



# Climate Change in Svalbard

**Kim Holmén**

International Director

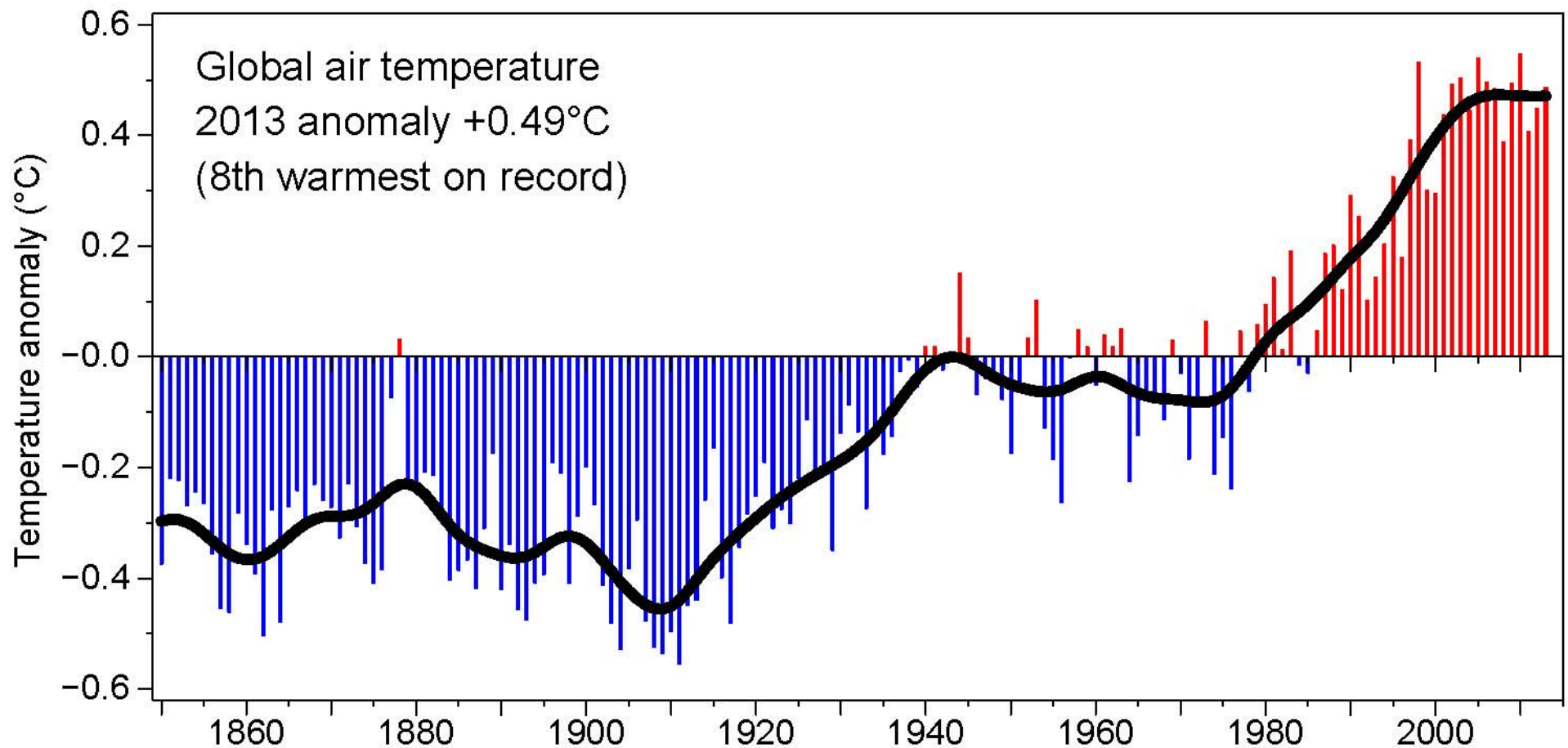
Norwegian Polar Institute

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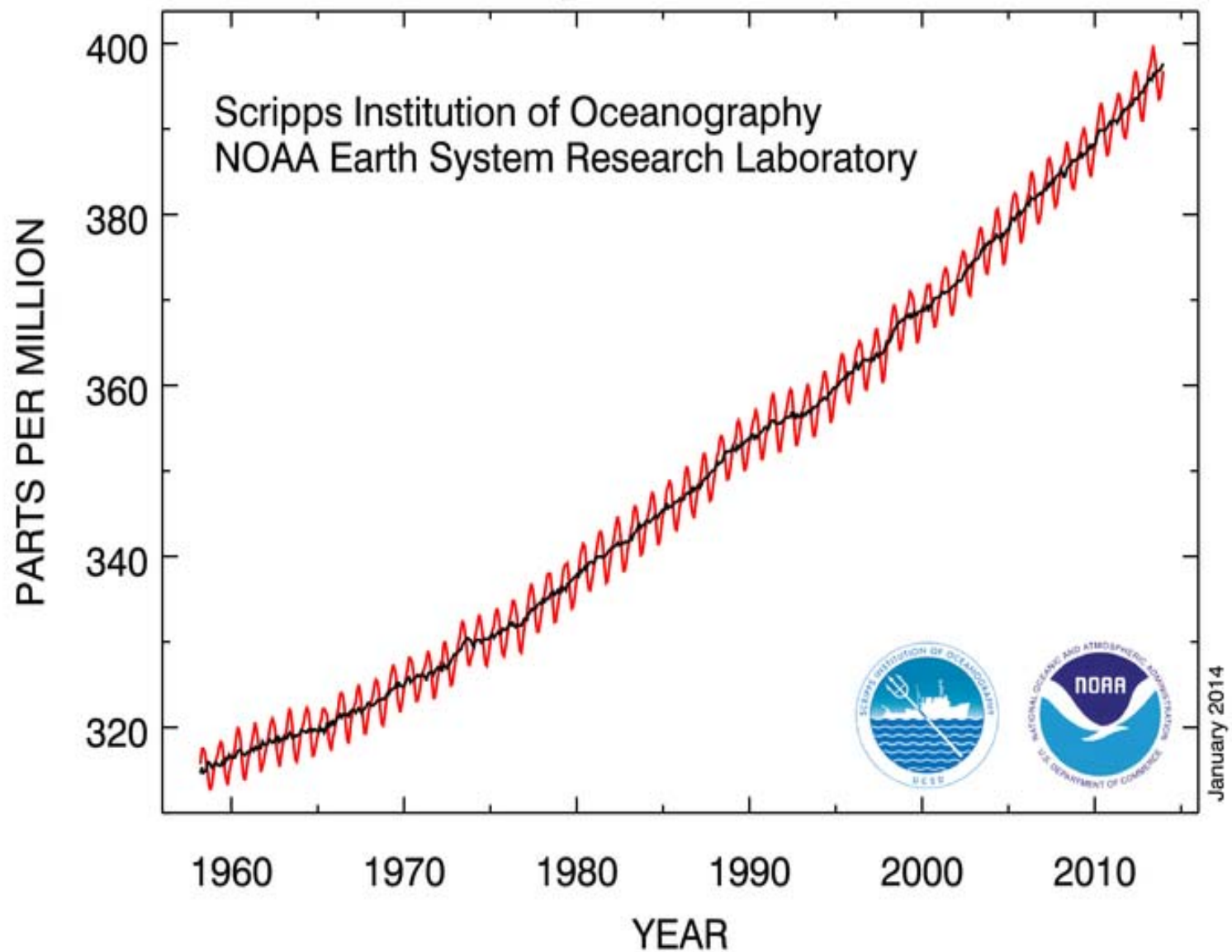


