S5–P1

Model resolution comparison for methane simulation in the Arctic region

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The Arctic region is most vulnerable to the global warming. The sea-ice cover has much reduced for the past decades, bringing about change in the heat budget balance, also accompanied by positive feedback by decreasing surface albedo. There is proposition that methane (CH_4), which is a strong greenhouse gas, can be released into the atmosphere from the reservoirs due to melting of permafrost soils and so. Thus the physical and biogeochemical system of the Arctic could trigger a positive feedback loop of the global warming. The boreal wetlands are known to be strong natural source of CH_4 to the atmosphere. However, the response of the boreal wetlands to climate warming is not studied well. In the Arctic region many wetlands exist especially in West Siberia, Russia and also in Alaska, which are thought to significantly affect the Arctic CH_4 cycles. Therefore, it is very important to reasonably quantify the source to understand global warming feedback in this region through this strong greenhouse gas and to predict the future of that as accurately as possible. However, there are also other influential anthropogenic sources such as biomass burnings and natural gas plants and pipe-lines. It makes understanding of CH_4 cycles in this region complicated.

We use the CCSR/NIES/FRCGC Atmospheric General Circulation Model (AGCM) based Chemistry Transport Model (ACTM) for simulations of CH_4. ACTM has been run at two horizontal resolutions, namely, T42 (~2.8 x 2.8o) and T106 (~1.125 x 1.125o) to evaluate spatial representation errors arising from different category of sources in small area (e.g., oil drilling or gas pipeline leaks) or high-to-low emission transitions, e.g., along the complex coastal lines, for simulating the atmospheric CH_4variability. The model simulations will be compared with the already existing CH_4 measurements by various international organizations and those acquired as the part of the newly funded Arctic GRENE project. Detailed results will be discussed during the presentation.

S5–P2

Global methane simulation for the period 1910-2010 using atmospheric general circulation model based chemistry transport model

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Methane (CH_4) is produced both naturally and anthropogenically on the Earth's surface, and thought to be second only to carbon dioxide (CO_2) as an agent of present/future global warming. Methane is also chemically active, contributing to formation of tropospheric ozone and stratospheric water vapor, which further increases its importance to the Earth's radiative balance. Atmospheric CH_4 concentration has increased from 900 ppb in 1900 to ~1800 ppb in 2000s [1]. During the same period, the anthropogenic CH_4 emission has increased from 92 Tg/yr to about 310 Tg/yr. Mass balance calculation suggest that the increase in atmospheric concentration is caused entirely due to increase in anthropogenic emissions [2].

Model simulations of atmospheric CH_4 at monthly time scale with a horizontal resolution of T42 spectral truncation (~2.8x2.8°) and 67 sigma-pressure vertical layers (surface - ~90 km), for ten different emission scenarios based on combinations of anthropogenic (fossil fuel, biofuel, industrial process, livestock, waste handling and fire) and natural (wetland and rice) emission types, are being conducted using the CCSR/NIES/FRCGC Atmospheric General Circulation Model (AGCM) based Chemistry Transport Model (ACTM) for the period of 1900-2010. The model simulations will be compared with CH_4 concentrations as measured from the air bubbles trapped in the polar ice columns, and direct measurements since the 1970s at multiple sites around the globe.

Results on the contribution of different CH_4 emission types to latitudinal and inter-annual/decadal variation of CH_4 concentration over the past century will be discussed.

References:

[1] Etheridge, D.M., L.P. Steele, R.J. Francey, and R.L. Langenfelds. 1998. Atmospheric methane between 1000 A.D. and present: evidence of anthropogenic emissions and climatic variability. Journal of Geophysical Research, 103, 15979-15996.

[2] EDGAR- Emission Database for Global Atmospheric Research (http://edgar.jrc.ec.europa.eu/archived_datasets.php)

S5–P3

OCEANIC AND TERRESTRIAL BIOSPHERIC CO_2 UPTAKE ESTIMATED FROM ATMOSPHERIC POTENTIAL OXYGEN OBSERVED AT NY-ÅLESUND, SVALBARD AND SYOWA, ANTARCTICA

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Simultaneous measurements of the atmospheric O_2/N_2 ratio and CO_2 concentration were made at Ny-Ålesund, Svalbard and Syowa, Antarctica for the period 2001-2009. Based on these measurements, the observed atmospheric potential oxygen (APO) values were calculated. The APO variations produced by changes in the oceanic heat content were estimated using an atmospheric transport model and heat-driven air-sea O_2 (N_2) fluxes, and then subtracted from observed interannual variations of APO. The oceanic CO_2 uptake derived from the resulting "corrected" secular trend of APO showed interannual variability of less than ±0.6 GtC yr^{-1}, significantly smaller than that derived from the "uncorrected" trend of APO (±0.9 GtC yr^{-1}). The average CO_2 uptake during the period 2001-2009 was estimated to be 2.9±0.7 and 0.8±0.8 GtC yr^{-1} for the ocean and terrestrial biosphere, respectively. By excluding the influence of El Niño around 2002-2003, the terrestrial biospheric CO_2 uptake for the period 2004-2009 increased to 1.5±0.8 GtC yr^{-1}, while the oceanic uptake decreased slightly to 2.8±0.7 GtC yr^{-1}.

