11SM

Weather And Climate Extreme Events in a Changing Climate

Supplementary Material

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11.SM.5 Table of Contents

11.SM.1 Mean Temperature Anomalies for CMIP5 Model Output

Table 11.SM.1 lists annual mean global surface air temperature (GSAT) anomalies for CMIP5 model output for selected time periods and all RCPs, in a similar format as Table 4.2 (Chapter 4). See Hauser (2021b) for respective numbers for individual CMIP5 and CMIP6 models.

Table 11.SM.1 | CMIP5 annual mean global surface air temperature (GSAT) anomalies (°C) from the 1850–1900 reference period for selected time periods, regions and all RCPs. Displayed are multi-model averages and 5–95% ranges. Numbers in brackets in the top row indicate the number of models.

	RCP2.6 (21)	RCP4.5 (30)	RCP6.0 (14)	RCP8.5 (32)
near term (2021–2040)	1.5 (1.1–2.0)	1.6 (1.2–2.0)	1.5 (1.0–1.9)	1.7 (1.2–2.3)
mid-term (2041–2060)	1.7 (1.3–2.2)	2.0 (1.5–2.6)	1.9 (1.4–2.4)	2.5 (1.9–3.2)
long term (2081–2100)	1.7 (1.1–2.3)	2.5 (1.8–3.2)	2.8 (2.3–3.6)	4.4 (3.2–5.5)
AR5 'near term' (2016–2035)	1.4 (1.0–1.9)	1.4 (1.1–1.9)	1.4 (0.9–1.8)	1.5 (1.1–2.1)
AR5 'mid-term' (2046–2065)	1.7 (1.2–2.2)	2.1 (1.6–2.7)	2.0 (1.5–2.5)	2.7 (2.1–3.5)
2020 (2011–2030)	1.4 (1.0–1.8)	1.3 (0.9–1.7)	1.3 (0.9–1.7)	1.4 (1.0–1.8)
2030 (2021–2040)	1.5 (1.1–2.0)	1.6 (1.2–2.0)	1.5 (1.0–1.9)	1.7 (1.2–2.3)
2040 (2031–2050)	1.7 (1.2–2.2)	1.8 (1.4–2.3)	1.7 (1.2–2.1)	2.1 (1.6–2.7)
2050 (2041–2060)	1.7 (1.3–2.2)	2.0 (1.5–2.6)	1.9 (1.4–2.4)	2.5 (1.9–3.2)
2060 (2051–2070)	1.7 (1.2–2.3)	2.2 (1.6–2.8)	2.1 (1.6–2.6)	2.9 (2.3–3.8)
2070 (2061–2080)	1.7 (1.2–2.3)	2.3 (1.7–3.0)	2.3 (1.9–2.9)	3.4 (2.6–4.3)
2080 (2071–2090)	1.7 (1.1–2.3)	2.4 (1.8–3.1)	2.6 (2.1–3.3)	3.9 (2.9–4.9)
2090 (2081–2100)	1.7 (1.1–2.3)	2.5 (1.8–3.2)	2.8 (2.3–3.6)	4.4 (3.2–5.5)
2100 (2091–2100)	1.7 (1.0–2.3)	2.5 (1.9–3.2)	2.9 (2.4–3.7)	4.6 (3.4–5.7)

11.SM.2 Methods Used for the Figures

11.SM.2.1 Overview

This section provides additional methods used for the figures produced specifically for Chapter 11. These figures are either based on published observational data or data from the sixth phase of the Coupled Model Intercomparison Project (CMIP6; Eyring et al., 2016). See also Appendix 11.A for additional information on the used data.

11.SM.2.2 Climate Indices

Figures 11.11 and 11.17 show trends of observed climate indices. Most of the shown climate indices are defined by the Expert Team on Climate Change Detection and Indices (Karl et al., 1999; Peterson et al., 2001), which were calculated on an annual basis according to the standard procedure. The used ETCCDI indices include hottest daily maximum temperature (TXx), hottest daily minimum temperature (TNn), the annual number of days when daily maximum temperature exceeds its 90th percentile from a base period (TX90p), and consecutive dry days (CDD). Further, trends in the Standardized Precipitation Index (SPI) and the Standardized Precipitation Evapotranspiration Index (SPEI) at an accumulation scale of 12 months (SPI-12 and SPEI-12) are shown.

Model data from CMIP6 is shown in Figures 11.2, 11.9, 11.16, 11.18 and 11.19 (all other figures showing CMIP6 data are taken from publications). The following indices were computed for the figures: TXx, TNn, annual maximum daily precipitation (Rx1day) and CDD. In addition, total soil moisture (summed over the whole column), a soil-moisture-based drought frequency index and a soil-moisture-based drought intensity index were analysed. For soil-moisture data from CMIP6 all values are masked over the ocean, land ice, Antarctica and Greenland.

11.SM.2.2.1 Soil-Moisture-Based Drought Indices

The soil-moisture-based drought indices are displayed in Figures 11.18 and 11.19. Both drought indices are calculated for annual mean and seasonal mean data. First, soil moisture is normalized subtracting the mean over 1850–1900 and dividing it by the standard deviation over the same time period. For the drought frequency the 10th quantile over the period 1850–1900 is calculated and all soil moisture values below this threshold are defined as drought. Finally, the drought frequency for a certain time period is given as fraction of years or season under drought. Time periods are selected for certain global warming levels (see below), where 30-year periods are used. For the drought intensity we calculate the 10th quantile over the period 1850–1900 and for certain global warming levels.

