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ISSN 2005-9833

Korea Polar Research Institute

2017 ANNUAL REPORT OF KOREA POLAR RESEARCH INSTITUTE

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2017 ANNUAL REPORT OF KOPRI

KOREA POLAR RESEARCH INSTITUTE

Korea Polar Research Institute(KOPRI) is a government supported research institute under the Ministry of Oceans and Fisheries.
As the national operator of the Korean polar programs, the major functions include polar basic research, state-of-the-art applied science, operation of Korean polar infrastructure, polar policy research, implementation of industry-academia-research cooperation program, and promotion of international cooperation.
Key research areas are polar climate sciences, polar earth-system sciences, polar life sciences, polar ocean sciences, polar paleoenvironment.
The polar infrastructure KOPRI operates include the King Sejong Station, Jang Bogo Station, the Dasan Sation, and the ice-breaking Research vessel 'Araon'.

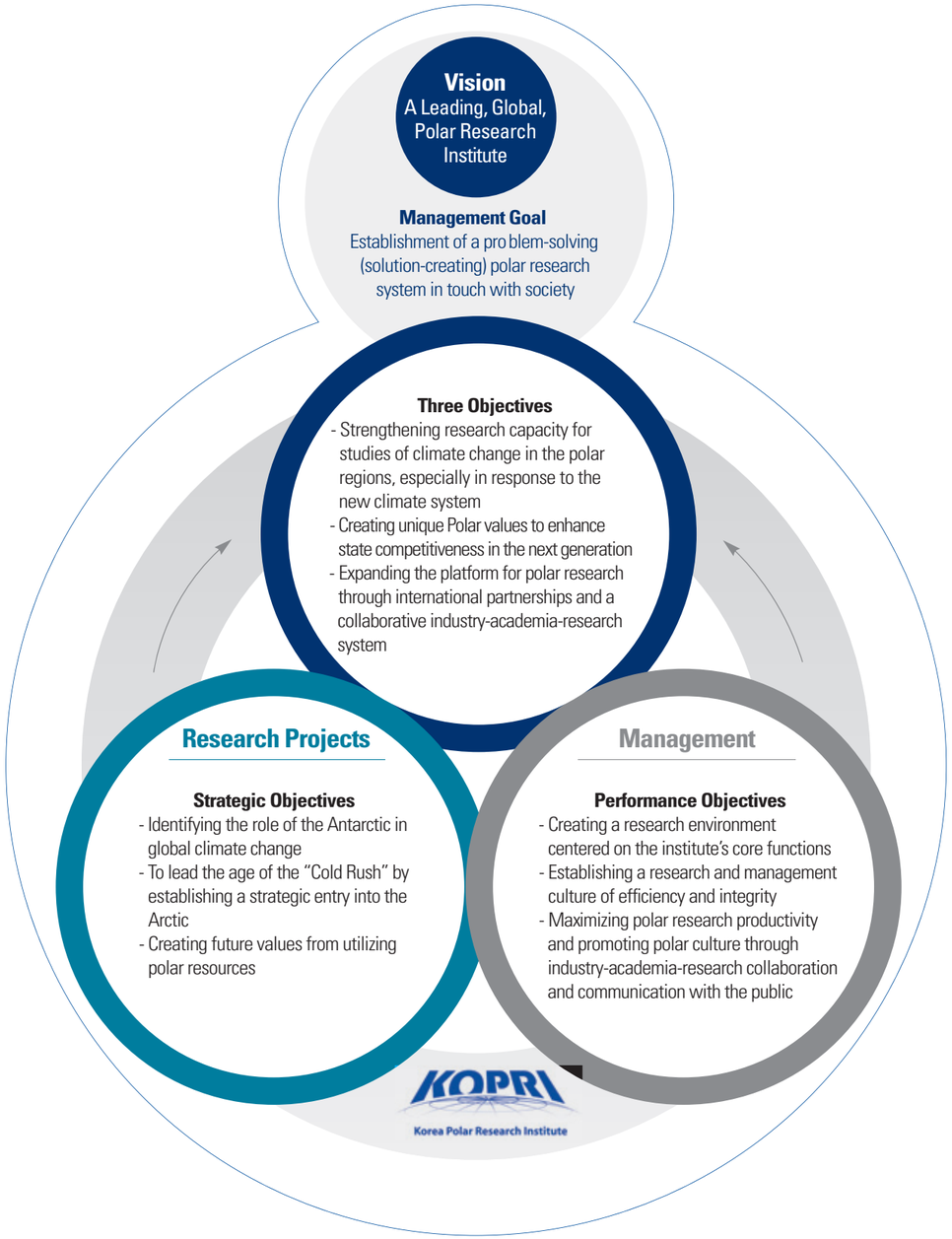
Korea Polar Research Institute

KOPRI for Tomorrow's

Global, Leading, Polar Research

Through utilizing cutting-edge Polar infrastructure, Korea Polar Research Institute(KOPRI) works to remain a leading Polar research institute that will continue to conduct research that preemptively addresses the global phenomenon of climate change and produce future values of the Polar regions.

VISION & MISSION



CONTENTS

Learning from 30 years of history in Antarctica, we will readily prepare for the next 30 years

February 17th, 2018 marks the 30th anniversary of Korea stepping foot on Antarctica. For the past 30 years, Korea Polar Research Institute (KOPRI) has made great strides in developing polar infrastructure for Antarctic research with construction of the King Sejong, Jang Bogo Antarctic stations and the ice-breaking research vessel, Araon. By the ceaseless efforts of countless researchers to establish a solid foundation for Korea's polar scientific research, we have alas reached a period of transition to prepare for the next 30 years.

In April, 2017, the Korean government finalized the Master Plan for the 3rd Antarctic Research Activity(2017~21). Based on a vision for "an international effort to contribute to Antarctic research to resolve current issues in global climate", a roadmap was put together for the leading nations in Antarctic research. Our institute will be dedicated to advancing Korea as a global partner in this effort for Antarctic research and governance by expanding the scope of Antarctic research in the fields of climate change, ecosystem conservation and other globally relevant matters, as well as modernizing a support system for safe and sustainable research.

2017 was a remarkably fruitful year for KOPRI in fulfilling globally significant, research accomplishments. For instance, a groundbreaking research identified the correlation between Penguins' grouping behaviour and their crying noise, while chemical analysis of ice uncovered self-purification process of pollutants and heavy metals. Another research work--the results of which were published in the scientific journal *Nature*---newly disclosed how pools of water on Antarctic ice shelves could reduce sea level rise.

Internally, we focused on raising our capacity to reflect the cultures of Polar research that are well-developed. Namely, we are improving methods of research operation, nurturing researchers to broaden scientific frameworks at the labs, increasing efficiency of research costs for new, innovative research projects and maintaining efficient operation and expansion of infrastructure for excellent research productivity.

At KOPRI, in preparing for the next 30 years, we will aspire to be a research institute that tackles the global issue of climate change and demonstrate the priceless value the polar regions bear for our collective future.

Thank you.

Ho Il Yoon

President of the Korea Polar Research Institute

Yoon Ho Il

Unearthing Secrets of the Polar Regions through Strategic Research

2017 Research Overview

Throughout the year 2017, KOPRI conducted research spending up to KRW 62.3 billion, or KRW 630 million per researcher.

Based on the three strategic goals of "discovering the cause of climate and ecosystem change in the Polar regions in response to global environmental changes," "practicalizing polar research to create new value," and "pursuing future values through research and development in the Antarctic and Arctic regions," KOPRI conducted a total of 18 in-house projects and 12 national R&D projects.

In order to vitalize polar research and nurture polar experts, KOPRI has operated the Polar Academic Program(PAP) since 2010 to provide research funds to Korean universities that proposed creative themes for polar research. In 2017, the institute provided research funds to 13 projects from 11 universities.

In addition, KOPRI launched the Polar Industrial Program(PIP) to enhance its cooperation with industries. Currently, 2 projects are being conducted under PIP.

KOPRI listed 202 research papers in major academic journals in Korea and abroad(1 paper in Nature, Science, and Cell; 121 in SCI-level journals; 52 in SCIE-level journals; 22 in KCI-level journals; 1 in Korean journals; and 5 in international journals). In addition, the institute reinforced its intellectual property rights, including 20 patent applications and 19 patent registrations.

2017 Research Grant(Million won)

Total **62,397**

2017 Research Papers in Major Academic Journals in Korea and Abroad

Total **202**

Intellectual Property Rights

patent applications **20**

patent registrations **19**

Research Performance Scale in 2017 (Unit: 1 Million won)

Division		Financial resource	Research Grant
Main Projects	In-House projects	KOPRI	38,882
	The Polar Academic Program		1,400
	The Polar Industrial Program		933
	Creative Research Project		3,132
Subtotal			44,347
National R&D Projects		Ministry of Oceans and Fisheries	13,950
		Ministry of Science, ICT and Future Planning	3,800
Consigned Research Project		Public Organization	300
Subtotal			18,050
Total			62,397

RESEARCH ACTIVITIES

01

Identifying the Role of the Antarctic in Global Climate Change

Reconstruct Paleoenvironmental Change from Sediment Core

Investigation for the cause of east-west different climate responses in Antarctica

Taejin Choi (ctjin@kopri.re.kr)

Trends of temperature change in Antarctica show great regional and seasonal variations and the main cause for such trends of change is due to the change of atmospheric circulation field around Antarctica. Changes in the atmospheric circulation field not only affect regional changes in temperature but also regional changes in the Antarctic ice sheets and surrounding sea ice. Given the fact that one of the greatest changes in the future global climate is global sea level rise due to the influx of the Antarctic ice sheets into the sea, it is necessary to understand why atmospheric circulation field has changed and how the change has brought about differences in regional climate change in order to understand the current changes in Antarctic ice sheets and more precisely predict future behavior. Launched in 2017, this project aims to investigate the role of the atmosphere in the east-west climate differences in Antarctica with the following three detailed research goals;

1) Investigation of the sensitivity of Antarctic climate to change in external forcing
2) Characterization of atmospheric processes in the Pacific sector of Antarctica through insitu observation and synoptic scale numerical simulations
3) Investigation of the relationship between biogenic dimethylsufide(DMS) and aerosol particle formation in Antarctic atmosphere

Highlights from research work in 2017 include 1) first-ever report that showed how westerly wind change around the Antarctic during the Last Glacial Maximum is closely related to the Antarctic sea ice change, and 2) observational evidence that show growth of particles from gas to be significantly active during spring and summer seasons.

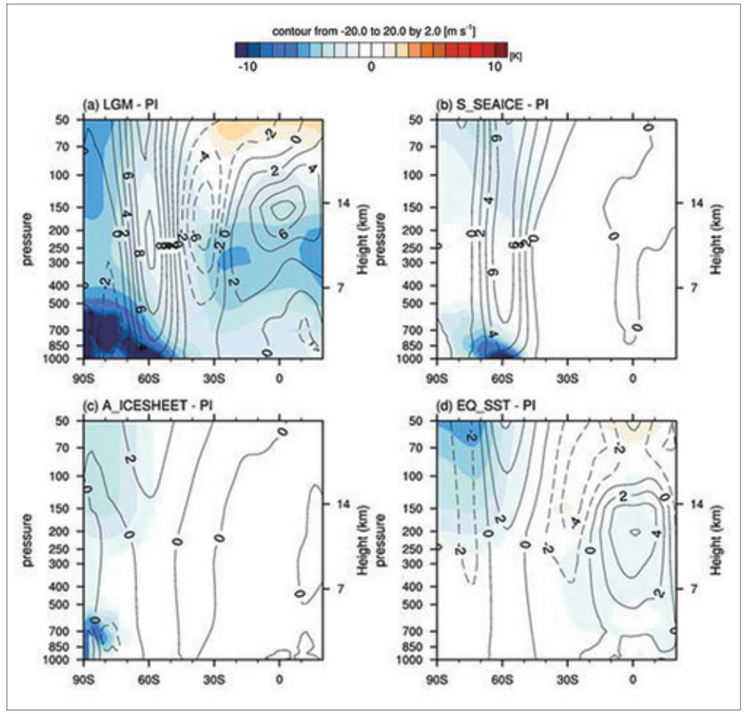


Figure 1. Changes in zonally averaged temperature(shading) and zonal wind (contour) from (a) LGM, (b) Change in sea ice concentration, (c) Change in Ice sheet condition, and (d) Change in tropical sea surface temperature experiments compared to the Preindustrial simulation experiment.

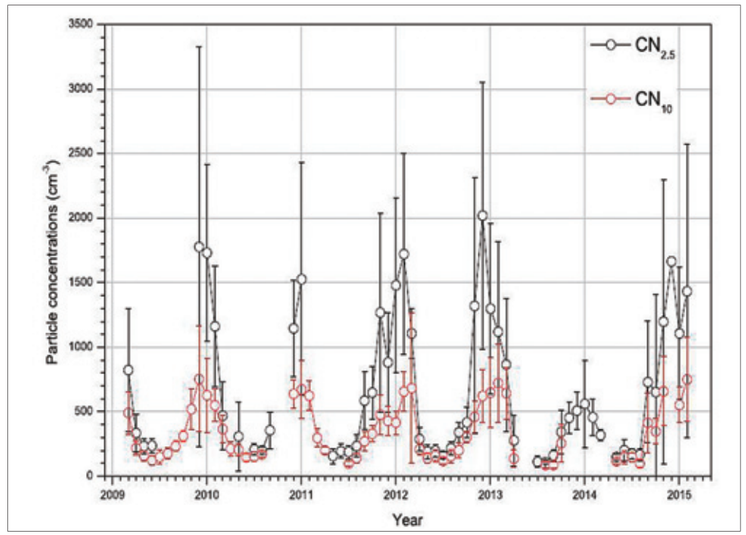


Figure 2. Monthly variations of mean $CN_{2.5}$(black opened circle) and CN_{10}(red opened circle) concentrations with a standard deviation from March 2009 to February 2015.

02

Identifying the Role of the Antarctic in Global Climate Change

Reconstruct Paleoenvironmental Change from Sediment Core

Reconstruction of Antarctic Ice Sheet and Ocean History for the past two million years

Min Kyung Lee (mklee@kopri.re.kr)

The polar regions represent an ideal place to detect climate change as they are more sensitive to climate change compared to the mid-and low-latitude regions. Especially, Antarctica has experienced an array of global climate and environmental changes such as changes in atmospheric carbon dioxide concentration, which affects marine productivity of the Southern Ocean, formation of deep water, the main driver of global ocean circulation, and sea level change due to increase and decrease of Antarctic ice sheet. In efforts at investigating these issues, Antarctic paleoenvironmental studies provide essential information to understand the trends and impacts of global climate change.

Continuous records of paleoenvironmental changes can be obtained from marine sediments, lake sediments, and ice cores. Among these, marine sediments are most suitable for answering the above-mentioned issues.

Currently, as KOPRI operates the IB/RV Araon as well as the King Sejong and Jang Bogo Antarctic stations, which are located in areas where paleoenvironmental research is active, it is relatively easy to acquire new data from the unexplored regions of scientific interest. Until now, not many sediment cores longer than 10m have been sampled in the Southern Ocean. Sampling with the Jumbo Piston Corer installed on the IBRV Araon can yield up to 39m of marine sediment cores. The physical, chemical and biological climatic indicators contained in the sediments can be used to reconstruct the past environmental changes, thereby recovering climate change in the Antarctic ice sheet-ocean-climate change for the past two million years. The goal of this project is to reconstruct the past 2 million years of ice sheet-ocean-climate change from sediment records and examine the impact changes in the Antarctic cryosphere and marine environment exerted on global environmental change.

The major tasks of this research project are as follows: 1) reconstruction of paleoclimatic and paleoenvironmental changes since the Last Glacial Maximum; 2) reconstruction of paleoenvironmental changes during the Pleistocene; 3) introduction of climatic indicator and age dating methods and investigation of principle applicable as proxies. We will analyze sediment cores obtained from the continental shelf and the deep sea in the Southern Ocean to reconstruct the past environment and identify the principles for the introduction of the dating method and the climate indicator and the development of avai lable climatic proxy.

In March 2017, we carried out an expedition exploring he Antarctic Bellinghausen Sea with scientists from New Zealand and the United States. We obtained sediment cores using Giant Gravity Corer, Gravity Corer, Multi-Corer and Box Corer from the continental shelf of the Bellinghausen Sea and the outer deep sea.

Particularly, we obtained a sediment core from the Crystal Sound basi n of the western Antarctic Peninsula that must have been deposited during the process of transition from sub-ice shelf to open-marine environment. Using such sediment cores, we are striving to reconstruct paleoenvironmental changes from changes in ice shelf / ice sheet / sea ice.

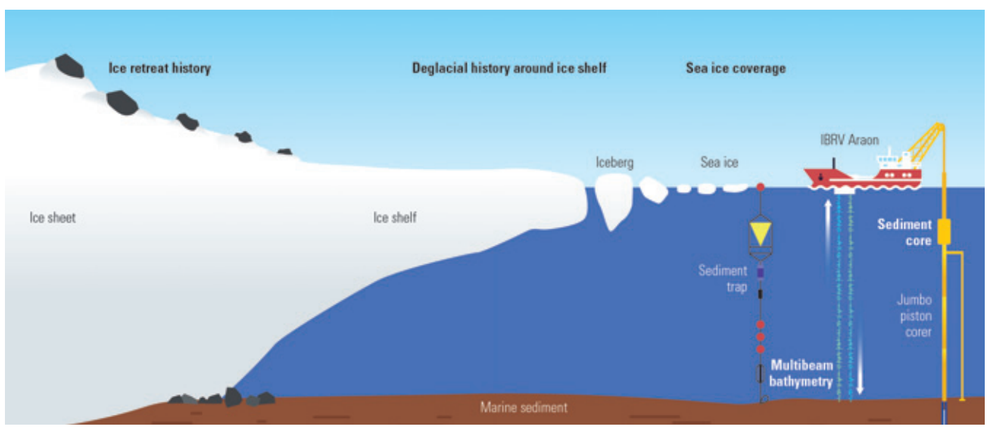


Figure 1. Strategies of "Reconstructing Antarctic ice sheet and ocean history for the past two million years using sediment records" project

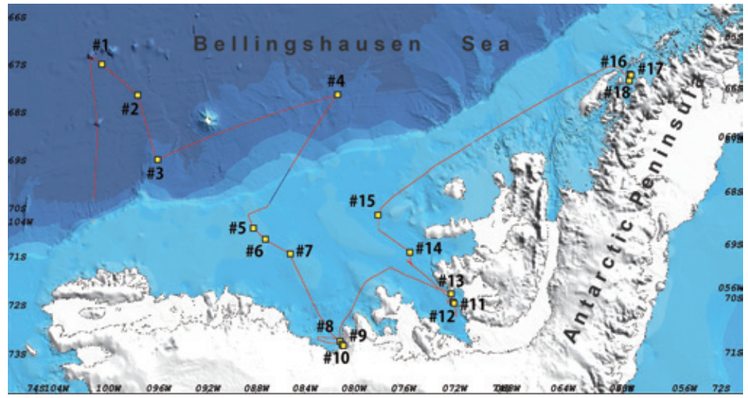


Figure 2. Study area and core locations during 2017 Antarctic Cruise on IBRV Araon.

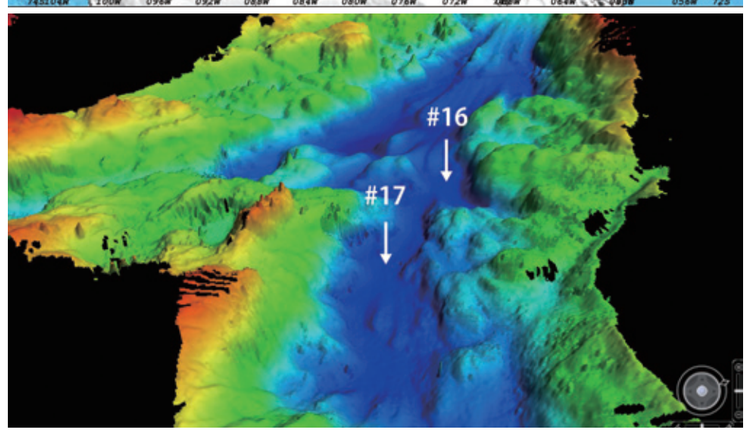


Figure 3. Bathymetric reconstruction of Crystal Sound basin based on multibeam data.

03

Identifying the Role of the Antarctic in Global Climate Change

Solidifying the Foundation for Ecological Research of Antarctic Coast and Shoreline

Modeling Responses of Terrestrial Organisms to Environmental Changes on King George Island

Hyoungseok Lee (soulaid@kopri.re.kr)

Figure 1. Measurement of photosynthesis of *Deschampsia antarctica* using the three fluorescence-using instrument

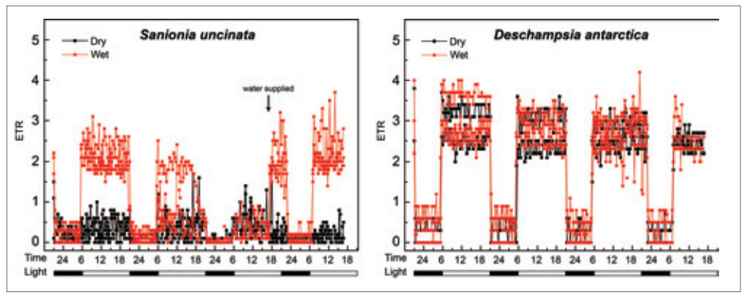


Figure 2. Photosynthesis of *Saionia Uncinata* and *Deschampsia antarctica* according to the available water

King George Island is one of the best places to study the effects of environmental changes of the ecosystem as it harbors diverse organisms and is strongly affected by global warming. Changes in temperature, water fall, wind speed, and wind direction from global warming may result in corresponding changes in microclimate such as light intensity by snow cover, air temperature, ground temperature, relative humidity, and soil water content. The Barton Peninsular of King George Island covers only a small area but the diversity in its geological features, such as in altitude and slope, result in various microclimates and simultaneously a diverse vegetation composition. Moreover, the Barton Peninsula, home to 2 flowering plants, 33 genera of mosses, and more than 35 genera of lichen, is an ecosystem with one of the most diverse vegetation in Antarctica. Understanding the physiological response of vegetation and adaptation mechanisms to the changing environment can provide insight when predicting vegetation change from global warming. In this project, we aimed to develop a biological response model by studying the distribution of vegetation according to the microclimate and their preferred niche, and the biological responses of the representative vegetation to the changing environmental factors.

