

## 1.4 Impacts of Climate Change

- The IPCC Third Assessment Report concludes that most of the warming observed over the last 50 years is attributable to human activities.
- The impacts of climate change have already begun to appear around the world, including Japan. The IPCC Report shows that the risks associated with climate change will increase with higher temperatures and that if temperatures rise about two degrees Celsius over the next 100 years, the distribution of negative impacts will begin to extend to most regions of the world.
- The level of impacts will vary depending on the country or region. The risk of adverse effects will increase as the rate and scale of temperature changes increase.
- In recent years, extreme weather events are occurring frequently around the world. There is a concern that climate change could result in more frequent and more severe extreme weather events, with increasing damage.

### <Significance of Sharing Scientific Background Knowledge>

- Precise and impartial scientific background knowledge is required in order to address climate change. Also, in promoting measures to cope with climate change, it is also important to ensure that this scientific background knowledge is shared at both the local and global levels.
- It is especially important to share scientific background knowledge about causal links between anthropogenic GHG emissions and impacts on human and ecosystems due to temperature rise and climate change, and about the levels of these impacts. When such knowledge becomes available, the issue of acceptable levels of impacts becomes more a matter of economy and policy, etc., than of science alone, and should be regarded as a matter for decisions to be made by human society.

### <Observed Phenomena and Impacts of Climate Change >

- Impacts of climate change have already appeared. Regarding their causes, the IPCC Third Assessment Report concludes that "there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."
- Temperature increases have been observed in various parts of the world. Over the 20<sup>th</sup> century, the average global temperature rose by  $0.6 \pm 0.2$  degrees Celsius, and it is likely that the 1990s was

the warmest decade of the millennium. The IPCC Report summarizes the changes that have already been observed (see Table 1.1).

Table 1.1 Changes Observed in Recent Years

Indicator	Observed changes
Global mean surface temperature	Increased by 0.6 over the 20th century
Global mean sea level	Increased by 10-20centimeters over the 20th century
Hot days/heat index	Increased (likely)
Cold/frost days	Decreased for nearly all land areas
Heavy precipitation events	Increased at mid-and high northern latitude (likely)
Drought	Increased frequency in some regions
Glaciers	Widespread retreat
Snow cover	Decreased in area by 10% (since the1960s)
Weather-related economic losses	Ten-fold increase (over the last 40years)

Source: IPCC Third Assessment Report (2001)

- Phenomena that seem to be impacts of climate change have also been observed in Japan, such as the following:
  - *Prunus yedoensis* (cherry trees) now start blossoming [on average] five days earlier than they did 50 years ago.
  - The distribution of alpine plants has decreased and the distribution of forested area has increased in Hokkaido, the northernmost island of Japan.
  - Inland distribution of broad-leaved evergreen trees such as *Quercus myrsinifolia* (Japanese white oak) has increased.
  - The distribution areas of butterflies, moths, dragonflies, and cicadas have moved north as they disappear from the southern limits of distribution.
  - *Papilio Memnon* (a butterfly), whose northern limit of distribution used to be the islands of Kyushu and Shikoku, were first observed in Mie Prefecture on Honshu Island in the 1990s.
  - *Cyrtophora moluccensis* (a tent spider) that were formerly observed only in western Japan in the 1970s appeared in Tokyo and vicinity in the 1980s.
  - *Anser albifrons* (white-fronted goose) extended its wintering sites to Hokkaido.
  - Tropical fish species have appeared in Osaka Bay.

Source: “Global Warming and Japan – Estimated Effects on Nature and People”  
(Harasawa and Nishioka, eds. 2003)

### <Estimated Future Impacts of Climate Change>

- Various possible adverse effects are predicted in the future (see Table 1.2).

Table-1.2 Various Projected Impacts of Climate Change

Subject	Projected Impacts
Global mean surface temperature	Increased by 1.4-5.8°C from 1990 to 2100
Global mean sea level	Increased by 9-88cm from 1990 to 2100
Impacts on weather events	Increase of flood and drought
Impacts on human health	Increase of heat stress and infectious diseases such as malaria
Impacts on ecosystem	Extinction of some animal and plant species, migration of ecosystem
Impacts on agriculture	Decrease of grain harvest at many regions, temporary increases in some regions
Impacts on water resources	Change in supply and demand balance, adverse effects on water quality
Impacts on market	Large economic loss especially in developing countries which rely on primary products

Source: IPCC Third Assessment Report (2001)

- Possible adverse effects predicted in Japan include a one-meter sea level rise, which will lead to the loss of more than 90 percent of its beaches. Also tidal wetlands where migratory birds feed will disappear.
  - Increased temperature may lead to fluctuations in rainfall, affecting watersheds.
  - The potential malaria distribution area may expand to include western Japan.
  - Increased incidence of heat stroke due to heat waves.

