

## 気象談話会の記録（第 501 回以降）

### 第 501 回

Date: Friday, 19 June 2009, 15:00-17:00

Venue: Room No. 547, NIAES

#### **1) Ma. Carmelita R. Alberto (International Rice Research Institute)**

##### **“CO<sub>2</sub> and heat fluxes in rice fields: Comparative assessment of flooded and non-flooded fields in the Philippines”**

This paper reports the seasonal fluxes of heat, moisture and CO<sub>2</sub> under flooded and aerobic soil conditions during 2008 dry season. The fluxes were correlated with the microclimate prevalent in each location. This study was intended to monitor the environmental impact, in terms of carbon budget and heat exchange, of shifting from lowland rice production to aerobic rice cultivation as an alternative to maintain crop productivity under water scarcity.

#### **2) Ryuichi Hirata (Agro-Meteorology Division, NIAES)**

##### **“Carbon dioxide exchange at four grassland sites across Japan and influence of manure application on ecosystem carbon budget”**

GHGG-Japan (Green House Gases of Grassland in Japan) project has established a network of four flux tower sites of grassland in Japan which cover from warm temperate region to cool temperate region. Each site has two plots: one plot is managed applied chemical fertilizer and the other is managed applied organic manure fertilizer. Eddy covariance system has been installed at both plots in four grassland site. In this study, we investigate the effect of manure application on carbon balance of grassland by comparing the two different managed plots among four sites.

### 第 502 回

Date: 23 July 2009, 15:30-17:15

Venue: Room No. 547, NIAES

#### **Rebecca C. LAZA (International Rice Research Institute, JSPS Invitation Fellowship for Research at NIAES)**

##### **“High nighttime temperature: a hidden stress for rice crop”**

Global climate change will have profound effects on rice production and the livelihood of rice farmers. Rising air temperature or more frequent occurrence of extreme heat or drought brought about by shifts in weather patterns may increase crop yield losses. Minimum temperature increased about twice as maximum temperature over global land areas since 1950 (0.204 vs. 0.141 per decade). Earlier findings at IRRI showed that annual mean maximum temperature increased by 0.35°C and minimum temperature by 1.13°C and that rice grain yield declined by 10% for each 1°C increase in growing-season minimum temperature in the dry season. Using field growth chambers, preliminary field experiments were conducted in 2006-2007 wet and dry seasons to determine the effect of high night temperature on rice yield and the genotypic sensitivity to high night temperature. Total biomass was reduced by 5-15% in the wet and 3-21% in the dry season. Across seasons, the total number of spikelets per m<sup>2</sup> was reduced by high night temperature. Genotypic sensitivity to high night temperature was observed, i.e. the recently-developed variety IR72 was more tolerant to warmer night temperature than the old variety IR8. Percentage reduction in grain yield of IR8 ranged from 3-35% and that of IR72 from -4 to 12%. Field

chamber studies with controlled temperature confirmed previous results on the effect of high night temperature based on correlation analysis of historical data sets. Experiments are on-going to elucidate the yield reduction observed and to understand how physiological processes such as respiration and photosynthesis are affected by high night temperature.

#### 第 503 回

Date: Thursday, 20 August 2009, 15:30-17:15

Venue: Room No. 547, NIAES

##### **1) Chunwu Zhu (JSPS Fellow, Agro-Meteorology Division, NIAES)**

###### **“Effects of elevated CO<sub>2</sub> on photosynthetic acclimation and senescence of flag leaf in wheat and rice”**

Acclimation of photosynthesis under elevated CO<sub>2</sub> has been reported frequently, but its magnitude is species-dependent. In this paper, we study the mechanisms of photosynthetic acclimation of different crop flag leaf at different growth stage, and the relation between photosynthetic acclimation and senescence in wheat and rice. The senescence progress and different mechanisms of flag leaf in wheat and rice will also be discussed.

##### **2) Estela M. Pasuquin (International Rice Research Institute)**

###### **“Responses of Rice to Elevated Temperature under Climate Change”**

Atmospheric temperature is predicted to rise by 1-6 °C over the next century, with adverse consequences in rice productivity. Rice is the main source of food for half of the world's population; therefore continuous studies are needed to understand the basis for improvement of yield under the predicted temperature rise. This seminar will outline my proposed PhD study. This study will examine the responses of rice to elevated temperature and other climatic factors; irradiance and relative humidity, focusing on growth responses and accumulation and partitioning of dry matter. Some initial data will be presented.

#### 第 504 回

Date: Friday, 20 December 2009, 14:00-15:30

Venue: Room No. 153, NIAES

##### **Xiangming Xiao (Department of Botany and Microbiology, College of Atmospheric and Geographic Sciences, University of Oklahoma)**

###### **“Leaf chlorophyll, light use efficiency and gross primary production of vegetation”**

The terrestrial carbon cycle begins with plant photosynthesis that is composed of light absorption process by chlorophyll and carbon fixation process. Leaf and plant canopy can be divided into leaf chlorophyll content and non-photosynthetic vegetation (NPV), and accordingly, the fraction of photosynthetically active radiation (PAR) absorbed by the canopy is partitioned into the FPAR by chlorophyll (FPARchl) and FPARnpv, respectively. In this seminar, I will introduce the satellite-based Vegetation Photosynthesis Model (VPM) that is based on the conceptual partition of FPARcanopy into FPARchl and FPARnpv, and discuss evaluation of the VPM model across various CO<sub>2</sub> eddy flux tower sites from forests to grassland and croplands (C<sub>3</sub> and C<sub>4</sub> plants). I will also discuss maximum light use efficiency of C<sub>3</sub> and C<sub>4</sub> plants, and the needs and challenges for mapping C<sub>3</sub> and C<sub>4</sub> vegetation, the key issues in satellite-based modeling of gross primary production.

第505回

日時：2010年2月15日（月）15:00～16:30

場所：453号室

松永 壮（財団法人石油産業活性化センター）

「植物起源揮発性有機ガス(BVOC)と、その周辺の大気化学」

- 生物起源の有機ガス（生物起源揮発性有機化合物、BVOC）の重要性と近年の研究
- スギのセスキテルペン（BVOCの一つで比較的最近研究が始まった）放出
- 日焼け止め物質の放出とその将来展望

第 506 回

日時：2010年4月26日（月）15:30～17:00

場所：547号室

于 貴瑞（Yu Guirui、中国科学院地理科学及資源研究所）

「中国科学院地理科学及資源研究所の研究領域とその注目している三つの地域的な環境問題」

中国科学院地理科学及資源研究所の役割と研究領域を総括するうえで、特に当研究所が注目している三つの地域的な環境問題である、華北平原の食料生産と水資源、南方赤色土壌山地の総合利用と森林生態、チベット高原の生態系と気候変動について紹介し、共同研究の議題とアプローチについて意見交換を行いたい。

第 507 回

日時：2010年10月7日（木）10:00～12:00

場所：547会議室

1) 徐 炯鎬（Seo, Hyeong-Ho、農村振興庁温暖化対応農業研究センター）

“Strategy for Addressing Climate Change Agricultural Sector in the Korea”

The Korea National Institute of Meteorological Research reported that the mean temperature in Korea peninsula had risen by 1.5 °C during the past 100 years, exceeding the global warming trend announced by IPCC. If this trend would continue, the agriculture of Korea will be affected by climate change faster than those of other regions. A total of 62 climate change-related cases affecting the agriculture area had been observed. These impacts are categorized as follows: 1) moving north of cultivation sites; 2) increase of disease, insect, and weeds due to the change of wintering environment; 3) degradation of quality and production due to reduced breeding time and early fruiting; and 4) reduction in milk and disease incidence. The agriculture sector should develop adaptive measures to minimize the impact of climate change and should formulate strategies to mitigate greenhouse gases (N<sub>2</sub>O, CH<sub>4</sub>), realizing a low carbon green agriculture. The Rural Development Administration (RDA) of Korea plans to transform its agriculture R&D system focusing on addressing climate change and developing advanced agricultural technologies. Our basic direction is: 1) to support Korean greenhouse gas reduction initiatives through development and extension of low-carbon agricultural technologies; 2) to intensify studies to counter global warming in area such as new varieties, alternative crops, and energy-saving agricultural technologies; 3) to prevent damage caused by disease and insect pest, and calamities, and the

degradation of quality and production. To fully utilize technological opportunities, RDA plans to develop and disseminate low carbon agricultural technologies, research on new and renewable energy and bioenergy, develop new varieties adaptable to global warming conditions in the Korean peninsula, and explore alternative tropical crops such as mango and papaya. To minimize potential bad effects and risks, we will recalculate the suitable farming area, develop technologies to prevent or control disease, insect pest, and weeds and to mitigate disasters, and improve facilities for livestock rearing. Korea will be obliged to reduce greenhouse gas emission from 2013. If we can develop and apply low gas-producing agricultural technologies and carbon sink, we will be able to reduce greenhouse gases from agricultural sector by 0.6% annually until 2020, and minimize the bad effects of climate change.

## 2) 權 英淳 (Kwon, Youngsoon、農村振興庁温暖化対応農業研究センター)

### “Research Projects of Agricultural Research Center for Climate Change”

- 1) Prediction of dormancy release and cold hardiness in fruit trees using phenology model
- 2) Evaluation of agroclimatic zone in major crops Using Digital Climate Modeling
- 3) Estimation of cultivation limit zone of tropical crops by climate change scenario
- 4) Development of agricultural drought index using precipitation and evapotranspiration
- 5) Establishment of crop-Weather relationship experimental fields for evaluation influence of climate change on crops in Jeju island, Korea
- 6) CO<sub>2</sub> sink assessments for long-term monitoring in a mandarin orchard in Jeju, Korea

