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# HIGH-RESOLUTION PROJECTIONS OF TEMPERATURE CHANGES OVER CHINA

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**Abstract:** Planning of mitigation and adaptation strategies to the changing climate is of great significance to China, due to its large population and fast growing economy. This study presents a high-resolution regional climate simulation for China using the Weather Research and Forecasting (WRF) Model. A historical simulation from 1980 to 2005 was performed and validated, while for the future two simulations from 2006 to 2099 were performed under two emission scenarios (i.e. RCP 4.5 and RCP 8.5). The projections indicate that China is likely to suffer a significant temperature rise by the end of the century, with greater changes and uncertainties under RCP 8.5. The presented study could provide decision support for the policy making of mitigation and adaptation strategies.

**Keywords:** regional climate model, WRF, climate change, temperature

## 1 BACKGROUND

Climate change is becoming one of the most pressing issues with the increase of greenhouse gas emissions. It has already caused evident impacts on natural and human society over the globe in recent decades. (IPCC 2014). China, with the largest population in the world, has also been struggling with the changing climate. China observed a ground average temperature increase of 0.24℃/decade from 1951 to 2017, exceeding the global ground average temperature increase rate. Climate change has caused significant impact on China's natural ecosystems, agriculture, water resource, and human health (Zhang et al. 2006). Extreme climate events such as floods and droughts have also brought huge economic losses (Ding et al. 2007). Therefore, future climate projections over China is of great significance in terms of the quantification of climate change and the policy making of mitigation and adaptation strategies.

Planning adaptation strategies against the changing climate requires a thorough assessment of the potential impacts of climate change at local scales (Wang et al. 2016). However, the coarse resolution of global climate models (GCMs) is usually unable to provide regional or local information for researchers and policy makers. Therefore, downscaling techniques are required to producing climate projections in finer resolution, which are indispensable for either dynamical or statistical downscaling method. Statistical downscaling methods have many limitations and are subject to a number of widely-known assumptions on the underlying probabilistic model, parameter stability, as well as temporal dependence (Wang et al. 2014), whereas physical-based regional climate models (RCMs), as a dynamical downscaling method, have advantages in simulating meso-scale climate and providing add-in information from GCMs. This study presents high-resolution projections of temperature changes over China with a RCM approach, using the Weather Research and Forecasting (WRF) Model. Part 2 introduces mothed and data, part 3 provides result analysis, and part 4 provides the conclusions.

## 2 DATA AND METHODS

The observed data for mean daily temperature (hereinafter referred to as Tmean) is obtained from the 50-km gridded CRU dataset, provided by Climatic Research Unit (CRU)**,** University of East Anglia. And for Regional climate modeling, the WRF model developed by National Center for Atmospheric Research (NCAR) from US is employed to develop high-resolution climate projections over China from 1980 to 2099. The historical time period from 1980 to 2005 is defined as reference (RF) baseline period, and future period from 2006 to 2099 is divided into three major periods, 2030s, 2050s, and 2080s, respectively under two emission scenarios (i.e. RCP 4.5 and RCP 8.5).

## 3 RESULTS

To validate the capability of WRF experiments in reproducing the mean temperature of current climate in China, Tmean from WRF output in RF period is extracted and compared to CRU observation data in the same period (see Figure 1). The pattern of WRF simulation (Figure 1(b)) shows good fit to the observation data (Figure 1(a)). For most of the study area, Tmean simulation by WRF shows little bias from the observation. However, WRF overestimates Tmean in Sichuan Basin and underestimates Tmean in Tibet Plateau. This could be caused by the setup of parameters and schemes in the simulation, leading to the temperature bias in certain topography (e.g. high-altitude area and basin).

