Electronic Supplementary Material to: Storm-Resolving Earth: How Well Do Global KM-Scale Models Simulate Storms in East Asia's 2020 Record-breaking Wet Summer*

Xiaotong Huang[1], Puxi Li[1], Hongyong Yu[2], Xuelin Hu[1], Haoming Chen[1], Jian Li[1], Andreas F. Prein[3], Yuanchun Zhang[4], Moran Zhuang[5], Yufei Wu[6], and Tianjun Zhou[7]

[1]*State Key Laboratory of Severe Weather Meteorological Science and Technology (LaSW)*, *Chinese Academy of Meteorological Sciences*, *China Meteorological Administration*, *Beijing*, *China*

[2]*State Key Laboratory of Earth Surface Processes and Disaster Risk Reduction*, *Faculty of Geographical Science*, *Beijing Normal University*, *Beijing*, *China*

[3]*Institute for Atmospheric and Climate Science*, *ETH Zürich*, *Zurich*, *Switzerland*

[4]*State Key Laboratory of Atmospheric Environment and Extreme Meteorology*, *Institute of Atmospheric Physics*, *Chinese Academy of Sciences*, *Beijing*, *China*

[5]*CMA Earth System Modeling and Prediction Centre*, *China Meteorological Administration*, *Beijing*, *China*

[6]*Xiong'an Atmospheric Boundary Layer Key Laboratory*, *China Meteorological Administration*, *Xiong'an New Area*, *China*

[7]*State Key Laboratory of Earth System Numerical Modeling and Application*, *Institute of Atmospheric Physics*, *Chinese Academy of Sciences*, *Beijing*, *China*

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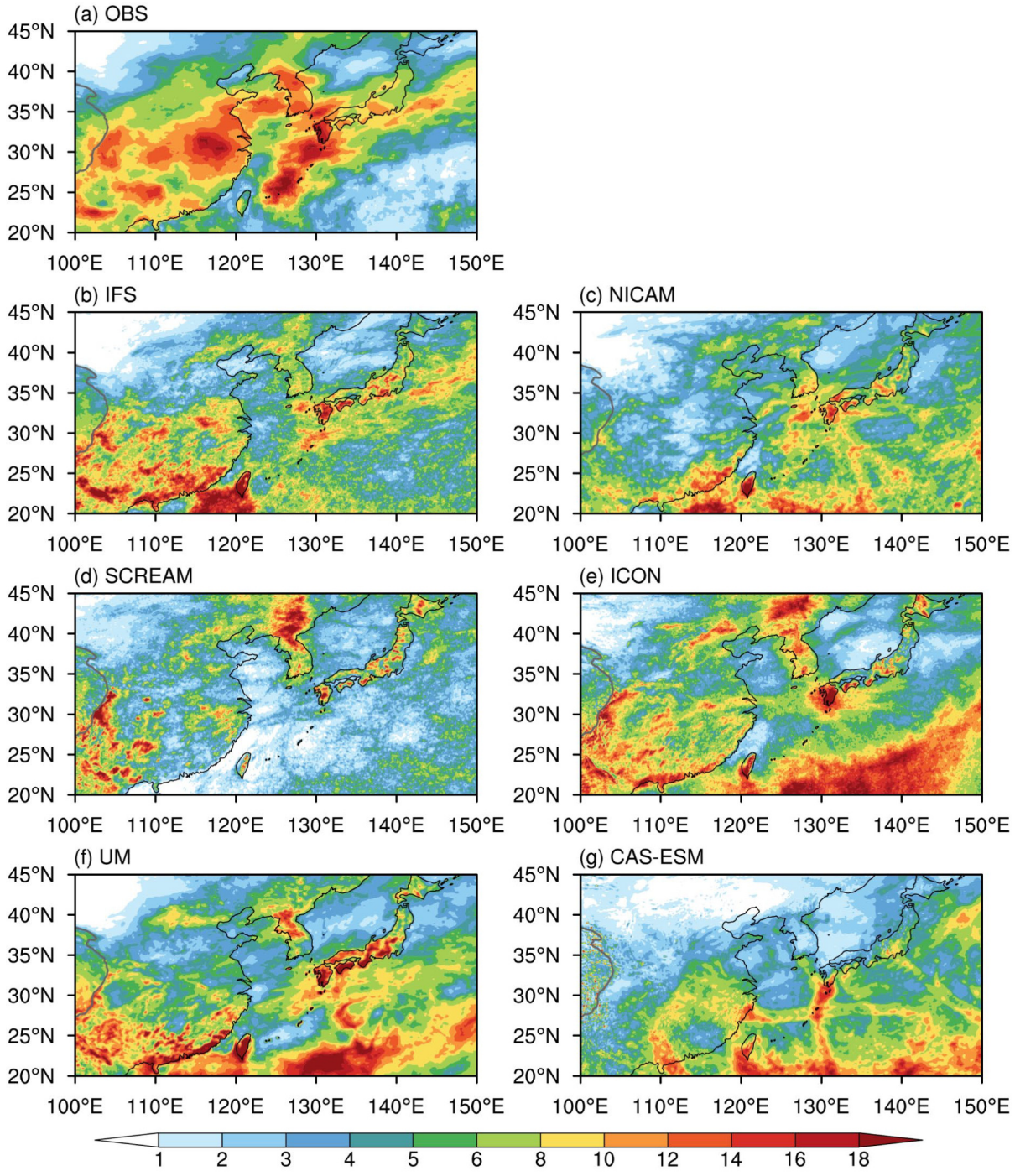

