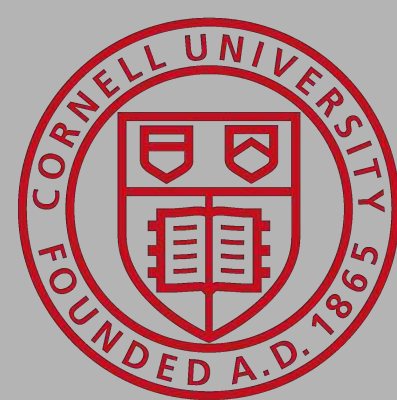
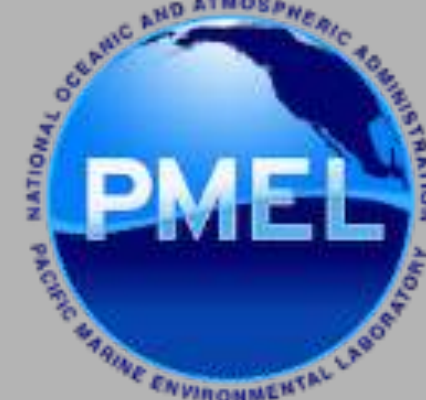


# CHAOZ in a nutshell: Five years of work in sixteen square feet

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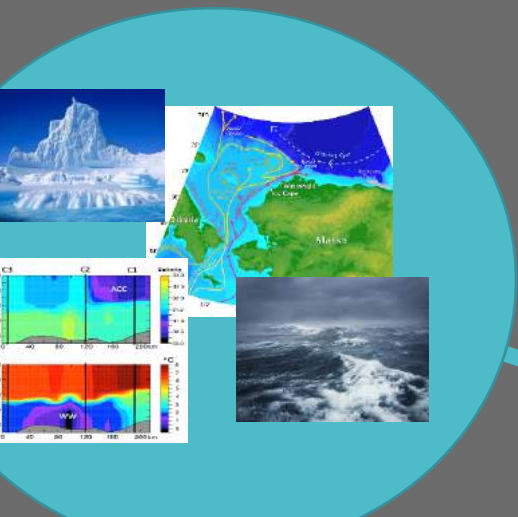


## CHAOZ is the Chukchi Acoustics, Oceanography and Zooplankton Study

Name refers to the Arctic marine soundscape (think alien barnyard)

### Objectives

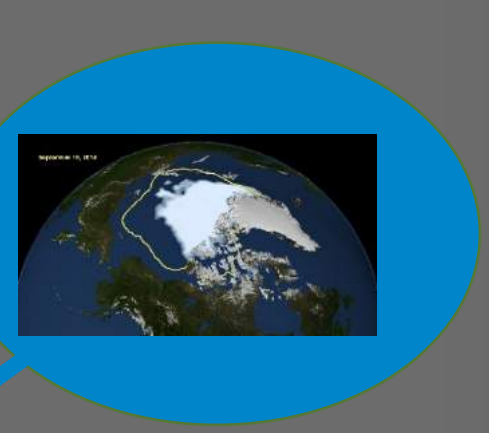
Document the distribution and relative abundance of whales relate changes in those variables to oceanographic conditions, indices of potential prey density, and anthropogenic activities and develop noise and climate models.



