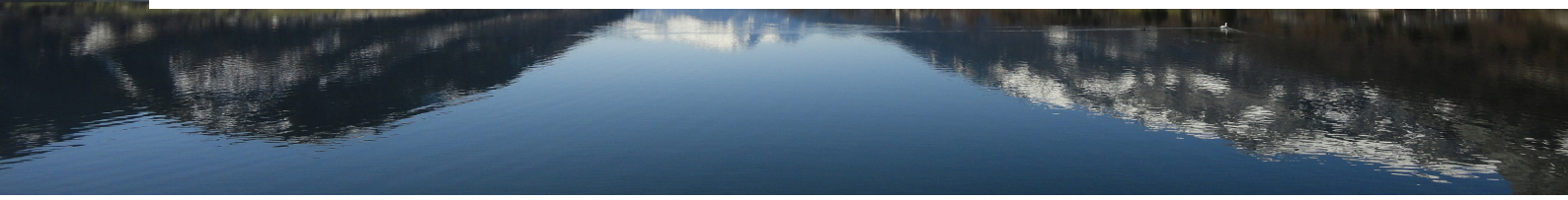
Climate Fact Sheet

Styria



At a glance

The Regional Climate Factsheet provides brief and concise information on possible future climate developments in Styria in the 21st century. They are based on the results of 55 regional climate model simulations, which are based on the Representative Concentration Pathways (RCPs). RCP8.5 represents a “business-as-usual” scenario, RCP4.5 a “medium” scenario, and RCP2.6 a “climate protection” scenario. 18 different parameters for climate change are presented, which are relevant for various societal sectors. They are supplemented by an expert judgement of the reliability of the shown changes. The relationship to the climate of the near past is illustrated by the same key figures calculated from observation data for Styria. At the end of the 21st century, the annual mean near-surface temperature increases between 0.6 °C and 2.1 °C in RCP2.6, between 1.4 °C and 3.2 °C in RCP4.5, and between 2.9 °C and 5.5 °C in RCP8.5; these increases are robust for all scenarios. For the annual precipitation at the end of the 21st century the projections show changes between -4.3 mm/month and 12.5 mm/month for RCP2.6, between -0.5 and 13.4 mm/month for RCP4.5, and between -10.0 mm/month and 20.8 mm/month for RCP8.5. However, only the changes in annual precipitation projected under RCP8.5 and RCP4.5 are robust.

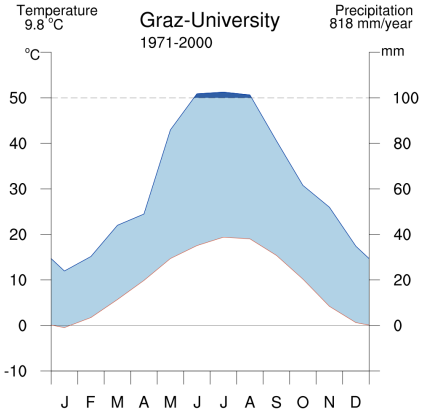
	Climate Changes for a			
Parameter	Business as usual scenario	Medium scenario	Climate protection scenario	Details
temperature	increase	increase	increase	pp. 4, 14
summer days	increase	increase	increase	pp. 5, 14
hot days	increase	increase	increase	pp. 5, 14
tropical nights	increase	increase	increase	pp. 6, 14
length of hot periods	increase	increase	tendency towards increase	pp. 6, 14
days > 5 °C	increase	increase	increase	pp. 7, 14
heating degree days	decrease	decrease	decrease	pp. 7, 14
frost days	decrease	decrease	decrease	pp. 8, 14
spring frost days	decrease	decrease	decrease	pp. 8, 14
precipitation	increase	increase	tendency towards increase	pp. 9, 14
precipitation > 20 mm	increase	increase	tendency towards increase	pp. 9, 15
dry days	increase	no changes	no changes	pp. 10, 15
wet days	decrease	no changes	no changes	pp. 10, 15
p95th	increase	increase	tendency towards increase	pp. 11, 15
p99th	increase	increase	tendency towards increase	pp. 11, 15
wind speed	decrease	tendency towards decrease	tendency towards decrease	pp. 12, 16
water balance	no changes	tendency towards increase	tendency towards increase	pp. 12, 16
sultriness	increase	increase	increase	pp. 13, 16

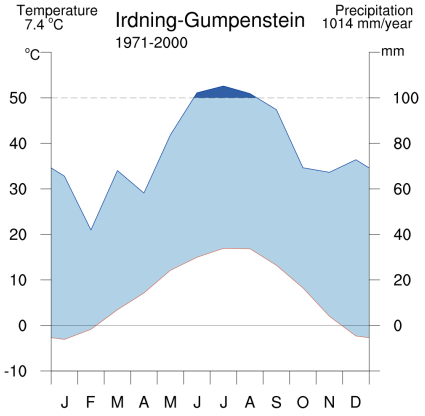
Today's climate and observed changes

The climate of Styria divided into two main climates: A wet continental climate zone in the South and South Eastern region, and an Alpine climate in the North and North Western region. In the following, climate indices derived from data measured by two climate stations is presented as present day reference for the climate projections. The stations are chosen the way that they represent the different climate zones within Styria: Irdning-Gumpenstein is representative for the Alpine region of Styria, Graz-University for the wet continental parts of Styria.

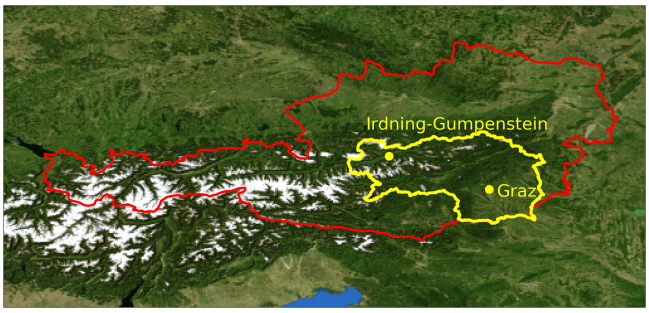
Climate diagrams and climate indices for the climate stations Graz-University and Irdning-Gumpenstein

For the climate stations Graz-University and Irdning-Gumpenstein longtime climate observations are available through the HOM-START database of the Austrian Zentralanstalt für Meteorologie und Geodynamik (ZAMG). The following climate diagrams and indices for the period of 1971 to 2000 are derived from these data.





	Graz-University	Irdning-Gumpenstein
Temperature [°C]	9.8	7.4
Summer days [days/year]	42	36
Hot days [days/year]	4	4
Tropical nights [nights/year]	1	0
Mean length of hot periods [days]	2	2
Days > 5°C [days/year]	250	219
Heating degree days [HDD]	2847	3594
Frost days [days/year]	96	139
Spring frost days [days/year]	2	11
Precipitation [mm/month]	68.2	84.5
Precipitation > 20mm [days/year]	9	10
Dry days [days/year]	273	237
Wet days [days/year]	92	128
p95th [mm/day]	28.0	25.0
p99th [mm/day]	48.0	40.0



For the period of 1970 to 2009, an increase of the annual mean temperature of about 2.4 °C was observed for Graz-University. For the same period, the mean observed increase for Irdning-Gumpenstein is about 1.6 °C. The lowest annual mean temperature recorded since 1948 in the series of measurements for Graz-University was in the year 1962 with 8.1 °C, the highest value in the year 2000 with 11.9 °C. For Irdning-Gumpenstein, the lowest annual mean temperature recorded since 1953 in the series of measurements was in the year 1954 with 5.4 °C, the highest value in the year 2008 with 8.9 °C.

For the annual mean precipitation, the measurements do not show any clear trends during the course of the 21st century. The lowest annual precipitation values since 1953 in Graz-University were recorded in the year 1969 with 559 mm, the highest values in 2009 with 1458 mm. For Irdning-Gumpenstein, the lowest annual precipitation values since 1953 were recorded in the year 1969 with 755 mm, the highest values in 1970 with 1459 mm.

