Title: Biogeochemical observational studies in the Arctic Ocean

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Background

- Biogeochemical observations in the Arctic Basins, the Siberian shelf seas, the Chukchi Sea and the Bering Sea.
- In Arctic Basins and Chukchi Sea:
  Differences in the distribution of Chl-a, and nutrients including Fe
  Influence of water mass dynamics on these parameters.
- In Siberian shelf seas (SSS):
  Spatial-temporal variability of the marine carbon cycle components:
  Transport and fate of terrestrial OC
  Methane and carbon dioxide marine fluxes to atmosphere
  Chemical and physical shelf-basin interactions.
- In the Bering Sea:
  Melting sea ice as a sources of Fe to surface waters, in particular to the Green Belt
Objectives

1. Investigate how changes in the sea ice regime affect the biogeochemistry and hydrology of the Arctic Ocean.

2. Investigate how changes in the hydrological cycle of surrounding land and alteration of terrestrial carbon cycles contribute to formation and propagation of halocline waters and affect hydrological and biogeochemical parameters of shelf water masses.

3. Investigate biogeochemical cycles in the Siberian shelf seas (SSS), especially in terms of CO$_2$ and CH$_4$, and their impact on the pan-Arctic ecosystem and climate.

4. Investigate physical and biogeochemical processes between arctic shelves and adjacent basins

5. Integrate observations toward understanding the effects of expected climate changes on the Arctic Ocean biogeochemical cycles and ecosystems
Methodology

1. Coordinated observations on the R/V Mirai Arctic cruise during 2009-2013 and collaboration on data analysis.

2. Joint exploration in the SSS and the Arctic Basins onboard icebreakers, e.g., Russian vessels: detecting carbon and freshwater changes over the SSS.

3. Combined analysis of observed data from Arctic Basins, SSS, Chukchi, and Bering seas.
Results from last year: R/V Mirai cruises

Publications in 2011

Nishino et al., 2011a:

Nishino et al., 2011b:
Results from last year: R/V Mirai cruises

Presentations in 2011

Aguilar-Islas, A. M., Rember, R., Nishino, S., and T. Kikuchi
Input of trace metals to the Canada Basin,
Gordon Research Conference in Chemical Oceanography,
August 2011, Andover, NH, USA

Nishino, S., M. Itoh, Y. Kawaguchi, T. Kikuchi, and M. Aoyama (2011),
Impact of an extraordinary large warm-core eddy to the Arctic phytoplankton,
Arctic Science Summit Week 2011 Science Symposium,
March 2011, Seoul, Korea.

Nishino, S., T. Kikuchi, M. Yamamoto-Kawai,
Y. Kawaguchi, T. Hirawake, and M. Itoh
Changes in spreading of nutrient-rich shelf water into the Canada Basin due to sea ice melt,
Ecosystem Studies of Sub-Arctic Seas 2011 Open Science Meeting, May 2011, Seattle, WA, USA.
Invited talk
Results from last year: SSS cruises

Publications

Carbon transport by the Lena River from its headwaters to the Arctic Ocean, with emphasis on fluvial input of terrestrial particulate organic carbon vs. carbon transport by coastal erosion
Biogeosciences, 8, 2407-2426.

On Carbon Transport and Fate in the East Siberian Arctic Land-Shelf-Atmosphere System
Environment Research Letters, 7, 015201, doi: 10.1088/1748-9326/7/1/015201
Schedule

2012:

• Drilling subsea permafrost from the fast ice (March-April) –IARC lead
• East Siberian Seas Cruises (August-September)- IARC lead
• Working on joint manuscripts

2013:

• R/V Mirai Arctic cruise:
  In September-October with IARC participation
Expected achievements for 2012

- Combined analysis of hydrographic and nutrient data from previous observations to address Russian shelf-Makarov Basin interactions. Tentative publication title: 
  Change of water mass in the East Siberian Sea affecting the primary production in the Makarov Basin

- Results from trace metal sampling from the 2010 R/V Mirai Arctic cruise
  Tentative publication title: 
  Shelf input of iron and copper to the Canada Basin

- Presentations at international meetings: 
  Ocean Sciences Meeting, February 2012
  Arctic ocean circulation and eddies characterizing nutrient and phytoplankton distributions in the Canada Basin

  AGU Fall meeting, December 2012 - TBD
Challenges and Concerns

• Data integration and joint cruises of R/V Mirai and Russian vessels to understand East Siberian land – shelf – basin interactions and their impact on Arctic biogeochemical cycles and ecosystem

• The Russian sector of the Arctic Ocean is a target area for future biogeochemical and ecological studies, because biological activity in this area is expected to increase dramatically with the sea ice loss.

• IARC-based International Siberian Shelf Studies project is required to be extended to the entire East Siberian Arctic Shelf, because of no other biogeochemical and ecological studies are expected in the Russian sector of the Pacific Arctic in the near future.

• Limited trace metal sampling time on R/V Mirai cruises. Stations and depth

From Nishino et al. [2011]