

# Diagnosing the Recent Decline in Arctic Sea Ice and Prospects for the Future

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NOAA Earth System Research Laboratory/NCAR Societal  
Impacts Program Seminar Series

July 28, 2008

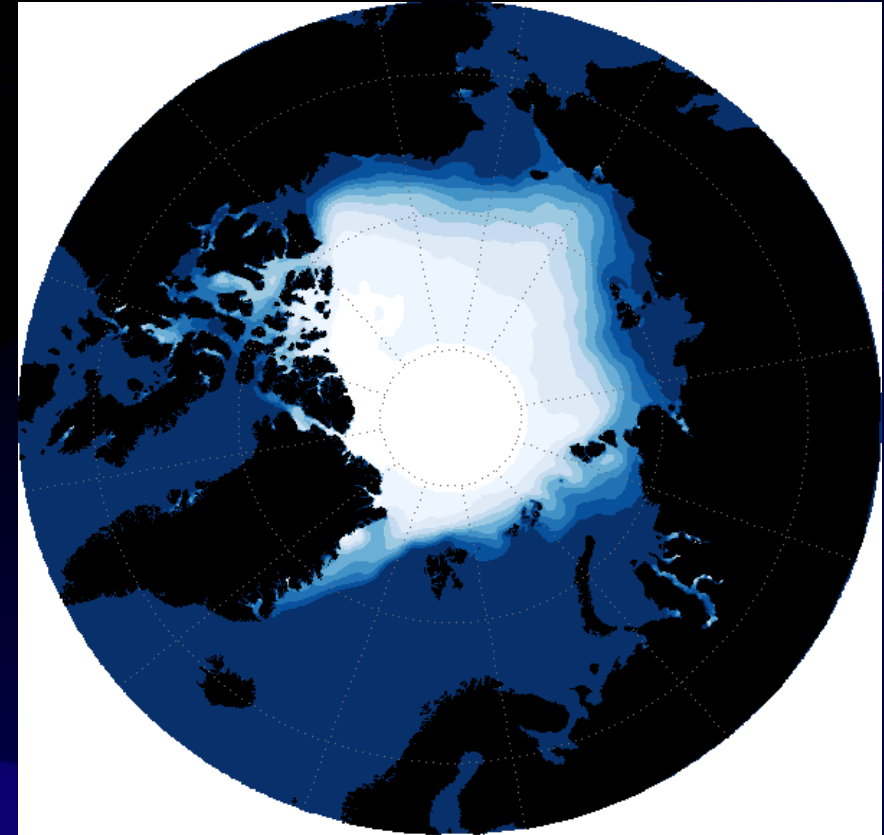
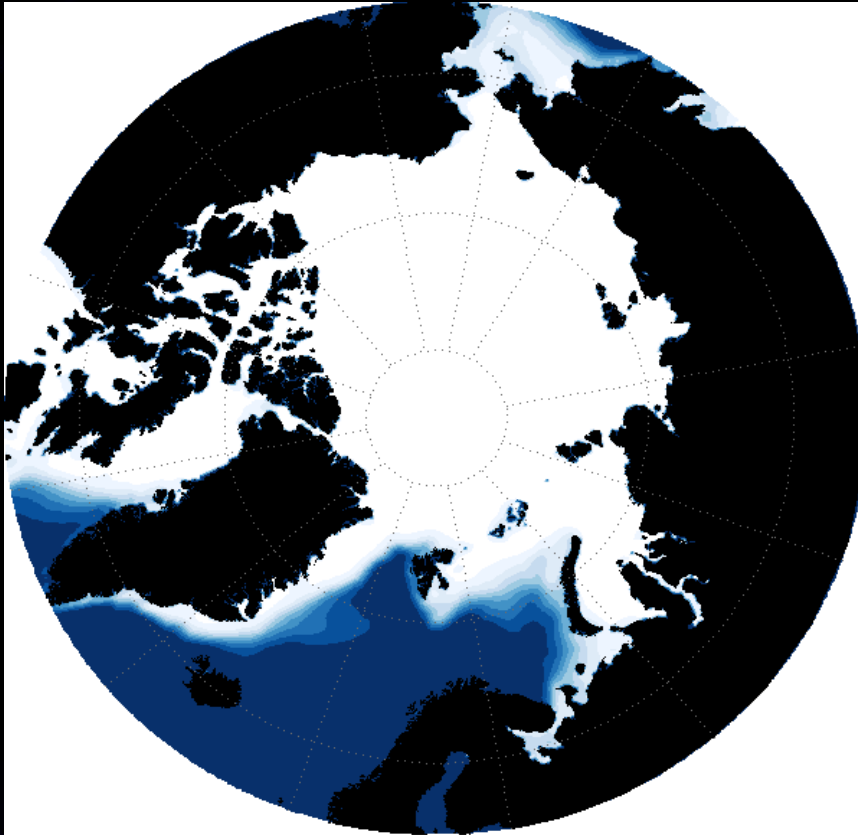
# Outline

- An Arctic sea-ice primer
- Recent changes in Arctic sea-ice
- The impacts of a diminished ice cover

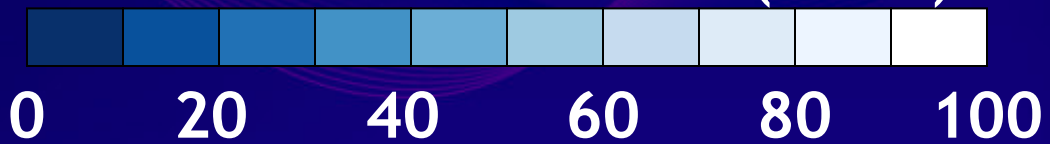
# Sea-ice coverage

Max

Min



Sea-ice concentration (%100)