Environmental factors such as light intensity, air temperature, ground temperature, and humidity were measured on long-term monitoring sites for the past 3 years. Temperature was found to be increasing and variation among the sites tending to increase. Overall, the relative humidity decreased with bigger variation among the sites. Analysis of vegetation distribution of 11 genera of lichen, 15 genera of mosses, and 2 flowering plants at 133 sites revealed *Usnea, Himantormia,* and *Placopsis* dominated the dry areas while *Psoroma* and *Ochlorechia* were dominant in the wet areas with *Chorisodonthium, Cladonia, Stereocaulon,* and *Sphaerophorus* dominant in the mid-ltatitude wet areas, respectively(Fig. 3).

We also selected *Deschampsia antarctica* and *Sanionia uncinata* as representative vegetation in this area and continuously measured photosynthetic activity as an indicator of physiological response in the vegetation(Fig. 1). It was found that as water content decreased, there was no significant variation in the photosynthesis of *Deschampsia antarctica* while that of *Sanionia uncinata* dramatically decreased, which indicates mosses may be more sensitive than the flowers in this area(Fig. 2). These vegetation distribution and physiological response data according to the microclimate will be used in the biological response modelling for the prediction of vegetation change pattern.

Antarctic Near-shore and Terresterial Observing System(ANTOS) was organized by Scientific Committee on Antarctic Research(SCAR) in order to conduct continuous observation of near-shore and terrestrial Antarctic ecosystems. Therefore, data and information on air temperature, soil temperature, water content, light intensity, and wind speed is expected to increase. With the sustainable management and sharing of these data, great strides will be made in understanding the changes in Antarctic ecosystems.

To contribute to this effort, we built a website for the sustainable management and sharing of the environmental data collected(Fig. 4). This database allows for real-time collection and processing of field and satellite data. This accessibility enables researchers not only to process their data, it enables them to compare data results on the website, which adds more ease and efficiency to the process of data understanding and analysis. Researchers can search for data using keywords in data type, location, and measurement duration and download them from the website or contact the person charge in of the data in question. We have made metadata containing information on the location, instruments, and sensor used for the data that was collected accessible to the public.

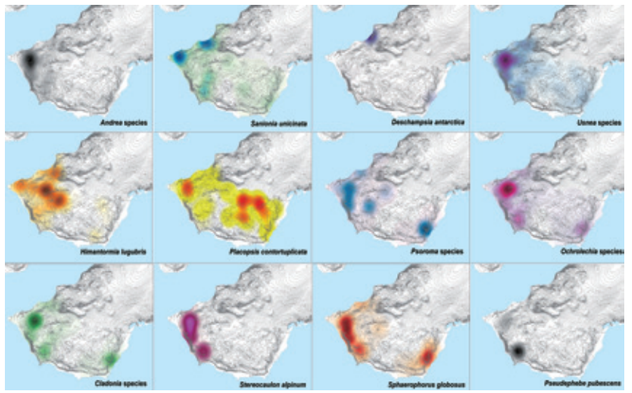


Figure 3. Distribution of representative vegetation in the Barton Peninsula

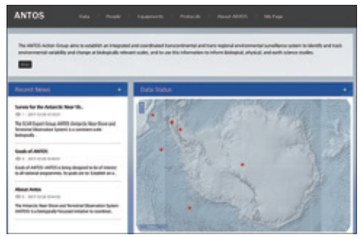


Figure 4. Webpage of ANTOS

Figure 5. Comparison of temperature between sites on ANTOS website

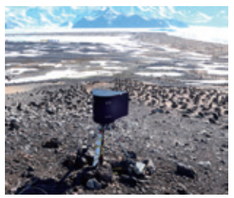
04

Identifying the Role of the Antarctic in Global Climate Change

First Steps in Ecosystem Conservation of Ross Sea Region Marine Protected Area

Ecosystem Structure and Function of Marine Protected Area(MPA) in Antarctica

Jeong-Hoon Kim (jhkim94@kopri.re.kr)



Monitoring Camera System Set-up for Penguin Ecological Survey

As habitat for 38% of Adélie Penguins, 26% of Emperor Penguins, 45% of Weddell seals, 50% of killer whales and other marine mammals dependent on fish and krill on the entire globe, the Ross Sea is an ecologically significant region. As such, if there is a dramatic environmental change or overfishing of living resources, the food chain from small(zooplankton, krill, small fish, etc.) to large(penguins, whales, seals, Antarctic toothfish, etc.) predators can be collapsed. At the 2016 annual Meeting, the Convention for the Conservation of Antarctic Marine Living Resources(CCAMLR) designated the Ross Sea as a Marine Protected Area(MPA) to preserve biodiversity and restore the declining population of vulnerable species.

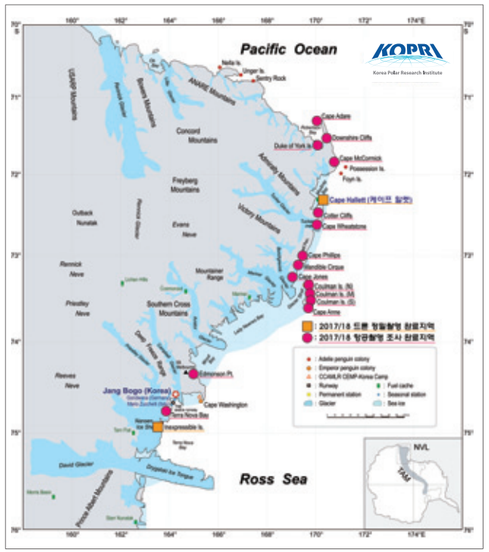


Figure 2. Locations of penguin colonies where the aerial survey was completed in 2016 and 2017

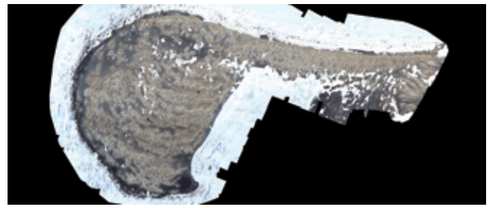


Figure 3. View of Adélie colony (Seabee Hook) in Cape Hallett taken by a DSLR camera mounted on a counting drone for measurement of total number of nests

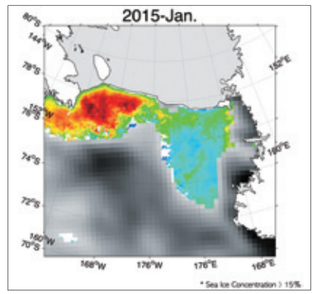


Figure 4. Analysis of the characteristics of polynya in the Ross Sea via remote sensing(Satellite data source: NASA)

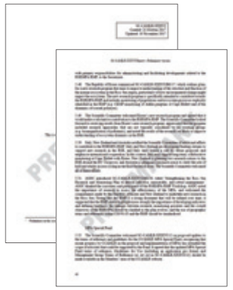
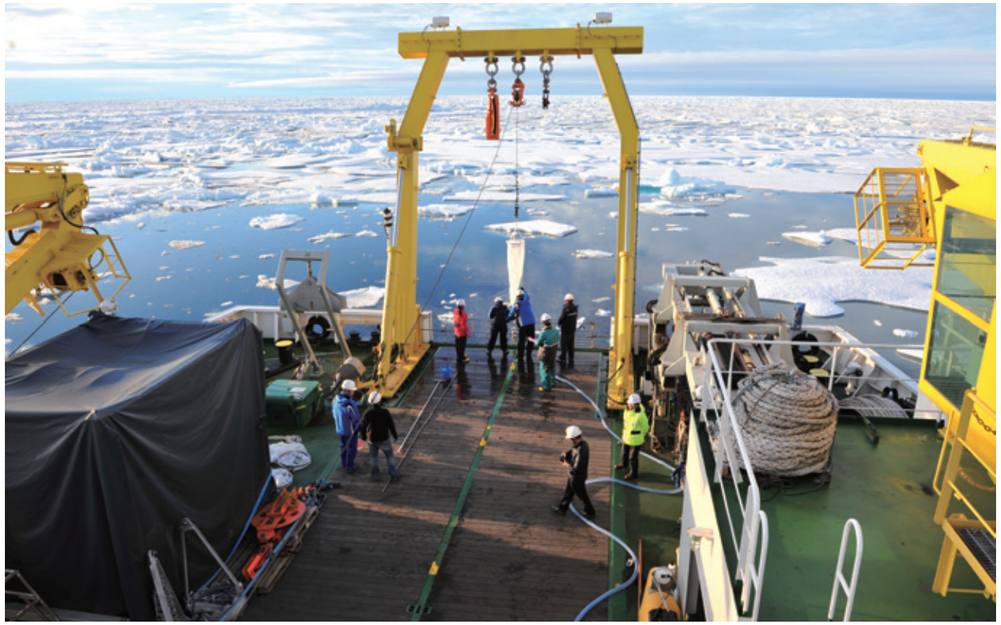


Figure 5. Interest and Support for this research project from the Scientific Committee of the Commission for the Conservation of Antarctic Marine Living Resources 36th SC-CAMLR, 2017

This project has been analyzing the biological diversity and food chain structure to understand the ecological structure and function of the Ross Sea Region MPA. We plan to analyze genetic diversity of marine organisms using Next Generation Sequencing(NGS), and investigate the food chain structure by analyzing stable isotopes. We are also planning to analyze the biomagnification of pollutants according to the food chain structure.

In order to investigate the effects of environmental change on the marine ecosystem, we are carrying out remote sensing as well as field observations. By analyzing satellite images, we are monitoring not only the changes in polynya, but in the physical(sea surface temperature) and biological(chlorophyll distribution and concentration) environment on a long-term basis. In addition, we plan to investigate how geochemical factors affect primary productivity in the Ross Sea.

Launched in 2017, this research project will diagnose the effects of environmental change on the marine ecological structure and indicator species in the Ross Sea Region MPA and provide the scientific evidence necessary in putting together conservation measures, in doing so contribute to the global efforts in conserving the Antarctic environment.



05

Identifying the Role of the Antarctic in Global Climate Change

Investigating The Melting of Ice Shelf to Understand Changes in Marine Environment

Ocean-to-Ice Interactions in Amundsen Sea: Ice Shelf Melting and its Impact on Ocean Processes

Sang Hoon Lee (shlee@kopri.re.kr)

The Amundsen Sea is at the center of the world's most rapidly warming area, where many believe the collapse of ice shelves and glacier is just a matter of time. Upwelling of deep warm water into the continental shelf plays a significant role in this regard by melting the base of the floating ice shelves, but the overall loss is a combined result of ocean-ice-atmosphere interaction. The objectives of the KOPRI Amundsen project are to assess the changes of the ocean processes due to the Western Antarctic warming and glacial melt-water dispersion via multi-national operation of the Earth observing network. During phase one(2010-2016), this project investigated ocean circulation patterns and heat flux to the Antarctic coast, ecosystem structures and diversities, and biogeochemical cycles in the study area. In the phase two(2017-2019), the project is focused on the ice shelf melting and retreat, the effect of meltwater discharge to the oceanic physical and chemical processes, and the subsequent changes in the biogeochemical processes and food web structure. The project produced high-impact scientific findings from the major areas of the research(illustrated in the figures) in 2017, and carries out its 5th field expedition to the study area from 2017 December to 2018 February.

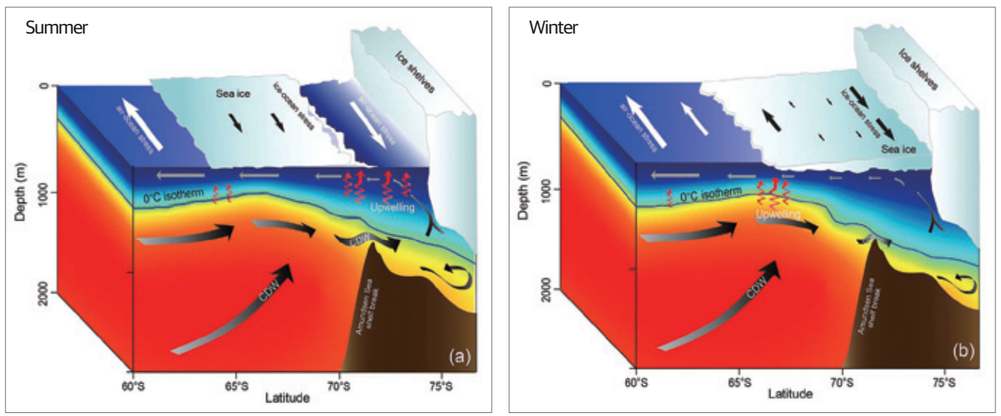
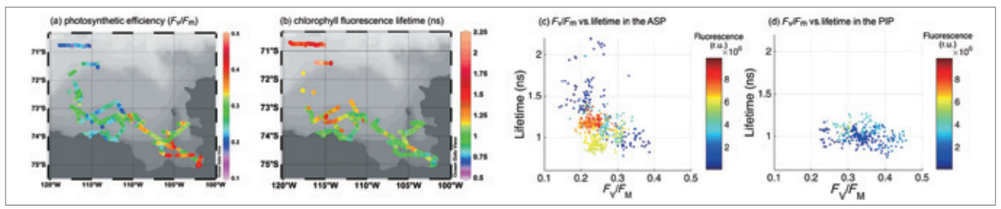


Figure 1. Schematic diagrams explaining the circulation of deep warm water and its relationship with wind forcing and sea ice distribution during austral summer(a) and winter(b) in the Amundsen Sea(*Continental Shelf Research* 2017).



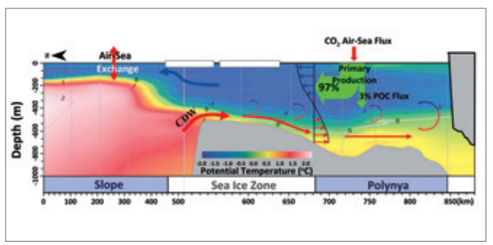


Figure 2. High spatial resolution horizontal distributions of (a) the phytoplankton photosynthetic efficiency(Fv/Fm), (b) chlorophyll fluorescence lifetime(ns), (c) relationship between Fv/Fm values and chlorophyll fluorescence lifetimes in the ASP, and (d) relationship between Fv/Fm values and chlorophyll fluorescence lifetimes in the PIP reconstructed based on continuous underway measurements (*Limnology and Oceanography* 2017).

Figure 3. A schematic diagram of carbon flow in the Amundsen Sea overlain on top of potential temperature distribution along a cross-shelf transect. The thick red and blue arrows indicate flow path of Circumpolar Deep Water(CDW) and the water in the upper layer leaving the shelf, respectively. Small arrows are the schematic representation of the currents obtained from multi-year ADCP moorings (*Geophysical Research Letters* 2017).

06

Identifying the Role of the Antarctic in Global Climate Change

Providing Future Scenarios of Climate Impacts on the Antarctic Marine Environment and Ecosystem

Studies on the Changes in Coastal Marine Systems of the Antarctic Peninsula: A 2050 Outlook

In-Young Ahn (iahn@kopri.re.kr)

The CHAMP2050 is the first station-based interdisciplinary coastal marine project started in 2017. It aims to assess the climate impacts on the Antarctic coastal marine environment and to elucidate driving forces and/or underlying mechanisms for ecosystem responses, particularly in the context of ice sheet shrinking in the Peninsula region, seeking to generate future scenarios. Coastal marine environment of Antarctic Peninsula is likely among the most sensitive areas to climate change. Situated in the rapidly changing peninsular region and also in maritime Antarctic, the King Sejong Station is a sentinel site for fulfilling the final goal of the project. In 2017, we focused on the impacts of glacier retreat on the seawater properties and planktonic/benthic communities using the Marian cove as an ecosystem model. First of all, by analysing the past 6 years of CTD data(2011-2017) and about 20 years of phytoplankton specimens (1996-2016), we have characterized the seasonal and decadal pattern of varitaion of water properties and phytoplankton composition. In addition, we investigated the distribution patterns and food web structure of benthic communities in order to assess the impacts of glacier retreat in Marian Cove.

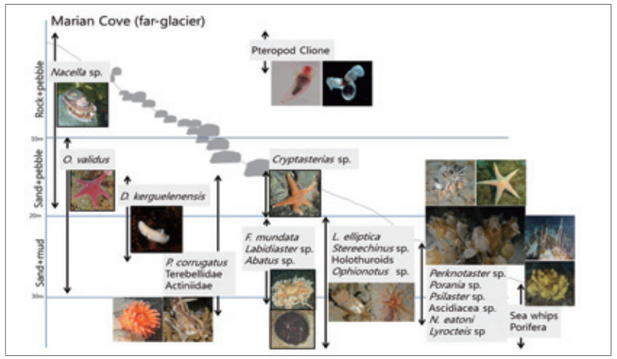


Figure 1. Distribution of invertebrate species in Marian Cove

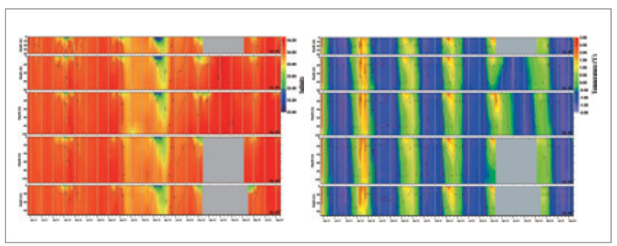


Figure 2. Seasonal variation of temperature and salinity profiles in Marian Cove since 2011

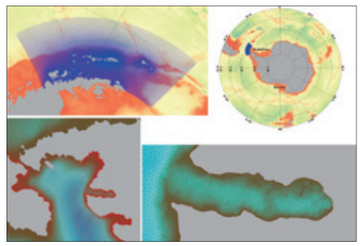


Figure 3. Model domain to identify the seawater circulation using FVCOM in Marian Cove, Mexwell bay, and Antarctic Peninsula

07

Identifying the Role of the Antarctic in Global Climate Change

Studying Changes in the Cryosphere through Multidisciplinary Research

Investigating Cryospheric Evolution of the Victoria Land, Antarctica -ICE-

Won Sang Lee (wonsang@kopri.re.kr)

Figure 1. Hot water drilling site on the Nansen Ice Shelf

The dramatic mass loss in the polar regions and global sea level rise caused by global warming and climate change represent major global issues. Multidisciplinary research that links cryosphere-lithosphere-hydrosphere-atmosphere is the only way to identify the role of cryosphere in future sea level change. The international and multidisciplinary study of ice sheet around the Jang Bogo Antarctic station, led by KOPRI, is gathering speed towards an innovative understanding of ice sheet revolution. Seismic and geodetic observation networks are being operated on a long term scale in order to monitor the influence of the crustal activities such as glacier isostatic adjustment and subglacial volcanism on the flow of ice sheet. The ice flow from grounded ice sheet forms ice shelves and ice tongue in strong interaction with ocean. To figure out the interaction in the junction of glacier/bedrock/ocean, we are conducting helicopter geophysical exploration, physical oceanography survey, basal melting monitoring, and etc. In addition to the basal melting of floating ice, the ice sheet also loses its mass by surface melting due to heat transfer from warm air and solar radiation. The Nansen Ice Shelf near the Jang Bogo station is one of the unique ice shelves with the condition that the surface melting forms melt ponds and supra-glacial rivers.

In 2017, we conducted helicopter geophysical surveys and GPS monitoring of the David Glacier perturbed by subglacial lakes and the Campbell Glacier affected by adjacent volcanic activity, in order to figure out cryosphere-lithosphere interaction. The newest technology of autonomous underwater vehicle and hot water drilling was applied to look into the basal interaction of ice shelf. Through an investigation of the surface process on the Nansen Ice Shelf, we also verified our hypothesis that the well-developed supra-glacial river rather stabilizes the ice shelf than accelerates the unstability, contrary to the theory that strong surface melting accelerates the breakup of ice shelf.

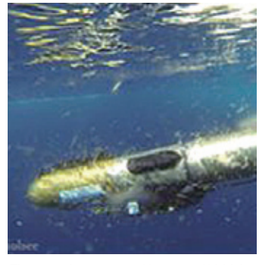


Figure 2. Autonomous Unmanned Vehicle heading toward the base of ice shelf

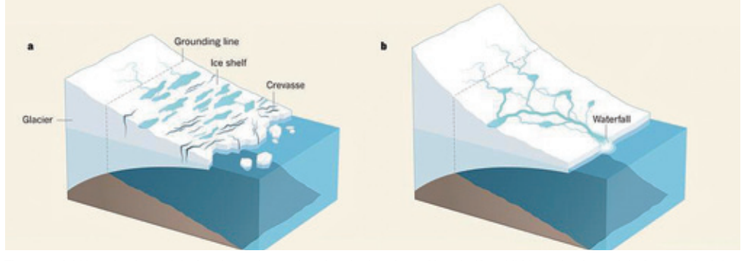


Figure 3. (a) Hypothesis model of melt ponds accelerating the breakup of ice shelf and (b) hypothesis model of supra-glacial river stabilizing the ice shelf

08

Identifying the Role of the Antarctic in Global Climate Change

Pioneering Analytical Research on the Diverse Components of Climate Change in the Polar Regions

Developments of Analytical Methods for Climate Regulating Components and its Application to Polar Environment

Ki-Tae Park (ktpark@kopri.re.kr)

Climate change in the polar regions is more rapid and severe than any other region on the Earth. Recent studies revealed that changes in the polar environment could trigger changes in the emission of climate relevant compounds, including warming gases (CO_2, CH_4 and N_2O) and cooling components (dimethyl sulfide; DMS, aerosol particles). Climate feedback is important in understanding global warming as feedback processes may amplify or diminish the effects of each climate forcing. As such, it plays an important part in determining the status of future climate.