11.SM.2.3 Observed Trends in TXx, TNn, TX90p and CDD

Observed trends in TXx, TNn, TX90p and CDD are shown in Figures 11.9 and 11.17 (a). The data is obtained from Dunn et al. (2020) and the calculation of the trends and the selection of valid grid points follows the method outlined in Dunn et al. (2020). In contrast to Dunn et al. (2020), however, we show trends for the time period 1960–2018 and the significance was calculated the $p = 0.1$ level.

11.SM.2.4 Observed Trends in SPI and SPEI

Trends in SPI and SPEI are shown in Figure 11.17b and c. The data is obtained from Spinoni et al. (2019) and trends were calculated by linear regression analysis. Time was the independent variable and the drought severity the dependent variable. The slope of the regression indicates the amount of change. Data was available for five-year periods. Significance was analysed by means of the non-parametric Mann–Kendall statistic that measures the degree to which a trend is consistently increasing or decreasing. Autocorrelation was considered in the trend analysis returning the corrected p values after accounting for temporal-pseudo replication (Hamed and Ramachandra Rao, 1998).

11.SM.2.5 CMIP6 Data

CMIP6 data is specifically analysed for Chapter 11 in Figures 11.3, 11.11, 11.16, 11.18 and 11.19, and FAQ 11.1, Figure 1 (all other figures showing CMIP6 data are taken from publications). For these figures historical simulations (1850–2015) are combined with the Shared Socio-economic Pathways (SSPs) projections (O'Neill et al., 2016). The following SSPs were chosen: SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5. This subset of SSPs includes all Tier 1 scenarios (SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5) and additionally the scenario most consistent with a stabilisation at +1.5°C at the end of the 21st century as aimed for in the Paris Agreement (SSP1-1.9; O'Neill et al. (2016)).

An 'ensemble of opportunity' is used, including all available models that pass very basic checks. Only the first ensemble member of each model is used, and all models are weighted equally. In order to be used, models must (i) provide the corresponding variable, (ii) run from 1850 to 2099, (iii) must not have duplicate time steps or missing time steps, and (iv) must not have any obvious data errors (e.g., negative soil moisture, or an inconsistency between historical simulation and projection). The exact model ensemble used for each figure is given in Appendix 11.

11.SM.2.6 Global Warming Levels

Global warming levels (GWLs) expressed as changes in global mean surface air temperature (GSAT) relative to the 1850–1900 period are used to display changes in climate indices in Chapter 11. See Cross-Chapter Box 11.1 for details. Global warming levels are computed as outlined in Hauser et al. (2021) using 20-year periods, except for the soil-moisture-based drought indices where 30-year periods are used.

11.SM.2.7 Scaling of Regional Climate Indices

Figure 11.3 shows regional mean changes in TXx as a function of GWL. To obtain regional averages of climate indices they are first calculated on the original model grid. Then regional averages are computed, weighting each grid cell with its area (if available, otherwise the grid cells are weighted by the cosine of the latitude). Finally, the mean of the climate index is calculated at GWLs between 0.1°C and 5°C in steps of 0.1°C. In Figure 11.3 TXx scaling is shown for individual models (panel a), as a multi-model mean for selected SSPs (panel a), or as a multi-model mean over all used SSPs (Section 11.SM.1.5; all panels).

11.SM.2.8 Maps at Global Warming Levels

Maps of climate indices at global warming levels are shown in Figures 11.11, 11.16 and 11.19. The response of the climate indices is calculated at three different global warming levels: 1.5°C, 2°C and 4°C. The model data is interpolated on a common 2.5° x 2.5° latitude-longitude grid using a conservative regridding scheme. All models from each of the five used SSPs (Section 11.SM.1.5) that reaches the warming level is included in the ensemble, thus each model can contribute more than one data point for a given warming level. Finally, the median over all models is calculated.

11.SM.2.9 Warmest Three-month Season

FAQ 11.1, Figure 1 displays changes in mean precipitation and temperatures for the warmest three consecutive months, which corresponds to summer in mid- to high latitudes. The warmest months were determined for each model and grid point individually from the period 1850–1900. The warmest three-month season was kept constant over the whole period of the simulation.

11.SM.3 Multi-model Median Regional Means at Warming Levels for Selected Indices

Table 11.SM.2 | Multi-model median regional changes in annual hottest daily maximum temperature (TXx) for the globe, global ocean, global land, global land excluding Antarctica, and AR6 land regions for three global warming levels (GWLs) as simulated by CMIP6 models under the forcing scenarios SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5. Regional averages are calculated from the original model grid using the grid-cell area as weights if available, else the grid cells where weighted with the cosine of the latitude. See also Hauser (2021b).