# FYI vs. MYI



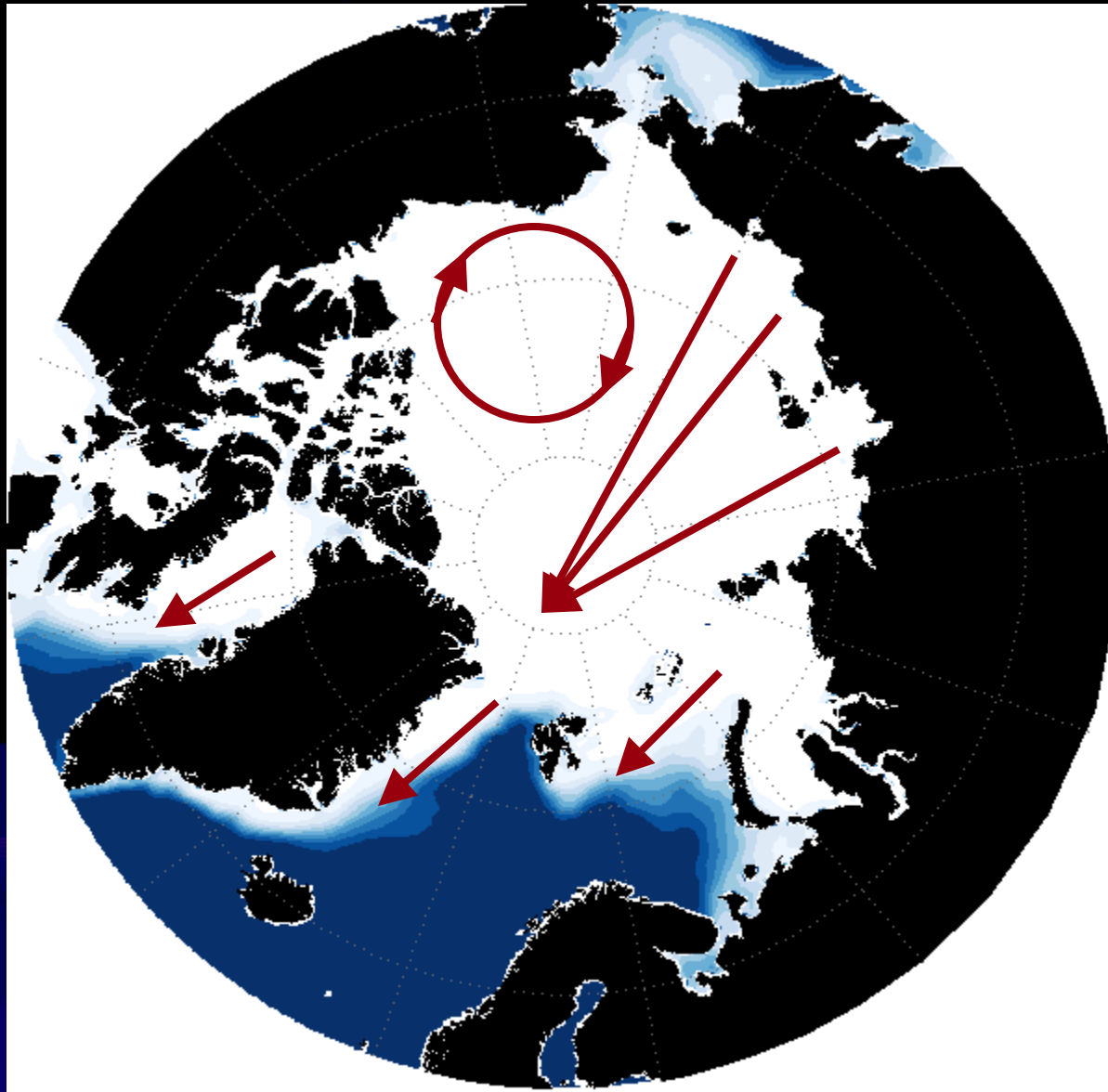
First-year ice



Multiyear ice



# Sea-ice Motion



# Data Collection



Ice camps

Ice breakers



# How reliable is that reading?



**Or this one?**





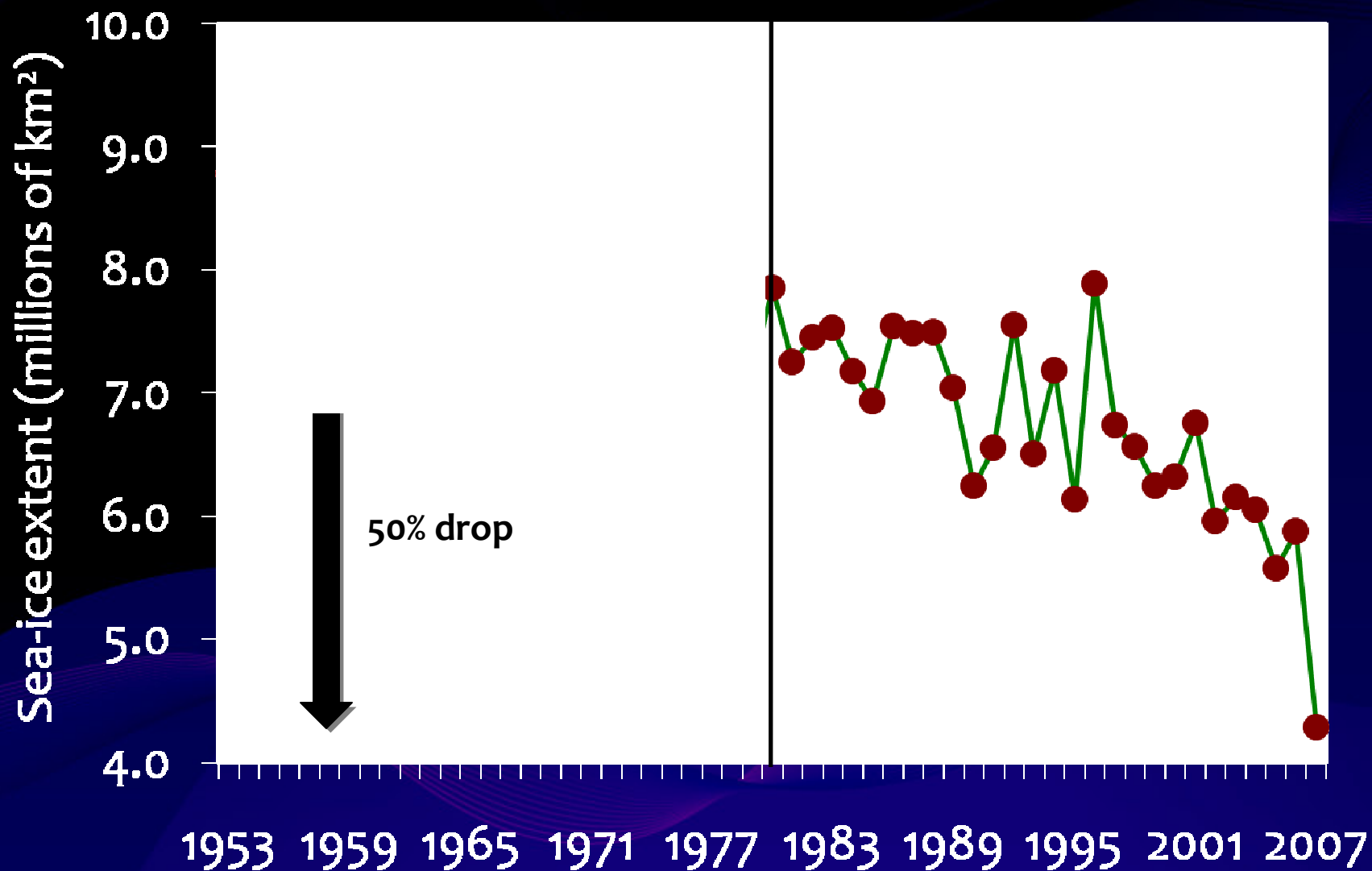
# Life in the field...



The background of the slide is a dark purple to blue gradient with several overlapping, wavy, ribbon-like shapes that create a sense of movement and depth. The text is centered in a white, bold, sans-serif font.

# Recent changes in Arctic sea-ice

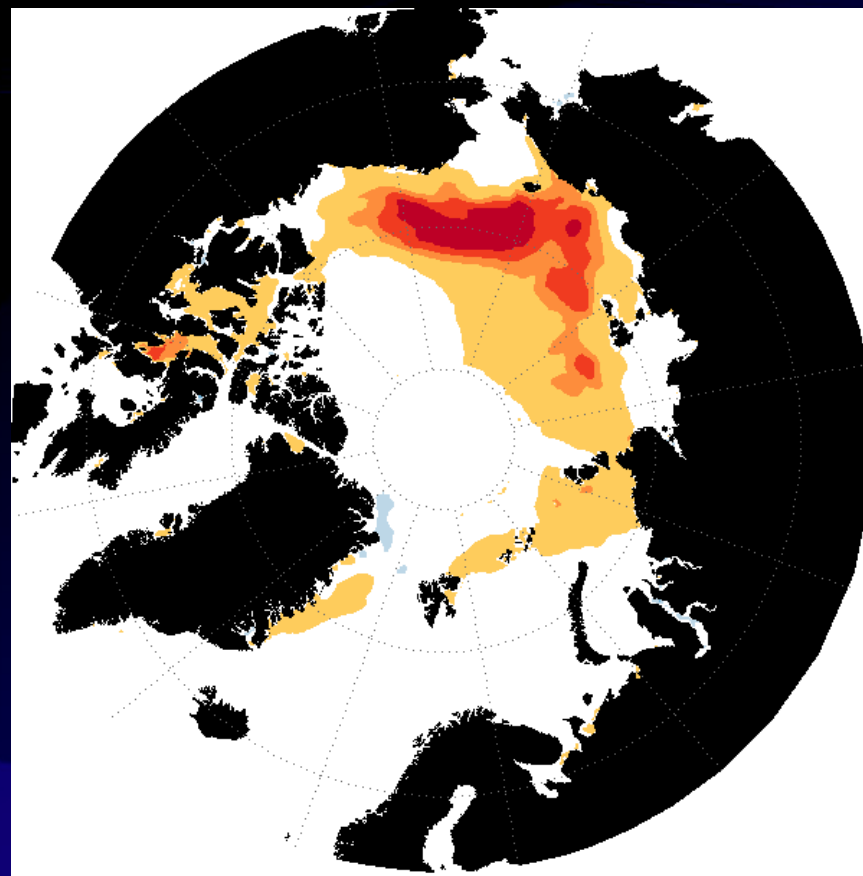
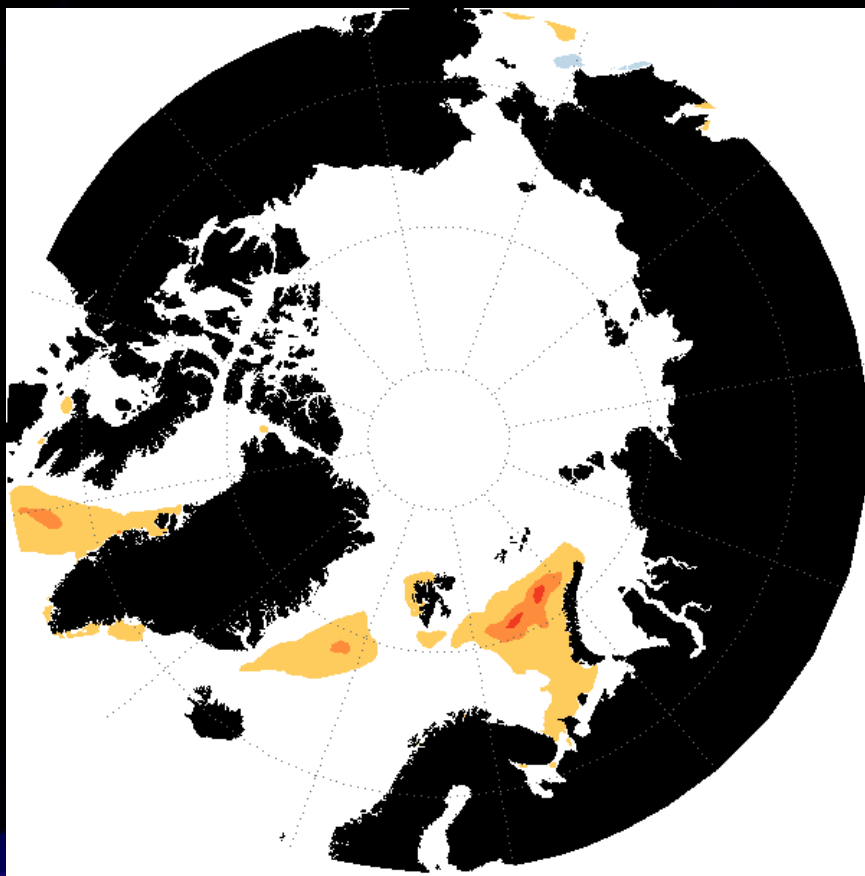
# September sea-ice extent



# Trends in Ice Extent

Mar

Sep



Decadal Trend (%100)



