Time series benthic community structure, biomass and sediment studies during the RUSALCA program 2004-2012, and development of the Distributed Biological Observatory international network

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February 21-22, 2014
RUSALCA PI Meeting
Honolulu, Hawaii

RUSALCA sampling 2004, 2009, and 2012
-DBO3 as purple triangles

East Siberian Sea

Chukchi Sea

Beaufo Sea

RUSSIA

UNITED STATES

70°N

65°N

175°E 180° 175°W 170°W 165°W 160°W

DBO3

RUSALCA2012

RUSALCA2009

RUSALCA2004

0 15 30 60 90

Nautical Miles

Depth (m)

0 - 30

31 - 50

51 - 80

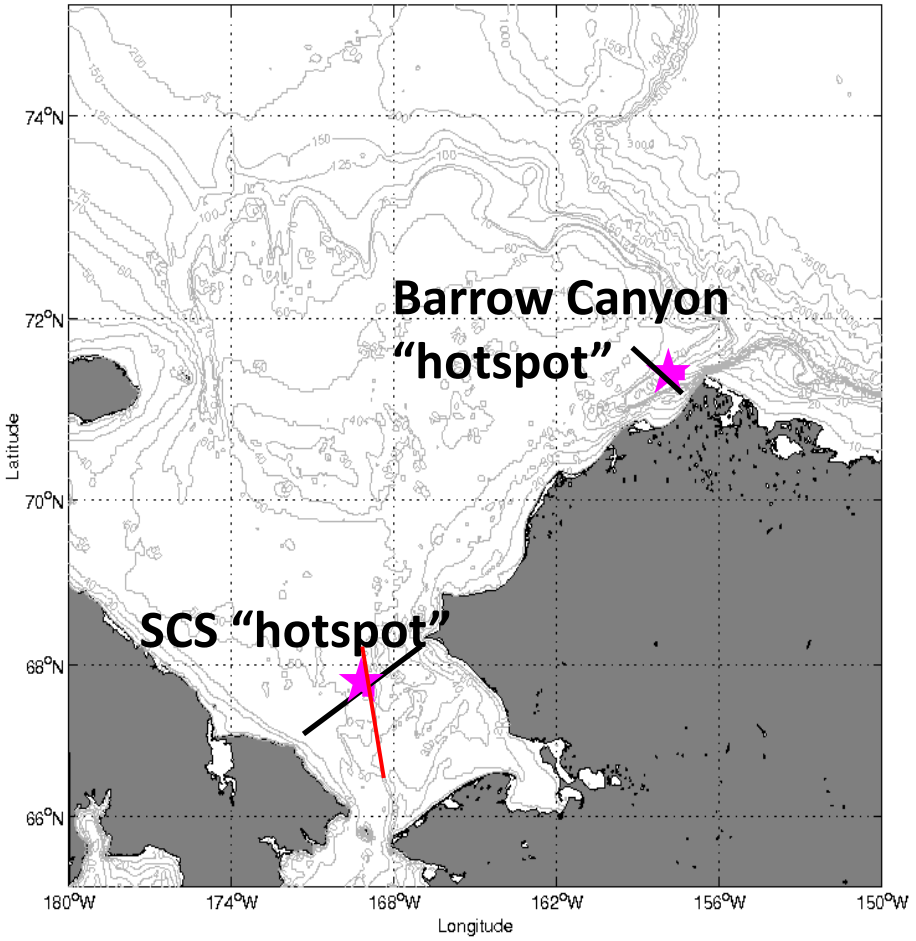
81 - 200

DBO3=8 stations US side

CS line: 7 stations between the USA and Russia

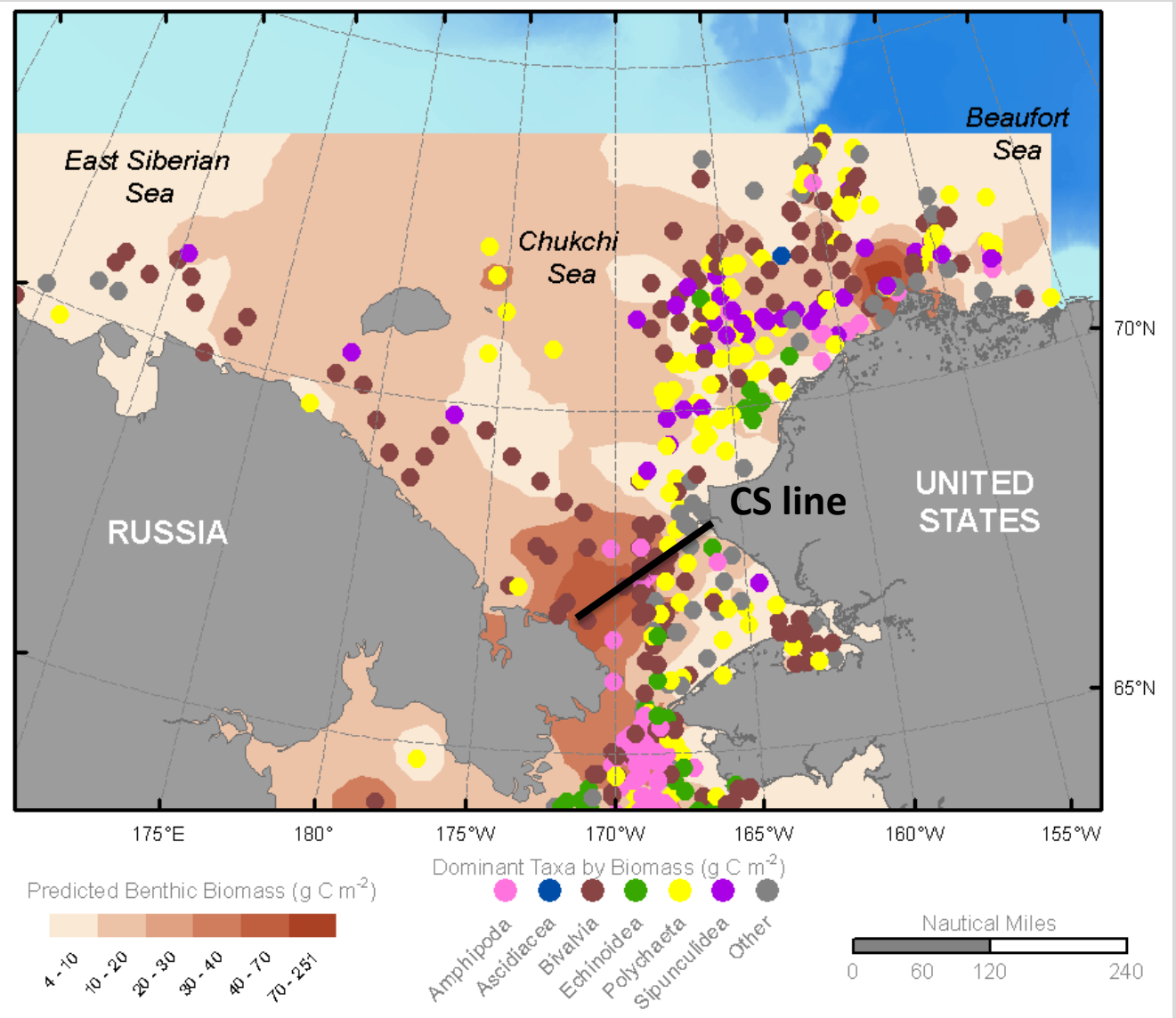
Distributed Biological Observatory (DBO)

- Aim: identification and consistent sampling of biophysical responses to ocean climate variability at biological 'hotspot' locations across a latitudinal gradient.
- The DBO depends on international cooperation to sample oceanographic stations over temporal and spatial scales and conduct joint analysis of shared data.



http://www.arctic.noaa.gov/dbo/

Rich benthic communities on the western side of the Bering/Chukchi Sea system 1970-2010

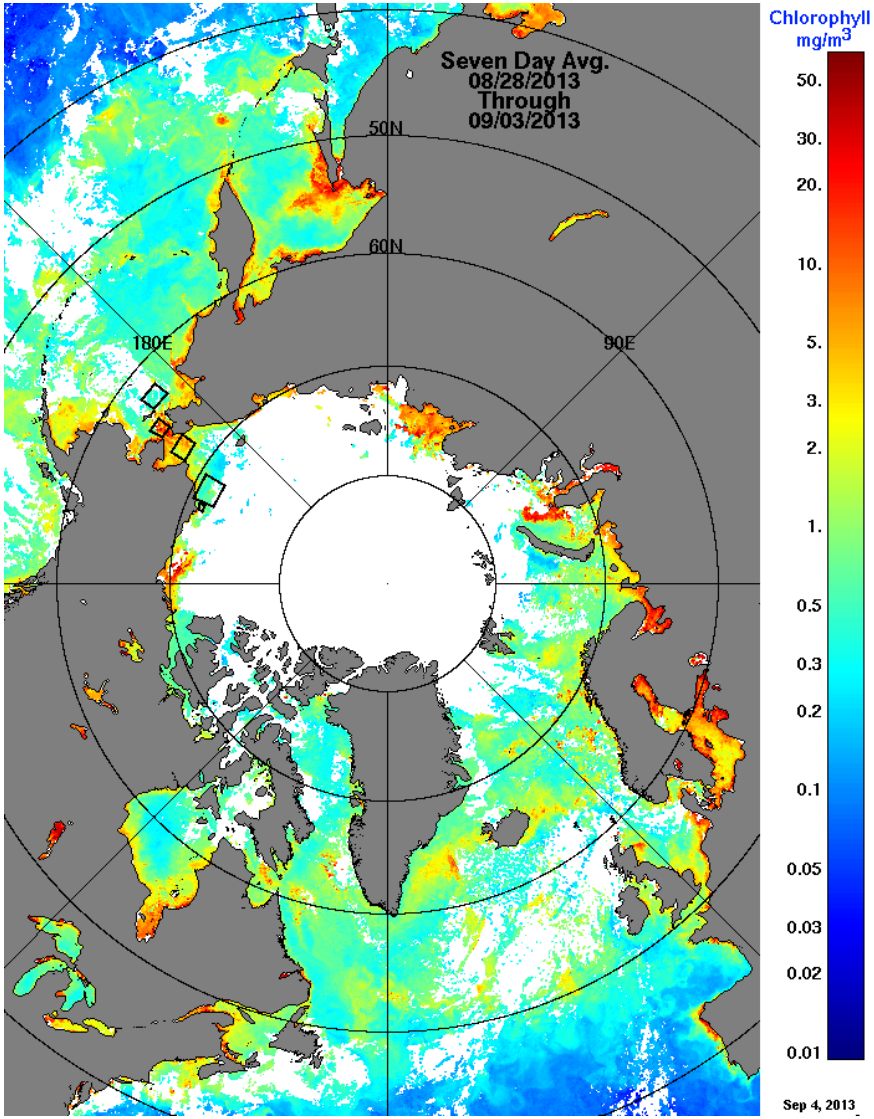


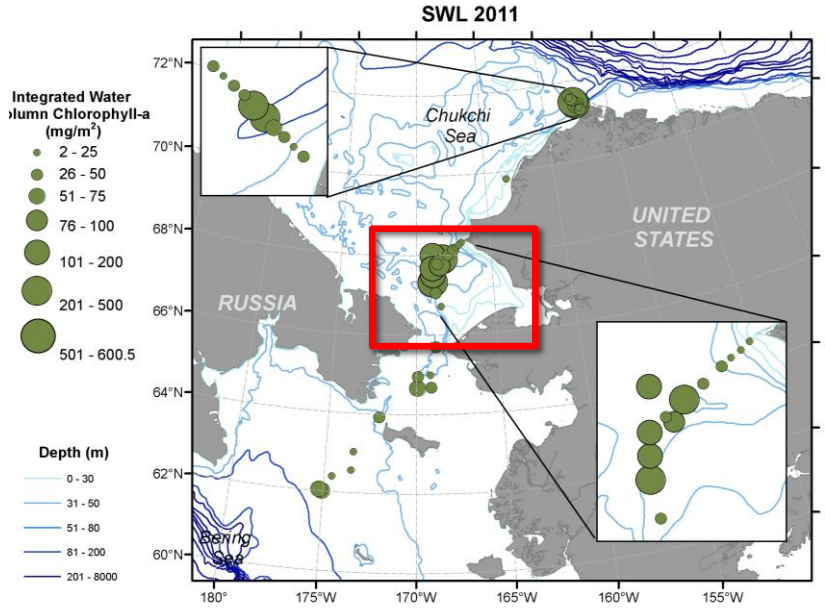
- **"footprints"** of high benthic biomass reflect pelagic-benthic coupling and export of carbon to sediments