	Projections		
	+1.5°C GWL	+2.0°C GWL	+4.0°C GWL
Global (global)	1.40°C	1.90°C	3.93°C
Ocean (ocean)	1.22°C	1.64°C	3.40°C
Land (land)	1.88°C	2.55°C	5.25°C
Land w/o Antarctica (land_wo_antarctica)	1.94°C	2.65°C	5.47°C
Greenland/Iceland (GIC)	1.21°C	1.54°C	2.97°C
North-Western North America (NWN)	1.93°C	2.55°C	5.23°C
North-Eastern North America (NEN)	2.22°C	2.99°C	5.96°C
Western North America (WNA)	2.24°C	3.01°C	5.95°C
Central North America (CNA)	2.33°C	3.12°C	5.71°C
Eastern North America (ENA)	1.97°C	2.72°C	5.68°C
Northern Central America (NCA)	1.81°C	2.45°C	4.84°C
Southern Central America (SCA)	1.77°C	2.32°C	4.76°C
Caribbean (CAR)	1.59°C	2.11°C	4.33°C
North-Western South America (NWS)	1.87°C	2.52°C	5.41°C
Northern South America (NSA)	2.24°C	2.98°C	6.35°C
North-Eastern South America (NES)	2.04°C	2.69°C	5.39°C
South American Monsoon (SAM)	2.58°C	3.44°C	7.33°C
South-Western South America (SWS)	1.91°C	2.50°C	4.83°C
South-Eastern South America (SES)	1.95°C	2.57°C	5.45°C
Southern South America (SSA)	1.91°C	2.41°C	4.52°C
Northern Europe (NEU)	1.81°C	2.54°C	4.99°C
Western and Central Europe (WCE)	2.33°C	3.20°C	6.23°C
Eastern Europe (EEU)	2.20°C	2.97°C	5.76°C
Mediterranean (MED)	2.50°C	3.30°C	6.61°C
Sahara (SAH)	2.39°C	3.09°C	6.03°C
Western Africa (WAF)	1.62°C	2.19°C	4.53°C
Central Africa (CAF)	1.56°C	2.12°C	4.67°C
North Eastern Africa (NEAF)	1.66°C	2.24°C	4.45°C
South Eastern Africa (SEAF)	1.59°C	2.08°C	4.24°C
West Southern Africa (WSAF)	2.03°C	2.73°C	5.29°C
East Southern Africa (ESAF)	1.93°C	2.66°C	5.45°C
Madagascar (MDG)	1.63°C	2.17°C	4.65°C
Russian Arctic (RAR)	1.99°C	2.77°C	5.52°C
West Siberia (WSB)	2.11°C	2.80°C	5.09°C
East Siberia (ESB)	2.09°C	2.87°C	5.97°C
Russian Far East (RFE)	1.93°C	2.69°C	5.45°C
West Central Asia (WCA)	2.34°C	3.08°C	6.09°C
East Central Asia (ECA)	2.17°C	2.92°C	5.70°C
Tibetan Plateau (TIB)	1.65°C	2.32°C	4.55°C
East Asia (EAS)	1.50°C	2.19°C	4.66°C
Arabian Peninsula (ARP)	2.29°C	3.06°C	5.99°C
South Asia (SAS)	1.20°C	1.81°C	4.12°C
South East Asia (SEA)	1.40°C	1.85°C	4.23°C
Northern Australia (NAU)	1.59°C	2.03°C	3.99°C
Central Australia (CAU)	1.95°C	2.53°C	4.85°C
Eastern Australia (EAU)	1.60°C	2.13°C	4.25°C
Southern Australia (SAU)	1.71°C	2.30°C	4.48°C
New Zealand (NZ)	1.36°C	1.82°C	3.68°C
East Antarctica (EAN)	1.18°C	1.65°C	3.22°C
West Antarctica (WAN)	0.62°C	0.84°C	1.81°C

Table 11.SM.3 | As Table 11.SM.2 but for changes in the annual daily minimum temperature (TNn).

	Projections		
	+1.5°C GWL	+2.0°C GWL	+4.0°C GWL
Global (global)	1.99°C	2.63°C	5.19°C
Ocean (ocean)	1.74°C	2.28°C	4.53°C
Land (land)	2.64°C	3.48°C	6.80°C
Land w/o Antarctica (land_wo_antarctica)	2.73°C	3.59°C	7.05°C
Greenland/Iceland (GIC)	3.88°C	4.99°C	9.90°C
North-Western North America (NWN)	4.46°C	6.01°C	12.38°C
North-Eastern North America (NEN)	4.85°C	6.37°C	13.22°C
Western North America (WNA)	2.80°C	3.92°C	7.80°C
Central North America (CNA)	2.54°C	3.76°C	7.82°C
Eastern North America (ENA)	3.67°C	4.99°C	9.72°C
Northern Central America (NCA)	1.79°C	2.36°C	5.03°C
Southern Central America (SCA)	1.59°C	2.08°C	3.87°C
Caribbean (CAR)	1.51°C	2.02°C	3.74°C
North-Western South America (NWS)	1.87°C	2.43°C	4.89°C
Northern South America (NSA)	1.81°C	2.36°C	4.62°C
North-Eastern South America (NES)	1.79°C	2.35°C	4.40°C
South American Monsoon (SAM)	1.78°C	2.41°C	4.79°C
South-Western South America (SWS)	2.04°C	2.66°C	5.90°C
South-Eastern South America (SES)	1.42°C	1.80°C	3.75°C
Southern South America (SSA)	2.14°C	2.79°C	6.40°C
Northern Europe (NEU)	5.08°C	6.46°C	10.59°C
Western and Central Europe (WCE)	4.80°C	6.06°C	11.04°C
Eastern Europe (EEU)	4.90°C	6.16°C	11.33°C
Mediterranean (MED)	2.20°C	2.79°C	5.28°C
Sahara (SAH)	2.15°C	2.74°C	5.35°C
Western Africa (WAF)	2.04°C	2.65°C	4.63°C
Central Africa (CAF)	1.89°C	2.52°C	4.94°C
North Eastern Africa (NEAF)	1.95°C	2.51°C	4.90°C
South Eastern Africa (SEAF)	1.83°C	2.36°C	4.54°C
West Southern Africa (WSAF)	1.77°C	2.40°C	4.75°C
East Southern Africa (ESAF)	1.78°C	2.28°C	4.42°C
Madagascar (MDG)	1.63°C	2.08°C	3.93°C
Russian Arctic (RAR)	4.81°C	6.44°C	12.78°C
West Siberia (WSB)	4.05°C	5.52°C	10.26°C
East Siberia (ESB)	3.42°C	4.55°C	8.62°C
Russian Far East (RFE)	4.10°C	5.56°C	11.17°C
West Central Asia (WCA)	2.75°C	3.56°C	7.32°C
East Central Asia (ECA)	2.26°C	2.97°C	5.77°C
Tibetan Plateau (TIB)	2.42°C	2.97°C	5.74°C
East Asia (EAS)	2.11°C	2.95°C	5.83°C
Arabian Peninsula (ARP)	2.30°C	2.84°C	5.96°C
South Asia (SAS)	1.79°C	2.48°C	5.23°C
South East Asia (SEA)	1.46°C	1.96°C	4.10°C
Northern Australia (NAU)	1.97°C	2.57°C	5.08°C
Central Australia (CAU)	1.62°C	2.06°C	4.22°C
Eastern Australia (EAU)	1.37°C	1.89°C	3.76°C
Southern Australia (SAU)	1.10°C	1.52°C	2.95°C
New Zealand (NZ)	1.33°C	1.74°C	3.41°C
East Antarctica (EAN)	1.64°C	2.17°C	4.38°C
West Antarctica (WAN)	2.26°C	2.95°C	5.58°C

