

Diatom analysis on the late Pleistocene Takano Formation, Nagano, Japan

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Diatom analysis has been performed at a 0.5 m interval for a sediment core of 53.88 m length from the late Pleistocene Takano Formation. According to the age-model proposed by Tawara et al. (2006), this core can covers from 170 ka to 40 ka in age and analysis interval correspond to about 1500 years.

From 170 ka to 140 ka, benthic diatoms such as *Achnanthes* spp. and *Staurosira* spp. are dominant, and diatom abundance is very low (lower than 1.0×10^8 valves/g). After 140 ka, planktonic diatoms such as *Cyclotella radiosa*, *Aulacoseira ambigua*, *Cyclotella stelligera*, *Aulacoseira alpigena* are dominant. From 140 ka to 130 ka, *C. radiosa* is dominant, and diatom abundance is low ($1.6 - 6.9 \times 10^8$ valves/g). From 130 ka to 115 ka, *Aul. alpigena* is dominant, and diatom abundance is high (over 10×10^8 valves/g). From 115 ka to 100 ka, *C. stelligera* is dominant, and diatom abundance varies largely ($0.1 - 38.2 \times 10^8$ valves/g). From 100 ka to 70 ka, *C. radiosa* is dominant, and diatom abundance is abundant, between 3.2×10^8 valves/g and 56×10^8 valves/g. From 70 ka to 40 ka, *C. radiosa* and *Aul. alpigena* are dominant, and diatom abundance is low, fluctuating a little between 0.9×10^8 valves/g and 20×10^8 valves/g.

These results are compared with the diatoms analysis of the sediment cores from Lake Biwa. After 140 ka, planktonic diatoms are dominant in the Takano Formation, and the diatom assemblage changes synchronously between Takano Formation and Lake Biwa.

Is small *Abies mariesii* forest in Pseudo-Alpine Zone spreading? :Case study in the Akitakomagatake

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Pseudo-Alpine Zone composed of Sasa and shrubs occupies on subalpine zone of mountain along the Sea of Japan in eastern Japan. It is considered that heavy snowfall on those mountains prevents coniferous trees from growing and consequently Pseudo-Alpine Zone exists. But there is Pseudo-Alpine Zone in the part of the Ou Backbone Range which is less snowfall than mountains along the Sea of Japan. On Akitakomagatake, the one of mountains which has Pseudo-Alpine Zone, small *Abies mariesii* forests are scattered.

This landscape has been hitherto considered that spreading *Abies mariesii* forest which finally results in matured coniferous forest on the basis of pollen analysis. Purpose of this study is discussing whether small *Abies mariesii* forest is spreading or not in terms of tree distribution and local environment.

As the result, *Abies mariesii* seeding is distributed only within the small *Abies mariesii* forest, not in surrounding *Sasa kurilensis* and *Fagus crenata*. In addition, soil moisture is higher in the small *Abies mariesii* forest than in the surrounding vegetation. These results suggest that the small *Abies mariesii* forest is not spreading but just being established on appropriate site.

Keywords: *Abies mariesii* forest, Pseudo-Alpine Zone, Spreading range, Soil moisture

The chemical characteristics of spring and river water in Kamikochi at the Japanese Alps

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There are much spring waters in the Azusa River which flows through Kamikochi. These spring waters form the branch of the Azusa River. Spring water shows the characteristics reflecting an underground water flow. Therefore, in order to understand the water cycle of Kamikochi, it is important to understand the formation mechanism of spring water. The purpose of this study is to clarify the chemical characteristics of spring and river water in Kamikochi. We set up the thermometer in five places of a basin for the measuring of spring and river water temperature. The water samples were collected in water temperature measuring site and Azusa River. The pH, electric conductivity, major ions (Na^+ , K^+ , Mg^{2+} , Ca^{2+} , Cl^- , NO_3^- and SO_4^{2-}), and stable isotope of water were analyzed with the pH meter, conductivity meter, ion chromatographs, and isotopic water analyzer, respectively. In addition, HCO_3^- concentration was measured using the sulfuric acid titration method. At almost observation points, the temperatures of spring and river water showed seasonal change. However, only one site did not have change of spring water temperature through a whole year.

