Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

ACG033-01 Room:201B Time:May 25 14:15-14:30

Numerical simulation of stratospheric sudden warming in January 2009 using NICAM and the reconsideration of gravity wave

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In this study, the major stratospheric sudden warming (SSW) occurred in January 2009 is simulated using the cloud-resolving non-hydrostatic global model NICAM with G-level 10 (7 km resolution). The results of the prediction are compared with the operational prediction by the Global Spectral Model (GSM) of the JMA with 20 km resolution. According to the results, the major warming was predicted well by NICAM, but the intensity was weaker than the observation and GSM. However, the deceleration of westerly of the polar night jet was stronger in NICAM than GSM. It is interesting to note that large amplitude gravity waves are superimposed in NICAM on the planetary waves of the wavenumber 2 type SSW. Those gravity waves are not seen in GSM and they have been parameterized as the gravity wave drags in the previous global models. We find by NICAM that the stratospheric circulation is filled by abundant gravity waves as inferred by previous observations.

Keywords: Stratospheric Sudden Warming, Cloud resolving GCM, NICAM, Gravity wave drag, Gravity waves, PSC

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ACG033-02 Room:201B Time:May 25 14:30-14:45

PSCs in the Northern Hemisphere and Southern Hemisphere Simulated by the Global Cloud Resolving Model NICAM

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In this study, a cloud-resolving atmospheric general circulation model NICAM is applied to numerical simulations with a simple cloud microphysics scheme g98 of polar stratospheric clouds (PSCs). NICAM (Nonhydrostatic ICosahedral Atmospheric Model) is developed and being improved by Atmosphere and Ocean Research Institute, University of Tokyo and Frontier Research Center for Global Change/Japan Agency for Marine-Earth Sciences and Technology, and is installed at the high-performance computing system T2K-Tsukuba at University of Tsukuba.

PSCs are optically thin clouds which appear regularly in the winter polar stratosphere at 15 to 25 km altitudes. PSCs are divided into Type I and Type II depending on their forming temperature. Type I is called NAT (Nitric Acid Trihydrate) and appears at temperature below 189.1K (-77C) about 55hPa (19km altitudes), and Type II are ice particles that form when the temperature falls below -84C.

Keywords: NICAM, Polar Stratosphere Clouds, Cloud ice mixing ratio

Japan Geoscience Union Meeting 2011
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ACG033-03 Room:201B Time:May 25 14:45-15:00

Increased stable carbon isotopic ratios of dicarboxylic acids in the Arctic aerosols during and after polar sunrise

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Stable carbon isotopic ratios (d13C) of low molecular weight dicarboxylic acids and ketocarboxylic acids were measured in the Arctic aerosols collected from late winter to early summer including dark winter and polar sunrise seasons after derivatization to butyl esters and/or dibutoxy acetals using a capillary gas chromatography combined to on-line combustion/isotope ratio mass spectrometer. We found that d13C of oxalic acid (C2) increased from -23 permil in early March (before polar sunrise) to -5 permil in May (after polar sunrise). Malonic acid (C3) also showed an increase of d13C from late February (-25 permil) to May 8 (-17 permil). Glyoxylic acid (2-oxoethanoic acid), a precursor of oxalic acid, also showed similar increase from -18 permil in late February to -10 permil in May. In contrast, isotopic composition of succinic acid (-32 permil to -24 permil) did not show a systematic trend. Concentrations of oxalic acid and glyoxylic acid preferentially declined when the isotopic ratios of C2, wC2 and C3 increased. We interpret that the enrichment of 13C occurred in the course of increased solar radiation during polar sunrise as a result of preferential decomposition of small diacids and ketoacid that are enriched with 12C. We consider that 12C-12C bond decay preferentially over 12C-13C bond of oxalic and other acids during photochemical decomposition. Here, we propose that d13C of oxalic acid can be used as a tracer to evaluate photochemical aging of organic aerosols.