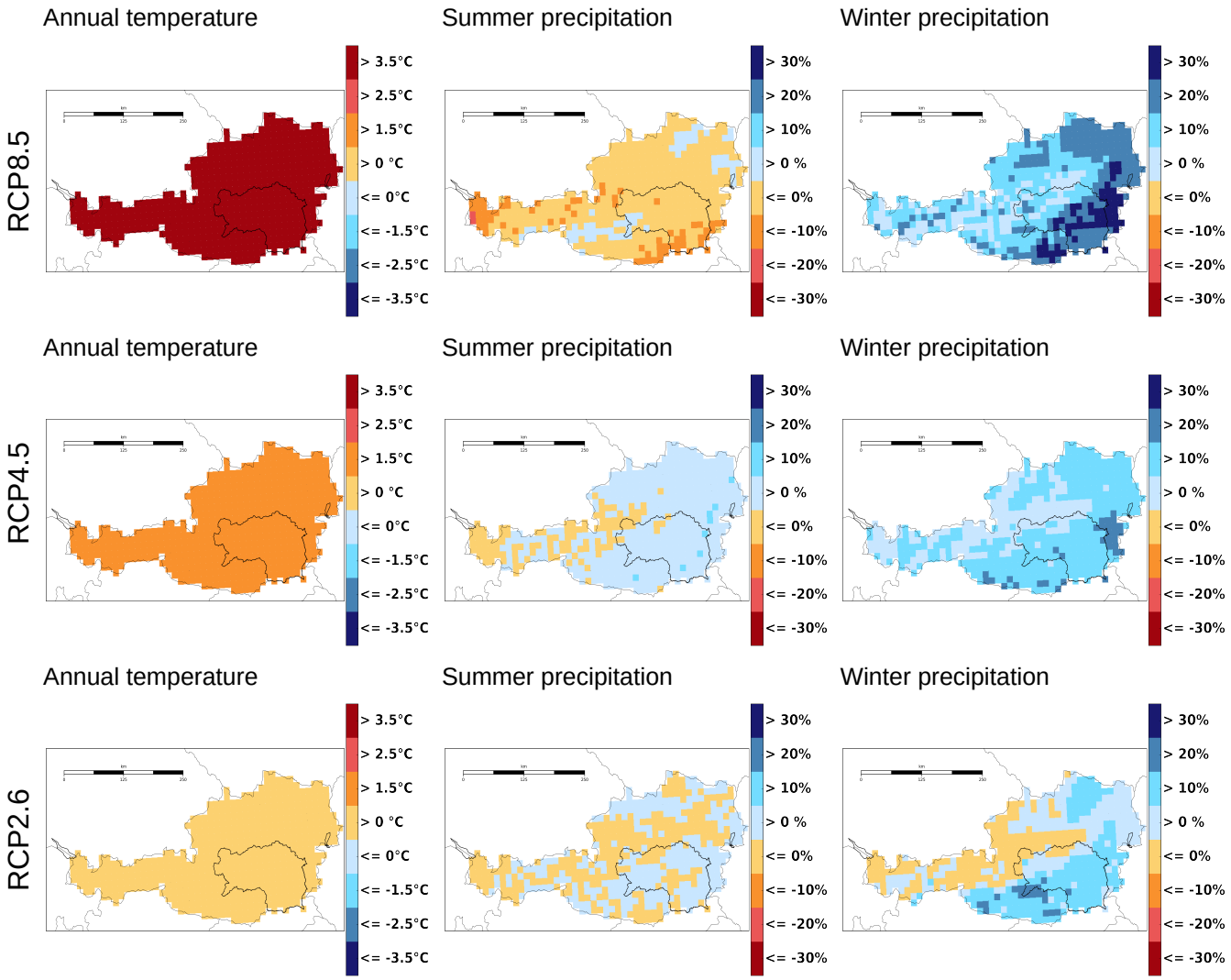
Data source for the information on present day and past climate: HOM-START database of the Austrian Zentralanstalt für Meteorologie und Geodynamik (ZAMG)

Climate diagram following Walter-Lieth: Surface air temperature is given in °C, precipitation in mm (corresponds to litre per square meter). The scaling for the units of temperature and precipitation are in the ratio 1:2.

Projected climate changes

The projected changes shown in this Climate Fact Sheet are based on an ensemble of climate projections which were created in the context of the EURO-CORDEX initiative as well as on regional climate projections provided by the ReKliEs-DE project, funded by the German Ministry of Research and Education (see page 19 for more information). Climate projections give possible future pathways of climate for the coming decades, based on scenarios for the development of global population, economy, and technological development, resulting in different temporal releases of greenhouse gases into the atmosphere. Here, projections are based on three different Representative Concentration Pathways (RCPs). RCP8.5 represents a business-as-usual scenario, RCP4.5 a meduim scenario, and RCP2.6 a climate protection scenario. The global climate projections are regionally refined by regional climate models. All EURO-CORDEX and ReKliEs-DE simulations are stored on a common grid with a horizontal grid resolution of about 12 x 12 km. The climate projections for Styria are calculated as mean value of all grid boxes located in the region of Styria. Two distinct future time periods are considered and opposed to the climate reference period of 1971 to 2000: 2036-2065 for the middle of the 21st century and 2070 to 2099 for the end of the 21st century.

Mean changes for the period 2070 - 2099 relative to 1971 - 2000



Symbols of the expert judgement on the robustness of the projections

Increase: The majority of the simulations projects significant increases

Tendency towards an increase: The majority of the simulations projects non-significant increases

Decrease : The majority of the simulations projects significant decreases

Tendency towards a decrease: The majority of the simulations projects non-significant decreases

Unclear: The majority of the simulations projects significant changes, but do not agree on the direction of changes

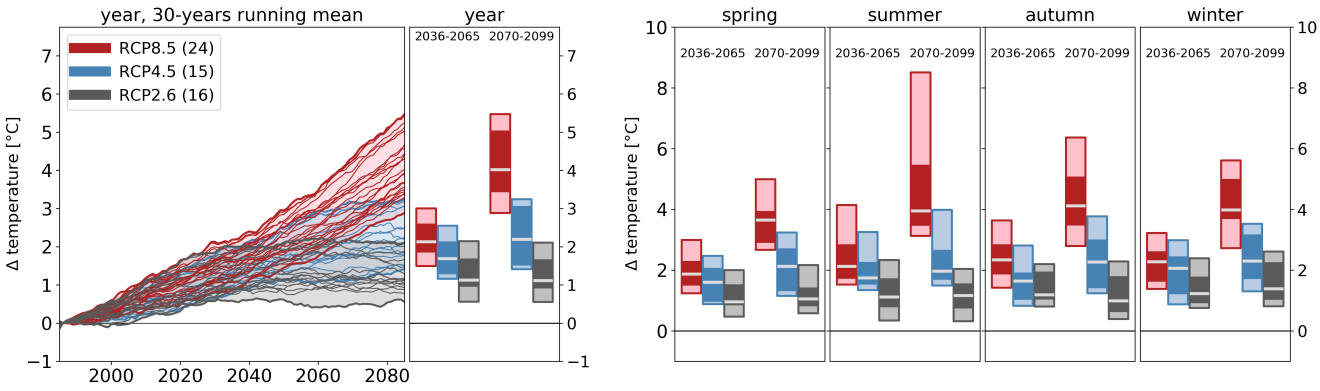
No changes: The majority of the simulations projects non-significant increases, with no preferred direction of changes

Please consider:

Each climate index presented on the following pages is complemented by an expert judgement on the robustness of the projected changes, which is described in more detail on page 16. The definition of each climate index is given on page 18. Their graphical representation is explained on page 17. These information are necessary for the understanding of the figures. All climate indices are displayed with the identical method. The changes of the annual values are additionally given. In addition to the figures, the projected changes for each index for the middle and the end of the 21st century are given as short narratives.

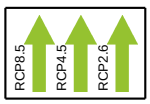
Projected changes of temperature-based indices

Annual and seasonal temperature

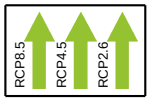


For all three RCPs an increase of the temperature is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from 1.5 to 3.0 °C for RCP8.5, from 1.2 to 2.5 °C for RCP4.5, and from 0.6 to 2.1 °C for RCP2.6.

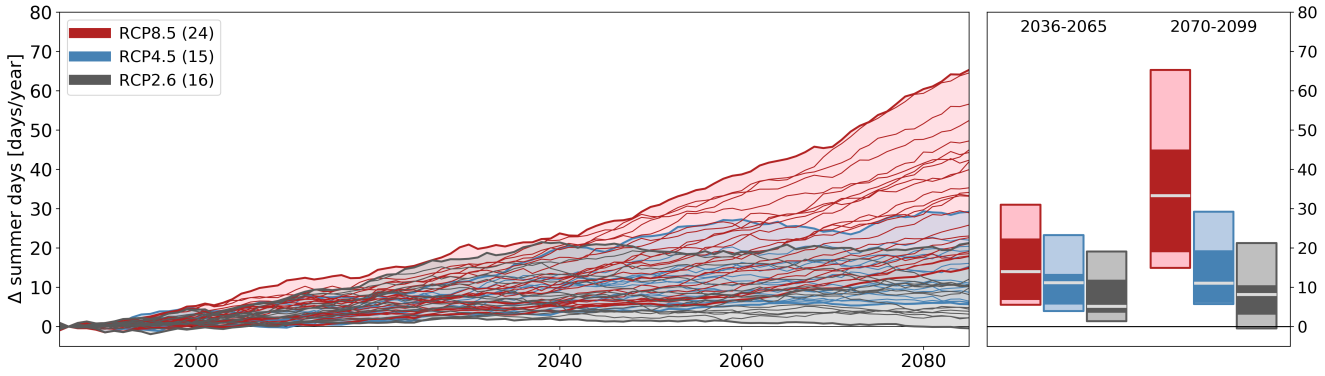


For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 2.9 and 5.5 °C, for RCP4.5 between 1.4 and 3.2 °C, and for RCP2.6 between 0.6 and 2.1 °C.



