Arctic Report Card: Update for 2011

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NOTE:

High-resolution copies of some of the maps in this slide set are available online at
www.climatewatch.noaa.gov/article/2011/arctic-report-2011

Jacqueline Richter-Menge:

Good day, Everyone. Thanks for joining us for the public release of the annual update to the Arctic Report Card, which is sponsored by NOAA's Climate Program Office (See next slide).

It's my pleasure as one of the editors of the Report Card to provide you with a summary of the highlights of this year's update before we open the lines to take questions. Before providing you with the highlights, I want to give you some background on this web-based product.

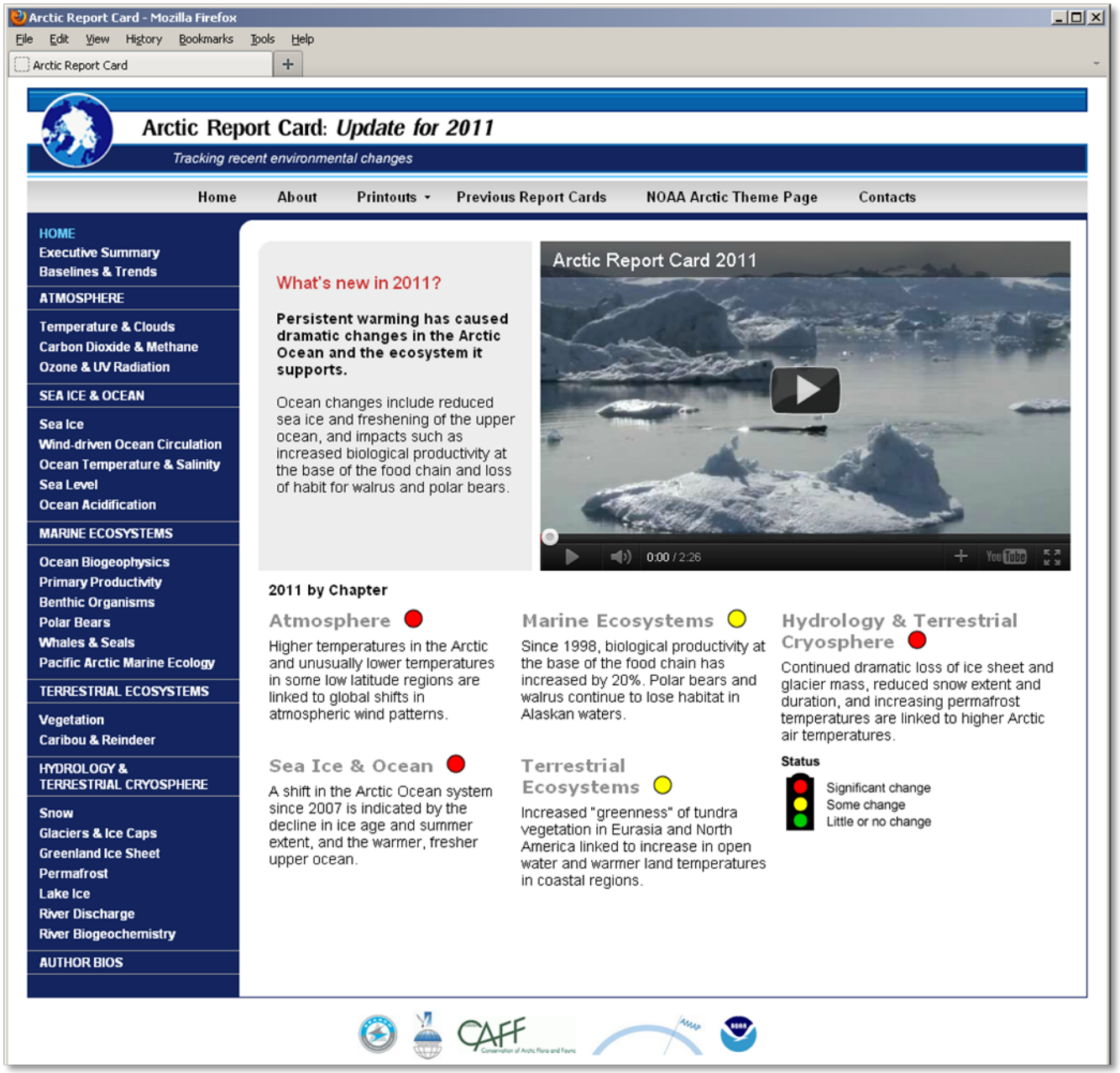
First and foremost the Arctic Report Card reflects the work of a large international team of researchers. This year's report card has a record 121 contributing authors from 14 different countries.

The scientific content of the report card was independently peer-reviewed by the Arctic Monitoring and Assessment Programme of the Arctic Council.

The Circumpolar Biodiversity Monitoring Program, the cornerstone program of the Arctic Council's Conservation of Arctic Flora and Fauna Working Group, provides leadership on the biodiversity elements of the report card.

The 2011 update has a new look and increased scope. There are 23 essays that describe key environmental indicators encompassing the Arctic atmosphere, sea ice, ocean and land, and the marine and terrestrial ecosystems. Key highlights are featured on the Home Page, where you'll also find a video that does a nice job of summarizing the report card.

http://www.arctic.noaa.gov/reportcard/



Jacqueline Richter-Menge (continued):

So, on to the main event: Highlights of the content.

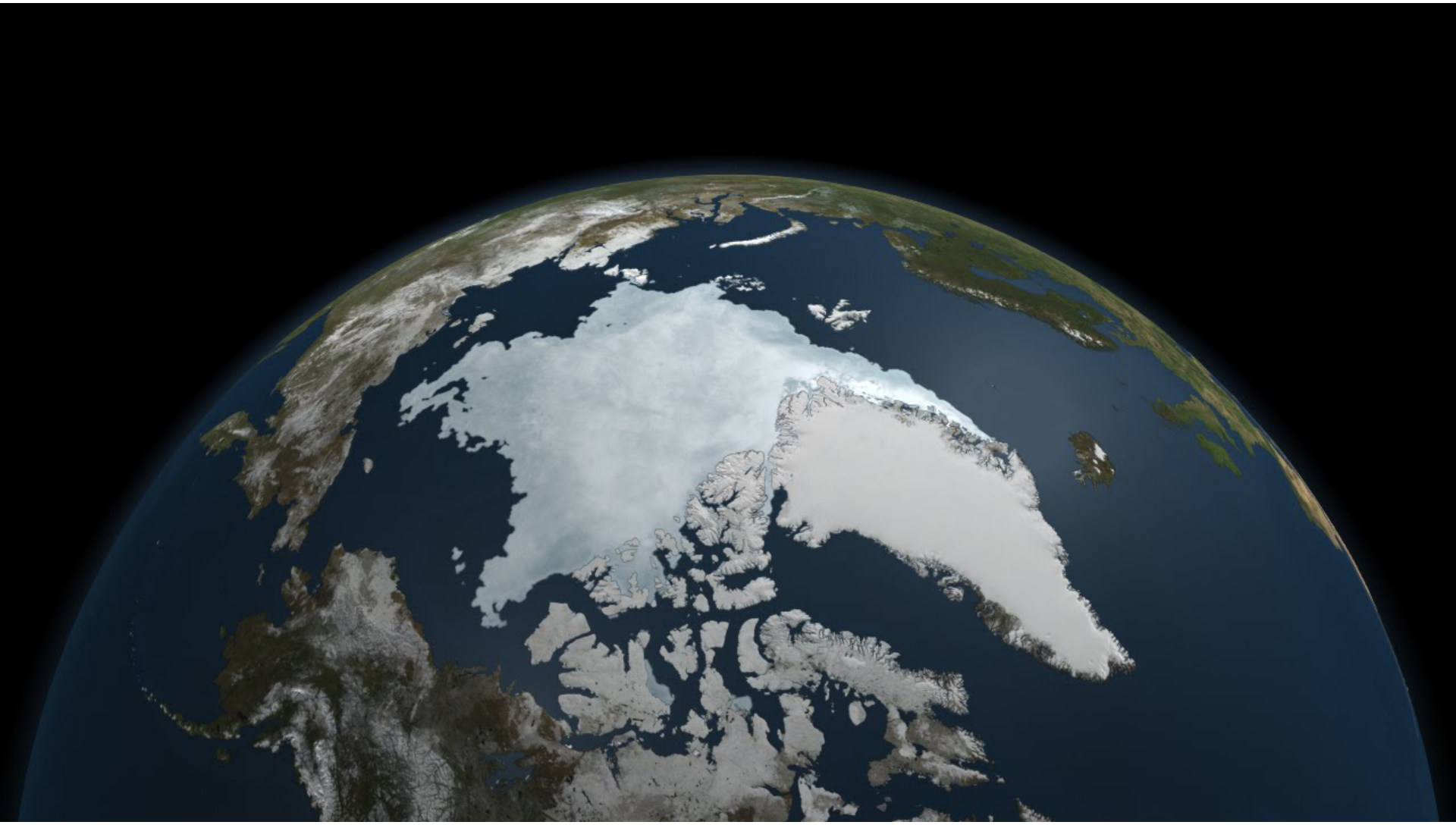
A major conclusion of the 2011 Report is that there are now a sufficient number of years of observational data to indicate a shift in the Arctic Ocean system since 2006. This shift is characterized by the persistent decline in the thickness and summer extent of the sea ice cover, and by a warmer, less salty upper ocean.