Table 11.SM.4 | As Table 11.SM.2 but for changes in annual maximum daily precipitation (Rx1day).

	Projections		
	+1.5°C GWL	+2.0°C GWL	+4.0°C GWL
Global (global)	6.96%	9.96%	24.02%
Ocean (ocean)	6.49%	9.12%	22.81%
Land (land)	8.42%	11.42%	26.58%
Land w/o Antarctica (land_wo_antarctica)	8.37%	11.30%	26.56%
Greenland/Iceland (GIC)	11.76%	15.66%	33.77%
North-Western North America (NWN)	9.06%	12.49%	27.28%
North-Eastern North America (NEN)	9.99%	13.29%	26.54%
Western North America (WNA)	7.09%	8.01%	16.89%
Central North AmericcanCNA)	7.39%	9.91%	17.93%
Eastern North America (ENA)	8.05%	10.67%	22.03%
Northern Central America (NCA)	5.28%	7.29%	15.89%
Southern Central America (SCA)	2.24%	4.55%	8.36%
Caribbean (CAR)	3.38%	2.56%	4.17%
North-Western South America (NWS)	8.05%	11.05%	26.81%
Northern South America (NSA)	6.26%	8.31%	17.42%
North-Eastern South America (NES)	7.26%	9.35%	27.46%
South American Monsoon (SAM)	5.73%	9.06%	18.72%
South-Western South America (SWS)	1.64%	2.50%	3.15%
South-Eastern South America (SES)	8.45%	11.91%	24.59%
Southern South America (SSA)	4.87%	7.09%	14.37%
Northern Europe (NEU)	9.33%	11.55%	23.21%
Western and Central Europe (WCE)	7.48%	9.51%	18.37%
Eastern Europe (EEU)	7.28%	8.78%	18.88%
Mediterranean (MED)	3.61%	4.42%	8.88%
Sahara (SAH)	19.43%	24.07%	45.50%
Western Africa (WAF)	18.26%	19.74%	46.24%
Central Africa (CAF)	14.36%	18.24%	47.14%
North Eastern Africa (NEAF)	13.38%	17.42%	46.12%
South Eastern Africa (SEAF)	11.23%	15.66%	41.36%
West Southern Africa (WSAF)	4.68%	6.40%	9.36%
East Southern Africa (ESAF)	5.95%	9.25%	20.87%
Madagascar (MDG)	6.28%	8.18%	22.26%
Russian Arctic (RAR)	10.95%	15.89%	31.50%
West Siberia (WSB)	8.22%	10.53%	19.17%
East Siberia (ESB)	8.11%	11.36%	24.80%
Russian Far East (RFE)	10.54%	15.40%	35.29%
West Central Asia (WCA)	9.14%	11.48%	24.16%
East Central Asia (ECA)	9.10%	12.75%	29.93%
Tibetan Plateau (TIB)	8.80%	12.46%	30.70%
East Asia (EAS)	7.28%	10.76%	28.69%
Arabian Peninsula (ARP)	11.07%	17.46%	43.04%
South Asia (SAS)	10.39%	15.84%	41.56%
South East Asia (SEA)	6.77%	10.57%	33.37%
Northern Australia (NAU)	6.97%	9.33%	28.35%
Central Australia (CAU)	5.82%	7.06%	15.27%
Eastern Australia (EAU)	4.01%	5.97%	14.73%
Southern Australia (SAU)	5.84%	6.53%	14.18%
New Zealand (NZ)	8.21%	12.11%	25.55%
East Antarctica (EAN)	11.68%	15.56%	35.98%
West Antarctica (WAN)	8.42%	11.47%	23.65%

Table 11.SM.5 | As Table 11.SM.2 but for changes in annual maximum five-day precipitation (Rx5day).

