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Supporting Information for

A subseasonal Earth system prediction framework with CESM2

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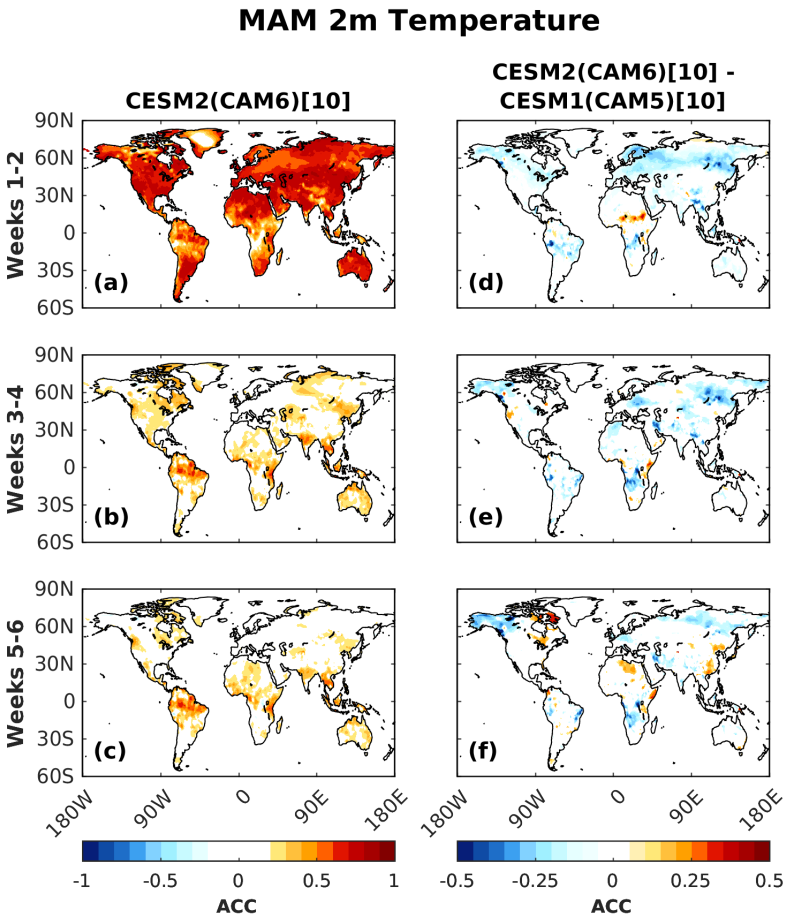

Figure S1: Same as Figure 3, but for MAM. Note, there is no CESM2(WACCM6) data for April - August.