S5–P4

Constructing Arctic CO_2 data assimilation system using online transport model and LETKF

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This research aims to establish a local ensemble transformed Kalman filter (LETKF) data assimilation system to estimate global surface especially focusing on arctic CO_2 fluxes from data assimilation of various observation data. The 4D-EnKF is able to estimate the dynamically consistent atmospheric state with the optimal use of observation data at reasonable computational costs. Online atmospheric transport model is employed in the data assimilation system to optimize surface CO_2 fluxes at spatial and temporal resolutions of 3 days and T42 (2.8°), respectively. We have conducted data assimilation experiments with real observations. It is important to remove a bias in satellite data before data assimilation, in order to obtain a robust estimation of surface CO_2 fluxes. For this purpose, a bias correction scheme was developed using the global CO_2 concentration reanalysis data produced at Japan Meteorological Agency (JMA) and applied to satellite data. To provide more constraints from other observations, we introduced aircraft observation data (CONTRAIL). Combination use of these observation data allowed us to obtain realistic CO_2 concentration field and modify surface CO_2 flux almost entire earth surface especially over land. To obtain more robust arctic CO_2 flux, we need more observation data neighbourhood of the area. This work was supported partly by Grants-in-Aid from the GRENE Arctic Climate Change Research Project, the Ministry of Education, Culture, Sports, Science and Technology. GOSAT Observation data are provided from GOSAT Research Announcement office. We would like to acknowledge JAL Foundation for coordinating the CONTRAIL project.

S5–P5

TIME SERIES OF TROPOSPHERIC N_2O ISOTOPOMER RATIOS OVER WESTERN SIBERIA

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Nitrous oxide (N_2O) is one of the increasing greenhouse gases in the troposphere and is the most important stratospheric ozone-depleting gas emitted in the 21st century. In Arctic region, origin of atmospheric N_2O include human activity in Europe, Russia, and North America (e.g., agriculture), biomass burning (forest fires), oceans in high-latitude northern hemisphere, and future climate change might cause substantial change in such sources. Isotopomer ratios of N_2O, which include not only elemental $^{15}N/^{14}N$ and $^{18}O/^{16}O$ ratios but also site-specific $^{15}N/^{14}N$ ratio in asymmetric NNO molecule, are regarded as useful parameters to infer the origin and production–consumption mechanisms of N_2O, and to estimate its global budget. Previous studies on N_2O trapped in the firn in polar ice sheet revealed the secular trend of isotopomer ratios, but there has been no reports on long-term monitoring of N_2O isotopomer ratios in Arctic atmosphere.

We have been measuring mixing ratio and isotopomer ratios of N_2O in air samples collected at altitude of 500 m and 7000 m over Novosibirsk, western Siberia (55°N, 83°E) by monthly aircraft sampling since 2005. Results show that the bulk nitrogen isotope ratio ($\delta^{15}N^{bulk}$) are decreasing at the similar rate (about -0.04‰yr^{-1}) as reported by firn-air analysis while the N_2O mixing ratio are increasing (about 0.8 ppbv yr^{-1}). Short-term variations and vertical gradient will also be discussed along with atmospheric model simulation.

ANALYSIS OF INTER-ANNUAL VARIATIONS IN SEASONAL CYCLE OF APO AT CAPE OCHI-ISHI

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Atmospheric potential oxygen (APO), defined as a combination of atmospheric O_2 and weighted CO_2 concentrations ($APO=O_2+1.1\times CO_2$), is invariant with respect to the terrestrial biotic gas exchange. Therefore, the variation of APO mainly reflects air-sea gas exchanges of O_2 and CO_2. We have been observing the atmospheric CO_2 and O_2 at Cape Ochi-ishi (COI; 43.2°N, 145.5°E) by using flask sampling system (*Tohjima et al.*, 2008) since December 1998 and by using in situ measurement systems since March 2005 (*Yamagishi et al.*, 2008) (Fig. 1). The observed APO shows clear seasonal cycles with the average minimum in March and the average maximum in June. Although the inter-annual variability in the seasonal cycles at COI was rather small, anomalous seasonal cycles were sometimes observed. For example, significantly enhanced seasonal maximum was observed in June 2005 (Fig. 2).

