Special event for COP8 of the UNFCCC

Observation of Changes in Precipitation Patterns and Extreme Events Induced by Water Cycle Variations through Climate Change

Organized by the Delegation of Japan
Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT)

24 October 2002
18:00 - 20:00 p.m.
Hall G

Agenda

- Observation of changes in precipitation patterns and extreme events induced by water cycle variations through climate change
  WCRP's initiative and the start of the first-ever monitoring of global water cycle for improved prediction in October 2002

  -Prof. Toshio Koike, University of Tokyo, Lead Scientist of CEOP
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- The role of the Earth observation Satellites in the Observation of Rainfall

  -Dr. Riko Oki, National Space Development Agency of Japan
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  http://www.eorc.nasda.go.jp/TRMM/index_e.htm

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Observation of Changes in Precipitation Patterns and Extreme Events Induced by Water Cycle Variations through Climate Change

SUMMARY

Prof. Toshio Koike, University of Tokyo
Lead Scientist of the CEOP

The climate of the aqua planet earth is formed and controlled by the water and its circulation. The transport and distribution of large amount of water including its constant switching among its solid, liquid, and gaseous states is one of the most important features of Earth's climate. A little more than half of the solar radiation energy absorbed at Earth's surface is transformed into latent heat, which is released again in to the troposphere when water vapor condenses into clouds. Water vapor and clouds as well as carbon dioxide show a strong greenhouse effect and absorb Earth's infrared radiation very efficiently.

A basic element of the global water budget, and a crucial factor for life on land, is the exchange of water between the oceans of the continents. Although freshwater reservoirs hold hundreds of times less water than do the oceans, its recycling over land is quite efficient with its far shallower depths. The transpiration of water from vegetation plays a vital role in the recycling of water over the continents. The difference between precipitation over the continents and the amount of water transported from the oceans consists mostly of water that enters the atmosphere through evapotranspiration.

For many hundreds of years, humans' impact on the water cycle was insignificant and entirely of a local character. The situation has changed drastically during recent decades. In many parts of the world the unfavorable results of humans' activities including emission of greenhouse-gas and aerosol and change of land cover have now been discovered. The scientific evidence that humans are changing climate and the water cycle in increasingly compelling.

As atmospheric greenhouse-gas concentrations continue to rise, the global average of precipitation will increase and it's timing and regional patterns of precipitation will change. The snow storage season shortens and the ratio of rain to snow and the flood frequencies increase in mountainous and higher latitude areas. A result from the numerical experiments indicates that soil moisture decreases in summer, whereas it increases in winter over very extensive regions in middle to high latitudes of the Northern Hemisphere, On the other hand, simulated soil moisture decreases during much of a year in many semi-arid regions of the world. It is likely that the reduction in soil moisture results in the outward expansion of desert.

The IPCC concluded in 1996 that: "the flood related consequences of climate change may be as serious and widely distributed as the adverse impacts of droughts" and "there is more evidence now that flooding is likely to become a larger problem in many temperate regions". One of the potential soil moisture reduction in many semi-arid regions predicted by numerical models suggests greatly increased demand of water from many semi-arid regions of the world, where water is critically important for agriculture as well as other human activities. Humans add vulnerability to floods and droughts due to the climate change in addition to the population increase.

Many uncertainties still remain. There are significant limitations in the ability of climate models to incorporate and reproduce important aspects of the water cycle. Many fundamental hydrologic processes, such as the formation and distribution of cloud and precipitation, occur on a spatial scale smaller than most climate models are able to resolve. Substantial improvements in methods to downscale climate information on the global scale are needed to improve our understanding of regional and small-scale hydrological processes in conjunction with regional and global variation of the climate and the water cycle.

There is no physically consistent and comprehensive water cycle data set, which covers interactions among phenomena on local, regional, and global scales. By considering the launching schedule of new satellites, which are very useful for the global water cycle monitoring, the World Climate Research Programme (WCRP), the several national numerical weather prediction centers, and the Committee of Earth Observing Satellite (CEOS) space agencies proposed the Coordinate Enhanced Observing Period (CEOP) project for integrating two full year water cycle data sets under the framework of the Integrated Global Observing Strategy (IGOS) partnership.

Many science communities who are implementing field research work on the water cycle all over the world were organized under the framework of the WCRP, Global Energy and Water Cycle Experiment (GEWEX). At this moment, 36 research groups are joining and going to provide the observed data, which covers the global climate variability. All ground data will be submitted to US University Cooperation for Atmospheric Research (UCAR) and will be archived and transformed to unified formatted data sets.

In addition, the national meteorological bureaus and agencies will provide the special outputs of the numerical weather prediction models to the CEOP. At this moment, US National Center for Environment Prediction (NCEP), NASA Data Assimilation Office, UK Met Office, Indian Center for Medium Range Weather Forecast is joining the CEOP. They will provide the very high temporal resolution model outputs at each reference site and 2D and 3D regional and global products. Max-Plank Institute, Homburg, Germany, takes an important role as a model out put archiving center.

Space agencies have already launched the four new satellites, TRMM, Terra, ENVISAT, Aqua. One more satellite, ADEOS-II will be launched at the end of 2002. NASA Goddard Space Flight Center will provide global land 4DDA products by combining the observed data and modeling. The satellite data and the other all data will be archived by the efforts of the University of Tokyo and NASDA.

By integrating the CEOP data, we will be able to generate first-ever entire water cycle data sets, which cover the local-regional-global interactions. The CEOP integrated data sets will be open to the international community. Based on the CEOP data, we can address the regional climate physical processes, validate and improve operational numerical weather prediction models and climate ones, and develop a method for downscaling. CEOP is a first scientific challenge toward establishing an integrated global water cycle observation system and promoting a study on the water cycle variations in conjunction with the global climate change.

The role of the Earth observation Satellites in the Observation of Rainfall

Dr. Riko Oki, National Space Development Agency of Japan

The Earth's climate is formed by the water through its circulation. Since heating of atmosphere is mostly caused by the latent heat release by the phase change from water vapor to liquid water or ice, to observe the amount of rainfall corresponds to measurement of atmospheric heating indirectly. It is said that tropical rain/convective system is the heat engine of global atmospheric circulation, because two thirds of the world's rain falls in the tropics. The Tropical Rainfall Measuring (TRMM) Satellite was launched in 1997 as a joint Japan-U.S. project to detect the change of global atmospheric circulation and climate change including El Nino by observing the change of tropical rainfall distribution. The TRMM satellite carries out its mission in very good conditions and the satellite has achieved better results than expected over the past four years. Accurate and detailed rain distribution has been observed by the combination of precipitation radar and a microwave radiometer.

The Global Precipitation Measurement (GPM), a follow-on mission of TRMM, is currently being studied. The fundamental concept of this mission is to measure global precipitation including snow accurately and frequently (three hourly) by using a primary satellite that will carry a precipitation radar (DPR) and a constellation of multiple satellites that carry microwave radiometers which will be realized by international cooperation. It is expected that the measured data will contribute to research and monitoring of global warming and climate change by observing the change of global precipitation that follow the climate change.