Climate change impacts on alpine ecosystems in the Daisetsuzan National Park in northern Japan

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Alpine ecosystems are the most sensitive nature against rapid climate warming. Thus, alpine ecosystem is a suitable system for the detection and prediction of the ecological impacts of climate change. So far, there are many reports on the physiological, phenological, and distributional responses of organisms inhabiting alpine ecosystems to climate change. Recent climate change may increase the risk of species extinction, decreasing population, diversity reduction, and vegetation changes in alpine ecosystems. However, long-term monitoring of climate, environment, and ecosystem changes in Japanese alpine regions are restricted. I introduce the evidence of climate change and its impacts on alpine ecosystems in the Daisetsuzan National Park in Hokkaido, northern Japan. As the major ecological responses to climate change, the modification of phenological events and the distribution shift of organisms are known in many ecosystems in the world. Warm summer temperature and early snowmelt accelerate the phenological progress of alpine plants that cause earlier and shorter flowering season of alpine plant communities. Rapid changes in plant phenologies may disturb the plant-pollinator interactions, resulting in the decrease in pollination service for plants and food resource for insects. Phenological mismatch between alpine plants and bumble bees was detected in unusually warm summer in this area. Major vegetation changes observed in the Daisetsuzan National Park are decreasing populations in alpine snow-meadows and expansion of dwarf bamboo. These changes may be caused by the recent warm summer temperature, longer snow-free period, and drier soil conditions. Expansion of bamboo distribution results in the decreasing species diversity of alpine plant communities due to strong shading effect by dwarf bamboos. On the other hand, alpine vegetation successfully recovered by the bamboo removal treatment. Thus, the bamboo removal may be a useful management to conserve biodiversity of alpine ecosystems. For the practical and effective conservation of alpine ecosystems under warming climate, long-term ecosystem monitoring and experimental approaches are necessary to construct the adaptive management protocol of the alpine ecosystem conservation.

Keywords: alpine ecosystem, climate change, alpine plants

Effects of climate change on flowering phenology of montane plants: a case study for a spring ephemeral and alpine plants

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Plant phenology, seasonal and periodic behavior shown by plants, is though to be largely affected by global climate change. Most studies on plant phenology have been carried out on the low-elevation sites in and/or near the urban area. Phenological observation has been rarely conducted in the montane area, especially in the alpine region, where global climate change would have a strong impact. In this presentation, I will show seasonal and yearly variations of flowering phenology in montane plants inhabiting in a secondary forest and alpine ecosystems having a snowy climatic regime. Target species are *Erythronium japonicum*, *Diapensia lapponica* var. *obovata*, and *Sieversia pentapetala*. I and co-researchers observed these flowering phenology from 2010 to 2015, and also measured air and soil temperatures, and recorded directly or estimated indirectly dates of snowmelt. According to an analyzing technique reported by Kimball et al. (2014), we could express temporal changes of the flowering rate as a logistic curve, using degree-day accumulations based on air and soil temperatures, day of year, and day from snowmelt as explanatory variables. I will show the species specific difference of significant variables against the flowering phenology, and the effectiveness using a logistic model for describing and predicting flowering phenology of montane plants.

Keywords: phenology, alpine plants, climate change

Monitoring of snowmelt in the Japanese alpine zone by using time-lapse cameras

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The vulnerability of alpine ecosystems to climate change, as pointed out by IPCC, and the necessity to conduct monitoring in the alpine zone have been recognized worldwide. The Japanese alpine zone is characterized by extremely heavy snowfall, and snowmelt is a key factor for the growth of alpine vegetation. National Institute for Environmental Studies has, therefore, launched long-term monitoring of snowmelt and ecosystems in the Japanese alpine zone since 2011 by using automated digital time-lapse cameras, and 18 monitoring sites are under operation currently. By comparing the photographs taken at the same time each year, we can determine the time for snow fall and melting and the spatial differences in their speed,
In this study, a new monitoring method by digital cameras was developed in order to detect yearly changes of snow-cover areas at high temporal and spatial resolutions. We used images derived from the cameras that we have installed at mountain lodges in Nagano Prefecture (at elevations around 2350–3100 m) and at around Mt. Rishiri in Hokkaido, and in addition, the live camera images that have already been operated by local governments in Tohoku area and Mt.Fuji. RGB digital numbers were derived from each pixel within the images. The snow-cover and snow-free pixels were automatically classified by statistic discriminate analysis based on the variance of gray-level histograms for each image.
The detected snowmelt dates showed site-specific characteristics and yearly variations.

