AGU PUBLICATIONS

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Supporting Information for

The Influence of Ocean Coupling on Simulated and Projected Tropical Cyclone Precipitation in the HighResMIP–PRIMAVERA Simulations

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Text S1.

The modeling centers listed in Table S1 conducted both AGCM (uncoupled) and AOGCM (coupled) simulations spanning 1950–2050 which covers historical (1950–2014) and future (2015–2050) periods. Initial conditions of these simulations were provided through the ERA-20C reanalysis (Poli et al., 2016). Imposed boundary conditions were based on climatological seasonally varying leaf area index and constant land use during present-day period (Haarsma et al., 2016). Both simulations were driven by the same forcing fields, including the historic and time-varying forcings (Eyring et al., 2016) during 1950–2014 and the high-emission SSP585 scenario (O'Neill et al., 2016) for 2015–2050. The selection of SSP585 is to enhance anthropogenic signal, because the ensemble size (typically 1–3) of each GCM is small (Roberts et al., 2020a). When multiple ensemble members were available, we chose the first ensemble member of each GCM to analyze its outputs, because a majority of the GCMs used in this study have only one ensemble member. GCM outputs at the 3–6 hourly frequencies were employed in our analyses. For the AGCM simulations over 1950–2014, SSTs and sea ice were prescribed by the daily 0.25°×0.25° Hadley Centre Global Sea Ice and Sea Surface Temperature (HadISST.2.2.0; Kennedy et al., 2017) dataset. For the AGCM simulations over 2015–2050, SSTs and sea ice forcings were constructed by imposing a future warming trend (estimated from the CMIP5 RCP8.5 simulations) on historical SSTs and sea ice (Haarsma et al., 2016). For the AOGCMs, a 50-year integration was first started with the 1950 initial conditions and 1950s forcings as model spin-up. Then it was continued for another 100 years with the abovementioned forcings 1950–2050 and fully coupled atmosphere–ocean (Haarsma et al., 2016). The experimental design enables a robust comparison between the AGCMs and AOGCMs, which may lead to process-oriented understanding of the origins of GCM biases (Haarsma et al., 2016).