# Climate Research Unit, University of East Anglia

<http://www.cru.uea.ac.uk/cru/info/warming/>



## Atmospheric CO<sub>2</sub> at Mauna Loa Observatory

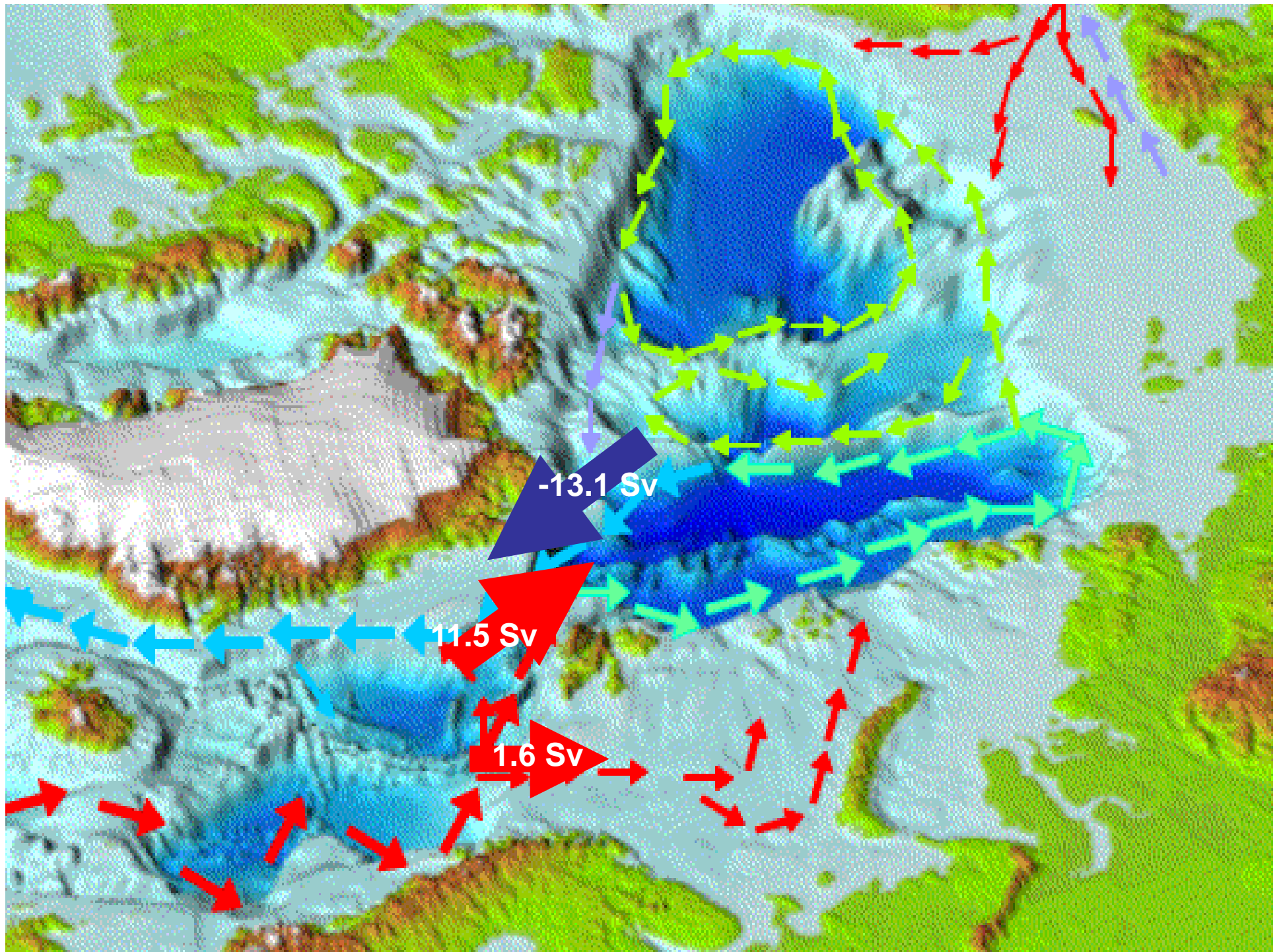




# Svalbard: Norwegian Arctic









# SVALBARD

Ny-Ålesund

Longyearbyen

Barentsburg

Hornsund

~60,000 km<sup>2</sup>  
~60% glaciers

# CLIMATE CHANGE ?

- Detection
  - Is climate changing?
  - Are these changes unique?
- Attribution
  - What is causing the changes?
    - Natural variation (Sun, volcanoes, etc.)
    - Greenhouse gases released by humankind
    - Other human induced changes