Oceanography



Marine Mammals



Climate modeling

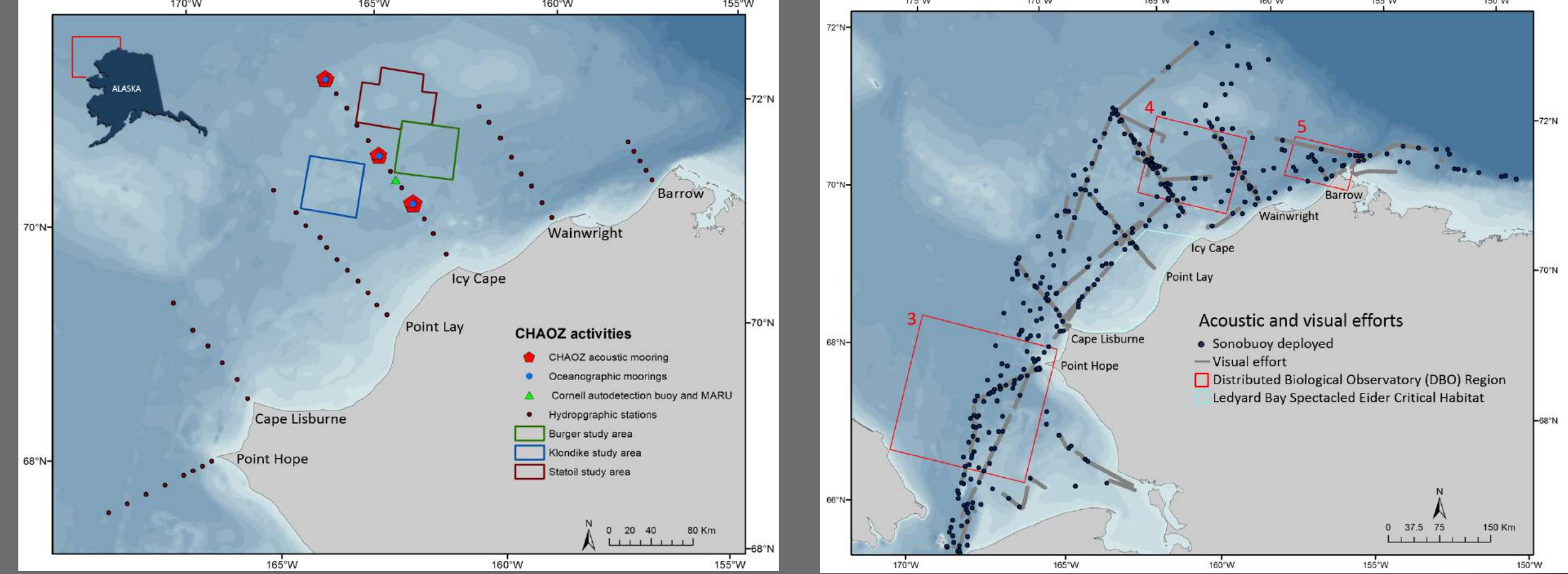


Zooplankton



Noisy Humans

### Field Methods



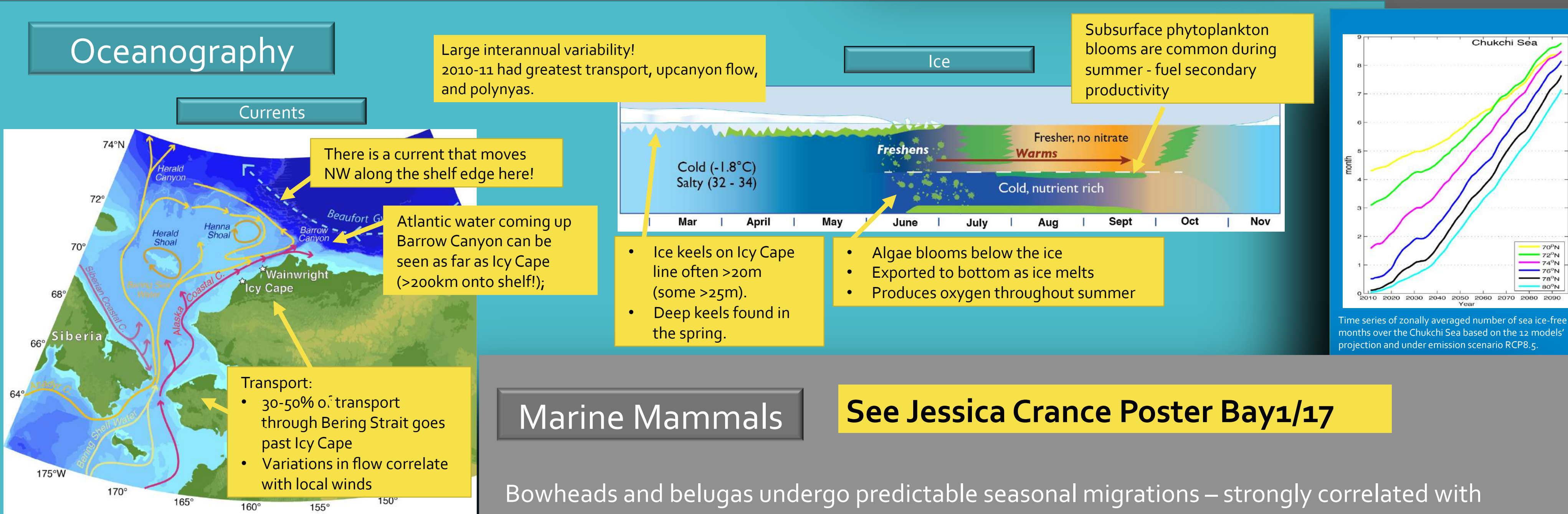
- Three long-term mooring clusters (Passive acoustics, T, P, currents, Par, S, Fluor, N, ice depth, O<sub>2</sub>, turbidity, zoops)
- Six biophysical sampling lines (T, O<sub>2</sub>, Par, S, Fluor, Nutrients, zoops, larval fish)
- One near-real-time autodetection buoy
- Visual survey (Daylight 3 pers. team: 25x Big-Eyes)
- Passive acoustic monitoring (24/7 sonobuoys)