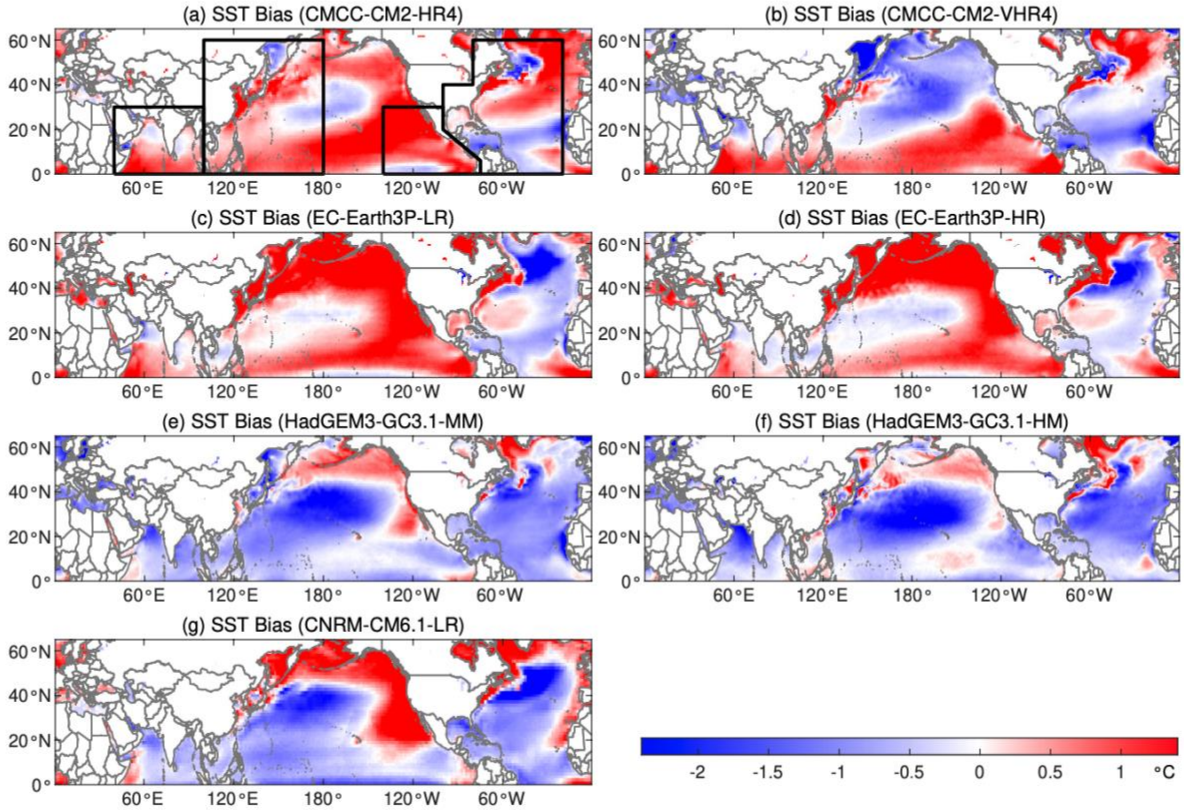

Figure S1. Sea surface temperature (SST) biases (ºC) in the AOGCMs from May to November 1950–2014. The four black boxes in (a) encompass (from right to left) the North Atlantic (NA), eastern North Pacific (EP), western North Pacific (WP), and North Indian (NI) basins. For climate models without SSTs in their data archive, SSTs were indirectly estimated from surface upwelling longwave radiation using the Stefan-Boltzmann law. Note that neither SSTs nor surface upwelling longwave radiation are available in the CNRM-CM6.1-HR model.

