The 24th International Symposium on Polar Sciences

30 years of footsteps in Antarctica : Looking Back and Looking Forward

29-30 MAY 2018

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KOREA POLAR RESEARCH INSTITUTE

SYMPOSIUM PROGRAM

The 24th International Symposium on Polar Sciences

30 years of footsteps in Antarctica: Looking back and looking forward

May 29-30, 2018

Korea Polar Research Institute

Incheon, Republic of Korea

Organized by

Korea Polar Research Institute

Contents

Welcome Word

The 24th International Symposium on Polar Sciences

Distinguished scholars and guests,

It gives me great pleasure to welcome Antarctic friends and family from around the globe to our 24th International Symposium on Polar Sciences. My special thanks go to Professor Steven L. Chown and Professor Axel Timmermann who graciously accepted our invitation to stand as keynote speakers.

I am delighted and excited that over 250 people from 11 different countries are attending our symposium to exchange their distinctive views and outstanding ideas on recent scientific achievements in Antarctica and to discuss collaborations.

Antarctica is a treasure chest buried in snow and ice, holding the secrets and mysteries of the nature, and is a place that is feeling the impacts of climate change in the most dramatic way.

Right at this moment, glaciers in the Marian Cove in front of the King Sejong Station are retreating and dwindling at a brisk pace.

To locate the right key to the chest, KOPRI has devoted its passion and commitment for the past three decades.

This year's symposium is not just a usual and annual forum, but marks the 30th anniversary of the King Sejong Station, a full-fledged start of the national polar research program. I note that Korean Antarctic interests began even before the establishing of the Station. Our ship sailed to the Southern Ocean and undertook exploratory krill fishing with baseline environmental studies. A group of mountaineers and scientists ventured into the unfamiliar Antarctic terrain. Like other nations, our Antarctic story is built on a patchwork owing to the efforts of many.

Let me remind ourselves that our first Antarctic Station took its name after King Sejong the Great, undoubtedly one of the greatest in our history, known for his enthusiasm for knowledge and scientific innovation. In his honor, KOPRI has written its history and continued to expand the depth and breadth of its research.

I would like us to take this symposium as an opportunity to reflect on our trails in Antarctica. Then we will move forward into an uncharted world with clearly printed footsteps behind us as the wake and as the guide.

For the next two days, scientists and experts will present their research results and future outlooks on Antarctic science. There will be 6 sessions, where presenters will cover a wide range of Antarctic science; our journey will start from high up the space and plunge into the abyss to observe the life flourishing there, and continue on to the glacier and the underlying continent.

I am confident that inspirational ideas and keen insights from the symposium will lead you to fruitful achievements.

I hope you will enjoy the full suite of beauty the Korean spring has to offer.

Once again, we welcome you to Korea and KOPRI.

Yoon Ho Il

Ho Il YOON
President
Korea Polar Research Institute

Committee

The 24th International Symposium on Polar Sciences Steering Committee

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Social Events and Side Meetings

Social Events

Icebreaker Reception

18:30-20:00, May 28 at Grand Ballroom, Sheraton Grand Incheon Hotel

Banquet Dinner

18:00-19:30, May 30 at KOPRI Main Hall (KOPRI Main Building 1st Floor)

For Early Career Polar Scientists

Korean Early Career Polar Scientists Gathering

12:30 - 13:30, May 29 at Polar Bear Seminar Room (KOPRI Main Building 3rd Floor)

Young Scientists Awards

Young Scientists Awards will be presented to the outstanding poster presentations and the award ceremony will take place as a part of the banquet dinner in 18:00 - 19:30, May 30 at Main Hall (KOPRI Main Building 1st Floor)

Side Meetings

LIONESS-WRS Workshop

10:00-18:00, May 28 at Penguin Seminar Room (Cafeteria Building 2nd Floor)

LIONESS-WRS (Land-Ice/Ocean Network Exploration with Semiautonomous Systems in the Western Ross Sea) Workshop will take place to strengthen international collaboration in the Terra Nova Bay/Northern Victoria Land, Antarctica, and to seek potential research opportunities in other regions (e.g., Thwaites/Totten/Larsen C/Ellsemere etc.) under the LIONESS framework. During the workshop, we will be discussing very interesting preliminary results coming out from our collaborative efforts conducted in the 2017/2018 field season as well.

Program at a Glance

May 28 (Monday)		
Time	**Place**	**Program**
18:30 - 20:00	Grand Ballroom, Sheraton Grand Incheon Hotel	o Icebreaker Reception

May 29 (Tuesday)		
Time	**Place**	**Program**
08:30 - 09:00	Reception Desk	o Registration
09:00 - 09:30	Auditorium	o Opening Remarks
09:40 - 12:30	Auditorium & Sejong International Conference Room	o Plenary Lecture 1 o S1. Earth's atmosphere and space environment observed from the Antarctica o S2. Ocean and cryosphere changes around the Antarctica I
12:30 - 14:00	Main Hall & Polar Bear Seminar Room	o Lunch o Korean Early Career Polar Scientists Gathering
14:10 - 16:20	Auditorium	o S3. Glacier history around the Antarctic Peninsula
16:30 - 18:00	Hallway	o Coffee Break and Poster Session

May 30 (Wednesday)		
Time	**Place**	**Program**
08:30 - 09:00	Reception Desk	o Registration
09:00 - 11:50	Auditorium	o Plenary Lecture 2, o S4. Ocean and cryosphere changes around the Antarctica II
12:00 - 13:00	Main Hall	o Lunch
13:00 - 15:20	Auditorium	o S5. Ecological dynamics and biotechnological potential of Antarctic organisms
15:20 - 15:50	Hallway	o Coffee Break and Poster Session
15:50 - 18:00	Auditorium	o S6. Chronicle of geoscience in Antarctica: From the Era of Peninsula to the Age of Continent
18:00 - 19:30	Main Hall	o Banquet Dinner and Young Scientists Award

Detailed Program

May 29 (Tuesday)		
Registration - Reception Desk		
08:30 - 09:00	Registration	
Opening Ceremony - Auditorium		
09:00 - 09:20	Welcome Remarks	
09:20 - 09:30	Group Photo Session	
Plenary Lecture 1 - Auditorium		
09:40 - 10:20	**PL 01. Steven L. Chown** (SCAR) *Choosing our Future: Antarctic Science in a Global Setting*	
Session 1 - Auditorium **Session 2** - Sejong International Conference Room	**S1. Earth's atmosphere and space environment observed from the Antarctica**	**S2. Ocean and cryosphere changes around the Antarctica I**
10:30 - 10:50	**S1 01. Hongqiao Hu** (Polar Research Institute of China, People's Republic of China) *Ground-based Polar Upper Atmospheric Physics Observations at PRIC*	**S2 01. In-Young Ahn** (KOPRI, Republic of Korea) *Antarctic fjords as an ecosystem model for climate-related studies: a case of Marian Cove in King George Island*
10:50 - 11:10	**S1 02. Byung-Ju Sohn** (Seoul Nat'l Univ., Republic of Korea) *Rapidly warming Antarctic continent over a recent decade*	**S2 02. Francyne Elias-Piera** (KOPRI, Republic of Korea) *A seasonal trophic strategy of the amphipod Gondogeneia antarctica in an Antarctic nearshore habitat at King Sejong Station*
11:10 - 11:30	**S1 03. Yong Ha Kim** (Chungnam Nat'l Univ., Republic of Korea) *Ablation model analysis of meteor radar data from King Sejong Station, Antarctica*	**S2 03. Taewon Kim** (Inha Univ., Republic of Korea) *Effects of freshening and acidification on marine benthic animals of Antarctica*
11:30 - 11:50	**S1 04. Tae-Jin Choi** (KOPRI, Republic of Korea) *Revisit to 30-year Climate Observed at King Sejong Station, Antarctica*	**S2 04. Dongseon Kim** (Korea Institution of Ocean Science & Technology, Republic of Korea) *Ocean acidification in the Amundsen Sea, Antarctica*
11:50 - 12:10	**S1 05. Hye-Yeong Chun** (Yonsei Univ., Republic of Korea) *Characteristics and sources of gravity waves observed from meteor radar at King Sejong Station (62°13'S, 58°47'W) and radiosondes at Jang Bogo Station (74°37'S, 164°13'E), Antarctica*	**S2 05. James Hooper** (Univ. of Wollongong, Australia) *The role of Patagonian Dust-Fe in fertilisation of the Southern Ocean*
12:10 - 12:30	**S1 06. Hataek Kwon** (KOPRI, Republic of Korea) *Impact of stratospheric polar vortex weakening events on the surface air temperature at King Sejong station*	**S2 06. Jinku Park** (Pusan National Univ., Republic of Korea) *Physical forcings determining the inter-annual variability of early bloom properties in the central Ross Sea Polynya*
12:30 - 14:00	Lunch & Korean Early Career Polar Scientists Gathering	

Session 3 - Auditorium	S3. Glacier history around the Antarctic Peninsula
14:10 - 14:40	**S3 01. Claus-Dieter Hillenbrand** (British Antarctic Survey, UK) *Reconstruction of Late Quaternary palaeoenvironmental changes in the Antarctic Peninsula by multi-proxy analysis of drift sediments from its Pacific margin*
14:40 - 15:00	**S3 02. Jae Il Lee** (KOPRI, Republic of Korea) *KOPRI researches on past environmental changes around the Antarctic Peninsula*
15:00 - 15:20	**S3 03. Yeong Bae Seong** (Korea Univ., Republic of Korea) *Late Quaternary deglacial history in Larsen B and C embayment, Antarctica*
15:20 - 15:40	**S3 04. Cristina Subt** (Univ. of South Florida, USA) *Dating the Undatable: Pushing 14C dating in marginal marine Antarctic sediments to new limits*
15:40 - 16:00	**S3 05. Jinwook Kim** (Yonsei Univ., Republic of Korea) *Psychrophilic microbe-mineral interaction and its implications to Fe-cycling in Antarctic region*
16:00 - 16:20	**S3 06. Sunghan Kim** (KOPRI, Republic of Korea) *Changes in Magnetic susceptibility and grain size in the Southern Ocean off the northern Antarctic Peninsula since the last glacial period and its implication for ice calving activity*
16:30 - 18:00	Coffee Break & Poster Session

May 30 (Wednesday)	
Registration - Reception Desk	
08:30 - 09:00	Registration
Plenary Lecture 2 - Auditorium	
09:00 - 09:40	**PL 02. Axel Timmermann** (Institute for Basic Science) *Global Warming Slowdown due to Collapsing Antarctic Ice Sheets and Melting Icebergs*
Session 4 - Auditorium	**S4. Ocean and cryosphere changes around the Antarctica II**
09:40 - 10:10	**S4 01. Karen Heywood** (Univ. of East Anglia., UK) *Variation in the distribution and properties of Circumpolar Deep Water in the Eastern Amundsen Sea, on seasonal timescales, using seal borne tags*
10:10 - 10:30	**S4 02. Craig M. Lee** (Univ. of Washington, USA) *Sustained, Autonomous Observations Beneath Ice Shelve*
10:30 - 10:50	**S4 03. Pierre Dutrieux** (Lamont-Doherty Earth Observatory of Columbia Univ., USA) *Seaglider and Float Observations Beneath Dotson Ice Shelf, West Antarctica*
10:50 - 11:10	**S4 04. Tae-Wan Kim** (KOPRI, Republic of Korea) *Oceanic exchanges at the Dotson Ice Shelf calving front, West Antarctica*
11:10 - 11:30	**S4 05. Christine Dow** (Univ. of Waterloo, Canada) *Weakening of the Nansen Ice Shelf due to the presence of a large basal channel*
11:30 - 11:50	**S4 06. Stefan Jendersie** (National Institute for Water and Atmospheric Research, New Zealand) *Tele connection between ice shelves in the Ross Sea Sector*
12:00 - 13:00	Lunch
Session 5 - Auditorium	**S5. Ecological dynamics and biotechnological potential of Antarctic organisms**
13:00 - 13:30	**S5 01. John C. Priscu** (Montana State Univ., USA) *Aquatic ecosystems beneath Antarctic ice*
13:30 - 13:50	**S5 02. Ok-Sun Kim** (KOPRI, Republic of Korea) *Comprehensive study on the distribution of microbial communities in terrestrial ecosystem on Barton Peninsula, Antarctica*

13:50 - 14:10	**S5 03. Woo Jun Sul** (Chung-Ang Uni., Republic of Korea) *Influence of proximity to Antarctic research stations and anthropogenic activity on abundance of antibiotic resistance genes in soils*
14:10 - 14:40	**S5 04. Bill J. Baker** (Univ. of South Florida, USA) *Chemistry and bioacticity of Antarctic marine organisms*
14:40 - 15:00	**S5 05. Se Jong Han** (KOPRI, Republic of Korea) *Production of biodiesel and bioethanol from the biomass of psychrophilic microalgae chlamydomonas sp. knm0029c*
15:00 - 15:20	**S5 06. Hyuncheol Oh** (Wonkwang Univ., Republic of Korea) *Bioactive secondary metabolites from Antarctic lichens and fungi*
15:20 - 15:50	Coffee Break & Poster Session
Session 6 - Auditorium	**S6. Chronicle of geoscience in Antarctica: From the Era of Peninsula to the Age of Continent**
15:50 - 16:20	**S6 01. John Smellie** (Univ. of Leicester, UK) *Victoria Land volcanism - an overview of recent volcanological and palaeoenvironmental research*
16:20 - 16:40	**S6 02. Gi Bom Kim** (Gyeongsang Nat'l Univ., Republic of Korea) *Bimodal Bubble Generation in Explosive Silicic Volcanism*
16:40 - 17:00	**S6 03. Laura De Santis** (National Institute of Oceanography and Experimental Geophysics, Italy) *The Italian contribution to Seismostratigraphic studies on the Ross Sea*
17:00 - 17:20	**S6 04. Yongcheol Park** (KOPRI, Republic of Korea) *P-wave velocity structure beneath the northern victoria land, antarctica: two separate mantle heat sources*
17:20 - 17:40	**S6 05. Seung-Sep Kim** (Chungnam Nat'l Univ., Republic of Korea) *The kinematic evolution of the Macquarie Plate and its implications for oceanic lithosphere fragmentation*
17:40 - 18:00	**S6 06. Sung-Hyun Park** (KOPRI, Republic of Korea) *Newly Discovered mantle province beneath the Southern Ocean*
18:00 - 19:30	Closing Remarks & Banquet Dinner

List of Posters

May 29-30 (Tuesday-Wednesday)		
Poster Session - Hallway		
PP 01	**Wuju Son** (UST, KOPRI, Korea)	*Identifying multiple Sound Scattering Layers*
PP 02	**Kyuin Hwang** (UST, KOPRI, Korea)	*Evaluation of fungal universal primers for NGS-based diversity studies*
PP 03	**Giovanni Pio Liberato** (Univ. of Siena, Italy)	*Stratigraphy of Permian-Triassic fluvial-dominatted succession in Southern Victoria Land (Antarctica): Preliminary data*
PP 04	**Luca Zurli** (Univ. of Siena, Italy)	*Provenance of Ross Sea Drift in McMurdo Sound (Antarctica) and implication for middle Quaternary to LGM glacial transport: new evidence from petrographic data*
PP 05	**Hojin Jo** (UST, KOPRI, Korea)	*Transcriptome analysis to reveal dormancy mechanisms of Antarctic moss, Sanionia uncinata*
PP 06	**Jae Eun So** (UST, KOPRI, Korea)	*The revision of lichen flora around Maxwell bay, King George Island, Antarctica*
PP 07	**Ji-Hee Yoo** (Yonsei Univ., Korea)	*Characteristics of inertia-gravity waves revealed in radiosonde data at Jang Bogo Station (74°37'S, 164°13'E), Antarctica*
PP 08	**Mi Young Byun** (KOPRI, Korea)	*Conserved function of poaceae type II galactionl synthase genes, involved in tolerance to multiple abiotic stresses through the accumulation of Raffinose family oligosaccharides*
PP 09	**Mi Jung Lee** (KOPRI, Korea)	*Rittmann volcano, northern Victoria Land, Antarctica as the source of englacial tephra*
PP 10	**Byeong-Gwon Song** (Yonsei Univ., Korea)	*Gravity wave activities in the upper mesosphere observed at King Sejong Station, Antarctica(62.22°S, 58.78°W) and their potential sources in the lower atmosphere*
PP 11	**Sung Mi Cho** (KOPRI, Korea)	*Species diversity of Antarctic lichen photobionts and their photobiological characteristics*
PP 12	**Hyoung Sul La** (KOPRI, Korea)	*Spatial patterns of summer mesozooplakton community in the western Arctic Ocean*
PP 13	**Jaewook Lee** (Chungnam Nat'l Univ., Korea)	*Evidence for non-linear wave-wave interactions in mesospheric winds measured by a meteor radar at King Sejong Station, Antarctica*
PP 14	**Suin Moon** (Chungnam Nat'l Univ., Korea)	*Predicting ionospheric F2 layer's critical frequency over Jeju Station using artificial neural networks*
PP 15	**Sangbeom Ha** (Pusan Nat'l Univ., Korea)	*Glacio-marine sedimentation in the continental slope and rise to the east of Pennell-Iselin Banks in the Ross Sea*

PP 16	**Junseok Hong** (Chungnam Nat'l Univ., Korea)	*Optical features and ionospheric irregularities observed at a sub-auroral station (L=2.5) during the St. Patrick's day storm*
PP 17	**Eun-Byeol Jo** (Chungnam Nat'l Univ., Korea)	*An investigation of relation between sporadic E layer and vertical ion drift convergence using ionosonde data in Korea*
PP 18	**Se-Heon Jeong** (Chungnam Nat'l Univ., Korea)	*Manually scaling one year ionograms measured by Jeju ionosonde in 2012*
PP 19	**Wonseok Lee** (Chungnam Nat'l Univ., Korea)	*A first comparison of meteor radar and Fabry-Perot Interferometer winds at King Sejong Station*
PP 20	**Hosik Kam** (Chungnam Nat'l Univ., Korea)	*Propagation analysis of mesospheric gravity waves on OH and OI-557.7nm airglow layers over King Sejong Station*
PP 21	**JeongHeon Kim** (Chungnam Nat'l Univ., Korea)	*Developing a data-assimilated SAMI2-CNU model using Korean ionosonde data*
PP 22	**Sung Jin Kim** (KOPRI, Korea)	*Cryoprotective Effect and Partial Characterization of a Novel Exopolysaccharide (P-ArcPo 20) Produced by Pseudoalteromonas tetraodonis Strain ArcPo 20*
PP 23	**Ji-Hoon Kihm** (UST, KOPRI, Korea)	*The new species of Dactylobiotus (Parachela, Eutardigrada) from King George Island, Antartica*
PP 24	**Jae-Ryong Oh** (UST, KOPRI, Korea)	*Late carboniferous oncoid from the Brøggerhalvøya, NW Svalbard, Arctic Norway*
PP 25	**Sookwan Kim** (UST, KOPRI, Korea)	*Clues to late Cenocoic ice-sheet dynamics and bottom-current activity in the northwestern Ross Sea margin, Antarctica*
PP 26	**Chang-Uk Hyun** (KOPRI, Korea)	*Adélie penguin counting using very-high-resolution UAV images and deep learning-based object detection technique*
PP 27	**Mauro Mazzola** (Nat'l Research Council, Institute of Atmospheric Sciences and Climate, Italy)	*The Italy-Korea cooperative project SAMEECA: Surface-Atmospheric Mass and Energy Exchanges at a Coastal Antarctic site*
PP 28	**Hye Jeong Kim** (Seoul Nat'l Univ., Korea)	*Quartz grain microtextures of beach sands from the Punta Arenas area, southernmost Chile and King George Island, Antarctica*
PP 29	**Eunsol Kim** (Chungnam Nat'l Univ., Korea)	*Climatology of ionospheric density profiles in the auroral and polar cap regions from long-term incoherent scatter radar observations*
PP 30	**Young Kyu Park** (Yonsei Univ., Korea)	*Geochemical identification of sediment provenance during glacial-interglacial period: the Southern Drake Passage*

PP 31	**Jaewoo Jung** (Yonsei Univ., Korea)	*Illite crystallinity responding depositional environments during the Holocene: Larsen Ice Shelf C, Antarctic Peninsula*
PP 32	**Young-bae Ham** (UST, KOPRI, Korea)	*Comparison of neutral winds and ion drifts observed at Jang Bogo Station, Antarctica*
PP 33	**Jae-In Kim** (KOPRI, Korea)	*Utilization of aerial imagery for study on population ecology of Adélie penguins in Cape Hallett, Antarctica*
PP 34	**Young Shin Kwon** (UST, KOPRI, Korea)	*Amundsen Sea specific ecosystem model: Result of the lower-trophic level*
PP 35	**Hong Nhung Vu** (UST, KOPRI, Korea)	*Transcriptome analysis of Antarctic and Korea Diophrys oligothrix ciliate*
PP 36	**Hosang Kim** (Seoul Nat'l Univ., Korea)	*Spatio-temporal photosynthetic variability of Antarctic Intertidal algaes*
PP 37	**Sung Joon Song** (Seoul Nat'l Univ., Korea)	*A new species of the genus Dactylopusia (Copepoda: Harpacticoida: Dactylopusiidae) discovered in King Sejong Island, Antarctica*
PP 38	**Hanna Bae** (Seoul Nat'l Univ., Korea)	*Variation of diatom communities caused by drastic environmental changes in Marian Cove, Antarctica, during the austral summer*
PP 39	**Chang Woo Lee** (KOPRI, Korea)	*Crystal structure of dihydrodipicolinate reductase (PaDHDPR) from Paenisporosarcina sp. TG-14: structural basis for NADPH preference as a cofactor*
PP 40	**Ju-Mi Hong** (KOPRI, Korea)	*Anti-cancer activity of lobaric acid and lobarstin extracted from the Antarctic lichen Stereocaulon alpnum*
PP 41	**Sung-suk Suh** (Mokpo Nat'l Univ., Korea)	*Anticancer activity of ramalin, a secondary metabolite from the Antarctic lichen Ramalina terebrata, against colorectal cancer cells*
PP 42	**Dockyu Kim** (KOPRI, Korea)	*Soil temperature increase effects on maritime Antarctic soil microbial community and humic acid degradation*
PP 43	**Dong-U Kim** (KOPRI, Korea)	*Can spatial variation of megabenthic epifauna reflect successional processes in Marian Cove, a rapid warming fjord in King George Island, Antarctica?*
PP 44	**Eunho Ko** (UST, KOPRI, Korea)	*Effect of sea ice melting processes on phytoplankton physiology in the Northern Chukchi Sea*
PP 45	**Manuel Dall'Osto** (ICM-CSIC, Spain)	*Polar atmosphere-ice-ocean interactions: Impact on climate and ecology*

