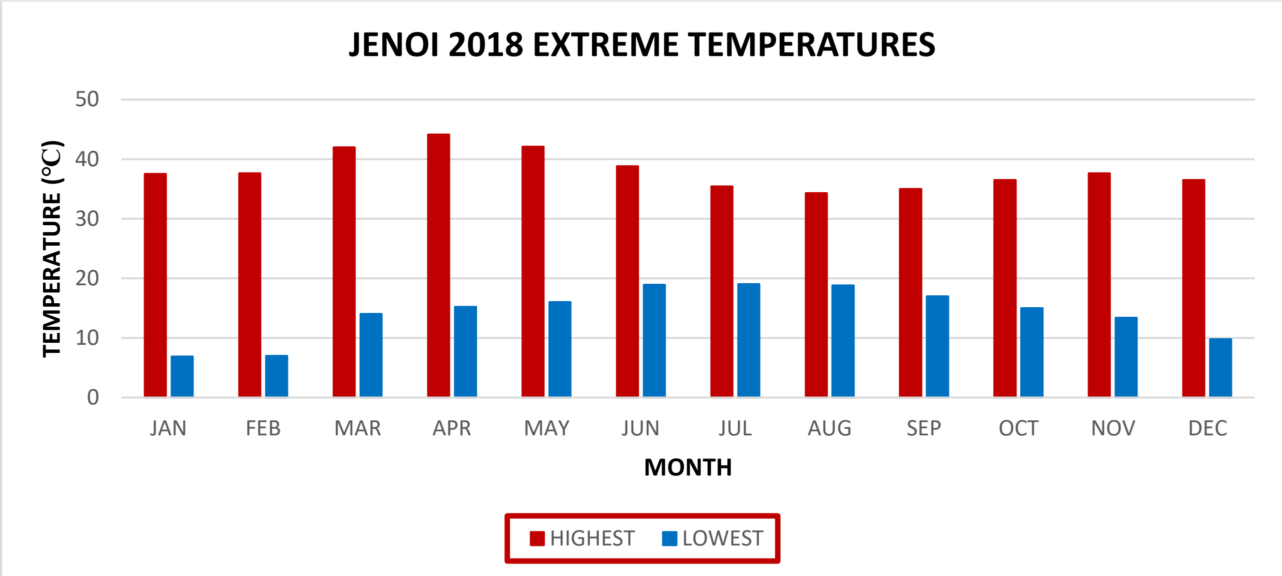


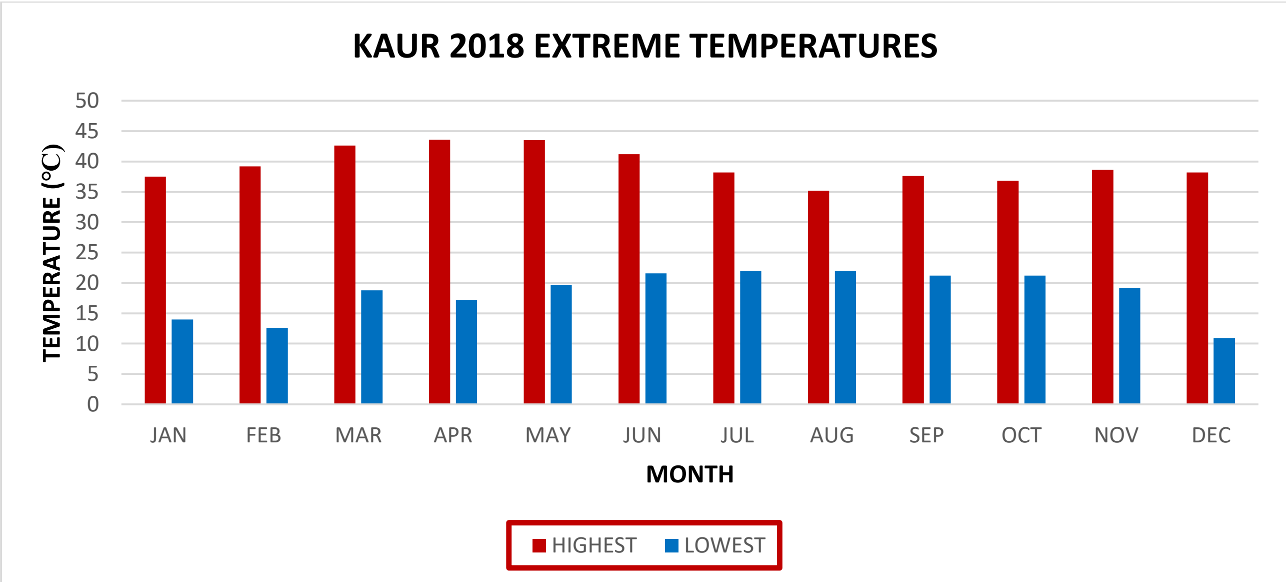
3.0 EXTREME TEMPERATURE & RAINFALL:

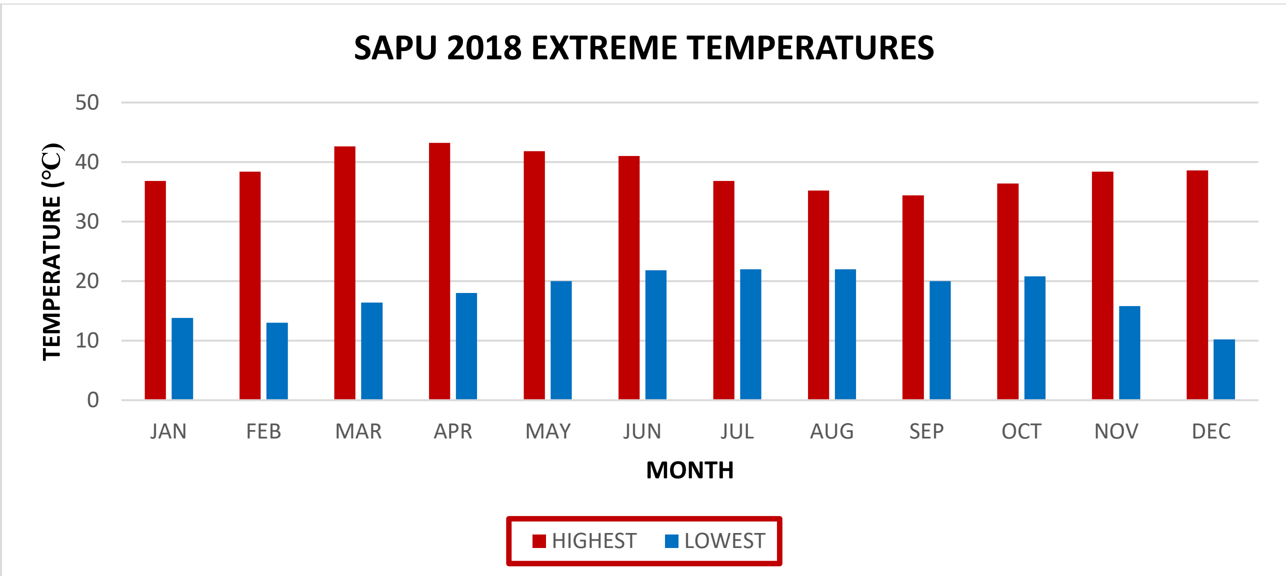
Generally, the highest temperatures occurred in April and lowest in Jan-Feb over the Western portion of the country, and in December over the inland areas as shown on the plots below. However, there is a decrease in the diurnal-monthly temperature ranges in the months of July, August, September due to the prevalence of Low and Medium level Cloud coverage which increased thereafter with the dominance of clear skies. It is quite evident from the temperature plots below that temperature extremes are greatest inland.

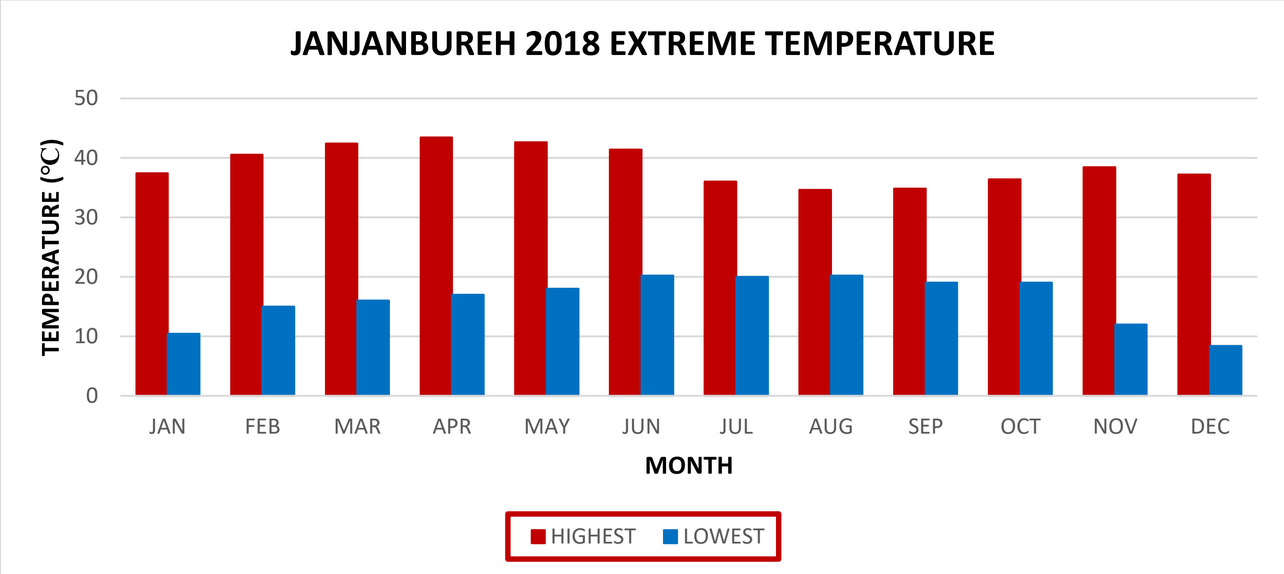
Similar to the effects of Duststorms/ Thick dust haze, increases in cloudiness suppresses warming during the daytime and enhances minimum temperatures at night. In lieu of this the daily temperature range is lowered.

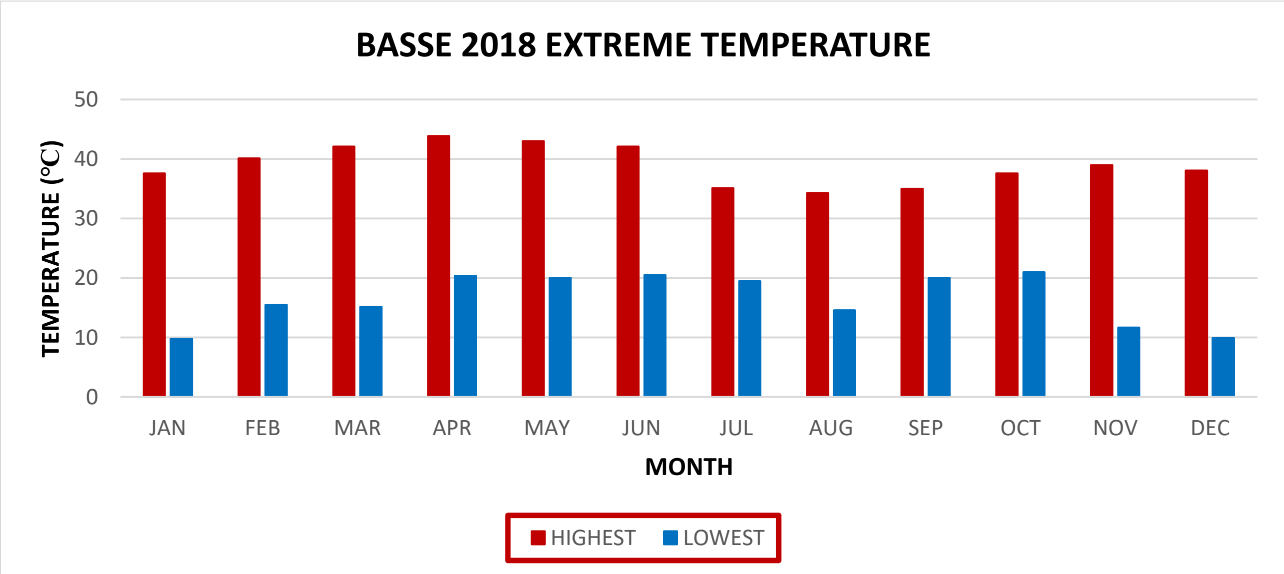



JENOI 2018 EXTREME TEMPERATURES
TEMPERATURE (°C)
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
HIGHEST
LOWEST


KAUR 2018 EXTREME TEMPERATURES
TEMPERATURE (°C)
50
45
40
35
30
25
20
15
10
5
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
HIGHEST
LOWEST


SAPU 2018 EXTREME TEMPERATURES
TEMPERATURE (°C)
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
HIGHEST
LOWEST

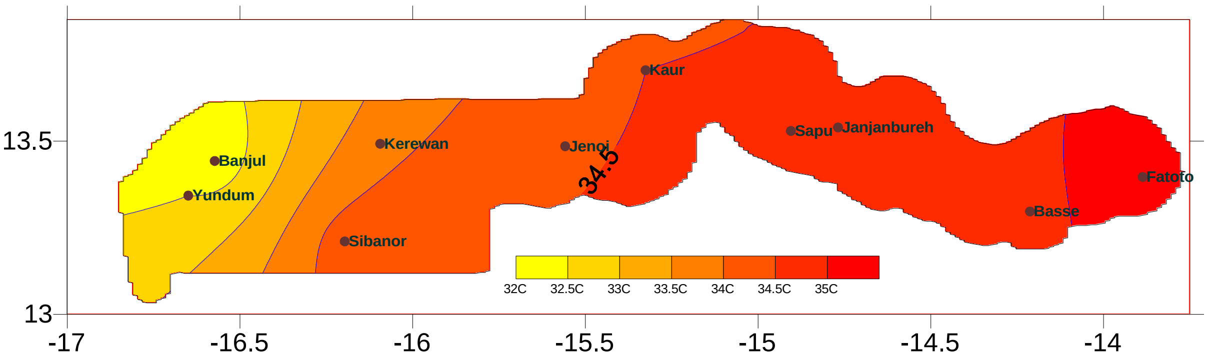




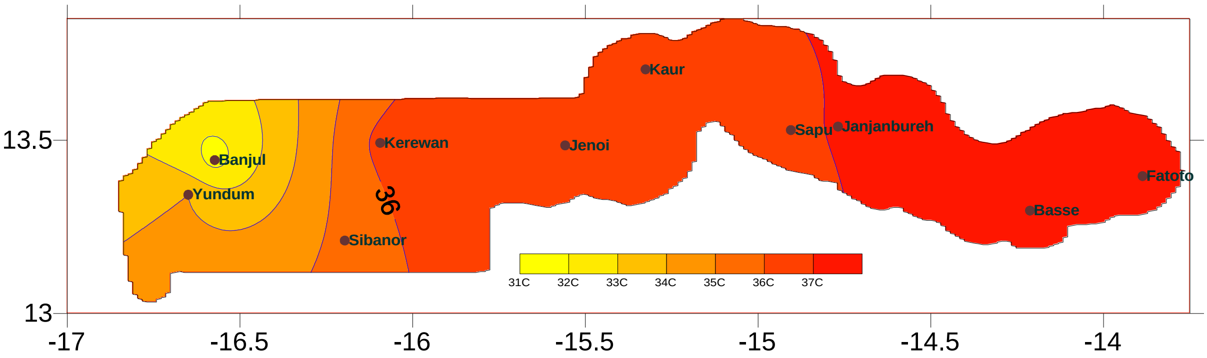
The figure above also shows the ***monthly range of temperature***, which indicate the difference between the highest and lowest temperature for each month.

As mentioned above, both diurnal & monthly temperature ranges are lower during the rainy season particularly July - September due to the amount of cloud coverage and greatest in the dry season from December to April. The diurnal & monthly temperature ranges are also least over Coastal areas and greatest inland.

