National Institute of Polar Research

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Contents

A Newly Installed Meteor Radar in Longyearbyen

WHERE DOES ARCTIC RESEARCH GO FROM HERE?

by Okitsugu Watanabe

Member of Japan National Committee for Polar Research

Arctic research has a long history in Japan. It perhaps started with the pioneering work by Ukichiro Nakaya on ice cores from Greenland shortly after World War II. From the latter half of the 1960s through the 1980s, Japanese scientists, mainly in universities, did research on Arctic sea ice, permafrost in Canada and the Soviet Arctic, and Alaskan glaciers, and did Arctic meteorological observations.

A major turning point in Arctic research and organized observations came with Gorbachev's Murmansk Declaration in 1990. That provided an opportunity for increased international cooperation in Arctic research, and led to the formation of the International Arctic Science Committee (IASC). It started with 8 countries that face the Arctic Ocean; from the next year countries that have a history of Arctic observational research and still have a deep connection to the Arctic were permitted to join. Japan is one of the countries in this category that joined. Italy joined the Committee the year before last, bringing it to its present membership of 16. South Korea now has an application for membership pending.

In the first years of IASC's existence the need for international cooperative research was a major topic of discussion, but such discussion was largely a formality that had little effect on the actual research being done. Several years after IASC was formed, several cooperative research topics were adopted, working groups set up and preliminary investigations started. However, the reality was repeated discussions in which each country promoted its own self interest.

However, recently there has been major change in the direction of IASC's international scale Arctic research activities. It is undeniable that one of the main factors forming the background to this change was the formation of the EU. IASC is an international organization, but it cannot be denied that its main foundation and center of gravity lie in the Atlantic sector of the Arctic. This reflects the geopolitical situation surrounding the Arctic Ocean. Most of the coastline of the Arctic Ocean is occupied by Russia, Canada and the United States; those countries are strongly involved with one another, and the organization cannot easily do anything without them. Meanwhile, European countries have played the major role historically in Arctic exploration and scientific observations. In a practical sense the easiest way for a country to develop and maintain an involvement in the Arctic is through scientific activity. The Arctic is also strongly related to the global environment.

After the formation of the EU, researchers in other European countries, which until then had not shown much interest in Arctic research, started to participate in cooperative observations. This movement naturally affected all IASC observational activities. Not only international scale cooperative activities, but also activities in individual research fields became significantly more active.

Without question, during the last 10 years Japan's Arctic research has become fleshed out and expanded in both quality and quantity. However, I think it is necessary to pay close attention to these international trends, and deepen our understanding of the importance of international cooperative research. In particular, there are going to be increasing needs for sharing of the burdens of both the costs of and personnel contributions to international cooperative observations, cooperation in the compilation of an international observational data base, and substantive participation in sharing the means of making observations. Meeting these requirements in a responsible and practical manner is one of the principal tasks now facing Japanese Arctic research.

Kaz Higuchi

Visiting Professor (April - August 2000)

Dr. Kaz(ufumi) Higuchi is a 3rd -generation Japanese Canadian. Although he was born in Japan, he grew up in a small town in northern Ontario. He obtained his B.Sc. in theoretical physics from Carleton University in Ottawa. Upon graduation, he was accepted into the graduate program in biophysics at Queen's University (Kingston, Ontario) and the University of Western Ontario (London, Ontario). However, for financial reasons, he joined the Atmospheric Environment Service (now called the Meteorological Service of Canada), Environment Canada as a weather forecaster in training. After finishing the 1-year course, he was posted to the Arctic Weather Central in Edmonton, Alberta. This is where he obtained his first taste of the Arctic. After only 1 year of operational duties, Dr. Higuchi was accepted into the federal government's educational development program and completed his M.Sc. in atmospheric physics at the University of Toronto in 1977.

After a series of unforeseen events, Dr. Higuchi somehow ended up doing his Ph.D. in carbon cycle at the University of Toronto in 1979, under the supervision of Professor R.E. (Ted) Munn. After obtaining his Ph.D. in 1983, he returned to Environment Canada as a research scientist, and joined a very new and very small research group on carbon cycle in the Atmospheric Environment Service (AES). The main focus of his research activities during these early years was on the interpretation of the CO_2 concentration measurements obtained by the group at Alert, Ocean Station P (and later Cape St. James on the west coast of Canada), and Sable Island off the Canadian east coast.

Over the last 10 years, Dr. Higuchi carried on various collaborative projects involving various aspects of the carbon cycle with Japanese scientists from various institutes, particularly Tohoku University, the National Institute for Resources and Environment in Tsukuba, and the National Institute of Polar Research.

In 1998, Dr. Higuchi was appointed as the Head of the Carbon Cycle Research Laboratory (CCRL), which is composed of concentration and stable isotope laboratories. CCRL also has a small group of scientists doing carbon cycle modeling and data interpretation.

Dr. Higuchi is also actively involved in research activities related to atmospheric and climate dynamics, with focus on trying to understand how low-frequency variability modes such the Artic Oscillation and the North Atlantic Oscillation might vary under changing (warming) climate, and how these changes might impact on such synoptic phenomena as storm tracks and atmospheric blocks.