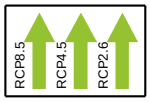
Projected changes of temperature-based indices

Summer days

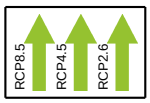


For all three RCPs an increase of the number of summer days is projected.

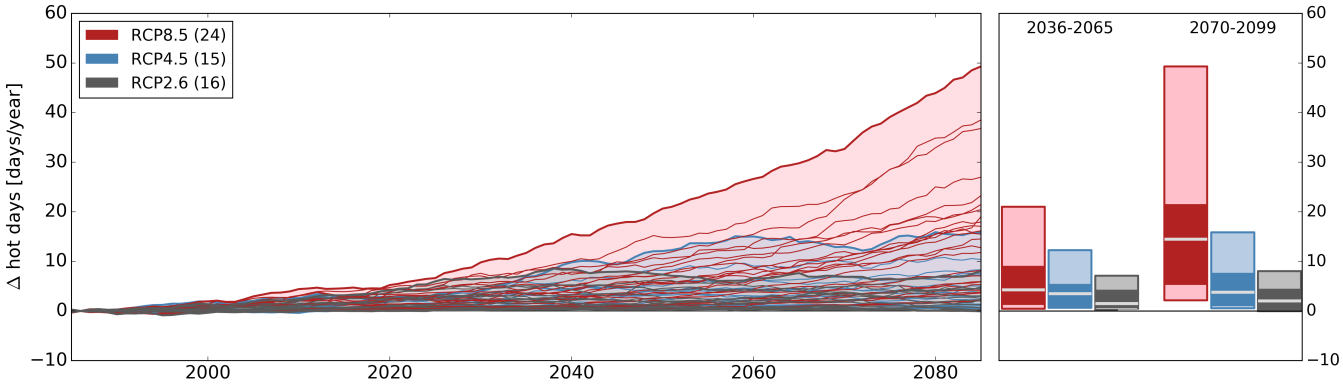
The bandwidth of projected annual changes for the **middle of the 21st century** spans from 6 to 31 days/year for RCP8.5, from 4 to 23 days/year for RCP4.5, and from 1 to 19 days/year for RCP2.6.



For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 15 and 65 days/year, for RCP4.5 between 6 and 29 days/year, and for RCP2.6 between 0 and 21 days/year.

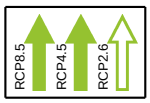


Hot days

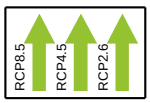


For all three RCPs an increase of the number of hot days is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from 0 to 21 days/year for RCP8.5, from 1 to 12 days/year for RCP4.5, and from 0 to 7 days/year for RCP2.6.

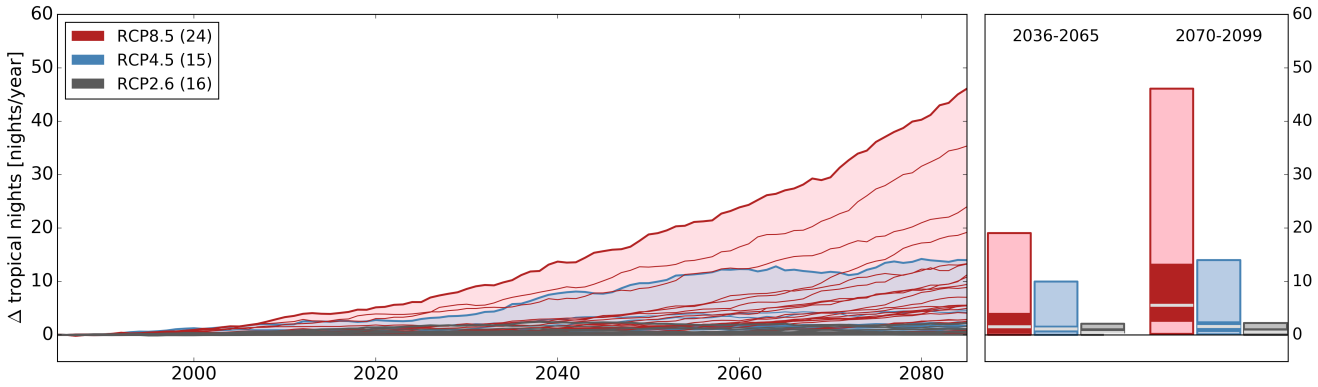


For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 2 and 49 days/year, for RCP4.5 between 1 and 16 days/year, and for RCP2.6 between 0 and 8 days/year.



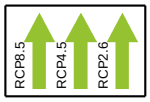
Projected changes of temperature-based indices

Tropical nights

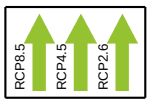


For all three RCPs an increase of the number of tropical nights is projected.

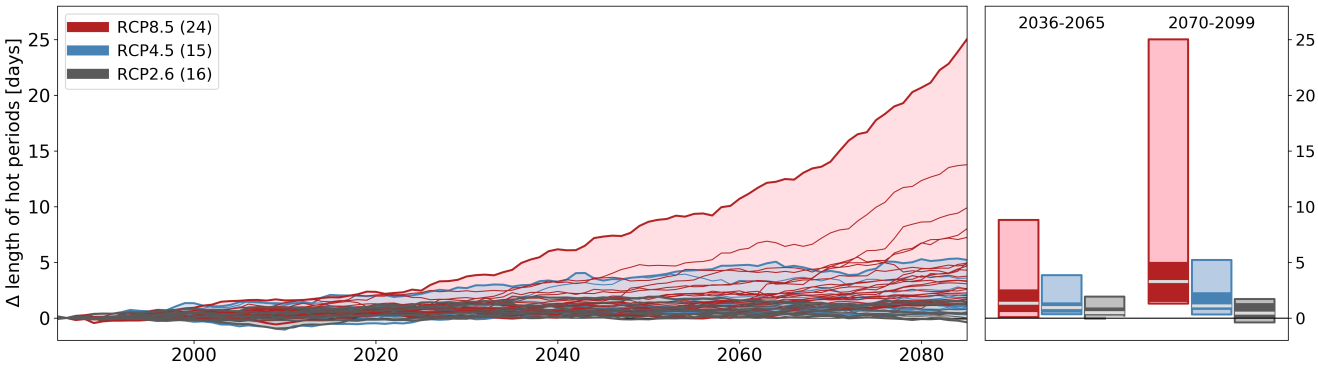
The bandwidth of projected annual changes for the **middle of the 21st century** spans from 0 to 19 nights/year for RCP8.5, from 0 to 10 nights/year for RCP4.5, and from 0 to 2 nights/year for RCP2.6.



For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 0 and 46 nights/year, for RCP4.5 between 0 and 14 nights/year, and for RCP2.6 between 0 and 2 nights/year.

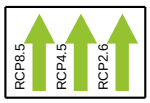


Duration of heat waves

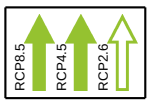


For all three RCPs an increase of the maximum length of hot periods is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from 0 to 9 days for RCP8.5, from 0 to 4 days for RCP4.5, and from 0 to 2 days for RCP2.6.

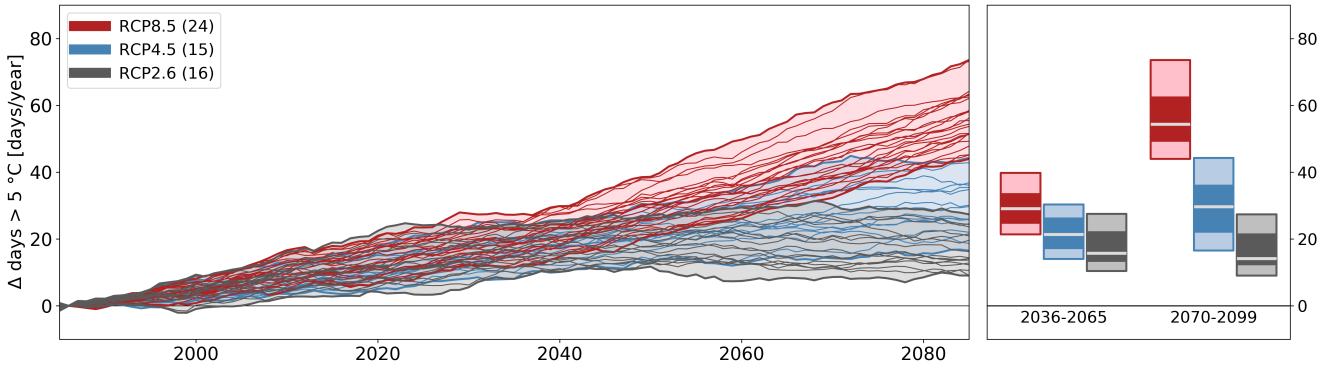


For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 1 and 25 days, for RCP4.5 between 0 and 5 days, and for RCP2.6 between 0 and 2 days.



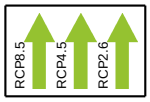
Projected changes of temperature-based indices

Days warmer than 5 °C

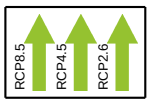


For all three RCPs an increase of the number of days > 5 °C is projected.

