

## RESEARCH ARTICLE

# CHARACTERISTICS AND IMPACTS OF EXTREME PRECIPITATION UNDER CLIMATE CHANGE: BASED ON CNKI LITERATURE INVESTIGATION

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## ARTICLE DETAILS

## Article History:

Received 20 April 2022  
Accepted 24 May 2022  
Available online 27 May 2022

## ABSTRACT

Extreme precipitation event is one of the most extensive and harmful meteorological disasters in China and even the world. Discussing the research situation of extreme precipitation under the background of climate change can grasp the research status and hot spots in this field from a macro perspective and provide a reference for in-depth understanding of the causes and trends of extreme precipitation. Since 1992, the research on extreme precipitation has been gradually carried out, so this study systematically counts and analyzes the scientific literature from the CNKI database from 1992 to 2022 by bibliometric. It shows that the frequency and intensity of extreme precipitation events increase in the China monsoon region, and the regional differences are obvious. It also has a great impact on agricultural production and vegetation coverage. In addition, in recent years, scholars have gradually carried out research on the relationship between extreme precipitation and atmospheric circulation, especially the relationship between the spatial and temporal characteristics of extreme precipitation and ENSO events, which has become a new research hotspot. It is suggested that future studies should comprehensively analyze various influencing factors, quantitatively analyze the impact of extreme precipitation on agricultural production and vegetation coverage, and put forward corresponding solutions.

## KEYWORDS

Climate Change, Extreme Precipitation, Literature Investigation

## 1. INTRODUCTION

In recent years, climate change with warming as the main feature and its impact on nature and human society has become a global issue of common concern to the international community, governments and the scientific community (Huang et al., 2019). The Second Working Group of the Sixth Assessment Report (AR6) issued by the Intergovernmental Panel on Climate Change (IPCC) elaborated on the current and future impacts and risks of climate change, adaptation measures, development of climate resilience, and the importance and urgency of transformation of industrial and social systems (Wu 2022).

Persistent global warming will cause great changes in the water cycle, and heavy precipitation events are likely to become stronger and more frequent. The frequency of heavy precipitation events accelerates with the increase of global warming, and the more extreme the heavy precipitation events, the greater the percentage of increase in their frequency (Zhou and Qian 2021).

Currently, scholars have carried out a lot of research on the characteristics and trends of extreme precipitation based on different spatial and temporal scales, and a wealth of research results have been achieved. Ren et al. Used grid data to discuss the change of extreme precipitation events in southern China from 1961 to 2011 (Ren et al., 2014). She et al. made use of the daily precipitation observation data of 27 meteorological stations in Huaihe River Basin from 1960 to 2009 and analyzed the temporal and spatial variation trend of annual extreme precipitation events and the statistical characteristics of precipitation extremes in

Huaihe River Basin (She et al., 2011). Li et al. used Mann-Kendall method to evaluate the spatial distribution and temporal variation characteristics of extreme precipitation events in the Loess Plateau (Li et al., 2010).

Although the above studies have comprehensively summarized the progress of extreme precipitation under climate change, they lack a clear and intuitive overview of the characteristics and impacts of extreme precipitation literature under climate change. The research on extreme precipitation based on climate change has been developing and deepening, but there is no report on the characteristics and impacts of extreme precipitation in this field. How to comprehensively and intuitively answer the question of the development and change characteristics of extreme precipitation under climate change and its impact on various elements of the ecosystem? Based on the method of literature investigation, this study makes a more comprehensive quantitative statistical analysis of the literature on extreme precipitation collected by CNKI.

## 2. RESEARCH DATA SOURCES AND METHODS

## 2.1 Data Sources

The data in this study are selected from China Journal Full-text Database (CNKI). In terms of data collection, "extreme precipitation event" is taken as the retrieval subject, and the search time period is "1992-2022". The types of documents retrieved include academic journals, dissertations and conferences. The study area is the China monsoon region. The data was collected on May 5, 2022, and a total of 547 valid documents were

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DOI:  
10.26480/esmy.02.2022.112.113

obtained. Among them, there are 391 academic journals, 84 dissertations and 72 conferences. The record contents of each document include title, author, institution, abstract, keywords, publication year, publication journals and references. This study focuses on the characteristics of extreme precipitation in various regions, its relationship with atmospheric circulation, and its impact on crops and urban population.

## 2.2 Research Methods

The study mainly adopts the method of literature research, combining quantitative research and analysis of the literature data obtained, to achieve the goal of summarizing and analyzing the characteristics and impacts of extreme precipitation under climate change. However, there are some defects in the literature itself, such as many authors have certain ideological tendencies, the retained literature has been screened or the viewpoints are incomplete, there are still some shortcomings in this study.

