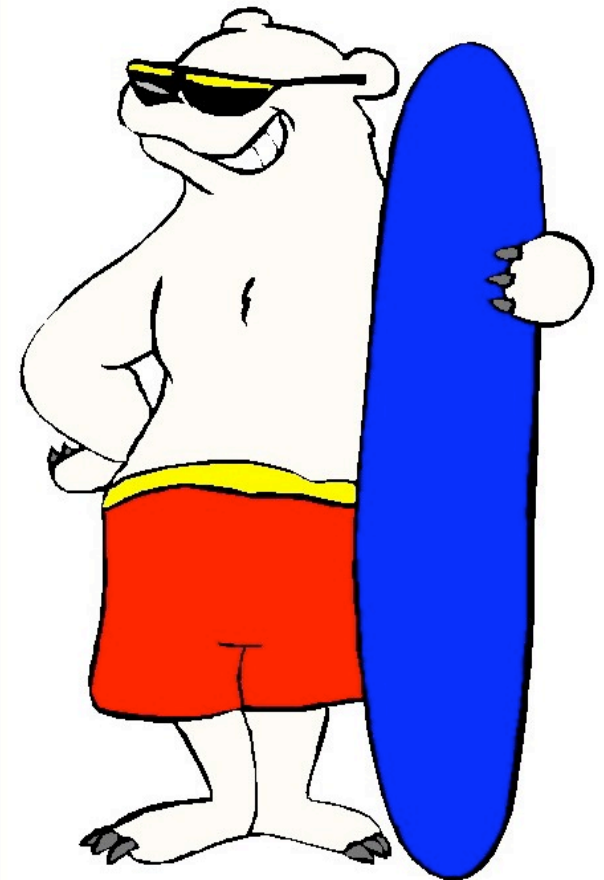


The Recent Summer Arctic Sea Ice Loss

Or Where will the Polar Bears Go?

James Overland

Muyin Wang, Nancy Soreide, Nick Bond and Phyllis Stabeno





Multi-year sea ice



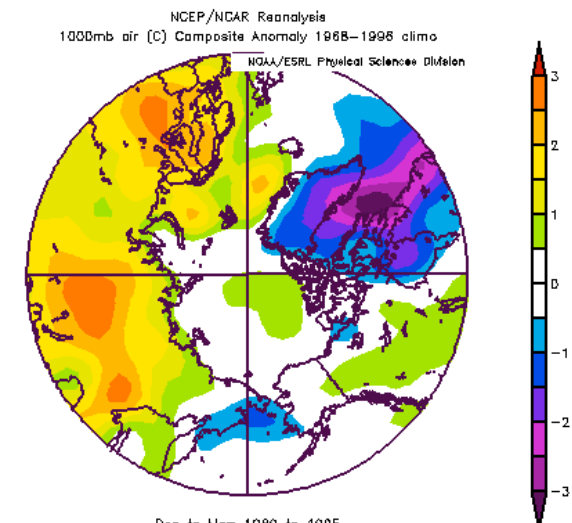
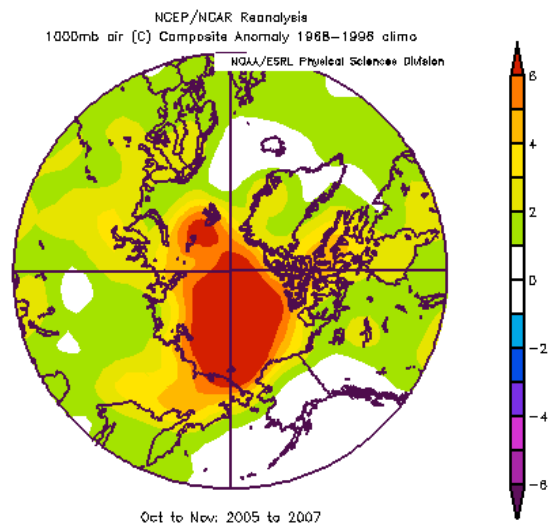
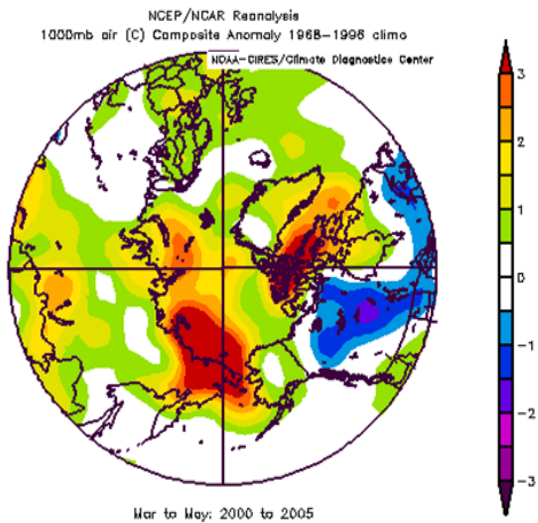
First year sea ice