Keywords: RGB, discriminate analysis method, ortho-rectify

Timing, magnitude and origin of seasonal rockfall activity in the Southern Japanese Alps: A multi-method approach

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Recent technological advances have enabled us to monitor bedrock micro-cracking at high time resolution and succeeding rockfall activity at high spatial resolution. Precise evaluation of the trigger of each rockfall event, however, requires a combination of multiple methods that detect cracking and falling activities and provide data on their controlling environmental parameters. Long-term monitoring is also necessary to evaluate the contribution of each trigger to the rockwall erosion.
Multi-method monitoring has been conducted to detect the timing and trigger of rockfall activity on an alpine rockslide cliff composed of Cretaceous sandstone and shale in the southern Japanese Alps (Aresawa rockslide, 2900 m ASL). The monitoring programme includes manual measurements of peeling from painted rockface and collection of fallen debris (4-5 times per year) and thermography of rockface (yearly), and data logging of time-lapse photography of rockface (daily), crack opening, rock temperature and moisture (3-4 hr intervals) and meteorological elements (air temperature and precipitation at 10-min intervals). A stereographic pair of sequential photographs allow us to visually identify the location of new erosion at daily resolution. Combined with precipitation data, the photographs also indicate the type of precipitation (rain or snow).
Five years (2010-2015) of debris trapping show major rockfall activity in winter (between November and May) and occasional activity associated with heavy rains in summer. Highly active areas of the rockwall experience retreat by >1 mm per year. Time-lapse photography displayed at least eight rockfall events within the shot area in the 2014-2015 period. The integration of multiple data enables understanding of a sequence of natural processes towards rockfalls, suggesting that at least three types of rockfall processes recur annually (Fig. 1A). (1) In summer and early autumn, heavy rainfalls (>100 mm/day) raise the rock moisture content close to the saturation level, often triggering significant rockfalls, probably due to raised water pressure in rock joints or lubrication of joints. (2) In late autumn and late spring, light or intermediate rainfalls are sometimes followed by high moisture, shallow freezing, rapid thawing and eventually by small-scale rock peeling. (3) In early winter and early spring, the same process occurs as in the second case but rainfall is replaced by snowfall (Fig. 1B).

Keywords: Rockfall , Monitoring, Time-lapse photography, Freeze-thaw, Japanese Alps

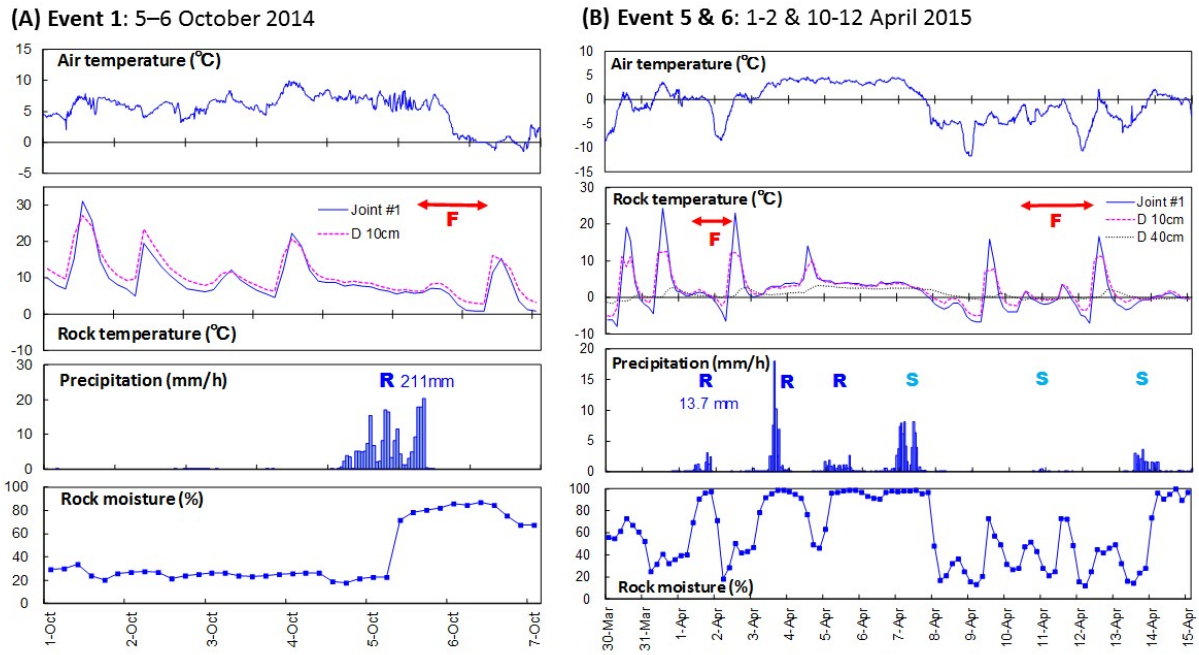

Fig. 1. Examples of rockfall events (F) and corresponding environmental conditions in the 2014-2015 period. Symbols: R=Rain, S=Snow, D=Depth.