PP 46	**Yeonggi Kim** (KOPRI, Korea)	*Oceanographic characteristics in the Marian Cove*
PP 47	**Heewon Yang** (KOPRI, Korea)	*Oceanic heat transport and basal melting of the Dotson Ice Shelf*
PP 48	**Young Wook Ko** (Sungkyunkwan Univ., Korea)	*Changes in algal community structure of Maxwell Bay, King George Island, Antarctica: A comparison of 1988-1989 and 2016-2018 surveys*
PP 49	**Hyo Jin Kang** (UST, KOPRI, Korea)	*Comparison of seasonal characteristics of cloud condensation nuclei measured at polar regions*
PP 50	**Seojeong Park** (Inha Univ., Korea)	*Effects of low salinity and low pH on behavioral aspects of Antarctic amphipod, Gondogeneia antarctica*
PP 51	**Eunchong Sin** (UST, KOPRI, Korea)	*Effect of low pH and low salinity on the behavior and physiology of the limpet, Nacella concinna*
PP 52	**Sun-Yong Ha** (KOPRI, Korea)	*Distribution of DOM and CDOM by the glacial melting in the Marian Cove*
PP 53	**Bokyung Kim** (KOPRI, Korea)	*Physiological characteristics and related biochemical parameters of snow algae from King George Island, Antarctica*
PP 54	**Minkyoung Kim** (Seoul Nat'l Univ., Korea)	*Episodic dumping of ice rafted benthic organisms on the Amundsen shelf, Antarctica*
PP 55	**Seong-Joong Kim** (KOPRI, Korea)	*Southern hemisphere westerly wind for the Last Glacial Maximum*
PP 56	**Gillian Li Yin Lee** (Universiti Putra Malaysia, Malaysia)	*Metabolic pathway of phenol degradation of a cold-adapted Antarctic bacterium revealed through whole genome sequencing*
PP 57	**Chang-Uk Hyun** (KOPRI, Korea)	*Monitoring glacier retreat using time-series remote sensing imagery in Marian Cove, King George Island, Antarctica*
PP 58	**Chang-Uk Hyun** (KOPRI, Korea)	*Investigating snow cover effect on distribution of lichen and moss in Barton Peninsula, King George Island, Antarctica*
PP 59	**Walker O. Smith** (Shanghai Jiao Tong Univ., People's Republic of China)	*Temporal and Spatial Distributions of Nutrients and Particulate Matter in the Ross Sea*
PP 60	**Craig Stevens** (NIWA, Univ. of Auckland, New Zealand)	*An Ice-Ocean Interaction Transect from the Ross Ice Shelf to Terra Nova Bay*

Plenary Lecture 1

May 29 09:40-10:20 Auditorium

Choosing our Future: Antarctic Science in a Global Setting

Steven L. Chown

Steven L. Chown[1,2]

[1]*School of Biological Sciences, Monash University, Victoria 3800, Australia*
[2]*Scientific Committee on Antarctic Research, Cambridge, United Kingdom*

ABSTRACT

The Paris Agreement has changed views on how much can be done to improve the way humans interact with our world. The Sustainable Development Goals have had a similar effect. Despite these compelling global efforts, reports continue to highlight declining quality of ecosystems, increasing threats to species, and growing greenhouse gas emissions. Much needs to be done to develop a clearer picture of status, trends, pressures, and the impacts of mitigation response on regional systems. For the Southern Ocean and Antarctica, which comprise nearly a third of the globe, and contribute significantly to global biodiversity, ecosystems services, and sea level rise, this is especially true. The next several decades are a crucial time for determining whether change accelerates or can be retarded. How policy decisions play out in Antarctica and the Southern Ocean, how nations are in turn affected by these southern polar outcomes, and the nature of the feedbacks, will influence both global livelihoods and the future of the Antarctic region. Science is the only means available to develop the reliable knowledge needed to inform decision-making and reveal its consequences. Providing the best understanding of the Antarctic region and its global role, estimates of confidence in specific knowledge areas, and practicable approaches to address knowledge gaps are significant modern challenges for the science community. The community of scientists that constitutes the Scientific Committee on Antarctic Research (SCAR) has an important role to play in facilitating work to address these challenges. SCAR has already commenced doing so. Over the next few years, it will further deliver this agenda. Outcomes will be delivered to a suite of decision-making bodies in keeping with SCAR's status as a committee of the International Council for Science.

Plenary Lecture 2

May 30 09:00-09:40 Auditorium

Global Warming Slowdown due to Collapsing Antarctic Ice Sheets and Melting Icebergs

Axel Timmermann

Axel Timmermann[1], Fabian Schloesser, Tobias Friedrich, Rob deConto, David Pollard

[1] IBS Center for Climate Physics (ICCP), Pusan National University, Korea

ABSTRACT

Recent ice-sheet model projections suggest that increasing greenhouse gas concentrations may cause a rapid collapse of marine-based Antarctic ice sheets (AIS). Including new physical parameterizations for ice-shelf hydrofracturing and ice-cliff instability mechanisms3, these simulations suggest that AIS melting alone may contribute up to 1 m to global eustatic sea level rise by 2100 CE, with freshwater/iceberg discharge fluxes from Antarctica into the Southern Ocean reaching unprecedented levels beyond 106 m3/s. Here, we use a coupled climate/iceberg model of intermediate complexity to explore the climatic response to such future AIS projections. Under pre-industrial and future warming conditions, the massive Southern Ocean iceberg forcing triggers substantial changes in oceanic and atmospheric circulations and large-scale temperature patterns, with potential feedbacks to the AIS. For the RCP8.5 (RCP4.5) future radiative forcing scenario, the projected global warming reduced by about 0.5 ◦C (0.3 ◦C) over the next 8 decades. The cooling is concentrated at Southern Hemisphere mid and high latitudes, and essentially cancels the zonally averaged greenhouse warming near 50 ◦S. Our findings document the importance of coupled climate/ice-sheet feedback mechanisms for future climate and sea level projections.

Abstract of Presentation

Oral Presentation

Ground-based Polar Upper Atmospheric Physics Observations at PRIC

Hongqiao Hu

Hongqiao Hu and UAP group[1]

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ABSTRACT

The polar regions are the entrances of the solar wind energy entering geospace. Chinese Arctic and Antarctic Stations provide idea ground-based platforms to monitor space weather. With supports from Chinese Meridian Project and Polar Exploration Capability Project, Zhongshan Station in Antarctica and Yellow River Station in Svalbard, both located at cusp latitudes and conjugated with each other, have become comprehensive facilities for space physics observation. In this presentation, Chinese Upper Atmospheric Physics Observations in polar regions will be introduced and prospected.

Rapidly warming Antarctic continent over a recent decade

Byung-Ju Sohn

[1]Byung-Ju Sohn, [1]Sang-Moo Lee and [2]Teruo Aoki

[1] Seoul National University
[2] Okayama University

ABSTRACT

Apparent emission temperature (ignoring the scattering effects) at 6.9 GHz from the ice sheet over the Antarctic continent has been retrieved from AMSR brightness temperature measurements by applying the so-called "combined Fresnel equation", which combines two Fresnel polarized reflectivity equations into one. The method was first developed and successfully applied for the sea ice over the Arctic Ocean. The comparison of the pixel-based sea ice temperature with CRREL IMB buoy measurements over the Arctic Ocean showed a correlation coefficient of about 0.99 with a mean bias of 0.83 K, demonstrating that retrieved emission temperature is in an excellent agreement with buoy measurements. Encouraged by successful observations of the sea-ice top layer's emission temperature over the Arctic, the method was applied for the Antarctica where the accumulated snow turns into the ice sheet.

We retrieved the apparent emission temperature at 6.9 GHz in which the temperature-dependent e-folding depth ranges from about10 m (at 265K) to about 30 m (at 190K). Retrieved apparent emission temperature shows a good agreement with READER's AWS 2-m air temperature observations over the continent, with a correlation coefficient of 0.96 on August monthly time scale. Further comparison with 10-m deep layer temperatures at various levels taken during the Japanese expedition from the Syowa station to the Dome Fuji station (15 November 2007 - 24 December 2007) also shows a high correlation of 0.986. The obtained 11 years of August temperature is analyzed to examine the changes in emission temperature. It is based on the assumption that scattering contribution to the year-to-year variation in the retrieved temperature should be weak because we do not see any compelling reasons of causing the substantial variation of the scattering signatures over the 10-year period. Results indicates that the entire Arctic ice sheet has been rapidly warming over the 2003-2013 period, giving a temperature rise with about 1.5K/10 year. At a surprise, such magnitude of change appears to be consistent with ERA-Interim and NECP Reanalysis skin temperature change.

Ablation model analysis of meteor radar data from King Sejong Station, Antarctica

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ABSTRACT

The meteor radar at King Sejong Station (KSS), Antarctica (62.22°S, 58.78° W) observes more than 20000 meteors a day, providing physical parameters, such as speeds, plasma line densities and altitudes of meteor trails. Utilizing a meteoroid ablation model, we determined initial mass and velocity of incoming meteoroids from the observed parameters, assuming an atmospheric model and entry angles. According to the ablation model simulation, a meteoroid would be observed at an altitude of 3.9 km lower and 1.6 km higher if its initial mass and velocity increase by 10 times and by 5 km/s, respectively. The meteor altitude would also appear 1.2 km lower if the entry angle becomes 15° steeper. Applying the ablation model to KSS meteor radar data we derived the initial mass distribution whose logarithmic distribution is close to a Gaussian shape with a full with of half maximum (FWHM) in range of 1.9 ~ 2.2. The FWHMs of mass distributions cause FWHMs of meteor altitude distributions to be 5.2 ~ 6.1 km in December and 8.0 ~ 9.2 km in June. This indicates that meteor altitude distributions are affected by seasonal atmospheric density variation (~3km) more sensitively than by variation in the incoming meteoroid mass distributions (~1 km). Therefore, we conclude that observed meteor altitude distributions are mainly dependent on the atmospheric density, and thus can be used as a mesospheric temperature indicator with an appropriate calibration method.

Revisit to 30-year Climate Observed at King Sejong Station, Antarctica

Tae-Jin Choi

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ABSTRACT

Since February 1988, meteorological observation has been made at King Sejong Station(KSJ) to study Antarctic climate as well as to provide essential weather information for field activities. Variables such as surface pressure, wind, humidity, air temperature, precipitation, and insolation had been recorded automatically at 10-min interval at most of time. In addition, the meteorologist at KSJ observed cloud, sea surface, tide, sea-ice, visibility, and weather phenomena every three hours. Based on these data, KSJ has proudly contributed to Antarctic weather analysis and forecastby transmitting weather data to World Meteorological Organization for 30-years.

King Sejong Station is located on the King George Islands, north off the Antarctic Peninsula. Because KSJ is located at polar front zone, the station experiences frequent passage of cyclonic systems with very strong wind and overcast sky. Variation of surrounding large-scale circulations might affect polar front then weather conditions observed at KSJ. In that respect, KSJ offers a good opportunity to monitor atmospheric activity of Antarctica.

In this talk, we will present some fundamental statistics regarding the climatology observed at KSJ. In addition, long-term trend of temperature will be analyzed based on quality-controlled temperature data. Then some unique phenomena such as blizzard will be explained to help understand weather at KSJ. Moreover, we will talk about the linkage between inter-annual variations of weather, sea-ice with surrounding large-scale environments.

Acknowledgement
This study was supported by PE18010 of Korea Polar Research Institute

Characteristics and sources of gravity waves observed from meteor radar at King Sejong Station (62°13'S, 58°47'W) and radiosondes at Jang Bogo Station (74°37'S, 164°13'E), Antarctica

Hye-Yeong Chun

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ABSTRACT

Activities of gravity waves (GWs) in the upper mesosphere (80-100 km) and their correlation with potential sources in the lower atmosphere are investigated using 8-year (2007-2014) meteor radar observations at King Sejong Station (KSS), Antarctica. To extract GWs from hourly wind data derived from the meteor radar observations, large-scale components with period longer than 5.5 hours within an 8-day moving bin are removed from the original meteor data, and then hourly variance of wind is used as the proxy of GW activities. A semi-annual variation in GW activities is evident with a solsticial maximum and equinoctial mininum below 94 km, while maximum activities appear in August-September above 94 km. The observed GW activities in the upper mesosphere in spring and autumn are associated with the jet stream in the upper stratosphere, while mountains are likely the major source in wintertime. Interestingly, strong correlation appears between the observed GWs in the upper mesosphere and convective clouds in the storm tracks where major convective activities exist in winter extratropics. In the troposphere and lower stratosphere, characteristics and sources of inertia-GWs (IGWs) are examined, using high-resolution radiosonde data observed daily at JBS for 25 months (Dec. 2014-Dec. 2016). The vertical propagation of IGWs exhibits strong seasonal variations in the stratosphere with an enhancement (reduction) of down-going (up-going) IGWs from May to mid-October. The intrinsic phase speed of IGWs is isotropic, while the ground-relative phase and group velocities are dominant in the east and southeast, respectively, due to prevailing westerlies. The intrinsic frequency, vertical wavelength, and horizontal wavelength of IGWs averaged in the troposphere (stratosphere) are 3.40f (1.81f) (where f is the Coriolis parameter), 1.21 km (1.30 km), and 63.65 km (197.85 km), respectively. The wave energy in the stratosphere is larger than in the troposphere, and it has clear seasonal variations with the maximum in September. The momentum flux (MF) of down-going IGWs in the stratosphere is mostly positive for both zonal and meridional directions, whereas that of up-going IGWs is more negative (positive) in zonal (meridional) direction. The sources of the observed waves are exmained using a three-dimensional ray tracing model of IGWs, and the results will be presented in the workshop.

Impact of stratospheric polar vortex weakening events on the surface air temperature at King Sejong station

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ABSTRACT

The Surface air temperature of the Antarctic Peninsula region has undergone significant change since the 1950s. It has had a globally large increase in mean annual temperature from the 1951 to 1998 followed by a decline that still continues.

In this study the possible impacts of stratospheric polar vortex weakening events on the surface air temperature at King Sejong station, which is located at the northern Antarctic Peninsula are examined. The daily surface air temperature observation and reanalysis data from 1989 to 2017 are utilized for the analysis of surface air temperature changed and the detection of stratospheric polar vortex weakening event.

It is found that King Sejong station, including Antarctic Peninsula tends to experience anomalously cold surface air temperature anomalies for up to 90 days after the stratospheric polar vortex weakening events. The cold surface air temperature anomalies begins to appear after the stratospheric polar vortex weakening events occur, and it shows the highest value around 60 days after the event. The resulting surface air temperature anomalies over Antarctic continent largely resemble those associated with negative Southern Hemisphere annual mode (SAM).

Antarctic fjords as an ecosystem model for climate-related studies: A case of Marian Cove in King George Island

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ABSTRACT

King George Island is located at the northern tip of the Antarctic Peninsula, one of the most rapidly warming regions on earth. About 90% of the island is covered by glaciers, and significant glacier retreat has been observed in many coastal areas including a small embayment, Marian Cove (MC). In MC tidewater glaciers have retreated ca. 1.9 km for the last six decades (1956-2017). Recent studies showed a suite of environmental gradients and distinct assemblages of benthic communities in response to the glacier retreat, and these findings apparently warrant MC as a model ecosystem for the studies of climate impacts. As a follow-up, we started to work on the benthic communities as part of a new project CHAMP2050 (**CHA**nges in Coastal **M**arine Systems of the Antarctic **P**eninsula: A **2050** Outlook, 2017-2019). In this presentation, we introduce new findings from recent studies including a unique trophic structure of benthic communities and images of megabenthos in the deep bottom (>30~90m) which were obtained for the first time by ROV survey. We would expect that these findings could be used to testify the idea that current spatial distribution of megabenthos reflects somehow successional processes, which in turn may provide insight into future scenario in the Antarctic fjords.

A seasonal trophic strategy of the amphipod *Gondogeneia antarctica* in an Antarctic nearshore habitat at King Sejong Station

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ABSTRACT

The amphipod *Gondogeneia antarctica* is one of species predominating shallow Antarctic nearshore benthic communities. *G. antarctica* has been considered as a key component of nearshore Antarctic food web, being preyed on by a high number of predators, and relying on various food sources over a year. In order to investigate its trophic preference over a year, *G. Antarctica* and its potential food (Suspended Particulate Matter and macroalgae) were collected from intertidal water at King Sejong Station (Feb-Nov 2015). The C and N stable isotopes and fatty acids were analyzed in the potential food and the body of amphipods. We found similar δ^{13}Cvaluesof*G. antarctica* during the year (e.g. -19. 4‰ ± 0.8: austral summer, -20.2‰ ± 0.5: winter), being close to those of red algae analyzed *(Iridaea cordata* -21.1‰ ± 3.2, *Gigartina skottsbergii* -22.6‰ ± 1.5, *Palmaria decipiens* -19.9‰ ± 0.7), indicating that the macroalgae were a primary food source, and SPM (-25.4‰ ± 1.2) the secondary one. Throughout the period of investigation, there was a constant dominance of particular FAs (C16:0, C20:5$_{(n-3)}$, C18:1$_{(n-9)}$, C18:2$_{(n-6)trans}$, C16:1$_{(n-9)}$ and C22:6$_{(n-3)}$), which were very close to those of the red algae and also similar to those from previous studies on this amphipod, strongly supporting the isotopic findings that *G. antarctica* is a herbivore with macroalgae as the principal diet all year round. We found, however, the increased δ^{15}N values from 5.6 in winter to 7.7‰ in summer, which indicated that when food is relatively abundant in summer, it seems to be omnivorous, i.e. eating both plant and animal materials. Microscopic analysis showed that the digestive tract was full of detrital matter in summer, but mostly of macroalgae in winter, supporting the idea of seasonal trophic shift. In addition, total concentration of free fatty acid continuously increased from February to May and afterwrds decreased, which indicated accumulation of energy reserve utilizing all the possible food resources in summer for use in winter. Thus, the trophic shift of *G. antarctica* from herbivory in winter to omnivory *in summer* likely a strategy to cope with food shortage in winter, allowing eventually this amphipod species to adapt successfully to the Antarctic nearshore environment with seasonally highly fluctuating food availability.

Effects of freshening and acidification on marine benthic animals of Antarctica

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ABSTRACT

Climate change poses a big threat to the Antarctic ecosystem. Warming induces glacier retreat and eventually salinity of seawater can decrease by melting water. Also increased CO_2 induced by human activity can decrease the seawater pH in the Antarctica. Here we were interested in how the marine benthic ecosystems in the Marian Cove will change in response to freshening and acidification. We selected Antarctic amphipods (*Gondogeneis Antarctica*) living in the shallow water and limpets (*Nacella concinna*) living in the intertidal region as model animals to predict the fate of benthic animals in future. We exposed them to 4 treatments combined with 2 salinity (34 and 27 psu) and 2 pH regimes (pH 8.0 and 7.6). Though many behavioral aspects remained same under changed conditions, shelter using behavior of amphipods were retarded and moving distance of limpets decreased in the low pH and low salinity treatment. We suspect that multiple stresses of climate changes can induce behavioral changes in the marine benthos in the Antarctica and eventually this may result in breaking the balance in the ecosystems in the Antarctica.

Ocean acidification in the Amundsen Sea, Antarctica

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ABSTRACT

Aragonite saturation states (W_{arag}) are estimated from dissolved inorganic carbon (DIC) and total alkalinity (TA) data in the Amundsen Sea. W_{arag} is a good proxy for the ocean acidification. Aragonite undersaturation (W_{arag} <1.0) indicates that the ocean acidification is severely occurring at present. In the Amundsen Sea, W_{arag} values of the surface waters ranges from 1.1 to 2.9 and are higher than 1.0, implying that the entire surface waters are supersaturated with respect to aragonite. W_{arag} decreases with water depth and reaches below 1.0 at the 400 m water depth, implying that the aragonite undersaturation occurs below the 400 m water depth in the Amundsen Sea. W_{arag} is considerably affected several processes, such as sea-ice melting, photosynthesis, remineralization of organic matter, and air-sea CO_2exchange.IntheAmundsenSea,W_{arag} values are very well correlated with DIC concentration (R^2=0.96),indicatingthatW_{arag} is mainly affected by biological activity (photosynthesis and remineralization of organic matter) in the Amundsen Sea.

The role of Patagonian Dust-Fe in fertilisation of the Southern Ocean

James Hooper

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ABSTRACT

Although Antarctic ice cores show relative agreement on dust flux over the last glacial cycle, the same cores show marked differences in Methane Sulphonic Acid (MSA) deposition - commonly regarded as a proxy for oceanic phytoplankton growth - over the same period. This contradiction has complicated our understanding of the fertilisation effect of dust on the High-Nutrient Low-Chlorophyll (HNLC) Fe-limited Southern Ocean. The uncertainty surrounds whether it is dust fertilisation, or another mechanism such as marine nutrient upwelling, or changes in temperature and/or solar radiation, which is the main factor driving primary productivity in this region. If dust fertilisation is important, why is it that in some ice cores dust and MSA deposition is correlated, while in others they are out of phase? Questions such as these have fuelled doubt over the precise role of dust in ocean fertilisation.

