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Research Article

# Effect of Climate Change and its Impact on Monsoon Rain Fall in India

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## Abstract

Many researchers broadly agreed that the increase in temperature is due to anthropogenic changes. Many scientists have discussed the relation between global warming and climate change. It is also observed that the variability in rainfall and cyclonic pattern are associated with global warming. In the present study, the author investigates the impact of climate change on the southwest monsoon rainfall in India. There are frequent changes and a shift westward of the Indian summer monsoon. The rainfall dipped by 70% from the normal level and the rainfall intensity was affected in some regions. The variability of rainfall and onset of monsoons are due to the shifting phenomenon of other monsoon seasons in the region. It was also observed that the onset of monsoon was delayed by at least 15 days. The decadal variability of southwest monsoon rainfall and the variability in frequency and intensity of flooding during the monsoon season have an impact on the human, financial, infrastructure and food security in India.

## Introduction

The Earth's system is dependent on the circulation of precipitation globally, which modulates the Earth's temperature by transferring the heat from the tropics to the higher latitudes. This system is defenseless to long-term variations in temperature, which is termed climate change. The research is going on in measuring the relation between climate change and environmental systems. One of the highly dependent upon weather system is the southwest monsoon season of India. Though much of literature on interactivity of the monsoon seasons is available,

the impact of climate change with respect to increasing temperatures on monsoon rainfall intensities in India has not addressed extensively.

In the present study the author presents the relation between an increase in precipitation and global warming and understanding the impact of climate changing trends on southwest monsoon of India rainfall and its unpredictability. The studies on climate change are with reference to the temperature anomalies from the 20th century to early 21 century and the rainfall variability of the southwest monsoon examined with reference to the seasonal rainfall variance. The temperature records of last century have been analyzed to understand the effect of climate change from the overall variation. The distribution of temperature and its effect on the southwest monsoon precipitation of India. To understand the effect on the southwest monsoon rainfall distribution over India the southwest monsoon pattern was studied and presented. The random nature of the southwest monsoon caused the damage of farmlands, livestock and financial losses, which lead to insecurity in food supply. Thus, the predictability and understanding the southwest monsoon pattern of India is utmost important. (Reuter et.al 2012).

## Climate change and climate variability

Climate change is a natural phenomenon which is continuous and a long-term procession, which is statistically important. The extensive burning of fossil fuels, disproportionate emission of greenhouse gases and urbanizations are the main causes of global warming. (Y.Yloo et. al). Climate changeability is concerned with the standard deviation, extremities and the shape of the frequency distribution of the climate elements in space and time (Serreze and Barry, 2010). The temperature records from early to 1850s are treated untrustworthy to be used to infer the climate change, due to the erraticism of data collection methods.

The temperature anomalies, the deviation from the reference temperature (NOAA, 2012b), are used as means to compare the change in temperatures. The positive value shows a higher temperature, and a negative value indicates a lower temperature from the reference value, which are the average values of the climate element over a period of 30 years. An increase in temperature has been observed after the last decrease from 1945to 1973 (Brohan et.al., 2006). The anthropologically associated carbon emission and urbanization are muscularly forced an exponential growth. The raise in temperature has an instantaneous effect on rainfall distribution of southwest monsoon. The total annual amount of global rainfall was studied and presented by NOAA-NCDC (2011) (Fig.1), which shows not only changes with respect to time, but also with respect to the global rainfall averages. It is also observed that during 1950 to 1970, the negative precipitation anomalies are more frequent and later on the oscillating nature of rainfall is due to the increase in the global air temperature. As a result, we can conclude that there is a dependency of rainfall on the increasing temperatures globally.

## Monsoon Weather Systems

The monsoon weather systems are resultants of land sea temperature variations due to the solar radiation, whereas the seasons are formed due to the tilt in earth's rotation (Huffman et .al, 1997). As the Earth rotates and revolves around the Sun, the land surface area at the northern hemisphere warms up greater than the southern hemisphere due the difference in the land surface area of the hemispheres. As a result, a variation in season between the northern and southern hemispheres, which are separated by a boundary over the South China Sea (Kripalani and Kulkarni, 1997). The rapid cooling followed by a dip in pressure are caused by the less solar radiation at northern hemisphere

are the results of the tilt in earth. The southwest monsoon rainfall is modulated by the warm northern hemisphere, where the heated air will rise and transported towards the southern hemisphere by monsoonal winds (Wolfson 2012).

The Southeast Asian countries comprise East India, South China, Myanmar, Thailand, Vietnam, Laos, Kampuchea, Malaysia, Singapore, Indonesia, Borneo, the Philippine islands, Portuguese Timor and western New Guinea are influenced by the monsoon which is a 'large-scale seasonal reversal of the wind regime'. Most of the monsoonal areas receive to a highest of double maximum rainfalls. Monsoon rainfall can also affect regions that were not originally considered as monsoonal. The two main monsoon regimes are specifically named the northeast monsoon (winter monsoon) from November to March, and the southwest monsoon (summer monsoon) from late May to September. Furthermore, October is the transition month from the southwest to northeast monsoon seasons (Cruz et al., 2012). The semipermanent system that accumulates cold, dry air in Northeastern Siberia, which reaches maximum intensity in winter that causes the lowest temperatures and highest pressures in weather systems. Interesting factor that influences the monsoon rainfall onset dates is the Himalayan uplift, or the Tibetan Plateau (Kilaru et al., 2013). The rate of growth of the Tibetan Plateau is faster than its erosion process possibly (Mishra and Kumar, 2014). The decrease in rainfall over major parts of the region may account for the slow erosion processes. This has been argued as a factor that promoted the monsoon strengthening in Asia. The increased convection at high temperatures results in more rainfall at the leeward region, which may be a contributor of the flooding in Indian regions.

