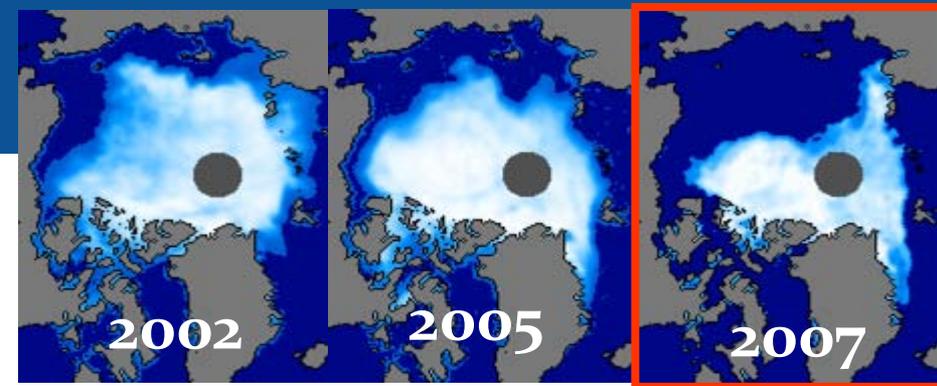




The Arctic Research Program: Status and Future 2015-2025



Kathleen Crane, NOAA
Arctic Research Program



Arctic Research Program Climate Observation Division

Kathleen Crane

GOALS: 2004-2014

- To understand the causes and consequences of climate change in the Arctic.
- To capture the transition of the Arctic from an ice covered ocean to an ocean where ice may disappear in the summer.
- To facilitate and deploy Arctic system-wide observing tools to track:
 - Arctic atmospheric changes and impacts
 - ice-ocean-ecosystem changes and impacts



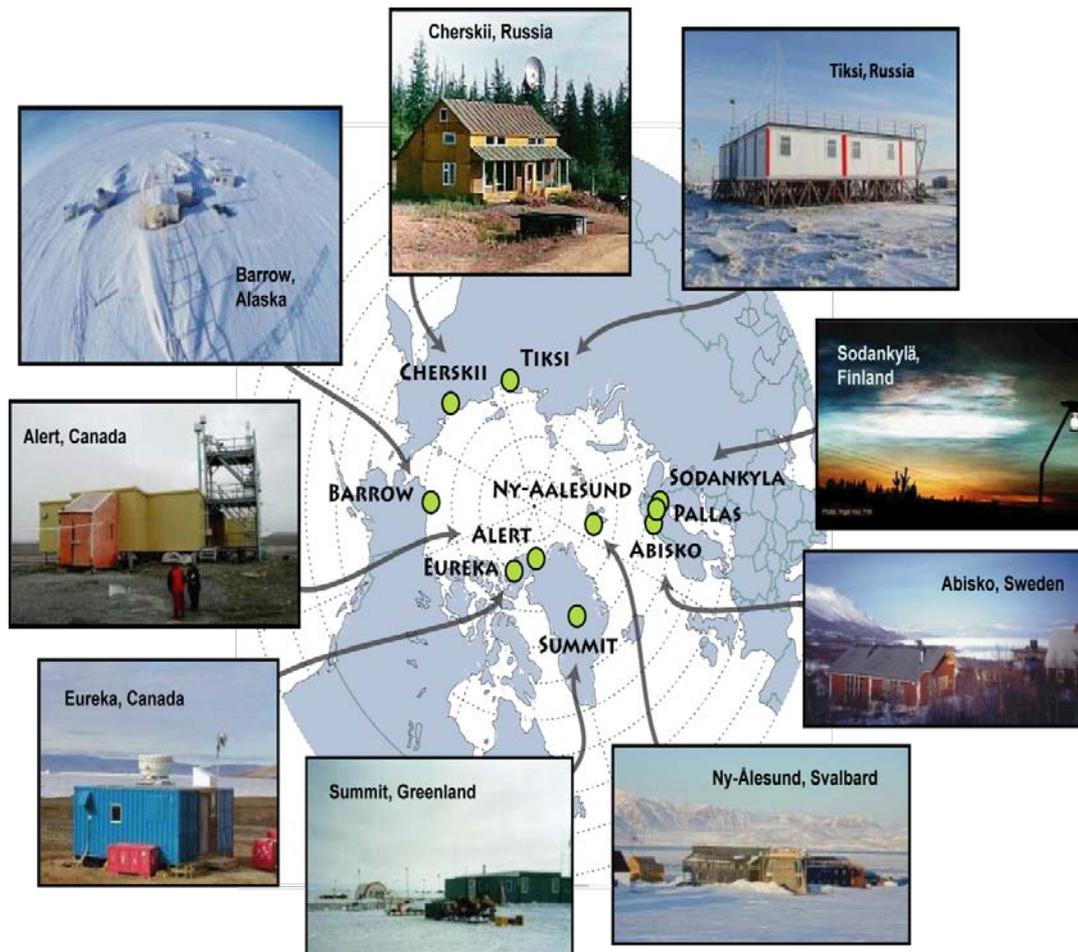
U. S. Strategic Partners:

