Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-01 Room:IC Time:May 21 09:00-09:30

Two kinds of effects for storm-runoff mitigation and the role of forest

TANI, Makoto[1*]

[1]Graduate School of Agriculture, Kyoto University

Flattening of a rainfall waveform into a runoff waveform is derived from the fluctuating of water storage in a catchment. However, because a catchment consists of plural flow components with different time scales, an allocation of rainwater into these components and an effect of water storage fluctuation within each component both have different influences on the hydrograph response.

In a mountainous topography due to a high tectonic activity like Japan, the time scale is approximately divided into two: storm- and baseflow components. When the allocation of rainwater to stormflow is smaller, the weight of baseflow is larger and the storm hydrograph is more flattened. If the allocation is the same, the hydrograph is more flattened for a storm flow component with a larger fluctuation of water storage.

If the stormflow component consists of two or more sub-components, the rainwater allocation to each of them would give a similar influence on the storm hydrograph to that for the allocation to the storm- and baseflow components. This assumption is reflected to Takasao's runoff model where the saturation overland flow may occur where the A layer is saturated, Nevertheless, the author has not obtained a result that the flow is transited to a component with a shorter time scale predicted by Takasao's model.

Hillslope hydrology suggests that stormflow is yielded by saturated subsurface flow within a soil layer including preferential pathways and that this system is robust for a large scale storm. This robustness is created through soil layer development accompanied with the both developments of tree-root system and preferential pathways contributing to the stability of soil layer against the landslide initiation on a steep slope.

Although the rainwater allocation is mainly controlled by the geology unrelated to forest, the effect of water storage fluctuation within a soil layer supported by the root system is robust for large storm events. This is the most important role of forest in the storm-runoff mitigation.

Keywords: forest influences, hillslope hydrology, rainfall runoff response, stormflow mitigation, subsurface flow, Takasao's runoff model

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-02 Room:IC Time:May 21 09:30-10:00

Collapse prevention force of forest root systems in mountainous steep slopes

KITAHARA, Hikaru[1*]

[1]Faculty of Agri.,Shinshu Univ.

Though traditinal methods of thinking for slope stability with forest root systems have been used for two dimentional soil layer, it evaluated to only vartical root systems. Slope collapses occur three dimention. On the analysis of slope stability, it is necessary to evaluate the horizontal root systems. This report shows that the collapse prevention force(C,kN/m2) of the horizontal root systems as the cohesion value in Coulomb's equation in the various species, various stand density,and various age of forest. Culculate method of C is summarized the pulling force for root diameter in vertical one square meter of soil layer. The smallest point of C in the artificial Hinoki forest and Larix forest is the center between two stands. The C in the saturated soil condition is 70% of the ordinary condition. The C changes for tree species,stand density. Thinnig makes C value twice as large as the no thinnig. Three dimentional analysis for slope stability shows the horizontal root systems is up to 0.2 for the rate of slope stability in the saturated soil condition. Maximum C for stand density is about 900/ha.

Keywords: root system, collapse prevention, mountainous slope, forest, Coulomb's equation, slope stability

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-03 Room:IC Time:May 21 10:00-10:30

Rainfall-Runoff-Inundation Analysis of 2011 Thailand Flood in the Chao Phraya River Basin

SAYAMA, Takahiro[1*], TATEBE Yuya[1], TANAKA Shigenobu[1]

[1]ICHARM, PWRI

A large amount of rainfall during the 2011 monsoonal season caused an unprecedented flood disaster over the Chao Phraya River basin in Thailand. The number of death and missing tolls exceeded 800 people. Flooding caused severe damage even to urban life in Northern part of Bangkok. Furthermore, several industrial zones with factories of foreign capitals were also severely damaged. Because of economic globalization, the flooding influenced the world's supply chains and its economic impact was immediately felt by other countries.

