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Evaluation climate change in iraq using the general circulation model

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Abstract

Global Climate Models (GCM) has been developed to perform climate projection to simulate and understand climate change in response to emission of greenhouse. The aim of this study is to use simple numerical climate models to investigate effect of various parameters, functions, and components of climate system on the temperature rise. Two climate changes scenarios used to estimate and explore the future rise surface air temperature over Iraq until 2050. EZgcm project has been supported at times by National Aeronautics and Space Administration (NASA), as an easy model has been used by research to study climate of the past, present, and future. The results have been shown that the surface air temperature of Baghdad city was at starter of the first decade of the study for scenario A ($16.8\,^{\circ}$C) with an increase of about half a degree in each decade until reaching $21.2\,^{\circ}$C in the last decade of the study and this is the highest score recorded in the study for scenario A. The temperature of scenario C has been $17.8\,^{\circ}$C at the first of the study, which is higher than the scenario A. However the temperatures slow rise over last time pored study as the temperature increases a little to reach $18.3\,^{\circ}$C in the last decade of the study.

Keywords: Climate Change, General Circulation Model, Surface Air Temperature Anomaly and annual temperature of Baghdad

Introduction

The climate system as specified in interactive system consisting of five main components: Atmosphere, Hydrosphere, Cryosphere, Lithosphere and Biosphere forced or influenced by various external forcing mechanisms the most important of which the sun is considerable an external forcing. They are affected by a broad range of natural animate

processes, or combination including interactions of our climate system [1]. Thus to develop our comprehension of how changes in these traits show themselves over decade -to-century time scales, so that have to address most the issues including those combination that will all efficiently advance this understanding properties. While the presence climate patterns offers trust that several portion of the changeability in the climate attributes might be concerning to the condition of these futures [2]. Eventually basic on comprehend the physics that control both the Evolution of climate system and the Patterns them. A relation between climates attributes patterns and the climate patterns might afford beside several statistical forecasting abilities, yet just of configurations or kinds of charges effectively documented. Forecasting future changes demands that could understand and physical interactions dominant climate sensitivity and identify and feedbacks the slow components of the system in which predictability resides [3]. Changes in solar energy production in terms of both the total radiation flow (External Radiation) or terms of distribution spectroscopy to this radiation directly affect the radiological environment and the budget for energy on the surface of the earth and the sensitivity of the climate system and in response to much forms of lifetime. furthermore changes in the concentric in the atmosphere for a number of trace elements directly affect radiation energy transfer across the column in the Atmosphere and thus the power equilibrium in the Atmosphere involving temperature on the earth`s surface [4]. It is modifying these direct climate impacts through numerous feedback that indirectly affect surface temperature and flows of radiation and the hydrological cycle and the hesitation and density of ecosystem structure and storms sea level and work. Increase the dexterity that such feedbacks can be quantified is the main defy for the science of the earth system over the next decades [5]. The main cause for the widespread concern about the current global climate change is that popularly efficacies increase the greenhouse effect in the atmosphere and the burden of tropospheric aerosols and weaken the ozone shield in the stratosphere versus ultraviolet radiance. Greenhouse gas (for example, H_2O, CO_2, CH_4, N_2O, vehicles, and O_3 in the Atmosphere) surface temperature image by trapping part of the long wave radiation outgoing flow [6]. Aerosols tend to cause surface cooling and scattering of solar radiation into space (although in can produce the opposite office if it consists of vary dark or material if they are above the bright surface such as snow or ice), and the practiced indirect effects. It has hat yet been determined het effect of feedback countless respond to changes in the gas in the Atmosphere and the content of the aerosol and a better understanding of these climate impacts will be essential to our ability to predict the nature and magnitude of the climate`s response to human change in any of influencing factors [7]. in this studied used Employing more advanced climate model to understand the dynamics such as large-scale wind and atmospheric circulation systems, ocean currents, convective motions in the atmosphere and ocean. The aim of this research is to use simple climate mathematical models to investigate effects of various parameters, functions, and components of the climate system on the temperature rise. The goal also includes the use of the output of a more complex climate models, adopted by the IPCC, to explore the future rise of temperature over Iraq.

Climate Change Model

Climate models use quantitative methods to simulate the interactions of the atmosphere, land surface, oceans, and ice. They are used for a variety of purposes from study of the dynamics for weather and climate system to projections of future climate. All climate models very nearly balance, incoming energy as short wave electromagnetic radiation (visible and ultraviolet) to the earth with outgoing energy as long wave (infrared) electromagnetic radiation from the earth [8]. Any imbalance results in a change in the average temperature of the earth. There have been major advances in the development and use of models over the last 20 years and the current models give us a reliable guide to the direction of future climate change. Computer models cannot predict the future exactly, due to the large number of uncertainties involved. The models are based mainly on the laws of physics, but also empirical techniques, which use, for example, studies of detailed processes involved in convention processes [9]. The most super computer models simulate the entire climate system. In addition to linking the atmosphere and ocean. They also deducted the interactions between the various elements, such as ice

