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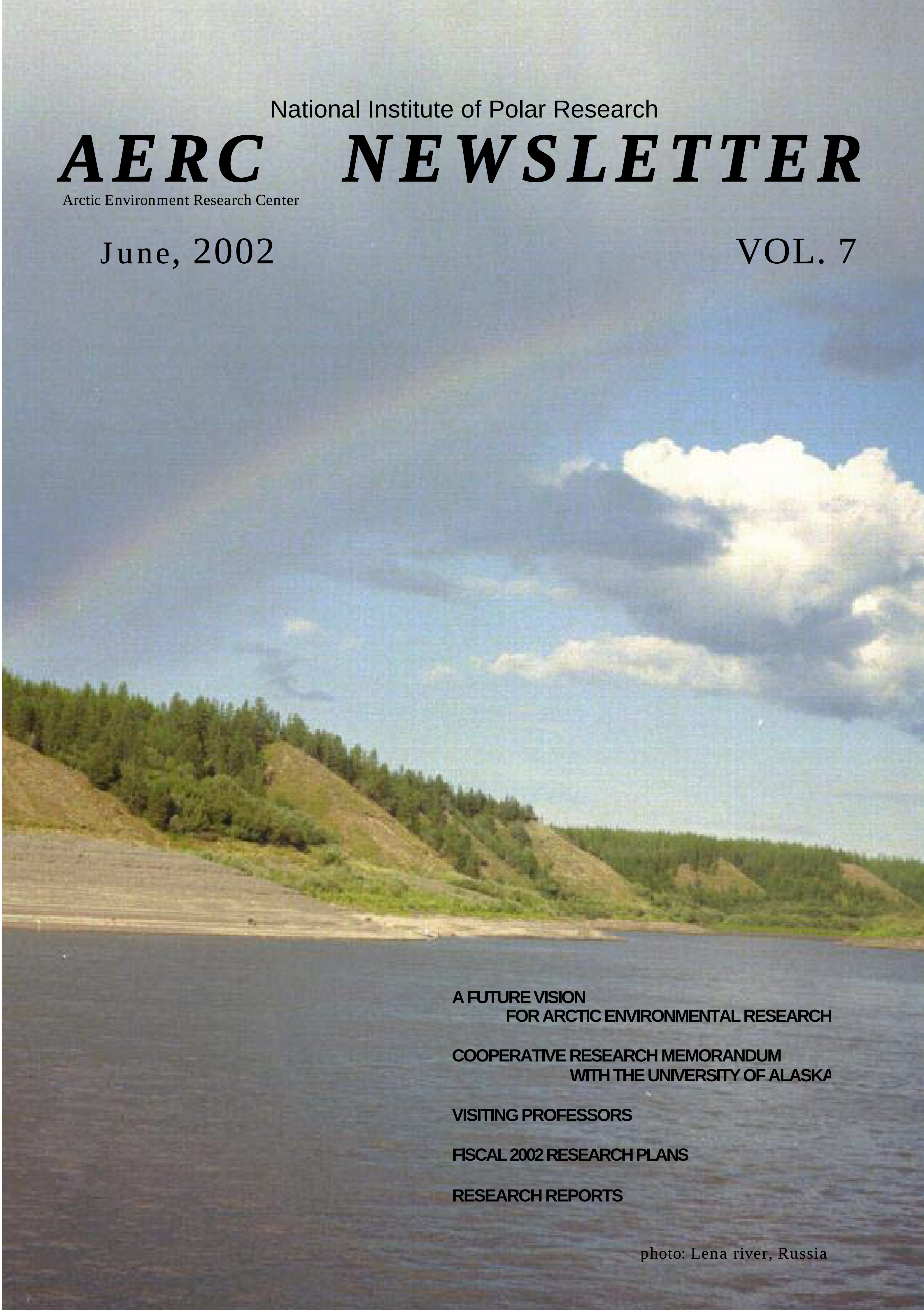

A FUTURE VISION
FOR ARCTIC ENVIRONMENTAL RESEARCH

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photo: Lena river, Russia

A FUTURE VISION FOR ARCTIC ENVIRONMENTAL RESEARCH

FUJII Yoshiyuki (Head of Arctic Environment Research Center)

The scheme of scientific and technological research in Japan is at a major turning point, with the merger of the Ministry of Education, Science, Sports and Culture and the Science and Technology Agency; the formulation of the Science and Technology Basic Plan (2001-2005); and proposals for the major restructuring of universities. Against this background, the Arctic Environment Research Center (referred to below as the Arctic Center) needs to come up with a new vision for the future.

"The environment" is one of 4 areas emphasized in Japan's new basic plan for science and technology. Within this broad area, the Council for Science and Technology Policy has designated 5 scientific issues for emphasis including "Research on Global Warming". Consideration is being given to promoting unified initiatives, crossing the boundaries between government ministries, for each issue, with a scenario approach. In the Arctic, where global warming is most in evidence, research on global warming is particularly important. What are important in research on climatic and environmental variability are high quality observations that are continued for a long time combined with research on unexplained elements in the process, and synthesis of the results of the two.

The Arctic Center has established an observational base in Svalbard which serves as a cooperative facility that is used by many university researchers. Subjects studied at this base include atmospheric science, the terrestrial ecosystem and glaciology. We hope to strengthen the long-term monitoring effort within the framework of the "Global Warming Research Initiative". This monitoring program would become the Arctic counterpart of the monitoring being conducted at Syowa Station in Antarctica. Understanding of global warming and related phenomena requires long-term continuation of high quality monitoring efforts. Considering the multi-faceted natural environment of the Arctic, it is important to also establish environmental monitoring bases in Arctic regions of Russia, Canada and/or Alaska to form a circumpolar observational network. Having this kind of observational network in the Arctic is expected to not only lead to primary results from the monitoring itself but also to attract a great many researchers from these and other countries, leading to secondary results as well.

In order to promote research in the Arctic efficiently and effectively, it is important to have a cooperative research system that provides for close coordination with other research organizations. The basis of such coordination must be exchange and sharing of information among researchers. The Arctic Center has been providing a variety of information by issuing the Center News and providing information on observations by issuing the Japanese Arctic Research Directory that was started last year in cooperation with the Japan National Committee for Polar Research of the Science Council of Japan, and intends to continue to cooperate in building a network of Arctic scientists in Japan.

We also need to cooperate with other Arctic research organizations. I believe that this should start with cooperative research with those institutions, each institution complementing the other's efforts. This would include mutual sharing of observational and other research facilities possessed by each institution. The next step is to propose cooperative research projects. This cooperation among research institutions and cooperative research by scientists can form the basis for a multi-layered cooperative research system.

At present, with Japan's science and technology system about to undergo major change, it is difficult to foresee the prospects for research in the Arctic. Considering the importance of Arctic research in the global environmental field, we must form a clear "grand design" for Arctic research that considers the structural changes taking place in Japan. I hope to have numerous opportunities to exchange views with other people engaged in Arctic research in the months and years to come.

COOPERATIVE RESEARCH MEMORANDUM WITH THE UNIVERSITY OF ALASKA

In June 2001 the National Institute of Polar Research signed a memorandum on cooperative research with the International Arctic Research Center and the Geophysical Institute of the University of Alaska. This agreement covers a wide range of cooperative research for a period of 5 years, without being limited to any specific research field or research project. This will open the path for researchers from the National Institute of Polar Research to conduct observations in the Alaska region.

