Supplementary Materials

Little change in Palmer Drought Severity Index across global land under warming in climate projections

Yuting Yang1,7, Shulei Zhang1,2,7, Michael L. Roderick3,4, Tim R. McVicar4,5, Dawen Yang1, Wenbin Liu6, Xiaoyan Li2

1State Key Laboratory of Hydroscience and Engineering, Department of Hydraulic Engineering, Tsinghua University, Beijing, China
2State Key Laboratory of Earth Surface Process and Resource Ecology, School of Natural Resources, Faculty of Geographical Science, Beijing Normal University, Beijing, China
3Research School of Earth Sciences, Australian National University, Canberra, ACT, Australia
4Australian Research Council Centre of Excellence for Climate Extremes, Canberra, ACT, Australia
5CSIRO Land and Water, Canberra, ACT, Australia
6Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China
7Equal contribution.

Corresponding Author: Yuting Yang (yuting_yang@tsinghua.edu.cn)
Supplementary Figure S1. Evapotranspiration estimated using the standard PDSI model forced with reference crop $E_p$ ($E_{PDSI\_PM-RC}$) compared with the direct output from the CMIP5 models ($E_{CMIP5}$). a, Changes in annual mean $E_{PDSI\_PM-RC}$ and $E_{CMIP5}$ relative to the 1901-1960 baseline. The solid curves represent the ensemble mean of 16 CMIP5 models and the shaded areas are plus/minus one standard deviation among models. b, Spatial distribution of trend in annual $E_{PDSI\_PM-RC}$ over 1901-2100. c, Spatial distribution of trend in annual $E_{CMIP5}$ over 1901-2100.
Supplementary Figure S2 Global average time series of fractional land area experiencing drought/moist conditions. a-c, Global average time series of land area experiencing drought (PDSI < -2.0, red) and moist (PDSI > 2.0, blue) conditions for (a) PDSI_PM-RC, (b) PDSI_CMIP5 and (c) PDSI_PM[CO₂], respectively. The solid curve represents the ensemble mean of 16 CMIP5 models and the shading represents plus/minus one standard deviation among models.
Supplementary Figure S3 Time series of the three PDSIs at the global scale. Here the PDSI is calculated using the global averaged forcing variables.
**Supplementary Figure S4.** Changes in global mean Standardised Precipitation-Evapotranspiration Index (SPEI) and area in drought/moist relative to the 1901-1960 baseline. 

**a**, SPEI with $E_P$ calculated from the reference crop Penman-Monteith $E_P$ (SPEI_PM-RC; green line) and SPEI with $E_P$ calculated from the modified Penman-Monteith model with CO$_2$ adjustment (SPEI_PM[CO$_2$]; black line). 

**b**, Changes in drought (SPEI < -1.5) and moist (SPEI > 1.5) areas relative to the 1901-1960 baseline detected by SPEI_PM[CO$_2$]. 

**c**, Changes in drought (SPEI < -1.5) and moist (SPEI > 1.5) areas relative to the 1901-1960 baseline detected by SPEI_PM-RC. The solid curves represent the ensemble mean of 16 CMIP5 models and the shaded areas are plus/minor one standard deviation among models.
### Table S1. The 16 CMIP5 models used in this study.

| Model name      | Nation     | Modeling Center                                                                 | Reference                  |
|-----------------|------------|---------------------------------------------------------------------------------|----------------------------|
| bcc-csm1-1      | China      | Beijing Climate Center, China Meteorological Administration                     | Wu et al. [2012]           |
| bcc-csm1-1-m    | China      | Beijing Climate Center, China Meteorological Administration                     | Wu et al. [2012]           |
| BNU-ESM         | China      | Beijing Normal University                                                       | Wei et al. [2012]          |
| CNRM-CM5        | France     | Centre National de Recherches                                                    | Voldoire et al., [2013]    |
| GFDL-ESM2G      | USA        | NOAA Geophysical Fluid Dynamics Laboratory                                       | Dunne et al. [2012]        |
| GFDL-ESM2M      | USA        | NOAA Geophysical Fluid Dynamics Laboratory                                       | Dunne et al. [2012]        |
| GISS-E2-H       | USA        | NASA Goddard Institute for Space Studies                                         | Schmidt et al. [2014]      |
| GISS-E2-R       | USA        | NASA Goddard Institute for Space Studies                                         | Schmidt et al. [2014]      |
| IPSL-CM5A-LR    | France     | Institute Pierre-Simon Laplace                                                  | Hourdin et al. [2013]      |
| IPSL-CM5A-MR    | France     | Institute Pierre-Simon Laplace                                                  | Hourdin et al. [2013]      |
| IPSL-CM5B-LR    | France     | Institute Pierre-Simon Laplace                                                  | Hourdin et al. [2013]      |
| MIROC5          | Japan      | National Institute for Environmental Studies, The University of Tokyo           | Watanabe et al. [2011]     |
| MIROC-ESM       | Japan      | National Institute for Environmental Studies, The University of Tokyo           | Watanabe et al. [2011]     |
| MIROC-ESM-CHEM  | Japan      | National Institute for Environmental Studies, The University of Tokyo           | Watanabe et al. [2011]     |
| NorESM1-M       | Norway     | Norwegian Climate Centre                                                        | Bentsen et al. [2013]      |
| NorESM1-ME      | Norway     | Norwegian Climate Centre                                                        | Bentsen et al. [2013]      |

#### References in Supplementary Table S1

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