### Future predictions

- Results consistent with recent publications predicting a regime shift
  - Shift may have already begun
- Two scenarios based on winds
  - Generalist feeders might be okay
  - Specialist feeders (like walrus) will not do well
  - Ambient noise levels will increase



### Key Findings



### Marine Mammals

See Jessica Crance Poster Bay1/17

Bowheads and belugas undergo predictable seasonal migrations – strongly correlated with month and ice concentration



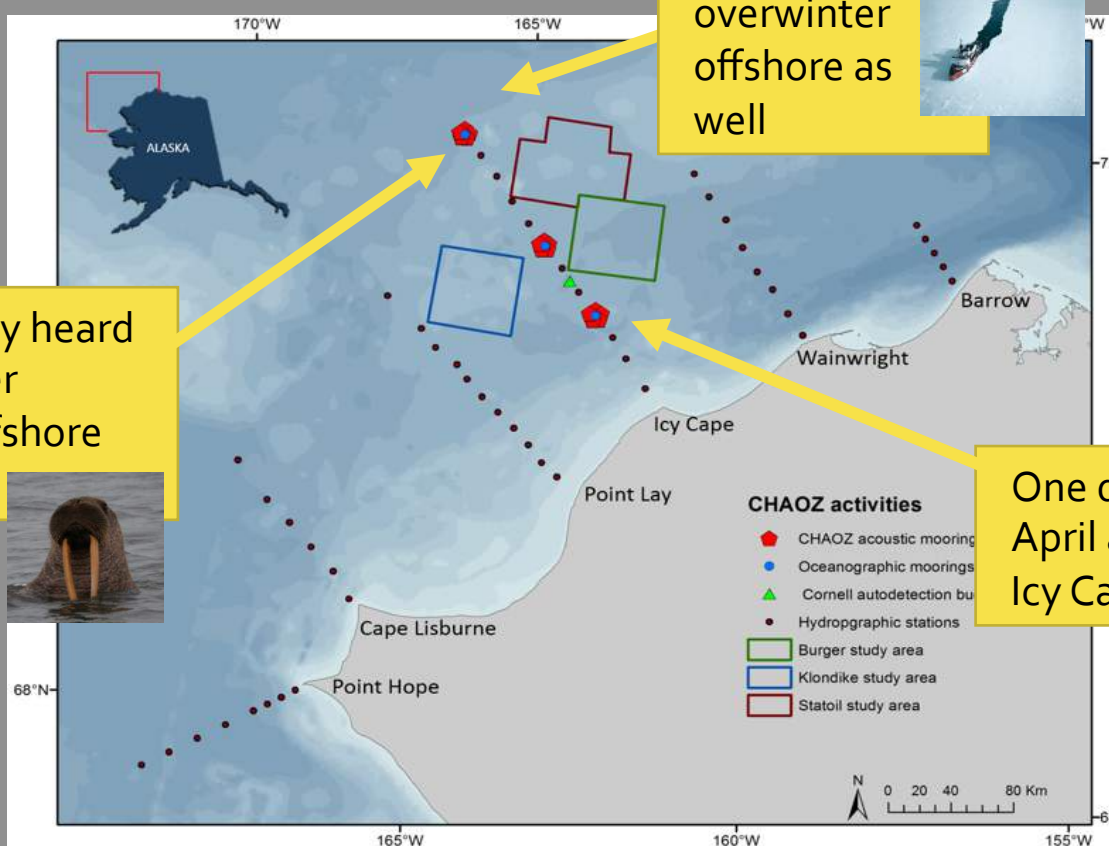
- Calling...
  - Ceased when ice thickness was > 0.5m
  - Correlated with winds from SSW (ice arrival/tailwind?)
  - Trimodal distribution (fall 2020 – age/sex cohorts?)
  - Gunshot call type correlated with ice formation (Navigation aid/migratory assembly signal?)