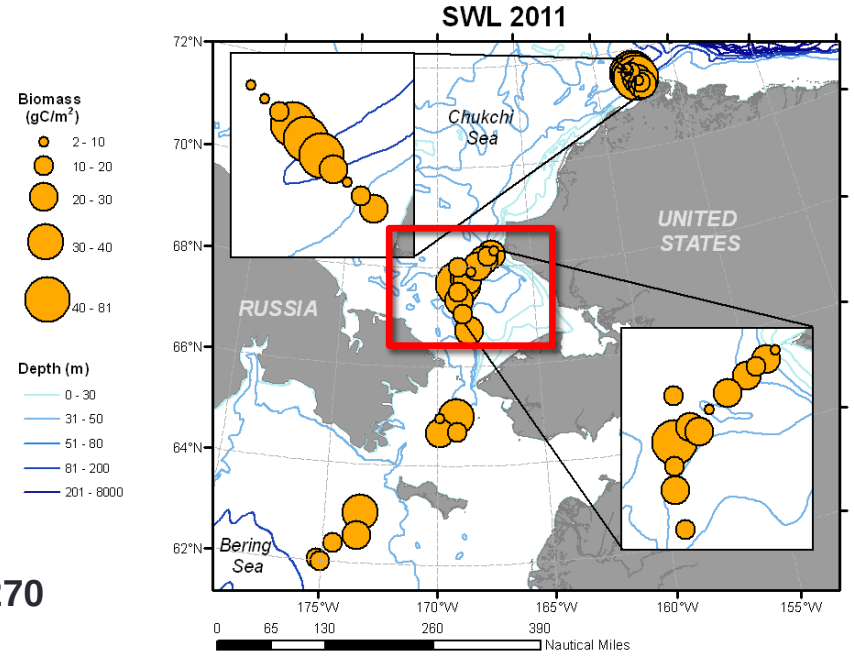
- advection of organic carbon also influences biomass patterns

[updated from Grebmeier et al. 2006a]

NASA DBO-surface chlorophyll and field collected intregated values

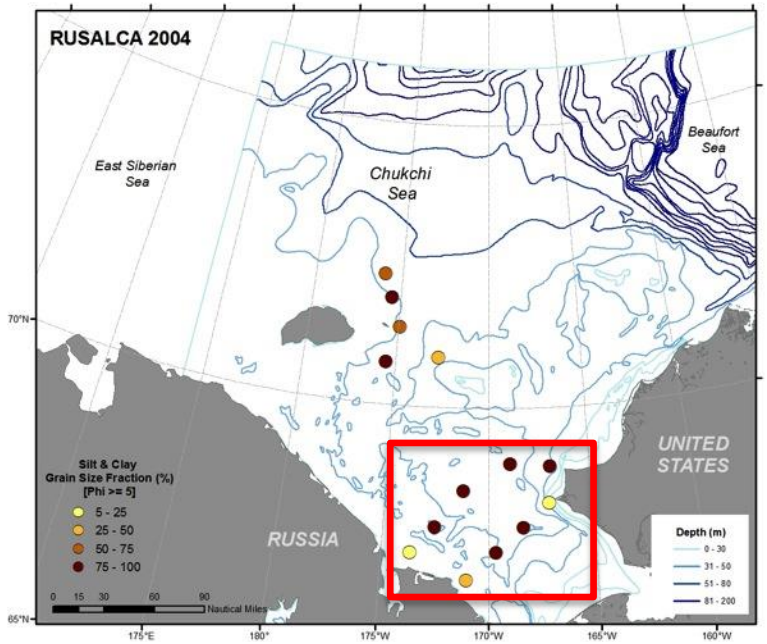


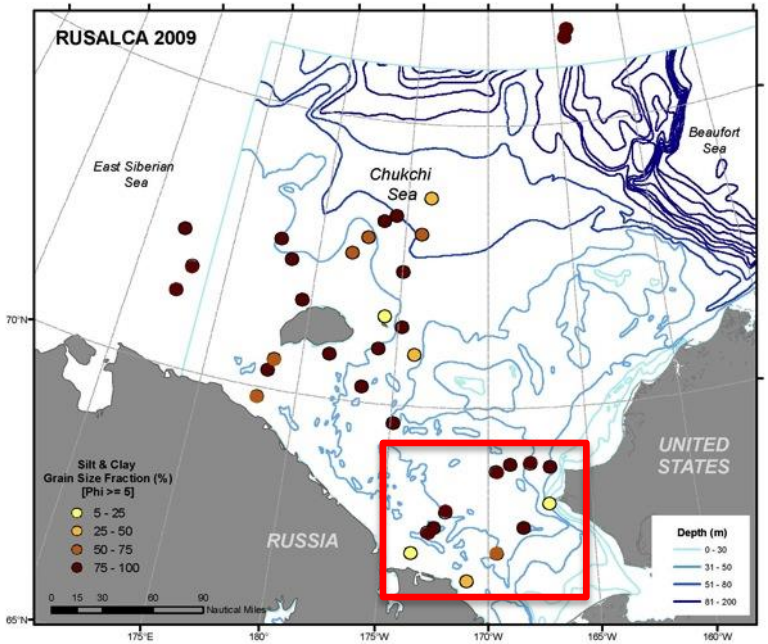


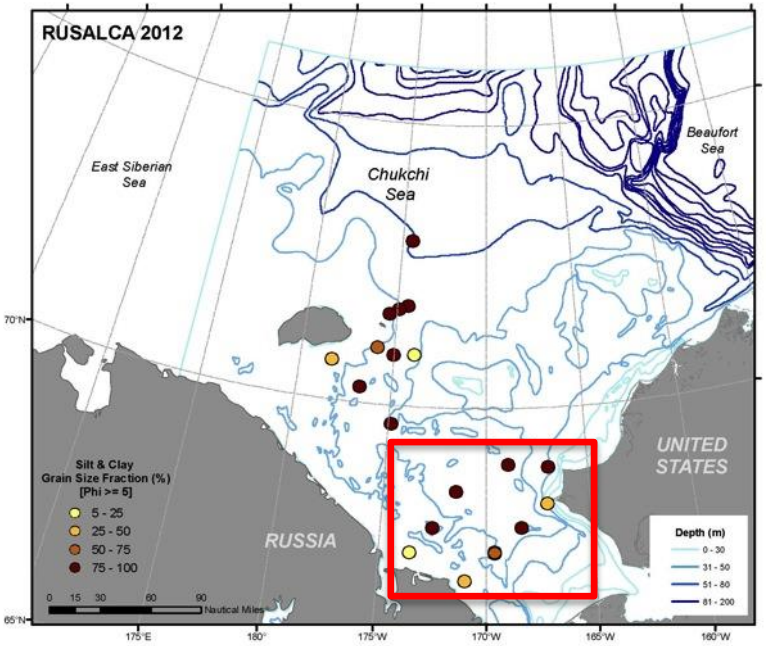


http://neptune.gsfc.nasa.gov/csb/index.php?section=270

% Silt and clay content-indicator of deposition zones

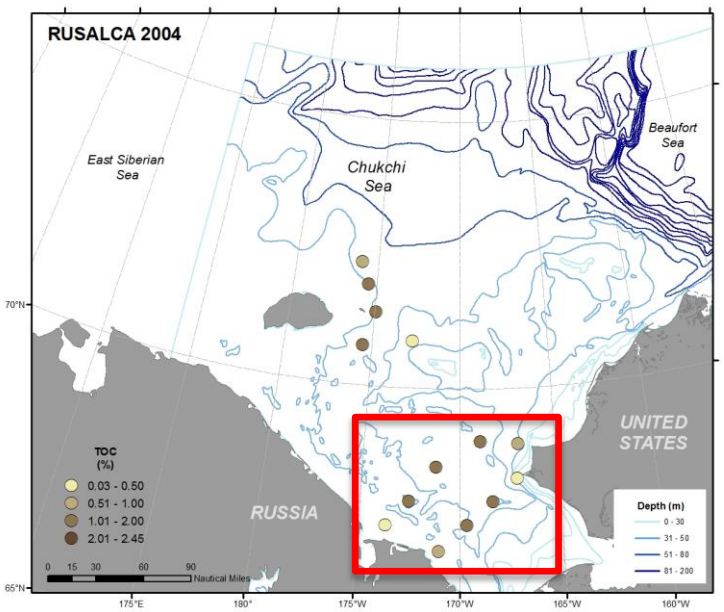


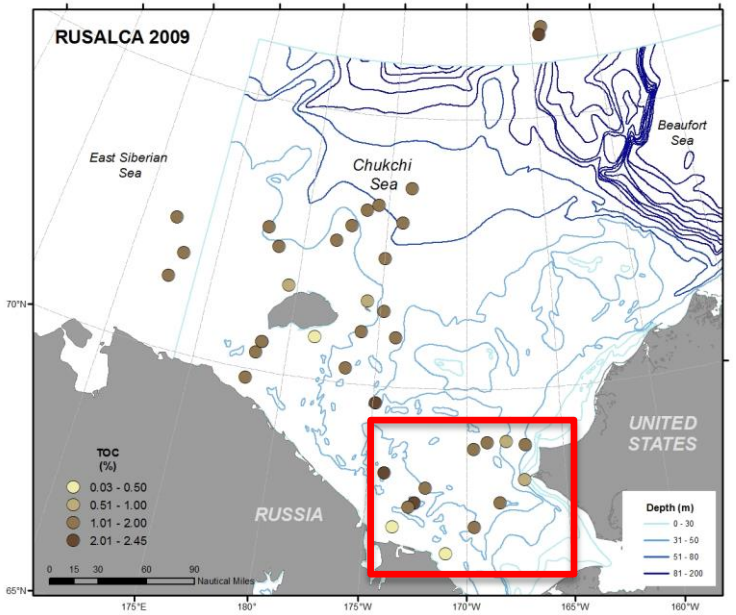


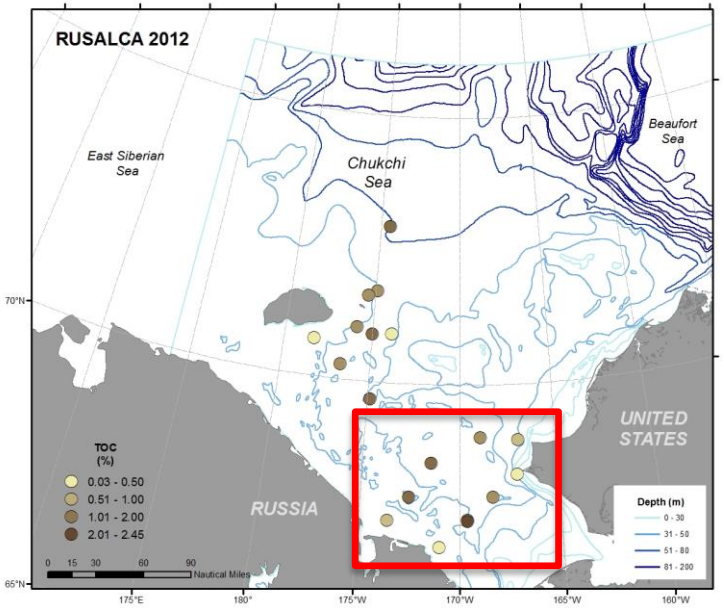


- Higher silt and clay (%) in upper/central Herald Valley and western side of Herald Canyon; also around Wrangell Island
- Sandy sediments (low % silt/clay) along the Alaskan and Chukotka coastline
- Indication of few station coarsening of grain size NW of Bering Strait perhaps related to recent flow increase
- Percent Total organic carbon has similar patterns

Total organic carbon (TOC) content in surface sediments -indicator current speed and material deposition zones