In mid-October 2011, ICHARM decided to conduct quick response-type simulations. The aims of the simulation were to understand the basin's flood situation holistically and predict the possible development of the large scale flooding with available satellite-based information. The model used in this study was based on two-dimensional diffusive wave equations for rainfall-runoff and inundation calculations. The model takes into account the effects of lateral subsurface flow and vertical infiltration flow since these two types of flow are also important processes.

This paper presents prediction results obtained in mid-October 2011, when the flooding in Thailand was approaching to its peak. Our scientific question was how well we can predict the possible development of a large-scale flooding event with limited information and how much we can improve the prediction with more local information. To address the questions, we compare simulation results with assumed conditions in the quick response simulation and the one reflecting more local information by means of adjusting satellite based rainfall with gauged rainfall, incorporating evapotranspiration effects, updating river cross section information, setting tidal boundary conditions, etc. The analysis revealed the importance of evapotranspiration for better flood predictions. The impact of evapotranspiration for mitigating the long-term and large scale flooding and how to incorporate the effect into the prediction will be also discussed.

By conducting the prediction and validation for the Thailand flooding, quite a few important aspects became clear concerning the current simulation model: what the current model can and cannot predict and what information we should prioritize as input over other information. Conducting this kind of prediction and validation repeatedly for large-scale flooding events in the world can reduce prediction uncertainty and also help understand hydrologic processes at the large river basin scale.

Keywords: flood, hydrology, Thailand, Chao Phraya River, Rainfall-Runoff-Inundation

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-04 Room:IC Time:May 21 10:45-11:15

Climate change impact assessment of water related natural hazards in Japan

NAKAKITA, Eiichi[1*]

[1]Eiichi Nakakita, [2]Kyoto University's Kakushin group

Under the KAKUSHIN Program, Meteorological Research Institute (MRI) of Japan Meteorological Agency, Disaster Prevention Research Institute (DPRI) of Kyoto University, and International Centre for Water Hazard and Risk Management (ICHARM) of Public Works Research Institute (PWRI) have been performing climate projections for the near future and for the end of the 21st century using atmospheric models of unprecedented super-high-resolution. The climate change studies have been based on a global 20-km mesh atmospheric general circulation model (GCM); emphasis has been placed on extreme events, including tropical cyclones and heavy precipitation during the East Asian summer monsoon season.

DPRI has been performing "Prediction and evaluation of disaster environment in Japan" with the sub-project title of "Integrated assessment of climate change impacts on watersheds in a disaster environment". One of the important subjects in this sub-project is the interface between GCM and RCM, and various models on natural hazard. For example, MRI slightly changed its GCM and RCM so that they could output hourly rainfall from GCM. It is the typhoon resolving output from the GCM that has realized the impact assessment on Japanese river regime. Namely, GCM with the super-high spatio-temporal resolutions (20 km-1 hour) made it possible to evaluate extreme hazard (ex. Max. discharge) in Japan. (However, we must make sure that this does not mean that we can evaluate the changes in such a high spatial resolution.

Results from typical climate change assessments on disaster environment in Japan will be shown as projections of change in design value. Most of the design value is expected to increase as expectation. This means that we can get approximate projection on changes in return period of extreme events. However, there is a risk that the return period does not have enough accuracy. Also, there is no guarantee that quite extreme events could be properly projected within the limited number of ensembles as GCM output with such a high resolution. On the other hand, the risk management deals with phenomena beyond design hazards. In this sense, it is very important to take into account the result from the worst case scenario, which was produced by a physically based virtual shifts of typhoon track, as one of the forcing for risk management on climate change. Taking into consideration above items, it is very important for climate change adaptation to discriminate more between planning with uncertain design level and risk management with the worst case scenario.

Keywords: climate change, global warming, heavy rainfall, typhoon, extreme events, disaster

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-05 Room:IC Time:May 21 11:15-11:45

What should be considered for coping with huge floods when only small to medium size historical data are available?

SHIIBA, Michiharu[1*]

[1]Graduate School of Engineering, KyotoUniversity

It is shortsighted to insist that it is impossible to forecast huge floods events when only small to medium size historical flood data. It is important to figure out the non-linearity of flow and the structural non-linearity of flow fields. The most important thing to be considered during identification processes is to figure out the non-linearity of flow and the structural non-linearity of flow fields rather than to fitting of model parameters.

