Japan Geoscience Union Meeting 2013
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熱帯アフリカ・ルウェンゾリ山の熱帯高山氷河における雪氷生物生態系の分析
Ecological analysis of glacial biology on tropical glaciers of Ruwenzori mountains,Uganda,Africa

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Introduction

Ruwenzori mountains are located at the westernmost of uganda, tropical africa. Although in the equatorial area(0N, 29E), there are glaciers(4700-5000m a.s.l.) In africa, only three mountains have glaciers, Kilimanjaro, Mt.Kenya, and Ruwenzori, and some scientists said that all of these glaciers will disappear during 2020s. So, it is urgent to research this area as soon as possible.

On glacier's surface, there are some psychrophylic microorganisms like snow algae. And almost no glacial biological research was carried out on tropical region. So, we took researches on Ruwenzori mountains on Feb.2012 and Feb.2013.

We analyzed altitudinal distribution and biomass of snow algae and also analyzed optimum temperature of yeasts which were collected in Ruwenzori mountains.

Methods

Sampling was held on 4 sites, the one one the Mt.Speke and the others on the Stanley Plateau Glacier(S1=4714m,S2=4740m,S3=4850m) We sampled glacier surface ice by a stainless scoop rinsed with ice around the site. After melting, we put formalin into sample. Volume of formaline is about 3% of melting ice4.

First, we counted snow algae in this sample by a fluorescence microscope and calculated algal biomass.

Second, we analyzed the optimum temperature of yeasts which was picked on Ruwenzori glaciers. We put the yeasts into YEPD liquid culture medium and cultivated it on different temeperature(5-30 degrees Celsius, with 5 degree interval). After cultivation, we measured optical density by absorption photometer(filter:660nm).

Results

On first experimental work, 5 kinds of snow algae are found.

These are; Cylindrocystis brebissonii, Ceratodon purpureus(The mosses), green round unicellular organisms, red round unicellular organisms, and protonema algae, which has never reported on other glacial biological research.

Cylindrocystis brebissonii are found all altitude. It was found at only lower ablation area of glacier in himalaya and patagonia, so that suggest all of Ruwenzori glacier has become ablation area. Ceratodon purpureus are found only ST-S1. It is also no report that mosses inhabit on glacier surface.

On second experimental work, we analyzed several kinds of yeasts, but for all yeasts, their optimum temperature is 20-30 degrees Celsius, not cold but middle-high temperature, although they are picked at glacier surface, which is considered as cold environment.

It suggest that there are positive feedback effect on melting glaciers. If glacier surface are becoming warm by some trigger such as global warming, glacial microorganisms which has middle-high optimum temperature are increasing and reducing glacier surface albedo. After that, because of reducing surface albedo, glacier surface has more heating energy and becoming warm, so some microorganisms are more increasing... it is positive feedback.

We suggest that glacier melting will occur more rapidly than we expected because of this positive feedback.

キーワード: 雪氷微生物, 氷河融解, 熱帯アフリカ

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航空レーザー測量による上高地梓川流域の積雪深分布
Measurement of snow depth distribution in the Kamikochi-Azusa river basin using an airborne laser scanning

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航空レーザー測量では、GPS により航空機の 3 次元位置を精確に求め、航空機から地上をレーザー・スキャンすることにより航空機から地上までの距離を計測し、地表面（冬季は積雪表面）の 3 次元座標を算出する。無積雪期と積雪期に航空レーザー測量を実施することにより、同じ水平座標について地表面高と積雪表面高が得られるので、その差分が積雪深になる。2012 年積雪期に上高地梓川流域において航空レーザー測量を行ったので、無積雪期との差分により得られた積雪深分布を報告する。

キーワード: 積雪深, 上高地梓川, 航空レーザー測量
Keywords: snow depth, Kamikochi-Azusa river, airborne laser scanning

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吹雪による大気への昇華蒸発の寄与の比較検討
Comparison investigation of contribution of the sublimation to the air by blowing snow

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If a strong wind blows in a snow cover region, snow particles which once lay move in the air and are transported to the leeward with energy exchange between the air and the snow cover. Since this blowing snow is generated not only in land but in the vast snow cover region including the sea ice, the influence of the energy exchange will reach far and wide.