**THE ARCTIC IS WARMING FASTER THAN
ANYWHERE ELSE**

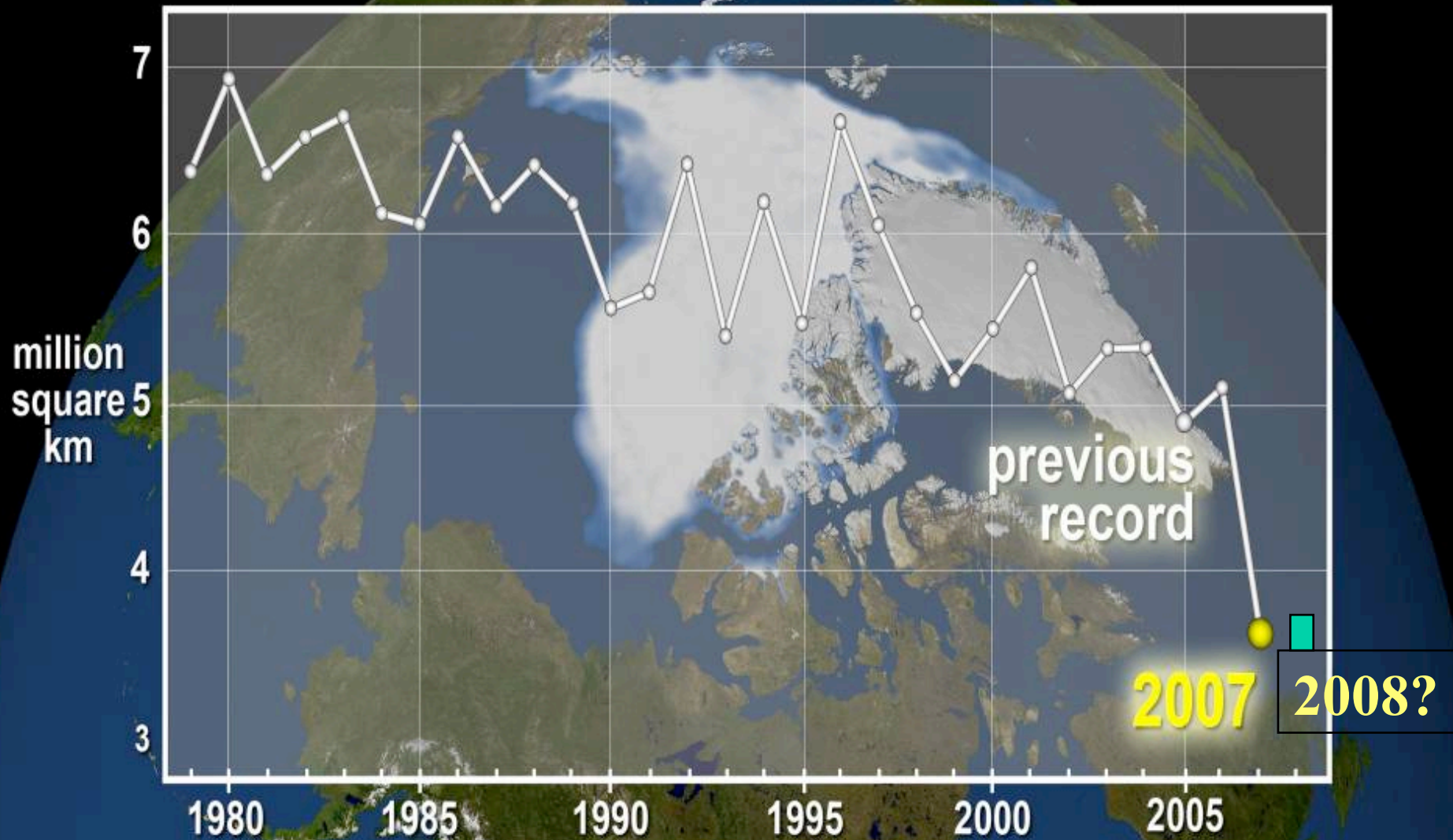


Recent (2005-2007) Central Arctic Fall Temperature Anomalies Greater Than $+6^{\circ}\text{C}$