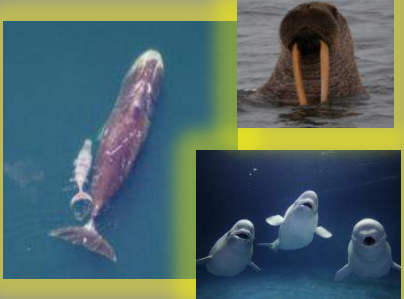
- Two population move through area
  - Ellen Garland working on repertoires
  - Icy Cape close to important molting/ breeding lagoon.



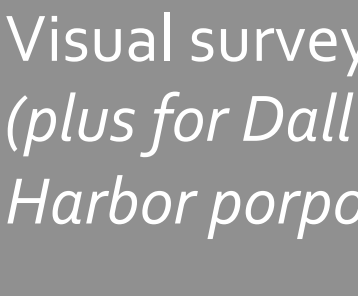
- Gray whales strongly correlated to prey availability (ammonium/zoops)



### Techniques: Acoustic vs. Visual ?



Comparable results (no beluga seen or heard)

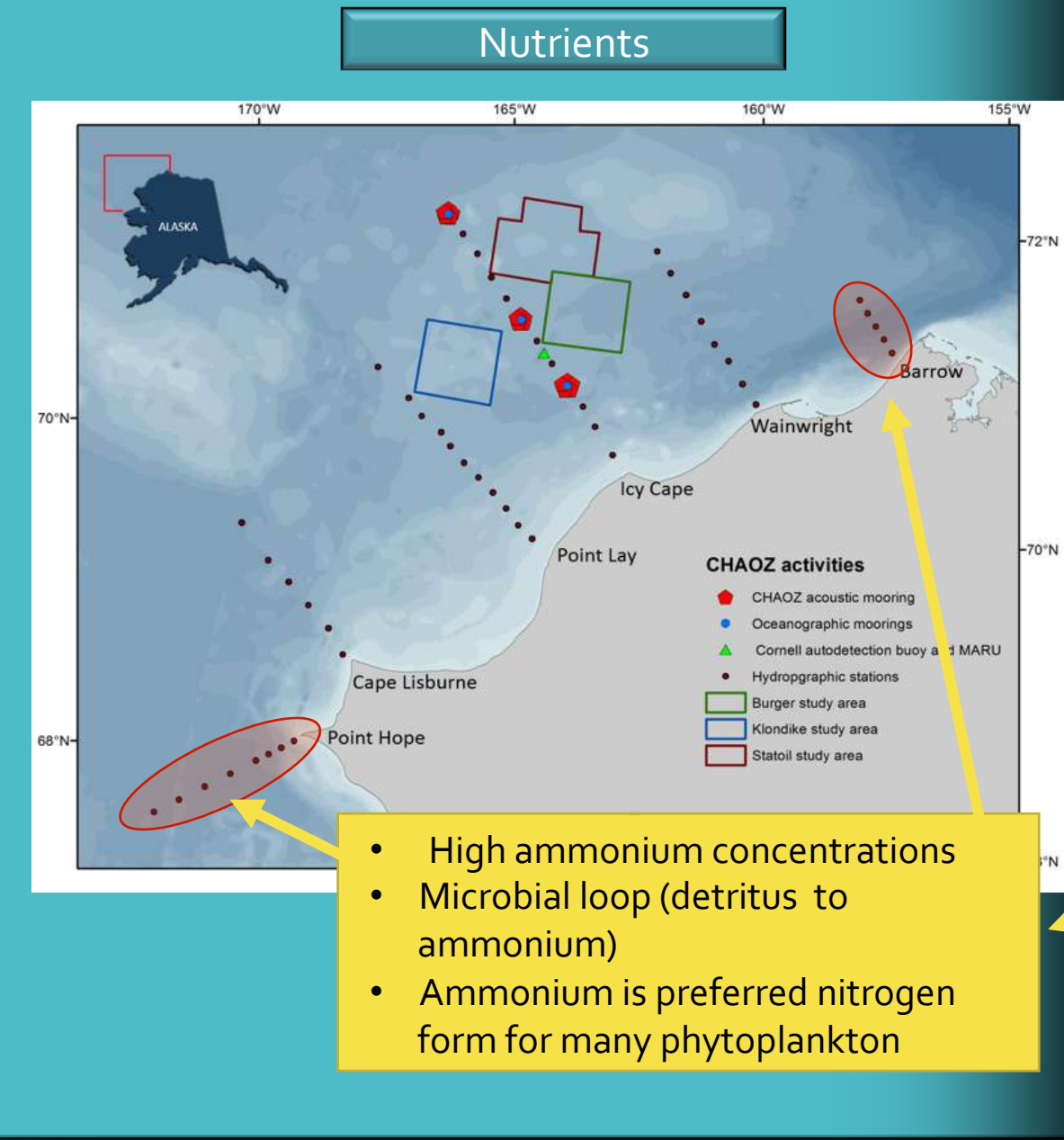


Visual survey better (plus for Dall's and Harbor porpoise)