**Monsoonal changes due to increase in temperatures.**

The frequent changes and shifts to the monsoon precipitation in the later part of 21st century and early part of 22nd century is due to the increase in temperatures, which affects the Indian summer monsoon (Schewe ad Levermann 2012). The increase in temperature also a cause in delayed monsoon upto 15 days Asfaq et al, 2009. The extent of these distributional changes in the monsoon and of the climate have been depicted in the fig4.a and b, which is harmful to the Indian agriculture sector, as 75% of the total rainfall of India is from the summer monsoon. On the other hand, northeastern India and Bangladesh received an early monsoon onset and experienced maximum flooding, that caused huge death toll (Coenraad's, 2006). The spatio- temporal distribution of monsoon is dependent on the strength of the monsoon system and also the small-scale circulations, which are more susceptible (Rajeevan et.al., 2008). Kriplani and Kulkarni, 1997; Ranatunge et.al., 2003; Sivaram and AALNSarma, 2008 have linked the monsoon variability with the ENSO and LNSO in their studies. Turner (2013) found that the monsoonal rainfall in India will increase during LNSO. There is no doubt that precipitation patterns have changed globally in recent. increasing intensities of rainfall during the monsoons are not only a source of major flood but also a triggering cause of major landslide event. The World Bank (2011) estimated the economic damages and losses due to the flooding, to be US$ 45.7 Billion. According to Coenraads (2006) these broad-scale floods covering large areas and caused by monsoon rains are also mostly common in Northeastern India. However, India receives yearly monsoon rainfall during the wet season from June to end of September.

## Conclusions

It is apparent that the distribution of monsoon rainfall is greatly influenced by a number of weather systems, such as increase in temperatures, ocean atmospheric interactions such as ENSO and LNSO, and topography. Increasing in number of monsoonal floods in India is an issue to overcome. Understanding the shift and predicting changing trends of monsoon may be central to managing the floods that impact on millions of people, damage to lives and property, destruction of ecology and farmlands and the long-term effect on food security.

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**Figure1:** Global Temperature anomalies.

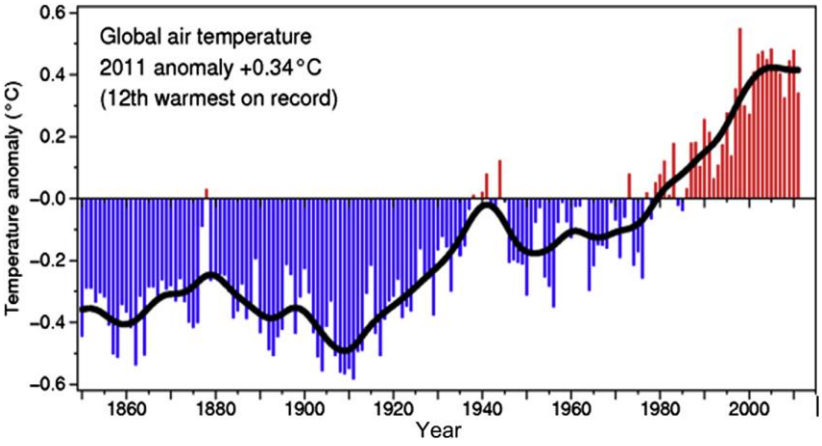
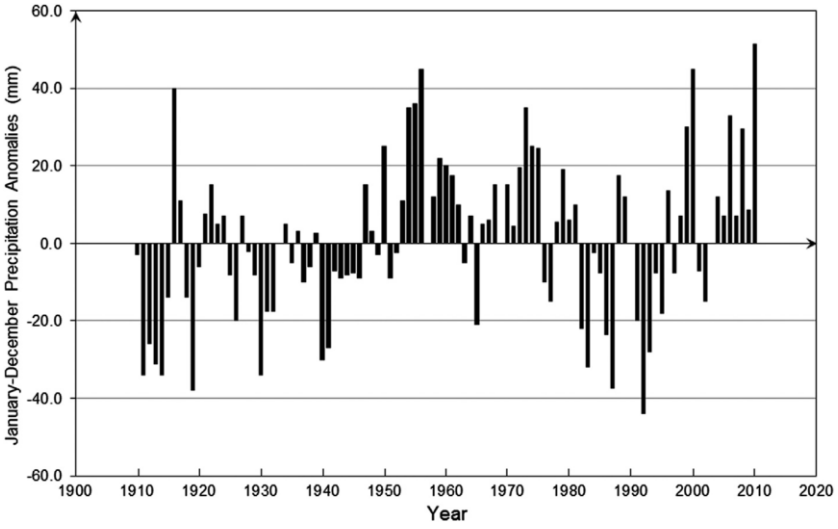



**Figure 2:** Global rainfall anomalies.

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