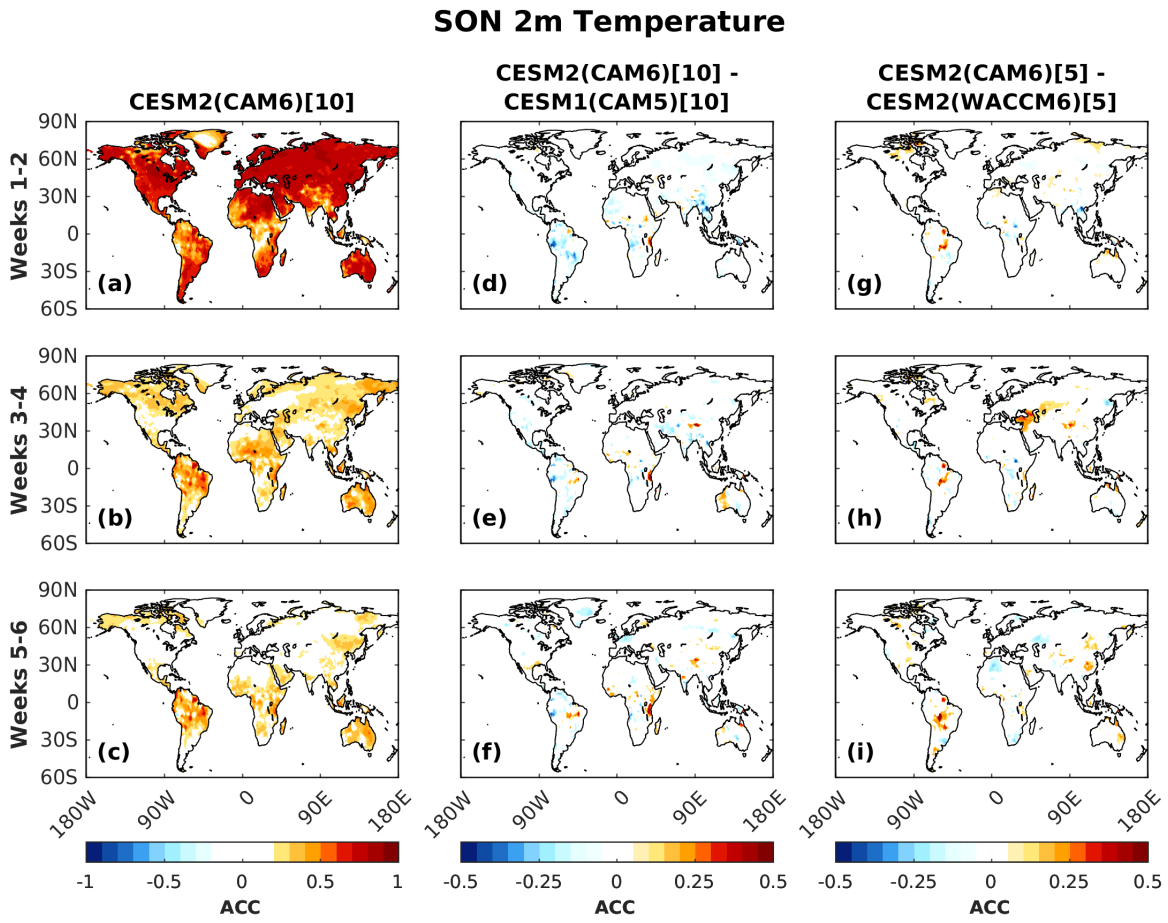

Figure S2: Same as Figure 2 but for SON.

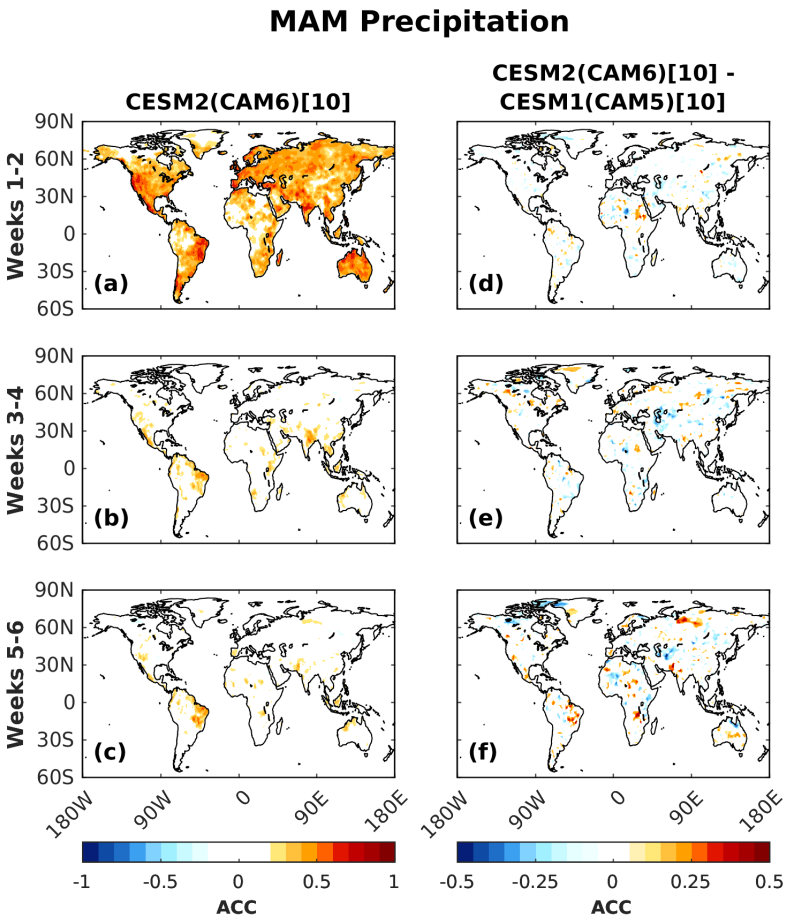

Figure S3: Same as Figure 5, but for MAM. Note, there is no CESM2(WACCM6) data for April - August.

