**D**istributed **B**iological **O**bservatory (**DBO**)

*Linking Physics & Biology in the Arctic* 

# Status Report on PAG-endorsed DBO and PACEO ongoing and planned activities

#### Jacqueline M. Grebmeier and PAG partners

Chesapeake Biological Laboratory University of Maryland Center for Environmental Science, Solomons, MD, USA

> Pacific Arctic Group October 28-29, 2016 Qingdao, China





PAG is engaged in project development and sampling in the Pacific Arctic region in rapid transition to investigate climate, oceanography, air-sea ice interactions, physical oceanography, and modeling



# Linking Physics to Biology: the Distributed Biological Observatory (DBO)



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

- DBO sites (red boxes) are regional "hotspot" transect lines and stations located along a latitudinal gradient
- DBO sites are considered to exhibit high productivity, biodiversity, and overall rates of change
- DBO sites serve as a change detection array for the identification and consistent monitoring of biophysical responses
- Sites occupied by national and international entities with shared data plan









# New development and of long-term monitoring activity in the higher Pacific Arctic - the Pacific Arctic Climate **Ecosystem Observatory (PACEO)**

**Proposed international Pacific Arctic** climate monitoring sections





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)



# PAG research cruises in the Pacific Arctic Region with DBO and PACEO sampling efforts

#### Japan: RV Mirai

China: RV Xuelong





#### Korea: RV Araon



#### Canada: CCGS Sir Wilfrid Laurier, Louis St. Laurent

USA: Healy, RV Aquila, Brown, Norseman2, etc.





# Session Speakers

- Physical oceanography
  - Robert Pickart with Jackie Grebmeier talk
  - Jinping Zhao
  - Tao Li
  - Shigeto Nishino
  - Motoyo Itoh
  - Kyoung-Ho Cho
  - Joo-Hong Kim
- Chemical oceanography
  - Sun-Yong Ha, Jin-young Jung
- Biogeochemical oceanography
  - Jisoo Park, Haiyan Jin
- Ecosystem
  - Jackie Grebmeier
  - Eun Jung Choy
  - Hyoung Sul La
- Sediment trap
  - Jonaotaro Onodera, Dong-sun Kim

# Session Speakers

- Atmosphere and sea ice
  - Joo-Hong Kim
  - Keyhong Park
- Satellite observations
  - Hyun-cheol Kim
  - Qiang Hao
- Modelling
  - Xiandong Zhang
  - Baek-Min Kim (presented by Joo-Hong Kim)
  - Jian Wang (presented by Jackie Grebmeier)
- Other activities
  - (paleoceanography, Wenshen Xiao

#### The Distributed Biological Observatory (DBO) Physical Oceanographic Component

Robert S. Pickart and Carolina Nobre



Data Coverage - CTD

### All CTD crossings per year



Data Coverage - CTD

# All CTD crossings per line



#### Science Highlights



**Overall Mean Sections** 





Distance (km)

**ACW Presence** 



**NVWW Presence** 

#### Upwelling Events

#### Mean unforced salinity



#### Mean upwelling salinity



#### Upwelling Events



Unforced Sections

Upwelling Sections

#### Upwelling Events



How does this relate to storms?

#### Trends in Annual Sea Ice Persistence (DBO 1-8)

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







- Trends in annual sea ice persistence have accelerated since 2000
- Recent gains in annual sea ice persistence in the south (DBO 1–2) transition to losses in the north (DBO 3–8)

[Karen Frey, Clark University]

**Regional Decline in Sea Ice Persistence for DBO1-5** 



[courtesy Karen Frey]



#### DBO Integrated Chlorophyll a (mg/m2) during July



#### Change over time (pre- and post- 2005) in benthic macrofaunal biomass



- based on time series data from 1973-2012
- Observing northward movement of centroid benthic biomass at DBO1-3 regions
- Related to changes in advection, production and deposition areas

Key:

- SLIP-St. Lawrence Island Polynya
- Chirikov=Chirikov Basin
- SECS=SE Chukchi Sea
- NECS=NE Chukchi Sea

(modified from Grebmeier et al. 2015, data from Pacific Arctic Marine Regional Synthesis (PacMARS) Grebmeier and Cooper

# DBO sampling allowing tracking of changing benthic fauna as subset of western SLIP region (DBO1)



**Figure 7.** Times series of **a.** benthic biomass and **b.** dominant macrofaunal taxa in the DBO1 region. The red boxes in the **Fig. 7a** map are the locations of the southern (62°N) and northern (63°N) DBO1 time series sites. In **Fig. 7b** the red box highlights the declining biomass of bivalves (brown columns) and increasing polychaete biomass (yellow columns) in the southern station (bottom histogram series) compared to the increasing benthic biomass in the northern DBO site





Interpretation: Sea ice melt present (particularly orange colors at surface), Alaska Coastal Water to the right  $\delta^{18}$ o [% vsmow]





-160\*

Thank you for your attention.

JG6

JG5

#### **Questions and comments?**

Thank you to all DBO collaborators, field and laboratory technicians over the years for the time series efforts. Financial support for the science provided by the US NSF, NOAA, BOEM, NASA, and ongoing international science partners in the Pacific Arctic Group.



JG6 Jackie Grebmeier, 2011-01-11

JG5 Jackie Grebmeier, 2011-01-11