OAR OER, ESRL, PMEL, GLERL, AOML, GFDL
NOAA Lines NMFS-AFSC, NESDIS-NIC, NOS-AOOS
Interagency NSF, ONR, FWS, BOEM, NASA, USGS
US Academia UAF, WHOI, UW, UMD, OSU, Cis

International Strategic Partners: Arctic Council countries, China, Korea, Japan

Unique Value - International

Arctic Climate Observatories, IASOA



- How does Arctic atmosphere interact with the rest of the Arctic (marine, ice and terrestrial) system?
- Which recent changes in the Arctic climate contribute to severe weather events in the middle latitudes?
- In 2014 6 of the Arctic Observatories recorded methane concentrations of > 400 ppm

Co funding from Canada, Russia, Finland, Norway, Sweden, Denmark, NSF, NOAA
T. Uttal Lead for NOAA



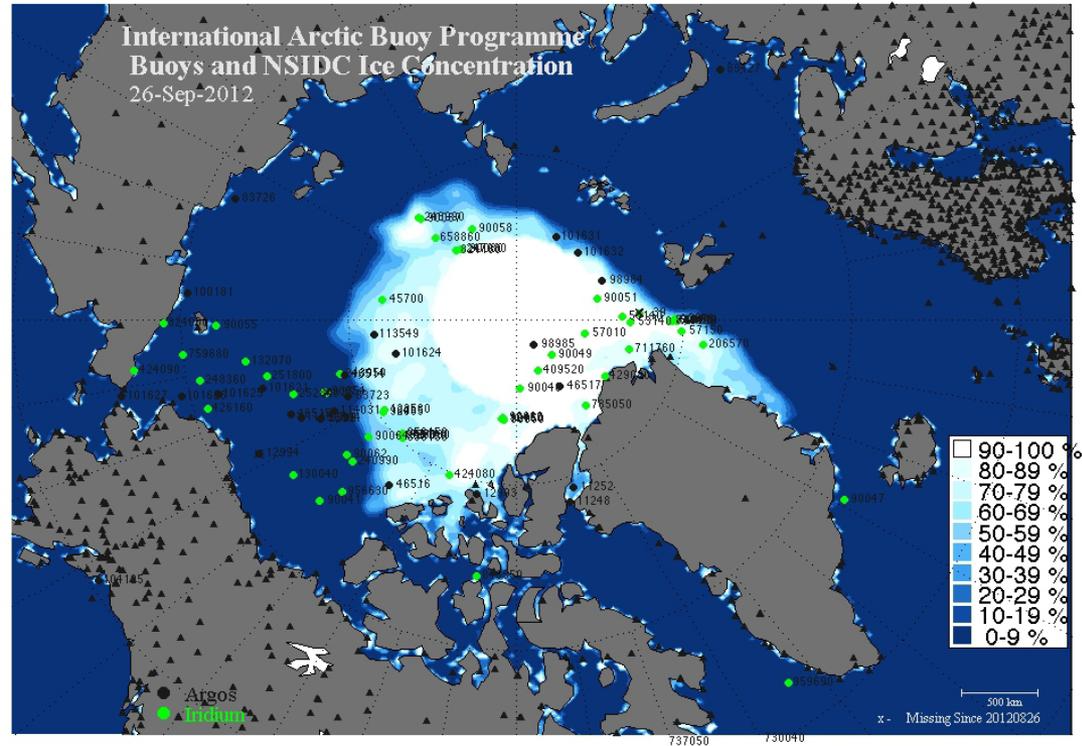
1. Monitor fresh water, heat, nutrient fluxes through the Bering Strait
2. Monitor ecosystem indicators of climate change in the Pacific Arctic
3. Model and forecast changes in ecosystems and Arctic wide physical systems

In 2014, RUSALCA operated completely from a Russian port and redeployed the Western Bering Strait Mooring with the aid of PMEL, NOAA



Partnering Success: the International Arctic Buoy Programme and Ice Mass Balance Studies

- CRREL (4 IMB's and 1 ice thickness sonar)
- IABP (10 buoys a year)
- Collaboration with NIC, NSF, ONR and many Arctic countries



Sea Ice thinning from ocean heat transported through the Bering Strait; and consequent new air-sea interactions.

Arctic Report Card: Update for 2013

Tracking recent environmental changes

Unique Product-
Arctic Report Card

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SEA ICE & OCEAN

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Sea Ice Biota

Marine Fishes

Benthic Communities

TERRESTRIAL ECOSYSTEMS

Vegetation

Muskoxen

Caribou & Reindeer

TERRESTRIAL CRYOSPHERE

Snow

Glaciers & Ice Caps

Greenland Ice Sheet

Lake Ice

Permafrost

What's new in 2013?

There were fewer snow and ice extremes than in 2012. Many regions and components of the Arctic environment were closer to their long-term averages, but the effects of a persistent warming trend that began over 30 years ago remain clearly evident.

The impacts of the warming climate on the physical environment during those 30 years are influencing Arctic ecosystems on the land and in the sea.

Highlights

Summer surface air temperatures were particularly low across the central Arctic Ocean, northern Canada and Greenland relative to 2007-2012 (a period of pronounced summer sea ice retreat), and were somewhat lower than the long-term average of 1981-2010.