Natural and artificial factors controlling 275-day flow in the Japanese Alps region

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City dwellers living at low-lying flat lands depend heavily on water resources supply from mountainous areas. At the same time, they are put at risk of flood due to heavy rains. For assuring river flow at drought periods and reducing a sudden increase in flood runoff, it is fundamentally important to maintain or improve water storage function, especially groundwater storage function, in watersheds. However, it has not yet been established to diagnose/evaluate quantitatively such a function. The objectives of the present study are to identify natural/artificial factors controlling groundwater storage function and to quantify their impacts, through a multivariate analysis based on flow regime and geographical information. We used river flow and dam-inflow data at 170 stations across the Japanese Alps region. As data sets of natural/artificial factors, we used mesh (i.e., raster) data of climatic normal, surface geology, terrain classification, and land use pattern, all of which are provided by Ministry of Land, Infrastructure, Transport and Tourism. Multiple regression analysis for the 95-day flow (i.e., high flow condition) with stepwise variable screening revealed statistically significant factors including annual total precipitation amount, annual mean temperature, annual maximum snow depth, upland area, volcano area, and quaternary rock area. On the other hand, for an analysis of the 275-day flow (i.e., low flow condition), impact of precipitation and temperature were not significant. This indicates that the 275-day flow is a good index reflecting water storage as snow or groundwater. Partial regression coefficients of a multiple regression equation clarify large negative impact of golf course, ski slope, and wilderness (above the timberline); 275-day flow decreases with increasing areas of these types of land use. In contrast, uplands (mainly alluvial fans) and paddy fields had a positive impact. Also, forest have a slight positive impact. Consequently, construction of golf courses and ski slopes with forest cutting and land reclamation have likely reduced water storage function of watersheds. It is particularly important to properly manage alluvial funs and paddy fields for maintaining the function. Such a function should be revisited as geo-ecological service and considered for watershed management and national land policy.

Keywords: Flow regime, Japanese Alps region, geo-ecosystem service

The thickness and flows of an ice mass of the Kakunezato perennial snow patch, Mt. Kashimayari, the northern Japanese Alps

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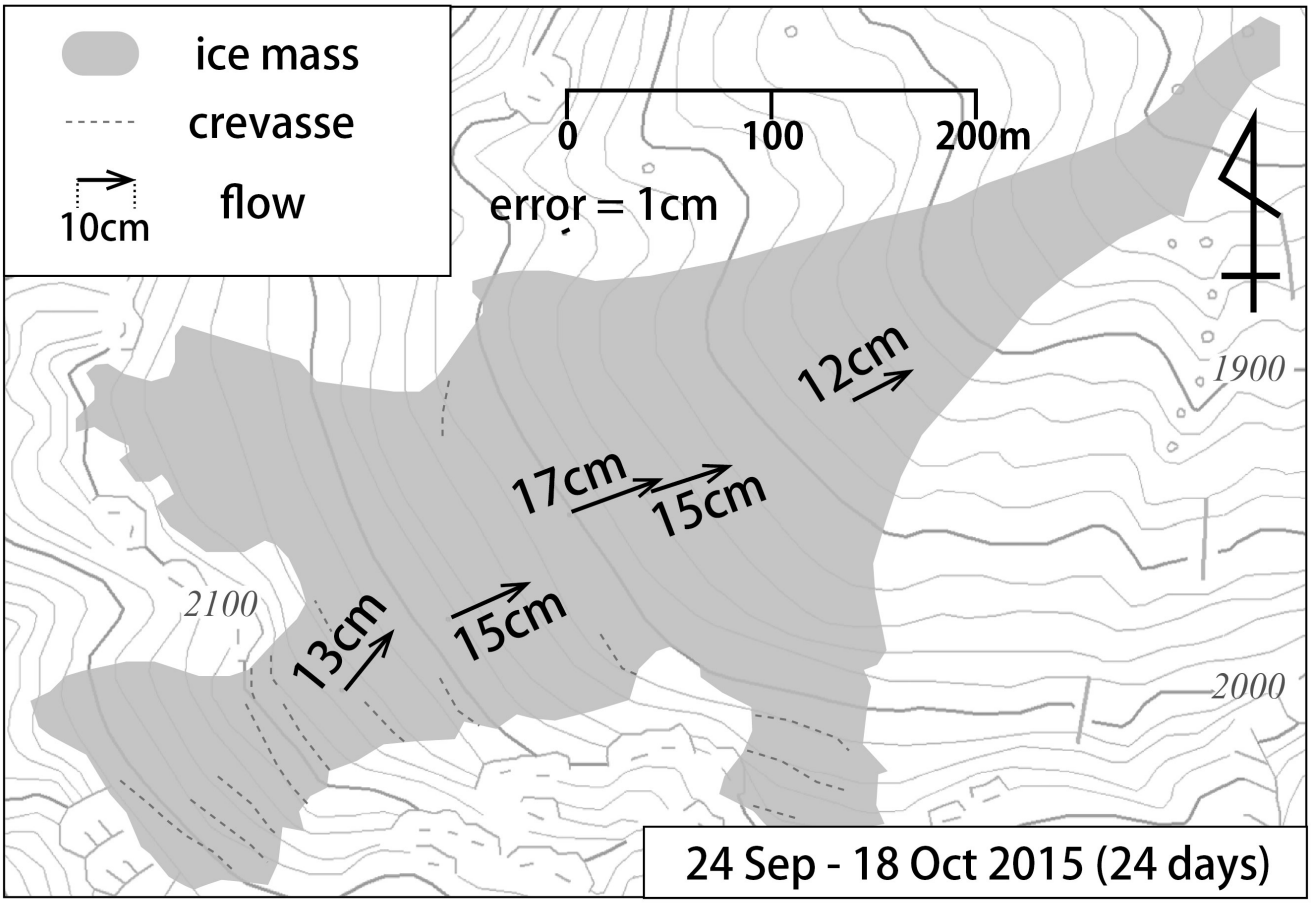
We describe field measurements (ground penetrating radar (GPR), geodetic survey and crevasse observation) to provide new information on the surface flow velocity, the ice thickness and the snow density profile of the Kakunezato perennial snow patch in Mt. Kashimayari (2889 m asl) in the northern Japanese Alps, central Japan.
We found the thick ice mass (over 40 m in thickness) in the central part of the Kakunezato perennial snow patch. The snow density is > 820kg/m^3 below 1 m in depth from the surface in October 2015. The ice mass had flowed 12 - 17 cm / 24 days in the autumn of 2015. Thus, we regard the snow patch as small active glacier.

