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ABSTRACT: One of the major events transpiring in the 21st century is the unforeseen outbreak due to COVID-19. This pandemic directly altered human activities due to the forced confinement of millions of inhabitants over the world. It is well known that one of the main factors that affect global warming is human activities; however, during the first part of 2020, they were severely reduced by the spread of the coronavirus. This study strives to investigate the possible impact of quarantine initiation worldwide and the linked outcomes on a global scale related to the temperatures since the worthwhile. To achieve this goal, the evaluation of the short-term temperature status at the continental scale was conducted in two particular forms: (i) concerning the short-term comparing the data from 2016, 2017, 2018, and 2019; and, assessing the long-term differences comprising 30 years of data (1981–2010). The data employed in this study were obtained from the respective NASA and Copernicus databases. The temperature maps and temperature differences of different years before the pandemic was compared to the Coronavirus onset (winter and spring) data with the aid of Python programing language. Continental temperature mapping results showed that the temperature difference of the American continent had attained its maximum value in January 2016, and yet, the temperature is observed to be warmer than in 2016. The largest difference in the short-term temperature in terms of comparison to 2020 referred to the months when the maximum quarantine began, that is, February and March, and the temperature was cooler in comparison to the prior years. The long-term mean study denoted that the temperatures throughout the South American continent remained consistent during the first part of 2020 in comparison to the 30-year average data, but temperatures in North America declined from February to April. Similarly, the temperatures in Eurasia in April is observed to be lower compared to the 30 years average in February and March. Accordingly, the average temperature of the Earth has dropped about 0.3°C compared to 2019. We concluded that temperature could show some specific changes and hypothesize that under the COVID-19 pandemic, it could manifest different trends. The next step would be to conduct further analysis to observe at the regional scale if under unforeseen phenomena are or not affecting global warning during the coming years.

KEYWORDS: Human activities, global warming, temperature, COVID-19, climate models

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Introduction

It is possible that each century, a virus pandemic rages worldwide in general, but in 2019, an unknown, novel, and atypical virus (COVID-19) with symptoms similar to pneumonia broke out in Wuhan, China (El Zowalaty & Järhult, 2020; Wu et al., 2020). The results of preliminary studies revealed that the COVID-19 virus reportedly shared an identical receptor, ACE2 (Angiotensin-converting enzyme 2), with the Severe Acute Respiratory Syndrome coronavirus (SARS-COV) (Zaki et al., 2012). The World Health Organization (WHO) established an international committee to oversee the disease, and on February 11/2020, named the condition as COVID-19 (Coronavirus Disease) (Chang et al., 2020; Zhao et al., 2020). This disease, which is spreading out rapidly worldwide, maintains many differences with other viruses that have been recognized previously. For instance, COVID-19 renders quick transmission and asymptomaticity among infected individuals as particular features. The number of COVID-19 infection cases has reached more than nine million cases worldwide within the period from January to June 2020, the statistics are still increasing (Gorbalenya et al., 2020; World Health Organization, 2020). The World Health Organization (WHO) resolved to control the COVID-19 pandemic by implementing quarantine measures worldwide due to the lack of vaccines and efficient control measures to halt the virus (Mehta et al., 2020; Palayew et al., 2020). Consequently, many countries relented to reduce all production and transportation ventures and other social, economic, political, etc. activities to zero (Ashraf, 2020; Muscogiuri et al., 2020; Piguillem & Shi, 2020; Sjödin et al., 2020). The viral diseases could not be observed in the changes concerning the world environment in the past since the industrial ventures had yet to be initiated in the world. Yet, the cessation of production and human activities has reduced the consumption of energy, fossil fuels, effluents, and decreased pollutions worldwide similarly since all human activities in the 21st century are associated with the industrial activities

(Oldekop et al., 2020; Steffen et al., 2020; You et al., 2020). Cessation of industrial activities can render a direct impact on ecosystems, remarkably on global climate change (Danovaro et al., 2020; McMichael, 2003; O'Brien & Leichenko, 2000; Shi et al., 2015). Le Quéré et al. (2020) estimated that daily global CO_2 emissions could have been reduced by −17% by early April 2020 compared with the mean 2019 levels and some peaks in specific countries by −26% on average. Therefore, one of the Sustainable Development Goals for 2030 is to examine the impact of climate-related on this pandemic because climate action is considered the 13th objective of the Sustainable Development Goals (https://www.un.org/sustainabledevelopment/climate-change/). Additionally, another objective of Sustainable Development Goals is their third objective, which is related to human health and well-being, and the coronavirus directly impacts the discussed human well-being aspects while rendering an indirect impact on greenhouse gases and climate (Mandal & Pal, 2020; Wang & Su, 2020).

It is well-known that any change in climatic conditions could directly impact the survival of natural ecosystems (Malhi et al., 2020) or modify human settlements (Živković, 2019) on Earth. Reducing pollution in the environment can positively affect the reduction of greenhouse gases, and subsequently altering the global temperature (Chakraborty & Maity, 2020; Diffenbaugh et al., 2020; Zambrano-Monserrate et al., 2020). Based on the conclusions of Rosenbloom and Markard's (2020) study on the impacts of the COVID-19 pandemic on air pollution development and particularly greenhouse gases, it was revealed that the production of greenhouse gases could be dramatically declined following the COVID-19 pandemic and global closure of industrial factories. Moreover, the valid role of human activities on specific climate parameters could have become more evident with the outbreak of COVID-19, but the extent of these changes at the national and international scales is still unknown and requires to be further investigated (Rosenbloom & Markard, 2020).

Recent studies concerning the temperature changes at the Earth's surface indicated that the Earth is warming rapidly, with temperatures rising by approximately 1.53°C between 2006 and 2015 (Intergovernmental Panel on Climate Change [IPCC], 2018; Intergovernmental Panel on Climate Change [IPCC], 2019). Various climate models have similarly rendered this temperature increase rate for years ahead, which will unquestionably have a direct impact on the environment and human life, challenging human survival in the future (Wang et al., 2019; Watts et al., 2018). Yet, maintaining recent, historical, and future information on temperature changes can assist in better management of other aspects within other connected Earth's spheres such as the pedosphere (Brevik et al., 2020; Rodrigo-Comino et al., 2018). This information should be further investigated on a global and regional scale, respectively (Alexander et al., 2006; Caesar et al., 2006). Some events occurring during world history can have an unforeseen impact on the Earth's temperature, but accommodating this information would serve in predicting and analyzing the coming trends on the Earth's surface. The data is often estimated locally by researchers given that the climate data assembled from the Earth's surface is quite extensive, but this information does fail to signify the relevance of this issue (Office of the Leading Group for Promoting the Belt and Road Initiative, 2019). The results showed that the surface air temperature which the coronavirus 2019 (COVID-19) outbreak decreased by 0.05°C in commercial areas of the city in Osaka, Japan (Nakajima et al., 2021). And also, to evaluate the effect of suppressed human activities on temperature in the Tokyo Metropolitan area, a research made for temperature. The result show that the temperature in Tokyo ranges of ±0.19°C on the average over the strong self-restraint period from April to May (Fujibe, 2020). The effect of suppressed human activities on temperature show that decrease of up to 1°C in the surface temperature for regions city (Ali et al., 2021; Potter & Alexander, 2021; Teufel et al., 2021).

