Update on the Pacific Arctic Region Synthesis Activity as part of the ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA)

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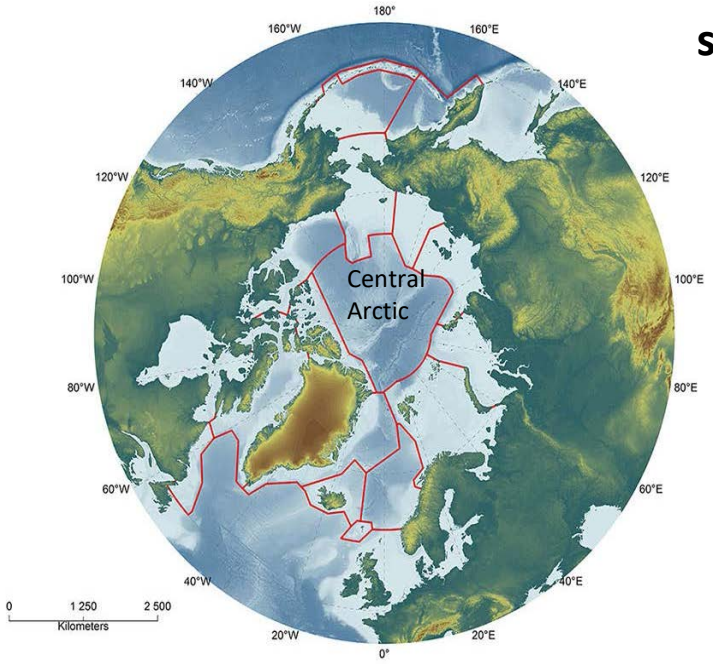
Pacific Arctic Group Meeting
November 7, 2017
NOAA/PMEL
Seattle, Washington, USA

Pacific and Atlantic Regions for the WGICA study



WGICA in coordination with results of the Arctic fish stocks and fisheries meetings of the Scientific Experts on Fish Stocks in the Central Arctic Ocean (FisCAO)

- Large Marine Ecosystems (LME): 18 Arctic LMEs, was adopted by the Arctic Council in 2013

- Participants at the WGICA May 2016 meeting agreed on a framework for undertaking an IEA for the Central Arctic Ocean Components for such an assessment should include:

Ecosystem components	Vulnerabilities/drivers/impact inducing anthropogenic activities
productivity/plankton	fishing
sea ice biota	shipping
benthos	oil and gas
fish	warming
birds	acidification
mammals	pollution

Two assessment teams were established to initiate work on the development of **integrated assessments** on a subregional basis, then combine in final report

1. Amerasian Basin/Pacific gateway team (lead: Jackie Grebmeier, USA), and
2. Eurasian Basin/Atlantic gateway team (lead: Randi Ingvaldsen, Norway)

Develop an ecosystem status report of each geographic area based on literature. Extend the assessment from the gateway, focused on shelf-basin exchange and extending as far into the Central Arctic Ocean as feasible.

a. Abundance and trends of biota.
b. Seasonal distribution of biota (including recent changes and future projections).
c. Identify biologically important and sensitive areas.
d. Emphasize spatial and temporal aspects in status reports
e. Integrate the following topics in the status reports:
    1) Climate and oceanography
    2) Sea ice biota, plankton, benthos
    3) Fish and fish stocks
    4) Marine mammals and birds
    5) Descriptions of vulnerabilities to potential impacts from climate change, shipping, potential fishing, and other anthropogenic activities

Goal of WGICA

Goal to produce an Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean (CAO)

Work Plan

- A review of the scientific literature on the level of primary production by phytoplankton and ice algae
- A summary of knowledge of fish and fish stocks in the CAO, including new information from acoustic records from research ice-breakers
- An overview of marine mammal and seabird abundance, distribution, habitat use, and ecology
- A climate impact assessment based on a review of knowledge of changes in the CAO ecosystem that have taken place during the period of the 'Great melt' in the recent decades after the 1980s
- A vulnerability assessment to shipping with information on sensitivity and potential vulnerability of species and their ice habitats to oil spills, noise and visual disturbance from ships