	Projections		
	+1.5°C GWL	+2.0°C GWL	+4.0°C GWL
Global (global)	5.24%	7.45%	18.94%
Ocean (ocean)	4.77%	6.74%	17.92%
Land (land)	6.13%	8.54%	20.76%
Land w/o Antarctica (land_wo_antarctica)	6.07%	8.42%	20.52%
Greenland/Iceland (GIC)	11.38%	15.12%	34.24%
North-Western North America (NWN)	7.87%	11.44%	24.67%
North-Eastern North America (NEN)	8.83%	11.51%	22.90%
Western North America (WNA)	5.08%	6.24%	11.99%
Central North America (CNA)	5.04%	7.74%	14.33%
Eastern North America (ENA)	6.06%	8.47%	18.41%
Northern Central America (NCA)	3.30%	4.34%	10.77%
Southern Central America (SCA)	0.23%	1.02%	1.72%
Caribbean (CAR)	0.21%	-0.18%	-1.94%
North-Western South America (NWS)	5.65%	7.47%	17.66%
Northern South America (NSA)	3.91%	5.48%	11.10%
North-Eastern South America (NES)	6.19%	8.32%	20.24%
South American Monsoon (SAM)	4.56%	7.04%	11.26%
South-Western South America (SWS)	-0.96%	-0.24%	-1.75%
South-Eastern South America (SES)	6.75%	9.53%	21.74%
Southern South America (SSA)	2.71%	3.92%	8.37%
Northern Europe (NEU)	7.44%	9.42%	18.64%
Western and Central Europe (WCE)	6.26%	8.05%	15.30%
Eastern Europe (EEU)	6.20%	8.10%	16.22%
Mediterranean (MED)	1.02%	1.36%	2.24%
Sahara (SAH)	17.35%	21.19%	42.94%
Western Africa (WAF)	13.91%	16.20%	31.56%
Central Africa (CAF)	11.01%	14.67%	33.88%
North Eastern Africa (NEAF)	9.63%	14.11%	35.71%
South Eastern Africa (SEAF)	7.35%	9.84%	29.05%
West Southern Africa (WSAF)	2.33%	3.13%	4.53%
East Southern Africa (ESAF)	4.40%	6.25%	16.42%
Madagascar (MDG)	4.93%	5.46%	15.03%
Russian Arctic (RAR)	10.02%	14.39%	29.14%
West Siberia (WSB)	7.18%	9.21%	16.93%
East Siberia (ESB)	6.32%	9.03%	21.07%
Russian Far East (RFE)	8.74%	12.76%	28.94%
West Central Asia (WCA)	7.42%	9.60%	20.98%
East Central Asia (ECA)	8.48%	11.50%	26.81%
Tibetan Plateau (TIB)	5.78%	9.01%	26.12%
East Asia (EAS)	4.08%	6.38%	22.49%
Arabian Peninsula (ARP)	10.86%	16.94%	45.56%
South Asia (SAS)	8.55%	13.32%	34.05%
South East Asia (SEA)	4.56%	7.44%	23.12%
Northern Australia (NAU)	5.98%	7.14%	21.51%
Central Australia (CAU)	4.55%	5.50%	11.15%
Eastern Australia (EAU)	2.48%	3.81%	10.23%
Southern Australia (SAU)	3.04%	2.80%	8.64%
New Zealand (NZ)	5.85%	8.08%	18.04%
East Antarctica (EAN)	10.74%	14.50%	34.17%
West Antarctica (WAN)	7.75%	10.22%	21.85%

Table 11.SM.6 | As Table 11.SM.2 but for changes in annual mean total soil moisture (summed over the whole soil column).

	Projections		
	+1.5°C GWL	+2.0°C GWL	+4.0°C GWL
Global (global)	No data	No data	No data
Ocean (ocean)	No data	No data	No data
Land (land)	No data	No data	No data
Land w/o Antarctica (land_wo_antarctica)	–0.93σ	–1.63σ	–3.53σ
Greenland/Iceland (GIC)	–0.54σ	–0.50σ	–2.04σ
North-Western North America (NWN)	–0.02σ	0.34σ	–2.72σ
North-Eastern North America (NEN)	–1.00σ	–0.77σ	–2.21σ
Western North America (WNA)	–0.53σ	–0.72σ	–1.63σ
Central North America (CNA)	–1.28σ	–1.14σ	–1.59σ
Eastern North America (ENA)	–0.35σ	–0.32σ	–0.76σ
Northern Central America (NCA)	–0.94σ	–1.04σ	–1.52σ
Southern Central America (SCA)	–1.40σ	–1.40σ	–3.42σ
Caribbean (CAR)	–0.54σ	–0.69σ	–1.22σ
North-Western South America (NWS)	–1.20σ	–1.33σ	–3.50σ
Northern South America (NSA)	–1.21σ	–1.66σ	–3.05σ
North-Eastern South America (NES)	–0.38σ	–0.31σ	–0.50σ
South American Monsoon (SAM)	–1.34σ	–1.71σ	–3.81σ
South-Western South America (SWS)	–2.33σ	–2.91σ	–4.83σ
South-Eastern South America (SES)	0.16σ	0.32σ	–0.11σ
Southern South America (SSA)	–1.22σ	–1.58σ	–2.10σ
Northern Europe (NEU)	0.42σ	0.16σ	–0.28σ
Western and Central Europe (WCE)	0.05σ	–0.11σ	–0.72σ
Eastern Europe (EEU)	0.55σ	0.38σ	0.59σ
Mediterranean (MED)	–2.03σ	–2.75σ	–4.18σ
Sahara (SAH)	1.31σ	1.59σ	3.59σ
Western Africa (WAF)	2.14σ	2.44σ	2.68σ
Central Africa (CAF)	1.76σ	2.03σ	2.57σ
North Eastern Africa (NEAF)	1.40σ	2.27σ	3.78σ
South Eastern Africa (SEAF)	0.70σ	1.14σ	2.08σ
West Southern Africa (WSAF)	–0.93σ	–1.21σ	–2.54σ
East Southern Africa (ESAF)	–0.66σ	–0.82σ	–1.89σ
Madagascar (MDG)	–0.09σ	–0.28σ	–1.01σ
Russian Arctic (RAR)	0.80σ	0.88σ	–1.28σ
West Siberia (WSB)	1.22σ	1.24σ	1.43σ
East Siberia (ESB)	0.09σ	0.11σ	0.99σ
Russian Far East (RFE)	–0.20σ	0.00σ	–0.04σ
West Central Asia (WCA)	0.04σ	0.25σ	0.15σ
East Central Asia (ECA)	0.13σ	0.29σ	1.27σ
Tibetan Plateau (TIB)	–0.16σ	–0.48σ	–1.39σ
East Asia (EAS)	–0.30σ	–0.23σ	–0.35σ
Arabian Peninsula (ARP)	0.47σ	0.74σ	3.12σ
South Asia (SAS)	1.03σ	1.33σ	2.26σ
South East Asia (SEA)	–0.16σ	–0.07σ	–0.72σ
Northern Australia (NAU)	–0.03σ	–0.03σ	–0.20σ
Central Australia (CAU)	–0.16σ	–0.21σ	–0.46σ
Eastern Australia (EAU)	–0.41σ	–0.46σ	–0.68σ
Southern Australia (SAU)	–0.61σ	–0.96σ	–1.14σ
New Zealand (NZ)	–0.23σ	–0.10σ	–0.17σ
East Antarctica (EAN)	No data	No data	No data
West Antarctica (WAN)	No data	No data	No data

