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Climate Change and Infectious Diseases in Funtua Local Government Area of Katsina State, Nigeria

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Abstract

This study examines the impact of climate change on the prevalence of cholera and malaria in Funtua Local Government Area of Katsina state. Monthly and

annual trends of climatic data (temperature and rainfall) and infectious diseases (cholera and malaria) from 1985-2014 were analyzed and plotted in order to determine the degree of congruence between the climatic data and the prevalence of cholera and malaria in the study area. Linear trend line equation was used in determining the monthly and annual changes in both temperature and rainfall, and the prevalence of cholera and malaria. The result revealed that as the rainfall and temperature is increasing from 1985 to 2014, likewise the occurrences of cholera and malaria diseases kept on increasing. The highest occurrences of cholera and malaria cases were recorded in 2013 and 2014, while the months of July, August, September and October recorded the highest occurrence of both malaria and cholera with a single peak in August. Further findings revealed that the yearly occurrence of the diseases for the months of July, August, September and October has been increasing from 1985 to 2014. The study recommends that people should avoid drinking water directly from ponds and rivers without been treated, and government should sink bore holes in rural communities in order to reduce the risk of cholera. Treated mosquito nets should be provided in order to reduce the risk of malaria and the monthly sanitation program should be encouraged and intensified.

Key words: cholera, malaria, rainfall, temperature, trends

1. Introduction

It is a well-established fact that climate change is one of the greatest challenges to humanity. Climate change is a change in the average pattern of weather over a long period of time. Greenhouse gases play an important role in determining climate and causing climate change (IPCC, 2007). The long term good health of a population in a given society depends on the continued stability and functioning of the ecological and physical systems of the biosphere (Bambaiha, 2009). Changes in climate, especially temperature, precipitation patterns, and extreme weather events such as floods, droughts and heat waves play a significant role in the spread of some infectious diseases, injury, death and damage to infrastructure worldwide (Bambaiha, 2009; Environment Protection Agency [EPA], 2010). For example, flooding as witnessed in some parts of Katsina state in 2012 and 2013 brought about injuries, death, and trauma as floods destroyed people's sources of livelihoods such as farmlands including farm produce and infrastructures worth millions of Naira (Abaje, Ogoh, Amos & Abashiya, 2015).

Instrumental observation for the past 157 years indicated that surface temperature have risen globally, with importance regional variation. For global average, warming in the last century has happened in two phase from the 1910s to the 1940s (0.35^{o}C) and more strongly from the 1970s to the present (0.55^{o}C) (Trenberth *et al*, 2007; Abaje, Sawa & Ati, 2014). If this warming trends continue, climate variables that have direct effects on human health, such as floods, droughts, heat waves, and other extreme weather events may become more frequent and severe (Ayanlade, Adeoye & Babatimehin, 2010).

A warmer and more variable climate leads to higher levels of some air pollutants and more frequent extreme weather events. It increases the rate and ranges of transmission of infectious diseases through unclean water and contaminated food, and by affecting vector organisms (such as mosquitoes) and intermediate or reservoir host species that harbor the infectious agent (such as cattle, bats and rodents) (Lunde & Lindtjorn, 2013).

Increases in temperature and changes in rainfall patterns have pose a risk to human health in tropical and sub-tropical countries. This is even more so because majority of the people in these areas are poor and more vulnerable to climate change because of their lower adaptive capacity for coping with and adapting to environmental challenges (Ayanlade *et al*, 2010). Changes in temperature, rainfall and seasonality compromised agricultural production in many regions of the world, including some of the least developed countries, thus jeopardizing child health and growth, and the overall health and functional capacity of adults (Lunde & Lindtjorn, 2013).

Several researches (for examples Bambaiha, 2009; Shuman, 2011) revealed that climate change affects infectious disease patterns. This is because disease agents (viruses, bacteria, and other parasites) and their vectors (such as insects or rodents) are clearly sensitive to temperature, moisture, and other ambient environmental conditions (Ayanlade *et al*, 2010; Shuman, 2011). It is against this background that the study seeks to: 1) analyze trends in temperature and rainfall and the effects on the spread of malaria and cholera in Funtua Local Government Area; and, 2) find out the months and years with the highest cases of cholera and malaria in the area.