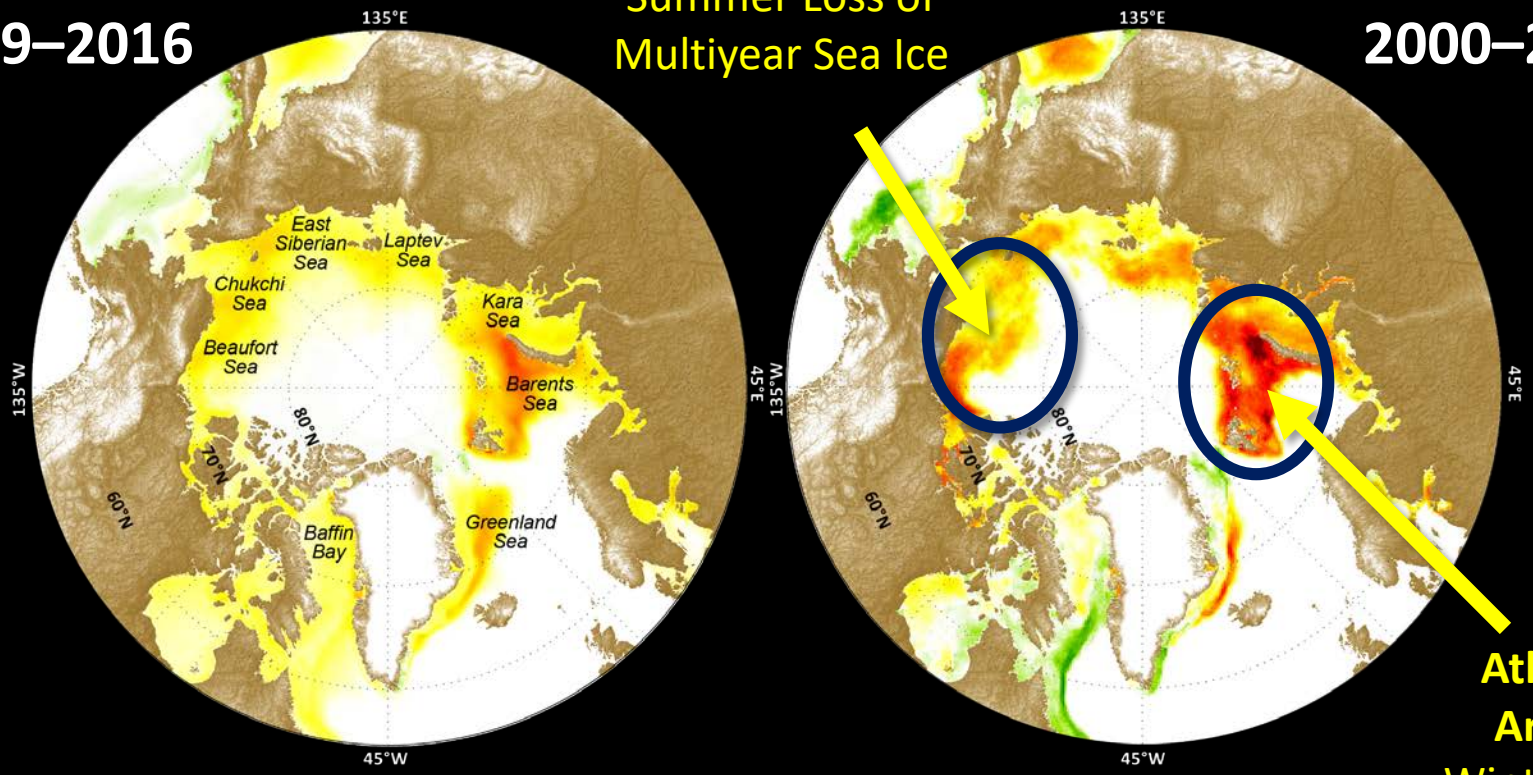
ICES. 2017. Interim Report of the ICES/PICES/PAME Working Group on Integrated Eco-system Assessment (IEA) for the Central Arctic Ocean (WGICA). WGICA 2017 REPORT 19-21 April 2017. Seattle, USA . ICES CM 2017/SSSGIEA:11. 47 pp.

Pan-Arctic Trends in Annual Sea Ice Persistence 1979-2016

Pacific Arctic:
Summer Loss of
Multiyear Sea Ice

1979–2016

2000–2016



Atlantic Arctic:
Winter Loss
of First-Year
Sea Ice

Trends in Annual Sea Ice Persistence (days/year)