Table 11.SM.7 | As Table 11.SM.2 but for changes in annual mean soil moisture in the upper 10 cm of the soil column.

	Projections		
	+1.5°C GWL	+2.0°C GWL	+4.0°C GWL
Global (global)	No data	No data	No data
Ocean (ocean)	No data	No data	No data
Land (land)	No data	No data	No data
Land w/o Antarctica (land_wo_antarctica)	–1.40σ	–2.38σ	–6.72σ
Greenland/Iceland (GIC)	–0.92σ	–1.12σ	–3.14σ
North-Western North America (NWN)	–0.00σ	–0.01σ	–0.93σ
North-Eastern North America (NEN)	–0.45σ	–0.63σ	–2.14σ
Western North America (WNA)	–0.70σ	–0.97σ	–1.66σ
Central North America (CNA)	–0.59σ	–0.83σ	–1.50σ
Eastern North America (ENA)	–0.78σ	–1.14σ	–2.64σ
Northern Central America (NCA)	–0.62σ	–0.76σ	–1.20σ
Southern Central America (SCA)	–1.04σ	–1.36σ	–3.43σ
Caribbean (CAR)	–0.54σ	–0.66σ	–1.44σ
North-Western South America (NWS)	–0.95σ	–1.23σ	–3.22σ
Northern South America (NSA)	–1.06σ	–1.44σ	–2.92σ
North-Eastern South America (NES)	–1.01σ	–1.25σ	–2.59σ
South American Monsoon (SAM)	–1.58σ	–1.92σ	–3.36σ
South-Western South America (SWS)	–1.53σ	–1.87σ	–2.89σ
South-Eastern South America (SES)	–0.39σ	–0.37σ	–0.96σ
Southern South America (SSA)	–1.25σ	–1.32σ	–2.46σ
Northern Europe (NEU)	–0.88σ	–1.39σ	–3.79σ
Western and Central Europe (WCE)	–0.81σ	–1.23σ	–1.97σ
Eastern Europe (EEU)	–0.48σ	–0.77σ	–1.59σ
Mediterranean (MED)	–1.45σ	–2.03σ	–3.62σ
Sahara (SAH)	0.70σ	0.69σ	1.35σ
Western Africa (WAF)	1.33σ	1.24σ	1.54σ
Central Africa (CAF)	0.92σ	1.11σ	1.52σ
North Eastern Africa (NEAF)	0.56σ	0.74σ	2.22σ
South Eastern Africa (SEAF)	0.17σ	0.29σ	0.62σ
West Southern Africa (WSAF)	–0.93σ	–1.16σ	–2.08σ
East Southern Africa (ESAF)	–0.86σ	–1.11σ	–2.41σ
Madagascar (MDG)	–0.51σ	–0.82σ	–1.68σ
Russian Arctic (RAR)	0.44σ	0.37σ	–1.21σ
West Siberia (WSB)	0.21σ	0.08σ	–0.06σ
East Siberia (ESB)	0.62σ	0.65σ	1.06σ
Russian Far East (RFE)	–0.07σ	–0.39σ	–1.51σ
West Central Asia (WCA)	–0.21σ	–0.38σ	–0.55σ
East Central Asia (ECA)	0.66σ	0.97σ	2.38σ
Tibetan Plateau (TIB)	0.15σ	0.25σ	–0.00σ
East Asia (EAS)	–0.43σ	–0.49σ	–0.81σ
Arabian Peninsula (ARP)	0.20σ	0.25σ	0.64σ
South Asia (SAS)	0.71σ	0.80σ	1.41σ
South East Asia (SEA)	–0.51σ	–0.34σ	–1.12σ
Northern Australia (NAU)	–0.14σ	–0.14σ	–0.24σ
Central Australia (CAU)	–0.16σ	–0.21σ	–0.54σ
Eastern Australia (EAU)	–0.42σ	–0.41σ	–0.67σ
Southern Australia (SAU)	–0.57σ	–0.62σ	–0.98σ
New Zealand (NZ)	–0.37σ	–0.39σ	–0.37σ
East Antarctica (EAN)	No data	No data	No data
West Antarctica (WAN)	No data	No data	No data

Table 11.SM.8 | As Table 11.SM.2 but for changes in consecutive dry days (CDD).