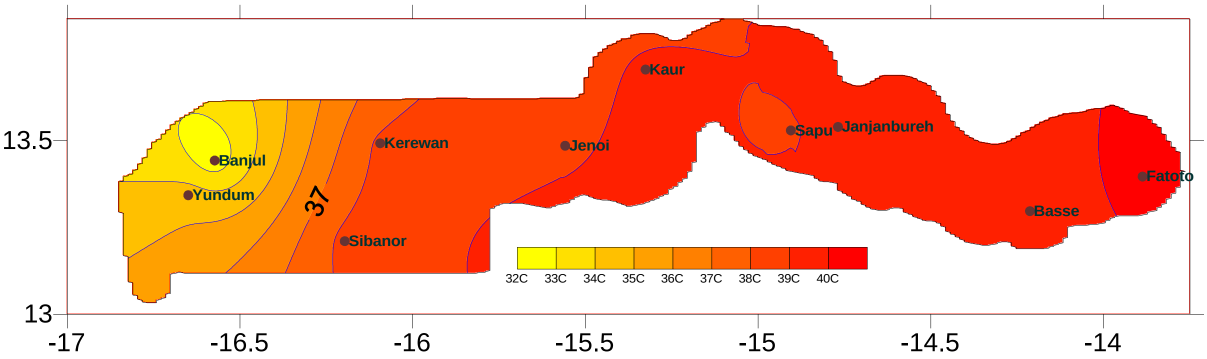
3.1 AVERAGE MONTHLY TEMPERATURES:



