

How Should We Address Climate Change?

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Global warming goes on

The climate has always been changing. Here we refer to the changes concerning the current global warming, which is unprecedented both in terms of the rate at which the warming takes place and the extent to which human activities exert impacts on it. Observational analyses indicate that the global mean temperature increased by about $0.6^{\circ}\text{C}/\text{century}$ over the last century; ten of the 11 warmest years since 1850 occurred after 1995^[1,2]. In comparison with the temperature fluctuations during the past 2,000 years, the warming over the past century is unusual^[3]. According to the Fourth Assessment Report of IPCC, almost all climate models, under foreseeable

anthropogenic emission scenarios, come to a same consensus: the global temperature is to rise further by a range between 0.64 and 0.70°C from 2010 to 2030. It is perceived that a warming process goes on, somehow beyond natural variability.

Climate change on a regional scale in China is more remarkable than the global mean trend. A recent study by Huang et al. showed that from the 1950s to the early 21st century, the decadal mean temperature in northern China, in particular, has risen by up to $3\text{--}4^{\circ}\text{C}$ (Fig.1). Changes in climate extremes, related to disastrous weather phenomena, are even more obvious. Yan and Yang (2000) found that



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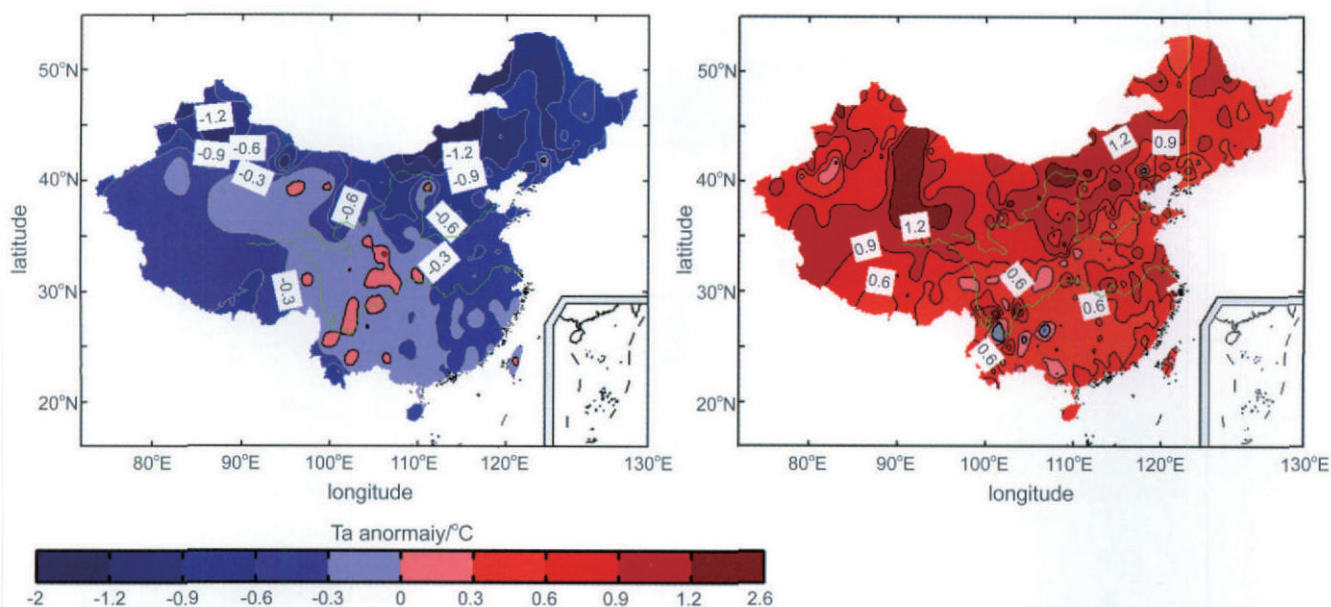


Fig. 1. Temperature anomalies in China during the 1950s (left) and the early 2000s (right).

long-term trends in extreme temperatures in many places in China could be 5–10 times of those in mean climatology. Changes in precipitation present a rather complicated regional pattern. The widely-concerned drying process in North China has developed due to a few abrupt decreases of precipitation (climatic jumps^[6]), together with a rise in frequency of floods in the middle and lower reaches of the Yangtze River^[5], during the last few decades. Current studies are yet to address whether the regional climate trends in precipitation are irreversible or not.