## Future change

- Models

## Effects of climate change

- Ecosystems
- Society

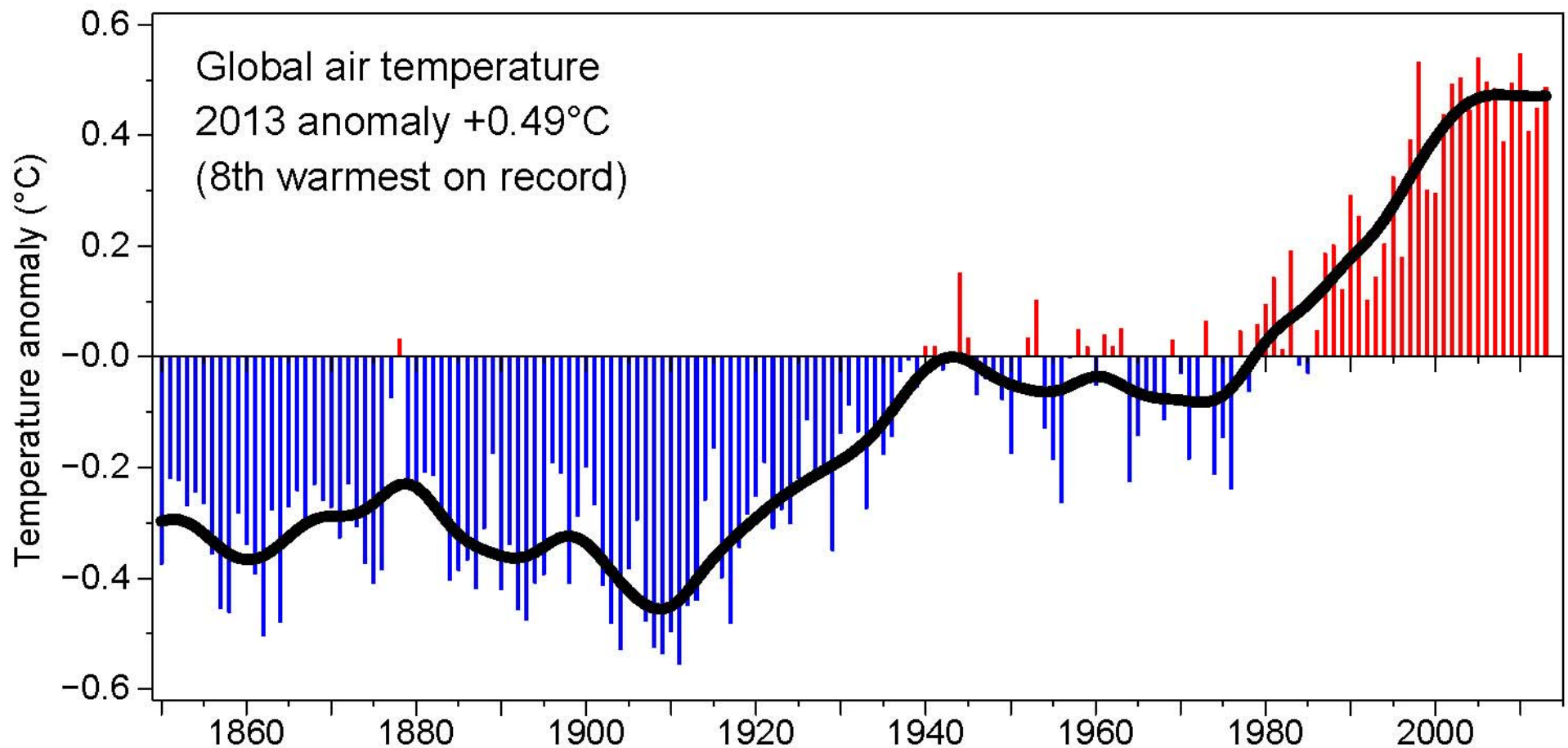
- Agriculture
- Infrastructure

- Combined effects



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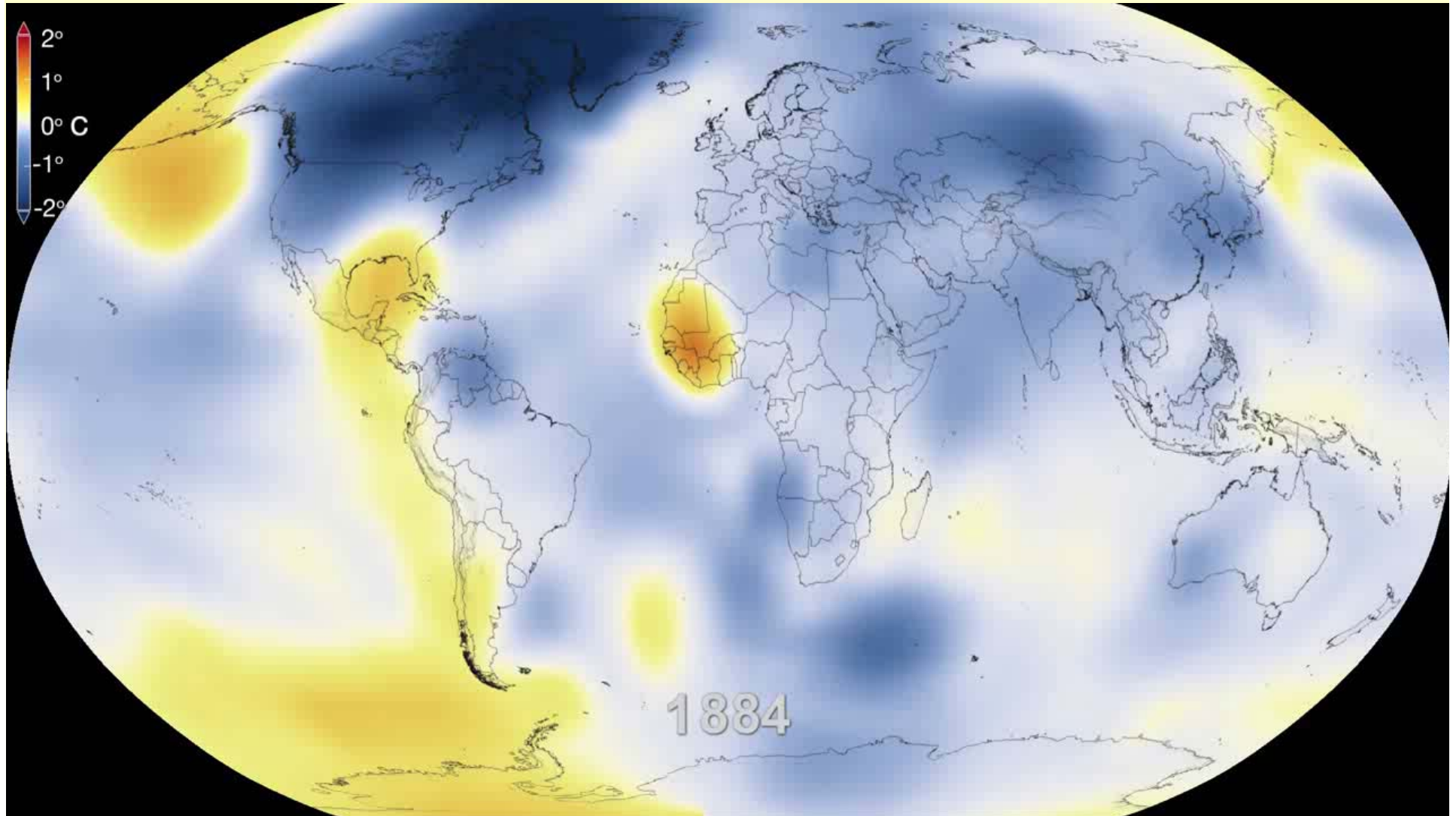
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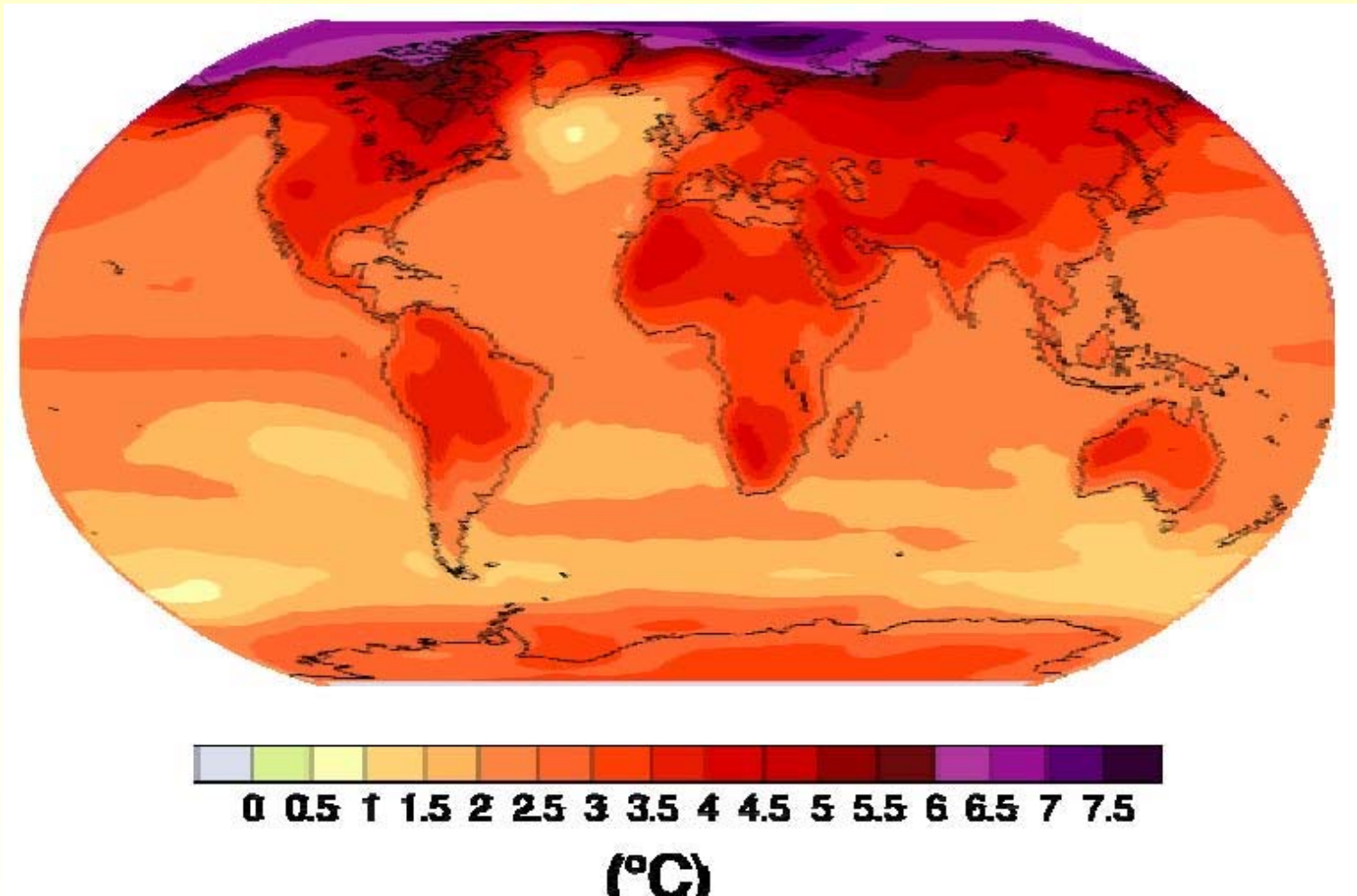


National Aeronautics and Space Administration  
Goddard Institute for Space Studies



<http://data.giss.nasa.gov/gistemp/animations/>

# Geographical pattern of surface warming

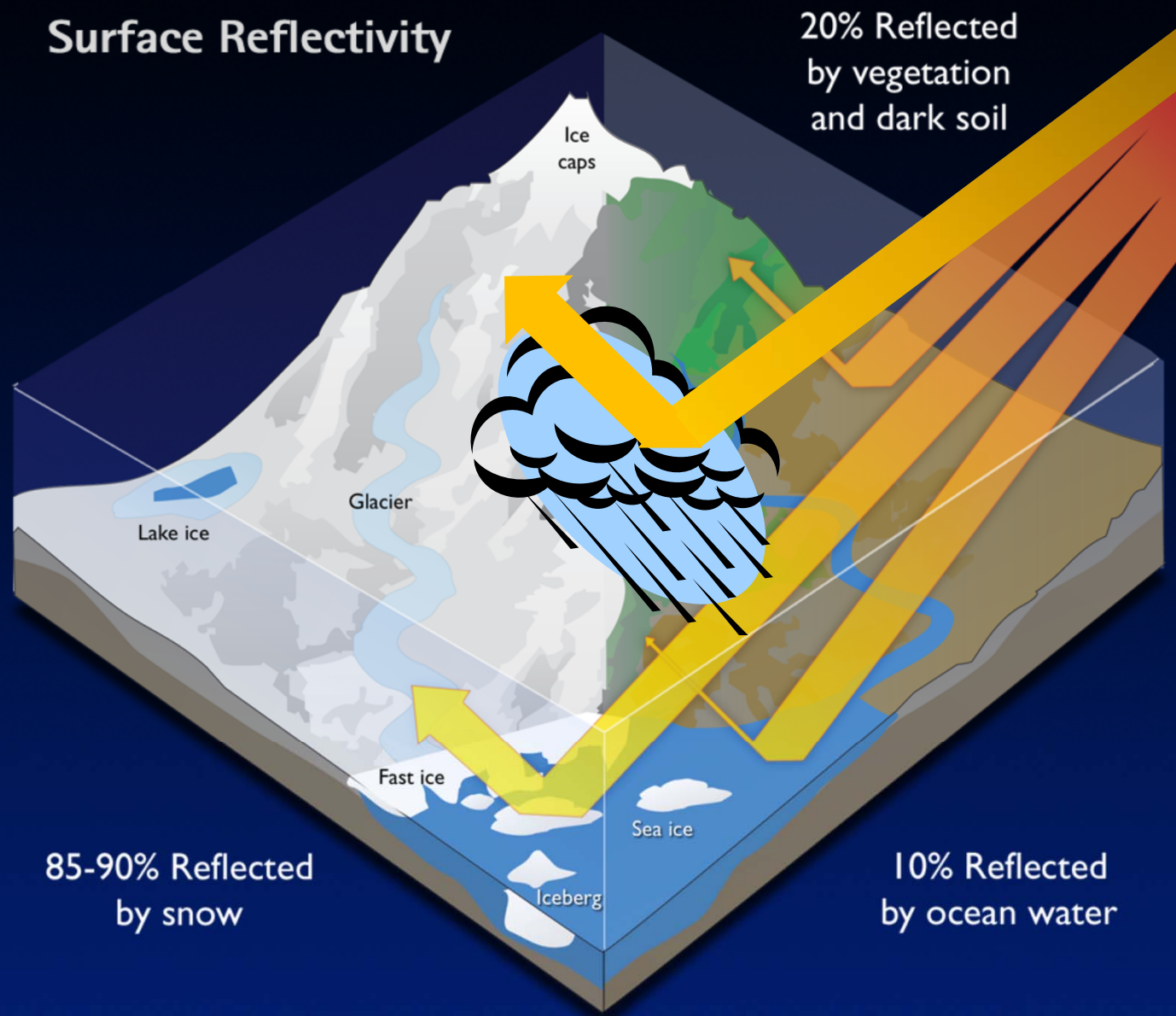


Projected surface temperature changes for the late 21st century (2090-2099). The map shows the multi-AOGCM average projection for the A1B SRES scenario. All temperatures are relative to the period 1980-1999.