The seasonal cycle of APO is mainly driven by oceanic O_2 emissions associated with the primary production during spring-summer and by O_2 drawdown associated with the vertical mixing of sea water during fall-winter, which brings deeper waters with depleted O_2 in contact with the atmosphere. Additionally, the temperature-induced solubility changes also slightly contribute to the seasonal variations in the air-sea gas exchanges. In order to investigate the cause of the anomalous seasonal cycles, we examine temporal variations in the net primary production (NPP) estimated from Vertically Generalized Production Model (VGPM), the sea surface temperature (SST) and the mixed layer depth (MLD). For example, the VGPM in the western North Pacific shows anomalously high NPP in June 2005. Therefore, the enhanced O_2 emissions associated with high production might elevate the APO maximum at COI in 2005.

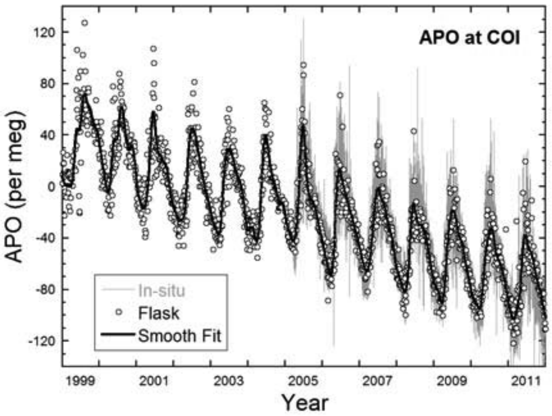

Fig. 1. Time series of APO at COI. Circles and gray lines represent flask and in-situ observation, respectively. Thick black curve represents the smooth fit to the data.

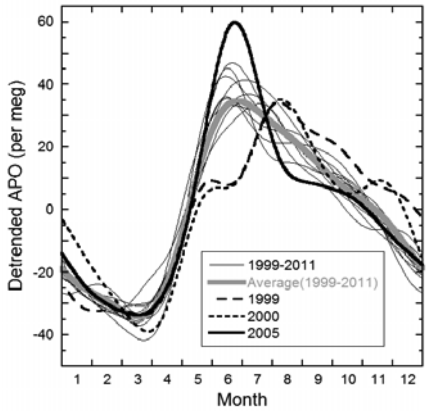

Fig. 2. Detrended seasonal cycles of APO at COI from 1999 to 2011.

Tohjima et al., Tellus (2008), 60B, 213-225.
Yamagishi et al., Atmos. Chem. Phys. (2008), 8, 3325-3335.

S5–P7

HIGH PRECISION CONTINUOUS MEASUREMENT SYSTEM FOR THE ATMOSPHERIC O_2/N_2 RATIO AT NY-ÅLESUND, SVALBARD

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To elucidate temporal variations of atmospheric O_2 at Ny-Ålesund (79˚N, 12˚E), Svalbard in detail, as well as to contribute to a better understanding of the global carbon cycle, a high precision continuous measurement system for the atmospheric O_2/N_2 ratio was developed using a fuel cell oxygen analyzer. To obtain highly precise values of the atmospheric O_2/N_2 ratio, pressure fluctuations of the sample and standard air in the fuel cells were reduced to an order of 10^{-3} Pa, with temperatures stabilized to 32.0±0.1ºC. A non-dispersive infrared analyzer was also installed into the system to allow simultaneous measurements of the atmospheric CO_2 concentration. Considering remoteness of the observation site, three special attentions were further paid when the measurement system was constructed; (1) the start-up and shutdown of the system can be controlled in Japan using the Internet, (2) all the output data from the system are recorded on a hard disk and also collected in Japan through the Internet, and (3) two water traps were equipped in parallel on the air sample line to make it possible to operate the system over a long time without manually replacing the trap. The two traps are alternately switched to cool at −80ºC and heat at 50ºC in order to remove water vapor contained in the sample air and the trap, respectively. By repeatedly analyzing the same sample air, the analytical precision of the measurement system was estimated to be ±1.4 per meg (0.3 ppm), which is sufficient for clearly detecting very small spatiotemporal variations of the atmospheric O_2/N_2 ratio. We also tested the system by continuously measuring the O_2/N_2 ratio in the boundary layer atmosphere at Aobayama (38˚N, 141˚E), Sendai, Japan, and it was confirmed that the system is capable of clearly detecting very small but persistent seasonal and diurnal cycles, along with short-term variations on time scales of several hours to several days, caused by terrestrial biospheric and human activities. Systematic and continuous observation of the atmospheric O_2/N_2 ratio using the developed system is planed to start at Ny-Ålesund in December 2012.