As a result of increased open water area, biological productivity at the base of the marine food chain has increased, but sea ice-dependent marine mammals, such as polar bears and walrus, continue to lose habitat. Both the greening of tundra vegetation and the warming of permafrost are linked to warmer land temperatures in coastal regions, often adjacent to the areas of greatest sea ice retreat.

Helping me share and explain the evidence of the shift in the characteristics of the Arctic Ocean system and its impacts are three contributing authors – Don Perovich, lead author of the sea ice update; Karen Frey, responsible for our first focused essay on ocean primary productivity; and Howie Epstein, a contributing author to the essay describing changes in Arctic vegetation.

Don…

A cloud-free composite image of the Arctic region



Credit: Scientific Visualization Studio, NASA-GSFC

Don Perovich:

Hi everyone. I'm Don Perovich of the Cold Regions Research and Engineering Laboratory. My research focuses on Arctic sea ice cover – the frozen ocean at the top of the world.

This year's end-of-summer ice extent was the second smallest of the 32-year satellite record (see next slide). The past five years have had the five smallest September ice extents showing that Arctic sea ice has not recovered from the large decrease observed in 2007. The ice loss has been greatest off the coasts of Alaska and Siberia. This ice decrease is indicative of a shift to a new state of reduced sea ice coverage.

A related shift to a warmer and fresher upper ocean has also persisted since summer 2007. This new state of the sea ice and ocean has implications for other components of the Arctic system, particularly marine ecosystems.

I'll let Karen explain…

Summer minimum sea ice extent was the second-lowest extent on record.

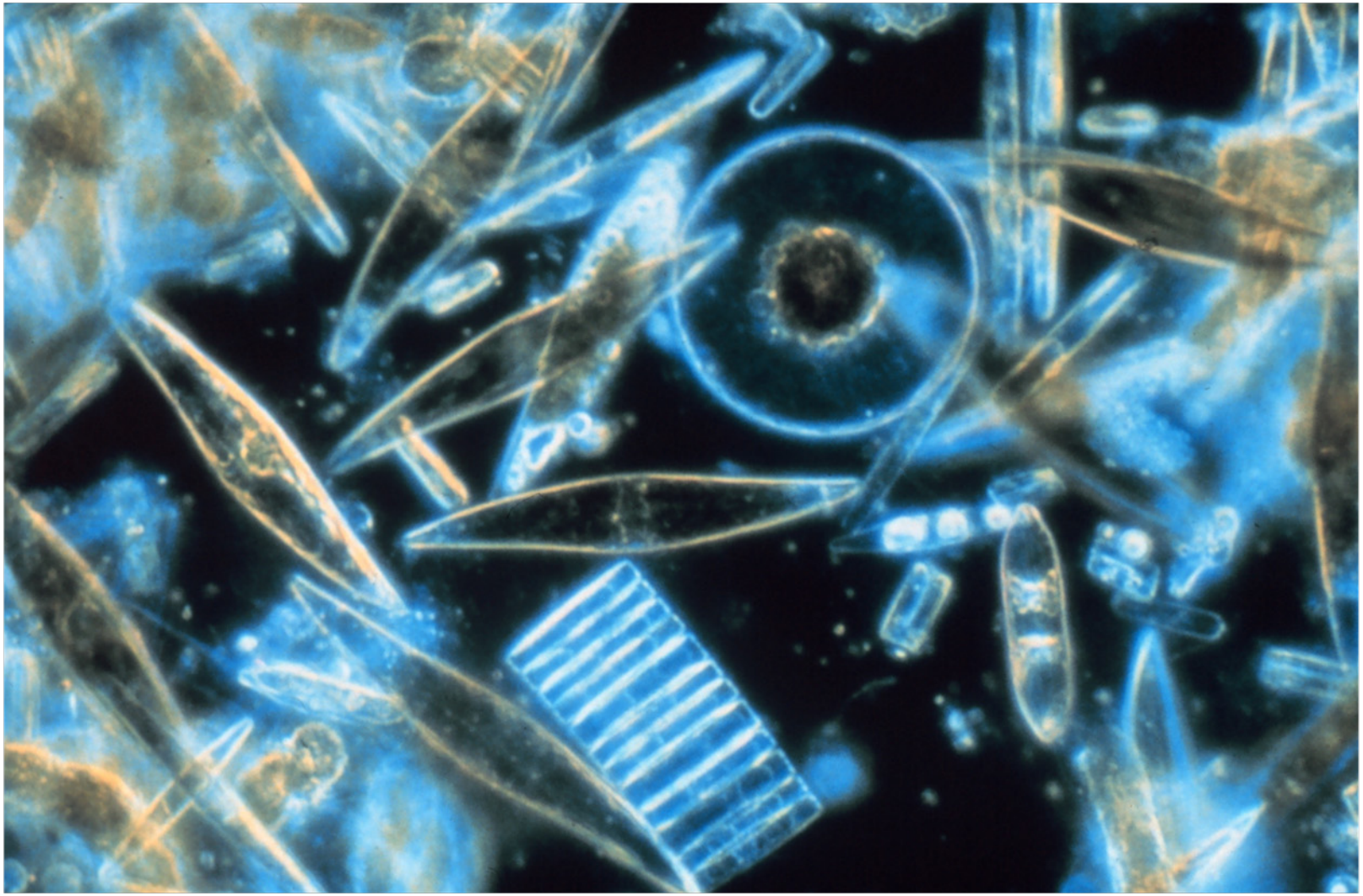
Credit: NSIDC & NASA Earth Observatory

Karen Frey:

Hello everyone, my name is Karen Frey and I'm an Assistant Professor in the Graduate School of Geography at Clark University. My research includes investigations of the biology and biogeochemistry of the Arctic Ocean and in particular, how these have responded to recent declines in sea ice cover.

Sea ice has strong links to primary production of phytoplankton, which is the base of the food chain in the Arctic Ocean (see next slide). This is because sea ice cover limits light availability and impacts the stability of the ocean waters below. Dramatic declines in sea ice over the recent past, as Don discussed, therefore have important consequences for ocean primary production.

