Supporting Information for

A re-examination of the dry gets drier and wet gets wetter paradigm over global land: insight from terrestrial water storage changes

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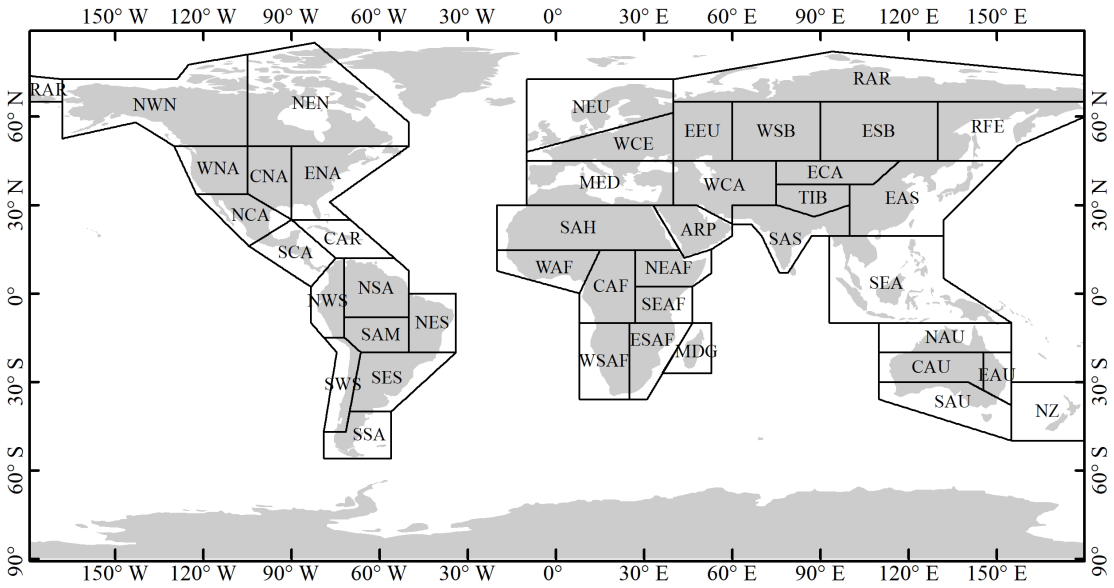

Figure S1. Location of the 43 selected Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Adaptation (SREX) regions from the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6). The regional abbreviations are listed in Table S1.

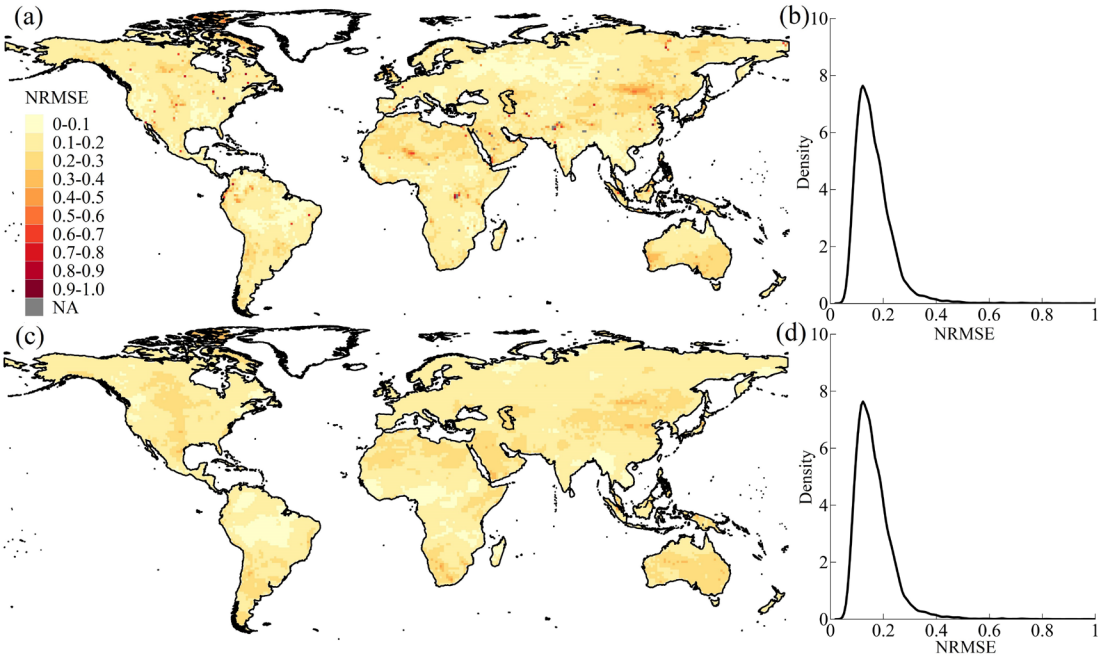

Figure S2. Global distribution and probability density function of the normalized root mean square error (NRMSE) between TWSA derived from the GRACE mission and ensemble mean of (a, b) DATASET and (c, d) CMIP6 models during the period April 2002-December 2014.