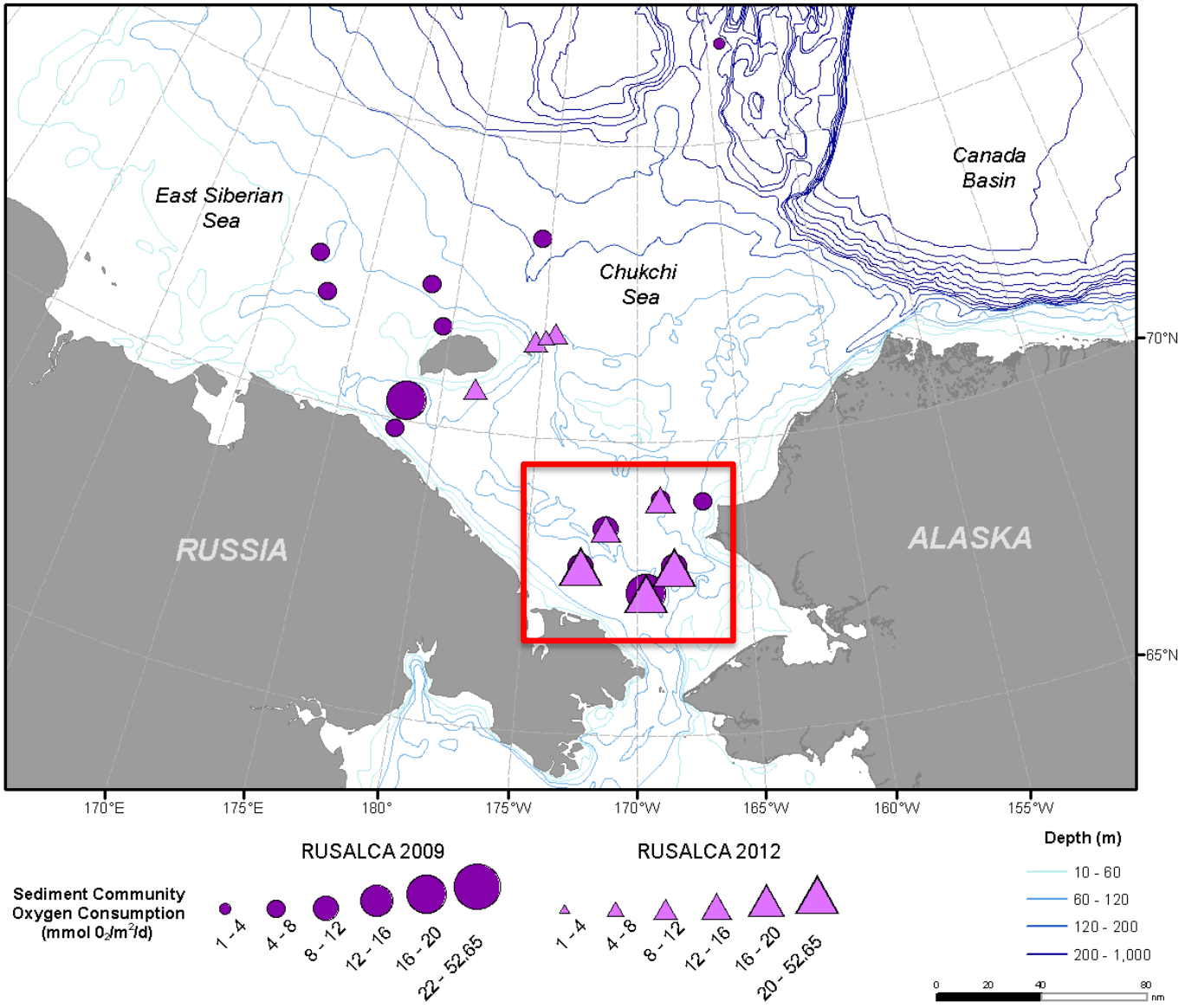




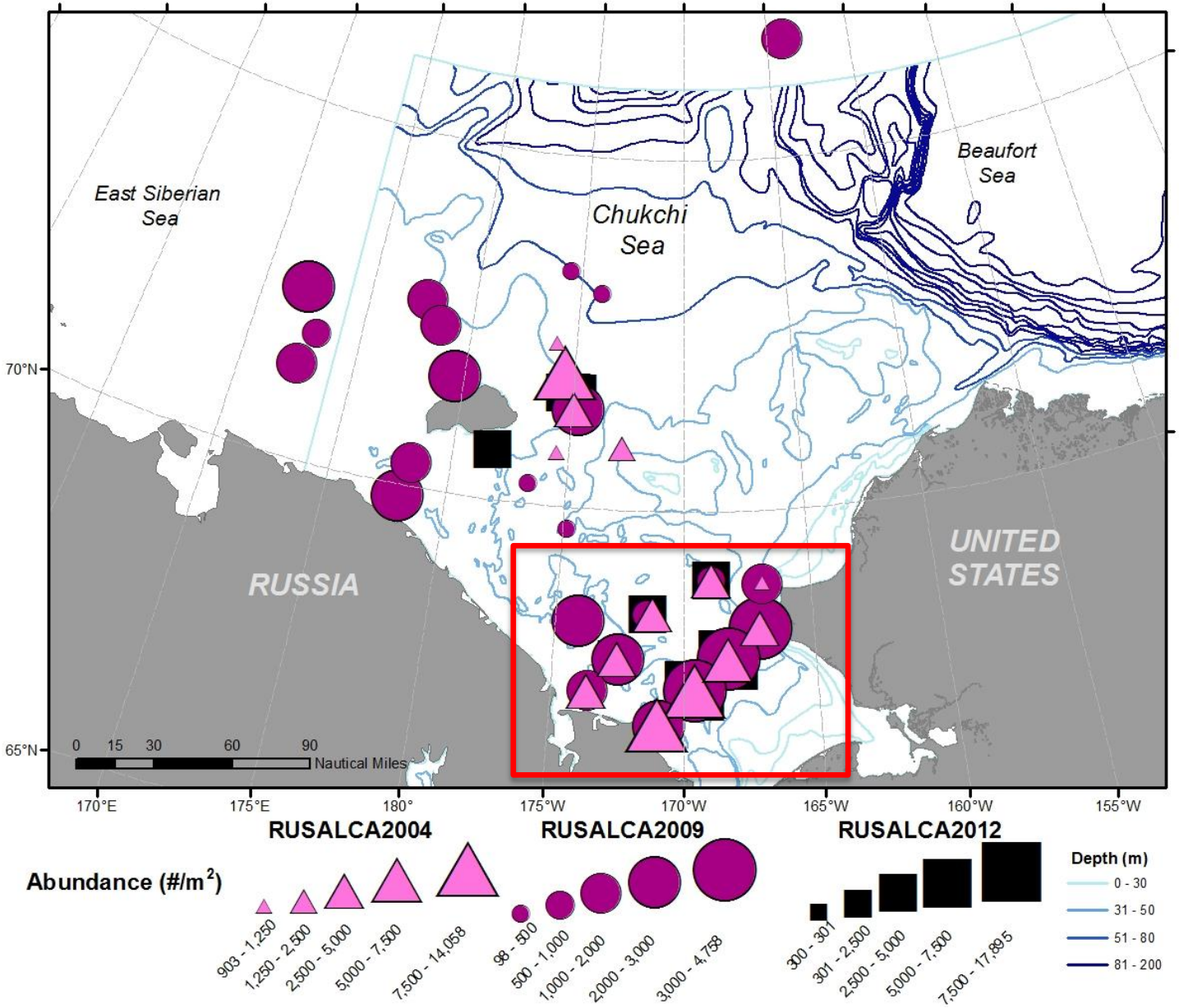
- TOC related to silt/clay fraction of organic carbon
- Higher TOC in deposition zone in central Herald Valley
- Lower TOC along the coasts of US and Russia

Sediment Community Oxygen Consumption RUSALCA 2009 and 2012

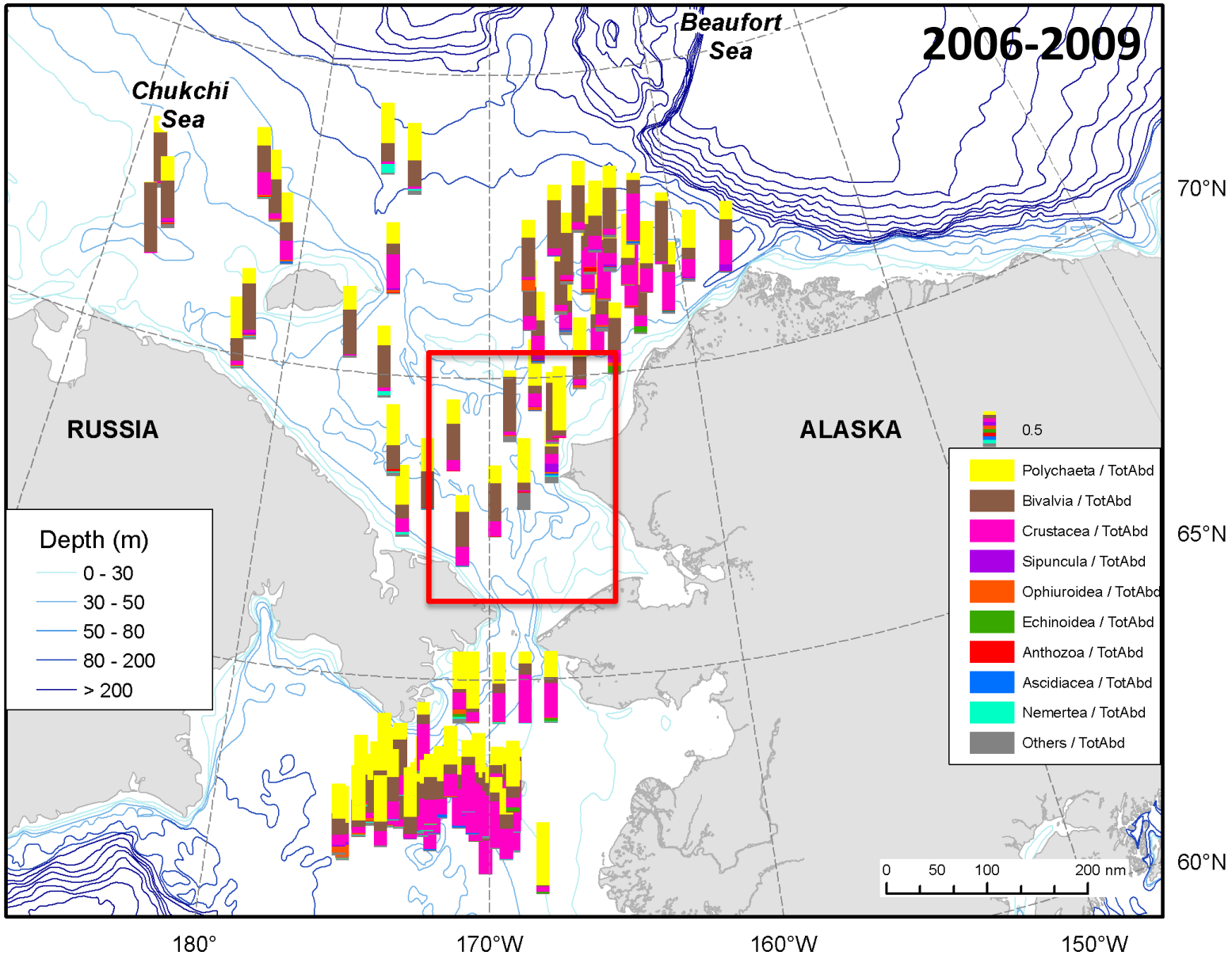
- spatial patterns indicative of the amount of carbon reaching the sediments