Arctic Research Activities in 2000

◆ Dynamical Coupling of the Middle Atmosphere and Thermosphere in the Arctic

by Takehiko Aso

The main purpose of this research, as stated in Newsletter No. 10 (Japanese edition), is to clarify the dynamical coupling that takes place through a wide altitude range from the stratosphere and mesosphere through the thermosphere and magnetosphere. The research employs the EISCAT radar and collaborating ground-based and satellite observations, together with numerical analysis and modeling, to investigate the behavior of atmospheric tidal wave, gravity wave and planetary wave motions in these regions, and clarify the underlying physical processes. In particular, attention will be focused on acquiring knowledge that will aid our understanding of polar atmospheric environmental variabilities. Multi-instrument observations, including observations with radar and optical instruments, will be used to measure electromagnetic disturbances that enter the atmosphere from above through the magnetosphere and the response of the lower polar atmosphere to this forcing in the form of physical quantities such as velocity and temperature fields. These observations will be coordinated on a global scale through the use of longitudinal chains and meridional networks.

During the current fiscal year, new meteor radar has been installed near the EISCAT Svalbard radar to further complement the highly capable IS radar and render possible continuous long term observations of atmospheric wave motions. In summary, the following radar and optical observations are of our great concern.

(1) Arctic radar observations

Coordinated observations has been made of wave motions and plasma dynamics in the middle atmosphere and lower thermosphere using the EISCAT radar, Tromsø MF radar, Longyearbyen SSR radar and Super DARN HF radar network.

(2) Radar observations of meteor trails

Meteor radar is now installed, and the observation of atmospheric wave motions has started. From now the drift of meteor trails in the polar regions will be studied by comparing ion drift and electric field measurements with the EISCAT radar and HF radar observations. Also, temperature and electron density measurements are planned. The dynamical effect on the neutral wind during geomagnetic disturbances will also be considered.

(3) Optical observations of airglow and aurora

Spectral observations using the aurora and airglow spectrograph developed by the National Institute of Polar Research will be continued at Longyearbyen. In addition, PSC, airglow and aurora observations are under way using the ALIS network being operated jointly with the Swedish Institute of Space Physics.

(4) Stratospheric ozone observations using optical sensors on small balloons

Ozone in the Arctic upper stratosphere is being measured by optical sensors onboard small balloons to study atmospheric wave motions in the upper stratosphere.

In parallel with these observations, comprehensive data analysis including numerical modelings are properly going on.

◆ Variations of Atmospheric Constituents and Their Climatic Impact in the Arctic

by Takashi Yamanouchi

Our goals in this research are to clarify the variability of greenhouse gases, aerosols, ozone and clouds in the Arctic troposphere and stratosphere; explain the transport, transformation and extinction processes that produce that variability, compare with the Antarctic and evaluate the effect on climate through, for example, the radiation effect. The following specific research was planned during the current fiscal year.

(1) Long term continuing observations at the Ny-Ålesund station: At the Ny-Ålesund scientific station in the Svalbard, we continued our long term sampling of greenhouse gases. In addition, we continued our long term observations of ozone and surface meteorology. Through these observations, and isotope analysis, we hoped to clarify the variability in concentrations of greenhouse gases and the causes of variability. We also planed to analyze all of the data available to date concerning exchange of carbon dioxide between ocean and atmosphere, and to continue relevant operations in collaboration with the oceanographic group.

(2) Aerosol and cloud observations: Measurements of aerosol number concentrations, vertical distributions, composition and precursor gases; and observations of precipitable water, cloud liquid water, ice water amount and precipitated snow particles, had been continued at Ny-Ålesund station to determine the relationship between clouds and precipitation. We investigated aerosol transport and transfornation processes, and at the same time the processes by which they were entrained into clouds and precipitation.

(3) Coordinated airborne and ground-based

observations of aerosols and radiation ASTAR2000 (Arctic Study of Tropospheric Aerosols and Radiation): In collaboration with the Alfred-Wegener Institute of Polar and Marine Research in Germany, observations were carried out in the Svalbard area through April. An aircraft was used to measure vertical distributions of radiation and aerosols, while remote sensing and sampling were conducted on ground. Aerosol sonde observations and tethered balloon observations were also attempted. In addition, SAGE-II satellite observations were used, and the radiation effect of aerosols over a wide area was evaluated by incorporating the observational results into an Arctic regional climate model.

(4) Continuous observations of all 3 components of wind in the troposphere and stratosphere were carried out with the SOUSY Svalbard Radar during the ASTAR2000 observation period. Objective analysis data for the same period were used in the analysis to determine the characteristics of short term disturbances and the relation to synoptic scale disturbances in the Arctic.

◆ Research on Global and Local Environmental Variabilities Using Ice Cores Drilled around the Arctic

by Kokichi Kamiyama

1. Participation in the North GRIP project (North Greenland Icecore Project): This project is drilling a deep core, with the aim of reaching the bedrock at a depth of 3,100m. During the current fiscal year we planned to greatly augment the in-site core analysis work. Both the drilling and in-site analysis work were being shared among participating nations. It was planned to send part of the core to Japan for further analysis work after the end of the observation season. It was expected that at depth greater than 2,700m, it would be possible to obtain ice from the most recent interglacial period (the Sangamon).

2. Ice core observations and analysis in conjunction with the IASC / ICAPP (Ice Core Circum Arctic Paleoclimate Program) and the SCAR / PICE (Paleoenvironments from Ice Cores): This research involved comparison of information from ice cores obtained in different locations.

(1) Glaciological research in Canada: We conducted preliminary glaciological research and drilled ice cores on glaciers on Mount Logan in the Yukon Territory in collaboration with the Canadian Geological Survey.