Keywords: glacier, perennial snow patch, flow, Japanese Alps



The flow of the Kakunezato perennial snow patch

LiDAR UAS sensing platform for high spatial and temporal resolution mapping of geomorphic evolution

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Water and sediment transport from rivers to adjacent floodplains is a foundational physical process in the generation of complex floodplain, wetland, and riparian ecosystems. In highly transformed natural environments, however, human engineering works often restrict lateral connectivity of water and sediment during flood pulses, restricting important floodplain hydrogeomorphic processes. In California’s Sacramento and San Joaquin River Delta, intentional levee breaching and removal is an emerging floodplain restoration practice intended to generate dynamic geomorphic feature creation and evolution. The localized nature of water and sediments pulses therefore requires high spatial and temporal resolution mapping. We have used a highly mobile Unmanned Aerial System (UAS) platform with robust laser scanning payload to generate repeat topographic observations from Light Detection and Ranging (LiDAR) before and after intentional levee breaches along the lower Cosumnes River, USA. While breach architecture influences hydrogeomorphic process on nearby floodplain areas and main channel reaches, the use of the UAS LiDAR allows for high precision estimation of sedimentation rates, and development and evolution of archetypal crevasse-splay complexes along dominant flowpaths. Advective sediment transport along flow paths helps to generate overlapping crevasse-splay complexes, while turbulent diffusion promotes the incipient formation of lateral levees through large wood and sediment accumulation in near bank areas. It is only from these repeat mapping surveys at high spatial and temporal resolution that deposition and scour volumes can be tied to specific flood events, as the opposed to the current practice that relies on posterior mapping to estimate net flux rates after flood season cessation. Understanding the variable hydrogeomorphic responses to intentional levee breach activities will help engineers design floodplain restoration actions that maximize desired floodplain topographic change while also minimizing potential undesirable consequences such as levee breach closure or excessive upstream channel incision.

Keywords: Geomorphology, Hydrology , Remote Sensing

Characteristics of atmospheric mercury and gaseous substances observed at Mt. Fuji monitoring station during 2015 summer observation campaign

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It is well known that the mercury has the highly neurotoxic effect and harmful for living things, even small amount of mercury (Hg). For this reason, it is very important to understand the Hg behavior in the environment. Mt. Fuji has an elevation of 3776 meters and is a single peak mountain. Because of the high elevation, this sampling point (3766m) wasn't affected by the domestic pollution sources. Therefore, this mountain is suitable for observing long-range transport of atmospheric Hg. The purpose of this study is to clarify the dynamics of atmospheric Hg and gaseous substances synchronized with it came to Mt. Fuji monitoring site.
Mt. Fuji is the highest mountain in Japan (elevation : 3776 m). In this site, from 7 August 2015 to 23 August 2015, we continuously observed atmospheric Hg at Mt. Fuji monitoring site. Electric power was provided from a former meteorological station and a inlet tube was fixed at 1 meter distance from the building. Also, gaseous substances (SO_2 and CO) were observed at the same time. Based on the observation data, the passway of airmass was analyzed by back trajectory analysis.
The mean concentration of atmospheric Hg was 2.03 ng/m^3. This mean value was higher than the background concentration level of the northern hemisphere (1.5~1.7 ng/m^3). The high concentration period was observed from 11 to 12 August 2015. The peak concentration for each date were 5.59 and 6.17 ng/m^3, respectively. These concentration were observed during the day time. On 11 August, the peak of SO_2 and CO concentration were also observed. On the other hand, on 12 August, the peak of CO was observed. In order to clarify the relationship between airmass route and these concentration peaks, we conducted the back trajectory analysis. Then, it is considered that volcanic gas released from Mt. Aso on 6 August may reached at Mt. Fuji monitoring site on 11 August. On the other hand, on 12 August, the air mass may came from the Asian continent to Mt. Fuji monitoring site, when high concentration peaks of atomospheric Hg and CO were observed. Result from our observation, it is considered that the atmospheric Hg and CO may came from the Asian continent to Mt. Fuji monitoring site on 12 August.

