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

AHW28-P01 Room:Convention Hall Time:May 20 17:00-18:00

The resolution dependency of the topographic effect on solar radiation flux on a complex topography

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Introduction

The solar radiation flux is the fundamental energy source for carbon, heat and water cycle. The topographic condition affects the radiation amount over complex topography by its shadow and inclination. The in-situ observation in the mountainous area often suffers from such topographic effects. On the other hand, the scale of the meteorological consideration still stays more than km scale or just one point observation. The resolution does not seem to be enough for mountainous area. Here, the solar radiation flux on the surface of mountainous area was studied, where we have many studies relating to ”Japanese Alps Inter-University Cooperative Project”.

Data and method

The global solar radiation was estimated for 360x160 points with 100m distance in 36 km x 16 km area including Mt. Norikura in central mountainous area in Japan. The altitude ranges from 600 m to 3000 m. The Takayama field station of Gifu University is located at 1342 m. The hourly global solar radiation flux, temperature and pressure data there in 2010 were used to estimate the solar radiation flux in the area. Digital Map 50 m Grid (Elevation) by Geospatial information authority of Japan was also used. The elevation data are averaged in 100 m, 200 m, 500 m, 1000 m, 2000 m and 5000 m to know resolution dependency. The skylines from each target point were calculated using elevation data in the area of 70 km distance for 50 m grid and about 200 km for larger grids. The difference is due to the computational power, but almost all points in fine scale elevation data catch the skyline near area because fine elevation data resolves mountains well. The sky view factor was calculated using the skyline data, but the sky was projected onto the inclined surface. It often shows lower value than it for horizontal plain. The observed solar radiation was divided into direct and diffusive components using Spitters et. al. 1984 or Liu and Jordan 1960. The latter includes air mass consideration. The shadows of mountains are considered for the direct component flux and sky view factor of the diffusive component and the reflection from ground surface from other area are assumed to reach the target area. The total solar radiation received under horizontal unit area, that means large inclined area, was computed.

Results and discussion

The standard deviation for annual mean solar radiation flux distribution is increased from several Wm^{-2} for 5000 km grid to 30 Wm^{-2} for 50 m grid with forest albedo (0.15). The mean solar radiation is about 150 Wm^{-2}. The increasing tendency does not show saturation. The finer scale produces larger variation. The increasing is rapid for valley area under 500 m grid. The tendency is strengthen by higher albedo. The above results are for inclined surface under unit horizontal area. Heat is exchanged in inclined surface but usual observation of global radiation is done horizontally. In such a case, the standard deviation stays only about 6 Wm^{-2}. The inclination of surface is a major reason of the spacial variation. The difference between horizontal and inclined surface can be a reason of the imbalance of heat budget analysis over slope and it is necessary to be counted in observational data analysis.

The comparison between the observed global radiation of Takayama evergreen coniferous site (TKC) at 800m and the estimated one for horizontal plain shows 10% mean bias error for fine days, but the difference become much larger for cloudy days. Sometimes TKC observation shows larger value than Takayama station in spite of altitude difference due to local weather condition. The facts indicate the limitation of the approach here. Finally, the estimated results with snow albedo in winter and with forest albedo in other seasons are produced hourly with 50m grid elevation data for 2010 in the area. It may be useful for the solar radiation data in the area.

Keywords: Solar radiation, Japanese alps, topographic effect

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AHW28-P02 Room:Convention Hall Time:May 20 17:00-18:00

Vegetation and climate history for the past 34,000 years based on the sediment core analysis from Lake Aoki, Nagano Pref

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Lake Aoki is an oligtrophic lake located in the northwestern part of Nagano Prefecture. The lake is 1.8 km2 large, and 58 m deep in maximum. The sediment core analyzed was taken at a site of 55 m depth near the central basin of the lake, and is as long as 28 m. It consists of silty clay with many thin lamina of sand. Maker tephra bed identified and 14C age measurement enable age estimation of the cored sediments as old as 34,000 years ago.

Pollen analysis and total organic carbon content (TOC) measurement were performed for the cored sediment in short intervals. On the basis of pollen composition, vegetation change for the past 34 ka as follows; dominance of arctic conifer trees associated with cool-temperate deciduous broad-leaved trees in 34 to 30 ka, predominance of arctic conifers in 30 - 15 ka suggesting the Last Glacial maximum, quick change from arctic forest to cool-temperate forest in 15 to 12 ka, and stable cool-temperate deciduous broad-leaved forest in 12 to 2 ka.

TOC, a paleoclimate proxy, which can show winter temperature via plankton productivity in lake, shows quasi-periodic fluctuation which means warmness concordant with pollen composition. But dilution by non-organic clastic sediment decreases TOC contents in a few horizons, implying increases of erosion of the neighbor mountains.