Keywords: huge floods, small to medium size floods, identification, non-linearity, model structure

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-06 Room:IC Time:May 21 11:45-12:15

Analysis of the heavy flood at the Kumano River basin in 2011

TACHIKAWA, Yasuto[1*], KIM Sunmin[1], MENO Takashi[1], SHIIBA Michiharu[1], YOROZU Kazuaki[1]

[1]Dept. of Civil and Earth Resources Eng., Graduate School of Engineering, Kyoto University

Historical heavy flood occurred at the Kumano River basin from August 23 to September 5 in 2011 by the Typhoon 12. The peak discharge of the flood at the Ouga station (2,251km^2), the reference point to develop a flood control plan for the Kumano River basin, was estimated to exceed the design flood 19,000m^3/s. The water level of the flood was far exceeding the past floods, thus the estimated discharge using the rating curve includes uncertainties. In this study, we examined the uncertainty to estimate the largest-ever flood using a distributed hydrologic model with parameter values identified by using the past medium scale floods, and then we estimated the flood discharge using the distributed hydrologic model in terms of rainfall-runoff relationship.

A procedure for the analysis was as follows:

1) A catchment model was developed using a digital elevation model. The flow direction of the catchment was modeled using the 8-direction method, which assumes the flow direction 1-dimensionally to the steepest gradient direction. Each slope unit, determined by the flow direction, was represented by a rectangle formed by the two adjacent nodes of the DEM. The spatial resolution of the topographic data was 250m. The catchment model was constructed as a network of rectangles. Each rectangular unit was used for the element of runoff flow simulation [1][2].

2) The kinematic wave flow model was applied to slope and river flow, to route the water downstream according to the flow direction information. A discharge-depth relationship including soil moisture was introduced to the kinematic wave model [3], which forms a unit of a distributed hydrologic model [4].

3) The study area has several dam reservoirs. The catchment model was sub-divided at the locations of the dam reservoirs and model parameter values were identified for each sub-catchment.

4) The past seven floods at 1990, 1994, 1997, 2001, 2003, 2004A and 2004B were selected. The best fitted model parameter values were identified for each flood using the SCE-UA method [5].

5) Two kinds of rainfall data, the ground-based observation data by the Electric Power Development Co., Ltd. and the Radar/Raingauge-Analyzed Precipitation data by Japan Meteorological Agency were used. The best fitted model parameters were identified for each rainfall data. Then, the past floods were reproduced using the best fitted parameter values identified by other floods.

Through the analysis, we found that the best fitted model parameters related to surface soil characteristics differed according to floods, however the difference of the simulated discharges using these parameters was quite small. This shows the low sensitivities of model parameters because of the large amount of flood discharge than the stored water in the soil layer.

Finally, we estimated the peak discharge of the heavy flood in 2011 at Ouga, which was in the range from 23,115 to 26,098 m^3/s. We should carefully use observed river discharge estimated by a rating curve, especially when the water stage was far exceeding the past floods. To develop a new method to estimate/assimilate river discharge using observation, a hydrologic model and a 2-dimensional river routing model is the next step.

[1] Shiiba, Ichikawa, Sakakibara, Tachikawa: A new numerical representation form of basin topography, J. of JSCE, 621/II-47, 1-9, 1999.

[2] Hydrology and Water Resources Research Lab., Kyoto Univ.: GeoHyMoS, http://hywr.kuciv.kyoto-u.ac.jp/geohymos/geohymos.html