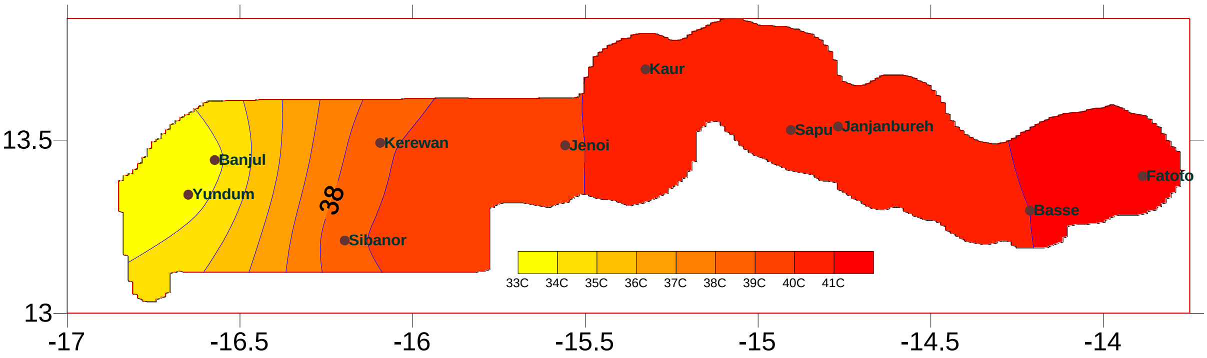
JANUARY MAXIMUM TEMPERATURE



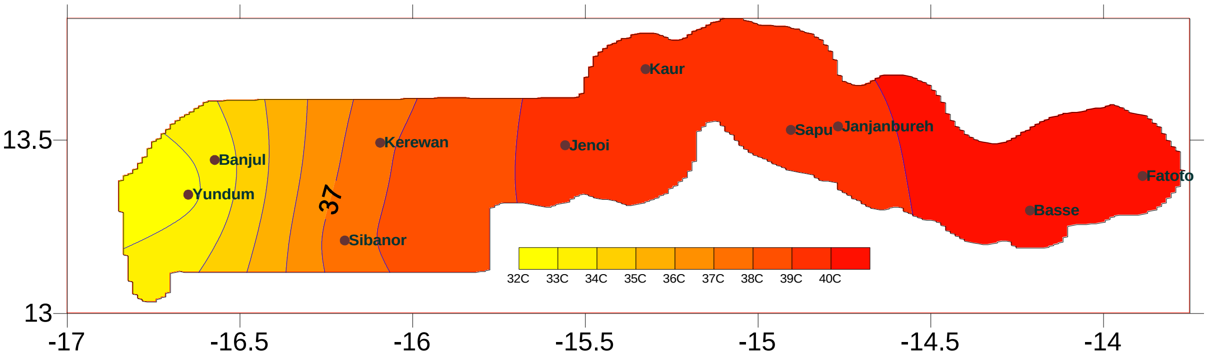
FEBRUARY MAXIMUM TEMPERATURE



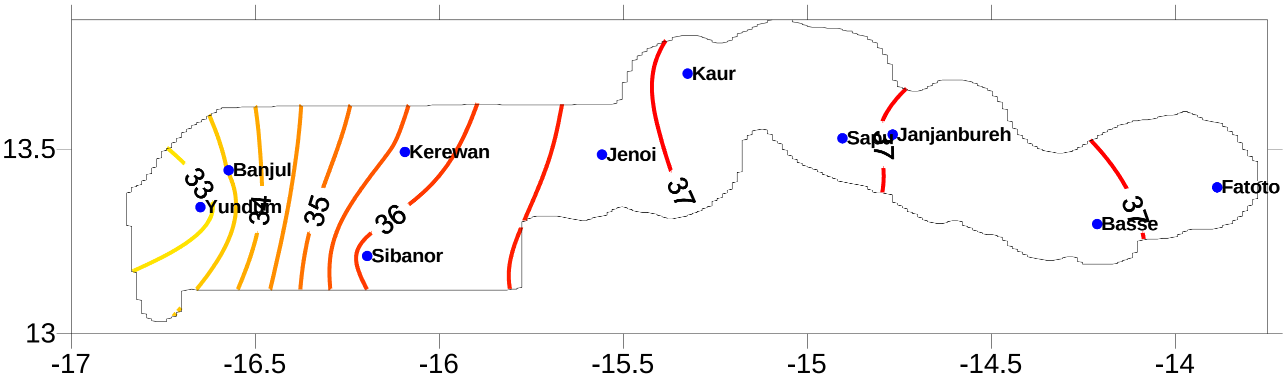
MARCH MAXIMUM TEMPERATURE



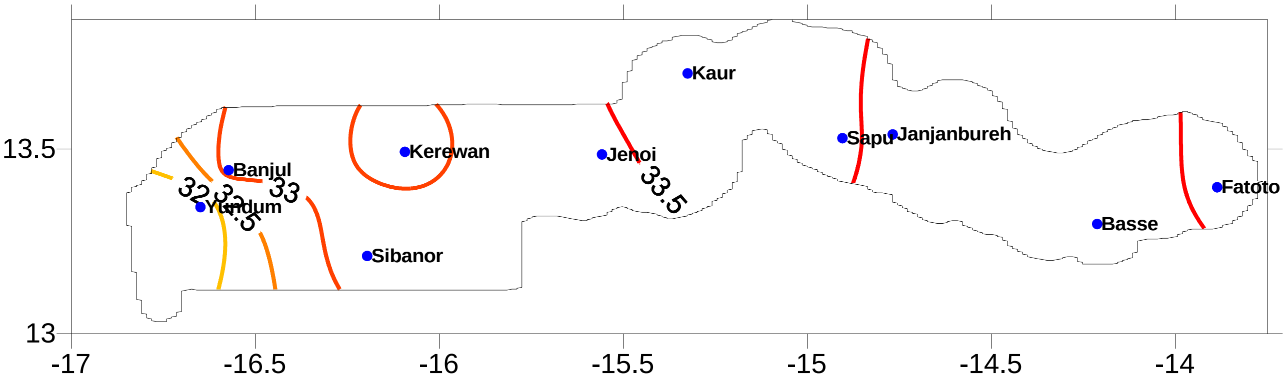
APRIL MAXIMUM TEMPERATURE



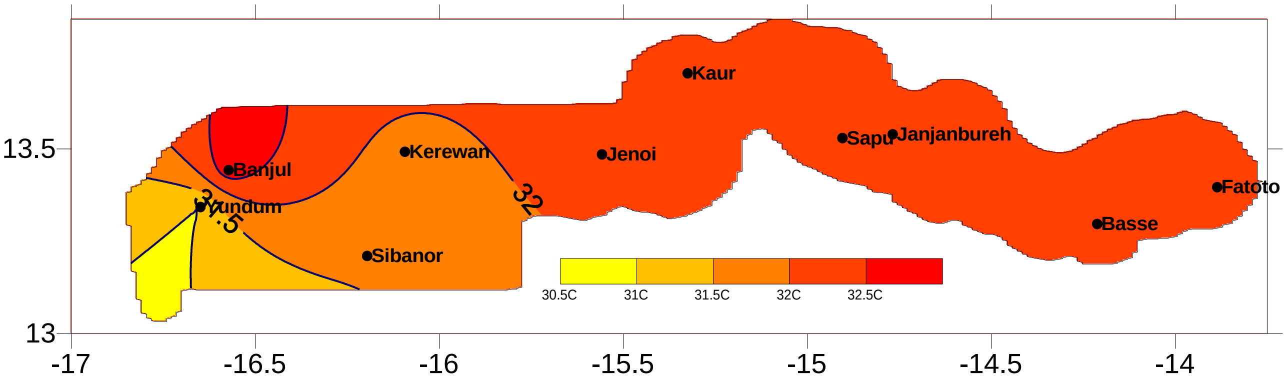
MAY MAXIMUM TEMPERATURE



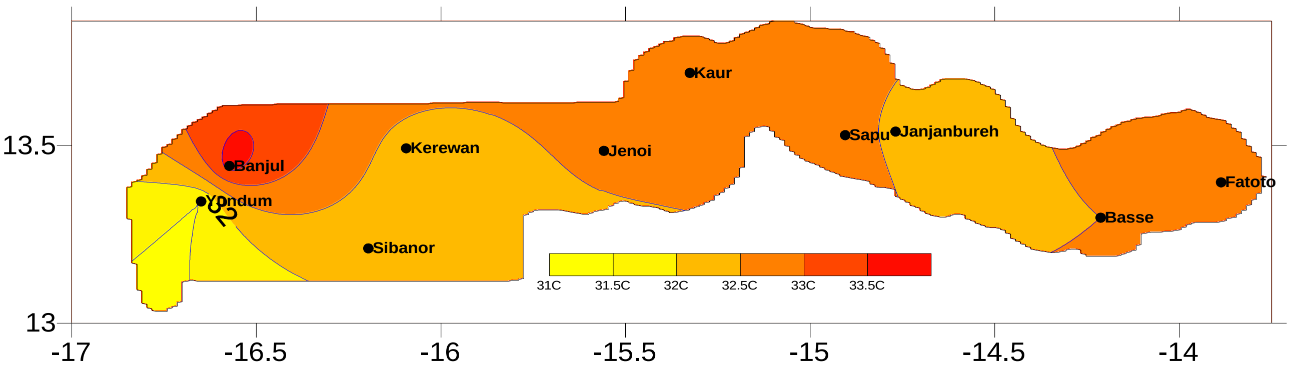
JUNE MAXIMUM TEMPERATURE



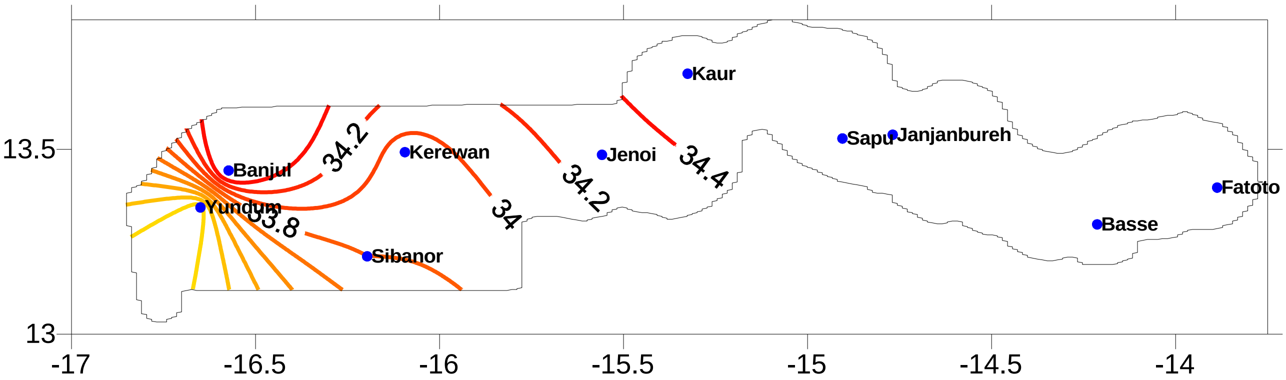
JULY MAXIMUM TEMPERATURE



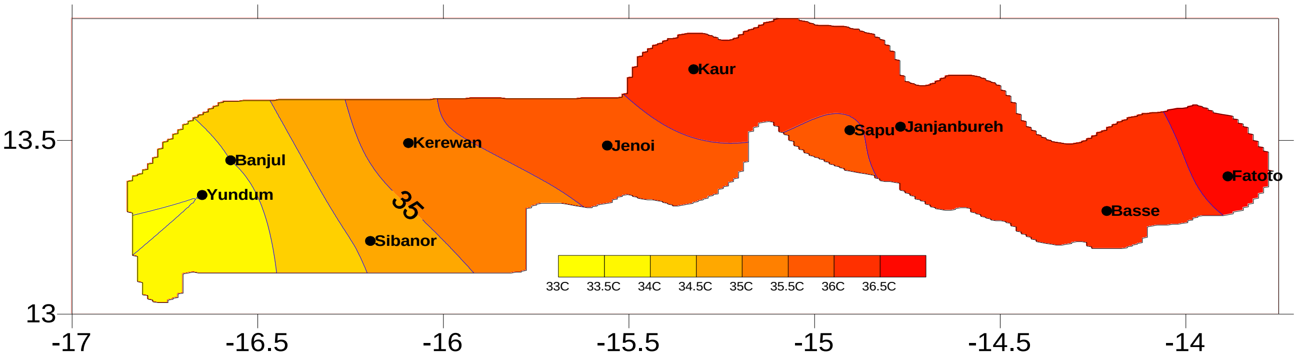
AUGUST MAXIMUM TEMPERATURE



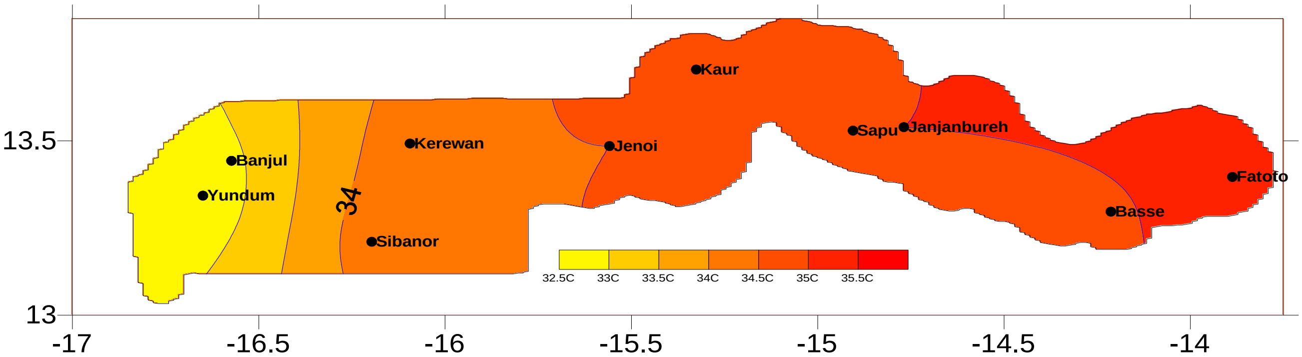
SEPTEMBER MAXIMUM TEMPERATURE



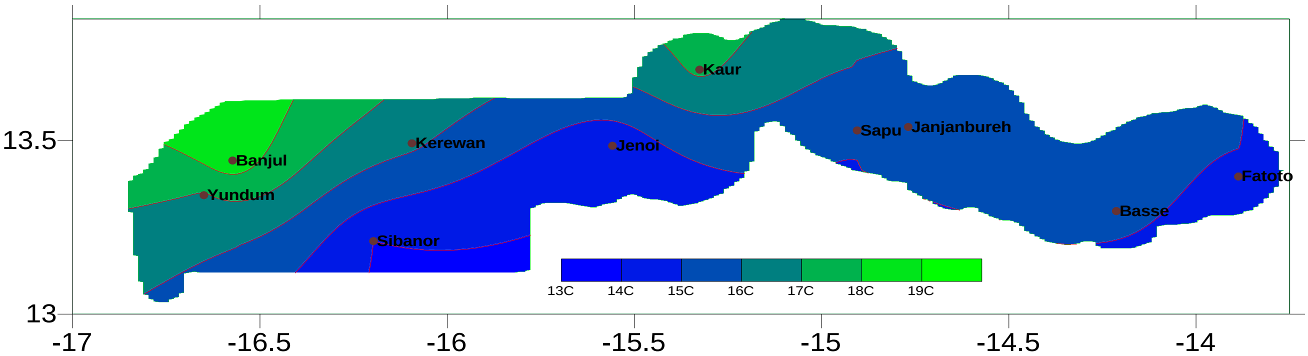
OCTOBER MAXIMUM TEMPERATURE



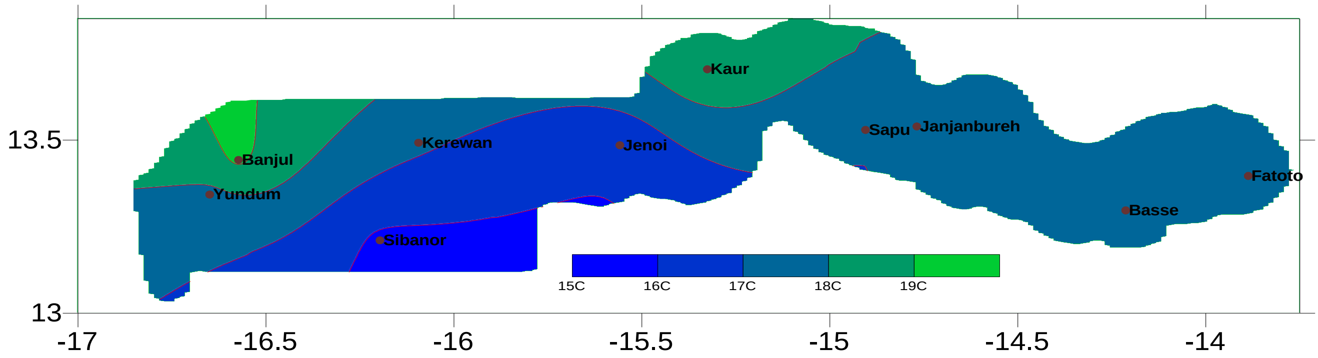
NOVEMBER MAXIMUM TEMPERATURE



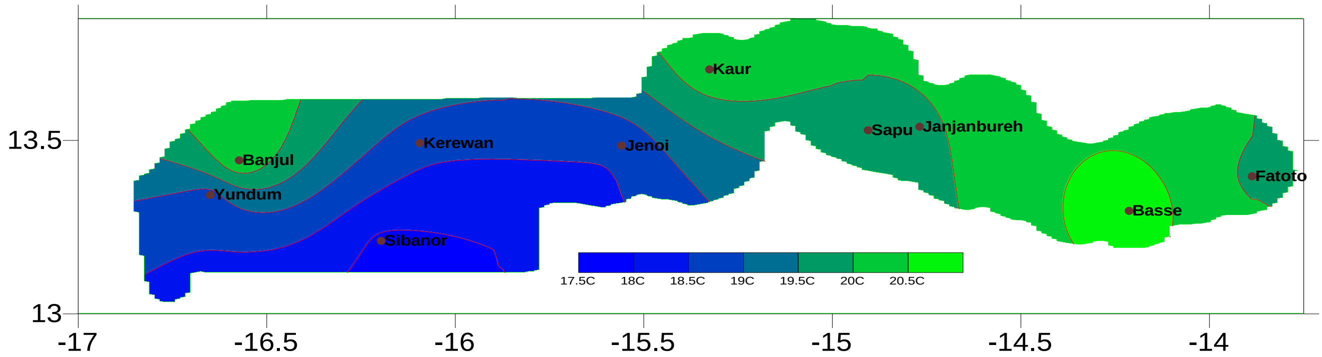
DECEMBER MAXIMUM TEMPERATURE



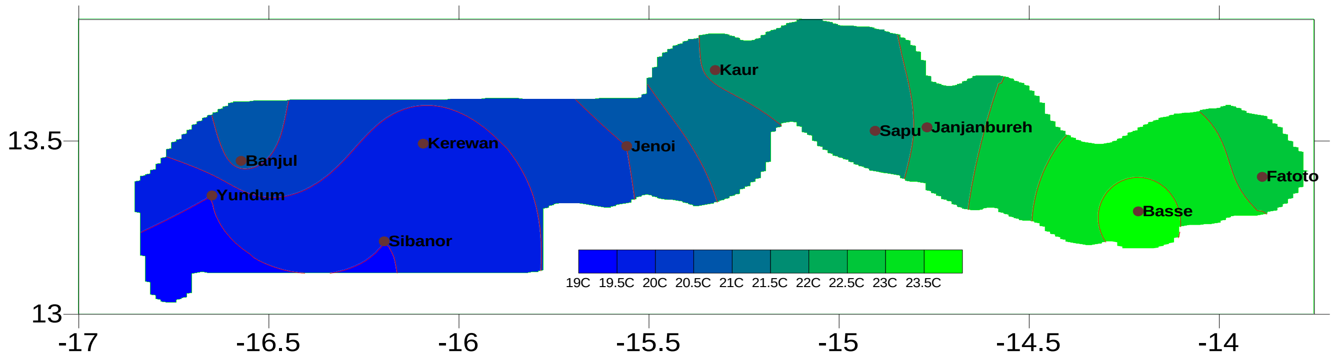
JANUARY MINIMUM TEMPERATURE



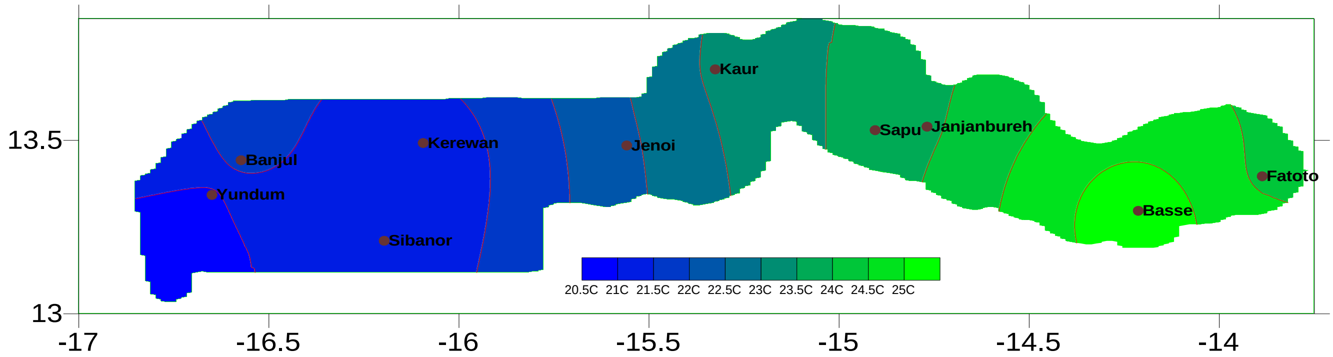
FEBRUARY MINIMUM TEMPERATURE



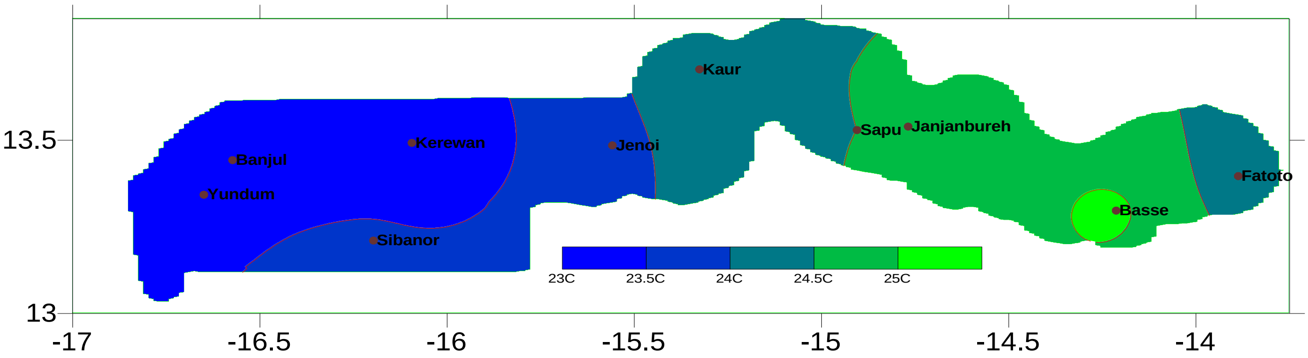
MARCH MINIMUM TEMPERATURE



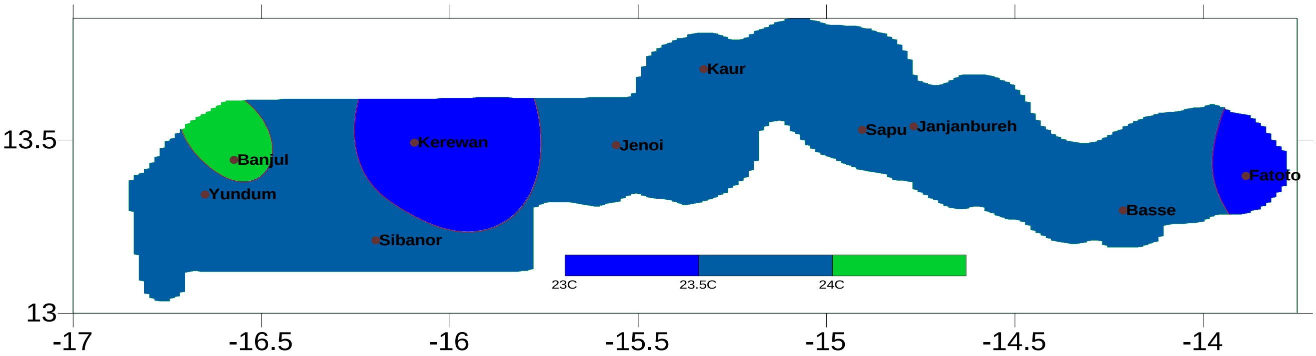
APRIL MINIMUM TEMPERATURE



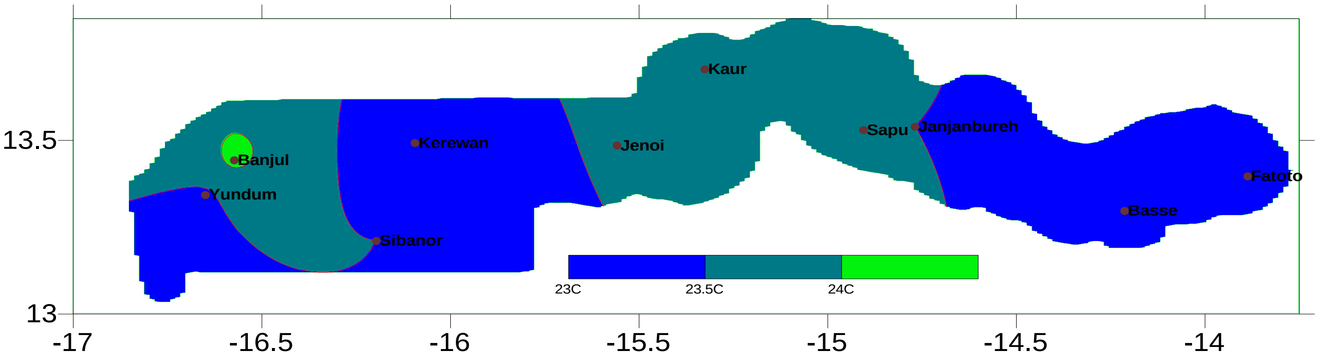
MAY MINIMUM TEMPERATURE



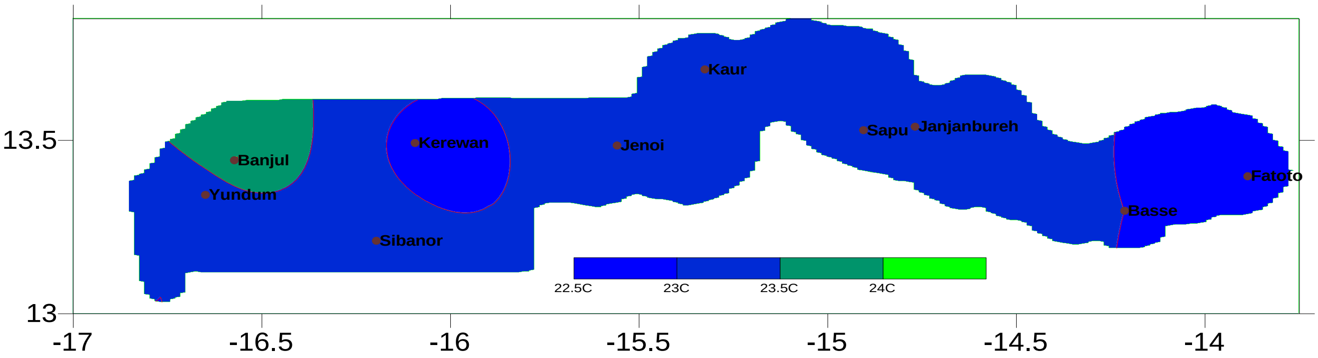
JUNE MINIMUM TEMPERATURE



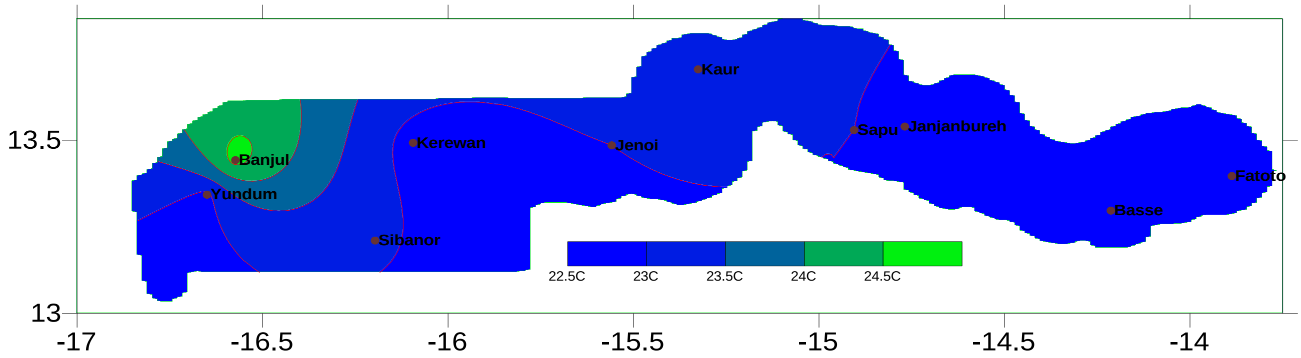
JULY MINIMUM TEMPERATURE



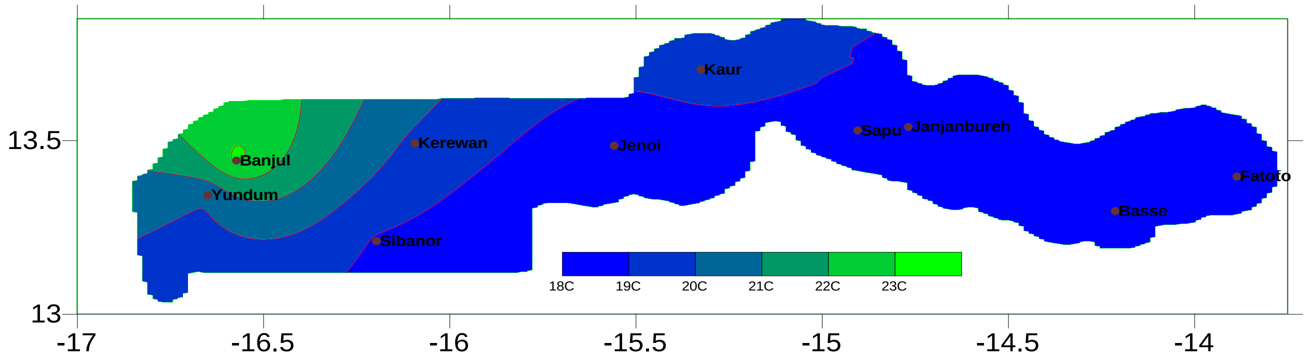
AUGUST MINIMUM TEMPERATURE



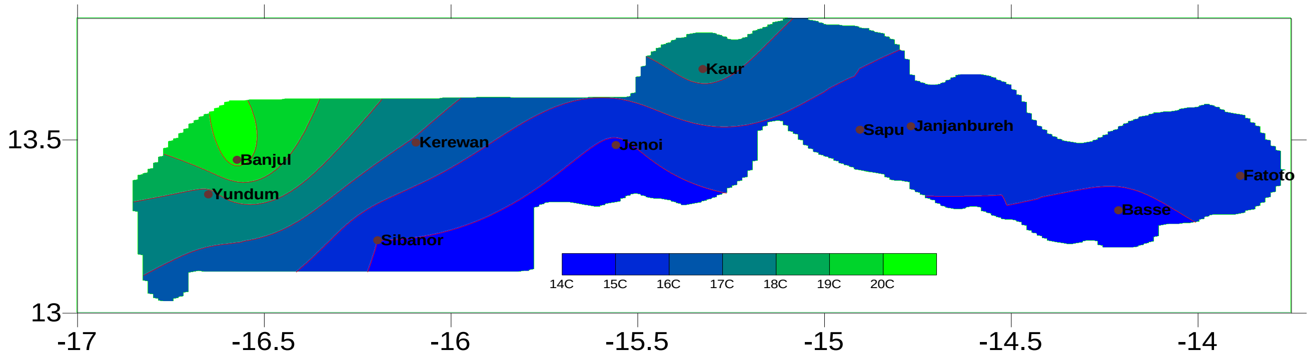
SEPTEMBER MINIMUM TEMPERATURE



OCTOBER MINIMUM TEMPERATURE



NOVEMBER MINIMUM TEMPERATURE



DECEMBER MINIMUM TEMPERATURE

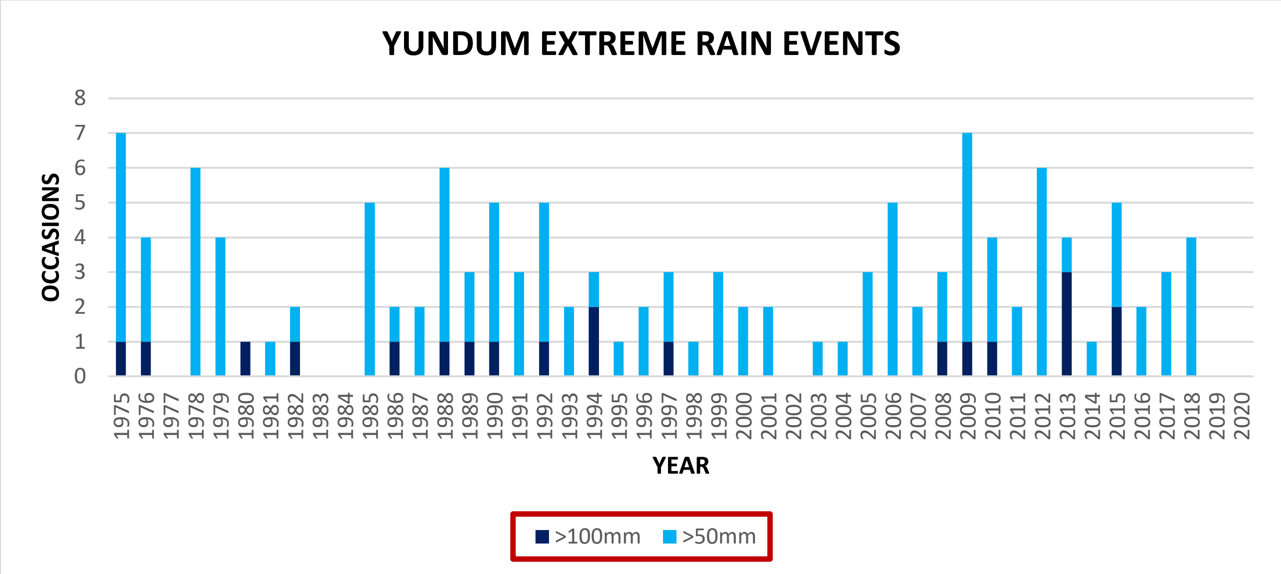
From both the Mean Maximum/ Minimum Surface Air Temperature charts/ plots, it is quite evident as stipulated earlier on that temperature gradients are unusually very weak during the months from June to October, particularly during JAS. However, stronger temperature gradients are evident more to the western areas of the country than inland areas which is as a result of the influence of the marine effect (Atlantic Ocean) to the west. Hence, the marked temperature difference over the near-coastal areas is brought about by Ocean/ Land contrasts i.e. differential heating which creates the land – Sea breeze effects.

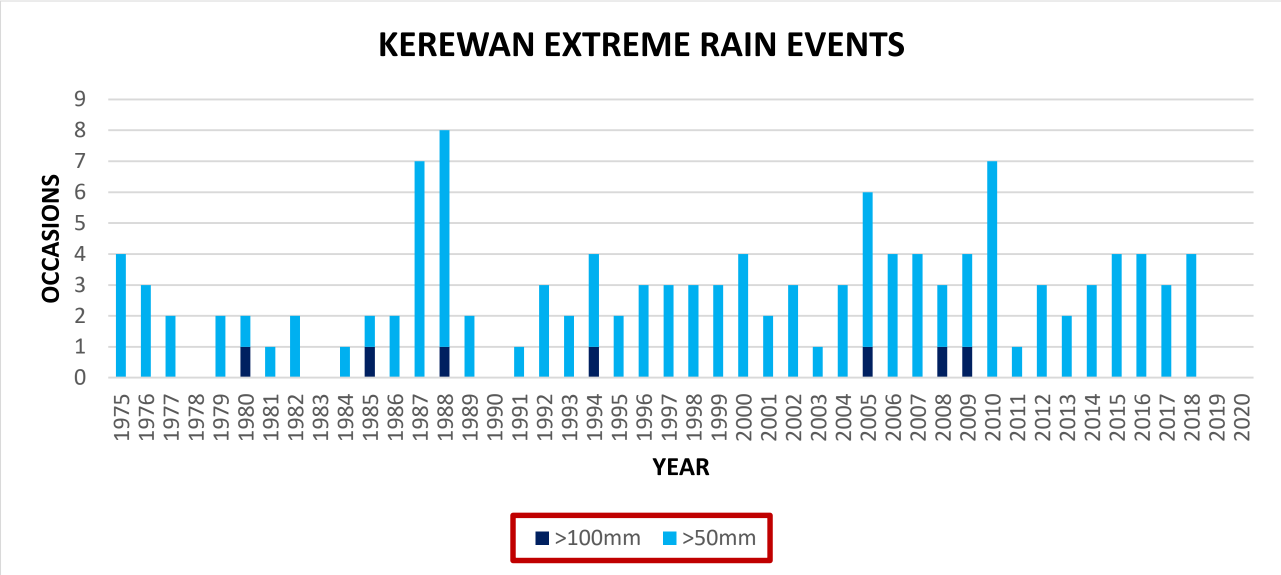
The table on the next page indicates the Number of days with Surface Air Temperatures exceeding XX degrees Celsius with Yundum representing near-coastal areas; whereas, Basse represents the inland areas. Temperature extremes increases the risk of heat stress to humans, livestock, plants and even the earth (soils). Thus from this data, the years with heatwaves can easily be identified especially when temperatures exceeds 43℃ for 3 consecutive days….