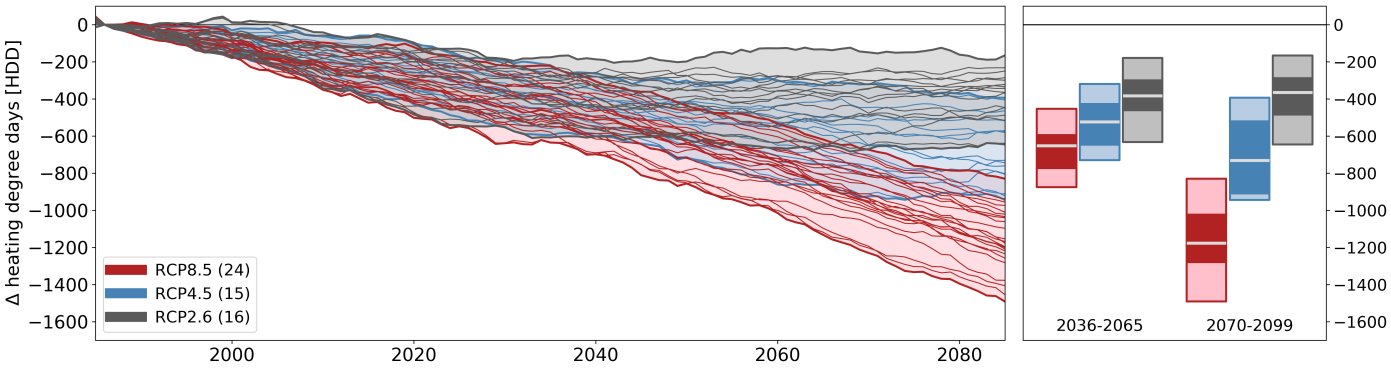
The bandwidth of projected annual changes for the **middle of the 21st century** spans from 21 to 40 days/year for RCP8.5, from 14 to 30 days/year for RCP4.5, and from 10 to 28 days/year for RCP2.6.



For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 44 and 74 days/year, for RCP4.5 between 17 and 44 days/year, and for RCP2.6 between 9 and 27 days/year.



Heating degree days



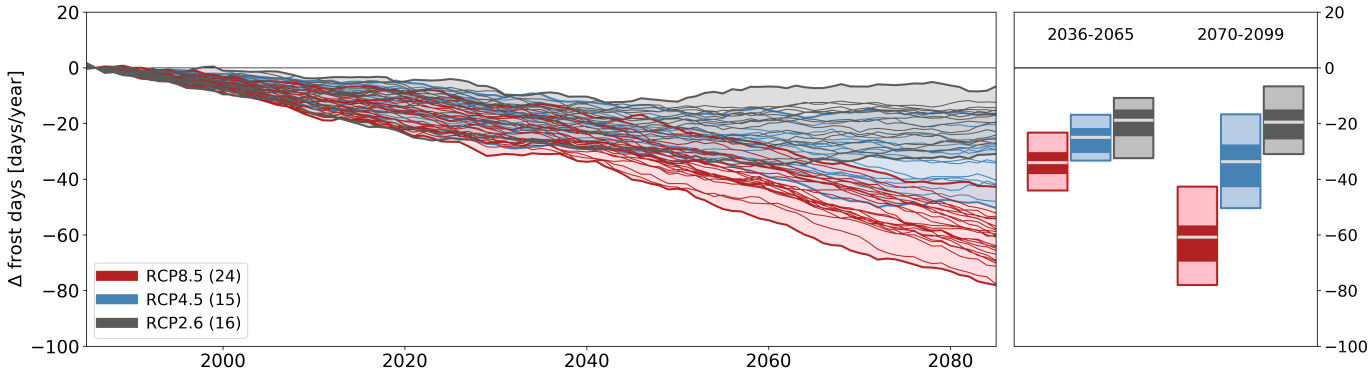
For all three RCPs a decrease of the number of heating degree days is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from -876 to -453 HDD for RCP8.5, from -730 to -320 HDD for RCP4.5, and from -632 to -179 HDD for RCP2.6.

For the **end of the 21st century,** the projected annual descreases for RCP8.5 is between -1491 and -830 HDD, for RCP4.5 between -944 and -394 HDD, and for RCP2.6 between -645 and -166 HDD.

Projected changes of temperature-based indices

Frost days

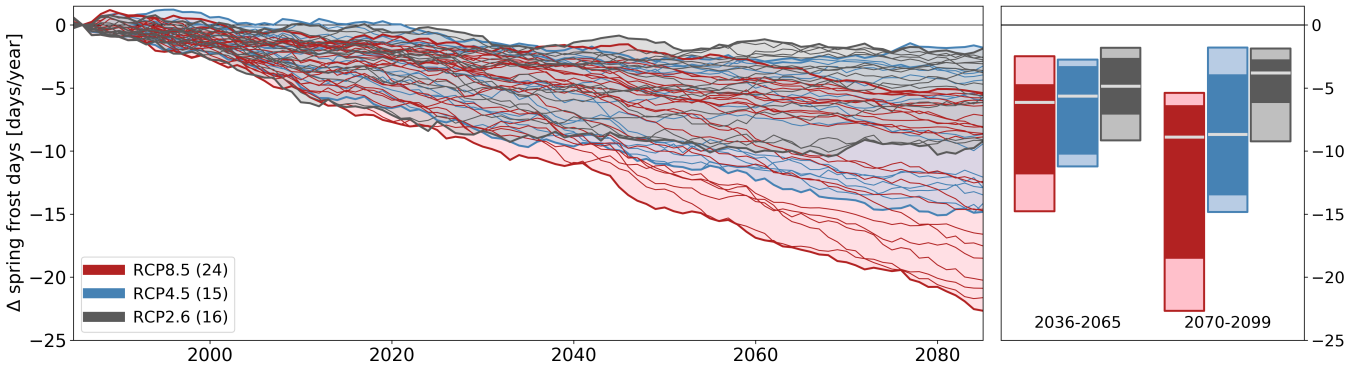


For all three RCPs a decrease of the number of frost days is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from -44 to -23 days/year for RCP8.5, from -33 to -17 days/year for RCP4.5, and from -33 to -11 days/year for RCP2.6.

For the **end of the 21st century,** the projected annual descreases for RCP8.5 is between -78 and -43 days/year, for RCP4.5 between -50 and -17 days/year, and for RCP2.6 between -31 and -7 days/year.

Spring frost days



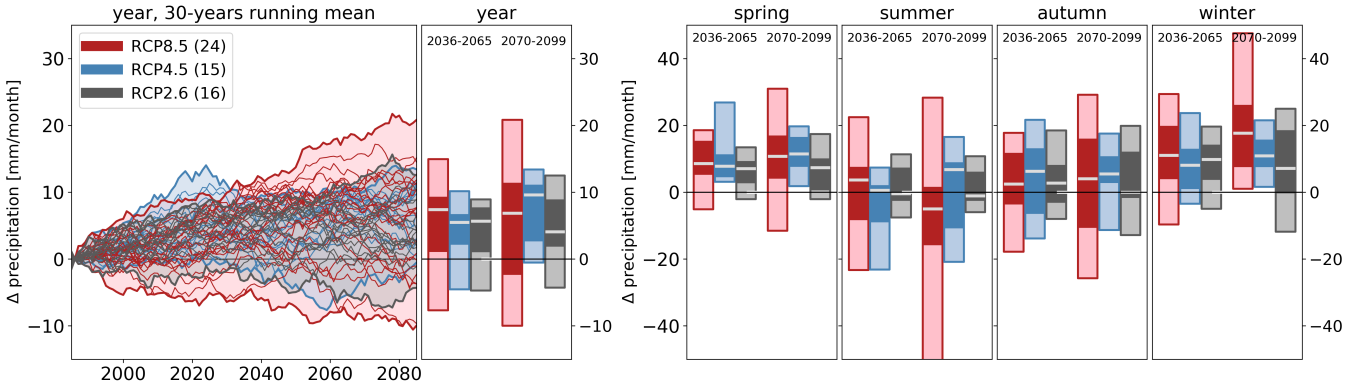
For all three RCPs a decrease of the number of spring frost days is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from -15 to -2 days/year for RCP8.5, from -11 to -3 days/year for RCP4.5, and from -9 to -2 days/year for RCP2.6.

For the **end of the 21st century,** the projected annual descreases for RCP8.5 is between -23 and -5 days/year, for RCP4.5 between -15 and -2 days/year, and for RCP2.6 between -9 and -2 days/year.

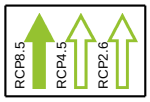
Projected changes of precipitation-based indices

Annual and seasonal precipitation

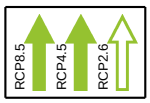


For the different RCPs no clear signal of the precipitation is projected.

