# Supporting Information for "The new Max Planck Institute Grand Ensemble with CMIP6 forcing and high-frequency model output"

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April 27, 2023, 2:50pm
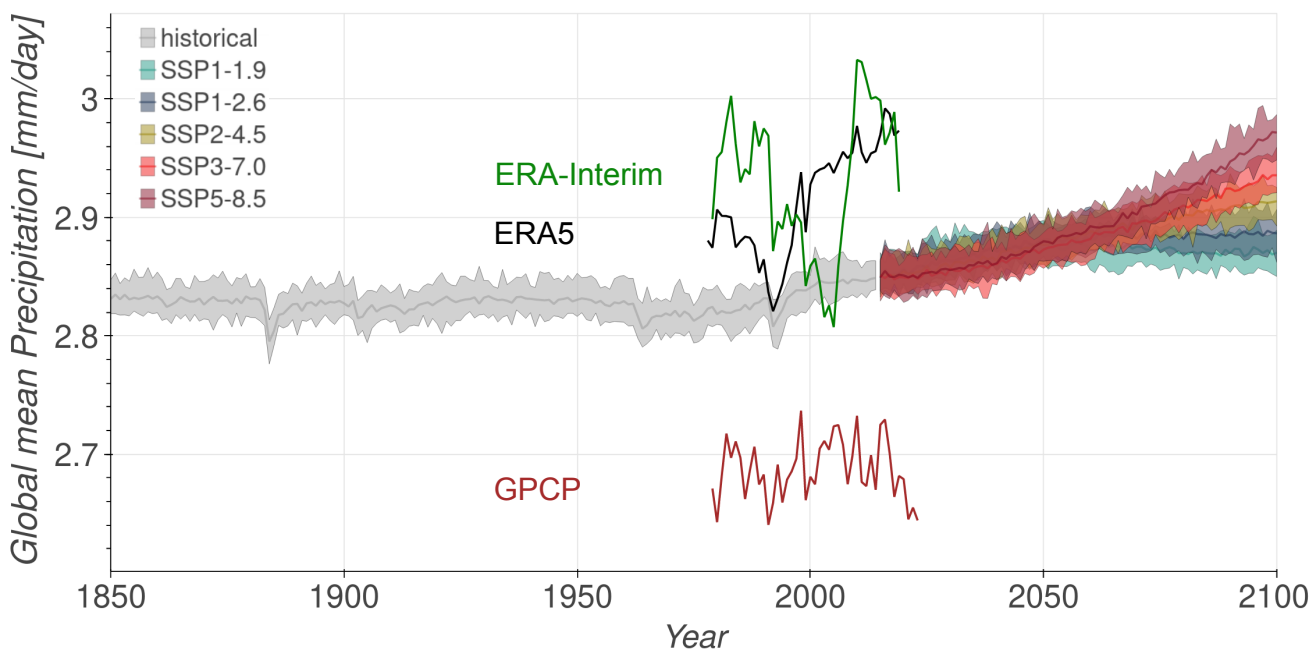
**Figure S1.** **Global mean precipitation in MPI-GE CMIP6 compared to different reanalyses and observations.** Same as Figure 1b) but showing both ERA5, ERA-Interim and the observational product of the Global Precipitation Climatology Project (GPCP) version 2.3.
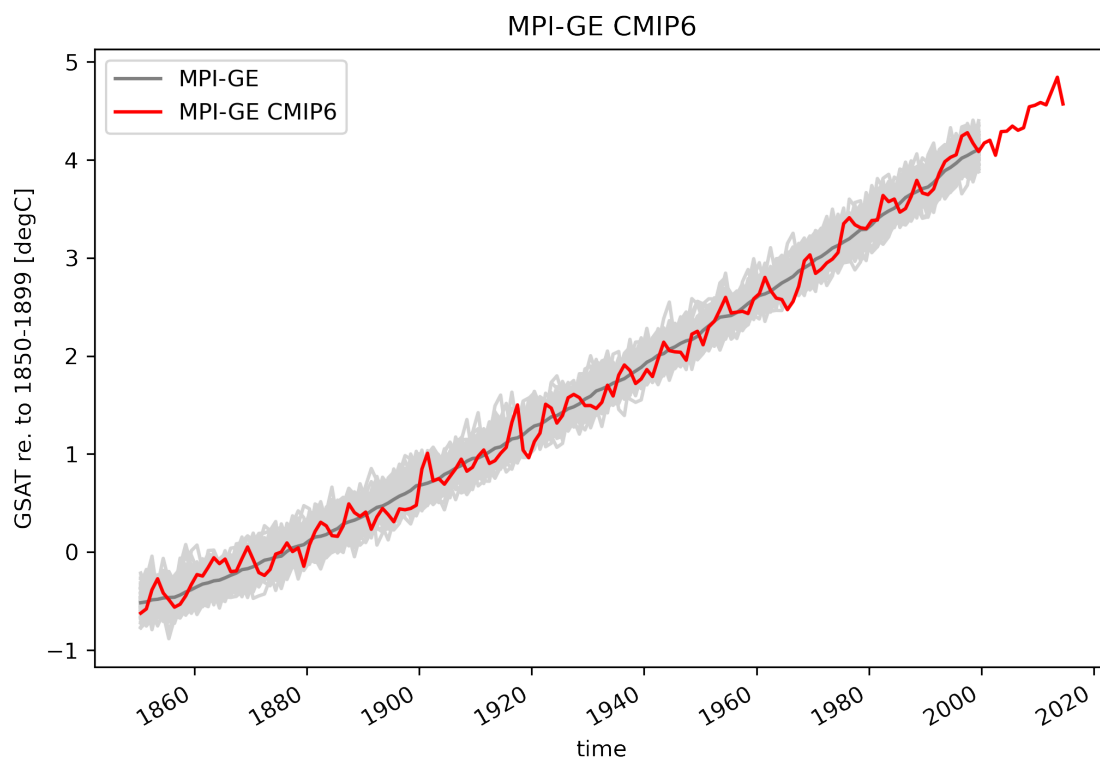
**Figure S2.** **Comparison of the global mean temperature response of MPI-GE CMIP5 and MPI-GE CMIP6 to a 1%CO$_2$ increase per year relative to 1850-1899.** The 100 realisations of MPI-GE CMIP5 are shown in light grey and the ensemble mean in dark grey. A single realisation of MPI-GE CMIP6 is shown in red. Note that the 100 realisations for the historical period of MPI-GE CMIP5 end in year 2005.