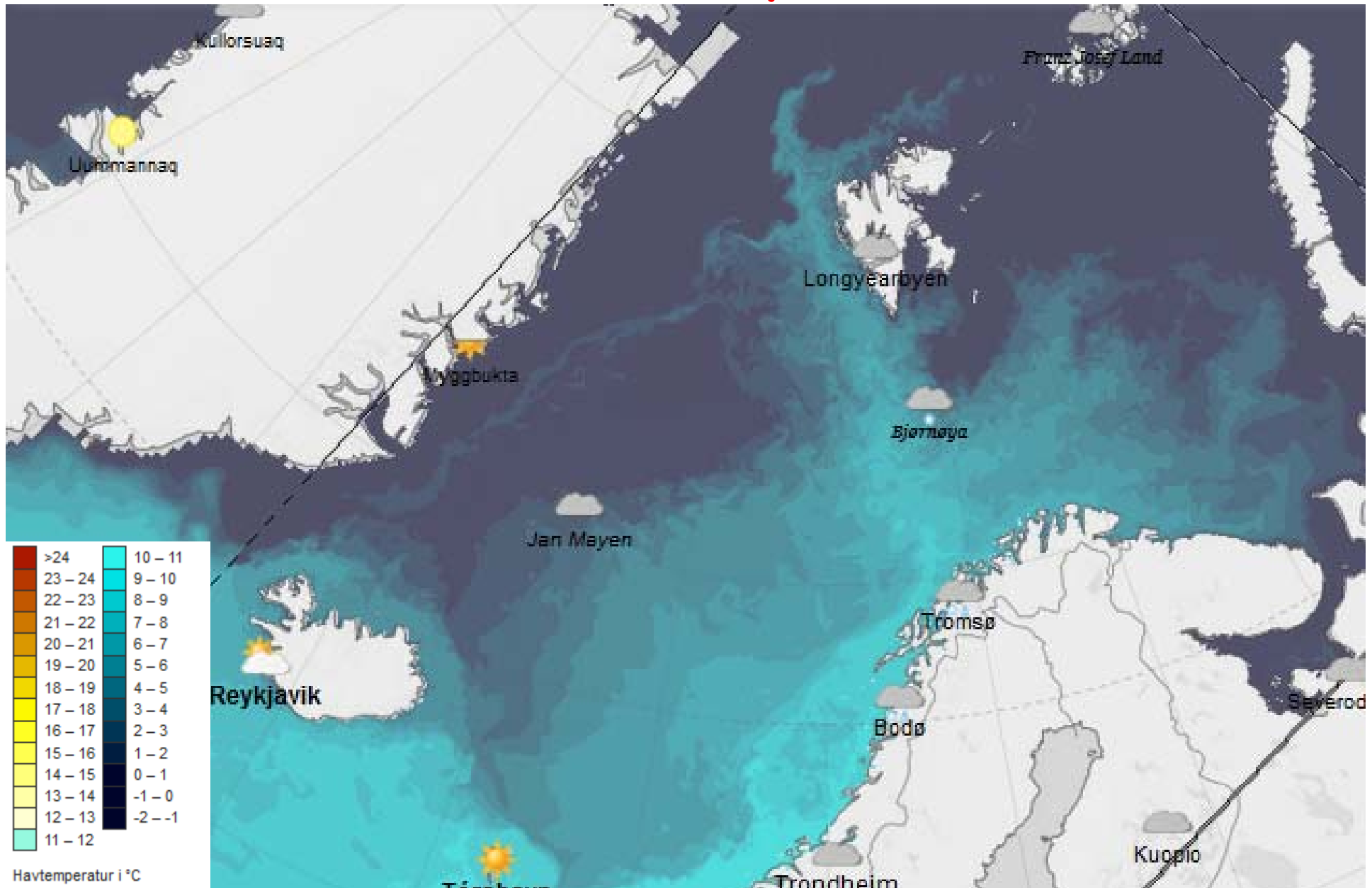
# IMPACTS OF A WARMING ARCTIC

## Surface Reflectivity



# Sea surface temperature December 8, 2014

yr.no





Sea Ice Extent  
01/19/2014

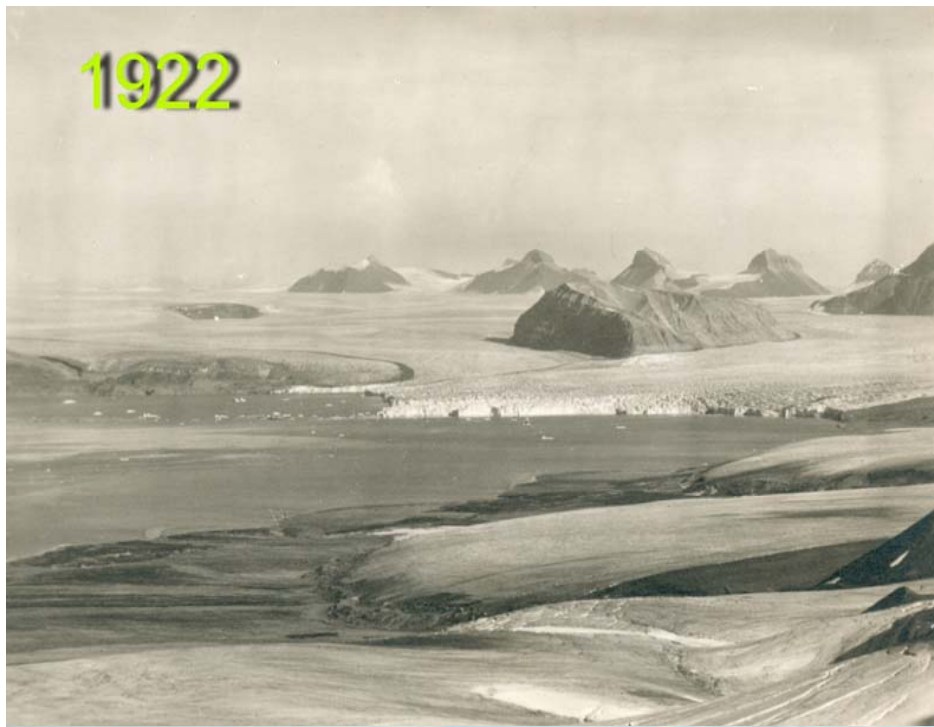


National Snow and Ice Data Center, Boulder, CO

median  
1981-2010

Kim Hol

1922



1939



2002



June 21, 2010



Deviation from the normal course Aigué explains as usually due to the presence not far away of another typhoon. However, there is record of a hurricane in Fiji which recurved so sharply on its course that its center passed twice over the city of Levuka, and yet no other disturbance was known to be anywhere near. Furthermore, this hurricane traveled northwest from Levuka after its first passage over that city, the opposite direction from that which tropical cyclones normally take in that latitude in the southern hemisphere.<sup>27</sup>

*Bifurcation of cyclones.*—Sometimes it happens that a well-developed cyclone apparently divides into two independent, comparable storms, each of which henceforth follows an independent course. Aigué suggests that

The oceanographic observations have, however, been even more interesting. Ice conditions were exceptional. In fact, so little ice has never before been noted. The expedition all but established a record, sailing as far north as 81° 29' in ice-free water. This is the farthest north ever reached with modern oceanographic apparatus.

The character of the waters of the great polar basin has heretofore been practically unknown. Dr. Hoel reports that he made a section of the Gulf Stream at 81° north latitude and took soundings to a depth of 3,100 meters. These show the Gulf Stream very warm, and it could be traced as a surface current till beyond the 81st parallel. The warmth of the waters makes it probable that the favorable ice conditions will continue for some

## THE CHANGING ARCTIC.

By GEORGE NICOLAS IFFT.

[Under date of October 10, 1922, the American consul at Bergen, Norway, submitted the following report to the State Department, Washington, D. C.]

The Arctic seems to be warming up. Reports from fishermen, seal hunters, and explorers who sail the seas about Spitzbergen and the eastern Arctic, all point to a radical change in climatic conditions, and hitherto unheard-of high temperatures in that part of the earth's surface.

In August, 1922, the Norwegian Department of Commerce sent an expedition to Spitzbergen and Bear Island under the leadership of Dr. Adolf Hoel, lecturer on geology at the University of Christiania. Its purpose was to survey and chart the lands adjacent to the Norwegian mines on those islands, take soundings of the adjacent waters, and make other oceanographic investigations.