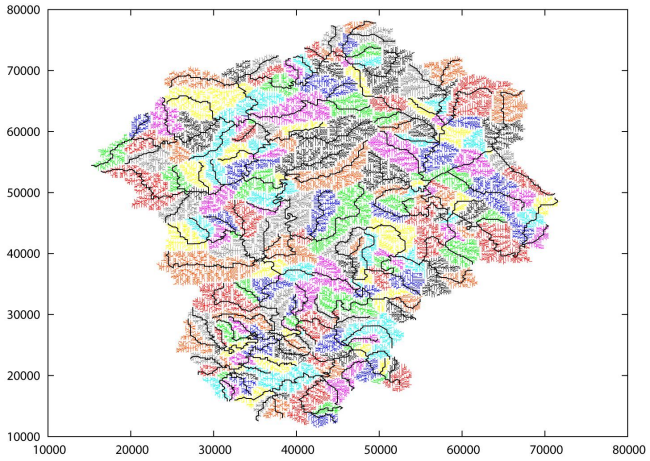
[3] Tachikawa, Nagatani, Takara: Development of stage-discharge relationship equation incorporating saturated-unsaturated flow mechanism, Annual J. of Hyd. Eng., JSCE, 48, 7-12, 2004.

[4] Ichikawa, Murakami, Tachikawa, Shiiba: Development of a basin runoff simulation system based on a new digital topographic model, J. of JSCE, 691/II-57, 43-52, 2001.

[5] Duan, Sorooshian, Gupta: Optimal use of the SCE-UA global optimization method for calibrating watershed models, J. of Hydrol., 158, 265-284, 1994.

Keywords: flood, Kumano River, Tyhoon 12, rainfall-runoff model, runoff prediction, design flood

U05-06 Room:IC Time:May 21 11:45-12:15



Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-07 Room:IC Time:May 21 13:45-14:00

Observation of water discharge increase from the forested catchments just after the 2011 Tohoku earthquake.

TSUBOYAMA, Yoshio[1*], TAMAI, Koji[1], SHIMIZU Takanori[1], KUBOTA Tayoko[2], IIDA Shin'ichi[1], NOBUHIRO Tatsuhiko[1], SAWANO Shinji[1]

[1]Forestry and Forest Products Research Institute, [2]Tohoku Research Center, Forestry and Forest Products Research Institute

The tremor with an intensity on the Japanese seven-stage seismic scale was observed at 6- at maximum in Ibaraki prefecture by the 2011 Tohoku earthquake. Forestry and Forest Products Research Institute performs the hydrological observation at 5 watersheds in 3 observation sites named Hitachi-Ohta (Hitachi-Ohta city), Katsura (Shirosato Town) and Tsukuba (Ishioka city) in Ibaraki Prefecture. The water level was observed to increase around 4-10mm just after the earthquake in these all watersheds. Maximum height was observed at 3 ? 6 hours later than earthquake. The snow did not cover at that time. Landslides also did not observed after the earthquake. Thus the water discharge increase was supposed to be caused by tremor of the forest ground.

Keywords: Mountanious watershed, 2011 Tohoku earthquake, Water discharge observation, Ibaraki Prefecture

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-08 Room:IC Time:May 21 14:00-14:15

Estimation groundwater recharge using DFM and water budget in different land use

KUDO, Keishi[1*], Jun Shimada[1], Atsushi Maruyama[2], Nobuhiro Tanaka[3]

[1]Graduate School of Science and Technology, [2]Kyushu Okinawa Agricultural Research Center, [3]Kumamoto prefecture office

City of Kumamoto is located in Southwestern Japan and has a population of about 0.7 million people. Kumamoto region is a unique area in Japan because almost 100% of the tap water supply in this region is dependent on groundwater. Prefecture government of the Kumamoto has much concern about the sustainable use of groundwater resources for their future generations. Thus, Groundwater recharge rate was estimated by using Displacement Flow Model and water budget ware studied in two adjacent forest and grassland watersheds at the western foot of Mt. Aso known as recharge area of major local aquifer of Kumamoto region. The forest watershed consists mainly of Japanese cypress plantations. But the surrounding areas have Japanese cedar and mix forest. The grassland watershed consists mainly of pasture and Japanese silver grass. The geological structure of both watersheds consists of the Aso-2 pyroclastic sediments. The soil structure of forest watershed is laid on tuff, volcanic ash 1 and litter from the bottom. On the other hand, the soil structure of grassland watershed is laid over andesites, volcanic ash 1 and 2. As for the hydrometric observation system for each catchments, parshall flume runoff weir for the river discharge, meteoric tower for the evapo-transpiration monitoring purpose, and precipitation gage are installed to calculate groundwater recharge rate by catchment scale water balance method. Also soil column profile was taken for each catchments to evaluate the vertical recharge rate and soil water movement through unsaturated soil.