2. Study Area

Funtua LGA (Figure 1) is located between latitude 11^{o} 12$^{'}$N to 11^{o} 70$^{'}$N and longitude 7^{o} 12$^{'}$E to 7^{o} 42$^{'}$E. It is bordered by Giwa L.G.A of Kaduna state

to the South, Faskari L.G.A to the North, Bakori and Danja L.G.As to the East and Dandume L.G to the West. Funtua has about 225,156 people as at 2006 population census (Federal Republic of Nigeria, FRN, 2010).

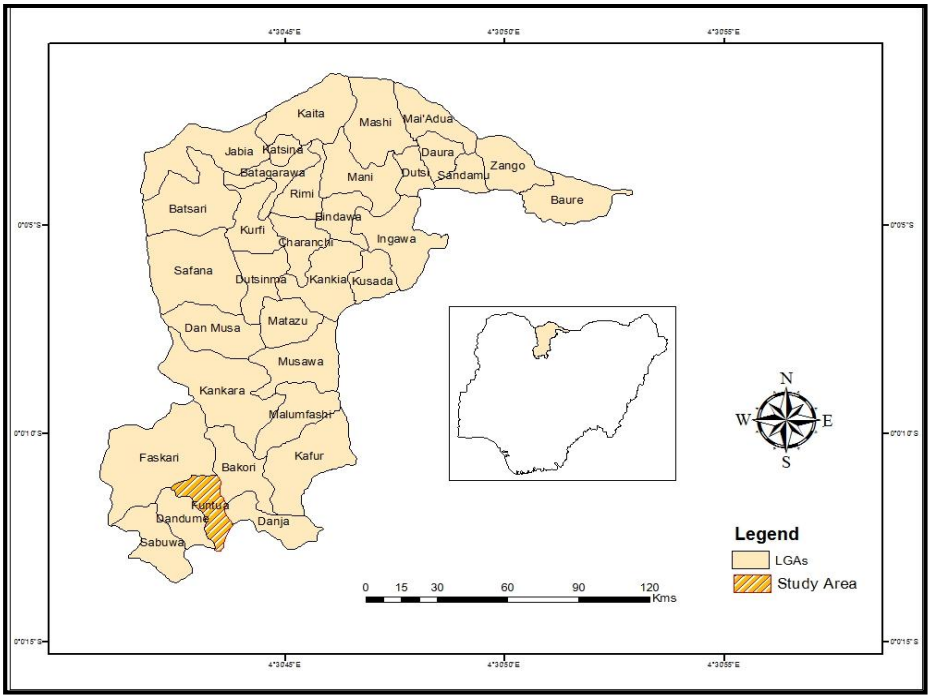

Figure 1: Map of Katsina State showing the Study Area

The climate is the tropical wet and dry type classified as Aw by Koppen. The total annual rainfall is about 1000mm. the average minimum and maximum temperature is 19ºC and 32ºC respectively. Generally, the climate varies considerably according to months and seasons. A cool dry (harmattan) season from December to February; a hot dry season from March to May; a warm wet season from June to September; a less marked season after rains during the months of October to November, which is characterized by decreasing rainfall and a gradual lowering of temperature.

The LGA is general composed of undulating plains which generally rise up to about 600-700 m above sea level. The vegetation of the area is the Sudan Savanna type which combines the characteristics and species of both the Guinea and Sahel Savanna (Abaje, 2007).

3. Materials and Method

Data for this research work were obtained from two sources. Monthly data of malaria and cholera for 30 years (1985-2014) were obtained from General Hospital Funtua, while monthly data of temperature and rainfall were collected from the Nigerian Meteorological Agency (NIMET) Zaria for a period of 30 years. The climatic data for Zaria were used for the analysis due to: 1) the absence of a well-equipped synoptic station in the study area; and 2) the study area (Funtua LGA), latitude 11^0 31'N and longitude 07^0 18'E, and where the data were collected (Zaria Synoptic Station), latitude 11^0 08'N and longitude 07^0 41'E, have the same climatic characteristics.

