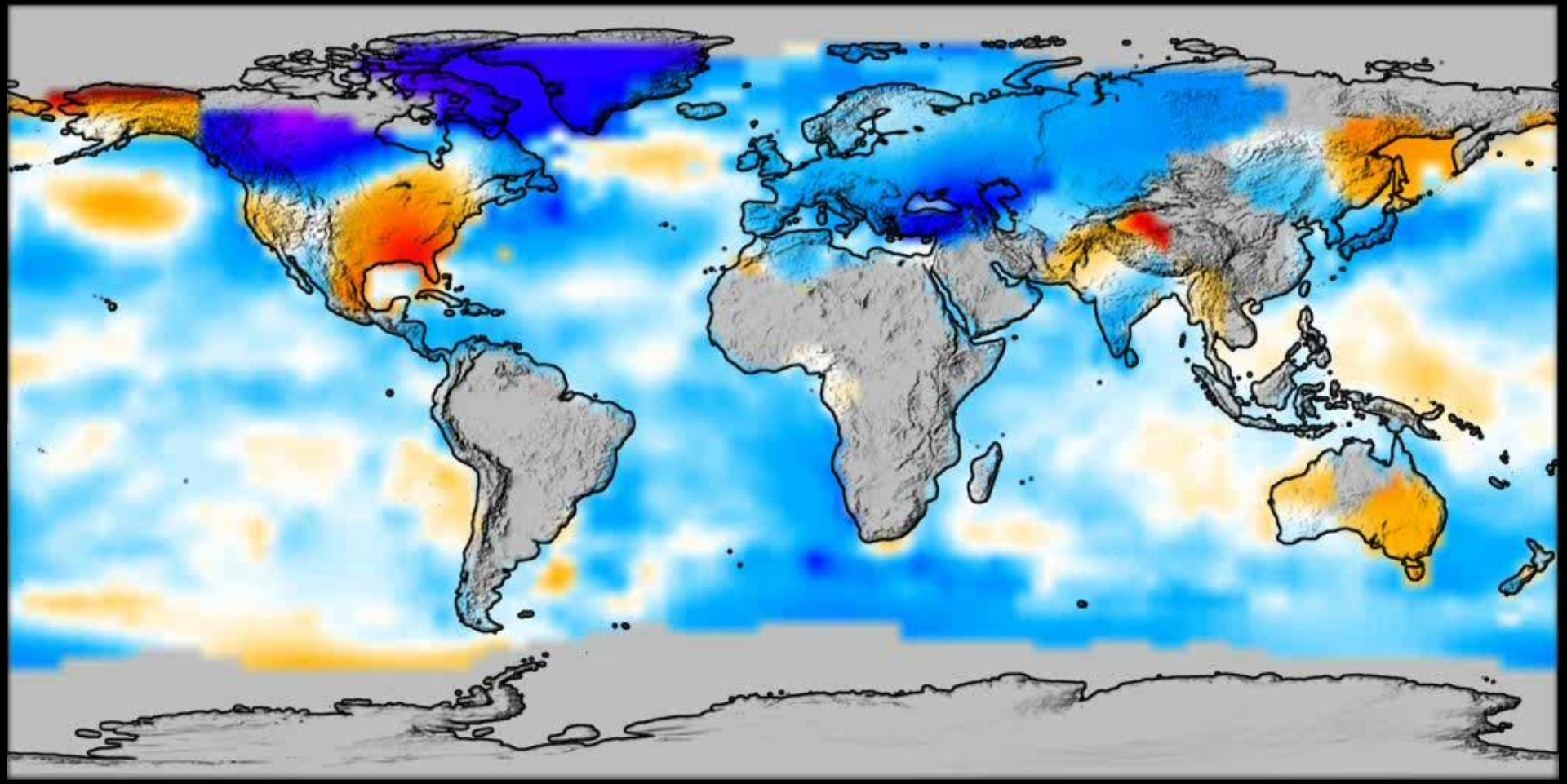
# The Polar Regions: Climate Change and Environmental Management

