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Impact of Lockdown due to outbreak of COVID on future climate simulations over West Africa: Preliminary Result from MRI-ESM2.0 Model

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Abstracts

The outbreak of Coronavirus disease (COVID 19) necessitated global lockdown to curtail its spread for the greater part of year 2020. These lockdowns led to shutting down of human activities and ultimately led to reduction in greenhouse gas emission during the period. The study seeks to assess the impact of this reduction on the climate of West Africa. A global Climate Model, MRI-ESM2.0, participating in the CovidMIP experiment is used in this assessment. The model was run at normal SSP245 scenario and SSP245-COVID scenario, the latter is when GHG reduced due to Covid lockdown, which is regarded as a forcing in the model. **The difference between SSP245-COVID scenario and simulations at SSP245 scenario was used to quantify the impact of lockdown. Result shows that there is a reduction in 2 m, maximum and minimum temperature in the Sahelian part of West Africa up to anomaly of 0.5°C. There is however warming anomaly in the Guinea coast.** Rainfall anomalies up to -70 mm/month anomaly is simulated in most part of Nigeria and along the coastal areas of Benin, Togo, Ghana and Cote-D'ivoire. The slowing down of warming is however not statistically significant as the lockdown is not sustained enough to have appreciable impact on on-going warming trend.

Keywords: COVID, CovidMIP, Rainfall, Temperature, West Africa, Lockdown, MRI-ESM2.0

1.0 Introduction

The Coronavirus disease (COVID-19) was first discovered in Wuhan, China in December 2019. It is an infectious disease caused by the SARS-CoV-2 virus. The World Health Organization (WHO) declared the outbreak a

Public Health Emergency of International Concern on 30th January 2020, and a pandemic on 11th March 2020 after it was discovered it has spread worldwide, causing thousands of deaths. Many National governments including governments in the West African sub-region implemented a nationwide lockdown in order to control the rapid spread of the disease. COVID19 being a highly infectious disease, lockdown is globally considered and recommended as an important non-pharmaceutical measure to break its cycle of transmission. This greatly reduced economic activities, which consequently reduced greenhouse gases and air pollutants (Quere *et al*. 2020). Lockdown by heavy industrialized countries such as United States, United Kingdom, Canada, China, Japan, Germany France, Italy, Spain etc. led to shutting down of heavy industries, which in turn resulted in drastic reduction in global emission of GHGs, such as NO_2, $PM_{2.5}$, PM_{10} and CO (Quere *et al.* 2020 and Frieddlingstein *et al.* 2020).

Changes in greenhouse gases and aerosols have been identified as the drivers of climate change in the twentieth century (Kaufman *et al.* 2002), the increase in atmospheric constituents can induce positive or negative radiative forcings which can have climatic fast or slow response. Fast response is when the climate adjusts to changes in atmospheric GHG over a shorter time scale of days to months without ocean mediation while climate adjustment due to the change in Sea Surface Temperature (SST) on a longer time scale of years to decades is regarded as the slow response. Covid 19 lockdown has been identified to reduce GHG and aerosols across the world (Ratman *et al.* 2020, Sharma *et al.* 2020, Field *et al.* 2020). Liu et al (2020) in studies of the impacts of COVID19 on emission of CO_2 reported decrease of about 1.9% in the United States in February 2020, 8.4% reduction in Europe at the onset of the outbreak. He further reported reduction up to about 25.6, 25, 27, 26.6 and 6.7% in the United States, Europe, India, Brazil and Japan respectively at the peak of the first-wave of the infection in April 2020. Carbon dioxide (CO_2) have longer lifetime in the atmosphere, this means that the impact of the changes in emissions of CO_2 is likely to be long-lived, and also exert considerable climate impact on decadal timescales (Forster *et al,* 2020). In a similar study, Goldberg *et al.* (2020) and Zhao *et al*. (2020), reported that nitrogen dioxide (NO_2), at both national and city-scales have decreased on the order of 20–60% in China, India, Europe, and the United States. The drastic changes in NO_2 are reported by Venter *et al*. (2020) as a consequence of lockdown in the transportation sector. There have been various reports of changes in emission of other GHGs and Particulate Matters in China, Spain, USA, Italy and India as reported by Field *et al.* (2020), Pei *et al.* (2020), Chauhan and Singh (2020).

The impact of the lockdown has been established to have considerable impact on emission in the atmosphere, in the same vein, it is expected to also impact climate at a short time scale (Yang *et al.* 2020, Forster *et al*. 2020). Jones *et al*. (2021) summarized that reduction in emissions is expected to have regional impacts on atmospheric composition, and therefore could have implications for weather and climate. Expected global climate response due to the restrictions is expected to be probably non-significant at global level, but a considerable response at regional climate scale. Changes in aerosol loading in the atmosphere may contribute changes in extreme events at a very short time scale. This paper is a preliminary study to identify changes in climate signature occasioned by the lockdowns using a global model, to ascertain if lockdown of similar magnitude can be used to decelerate impact of climate change in the nearest future.

2.0 Materials and Methods

2.1 Study area

The study was conducted in the West African sub-region which lies in areas between longitude 20°W and 20°E and latitude 0° and 20°N. The area is bounded in the south by the Gulf of Guinea (GoG), In the north by Mauritania, Mali and Niger. Its eastern and western limits are Mount Cameroun and the Atlantic Ocean, respectively (Figure 1).

To compare changes in different eco-climatic zones, the West Africa domain considered is divided into three climatic zones, these zones are, Guinea Coast (4°–8°N), Savannah (8°–11°N) and Sahel (11°–16°N) (Omotosho and Abiodun 2007; Ajayi and Ilori 2020). The Guinea Coast is characterized by sub-humid climate with an average annual rainfall range between 1250 and 1500 mm; the southern boundary is the Atlantic Ocean. The Savannah region is a semi-arid zone with an average annual rainfall between 750 and 1250 mm. The Sahel zone is characterized by aridity with little or no rainfall. It covers the areas north of Nigeria, Mali and Niger and has a single rainfall peak with a very short rainy season (June–September). The annual rainfall is less than 750 mm. Topography also plays important roles in the variability of climate of the sub-region. Important highlands in the sub-region are Fouta Djallon, Jos Plateau and the Cameroon Highlands