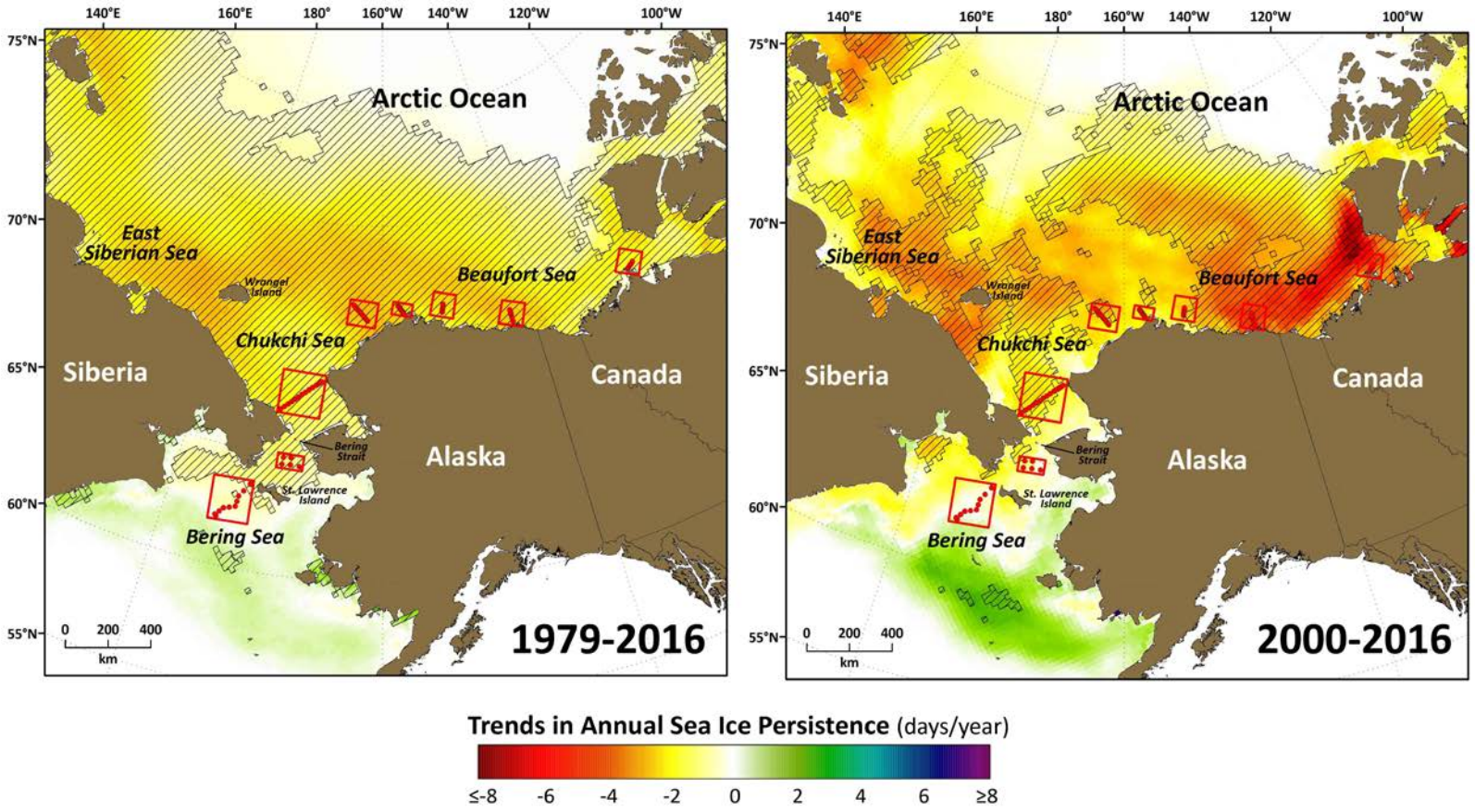
≤-10 -8 -6 -4 -2 0 2 4 6 8 ≥10

Based on SSMR and SSM/I satellite data

[Courtesy Karen Frey, Clark University, USA]

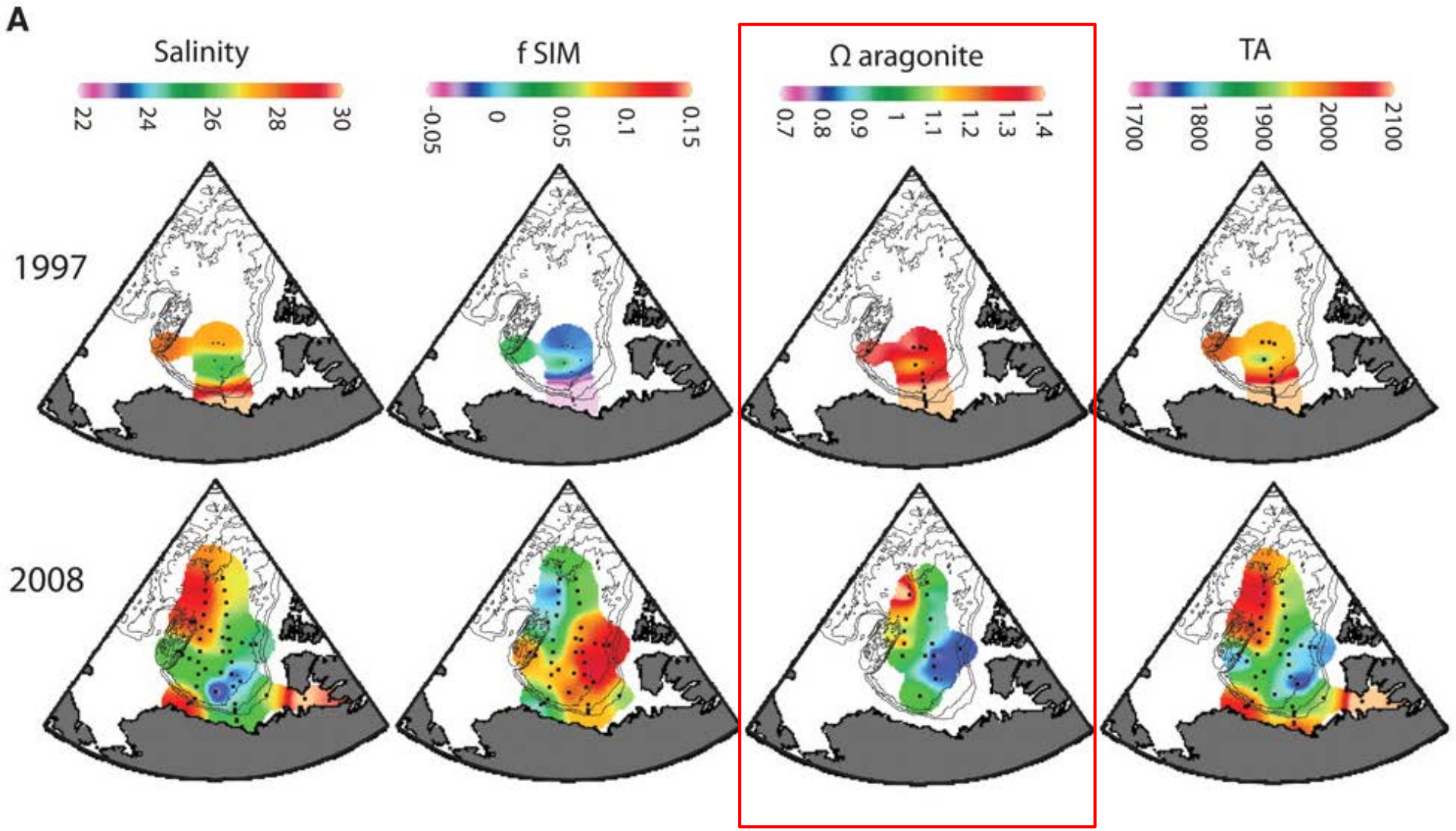
Trends in Annual Sea Ice Persistence in Relation to DBO 1–8