Keywords: atmospheric mercury, gaseous substance, Mt. Fuji

The environmental condition of small subalpine coniferous forest on Mt. Aomatsubayama, northern Japan

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The coniferous forest (largely composed of *Abies mariesii*) is presently the typical vegetation of the subalpine zone in Japan. However, around Mt.Aomatsubayama, Kitakami Mountains in northern Japan, the expected predominance of *A. mariesii* is not extensively observed, and the predominant vegetation is instead the dwarf bamboo (*Sasa kurilensis*) grasslands and broad leaf forests. It's called Pseudo-Alpine zone. However it is unknown why the area under coniferous forest is small in this region. The clarification of the reason why small *A.mariesii* forest formed will make a major contribution the understanding of Pseudo-Alpine zone.The purpose of this study is to clarify the environmental condition of small *A. mariesii* forests in Mt.Aomatsubayama from the perspectives of distribution of vegetation; geomorphic characteristics; soil conditions.

In this site, there are few mixed forest of *A.mariesii* and other plants. Therefore the boundary of *A.mariesii* forest is sharply defined. Most of the *A.mariesii* forests distributed in a gentle slope on the summits (about Alt.1300-1360 m). The dominance vegetations are *S. kurilensis* grasslands, *Fagus crenata* and *Betula ermanii* broad leaf forests. The soil profiles in these vegetations resembled each other regarding the existence of humic soil layer before To-Cu tephra layer (6ka:Machida and Arai, 1992). The soil in the *A.mariesii* forest area had higher moisture content than that in other vegetation area.

As these results, it's considered that *A.mariesii* forest is distributed in a gentle slope on the summits and high soil water area. This means Pseudo-Alpine zone is formed by the localized-distribution of *A.mariesii* forest on high soil water area.

Keywords: Coniferous forest, Abies mariesii, Location environment, Landform, Soil condition

Topographic factors controlling vegetation in the timberline ecotone, Kiso Range, central Japan

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High varieties of plant habitats around the main ridges of Japanese high mountains reflect microclimate and soil conditions varying within in a narrow area. Such complex distributions of vegetation have been studied qualitatively through comparisons between the distributions and other environmental factors. The compared factors were usually derived from narrow areas in previous studies. In contrast, this study examined topographical thresholds of physiognomy through a statistical analysis of the vegetation and topographical parameters calculated from a digital elevation model (DEM), covering the whole alpine zone and the part of the subalpine zone in the Kiso Range.
Bare ground, dwarf pine (*Pinus pumila*) area, alpine meadow, birch (*Betula ermanii*) forest, and subalpine conifer forest were digitally mapped using orthophotographs of the whole area above 2200m a.s.l. Elevation, slope direction, gradient, ridge-valley index (RVI) and vertical distance from the main ridge (VDMR) in same area were calculated from the 10-m-grid DEM. RVI values are based on the lines of sight at each point, the high and low values of which correspond to a ridge and a valley, respectively. Then the vegetation of each grid was linked to the topographical parameters of the grid.
Frequency distributions of altitudes of three vegetations indicate a vertical zonation; in ascending order, coniferous forest, birch forest and dwarf pine area. Each vegetation also has different trends in slope direction, RVI and VDMR from the others. Those trends seem to reflect spatially different snow thickness which is originated from snow redistribution by topographical modulation of winds.
RVI and East-west component of the direction were combined to make a topographical variable of snow redistribution, which is independent from elevation. The combined variable increases when the position is located in more wind-leeward areas, thus the variable is called wind-leeward (WL) index hereafter. We confirmed that 0.68 is the correlation coefficient between the WL indices and snow depths measured around the timberline of the northernmost part of study area.
Boundaries of dominant vegetation are linear in the diagram of altitudes and WL indices (Fig.1). The boundary between dwarf pine and tall tree forests, namely timberline, is roughly constant at 2500 m a.s.l. between dwarf pines and conifers, if WL indices are less than -2. In the area having a WL index larger than -2, the boundary consisting of birches increases linearly with WL indices. An increase of WL index probably relaxes the stresses inhibiting the growth of forest, such as strong wind and icing, which favors the growth of birches resistant to snow pressure. This figure also shows no altitudinal zone for bare ground and alpine meadows. These distributions are controlled not by the altitudes but by the shape of ground surface.
The physiognomy in the timberline ecotone of the Kiso Range was roughly described by two indices indirectly expressing temperature (altitude) and snow thickness (WL index). Thus, this approach can be a range-scale quantification of dominant factors controlling the physiognomy.