Fig. S1. Spatial pattern of total precipitation (units: mm d^{-1}) from June to August (JJA) 2020 of (a) observation and models including (b) IFS, (c) NICAM, (d) SCREAM, (e) ICON, (f) UM and (g) CAS-ESM. The gray line near the left boundary represents 3000 m elevation.

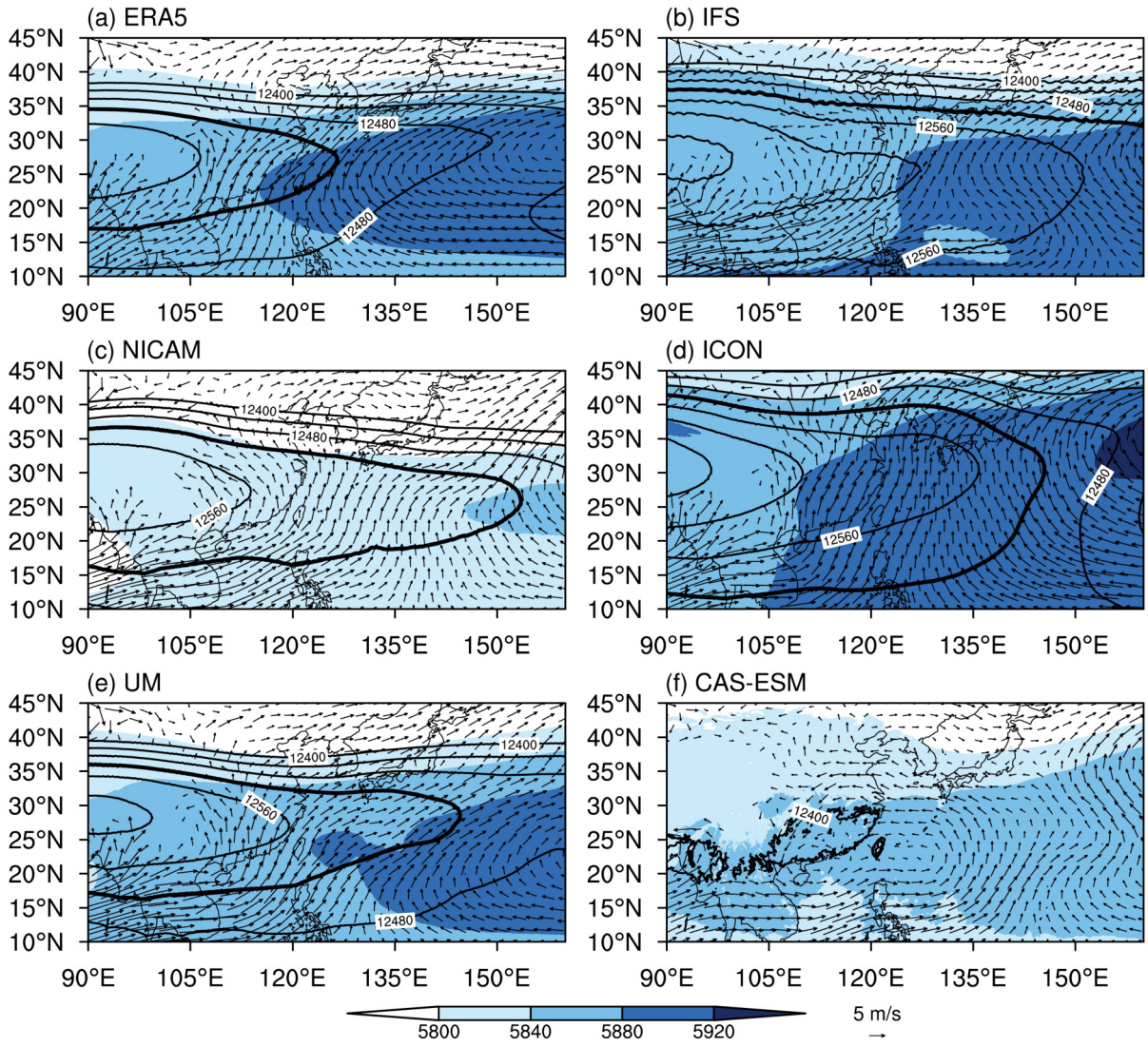

Fig. S2. Large-scale circulations averaged over June to August (JJA) 2020 of (a) ERA5 reanalysis and models including (b) IFS, (c) NICAM, (d) ICON, (e) UM and (f) CAS-ESM. Contour shades and lines indicate 500 hPa and 200 hPa geopotential height, respectively. The bold line indicates the 12 520 gpm contour at 200 hPa. Vectors show 850 hPa wind fields.

