

National Institute of Polar Research

AERC

Arctic Environment Research Center
NEWSLETTER

DIGEST

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VOL. 3

*Arctic Researches
on going...*

Arctic Airborne Measurement Program '98
North Greenland Ice-core Project
International North Water Polynya Study
Japanese Arctic Glaciological Expedition
Ecosystem Change at the Glacier-edge Areas

♣ Greetings from the New Center Director ♣

Yoshiyuki Fujii

On April 1, 1997, I became Director of the Arctic Environment Research Center. This was the Center's 8th year. In this time the Center has come to play an important role in Japan's Arctic environmental research. The Center has also earned a strong international reputation through its participation in the International Cooperative Research Project on Arctic Environment, a 5-year project now in its 3rd year, and through participation in such groups as the International Arctic Scientific Committee (IASC).

In April of 1997, we exchanged written agreements providing for scientific exchanges and cooperative research between the National Institute of Polar Research and the Research Institute of Mathematical and Physical Sciences of the University of Tromsø, Norway, and the Norwegian Polar Research Institute, increasing the number of superimposed levels of international cooperation in Arctic research. Already this year we have been proceeding with plans for participating in the international North Water polynya study (NOW) with Canada; in the North Greenland Ice Core Project (NGRIP) with several European countries; joint ice core drilling with Norway on Nordaustlandet, in the Svalbard archipelago; and a study of the ecology around a glacier terminus (ITEX).

In particular, the plan for aircraft observations, centering on atmospheric sciences, will be the first full-scale research project involving aircraft in the Arctic, and important accomplishments can be expected.

Thus, with the understanding and cooperation of everyone concerned, Arctic environmental research is steadily advancing. In the future, for better understanding of global scale environmental fluctuations, comparative research with the Antarctic and interdisciplinary studies are going to become increasingly important, and I hope to strengthen our cooperative research both domestically and internationally. I ask for the guidance and assistance of everyone concerned in this effort.

♣ 1997 Plans for the 3rd Year of the International Cooperative Research Project on Arctic Environment ♣

An Outline of the Research Plans of 4 Groups:

Atmospheric Environment, Glaciology, Terrestrial Environment and Cold Water Oceanography

♣ Atmospheric Environment Research Group

Main programs are continuation of already underway year-round monitoring of trace constituents related to atmospheric environment fluctuations (aerosols, carbon dioxide, ozone, methane, water vapor, clouds, precipitation, etc.); and aircraft observations (in March) to determine the spatial distributions of aerosols and gaseous constituents of the Arctic atmosphere. A variety of ground-based observations are to be carried out in conjunction with the aircraft observations.

Already underway observations at Ny-Ålesund by cooperation of the National Institute of Polar Research and other groups including Tohoku University include monitoring of trace constituents (carbon dioxide, methane, ground level ozone, etc.) and observations of precipitating clouds; and lidar observations by the

Solar Terrestrial Environment Laboratory, Nagoya University of Arctic stratospheric clouds in winter. Other ongoing observations to be continued include snowfall observations, water vapor observations, aerosol observations by OPC (Optical Particle Counter), and optical ozonesonde observations by high altitude balloons. Additional observations are planned to be carried out in conjunction with the aircraft observations during the coming year. These include microwave radiometer observations of integrated liquid water content and precipitable water, observations of cloud base temperatures by infrared radiation thermometer, observations of precipitation, fallen particle types (rain, snow, groupel etc.) and fallen particle size distribution, observation of optical thickness of cloud and/or aerosol by aureolemeter and observations of

aerosol particle size distribution by particle counter. The Solar Terrestrial Environment Laboratory, Nagoya University plans to collect aerosols at ground level from winter through spring. In addition, a Hokkaido University group plans aerosol observations in the Yakutsk and Tiksi regions; while another Hokkaido University group plans to observe winter snowfall, water vapor and aerosols in Kiruna. During the period of observations in Kiruna, similar observations will be carried out at Ny-Ålesund.