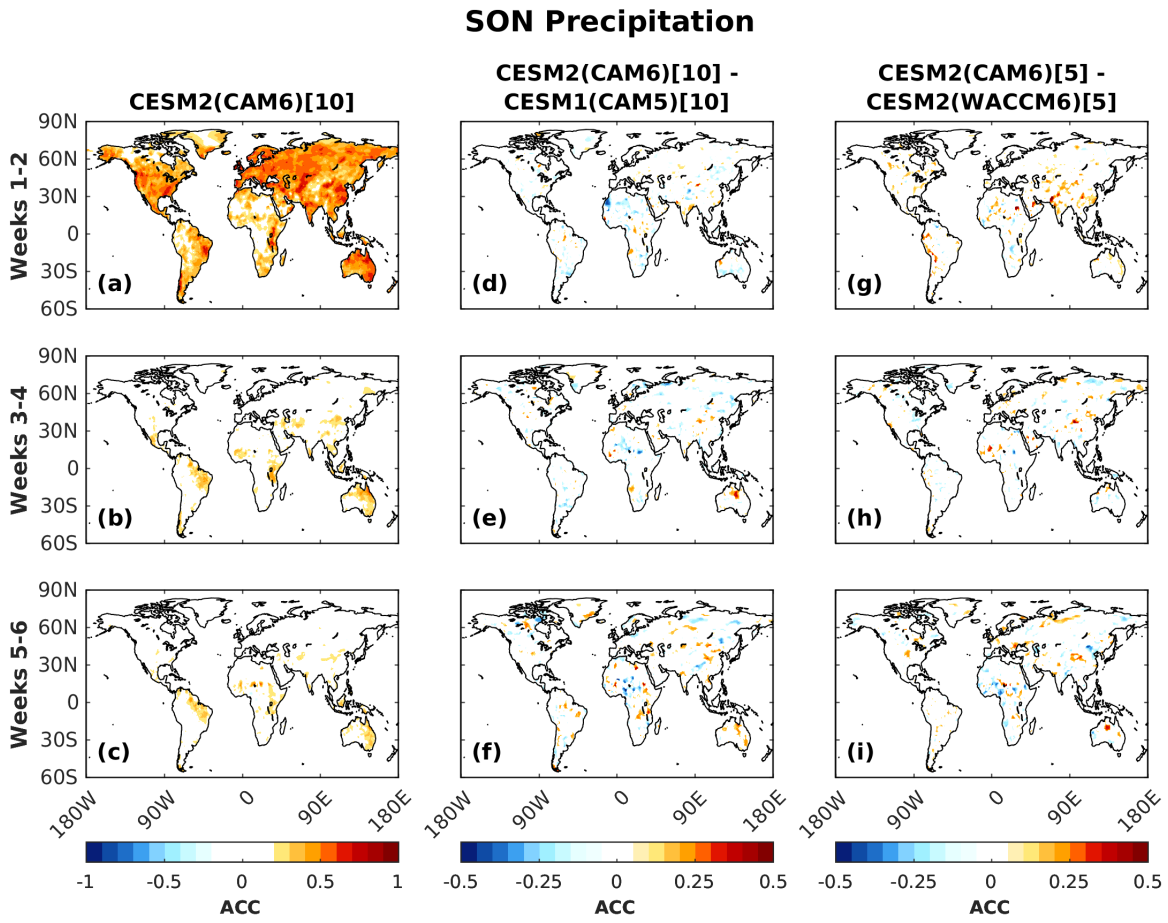

Figure S4: Same as Figure 5 but for SON.

