Long-term field experiment for detection and study of climatological change in East Antarctica

*Naohiko Hirasawa[1], Teruo Aoki[2], Masahiko Hayashi[3], Koji Fujita[4], Yoshinori Iizuka[5], Naoyuki Kurita[4], Hideaki Motoyama[1]

1.National Institute of Polar Research, 2.Meteorological Research Institute, 3.Fukuoka University, 4.Nagoya Univarsity, 5.Hokkaido Univarsity

This presentation will make a review on the Antarctic climatic change during the last decades and discuss important observation to understand the mechanism of the present situation of Antarctica and the future trajectory.
The observational results have clearly indicated that West Antarctica has been warmed up since the middle of the last century, which is one of the areas with the highest warming rate. On the other hand, clear temporal tendency in surface temperature of East Antarctica is not detected. The mechanism of the suppression of surface warming of East Antarctica has not been understood yet.
If we see the tropospheric temperature for the last several decades, the scientific discussion on the temporal change has not been done sufficiently mainly due to limitation in observation. Thompson and Solomon (2002) showed stratospheric cooling tendency mainly responding to ozone hole growth for 1969 to 1998, and discussed it has induced enhancement of tropospheric polar vortex, which can suppress the Antarctic surface air temperature. However, Turner et al. (2006) showed the tropospheric warming tendency. These discussion is based upon very limited data, in particular, radiosonde observation has been operated at the coast of Antarctica, except for the South Pole station. So, at first, we should make effort to operate radiosonde with surface meteorological observation at interior station of Antarctica to confirm that the tropospheric warming tendency is robust feature above whole the Antarctic ice sheet or not.
In the last decade, some remarkable topics were observed in Droning Maud Land. One of the top issues is the extreme accumulation on the lower slope of the ice sheet at 2009 (Boening et al., 2006). The Japanese snow stakes data along the traverse route from Syowa station to Dome Fuji station also captured the same feature. Another issue is a warming event in 2012/13 summer, which would induce surface melting at higher elevated slope of the ice sheet than in normal summer. This warming event was intense one since 1970s for Syowa station, namely, which is a kind of extreme phenomenon. Increment in precipitation and extreme phenomena are the typical features emerged in the global warming, and thus, we should pay attention to the data from East Antarctica in climatological sense.
The purpose of this project are 1) detecting ongoing climatic changes in East Antarctica, 2) specifying the mechanisms together with the relevant processes, and 3) indicating possible trajectories of the detected changes from past to future, focusing on 1) transportation of heat, moisture and aerosols in atmosphere and exchange of those at the surface, paying attention to diurnal variation of boundary layer and katabatic wind circulation in summer and 2) contribution of radiative process forced by clouds, aerosols, moisture, and snow property to change in the surface heating and moisture budget.

Keywords: In-situ observation in East Antarctic interior , Global warming, Climatic system of atmosphere-icesheet-ocean

Interpretation of both-polar environmental variability through the investigation of sea ice variability

*Takeshi Tamura[1], Kouhei Mizobata[2], Eiji Watanabe[3], Makoto Sanpei[4], Masanobu Yamamoto[5], Daiki Nomura[5], Jun Nishioka[5], Yutaka Watanabe[5]

1.National Institute of Polar Research, 2.Tokyo Univ. of Marine Sci. and Tech., 3.JAMSTEC, 4.Hiroshima Univ., 5.Hokkaido Univ.

Sea ice area has been continuously monitored by satellite observations since 1970's. Long-term record of sea ice area to date reveals prominent difference between sea ice areas in the Arctic Ocean and the Southern Ocean. Drastic sea ice reduction has been observed, especially after 1990's in the Arctic Ocean, while sea ice area has gradually increased in the Southern Ocean. Although sea ice variability is considered to be the response to recent climate change, no detailed mechanisms controlling these different results is explained. To understand sea ice variability, which is one of the key mechanisms for global climate variability, the integrated/multidisciplinary investigation is quite indispensable for both polar oceans, where shows different sea ice dynamics. Sea ice variability is affected by the variability of atmosphere, ice sheet and ocean. Also sea ice variability modulates the variability of atmosphere, ice sheet, ocean and ecosystems. The atmosphere-ice-ocean system with their complicated interaction is still unclear, even the research for each process has been carried out. Resolving the mechanisms of this complicated system could contribute to forecasts of climate variability/weather/ice-navigation and conservation of ecosystem. However, few research groups cannot do this kind of effort. Hence, interdisciplinary and comprehensive research activity is needed.
Until now, the investigations in both polar oceans using available satellite observations, numerical simulation, and ice-strengthened vessel have been conducted in Japan. However, observations of the atmosphere above sea ice, the ocean underneath sea ice and ice sheet close to sea ice are big challenges for us due to the existence of sea ice. To overcome this situation, installation of Japanese own icebreaker, which can conduct direct measurements in sea ice area, is most effective solution.
Currently, Japanese research activities are usually conducted on the other country's icebreaker because Japan does not have our own icebreaker. However, the utilization of academic icebreaker will enable us to conduct interdisciplinary observational research covering the atmospheric science, glaciology, oceanography, and submarine geology. Furthermore, interdisciplinary observational research with icebreaker in both polar oceans will contribute to the interpretation of earth environmental variability through the investigation of sea ice variability. Installation of icebreaker, which is needed for breakthrough in polar science and the study of climate change, will open the door which leads to a new stage of global climatic and environmental science.