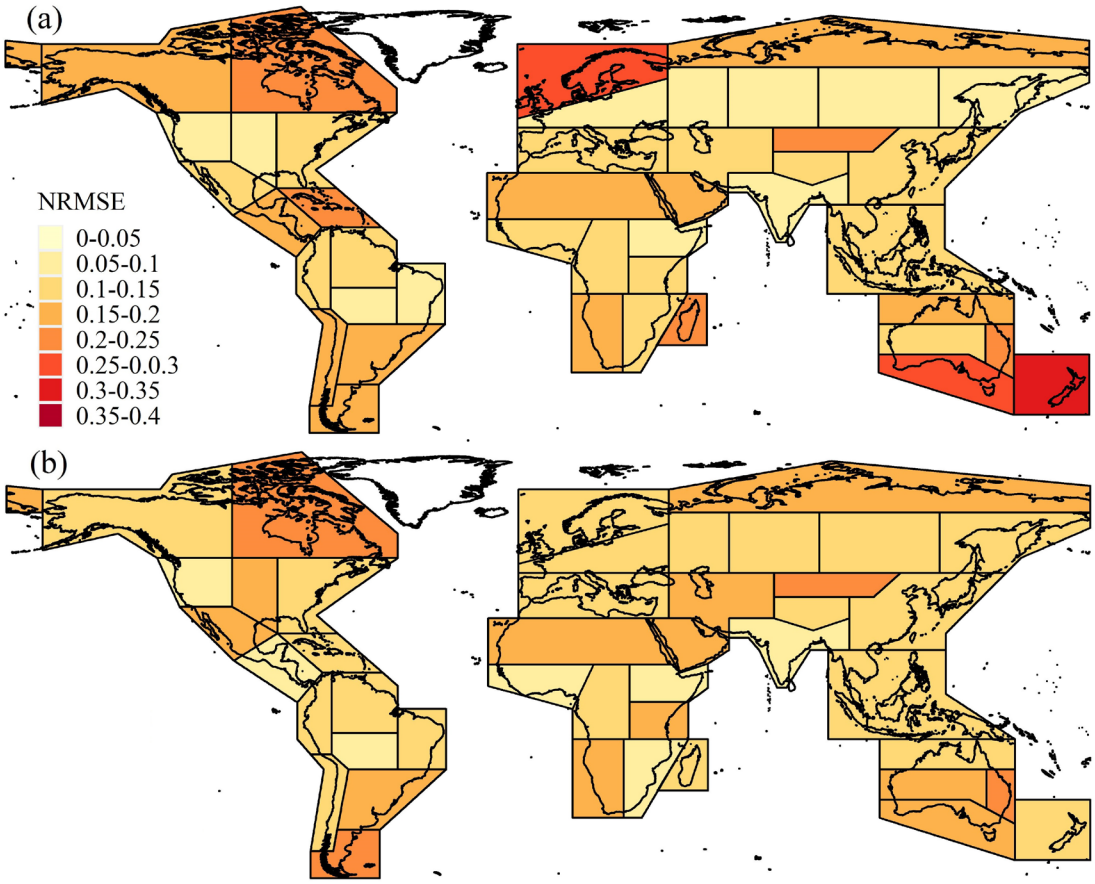

Figure S3. Global distribution of the normalized root mean square error (NRMSE) between TWSA derived from the GRACE mission and ensemble mean of (a) DATASET and (b) CMIP6 models in 43 selected IPCC SREX regions during the period April 2002-December 2014. Please refer to Figure S1 above for abbreviations of the IPCC SREX regions.