Spring 2000-2005 Fall 2005-2007 Winter 1989-1995 (+AO)

Annual Sea Ice Minimum



NASA

ALBEDO FEEDBACK

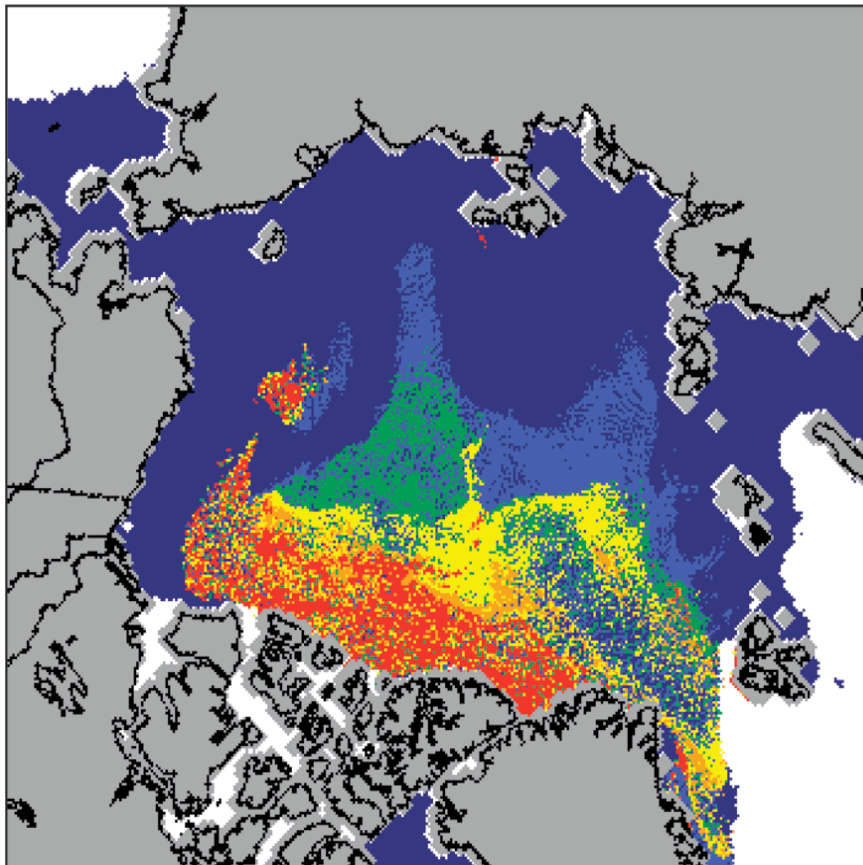
**ICE/OCEAN CONTRAST IN
REFLECTIVITY**

**OPENING OF THE ICE
PACK ALLOWS SOLAR
HEAT TO WARM THE
OCEAN**



What about Summer 2008?