Hatching indicates statistically significant trends (Mann-Kendall p<0.1)
Trends in annual sea ice persistence have accelerated since 2000



[Courtesy Karen Frey, Clark University, USA]

Surface distribution of aragonite saturation states



Yamamoto-Kawai (2009)

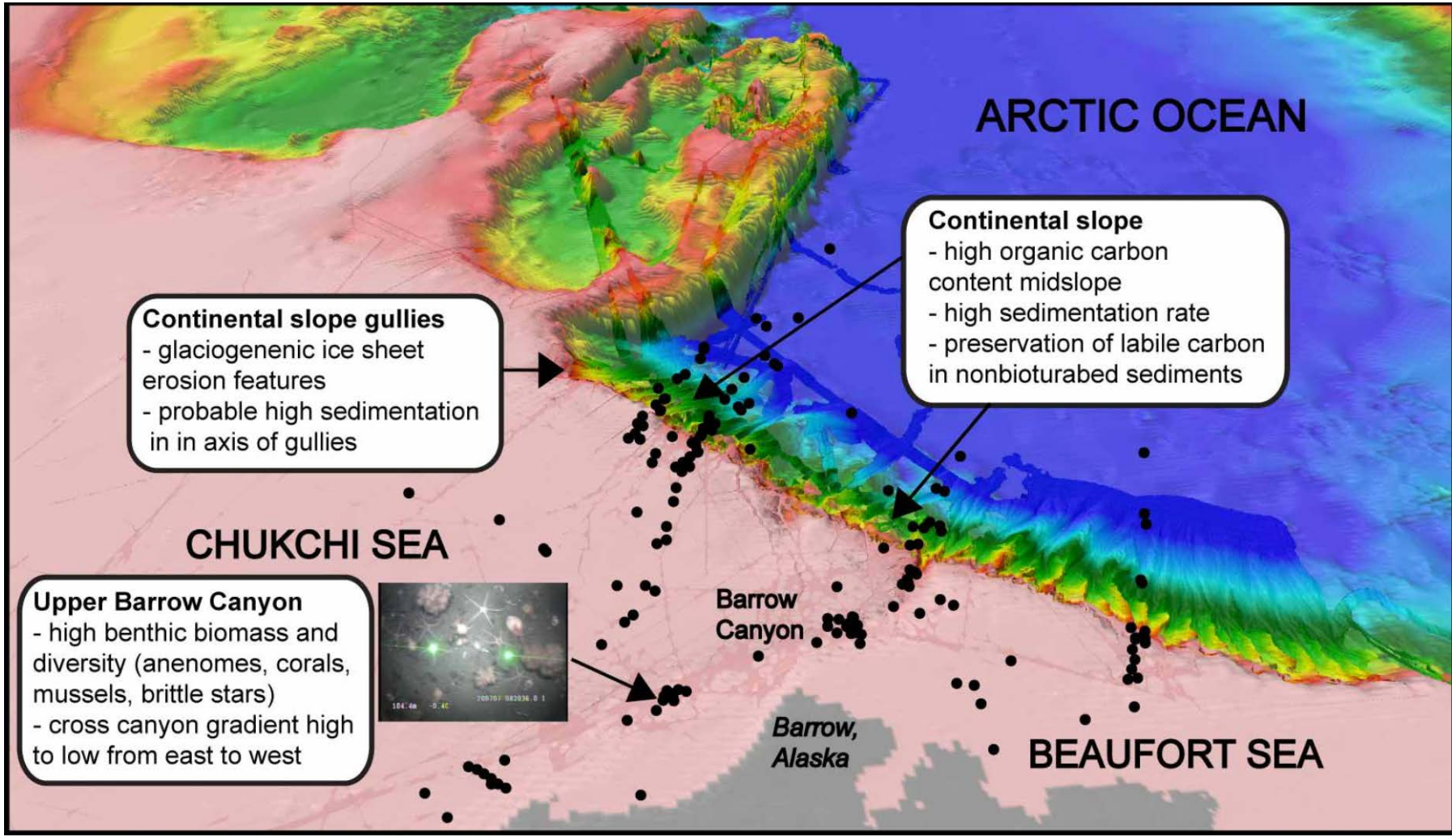
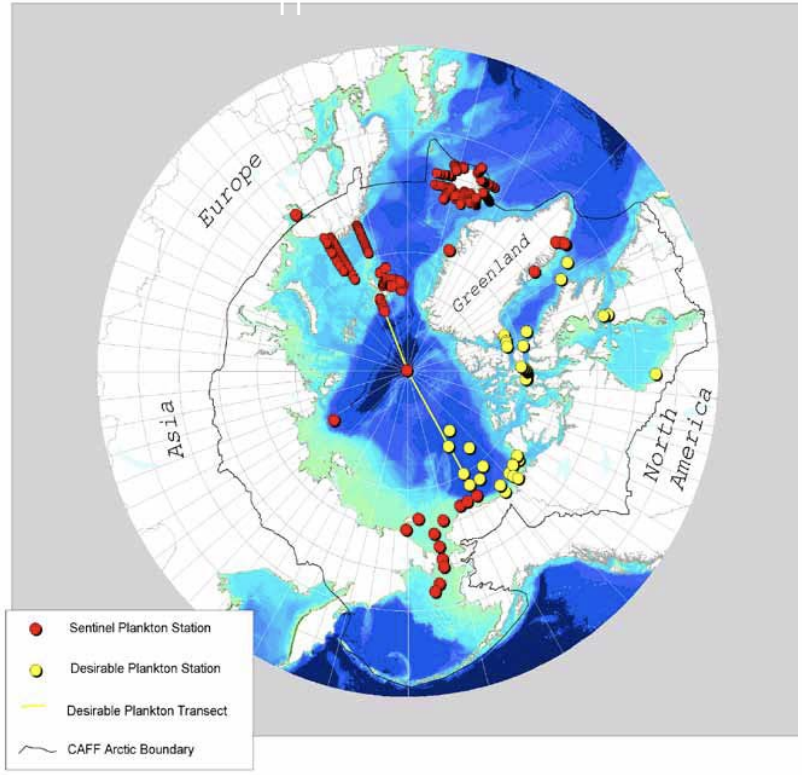