Monthly and annual trends analysis of the climatic data (temperature and rainfall) and infectious diseases (cholera and malaria) for the period of study (1985-2014) were analyzed and plotted in order to determine the degree of congruence between the climatic data and the prevalence of cholera and malaria in the study area. Linear trend line equation was also used in order to determine the monthly and annual changes in both temperature and rainfall and the prevalence of cholera and malaria. The data were analyzed using Microsoft Excel 2013 Tool.

4. Results and Discussion

The observed temperature and annual rainfall trends of the study area is shown in Figure 2. From the linear trend line equation, estimation of changes in average temperature expressed in ^oC for the period of study (1985-2014) showed an annual increase of 0.36^oC for the 30 years period of study at the rate of 0.012^oC $year^{-1}$. When compared with the long-term mean, the average temperature has been increasing at the rate of 0.05% $year^{-1}$. This is a clear indication that the earth's atmosphere is getting warmer in recent years. This observation is in line with the scientific consensus that the average temperature of earth's surface has risen between 0.4 and 0.8^oC in the last 100 years (Idowu, Ayoola, Opele & Ikenweiwe, 2011). The warming trend is also in agreement with the reports of other researches that the average surface temperatures have increased by 0.5°C or more during the last 50-100 years over most parts of Africa with minimum temperatures warming more rapidly than maximum temperatures (Rosenzweig *et al*, 2007; Trentberth *et al*, 2007); while over West Africa and the Sahel, surface temperatures have increased between 0.5-0.8°C between 1970 and 2010 (Niang, *et al*, 2014). The increase in temperatures is majorly as a result of increase in GHGs due to human activities as a result of

increasing technological development and subsequent high level industrialization.

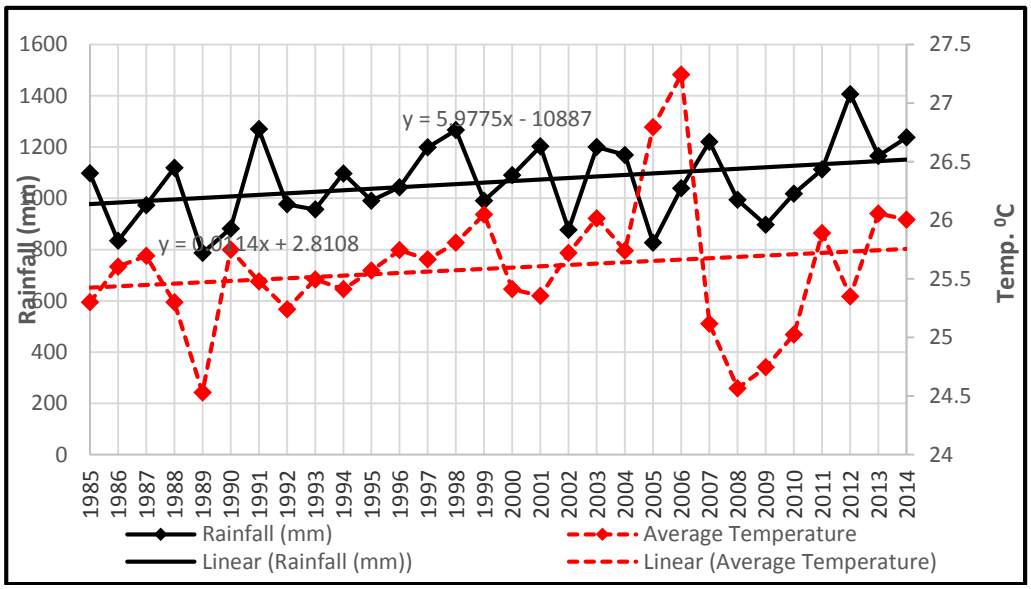

Figure 2: Annual Rainfall and Average Temperature

Estimation of changes in annual rainfall expressed in mm for the period of study (1985-2014) showed an annual increase of 179.4 mm for the 30 years period of study at the rate of 5.98 mm year^{-1}. When compared with the long-term mean, the annual rainfall has been increasing at the rate of 0.56% year^{-1}. The trend is in line with the findings of Abaje Ati & Iguisi (2012), NIMET (2012), and Abaje, Ati, Iguisi & Jidauna (2013) that the northern part of the country is now experiencing wetter conditions in recent years. This is also in agreement with the findings of Trenberth *et al*, (2007) that increases in heavy precipitation events have now been observed, even in places where total amounts have decreased and that these changes are associated with increased water vapor in the atmosphere arising from the warming of the world's oceans, especially at lower latitudes.