Accordingly, the main aim of this study was to investigate possible differences in global warming due to the occurrence of an unforeseen event caused, the Coronavirus (COVID-19) pandemic. The Coronavirus (COVID-19) pandemic has led to the closure or temporary cessation of countless human activities worldwide, and despite human factors being a significant determinant in climate change, not enough research has been conducted to address the issue on a global scale. Furthermore, we evaluate the impact of the Coronavirus pandemic on different global warming scenarios considering the short- and long-term global temperatures. Concerning the short-term periods, we compared the data from 2016, 2017, 2018, and 2019; and, for assessing the long-term differences, 30 years of data (1981–2010). The results of this study could serve to illustrate a possible indicator and adverse consequences of the COVID-19 pandemic worldwide at the continental scale.

Materials and Methods

The total available land of the Earth was examined in the present study. Accordingly, the surface of all seas, oceans, and lakes was separated from the land surface, and only the land surface temperature (continental lands with north and south poles) was assessed. Hence, the mask method was executed on all maps prepared in Linux and Python environments to determine the subject area (Figure 1).

The framework employed for drawing the temperature map is included in Figure 2. We showed that the preparation of daily average land temperature data was made using synoptic stations, conversion of daily average temperature data to monthly data, training sample generation, zoning of data on the world map, classification, accuracy assessment, and finally, performing regional classifications and evaluations of the obtained results. We registered the raw temperature data within the software and then performed the necessary analyzes.

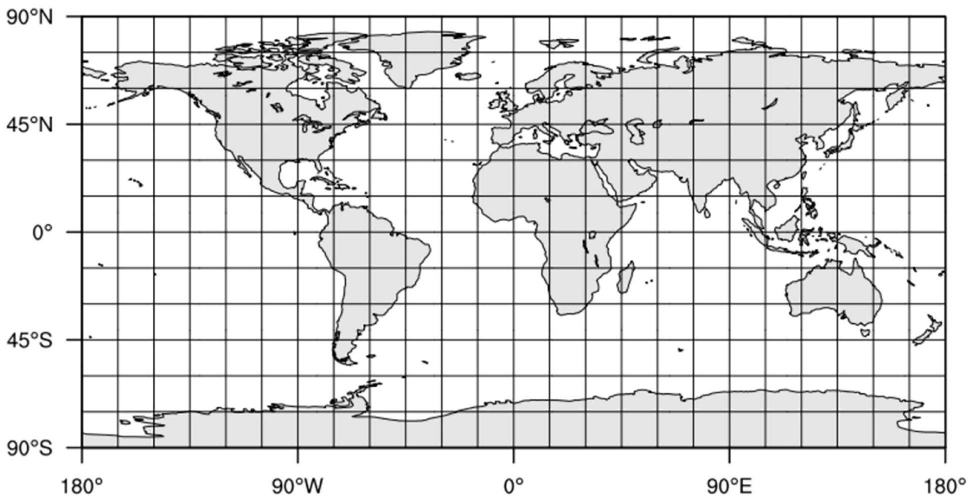


Figure 1. The selected study area.

Data availability

Synoptic station data were gathered across the world and subsequently recorded, collected, and transferred to the Global Meteorological Database. Firstly, NOAA (National Oceanic and Atmospheric Administration) is one of the employed daily temperature databases (http://dx.doi.org/10.7289/V5D21VHZ). Then, the Copernicus database (https://cds.climate.copernicus.eu/cdsapp#!/home) was similarly used to examine the 30-year temperature data. Data is available for all countries in each continent.

Methodology

The present study was divided into two different seasons in 2020, namely winter and spring, as the onset of the COVID-19 pandemic occurred in winter (January and February) and spring (March and April), and the onset has been ensuing ever since. The daily GRIB[1] format data was converted to NCL. Following, the daily data was converted into monthly data (See Appendix), and then the temperature maps pertaining to 2016, 2017, 2018, 2019, and 2020 were plotted to render a short-term comparison of COVID-19 impacts on the surface temperature changes. Ultimately, the temperature changes occurring in different months of 2016, 2017, 2018, 2019, and 2020 were examined (Figure 2). The mathematical model for drawing short-term temperature differences is presented in equation (1).

$$T - AV\ month = \frac{T1 + T2 + T3 + \ldots + T30}{30} \quad (1)$$

In this formula, *T-AV* month is the average monthly temperature, and *T* means the average daily temperature registered in synoptic stations, referred to each month. On the other hand, the 30-year averages for January, February, March, and April were prepared via monthly data to examine the possible long-term climate change differences occurring 1981-2010 and COVID-19 pandemic-induced temperature data changes. Further, these averages were analyzed considering the temperature data obtained in 2020 (Figure 2). The mathematical model for plotting a long-term temperature difference is presented in Equation 2.

$$T - AV\ \text{year} = \frac{M1 + M2 + M3 + \ldots + M30}{30} \quad (2)$$

T-AV year is the average monthly temperature, and *M* represents the average monthly temperature referred to each month.

Softwares and code availability

Python software and Linux environment were employed to draw the temperature maps. All GRIB data were analyzed in NC format in the NCL environment and Python. The steps of drawing the data included format conversion, processing reading the data by Python software, plotting, converting the temperature unit from Kelvin to Celsius, saving, and outputting the data. The Python code used for the analysis is available upon request. Additionally, some of the codes relevant to the Python software are included in Supplemental Material 1.

Results and Discussion

Short-term assessments of global temperatures

The results of the study concerning the different land surface temperatures during the last 4 years (2016, 2017, 2018, and 2019) and 2020, and the onset of the COVID-19 pandemic are displayed in Figure 3. January temperature difference between 2016 and 2020 revealed that the Eurasian continent (Europe and Asia) maintained the highest temperature this year, to the extent that the temperature difference in this period reached more than 15 degrees. Furthermore, the 2016 temperature in Antarctica was higher than in 2017, 2018, and 2019, while the North American continent presents a temperature difference above zero compared to January 2020. In the case of Oceania, the results showed that the temperature difference between