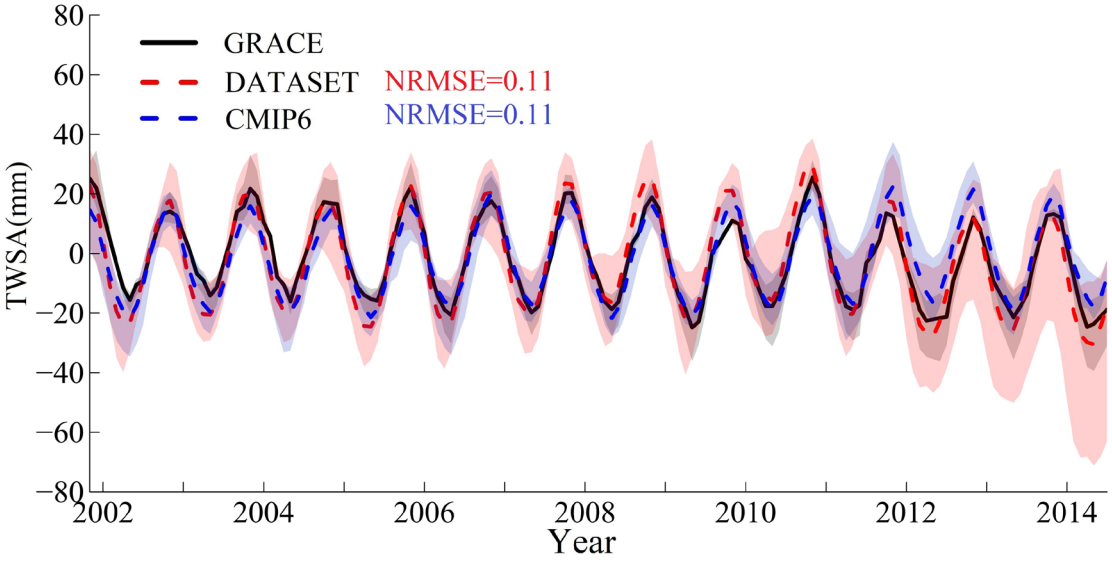

Figure S4. Time series of monthly TWSA derived from the GRACE mission and ensemble mean of DATASET and CMIP6 of the global land during the period April 2002-December 2014. NRMSE between GARCE and DATASET (0.11) and GRACE and CMIP6 (0.11) composite is also shown. The shaded areas represent the range of TWSA values among the individual datasets.

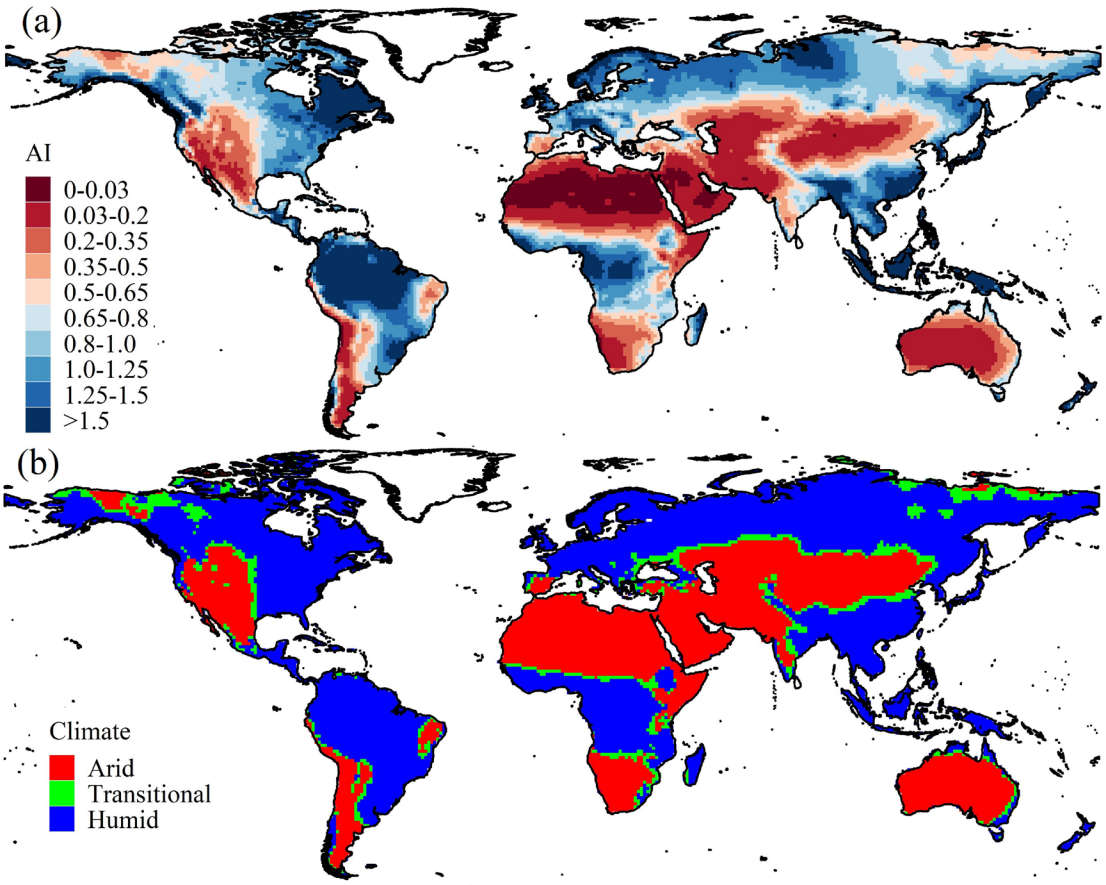

Figure S5. Global distribution of the (a) multi-year average aridity index (AI) and (b) climate type during the period 1985-2014. Note: The regions where AI>0.65 and <0.50 are defined as humid and arid regions, respectively. The AI is calculated as the ratio of average annual precipitation to potential evapotranspiration, which is provided by the Climatic Research Unit Time series (CRU TS-v4.05, https://crudata.uea.ac.uk).