Snow extent in May 2013 reached a new record low in Eurasia, while Northern Hemisphere-wide snow extent was below average for spring (April, May, June).



Minimum sea ice extent in September 2013 exceeded the record low of 2012, but was the 6th lowest since observations began in 1979 despite the relatively cool summer of 2013. The seven lowest minimum ice extents have occurred in the last seven years, 2007-2013.

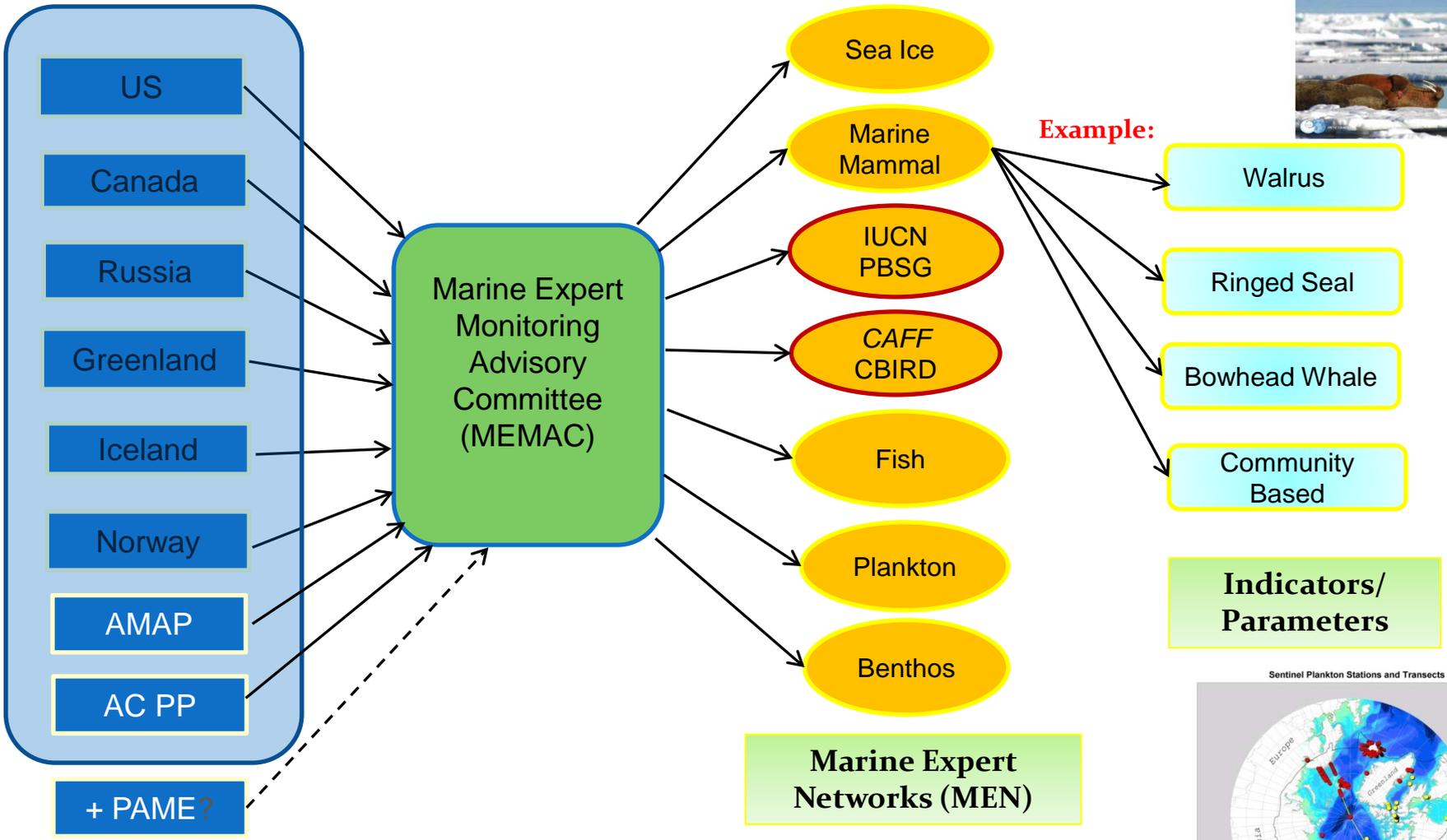
Arctic tundra vegetation greenness (a measure of productivity) and growing season length have continued to increase since observations began in 1982.

Large land mammals convey a mixed message, with muskox numbers stable/increasing since the 1970s, while many caribou and reindeer herds currently have unusually low populations for the period 1970-2013.

Changes in fish and bottom dwelling organisms include continued northward migration of species not previously seen in the Arctic.