(2) Glaciological research in Russia: In collaboration with the Russian Arctic and Antarctic Research Institute and with Brussel Free University, we planned to conduct a preliminary research for drilling ice cores in the Altai Mountains.

3. Glaciological observations in the Arctic: For the purpose of clarifying transportation mechanism in the atmosphere - ice - snow system, we conducted observations in Svalbard, as representative of the Arctic marine environment, and far eastern Siberia.

4. Circumpolar glaciological research: Groups of glaciers around the Arctic region would be surveyed to study the mutual interactions between the present arctic cryosphere and the surrounding cryosphere.

5. Comparison of ice core analysis and analytical data: Ice cores that had been drilled to date in Svalbard and the Canadian Arctic were analyzed, and ice core analysis data at numerous points were compared. Then ice core data at numerous points in the Arctic region were compared to study past climate and environment variability over a wide area of the Arctic.

◆ Research on Arctic Ocean Dynamics and Ecosystem Variability

by Mitsuo Fukuchi

A major cruise was not conducted by the International Arctic Polynya Programme in fiscal 2000. The main emphasis was on processing and analysis of data and samples obtained since fiscal 1999. Within Japan, for the most part individual participating researchers concentrated on their own work, but conferences were held so that researchers could compare their results. At the same time, within the framework of international cooperative research, we participated actively in international workshops and compared our results with those results from other countries, principally Canada but also United State and participating European countries. With progress in processing and analyzing data, we joined with cooperating researchers both in Japan and overseas to publish the results in international scientific journals.

An international oceanographic conference held in Copenhagen in June 2000 provided an excellent opportunity for scientists engaged in this work to meet. It was also planned to hold workshops as appropriate at the regular meetings of the Oceanographical Society of Japan, held in spring and fall every year, as had also been done in 1999; at the 23rd Polar Biology Symposium held at the National Institute of Polar Research; and at the 16th International Symposium on the Okhotsk Sea and sea ice held in Mombetsu, Hokkaido. These meetings offered opportunities not only to summarize the results of the present research but also to plan the Post - Polynya Programme. We are also continuing to participate in the ongoing cooperative research between the Japanese National Institute of Polar Research and the Norsk Polarinstitutt in waters around Greenland and Svalbard.

◆ Research on Environmental Change in the Arctic Tundra

by Hiroshi Kanda

It is known that soil microorganisms, fungi, lichens, algae and mosses in the Arctic respond sensitively to environmental changes. During the current fiscal year work was concentrated on organisms living at the ground surface and underground. We researched the diversity of such organisms, the energy balance in the tundra ecosystem, cycle of matter and the effect of global environmental changes, with the aim of predicting changes in the structure and function of ecosystems both locally and throughout the Arctic region, and shifts in the distribution of species.

Research on the effect of global environmental changes on biological diversity and cycle of matter in the Arctic tundra ecosystem was covered the following specific topics.

1. The effect on biological diversity, and the mechanism through which that effect takes place

An environmental warming experiment chamber (OTC) and cloche (closed type) was used. The temperature and humidity both inside and outside the chamber were measured, and changed in soil microorganisms, plants and animals observed.

2. Clarification of factors that affect the carbon cycle

As a biological factor, the structure and composition of plant communities, and as soil - related factors, the depth of the active soil layer, underground water level and soil water content, were clarified, and the effect of these factors on the carbon cycle surveyed. In addition, work that has already been done on soil respiration was extended by determining the photosynthesis and respiration characteristics of a typical flowering plant (Salix polaris), a moss (Sanionia uncinata) and algal crust; and obtain data on and model the effect of tundra plant life on the overall carbon cycle.

3. The structure of the Arctic tundra ecosystem

The physiological and ecological characteristics of mosses, a typical form of tundra plant life, were clarified, and the adaptive significance of morphological plasticity studied. The moisture environment, light environment, and nutrients were measured, and the structure of the ecosystem clarified. In addition, the foraging activity and food of a sea bird that transfers both to land and to sea, the Brunnichs guillemot, was studied to determine the role of sea birds in the tundra ecosystem.

4. Biological activity in a glacier terminus area, and the ecological role of lichens

We studied the community sizes of microorganisms, fungi and lichens, as decomposition agents on which sufficient research has not yet been done, and the structures of their communities. In particular, to clarify the nature of microbiological activity in glacier areas, a microscope was used to detect living cells and directly observe, for example, coexistence between algae and bacteria. In addition, to clarify biological activity on ice and snow, we studied the height distributions of organisms on a glacier and the vertical distributions in upperstream pits. We also researched the phenomenon of lichenization in a glacier terminus area and rates of photosynthesis and respiration by lichens.

Research Reports

Report on ASTAR 2000 (Arctic Study on Tropospheric Aerosol and Radiation)

by Takashi Yamanouchi
National Institute of Polar Research

Aircraft observations during ASTAR 2000 ended ahead of schedule on April 20. Since the start on March 15, there had been 25 flights totaling 84 hours. The objective of ASTAR 2000 was to study the behavior of tropospheric aerosols, particularly Arctic haze, along with their radiation effect and effect on climate. This was a cooperative project with the lead roles being played by the Alfred-Wegener Institute of Polar and Marine Research (AWI) and the National Institute of Polar Research. Japan sent 9 researchers to participate in the field observations.

