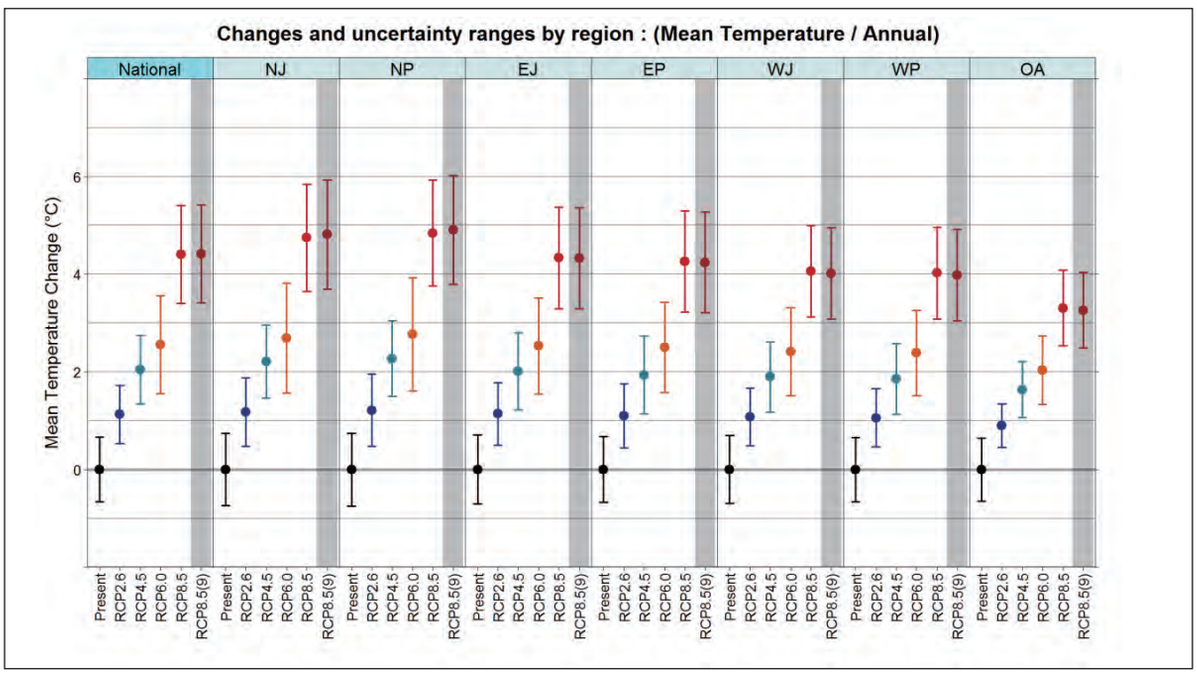
Results of Projections on the Climate in Japan at the end of 21st Century

Projections of annual mean temperature

- The annual mean temperature is projected to increase nationwide. (It is projected to rise by 0.5 - 1.7℃ under the RCP2.6 scenario and by 0.5 - 1.7℃ under the RCP2.6 scenario and by 3.4 - 5.4℃ under the RCP8.5 scenario as national averages)
- The temperature increase at higher latitudes seems to be larger than that at lower latitudes.

