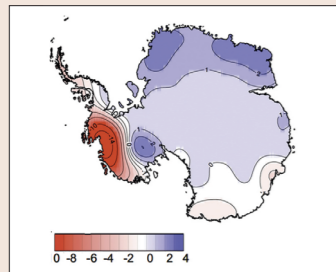
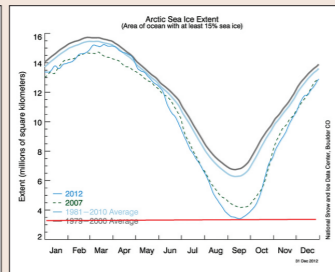


**Research Background and Importance**

- In parallel to global warming, a rapid warming and associated melting of sea ice and ice sheet occur in west Antarctica, but in east Antarctica there is only a little temperature change and sea ice and ice sheet are growing (Fig.1-1). The cause of this east-west difference in Antarctic climate change remains uncertain and need to be examined.
- In contrast to Antarctica, the Arctic warming occurs much faster than the rest world and sea ice is disappearing markedly (Fig.1-2). However, in mid-latitudes cold air outbreaks occur more frequently toward present, leading to a socio-economic loss. This seems to be related to the marked sea ice loss in early winter in the Arctic, but its exact mechanism needs to be investigated.



1-1



1-2

**Aim and Contents of research**

**Objectives**

- Investigation of the climate change mechanism via reconstruction of past climate records, present climate observation, and using numerical simulation
- Examining the cause of the climate contrast between west and east Antarctica
- Understanding the role of Arctic sea ice in modulating the Arctic Oscillation

**Contents**

- Quantification of polar climate change through proxy reconstruction and in-situ observation under the framework of infrastructure
- Investigation of the climate change mechanism through numerical simulation with an improved model based on observed data

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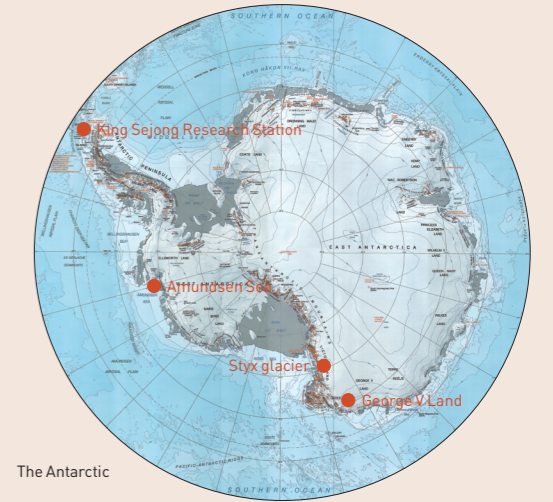


**Investigation of climate change mechanism by observation and simulation of polar climate for the past and present**

- Polar Climate Change Research
- Polar Earth-System Sciences
- Polar Life Sciences
- Polar Ocean Environment
- Arctic Research
- Promotion Program

**Division of Polar Climate Change Research**

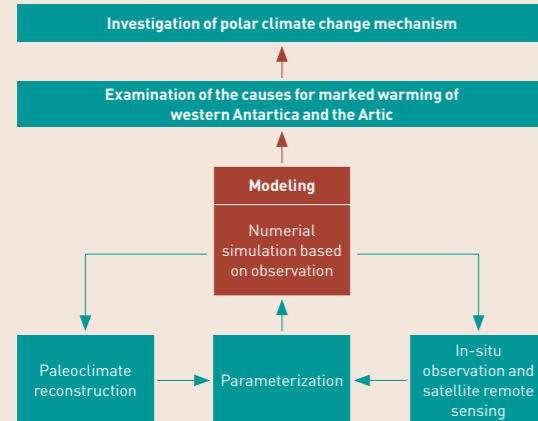
<b>Principle Investigator</b>	Kim, Seong-Joong
<b>E-Mail</b>	seongkim@kopri.re.kr
<b>Partner Organizations</b>	NCAR, Cambridge Univ., ENEA, NPI
<b>Research Duration</b>	2014. 1 ~ 2016. 12 (total: 3yr)
<b>Research Area</b>	<ul style="list-style-type: none"> <li>◦ Ice coring and proxy reconstruction: Antarctic George V Land GV7, Terra Nova Bay Styx glacier</li> <li>◦ Atmosphere observation: King Sejong Research Station, Amundsen Sea, Terra Nova Bay, Arctic Ocean</li> <li>◦ Numerical Modelling: Antarctic and Arctic</li> </ul>