## MPI-ESM-XR 1950-2021 maximum summer daily precipitation
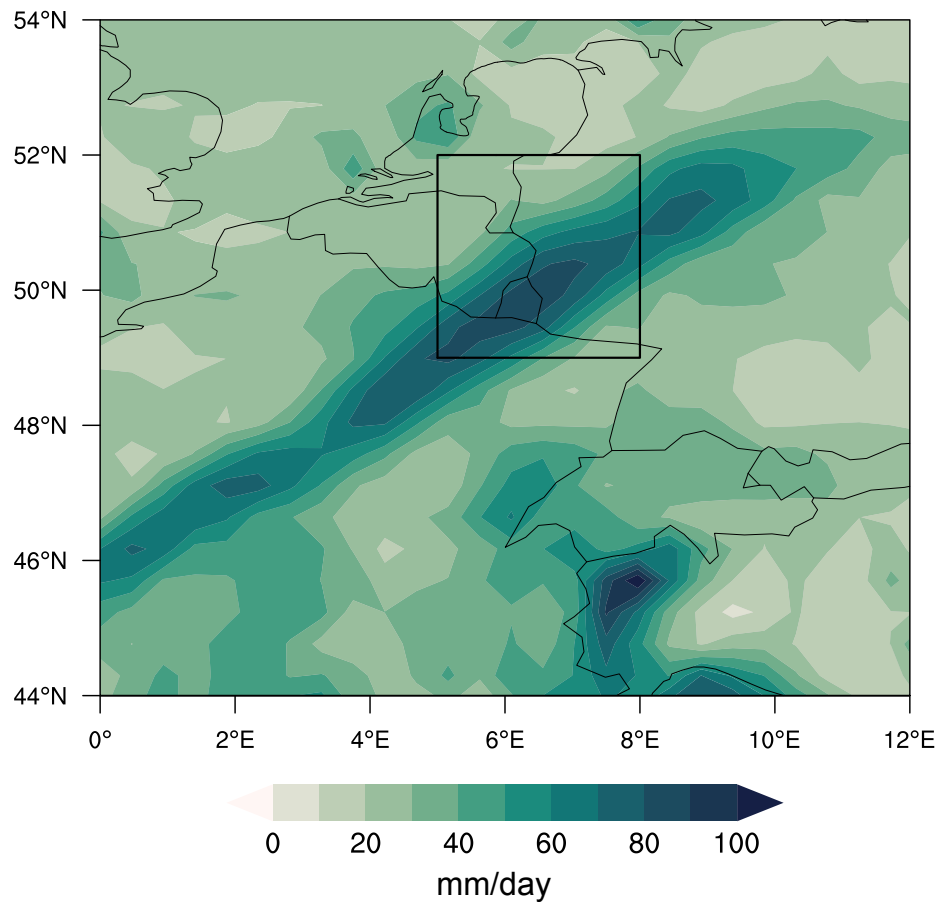


**Figure S3.   Spatial pattern of the maximum daily summer precipitation in western Europe between 1950-2021 as simulated by MPI-ESM-XR.** The black box marks the region of interest averaged for Figure 2 and 3.
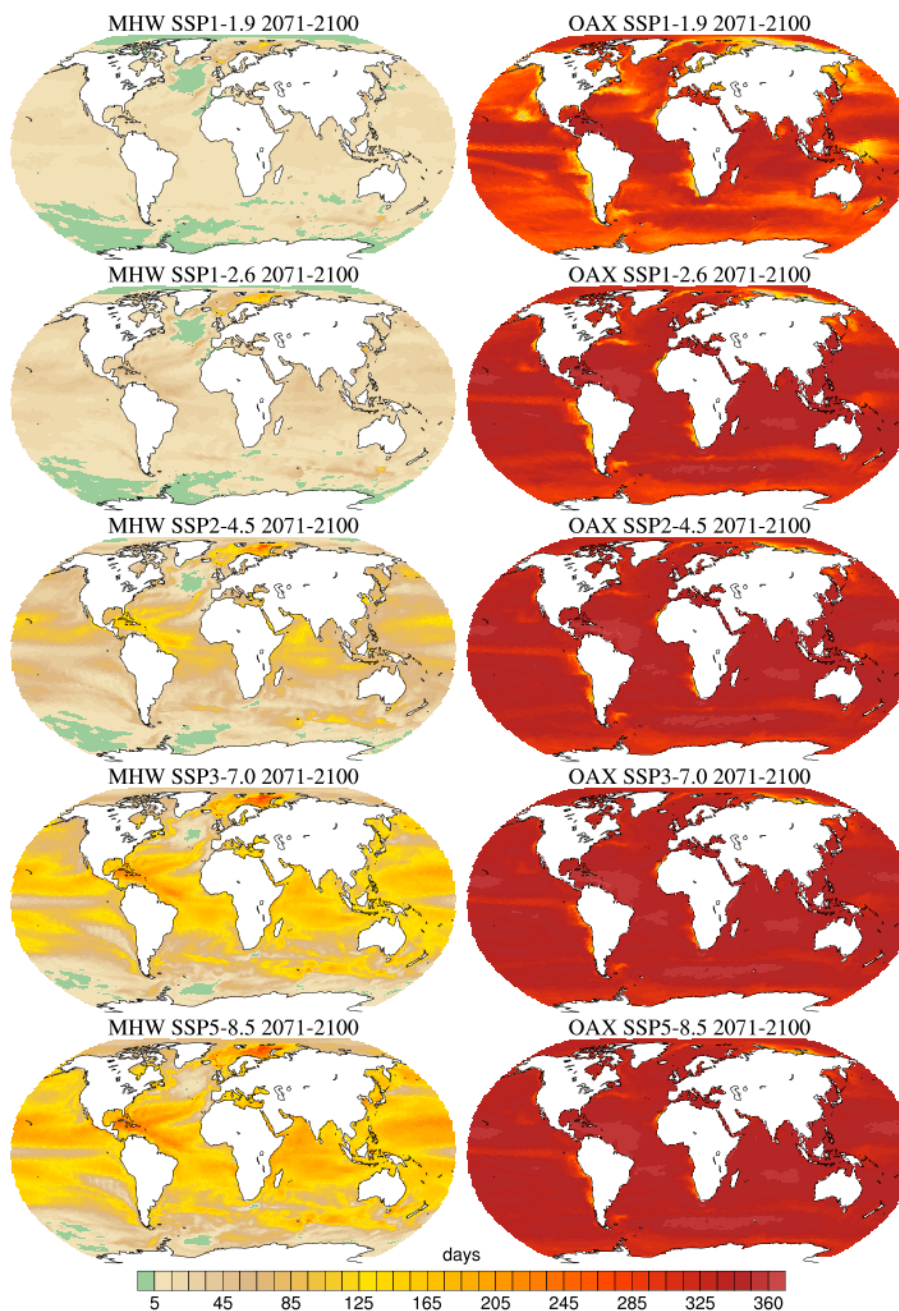
**Figure S4.** **Spatial distribution of marine heat waves (MHW) and ocean acidity extremes (OAX) for different emission scenarios.** Ensemble mean number of MHW days per year (left panels) and number of OAX days per year (right panels) during 2071-2100 under the emission scenarios SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5. The MHW and OAX are defined based on the 99$^{th}$ percentile of daily mean sea surface temperature and of daily mean surface hydrogen ion concentration, respectively.

:
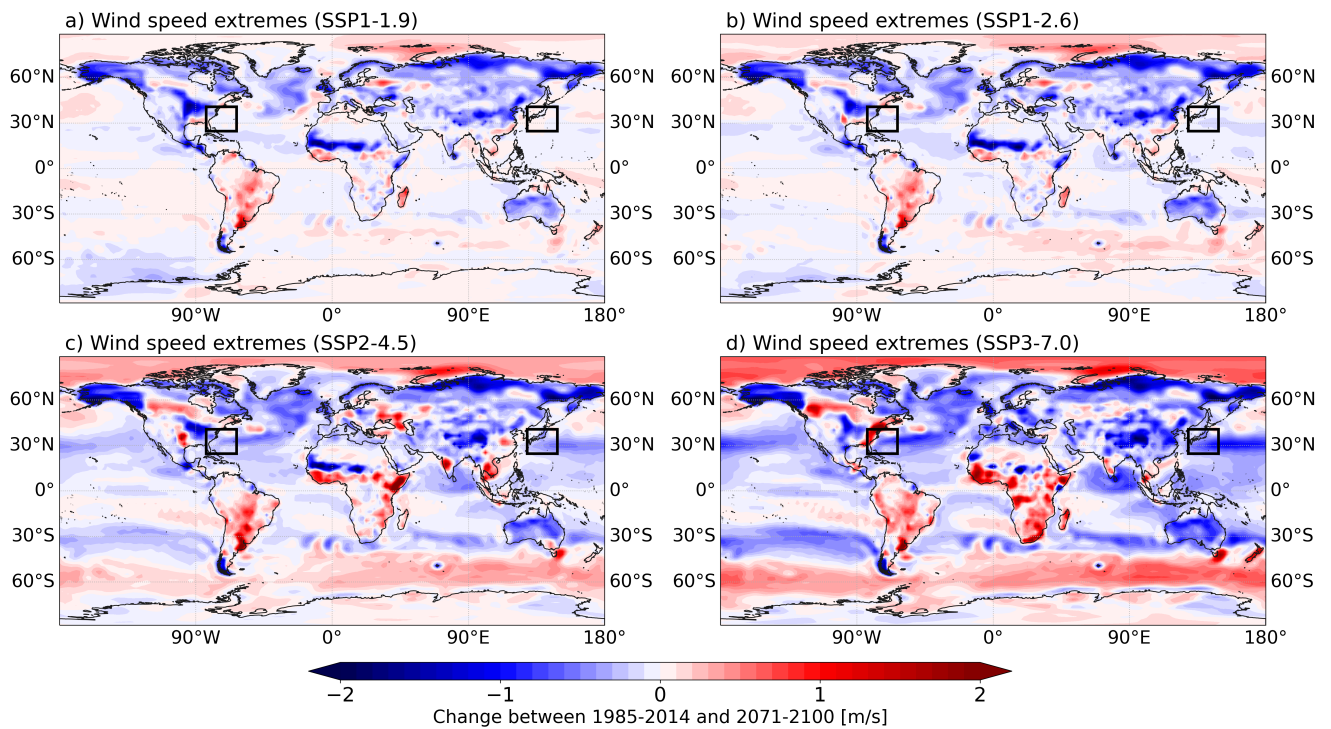


**Figure S5.  Projected changes in near-surface wind speed for lower-emission scenarios.** Absolute change in ensemble mean 95th annual percentiles of surface wind speed between 1985-2014 and 2071-2100, based on **a)** SSP1-1.9, **b)** SSP1-2.6, **c)** SSP2-4.5, **d)** SSP3-7.0 forcing. Black rectangles mark regions for which storm activity has been calculated.