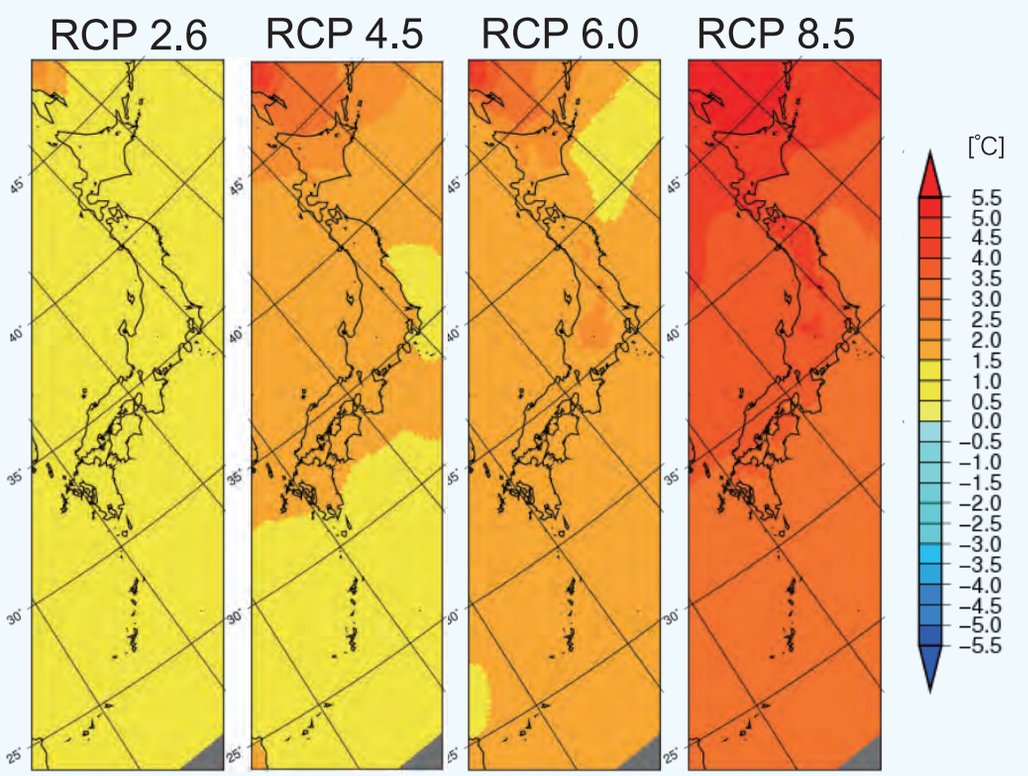


In this graph, the circular marks (points) in the middle of the vertical lines indicate the average values of plural cases and the solid lines indicate the range of uncertainties, including interannual fluctuations. "Present" on the horizontal axis indicates the present climate, and RCP2.6 - RCP8.5 indicate the results of each RCP scenario at the end of the 21st century, and show the range of uncertainties based on the results of the three cases. Although the ranges of uncertainty based on the results of nine cases under the RCP8.5 scenario are also shown here for reference, it should be noted that these values cannot be compared with the values of other scenarios.

(℃)	National	NJ	NP	EJ	EP	WJ	WP	OA
RCP2.6	1.1 (0.5 ~ 1.7)	1.2 (0.5 ~ 1.9)	1.2 (0.5 ~ 2.0)	1.1 (0.5 ~ 1.8)	1.1 (0.4 ~ 1.8)	1.1 (0.5 ~ 1.7)	1.1 (0.5 ~ 1.7)	0.9 (0.4 ~ 1.3)
RCP4.5	2.0 (1.3 ~ 2.7)	2.2 (1.5 ~ 3.0)	2.3 (1.5 ~ 3.0)	2.0 (1.2 ~ 2.8)	1.9 (1.1 ~ 2.7)	1.9 (1.2 ~ 2.6)	1.9 (1.1 ~ 2.6)	1.6 (1.1 ~ 2.2)
RCP6.0	2.6 (1.6 ~ 3.6)	2.7 (1.6 ~ 3.8)	2.8 (1.6 ~ 3.9)	2.5 (1.5 ~ 3.5)	2.5 (1.6 ~ 3.4)	2.4 (1.5 ~ 3.3)	2.4 (1.5 ~ 3.3)	2.0 (1.3 ~ 2.7)
RCP8.5	4.4 (3.4 ~ 5.4)	4.7 (3.6 ~ 5.8)	4.8 (3.8 ~ 5.9)	4.3 (3.3 ~ 5.4)	4.3 (3.2 ~ 5.3)	4.1 (3.1 ~ 5.0)	4.0 (3.1 ~ 5.0)	3.3 (2.5 ~ 4.1)
RCP8.5(9)	4.4 (3.4 ~ 5.4)	4.8 (3.7 ~ 5.9)	4.9 (3.8 ~ 6.0)	4.3 (3.3 ~ 5.4)	4.2 (3.2 ~ 5.3)	4.0 (3.1 ~ 4.9)	4.0 (3.0 ~ 4.9)	3.3 (2.5 ~ 4.0)
(Major city)	-	Sapporo	Kushiro	Niigata	Tokyo	Fukuoka	Osaka	Naha
Climatic normal	-	8.9	6.2	13.9	15.4	17.0	16.9	23.1

Figures in this table indicate average values of three cases (YS[4]) under each scenario with the range of uncertainties in parentheses (For the case of RCP8.5 alone, however, both the average value and the range of uncertainties of all nine cases are described). The climate normal (annual average for 1981-2010) for the major city in each region is also shown for reference..