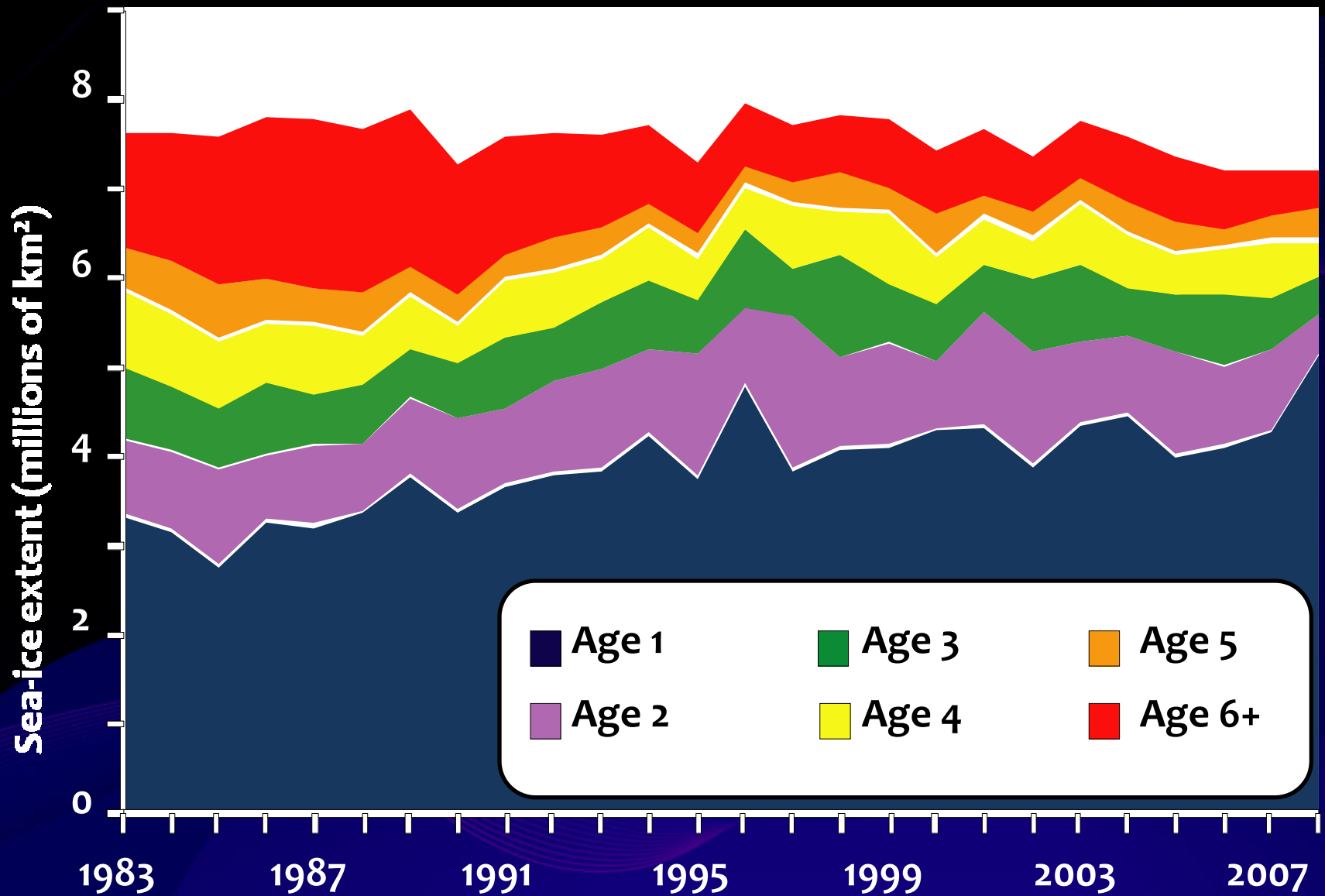
-20

-10

10

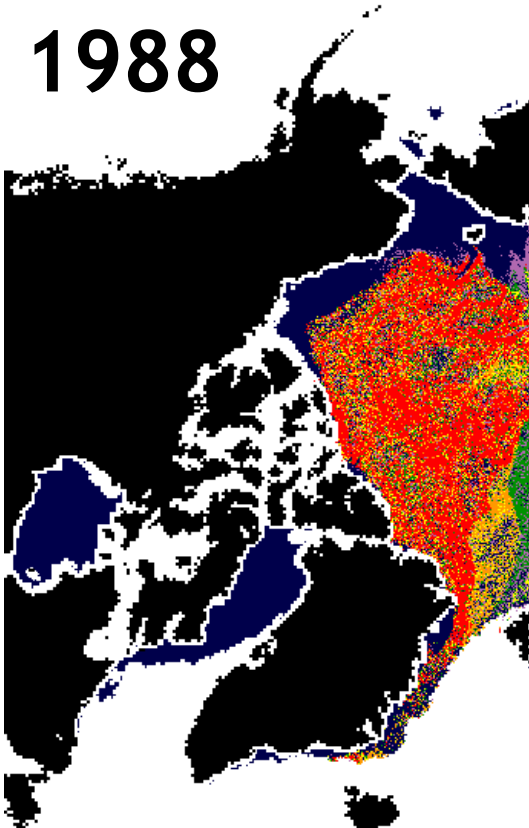
20

# Spring ice age

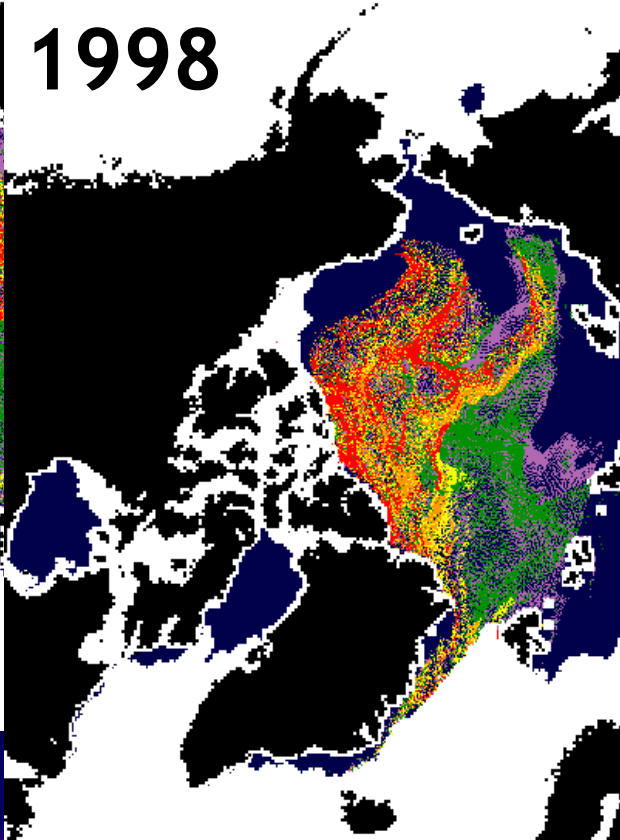


# Spring ice age pattern

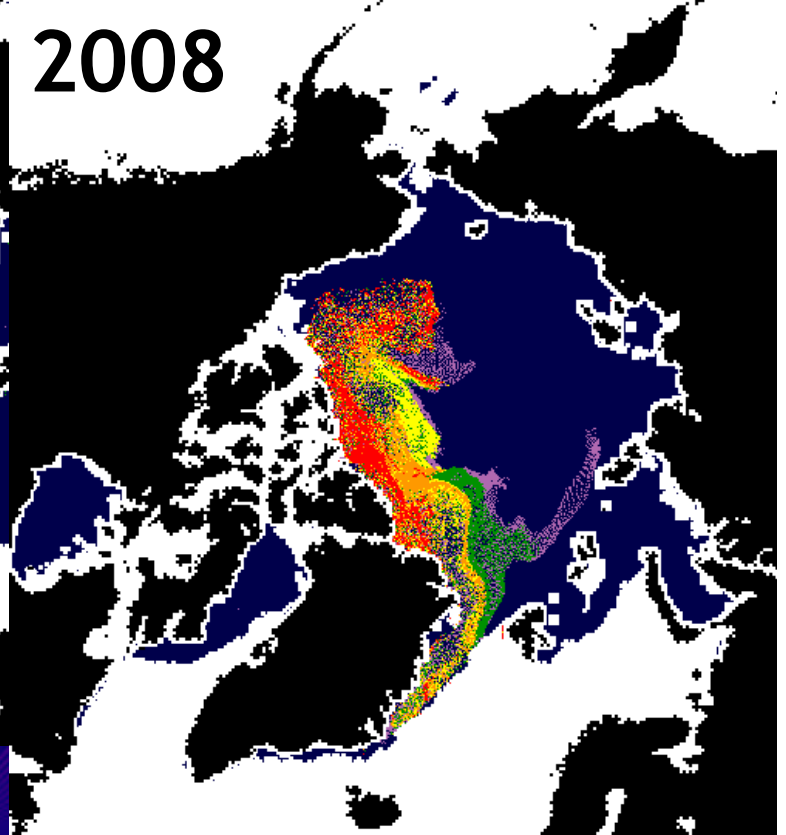
1988



1998



2008



Age 1

Age 3

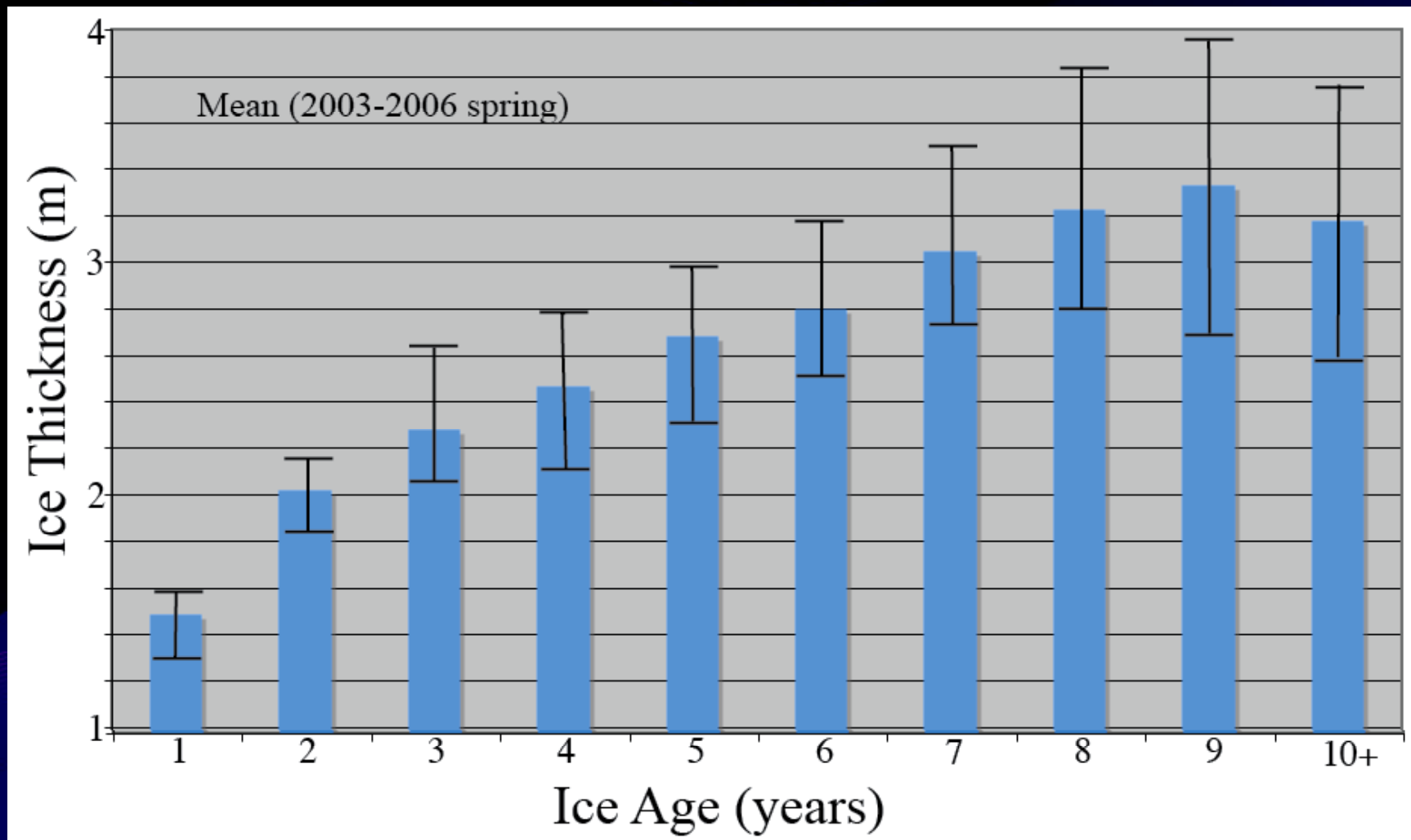
Age 5

Age 2

Age 4

Age 6+

# Younger ice is thinner ice!



The background is a dark purple gradient with several layers of wavy, overlapping lines in a lighter shade of purple. These lines create a sense of depth and movement, resembling a stylized landscape or abstract data visualization.

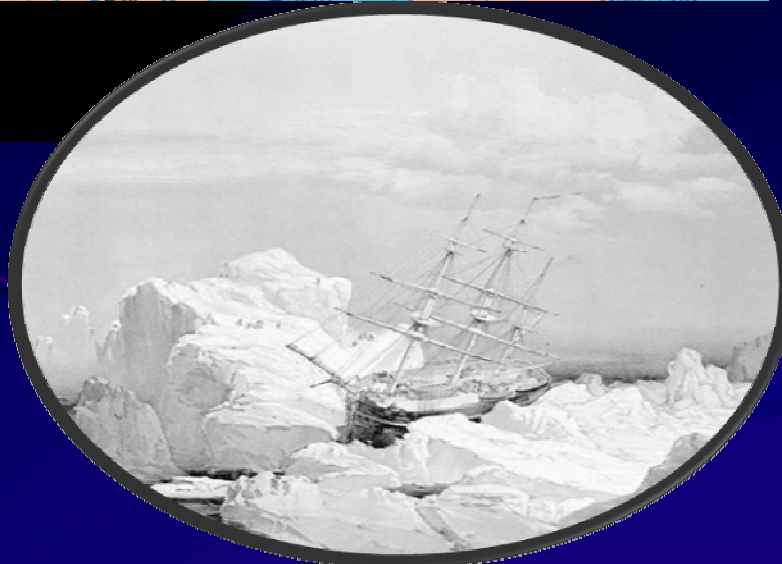
# Impacts of declining ice



# Arctic Shipping - Northwest Passage



# Sir John Franklin and the NWP



**£20,000**  
**REWARD**  
WILL BE GIVEN BY  
**Her Majesty's Government**  
TO ANY PARTY OR PARTIES, OF ANY COUNTRY, WHO SHALL RENDER EFFICIENT ASSISTANCE TO THE CREWS OF THE

**DISCOVERY SHIPS**  
UNDER THE COMMAND OF  