S5–P8

APPLICATION OF RADON-222 AS A TRACER FOR CHARACTERIZING FETCH REGIONS AND EVALUATING A GLOBAL 3D MODEL

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In order to estimate the regional/continental sources and sinks for atmospheric CO_2, atmospheric Radon-222 has been used at Rishiri Island (45°07’N, 141°12’E) as a tracer being monitored since December 2008. This work analyzed the first two years atmospheric Radon-222 data to evaluate the seasonal transport pattern. In summer, clear diurnal variation was observed with maximum Radon-222 concentration before the dawn, while the minimum appeared in the afternoon. This was caused by the local radon-222 source. However the magnitude of local source was quite weak. Seasonal Radon-222 variation was characterized by high concentrations from November to February and low concentrations from May to July, caused by the alternation of continental and maritime fetch regions. Seasonal high and low Radon-222 events were examined by using the back trajectory cluster analyses to clarify the fetch regions (Fig. 1). The results indicated that the predominant continental fetch region was southeastern Siberia and northeastern China. Radon-222 emitted from China and South Korea, whose economies are growing rapidly, did not significantly affect the Rishiri site. This implies that current observation of CO_2 at Rishiri Island is more directly influenced by the carbon sink region vegetated by boreal forest. The major maritime fetch region was the Sea of Okhotsk and the Bering Sea. A global three-dimensional model (NICAM-TM) accurately simulated Radon-222 concentrations on Rishiri Island and in the seasonal fetch regions. Other than to evaluate the sources of atmospheric greenhouse gases being monitored at Rishiri Island, the time series of Radon-222 data will also allow us to validate model simulations used to examine trans-boundary air pollution.

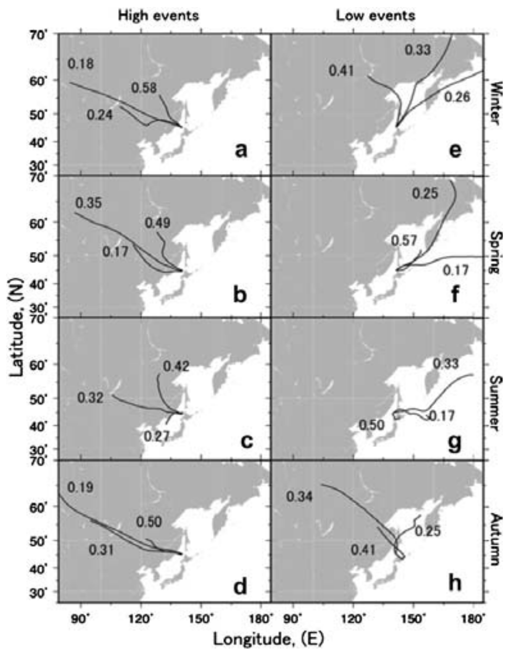

Fig. 1. Fetch regions for high and low radon-222 events at RIO as indicated by 120-h back trajectory clusters. The values near each trajectory show the ratio of events contributing to that cluster relative to total events in the specified season.

S5–P9

RECONSTRUCTION OF PAST VARIATIONS OF THE CARBON AND HYDROGEN ISOTOPIC RATIOS IN ATMOSPHERIC METHANE FROM ITS VERTICAL DISTRIBUTION OBSERVED IN NGRIP FIRN

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Temporal variations of $\delta^{13}C$ and δD of atmospheric CH_4 in the past 50 years were reconstructed from the isotopic ratios of CH_4 observed in firn at North GRIP. The one-dimensional diffusion model was used to simulate the diffusion process and the gravitational separation of CH_4 molecule in the firn. The effective diffusivity was determined so that the difference between the modeled and observed CO_2 concentration profiles was minimized. An approximate history of the atmospheric CH_4 concentration was constructed for NGRIP by combining the data from the direct atmospheric measurements at Point Barrow, Alert, and Ny-Ålesund with those from ice cores at Greenland. In order to reconstruct the past $\delta^{13}C$ and δD of atmospheric CH_4 from their values in the firn, the effective age of CH_4 at each sampling depth was determined by using an approximate history of the atmospheric CH_4 concentration. Effective age at each sampling depth was determined so that the model-calculated concentration at that depth agreed with a value in the concentration history. To correct for the diffusion effect on $\delta^{13}C$ of CH_4 in the firn, the diffusion model was run without the gravitational effect, using concentration histories for three kinds of CH_4 molecules, $^{12}CH_4$ with D_{16}, $^{13}CH_4$ with D_{17}, and $^{13}CH_4$ with D_{16}. Here, D_{16} and D_{17} represent the effective diffusivities of CH_4 molecules with masses 16 and 17, respectively. The diffusion correction was determined as a difference between the isotopic value of the heavier molecule actually predicted in the firn ($\delta^{13}C(D_{17})$) and the value which theoretically excluded the effect of diffusive separation ($\delta^{13}C(D_{16})$). Correction for the diffusion effect on δD was the same as that of $\delta^{13}C$, but used three molecules of CH_4 with D_{16}, CH_3D with D_{17} and CH_3D with D_{16}. The values of the atmospheric $\delta^{13}C$, thus estimated, were in good agreement with those from direct atmospheric measurements at Ny-Ålesund. The statistical uncertainty of the reconstruction procedure was examined by repeating model calculation with 100 different data sets provided by adding normal pseudo random numbers to the observed values in firn. We will also discuss an application of the diffusion correction to the isotopic values of CH_4 observed by ice core analyses.