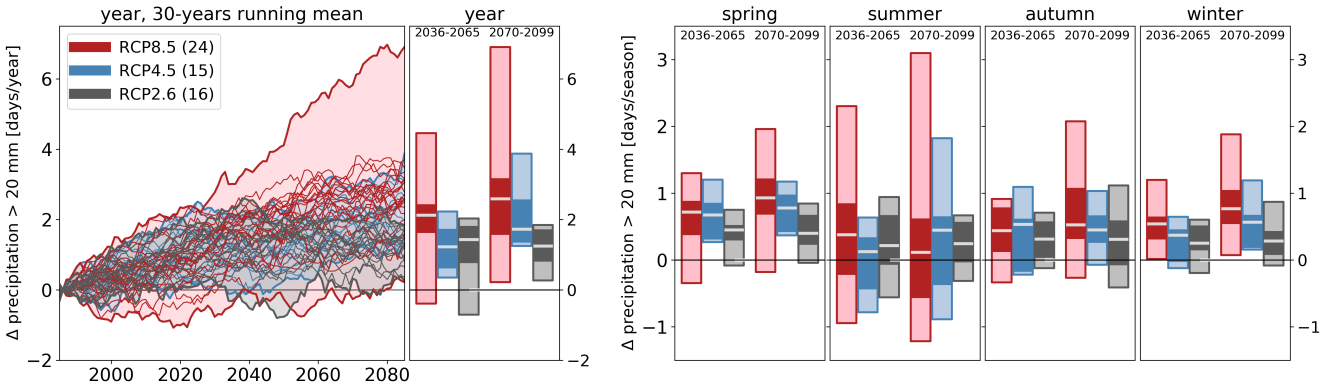
The bandwidth of projected annual changes for the **middle of the 21st century** spans from -7.7 to 14.9 mm/month for RCP8.5, from -4.5 to 10.1 mm/month for RCP4.5, and from -4.7 to 8.9 mm/month for RCP2.6.



For the **end of the 21st century,** the projected annual changes for RCP8.5 is between -10.0 and 20.8 mm/month, for RCP4.5 between -0.5 and 13.4 mm/month, and for RCP2.6 between -4.3 and 12.5 mm/month.

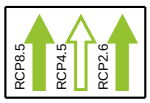


Days with precipitation > 20 mm/day

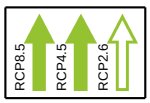


For all three RCPs an increase of the number of days with precipitation exceeding 20 mm is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from 0 to 4 days/year for RCP8.5, from 0 to 2 days/year for RCP4.5, and from -1 to 2 days/year for RCP2.6.

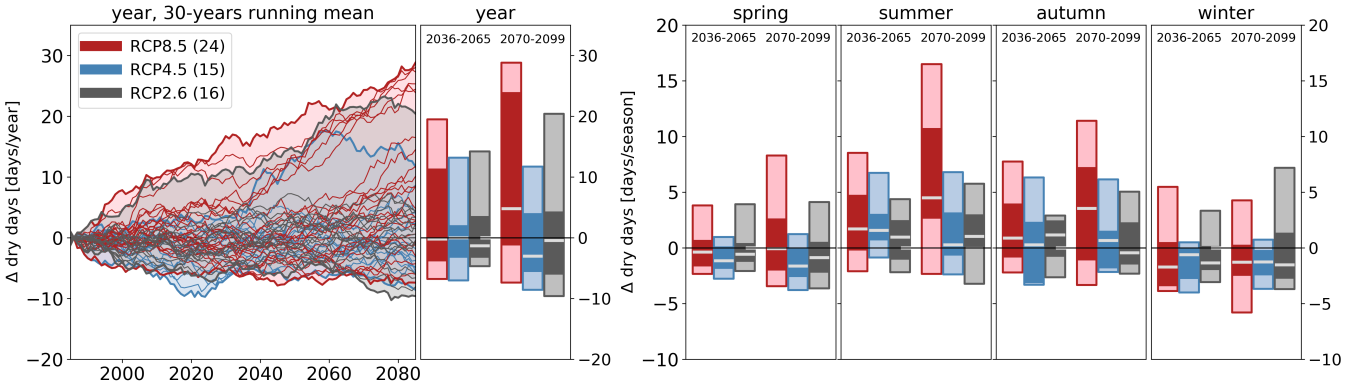


For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 0 and 7 days/year, for RCP4.5 between 1 and 4 days/year, and for RCP2.6 between 0 and 2 days/year.



Projected changes of precipitation-based indices

Dry days (precipitation < 1 mm/day)

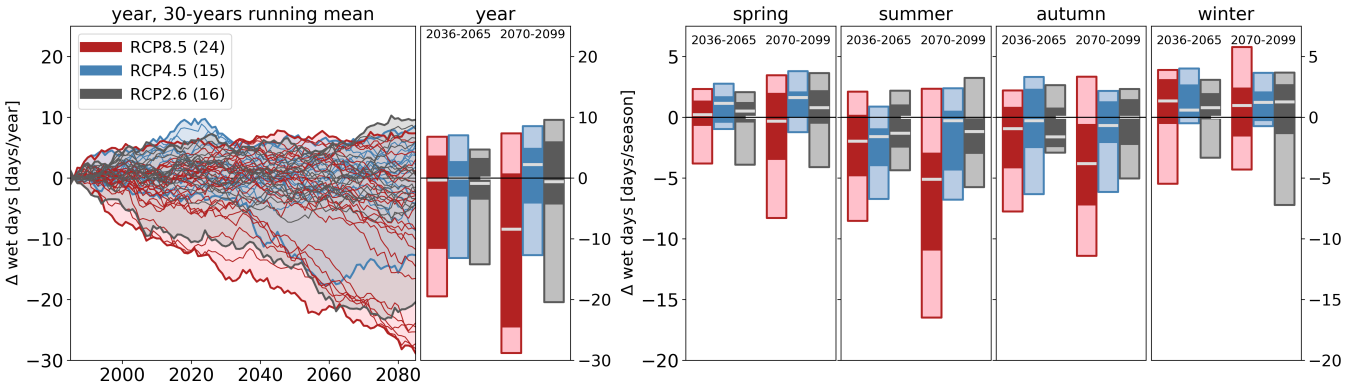


For the different RCPs no clear signal of the number of dry days is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from -7 to 19 days/year for RCP8.5, from -7 to 13 days/year for RCP4.5, and from -5 to 14 days/year for RCP2.6.

For the **end of the 21st century,** the projected annual changes for RCP8.5 is between -7 and 29 days/year, for RCP4.5 between -9 and 12 days/year, and for RCP2.6 between -10 and 20 days/year.

Wet days (precipitation ≥ 1 mm/day)



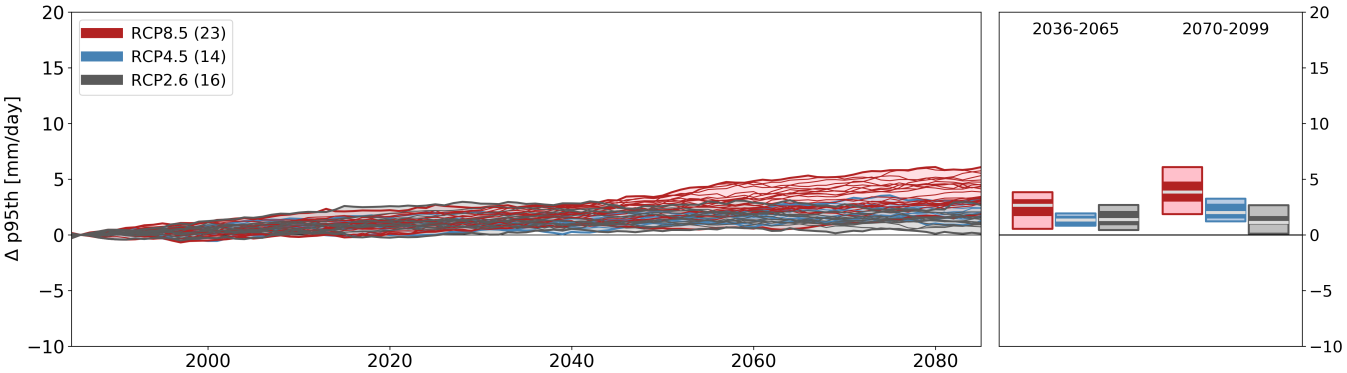
For the different RCPs no clear signal of the number of wet days is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from -19 to 7 days/year for RCP8.5, from -13 to 7 days/year for RCP4.5, and from -14 to 5 days/year for RCP2.6.

For the **end of the 21st century,** the projected annual changes for RCP8.5 is between -29 and 7 days/year, for RCP4.5 between -13 and 9 days/year, and for RCP2.6 between -20 and 10 days/year.

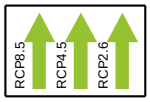
Projected changes of precipitation-based indices

95th percentile of precipitation on wet days

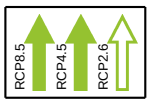


For all three RCPs an increase of the p95th is projected.

