Supplementary Information for

Near-global Summer Circulation Response to the Spring Surface Temperature Anomaly in Tibetan Plateau ---- The GEWEX/LS4P First Phase Experiment

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Introduction

This supplementary material contains Tables S1-S3 and Figure S1 which are referenced in the main manuscript. Detailed information of each LS4P-I Earth System Models and the statistics of model performance in LS4P-I experiments, including information on the area covered by the eight hot spots, is provided in Xue et al. (2021, 2022, 2023). Here we only list basic model features in Table S1, S2 and S3.

Table S1. List of LS4P-I Earth System Models

Model	Institution	Resolution	Ensemble size	Key references*
ACCESS-S2	Bureau of Meteorology, Australia	N216L85, ocean 0.25	11 members	MacLachlan et al. (2015)
AFES-HU ver 4.1	Hokkaido University, Japan	T79 (~ 150 km) and 56 vertical levels up to about 0.1 hPa	30 members	Nakamura et al. (2015)
CAS-ESM	Institute of Atmospheric Physics, Chinese Academy of Sciences, China	1.4° × 1.4°	8 members	Lin et al. (2016)
CAS-FGOALS-f2	BNU and IAP/LASG, China	100 km × 100km	8 members	Bao et al. (2019)
CFS/SSiB2	University of California – Los Angeles, USA	T126 (~ 1° × 1°) and 47 vertical levels	10 members	Xue et al. (2004) ; Lee et al. (2019)
CMCC-SPS3	Fondazione Centro euro-Mediterraneo sui Cambiamenti Climatici (CMCC), Italy	ne30np4 (~ 111 km grid spacing at the Equator) and 46 atmospheric vertical levels up to 0.2 hPa	20 members	Sanna et al. (2016)
CNRM-CM6-1 AMIP	CNRM, France	Tl127 (~ 150 km) and 91 levels up to 0.01 hPa	30 members	Voldoire et al. (2019)
CNRM-CM6-1 CMIP	CNRM, France	Atmos: same as CNRM-CM6-1 AMIP Ocean: ORCA1 (~100 km), 75 vertical levels	30 members	Voldoire et al. (2019)
ECMWF-IFS version: CY46R1	ECMWF, United Kingdom	Atmos: Tco199 (~ 25 km) 91 vertical levels Ocean: ORCA025(~ 25 km) 75 vertical levels	30 members	Johnson et al. (2019)

E3SM	Lawrence Livermore National Laboratory, USA	1° ×1° and 72 levels up to ~0.1 hPa	6 members	Golaz et al. (2019); Tang et al. (2019)
GRAPES_GFS	China Meteorological Administration, China	0.5° ×0.5°	8 members	Chen et al. (2020)
IITM CFS	Indian Institute of Tropical Meteorology, Ministry of Earth Sciences, India	T126 (~1° ×1°) and 47 levels up to 0.01 hPa	10 members	Saha et al. (2017)
JMA/MRI-CPS2	Japan Meteorological Agency/Meteorological Research Institute, Japan	Atmosphere: 110 km Ocean: 1° × 0.3–0.5°	10 members	Takaya et al. (2018)
KIM HR	Korea Institute of Atmospheric Prediction Systems, South Korea	T254L64(~55 km; up to 0.3 hPa)	10 members	Hong et al. (2018) but with spectral dynamical core (Hong et al. 2013)
KIM LR	Korea Institute of Atmospheric Prediction Systems, South Korea	T126L42(~111 km; up to 2.5 hPa)	10 members	Hong et al. (2018) but with spectral dynamical core (Hong et al. 2013)
NASA_GEOS5	NASA Goddard Space Flight Center, USA	1°	30 members	Molodet al. (2020)

Table S2: Bias of May 2003 T2m Anomalies in EXP-CTRL run and Simulated May 2003 T2m Differences due to the TP LST/ SUBT Effect