Source: Harasawa and Nishioka, eds. 2003

### <The Relationship between Temperature Rise and Impact Risks>

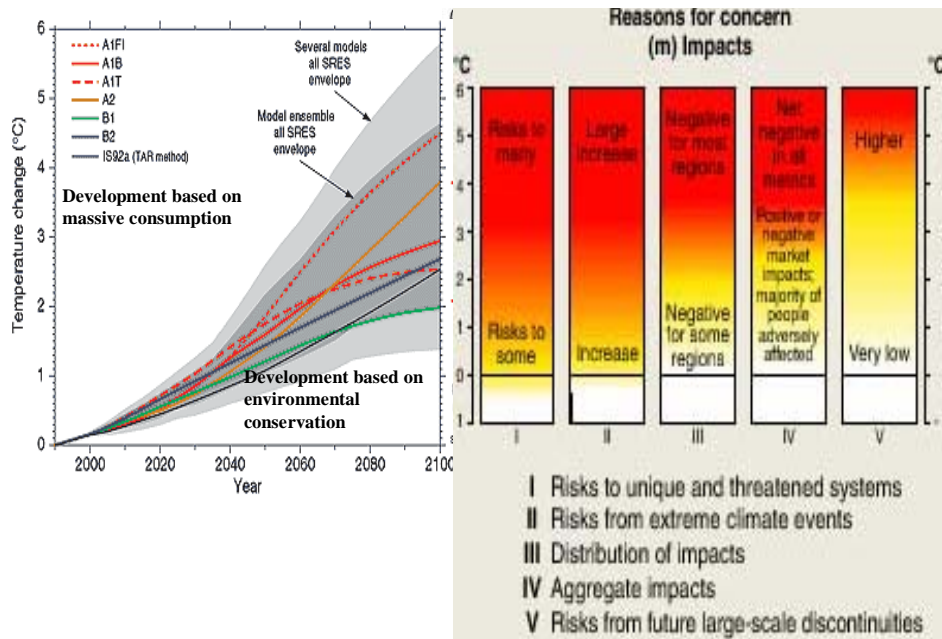
- The IPCC Third Assessment Report looks at how the scale of temperature increases will affect the level of risks for five factors and in accordance with various future socio-economic development scenarios (see Figure 1.7). This two-part Figure shows that a small increase in temperature may bring about climate change that could have positive impacts on some regions and in some areas of concern, but that the risks of climate change will increase with greater temperature increases. If

temperature rises two degrees Celsius over the next 100 years, the distribution of negative impacts will begin to extend to most regions of the world.

### <Regional Differences in Impact Occurrence >

- The levels of impacts are not the same around the world, but vary according to country or region. Levels of damage to humans and ecosystems also vary according to levels of preparedness vis a vis these impacts. Impacts are thought to be particularly serious in developing countries in tropical and subtropical zones, due to geographical factors that make them vulnerable to climate change impacts as well as their inability to sufficiently prepare for such impacts.