On the other hand, according to climate models, temperature rising is predicted in the snow cover region of high latitude which blowing snow also occurs, and the uncertainty of warming prediction has been widely discussed.

Therefore, in this research, the mean stress falls on the influence of the water vapor in the snow cover region. The water vapor has the greatest contribution as greenhouse gas. If blowing snow occurs, the snow particles moving in the air sublimate and change the water vapor amount of the air. Little attention has been given to the point. It is because the field observation under a fixed climate condition is difficult, observation using instruments which measures blowing snow correctly is hardly carried out in windy regions where sublimation is produced, and so on. In this presentation, the past blowing snow research carried out in the snow cover region is compared, the estimate of the amount of sublimation is arranged, and the contribution of the sublimation to the atmosphere by blowing snow is investigated.

キーワード: 昇華蒸発, 積雪, 吹雪, 気候変動
Keywords: sublimation, snow cover, blowing snow, climate change

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飛騨山脈、剱岳池ノ谷右俣雪渓の氷厚と流動
Dynamics and GPR stratigraphy of the Ikenotan-migimata perennial snow patch in Mt. Tsurugi, the northern Japanese Alps,

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We have investigated surface flow velocity and ice thickness of the Ikenotan-migimata perennial snow patch in Mt. Tsurugi (2999 m asl) in the northern Japanese Alps, central Japan since 2012.

We found the thick ice mass (about 40 m in thickness) in the lower part of the Ikenotan-migimata perennial snow patch based on the GPR sounding in the autumn of 2012. We measured that the ice mass had flowed 10-15 cm month-1 in the autumn of 2012. Thus, we regard the snow patch as small active glacier.

キーワード: 氷河, 多年性雪渓, 剱岳, 流動, 地中レーダー
Keywords: glacier, perennial snow patch, Mt. Tsurugi, glacier flow, GPR

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ACC32-P05 会場:コンベンションホール 時間:5 月 24 日 16:15-17:30

南パタゴニア氷原の 8 つの氷河における流動速度と末端位置の変動: 2002-2011 年
Surface Velocities and Ice-Front Positions of Eight Major Glaciers in the Southern Patagonian Ice Field, South America,

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パタゴニア氷原は世界最大の温暖氷塊であり，その中の多くの氷河では近年急激な後退が報告されている．しかし，アクセス困難な環境から連続的かつ広範囲な観測は行われておらず，パタゴニア地域の氷河の流動の詳細は一部を除いてほとんど明らかになっていないのが現状である．そこで本研究では，全天候型マイクロ波リモートセンシングの一種である合成開口レーダー（Synthetic Aperture Radar: SAR） を用いて，南パタゴニア氷原の 8 つの氷河について流動速度を測定する．さらに，マイクロ波の反射強度から得られる強度画像より氷河の末端位置を読み取り，その変動を流動速度の測定結果と合わせて考察する．

本研究では，ALOS/PALSAR（日本名「だいち」，2006 年～2011 年）と Envisat/ASAR（2002 年～2012 年）の 2 つの SAR 衛星のデータを用いて Pixel offset （別名 Feature tracking, Speckle tracking） 法を適用し，南パタゴニア氷原の 8 つの氷河の 2002 年から 2011 年の流動を検出した．そして，氷河が地形勾配に沿って流動しているという仮定のもと流動速度を測定した．地形データには SRTM4 の数値標高モデルを用いた．氷河の末端位置の変動を見るためには，UTM 座標へと変換した強度画像（分解能 40 m）を用いた．末端の位置は目視により決定した．