Phytoplankton are the base of the ocean food web

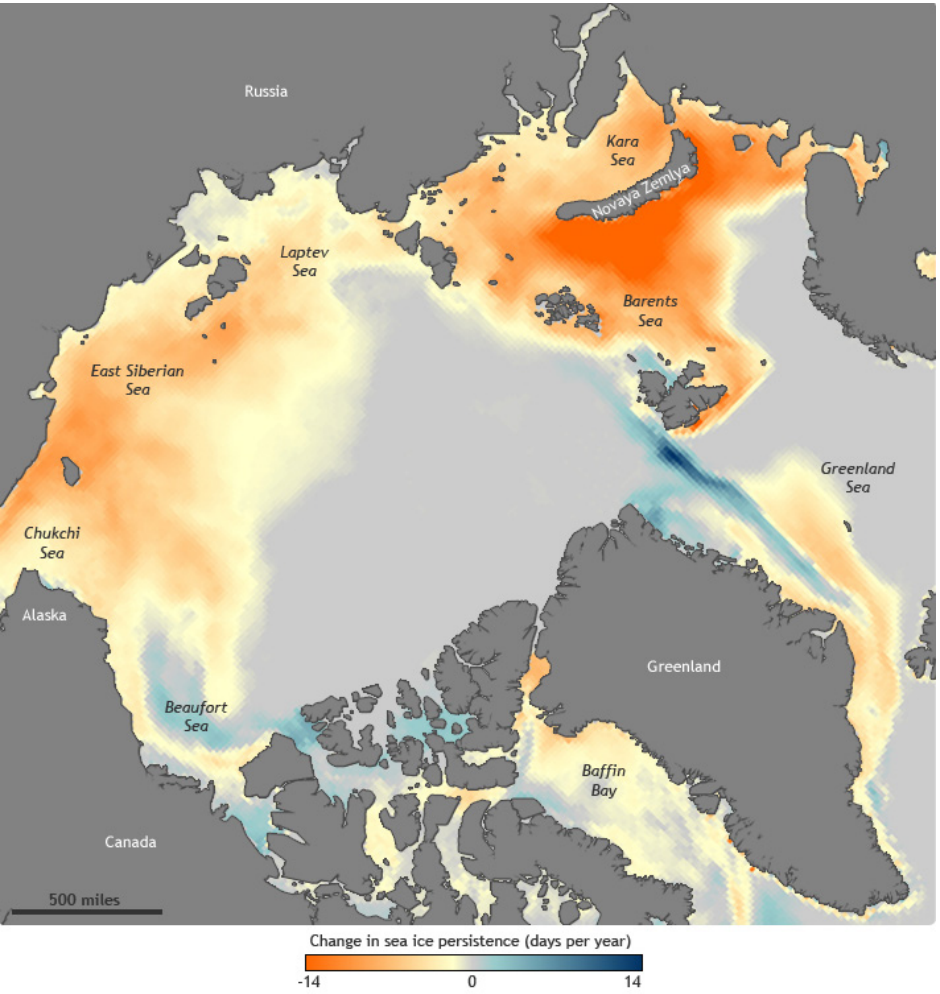


Credit: NSF Polar Programs

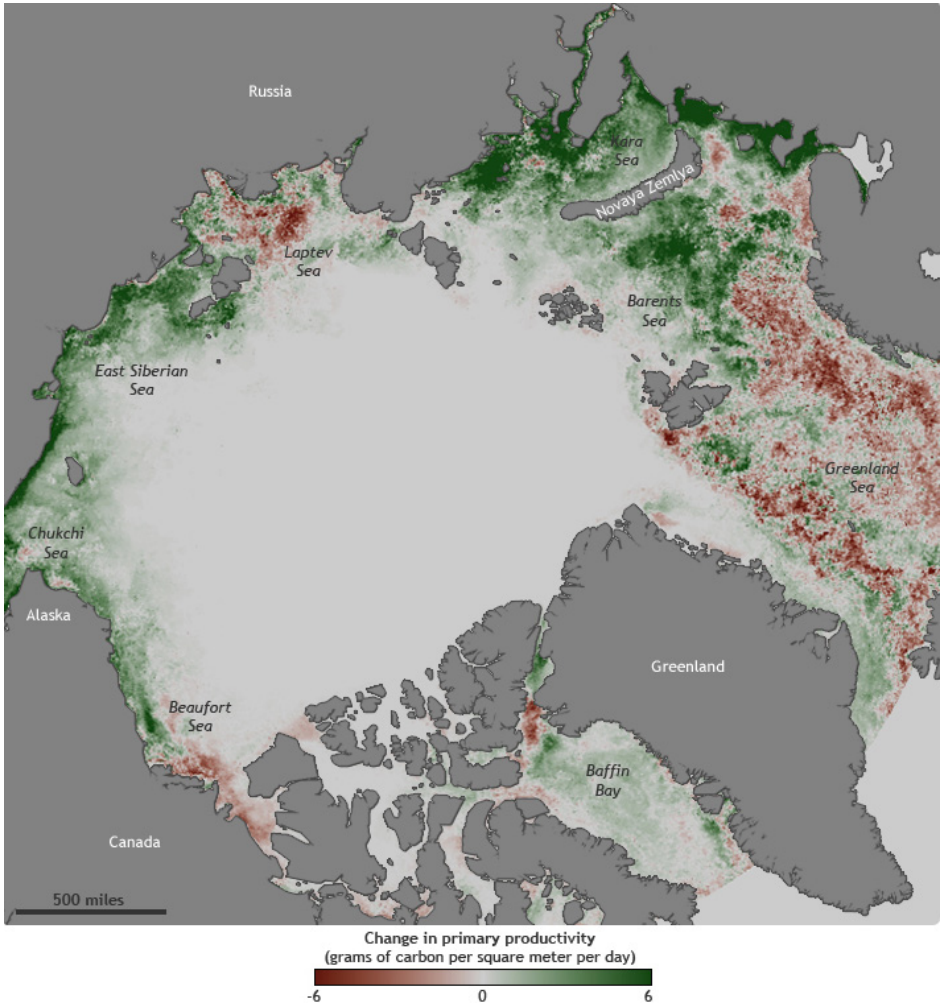
Karen Frey (continued)**:**

We have indeed seen changes in Arctic Ocean primary production that are linked to sea ice declines. Ocean color data collected from satellites over a 12-year period between 1998 and 2009 show a roughly 20% overall increase in primary production in the Arctic Ocean, resulting mainly from increases in open water area and lengthening of the open water season in coastal regions. These increases are particularly strong in the eastern Arctic, where production has increased 70% in the Kara Sea and 135% in the East Siberian Sea (see next slide).

Sea ice persistence



Primary productivity



Credit: Data courtesy Karen Frey; Maps by Climate.gov Team

Karen Frey (continued)**:**

There are also measureable changes linked with declines in sea ice at the top of the food chain, which includes marine mammals like walruses, whales, and polar bears (see next slide).

For polar bears, 7 of 19 sub-populations appear to be declining in number, with trends in two of the populations linked to reductions in sea ice. In addition, thousands of walruses hauled out on the NW coast of Alaska by mid-August 2011, which is thought to be triggered by reduced sea ice in the Chukchi Sea.

And the distribution of tagged bowhead whales from two different populations (one from Alaska and one from West Greenland) have overlapped in the Northwest Passage, which previously was impossible because sea ice barriers restricted these movements.

Walruses in Bering Sea

Credit: Captain Budd Christman, NOAA Corps

Polar bear on sea ice

Credit: Dr. Pablo Clemente-Colon, NOAA National Ice Center

Jacqueline Richter-Menge:

Thanks, Karen.

Another significant impact on the marine ecosystem that can be linked to the persistent reduction in the extent of the summer sea ice cover is ocean acidification; the increased amount of open water enhances the uptake of Carbon Dioxide from the atmosphere and, in turn, reduces the pH (increases the acidity) of the water.

While the marine environment often dominants the stage when it comes to talking about the Arctic, there is also a significant terrestrial, or land, component to the Arctic system. Land-based observations also provide strong evidence of the warming environment, including the impact of a reduced summer sea ice cover.

Let me hand this over to Howie Epstein…

Howie Epstein:

Good afternoon, everyone. I'm Howie Epstein, Professor in the Department of Environmental Sciences at the University of Virginia. One of my areas of research has been the arctic tundra, with a particular emphasis recently on the greening, or increasing, of arctic tundra vegetation.

The above-ground portion of arctic tundra vegetation has been increasing for as long as we've been able to physically observe its dynamics. Repeat photographs in northern Alaska extending back to around 1950 were one of the first indications that the arctic tundra was getting greener. More recent studies, using both satellite imagery and field observations, have corroborated this finding and indicate the phenomenon to be rather widespread throughout the arctic tundra (see next slide).

Arctic Tundra Getting “Greener”