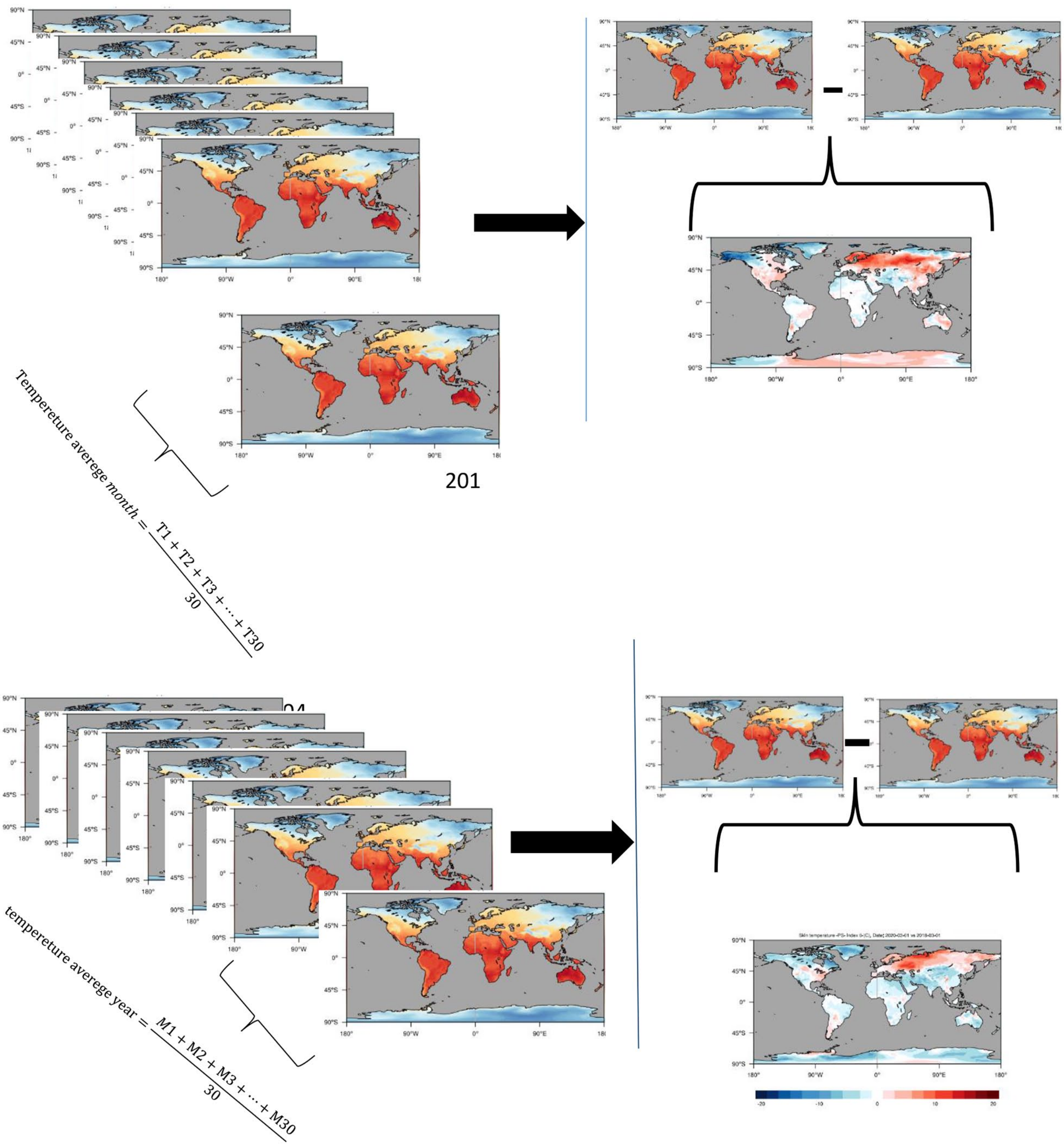


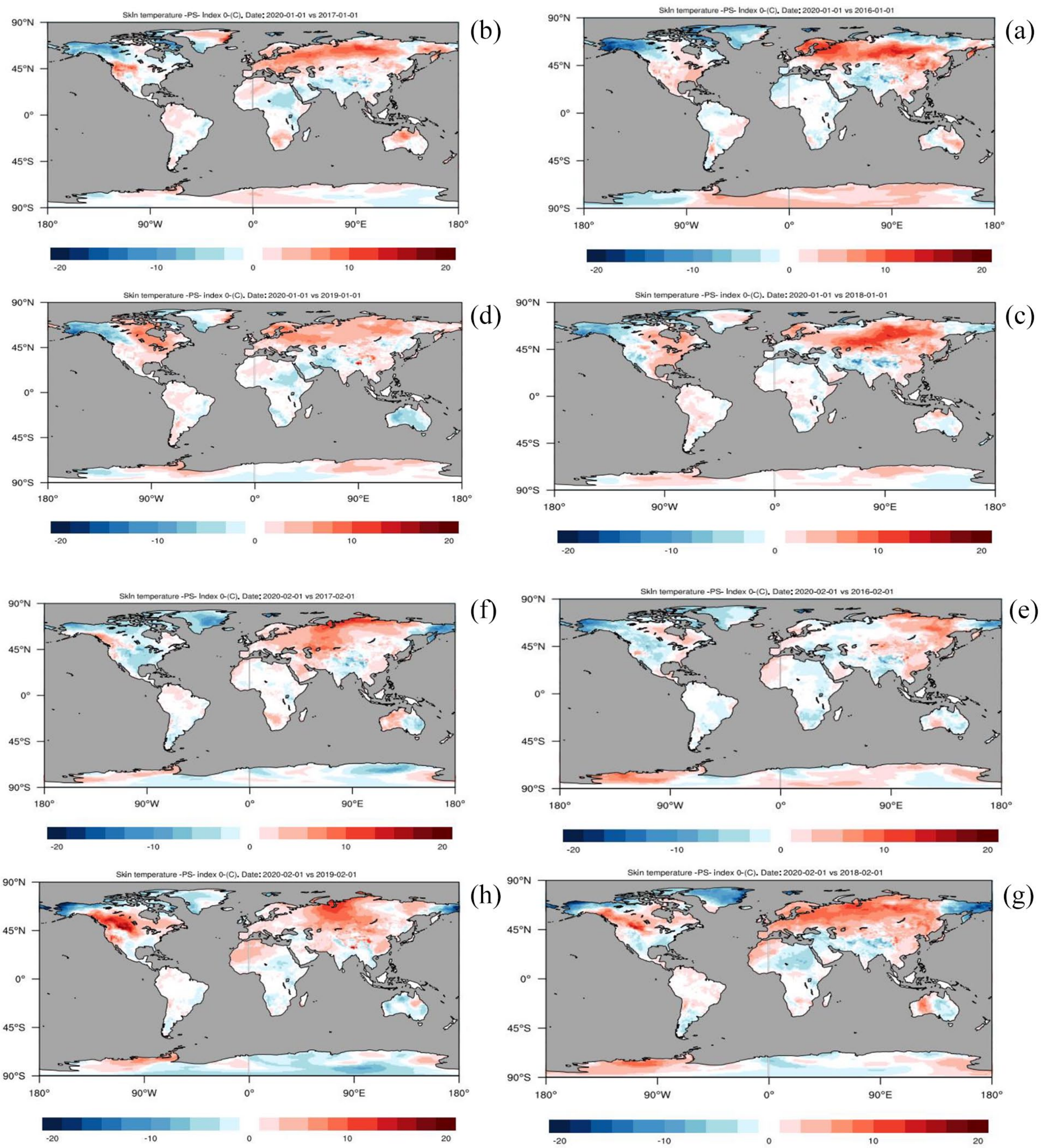
Figure 2. Flowchart of the integration, difference measurements, and formulations of temperature data at the global scale.

2020 and 2019 is remarkable to the extent that the continent is progressing toward the reduction in temperatures, and is colder compared to the past 4 years. The land surface temperature difference in Africa in 2016, 2017, and 2018 is progressing from unchanged to increase. Also, the largest temperature difference in terms of comparison to January 2020 refers to 2016.