A sediment core of 28 m length recorded well climate condition and vegetation history around the Northern Japanese Alps since the Last Glacial maximum

Keywords: pollen analysis, Lake Aoki, total organic carbon, Last Glacial Maximum, Japanese Alps, Japanese central highland

Japan Geoscience Union Meeting 2012
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AHW28-P03 Room:Convention Hall Time:May 20 17:00-18:00

Monitoring rockwall erosion and soil transport in an alpine area, Southern Japanese Alps

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Purpose and methodology

Monitoring of rockwall dynamics is undertaken in the Mt. Ainodake area, Southern Japanese Alps, in an attempt to determine contemporary rates of erosion, amount of debris production and transport and to analyze their controlling factors. In August 2010 a new monitoring site was established on the Aresawa rock-slide scarp, where observations highlight climatic conditions (e.g. freeze-thaw process, snowmelt and heavy rain) and bedrock conditions (e.g. rock joints, rock mass strength and micro-topography). The new monitoring system is combined with foregoing monitoring campaigns on (1) pre-failure movement of the Aresawa headscarp area (Nishii & Matsuoka 2010), (2) soil movement associated with freeze-thaw action on the mountain-top slope (Matsuoka 1998, 2005) and (3) meteorological conditions (e.g. air temperature, precipitation and wind direction and speed), towards comprehensive evaluation of high-mountain geodynamics and sediment budget.

The following methods permit visual, quantitative and continuous observations of the dynamics of the rockwalls, where Matsuoka (1990, 2001) conducted preceding measurements.

- Photo-evaluation of shattered area on painted rockface
- Manual collection of fallen debris from painted rockface
- Automatic recording of rock-joint opening and rock temperatures (at 1, 10, 40 cm depth)
- Visual observation of rockface and foot slope with interval camera (daily) and terrestrial LiDAR (annually).

Continuous data have so far been acquired from August 2010 and October 2011 (see Figure) unless some interruption resulted from consumption of battery and extraordinary operation of the interval camera. The camera displayed limited snow cover on the rockface even in mid-winter, which was supported by large diurnal amplitudes of rock surface temperature. As a result, the rockface frequently experienced diurnal freeze-thaw cycles from September to May, with seasonal frost penetration to a few meters.

Results and discussion

A comparison between shattered bedrock, trapped debris, visual images and meteorological records showed that significant rockfalls and foot slope erosion occurred (1) during the night of 7-8 July, 2011 (precipitation ca. 30 mm) and (2) between 1 and 4 September 2011 when a large typhoon (precipitation 700 mm in total) crossed central Japan (see Figure). In addition, small, but continuous debris production seem to have dominated on the rockface during freeze-thaw and snowmelt periods. In normal years rockfalls prevail in freeze-thaw and snow-melt periods (Matsuoka 1990, Matsuoka & Sakai 1999), whereas the 2010-2011 period encountered an extraordinary and highly active debris production, partly responding to a heavy rain event.

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Figure: A. Rockwall retreat based on trapped debris. B. Rockwall temperature at surface and 40 cm depth. C. Daily precipitation. D. Snow condition at noon on 4 Dec 2011.

Keywords: rockfall, rock weathering, freeze-thaw, periglacial, monitoring, Japanse Alps

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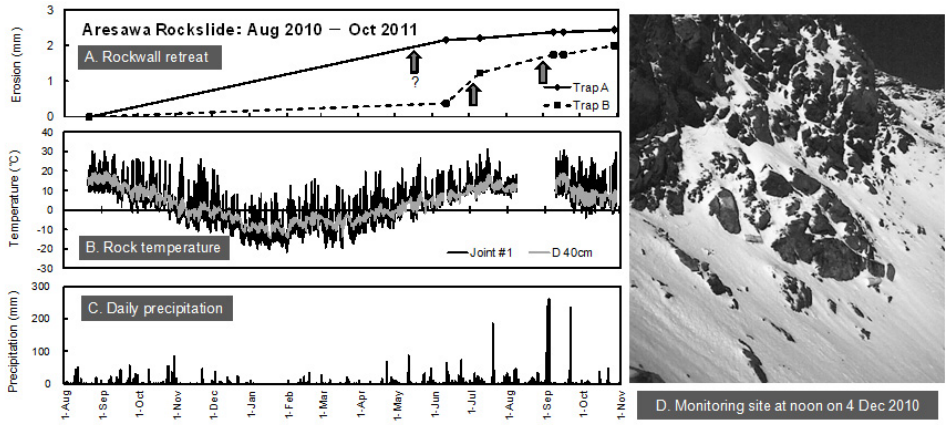

D. Monitoring site at noon on 4 Dec 2010

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AHW28-P04 Room:Convention Hall Time:May 20 17:00-18:00

Denudation rate of a large landslide in the Japanese Alps

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Akakuzure landslide, one of large landslides in the Japanese Alps, has an anaclinal structure as a result of deep-seated gravitational slope deformation. Denudation rate of the bare ground in the landslide was evaluated from two kinds of geodetic surveys. The airborne LiDAR survey was performed for the whole landslide in 2003 and 2007. In contrast, the ground-based LiDAR was performed for the upper area of the landslide in October 2010, June and November 2011. In addition, meteorological parameters (air and ground surface temperatures and precipitation) were also monitored. The average denudation rate during 2003 to 2007 and during 2007 to 2010 indicated 0.22 m/yr and 0.18 m/yr, respectively. On one part, denudation rate during winter (October 2010 to June 2011) was about three times of that during summer (June to November 2011). Annual and diurnal frost actions probably cause such seasonal variation in denudation.

