

Sea ice reduction and its impact to Arctic marine ecosystem



Right) Time series (1979-2008) of some parameters on Arctic climate environment; September sea ice extent in the Arctic Ocean (blue), September surface ocean temperature off the Alaskan coast of the Arctic Ocean (Red), Minimum soil temperature near Yakutuk (Yellow), and averaged surface air temperature north of 70N (Green). Note that we have to clarify the relationship among them to understand how the Arctic climate is changing. . .



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R/V Mirai (JAMSTEC) (1998~)



In collaboration with Japanese research institutions & universities, JAMSTEC have been conducting R/V Mirai Arctic Ocean Cruise since 1998. (1998, 1999, 2000, 2002, 2004, 2006, 2008, 2009, 2010)



Based on the observational results in the sea-ice reduction area by R/V Mirai, we published lots of papers which shows evidences of Arctic environmental changes and the influences.





DBO workshop/PAG meeting @ Sydney, Canada November 15-17, 2011

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Ievel pressure during August-September, 2007.



@ Sydney, Canada November 15-17, 2011 Sea ice reduction and its impact to Arctic marine ecosystem

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Oshoro-Maru (Hokkaido Univ.)

To investigate Arctic marine ecosystem,

Oshoro-Maru had observational cruise in the Chukchi Sea in 1991, 1992, 2007 and 2008.





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Based on our previous experiments and publications, we planed to initiate multidisciplinary project entitled "Sea ice reduction and its impact to Arctic marine ecosystem".





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Question: How does sea ice variability (melting/formation, motion, seasonal cycle, recent inter-annually rapid decrease) affect the Arctic Ocean environments (physical, chemical, and biological)? Keywords: Ocean circulation, upwelling, and eddies; water masses; Bottom processes (Nutrients, Fe, organic materials); Dense shelf water and its contact to the bottom; Freshening, warming, and acidification; Biological hotspots; Primary production; Pelagic-Benthic coupling; Annual changes of biomass/distribution of phyto- and zoo- plankton; Carbon cycling; Food chain; DOMs and microbial loop



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Action

- Ship-based observation by R/V Mirai and Oshoro-Maru 1)
- 2) Mooring observation to find seasonal changes of ecosystem
- 3) **Bio-Logging**
- Satellite monitoring 4)
- 5) Numerical simulation





DBO workshop/PAG meeting

@ Sydney, Canada

R/V Mirai Arctic Ocean cruise in 2012

150°V

160°W

Cruise plan: To be determined (maybe, early September to late October, 2012) Main target area: Chukchi shelf and shelf slope

CTD/LADCP/water sampling & XCTD Mooring recovery/deployment Plankton net sampling Bio-geochemical measurements Multiple corer sampling General meteorological monitoring Surface water sampling/monitoring Shipboard ADCP monitoring and so on...

170°W

R/V Mirai (JAMSTEC)



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Mooring observation

Acoustic Water Column Profiler (ASL Env. Sci.) will be used for detecting dynamics of marine zooplankton.



Example 200k Hz echo sounder data from the VENUS Observatory in Saanich Inlet (260,000 pings)http://venus.uvic.ca/data/data-plots/Three-day Echogram, September 12 – 14, 2006

Instrument Frequency (kHz)	Approximate Minimum Particle Size Detected (mm)		Representative Organisms	Estimated effective Range (m)
775	2		small copepods, nauplii	50
460	6		mysids, larval euphausiids	100
200	16		larval fish, euphausiids	200
125	20	The Arit	adult euphausiids, mysids, amphipods	250
70	30		small fish	Est 275
38	75		larger fish	Est 325



R/V Mirai and Oshoro-Maru joint Arctic Ocean cruise in 2013

Chukchi Sea (joint cruise)

- Re-visit of biological hotspots
- Hydrography and biology (lower to higher trophic levels)

<u>Western Canada Basin &</u> <u>Makarov Basin (R/V Mirai)</u>

- Nut-rich shelf water
- Nut-rich Siberian river water
- Biological hotspot after the sea-ice melt
- Future target area for the biogeochemical studies

Distribution of silicate integrated from the sea surface to a depth of 10 m [mol/m²]



Data: Hydro-Chemical Atlas by AARI and IARC. Nishino et al. [2009]



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Table 1 Yearly Plan of the project





Eddies in the Beaufort Sea & its impact to ecosystem

ASOF ISSG meeting @ Bergen, Norway November 8, 2011

Eddies in the Beaufort Sea & its impact to ecosystem Watanabe (2011, JGR) & Nishino et al. (2011, GRL)





Eddies in the Beaufort Sea & its impact to ecosystem

ASOF ISSG meeting @ Bergen, Norway November 8, 2011





Eddies in the Beaufort Sea & its impact to ecosystem

How are such surface-intensified warm-core eddies generated

in the western Arctic Ocean?

(Watanabe, 2011JGR. . . Published on the exact same day (Aug.26 2011) as Nishino et al. (2011GRL).)

Eddy-resolving coupled sea ice-ocean model with atmospheric forcing were used to examine meso-scale eddies and shelf-basin exchange of Pacific Summer Water.



Pacific water content during May 1 - December 31 2003. [Courtesy from E. Watanabe]



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