The results of February land surface temperature differences between 2016, 2017, 2018, and 2019 compared to 2020 revealed that the temperature manifested two distinct behaviors in Eurasia, and according to this, the temperature in February 2016 was higher in the eastern regions of the continent. The temperature has been annually rising toward the western regions of the continent (temperature differences amount to more than 12°). The February temperatures have been further rising in Eurasia since 2016 onwards, but the same temperatures have encountered a decrease in the majority of the continent as the COVID-19 pandemic began, and production restrictions along with global quarantine measures were implemented (Figure 3). The February temperature survey in Oceania among different years (2016, 2017, 2018, and 2019) determined that the temperature is higher compared to 2020, and this difference is progressing every year. Contrarily, the results of the temperature difference revealed that the temperature has dropped throughout the content at the same during the pandemic's onset. The February temperature difference of 2020 in America confirmed that the largest temperature difference (below zero) is referred to 2017, but possibly, the quarantine measures and closure of factories worldwide could affect a decrease in the continent's temperature in comparison to 2018 and 2019.

The results of Christidis et al. (2020) on temperature changes in Europe determined that the temperature in 2018 has reached the highest levels observed in the last century, which is consistent with the results of this study. They also directly linked this outcome to the increased human activity, as the results of this study similarly showed that the cessation of industrial activities and the implementation of quarantine measures have reduced human activity, and subsequently could provoke temperature changes worldwide.

Asian, European, and African countries are recognized for having vulnerable climates to the extent that any temperature change will inflict the greatest impact on their respective water resources and environmental pursuits (Wang, et al., 2019). According to the results of this study, the temperature has gradually increased since 2016 until 2018, and the reports of polar glacier meltdowns in Russian regions with a speed of 25 m per day (m/day) has been estimated during these years (Willis et al., 2018). However, the results of comparing the



(Continued)

Figure 3. (Continued)

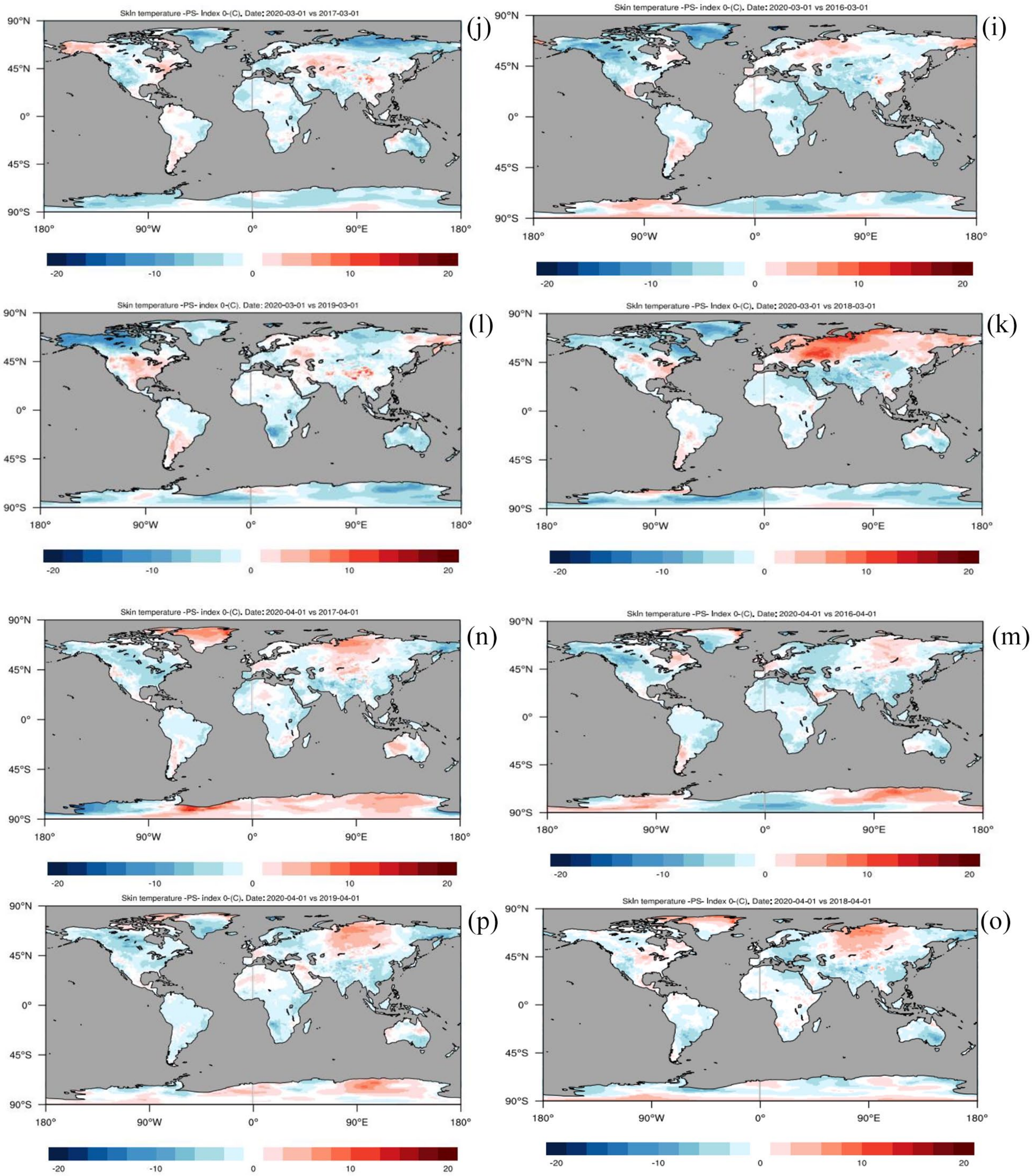


Figure 3. Comparison of monthly temperature differences in contrast to 2020. ((a) 2020-01 vs 2016-01, (b) 2020-01 vs 2017-01, (c) 2020-01 vs 2018-01, (d) 2020-01 vs 2019-01, (e) 2020-02 vs 2016-02, (f) 2020-02 vs 2017-02, (g) 2020-02 vs 2018-02, (h) 2020-02 vs 2019-02, (i) 2020-03 vs 2016-03, (j) 2020-03 vs 2017-03, (k) 2020-03 vs 2018-03; (l) 2020-03 vs 2019-03, (m) 2020-04 vs 2016-04, (N) 2020-04 vs 2017-04: (o) 2020-04 vs 2018-04, (p) 2020-04 vs 2019-04).

March temperature differences observed in 2016 and 2017 to 2020 indicated that the temperatures were lower on all continents to the extent that Greenland's March temperature in 2016 depicts approximately −20°C worth of temperature difference compared to 2020. March temperature analysis confirmed that the temperatures reached the highest value in 2018, while this temperature had reached approximately 15°C in Asian regions, depicting a higher temperature than 2020. As the results indicated, the changes in this month have undergone a decrease due to the implementation of maximum production cessation laws worldwide, and the March 2020 temperature has decreased compared to prior years.

A prior study conducted on the daily temperature of the Earth's surface aimed to investigate the temperature differences observed in the 1979 to 2018 period. The results of this study reported an increase in temperature amounting to approximately 0.5°C, with a maximum temperature of 40°C and a minimum one of 20°C during the day. Accordingly, this factor was further reported to directly impacts economic ventures worldwide (Yang & Zhang, 2020). The April temperature difference is quite different from January, February, and March, and accordingly, the temperature on the entire surface of the earth has undergone a sharp decrease to the extent that all continents have displayed decreased temperatures in the rest of the years given the high temperatures observed in April 2020. As the measures restricting the activity of associations and organizations intensified in most countries, particularly in the United States and Europe, it directly influenced the temperature, and the temperature differences revealed that the Earth's land surface temperature had decreased, causing the Americas' temperatures to drop by approximately −8 to −10°C in April compared to the past year, 2019.

