Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW28-01 Room:101A Time:May 22 14:15-14:30

DThe estimation for temporal and spatial fluctuations of forest fire hazard index

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Mapped estimates of the risk of forest fire would benefit forest management, and could be used to decide restrictions on the public use of forest areas. In this study, the litter moisture content ratios were predicted with this model and forest fire hazard were estimated the forested parks in Japan. Model was adapted to the around 40ha area in this park classified into 9 stands with tree height, tree species and slope direction. Fuel moisture decreased with each speed for each forest stand among simulated days depending the solar radiation on the each forest floor. Litter moisture was less than 0.2g g-1 and fire risk is judged to be highest in 7 forest stands among 9 stands on the day after long drought period. On the otherhand, spatial variation of litter moisture was widest to be 0.198 - 0.811g g-1 on the day during the drying process. This means that litter drying speed and fire risk is different between forest stands. Thus, it is significant to construct the forest fire warning system for each forest stand to manage the people activities in this public forested area to prevent the forest fire.

Keywords: Fuel moisture, Solar radiation on the forest floor

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW28-02 Room:101A Time:May 22 14:30-14:45

Developing Distributed Hydrologic-Vegetation Dynamics Coupling Model: A Case Study in African River Basins

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We develop an eco-hydrological model (WEB-DHM + DVM) that can simulate vegetation growth, soil moisture, river discharge, ground water dynamics and land surface fluxes at the same time in river basin scales. Modeling of vegetation dynamics in a hydrological model makes it possible to discuss the integrated management of water resources and bioresources in river basins. Moreover, dynamic vegetation modeling can contribute climate and weather prediction because we have a strong feedback of vegetation distribution to regional climate through land-atmosphere interactions especially in semi-arid regions. Considering landscape changes driven by human exploitation and climate change, we need to calculate vegetation dynamics as a diagnostic valuable in a basin-scale hydrological model. We apply the model to the Medjerda River Basin located in North Africa for a model confirmation study. The simulated river discharge has a good agreement with the in-situ observed river discharge. In addition, we show the model has adequate capacity for simulating vegetation dynamics in the semi-arid region by comparing simulated leaf area index (LAI) with the Moderate Resolution Imaging Spectroradiometer (MODIS) 8-daily LAI product. We also demonstrate the assessment of climate change impact on vegetation dynamics in the Volta River Basin located in West Africa by using WEB-DHM + DVM and multi General Circulation Models (GCMs) output. Our future projections and sensitivity analyses show that an extension of dry season duration and high land surface temperature produced by climate change may cause a dieback of vegetation in West Africa, while an increase of atmospheric humidity has a positive impact on vegetation growth. The negative impacts of certain climate forcings sometimes overwhelm the positive impacts of the other forcings, and positive and negative impacts sometimes cancel each other. Thus, there are different magnitudes of change in biomass amount in different GCMs, although we select three GCMs whose climatologies agree well with past climate. This approach demonstrates that multi-model climate change assessment is crucial, and the sensitivity analysis developed here is useful for extracting principal environmental drivers of terrestrial biomass under a changing climate. The method in this study makes it possible to address the impact of future change of terrestrial biomass on climate and water resources on a regional scale.

Keywords: vegetation dynamics, distributed hydrological model, climate change

Japan Geoscience Union Meeting 2013
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AHW28-03 Room:101A Time:May 22 14:45-15:00

Separation of ET in Nile delta into transpiration and evaporation (E) by canopy model and E reduction by windbreak trees

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Agriculture can be considered as human intervention to the regional ecosystems. Thus its influence to hydrologic cycle is one of the important contemporary issues. In the present study, evapotranspiration (ET) of cropland in Nile delta was determined by applying eddy correlation method. In addition, 2-layer canopy model was applied to separate ET into soil evaporation (E) and transpiration (T). It was found that in the furrow period in 2011, ET (=E) was 221 mm for 2 months, while in growing season of maize ET was some 554 mm with T=256 mm and E=298 mm. With introduction of windbreak trees to the edge of cropland in the direction of prevailing wind direction, both E and T were reduced some 20-25% during growing season, and E was reduced by 30% during furrow period. Transpiration of wind break trees were found to be a minor component.