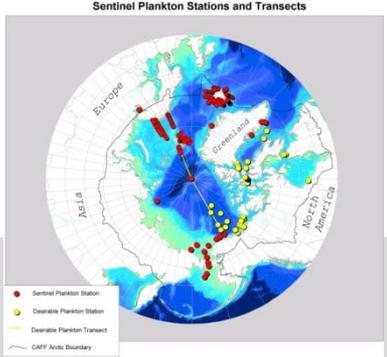


The ARCTIC COUNCIL's Arctic Marine Biodiversity Monitoring Plan



**Indicators/
Parameters**

**Marine Expert
Networks (MEN)**



GOALS: 2015-2025

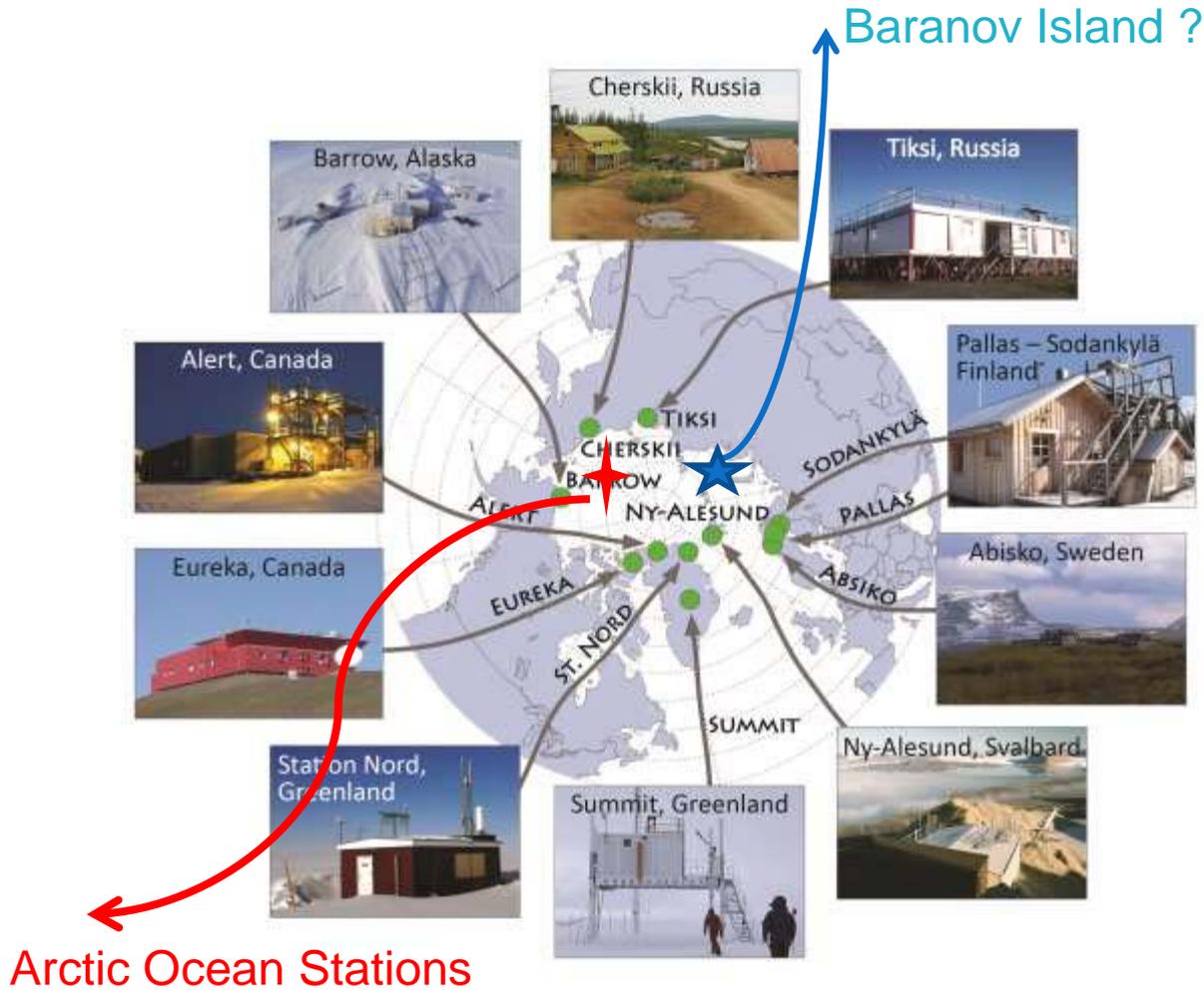


1. Expand IASOA into the Arctic Ocean
2. Continue repeat sampling of three transects in the Chukchi Sea
3. Expand RUSALCA northwards
4. Design and implement Pacific Arctic ocean climate lines
5. Provide data to modelers of global environmental response to Arctic change