S5–P10

Observations of atmospheric greenhouse gases from a tower network and aircraft over Siberia

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The north polar region plays an important role for atmospheric greenhouse gases such by photosynthesis and respiration in forest, CH_4 emission from wetland, leakage of natural gas from gas/oil production facilities, and forest fires. To understand the temporal changes and spatial distributions of fluxes for greenhouse gases in Siberia, our group started several kinds of observation for atmospheric greenhouse gases under GRENE project in addition to some ongoing measurements. The observation sites are summarized in Figure 1.

Continuous measurements of CO_2 and CH_4 have been conducted from a network of towers (JR-STATION: Japan–Russia Siberian Tall Tower Inland Observation Network) in taiga, steppe, and wetland regions in Siberia since 2002.

Routine flask samplings have been carried out over 3 sites in Siberia using chartered aircrafts since 1993. The sample airs are brought back to Japan and mixing ratios of greenhouse gases and their isotope ratios are analyzed. Continuous CO_2 measurements with a light aircraft over the JR-STATION site, Berezorechka, were conducted from 2002.

We also have conducted frequent CO_2 observation in the upper troposphere/lower stratosphere over Siberia by using the commercial airliner operated between Japan and Europe since 2005. The flask sampling by the commercial airliner has started since 2012 to measure mixing ratios of greenhouse gases and isotope ratios of CO_2 and CH_4.

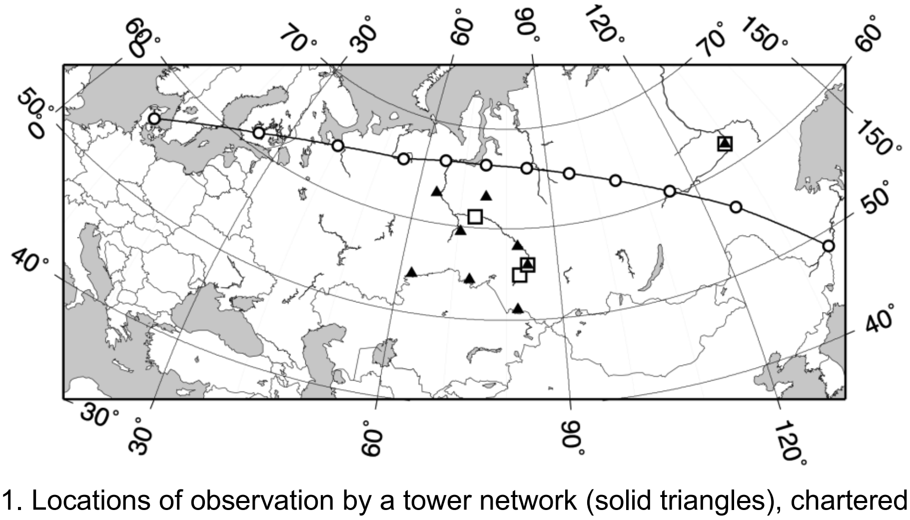

Figure 1. Locations of observation by a tower network (solid triangles), chartered aircraft (open squares) and commercial airliners (open circles and solid line).

S5–P11

GOALS AND ACTIVITIES OF THE TERRESTRIAL MODELING GROUP OF "GRENE ARCTIC CLIMATE CHANGE RESEARCH PROJECT"

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The goals of the modeling group in the terrestrial research project of the GRENE Arctic Climate Change Research Project (GRENE-TEA) are to a) feed the possible improvement of the physical and ecological processes for the Arctic terrestrial modeling (excl. glaciers and ice sheets) in the extant terrestrial schemes in the coupled global climate models (CGCMs) to the CGCM research project, and b) lay the foundations of the future-generation Arctic terrestrial model development. To achieve these goals we have been attempting to 1) deepen the feasibility of mutual collaborations and comparisons between the participating models, and 2) enhance communications with the in-situ and remote-sensing observationists to transform the collections of observable data and information more effectual for calibration, validation, improvement and development of the conceptual and numerical models. We will report our activities, especially the making and the resultant "brochures" of the participating models which provide the scope, targets, specifics and capability of each model to serve as mutual references among models, and as resources for communications with other researchers (e.g., observationists, data managers), staffs and the public.