	Projections		
	+1.5°C GWL	+2.0°C GWL	+4.0°C GWL
Global (global)	0.91day	0.96day	1.48day
Ocean (ocean)	1.65day	1.80day	3.24day
Land (land)	–0.61day	–0.71day	–2.11day
Land w/o Antarctica (land_wo_antarctica)	0.37day	0.46day	0.73day
Greenland/Iceland (GIC)	–3.46day	–4.85day	–8.52day
North-Western North America (NWN)	–0.91day	–1.47day	–2.51day
North-Eastern North America (NEN)	–1.94day	–2.51day	–5.16day
Western North America (WNA)	0.92day	1.00day	0.25day
Central North America (CNA)	0.37day	0.32day	1.20day
Eastern North America (ENA)	0.19day	0.27day	0.84day
Northern Central America (NCA)	3.46day	4.04day	8.48day
Southern Central America (SCA)	2.63day	4.01day	9.50day
Caribbean (CAR)	1.27day	1.56day	3.29day
North-Western South America (NWS)	1.48day	1.78day	3.99day
Northern South America (NSA)	6.65day	9.37day	19.56day
North-Eastern South America (NES)	15.14day	18.63day	28.44day
South American Monsoon (SAM)	8.90day	10.34day	19.05day
South-Western South America (SWS)	4.11day	5.90day	10.09day
South-Eastern South America (SES)	2.54day	2.90day	3.99day
Southern South America (SSA)	0.91day	1.16day	2.09day
Northern Europe (NEU)	–0.27day	–0.06day	0.25day
Western and Central Europe (WCE)	1.03day	1.82day	4.09day
Eastern Europe (EEU)	0.33day	1.08day	1.83day
Mediterranean (MED)	4.96day	7.13day	16.07day
Sahara (SAH)	–8.12day	–7.92day	–15.07day
Western Africa (WAF)	–1.07day	–0.43day	–0.79day
Central Africa (CAF)	–1.39day	–1.05day	–1.29day
North Eastern Africa (NEAF)	–1.89day	–2.63day	–9.28day
South Eastern Africa (SEAF)	2.11day	2.50day	0.89day
West Southern Africa (WSAF)	9.81day	14.63day	28.84day
East Southern Africa (ESAF)	8.76day	11.29day	23.51day
Madagascar (MDG)	5.98day	8.23day	17.35day
Russian Arctic (RAR)	–3.73day	–4.75day	–7.41day
West Siberia (WSB)	–0.83day	–1.02day	–0.16day
East Siberia (ESB)	–3.46day	–4.73day	–8.75day
Russian Far East (RFE)	–2.55day	–3.25day	–5.71day
West Central Asia (WCA)	–1.07day	–0.42day	–0.55day
East Central Asia (ECA)	–6.75day	–8.59day	–14.95day
Tibetan Plateau (TIB)	–1.48day	–1.66day	–5.48day
East Asia (EAS)	1.42day	0.93day	1.08day
Arabian Peninsula (ARP)	–6.79day	–8.04day	–19.71day
South Asia (SAS)	–2.13day	–2.13day	–8.97day
South East Asia (SEA)	3.11day	3.29day	7.74day
Northern Australia (NAU)	6.61day	5.46day	8.13day
Central Australia (CAU)	3.76day	4.06day	9.81day
Eastern Australia (EAU)	4.46day	4.37day	9.06day
Southern Australia (SAU)	2.93day	3.38day	7.07day
New Zealand (NZ)	0.11day	0.17day	0.32day
East Antarctica (EAN)	–12.44day	–16.04day	–34.35day
West Antarctica (WAN)	–2.09day	–2.79day	–5.22day

11.SM.4 Data Table

Table 11.SM.9 | Input data table. Input datasets and code used to create chapter figures.

Figure Number	Dataset/Code Name	Type	File Name/ Specificities	License Type	Dataset/ Code Citation	Dataset/Code URL	Related Publications/ Software Used	Notes
Figure 11.2	HadEX3 (v3.0.2) – TXx	Input dataset	HadEX3_TXx_1901-2018_ADW_61-90_1.25x1.875 deg.nc	Open Government License http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/		https://www.metoffice.gov.uk/hadobs/hadex3/	Dunn et al. (2020)	
	HadEX3 (v3.0.2) – TNn	Input dataset	HadEX3_TNn_1901-2018_ADW_61-90_1.25x1.875 deg.nc	Open Government License http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/		https://www.metoffice.gov.uk/hadobs/hadex3/	Dunn et al. (2020)	
	Global average annual mean temperature	Input dataset	glob_temp.csv				Section 2.3.1.1.3	Data provided from Chapter 2.
	Land average annual mean temperature	Input dataset	land_temp.csv				Section 2.3.1.1.3	Data provided from Chapter 2.
	Figure 11.2 code	Code	Figure_11.2_obs_ts_plots.ipynb					
Figure 11.3	Figure 11.3 code	Code	Figure_11.3_TXx_scaling.ipynb					
Box 11.1, Figure 1	Changes in annual maximum precipitation	Input dataset	pfahl_2017.nc				Pfahl et al. (2017)	Data provided by Stephan Pfahl.
	Box 11.1, Figure 1 code	Code	Box_11.1_Figure_1_Pfahl_2017.ipynb					
Figure 11.6	Figure 11.6 input dataset	Input dataset	Changes in txx_baseline0deg.xlsx				Li et al. (2020)	Figure created by Chao Li.
Figure 11.7	Figure 11.7 input dataset	Input dataset	Changes in rx1day_baseline0deg.xlsx				Li et al. (2020)	Figure created by Chao Li.
Figure 11.9	HadEX3 (v3.0.2) – TXx	Input dataset	HadEX3_TXx_1901-2018_ADW_61-90_1.25x1.875 deg.nc	Open Government License		https://www.metoffice.gov.uk/hadobs/hadex3/	Dunn et al. (2020)	
	HadEX3 (v3.0.2) – TX90p	Input dataset	HadEX3_TX90p_1901-2018_ADW_61-90_1.25x1.875 deg.nc	Open Government License		https://www.metoffice.gov.uk/hadobs/hadex3/	Dunn et al. (2020)	Converted from percent to days per year.
	HadEX3 (v3.0.2) – TNn	Input dataset	HadEX3_TNn_1901-2018_ADW_61-90_1.25x1.875 deg.nc	Open Government License		https://www.metoffice.gov.uk/hadobs/hadex3/	Dunn et al. (2020)	
	Figure 11.9 code	Code	Figure_11.9_HadEX3_maps.ipynb					
Figure 11.10	CMIP6 data	Input dataset	TXx_TNn_error_CMIP6.nc				Wehner et al. (2020)	Data provided by Michael Wehner.
	Figure 11.10	Code	Figure_11.10_Wehner_temperature_bias.ipynb					