Keywords: both polar oceans, sea ice variability, atmosphere-ice-ocean system, research icebreaker

Drilling of deep ice core exceeding 800,000 years for reconstructing past climate

*Kenji Kawamura[1,2], Shuji Fujita[1,2], Kumiko Goto-Azuma[1,2], Hideaki Motoyama[1,2], . Dome Fuji Ice Core Consortium[3]

1.National Institute of Polar Research, Research Organization of Information and Systems(ROIS), 2.The Graduate University for Advanced Studies (SOKENDAI) , 3.Dome Fuji Ice Core Consortium

In the next phase of the Antarctic research activities of Japan, National Institute of Polar Research along with Dome Fuji Ice Core Consortium (ICC) in Japan plan to perform various activities related to drilling of the “oldest ice” with age much older than 800 kyr ago, in the vicinity of Dome Fuji. We call the planned ice core as “the 3rd DF deep core”. In the near future, we aim to: (i) investigate glaciological conditions (ice sheet surface conditions, englacial conditions and subglacial conditions) of the candidate site area; (ii) determine the exact location of the drilling site and (iii) start to perform pilot hole drilling, casing and shallow/middle range deep drilling.

Keywords: Antarctica, ice sheet, ice core

Holocene paleo-environmental changes of coastal freshwater lakes in Soya Coast, East Antarctica using fossil diatom assemblages

*IJIN KANG[1], Kaoru Kashima[1], Koji Seto[2], Yukinori Tani[3], Takahiro Watanabe[4], Toshio Nakamura[5], Genki I. Matsumoto[6], Satoshi Imura[7]

1.Department of Earth and Planetary Sciences, Graduate School of Sciences, Kyushu University, 2.Research Center for Coastal Lagoon Environments, Shimane University, 3.Institute of Environmental Sciences, University of Shizuoka, 4.Japan Atomic Energy Agency, 5.Center for Chronological Research, Nagoya University, 6.School of Social Information Studies, Otsuma Women's University, 7.National Institute of Polar Research

The East Antarctic Ice Sheet (EAIS) is the largest glacial system on Earth, and documenting its changes is important to understand and estimate its future behavior. Antarctic coastal lakes are invaluable archives of paleoclimate and paleoenvironment changes caused by the retreat of Antarctic Ice Sheet. In Soya Kaigan (Coast) of Lutzow-Holm Bay region, many coastal lakes are located in ice-free areas. Some costal lakes located below 20m ASL are marine relict lakes resulted from the recession of glaciers and subsequent isostatic uplift (Igarashi et al., 1995, Miura et al., 1998). This study discussed the environmental change inferred from microscopic observation of fossil diatom assemblages in a sediment cores from such coastal freshwater lakes, Lake Oyako-ike, Lake Maruwanminami-ike and Lake Maruwan-Oike, in Soya Coast along with biomarkers and microscopic observation of microalgae and cyanobacteria, sedimentary facies and AMS ^{14}C dating.
Diatoms are one of the most common phytoplankton (Class: Bacilllariophyceae), and it is used as powerful and reliable environmental indicators (Cholnoky, 1968; Lowe, 1974) which can be attributed to their high abundance and species diversity. Also, they are distributed among most aquatic environment. Additionally, their cell wall is made of silica (hydrated silicon dioxide) called as frustule, so that their remains are highly durable and well preserved in accumulated sediments as fossils (Smol, J. P., & Stoermer, E. F. (Eds.). 2010). In this study, Diatom analysis was conducted in order to understand past water quality such as salinity when they live on.
The Ok4C-01 core (length 135 cm) from Lake Oyako-ike was divided in 5 zones according to the diatom assemblage changes. This lake has changed from costal marine to freshwater lake at ca. 1100 cal yr BP (core depth 60 cm). The MwS4C-01 core (length 147 cm) from Lake Maruwanminami-ike was also divided in 4 zones. This lake has changed from coastal marine to freshwater lake at ca. 2400 cal yr BP (core depth 65 cm). The Mw4C-01 core (length 226 cm) from Lake Maruwan-Oike was divided in 4 zones as well. This lake has changed from coastal marine to freshwater lake at ca. 2800 cal yr BP (core depth 22 cm). Diatom assemblage changes in these sediment cores show similar pattern with other results such as sediment facies and elemental analyses (TC, TS, TN contents). However, to compare the environmental changes between these lakes, we need more examine the age model.

Keywords: Antarctic coastal lakes, Paleolimnology, Holocene

Introduction of the ICARP III final Report

*Yuji Kodama[1], Atsuko Sugimoto[2], Teruo Aoki[3]

1.National Institute of Polar Research, 2.Hokkaido University, 3.Meteorological Research Institute

International Arctic Science Committee (IASC, Secretariat: Potsdam, Germany) has announced the final report of the Third International Conference on Arctic Research Planning (ICARPIII). The ICARP is an event which is hosted by IASC, and has been held every 10 years. The ICARP III symposium was held in ASSW (Arctic Science Summit Week) 2015 in Toyama, Japan, and announced Toyama Conference Statement, which became the base of this final report. The “Long-term plan for Arctic Environmental Research”, which is produced by the Japan Consortium for Arctic Environmental Research (JCAR), is referred in the final report.
The final report presented three key messages as Arctic research priorities for next decades: 1) The role of the arctic in the global system, 2) Observing and predicting future climate Dynamics and ecosystem responses, 3) Understanding the vulnerability and resilience of Arctic environments and societies and supporting sustainable development. In addition, communication, traditional and local knowledge, and capacity building are shown as the overarching messages. In the concluding remarks emphases are made on the follows. New approaches, integrating scientific disciplines and bringing in local and regional right holders and stakeholders in a knowledge-based dialogue through trans-disciplinarity, co-designed, solutions-oriented science, and comprehensive, high-quality observations of the rapidly changing Arctic. ICARP III final report clearly emphasizes the importance of knowledge transfer between research community and end-users.

Keywords: ICARP, Arctic, research priorities

