Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

ACC28-P01 Room:Convention Hall Time:May 25 18:15-19:30

Development of a simple snow load gauge using plastic bottles

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Gravity observations with a superconducting gravimeter is performed at the underground site of the Kamioka Observatory, Institute for Cosmic Ray Research, The University of Tokyo. Since this station is located in an area where there is heavy snowfall in winter, the observation is subject to a significant effect of snow load. We developed a simple snow load gauge using plastic bottles with the aim of such hydrologic corrections. It is based on the principle of a snow pillow, which detects water equivalent of snowpack in terms of pressure changes of the anti-freeze coolant inside the sensing unit, and is much smaller and cheaper than the existing products thanks to the usage of plastic bottles. A laboratory test of artificially loading the instruments has revealed an almost linear relation between the load and the liquid pressure inside the bottles. The instrument was installed at the top of Mt. Ikenoyama, above the Kamioka underground site, in order to observe in situ snow load. Resultant time series of pressure changes turned out to be very similar to the observed gravity changes, suggesting that our instrument produced highly plausible recordings of snow load. We plan to make this observation at multiple sites in the mountain in order to measure 2-D distribution of snow load.

Keywords: snow load gauge, superconducting gravimeter, plastic bottle

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Dependence of the size distribution of BC in snow on thawing temperature

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Black Carbon aerosols(BC), mainly consists of soot or soot like matter generated by the combustion of fossil fuel or biomass, absorb the solar radiation to heat the atmosphere. Moreover, BC deposited on snow decrease the snow albedo and contribute to the warming in the higher latitudes. Therefore, BC have the significant influence on the climate but quantitative estimation of it has a large uncertainty, For example, IPCC(2013) estimated the radiative forcing by BC on snow to 0.04(0.02-0.09)(W/m^2), but in Flanner et al.(2007) estimated to 0.049(0.007-0.12)(W/m^2). The snow albedo is estimated by a radiative transfer model in the snow layers considering snow grain size and impurities such as BC. The size distribution of BC particles in snow is significant to estimate BC influence on the snow albedo.

We are measuring the size distribution of BC mass concentration in snow with the incandensence method (MacConel et al. 2007). Before the measurement, snow samples are melted and are aerosolized by a nebulizer. In these procedures, there are some factors to reduce the accuracy or precision. One of them is the influence of the thawing temperature of snow samples on the size distribution of BC in the thawing snow. Many researchers (e.g. Brandt et al., 2011) heated to thaw out snow faster. However, Schwarz et al.(2012) suggested that the size distribution of BC in the thawed snow could be varied with the thawing temperature significantly. In this paper, we present the experiment to examine the thawing temperature influence on the measurement of BC in snow by the incandensence method and the results.

We adopted two snow samples obtained at Hakusan and Shirouma in 2013 for this experiment. The snow samples are well uniformed with a mixer and are divided into 9 bottles, respectively. 3 bottle samples were melted at 70 ℃,20 ℃ and 5 ℃, respectively, using a water bass. Then, we measured the size distribution of BC mass concentration in the melted snow in each bottle with the SP2 instrument.

The mass concentration of BC in the lower thawing temperature samples was higher than those in the higher temperature samples. Their ratio between samples melted at 5 ℃ and 70 ℃ was 40.8% for the Hakusan snow case, and 11% for Shirouma snow case. Smaller size of BC was more sensitive to the thawing temperature. These result showed that the thawing temperature has a significant influence on the mass concentration and size distribution of BC in thawing snow, and that lower thawing temperature is better for the measurement of size distribution of BC mass concentration in snow. Because not only the temperature but also thawing/preserve time may affect the size distribution of BC in the thawing snow BC, we are planning of next experiment to examine the time influence.

Keywords: snow, BC, size distribution, SP2, thawing temperature

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Surface albedo over snow-covered boreal forests, Alaska

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Previous research has demonstrated the high variations of the surface albedo in winter/spring in snow-covered regions in various global climate models. In this study, we focus on the surface albedo over snow-covered forests which is suggested probably too high in various global climate models. This study was carried out to verify the occurrence frequency of ice accretion and snow accretion in the boreal forest regions. Using the interval camera installed on the observation tower of 16 m in height at the site located to the north of Fairbanks, Alaska, ice accretion and snow accretion in black spruce forest regions were measured. Based on the results, the surface albedo variation of snow-covered forests and differences in the snow albedo parameterization are discussed to contribute to a better understanding of the role of snow in the climate system.