✿ Glaciological Research Group

<Research objectives>

In clarifying climatic systems, international cooperative research is important, and simultaneous observations in both the north and south polar regions are necessary. This is the background to the present research plan. Against this background has emerged cooperation between the International Arctic Scientific Committee (IASC) and the Scientific Committee for Antarctic Research (SCAR). In particular, the Ice core Circum-Arctic Paleoclimate Programme (ICAPP) was proposed for the purpose of clarifying the present state and mechanism of occurrence in the Arctic of global - scale climatic fluctuations.

In contrast to the Antarctic, the Arctic cryosphere has a complicated climatic system reflecting the distribution of land and water areas. In the past several years, ice cores have been obtained in Norway, Greenland and the Svalbard archipelago, and used to recreate the climate and environmental fluctuations of the past several hundred to thousand years; and a number of important results have been obtained. The present international cooperative program seeks to extend this research all around the Arctic to determine environmental conditions in the Arctic cryosphere and their changes, and obtain overall clarification of the sources and transport processes of various substances that contribute to environmental fluctuations.

<Research Plan in 1997>

(i) North GRIP (May to July):

We will participate in the North Greenland Ice Core Project (NGRIP) and cooperate in deep ice core drilling and processing in the northern ice sheet summit area, 500km north of the Greenland summit (2nd year of a 5-year project).

(ii) Ice core drilling on Nordaustlandet, Svalbard : Preliminary observations will be conducted on Nordaustlandet, Svalbard, in July. At the same time, glaciological observations such as aerosol, pit observations will be carried out. In March 1998, ice core drilling will be conducted on the same ice cap in cooperation with Norwegian researchers.

(iii) Glaciological survey at summit of Akademia Nauka Glacier (ICAPP):

A glaciological survey will be conducted at the summit of the Akademia Nauka ice cap in the Arctic, and the environment in the area will be surveyed.

(iv) Observations at Ny-Ålesund Base:

Observations of fluctuations of atmospheric aerosols will be continued throughout the year. Concentrated observations, including collection of samples of freshly fallen snow, will be carried out in July and March. In addition, Snow layer observations will be carried out to study the process by which substances that fall from the sky become fixed in the snow pack.

(v) Glaciological research on the Penny ice cap in the Canadian Arctic:

Results of analysis of an ice core obtained in 1996 will be discussed at the Canadian Geological Survey; and information about the environment at the observation point will be collected.

(vi) Snow survey in eastern Siberia:

Glaciological observations will be carried out over a wide area in eastern Siberia; and mutual interactions between fluctuations of the Siberian High and the surface cryosphere will be studied.

✿ Terrestrial Environment Research Group

The planned surveys and observations of the international cooperative research program "Ecosystem change at the glacier edge areas in the Arctic", carried out at Ny-Ålesund, Svalbard, for 3 years starting in 1994, have been completed. For 2 years starting in 1997, the following observations are to be carried out based on the results of observations thus far, with emphasis on monitoring of an Arctic ecosystem.

i) Experiment on the soil environment and the response of vegetation:

Until now a preliminary experiment has been conducted for 3 years in an OTC (Open Top Chamber) on the lateral moraine of the Austre Brøgger Glacier. The experiment has included a

chamber material test, test of the ability of the instruments to withstand cold and water, response of the vegetation to fluctuations in the soil environment, and transplantation test. Based on these results, from the current year we will start observations at 3 points in the middle of the moraine, using a new chamber for testing the greenhouse effect. At observation points 1 and 2 on the new moraine, we will measure soil moisture, soil decomposition, nutrients and ground temperature; and survey the distributions of soil bacteria, animals, algae, lichens, mosses and flowering plants. At observation point 3 on the old moraine, a phenology survey will be conducted with emphasis on *Dryas octopetala*.

ii) Survey of algal distribution in the glaciated area:

The survey of distribution of algae, particularly diatoms, in the river area that was carried out last year gave the interesting result that the diatoms can be classified into 2 groups, those the distributions of which originate from glaciers and those the distributions of which originate from lakes and swamps. This is also important for the

study of the ecosystem around the glacier terminus, and the survey will be continued this year.