The main objective of this research project is to develop the analytical techniques for important climate relevant compounds and its application to polar environment with the following 3 detailed goals:

Research Goal 1
-
Development of trace level climate gas (N_2O, DMS) analytical system

Research Goal 2
-
Development of analytical method for the analysis of molecular characteristics of aerosol particles

Research Goal 3
-
Application of newly developed analytical methods to polar environment

Currently, we have developed a trace gas extraction system for the analysis of nano-molar dissolved N_2O(Fig. 1) and automated pre-treatment system for the analysis of ppt-level atmospheric DMS (Fig. 2). Furthermore, an analytical technique for identifying the molecular characteristic of aerosol particles collected in the Arctic site has been developed by using the ultra high resolution mass spectrometer(15T FT-ICR MS). The polar regions are a hotspot for the emission of diverse climate components. To deepen our understanding of the changing emission of these climate relevant compounds, we plan to develop unique analytical techniques which can be utilized in the remote polar environment.

Figure 1. Trace gas extraction system for the analysis of dissolved N_2O.

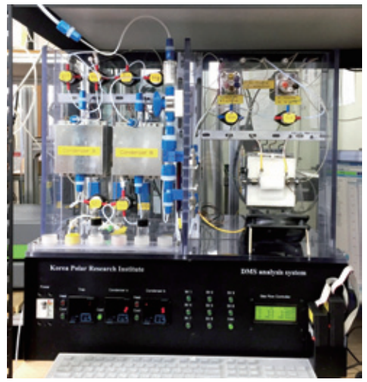


Figure 2. Automated system for the analysis atmospheric DMS installed at King Sejong Station, Antarctic.

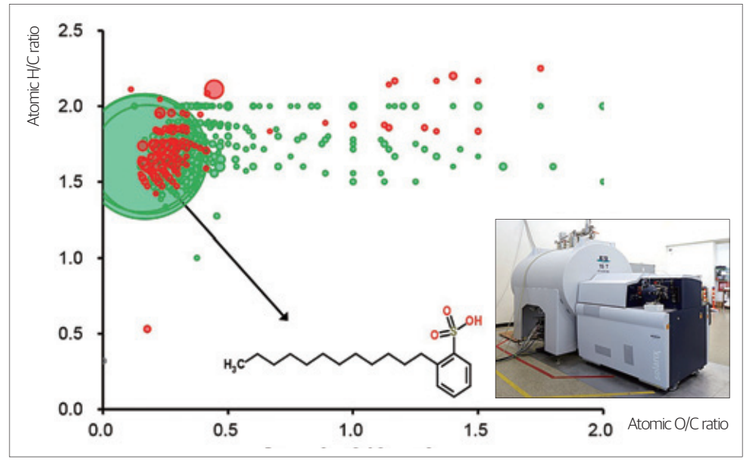


Figure 3. Molecular characteristics of aerosol particles collected during spring in the Arctic site.

09

Identifying the Role of the Antarctic in Global Climate Change

Observing Off-Shore and Terresterial Ecosystems around Jang Bogo Station, Antarctica

The Jang Bogo Long-term Ecological Research(JBG-LTER) - Korea·New Zealand·Italy Joint Platform Construction

Han-Gu Choi (hchoi82@kopri.re.kr)

We have investigated the impact of environmental change on Antarctic organisms and their resilience through construction and operation of a joint observing platform with Italy and New Zealand and continuing ecological monitoring around Jang Bogo Antarctic Station, Terra Nova Bay, Ross Sea, Antarctica.

We are undertaking continuous observation of terrestrial factors(atmospheric factors: temperature, wind speed, relative humidity, light, PAR, snow fall; soil factors: temperature, relative humidity, PAR by automated weather station and Hobo logger) and coastal ecological factors(seawater temperature, salinity, pH, Chl-a, RQ, OC, dissolved carbon dioxide, dissolved oxygen by CTD, UDA and ADCP)(Fig. 2, 3). We have also investigated biodiversity(photosynthetic algae, mosses, protozoa, mollusks), changes in major populations(Antarctic scallop, south polar skua) and long-term changes in the ecosystem from environmental change in terrestrial and coastal regions around Jang Bogo Station.

We have been taking a leading role in ANTOS(Antarctic Near-shore and Terrestrial Observing System), which is currently registered as a SCAR Action Group, and have also carried out a joint scientific scuba diving exploration using the same underwater observation equipment while standardizing the data as an international collaboration with New Zealand and Italian research teams in Cape Evans – New Harbor – Terra Nova Bay(Fig. 1).

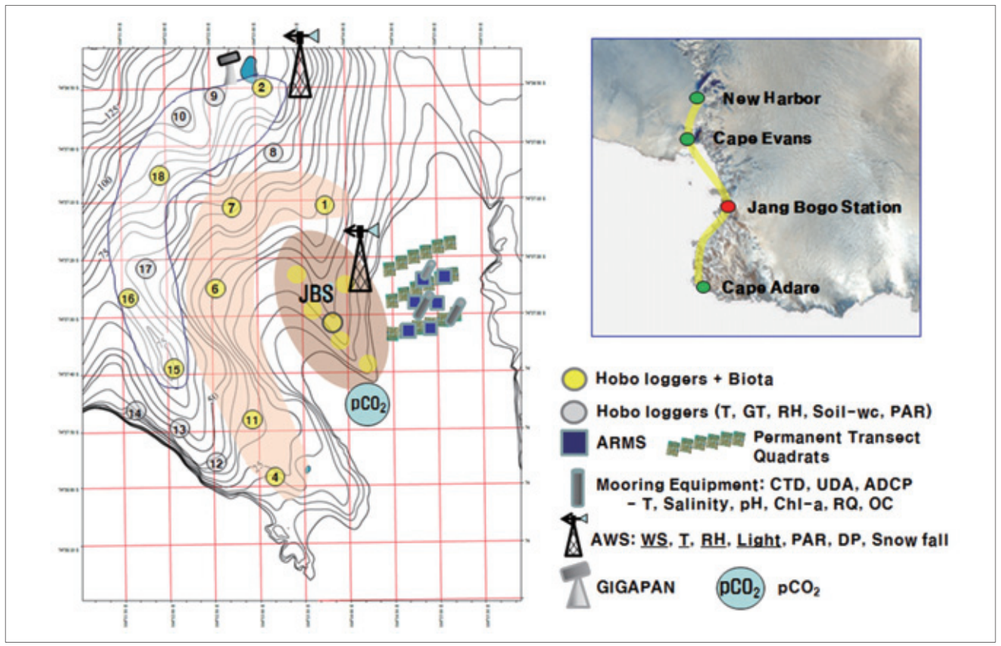


Figure 1. Continuous observation and investigation of various ecological factors, biodiversity and species distribution in off-shore and terrestrial regions around Jang Bogo Station in Tera Nova Bay, Antarctica

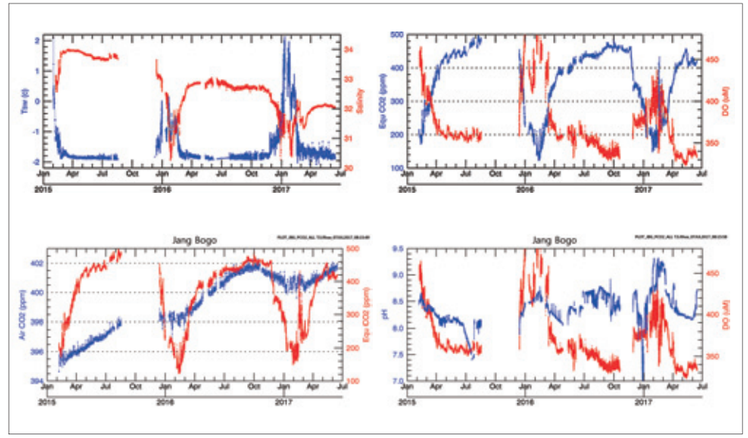


Figure 2. Time series of seawater temperature, salinity, atmospheric carbon dioxide, dissolved carbon dioxide, dissolved oxygen, and pH around Jangbogo Station in Tera Nova Bay, Antarctica

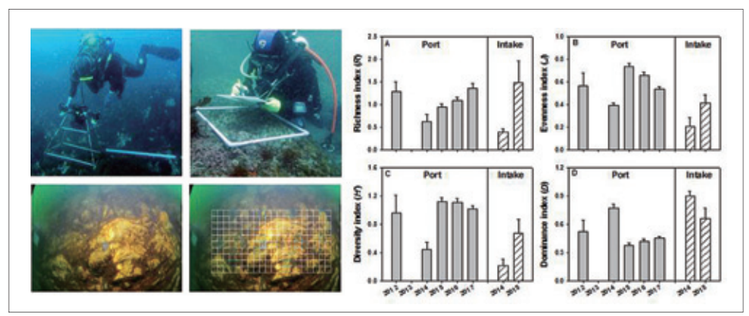


Figure 3. Acquiring images of benthic community by SCUBA diving and estimating richness index, evenness index, diversity index and dominance index of benthic communities from the images

01
The Arctic in the Age of the Cold Rush

Peering into the Future through Observations of Rapid Environmental Change in in the Arctic Ocean

Korea-Arctic Ocean Observing System(K-AOOS)

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The Artic Ocean, a region that has been most susceptible to the effects of global warming, has been exerting significant impact on the global climate system. With the Arctic warming at a rate faster than the global average, the rapid melting of sea ice is exerting major impact on the climate and adjacent ecological environment, whether it be heat circulation between the ocean-sea ice-atmosphere, or changes in oceanographic current, etc. In order to understand how climate change will affect the marine environment of the Arctic ocean, research on the physical properties of sea ice motion, biogeochemical systems and its related mechanisms needs to be undertaken.

Funded by the Korean Ministry of Oceans and Fisheries, KOPRI has been carrying out a 5 year research project by the name, "Korea-Arctic Ocean Observing System, K-AOOS", launched in 2016 to last until 2020. This project assesses the most rapidly changing regions in the Pacific Central Arctic Ocean(CAO) near Chukchi and East Siberian Seas, aiming to examine the changes in the atmospheric, physical-biogeochemical marine environment that occur with changes in sea ice, as well as analyze the causes of the environmental change of the Arctic Ocean to make prediction of future changes. In August 2017, through IB/RV Araon, we conducted research on temporal and spatial variation of sea ice distribution in the Arctic Bering Sea, Chukchi Sea, and East Siberian Sea, unique physical changes of ocean and sea ice, the force of ocean-atmosphere gas exchange and the physical and biogeochemical processes of marginal sea ice zone. Through this research, this project aims to achieve a better understanding of the phenomenon of rapid environmental change in the Pacific Central Arctic Ocean(CAO) and construct a WebGIS(Korea Arctic Ocean-data System, KAOS) of the CAO on a temporal and spatial scale, so as to provide the scientific foundation for national strategies addressing global polar issues.

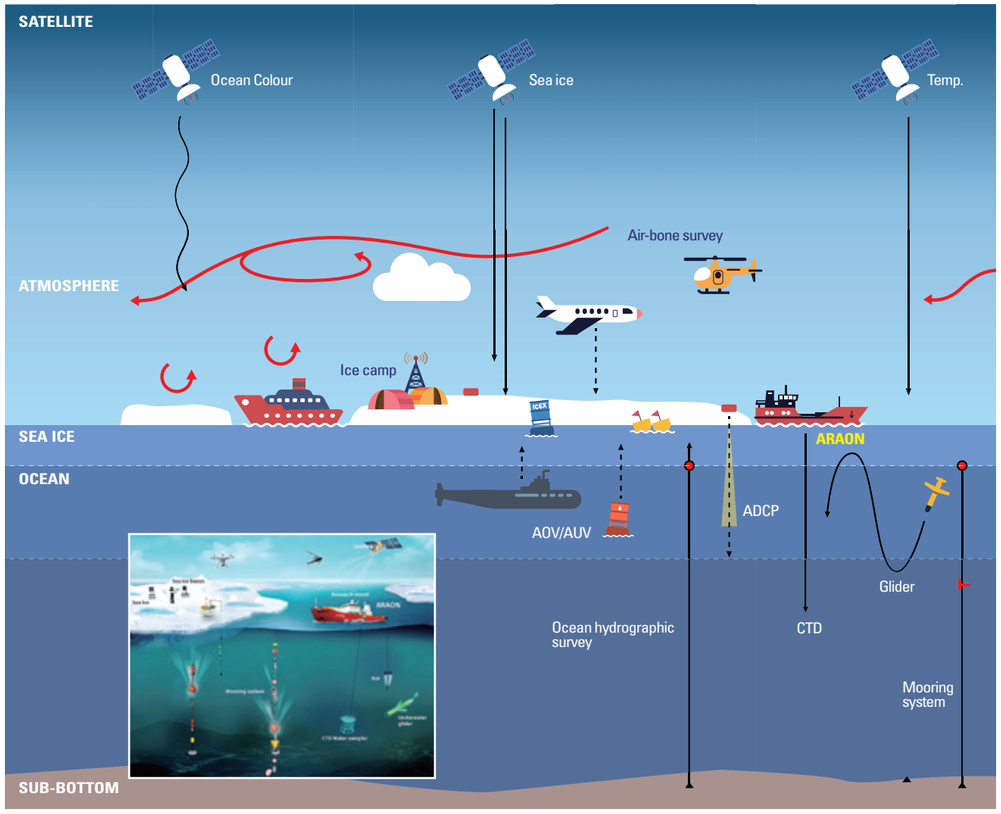

Figure 1. Korea-Arctic Ocean Observing System(K-AOOS) program using R/V Araon

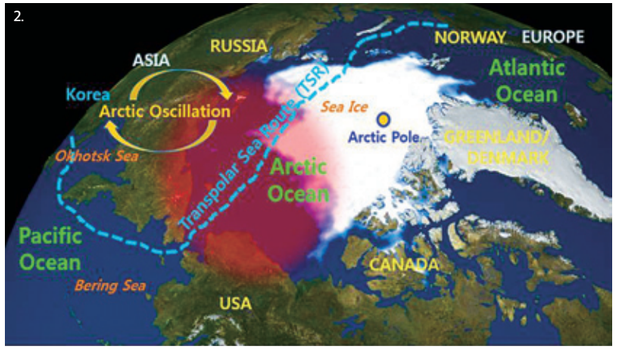

Figure 2. Pacific Central Arctic Ocean(CAO) study area in rapid sea-ice decrease(red zone) affecting the cliamte, ecosystem and Northern Sea Route

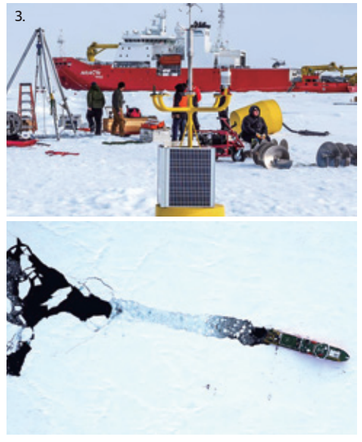

Figure 3. Field activity during the Arctic Expedition(left: Sea-ice camp, Light: Araon penetrating sea ice)

02
The Arctic in the Age of the Cold Rush

Revealing the Mystery of the Arctic Seafloor

Investigation of Submarine Resource Environment and Seabed Methane Release in the Arctic

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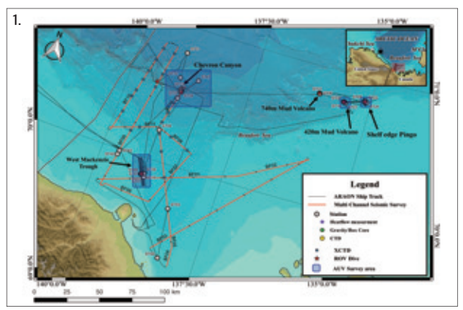
With warming of the Arctic, while opportunities for the development of enormous resources in the submarine environment becomes possible, there also is a growing concern on the release of methane from the subsea permafrost, which will accelerate global warming.

Funded by the Ministry of Ocean and Fishery, the research project "'Investigation of submarine resource environment and seabed methane release in the Arctic(2016-2021)" was launched in 2016 to acquire foundational scientific evidence for the assessment of the potential of submarine resources and investigate the emission of methane, a powerful greenhouse gas from the Arctic shelf.

A joint Korea-Canada-USA research cruise was conducted on the 2nd leg of 2017 Araon Arctic Expedition(Chief scientist: Dr. Young Keun Jin). A total of 48 researchers from 5 countries participated in the cruise, including 30 from Korea, 8 from the United States, 6 from Canada, 2 from China and 2 from Germany. The Korean team brought together domestic scientists from Korea Polar Research Institute, Seoul National University, Hanyang University, Sejong University, and Gyeongsang University. International participants consisted of members of Geological Survey of Canada(GSC) and Monterey Bay Aquarium Research Institute(MBARI). The cruise lasted from August 27 to September 16 for a total of 21 days.

The objectives of the 2017 cruise were to acquire geological/geophysical/oceanographic data to investigate the submarine resource environment of the continental shelf and slope of Canadian Beaufort Sea, and to investigate seafloor processes and methane cycle between subbottom-water column-atmosphere.

Highlights from the cruise include: 1) high-resolution multi-channel seismic data that uncovers seabed resource environment in the western part of the Mackenzie Trough, Beaufort Sea 2) a detailed bathymetric map(with 1-m resolution) of specific geologic structures such as gas seepage and pingo(ice mound) from Autonomous Underwater Vehicle (AUV) and Remotely Operated Vehicle (ROV) surveys 3) sediment/biological samples and gas hydrates from mud volcanos where gas emission and mud eruption were very active.



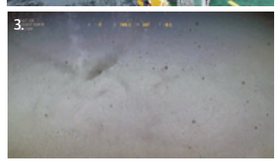


Figure 1. Overview map of expedition ARA08C.(black line) the ship track of the ARAON(red line) multichannel seismic lines, (symbolic dots) sampling/measuring stations, (red star) ROV driving sites, (blue box) AUV survey areas.

Figure 2. Launching of ROV on the Araon

Figure 3. ROV photography showing eruption of the 740 m Mud Volcano in the Beaufort Sea, Canada

03
The Arctic in the Age of the Cold Rush

Establishing a Systematic Observational Network for Permafrost Environmental Change

Circum Arctic Permafrost Environment Change Monitoring, Future Prediction and development Techniques of useful biomaterials(CAPEC)

Bang Yong Lee (bylee@kopri.re.kr)

The Arctic not only acts as a climate generator in the Northern Hemisphere, but also is the most sensitive area to environmental change. So, the Arctic has garnered widespread interests from all over the world. The Arctic has seen rapid melting of glaciers and soils, leading to rapid changes in the ecosystem, but the precise monitoring and prediction of the phenomena have been sparse. Accordingly, systematic observation is required to determine the pattern, cause and interconnectivity of environmental changes in the Arctic. Meanwhile, as the temperature rise in the Arctic is altering the Arctic oscillation pattern and is being assessed to in turn affect the climate of mid-latitude countries, including Korea, long-term, sustainable observation of the Arctic and the ensuing environmental change is becoming ever more necessary.

In order to better assess this environmental change in the Arctic, we have established six observation nodes in permafrost regions of 8 Arctic Council member countries: United States, Canada, Norway(Svalbard), Greenland, Iceland, and Russia. Based on these nodes, observation of ecosystem reactions and changes in environment is carried out along with data collection and analysis to systematically observe changes in the environment and to provide real-time information to predict and actual users of the future environment.

This research project has been supported by the Ministry of Science and ICT(National Research Foundation of Korea). Primary objectives include accurate diagnosis and analysis of rapidly changing weather conditions and ecosystems in the Arctic based on observation nodes, forecast of ripple effects on mid- and low-latitude regions such as the Korean Peninsula, and development of technologies designed to utilize useful substances from the Arctic.

This project has carried out using the database of environmental factors such as weather, soil, and vegetation that are accumulated over the years.

It is expected to identify the process for exchanging greenhouse gases between climate, permafrost layer and vegetation and to achieve spatial representation in combination with satellite exploration data, thereby improving the permafrost algorithm of climate models and improving the accuracy of prediction of future environmental changes.

In addition, centered on Arctic permafrost regions, this project will expand the areas of research activity by establishing observatory networks for Arctic climate research and contribute to advancing research in the relevant fields of study(air quality, permafrost, biodiversity research, and and transmission technology based on IOT).

Figure 1. Environmental research and monitoring activities in Cambridge Bay, Canada.

04
The Arctic in the Age of the Cold Rush

Exploring the Fjords of Svalbard, the Barometer of Climate Change

Changes in Environment and Coastal Geomorphology of Svalbard Fjords

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Up to 62% of the Svalbard archipelago is covered by glaciers and ice caps, which are highly sensitive to the global climate changes during the late Quaternary glacial-interglacial cycles. Situated in a relatively warmer part of the Arctic, the melting rate of the glaciers in Svalbard have recently begun accelerating, due to the combination of increasing inflow of the warm North Atlantic current and rising summer temperatures in the Arctic. Regarding their environmental vulnerability, the Svalbard fjords provide an excellent setting for mapping and investigating geologic and environmental consequences of the past and future climate changes.