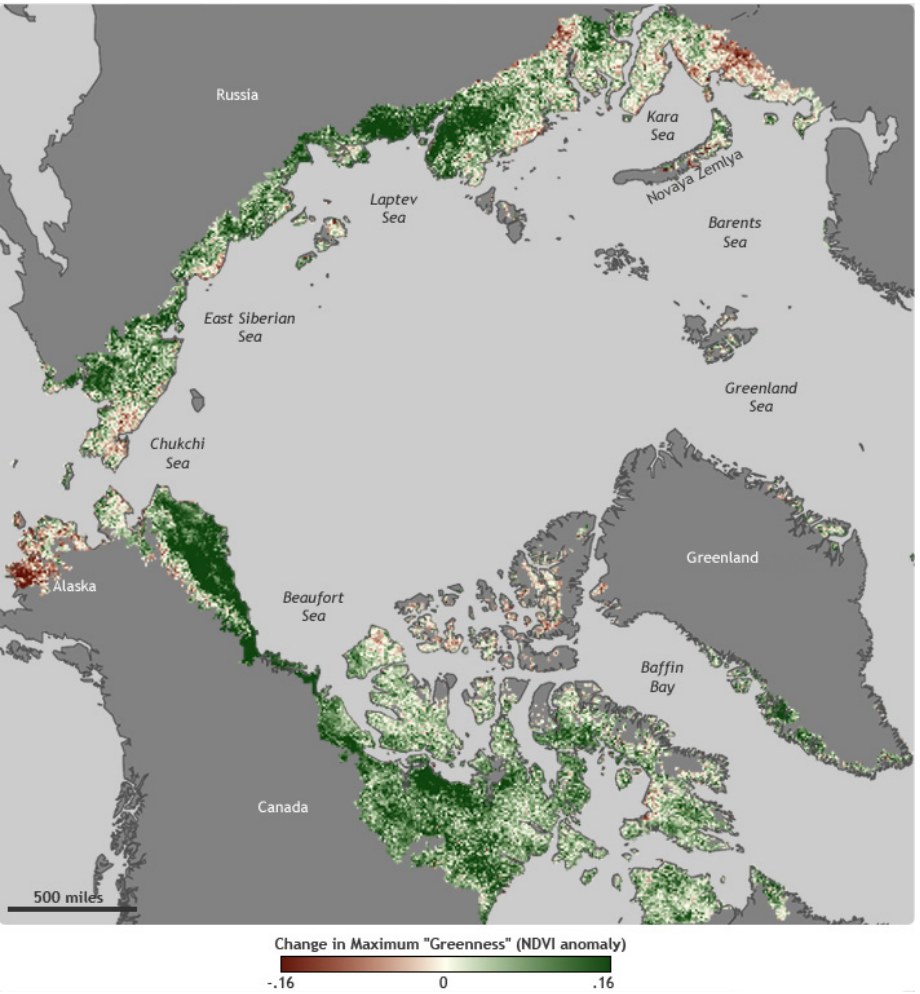
Credit: Greg Balogh, U.S. Fish and Wildlife Service

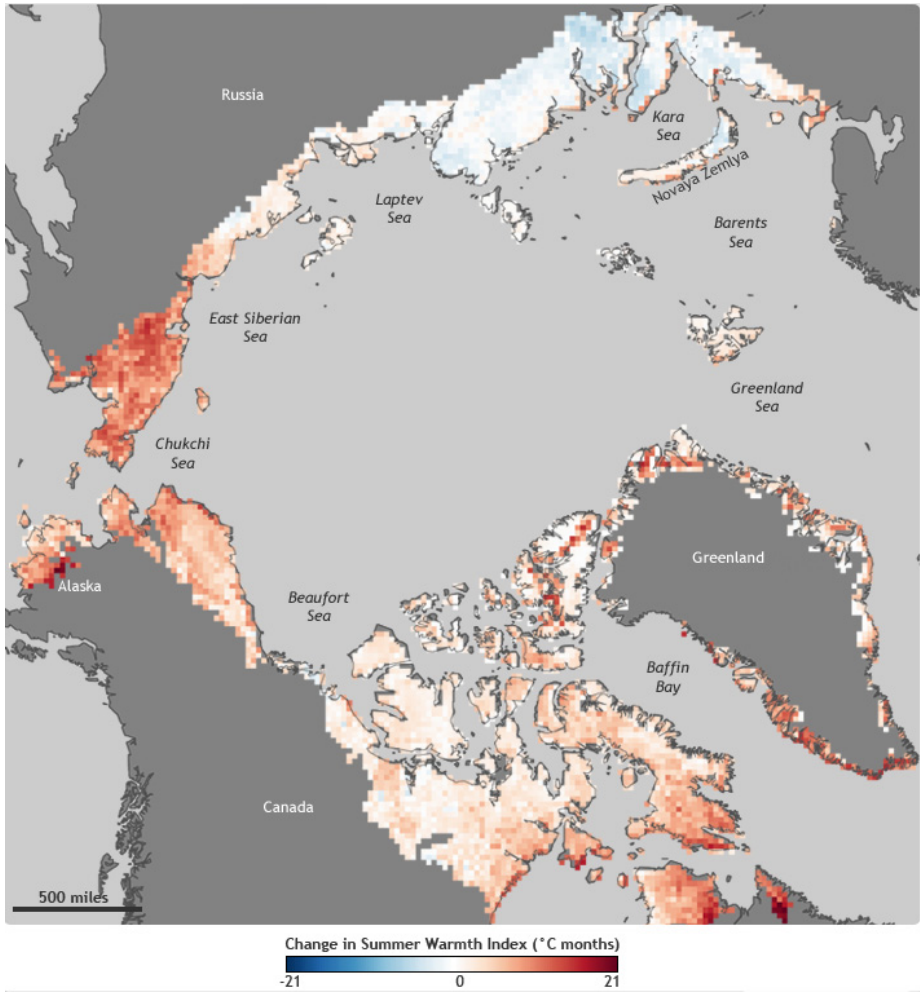
Howie Epstein (continued)**:**

A study by Bhatt *et al.*, published in 2010, suggests that regional greening of the arctic tundra over the course of the recent satellite record from 1982-2010 is highly correlated with the reduction of near-coastal sea ice, just mentioned by Don, and with increases in the total summer warmth. The seasonality of arctic tundra has been changing as well, with the Eurasian tundra reaching its peak greenness two weeks earlier now compared to the 1980s.

With regard to permafrost, temperature at 20-meter depth reached a record high in 2011 for all permafrost sampling sites on the coastal North Slope region of Alaska. Both tundra greening and warming permafrost are indicative of the warming land surface temperatures (see next slide). The interactions between changing vegetation and changing permafrost are complex and are currently being studied.

Tundra Growing Greener As Summer Warmth Increases





Credit: Data courtesy Uma Bhatt, U. of Alaska; Maps by Climate.gov Team

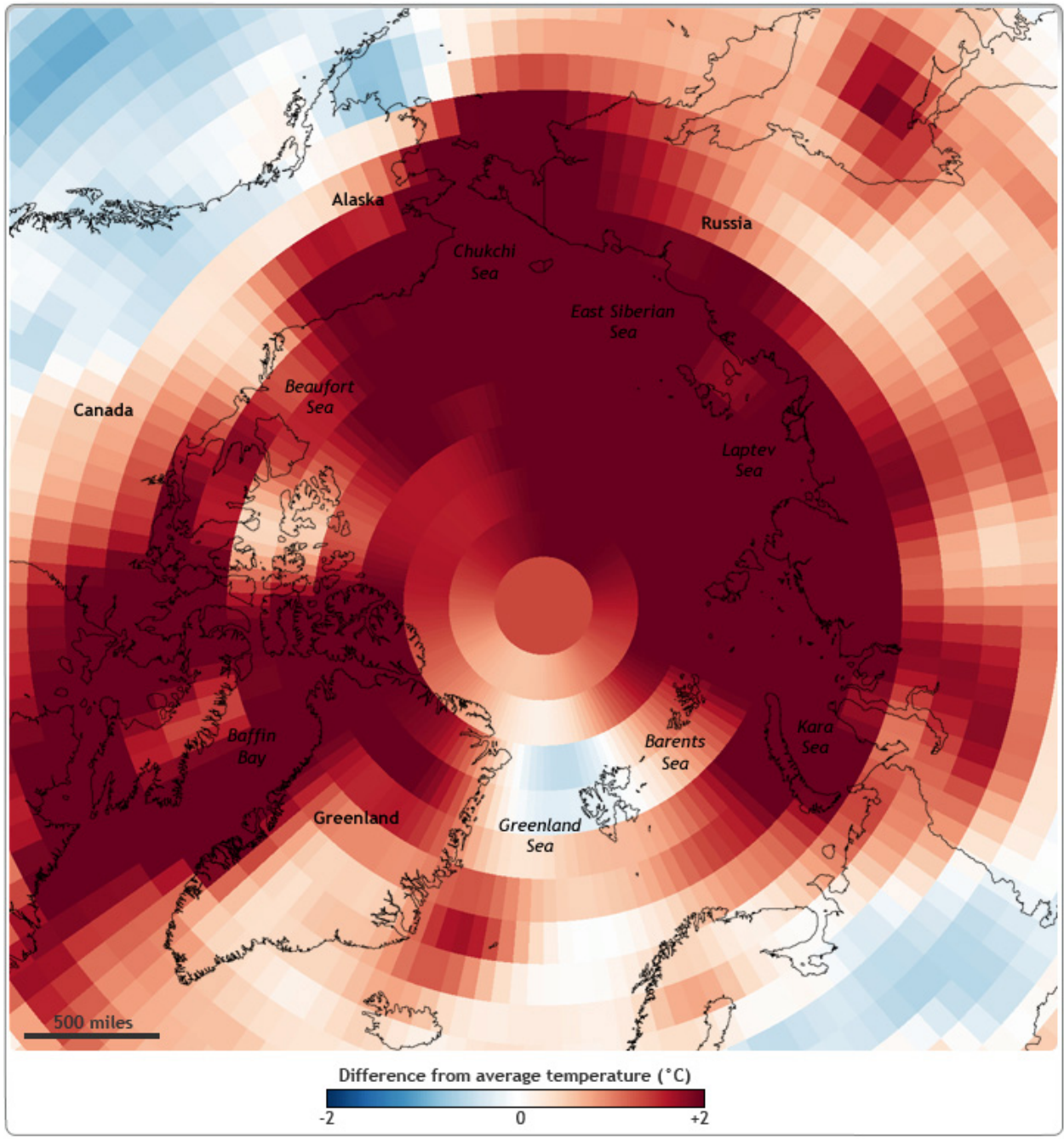
Jacqueline Richter-Menge:

Thanks, Howie.