We present new, contemporary, ice core evidence of event-scale correlations between dust Fe and MSA deposition in the high latitude South Atlantic Ocean. This suggests there is a strong relationship between dust and HNLC ocean fertilisation in this region at the present time, that is, dust fertilisation plays an important role in marine productivity. The difference between this finding and the variability in the MSA/dust flux relationship over glacial/interglacial time periods implies that while dust deposition drives event/centennial scale ocean productivity under current climate conditions, over longer time periods the relationship is less clear. Why this is the case is the subject of on-going research, although fluctuating dust and MSA concentrations in Antarctic ice cores over paleo time scales are perhaps subject to other factors such as changes in atmospheric and ocean circulation patterns, aeolian transport pathways, sea ice duration and extent, and the location of HNLC regions.

Despite this, because our results imply dust emissions are linked to marine productivity over the recent past we use dust deposition data from Patagonian peat cores to explore what impact dust may have had on oceanic fertilisation during the Holocene and Anthropocene.

Physical forcings determining the inter-annual variability of early bloom properties in the central Ross Sea Polynya

Jinku Park

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ABSTRACT

To understand the inter-annual variability (IAV) of the early bloom in the central Ross Sea Polynya (RSP), the annual phenology of phytoplankton bloom was extracted from the satellite ocean color data from 2002 to 2017 using the adjusted Gaussian fitting method. From the extracted phenologies, we examined the IAV of the bloom properties such as bloom amplitude, bloom timings of initiation and peak, and remanent concentration meaning the chlorophyll concentration left after the bloom. Moreover, we also investigated what physical factors (temperature, wind, sea ice and light) closely related to them using the multi-linear regression model. The first, the research result shows that the bloom amplitude has steadily increased since 2002 and is likely to be related to the development of the polynya. The bloom amplitude increased with extremely strong winds. The specific reason is that the enhanced expansion of the RSP with a monotonic variation in the wind direction (west-southerly to east-southerly) is likely to contribute the continuous increase in the bloom amplitude. The second result is that the bloom initiation and peak timings are closely correlated with the onset timing of the RSP associated with the ice melting and the ice drift. The third result is that the IAV of the remanent concentration is likely to be related to stratification by solar warming. Through the recently increased PAR, the strengthened stratification and the reduced remanent concentration are expected. This study is confined to the physical environmental properties affecting the IAV of the early bloom in the central RSP. In addition, because the remotely sensed data is applied to simple statistical approach, it might be expected that there is a gap with the natural phenomena. However, it is expected that useful information can be provided in the experimental design to acquire accurate observation data in the related research field in the future.

Reconstruction of Late Quaternary palaeoenvironmental changes in the Antarctic Peninsula by multi-proxy analysis of drift sediments from its Pacific margin

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ABSTRACT

Giant sediment drifts located on the continental rise west of the Antarctic Peninsula and in the Bellingshausen Sea contain a high-resolution archive of ice sheet history in West Antarctica and palaeoceanographic changes in the Southern Ocean. However, previous studies on sediment cores retrieved from these contourite drifts, including records recovered during Ocean Drilling Program (ODP) Leg 178, were compromised by lack of reliable chronological control. This shortcoming is mainly caused by the very low abundance of calcareous microfossils in the sediments that are required for applying radiocarbon dating and stable oxygen isotope ($\delta^{18}O$) stratigraphy. Moreover, sediments assumed to have been deposited during glacial periods consist almost entirely of fine-grained terrigenous detritus, i.e. they lack even siliceous microfossils that could be utilised for biostratigraphic purposes.

International Ocean Discovery Program (IODP) proposal 732-Full2 aims to obtain continuous, high-resolution records from sites on the West Antarctic sediment drifts and to develop reliable age models for them. The strategy for achieving the second objective is to use a range of chronostratigraphic techniques including $\delta^{18}O$ stratigraphy and relative geomagnetic palaeointensity on sedimentary sequences recovered from the shallowest parts of the driftcrests, where the preservation of calcareous microfossils is expected be higher than in deeper water.

Here we present results of multi-proxy investigations on piston and box cores recovered from the proposed drill sites during site survey investigation cruise JR298 of the RRS James Clark Ross in 2015. Apart from the integrated chronological approach, the new records augment previous assessments of palaeoenvironmental changes on the West Antarctic continental margin during glacial-interglacial cycles of the Late Quaternary. We will present results of geochemical analyses, physical properties measurements, detailed grain-size investigations and clay-mineral studies. We will utilise these data for reconstructing glacial-interglacial changes in (i) the extent of Antarctic glaciers across the neighbouring continental shelf, (ii) bottom-water circulation on the continental rise, and (iii) biological productivity in the surface waters.

KOPRI researches on past environmental changes around the Antarctic Peninsula

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ABSTRACT

Paleoenvironmental research project has been one of the major research projects of KOPRI since 2000. Earlier projects have focused on the reconstruction of the late glacial to Holocene environmental changes in the Antarctic Peninsula region. Published works include studies on: late glacial to Holocene climatic and oceanographic history from the South Shetland Islands (SSI), northwestern margin of the northern Antarctic Peninsula (AP), the South Scotia Sea, and the Drake Passage; Holocene climate variability from the SSI, the Bransfield Strait (BR), the Scotia Sea, and the South Orkney Plateau; glacial-interglacial provenance changes from the Drake Passage sediments; origin of lithogenic and biogenic particles using sediment traps from the BR and King George Island (KGI); tephra geochemistry; clay mineralogy of the SSI shelf sediment; provenance of BR sediments; soil mineralogy and geochemistry from KGI; and deglaciation history of KGI based on radiocarbon dating on sorted circles and surface exposure dating.

The launch of the first Korean icebreaker Araon in 2009 made it possible to explore much larger portion of the Antarctic ocean, including the ice-shelf retreating area of the eastern part of the AP. Araon explored the AP region in 2013 (northern AP including Larsen ice shelves), 2017 (Bellingshausen Sea), and 2018 (northern AP and BR). Some important findings from the 2013 cruise are presented in this session. In 2014 Jang Bogo station was built in Terra Nova Bay, and our research has been expanded into areas encompassing the West Antarctic margins, from the AP to the Ross Sea. Main scientific objectives of the on-going paleoenvironmental research project of KOPRI are to reconstruct the deglacial history of the West Antarctic Ice Sheet and to understand the Quaternary paleoceanographic changes in the Pacific sector of the Southern Ocean.

Late Quaternary deglacial history in Larsen B and C embayment, Antarctica

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ABSTRACT

The Antarctic Peninsula experienced rapid regional warming over the last century, with a rise in temperature six times greater than the global mean. The recent sequential retreat and collapse of the Larsen B ice shelf (LBIS), that occurred seven years after the collapse of the Larsen A ice shelf (LAIS), attracted much attention in the public media and scientific research, particularly regarding the feedback between the sea level rise observed under global warming and the future stability of the Larsen C ice shelf (LCIS) triggered by gradually warming climate which destabilizes these ice shelves in sequence from North to South. Trillion ton of iceberg which broke off on July 12, 2017 from LCIS throws a question on its stability and/or forthcoming destiny analogous to the ones to the north (MIDAS Project, 2017). The LAIS is thought to have collapsed almost completely during the middle to late Holocene, and then re-formed again before the collapse in January 1995, whereas the LBIS was not disintegrated throughout the Holocene until its latest collapse. Glacial flow accelerated as the buttressing LBIS disintegrated. This triggered a mass loss of 27 km^3 yr^{-1} since the 2002 collapse, and this has contributed to global sea level change.

Here, we document post-LGM deglacial history in the Larson B and C Embayment (LBE & LBC) which can role as a window to see the future, based on both marine and terrestrial records, and defined mainly by the use of two sources (meteoric & in-situ) of ^{10}Be complemented with basic sedimentological analysis of sediment cores (EAP13-GC17 & EAP13GC16). The meteoric ^{10}Be data, obtained from marine sediments, show four distinct units (from subglacial in the bottom through deglacial and sub-floating ice shelf, to open marine in the top), implying that the recent collapse of the LBIS is unprecedented for the Holocene. However, terrestrial exposure ages of ^{10}Be coupled with in-situ ^{14}C data highlight differences between the two sectors. Ice thinning in the area between LBE & LBC started about 14ka and lasted until 6 ka, then remained relatively limited from 6 ka to its latest collapse. In contrast, area between LAE & LBE likely reorganized after a complete collapse during the late-Holocene, a pattern of similarity in ice evolution to the Larsen A ice shelf. We, thus, propose the initial timing of deglaciation around the Larsen Ice Shelf area propagated southward during the Holocene and given the location of ice shelf both on the land and the sea, data based on both places can better constrain its dynamics.

Dating the Undatable: Pushing ^{14}C dating in marginal marine Antarctic sediments to new limits

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ABSTRACT

In order to determine the timing of Antarctic ice sheet retreat and advance during the Late Quaternary, various tools are used to measure the age of marginal marine sediments, but these chronologies pose more than a few difficulties in acquisition due to the rarity of microfossils around the Antarctic margins. Carbonate ^{14}C dating is a well-established approach, but requires foraminiferal microfossils, shells or other carbonate materials that are rare in most Antarctic regions, and may suffer from vital effects. Bulk acid insoluble organic (AIO) ^{14}C dates are frequently used as analternative, but this approach works best where high productivity and sedimentation rates reign, and not too well in condensed sequences where high proportions of detritus are present. Compound specific dating methods have also been employed, but these may still yield an average age from a mixture of components and require very large sample sizes. Alternate dating methods have also been used, such as magnetic intensity dating, or regional correlation with well-dated cores, but these may not always provide accurate and precise dates. Here we present the progressive improvements of Ramped PyrOx ^{14}C dating, which utilizes the thermochemical degradation of components within a bulk AIO sediment sample. These improvements include novel techniques, such as compositing and isotope dilution that are used to date sediments where the proportion of contemporaneously deposited carbon is very small relative to other detrital components and maximize the accuracy of resulting dates while minimizing costs in precision from utilizing ultra-small fractions of the bulk sample. Ramped PyrOx ^{14}C dating techniques allows us to generate chronologies for cores that would otherwise go undated. Furthermore, these techniques can be used to push the limits of radio carbon dating not only to regions where accurate core chronologies have been difficult to comeby, but also further back in time, into marine sediment horizons deposited at or before the last glacial maximum (LGM), where highly detrital material has precluded radiocarbon dating in the past. Wider use of these techniques can enable more coordinated *a priori* coring efforts to constrain regional glacial responses to rapid warming.

Psychrophilic microbe-mineral interaction and its implications to Fe-cycling in Antarctic region

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ABSTRACT

Role of extremophiles in the biogeochemical metal-cycling are of an important process resulting in the modification of mineral assemblages and hydrochemistry by the metal redox reaction. The unexpected mineralization that bypasses the thermodynamic barriers could be a consequence of bacterial survival and growth strategy in extreme conditions. Investigations on microbe-mineral interactions in such a harsh condition, example of Antarctic region, and its implications to the Fe-cycling will be discussed.

Changes in Magnetic susceptibility and gran size in the Southern Ocean off the northern Antarctic Peninsula since the last glacial period and its implication for ice calving activity

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ABSTRACT

Magnetic susceptibility (MS) values in Scotia Sea sediments showed strong correlations to ice core dust input, which emphasizes the role of atmospheric circulation in the Southern Ocean. Thus, the correlation between them was suggested as a powerfuSl tool for age construction of marine sediments in the Southern Ocean. However, controls for MS variation in Scotia Sea sediments are not clear. In this study, we document grain size analysis and MS record of sediment cores from the Southern Ocean off the northern Antarctic Peninsula (the south Scotia Sea and the northern Powell Basin) to reveal which size fraction is responsible for MS variation and how the size fraction is transported to the Southern Ocean deep-sea since the last glacial period. MS values of all cores GC02-SS02, GC03-C2, GC03-C4, and GC04-G03 are strongly related to sand sized and coarse silt sized fractions. Sand sized and coarse silt sized fractions have high MS values compared to other size fraction, which indicates that they are the size fraction which is responsible to increased MS values during the glacial period. They are most likely transported by ice rafting from the Antarctic Peninsula and the Weddell Sea. Thus, strong correlation between MS and ice core dust record indicates a strong linkage between circulations of cryosphere (iceberg calving activity) and atmosphere (dust input) in the Southern Ocean off the northern Antarctic Peninsula.

Variation in the distribution and properties of Circumpolar Deep Water in the Eastern Amundsen Sea, on seasonal timescales, using seal-borne tags

Karen Heywood

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ABSTRACT

In the Amundsen Sea, warm saline Circumpolar Deep Water (CDW) crosses the continental shelf toward the vulnerable West Antarctic ice shelves, contributing to their basal melting. Due to lack of observations, little is known about the spatial and temporal variability of CDW, particularly seasonally. A new dataset of 6704 seal-tag temperature and salinity profiles in the easternmost trough between February and December 2014 reveals a CDW layer on average 49 db thicker in late winter (August to October) than in late summer (February to April), the reverse seasonality of that seen at moorings in the western trough. This layer contains more heat in winter, but on the 27.76 kg m^{-3}densitysurfaceCDWis0.32˚C warmer in summer than winter, across the northeastern Amundsen sea, which may indicate wintertime shoaling offshelf changes CDW properties onshelf. In Pine Island Bay these seasonal changes on density surfaces are reduced, likely by gyre circulation.

I shall conclude by describing upcoming campaigns in the Amundsen Sea and new technologies being developed for Antarctic oceanography.

Sustained, Autonomous Observations Beneath Ice Shelves

Craig M. Lee

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ABSTRACT

Interactions between oceans and ice sheets are crucial to the regulation of the global overturning circulation and the current acceleration of ice flow into the ocean and associated sea-level rise. However, challenges imposed by harsh, remote polar environments and by the complex, hazardous environment near and beneath the great ice shelves, severely limit availability of the measurements required to advance understanding of key processes and constrain models. As a step toward addressing this problem, three Seagliders, specifically adapted for acoustic navigation and autonomous operations under ice shelves, four profiling floats and a small array of acoustic navigation beacons were deployed at the Dotson ice shelf for a year-long mission sampling that includes extensive glider- and float-based observations deep within the ice shelf cavity. Seagliders successfully occupied multiple axial and transverse sections within the cavity, traversing distances of up to 140 km under the shelf. The acoustic navigation array allowed Seagliders to geolocate and navigate deep within the cavity interior. Profiling floats deployed at the inflow were carried into the cavity and ejected roughly two months later. This presentation will discuss the technologies developed and the approach employed for the Dotson mission, provide an overview of the mission's accomplishments and offer thoughts on future directions in autonomous observing of ocean-ice sheet interactions.

Seaglider and Float Observations Beneath Dotson Ice Shelf, West Antarctica

Pierre Dutrieux

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ABSTRACT

Interactions between Oceans and Ice sheets are crucial to the regulation of the global overturning circulation and the current acceleration of ice flow into the ocean and associated sea-level rise. Satellite and moored ocean observations demonstrate with increasing temporal and spatial accuracy that the interaction is complex, and occurs on broad ranges of scales. But the establishment of clear relationships between ocean and ice sheet will remain elusive until we obtain direct in-situ observations. Three Seagliders and four EM-APEX floats sampled near and under the Dotson ice shelf in West Antarctica in January 2018, with observations continuing through the winter into summer 2018/2019. Initial analysis of the hundreds of kilometers of tracks already obtained reveal that past and initial bathymetric inversion from airborne gravity observations suffered significant biases, and that an inferred ridge seemingly blocking access for warmer deep waters to the ice grounding line does not in fact exist. Observed water properties map expected features of under ice shelf circulation, with inflowing warmer water from the deep eastern side of the cavity and outflowing meltwater from the shallower western side of the cavity. Fortuitous observations of water properties in hundreds of meters high rifts at the ice shelf base will also be presented.

Oceanic exchanges at the Dotson Ice Shelf calving front, West Antarctica

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ABSTRACT

Recently, the rapid retreat of the ice shelves in the West Antarctica due to climate change has been established from remotely satellite observation. Especially, widespread thinning of ice shelves in the coast around the Amundsen Sea has been recorded in recent decades due to intrusions of relatively warm Circumpolar Deep Water (CDW) onto the continental shelf. Such an intrusion of CDW supplies heat to the Ice shelves and leads to ice shelves basal melting and spreading of meltwater from the glacier. Dotson Ice Shelf (DIS) is an ice shelf south of Amundsen Sea polynya (ASP), which has been found to have a high basal melting rate due to oceanic heat transport steered towards it in the Dotson-Getz Trough (DGT). In order to estimate the oceanic heat transport into the cavity, three long-term moorings were deployed in front of DIS in January 2014 and measured vertical profiles of current velocities, temperature, and salinity for two years. During the measurement period, modified CDW (mCDW) was observed to intrude along the bottom of the eastern slope of DGT. This warm salty water melts glacial ice, mixes with the meltwater and spreads to the north along the western slopes of DGT. A strong seasonal variation was observed, with maximum southward flow during austral summer and minimum in austral autumn and winter. The seasonal variation correlated with the local Ocean Surface Stress Curl (OSSC) by sea ice and wind distribution in ocean surface, in similarity with previous studies form nearby regions. Meltwater outflows showed maximum during autumn and minimum during spring. The outflow velocities were influenced by zonal density gradients induced by the seasonal variation of meltwater fraction. Also, the meltwater fraction at western slope lags heat transport at eastern slope by 145 days. The thickness of mCDW on the eastern slope of the DIS showed a strong inter-annual variation affected by Ekman upwelling along DGT. During austral summer, southeasterly wind on the eastern boundary of ASP shows the strong inter-annual variability associated with the longitudinal location of Amundsen Sea Low (ASL).

Weakening of the Nansen Ice Shelf due to the presence of a large basal channel

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ABSTRACT

Ice shelves are a critical component for resisting the advance of Antarctic ice into the ocean. With increasing ocean and air temperatures, a concern is that these buttressing shelves will thin, break up and allow grounded ice to contribute directly to sea-level rise. This investigation focuses on the Nansen Ice Shelf, Terra Nova Bay, East Antarctica. We present data from two aerial geophysics campaigns flown in 2011 and 2014, along with ice surface and basal DEM reconstruction, and ice strain rate calculations to examine the role of a substantial basal channel in the stability of this ice shelf.

The basal channel weakened the ice shelf allowing formation of a transverse fracture, first visible in satellite imagery in 1987. This fracture culminated in a large calving event in April 2016. In years when surface water formed on Nansen Ice Shelf, a river flowed into the transverse fracture contributing to its destabilizing effect. In November 2016, we identified a new fracture, which also formed over the basal channel. We compare the Nansen Ice Shelf fractures with those at other vulnerable ice-shelf systems, including Petermann and Totten Glaciers, to evaluate the role that basal channels may play in simultaneous basal and surface weakening and their consequent effect on ice-shelf rifting and stability.

Tele connection between ice shelves in the Ross Sea Sector

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ABSTRACT

Investigating the causes and predicting the temporal scales of global sea level rise driven by a warming ocean has been increasingly shifting towards the question of fresh water input from melting ice sheets.

While floating ice shelves play a key role in protecting the grounded ice sheets of Antarctica their melting contributes only minor to the global sea level rise. However, the ice shelf generated fresh water signatures are very important regionally: in driving currents, pre conditioning sea ice formation, and hence determine the access of heat to floating ice shelves and ice tongues along Antarctica's coasts.

Such fresh water signatures, carried by coastal currents, can tele connect ice shelf processes over thousands of kilometers. In the Ross Sea the Antarctic Coastal Current links ice shelves in the Amundsen Sea to the Ross Ice Shelf. The Victoria Land Coastal Current connects the Ross Ice Shelf with the Drygalski Ice Tongue.

Results from two numerical studies are presented that investigated the effects of remotely produced fresh water components on the regional circulation of the continental Ross Sea and the local circulation in the Drygalski Basin.

Aquatic ecosystems beneath Antarctic ice

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ABSTRACT

The first measurements on permanently ice-covered Antarctic lakes were made by R.F. Scott in 1903, when he gathered morphometric data from Lake Bonney, Taylor Valley. It was not until the late 1950's when research initiated as part of the International Geophysical Year led to systematic studies of Antarctic lakes. Most of these studies focused on coastal lakes along the Soya Coast, the Vestfold Hills, the Bungar Hills, the South Orkney Islands, and Southern Victoria Land. Lakes in Southern Victoria Land, the most southerly of these lakes, are the only that maintain permanent ice covers overlying deep water columns (~20 to 85m). Research in the Southern Victoria Land lakes over the past 60 years, particularly the climate integrated studies conducted in the Taylor Valley by the NSF-funded Long Term Ecological Research Program, have shown that most organisms in the lakes are not just "surviving the extremes" but are actively feeding, growing and reproducing. As such, they are ecosystems in which we can identify and begin to understand physiological and genomic adaptations in the context of one of the most extreme environments on our planet. Research in these coastal lakes led scientist to hypothesize that subglacial lakes, discovered more than 40 years ago beneath the Antarctic ice sheet, may also contain a diverse group of microorganisms that form functional ecosystems beneath the ice sheets. The first biological studies on subglacial lakes focused on Lake Vostok, a ~1 km deep lake lying ~4 km beneath the East Antarctic Ice Sheet. This research (published in 1999) revealed that a relatively diverse group of microorganisms were present in Lake Vostok at densities of ~10^3 cell ml^{-1}. Importantly, these first reports of life in Vostok were indirect, focusing on organisms found in accretion ice overlying the lake. It was not until 2012-2013 when three national programs began drilling programs to directly sample subglacial lakes. Russian drillers penetrated Lake Vostok in February 2012 allowing water to flood their borehole as hydraulic equilibrium was reached. Ice cores representing this water were collected the following season after the lake water in the borehole had refrozen. Unfortunately, these samples were badly contaminated by hydrocarbon-based drilling fluid leading to equivocal results of life in Lake Vostok. In December 2012, scientists from the United Kingdom attempted to access Subglacial Lake Ellsworth, West Antarctica, using a clean access hot-water drill. Their mission had to be cancelled owing to equipment and operational failures. One month later a US team, using a hot-water drill and clean protocols, successfully accessed and sampled water and sediment from Subglacial Lake Whillans, West Antarctica. The results from Whillans revealed a functional ecosystem containing a highly diverse group of microorganisms. Results from these three campaigns provided a wealth of new technological and scientific knowledge about subglacial lakes and pave the way for future Antarctic subglaciallake research.