**SIR JOHN FRANKLIN,**

1.—To any Party or Parties who, in the judgment of the Board of Admiralty, shall discover and effectually relieve the Crews of Her Majesty's Ships "Erebus" and "Terror," the

**£20,000.**

OR

2.—To any Party or Parties who, in the judgment of the Board of Admiralty, shall discover and effectually relieve *any* of the Crews of Her Majesty's Ships "Erebus" and "Terror," or shall convey such intelligence as shall lead to the relief of such Crews or *any* of them, the Sum of

**£10,000.**

OR

3.—To any Party or Parties who, in the judgment of the Board of Admiralty, shall by virtue of his or their efforts first succeed in ascertaining their fate,

**£10,000.**

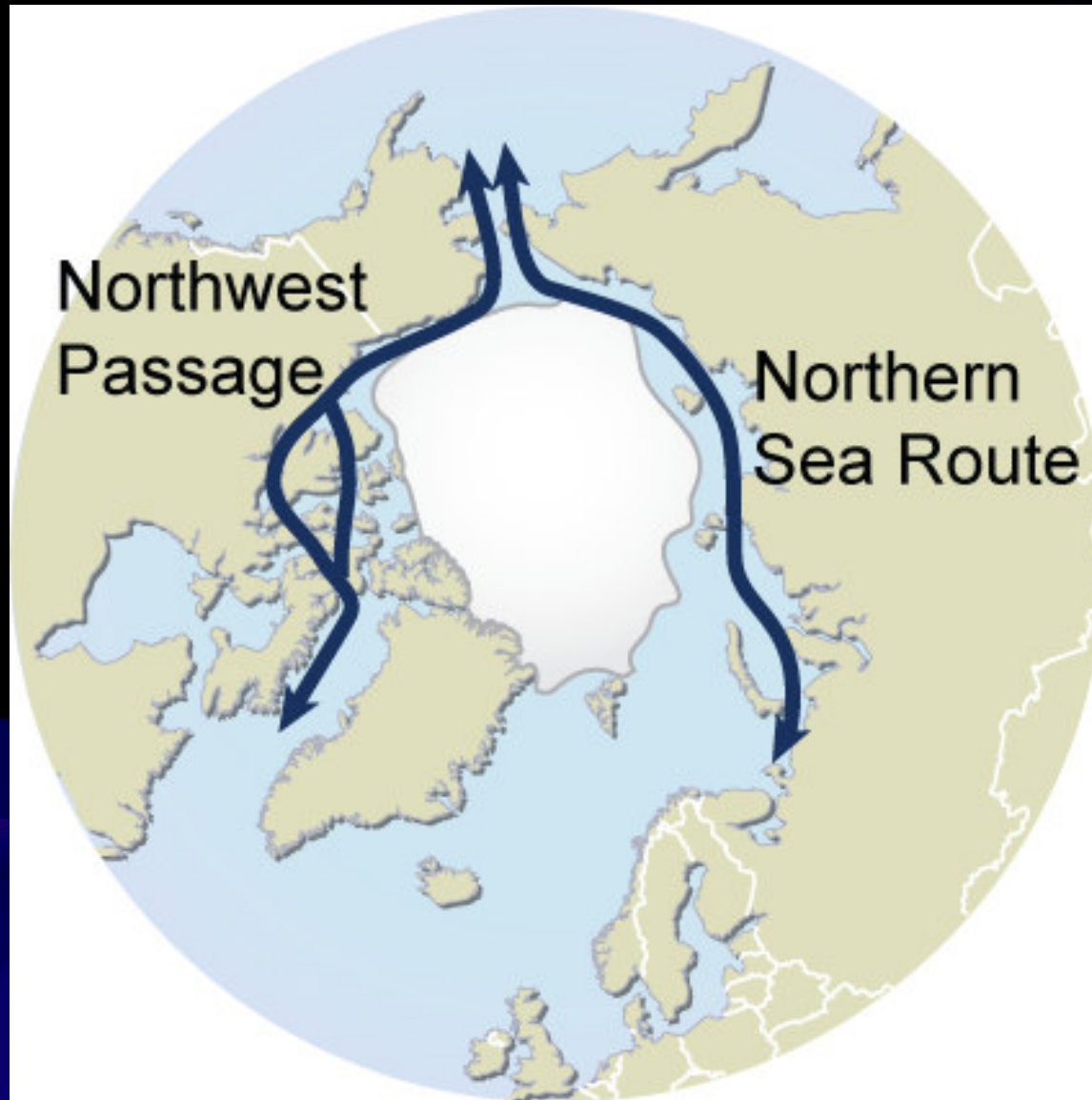
**W. A. B. HAMILTON,**  
Secretary of the Admiralty.

Admiralty, March 26, 1850.  
pp. (1-2)

# “The Icebergs”



# Arctic Shipping - Northern Sea Route



# Arctic Shipping

Route	Distance	Distance
Tokyo - London	NWP: 8,500 miles	Panama Canal: 15,500 miles
Vancouver - Rotterdam	NSR: 5,400 miles	Panama Canal: 8,900 miles
Shanghai - Murmansk	NSR: 6,500 miles	Suez Canal: 12,000 miles