a) Reconstructed with MPI-GE CMIP6 (30)

b) Reconstructed with MPI-GE CMIP5 (100)

c) Reconstructed with MPI-GE CMIP5 (30)

Temperature anomaly (°C)
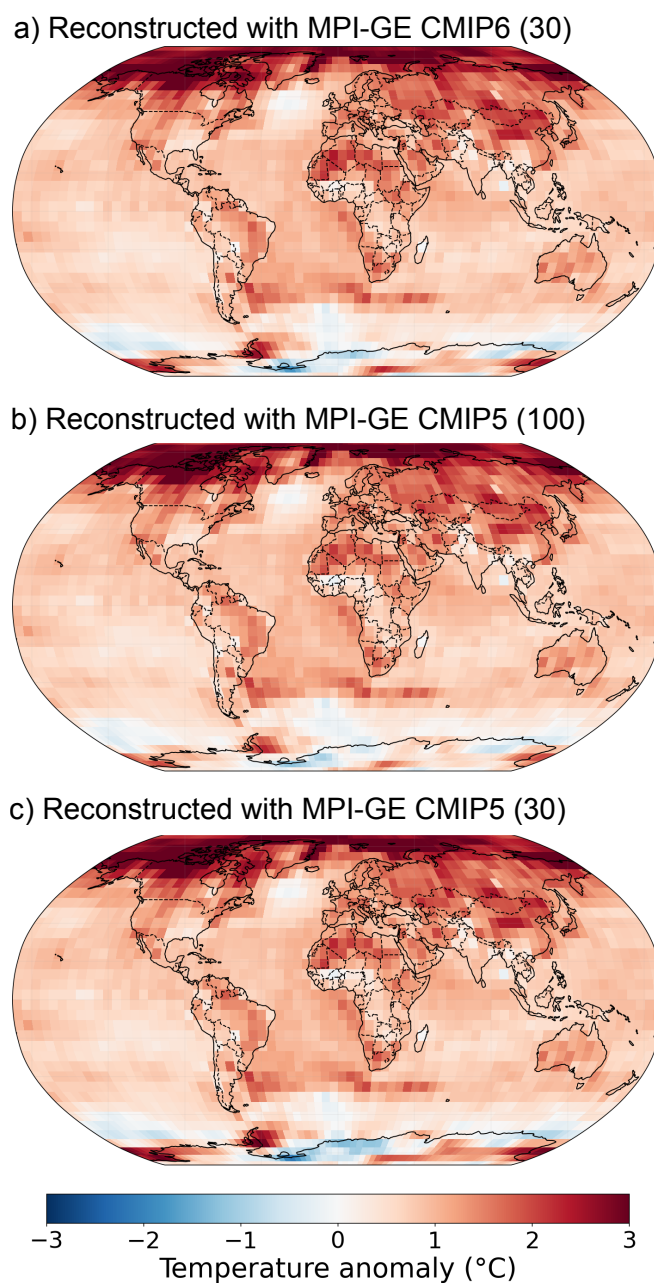
**Figure S6.** **Comparison of using MPI-GE CMIP6 and MPI-GE CMIP5 to infill observations of surface temperature with artificial intelligence.** Spatial reconstruction of the HadCRUT5 data set using **a)** the AI 30 members model based on MPI-GE CMIP6, **b)** the AI 100 members model based on MPI-GE CMIP5, and **c)** the AI 30 members model based on a first 30 members of MPI-GE CMIP5.

Data as listed in the following tables can be accessed either via DKRZ ESGF server or DKRZ

WDCC long term archive (DKRZ LTA):

- ESGF: https://esgf-data.dkrz.de/search/cmip6-dkrz/

- DKRZ LTA 3hourly: http://hdl.handle.net/21.14106/5bb56765ffe486031cd6600a3d34ba3ad99c7f20

- DKRZ LTA 6hourly: http://hdl.handle.net/21.14106/b61690b4d0080648815e2ceba91f5a764a3addc3

- DKRZ LTA daily: http://hdl.handle.net/21.14106/1ce9699e340e6c46f4b34626bae2b65714696c56

Table S1: Parameters with daily output on ESGF available for all 30 realisations.