第 508 回

日時： 2010 年 11 月 2 日（火） 15:30～16:30

場所： 153 会議室

### Ma. Carmelita R. Alberto (International Rice Research Institute)

#### “Evapotranspiration and energy exchange in flooded and aerobic rice fields in the Philippines”

The seasonal and annual variability of surface energy components, evapotranspiration, crop coefficient, and crop water productivity were investigated under two different rice environments: flooded and aerobic soil conditions, using the eddy covariance technique during 2008-2009 cropping periods. This study was intended to monitor the environmental impact, in terms of evapotranspiration and energy exchange, of shifting from lowland rice production to aerobic rice cultivation as an alternative to maintain crop productivity under water scarcity. Average of four cropping seasons, the available energy ( $R_n - G$ ) was partitioned to  $82.5 \pm 3.3\%$  latent heat flux (LE) and  $11.6 \pm 2.2\%$  sensible heat flux (H) for the flooded rice field while it was  $76.6 \pm 1.1\%$  latent heat flux (LE) and  $18.3 \pm 0.7\%$  sensible heat flux (H) for the aerobic field. The aerobic rice fields had 53% more sensible heat flux while flooded rice fields had 11% more latent heat flux. Consequently, the aerobic rice fields had higher Bowen ratio ( $0.22 \pm 0.02$ ) than flooded fields ( $0.14 \pm 0.04$ ), indicating that a larger proportion of the available energy was used for sensible heat transfer or for warming the surrounding air. The aerobic rice field had lower average growing season evapotranspiration (ET) rates ( $3.68 \pm 0.26 \text{ mm d}^{-1}$ ) than the flooded field ( $4.12 \pm 0.20 \text{ mm d}^{-1}$ ). The ET rates in aerobic rice fields were influenced more by net radiation and bulk surface conductance ( $G_s$ ) while the flooded rice fields were primarily controlled by net radiation. The crop coefficient  $K_c$  ( $=ET/ET_o$  and  $ET_o$  is the reference ET) of aerobic fields ( $0.97 \pm 0.04$ ) was lower than that of flooded rice fields ( $1.09 \pm 0.07$ ). However the crop water productivity (WPET), defined as the grain yield per unit of water evapotranspired, of aerobic rice ( $0.40\text{-}0.48 \text{ g grain kg}^{-1} \text{ water}$ ) was lower than that of

flooded rice (0.93-1.54 g grain kg<sup>-1</sup> water). Even if the average growing season evapotranspiration rate of the aerobic rice fields was about 10% lower than that of the flooded fields, but the yield of the aerobic rice was much lower than that of the flooded rice, so, the WPET of aerobic fields was about 60% lower than that of the flooded rice fields. The concept of aerobic rice holds promise as a water-saving technology in the tropics if water productivity could be enhanced through the development of aerobic rice varieties that can achieve high yields per unit evapotranspiration. Likewise, to reduce sensible heat transfer that brings warmer aerobic rice environment, the amount and timing of irrigation input should also be optimized so as to prevent extreme dry soil conditions. The results of this investigation showed significant differences in energy budget between flooded and aerobic rice ecosystems. This information should also be taken into consideration in evaluating alternative water-saving technologies for environmentally sustainable rice production systems.

#### 第 509 回

日時： 2010 年 11 月 5 日（金） 10:00～12:00

場所： 547 会議室

##### 1) Daniel EPRON (ナンシー大学、INRA Champenoux 森林生理生態学研究室)

###### “Soil respiration and soil carbon allocation in Congo”

A better understanding of genetic and environmental control on carbon allocation is required for accurately predicted tree yield, especially in marginal area where plantations are thought to extent. In Congo, the wood production was twice higher in the most productive clone compared to the less productive one. This was due to a higher aboveground net primary productivity (NPP), the surplus being allocated to wood production. In addition, an increase in leaf lifespan reduced the amount of carbon allocated to leaf production. Similar conclusions can be drawn when comparing K<sup>+</sup> fertilised and control stand in Brazil where most of the surplus of aboveground NPP in fertilised plots was allocated to wood production and where leaf lifespan was also increased. Soil respiration increased with increasing NPP reflecting that more carbon is allocated belowground.

##### 2) 壇浦 正子(京都大学大学院農学研究科)

###### “Carbon allocation belowground in Pinus Pinaster using stable carbon isotope pulse labeling technique”

アフリカコンゴをはじめとする生態系での同位体研究(<sup>13</sup>C<sub>2</sub> ラベリング) を使った研究の紹介をしていただきます。具体的には同位体ラベリングを植物に行い土壌を含めた生態系の物質の流れを明らかにします。

#### 第 510 回

日時： 2011 年 5 月 26 日（木） 15 : 00～17 : 00

場所： 153 会議室

##### 和田龍一（帝京科学大学）、児玉直美（農業環境技術研究所 大気環境研究領域）

「中赤外半導体レーザー(QCL)の植物生理学への応用: 実験のセットアップと測定精度について」

「遺伝子組み換えユーカリを用いた、気孔と葉内の CO<sub>2</sub> 拡散抵抗の短期環境応答性の検証」

植物の葉での光合成の過程における大気から二酸化炭素の固定が起こる場所までの拡散の過程は植物の生産性や植生地の炭素循環に おける重要な律速要因である。従来までは、植物の葉

と大気間の拡散を制限する気孔が重要な要因であるとされ、気孔の開閉の環境応答について様々な知見が提案されてきた。1980年代から90年代にかけて葉の内部の拡散抵抗すなわち気孔からCO<sub>2</sub>の固定が起きている葉緑体までの拡散が、従来考えられたものよりも大きいという知見が蓄積され、その重要性が提唱されている。葉の内部のCO<sub>2</sub>拡散抵抗は主に従来までに3つの方法で推定されてきたが、安定同位体の手法が信頼性が高いことが証明されている。

従来の手法ではIRMS（安定同位体質量分析計）を用いてCO<sub>2</sub>の安定同位体を測定し、葉の内部の拡散抵抗を推定ことが一般的であった。しかしながらこの手法では前処理によるコンタミネーションの可能性や、分析のために大量のサンプルが必要であり、また分析に時間がかかることから高い時間分解能での測定が不可能であった。葉の内部のCO<sub>2</sub>拡散はアクアポリンという膜たんぱく質などを介して環境にすばやく反応すると予測されており、これを実証するためには、高時間分解能での連続的な測定が必要である。現在までに、分光学的手法を用いることによってCO<sub>2</sub>などの安定同位体比を高精度・高時間分解能で測定することが検証されてきた。

そこで本研究では、中赤外CO<sub>2</sub>分光法を用い（Quantum cascade laser, Aerodyne Research Inc.）、CO<sub>2</sub>の安定同位体を高精度（0.1‰以下）で秒単位で測定をすることによって、葉の内部のCO<sub>2</sub>拡散抵抗を連続的に測定する手法を開発した。また植物の葉に出入りする水蒸気を異なるレーザー（Losgatos Research Inc.）を適用しCO<sub>2</sub>と水蒸気の安定同位体比の測定を同時に行った。この方法によって葉の中の水分の経路の変化を同時にモニタリングが可能なシステムをセットアップした。このシステムをアクアポリンの発現量を遺伝的に改良したユーカリに適用して、アクアポリンのCO<sub>2</sub>拡散に対する貢献度について検証をしたいと考えている。本セミナーでは、まず測定システムの概要と、測定における精度について説明し、取得したデータについて議論を行う予定である。

#### 第 511 回

日時：2011年6月30日（金）15：00～17：00

場所：547 会議室

##### 1) 杜明遠（農業環境技術研究所 大気環境研究領域）

###### 「私の大気乱流拡散の観測とシミュレーション研究」

防風網による風への影響の観測研究から、防風網による風速、温度、蒸発散、花粉の拡散への影響など、今までの大気乱流拡散についての観測と数値シミュレーション研究をまとめて紹介する。特に、現在進行中の東京電力福島第一原子力発電所の放射能物質の拡散シミュレーションの初期結果を披露する。

##### 2) 西森基貴（農業環境技術研究所 大気環境研究領域）

###### 「文部科学省気候変動適応研究推進プログラム高知県課題の目指すもの」

昨年10月より開始された標記課題の目標、概要および現在までの進捗状況について概説するとともに、当プログラム内外での気候変動適応研究の在り方、および震災をうけた、それら研究の状況変化などについても議論したい。

#### 第 512 回

日時：2011年7月28日（金）15：00～17：00

場所：547 会議室

**1) 金元植（農業環境技術研究所 大気環境研究領域）**

**「FluxPro: 次世代水・二酸化炭素フラックスの観測と予報を向けて」**

農業生産に関わるある環境変数を、監視から予報まで素早く処理することは、作物生育の精緻な管理や極端現象の素早い対応に極めて重要である。そこで、 $H_2O$  や  $CO_2$  の動きを詳細に把握して、作物の生育や水環境を管理することに役に立つ「FluxPro」の開発を行った。現在、ある特定場所での生育監視には対応できているが、栽培管理に必要な予報情報や広域評価のための空間情報の発信には未だ至っていない。そこで、今回の発表では、今までの開発過程から明らかになった研究結果や今後の研究方向と課題に付いて発表させて頂く。

**2) 眞崎 良光（農業環境技術研究所 大気環境研究領域）**

**「水文モデルを用いた作物栽培のための水資源量の解析に向けて」**

食料生産変動 RP では、気候・水文環境の変動に伴う主要作物の生産変動に関する研究に取り組んでおり、その課題の一つとして、作物栽培に利用できる水資源量の解析モデルの高精度化に取り組んでいる。ケーススタディとしてオーストラリアの作物栽培に関する水事情を取り上げ、水文モデルを利用した解析の方向性について報告する。

第 513 回

日時：2011 年 8 月 5 日（金）15：00～16:30

場所：547 会議室

**近藤純正（東北大学名誉教授）**

**「地球温暖化と都市昇温問題」**

近世数百年間は、干ばつ・洪水・冷夏による凶作・飢饉で人々は苦しめられてきた。江戸 300 年間の平和な時代、教育と治水と灌漑などの国づくりにより大規模な干ばつと洪水は時代と共に克服された。こうして先進国となった今日、こんどは人為的な原因により気候が大きく変わりはじめた。都市では地球温暖化と異なる原因により、地球温暖化量を上回る大きさの気温上昇（熱汚染）がある。地球温暖化と都市の熱汚染が重なり、熱中症による死者が増加する傾向にある。観測法の時代による変更、そのほか「日だまり効果」などの補正を行い日本のバックグラウンド温暖化量を求めると、この 127 年間の昇温率は 100 年間当たり  $0.67^{\circ}C$  であり、4 回の気温ジャンプをともなっている。気温と太陽黒点数の間には高い相関関係があり、また気候と海洋変動（漁獲量変動）は密接に関係している。バックグラウンド温暖化量を基準として求めた 91 都市の都市化による気温上昇（熱汚染）は、風速が弱いほど、また都市化率が大きいほど大きい。特に最低気温が下がり難くなった。その主な要因は、都市構造物の熱パラメータ（熱容量と熱伝導率の積）が大きくなったことであり、ほかに緑地の減少、人工熱の増加、ビルの高層化などがある。大気混濁係数は大戦中・直後の極小から 1960 年代に極大となり、その後若干下がる傾向にある。都市では熱汚染の増加と水蒸気供給源の減少により相対湿度が低下し、その結果として霧日数が少なくなった。また粗度の増加により平均風速は弱くなったが、最大瞬間風速の減少はわずかである。熱中症対策の指標となる半湿りの黒球温度、人体の蒸発効率（植物の気孔と人体の汗腺の類似性）、緑のカーテンの効果、都市昇温の緩和策などについて熱収支的観点から議論する。今後、エネルギー消費が増えると熱汚染が地球規模に広がることになる（第 2 の地球温暖化問題）。エネルギー消費を抑えた社会を目指したい。

第 514 回

日時：2011 年 9 月 28 日（水）13:15～14:30

場所：453 会議室

**Laza, Ma. Rebecca (International Rice Research Institute)**

**“Addressing Climate Change Challenges to Food Security”**

Climate change is forecast to reduce rice production if no steps are taken to adapt rice to it. In this seminar, IRRI's approach to help rice production in the face of climate change will be presented. Briefly, research is undertaken to investigate genes for stress tolerance and to develop improved rice varieties that can cope better with the conditions predicted to occur such as too little or too much water and rising temperatures and to improve crop management to develop varieties that can better cope with environmental stresses, and then share knowledge and breeding materials with many partners in rice-growing countries.