and land [10]. Climate models have been used successfully to reproduce the main features of the current climate; the temperature changes over the last hundred years, Current models enable us to attribute the causes of past climate change, and predict the main features of the future climate, with a high degree of confidence The most talked-about models of recent years have been those relating temperature to emissions of carbon dioxide (and other greenhouse gases). These models project an upward trend in the surface temperature record, as Well as a more rapid increase in temperature at higher altitudes [11].
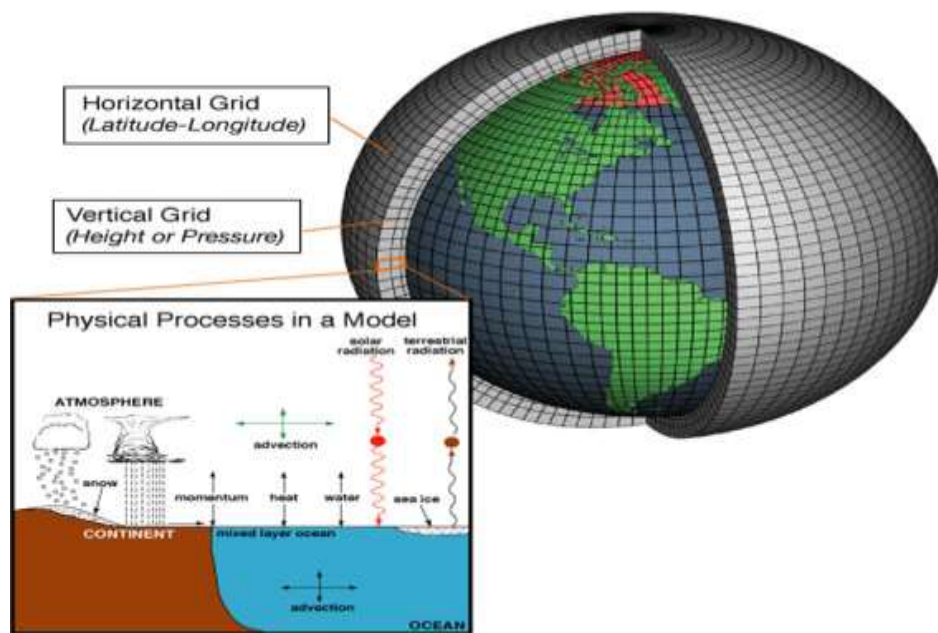
Figure (1): model structure vertical and Horizontal Grid with physical processes for Atmosphere Land Ocean [12].

Climate models are systems of differential equations based on the basic laws of physics, fluid motion, and chemistry. Scientists divide the planet into A 3-dimensional grid to examine model as shown Figure (1), apply the basic equations, and evaluate the results. Atmospheric models calculate winds, heat transfer, radiation, relative humidity, and surface hydrology within each grid and evaluate interactions with neighboring points. [13]. The assessment of surface air temperature changes for relatively long periods of time extends to 2050 and the study of the amount These changes are monthly, quarterly, annual and selected cities Iraq using the general circulation model.

1- Use of the general wind rotation model by choosing more than one scenario (experiment).

2- Find changes that occur on the surface air temperature for contractual periods up to

3- To find the spatial variation of main cities of Iraq and for each period of time.

4- Find the rate of nodal variation of surface air temperature.

Data Source

The Intergovernmental panel on Climate Change (IPCC) established a new set of scenarios in 2000 for use in the Third Assessment Report (Special Report on Emissions Scenarios - SRES). It was created SRES scenarios to explore future growth in the global climate with particular reference to the emissions of GHGs and aerosol precursor's production [14].

The first step of to run model that the data is to select the experiment for partially case as shown in Figure (2-5) this is the first window in the EZgcm refer to selecting the experiment, choose on Post- processing from the toolbar in this window and in the post- processing phase in this window there are 3 steps. Averaging climate model output for years:

The first step is to choose the simulation and we can choose one of the four scenarios. In this experiment, scenario A and scenario C were chosen, exception of B scenario because it is approximated for A. and Q scenario exception is because it is a combination of three scenarios and when choosing A or C Scenario the remaining conservative scenarios will follow the same steps. After the scenario selection process, the time period for the scenario was determined. The starting point was set in 1961 and for a period of time 10 years until 2050. The periods of study in this thesis became nine decade periods. The program calculates averages for the required decade periods climate model output for years like 1961 through 1970 working averaging simulation this process takes some time for the program to the simulation load.

The second step is to identify the climatic elements in this simulation. There are 5 elements that can choose one or all of the climatic elements. Only the temperature air surface was selected because Iraq is strongly influenced by temperature because the temperature is sensitive and there is little rain. Iraq does not have a Sea. Second, the study will become extensive, and useless. This is why has been chosen temperature air surface. After selecting the temperature air surface elements, we can determine the time period, whether it is annual, seasonal or monthly, and this process is called extracting data Where you take some time to Extract.