| name | parameter long name | unit | level |
|---|---|---|---|
| **daily atmosphere / land** | | | |
| clt | Total Cloud Cover Percentage | % | 1 |
| cnc | Canopy Covered Area Percentage | % | 1 |
| es | Bare Soil Evaporation | kg m-2 s-1 | 1 |
| hfls | Surface Upward Latent Heat Flux | W m-2 | 1 |
| hfss | Surface Upward Sensible Heat Flux | W m-2 | 1 |
| hur | Relative Humidity | % | 47 |
| hurs | Near-Surface Relative Humidity | % | 1 |
| hursmax | Daily Maximum Near-Surface Relative Humidity | % | 1 |
| hursmin | Daily Minimum Near-Surface Relative Humidity | % | 1 |
| hus | Specific Humidity | 1 | 47 |
| hus850 | Specific Humidity at 850hPa | 1 | 1 |
| huss | Near-Surface Specific Humidity | 1 | 1 |
| lai | Leaf Area Index | 1 | 1 |
| mlotst | Ocean Mixed Layer Thickness Defined by Sigma T | m | 1 |
| mrro | Total Runoff | kg m-2 s-1 | 1 |
| mrso | Total Soil Moisture Content | kg m-2 | 1 |
| mrsol | Total Water Content of Soil Layer | kg m-2 | 1 |
| mrsos | Moisture in Upper Portion of Soil Column | kg m-2 | 1 |
| od550aer | Ambient Aerosol Optical Thickness at 550nm | 1 | 1 |
| pr | Precipitation | kg m-2 s-1 | 1 |
| prc | Convective Precipitation | kg m-2 s-1 | 1 |
| prsn | Snowfall Flux | kg m-2 s-1 | 1 |
| ps | Surface Air Pressure | Pa | 1 |
| psl | Sea Level Pressure | Pa | 1 |
| rlds | Surface Downwelling Longwave Radiation | W m-2 | 1 |
| rldscs | Surface Downwelling Clear-Sky Longwave Radiation | W m-2 | 1 |
| rlus | Surface Upwelling Longwave Radiation | W m-2 | 1 |
| rlut | TOA Outgoing Longwave Radiation | W m-2 | 1 |
| rlutcs | TOA Outgoing Clear-Sky Longwave Radiation | W m-2 | 1 |
| rsds | Surface Downwelling Shortwave Radiation | W m-2 | 1 |
| rsdscs | Surface Downwelling Clear-Sky Shortwave Radiation | W m-2 | 1 |
| rsdt | TOA Incident Shortwave Radiation | W m-2 | 1 |
| rsus | Surface Upwelling Shortwave Radiation | W m-2 | 1 |
| rsuscs | Surface Upwelling Clear-Sky Shortwave Radiation | W m-2 | 1 |
| rsut | TOA Outgoing Shortwave Radiation | W m-2 | 1 |
| rsutcs | TOA Outgoing Clear-Sky Shortwave Radiation | W m-2 | 1 |
| rzwc | Root Zone Soil Moisture | kg m-2 | 1 |
| sbl | Surface Snow and Ice Sublimation Flux | kg m-2 s-1 | 1 |
| sfcWind | Daily-Mean Near-Surface Wind Speed | m s-1 | 1 |
| sfcWindmax | Daily Maximum Near-Surface Wind Speed | m s-1 | 1 |
| snc | Snow Area Percentage | % | 1 |
| snw | Surface Snow Amount | kg m-2 | 1 |
| Continued on next page | | | |

Table S1 – continued from previous page

| name | parameter long name | unit | level |
|---|---|---|---|
| snwc | Snow water equivalent intercepted by the vegetation | kg m-2 | 1 |
| ta | Air Temperature | K | 47 |
| ta500 | Air Temperature at 500hPa | K | 1 |
| ta700 | Air Temperature at 700hPa | K | 1 |
| ta850 | Air Temperature at 850hPa | K | 1 |
| tas | Near-Surface Air Temperature | K | 1 |
| tasmax | Daily Maximum Near-Surface Air Temperature | K | 1 |
| tasmin | Daily Minimum Near-Surface Air Temperature | K | 1 |
| tauu | Surface Downward Eastward Wind Stress | Pa | 1 |
| tauv | Surface Downward Northward Wind Stress | Pa | 1 |
| tdps | 2m Dewpoint Temperature | K | 1 |
| tr | Surface Radiative Temperature | K | 1 |
| ts | Surface Temperature | K | 1 |
| tsl | Temperature of Soil | K | 1 |
| ua | Eastward Wind | m s-1 | 47 |
| ua10 | Eastward Wind at 10hPa | m s-1 | 1 |
| uas | Eastward Near-Surface Wind | m s-1 | 1 |
| va | Northward Wind | m s-1 | 47 |
| vas | Northward Near-Surface Wind | m s-1 | 1 |
| wap | Omega (=dp/dt) | Pa s-1 | 47 |
| wap500 | Pressure Tendency | Pa s-1 | 1 |
| zg | Geopotential Height | m | 47 |
| zg10 | Geopotential Height at 10hPa | m | 1 |
| zg100 | Geopotential Height at 100hPa | m | 1 |
| zg1000 | Geopotential Height at 1000hPa | m | 1 |
| zg500 | Geopotential Height at 500hPa | m | 1 |
| **daily ocean / sea ice / biogeochem** | | | |
| chlos | Surface Mass Concentration of Total Phytoplankton Expressed as Chlorophyll in Sea Water | kg m-3 | 1 |
| omldamax | Mean Daily Maximum Ocean Mixed Layer Thickness Defined by Mixing Scheme | m | 1 |
| phycos | Sea Surface Phytoplankton Carbon Concentration | mol m-3 | 1 |
| siconc | Sea-Ice Area Percentage (Ocean Grid) | % | 1 |
| sisnthick | Snow Thickness | m | 1 |
| sispeed | Sea-Ice Speed | m s-1 | 1 |
| sithick | Sea Ice Thickness | m | 1 |
| sitimefrac | Fraction of Time Steps with Sea Ice | 1 | 1 |
| siu | X-Component of Sea-Ice Velocity | m s-1 | 1 |
| siv | Y-Component of Sea-Ice Velocity | m s-1 | 1 |
| sos | Sea Surface Salinity | 0.001 | 1 |
| sossq | Square of Sea Surface Salinity | 1.00E-06 | 1 |
| t20d | Depth of 20 degree Celsius Isotherm | m | 1 |
| tos | Sea Surface Temperature | degC | 1 |
| tossq | Square of Sea Surface Temperature | degC2 | 1 |