Figure 3 shows the trend of cholera and malaria cases in the study area. An examination of both Figures 2 and 3 show that as the temperature and rainfall is increasing from 1985 to the recent years so also is prevalence of both malaria and cholera increasing from 1985 to the recent years. This agrees with Shuman (2011) result that malaria parasites are able to develop more rapidly within mosquitoes at higher temperatures (greater than 20ºC), and that in the case of malaria due to Plasmodium falciparum, one mosquito can infect about 200 individuals if temperature conditions are ideal (higher temperature), allowing for the rapid spread of the disease. The result is also in agreement with Bambaiha (2009) that increase in rainfall often triggers outbreaks of cholera. This is because the heavy rains lead to flooding, destruction of pit latrines and contamination of water sources that serve as their main sources of water for consumption and other domestic activities in the area and hence leading to other forms of diseases like diarrhea and blue jaundice in children (Ishaya and Abaje, 2009).

A closer examination of Figure 3 shows that cholera and malaria cases were minimal from 1985 to 1993, but from 1994 there was a sharp increase in their occurrences. The highest occurrences of cholera cases were recorded in 2013 while 1985 was the year with least occurrence of cholera cases in the study area. On the other hand, 2014 recorded the highest number of malaria cases while 1987 recoded least number of malaria cases in the area. These years (1985 and 1987) with least occurrence of both cholera and malaria respectively coincided with the drought of the 1980s that ravaged the northern part of the country. This was reported in the work of Abaje *et al* (2013) that the drought of the 1987 was more severe than the driest year (1973) of the Catastrophic Sahelian Droughts of 1968-1973. This point to the fact that rainfall is one of the major determinant factors for the prevalence of cholera and malaria in the area.

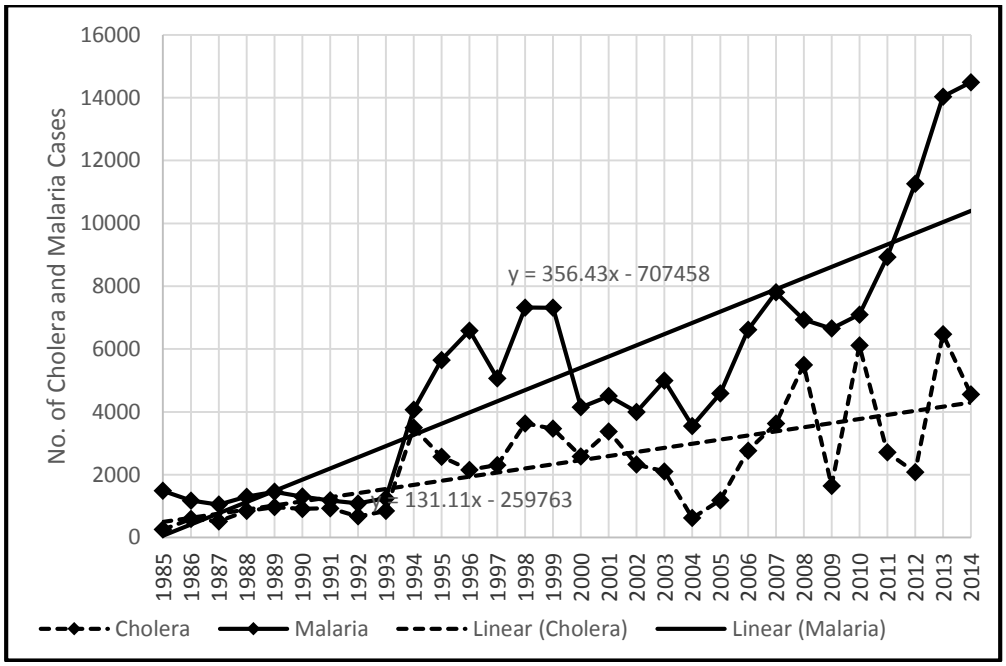

Figure 3: Annual Occurrence of Cholera and Malaria

Figure 4 shows how rainfall, temperature, cholera and malaria relate in the study area on monthly basis from 1985 to 2014. The results show a direct relationship between the amount of rainfall and the number of cholera and malaria cases recorded in the study area. The highest occurrence of both malaria and cholera cases were recorded in the months of July, August, September and October with a single peak in August; likewise the highest amount of rainfall is recorded in the months of July, August and September with a single peak in August.