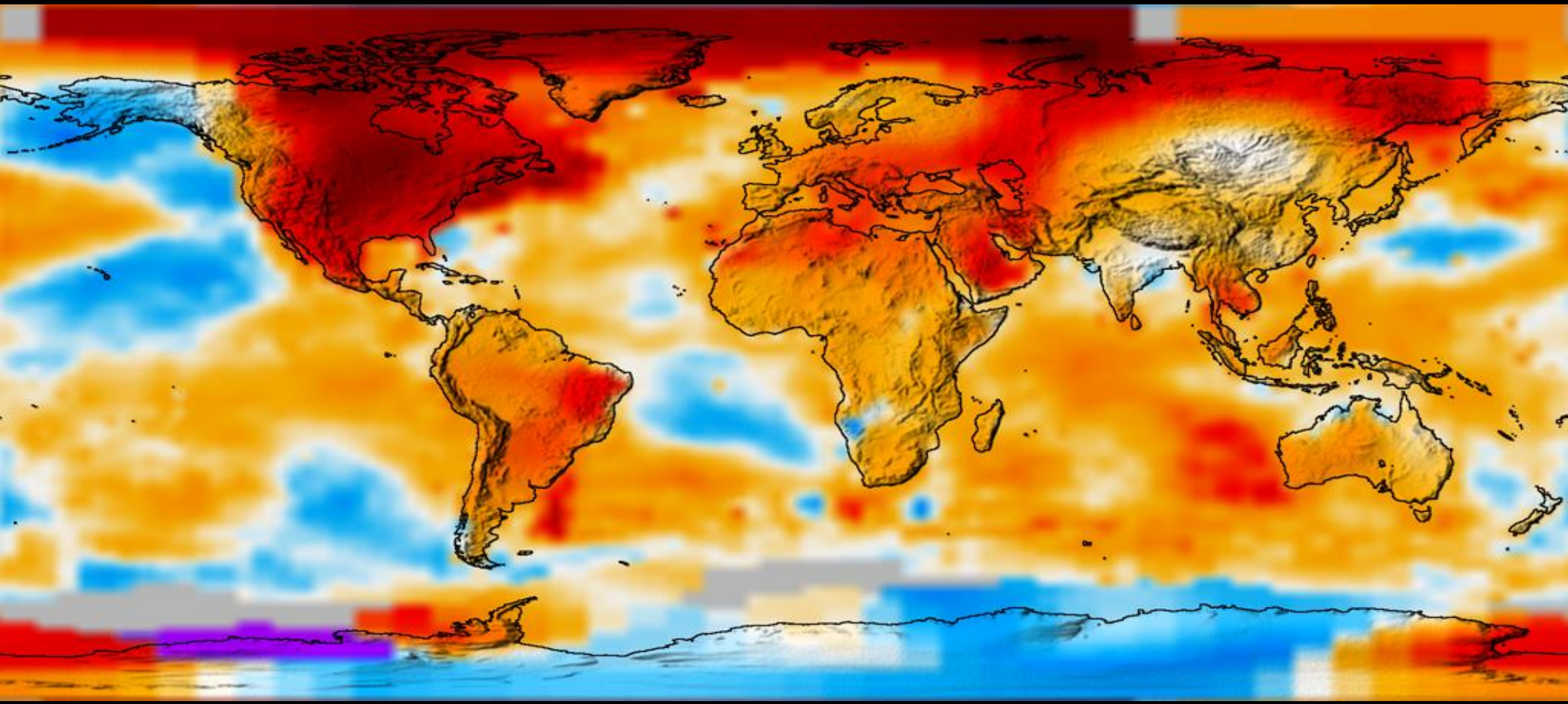
By Jan-Gunnar Winther, director Norwegian Polar Institute