Normally, water budget is expressed by P-E-R=I, P is rainfall, E is evapotranspiration, R is runoff and I is groundwater recharge, respectively. However, this study has been conducted detail water budget that stream discharge component was separated direct runoff and groundwater runoff components. Stream discharge composed of groundwater runoff and direct runoff components ratio was decided by two component hydrograph separation during two different rain storms. EC value as a tracer for two component hydrograph separation was applied to a two storm events. Two storms from dry and wet soil conditions in forest watershed, old water percentages at the hydrograph peak was estimated from EC value as a tracer for two component hydrograph separation were almost 100% and 37%, respectively. Two storms from dry and wet soil conditions in grassland watershed, old water percentages at the hydrograph peak was estimated from EC value as a tracer for two component hydrograph separation were 40% and 43%, respectively. Groundwater recharge rate in forest watershed was estimated using detail water budget and it was less than grassland watershed. On the other hand, groundwater recharge rate in forest watershed was estimated using displacement flow model that was estimated groundwater recharge rate from stable isotope composition of rainfall and soil water contain unsaturated zone and it was large than grassland watershed. Groundwater recharge rate in forest watershed agreed two results, water budget and displacement flow model using unsaturated soil zone stable isotope profiles. Groundwater recharge rate from water budget was larger than Displacement flow model using unsaturated soil zone stable isotope profiles in grassland watershed. But, there is a possibility for large error because number of events of two component hydrograph separation or short term of observation in detail water budget. Thus, Groundwater recharge rate from Displacement flow model using unsaturated soil zone stable isotope profiles was suggested reasonable value in both forest and grassland watersheds. As a future work, it is necessary to re-evaluate groundwater recharge rate from water budget and enrich accuracy of observation by keep observing.

Keywords: Groundwater recharge, Water budget, Displacement Flow Model, vegetation

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-09 Room:IC Time:May 21 14:15-14:30

Influence of rainfall increase according to heavy rain and typhoon on nitrogen exports in a forested watershed

SHINOMIYA, Yoshiki[1*], OHDOSHI Kunio[2], YOKOYAMA Yuichi[3], NAKAYAMA Kenji[3]

[1]Forestry and Forest Products Research Institut, [2]Kochi University, [3]Yonden Consultants Co., Inc.

As the rainfall increases, the nitrogen runoff tends to increase in a forested catchment. Therefore, it is expected that runoff of nutrients such as nitrogen and suspended sediments increase from a forested catchment when the rainfall increases by a frequency increase of the heavy rain and the occurrence of a super-typhoon. There is a possibility to influence the river water quality and the stream ecosystem. It was thought that it was one method to actually evaluate the nutrients and suspended sediments dynamics in the forest in the region where the frequency of the heavy rain was high for the more accurate prediction in the future concerning nitrogen output and suspended sediments discharge. In this study, based on the observation in a forested catchment where annual rainfall is more than 2500 mm and the frequency of the heavy rain is high (a southwestern part of Kochi Prefecture, Shimanto River headwaters), the nitrate dynamics were investigated when the total rainfall and annual rainfall increases. The amount of the runoff water was observed in Yusuhara town (YS catchment) and Tsuno town (HT catchment) in Kochi Prefecture, and a regular collecting stream water of the frequency of once or twice a month and was done. Stream water at the runoff was obtained by an automatic water sampler. After it had filtered it, nitrate concentration was analyzed by the ion chromatography. As a result, 1) the relationship between the amount of a total runoff water of one rainfall and the nitrate runoff of one rainfall becomes a tendency of reaching the peak. 2) There is no correlation with the volume of water (rainfall depth and discharge) during year and the annual nitrate runoff. 3) It was thought that the variation in nitrate concentration in stream water observed at the runoff according to the typhoon of the total rainfall 212 mm May, 2011 and total rainfall 742 mm August of the same year in the HT catchment, was almost similar to that in the YS catchment (First,the nitrate concentration rose once and a remarkable decrease, and then the continuance of low concentration), and this may suggest a universality of findings in the YS catchment.