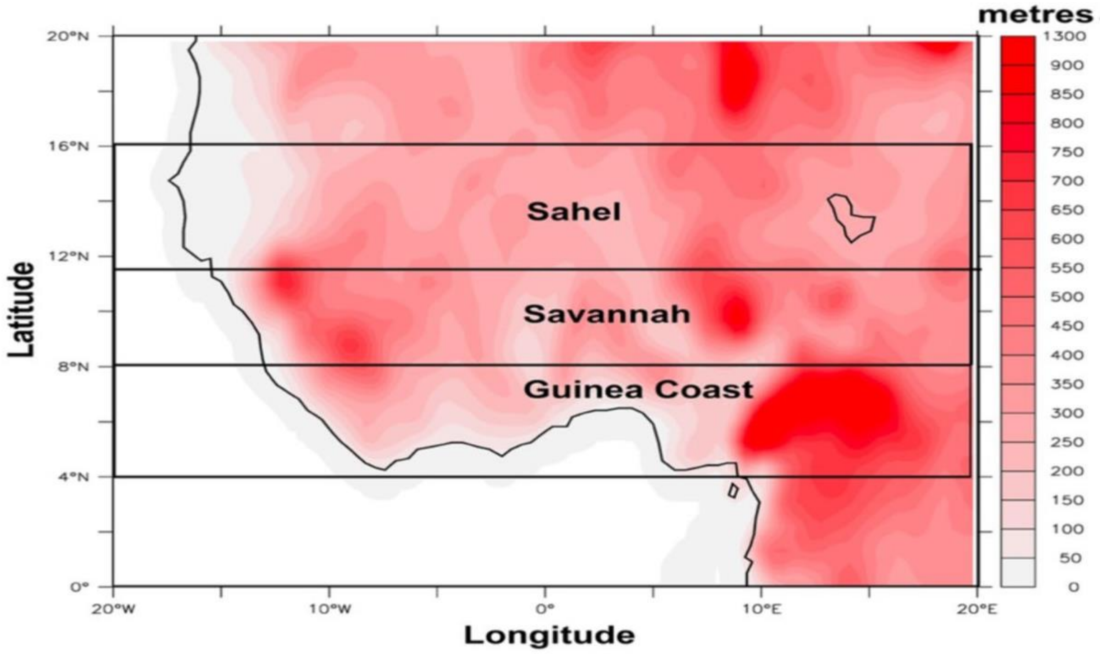

Figure 1: Map of West Africa map showing broad eco-climatic zones and elevation in meters (after Ajayi and Ilori. 2020)

2.2 Data and Methodology

The data used for this study is obtained from the CovidMIP simulations released under the Detection and Attribution Model Intercomparison Project (DAMIP) Gillett *et al.* (2016). CovidMIP is created to enable analysis of the effect of reduced emissions on the climate; the COVID-19 emission scenarios (CovidMIP) was run for 2020 to 2050 to account for both short-term and long-term impact. All CovidMIP scenarios are based on the SSP245 scenario as a baseline against which to apply the emissions reductions. Simulations with COVID lockdown were run from SSP245 from 1st January 2020 and following the new forcing in line with emissions reductions. The CovidMIP protocol is open to all international institutions participating in CMIP6, at present several models are participating in CovidMIP and their data is available for analysis. The models are E3SM, ACCESS-ESM1-5, CanESM5, CESM2, EC-Earth3, GISS-E2-1-G, MIROC-ES2L, MPI-ESM1-2-LR, MRI-ESM2-0 NorESM2-LM, and UKESM1-0-LL. More on the protocol for CovidMIP can be found in Lamboll et al (2020)

The current study, which is a preliminary assessment employed one model from the DAMIP repository, dataset from MRI-ESM2.0 (Yukimoto *et al*. 2019) for 2 m temperature, maximum and minimum temperature and precipitation was downloaded from the DAMIP holding hosted by the *Earth.System Grid Federation* (*ESGF*) website (https://esgf-node.llnl.gov/search/cmip6/) for **SSP245-Covid (using the emission occasion by the**

Covid lockdown) and SSP245 (CMIP6 , no Covid scenario).

The SSP245 without Covid lockdown is the control experiment hereafter referred to as SSP245, while the lockdown scenario is hereafter referred to as SSP245-Covid. The difference between SSP245-Covid and simulations at SSP245 scenario was used to quantify the impact of lockdown on climate in the study area (SSP245 minus SSP245-Covid). The impact is divided into near-time anomaly (2020-2024) and long-time anomaly (2020-2050). Changes in the trend is also analyzed for short- (2020-2030**) and long-term impact (**2020-2050**). Changes to trends of inter-annual variability of precipitation and temperatures (2 m, maximum and minimum) is assessed for the three contiguous ecological zones based on Omotosho and Abiodun (**2007**), Ajayi and Ilori (2020) classification (figure 1) namely Guinea coast (4–8 ° N), Savannah (8–11 ° N), and Sahel (11–14 ° N).**

The statistical significance of projected impact was calculated using Mann-Kendall trend analysis. Man-Kendall test is used to test the significance of trends. It is a test for monotonic trends in a time series based on the Kendall rank correlation of the series and time (Mann 1945; Kendall 1975). The p-value derived from the test is used to determine if the trends in the scenarios are significant, it is considered significant if the p-value is ≤ 0.05, and insignificant if otherwise.

3.0 Result and Discussion

3.1 Near-Time Temperature Anomaly

The impact of the lockdown in 2020 is assessed for impacts on temperature of the period between 2020 and 2024. This to ascertained if reduction in GHGs in the year 2020 can have a considerable or significant impact of temperature distribution over West Africa in the near time.