❖ Cold Water Oceanography Research Group

There are hypotheses that absorption of greenhouse gases through chemical and biological activity in cold polar oceans serves as a global sink; and that sea ice causes major fluctuations in the energy budget and in the exchange of greenhouse gases between the atmosphere and the ocean. To clarify these mutual interactions between global environmental fluctuations and the cold ocean, we are participating in cruises and conducting oceanographic observations.

In the international North Water polynya study (NOW) starting 1997, in which Canada is playing the lead role, we plan to participate in cruises in 1997 through 1999, and will attempt to obtain observational and experimental data relevant to energy and material exchanges, and biological activity, in the cold water region of mixed sea ice and open water.

❖❖ Research Reports ❖❖

❖ The Arctic Airborne Measurement

Program '98 (AAMP98)

by Masataka Shiobara

Center for Antarctic Environment Monitoring,

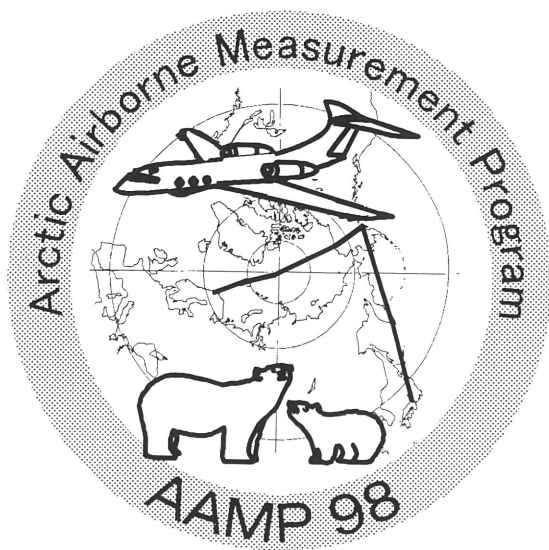
National Institute of Polar Research

The Arctic Environment Research Center is preparing for this year's Arctic Airborne Measurement Program '98 as an international cooperative Arctic environmental research project. The name was deliberately chosen to be rather generalized in order to preserve flexibility in the future content of the research, but this year's plan centers on atmospheric observations. The aircraft will carry instruments for measuring atmospheric trace gases, aerosols and cloud particles, and sampling devices; the instruments belong to Hokkaido University Graduate School of Science, Hokkaido University Graduate School of Engineering, Tohoku University Center for Atmospheric and Oceanic Studies, Miyagi University of Education, Nagoya University Solar Terrestrial Environment Laboratory, National Institute for Environmental Studies, and National Institute of Polar Research (NIPR).

The following are the research objectives of AAMP98:

- 1) To clarify the spatial distribution and fluctuations of trace gases.
- 2) To clarify the long - range transport and transformation processes of tropospheric aerosols.
- 3) To clarify the spatial distribution of tropospheric aerosols, and the radiation effect.
- 4) To clarify the structure of atmospheric disturbance and cloud microphysical processes.

In the material circulation in the polar troposphere and stratosphere, the polar vortex plays an important role. This observation program will focus on the role of the polar vortex in the transport and exchange of matter and chemical processes. Aircraft observations will be conducted over a wide area in the first half of March, which is generally when the polar vortex breaks down. For this reason, there will be long - range round trip flights along the track, Nagoya - Barrow - North Pole - Spitsbergen, and vertical profile observations above Barrow and Spitsbergen. The observations along the path from Alaska over the North Pole to the Atlantic



are not only the first for Japan, but are at best rare worldwide. The data obtained will be extremely valuable, and we will work hard for success.

At the same time as the flights, the ground observations at Ny-Alesund, Svalbard will be strengthened, with participation from Tohoku University, Nagoya University, Osaka Kyoiku University and NIPR. The aircraft observations will provide a check on ground-based remote sensing and balloon-borne observations. At the same time, the ground-based observations will be essential for interpretation of the aircraft observations and to permit comparison of simultaneous observations. For this reason, we plan cooperation with the Norwegian Polar Institute, the Norwegian Institute for Air Research, and the Alfred Wegener Institute for Polar and Marine Research in Germany.