*EGM on Oceans, Seas and Sustainable Development: Implementation and follow-up to Rio+20. New York April 19th 2013*

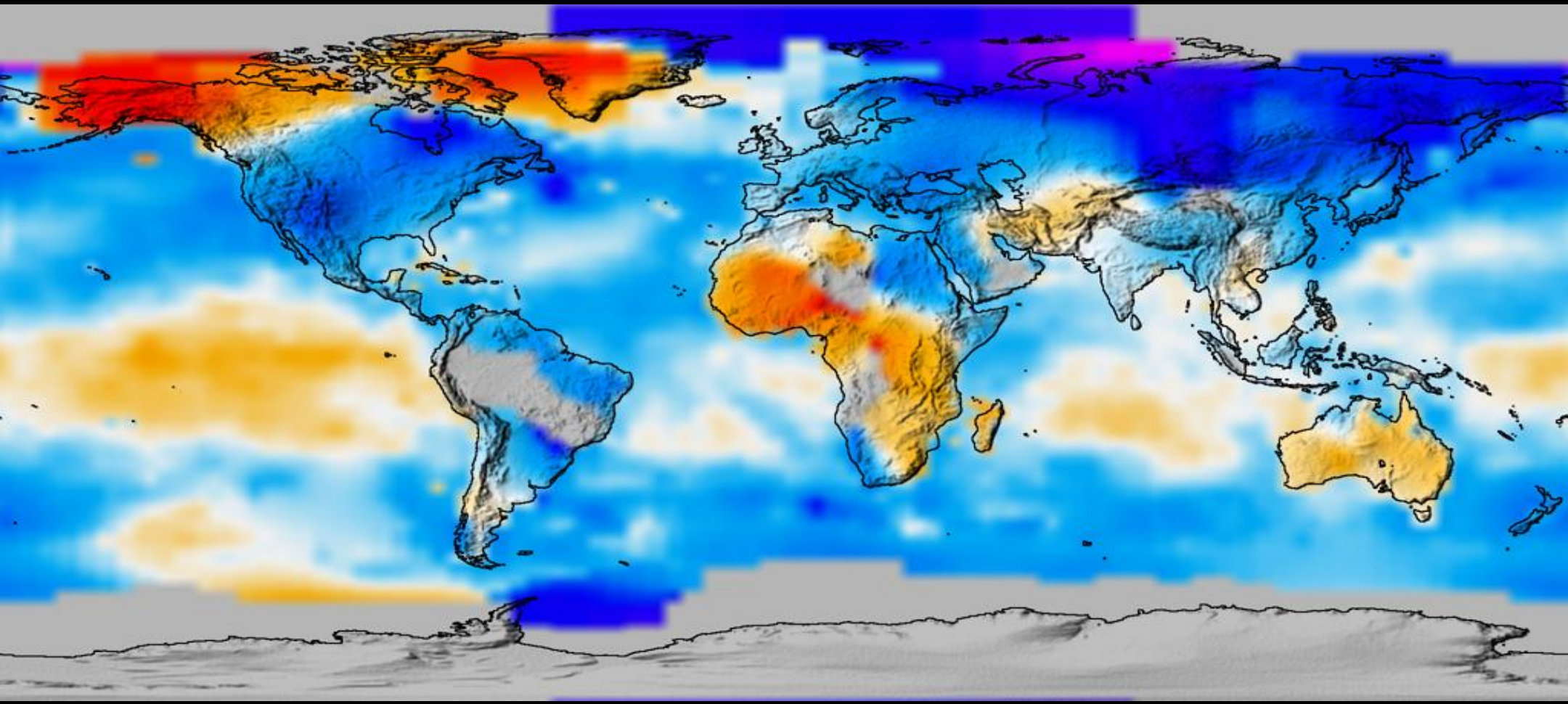
# 1881

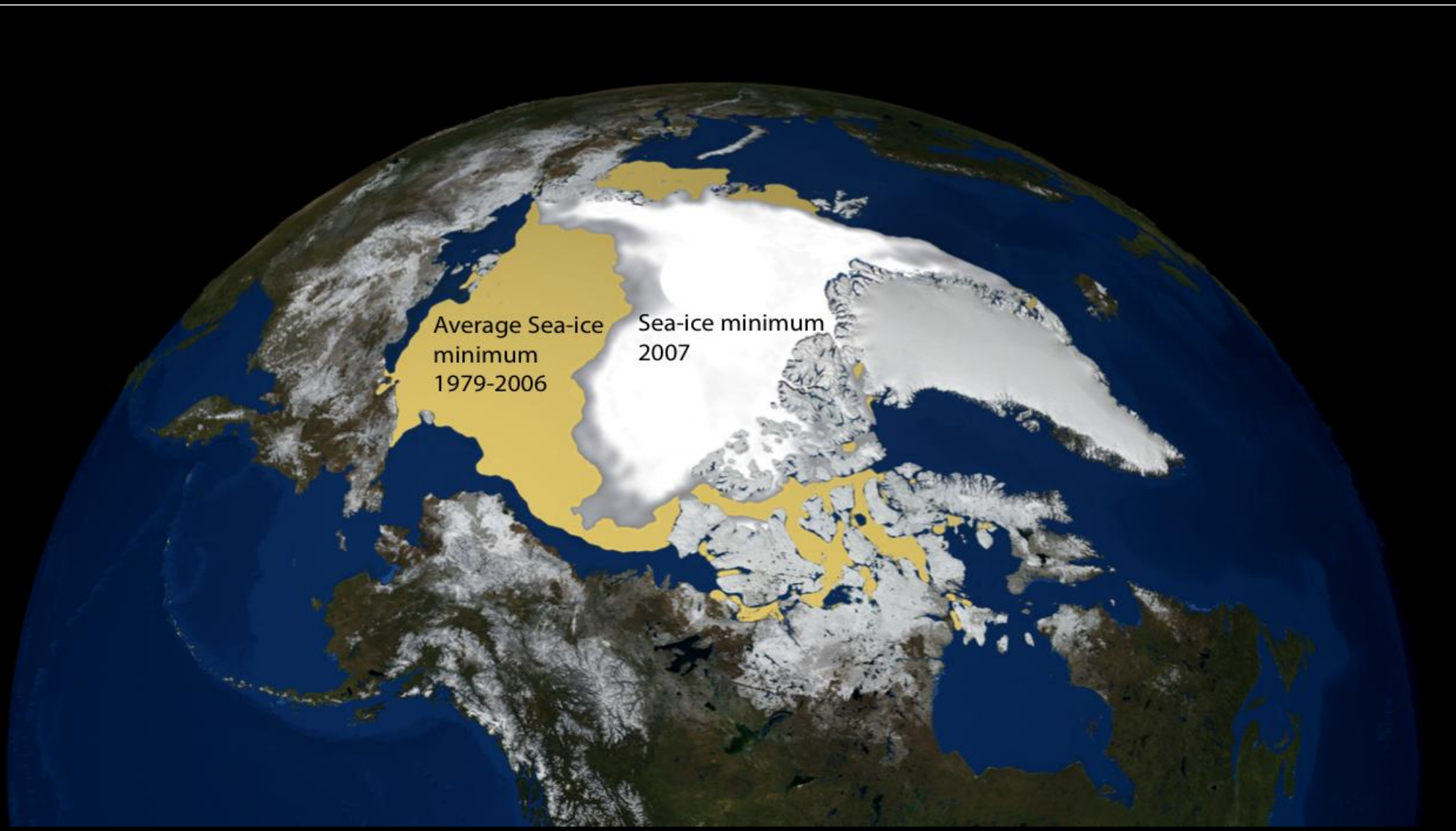