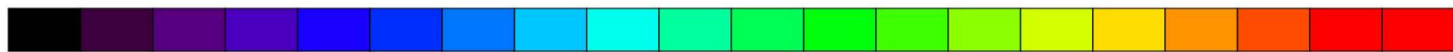
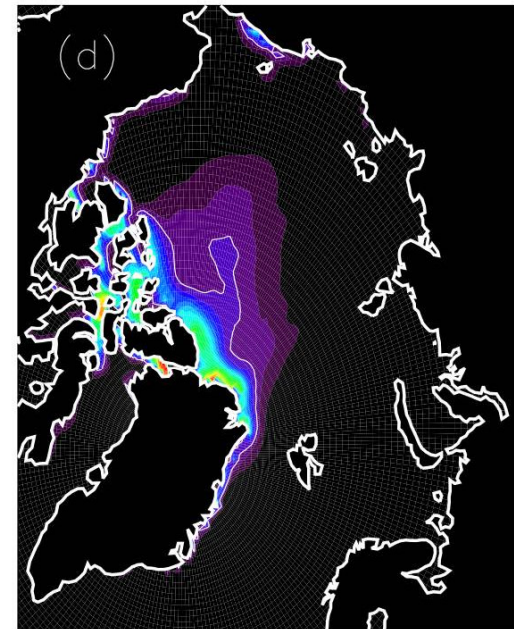
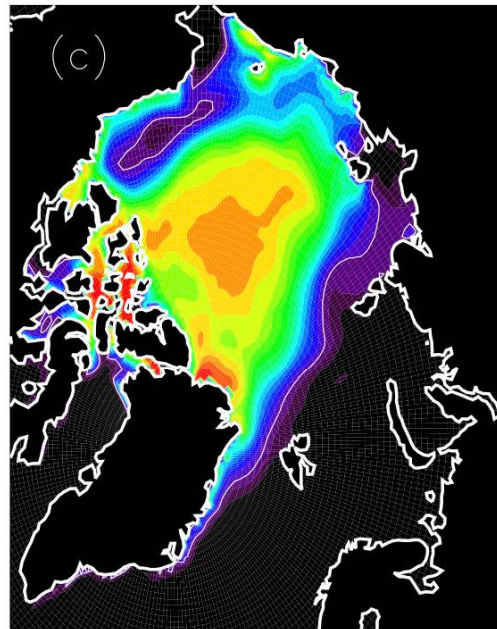
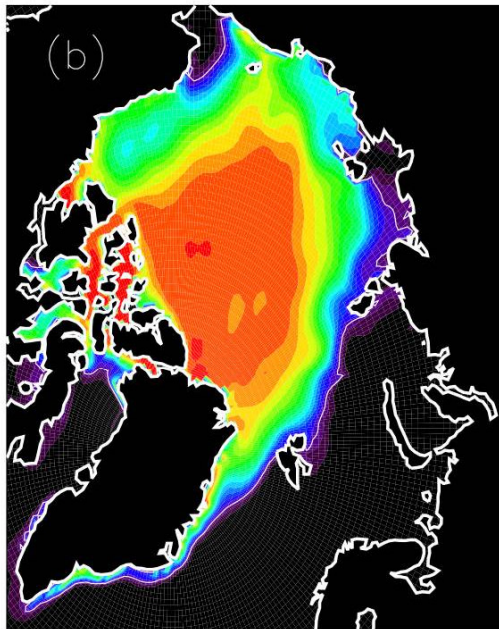