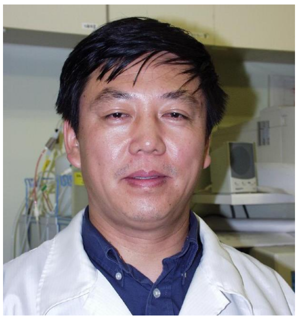
The signing ceremony was attended by this author, Prof. Takehiko Aso and Prof. Takashi Yamanouchi from the National Institute of Polar Research (photograph). These 3 scientists toured the International Arctic Research Center and the Geophysical Institute, the Poker Flat Experiment Station near Fairbanks, and the Barrow Arctic Science Consortium and NOAA observational facilities at Point Barrow.

(byFUJII Yoshiyuki)

Visiting Professor (June-September, 2001)

Li Yuansheng

Polar Research Institute of China



Prof. Li Yuansheng is a Chinese scientist from the Polar Research Institute of China. He was born in Inner Mongolia. He grew up in a small village in the grassland near the boundary between Inner and Outer Mongolia. He graduated from Nanjing University and received his B.Sc. in geochemistry in 1982. His first job after graduation was in Hebei Geological College as an assistant professor in fluid inclusion geochemistry in minerals from 1982 to 1986. He moved to the Institute of Geochemistry, Chinese Academy of Sciences in late 1986, where he studied fluid inclusions in minerals in the Fluid Inclusion Research Laboratory. In 1987 he was appointed Head of the Fluid Inclusion laboratory. He served in that position for 9 years, from 1986 to 1995. He was the first young fellow in charge of a project (1988-1991) supported by National Science Foundation of China due to his discovery of natural immiscibility in granite magma.

In late 1994 he was accepted to stay in Canada for one year as a visiting scholar with financial support from the Chinese Academy of Sciences. But instead of visiting Canada he chose to move to the Polar Research Institute of China in 1995 because of his interest in Antarctic glaciology. His first experience in field work in Antarctic glaciology was through a collaborative study with Japanese polar glaciologists. He learned much from Prof. O. Watanabe, Prof. Y. Fujii, Dr. H. Motoyama, Prof. T. Yamanouchi and other Japanese scientists on polar glaciology, snow and atmospheric chemistry, and how to conduct on inland traverse on the Antarctic ice sheet. He joined the JARE 38th overland traverse to Dome Fuji Station in the 1996/1997 season. After returning to China, he became the leader of a CHARE inland traverse party, which went to Antarctica two times for inland ice sheet exploration from Zhongshan Base to Dome A. In the 1998/1999 season, he and his members succeeded in setting up a new glaciological observation profile from Zhongshan Base to Dome A, and reached 79 degrees and 16 minutes south. The distance was 1100 km from the coast. According to Prof. Fujii's suggestion, he collected drifting snow samples on the route from Zhongshan Base to Dome A. One of the major chemical results from the snow samples is information on the spatial distribution of nitrate in the Antarctic drifting snow. It provided new knowledge about the nitrogen cycle over Antarctica and its depositional process onto the ice sheet. His air samples collected in the lower troposphere from Shanghai to Zhongshan Base to Dome A, we also acquired new knowledge about the latitudinal distribution of freon in the lower atmosphere; the concentration of freon on the Antarctic plateau is higher than that in middle latitudes in the southern hemisphere, and increases with elevation on the Antarctic ice sheet.

Japanese polar glaciologists have more than 30 years of experience in Antarctic ice sheet expeditions, middle depth and deep ice core drilling. The Dome Fuji ice core is the best one in the world both in its quality and its drilling rate of progress. It is a great contribution of Japanese scientists to international glaciology, not only in science but also in technology. Prof. Li's research work on Antarctic glaciology has profited considerably from the glaciologists of the National Institute of Polar Research, Japan.

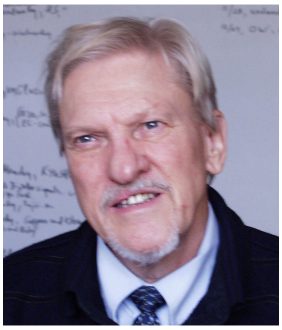
The Antarctic ice sheet and the Arctic Greenland ice cap play important roles in global change. We can obtain considerable information on the variation of atmospheric circulation from chemical species and dust in polar snow and polar ice cores. The two largest glaciological research profiles in the eastern Antarctic ice sheet (Syowa Station to Dome F, and Zhongshan Base to Dome A), and also the most important ice core drilling sites at Dome Fuji and Dome A, have been and are being developed by JARE and CHARE, respectively. Prof. Li Yuansheng will be actively involved in research activities related to snow, ice core and atmospheric chemistry on Dome A, and still will be interested in Dome F field work and the Dome F second deep ice core drilling project, in the future.

Snowfall, dust-fall and environment of the atmosphere during winter and spring in northern China are also interesting research subjects. Prof. Li is planning to do research on these subjects. The cold air mass has strong influence on the weather in most parts of China and Japan. In the last few years sand and dust storms have occurred frequently in northern China in winter and spring. We also should be concerned of climate change in that region. Chemical species, water and dust in fresh snowfall are indicative of the environment of the atmosphere above the area. Seasonal and annual variations of the sources of these species, water vapor and dust (in different sizes) can be used to provide important information about the atmospheric circulation. For this purpose, building a long distance field observation network in north China is necessary and very important. The observation profile should be from Huhehaote to Xilinhaote, Wulanhaote and Mohe, with a length of about 2000km. The direction of the profile will be southwest to northeast, almost perpendicular to the main wind direction. If we conduct field observations and collect snow and dust samples every January and February, we will obtain much valuable new information.

Visiting Professor (September-December, 2001)

Henrik B. Clausen

University of Copenhagen



I come from the University of Copenhagen (UCPH), Denmark, where I have been associated professor at the Department of Geophysics since 1972. In 1963 I took my master degree in chemical engineering at the Technical University of Denmark and started to work for prof. Willi Dansgaard at UCPH to develop a new dating technique for ice bergs based on the natural radioactive isotope ^{32}Si.

In the last 37 years I have spent more than 5 years in Greenland and half a year in Antarctica.

In the last part of the 1960'ies our group got contact to prof. Chester Langway, (at that time at CRREL in Hanover, USA) who was involved in the first deep drilling of ice cores to bedrock at Camp Century in 1966 in Greenland.

This was the beginning to an extremely fruitful collaboration on ice core studies, a collaboration, which from the early 1970 also involved our Swiss colleagues from University of Bern.

Especially the ice core dating by stable and radioactive isotopes and content of chemical impurities became the main road of my scientific work.

During the first half of the 1970'ies the American thermodrilling technique was used to obtain ice cores to intermediate depths (some 400 m) for the American/Swiss/ Danish ice core study program with the intension of drilling to bedrock in central Greenland.

The years 1977-78 are important years in ice core studies: It became clear that the existing deep drilling system used at Camp Century and the thermodrilling system could not be used for a future deep drilling.

At UCPH an electromechanical drill for obtaining ice cores to some 100 m was developed as well as a new deep drilling technique, prof. Langway (now at SUNY at Buffalo, USA) introduced ionchromatography in chemical analysis of ice cores, dr. C.U. Hammer at UCPH developed and introduced the Electrical Conductivity Method (ECM) for acidity measurements of ice cores and personally I had my first contact to a Japanese scientist in glaciology, dr. Hitoshi Shoji in Buffalo (now at New Energy Resources Research Center, Kitami).

All this ended in the US / Swiss / Danish GISP program, a successful deep drilling to bedrock at Dye3, SE Greenland in 1979-81.