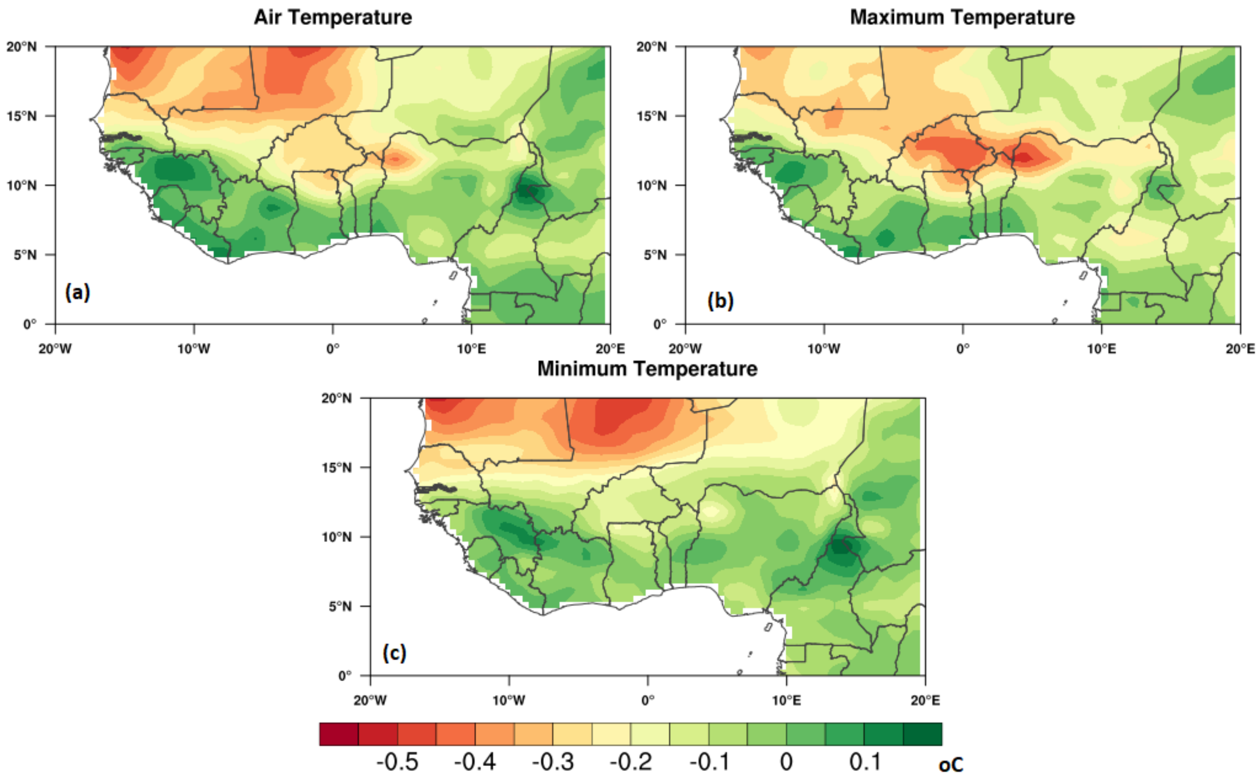

Figure 2: Anomaly between SSP245 and SSP245-COVID Scenario for near-time between 2020-2024 for (a) Air temperature (b) Maximum temperature (c) Minimum temperature.

Figure 2a shows the simulated differences in 2 m air temperature in SSP245-Covid (With Covid19 lockdown taken into account) and SSP245 (If Covid19 lockdown never occurred), the result shows that lockdown induced cooling of up to 0.5°C is found in some areas in the northern part of West Africa and warming in the southern part especially along the coast. Average annual temperature anomalies between ~-0.5°C to ~-0.3°C is found in most parts of Mauritania, Senegal, Mali Burkina-Faso and the Northwestern Tip of Nigeria. There was however warming of about ~0.1°C in the coastal nations of Sierra-Leone, Liberia, Guinea, Cote-d'ivoire, while there is no appreciable temperature change in the southern part of Ghana, Togo and Benin Republic. In Nigeria however, there are cooling of up to 0.2°C around the Niger Delta region while insignificant warming is observed in Southwest Nigeria.

A Similar pattern of Figure 2a is observed in figure 2b, which is the changes in maximum temperature except that Covid lockdown induced cooling in maximum temperature occurs more around the Central Sahel. The cooling is maximum at about ~0.5°C in most parts of Burkina Faso and North-Western Nigeria. The cooling of about 0.3-0.4°C occurs in most parts of Mali and Mauritania. In the minimum temperature, there is a reduction in average annual temperature occasioned by Covid lockdown in parts of Mauritania and Northern Mali with a very strong signal of up to -0.5^{o}c in these areas. Weaker signals of temperature difference between -0.2^{o}C and -0.3^{o}C is projected in Senegal, Southern Mali, Burkina Faso and Niger Republic. There is however weak cooling and warming signal of about 0.1^{o}C in most of Sierra-Leone, Liberia, Cote-d'ivoire. Nigeria, Benin, Togo and Ghana.

3.2 Far-time Temperature Anomaly

The change in GHG in the atmosphere occasioned by lockdown in 2020 might have a longer-term impact as GHG lingers for longer time in the atmosphere (Figure 3). Figure 3a shows the anomaly between SSP245 and SSP245-Covid scenario between 2020-2050.

The 2 m, minimum and maximum temperatures shows same patterns with varying degree of signals. Figure 3a show that in 2 m temperature, there is a cooling due to the restriction in parts of the northwestern part of the sub-region while there is strong warming anomaly in the Chad, South Niger Republic and Northeastern Nigeria up to 0.2^{o}C. There is however varying degree of warming to the Southern part of West Africa along the Guinea coast. Maximum temperature anomaly presented same pattern with 2 m air temperature (figure 3b) with maximum cooling anomaly up to -0.3^{o}C in Mauritania, Senegal and Northern Mali.

There is also a similar pattern of warming in most parts of Chad and Northeastern Nigeria. There is varying degree of warming signal towards the south part of West Africa. Figure 3c shows that the night time temperature also reduced due to covid lockdown in Northwestern and extreme northern part of the sub-region with maximum cooling anomaly of up to 0.25^{o}C over Mauritania and Northern Mali. Areas to the Eastern part have a warming anomaly with maximum anomaly recorded in Chad, North-eastern Nigeria and Southern part of Niger Republic. There is also warming up to 0.1^{o}C in parts of Ghana, Liberia, Sierra-Leone and Guinea.