# Sea-ice projections

1990-1999

2010-2019

2040-2049



0

20

40

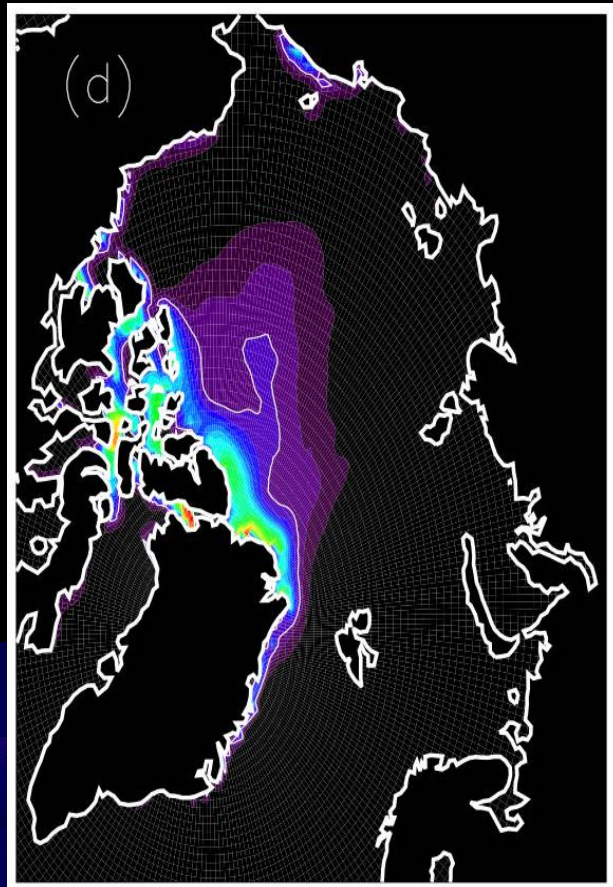
60

80

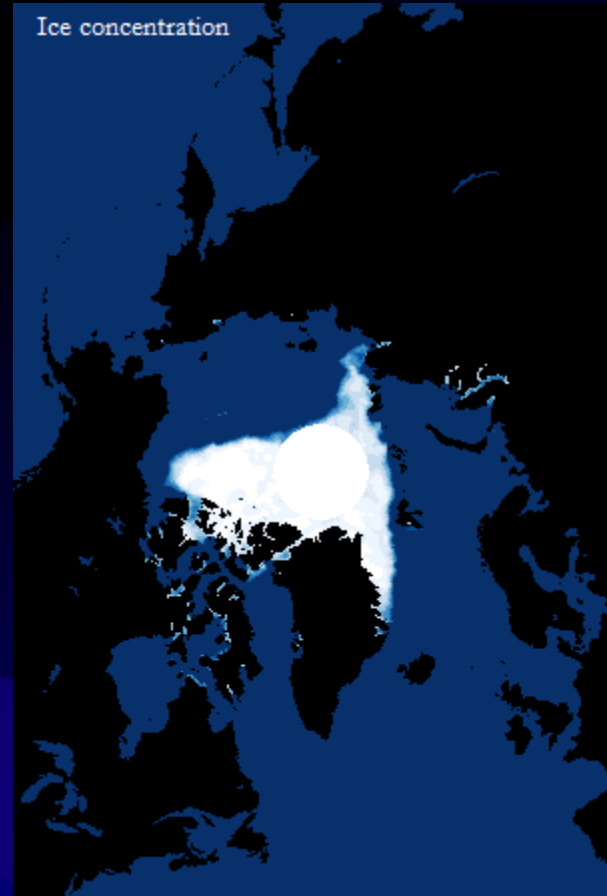
100

# Accelerated Melt!

2040-2049

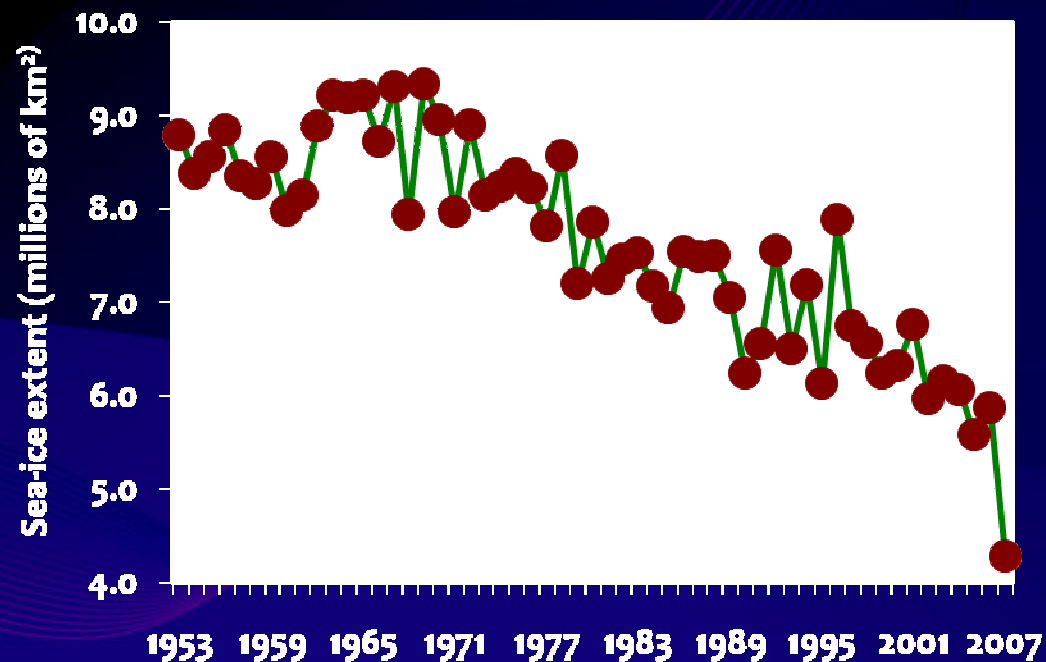


2007



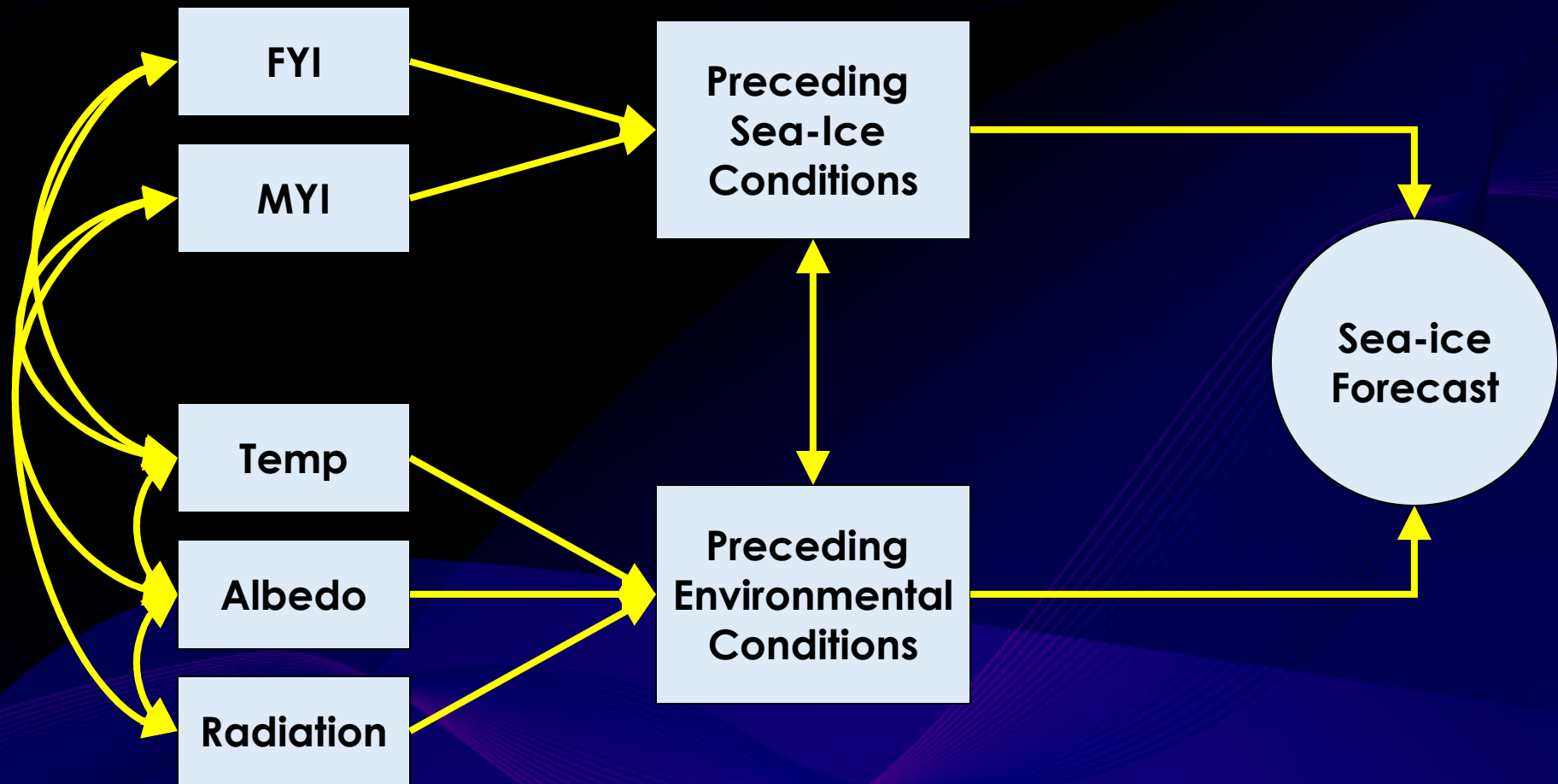
# Arctic Shipping Needs

- Seasonal forecasts
- Economic models
- Policy issues



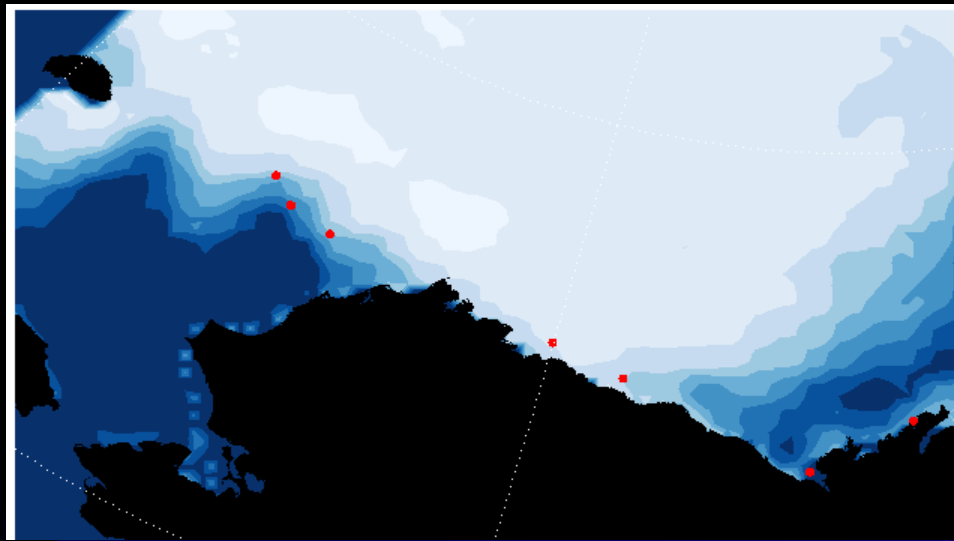


# Conceptual Model

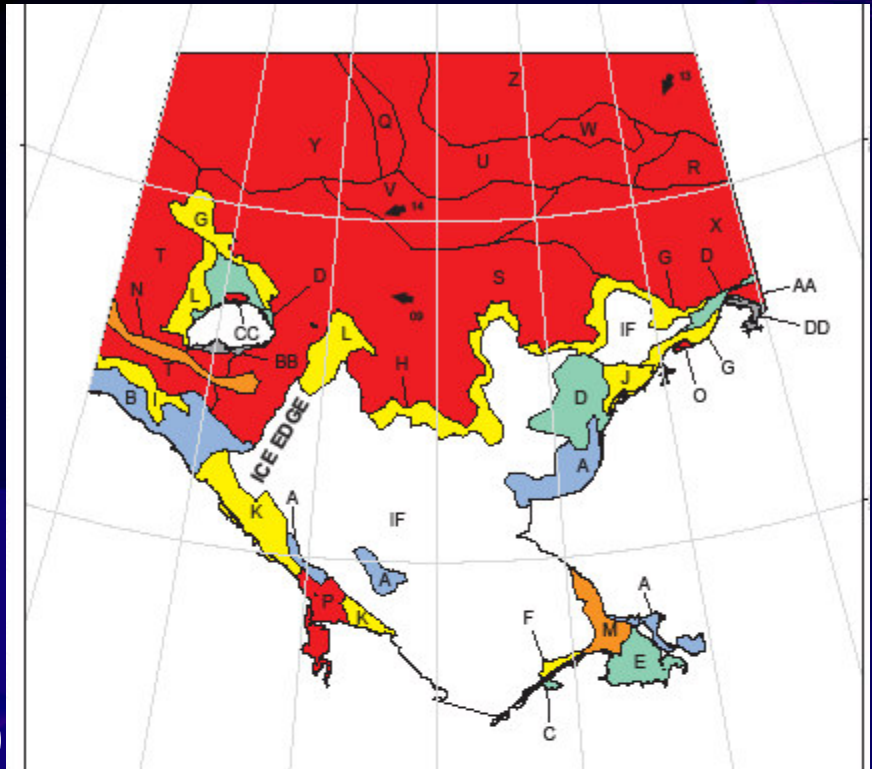
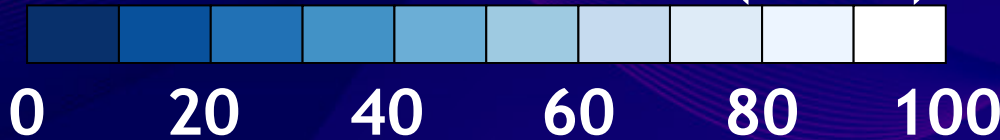


# Forecast Products

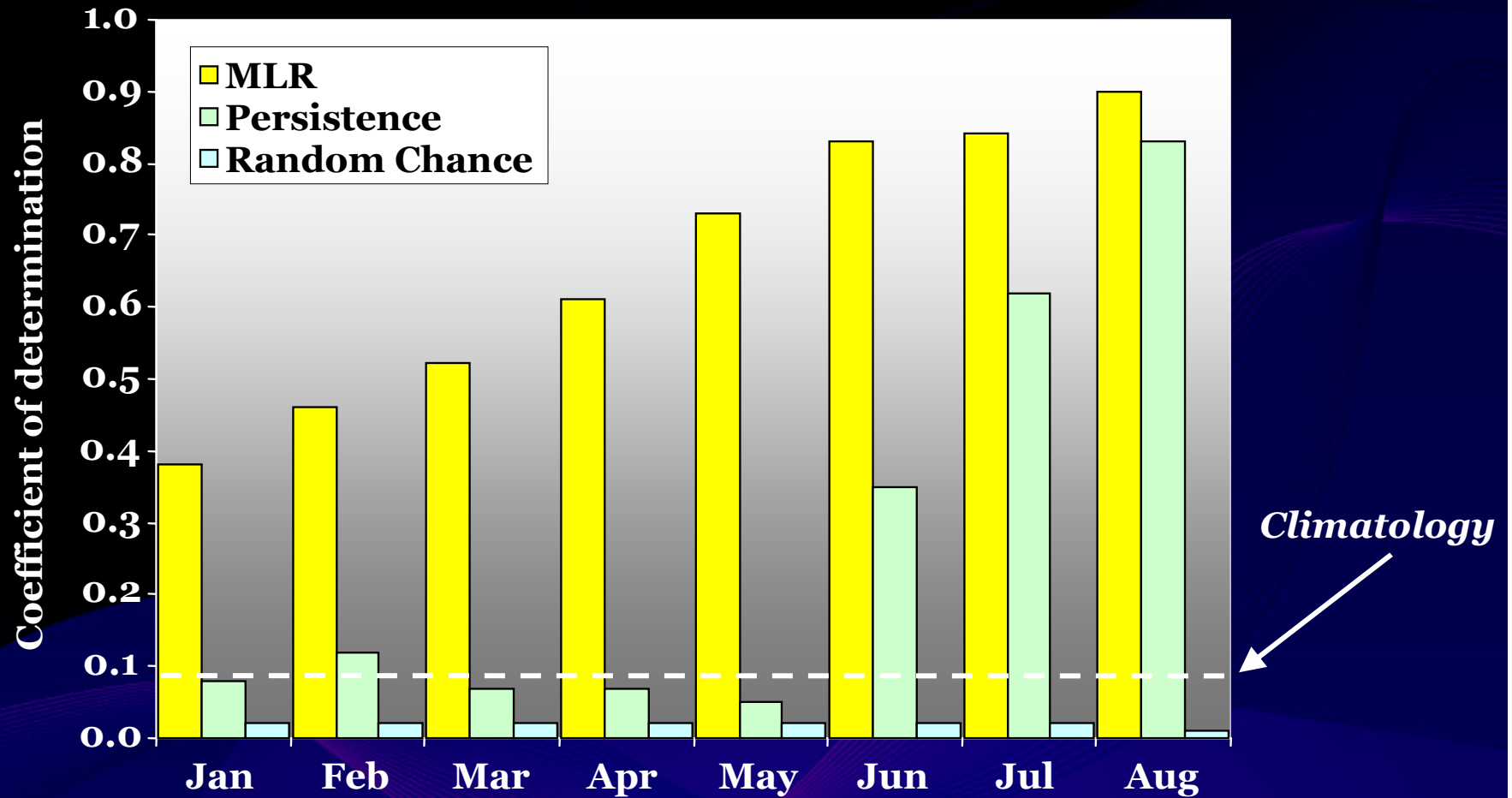
- Sea-ice concentration
- “Ice-out” and “ice-in” dates