In 2015, KOPRI launched a research project titled "Research on environmental changes in fjords and coastal geomorphology due to the erosion and redeposition processes of the Svalbard archipelago in the Arctic region" with the support of the National Research Foundation of Korea (NRF) and the Ministry of Science and ICT. The main objectives of this project are 1) evaluating and mapping geology and coastal geomorphology, 2) reconstructing environmental changes prompted by the Holocene climate changes in the fjord systems in Svalbard, and 3) developing paleoenvironmental proxies applicable the Arctic research. The first Korea-Norway joint expedition in 2016 yielded invaluable data and sediment cores preserving records of the Holocene and recent environmental changes in Dicksonfjorden, Isfjorden, Van Mijenfjorden, and Hornsund.

In 2017, our efforts to unravel the geologic and environmental histories of Svalbard extended to the fjords in northern Svalbard(Wiejefjorden, Woodfjorden, Lifdefjorden) and even beyond the edge of summer sea-ice cover in regions further north during the second Korea-Norway International Expedition on the R/V Helmer Hanssen(July 26 – August 1, 2017). The sediment cores collected during the expeditions allowed us to successfully interpret the Holocene history of fjord environmental changes driven by climate variations, such as changing sediment provenance led by the retreating tidewater glacier in Dicksonfjorden, as well as varying influences of the warm Atlantic water in the surface productivity and sea-ice distributions in Woodfjorden. We will continue to parse the mechanisms of environmental changes, such as sediment delivery, sea-ice formation, and glacial retreat, in the Svalbard archipelago in order probe the impacts of the future climate changes in polar regions.

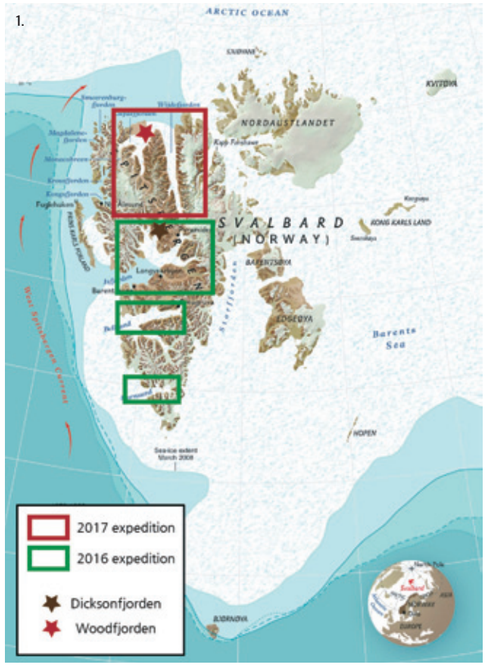

Figure 1. Map of the Svalbard archipelago showing the areas explored during the first(2016) and second(2017) expeditions and the fjords where the Holocene environmental changes are currently being investigated.

Figure 2. Images of a tidewater glacier in the Svalbard archipelago (a) and sediment core collection during the 2017 Korea-Norway International Expedition (b).

05
The Arctic in the Age of the Cold Rush

Near Real-time Monitoring of Arctic Sea Ice through Remote Sensing

Research on Analytical Technique for Satellite Observation of Arctic Sea-ice

Hyun Cheol Kim (kimhc@kopri.re.kr)

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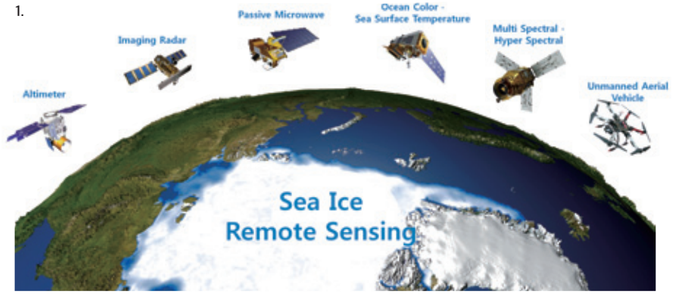

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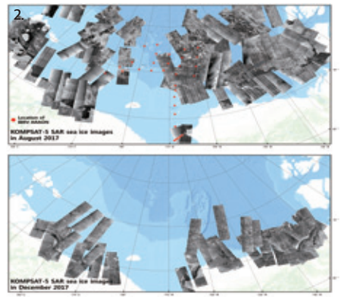

Figure 1. Arctic sea ice observation based on various remote sensing such as synthetic aperture radar, High-resolution Imagery (Multi-/Hyper- spectral), ocean color/sea surface temperature, passive microwave, altimeter, and unmanned aerial vehicle(Upper left).

Figure 2. Sea ice in the East Siberian Sea, Chukchi Sea, and Beaufort Sea in August and September, 2017 observed by KOMPSAT-5 SAR wide swath imaging mode(Upper right).

Arctic sea ice is a key indicator of climate change. It also plays a key role in the development of the new Northern Sea Route (NSR). Satellite remote sensing technology is a useful tool to conduct observations of sea ice in the Arctic Ocean. Therefore, developing appropriate techniques for processing and analysis to retrieve sea ice characters. from satellite data is necessary. A project launched i n 2017 at KOPRI to be completed in 2019, “Research on analytical technique for satellite observation of Arctic sea ice" consists of three objectives: 1) developing prototype satellite data archive/manage system for Arctic sea ice monitoring 2) advancing sea ice remote sensing data processing and analysis technique, and 3) contributing to efforts of international satellite observation network for the Arctic. For a successful accomplishment of sea ice satellite data analysis we have and will continue to collaborate with various research groups, industries, and academia.

This project will establish the STAR(Satellite remote sensing Team for Arctic and Antarctic Research)system, which will archive and manage in near-real time masses of remote sensing data acquired by various sensings such as synthetic aperture radar, high-resolution imagery(multi-spectral and hyper-spectral) ocean color/sea surface temperature passive microwave altimeter and unmanned aerial vehicle(UAV), etc.

Moreover, through the development of sea ice satellite data processing and analysis technology, this project will generate sea ice data necessary for climate change research and development of NSR and verify satellite-based sea ice data through field surveys carried out on ARAON. Finally, this project will establish a data receiving system of KOMPSATs (KOrea Multi-Purpose SATellites) for the polar regions by collaborating with KARI(Korea Aerospace Research Institute), and in so doing lay the foundation for international satellite observation network.

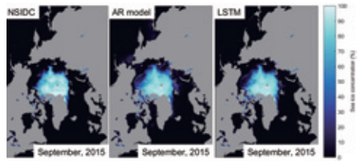

Figure 3. Predictions of September sea ice concentrations (SICs) by combining historical satellite data with a deep learning technique. (left) the observed SIC; (middle) the predicted SIC obtained using the AR model; (right) the predicted SIC obtained using the DL model.

06
The Arctic in the Age of the Cold Rush

Investigating Changes in Sea-ice Ecosystem via Monitoring the Carbon Assimilation Rate

Carbon assimilation rate of sea ice ecosystem in the Kongsfjorden MIZ, Arctic

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1.

2.

Figure 1. Photograph of observation activity on Arctic sea ice

Figure 2. Photograph of sea ice core sampling

Primary production in the Arctic Ocean had been assessed to be low due to extreme environmental conditions. However, recent research have shown that the Arctic sea ice ecosystem was found to have a very high carbon assimilation rate. Past studies of the sea ice ecosystem carried out by mainly Arctic countries reported that in the Arctic Ocean, the contribution of sea ice algae to the total primary production ranges approximately from 15 to 20%.

Change in production of sea ice algae is expected to increase with the first year ice in the future and necessity of re-evaluation will be emphasized. This project will focus on understanding the carbon assimilation rate of sea ice ecosystem and the carbon behavior depending on the growth stage in the Kongsfjorden marginal ice zone around the Arctic Dasan station in 2017 ~ 2019(Phase 1). During the study period, species diversity and the contribution of organic matter of the marine ecosystem in the Konsfjorden marginal ice zone and the carbon assimilation rate of sea ice algae will be evaluated and analyzed. This project will therefore advance understanding of the change of carbon assimilation rate by variation of sea ice ecosystem and the carbon behavior based on sea ice-ocean pCO_2 continuous observation system with the sea ice growth stage.

Figure 3. Sea ice algae attached on the bottom of sea ice

07
The Arctic in the Age of the Cold Rush

Investigating Earliest Animal Evolution through Early Cambrian Animal Fossils

Early Animal Evolution and the Primitive Earth System of Northern Greenland

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Most of the organisms that we call 'animals' arose in the fossil record about 540 million years ago at the beginning of the Cambrian Period, and underwent a radical morphological evolution to attain the great variety of morphological blueprints that we see today. The morphological origin of the modern animals, therefore, lies in the Early Cambrian animal fossils. However, only the hard part of the animals, such as bones and shells, can get fossilized in normal condition, and less than 14% of animal species have hard parts in the body. This means that about 86% of the animals usually do not leave a hint in the fossil record. Nevertheless, there are several fossil localities around the world which yield fossils that preserve details of soft parts, such as eyes, guts, and appendages. These localities include Burgess Shale of Canada, Chengjiang biota of China, and Sirius Passet of North Greenland.

In order to solve the mystery of the early animal evolution, Korea Polar Research Institute carried out a field expedition to Sirius Passet, North Greenland, and collected more than 6,000 specimens of diverse animal fossils from the Early Cambrian. The main research focus this year was on the early evolution of nervous system, including brain, in a stem-group arthropod. The newly collected specimens from North Greenland enabled us to reconstruct the almost complete shape of the stem-group arthropod(Fig. 1), which provides a clue to the morphological origin of arthropods, the most diverse animal group in the history of Earth. Significantly, some of the specimens preserve the remnant of the brain of the animal, which was detected by Carbon elemental map(Fig. 2).

Figure 1. A stem-group arthropod *Kerygmachela kierkegaardi* from North Greenland, and its artistic reconstruction.

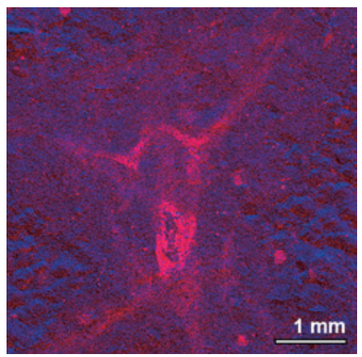


Figure 2. Carbon elemental map of the head region of *Kerygmachela kierkegaardi* in which the nervous system (brain) is recognizable.

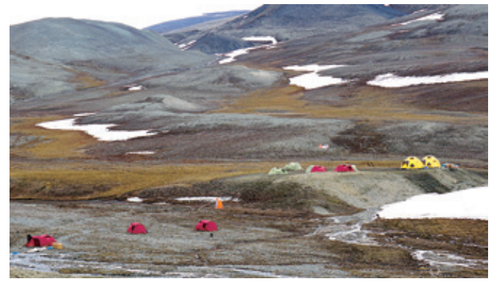


Figure 3. 2017 KOPRI field camp at Sirius Passet, North Greenland.

Sirius Passet of North Greenland is located above the 82°N, being the northern most terrestrial area even in the Arctic. This area is extremely remote; the closest human settlement is St. Nord, a very small Danish military Base, which is 390 km to the East. Due to its remoteness, most of the area has remained untouched by human activities. The expertise in the Polar regions, enabled Korea Polar Research Institute to successfully set up a field camp at Sirius Passet(Fig. 3). The summer temperature of this area soars up above 15°C rendering a favourable condition for field activity compared to other polar regions. The various Arctic environments of this area (Fig. 4) along with the affluent ecology have remained largely unstudied, providing plenty of research opportunities for the future.

Figure4. Ecology and the Arctic environment of Sirius Passet, North Greenland.

01

Future Values and Technology from Polar Resources

Undertaking a Range of Geophysical studies at Terror Rift

Characterizing Mantle Domain Beneath West Antarctic Rift System and Antarctic Mid-ocean Ridges

Yongcheol Park (ypark@kopri.re.kr)

Figure 1. Heat flow measurements at the Adare Trough. Heat flow values show they are higher than that of normal oceanic crust(s) (Stein and Stein, 1982).

The West Antarctic Rift System(WARS) is one of the largest active rift valleys lying between East and West Antarctica. The origin and development of WARS is closely linked to the formation of the Trans Antarctic Mountains, which stretches between the Ross Sea and the Weddell Sea with a total length of about 3,500 km. Because the western parts of WARS, however, are covered by thick ice, and the eastern parts of the WARS are developed under seawater, it is hard to understand its detailed structure. The phase I of this project(2014-2016) aimed for an understanding of the origin and development of WARS, and focused on the Balleny Island and the Adare Trough located on the northern tip of the WARS, and the Australian-Antarctic Ridge(AAR), which was developed as an extension of WARS. The results from this phase found that the geothermal values at Adare Trough were higher than the average value, which indicates that the mantle beneath the Adare Trough consists of hotter material than other areas. Through analyzing rock samples such as xenoliths from the KR1 and KR2 areas on the AAR, we found that the AAR is composed of characteristics that is uniquely of Antarctic mantle, different from those of the Pacific and/or Indian oceanic mantles.

In 2017, with the beginning of phase II of the project, we carried out various geophysical studies focusing on the Terror Rift, where tectonic earthquake events are highly active. Employing teleseismic data from Jang Bogo Station, we computed a three-dimensional P-wave seismic velocity model beneath the Terror Rift and Jang Bogo Station and found two low velocity anomalies beneath the Terror Rift and Mt. Melbourne area. As a result, we discovered a low velocity layer to be evident in the lower parts of the Terror Rift and confirmed that the rift activity oriented in the East-West direction was caused by hot mantle material from its buoyancy moving into the cold lithosphere and spreading in the East-West direction,

To compute a model with higher resolution and measure tectonic activities at the Terror Rift, 5 ocean bottom seismographs will be deployed during the 2017-18 summer Antarctic field season, and year-round data will be retrieved during the 2018-19 summer Antarctic field season. The retrieved year-round seismic data will provide a better understanding about the tectonics of WARS by generating better three-dimensional velocity models, locating precise tectonic events and their frequency, visualizing seasonal seismic noise patterns, etc. The KR3, unexplored area from AAR has also been investigated by a multibeam echosounder and a sub-bottom profiler. From detailed bathymetry, we found that KR3 consists of two separate ridges rather than one, and named them as the KR3 and KR4, respectively. During phase II of this project, we plan to investigate the origin, development and the relationship between WARS and AAR by carrying out seismic surveys, rock and mantle xenoliths sampling, and monitoring with geophysical instruments.

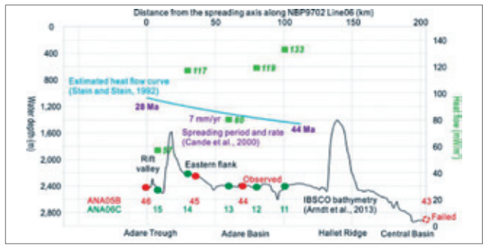


Figure 2. 200km depth profile from 3D P-wave velocity model. Red and Blue colors indicate relatively slow and fast regions, respectively.

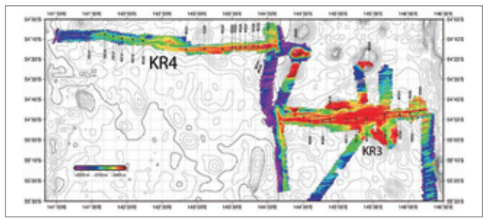


Figure 3. Deploying OBS in the 2016-17 summer Antarctic field season at Ross Sea.

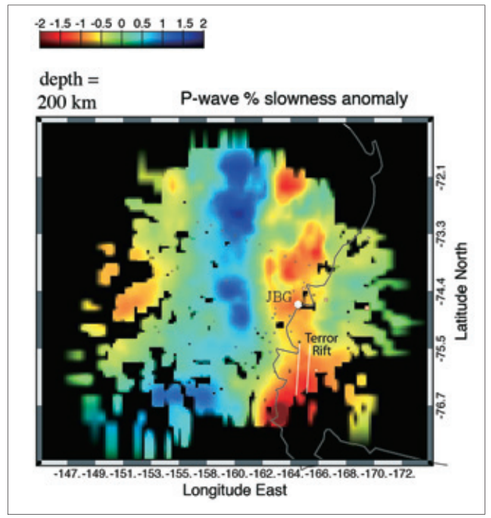


Figure 4. Multibeam echosounder image. New image shows two separate oceanic ridges(KR4 and KR3).

02

Future Values and Technology from Polar Resources

Illuminations of Aurora Research on Polar Upper Atmosphere

Understanding Polar Upper Atmospheric Changes via Energy Inputs from the Space Environment and the Lower Atmosphere

Geonhwa Jee (ghjee@kopri.re.kr)

Figure 1. Optical observatory of space environment at which an all sky camera and Fabry-Perot interferometer are installed for measurements of airglow emissions to monitor atmospheric waves and thermospheric winds and temperature, respectively.

In addition to light energy, various forms of energy are emitted from the Sun. They reach the Earth with solar wind, which interacts with the Earth's magnetic field to form the magnetosphere. When the solar energy enters the polar upper atmosphere, this causes a variety of phenomena such as aurora, ionospheric plasma convection and ionization enhancement, thermosphere heating, and chemical composition changes in the mesosphere and stratosphere. The polar upper atmosphere is also significantly affected by the lower atmosphere via atmospheric waves.

In order to understand the physical mechanisms of the changes in the polar upper atmosphere, it is critical to monitor various upper atmospheric parameters in the polar regions. We are currently operating a number of ground-based optical and radar instruments at Arctic and Antarctic stations, including michelson interferometers, Fabry-Perot interferometers(FPIs), meteor radars, all sky cameras, ionospheric digisonde(VIPIR), magnetometers, neutron monitor, GPS TEC/Scintillation monitors. This year, we added two more instruments at Antarctic stations. A FPI was installed at King Sejong station to expand the existing observations of neutral winds and temperature in the Mesophere and Lower Thermosphere(MLT) in collaboration with National Center for Atmospheric Research (NCAR), USA(Figure 1). At Jang Bogo Station, an all sky camera was installed to monitor visible aurora, which will be utilized to study the relationship between aurora and upper atmospheric changes responding to the energy inputs from outer space.

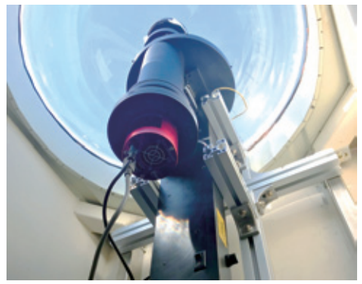


Figure 2. All sky camera to monitor visible aurora. It will provide valuable data for the study on the relation between aurora and upper atmospheric changes responding to the energy inputs from the outer space.

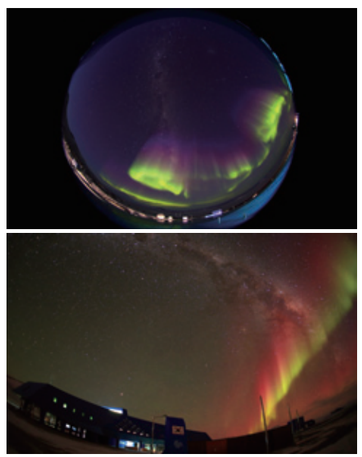


Figure 3. Various auroral images taken at Jang Bogo Station (JBS), Antarctica

03

Future Values and Technology from Polar Resources

Decoding the Genome of Polar Organisms as Resources of Increasing Value

Polar Genomics 101 Project: Genome Analysis of Polar Organisms and Establishment of Application Platform

Hyun Park (hpark@kopri.re.kr)

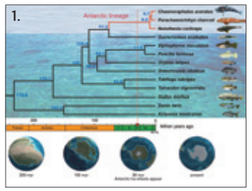
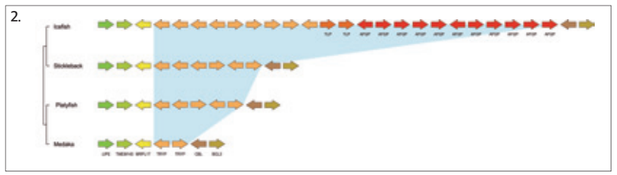


Figure 1. The phylogenetic tree of Antarctic fish and other teleosts. The phylogenetic tree was constructed from 3,718 one-to-one high-quality orthologous by maximum likelihood methods.

Figure 2. Gene synteny of icefish antifreeze glycoproteins comparing with other teleost.



Since the advent of continental glaciation and the cooling of the Southern Ocean ~38 million years ago (Mya), the Southern Ocean became thermally isolated and attained its present frigid temperatures(-2 to +2°C) by the mid-Miocene(14-10 Mya). Given this long unique evolutionary history and current environmental setting, the Antarctic biota provides many opportunities to address fundamental biological problems, in particular the links from genome to survival of organisms. Among these Antarctic biota, a unique group of fish inhabits the Antarctic Ocean where the waters are at their freezing point (-1.9°C)for much of the year. These fish, known to be difficult to handle, are classified as *notothenioids* or notothens in short. Within this group, there are approximately 120 species and they make up approximately 90 percent of the fish biomass in the Antarctic Ocean. These fish are interesting from an evolutionary point of view as they have evolved from a bottom dwelling fish lacking a swim bladder. This hypothetical ancestor gave rise to a variety of closely related species which differ in size, shape, color and occupy distinct ecological niches in the ocean. Studies of this group of fish are fascinating and important considering the fact that when the Antarctic Ocean cooled to a freezing point of sea water about 20-30 million years ago, the existing fish fauna became extinct except for a sculpin-like bottom fish, which gave rise to a diversity of fauna, closely resembling in appearance. We sequenced Antarctic icvefish, *Chaenocephalus aceratus*, using single-molecule, real-time sequencing technique with Pacbio sequl system and assembled high quality de novo genome. These results provide a unique opportunity and comprehensive information to study the adaptive radiation of Antarctic fish species in the Southern Ocean.