Keywords: heavy rain, typhoon, inorganic nitrogen, forest, streamwater

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-10 Room:IC Time:May 21 14:30-14:45

Transpiration evaluated by sap flow measurements and bandpass eddy covariance method in a Cambodian deciduous forest

IIDA, Shin'ichi[1*], Takanori SHIMIZU[1], Koji TAMAI[1], Naoki KABEYA[2], Akira SHIMIZU[2], Sophal CHANN[3], Nang KETH[3]

[1]Department of Soil and Water Conservation, Forestry and Forest Products Research Institute, Japan, [2]Kyushu Research Center, Forestry and Forest Products Research Institute, Japan, [3]Institute of Forest-Wildlife Research and Development, Cambodia

Introduction

Cambodia still retains forests in the lowland plains, unlike Thailand and Vietnam, where the remaining forests are mostly in mountainous areas (Tani et al., 2007). However, few studies have examined the hydrologic and/or environmental processes in the unique and valuable forests in Cambodia. Recently, intensive observations were started and knowledge of hydrologic and ecological features is accumulating for the evergreen forest located in Kampong Thom province, Cambodia (e.g., Shimizu et al., 2007). On the other hand, deciduous forests occupy 44% area of total forest in Cambodia, and larger than evergreen forest covering 34% (FAO, 2010). Thus, also for the deciduous forest, accumulating the results of observation is highly required to understand the hydrologic and ecological processes. We obtained the transpiration in the stand scale by the sap flow measurement (SFM) and compared it with the estimations by the bandpass eddy covariance method (BECM) in a deciduous forest.

Method

We established an observation plot in a tropical broadleaved deciduous forest in Kratie Province, some 200 km northeast of Phnom Penh, Cambodia (12.55'N and 106.11'E). The main tree species in the stand were *Dipterocarpus tuberculatus* and *Terminalia tomentosa*. A 30-m-high observation tower was built and the measurements were initiated in February 2009. A stand density of 350 stems/ha, a mean tree height (TH) of 11.3 m, and a mean diameter at breast height (DBH) of 24.5 cm were obtained within an area of 20 by 20 m near the tower. The forest had open canopy, and leaf area index at five points by the plant canopy analyzer (Licor, type LAI-2000) during the main foliated period were 0.9. More detailed information was described in Iida et al. (in press).

We measured sap flux density (F) for 12 deciduous trees near the tower: 3 trees of *D. tuberculatus*, 3 trees of *T. tomentosa*, 5 trees of *Shorea obtusa* and a tree of *Xylia xylocarpa* by using handmade Granier sensors. Details of these trees were described in Iida et al. (2011). Based on the wood core sampling, we determined the width of the sapwood (SW) and obtained sapwood area (SA). When SW is less than 20 mm we applied the correction (Clearwarer et al., 1999). The single-tree transpiration (q) can be calculated as q = F x SA. Finally, we obtained the stand-scale transpiration (TR_SFM) as dividing a total q of 12 trees by the plot area. On the other hand, we applied BECM over and under the canopy, and evaluated the evapotranspiration from whole ecosystem (ET) and from the forest floor (ETfloor). As a result, transpiration from overstory trees estimated by BECM (TR_BECM) was calculated as TR_BECM = ET - ETfloor.