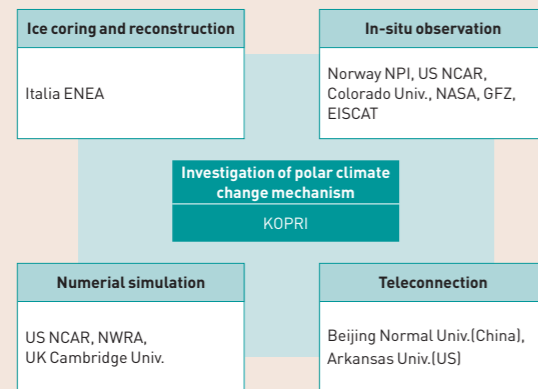
The Antarctic

## Research method

## Research Framework



## International Cooperation



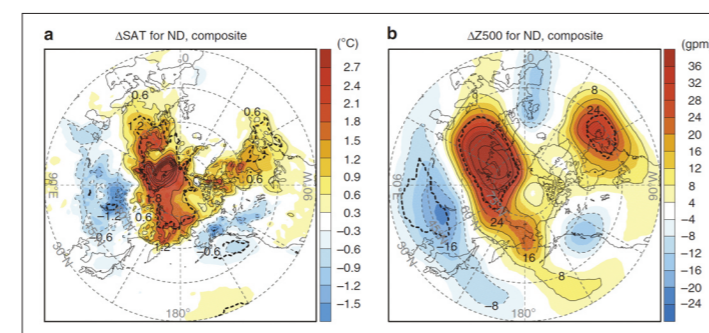
- Ice coring in the south Victoria Land and Terra Nova Bay and proxy reconstruction of ice cores sampled in Greenland NEEM on the shallow and deep records
- Quantification of climate change through in-situ observations of atmosphere properties and aerosols in the research stations and international collaboration
- Investigation of climate change mechanism through numerical modelling using in-situ observed data

## Overall Outcomes

### ◦ Weakening of the stratospheric polar vortex by Arctic sea-ice loss

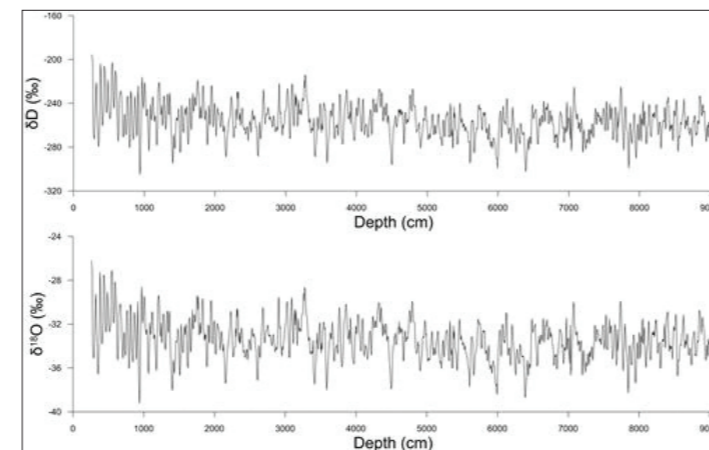
(Nature Communications, 5:4646, DOI: 10.1038/ncomms5646, 2014)

- Using NCAR CAM5 model, we show that the Arctic sea ice loss, especially in the Kara-Barents Seas, enhances planetary wave activities and warms the stratosphere that subsequently weakens stratosphere polar vortex associated with the increase in pressure over the Arctic. The reduction of meridional pressure between mid-latitudes and the pole leads to the weakening of polar vortex, consequently allowing more frequent cold air intrusions to east Asia



### ◦ Estimation of Age and depth relationship for NEEM ice core and climate, environmental record reconstruction

- Oxygen and hydrogen isotope ratio reconstruction for age estimation for NEEM shallow ice core (~85.6m)



### ◦ Antarctic GV7 ice coring and snowpit climate, environment proxy record reconstruction

- In collaboration with Italy, from Talos dome to GV7 site, traverse and ice core sampling at depth of 80.4m
- Reconstruction of Oxygen and hydrogen isotope ratio, mineral dust concentration, major ions, and trace elements



Traverse for GV7 ice coring

### ◦ 2014-15 Styx glacier shallow ice core drilling program

- The first shallow ice-core drilling of KOPRI on Styx glacier, northern Victoria Land, Antarctica since the establishment of the Antarctic Jang Bogo station and ice core drilling at depth of ~210.5m
- Geophysical survey, snowpit sampling, firn core drilling, density measurement
- In collaboration with SNU, firn gas sampling and borehole temperature logging



Ice coring of Styx glacier

### ◦ Observation for the atmosphere properties

- Steady collection of atmosphere property and meteorological data using Antarctic King Sejong Automatic Meteorological Observation System (AMOS)
- Steady observation for the Global Atmosphere Watch (GAW) components (Atmosphere CO<sub>2</sub> concentration, vertical total ozone content, ultraviolet, total UV, UV-A, UV-B)
- Observation for the meteorology, clouds, wind property at the Jangbogo Station, Terra Nova Bay

### ◦ Participation in the international Arctic observation program (N-ICE)

- Under the collaboration with Norway Polar Institute (NPI), German AWI research team, winter observation using research vessel Lance
- From January to March, 2015, KOPRI team observes atmosphere-sea ice interaction and planetary boundary layers

### ◦ Study for the climate change mechanism through a numerical simulations using in-situ observation data

- Evaluation for the performance of sea ice reproduction in general circulation model
- Reproduction of increase in turbulent heat fluxes from ocean to atmosphere in a high-resolution climate model

## Future Plans and Application

◦ Understanding of the cause of rapid warming in west Antarctica and its role in global climate change through observations and simulations

◦ Improvement of winter weather forecast over east Asia through an understanding of the relation between Arctic sea ice and the Arctic polar vortex

◦ Leading an international joint ice coring program for drilling ice core in Antarctica and reconstructing high-resolution ice record of climate and environmental changes during the past 20 ka