Aircraft Observations

The aircraft used was AWI's Polar 4 (a Dornier 228, shown in Fig. 1); it was based at Longyearbyen Airport in Svalbard during the observations. Observations of the number concentrations of aerosol particles classified by diameter, measurements of scattering and absorption coefficients, and sampling were carried out by researchers from Japan (National Institute of Polar Research, School of Engineering, Hokkaido University and the Solar and Terrestrial Environment Research Institute, Nagoya University); measurement of the extinction coefficients using a sun photometer was carried out by researchers from Germany. From March 15 until the end of the observations on April 20 (the observations were ended earlier than had been planned on account of satellite passage times), 20 flights. more than originally planned, were carried out (Fig. 2). Since sun photometer observations could only be made when the height of the sun was 7 degrees to 15 degrees, the times when observations could be carried out were limited.

The standard method of observations was to first decide on the flight path, then take observations flying repeatedly over that path, first near the land or sea surface, then at 1km height intervals up to a maximum of 8km. Each level flight was carried out in a straight line, and direct sunlight measured by the sun photometer; at several heights the airplane direction was turned around 180 degrees to measure the sky brightness. Measurement of aerosols was done continuously, but whenever a layer of high aerosol concentration was found, the flight within that layer was continued for 15 minutes and filter sampling carried out. When the weather was clear at Ny-Ålesund, the flights were conducted in the vicinity of the Rabben station at Ny-Ålesund for coordination with ground observations; when the weather at Ny-Ålesund was not clear, we searched for a nearby area of ocean (including sea ice) where the weather was clear. For comparison with satellite observations, we selected the area

Fig. 1 The Polar 4 that was used in the observations.

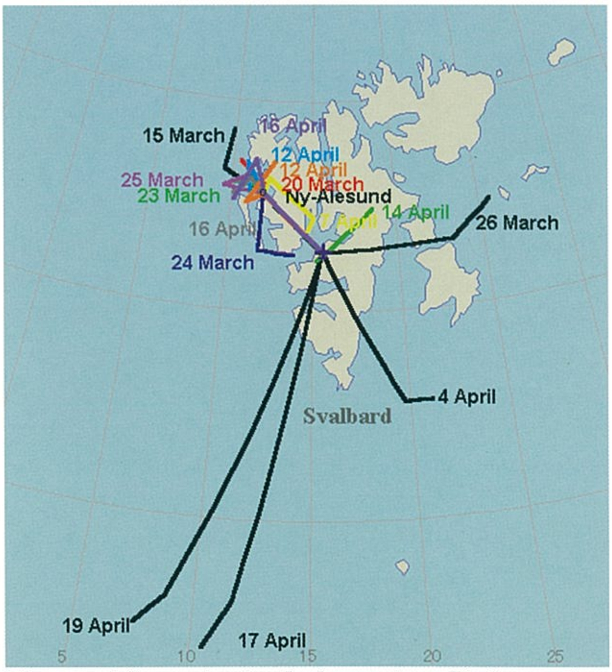


Fig. 2 The principal observing flight paths

south of Svalbard observed by the SAGE-II satellite.

Ground Observations

Observations on the ground at Ny-Ålesund emphasized standard observations such as remote sensing of aerosols, local observations and sampling, beefed up for coordination with the aircraft observations. At AWI's Koldewey station (in Ny-Ålesund) observations were carried out using tropospheric lidar (Ramen and back scattering), sun photometer, star photometer, FTIR and high altitude sonde observations. At the Rabben station of the National Institute of Polar Research, remote sensing observations were carried out using micropulse lidar, sky radiometer, microwave radiometer and precipitation particle counter; and in addition aerosols were measured on site using an optical particle counter (OPC) and filter sampler. In cooperation with AWI, an aerosol sonde (OPC) was flown on April 12 in coordination with an aircraft flight. In addition, as a new attempt, the balloon from which the OPC was suspended was tethered to measure the vertical distribution of aerosols close to the ground; we were successful in obtaining a detailed vertical profile up to about 1km. Coordinated aerosol observations were also carried out by the Norwegian Atmospheric Research Institute (NILU) at the Zeppelin mountaintop observatory at a height of 470m, and by Stockholm University (MISU). The radiation budget at the ground was observed by the Norsk Polarinstitutt and AWI.

Other Observations

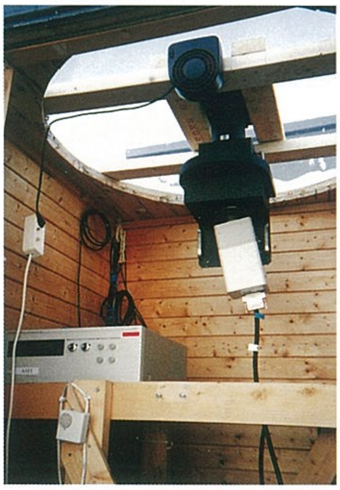
We were able to obtain the participation of the SOUSY Svalbard radar of the Max Planck Institute at Longyearbyen; it provided the vertical profiles of 3-dimensional winds in the troposphere and stratosphere. However, the raw winds which it measures requires correction. On short notice, for 2 days (April 15 and 16), comparative upper atmosphere sonde observations were carried out at Longyearbyen at 3 hour intervals by AWI. Wind speed profiles were also observed twice by aircraft.

The 5 weeks of concentrated observations provided interesting and valuable data, including data on dense Arctic haze. Some typical examples of these data are already available on the Web (http://kolpc8.awi-koldewey.no/astar/), and active analysis work will now be carried out. In addition, analysis of the atmospheric circulation field using objective analysis data from outside of the immediate ASTAR observation sites, and incorporation of the observational results from this project into a 3-dimensional numerical Arctic climate model, are being carried out. It is expected that these studies will help to clarify the behavior of aerosols and their effect on climate.