Temperature changes in Europe showed that temperature changes resulting from human activities are the most prevalent factor in climate change. Parallel with this, the temperature in summer 2018 reached the highest record value in Europe, which was the aftermath of a 30% increase in human activities in the same region (McCarthy et al., 2019; Vautard et al., 2019).

Investigating the temperature changes in the UK employing a more extensive region data confirmed that the limitations of local-scale studies have not always been appropriate for prediction due to local effects, thus, suggesting to employ smaller scales to predict temperature changes (Christidis et al., 2020). The results of daily data analysis in the UK attested that the temperature had warmed by approximately 1°C, and this trend is still increasing, with all models displaying an increase in 2019 temperature. In this study, 16 respective climate models were studied to predict temperature changes in the United Kingdom, and two categories of natural and human activities were further taken into account. The most relevant human activities concerning the temperature changes are changes in greenhouse gases arising from the factories, aerosols, ozone, and land use, whereas the natural impacts concerning the temperature changes are solar activities and volcanic aerosol emissions (Christidis et al., 2020). The results of this study likewise confirmed that the temperature had decreased in comparison to the average of 2020 winter and spring months, which is consistent with the decrease in human activities (possible implementation of quarantine measures worldwide).

Linear models rendered more accuracy for examining temperature changes than other models such as the HadUK-Grid.

Comparison of 2020 temperature with the long-term average datasets (30-years average temperature)

The results of the temperature difference comparison between 2020 winter and spring months and the average of the same months in the 30 years are displayed in Figure 4. The results of comparing the January 2020 land surface temperature differences with the long-term average (30-year average) revealed that the temperature manifested two different trends in North America. Accordingly, the January 2020 temperature was higher in the eastern regions of the continent while the temperature in the western regions of the same continent appeared below the average temperature referred to in 30 years. Contrarily in South America, the temperature has prevailed unchanged from the average temperature of 30-years. The results further indicate that the central regions of Eurasia are warmer compared to the 30-year average temperature, but the respective northern and southern regions remain moderately unchanged. Moreover, Northern Australia maintains a warmer temperature, whereas Western Australia is cooler compared to the average temperature of 30-years in this country. The temperature changes could not be particularly severe in Asia since the lockdown of countries was originated from Asia in January.

The results of the February temperature difference comparison between Earth's land surface and the 30-year average revealed that the February 2020 temperature increase in Eurasia was higher in the Northern regions of the continent than the South, reaching approximately 20°C and even extending to the Northern regions of the African continent. These month's temperatures in the Australian continent also displayed a radically different behavior compared to January. According to this difference, the temperature increased in general, yet a temperature shift from the east to west is observed, unlike January. The February temperature survey in the Americas also observed that temperatures had progressed toward a decrease, but an increase transpired between 0°C and −8°C (Figure 4). As the results presented, the temperature throughout the South American continent was the same as in January, showing no changes compared to the long-term average (Figure 4). The most extensive geographical range of above-zero temperatures was observed in February, which coincided with the quarantine measures and shutdown of factories worldwide. The results of comparing March 2020 temperature differences with the long-term average revealed that the temperature had undergone a rise in all continents, which was causing the meltdown of glaciers in northern regions of Russia (Willis et al., 2018). The temperature in Antarctica had dropped in comparison to the long-term average despite the initial temperature progress toward an increase at the beginning of this season (spring). Furthermore, the March 2020 temperature in Greenland has been lower. Yet, the temperature on the American continent was differently considering that the

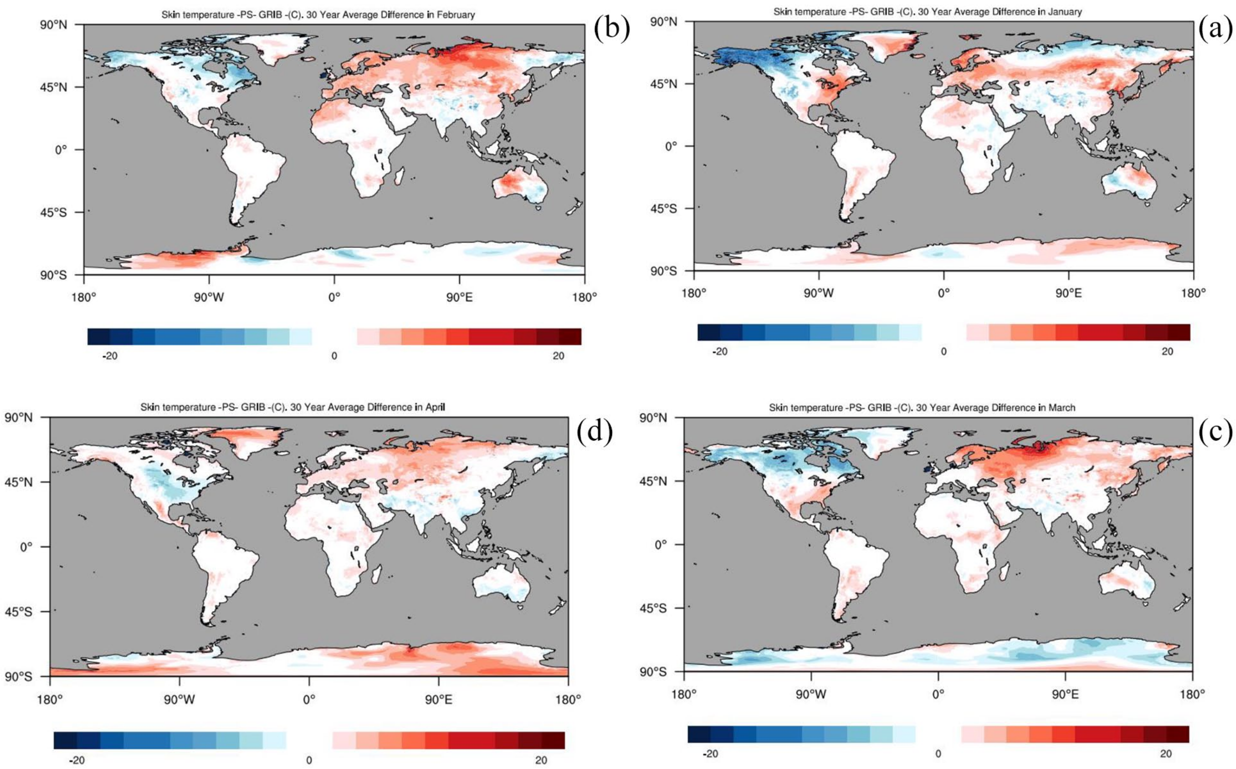


Figure 4. Comparing the temperature difference of 2020 with the 30-years temperature average. ((a) 30 Years Average difference in January, (b) 30 Years Average difference in February, (c) 30 Years Average difference in March, and (d) 30 Years Average difference in April).

North American continent maintained significantly lower temperatures than the South American counterpart in comparison to the long-term average. The temperature difference in February was so significant that the differences ranging between 20°C and −20°C. These temperature differences are anticipated and could be considered in the future, taking into account the quarantine implementations worldwide.