Keywords: Vertical distribution, Timberline, Alpine vegetation, Geoecology, GIS, Kiso Range

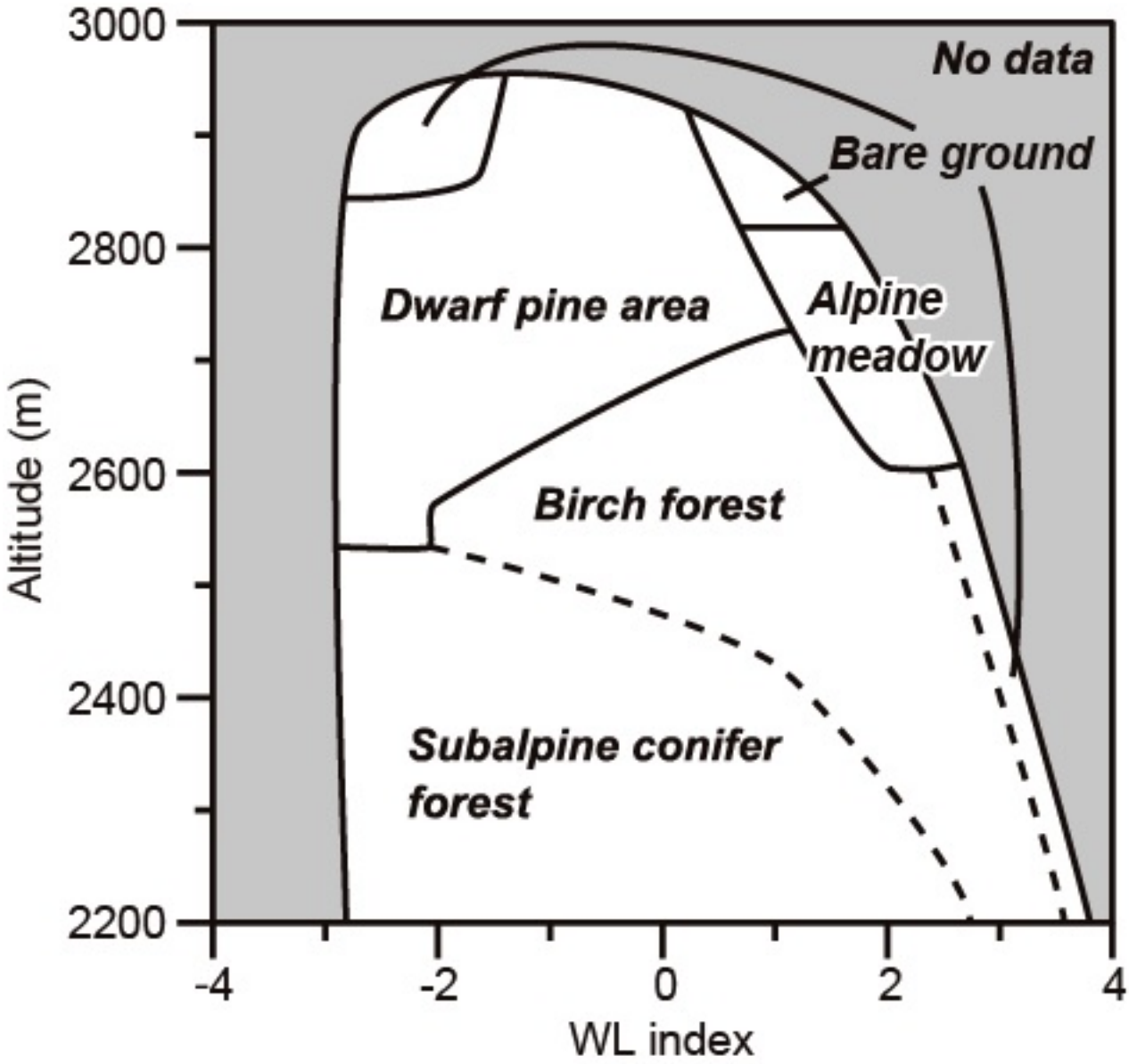

Fig.1: Altitude and the wind-leeward (WL) index in the Kiso Range classified by the dominant vegetation.

Vertical distribution of air temperature in the Kamikochi region

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Meteorological observation was conducted in the Kamikochi region to reveal meteorological characteristics and vertical distribution of air temperature. Monthly mean temperature was highest in August and lowest in January. Specific humidity also showed clear annual changes, with a minimum in January and a maximum in August. Solar radiation also indicated seasonal changes. It was largest in May and smallest in December and had a positive relationship with daily-temperature-range (DTR). DTR gradually decreased with increasing altitude.
Strong temperature inversion appeared during winter. Contrastingly, however, the number of days inversion occurred increased during spring and autumn. Inversion intensity was affected by night length; therefore, strong cold air pools appeared in winter. Synoptic types, such as migratory anticyclones, covered the central Japan and were associated with strong inversion. On the other hand, pressure patterns like the North Pacific High covered this region and were related to weak inversion.
Temperature Lapse Rate (TLR) showed clear seasonal change, becoming steeper in spring and shallower in autumn. There was a significant negative relationship between specific humidity and TLR, which means that dryer air led to steeper lapse rates. Steeper TLRs were associated with winter monsoon pressure patterns and migratory anticyclones. Lapse rate became steeper during sunny days because of low humidity. Shallow TLRs, however, appeared frequently on sunny days during autumn. This was probably caused by subsidence inversion with a migratory anticyclone, a major synoptic type in autumn.