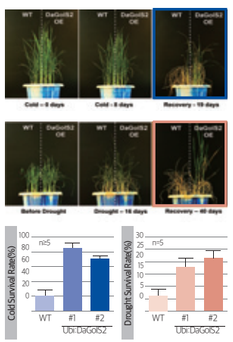


Figure 3. The cold (top row) and drought (bottom row) resistance phenotype of transgenic rices overexpressing *DaGolS2* originated from *Deschampsia antarctica*. *DaGolS2* overexpressing rice plants showed 3 fold and 2.5 fold higher resistance than wild type rice plants, under cold and drought stress conditions, respectively.

The representative Antarctic flowering plant *Deschampsia antarctica* is an attractive extremophile with important genetic resources for crop engineering for enhancing tolerance to environmental stresses. To elucidate the function of stress responsive genes, we have isolated *DaGolS2* gene related to the tolerance to cold and drought of *D. antarctica*, and used transgenic approach to investigate its function in planta. The transgenic plants overexpressing *DaGolS2* showed about 3 fold higher tolerance to cold and drought stresses compared to wild type rice plants, suggesting the potential for crop engineering to overcome environmental damages.

04

Future Values and Technology from Polar Resources

Assessing the Vitality of Polar Organisms' Metabolites

Commercialization of Useful Metabolites from Polar Organisms

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In order to commercialize metabolites, polar organisms were collected, the extract and metabolite libraries prepared and activities of the new metabolites measured.

Fifty lichens living near the King Sejong Station in Antarctica were collected in January and February of 2017, and 10 microorganisms were deposited to Korean Collection for Type Cultures.

Hundred-nineteen extracts of Antarctic lichen and fungi were obtained and 807 metabolic library data bases were obtained.

IC_{50} values against *Candida albicans, Staphylococcus aureus*, and *Escherichia coli* were measured in order to confirm the antifungal and antibacterial activities of lichen and fungus extracts obtained from Antarctica. Anti-inflammatory activities of curvularin derivatives from marine fungal extracts were verified(Fig. 1). Also, anticancer activities of 34 extracts of Antarctic lichen were confirmed.

Preliminary process was made for the technology transfer of the cold-active protease(P66), and autodimer formation of purified P66 was proved(Fig. 2).

In order to determine the cryopreservation effect of the anti-freezing extracellular polysaccharide p-CY01 on the blood, a large volume of blood pack was frozen and then thawed via p-CY01(Fig. 3). A number of 20L-scale fermentations were carried out to secure 2.3kg of p-CY01.

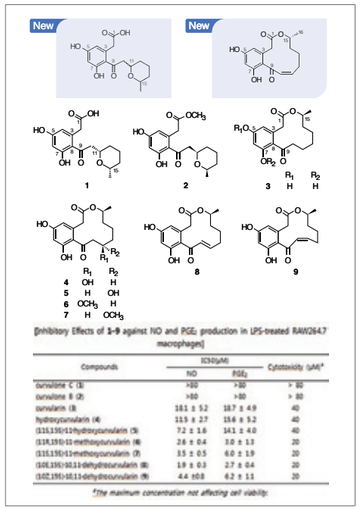


Figure 1. Molecular structure and activities of curvularin and its derivatives

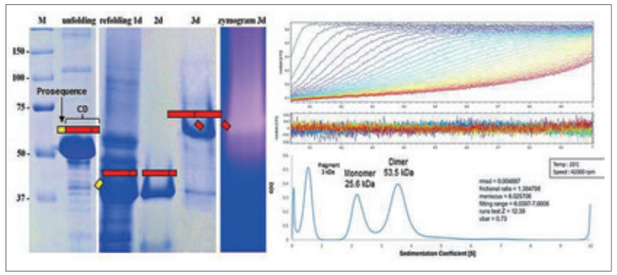


Figure 2. Verification of dimer formation of cold-active protease P66

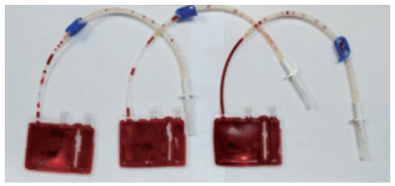


Figure 3. Cryopreservation of blood with extracellular polysaccharide CY-01

05

Future Values and Technology from Polar Resources

Securing Transport Route and Sampling for Antarctic Inland Research

The Antarctic Korean Route Expedition and Development of Technologies for Deep Ice Coring and Hot Water drilling / Crustal evolution of Victoria Land, Antarctica, and the formative process of planets

Jong Ik Lee (jilee@kopri.re.kr)

Figure 1. At 30Km of D1

Figure 2. K-Route Fleet

Recently, a number of international, large-scale, multidisciplinary research have been carried out on Antarctic inland in order to solve the global issues of climate and environmental changes.

In 2014, Korea Polar Research Institute(KOPRI) built the Antarctic Jang Bogo station, the second Korean Antarctic research station on Victoria land, East Antarctica. This was a landmark in Korean Antarctic research and field work. From 2017, KOPRI launched a new project for Antarctic inland research. This project includes: 1) expedition of traverse route into Antarctic inland, 2) development of Polar research facilities and technologies for inland research activities and 3) sampling of deep ice core and subglacial lake water and sediments.

As a first step, KOPRI set up a traverse system with two snow vehicles, one tracter, one fuel tank sledge, three cargo sledges, one living container, one excavator and two snowmobiles. The communication and navigation systems of all vehicles were modified for extreme Antarctic conditions. In 2017/18 field season, the traverse advanced 300 km from Jang Bogo station(titled D1 site). During the traverse, several safety guards explored the route before the traverse fleet and assigned safety attention level(SAL0 ~ SAL4) in order to avoid crevasses and secure a safety route. As for scientific issues, researchers sampled surface snow and 10m deep firn core for initial environmental examination(IEE) and repaired the automatic weather station(AWS) installed in D1 site. After the traverse, airborne geophysical surveys were carried out for the traverse in 2018/19 field season.

Subsequently, this project will continue to enforce the traverse fleet with several snow vehicles, sledges, excavators and develop new technologies for the operation of an insulation container and a temporary bridge for safe passage of crevasses.

Figure 3. Returning to Jang Bogo Station

06

Future Values and Technology from Polar Resources

Discovering New Industrial Materials from Polar Microalgae

Large-scale Production and Clinical Evaluation of Cell Protecting Substance(CPS) from Polar Microalgae

Sanghee Kim (sangheekim@kopri.re.kr)

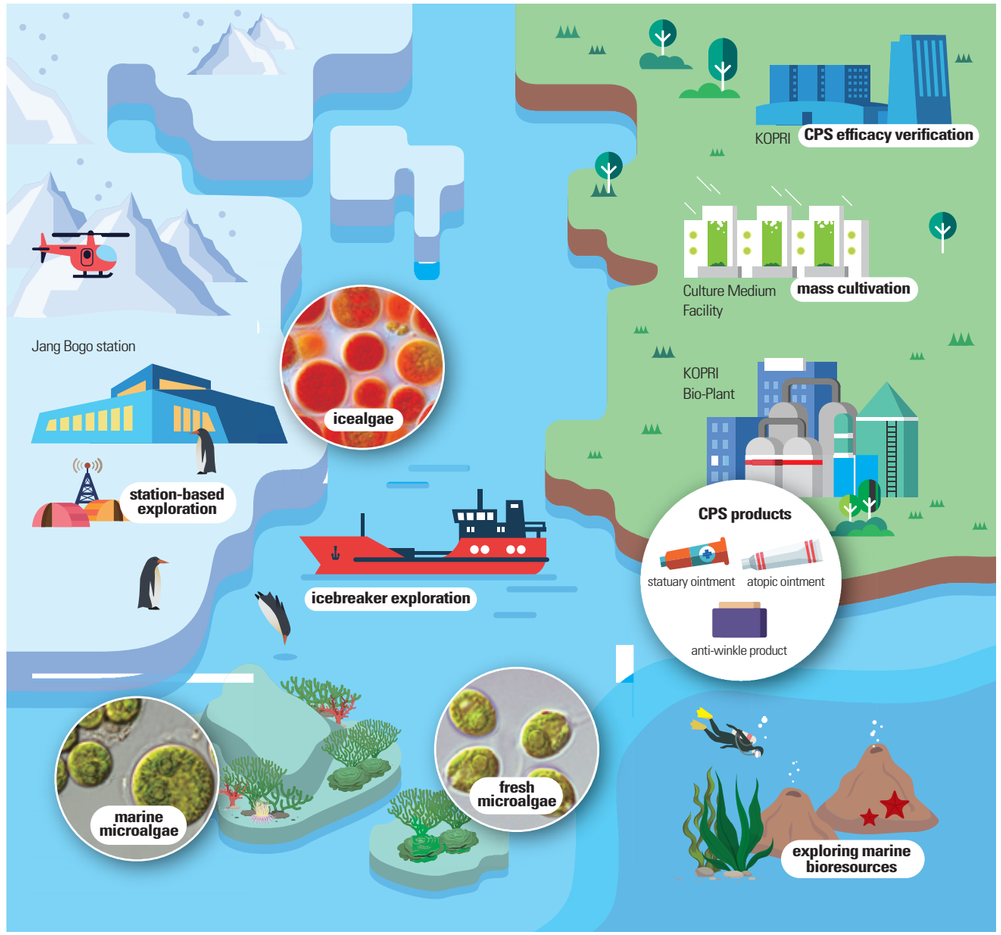


Figure 1. View of Polar microalgae for industrial application

* CPS:Cell protecting substance

Microalgae such as Chlorella and Spirulina have been used in various fields such as basic science and climate change research, alternative energy, food and medicines, and health supplement foods, and have become a feedstock for future biotechnology industry. Started in 2017, this project is the first to apply Polar microalgae. Through this project, we aim to expand the scope of application to the development of new medicine, starting with the development of "cosmeceutical" that combines cosmetics and pharmaceuticals, and lay the foundation for the practical application of "Polar bio-material."

A cell line test was conducted on more than 100 strains of microalgae that have been collected from the Antarctic and Arctic and cultured for more than 10 years. From the results of treating microalgae extracts with malignant skin disease cells and cancer cells, they were confirmed to have anti-cancer and inflammatory components with no toxicity on normal cells. Two of them have shown superior antioxidative and anti-inflammatory properties than the Sangwang mushroom and Korean kiwi extracts, which have been commercially proven. Other strain extracts inhibited MMP-1 induced by oxidative damage and increased hyaluronic acid, which has been shown to reduce cell damage and wrinkles from ultraviolet rays.

We have succeeded in mass cultivation of 1 ton of each Polar strain, which was the first task to complete for industrialization, and produced a microalgae transformant containing a cold activated promoter isolated from Polar organisms.

By identifying the high environmental defense ability and metabolic activities of the Polar microalgae prospering in harsh polar habitats, we have completed the first step in going beyond basic research on Polar microalgae.

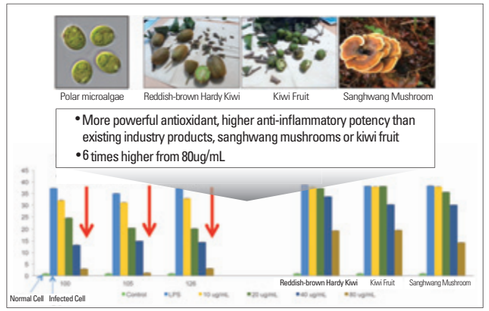


Figure 2. Comparison of antioxidant and anti-inflammatory effects of Polar microalgae

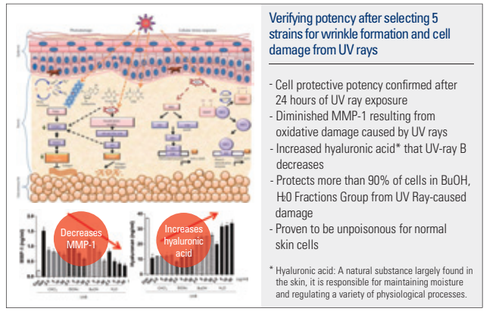


Figure 3. Polar microlage extract effectively blocks UV damage

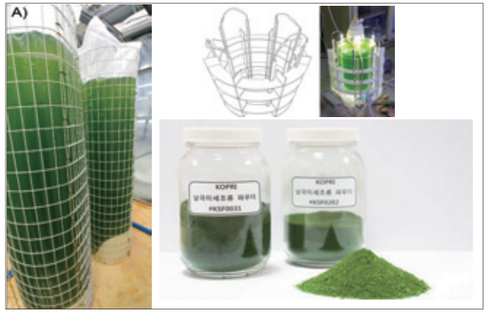


Figure 4. Mass culture system and dried powder produced

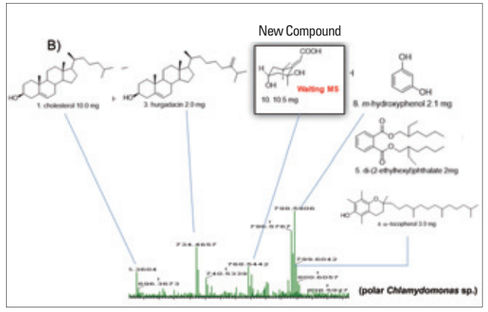


Figure 5. New compounds extracted from polar microalgae

01
PAP&PIP

Producing Outstanding Research Performance and Specialized Professionals in Partnership with Universities

Overview of Domestic Polar Academic Program(PAP)

To promote polar scientific research in Korea, KOPRI launched the Polar Academic Program (PAP) through which a research fund of 1 billion KRW is granted to Korean universities for joint collaborative research to be conducted between academia and research institutes.

The goals of PAP include: discovering creative ideas for polar research; conducting field-based polar research by allowing accessibility and joint use of polar infrastructure(Antarctic and Arctic research stations and icebreaker Araon); and fostering the next generation of researchers specializing in polar science.

Since 2010, this program has supported a total of 19 universities and two research institutes in Korea for research. In addition, 56 students in master's programs and 62 in doctoral programs participated in PAP over the past three years(2015-2017), thereby solidifying the foundation for polar research and polar experts. The program also generated outstanding results in terms of academic papers in polar science: 16 out of 35 SCI-level papers obtained a standardized impact factor of 80 points or higher.

In 2017, a total of 13 polar research projects drew the participation of 80 researchers(26 doctoral degree holders; 24 master's degree holders; and 30 bachelor's degree holders) from eleven universities across Korea.

Timeline for a New PAP Project (to be prepared by the Project Development Team)

February – March
Announcing a new project and receiving applications

April
Selecting and assessing the new project

By May 1
Entering into an agreement for the new project and launching the project

Areas of Recruitment in a New PAP Project

Classification	Major content
Polar-GeoScience	Area related to polar geoscience, including rocks, geological features, and Antarctic meteorites in polar regions.
Polar-BioScience	Area related to polar bioscience, including polar ecosystems and life in polar regions.
Polar-OceanoScience	Area related to polar marine science, including sea ice and atmosphere in polar regions.
Polar-Paleo/CryoScience	Area related to paleoclimate and permafrost in polar regions, including polar glacier, submarine sediment, and restoration of the paleoenvironment.
Polar-Atmo/Cosmo Science	Area related to polar climate and space science, including lower/upper atmosphere, space environment, and satellite science.

Polar Academic Program (PAP) in 2017

Project Title	Project Investigator	Period
Extraction of grounding line of Antarctic ice shelves in high resolution using satellite multisensor data fusion	Kim, Duk-jin(Seoul National University)	'16.06.01 ~'17.05.31
Studies on the change in polar marine inorganic carbon cycle in response to sea ice melting and formation	KIM TAE WOOK(Incheon National University)	'16.06.01 ~'17.05.31
Magnetism of Chondrites: Implications for the evolution of Planetesimals	YONGJAE YU(Chungnam National University)	'16.06.01 ~'17.05.31
Development and application of protist DNA barcode for polar marine host-parasite identification	Jung Jae-Ho(Gangneung-Wonju National University)	'16.06.01 ~'17.05.31
Development of damage-tolerant TRIP high-entropy alloys for sustainable arctic materials	Eun Soo, Park(Seoul National University)	'16.06.01 ~'17.05.31
Highly precise and assured navigation system for unmanned explorations in the polar regions	Jiyun Lee(KAIST)	'16.06.01 ~'17.05.31
The impact of climate change on the life of Inuit in case of Nunavut, Canada	Seung Ho Lee(Konkuk University)	'16.09.02 ~'17.05.31
Understanding the process of polar shrub expansion using the Ecosystem Demography Model	yeonjoo.kim(Yonsei University)	'16.09.02 ~'17.05.31
Study on behavioral characteristics of tardigrade using microfluidic chip	Sung hyung jin(KAIST)	'16.09.02 ~'17.05.31
Establishment of CSF expression in arctic Chlorella sp. via genetic transformation	Kim sung ryong(Sogang University)	'16.09.02 ~'17.05.31
Identyfying sources of methylmercury in arctic Sea using a mass flus model	Seunghee Han(GIST)	'16.09.02 ~'17.05.31
Test of underwater obsevation data transfer system using a pop-up buoy in extremely severe environment	Jae-Hun Park(Inha University)	'16.09.02 ~'17.05.31
Study of radioactive isotopes for environmental samples from Antarctica	HAHN INSIK(Ewha Womans University)	'16.09.02 ~'17.05.31

02
PAP&PIP

Pioneering New Polar Industries with Participation of Specialist Companies

Overview of Domestic Polar Industrial Program(PIP)

KOPRI has been conducting the Polar Industrial Program(PIP) with an annual research fund of KRW 600 million. The objectives of this industry-research institute collaborative research program include: ensuring research excellence in Polar regions by developing equipment and technology necessary to conduct Polar research and commercializing such equipment and technology to create new Polar industries and support small and medium-sized enterprises.

The two projects carried out in 2017 were promoted by small businesses to develop systems and equipment required by KOPRI and to utilize them in polar regions.

Timeline for a New PIP Project (to be prepared by the Project Development Team)

February Selecting technology items

March Conducting planned research

April Preparing a request for proposal(RFP)

May Announcing the project; selecting participants; and launching the project

Polar Industrial Program(PIP) in 2017

Project Title	Project Investigator	Period
A development of ice-penetrating radar (IPR) for internal ice structure analysis	Seung-Ha Shin (U-Tel Co., Ltd.)	'17.11.01 ~'18.10.31
Development of advanced technology for underwater rock drilling and obtaining a rock core in deepsea(1,000M)	Ho Kyung Jeon (Shingyang Technology Co., Ltd.)	'17.12.29 ~'18.12.28

RESEARCH INFRA STRUCTURE & RESEARCH SUPPORT

The Antarctic
King Sejong Station

Managing Maintenance of New Research Facility and Supporting Research Activities

Leader of the 30th overwintering team
Seong Joong Kim (seongjkim@kopri.re.kr)

Once the 17 members of the 30th overwintering team had been finalized, the team participated in the dispatch ceremony on October 18th, 2016. Subsequently, the team underwent training for Polar environment in Busan for one week, solidifying teamwork and necessary safety knowledge. We departed Incheon airport on November 27th and arrived at the Antarctic King Sejong Station on December 8. Once all necessary information was exchanged with the 29th overwintering party, we officially commenced our duties as the 30th overwintering party(figure 1).

In the summer of 2016 to 2017, more than 50 construction workers stayed in the station until the middle of April in conjunction with the construction of the new research center. During the construction period(from December 2016 to mid-April 2017), as much as 107 people stayed at the station, from Korean researchers, summer support staff and maintenance staff. Due to the low level of snowfall, there was a slight discomfort with the low supply of water to be shared among the many people. Due to the construction work for the new building, the generator was often overloaded, which caused a certain level of unease; sometimes, two generators had to be operated at the same time. During the construction work, there unfortunately was one person that got injured, who had to be immediately transported to Puntas Arenas as a case of emergency. This all being said, despite the various forms of difficulty and inconvenience that had to be endured, 95% of the construction work could be completed for the new research building(figure 2).

The biggest task of the 30th overwintering party in 2017 was the maintenance of the new research building facilities. As the construction work was not fully complete, it was necessary to safely maintain the facilities until the end of the construction in December, 2017 for it to be soundly passed-over to the next party. In spite of the accumulation of dust from the unfinished construction work that inevitably resulted in a poor working environment, the hard-work of party members allowed for all furniture to be prepared by mid-September. a point much earlier than expected(figure 3),

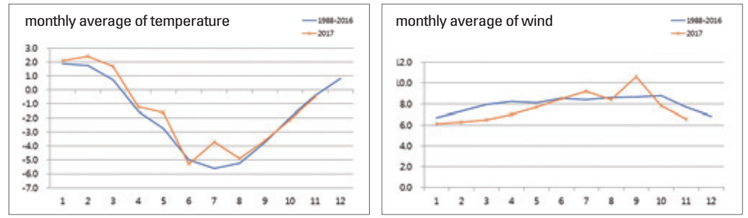


Figure 4. Comparison of monthly average of temperature (left) and wind (right) in 2017 and previous years (1988-2016)

In terms of weather conditions during 2017 summer, low levels of rainfall resulted in weather that was a lot drier than other years. Blizzards came from April and increased in occurence once temperatures fell in late June, but once temperatures rose in July, snow fell mixed with rain. However, as temperatures dropped from August to early October, the Marian Cove stayed frozen. During the winter season, although the wind speed was relatively higher than other years, relatively weak west wind series resulted in raising temperatures.