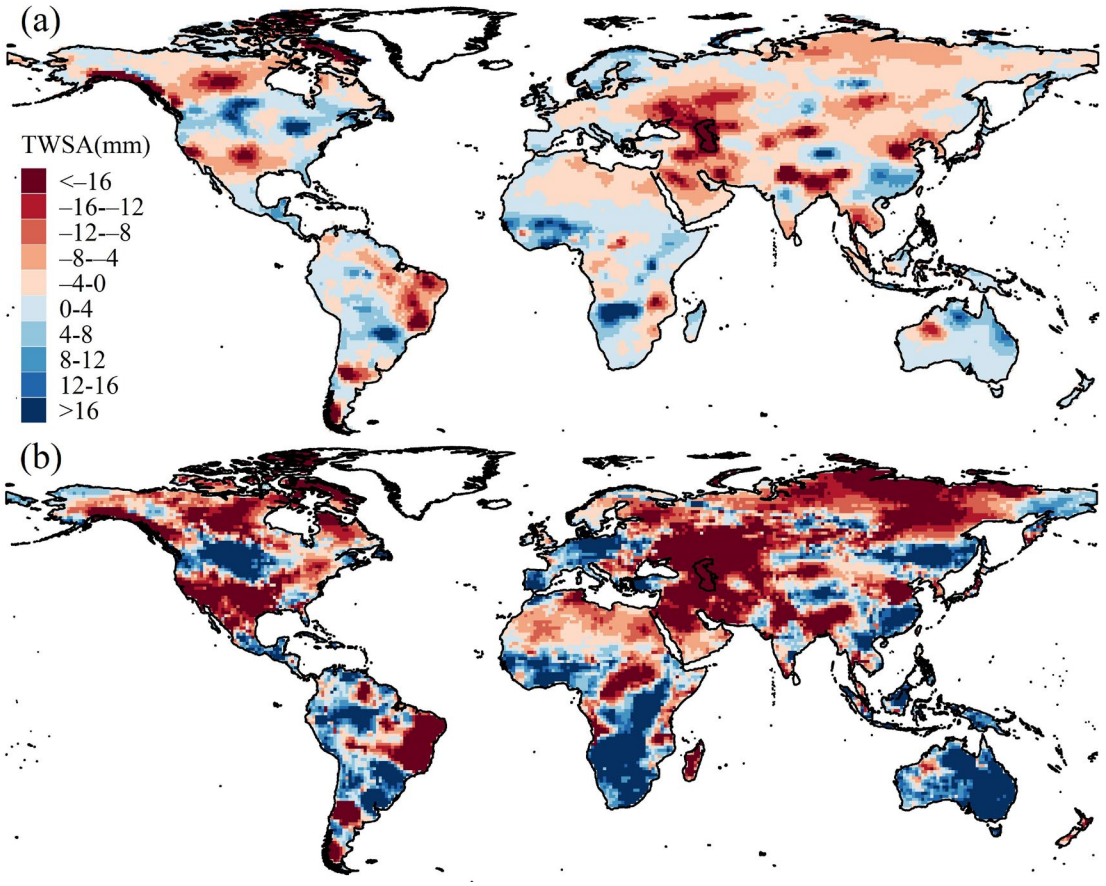

Figure S6. Global distribution of the multi-year average TWSA from the ensemble of (a) DATASET and (b) CMIP6 GCMs during the period 1985-2014.