The main scientific outcome of this project was a clear confirmation of the abrupt climatic changes during the last glacial period, abrupt changes that were observed in the lowest 100 m of the Camp Century ice core. Dye3 was not the most perfect site to perform a deep drilling, it was however the only place possible with the funding available at that time. The summit position of the Greenland ice cap had always been our first priority for a deep drilling site, and during the years after the Dye3 drilling we continued in the US/Swiss/Danish GISP program to survey central Greenland for a suitable drilling site by making many shallow ice cores in the region.

Unfortunately it was not possible to continue the US/Swiss/Danish deep drilling program, so in the late 1980'ies we succeeded to create an European drilling project GRIP that at the summit of the Greenland ice cap reached bedrock in 1992. It was in 1987 I first met prof. Watanabe, and in the following years the collaboration between NIPR and UCPH grew in the fields of science based on ice core studies and in the development of deep ice core drilling technique, and Japan joined the GRIP deep drilling program together with 8 European countries. In the present deep drilling program in Greenland, NorthGRIP, 6 European countries, Japan and USA participate.

I am extremely thankful to director Watanabe for giving me an opportunity to spend 3 months as a visiting professor at NIPR and for me it has been a rewarding and an inspiring experience to work with prof. Fujii and the group at AERC. Also by all the hospitality and friendship I met, I learned at lot about the Japanese way of life. For all this I want to express my sincere thanks.

Fiscal 2002 Research Plans

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

ASO Takehiko

During FY2002, we will continue to work on the observations of the dynamics in the Arctic polar middle atmosphere, thermosphere and magnetosphere, and on the comprehensive data analysis. In addition, during the year we will introduce a data archiving server system with the aim of securing various data on the polar upper atmosphere dynamics. The specific topics to be taken up are as follows.

(1) EISCAT radar ..... Observations of the polar magnetosphere and the middle atmosphere dynamics by EISCAT radar will be continued. In addition, based on simultaneous EISCAT heating and ground optical observations, and on long term continuous EISCAT data, we will investigate a variety of problems in the polar upper atmosphere including coupling between plasma and neutral particles and ion dynamics. The EISCAT radar data on the plasma dynamics and electric field will be used to investigate dynamical coupling between geomagnetic disturbances and neutral wind field in simultaneous meteor and EISCAT radar runs.

(2) Meteor radar ..... We will continue with the meteor radar observations of the polar mesosphere and lower thermosphere dynamics, and perform global-scale analysis of long term radar data. The analysis combines these data with other radar and optical observations from Arctic sites which are in the same circumpolar latitude band or form a conjugate point of an Antarctic station and also with other data including TIMED satellite. The analysis will attempt to determine climatology and seasonal variability, wave mode, east-west wave number, in-situ excitation, penetration of non-migrating modes, north-south symmetry or asymmetry and nonlinear coupling of pertinent tidal waves; the effect of electromagnetic disturbances on the lower atmosphere via wave excitation. In addition, the data will be closely compared with the results of simultaneous ESR radar (IS) and SSR radar (MST) observations.

(3) HF radar ..... We will conduct HF-radar observations of thermosphere and magnetosphere dynamics, wind field in the lower thermosphere in meteor mode and PMSE occurrence.

(4) Aurora and airglow spectrograph ..... The aurora spectrograph will be used to study correlation of oxygen ion-line emission with ionospheric disturbances due to particle precipitation observed by EISCAT radar. We will attempt to derive neutral atmosphere temperature from the analysis of OH airglow spectrum.

(5) ALIS ..... We will try again the artificial aurora experiment through simultaneous ALIS, EISCAT heating and EISCAT radar rums and study altitude distribution by tomographic reconstruction and involved excitation processes by plasma measurement. In addition, we will try auroral tomography observations with ALIS, FAST satellite and EISCAT radar.

(6) Numerical modeling and comprehensive analysis: We will go on with comprehensive analysis of acquired data set and compare with numerical modelings.

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

YAMANOUCHI Takashi

The purposes of this research are to clarify the variability of greenhouse gases, aerosols, ozone and clouds in the Arctic troposphere and stratosphere, the causes of that variability, and the respective sources, sinks and transport processes; to compare these results with similar results in the Antarctic; and to evaluate the effect on climate through the radiative effect. The fiscal 2002 research plan is as follows.

(1) With regard to the greenhouse gases, ground observations at the Ny-Ålesund base will be continued. These fulfill the role of monitoring through accumulation of highly accurate observations. At the same time we will analyze the relation between concentration in the atmosphere and stable isotope ratio and observations of the exchange of carbon dioxide between atmosphere and ocean, to clarify the material cycle including sources, sinks and transport mechanisms. We are also considering participating in the EU's seaborne CONVECTION project, in collaboration with the oceanography group.

(2) Regarding aerosols and clouds, to the extent possible we will conduct ground observations at the Ny-Ålesund base and also remote sensing observations. In particular, we will observe amount of precipitation, cloud water content and snowfall particles to determine the relation of aerosols to clouds and precipitation. Together with the Doppler radar observations being conducted at Bear Island in the Greenland Sea, observations at the two points are being used to track the time development (or

decay) of disturbances which pass over first one of the points and then the other. We hope in this way to clarify the processes of development and decay of disturbances.

(3) Regarding the results of the ASTAR2000, Arctic Study of Tropospheric Aerosols and Radiation, conducted jointly by Japan and Germany at the end of fiscal 1999 and in the spring of 2000, we are proceeding with combined analysis of results obtained by many researchers. We will continue to incorporate the observational results into the HIRHAM, Arctic regional climate model, to determine the radiation forcing and the effect on climate.

(4) We will proceed with analysis of observations taken on a jet aircraft flight across the Arctic Ocean in March 2002 (AAMP02). The cross - Arctic flight was mainly in the stratosphere, but included local airborne observations in Alaska and around Svalbard. These observations aimed to measure greenhouse gases and to clarify the transport of aerosols, the aerosol radiative effect, and the structure of clouds and turbulence. In particular, we will concentrate on analysis of long range transport of substances in the atmosphere, exchanges between the troposphere and stratosphere, optical thickness in the upper troposphere and stratosphere, and growth and decay of the Polar Low. We will also analyze the concentrated observations that were conducted on the ground at Ny-Ålesund simultaneously with the airborne observations. Regarding optical thickness in the upper troposphere and lower stratosphere, we will compare the airborne observations with SAGE-III satellite observations, and will analyze the atmospheric circulation field and trajectories using objectively analyzed meteorological data at the time of the airborne observations. Since these were international cooperative observations conducted jointly with Germany and other countries, we will hold workshop sessions in Japan and in other countries including Norway and Germany, and will participate in meetings at which results will be announced.

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

GOTO-AZUMA Kumiko

The polar regions, as cold sources, play important roles in the Earth's climatic system, together with the tropics acting as a heat source. The transport processes that occur between the tropical heat source and the polar cold sources transport substances from many sources toward the polar regions where these transports converge, and the substances are deposited on and preserved in glaciers and icecaps. Substances in ice cores form time series of such deposits. The amounts and composition ratios of substances in the cores become indices of climatic and environmental variability. In addition, the expansion and contraction of the polar cryospheres greatly affects their roles as cold sources.

There are great differences in climatic and environmental variability from one region to another. To clarify the mechanism of climatic and environmental variability in the Arctic, it is necessary to clarify the climatic and environmental changes that occurred in the past in many regions. In the present research, we are drilling ice cores at many locations, and analyzing them to reproduce past climatic and environmental changes throughout the Arctic. At the same time, we are seeking to clarify the present motions of the Arctic cryosphere, mainly using observations.

During the current fiscal year, we are emphasizing the drilling and analysis of ice cores. Specifically, we are doing the following research.