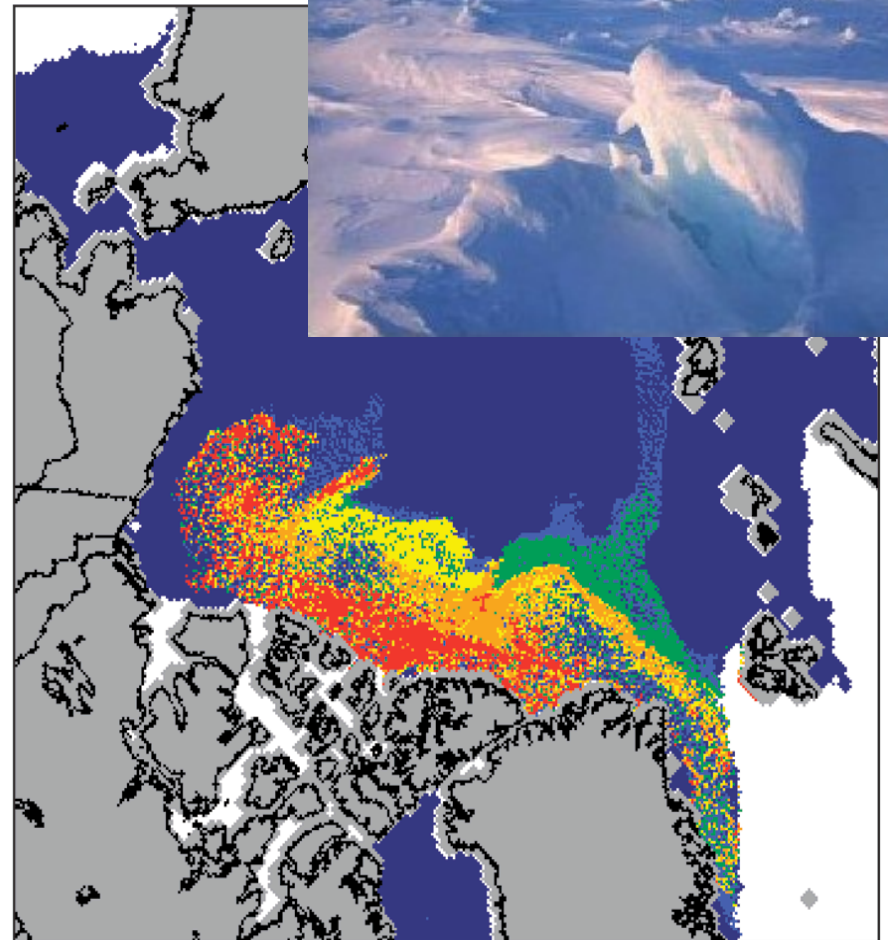
March 2007



OW 1 2 3 4 5 6+

Age of ice

March 2008



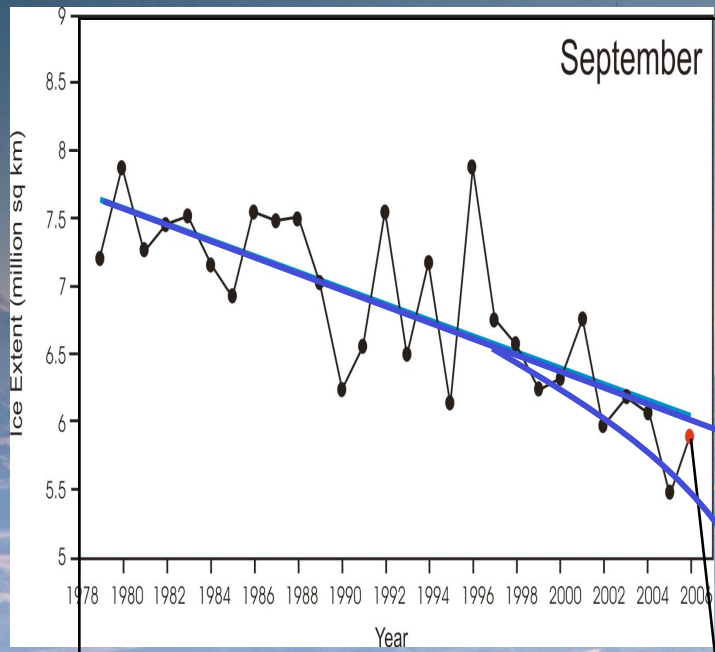
MULTI-YEAR ICE AMOUNTS

A sunset over the ocean with two large rock formations in the foreground. The sun is low on the horizon, casting a warm orange glow across the sky and reflecting on the water. The rock formations are dark silhouettes against the bright sky.

**THE SUMMER ARCTIC ICE PACK IS MELTING AT A
RATE THAT EXCEEDS MOST EXPECTATIONS**

WHY SO FAST?