解析を行った結果，8 つの氷河（Jorge Montt 氷河，Occidental 氷河，Pio XI 氷河，O ’Higgins 氷河，Viedma 氷河，Upsala 氷河，Perito Moreno 氷河，Grey 氷河）全てについて流動速度を測定することができた．中でも Upsala 氷河，Jorge Montt 氷河，Occidental 氷河，Pio XI 氷河において明瞭な時間変化が見られた．これら 4 つの氷河のうち Upsala 氷河，Jorge Montt 氷河，Occidental 氷河では，流動速度の増加とともに末端が急激に後退していた．いずれの氷河においても加速度は末端付近で最大となっており，このことは末端付近においてクレバスの深さを増加させるような力が働いたと解釈することができる．よって，この結果は，クレバスの深さが氷厚に等しくなるところでカービングが起こるという，Benn et al. (2007) と Nick et al. (2010) に記されているモデルを支持するようなものであった．一方，PioXI 氷河では 2003 年，2005 年，2007 年に南側末端を中心に急激な加速が見られた．この変動は季節変化だけでは説明できず，他の 7 つの氷河のふるまいとも大きく異なっていた．また，先に述べた 3 つの氷河のような末端の急激な後退も見られず，2003 年と 2011 年を比較すると末端は前進していた．

キーワード: 合成開口レーダー, パタゴニア, カービング氷河
Keywords: SAR, Patagonia, calving glaciers

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2005 年以降のモンゴル・ポタニン氷河の質量収支
Surface mass balance of Potanin Glacier, Mongolian Altai, since 2005

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The Mongolian Altai area has undergone few glaciological surveys and glacier balance studies. In this study, stake observations and pollen analysis with pit observations were used for the estimation of the surface mass balance of the Potanin glacier in the Mongolian Altai. The mass balance was estimated to be -0.58 and -1.03 and -0.17 m w.e. for the mass balance years of 2005, 2008 and 2009. The observed less negative mass balance in 2005 and 2009 and more negative mass balance in 2008 were due to higher solid precipitation in 2004-2005 and 2008-2009 than in 2007-2008 and high summer temperatures in 2008 than in 2005 and 2009. A comparison with Maliy Aktru Glacier in the Russian Altai demonstrated that the two glaciers share the same tendency in mass balance fluctuation from 2005 to 2009. Potanin Glacier has a smaller accumulation area ratio (AAR) and higher equilibrium line altitude (ELA) than Maliy Aktru Glacier. We concluded that the higher negative mass balance at Potanin Glacier compared to Maliy Aktru glacier is due to 1) small AAR due to higher ELA against glacier-existing altitude range, 2) drier and warmer climate of the region and 3) the longer response time to climate change.

キーワード: 氷河, 質量収支, アルタイ
Keywords: glacier, mass balance, Altai

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ACC32-P07 会場:コンベンションホール 時間:5 月 24 日 16:15-17:30

チベット南東部・Mount Gongga に空間デブリカバー効果
Spatial debris-cover effect on the maritime glaciers of Mount Gongga, south-eastern Tibetan Plateau