1) As one link in the International Circum-Arctic Paleoclimate(ICAPP) project being carried out under the International Arctic Scientific Committee (IASC), last year a preliminary survey was carried out on the Mt. Logan Glacier in Canada. As a result it became clear that the most suitable location for drilling an ice core is King Col (4,200meters) on Mt. Logan. During the current fiscal year, we are drilling an ice core on King Col with the aim of reproducing past climates and environments on the Pacific side of the Arctic, and analyzing the core on site. The ice core will also be brought back to Japan and analysis started. We are also conducting ice radar and GPS observations on King Col to observe the ice thickness and glacier flow.

2) Under the ICAPP project, in Alaska, where until now there have been almost no records of past climate and environment changes, ice core drilling is planned. During the current fiscal year a preliminary survey will be conducted. It will include preliminary glacier observations including observations of snow melt conditions and snow accumulation.

3) In continuation of work done last year, we will participate in North GRIP (North GReenland Icecap core Project) and analyze a deep ice core that was drilled last year. Through comparison of the results that are obtained with results obtained from analysis of the Dome Fuji deep ice core drilled in Antarctica, we will compare ice age cycles in the Arctic and Antarctic, and research the mechanism of large scale climatic variability.

◆ Research on Arctic Ocean Dynamics and Ecosystem Variability

FUKUCHI Mitsuo

In April, 2002, an international conference was held in the Netherlands to discuss plans for international oceanographic observations in the Arctic Ocean region. We plan to participate actively in these observations and to seek to fit the present research topic into an international framework.

This year, the first cruise of CASES (Canadian Arctic Shelf Exchange Study), centering on Laval University, is planned. A workshop is to be held in Rimouski, Quebec, to finalize plans for the first year's cruise. We plan to attend the workshop and participate in discussing the division of labor for the fiscal 2002 observations as well as planning for what will follow. We plan to participate in the CASES cruise to the polynya region in the eastern Beaufort Sea, where mooring observations will be conducted, that is planned for September 2002.

A meeting is planned in California in March 2003 to report on the results of the current year's cruise and to make plans for the next year. We will attend to the extent possible.

In addition to the CASES project, we are also planning to participate in international cooperative research in the Greenland Sea, the Barents Sea and the Arctic Ocean around Svalbard. At the same time, we will attempt to evaluate the effect of the ocean ecosystem on the terrestrial ecosystem, and to participate in international research conferences held to plan international cooperative observations relevant to this research.

At the same time, we will be gathering information about the Southern Ocean that is indispensable to evaluate the relation of oceanic motions and ecosystem variability in the Arctic to global scale environmental variability; and to the extent possible will take observations for the purpose of comparison.

During the current fiscal year we will hire research assistants to process and analyze data and samples obtained thus far and, to the extent possible, to provide specialized support to the field observations.

◆ Research on Environmental Change in the Arctic Tundra

KANDA Hiroshi

The Terrestrial Environment Research Group has been researching the carbon cycle in the deglaciated area left by the receding Ostbrøgger Glacier near Ny-Ålesund, Spitsbergen. The principal research topics are the amounts of carbon and nitrogen in the soil, release of carbon dioxide from the ground surface (rate of soil respiration), biomass and activity of soil microorganism, root biomass and respiration activity, and primary production of vascular plants (Arctic willow) and mosses (*Sanionia uncinata*). During fiscal 2002, like last year, we plan to survey the carbon environment on moraines near Ny-Ålesund in different stages of plant succession following glacial retreat, from many study sites. We believe that by obtaining more data to add to our existing data, we will be able to construct a compartment model of the carbon cycle in the ecosystem using measurements of pure primary productivity in different areas.

In addition, we will conduct a phenology survey of *Polygonium vivitarum* and continue our survey of the type of breeding that takes place. In particular, we plan to take data on the meaning of preformation and the accumulation of stored substances. Since it is known that the *Pythium* sp. fungus, which is parasitic on communities of *Sanionia uncinata*, plays an important role in the process of decomposition of tundra vegetation, last year we deployed a chamber to evaluate the effect on colony formation in different environments. During the current fiscal year, we plan to carefully examine the change in fungus colonies accompanying warming after 1 year. We plan to cooperate with Norwegian researchers in deploying new chambers in a number of plant colonies to study the effect of ultraviolet radiation on vegetation.

During the current fiscal year, for the purpose of comparison with ecosystem variability following deglaciated area on Spitsbergen, we will start a full scale biological and geological study of tundra ecology on Ellesmere Island in Arctic Canada. In a preliminary survey conducted in July last year, we conducted the following observations from a base at Oobloyah Bay, a major observation point on Ellesmere.

1) Research on the distributions and diversity of plants, mosses, lichens, algae and soil microorganisms around the base.
2) Research on the moisture physiology and photosynthetic activity in *Sanionia uncinata*.
3) Research on breeding ecology, seen from the morphological and sexual characteristics of *Cassiope tetragona*.
4) Surveys of glacial geomorphology and vegetation after glacial retreat.

Research Reports

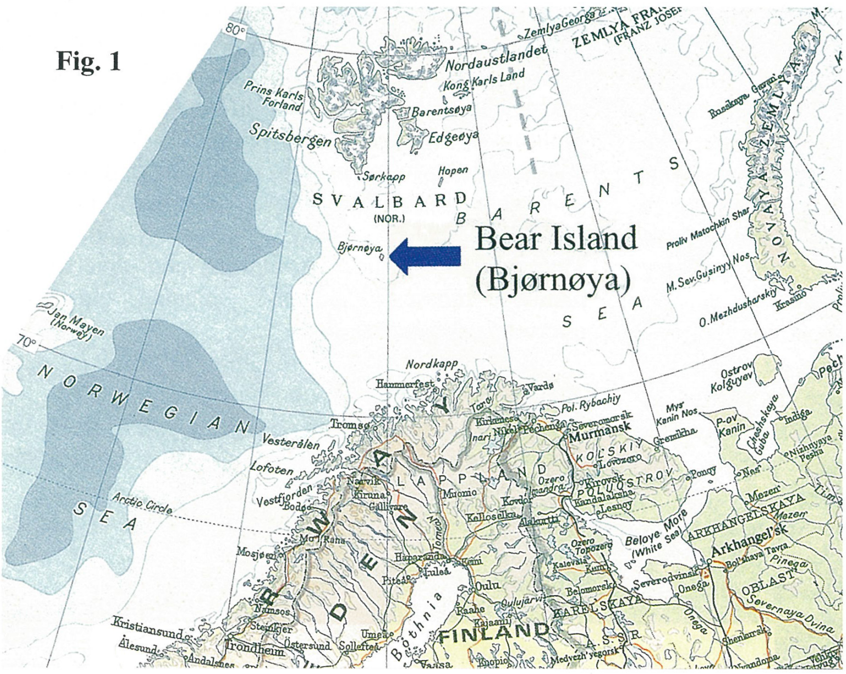
Radar Observations on Bear Island (report of stay at the Island)

ASUMA Yoshio (Graduate School of Science, Hokkaido University)

Bear Island, or Bjørnøya in Norwegian, lies at (74°18'N, 19°06'E) in the Norwegian Sea, about 200km south of the southern tip of Spitsbergen and about 500km south of the NIPR polar observation station at Ny-Ålesund (Fig. 1). Bear Island is about 20km in the north-south direction and 15km in the east-west direction, with an area of 176 square kilometers. We set up a vertically pointing Doppler radar here and collected data for about 8 month, from October 1999 to June 2000, to investigate precipitation and storm activities in the Arctic. Bear Island lies near the northernmost branching point of the Gulf Stream; one branch flows northeastward along the coast of the Norwegian Peninsula, while the other flows directly northward. Since the sea surface nearby Bear Island does not freeze over even in the mid-winter, many storms pass overhead the island. For this reason, the island receives a great amount of precipitation even in the mid-winter as well as in other seasons. Here is a well-known place where "the most beautiful polar low" turns up in meteorological satellite images. On the other hand, Ny-Ålesund is located in the northern Spitsbergen, where the surrounding ocean surface is frozen over in the mid-winter. As a result, it receives very little precipitation. Almost the same type of the radar system is installed at Ny-Ålesund; our objective was to compare the two sites by radar. In Bear Island, radar echoes appeared almost every day, and radar reflectivities were strong. Detailed analysis is still in progress and the results will be presented at a later opportunity; here I will report the life of Bear Island Meteorological Station.