Goal 1: 2015-2025

Facilitate new Atmospheric Observations above the Arctic Ocean

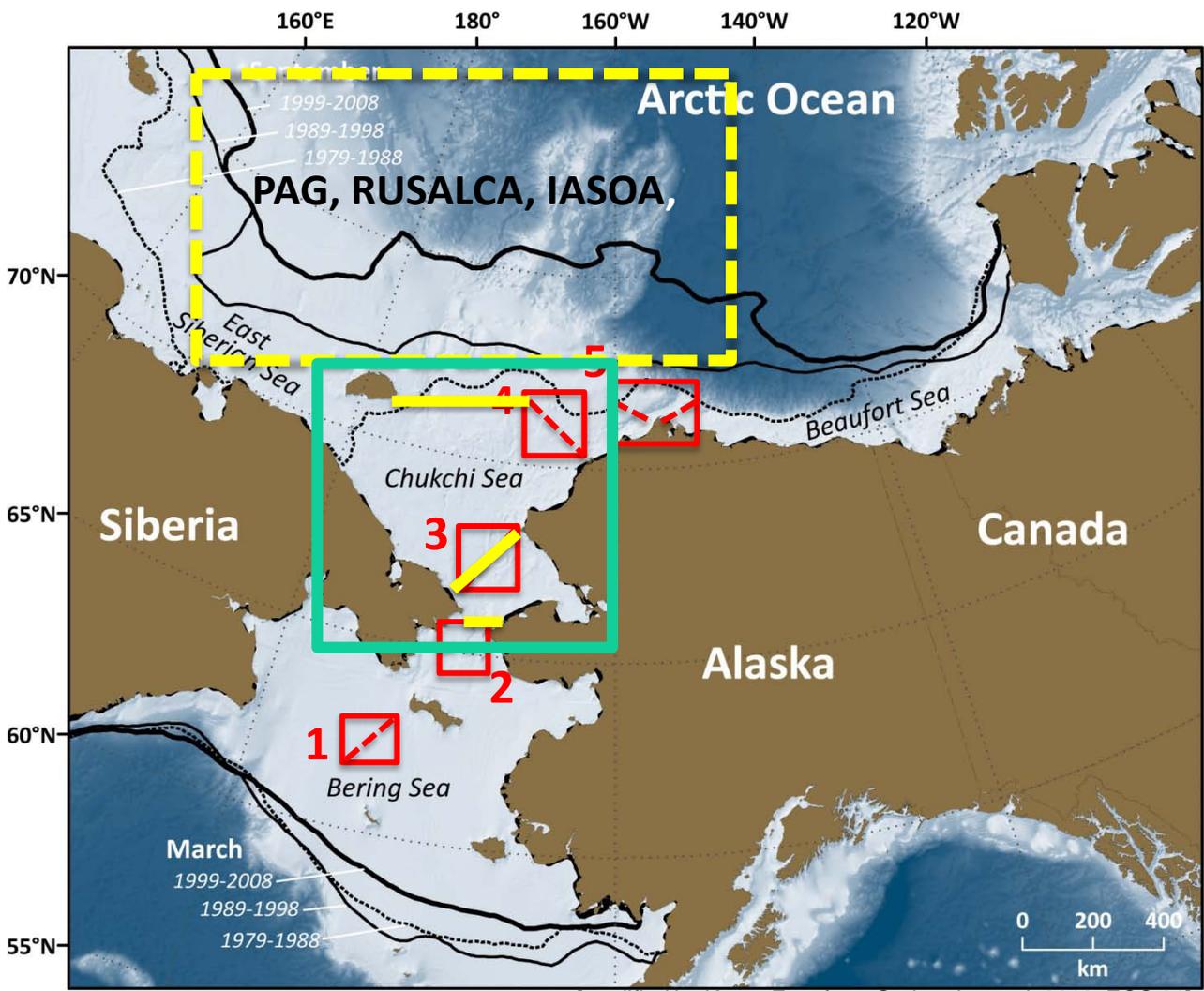


TIKSI



Taneil Uttal, Lead, ESRL

Goal 2. Continue repeat sampling of three transects in the Chukchi Sea, Goal 3. Expand RUSALCA northwards