Step three after completion of the extraction process, the files appear in the files Created box and upload any file and click on downloaded selected file In this way we will save the files as NS file, The results can also be displayed by selecting proceed visualization .
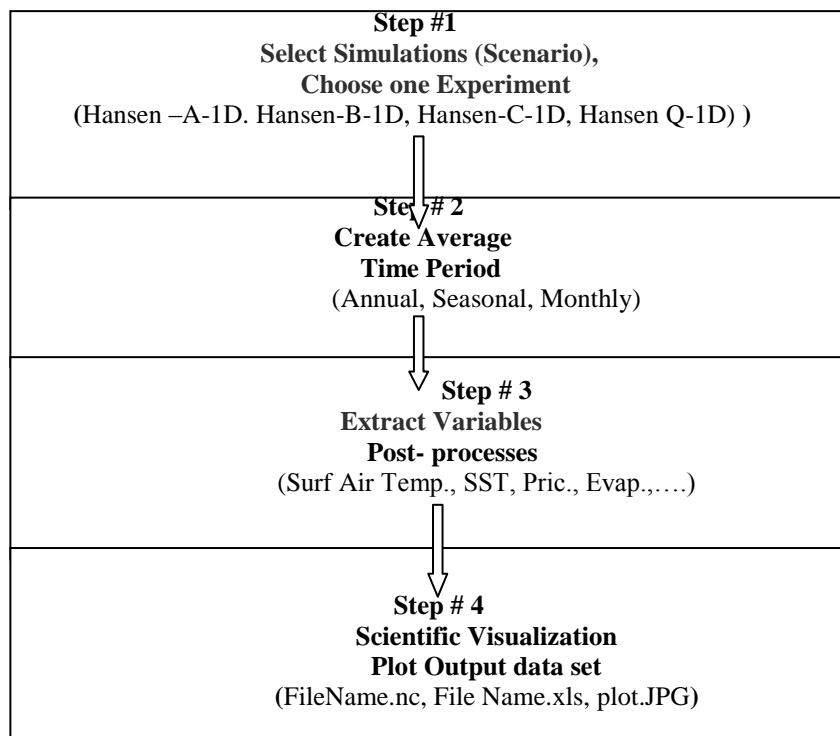
Step #1
Select Simulations (Scenario),
Choose one Experiment
(Hansen –A-1D. Hansen-B-1D, Hansen-C-1D, Hansen Q-1D))

Step # 2
Create Average
Time Period
(Annual, Seasonal, Monthly)

Step # 3
Extract Variables
Post- processes
(Surf Air Temp., SST, Pric., Evap.,….)

Step # 4
Scientific Visualization
Plot Output data set
(FileName.nc, File Name.xls, plot.JPG)

Figure (2): the main steps for Initialized Conditions EZgcm processes.