SubX formatted variables (atmosphere, land, sea-ice)					
SubX Priority	**Original CESM variable name**	**SubX Formatted Filename**	**Description**	**CESM2 (CAM6)**	**CESM2 (WACCM6)**
p1	FLUT	rlut	Upwelling longwave flux at top of model	Y	Y
p1	PRECC+PRECL	pr_sfc	Total (convective and large-scale) precipitation rate (liq + ice)	Y	Y
p1	TREFHT	tas_2m	Reference height temperature	Y	Y
p1	TS	ts	Surface temperature	Y	Y
p1	U200	ua_200	Zonal wind at 200 hPa	Y	Y
p1	U850	ua_850	Zonal wind at 850 hPa	Y	Y
p1	U850	ua_850	Zonal wind at 850 hPa	Y	Y
p1	V850	va_850	Meridional wind at 850 hPa	Y	Y
p1	Z200	zg_200	Geopotential height at 200 hPa	Y	Y
p1	Z500	zg_500	Geopotential height at 500 hPa	Y	Y
p2	CAPE	cape	Convective available potential energy	Y	Y
p2	LHFLX	hfls_sfc	Surface latent heat flux	Y	Y
p2	SHFLX	hfss_sfc	Surface sensible heat flux	Y	Y
p2	Q850	huss_850	Specific humidity at 850 hPa	Y	Y
p2	QRUNOFF	mrro	Total liquid runoff	Y	Y
p2	SOILLIQ	mrso	Soil liquid water	Y	Y
p2	PSL	psl	Sea-level pressure	Y	Y
p2	FLNS-FSNS	rad_sfc	Net surface radiation	Y	Y
p2	H2OSOI	rzsm	Volumetric soil water	Y	Y
p2	ICEFRAC	sic	Sea-ice fraction in %	Y	Y
p2	FSNO	snc	Snow fraction in %	Y	Y

p2	TAUX	stx_sfc	Zonal surface stress	Y	Y
p2	TAUY	sty_sfc	Meridional surface stress	Y	Y
p2	TREFHTMX	tasmax_2m	Maximum daily reference height temperature	Y	Y
p2	TREFHTMN	tasmin_2m	Minimum daily reference height temperature	Y	Y
p2	U100	ua_100	Zonal wind at 100 hPa	Y	Y
p2	U10	uvas	10-meter wind speed	Y	Y
p2	V100	va_100	Meridional wind at 100 hPa	Y	Y
p2	OMEGA500	wap_500	Vertical velocity at 500 hPa	Y	Y
p3	T010	ta_10	Temperature at 10 hPa	Y	Y
p3	T100	ta_100	Temperature at 100 hPa	Y	Y
p3	T030	ta_30	Temperature at 30 hPa	Y	Y
p3	T050	ta_50	Temperature at 50 hPa	Y	Y
p3	T010	ua_10	Zonal wind at 10 hPa	Y	Y
p3	U030	ua_30	Zonal wind at 30 hPa	Y	Y
p3	U050	ua_50	Zonal wind at 50 hPa	Y	Y
p3	V010	va_10	Meridional wind at 10 hPa	Y	Y
p3	V030	va_30	Meridional wind at 30 hPa	Y	Y
p3	V050	va_50	Meridional wind at 50 hPa	Y	Y
p3	Z010	zg_10	Geopotential height at 10 hPa	Y	Y
p3	Z030	zg_30	Geopotential height at 30 hPa	Y	Y
p3	Z050	zg_50	Geopotential height at 50 hPa	Y	Y
p3	Z850	zg_850	Geopotential height at 850 hPa	Y	Y

Table S1: CESM2(CAM6) and CESM2(WACCM6) output from the atmosphere, land, and sea-ice models that follows the SubX naming convention. ‘Y’ and ‘N’ specify whether that particular variable is outputted for that model configuration.

Atmosphere model daily mean output			
Original CESM variable name	**Description**	**CESM2 (CAM6)**	**CESM2 (WACCM6)**
CLDTOT	Vertically-integrated total cloud	Y	Y
FLDS	Downwelling longwave flux at surface	Y	Y
FLNT	Net longwave flux at top of model	Y	Y
FSDS	Downwelling solar flux at surface	Y	Y
FSNT	Net solar flux at top of model	Y	Y
PHIS	Surface geopotential	Y	Y
PRECC	Convective precipitation rate	Y	Y
PRECL	Large-scale precipitation rate	Y	Y
PS	Surface pressure	Y	Y
PSL	Sea-level pressure	Y	Y
QFLX	Surface water flux	Y	N
QREFHT	Reference height humidity	Y	Y
RH600	Relative humidity at 600 hPa	Y	Y
RHREFHT	Reference height relative humidity	Y	Y
SNOWHICE	Snow depth over ice	Y	Y
SNOWHLND	Water equivalent snow depth	Y	Y
SST	Sea-surface temperature	Y	Y
TGCLDIWP	Total grid-box cloud ice water path	Y	N
TGCLDLWP	Total grid-box cloud liquid water path	Y	N
THzm	Zonal-mean potential temp	Y	Y
TMQ	Total precipitable water	Y	Y
TROP_P	Tropopause pressure	Y	Y
TROP_T	Tropopause temperature	Y	Y