第 515 回

日時：2011 年 9 月 29 日（木）13 : 15～15 : 15

場所：153 会議室

**1) 飯泉仁之直（農業環境技術研究所 大気環境研究領域）**

**“Approaches to the Representation of Crop Growth Heterogeneities in Coarse-resolution Land Surface Models”**

The energy and material exchanges between the atmosphere and cropland are significantly different from those for areas of natural vegetation and are strongly affected by crop phenology and productivity. For land surface models embedded in global climate models (GCMs), an accurate representation of crop phenology and productivity is important for the realistic simulation of these exchanges. At a GCM-grid scale (hundreds of kilometers in latitude and longitude), crop growth can vary widely depending on local climate and management conditions. However, few studies have considered the crop growth heterogeneities in a GCM grid box. This study proposes two approaches to reflect the consequences of crop growth heterogeneities on these exchanges in a GCM. Accordingly, this study offers a combination of land surface models coupled with the crop-growth components of dynamic global vegetation models (agro-DGVMs) or large-area crop models: the stochastic parameter-based ensemble approach, which relies on the Bayesian Metropolis-Hastings (M-H) algorithm, and the mosaic-like ensemble approach, which relies on the downhill simplex algorithm. The feasibilities of the two approaches are examined, and the combination of the crop growth component of the Soil and Water Assessment Tool (SWAT) applied to maize in the Central Great Plains of the United States and the coarse-resolution reanalysis data is used as an example. The results demonstrate that the two approaches captured the major characteristics of the given spatial variation of the crop phenology and yield for the fine grids located within a coarse grid box; this finding suggests that the two approaches are applicable to the capture of crop growth heterogeneities in a GCM grid box. The computational costs required for the two approaches in this study were nearly comparable, but the computation time for the mosaic-like

ensemble approach relying on the simplex algorithm could be substantially shortened in comparison to the other approach if a number of computer resources were available. The approaches proposed in this study are expected to improve the representation of atmosphere-cropland interactions in a GCM grid box simulated in land surface models with due consideration of crop growth heterogeneities.

## 2) 櫻井玄（農業環境技術研究所 大気環境研究領域）

### 「過去における CO<sub>2</sub> 施肥効果の推定」

大気中の二酸化炭素 (CO<sub>2</sub>) の濃度の増加に伴い、CO<sub>2</sub> の植物に対する施肥効果によって、作物生産性がどの程度増加するののかという問題は、将来の作物生産性を評価する上で極めて重要である。しかしながら、過去数十年間においても CO<sub>2</sub> 濃度は大きく増加しているが、過去における CO<sub>2</sub> の施肥効果を明確に算定した研究はない。本研究では、ダイズを対象として、過去における CO<sub>2</sub> の施肥効果の量を推定するために (1) ダウンレギュレーションの補正効果を加味したセミプロセスモデルを開発し、(2) FACE 実験の結果をもとに階層ベイズ法を用いて補正効果のパラメータをモデル選択し、(3) そのモデルを、アメリカ・ブラジル・中国の収量データを用いてデータ同化することによって、過去の CO<sub>2</sub> 施肥効果を推定した。(4) また、データ同化されたモデルを用いて将来予測も行った。(5) さらに、将来予測におけるダウンレギュレーションの効果も評価した。その結果、過去においては、収量増加に及ぼす要因は気温上昇よりも CO<sub>2</sub> 濃度上昇の寄与が大きかった。また、特に低緯度ほど CO<sub>2</sub> 施肥効果が大きかった。技術の進歩による寄与は、国によって異なり、アメリカ、中国で大きかったが、ブラジルでは小さく、CO<sub>2</sub> の施肥効果とあまり差がない程度であった。気候シナリオによる将来推計では、アメリカでは収量は微減するが、中国、ブラジルでは増加することが予測された。興味深いことに、将来予測では、気温の効果との交互作用の結果、ダウンレギュレーションの効果は相殺されていた。

第 516 回

日時：2011 年 10 月 27 日（木）13：15～15：15

場所：153 会議室

## 1) 横沢正幸（農業環境技術研究所 大気環境研究領域）

### 「ティッピングポイントとその早期検出シグナル」

最近、nature や nature climate change 誌などで見かける複雑系の臨界現象のティッピングポイントを事前に検出する方法についてレビューし、農業環境分野での応用可能性を考える。

## 2) 福井眞（農業環境技術研究所 大気環境研究領域）

### 「日本全国を対象とした温暖化のコメ生産への影響」

#### 「生物多様性の創出・維持機構の数理解析」

今回の発表では、発表者が従事している環境省の環境研究総合推進費 (S-8) 「温暖化影響評価・適応政策に関する総合的研究」の担当研究の進捗と展望についてと、以前の研究の一つを紹介します。(1) 日本におけるコメ収量が将来予想される気候変化によって受ける影響を評価すべく、メッシュデータを用い、高解像度で地域ごとにプロセスベースモデルによってコメの収量予測を行った。さらに適応策として現行作付け品種以外の収量ポテンシャル、あるいは現行移植日からの変更による影響の評価を行うため、各品種、各移植日での収量予測を行った。(2) ここ最近、生物多様性という言葉が世に広まり、その重要性が認識されつつある。生物多様性は 3 階層（遺伝的多様性、種多様性、生態系多様性）に渡る多様性を意味するものであるが、ここでは種多様

性に注目する。いかにして自然界の生態系は多様な生物種の共存を許しているのだろうか。本発表では、ある生態系における植物の共存を説明する仮説の一つとして植物—土壌—微生物フィードバックについて説明し、さらにこの仮説から生態系の食物連鎖の上位生物が下位食物連鎖構造に多様性をもたらしていることを紹介する。

#### 第 517 回

Date: Thursday, 8 December 2011, 15:00-17:00

Venue: Room No. 453, NIAES

##### **1) TOKIDA Takeshi (Agro-Meteorology Division, NIAES)**

###### **“Rice growth and methane emission responses to free-air CO<sub>2</sub> enrichment and soil/water warming”**

Climate change will affect not only rice production but also various processes occurring in the atmosphere-plant-soil continuum. Among others, I have been working on CH<sub>4</sub>-emission response to elevated [CO<sub>2</sub>] and soil temperature in Shizukuishi (2007-2008) and Tsukubamirai (2010-) rice FACE projects. In this seminar, I will present observational evidence showing that elevated CO<sub>2</sub> and soil warming substantially increase CH<sub>4</sub> emission from rice paddies, a process of strong positive feedback of global warming. I will also give some mechanistic explanations behind that observation and highlight the importance plant (rice) response, in addition to edaphic factors, in order to correctly predict future CH<sub>4</sub> emission and to develop countermeasures for the potential mitigation. countermeasures for the potential mitigation.

##### **2) ZHU Chun-wu (Agro-Meteorology Division, NIAES)**

###### **“Rice genotypic differences in response to CO<sub>2</sub> and soil/water warming”**

The enhancement of atmospheric [CO<sub>2</sub>] concentrations has direct impacts on rice by increasing the net photosynthesis of leaf, thus promoting growth and yield. Recent rice FACE studies have shown that there are significant differences in growth and yield responses to elevated [CO<sub>2</sub>] among genotypes in China and Japan FACE, which will be an important source of adaptation technology development. We are interesting in comparing the Japanese and Chinese varieties response to elevated CO<sub>2</sub>. In 2009, my work was to test four Chinese varieties responses at Japan with climate chamber, and then chose two varieties with strong response as the tested material, with Koshihikari for Japan new FACE in 2010. In the seminar, I will present the growth, photosynthetic system and yield response to elevated CO<sub>2</sub> of the tested varieties in climatic chamber and FACE, and confirm whether the hybrid rice have the common phenomena with the high CO<sub>2</sub>-response, and test whether the varieties with the strong response to FACE in China have similar response to FACE in Japan. In addition, I also warn that in future, we should beware the increased risk of lodging of cultivars with strong response, which may consequently lead to reduction in rice yield.

#### 第 518 回

Date: Thursday, 26 January, 2012, 15:00-17:00

Venue: Room No. 547, NIAES

##### **1) YOSHIMOTO Mayumi (Agro-Meteorology Division, NIAES)**

### **“Evaluation of heat stress risk of rice in Japan by panicle temperature model (IM2PACT) and MeteoCrop DB”**

Projected global warming is expected to increase the occurrence of heat-induced spikelet sterility (HISS) of rice. Previous chamber experiments have shown that HISS can occur where temperature at flowering time exceeds the threshold temperature of around 35°C. However, it is difficult to predict because the thermal conditions of rice canopy can be different from the air temperature under field condition. To cope with this, we developed a simple micrometeorology model focusing canopy and panicle temperature (IM2PACT), which was incorporated into the general meteorology database, MeteoCrop DB. Using this, we evaluated the potential risk of heat stress caused by meteorological factors in Japan, and attempted to simulate the future risk by applying the climate change data based on a several GCMs and the A1B scenario.

#### **2) SAKAI Hidemitsu (Agro-Meteorology Division, NIAES)**

### **“Could rice breeding for the past 100 years in Japan improve responses to increasing atmospheric CO<sub>2</sub>?”**

It's been more than 100 years since systematic cross breeding began in Japan. Rice yield greatly increased by this cross breeding so far. At the same time, atmospheric CO<sub>2</sub> also increased by about 80 ppm during this period. It is unclear whether varieties with high sensitivity to increasing CO<sub>2</sub> had been selected. To evaluate the effects of past breeding on rice sensitivity to elevated CO<sub>2</sub>, growth and yield responses to free-air CO<sub>2</sub> enrichment (FACE) were determined for five rice varieties released in 1882, 1934, 1956, 1976 and 2009. Here I report some results of this experiment.

#### 第 519 回

Date: Thursday, 16 February 2012, 13:30-14:30

Venue: Room No. 153, NIAES

#### **JUNG Yoo-Rim (Pukyong National University, Korea)**

### **“Research Report in NIAES”**

Miss Jung is a PhD student of Integrated Climate System Modeling Lab., Department of Environmental & Atmospheric Sciences, Pukyong National University. She has been staying at NIAES since early January as one of the participants for the 19th Winter Institute Program and studying with Dr. Kuwagata these several weeks. Before her return to Korea, we asked her to have a seminar on her study.

#### 第 520 回

Date: Thursday, 1 March, 2012, 15:00-17:00

Venue: Room No. 547, NIAES

#### **1) USUI Yasuhiro (Agro-Meteorology Division, NIAES)**

### **“Effects of soil/water warming on growth, yield and the appearance quality of rice grains and their variation among cultivars and years”**

The rise in the global average air temperature at the end of the 21st Century compared to the mean value from 1980 to 1999 will be around 1.8-4.0 °C, with a likely range of 1.1-6.4 °C (IPCC, 2007). It is

anticipated that the rising of air temperature affects the crop production. As well as air temperature rising, it might well be the increasing of soil and water temperature in the ponded paddy field in the future. In this seminar, I will introduce the growth, yield and appearance quality responses of rice grains and their variation among cultivars and years at the open system elevated soil-water temperature (2 °C) plot in NIAES field.