Table S2: Parameters with 3-hourly output on either
ESGF or *DKRZ LTA (\*)* for any of the 30 realisations.

| name | parameter long name | unit | level | r1-r10 | r11-r30 |
|---|---|---|---|---|---|
| **atmosphere / land** | | | | | |
| clt | Total Cloud Cover Percentage | % | 1 | x | |
| hfls | Surface Upward Latent Heat Flux | W m-2 | 1 | x | |
| hfss | Surface Upward Sensible Heat Flux | W m-2 | 1 | x | |
| hus | Specific Humidity | 1 | 47 | x | |
| huss | Near-Surface Specific Humidity | 1 | 1 | x | |
| mrro | Total Runoff | kg m-2 s-1 | 1 | x | x |
| mrsos | Moisture in Upper Portion of Soil Column | kg m-2 | 1 | x | |
| pr | Precipitation | kg m-2 s-1 | 1 | x | |
| prc | Convective Precipitation | kg m-2 s-1 | 1 | x | |
| prra | Rainfall Flux | kg m-2 s-1 | 1 | x | |
| prsn | Snowfall Flux | kg m-2 s-1 | 1 | x | |
| ps | Surface Air Pressure | Pa | 1 | x | |
| psl | Sea Level Pressure | Pa | 1 | x | x |
| rlds | Surface Downwelling Longwave Radiation | W m-2 | 1 | x | |
| rldscs | Surface Downwelling Clear-Sky Longwave Radiation | W m-2 | 1 | x | |
| rlus | Surface Upwelling Longwave Radiation | W m-2 | 1 | x | |
| rlut | TOA Outgoing Longwave Radiation | W m-2 | 1 | x | |
| rlutcs | TOA Outgoing Clear-Sky Longwave Radiation | W m-2 | 1 | x | |
| rsds | Surface Downwelling Shortwave Radiation | W m-2 | 1 | x | |
| rsdscs | Surface Downwelling Clear-Sky Shortwave Radiation | W m-2 | 1 | x | |
| rsdt | TOA Incident Shortwave Radiation | W m-2 | 1 | x | |
| rsucs | Upwelling Clear-Sky Shortwave Radiation | W m-2 | 48 | x | |
| rsus | Surface Upwelling Shortwave Radiation | W m-2 | 1 | x | |
| rsuscs | Surface Upwelling Clear-Sky Shortwave Radiation | W m-2 | 1 | x | |
| rsut | TOA Outgoing Shortwave Radiation | W m-2 | 1 | x | |
| rsutcs | TOA Outgoing Clear-Sky Shortwave Radiation | W m-2 | 1 | x | |
| sfcWind | Near-Surface Wind Speed | m s-1 | 1 | x | x |
| ta | Air Temperature | K | 47 | x | |
| tas | Near-Surface Air Temperature | K | 1 | x | $x^*$ |
| ua | Eastward Wind | m s-1 | 7 | x | |
| uas | Eastward Near-Surface Wind | m s-1 | 1 | x | x |
| va | Northward Wind | m s-1 | 7 | x | |
| vas | Northward Near-Surface Wind | m s-1 | 1 | x | x |
| wap | Omega (=dp/dt) | Pa s-1 | 7 | x | |
| **ocean / sea ice / biogeochem** | | | | | |
| tos | Sea Surface Temperature | degC | 1 | x | |

Table S3: Parameters with 6-hourly output on either ESGF or *DKRZ LTA (*)* for any of the 30 realisations.

| name | parameter long name | unit | level | r1-r10 | r11-r30 |
|---|---|---|---|---|---|
| **atmosphere / land** | | | | | |
| *hur** | *Relative Humidity** | *1** | *47** | | *r11** |
| hurs | Near-Surface Relative Humidity | % | 1 | x | x |
| hus | Specific Humidity | 1 | 47 | x | x |
| huss | Near-Surface Specific Humidity | 1 | 1 | x | x |
| mrsol | Total Water Content of Soil Layer | kg m-2 | 5 | x | x |
| mrsos | Moisture in Upper Portion of Soil Column | kg m-2 | 1 | x | x |
| pr | Precipitation | kg m-2 s-1 | 1 | x | x |
| ps | Surface Air Pressure | Pa | 1 | x | x |
| psl | Sea Level Pressure | Pa | 1 | x | x |
| sfcWind | Near-Surface Wind Speed | m s-1 | 1 | | x |
| snw | Surface Snow Amount | kg m-2 | 1 | | x |
| ta | Air Temperature | K | 47 | x | x |
| tas | Near-Surface Air Temperature | K | 1 | x | x |
| ts | Surface Temperature | K | 1 | | x |
| tsl | Temperature of Soil | K | 1 | x | x |
| ua | Eastward Wind | m s-1 | 47 | x | x |
| uas | Eastward Near-Surface Wind | m s-1 | 1 | x | x |
| va | Northward Wind | m s-1 | 47 | x | x |
| vas | Northward Near-Surface Wind | m s-1 | 1 | x | x |
| wap | Omega (=dp/dt) | Pa s-1 | 4 | x | x |
| zg | Geopotential Height | m | 28 | x | x |
| zg500 | Geopotential Height at 500hPa | m | 1 | x | x |

Table S4: Parameters with daily output on either ESGF or *DKRZ LTA (\*)* for any of the 30 realisations.