U10	10m wind speed	Y	N
UVzm	Meridional flux of zonal momentum, zonal mean	Y	Y
UWzm	Vertical flux of zonal momentum, zonal mean	Y	Y
Uzm	Zonal mean zonal wind	Y	Y
VTHzm	Meridional heat flux, zonal mean	Y	Y
Vzm	Zonal-mean meridional wind	Y	Y
WSPDSRFAV	Horizontal total wind speed average at the surface	Y	N
WSPDSRFMX	Horizontal total wind speed maximum at the surface	Y	N
WThzm	Vertical Heat Flux, zonal mean	Y	Y
Wzm	Zonal mean vertical wind	Y	Y

Table S2: Additional daily-mean output from the atmosphere model.

Atmosphere model 6-hourly instantaneous output			
Original CESM variable name	**Description**	**CESM2 (CAM6)**	**CESM2 (WACCM6)**
PS	Surface pressure	Y	Y
PSL	Sea-level pressure	Y	Y
U10	10m wind speed	Y	Y
UBOT	Lowest model level zonal wind	Y	Y
VBOT	Lowest model level meridional wind	Y	Y
Z200	Geopotential height at 200 hPa	Y	Y
Z500	Geopotential height at 200 hPa	Y	Y

Table S3: 6-hourly instantaneous atmosphere model output.

Original CESM variable name	Description	CESM2 (CAM6)	CESM2 (WACCM6)
OMEGA	Vertical velocity	Y[1]	Y[2]
O3	Ozone	N	Y[2]
Q	Specific humidity	Y[1]	Y[2]
RELHUM	Relative humidity	Y[1]	Y[2]*
T	Temperature	Y[1]	Y[2]
U	Zonal wind	Y[1]	Y[2]
UQ	Zonal water transport	Y[1]	Y[2]
V	Meridional wind	Y[1]	Y[2]
VQ	Meridional water transport	Y[1]	Y[2]
Z3	Geopotential height	Y[1]	Y[2]
T_12_COS	Temperature 12hr cos coeff	N	Y[3]
T_12_SIN	Temperature 12hr sin coeff	N	Y[3]
T_24_COS	Temperature 24hr cos coeff	N	Y[3]
T_24_SIN	Temperature 24hr sin coeff	N	Y[3]
U_12_COS	Zonal wind 12hr cos coeff	N	Y[3]
U_12_SIN	Zonal wind 12hr sin coeff	N	Y[3]
U_24_COS	Zonal wind 24hr cos coeff	N	Y[3]
U_24_SIN	Zonal wind 24hr sin coeff	N	Y[3]
V_12_COS	Meridional wind 12hr cos coeff	N	Y[3]
V_12_SIN	Meridional wind 12hr sin coeff	N	Y[3]
V_24_COS	Meridional wind 24hr cos coeff	N	Y[3]
V_24_SIN	Meridional wind 24hr sin coeff	N	Y[3]

Table S4: Three-dimensional atmosphere mode output. *indicates that the RELHUM is only

consistently available for CESM2(WACCM6) starting with year 2020. Variable is available at 14 pressure levels (1000, 925, 850, 700, 500, 300, 200, 100, 70, 50, 30, 20, 10, 5 hPa). Variable is available at 22 pressure levels (1000, 925, 850, 700, 500, 200, 300, 100, 70, 50, 30, 20, 10, 5, 3, 2, 1, 0.5, 0.1, 0.01, 0.001, and 1e-5 hPa).[3]Variable is available at 8 pressure levels (10, 5, 1, 0.5, 0.1, 0.01, 0.001, 1e-5 hPa). X_24_COS, X_24_SIN, and X_12_COS and X_12_SIN are the coefficients of the diurnal (24 h) and semidiurnal (12 h) tide in field X (temperature, zonal or meridional wind).