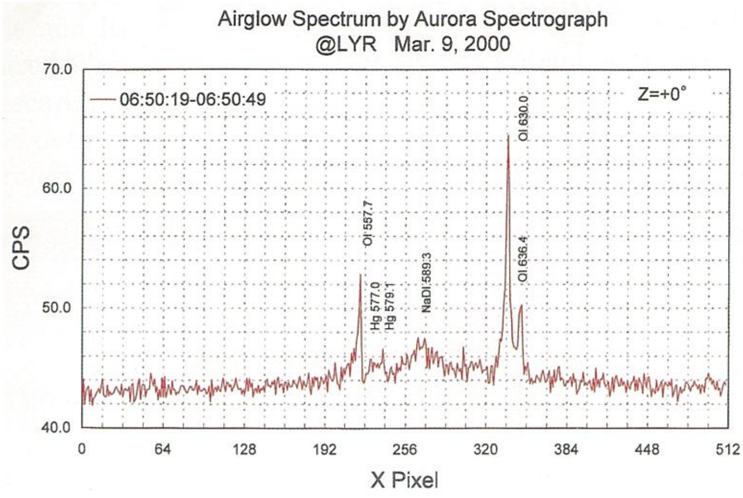
Installation of an Auroral Spectrograph in the Arctic

by Shoichi Okano
Graduate School of Science, Tohoku University

In March 2000, a new aurora spectrograph was installed at Longyearbyen, island of Spitsbergen, in the Arctic. I worked on this project at the National Institute of Polar Research for 4 1/2 years, from April 1995 to September 1999; in October 1999 I took up my present position at Tohoku University. At the National Institute of Polar Research we were able to make the aurora spectrograph and calibration facility to test its performance, and the assistance of the staff there in this work is very much appreciated. However, I still have unfinished business, namely, to actually use this equipment to observe the differences in the rapidly fluctuating auroral spectrum at various locations on the (magnetic) celestial meridian and its time variation. Observations for a similar purpose have been carried out in the past, but not over a wide range of wavelengths, and not with high wavelength resolution at any desired



The aurora spectrograph installed in place at the aurora observatory in Longyearbyen. The unit consists of an optical system with a 6mm focal length, F1.4 fisheye lens, a slit, a grism that acts as the wavelength dispersion element and a high sensitivity CCD camera.



The airglow spectrum at the zenith, recreated from image data obtained in a test observation during a quiescent aurora period. The exposure time was 20 seconds. The green line (557.7nm) of airglow emitted by oxygen atoms in the vicinity of 95km altitude, and the very weak aurora oxygen red lines (630.0nm, 636.4nm) that cannot be seen by the naked eye, are visible.
Lines from mercury lamps and sodium lamps in the city can also be seen

location on the (magnetic) celestial meridian. If these observations become possible, then it will become possible to estimate what kind of charged particles are incident on the upper polar atmosphere, and with what kind of space and time variations. This will represent a major contribution to the study of the magnetosphere. When I started to work at the National Institute of Polar Research, the aurora spectrograph was one of the projects that I hoped to accomplish there, but the design proved to be very difficult. Thanks to the ideas and assistance of Prof. Makoto Taguchi, who is now attached to the Antarctic Environment Monitoring Center at the National Institute of Polar Research, I was able to complete the design and production successfully. Calibration with the above - mentioned facility was completed in February 2000, and the unit was finally installed on the firing line after I left the National Institute of Polar Research. The installation was carried out by a team under the leadership of Prof. Takehiko Aso of the Arctic Environment Research Center at the National Institute of Polar Research, and including also Prof. Kaoru Sato of the Arctic Environment Research Center, Research Assiociate Masaki Okada of the NIPR Information Science Center and myself. The four of us arrived in Svalbard on March 5. It was installed at an aurora observing station maintained by Tromso University on the outskirts of Longyearbyen. The equipment was shipped by air from Japan well in advance of the departure of the installation team, but the installation conflicted with a local sun festival celebrating the end of the long polar night, and the cargo bays of the few aircraft available had been monopolized with supplies to take care of tourists expected to attend the festival, so when we arrived our equipment was not there yet. Having encountered similar problems a number of times before, we did not panic, but pressed the airline to proceed with the shipment, and on March 7 we were reunited with our equipment. Upon rechecking the equipment, we found that vibrations during travel had caused it to go slightly out of focus. Fortunately we had brought a spectral lamp for such an eventuality, and were able to readjust the equipment on the spot. With the help of an engineer attached to the Norwegian aurora observatory, we completed installation of the unit underneath a plastic dome on March 8 (see photograph), and immediately started test observations.

During our stay the geomagnetic field was quiet and unfortunately we were not able to observe any aurora activity, but as anticipated we were able to observe the spectrum of airglow (light that is present over the whole globe, produced by faint emission in the upper atmosphere and invisible to the naked eye) with high sensitivity and resolution of 1.5nm throughout the visible range (420 to 730nm) (see graph). Since we were scheduled to leave Svalbard on March 10, we set the computer to conduct automatic observations from the evening of March 9 until the observations would have to be ended on March 20 because there is no more night after that date. The data from that period arrived in Japan and we are looking forward to analyzing the data and planning the next season's observations.

I would like to take this opportunity to thank all of the people at the National Institute of Polar Research whose cooperation made this work possible.

