VIEWpoint 新观点

High-Resolution Revolution Brings Insight into China's Climate

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Explainer | An explainer on research from the Climate Science for Service Partnership (CSSP) China for decision-makers in China // No. 07

Summary

The lack of a long-term dataset at fine resolution has restricted our understanding of the varied and complicated climate of China. A high-resolution (25km) dataset recently developed by the UK Met Office can better represent the year-to-year variations in China's climate and confirms a sustained increase in temperature since the 1850s, while maintaining consistency with the global climate.

Why?

China is a vast country, influenced by complex orography. It experiences varied climates and weather extremes (e.g., heatwaves, floods) and has shown a widespread warming trend (Zhou et al., 2016). To understand the full picture of climate variability and changes to weather extremes, continuous, homogeneous and unbiased long-term observational records are essential. However, pre-1950s records of surface climate are sparse in many parts of China, especially in western regions including the Himalayas and the Tibetan Plateau. Although satellites can provide fine-scale datasets with increasingly comprehensive coverage, such datasets are only available from 1979.

The lack of a long-term high-quality dataset has been limiting our understanding into important drivers and trends in China's climate. Although some attempts have been made to extend the period of the existing dataset by using global climate models, poor performance is still seen over China, for example, in reproducing precipitation extremes, due to coarse spatial resolution of the global dataset.

To better represent the regional climate in China, while maintaining consistency with the global climate, there is an urgent need for a dataset with global climate features and local orographic details at a finer resolution.

How?

Amato et al. (2019) attempted to resolve some of the limitations associated with coarse resolution in current global datasets by downscaling the horizontal spatial resolution of a global dataset (20CRv2c) over China. This global dataset provides winds, temperature, and humidity at a spatiotemporal resolution of 200km and 6 hourly.

A historical climate dataset with finer spatial resolution over China (20CR-DS) from 1851 to 2010 was generated with available output at daily/monthly time scales, by using a Met Office high-resolution climate model to extend the effects of large-scale climate processes to regional scale (25km). The strengths and limitations of the downscaled dataset were also assessed.

The strength of the downscaled dataset is that it can represent spatial and temporal trends realistically, despite a small warm and seasonal wet bias. It can represent China's climatological annual cycle (in temperature and precipitation), particularly over areas with sparse observations such as the Tibetan Plateau. Moreover, the dataset can better signify the interannual variability and trends in observed temperature since 1901, with confirmation of a significant and sustained increase in temperature since the 1850s.

What now?

The fine-resolution long-term climate data (20CR-DS) is the first reanalysis dataset downscaled over China for the entire twentieth century and the latter half of the nineteenth century. This work is an imperative first step towards a deepened understanding of the patterns and drivers of high-impact events over China such as heatwaves, droughts, and precipitation. With valuable fine resolution and being freely available as monthly averages in a standard (NetCDF) format (Sadri et al., 2019), the dataset is expected to be widely used in future scientific analysis, impact studies and the development of climate services.

A set of Python-based tutorials for 20CR-DS has also been provided in a more computationally efficient (Zarr) format by the Met Office in Jupyter Notebooks to promote its applications in the research community, and examination of the higher frequency datasets (daily, 3-hourly and hourly) is ongoing. More recently, a 20CR-DS-based prototype climate service has been under active development for air quality control in China; it is expected the enhanced resolution may improve the regional projections of the Haze Weather Index.

References

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