VIEWpoint 新观点

High-resolution revolution brings insight into China's climate

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Explainer

Accessible research from Climate Science for Service Partnership (CSSP) China, for decision-makers No.07

Focus

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

Importance

China experiences varied climates and weather extremes (e.g., heatwaves, floods) and has shown a widespread warming trend. To understand the full picture, 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. Although satellites can provide fine-scale datasets with increasingly comprehensive coverage, they are only available from 1979. While 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 due to coarse spatial resolution of the global dataset. To better represent China's regional climate, 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.

Approach

Amato et al. (2019) attempted to resolve some of the limitations by downscaling the horizontal spatial resolution of a global dataset (20CRv2c) over China. It 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 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.

Next steps

20CR-DS is the first reanalysis dataset downscaled over China for the 20th century and the latter half of the 19th century. It 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, the dataset is expected to be widely used in future scientific analysis, impact studies and the development of climate services. The Met Office has produced Python-based tutorials for 20CR-DS in a more computationally efficient (Zarr) format in Jupyter Notebooks, and examination of higher frequency datasets (daily, 3-hourly and hourly) is ongoing. More recently, a 20CR-DS-based prototype climate service is in development for air quality control in China; which may improve regional projections of the Haze Weather Index.

References

Amato et al., 2019 DOI:10.1175/JAMC-D-19-0083.1

Sadri et al., 2019 DOI:10.5281/ZENODO.2558135

Zhou et al., 2016 DOI:10.1002/joc.4400

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Produced by VIEWpoint, a CSSP China project from the Institute for Environmental Analytics, highlighting research and improving the uptake of climate services developed in the partnership, through accessible resources.