The Ecology of Plants Living in a Fluctuating Environment

by Satomi Nishitani
Nippon Medical School

The Arctic ecosystem is attracting great attention because global warming is expected to have a particularly great impact on the Arctic. In the terrestrial plant project being conducted at Ny Alesund, in the Svalbard archipelago, prediction of ecological variability accompanying global warming is a centrally important topic. Specific research topics include determining the effect of environmental variability on the primary transition process in an area from which a glacier has recently retreated, determining the effect on plant life in a warming manipulation experiment, and construction of a model of the carbon cycle. In observations of the carbon cycle, in addition to the soil respiration measurements that have already been done to date, during the current fiscal year we are emphasizing determination of the photosynthesis and respiration characteristics of mosses and seed plants.

My own group is interested in the Arctic environment from a different point of view. We are interested in year - to - year variations. Aside from variations with a long term trend such as global warming, the Arctic is an environment which undergoes large changes from year to year. For example, the time of snow melting at Ny Alesund varies up to 1 month from year to year (Winther et al, 1999). There can be snow even in midsummer (Fig. 1). In addition, since the growing season in the Arctic is short, the effect of climate variability on plants can be expected to be severe, and only species that are able to cope with such changes can survive. In other words, the Arctic is an ideal environment in which to study the adaptation of plants to environmental variability. As for how plants can be expected to react to unexpected environmental changes, although some theoretical research has been done, the ecology of plants that are actually living in such an environment has not yet been adequately researched. Therefore we have been studying the adaptation of *Polygonum viviparum* (of the family Polygonaceae, Fig. 2). This species is widely distributed from the Arctic to high mountains in the temperate zone; clearly it has been successful in adapting to environmental changes.

Fig. 1 Snow in midsummer (July 28). Is it only humans who see anything unusual in this?

Fig. 2 *Polygonum viviparum.* Bulbils are attached to the 5cm long scape. Each of them will start to grow into a new individual the next year. Some individuals have flowers at the tips of the scapes, but most of these do not produce fruit.

When this species finishes its growth in a given year, primordia of the leaves and reproductive organs for the next year are already forming inside the plant's buds. This phenomenon, called preformation, is observed in many perennial plants. This preformation makes it possible for the plant to grow rapidly as soon as the snow disappears the next spring. However, the preformation of *Polygonum viviparum* is special. In the alpine zone of North America, it has been reported that enough primordia to last the next

3 years have been observed in the plant's buds (Diggle 1997). At Ny Alesund, we observed primordia for 2 years. While the difference between these two cases is itself interesting, we must first ask why so many primordia form. If the purpose is just to permit rapid growth in spring, then enough primordia for 1 year should be sufficient. We suggest that the large number of primordia permits flexible response to various circumstances; for example, the plant can spread a great many leaves to take maximum advantage of the abundant sunlight in a year with good weather, while if leaves should be lost to some disaster such as an unseasonable frost, there are spares available. To prove this hypothesis, in 1998 we did an outdoor experiment involving cutting of leaves (for the result see the 22nd Polar Biology Symposium abstracts volume). At present, we are planning an experiment in which we will produce climatic variations in an artificial climate chamber, and observe the reactions of the plants.

In the summer of 2000, we visited Ny Alesund for the 3rd time; our cumulative stay there came to more than 150 days. Whenever we see people finish a project there and see them off as they leave, we should perhaps feel a mixture of loneliness and envy. However, in Ny Alesund, I do not feel that way. I feel a bit sorry for them having to go back as I face the airplane and wave.

Nature around the Sofiyskiy Glacier in the Russian Altai Mountains

by Takao Kameda
Kitami Institute of Technology

From July 15 to 24, 2000, a glaciological research, principally surface core drilling, was conducted at an altitude of 3,450m ("Camp" in Fig. 1) in the accumulation area of Sofiyskiy Glacier in the Altai Mountains, Russian Federation. This research, intended to be preliminary to the main research to be carried out in 2001, had the following objectives:

1) Evaluation of the possibility of research on past climate and environment variability by analysis of an ice core from the Sofiyskiy Glacier.
2) Resolution of logistical problems including transport and supply by available means including helicopters.
3) Investigation of the possibility of cooperative research with Russian researchers. A summary of the results of this research has already been reported by Fujii et al (2000), so here I will discuss the nature,