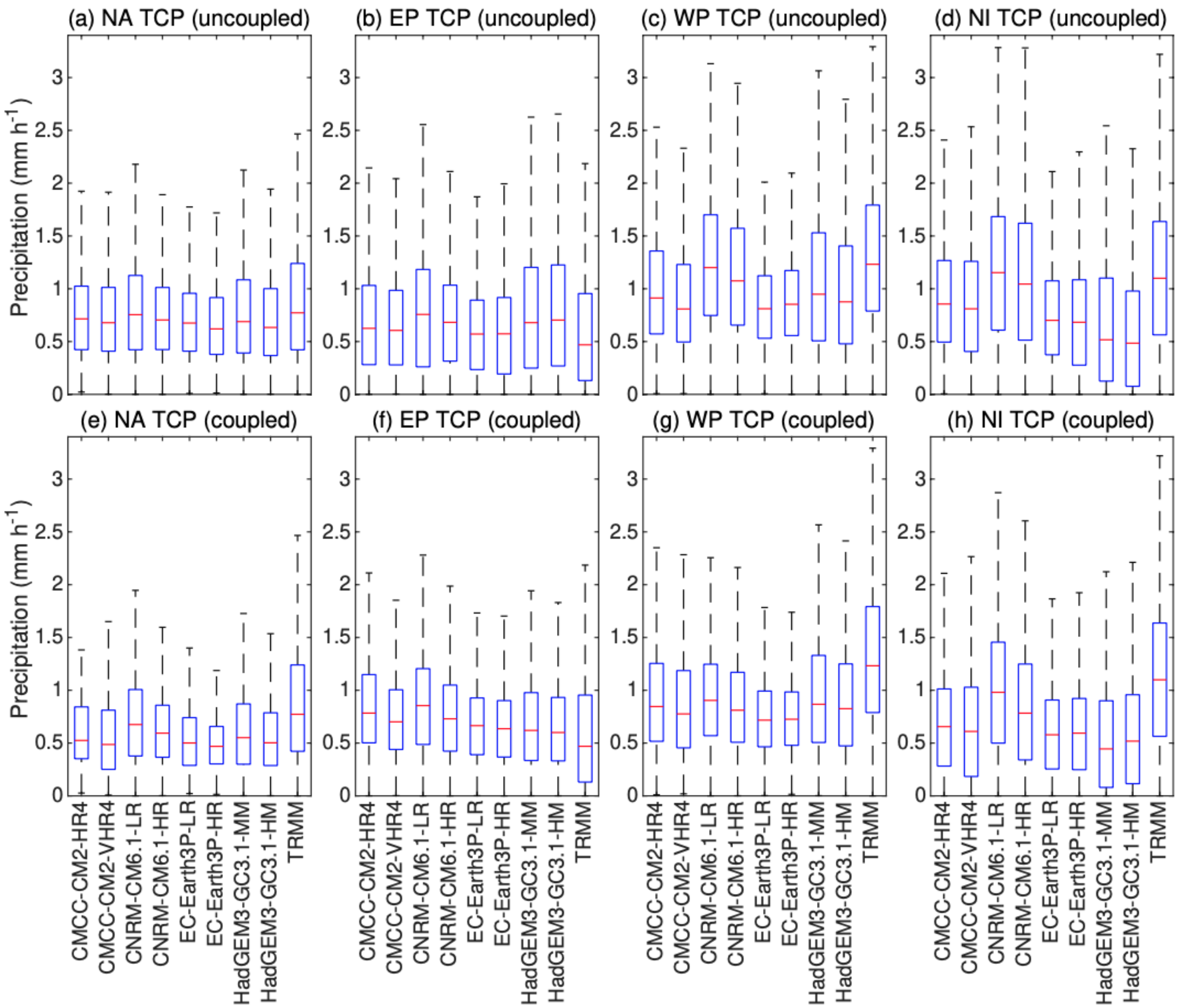

Figure S2. Boxplots of observed (TRMM) and simulated tropical cyclone precipitation (TCP, mm h^{-1}) over ocean from 1998–2014 in the (a–d) uncoupled and coupled (e–h) simulations. Ocean basins include the North Atlantic (NA), eastern North Pacific (EP), western North Pacific (WP), and North Indian (NI) basins.