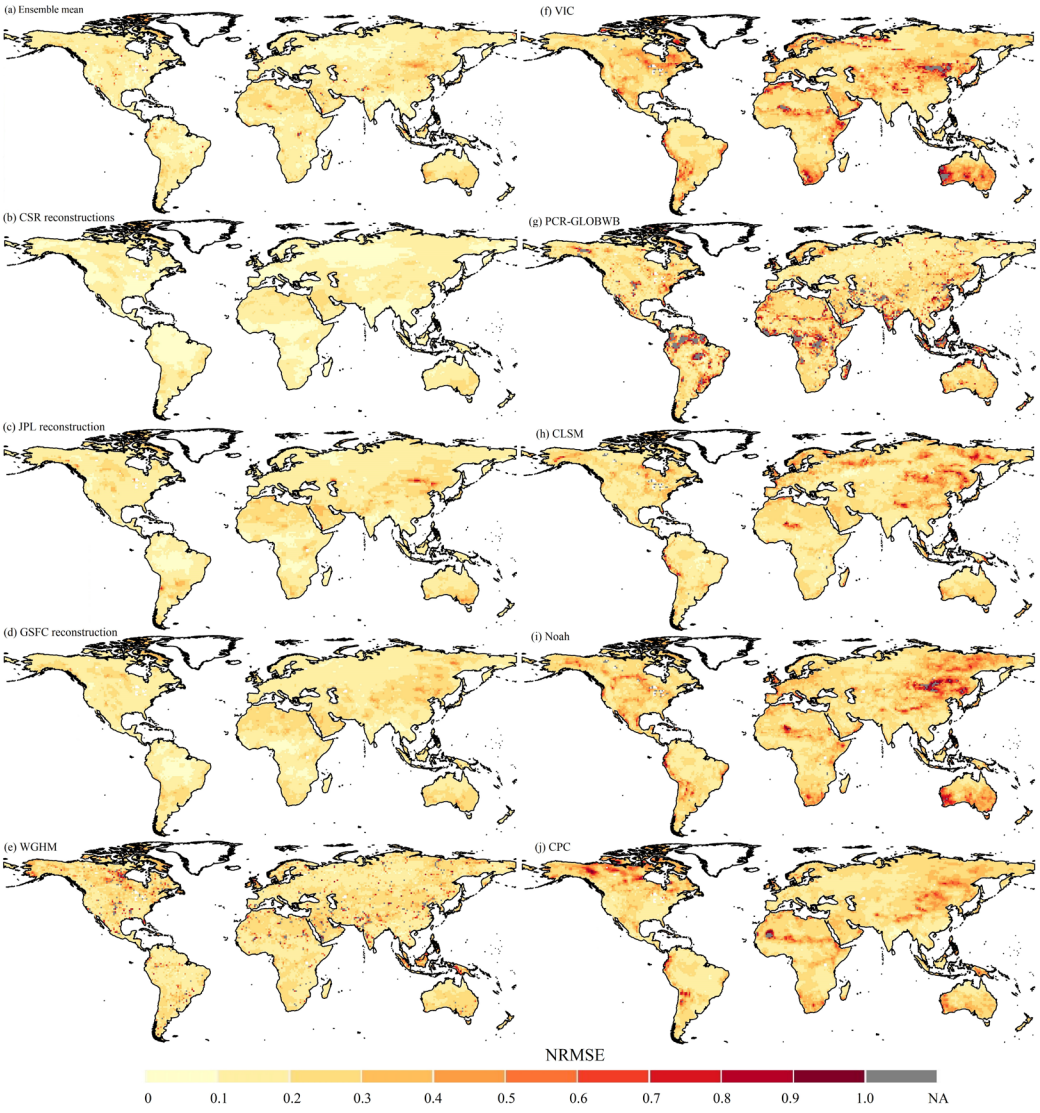

Figure S7. Global distribution of NRMSE between TWSA derived from the GRACE mission and each member and the ensemble mean of DATASET during the period April 2002-December 2014.

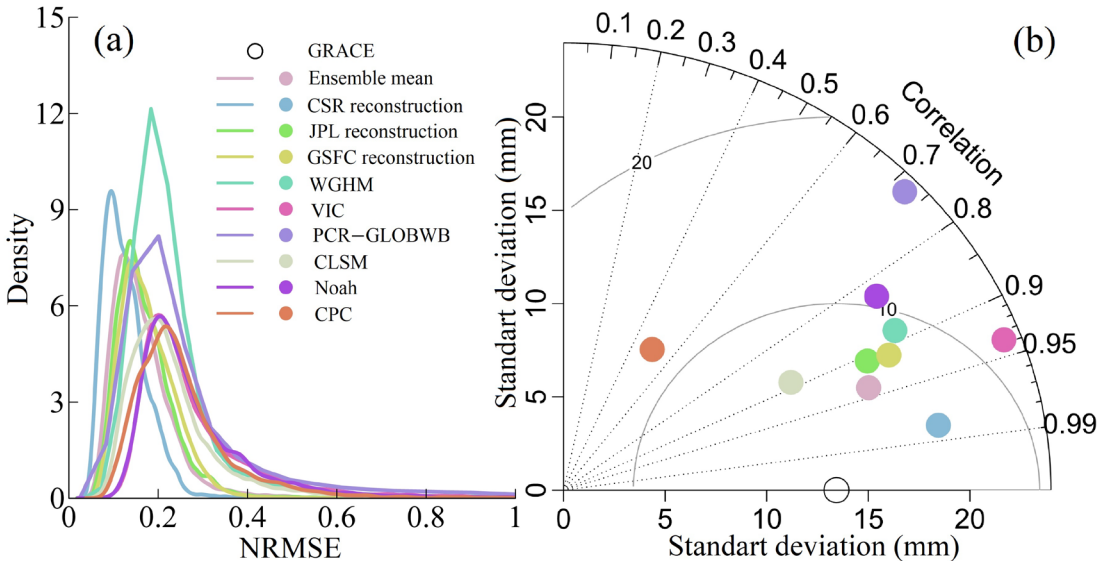

Figure S8. (a) Probability density function and (b) Taylor diagram of NRMSE between TWSA derived from the GRACE mission and each member and the ensemble mean of DATASET during the period April 2002-December 2014.