Keywords: LiDAR monitoring, frost action, gravitational deformation, denudatioin rate

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AHW28-P05 Room:Convention Hall Time:May 20 17:00-18:00

Periglacial Environment around Mount Warusawa, Southern Japanese Alps

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Observations were carried out at Maru-yama station (3020 masl) from September 7th 2006 to August 31st 2008. The annual mean air temperature at the station in 2007 was -1.6^{o}C. During this period, the normal value of the annual mean surface air temperature at Maru-yama was estimated to be -1.8^{o}C. This was achieved by evaluating the normal values at Mt. Fuji meteorological station (3775 masl) of the Japan Meteorological Agency with a lapse rate of 0.6^{o}C/100 m. Therefore, the climatic value of the annual mean air temperature at Maru-yama was estimated to be ca. -1.8^{o}C.

The ground temperature of the north slope was lower than that of the south slope, and the ground temperature of the surface rubble layer at the north slope was the lowest.

The estimated normal value of the annual mean air temperature was very close to the threshold value (ca. -2^{o}C) for the mountain permafrost distribution suggested by previous studies. And specific place in Maru-yama has a low-ground temperature possibility during the long period. Moreover, it is possible that some mountain permafrost conditions exist around the summit area of Maru-yama.

Keywords: Periglacial environment, Periglacial landform, Meteorological observation, Mountain Permafrost, Southern Japanese Alps

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AHW28-P06 Room:Convention Hall Time:May 20 17:00-18:00

Spatial distribution of chemical components in snow layers at mountainous area, central Japan

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In mountainous area where less affected by human activities, we are able to collect efficiently chemical components in the snow layers, which is transported long-range from continent. In recent years, increase of acid material by the artificial source has been concerned. Although the studies about spatial distribution of chemical components have been executed actively on plain field and seacoast region, it is few in mountainous area of central Japan because of the difficulty of access. Therefore, it is significant to collect the data of chemical components in snow layers at mountainous area.

This study purposes of two things. First, we aim to clarify the origin of the chemical components preserved in snow layers on mountainous area of central Japan. Second, we discuss the spatial distribution of the chemical components in snow layers at mountainous area of central Japan.

We collected the samples of snow layers during February to April of 2011 in mountainous area of central Japan, and then we performed chemical analysis the samples using the ion chromatography.

In the results, it has become clear that the source of Na^+, Mg^{2+}, and Cl^- are sea salt components. On the other hand, the source of SO_4^{2-} and NO_3^- are mainly non-sea salt components. Additionally, Na^+/Cation and Cl^-/Anion are decreased with distance from the Sea of Japan. The opposite way round, nssSO_4^{2-}/Anion (non-sea salt SO_4^{2-}/Anion) is increase with distance from the Sea of Japan.

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AHW28-P07 Room:Convention Hall Time:May 20 17:00-18:00

Changing of snow chemistry in the Japanese Alps

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Various chemical materials were included in precipitation. Precipitated chemical materials have been stored in the snow layers before the start of snowmelt. Therefore, we get the atmospheric information in winter season from snowpack. We conducted the snow pit study, and the chemistry of snow layer was studied in detail. In this study, we aim to clarify characteristics of snow chemistry in the Japanese Alps. We conducted the sequential snow pit study during winter in Mt. Nisi-hodaka, the Japanese Alps. The snow pits were dug through the entire snowpack. We observed the cross-section of the snow pit to clarify snow conditions, which are snow stratigraphy, temperature, and density of snow. Afterwards we collected the snow samples. The snow samples were melted in a clean room. The pH and electric conductivity and concentrations of major ions were measured. Almost snow samples are acid snow (less than pH 5.62).

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Spatial distribution of chemical components in fresh snow at the Japanese Alps

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The Japanese Alps area is one of the world's best snowy regions. In this area winter precipitation is observed mainly two patterns such as winter monsoon pattern and low pressure pattern. Therefore, the chemical characteristics of the snowpack are different by snowfall types. In order to understand hydro-chemical cycle of this area, it is important to evaluate the influence of snowfall. The purpose of this study was to clarify spatial distribution of chemical components in fresh snow. We conducted a snow pit study immediately after snowfall, on the route from Matsumoto to the city of Japan Sea side. Snow density and temperatures were measured every 0.03 m. After these measurements, we collected fresh snow samples. The samples were melted, then pH, electric conductivity and major ions (Na^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, NO_3^- and SO_4^{2-}) were analyzed in clean room. The concentrations of the sea salt components in fresh snow were lower at the inland observation point.

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AHW28-P09 Room:Convention Hall Time:May 20 17:00-18:00

The regional and chemical characteristics of spring water in Kamikochi, 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. In this study, we aimed to clarify the characteristics of spring water which forms the branch of Azusa River 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 from July 2011. The pH, electric conductivity and major ions were analyzed with the pH meter, conductivity meter, and ion chromatographs (Dionex: ICS-2000), respectively. In addition, HCO_3^- concentration was measured using the sulfuric acid titration method. The temperatures of spring waters were almost constant from the end of August to the beginning of October.