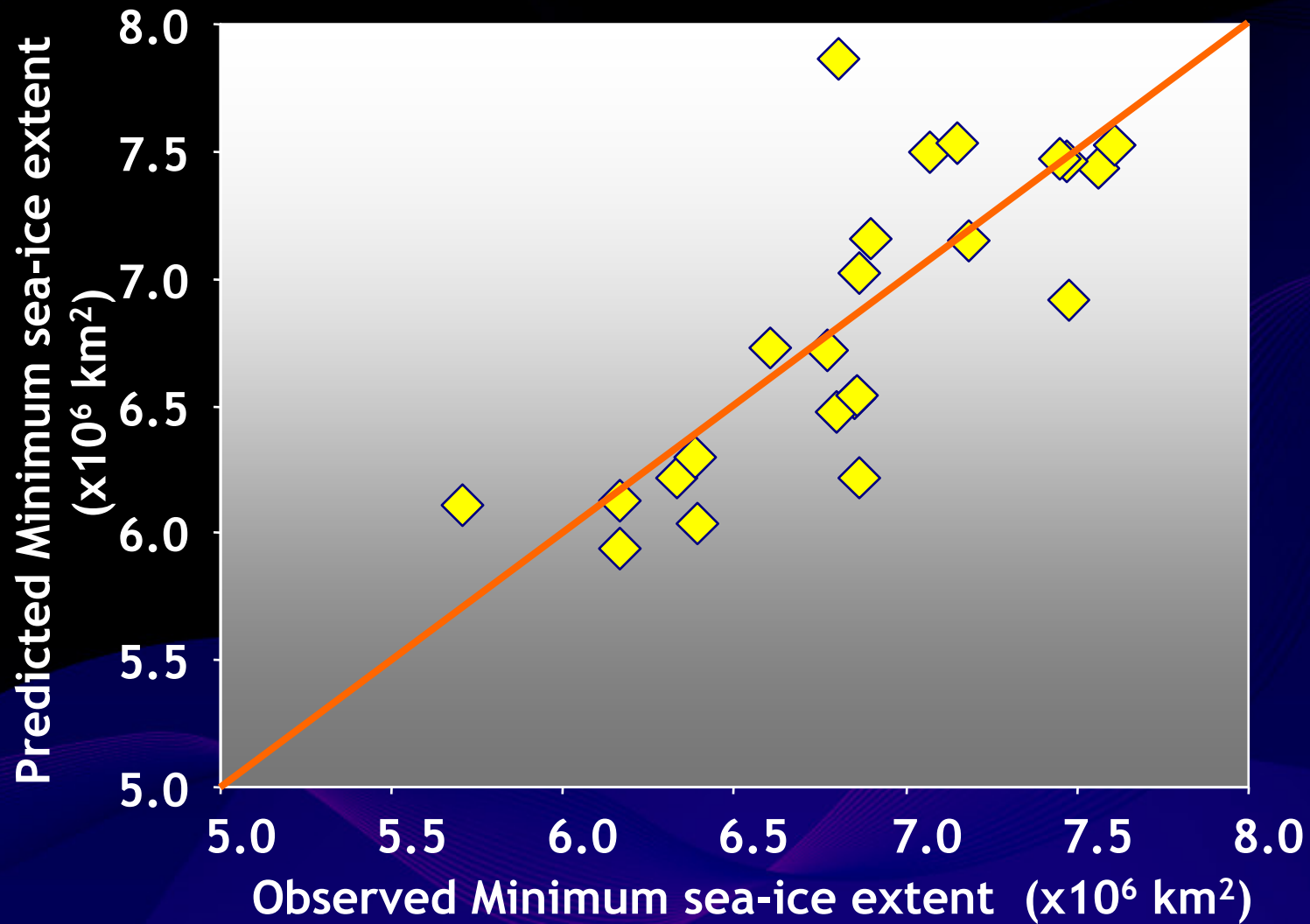
Sea-ice concentration (%100)



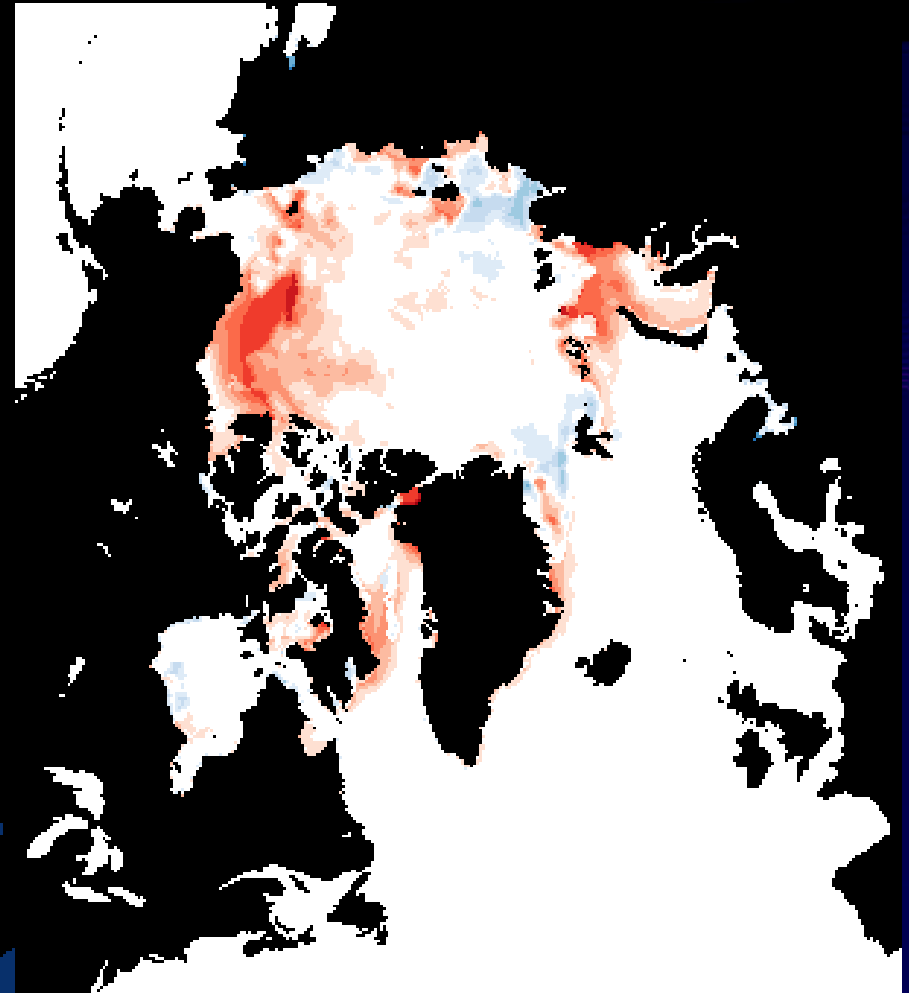
# Model Results



# Observed vs. Predicted

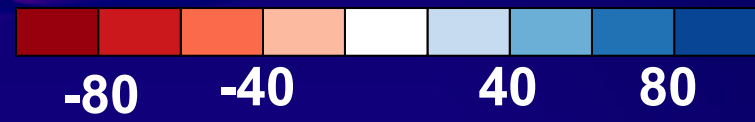
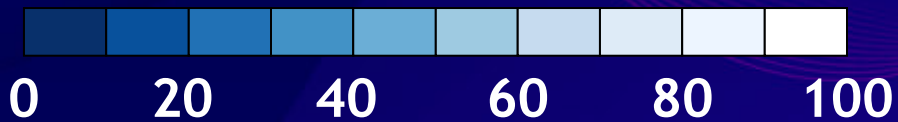


# 2008



Sea-ice concentration (%100)

Anomaly (%100)



# Sea ice and erosion



# Sea-ice and erosion



*Courtesy Cam Wobus*

007

# Sea-ice and Polar Bears

- “projected changes in future sea ice conditions, if realized, will result in loss of two thirds of the world’s current polar bear population by the mid 21st century.”

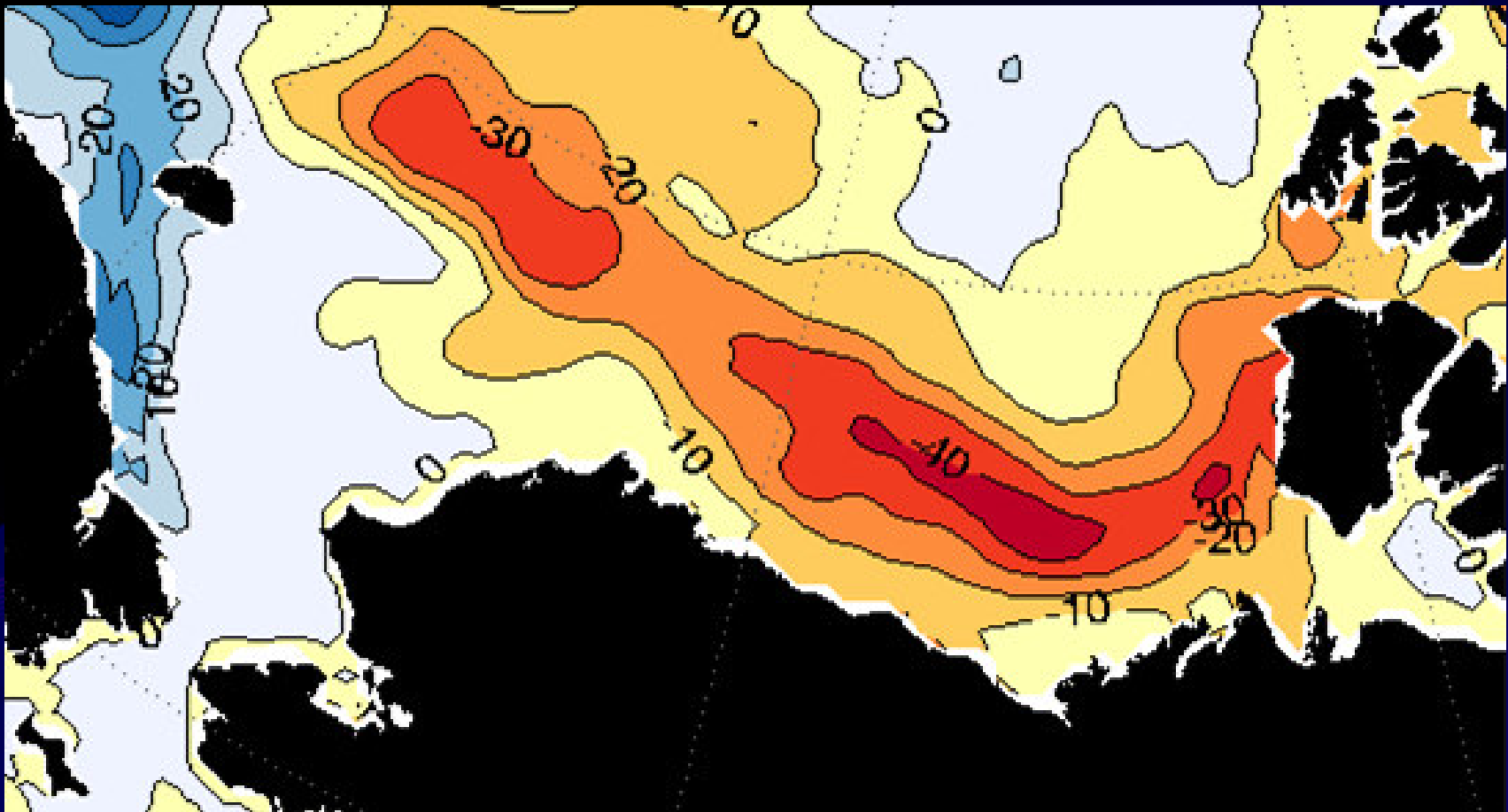
--USGS (2007)