Keywords: temperature inversion, cold air pool, temperature lapse rate

Heat balance analysis for the snow surface in the Norikura highland

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In this study, we calculated the amount of snowmelt and the ablation process of snow cover. The degree-day method, which uses daily mean air temperature, has been generally applied to estimate the snow surface melting. However, it is difficult to estimate its effect in terms of time-dependent spatial snow melting. We installed a meteorological station at a site located 1590 m.a.s.l., in the Norikura highland and carried out a heat balance analysis for the snow surface. We obtained the following meteorological data: air temperature, short wave net radiation, long wave net radiation, relative humidity, precipitation, atmospheric pressure, wind speed, and snow depth. We applied the heat balance method to analyze the heat balance and turbulent heat flux on the snow surface.
During the three snow cover seasons, the mean air temperature in this site is -3.7 C and the maximum snow depth has been about 150-180 cm. The result of the heat balance analysis on this site revealed that the net radiation heat flux comprised the largest proportion of the snowmelt energy, followed by the sensible heat flux (second largest). However, latent heat flux contributed to the large negative melt energy flux. We suggested why net radiation heat flux becomes very large because the wind speed of this site has been recorded about 1.0 m/s during the snow cover period, and then the turbulent heat flux became small amount of heat flux. In addition, the small amount of sensible heat flux was caused by low air temperature.

Keywords: heat balance analysis, snowmelt, Norikura highland

Meteorological conditions of the lake and land breeze in the lake Suwa

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The subject of the present study is the lake and land breezes in the lake Suwa. Lake and land breezes are meteorological phenomenon of a local scale. Most of the previous studies have been conducted exclusively in the summer season. In addition, very few studies have been conducted on the breezes in Japan. Therefore this study analyzes the meteorological observation data from 2012-2014, to elucidate that lake and land breezes have an impact on the surrounding local climate of the lake Suwa. Lake Suwa is famous as a frozen lake in winter; hence, this study involves analysis of the formation of ice in it. Lake breezes develop, largely in the summer. On the other hand, we confirm that land breezes appear mainly in the winter. We presume that this seasonality of lake and land breezes is related to the air temperature variation. Specific humidity variation in the Suwa area is due to the west wind causing a rise in the specific humidity and the east wind lowering it. This is caused mainly because the west wind carries moist air from Lake Suwa whereas the east wind carries dry air from the land. Ice formation occurred extensively in 2012 and 2014. This resulted due to the decline in temperature and weakening of wind velocity.

Keywords: lake and land breeze, lake Suwa

Long-term Monitoring of Geo-environment on Post-fire 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 *P. pumila* received nearly impact of the fire. In the *P. 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 fifth 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 *P. pumila* communities are flushed out to surroundings. The litter layer on the forest-floor in the *P. pumila* communities were 3-4 cm thick in August of 2011, but it became 0.5 cm thick in September of 2015. The *P. 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 *P. pumila* communities and the no fired *P. 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, 2012 and 2014, 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 *P. pumila* communities.

Keywords: Fire, Alpine zone, Pinus pumila, Slope erosion, Ground temperature variation, Shirouma-dake

Geomorphological conditions of glacier and snow patch in the Northern Japanese Alps

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Tateyama mountain range located in the northern part of the Japanese Alps has three glaciers (Gozensawa, Sannomado, Komado). We researched glacier mass balance and environmental conditions based on fieldwork and satellite data analysis. High resolution 10cm DEMs of three glaciers were produced using images taken by Cessna plane. Kinematic GNSS survey data and 10cm DEM were compared, the average vertical error of the entire glacier is -44±10cm. The terminal elevations and area of Gozensawa, Sannomado, and Komado Glaciers are 2502 m, 1870 m, 1698 m, and 0.112km^{2,} 0.167km^{2,} 0.154km^{2} respectively. We report our result including snow data in March.

Keywords: glacier, snow patch, mass balance, SfM

Research on Small-scale Landslides group in Northern part of Kashiwazaki City

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Many landslides exist in Chuetsu region of Niigata Prefecture. We reserched small-scale lindslides in the Northern part of Kashiwazaki City using the satellite image analysis and field survey, to understand recent behavior and distribution of landslides in the study area. First, we extcacted the distribution and size of these landslides using field survey and airborne LIDAR data. Second, we investigated the movement of landslides using DInSAR analysis of ALOS-2/PALSAR-2.