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Nitrogen dynamics in two small watersheds with different stream nitrate concentrations

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Nitrogen dynamics were compared in two stream watersheds (#3 and #7) with different nitrate concentrations in their stream water. The nitrate concentration was always higher in the stream of #3 (1.6 mgN/L) than in that of #7 (0.3 mgN/L). Nitrogen deposition rate was higher in #7 than in #3, but nitrogen leaching rate at 40 cm below ground surface was higher in #3 than in #7. Increase in nitrogen isotope ratio of nitrate was observed in the bottom of the #7 watershed. Low plant uptake and immobilization by microorganisms with no clear denitrification in the #3 watershed might result in higher nitrate concentration in its stream.

Keywords: nitrogen dynamics, nitrate, stream, isotope ratio

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Mapping of Stable Isotopes in Precipitation over the Japan Alps Area and Its Verification

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The isotope map serves as a useful tool for understanding movement, distribution patter, and biogeochemical processes of water on the Earth, because the stable isotope rations of water include information related to not only the processes of water cycle but also the cycle of various substances transported by water flow. However, the isotope map for the mountainous region cannot be easily made, because existing isotope data are very scarce in that region. Precipitation samples were collected at 14 points from July 2010 to June 2011 across the Japan Alps area and isotopic measurements of these samples were made to construct the isotope map. River water samples were collected at 45 point over the Fuji and Chikuma River basin. River water data are used by validation of the isotope map in precipitation. Correlations between $delta^{18}O$ and altitude were significant through warm seasons whereas no significance was found in winter. Annual $delta^{18}O$ in the Japan Alps area is controlled by altitude effect. The isotope map was created using the three interpolated methods which is (1) regression model by altitude the explaining variable, (2) geostatistical model and (3) hybrid model. Validity of these models more different among the basins, suggesting different hydrological characteristics. In particular, downstream areas have higher $delta^{18}O$ values in river water than in precipitation.

Keywords: Stable isotope, Japan Alps area, Altitude effect, Spatial distribution

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AHW28-P12 Room:Convention Hall Time:May 20 17:00-18:00

Estimation of catchment transit time in Fuji River Basin by using an improved lumped model

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As an important parameter that reflects the characteristics of catchments, the catchment transit time (CTT) has been given much more widely attentions especially in recent years. The CTT is defined as the time water spends travelling through a catchment to the stream network [1], and it describes how catchments retain and release water and solutes and thus control geochemical and biogeochemical cycling and contamination persistence [2]. Conventional approaches for estimating CTT require specific hydrological characteristics such as transit time distribution (TTD) functions. The objectives of the present study are to develop a new approach for estimating CTT without prior information on such TTD functions and to apply it to the Fuji River basin in the Central Japan Alps Region.

In this study, an improved Tank model [3] was used to compute mean CTT and TTD functions simultaneously. It involved water fluxes and isotope mass balance. Water storage capacity in the catchment, which strongly affects CTT, is reflected in isotope mass balance more sensitively than in water fluxes. A model calibrated with observed discharge and isotope data is used for virtual age tracer computation to estimate CTT. This model does not only consider the hydrological data and physical process of the research area but also reflects the actual TTD with considering the geological condition, land use and the other catchment-hydrological conditions. For the calibration of the model, we used river discharge record obtained by the Ministry of Land, Infrastructure and Transportation, and are collecting isotope data of precipitation and river waters monthly or semi-weekly. Five sub-catchments (SC1˜SC5) in the Fuji River basin was selected to test the model with five layers: the surface layer, upper-soil layer, lower-soil layer, groundwater aquifer layer and bedrock layer (Layer 1- Layer 5). The evaluation of the model output was assessed using Nash-Sutcliffe efficiency (NSE), root mean square error-observations standard deviation ratio (RSR), and percent bias (PBIAS) [4].

Using long time-series of discharge records for calibration, the simulated discharge basically satisfied requirements of reproducing water fluxes and their balance, while improvements in parameter estimations relating to isotope mass balance is necessary. The results of each sub-catchment demonstrated that the mean CTT of SC4 (1873 days = 5.13 years) is the longest among the other sub-catchments. However, the mean CTT of SC5 was estimated to be 316 days as the smallest one. The time of 6.78 years are required to renew 99.9% of the water volume in the SC5. The other sub-catchments need more than ten years to get 99.9% water volume refreshed. The estimated TTD functions demonstrate their dependence on precipitation amount and area of the catchment.

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Keywords: Catchment transit time, Tank model, isotope tracer, water flux

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AHW28-P13 Room:Convention Hall Time:May 20 17:00-18:00

Snow Depth Measurement using Kinematic GPS on Karasawa Cirque, Japanese Northern Alps

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In the mountainous area, snow depth is known to increases so as to become of high altitudes. However, the snow depth distribution are hardly measured in the high mountain. It is significant to clarify the snow depth distribution based on actual measurement of snow depth in order to calculate the water equivalent of snow in its hydrographic basin. The measurement using GPS is attracted to attentions because the method of the GPS measurement is simple and high resolution. Especially, the Kinematic GPS measurement using two GPS receivers make possible to the measurement a wide area in a short time. We aim to measure the snow depth based on the Kinematic GPS measurement in Karasawa Cirque where is one of the biggest cirque in Japan.

Keywords: GPS, Kinematic measurement, Snow depth, Karasawa Cirque

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A relationship between air temperature and shoot elongation of alpine dwarf pine at Mt. Kisokomagatake

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There are not any long time-series meteorological data around mountainous area in Japan, excetp for Mt. Fuji. However, it is possible to reconstruct climate in mountainous area in combination with various data.