Results and Discussion

EZgcm model was run for calculate an estimated decadal surface air temperature. This model provides estimated for temperature for global scale, but focused on Iraqi region. Two scenarios (A, and C) were used to calculate and analysis what's the changes that happen for surface air temperature upon the causes in Figure (3) that shown surface air temperature increased approximately 1.5 ℃ for each decade. Where the contour lines have been paralleled to the latitudes with a little tendency to decrease towards the eastern side of Iraq and this indicates that the increase of temperature is directly proportional to the latitude. The significantly based of the model that depended on the located point on earth that's mean equator areas have been high temperature, while Polar Regions cold (lowest) temperature, and Extra-tropical areas, which Iraq is located between these two regions. Although it is well known that the temperature of Iraq is higher when compared to neighbouring countries except South. For example, it is known that the annual rates of temperature for Jordan are less than the average temperature for Iraq, however in this EZgcm model have been found that the temperature of Jordan is higher than the average temperature of Iraq and the difference more than $2.5\,^{o}$C, whereas the two scenarios estimated the annual temperature of Jordan is higher than Iraq and for all centuries. This is a contrary to the truth, for example when it is compared between observation surface air temperature of the decade for Baghdad city for time period 1981-1990 issued by the Iraqi Meteorological Organization and Seismology (IMOS) have been $22.5\,^{o}$C, while surface air temperature for the same period has been$17.7\,^{o}$C for scenario A, and $17.1\,^{o}$C for scenario C. First explain of this results have been erred in model that this model design for global region. The second possibility is that Baghdad's temperature is estimated less than observation data, the model calculate without taken height level and topography with the neighbouring countries. The model has been considered one surface level, that has meant the location of Baghdad at a one level for model, while the fact in Jordan is higher than Baghdad. The temperatures decrease with height while in neighbouring countries the level of the surface of the earth is high and the model censored to take it into under of consideration. The periods before the decade 2011-2020 are a stage in which the temperature increases up to $20\,^{o}$C in the ,while the results of this point of reversal between the previous periods and the subsequent periods to be controlled this temperature for the next 30 years is higher than the critical point and this point lies within the current period. Surface air temperature gradient is taken compared to the latitudes due to, equivalent lines are roughly paralleled to the latitudes where it is observed that the gradient is not proportional to all decade, but changes according to time As we forward towards the last decade (2040-2050) and towards