Keywords: Arctic, Aerosols, Water soluble organic compounds, Dicarboxylic acids, Stable carbon isotopic composition

Japan Geoscience Union Meeting 2011
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ACG033-04 Room:201B Time:May 25 15:00-15:15

Studies of the upper atmosphere in the arctic region from observations and numerical simulations

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The polar upper atmosphere shows significant variations due to the energy inputs from the solar X-ray and EUV radiation and from the magnetosphere. The auroral phenomena are manifestation of the energy inputs from the magnetosphere. In addition, recent observational and simulation studies have revealed spatio-temporal variations in the upper atmosphere caused by effects from the lower atmosphere. For example, decrease and increase in temperature are found in the mesosphere and lower-thermosphere, respectively, during sudden stratospheric warming (SSW) events. The ionospheric electrons also vary due to upward-propagating tidal waves during SSW events. The problem of the global warming is one of the main interests in the world in the 21st century. The temperature in the upper atmosphere seems to show decreasing trend during several decades, suggesting the global cooling in the region. The increase of greenhouse gases warms the troposphere while cooling the middle and upper atmosphere. In addition, some people reported visually-apparent noctilucent clouds in the mid-latitude region for several years. This also suggests decrease in temperature in the mesosphere. As mentioned above, the polar upper atmosphere is strongly coupled with the upper and lower regions (the magnetosphere or near Earth space, troposphere, and stratosphere) through the processes of energy and momentum transfer and photochemical processes. The sciences of the coupling regions will enable us to open up the area for the atmospheric science and to take a broad view of the Earth's environment.

We present an overview of our research activities in the arctic region. Some research projects using radars and optical instruments, which have been developed for several decades, and numerical models (e.g., Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy: GAIA) are shown in this presentation as well as some research products.

Keywords: Upper Atmosphere, atmospheric vertical coupling, aurora, noctilucent cloud, radar-optical observations, numerical simulation

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ACG033-05 Room:201B Time:May 25 15:15-15:30

Satellite monitoring for the Arctic sea ice thickness

Kazutaka Tateyama[1*], Hiroyuki Enomoto[1]

[1]Kitami Institute of Technology

Arctic Ocean freezes up entirely in winter, about 60 % of ice such as second-year and multi-year ice survives over summer. Summer sea ice reflects 90% of sunlight. Therefore it has an important role in cooling as a radiator of earth system. In 2007, a large decrease occurred beyond the the Global Warming scenarios [Levinson and Lawrimore, 2008; Strove et al., 2008]. Changing the Arctic Ocean into seasonal ice covered area may accelerate global warming larger. On the other hand, a remarkable multi-year ice thinning (0.5m/decade) have been reported from field observations [Rothrock et al., 2008]. Those field observations were limited time and place has been. Therefore developing of quantitative satellite monitoring of sea ice thickness is one of the important for international research project.

This study aims to estimate the Arctic sea ice thickness from satellite sensors based on the field observations in the Canada Basin using an electromagnetic induction ice thickness profiler (EM) and passive microwave radiometer (Passive Microwave Radiometer: PMR) mounted on the icebreakers since 2008. An ice thickness estimation algorithm has been developed from the record of EM thicknesses and PMR brightness temperatures distribution. this algorithm applied to satellite PMR data to survey long-term changes of Arctic ice thickness since 1978.