Dr. Hoel, who has just returned, reports the location of hitherto unknown coal deposits on the eastern shores of Advent Bay—deposits of vast extent and superior quality. This is regarded as of first importance, as so far most of the coal mined by the Norwegian companies on those islands has not been of the best quality.

[Weather Bureau, Washington, D. C., Dec. 10, 1922.]

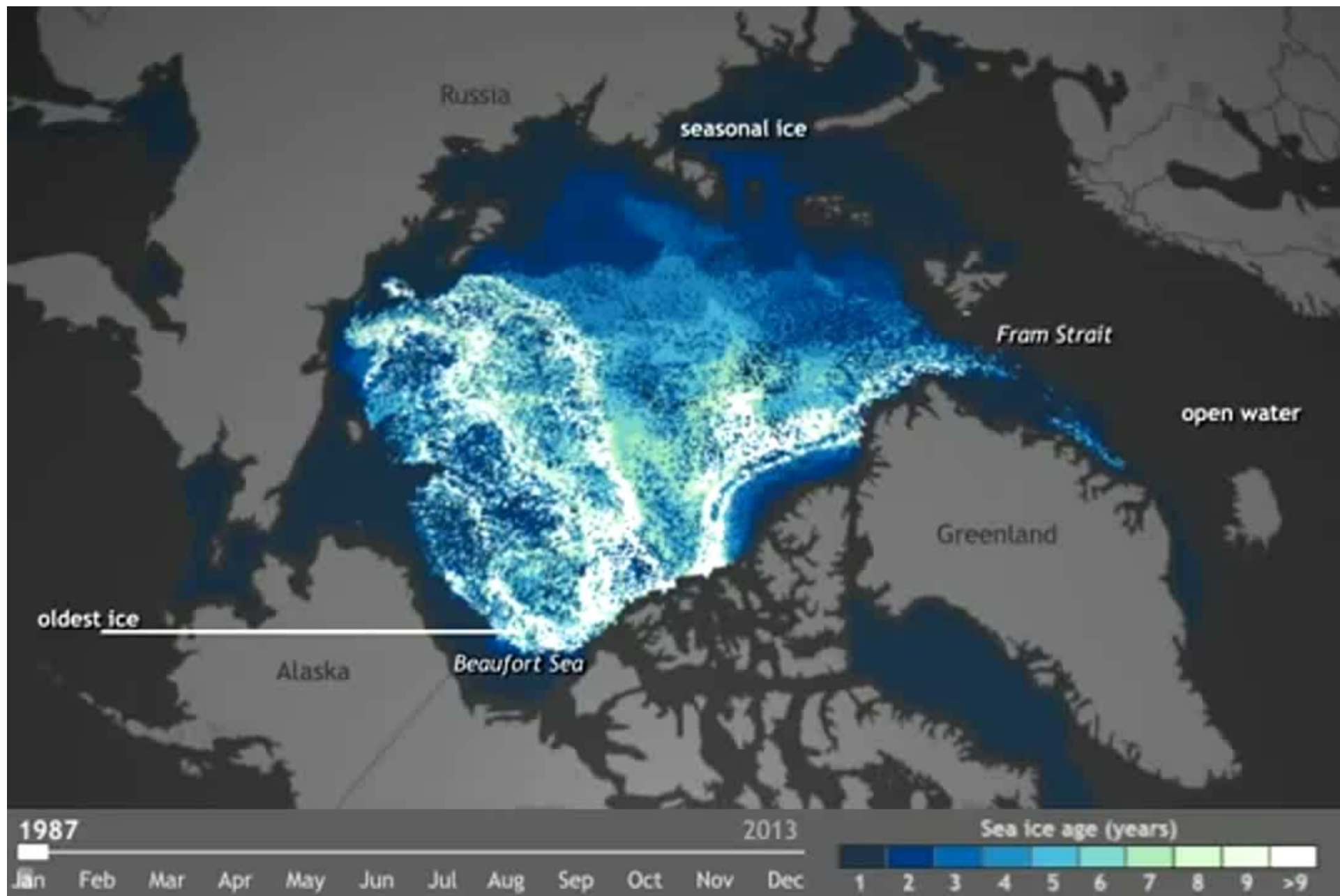
An interesting memorandum was recently received by the Weather Bureau in connection with a marine weather report from Mr. W. Scott, fifth officer of the American S. S. *Manchuria*. It deals with the appearance of several varieties of small land birds a considerable distance at sea on the 27th to 29th of October, 1922, during a voyage from New York to Hamburg, and is presented here, with an inclusion of the list of observed bird varieties, for the scientific interest involved.

S. S. *Manchuria*,  
Voyage 50—N. Y.—HAMBURG,  
October 28, 1922.

It may be of some interest to the Department of Plants and Animals or to the Smithsonian Institution to note that on October 27, latitude 40° 36', longitude 68°, to noon 28th, latitude 41° 45', longitude 59° 27',

<sup>27</sup> R. L. Holmes: Quart. Journ. Royal Meteorol. Soc., January, 1905.