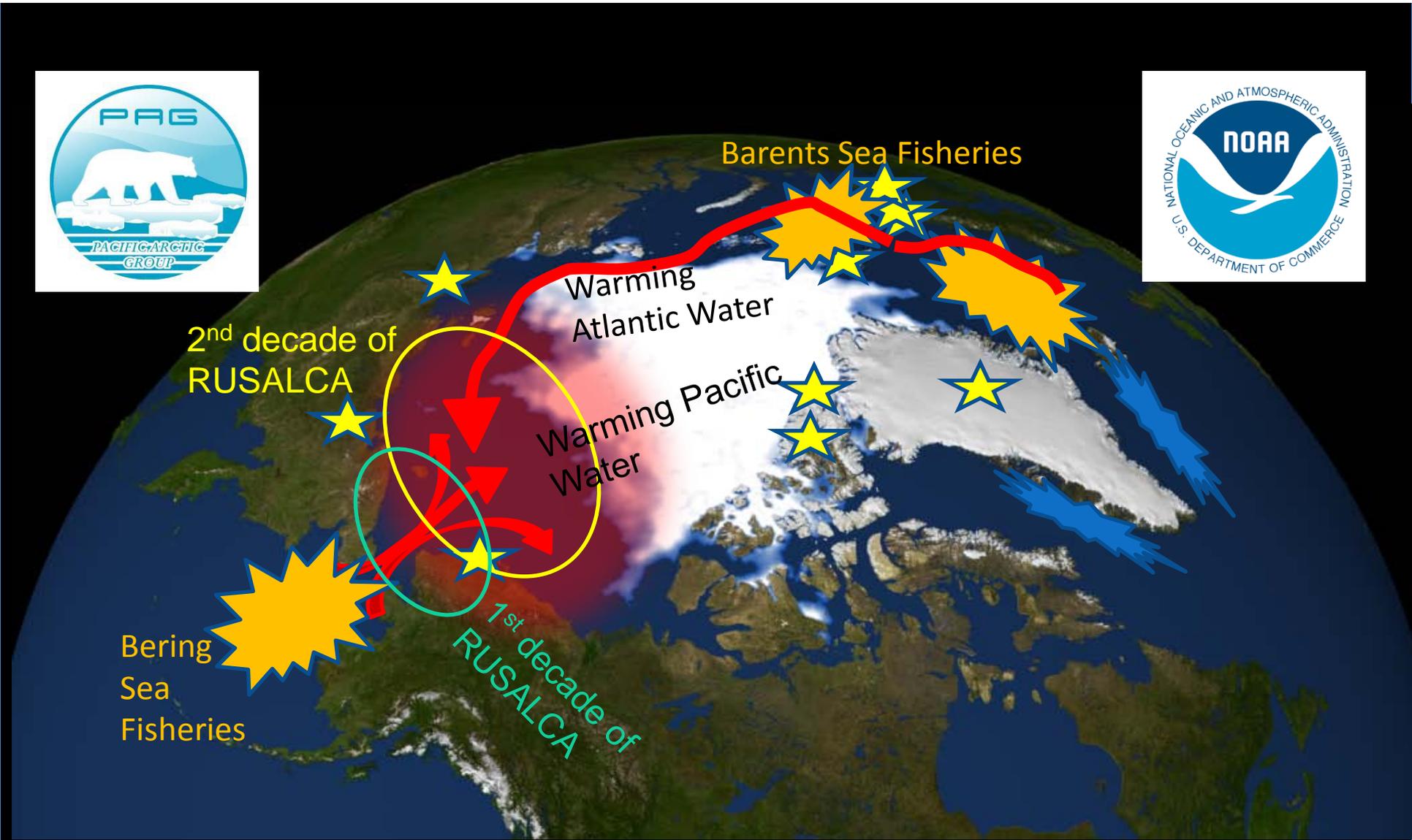
- DBO sites (red boxes) are regional “hotspot” transect lines and stations
- Chukchi sites are considered to exhibit high productivity, biodiversity, and overall rates of change
- Green Box sites indicate RUSALCA, DBO, Geotraces transects, 2015-2020
- 2015-2020 sites occupied by national and international entities with shared data plan (Yellow Box)