At the root of the shift in the characteristics of the Arctic system is the continued widespread warming of surface air temperatures in the Arctic region. In 2011, annual near-surface air temperatures over much of the ocean were approximately +1.5 degrees Centigrade (or about 2 ½ degrees Fahrenheit) greater than the 1981-2010 baseline period. Land surface temperatures were also above their baseline values. This continued a decade-long phenomenon is called "Arctic Amplification," where deviations from historical air temperatures in the Arctic are two or more times greater than those observed at lower latitudes.

The amplification of warming in the Arctic reflects a powerful feedback between the region's ice covers and air temperature: As the air temperature increases, ice melts; as the ice (which is a bright, white, highly reflective surface) melts, it reveals darker ocean and land surfaces that absorb more solar energy during a summer season when the sun never sets; this causes more heating, which causes more melting…and on it goes**.**

Global warming is **amplified** in the Arctic. Warming is **2-3 times** what has been observed at lower latitudes.

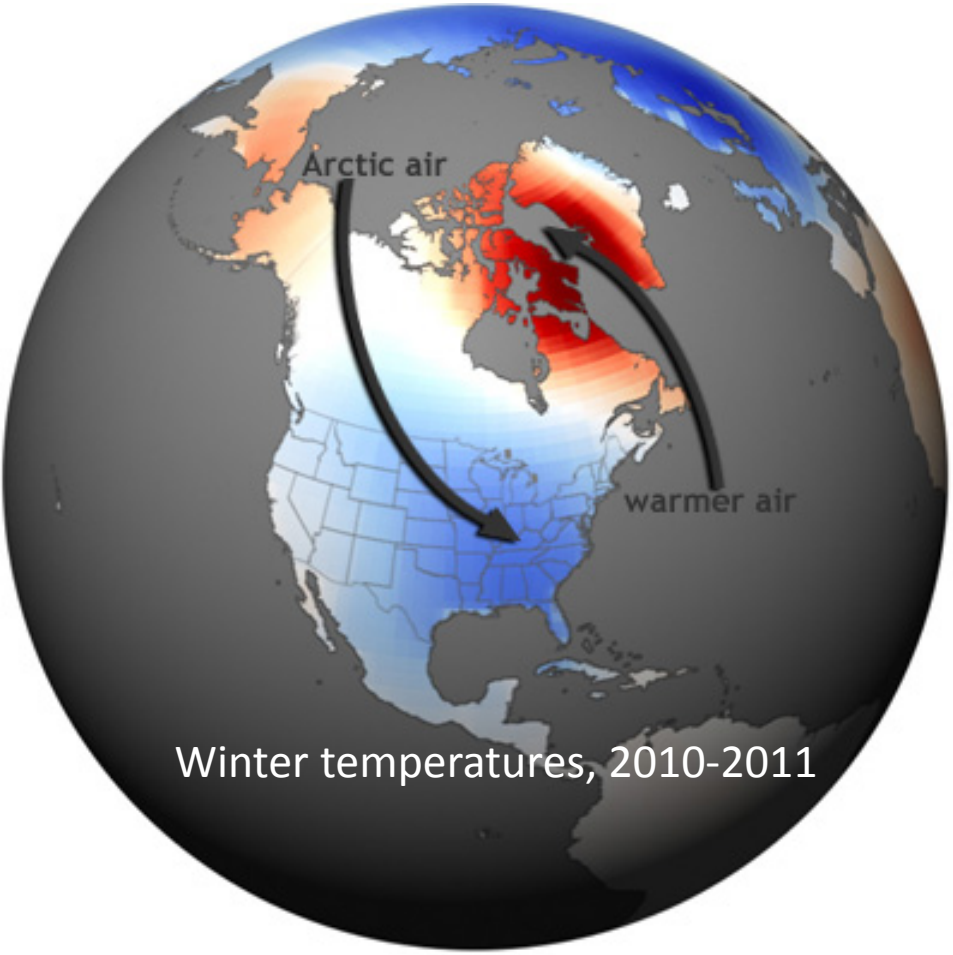


Credit: Data courtesy NOAA ESRL; Map by Climate.gov Team

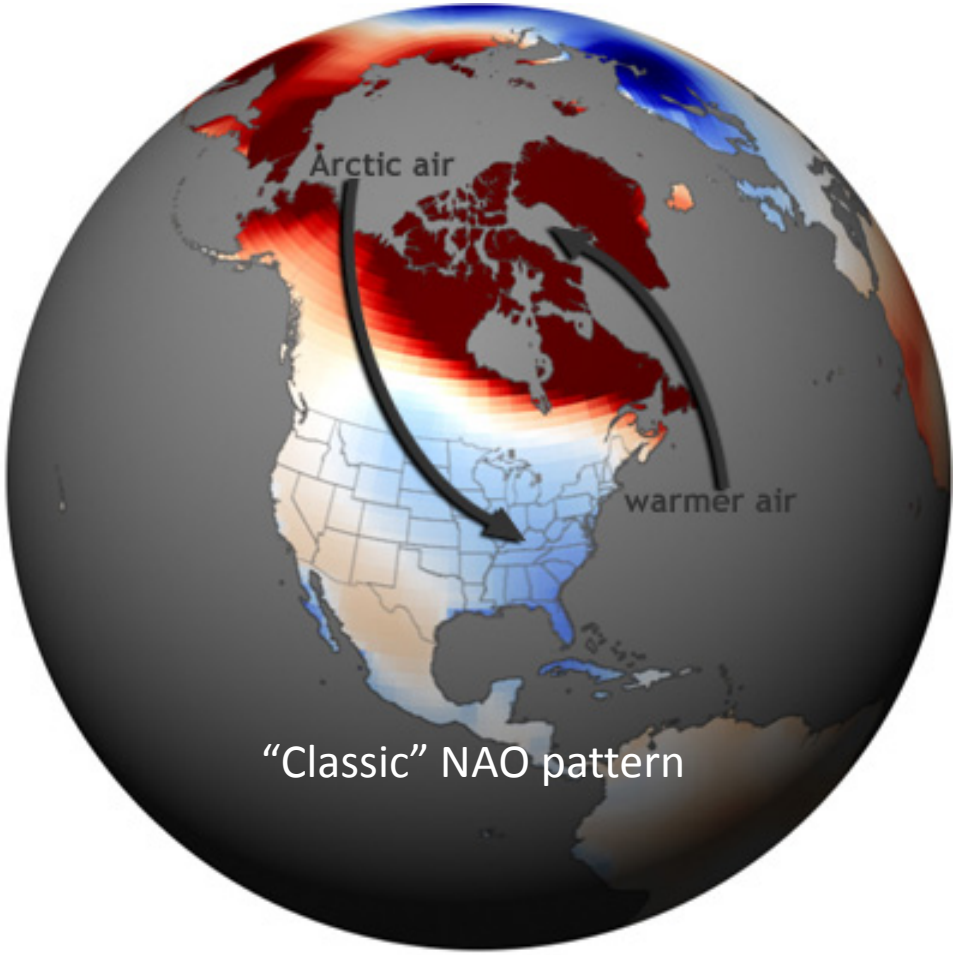
Jacqueline Richter-Menge (continued)**:**

Another key highlight of the 2011 Report, related to the atmosphere, is the repeated occurrence of a wind pattern that pushes cold arctic air into lower latitudes and pulls warmer air into the Arctic. During the last two winters, this exchange resulted in severe cold weather in eastern North America, northern Europe and eastern Asia, and in higher than normal air temperatures in the Arctic (see next slide).

