

# *Climate in Japan at the end of 21st Century*

Climate change projections considering the uncertainties

- Results of Projections on the Climate in Japan at the end of 21st Century
  - Specifications of Climate Change Projection Calculations
    - Consideration of Uncertainty in this Projection
      - Reproducibility of Present Climate
  - Instructions on Using the Products of this Projection
- Outline
- Summary

# Outline

## Climate projection for the national adaptation plan in Japan

In November 2014, the Synthesis Report of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) was published. The summary report (SPM : Summary for Policymakers) points out the following.

- The evidence for warming of the climate system is unequivocal. Since the 1950s, there have been many observations of unprecedented changes.
- Continued emissions of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive, and irreversible impacts on people and ecosystems.
- Substantial reductions of emissions over the next few decades may contribute to climate-resilient pathways for sustainable development.

Also in our country, an agreement was also reached on a national policy to proceed by around the summer of 2015 with the task of drawing up the “Adaptation Plan,” which summarizes approaches to be undertaken by the government for comprehensive and systematic adaptations to climate change.

Consequently, the Ministry of the Environment and the Japan Meteorological Agency projected the future climate change for Japan, taking into account associated uncertainties with a view to providing information related to climate change projections, on which to base assessments of the impacts of climate change. This publication summarizes the results of the climate projection.

## Multiple projections are performed and associated uncertainties are estimated.

In this projection, using climate models, we projected the future climate around Japan (2080-2100; hereafter referred to as “future climate”) and compared the results with simulated present climate (1984-2004; hereafter referred to as “present climate”).

To project the future climate, we performed calculations based on four greenhouse gases (GHG) emission scenarios, namely, RCP2.6, RCP4.5, RCP6.0, and RCP8.5, which correspond to the levels of concentration of GHG (for RCP (Representative Concentration Pathways) scenarios, see p.23). When performing model simulations, we set up different conditions and calculated nine cases for the RCP8.5 scenario and three cases for the remaining three scenarios. Consequently, calculations for 18 cases were conducted in total (for details, see p.19).

The results of the projection are summarized for the following items.

- Changes in temperature (annual mean temperature, maximum daily temperature, minimum daily temperature, number of hot days, and number of frost days<sup>1</sup> ).
- Changes in precipitation (annual precipitation, intense precipitation, number of dry days<sup>2</sup> ).
- Changes in snow depth and snowfall (annual maximum snow depth and annual snowfall).

In this publication we divide Japan into seven regions for convenience, and show results for whole Japan as well as for each region (for details, see p.5), in order to examine not only the situation of Japan but also differences among regions.

Furthermore, for mean temperature, maximum daily temperature, minimum daily temperature, and annual precipitation, we performed a statistical analysis on a range of uncertainties, using the results for all 18 cases (for details, see p.24-27).

1----- In this publication, “hot day” is defined as a day on which the daily maximum temperature rises not less than 30°C, and “frost day” is defined as a day on which the daily maximum temperature does not rise above 0°C.

2----- “The number of dry days” means the number of days on which the amount of precipitation is less than 1.0 mm.

## Temperature, precipitation, snow depth, and snowfall at the end of this century are projected.

The features of future climate change compared to the present climate were summarized. An outline of changes in terms of national averages is shown below.

### Changes in temperature (for details, see p.4-11)

The annual mean temperature is projected to rise 0.5°C - 1.7°C by the end of this century under the RCP2.6 scenario in which “strict countermeasures are taken against global warming,” and by 3.4°C - 5.4°C under the RCP8.5 scenario in which “no stricter countermeasures than current situation are taken against global warming.”<sup>3</sup> The maximum daily temperature and the minimum daily temperature are also projected to rise, and the increase in the minimum daily temperature tends to be slightly larger. According to the geographical distribution of temperature changes, change in northern Japan tends to be larger than those in other regions.

The number of hot days is projected to increase, especially in western Japan. The number of frost days is projected to decrease, especially in northern Japan. The changing tendency is more evident in the case of the scenario where “no stricter countermeasures than current situation are taken against global warming.”

### Changes in precipitation (for details, see p.12-15)

With respect to future changes in the amount of annual precipitation, no scenario clearly shows whether the tendency is in the direction of increase or in the direction of decrease, and the magnitude of uncertainty is large. In many projections the average value increases, but the range of uncertainties shows the future changes extends to both increasing and decreasing sides.

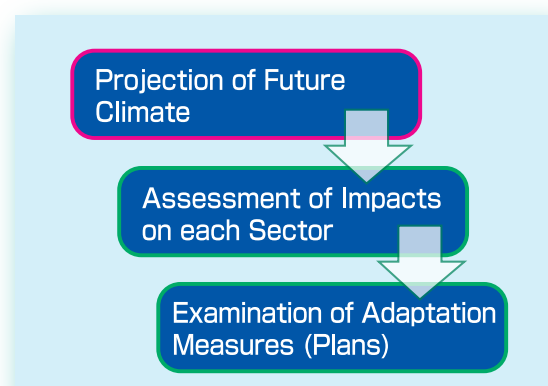
Intence precipitation and the number of dry days are both projected to increase under many scenarios and cases. The changing trend is more evident in the case of the scenario in which “no stricter countermeasures than current situation are taken against global warming.”

### Changes in snow depth and snowfall (for details, see p.16-17)

Both annual maximum snow depth and annual amount of snowfall are projected to decrease under most of the scenarios. The decreasing tendency in the Sea of Japan side of eastern Japan is projected to become particularly large. The changing trend is more evident in the case of the scenario in which “no stricter countermeasures than current situation are taken against global warming.”

## Results of the projection will be used for impact assessments and examination of adaptation measures.

The results of the projection will be used as materials for educational measures against future climate change. At the same time, they will also provide basic information for us to comprehend various impacts caused by climate change (such as impacts on the agricultural sector, health hazards due to higher temperatures, and flooding and slope failures due to heavy rains). Based on the results of an impact assessment on each sector, the “Adaptation Plan” is to be drawn up, which is expected to promote actual climate change adaptation measures.



Flow to the point for examining adaptation measures

<sup>3</sup>----- The projected value (magnitude of change) represents the average value of the difference in temperatures for each of the scenarios between the future climate (annual mean temperature during the period of 2080-2100) and the present climate (annual mean temperature during the period of 1984-2004). This also indicates the range of projections, but it should be noted that this does not represent the entire range of uncertainties considered in AR5.