Geo-environmental changes after the fire on the alpine slopes of Mount Shirouma-dake, northern Japanese Alps

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This is the continuous study to clarify the geo-environmental changes on the post-fire alpine slopes of Mount Shirouma-dake in the Northern Japanese Alps. The fire occurred at May 9, 2009 on the alpine slopes of Mount Shirouma-dake, and the fire spread to the *Pinus pumila* communities and grasslands. Although the grass had a little damage by the fire, the *Pinus pumila* received nearly impact of the fire. In the *Pinus pumila* communities where the leaf burnt, forest floor is exposed and become easy to be affected by atmospheric condition such as rain, wind, snow, and etc.

First, we illustrated a map of micro-landforms, based on geomorphological fieldworks. We observed these micro-landforms repeatedly for four years after the fire. As the results of the observation, it is clear that remarkable changes of these micro-landforms have not occurred but some litters on the forest-floor in the *Pinus pumila* communities are flushed out to surroundings. The litter layer on the forest-floor in the *Pinus pumila* communities were 3-4 cm thick in August of 2011, but it became 1-2 cm thick in September of 2013. The *Pinus pumila* communities established on the slopes consists of angular and sub-angular gravel with openwork texture, which are covered by thin soil layer. Therefore, it is necessary to pay attention to soil erosion following the outflow of the litter.

In addition, we observe the ground temperature and soil moisture, under the fired *Pinus pumila* communities and the no fired *Pinus pumila* communities after the fire, to find influence of the fire. The ground temperature sensors were installed into at 1 cm, 10 cm, and 40 cm depth. The soil moisture sensors were installed into at 1 cm and 10 cm depth. The 1 cm depth of the soil on the post-fire slopes, diurnal freeze-thaw cycles occurred in October and November of 2011 and 2012, but it had not occurred in 2009 and 2010. In addition, the period of seasonal frost at 10 cm and 40 cm depth on the post-fire slopes are extended for two weeks. These thermal condition changes are triggered by decrease in the thickness of the litter layer on the fired *Pinus pumila* communities.

Combining time-lapse photography and multisensor data logging to monitor slope dynamics in the southern Japanese Alps

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Onsite time-lapse photography (TLP) is applied to visual monitoring of soil movements and rockfalls in an alpine zone (Mt. Ainodake area) of the southern Japanese Alps. The time-series images greatly improve understanding of slope processes in remote, seasonally inaccessible areas. TLP detects the timing of slope movements at a high time resolution. Stereographic view of successive images displays 3D slope dynamics that indicates the location and magnitude of displacement. When combined with sensor-based data logging, TLP allows more reliable evaluation of thresholds (environmental controls) for slope movements. This presentation demonstrates (1) how visual information improves the interpretation of both slow progressive soil movements (frost creep) and rapid temporary movements (rill erosion and rockfalls) and (2) how highly active is slope dynamics in the southern Japanese Alps that experience deep seasonal frost in winter and heavy rain storms in summer.

Continuous monitoring of a painted line drawn on a debris lobe highlights biannual shallow soil movements, mostly derived from diurnal frost heave by needle ice or shallow ice lens formation and approximated by the potential frost creep. The surface velocity shows a small interannual variation mainly reflecting snow conditions, but an extraordinary velocity is recorded once per decade. This is due to episodic rill erosion released when the topmost frozen soil is rapidly thawed and super-saturated by intensive rainfall during seasonal thawing periods.

Year-round TLP images of a rockslide scarp allows evaluation of the timing and magnitude of rockfalls at different scales. Close-up images of color-painted quadrangles (50 cm square) indicates centimeter- to decimeter-scale spalling events. Spalling activity reach a maximum at the beginning of seasonal thawing, when the rockwall experiences both diurnal freeze-thaw alternations within the outermost 20 cm and progressive warming of the still-frozen substrate. Stereographic view of successive images also identifies block-scale rockfalls. Such an event occurred between 16 h on 7 July and 8 h on 8 July 2011, triggered by nocturnal rainfall (total 33 mm).