**2) HASEGAWA Toshihiro (Agro-Meteorology Division, NIAES)**

**“Grain growth models for a climate change study”**

Grain growth is sensitive to temperature change and excessive temperatures often result in poor grain growth. Crop models should be capable of reproducing this temperature dependence, but sensitivity of existing approaches to temperature is not evident. In this seminar, I will try to develop a grain growth model scheme based on the discussion among participants, and 'hopefully' show some examples of the analyses.

**第 521 回**

Date: Thursday, 7 June, 2012, 13:30-15:30

Venue: Room No. 547, NIAES

**1) KUWAGATA Tsuneo (Agro-Meteorology Division, NIAES)**

**“Influence of low air-humidity and low root-temperature on water use, growth and aquaporin expressions in rice plants”**

The effects of low air-humidity and low root-temperature (LRT) on water use, growth and aquaporin gene expressions were investigated in rice plants. The daily transpiration of the plants grown at low-humidity was 1.5 to 2 times higher than that at high-humidity. LRT at 13 C reduced transpiration, and the extent was larger at lower humidity. LRT also reduced total dry matter production and leaf area

expansion, and the extent was larger at lower humidity. These results suggest that the suppression of plant growth by LRT is associated with water stress due to decreased water uptake ability of root. On the other hand, net assimilation rate was not affected by low-humidity and LRT, and water use efficiency was larger for LRT. We found that low-humidity and LRT induced coordinated up-regulation of many PIP and TIP aquaporin genes in both the leaves and the roots. Expression levels of several root-specific aquaporins, including OsPIP2;4 and OsPIP2;5, were increased significantly after 6 and 13 days of LRT exposure. Taken together, we discuss the possibility that aquaporins are part of an integrated response of rice plants to low air-humidity and LRT.

**2) ONO Keisuke (Agro-Meteorology Division, NIAES)**

**“Canopy-scale relationship between stomatal conductance and photosynthesis in irrigated rice”**

Both canopy- and leaf-scale analyses are needed to better understand crop response to environment changes. Bulk stomatal conductance, which represents stomatal behavior at canopy scales, is independent from the LAI development and thus potentially more suitable for diagnosing the plant status than surface conductance in the conventional big-leaf approach. We investigated the relationship between bulk stomatal conductance and gross primary productivity on diurnal to seasonal time scales using eddy flux measurements at the Mase AsiaFlux site, and found that the relationship was generally explained by the Ball-Berry-Leuning mode at the different time scales but highly dependent on the

surface condition such as wetness.

#### 第 522 回

Date: Thursday, 28 June, 2012, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) ISHIGOOKA Yasushi (Agro-Meteorology Division, NIAES)**

##### **“Spatial and temporal characterization of climatic change impact on rice production and quality in Japan”**

Large-scale simulation study has been conducted to assess the potential impact on rice production and quality under the observed and projected climatic conditions. A process-based rice development model, which is applicable for multi-cultivars, was introduced and applied for all paddy area in Japan using mesh meteorological data having 2nd spatial resolution (10km x 10km approximately) from 1981 to 2000 derived from multi-GCMs. In this seminar, I will introduce some results of model implementation such as changes in growing period and potential yield with several agro-climatic indices which can influence yield and quality as the risk factor, and discuss the adaptation strategies for reducing impact of climate change on rice production and quality.

##### **2) MANO Masayoshi (Agro-Meteorology Division, NIAES)**

##### **“An idea to separate eddy covariance NEE into GPP and RE using only daytime data”**

Eddy covariance is the direct way to measure net exchange of CO<sub>2</sub> (NEE), and it has several advantages (i.e., quasi-continuous and area-averaged flux measurements). However, it has disadvantages too. For instance, CO<sub>2</sub> uptake by photosynthesis (gross primary production - GPP) is inferred using ecosystem respiration (RE) from nighttime measurements assuming the same temperature dependence of RE between day and nighttime. Since it is unclear whether this assumption is valid or not, it is desirable to separate NEE into GPP and RE using only daytime data. Here, I'd like to present an idea of separation method of NEE using only daytime data: the method of thinking is that the difference between NEEs at the same PAR level (i.e., equal to the same GPP) is caused by the RE difference if the temperature level is different. In the presentation, I will report a preliminary result of the Mase flux site data, and hope for productive discussion together.

#### 第 523 回

Date: Thursday, 26 July, 2012, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) KIM Wonsik (Agro-Meteorology Division, NIAES)**

##### **“Analysis of random error on eddy covariance measurement for FluxPro as a realtime data assimilation system”**

It is known from the theory, that the data assimilation DA system is optimal in case that 1) the model perfectly matches the real system, 2) both the process and the observation noises are white, and 3) those covariances are absolutely known. The effort to estimate the characteristics of error of DA system is deserved even though it is impassible to construct the ideal DA system in real world. Especially, the

understanding of the characteristics of random error on eddy covariance EC system is valuable for not only the DA system construction but also EC uncertainty analysis itself before the equipping DA scheme in FluxPro as a realtime data assimilation system. In the context, the error analysis of EC system have been investigated above all. As a result, we estimated the relative error E which is the value come from the standard deviation of 1 hr-covariance divided by the absolute covariance between vertical wind velocity and target scalar collected over various types of land cover and at different instrumental heights. We also investigated E characteristics according to a spatiotemporal scale and the flux averaging interval. As a result, we suggest that if E is estimated near the ideal EC measurement condition satisfying stationarity, it is stable and uniform value regardless of the land cover, spatiotemporal scale, and kind of flux. Based on the constancy of E, we determined the baseline, that is a white noise of EC measurement, as a function of the averaging interval.

## **2) TAKIMOTO Takahiro (Agro-Meteorology Division, NIAES)**

### **“Study on soil temperature and moisture model”**

The climatic changes and evaluation of their effects on agriculture in Asian monsoon region are ongoing under the research framework of the GReen Network of Excellence (GRENE). One of the aims of our team is to prepare soil temperature and moisture data as information platform to design adaptation and mitigation strategies of major crops against the predicted climatic changes. In this seminar, I will introduce the brief overview of soil temperature and moisture model, and discuss some results.

## **第 524 回**

Date: Thursday, 30 August, 2012, 13:30-15:30

Venue: Room No. 547, NIAES

## **1) YOSHIDA Ryuhei (Agro-Meteorology Division, NIAES)**

### **“Effects of land-use changes on warming rates and rice yield in Shikoku, West Japan”**

This study evaluated the impacts of historical land-use changes (LUCs) during the last two decades (1987-2006) on the warming rates and rice yields in Shikoku, Japan. Two types of numerical simulations, historical LUCs and fixed LUCs throughout the period, were performed by using the non-hydrostatic regional atmospheric model (JMA-NHM) and large-area rice growth model (PRYSBI). In Shikoku, marked decrease in paddy fields and increase in building lots and roads have been observed since 1987. The evaluation suggests that LUCs caused five times larger warming rates in and around paddy fields than those in and around other land uses. Also 0.27 % decrease in rice yields in 2006 ( $12 \text{ kg ha}^{-1}$ ), relative to 1987, occurred as a result of the change in thermal conditions in and around paddy fields. These results demonstrate that there were small but detectable LUCs-induced impacts on the surface climates, warming rates, and rice yields in Shikoku.

## **2) MIYATA Akira (Agro-Meteorology Division, NIAES)**

### **“GHGG-Japan from 2004 to 2011 with recent trends in FLUXNET”**

Because of growth of scientific interests within flux communities along with technical progress in in-situ analysis of non-CO<sub>2</sub> greenhouse gases, FLUXNET, the global research network of flux monitoring towers for carbon, water, and energy cycles in terrestrial ecosystems, is expanding its study target to non-CO<sub>2</sub> greenhouse gases, although CO<sub>2</sub> and water still remain as the main target. FLUXNET, in

conjunction with InGOS (Integrated Non-CO<sub>2</sub> Greenhouse gas Observation System), will hold the meeting on N<sub>2</sub>O and CH<sub>4</sub> fluxes in early September. In this seminar, I will make preliminary presentation to the FLUXNET meeting about GHGG-Japan, the domestic project started in 2004 for full accounting of greenhouse gas budget in grasslands in Japan and influence of manure application on the fluxes.

第 525 回

Date: Thursday, 4 October, 2012, 13:30-14:30

Venue: Room No. 547, NIAES

**Charles P. Chen (Agro-Meteorology Division, NIAES)**

**“Crop responses to tropospheric ozone: mechanisms of damage and tolerance in *Glycine max.* and *Oryza sativa*”**

The global background concentration of tropospheric ozone has been rising since the Industrial Revolution, and is widely recognized as a problem affecting crop growth and yields. However, the mechanisms of damage and tolerance in plants are complex and still relatively unclear. The leaf-level response of soybean to acute and chronic ozone was characterized using simultaneous measurements of chlorophyll fluorescence imaging and gas exchange. The results showed that both acute and chronic ozone exposure induces spatially heterogeneous damage across the soybean leaf, but the underlying physiological mechanisms of damage differ. In addition, recent QTL analyses of ozone sensitivity and tolerance in rice have identified several loci which are associated with increased ozone tolerance. I will share results concerning one QTL, OzT8, which has been found to be associated with relative maintenance of photosynthetic capacity under ozone stress, and could potentially be used to breed future rice lines with greater tolerance to ozone exposure.

第 526 回

Date: Thursday, 25 October, 2012, 13:30-15:30

Venue: Room No. 547, NIAES

**1) KODAMA Naomi (Agro-Meteorology Division, NIAES)**

**2) YONEMURA Seiichiro (Agro-Meteorology Division, NIAES)**

第 527 回

Date: Thursday, 29 November, 2012, 13:30-15:30

Venue: Room No. 547, NIAES

**1) DU Mingyuan (Agro-Meteorology Division, NIAES)**

**“Importance of long-term monitoring of bio-meteorological elements on high mountain area on the Tibetan Plateau”**

We have set two long-term monitoring trans-section along two mountain slopes on the Tibetan Plateau: 1200m difference in altitude from 3200m to 4400 and from 4300m to 5500m since 2005. Air temperature (1.5 m above ground), precipitation and soil temperature and soil water content (5cm, 20

cm and 50cm in soil) were recorded at 30-min interval. Some results will show and the importance of this monitoring will be stressed considering global warming, vegetation distribution and species diversity.