Anthropogenic + Unusual Climate Patterns + Ice/ocean Feedbacks
= NEW STATE
Difficult to return to 1980s



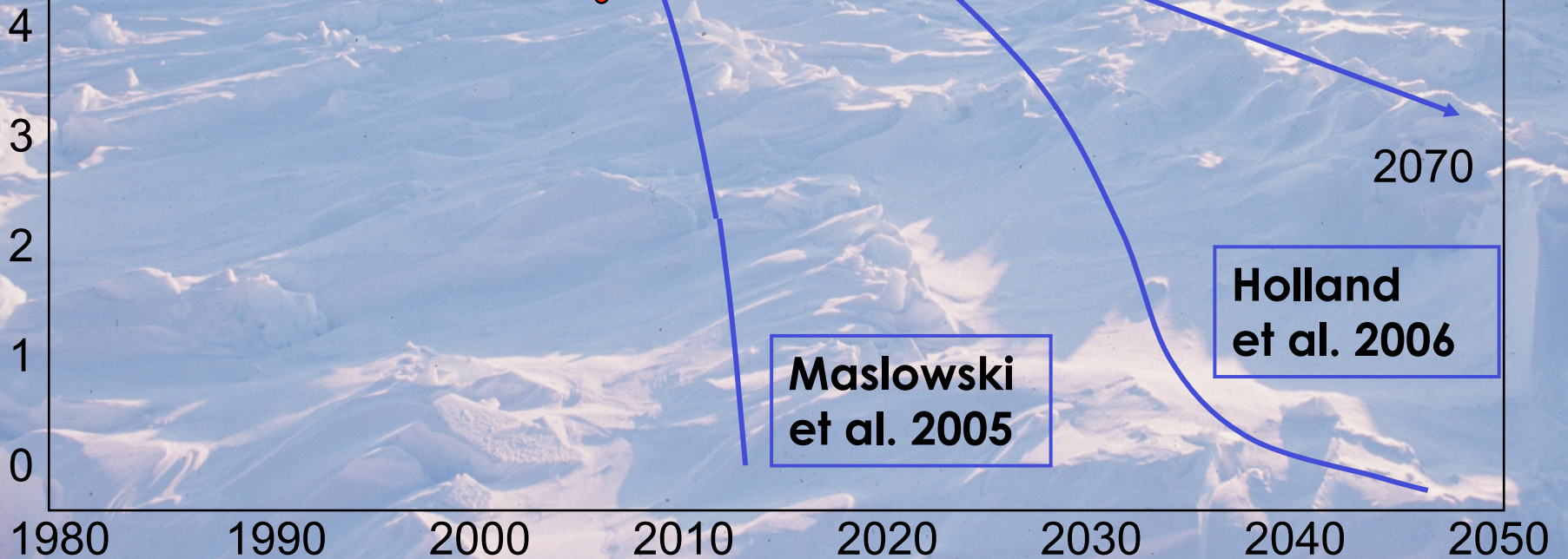
We are on a faster track
for sea ice loss than
“Mean” model projections