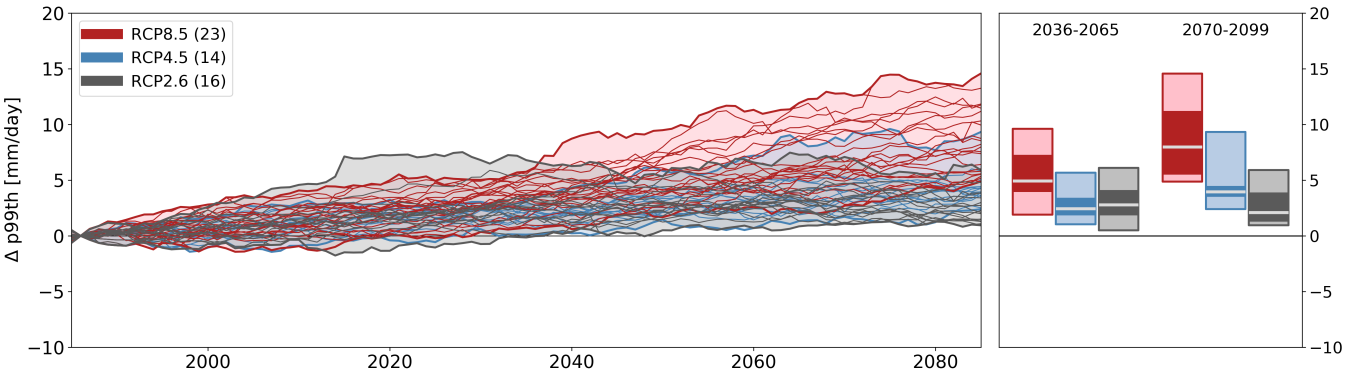
The bandwidth of projected annual changes for the **middle of the 21st century** spans from 0.5 to 3.8 mm/day for RCP8.5, from 0.8 to 1.9 mm/day for RCP4.5, and from 0.4 to 2.7 mm/day for RCP2.6.



For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 1.9 and 6.1 mm/day, for RCP4.5 between 1.2 and 3.2 mm/day, and for RCP2.6 between 0.1 and 2.7 mm/day.

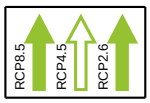


99th percentile of precipitation on wet days

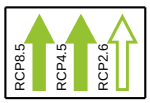


For all three RCPs an increase of the p99th is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from 1.9 to 9.6 mm/day for RCP8.5, from 1.0 to 5.7 mm/day for RCP4.5, and from 0.5 to 6.1 mm/day for RCP2.6.

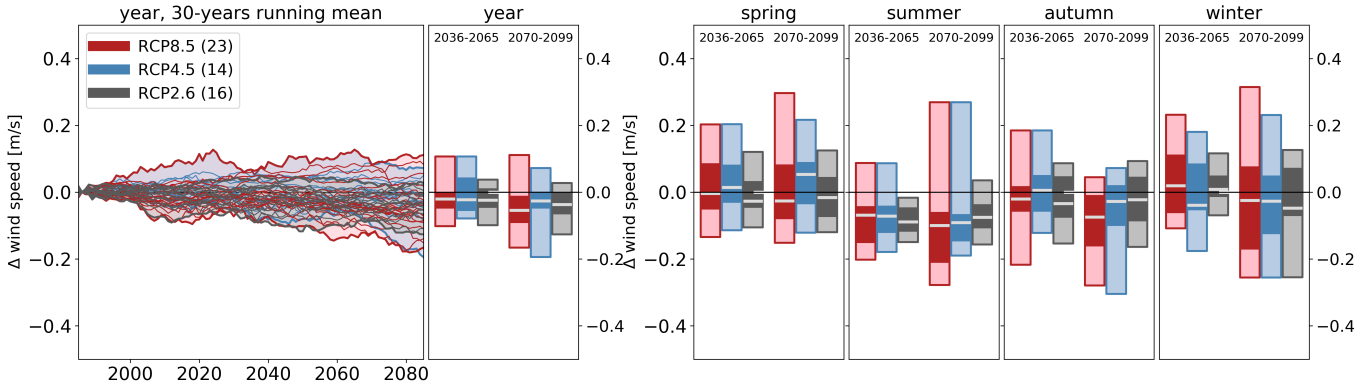


For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 4.9 and 14.6 mm/day, for RCP4.5 between 2.4 and 9.3 mm/day, and for RCP2.6 between 0.9 and 5.9 mm/day.



Projected changes of other indices

Wind speed

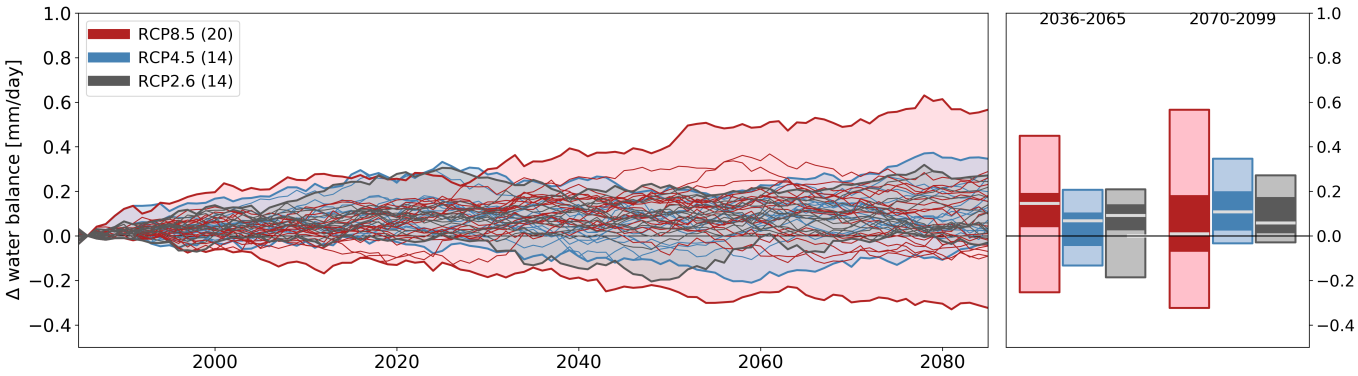


For the different RCPs no clear signal of the wind speed is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from -0.1 to 0.11 m/s for RCP8.5, from -0.08 to 0.11 m/s for RCP4.5, and from -0.1 to 0.04 m/s for RCP2.6.

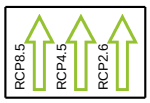
For the **end of the 21st century,** the projected annual changes for RCP8.5 is between -0.17 and 0.11 m/s, for RCP4.5 between -0.19 and 0.07 m/s, and for RCP2.6 between -0.13 and 0.03 m/s.

Climatic water balance (p-e)



For the different RCPs no clear signal of the climatic water balance is projected.

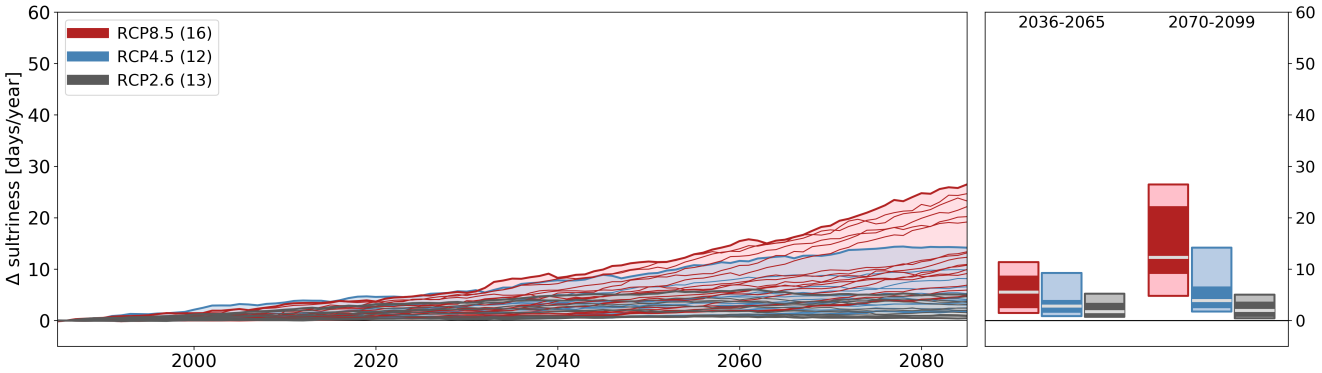
The bandwidth of projected annual changes for the **middle of the 21st century** spans from -0.25 to 0.45 mm/day for RCP8.5, from -0.13 to 0.21 mm/day for RCP4.5, and from -0.19 to 0.21 mm/day for RCP2.6.



For the **end of the 21st century,** the projected annual changes for RCP8.5 is between -0.32 and 0.57 mm/day, for RCP4.5 between -0.03 and 0.35 mm/day, and for RCP2.6 between -0.03 and 0.27 mm/day.

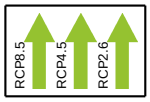
Projected changes of other indices

Sultriness

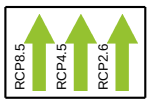


For all three RCPs an increase of the number of sultriness days is projected.