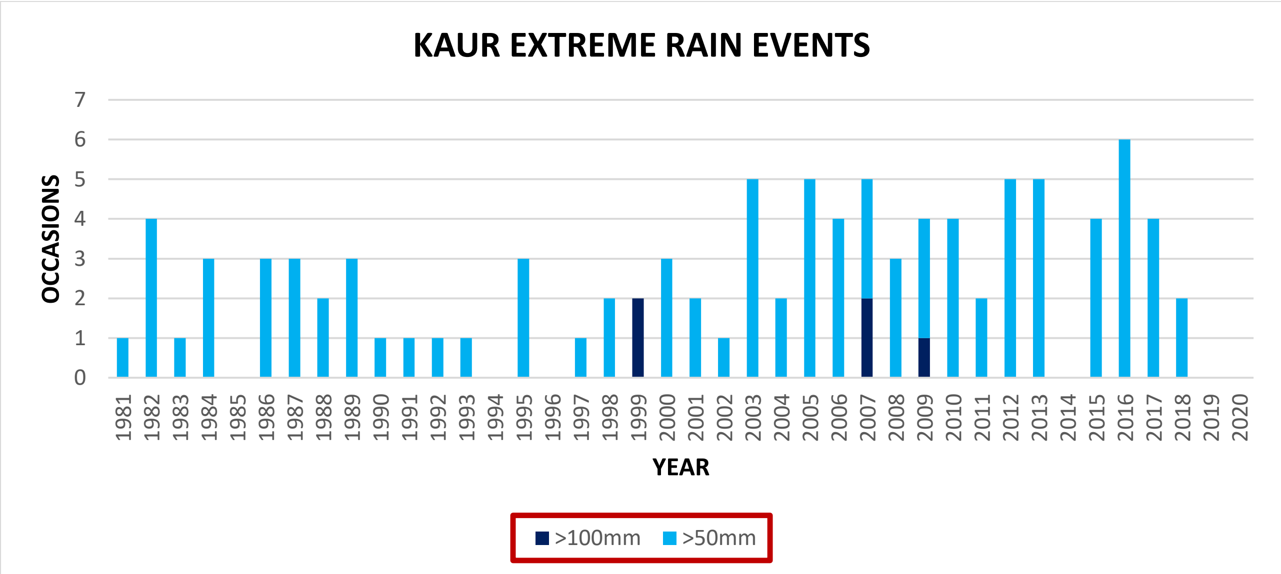
YEAR	TEMP >40°C		TEMP >41°C		TEMP >42°C		TEMP >43°C		TEMP >44°C		TEMP >45°C	
	YUNDUM	BASSE	YUNDUM	BASSE	YUNDUM	BASSE	YUNDUM	BASSE	YUNDUM	BASSE	YUNDUM	BASSE
1975	0	42	0	18	0	4	0	0	0	0	0	0
1976	0	22	0	7	0	1	0	0	0	0	0	0
1977	0	32	0	14	0	2	0	0	0	0	0	0
1978	0	31	0	9	0	1	0	0	0	0	0	0
1979	0	39	0	17	0	6	0	2	0	0	0	0
1980	2	50	1	27	1	15	1	7	1	1	1	0
1981	0	31	0	8	0	3	0	0	0	0	0	0
1982	1	20	0	8	0	2	0	0	0	0	0	0
1983	13	33	4	11	0	4	0	0	0	0	0	0
1984	2	19	0	9	0	1	0	0	0	0	0	0
1985	1	34	0	11	0	3	0	2	0	1	0	1
1986	1	32	0	17	0	5	0	3	0	0	0	0
1987	4	38	1	17	0	7	0	2	0	0	0	0
1988	4	62	3	43	1	17	0	3	0	1	0	1
1989	4	46	1	28	0	12	0	2	0	0	0	0
1990	4	87	1	52	0	24	0	7	0	0	0	0
1991	5	64	2	31	0	12	0	3	0	1	0	0
1992	3	38	0	20	0	9	0	1	0	0	0	0
1993	1	64	1	42	0	14	0	3	0	1	0	0
1994	7	66	1	46	1	21	0	7	0	2	0	1
1995	3	64	0	40	0	19	0	4	0	0	0	0
1996	10	77	6	53	4	31	1	11	0	3	0	0
1997	2	55	1	30	0	9	0	1	0	0	0	0
1998	9	119	4	85	0	58	0	23	0	7	0	0
1999	0	70	0	48	0	22	0	5	0	2	0	0
2000	4	75	1	49	0	21	0	5	0	3	0	1
2001	4	80	2	48	0	23	0	5	0	1	0	0
2002	5	71	4	44	1	22	0	7	0	1	0	0
2003	5	82	2	46	2	20	1	9	1	3	0	0
2004	4	70	4	46	0	22	0	5	0	1	0	0
2005	5	72	2	52	1	30	1	10	0	1	0	0
2006	4	66	0	40	0	16	0	4	0	0	0	0
2007	6	88	1	60	1	28	0	7	0	0	0	0
2008	3	89	2	56	0	24	0	6	0	1	0	1
2009	0	69	0	48	0	26	0	6	0	1	0	0
2010	13	96	6	59	3	33	1	13	0	3	0	0
2011	3	80	1	57	1	21	0	8	0	0	0	0
2012	5	69	1	33	0	13	0	4	0	0	0	0
2013	1	83	0	57	0	25	0	8	0	3	0	0
2014	1	63	0	38	0	18	0	6	0	0	0	0
2015	4	60	2	30	2	5	0	2	0	1	0	0
2016	9	82	4	48	4	22	1	7	1	2	0	0
2017	9	84	7	55	7	21	0	2	0	1	0	0
2018	6	86	3	42	3	18	0	3	0	0	0	0
2019												

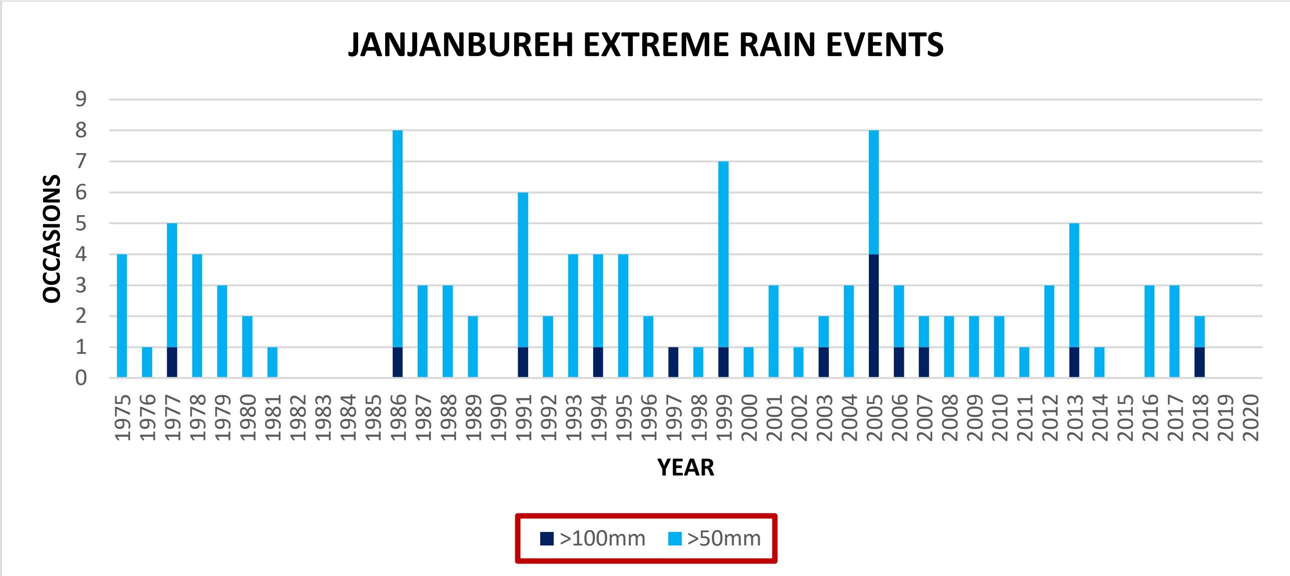
Due to the nature of the terrain with its associated geomorphology and depending on the intensity, duration and soil moisture content, there is a potential for flash flooding when rainfall exceeds 50mm.

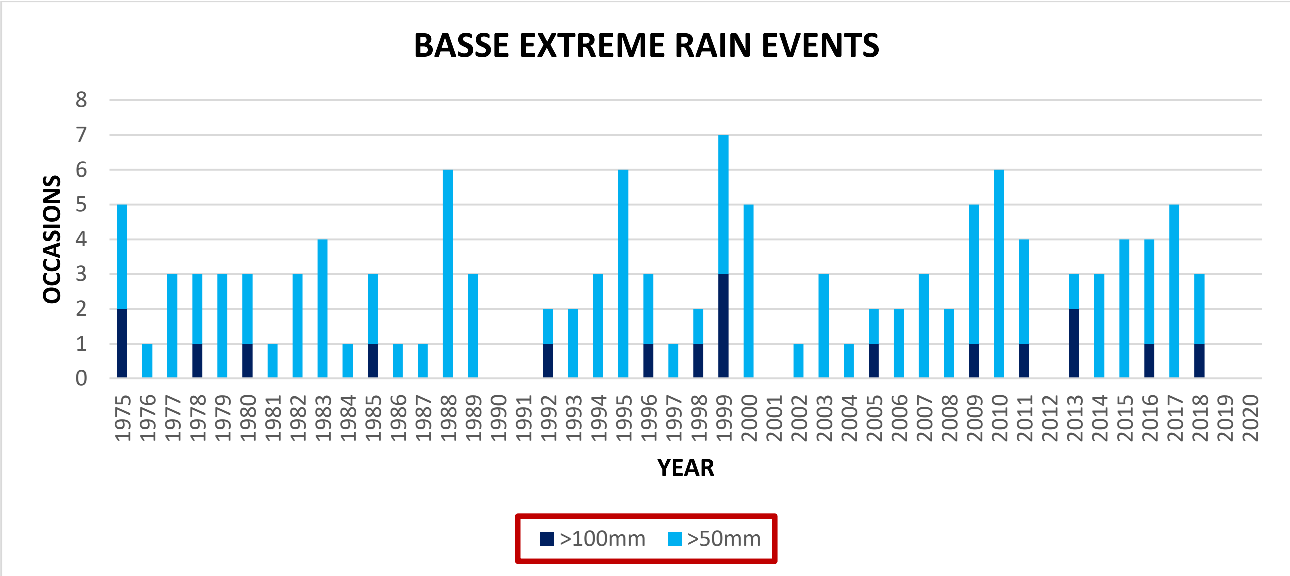
Hence, the following plots indicates years when Extreme Rainfall Event occurred at different regions and periods.


YUNDUM EXTREME RAIN EVENTS
OCCASIONS
YEAR
>100mm
>50mm


KEREWAN EXTREME RAIN EVENTS
OCCASIONS
YEAR
>100mm
>50mm


KAUR EXTREME RAIN EVENTS
OCCASIONS
YEAR
>100mm
>50mm



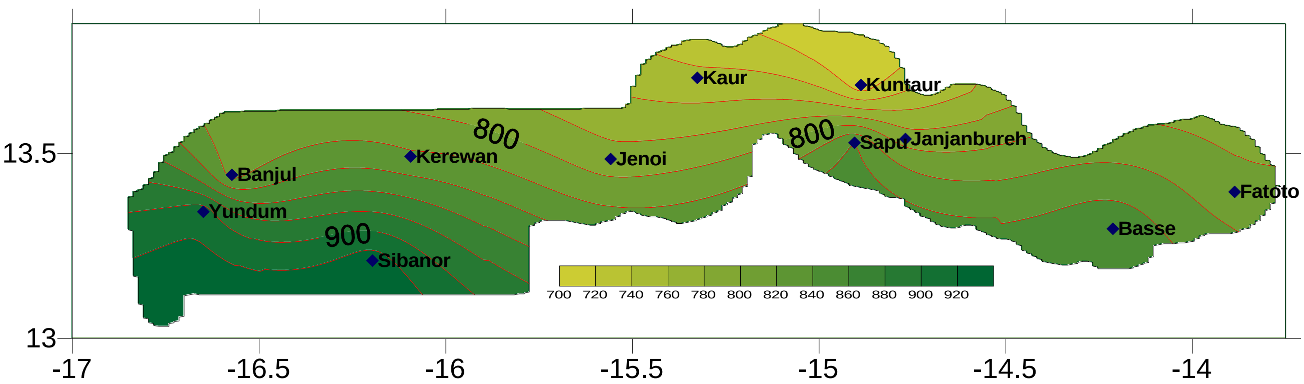


From the above plots it is quite evident that rainfall amount and intensity are highly variable, irregular, erratic both spatially and temporally as depicted on the above plots for the different regions or locality in a given year.

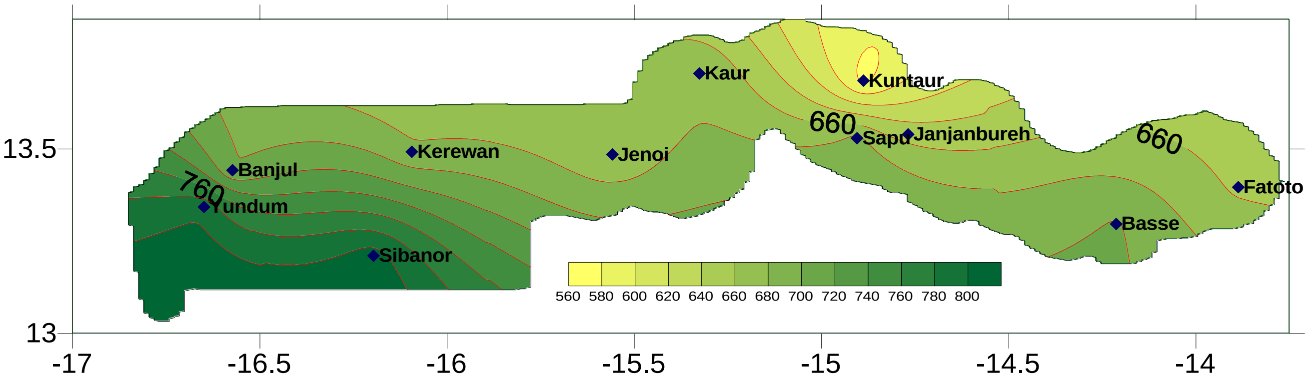
Hence, the following maps below show the average rainfall amount received over different areas.

3.2 AVERAGE RAINFALL:

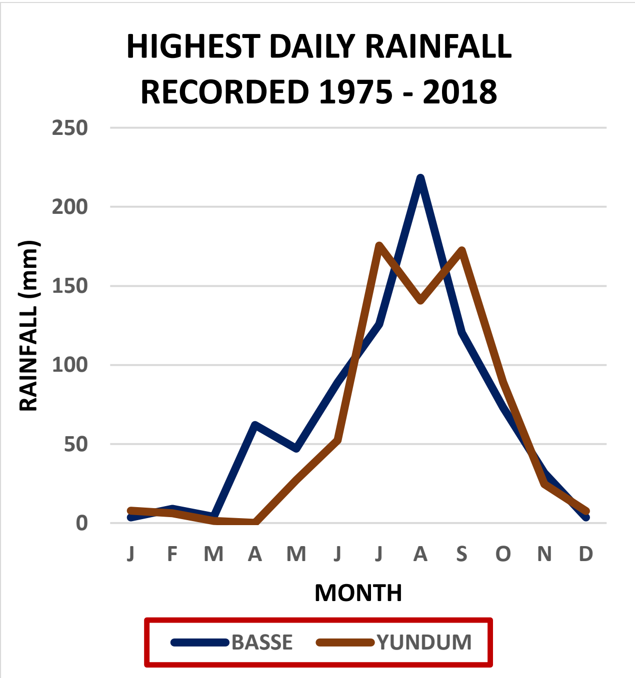
LONG TERM SEASONAL RAINFALL AVERAGE IN mm (44YRS)

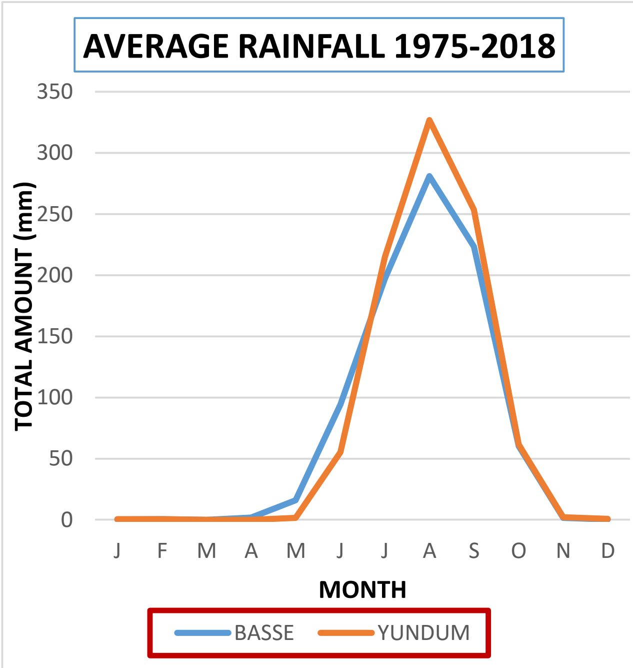


LONG TERM JULY TO SEPTEMBER (JAS) RAINFALL AVERAGE IN mm (44YRS)



The Long Term Seasonal and JAS rainfall average is based on the forty-four years mean from 1975 to 2018 data. The average annual rainfall amount varies enormously over the country from about 700mm to 920mm with the wettest areas been over the southwestern sectors (WCR) of the country and driest to the north (CRR North).





From the above plots, it is worth noting the evident that over 80% of the seasonal rainfall occurs in the months of July, August and September (JAS).

The table below indicates some of the extreme events that were recorded during the past 44 years from 1975 to 2018 respectively.