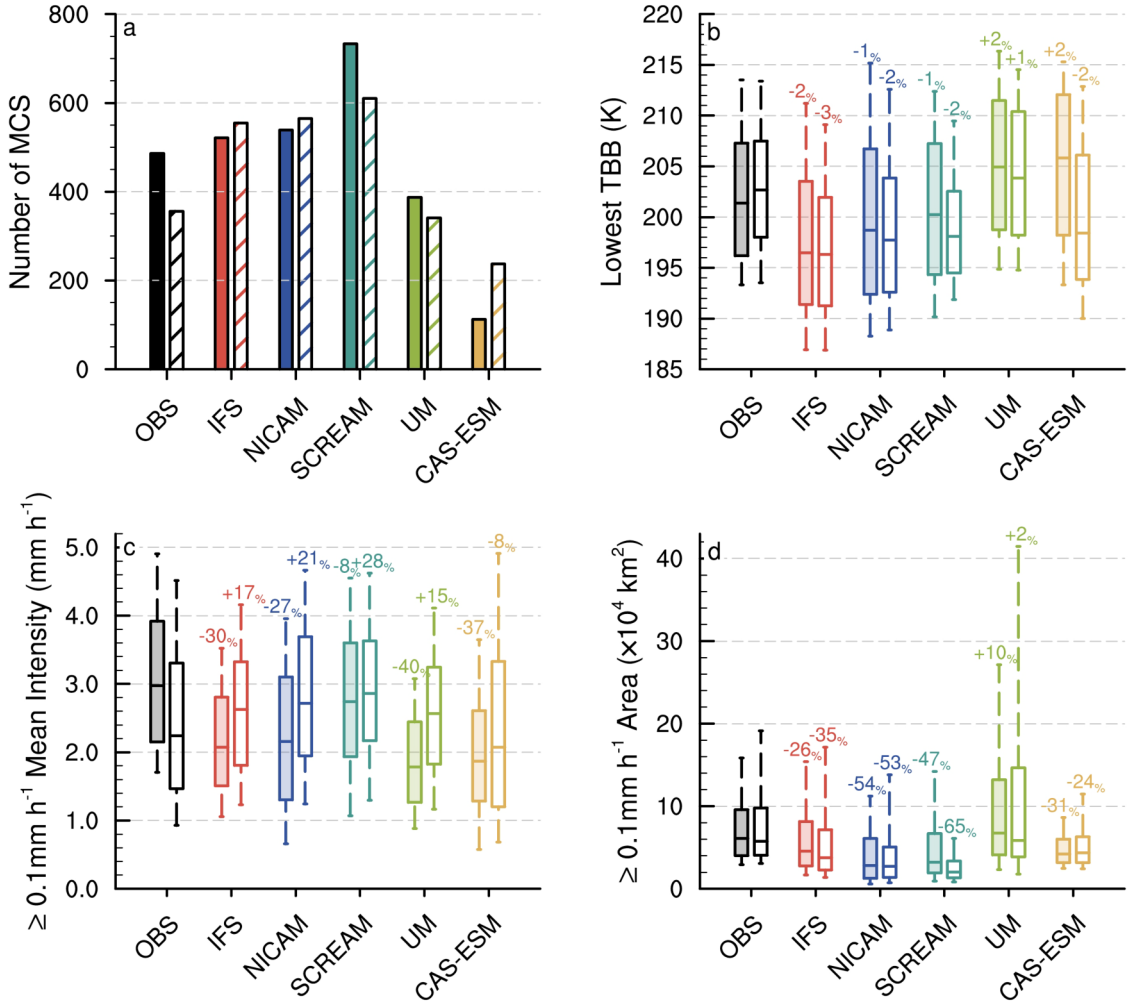

Fig. S3. Tracked MCS numbers and box plots of MCS properties, separating MCSs initiated over land (left filled box in each pair) and sea (right box in each pair): (a) number of MCSs tracked in 20°–45°N, 100°–150°E according to observations and model simulations; (b) lowest TBB (units: K) in the MCS lifetime; (c) mean precipitation intensity (units: mm h^{-1}) of pixels ⩾ 0.1 mm h^{-1} averaged over the lifespan; (d) area (units: 10^4 km^2) of precipitation ⩾ 0.1 mm h^{-1} averaged over the lifespan. The box limits indicate the 10th, 25th, 50th, 75th and 90th percentiles of MCS properties. The numbers above each model's box show the percentage bias of the median number relative to observations.