The bandwidth of projected annual changes for the **middle of the 21st century** spans from 1 to 11 sultriness days for RCP8.5, from 1 to 9 sultriness days for RCP4.5, and from 1 to 5 sultriness days for RCP2.6.



For the **end of the 21st century,** the projected annual increases for RCP8.5 is between 5 and 26 sultriness days, for RCP4.5 between 2 and 14 sultriness days, and for RCP2.6 between 0 and 5 sultriness days.



Overview
temperature-based indices

	projected climate changes	minimum to maximum 2036-2065	minimum to maximum 2071-2100
RCP8.5	temperature [°C]	1.49 to 3.00	2.88 to 5.47
	number of summer days [days/year]	5.56 to 30.99	14.92 to 65.27
	number of hot days [days/year]	0.46 to 21.01	2.14 to 49.31
	number of tropical nights [nights/year]	0.01 to 19.05	0.20 to 46.10
	maximum length of hot periods [days]	0.08 to 8.81	1.29 to 25.02
	number of days > 5 °C [days/year]	21.35 to 39.77	43.95 to 73.54
	number of heating degree days [HDD]	-875.63 to -452.83	-1491.38 to -829.62
	number of frost days [days/year]	-44.11 to -23.33	-78.02 to -42.71
	number of spring frost days [days/year]	-14.77 to -2.49	-22.66 to -5.39
RCP4.5	temperature [°C]	1.16 to 2.55	1.41 to 3.24
	number of summer days [days/year]	3.97 to 23.28	5.70 to 29.20
	number of hot days [days/year]	0.66 to 12.28	0.56 to 15.84
	number of tropical nights [nights/year]	0.01 to 9.97	0.08 to 14.00
	maximum length of hot periods [days]	0.34 to 3.84	0.32 to 5.21
	number of days > 5 °C [days/year]	14.03 to 30.33	16.53 to 44.28
	number of heating degree days [HDD]	-730.28 to -319.65	-943.93 to -393.68
	number of frost days [days/year]	-33.30 to -16.84	-50.35 to -16.74
	number of spring frost days [days/year]	-11.21 to -2.75	-14.82 to -1.79
RCP2.6	temperature [°C]	0.56 to 2.14	0.55 to 2.11
	number of summer days [days/year]	1.37 to 19.11	-0.44 to 21.24
	number of hot days [days/year]	0.20 to 7.10	-0.06 to 8.04
	number of tropical nights [nights/year]	0.02 to 2.08	0.02 to 2.24
	maximum length of hot periods [days]	-0.05 to 1.93	-0.39 to 1.69
	number of days > 5 °C [days/year]	10.40 to 27.52	9.07 to 27.38
	number of heating degree days [HDD]	-632.37 to -179.44	-645.03 to -165.78
	number of frost days [days/year]	-32.51 to -10.80	-30.97 to -6.69
	number of spring frost days [days/year]	-9.14 to -1.81	-9.22 to -1.87

Overview
precipitation-based indices

	projected climate changes	minimum to maximum 2036-2065	minimum to maximum 2071-2100
RCP8.5	precipitation [mm/month]	-7.67 to 14.94	-9.97 to 20.81
	number of days with precipitation > 20 mm [days/year]	-0.39 to 4.46	0.22 to 6.91
	number of dry days [days/year]	-6.78 to 19.49	-7.39 to 28.82
	number of wet days [days/year]	-19.49 to 6.78	-28.82 to 7.36
	p95th [mm/day]	0.54 to 3.82	1.87 to 6.08
	p99th [mm/day]	1.90 to 9.61	4.88 to 14.58
RCP4.5	precipitation [mm/month]	-4.55 to 10.14	-0.53 to 13.40
	number of days with precipitation > 20 mm [days/year]	0.35 to 2.23	1.25 to 3.87
	number of dry days [days/year]	-7.04 to 13.18	-8.57 to 11.70
	number of wet days [days/year]	-13.18 to 7.04	-12.70 to 8.54
	p95th [mm/day]	0.83 to 1.93	1.20 to 3.24
	p99th [mm/day]	1.04 to 5.67	2.40 to 9.33
RCP2.6	precipitation [mm/month]	-4.72 to 8.92	-4.30 to 12.51
	number of days with precipitation > 20 mm [days/year]	-0.71 to 2.03	0.27 to 1.84
	number of dry days [days/year]	-4.67 to 14.22	-9.61 to 20.41
	number of wet days [days/year]	-14.22 to 4.67	-20.45 to 9.58
	p95th [mm/day]	0.44 to 2.68	0.11 to 2.67
	p99th [mm/day]	0.49 to 6.10	0.95 to 5.90

Overview
other indices

	projected climate changes	minimum to maximum 2036-2065	minimum to maximum 2071-2100
RCP8.5	wind speed [m/s]	-0.10 to 0.11	-0.17 to 0.11
	climatic water balance [mm/day]	-0.25 to 0.45	-0.32 to 0.57
	number of sultriness days [days/year]	1.47 to 11.37	4.79 to 26.47
RCP4.5	wind speed [m/s]	-0.08 to 0.11	-0.19 to 0.07
	climatic water balance [mm/day]	-0.13 to 0.21	-0.03 to 0.35
	number of sultriness days [days/year]	0.85 to 9.25	1.75 to 14.18
RCP2.6	wind speed [m/s]	-0.10 to 0.04	-0.13 to 0.03
	climatic water balance [mm/day]	-0.19 to 0.21	-0.03 to 0.27
	number of sultriness days [days/year]	0.71 to 5.25	0.43 to 5.05

Expert judgement on the robustness of the projections

To judge on the robustness of the projected changes, the agreement of the projections on the sign of the projected changes for the end of the 21st century, as well as the statistical significance of the changes projected by each single simulation is taken into account. Statistical significance is calculated using the Mann-Whitney test (respectively U-test), which is applied for each model simulation individually. The Null-Hypothesis is that the distribution of the annual values of the respective index in future climate differs from today's distribution, where a confidence level of 0.9 is assumed.

Increase is assigned in case that the majority of the simulations (>66%) projects significant future increases of the climate index.

Decrease is assigned in case that the majority of the simulations (>66%) projects significant future increases of the climate index.

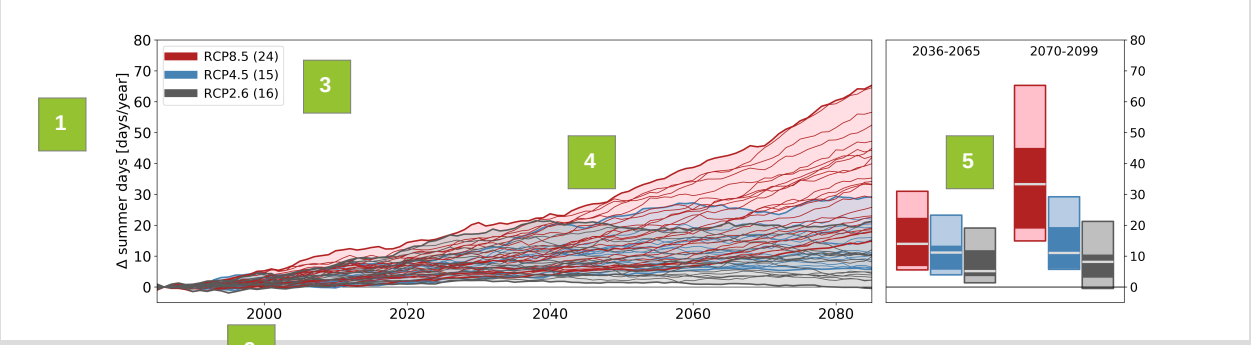
Tendency towards an increase is assigned in case that the majority of the simulations (>66%) projects future increases of the climate index, with no majority projecting significant increases.

Tendency towards a decrease is assigned in case that the majority of the simulations (>66%) projects future descreases of the climate index, with no majority projecting significant decreases.

Unclear: The majority of the simulations projects significant changes (increases or decreases), but there is no agreement on a specific direction of the changes.

No Changes: The majority of the simulations projects only non-significant changes and there is no majority (>66%) agreeing on a specific direction of the changes.

Reading the climate change figures



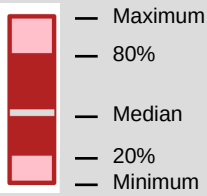
1 Scale and units of the projected changes for the respective parameter

2 Time scale: years for the time series diagram and 30-year periods for the boxplot diagrams

3 Legend for the time series and boxplot diagrams. Colors are indicating the underlying emission scenarios, where RCP denotes Representative Concentration Pathways. RCP8.5: Pathway for a "business as usual" scenario with high greenhouse gas emissions. RCP4.5: "medium" scenario, with medium amount of greenhouse gas emissions. RCP2.6: "climate protection" scenario, with smaller or even negative greenhouse gas emissions. The numbers in brackets indicate the number of simulations entering the analysis for the respective index and scenario. As some variables were not provided for all model simulations, this numbers slightly differ for some of the indices from the total number of simulations available.