Comprehensive study on the distribution of microbial communities in terrestrial ecosystems on Barton Peninsular, Antarctica

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ABSTRACT

In recent years, applications of molecular methods to study microbial ecology have allowed the extension of our knowledge that Antarctica contains unexpected high diversity of bacteria and their complex of community. Here, we studied on the spatial distribution of soil bacterial communities and their relation to local environmental gradients in ice-free region from Barton Peninsular in the maritime Antarctic. Six bacterial phyla, *Actinobacteria*, *Proteobacteria*, *Acidobacteria*, *Chloroflexi* and *Bacteroidetes*, were dominant, but their relative abundance varied greatly throughout the locations. Spatial mapping of bacterial communities revealed that soil pH was the primary driver of bacterial community structure. A large proportion of remaining community composition was spatially structured following the post-Last Glacial Maximum (LGM) deglaciation trajectory which was evidenced by glacial striations and geochemical signatures remained on outcrops. In addition, considerable proportion of community variation were explained by geochemical properties, geochemistry as well as edaphic components play equally important roles in structuring bacterial communities. Taken together, these results greatly advance our understanding of the adaptation of soil bacterial populations to this extreme environment.

Influence of proximity to antarctic research stations and anthropogenic activity on abundance of antibiotic resistance genes in soils

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ABSTRACT

Soil microbial community and its functions were well not known in Antarctica which is pristine extreme environmental habitats. To explore environmental changes including global warming and human activities to the Antarctic ecosystem, especially to Antarctic soil microbes, we collected a soil near the Jang Bogo Research Station in Antarctica. A qPCR array with 384 primer sets targeting antibiotic resistance genes and mobile genetic elements (MGEs) was used to detect and quantify these genes. A total of 73 ARGs and MGEs encompassing eight major antibiotic resistance gene categories were detected, but most at very low levels. The Antarctic soil appeared to be a common reservoir for seven ARGs since they were present in most samples (42%-88%). If the seven wide spread genes were removed, there was a correlation between the relative abundance of MGEs and ARGs, more typical of contaminated sites. There was a relationship between ARG content and distance from both research stations, with a significant effect at the Jang Bogo Station especially when excluding the seven wide spread genes; however, t he relative abundance of ARGs did not increase over the four year period. Also,we found microbial lignocellulose degradation in the humic substances-rich soil in Antarctica. Overall, this study identifies that human activity and certain soil characteristics correlate with antibiotic resistance genes in these oligotrophic Antarctic soils and provides a baseline of ARGs and MGEs for future comparisons. Also, from PacBio SMRT sequencing and cutting-edge metagenomic analysis using King Sejong Station soil, the phylum Actinobacteria was the majority and several lignocellulose degradation-related carbohydrate-active enzymes (CAZymes) were observed. Among the CAZymes, glycoside hydrolases 5 (GH5), GH13, auxiliary activities 2 (AA2) and AA4 can be the candidate of cold-adapted enzymes for degrading lignocellulose. The biodegradation of lignocellulose can be the way to produce renewable biofuel, as global warming progresses, lignocellulose degradation can increase production of greenhouse gas such as carbon dioxide.

Chemistry and bioactivity of Antarctic marine organisms

Bill J. Baker

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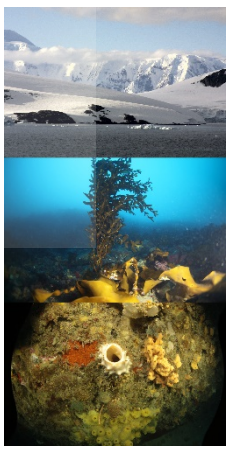
ABSTRACT

Antarctica is a continent of enigmas. Stunning geographic beauty belies its inhospitable climate. Covered a mile thick in ice, it is the world's largest desert. Fossil ferns found in its mountains speak of its prehistory as a tropical rainforest, but now is largely devoid of life. Its most famous inhabitant, the penguin, is thought of as a flightless bird, but soars underwater much as a falcon glides the sky. Perhaps one of the greatest enigmas is the contrast between the terrestrial and marine environments. On land, monochromatic snow and ice support little life, yet the sea teams with life, life that expresses itself with the full rainbow of colors.



Color is but one manifestation of chemical ecology. The Antarctic benthos supports an extensive community of predators and prey, competitors and facilitators. A harsh geographic history has contributed to marine diversification and enhanced what we now recognize as a rich flora and fauna, commensurate in some instances with temperate kelp forests and even approaching the richness of tropical marine environments. Not surprisingly, Antarctic benthic ecology is highly dependent on chemical mediation of interspecific interactions, interweaving chemodiversity with biodiversity in a classical yin and yang feedback loop. The evolution of selective chemical defenses facilitates drug discovery research, producing suites of metabolites that inform structure-activity studies and add breadth to bioactivity profiles. This presentation will focus on recent and contextual research from our lab which has demonstrated the potential for new biomedical leads and scaffolds from these difficult to access biological resources.

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Production of biodiesel and bioethanol from the biomass of psychrophilic microalgae *chlamydomonas* sp. knm0029c

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ABSTRACT

Biofuels derived from microalgae have been recognized as future resources to replace fossil fuels because of their eco-friendliness and availability of by-products. However, it is not easy to cultivate microalgae in winter when the outside temperature drop to below 0˚C. In this study, biomass of psychrophilic microalgae *Chlamydomonas* KNM0029C originated from polar region was obtained and biodiesel and bioethanol were produced from it. KNM0029C was grown in TAP medium at 4˚C with 80 μmol photon $m^{-2}s^{-1}$, and analysis of the fatty acid methylester (FAME) showed a predominance of polyunsaturated fatty acid such as C16:4, C18:3, and C18:2. The modification of TAP medium using response surface methodology (RSM) led to enhancement of lipid production and content to be 237.7mg/L and 20%, respectively. A 20L photo-bioreactor was designed and fabricated to obtain 23g of biomass, which was equivalent to 1.12g/L of dry cell mass. The carbohydrate, protein, and lipid compositions of KNM0029C biomass were analyzed to be 54.4%, 24.2%, and 21%, respectively. The recovery of FAME was performed by extraction of lipid using chloroform:methanol (1:2) from wet biomass with sonication, and the FAME yield was 156.5mg/g DCW. Bioethanol was produced by yeast fermentation using residual biomass after sonication and enzyme treatment. The highest yield was 0.22g of ethanol per gram of residual biomass after 24 h of culture. Overall, 156mg of biodiesel and 170mg of bioethanol were obtained from 1g of KNM0029C grown at low temperature.

Bioactive secondary metabolites from Antarctic lichens and fungi

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ABSTRACT

Natural products possess unmatched chemical diversity and drug-like properties, and have played a pivotal role as sources for drug lead compounds. Although identification of new chemotypes for drug development in various areas is still necessary, it is now difficult to isolate new chemistry from the conventional natural resources, which have been thoroughly investigated. Therefore, there is a growing opinion that natural products research needs to focus on the chemistry of untapped natural resources such as microbes from unexplored habitats or relatively less screened organisms for their potential. In line with this, organisms from polar habitats have recently gained much interest as a rich source of various chemical scaffolds with interesting biological activities, mainly due to the fact that polar organisms have been found to develop unique defense mechanisms against the extreme environments. Therefore, we have initiated the investigation of bioactive secondary metabolites from polar organisms collected from Antarctic habitats as a potential source of novel bioactive metabolites.

In the course of these studies, the organic extracts of lichens and microbial strains collected from Antarctic habitats were investigated. Bioassay-guided investigation on these extracts afforded several classes of compounds. The structures were mainly determined by analysis of various spectroscopic data such as MS and NMR data, and chemical methods.

This presentation will summarize various types of secondary metabolites that we have accessed through studies of Antarctic lichens and Antarctic marine-derived fungi, with emphasis on the structure elucidation and biological activities including PTP1B inhibitory effects and anti-inflammatory effects.

Victoria Land volcanism - an overview of recent volcanological and palaeoenvironmental research

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ABSTRACT

Neogene volcanism is widespread in Victoria Land and extends along 800 km of East Antarctica's margin with the Ross Sea. It is characterised by a combination of large long-lived central volcanoes and countless small isolated short-lived centres. The volcanism is overwhelmingly glaciovolcanic (i.e. eruptions occurred beneath a coeval ice sheet) and it has been a focus of volcanological research, particularly since the early 2000's. This has resulted in numerous scientific advances of significance for our understanding of glaciovolcanism. In particular, lava-fed deltas fed by 'a'ā lavas were identified for the first time anywhere; they are the most characteristic volcanic sequence type in the region and their distinctive lithofacies and internal architecture will be illustrated and discussed. The age of the volcanism is also significant, covering the period between c.12 and < 2 Ma, a period that has largely been removed by glacial erosion in the Ross Sea. Thus, the Victoria Land volcanism is a unique, and uniquely important, terrestrial record of the evolving environment and, in particular, for determining critical parameters of the Mio-Pliocene East Antarctic Ice Sheet at the Ross Sea margin. Using volcanic studies to resolve important palaeoenvironmental problems is still uncommon and has only been widely applied in Antarctica. Moreover, a new avenue of related research is seeking to identify and assess the significance of volcanic sequences formed during interglacial periods. No sequences were recognised previously but they are proving to be widespread although volumetrically minor. This talk will briefly review the Mio-Pliocene volcanism in Victoria Land before focussing on a few selected recent advances in volcanological and palaeoenvironmental research that have occurred during the past decade. The latter, in particular, demonstrate the power of volcanic-led investigations for documenting the evolving eruptive environment and they are already beginning to cause changes in longstanding views regarded as paradigms in our understanding of Antarctic Mio-Pliocene palaeoenvironmental evolution.

Bimodal Bubble Generation in Explosive Silicic Volcanism

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ABSTRACT

Exsolution of volatiles and expansion of gas bubbles in ascending magma body are key controls for the explosivity and the style of explosive silicic volcanism. However, questions as to how magmatic bubbles nucleate and grow till they excape from the conduit have yet to be fully answered. Mt. Baekdusan and Mt. Melbourne are all intraplate stratovolcanoes, where powerful Plinian eruptions produced a huge volume of pumiceous tephra deposits in recent geological pasts. In textural and geochemical analyses on pumices from these two silicic volcanoes, we recognized that nucleation and growth of gas bubbles were fundamentally controlled by crystal contents in magmatic melts. The bubble pockets found in the Millennium gray pumices and obsidian trajectiles of Mt. Melbourne point toward the bimodality of bubble generation in ascending magma body. The bubble pocket refers to a single, enclosed, near-spherical space within pumice, marked by internal networks of submillimeter-size bubbles with delicate glass film (<10 μm in thickness) forming bubble wall. The near-spherical shape of bubble pockets and intact internal glass film networks suggest that the structures were developed in the latest magma ascending stage, then immediately quenched by eruption without additional deformation. Stretched bubbles arranged radially around shattered crystals implies that the magma adjacent the crystal was isotropically expended till the times of quenching. Thin glass film on the surface of crystals suggests that heterogeneous bubble nucleation is not likely the control of the bimodal bubble expansion. Alternatively, the process was controlled by decrepitation of melt inclusions near the level of magma fragmentation.

The Italian contribution to Seismostratigraphic studies of the Ross Sea

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ABSTRACT

The Italian vessel OGS Explora has been employed by the National Antarctic Research Program (PNRA) for 11 geophysical expeditions in the Antarctic margin from 1988 to 2017. Seven expeditions were carried out in the Ross Sea where 13,000 km of multichannel seismic reflection and gravity profiles and about 50,000 kmq of multibeam data were collected. The Italian data set has been instrumental to locate sites of the Ocean Drilling Project expedition 178 in the Antarctic Pensinula, of the International Ocean Discovery Program IODP 318 in the Wilkes Land margin and IODP 374 in the Ross Sea. The multichannel seismic data are archived together with those from all Nations, in the Antarctic Seismic Data Library System https://www.scar.org/data-databases/sdls/ and are freely available for scientific purpose and international collaboration in research projects. A large number of publications resulted by the use of the Italian marine geophysical data that made significant original contributions to our understanding of the Cenozoic evolution of Antarctica. Seismostratigraphic studies of the continent shelf and slope in the Ross Sea have provided a new view of ice sheet variability in relation to tectonic and morphologic change. Early work, in the frame of the SCAR/ANTOSTRAT project, produced a significant advance in the knowledge of the paleogeography of the Ross Sea by combining a large set of observations and data at different resolution, collected by several Nations. The ANTOSTRAT depth contour and sediment thickness maps of 8 Ross Sea, seismic Cenozoic sequences and the related research scientific papers were published in the AGU Atlas of the Antarctic Research Series vol., 68 (1995) that represented milestones for deep and shallow drilling projects (Cape Roberts project and IODP Exp. 374 McKay, De Santis, Kulhanek et al., 2018) and proposals (e.g. Luyendyk et al., ANDRILL-CH, 2011), aiming to reconcile the low latitude marine isotope record with direct regional observation at high latitude. Backstripping technique was applied to geological sections obtained from seismic profiles and drill sites to reconstruct paleobathymetric evolution of the continental margin (De Santis et al., 1999). This approach pioneered regional WAIS paleogeography reconstructions (e.g. Wilson et al., 2012). The scientific production that followed refined and further improved the knowledge of the depositional processes through the exploitation of geophysical data processing and interpretation (Geletti and Busetti, 2011; Sauli et al., 2014). Tomographic analysis has been employed to investigate sedimentary processes and petrophysical characters (Accaino et al., 2005; Bohm et al., 2010). Recently the collaboration with KOPRI resulted in the acquisition of unique geophysical data set in the Central Basin (Kim et al., 2018) that provides original insights on the bottom water circulation and its relationship with Antarctic Ice Sheet dynamics in the Cenozoic.

P-wave velocity structure beneath the northern victoria land, antarctica: two separate mantle heat sources

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ABSTRACT

The Extreme Geophysics Group (EGG) at Korea Polar Research Intititue (KOPRI) have installed four broadband seismic stations around Mt. Melbourne during the Antarctic summer in 2010-2011 to monitor the activities of Mt. Melbourne. Next summer season, seven broadband seismic stations were installed around the end of David Glacier which is the biggest glacier outlet in the Terra Nova Bay area. The number of seismic station is increasing year by year, and the Korea Polar Seismic Network (KPSN) consists of seventeen broadband stations and one infrasound array. The division of Polar Earth-system Science is focused on the research titled "Characterizing mantle domain beneath West Antarctic Rift System and Antarctic mid-ocean ridges", and trying to install OBSs (Ocean Bottom Seismometers) in Terra Nova Bay in order to optimize the data usage combining with the data set from the landbased seismic network. To compute a 3-dimensional velocity model, we utilized the mothod of VanDecar using 9723 rays from 644 teleseismic events observed on the KPSN and OBSs. The P-wave upper mantle velocity structure was modeled with the teleseismic events observed on the KPSN and the Transantarcic Moutains Northern Network (TAMNNET) to extend the spatial coverage of the rays. The results show two separate low velocity anomalies located beneath Terra Rift and the inland area from Mt. Melbourne to the north, respectively in 100 km depth. However, these two low-velocity anomalies are connected below 200 km in depth. The southern low-velocity anomaly should be related with the origin of the Terror rift.

The kinematic evolution of the Macquarie Plate and its implications for oceanic lithosphere fragmentation

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ABSTRACT

The tectonic evolution of the Southeast Indian Ridge (SEIR), and in particular of its easternmost edge, has not been constrained by high-resolution shipboard data and therefore the kinematic details of its behavior are uncertain. Using new shipboard magnetic data obtained by RVIB *Araon* and M/V *L'Astrolabe* along the easternmost SEIR and the available archival magnetic data, we estimate the finite rotation parameters of the Macquarie-Antarctic and Australian-Antarctic motions for eight anomalies (1o, 2, 2Ay, 2Ao, 3y, 3o, 3Ay, and 3Ao). The new finite rotations indicate that the motions of the Macquarie Plate since its creation ~6.24 million years ago behaved as an independent and rigid plate, confirming previous estimates. The change in the Australian-Antarctic spreading direction from N-S to NW-SE, appears to coincide with the formation of the Macquarie Plate at ~6.24 Ma. Analysis of the estimated plate motions indicates that the initiation and growth stages of the Macquarie Plate resemble the kinematic evolution of other microplates and continental breakup whereby a rapid acceleration in angular velocity took place after its initial formation, followed by a slow decay. The reconstructed Macquarie-Pacific motions further might show that the resisting force of young oceanic crust against subduction at the Hjort Trench may have sustained only the initial development stage of the Macquarie Plate. During the growth stage, the independent motion of the Macquarie Plate may have been enhanced by the increased subducting rates at the Hjort Trench and decrease in the resistive strength, while the Macquarie Plate has exhibited constant growth by seafloor spreading. Based on our kinematic studies, we find that fragmentation of oceanic lithosphere may be a common tectonic process for accommodating plate reorganization.

Newly Discovered mantle province beneath the Southern Ocean

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ABSTRACT

It is generally accepted that Earth's upper mantle is characterized by Indian- and Pacific-type domains with distinctive isotope characteristics. The boundary between these two mantle regions has been hypothesized to be located at the Australian-Antarctic-Discordance (AAD), where regions west and east of the AAD are Indian- and Pacific-type, respectively. It was further posited that the Pacific mantle is flowing into the Indian mantle because isotopes show he boundary is moving westward with time. This story has important implications for the global mantle convection. However, our recent recovery of basalts from a 2,000-km sampling gap along the Australian-Antarctic Ridge (AAR), located east of the AAD on the Pacific side, challenges this story: Sr, Nd, Pb, and Hf isotopic compositions of AAR MORB are distinct from those of Pacific and Indian MORB. Rather, the AAR lavas show mixing relationships with Cenozoic volcanoes from the West Antarctic Rift System, the Balleny and Scott Islands, New Zealand, suggesting that mantle beneath this region in a state of dynamic mixing. A deep plume beneath the WARS may sustain the dynamic mixing. The dynamic mixing zone does not extend to adjacent Marie Byrd Land or east Australia because the Cenozoic volcanism in these regions shows slightly different isotopic trends than the AAR. In multi-dimensional isotopic space, however, these bordering regions also share isotopic space with the AAR that is distinct from both the Indian and Pacific mantles. These isotopic evidences suggest the presence of an isotopically distinct mantle province between the Indian and Pacific. The dynamic mixing zone further exhibits a distinct mixing relationship with the Hikurangi seamounts, which were erupted at ~90 Ma. According to tectonic reconstruction models, Hikurangi seamounts are related to super-plume activity that caused Gondwana to break up at ~ 90 Ma, suggesting that the newly discovered mantle province in question may be traced back to the Gondwana break-up. These results indicate that dynamics along the AAD should be reinterpreted in light of interaction with a super-plume.

Poster Presentation

Identifying multiple Sound Scattering Layers

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ABSTRACT

Sound scattering layers(SSLs) are ubiquitous acoustic signatures which have been observed in all the World's oceans. SSLs normally consist of a variety of organisms, mostly zooplankton and small fish which are important link in the food web between phytoplankton and top predators. Many of the zooplankton making up scattering layers are found in different 'vertical life-zones' because of diel vertical migrations, swaming and feeding. Hence, knowledge of the main depths of SSLs would be helpful to understand zooplankton ecology.

The weighted mean depth (WMD) has been used to represent the main depths of SSLs. In practical use of the WMD, however, there are some problems for identifying each individual SSL within multiple SSL conditions. To overcome these drawbacks, we aimed to develop an algorithm which not only identifies individual SSLs, but also determines the main depths and thickness of the each scattering layer. The algorithm involved three stages. Firstly, horizontally extensive echoes above background noise were classified as the potential SSLs. Secondly, the edges of the potential SSLs within vertical columns were detected and then horizontally linked those boundaries. Finally, identified SSLs were separated into individual SSLs and then calculated their own main depths ans thickness. To examine the usefulness of the algorithm, we used the acoustic data obtained from the Amundsen Sea and validated the algorithm by comparing its ouputs to the WMD results. Results showed that the algorithm identified SSLs and calculated their own main depths, while the WMD estimated the midpoints between SSLs as their main depths. This research recommended that our algorithm is more useful to determine the main depths of SSLs than the WMD in multiple SSL conditions.

Evaluation of fungal universal primers for ngs-BASED DIVERSITY STUDIES.

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ABSTRACT

The development of low-cost high-throughput next generation sequencing (NGS) have opened new doors of investigation in microbial ecology. The NGS-based diversity study has quickly become a new gold standard method in this field and various methodological improvements have been followed for efficiently use this attractive method.However, since the most of these methodological improvements have been focused on the bacterial diversity study, several critical issues of fungal diversity study were still a debated. Especially opinion about the choice of primer is have not been unified yet. Most of the current fungal diversity studies performed with an internal transcribed spacer (ITS) which known to have the higher resolution than other markers. But some mycologists preferred 28S rRNA since several problems, such as poor binding or taxonomic biases during PCR, have been reported from ITS primers. Thus, we comprehensively evaluated the performance of both markers and primers with various criteria-Sensitivity (taxonomic coverage) of the primer; Specificity of the primer; Resolution of the marker; Length suitability of marker; DB coverage of marker. And by the comparing the scores of the markers/primers, we found several valuable clues that will help in selecting both marker and primer.

Stratigraphy of a Permian-Triassic fluvial-dominated succession in Southern Victoria Land (Antarctica): preliminary data

Giovanni Pio Liberato

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ABSTRACT

Permian-Triassic deposits characterize largely Allan Hills, located at the edge of the East Antarctica Ice Plateau in the northern part of the Southern Victoria Land. Here, they show an extensive exposure of some hundreds meters thick siliciclastic continental succession of the Permian to Early Jurassic Beacon Supergroup. We present preliminary data of the stratigraphic-sedimentological features of these deposits focusing on the Permian-Triassic boundary (PTB). Fourteen stratigraphic sections on the Weller Coal Measures, Feather Sandstone Fm. (including the Fleming Member) and Lashly Formation, were logged and sampled across an area of ca. 25 square kilometers in the north-eastern sector of Allan Hills, obtaining a new geological map and a new stratigraphic frame. The studied portion of the succession is characterized by marked facies changes, particularly through the PTB, accompanied by remarkable changes in paleoflora, from Glossopteris- to Dicroidium dominated associations. The paleoenvironmental changes are marked by the transition from a wide floodplain with high-energy meandering streams developing coarse sandstone bars and wide marshes along the alluvial plain during the Permian, to braided sandy rivers lacking of significant vegetated apparatus during the Early Triassic, and then passing gradually to sandy-braided rivers with associated and increasing vegetated peats in the alluvial plain during the Middle Triassic. This evolutionary scenario emphasizes the climate deterioration linked with the PTB event determining a semiarid scenario during the Early Triassic, and then the progressive climate amelioration causing the reforestation and changing of the fluvial system during the Middle Triassic.