Keywords: time-lapse photography, field monitoring, rockfalls, solifluction, periglacial, Japanese Alps

Evaluation of long-term variability of rainfall-runoff properties in forested alpine catchment

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The water conservation function of forest, so-called "Green Dam" in Japan, is recognized as one of the important forest's functions. However it is often miss-understood by general public such as "sponge theory". Water balance in forested catchment is not clear because of its complexity by many hydro processes. The authors investigate the long-term variability of rainfall-runoff properties by forest growth and climate changes in the Gamansawa catchment (3 km²), Nakatsudawa, Gifu, Japan. The study area has long-term hydrological data acquired by Gifu prefecture and Forestry Agency, Japan from 1984 to 2007. Main forest types are cypress(67%), cedar(4%), broad-leaves forest(20%) and so on. The long-term tendency of forest variation is investigated by satellite image analysis with Landsat/MSS, TM and Terra/ASTER images acquired from 1984 to 2010. The mean NDVI over the study area are increasing. Therefore the forest should be growing in the research period. The authors investigate the trend of event based discharge rates f (=total direct discharge at the event / total rainfall at the event). The hydrological data is divided to many rainfall events and event based discharge rates are evaluated. The event based discharge rates are on a slightly decreasing trend with $df/dt = -0.006 [y^{-1}]$. Moreover the long-term hydrological data is divided to four periods and apply to the 4-layer tank model in order to evaluate the variation of hydrological properties in the study area. We assumed that the long-term variation in forest property is mostly surface soil layer such as soil layer thickness and lateral permeability. Vertical permeability depends on bed rock cracks should not so much increase. Based on this assumption, the model parameter of the bottom hole, which is related to infiltration to aquifer, is fixed. The model parameters of the second and lower tanks are also fixed. And the variability of the model parameters of side holes of the first tank, which are related to direct discharge, is investigated. We obtained the results as the model parameters of the side holes have the tendency of decrease as 0.9 to 0.7[d⁻¹], during the research period. Next, using these model parameters, the test rainfall events are simulated and the following results were obtained. 1) The peak discharge volume is decreased. 2) The event based discharge rates f are decreased as 0.6 to 0.5. This trend is the almost same as the mentioned event based discharge rates with long-term hydrological data analysis. These results suggest the flood mitigation function is increased during this period. On the other hand, although the model parameter of the bottom hole is fixed, total infiltration volume to lower tanks and base flow are increased. This result suggests that water conservation to aquifer also increase without increasing of vertical permeability such as bed cracks. It can be explained as follows. Consider a simple tank has one side hole and one bottom hole. The discharge from the side hole q [mm/d] is defined as $q = ah$, where h [mm] is the storage depth of the tank, a [d⁻¹] is the side hole size. The infiltration from the bottom hole i [mm/d] is defined as $i = bh$, where b [d⁻¹] is the bottom hole size. The time variation of h is defined as $dh/dt = q - i$. We obtain the total infiltration volume I as $I = bC/(a+b)$, where C is a constant of integration. By the above equation, when a is decreased with fixed b , total infiltration is increased. Therefore, it is suggested that increasing of water conservation can be explained with lateral permeability depend on forest growth. Moreover, we simulated two cases about evapotranspiration. First case is considered evapotranspiration with Hammon equation, and second is not considered. Hammon equation estimates probability evapotranspiration based on air temperature and daylight time. The results with two cases are the almost same. It is suggested that influence of climate changes have less effect than other factors.