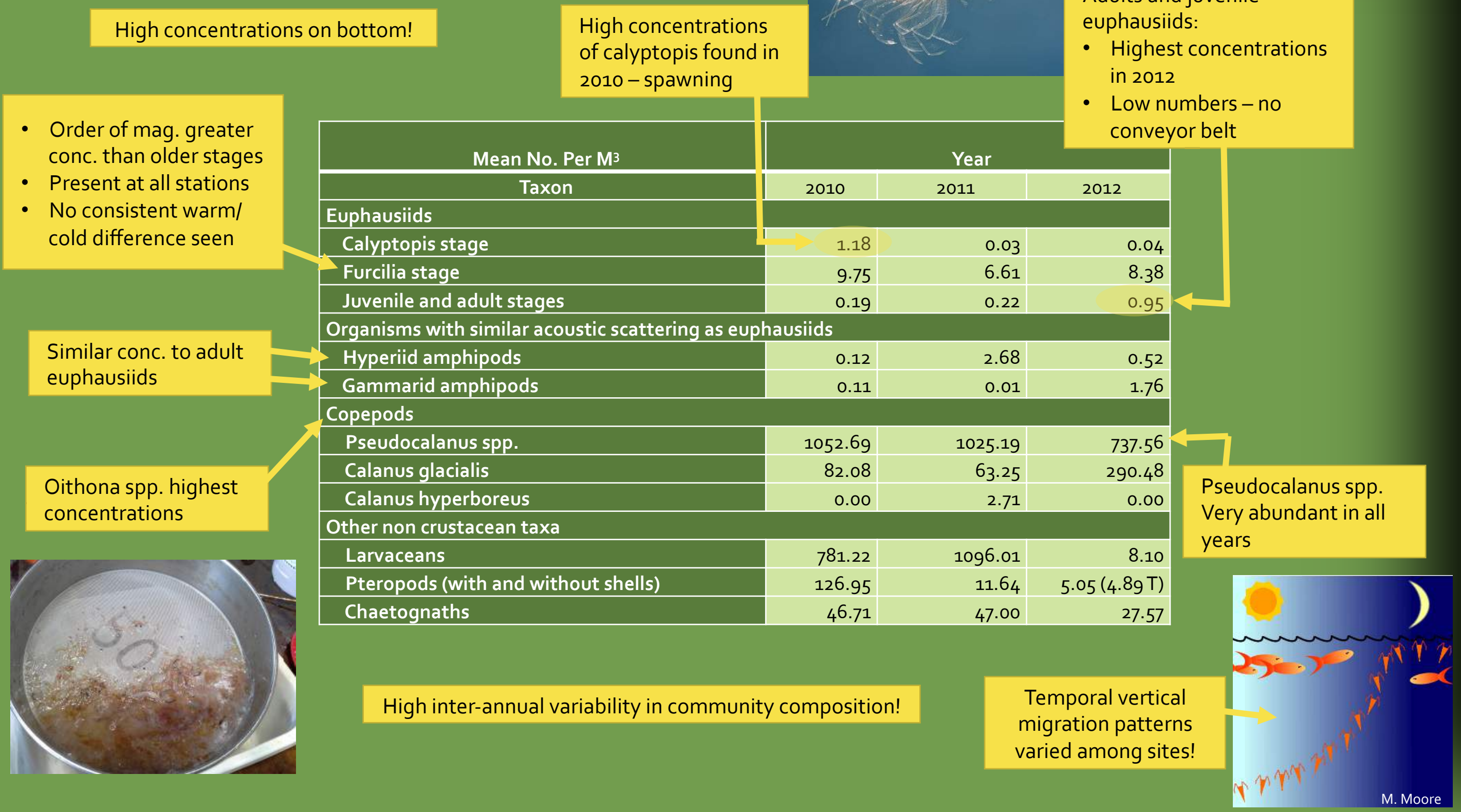