IPCC 2007

2070

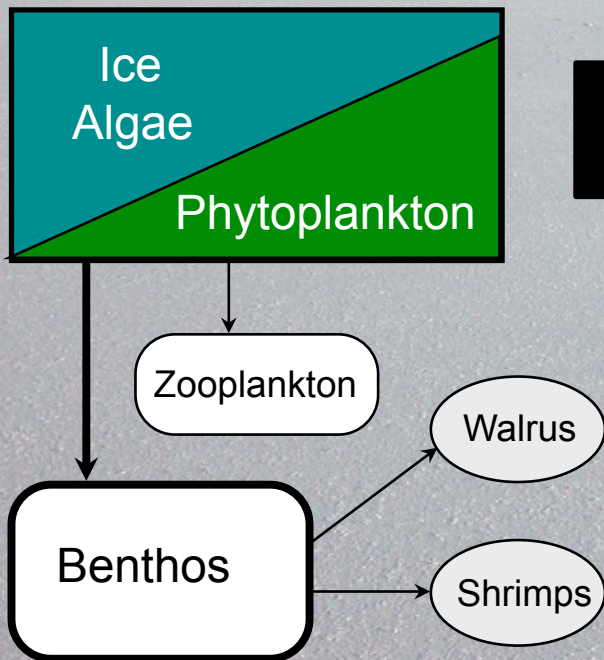
Holland
et al. 2006

Maslowski
et al. 2005

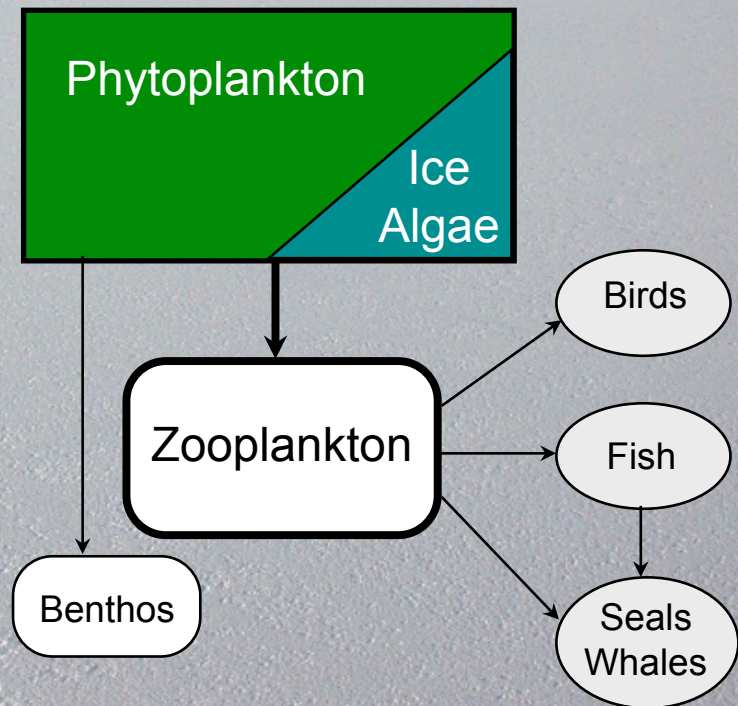


Sea ice reduction is expected to increase pelagic production at the expense of the benthic ecosystem

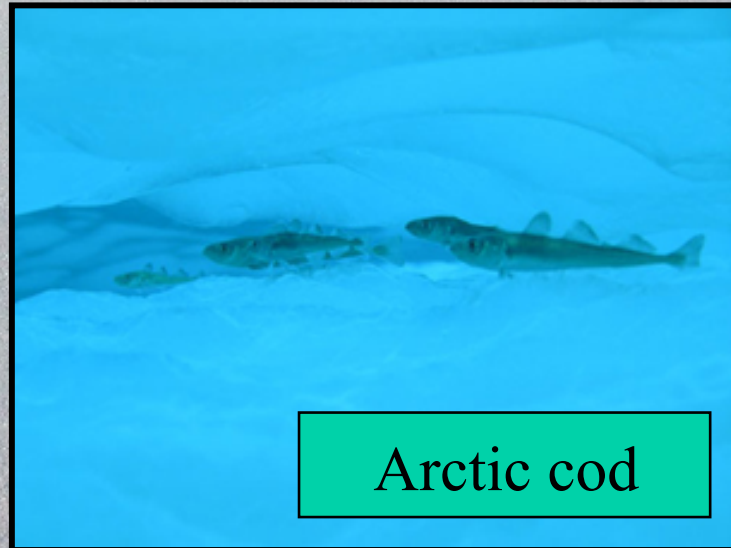
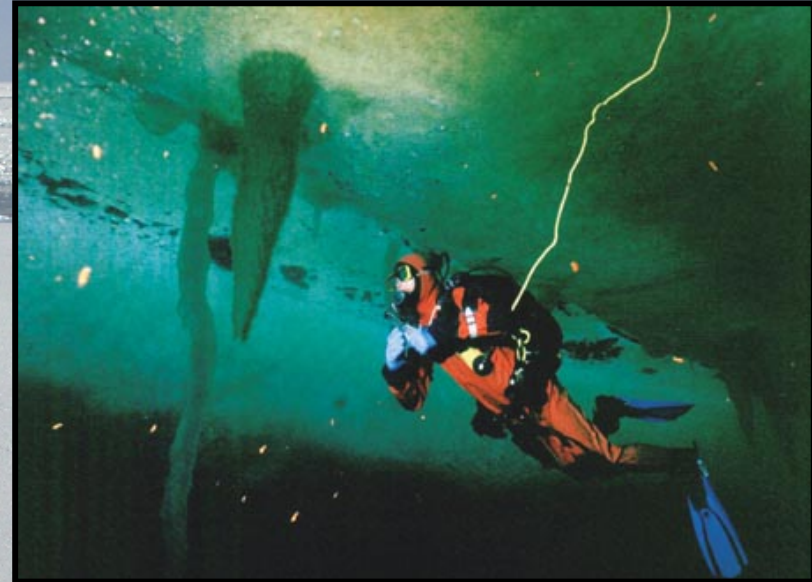
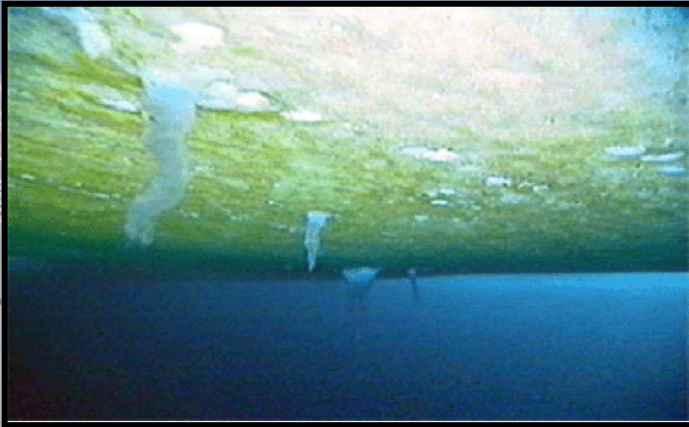
Arctic Ecosystem