April 2020 temperature differences and the long-term average determined that the temperature in Antarctica and the North Pole had undergone a rise by approximately 10°C. The temperature has decreased in April compared to March of the same year in Eurasia, with a maximum temperature difference of 3°C. Similar results were observed in Oceania, where April 2020 temperatures decreased compared to the 30-year average (in spring). However, no considerable shift was obtained from the 30-year average in South America within the 4 months (January, February, March, and April). Temperatures in North America have also been colder compared to the long-term average (up to −3°C), but these changes have been less in comparison to March.

Recent studies on the long-term trend of land surface temperature determined that the new decade's (2009–2018) temperature is approximately 0.7°C warmer than the previous decade (1951–1980), while simultaneously, the temperature changes have extended above 30°C, the impacts of which are due to the increased production of factories and human activities on Earth (Cattiaux et al., 2010; Fischer et al., 2013). In a similar study conducted by Sippel et al. (2020), daily temperature data were employed to study climate change, using a variety of temperature forecasting models courtesy of the National Centers for Environmental Prediction (NCEP) and CMIP5 temperature forecasts for 2020 and the future alike. The ultimate results demonstrated that the temperature increased by approximately 1°C from 1950 to 2018, and this gradual increase over time was also anticipated by the discussed climate models, namely the National Centers for Environmental Prediction (NCEP) and CMIP5 models.

In the present study, the change trends observed in the average winter and spring months' temperature denoted that this factor corresponded with the beginning of human activity decline (resulting from the COVID-19 outbreak and implemented quarantine measures) worldwide since the maximum decrease in temperature had become more severe since late winter. The temperature had been dropped compared to the 30-year average, and the Earth's surface temperature has similarly undergone a decrease. Moreover, a survey of the average temperatures of the previous years (2016–2018) during the winter and spring has designated the trend of increasing temperature. Consequently, the COVID-19 pandemic could be able to subdue many of the factors impacting the increase in temperature suddenly and temporarily. Other researchers further studied the average temperature in the United States during the 1980 to 2009 period to confirm that the temperature is lower in the spring. Yet, this factor leads to unregulated streams and increased human activities in the autumn, winter, and summer seasons to the extent that it has increased the spring

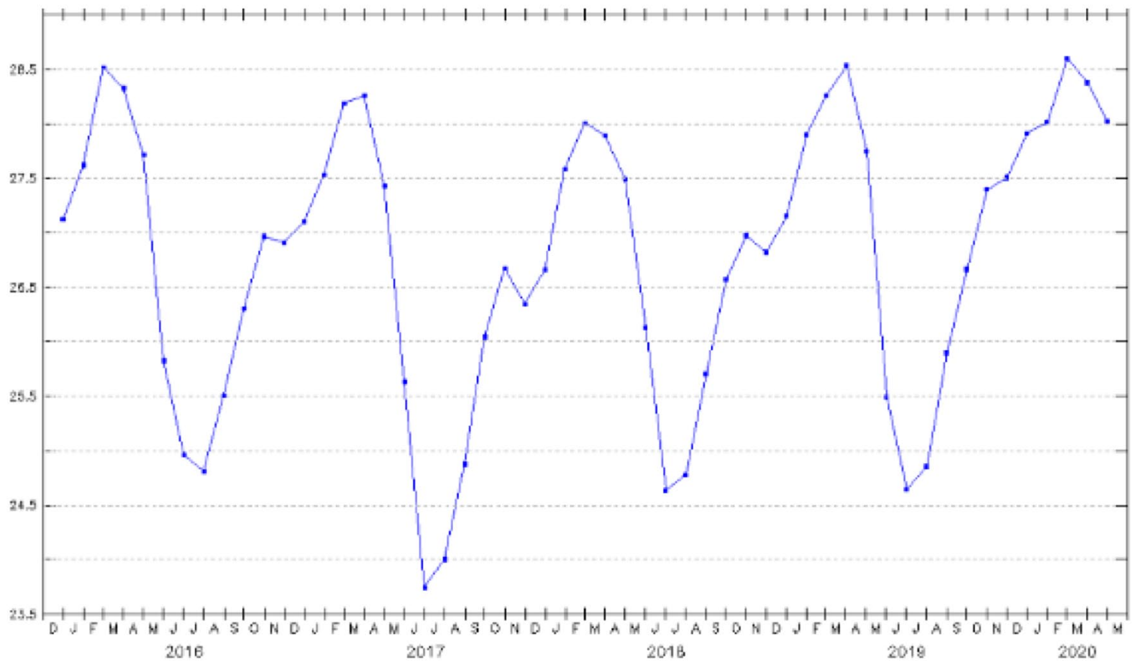


Figure 5. Monthly average land surface temperature over the world.

temperature by approximately 0.17°C/decade per century (Isaak et al., 2012).

Average Earth temperature

The average monthly temperature of the Earth revealed significant changes in the study of Earth's temperature. According to this, the minimum and maximum temperature differences in the years before 2018 were quite severe, but from 2018 to 2020 this difference gap has decreased and the earth's surface temperature is progressing toward a rise (Figure 5). Based on the information obtained from the World Meteorological Organization, the results revealed that the average temperature of the earth is currently increasing. The average temperature of the Earth has risen by approximately 0.5°C in 2018 compared to 2017. Moreover, the average temperature in 2020 has reached roughly 28.2°C, shown an increase of nearly 0.2°C compared to 2019 estimations. Consequently, it can be concluded that the average global temperature in 2020 could be decreased compared to the prior years (Figure 5). The results show approximately 0.3°C temperature decrease in the early2020. This decrease can grow up to 0.5°C if the worldwide lockdowns persist.

Conclusions

In this research, we compared the Earth's surface temperature using different term periods. The main aim was to detect if the current COVID-19 pandemic impacts, the reduction of human activities and forced quarantine, would have affected global warming values by reducing the mean temperature values. Our results showed that the largest difference in the short-term temperature in terms of comparison to 2020 referred to the months when the quarantine began, that is, February and March, and the temperature was cooler in comparison to the prior years. The long-term mean assessment highlighted that the temperatures throughout the South American continent remained consistent during the first part of 2020 in comparison to the 30-year average data, but temperatures in North America declined from February to April. Similarly, the temperatures in Europe and Asia in April were lower compared to the last 30 years average data in February and March. Also, the average temperature of the Earth dropped about 0.3°C compared to 2019. Based on the results, there was an approximately 0.2°C decrease in average temperature in early 2020. If the lockdown persists, this decrease can grow to about 0.4°C in late 2020 and continue over 2021. On a short term and long-term scale, temperature variations based on the COVID-19 expansion were more pronounced in North America, Europe, and Asia. In contrast, minimal temperature changes occurred respectively in Australia, Africa, and South America. Considering that future analysis during the coming years must be also conducted, we hypothesize that the impacts of COVID-19 pandemic on human activities could manifest different temperature trends over the world. These changes could be different considering diverse spatial scales (from regional to country scales), but observing these results, this unforeseen phenomena could represent a new factor to be considered for global warming and climate change studies during the coming years.

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Author Contributions

S.S. conceived the study with P.N. conducted the statistical analysis. All authors contributed to the interpretation of the results and the writing of the manuscript.

Declaration of Conflicting Interests

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Note

1. General Regularly-distributed Information in Binary form

Supplemental Material

Supplemental material for this article is available online.