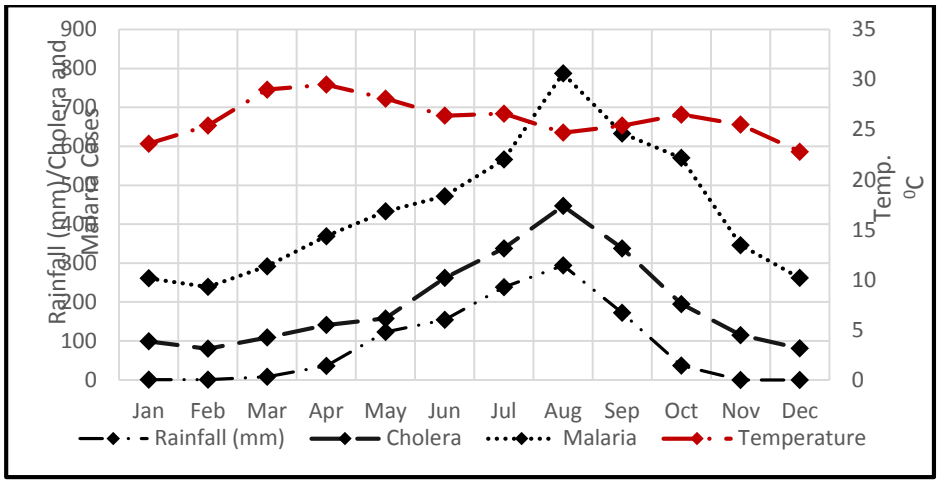

Fig. 4: Mean Monthly Trends of Temperature, Rainfall, Cholera and Malaria (1985-2014)

Findings based on this result showed the prevalence of cholera in the area may not be unconnected with the high rainfall of July, August and September. The heavy rains often triggers the outbreak of cholera because it lead to flooding, destruction of pit latrines and contamination of water sources as a result of indiscriminate waste disposal along water bodies and the subsequent consumption of the contaminated water by the people. Climate change characterized by increased rainfall also lead to growth of grasses and availability of stagnant water in their surrounding that serve as breeding places for mosquitoes during the rainy season. This partly explains the increased malaria cases and epidemics in the area. The role of temperature in determining the prevalence of these infectious diseases (cholera and malaria) in the study area is minimal when compared with rainfall.

5. Conclusion and Recommendations

Climate change plays a significant role in the prevalence of both cholera and malaria cases in the study area. If climate change continues unabated, it is likely that the range of these deadly diseases (malaria and cholera) will expand or shift resulting in death as populations without pre-existing immunity are increasingly affected. This research also found out that rainfall is the major determinant factor for the prevalence of cholera and malaria cases in the study area. As the rainfall amount increases from the beginning of the study period (1985) to the recent years, so also the number of cholera and malaria cases increase. The highest amount of rainfall is recorded in the months of July, August and September with a peak in August likewise the highest

occurrences of both malaria and cholera are also recorded during these months with a peak in August.

The study recommends the reduction in greenhouse gas emissions which is the major cause of climate change; that laws should be enacted on indiscriminate waste disposal along water channels in the area, and the monthly environmental sanitation should be encouraged and strengthened. People should ensure that there is no any stagnant water around their surrounding and grasses should be cleared. Also, the use of mosquito nets should be encouraged. Government should assist in the sinking of bore holes in rural communities, and people should also be ensured that water obtained from ponds is treated before consumption. Lastly, there is need to carry out research on the impact of climate change on measles and meningitis in the area.

References

Abaje, I.B. (2007). *Introduction to Soils and Vegetation*. Kafanchan: Personal Touch Productions, (Chapter 8).

