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# Anthropogenic Influence on 2019 May–June Extremely Low Precipitation in Southwestern China

Chunhui Lu, Jie Jiang, Ruidan Chen, Safi Ullah, Rong Yu, Fraser C. Lott, Simon F. B. Tett, and Buwen Dong

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Corresponding author: Jie Jiang, jiangj@lasg.iap.ac.cn

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**AFFILIATIONS:** **Lu**—National Climate Center, China Meteorological Administration, Beijing, China; **Jiang**—LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences, and University of Chinese Academy of Sciences, Beijing, China; **Chen**—Center for Monsoon and Environment Research/Guangdong Province Key Laboratory for Climate Change and Natural Disaster Studies/School of Atmospheric Sciences, Sun Yat-sen University, Guangzhou, and Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), Zhuhai, China; **Ullah**—Key Laboratory of Meteorological Disaster, Ministry of Education, Joint International Research Laboratory of Climate and Environmental Change, Collaborative Innovation Center on Forecast and Evaluation of Meteorological Disasters, Nanjing University of Information Science and Technology, Nanjing, and Department of Atmospheric and Oceanic Sciences and Institute of Atmospheric Sciences, Fudan University, Shanghai, China; **Yu**—State Key Laboratory of Severe Weather, Chinese Academy of Meteorological Sciences, Beijing, China; **Lott**—Met Office Hadley Centre, Exeter, United Kingdom; **Tett**—School of Geosciences, University of Edinburgh, Edinburgh, United Kingdom; **Dong**—National Centre for Atmospheric Science, Department of Meteorology, University of Reading, United Kingdom

**CMIP6 model information.**
Twelve CMIP6 models are used as shown in Table ES1. The historical simulations are forced by all external forcings, which include anthropogenic and natural forcings. The hist-nat simulations are forced by natural-only forcing. The hist-aer and hist-GHG simulations are forced by anthropogenic aerosols and greenhouse gases, respectively (Gillett et al. 2016). As the SSTs are evolving in the coupled simulations and do not tie to the observed 2019 boundary conditions, it is not suitable in the coupled simulations to look at individual years. Thus, we select the period of 2005–14 as present-day climate for CMIP6 simulations. As with the HadGEM3-GA6 simulations probabilities of a 2019-like event were computed for the historical, hist-aer, and hist-GHG ensembles and compared to the probability in the hist-nat ensemble to estimate the impact of anthropogenic forcing.

**Probability ratio results from different fitting methods.**
We also used other fitting functions to fit the probability distribution of precipitation anomaly, and the fitting results of Gaussian distribution passed the significance test. The corresponding probability ratio is 6.41 (4.54–9.76). If we calculate the PR directly based on the raw data rather than using a fitting function, the estimate of PR is 4.91 (3.00–9.67). Similar PR evaluation results give us more confidence about our conclusions.

## Reference

Gillett, N. P., and Coauthors, 2016: The Detection and Attribution Model Intercomparison Project (DAMIP v1.0) contribution to CMIP6. *Geosci. Model Dev.*, **9**, 3685–3697, https://doi.org/10.5194/gmd-9-3685-2016.

**Table ES1. CMIP6 models used in Fig. ES1.**

| Model (12) | Institute | Historical (81) | Hist-GHG (58) | Hist-aer (57) | Hist-nat (60) |
|---|---|---|---|---|---|
| BCC-CSM2-MR | BCC-CMA/China | 3 | 3 | 3 | 3 |
| CanESM5 | CCCma/Canada | 10 | 10 | 10 | 10 |
| CESM2 | NSF-DOE-NCAR/United States | 10 | 3 | 2 | 3 |
| CNRM-CM6.1 | CNRM-CERFACS/France | 10 | 10 | 10 | 10 |
| FGOALS-g3 | LASG-CESS/China | 3 | 3 | 3 | 3 |
| GFDL-ESM4 | NOAA-GFDL/United States | 3 | 1 | 1 | 3 |
| GISS-E2–1-G | NASA-GISS/United States | 10 | 5 | 5 | 5 |
| HadGEM3-GC31-LL | Met Office Hadley Centre/ United Kingdom | 4 | 4 | 4 | 4 |
| IPSL-CM6A-LR | IPSL/France | 10 | 10 | 10 | 10 |
| MIROC6 | MIROC/Japan | 10 | 3 | 3 | 3 |
| MRI-ESM2.0 | MRI/Japan | 5 | 3 | 3 | 3 |
| NorESM2-LM | NCC-NMI/Norway | 3 | 3 | 3 | 3 |