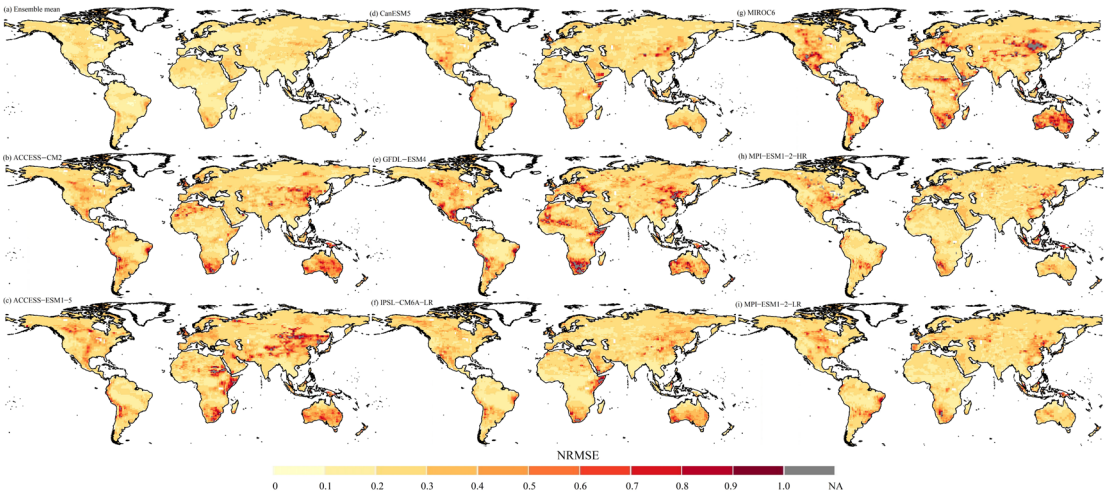

Figure S9. Global distribution of NRMSE between TWSA derived from the GRACE mission and each member and the ensemble mean of the eight GCMs before bias correction during the period April 2002-December 2014.

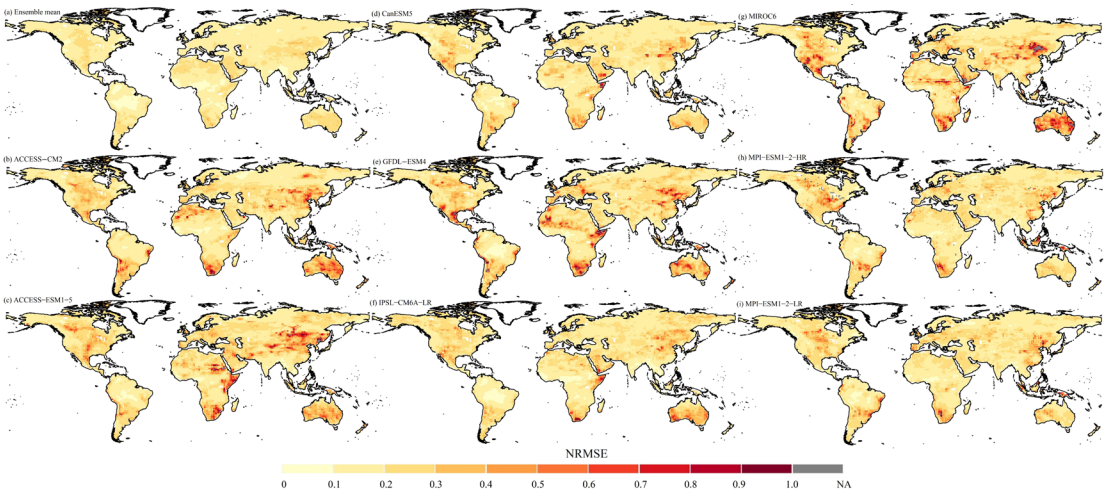

Figure S10. Global distribution of NRMSE between TWSA derived from the GRACE mission and each member and the ensemble mean of the eight GCMs after bias correction during the period April 2002-December 2014.

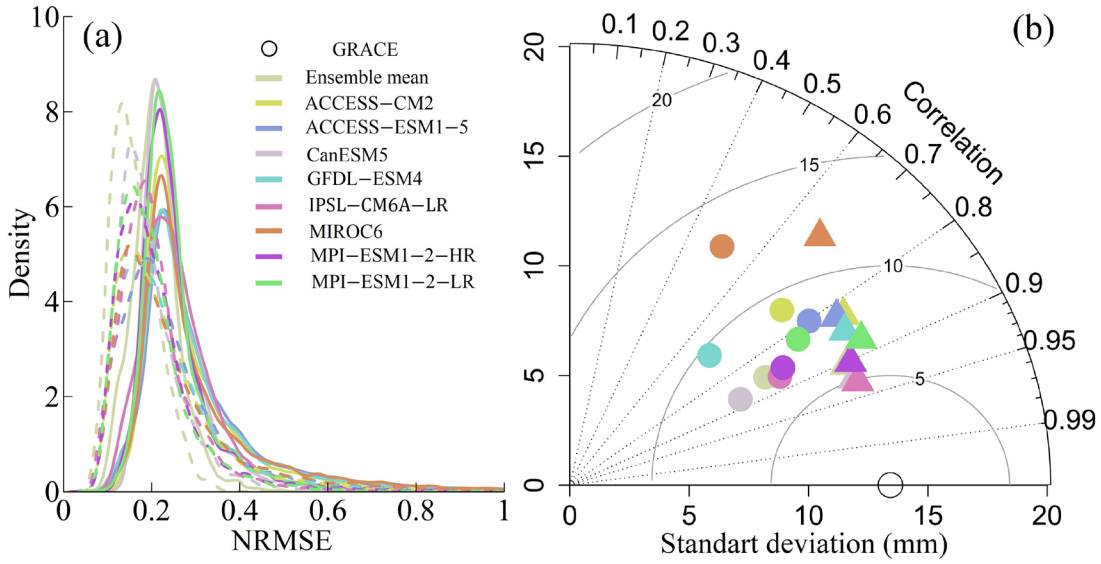

Figure S11. (a) Probability density function and (b) Taylor diagram of NRMSE between TWSA derived from the GRACE mission and each member and the ensemble mean of eight GCMs before (solid line and circles) and after (dash line and triangles) bias correction during the period April 2002-December 2014.