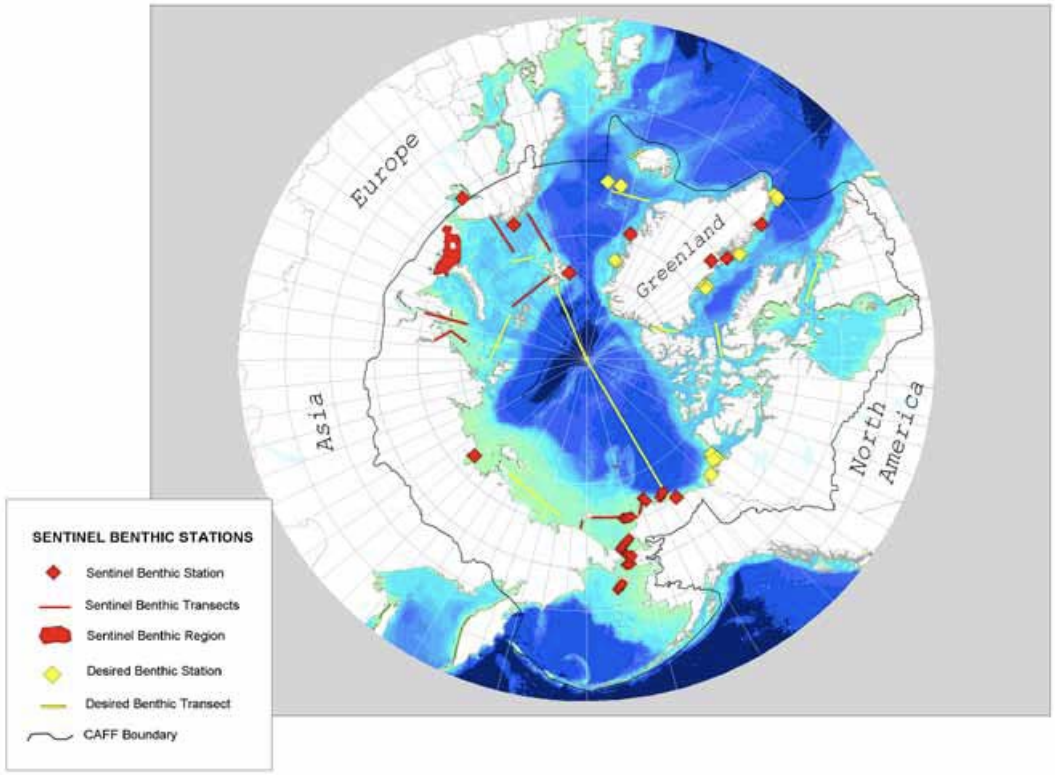
Figure 1. Distribution of station in the Barrow Canyon region, including the upper Barrow Canyon "hotspot" of high benthic biomass. The synthesis activity is on the shelf (pink). Figure a joint product of PIs Grebmeier and Cooper, and Dr. Margo Edwards at the University of Hawaii

Arctic Marine Biodiversity Monitoring Plan (CAFF)