## **2) FUKUOKA Minehiko (Agro-Meteorology Division, NIAES)**

### **“What should we do before naming a research product?”**

We sometimes have an opportunity to name a research product, such as a device, model, or database. It is typically raised just before submitting the manuscript of a paper concerning the product. To confirm the uniqueness of the product name, you will 'Google' a possible name of the product. However, Googling is not sufficient because it does not look into Japanese Trademark Database. Unlike researchers working for profit-making companies, we, working for a non-commercial institute, scarcely care for securing trademark rights. However, in the case of non-patentable products, trademarks will be the most effective way to legitimately control the transfer of your technology to the industrial sector. The speaker will explain why we should make a search over the Japanese Trademark Database of Industrial Property Digital Library before submitting your manuscript, to make sure that a possible name of the product can be registered as a trademark.

## **第 528 回**

Date: Thursday, 10 January, 2013, 13:30-15:30

Venue: Room No. 453, NIAES

## **1) OKADA Masashi (Agro-Meteorology Division, NIAES)**

### **“An integrated model for assessing both crop productivity and agricultural water resources at a large scale”**

Agriculture utilizes regional water resources as well as local resources such as temperature, rainfall, solar energy. While many studies assessed the impacts of climate change on agriculture, there are few studies accounting for dynamical interactions between water resources and crop production. This study proposes an integrated model for assessing both crop productivity and agricultural water resources at a large scale. The integrated model was consisting of five sub-models for the following processes: land surface, crop growth, river routing, reservoir operation, and anthropogenic water withdrawal. I will introduce the model description, and then discuss mainly about the reproducibility of crop yield and water balance at the Songhua river watershed in Northeast China, which has extensive crop land in China including semi-arid climatic areas.

## **2) NISHIMORI Motoki (Agro-Meteorology Division, NIAES)**

### **“Downscaling of climate change projection and its application for promoting local agriculture and water use”**

This research project integrally implements dynamical and statistical downscalings and developments of simulation technologies for climate change adaptations (CCA). They are essential for planning strategic estimations and policies for climate change of Kochi Prefecture that is located in the western part of Japan and has complicated topography and various land use. In Kochi Pref., we have serious vulnerabilities to typhoon and heavy rain, and their economic structures strongly depend on the primary industries. We apply the SD methods, first, to obtain detailed climate change scenarios on the river and

coastal basins and we also develop the method for stochastic rainfall level. Secondly, we use the climate change scenarios to adaptive simulation technologies for agriculture and water resources/environments, and finally we present local countermeasure options to climate change impact assessments, adaptive strategy, and environmental policy scenarios in Kochi.

#### 第 529 回

Date: Thursday, 31 January, 2013, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) SAKURAI Gen (Agro-Meteorology Division, NIAES)**

###### **“Bayesian calibration of the crop model using global crop yield data”**

With a growing global population and a changing climate, the need to examine the relationship between weather and crop production in global scale is increasingly important. Previous statistical analyses of historical global data on past crop yields and climate conditions have revealed the relationship between weather and crop yield in global scale. However, for simple statistical model, it is difficult to include complex interaction among climate factors or to consider non-linear responses to daily changes of weather condition. On the other hand, it is also difficult to apply process based models of crop growth to global scale prediction of crop production because of the lack of the knowledge about parameter values for each special grid. Here, we propose a synthesis approach in which the key parameters of a process based crop model are statistically estimated by Bayesian statistics using global crop yield data set. This approach should compensate the weak points of both simple statistic approach and the process-based-model approach and enable us to predict the future global crop productivity more precisely.

##### **2) YOKOZAWA Masayuki (Agro-Meteorology Division, NIAES)**

###### **“Parameter optimization in network dynamics including unmeasured variables by the symbolic-numeric approach”**

The investigation of network dynamics is a major issue in various studies including systems biology, climate system, plant community and so on. One of the essential steps in a dynamics investigation is the parameter estimation in the model that expresses underline phenomena. Recently, a new approach has been proposed for parameter optimization by using differential elimination, to estimate kinetic parameter values of differential equation system with a high degree of accuracy. I review some articles on the differential elimination method and outline the mathematical foundation, Groebnar basis and Buchberger's algorithm.

#### 第 530 回

Date: Tuesday, 12 February, 2013, 13:30-14:30

Venue: Room No. 547, NIAES

##### **Dr. Shabtai Cohen (Head, Dept of Environmental Physics and Irrigation Institute of Soil, Water and Environmental Sciences, ARO Volcani Center, Israel)**

###### **“Global dimming and brightening and evaporation in Israel”**

Significant decreasing multi-decadal trends in global radiation measured at the earth's surface, starting in the late 1950's, were reported near the end of the 20th century (Stanhill and Cohen, 2001). Many of these decreasing trends, called "global dimming", were in excess of 1% per decade, and they were viewed with considerable skepticism by the scientific community. Beginning in the 1990's a partial recovery in global radiation has been observed in many places in the world (Wild et al., 2005). The changes in global radiation were most likely caused by atmospheric pollution and especially sulfate aerosols which influence cloudiness and cloud properties. During the same period evaporation rates were also found to decrease (Peterson et al., 1995). Those decreases were similar in magnitude to that of the dimming (Roderick and Farquhar, 2002). However, there has been some debate on the significance of changes in evaporation, because changes in regional and local evaporation rates can sometimes be in opposite directions (Brutsaert and Parlange, 1998). The latter is predicted by the Bouchet (1963) hypothesis. As our climate changes, a major concern in arid regions is whether the intensity of the hydrological cycle is increasing (spinning up) or decreasing (spinning down). A decreasing hydrological cycle can lead to reductions in rainfall, increasing aridity and droughts. Analysis of evaporation measurements made between 1964 and 1998 at Bet Dagan in Israel's central coastal plain showed a small but statistically significant increase in screened Class A pan evaporation, mainly in the dry, summer half of the year (Cohen, lanetz and Stanhill, 2002). No changes were found in the total open water evaporation or reference crop evapotranspiration estimated with Penman's combined heat balance and aerodynamic equation because the decreases found in the radiation balance term were offset by increases in the aerodynamic term. The climatic changes responsible for these opposing trends were, respectively, decreases in global irradiance and increases in water vapor pressure deficit and wind speed, the latter associated with changes in wind direction. Increases in windspeed were found to be concentrated in afternoon hours of summer and fall months, while those of vapour pressure deficit were in the late afternoon of fall months. Normalized pan evaporation for dry months showed no significant time trend, but a significant increase was found for wet months. These results support the view that the widespread reductions in potential evaporation that have been reported, although not found at Bet Dagan, were caused by global dimming rather than an increase in the rate of atmospheric moisture cycling due to global warming. The trends should have a negative effect on water supply and demand (Moeller and Stanhill, 2007). These developments will be presented and discussed in the lecture.

#### 第 531 回

Date: Thursday, 28 February, 2013, 13:30-15:30

Venue: Room No. 547, NIAES

**1) SAKAI Hidemitsu (Agro-Meteorology Division, NIAES)**

**2) IIZUMI Toshichika (Agro-Meteorology Division, NIAES)**

**"Characterizing the reliability of global crop prediction based on seasonal climate forecast"**

Reliable crop prediction, based on seasonal climate forecast, is attributed to the strong climate-crop relationship and reliable forecast on climatic constraints of crops. Here we present the global assessments of the climatic constraints of crops, degree of climate-crop relationship, and reliability of seasonal forecast on the climatic constraints, based on the statistical crop models and ensemble

seasonal climate forecasts. Maize, soybean, rice, and wheat are taken as the examples. We then classified the reliability of the within-season crop prediction into four categories in accordance with two aspects, i.e., the degree of climate-crop relationship and the reliability of climate forecast: (I) reliable; (II) less reliable due to low reliability of climate forecast; (IV) less reliable due to weak climate-crop relationship; and (III) little reliable due to both low reliability of climate forecast and weak climate-crop relationship. Results show that the strong climate-crop relationship appeared in the area that produces 24-38% of the global crop production. On a global scale, 51-59% of the maize and soybean production is sensitive to the soil moisture level during the reproductive growth period, while 47-53% of the rice and wheat production is sensitive to the temperature. Due to higher reliability of the temperature forecasts than others, the area where the crop yield is temperature-sensitive and the temperature forecasts are reliable is certainly a nest of reliable crop prediction. The categorized reliability of crop prediction indicates that improvements of soil-moisture forecast in 30-50°N for July-October and in 30-40°S for February-April were needed for better maize and soybean prediction. Improved temperature forecasts in 20-60°N for March-August are keys for rice and wheat prediction. This study establishes the novel assessments on the reliability of crop prediction that, ultimately enable us to predict the impacts of climate extremes on the food access of people to global commodity markets.

#### 第 532 回

Date: Thursday, 4 April, 2013, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) USUI Yasuhiro (Agro-Meteorology Division, NIAES)**

##### **“Effects of recent hot summers on spikelet fertility and grain quality of some rice cultivars in the central part of Kanto region, Japan”**

Recently, extreme hot summers occur more frequently notably in the central part of Kanto region, and some adverse impacts on rice production are becoming apparent. For example, the highest temperature on record was recorded in mid-August 2007 at many weather stations in Central Japan, where we observed higher-than-usual spikelet sterility. Severe reduction in appearance quality occurred in 2010, the hottest summer ever in Japan. Kumagaya-city of Saitama Prefecture and Tatebayashi-city of Gumma Prefecture are known to be the hot spots, where extreme high temperatures are recorded almost every year, but how these heat events influence reproductive processes is not clear. In this study, we examined variation in grain setting, grain filling and apparent quality of a few rice cultivars commonly planted at different timings at the two experimental stations in the 2011 and 2012 growing seasons.

##### **2) YOSHIMOTO Mayumi (Agro-Meteorology Division, NIAES)**

##### **“Low nitrogen fertilization elevates rice panicle temperature through the micrometeorological change of plant canopy”**

Frequent occurrence of immature rice grains in recent hot summers is possible to be due to low nitrogen (N) fertilization concerning of rice taste. Spikelet sterility rate as well of field-grown rice exposed to high temperatures at flowering is reported to have increased as N application rate was lower. Thus, N application is a key management for avoiding heat stress as well as promoting plant growth. While, the panicle transpirational conductance is one of the determinants of panicle temperature ( $T_p$ ) via

evaporative cooling of panicles as organs sensitive to heat. Low N fertilization might exacerbate heat stress through the change of transpiration of panicles as well as negative influence from plant physiological traits. We conducted field experiments with different N treatments, where plant transpirational characteristics, micrometeorology and canopy structure were measured. And by applying the measured factors to the  $T_p$  model (IM2PACT), we quantified the effects of low N on  $T_p$  through the changes of their factors. The  $T_p$  was estimated to be elevated by low N by more than 1 C at most under typical weather condition in Tsukuba.