Sub-Arctic Ecosystem



Arctic Ecosystem: Ice micro-algae, mostly diatoms, grow in the ice and at the ice-water interface in the spring



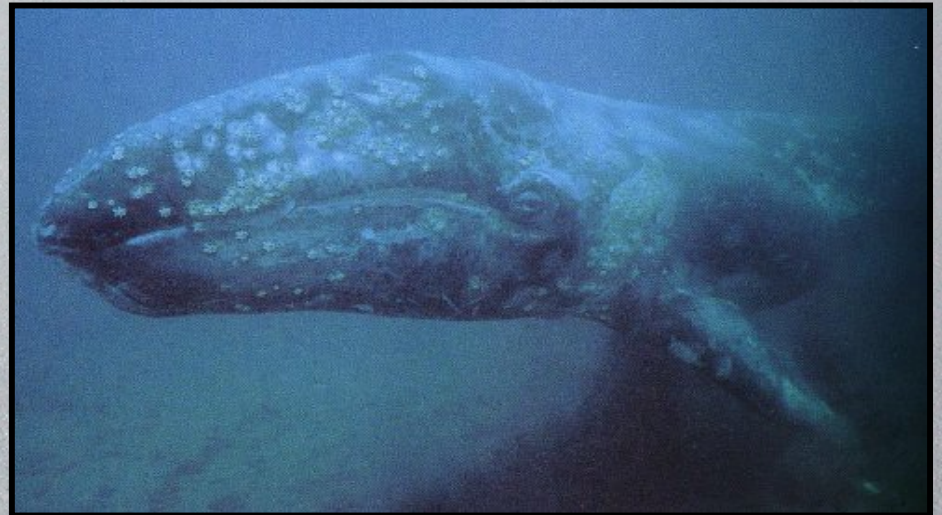
Arctic cod

Sub-Arctic Ecosystem: Shift from benthos-rich ecosystem to pelagic-dominated ecosystem in the Bering Sea

Walleye Pollock
northward expansion



Increased Gray Whale
calf production



The charismatic losers: Walrus Calves get separated from their mothers; Haul-outs are on land



Walrus calf Carin Ashjian, 2004

Маяк с радиоактивным элементом находится на мысу Ванкарем, в одном километре от села. В десятках метров от маяка отдыхает многотысячное стадо моржей.



Clam food



Climate Contributor to
Endangered Species Act Responses
on
Polar Bears (2007) and
Ribbon Seals (2008)