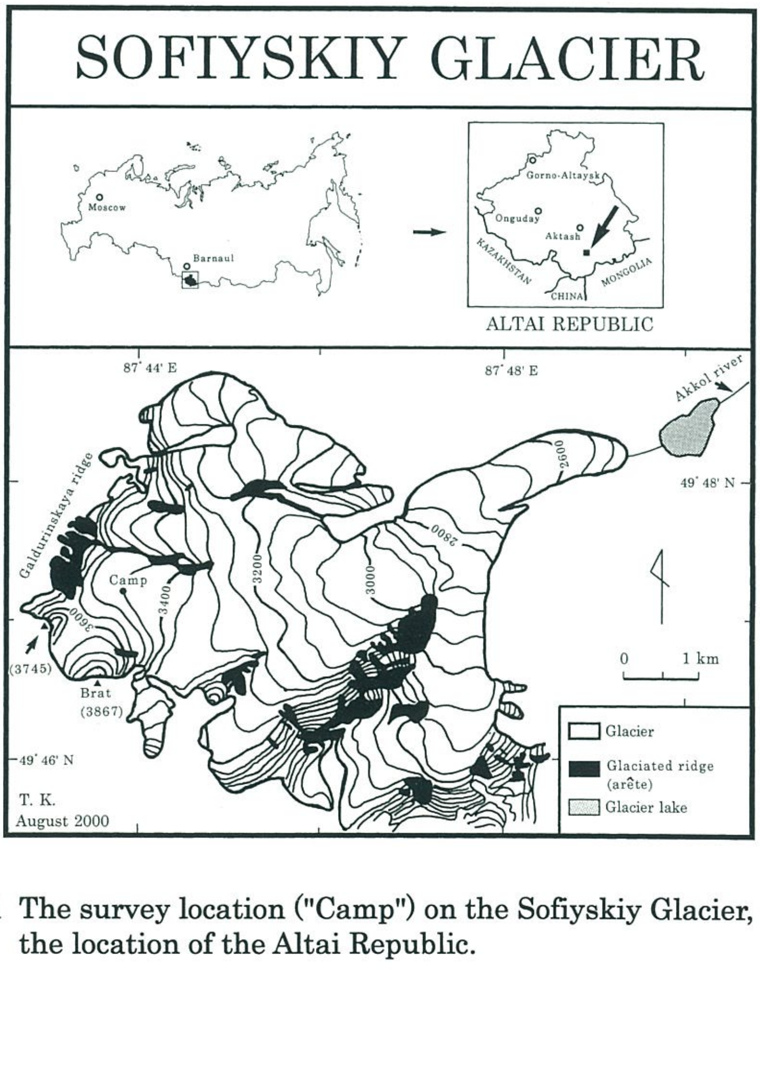


Fig. 1 The survey location ("Camp") on the Sofiyskiy Glacier, and the location of the Altai Republic.

Photo 1 Rock glaciers.

Photo 2 The Sofiyskiy Glacier.

Photo 3 The accumulation area of the Sofiyskiy Glacier, with the campsite in the middle

particularly glaciers and glacial landforms, surrounding Sofiyskiy Glacier.

We took off for Sofiyskiy Glacier in a MI-8 helicopter from Barnaul, the capital of the Altai Krai of the Russian Federation. The direct line of flight distance is about 300km. At first we passed over forest, cities and villages, but gradually we entered mountainous terrain. About 3 hours after takeoff, suddenly the South Chuiskiy Range, in which the Sofiyskiy Glacier is located, became visible off in the distance. Until that point the terrain had been relatively gentle and grassy, but suddenly mountains with glistening white summits appeared. We passed near the Mariy Aktru Glacier (of which a color photograph appeared in Kameda et al, 2000) in the North Chuiskiy Range. The mass balance of this glacier has been observed by researchers from Tomsk University, and the results published in the Glacier Mass Balance Bulletin.

Then the helicopter followed a landform gouged out by the glacier, and followed the gorge of the Akkol River toward the Sofiyskiy Glacier. On the southeastern slope of one of the ridges, a rock glacier forming a characteristic pattern (Photo 1) was well developed. The Sofiyskiy Glacier, which we surveyed, is shown in Photo 2, here photographed from near its terminus. At the base of Brat Peak (3,867m), the white peak in the middle of the photograph, we drilled a core to a depth of 12.3m using a hand auger, conducted observations in a 3m deep pit and also conducted meteorological observations. A side moraine formed during Little Ice Age can be seen in the middle of this Photo 2.

Photo 3 shows the accumulation area of the Sofiyskiy Glacier. It measures about 1.5km by 1.5km. We built our camp in the middle of the area shown in this photograph. According to radio echo sounding, the ice thickness at this point is 210m (Dr. F. Pattyn, personal communication). A striped pattern can be seen on the snow surface in Photo 3; this is believed to stem from nonuniformity in the way the snow accumulates and uneven melting of snow at the surface. This photo shows Prof. Fujii (second from lower right, with pack on the snow) gazing toward the Potanina Glacier located 70km to the south near the triple point where the borders of Russia, China and Mongolia come together. It is the largest glacier. We understand that with so little melting on this glacier, it is easy to obtain deep, good quality ice cores from it. Since it is in a border area, it is hard to obtain permission to do field research there, but it is a candidate site for a future core drilling.

Thus we obtained the impression that

the Altai Mountains of Russia are a storehouse of interesting glaciers and glacial landforms. As should also be clear that part of the Altai Mountains has been designated a World Heritage site by UNESCO, we feel deeply that the nature of this area should be passed on to future generations.

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Fall Oceanographic Observations in the Barents Sea