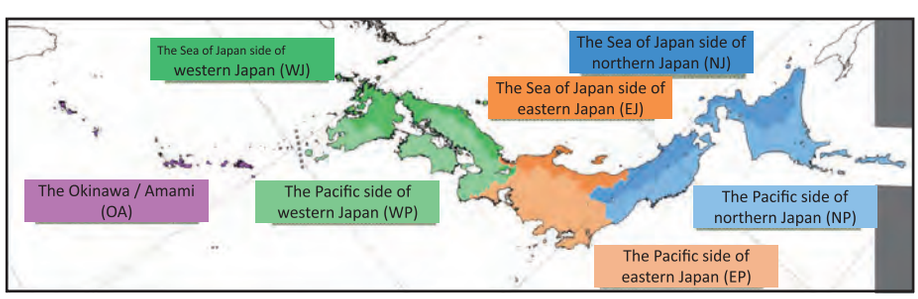
4----- One of the three types of cumulus convection parameterization (for details, see p.21)



Distribution of future changes in annual mean temperature (SST1[5] /YS case alone is shown for each scenario)[6]

Regional Division

Some of the projections in this publication are shown as calculation results for each of the seven regions shown in the Japanese map below (i.e. Sea of Japan side of northern Japan (NJ); Pacific side of northern Japan (NP); Sea of Japan side of eastern Japan (EJ); Pacific side of eastern Japan (EP); Sea of Japan side of western Japan (WJ); Pacific side of western Japan (WP); and Okinawa/Amami (OA)). The climatic characteristics and administrative boundaries of Japan are taken into account. Future changes are mainly discussed as either averages or accumulated values for each region, which are not representative values for any specific location.



Regional divisions for analyses of projected data

Source: Japan Meteorological Agency (2013), "Global Warming Projection Volume 8"

(Note) Although IPCC AR5 illustrates the calculation results based on a large number of climate models, the calculation results in this publication are based on one specific model. Therefore, even if this publication indicates, for example, "An increase of 0.5 - 1.7℃ under the RCP2.6 scenario" (see p.4), it should be noted that the entire range of temperature increases under the RCP2.6 scenario shown in AR5 is not covered.

(Note) Although we illustrate in Tables/Charts annual average values (average values for the period 1981-2010) in a certain representative major city of each region for reference, it is not possible for us to simply compare the regional average value derived from the present climate based on model calculations, with the annual average value obtained from actual observations at a specific location. Furthermore, although we give values here for a representative major city in each region, the value indicated for that city is by no means a representative value of the climate of the entire region to which the city belongs. (This applies to other examples of cities cited as reference in Tables/Charts for other indications.)