Figure Number	Dataset/Code Name	Type	File Name/ Specificities	License Type	Dataset/ Code Citation	Dataset/Code URL	Related Publications/ Software Used	Notes
Figure 11.11	Figure 11.11 code for annual maximum temperature (TXx)	Code	Figure_11.11_TXx_map.ipynb					
	Figure 11.11 code for annual maximum temperature (TNn)	Code	Figure_11.11_TNn_map.ipynb					
Figure 11.12	Figure 11.12 input dataset	Input dataset	Changes in txx_baseline0deg.xlsx				Li et al. (2020)	Figure created by Chao Li.
Figure 11.13	Figure 11.13a	Input dataset					Sun et al.(2020)	Panel a created by Qiaohong Sun.
	Figure 11.13b and c	Input dataset	station_MK_1950_2018.csv				Sun et al. (2020)	Data provided by Qiaohong Sun.
	Code for Figure 11.13b and c	Code	Figure_11.13_Rx1day_trend_maps_Sun.ipynb					
Figure 11.14	Bias of CMIP6 w.r.t ERA5	Input dataset	Rx_CMIP6_errors_ERA5.nc				Wehner et al. (2020)	Data provided by Michael Wehner.
	Bias of CMIP6 w.r.t HadEX3	Input dataset	Rx_CMIP6_errors_HadEx3.nc				Wehner et al. (2020)	Data provided by Michael Wehner.
	Bias of CMIP6 w.r.t REGEN	Input dataset	Rx_CMIP6_errors_REGEN.nc				Wehner et al. (2020)	Data provided by Michael Wehner.
	Figure 11.14 code	Code	Figure_11.14_Wehner_precipitation_bias.ipynb					
Figure 11.15	Figure 11.15 input dataset	Input dataset	Changes in rx1day_baseline0deg.xlsx				Li et al. (2020)	Figure created by Chao Li.
Figure 11.16	Figure 11.16 code	Code	Figure_11.16_Rx1day_map.ipynb					
Figure 11.17	HadEX3 (v3.0.2) – CDD	Input dataset	HadEX3_CDD_1901-2018_ADW_61-90_1.25x1.875 deg.nc	Open Government License		https://www.metoffice.gov.uk/hadobs/hadex3/	Dunn et al. (2020)	
	SPI-12 and SPEI-12 trends	Input dataset	results_spinoni_01.nc				Spinoni et al. (2019)	SPI and SPEI data from Spinoni et al. (2019), processed by Sergio Vicente Serrano.
	Figure 11.17 code	Code	Figure_11.17_CDD_SPI_SPEI.ipynb					
Figure 11.18	Figure 11.18 code	Code	SMDroughtIndex.ipynb					

Figure Number	Dataset/Code Name	Type	File Name/ Specificities	License Type	Dataset/ Code Citation	Dataset/Code URL	Related Publications/ Software Used	Notes
Figure 11.19	Code for CDD	Code	Figure_11.19_ CDD_map.ipynb					
	Code for total soil moisture	Code	Figure_11.19_ SM_map.ipynb					
	Code for soil-moisture-based drought frequency	Code	SMDroughtIndex. ipynb					
Box 11.4, Figure 1	Input dataset Box 11.4, Figure 1	Input dataset	sippel_2015_fig3.txt				Sippel et al. (2015)	Data provided by Sebsatian Sippel.
	Box 11.4, Figure 1 code	Code	Box_11.4_Figure_1_ Sippel_2015.ipynb					
Box 11.4, Figure 2	Global ECMWF Reanalysis v5 (ERA5) – temperature	Input dataset	era5_deterministic_ recent.t2m.025deg. 1m.*.nc	Copernicus License https://cds.climate.copernicus.eu/api/v2/terms/static/licence-to-use-copernicus-products.pdf			Hersbach et al. (2020)	
	Global ECMWF Reanalysis v5 (ERA5) – geopotential	Input dataset	era5_deterministic_ recent.z200.025deg. 1m.2018.nc	Copernicus License			Hersbach et al. (2020)	
	Box 11.4, Figure 2 code	Code	Box_11.4_Figure_2_ 2018.ipynb					
FAQ 11.1, Figure 1	FAQ 11.1, Figure 1	Code	FAQ_11.1_ Figure_1_mean_vs_ extreme.ipynb					

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