#### 第 533 回

Date: Thursday, 6 June, 2013, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) HASEGAWA Toshihiro (Agro-Meteorology Division, NIAES)**

##### **2) FUKUI Shin (Agro-Meteorology Division, NIAES)**

##### **“The phenological characteristics of rice cultivar estimated from performance test data”**

It is important to understand the differences among crop varieties on phenological characteristics quantitatively. There are many rice varieties in Japan and each variety has its trait and phenology reflecting the optimal growth condition. Thus the yield and growing period under a certain environmental condition differs depending on cultivar variation. The crop model for rice ( e.g. SIMRIW ) can estimate the crop phenology using daily temperature and day-length at this moment. However, the model parameters are set for a specific cultivar and on a few cultivating stations. Therefore, it arises incompatibility to apply such model parameters to large scale area, as utilizing for projection covering all over the country. In this study, parameters for major cultivars are estimated by genetic algorithm using the statistics data of performance test for recommendable varieties (76 stations, 1980-2009). Estimated parameters should represents the phenological characteristics and the result clearly showed the cultivar feature especially the sensitivity to day-length. The imaginary cultivar parameters for a certain area were obtained in the same manner. The characteristic trait of imaginary cultivar on a certain region should be useful information when we develop an appropriate cultivar.

#### 第 534 回

Date: Thursday, 27 June, 2013, 13:30-15:30

Venue: Room No. 453, NIAES

##### **1) ONO Keisuke (Agro-Meteorology Division, NIAES)**

##### **“Tillage-induced changes in aerodynamic roughness and their influence on carbon and nitrogen dynamics in a fallow paddy”**

For cultivation of one rice crop, a predominant crop in Japan, the fallow season can be as long as the growing season. Therefore, even a small change in the surface condition can alter the carbon and nitrogen dynamics through its integration over the entire fallow season. Aerodynamic roughness length ( $z_0$ ) is an important parameter to determine the rate of surface exchange of energy and materials. Relationships between  $z_0$  and surface conditions are widely documented, but tillage-induced changes in

z0 have not been investigated. The purpose of this study was thus to quantify tillage-induced changes in z0 and their influence on carbon and nitrogen dynamics during the fallow season at the Mase rice paddy site. In the seminar, some important results on the influence found by using numerical models are presented.

## **2) ISHIGOOA Yasushi (Agro-Meteorology Division, NIAES)**

### **“The phenological characteristics of rice cultivar estimated from performance test data”**

Extreme high temperatures during the rice growing season which possibly cause serious degradation of rice yield and quality have become more frequent recently in Japan and are predicted to be even more frequent and severer in the future. In this study, the effectiveness of moving cultivation schedule as adaptation to reduce impact of climate change on rice production and quality in large scale was evaluated in large scale. A process-based rice development model, which is applicable for multi-cultivars, was introduced and applied for all paddy area in Japan using mesh meteorological data having 2nd spatial resolution (10km x 10km approximately) from 1981 to 2100 derived from multi-GCMs. In this seminar, I will introduce some results of model implementation and discuss the strategies for selection of optimal transplanting date which can reduce the impact of climate change on rice production and quality.

第 535 回

Date: Thursday, 1 August, 2013, 13:30-15:30

Venue: Room No. 453, NIAES

## **1) KIM Wonsik (Agro-Meteorology Division, NIAES)**

### **“Weighted mean method for eddy covariance flux measurement”**

The study to monitor the exchange of energy, water vapor and carbon dioxide between the atmosphere and terrestrial ecosystem has been carried out with eddy covariance method throughout the world (<http://fluxnet.ornl.gov>). The monitored exchange quantity, named flux  $F$ , is conventionally determined by a mean of 1 hr or 30 min interval because no technique have been fortified to directly measure a momentary  $F$  itself at an instant of time. Therefore, the posterior analysis with this sampling should be paid attention to those spatial or temporal averaging and summation in the consideration of the sampling uncertainty. In particular, the averaging reckoned by arithmetic mean  $F_a$  might be in error because the sample  $F$  used in this averaging has nonidentical inherent quality within one another according to different micrometeorological conditions while those are observed under the same instruments. To overcome this issue, we propose the weighted mean  $F_w$  using a relative sampling error estimated by a sampling measurement and introduce  $F_w$  performance tested with 3 years EC measurements at tangerine orchard.

## **2) KUWAGATA Tsuneo (Agro-Meteorology Division, NIAES)**

### **“Environmental response of aquaporin expressions in the rice roots under natural weather conditions”**

Many of studies about the environmental response of gene expression of plants are made in laboratory conditions, but few studies have been done in outdoor field. Aquaporins, the water channel proteins, play crucial roles not only in regulation of plant water status, but also in uptake and transport of some kinds of minerals such as Silicon and Boron. Here we focused on the environmental response of

aquaporin expressions in the rice roots under natural weather conditions. During June to August, rice seedlings were grown hydroponically under field condition, and the roots of the 16 day-old plants were collected every morning at 8:00 AM. The mRNA expression level of each aquaporin (AQP) member was quantified by real time PCR. Among various meteorological parameters, such as air temperature, solar radiation, wind speed, etc., the expression levels of the most AQPs positively correlated with air (or root) temperature (T or Tr) within 24 hours. The expression levels of several AQPs, root specific ones in particular, also highly correlated with the evaporative demand (potential evaporation, Ep) during morning hours. Finally we divided the 18 AQPs in the rice root into several groups according to the environmental response under natural weather conditions.

#### 第 536 回

Date: Thursday, 29 August, 2013, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) TAKIMOTO Takahiro (Agro-Meteorology Division, NIAES)**

##### **“Long-term analysis of the heat and water balance over the Tibetan Plateau”**

The Tibetan Plateau (TP) plays an important role in the global water cycle and is strongly influenced by climate change. In recent years, long-term observation shows that the TP has been experiencing rapid warming and wetting. However, there are few studies about heat and water balance associated with climate change. The objectives in this study are (1) to quantify heat and water balance by using meteorological station data and one-dimensional model and (2) to investigate these spatio-temporal characteristics. In the seminar, I will introduce the results of spatio-temporal analysis of the heat and water budget component over the TP.

##### **2) MIYATA Akira (Agro-Meteorology Division, NIAES)**

##### **“Agro-meteorology Division in the past 30 years”**

As one of the anniversary events, NIAES is going to publish its 30-years' history since its establishment in December 1983. I am now preparing a short review on the past 30 years of the Agro-meteorology Division by tracing succession of the studies. I would like to discuss the outline of the review with attendees. Presentation and discussion may be made in Japanese.

#### 第 537 回

Date: Thursday, 3 October, 2013, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) KODAMA Naomi (Agro-Meteorology Division, NIAES)**

##### **“High-throughput automated analysis of two dimensional positions and body lengths of earthworms (Oligochaeta); MimizuTrac”**

Earthworms inhabit almost all ecosystems and are important soil macrofauna moving mainly for foraging. Their biomass is large, and their burrowing and ingestion of soils alters soil physicochemical properties. Furthermore, the mucus excreted from the surface of their skin affects the surrounding soil microbes which in turn have a strong influence on soil material flow dynamics. Also because of their

huge biomass the earthworms are regarded as indicator as "soil health". However, primarily owing to the difficulties involved in quantifying their behavior, the extent of their impact on soil material flow dynamics and "soil health" is poorly known. Image data have proven to be a powerful tool in quantifying the movements of objects, with the aid of image processing tools. Image data sets are often huge and time consuming to analyze especially if the data are continuously recorded and manually proceeded. Thus, the objective of this study was to develop a system to quantify earthworm movement. Our newly developed program successfully tracked the two-dimensional positions of three separate parts of the earthworm along with its change in body length. From the output data, we estimated the velocity. The performance of the program has been verified by comparison with manually estimated data. To date, there are no existing systems to quantify earthworm activity, because they can move and stretch their bodies out of view in continuously recorded image data. The system developed in this study will reduce labor intensity and errors involved in the quantification of huge data sets and provide more reliable estimated values. In combination with other techniques, such as metabolic gas emission from the earthworm bodies, this program will provide continuous observations of earthworm behavior in response to environmental variables under laboratory conditions.

**2) IIZUMI Toshichika (Agro-Meteorology Division, NIAES)**

**“Impacts of ENSO on global yields of major crops”**

第 538 回

Date: Thursday, 31 October, 2013, 13:30-14:30

Venue: Room No. 547, NIAES

**1) OKADA Masashi (Agro-Meteorology Division, NIAES)**

**“Modeling crop yields and water balance over water-limited region”**

Crop growth and yields in water-limited regions are affected by irrigation management as well as variations in climatic condition, especially precipitation. While many crop models can simulate the impacts of variations in precipitation on given irrigation scenarios, only a few models can simulate variations in crop yields accounting for available agricultural water resources responding to regional climatic and socioeconomic conditions. We developed a coupled model for assessing both crop yields and agricultural water resources and tested its performance, taking Songhua river watershed, Northeast China, where a major semi-arid crop-producing region in China. Results showed that the simulated mean evapotranspiration and surface soil moisture content during the growing season over the area matched with the corresponding observations. The simulated mean river discharge during the growing season fell within the range of the year-to-year variations in the observations during the past years. Also, the simulated the long-term trend and annual variations in crop yield faithfully reproduced the corresponding observations.

第 539 回

Date: Thursday, 28 November, 2013, 13:30-15:30

Venue: Room No. 153, NIAES

**1) Charles P. Chen (Agro-Meteorology Division, NIAES)**

**“Contrasting the leaf photosynthetic response of the rice cultivars Takanari and Koshihikari to elevated [CO<sub>2</sub>] under free-air conditions”**

The development of crops which are well-suited to growth under future environmental conditions such as higher atmospheric CO<sub>2</sub> concentrations ([CO<sub>2</sub>]) is essential to meet the challenge of ensuring food security in the face of the growing human population and changing climate. A high-yielding indica rice variety (*Oryza sativa* L. cv. Takanari) has been identified as a potential candidate for such breeding, due to its extremely high productivity in present [CO<sub>2</sub>]. To test if it could further increase its productivity under elevated [CO<sub>2</sub>] (eCO<sub>2</sub>), Takanari was grown in the paddy field under season-long free-air CO<sub>2</sub> enrichment (FACE, approx. 200 μmol mol<sup>-1</sup> above ambient [CO<sub>2</sub>]) and its leaf physiology was compared with the representative japonica variety ‘Koshihikari’ over two growing seasons. Takanari showed consistently higher midday photosynthesis, stomatal conductance, and carboxylation rate of Rubisco than Koshihikari under both ambient and eCO<sub>2</sub> growth conditions from heading to the mid-grain filling stage. In contrast to Koshihikari, Takanari showed no decrease in total leaf nitrogen on an area basis when grown in eCO<sub>2</sub>, and exhibited higher Rubisco content than Koshihikari at the mid-grain filling stage. Chlorophyll content was higher in Takanari than Koshihikari at the same leaf nitrogen level. These results indicate that Takanari performs strongly at the leaf-level in eCO<sub>2</sub> and may be a valuable resource for rice breeding programs which seek to increase crop productivity under current and future [CO<sub>2</sub>].

**2) DU Mingyuan (Agro-Meteorology Division, NIAES)**

**“Applications of dust particle counter”**

Three applications of dust particle counter would be reported. One: Dust particle counter were used for measure dust concentration at three stations with different surface conditions in a small area at Dunhuang, China from March 25 to April 15, 2004. Convergence/divergence method was used for evaluating regional dust emission from the area by calculating horizontal dust transportation (horizontal dust flux) from the three stations. The results show that although the horizontal dust flux at Gobi desert was the most among the three stations due to strong wind there, dust concentration at cropland was the most among the three stations and regional dust emission occurred only when the wind blow from cropland to Gobi desert. This suggests that agriculture activities play an important role for regional dust emission at Dunhuang, China. Two: Dust particle counter were used for measure dust concentration at three stations in Japan for understanding the characteristics of dust event in Japan.