S5–P12

Arctic Data archive System (ADS)

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In Arctic region, various changes are being caused by global warming. In previous studies, the decrease of Arctic sea ice extent, the increase in soil temperature in the region of Siberia, permafrost melting, the increase in Arctic river runoff, reduction in snow cover has been revealed. Also the impact of human activities and ecosystems due to these changes is concerned. The actual condition and mechanism of environmental change in arctic has not been elucidated. Previous studies have been carried out to separate the atmosphere, oceans, by land. Arctic is a system consisting of atmosphere, ocean, land surface, from snow and ice, these systems including the phenomenon of different spatial scales and time scale, respectively. In order to clarify the variability of the Arctic environment, through interdisciplinary research, research is needed in using a database that integrates the results of observation and research data across multiple areas.

On the other hand, arctic research by Japanese researchers has been carried out all the time from the last century. The result of their research includes many irreplaceable data, such as observation time series, sample, and its analysis, which each researcher got in the field. Since researcher and organization have had those data in their keeping by their way, many data has not managed and kept systematically.

Now, a new ‘Arctic Data archive System (ADS)’ was launched on purpose to collect, manage and open some arctic data supported by Green Network of Excellence (GRENE), Rapid Change of the Arctic Climate System and its Global Influences (a tentative English title). ADS can search various keywords using metadata which are related with a one-to-one correspondence. This schema fits some format of typical Earth environment data, and we plan additional schema.

S5–P13

RECENT GLACIER CHANGES IN SUNTAR-KHAYATA REGION, EASTERN SIBERIA.

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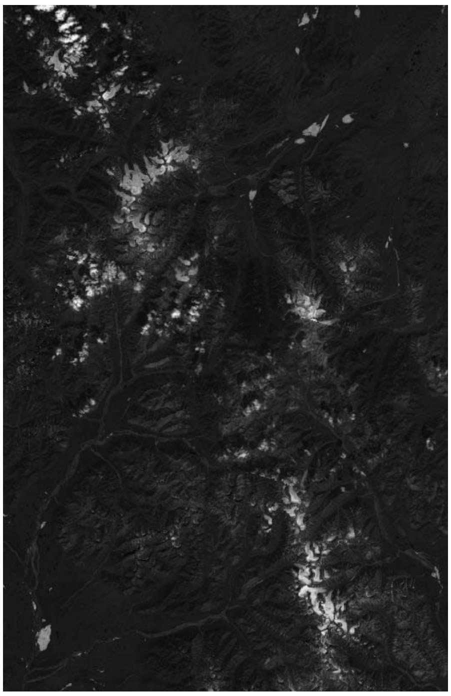
Arctic is a significant regional impact of global warming. Arctic glaciers, it is expected to have a large impact of global warming.Research of the distribution of glacial in Russian region is carried out actively in the past, these results are listed in the in world glacier inventory.In recent years, the description of the glacier is also performed in GLIMS project.

On the other hand, glacier inventory exists Suntar-Khayata region, Eastern Siberia is a detailed investigation has been carried out in the period from 1959 to1957 as IGY. In this region, actual conditions has become clear in recent glacier changes reinvestigation is carried out in the 2000s. In this study, we have carried out to clarify the recent glacier changes in the region using satellite data.



The satellite image of Suntar-Khayata region, Eastern Siberia

CRYOSPHERIC STUDY IN THE GRENE-ARCTIC PROJECT: PLAN AND REPORT FROM RESEARCH IN 2012

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GRENE-Arctic project has some implementing groups of “The role of Arctic cryophere in the global change” This study will contribute to the strategic targets of 1)understanding the mechanism of warming amplification in the Arctic, 2)understanding the Arctic system for global climate and future change.

During the first intensive observing period in 2012, glacier research in Siberia and ice sheet research in Geenland are carried out. Snow cover research and local weather research groups set the instruments in the various research fields, in Scandinavia, Alaska and Siberia.

Regional cryospheric reports and circum-Arctic weather conditions in 2012 summer indicates a trans-Arctic cryosphere-weather conditions, connecting Greenland melting, Siberian dry and hot summer, and instabilities of Siberian coast, northern Greenland and Japanese monsoonal weather. Alternative temperature patterns and over Arctic regions causes regional warm/cool area and temperature gradient zones.

S5–P15

OVERVIEW OF REGIONAL AND INTERANNUAL VARIATIONS OF SNOW AND SURFACE CONDITIONS AT GRENE ARCTIC OBSERVATION SITES DERIVED BY SATELLITE MICROWAVE DATA