## 3. RESULTS

### 3.1 Extreme Weather Characteristics Based on Literature Analysis

In order to better understand the characteristics and evolution trends of extreme precipitation under climate change, 547 articles selected from CNKI database were analyzed, of which 275 systematically expounded the characteristics of extreme weather. And it has been cited 2903 times by the end of retrieval. The research mainly focuses on the spatial and temporal variation characteristics of extreme precipitation in the Yangtze River and Yellow River basins, in addition to Shandong, Heilongjiang and other provinces. Based on the comprehensive analysis of the literature, it is found that from the perspective of precipitation geographic space, in the east monsoon region of China, the frequency and intensity of extreme precipitation events increased, and the regional differences are obvious. The extreme precipitation index in most parts of North China is decreasing, while that in the middle and lower reaches of the Yangtze River and South China is increasing. From the perspective of time change, that in Northeast China and the northern part of North China increased significantly in spring, and it also increased in autumn in North China, while in summer, extreme precipitation is mainly concentrated in the south region of China.

### 3.2 Impact of Extreme Weather Based on Literature Analysis

Through literature analysis, it is concluded that the studies mainly focus on the impact of extreme precipitation on agricultural production and vegetation, and it shows that extreme precipitation will significantly reduce the net ecosystem productivity and total primary productivity of farmland, while the impact of extreme climate on vegetation cover is manifested in the increasing trend of NDVI in coastal areas and sub-regions of China. It is expected that this trend will continue in the future. In addition, some scholars focus on the impact of extreme precipitation on cities and population and propose to build sponge cities and strengthen the construction of resilient cities. At the same time, the research on the impact of extreme precipitation on water resources is increasing, and the total amount of water quality and water resources will be affected by rainfall to a certain extent. In addition, some studies focused on the impact of extreme precipitation on HFMD. Ai et al. used Poisson regression model to research the relationship between extreme precipitation events and the incidence of HFMD in children aged 0-14 years in Guangyuan City from 2008 to 2011 and concluded that relevant departments should do a good job in the prevention and control of HFMD in late spring and early summer. It is necessary to strengthen the prevention and control of HFMD in children after extreme precipitation events, especially for girls, 2-year-old children and 5-14-year-old children (Ai and Jiang 2017).

### 3.3 Research Trends Based on Literature

Traditional research focuses on the characteristics of extreme precipitation in various regions, and its impact on agricultural production and vegetation coverage, but there are few studies on its causes and the relationship with atmospheric circulation. With the in-depth study of it, the research field is also expanding. It began to focus on the relationship with other meteorological factors such as temperature, and had a new understanding of its causes, not only to study the impact of global warming on extreme precipitation, but also to expand its vision to the characteristics of extreme precipitation under the combined effect of

global change and urban effects. In addition, in recent years, scholars have gradually carried out the research on the relationship between extreme precipitation and atmospheric circulation, especially the correlation between the spatial and temporal variation characteristics of extreme precipitation and ENSO events.

## 4. CONCLUSIONS AND RECOMMENDATIONS

According to the research results, the research on extreme precipitation under climate change is mainly concentrated in the field of meteorology, because the characteristics of extreme precipitation will be affected by geographical location, there are obvious regional differences, so meteorology can make full use of meteorological data from different stations to study the characteristics of extreme precipitation and analyze its impact. On the whole, the frequency of extreme precipitation events in the monsoon region of eastern China has increased, mainly due to the increase of precipitation frequency and intensity in southern China, while the frequency in North China and Northeast China has decreased, and it also indicated that the abnormal warming of the Western Pacific Warm Pool is the main reason for the above characteristics.

The warm phase of the Pacific Decadal Oscillation and ENSO events are also correlated with extreme precipitation events. The impact of extreme precipitation events is mainly concentrated in the agricultural ecosystem and food production, because the agricultural ecosystem itself is relatively fragile, poor self-regulation ability, under the background of global warming. The increase of extreme weather increases the vulnerability of agricultural ecosystem, which is greatly affected by extreme precipitation events. Although research on extreme precipitation under climate change has been widely concerned, compared with other fields, the research foundation is relatively weak and the overall level is still relatively backward.

For the research in this field, there are still many directions that need to be broken through, such as the vast territory of our country, the great differences between the north and the south, and the different performances of it in the north and the south region. Therefore, how to study different regions and combine complex impact factors is an important consideration in future research. In addition, how to quantitatively analyze the impact of extreme precipitation on cities and population, and how to deal with extreme weather, are all academic frontier issues that need to be studied and broken through.

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