Global Environmental Change (Introduction to Global Warming)

［Course Contents and Teaching Tips］

・1st session : Guidance / Professor Kenji KAI

This course is “Introduction to Global Warming”. I will lecture on the subject “How will global warming influence the environment in the near future?”, from the fields of science, engineering, agriculture, humanities, and so on. Specifically, I will cover the following topics: the mechanisms of global warming, its influence on changes of natural environment and industries, and prediction and measures/outlook regarding the environment in the near future. In the first class, as an orientation, I will explain the following things: Course aims/Contents/Evaluation/Textbooks/Reference books/Any other notes

・2nd session : Mechanisms of global warming / Professor Hiroshi KANZAWA

First of all, in this course, I will briefly introduce the observational evidence regarding global warming. I will then explain the mechanisms of global warming and of temperature rise from near the ground by increases in the greenhouse gas in the atmosphere, using a simple earth model of a layer of atmosphere with suitable transmittance and the ground, regarding solar radiation (short wave radiation; electromagnetic waves of mainly visible range, ultraviolet region and near infrared) and earth radiation (long wave radiation; electromagnetic waves of mainly mid infrared and far infrared). I will also refer to vapor feedback and cloud feedback.

・3rd session : Greenhouse gases and aerosols / Associate Professor Kazuo OSADA

In this course you will learn about greenhouse gasses and aerosol particles, which suppress warming. What kind of substances are these? Where do they come from? What is their concentration in the atmosphere? What are the variable factors of the concentration? What is the artificial influence on concentration? I will explain the variable factors of the material components involving the warming using data such as the following.

cf) http://www.data.kishou.go.jp/obs-env/ghghp/20gases.html

http://www.data.kishou.go.jp/obs-env/aerosolhp/index.html

・4th session : Paleoclimate(Climates of the past) / Professor Takeshi NAKATSUKA

Climate change can occur due to vibration inside a climate system like air-sea interaction, or natural external forces such as a change of solar activity or volcanic eruptions. To understand the causes of global warming accurately, therefore, we must analyze the relationship with the changes of external force including greenhouse gas, highlighting the true state of the long-term and short-term climate changes in the distant past, before man had a big influence on the climate, using a variety of the paleoclimatic proxies (tree ring dating or lake bottom deposits, etc).

In this course, I will show the latest results regarding paleoclimate for about the last 1000 years, and discuss the mechanism of the changes.

・ 5th session : Reconstruction of the past climate and prediction of the future climate / Associate Professor Kengo SUDO

Climate change is influenced not only by heating by increasing greenhouse gasses like CO2, but also by cooling by the direct and indirect effects of aerosols, land use change, changes in sea ice and snow ice or natural changes (e.g. eruption). We will understand the role of these factors in climate change, and use a numeric model displaying the earth's climate to predict climate change in the future.

In this course I will introduce an outline of the climate model and explain the influences on climate change in the past, focusing on each artificial factor. I will then outline the current conditions of climate change prediction.

・6th session : Climatic change of precipitation / Professor Kenji NAKAMURA

Precipitation is one of the major components of the Earth climate system. Precipitation has also a big impact as a major fresh water resource to the ecosystem and human activity. Thus, understanding and prediction of the change of the precipitation under the current global climate change is very important.

Almost all the climate models show increase of global precipitation basically due to the saturated water vapor pressure increase. Increase of extreme events is also reported. Observational studies also support at least partly the model results. Precipitation has, however, large spatiotemporal variation, and the reliability of the results is crucial. In the lecture, model and observational results will be introduced including current

observation technology.

・7th session : Climatic change of the oceans / Professor Takeshi NAKATSUKA

Global warming has caused a variety of influences on the physical environment and bioenvironment in the sea, as well as rapidly raising the sea level. Warming in the polar regions slows the sea's vertical circulation down and lowers the rate of the absorption of greenhouse gas or oxygen particles in the deep levels of the sea, and prevents deep water containing a lot of salt from rising to the surface, thus decreasing the amount of productions from phytoplankton.

In this course I will lecture on the influence of global warming on the sea, introducing the Sea of Okhotsk and the Oyashio current, which are remarkable for the influence of global warming.