Figure 1.7 Relationship between Temperature Rise and its Impacts and Risks

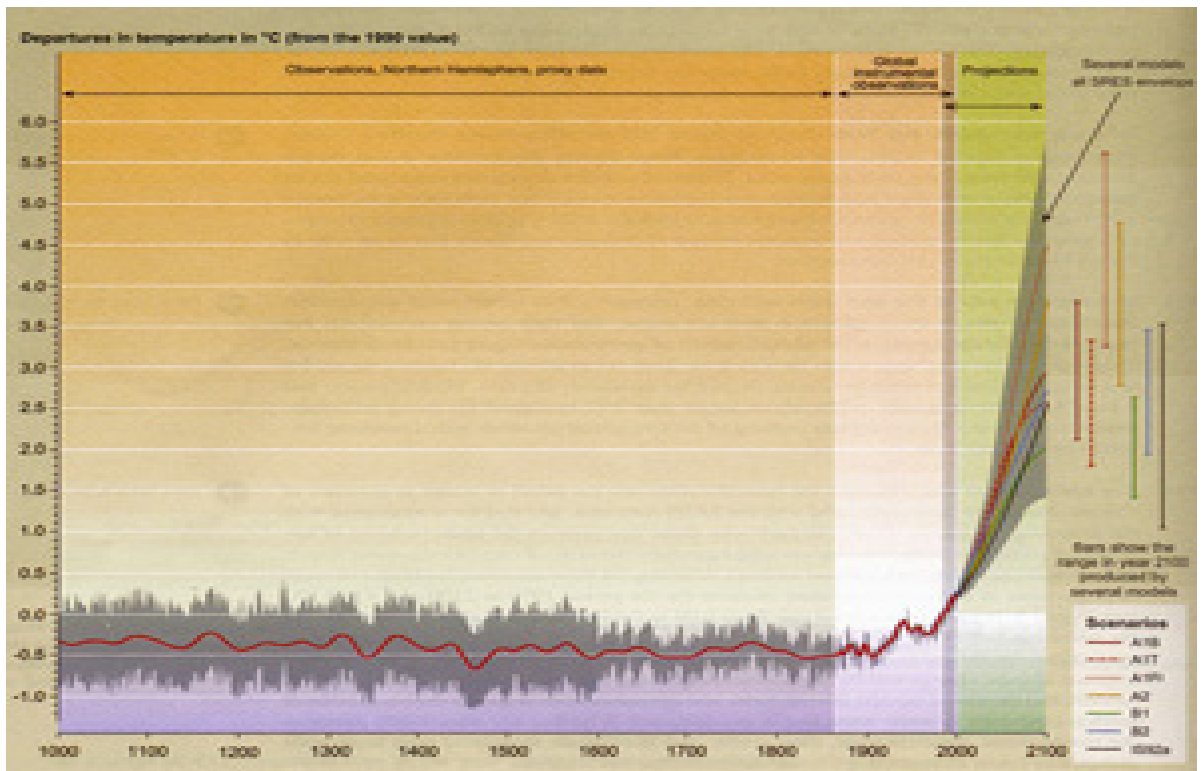


Source: IPCC Third Assessment Report (2001)

### <Rate of Change and Impact Levels>

- In addition to the level of temperature change, the rate of change is also important in considering impacts on ecosystems and on agriculture. According to the temperature rise predicted by models, although there are some variations depending on the models and scenarios used, it is clear that every model predicts a temperature rise that is drastic compared to the last 1000 years (see Figure 1.8).

Figure 1.8 Prediction of Drastic Temperature Change



Source: IPCC Third Assessment Report (2001)

<Extreme Weather Events and Climate Change Impacts>

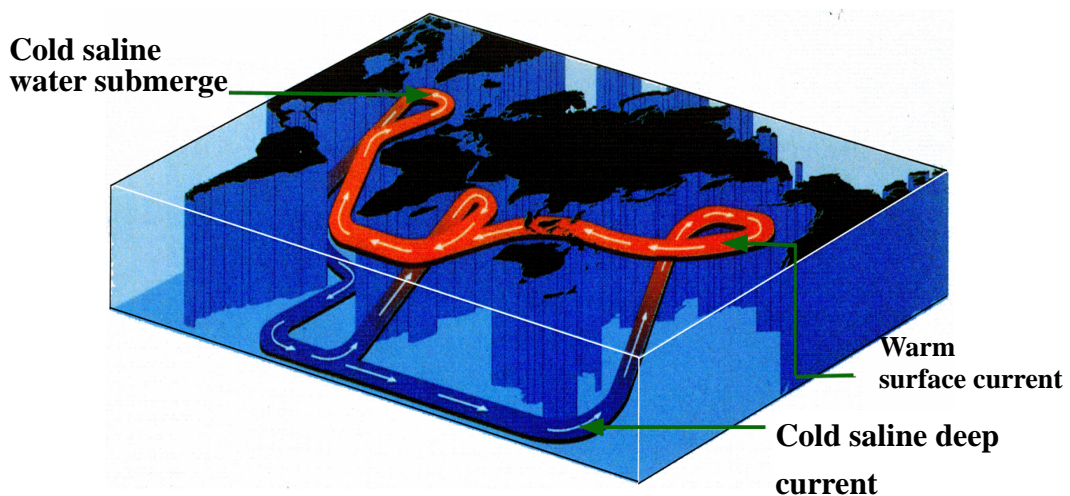
- According to the IPCC Third Assessment Report, climate change will not only have medium and long-term impacts, but may also cause increased frequency and intensity of extreme weather events.
- In particular, much concern has been expressed recently that the frequent extreme weather events now happening around the world, such as drought and abnormally high temperatures, might be part of climate change. It is necessary to compile and analyze observation data that may have a bearing on future extreme weather events around the world in order to enhance scientific knowledge of climate change impacts.
- Scientific study on the impacts of climate change has so far focused on predictions of average global impacts. It is expected, however, that extreme weather events that are unpredictable using conventional methods based on past weather data will frequently occur as impacts of climate change in various parts of the world. It is therefore necessary from now on to undertake further

studies of the occurrence of the extreme weather events that are accompanying climate change and their regional impacts, in addition to the global impacts of climate change.

### <Probability of Catastrophic Events>

- While catastrophic events are estimated to be unlikely during the 21<sup>st</sup> century, there is some concern regarding the following possibilities: rapid climate change due to rapid emissions of GHG being held in the marine and terrestrial biosphere; significant rise of sea level due to melting of the Antarctic and Greenland ice sheets (4-6 meter rise in case of irreversible collapse of the Western Antarctic Ice Sheet); and a colder Europe due to the collapse of the global ocean circulation system. For example, the ocean circulation system circulates every 2000 years, maintaining climate with its vast heat capacity. Figure 1.9 shows the possibility of Europe becoming colder due to changes in the speed and direction of the Gulf Stream (a warm current) triggered by climate change.

Figure 1.9 Example of Catastrophic Event Caused by Extreme climate change (Collapse of the oceanic circulation system)



- Although catastrophic events are estimated to be unlikely during the 21<sup>st</sup> century, rapid climate change could increase the probability of such events occurring.