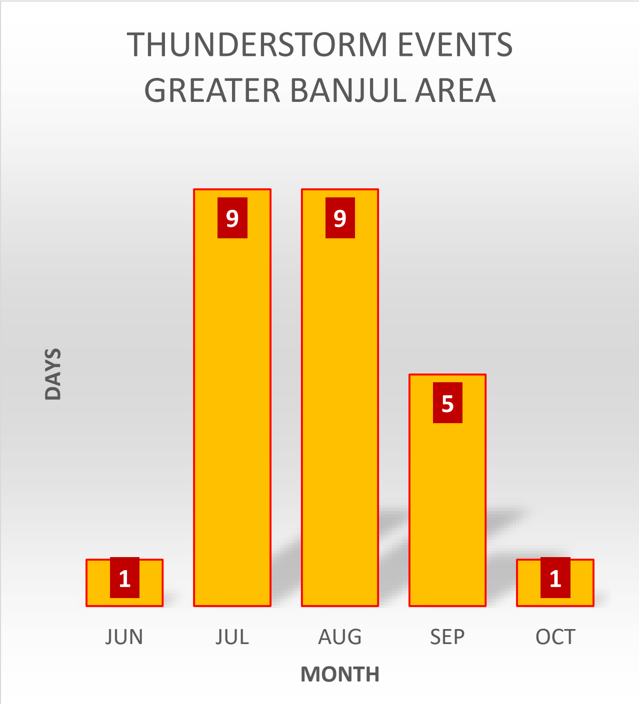
DISCRIPTION	PARAMETER	VALUE	LOCATION	DATE
Highest Monthly	Rainfall	654.2mm 722.7mm 740.9mm	Yundum Basse Jambanjelley	AUG 2009 AUG1999 AUG1999
Highest Daily	Rainfall	218.3mm	Basse	24-08-1992
Lowest Seasonal	Rainfall	223.2mm	Kaur	1883
Highest Seasonal	Rainfall	1452.8mm	Sibanor	1988
Highest Daily	Temperature	49℃	Jenoi	29-03-2001
Lowest Daily	Temperature	4℃	Jenoi	08-01-2003
Highest Gust	Wind speed	114Km/h	Greater Banjul Area & Environs	27-08-2014 @ 18:00UTC

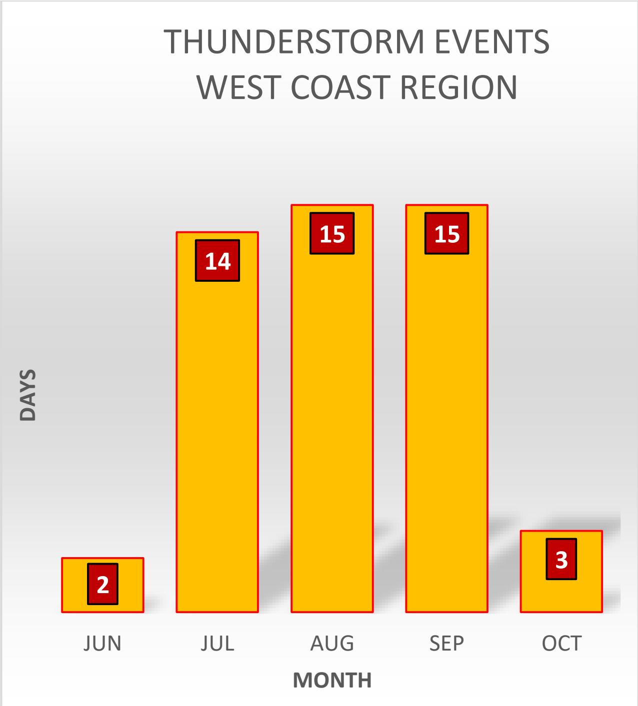
4.0 SEVERE WEATHER:

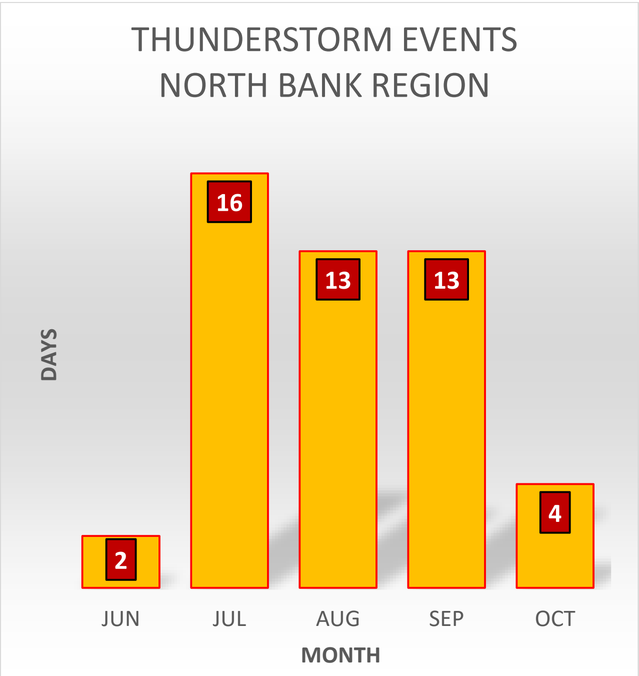
As already mentioned, Severe Thunderstorm is defined as one which produces; frequent lightning, hail, squall line, heavy precipitation, flash floods and or any combination of these.

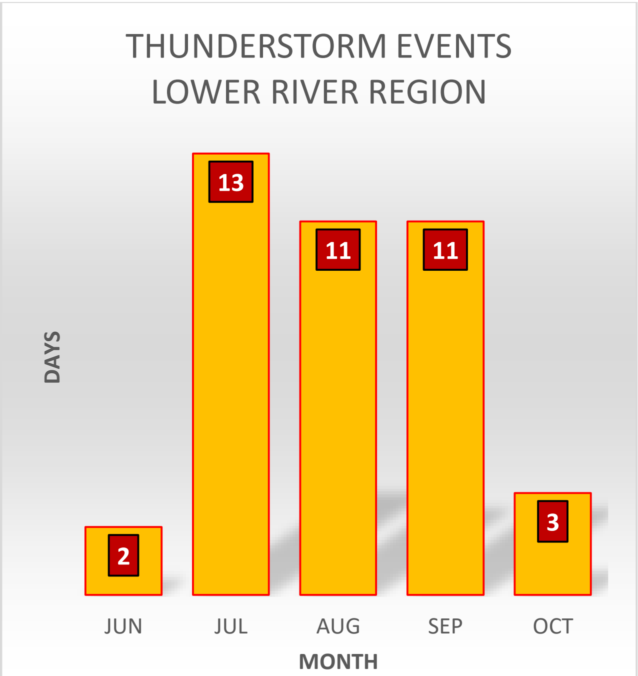
There are lightning strikes event occurring daily worldwide and the threat of lightning doesn't just come when you hear thunder roar nearby or see the storms cloud rolling in overhead. Lightning can strike the ground more than 15 kilometres outside of a storm system which means you may never see it coming. Hence, be always on the alert/ guard….

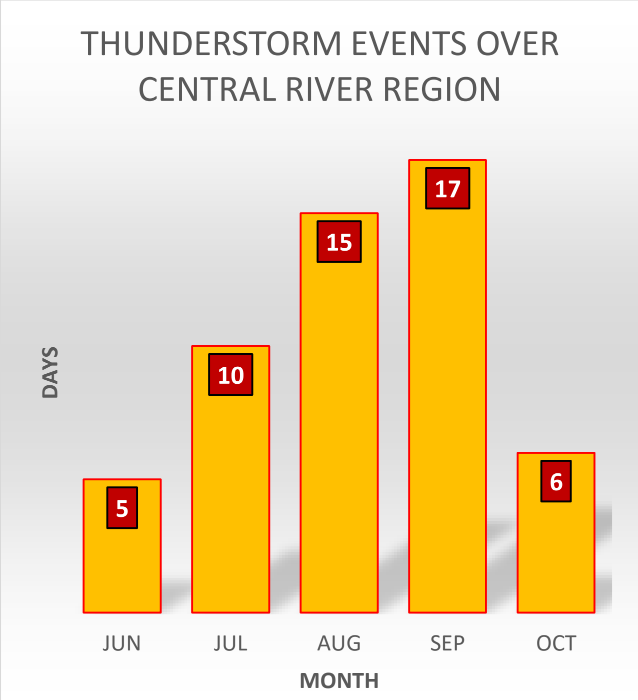
The following plotted graphs represent regional events of Cloud to Ground (CG) Lightning Flashes within The Gambia during the 2018 rainy season.

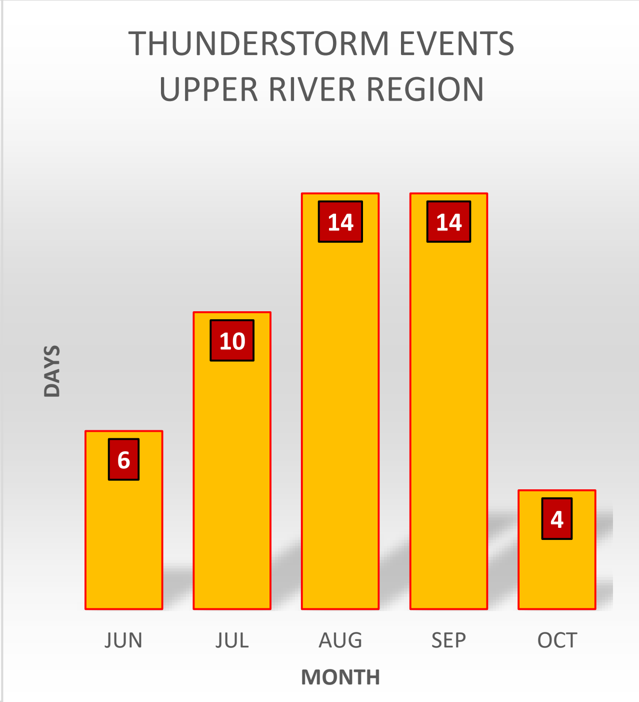




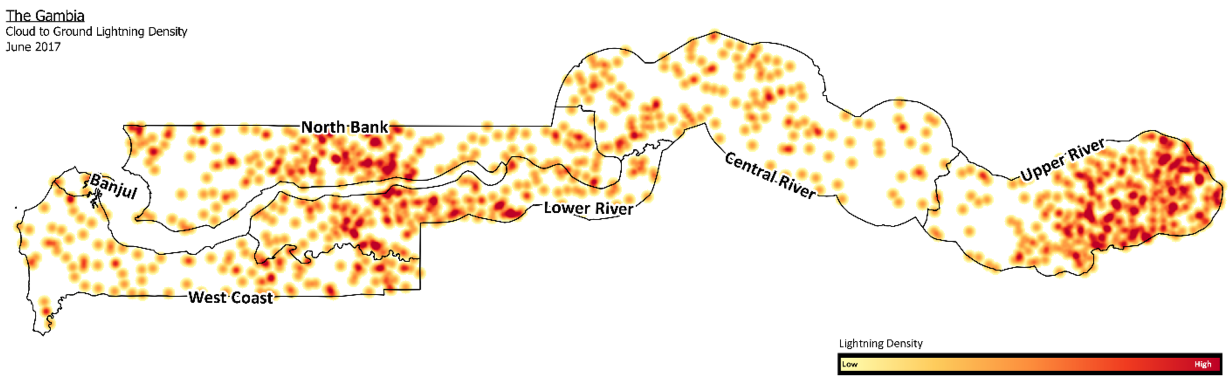


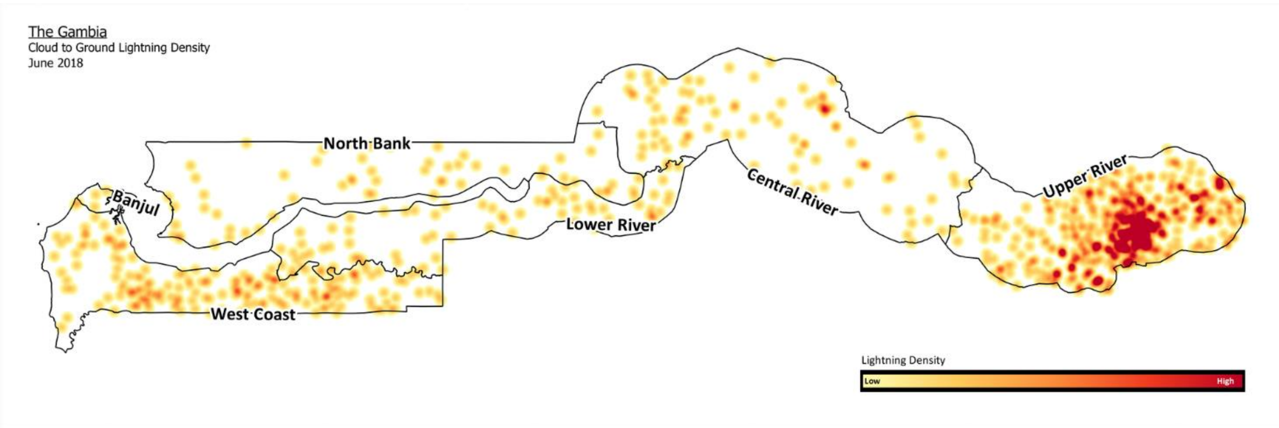


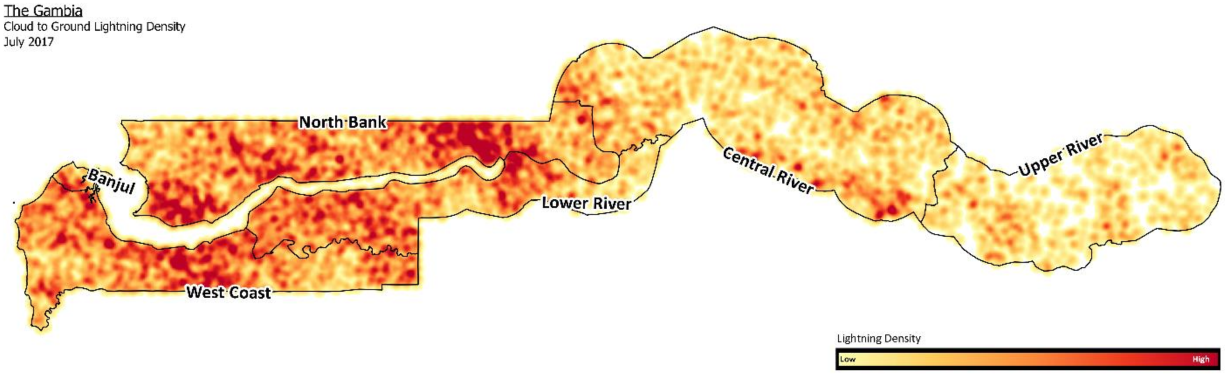


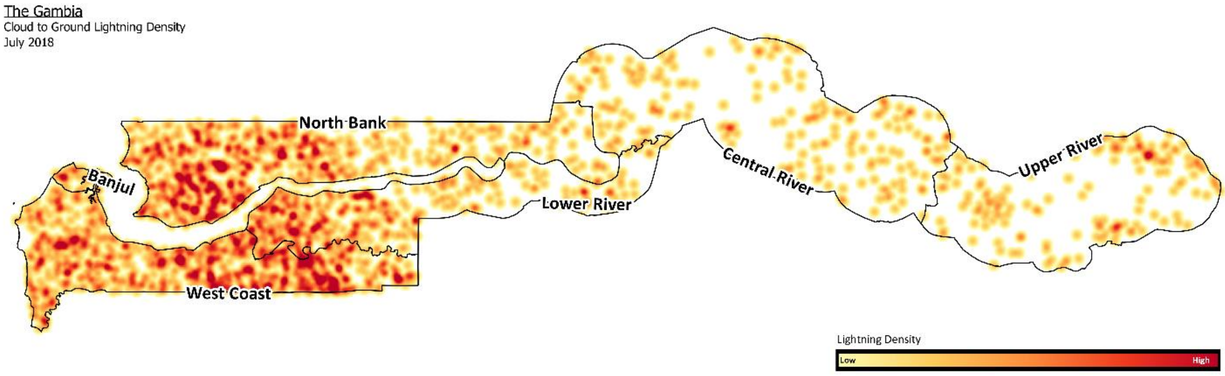


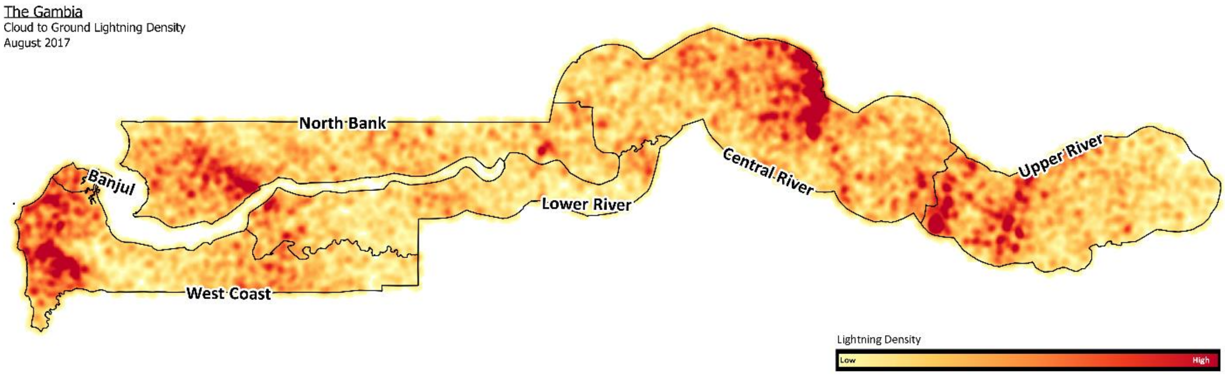
The CG-Lightning Density plots below indicates areas that had experienced Thunderstorm events with areas of high density in red clusters indicating severe weather such as lightning strikes, occasional windstorms and moderate to heavy rain-showers that may had led to flash-floods particularly during the months of August and September when soil moisture had increased. There is a remarkable decrease in both CG-Lightning and Thunderstorms activities as compared to year 2017….