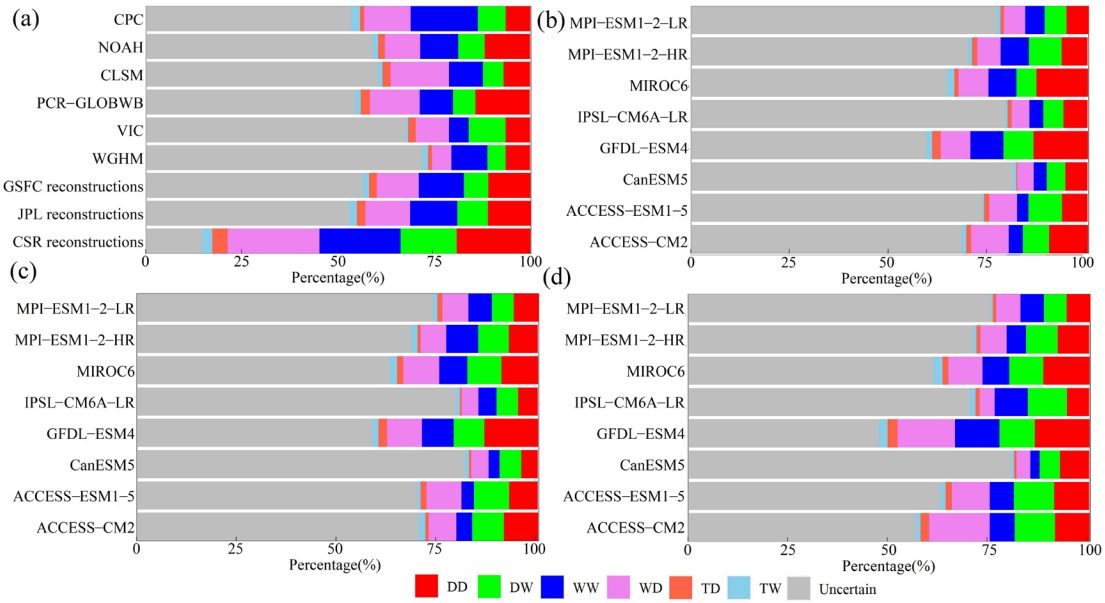

Figure S11. Same as the Figure 5, but based on individual dataset during the (a) historical (1985-2014) and future (2071-2100) period under (b) SSP126, (c) SSP245, and (d) SSP585 scenarios, respectively.