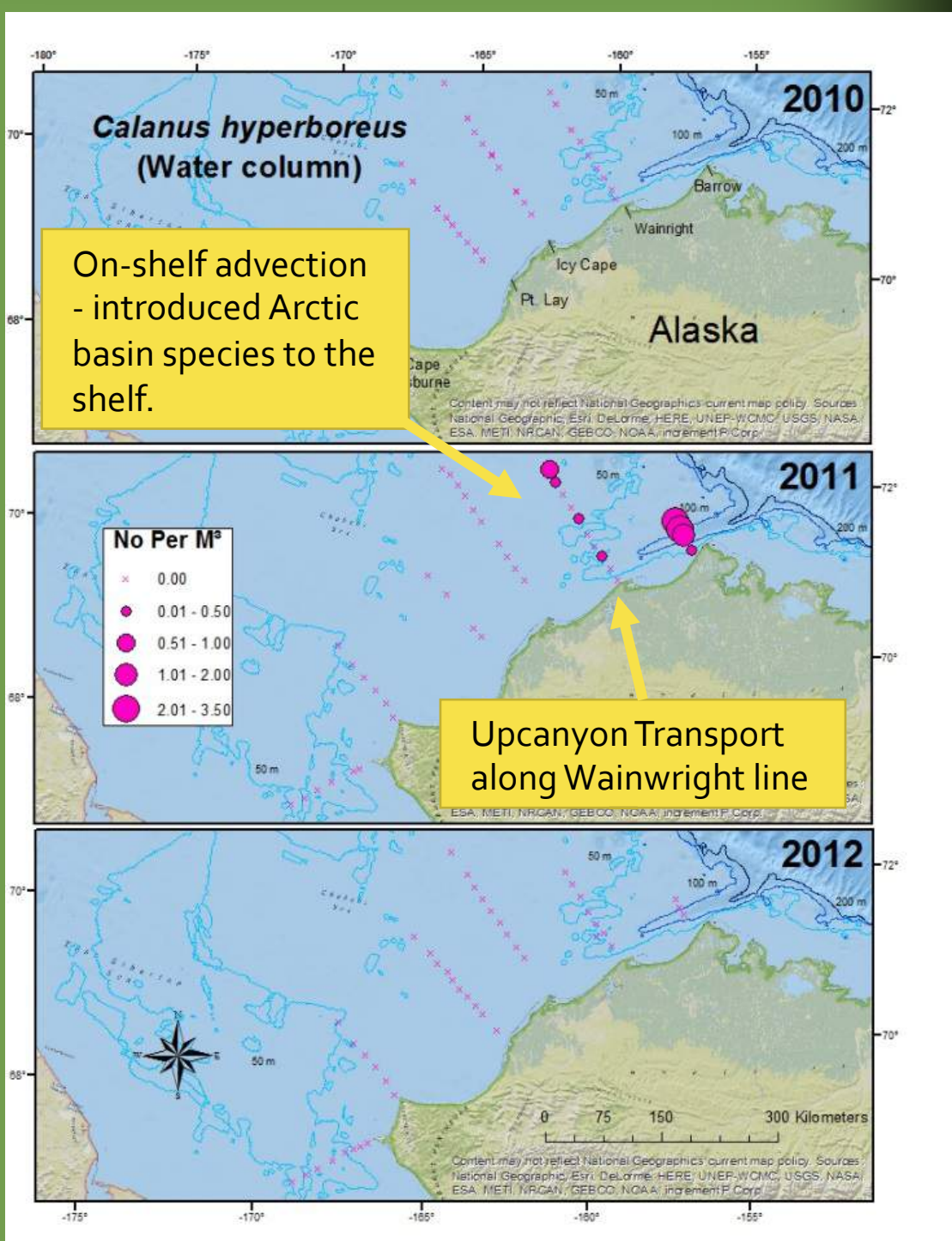