・8th session : Climatic change of glaciers / Associate Professor Koji FUJITA

70 percent of the fresh water on the earth exists as ice. 99% of this ice is comprised of the ice sheets of the Antarctic and Greenland; the remainder is around the world as glaciers and ice caps. Although glaciers account for less than 1%, it is estimated that they account for nearly half the seawater increase because they melt earlier than ice sheets.

In this course I will introduce the recent tendencies of glacier change and research on estimating glacier response to climate change, as well as introducing the methods for estimating and observing glacier change.

・9th session : Impact to vegetation / Associate Professor Tomoomi KUMAGAI

The rise of CO2 concentration can heighten photosynthetic ability, and warming may enhance plant productivity in particular areas. However, rising photosynthetic ability requires more water and nutrition, and the high temperatures and dryness that comes with warming can cause movement and collapse of vegetation. Vegetation is important as a place for the exchange of solar energy, and also plays an important role in air circulation and climate formation. Thus the vegetation changed by warming will, in its turn, cause further climate change.

In this course I will lecture on the complex relationship between this type of vegetation, warming, and climate change.

・10th session : Impacts on agriculture / Professor Tsugihiro WATANABE

What and how is climate change impacts due to global warming on agriculture? The IPCC reports in its Fourth Assessment Report (2007) that there would be "direct impacts" of changed climate conditions including temperature or precipitation, and "indirect impacts", which are caused by changes of hydrological regime in each region, or number and population of hazardous insects that damage crops. The appearance and extent of these impacts depend on location on the earth, or socio-economy conditions of agricultural production. Using the outcomes of an integrated research on paddy rice production in humid regions, and crop farming in semi-arid regions, in this course the impacts of climate change on agricultural production are summarized and projected future problem and necessary adaptive measure are overviewed.

・11th session : Impact to water resources / Professor Makoto TANIGUCHI

Hydro-environmental changes due to global warming and changes of water demand with social change caused by increase and concentration in population or globalization renders the water balance on earth unstable. It is important for the assessment of impact on water resources by warming and human activities to grasp the change of inland water storage by using GLACE satellites with the climate model.

In this course I will lecture on how the change of water resources due to warming impacts society.

・12th session : Architecture harmonized with the environment / Professor Masaya OKUMIYA

Final energy consumption has increased every year in Japan. Compared to 1990, civilian energy consumption has increased by about 40 percent, while energy consumption of industry has increased by just 1~2 percent. It is therefore an urgent issue that we optimize energy consumption in residences or buildings for business use as well as realizing eco construction and environments geared towards reducing CO2 emissions.

In this course, I will introduce energy-saving buildings (especially air-conditioning systems) from the four viewpoints below:

1. Concept of constructing eco house systems

2. Legal system and valuation methods regarding energy saving construction
3. Techniques for energy saving construction
4. Techniques for mechanical energy saving

・13th session : Downscaling simulations of global/urban warming **/ Associate Professor Satoru IIZUKA**

In recent years, downscaling simulations of global/urban warming have attracted much attention due to the rapid growth of computer resources. "Downscaling" indicates spatial refinement from larger scales to smaller scales.

In this lecture, we will discuss the latest downscaling simulation techniques from global to building scales (global/regional/urban/city-blocks/building scales), present and future projections of global/urban warming by downscaling simulations, and applications of downscaling information to mitigation and adaptation measures against global/urban warming.

・14th session : Climate policy and future perspective / Professor Tsuneo TAKEUCHI

Global warming countermeasures are called Climate Policy in international society. Thanks to the warnings of scientists, the policy makers realized that Climate Policy was important, and it became a new subject in the international community after the Cold War. Since then, a CO2-reduction goal has been introduced in each country or region. The method of reduction can be classified into three patterns: 1. Expanding nuclear power 2. Energy saving by public participation 3. Reforming energy supply systems and urban structures. Which is the most fundamental and continuous method? Is it impossible to reduce CO2 without nuclear power in Japan? Is it unnecessary to reduce CO2 if artificial CO2 emission is not the cause of warming?

・15th session : Summary / Professor Kenji KAI

I will review the basis and influence of, and measures of dealing with, warming. I will then discuss what will happen to the environment in the near future due to warming, viewed from the perspectives of science, engineering and sociology.