Thoughts on Climate Problems

and

Introduction of a New Japan-Republic of South Africa Bilateral Project

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Climate change and climate variation

A Google search for “global warming” produces about thirty million entries. Not a day goes by without some mention of global warming in the media. Books casting doubt on claims of human beings’ involvement in global warming are piled high in the corners of bookshops. There are misunderstandings at all levels in the information that floods our society, and these appear to be amplifying the issues of contention.

One of these misunderstandings is the tendency to confuse “climate variation” with “climate change”. Climate variation refers to a situation in which, due to various internal factors, climate fluctuates significantly around the normal state from seasons to decades. A period of thirty years is often used to define the normal state by averaging. On the other hand, climate change refers to a situation in which this normal state changes over a longer period of time. This often results from some external impact on the atmospheric and oceanic system that spawns natural climate variation.

Importance of terminology

The intensely hot summer of 2004 and the heavy snows of the winter of 2005/6 are still fresh in our memory. Since intense heat and heavy snows are included among day-to-day meteorological phenomena, there will be cooler days in the heat of summer, and rays of sunshine amid the heavy snows. If these natural variations differ significantly from normal years over the season as a whole, they could justifiably be called climate variation. Concentrations of carbon dioxide, one of the “greenhouse gases” responsible for global warming, have been increasing unabated since the industrial revolution; the relationship between this and the rise in earth surface temperatures in recent years has

become a major focal point as a problem of global warming. Since this is thought to be caused by human activity outside the atmospheric and oceanic system, it is a problem of climate change. The earth's rotational orbit and the tilt of the earth's axis fluctuate on a timescale of tens of thousands of years or more. These cause ice ages and interglacial periods due to changes in the sunlight radiation shed on the earth, and as such, these could also be described as climate change.

Given this interpretation, it is somewhat embarrassing that, in Japanese, the IPCC is translated as the "Intergovernmental Panel on Climate Variation" and the UNFCC as the "United Nations Framework Convention on Climate Variation". In fact, of course, they should have been translated literally as "Intergovernmental Panel on Climate Change" and "United Nations Framework Convention on Climate Change", as they are in English. Again, "global warming projection" is often translated in Japanese as "global warming prediction", but the word "prediction" invites misunderstanding that the initial value problem can be explained in the manner of a weather forecast. Since this is a future projection with a high degree of uncertainty, depending partly on scenarios such as socio-economic policies, it should more correctly be translated as "global warming projection". In fact, IPCC reports make very careful distinctions between the terms "variation" and "change", "prediction" and "projection".

Limitations of models used for the IPCC report

This distinction between the concepts of "variation" and "change" is by no means limited to the realm of semantics. It causes serious discrepancies when considering application measures for local communities. It is climate variation, not climate change, that is directly related to the abnormal weather and extreme phenomena which impact our socio-economic conditions. Climate change is change in the background state which gives birth to climate variation.

It is extremely important that we understand the above graded structure. Let me give a specific example. A phenomenon called the Pacific-Japan pattern (PJ pattern) brings summer to Japan and East Asia. From around April, the sun reaches a high elevation near Indonesia, stimulating convection activity there. Warm air rises, and then falls near the Philippines. The resultant fine weather

over waters near the Philippines causes seawater temperatures to rise significantly there. Then, in around July, the center of convection activity moves to this warmed sea region. The region of falling warm air moves northwards in tandem, until the region near Japan is covered with the Bonin (Ogasawara) high, ushering in the summer. This is called the atmospheric PJ pattern by the late Professor T. Nitta of Tokyo University. El Niño is a phenomenon that interrupts this seasonal progression and causes cool summer in Japan. When this phenomenon occurs, the warm seawater near the Philippines moves towards the region ranging from the eastern Pacific to the International Date Line, making strong convection less likely to occur. The Bonin (Ogasawara) high that brings summer to Japan is not reinforced, either. On the other hand, it has become clear that, if the Indian Ocean Dipole Mode phenomenon occurs in the Indian Ocean, convection becomes active over the region ranging from northern India to near the Philippines. In that case, temperatures in Japan are extremely high. Models to predict climate variation first need to resolve those rich climate phenomena.

The IPCC report discusses the global climate tens of years or a hundred years hence, using models of climate change based on greenhouse gas emission scenarios. While scientifically tricky problems such as the treatment of clouds still remain, I think there is no major error in this approach, insofar as it concerns average imaging for the planet as a whole. However, it would be dangerous to discuss the impact on local communities using the results of the models used for the IPCC report. This is due to serious problems with the reproducibility of climate variation in those models.

For more appropriate application measures

Of course, the outlook is not all pessimistic. This is because, though somewhat hidden behind more prominent IPCC topics, initiatives aimed at predicting climate variation, rather than projecting climate change, have been progressing rapidly of late in professional climate science community. We are now at the level whereby the occurrence of El Niño can be predicted one or two years in advance. This is all due to rapid growth in wide-area planetary observation using satellites and buoys, the enhancement of scientific knowledge, and advances in techniques for assimilating observed data into

models and making seasonal predictions. Predicting the likelihood of droughts, floods, abnormally high or low temperatures, etc., between several months and one year in advance will make a direct contribution to socio-economic activities. Measures aimed at protecting the global environment should be promoted in parallel with this prediction of specific climate variation and application measures based on it. Systems in developing countries are particularly vulnerable to flooding, drought, and other calamities. If we can cooperate, based on predicted data, in preventing or mitigating disasters as well as promoting infrastructure development and capacity building, we should be able to encourage an understanding of measures to cherish the environment in those countries as well. I believe that this objective was recently spelled out at the 3rd World Climate Conference (WCC-3) held in Geneva in 2009.

A new project for climate research applications

We have started a new project supported by Japan Science and Technology Agency (JST) and Japan International Cooperation Agency (JICA) to develop application studies based on prediction of climate variation in the Southern African region. The title of the project is "**Prediction of Climate Variations and its Application in the Southern African Region."** Since production systems in the Southern Africa are highly dependent on nature, they are extremely vulnerable to risks due to climate variations. This project aims to clarify mechanisms of long-term modulation as well as generation of climate modes such as the Subtropical Dipole Mode that influences the climate in the Southern Africa, and thus contributes to sustainable development of the society in the region. By analyzing prediction data together with in situ validation data, we will not only deepen our understanding of predictability of climate variations but also improve parameterization schemes for cloud and precipitation processes to reduce climate model biases. I believe that those efforts will also contribute to deeper understanding of the unique evolution of our habitable aqua-planet.

This essay is assembled on the basis of my writings to provide a theoretical background to the aforementioned bilateral project of Japan and Republic of South Africa.