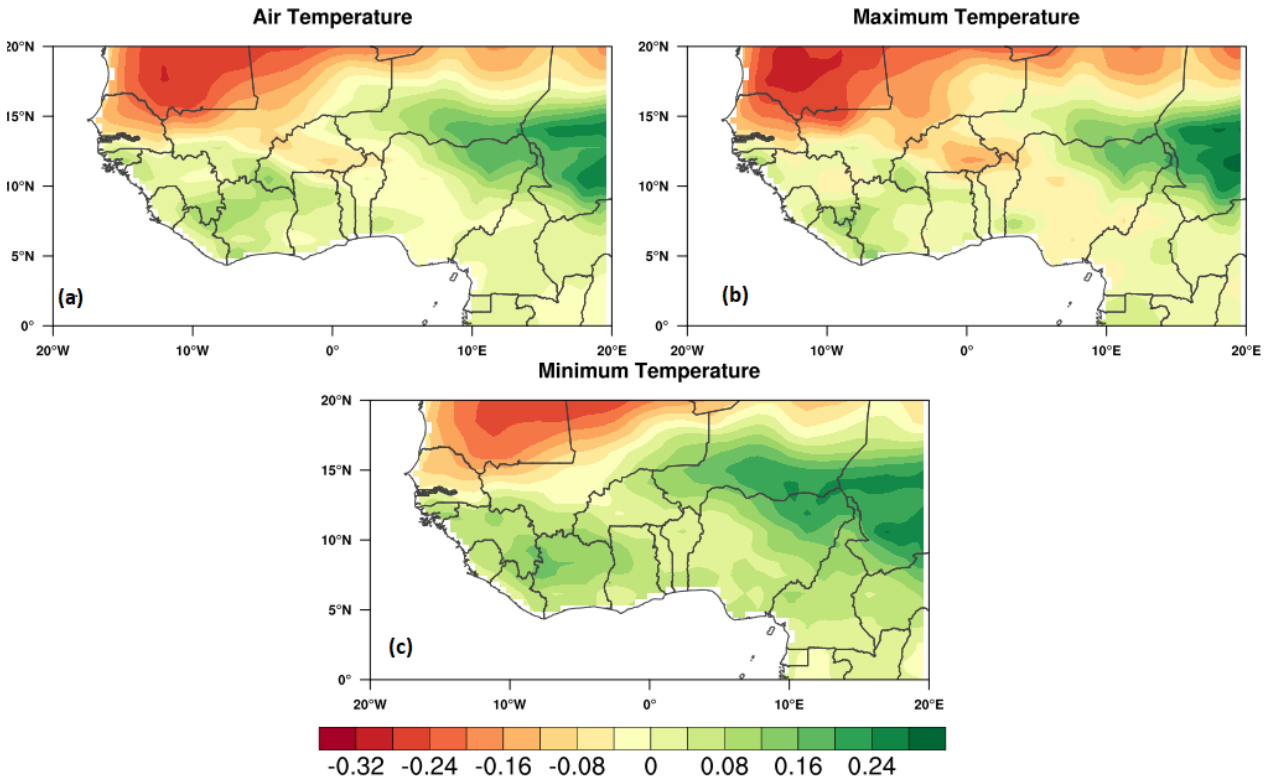

Figure 3: Anomaly between SSP245 and SSP245-COVID Scenario for far-time between 2020-2050 for (a) Air temperature (b) Maximum temperature (c) Minimum temperature.

3.2 Near Time Rainfall anomalies

The impact of the changes in GHGs in the atmosphere is also expected to have profound impact on rainfall of West Africa. West African rainfall, which is part of the monsoon, is a product of temperature gradient between the coast and the Saharan desert; any perturbation to the temperature field is expected to impact rainfall distribution (Ajayi, 2013). Figure 4 shows the near-time rainfall difference between Covid lockdown scenario and non-Covid scenario.

There is rainfall reduction in many parts of West Africa; this is in contrast with result of Yang *et al.* (2022) in which the lockdown increased summer rainfall in China. The rainfall difference is maximum in South and middle part of Nigeria up to -70 mm/month.

The signal of rainfall change is also strong in parts of coastal region of Benin, Togo Ghana and Cote-D'ivoire at about – 60 to -70 mm/month. There are also increment in rainfall in the Futa-Djallon area and most part of Guinea Republic up to about 150 mm/month. The signal of change in rainfall is relatively weaker than the change along the coast. In most part of savannah and Sahelian region, the rainfall change is in region of -25 to -50 mm/month. This shows that in the near-time, rainfall is expected to reduce more along the coast much more than in the Sahel.

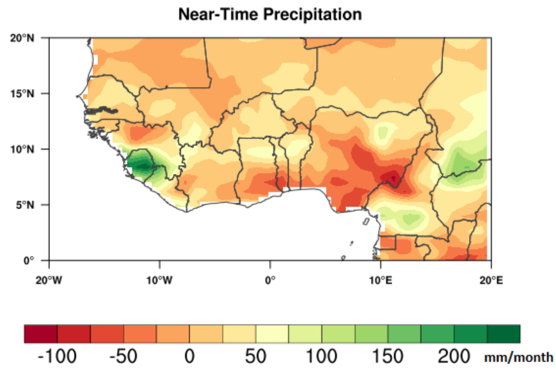

Figure 4: Rainfall anomaly between SSP245 and SSP245-COVID Scenario for Near future between 2020-2024

3.3 Far-Time precipitation anomaly

The impact of lockdown on rainfall in far-period shows very weak impact along the coast (figure 5), and relatively strong increment in the Northern belt. The figure shows that in areas around the Futa-djallon mountain, the rainfall reduces at about 50 mm/month when compared to non-covid scenario. In the areas around Southern Niger, Burkina-Faso and parts of Mauritania, rainfall increases by about 150 mm/month while the increment was also observed in the desert though with a weaker signal.

3.4 Impact on temperature trend

The section highlights how the lockdown had slowed down the on-going impact of climate change at short-time (2020-2030) and long-timescale (2020-2050). The trend of temperature is shown in figure 6-8. The trend of air temperature between time period 2020 and 2030 shows that maximum increment of air temperature is observed in the central Sahel (figure 6), the trend is about 0.07°C per year and about 0.04°C /year in most part of Nigeria, and along the Guinea coast. The trend in the no-covid scenario (figure 6) is however significant at 95% confidence level in most parts of the study domain. Comparing this to incidence of lockdown (figure 6b), the hitherto steep trend of 0.07°C/year in the SSP245 experiment in the Central Sahel reduced to about 0.04°C/year in Covid scenario (SSP245-covid) though not significant at 95% confidence level. There is however a significant increment in the trend (0.07-0.08°C/year) in most parts of Nigeria, Cameroun and Southern Chad. There was insignificant increment in trend from 0.04°C/year to 0.06°C/year along the Guinea Coast.

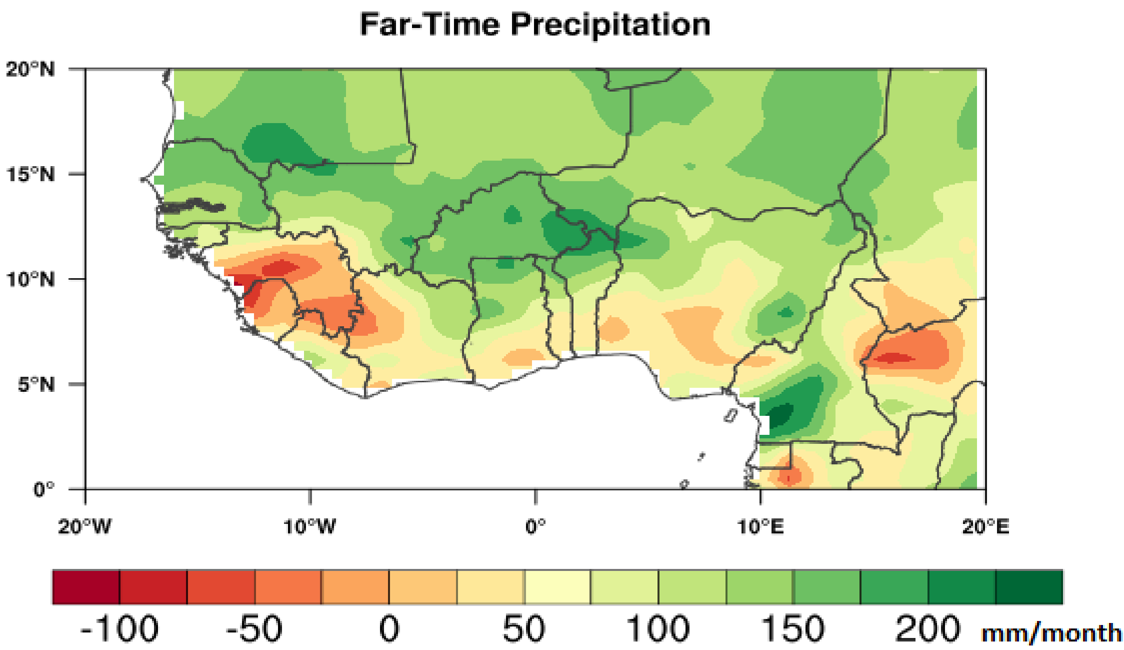

Figure 5: Rainfall anomaly between SSP245 and SSP245-COVID Scenario for far-time between 2020-2050.