There is no regular air or ferry service to Bear Island, so the Norwegian Coast Guard ships are used. It takes 3 days from Tromsø. As implied by the island's name, it is a small island which is a paradise for polar bears. There used to be many residents on the island with a mine and a railroad, but nowadays it is a ghost town. All that is there today is the Meteorological Station of Det Norske Meteoroligiske Institutt (Fig. 2), at the northern tip of the island. The Meteorological Station is surrounded by 20m high cliffs from the sea, above which is a broad wetland. The station is operated by 7 or 8 people; each crew is replaced after half a year on duty. Half of the crew members work for the meteorological institute and the other half for the radio and telecommunication institute. Except for 2 cooks, all crew members take both meteorological observations and have radio communication duties. The station operates 24 hours, with 3 shifts each day. This Meteorological Station provides both surface and upper air observations in the middle of the Norwegian Sea, where is data sparse Arctic area to the whole world. The station also serves as an important base for rescues at sea. The Meteorological Station has an excellent helicopter platform and a huge hangar. I stayed there for 1 week, during which time the helicopter came and went frequently. Its crew members had their meals at the station and rested there briefly between flights.

Fig. 1



The Meteorological Station building was built in 1964; it underwent major renovation in 1994 and is well equipped with modern facilities. It has a large dinning room, drawing room, training gym and pool bar, and is quite a comfortable place to

Fig. 2

come, and there is also a functioning post office). Looking at photographs of past crew members on the wall, I noticed that starting about 1980 the station had female crew members; while I was there 3 of the crew members were female. Since there where a total of 7 crew members, it was a good ratio.

In winter polar bears frequently come on sea ice, and have claimed a number of victims. For some reason the polar bears seem to like science and show a great deal of interest in the meteorological instruments (I remember hearing the same thing from a Canadian scientist). For this reason measures are taken to protect all of the outdoor instruments from polar bears; they are surrounded by nets and cages. Of course, we also took measures to protect our radar from polar bears (Fig. 3: Normally the ladder is removed). All entrances to the station are equipped with signal grenades, to warn of bears, and with rifles. Today all of the station buildings including the upper air station, the helicopter hangar and living quarters are all connected by long indoor hallways so it is possible to move among them without going outside, largely eliminating the danger of being attacked by a bear. In addition, there are 5 or 6 dogs in exposed locations; normally when approached they will happily greet a person, but it seems that they will also gang up to drive a bear away. I was shown a video of the dogs driving a polar bear away; their vigor in attacking the bear was impressive.

In summer, Bear Island is a paradise for birds. In June, when we removed our radar, it was the breeding season for sea birds. The coastal cliffs were monopolized by sea gulls; one could not even approach them. When I tried, at first many sea gulls stood atop the cliff and posed menacingly. When I failed to get the message and tried to take photographs of their striking pose, they started to circle overhead, made menacing sounds and then attacked my head. Since there was no place to run and hide, it was frightening. It was like a Hitchcock movie. Later the station director told me that if one carries a long pole they will attack just the tip of the pole so it is safe for the person, and that if you approach from below the cliff you can see them up close without being attacked; but I did not feel like risking another attack.

A bit removed from the cliffs, one is in the area occupied by the wild ducks. They were also laying eggs, but were more peaceful than the sea gulls. They had nests on the rocks and the females guarded the eggs closely. The female wild ducks are well camouflaged so that it is hard to tell them apart from the surrounding rocks. In striking contrast, the male birds are large and stand out. When I approached a female wild duck that was sitting on her eggs, she did not move in the slightest, and sat on her eggs. However, when I approached very close, she suddenly flew away, startling me. Three large pale green eggs remained in the nest. I suspect that the female wild duck was trying to attract attention to herself in a desperate attempt to distract the perceived enemy from the eggs. I had second thoughts about interfering with egg laying.

The work at the Meteorological Station was pleasant. Electricity was generated by the station's own generator, but the supply was very stable. Breakfast was at 8 a.m., lunch at 12 noon and dinner at 6 p.m., but since work goes for 24 hours, snacks and drinks are always left out in the dinning room. The time difference between Bear Island and Japan is 7 hours in summer. Since there is no town where one can go shopping, it is possible to live on Japan time. After dinner I talked with crew members for a while. Since wine was served with dinner, I felt sleepy and went to bed at 8 p.m. due to alcohol and jet lag, even though it was a bit early. I woke up at 1 or 2 a.m. and start to work. Since it was mid-night sun, and I did my work in the

Fig. 3

helicopter hangar and the upper air station, a long way from the living quarters, with no one normally around, I could work smoothly at my own pace without worrying about the time. Of course when I need something from the Meteorological Station, I asked for it during daytime hours.

Supplies were transported from the Norwegian mainland to the island by the Norwegian Coast Guard. There is an agreement with the Meteorological Station according to which the Coast Guard is fully responsible for the station's transport. When I shipped our supplies to the island, it was on board the Lance, which has appeared in the pages of this Newsletter before; the return was on the Nordkapp. It was in June, when the island's barge was still frozen into the ice and could not be used, so transport from the station to the ship was by helicopter (Fig. 4). Considering the cost, transportation by helicopter would be inconceivable in Japan. What was also surprising was the level of activity of the female crew members. The female helicopter engineer expertly loaded the supplies onto the helicopter. I could only marvel at the female crew member's work.

Fig. 4

Siberian Snow Accumulation Survey

FUKASAWA Tatsuya (Graduate School of Engineering, Hokkaido University)

This was my first Siberian snow accumulation survey. It was also the first time that I went into the field with primary responsibility for a survey. On March 10, 2001, 3 of us -- Yoshiyuki Fujii, Director of the Arctic Environment Research Center, National Institute of Polar Research; Naoyuki Kurita, a doctoral candidate at graduate school of environmental earth science, Hokkaido University; and myself, took off from Narita Airport in an Aeroflot plane. Our mission was to conduct a survey of snow accumulation. We took 6 nights and 7 days to travel the 1,500km from Yakutsk to Magadan. Our plan was to observe the layer structure of the accumulated snow, measure the snow density and take snow samples about every 100km. After return to Japan, the snow samples would be analyzed for chemical composition, heavy metal composition, oxygen isotopes and so on to clarify the amount of pollutants deposited and the origin of water vapor. Another important objective was to take samples at several locations removed from the road to study the effect of the road. We were accompanied by V.N. Makarov of the Yakutsk Permafrost Research Institute, Russian Academy of Sciences; our driver Sasha; and our mechanic Misha. Prof. Fujii traveled separately from Yakutsk to St. Petersburg to attend a conference.