Zooplankton



Benthic fauna

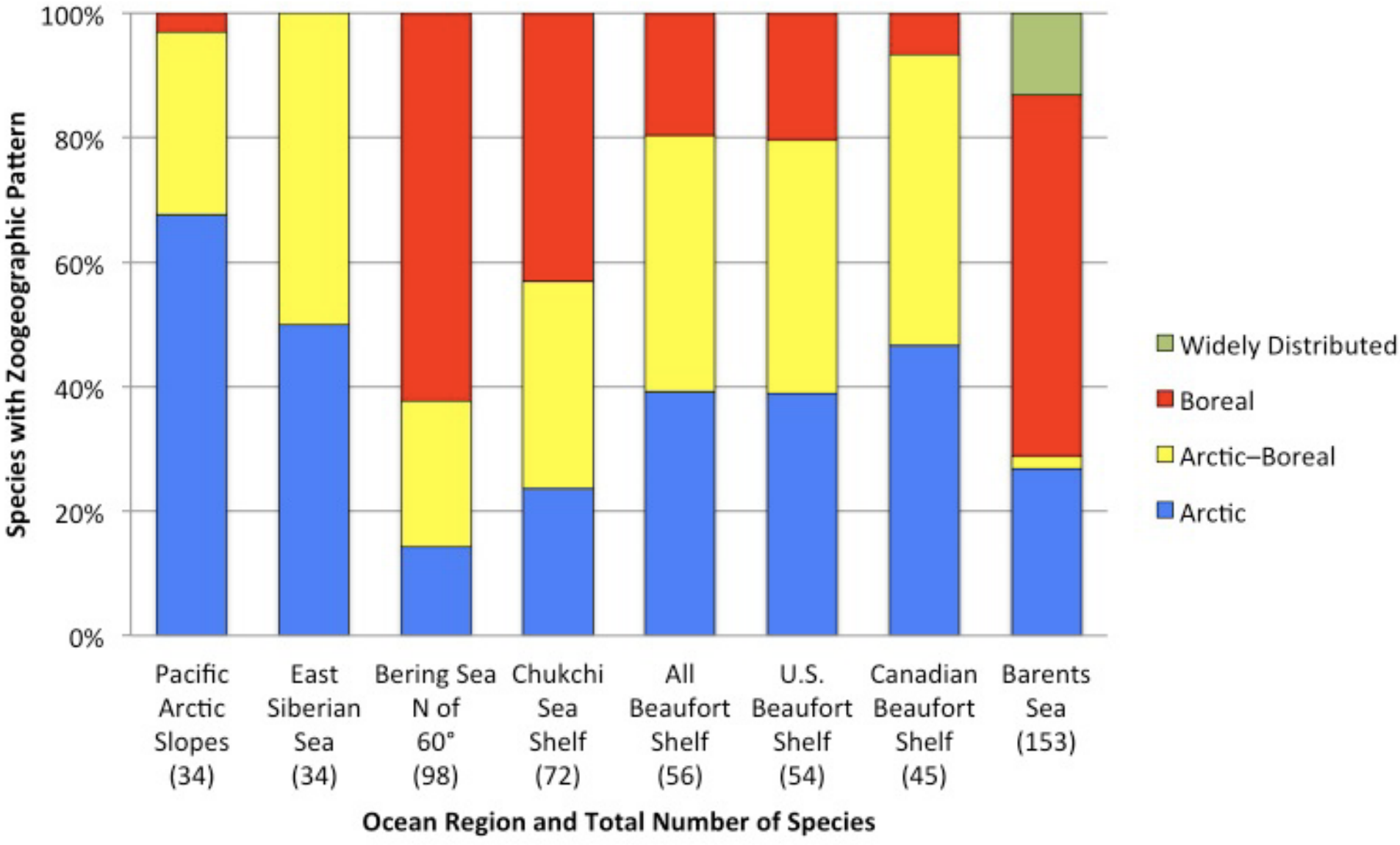


Map of contemporary marine fish data sources

- Green squares indicate data from benthic trawl monitoring efforts
- Blue squares indicate data from benthic trawl surveys
- red triangles indicate data from pelagic trawl monitoring efforts
- fish communities in waters below 1,500 m as well as mid-water realm are poorly known due to a lack of commercially important species

[**S**tate of the **A**rctic **M**arine **B**iodiversity Report (SAMBR), 2017]

Proportions of marine fish species of each major zoogeographic pattern in Pacific Arctic subregions and the Barents Sea

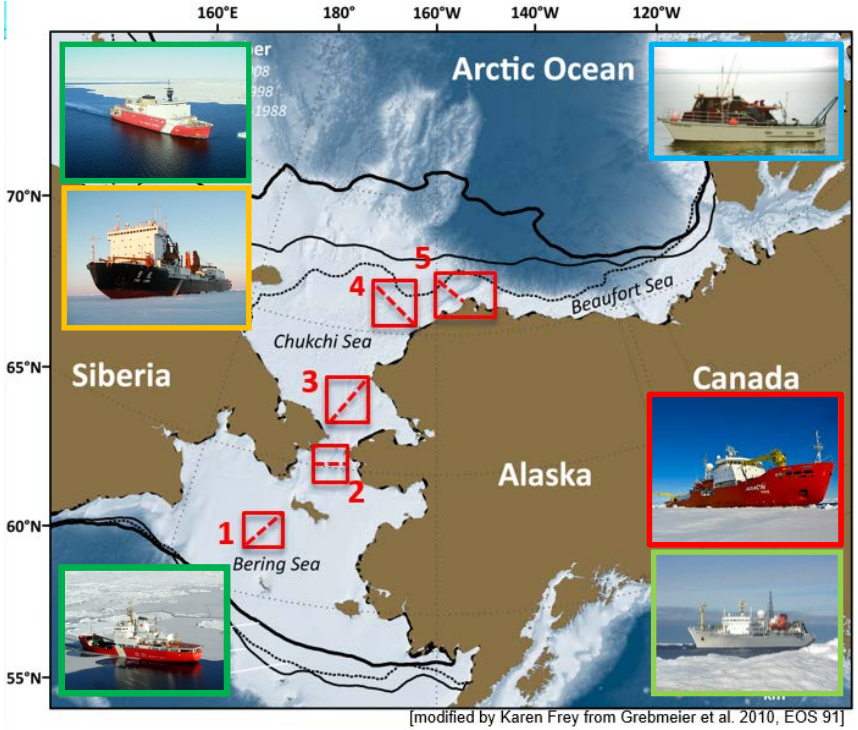


[Modified from Mecklemburg and Steinke 2015]