Keywords: Arctic Ocean, Sea ice thickness, Satellite remote sensing

Japan Geoscience Union Meeting 2011
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ACG033-06 Room:201B Time:May 25 15:30-15:45

Interannual changes in sea ice conditions on the Northern Sea Routes obtained by satellite microwave sensors

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This study sets seven sea areas and three temporal segmentations for the analysis of NSR and examined sea ice area by sea area using data obtained from SMMR, SSM/I and AMSR-E. In analyze using SMMR and SSM/I, the results indicated the sea ice was in the decreasing tendency from first phase to third phase. Recently sea ice area decreased in third phase compared with in first phase and second phase as an example in southwestern Chukchi Sea and western East Siberian Sea. And, we research region that sea ice conditions was severe in first phase like western Laptev Sea, northeastern Kara Sea and eastern East Siberian Sea. In third phase, western Laptev Sea and northeastern Kara Sea is still severe region for navigation. On the contrary, in eastern East Siberian Sea, sea ice area was a decreased greatly in third phase comparison with first phase and second phase. Furthermore, we analyzed sea ice area using AMSR-E data because we analyzed by high resolution data. Most sea ice disappears during summer in the sea near doorway of Arctic Ocean such as southwestern Chukchi Sea and southwestern Kara Sea. Sea ice area in western Laptev Sea was severe region as well as analysis using SMMR and SSM/I. Also decrease of sea ice in western Laptev Sea was hardly seen during 2007 that sea ice decreases remarkably. In analysis of standard deviation, western Laptev Sea indicated high values. Therefore around western Laptev Sea is key area for navigation such as prediction of sea ice condition or sailing plan of ship.

Keywords: Sea ice, Arctic Ocean, Northern Sea Route

Japan Geoscience Union Meeting 2011
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ACG033-07 Room:201B Time:May 25 15:45-16:00

Detection of Melt Pond in the Acrtic

Yasuhiro Tanaka[1*], Kazutaka Tateyama,[1], Shuhei Takahashi[1], Hiroyuki Enomoto[1], Shuki Ushio[2]

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Once ice area decrease by the ice-albedo feedback effect, it depends and absorbs short wave radiation because the open water increase, and reflectance falls and promotes melting. This becomes important to understand arctic climate change. In recent years, a number of melt pond is molded in arctic sea ice surface with arctic sea ice area decrease. There seems to be promotes melting ,and absorption of the sunlight on the sea ice increases by a feedback effect when rate of melt pond on the sea ice increase.

This study analyzed melt pond and ice concentration distribution by using icebreaker in situ data in the Arctic Ocean by American observation project HOTRAX2005 from August September in 2005, by a Chinese observation team August 9 from September 4 in 2008, by observation project JOIS2009 of Canada from September 17 to October 15 in 2009. Sea ice and melt pond distribution was obtained by the front camera image on boaded on icebreaker.

The result are shown in figure. In 2005, the highly ice-covered area(over 90%) successively seen from 78N to 84N of section and melt pond is formed to Arctic center neighborhood. In 2008, latitude is the higher, the increaser tendency ice concentration, but the highly ice-covered area is not seen. In comparison with 2005, melt pond develops, and sea ice melting to developing. In 2009, melt pond is not almost seen because there was observation of after the freeze began.

Keywords: Detection of Melt Pond in the Acrtic

Japan Geoscience Union Meeting 2011
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ACG033-08 Room:201B Time:May 25 16:00-16:15

The GreenLand Ice Sheet monitoring Network (GLISN)

Masaki Kanao[1], Seiji Tsuboi[2*], Yoko Tono[2], Tetsuto Himeno[1], Genti Toyokuni[1]