On the morning we left Yakutsk, as we waited in front of our hotel the vehicle that appeared in front of us was a truck, several years old and outfitted with summer tires. The cabin was painted orange to distinguish it from a military truck. That was the cabin in which Kurita and I spent the next 6 days. We loaded our supplies, bid farewell to Fujii and finally got under way at 7a.m. on March 14, 2001, 1 day later than planned.

Immediately after leaving the city we crossed the frozen Lena River, then drove on a frozen tributary. Occasionally the driver slammed on the brakes to stop before a bit of thin ice, then backed up to avoid it, but in any case we safely reached the first observation point at 5p.m. Kurita and I prepared our equipment and headed to take the first sample. The temperature was -12.3 degrees C, and the sun was low in the sky. The snow was 30cm deep, with 1cm of fresh snow on the surface. Below it were layers of solid-type depth hoar and depth hoar, while the bottom layer, more than 10cm thick, has granular snow crystals of grain size 5 to 10mm. I was very excited to see granular snow crystals for the first time. Soon the sun started to set. We rushed to take our samples and finished all of our work just as the sun finished setting at 6:30.

I thought that we were through for the day and was about to relax when the truck started off for the next observation point. It was 11p.m. before we arrived at our camp site. By then the temperature had dropped to almost -30 degrees C. In our little cabin we had a welcoming party with a dinner of soup, bread and vodka. Since it was late at night, we drank only a little bit of vodka and climbed into our sleeping bags.

The next morning, although still a wee bit groggy from the vodka, we started our activity with the sunrise. After taking the first samples of the day we returned to the truck for breakfast. We drove to the next point 100km away and took more samples, then after lunch drove to the next point another 100km away and took still more samples, then repeated the process yet another time, driving another 100km and taking more samples. Naturally, we arrived late at night and had only a light evening meal. We went to sleep and got up to start sampling early in the morning again, repeating the pattern that would be with us the rest of the trip.

The 4th day, to test the effect of the road we did sampling at points 200m (our normal sampling point), 1km, 5km and 10km from the road along a track perpendicular to the road. We conducted reconnaissance at a number of points but decided that those points were not suitable, and wound up doing it at a location which we had guessed would be suitable from looking at a map. To confirm that there were no sources of pollutant discharge away from the road, we first drove to the farthest point from the road, measured the distance to that point with the vehicle's odometer, did our sampling there and then returned. We completed our sampling at 10km, 5km and 1km, then started to drive toward the 200m point. When we did, we suddenly came upon the road. The distance was 200m. That would seem to indicate that we had skipped the sampling at the 1km point. It seems that what I had been confirming visually was distance at an angle to the road. In addition, it seems that error had crept into the trip meter, perhaps because of snow and the poor road. In panic I asked Dr. Makarov to return, but he was not very understanding, and we started to develop a mutual dislike for one another. Be that as it may, unless we returned I could not do the sampling correctly. I persisted, and eventually Dr. Makarov gave in and we were able to finish the sampling. After that, as if to make up for the lost time we drove straight to the next point, and camped.

Along the way we had engine trouble when a spark plug became wet with fuel and would no longer spark, ran out of drinking water and ran out of bread, but but in the end we made it to Magadan safely. For the first time in a while, we saw city streets and the ocean again. We took our last samples within the city to end the survey. The total distance we had driven was about 2,000km. The last night we had a farewell party in the hotel. We traveled from Magadan to Vladivostok the next morning, and arrived back in Japan March 22.

Every day we started sampling with the sunrise and finished sampling when the sun set. The rest of the time was devoted to moving from place to place, in what amounted to a death march. The temperature plunged rapidly as soon as the sun set, dipping below -30 degrees C. Considering age, I expect that Dr. Makarov and the other Russians had it a good deal rougher than we did. The number of days was less than originally planned, the distance covered longer and the amount of snow greater. It is primarily because of the support of Dr. Makarov and the other Russians that we were nevertheless able to complete our work successfully. We returned to Japan and to our normal research routines, but while analyzing the samples along with our students, we thought back to the field work and felt a sense of thanks for the help that we received.

Finally, I wish to thank Prof. Fujii of the National Institute of Polar Research, who suggested that I take part in this research, and Mr. Kurita of the Graduate School of Environmental Earth Science, Hokkaido University, who shared the field work with me.

Superconducting Gravimeter Observations at Ny-Ålesund in the Arctic

FUKUDA Yoichi (Graduate School of Science, Kyoto University)

After leaving Amsterdam, I changed planes at Oslo and Tromsø, and arrived at Longyearbyen at 1:30a.m., under the midnight sun. I was scheduled to take a charter flight to Ny-Ålesund the next morning, but that day it was foggy and the flight was canceled, so I arrived one day late. Looking down on the base from the airstrip, which is on a plateau, the ground was completely covered with snow except for roads which had been plowed, forming a beautiful contrast with the blue ocean in which some sea ice was still present. This was in May 2000, when I visited Ny-Ålesund to do maintenance work on the superconducting gravimeter and continue the observations.

The superconducting gravimeter observations are being conducted at Ny-Ålesund, which forms the 7th observation point of GGP (Global Geodynamics Projects)-Japan. These observations were started in September 1999 by Tadahiro Sato of National Astronomical Observatory, with assistance from the OHP (Ocean Hemisphere Project). A detailed explanation of the superconducting gravimeter observations and the GGP appeared in Japanese in a special issue of Gekkan Chikyu (Earth Monthly), published by Kaiyo Shuppan, titled "Superconducting Gravimeter Network" (Vol. 242, 1999), and a related paper appeared in EOS (Vol. 80, No. 11, 1999). Details of the superconducting gravimeter observations at Ny-Ålesund were published by Nawa et al (Gekkan Chikyu, Vol. 259, 33-39). These papers explain the purpose of the superconducting gravimeter observations, recent results, and the process by which the observations at Ny-Ålesund came to be undertaken and their present status.

What most people think of when they hear the word "gravimeter" is a portable type gravimeter such as the Lacoste gravimeter. These are used mostly in outdoor surveys to determine the underground density structures. There are also a number of other reasons why one might want to measure gravity, and several types of gravimeters for those different purposes. The superconducting gravimeter introduced here is a permanently installed type relative gravimeter which cannot be moved easily and is used to study changes of gravity over time at a single location.

There are several reasons why gravity varies with time; the variations of largest amplitude are caused by earth tides. "Earth tides" is a generic term for changes in the earth's gravitational potential and shape caused by the gravitational attraction of the sun and moon, similar to the ebb and flow of the ocean tide. In particular, the variation of gravity is called the gravity tide. Since the motions of heavenly bodies which cause the gravitational attraction (input signals) are known very accurately, tidal observations aim to observe the earth's response (output signals) in order to determine the elastic and viscous properties of the earth's interior. This is one of the most important purposes of observations using a permanently installed relative gravimeter.

The spring type gravimeters which were used before superconducting gravimeters came into general use toward the end of the 1980s were barely adequate to determine the δ-factor (ratio between gravity variations of a rigid earth and an elastic earth, an index of the earth's elasticity) of the large amplitude diurnal and semidiurnal tides (the principal tidal components). This situation changed greatly with the introduction of the superconducting gravimeter, which provides both high sensitivity (detection accuracy of 1ngal = 1×10^{-11} m/s^2 or better) and long term stability (mechanical drift on the order of several microgals per year). Recent gravitational tide observations encompass a greatly expanded range of research objectives including research on the latitudinal dependence of the δ-factor, determination of the earth's interior viscosity from phase displacement and research on core - mantle coupling from fluid core resonance that occurs in the diurnal tide.