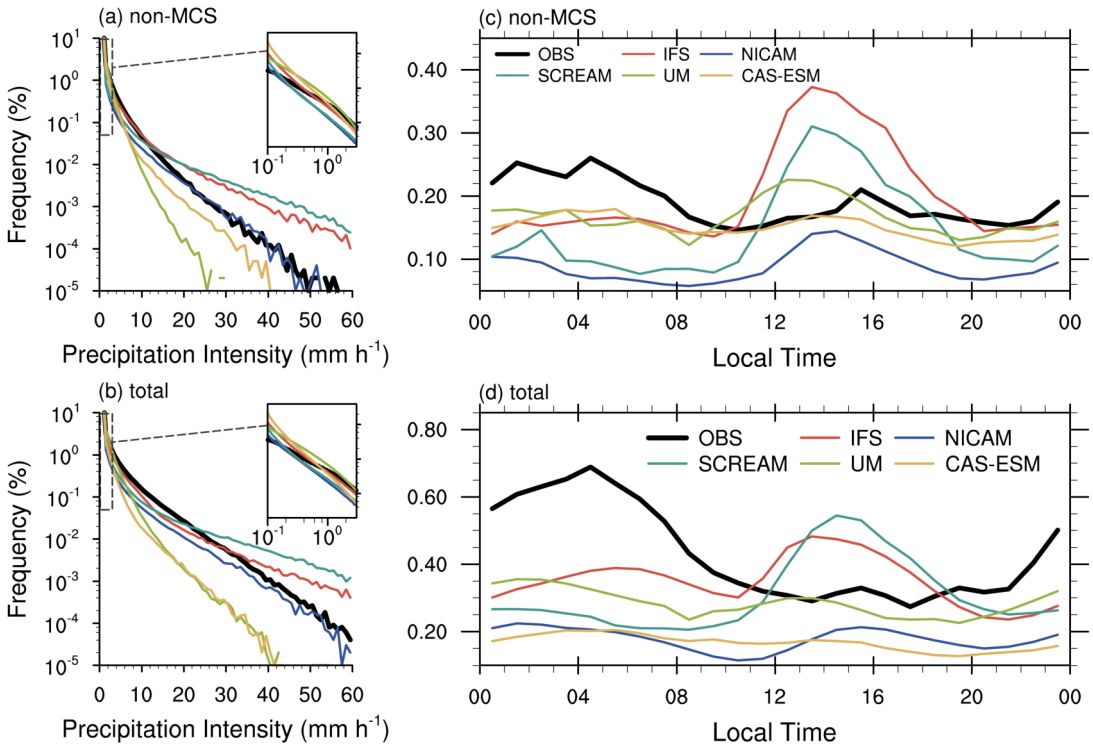

Fig. S4. Frequency–intensity plots of precipitation intensity (units: mm h^{-1}) and diurnal variations of non-MCS and total precipitation (units: mm h^{-1}) in 27°–33°N, 102.5°–110°E, Sichuan Basin. (a) Frequency versus non-MCS precipitation intensity. (b) Frequency versus total precipitation intensity. (c) Diurnal variations of non-MCS precipitation. (d) Diurnal variations of total precipitation.

Table S1. Configuration of six global kilometer-scale simulations used in this study. Tabulated are the model names, institutions, simulation marks, grid structures, nominal resolutions, number of vertical levels (not counting soil levels), model heights, and treatments of convection parameterizations, model components, and references to recent scientific documentation for each model. For convection parameterization (CP), the letters "N", "F" denote none or full parameterization.

Name	Institution	Simulation	Grid	Δx	$\#_{lev}$	H_{top}	CP	Reference
IFS	ECMWF	tco3999-ng5_deepoff	Octahedral	2.8 km	137	80 km	N	Rackow et al. (2025)
NICAM	FRCGC/JAMSTEC	gl11	Icosahedral	3.5 km	78	50 km	N	Takasuka et al. (2024)
SCREAM	DOE	–	Cubed-sphere	3.25 km	128	40 km	N	Donahue et al. (2024)
ICON	MPI-M	d3hp003	Icosahedral	2.2 km	90	75 km	N	Hohenegger et al. (2023)
UM	UKMO	n1280_CoMA9_TBv1p2	Lat-lon	10 km	85	80 km	F	Lock et al. (2024)
CAS-ESM	IAP	10km_NOCU	Lat-lon	10 km	35	35 km	N	Zhang et al. (2020)

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