# 2012

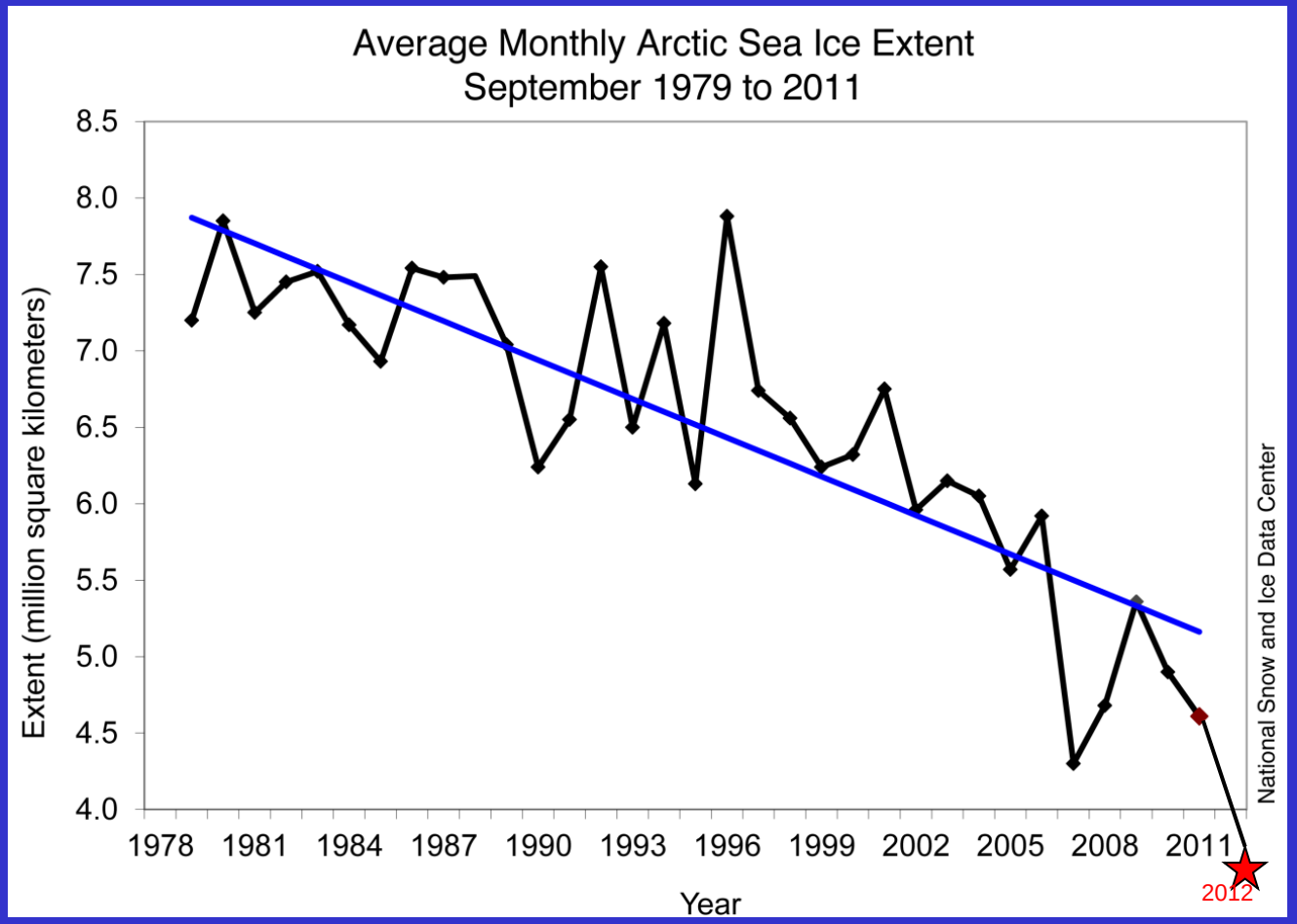


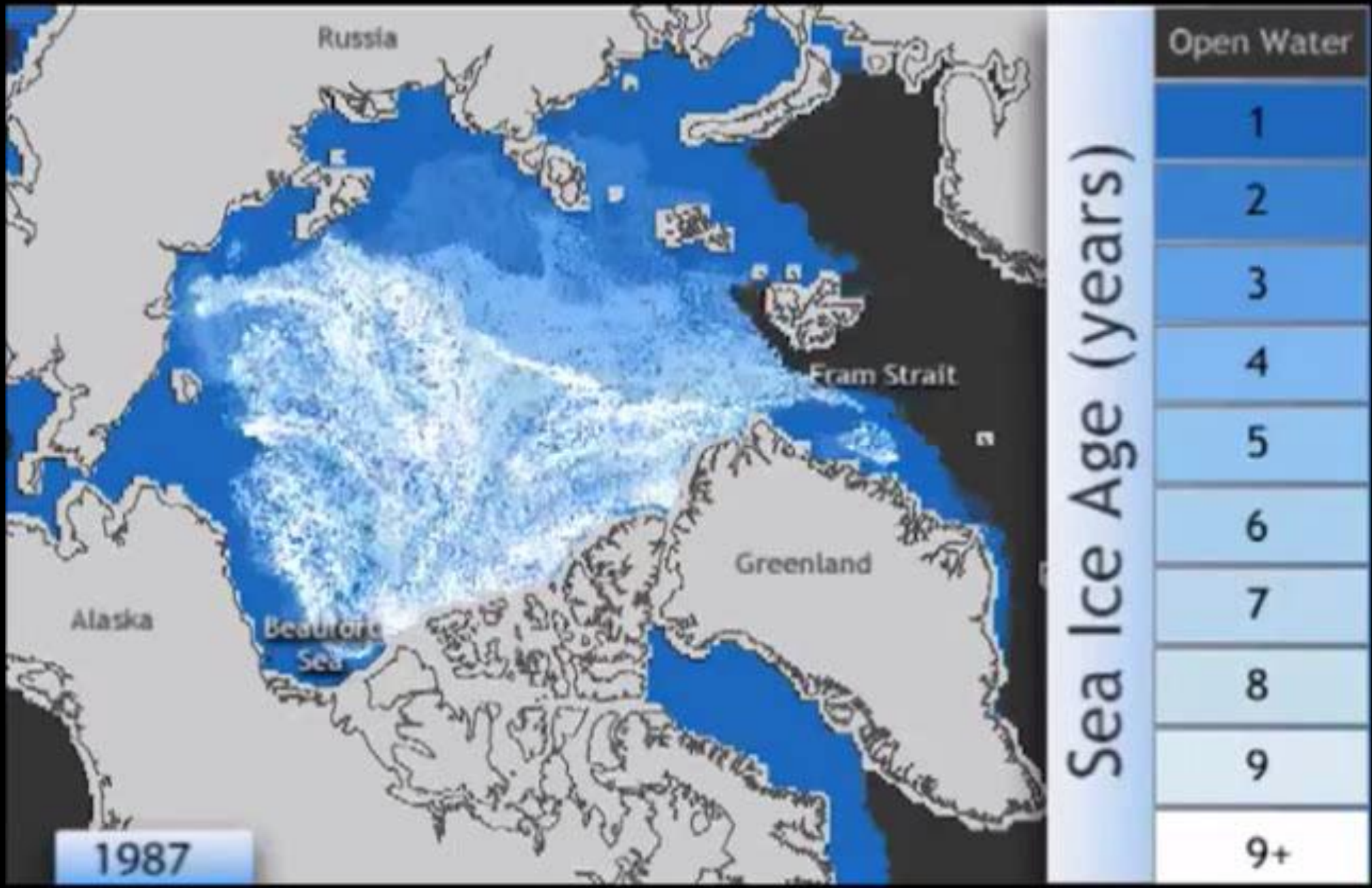
# 1912




Average Sea-ice