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The Greenland Ice Sheet and its response to climate change have potentially a great impact upon mankind, both through long-term sea level rise and through modulation of fresh water input to the oceans. Internationally monitoring the dynamic response of the Greenland Ice Sheet to climate change is a fundamental component of long-term observational efforts for monitoring climate change. Glacial earthquakes have been observed along the edges of Greenland with strong seasonality and increasing frequency since 2002 (Ekstrom et al, 2003, 2006) by continuously monitoring data from the Global Seismographic Network (GSN). These glacial earthquakes in the magnitude range 4.6-5.1 may be modeled as a large glacial ice mass sliding downhill several meters on its basal surface over duration of 30 to 60 seconds. The detection, enumeration, and characterization of smaller glacial earthquakes are limited by the propagation distance to globally distributed seismic stations, i.e., the Global Seismographic Network (GSN) with the International Federation of Digital Seismograph Networks (FDSN). Glacial earthquakes have been observed at seismic stations within Greenland (Larsen et al, 2006), but the current coverage is very sparse. In order to define the fine structure and detailed mechanisms of glacial earthquakes within the Greenland Ice Sheet, a broadband, real-time seismic network needs to be installed throughout Greenland's Ice Sheet and perimeter. The International Polar Year 2007-2008 was a good chance to initiate this program with international collaboration. All of the partners are committed to free, unrestricted, open access to all data from The GreenLand Ice Sheet monitoring Network (GLISN) in real-time. In this presentation, seismicity around the Greenland region, including glacial related signals are presented with discussion associated with recent global warming.

Keywords: Greenland, global warming, glacial earthquakes, broadband seismometer, monitoring

Japan Geoscience Union Meeting 2011
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ACG033-09 Room:201B Time:May 25 16:30-16:45

New progress in the structure of Arctic Environmental Research

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Arctic is the region where the global warming is mostly amplificated, and the atmosphere/ocean/cryosphere/land system is changing. Since last year, new move on the Arctic Environmental Research (AER) has started at MEXT. Arctic Research Examination Working Group was formed under the Earth Observation Promotion Committee. Discussion on the future of the AER was made at this Committee, and determination of important research themes, formation of Consortium, and development of new Program on Arctic Climate variation was proposed in July 2010. Afterwards, there were actions to realize this, and now a new research structure in Japan is being developed (February, 2011). This presentation will inform the latest condition about the new structure of AER to Arctic Scientists.

Keywords: Arctic, Environment, Global Warming, Promotion, Cryosphere

Japan Geoscience Union Meeting 2011
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ACG033-10 Room:201B Time:May 25 16:45-17:00

Observation of spectral reflectance of boreal forest in Alaska for GCOM-C/SGLI

Rikie Suzuki[1*], Shin Nagai[1], Taro Nakai[2], Yongwon Kim[2], Hideki Kobayashi[1]

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The ”Second-generation Global Imager (SGLI)” of the satellite ”Global Change Observation Mission (GCOM)-C”, planned in 2014 or 2015, is a multi-viewing angle optical sensor. The sensor observes the reflected radiation from the land surface at 45 degree slant viewing angles (forward and backward along the orbit) in addition to the nadir. This function enables us to consider the Bidirectional Reflectance Factor (BRF) of the forest, and to construct robust 3D forest radiative transfer models for the simulation of the forest structure included Leaf Area Index (LAI) and above-ground biomass. To acquire *in-situ* BRF data of the forest for the validation of GCOM-C/SGLI data, we carried out the survey of BRF at a boreal forest in Alaska.

A black spruce forest, a typical boreal forest in Alaska, located in the Poker Flat Research Range (PFRR) of University of Alaska Fairbanks (210 m MSL) was targeted. Since the forest homogeneously extends about 500 m wide and the terrain is relatively even, this forest site is highly suitable for the validation of the remote sensing measurement. The tree stand ($>$ 1.3m) density was about 4000 tree/ha.

The observation of the BRF was taken place around the noon of July 7 and 8, 2010 from the top of the tower (17 m) that was constructed in the forest by the JAMSTEC and IARC Collaboration Study (JICS). We measured the reflected irradiance from the forest by the spectroradiometer (MS-720; EKO Instruments) changing the viewing angle from 20 to 70 degrees and -20 to -70 degrees (off-nadir angle; positive and negative angles mean forward and back scatter angles, respectively) with 5 degrees step in the principal plane and the orthogonal (cross) plane. The global radiation was simultaneously measured by the other spectroradiometer for the calculation of the reflectance.