During the winter months, party members in marine research could successfully conduct water sampling and CTD measurements with the active support of other members. Members in atmospheric and upper-atmospheric research had a lot of equipment to maintain. They inspected all equipment and backed up all data on a daily basis. Members in biological research conducted Gaya Hill soil sampling and measurement of wastewater conditions. A member in geological research installed cameras all around glacial walls of the Marian Cove to detect changes, regularly shooting and backing-up the captured footage. As leader of the research team, he coordinated the schedule of all research support crew for the summer research team all the while successfully editing "Snow Land, Ice Land".

International cooperation was also very active. During the summer months, our party was proactive to participate in the events of neighboring stations(i.e. anniversary celebrations) to maintain good relations. On the 30th anniversary celebration of Sejong Station, many guests from neighboring stations were invited, where we shared our traditional Korean food and culture. In late May, party members participated in championship games at a sports event hosted by the Chilean army in Fildes Station. In July, member joined a special event for camaraderie, the Antarctic Olympic games hosted at the Frei Station by the Chilean Air Force(figure 5).

Figure 1. The 30th overwintering team at King Sejong Station

Figure 2. Station view from the new research facility

Figure 3. Furniture building in the new research facility

Figure 5. With the participants of the Antarctic Olympics

The Antarctic
Jang Bogo Station

Station Stabilization through Facility Reinforcements and Enhanced Maintenance

Leader of the 4th overwintering team
Jeong Han Yim (jhyim@kopri.re.kr)

In 2017, the 4th overwintering team was dispatched to the Jang Bogo Station, consisting of 17 members for three sub-teams: maintenance, research and general management. After arriving in the Antarctic on November 8th, 2016, for 12 months, we supported the summer research team and worked to maintain station operation, after which we departed the Antarctic on November 6th, 2017.

During the 2016~2017 overwintering period at Jang Bogo Station, 650 tonnes of gas, 55 containers, station supplies, 111 summer research and support crew were transported to Antarctica through 7 operations of a rented airplane, 2 operations of an Italian supply ship, 3 operations of Araon and 4 operations of helicopter. Particularly, for the first time ever at Jang Bogo Station, the 3rd round of supplies from Araon were unloaded by water, which proved the possibility of unloading large quantities of goods and gas during seasons without sea-ice.

The main mission of the 4th overwintering team at Jang Bogo was to stabilize station operation. To carry out this mission, we carried out a variety of tasks to fortify and better maintain research facilities in Jang Bogo infrastructure.

The first task was to support "2016/2017 Antarctic summer research'. For atmospheric research, equipment for greenhouse gas analysis and aerosol sampling, inlet and outlet pipe for aerosol sampling equipment, ionosfera send/receive antenna and internal radar equipment for space climate observation, radon detector, a sun-photo meter for joint research with the Italian station during the summer, AWS at the Work Tower were installed, Electrical improvement for AWS installed in the Atmospheric Substance Observatory.

Figure 1. The 4th overwintering team to Jang Bogo Station

Overwintering team members also supported the operations of the weather research team, penguin research team(Cape Hallett), glacier research team(Styx Glacier), geophysics research team(Morris Basin) and SODAR(Sonic Detection and Ranging).

For the space research team, 2 whole-sky cameras and a magnetometer were installed while a ionosfera antenna was repaired. For geophysics research, support was given to the GPR expedition in search of crevasses, while installation and maintenance of geophysical observational equipment (installed GPS, Amigos system, seismometer, Infrasound, super conductive gravimeter) was carried out.(MT expedition was carried out)

For oceanographic research team, support was given to netting operations and summer research team. Also, CTD surveys at a total of 25 stations and station drainwater surveys were conducted.

Team members also carried out installation of solar panels, sump freshwater supply line, pipeline housing on outdoor pipeline to prevent freezing, automatic door to prevent inflow of snow, waste disposal facility (huller, can compressor), removable rack for refrigerator and freezer, as well as renovating work facilities in the machine room, replacement of wastewater filter, installation of a large, office-use humidifier, construction of an automatic generator and other repair work for station maintenance. Weather conditions in 2017 showed a similar pattern to conditions in 2016.

Mean, High and Low Measurements of Elements (2017.1.1 ~ 12.31)

Elements / Months	Pressure (hPa)			Temperature (°C)			Wind speeed(m/s)		Moisture (%)	
	Mean	High	Low	Mean	High	Low	Mean	Max. Instant.	Mean	Low
1	993.85	1003.9	969.8	-1.24	4.5	-8.5	4.16	24.3	62.9	20
		14 days	3 days		3 days	19 days		12 days		2 days
2	990.1	1007.1	977.5	-5.94	2.2	-15.4	5.1	33.5	53.3	25
		28 days	20 days		9 days	27 days		16 days		20 days
3	990.01	1008.9	980.7	-13.27	-2.6	-23.5	5.8	28.5	59.2	26
		1day	21 days		2 days	29 days		14 days		2 days
4	985.9	999.1	971.6	-20.49	-9.6	-29.2	3.6	32.1	54.3	21
		29 days	10 days		3 days	19 days		12 days		27 days
5	979.96	1002.1	967.2	-18.41	-5.6	-29.9	5.9	37.2	51.0	20
		25 days	14 days		16 days	9 days		19 days		5 days
6	985.47	1003.1	966.9	-23.44	-7.8	-35.4	3.5	27.1	52.6	20
		29 days	17 days		1 days	28 days		26 days		1 days
7	982.58	1005.8	968.8	-23.51	-7.3	-33.7	5.4	35.0	51.3	17
		23 days	21 days		1 days	31 days		14 days		1 days
8	978.31	998.1	953.1	-23.5	-4.9	-36.4	5.1	36.4	53.0	17
		18 days	22 days		9 days	29 days		8 days		5 days
9	981.06	999.2	963.3	-23.71	-6.8	-35.9	4.2	33.0	53.0	14
		7 days	1 day		18 days	1 day		18 days		18 days

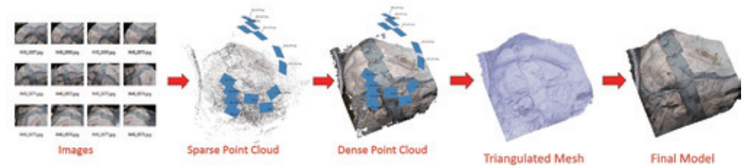
Figure 2. Piloting a barge

Figure 3. Sea ice survey

The Arctic
Dasan Station

Supporting Safe Research Activities in the Arctic

Station SupportTeam



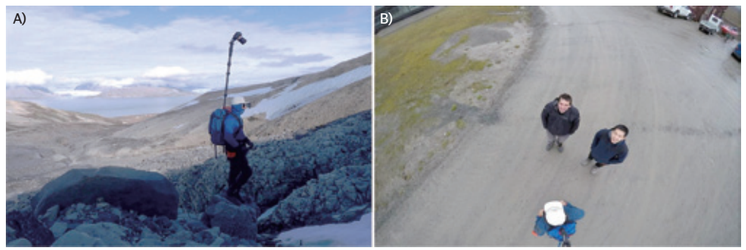


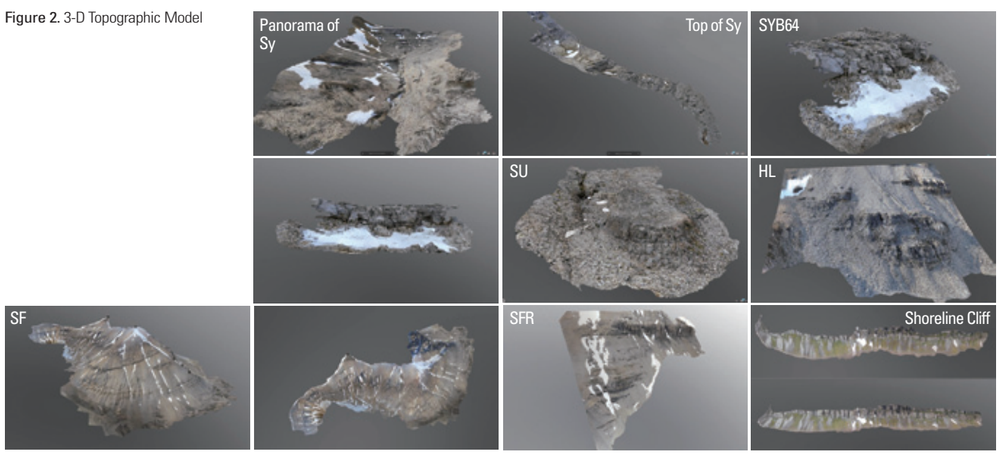
Figure 1. Diagram capturing the making of the 3-D Topographic Model and field operations(A, B)

In the summer of 2017, 75 researchers(including 45 external researchers) from KOPRI and 21 other organizations visited the Arctic Dasan Station to conduct summer research activities. The research activities commenced on March 10. Before the beginning of the summer season, a support team was deployed to prepare for the summer research activities and to inspect the maintenance status at the station. By doing so, the team established a suitable environment to facilitate the researchers' summer stay and research.

Particularly during this summer, with the launching of a new research project that assesses the carbon absorption factor of marine ecosystems in the Kongsfjorden Marginal Ice Zone(MIZ) near the Arctic Dasan Station, sampling and analysis of basic marine data in Kongsfjorden were carried out. In addition, experiments and surveys were conducted to test and assess technology that the Korean(KICT) needs to build for oil sand plant buildings in the extreme conditions of the Arctic. Field surveys were also conducted to identify the changes in paleo-environement and regulatory factors recorded in mud deposits of the Late Paleozoic age near the Arctic Dasan Station. A three dimensional terrain model of the main sections was produced.

In addition, active research was conducted during the summer season, not only at the Arctic Dasan Station, but also in Council, Alaska in the United States; Cambridge Bay in Canada; the East Siberian Sea; and the Northwest Arctic Ocean.

Figure 2. 3-D Topographic Model



The Ice-Breaking Research Vessel (IB/RV) Araon

Traversing the Antarctic and the Arctic on Research and Supply Cruises

Ship Operation Team

In 2017, the ice-breaking research vessel Araon was operated for a total of 277 days(209 days in the Antarctic, 68 in Arctic) for research cruise and station supply support.

In 2016/17, Araon departed from Lyttelton Bay, New Zealand on December 29th, 2016 to embark on the Antarctic cruise to Ross Sea, Antarctica and after completing a total of 4 research projects, "Reconstructing Antarctic ice sheet and ocean history for the past two million years using sediment records", "Characterizing mantle domain beneath West Antarctic Rift System and Antarctic mid-ocean ridges", "Pilot survey for a channel investigation and production of nautical chart in Antarctica", 'Investigating Cryospheric Evolution of the Victoria Land, Antarctica -ICE-', returned to Lyttelton Bay on February 27th, 2017. Afterwards, Araon departed Lyttelton Bay on February 27th for the 3rd leg of the Antarctic research cruise, carrying out the research project "Reconstruction of Antarctic ice sheet and ocean history for the past two million years using sediment records" in the Bellingshausen Sea, after which it arrived in Punta Arenas, Chile on April 6th, 2017. For the 5th leg, Araon left Puntas Arenas for Sejong Antarctic Station to transport construction staff for the expansion work at the Sejong Station back to Puntas Arenas. After completing the 5th(final) leg of the Antarctic cruise, it returned to Korea on May 24th.

After completing 209 days of Antarctic cruise, Araon was docked and underwent a 16-day repair at the Yeosu Shipyard. After dock repair, a mock cruise was carried out for a total of 17 days to test research equipment near the Ulleung Basin of the East Sea and Oedo Island. After completion of the mock cruise,

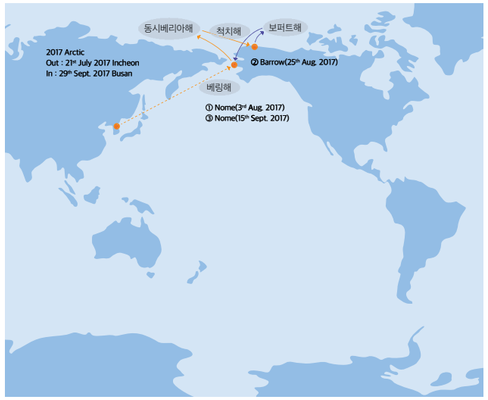


Figure 1. 2017 Arctic Cruises

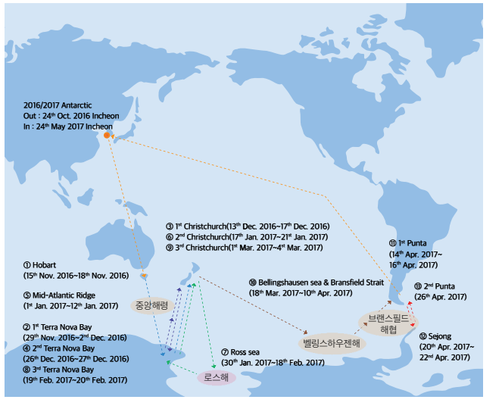


Figure 2. 2016/2017 Antarctic Cruises

Araon was anchored at the Incheon Port from July 5th to 21st for loading of research equipment, general reapir, loading of housekeeping supplies and preparation of the 2017 Arctic cruise. From July 21st to September 29th, 2017, Araon was operated in the Arctic Ocean.

The 1st leg of the Arctic Cruise covered the Bering Sea, Chukchi Sea, and East Siberian Sea to carry out research for 3 projects, "Korea-Arctic Ocean Observing System(K-AOOS)", "Research on analytical technique for satellite observation of Arctic sea ice", and "Development and Application of the Korea Polar Prediction System(KPOPS) for Climate Change and Disastrous Weather Events". The 2nd leg carried out the research project, "Investigation of submarine resource environment and seabed methane release in the Arctic".

After completing the Arctic Cruise, Araon had approximately 1 month of preparation time for the Antarctic cruise, embarking on October 26th, 2017 for Antarctic cruise. The 1st leg was operated to transport supplies for the Jang Bogo Station. After passing through Hobart, Australia and Lyttleton, New Zealand to bring supplies for the overwintering team, heavy equipment as well as employees, it returned safely to New Zealand. Afterwards, it departed on December 21st for the 2nd leg of Antarctic research cruise in Amundsen Sea. In 2017/18, there were a total of 4 legs for the Antarctic cruise and upon completing the 3rd leg in Ross Sea and 4th leg in the Antarctic Peninsula, Araon is planned to return to Korea on June 10th, 2018.

Figure 3. 2016 Araon Research Work in Sea Ice

International Cooperation Centers-Chile

Enhancing Korea-Chile Cooperation for Antarctic Activities

Korea-Chile Antarctic Cooperation Center
Dong Min Jin (dmjin@kopri.re.kr)

Korea has developed its cooperative relations with Chile in Antarctic activities since the establishment of King Sejong station in February 1988. In 2012, KOPRI and Instituto Antártico Chileno (INACH) adopted a Memorandum of Understanding (MOU), and upon the 2015 Bilateral Summit between the two nations, exchanged a Letter of Intent (LOI) to reinforce cooperation, specifically by establishing the Korea-Chile Antarctic Cooperation Center. Based on the annex to the MOU signed between the two institutions, the Center was inaugurated within the INACH building. From October 2016 to October 2017, KOPRI dispatched Mr. Dongmin Jin as the director of the Center, where he surveyed the Antarctic field activities and researches carried out by Chile and other Antarctic nations. As a part of its mission, the Center also focused on understanding the current developments in Arctic policy, formulated and undertook joint research between INACH and KOPRI, assisted the supply operations for the Antarctic King Sejong Station and supported pre/post-field research activities in Punta Areas.

In December 2016, the President of INACH visited KOPRI and had discussions on enhancing the Korean-Chilean cooperation. In January 2017, a delegation from the Korean government visited INACH and had the opportunity to hear about the developments and plans for furthering Korea and Chile's scientific cooperation. In April 2017, President of KOPRI, Dr. Ho Il Yoon visited Punta Arenas, where he met the president of the University of Magallanes to discuss measures for research collaboration. The visit led to a bilateral workshop which took place in May, 2017 in Incheon, where scientists from INACH and the Research Center Dynamics of High Latitude Marine Ecosystems (IDEAL) participated to discuss the cooperation measures for paleooceanic, paleontological, marine ecological, terrestrial ecosystem research.

In April 2017, when the IBRV Araon entered the Port of Punta Arenas, scientists and students from INACH and University of Magallanes were invited to an Open Ship Day, through which bilateral cooperation could furthermore be promoted. In both November 2016 and June 2017, the Center director participated in the "Antarctic School Fair," a Chilean educational program for the Antarctic, where Mr. Jin gave a lecture introducing Korea's research activities in the Antarctic and the opportunities to visit the King Sejong Station, as well as highlighting the importance of international cooperation in the Antarctic. These efforts built the foundation for strengthening the Antarctic cooperation activities. In addition, the Center introduced Korea's activities in the Antarctic to other nations carrying out Antarctic activities via Punta Arenas and discussed cooperation opportunities while also supporting a variety of operations for summer research activities at King Sejong Station and on IBRV Araon.

Figure 1. A Chilean student and the Antarctic Explorers visiting the Sejong Station

Figure 2. Chilean participants in the Korea-Chile Joint Workshop

International Cooperation Centers-Norway

KOPRI-NPI : Taking part in active and diverse forms of engagement

KOPRI-NPI Cooperative Polar Research Center (Norway)
Yoo Kyung Lee(yklee@kopri.re.kr)

The KOPRI-NPI Cooperative Polar Research Center was established in April 2014 at the Fram Center in Tromsø, Norway, to promote cooperation between KOPRI and the Norwegian Polar Institute (NPI), an institute that is most active in carrying out research in Svalbard, where the Arctic Dasan Research Station is also located.

From May 17 to November 20, 2017, Dr. Yoo Kyung Lee was dispatched to the Center as the director, where she conducted field research activities and monitored policy developments of Norway, together with other Arctic nations, Dr. Lee also explored and developed joint research opportunities between KOPRI and NPI, as well as supporting supply and research operations for the Arctic Dasan Station. In-depth discussions on research cooperation measures with the biodiversity research team at NPI were carried out, specifically in relation to the Climate-ecological Observatory for Arctic Tundra (COAT) project. Furthermore, following a meeting with the executive officer of CliC (Climate and Cryosphere), information on opportunities for research collaboration in the CliC project was disseminated with Korean researchers. Dr. Lee also introduced the sub-Arctic plants around Tromsø to the participants of "21Century Dasan Juniors" program, an Arctic study-explore program for Korean high school students. She also supported the visit of the Korean Ambassador to Norway to NPI and the Arctic Council Secretariat, through which developments and future plans for Korea and Norway's bilateral cooperation were shared.

During her term, Dr. Lee observed and photographed 84 species of sub-Arctic plants belonging to 34 families inhabiting Tromsø and its neighboring regions. Also, she edited a collection of stories and research accomplishments of 25 Arctic researchers in a book titled "Arctic Note", and wrote an additional volume introducing Arctic vegetation in English.

Figure 1. Seminar presentation at NPI.

International Cooperation Centers-New Zealand

Figure 1. Over 500 Christchurch citizens visit Araon in Lyttleton Harbor on open ship day in early March 2017.

Figure 2. KOPRI president, Ho Il Yoon, city council members, and many local Antarctic collaborators attend the opening ceremony of Araon's open ship event held in Lyttleton Harbor in early March, 2017

Expanding and Promoting Korea-New Zealand Joint Research with Local Communities

Korea-New Zealand Antarctic Cooperation Center
Yeadong Kim(ydkim@kopri.re.kr)

The Korea-New Zealand Antarctic Cooperation Centre was established in November 2011 at the International Antarctic Center in Christchurch, New Zealand to support the research activities of the Jang Bogo Antarctic Station inaugurated in February of the same year at Terra Nova Bay, Ross Sea, Antarctica. The main tasks carried out at the Centre includes surveying major Antarctic field activities, understanding the research and policy developments of New Zealand and Oceania, supporting the supply operations for Jang Bogo Station and research activities in New Zealand. Ever since the founding of the Centre, the scope of joint research activities has been continually expanding; having begun with crysopheric and paleoenvironmental research, it now includes ecological research in the Ross Sea and technology development for hot water drilling. Particularly, a research camp for a joint ecological research in the Ross Sea was successfully set-up in Cape Adare and Cape Hallett through joint air operation. In addition, an LOI between KOPRI and NIWA was completed for joint research between New Zealand's RV Tangaroa and IBRV Araon.

The Centre established a vital platform of cooperation with Christchurch, a city that functions as a gateway to the Antarctic, by actively engaging with Antarctica New Zealand, of which office was newly set-up by Christchurch's City Council. Korean Antarctic activities were introduced to the New Zealand's public through "Christchurch Antarctic Talks", a series of presentations organized by the University of Canterbury, which allowed for Korean Antarctic activities to be shared and promoted. In early March 2017, an Open Ship Day was organized at IBRV Araon at the port of Lyttleton in cooperation with the city of Christchurch. A total of 500 New Zealanders participated in the event, where they shared Araon performance as an ice-breaking research vessel and the accomplishments of Korea's Antarctic research.

Station Support

Ensuring Field Safety and Stable Station Operation

Station Support Team

Figure 1. Polar Safety Training

Figure 2. Airstrip Exit Sign User Training

In 2017, the Station Support Team focused on strengthening safety and research support in the operation of Polar infrastructure and research activities. To deal with emergency situations in which a person must be immediately transported from the Arctic or Antarctic research stations for medical assistance, we put together a protocol for medical evacuation. We composed the protocol after collecting information on the list of internal and external emergency contacts, evacuation route, transportation method to the nearest city from each of the Polar research stations, as well as taking into account the operational environment, accessibility conditions for airplane operations and other relevant factors.

To promote the safety of field workers the Polar research stations, the Polar safety training program was executed for a total of 12 times. In cooperation with the Gil Hospital of Gacheon University, process of medical assessment for field workers engaging in Polar activities was also enhanced. At the Jang Bogo Station, a MOSKIT air strip was prepared for the take-off/landing of airplanes in emergency situations and a mock drill was executed with the 5th overwintering party.