Keywords: ice accretion, snow accretion, albedo, boreal forest

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Long-traveling conditions for the rock-on-snow avalanche: insights from the field and laboratory evidences

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On March 12, 2011, a large earthquake induced rock avalanches in Nagano and Niigata prefecture Japan. These rock avalanches travelled long, about 1 km to 1.5 km sliding on snow with apparent friction angle of 6? to 17.1?. It looks uncommon phenomena. Because rock avalanches often stop on snow covering steep slope. We hypothesized that the nature of snow dominate the mobility of the rock-on-snow avalanche, and flew rocks on snow 3.5-m-long slope varying snow hardness, and then we flew a rock and earth of 6 ton on 28-m long snow covering slope. Snow is low friction material but its aggregates is effective cushion by self-deformation, so travelling on normal autochthonous snow cover and mixing snow into the falling material do not contribute such long travelling. However, hardened and consolidated snow provide it because of ice-like low friction and impermeability. The consolidated snow is formed at the contact surface on snow cover by impulsive compressing. Hence, when a falling material plunge into lower thick snow cover, consolidated snow is formed. Then, falling material slide on it by pushing following flow. When the forming consolidated snow basement, water and air are expelled from snow to upper falling material, and they probably reduce friction. As the consolidated snow is impermeable, frictional heat and heart transferring produced snowmelt are kept on the consolidated snow, and it reduce further friction. With downsizing of falling material, the resistivity against forehand snow cover decreases, and it leads to stopping. In addition, with lessening pressure of the falling material to underlying snow cover, forming impermeable consolidated snow stops, and water pressure disappear, and it leads to stopping. Wet and granular snow is likely to be consolidated. Thus these snow covered area and/or season are preferable condition of the long travelling rock-on-snow avalanches.

Keywords: snow cover, rock-on-snow avalanche, snow avalanche, rockfall, earthquake

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The research expedition of the glacier and mountain permafrost in the Bhutan Himalayas in 2014

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The glacier and mountain permafrost research expedition was carried out in September and October of 2014 in the central part of the Bhutan Himalayas. The aims of this expedition were 1) to make a rock glaciers inventory and identify the lower limit of mountain permafrost in the Bhutan Himalayas, and 2) to measure the ice thickness of the Gangjula glacier based on the ground penetrating radar (GPR) soundings.

We identified total 81 rock glaciers. Active rock glaciers appeared above 4600 m. We estimated that mean annual air temperature at the terminus of the active rock glaciers are less than -0.8oC based on ERA-Interim data from 1979 to 2013. These indicate that the lower limit of mountain permafrost in Bhutan Himalayas is 4600 m. This lower limit of mountain permafrost is slightly lower than that in Khumbu Himal (5000-5300 m) and that in Kanchenjunga Himal (4800 m).

The Gangjula glacier is a small saddle glacier. Length=1.1 km, width=0.3 km, surface area=0.31km^2, elevation=4900-5200 m and the ELA=glacier top. We used GSSI SIR3000 + 100MHz antenna and got 6 cross and 1 longitudinal GPR profiles. The results of GPR soundings indicated that the maximum thickness of the Gangjula glacier was 76 m.

Keywords: Bhutan, Himalaya, glacier, rock glacier, permafrost, ground penetrating radar

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Seasonal variations in the thermal structures of proglacial lakes in the Southern Patagonia Icefield

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Patagonia Icefields are loosing ice mass at one of the greatest rates in the world. The icefields are characterized by a number of outlet glaciers calving into lakes and the ocean. Many of these calving glaciers are retreating, but rates of the retreats are significantly different in each glacier. For example, Glaciar Upsala retreated by 2.9 km over the period of 2008 — 2011. Mass loss from the glacier accounts for about 15% of the total mass loss from the Southern Patagonia Icefield in 2000 — 2012. On the other hand, Glaciar Perito Moreno has shown no significant change in the terminus position over the past century. Recent studies in Greenland and Alaska suggest the importance of melting of calving face below the sea surface for recent mass loss of calving glaciers. Despite the increasing numbers of data from fjord of tidewater glaciers, little is known even in the thermal structure in lake, seasonal variation and how various water masses mix. To investigate the thermal structure of proglacial lake, we measured temperature and turbidity of lake water in front of calving glaciers in the Southern Patagonia Icefield. Lake measurements were carried out at Glaciar Upsala, which overs an area of 840 km^2 and flows into a ~600 m deep lake, and Glaciar Perito Moreno, which overs an area of 259 km^2 and flows into a shallower lake (~200 m deep). We repeated measurements in summer (December, 2013) and spring (October, 2014) to investigate seasonal variations in the lake water properties.

Our results in spring showed relatively uniform water temperature and turbidity from the lake surface to the bottom, whereas temperature and turbidity showed steeper vertical gradients in summer. These results are consistent in the two lakes. In summer, water temperature in front of Glacier Upsala (2 — 4^{o}C) was colder than in spring, because of large amounts of subglacial discharge from the glacier. Turbid and cold water (<1^{o}C) was found at the deepest part of the lake (>500 m below the lake surface), which is a strong indication of subglacial meltwater discharge. Contrasting to Glaciar Upsala, cold deep water was missing in the lake of Glaciar Perito Moreno both in summer and spring. In summer, water temperature (6^{o}C) was warmer than in spring by ~3^{o}C within whole lake, and in particular, warm water layer (~8^{o}C) observed at the lake surface (<5 m below the lake surface).

These data indicate different thermal structures in front of the two freshwater calving glaciers in Patagonia. The structure is probably dependent on the bathymetry and subglacial discharge. Warmer lake is formed by relatively small amount of subglacial discharge and shallow lake, which should play crucial roles in the melting of calving face below the lake surface.

Keywords: calving glacier, proglacial lake, subaqueous melt, Patagonia