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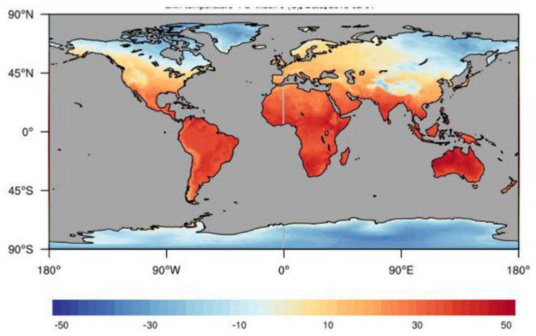
Appendix

The surface temperature of the Earth.



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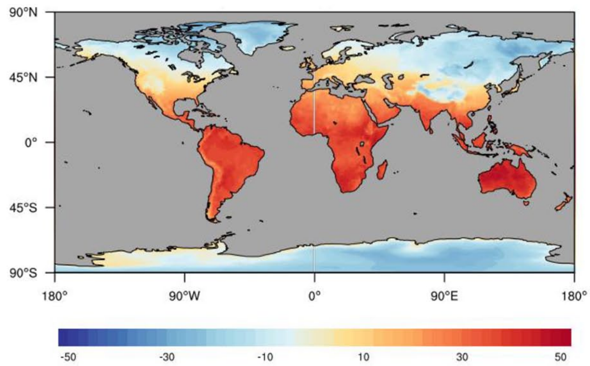

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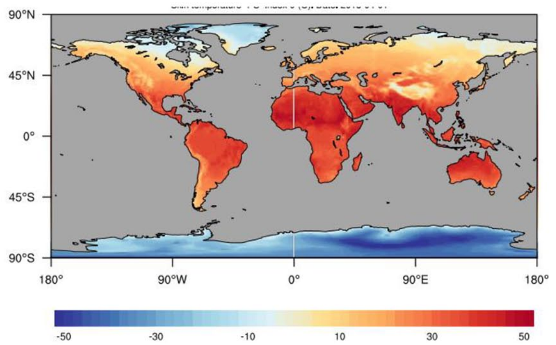

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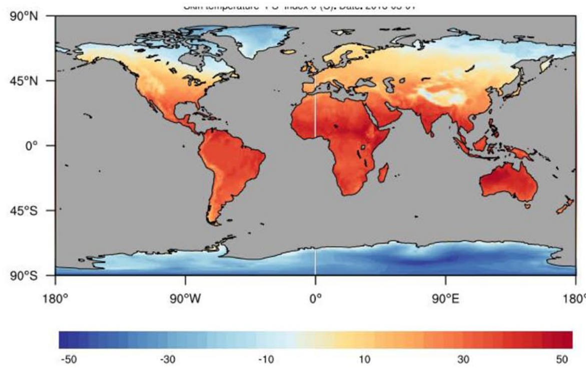

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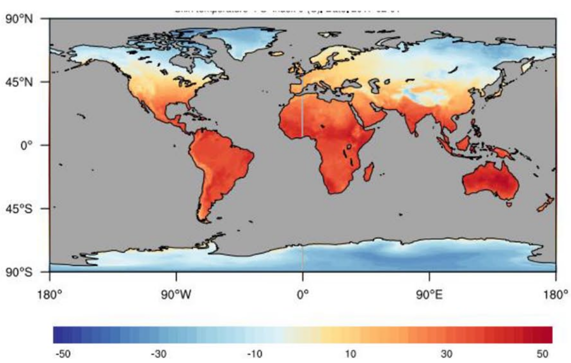

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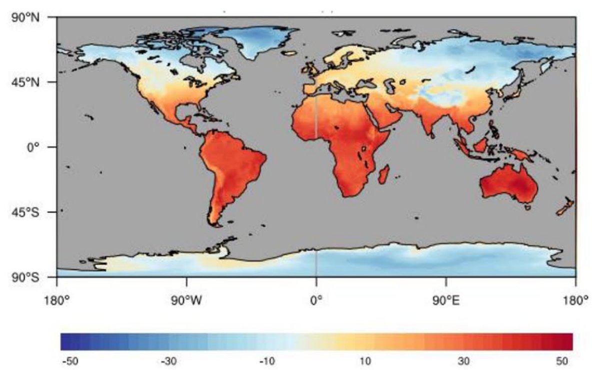

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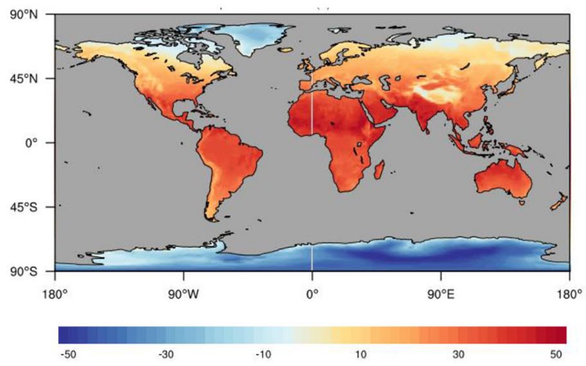

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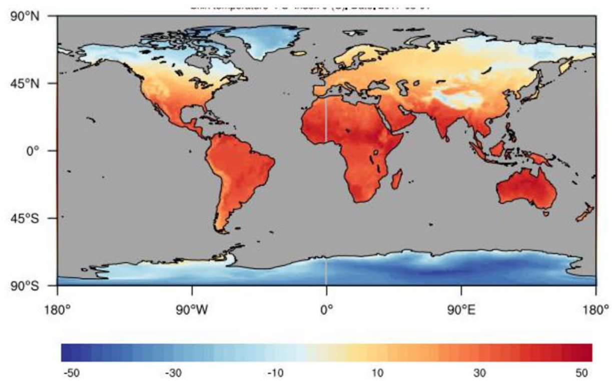

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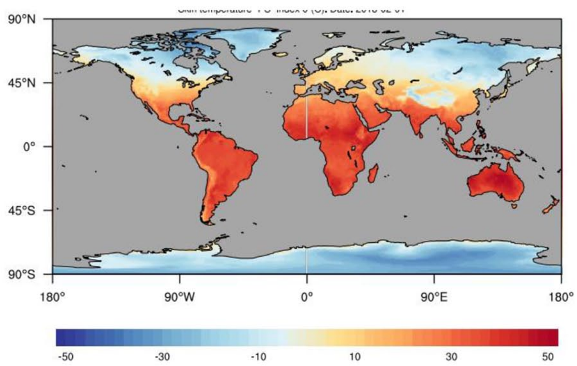

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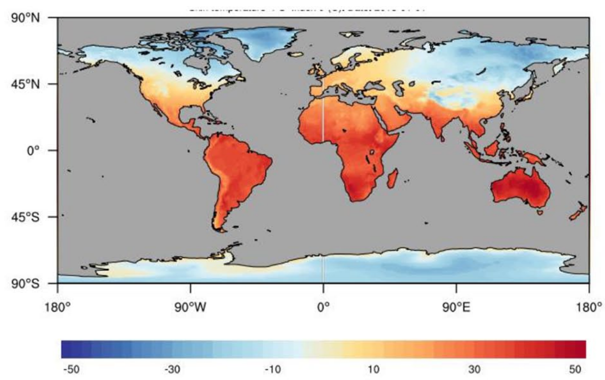