The BRF in the principle plane showed a kind of bowl-shape distribution with its minimum and maximum at approximately 30 and -70 degrees in visible and near-infrared bands, respectively, that is, the forward scatter was generally smaller than the back scatter. However the Normalized Difference Vegetation Index (NDVI) showed larger value in the forward scatter than in the back scatter. The observation in snow-cover season is planned in March 2011.

Keywords: boreal forest, 3D radiative transfer model, leaf area index, BRDF, black spruce, satellite remote sensing

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ACG033-11 Room:201B Time:May 25 17:00-17:15

Study of the ice changes in Southeast Alaska based on the geodetic observations on the ground

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Southeast Alaska (SE-AK) shows very rapid uplifting (peak rate exceeding 30 mm/yr), which is mainly caused by Glacier Isostatic Adjustment (GIA) due to the unloading effects of the past-ices and the present-day ice changes. Geodetic observations with GPS and Absolute Gravity (AG) carried out in SE-AK clearly detect the effects of ice changes. Comparisons between the observed rates and the model predictions indicate that, in the order of the magnitudes, three of the LIA ices, the present-day ices (PDI) and the LGM ices contribute to the observed gravity and uplift rates. An important result obtained from the comparisons is; The observations clearly detect not only the effects of the PDI changes but also their rate changes that is considered to be an effect of the recent global warming. From the study in SE-AK, we have confirmed that combining the GPS observation with the AG observation provides useful data to study the ice changes in the glacial areas and to discuss the effects of the past-ices and the PDI separately. On the other hand, the AG and GPS observations on the ground will also provide useful data to be applied to the calibration and the validation of such satellite measurements as GRACE, GOCE and IceSat and so on.

Keywords: Southeast Alaska, glacier changes, Absolute gravity observation, GPS observation, load deformation, global warming

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ACG033-12 Room:201B Time:May 25 17:15-17:30

A wildfire monitoring system as a platform of remote sensing study

Koji Nakau[1*]

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Wildfire emits carbon into atmosphere for 1.7 to 4.1GtC/yr in entire earth (IPCC AR4, Mack et al. 1996, Andreae et al. 2001). Although this amount corresponds to 3-5% of GPP (Gross Primary Product), it corresponds around one quarter to one half amount of GHGs emission by anthropogenic fuel combustion. With consideration of existence of much human induced wildfire, this amount should not be negligible. Thus, studies of accurate impact of wild fire are quite important for climate study as well as disaster management of wild fire.

On the other hand, Arctic and Subarctic region is suitable for research and development of wildfire remote sensing, because frequent observation comparing low- and mid- latitude area and because much fire occur in this area. Therefore JAXA is developing a wildfire monitoring system in IJIS (IARC-JAXA Information System) and IJ-Dir (IARC-JAXA Research Directory) system.

In IJ-Dir system, not only holding meta-data of research activities related to IARC but also satellite imagery including RGB, infrared and hotspots of wildfire as near real time products of MODIS. We can overlay our own research plots and wildfire hotspots over MODIS RGB or Infrared imagery on same day.

This system is easy for researchers to handle satellite imagery and to compare their own ground observation datasets and satellite imagery as a first step of remote sensing study using satellite imagery. Therefore it should be useful for making a plan of ground observation, or should be useful to induce a new remote sensing study by researchers who is not specialist of remote sensing.

Keywords: Remote sensing, Arctic, Forest fire, Wildfire, Disaster

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ACG033-13 Room:201B Time:May 25 17:30-17:45

Global Warming and the Human-Nature Dimension in Siberia

Tetsuya Hiyama[1*], Yasushi Yamaguchi[2], Takeshi Ohta[3], Hiroki Takakura[4], Gen Inoue[1]