Keywords: Nile-delta, croplands, evapotranspiration, soil evaporation and transpiration, Windbreak trees

Japan Geoscience Union Meeting 2013
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AHW28-04 Room:101A Time:May 22 15:00-15:15

CO2 flux over the Lake Kasumigaura and factors influencing its variation: a preliminaly analysis of 5-year observation

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In this research, CO2 flux over the Lake Kasumigaura was measured mainly with eddy correlation method at the center observatory from June in 2007 to November in 2012 for five years. It was found that CO2 flux of hourly time scale changed in the range of about -0.5˜0.5 mg/m2/s.Absorption and release of CO2 occurred alternatively,and both processes occurred both in the daytime and the night. Comparison with previous studies indicated that the CO2 flux over a unit area over the Lake Kasumigaura was slightly smaller than that of a forest, and larger than that of a prairie,and several orders of magnitude larger than that of the ocean. With regards CO2 flux changes on seasonally time scale, it was found that the amount of daily CO2 release differed greatly in the range of about -10˜10 g/m2/day. The amount of the 10-day average CO2 release changed in the range of about -6˜2 g/m2/day regardless of the season through the whole period. However,negative flux was dominant in most of the time. A change of the dissolved CO2 levels Cw of the lake was found to be a factor of CO2 flux change on seasonally time scale. There are an internal factors and an external factors that affect Cw values. Cw change cannot be attributed to a single factor, but various factors work simultaneously and intricately.

Keywords: eddy correlation method, Lake Kasumigaura, CO2 flux, photosynthesis, phytoplankton

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW28-05 Room:101A Time:May 22 15:15-15:30

Changes in watershed environments and water balance of Lake Kasumigaura from 1970s to present

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Water balance of Lake Kasumigaura was estimated by Muraoka (1981) for 1970s. Since then, watershed environments have been changed drastically; also human interventions to the water balance have been made in various forms. However, systematic and comprehensive estimation of water balance has not been carried out. Thus in the present study, first the same methods of Muraoka (1981) were applied to the present measurements to estimate water balance. Next, some of the water balance components which have become available with advent of better measurements technology were employed. Among them is the lake surface evaporation.

As a result, annual inflow and outflow of Lake Kasumigaura increased by about 30%. Main cause of this increase was the increase of artificial flow (both intake and outflow) such as service water, industrial water, and treated sewage. Natural hydrologic flow such as river and groundwater discharge also increased but by smaller amount of 5 - 35%.

Keywords: water balance, Lake Kasumigaura, water intake, hydrological cycle

Japan Geoscience Union Meeting 2013
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AHW28-06 Room:101A Time:May 22 15:45-16:00

Year-round observation of energy balance components within a permafrost black spruce forest in interior Alaska

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Black spruce is one of the most abundant forest types in the North American boreal forest, also occupying approximately 44 % of the forest cover in interior Alaska. In this study, energy balance components such as radiation and eddy covariance fluxes were observed year-round in 2011, within a black spruce forest underlain by permafrost at the University of Alaska Fairbanks Poker Flat Research Range, located in interior Alaska. This research was conducted under the JAMSTEC-IARC Collaboration Study, with funding provided by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) under a grant to the International Arctic Research Center (IARC).

Here, if ground heat flux was observed using the default value of thermal conductivity, the sum of sensible and latent heat flux exceeded the available energy in summer. By multiplying the correction factor of 0.74 by ground heat flux, the deficit of energy balance was minimal. This 0.74 value was consistent with the thermal conductivity of the heat flux plate (HFP01SC) value of 0.8 W m^{-1} K^{-1}, whereas the maximum Sphagnum thermal conductivity has been reported to have ranged from 0.5 to 0.6 W m^{-1} K^{-1} at high volumetric water content. As a result, the energy balance of this black spruce forest was almost closed in summer, and ground heat flux was proven to play an important role in energy balance, explaining 26.5 % of the net radiation in summer.