Keywords: Landslide, Airborne LIDAR Data, DinSAR

The distribution of rockfall and topographical change in Shirouma Daisekkei, the Northern Japanese Alps

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Shirouma-Daisekkei is one of the three largest snow patches in the Japanese Alps. More than 10,000 climbers pass on the snow patch every year. The climbers have suffered accidents of rockfall and rock slip. In August 2005, rock slip at the rock wall of Shakushi-dake causes injured two people. In August 2008, rock slip at upper part of snow patch causes two climbers sacrificed (Kariya et al., 2008). In this study, we carried out field survey during 2014-2015, to clarify the state of rockfall and rock slip, and topographical change around Shirouma-daisekkei. Interval camera showed many rock fragments appeared from inside of snow emerged by declining snow surface in 2014. On the other hand, many rock fragments were produced from rock wall after June 2015. The total number of rock fragments (>30cm) is 570 on the snow patch at the end of September. The distribution of rock fragments is local, and reflected the differences in the local geological feature of this study area.

Keywords: rockfall, Shirouma-Daisekkei, topographical change

Development of Lake Shibire related to landslides in western part of Misaka Mountains, central Japan

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Lake Shibire is a small circular lake without an outlet in montane environment. Although the origin of Lake Shibire has been discussed by the previous authors (e.g. volcanic crater, meteoroid impact, and landslide), conclusive evidences have not been presented yet. We have performed integrated research on geology and geomorphology of Lake Shibire and its adjacent areas. Geomorphological mapping with GIS, geological survey in the field, radiometric dating and tephrochronology of lacustrine sediments, and core drilling of riparian terraces enabled us to reconstruct the late Quaternary landscape evolution of Lake Shibire.

Initially, Lake Shibire was formed by large landslide at 50 cal BP. A closed depression on the main landslide body was inundated. At almost the same time, two subsidiary landslide-dammed lakes occurred around the main landslide body. Later, the initial landslide lake was separated into two lakes (the east and the west lakes) by the secondary landslide activity around 47 cal ka. The western lake has been continued to exist until present but the eastern lake was dissected by valley head incision in the late Holocene. Two subsidiary lakes were also extinguished but the timing was not unclear. A buried soil layer embedded in lacustrine sediments beneath a riparian terrace surface indicates that elevation level of Lake Shibire around 3.5 cal ka was 0.95 m lower than today. We concluded that both the present Lake Shibire and its ancestral paleolakes were created and affected by repeated landslide activities since 50 cal ka. Other theories of the origin should be rejected.

Keywords: landslide, dammed lake, lacustrine deposit, 14C date, late Pleistocene

Geomorphological and geological characteristics and origin of landslide lobes in the Dakesawa basin, the Kamikochi Valley of Japanese Alps

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Recently, the features of deep-seated gravitational slope deformation and bedrock landslides have been discovered in the Kamikochi Valley in northern Japanese Alps, based on field investigation and GIS analysis of high resolution digital terrain models. In the JpGU 2016 meeting, we will show the geologic and geomorphic characteristics and historical development of a landslide feature with a large lobe (270×380 m) composed of angular blocks in the Dakesawa basin of the lower Kamikochi Valley.
The main results are as follows: 1) a landslide lobe was formed as a result of bedrock (granite and granodiorite) landslide occurred on the uppermost parts of valley side slopes, 2) those slopes are gravitationally deformed with formation of linear depressions and antiscarps, 3) geomorphic separation of a landslide lobe into the higher and the lower parts suggests the occurrence of two landslide events, 4) the initial landslide event would occur before 180-120 cal BP, according to ^{14}C ages of surficial soils on the lobe, and 5) a series of landslide events can be classified into a medium-scale landslide phenomenon.

Keywords: Bedrock landslide, Deep-seated gravitational slope deformation, Block field, Holocene

Large-scale bedrock landslide and the evolution of natural history in Kamikochi Valley, northern Japanese Alps

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The Kamikochi Valley demonstrates a spectacular landscape composed of glacigenic troughs and cirques, periglacial debris-covered slopes, and fluviogenic flood plains as well as alpine-subalpine vegetation continuum so that this scenic spot has been visited by numerous climbers and tourists. Quaternary geology and geomorphology of the Kamikochi have progressed during the last several decades. Although the previous studies have emphasized an importance of Quaternary glaciations and periglaciations, the role of landslide processes has not always been focused despite the Kamikochi is situated under volcano-seismic active environments with high precipitation. Our reappraisal of geomorphology has revealed that large scale bedrock landslides related to deep-seated gravitational slope deformation (DSGSD) are important factors affecting the evolution of landscape (landforms and vegetation) of the Kamikochi.

For example, Bentensawa (6-7 ka) and Myojinike (age unknown) rock avalanches caused a river obstruction forming dammed lake or flood plain. Dakesawa rock avalanche (past 1000 yrs?) produced block field without surficial fine materials such like a block stream. Genbunsawa rock avalanche (4 ka) caused many hummocks 5-10 m high.

Landslide deposits have created unique natural environments different from outside landslide areas, which would have caused unique landscape. In this meeting, we will show chronological tables (^{14}C and TCN), geomorphological maps, oblique airphotos all of which focuses on bedrock landslide phenomena in Kamikochi Valley.

Keywords: Large-scale bedrock landslide, Natural history, Landscape evolution, Last Glacial , Holocene

