

Aim and Contents of research

- °To assess the rapid warming of the Amundsen, and related physical, chemical, and biological processes under the current trend of climate change, by implementing an Earth observation system from space down to deep sea
- °To assess the impacts of the warming on the biology and biogeochemistry in the region, in particular, the polynya and costal waters
- °To understand the temporal and spatial distributions of the climate gases in and out of the ploynya and their fluxes along with ecological processes

Research method

- °To determine the spatial and temporal variability of the basic physical properties of sea ice that are important to air-sea interaction and to biological processes in the rapidly melting Antarctic sea-ice zone (ice and snow cover thickness distributions; structural, chemical and thermal properties of the snow and ice; upper ocean hydrography; floe size and lead distribution)
- °To document changes in hydrography and biogeochemical cycles associated with sea ice variabilities and to investigate the significance in larger temporal and spatial scales
- °To examine the links between biogeochemical processes and food web structure, including the identification of key functional groups and interactions, and the roles
- °To study and predict the impacts of the combined changes in ocean physics, biogeochemical capacities, and marine ecosystems in polar waters
- °To undertake sustained measurements and sampling programs in waters transecting between the study sites in both poles and to detect basin scale and decadal changes

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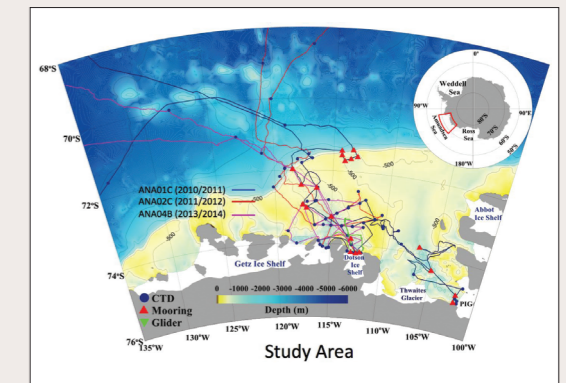
Physical & Bio-geochemical Processes in the Amundsen Sea

Their Roles & Responses in Global Climate Change

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

Division of Polar Ocean Environment

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Partner Organizations	Louisiana State University, Pusan National University, UNIST, Pukyong National University
Research Duration	Phase 2. Jan 2013 ~ Dec 2016 (4 yrs)
Research Area	Amundsen Sea in the Western Antarctic



Stations and ship tracks of 3 expeditions (color-coded). Oceanographic observations and water samplings made at blue circles, long-term moorings deployed at red triangles, Glider paths in light blue.

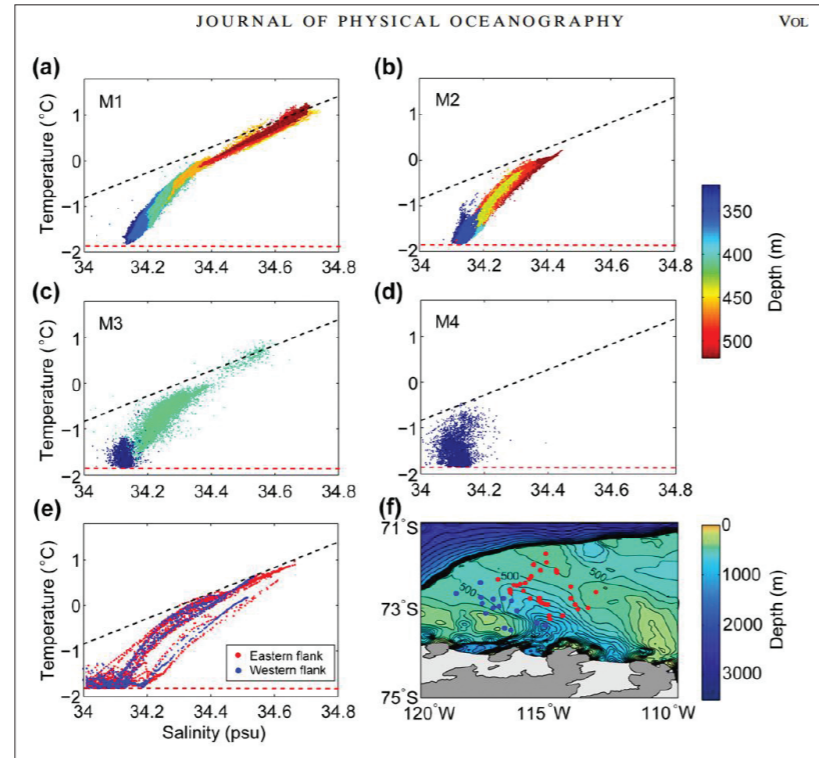
Research Background and Importance

°The Amundsen Sea is experiencing one of the world's most rapid losses of glaciers and sea ice, which may in due course accelerate the collapse of the coastal ice shelf and associated glaciers. Upwelling of deep warm water onto the continental shelf plays a part by warming the base of the floating ice shelves, but the overall loss is a combined impact from both oceanic and atmospheric effects. These make the Amundsen Sea a perfect place to study the causes and trend of the rapid warming, its impacts on the ecosystem and the biogeochemical cycle.