the pole, surface air temperature of Baghdad city was at starter of the first decade of the study $16.8\,^{o}$C with an increase of about half a degree in each decade until reaching $21.2\,^{o}$C in the last decade of the study and this is the highest score recorded in the study for scenario A. The temperature of scenario C has been $17.8\,^{o}$C at the first of the study, which is higher than the scenario A. But here the temperatures slow rise over last time pored study as the temperature increases a little to reach $18.3\,^{o}$C in the last decade of the study and this is because simulation in the scenario C They used reductions in material density, introduction of clean technologies and efficient use of resources This leads to the maintenance of temperatures at a rate or a small increase and this is evident shown in Figure (4).
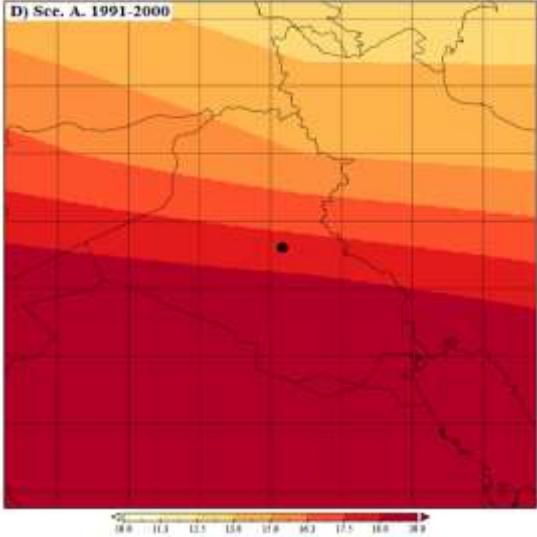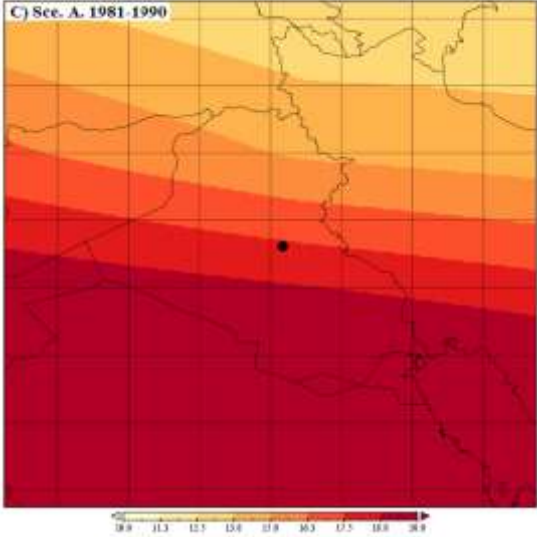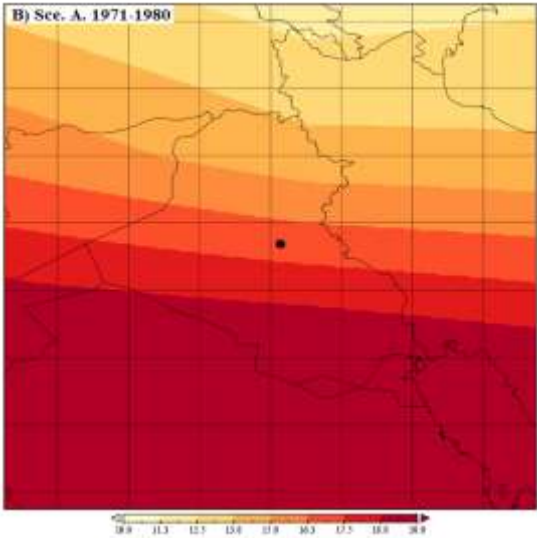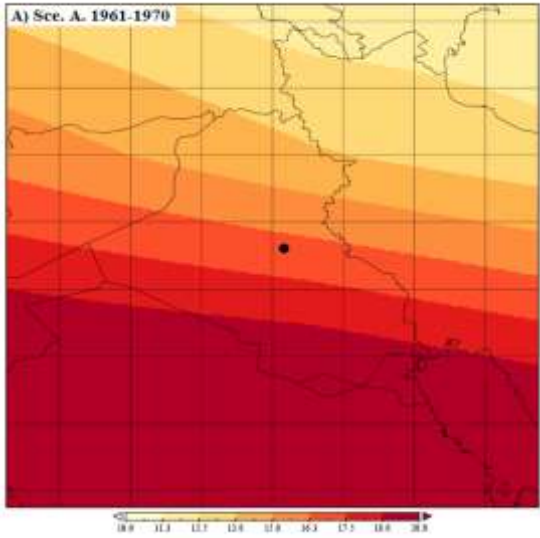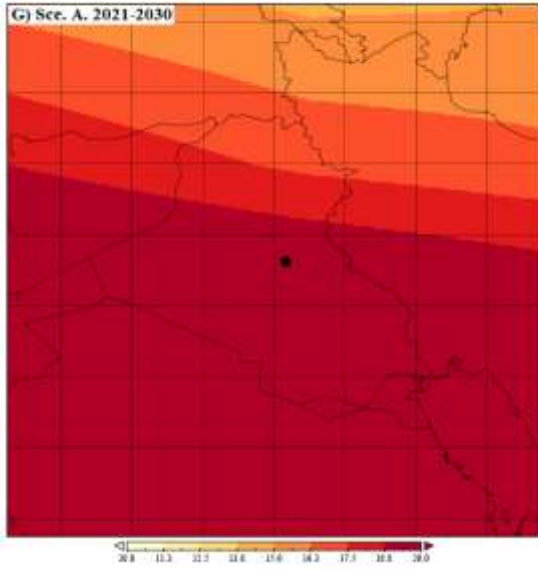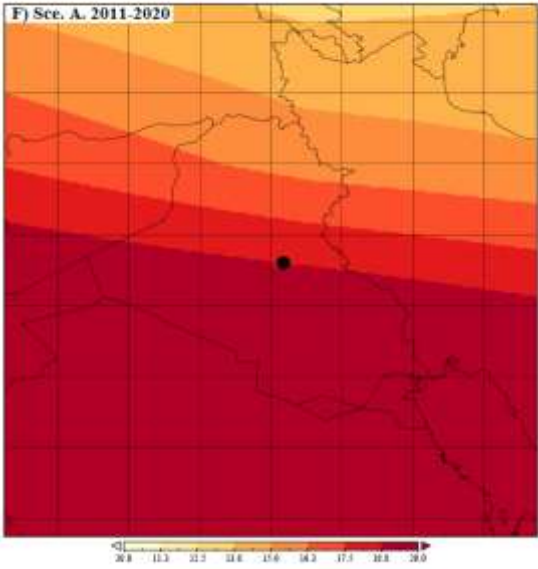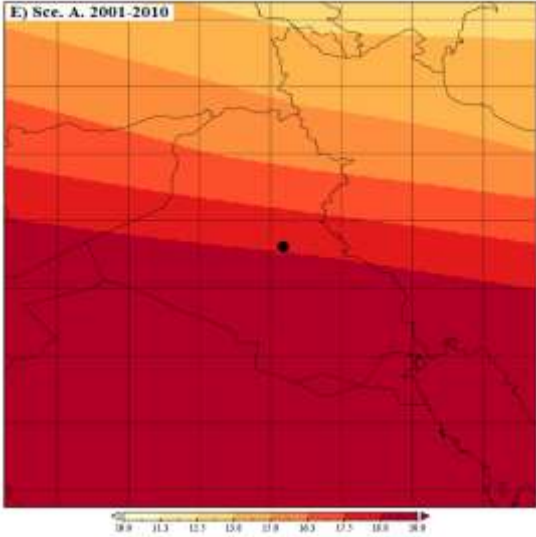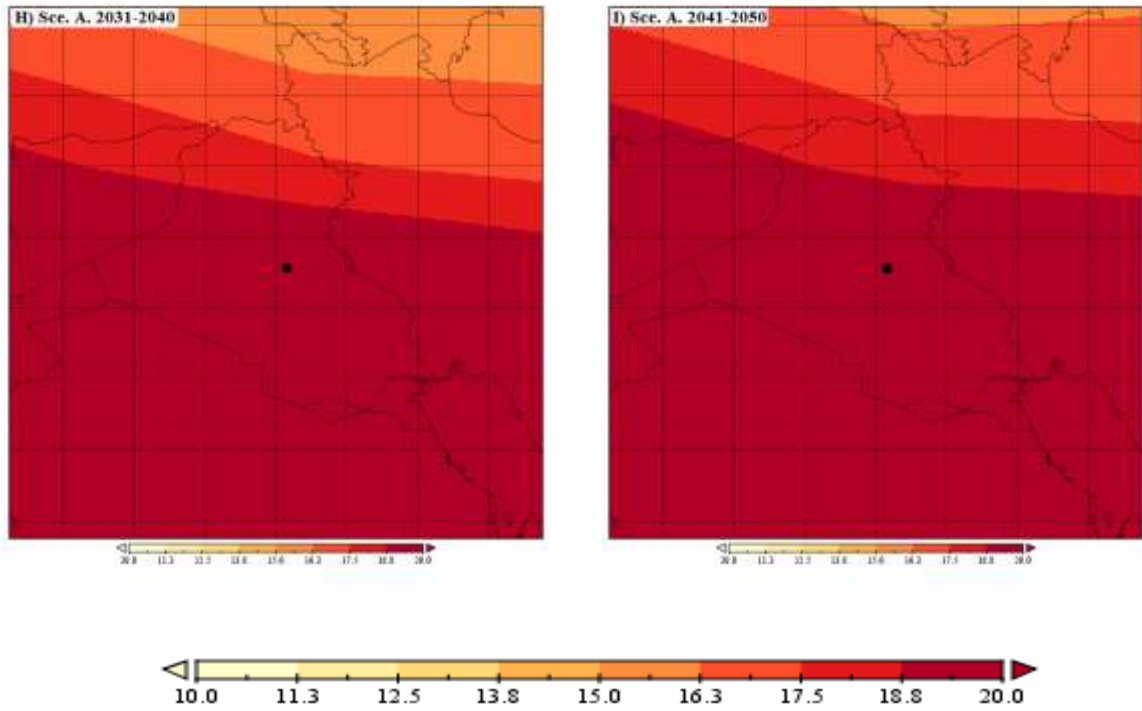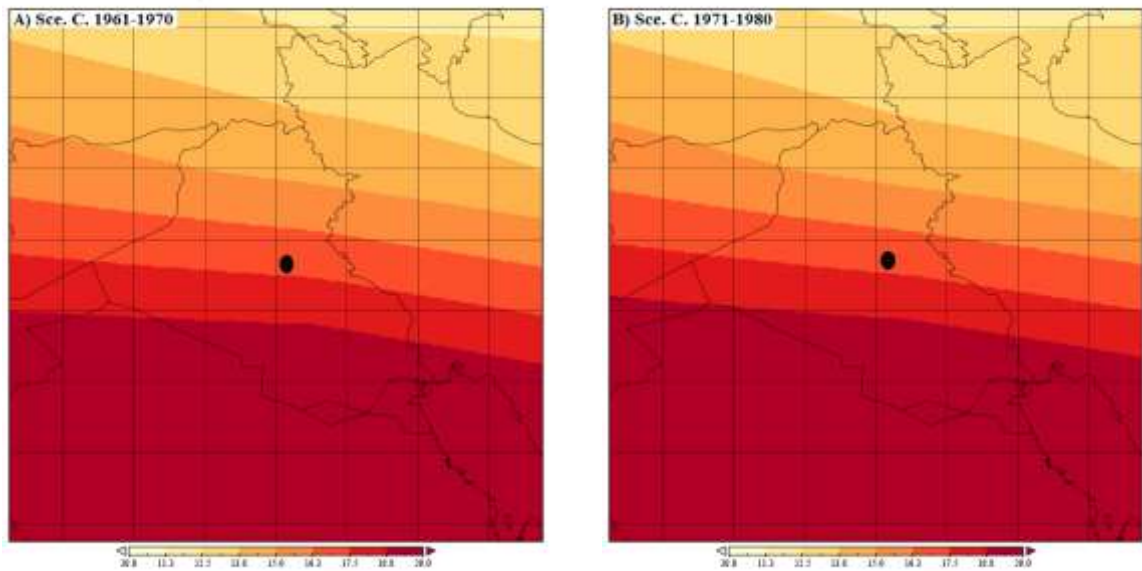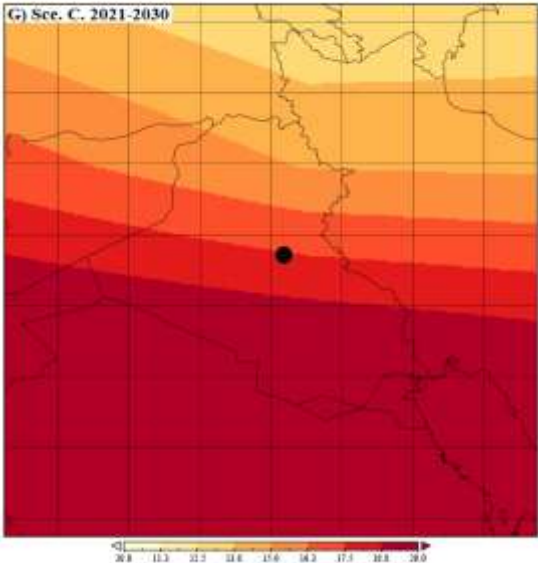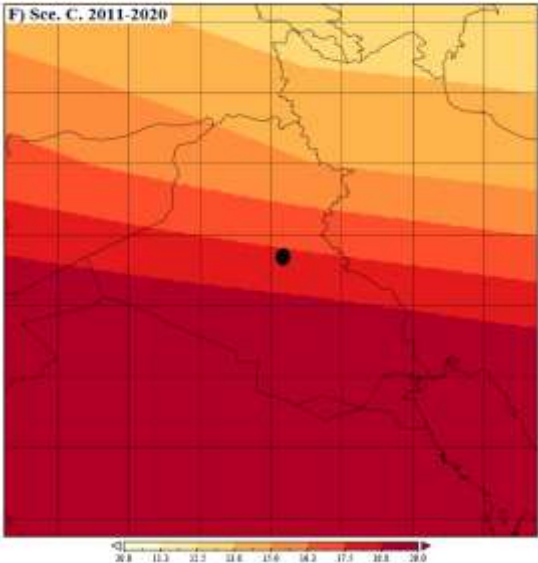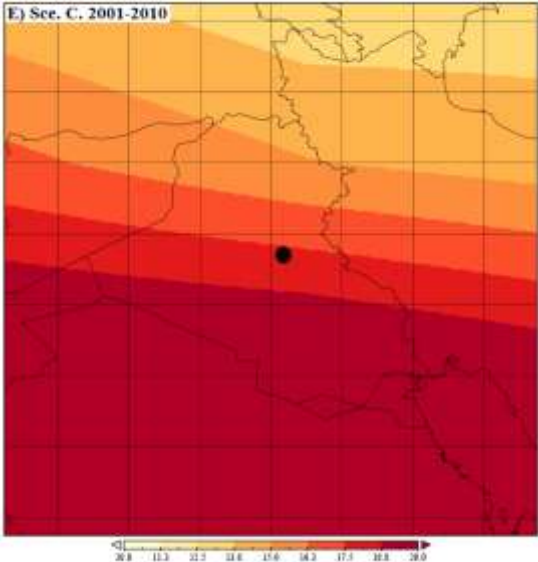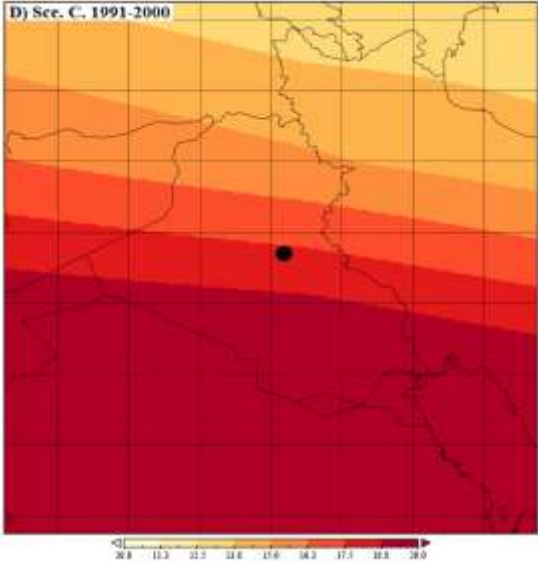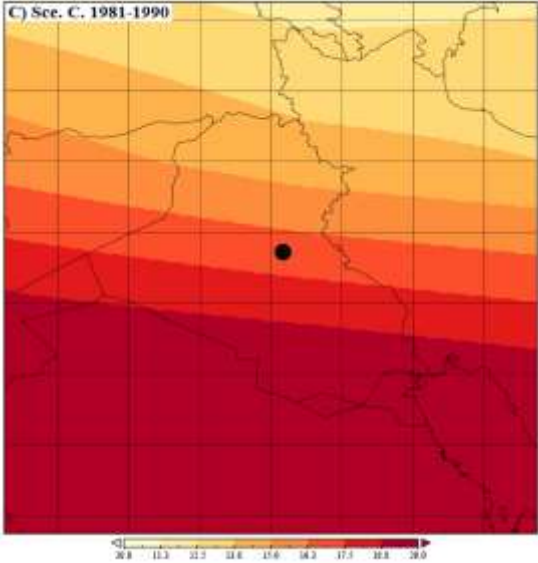
Figure (3): Decade Surface Air Temperature, Scenario **A** Shaded Interval
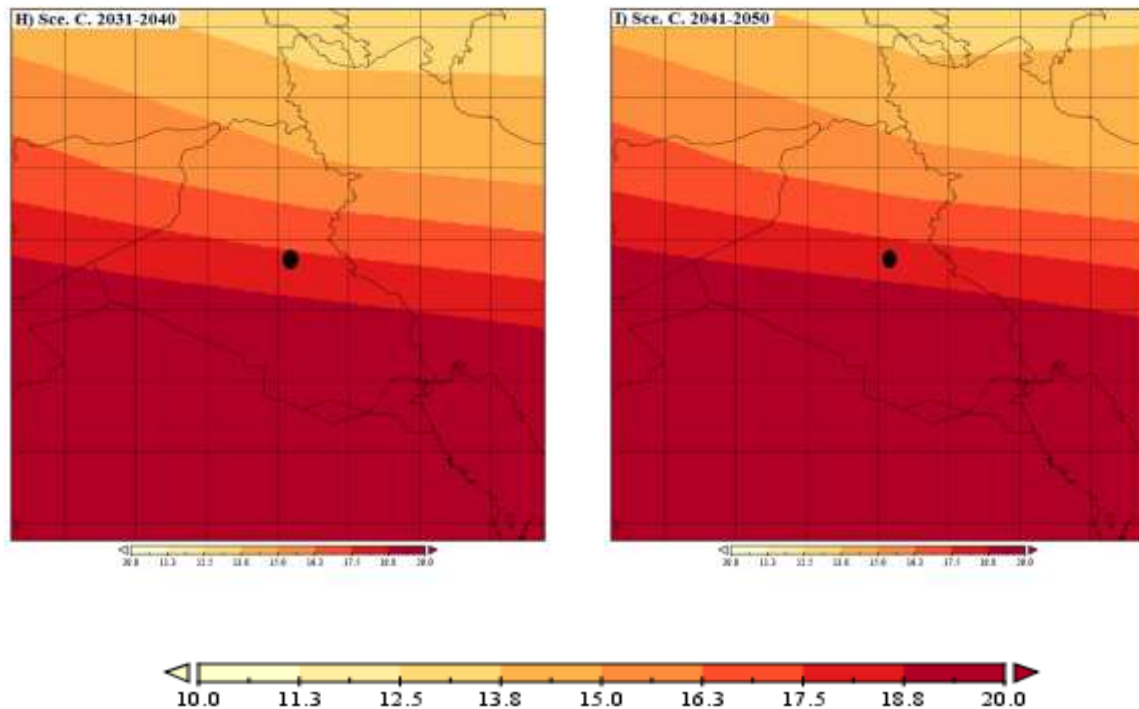
1.3 °C for Iraq.