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Siberia is one of the areas where global warming will be evident. Perceivable changes in the ecosystem and cryosphere environment have already been reported such as damage to the forest or frequent flood. We have launched a research project in 2009 at Research Institute for Humanity and Nature (RIHN) to elucidate following three aspects in Siberia, from both the natural and the human social science perspectives. These are, 1) grasp of variations in water and carbon cycles and predictions into the near future, 2) field observation of the characteristics of the water and carbon cycles including those environmental driving forces, and 3) understanding of the capability of multi-ethnic people, who have historically unique social systems, to adapt to the changes in climate and terrestrial ecosystem. The Lena River Basin in Eastern Siberia, in which larch forest occupies the region in spite of little precipitation because of the existence of permafrost, has been selected as the epitome of the global warming. In order to achieve the goals, three research groups were organized. The Siberia bird's-eye group (Group 1) tries to understand the climate and the social changes using climatic and satellite remote sensing data, from the bird's eye point of view. The water cycle and ecosystem interaction process study group (Group 2) makes clear interaction between the climate and the vegetation through dendrochronology, isotope-analysis, flux monitoring, and hydrological aspects. The human ecology group (Group 3) seeks to elucidate influence level on the residential life in the city and agricultural districts in Eastern Siberia. The culture and the social system of the minorities are also studied to address the environmental adaptation. In this presentation, we will introduce the research structure and some new results of this project.

Keywords: global warming, permafrost, taiga, flood, adaptation

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ACG033-14 Room:201B Time:May 25 17:45-18:00

Remote sensing of burnt moss fractional areas during an Alaskan spruce forest fire

Keiji Kushida[1*], Shiro Tsuyuzaki[2], Masami Fukuda[3]

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We evaluated the fractional area of burnt mosses during wildfires in an Alaskan black spruce forest. The spectral reflectance of the burnt areas, live mosses, and damaged mosses were measured just after a forest fire in a black spruce forest, interior Alaska. These spectral data was used for estimating the fractional areas of these landcovers after Alaskan black spruce forest fires from the moderate resolution imaging spectroradiometer (MODIS) sensor onboard Terra satellite. The accuracy of the estimation was evaluated by comparing with the fractional areas interpreted from aerial photographs acquired from an airplane. The fractional moss burnt areas concern with vegetation recovery after fire as well as carbon dioxide release during the combustion.

Keywords: Remote sensing, boreal forest, wildfire

Japan Geoscience Union Meeting 2011
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Sedimentary organic matter variations in the Chukchi Borderland since the last interglacial period

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It is well established that anthropogenic climate change has a particularly strong impact on the Arctic through decreasing sea ice extent, northward vegetation shifts, permafrost thawing, changes in the hydrological cycle, coastal erosion, river discharge and marine productivity. These changes in turn lead to changes in carbon cycling potentially affecting atmospheric carbon dioxide and methane concentrations. In order to assess the future impact of anthropogenic influence on the carbon cycle in the Arctic, it is essential to reconstruct the range of natural carbon cycle variation and associated environmental conditions during the last glacial-interglacial cycle. For this reason sediment piston cores have been recovered in recent years from the so far poorly studied continental margins of the Chukchi Borderland region, an area potentially strongly responding to climate change through changing ocean currents, summer sea ice extent, as well as variable marine and terrigenous organic matter supply. In this study we would like to present organic matter variations in the Chukchi Borderland since the last interglacial period and discuss implications for oceanic and climatic conditions in the Chukchi Sea area and adjacent land masses.

Keywords: organic carbon, coastal erosion, freshwater influx, glacial-interglacial cycle, sediment transport

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ACG033-16 Room:201B Time:May 25 18:15-18:30

Effect of vegetation change upon the polar amplification

Ryouta O'ishi[1*], Ayako Abe-Ouchi[1]

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In the present study, we investigated the effect of vegetation change upon the polar amplification in two warming experimants, 6ka (climate optimum) and doubled atmospheric CO2, using an atmosphere-ocean-vegetation coupled general circulation model. The result indicates vegetation change and related albedo-feedback in both experiments strengthenes the polar amplification.

Keywords: GCM, Atmosphere-vegetation interaction, polar amplification