This research was investigated that a relationship between monthly mean air temperature in July and shoot elongation of alpine dwarf pine at Mt. Kisokomagatake from 1980 to 2009. The result shows a positive correlation on the relationship, and indicates that data of shoot elongation of alpine dwarf pine can reonstruct summer air temperature. We will study climate reconstruction in mountainous area with tree width as a proxy data.

Keywords: mountainous area, air temperature, shoot elongation of alpine dwarf pine

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Alpine vegetation monitoring using digital photography in the Kisokomagatake, central Japan

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The arctic and alpine floras are regarded as highly sensitive to the impacts of climate change. The climate changes will become increasingly pronounced over the next one hundred year. Therefore, we should accelerate our effort to assess and monitor trends in conditions of alpine vegetation to obtain early-warning signals of environmental change. However, most alpine regions are poorly monitored in Japan due to the harsh climate and difficult access.

We started the vegetation investigation at Mt. Koma and Mt. Sannosawa in central Japan. We also developed an automated green vegetation cover extraction methods using digital photography to simplify and accurately quantify the investigation. This study reported vegetation changes between 2008 and 2011.

We set 4 permanent quadrats of 1 m^2 at 14 sites on 6 regions and divided the each quadrat into 100 small grids (0.1 m^2). All vascular plant species were recorded each grids. Percentage of green vegetation cover was calculated using digital photography of each quadrats as follows. The classification of green vegetation and background was achieved by determining a threshold in one-dimensional colour space, which is based on transform values (G/(R + G + B)) from RGB image. Soil surface temperature (at depth of 0.5-1 cm) was automatically recorded with data loggers at 1-h intervals to determine the timing of snowmelt.

Species richness per quadrats slightly increased during three years. Total number of emerged species in 100 small grids significantly increased. Vegetation cover also significantly increased in some quadrats. These results seem to be primarily caused by the recent warming in the region. Unusually high summer temperatures, which were 1.5 degrees higher than usual, have recorded in 2010. Vegetation cover of shrub species, such as *Pinus pumila*, increased in some quadrats. Because species richness tended to decrease at the quadrats that shrub species were dominant, species composition would be changed if these trends continue.

The results of this study suggest that changes in the vegetation cover will precede detectable changes in number of species and composition. The vegetation cover can be obtained by digital photography, which is more effective, objective, and accurate than human conducted methods.

It should be considered that short-term studies are not enough to resolve the uncertainty of whether recorded signals are consistent trends towards serious changes in numbers of species and composition. We will continue the monitoring to reveal longer term vegetation changes.

Keywords: vegetation monitoring, alpine plant, species richness, plant cover, digital photography

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Marked loss of genetic diversity within glacial-relic populations of Dryas octopetala in the Japanese Alps

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For arctic-alpine species with wide-ranging distributions throughout circum-arctic regions and southward into mid-latitude mountains, range shifts in response to climatic change were both latitudinal (especially in circum-arctic areas) and altitudinal (in mountain regions). Latitudinal range shifts occurred over large areas and involved long-distance dispersal, whereas altitudinal shifts were more localized. Therefore, the genetic consequence of these types of range shift can be predicted to differ. *Dryas octopetala* L., an arctic-alpine plant, is widely distributed from the Eurasian and American arctic tundra to temperate mountains in Europe, in North America, and in Asia south to Japan, which is one of the southernmost areas for the cold-adapted species. In this study, we compared the genetic structure of *D. octopetala* populations along latitudinal transects from the High Arctic to mid-latitude mountains in the Japanese Alps. Investigation of genetic variation within *D. octopetala* populations inhabiting the Japanese Alps provides an example of how cold-adapted organisms survived at the southernmost limits of the distribution, at least since Holocene warming.

We analyzed a total of 656 individuals across 14 populations (six in the Japanese Alps, one in Hokkaido, one in China, three in North America, two in North Europe, one in the High Arctic) using nine nuclear microsatellite loci. Population genetic structure was assessed by analyzing genetic diversity indices for each population, examining clustering among populations.

The clustering analysis among the populations revealed an isolated marginal group of populations in the Japanese archipelago. The populations in the Japanese Alps exhibited low genetic diversity within populations compared with those in high latitude regions. Loss of genetic diversity was especially pronounced in the Southern Japanese Alps. High level of genetic diversity was detected in two Alaskan populations, supporting the Beringia refugium hypothesis for arctic and alpine plants. No significance of isolation-by-distance in the populations demonstrated that genetic drift was a strong force shaping the genetic structure in the Japanese Alps. The resulting stochastic reduction of genetic diversity in the cold-adapted plants at the southernmost limit of the distribution may constrain their evolutionary potential, thereby inhibiting adaptation under climate change.