Keywords: water conservation function, climate change, percolation, tank model

Canopy photosynthetic and soil respiratory responses to rising temperature in a cool-temperate deciduous forest

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Prediction of possible influences of global warming on terrestrial ecosystem structure and functions is one of an urgent research tasks in environmental sciences. This paper overviews our challenging research by open-field warming experiments on forest canopy photosynthetic productivity and on soil respiration in a cool-temperate deciduous broadleaf forest at Takayama AsiaFlux and JaLTER site, located on a mountainous landscape in central Japan. Canopy warming experiment is conducted by three open-top canopy chambers (OTCC) on branches of a mature tree of *Quercus crispula*, one of the dominant canopy species in the forest. The OTCC increased mean daytime air temperature by about 2 degree-C, with midday maximum of about 5 degree-C throughout the growing seasons. Soil warming treatment, with 3 degree-C higher than the control area, was made by installing electric heating cables below the soil surface.

Warming treatment at the canopy-top led (1) expansion of canopy photosynthetically active season in about 10 days by 3-5 days earlier leaf budbreak and expansion and about 5 days delay of leaf senescence, and (2) slightly higher chlorophyll content and photosynthetic capacity of oak leaves. Warming treatment of forest soil showed (1) higher soil respiration throughout the seasons, resulting in 15% higher CO₂ efflux from the soil during the growing season, but (2) the temperature response of soil respiration acclimated to the higher temperature condition characterized by lower slope of the response curve. We also examined the possible effects of growing period length on forest canopy and understory vegetation ecosystem CO₂ budget under future climate conditions by using canopy-phenology ecosystem carbon cycling combined model. Our simulation indicated that annual total ecosystem GPP, RE and NEP was greater under the future condition than under the current condition by 9-12 %, 9-13% and 12-17%.

Our study demonstrates that open-field warming experiments provide us with useful and insightful knowledge on the ecophysiological responses of both canopy and soil processes to rising temperature, and their critical roles in predicting future changes of forest carbon cycle processes in cool-temperate region in Japan where ecosystem structure, functions and services are subjected to influence of the climate change.

Keywords: global warming, forest, photosynthesis, soil respiration, phenology

Effects of Open-top Chamber on Soil Oribatid Mites (Acari:Oribatida) at Mt. Kisokomagatake

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INTRODUCTION

Forest limit ecosystem on high mountains was one of the most vulnerable ecosystems against global warming. We investigated effects of artificial warming using an open-top chamber on forest limit ecosystem (2600m in elevation) of Mt. Kiso-komagatake, Chuo-alps, Nagano, central of Japan. Oribatid mites were useful environmental bio-indicator because they distribute most of all terrestrial soil habitats. Therefore, oribatid fauna were compared between artificial warming sites and control site in the study area. We investigate vertical distribution concerned with elevation of oribatid fauna from 2600m to 1250m. On the other hand, Mortality of oribatid species was investigated under different temperature in incubator.

METHOD

Research sites of vertical distribution were established at 1250m, 1700m, 1900m and 2100m above sea level in Nishikoma Station of Shinshu University. We selected two plots (coniferous forest and broad leaved forest) in each elevation site. Five soil samples were randomly corrected using core sampler (100cc) 5cm depth on 26 July 2012. Oribatid mites were corrected using the Tullgren funnel on same day. Additionally, two soil samples (about 400cc) were corrected at 1250m, 1400m, 1700m, 1800m, 1900m, 2000m, 2100m, 2200m and 2600m above sea level on 28 Aug. 2012.

Nine open-top-chambers (1m X 1m, about 2m in height) were established at 2650m above sea level near Mt. Shogigasira. Two soil samples (100cc, 5cm depth) were corrected using core sampler from each open-top-chamber on 20 Sept. 2013. Also two soil samples were corrected from control site close to each open-top-chamber. Two soil samples were set on one Tullgren funnel in laboratory on same day.

Soil samples (about 5000cc) were corrected from 2100m and 1250m above sea level in Nishikoma station of Shinshu University on 17 July 2013 and each soil sample was softly stirred by hand in laboratory and was divided in 15 nonwoven fabric bags (400cc). Each bag was set in unglazed pottery (11cm in diameter). Five potteries were incubated in incubator under 10 degrees centigrade, 20 degrees centigrade and 30 degrees centigrade from 17 July to 12 Aug. 2013.