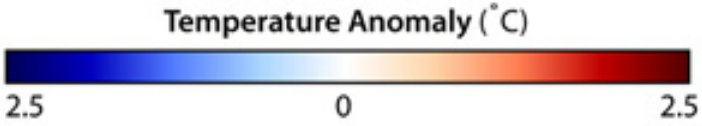
Influence of NAO/AO wind patterns on winter 2010-2011 temperature



Winter temperatures, 2010-2011



"Classic" NAO pattern



Credit: Data courtesy Marty Hoerling, NOAA ESRL; Map by Climate.gov Team

Jacqueline Richter-Menge (continued)**:**

The warmer Arctic air temperatures resulted in:

» record loss of ice sheet mass in Greenland and a continued overall trend of ice loss at other smaller glaciers and ice caps in the Arctic region,

» record low and late spring snow cover in Eurasia, and

» shorter lake ice duration.

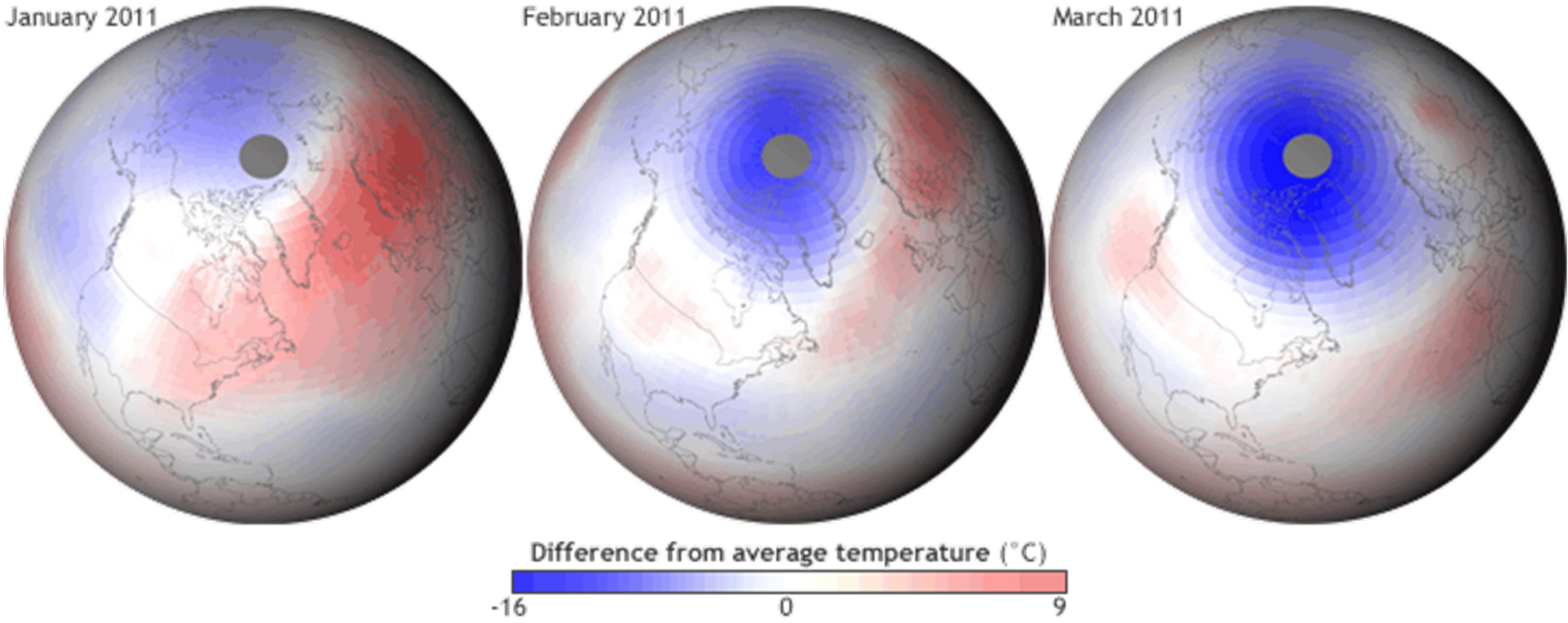
(See next slide.)

Credit: Konrad Steffen, CIRES, U. of Colorado

Jacqueline Richter-Menge (continued)**:**

Another potential indicator of recent atmospheric changes was the record low ozone concentrations in March 2011, leading to elevated Ultra Violet levels throughout the Arctic and sub-Arctic (next slide).

Unusually Chilly Stratosphere Led to Record Arctic Ozone Hole



Credit: Data courtesy NASA Aqua/AMSU Team; Maps by Dan Pisut, NOAA Environmental Visualization Lab

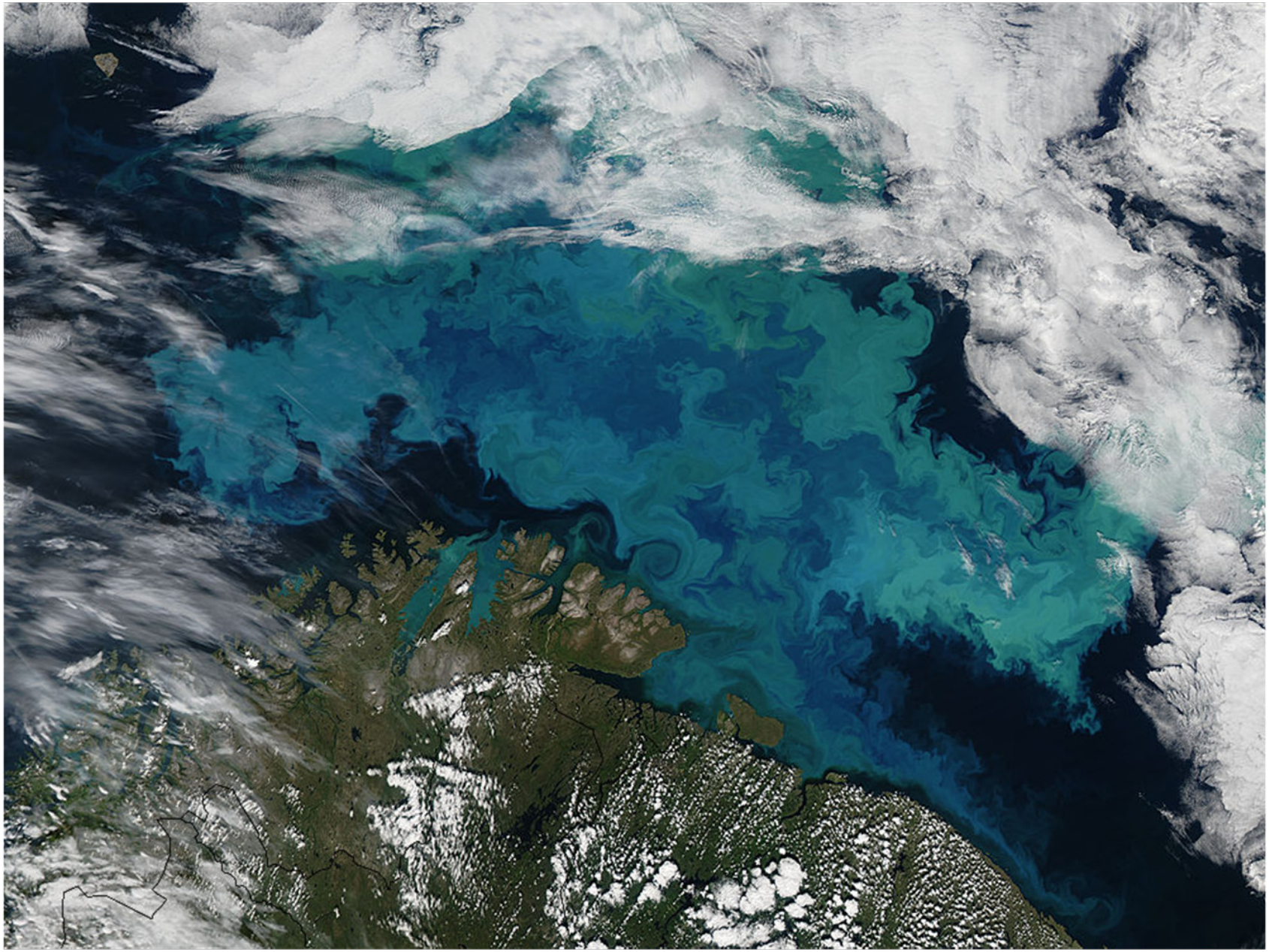
Jacqueline Richter-Menge (continued):

So…what's the bottom line of the 2011 update? What key points would we like you to take away?

First, **the Arctic is clearly experiencing the impacts of a prolonged and intensified warming trend.** This condition has led to a shift in the characteristics of the Arctic Ocean environment, marked by an increase in the extent and duration of the open water season, and an upper ocean that is warmer and less salty.