Benthic macroinfaunal abundance during RUSALCA 2004, 2009 and 2012

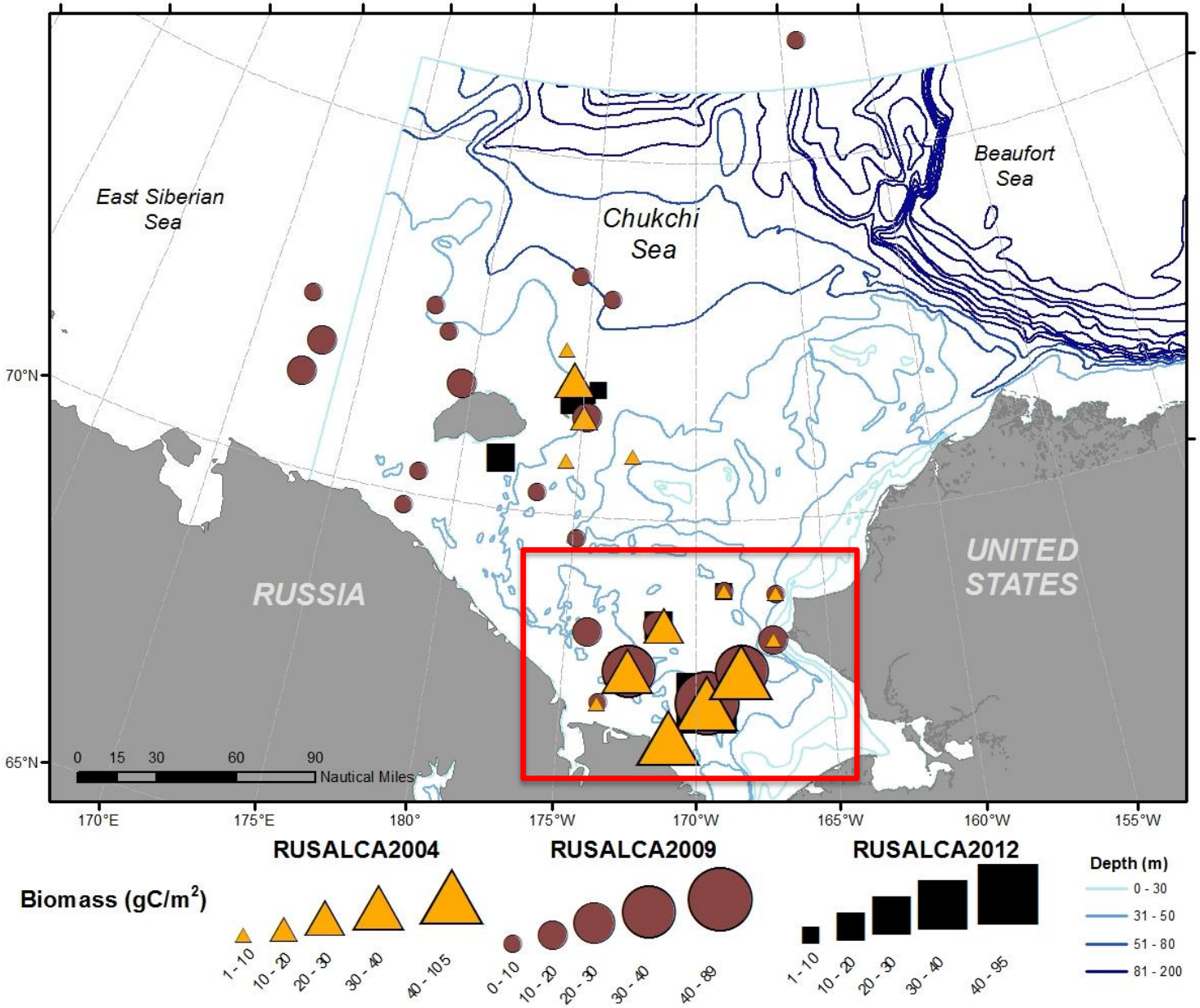


Histograms of major macrofaunal type, by abundance

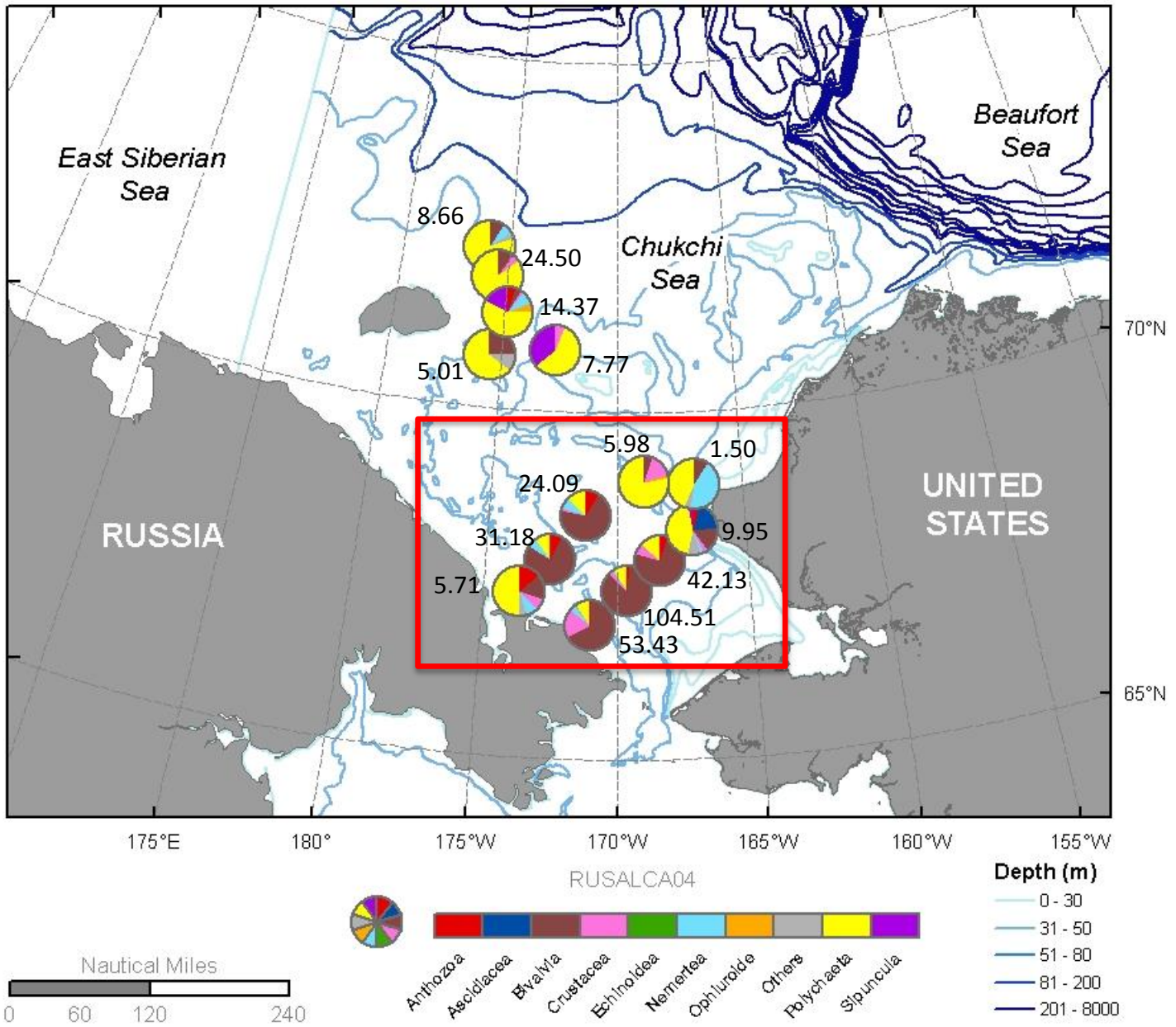


[data from Grebmeier, Feder and Blachard in PacMARS allstn data file]

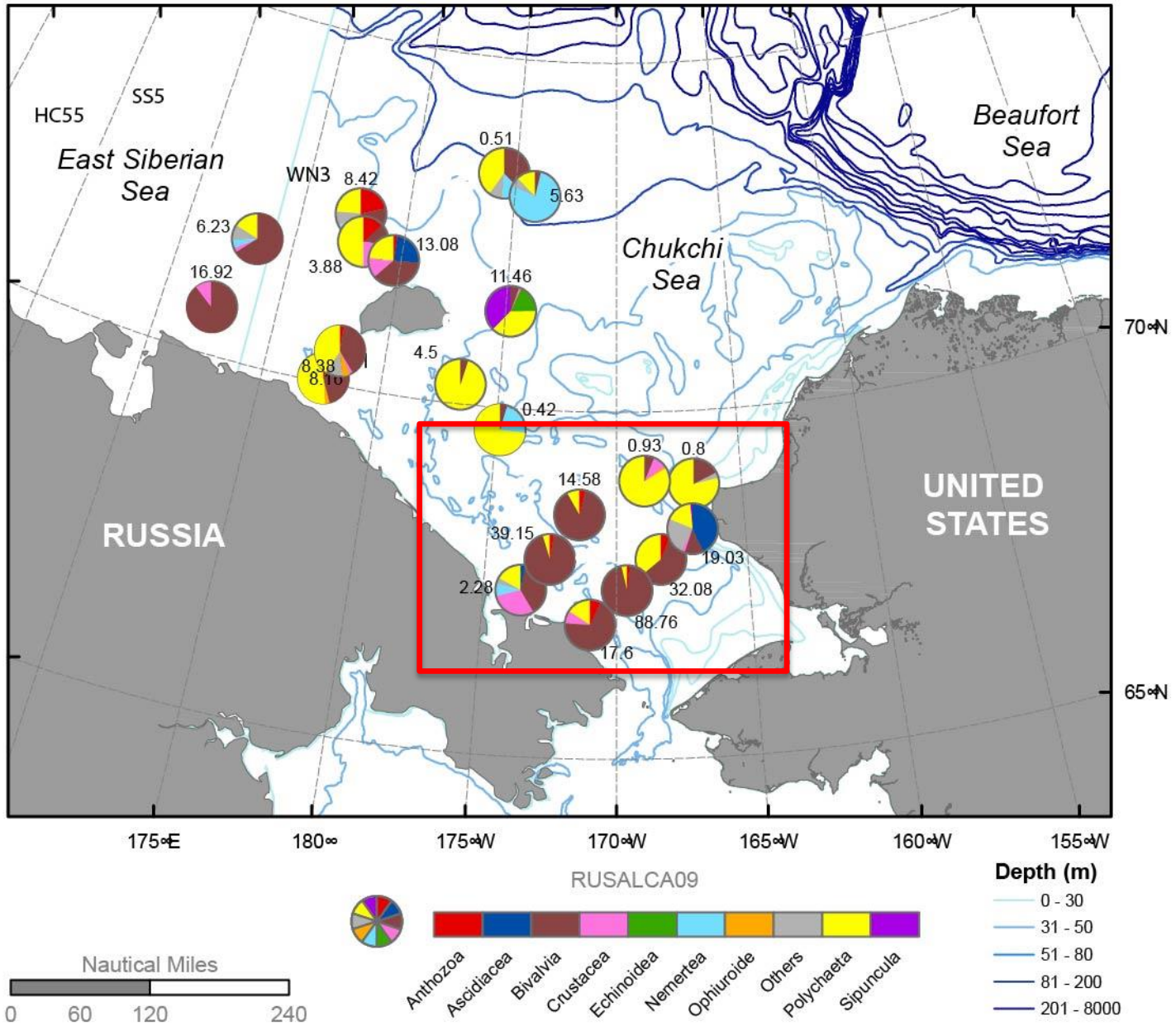
Benthic macroinfaunal biomass (gC/m^2) during RUSALCA 2004. 2009 and 2012