From the point of view of acceleration measurement, vertical accelerations due to gravity and to seismic movements differ only in frequency, so the superconducting gravimeter, which can measure over a wide range of frequencies, can also be used as a highly sensitive seismometer for measuring long period vertical seismic accelerations. A well known example of recent research using this possibility is the discovery of the incessant excitation of the Earth's free oscillations (Nawa et al, PEPI, 120, 289-297, 2000). It now appears the Earth's free oscillations, which it had been believed were only excited by large earthquakes, are present constantly, probably excited by atmospheric motions. This is considered one of the most important discoveries of earth science in the 1990s. The opportunity for this discovery was created by observations with the superconducting gravimeter at Syowa Station in Antarctica.

Photo:
The superconducting gravimeter with replenishment of liquid helium in progress. From left are the gravimeter control unit, the superconducting gravimeter main unit, the liquid helium transport Dewar tank and the personal computer used for data logging. Outside of the observation room there is additional equipment including a freezer compressor and a chiller used to cool the compressor.

Meanwhile, the long term stability of the superconducting gravimeter is being exploited to do important research on long term gravity variations. This includes not only the study of long period tides with periods of 14 days (Mf) and more, but also gravity variations accompanying polar motions (the vertical component of centrifugal force variation accompanying instantaneous perturbations of the earth's rotation axis), which had been previously known theoretically but were virtually impossible to observe. With the superconducting gravimeter they are observed as a matter of course. In addition, although at present this involves only the annual term, gravity variations caused by changes of mass that accompany oceanic motions are being observed by the superconducting gravimeters at Syowa Station, in Australia and at Esashi in Japan (Sato et al, PEPI, 123, 45-63, 2001). This is the first time in history that gravity observations on the ground have observed long period oceanic variability other than tidal motions.

The concept of monitoring fluid motions on the earth's surface, including motions in the atmosphere, ocean, ground water and ice sheets, by monitoring variations of gravity is the basic concept behind satellite gravity missions that are expected to bring about a revolution in earth science in the 21st century, starting with the GRACE satellite that was launched in March 2002. The significance of having demonstrated that concept by ground based observations is very great.

Thus, superconducting gravimeter observations have added precision to Earth tide observations, and, at the same time, provided a number of other results that could not have been foreseen until now. The purpose of GGP is to promote further progress in this research through international cooperation. In addition, GGP-Japan maintains the observation points that have been established by Japan and serves as a point of contact for Japanese researchers for the purpose of data exchange. Ny-Ålesund is GGP-Japan's 7th observation point, after Syowa Station, Canberra (Australia), Bandung (Indonesia), Kyoto, Matsushiro and Esashi. In the past, superconducting gravimeter observation points were concentrated in mid-latitudes of the Northern Hemisphere, in Europe, Japan and North America, but in research on global scale phenomena, especially those that are latitude dependent, it is clear that it is indispensable to have a north-south distribution of observation points. From this point of view, researchers from Japanese institutions, principally the National Institute of Polar Research, started observations at Syowa Station in 1992-1993. Subsequently, observation points were established at Canberra and Bandung. With the establishment of the observation point at Ny-Ålesund, the latitudinal coverage of the network of points is complete. It is a pleasure to note that, stimulated by this Japanese activity (GGP-Japan maintains 1/3 of all of GGP's observation points), other countries have established or are planning new observation points in South Africa and South America.

Thus, the superconducting gravity observations at Ny-Ålesund form one link in a worldwide network, and, at the same time, are coordinated with observations at Syowa Station, in the opposite polar region. It is hoped that data from the two stations can be combined to detect translation movements of the Earth's core and gravity changes that accompany internal gravity waves in the fluid core. If these attempts are successful, the result could be one of the first great discoveries of the 21st century. In addition, from the geographical location of Ny-Ålesund, detection of secular gravity changes that accompany post - glacial rebound can also be expected. For this purpose, it is not sufficient to only measure gravity; it is important to make comprehensive observations, including accurate observations of position changes using a space surveying technology such as VLBI or GPS, and surface tide observations on - site. Syowa Station is one of the observation points where all of these observations are being made, and the Ny-Ålesund base also satisfies these conditions.

To detect secular gravity changes it is also important to make absolute gravity observations. In Ny-Ålesund, with the research cooperation of GGP, in the summer of 2000 a French researcher made absolute gravity observations, which were followed by similar observations by a German researcher in August 2001. It is perhaps necessary for Japan to also make efforts toward conducting continuing absolute gravity observations both at Syowa Station and Ny-Ålesund.

These are the dreams and expectations created by superconducting gravimeter observations. It is also a fact that continuing such observations can become troublesome. One of the most important operations in maintaining the superconducting gravimeter is replenishing liquid helium to maintain the ultra low temperature (see Photo). Japanese scientists say that they are "feeding" the gravimeter. When done in Japan, this is normally done by a group of at least 2 people, but while I was in Ny-Ålesund I was the only one from Japan there, so I first showed a video of the operation to researchers from the Norwegian cartographic office who were to help me (there are 3 people in residence to conduct VLBI observations, etc.) so that they would know what to do. They were very capable people, and immediately understood the operation. Mr. Herge, the one who actually helped me, was a fairly tall man (I am not exactly short for a Japanese) and was able to check the liquid helium level without using a stand, whereas I would need a stand. He was also able to remove a fairly heavy cooler called the cold head from the gravimeter main unit without difficulty. I realized that being big can be an advantage in such a situation, and my own job was made much easier as a result. Thanks to Mr. Herge and his coworkers, a series of operations starting with the liquid helium replenishment and including the installation of a new thermometer, moving of the cooler and other planned work went smoothly, leaving time for Mr. Herge and his coworkers to invite me out for a snowmobile tour on Sunday afternoon.

The one week went by quickly. Monday morning, I secretly hoped that it would get foggy to delay the arrival of the plane that was to take me back to noisy Japan, but unfortunately the plane was already waiting for me on the runway immediately in front of the gravimeter laboratory.

Finally, I would like to express my thanks to Dr. Shinji Morimoto of the Arctic Environment Research Center, National Institute of Polar Research, who helped greatly with my arrangements for lodging in Ny-Ålesund and Longyearbyen, and reservations for the charter aircraft.

Water relations of *Sanionia uncinata* moss
- Terrestrial Biology Research at Ny-Ålesund

UENO Takeshi (The Graduate University for Advanced Studies)

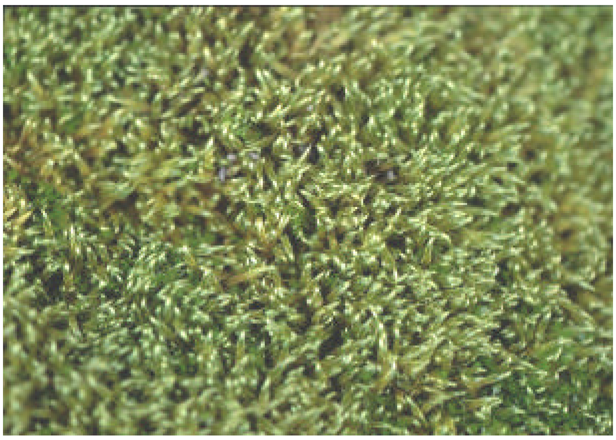


Photo 1:
***Sanionia uncinata*. On dry ground this moss forms a dense colony, while on wet ground it forms more spaced - out colonies. This photo is of a colony on dry ground.**

In high latitudes of the Arctic, the most important factor determining the distribution of plants is the water availability during the growing period. In the deglaciated area of Austre Brøgger Glacier near Ny-Ålesund, topographical conditions create a variety of moisture environments, and it is easy to observe the plant distribution pattern along water gradients.