Results and concluding remarks

Daily TR_SFM corresponded well with TR_BECM (TR_BECM = 0.91 x TR_SFM, R^2=0.79), and we concluded that SFM is a useful tool for evaluating transpiration in this site. During the period from June 2010 to May 2011 including lack of data occurred from September to December 2010, TR_SFM and ET were 310 and 520 mm, respectively. The contribution of overstory trees to ET (TR_SFM/ET) was 60%, while that of TR_BECM (TR_BECM/ET) was 50%. The other source of ET, that is the understory vegetation on the forest floor, occupies 40 to 50% of ET: evapotranspiration from the understory vegetation is nearly equal to that from overstoty trees in this site.

References

Clearwater, M. J., et al. (1999) Tree Physiol., 19, 681-687.
FAO (2010) Global Forest Resources Assessment 2010, Country report Cambodia. FAO, Rome.
Iida, S. et al. (2011) Kanto J. For. Res., 62, 298-231.
Iida, S. et al. Hydrol. Process., in press.
Shimizu, A., et al. (2007) In: Sawada, H. et al. (eds.) Forest Environment in the Mekong River Basin. Springer-Verlag, Tokyo, 135-146.
Tani, A. et al. (2007) In: Sawada, H. et al. (eds.) Forest Environment in the Mekong River Basin. Springer-Verlag, Tokyo, 201-213.

Keywords: Cambodia, lowland deciduous forest, transpiration, sap flow, bandpass eddy covariance method

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-11 Room:IC Time:May 21 14:45-15:15

Effect of partial and clear cutting on runoff at forested small watershed

NOGUCHI, Shoji[1*], Tayoko Kubota[1]

[1]Forestry and Forest Products Research Insitute

This study was conducted in the Kamabuchi Experimental Watershed of the Forestry and Forest Products Research Institute. The site is located in north part of the mainland (Honshu) of Japan, Yamagata prefecture. Surficial geology is tuff of the Tertiary. Annual average precipitation at the site is 2456 mm. Streamflow have been recorded at recorded at 45 degree V-notch gauging weirs at the outlet of the No1 (: 3.06 ha) and No2 (: 2.48 ha) experimental watersheds since 1939, and the No3 (1.53 ha) and No4 (1.12 ha) experimental watersheds since 1961 within the site. In 1961 the No3 and No4 watershed were covered with a deciduous broad-leaved forest and Sugi (Cryptomeria japonica), respectively. In 1964 the forests were 50 % partial-cut near the stream at the No3 watershed and near the ridge at the No4 watershed. In 1970 other parts of forests at both watersheds were clear-cut and replanted with Sugi (Cryptomeria japonica). Therefore, this study aims to evaluate the effect of partial and clear cutting on runoff at the No3 and No4 experimental watersheds using 21 years records (1961-1981) during no snow cover period (May- October). Hourly discharge was plotted continuously on semilogarithmic paper. A point of inflection was obtained on the falling limb of the hydrograph between 12 and 72 h after storm. Stormflow was defined as the area above the separation line; the line on the hydrograph which connects the point of rise to the point of inflection. After partial cutting, runoff at the No3 experimental watershed more increased than that at the No4 experimental watershed. After clear cutting, runoff at both experimental watersheds more increased than those after partial cutting. The results showed that location of forest cutting was important to control runoff and stormflow in the watersheds.

Keywords: double mass curve, stormflow, partial cutting, clear cutting, Kamabuchi Experimental Watershed

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-12 Room:IC Time:May 21 15:30-16:00

Biosphere-climate interaction over Eurasia through water cycle

YASUNARI, Tetsuzo[1*]

[1]Hydrospheric Atmospheric Research Center, Nagoya University

In this paper, we discuss one typical example of the biosphere-climate interaction via water cycle in the northern Eurasia. Taiga in the boreal zone plays important and sensitive roles in global and regional water?energy?carbon (WEC) cycles and in the climate system. Recent in situ observations suggested that Siberia taiga is strongly coupled with its permafrost through the seasonal and interannual variations of WEC processes. In other words, the taiga (represented by larch trees) and the permafrost may behave as a coupled eco-climate system across a broad boreal zone of Siberia.