Three: Dust particle counter were used for measure PM<sub>2.5</sub> in Tsukuba. Some charecterists of PM<sub>2.5</sub> in spring 2013 would be reported.

**第 540 回**

Date: Thursday, 26 December, 2013, 13:30-15:30

Venue: Room No. 453, NIAES

**1) FUKUOKA Minehiko (Agro-Meteorology Division, NIAES)**

**2) MISHIMORI Motoki (Agro-Meteorology Division, NIAES)**

**“Impact and adaptation study for climate change on local paddy rice production in Kochi Prefecture”**

A technology to estimate heading date, yield and content rate of protein of paddy rice for Koshi-hikari

and Hino-hikari (every most popular early- and normal- ripening variety in Japan) are established. Although the yield is projected to increase owing to fertilization effect of CO<sub>2</sub>, when extreme higher temperature occurs near future, the yields would significantly decrease and the protein contents slightly increase for the preliminary experiments by using a simple 'pseudo-warming' climate scenario made of observed daily temperature added constant increasing. It suggests that fertilizer applications for paddy rice cultivation is quite important.

#### 第 541 回 (講演は日本語で実施)

Date: Wednesday, 22 January, 2014, 15:00-16:20

Venue: Room No. 453, NIAES

**Dr. Atsushi J. Nagano (Center for Ecological Research, Kyoto University)**

#### **"Modeling of field transcriptomes: from prediction toward designing"**

Recent advances in plant molecular biology have revealed large effects of the circadian clock, organism age, and environmental stimuli on transcriptomes under simple, controlled laboratory conditions. However, the factors that control transcriptomes under natural conditions are largely unknown. We have developed statistical models using extensive field transcriptome data and the corresponding meteorological data (Nagano et al., (2012) Cell. 151 (6), 1358-1369.). We named this approach as "field transcriptomics". We showed that the transcriptome dynamics of rice leaves in a paddy field were mainly governed by ambient temperature and endogenous diurnal rhythms, as well as by plant age and solar radiation. We also found diurnal gates for environmental stimuli, detected associations between the thresholds for plant response to solar radiation and signal-to-noise ratios for day-length change, and predicted transcriptomes under given environmental conditions. Our models comprehensively describe transcriptome dynamics under complex field conditions and will help researchers to translate the vast molecular knowledge amassed in laboratories into solutions to problems in agricultural and natural environments.

As a next step, we are trying to combine quantitative genetics and field transcriptomics to elucidate genetic factors controlling the parameters in the model. For this project, we established a highly-parallelized cost-effective RNA-Seq system and a novel algorithm to analyze relations among genomic polymorphisms, transcriptome dynamics and high-density meteorological time-series. After the modeling, we will be able to simulate transcriptome dynamics in any genotypes, locations and times. In addition of the prediction, we will be able to design a genome having desired transcriptome dynamics.

#### 第 542 回

Date: Monday, 3 February, 2014, 13:30-15:00

Venue: Room No. 547, NIAES

**1) YOSHIMOTO Mayumi (Agro-Meteorology Division, NIAES)**

#### **"Heat risk prediction model estimating temperatures all the rice spikelets encounter in the field"**

High temperatures during flowering induce spikelets sterility of rice (HISS). As panicles gradually emerge in the field for a several days and spikelets gradually flower from upper part to lower part of a

panicle for a several days, and flowering hour varies with the weather conditions and varieties, the temperature that individual spikelet encounters at flowering is different among spikelets, which causes the uncertainty in evaluation of sterility rate on rice yield models. We developed a heat risk prediction model to estimate the temperatures that all spikelets in the field are exposed at flowering, by combining the distributions of panicles emergence, of spikelets flowering, and of their flowering hours in a day, which was incorporated with the panicle temperature estimation model (IM2PACT). The model simulation showed that Koshihikari in Tsukuba, 2013 might avoid the HISS damage because the heading date was one week earlier than the highest risk period. Applying the model to AgMIP sentinel sites suggested that introducing the early morning flowering line is more effective in India than in the Philippines and China for cooling the panicle temperature.

## **2) SAKAI Hidemitsu (Agro-Meteorology Division, NIAES)**

第 543 回

Date: Tuesday, 26 March, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

### **1) YONEMURA Seiichiro (Agro-Meteorology Division, NIAES)**

#### **“Performance of the flow-through-chamber technique to estimate NO and N<sub>2</sub>O emission rates of agricultural volcanic soil in laboratory”**

Flow-through-chamber technique has several merits in comparison with closed-chamber technique regardless of its complexity and several scientific groups have developed the kind of measurement systems so far. However, information of the careful tests of the systems is not fully documented and most of agricultural researchers do not use such kind of systems. We applied our flow-through chamber system to measurements of NO and N<sub>2</sub>O exchanges by agricultural soil in laboratory and carefully checked the methodology. The NO and N<sub>2</sub>O emission rates estimated by the flow-through-chamber technique corresponded well with those by the closed-chamber technique within 10% and were not influenced by the flow rate flushing through chambers. Strong stirring of soil by the fan resulted in a little (6%) increase of NO emission but no significant increase in N<sub>2</sub>O emission. Unexpectedly, the NO and N<sub>2</sub>O emission rates per unit soil were smaller or larger with increases in soil weight, respectively. However, further from the dependence of NO emission rate on NO concentration itself, we calculated both production rate (45.4 ngN g<sup>-1</sup> h<sup>-1</sup>) and consumption rate (0.24x10<sup>-5</sup> m<sup>3</sup> kg<sup>-1</sup> s<sup>-1</sup>) of NO over initial

3.5 days after N application, which show compensation concentration of 9.3 ppm. The simultaneous estimation of production and consumption rates of NO is very difficult by the closed-chamber technique but was found to be possible by simply changing soil weight in our system.

### **2) USUI Yasuhiro (Agro-Meteorology Division, NIAES) (講演は日本語で実施)**

#### **“Impacts of mass transport through ponded water in a paddy field on the atmosphere near the water surface”**

Many physical, chemical, and biological phenomena take place in the ponded water of a paddy field. It is important to capture directly the feature of these phenomena which vary from hour to hour. It is thought to have an impact on the surround environment because paddy field area has a large proportion of crop land. However, until recently, a lack of proper instrumentation made difficult to do continuous

measurement. Presenters have been working on development of measuring technique and its measurement for physical phenomena at the paddy field. In this presentation, I will give an explanation about these measuring techniques and past measurements achievements.

#### 第 544 回

Date: Thursday, 5 June, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) Toshihiro HASEGAWA (Agro-Meteorology Division, NIAES)**

###### **“Phenotyping yield-related traits of rice genotypes”**

Grain yield is the most important agronomic trait that is strongly controlled by both genetic and environmental factors. To develop varieties that are highly adaptive to climate change, we need to understand environmental responses and their association with genetic traits. Yields are a result of various processes and environmental responses need to be characterized. However, phenotyping methods for the environmental responses have not been established. Here I propose that a simplified rice model can be utilized and show that key traits that are responsible for the yield variation among major rice cultivars.

##### **2) Wonsik KIM (Agro-Meteorology Division, NIAES)**

###### **“Long-term analysis of evapotranspiration over a diverse land use area”**

Evapotranspiration (ET) over a diverse land use area in northern Thailand was successfully estimated by long-term eddy covariance measurements. Some measurement gaps due to instrumentation problems and administrative difficulties were unavoidable. Monthly ET trends revealed a maximum of  $150 \pm 10$  mm in June and a minimum of  $60 \pm 10$  mm in January. The annual mean ET was estimated to be  $1300 \pm 140$  mm. The interannual variation in ET reflects the response of the land surface to meteorological events and land use/cover changes (LUCC); however, the effect of rainfall variation on ET was greater than that of LUCC. Effective heterogeneity was evaluated using the Bowen ratio; such information will be useful for understanding the effect of land surface heterogeneity on latent and sensible heat fluxes.

#### 第 545 回

Date: Thursday, 26 June, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) Masaki YOKOYAMA (Agro-Meteorology Division, NIAES)**

###### **“Elevation and spatial resolution dependencies of climate models in extreme daily precipitation at Kochi”**

Recently, climate models have been developed especially on spatial resolution, so that it is possible to analyze climate models on river basin scale. However, the reproducibility of precipitation is still an important problem for climate change projection. In order to clarify the characteristics of climate models, we analyzed a relationship between extreme daily precipitation and elevation by using daily precipitation data taken from point observation and fourteen climate models. Our results show as follows: (1) The spatiotemporal distributions of daily precipitation derived from the climate models with higher spatial resolution would approach to observational value. (2) In case of using higher spatial

resolution models, extreme daily precipitations tend to be suppressed at higher elevation places.

**2) Yasushi ISHIGOOKA (Agro-Meteorology Division, NIAES)**

**“Effectiveness of moving cultivation schedule as adaptation to reduce impact of climate change on rice production and quality”**

Moving cultivation schedule is widely recognized as one of the important adaptation measures to climate change in rice cultivation in Japan, which has already been introduced in some regions to prevent the heat damages in rice productivity along with recent frequent emergence of high summer temperature. To reveal the effectiveness of this adaptation measure against projected future climate change, model-simulation was conducted using projected meteorological data from 1981 to 2100 derived from CMIP5 multi-GCMs. In this seminar, I will introduce some results of model implementation and discuss the effectiveness and the limitation of this measure by regions having different climate and cultivation conditions.

第 546 回

Date: Thursday, 31 July, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

**1) Toshichika IIZUMI (Agro-Meteorology Division, NIAES)**

**“Climate-induced changes in year-to-year variations in yields of major crops”**

Incidences of climatic extremes and associated crop failures in major food-producing regions have implications for commodity prices and generate concerns for national governments and commercial entities in import-dependent countries. While recent changes in temperature and precipitation extremes are evident, their impacts on the year-to-year variability of yield remain unclear. Here we present a global assessment of the impacts of recent climate change on year-to-year variations in yields of major crops. We found that crop yield variability, in a large portion (24-53%) of the global harvested area, decreased from the earlier decade (1982—1993) to the later decade (1994—2005). However, yield variability also increased in a substantial portion (9—17%) of the harvested area. The changes in yield variability across 20—31% of the harvested area could be reasonably explained by changes in an agro-climatic index. Precipitation plays a role comparable to or more important than temperature to explain both increase and decrease in the variability of yield. Our findings reveal that climate change in the last two decades has led to more unstable yields in some regions (4-13%). However, climate change has reduced yield variability in many more regions of the world (10-18%). This suggests complex influences of climate change on yield variability.