Keywords: arctic-alpine plant, genetic diversity, genetic structure, glacial relic

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Effects of gap-mosaic structures on biodegradation of organic matter in soil ecosystems in old-growth forest

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Old-growth forests serve as a global carbon sink, but they are not protected by international treaties, because it is generally thought that ageing forests cease to accumulate carbon in live woody tissues (kira & shidei 1967; Odum 1969). Recently studies reported however, old-growth forests can continue to accumulate carbon, contrary to the longstanding view that they are carbon neutral (Luyssaert et al. 2008; Lewis et al. 2009). If this is true, most of carbon may move into non-living pools such as litter (leaf and woddy detritus) and soil. In addition, Old-growth forests generally have higher spatial heterogeneous structures (gap-mosaic structures). These forests structural properties may be greatly contributed to the carbon cycling of old-growth forests. In this study, we therefore focused on determining the litter decomposition rates and chemical properties of soil organic matter (SOM) in three stages of forest standings plots of old-growth forest to clarify the relationship between spatial heterogeneous and organic matter decomposition in surface soil ecosystems.

We conducted this study on Kayanodaira Research Station, Shinshu University, Japan (a permanent plot of 1 ha was set on a research station in 2005). The study area has a seasonal cool-temperate climate. The dominant species are *Fugus crenate* Blume (300˜500 age). From November 2010, three experimental plots (15 m^2) were established by differences of vegetation conditions to gap, young, and mature sites. Litter decomposition rate was estimated by litterbag methods from Novenber 2010 to October 2011. Characterization of SOM was performed by optical properties. All investigation was performed 5 replicate.

Litter mass remaining rate during 350 days decreased from gap (86.8) > young (82.1) > mature (81.6) at L layer and decreased from gap (94.6) > young (89.0) > mature (85.5) at FH layers. Degree of biodegradation of SOM estimated from aliphaticity (Alkyl C:O-alkyl C ratio) in gap site showed significantly lower values. These results strongly suggest that gap structure slow the microbial activities in soil ecosystems in old-growth forest.

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Ecophysiological dynamics of forest canopy photosynthesis and its optical observation

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Forest ecosystem has a crucial role in regulating the earth system as well as in supporting various ecosystem services such as primary production and biodiversity persistence. Understanding on the ecophysiological dynamics of forest canopy photosynthesis and ecosystem-scale carbon cycling is still an important theme of environmental science. In addition, the progress of satellite optical remote sensing provides us to observe the broad-scale ecosystem structure from days to years, and from plot to continental scales. In this study we aimed to reveal the functional role of leaf-level ecophysiology and forest leaf area distribution in forest canopy photosynthesis in a cool-temperate deciduous broadleaf forest at "Takayama" super-site, in central Japan. Simultaneously we made optical remote sensing of canopy structure in means of several vegetation indices (NDVI, EVI, GRVI, CI) to detect the phenological changes of canopy photosynthetic property. Our in-situ observation of leaf and canopy characteristics, which were analyzed by an ecosystem carbon cycling model, revealed that their phenological changes and summer micro-meteorology are responsible for seasonal and inter-annual variations in canopy photosynthesis. Significant correlations were found between the vegetation indices and canopy photosynthetic capacity, but the relationships changed throughout the seasons from spring to summer, and to autumn. Our next challenge goes to apply these findings to gain insights into detailed understanding on the carbon metabolism of forest ecosystem and also to assess the canopy photosynthesis at landscape - regional scales by satellite remote sensing.

Keywords: forest ecosystem, photosynthesis, ecophysiology, remote sensing

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Carbon dynamics along a chronosequence of Japanese Cedar plantations in central Japan

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Managed, even-aged Japanese cedar plantations are now the most extensive managed forest ecosystem in Japan, comprising ˜20% of the Japanese forested landscape. The age-dependent variability of ecosystem carbon dynamics was assessed by measuring biometric based net ecosystem production (NEP) of nine cedar plantations in Takayama, central Japan. The study sites ranged in age from 3 -year-old after plantation to mature stands (105 years). Total net primary production (NPP) was low immediately after plantation, highest 36 years stand, and then gradually decreased with age. In contrast, soil respiration had no clear trend with age, although root biomass related to soil respiration. After harvesting, cedar plantations are typically a net source of carbon around 5 years, followed by peak in NEP in mid-aged forest (ca. 40 years). In maturing stands, NEP declines as a result of the age-related reduction of growth.

Keywords: net ecosystem production, net primary production, soil respiration, cedar plantation, biometric, Takayama Forest

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Carbon budget in a deciduous broad-leaved forest considering the expanded growing season length by global warming

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The growing season length of plants is one of the major interests in studying the current and future carbon cycles in terrestrial ecosystems, since it would directly affect the photosynthetic CO_2 uptake and respiratory CO_2 release in those ecosystems. In this study, we examined the possible effects of growing season length under current climate and in future climate on forest ecosystem CO_2 budget, by combining in-situ observation of canopy phenology and ecosystem carbon cycling model.. First, by using daily canopy surface images and air temperature data at the Takayama deciduous broad-leaved forest site (TKY) from 2004 to 2009, we examined the dates of the beginning of leaf expansion, the beginning of autumn leaf color development, and the end of leaf-fall, and their relationships with air temperature. We found that (1) leaf expansion began when the accumulated effective air temperature from the first day of the year (based on a 5 deg C threshold) exceeded 140.0 +/- 13.5 deg C (average +/- standard deviation) during spring; (2) leaf color development began when the 5-day moving-average daily temperature fell below 10.8 +/- 1.3 deg C during autumn; and (3) the leaf-fall period, which was defined as the period between the beginning of autumn leaf color development and the end of leaf-fall, was 30.7 +/- 4.0 days. Second, we adapted these relationships between leaf phenology and air temperature to account for the seasonal variation of leaf area index (LAI) under future climatic conditions referring to the projection data of climatic conditions based on several scenarios from CMIP3 Multi-Climate Models. As a result, the growing season length was expected to expand in future climate than present. Finally, we introduced thus simulated phenology of LAI into NCAR/LSM model to examine its possible effects on canopy photosynthesis, ecosystem respiration and resulting net ecosystem CO_2 budget in the future climate. Our analysis could provide the importance of phenological field observation and the consideration of phenological impact for future climate studies.