Provenance of Ross Sea Drift in McMurdo Sound (Antarctica) and implication for middle Quaternary to LGM glacial transport: new evidence from petrographic data

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ABSTRACT

The provenance of Ross Sea Drift deposits from the McMurdo Sound region (Antarctica), ranging from middle Quaternary to Last Glacial Maximum age (LGM), has been investigated whit a petrographic approach. A total of 19 bulk till samples from four main areas of Dry Valleys in Southern Victoria Land was analyzed, macroscopically and microscopically, for three different granulometric fractions: pebble to cobble (>4mm), granule (2-4mm) and coarse to very coarse sand grain size (2mm-425μm). Deposits were classified following the lithological composition of clasts and occurrence of different petrographic groups was evaluated for each sample. Clasts composition predominantly reflects source rocks cropping out in the region between Mackay and Koettlitz glaciers. McMurdo Volcanic Group rocks being the most represented lithologies in the Royal Society Range (RSR) foothills, while Granite Harbour Intrusive Complex rocks are more widespread in Taylor and Wright valleys. The lithological distribution of collected samples supports a distal provenance due to a grounded Ross Ice Sheet in Taylor Valley, while specific distribution of volcanic lithologies in Royal Society Range foothills is evidance for a northward ice flow from Koettlitz Glacier catchment, thus supporting some previous glaciological models of an expanded lobe during the LGM. In addition, middle-Quaternary Trilogy Drift composition from Wright Valley accounts for a local provenance, thus allowing the hypothesis of a thickened Wilson Piedmont Glacier rather than a grounded Ross Ice Sheet during past ice advances.

Transcriptome analysis to reveal the dormancy mechanisms of the Antarctic moss, *Sanionia uncinata*

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ABSTRACT

Being sessile, plants have to cope with unfavorable environment conditions such as drought, salinity, and extreme temperatures To survive in such environments, plants have adapted their physiology. Dormancy, a phenomenon in which the activity or growth of an organism is temporarily suspended controlling the physiological activity, is an important physiological process to survive cold winters. Interestingly, the Antarctic moss has long maintained populations in the Antarctic, repeating the growth-dormancy cycle in meristem tissues. It is expected to have the seasonal molecular switches, but has not yet been discovered in moss.

Sanionia uncinata is one of the dominant moss species in the maritime Antarctic. In this study, we have tried to monitor the seasonal and monthly changes in gene expressions of Antarctic moss during a year to understand the growth regulatory system for adaptation as well as the life cycle of Antarctic moss. The samples were collected monthly in 2015-2016. We aim to analyze Differentially Expressed Genes (DEGs) related with dormancy at the paradormancy, endodormancy, ecodormancy by RNA-Seq analysis. Gene set enrichment analysis will be conducted on the DEGs identified from each dormancy transition. We also have plans to identify the seasonal difference in gene expression for the known dormancy genes based on sequence homology analysis. This study will provide the monthly transcriptome profiles of the Antarctic moss at different dormancy stages and improve the understanding of dormancy.

The Revision of Lichen Flora around Maxwell bay, King George Island, Antarctic

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ABSTRACT

Maxwell bay(62°25′S; 58°85′W) lies between King George Island and Nelson Isalnd, Antarctica around where 8 Antarctic Scientific Stations are situated. Since the lastest floristic note were published in 2006 near King Sejong Station, Barton peninsula, meaningful research products and specimen have been accumulated steadily over 10 years.

The present study aims to update the lichen flora around Maxwell bay including Barton peninsula, Fildes peninsula, Weaver peninsula, Potter peninsula and Ardley Island. About 900 lichen specimens were collected from the Antarctic expedition 2008 – 2016: 48 genera, 105 species were identified by their own morphology and chemistry and 33 species are endemic to Antarctic. Molecular analysis were performed, if necessary, ITS, LSU and mtSSU loci were used. Fourty four reported species are new to Maxwell bay region and 12 among the species are also newly recorded in King George Island.

Two species are new to the Antarctic – *Pertusaria aff. dactylina* and *Verrucaria striatula*. Molecular analysis with the specimen of *Pertusaria aff. dacytlina* is needed for avoiding ambiguous conclusion. Ecological and geographical factors will be discussed with lichen phenotypes and habitat preference of species. Examined closely with the specimen, previously reported taxa *Cladonia furcata* were excluded by misidentification.

Characteristics of inertia-gravity waves revealed in radiosonde data at Jang Bogo Station (74°37'S, 164°13'E), Antarctica

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ABSTRACT

High-resolution radiosonde data collected at Jang Bogo Station (74°37'S, 164°13'E), the second Korean Antarctic research station, are used to examine wind and temperature and characteristics of inertia-gravity waves (IGWs) for 25 months (Dec. 2014-Dec. 2016). Observed wind and temperature data at JBS are compared with those from four global reanalysis data (CFSv2, MERRA, ERA-Interim, and NCEP/DOE R2). Reanalyses having coarse horizontal resolution contain significant uncertainties of winds in the troposphere, whereas all reanalyses underestimate the speed of polar stratospheric jet in the stratosphere. During the spring warming in the stratosphere, considerable cold biases are observed in models, indicating the delay of polar vortex breaking. The analysis of GWs are conducted for two atmospheric layers covering the troposphere (z = 2-7 km) and the lower stratosphere (z = 15-22 km). In the stratosphere, IGWs dominantly propagate upward while from May to October, downward (upward) propagating IGWs enhance (reduce). In the troposphere, 60 (40) % of IGWs propgate upward (downward) without obvious seasonal variations. Most of IGWs are significantly advected to the eastward with oblique angle due to the strong background wind. The average intrinsic frequency, vertical wavelength, and horizontal wavelength of IGWs in the troposphere (stratosphere) are 3.48 f (1.94 f) (where f is the Coriolis parameter), 1.48 km (1.48 km), and 67.17 km (222.94 km), respectively. Intrinsic frequency and vertical wavelength in the stratosphere show clear seasonal variations with an increase (decrease) from autumn to winter (spring to summer), resulting corresponding horizontal wavelength increasing (decreasing) from spring to summer (autumn to winter), while the variations are not shown in the troposphere. Wave energy in the stratosphere has clear seasonal variations with the maximum in September (6.2 J kg^{-1}) and minimum in January (2.5Jkg^{-1}), while that in the troposphere is much smaller without the seasonal variations. The zonal and meridional momentum flux of up-going (down-going) IGWs in the stratosphere is generally westward (eastward) with and southward (northward) with average of -0.01 m^2s^{-2} (0.022 m^2 s^{-2}) and -0.0015m^2 s^{-2} (0.024m^2 s^{-2}), respectively.

Conserved function of Poaceae type II galactinol synthase genes, involved in tolerance to multiple abiotic stresses through the accumulation of Raffinose family oligosaccharides

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ABSTRACT

Plant, a sessile organism, cannot escape unfavorable environmental conditions such as drought, high salinity, and extreme temperatures, profoundly affect growth, development, and productivity of higher plants. To survive in such harsh conditions, plants have evolved defense mechanisms that include physiological and biochemical changes. One of the alterations is increased levels of protective substance. Raffinose family oligosaccharides (RFOs) have a crucial role in abiotic stress tolerance in plants. *Deschampsia antarctica* is one of the two vascular plants adapted to the severe environment of the Antarctic, which have evolved mechanisms for coping with these harsh conditions. In this report, we have identified and characterized a cold stress related gene from *D. antarctica* that involved in adaptive mechanism of an Antarctic hairgrass. To investigate its possible cellular role in abiotic stress tolerance, we generated transgenic rice plants that overexpressing *DaGolS2* genes. *DaGolS2*-overexpressing transgenic rice plants (*Ubi:DaGolS2*) showed markedly enhanced tolerance to cold and drought stress compared to wild-type plants. *OsGolS2*, which is homologus gene of *DaGolS2* in rice, was also responsive to abiotic stress in rice plants. In addition, *OsGolS2*-overexpressing transgenic plants (*Ubi:OsGolS2*) displayed highly increased tolerance to cold and drought stress relative to wild-type plants. Moreover, rice plants constitutively overexpressing *DaGolS2* or *OsGolS2* exhibited not only significantly increased galactinol but also raffinose content under normal and cold or drought stress condition as well. These results suggest that overexpression of type II galactinol synthase gene of *Deschampsia antarctica* and *Oryza sativa* confers enhanced tolerance to dehydration and cold stress by accumulation of RFO.

Rittmann volcano, northern Victoria Land, Antarctica as the source of englacial tephra

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ABSTRACT

Northern Victoria Land, Antarctica is the home to the "active" volcanoes: The Pleiades, Mt. Melbourne and Rittmann volcano. All three volcanoes have evidence of recent activity which has resulted in the occurrence of tephra in ice cores, blue ice/snow areas and as surficial tephra layers. Although there is a significant area of geothermal activity at Rittmann, until now there has been no evidence of any recent eruptive activity. A trachytic tephra is described from an ice core at Styx Glacier in northern Victoria Land and is correlated with a known 1254 CE tephra in 5 ice cores from East and West Antarctica. The tephra is also identified in a blue ice patch near Brimstone Peak and a tephra in a sediment core from the Ross Sea has many similarities in composition. A volcanic breccia, presumably formed by large explosive pyroclastic eruptions from Rittmann volcano, has glassy fiamme-like clasts. Electron microprobe analyses of the glass and some whole rock analyses of lavas have trachytic compositions identical to the 1254 tephra. Rittmann volcano is now considered the source of the 1254 eruption. The 1254 tephra is spread over 2000 km from Rittmann and is the most significant tephrochronological marker in Antarctic ice cores. The eruption of the 1254 tephra is the largest known of any Quaternary volcano in Antarctica and probably resulted in the formation of a 2 km wide caldera which defines the summit area of Rittmann volcano. This new discovery and the occurrence of numerous Holocene eruptions from Melbourne volcano show that there is a significant volcanic hazard from these volcanoes especially to aircraft operations.

Gravity wave activities in the upper mesosphere observed at King Sejong Station, Antarctica (62.22°S, 58.78°W) and their potential sources in the lower atmosphere

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ABSTRACT

Gravity waves (GWs), generated from various sources (mountain, jet-front system, convection and so on), play an important role in determining the structure of the middle atmosphere by transferring momentum and energy from the lower to the higher altitudes. High latitudes in the Southern Hemisphere are one of the regions where the strongest GW activities are observed. King Sejong Station (KSS) is located in the hot spot areas of strong GW activities along the Antarctic Peninsula. In this study, we investigate GW activities in the upper mesosphere (80-100 km) and their potential sources in the lower atmosphere using 8-year (2007-2014) meteor radar observations at KSS. After explicitly removing large-scale wind components from the original meteor data, hourly variances of radial winds induced by GWs are used as the proxy of GW activities. A semi-annual variation of GW activities in the upper mesosphere with solsticial maxima and equinoctial minima exists, except above 94 km where maximum GW activities appear in August-September. GWs generated by orography can reach the upper mesosphere without encountering a critical level due to the strong westerly from the troposphere to the mesosphere in wintertime. The residual of the nonlinear balance equation (RNBE), a diagnostic of the jet-front GW generation, in the upper stratosphere correlates well with the GW acitivities in the upper mesosphere, particularly in spring and autumn. Significant positive correlations are found between the observed GWs in the upper mesosphere and deep convections in the midlatitude storm-track regions in autumn and winter.

Species diversity of Antarctic lichen photobionts and their photobiological characteristics

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ABSTRACT

Antarctic lichens have occupied the higher biomass with reported over 400 species, and it is considered as important organisms for Antarctic vegetation. Lichen is symbioses between fungi (mycobionts) and photoautotrophic green algae or cyanobacteria (photobionts). Most of lichen studies have discovered the symbiont diversity, but physiological characteristics of photobionts are still unrevealing topic. To understand the photobiological features of photobionts, we isolated 30 photobionts strains from 8 samples of *Cladonia borealis*, *Ochrolechia frigida, Psoroma* sp., and *Xanthoria* sp. collected from near King Sejong Station and Adeli Island in Antarctica. Culture-based photobionts were first identified by molecular phylogeny and the species abundance was validated by metagenome analyses. Based on the molecular identification and morphological observation, photobionts were classified in Trebouxiophyceae (T1, T2 and T3 clades) and Chlorophyceae (C1, C2, C3 and C4 clades). Each clade photobionts have shown the distinctive characters response on UV irradiation and pigment changes under nitrogen deplete conditions. Also, some strains have produced three-dimensional growth morphology, color changes green to dark brown, highly dried colonization or mucilage colonization. Biological roles of isolated photobionts especially associated with abiotic stress resistance, interacting mechanisms with fungi, lichen morphology constructing process will be discussed.

Spatial patterns of summer mesozooplankton community in the western arctic ocean

Hyoung Sul La

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ABSTRACT

Rapid sea ice reduction could make the western Arctic Ocean an ideal environmental setting for investigation of the impacts of climate change on the pelagic marine ecosystem. To examine the essential factors affecting the distribution of mesozooplankton abundance, a key component of marine ecosystem, the spatial patterns of mesozooplankton communities in the western Arctic Ocean was studied during summer. Mesozooplankton were sampled in the western Arctic Ocean from the northern Bering Strait to the western Arctic Ocean in the summers of 2014, 2015, and 2016. Twenty-eight mesozooplankton taxa including fifteen copepod species were identified. Mean mesozooplankton abundance and carbon contents were ranged 143 - 392 ind.m-3.,11-40mgm-3,respectively.Calanus glacialis, Cirriped larvae, Eucalanus bungii, Oikopleura spp., Ophioplutes larvae, and Pseudocalanus spp. were dominant taxa, representing 78 - 93 % of mesozooplankton abundance in all years. Copepods were generally dominant taxa, while planktonic larvae were mainly distributed in the northern Bering Strait and Chukchi Shelf. Mean composition of copepods among mesozooplankton community was increased from 41% to 65%, while planktonic larvae was decreased from 32 % to 12 % between 2014 and 2016. Within the western Arctic Ocean, mesozooplankton abundance was higher around Mendeleyev Ridge than the abundance around Chukchi Plateau, associated with high phytoplankton biomass. Based on the mesozooplankton communities and environmental variables (temperature, salinity, chlorophyll a, nutrients, and sea ice concentration) the study region was clearly classified into three habitats (northern Bering Strait, Chukchi Shelf, and the western Arctic Ocean) each year. This result could provide useful basic data on the composition and distribution of mesozooplankton, and will support a foundation to verify the changes within Arctic pelagic ecosystem under present and future climate change.

Evidence for non-linear wave-wave interactions in mesospheric winds measured by a meteor radar at King Sejong station, Antarctica

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ABSTRACT

King Sejong Station (62.22°S, 58.17°W, KSS) is located near the tip of Antarctic Peninsula, where strong activity of atmospheric waves is known. Atmospheric waves are prominently observed in the mesosphere and lower thermosphere (MLT) region. We have analyzed tidal waves and planetary waves (PWs) using MLT wind data observed by a meteor radar at KSS from 2010 to 2017. We noticed that the semidiurnal tidal wave is more dominant than the diurnal tidal wave, and the semidiurnal tidal wave is stronger in austral summer than that in austral winter. PWs with periods of 8-, 16-, and 27-day were found to be active in austral winter. Through bi-spectral analysis we found evidence that nonlinear interaction occurred between the semidiurnal tidal wave and PWs. The interaction seems to generate a family of secondary waves with periods corresponding to sum and difference of those of the semidiurnal tide and PWs. We also noted amplitude variations of the semidiurnal tide with periods of PWs as consequence of the nonlinear interaction. Such nonlinear wave interaction may contribute significantly to dynamics of the MLT region over Antarctica.

Predicting ionospheric f2 layer's critical frequency over jeju station using artificial neural networks

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ABSTRACT

The multilayer perceptron (MLP), which is multilayer feedforward neutral network having one or more hidden layers, has the advantage of solving nonlinear problem. Prediction for ionospheric F2 layer's critical frequency, foF2, is attempted using the MLP model. The data used for training the MLP model are from measurements of Jeju ionsonde (126.30°E, 33.43°N) operated by Korean Space Weather Center (KSWC) for 8 years of 2009 - 2016. The input elements in the model include date, hour, solar activity index, and geomagnetic activity index. As the geomagnetic index, the Aj index was adopted, which is converted in similar manner to Ap index from Kj index that is an equivalent of K index for Jeju location. (The Kj index is published by KSWC). The model networks are constructed to calculate the target output, foF2 values at input time and after 1 hour to 4 hours, and thus the model can be regarded as both nowcasting and forecasting of foF2. Through the error back propagation algorithm, the networks modify their weights by training with the data. To make better results, we attempted various sets of network elements, such as combination of input parameters, learning rate, number of hidden nodes, and number of hidden layers. As performance measures, root mean square error (RMSE) and correlation coefficient are computed with the test data of 2016. The best performed model parameters so far found consists of 8 inputs, 27 hidden nodes and 5 output nodes, resulting in RMSE of 0.767 MHz and correlation coefficient of 0.92. The current model has slightly better performance than IRI-2016 model for test year, 2016.

Glacio-marine sedimentation in the continental slope and rise to the east of Pennel-Iselin Banks in the Ross Sea

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ABSTRACT

The growth and retreat of glaciers in response to the glacial-interglacial changes were revealed from the subglacial marine sedimentary sequences have been studied extensively in the continental shelf areas of the Ross Sea. The purpose of this study is to comprehend the glacio-marine sedimentation change on the continental slope and rise to the east of Pennell-Iselin Banks in the Ross Sea, using three gravity cores (C1, C2, C3) and three box cores (BC1, BC2, BC3) collected from sites (RS14-1, 2, 3), respectively, across the continental slope and rise to the eastern side of the Pennell-Iselin Bank during XXIX° (2014) PNRA expedition (Rosslope Ⅱ project). Sedimentological (grain size, magnetic susceptibility), elemental (XRF), geochemical (biogenic opal, total organic carbon, total nitrogen, C/N ratio, $CaCO_3$),andisotopic($\delta^{13}C$ and $\delta^{15}N$ of organic matter) parameters were measured along with AMS ^{14}C dating of bulk sediments. Core-sediments consist mostly of hemipelagic san dy clay or silty clay with scattered IRDs (Ice-Rafted Debris). A comparison of sediment properties between boxcores and the top of gravity cores reveals that the loss of sediment during sampling is trivial. Alternation of sediment colors between brown and gray is distinct throughout the cores. Based on the sediment properties, sediment lithology was divided into two units (A and B), and two sub units (B1 and B2). AMS ^{14}C dates and sediment properties as sign Unit A, Unit B1, and Unit B2 to interglacial, deglacial, and glacial conditions, respectively. Unit A represents the interglacial sediments deposited mainly by the suspension settling of biogenic particles with IRDs in the open marine condition. Unit B1 reflects the deglacial sediments with an increase in IRDs showing the transition of sediment properties from Unit B2 to Unit A by the retreat of subglacial ices. Unit B2 is characterized by different sediment properties, mainly supplied by the continuously lateral melt-water plume or distal part of debris flow originating from the front of grounding floes in the subglacial continental shelf under the ice shelf during the glacial period. Thus, Unit B contains mostly reworked and eroded continental shelf sediments with scattered IRDs. The influence of subglacial sedimentation from the continental shelf in terms of melt-water transport and/or distal stage of debris flow was limited to around Site C2 during the deglacial and glacial periods. Site C1 in the continental rise remains seasonally open during the glacial period, as recognized by the peaks of biogenic opal and TOC contents.

Optical features and ionospheric irregularities observed at a sub-auroral station (l=2.5) during the st. patrick's day storm

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ABSTRACT

During the St. Patrick's day storm on 17 March 2015, the all sky camera at King Sejong station (62.2S, 58.8W, L=2.5) captured diffuse aurora and stable auroral red (SAR) arc. Rate of total electron content index (ROTI) increased near the boundary of the diffuse aurora, but no enhancement near the SAR arc. This implies that the SAR arc does not cause significant ionospheric irregularities that are usually accompanied to auroral disturbances. Interestingly, two events of strong ionospheric irregularities were detected by a Global Positioning System (GPS) scintillation monitor before the expansion of diffuse aurora. We find that the signals of phase scintillation passed near the boundaries of tongue of ionization (TOI) and polar cap patches on total electron contents (TEC) map. These locations also show high values of ROTI, representing the steep gradient of ionospheric densities. It remains uncertain whether the steep gradient simply causes ionospheric irregularities detected by the GPS phase scintillation or other factors from geomagnetic storm are in act for scintillation.

An investigation of relation between sporadic E layer and vertical ion drift convergence using ionosonde data in Korea

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ABSTRACT

We investigated seasonal and local time variations of occurrence rate, critical frequency and height of sporadic E (Es) layer using data from ionosondes at Icheon (127.54°E, 37.14°N) and Jeju (126.30°E, 33.43°N) during 2011 – 2017. The ionosonde data were obtained with an auto-scaling program, Automatic Real-Time Ionogram Scaling with True Analysis 5 (ARTIST5). The occurrence rates and critical frequencies of Es show a maximum in summer, while the Es layer tends to be higher in spring and autumn equinox months than in other months. This tendency is due to greater occurrence rate of Es over an altitude of 120 km in the late afternoon. The critical frequency of Es maximizes around local noon time. The occurrence rate and height of the Es display semidiurnal variations from spring to autumn (March – November), but diurnal variation during winter (December – February). We also examined relation between Es occurrence and vertical ion drift calculated from Horizontal Wind Model (HWM) 14. We found that the Es height roughly matches with the altitude at which the direction changes in vertical ion drift velocity, implying convergence of ions. We discuss how the seasonal and local time variations of Es occurrence rate are related to vertical ion drift convergence.