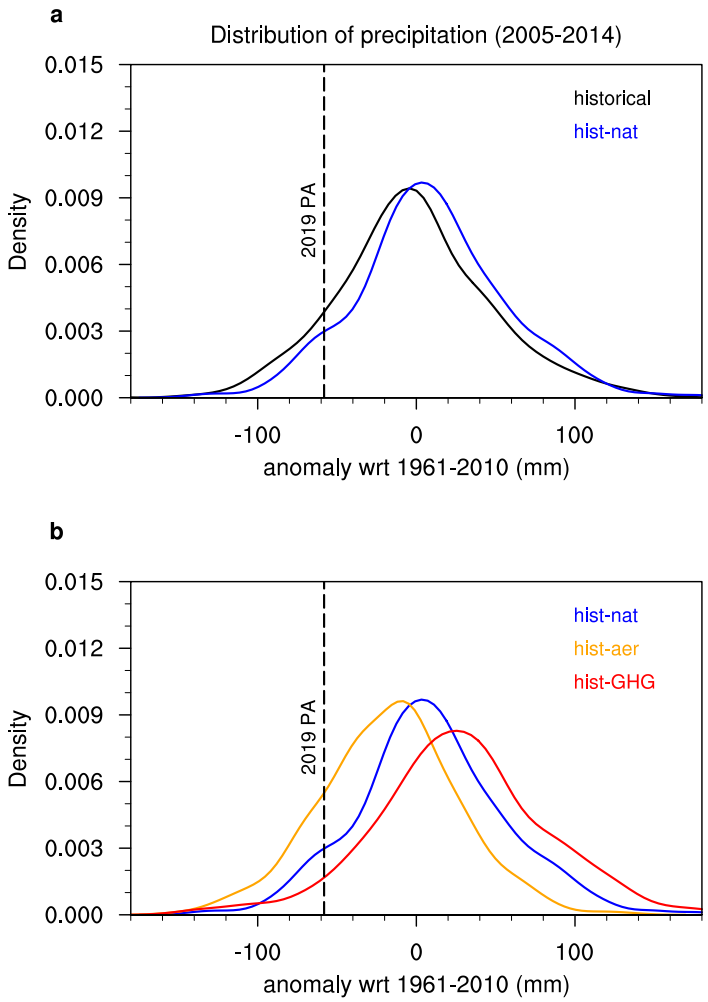


**Fig. ES1. Kernel estimate of the probability density function of PA (mm) during the period of 2005–14 relative to 1961–2010 climatology in historical simulation. (a): historical (black) and hist-nat (blue) simulations; (b): hist-nat (blue), hist-aer (yellow) and hist-GHG (red) simulations. The dashed black line denotes the observed event in 2019.**

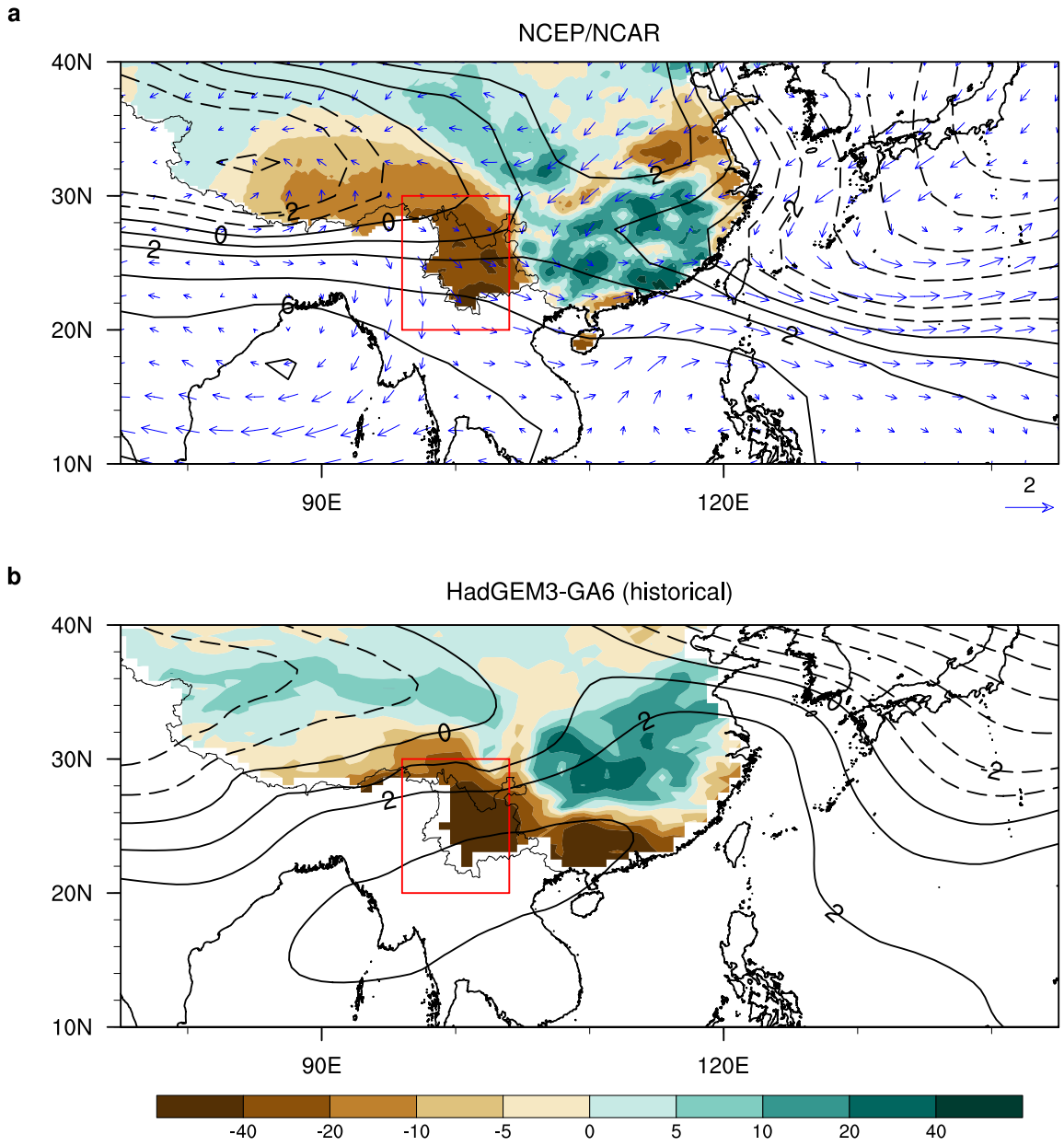


**Fig. ES2. Composite patterns of precipitation anomalies (shading: mm), geopotential height anomalies at 500 hPa (contour: gpm) and wind anomalies at 850 hPa (vector: m $s^{-1}$) in May–June during the period of 1961–2013 for regional mean PA lower than minus one standard deviation, for (a) NCEP–NCAR and (b) historical simulations of HadGEM3-GA6.**