The project office for AAMP98 is in the NIPR Arctic Environment Research Center. The overall project director is Yoshiyuki Fujii, Head of the Arctic Environment Research Center. Masataka Shiobara and Makoto Wada are in charge of the aircraft observations and the ground-based observations, respectively. The research plans are available from the project office in both Japanese and English; and also at <http://caem21.nipr.ac.jp/AAMP98.htm>.

♣ NGRIP Research Report

by Makoto Igarashi

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The North Greenland Ice Core Project (NGRIP), an international cooperative effort at 75.1 degrees N, 42.3 degrees W, elevation about 2,918m, ice thickness 3,090m, on the ice divide running north

from the summit of the Greenland ice sheet, is a 5-year project, running from 1995 to 2000. The central role in this project is being played by the Niels Bohr Astrogeophysical Research Institute at the University of Copenhagen in Denmark. Countries that are involved include Japan, Germany, France, Iceland, Switzerland, Belgium, Sweden and the United States. The current year is the 3rd year of the project.

I participated in the in-situ ice core processing for about one month, from May 21 to June 27. Other 6 Japanese participate in this project as core processors and drillers.

There have been 2 previous deep ice core drilling projects in the central part of the Greenland ice sheet, called GRIP and GISP2, and they succeeded in obtaining cores dating back to the Eemian Interglacial. Analysis of the stable oxygen isotopes in these cores revealed evidence of major short - term air temperature fluctuations during the Eemian Interglacial rivaling the Dansgaard - Oeschger Event during the Wisconsin Glacial (Dansgaard, 1993). These results indicate climates that were greatly different from the very stable climate of Holocene. However, from results of physical analysis of these 2 ice cores, it is possible that this evidence, indicating major short - term air temperature fluctuations during the Eemian Interglacial, really stems from disruption of the ice layers. This disruption could have occurred because the ice layers that date from the early and middle Eemian are only a few hundred meters above the bedrock (Johnsen, 1995). Consequently, the main objective of the present project is to obtain ice cores dating from the Eemian Interglacial from a location where they could not have been easily affected by the bedrock, so that we can confirm whether or not these short-term air temperature fluctuations are real. In order to resolve this problem, it was decided to drill at the NGRIP site where it is believed that the amount of annual accumulation is less than that at the summit of Greenland ice sheet, where GRIP and GISP2 were carried out.

This year's NGRIP camp opened on May 15, and all work was completed by August 4. This period of slightly less than 3 months was divided into the first half and the second half, with about 30 researchers staying at the camp as camp helpers during each half, so that a total of about 60

researchers were involved. There were 5 or 6 women in the camp at any one time. There were also cooks, mechanics and carpenters in the camp as helpers. Every day there were lavish meals that one would not expect to have in the middle of a large ice sheet, and the system was also set up to permit quick response to requests for repairs to scientific instruments.

The deep drilling started from 1995, when it reached 351.47m. This year the drilling picked up from where it left off last year, and reached 1371.80m by the end of the season. Except for the brittle zone from 680m to 1280m where the ice is brittle, the core was sliced on the spot to obtain samples for measurement of layer position, air bubbles, clathrates, etc. by DEP (Dielectric Profiling), Line Scanner, ECM (Electric Conductivity Measurement) and digital video. After the measurements were made, the sliced pieces of core were packed and shipped to Denmark. Some core samples were sent to Germany and Japan. Core samples from the brittle zone are being stored on site so that volume relaxation will occur; they will be sliced, and measurements made, next year.

At the camp, in addition to the deep drilling, shallow cores of depths 98.57m and 151.5m were taken. We were able to bring the entire 98.57m core back to Japan. Using this core, we are performing comprehensive chemical and physical analyses, and we plan to pursue cooperative research with overseas scientists. In addition, surface layer pit observations to a depth of about 5m were conducted by Japan and by an American - Danish team. The American - Danish team concentrated on measurements of the composition and stable oxygen isotopes of solid particles found in the snow pack; the Japanese plan to analyze the major chemical constituents.