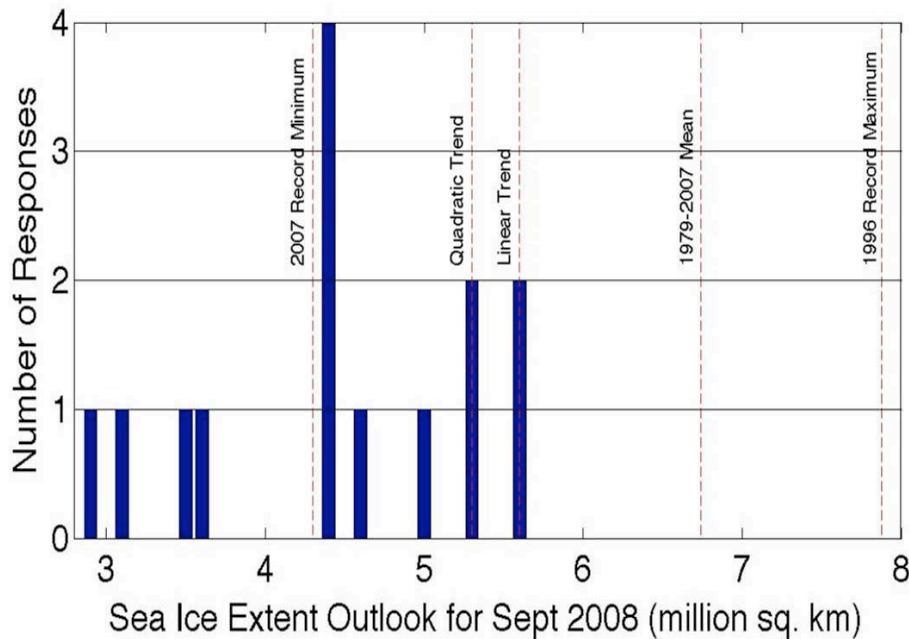


US Arctic Research Commission
Transportation Report

Products

Annual Arctic Reportcard

September Sea Ice Outlook



07 02:56:16 2008
Exposure: 318
Ap: -9.0°C

North Pole Webcam



Arctic Report Card 2007
Tracking recent environmental changes

Home
Atmosphere
Sea Ice
Ocean
Land
Greenland
Biology

<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">■ Atmosphere</td> <td style="width: 50%;">■ Biology</td> </tr> <tr> <td>■ Sea Ice</td> <td>■ Ocean</td> </tr> <tr> <td>■ Greenland</td> <td>■ Land</td> </tr> </table> <p style="text-align: center; font-size: small;">Warming and mixed signals</p> </div>	■ Atmosphere	■ Biology	■ Sea Ice	■ Ocean	■ Greenland	■ Land	<p style="font-size: x-small;"><i>Collectively, the observations indicate that the overall warming of the Arctic system continued in 2007. There are some elements that are stabilizing or returning to climatological norms. These mixed tendencies illustrate the sensitivity and complexity of the Arctic System.</i></p>
■ Atmosphere	■ Biology						
■ Sea Ice	■ Ocean						
■ Greenland	■ Land						

<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <p style="font-size: x-small;">Atmosphere Hot spot shifts toward Europe</p> </div>	<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <p style="font-size: x-small;">Ocean North Pole Temperatures at depth returning to 1990s values</p> </div>	<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <p style="font-size: x-small;">Sea Ice Summer extent at record minimum</p> </div>
<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <p style="font-size: x-small;">Biology Increasing tundra shrub cover and variable treeline advance Up to 80% declines in some caribou herds, while goose populations double</p> </div>	<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <p style="font-size: x-small;">Greenland Recent warm temperatures associated with net ice loss</p> </div>	<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <p style="font-size: x-small;">Land Increase in permafrost temperatures is slowing down</p> </div>

[About the Report Card](#) :: [State of the Arctic Report 2006](#) :: [Arctic Theme Page](#) :: [Printable Handout](#) :: [Full Arctic Report Card \(PDF\)](#)
[BAMS State of the Climate in 2006](#) :: [Executive Summary \(PDF\)](#) :: [Full report \(PDF\)](#)

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SUMMARY

**Arctic Climate in the Last
Decade is Unique
Compared to 20th Century**

**40% sea ice loss in summer 2007,
2008?; other climate
indicators**

**Causes: Anthropogenic
+ Unusual Climate patterns
+ Ice/ocean feedbacks
= NEW STATE**

Biology: Large Responses

Relevance:

Arctic is Changing!

Performance/Quality:

**International Leadership-
Outlook, Arctic Council, ESSAS,
Publications, Invited Presentations**

Transitions:

**Reportcard, Endangered Species,
Transportation, N. Pacific Fisheries
Council, Alaska Groups**

Future:

**Stay the course
Biological Impacts
5th IPCC Report**