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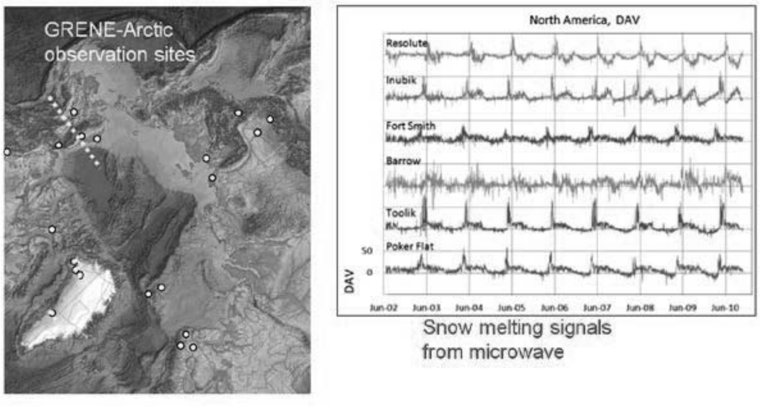
New Japanese project for Arctic research: GRENE Arctic Climate Change Research Project has started. Snow and ice research group in GRENE Arctic project will observed snow conditions from site field observations, and expand the knowledge by satellite observation. This study overviews snow and related ground conditions at all major observation sites of GRENE Arctic project by using the satellite microwave data. Satellite microwave data of AMSR-E is available for observing snow cover, melting, ground freezing. This study extracted daily microwave data for ten years period from the observation sites and descried snow conditions. As the snow condition affects many other researches through hydrological process and atmospheric boundary conditions, the seasonal cycle of snow condition is substantial for initiating project

The main target area are, Siberia, North America, Scandinavia and Greenland. Snow cover and melting periods are indicated and regional and interannual changes are summarized in this study. Melting tendencies by several observation points are investigated in Greenland ice sheet.



Field observation sites in the GRENE Arctic project and example of data.

S5–P16

JAPANESE FIELD ACTIVITIES IN THE GREENLAND ICE SHEET MONITORING NETWORK (GLISN)

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Due to the recent climate change, the number of cryo-seismic events at the Greenland ice sheet is drastically increasing. Such events are caused by internal deformation of the ice sheet, sliding at the base, disintegration at the calving front, etc. Therefore, long-term seismic monitoring of the Greenland ice sheet will contribute to investigate the ice collapsing process, and reveal fundamental role of the ice sheet dynamics upon the global environment. The Greenland Ice Sheet Monitoring Network (GLISN), launched in 2009, is an international project to develop and integrate about 30 seismic stations on and around the Greenland.

Japan has been a partner of the GLISN from its beginning, and dispatched a research expedition in the recent two years. In 2011, together with the USA team, we installed a new seismic station “ICE-S” at southern part of the internal ice sheet. In 2012, we visited three stations (ICE-S, NUUK, DYE-2) to upgrade installations and retrieve data. In the presentation, we will summarize our activities for two years, and provide results of primary analyses using the intra-Greenlandic seismic waveform data.

S5–P17

GLACIOLOGICAL OBSERVATIONS IN SUNTAR-KHAYATA RANGE, EASTERN SIBERIA, 2012

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In the GRENE research project, climatic data were recorded through observations of the Suntar-Khayata No. 31 glacier in eastern Siberia in order to gain an understanding of glacial climatic change response. From July to September, 2012, we installed stakes, interval cameras, snow depth sensors, and rain gauges in the glacier. In addition, we installed two Automatic Weather Stations (AWSs)—one was installed in the glacier, and the other at an IGY station. Air temperature, relative humidity, atmospheric pressure, solar radiation, wind speed, wind direction, and precipitation were measured at the AWS. In addition, we surveyed the area using GPS to obtain the DEM data of some of the glaciers and moraines. Further, we observed snow algal communities, the ice core, etc. This paper presents our observation results.

S5–P18

Is warming Arctic causing colder winters in Siberia?

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Global climate models predict warming in the Northern Hemisphere (NH) high latitudes to middle latitudes during boreal winter. However, recent trends in observed NH winter surface land temperatures diverge from these projections. For the last two decades, large---scale cooling trends have existed instead across large stretches of eastern North America and northern Eurasia. We argue that this unforeseen trend is probably not due to internal variability alone. The study is based on analysis of observed data and modeling. Delayed freeze---up in the Arctic and the consequent heat input in the atmosphere lead to significant changes in the circulation caused by a number of factors. Those factors include a direct response to the heat anomaly over the open ocean and a dynamic response to changes in the snowcover in northern Eurasia. Understanding this counterintuitive response to radiative warming of the climate system has the potential for improving climate predictions at seasonal and longer timescales.

