

Natural Disasters and Average Temperature in China

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Abstract

As the global climate change intensifies, it has led to more frequent and intensified natural disasters in China. Here we employed a linear regression to analyze the relationship between the frequency of natural disasters and the average temperature of 194 national stations in China from 1951 to 2011. The results indicate that earthquake (seismic activity), flood and storm are strongly affected by the climate. If the average temperature in China increases by 1 °C, the occurrence of earthquake (seismic activity), flood and storm would increase by 2, 4 and 4 occurrences per year respectively.

Keywords: Climate change, natural disasters, average temperature, linear regression.

Introduction

In recent years, natural disasters have happened more frequently around the world and caused enormous losses of life and property to human society. In 2011, natural disasters left 29782 people dead or missing and caused damages of about \$3360 billion worldwide¹.

China is among the countries that have been affected most frequently by natural disasters. During the 11th Five-year Plan Period, China encountered several most severe natural disasters since the foundation of the People's Republic of China in 1949. Grave disasters such as freezing rain and snow in southern China, Wenchuan earthquake, Yushu earthquake and Zhouqu extra-large mountain torrents and debris flow happened in succession². Serious floods, droughts, geological disasters, typhoons, hailstorms, high temperatures, heat waves, sea ice, snow disasters and forest fires broke out from time to time, which have threatened the economic and social development in the affected regions and the whole nation at large². Studies have shown that as climate change intensifies, it has led to more frequent and intensified natural disasters in China³.

A qualitative analysis between natural disasters and average global temperature has been described⁴; however, quantitative analysis of natural disasters and average temperature in China is still scarce and will be helpful. Because average temperature is considered a major driving force of climate change, we conducted a linear regression to analyze the relationship between natural disasters and the average temperature in China.

Data Source and Regression Analysis

The dataset of natural occurrence was derived from the

Emergency Events Database⁵. Statistics of natural disasters from 1951-2011 are shown in table 1. There are 10 types of natural disasters in EM-DAT: drought, earthquake (seismic activity), epidemic, extreme temperature, flood, insect infestation, mass movement dry, mass movement wet, storm and wildfire. Earthquake (seismic activity), flood and storm are the three major types of natural disasters, making up to 84.13% of total occurrences over the sixty-one-year period. The total affected population was 2.98 billion and the total estimated damage was US \$362 million.

The average temperature in this study was compiled from the month average temperature data from 1951 to 2011 of 194 stations in China meteorological Data Sharing Service System⁶. We chose the annual average temperature in China as the independent variable and the natural disaster occurrence as the dependent and then analyzed the relationship between the annual average temperature and the natural disaster occurrence.

Results

The results are shown in table 2. All kinds of natural disasters show a significant linear relationship with average temperature except for epidemic, insect infestation, mass movement dry and wildfire. The R square values for earthquake (seismic activity), flood and storm are equal to or higher than 0.250.

According to p values (indicating significance level), natural disasters can be classified into three groups: (a) that are strongly affected by climate ($p < 0.001$): earthquake (seismic activity), flood and storm; (b) that are moderately affected by climate ($0.05 > p > 0.001$): Drought, Extreme temperature and Mass movement wet and (c) that are least affected by climate ($p > 0.05$): epidemic, insect infestation, mass movement dry and wildfire. Such demarcation of natural disasters according to their correlation with average temperature in China helps identify disasters that need more surveillance for under global warming.

Discussion

Several studies have shown that climate change is related to extreme events especially extreme temperature⁷. Flood events will increase in China as climate change intensifies⁸. According to the regression analysis, if the average temperature in China increases by 1 °C, earthquake (seismic activity), flood and storm would increase by 2, 4 and 4 occurrences per year respectively. The results indicate a need for increased concern and more efforts in disaster prevention in China as global temperature rises.

Table 1
Descriptive statistics of natural disaster occurrence in China from 1951-2011

Natural Disaster Type	N	Minimum	Maximum	Mean/yr	Std. Deviation	Sum	Total Affected Population	Total Estimated Damage(US \$)
Drought	61	0	3	0.508	0.809	31	4.65E+08	2.61E+07
Earthquake (seismic activity)	61	0	11	1.934	2.337	118	6.91E+07	9.51E+07
Epidemic	61	0	3	0.131	0.499	8	9.83E+03	0
Extreme temperature	61	0	3	0.180	0.533	11	8.12E+07	2.14E+07
Flood	61	0	20	3.295	3.976	201	1.91E+09	1.69E+08
Insect infestation	61	0	1	0.016	0.128	1	0	0
Mass movement dry	61	0	2	0.098	0.351	6	5.47E+03	0
Mass movement wet	61	0	6	0.607	1.144	37	8.38E+04	9.52E+05
Storm	61	0	14	3.459	3.888	211	4.57E+08	4.90E+07
Wildfire	61	0	1	0.098	0.300	6	5.66E+04	1.10E+05
Total						630	2.98E+09	3.62E+08

*A "0" in EM-DAT does not represent a value and can mean that no information is available.

Table 2
Linear regression between natural disaster occurrence and average temperature in China from 1951-2011

Natural Disaster type	Average Temperature Coefficient	R square	Sig.
Drought	0.575	0.135	0.004
Earthquake (seismic activity)	2.256	0.250	<0.001
Epidemic	0.198	0.0422	0.112
Extreme temperature	0.285	0.0767	0.031
Flood	4.461	0.337	<0.001
Insect infestation	0.0310	0.0157	0.336
Mass movement dry	0.124	0.0332	0.160
Mass movement wet	0.754	0.117	0.007
Storm	3.757	0.250	<0.001
Wildfire	0.0864	0.0222	0.252

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