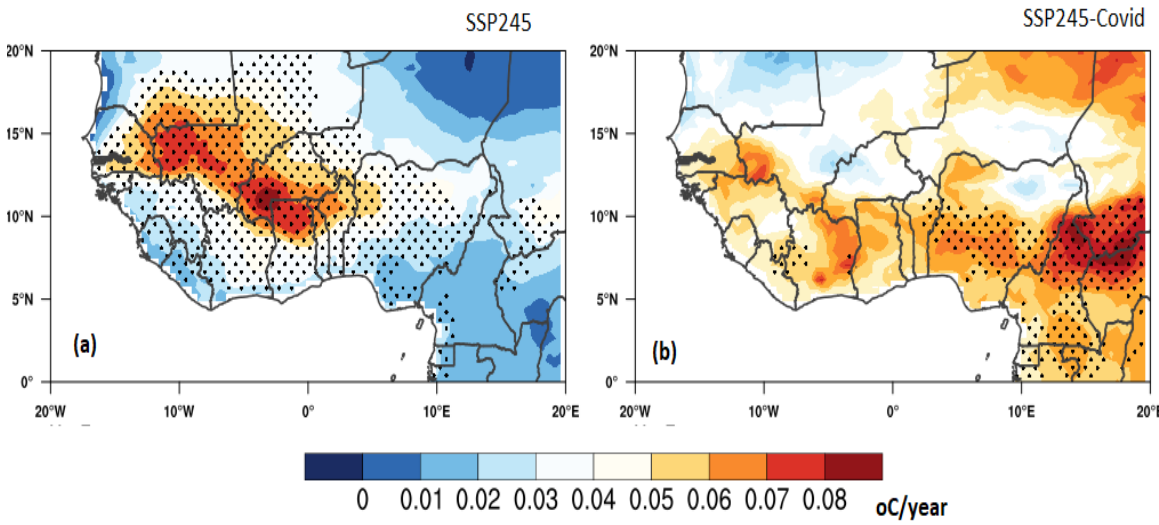

Figure 6: Trends in 2 m air temperature between 2020 and 2030 for (a) SSP245 scenario (b) SSP245-Covid scenario.

The maximum and minimum temperature also has the trend distribution like that of air temperature discussed above, Figure 7a shows that maximum temperature has a trend of about 0.07°C /year in Central Sahel and weak trend of 0.01°C/year in parts of Southern Nigeria, Cameroun, and along the Guinea

Coast. Other areas have trends ranging between 0.04-0.05°C/year.

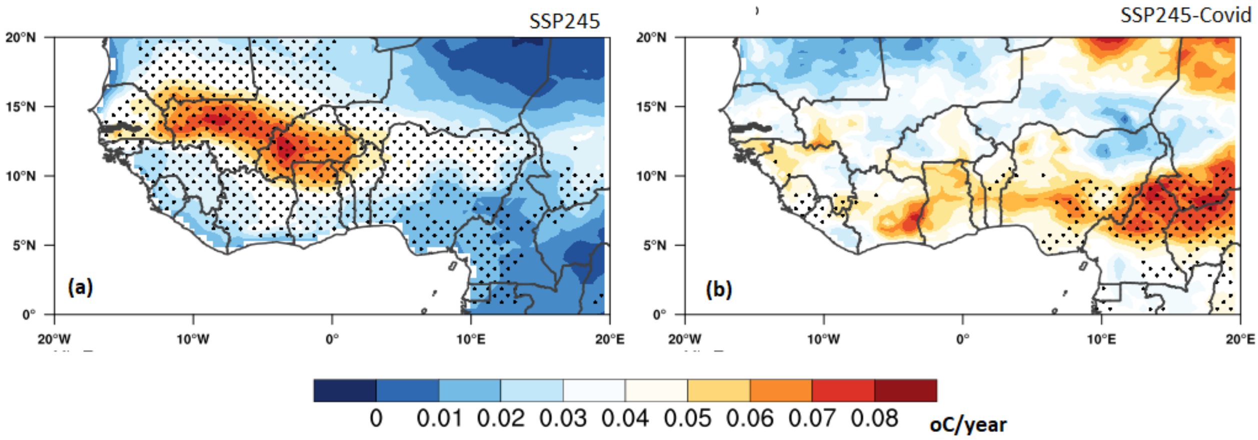

Figure 7: Trends in maximum temperature between 2020 and 2030 for (a) SSP245 scenario (b) SSP245-Covid scenario

In the SSP245-Covid scenario (figure 7b), the trend however reduces to about an insignificant 0.04-0.05°C/year in the central Sahel and stronger rate of warming (0.06-0.07°c/year) in Northern Cameroun and Southern Chad. There is also stronger rate of warming in covid scenario in Southern-Eastern part of Nigeria.

Figure 8a and 8b shows that night time temperature (Minimum temperature) will have increasing warming in the SSP245 (no-Covid-lockdown) scenario between 0.05°C/year – 0.08°C/year with maximum observed in Burkina Faso, South Mali and North Ghana.

While at SSP245-Covid scenario, the significant rate of warming over most of Nigeria and Cameroun ranges between 0.05°C /year and 0.08°C/year. While it is at about 0.05°C/year elsewhere along the Guinea Coast. The rate of warming is at 0.04°C/year in the Sahel and are not statistically significant at 95% confidence level.

The impacts of the lockdown on trend at a longer time scale (between 2020 - 2050) is shown in figure 9-11. Figure 9a shows the distribution of the trend of air temperature, with maximum rate of warming (0.05°C/year) in central Sahelian part of Burkina Faso and

Mali while the rate of warming of about 0.036°C/year is observed in Northern Nigeria, Niger Republic and Chad Republic. Trend at the Niger coast ranged between 0.028°C/year-0.036°C/year. The least rate of warming (at 0.02°C/year) of air temperature is simulated over Southern part of Nigeria and most parts of Cameroun.