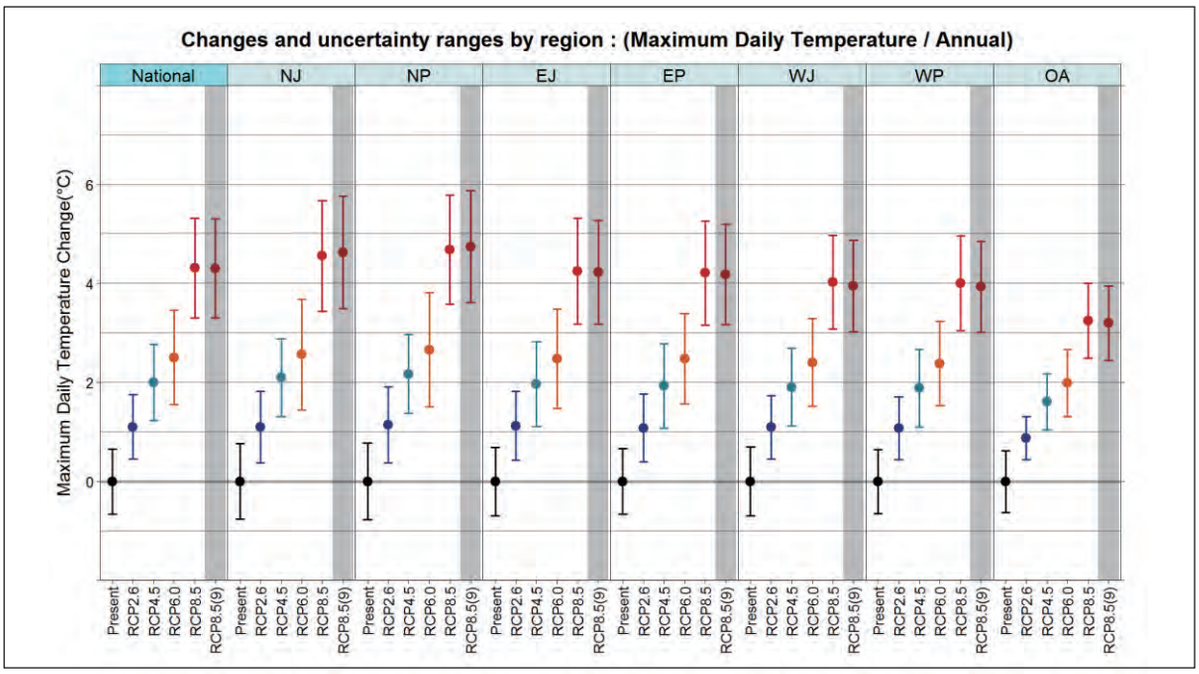
5----- One of the three patterns of the future sea surface temperatures (for details, see p.20)

6----- It should be noted that the distribution maps of future changes shown in this publication are merely an element of the projection results and its purpose is for us to roughly understand differences in the tendencies of regional changes. (This also applies to other similar Tables/Charts for other indications.)

Projections of daily maximum temperature and daily minimum temperature

- Daily maximum temperature and daily minimum temperature are projected to increase nationwide.
- The increase of daily minimum temperature will be slightly larger than that of daily maximum temperature.

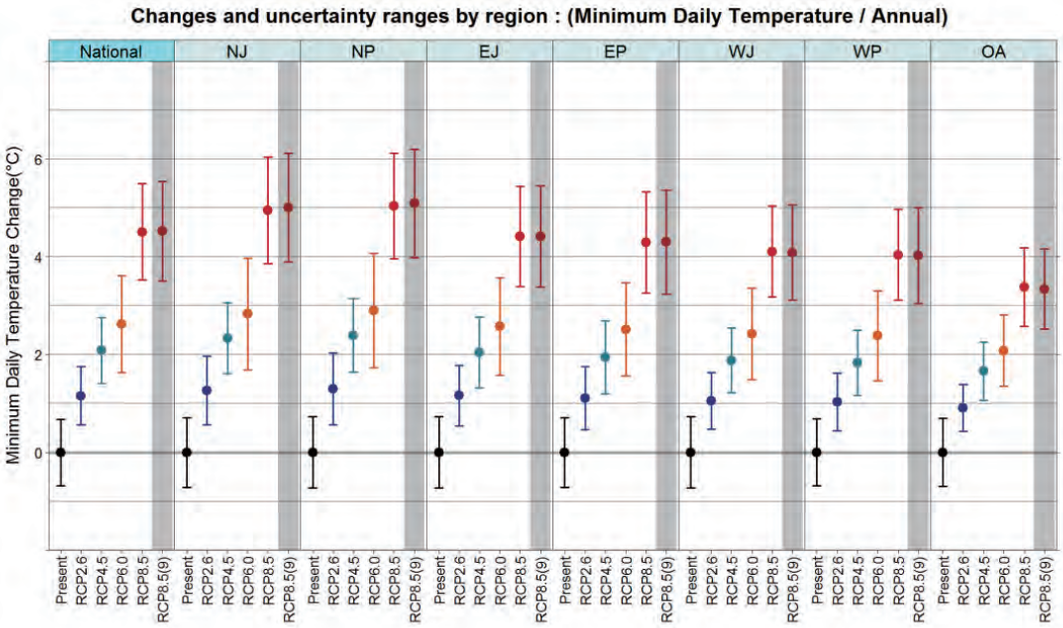
  (Under the RCP8.5 scenario, the daily maximum temperature is projected to rise by 3.3 - 5.3℃, and the daily minimum temperature by 3.5 - 5.5℃.)
  (national average, annual average)