by Gen Hashida
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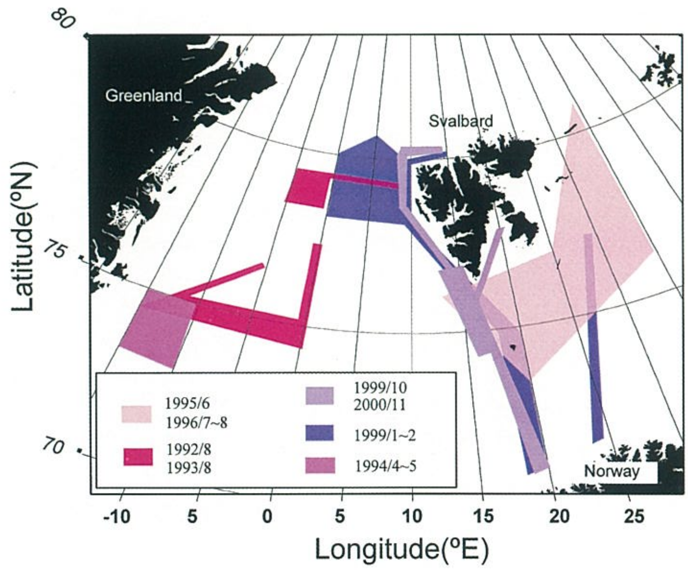
Since 1992, the National Institute of Polar Research and the Atmospheric and Oceanic Variability Observation Research Center of the Graduate School of Science, Tohoku University have been jointly conducting research on the air - sea exchange process of carbon dioxide in the Barents Sea and Greenland Sea (Antarctic Record, Volume 38 No. 1, 1994; Antarctic Record, Volume 43 No. 2, 1999; and the present newsletter Nos. 4, 5 and 9). With cooperation of many people, we have now successfully completed 9 cruises. Since fall data were not obtained on previous cruises, from November 6 to 23, 1999, Tomonori Watai, then a nondegree candidate research student in the Graduate School of Science, Tohoku University (present affiliation: Earth and Human Environmental Forum (a foundation)); and from October 16 to 27, 2000, Shin'ichiro Nakaoka, a regular graduate student in the Graduate School of Science, Tohoku University, conducted observations on board the research vessel LANCE, operated by the Norsk Polarinstitutt. Specific observations included sampling of water from the ocean surface and several depths to measure total dissolved inorganic carbon concentration and nutrient concentrations; and equilibrium air sampling to determine the partial pressure of carbon dioxide in ocean surface water. The use of the LANCE has been discussed in detail by Ito (this Newsletter No. 4, 1996); it is used in many ways. Since 1995 it has been used for patrol duties with the Norwegian Coast Guard for 7 months of each year and the rest of the year has been available to the Norsk Polarinstitutt for observations and logistical supply operations. From the end of 2000 until April 2001 it was scheduled to take part in Antarctic observations, and then, without undertaking patrol duties, to be available for the rest of the year for work conducted by the Norsk Polarinstitutt and other European research institutions. Of the observations reported on here, those in November 1999 were conducted as ancillary work on an operational cruise of the Norwegian Coast Guard; and those in November 2000 as ancillary observations on a cruise to study large marine animals.

The cruise in November 1999 was beset by bad weather from beginning to end, and the



boat unavoidably spent much of its time biding its time in fjords and in the lee of islands. Mr. Watai wrote as follows in his private notes on the cruise. "... From the middle of the cruise CTD observations had to be ended and it was only possible to take surface observations. Because the boat was on patrol duty even these surface observations had to be carried out while inspecting ships that were encountered. So compared to the first half of the cruise I had lots of free time on my hands. The total carbon concentration in the sea water that I sampled would be measured after the water was taken back to Japan, but nutrients had to be measured on board the ship, and I struggled to do that. Weighing chemicals with a graduated cylinder in a laboratory on a violently rolling ship is extremely difficult. If the rolling and pitching become too violent mixing chemicals becomes impossible, so I try to do measurements when the rolling and pitching have calmed down a bit, but once I start working I cannot interrupt it for 3 hours. If I am already into making measurements and then the rolling and pitching become violent the situation becomes tragic. I use my right hand and my left hand to hold laboratory apparatus, but I feel a need for a third hand to balance myself. If I keep busy working in the lab between my assigned watches I don't notice it so much, or perhaps I am getting used to the rolling and pitching, but if I find myself with free time I become unable to bear the seasickness and climb into bed. I cannot eat enough and find myself craving familiar Japanese food. My biggest secret is that my observation notes contain a list of the things I want to eat when I get back to Japan."

The weather during the cruise in October 2000 was relatively calm. Mr. Nakaoka wrote as follows in his notes. "I set out on this journey resigned to finding that the Svalbard archipelago in October is a very cold and dark place, but in the daytime it is as light as Japan in late afternoon, the temperature almost never falls below freezing, and the sea is unexpectedly calm. Since this is my first time to do oceanographic observations before I boarded the ship I was afraid of becoming seasick. However, perhaps because the seasick pills I brought with me were effective or perhaps because I am built to be a good sailor, it was only the first half day of the cruise that was difficult; since then even when the rolling and pitching become violent I am able to function nearly as well as on land. What remains strongest in my memory is the several days that we spent in a fjord. While waiting interminably for the sun to rise, I gazed at an icecap that seemed about to collapse at any moment, and felt that time passed more slowly than in Japan and that I had more time to breathe. The opportunity that I had to think about myself in that situation was as much of a gain from this cruise as all of the samples that I obtained."

I, myself, have gone on 3 cruises on the LANCE. I concealed my condition when in front of other people, but perhaps because the LANCE did not agree with me, there was no cruise on which I did not become seasick. Even so, the times between observations when, holding a cup of strong Norwegian coffee in my hand, I would stand on the bridge listening to veteran crew members recount tales passed down through the generations about the northern seas which are their front yard, brought me great pleasure.

EDITOR'S NOTE

In 1995 the Arctic Environment Research Center of the National Institute of Polar Research, Japan, started distributing a newsletter (2 domestic editions in Japanese per year) to give Japanese scientists news of Japanese projects under way, news of important research abroad and news of domestic and international conferences. This volume, AERC NEWSLETTER, Vol. 6, incorporates numbers 12 and 13 of the domestic bulletin, which includes news of Japanese Arctic research projects and other news of potential interest and/or novelty to international readers. Contributions are welcome and should be addressed to:

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