Second, **the Arctic is a system with strong links between the ocean, land, and atmosphere and the ecosystems they support.** Consequently, the impacts of the shift in the characteristics of the Arctic Ocean reach well beyond the ocean itself, and are acting together to amplify the evidence of change.

Blooms cover millions of square miles



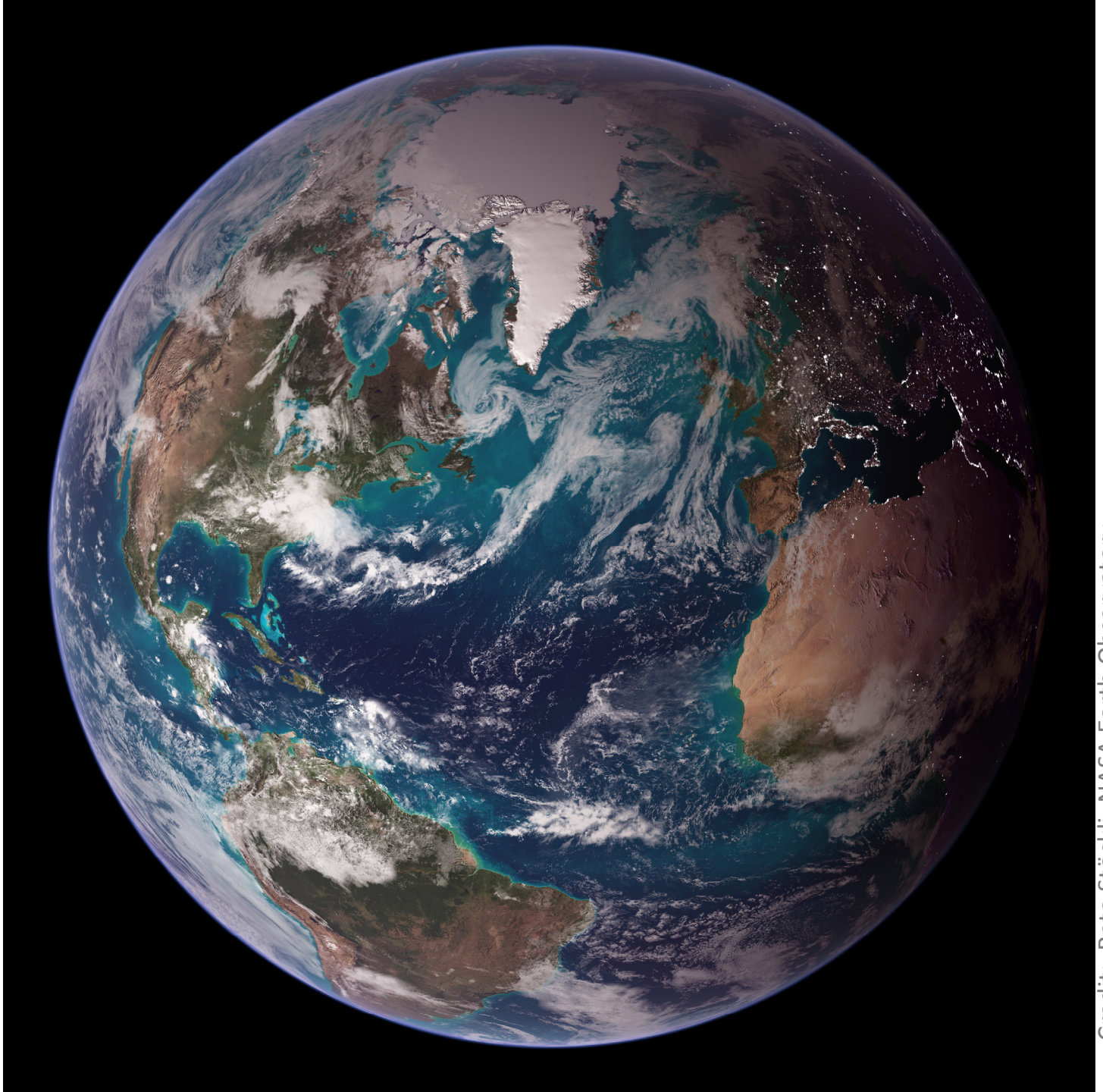
Credit: NASA Aqua/MODIS

Jacqueline Richter-Menge (continued)**:**

Third, **the Arctic system impacts and is, in turn, impacted by the global system** (see next slide). The Arctic does not act in isolation. For instance, we see a connection between the wind patterns of the Arctic and lower latitudes. The increase in the loss of snow and glacier ice contributes to sea level rise. And, the changes in the foundation of the Arctic marine ecosystem are bound to have increasing impacts on the regions commercial fisheries, which furnish about 50% of the U.S. catch.

My final point: **the 2011 Report Card shows that record-setting changes are occurring throughout the Arctic environmental system.** Given the projections of continued warming, it is very likely — indeed expected — that these changes will continue in years to come, with increasing climatic, physical, biological, and socio-economic impacts.

Thank you.



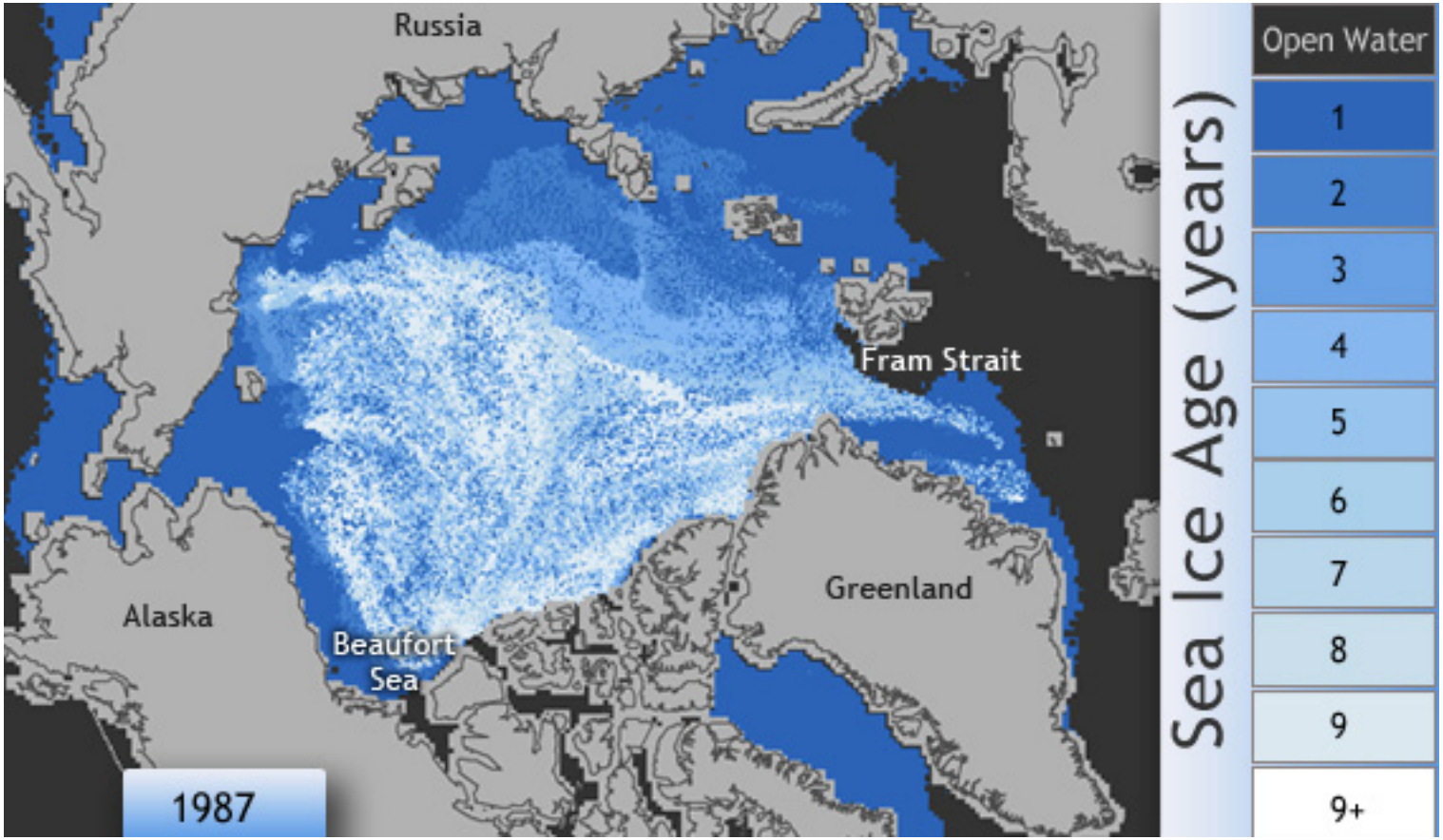
Credit: Reto Stöckli, NASA Earth Observatory