Overall Outcomes

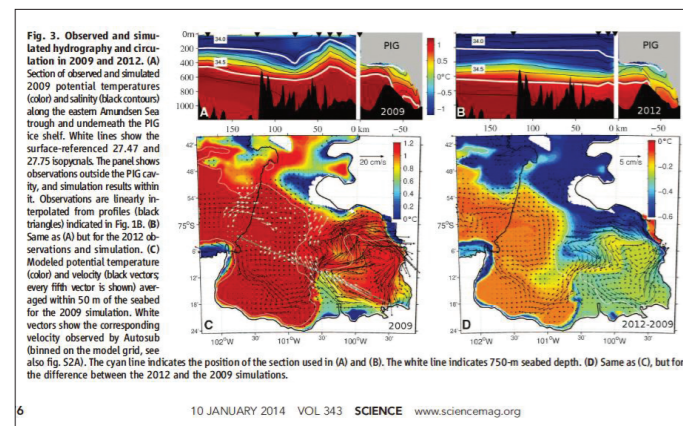
Flow patterns of the Amundsen coastal currents over the continental shelf and in the trough channel

- (a)-(d) Daily averages of temperature and salinity at the moorings (color coded by depth).
- (e) Eastern (red) and western (blue) flanks of the trough, from historical data.
- Black and red dashed lines represent the Gade line and freezing temperature, respectively. (f) Location of historical CTD stations (JPO 2014).



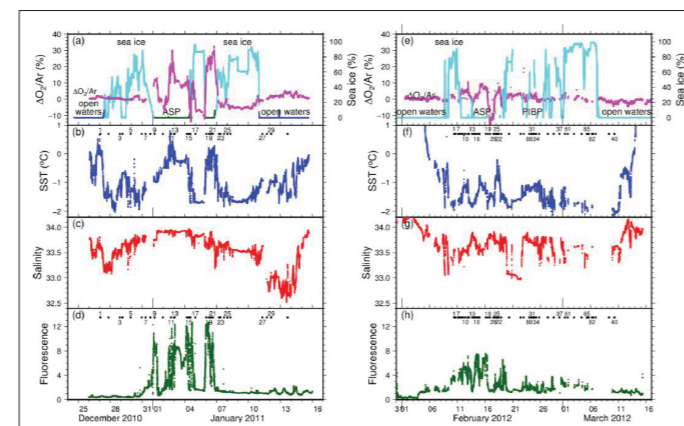
Recent trends of the Amundsen local climate change, and its linkage to the global ocean temperature variatio

- Temperature (T) comparison in Pine Island Glacier (PIG) area between 2009 and 2012. (A) 2009 T (color) and salinity (S; black contours) along the eastern Amundsen Sea trough (observed) and underneath the PIG ice shelf (simulated).
- (B) Same as (A) but for the 2012 observations and simulation. (C) Modeled potential T (color) and velocity (black vectors) averaged within 50 m of the seabed for the 2009 simulation.
- (D) Same as (C), but for the difference between the 2012 and the 2009 simulations. D presents minus T, which indicates the 2012 T are lower (colder) than 2009. Despite the global warming, this area underwent cooling period in recent years (Science 2014).



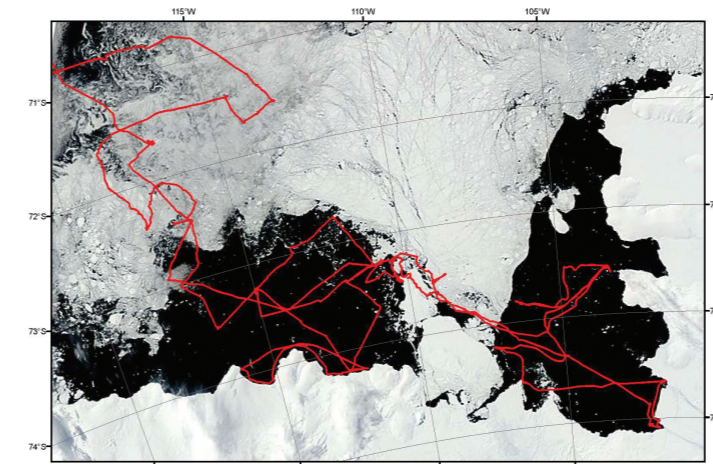
Net Community Production from the Amundsen Sea measured by the del O2/Ar method

- Time series of (a) the del O2/Ar and sea ice concentration, (b) sea surface temperature, (c) salinity, and (d) fluorescence in 2011.
- The same parameters in 2012 are shown in the right column. Numbers and dots in the SST and fluorescence plots indicate the CTD stations on the corresponding dates (JGR Oceans 2014).



etc.

- ° Satellite image of the Amundsen Sea study area taken during 2012 expedition. Ship track in red, frozen sea shown as white. Antarctic continental glacier are the white along the coast at the bottom of the picture. Black is the polynya, a huge melt pond amongst frozen sea, due to the intrusion of relatively warm deep water from ocean.



- ° Araon reached the deep down South, facing the white cliff of the ice shelf, which is a hang-over of the Antarctic continental glacier on the sea water.



Future Plans and Application

- ° To strengthen the scientific basis that help understand the issues of environmental changes in global perspective
- ° To upgrade the Korea's standing to a major scientific contributor by conducting internationally networked research in poorly explored polar regions.
- ° To establish long-term data base and specimen archives on the physical changes and biodiversity and ecosystem functioning in the study area.