Infaunal community composition by biomass during RUSALCA04

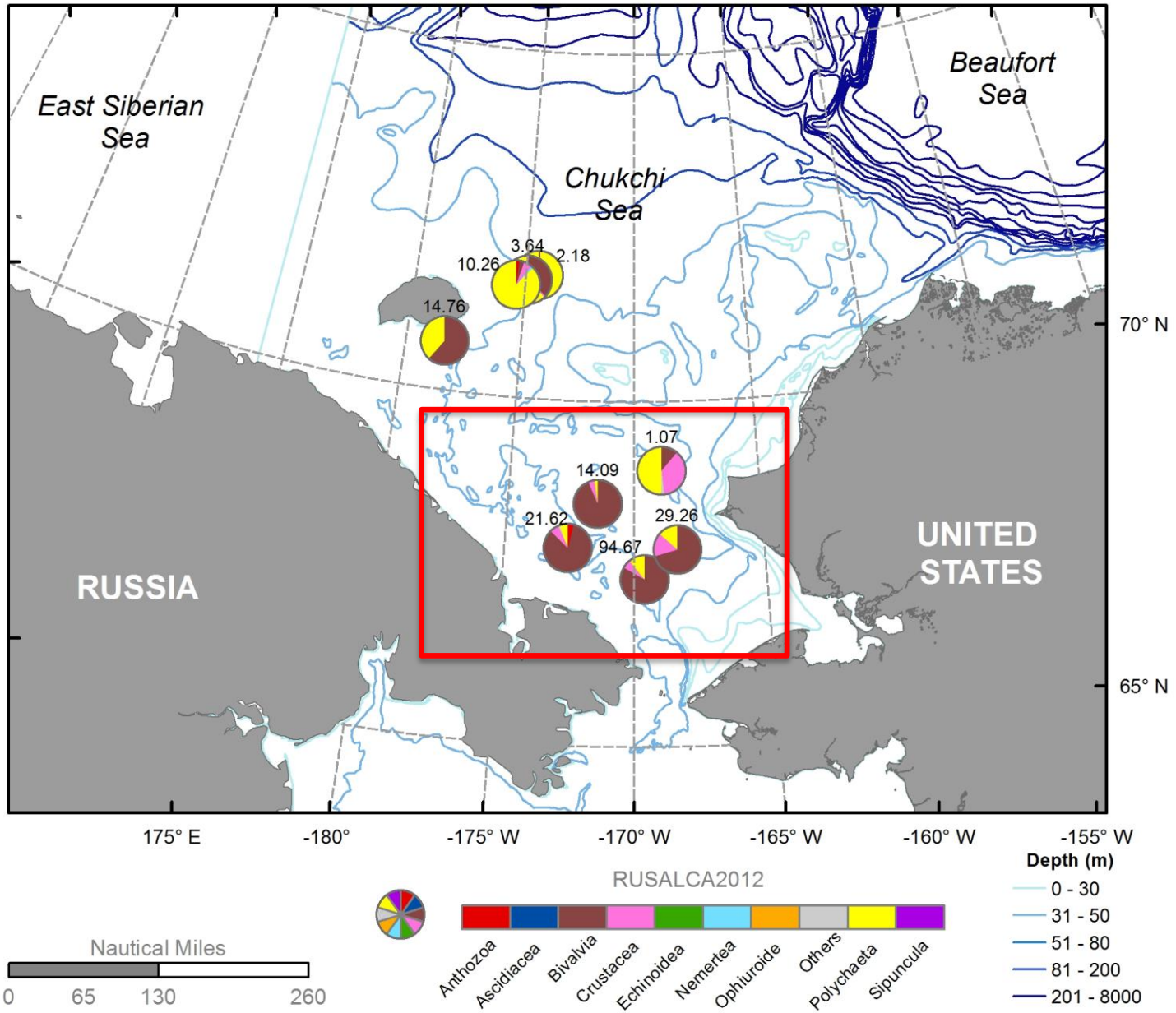


Infaunal community composition by biomass during RUSALCA09

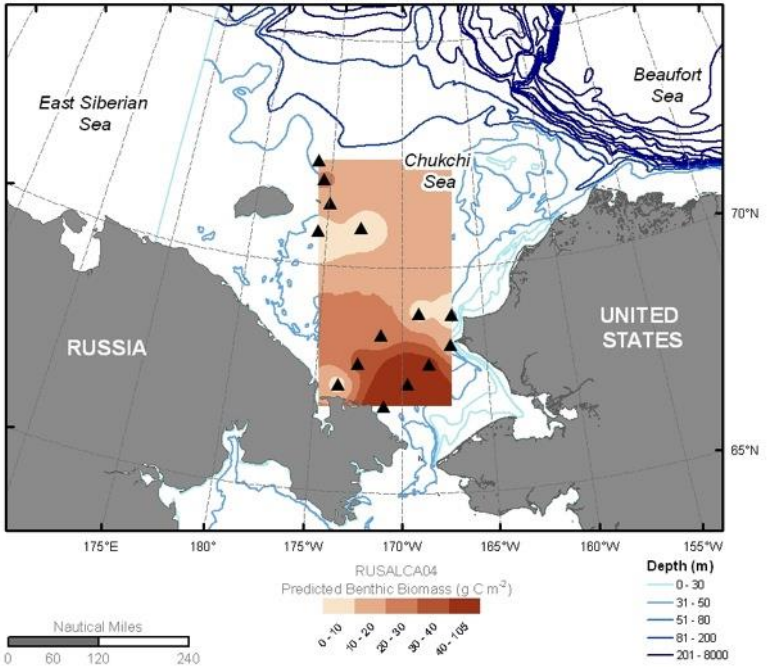


Infaunal community composition by biomass during RUSALCA12

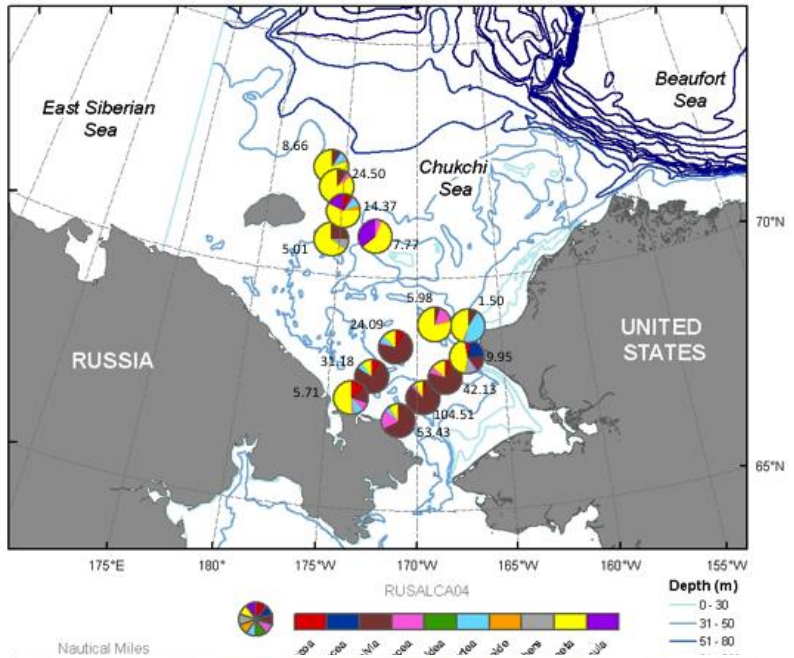
(subset of sites using Haps corer. The van Veen grabs are nearly all processed=20 stns)