PAG Synthesis activities

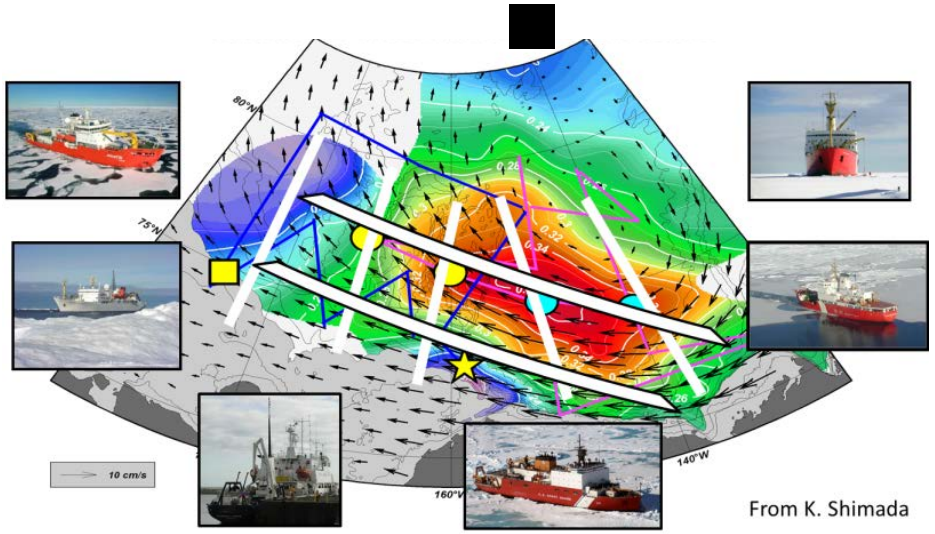
- PAG continues to develop and implement long-term monitoring activities such as
  - ✓ Distributed Biological Observatory (DBO)
  - ✓ Pacific Arctic Climate Ecosystem Observatory (PACEO)

Distributed Biological Observatory (DBO)



[modified by Karen Frey from Grebmeier et al. 2010, EOS 91]

Pacific Arctic Climate Ecosystem Observatory (PACEO)