Supplemental slides
beyond this point

Additional Graphics & Videos
are available online at
www.arctic.noaa.gov/reportcard/
&
www.climatewatch.noaa.gov/article/2011/arctic-report-2011

Less than half of the ice at winter max has survived at least one summer

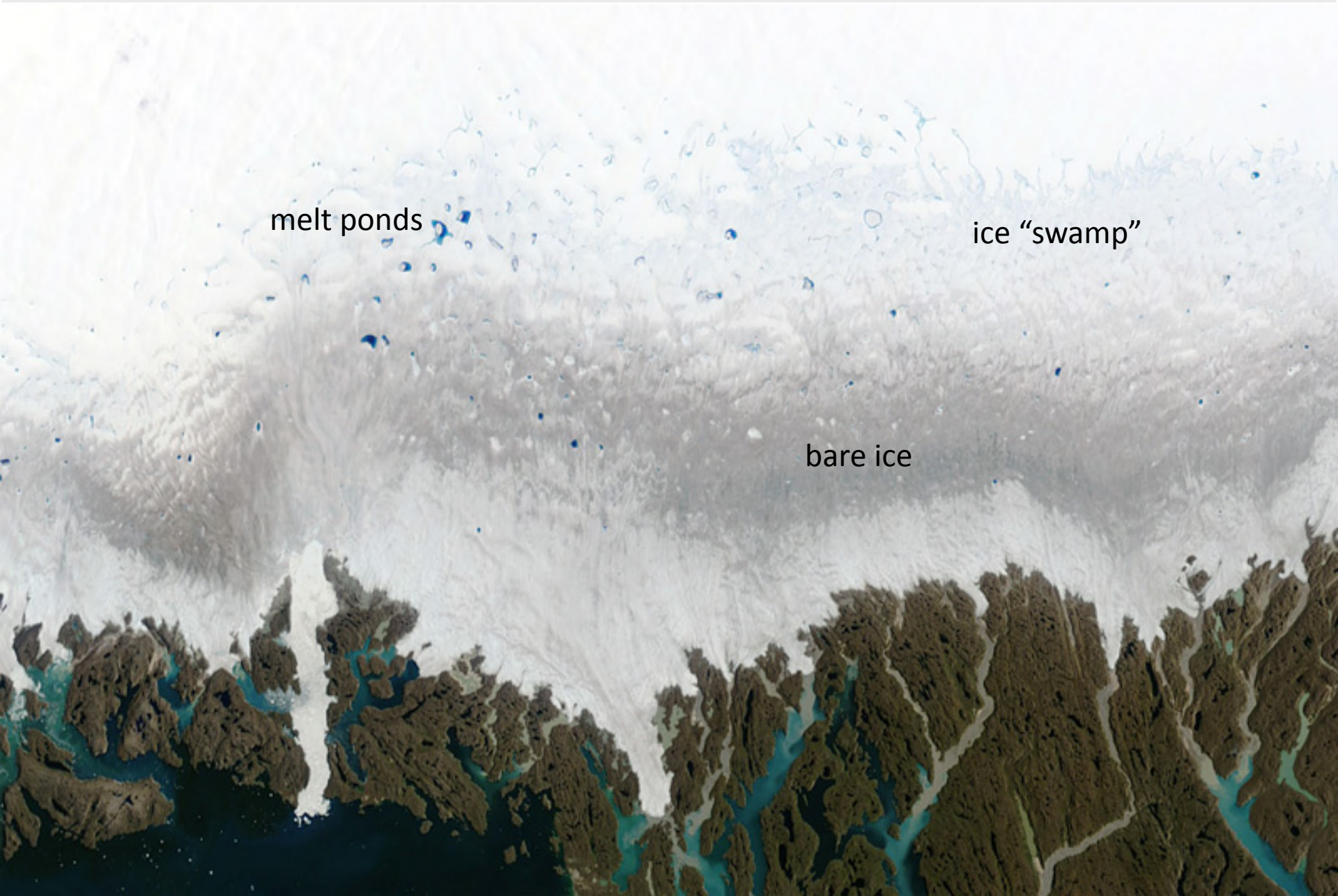
http://www.climatewatch.noaa.gov/video/2011/old-ice-becoming-rare-in-arctic



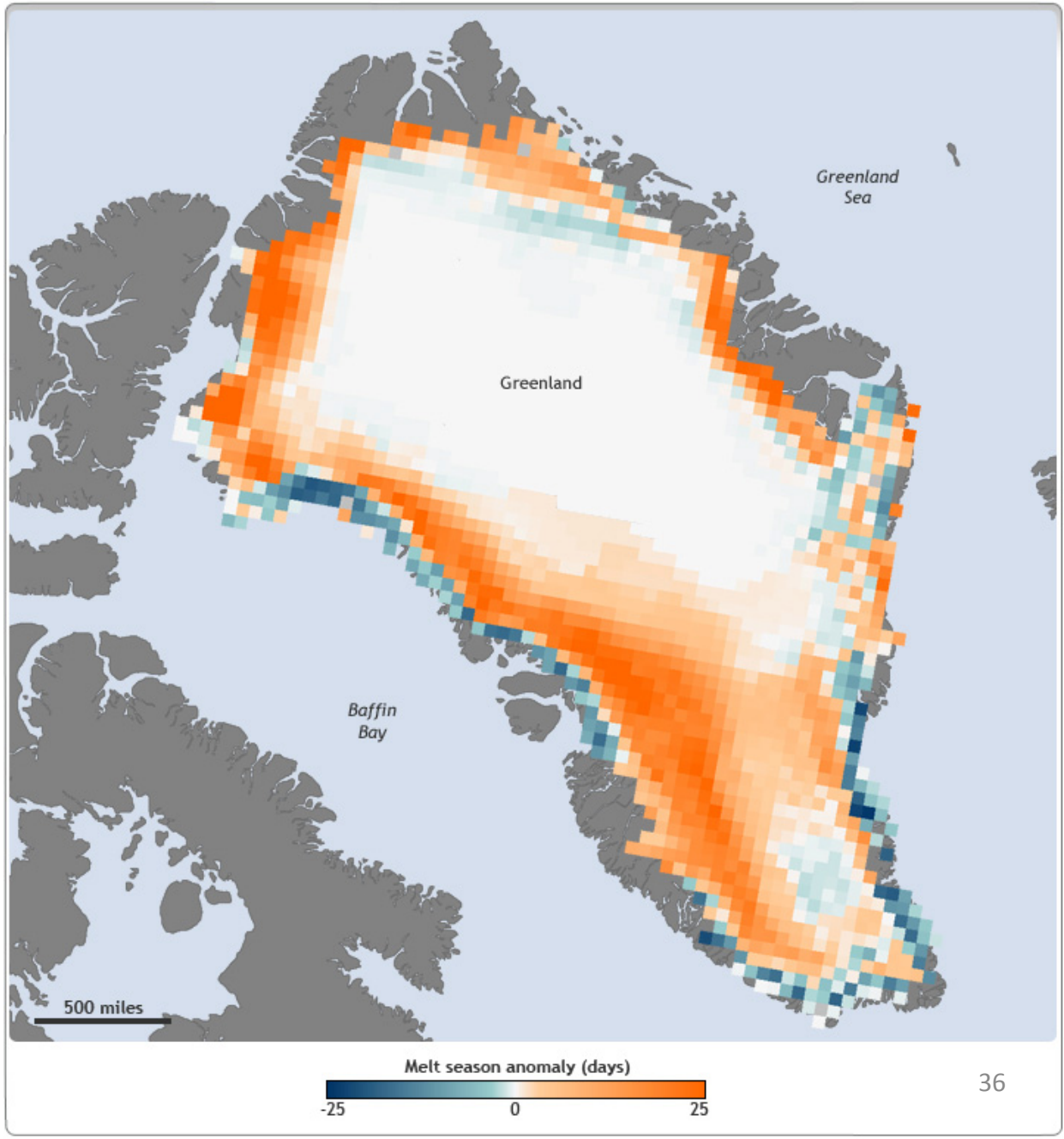
Credit: Animation by Climate.gov Team using data courtesy J. Maslanik, U. of Colorado

Enormous melt ponds collapse and drain through the ice sheet.

Surface melt on Greenland ice sheet



2011 surface melt on the Greenland Ice Sheet was well above average.



Credit: Data courtesy Marco Tedesco; Map by Climate.gov Team