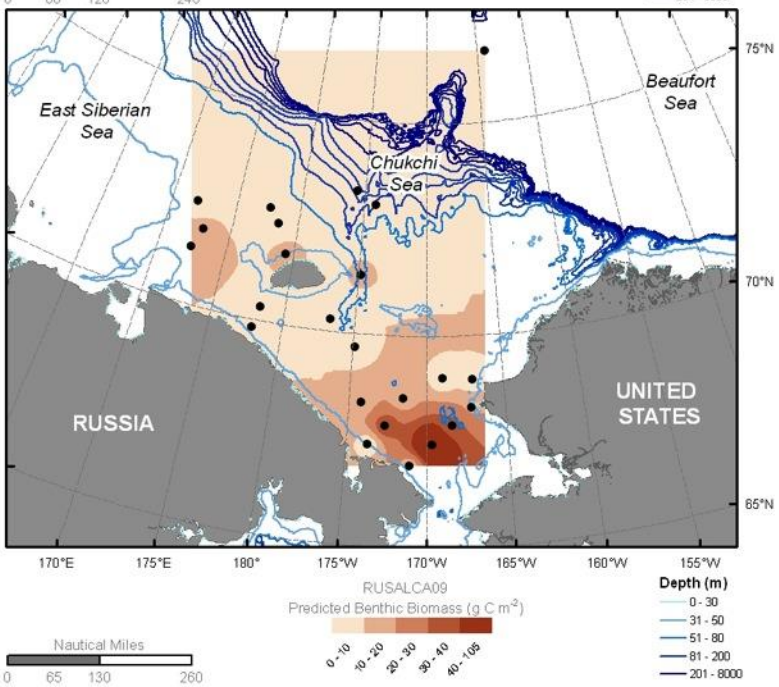


Infaunal biomass and community composition during RUSALCA04 and 09

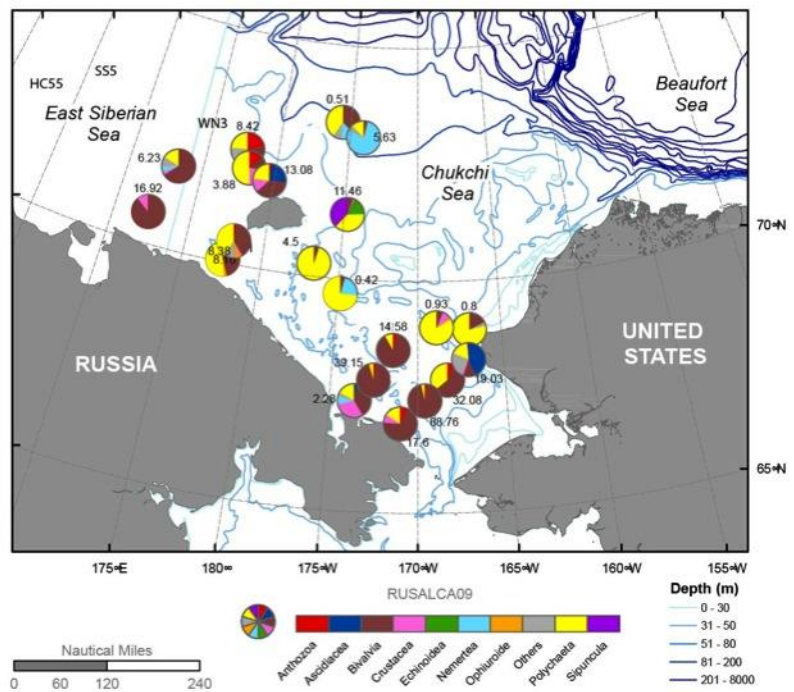


2004

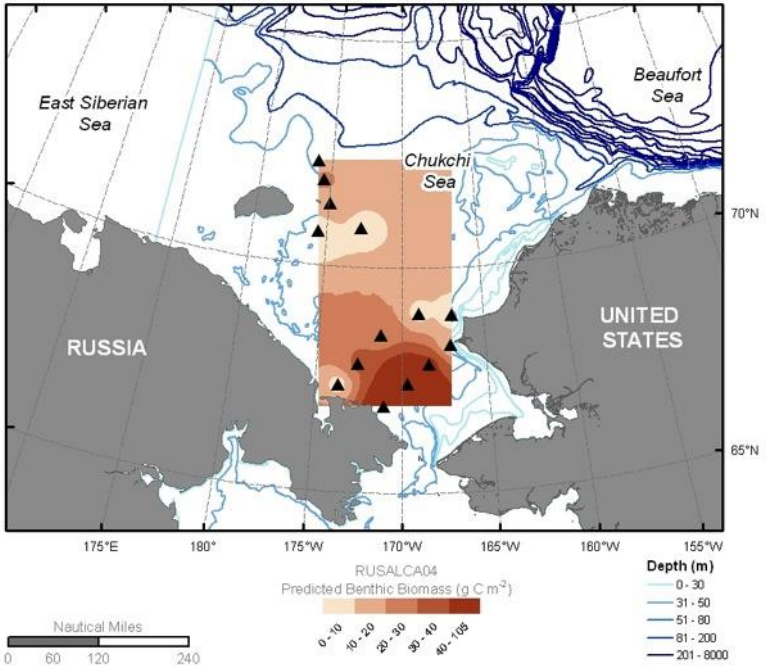




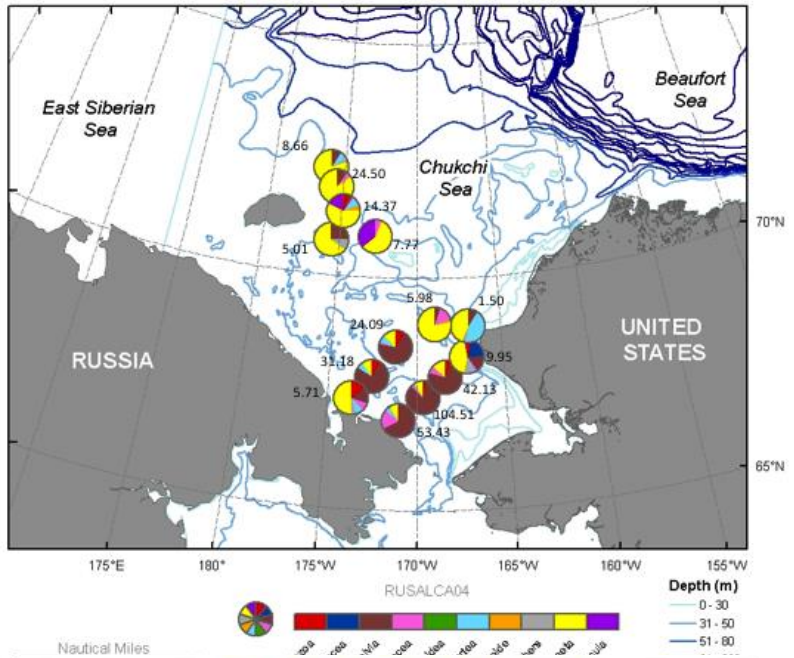
2009

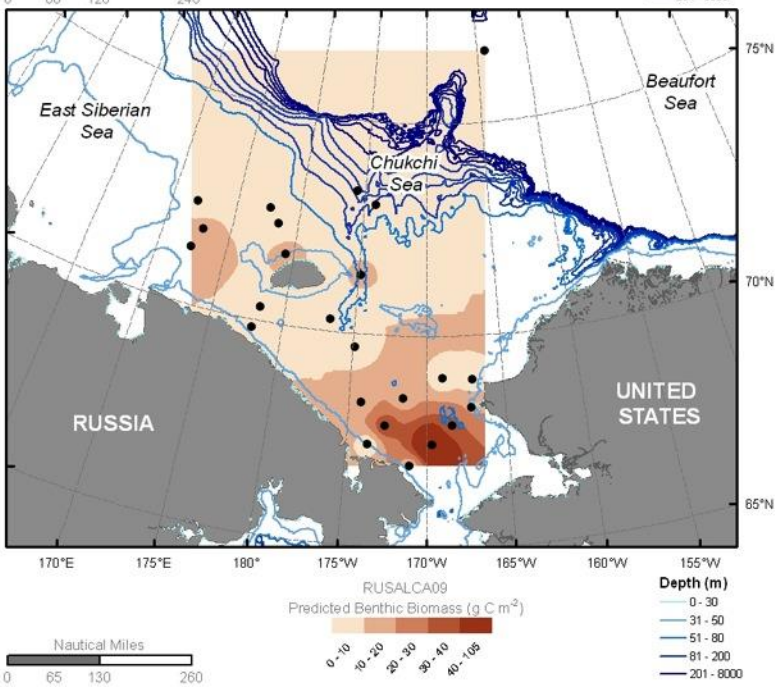


Infaunal biomass and community composition during RUSALCA04 and 09

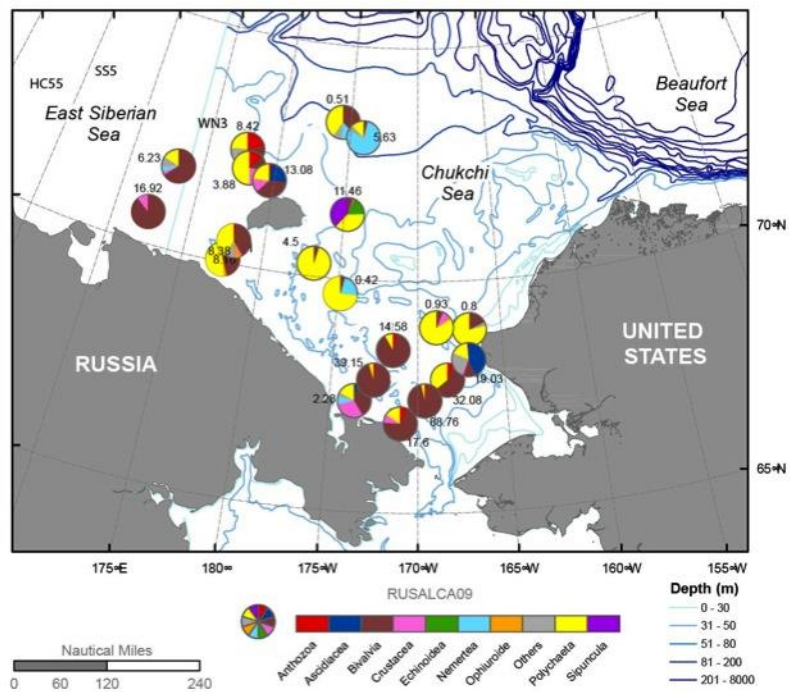


2004





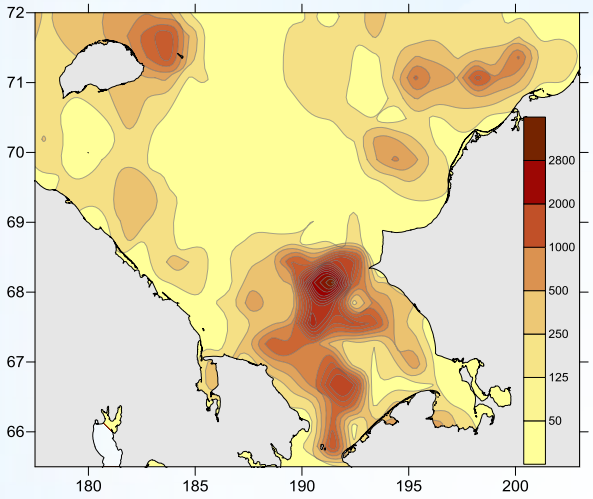
2009



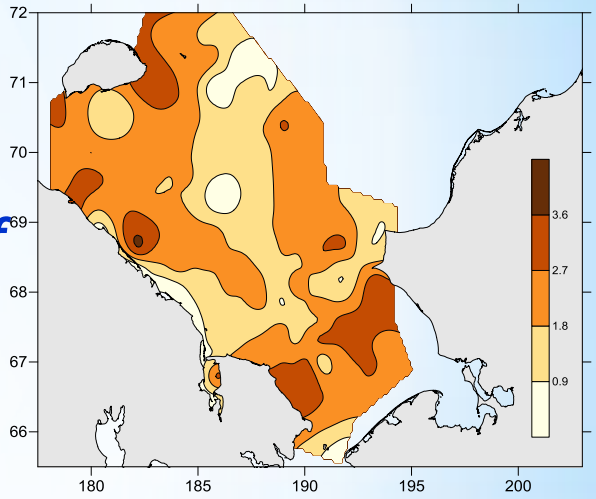
Regional and local functional characteristics

Skvortsov Vladimir.[2,1] *& Denisenko Stanislav.*[1,2]

Zoobenthos biomass

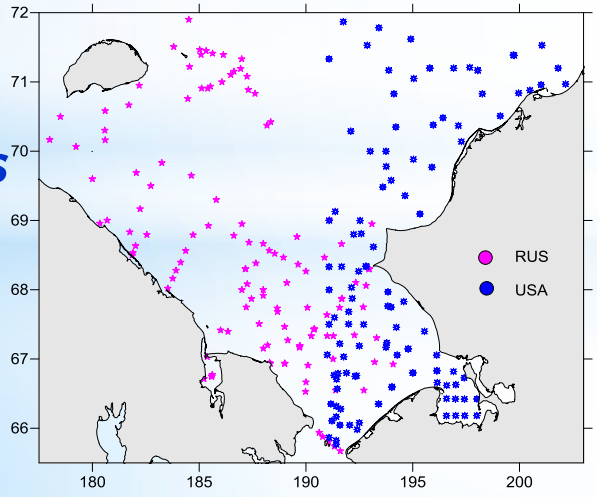


Information biodiversity of zoobenthos

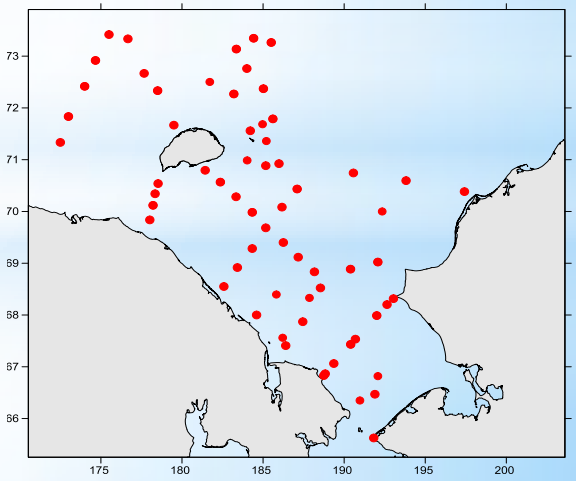


Chukchi Sea

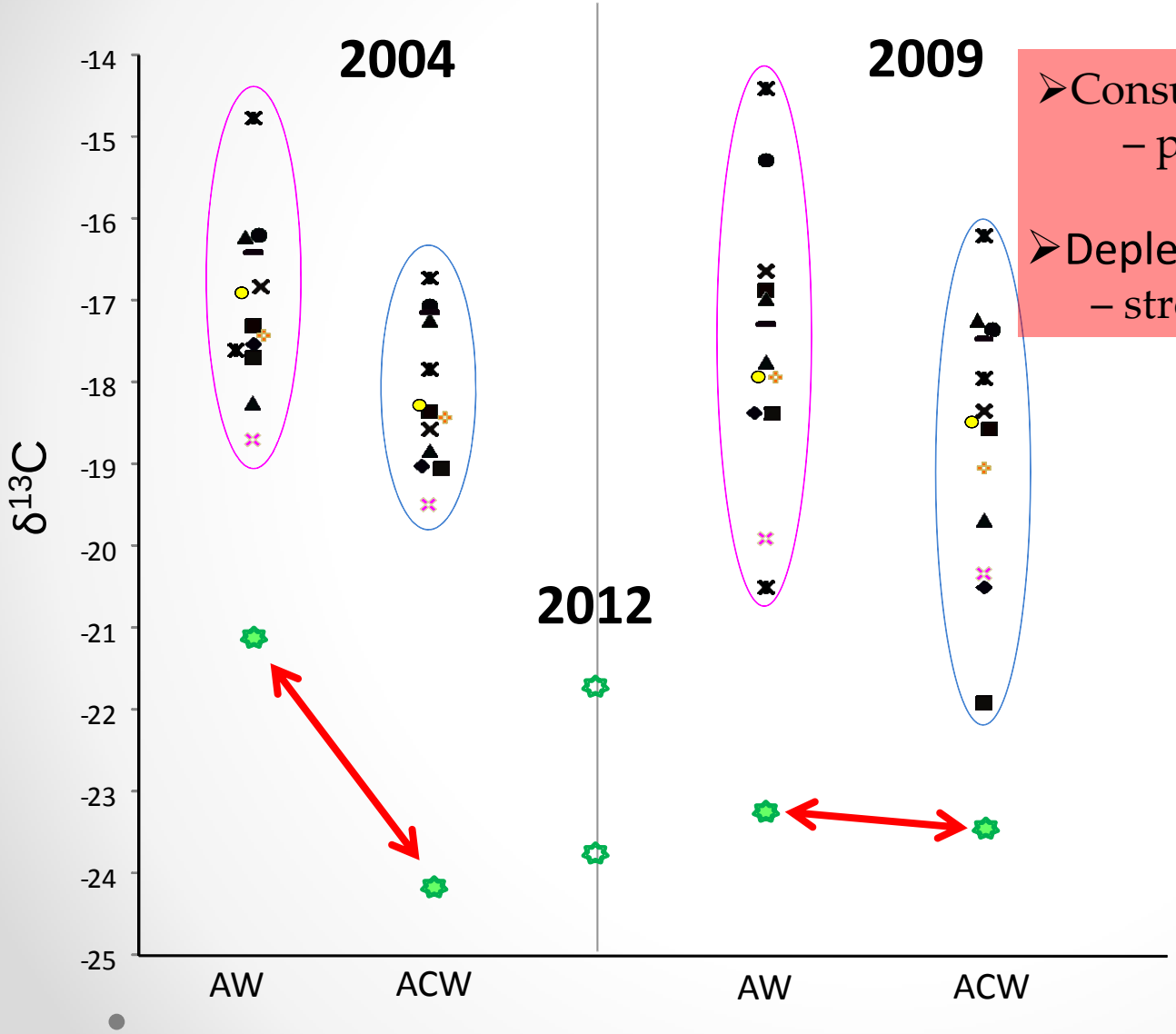
Zoobenthos sampling stations



Zoobenthos sampling stations



Food web – carbon source

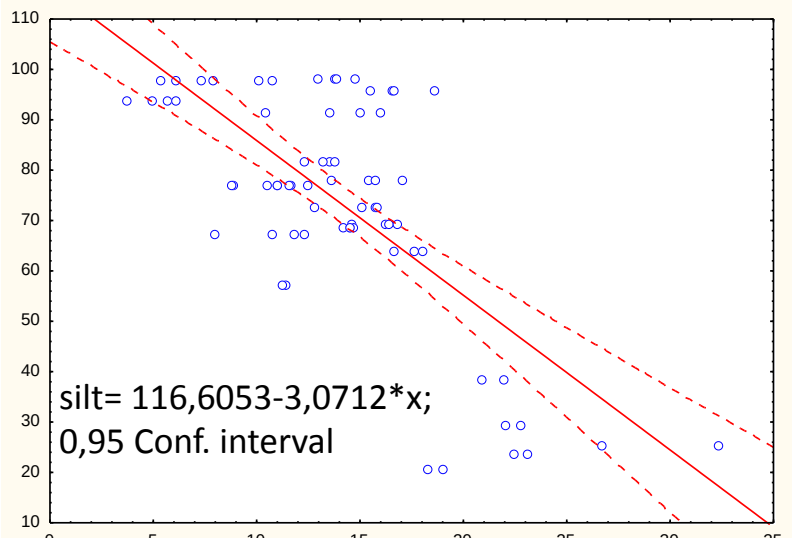


- Consumer $\delta^{13}C$ depleted in ACW – possible freshwater signal
- Depleted $\delta^{13}C$ POM in AW in 2009 – strong freshwater signal in 2009