S5–P19

Influences of the sea ice concentration and sea surface temperature to the atmosphere

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Since 1980s the sea ice extent in the Arctic Ocean has been decreasing. It is important for the climatology in the Arctic whether the sea ice exists or not. The purpose of this study is to investigate the differences of the influences to the atmosphere due to the different conditions in sea ice concentration and sea surface temperature with global atmospheric model NICAM (Nonhydrostatic ICosahedral Atmospheric Model). Two experiments will be carried out. One is that the monthly climatology of the sea ice concentration and sea surface temperature is used as the boundary condition (normal year), and the other is that the monthly data of them in 2007 is used (less sea ice year). The time integration will be conducted for 50 years for each experiment. The sea ice concentration, sea ice mass and sea surface temperature are fixed within each month during the integration. The horizontal resolution is 112 km (glevel-6) and 40 points are taken for the vertical grid. The experiment is now in progress. A figure shows the annual mean surface air temperature for fifth year of the time integration. All experiments will be finished before ISAR-3 and the influences in the Arctic atmosphere due to the sea ice extent will be discussed.

S5–P20

Greenland SST change and accompanying changes in the northern hemispheric climate and predictability of the North Atlantic Oscillation

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A sudden change in the reference Greeland Sea surface temperature (GSST) between Feb and Mar 1979 is identified. It is found to be a part of complex changes in the northern North Atlantic seas. The GSST change, in particular, resulted in a major change in the near-surface baroclinicity in the region, in addition to large change in the net surface heat flux at the air-sea boundary over the Greenland Sea. The differences in the atmospheric mean state between two periods, one before and the other after the GSST change in the late 1970's, resemble those between the high- and low-NAO index states.

In addition to the changes in the mean state, major changes in the interannual variability of the atmosphere are found. A particularly interesting change in the interannual variability is found in the relationship between Jul GSST and the NAO phase in the following Feb. There was a strong correlation between Jul GSST and the NAO phase in the following Feb before the late 1970's, but not at all after the late 1970's.

Also, a similarly sudden change of opposite sign was found in the reference winter SST in the Okhotsk Sea two months before the change in the GSST, indicating that the changes are likely to be a part of changes in the entire Arctic and sub-Arctic regions.

S5–P21

DEVELOPMENT OF A LOWER TROPHIC LEVEL ECOCYSTEM MODEL FOR ARCTIC OCEAN

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A 1-box numerical model describing the lower trophic level ecosystem in the western Arctic Ocean (Chukchi Sea and Beaufort Sea) was developed to investigate the relationship between the timing of sea ice melting and ecosystem change. For this purpose, the model consists of thirteen state variables which include the typical biology in the water column and sea ice. The primary producer in the model was divided to three components: “Ice Algae”, “Centric Diatoms”, and “Autotrophic Flagellates”. Ice algae is mainly pennate diatoms that adapted to low light intensity. Centric diatoms are the dominant species in the ice-edge bloom, and they are adapted to strong light intensity. Autotrophic flagellates are a major phytoplankton group after the bloom, and they can also live under sea ice. Zooplankton grazing these primary producers, was categorized into “Amphipods”, “Copepods”, and “Heterotrophic Flagellates”. Top predator in the model was “Nektons” including krill, arrow warm, and other predatory species. In addition, the model includes other nutrient and detritus components. The idealized annual physical forcing (sea surface temperature, sea surface light intensity, and mixed layer depth) and sea ice condition at the Northwind Abyssal Plain (NAP) were given for the model. In the Arctic Ocean, amphipods and copepods are important food sources for higher trophic level animals such as marine mammals, sea birds, and fishes. We will introduce the seasonal variation of zooplankton biomass simulated by the model, and will discuss the effect of the timing of sea ice melting on the lower trophic level ecosystem.

S5–P22

SEA-ICE THICKNESS CHARACTERISTICS REVEALED BY OBSERVATIONS IN THE CANADA BASIN

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To observe ocean and sea ice conditions in the Canada Basin of the Arctic Ocean, a scientific cruise of the Canadian Coast Guard Ship *Louis S. St-Laurent* was conducted from 2 August to 8 September 2012. Using an electromagnetic induction instrument (EM) along with Passive Microwave Radiometers (PMR), underway measurements of sea-ice thickness were carried out on August 8 to 10 (offshore of Barrow) and 27 to 29 (around 80^{o}N). Sea-ice thicknesses measured by the EM spatially changed with the range of 0.1-3.0 m. To reveal sea-ice thickness distribution in more detail, probability density was examined. Although the modal sea-ice thickness existed in 0-0.1 m, the probability density was higher around 80^{o}N than offshore of Barrow. Measurements of sea-ice thickness with a portable EM were also done along four transect lines at two ice stations (80.88^{o}N, 137.41^{o}W and 80.21^{o}N, 129.97^{o}W) on August 26 and 27. The mean sea-ice thicknesses for each transect lines were 1.35, 1.34, 0.38, and 2.46 m, respectively. From the entire data, the maximum (minimum) sea-ice thickness was 2.52 (0.26) m. Sea-ice thicknesses obtained from the EM agree fairly well with those based on the drill-hole measurements. The correlation coefficient between them was 0.96. In addition to the detailed discussion, results obtained from PMR and relationship between sea ice and ocean conditions will be introduced during the presentation of the day.