♣ 1997 Research Cruise,

International North Water Polynya Study

by Yasuhiro Kashino

Department of Life Science, Faculty of Science,
Himeji Institute of Technology

The sun kept staying in the northern sky. It was my first experience with the midnight sun. As a participant in the international North Water polynya study (NOW), from August 18 to August 28, 1997, I boarded the Canadian icebreaker CCGS Louis S. St. Laurent in the polynya region of northern Baffin Bay. I aimed to determine the

light and temperature conditions in this polynya region, and to collect phytoplankton in order to determine what kinds of phytoplankton are involved in primary production, and how they acclimate to light. That icebreaker reached the North Pole in 1994; indeed, it is very stable and was comfortable to stay on. However, the broken-up sea ice sometimes collected around the intake port for the ship's cooling water, forming an air pocket, and the sea water supply for laboratory use from the cooling water was stopped. When that happened, I had to call the ship's engineers and had them restart it. Although it should be a troublesome operation for them, they accepted my request cheerfully, and accordingly, I was able to continue to collect phytoplankton by their helpful supports.

If I had been only in my research, I would have suffered from lack of exercise. Since the icebreaker was rather large, 120 m long and 25 m wide, it was possible to walk around the deck for exercise. But there was also a training gym inside the ship, with many people sweating through workouts during breaks in their research activity. I used to become one of them.

Even if with the midnight sun outside, the life followed a 24-hour cycle inside the ship. Large operations such as setting sediment traps were done during "daytime" hours as much as possible. Of course, meal hours were rigidly fixed. Additionally, from 9 to 10 p.m. was "bar hour", one of the little pleasures of life on the ship. I heard before boarding that liquor is prohibited in Canada's Northwest Territories. However, it is different on the water. Like the dining room, the bar was partitioned into areas for officers and petty officers. We researchers were usually able to use the officers' bar, but, since the petty officers helped us greatly in our research, sometimes we joined them in their area.

Since we spent days with our research almost all the day, and without newspapers or television, one might lose track of what day of the week it was. But, in fact, we always knew exactly what day it was. On Sunday, we had to wear a necktie to meals. It warmed my heart to see a graduate student ironing joyfully his shirt before a meal, and I came to understand the importance of tradition.

Major events during the cruise were two barbecue parties. They were scheduled to be held

on the helicopter deck, but, guess what, both times it snowed! I thought that they might be postponed. However, they were held as scheduled, especially inside the helicopter hangar after the helicopter was moved out. I usually heard that Europeans and Americans enjoy their parties, and it was a great pleasure that I recognized their strong decision to enjoy party. Then the last "night" of the cruise, we held a party of thanks to the ship's crew.

In mid-August, I stayed in Resolute for two days before the cruise. It was rather desolate, but here and there I could see moss basking in the rays of the summer sun. However, at the end of August, when I returned to Resolute again after the cruise, the airport was already blanketed in snow even though it was still the season of the midnight sun. In Edmonton on the way to Japan, I experienced my first real "night" in those days, with mixed feelings of deep emotion at the darkness and love of the sight of starry night.

✿ Ice Core Drilling on Nordaustlandet

by Kokichi Kamiyama,
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To clarify climatic and environmental fluctuations in the Arctic over the last several hundred years, the Japanese Arctic Glaciological Expedition (JAGE) has been drilling cores since 1987, in the Svalbard archipelago, mainland Norway and Greenland. In 1995, a 210m long ice core was drilled on the Vestfonna of Nordaustlandet, Svalbard archipelago, in cooperation with Russian and Norwegian researchers, as one link of the Ice-core Circum-Arctic Paleoclimate Programme (ICAPP), which is a cooperative research project of the International Arctic Scientific Committee (IASC) Glaciology Working Group. In 1998 drilling on the Austfonna is planned, mainly as a cooperative project between Japan and Norway.

This is part of a series of drillings surrounding the Arctic Ocean, to clarify the environmental fluctuations at the drilling sites so that they can be compared in order to analyze the climatic and environmental fluctuations over the whole Arctic region. Both polar regions play important roles in climatic fluctuations as "cold sources" for the earth. The Arctic region, one of these cold sources, is more complicated than the Antarctic region because of the proximity to human activity and

the more complicated distribution of land and ocean areas.