The model demonstrates that under the present climate condition in eastern Siberia, larch trees help control the seasonal melting of permafrost, which in turn provides sufficient water to the larch trees. Without permafrost processes, larch may not survive and may be replaced by a dominance of pine and other species that tolerate drier hydroclimatic conditions. Climate warming sensitivity experiments show that this symbiotic system cannot be maintained under warming of about 2 degree or more. Under this condition, sub-boreal forests are dominated, decoupled from the permafrost processes. Our results thus suggests that future global warming could drastically alter the taiga?permafrost coupled system, with associated changes of WEC processes and feedback to climate.

In addition, interannual variability of summer precipitation in the east Siberia depends partly on evapotranspiration from the Taiga forest, combined with water vapor transport from the Arctic Sea.

The results discussed here are based on Zhang, Yasunari and Ohta(Env.Res. Lett.,2011).and Watanabe (2012 Master thesis, Nagoya Univ.).

Keywords: biosphere-climate interaction, water cycle, Eurasian continent

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-13 Room:IC Time:May 21 16:00-16:30

Response of permafrost ecosystem to changing moisture condition in Eastern Siberia

SUGIMOTO, Atsuko[1*], Alexandra POPOVA[2], UETA, Akihiro[2], TEI, Shunsuke[2], TAKANO, Shinya[2], Trofim MAXIMOV[3]

[1]Environmental Earth Sci, Hokkaido Univ., [2]Environmental Sci. Hokkaido Univ., [3]Inst. Biol Problems of Cryolithozone

Deciduous conifer larch trees covers a huge area in eastern Siberia, which is called taiga and maintained on permafrost which is the largest and deepest in the world. Climate at Yakutsk in eastern Siberia is continental and dry, and annual mean precipitation is only 210mm. Not only severe dry climate but also large year to year variation affects the ecosystem.

One of the important functions of this forest ecosystem is to provide water to the atmosphere through transpiration. Tree growth and production depend on the moisture condition of the ecosystem. Direct water stress and indirect effect of moisture condition may affect the production through a change in nutrient availability.

Ecosystem near Yakutsk in eastern Siberia experienced extreme drought during the period from 2000 to 2003, which was followed by extreme wet condition for the period from 2005 to 2007.Reponse of this ecosystem for these extreme conditions will be reported.

Keywords: permafrost, taiga, ecosystem, stable isotopes

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

U05-14 Room:IC Time:May 21 16:30-17:00

Annual evapotranspiration increasing in response to the climate warming detected from small forested catchments in Japan

TANI, Makoto[1*], KATSUYAMA, Masanori[1], Yoshiko Kosugi[1]

[1]Graduate School of Agriculture, Kyoto University

Evaporation rate from the wet canopy is high for forest due to its community height, and transpiration rate is also high even in a dry period because of a high sustainability of tree with a long life against stresses. Long-term observations conducted in Kitatani in the Tatsunokuchi-yama Experimental Forest with broad-leaved forest in Okayama Pref., Kiryu Experimental Watershed with Japanese cypress forest in Shiga Pref., and Shirasaka Experimental watershed with broad-leaved forest in Aichi Pref. demonstrated an increasing trend of the annual evapotranspiration in response to that of the annual air temperature since 1990 (see Figure). However, this may turn over because further warming will give a high dry stress to the forest in near future, resulting in a natural decrease of the stand density and/or forest decline. A more serious result is concerned for an inland area of the continent where some of the precipitation source is derived from the land evapotranspiration. The data bases by Forestry and Forest Products Research Institute and The University of Tokyo Forest are greatly appreciated.

Figure. Comparison of the trend of annual loss with that of annual air temperature based on the long-term data obtained from three small forested catchments, namely, Kitatani in the Tatsunokuchi-yama Experimental Forest of Forestry and Forest Products Research Institute, Kiryu Experimental Watershed of Kyoto University, and Shirasaka Experimental Watershed of University of Tokyo Forest.
The cumulative anomalies curve in the figure represents the trend by the curve gradient (Lozowski: J. Climate 2,1989).

Keywords: climate change, evapotranspiration, forest hydrology, forestry, long-term hydrological observation, water resource