On the other hand, a large energy balance deficit was observed in spring. The energy balance deficit during the snowmelt season was mostly explained by the latent heat energy of fusion consumed by snowmelt, which was calculated from the observed snow water equivalent.

The mean daily evapotranspiration of this forest in summer was 1.37 mm day^{-1}, considered typical for boreal forests. Further, the annual evapotranspiration and sublimation amounted to 207.3 mm $year^{-1}$, which was much smaller than the annual precipitation, and sublimation accounted for 8.8 % (18.2 mm $year^{-1}$) of this annual total value. Thus, sublimation is *not* negligible in the annual water balance for boreal forests.

Keywords: energy balance, black spruce, permafrost, ground heat flux, evapotranpiration, sublimation

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(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW28-07 Room:101A Time:May 22 16:15-16:36

Climate change and the ecohydrological feedback of Siberian permafrost ecosystems

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High levels of precipitation in the Lena River Basin, Siberia, from 2005 to 2008 led to tremendous changes in terrestrial environments. The changes observed include a deepening and moistening of the active layers, hindrance of tree growth, and the expansion of water surfaces due to floods. The anomalously wet condition of forest soils caused larch trees to wither at our forest monitoring site in the middle part of the basin. However an analysis of satellite data revealed that such tree withering occurred only at certain points. On the basis of our permafrost-ecosystem models, we have identified increases in thawing depth and surface soil moisture, and an increase in net primary production. The annual maximum thawing depth (AMTD) was revealed to have gradually increased (deepened) on a decadal scale. Increase in terrestrial water storage in the Lena River Basin generated increases in river base flows during the open water season. Our results also indicated that between 1950 and 2008 the basin-scale AMTD increased at an average rate of approximately 1 cm/year in the region. Moistening and warming of surface soil affect methane emissions from Siberian terrestrial ecosystems. Regional methane fluxes were estimated using an inversion model with data collected from aircraft and tower measurements in Siberia. In 2007 and 2008, enhanced methane fluxes from the wetlands in Western Siberia were estimated under relatively wet conditions with high temperatures. Interestingly, methane fluxes after 2008 have gradually decreased but those in Eastern Siberia have increased unsymmetrically. Such an unsymmetrical (seesaw) pattern between Western and Eastern Siberia has also been observed for carbon dioxide exchanges in terrestrial ecosystems. Gross primary production and ecosystem respiration in the 2000s were estimated using our permafrost-ecosystem models, which showed a decreasing trend in Western Siberia and an increasing trend in Eastern Siberia. These differences were primarily due to the differences in the trends of temperature and precipitation between the two regions.

Keywords: global warming, permafrost, annual maximum thawing depth (AMTD), methane, carbon dioxide

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AHW28-08 Room:101A Time:May 22 16:36-16:51

Methane flux observation over a forest ecosystem by micrometeorological and chamber methods using laser based analyzers

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Recent applicability of laser-based analyzers allows the FLUXNET community continuously measure methane flux over various terrestrial ecosystems with high precisions. Such measurements have mainly conducted at ecosystems, such as wetland and agricultural land, which are expected to be an obvious methane source. On the other hand, measurements at forest ecosystems are limited in part due to difficulty in measuring approximately 1-order smaller magnitude of fluxes than those of emission fluxes. In this study, we have conducted a continuous measurement of methane flux over a forest in order to quantify the spatially representative flux, understand processes, and improve our ability to measure the fluxes.

