

# Global Environmental Research Area

## Global System Changes

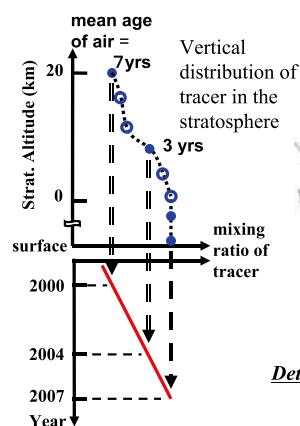
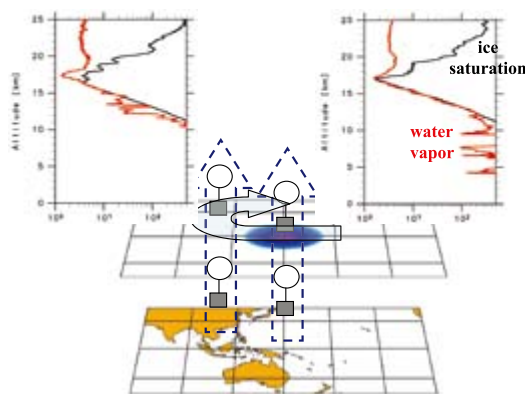
### Studies on Variability of Stratospheric Processes and Uncertainties in the Prediction of Future Change of Stratospheric Ozone (FY2007-2009)

Principal Investigator: **Takashi IMAMURA**, National Institute for Environmental Studies (NIES) <A-071>

NIES, Hokkaido University, Miyagi University of Education, The University of Tokyo

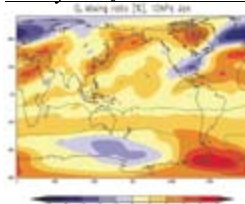
In this research project, the following investigation is being conducted: (i) detection of the variation of water vapor in the tropical tropopause region, (ii) determination of the mean age of stratospheric air over Japan, (iii) understanding the ability of our stratospheric chemistry-climate model to reproduce

past trend and to predict future change of the ozone layer, and (iv) understanding of the impact of solar activity change on ozone distribution. The results of these works are expected to provide scientific grounds when further countermeasures for ozone layer protection are considered.

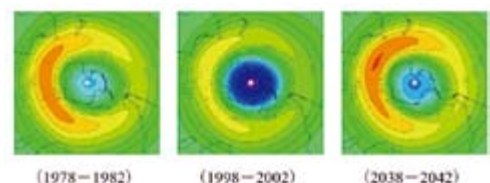


Detection of changing of water vapor and the age of air in the ozone layer  
Evaluation of uncertainty of the predicted change of the ozone layer

#### Impact of changing the solar activity on ozone distribution



#### Validation of stratospheric chemistry model future development of ozone hole



## Asian Precipitation-Highly-Resolved Observational Data Integration towards Evaluation of the Water Resources (APHRODITE's Water Resources)

(FY2006-2010)

Principal Investigator : **Akiyo YATAGAI**, Research Institute for Humanity and Nature (RIHN)

<B-062>

RIHN, Meteorological Research Institute

The recent high-resolution General Circulation Models (GCMs) have allowed us to improve our understanding of the regional impacts of global warming on water resources. However observational datasets to validate such GCMs have not been developed. We propose to develop state-of-the-art daily grid precipitation datasets based on long-term

rain-gauge observations over Asia, and to assess the performance of GCMs. Our project will also highlight the importance of orographically-enhanced precipitation to the water resources. The gridded precipitation products developed by this project are released from the following web-page.  
<http://www.chikyu.ac.jp/precip/>

## Upgrading of GHG Inventory and Evaluation of Reduction Measures in Waste Sector

(FY2007-2009)

Principal Investigator : **Masato YAMADA**, National Institute for Environmental Studies (NIES)

<B-071>

NIES, Ryukoku University, Osaka University

In order to achieve the reduction target on GHG emission in Japan, strategies for maximizing effects of several reduction measures should be considered. Moreover, it is important to promote the Clean Development Mechanism project in developing countries. Upgrading of the GHG inventory according to change in society and advancement in technol-

ogy is basic for these activities. In this study, we are upgrading emission factors for waste disposal activities, revising emission factors from the waste incineration and the wastewater handling, evaluating methane reduction technologies for the Asian landfill and applying the life cycle assessment to integrated evaluation of reduction measures.