| name | parameter long name | unit | level | r1-r10 | r11-r30 |
|---|---|---|---|---|---|
| atmosphere / land | | | | | |
| ares | Aerodynamic Resistance | s m-1 | 1 | x | |
| cct | Air Pressure at Convective Cloud Top | Pa | 1 | | x |
| cl | Percentage Cloud Cover | % | 47 | | x |
| cli | Mass Fraction of Cloud Ice | kg kg-1 | 47 | | x |
| clivi | Ice Water Path | kg m-2 | 1 | | x |
| clt | Total Cloud Cover Percentage | % | 1 | x | x |
| clw | Mass Fraction of Cloud Liquid Water | kg kg-1 | 47 | | x |
| clwvi | Condensed Water Path | kg m-2 | 1 | | x |
| cnc | Canopy Covered Area Percentage | % | 1 | x | x |
| es | Bare Soil Evaporation | kg m-2 s-1 | 1 | x | x |
| hfls | Surface Upward Latent Heat Flux | W m-2 | 1 | x | x |
| hfss | Surface Upward Sensible Heat Flux | W m-2 | 1 | x | x |
| hur | Relative Humidity | % | 47 | x | x |
| hurs | Near-Surface Relative Humidity | % | 1 | x | x |
| hursmax | Daily Maximum Near-Surface Relative Humidity | % | 1 | x | x |
| hursmin | Daily Minimum Near-Surface Relative Humidity | % | 1 | x | x |
| hus | Specific Humidity | 1 | 47 | x | x |
| hus850 | Specific Humidity at 850hPa | 1 | 1 | x | x |
| huss | Near-Surface Specific Humidity | 1 | 1 | x | x |
| lai | Leaf Area Index | 1 | 1 | x | x |
| mc | Convective Mass Flux | kg m-2 s-1 | 48 | | x |
| mlotst | Ocean Mixed Layer Thickness Defined by Sigma T | m | 1 | x | x |
| mrro | Total Runoff | kg m-2 s-1 | 1 | x | x |
| mrrob | Subsurface Runoff | kg m-2 s-1 | 1 | x | |
| mrros | Surface Runoff | kg m-2 s-1 | 1 | x | |
| mrso | Total Soil Moisture Content | kg m-2 | 1 | x | x |
| mrsol | Total Water Content of Soil Layer | kg m-2 | 1 | x | x |
| mrsos | Moisture in Upper Portion of Soil Column | kg m-2 | 1 | x | x |
| od550aer | Ambient Aerosol Optical Thickness at 550nm | 1 | 1 | x | x |
| pr | Precipitation | kg m-2 s-1 | 1 | x | x |
| prc | Convective Precipitation | kg m-2 s-1 | 1 | x | x |
| prra | Rainfall Flux over Land | kg m-2 s-1 | 1 | x | |
| prsn | Snowfall Flux | kg m-2 s-1 | 1 | x | x |
| prw | Water Vapor Path | kg m-2 | 1 | | x |
| ps | Surface Air Pressure | Pa | 1 | x | x |
| psl | Sea Level Pressure | Pa | 1 | x | x |
| rlds | Surface Downwelling Longwave Radiation | W m-2 | 1 | x | x |
| rldscs | Surface Downwelling Clear-Sky Longwave Radiation | W m-2 | 1 | x | x |
| rlus | Surface Upwelling Longwave Radiation | W m-2 | 1 | x | x |
| Continued on next page | | | | | |

Table S4 – continued from previous page

| name | parameter long name | unit | level | r1-r10 | r11-r30 |
|---|---|---|---|---|---|
| rlut | TOA Outgoing Longwave Radiation | W m-2 | 1 | x | x |
| rlutcs | TOA Outgoing Clear-Sky Longwave Radiation | W m-2 | 1 | x | x |
| rsds | Surface Downwelling Shortwave Radiation | W m-2 | 1 | x | x |
| rsdscs | Surface Downwelling Clear-Sky Shortwave Radiation | W m-2 | 1 | x | x |
| rsdt | TOA Incident Shortwave Radiation | W m-2 | 1 | x | x |
| rsus | Surface Upwelling Shortwave Radiation | W m-2 | 1 | x | x |
| rsuscs | Surface Upwelling Clear-Sky Shortwave Radiation | W m-2 | 1 | x | x |
| rsut | TOA Outgoing Shortwave Radiation | W m-2 | 1 | x | x |
| rsutcs | TOA Outgoing Clear-Sky Shortwave Radiation | W m-2 | 1 | x | x |
| rzwc | Root Zone Soil Moisture | kg m-2 | 1 | x | x |
| sbl | Surface Snow and Ice Sublimation Flux | kg m-2 s-1 | 1 | x | x |
| sfcWind | Daily-Mean Near-Surface Wind Speed | m s-1 | 1 | x | x |
| sfcWindmax | Daily Maximum Near-Surface Wind Speed | m s-1 | 1 | x | x |
| snc | Snow Area Percentage | % | 1 | x | x |
| snm | Surface Snow Melt | kg m-2 s-1 | 1 | x | |
| snw | Surface Snow Amount | kg m-2 | 1 | x | x |
| snwc | snow water equivalent intercepted by the vegetation | kg m-2 | 1 | x | x |
| ta | Air Temperature | K | 47 | x | x |
| ta500 | Air Temperature at 500hPa | K | 1 | x | x |
| ta700 | Air Temperature at 700hPa | K | 1 | x | x |
| ta850 | Air Temperature at 850hPa | K | 1 | x | x |
| tas | Near-Surface Air Temperature | K | 1 | x | x |
| tasmax | Daily Maximum Near-Surface Air Temperature | K | 1 | x | x |
| tasmin | Daily Minimum Near-Surface Air Temperature | K | 1 | x | x |
| tauu | Surface Downward Eastward Wind Stress | Pa | 1 | x | x |
| tauv | Surface Downward Northward Wind Stress | Pa | 1 | x | x |
| tdps | 2m Dewpoint Temperature | K | 1 | x | x |
| tr | Surface Radiative Temperature | K | 1 | x | x |
| tran | Transpiration | kg m-2 s-1 | 1 | | x |
| ts | Surface Temperature | K | 1 | x | x |
| tsl | Temperature of Soil | K | 1 | x | x |
| ua | Eastward Wind | m s-1 | 47 | x | x |
| ua10 | Eastward Wind at 10hPa | m s-1 | 1 | x | x |
| uas | Eastward Near-Surface Wind | m s-1 | 1 | x | x |
| utendnogw | Eastward Acceleration Due to Non-Orographic Gravity Wave Drag | m s-2 | 39 | | x |
| utendogw | Eastward Acceleration Due to Orographic Gravity Wave Drag | m s-2 | 39 | | x |
| va | Northward Wind | m s-1 | 47 | x | x |
| vas | Northward Near-Surface Wind | m s-1 | 1 | x | x |
| wap | Omega (=dp/dt) | Pa s-1 | 47 | x | x |
| wap500 | Pressure Tendency | Pa s-1 | 1 | x | x |