**2) Mingyuan DU (Agro-Meteorology Division, NIAES)**

**“Some questions about carbon balance on the Tibetan Plateau”**

Statistic data show that the production of livestock or meat in the Tibetan Plateau has increased more than 5 times since 1978, which means that there should be an equivalent increase in the consumption of plant biomass from the grassland. How is the “increased biomass” related to human activities and climate changes? How about the carbon balance? We have measured CO<sub>2</sub> flux of different type of grassland on the Plateau since 2001 and estimated the total GPP on the Plateau. In this seminar, I would like to talk about our observation results and have some discussions on some questions about carbon balance on the Tibetan Plateau.

#### 第 547 回

Date: Thursday, 28 August, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) Shin FUKUI (Agro-Meteorology Division, NIAES) (講演は日本語で実施)**

###### **“The improvement of phenology modeling by using water temperature”**

Growth of paddy-field rice at its youth stage is strongly affected by water temperature because the growth point is present under water. On the other hand, growth of plant is well explained by surrounding temperature and photoperiod, therefore several phenology models are proposed to describe plant growth using air temperature and photoperiod. These models can reproduce crop phenology in general, however, it often reduces the accuracy where there is large difference between air and water temperatures for paddy-field rice especially at the youth stage. For high-precision phenology modeling, the effect of water temperature on rice growth should be included in the model. In this talk, I will report the result of the parameter estimation of phenology model using water temperature.

##### **2) Takahiro TAKIMOTO (Agro-Meteorology Division, NIAES) (講演は日本語で実施)**

#### 第 548 回

Date: Thursday, 25 September, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) Tsuneo KUWAGATA (Agro-Meteorology Division, NIAES)**

###### **“Temperature Difference between Meteorological Station and Nearby Farmland -Case Study for Kumagaya City in Japan-”**

Many of the surface meteorological stations of the Japan Meteorological Agency are located in urban areas, but few stations are located in farmland. The seasonal variation in temperature difference between a meteorological station in an urban-area and nearby farmland in Kumagaya City was examined over 2010-2012. The daily mean, maximum, and minimum temperatures ( $T_{\text{mean}}$ ,  $T_{\text{max}}$ , and  $T_{\text{min}}$ ) at the meteorological station (urban site) were higher than at the nearby farmland site across all seasons. Differences in the monthly temperatures between the two sites were 0.17-0.90°C ( $T_{\text{mean}}$ ), 0.55-1.63°C ( $T_{\text{max}}$ ), and 0.20-0.62°C ( $T_{\text{min}}$ ), and the maximum differences were in August ( $T_{\text{mean}}$  and  $T_{\text{max}}$ ) and April ( $T_{\text{min}}$ ). Large temperature difference over 1°C for  $T_{\text{max}}$  were observed during the paddy rice-growing season in farmland from July to September. Differences in daily  $T_{\text{max}}$  and  $T_{\text{mean}}$  between the two sites increased with daily solar radiation  $S_d$ . The sensitivities of these temperature differences to  $S_d$  were larger during the paddy rice-growing season. The number of “extremely hot days” ( $T_{\text{max}} \geq 35^\circ\text{C}$ ) at the farmland site was only 36% of the number at the urban site, while the relative proportion of “sultry nights” ( $T_{\text{min}} \geq 25^\circ\text{C}$ ) was 62%. The main part of this study has been already summarized in Kuwagata et al. (SOLA, 2014, 10, 45-49, doi:10.2151/sola.2014-010), and some additional results will be presented in the seminar.

#### 第 549 回

Date: Thursday, 30 October, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

**1) Toru SAKAI (Agro-Meteorology Division, NIAES)**

**“Assessment of soil moisture content through remotely sensed passive microwave sensors”**

Soil moisture is one of the most important environmental variable for regulating crop productivity. Remote sensing through passive microwave sensors provides global-scale patterns of soil moisture. However, most of these global datasets have a coarse spatial resolution of 0.25° latitude and longitude. Although satellite-based soil moisture is monitored pixel by pixel with high frequency, there is no guarantee that the pixel-level spatial variation is consistent with the spatial variation in agricultural fields. Without knowledge of the magnitude of errors or uncertainties in satellite-based soil moisture, the characterization of global-scale patterns is hardly reliable. In this study, the availability of satellite-based soil moisture is investigated using detailed datasets derived from flux tower sites.

**2) Minehiko FUKUOKA (Agro-Meteorology Division, NIAES)**

第 550 回

Date: Thursday, 27 November, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

**1) Masashi OKADA (Agro-Meteorology Division, NIAES)** (講演は日本語で実施)

**“Effectiveness and limitations of using irrigation for climate change adaptation in agriculture”**

Replacing a rainfed cropping system with an irrigated cropping system is assumed to be an effective measure for climate change adaptation. However, many previous agricultural impact assessments use fixed future irrigation scenarios that are sourced from statistical data or other independent studies and did not consider space-time-variations in the available agricultural water with changing climate conditions and land use. We therefore developed a large-scale coupled model for assessing both crop productivity and agricultural available water resources by embedding the PRYSBI-2 (Process-based Regional Yield Simulator with Bayesian Inference, version 2) large-area crop model into the global water resources model (called H08). In this seminar, I will introduce some results of the model's performance using the Songhua River watershed in China and discuss the effectiveness and the limitations of using irrigation for climate change adaptation.

**2) Keisuke ONO (Agro-Meteorology Division, NIAES)**

**“Assessing spatial representativeness of flux measurements at the Mase site”**

Spatial representativeness of measurements is important for interpreting tower flux data, particularly at agricultural sites in Asian countries because of their patchy land use. In general, spatial representativeness includes two different concepts: the source area and the point-to-area representativeness. The source area of a measurement can be defined as the area that directly affects the measurement. When we use a chamber, flux measurements represent only the area covered with the chamber. For tower measurements, however, it is hard to determine such a solid area because eddy covariance measurements are strongly dependent on atmospheric conditions: footprint models are often used for this purpose. On the other hand, the point-to-area representativeness is used to quantify

the extent to which a set of measurements at a point (i.e., a flux tower) reflects the actual aggregated conditions over an extended spatial domain (i.e., a whole ecosystem of interest) and a critical measure for upscaling of tower measurements. The Mase site, one of our flux stations, is in flat terrain and surrounded by rice paddies with similar cultivation practices. Nevertheless, the micro-scale variations in management and crop growth can be crucial for particular applications of flux measurements. Therefore, we assessed both of the spatial representativeness of eddy-covariance flux measurements collected at the Mase site. Some of the preliminary results are shown in the seminar.

#### 第 551 回

Date: Thursday, 18 December, 2014, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) Seiichiro YONEMURA (Agro-Meteorology Division, NIAES)**

###### **“Purification of air”**

The method to purify air is a basic technique in the measurements of gas exchange in ecosystems. Common several methods of the purification are illustrated and a purification system run in my laboratory is introduced in this presentation.

##### **2) Hiroki IKAWA (Agro-Meteorology Division, NIAES)**

###### **“Understory CO<sub>2</sub> and energy fluxes of a black spruce forest”**

I would like to introduce my work in the past few years as a post-doctoral researcher at the International Arctic Research Center, University of Alaska Fairbanks. Understory is one of the least understood components in carbon cycle in the high northern latitude regions. To quantify the understory CO<sub>2</sub> and energy fluxes and understand their environmental responses, eddy covariance (EC) measurements were performed above and within the canopy of a black spruce forest in interior Alaska. Gross primary productivity and evapotranspiration measured within the canopy were 80% and 100% of those measured above the canopy in 2011-2013. Because half the plant mass was allocated below the EC system within the canopy, our conservative estimates are that the understory contributed to 60% and nearly 100% of gross primary productivity and evapotranspiration of the ecosystem, respectively.

#### 第 552 回

Date: Thursday, 26 February, 2015, 13:30-15:30

Venue: Room No. 547, NIAES

##### **1) Motoki NISHIMORI (Agro-Meteorology Division, NIAES)**

###### **“MMLR-SD for multi-surface climate elements over Japan by using the general circulation field from reanalysis datasets, GCMs and RCMs”**

Multivariate multiple linear regression (MMLR) is employed for statistically downscaling of local-scale surface air temperature (T<sub>m</sub>), precipitation (Pr) and global solar radiation (Sr) over Japan. We compared and validated our results with direct outputs or bias-corrected dynamical downscaled (DD; RCMs-derived) data driven by the JRA-25 reanalysis dataset as same boundary conditions as the SD. As

the results, our MMLR-SD method has good estimation relative to the DDs' results even on daily time-scale.

Next, we examined MMLR-SD based on dynamically downscaled predictors, and the results are validated not only on Tm, Pr and Sr, but also on agriculture-related elements such as accumulated temperature and integrated solar radiation for crop growth periods.

## **2) Hidemitsu SAKAI (Agro-Meteorology Division, NIAES)**

### **第 553 回**

Date: Thursday, 12 March, 2015, 13:30-15:30

Venue: Room No. 547, NIAES

#### **1) Yasuhiro USUI (Agro-Meteorology Division, NIAES)**

##### **“Grain yield and quality under Free-Air CO<sub>2</sub> Enrichment (FACE) and soil/water warming”**

Rising temperatures are projected to reduce rice yield and quality by shortening growth periods and more frequent occurrences of heat stress, while increasing atmospheric CO<sub>2</sub> concentrations [CO<sub>2</sub>] can increase grain yield by promoting photosynthesis and biomass production. However, few open-field evaluations are available on the combined effects of temperature and [CO<sub>2</sub>], which limits our ability to predict future rice production. Under global warming, both air and soil temperatures are expected to rise. For irrigated rice, water temperature is the major factor that controls nutrient uptake, phenology and morphology, which ultimately affect yield and quality of rice. In this study, we attempted to determine the combined effects of elevated [CO<sub>2</sub>] (E-[CO<sub>2</sub>]) and water temperatures on the yield and quality of rice plants grown in open-fields.

#### **2) Mayumi YOSHIMOTO (Agro-Meteorology Division, NIAES)**

##### **“Elevated CO<sub>2</sub> alters the canopy micrometeorology”**

The increase of the atmospheric CO<sub>2</sub> directly affects the plant growth, physiology and productivity, but also indirectly affects them via the change of the canopy micrometeorology due to stomatal closure by the elevated CO<sub>2</sub>. Stomatal closure reduces leaf transpiration and elevates the canopy temperature by the decrease of evaporative cooling, which might accelerate the plant phenology and growth rate. Furthermore, the changes of thermal and hydrological environment inside the canopy might exacerbate the heat stress. It is essential to quantify those indirect effects of elevated CO<sub>2</sub> in order to accurately evaluate the crop production under the elevated CO<sub>2</sub> and global warming in the future. Free-Air CO<sub>2</sub> Enrichment (FACE) experiment provides us with a unique opportunity to observe the canopy micrometeorology under elevated CO<sub>2</sub>. We report the canopy micrometeorology observed in rice FACE experiment in Tsukubamirai, Ibaraki, Japan, and discuss the possibility of intensification of heat stress of rice by elevated CO<sub>2</sub> using the micrometeorological model.