## Research on the Feasibility to Estimate the GHG Emissions Reduction through Avoiding Deforestation

(FY2007-2009)

Principal Investigator : **Mitsuo MATSUMOTO**, Forestry and Forest Products Research Institute (FFPRI) <B-072>

FFPRI, Waseda University, The University of Tokyo

This study aims to examine the feasibility of REDD (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries) from both technical and socioeconomic viewpoints. So far, a total monitoring scheme of forest carbon stocks and changes was developed. It consists of combinations of satellite image analysis and estimation of carbon stocks density. A socio-economical model was devel-

oped as a method to settle reference levels for evaluation of emission reduction. Also the process of deforestation and forest degradation was analyzed, and incentive mechanisms were developed to distribute incentives to stakeholders. These results were provided for international discussion such as COP and SBSTA under the UNFCCC.

## Evaluation of the Effect of Global Warming on Soil Respiration of Japanese Forest Ecosystems

(FY2007-2009)

Principal Investigator: **Naishen LIANG**, National Institute for Environmental Studies (NIES) <B-073>

NIES, Hokkaido University, Shizuoka University, Hiroshima University

Most of the carbon cycle models apply the exponential functions to predict the future global heterotrophic respiration with a  $Q_{10}$  of 2.0 (ranging from 1.3 to 2.5). In their models, global heterotrophic respiration increases exponentially with temperature increase at a rate of  $6.2\% \pm 2.7\%$  per  $^{\circ}\text{C}$ , and resulting that the current carbon sink of terrestrial ecosystem will convert to a carbon source after

2050. Our ultimate objective is to evaluate the potential of carbon sink/source of whole Japanese forest soils under the climate change by using multi-approaches, including the soil warming experiment, open-top chamber facility, cross-country soil incubation and model simulation. Results are expected to improve the scientific basis of the post-Kyoto protocol as well as the IPCC 5th Assessment Report.

## Development of a Method for Evaluating CDM Activities in Asian Countries

(FY2007-2009)

Principal Investigator : **Eiichi ENDO**, National Institute of Advanced Industrial Science and Technology (AIST) <B-074>

AIST, University of Tsukuba

This study aims at developing a method to evaluate Clean Development Mechanism (CDM) activities in the next decades, focusing on investment in supply-side energy technologies in Asian countries, such as China and India. By combining energy system models of Japan and Asia and life cycle assess-

ment models, potential amount of CO<sub>2</sub> emission credit anticipated from those CDM activities will be discussed with their costs and benefits, in the light of the contribution of technology development to Japanese global environment policies.

## Research on the Global Forest Carbon Monitoring System

(FY2008-2010)

Principal Investigator : **Yoshiki YAMAGATA**, National Institute for Environmental Studies (NIES) <B-081>

NIES, Japan Aerospace Exploration Agency, Mitsubishi Research Institute, Inc., The University of Tokyo

The aim of this research project is to develop a system for mapping and monitoring of forest carbon stocks and of changes therein, through the synergetic use of in-situ networks and Earth Observation data. In particular, the project aims to assess the utility of using ALOS/PALSAR data to derive

information about the status of the forest cover mapping and for identification and spatial quantification of changes in the forest cover as a result of deforestation, forest degradation and regeneration. The project also contributes to GEOSS (Global Earth Observation System of Systems) task.