	May 2003 T2m (°C) (TP above 4000 m)		
Models	Bias of EXP-CTRL run	Simulated Differences due to TP LST/SUBT initialization	Ratio (%) between Simulated Differences and Observations
ACCESS-S2	1.30	-0.85	60.71
AFES-HU	-0.53	-1.13	80.71
CAS-ESM	0.59	-0.57	40.71
FGOALS-f2	0.95	-1.49	106.42
CFS/SSiB2	2.15	-1.46	104.28
CMCC-SPS3	2.64	-0.39	27.86
CNRMAMIP*	-0.35	-0.96	68.57
CNRMCMIP*	-0.35	-1.07	76.43
ECMWF	-2.35	-0.35	25.71
E3SM	0.42	-0.84	60.00
GRAPES	0.38	-1.11	78.28
IITMCFS	1.95	-0.25	17.86
JMA CPS2	1.38	-0.99	70.71
KIM HR	2.86	-0.12	8.60
KIM LR	1.64	-0.50	35.71
NASAGEOS5	2.27	-1.00	71.43

Ensemble Mean	1.02	-0.82	58.57

*Note: CNRM provided one group of EXP-CTRL simulations and two groups (by CNRMAMIP and CNRMCMIP models) of EXP-LST/ SUBT simulations.

Table S3: Domain Coordinates for Statistics of Hot Spots

Regions	**Coordinates for statistics**
Southern Yangtze River Basin	112E-121E ; 24N-30N
Northeast Asia	120E-135 ; 40N-52.8N
Northwest North America	124W-105W ; 45N-55N
Southern Great Plains	105W-90W ; 30N-40N
Central America	110W-87W ; 13N-29.5N
Northern South America	80W-51W ; 4N-12.5N
East Africa	27E-37E ; 3S-8N
Western Sahel	12W-10E ; 10.5N-18N

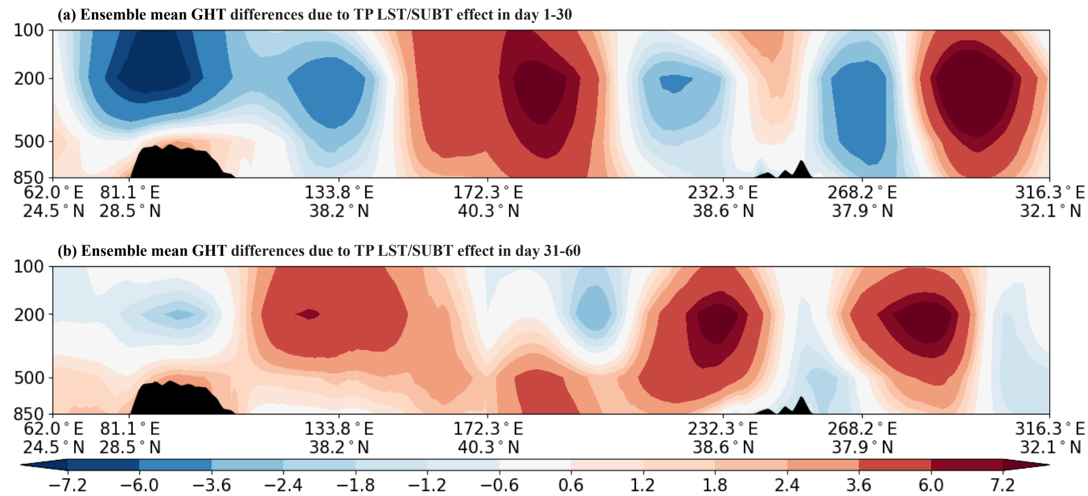

Figure S1: Same as Figure 7 but for the ensemble mean of the (a) day 1-30 and (b) day 31-60 day averaged evolution of geopotential height differences (m).

In Figure S1, the ensemble mean of 30-day averaged TRC wave train evolution is plotted to compare with the corresponding 20-day averaged wave train evolution (Figure 7) and the observation (Figure 8). The differences mainly exist in the regions near TP. In the first 30-day average (Figure S1a), strong negative geopotential height response is found in regions just downstream of the TP, in contrast to the positive geopotential height anomaly in the observation (Figure 8a). This discrepancy is mainly due to the phase change of the wave train since day 20 (Figure 7b). In the last 30-day average (Figure S1b), the geopotential height responses over TP and northeast Asia are opposite to the observed geopotential height anomaly (Figure 8b), which is also due to the faster phase evolution in the region with the phase changed since day 40 (not shown).

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