The measurement was conducted at Fujihokuroku Flux Research site in Yamanashi, Japan. A 50-year-old stand of planted Japanese larches dominates on volcanic ash soils, homogeneously. The hyperbolic relaxed eddy accumulation (HREA) method was applied to measure canopy scale fluxes since August, 2011. Five-height vertical methane concentration profile was also measured by same system switched flow lines. The robustness of the HREA method was confirmed by compared CO2 fluxes with the eddy covariance and HREA method. The measured fluxes were corrected for storage terms. The automated dynamic closed chambers were installed at six plots in the forest soil since October 2012. Concentration of methane, CO2, and water vapor were measured by flowing sample air from the HREA and chamber systems to respective laser-based analyzers (GGA-24r-EP and FGGA-24r-EP, Los Gatos Research Inc., USA) after dehydration. The analyzers were conducted two-point calibrations everyday, where there was no detectable change in the sensitivity.

Throughout the measurement period from August 2011 to December 2012, methane uptake was measured by the HREA method. The methane uptake showed a clear seasonal variation roughly coinciding with seasonality in soil temperature near the ground, where sensitivity to soil temperature (Q10) was 1.8. The methane uptake decreased to near zero at winter when the forest floor was covered by snow (approximately 30 cm depth). As previously reported for CO2 fluxes, the annual methane sink strongly changed with the friction velocity (u$*$) filtering correction. The annual sink was 900 mg CH4 m-2 y-1 with the u$*$-filtering correction and 700 mg CH4 m-2 y-1 without the u$*$-filtering correction. Based on the profile system, methane concentration was most depleted near the soil surface, indicating that measured methane sink mostly associated with soil processes. This was also consistent with the chamber measurement, where measured fluxes by the HREA and chamber systems were similar range.

Keywords: Methane flux, HREA method, automated dynamic chamber method, forest, continuous observation, laser-based analyzer

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AHW28-09 Room:101A Time:May 22 16:51-17:06

Carbon dioxide balance of tropical peat ecosystems

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Tropical peatlands, which are widely distributed on lowlands in Southeast Asia, have accumulated a huge amount of soil carbon under peat swamp forests over millennia. However, the carbon pool is presently disturbed on a large scale by land development and management, and consequently has become vulnerable. Peat degradation occurs most rapidly and massively in Indonesia, because of fires, drainage and deforestation of swamp forests. Peat fires release carbon dioxide (CO_2) through peat combustion intensively but occasionally, whereas drainage increases CO_2 emission steadily through the acceleration of oxidative peat decomposition. Therefore, tropical peatlands present the threat of switching from a carbon sink to a carbon source to the atmosphere. However, the ecosystem-scale CO_2 exchange is still unknown in tropical peatlands. A long-term field experiment in Central Kalimantan, Indonesia showed that tropical peat ecosystems, including a relatively intact peat swamp forest with little drainage (UF), a drained swamp forest (DF) and a drained burnt area (DB, a former swamp forest), functioned as net carbon sources. Mean annual net ecosystem CO_2 exchange (NEE) (with a standard deviation) for four years from July 2004 to July 2008 was 174 with 203, 328 with 204 and 499 with 72 gC m^{-2} y^{-1}, respectively, for the UF, DF and DB sites. The carbon emissions increased according to disturbance degrees. We found that the carbon balance of each ecosystem was chiefly controlled by groundwater level (GWL). The NEE showed a linear relationship with GWL on an annual basis. The relationships suggest that GWL lowering of every 0.1 m causes additional net annual CO_2 emissions of 79-238 gC m^{-2} probably because of the enhancement of oxidative peat decomposition. In addition, CO_2 uptake by vegetation photosynthesis was reduced by shading due to dense smoke from peat fires ignited accidentally or for agricultural practices. Our results may indicate that tropical peatland ecosystems are no longer a carbon sink under the pressure of human activities.