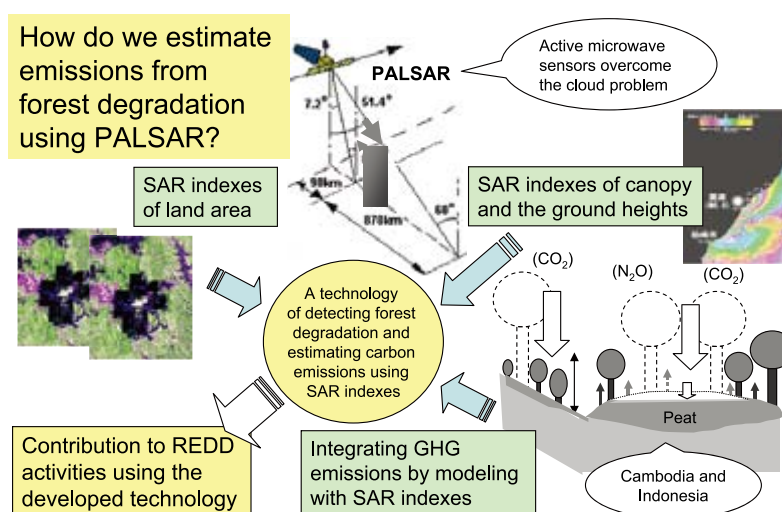
## Development of the Forest Degradation Index and the Carbon Emission Estimation Method Using PALSAR Data (FY2008-2010)

Principal Investigator : **Yoshiyuki KIYONO**, Forestry and Forest Products Research Institute (FFPRI) <B-082>

FFPRI, Gifu University, Japan Aerospace Exploration Agency, Hokkaido University

REDD (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries) has been drawing international attention in Post-Kyoto climate negotiations as a new mechanism to foster reduction of deforestation in those countries. PALSAR is an active microwave sensor in the Japanese satellite "ALOS" and expected to monitor tropical forest with overcoming the cloud problem.

Because feasibility of operational application of PALSAR data for detecting deforestation and degradation and estimating GHG emissions is still unclear, we will improve a technique using PALSAR and GHG modeling to give a new tool to monitor changes in GHG emissions in tropical forests including peat swamp forests.



## Investigation of Physical and Chemical Properties of Aerosol by Advance Technologies for Improvement of Prediction of Climate Change (FY2008-2010)

Principal Investigator : **Yutaka KONDO**, The University of Tokyo

<B-083>

The University of Tokyo, National Institute for Environmental Studies, Chiba University

This study is aimed to investigate impacts of aerosol on climate by combining observations using advanced technologies and climate models. Micro-physical processes of scattering and absorption of solar radiation by aerosol is to be fully understood by ground-based and aircraft observations of aerosol and radiation. Greatly updated knowledge on aerosol optical properties is included in climate pre-

diction models and estimation and prediction of aerosol radiative effects on global and Asian scales will be greatly improved. Changes in radiation, cloud cover, and precipitation is predicted by performing numerical experiments using improved models. These results will be included in the IPCC 5th Assessment Report.

## Experimental Study of Ocean Acidification Impact on Benthic Calcifies

(FY2008-2010)

Principal Investigator : **Yukihiro NOJIRI**, National Institute for Environmental Studies (NIES) <B-084>

NIES, Kyoto University, Fisheries Research Agency, Advanced Industrial Science and Technology, University of the Ryukyus

Ocean acidification has been started as the increasing atmospheric CO<sub>2</sub> dissolution into surface seawater. Its impact is expected to be serious for marine calcifies, because they produce carbonate shell or skeleton. In this study, a precise CO<sub>2</sub> con-

trolling system for culture of benthic calcifies has been developed and has been operated to experiment the near future impact of CO<sub>2</sub> increase on the coastal marine animals. Preliminary results for sea urchin, abalone and coral have been obtained.