- POM
- Surface deposit - bivalves
- *Strongylocentrotus droebach.*
- *Neptunea* sp.
- *Leptasterias* sp.
- *Nephtys* sp.
- *Pagurus rathbuni*
- *Hyas coarctatus*
- *Chionoecetes opilio*
- *Argis lar*
- *Gymnocanthus tricuspis*
- *Myoxocephalus scorpius*
- *Lumpenus fabricii*
- *Boreogadus saida*

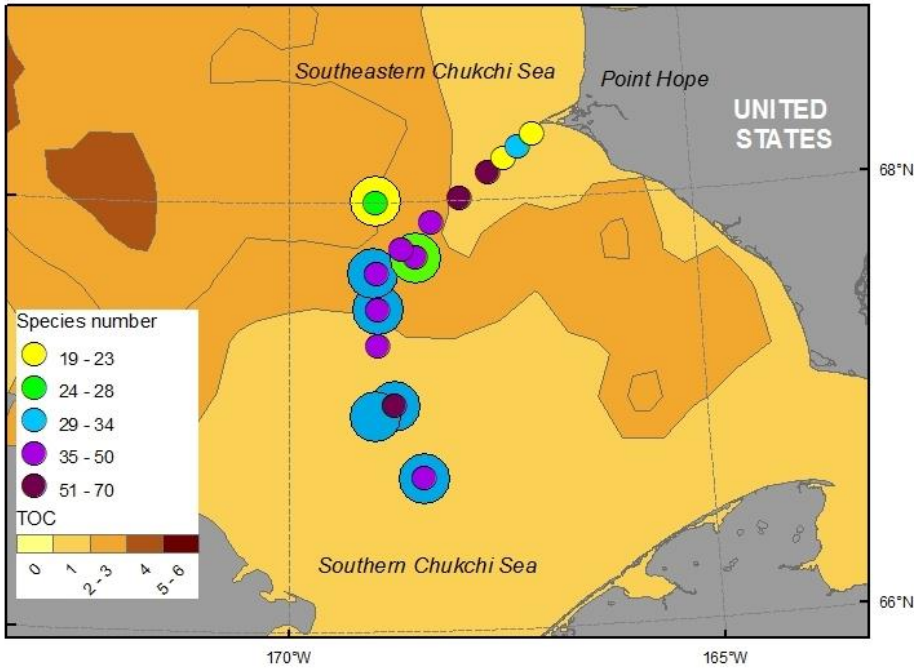
2004 results: Iken K et al (2010) *Deep-Sea Research II* 57: 71-85

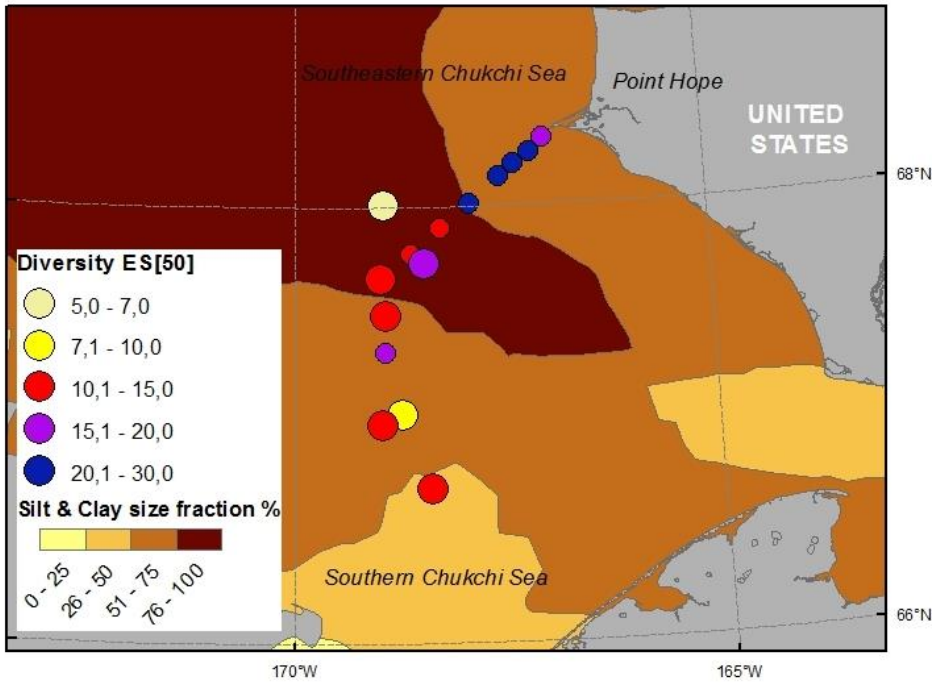
Southern and southeastern Chukchi Sea-2011
C30



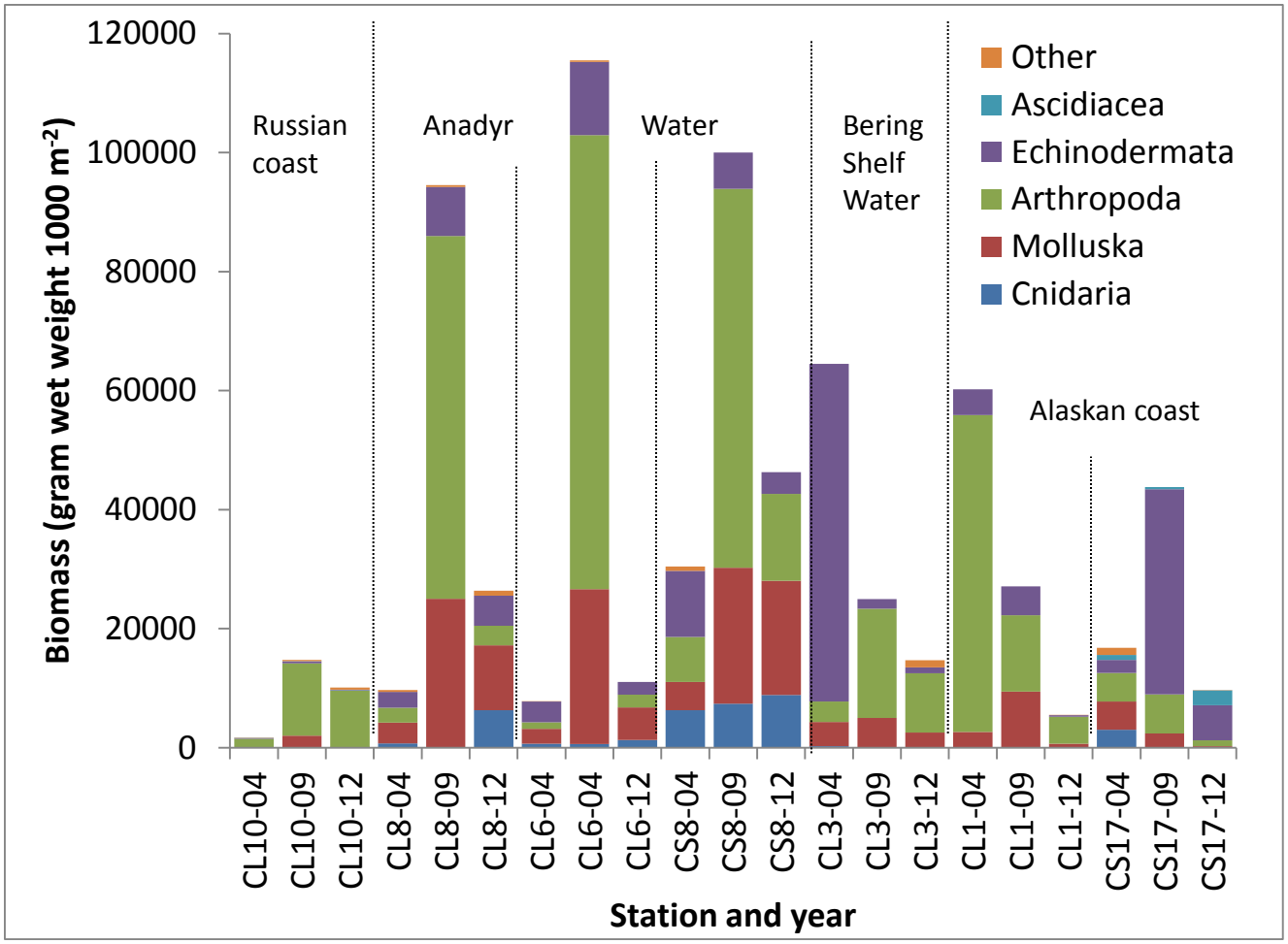
Spearman correlations:
Diversity & coarse sand/gravel: 0.51*
Diversity & fine sand: 0.47*
Diversity & silt: -0.52*
Diversity & TOC : -0.57*

[Monika Kedra, CBL]





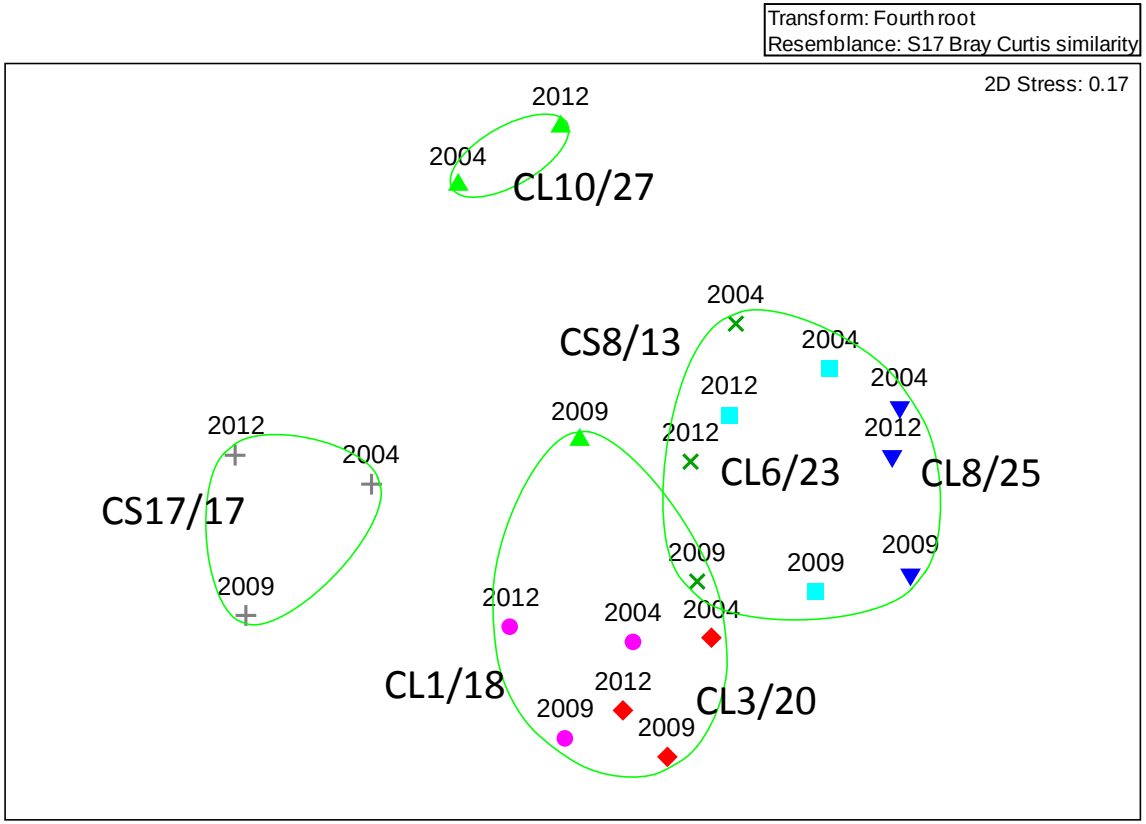
Epifaunal Biomass variable between years



- Peaks in 2009 driven by snow crabs

[Bluhm and Iken]