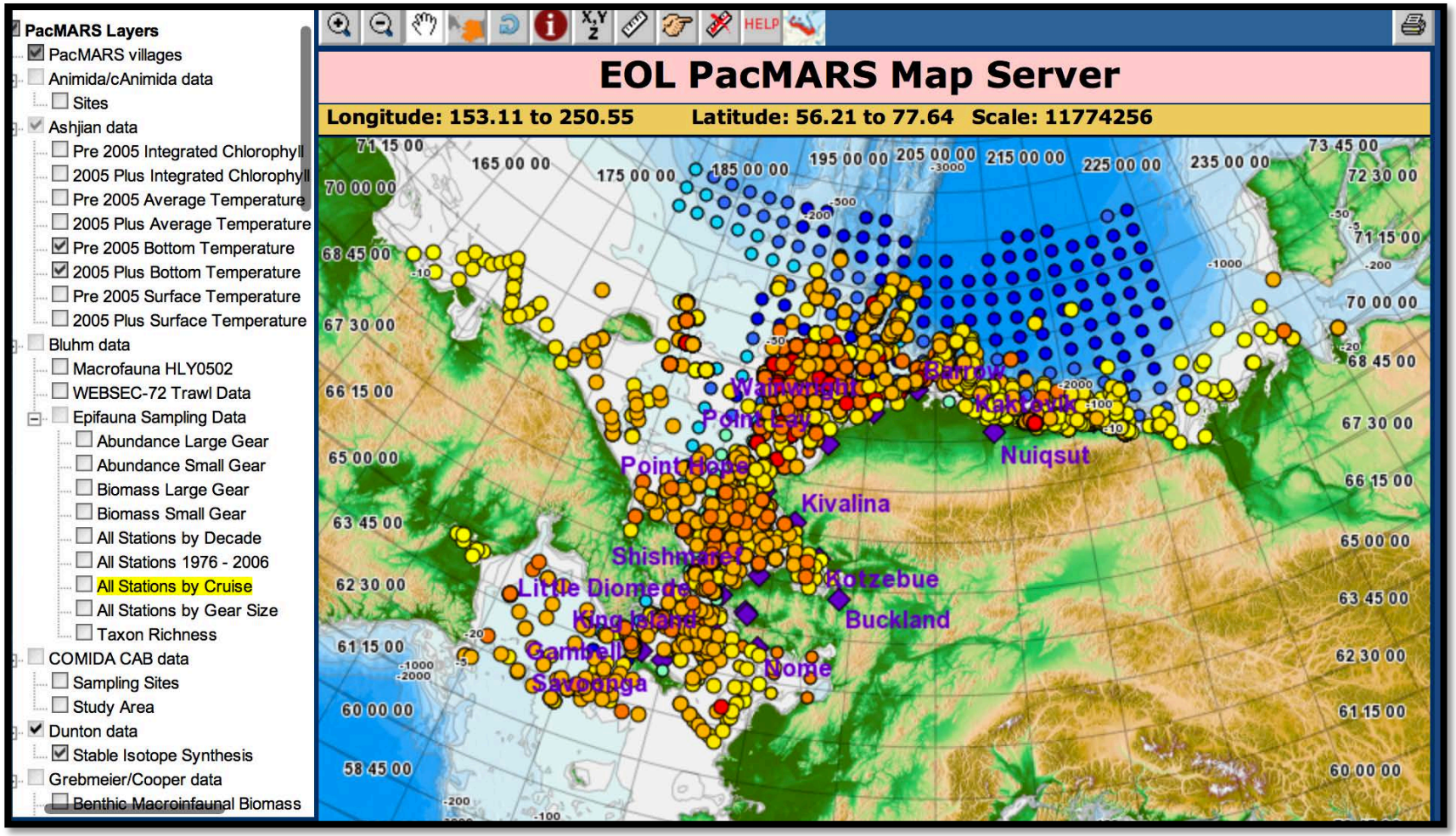


From K. Shimada

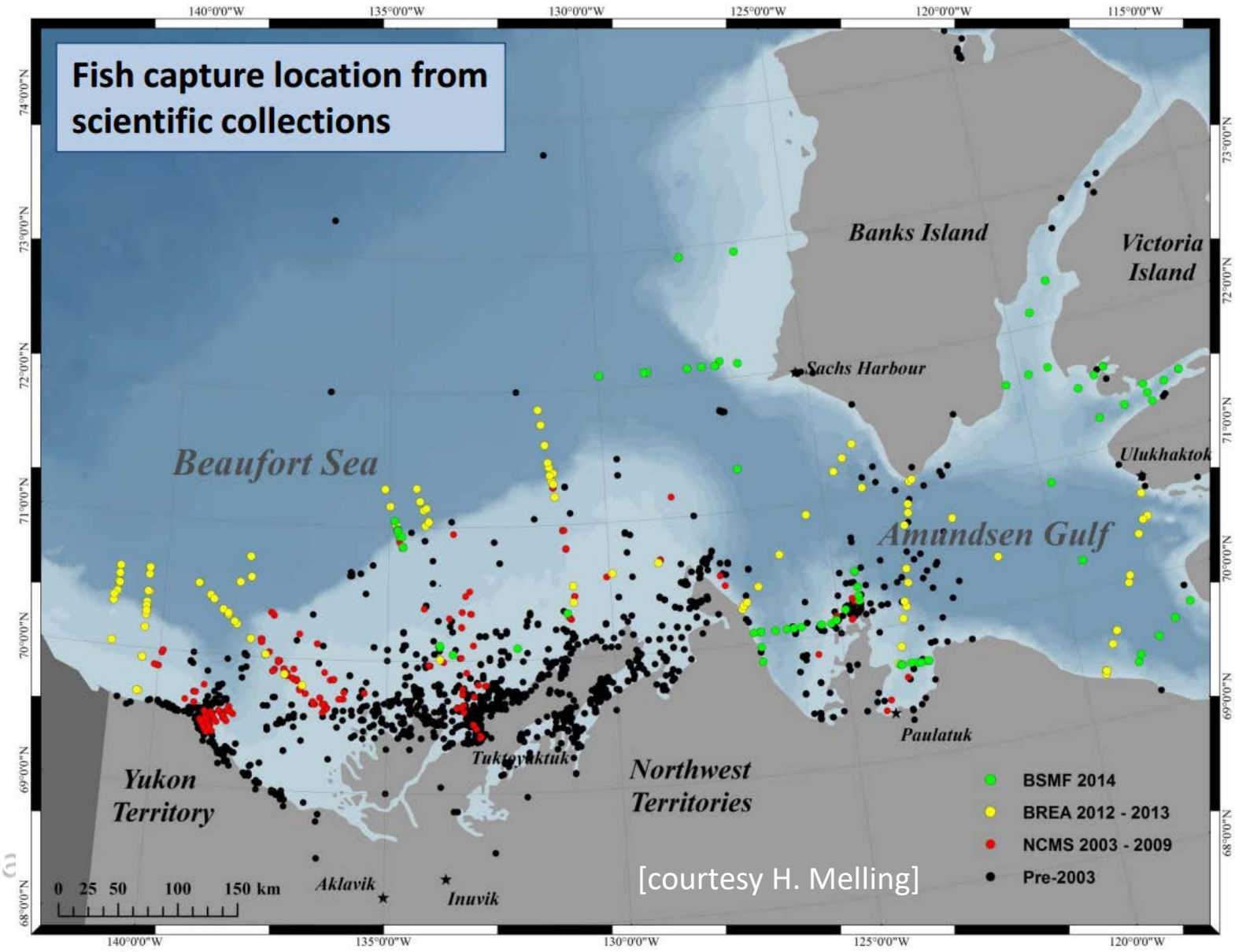
Background color: dynamic height at 100dbar relative to 800dbar from Mirai and Louis S. St-Laurent 2008 cruises (Oceanic Beaufort Gyre)
Black vectors: average sea ice motion vectors for Nov. 2007- Apr. 2008 (Sea Ice Beaufort Gyre)
Symbols: Mooring array in 2012-2013 (TUMSAT/KOPRI/NIPR & WHOI)

Pacific Marine Arctic Regional Synthesis (PacMARS):

Various data types such as chlorophyll, primary production, hydrography, currents, and winds were mapped into multiple GIS layers; all data available at EOL site http://arctic.eol.ucar.edu; project website http://pacmars.cbl.umces.edu



Mid-depth Trawl Surveys of 2012-14 will be repeated in 2017



PAG Relevant Research and Involvement in SBE/CAO Synthesis Activity

Examples of PAG-related research programs pertinent to Pacific subgroup WGICA:

1. PAG Ecosystem level studies being undertaken by science programs on RV Mirai, Araon, Sir Wilfrid Laurier, Xuelong, Healy, Sikuliaq, others In region

2. Arctic Ecosystem Integrated Survey: ArcticEIS2 (NOAA/NPRB)

3. Arctic Marine Biodiversity Observing Network

4. Beaufort Shelf Break Ecology-Plankton, Fish and Belugas

5. Canadian shelf-slope-basin fish studies (post BREA and Transboundary)

6. Joint Ocean-Ice Study (JOIS); AON=Arctic Observing Network; BGOS=Beaufort Gyre Observing System

Request: Can we have a 1-2 PAG participants from each country to participate in WGICA Pacific subgroup synthesis effort? Please provide name to Jackie G (lead)

Thank you. Any questions?