Abaje, I.B., Ati, O.F. & Iguisi, E.O. (2012). Changing Climatic Scenarios and Strategies for Drought Adaptation and Mitigation in the Sudano-Sahelian Ecological Zone of Nigeria. In M.A. Iliya and I.M. Dankani (Eds). *Climate Change and Sustainable Development in Nigeria.* Ibadan: Crown F. Publishers.

Abaje, I.B., Ati, O.F., Iguisi, E.O., & Jidauna, G.G. (2013). Droughts in the Sudano-Sahelian Ecological Zone of Nigeria: Implications for Agriculture and Water Resources Development. *Global Journal of Human Social Science (B): Geography, Geo-Sciences & Environmental.* 13 (2): 1-10.

Abaje, I.B., Ogoh, A.O., Amos, B.B. & Abashiya, M. (2015). Climate Change, Flood Disaster Assessment and Human Security in Katsina State, Nigeria. *American Journal of Human Ecology*, 4(4): 47-56. DOI: 10.11634/216796221504699.

Abaje, I.B., Sawa, B.A. & Ati, O.F. (2014). Climate Variability and Change, Impacts and Adaptation Strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology,* 6 (2): 103-112.

Ayanlade, A., Adeoye, N.O., & Babatimehin, O. (2010). Global climate change impacts on human health in sub-sahara Africa. *Global Journal of Human*

Social Science (B): Geography, Geo-Sciences & Environmental. Vol. 14 online. ISSN 2249-460x.

Bambaiha, N.D. (2009). An Assessment of the Impact of climate change on the Health Sector in Uganda: A case of Malaria and Cholera epidemics and how to improve planning for effective preparedness and response. Retrieved September 6, 2015 from http://www.health.go.ug/docs/climate.pdf

Environmental Protection Agency, EPA. (2010). Climate change Science Fact. U.S Environmental Protection Agency, Washington, DC, USA.

Federal Republic of Nigeria [FRN] (2010). Federal Republic of Nigeria 2006 Population and Housing Census. Priority Table Vol. III. Abuja: National Population Commission

Idowu, A.A., Ayoola, S.O., Opele A.I. & Ikenweiwe, N.B. (2011). Impact of Climate Change in Nigeria. *Iranica Journal of Energy & Environment* 2 (2): 145-152.

IPCC. (2007). *Climate Change 2007: Synthesis Report*. In Pachauri, R.K and A. Reisinger, A. (Eds.). Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (104 pp). Intergovernmental Panel on Climate Change, Geneva, Switzerland.

Ishaya, S. & Abaje, I.B. (2009). Assessment of bore wells water quality in Gwagwalada town of FCT. *Journal of Ecology and Natural Environment*, 1(2): 032-036.

Lunde, T.M. & Lindtjorn, B. (2013). Cattle and climate in Africa: How climate variability has influenced national cattle holding from 1961-2008. Retrieved September 6, 2015 from https://dx.doi.org/10.7717/peerj.55

Niang, I., Ruppel, O.C., Abdrabo, M., Essel, A., Lennard, C., Padgham, J., and Urquhart, P. (2014). Africa. *Climate Change 2014: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. United Kingdom and New York, NY: Cambridge University Press.

Nigerian Meteorological Agency (NIMET). (2012). Introduction. *2012 Nigeria Climate Review* (pp. 6-7). Nigerian Meteorological Agency (NIMET), Abuja.

Rosenzweig, C., Casassa, G., Karoly, D.J., Imeson, A., Liu, C., Menzel, A.,…Tryjanowski, P. (2007): Assessment of Observed Changes and Responses in Natural and Managed Systems. In Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (Eds.), *Climate Change 2007: Impacts, Adaptation and Vulnerability*, (pp. 97-131). Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

Shuman, E.K. (2011). Global Climate Change and Infectious Diseases. *Review*, 2(1): 11-19.

Trenberth, K.E., Jones, P.D., Ambenje, P., Bojariu, R., Easterling, D., Klein Tank, A.,… Zhai, P. (2007). Observations: Surface and Atmospheric Climate Change. In: Solomon, Qin, S., D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L. (Eds.). *Climate Change 2007: The Physical Science Basis*, (pp: 235-336). Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). United Kingdom and New York, NY: Cambridge University Press. Lambeck, K. (2010). The science of climate change: Questions and Answers. Australian Academy of science, Canberra.