Centering on Jang Bogo Station, airplane and helicopter operations were expanded. Also, in order to improve efficiency of gas usage, we inspected the technology required to replace Generator Oil with air fuel. As a result, from 2018, we have replaced Jang Bogo Station's supply of Generator Oil with air fuel.

At the Sejong Station, the first stage of construction work for the improvement of main facilities and research environment was completed. Summer research facilitiy and gas tanks were newly built in place of old facilities.

The communication system was improved for sound station operations. Specifically, to secure a stable communication network, the speed of the satellite internet was increased to 2 MGB in cooperation with KT,

In 2017, the 30th overwintering team(leader: Seong Joong Kim) worked at the Sejong Station, while the 4th overwintering team (leader: Jeong Han Lim) worked at the Jang Bogo Station for a total of 13 months, and returned home after successfully completing overwintering duties.

For the discussion of key, relevant affairs in the operation of polar infrastructure, as well as exchange of ideas and point of views among the various teams involved, the second open forum for the operation of polar research infrastructure took place. A total of 45 members participated in the forum, and discussion topics included the medical evacuation protocol, guidelines on helicopter operations for research support at Jang Bogo Station, unification of gas type at Jang Bogo Station, measures to improve the management of supplies, etc.

Figure 3. Summer Research Facility

Figure 4. Commencement Ceremony for the 30th overwintering party

Development of Polar Policy

Pioneering Polar Policy through Active, Domestic and International Cooperation

Development of Policy

Figure 1. 2017 Polar International Law Seminar

Figure 2. Side-Meeting of COP23 emi-nar

KOPRI is the only research institute in Korea that is dedicated to conducting polar research. KOPRI has played a contributing role in the establishment and implementation of Polar policy through addressing the relationship between climate change and Polar research and through active participation in the international Arctic and Antarctic meetings and conferences.

KOPRI has contributed to the establishment of 'The Third Antarctic Master Plan(2017-2021)' in 2016 and participated in the follow-up activities of the annual implementation plan of the Master Plan in 2017. KOPRI was also involved in the establishment of 'The Second Korean Arctic Master Plan (2018-2022)' in 2017.

KOPRI, as a national delegate institute, has participated in an array of international meetings regarding Polar issues. In May 2017, KOPRI introduced 'Inspections under the Antarctic Treaty and the Environmental Protocol' (WP040) at the 40th Antarctic Treaty Consultative Meeting(ATCM) which was prepared jointly with the Netherlands and the United States. In October 2017, KOPRI presented research on 'Marine ecosystems in the Marine Protected Area(MPA) in Antarctica's Ross Sea' at the 36th Annual Meetings of the Commission for the Conservation of Antarctic Marine Living Resources(CCAMLR). Moreover, KOPRI hosted a seminar titled 'Korea's Contribution to the Preparation of the IPCC Special Report on Ocean and Cryosphere in a Changing Climate' at COP23: 2017 UN Climate Change Conference Side Event held in Bonn, Germany in November 2017.

KOPRI has been operating KoARC(Korea Arctic Research Consortium) Secretariat since 2015 to promote collaboration among 30 domestic research institutes. Particularly in 2017, KoARC developed '2030 Arctic Research Roadmap' and derived multidisciplinary research themes from Arctic science, industry and policy sectors. Moreover, KoARC hosted international seminar sessions at '2017 Arctic Circle Assembly' held in Reykjavik, Iceland in October 2017 as well as at '2017 Arctic Partnership Week' held in Busan in December 2017 to introduce the activities and outcomes of KoARC.

Devoted to the 'Research Group of Polar Law', KOPRI also conducted 4 seminars in 2017 to discuss current issues in the field of Polar law and policy.

Figure 3. KoARC Seminar Session during 2017 Arctic Partnership Week

International Cooperation

Promoting international cooperation and fortifying Korea's global impact

International Cooperation Team

Figure 1. The Signing of the MOU between KOPRI and Direccion Nacional del Antartico (DNA)

KOPRI has engaged in a range of collaborative activities to enhance cooperation with its international partner organizations, bolster Korea's impact in international organizations and meetings, and develop future networks.

KOPRI has also made efforts to coordinate visits from partner organizations together with bilateral consultations made at international meetings in order to reinforce existing cooperation and cultivate a more cooperative spirit in research and field operations. In this way, a total of 13 cooperation documents were signed with the leading polar research institutes in 2017, such as with the Argentine Antarctic Program (Direccion Nacional del Antartico, DNA) and the University of Tromsø (UiT).

KORPI strives to enhance Korea' s status and impact in international polar research communities. For example, KOPRI articulated the need to improve the process of inspection in accordance with the Antarctic Treaty, at the Antarctic Treaty Consultative Meeting (ATCM) and subsequently carried out co-chairmanship tasks for the Intersessional Contact Group (ICG) to provide practical recommendations. In addition, a KOPRI researcher, Dr. Yeadong Kim, was selected as a SCAR visiting professor to the Polar Research Center at Istanbul Technical University in Turkey, while early career scientists received supports from KOPRI to give oral presentations at renowned international conferences, such as the SCAR Biology symposium.

KOPRI also hosted the 23rd International Symposium on Polar Sciences titled, "Life at the Extremes: Resilience, Adaptation and Application Potential," where a total of 170 experts from 14 countries participated to present their research (33 oral and, 28 poster presentations). On the sidelines of the Symposium, the Joint Workshop for Korea-Chile Bilateral Antarctic Cooperation, the Ross Sea Marine Protected Area (MPA) Roundtable Discussion, and other side-meetings were held for the development of international joint research. The 2017 Asian Polar Science Fellowship Program invited 8 polar researchers from 45 countries, including Thailand, Turkey and Malaysia, to conduct collaborative research with KOPRI scientists.

2.

Figure 2. Cover page of the ICG Report on Inspections in Antarctica

3.

Figure 3. The 23rd International Symposium on Polar Sciences

Public Relations

Bridging the Poles with the Korean with the Korean People through Antarctic Explorer Program, Books, Events & More

Public Relations Team

Figure 1. Media Facade

Figure 2. Antarctic Explorer Program

As the year that marked the 30zz anniversary of King Sejong Antarctic Station, 2017 was a particularly busy year for KOPRI communicating the importance of the polar regions and the polar research we conduct with the general public.

For the first time ever, KOPRI launched "the Antarctic Explorer Program" that allowed anyone, regardless of educational or vocational background, to visit and experience the Antarctic. From hundreds of applicants, four individuals were chosen to lodge at the King Sejong Station, experience first-hand the Antarctic landscape and research activities that take place and share their experiences upon their return. Also, an anniversary book for the King Sejong Station was published, entitled "Stories from 30 years at King Sejong Antarctic Station", organized into research achievements and episodes for easy, accessible understanding of what sorts of activities, events and experiences took place in the Antarctic for the past 30 years.

Newly conceived events launched in cooperation with the local government and industry were special achievements made this year. Video footage of Polar landscape projected on the Sejong Center Chamber Hall in Seoul, photographs exhibited on a walking trail on 7017 Seoul Street were well-received by the public. Through hosting a talk-show on climate Change and a trivia-games show, "Polar Golden Bell," curiosity for the polar regions could be raised among Korean youth.

The changes taking place in the Antarctic from global warming, extreme weather conditions during the winter, and other research topics of high interest by the general public were reported on mass media. Particularly, accomplishments made on the highly international Arctic cruise of Araon (participation of 11 countries) were made known both domestically and abroad through a Arctic research documentary, therein raising the status for Korean Polar research. Achievements like these were also disseminated on social media into accessible, news-bits to reach a wider audience.

Following the well-received Arctic research documentary program, a program introducing the activities of the overwintering team and the Antarctic Explorer Program at the King Sejong Station is being prepared for broadcasting. A new website that provides accessible information on the polar regions for the Korean public is being put together. KOPRI will continue making efforts to effectively communicate polar activities with the Korean people.

The Marvel of the Polar Landscape through Photography

7th Polar Photo Contest

KOPRI exhibited photographs taken by Antarctic and Arctic researchers for the sharing of the marvellous Polar landscape and enhance communication between KOPRI employees and Polar clients. The '7th Polar Photo Contest' was thus conducted for selection of photographs.

1st Place

Cha Dol Lee_ "Extreme Operations: Unloading from a barge"

2nd Place

Myoung Ho Seo_
"Let's Hurry to Bear the Eggs"
Han Jin Choi_
"A Baby Weddell"

Runner-up

Gyoung Suk Han_ "Unloading"

Soo Hwan Song_ "Ice Floe Survey"

Myoung Ho Seo_ "When will we count them all?"

APPENDIX

List of Main Projects

In-house Projects

Project Title	Project Leader	Period	Sponsor
Investigation for the cause of east-west different climate responses in Antarctica	CHOI, TAE JIN	'17.01.01 ~'17.12.31	KOPRI
Understanding polar upper atmospheric changes by energy inputs from the space environment and the lower atmosphere	Geonhwa Jee	'17.01.01 ~'17.12.31	
Reconstruction of Antarctic ice sheet and ocean history for the past two million years using sediment records	Min Kyung Lee	'17.01.01 ~'17.12.31	
Reconstruction of past climate and environmental changes using high resolution ice core records in Victoria Land, Antarctica	Soon Do Hur	'17.01.01 ~'17.12.31	
Characterizing mantle domain beneath West Antarctic Rift System and Antarctic mid-ocean ridges	Yongcheol Park	'17.01.01 ~'17.12.31	
Ocean-to-Ice Interactions in Amundsen Sea: Ice shelf melting and its impact on ocean processes	SangHoon Lee	'17.01.01 ~'17.12.31	
Studies on the Changes in Coastal Marine Systems of the Antarctic Peninsula: A 2050 Outlook	In-Young Ahn	'17.01.01 ~'17.12.31	
Polar Genomics 101 Project: Genome analysis of polar organisms and establishment of application platform	Park Hyun	'17.01.01 ~'17.12.31	
Modeling responses of terrestrial organisms to environmental changes on King George Island	Lee, Hyoungseok	'17.01.01 ~'17.12.31	
Commercialization of useful metabolites from polar organisms	Se Jong Han	'17.01.01 ~'17.12.31	
The Antarctic Korean Route Expedition and Development of Technologies for Deep Ice Coring and Hot Water Drilling	Jong Ik Lee	'17.01.01 ~'17.12.31	
Research on analytical technique for satellite observation of Arctic sea ice	Hyun-cheol Kim	'17.01.01 ~'17.12.31	
Development and Application of the Korea Polar Prediction System (KPOPS) for Climate Change and Disasterous Weather Events	KIM BAEK MIN	'17.01.01 ~'17.12.31	
Developments of Analytical Methods for Climate Regulating Components and its application to Polar Environment	Ki-Tae Park	'17.03.20 ~'17.12.31	
The Jang Bogo Long-term Ecological Research (JBG-LTER) - Korea-New Zealand-Italy Joint platform construction	Han-Gu Choi	'17.03.20 ~'17.12.31	
Early animal evolution and the primitive Earth system of north Greenland	Park Tae-yoon	'17.03.20 ~'17.12.31	
Carbon assimilation rate of sea ice ecosystem in the Kongsfjorden MIZ, Arctic	Sun-Yong Ha	'17.03.20 ~'17.12.31	
Large-scale production and Clinical evaluation of CPS (Cell-Protecting Substance) from polar microalgae	Kim Sanghee	'17.03.20 ~'17.12.31	

Project Title	Project Leader	Period	Sponsor
Investigating Cryospheric Evolution of the Victoria Land, Antarctica -ICE-	Won Sang Lee	'17.06.01 ~'18.05.31	Ministry of Oceans and Fisheries
Crustal evolution of Victoria Land, Antarctica, and the formative process of planets	Jong Ik Lee	'17.06.01 ~'18.05.31	
Korea-Arctic Ocean Observing System(K-AOOS)	Sung Ho Kang	'17.05.01 ~'18.04.30	
Investigation of submarine resource environment and seabed methane release in the Arctic	Young Keun Jin	'17.05.01 ~'18.04.30	
Ecosystem Structure and Function of Marine Protected Area (MPA) in Antarctica	Jeong-Hoon Kim	'17.06.01 ~'18.05.31	
Bioinformatics study on analysis of marine microbial genomes	Kyung Mo Kim	'17.07.01 ~'18.05.31	
Circum Arctic Permafrost Environment Change Monitoring, Future Prediction and development Techniques of useful biomaterials(CAPEC)	Bang Yong Lee	'17.01.01 ~'17.12.31	Ministry of Science and ICT
Changes in environments and coastal geomorphology of Svalbard fjords, Arctic	Seung Il Nam	'17.07.01~'18.04.30	
Dynamics and predictability study of mid-latitude blocking for wintertime seasonal prediction	Baek Min Kim	'17.05.01 ~'18.04.30	Korea Meteorological Administration

Entrusted Project by Government Agency

Project Title	Project Leader	Period	Sponsor
Bathymetric survey for mapping and undersea feature names near Jang Bogo station in Antarctica	Joohan Lee	'17.01.01 ~'17.12.22	Korea Hydrographic and Oceanographic Agency(Service Business)
The Second Korean Arctic Master Plan	Hyoung Chul Shin	'17.03.21 ~'17.12.20	Ministry of Oceans and Fisheries (Service Business)
Development of 2030 Arctic Research Roadmap	Hyoung Chul Shin	'17.04.06 ~'17.12.31	
Environmental Management and Monitoring of Antarctic Specially Protected Area(4)	Ho Sung Chung	'17.06.28 ~'18.06.26	Ministry of Environment(Service Business)
Development of damage monitoring system and evaluation of health monitoring	Bang Yong Lee	'17.03.01 ~'17.12.31	Ministry of Land, Infrastructure and Transport
Organic carbon transfer across the river-sea interface: a case study in Geum and Sumjin river systems	Jung-Hyun Kim	'17.06.01 ~'18.03.31	National Research Foundation of Korea
A multidisciplinary approach to understanding the vulnerability of Antarctica's physical and eco-systems to changing global climate	Hyoung Chul Shin	'17.01.01 ~'17.12.31	
Structural and functional characterization of Arctic soil microbiome	Yoo Kyung Lee	'17.03.01 ~'17.12.31	
The variation in the sediment provenance of the ArcticOcean: implications for middle to late Pleistoceneglacial history in the Arctic Ocean	Kwangchul Jang	'17.11.01 ~'18.10.31	
Phylogenetic elucidation of tardigrades through paleontological comparative research	Tae-yoon Park	'17.12.26 ~'18.12.25	University of Science and Technology
A preliminary study of core technology development for unmanned underwater vehicle exploration in the polar regions	Sukyoung Yun	'17.07.01 ~'17.11.30	Korea Research Institute Of Ships & Ocean Engineering

Polar Academic Program(PAP)

Project Title	Project Leader	Period	Sponsor
Extraction of grounding line of Antarctic ice shelves in high resolution using satellite multisensor data fusion	Kim, Duk-jin (Seoul National University)	'16.06.01 ~'17.05.31	KOPRI
Studies on the change in polar marine inorganic carbon cycle in response to sea ice melting and formation	KIM TAE WOOK (Incheon National University)	'16.06.01 ~'17.05.31	
Magnetism of Chondrites: Implications for the evolution of Planetesimals	YONGJAE YU (Chungnam National University)	'16.06.01 ~'17.05.31	
Development and application of protist DNA barcode for polar marine host-parasite identification	Jung Jae-Ho(Gangneung-Wonju National University)	'16.06.01 ~'17.05.31	
Development of damage-tolerant TRIP high-entropy alloys for sustainable arctic materials	Eun Soo, Park (Seoul National University)	'16.06.01 ~'17.05.31	
Highly precise and assured navigation system for unmanned explorations in the polar regions	Jiyun Lee(KAIST)	'16.06.01 ~'17.05.31	
The impact of climate change on the life of Inuit in case of Nunavut, Canada	Seung Ho Lee(Konkuk University)	'16.09.02 ~'17.05.31	
Understanding the process of polar shrub expansion using the Ecosystem Demography Model	yeonjoo.kim(Yonsei University)	'16.09.02 ~'17.05.31	
Study on behavioral characteristics of tardigrade using microfluidic chip	Sung hyung jin(KAIST)	'16.09.02 ~'17.05.31	
Establishment of CSF expression in arctic Chlorella sp. via genetic transformation	Kim sung ryong(Sogang University)	'16.09.02 ~'17.05.31	
Identyfying sources of methylmercury in arctic Sea using a mass flus model	Seunghee Han(GIST)	'16.09.02 ~'17.05.31	
Test of underwater obsevation data transfer system using a pop-up buoy in extremely severe environment	Jae-Hun Park (Inha University)	'16.09.02 ~'17.05.31	
Study of radioactive isotopes for environmental samples from Antarctica	HAHN INSIK (Ewha Womans University)	'16.09.02 ~'17.05.31	

Polar Industrial Program(PIP)

Project Title	Project Leader	Period	Sponsor
A development of ice-penetrating radar (IPR) for internal ice structure analysis	Seung-Ha Shin (U-Tel Co., Ltd.)	'17.11.01 ~'18.10.31	KOPRI
Development of advanced technology for underwater rock drilling and obtaining a rock core in deepsea(1,000M)	Ho Kyung Jeon (Shingyang Technology Co., Ltd.)	'17.12.29 ~'18.12.28	

List of Published Articles

*Only papers that have as its SCI/SCI(E) principal authors from KOPRI research projects are listed here.