Passive acoustics better (fin whale acoustic detection off Barrow Canyon)<sup>2</sup>

Crance et al. 2015, Polar Biology



### Zooplankton



### Report

The CHAOZ final report can be found at: <http://www.afsc.noaa.gov/nmml/cetacean/chaoz.php>

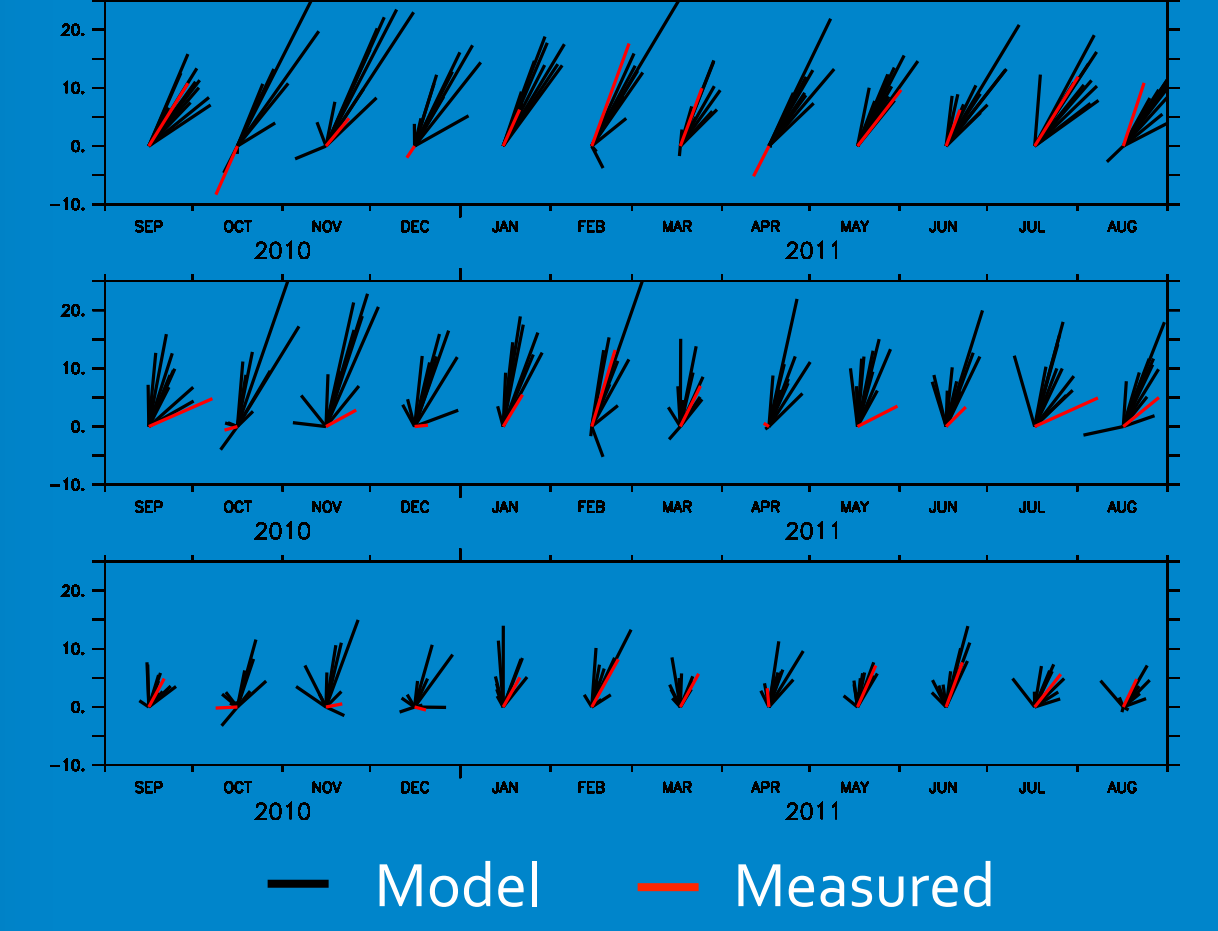
### Climate Modeling

National Center for Atmospheric Research (NCAR) climate model (Community Earth System Model: CESM1.0) was run using the sea ice extents from 2007/2008 as initial conditions.