Figure (4): Decade Surface Air Temperature, Scenario **C** Shaded Interval   1.3°C for Iraq.

The surface air temperature anomaly has been shown time series for decadal time. The variation of scenario A compared to the change to scenario C where the lowest value of scenario A is lower than the average in two degrees in 1970 and the highest value at the end of 2050, the observed from this period between 1970 and 2010 is the closest to A straight line represents a direct correlation between time change and increasing temperature As in Figure (5).

The second time period of study has been waved change to the end of the period. The reason for this difference between the two periods is that the first period enables the program's executor or the program designer to verify or verify the validity of the past period, since the real data are available in the past as opposed to the second period which have a fingerprint or a predictive indicator, but this situation is not based on all the charges, because the data is basically different about the rate, although the model is closed to the real data and the scenario C is closer to the rate that represents the zero point, for example, the starting point and end ± 0.5°C.

Anomalies method used to provides an opportunity to separate air temperature variations into two positive types, which are higher than the average and negative, which is less than the average, or the rate is known in the annual it became easy to determine the positive and negative values, The figure shows that (2020) is the point of the coup and is approaching the result obtained from the previous part is approaching zero, that is to be equal to the average.

The Scenario C has been a closer to the average of Scenario A. Although the difference in properties has been highest in the parties where the model value is higher than the model A at first of the study and the difference of 1.6°C while the model A is higher than the C at the end of the study and the difference is About 2.1°C. This result indicates that model C is the least difference between two extremes where the maximum variance is about 0.8°C for each of the characteristics of the general average. It is clear that trend the model A is larger than the model C and the model C will take the stability after the coup In contrast to model A which continues to increase.