Keywords: Carbon budget, Cool-temperate, Deciduous broad-leaved forest, Future climate scenarios, Phenology

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Recent changes in the genetic structure of the Asian black bear *Ursus t. japonicus* in the Japanese Alps region

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Asian black bear *Ursus thibetanus* habitats are dotted intermittently across South and East Asia. They have been divided into seven subspecies. In Japan, the subspecies U. t. Japonicus inhabits two of the main islands, Honshu and Shikoku. It is considered that the population of Kyushu is extinct. The Japanese Alps region is one of the most significant habitats for the Japanese black bears, since it provides a habitat, which is largely contiguous and as such their density is very high. The black bear is omnivorous, but they mainly rely upon a herbivorous diet plant-origin foods. In particular in late autumn before hibernation, it is estimated that they have to consume food amounting to ca. 5500kcal per day (per individual of 60kg bear). Their main food is a kind of beechnut, which are the also-called ”acorns”. As such, during years when the beech species provides a poor yield of nuts, many of the black bears come down to areas of human habitation in search of sufficient food to prepare for hibernation. In such years, damage to crops and attacks on humans by bears increase, so as a result a larger number of bears will be killed as a pest control under the ”prefectural wildlife conservation and management plan”. Nagano Prefecture carried out to estimation of the number of individual of black bears, it has also set an upper limit of ca. 150 on the maximum number of individuals that can be killed each year. Since then, a report the Wildlife Conservation and Management Program of Nagano Prefecture recently estimated that the number of black bear habiting Nagano Prefecture has increased significantly in this decade; 1913 individuals in 2001, 2771 in 2006 and 3624 in 2011. However, during in this decade, in 2006 and 2010, the number of bears killed has unfortunately exceeded the upper limit set, as higher population has resulted in a higher incidence of conflict with humans; 558 individuals in 2006 and 361 in 2010. In this present study, we have performed genetic analyses, in order to understand in more detail the population and genetic structures of black bears in the Japanese Alps and around the surrounding regions,. We analyzed 625-based sequences in the D-loop region of mitochondrial DNA using approximately 100 samples collected from diverse locations across Nagano Prefecture. We compared our analyzed data with the data of several previous analyses (Ohnishi et al., 2007, 2009), and also an impact assessment was carried out into the higher killing rate of recent years; i.e., we evaluated whether any effect of genetic bottleneck was resulting or not. As a result, the genetic diversity of black bears in Nagano Prefecture was found to be much higher than the previously evaluated; the haplotype diversity (Hd) found in this study was 0.679, and the nucleotide diversity (Pi) was 0.0031, whereas in Ohnishi et al. (2009), Hd=0.4734, Pi=0.0012. Of particular note, it was revealed that the genetic diversity observed amongst the northern bear populations was clearly higher, whilst the genetic diversity was comparatively low amongst the southern bear populations. Based upon the analysis of molecular variance (AMOVA), it was revealed that gene flow of black bears was significantly restricted between three identifiable regions of Nagano Prefecture; i.e., the northern, central and southern regions. This localized genetic population level data for the Japanese Alps and surrounding areas will be utilized in the formulation of future protection and management planning and policy.

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Chemical mimicry of an aphid to mutualistic ants

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Ant-aphid interaction is one of the most famous examples of mutualism in which ants attend aphids for their honeydew and protect them against enemies. However, ants also often hunt the aphids they attend. To explain the proximate factor causing ants' hunting behavior, Sakata (1994) proposed "marking hypothesis" which posits that ants mark something to the aphids providing ample honeydew and the nestmate ants tend to hunt those aphids with less marks (providing less honeydew). Recently, Endo and Itino (in press) found that the ants' cuticular hydrocarbons (CHCs), which are ants' nestmate recognition signals, work as the real marking substances in the *Stomaphis-Lasius* system.

Thus aphid needs to provide much honeydew to avoid ant's predation, however it is costly to produce much honeydew. Therefore, aphid may use chemical mimicry, which is used in many insects parasitic to ants, as an alternative strategy to avoid ant's predation.

Based on the fact that the CHCs work as marks, we hypothesize that the aphids mimic chemically to the ants' CHCs as a counter-adaptation against the ants' predation using CHC marks. To elucidate the resemblance of the aphids' and ants' CHCs in non-contact conditions, we reared the aphid *Stomaphis yanonis* in the absence of attending ants, analyzed their CHCs by GC-MS, and compared their CHC profiles with the attending ants' in the wild. We found that the CHC profiles of the non-ant-attended aphids (Figure (c)) resemble those of the mutualistic *Lasius fuji* ants (Figure (a)). This suggests that the aphids mimic chemically to the ants' CHCs.