In this graph, the circular marks (points) in the middle of the vertical lines indicate the average values of plural cases and solid lines indicate the range of uncertainties, including interannual fluctuations. "Present" on the horizontal axis indicates the present climate, and RCP2.6 - RCP8.5 indicate the results of each scenario of RCP at the end of the 21st century, and show the range of uncertainties based on the results of the three cases. Although the ranges of uncertainty based on the results of nine cases under the RCP8.5 scenario are also shown here for reference, it should be noted that these values cannot be compared to the values of other scenarios. (This also applies to the Chart of the daily lowest temperature.)

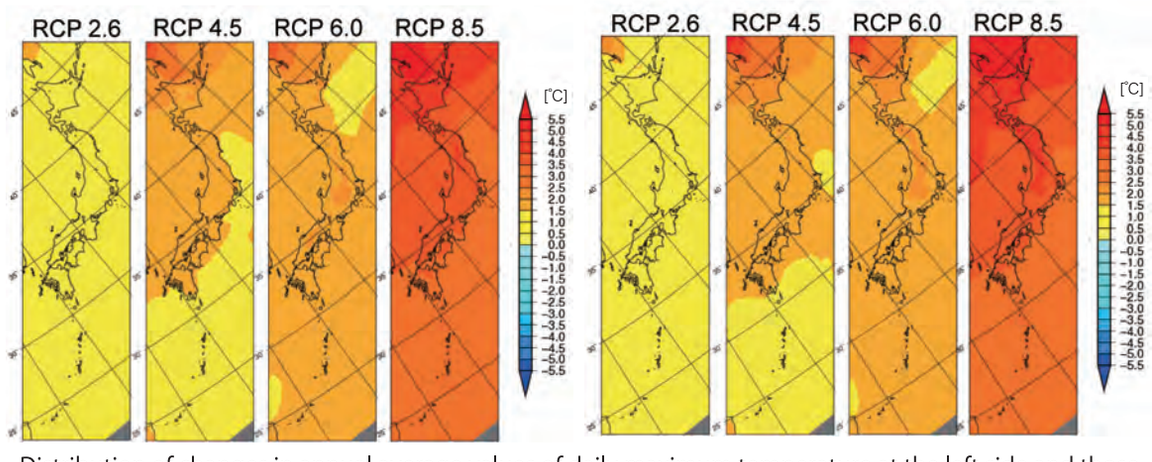
(℃)	National	NJ	NP	EJ	EP	WJ	WP	OA
RCP2.6	1.1 (0.5 ~ 1.8)	1.1 (0.4 ~ 1.8)	1.1 (0.4 ~ 1.9)	1.1 (0.4 ~ 1.8)	1.1 (0.4 ~ 1.8)	1.1 (0.5 ~ 1.7)	1.1 (0.4 ~ 1.7)	0.9 (0.4 ~ 1.3)
RCP4.5	2.0 (1.2 ~ 2.8)	2.1 (1.3 ~ 2.9)	2.2 (1.4 ~ 3.0)	2.0 (1.1 ~ 2.8)	1.9 (1.1 ~ 2.8)	1.9 (1.1 ~ 2.7)	1.9 (1.1 ~ 2.7)	1.6 (1.0 ~ 2.2)
RCP6.0	2.5 (1.6 ~ 3.5)	2.6 (1.4 ~ 3.7)	2.7 (1.5 ~ 3.8)	2.5 (1.5 ~ 3.5)	2.5 (1.6 ~ 3.4)	2.4 (1.5 ~ 3.3)	2.4 (1.5 ~ 3.2)	2.0 (1.3 ~ 2.7)
RCP8.5	4.3 (3.3 ~ 5.3)	4.6 (3.4 ~ 5.7)	4.7 (3.6 ~ 5.8)	4.2 (3.2 ~ 5.3)	4.2 (3.2 ~ 5.3)	4.0 (3.1 ~ 5.0)	4.0 (3.0 ~ 5.0)	3.2 (2.5 ~ 4.0)
RCP8.5(9)	4.3 (3.3 ~ 5.3)	4.6 (3.5 ~ 5.8)	4.7 (3.6 ~ 5.9)	4.2 (3.2 ~ 5.3)	4.2 (3.2 ~ 5.2)	4.0 (3.0 ~ 4.9)	3.9 (3.0 ~ 4.8)	3.2 (2.4 ~ 4.0)
(Major city)	-	Sapporo	Kushiro	Niigata	Tokyo	Fukuoka	Osaka	Naha
Climatic normal	-	12.9	10.2	17.6	19.8	20.9	21.1	25.7