Keywords: drainage, draught, eddy covariance technique, ENSO, fire

Japan Geoscience Union Meeting 2013
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AHW28-10 Room:101A Time:May 22 17:06-17:30

Nutrient limitation and the responses of the carbon dynamics in forest ecosystems to global change

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It is well known that net primary productivity and/or decomposition rate can be limited by nutrients when climate is mild. Particularly because phosphorus and nitrogen are directly involved in the carboxylation biochemical processes, the rate of carbon fixation in forest ecosystems can become lowered when the supply of these nutrients is low. The magnitude of the responses of forest ecosystems to global warming can be, thus, dependent on the strength of nutrient limitation. It is expected that the temperature dependency of the net primary productivity of a forest is low if the forest is strongly limited by nutrients. However, how/if such interactions of nutrients and temperature occur in natural forest ecosystems has not been elucidated well. In order to investigate such a research question, I and co-workers are comparing two altitudinal gradients (one phosphorus-impoverished and the other relatively phosphorus richer) on a humid tropical mountain. Our long-term observation indicates that trees adjust phosphorus-use efficiency when the demand for phosphorus co-varies with temperature and maintain net primary productivity despites the strong phosphorus limitation. Our results indicate that the temperature dependency of the net primary productivity under a strong nutrient limitation can be greater than expected earlier.

Keywords: Nutrients, P-use efficiency, Net primary productivity, Tropical rain forest, Altitude gradient, Carbon dynamics

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(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW28-11 Room:101A Time:May 22 17:30-17:45

^{13}C pulse labeling technique for study carbon allocation in tree

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Carbon is fixed by photosynthesis of plant and used for growth or storage, then finally released to atmosphere by respiration. It is necessary for better understanding of future climate change to construct process based model and estimate which and how factors affect carbon allocation in forest ecosystems. As one of the methods to analyze carbon balance, pulse labeling technique will be introduced. It is a method to trace stable carbon isotope which is fixed by the tree to see when and where carbon goes. By this method, the velocities of carbon of different tree species and its seasonal dependency were observed. Some experiments conducted in both Japan and abroad will be shown.

Keywords: Stable carbon isotope, pulse labeling, carbon allocation, ^{13}C

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW28-12 Room:101A Time:May 22 17:45-18:00

Japan Long-Term Ecological Research Network (JaLTER)

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JaLTER was established in November 2006 to provide scientific knowledge which contributes to conservation, advancement and sustainability of environment, ecosystem services, productivity and biodiversity for a society by conducting long-term and interdisciplinary research in ecological science including human dimensions. JaLTER is a formal member network of the International Long-Term Ecological Research Network (ILTER Network). JaLTER contains 56 sites including forests, grasslands, cropland, freshwater and marine. The goal of JaLTER are (1) Creation of general knowledge based on multidisciplinary long-term and large-scale research, (2) Creation of well-designed database to exchange and share original data to support scientific communities, general public people and policy makers, and to find better solutions for critical ecological and environmental problems, (3) Promotion of education regarding long-term and large-scale changes of ecosystem and environment. (4) Facilitation of collaboration and coordination among scientists of long-term ecological researches. To achieve these goals, we are promoting research theme such as (a) Response and feedback of biodiversity and ecosystem functioning under the climate changes, (b) Hydro-biogeochemical processes and ecosystem interaction from terrestrial to marine ecosystem, (c) Development and establishment of ecosystem monitoring network and techniques with multiple scales and dimensions.

In addition to the site-network based research on ecological theme, JaLTER has been promoting to link ecosystem research networks and institutes, so called ”J-community”, by JaLTER, JapanFlux (CO2 flux network), JAXA (Japan Aero-Space Agency) and JAMSTEC (Japan Agency for Marine-Earth Science and Technology). The J-community was established to meet multidisciplinary research on ecosystem structure, function and biodiversity under climate change. As part of this activity, a joint research project to develop earth observation algorithm by a new earth observation satellite ”GCOM-C” has been conducted since 2009. In addition, recently, new projects were established to clarify the relationship between biodiversity and ecosystem functions, and to evaluate their vulnerability to environmental changes.

Keywords: LTER, ecological research, ecosystem, biodiversity