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

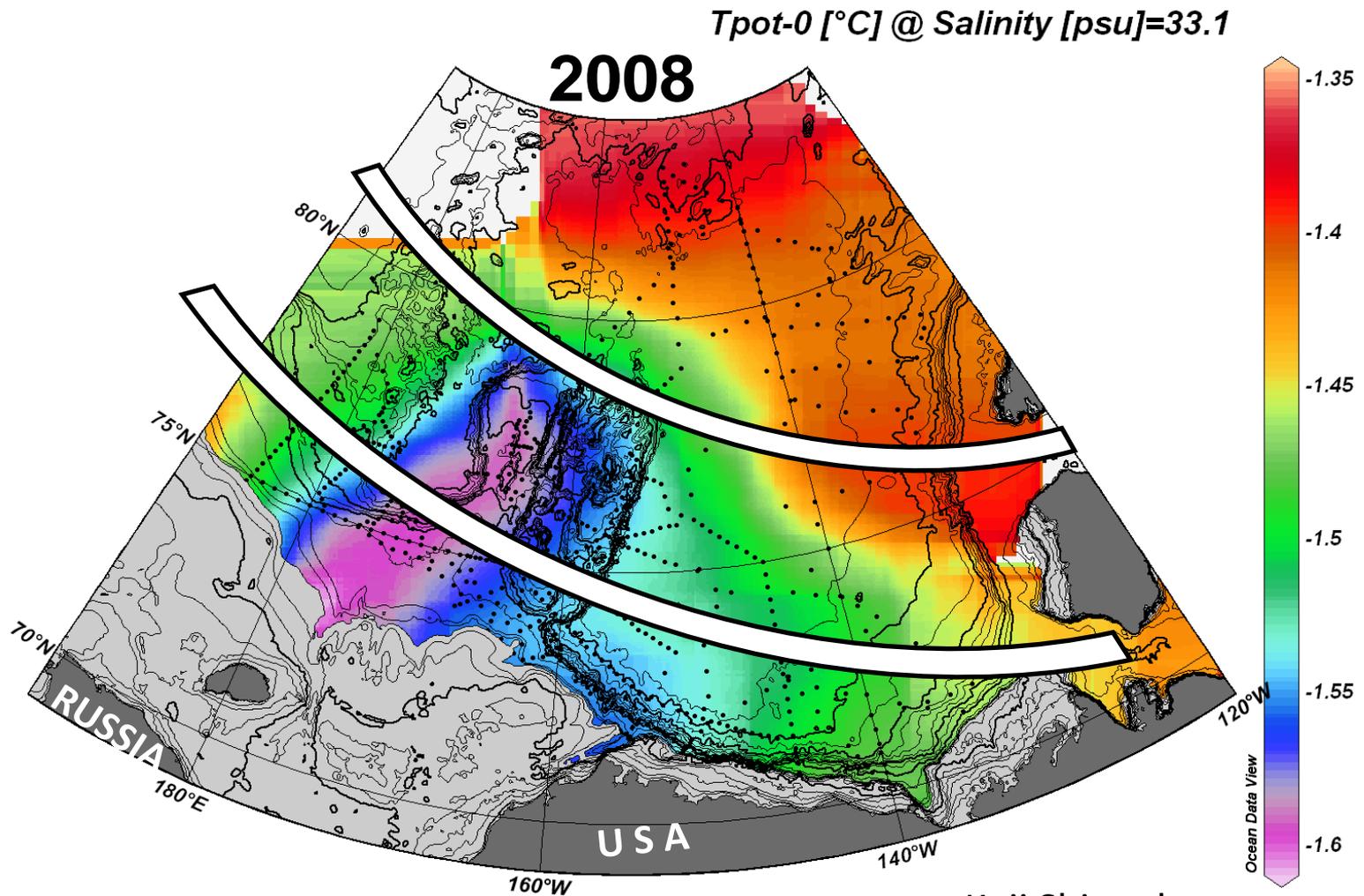




Goal 3: Expand RUSALCA northwards to observe the Pacific Arctic hot spot.



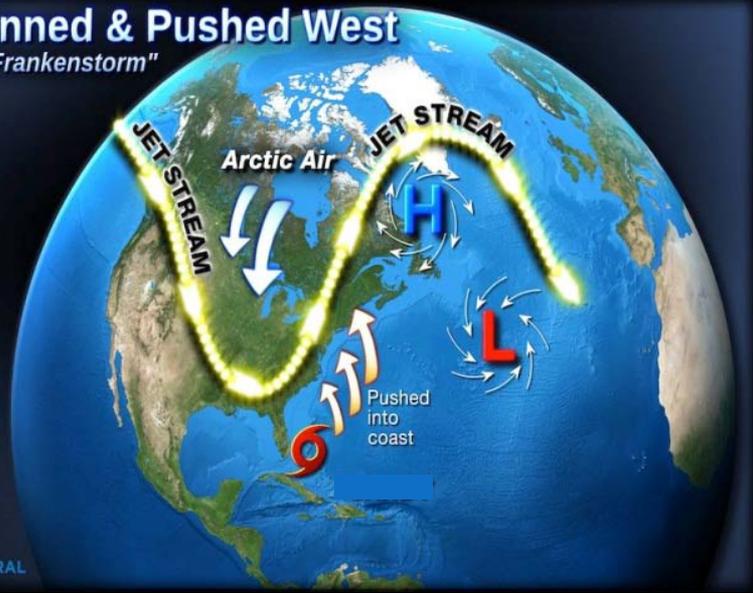
Goal 4: Design Pacific Arctic Ocean Climate Lines with the Pacific Arctic Group (China, Korea, Japan, Russia, Canada and the USA)



Koji Shimada

Sandy Pinned & Pushed West

Makings of a "Frankenstorm"