Table S4 – continued from previous page

| name | parameter long name | unit | level | r1-r10 | r11-r30 |
|---|---|---|---|---|---|
| zg | Geopotential Height | m | 47 | x | x |
| zg10 | Geopotential Height at 10hPa | m | 1 | x | x |
| zg100 | Geopotential Height at 100hPa | m | 1 | x | x |
| zg1000 | Geopotential Height at 1000hPa | m | 1 | x | x |
| zg500 | Geopotential Height at 500hPa | m | 1 | x | x |
| **ocean / sea ice / biogeochem** | | | | | |
| chlos | Surface Mass Concentration of Total Phytoplankton Expressed as Chlorophyll in Sea Water | kg m-3 | 1 | x | x |
| *fgco2** | *Surface Downward Mass Flux of Carbon Dioxide Expressed as Carbon** | *kg m-2 s-1** | *1** | | *x** |
| *intpp** | *Integrated Primary Production** | *mol C m-2 s-1** | *1** | | *x** |
| omldamax | Mean Daily Maximum Ocean Mixed Layer Thickness Defined by Mixing Scheme | m | 1 | x | x |
| *mlotst** | *Ocean Mixed Layer Thickness Defined by Sigma T** | *m** | *1** | | *x** |
| *ph** | *Surface Hydrogen Ion Concentration** | *kmol m-3** | *1** | | *x** |
| phycos | Sea Surface Phytoplankton Carbon Concentration | mol m-3 | 1 | x | x |
| siconc | Sea-Ice Area Percentage (Ocean Grid) | % | 1 | x | x |
| sisnthick | Snow Thickness | m | 1 | x | x |
| sispeed | Sea-Ice Speed | m s-1 | 1 | x | x |
| sitemptop | Surface Temperature of Sea Ice | K | 1 | | x |
| sithick | Sea Ice Thickness | m | 1 | x | x |
| sitimefrac | Fraction of Time Steps with Sea Ice | 1 | 1 | x | x |
| siu | X-Component of Sea-Ice Velocity | m s-1 | 1 | x | x |
| siv | Y-Component of Sea-Ice Velocity | m s-1 | 1 | x | x |
| sos | Sea Surface Salinity | 0.001 | 1 | x | x |
| sossq | Square of Sea Surface Salinity | 1.00E-06 | 1 | x | x |
| *spco2** | *Surface Partial Pressure of Carbon Dioxide in Sea Water** | *Pa** | *1** | | *x** |
| t20d | Depth of 20 degree Celsius Isotherm | m | 1 | x | x |
| tos | Sea Surface Temperature | degC | 1 | x | x |
| tossq | Square of Sea Surface Temperature | degC2 | 1 | x | x |
| *zos** | *Sea Surface Height above Geoid** | *m** | *1** | | *x** |

**Table S5.**   Coordinates of the grid points used for calculating storm activity in the model.

| Grid point | Latitude | Longitude |
|---|---|---|
| NW of Bermuda - North | 36.372° N | 69.375° W |
| NW of Bermuda - West | 32.642° N | 73.125° W |
| NW of Bermuda - East | 32.642° N | 65.625° W |
| SE of Japan - North | 36.372° N | 142.500° E |
| SE of Japan - West | 32.642° N | 138.750° E |
| SE of Japan - East | 32.642° N | 146.250° E |

**Table S6.** Comparison of central estimates of 20-year mean crossing times of the 1.5° C global warming threshold for MPI-GE CMIP6, IPCC AR6, and MPI-GE CMIP6 when using the historical warming of IPCC AR6 instead of the model's own historical warming. The time ranges for MPI-GE CMIP6 only stem from internal variability whereas those for AR6 include uncertainties in historical warming, climate sensitivity and internal variability.

| Scenario | MPI-GE CMIP6 | AR6 | Difference | With AR6 historical warming |
|---|---|---|---|---|
| SSP1-1.9 | NA | 2025-2044 | NA | NA |
| SSP1-2.6 | 2034-2053 | 2023-2042 | 11 | 2042-2061 |
| SSP2-4.5 | 2027-2046 | 2021-2040 | 6 | 2030-2049 |
| SSP3-7.0 | 2025-2044 | 2021-2040 | 4 | 2027-2046 |
| SSP5-8.5 | 2024-2043 | 2018-2037 | 6 | 2027-2046 |