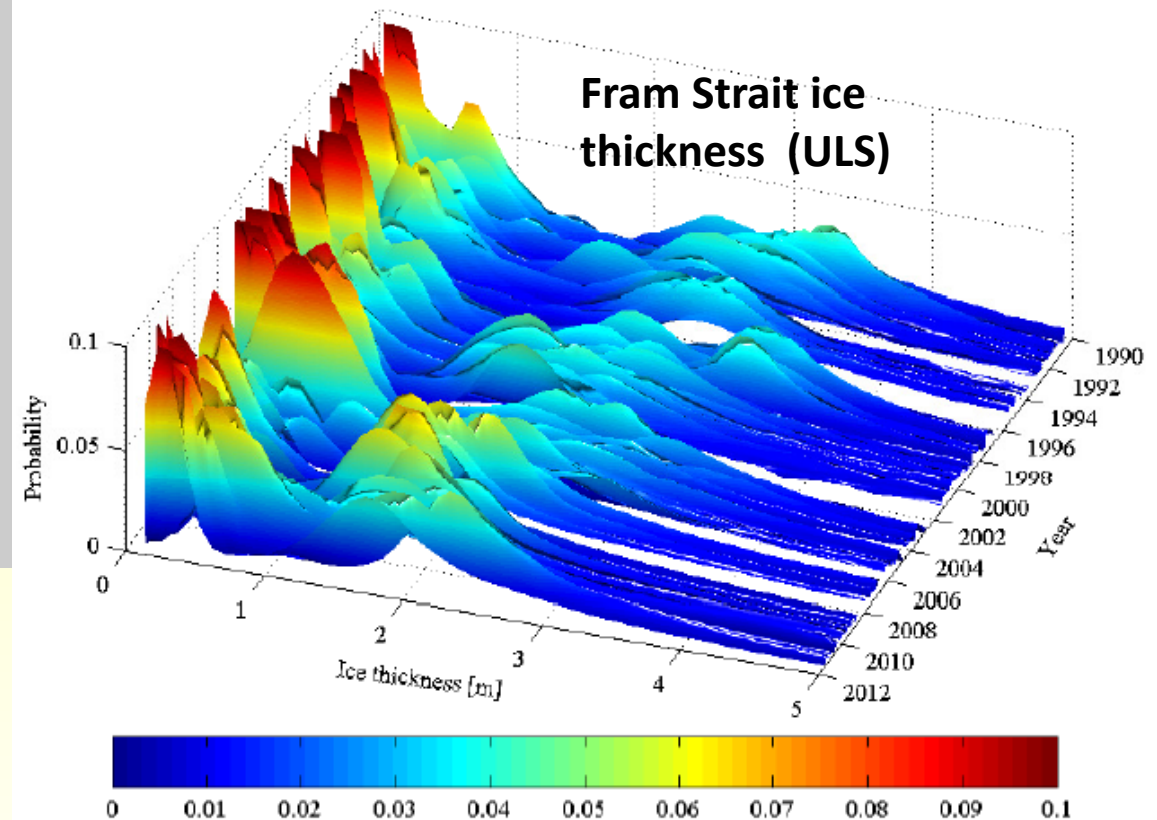




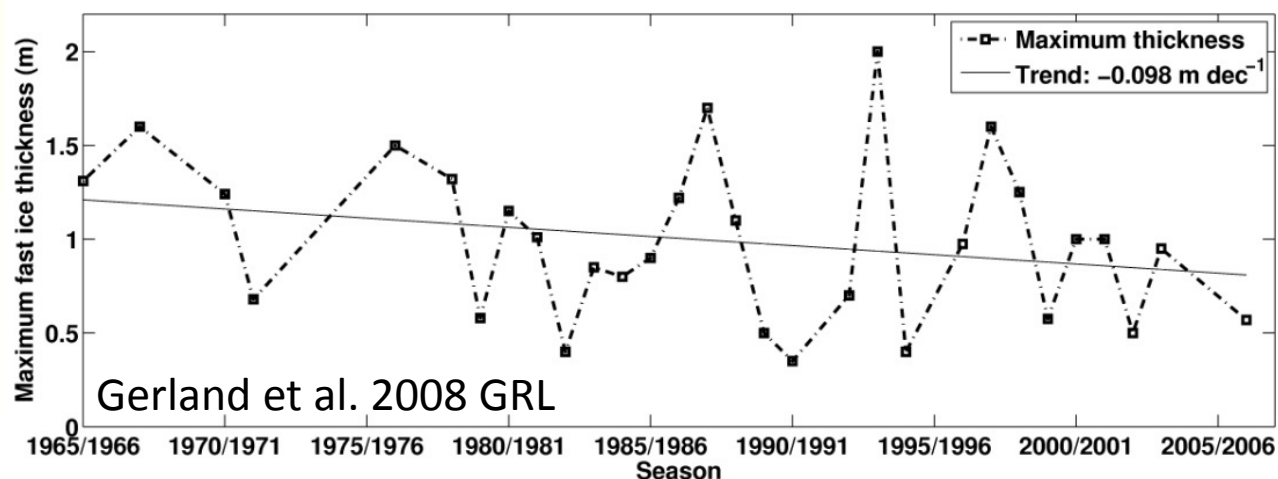


# What is changing in the Arctic Sea Ice System?

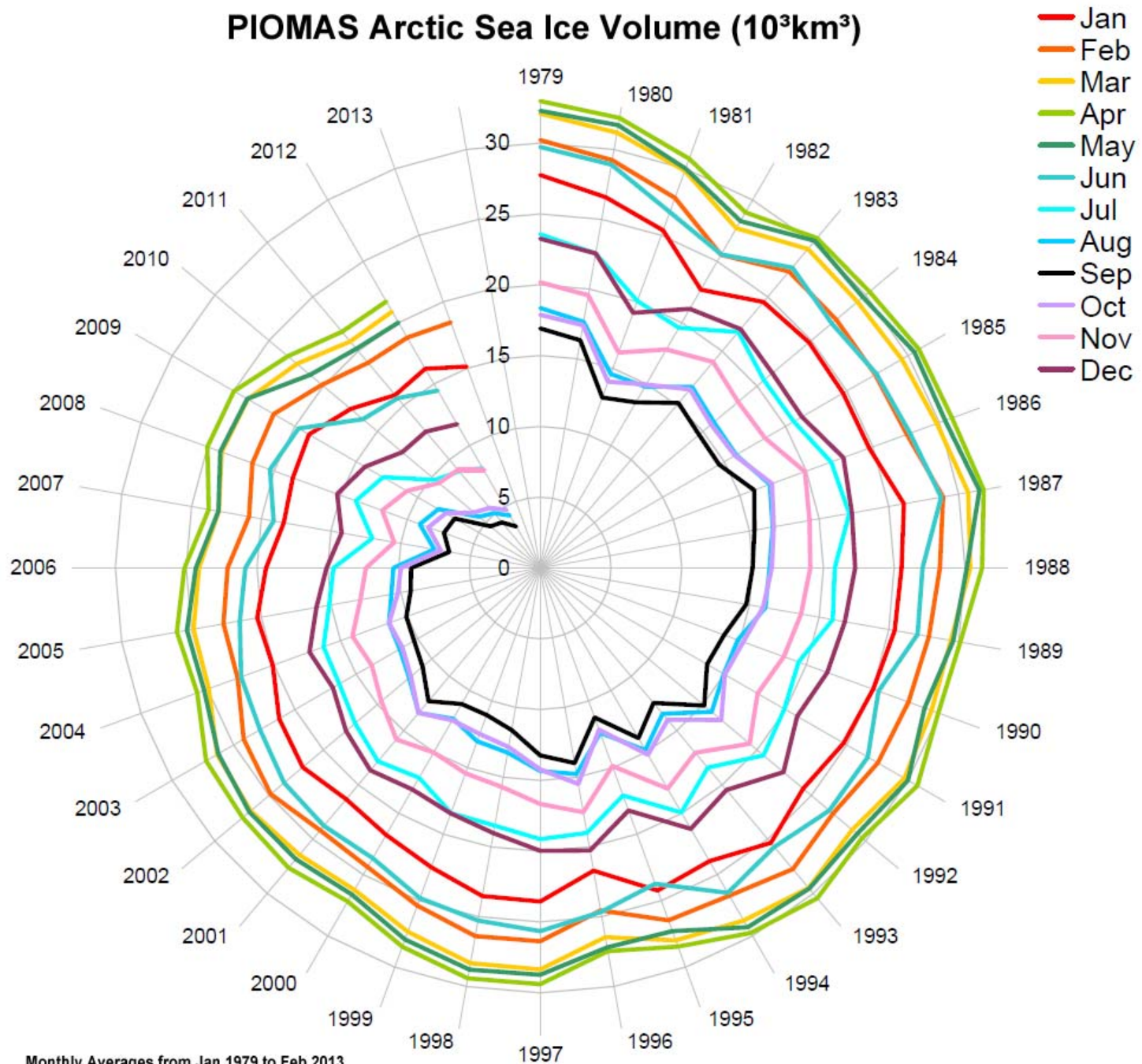
- Ice extent
- Ice dynamics and distribution
- Sea ice thickness



## Hopen max. seas. ice thickness ( drillings)



# PIOMAS Arctic Sea Ice Volume ( $10^3\text{km}^3$ )



Monthly Averages from Jan 1979 to Feb 2013

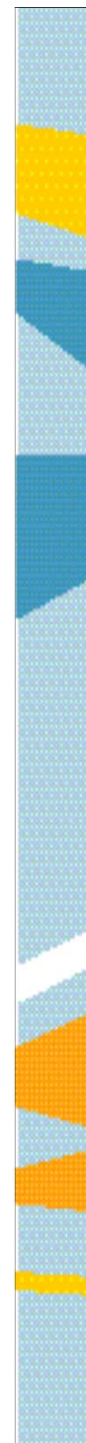
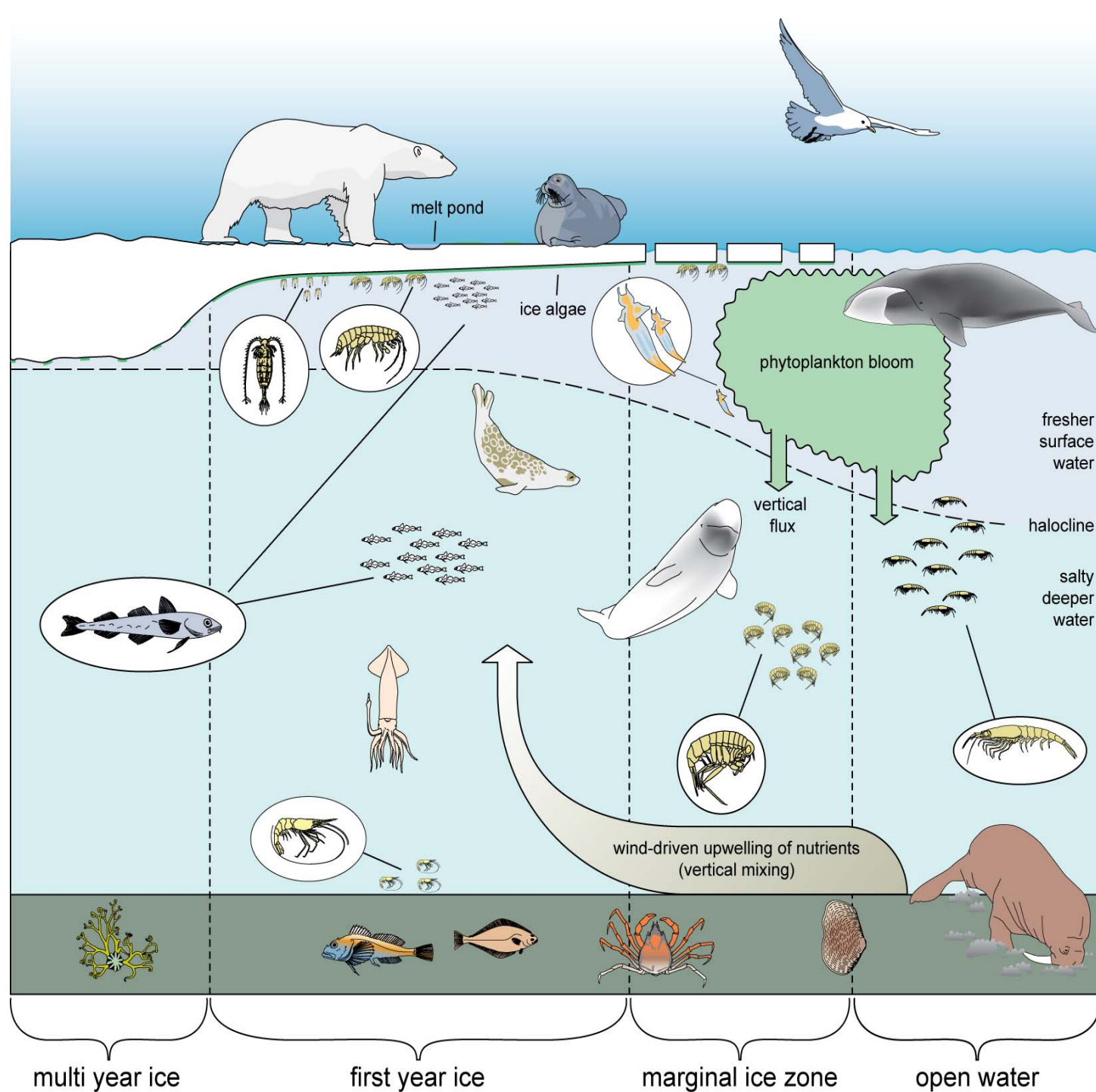
Source: <http://psc.apl.washington.edu/wordpress/research/projects/arctic-sea-ice-volume-anomaly/>