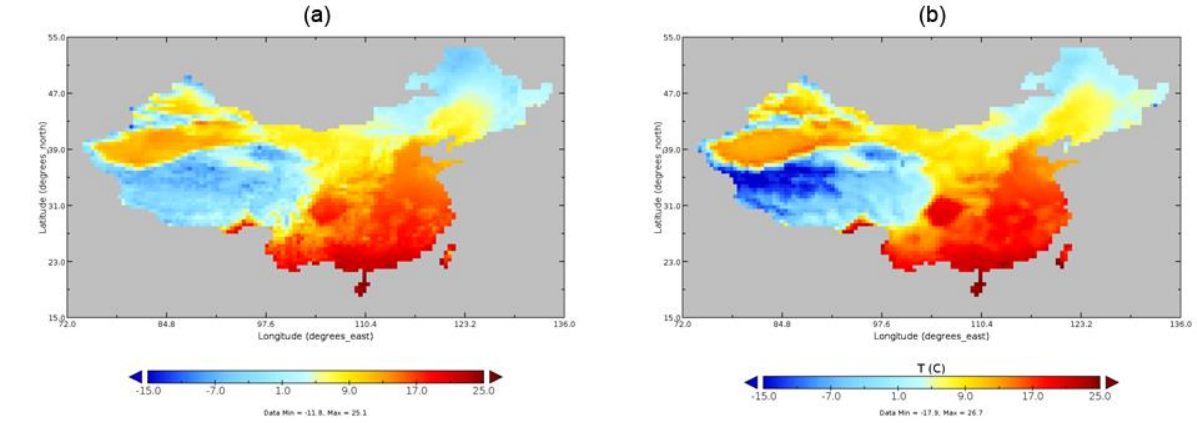


Figure 1: Validation results: (a) CRU observational data, (b) WRF simulation

Figure 2 shows the future projections over China under two emission scenarios (i.e. RCP4.5 and RCP 8.5) from 2006 to 2099. Future period is divided into three smaller periods, 2030s, 2050s and 2080s, for better demonstration of decadal trend changes. Results indicate that China is likely to experience a significant temperature increase through the century, with a higher increase pace in Xinjiang area, Sichuan basin, and parts of Southern China. Results also show that in each time period, Tmean under RCP 8.5 (Figure 2(d)(e)(f)) is higher than that under RCP 4.5 (Figure 2(a)(b)(c)), indicating that stronger green-house gas (GHG) emission would lead to higher temperature increase in China, and mitigation strategy is pressingly necessary for policy makers.

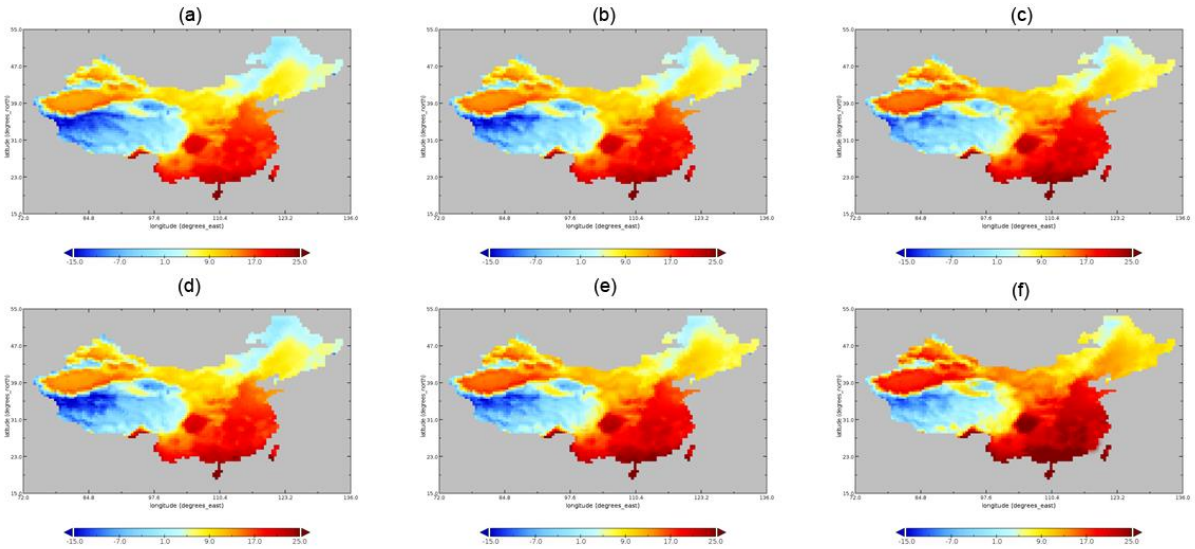


Figure 2: Future Tmean projections over China: (a) 2020s under RCP 4.5, (b) 2050s under RCP 4.5, (c) 2080s under RCP 4.5, (d) 2020s under RCP 8.5, (e) 2050s under RCP 8.5, and (f) 2080s under RCP 8.5.

## 4 CONCLUSION

This study presents a high-resolution regional climate simulation for China using the WRF model. Historical simulation from 1980 to 2005 is performed and validated, and WRF simulation shows good fit to observation. Two future simulations from 2006 to 2099 are performed under two emission scenarios (i.e. RCP 4.5 and RCP 8.5). The projections indicate that China is likely to suffer a significant temperature rise by the end of the century, with greater changes and uncertainties under RCP 8.5. The presented study could provide decision support for the policy making of mitigation and adaptation strategies.

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