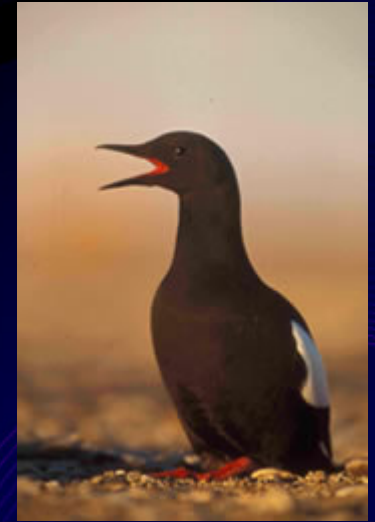
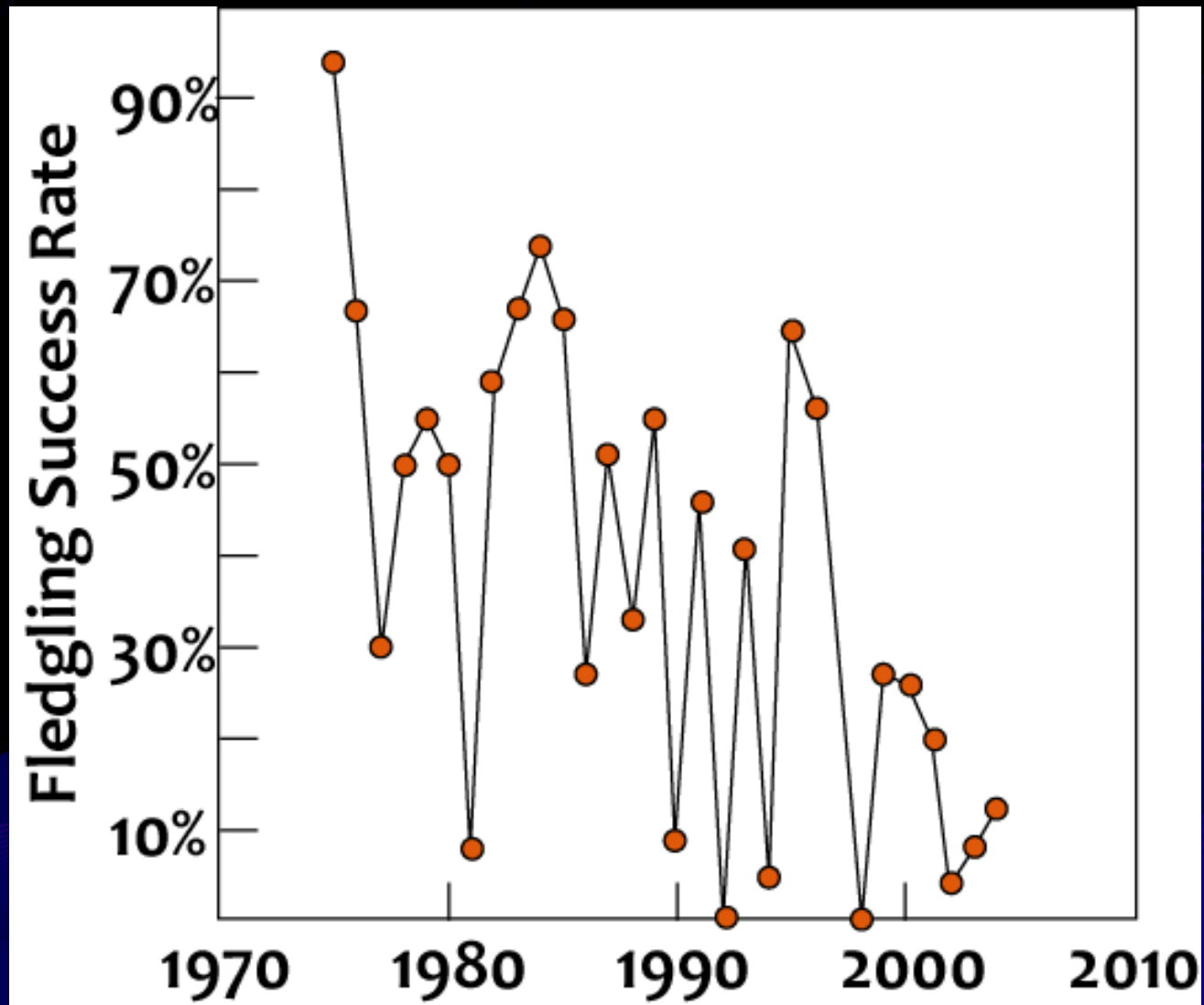


# Sea-ice and whales

- Strong connections between sea-ice concentration and Bowhead whale health

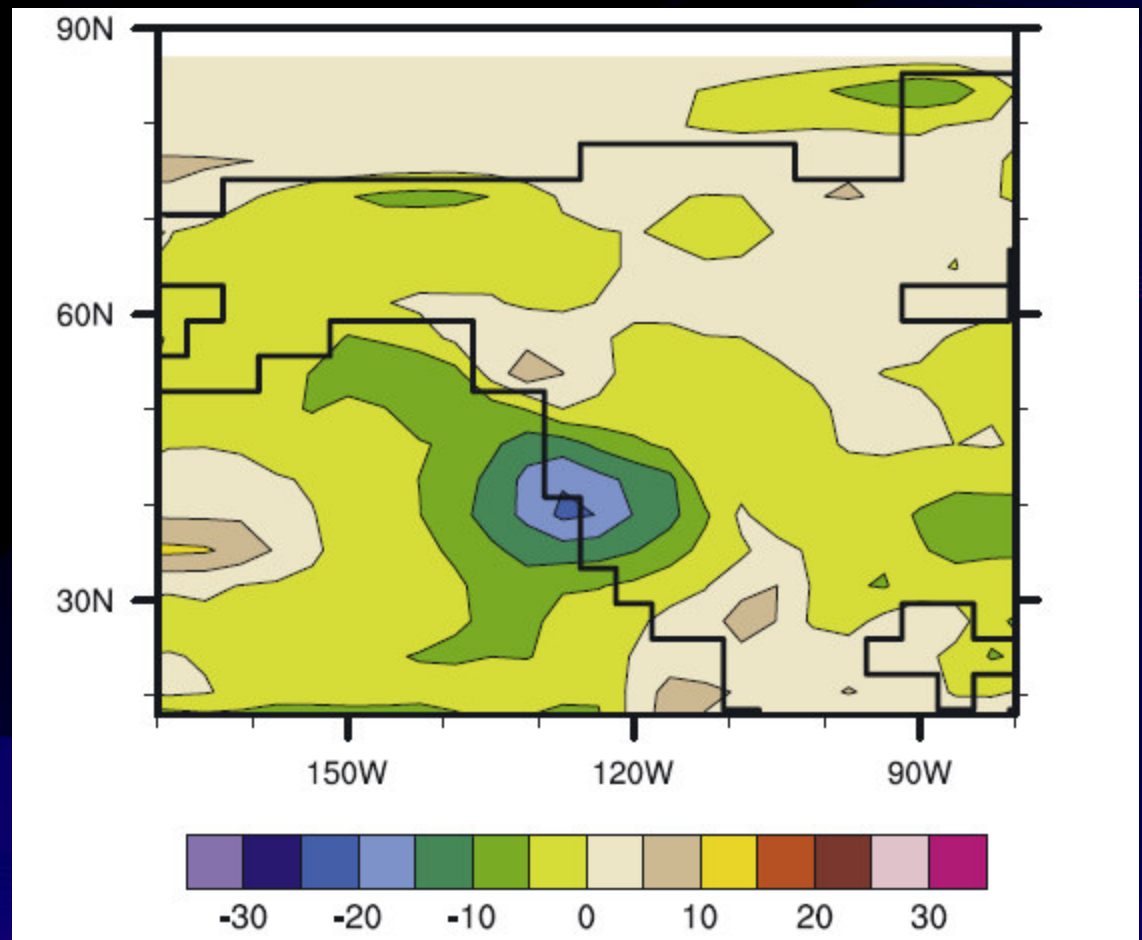


# Sea-ice and birds



# Sea-ice and precipitation

- Possible precipitation declines in western USA



# Next Steps

- How viable is Arctic navigation?
- How will changes in ice affect Arctic mammals?
- How will changes in ice affect Arctic peoples?
- Will changes in the ice affect temperate and tropical zones?

**Thanks for your time!**

<http://ccar.colorado.edu/arifs>

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