Andy Lee Robinson andy@haveland.com

# POLAR BEAR







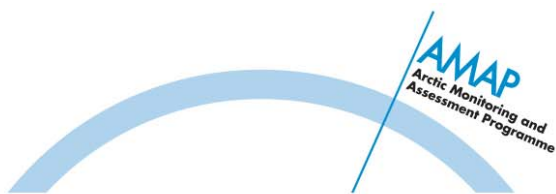


# Other drivers...



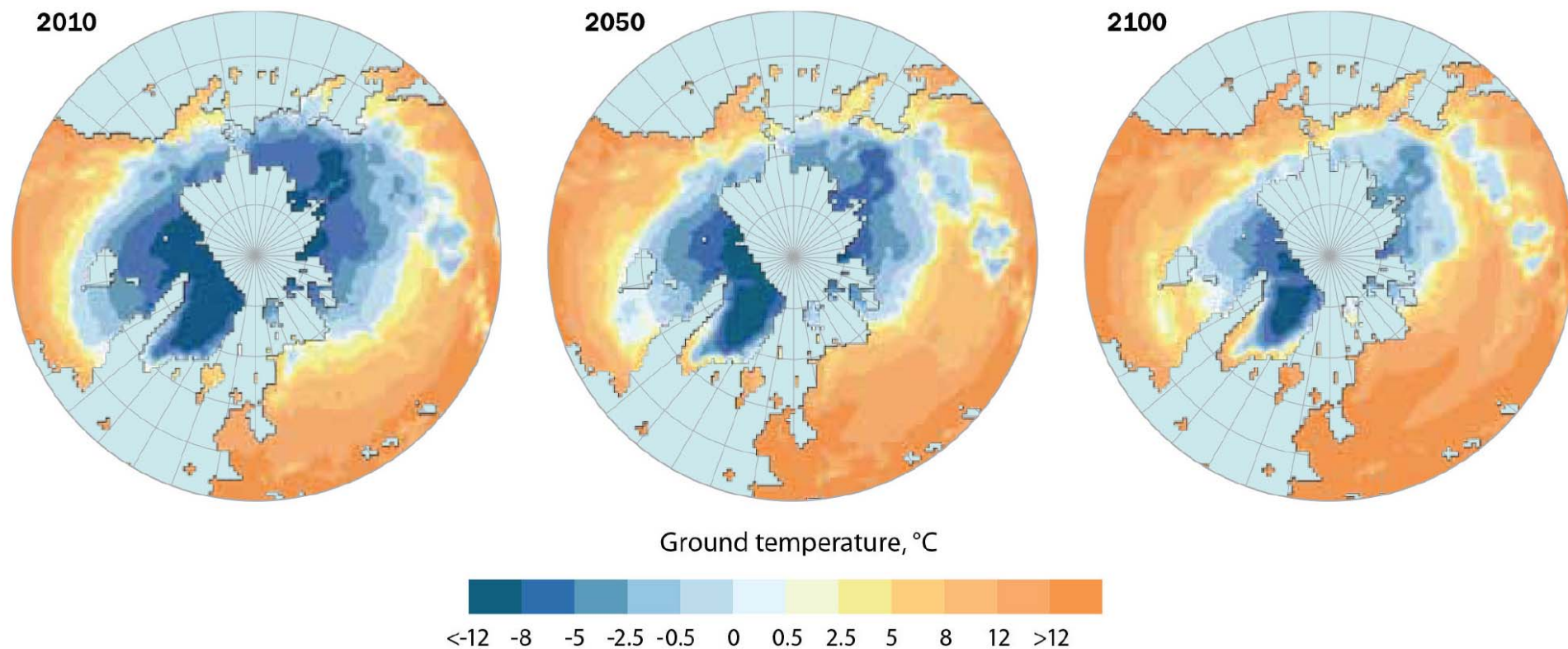
## Turist-Norge gror igjen

Aftenposten, January 19, 2013



# Arctic Monitoring and Assessment Programme

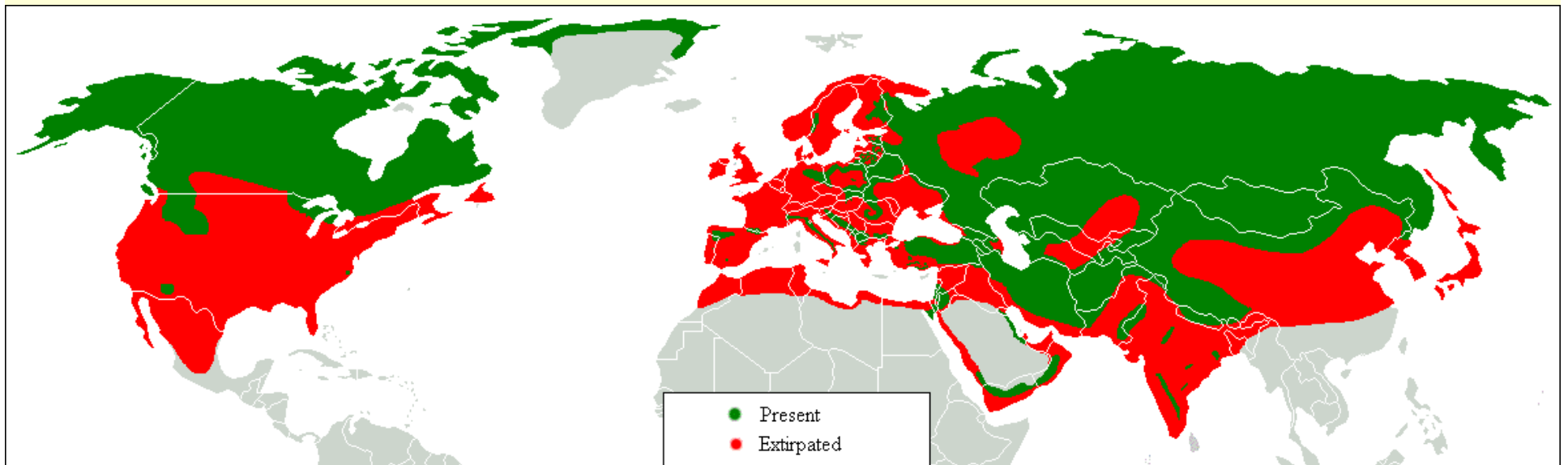
Arctic Climate Issues 2011



WOLF



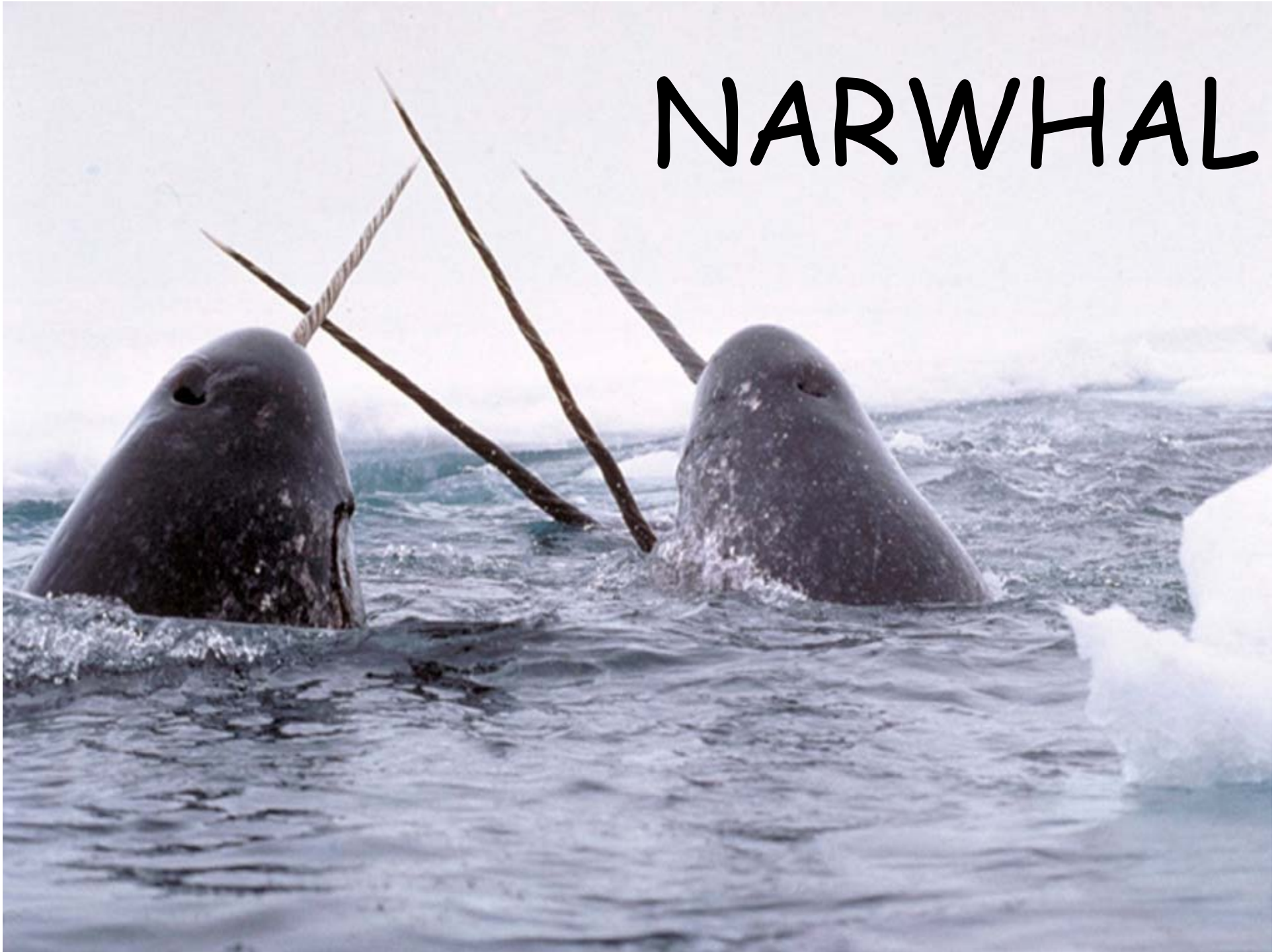