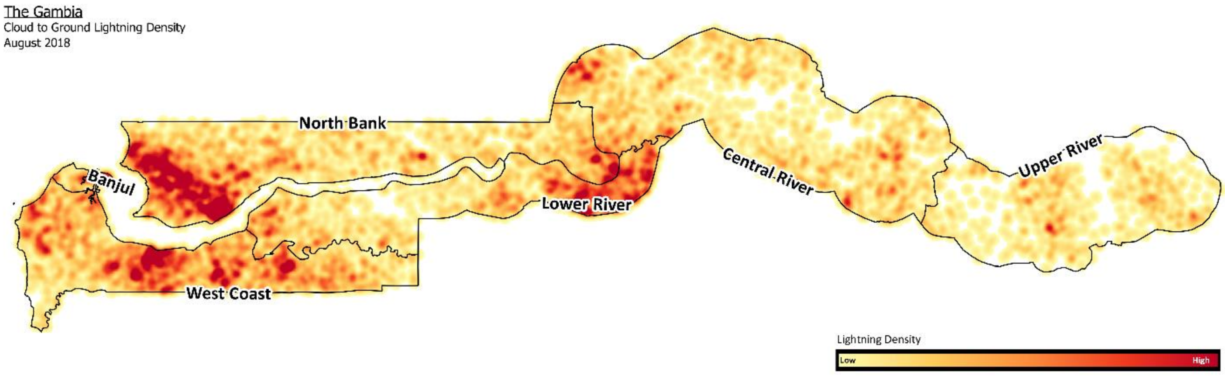


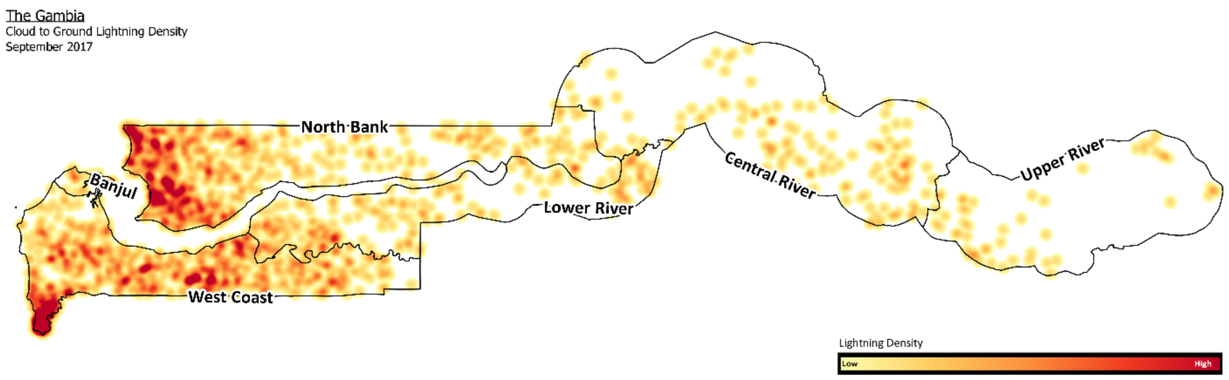


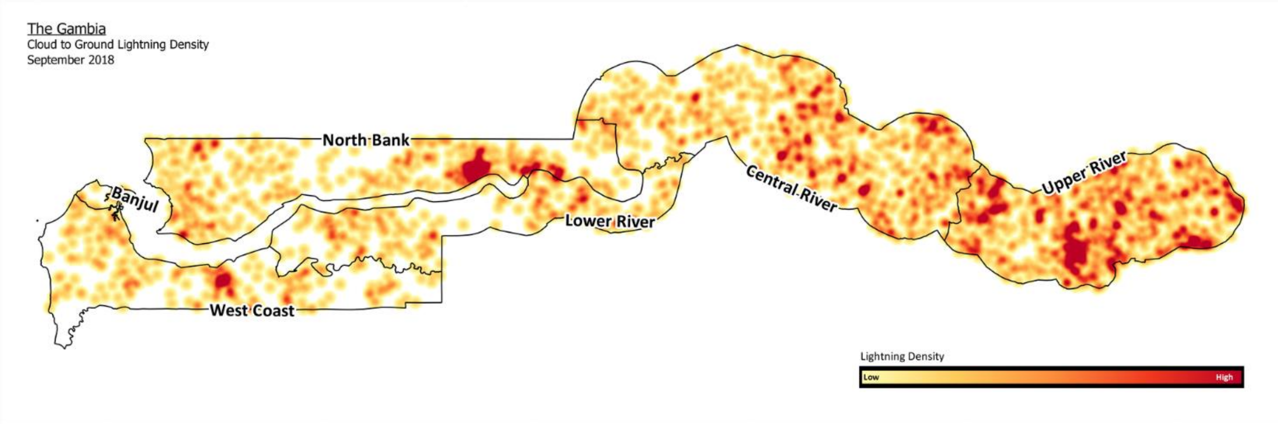

The Gambia
Cloud to Ground Lightning Density
July 2017
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High

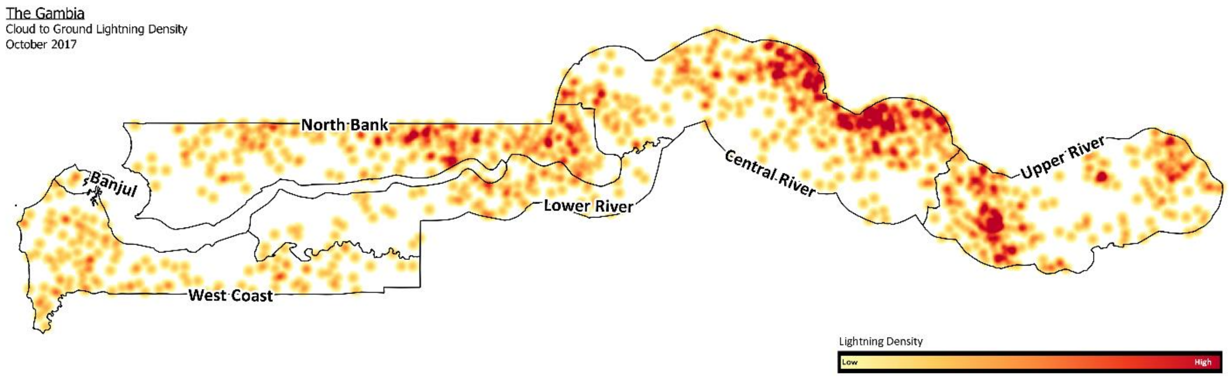

The Gambia
Cloud to Ground Lightning Density
July 2018
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High

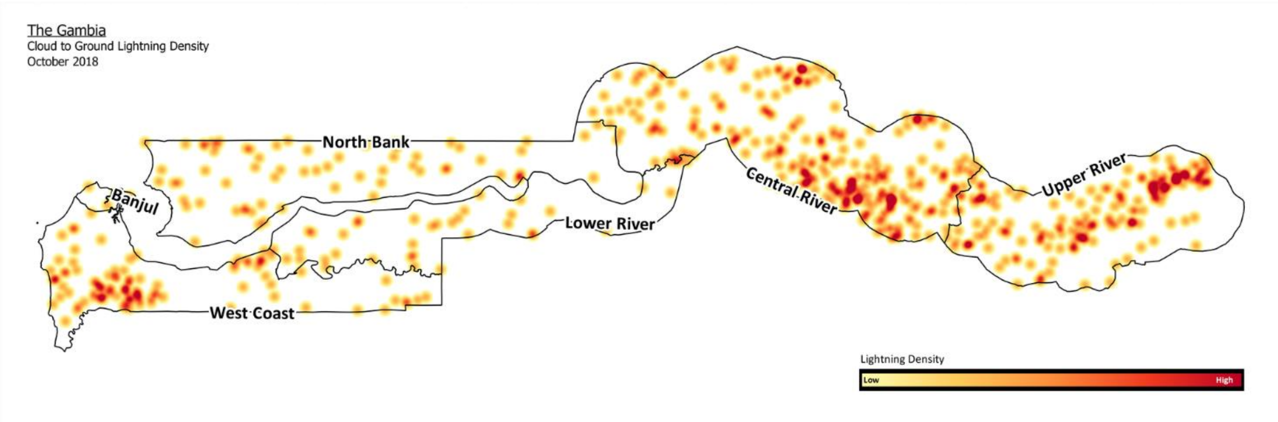

The Gambia
Cloud to Ground Lightning Density
August 2017
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High

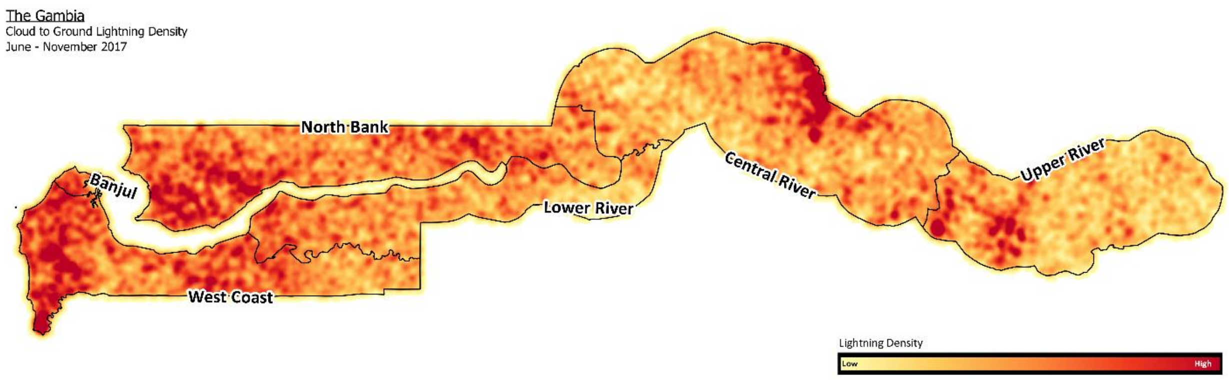

The Gambia
Cloud to Ground Lightning Density
August 2018
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High

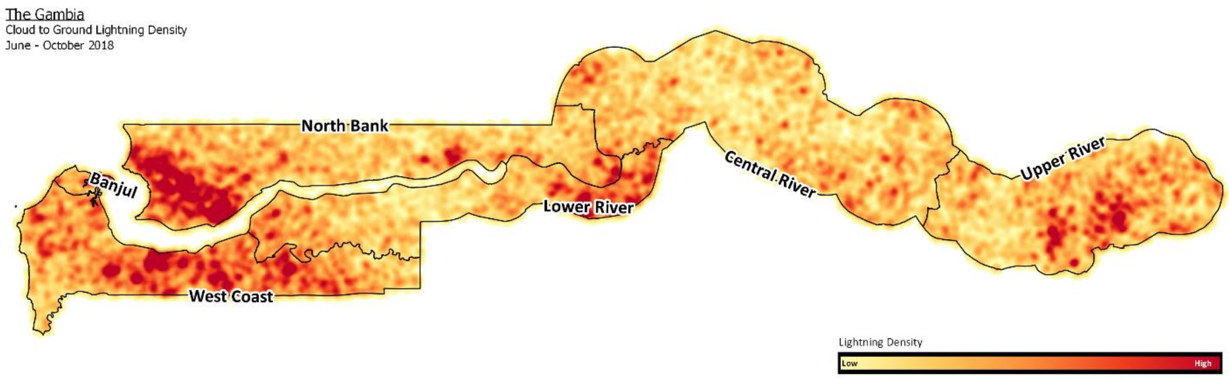

The Gambia
Cloud to Ground Lightning Density
September 2017
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High

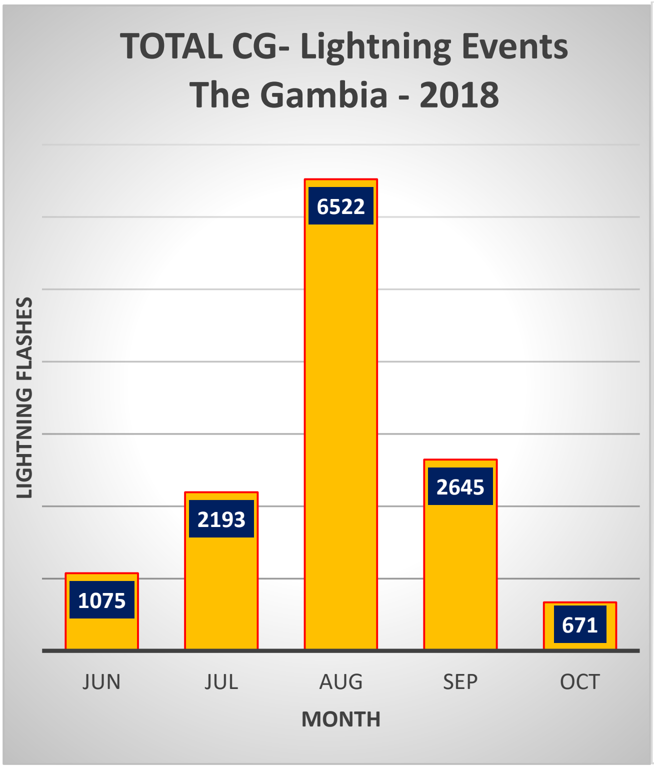

The Gambia
Cloud to Ground Lightning Density
September 2018
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High

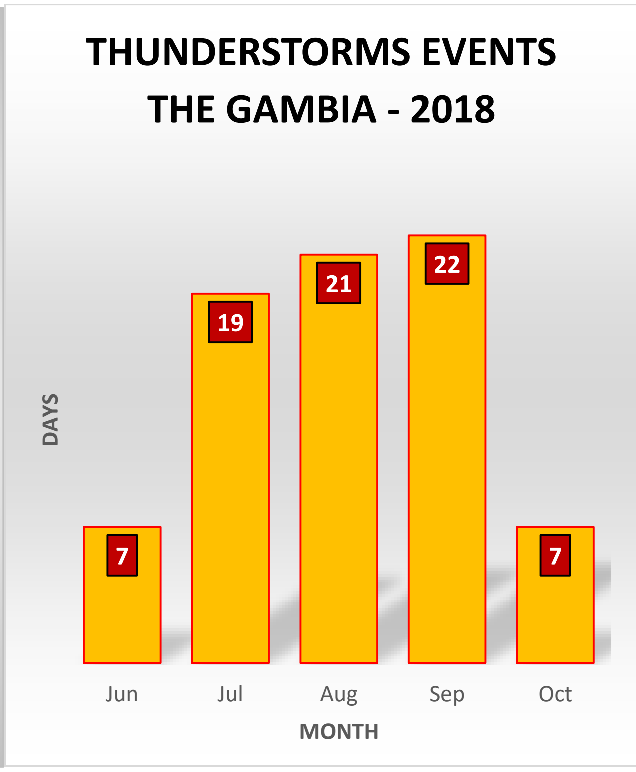

The Gambia
Cloud to Ground Lightning Density
October 2017
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High


The Gambia
Cloud to Ground Lightning Density
October 2018
North Bank
Banjul
Lower River
Central River
Upper River
West Coast
Lightning Density
Low
High

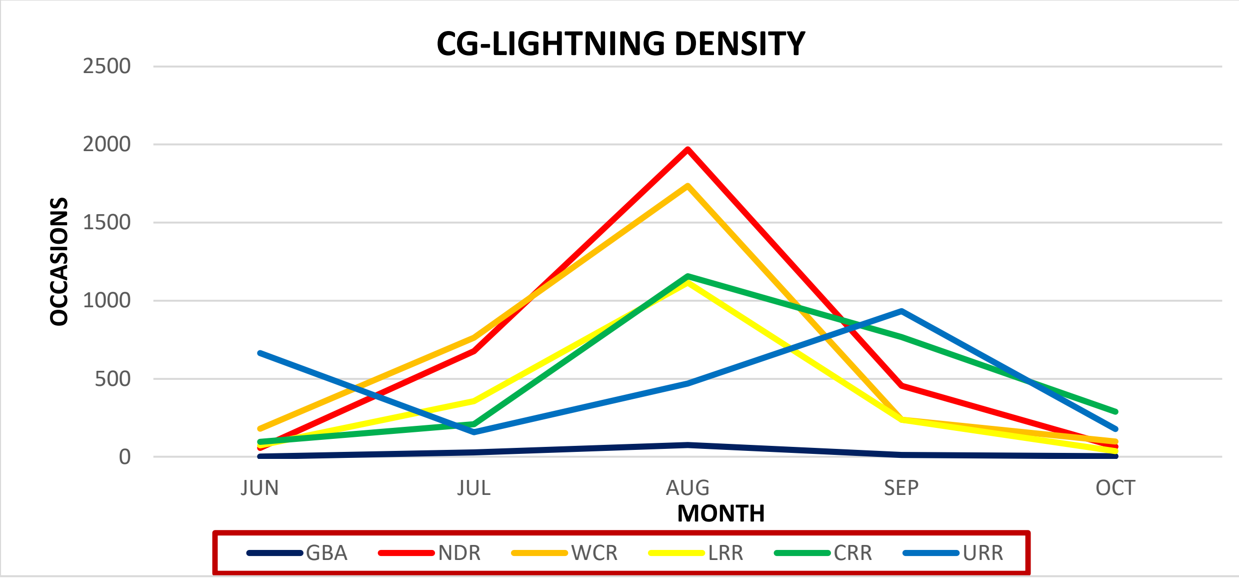


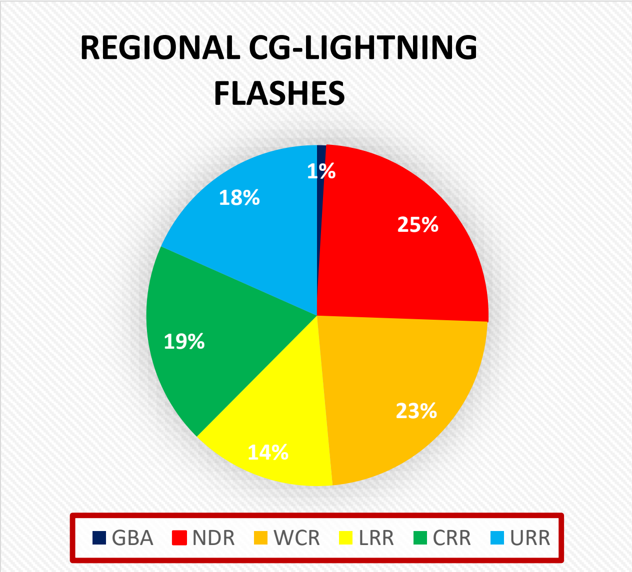


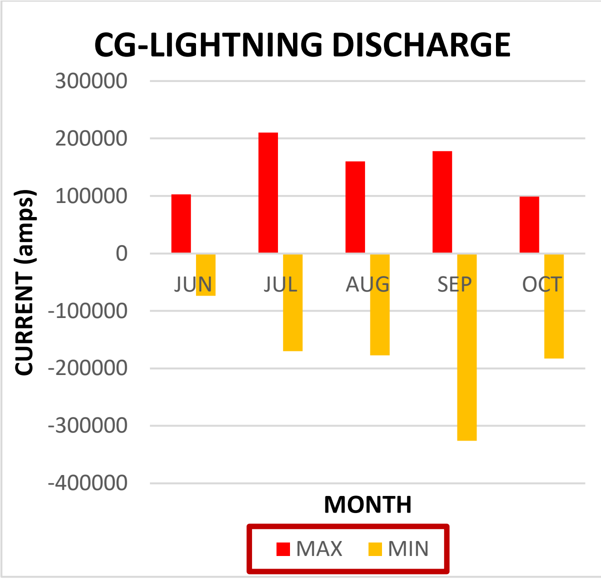




From the above analysis, The Gambia recorded a total of Seventy-six (76) Thunderstorm days in the year-2018; as compared to Ninety-six (96) during the previous year. However, on the contrary it is interesting to note that Thunderstorm events peaked in September whereas, there we more Cloud to Ground lightning flashes in August.