Manually scaling one year ionograms measured by Jeju ionosonde in 2012

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ABSTRACT

The ionosphere has been monitored for more than five decades by ionosondes in Korea. An ionosonde usually produce an ionogram that displays radio echoes in the frequency-range plane. The trace of echoes in this plane can be read either manually or automatically to produce useful ionospheric parameters such as foF2 (peak frequency of the F2 layer), hmF2 (peak height of the F2 layer), etc. Since monitoring of the ionosphere has to be carried out routinely in a given time cadence, automatic scaling the ionogram is usually executed to obtain the ionospheric parameters. However, automatic scaling may generate undesirable results that mis-represent the ionosphere drastically. To check the degree of mis-representation by an automatic scaling program, we scaled manually 35,136 ionograms in the entire year 2012 measured at Jeju (33.43°N, 126.30°E). When we scale manually, we classified 5 cases from error. We compare our manually scaled results with automatically scaled results that were obtained by ARTIST5002 program (developed by Lowell University). For this comparison, we present foF2 and hmF2's from both methods. The comparison shows that average differences of foF2 and hmF2 between two methods are ~0.03 MHz (0.12) and ~4.13 km (9.58), respectively. Overall, 36% of autoscaled results differ significantly from manually scaled results. Therefore, researchers should be warned about the quality of autoscaled parameters by ARTIST5002, and manually scaled parameters if available are recommended for any serious applications.

A first comparison of meteor radar and Fabry-perot interferometer winds at King Sejong Station

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ABSTRACT

In 2017, Fabry-Perot Interferometer (FPI) was installed at King Sejong Station in Antarctica. For an initial validation of the FPI wind, we compare FPI winds with winds derived from the co-located Meteor Radar (MR) during the first observational season (297 days) of 2017. The overall characteristics of FPI and MR winds are well correlated, showing consistent local time variations for both OH 892.0 nm and OI 557.7 nm airglow layers (87 and 97 km, respectively). However, large discrepancies appear 13 days. A correlation analysis indicates that correlation coefficients of zonal winds at 87 and 97 km are 0.28 and 0.54, respectively, and those of meridional wind are 0.36 and 0.54. Since the FPI wind is derived from the finite height range of the airglow emission layer, we calculated the weighted mean wind from the meteor radar wind profile assuming that the distribution of the airglow intensity has a form of Gaussian function. By adjusting the peak height and the Full Width at Half Maximum (FWHM) of the Gaussian distribution for the airglow layer, we investigated how the correlation between the two data varies. The correlation is the best with the peak height of 86 km and 97~98 km for the OH and OI airglows, respectively, with better correlation at OI airglow layer. Overall correlations are lower than those published in other studies. In the future, we will investigate thoroughly sources of these discrepancies between FPI and meteor winds as more observational data are accumulated .

Propagation analysis of mesospheric gravity waves on OH and OI-557.7nm airglow layers over King Sejong Station

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ABSTRACT

We analyzed mesospheric gravity waves in OH and OI 557.7 nm airglow images which were observed by an All-Sky Camera in 2013 at King Sejong Station (62°S, 58°W), Antarctic Peninsula. Adopting a new method developed by Matsuda et al. (2014) we obtained power spectra in the horizontal phase velocity domain from airglow images sequence in unit of relative emission intensity. Mesospheric gravity wave activities are compared vertically between OH and OI 557.7 nm layers and show seasonal variation from March to October. For selected events that concurrent gravity waves have different behavior between the two layers, we analyzed background conditions such as background winds from a meteor radar and temperatures from satellites. We found events in which filtering of waves by background winds had indeed occurred between the two layers. Furthermore, we compared our results with those of Antarctic Gravity Wave Imaging/Instrument Network (ANGWIN) data (Syowa (69°S, 40°E) ,Halley (76°S, 26°E), Davis (69°S, 78°E), and McMurdo (78°S, 167°E)) to understand mesospheric gravity wave activity over Antarctica.

Developing a data-assimilated SAMI2-CNU model using Korean ionosonde data

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ABSTRACT

In order to develop a data assimilation model based on the ionospheric data measured in Korean peninsula, we have been studying data-assimilation algorithms using the SAMI2-CNU [Kim et al., 2016]. Although the SAMI2-CNU model as a first principle physics model calculates the ionospheric E-layer reasonably well by adding measured solar X-rays, it does not practically reproduce the F2 layer measured by ionosondes due to lack of information on thermospheric composition and winds. To overcome this obstacle, we devise a method to estimate effective winds and composition from the peak height (hmF2) and peak density (NmF2) of F2 layer measured by ionosondes. The effective winds and O density scale factors were first computed from measured hmF2 and NmF2 in conjuction with the SAMI2-CNU model. The estimated wind and scale factor from the previous time step are then input to the SAMI2-CNU model for next time step. In this way, we are able to reproduce the F2 peak density and height reasonably close to measured values. As a test, we will present NmF2 and hmF2 values computed from the assimilated SAMI2-CNU model in comparison with ionosonde measurements at Jeju for a typical day in four seasons.

Cryoprotective Effect and Partial Characterization of a Novel Exopolysaccharide (P-ArcPo 20) Produced by *Pseudoalteromonas tetraodonis* Strain ArcPo 20

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ABSTRACT

Main body of the abstract Marine samples obtained from the Chukchi Sea, Arctic Ocean yielded 22 bacterial strains that secrete polysaccharides. Of those, seven strains produced cryoprotective exopolysaccharides (EPS). The strain ArcPo 20, identified as *Pseudoalteromonas tetraodonis* by 16S rDNA analysis, demonstrated the highest cryoprotective effect and was selected for the further study. The EPS, P-ArcPo 20, was purified by protease treatment and gel filtration chromatography. EPS characterization was confirmed by the gel permeation chromatography, gas chromatography-mass spectrometry and Fourier transform infrared spectroscopy analysis. The purified EPS (P-ArcPo 20) had a molecular weight of 1.1 x 10^7 Da, and its infrared spectrum showed absorption bands of hydroxyl and carboxylgroups. The principal sugar components of P-ArcPo 20 were determined to be glucose, galactose, and mannose, in the ratio of 1.5:1.0:0.3. The P-ArcPo 20 cryoprotective activity was characterized using an *E. coli* viability test. In the presence of 0.5% (w/v) EPS, the *E. coli* cell survival ratio was 91.22 ± 4.21% over five freeze-thaw cycles. These biochemical characteristics suggest that the EPS P-ArcPo 20 may be useful in cryoprotectant development for biotechnological and medical applications.

The new species of *Dactylobiotus* (Parachela, Eutardigrada) from King George Island, Antarctica

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ABSTRACT

Limno-terrestrial tardigrades form one of the most dominant groups in the scanty terrestrial freshwater ecosystem of Antarctica. However, due to their limited key morphological characters and restricted access to the habitats, taxonomic study on Antarctic tardigrades largely remains to be challenged. KOPRI ecology team collected several species of tardigrades near the King Sejong Station, King George Island, Antarctica during 2014-2015 season.

Among the collected tardigrades, one group shows a buccal-pharyngeal apparatus with ten peribuccal lamellae, and the cuticle structure which joins two claws in each limb. These characters warrant a generic assignment *Dactylobiotus*. This species is quite large in size (600-700 μm) with prominent eyespots and smooth cuticle. The egg has circular or slightly hexagonal cone-type processes with a tip. Compared to *D. ambiguus* and *D. caldarellai* which have a rather similar morphology, this species shows claws with longer primary branch at all limbs. The 18S, 28S rDNA and cytochrome c oxidase subunit 1 (CO1) sequences do not correspond to any previously-reported sequence, although only limited molecular data of tardigrades have been reported so far.

Based on the pt-ratio of the buccal-pharyngeal apparatus and claws, the morphology of eggs, and the DNA sequences of 3 partial genes, this species is considered as a new species of *Dactylobiotus*.

Late Carboniferous oncoids from the Brøggerhalvøya, NW Svalbard, Arctic Norway

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ABSTRACT

Numerous oncoids in the lower part of Wordiekammen Formation (Moscovian) are investigated from the two different localities (Strypbekken and Stupbekken) of Brøggerhalvøya, NW Svalbard. The oncoid-bearing beds are characterized by presence of rounded to ellipsoidal osagid-type meso-oncoids (2-20 mm) and macroids (>20 mm). Oncoids from Strypbekken are dominated by meso-oncoids with lesser amount of macroids (up to 50 mm). On the other hand, those from Stupbekken, consist prevalently of rather larger-sized oncoids (up to 70 mm. Nuclei of the oncoids are mostly green and phylloid algae and some are hard to identify. Cortices are composed of diverse biota. Compactly- or loosely-spaced, encrusting tubiform foraminifera (Palaeonubecularia) are abundant within the cortex. These tubes are marked by their dark micritic wall and display range in diameter (20-100 μm). Well-preserved microbes, which are also significant constituents of the oncoids, are appeared as cluster of radiating filamentous tubes. They commonly co-occur with peloidal and micritic massses with rare indistinct filaments (poorly-preserved microbes?). Colonial, branching hollow tubes (Nansenella?) and irregular-shaped encrusting laminar organisms (Archaeolithophyllum?) are also common. Based on preliminary microscopic observation, dimensions of oncoid appear to have relation to the biotic composition. Smaller oncoids are dominantly formed by foraminifera associated with structureless or slightly-laminated micritic mass (foraminiferal-microbial oncoids). Larger oncoids are mostly built by consortium of microbe, foraminifera, and alga (composite oncoids). Other possible candidate for causing size difference is water-energy level. Meso-oncoids are dominated within wacke- to packstone matrix, whereas, macroids are predominantly found in pack- to grainstone matrix implying the dissimilarity in degree of agitation. Although the biotic composition and associated facies of oncoids are valuable paleoenvironmental proxies, oncoids and oncoidal facies from the late Paleozoic sedimentary successions of Svalbard have been overlooked. Further detailed study of these oncoids and their surrounding facies will enable us to access more precise interpretation and reconstruction of depositional environments of the region.

Clues to late Cenozoic ice-sheet dynamics and bottom-current activity in the northwestern Ross Sea margin, Antarctica

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ABSTRACT

Reconstruction of glaciomarine sedimentation processes in the Antarctic continental margin may provide clues to the late Cenozoic ice-sheet dynamics and bottom-current activity during glacial and interglacial periods since the onset of glaciation. Previous geological and geophysical investigations on the Ross Sea continental shelf have revealed the occurrence of repetitive grounding events of the Antarctic ice sheets. In contrast to the continental shelf, there have been less studies for the Ross Sea slope and rise, where more continuous and detail sedimentary records are preserved with minimum hiatus. In this study, we conduct seismostratigraphic, reflection tomographic and oceanographic analyses in the northwestern Ross Sea continental margin that could provide a better understanding of the glaciomarine sedimentary processes, and how these may relate to ice sheet expansion and contraction on the continental shelf, as well as linking to late Cenozoic climatic and oceanographic evolution. The results indicate that there was a shift toward a cooler, less erosive glacial regime change with active bottom-current controlled sedimentation process through the late Miocene. After late Pliocene, the bottom-current activity was influenced by more persistent grounded ice sheet that extended to the continental shelf edge.

Adélie penguin counting using very-high-resolution UAV images and deep learning-based object detection technique

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ABSTRACT

Climate changes in polar regions affect to environment that can be directly linked to the living conditions of mammals. Adélie penguin (Pygoscelis adeliae) is known as a species reflecting environmental changes such as sea ice condition and food supply in Antarctica, therefore monitoring the Adélie penguin is crucial to investigate the effects from environmental changes. In this study, we propose a deep learning-based object detection technique using very-high-resolution (VHR) images acquired from unmanned aerial vehicle (UAV) for counting individual Adélie penguin.The VHR images with a spatial resolution of less than 1cm were acquires in Cape Hallett around Ross Sea, Antarctica using commercial UAV. The image acquisition using UAV has merits from shorter operation duration over large area than field investigation by researcher, preventing disturbance to penguins. Penguin counter software was developed using Google's tensorflow object detection application programming interface (API), an open source framework, with an image segregation – aggregation approach. This automated method can be applied to other Adélie penguin colonies around Ross Sea and other species of penguins in Antarctica with additional training and testing procedures.

The Italy-Korea cooperative project SAMEECA: Surface-Atmosphere Mass and Energy Exchanges at a Coastal Antarctic site

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ABSTRACT

The current vision of global climatic changes stresses on the interlinked action of many factors, often more evident at regional scales. Polar regions are among the areas most sensitive to perturbations of the climate: through connections involving ocean, atmosphere, biosphere, lithosphere and cryosphere, they respond to, amplify, and drive changes elsewhere in the Earth system, so that understanding their role is essential. Peculiar characteristics of Polar Regions contribute to modify the energy and radiation budget, and the characteristics of the polar atmospheric boundary layer (ABL), increasing relevance at regional level of coupling processes between components of the climate system, especially in the coastal region. In particular, the long polar night, the sea-ice and snow coverage, favouring the persistency of stable atmospheric conditions, and the local and mesoscale circulation interactions, all affect the status and variability at different time scales of components of the regional climate system. Predicting future conditions of the polar regions is the goal of the Polar Prediction Project and of one of its key elements, the Year of Polar Prediction (YOPP, http://www.polarprediction.net/yopp.html), scheduled to take place from mid-2017 to mid-2019). This requires the scientific knowledge of their present status as well as a process-based understanding of the mechanisms of change. The parameterization of physical processes in regional and global hydrodynamical numerical models of the atmosphere is not yet enough accurate for a correct representation of all components of the climatic system and of their connections, the knowledge of which is needed to determine the role of polar regions in the global climate. As an example, more extended and integrated dataset are required to improve the parameterization of the ABL, for complex orography areas such as the polar coastal regions.

The general scope of this project is to improve the understanding of the surface-atmosphere mass and energy exchanges at an Antarctic coastal site in the Ross Sea through continuous and accurate measurements of the atmospheric parameters, and development and verification of multiscale modelling, and through these activities, to address some of the relevant questions included in the roadmap for Antarctic and Southern Ocean science for the next two decades and beyond. Measurements will be carried out year-round at the Korean Jang Bogo Antarctic Research Station (JBS), located at the coast of Terra Nova Bay, in the vicinity of the Italian Mario Zucchelli Station (MZS), starting from Austral summer 2018/2019 and for at least one year. Measurement and analysis of radiation components, atmospheric constituents and energy fluxes, meteorological and micrometeorological parameters, will be implemented jointly by Korea Polar Research Institute (KOPRI), CNR and UNIFI, in a way similar to the collaboration already active in the Arctic. Such implementation will be very useful to close a gap in the global climate observation system (GCOS) and contribute to WMO programs providing scientific data and information on meteorological and radiation regimes, vertical structure and chemical composition of the atmosphere.

The proposed activities will contribute to specific YOPP objectives, such as: (i) Gather additional observations through field programmes aimed at improving understanding of key polar processes. (ii) Develop improved representation of key polar processes in uncoupled and coupled models used for prediction. The project results (data and parameterizations) will be of great importance to improve verification of polar weather and environmental predictions to obtain quantitative knowledge on model performance.

This project moves in the line of the desired cooperation with the Korean Polar Programme after opening of JBS. Reference are the framework agreement signed in 2010 between CSNA and KOPRI, and that signed between ISAC and KOPRI in 2014, also supported by MAE for the Arctic.

Quartz grain microtextures of beach sands from the Punta Arenas area, southernmost Chile and King George Island, Antarctica

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ABSTRACT

We analyzed variations of microtextures on quartz grains collected from present-day beaches of the Punta Arenas area, southernmost Chile and King George Island, West Antarctica. The beach sediments selected for this study were glacial till emplaced by glaciers flowing from the inland ice cap (King George Island) or ice sheet (the Punta Arenas area). Both study areas were under fast moving glaciers, but with different distance of transport and ice thickness: 4 km long and >360 m thick for King George Island and >100 km long and >1000 m thick for the Punta Arenas region. Bedrock geology of King George Island consists of fresh volcanic and some plutonic rocks and that of the Patagonian Andes of sedimentary and metamorphic rocks. Crushing (fracturing) and abrasion (grinding or attrition) are two dominant processes in the glacial environments, resulting in the formation of microtextures on the surface of quartz grains including chattermarks, conchoidal fractures, and multiple grooves amongst others. Quartz sands in both studied beaches exhibit dominance of mechanical microtextures formed by high shear-stress fracturing (>80%), followed by subordinate high-energy percurssion microtextures. Little difference in the amount of microtextures of a glacial origin in the studied beach sands of both regions indicate that differences in ice thickness, distance of transport, ice dynamics, and bedrock lithology did not have specific influences on quartz grain surface microtextures. After initial glacial transport, the studied beach sands experienced reworking in the present marine coastal environment, resulting in the formation of percussion-related microtextures. Because all the studied sand samples exhibit a higher frequency of high-stress fractures, the glacial signal survived overprinting in the marine coastal environment, probably due to the relatively short residence time in the current high-energy beach environment.

Climatology of ionospheric density profiles in the auroral and polar cap regions from long-term incoherent scatter radar observations

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ABSTRACT

Using long-term incoherent scatter radar (ISR) observations, we investigated climatological characteristics of electron density profiles in the auroral and polar cap regions in comparison with the mid-latitude ionosphere. The electron density profiles from 100 to 450 km are compared among the three radar stations (Millstone Hill, Tromso, Svalbard) during equinox, summer and winter for different solar and geomagnetic activity periods. The diurnal and seasonal variations of F-region density are mainly controlled by solar zenith angle also in the polar ionosphere. However, in winter when the solar radiation disappears, there are two peaks in the polar cap/cusp region. The first peak is caused by soft particle precipitation near magnetic local noon in the cusp region and the second peak is produced by plasma transport from the dayside lower latitudes to nightside polar cap region, particularly during high solar activity. Other noticeable features are in the E-region ionosphere. Even though the E-region completely disappears in the mid-latitude and also in the polar cap during nighttime, the E-region density is significantly enhanced by auroral particle precipitation in the auroral region (Tromso) even during low solar activity or geomagnetically quiet condition. We also found E-region density enhancement in the polar cap/cusp region during daytime in winter, which might be produced by particle precipitation. In addition, our results show the variations of the E- and F-region peak heights. The diurnal variations of hmF2 are smaller in the polar ionosphere especially for solstices, while the peak height increases gradually with time from day to midnight in the mid-latitude ionosphere. The mean hmE is about 120 km in the auroral region during nighttime and around 130 km in the polar cap/cusp region during daytime, while it is approximately 110 km for the other cases.

Geochemical identification of sediment provenance during glacial-interglacial period: the Southern Drake Passage

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ABSTRACT

Clay mineralogy and crystal size distribution in marine sediments are used for the indication of a sediment provenance and climatic changes. Objective of this study is to trace the sediment provenances in the Southern Drake Passage with clay mineralogy, elemental composition and crystal size distributions (CSDs) of clay mineral. In the present study, X-Ray Diffractometer (XRD) measurements showed that smectite, illite and chlorite are dominant phases. The semi-quantitative analysis showed that the relatively proportion of smectite is 50 - 60% in interglacial stage, 30 - 39% in the glacial stage. Comparing with REE data, sediments supply was influenced by Weddell sea current and Antarctic Circumpolar Current (ACC). Moreover, elemental composition and microscopic analysis of smectites were carried by Transmission Electron Microscopy (TEM) and energy dispersive spectroscopy (EDS). The composition of smectite clay minerals were plotted on the tertiary diagram indicating that Smectite in Drake Passage was transported from three provenances: South Shetland island, east and west side of Antarctic peninsula during glacial – interglacial period. The CSDs of smectite also indicate the various source of smectite. These results suggest that clay mineralogy, elemental composition and CSDs could be used as a novel method to define sediment provenance.

Illite crystallinity responding depositional environments during the Holocene: Larsen Ice Shelf C, Antarctic Peninsula

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ABSTRACT

Rapid regional warming over the past decades on Antarctic Peninsula is related to the breakup of Larsen Ice shelves and accelerating glacier mass loss. We hypothesized that "The glacial environmental changes in sediment deposition may be reflected in nano-scale properties of clay minerals such as Illite Crystallinity (IC) through the Holocene and Last Glacial Maximum (LGM)". Microbial alteration of IC was investigated accompanying with X-ray diffractometer, Transmission electron microscopy, Electron Energy Loss Spectroscopy, Pyrosequence, and isotopic analysis. IC shows an abrupt decrease (high crystallinity) in the sedimentary unit of bioturbated/non-laminated structure and relatively high isotopic composition ($\delta^{13}C$=-25.7‰ and $\delta^{15}N$=3.8‰) that is interpreted as occasionally open marine conditions. These observations indicate thatI Cobeys to the changes in depositional environments when open marine condition begins. Increase in the values of IC (low crystallinity) shows a strong relation with microbial Fe respiration, which modifies the IC through alteration of illite structure in anaerobic conditions. Electron energy loss spectroscopy confirmed tha tlow-crystalline illite consists of more reductive form of Fe in the structure. Variation in IC reveals a depositional environment reflecting biogeochemical process during the Holocene.

Comparison of neutral winds and ion drifts observed at Jang Bogo station, antarctica

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ABSTRACT

A distinct feature of the high latitude ionosphere is its convective motion which is generally antisunward over the polar cap and sunward in the auroral region. It is well known that this ionospheric plasma convection results in neutral wind patterns that resembles to the plasma convection pattern via ion-neutral collisions. At Jang Bogo station which is located inside the polar cap, Fabry-Perot Interferometer (FPI) and Vertical Incidence Pulsed Ionospheric Radar (VIPIR) have been simultaneously operated to observe neutral winds and ion drifts, respectively, and the data from these two instruments allow us to compare neutral winds and ion drifts to investigate their couplings. The results of this comparison show that there exist noticeable similarities in there diurnal variations within the polar cap. Comparing the vectors of neutral winds and ion drifts, however, the neutral wind vectors do no precisely coincide with the ion drift vectors, but the two vectors are consistently deviated each other. In this study, we present the preliminary results of the simultaneous observations of neutral winds and ion drifts during 2017 at Jang Bogo Stations, Antarctica.