Climate change relevant to human activities

Since the Industrial Revolution in the late 19th century, human activities have released considerable amount of carbon dioxide and other atmospheric greenhouse gases, incessantly increasing the concentrations of the atmospheric greenhouse gases. This is a causative factor responsible for global warming, beyond any reasonable doubt. Observations since the 1970s have shown that the sharp growth in the atmospheric CO₂ concentrations is mainly from anthropogenic sources^[2]. The IPCC report further demonstrates that the current concentration of greenhouse gases and its warming effects are far exceeding the natural variability over the last 650,000 years. The present growth rate on a decadal scale is higher than any period since there

was a record in this aspect about 20,000 years ago. The unprecedented high level of the anthropogenic emission is undoubtedly the main cause of the current rapid increase of the atmospheric greenhouse gases.

The concurrent population explosion also gives rise to the drastic increase in demand for land resources, such as the development of agriculture and forestry, which results in changes in ecosystems and climate as well. Based on regional climate modeling, Fu and Yuan^[4] suggested that changes in terrestrial vegetation should be influential to the seasonal evolution and intensity of the East Asian monsoons. Comparative modeling analyses between historical and modern climate in China further suggest that the effects of agriculture on climate in different regions vary depending on different environmental and climate backgrounds. This implies the complexity of the interactions between human activities and natural climate variations^[8]. Nevertheless, it is necessary to consider the effects of human activities in order to predict climate changes in a region.

Climate change intensifying impact on economic development

Alongside its growth, the socioeconomic development is subject to increasing influence of climate change. Statistics from the global insurance industry show that



losses on calamity have kept increasing since the 1950s. More than 70% of the losses were caused by disastrous weather or climatic events. Based on reports released to the public, China's economic losses due to floods in 1991, 1994 and 1995 were somewhere between \$20 and \$30 billion. In north China, droughts have aggravated the rampancy of desertification. At present, there are about 2.62 million square kilometers of land suffering from desertification, accounting for 27.3% of the national territory, costing 54 billion yuan in direct economic losses each year. From 1989 to 1996, annual losses from natural disasters in China made up 3.9% of its national GDP in average. As a developing country, China suffers more in this aspect than developed countries^[10].

Ways of coping with climate change

Because of its dramatic impact on national economies and sustainable development, climate change has aroused concern of governments worldwide, which have joined hands in supporting IPCC to carry out an assessment of climate change and its influence. The fourth IPCC report once again makes us understand that climate change and its impacts and adaptation to it should deserve special attention of both China's government and academic circles. It is not only an issue for scientists, but also for economists and politicians. Governmental authorities need to intensify the support to scientific research of climate change so as to safeguard a certain level of climate prediction and analysis capacity in order to provide a sound foundation for policy-makers in economic, political and diplomatic dimensions.

To help people understand our suggestions below, we would emphasize that uncertainty remains in current climate change projections due to complexity of the climate system^[9]. Therefore, even the scenarios projected by current climate models with high confidence might not occur definitely, while some small probability events, with critical influences, are likely to happen. Therefore, it is necessary for a nation to be well-prepared for coping with different scenarios of climate changes. In addition, as climate change may have different impacts on different sectors, relevant decision-making procedures and actions may not be the same. Therefore, various countermeasures should be assessed in line with their own characteristics.

These measures should be subject to the principle of overall optimization (i.e. principle of orderly adaptation to climate change), rather than local optimization. Furthermore, adaptation to climate change and mitigation may exert influence (feedbacks) on climate. Projections of climate change made based on current status of human activities have to be revised timely with regard to changes in human activities.

The following suggestions are made to develop science policies coping with climate change.

1. To strengthen research of the climate change scenarios which are most probable to occur in the future. It is necessary to assess all aspects of regional climate changes under global warming, in order to enhance foresighted fundamental research for the country's medium- and long-term plans of sustainable development.

2. To conduct research of other scenarios of climate changes that are less likely than those in (1) but with profound impacts. It is necessary to develop relevant strategies to cope with any possible climate changes, in particular abrupt climate change events, which are of small probability but huge social, ecological and economic influences, and the tendency of their occurrence probability with time.

3. Due to changes in human's adaptation and mitigation activities and its feedbacks to climate, the above-mentioned projection studies have to be updated timely. Reference might be made to IPCC assessment reports. It is noted, however, that the IPCC reports lay emphasis on (1) with insufficient attention to (2) and (3).

4. To keep stressing studies of climate extremes relevant to disasters on a regional scale, their changes in terms of frequency and strength, and impacts. This is because influence of climate change is exerted in a direct and powerful way by extreme events on a regional scale.

5. To develop a close relationship with decision makers at various levels when conducting research into climate change and its impact. Emphasis should be made on collaborative multi-disciplinary studies so as to offer direct advisory services to decision-makers at both national and sector levels. This is also a feasible approach to make the science of climate change serving the society while obtaining sustained support. ■



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