Land Model Output			
Original CESM variable name	**Description**	**CESM2 (CAM6)**	**CESM2 (WACCM6)**
AR	Autotrophic respiration	Y	Y
BTRAN2	Root zone soil wetness factor	Y	N
COL_FIRE_CLOSS	Total column-level fire C loss for non-peat fires outside land-type converted region	Y	N
CPHASE	Crop phenology phase	Y	Y
CWDC	Coarse woody debris carbon	Y	N
ER	Ecosystem respiration	Y	Y
FAREA_BURNED	Fractional area burned by fire	Y	N
FIRE	Emitted infrared (longwave) radiation	Y	N
FSNO*	Snow fraction	Y	Y
FUELC	Fuel load	Y	N
GPP	Gross primary production	Y	Y
H2OCAN	Intercepted water	Y	Y
H2OSOI*	volumetric soil water	Y	Y
H2OSNO	Snow depth (liquid water)	Y	Y
HR	heterotrophic respiration	Y	N
NBP	Net biome production	Y	Y

NEE	Net ecosystem exchange	Y	N
NPP	net primary production	Y	Y
QDRAI	Sub-surface drainage	Y	N
QOVER	Surface runoff	Y	Y
QRGWL	Surface runoff at glaciers (liquid only), wetlands, lakes	Y	N
QRUNOFF*	total liquid runoff - leave in units of kg/m2/s	Y	Y
QSOIL	Ground evaporation	Y	N
QVEGE	Canopy evaporation	Y	N
QVEGT	Canopy transpiration	Y	Y
RAIN	atmospheric rain, after rain/snow repartitioning based on temperature	Y	N
SOILWATER_10CM*	soil liquid water + ice in top 10cm of soil (veg landunits only)	Y	Y
SNOW	atmospheric snow, after rain/snow repartitioning based on temperature	Y	N
SNOWDP	Snow height	Y	Y
TLAI	total projected leaf area index	Y	Y
TOTECOSYSC	Total ecosystem carbon, incl veg but excl cpool and product pools	Y	N
TOTVEGC	Total vegetation carbon, excluding cpool	Y	N
TWS	Total water storage	Y	Y

Table S5: Land model output (All daily averages). Variables marked with a '*' also appear in the SubX priority 2 (p2) files.

Sea-ice Model Output			
Original CESM variable name	**Description**	**CESM2 (CAM6)**	**CESM2 (WACCM6)**
aice	Ice concentration	Y	Y
aicen	sub-gridscale ice concentration category	Y	Y
appeff_ai	Effective pond fraction	Y	N
apond	melt pond fraction of sea ice	Y	Y
apond_ai	melt pond fraction of grid cell	N	Y
congel	congelation/basal ice growth	Y	Y
daidtd	ice area tendency due to dynamics	Y	Y
daidtt	ice area tendency due to thermodynamics	Y	Y
dvidtd	ice volume tendency due to dynamics	Y	Y
dvidtt	ice volume tendency due to thermodynamics	Y	Y
fhocn_ai	Net ice/ocean heat flux	Y	N
frazil	frazil/open-water ice growth	Y	Y
fsthru	Penetrating shortwave	Y	N
fsurf_ai	Net surface heat flux	Y	N
fswabs	snow/ice/ocean absorbed solar flux	N	Y
fswabs_ai	snow/ice/ocean absorbed solar flux	Y	N
fswdn	Incoming shortwave	Y	Y
hi	Ice thickness	Y	Y
hs	Snow thickness	Y	Y
meltb	basal ice melt	Y	Y
meltl	Lateral melt	Y	Y

melts	Snow melt	Y	Y
meltt	Surface ice melt	Y	Y
snoice	snow-to-ice conversion growth	Y	N
snowfrac	Snow fraction	Y	Y
Tsfc	Temperature of the snow/sea ice surface	Y	N
uvel	Ice velocity	Y	Y
vvel	Ice velocity	Y	Y

Table S6: Sea-ice model output (all daily averages).

Ocean model output			
Original CESM variable name	**Description**	**CESM2 (CAM6)**	**CESM2 (WACCM6)**
HMXL	Mixed-layer depth	Y	Y
SSH	Sea-surface height	Y	N
SST	Sea-surface temperature	Y	N

Table S7: Ocean model output (all daily averages).