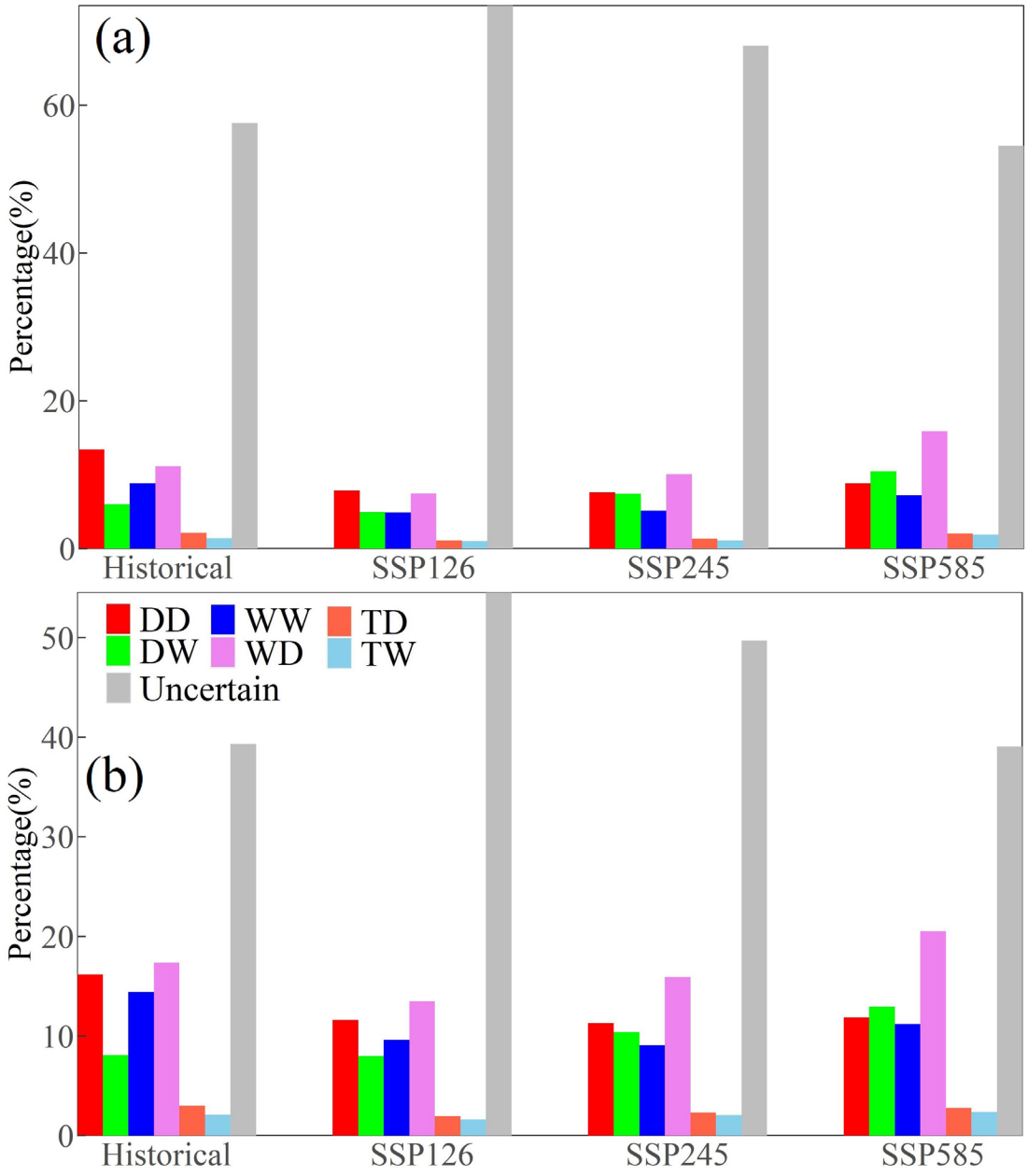

Figure S12. Same as the Figure 5, but with a significance of (a) 0.01 and (b) 0.1, respectively.

Table S1. Description of the 43 SREX regions from the IPCC AR6.

Acronym	Name	Continent	Type
ARP	Arabian-Peninsula	ASIA	Land
CAF	Central-Africa	AFRICA	Land
CAR	Caribbean	CENTRAL-AMERICA	Land-Ocean
CAU	C.Australia	OCEANIA	Land
CNA	C.North-America	NORTH-AMERICA	Land
EAS	E.Asia	ASIA	Land
EAU	E.Australia	OCEANIA	Land
ECA	E.C.Asia	ASIA	Land
EEU	E.Europe	EUROPE	Land
ENA	E.North-America	NORTH-AMERICA	Land
ESAF	E.Southern-Africa	AFRICA	Land
ESB	E.Siberia	ASIA	Land
MDG	Madagascar	AFRICA	Land
MED	Mediterranean	EUROPE-AFRICA	Land-Ocean
NAU	N.Australia	OCEANIA	Land
NCA	N.Central-America	CENTRAL-AMERICA	Land
NEAF	N.Eastern-Africa	AFRICA	Land
NEN	N.E.North-America	NORTH-AMERICA	Land
NES	N.E.South-America	SOUTH-AMERICA	Land
NEU	N.Europe	EUROPE	Land
NSA	N.South-America	SOUTH-AMERICA	Land
NWN	N.W.North-America	NORTH-AMERICA	Land
NWS	N.W.South-America	SOUTH-AMERICA	Land
NZ	New-Zealand	OCEANIA	Land
RAR	Russian-Arctic	ASIA	Land
RFE	Russian-Far-East	ASIA	Land
SAH	Sahara	AFRICA	Land
SAM	South-American-Monsoon	SOUTH-AMERICA	Land
SAS	S.Asia	ASIA	Land

SAU	S.Australia	OCEANIA	Land
SCA	S.Central-America	CENTRAL-AMERICA	Land
SEA	S.E.Asia	ASIA	Land-Ocean
SEAF	S.Eastern-Africa	AFRICA	Land
SES	S.E.South-America	SOUTH-AMERICA	Land
SSA	S.South-America	SOUTH-AMERICA	Land
SWS	S.W.South-America	SOUTH-AMERICA	Land
TIB	Tibetan-Plateau	ASIA	Land
WAF	Western-Africa	AFRICA	Land
WCA	W.C.Asia	ASIA	Land
WCE	West&Central-Europe	EUROPE	Land
WNA	W.North-America	NORTH-AMERICA	Land
WSAF	W.Southern-Africa	AFRICA	Land
WSB	W.Siberia	ASIA	Land

Table S2. Summary of attributes of different datasets used in this study.

Dataset	GRACE	WGHM	VIC	PCR-GLOBWB	Noah	CPC	CLSM	CMIP6
Parameter	Satellite	GHM			LSM			GCM
Surface water storage	√	√	×	√	×	×	×	×
Soil moisture	√	√	√	√	√	√	√	√
Groundwater storage	√	√	×	√	×	×	√	×
Canopy water	√	√	×	√	√	×	√	×
Snow water	√	√	×	√	√	×	√	√
Soil layers (no.)	/	1	3	2	4	10	10	5~10
Soil depth (m)	/	2	2	1.5	2	1.6	1	2~10