Utilization of aerial imagery for study on population ecology of Adelie penguins in Cape Hallett, Antarctica

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ABSTRACT

We monitored Adelie penguins population in Antarctica by aerial imagery sampled by a unmanned aerial vehicle (UAV) and helicopter. This paper examines the utilization of aerial imagery as a preliminary data for study on population ecology in Antarctica. Airborne remote sensing can lead to a reasonable trade-off between high accuracy of field survey and wide coverage of satellite remote sensing. Therefore, aerial imagery is most effective tool for a periodic monitoring on population ecology of Adelie penguins that live in the wide area of Antarctica, Cape Hallett, located in Victoria Land, East Antarctica. Cape Hallett has been designated as Antarctic Specially Protected Area (ASPA) No.106 because of its importance as breeding colonies of native birds and mammals. For global analysis of the ASPA No. 106, the images collected from both of UAV and Helicopter were mosaicked into a single image. In addition, we compared the resulting mosaic images derived from UAV and helicopter to consider the advantages and disadvantages of the two aerial systems. The drone image mosaic was able to clearly distinguish even small pebbles because of its high spatial resolution of 0.72 cm, while the helicopter image mosaic was only able to discriminate between penguin individuals due to the relatively low spatial resolution of 2.4 cm. However, helicopter, the manned aerial system, was able to secure a wide coverage even with a small number of images, and to prevent a missing target area by intuitional decision of the boarding investigator as well. These results suggest that two different types of aerial image data can complement each other and reduce missing data due to magnetic field error around polar region and human error.

Amundsen Sea specific ecosystem model: Results of the lower-trophic level

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ABSTRACT

The Amundsen Sea is one of the most productive marine ecosystem in the Southern Ocean during summer period. Due to the rapid climate change, the Amundsen Sea ecosystem is expected to undergo various influences by fast glacier melting (by stronger intrusion of the circumpolar deep water (CDW)), warming of the ocean surface, strong stratification, and ocean acidification. Therefore, it is required to assess further insights into how the ecosystem respond to rapid environmental change. Given the finite resources and time for research, model study can be a powerful tool to comprehend and diagnose this area with large temporal and spatial scales. In this study, ERSEM (European Regional Seas Ecosysten Model), a coupled pelagic-benthic ecosystem was applied to simulate the seasonal and inter-annual variability of Chlorophyll-*a* and surface primary production in the Amundsen Sea (*Phaeocystis*-dominated*)*. ERSEM permits study of the dynamics and mechanisms of the lower-trophic biota and carbon cycle. We incororated the sea ice effect and *Phaeocystis* dynamics into the ERSEM to devise a model specific to the Amundsen Sea. The performance of model was evaluated in the 1D frame throughout observation dataset (water temperature and salinity, nutrients, Chl-*a*, and surface primary production) from the Amundsen Sea Expedition of KOPRI (2010-2016) and the remote sensing data of ocean color (1997-2017). Model results were in good agreement with observations for the annual variation of surface primary production (RMSE of surface Chl-*a* = 0.6), the annual average productivity (Chl-*a*: 4 mg m^{-3}), and the season of maximum bloom (the middle part of January). However, the exceptional high and low bloom of some years could not be simulated, which is presumably as cribed to the fact that this model does not implement the iron supply cycles (from glacier, sea ice, dust deposition, etc.), variation of the mixed layer over winter season, dynamics of the krill and ice algae, and fluctuating in flux of CDW. The sensitivity runs exhibited that primary production was primarily drived by iron concentration, while it was much less sensitive to light or inhibited under the intense light. Therefore, it is most essential to monitor and costrain how the iron is distributed over this region and where it is supplied from for improving this Amundsen Sea Speicific Ecosystem Model.

Transcriptome analysis of Antarctic and korea Diophrys oligothrix ciliate

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ABSTRACT

Diophrys oligothrix is known as a typical marine and brackish ciliate with the first isolated in New Hampshire, USA by Borror et.al (1965). Owing to the global distribution, not only *Diophrys oligothrix* plays vital roles in marine food web and energy flow, it is considered as a good indicator in the marine biomonitoring of status as well. Although there are some morphological and taxonomic studies, our understanding about this ciliate are still ambiguous. Hence, in order to understand ecological underpinnings of evolution process, Antarctic *Diophrys oligothrix* transcriptomic was determined and compared with Korean *Diophrys oligothrix* transcriptome. Total RNA was extracted from those Antarctic and Korean ciliate, which were optimized growth at 4°C and 20°C, respectively. In this study, we obtained 29,424,143 and 19,963,807 high-quality reads from the Antarctic and Korean ciliate respectively by Illumina paired-end sequencing. Regarding Antarctic *Diophrys oligothrix*, a total of 45,738 unigenes (average length of 835.80 bps; N50:598) were identified with 5,358 significantly matched in Pfam database and 5,571 similar to proteins in the Uniprot database. Meanwhile, Korean *Diophrys oligothrix* data set generated 45,488 unigenes (an average length of 400.26 bps; N50:275) with 6,660 annotated in Pfam and 6,981 in UniProt. By comparing Antarctic and Korean *Diophrys oligothrix* transcriptome, we will be able to reveal positive selected genes that are responsible for Antarctic environmental adaptation. Moreover, this study will continuously support for further genetic, phylogenetic, and biochemistry studies of *Diophrys oligothrix* ciliate and other polar organisms.

Spatio-Temporal photosynthetic variability of Antarctic intertidal algaes

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ABSTRACT

Spatial and temporal variability in primary productivity (PP) of epilithic microalgae and macroalgae was measured in the intertidal gravel beach of Barton peninsula, Antarctica in 2017-2018 austral summer. There were only a few studies reported for the productivity of the primary producer in Antarctic intertidal zone. Algal photosynthetic parameters represented as quantum yield (F_v/F_m) and relative maximum electron transport rate ($rETR_m$, relative unit) were measured using a pulse amplitude modulated fluorometer. We selected ten sites for the study of spatial PP variations. Temporal PP variations were measured in every hour with light intensity and water temperature. In case of spatial PP variation, epilithic microalgal F_v/F_m was varied from 0.40 to 0.67, and $rETR_m$ was varied from 8.3 to 31.0. The F_v/F_m was 1.3 times greater around the King Sejong Station (n=3) located at the mouth of the Marian Cove than that in other sites. In contrast, the $rETR_m$ was 57% lower around the station than that in other sites. Macroalgal F_v/F_m was varied from 0.29 to 0.77, and $rETR_m$ was varied from 2.9 to 29.5. Unlike the result of microalgae, each macroalgae group (green, brown, and red algae) did not show a significant difference. In case of temporal PP variation, epilithic microalgae and red algae (*Palmaria decipiens*) showed diurnal rhythm related to daily variation of sunlight. The $rETR_m$ of both algae increased with sunrise. The photosynthetic activity of microalgae decreased in the afternoon, but that of macroalgae dropped in the late morning. In summary, epilithic microalgae and macroalgae showed spatial PP variation, but the trend was not same. In addition, we observed circadian photosynthetic rhythm for the both microalgae and macroalgae, and both cycles were different. Therefore, the location and the time should be considered when the photosynthetic studies of algal are performed.

A new species of the genus *dactylopusia* (copepoda: Harpacticoida: Dactylopusiidae) discovered in King sejong Island, antarctica

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ABSTRACT

A new species of the genus *Dactylopusia* Norman, 1903 (Copepoda: Harpacticoida, Dactylopusiidae) was collected from the subtidal muddy bottom (20 m depth) in King Sejong Island, Antarctica. Up to date 24 species or subspecies are currently recorded in the genus, of which only three valid species, *D. tisboides* (Claus, 1863), *D. spinipes* Brady, 1910, and *D. pectenis* (Pallares, 1975) have been reported from the Antarctica. The present new species is most closely related to 2 subspecies, *D. vulgaris vulgaris* Sars, 1905 and *D. vulgaris inornata* Lang, 1965 in sharing 3-segmented exopod of antenna, 3-segmented exopod and endopod of leg 1, distal segment of legs 2-4 with 7, 8, 8, second endopod of legs 3-4 with each 2 inner setae, about 5 times longer than wide in first endopod of leg 1, and exopod/baseoendopod of female leg 5 with 5/6 setae. However, the new species is easily distinguished by the following characters: both rami of female P5 without transverse striae on its surface, shape and setation of baseoendopod in male P5, incurved seta VI of female caudal ramus, setation of distal endopod of male P2 (2 bare and 1 bipinnate inner setae, 1 modified outer spine, and 2 modified distal strong spines).

Variation of diatom communities caused by drastic environmental changes in marian cove, antarctica, during the austral summer

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ABSTRACT

The climate changes caused an apparent glacial retreat over the last years in Marian Cove, South Shetland Island. The environments have rapidly changed with glacial retreat, which has impacted greatly on community structures. Diatom plays a crucial role as important primary producer in the harsh ecosystem. The diatom assemblages (n=24) were sampled in terms of changes by distances from glacier, depths (10-30 m), and types of substrates (rock, three species of macroalgae, and sediment). In the intertidal area, epiphytic and epilithic diatom such as *Fragilaria* spp. and *Licmophora gracilis* were dominated in general. Compositions of epilithic diatoms were clustered to three groups followed by distances from glacier. Interestingly, thick diatom patches were founded at the stations nearby glacier, which has been newly exposed to drastic environmental changes due to glacier melting or break-up. The clear distinction was founded on the composition of subtidal diatoms depending on water depths. Especieally, chain-form and tube-dwelling diatoms were mostly dominated at 20 m depth. Substrates were also key environmental factor controlling species composition of diatoms. For example, epilithic diatoms were tend to smaller than epiphytic and chain-form diatoms, and epiphytic diatoms were varied by different macroalgae species. In conclusion, distance from glacier, water depth, and type of substrate caused a significant difference on diatom community. The findings have necessitated future study to elucidate specific environmental factors controlling diatom community in this severe environment.

Crystal structure of dihydrodipicolinate reductase (*Pa*DHDPR) from *Paenisporosarcina* sp. TG-14: structural basis for NADPH preference as a cofactor

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ABSTRACT

Dihydrodipicolinate reductase (DHDPR) is a key enzyme in the diaminopimelate- and lysine-synthesis pathways that reduces DHDP to tetrahydrodipicolinate. Although DHDPR uses both NADPH and NADH as a cofactor, the structural basis for cofactor specificity and preference remains unclear. Here, we report that *Paenisporosarcina* sp. TG-14 *Pa*DHDPR has a strong preference for NADPH over NADH, as determined by isothermal titration calorimetry and enzymatic activity assays. We determined the crystal structures of *Pa*DHDPR alone, with its competitive inhibitor (dipicolinate), and the ternary complex of the enzyme with dipicolinate and NADPH, with results showing that only the ternary complex had a fully closed conformation and suggesting that binding of both substrate and nucleotide cofactor is required for enzymatic activity. Moreover, NADPH binding induced local conformational changes in the N-terminal long loop (residues 34-59) of *Pa*DHDPR, as the His35 and Lys36 residues in this loop interacted with the 2′-phosphate group of NADPH, possibly accounting for the strong preference of *Pa*DHDPR for NADPH. Mutation of these residues revealed reduced NADPH binding and enzymatic activity, confirming their importance in NADPH binding. These findings provide insight into the mechanism of action and cofactor selectivity of this important bacterial enzyme.

Anti-cancer activity of lobaric acid and lobarstin extracted from the Antarctic lichen *Stereocaulon alpnum*

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ABSTRACT

Lobaric acid and lobarstin, secondary metabolites derived from the antarctic lichen *Stereocaulon alpnum*, exert various biological activities, including antitumor, anti-proliferation, anti-inflammation, and antioxidant activities. However, the underlying mechanisms of these effects have not yet been elucidated in human cervix adenocarcinoma and human colon carcinoma. In the present study, we evaluated the anticancer effects of lobaric acid and lobarstin on human cervix adenocarcinoma HeLa cells and colon carcinoma HCT116 cells. We show that the proliferation of Hela and HCT116 cells treated with lobaric acid and lobarstin significantly decreased in a dose- and time-dependent manner. Using flow cytometry analysis, we observed that the treatment with these compounds resulted in significant apoptosis in both cell lines, following cell cycle perturbation and arrest in G2/M phase. Furthermore, using immunoblot analysis, we investigated the expression of cell cycle and apoptosis-related marker genes and found a significant downregulation of the apoptosis regulator B-cell lymphoma 2 (Bcl-2) and upregulation of the cleaved form of the poly (ADP-ribose) polymerase (PARP), a DNA repair and apoptosis regulator. These results suggest that lobaric acid and lobarstin could significantly inhibit cell proliferation through cell cycle arrest and induction of apoptosis via the mitochondrial apoptotic pathway in cervix adenocarcinoma and colon carcinoma cells. Taken together, our data suggests that lobaric acid and lobarstin might be novel agents for clinical treatment of cervix adenocarcinoma and colon carcinoma.

Anticancer activity of ramalin, a secondary metabolite from the Antarctic lichen *Ramalina terebrata*, against colorectal cancer cells

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ABSTRACT

Colorectal cancer is a leading cause of death worldwide and occurs through the highly complex coordination of multiple cellular pathways, resulting in carcinogenesis. Recent studies have increasingly revealed that constituents of lichen extracts exhibit potent pharmaceutical activities, including anticancer activity against various cancer cells, making them promising candidates for new anticancer therapeutic drugs. The main objective of this study was to evaluate the anticancer capacities of ramalin, a secondary metabolite from the Antarctic lichen Ramalina terebrata, in the human colorectal cancer cell line HCT116. In this study, ramalin displayed concentration-dependent anticancer activity against HCT116 cells, significantly suppressing proliferation and inducing apoptosis. Furthermore, ramalin induced cell cycle arrest in the gap 2/mitosis (G2/M) phase through the modulation of hallmark genes involved in the G2/M phase transition, such as tumour protein p53 (TP53), cyclin-dependent kinase inhibitor 1A (CDKN1A), cyclin-dependent kinase 1 (CDK1) and cyclin B1 (CCNB1). At both the transcriptional and translational level, ramalin caused a gradual increase in the expression of TP53 and its downstream gene CDKN1A, while decreasing the expression of CDK1 and CCNB1 in a concentration-dependent manner. In addition, ramalin significantly inhibited the migration and invasion of colorectal cancer cells in a concentration-dependent manner. Taken together, these data suggest that ramalin may be a therapeutic candidate for the targeted therapy of colorectal cancer.

Soil temperature increase effects on maritime Antarctic soil microbial community and humic acid degradation

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ABSTRACT

Soil humic substance (HS) is the largest constituent of soil organic matter. A major extractable component, humic acid (HA), of HS is dark brown to black high molecular weight organic polymer. To assess the effects of warming both on HA degradation and microbial community, microcosm beakers with HA-rich soils from King George Island in the maritime Antarctic, were incubated at elevated temperature of 5°C and 8°C, compared to the soil temperature (below 2.0°C) during thawing period. Under the microcosm systems, HA content steadily decreased to approximately 63% and 55%, compared to untreated control (100%, 287.0±2.8mg/g soil), until 90days-incubation at 5°C and 8°C, respectively, presumably by microbial degradation process. Culture-independent community analysis of 16S rRNA genes showed that, during the microcosm experiments, the relative abundances of bacterial phyla *Proteobacteria* (copiotrophic) and *Actinobacteria* (polymer-degrading) slightly increased and decreased, respectively, in parallel with the incubation temperature rising to 5°C and 8°C. In contrast, archaeal community, dominated by phylum Thaumarchaeota, hardly responded to the soil temperature increase, indicating that bacterial community was much more affected than archaea by warming, although fungal response was not consistent. Culture-dependent community analyses were subsequently performed for the indigenous bacteria at 5°C and 8°C which were enriched in an artificial mineral medium containing HA. Consequentially, addition of HA resulted in a rapid increase of *Proteobacteria* dominance at both 5°C and 8°C, with the relative abundance of class *Alphaproteobacteria*-related bacteria being highly increased to over 72.7% among Proteobacteria (100%) under HA-degradation process. The overall results of this study indicate that HA degradation is in progress by bacteria in maritime Antarctic soil, and soil temperature rise by global climate change can change the bacterial community structure and HA degradation rate

Can spatial variation of megabenthic epifauna reflect successional processes in Marian Cove, a rapid warming fjord in King George Island, Antarctica?

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ABSTRACT

Marian Cove (MC) is a fjord-like embayment (~4.5 km long, ~1.5 km wide, water depth ~120m) in King George Island, which belongs to the Antarctic Peninsula, one of the most rapidly warming regions on earth. In MC, tidewater glaciers have retreated ca. 1.9 km for the last six decades, and thus, its bottom substrate can be divided into several sections based on the time scale of being exposed after the glacier retreat (<10 yrs, 10-25 yrs, 25-60 yrs and >60 yrs). In the 2017/2018 season, we investigated spatial variations of benthic assemblage pattern in these sections (one station at each section) in order to infer any successional processes from the present pattern of distribution of the benthic communities. At each station, we sampled animals and took underwater photography down to 30 m by SCUBA diving. In addition, for the first time, using a ROV we obtained quantitative images of benthic communities at the deeper substrates (>30 to 90 m). Analysis showed clear distinction in the megabenthic assemblage among the stations along the distance from the retreating glaciers and also with water depth. Throughout the entire depth investigated (0~90 m), more diverse taxa and trophic groups were found at the stations which have been exposed for the longer time scale, indicating more stable habitat environment. In particular, we observed diverse sponge communities including the large-sized glass sponges at the station far from the glacier down to 90 m. On the other hand, at the station closest to the retreating glaciers, ascidians (order of abundance: *Cnemidocarpa verrucosa*> *Molgula pedunculata*> *Ascidia challengeri*) predominated (>95% of total biomass) throughout the depths (~90 m) except very shallow water (<10m), indicating that this area was at an early stage of succession. Ascidian density peaked at around 30m (~3 kg wet wt/m^2) and there after sharply decreased towards the deeper bottom. The persistent dominance of ascidians to the deep basin, however, strongly implies that the impact of glacier retreat reached out almost to the deep basin.

Effect of sea ice melting processes on phytoplankton physiology in the northern chukchi sea

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ABSTRACT

In recent years, sea ice extent and thickness of the Arctic Ocean have steadily declining. As the sea ice extent decreases, not only the freshwater but also the transmitted light in the upper layer increases. Also as the Arctic runoff increases, the organic matter that flows out can change the productivity of the Arctic phytoplankton. Recent changes in the marine environment of the Arctic Ocean are expected to affect the essential factors for the growth of phytoplankton. Three Arctic surveys are conducted in the northern Chukchi Sea in August from 2015 to 2017. During the cruise, the quantum efficiency of photochemistry in Photosystem Ⅱ (Fv/Fm) and electron transfer rate of phytoplankton are measured by using active fluorometry. The average Fv/Fm in the mixed layer ranged from 0.23 to 0.61 (35-94%; relative to maximum Fv/Fm), and the values in subsurface chlorophyll maximum layer were 0.40-0.58 (61-90%), which were significantly higher than those of the mixed layer. Year to year variation of the Fv/Fm may be attributed to the variation of sea ice extent. These changes in sea ice can influence the freshwater thickness and stratification in the upper layer, which controls the supply mechanism of nutrient to the surface layer. As a result, it is expected to affect on phytoplankton physiology. Through incubation experiments, we identified that the photochemical efficiency and growth of phytoplankton were limited by the nitrate in the upper layer of the northern Chukchi Sea. It showed a markedly increase in micro size of phytoplankton community in the addition of nitrate samples. We will discuss the variation in the photochemical efficiency and biomass of phytoplankton according to the difference of environmental factors caused by sea ice melting in the northern Chukchi Sea.

Polar atmosphere-ice-ocean interactions: Impact on climate and ecology

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ABSTRACT

The topic of this presentation is the natural marine aerosol, which is of paramount importance at the global scale and influences the Earth's radiative budget and the biogeochemical cycles. Currently there is a serious lack of aerosol data over polar regions in general. In particular, over the polar sea-ice zones, which is one of the largest ecosystems on Earth, composed of a variety of habitats and organisms tolerating extreme conditions. As climatic changes are rapidly amplifying in polar regions, understanding biogeochemical processes involved in the air-sea-ice interface is crucial to pinpoint climate feedbacks. Our approach consists in synergistically using our competences in plankton ecology, ocean-atmosphere biogeochemistry and atmospheric chemistry. Main results carried out at the ICM-CSIC Barcelona (Spain) with interdisciplinary collaborations with KOPRI.

(1) Atmospheric new particle formation and growth significantly influences climate by supplying new seeds for cloud condensation and brightness. Currently, there is a lack of understanding of whether and how marine biota emissions affect aerosol-cloud-climate interactions in the Arctic. Here, the aerosol population was categorised via cluster analysis of aerosol size distributions taken at Mt Zeppelin and Dasan Station (Svalbard) during a 11 year record (2000-2010) and at Station Nord (Greenland) during a 7 year period (2010-2016), and Dasan station Briefly, air mass trajectory analysis and atmospheric nitrogen and sulphur tracers link these frequent nucleation events to biogenic precursors released by open water and melting sea ice regions. The occurrence of such events across a full decade was anti-correlated with sea ice extent.

(2) Results are shown from the IBRV Araon ARA08B (summer 2017) Korean collaboration. Both ambient and laboratory studies are shown. Ambient data showed increased new particle formation in sea ice marginal zones during two days of the field study. 13 primary aerosol chamber experiments were carried out by bubbling different means (melted sea ice, melt pond, open ocean water) showing different amount of ultrafine particles being released and proportionally related to both organic and inorganic components.

Oceanographic characteristics in the Marian cove

Yeonggi Kim

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ABSTRACT

Marian Cove is a part of the Maxwell Bay surrounded by King George and Nelson Islands in South Shetland Islands, Antarctica. The cove is approximately 4.5km long and 1.5km wide and the maximum depth is about 120m. The region shows typical fjords characteristics in summer: it has 2-layer circulation system, in which colder and less saline surface melt water flow out to the Maxwell Bay, warm and saltier Maxwell Bay water inflow into subsurface layer. It is reported that surface wind and tide are main factor to vary ocean circulation in the cove. It is important that the circulation is significantly influenced to ecosystem in the area. Since March 2011, hydrographic measurement have been 71 times and atmospheric data in the Sejong station (AWS) are collected. Also, we use tide prediction model data from previous study (Lim, 2014). In this study, we understand hydrographic characteristics of the Marian cove and analyze the factors of temporal variation to identify the relationship between ocean circulation and forcings (surface wind and tide).