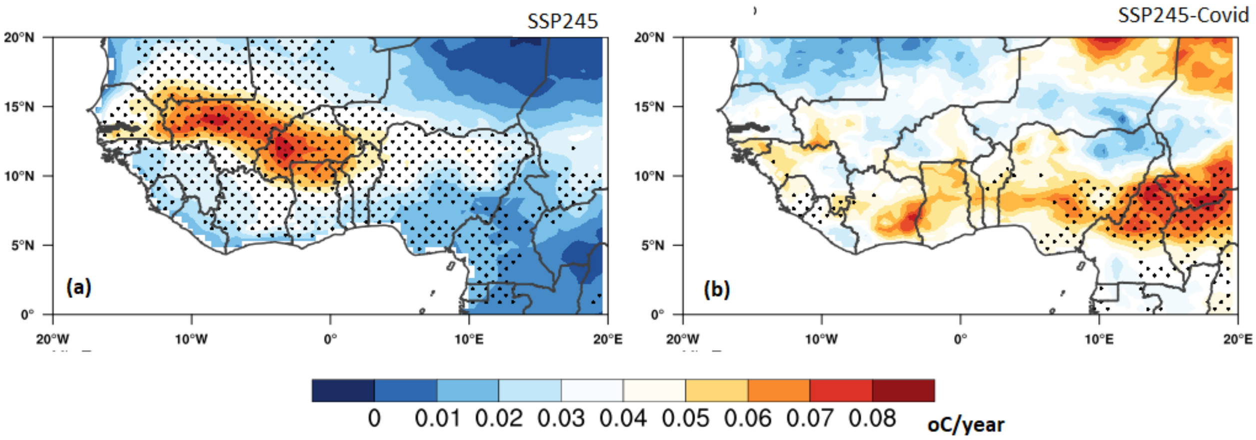

Figure 7: Trends in maximum temperature between 2020 and 2030 for (a) SSP245 scenario (b) SSP245-Covid scenario.

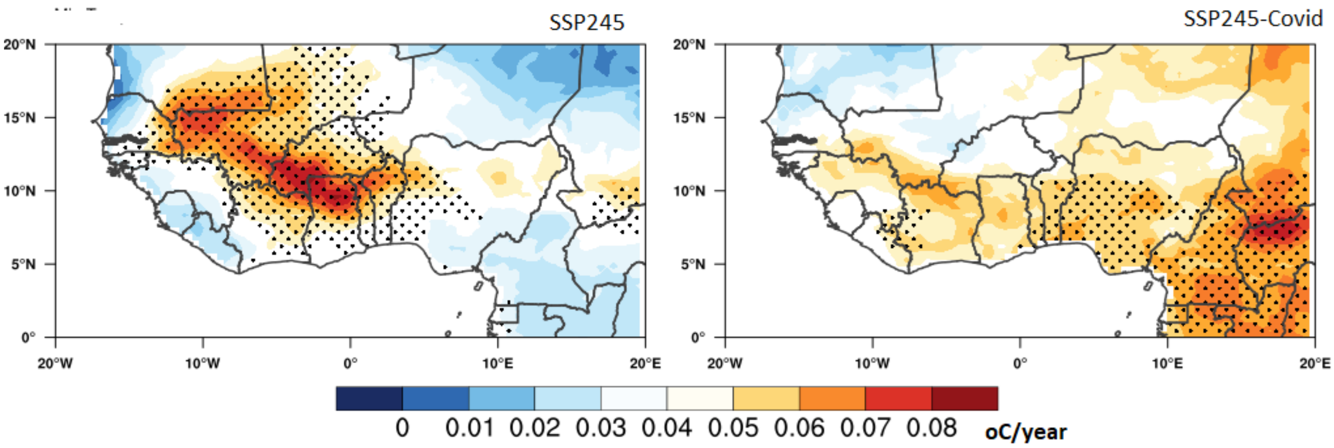

Figure 8: Trends in minimum temperature between 2020 and 2030 for (a) SSP245 scenario (b) SSP245-Covid scenario.

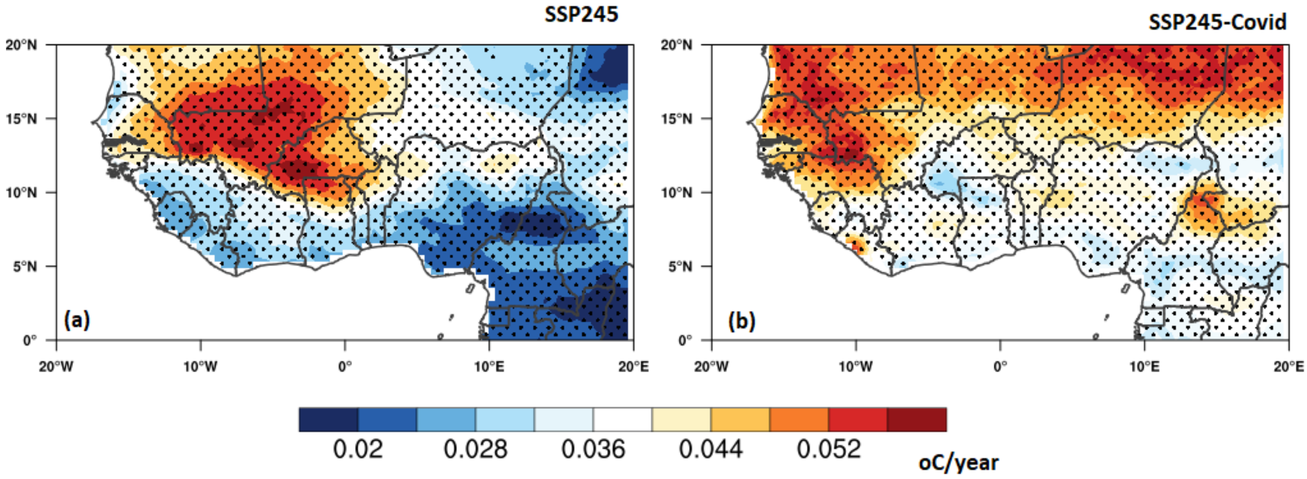

Figure 9: Trends in 2m air temperature between 2020 and 2050 for (a) SSP245 scenario (b) SSP245-Covid scenario.

The distribution of the rate of warming is modified in the covid scenario (figure 9b) with maximum rate of warming in the northern parts of West Africa (north of 15°N) at about 0.052°C/year, and rate of change at the southern part is at about 0.036°C/year.