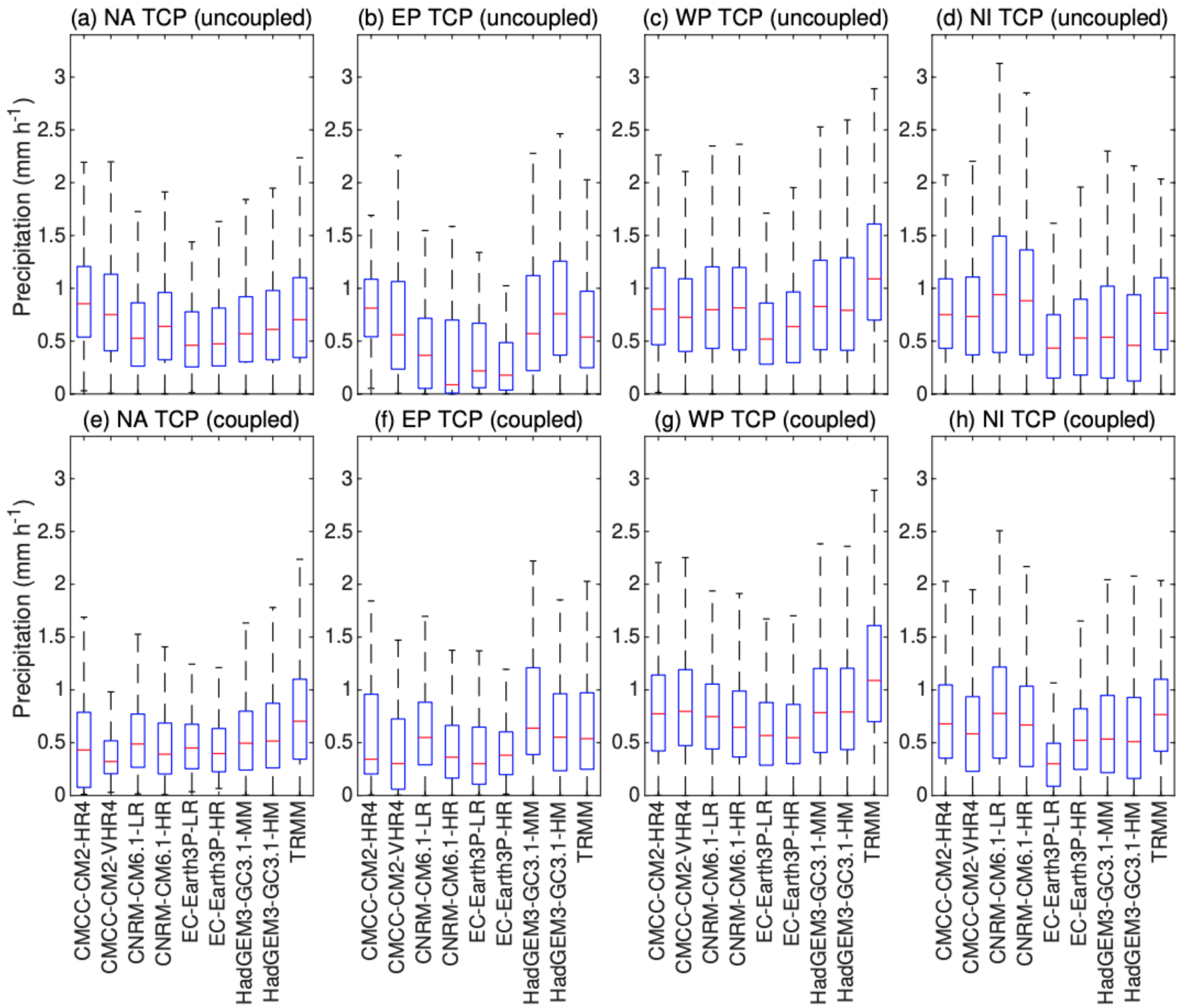

Figure S3. Same as Figure S2, but for tropical cyclone precipitation over land.