Oceanic heat transport and basal melting of the Dotson Ice Shelf

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ABSTRACT

Recently rapid basal melting in the West Antarctic ice shelf is related to warm and salty circumpolar deep water(CDW) inflow along the continental shelf (Wahlinet al., 2010; Dutrieux et al., 2014; Ha et al., 2014; Kim et al., 2016). In order to estimate the effect of oceanic heat transport on the ice shelves melting, we analyzed the temporal vatiability of water mass and currents obtained from two long-term mooring data in the eastern (K4) and western side (K5) of the Dotson Ice Shelf (DIS) January 2014 to January 2016. The observed bottom temperature and salinity at the eastern side (maximum 0.56 ℃, 34.56) is higher than that of the western side (maximum 0.38 ℃, 34.42). During observation periods, the strong southward flow (>10 cm/s) appear near the bottom at eastern side and show a clearly seasonal variation both isopycnal and the southward current. Calculated average heat transport using the observed data is 2.5 TW and shows that there is heat input in all season at bottom layer. The heat intrusion into under of ice shelf contributes to the ice shelf bottom melting of 190 Gton/y. In the western side(K5), northward currents appear at the middle layer depths in austral winter season. Calculated melt water fraction using the mooring data is more than 0.5% and shows time-lag with the heat transport at eastern side.

Changes in algal community structure of Maxwell Bay, King George Island, Antarctica: A comparison of 1988-1989 and 2016-2018 surveys

Young Wook Ko

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ABSTRACT

Since the construction of King Sejong Station in Antarctica in 1988, researches on various marine benthoses have been carried out for over 30 years. Studies on benthic algae have been conducted at the beginning of the study on flora and community structure in Maxwell Bay, subsequently taxonomic studies continued. This study was compared with the research conducted in 1988-1989 to investigate the changes of the marine algal communities over the past 30 years. Seven sites from previous research were selected as current research sites. Five quadrats (50cm×50cm) were photographed at depths 1, 5, 15, and 25m respectively through SCUBA diving. Destructive sampling was performed in only one out of five quadrats to minimize disturbed benthic algal community. At the intertidal site, two transect lines were installed perpendicular to the shoreline in order to analyze the change of the algal community by tidal level. Two quadrats were imaged at 5m intervals. In addition, we attempted a new approach to establishing broad scale of coastal ecosystem monitoring techniques using recently developed unmanned aerial vehicles (UAVs). The coverage and distribution of the dominant algal species in the intertidal zone were analyzed by comparing quadret with UAVs image at the low tide. This study provides baseline data for understanding long-term benthic marine communities through comparison with previous studies and will also provide insight into changes in Antarctic ecosystems due to global climate change, such as global warming.

Comparison of seasonal charicteristics of Cloud Condensation Nuclei measured at Polar regions

Hyo Jin Kang

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ABSTRACT

Cloud Condensation Nuclei (CCN) concentrations have been measured at polar stations, (i) King Sejong station (62.22˚S, 58.78˚W) of Antarctic Peninsula and (ii) Zeppelin station (78.91˚N, 11.89˚E, Above sea level 474m) of Arctic region.

Analysis of the CCN date were conducted for the periods from January 2009 to December 2010, for the cases when instruments of the both stations were operational. Commercially available CCN Counters (DMT-100) were deployed at both sites. Time resolution of measurements have been set as 1 second. The cycle of supersaturation was gradual increasing 5 steps, from 0.2% to 1.0%. The median value of CCN concentration at 0.4% supersaturation at Arctic and Antarctic stations were 89.13cm^{-3} and 112.53cm^{-3}, respectively. The seasonal variations of CCN show different patterns for both polar regions, showing the highest value of 151.96cm^{-3} in spring and the lowest value of 26.16cm^{-3} in autumn, for Arctic region. On the other hand, for Antarctic atmosphere, seasonal median CCN concentration was highest at 199.65cm^{-3} in austral summer and the lowest at 46.73cm^{-3} in austra lwinter.

CCN spectra was used to calculate the experimental parameters of C and k adapted from Seinfeld and Pandia (2016). During analysis period, for Arctic and Antarctic, entire median value of C were 98.78cm^{-3} and 124.99cm^{-3} and k values were estimated as 0.27and0.42,respectively.

Effects of low salinity and low pH on behavioral aspects of Antarctic amphipod, Gondogeneia antarctica

Seojeong Park

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Abstract

The glacier located in Marian Cove, King George Island, is collapsing rapidly due to climate change, and meltwater intrusion to the cove induces declining trends of mean salinity and pH. Following the seawater freshening and acidification, inevitable changes of the marine ecosystem near the glacier are expected. *Gondogeneia antarctica*, one of the abundant gammarid amphipod species in western Antarctic Peninsula, occupies important ecological niche in the cove. To predict the effects of the low salinity and pH on the population, we performed manipulation experiments for 40 days, raising *G. antarctica* in 4 different treatments combining two salinity (30 and 27 psu) and two pH (pH 8.0 and 7.6) levels. Low salinity increased cannibalism rates, while low pH influenced mortality except cannibalism. Foraging behavior rates was significantly reduced in the low pH levels. Meanwhile, swimming behavior during the nighttime was significantly lower in low salinity treatments. Low salinity and pH respectively decreased shelter utilization rates during the daytime, which indicates abnormal condition. Although the combined effects of low salinity and low pH were not observed during the experiments, the results suggest that each stressor due to glacier melting induces amphipods' abnormal behavior and eventually may reduce survival in the cove.

Effect of low pH and low salinity on the behavior and physiology of the limpet, Nacella concinna

Eunchong Sin

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ABSTRACT

The Marian Cove, King George Island is one of the regions where go through the rapid retreat of glaciers as a consequence of recent warming. The intertidal water can be influenced directly by freshwater runoff of melting glaciers with large variations in water pH and salinity. In this study, we investigated the effect of low pH and low salinity in behavior and physiology of the limpet, *Nacella concinna*, which is one of the most prominent invertebrates in Antarctica. We exposed the limpets to 2×2 different conditions of pH (8.00 and 7.55) and salinity (34.0 and 27.0 psu) and observed following items: righting after being flipped over, moving distance, mortality, and osmotic response with wet weight. There were no significant differences in righting response, mortality, and osmotic response between different treatments. And the moving response in daytime under high pH (8.0) and high salinity (34.0 psu) was significantly more active than under low pH and low salinity. Given the results, the combined stressors of low pH and low salinity can negatively affect on the limpet's movement in the daytime but cannot be a fatal effect on the limpets. This may explain why *N. concinna* is abundant on the intertidal zone where the animal can suffer freshwater inflow with large variation of pH and salinity.

Distribution of DOM and CDOM by the glacial melting in the Marine Cove

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ABSTRACT

Marian Cove is typical glaciers fjord of Antarcica (~4.5 km long, ~1.5 km wide, ~110m) and go through the rapid retreat of glaciers for 12.5 m/yr (1957-1994) and 62.0 m/yr (1994-2017). To determine the impact of glacial melting, we collected the CDOM and DOM samples at 10 sites (3 depths) and measured the light penetration on the seawater in the Marian Cove. The distribution of DOC and DON were no different with all sites in the Marian Cove. However, the CDOM showed the relatively higher at inner site (closed the glacial) than at outside site (st. 3) in the Marian Cove. In particular, the CDOM values of bottom at inner site (st. 16) presented the highest values due to glacial melting in the Marian Cove. Because the CDOM value was higher at inner Cove than at outside Cove, the light penetration also was different from inner to outside Cove by CDOM. PAR (Photosynthesis Active Radiation), UV-A (ultraviolet-A radiation), and UV-B (ultraviolet-B radiation) showed the lower penetration at inner Cove and deeper at outside Cove. Our results showed that CDOM from glacial source protect UVR (ultrabiolet radiation) and control the light transmissions depth. This will probably affect primary production of phytopalnkton and benthic communities.

Physiological characteristics and related biochemical parameters of snow algae from King George Island, Antarctica

Bokyung Kim

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ABSTRACT

Snow algae as primary producers can thrive when snow start to melt during spring and summer. Red and green snow caused by algal bloom is common on glaciers and snowfields worldwide. A detailed knowledge of snow algal biochemical compounds is crucial for understanding their survival strategies underlying rapid climate change, since these algae are potentially exposed to high level sunlight and UV irradiation. Hence, we collected reddish and greenish snow samples containing algae at the vicinity of penguin rockeries on February 2017 in the King George Island (62° 13' S, 58° 47' W, near the King Sejong Station), Antarctica. Spectral profiling and MAAs (mycosporine-like amino acids) were differences between reddish and greenish snow. Particularly in greenish snow, a high absorbance between 450-600 nm was observed. Similarly, the average MAAs concentration was 316.0 μg L^{-1} in greenish snow, higher than those of reddish (278.2μgL^{-1}). On the contrary, there is no difference in pigment composition between reddish and greenish snow. In this study, the lower MAAs and photo-protective pigments such as carotenoid in reddish snow than those of greenish reflect the synthetic pathways of photo-protective compounds within the snow algae. It is therefore possible that biochemical composition couldbe linked to the environmental conditions and physiological state of snow algae.

Episodic dumping of ice rafted benthic organisms on the Amundsen Shelf, Antarctica

Minkyoung Kim

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ABSTRACT

Individuals of benthic nemertean *Parborlasia* sp. specimens were intercepted by sediment traps, deployed at 400 m and 490 m (130 m and 567 m above the sea floor, respectively) on bottom tethered moorings in the sea ice zone and near the Dotson Ice Shelf on the Amunsen Shelf. The organic carbon flux derived from this benthic organism accounted up to 5 times the annual supply by small sinking particles. The most feasible mechanism for this flux is the acquisition of Parborlasia by anchor ice and subsequent transport by ice rafting. The implications of this phenomenon on Antarctic biology and carbon cycling will be discussed.

Southern hemisphere westerly wind for the last glacial maximum

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ABSTRACT

The southern hemisphere (SH) westerly wind change in the Last Glacial Maximum (LGM) is critical in understanding the glacial-interglacial carbon cycle since its strength and position influence the upwelling of the carbon rich deep water to the surface. To examine the change in SH westerly wind changes in the LGM, we adopted Community Atmosphere Model version 5 (CAM5) and performed LGM simulation with sensitivity experiments by specifying the LGM sea ice in the Southern Ocean, ice sheet over Antarctica, and tropical pacific sea surface temperature. We also compared our model results with the 5th Climate Modelling Intercomparison Project (CMIP5) LGM simulations. In the CAM5 LGM simulation, the SH westerly wind substantially increases between 40°S and 65°S, while the zonal-mean zonal wind decreases beyond this range. The position of the SH maximumw esterly wind moves poleward in the LGM simulation by about 5 degree. The CMIP5 LGM simulations using atmosphere-ocean coupled GCM shows slight increase in zonal-mean zonal wind sand poleward shifts of its position in the LGM.S ensitivity experiments suggest that the increase in the zonal-mean zonal wind is due to the increase in sea ice in the Southern Ocean in the LGM. These models results are at odds from existing hypotheses for the SH westerly wind change in the LGM, though proxy evidence shows varying outcome.

Metabolic pathway of phenol DEGRADATION of a cold-adapted antarctic bacteriUM revealed through whole genome sequencing

Gillian Li Yin Lee

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ABSTRACT

In recent years, study of the potential of Antarctic microorganisms for use in bioremediation has been of increasing interest, due to their adaptations to harsh conditions and their metabolic potential in removing a wide variety of organic pollutants at low temperature. In this study, the psychrotolerant bacterium *Rhodococcus* sp. strain AQ5-07, originally isolated from soil in King George Island (South Shetland Islands), was shown to be capable of utilizing phenol as sole carbon and energy source. The bacterium showed complete degradation of 0.5 g/L phenol within 84 h at 10°C. The phenol degradation pathway was predicted using bioinformatics analyses, by identifying the gene candidates responsible for the observed phenol-degrading phenotype. The assembled draft genome sequence (6.75 Mbp) of strain AQ5-07 was obtained through whole genome sequencing (WGS) using the Illumina Hiseq platform. The genome harbours the complete enzyme systems of the ortho-pathway for phenol degradation, suggesting that strain AQ5-07 degrades phenol via the β-ketoadipate pathway. The genome analysis identified a complete gene cluster containing catA, catB, catC, catR, pheR, pheA2 and pheA1. Based on the genome annotation, we predicted the degradation pathway of phenol in strain AQ5-07, and confirmed this experimentally through enzyme assays of catechol dioxygenases. The genomic data obtained provide improved understanding of the mechanism of phenol degradation by indigenous Antarctic bacteria, and also make an important contribution to knowledge of microbial biodiversity and function in Antarctica.

Monitoring glacier retreat using time-series remote sensing imagery in Marian Cove, King George Island, Antarctica

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ABSTRACT

Antarctic Peninsula is known as the area experiencing prominent global warming than other places in Antarctica. An effective way to investigate environmental changes from warming is long-term monitoring using remote sensing technique. We chose Marian Cove, King George Island, Antarctica as a monitoring site located in Antarctic Peninsula. To investigate glacier retreat trend in the target area, multiple commercial and publicly available remote sensing datasets including aerial photography, mid-resolution, i.e., a spatial resolution of about 15 m, satellite imagery and high-resolution, i.e., a spatial resolution of about or less than 1 m, satellite imagery acquired in austral summer were collected from 1956 to 2017, over sixty years. The remote sensing datasets were carefully registered to compensate spatial displacement between datasets and then glacier terminus in each dataset was mapped. From the retreat velocity of the terminuslines, acceleration trend of glacier retreat in recent years was figured out, and this approach will be applied to other monitoring sites such as Potter Cove and Collins Harbor in the coast of King George Island in further study.

Investigating Snow cover effect on distribution of lichen and moss in Barton Peninsula, King George Island, Antarctica

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ABSTRACT

Small vegetation such as lichen and moss is distributed in maritime Antarctic, and has undergone fluctuations in distribution patterns from environmental changes. Snow cover has been recognized as one of the factor affecting to the distribution patterns of lichen and moss, together with solar radiation and moisture. To investigate the effect of snow cover on distribution of lichen and moss around King Sejong Station in Barton Peninsula, King George Island, Antarctica,we acquired very-high-resolution digital images using RGB and near-infrared digital cameras attached on moving frame. Each image dataset was mosaicked using structure-from-motion (SfM) technique and spatially registered to produce an integrated multispectral imagery. The imagery was converted to a vegetation index map, which reflects vigor and biomass. The index values were divided into discrete zones along the distance from snow cover, and mean index value in each zone was calculated. From the results of the zonal analysis, decreasing vegetation index values were figured out according as the distance to snow increases,indicating a negative effect of snow cover on distribution of lichen and moss.

Temporal and Spatial Distributions of Nutrients and Particulate Matter in the Ross Sea

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ABSTRACT

The Ross Sea is one of the most studied regions in the Southern Ocean. Given the wealth of data collected in the past 5 decades, climatologies of nutrients (nitrate, phosphate, silicic acid) and particulate matter (chlorophyll, particulate organic carbon (POC), particulate organic nitrogen (PON), biogenic silica) were generated using objective methods. The climatologies generally confirm the concepts of seasonal growth of the phytoplankton bloom. Nitrate is removed largely through late December but remains above limiting concentrations. Chlorophyll largely mimics nitrate removal, reaching elevated levels in December but decreasing thereafter, and was apparently driven by accumulations of the haptophyte *Phaeocystis antarctica*. POC, however, did not decline with chlorophyll and remained relatively constant throughout the summer, which resulted in elevated POC:Chl ratios. Biogenic silica also continued to increase throughout the summer, suggesting that diatoms were routinely growing and accumulating in summer after the disappearance of the *Phaeocystis* bloom. They were characterized by low pigment levels, and are not detected by satellite ocean color estimates. Given this characteristic, the contribution of diatoms to annual productivity by bio-optical models has been underestimated, and the uncertainty in these estimates is quantified.

An Ice-Ocean Interaction Transect from the Ross Ice Shelf to Terra Nova Bay

Craig Stevens

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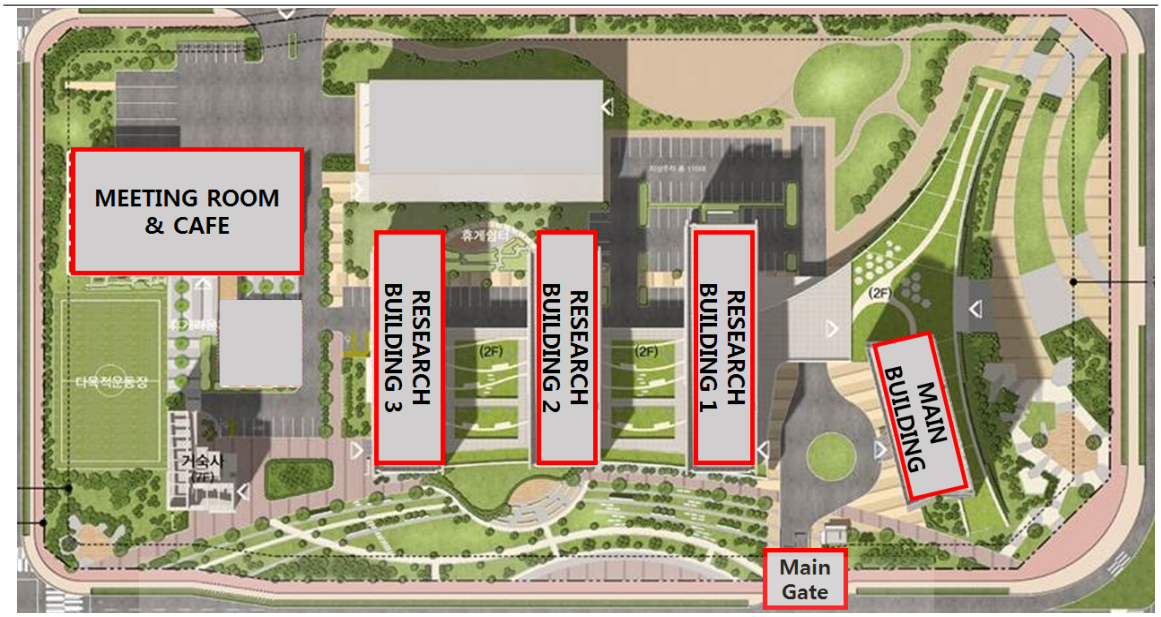
ABSTRACT

He we report on new hydrographic datasets from beneath the Ross Ice Shelf Cavity and around the Drygalski Ice Tongue. The cavity data come from the 2017 Aotearoa New Zealand Ross Ice Shelf Programme borehole melted in the central region of the Ross Ice Shelf Cavity. While comparable to the only previous data in the region, J9 in 1977, there are some unique features to these new profile and timeseries data. There are clear basal and benthic boundary layers separated by a highly interleaved region. In addition, there is evidence of ephemeral re-freezing on the shelf under-side, as well as regions within the interleaving that approach in situ freezing temperature. This structure is then compared with near-contemporary hydrographic profile and timeseries data from further north around the Drygalski Ice Tongue, near Jang Bogo Station. This region should be the receiver of shelf-related meltwater, as well as the generation point for high salinity shelf water, some of which potentially makes it back under the Ross Ice Shelf. The connecting waters are, in turn, affected by strongly seasonal sea ice processes.

Alphabetical List of Presenters

Floor Plan

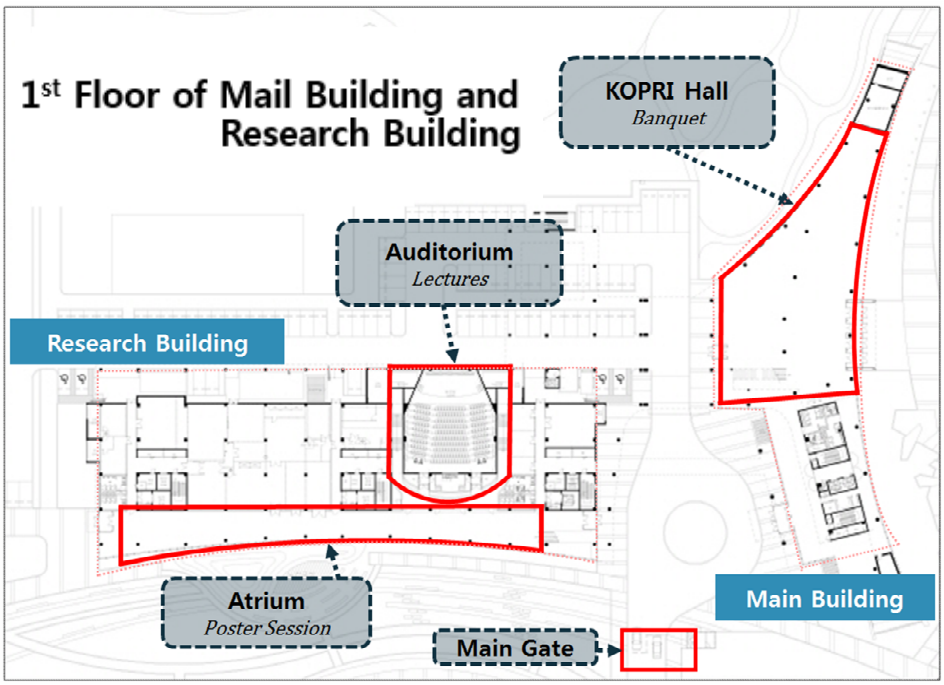
Overview



○ MAIN BUILDING
- KOPRI Hall(1F) for Lunch and Banquet dinner
- Polar Bear Seminar Room(3F) for Korean Early Career Polar Scientists Gathering

○ RESEARCH BUILDING
- Auditorium(1F) for Plenary Lectures and Oral Presentations (S1, S3, S4, S5, S6)
- Atrium(1F) for Poster Session

○ CAFETERIA BUILDING
- Sejong International Conference Room (2F) for Oral Presentations (S2)



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