Keywords: ant-aphid mutualism, chemical mimicry, cuticular hydrocarbons (CHC), Lasius fuji, Stomaphis yanonis

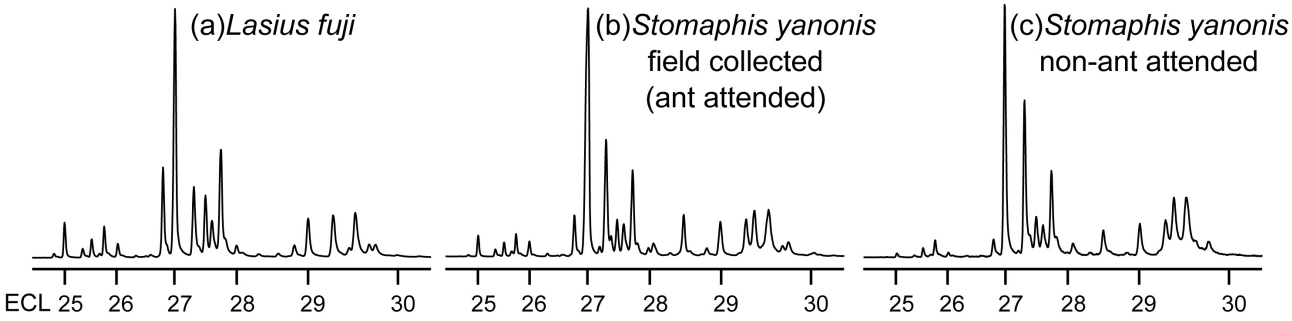

Figure Cuticular hydrocarbon profiles of (a) the ant *Lasius fuji*, (b) the aphid *Stomaphis yanonis* (field collected), and (c) *S. yanonis* (non-ant attended).

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Flower size variation along altitude and gene flow of Campanula punctata

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Abiotic environmental changes along altitude influence plant distribution and character variation. In some plants, altitudinal decrease of plant size is known as a genetic structural change in response to climatic change. Flower size variation may also be influenced by these abiotic factors. On the other hand, geographic variations of flower size have often been reported to reflect selection pressure by regional pollinator fauna. This suggests that flower size may change altitudinally in response to the size of pollinators.

Campanula punctata var. *hondoensis* is distributed over a broad altitudinal range, and their pollinator composition is known to be different along altitude. Thus, the selection pressure by pollinators may differ among altitudes.

Here, we investigate the pollinator fauna, flower size variation and gene flow along altitudinal gradient and found that 1. the composition of *Bombus* pollinators changes along altitude, 2. the flowers are basically smaller in higher altitudes while plant height or the number of flowers per plant does not change along altitude, 3. the flower size along altitudinal gradient correlates closely with pollinator size, 4. microsatellite analyses suggest no genetic differentiation along altitude.

These results suggest that flower size variation along altitude is influenced by the pollinators' selection pressure, and is maintained even in the presence of gene flow.

Keywords: flower size, pollinator, gene flow, altitude, natural selection

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The complex evolutionary history of the acquisition of morphological polymorphism in *Panorpodes paradoxus*

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The panorpodid scorpionfly *Panorpodes paradoxus* (Panorpodidae), which inhabits mountainous areas has many varied types of body color and wing spots pattern. In addition, it has known that female of *P. paradoxus*, which are living in the high altitude regions of the Central Japan and the several mountains of Tohoku (Aomori Prefecture), have short wings and these are called "short-winged type". Furthermore, the short-winged type has many morphological differences from "long-winged type"; (1) male's antenna is longer than that of long-winged one, (2) upper ridge of the hypandrium is rounder than long-winged one, (3) female's body color is dark brown (long-winged type's body color is generally pale yellowish brown), (4) female's wing spots pattern is characteristic and differ from long-winged one (there are many long-winged females which have not any wing spots, but short-winged female always has wing spots), (5) male of short-winged type has faint wing spots (appearance of wing spot is very rare in long-winged male), therefore, it is referred that "short-winged type" is an adaptation to high mountains, and suggested that "short-winged type" is a different species from "long-winged type" (Ichida, 1990).

So, in this study, we performed molecular phylogenetic analyses in order to confirm whether there are genetic differences between *P. paradoxus* of long- and short-winged types, together with this species having other varied morphological characteristics, or not. As a result, the long- and short-winged types did not separately compose monophyletic groups, and many varied types of body color and wing spots pattern did not related to the phylogenetic relationship. Furthermore, long-winged and short-winged populations occurring in the same mountain each composed monophyletic groups, but the two populations were never monophyletic.

Our phylogenetic analyses revealed that the many varied morphological types of *P. paradoxus* have complex evolutionary history. Although this species has varied wing length types, almost of mecopteran insects generally have long wings, consequently it is inferred that the short-winged type is the derivative character. The short-winged type differentiated in polyphyletic, and female of this type is darker in body color than long-winged type, and always has wing spots, and this derivative type is observed at high mountain regions. So it is possibly to refer that the short-winged type is the "ecomorph" in this species adapting to coldness, strong wind and ultraviolet radiation.