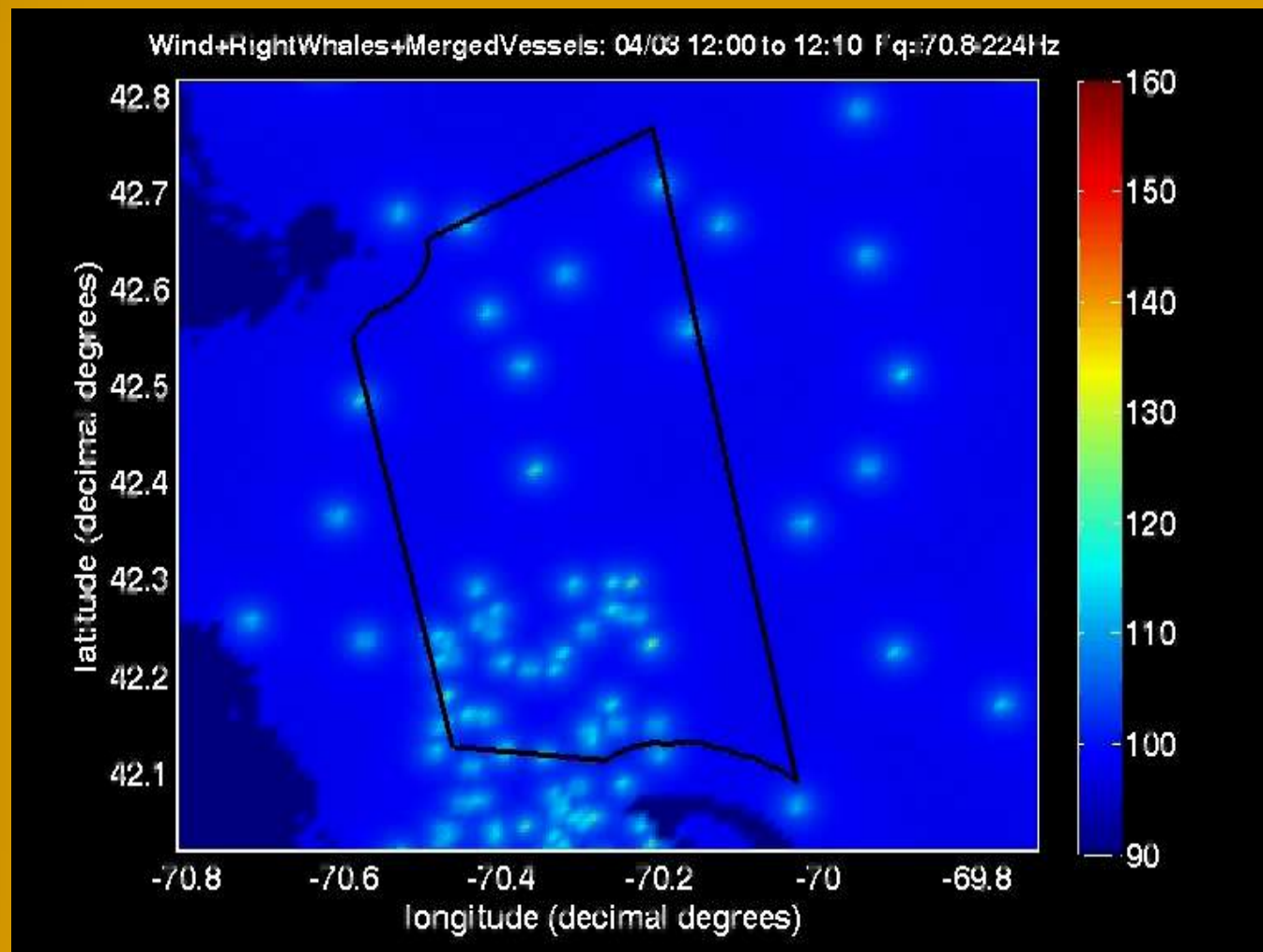
- Predictions:
- Late arrival of ice in fall and early ice retreat in spring
  - Dismal ice coverage
  - Large inter-annual variability in ice thickness

In addition to sea ice, the CESM1.0 was run to predict ocean conditions, like currents.

### Magnitude and Direction of Ocean Current



### Noisy Humans



A noise model, similar to the one developed for Cape Cod Bay, is being developed for the Chukchi Sea.



An autodetection buoy was deployed for the first time in the Arctic (Sept 1 – Nov 1, 2012)

- Detected and transmitted biotic and abiotic signals via satellite in near-real time
- Monitor for ambient noise levels – possible future mitigation tool for cumulative noise impacts

### Acknowledgments

The authors would like to thank the Captain and crew of the F/V Alaskan Enterprise, F/V Mystery Bay, and F/V Aquila, as well as Jeff Leonhard, Ed Rainey, Todd Mequet, and Edgar Brown (Naval Surface Warfare Center, Crane Division), Theresa Yost (Naval Operational Logistics Support Center), Capt. Robin Fitch (I&E Director Marine Science, Office of the Assistant Secretary of the Navy) for providing sonobuoys. We also thank all field crew and analysts.