In figure 10, the rate of maximum temperature warming is also maximum in the central Sahel around Burkina Faso and Southern Mali at the rate more than 0.05°C/year while figure 10 also show the same pattern for minimum temperature. The trend of warming is minimum in the Guinea coast for both minimum and maximum temperature at a rate less than 0.02°C/year. Covid lockdown had modified the distribution of the trend of maximum and minimum temperature as shown in figure 10b and figure 11b respectively.

In figure 11b, covid lockdown is expected to slow the warming down in parts of Mali and Burkina Faso from non-covid scenario of more than 0.05°C/year to average of about 0.02°C/year.

There is however increment in the trend of minimum temperature towards the northern part of the sub-continent. The rate of change of temperature increased in covid-lockdown scenario for night-time temperature (figure 11b), with maximum trends recorded in the northern part of West Africa.

3.6 Changes in Rainfall Trend

Rainfall changes is also expected to be impacted by Covid19 lockdowns but at a slower rate. This necessitated the analysis of rainfall response for only the long-term period between 2020 and 2050. Figure 12a and 12b shows the long-time impact on rainfall trend in the study area. Figure 12a shows in the control simulation (no-Covid lockdown scenario), the rainfall is expected to reduce by up to -10 mm/month/year in mid-part of West Africa. The reduction is strongest around Western Sahelian area between latitude 7° and 10°N encompassing countries such as Guinea, Southern Mali, Northern Ghana, Togo, Benin and part of North-western part of Nigeria. In the covid scenario, the strong negative trend has reduced but not statistically significant at 95% confidence level.

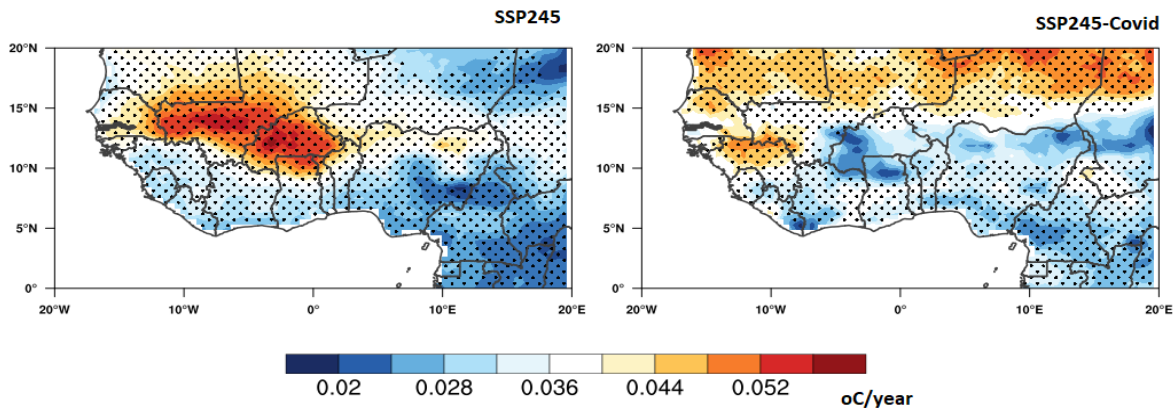

Figure 10: Trends of maximum temperature between 2020 and 2050 for (a) SSP245 scenario (b) SSP245-Covid scenario.

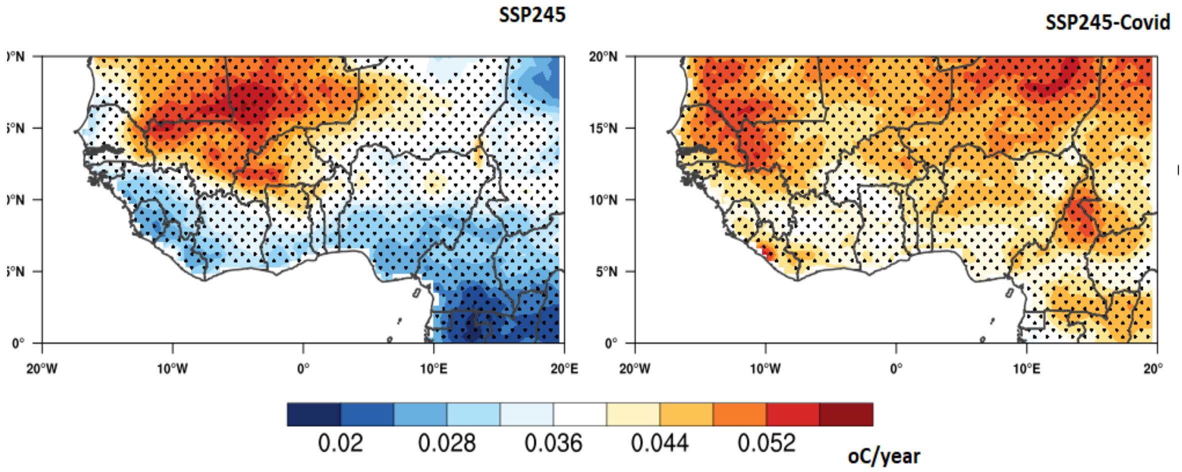

Figure 11: Trends in minimum temperature between 2020 and 2050 for (a) SSP245 scenario (b) SSP245-Covid scenario.

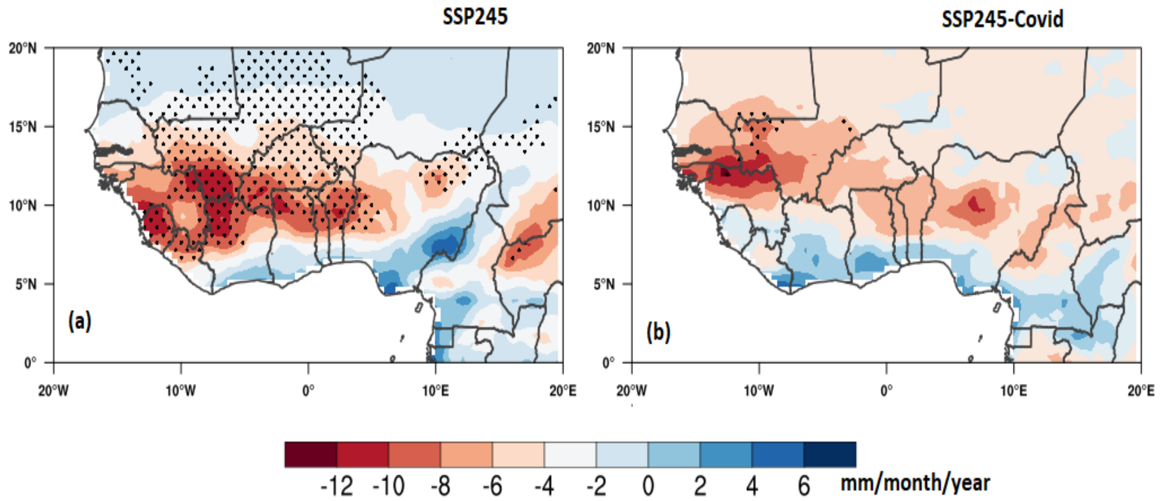

Figure 12: Trends in rainfall between 2020 and 2050 for (a) SSP245 scenario (b) SSP245-Covid scenario.