Since mosses do not have roots to absorb moisture from the soil, they can live on severely dry, rocky soil where other plants cannot put down roots. In Ny-Ålesund, mosses are the terrestrial plants that grow in the driest ground.

Mosses can withstand desiccation by becoming dormant. They are capable of restoring physiological activity quickly once water is absorbed. This does not mean that all mosses grow in dry ground. There are species that are only capable of growing in wetlands. What causes this difference in distribution? It is believed that one factor is a difference in physiological

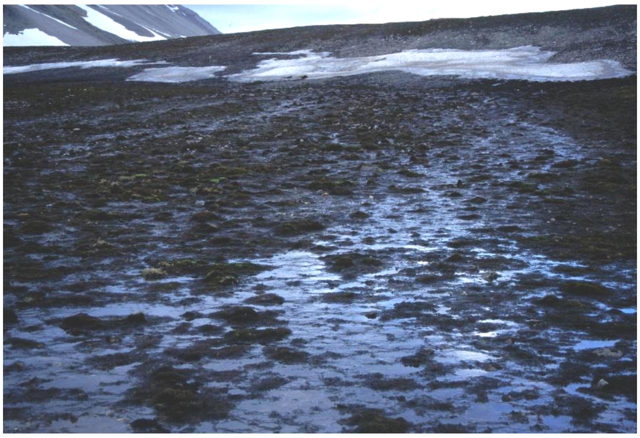


Photo 2:
Wet ground. This is at the base of a small hill. For at least one month while snow melt water is being supplied much of the ground surface here is covered by water.

response to dehydration.

One method of discovering a difference in physiological response to dehydration to compare water relations. Water relations of mosses include the relationship between relative water content and water potential, the water potential at which turgor pressure is lost, and the osmotic potential when adequate water has been absorbed (full turgor pressure). However, in the high latitude Arctic there are no previous reports on measurements of these characteristics. Therefore, we decided to measure the water potentials of mosses growing in different water environments around Ny-Ålesund, and determine their water relations. The measurements were performed on *Sanionia uncinata* (Photo 1). This moss grows in a wide variety of water environments around Ny-Ålesund, from wetlands (Photo 2) to dry ground (Photo 3), so it is a very convenient moss on which to compare the water relations of mosses growing in different water environments. Let us now discuss the water relations of *Sanionia uncinata* growing in wet ground and in dry ground.

First, let us discuss the relation between relative water content and water potential. In the type of *Sanionia uncinata* that grows in dry ground (referred to as the D-type below), the water potential decreases rapidly as the relative water content decreases. On the other hand, in the type of *Sanionia uncinata* that grows in wet ground (referred to as the W-type below), the water potential decreases more gradually as the relative water content decreases. This difference reflects a difference in the increase of absorption capacity with loss of water. It is believed that compared to the W-type, the absorption capacity of the D-type increases rapidly as water is lost.

Next, let us discuss the water potential when turgor pressure is lost, and the osmotic potential when adequate water has been absorbed. In most plants, the lower the water potential when turgor pressure is lost the easier it is to maintain turgor pressure when dehydration occurs; this value is affected by the osmotic potential when adequate water has been absorbed. Compared to the W-type, the D-type has a lower value of water potential when turgor pressure is lost, and the osmotic potential when adequate water as been absorbed is also lower. It is believed that the D-type is more resistant to drying than the W-type.

The 2000 field survey in Ny-Ålesund was conducted in a stressful situation. There was no end of reports of polar bear sightings in the center of town and near the airstrip, and a polar bear warning was issued. For this reason, it was necessary to assemble a party to go out into the field. This was so that one person could always be on watch (when observing small plants one's face is just above the ground and it is impossible to watch what is going on around you). We all carried rifles, but if you are attacked before you can pull the trigger, it is all over. There is always danger in field surveys conducted in nature, but when you are in a place like Ny-Ålesund with all kinds of facilities, it is easy to forget about the danger. Ny-Ålesund presents a peaceful ambience, where grazing reindeer can be often sighted, this experience reminded us that in Ny-Ålesund we are treading into severe nature.

Photo 3:
Dry ground. This is on top of a small hill. Since the principal source of water here is rain, the ground is alternately wet and dry depending on the weather. Patterned ground is well developed here; *Sanionia uncinata* grows in the spaces between polygon and polygon.

ALIS, Aurora and Artificial Airglow

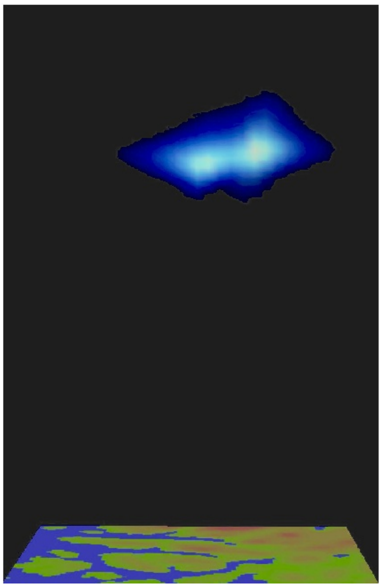
Björn Gustavsson (National Institute of Polar Research)

The main topic in my PhD work in Kiruna Sweden focused on multi-station imaging of aurora and artificial airglow and this work is something that I continue as a COE post doc here at NIPR.

The multi-station imaging data used is obtained from the Auroral Large Imaging System (ALIS) — a ground-based optical system for measuring the aurora, high-altitude clouds, and other atmospheric optical signatures at high latitude. It is composed of a grid of stations with approximately 50 km separation and consists currently (summer 2000) of six stations equipped with CCD-cameras with 60° field of view and interference filters that make it possible to make images in narrow wavelength regions around the most prominent emission lines from the upper atmosphere.

The main difference between the studies of aurora and artificial airglow is that for the later we cause the emission. For studies with ALIS this is done with the EISCAT Heating facility in Ramfjordmoen Tromsø, that transmits a radio wave with frequencies between 4.04 and 7 MHz. The transmitted energy (100-200 MW effective radiative power) is absorbed in the ionospheric Fregion at 200-300 km of altitude, this heats the electrons to temperatures as high as 3000 K, compared to typical quiet night time temperatures of 1000 K, and creates accelerated electrons. Some the energetic electrons excite the ambient atomic oxygen to the low-lying states (O(D),O(S)), that emits the "auroral red line" at 630.0 nm and the "auroral green line" at 557.7nm respectively.

The multi-station imaging makes it possible to determine the three dimensional distribution of the photon emission which enables a distinction to be made between the hori- zontal distribution and the altitude variation of emission.



During radio wave heating experiments the combined measurements from the other instruments in the region, e.g. electron concentration, electron and ion temperature measurements with the EISCAT incoherent scatter radars and the three dimensional distributions of the O(D) 6300 Å emission with 10 second time resolution make it possible to test the ionosphere-thermosphere models and the theories of the radio wave plasma interaction. The figure shows a volume rendering, that is a "three-dimensional image", of airglow caused by the EISCAT Heating facility in Tromsø. This is how you would see the airglow if you had hundred times more sensitive eyes and were at 260 km of altitude 300 km west of Tromsø looking eastward. The airglow cloud is at 240 km of altitude and the two regions are approximately 30 km in diameter.

EDITOR'S NOTE

The Arctic Environment Research Center of the National Institute of Polar Research, Japan, has been 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. 7, incorporates our Arctic research plan in 2002, and numbers 14 and 15 of the domestic bulletin, which includes news of potential interest and/or novelty to international readers. Contributions are welcome and should be addressed to:

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