NO	Articles
1	Ahn, D. H., S. C. Shin, et al. (2017). "Draft genome of the Antarctic dragonfish, Parachaenichthys charcoti." Gigascience 6(8).
2	Chambers, S. D., T. Choi, et al. (2017). "Investigating Local and Remote Terrestrial Influence on Air Masses at Contrasting Antarctic Sites Using Radon-222 and Back Trajectories." Journal of Geophysical Research-Atmospheres 122(24): 13525-13544.
3	Chi, J. and H. C. Kim (2017). "A fully data-driven method for predicting Antarctic sea ice concentrations using temporal mixture analysis and an autoregressive model." Remote Sensing Letters 8(2): 106-115.
4	Chi, J. and H. C. Kim (2017). "Prediction of Arctic Sea Ice Concentration Using a Fully Data Driven Deep Neural Network." Remote Sensing 9(12).
5	Choi, D. K. and T. Y. S. Park (2017). "Recent advances of trilobite research in Korea: Taxonomy, biostratigraphy, paleogeography, and ontogeny and phylogeny." Geosciences Journal 21(6): 891-911.
6	Choi, H., S. S. Kim, et al. (2017). "The kinematic evolution of the Macquarie Plate: A case study for the fragmentation of oceanic lithosphere." Earth and Planetary Science Letters 478: 132-142.
7	Choi, J. H., Y. G. Kim, et al. (2017). "Chemical characterization of dissolved organic matter in moist acidic tussock tundra soil using ultra-high resolution 15T FT-ICR mass spectrometry." Biotechnology and Bioprocess Engineering 22(5): 637-646.
8	Choi, N., J. H. Kim, et al. (2017). "Group association and vocal behaviour during foraging trips in Gentoo penguins." Scientific Reports 7.
9	Eom, J., K. W. Seo, et al. (2017). "Correlated error reduction in GRACE data over Greenland using extended empirical orthogonal functions." Journal of Geophysical Research-Solid Earth 122(7): 5578-5590.
10	Eom, J., K. W. Seo, et al. (2017). "Estimation of Amazon River discharge based on EOF analysis of GRACE gravity data." Remote Sensing of Environment 191: 55-66.
11	Han, D., S. I. Nam, et al. (2017). "Inference on Paleoclimate Change Using Microbial Habitat Preference in Arctic Holocene Sediments." Scientific Reports 7.
12	Han, H., S. H. Hong, et al. (2017). "A study of the feasibility of using KOMPSAT-5 SAR data to map sea ice in the Chukchi Sea in late summer." Remote Sensing Letters 8(5): 468-477.
13	Han, H. and H. Lee (2017). "Surface strain rates and crevassing of Campbell Glacier Tongue in East Antarctica analysed by tide-corrected DInSAR." Remote Sensing Letters 8(4): 330-339.
14	Han, Y., Y. Huh, et al. (2017). "Net deposition of mercury to the Antarctic Plateau enhanced by sea salt." Science of the Total Environment 583: 81-87.
15	Hyun, C. U. and H. C. Kim (2017). "A Feasibility Study of Sea Ice Motion and Deformation Measurements Using Multi-Sensor High-Resolution Optical Satellite Images." Remote Sensing 9(9).
16	Jogo, K., T. Nakamura, et al. (2017). "Mn-Cr ages and formation conditions of fayalite in CV3 carbonaceous chondrites: Constraints on the accretion ages of chondritic asteroids." Geochimica Et Cosmochimica Acta 199: 58-74.
17	Ju, J., J. Kim, et al. (2017). "Accelerated redox reaction between chromate and phenolic pollutants during freezing." Journal of Hazardous Materials 329: 330-338.
18	Jung, O., M. K. Sung, et al. (2017). "How does the SST variability over the western North Atlantic Ocean control Arctic warming over the Barents-Kara Seas?" Environmental Research Letters 12(3).
19	Jung, W., E. J. Kim, et al. (2017). "Enzymatic modification by point mutation and functional analysis of an omega-6 fatty acid desaturase from Arctic Chlamydomonas sp." Preparative Biochemistry & Biotechnology 47(2): 143-150.
20	Kang, J. H., H. Hwang, et al. (2017). "Pb concentrations and isotopic record preserved in northwest Greenland snow." Chemosphere 187: 294-301.
21	Kang, S., D. H. Ahn, et al. (2017). "The genome of the Antarctic-endemic copepod, Tigriopus kingsejongensis." Gigascience 6(1).
22	Kim, B. M., H. Choi, et al. (2017). "Amplitude-Dependent Relationship Between the Southern Annular Mode and the El Nino Southern Oscillation in Austral Summer." Asia-Pacific Journal of Atmospheric Sciences 53(1): 85-100.
23	Kim, B. M., J. Y. Hong, et al. (2017). "Major cause of unprecedented Arctic warming in January 2016: Critical role of an Atlantic windstorm." Scientific Reports 7.
24	Kim, B. M., S. Kang, et al. (2017). "First Insights into the Subterranean Crustacean Bathynellacea Transcriptome: Transcriptionally Reduced Opsin Repertoire and Evidence of Conserved Homeostasis Regulatory Mechanisms." Plos One 12(1).
25	Kim, E. J., J. H. Lee, et al. (2017). "Improving thermal hysteresis activity of antifreeze protein from recombinant Pichia pastoris by removal of N-glycosylation." Preparative Biochemistry & Biotechnology 47(3): 299-304.
26	Kim, H. C., I. N. Kim, et al. (2016). "Estimating Remineralized Phosphate and Its Remineralization Rate in the Northern East China Sea During Summer 1997: A Snapshot Study Before Three-Gorges Dam Construction." Terrestrial Atmospheric and Oceanic Sciences 27(6): 955-963.
27	Kim, H. J., J. H. Lee, et al. (2017). "Marine Antifreeze Proteins: Structure, Function, and Application to Cryopreservation as a Potential Cryoprotectant." Marine Drugs 15(2).
28	Kim, H. M. and B. M. Kim (2017). "Relative Contributions of Atmospheric Energy Transport and Sea Ice Loss to the Recent Warm Arctic Winter." Journal of Climate 30(18): 7441-7450.
29	Kim, I., D. Hahm, et al. (2017). "Characteristics of the horizontal and vertical distributions of dimethyl sulfide throughout the Amundsen Sea Polynya." Science of the Total Environment 584: 154-163.
30	Kim, J., Y. J. Yoon, et al. (2017). "Seasonal variations in physical characteristics of aerosol particles at the King Sejong Station, Antarctic Peninsula." Atmospheric Chemistry and Physics 17(21).
31	Kim, J. H., D. H. Lee, et al. (2017). "Contribution of petroleum-derived organic carbon to sedimentary organic carbon pool in the eastern Yellow Sea (the northwestern Pacific)." Chemosphere 168: 1389-1399.
32	Kim, K., H. Y. Chung, et al. (2017). "Freezing-enhanced reduction of chromate by nitrite." Science of the Total Environment 590: 107-113.
33	Kim, K. H., C. W. Lee, et al. (2017). "Crystal Structure and Functional Characterization of a Cytochrome P450 (BaCYP106A2) from Bacillus sp PAMC 23377." Journal of Microbiology and Biotechnology 27(8): 1472-1482.
34	Kim, K. M., H. Choe, et al. (2017). "Complete genome of a metabolically-diverse marine bacterium Shewanella japonica KCTC 22435(T)." Marine Genomics 35: 39-42.
35	Kim, M., Y. Gwak, et al. (2017). "Identification and Characterization of an Isoform Antifreeze Protein from the Antarctic Marine Diatom, Chaetoceros neogracile and Suggestion of the Core Region." Marine Drugs 15(10).
36	Kim, M., J. Y. Jung, et al. (2017). "Shifts in bacterial community structure during succession in a glacier foreland of the High Arctic." Fems Microbiology Ecology 93(1).
37	Kim, S., M. Oh, et al. (2017). "Genome sequencing of the winged midge, Parochlus steinenii, from the Antarctic Peninsula." Gigascience 6(3).
38	Kim, S. J., S. Y. Jun, et al. (2017). "Sensitivity of southern hemisphere westerly wind to boundary conditions for the last glacial maximum." Quaternary International 459: 165-174.
39	Kim, S. Y., L. Polyak, et al. (2017). "Terrestrial and aquatic palynomorphs in Holocene sediments from the Chukchi-Alaskan margin, western Arctic Ocean: Implications for the history of marine circulation and climatic environments." Holocene 27(7): 976-986.
40	Kim, T. W., H. K. Ha, et al. (2017). "Is Ekman pumping responsible for the seasonal variation of warm circumpolar deep water in the Amundsen Sea?" Continental Shelf Research 132: 38-48.
41	Koh, H. Y., H. Park, et al. (2017). "Proteomic and transcriptomic investigations on cold-responsive properties of the psychrophilic Antarctic bacterium Psychrobacter sp PAMC 21119 at subzero temperatures." Environmental Microbiology 19(2): 628-644.
42	Kwon, M., M. Kim, et al. (2017). "Niche specialization of bacteria in permanently ice-covered lakes of the McMurdo Dry Valleys, Antarctica." Environmental Microbiology 19(6): 2258-2271.
43	Lee, C., G. Jee, et al. (2017). "Polar Thermospheric Winds and Temperature Observed by Fabry-Perot Interferometer at Jang Bogo Station, Antarctica." Journal of Geophysical Research-Space Physics 122(9): 9685-9695.
44	Lee, C. W., S. Kwon, et al. (2017). "Crystal Structure and Functional Characterization of an Esterase (EaEST) from Exiguobacterium antarcticum." Plos One 12(1).
45	Lee, C. W., S. H. Park, et al. (2017). "Crystal structure of the inactive state of the receiver domain of Spo0A from Paenisporosarcina sp TG-14, a psychrophilic bacterium isolated from an Antarctic glacier." Journal of Microbiology 55(6): 464-474.
46	Lee, J., Y. J. Cho, et al. (2017). "Complete genome sequence of Pseudomonas antarctica PAMC 27494, a bacteriocin-producing psychrophile isolated from Antarctica." Journal of Biotechnology 259: 15-18.
47	Lee, J. I., R. M. McKay, et al. (2017). "Widespread persistence of expanded East Antarctic glaciers in the southwest Ross Sea during the last deglaciation." Geology 45(5): 403-406.
48	Lee, M. H., S. Lee, et al. (2017). "The Recent Increase in the Occurrence of a Boreal Summer Teleconnection and Its Relationship with Temperature Extremes." Journal of Climate 30(18): 7493-7504.
49	Lee, S., J. Hwang, et al. (2017). "Evidence of minimal carbon sequestration in the productive Amundsen Sea polynya." Geophysical Research Letters 44(15): 7892-7899.
50	Lee, S. H., I. W. Yeo, et al. (2017). "The role of eddies in solute transport and recovery in rock fractures: Implication for groundwater remediation." Hydrological Processes 31(20): 3580-3587.
51	Lee, W. Y., J. W. Jung, et al. (2017). "Behavioral responses of chinstrap and gentoo penguins to a stuffed skua and human nest intruders." Polar Biology 40(3): 615-624.
52	Lee, W. Y., H. C. Kim, et al. (2017). "Breeding records of kelp gulls in areas newly exposed by glacier retreat on King George Island, Antarctica." Journal of Ethology 35(1): 131-135.

List of Published Articles

NO	Articles
53	Park, A. K., H. Kim, et al. (2017). "Crystal structure of cis-dihydrodiol naphthalene dehydrogenase (NahB) from Pseudomonas sp MC1: Insights into the early binding process of the substrate." Biochemical and Biophysical Research Communications 491(2): 403-408.
54	Park, C., K. Nagashima, et al. (2017). "Calcium-aluminum-rich inclusions with fractionation and unidentified nuclear effects (FUN CAIs): II. Heterogeneities of magnesium isotopes and Al-26 in the early Solar System inferred from in situ high-precision magnesium-isotope measurements." Geochimica Et Cosmochimica Acta 201: 6-24.
55	Park, J., F. I. Kuzminov, et al. (2017). "Light availability rather than Fe controls the magnitude of massive phytoplankton bloom in the Amundsen Sea polynyas, Antarctica." Limnology and Oceanography 62(5): 2260-2276.
56	Park, K., K. Ohkushi, et al. (2017). "Lithostratigraphy and paleoceanography in the Chukchi Rise of the western Arctic Ocean since the last glacial period." Polar Science 11: 42-53.
57	Park, K. M., N. Chae, et al. (2017). "Redescription of Keronopsis helluo Penard, 1922 from Antarctica and Paraholosticha pannonica Gellert and Tunas, 1959 from Alaska (Ciliophora, Hypotricha)." European Journal of Protistology 60: 102-118.
58	Park, K. M., J. H. Jung, et al. (2017). "Pseudonotohymena antarctica n. g., n. sp (Ciliophora, Hypotricha), a New Species from Antarctic Soil." Journal of Eukaryotic Microbiology 64(4): 447-456.
59	Park, K. T., S. Jang, et al. (2017). "Observational evidence for the formation of DMS-derived aerosols during Arctic phytoplankton blooms." Atmospheric Chemistry and Physics 17(15): 9665-9675.
60	Park, S., E. H. Baek, et al. (2017). "Impact of detrained cumulus on climate simulated by the Community Atmosphere Model Version 5 with a unified convection scheme." Journal of Advances in Modeling Earth Systems 9(2): 1399-1411.
61	Park, S. H., C. W. Lee, et al. (2017). "Crystal structure and functional characterization of an isoaspartyl dipeptidase (CpsladA) from Colwellia psychrerythraea strain 34H." Plos One 12(7).
62	Park, T. Y. S. and J. H. Kihm (2017). "Head segmentation of trilobites." Lethaia 50(1): 1-6.
63	Schreck, M., S. I. Nam, et al. (2017). "Neogene dinoflagellate cysts and acritarchs from the high northern latitudes and their relation to sea surface temperature." Marine Micropaleontology 136: 51-65.
64	Shim, J. S., G. Jee, et al. (2017). "Climatology of plasmaspheric total electron content obtained from Jason 1 satellite." Journal of Geophysical Research-Space Physics 122(2): 1611-1623.
65	Shin, D. W., G. A. Baigorria, et al. (2017). "Assessing crop yield simulations driven by the NARCCAP regional climate models in the southeast United States." Journal of Geophysical Research-Atmospheres 122(5): 2549-2558.
66	Shin, S. C., I. H. Ahn, et al. (2017). "Characterization of Two Antimicrobial Peptides from Antarctic Fishes (Notothenia coriiceps and Parachaenichthys charcoti)." Plos One 12(1).
67	Song, I. S., C. Lee, et al. (2017). "Meteor radar observations of vertically propagating low-frequency inertia-gravity waves near the southern polar mesopause region." Journal of Geophysical Research-Space Physics 122(4): 4777-4800.
68	Suh, S. S., S. M. Kim, et al. (2017). "Anticancer activities of ethanol extract from the Antarctic freshwater microalga, Botryidiopsidaceae sp." Bmc Complementary and Alternative Medicine 17.
69	Suh, S. S., T. K. Kim, et al. (2017). "Anticancer Activity of Ramalin, a Secondary Metabolite from the Antarctic Lichen Ramalina terebrata, against Colorectal Cancer Cells." Molecules 22(8).
70	Suh, S. S., S. G. Lee, et al. (2017). "Comprehensive Expression Profiling and Functional Network Analysis of Porphyra-334, One Mycosporine-Like Amino Acid (MAA), in Human Keratinocyte Exposed with UV-radiation." Marine Drugs 15(7).
71	Suh, S. S., S. K. Oh, et al. (2017). "Porphyra-334, a mycosporine-like amino acid, attenuates UV-induced apoptosis in HaCaT cells." Acta Pharmaceutica 67(2): 257-264.
72	Suh, S. S., E. J. Yang, et al. (2017). "Bioactivities of ethanol extract from the Antarctic freshwater microalga, Chloromonas sp." International Journal of Medical Sciences 14(6): 560-569.
73	Wu, Q., G. Jee, et al. (2017). "First simultaneous multistation observations of the polar cap thermospheric winds." Journal of Geophysical Research-Space Physics 122(1): 907-915.
74	Xu, G. J., E. J. Yang, et al. (2017). "Environmental drivers of heterogeneity in the trophic-functional structure of protozoan communities during an annual cycle in a coastal ecosystem." Marine Pollution Bulletin 121(1-2): 400-403.
75	Youn, U. J., T. Sripisut, et al. (2017). "Bioactive polyprenylated benzophenone derivatives from the fruits extracts of Garcinia xanthochymus." Bioorganic & Medicinal Chemistry Letters 27(16): 3760-3765.

Registration of Patent

National Research & Development Project

States	Registration Date	Patent Number(Registration No.)	Title
Republic of Korea	2017-03-31	10-1723871	Composition for Preventing or Treating Inflammatory Diseases Comprising 3, 7-dimethyl-1,8-hydroxy-6-methoxyisochroman
Republic of Korea	2017-05-22	10-1741251	Cold-adapted Protease Derived from Pseudoalteromonas arctica PAMC 21717 and Uses Thereof
USA	2017-02-21	9,574,185	
USA	2017-05-09	9,644,194	
Republic of Korea	2017-03-31	10-1723870	Pharmaceutical Composition for Preventing and Treating Inflammatory Diseases Comprising TMC-256C1
Republic of Korea	2017-03-20	10-1723502	Method for reduction of hexavalent chromium using freezing
Republic of Korea	2017-03-31	10-1723869	Pharmaceutical Composition for Preventing or Treating Inflammatory Diseases Comprising Dihydroisocoumarin Derivatives
USA	2017-01-10	9,539,227	PHARMACEUTICAL COMPOSITION FOR THE PREVENTION OR TREATMENTOF INFLAMMATORY DISEASES OR IMMUNE DISEASES CONTAINING RAMALIN
EU	2017-01-11	2594552	Method of Synthesizing Ramalin
Germany	2017-01-11	602011034339.4	
Republic of Korea	2017-08-08	10-1768126	Pharmaceutical Composition for Preventing or Treating of Atherosclerosis and Inflammatory Diseases Comprising Lobaric Acid
Republic of Korea	2017-05-25	10-1742237	Pharmaceutical Composition for Preventing or Treating of Atherosclerosis and Inflammatory Diseases Comprising Lobastin
Republic of Korea	2017-08-02	10-1766382	The composition comprising protein from Leucosporidium sp for cryopreservation and preventing cryoinjury method thereof
Republic of Korea	2017-11-24	10-1803500	Novel Gene Implicated in Plant Cold Stress Tolerance and Use Thereof
Republic of Korea	2017-05-25	10-1742238	Novel compounds, Composition Comprising the Same for Preventing and Treating Inflammatory Diseases
Republic of Korea	2017-05-25	10-1742239	
Republic of Korea	2017-06-14	10-1749132	Composition for Preventing or Treating Inflammatory Diseases Comprising Tanzawaic Acid
Republic of Korea	2017-08-01	10-1765843	Cryoprotective Exopolysaccharide from Pseudoalteromonas elyakovii

New Members of KOPRI

Type	Name	Degree	Concentration	Name of Ph.D Thesis	Department
Research Staff	Sung Han Kim	Ph.D.	Geophysical Oceanography	Paleoceanography in the Bering Sea during the last 2.4 Ma (IODP Expedition 323 Site U1343)	Division of Polar Paleoenvironment
	Seong Joon Jeon	M.A.	Oceanography	-	Unit of Antarctic K-route Expedition
	Seung Hyun Gang	Ph.D.	Molecular Genetics	Phylogenetic and population genetic studies on Malaria vector mosquito Anopheles Hyrcanus group in Korea	Unit of Polar Genomics
	Chang Wook Hyun	Ph.D.	Energy System	Compositional analysis of geomaterials using reflectance spectroscopy and hyperspectral remote sensing technique	Unit of Arctic Sea-Ice Prediction
	Ji Yeon Park	Ph.D.	Environmental Engineering	A study on marine aerosols relating to submicrometer particles and biological materials in seawater	Division of Polar Climate Sciences
	Young Joo Lee	Ph.D.	Fish Oceanography	Phytoplankton dynamics and primary production in the Yellow Sea during winter and summer	Division of Polar Ocean Sciences
Technical & Administrative Support Staff	Chae Rin Jeong	M.A.	Political Science	-	International Support Team
	Ha Na Cho	M.A.	Marketing Administration	-	Public Relations
	Dong Jin Yoon	M.A.	Human-friendly & Intelligent Vehicle Engineering	-	Department of Polar Technology
	Jeong Ho Kim	B.A.	Business	-	Planning & Budget Team
	Hwan Joon Jang	B.B.	Business	-	Financing & Accounting Team

Members of the 30th Overwintering Team to the King Sejong Antarctic Station

Division	Position/Expertise	Name	Responsibilities	Notes
Station Management	Leader	Joung Han Yim	- Directing all station operations - International cooperation with foreign stations	- KOPRI
	Manager	Hyoung Geun Lee	- Managing practical tasks of station operation - Managing overwintering team task schedule - Writing of overwintering report, task communication	- KOPRI
Research	Biological Research	Han Woo Kim	- Monitoring of soil and seawater around the station	- KOPRI
	Space Science Research	Sae Hun Jeong	- Operating upper-atmospheric observational equipment such as meteor radar, SATI, all-sky camera, data collection, analysis and processing	
	Atmospheric Research	Hyo Joon Bae	- Operating observational equipment for measurements of greenhouse gases, aerosols, atmospheric content, data collection, quality management and processing - Air sampling on a regular basis for analysis of atmospheric composition	
	Geophysical Research	Min Wook Kim	- Operating geophysical equipment such as seismometer, geomagnetic sensor, gravimeter, data collection, analysis and processing	
	Oceanographic Research	Duk Won Bae	- Operating oceanographic research equipment, data collection, analysis and processing	
	Weather	Soo Hwan Song	- Observing and predicting weather, processing relevant material, managing maintenance tasks of observational equipment	- Visiting researcher from Korea Meterological Administration
Medical Services	Doctor	Gyeong Suk Han	- Treating patients, devising evacuation measures in case of emergency situations	
Facility Maintenance	Machinery	Sung Jae Park	- Operating heating system and maintaining plumbing system	- Member of the 20th and 28th overwintering team at King Sejong Station
	Machinery	Joon Han Ryu	- Operating and maintaining refrigerators, freezers and desalination system	- Member of the 24th and 28th overwintering team at King Sejong Station
	Heavy Equipment	Jeong Gyu Kim	- Operating and maintaining heavy equipment, such as crane, excavator, forklift, etc.	
	Electronics and Telecommunications	Do Yoon Kwon	- Operating satellite system, telecommunication devices, electronic equipment and conducting external communications	
	Electricity	Hong Pil Ha	- Managing electrical facilities and repairing electrical wiring and electronics	
	Power Generation	Gyoo Jin Lee	- Operating, repairing and maintaining power generation facilities	
	Safety	Cha Dol Koo	- Supervising safety of all station visitors	- Visiting staff from National Emergency Management Agency
	Cook	Jin Ha Lee	- Cooking, maintaining kitchen, cafeteria and food hygiene	

Members of the 4th Overwintering Team to the Jang Bogo Antarctic Station

Division	Position/Expertise	Name	Responsibilities	Notes
Station Management	Leader	Seong Joong Kim	- Directing all station operations - International cooperation with foreign stations	- KOPRI
	Manager	Seung Min Baek	- Managing practical tasks of station operation - Managing overwintering team task schedule - Writing of overwintering report, task communication	- KOPRI
Research	Geophysical Research	Jae Il Lee	- Operating geophysical equipment such as seismometer, geomagnetic sensor, gravimeter, data collection, analysis and processing	- KOPRI
	Biological Research	Chan Yang Kim	- Monitoring of soil and seawater around the station	
	Atmosphereric Research	Dae Gyoung Seong	- Operating observational equipment for measurements of greenhouse gases, aerosols, atmospheric content, data collection, quality management and processing - Air sampling on a regular basis for analysis of atmospheric composition	
	Upper-Atmospheric Research	Won Seok Lee	- Operating upper-atmospheric observational equipment such as meteor radar, SATI, all-sky camera, data collection, analysis and processing	
	Oceanographic Research	Dong Won Han	- Studying marine environment of Marian Cove	
	Climate Research	Joon Hwi Lee	- Observing and predicting weather, processing relevvant material, managing maintenance tasks of observational equipment	- Visiting researcher from Korea Meterological Administration - Member of the 16th overwintering team to Sejong Station, 2nd overwintering team to Jang Bogo Station
Medical Services	Doctor	Dong Gyoung Seo	- Treating patients, devising evacuation measures in case of emergency situations	
Facility Maintenance	Machinery	Dong Soo Choi	- Operating heating system and maintaining plumbing system	
	Machinery	Sang Joon Jeong	- Operating and maintaining refrigerators, freezers and desalination system	- Member of the 17th, 19th, and 23rd overwintering team to Sejong Station
	Heavy Equipment	Hyeon Soo Lee	- Operating and maintaining heavy equipment, such as crane, excavator, forklift, etc.	
	Electronics and Telecommunications	Sang Wook Kim	- Operating satellite system, telecommunication devices, electronic equipment and conducting external communications	
	Electricity	Jeong Eue Lee	- Managing electrical facilities and repairing electrical wiring and electronics	
	Power Generation	Jeong Goo Yoon	- Operating, repairing and maintaining power generation facilities	
	Maritime Safety	Jong Hyun Woo	- Supervising safety of all station visitors	- Visiting staff from the Ministry of National Defense(Navy)
	Cook	Seong Yoon Park	- Cooking, maintaining kitchen, cafeteria and food hygiene	

2017 KOPRI ANNUAL REPORT

2017 ANNUAL REPORT OF
KOREA POLAR RESEARCH INSTITUTE

PUBLISHING OFFICE
Korea Polar Research Institute

PUBLISHER
Ho Il Yoon

PUBLICATION DATE
March, 2018

EDITOR
Department of Knowledge & Information

DESIGN
Good Design Research Institute
+82-51-796-6600 / www.good-d.co.kr

ISSN 2005-9833