4 The **time series diagram** shows the projected 30-years running mean changes of the respective index with respect to the climate reference period of the years 1971 to 2000. The values are centered around the 15th year of each 30-years period, i.e. each value represents the mean value of the 30 years around this year. Each line belongs to a specific model simulation. They are colored as indicated in the legend in three colors, corresponding to the three emission scenarios. In addition, the range between the smallest and the largest changes projected by each of the three scenarios is shown by the respective background color.

5 In the **boxplot diagram** the range of the projected changes is shown for two specific time periods relative to the climate reference period of 1971 to 2000: The middle of the 21st century is represented by the years 2036 to 2065, the end of the 21st century by the period from 2070 to 2099. The bars show some characteristics of the ensemble of projections.



The total range of projections is found between the minimum and maximum value indicated in the bars. The median denotes the simulation of which the value of projected changes is located in the center of the entire bandwith of the ensemble. In addition, those values are marked where 20% of the ensemble project changes below or above this value.

Red color stands for the business as usual scenario (RCP8.5), RCP4.5 is given in blue and RCP2.6 in gray colors.

Definition of the climate indices

Parameter	Definition
Temperature	Defined as the temperature in 2 m height above surface. Summer temperatures cover the months June, July, August, winter temperatures the months November, December and January.
Summer days	Number of days per year with daily maximum temperatures of at least 25 °C
Hot days	Number of days per year with daily maximum temperatures of at least 30 °C
Tropical nights	Number of days per year with daily minimum temperatures of at least 20 °C
Duration of heat waves	Maximum annual duration [in days] of consecutive days with daily maximum temperatures of at least 30 °C
Days > 5 °C	Number of days per year with a daily average temperature above 5 °C
Heating degree days	The total amount of heating degree days per year can be used as measure for the need of heating per year. Heating degree days are defined using a temperature threshold (here 15 °C), below which heating is needed. It is calculated by summing up the daily differences of temperature and the threshold when temperatures are below the threshold. It is given in units of HDD.
Frost days	Number of days per year with daily minimum temperatures below 0 °C
Spring frost days	Number of days between 1st of April and 31st of May with a daily minimum temperature below 0 °C
Annual and seasonal precipitation	The sum of annual and seasonal precipitation is calculated from daily precipitation sums. It contains liquid as well as solid precipitation (rain and snow). The seasonal precipitation sums are based on the meteorological calendar, i.e. spring precipitation covers February, March and May, summer precipitation sums up months June, July, August, autumn precipitation is calculated from September, October, and November values, and winter precipitation sums up the months November, December and January.
Precipitation > 20 mm/day	Number of days per year with daily precipitation (rain and snow) higher than 20 mm
Dry days	Number of days per year with daily precipitation (rain and snow) lower than 1 mm
Wet days	Number of days per year with daily precipitation (rain and snow) of at least 1 mm
95th percentile of precipitation	Value of total daily precipitation that is exceeded on five percent of all wet days per year
99th percentile of precipitation	Value of total daily precipitation that is exceeded on one percent of all wet days per year
Wind speed	Mean annual wind speed in m/s
Climatic water balance	Difference between annual precipitation and annual evaporation in mm/day
Sultriness days	Number of days per year with daily values of vapor pressure greater than 18.8 hPa. The vapor pressure is calculated based on daily values of the near-surface air temperature and the relative humidity using the Magnus Formula.

Background information

Data sources for the information on observed climate

Information on present day and past climate are based on data from the HOM-START database of the Austrian Zentralanstalt für Meteorologie und Geodynamik (ZAMG). Daily values of minimum and maximum temperature as well as daily mean precipitation were used for the stations Graz-University and Irdning-Gumpenstein (https://www.zamg.ac.at/cms/de/klima/klimaforschung/datensaetze/hom-start). Mean daily temperature was derived from daily minimum and maximum temperature observations.

Data sources for the climate projections

The projected climate changes presented in this Regional Climate Fact Sheet are based on regional climate projections, which are presented in the framework of the EURO-COREX initiative (http://www.euro-cordex.net) as well as on regional climate projections provided by the ReKliEs-DE project, funded by the German Ministry of Research and Education (http://reklies.hlnug.de). The climate projections in this fact sheet are based on the Representative Concentration Pathways (RCPs), of which the RCP8.5 represents a “business-as-usual” scenario, RCP4.5 a “medium” scenario, and RCP2.6 a “climate protection” scenario. 55 climate projections were obtained in August 2018 from the ESGF data portal via the data node at the German Climate Computing Centre (https://esgf-data.dkrz.de). Of these, 16 simulations for the "climate protection" scenario (RCP2.6), 15 simulations for the "medium" (RCP4.5) and 24 simulations for the “business-as-usual” (RCP8.5) emission scenarios are available. The table below provides an overview of the regional climate models and their respective global forcing data. The EURO-CORDEX simulations are available on a grid with a spatial horizontal resolution of 12 km x 12 km. The climate change signals for the different variables presented in this regional climate fact sheet are calculated as the mean value for all grid cells located in this region.

business-as-usual scenario (RCP8.5)	
driving GCM and realization	RCM
CanESM2,r1i1p1	CCLM4-8-17
CanESM2,r1i1p1	REMO2015
EC-EARTH,r12i1p1	CCLM4-8-17
EC-EARTH,r12i1p1	REMO2015
EC-EARTH,r12i1p1	RACMO22E
EC-EARTH,r12i1p1	RCA4
EC-EARTH,r1i1p1	RACMO22E
EC-EARTH,r1i1p1	WRF361H
EC-EARTH,r3i1p1	HIRHAM5
HadGEM2,r1i1p1	CCLM4-8-17
HadGEM2,r1i1p1	RACMO22E
HadGEM2,r1i1p1	RCA4
HadGEM2,r1i1p1	REMO2015
HadGEM2,r1i1p1	WRF361H
IPSL-CM5A-MR,r1i1p1	WRF331F
IPSL-CM5A-MR,r1i1p1	RCA4
MPI-ESM-LR,r1i1p1	CCLM4-8-17
MPI-ESM-LR,r1i1p1	REMO2009
MPI-ESM-LR,r1i1p1	RCA4
MPI-ESM-LR,r1i1p1	WRF361H
MPI-ESM-LR,r2i1p1	REMO2009
MIROC5,r1i1p1	CCLM4-8-17
MIROC5,r1i1p1	REMO2015
NorESM1,r1i1p1	HIRHAM5

mean scenario (RCP4.5)	
driving GCM and realization	RCM
EC-EARTH,r12i1p1	CCLM4-8-17
EC-EARTH,r12i1p1	RCA4
EC-EARTH,r12i1p1	RACMO22E
EC-EARTH,r1i1p1	RACMO22E
EC-EARTH,r3i1p1	HIRHAM5
HadGEM2,r1i1p1	CCLM4-8-17
HadGEM2,r1i1p1	RACMO22E
HadGEM2,r1i1p1	RCA4
IPSL-CM5A-MR,r1i1p1	WRF331F
MPI-ESM-LR,r1i1p1	CCLM4-8-17
MPI-ESM-LR,r1i1p1	REMO2009
MPI-ESM-LR,r1i1p1	RCA4
MPI-ESM-LR,r2i1p1	REMO2009
NorESM1,r1i1p1	HIRHAM5
IPSL-CM5A-MR,r1i1p1	RCA4

climate protection scenario (RCP2.6)	
driving GCM and realization	RCM
EC-EARTH,r12i1p1	CCLM4-8-17
EC-EARTH,r12i1p1	RCA4
EC-EARTH,r12i1p1	REMO2015
EC-EARTH,r12i1p1	RACMO22E
EC-EARTH,r3i1p1	HIRHAM5
GFDL-ESM2G,r1i1p1	REMO2015
HadGEM2,r1i1p1	RACMO22E
HadGEM2,r1i1p1	REMO2015
HadGEM2,r1i1p1	RCA4
IPSL-CM5A-LR,r1i1p1	REMO2015
MIROC5,r1i1p1	REMO2015
MPI-ESM-LR,r1i1p1	REMO2009
MPI-ESM-LR,r1i1p1	CCLM4-8-17
MPI-ESM-LR,r1i1p1	RCA4
MPI-ESM-LR,r1i1p1	WRF361H
MPI-ESM-LR,r2i1p1	REMO2009

Disclaimer: This Regional Climate Fact Sheet was developed in the frame of the project LIFE LOCAL ADAPT – Integration of climate change adaptation into the work of local authorities. This project received funding from the European Union under project number LIFE15 CCA/DE/000133. The content provided in this fact sheet and the underlying data correspond to the current state of knowledge. All data have been carefully prepared and checked by the Climate Service Center Germany (GERICS). However, GERICS has only carried out part of the regional climate projections itself. All climate projections not carried out by GERICS were obtained from the publicly accessible ESGF data archive. GERICS does not take over guarantee for the topicality, correctness, completeness or quality of the provided information. GERICS also assumes no liability for decisions and their consequences, which are based on the use of this Regional Climate Fact Sheet.