Epifaunal community structure rather stable between years

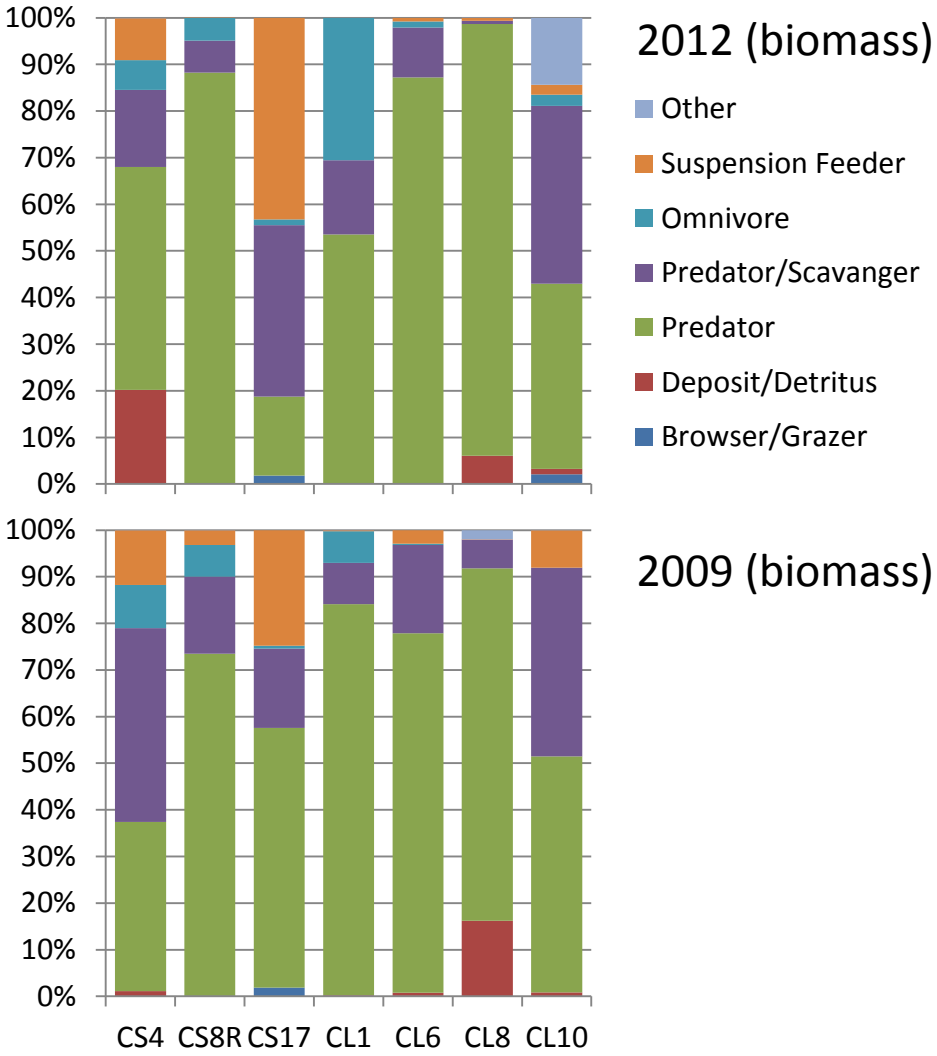


Green circle: 40% similarity

- Same stations (symbols) similar (close together) across years
- except CL10/R27 (local freshwater / ESCC)

[Bluhm and Iken]

Epifaunal feeding guild composition



- Epifauna dominated by predators and scavengers
- Relatively stable between years

[Bluhm and Iken]

Summary of RUSALCA Benthic Faunal Results

Benthic marcroinfauna and sediments: Jackie Grebmeier and Lee Cooper

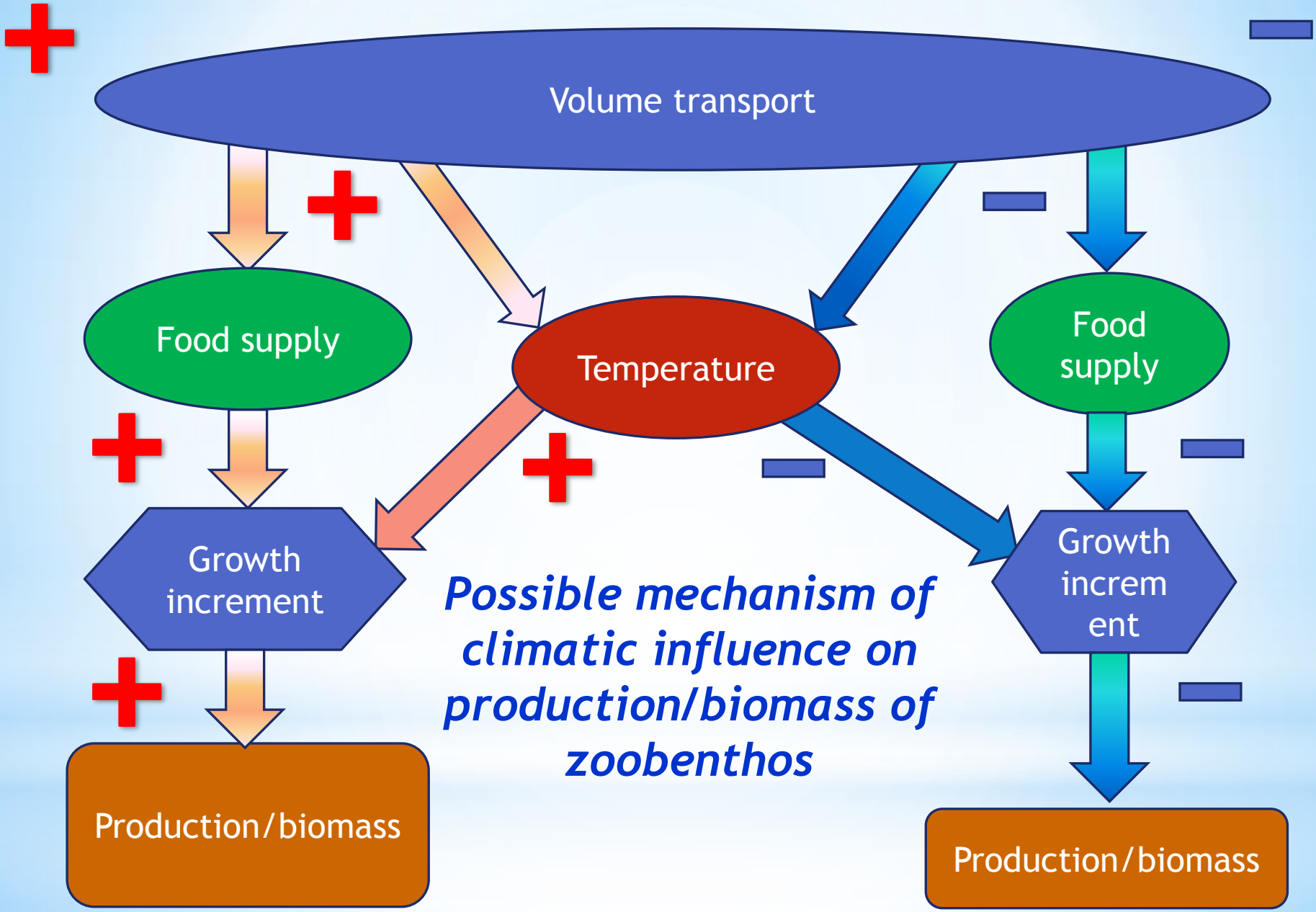
- highest carbon export to benthos coincident with highest areas of infaunal biomass (gCm^2), indicating strong pelagic-benthic coupling
- Dominant infauna: bivalves and polychaetes; important prey to walrus gray whales, and bearded seals
- Sediment stable carbon isotopes indicate marine vs. terrestrial influenced carbon
- Sedimentation rates vary from low values in high current regimes (Herald Canyon) to moderate deposition rate in Long Strait; bioturbation has impact on profiles

Benthic populations: Vladimir Skvortsov and Stanislav Denisenko

- Biodiversity greatest in SE Chukchi Sea and western Chukchi Sea
- Biomass largest SE Chukchi Sea and NE of Wrangell Island

Epifauna and foodweb dynamics: Bodil Bluhm, Katrin Iken, and Boris Sirenko

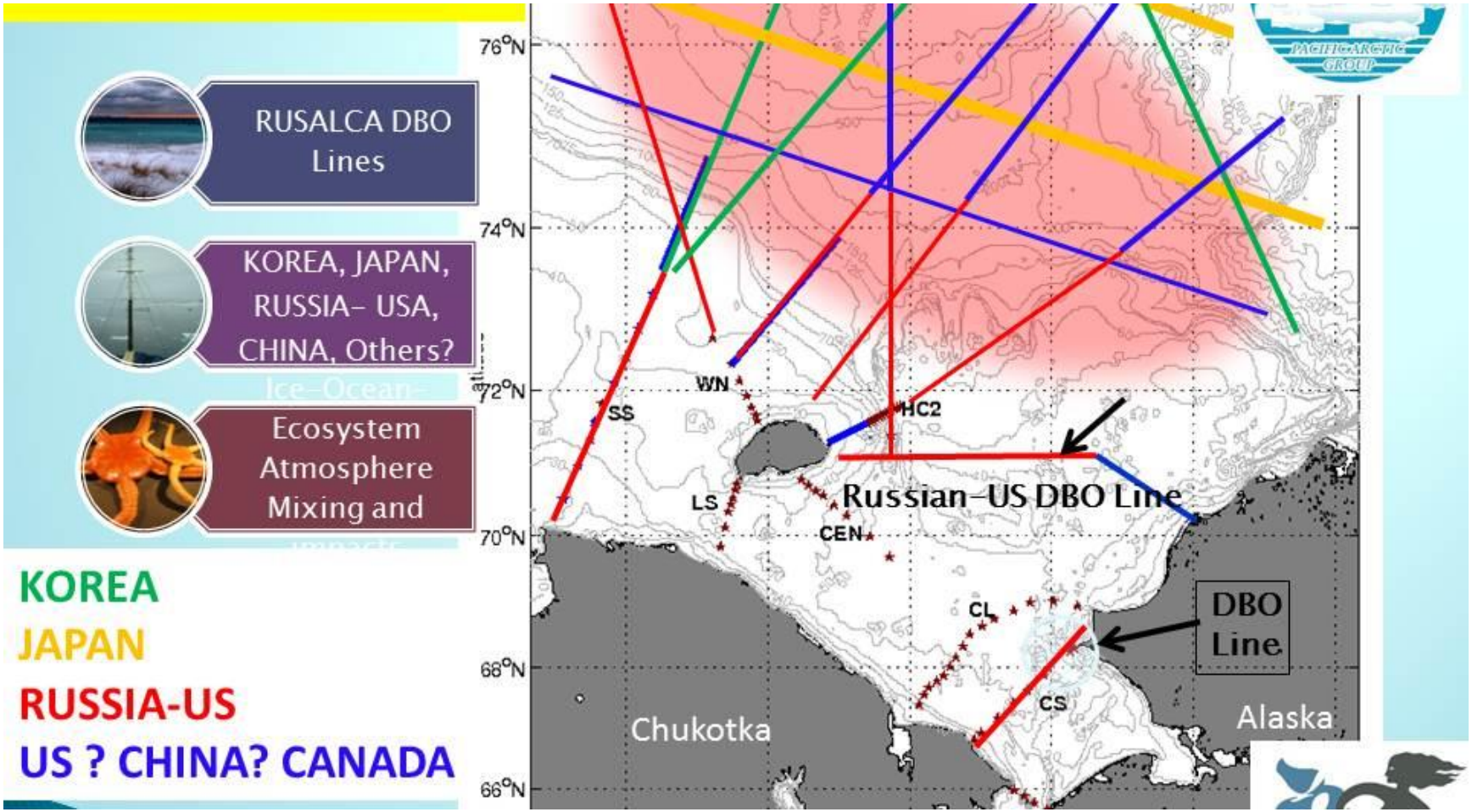
- Biomass variable between years
- Individual species can drive tends (stock fluctuations in snow crab?)
- Community structure stable in area, different by substrate and water mass
- Food web reflects water masses (tight pelagic-benthic coupling in AW)
- Food web structure stable between 2004 and 2009; Food source signal variable
- Combination of metrics tell more than one metrics



Possible mechanism of climatic influence on production/biomass of zoobenthos

[Stanislav Denisenko]

Maintain CS (DBO3), CL time series lines, develop Russian-US DBO4 line



Thank you. Any questions?

Acknowledgements:Thanks to Betty Carvellas for assistance at sea as well as preparation of an outreach web journal posted at http://arctic.cbl.umces.edu. Stanislav Denisenko and Petr Strelkov (Zoological Institute, St. Petersburg, Russia) and Alexander Bosin and Alexander Kolesnik (Pacific Oceanology Institute in Vladivostok, Russia) for assistance with deck operations on stations. Many thanks to Linton Beaven, Marisa Guarinello, Christian Johnson, Monika Kedra, Kathryn Osborne, Regan Simpson, and Lisa Wilt at CBL/UMCES for infaunal sorting and sediment analyses. Chirk Chu provided data processing of the benthic macroinfaunal data. GIS data interpolations and graphics were provided by Marisa Guarinello and Allyne Bayard at CBL.. Funding was provided by the Arctic Program (Climate Dynamics Office) of the US National Oceanic and Atmospheric Administration.

[photo courtesy Karen Frey]