3.7 Regional Trend

Results of the ranked non-parametric Mann-Kendall test (MK) applied to all weather variables considered under no Covid and Covid simulations as averaged over zones in figure 1 is presented in table 1. Averaging over entire West Africa, air temperature, maximum temperature and minimum temperature under both covid and no covid simulation projected statistically significant increasing trend except precipitation that show decreasing trend. The magnitude of change for air temperature, maximum and minimum temperature over West Africa under covid simulation (between 0.029-0.04 °C/year) observed to be higher than no covid simulation (between 0.023-0.03 °C/year). However, a statistically significant decreasing trend in precipitation with a magnitude of change projected to be around 2.75 mm/month/year is expected over West Africa in the future compared to non-significant increasing trend predicted for precipitation under no covid simulation. Similar results were obtained over the Guinea Coast, Savannah and the Sahel. The projected magnitude of change in all the temperature variables over the Sahel are generally higher than other agro-climatic zones (Guinea Coast and Savannah). Precipitation is projected to be reducing in all the zones for both covid and non-covid scenario. Negative precipitation trend is projected to be maximum in Savannah zone, which is consistent with result obtained by Ilori and Ajayi (2020), Emmanuel et al. (2019) and Akinsanola and Ogunjobi (2014)

Table 1: The trends of variables between 2020 and 2050 for Covid and non-Covid scenarios and their statistical significance across the three eco-climatic zones of West Africa

Variable	West-Africa		
	Trend	Tau	p-value
Tas (2 m air Temperature)	**0.03***	0.514	0.00005000
Tas_Covid	**0.04***	0.578	0.00000520
Tmax	**0.029***	0.484	0.00014000
Tmax_Covid	**0.036***	0.544	0.00001800
Tmin	**0.023***	0.415	0.00110000
Tmin_Covid	**0.029***	0.467	0.00024140
Precipitation	1.01	0.123	0.34120000
Preciptation_Covid	**-2.75***	-0.243	0.05696200
Guinea Coast			
Tas (2 m air temperature)	**0.026***	0.445	0.00046000
Tas_Covid	**0.043***	0.656	0.00000024
Tmax	**0.025***	0.458	0.00031400
Tmax_Covid	**0.029***	0.578	0.00000520
Tmin	**0.025***	0.445	0.00046300
Tmin_Covid	**0.024***	0.492	0.00010650
Precipitation	3.75	0.174	0.17392000
Preciptation_Covid	**-4.09***	-0.213	0.00958000
Savannah			
Tas (2 m air temperature)	**0.028***	0.458	0.00031000
Tas_Covid	**0.019***	0.316	0.01310000
Tmax	**0.026***	0.402	0.00157050
Tmax_Covid	**0.039***	0.535	0.00002500
Tmin	**0.024***	0.411	0.00124080

Tmin_Covid	**0.028***	0.488	0.00012243
Precipitation	-3.41	-0.140	0.27670000
Preciptation_Covid	**-6.54***	-0.325	0.01100000
Sahel			
Tas (2 m air temperature)	**0.032***	0.467	0.00024000
Tas_Covid	**0.046***	0.458	0.00031000
Tmax	**0.030***	0.394	0.00198000
Tmax_Covid	**0.044***	0.449	0.00041000
Tmin	**0.023***	0.320	0.01188700
Tmin_Covid	**0.035***	0.441	0.00052583
Precipitation	-1.630	-0.187	0.14383000
Preciptation_Covid	**-2.94***	-0.359	0.00478000

*Significant at 95% significant level

4.0 Conclusion

While it has been shown by Jones et al. (2021) that the imprint of COVID-19-related lockdown which consequently reduced societal activity is visible in changes in atmospheric greenhouse gases, the current study has shown that there is a very weak change in surface temperatures (2 m, maximum and minimum) and rainfall at a timescale between 2020 and 2050. The lockdown modifies the spatial and temporal distribution of temperature and rainfall more than changes in the mean value. Tebaldi et al. (2020) is of the opinion that there is need to have sustained lockdown at a longer time scale to change the current trajectory of climate change globally. The current study employed a model in CovidMIP protocol as preliminary studies, there is need for future work to include all the models participation in the MIP to reduce inherent uncertainties.

In conclusion, the following can be deduced from the study;

(1) There is cooling anomaly in air, maximum and minimum temperature up to 0.5^{o}C in the Sahelian part of West Africa due to the lockdown in near-time between 2020 and 2030. This might be attributed to reduction activities and thereby reducing GHG in the atmosphere while there is warming in some part of Guinea Coast. There is however cooling in Southern part of Nigeria.

(2) In the longer time-scale, between 2020 and 2050, cooling anomaly is simulated in northwestern part of the subregion while there is strong warming in the Chad, Southern part of Niger Republic and Northeastern Nigeria up to 0.2^{o}C. Warming anomaly is also simulated along the Guinea coast

(3) There is rainfall reduction in most part of West Africa due to the lockdown in Southern and middle part of Nigeria up to -70 mm/month. The signal of rainfall change is also strong in part of coastal region of Benin, Togo, Ghana and Cote-D'ivoire at about -60 to -70 mm/month.

(4) There is reduction in annual rate of temperature trend, at about 0.07^{o}C/year for no-covid scenario in the Sahel for no-covid to about 0.04^{o}C/year in covid scenario. The simulation of trend covid scenario is however non-significant and can be rejected.

(5) There is reducing trend up to 10 mm/month/year in the Savannah belt of West Africa, but the trend reduced in covid-scenario but not statistically significant.

(6) It can be deduced generally that, Covid lockdown modifies the spatial and temporal distribution of temperature and rainfall over the subcontinent and have little or no impact on the mean change of these parameters.

It can be generally concluded that the result of this preliminary studies shows that the lockdown attributed to Covid19 is not long enough to slow down the on going warming in the study area and consequently the rainfall change. There is a need for aggressive global effort in reducing GHG in the atmosphere and consequently slowing down the warming. If a global lockdown due to Covid19 could provide little and insignificant impact on on-going warming, then there is need for policy makers to formulate a more aggressive GHG reduction mechanism in order achieve the ambitious goal of COP21 Paris agreement.

The result is from simulation of one of the models (MRI-ESM) participating in the CovidMIP programme and the result is bound to have a lot of uncertainties. The follow-up studies will incorporate all the models participating in CovidMIP to reduce uncertainty in the result.

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