## Adaptive Measures to Changes in Geomorphology and Water Resources on Atoll Island Countries

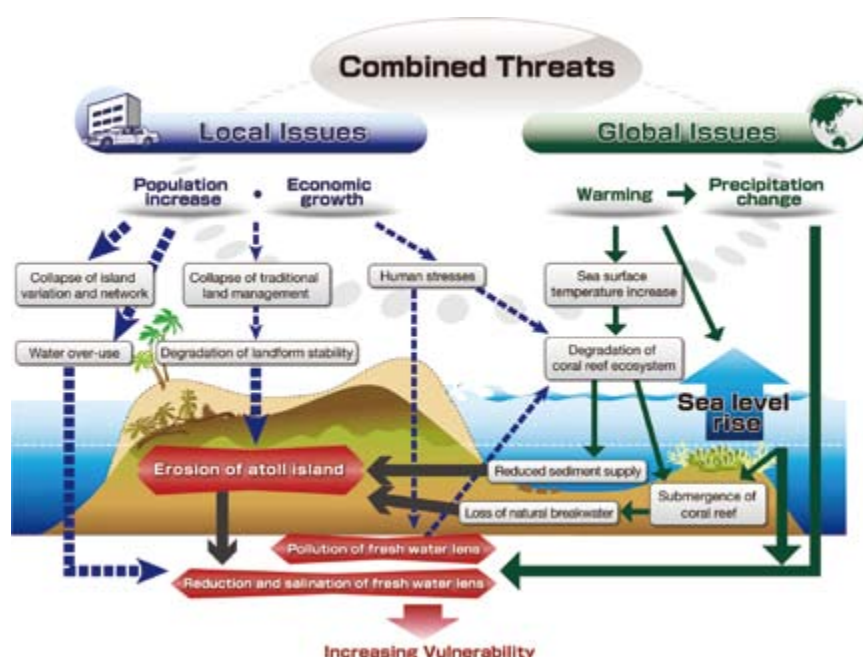
(FY2008-2010)

Principal Investigator : **Hiroya YAMANO**, National Institute for Environmental Studies (NIES) <Ba-085>

NIES, The University of Tokyo, Keio University, Ochanomizu University, Ibaraki University, Research Institute for Humanity and Nature

Small island countries established on coral atoll are vulnerable to climate change and sea-level rise caused by global warming. In this study, carrying capacity of the countries will be estimated by analyzing the history of geomorphic development, precipitation variability and human settlement. The vulnerability to climate change, sea-level rise and

changes in social structure will be assessed based on the changes in the carrying capacity. Based on these results, adaptive measures to both coastal erosion and degradation water resources in response to global warming will be proposed from the viewpoint of both scientific and social perspectives.



## Assessment of Combined Effects of Rising Temperature and Ozone Concentration on Rice Production and Quality, and its Application for Mitigation of Food Supply Risk in Asian Countries

(FY2008-2010)

Principal Investigator : **Yoshihisa KOHNO**, Central Research Institute of Electric Power Industry (CRIEPI) <Ba-086>

CRIEPI, National Institute for Environmental Studies, Center for Environmental Science in Saitama

Temperature rising accompanied by recent global warming may have potential to affect plant productivity through the increase in toxicity of tropospheric ozone. Rice plants are the most important crop for food supply in Asian countries. We will identify sensitivities of Asian rice varieties to combined effect of

temperature and ozone. Proteome and transcriptome analysis will be performed to identify stress-induced proteins and/or genes for developing a novel diagnostic tool. These activities will support to propose a sustainable and feasible adaptation for reducing a risk of Asian food security.

## Evaluating the Vulnerability of Agro-Environment in a Cold Region to Climate Change and Developing Adaptation Practices by Snow and Soil Frost Control

(FY2008-2010)

Principal Investigator : **Tomoyoshi HIROTA**, National Agricultural Research Center for Hokkaido Region (NARCH) <Ba-087>

NARCH, Hokkaido University

In eastern Hokkaido, one of Japan's primary arable farming regions, the depth of soil freezing in winter has decreased in recent years. To assess the impacts of such changes in soil frost depth on the global climate, i.e. greenhouse gas emissions, for the agricultural lands of northern Japan, emissions of nitrous oxide (N<sub>2</sub>O), which is a key of greenhouse gas, were measured for different soil frost depths from winter to early spring. Consequently, a positive correlation between soil frost depth and N<sub>2</sub>O emissions in early spring was found for agricultural

soils in Hokkaido. Therefore, recent shallow soil frost depths in winter may reduce N<sub>2</sub>O emissions in early spring. However, shallow soil frost depths adversely affect volunteer potatoes (or weed potatoes) by not killing unharvested potatoes, unlike deep soil freezing. We intend to develop new field management techniques utilizing soil frost depth control by managing snow cover both to reduce the impact on global warming and to protect to ensure sustainable crop production.