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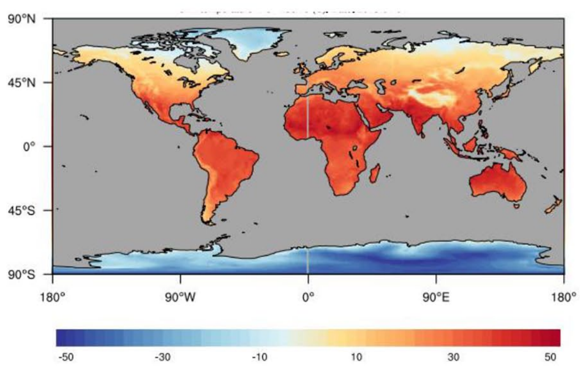

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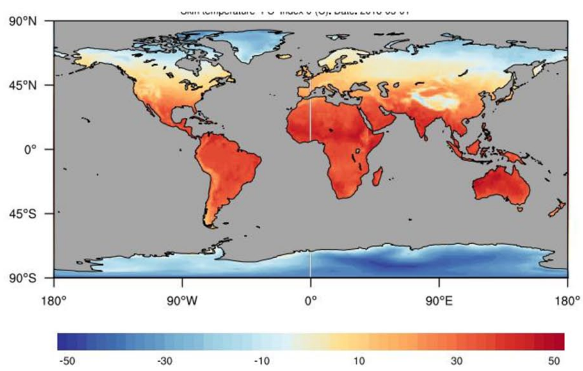

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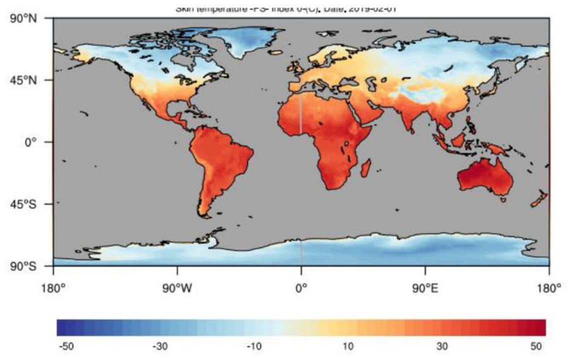

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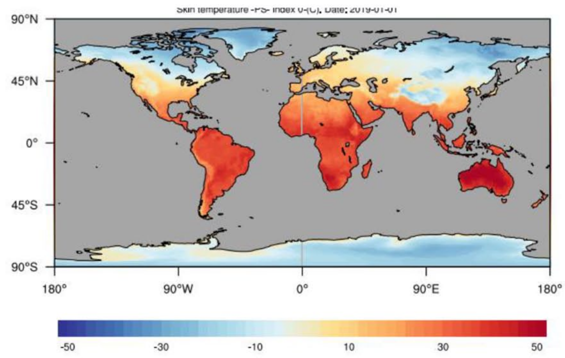

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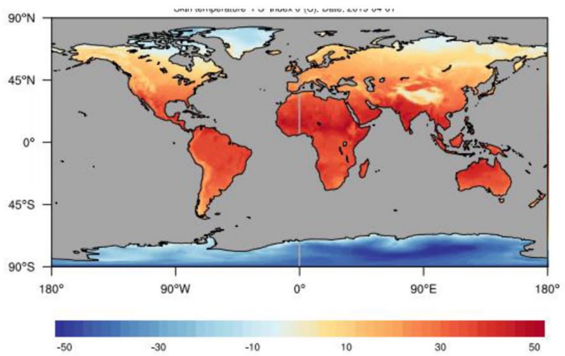

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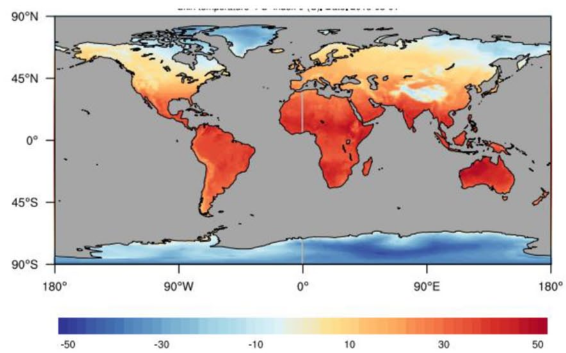

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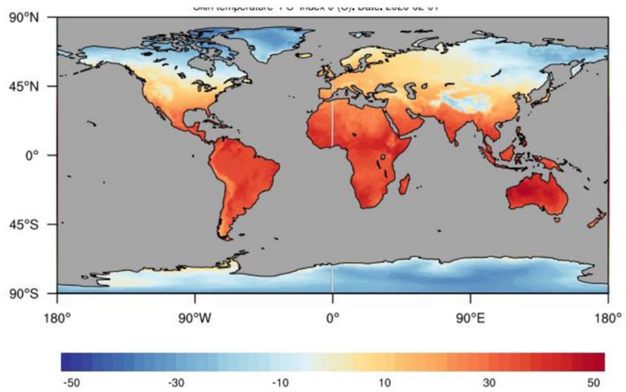

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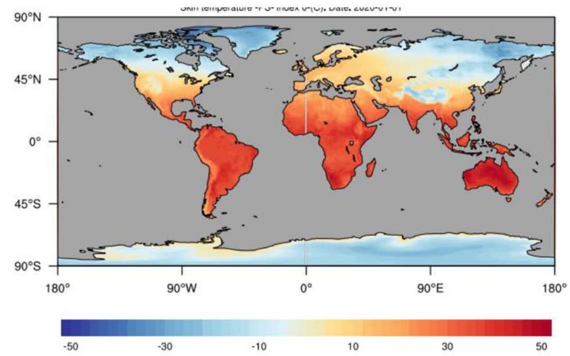

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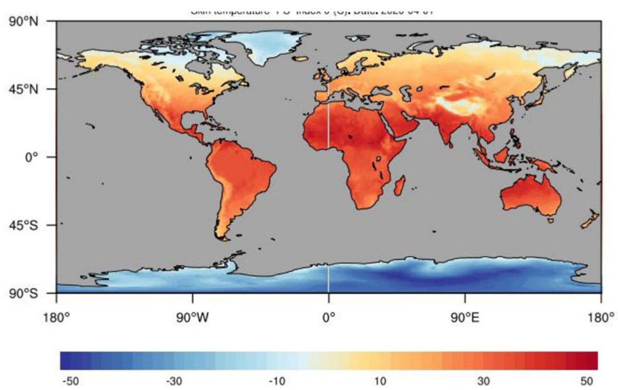

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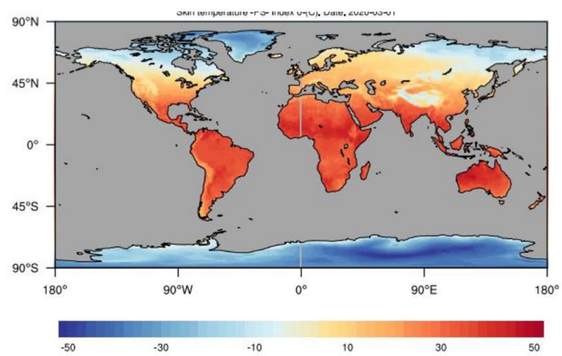

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