# Grey Wolf



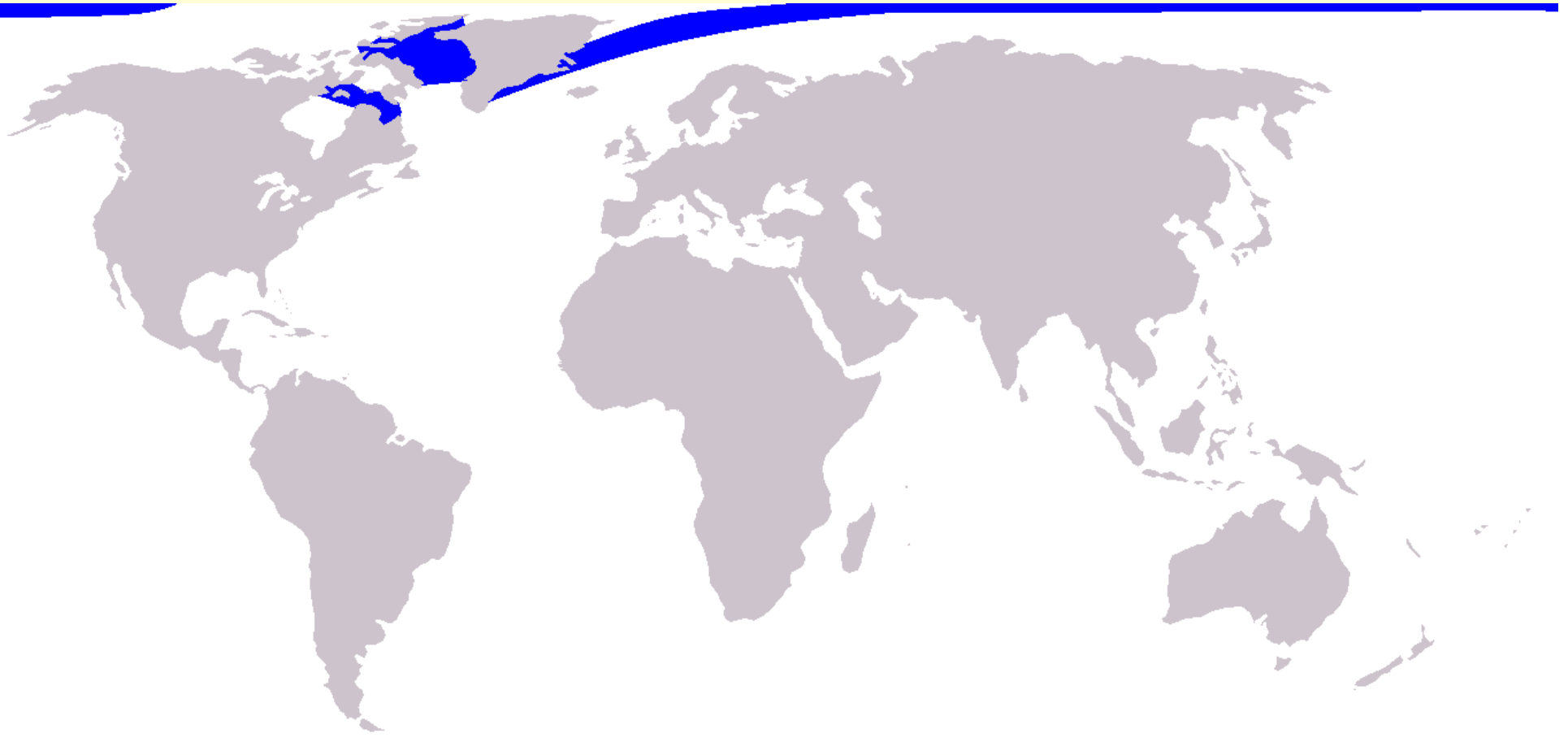
Wikimedia commons



# NARWHAL

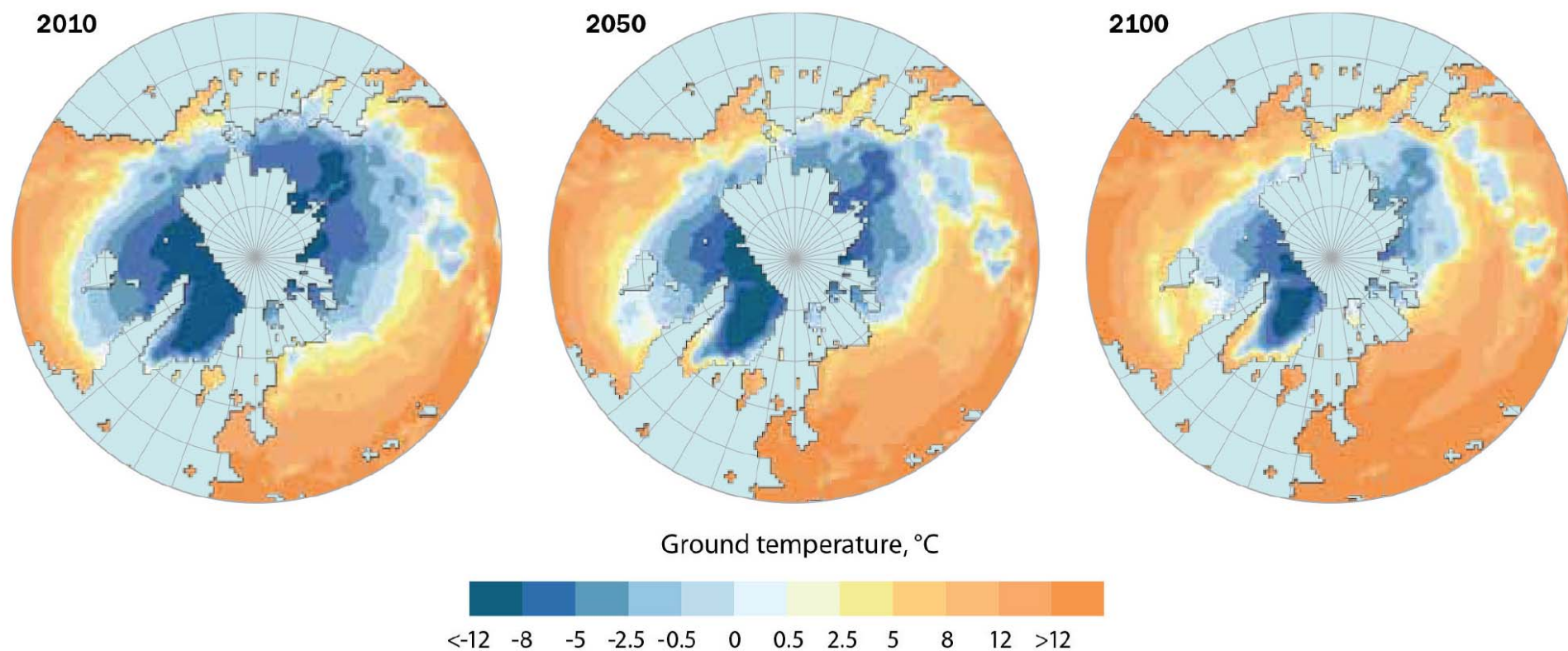


# Narwhal



# Arctic Monitoring and Assessment Programme

Arctic Climate Issues 2011



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# WALRUS

*Thanks for your attention !*



Photo: Kit Kovacs and Christian Lydersen

*Thanks for your attention !*

*Thanks for your attention !*