Northern Svalbard lies in the northernmost Atlantic Ocean where the sea ice coverage fluctuates greatly. Judging from analyses of ice cores, there has not been sufficient attention directed at fluctuations in the supply of water vapor to the Arctic region. In the 1980s Soviet researchers drilled all the way to the bedrock using a thermal drill, and part of their research results have been published in English. We are presently analyzing a core obtained in 1995, with particular emphasis on environmental fluctuations. By adding analysis results obtained from the Vestfonna, Asgordfonna and Greenland will contribute great progress to ICAPP. This work is already underway; with support from the Norsk Polarinstitut, fuel and some of the heavier scientific equipment were transported by ship and helicopter and cached on exposed rocks in the central part of Nordaustlandet last summer. We plan to perform some observations in spring of 1998, when the ice cover on the Arctic Ocean is still thick and the supply of water vapor to the atmosphere is small. Since the supply of water vapor to the atmosphere here is large, stable weather will contribute greatly to smooth execution of the plan.

✿ Terrestrial Biology Research at Ny-Ålesund, Summer 1997

by Naoya Wada
Biosphere Environment Science Department,
Faculty of Science, Toyama University

I spent about 10 days, in late July and early August, at the Japanese cooperative research base Rabben in Ny-Ålesund. It was my second summer in the Arctic. This time I went and came back alone. I was asked by Prof. Kanda of the National Institute of Polar Research to make a presentation in the "Svalbard Course: Science in the Arctic" that is held in Ny-Ålesund, so I was a bit uneasy as I headed for Norway.

When one does outdoor research in Ny-Ålesund, a rifle is necessary for protection against polar bears. The year before I had a problem obtaining one, but this time I arranged to borrow one from the shop ING. G. Paulsen in Longyearbyen. I reserved it before leaving Japan. The procedure was simple, and I was able to borrow the rifle without problems.

When I arrived in Ny-Ålesund by charter aircraft, I was greeted by a Santa Claus - like individual with thick white hair and a bright red down jacket. It was Dr. Ota, a Japanese who has worked at the Norsk Polarinstitut for many years. Last summer he was doing research in Ny-Ålesund with Michael and Barbara, German graduate students. We were at Rabben together, and Dr. Ota looked after me, from meals to liquor. I want to take this opportunity to thank him deeply for his help.

At the "Svalbard Course", scientists from each country presented their results to date and their plans. Most of the people who attended were managers of the various bases and Norwegian Government officials. Particularly noteworthy were the reports of large projects involving rocket - borne meteorological observations, and environmental monitoring.

I reported on the progress of the Japanese terrestrial biology project and my own research from the previous year (fluctuations in the factors limiting seed production by *Dryas octopetala* and in sexual expressions). My English was poor but I managed to throw a few jokes in and finish the presentation without incident. There were no Japanese in the audience but I declare the presentation to have been a success.

During my stay, I joined up with Prof. Kojima of Toyama University to assemble and install hexagonal chambers used in greenhouse

experiments, recovery of data loggers, sampling of glacial river water and measurement of its temperature, and survey of the number of flowers produced by *Dryas octopetala*. In the Arctic, where global warming is most pronounced, glaciers have started to melt; it is said that the water is affecting the terrestrial ecosystem as it flows down to the ocean. Ground that had been underneath the glaciers has become exposed, permafrost has started to melt; there is fear that greenhouse gases that have been trapped in plant life or the ground will escape to the atmosphere either directly or through biological activity, accelerating global warming. What can we researchers do about it? Perhaps it is necessary to combine long-range environmental monitoring with experiments which are manipulated to test hypotheses to clarify ecological changes in the Arctic. We also need to predict how global warming will affect our lives and perhaps our survival, and warn society. It appears that global warming is already a reality, and a number of countries are doing research on it. In this situation, I have the feeling that the significance of present Japanese Arctic research is being questioned. During my stay the weather was not very good, but I could see cute reindeer and beautiful rainbows. My 10 day stay in Ny-Ålesund was over all too quickly. Finally, I wish to thank the people who helped me in my research.

EDITOR'S NOTE

In 1995 the Arctic Environment Research Center of the National Institute of Polar Research, Japan, started distributing a newsletter (2 domestic edition in Japanese per a 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 digest, Vol. 3, incorporate numbers 6 and 7 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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