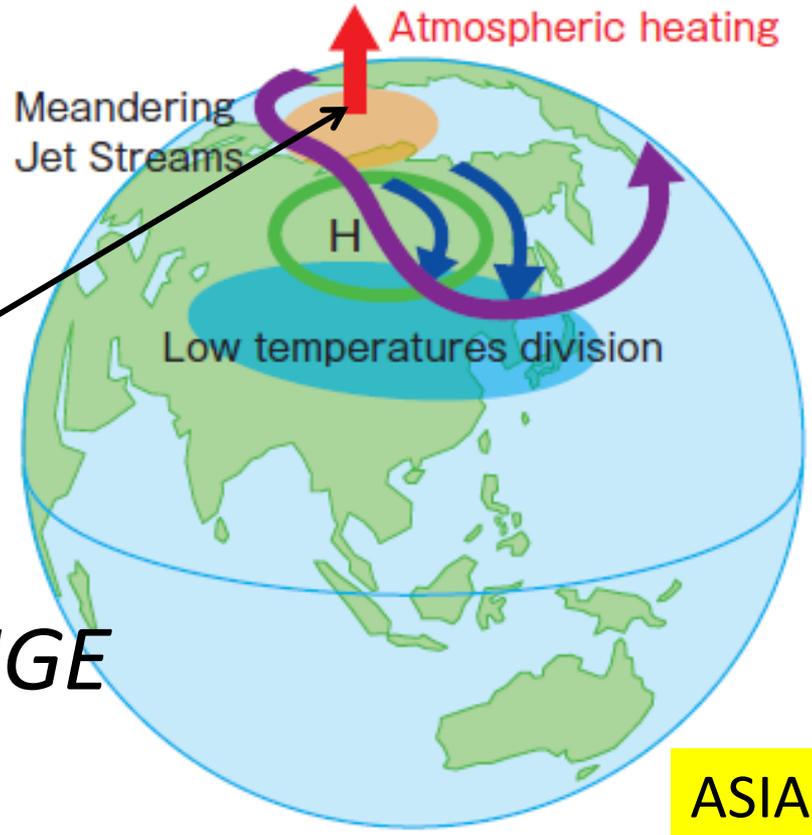


NORTH AMERICA

NEED OBSERVATIONS FROM THE PACIFIC ARCTIC HOT SPOT

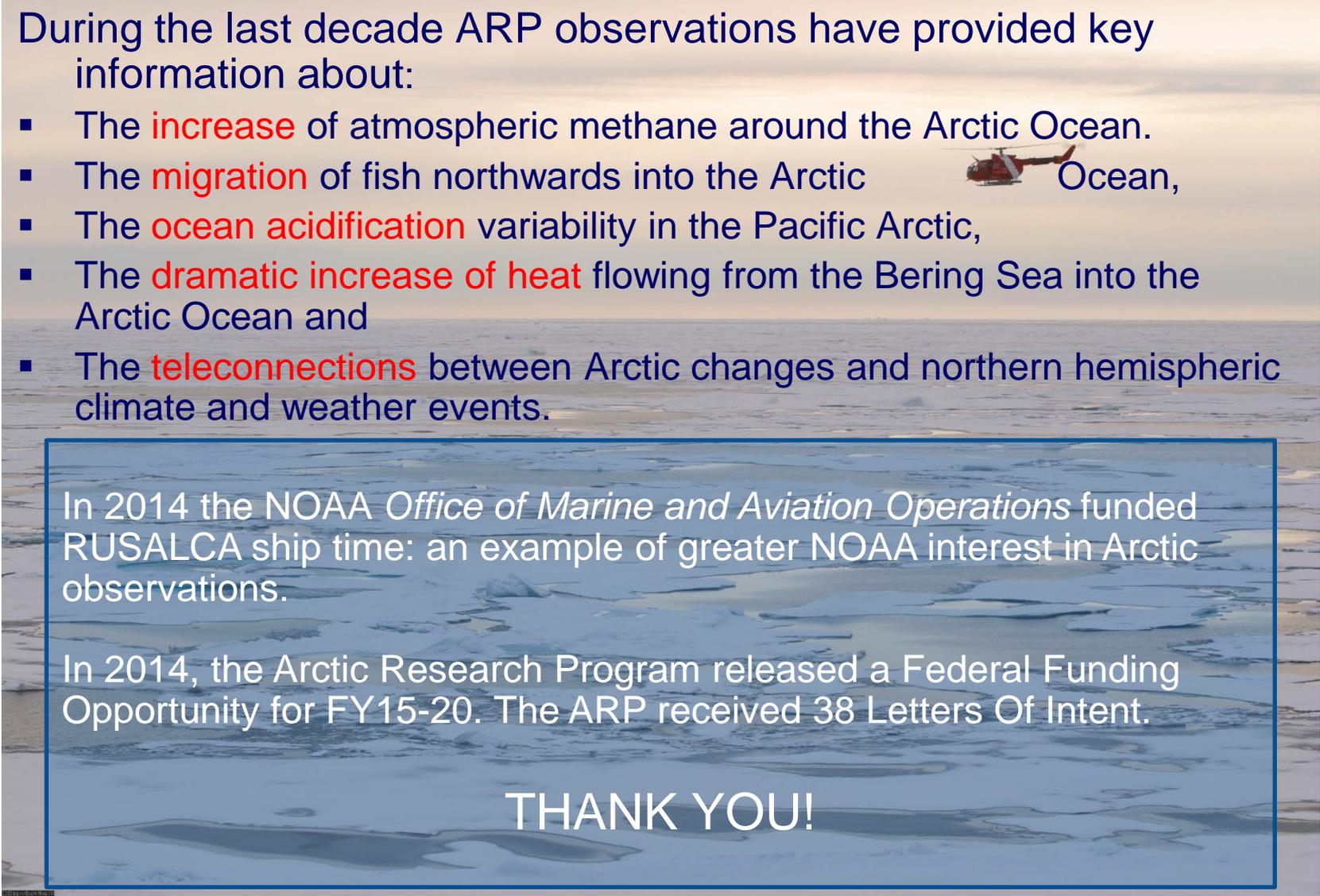
Goal 5: Provide data to modelers of Global Environmental response to Arctic change

The impacts of Arctic changes on weather and climate in Japan



ASIA

IMPACTS OF ARCTIC CHANGE ON THE MID-LATITUDES



During the last decade ARP observations have provided key information about:

- The **increase** of atmospheric methane around the Arctic Ocean.
- The **migration** of fish northwards into the Arctic Ocean,
- The **ocean acidification** variability in the Pacific Arctic,
- The **dramatic increase of heat** flowing from the Bering Sea into the Arctic Ocean and
- The **teleconnections** between Arctic changes and northern hemispheric climate and weather events.

In 2014 the NOAA *Office of Marine and Aviation Operations* funded RUSALCA ship time: an example of greater NOAA interest in Arctic observations.

In 2014, the Arctic Research Program released a Federal Funding Opportunity for FY15-20. The ARP received 38 Letters Of Intent.

THANK YOU!