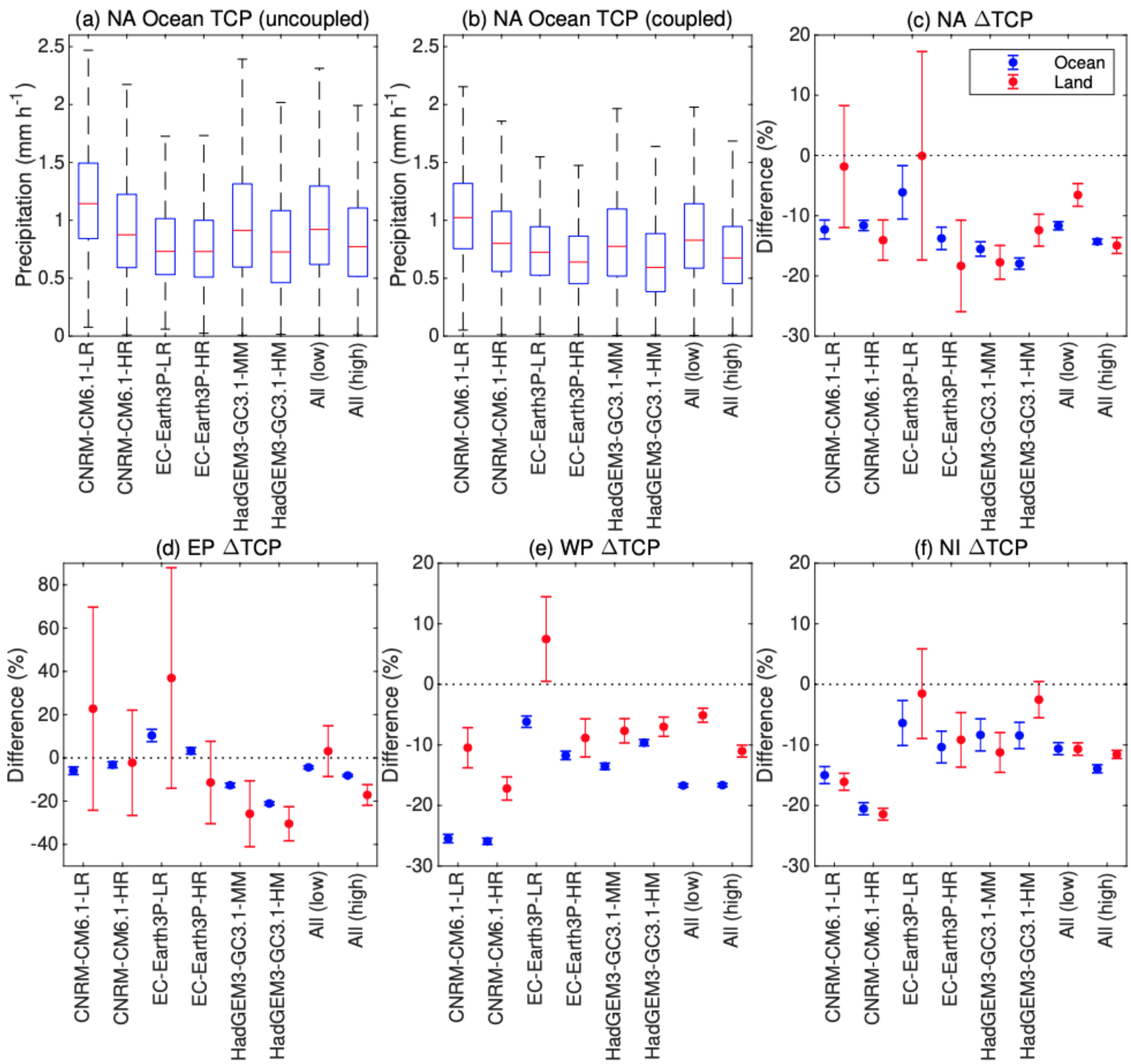

Figure S4. Same as Figure 1 in the paper, but based on tropical cyclone tracks identified by the TempestExtremes algorithm.