The temperature abnormalities of a selected point in northern Baghdad are a scenario A   Baghdad city is similar to its behaviour in the last period of the study, but in the first period there is greater volatility for this point. Scenario C is

fluctuating strongly around the rate in the first half of the study in the second half of the study a semi-straight line we are can be observed in Figure (6).
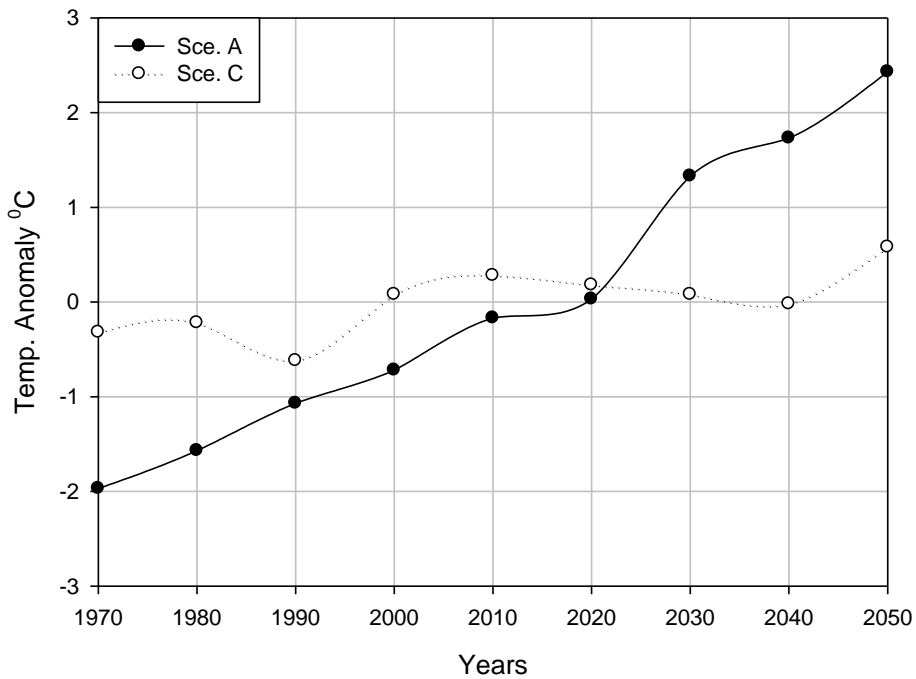

Figure (5): Time series of Surface Air Temperature Anomaly for Scenarios **A** (solid), and Scenarios **C** (dash) for Baghdad City.
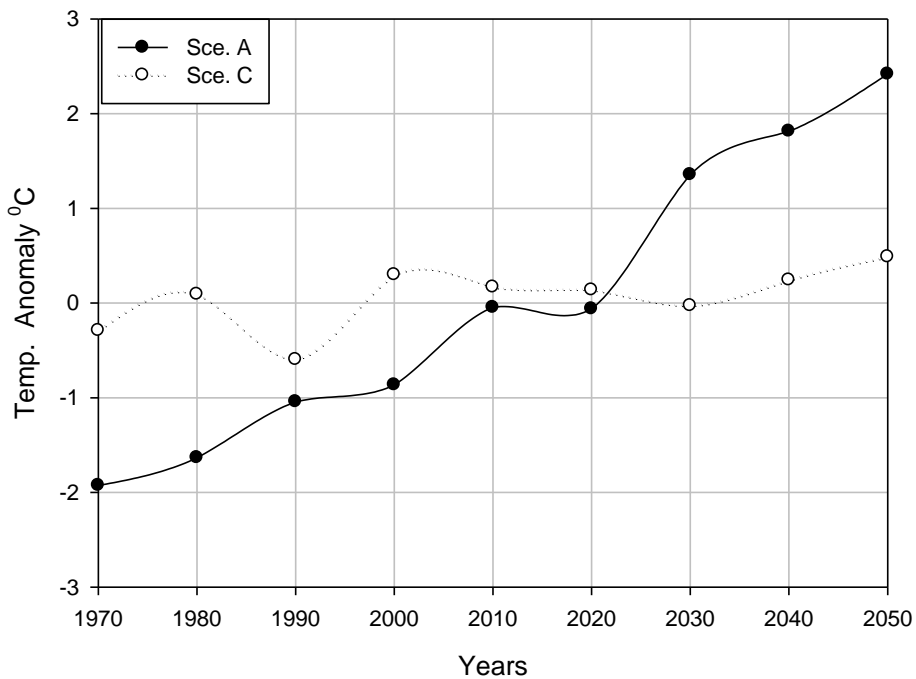

Figure (6): Time series of Surface Air Temperature Anomaly for Scenarios **A** (solid), and Scenarios **C** (dash) for case Lat. 36 – Lon. 45.

Conclusions

1. The annual surface air temperature of Baghdad city in the 1970's for scenario A has been 16.8 ℃, where the temperature abnormality has been above average 2.43 ℃, and the temperature of the air surface in 1970 was 17.4 ℃ was a temperature abnormality above average 0.58 ℃ scenario C has been conserved near to average than the future scenario of A.

2. Model scenario A has been difference between the values of the temperature anomaly of the start and end of the period is a very large difference is a greater than 3 ℃, in contrast to model C, which is ranging about the average value.

3. Surface air temperature of Baghdad City from scenario C is always greater than scenario A in the first decade 1970.

4. The pattern of temperature anomalies for scenario (A and C) for Baghdad city and the selected point north of Baghdad is three stages first, starter below the average and the temperature anomaly of scenario C is higher than the temperature anomalies for the second stage, which is the convergence of the scenarios between them and what is in the middle of the study periods, the last stage that starts with the point of the coup, after which the temperature abnormalities become a scenario of the largest temperature occurrence scenario C and are at the end of the study period.

5. The temperature Anomaly the northern point in Iraq for Scenario (A and C) are more contrast lines than the temperature anomaly of Baghdad City.

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