Figures in this table indicate the average values of three cases (YS) under each scenario with the range of uncertainties in parentheses (For the case of RCP8.5 alone, however, both the average value and the range of uncertainties of all nine cases are described). The climatic normal (annual average for the period 1981-2010) for the major city in each region is also shown for reference.



(°C)	National	NJ	NP	EJ	EP	WJ	WP	OA
RCP2.6	1.2 (0.6 ~ 1.8)	1.3 (0.6 ~ 2.0)	1.3 (0.6 ~ 2.0)	1.2 (0.5 ~ 1.8)	1.1 (0.5 ~ 1.8)	1.1 (0.5 ~ 1.6)	1.0 (0.4 ~ 1.6)	0.9 (0.4 ~ 1.4)
RCP4.5	2.1 (1.4 ~ 2.8)	2.3 (1.6 ~ 3.1)	2.4 (1.6 ~ 3.1)	2.0 (1.3 ~ 2.8)	1.9 (1.2 ~ 2.7)	1.9 (1.2 ~ 2.5)	1.8 (1.2 ~ 2.5)	1.7 (1.1 ~ 2.3)
RCP6.0	2.6 (1.6 ~ 3.6)	2.8 (1.7 ~ 4.0)	2.9 (1.7 ~ 4.1)	2.6 (1.6 ~ 3.6)	2.5 (1.6 ~ 3.5)	2.4 (1.5 ~ 3.4)	2.4 (1.5 ~ 3.3)	2.1 (1.4 ~ 2.8)
RCP8.5	4.5 (3.5 ~ 5.5)	5.0 (3.9 ~ 6.0)	5.0 (4.0 ~ 6.1)	4.4 (3.4 ~ 5.4)	4.3 (3.3 ~ 5.3)	4.1 (3.2 ~ 5.0)	4.0 (3.1 ~ 5.0)	3.4 (2.6 ~ 4.2)
RCP8.5(9)	4.5 (3.5 ~ 5.5)	5.0 (3.9 ~ 6.1)	5.1 (4.0 ~ 6.2)	4.4 (3.4 ~ 5.5)	4.3 (3.2 ~ 5.4)	4.1 (3.1 ~ 5.1)	4.0 (3.0 ~ 5.0)	3.3 (2.5 ~ 4.2)
(Major city)	-	Sapporo	Kushiro	Niigata	Tokyo	Fukuoka	Osaka	Naha
Climatic normal	-	5.3	2.3	10.6	13.2	13.6	13.3	20.8

Figures in this Table indicate the average values of three cases (YS) under each scenario with the range of uncertainties in parentheses (For the case of RCP8.5 alone, however, both the average value and the range of uncertainties of all nine cases are described). The climatic normal (annual average for the period 1981-2010) for the major city in each region is also shown for reference.



Distribution of changes in annual average values of daily maximum temperature at the left side and those of the daily minimum temperature at the right side (SST1/YS case alone is shown for each scenario)