The following plots shows the CG-Lightning density (top) and percentage (left) that were recorded in the different regions of The Gambia including the highest individual CG-Lightning discharge (right).

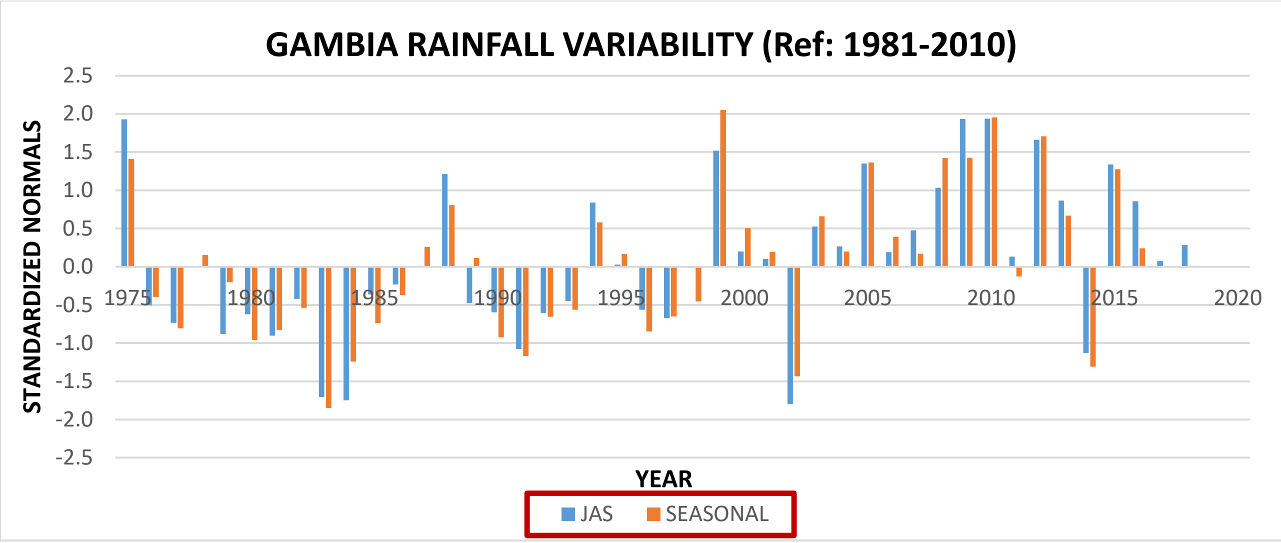
The table below indicates the regional ideal dates for rainfall events including Long-Term Normal (1975-2018) of the displacement of rain-belt. The average length of the rainy season can easily be obtained.

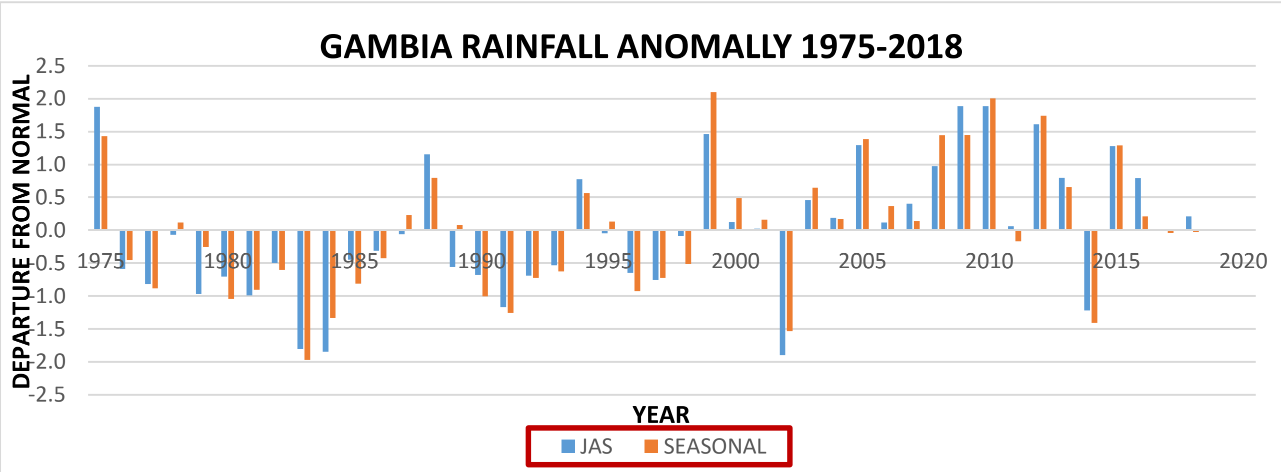
REGION	ONSET	NORMAL	CESSATION	NORMAL
GBA	27th June 2018	16 - June	07th Oct 2018	21 - October
NBR	27th Jun 2018	12 - June	15th Oct 2018	22 - October
WCR	24th Jun 2018	16 - June	21nd Oct 2018	22 - October
LRR	07th Jul 2018	11 - June	15th Oct 2018	21 - October
CRR North	27th Jun 2018	12 - June	13th Oct 2018	09 - October
CRR South	27th Jun 2018	07 - June	14th Oct 2018	23 - October
URR	02nd Jun 2018	30 - May	22rd Oct 2018	23 - October

5.0 INDICES:

An anomaly is a departure from average conditions. An anomaly therefore is when something is different from usual or normal. A temperature anomaly is how different the Earth's temperature at a particular location and particular time is from the normal/ usual temperatures for that place. Surface Air Temperature anomalies can indicate a specific pattern or trend such as global warming or cooling; whereas, rainfall anomalies can signal long-term climate change.

The subsequent plots and maps indicates rainfall and temperatures in a given month or year to the long-term average 1975 through 2018 and standardized averages of rainfall and temperature of a particular month or year from a reference based period 1981 through 2010.



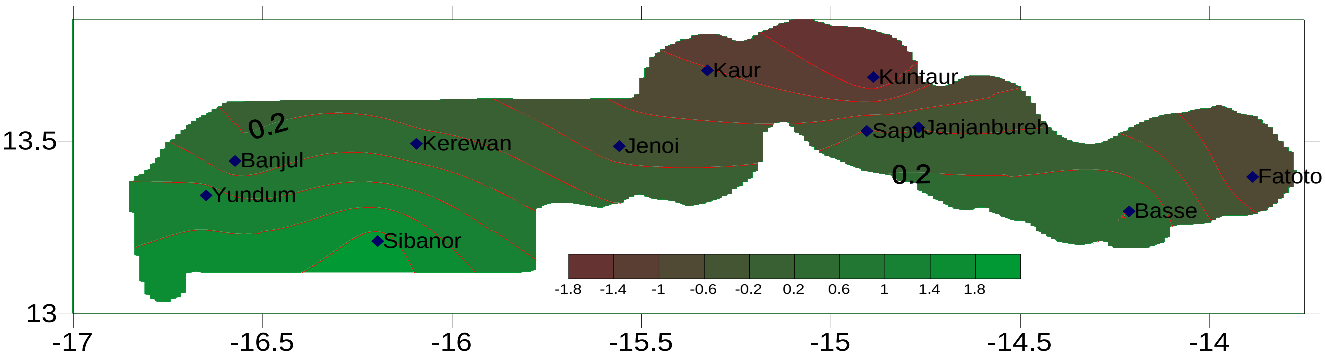


The two plots above compares **Wet and Dry Modes** over The Gambia. The plots indicates Rainfall anomalies and variability over The Gambia from 1975 to 2018 depicting Normal, Wet and Dry years……. JAS represents the months of July, August and September while Seasonal is from June to October respectively.

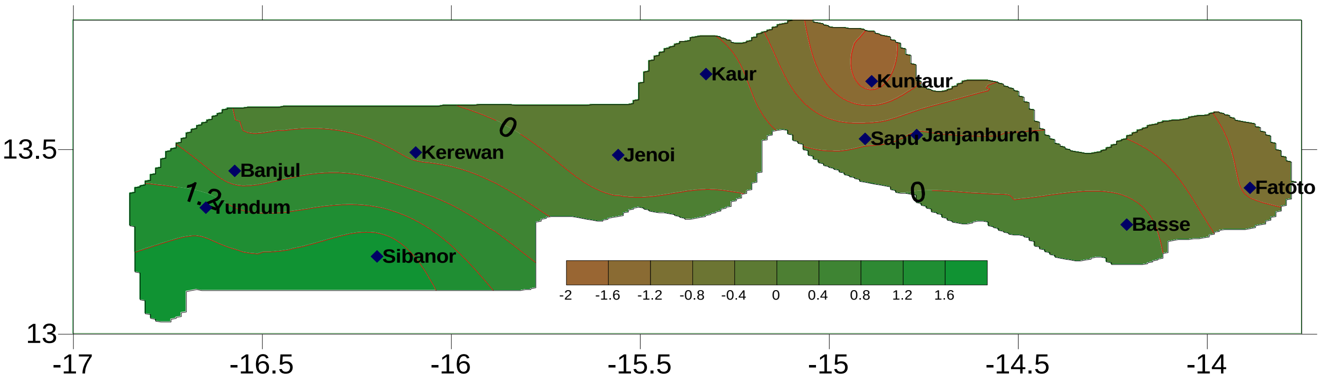
The following could easily be deduced from the plots upon assigning an Index greater than (+1) for Very Wet Years…..which happened to occur in 1975, 1999, 2005, 2008, 2009, 2010, 2012 & 2015; whereas, an index less than (-1) for Very Dry Years (Severe Drought)……. Which occurred in 1983, 1984, 1991, 2002 & 2014 and the category within (+/- 0.5) would be termed Normal years. Hence, the category from (+0.5 to +1.0) will be a Wet year and from (– 0.5 to -1.0) will be referred to as a Dry year.

The Standardized Seasonal and JAS Rainfall Index Map below is based on rainfall anomalies as defined by the Thirty years running-mean rainfall departures over The Gambia; Areas shaded in brown which are less than or equal to (<= -1.0) indicates areas where there are ***deficits*** of rain; Whereas, areas in Green greater than or equal to (>= +1.0) are characterized by ***surplus*** of rain.

STANDARDIZED SEASONAL RAINFALL



STANDARDIZED JAS RAINFALL



The following tables below shows Cold and Warm episodes by season which is generated by Consecutive overlapping 3-monthly seasonal temperature modes with Blue colour highlights indicating temperatures that were cooler than average, Black shows near-average temperatures, and Red shows where temperatures were warmer than average when Surface Air Temperature thresholds exceeded (+/- 1℃).

NEAR COASTAL AREAS 3 MONTHLY LONG TERM MEAN MAXIMUM SURFACE-AIR TEMPERATURE ANOMALLY

YEAR	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1975	0.1	-0.4	-0.2	-1.0	-0.7	-1.4	-1.4	-2.4	-2.5	-2.2	-1.5	-1.2
1976	-1.3	-1.3	-1.4	-1.5	-1.9	-1.9	-2.0	-1.8	-1.9	-1.7	-2.0	-1.4
1977	-0.6	0.4	0.5	-0.5	-0.9	-1.2	-1.3	-1.6	-1.7	-1.1	-0.6	-0.3
1978	-0.6	-0.6	-0.9	-0.8	-1.4	-1.6	-1.9	-1.7	-1.5	-1.7	-1.9	-2.1
1979	-1.1	-0.9	0.0	-0.2	-0.3	-0.9	-1.3	-0.9	-1.1	-1.1	-0.8	-0.6
1980	-0.5	-1.0	-0.7	-0.9	-1.1	-1.3	-1.1	-0.5	-0.1	-0.3	-0.8	-0.9
1981	-1.1	-0.5	-0.6	-0.3	-0.4	-0.4	-0.3	-0.4	-0.3	-0.3	-0.1	0.2
1982	-0.2	-0.6	-1.0	-0.7	-0.6	-0.2	-0.1	0.2	-0.4	-0.4	-1.2	-0.7
1983	-0.3	0.5	-0.1	-0.4	-0.6	0.1	0.6	0.6	0.6	0.8	0.9	0.9
1984	0.6	-0.5	-1.0	-1.5	-0.8	-0.6	-0.3	-0.3	0.1	0.0	0.1	-0.6
1985	-0.8	-0.9	-0.4	-1.1	-1.5	-1.6	-1.1	-1.0	-0.9	-0.6	-0.8	-1.2
1986	-1.4	-0.7	-0.2	-0.1	-0.4	-0.6	-1.0	-1.0	-1.1	-1.1	-1.1	-0.8
1987	-0.4	0.0	0.5	0.6	0.4	0.6	0.9	0.9	0.0	-0.2	-0.2	-0.3
1988	-0.7	-0.5	0.1	0.5	0.0	-0.3	-0.6	-0.5	-0.5	-0.7	-0.9	-0.9
1989	-0.7	-0.6	-0.5	-0.5	-0.4	-0.8	-1.0	-0.9	-0.9	-0.9	-0.8	-0.8
1990	0.1	0.3	0.8	0.8	0.9	0.9	0.3	0.7	0.6	0.6	0.1	0.0
1991	-0.2	-0.1	0.3	-0.1	0.2	-0.1	0.3	0.3	0.4	0.7	0.6	0.5
1992	-0.2	0.0	0.2	0.5	0.0	-0.6	-0.4	-0.4	-0.1	-0.1	0.1	-0.1
1993	-0.2	-0.5	-0.6	-0.3	0.2	0.7	0.9	0.8	0.7	0.0	-0.2	-0.6
1994	0.1	0.4	0.6	0.5	0.5	0.6	0.1	-0.3	-0.5	0.2	0.3	0.8
1995	0.8	0.4	0.0	-0.2	0.5	0.9	1.0	1.0	1.0	1.3	0.8	1.0
1996	0.7	0.8	0.5	1.0	1.5	1.4	1.0	0.8	0.8	0.7	0.9	0.9
1997	1.5	1.2	0.8	0.5	0.5	0.9	0.7	0.9	1.1	1.5	1.3	1.0
1998	1.0	1.2	1.3	1.1	1.0	0.7	0.4	0.1	0.6	0.9	0.9	0.2
1999	-0.2	-0.3	0.0	0.0	0.3	0.1	-0.4	-0.5	-0.6	-0.1	0.0	0.4
2000	0.2	0.6	0.4	-0.1	-0.7	-1.0	-0.5	-0.2	-0.3	-0.3	-0.4	0.6
2001	1.1	1.1	0.7	0.6	0.4	0.0	0.0	0.2	0.5	0.1	0.4	0.2
2002	0.4	0.0	0.0	-0.1	-0.1	0.3	0.8	1.1	0.8	0.5	0.8	0.9
2003	0.4	0.2	0.2	0.1	-0.2	-0.6	-0.4	-0.5	-0.2	-0.2	0.6	0.6
2004	0.7	0.4	-0.4	-0.4	-0.6	0.4	0.9	1.4	1.6	1.6	1.1	0.7
2005	-0.2	0.2	0.0	0.9	0.6	0.5	0.1	0.2	0.2	-0.2	-0.2	-0.1
2006	-0.1	-0.2	-0.3	-0.2	-0.2	0.1	0.3	0.1	0.0	0.1	0.4	0.7
2007	0.7	0.8	0.6	0.5	-0.1	-0.1	-0.6	-0.6	-0.6	-0.1	0.3	0.5
2008	0.3	0.1	-0.4	-0.1	0.1	0.2	-0.1	0.0	0.2	0.3	0.1	-0.4
2009	-1.1	-2.0	-1.3	-0.6	0.4	0.4	0.4	0.2	0.3	-0.2	-0.1	0.2
2010	0.8	1.1	0.5	0.8	0.9	0.9	0.5	-0.2	-0.1	0.1	0.5	0.5
2011	0.3	0.0	-0.1	-0.3	0.1	0.1	0.3	0.7	0.7	0.9	0.5	0.6
2012	0.3	0.3	0.2	0.5	0.1	0.5	0.6	0.5	0.2	-0.3	-0.3	-0.6
2013	-0.1	0.1	-0.4	-0.3	-0.4	0.6	0.1	0.3	-0.2	-0.2	-0.7	-0.7
2014	-0.4	-0.1	0.2	-0.1	0.5	0.9	1.2	0.8	0.5	0.2	0.0	-0.2
2015	-0.2	-0.3	-0.6	-0.1	0.5	1.4	1.6	1.3	0.4	-0.3	-0.5	0.3
2016	1.2	1.4	0.9	0.3	0.4	0.3	1.2	1.5	1.8	1.5	1.2	1.1
2017	0.7	0.8	1.6	1.8	2.0	1.1	0.9	0.7	1.1	1.4	1.3	0.9
2018	-0.1	0.1	0.3	0.9	0.8	0.6	0.7	0.5	0.6	0.6	1.2	1.1