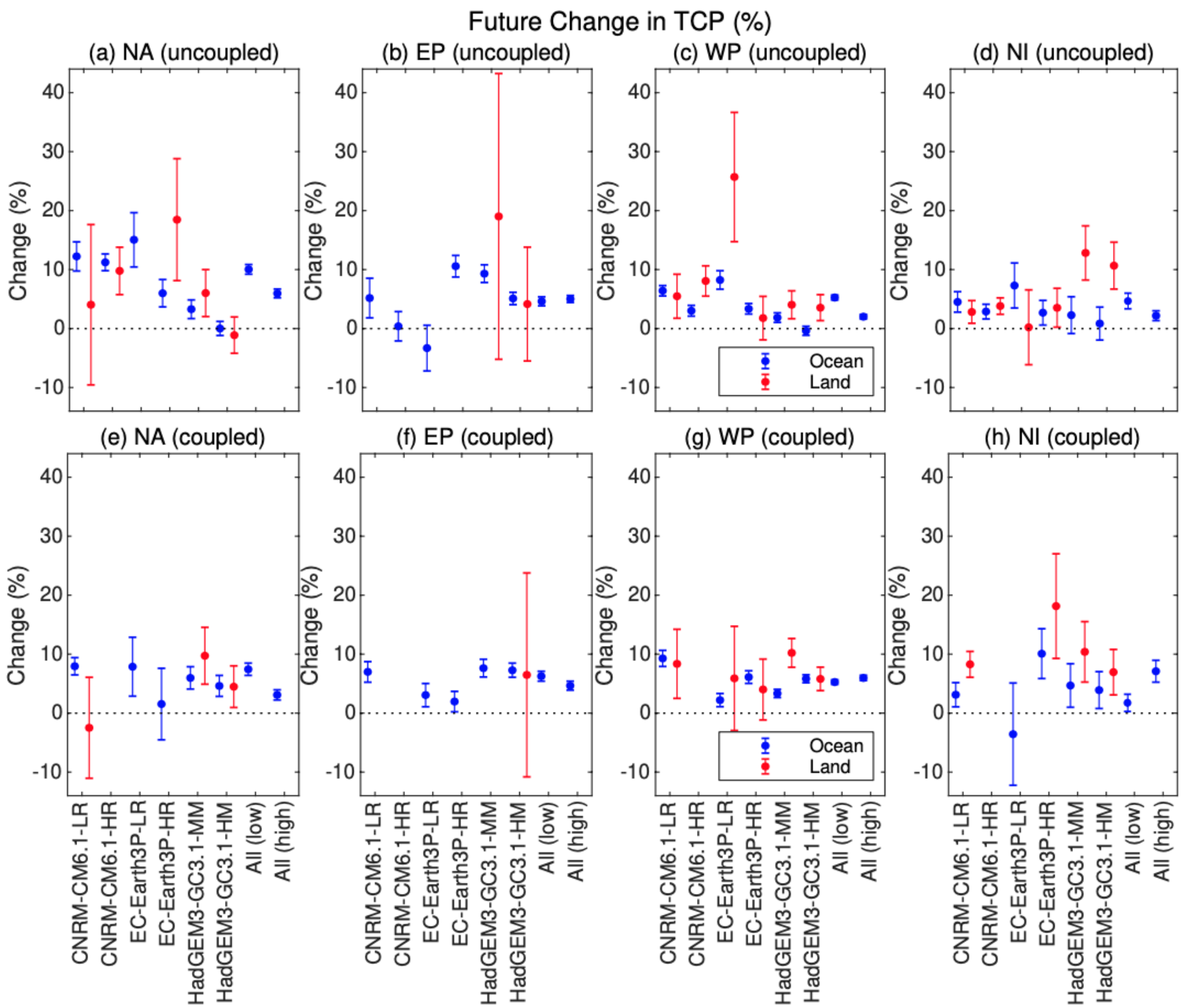

Figure S5. Same as Figure 4 in the paper, but based on tropical cyclone tracks identified by the TempestExtremes algorithm. TCP over land is required to have at least 50 6-hourly time steps. The models without meeting the criteria and therefore the ensemble of all low- and high-resolution models are not plotted.

Table S1. Global climate models and their characteristics

Model	CMCC-CM2	CNRM-CM6.1	EC-Earth3P	HadGEM3-GC3.1
Low and high resolution names	HR4, VHR4	LR, HR	LR, HR	MM, HM
Atmospheric mesh spacing at 0°N (km)	100, 28	156, 55	78, 39	93, 39
Atmospheric mesh spacing at 50°N (km)	64, 18	142, 50	71, 36	60, 25
Atmospheric nominal resolution in CMIP6	100, 25	250, 50	100, 50	100, 50
Atmospheric model levels	26	91	91	85
Ocean resolution (degree)	0.25, 0.25	1, 0.25	1, 0.25	0.25, 0.08
Institution names	Centro Euro-Mediterraneo sui Cambiamenti Climatici	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique	EC-Earth KNMI; Swedish Meteorological and Hydrological Institute; Barcelona Supercomputing Center; CNR	Met Office Hadley Centre; University of Reading; Natural Environment Research Council
References	Scoccimarro et al., (2017a, 2017b)	Voldoire (2019a, 2019b)	EC-Earth Consortium (2019a, 2019b)	Roberts (2017a, 2017b)