RESULTS and DISCUSSION

Results of investigation of vertical distribution show that *Cyrtozetes* sp., *Tectocepheus velatus* and *Phthiracarus japonicus* positively increased their population densities correlated with elevation, and especially, *Cyrtozetes* was only found upper from 1900m above sea level.

Results of comparative study using the open-top-chamber show that *Cyrtozetes* and *Phthiracarus* in the open-top-chamber were significantly decreased instead of *Ghilarobizetes* significantly increased.

These results suggest that *Cyrtozetes* and *Phthiracarus* are good indicators for global warming monitoring in high mountain ecosystem.

On the other hand, mortality rate of *Cyrtozetes* and *Phthiracarus* were not affected by temperature from result of incubation one month after. The reason of no affection of temperature on *Cyrtozetes* is probably its long life cycle. More studies will be needed about it.

Keywords: oribatid mites, vertical distribution, global warming, bio-indicator, *Cyrtozetes*

The parametric estimation of the amount of CO₂ to be stored as HWP of the wooden house, based on the each of tree specie

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In the term of the handling of wood in Kyoto Protocol, it has been considered to release carbon accumulated in growing stage immediately into atmosphere at the time of cutting down from forest in the first commitment period. In the second commitment period, it has been considered to fix carbon while it is used as harvest wood products (HWP), and to release carbon into atmosphere at discarded stage. The main utilization of domestic wood is to build wooden house domestically, and it has an important role as a carbon pool of HWP. However, the rate of utilization of domestic wood has been continued to decrease. In order to take concrete strategy to measure rate of increase in utilization of domestic wood in the future, it is important to estimate present amount of utilization by each of tree species and the amount of prospect for increased use in the future.

Future estimation of carbon pool by HWP for all over the country was studied in the past research. In the estimation for all over the country, national total gross floor space, the number of new constructions per year, the number of households, the amount of average for wood utilization are used as basic date, it has not been estimated by each of tree species. Therefore, in order to estimate target amount of increased utilization for each of tree species, it is urgent issue to make calculation flow based on area characteristic by using the amount of tree species used in each material by region, and the amount of carbon stock (hereinafter called carbon balance) for each of tree species by region.

In this study, it was investigated that estimation method of the amount of utilization by each of tree species and the amount of carbon stock which is applicable to wood statistics and all prefectures. Estimation, which is for Nagano, of the amount of utilization for each of tree species and the amount of carbon stock was conducted by using carbon balance for each of tree species in Nagano which was revealed by Yamagata et al. in the past research, and the rate of utilization for each of tree species which was surveyed by Nagano Prefecture.

As a result of estimation, it revealed that the amount of carbon stock would decrease with a peak of 380,000 [t-C] in 2021 (Heisei 33). From the increase in the total gross floor space in the whole area of Nagano by the increase in the average of gross floor space per house, the amount of carbon stock indicated an upward trend until 2021. However, the amount of carbon stock declined by the decrease in the number of new constructions per year and increase in the number of losses of existing houses in 2022 and later. In this research, we conducted the estimation of the case in which 60% of domestic wood utilization that Forestry Agency advocated as a measure against decrease in the amount of carbon stock was achieved. As a result of having changed the domestic wood utilization up to 60% in 2011 and later, the decrease in the amount of carbon stock was not seen until 2038 (Heisei 50).

The estimation revealed necessity to increase supply of domestic wood approximately 50,000m³ per year to achieve 60% of utilization rate for domestic wood. There is sufficient amount of accumulated forest resources in Nagano, however, it is necessary to secure supply capacity. Ido et al. pointed out that it is difficult to adjust the cut of timber from forest since it is difficult to show demand prospect. For this issue, the estimation of this study is very useful and contributes to increase distribution of domestic wood by feeding back the estimation result to supply side. Since there is a distribution of domestic wood between prefectures, it is necessary to estimate by the method of this study in other prefectures. It is important to create road map which raises rate of utilization of domestic wood by planning and grasping the wood distribution of the whole country by obtaining each demand prospect in the future.

Keywords: Kyoto Protocol, HWP, wooden house, carbon stock, domestic wood