INLAND AREAS 3 MONTHLY LONG TERM MEAN MAXIMUM SURFACE-AIR TEMPERATURE ANOMALLY

YEAR	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1975	-0.5	-0.3	-0.5	-0.7	-0.4	-0.6	-0.9	-1.9	-1.8	-1.9	-1.1	-1.2
1976	-1.2	-1.6	-1.6	-1.8	-2.0	-1.8	-1.4	-1.2	-0.9	-1.6	-2.0	-1.5
1977	-0.6	-0.3	-0.6	-0.8	-0.7	-0.4	-0.1	-0.4	-0.6	-0.7	-0.3	0.2
1978	0.3	0.0	-0.6	-1.0	-1.4	-1.7	-1.7	-1.6	-1.3	-2.1	-2.1	-1.8
1979	-0.8	-0.8	-1.0	-1.5	-1.6	-1.3	-0.8	0.0	-0.4	-0.5	-0.8	-0.2
1980	-0.8	-0.5	-0.8	0.1	-0.2	0.1	-0.4	-0.3	-0.2	0.0	-0.5	-1.2
1981	-1.3	-1.0	-0.9	-1.3	-1.0	-1.2	-1.0	-1.2	-1.1	-1.0	-0.8	-0.5
1982	-0.5	-1.1	-1.7	-1.7	-1.4	-1.0	-1.1	-0.9	-1.0	-0.7	-1.3	-0.8
1983	-0.7	-0.1	-0.8	-1.3	-1.4	-1.3	-0.8	-0.4	0.0	0.3	0.0	-0.2
1984	-0.8	-1.0	-1.1	-1.3	-1.5	-1.4	-0.8	-0.6	-0.4	-0.6	-0.6	-0.8
1985	-0.8	-0.9	-1.0	-1.2	-0.7	-0.2	-0.3	-0.9	-0.8	-0.7	-0.8	-1.5
1986	-1.6	-1.4	-1.1	-1.5	-0.9	-0.5	-0.3	-0.9	-1.0	-1.4	-1.4	-1.2
1987	-0.7	-0.4	-0.5	-0.8	-0.9	-0.7	-0.1	0.1	0.0	0.2	0.4	0.0
1988	-0.7	-0.8	-0.3	-0.1	-0.6	-1.0	-1.2	-0.9	-0.4	-0.1	-0.2	-0.2
1989	0.0	0.1	-0.1	-0.2	-0.6	-0.8	-1.1	-0.3	-0.2	0.2	0.1	-0.2
1990	0.1	0.1	0.6	0.6	1.0	0.9	1.2	1.2	1.2	0.9	0.5	0.8
1991	0.2	0.0	-0.3	-0.1	0.3	0.6	0.8	0.3	-0.2	-0.5	-0.3	0.0
1992	-0.3	-0.8	-0.9	-1.1	-0.9	-0.9	-0.1	-0.1	0.3	-0.3	0.1	-0.4
1993	-0.2	-0.5	-0.2	0.3	0.6	0.6	0.4	0.4	0.7	0.7	0.7	0.0
1994	0.2	0.0	0.3	0.3	0.1	0.2	-0.5	-0.5	-0.8	-0.6	-0.7	-0.5
1995	-0.2	-0.2	-0.3	0.0	0.6	0.9	0.7	0.8	1.1	1.5	0.5	0.6
1996	0.6	0.9	0.4	0.4	1.0	1.5	1.5	1.4	0.9	0.4	0.1	0.4
1997	1.0	0.4	-0.1	-0.7	-0.4	0.2	1.4	2.0	1.7	1.2	1.0	1.3
1998	1.8	1.8	2.1	1.9	2.0	1.6	1.3	0.7	0.7	0.6	0.6	-0.1
1999	-0.6	-0.2	0.0	0.6	0.5	0.2	-0.3	-0.4	-0.7	-0.4	-0.3	0.5
2000	0.3	0.6	0.5	0.8	0.6	0.4	0.2	0.3	0.0	-0.1	-0.2	0.7
2001	1.1	1.1	0.5	0.7	0.4	0.3	0.2	0.3	0.7	0.4	0.9	0.5
2002	0.8	0.5	0.4	0.5	0.4	1.2	1.3	1.5	0.8	0.6	0.7	1.0
2003	0.8	0.9	0.9	0.8	0.3	-0.2	-0.5	-0.6	-0.6	-0.5	-0.2	0.0
2004	0.2	0.2	0.4	0.4	0.1	-0.3	-0.3	0.2	0.7	0.6	0.7	0.3
2005	0.2	0.4	0.9	0.8	0.6	0.2	0.5	0.1	0.1	0.1	0.5	0.3
2006	-0.1	-0.2	0.1	0.3	-0.1	0.3	0.6	0.5	0.2	0.2	0.6	0.9
2007	0.9	0.9	0.9	0.9	1.0	0.8	0.1	0.0	0.0	0.6	0.6	0.6
2008	0.8	1.0	1.2	0.9	0.5	0.3	0.0	0.3	-0.1	0.4	0.4	0.3
2009	0.0	-0.3	0.3	0.5	0.5	0.4	0.2	0.2	0.2	0.1	0.5	0.9
2010	1.4	1.8	1.4	1.1	0.6	0.2	0.2	0.1	0.2	0.3	0.7	0.8
2011	0.4	0.2	0.5	0.9	0.6	0.8	1.0	1.1	1.0	0.8	0.8	0.6
2012	0.0	-0.2	-0.3	-0.2	0.1	0.2	0.3	0.2	0.4	0.6	0.5	0.3
2013	0.6	1.3	1.4	1.0	0.3	0.2	-0.3	-0.2	-0.5	-0.2	-0.5	0.0
2014	0.0	0.2	0.2	0.3	0.4	0.7	0.7	0.3	-0.3	-0.3	0.0	0.1
2015	0.2	-0.2	-0.2	-0.2	0.5	0.4	0.3	-0.4	-0.6	-0.8	-0.9	-0.4
2016	-0.2	0.3	0.3	0.6	0.8	0.6	0.4	0.1	0.7	0.9	0.8	0.3
2017	0.1	0.6	0.7	0.8	0.8	0.7	0.8	1.1	2.1	2.3	1.2	0.2
2018	-0.7	-0.2	-0.1	0.7	0.6	0.4	0.0	-0.3	-0.1	0.2	0.6	0.8

NEAR COASTAL 3 MONTHLY STANDARDIZED MEAN MAXIMUM SURFACE-AIR TEMPERATURE ANOMALLY

YEAR	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1975	0.0	-0.4	-0.2	-1.0	-0.8	-1.8	-1.9	-3.3	-3.4	-3.1	-1.9	-1.5
1976	-1.5	-1.4	-1.5	-1.8	-2.4	-2.5	-2.6	-2.4	-2.6	-2.3	-2.5	-1.7
1977	-0.9	0.3	0.4	-0.5	-1.1	-1.6	-1.7	-2.2	-2.3	-1.6	-0.9	-0.5
1978	-0.7	-0.6	-1.1	-1.0	-1.9	-2.2	-2.6	-2.3	-2.0	-2.2	-2.3	-2.4
1979	-1.4	-1.0	0.0	-0.2	-0.5	-1.4	-1.8	-1.3	-1.5	-1.5	-1.1	-0.8
1980	-0.6	-1.1	-0.7	-1.0	-1.4	-1.8	-1.5	-0.8	-0.2	-0.4	-1.0	-1.2
1981	-1.3	-0.5	-0.6	-0.4	-0.5	-0.6	-0.6	-0.6	-0.5	-0.5	-0.3	0.0
1982	-0.3	-0.6	-1.0	-0.8	-0.8	-0.3	-0.2	0.1	-0.6	-0.6	-1.6	-0.9
1983	-0.5	0.5	-0.3	-0.6	-0.8	0.1	0.6	0.7	0.6	0.8	0.9	0.8
1984	0.6	-0.5	-1.2	-1.6	-1.1	-0.9	-0.5	-0.6	-0.1	-0.2	-0.1	-0.9
1985	-1.0	-1.0	-0.4	-1.2	-1.8	-2.0	-1.5	-1.5	-1.3	-1.0	-1.1	-1.5
1986	-1.7	-0.8	-0.2	-0.1	-0.5	-0.8	-1.3	-1.4	-1.5	-1.5	-1.4	-1.1
1987	-0.6	0.0	0.6	0.6	0.4	0.7	1.0	1.0	-0.1	-0.4	-0.5	-0.5
1988	-0.8	-0.6	0.2	0.5	-0.1	-0.6	-0.9	-0.8	-0.8	-0.9	-1.2	-1.2
1989	-0.8	-0.7	-0.5	-0.5	-0.5	-1.1	-1.4	-1.3	-1.3	-1.2	-1.1	-1.0
1990	-0.1	0.2	0.8	0.8	0.9	0.9	0.3	0.8	0.6	0.6	0.0	-0.2
1991	-0.3	-0.2	0.3	0.0	0.3	-0.1	0.3	0.2	0.4	0.7	0.5	0.4
1992	-0.2	0.0	0.3	0.5	-0.1	-0.8	-0.7	-0.7	-0.2	-0.3	-0.1	-0.3
1993	-0.3	-0.6	-0.6	-0.4	0.2	0.7	1.0	0.8	0.8	0.0	-0.3	-0.8
1994	-0.1	0.3	0.6	0.4	0.5	0.6	0.1	-0.5	-0.7	0.0	0.2	0.6
1995	0.7	0.3	0.0	-0.3	0.5	1.0	1.2	1.1	1.2	1.4	0.8	0.8
1996	0.6	0.8	0.6	1.1	1.7	1.5	1.2	0.8	0.9	0.8	0.9	0.8
1997	1.4	1.1	0.7	0.4	0.4	0.9	0.7	1.1	1.4	1.7	1.4	0.9
1998	1.0	1.2	1.4	1.1	1.1	0.6	0.4	0.0	0.6	1.0	0.9	0.1
1999	-0.3	-0.4	0.0	0.0	0.3	0.0	-0.6	-0.7	-0.9	-0.2	-0.2	0.2
2000	0.1	0.5	0.4	-0.2	-0.9	-1.3	-0.8	-0.5	-0.5	-0.6	-0.6	0.5
2001	1.0	1.1	0.8	0.6	0.3	-0.2	-0.2	0.1	0.5	0.1	0.4	0.1
2002	0.4	-0.1	0.0	-0.2	-0.2	0.3	0.9	1.2	0.9	0.5	0.8	0.9
2003	0.4	0.1	0.2	0.1	-0.3	-0.8	-0.7	-0.8	-0.4	-0.4	0.6	0.6
2004	0.7	0.3	-0.6	-0.6	-0.8	0.4	1.0	1.8	1.9	1.9	1.1	0.6
2005	-0.3	0.1	0.0	0.8	0.6	0.3	0.0	0.1	0.1	-0.3	-0.3	-0.2
2006	-0.2	-0.2	-0.4	-0.3	-0.3	0.0	0.3	0.0	-0.2	0.0	0.3	0.5
2007	0.6	0.7	0.6	0.4	-0.3	-0.4	-0.9	-1.0	-0.9	-0.3	0.2	0.4
2008	0.2	0.0	-0.5	-0.2	0.0	0.0	-0.3	-0.1	0.1	0.2	-0.1	-0.5
2009	-1.2	-2.0	-1.3	-0.6	0.5	0.3	0.3	0.1	0.2	-0.2	-0.1	0.1
2010	0.7	1.0	0.5	0.7	1.0	0.9	0.5	-0.4	-0.3	-0.1	0.3	0.4
2011	0.2	-0.1	0.0	-0.3	0.1	0.1	0.3	0.8	0.9	1.0	0.5	0.5
2012	0.2	0.3	0.2	0.5	0.1	0.5	0.6	0.5	0.1	-0.5	-0.4	-0.8
2013	-0.3	0.0	-0.6	-0.5	-0.6	0.6	0.1	0.3	-0.3	-0.3	-0.9	-0.9
2014	-0.6	-0.2	0.2	-0.1	0.6	1.1	1.5	1.0	0.5	0.2	-0.1	-0.4
2015	-0.4	-0.4	-0.6	-0.2	0.6	1.7	1.9	1.5	0.4	-0.4	-0.7	0.1
2016	1.0	1.3	1.0	0.3	0.4	0.4	1.4	1.8	2.2	1.7	1.3	1.0
2017	0.7	0.7	1.9	2.1	2.4	1.2	1.1	0.8	1.4	1.6	1.5	0.8
2018	-0.1	0.0	0.5	1.0	0.9	0.7	0.8	0.6	0.7	0.6	1.3	1.1

INLAND AREAS 3 MONTHLY STANDARDIZED MEAN MAXIMUM SURFACE-AIR TEMPERATURE ANOMALLY

YEAR	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1975	-0.3	-0.5	-0.7	-0.4	-0.7	-1.5	-2.6	-2.6	-2.3	-1.5	-1.4	-1.0
1976	-1.5	-1.7	-1.8	-2.0	-1.9	-2.1	-1.8	-1.7	-2.0	-2.3	-1.7	-1.1
1977	-0.3	-0.6	-0.8	-0.7	-0.5	-0.7	-1.0	-1.3	-0.9	-0.5	0.1	0.1
1978	-0.1	-0.7	-1.0	-1.5	-1.9	-2.4	-2.2	-2.0	-2.5	-2.5	-2.1	-1.2
1979	-0.8	-1.1	-1.4	-1.6	-1.3	-1.4	-0.5	-1.0	-0.7	-1.1	-0.3	-0.1
1980	-0.6	-0.8	0.1	-0.2	0.1	-0.9	-0.8	-0.6	0.0	-0.5	-1.3	-1.4
1981	-1.0	-1.0	-1.3	-1.0	-1.2	-1.6	-1.7	-1.8	-1.2	-1.1	-0.7	-0.1
1982	-1.2	-1.8	-1.7	-1.5	-1.0	-1.7	-1.5	-1.7	-1.0	-1.5	-1.0	-1.0
1983	-0.1	-0.8	-1.3	-1.5	-1.3	-1.4	-1.0	-0.5	0.4	0.0	-0.2	-0.7
1984	-1.0	-0.8	-0.8	-1.1	-1.5	-1.5	-1.2	-1.1	-0.8	-0.7	-0.9	-1.2
1985	-0.9	-1.1	-1.2	-0.8	-0.3	-0.9	-1.5	-1.5	-0.8	-0.9	-1.5	-2.1
1986	-1.4	-1.2	-1.5	-0.9	-0.5	-0.9	-1.5	-1.7	-1.8	-1.7	-1.4	-0.8
1987	-0.5	-0.6	-0.7	-0.9	-0.7	-0.7	-0.4	-0.6	0.2	0.4	0.0	-0.5
1988	-0.8	-0.4	-0.1	-0.6	-1.1	-1.8	-1.5	-0.9	-0.2	-0.3	-0.3	-0.3
1989	0.0	-0.1	-0.2	-0.6	-0.9	-1.7	-0.9	-0.7	0.2	0.0	-0.2	-0.4
1990	0.1	0.6	0.6	1.0	0.9	0.6	0.7	0.7	1.0	0.5	0.7	0.6
1991	-0.1	-0.3	-0.1	0.3	0.6	0.3	-0.2	-0.9	-0.6	-0.5	-0.1	-0.1
1992	-0.9	-0.9	-1.1	-0.9	-0.9	-0.8	-0.7	-0.2	-0.4	0.0	-0.5	-0.1
1993	-0.5	-0.2	0.3	0.5	0.6	-0.2	-0.2	0.2	0.8	0.7	0.0	-0.1
1994	0.0	0.3	0.3	0.1	0.1	-1.0	-1.1	-1.4	-0.8	-0.9	-0.7	-0.4
1995	-0.2	-0.4	0.0	0.6	0.9	0.1	0.3	0.8	1.7	0.6	0.5	0.1
1996	0.8	0.4	0.3	1.0	1.5	1.0	0.9	0.4	0.4	0.0	0.2	0.8
1997	0.4	-0.1	-0.7	-0.4	0.2	0.8	1.5	1.2	1.4	1.1	1.2	1.1
1998	1.8	2.2	1.9	2.0	1.6	0.8	0.1	0.2	0.7	0.7	-0.1	-0.6
1999	-0.2	0.0	0.6	0.4	0.2	-0.9	-1.0	-1.3	-0.6	-0.5	0.4	0.5
2000	0.6	0.4	0.8	0.5	0.4	-0.4	-0.2	-0.5	-0.3	-0.4	0.4	1.2
2001	1.0	0.5	0.6	0.3	0.2	-0.4	-0.3	0.2	0.5	0.8	0.4	0.7
2002	0.5	0.4	0.4	0.3	1.2	0.8	1.0	0.2	0.6	0.7	0.9	0.8
2003	0.8	0.9	0.8	0.3	-0.3	-1.1	-1.2	-1.2	-0.6	-0.4	-0.1	0.0
2004	0.1	0.3	0.4	0.0	-0.4	-0.9	-0.4	0.2	0.6	0.7	0.2	0.3
2005	0.3	0.9	0.9	0.6	0.2	0.0	-0.4	-0.5	0.1	0.5	0.2	0.0
2006	-0.2	0.1	0.3	-0.1	0.3	0.0	-0.1	-0.4	0.2	0.6	0.8	0.7
2007	0.9	0.9	0.9	0.9	0.7	-0.5	-0.5	-0.4	0.7	0.6	0.5	0.4
2008	0.9	1.2	0.8	0.5	0.3	-0.6	-0.2	-0.6	0.4	0.3	0.3	-0.1
2009	-0.3	0.3	0.5	0.5	0.4	-0.3	-0.4	-0.2	0.2	0.4	0.7	1.2
2010	1.7	1.4	1.1	0.6	0.2	-0.4	-0.4	-0.4	0.3	0.7	0.8	0.8
2011	0.2	0.4	0.9	0.6	0.8	0.4	0.6	0.5	1.0	0.9	0.6	0.4
2012	-0.2	-0.4	-0.1	0.1	0.2	-0.2	-0.3	-0.1	0.7	0.5	0.2	0.0
2013	1.3	1.5	1.0	0.3	0.2	-0.8	-0.7	-1.0	-0.4	-0.7	-0.1	0.1
2014	0.1	0.2	0.3	0.4	0.7	0.2	-0.2	-0.9	-0.4	-0.1	0.0	0.1
2015	-0.2	-0.2	-0.2	0.5	0.4	-0.2	-1.0	-1.3	-1.0	-1.1	-0.5	-0.3
2016	0.3	0.2	0.5	0.8	0.6	-0.2	-0.4	0.4	1.1	0.9	0.2	-0.1
2017	0.5	0.7	0.8	0.8	0.7	0.2	0.7	1.9	2.7	1.5	0.2	-0.3
2018	-0.3	-0.1	0.7	0.5	0.3	-0.6	-0.9	-0.7	0.2	0.6	0.6	0.8

6.0 CONCLUSION:

The Gambia's Climate particularly with regards to seasonal rainfall has an established teleconnection (linkage) related to the El-Nino Southern Oscillation (ENSO), coupled with the localised dipole between the Northern-Tropical East Atlantic Ocean (Off-shore the coast of Mauritania/ northern Senegal) and Equatorial East Atlantic Ocean (Gulf of Guinea). Evidence has proven that there is a high skill with reasonable climate predictability especially during spring onwards the summer months that rainfall tends to be above, below or near normal depending on the cooling or warming state of these Sea Surfaces.

A major challenge faced by DWR is the prediction on the probability of extreme climate events with significant socioeconomic and ecological consequences. However, due to lack of capacity such as expertise and technologies including high-resolution Sub-regional/ National Climate Models; inability to produce reliable and effective predictions within the timescales ranging from Medium, sub-seasonal to seasonal range cannot be regularly made available. Capability to downscale Global Climate Models with its associated limitations and uncertainties is quite difficult to quantified in order to aid the public, stakeholders, policy- and decision makers make relevant planning and take actions to develop and apply appropriate response strategies to mitigate the harmful impacts or to harness the potential benefits that may arise..

For further references, please access the websites on the cover page…

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