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The Tibetan Plateau and surroundings contain a large number of debris-covered glaciers, on which debris cover affects glacier response to climate change by altering ice melting rates and spatial patterns of mass loss. Insufficient spatial distribution of debris thickness data makes it difficult to analyze regional debris-cover effects. Mount Gongga offers an opportunity to study a monsoonal maritime glacier system with debris-covered and debris-free glaciers in the south-eastern Tibetan Plateau, where specific, though incomplete, information is available for both the glaciology and meteorology. Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)-derived thermal property of the debris layer reveals that 68% of Mount Gongga glaciers have extensive mantles of supraglacial debris in the ablation zones, where the debris-covered proportions of the total glacier area vary from 1.74% to 53.0%. These glaciers show a general downglacier increasing trend in debris thickness with significant spatial inhomogeneity at each site. High-resolution in situ measurements of debris thickness indicate that thin debris thicknesses of $<$ 0.03 m are widely distributed on the glaciers. Against the background of global warming, we find that although the presence of supraglacial debris has a significant insulating effect on the trend of greater negative mass balance on the debris-covered glaciers, especially on the glaciers with debris-covered proportions $>$ 20%, it accelerates the trend of faster ice melting on ˜ 10.2% of the total ablation area and produces a more negative mass balance, which is primarily caused by temperature rise, on ˜25% of the debris-covered glaciers on Mount Gongga, with the consequence that regionally averaged mass balance of debris-covered glaciers is not statistically different from that of debris-free glaciers, all showing an intensive negative mass balance trend on Mount Gongga. Also, the intensely inhomogeneous ice melting caused by widespread debris cover in association with high ice velocities and relatively steep surface leads to active terminus regions of the debris-covered glaciers, of which the terminus retreat rates are faster than those of the debris-free glaciers. In addition, regional differences in the debris-cover effect are apparent, highlighting the importance of debris cover for understanding glacier status and hydrology in both the Tibetan Plateau and other mountain ranges around the world.

キーワード: デブリ, 融解, 影響, チベット
Keywords: debris, melting, effect, Tibetan Plateau

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Full Stokes dynamics at the Shirase Drainage Basin, Antarctica and comparison to the shallow ice approximation
Full Stokes dynamics at the Shirase Drainage Basin, Antarctica and comparison to the shallow ice approximation

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Covering an area of 2 x 105 km^2, the Shirase Drainage Basin is located in East Antarctica (37-50^o E, 70-78^o S). The basin is characterized by the convergence of the ice flow towards the Shirase glacier, one of the fastest flowing glacier in Antarctica. The Shirase glacier flows at a speed of 2.3 km a^{-1} at the grounding line (Rignot, 2002; Pattyn and Derauw, 2002; Nakamura and others, 2008) and drains about 10 Gt a^{-1} of ice through a narrow outlet into the Lutzow-Holm Bay (Fujii, 1981). With nearly 90% of total ice discharge from the basin being calved by the glacier, the fast flowing nature of the Shirase glacier is important for the investigation of the ice sheet mass budget in this region.

The dynamics of the Shirase glacier is investigated by means of the full Stokes equations and the shallow ice approximation. The model Elmer/Ice (http://elmerice.elmerfem.org) is applied to the Shirase Drainage Basin and employs the finite element method to solve the full Stokes equations, the temperature evolution equation and the evolution equation of the free surface. The shallow ice approximation is also implemented into Elmer/Ice so that both the full Stokes and the shallow ice approximation are computed on the same mesh. Data for the present geometry (surface and basal topographies with no shelf) are obtained from the BEDMAP2 data set (Fretwell and others, 2012) and a mesh of the computational domain is created using an initial footprint which contains elements from 15 km to 500 m horizontal resolution. The footprint is vertically extruded to form a 3D mesh of 240720 elements with 21 equidistant, terrain-following layers.

The approach taken in this study is to compare the response of the glacier to dynamical and climate forcings when separately the full Stokes and the shallow ice approximation are employed. The sensitivity experiments are modeled after the SeaRISE 2011 experiments (http://tinyurl.com/srise-lanl, http://tinyurl.com/srise-umt). Set C (three experiments) applies a change to the surface precipitation and temperature, Set S (three experiments) applies an amplification factor to change the basal sliding velocity and Set T (one experiment) combines the forcings. The experiments are compared to a constant climate control run beginning at present (epoch 2004-1-1 0:0:0) and running up to 100 years holding the climate constant to its present state. The present state of the glacier velocities and temperature field is obtained by computing a steady-state configuration for both the full Stokes as well as the shallow ice model.

キーワード: Shirase drainage basin, Antarctica, full Stokes, ice sheet modeling
Keywords: Shirase drainage basin, Antarctica, full Stokes, ice sheet modeling