minimum
1979-2006
Sea-ice minimum
2007

# Sea ice extent

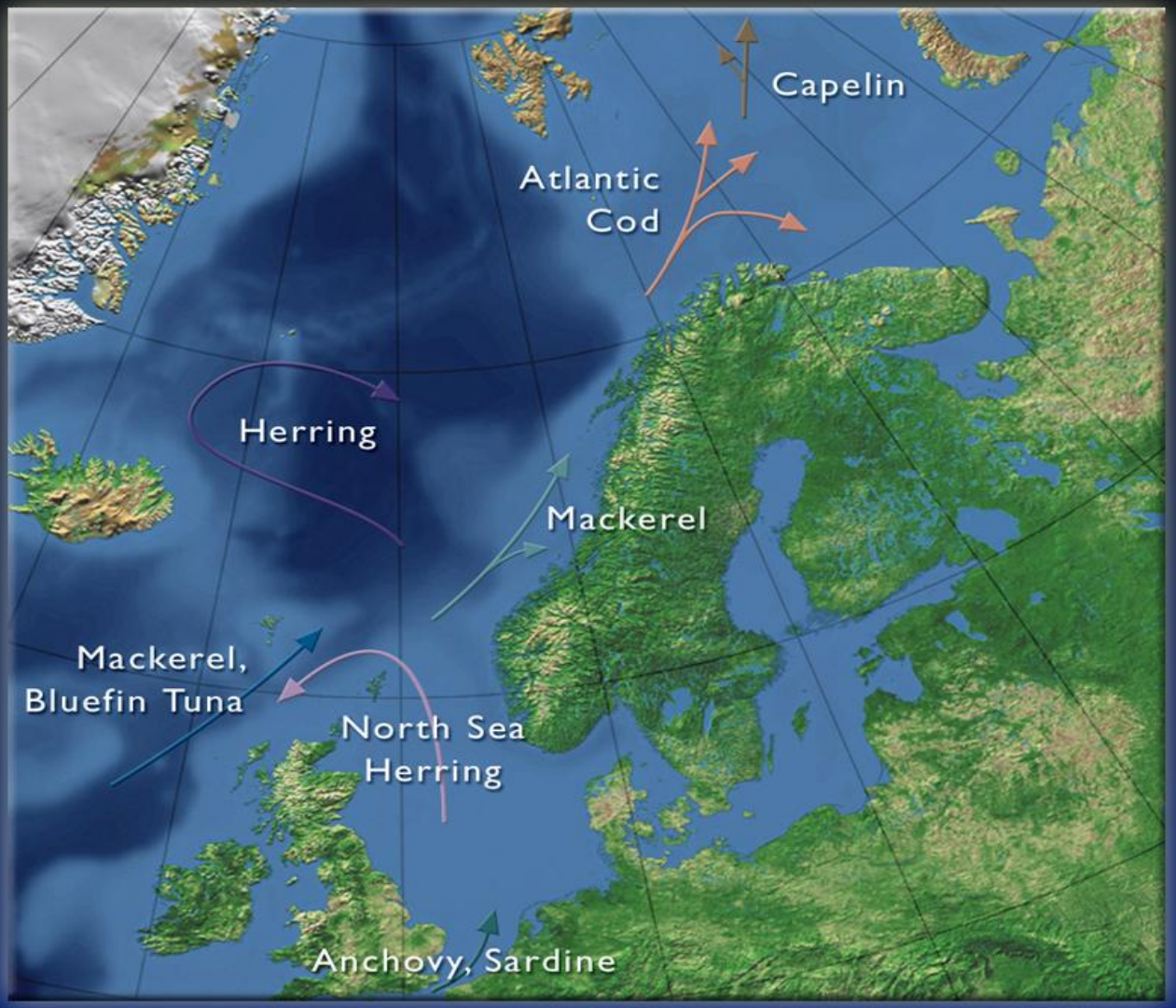




Russia
Fram Strait
Greenland
Alaska
Beaufort Sea
1987
Sea Ice Age (years)
Open Water
1
2
3
4
5
6
7
8
9
9+

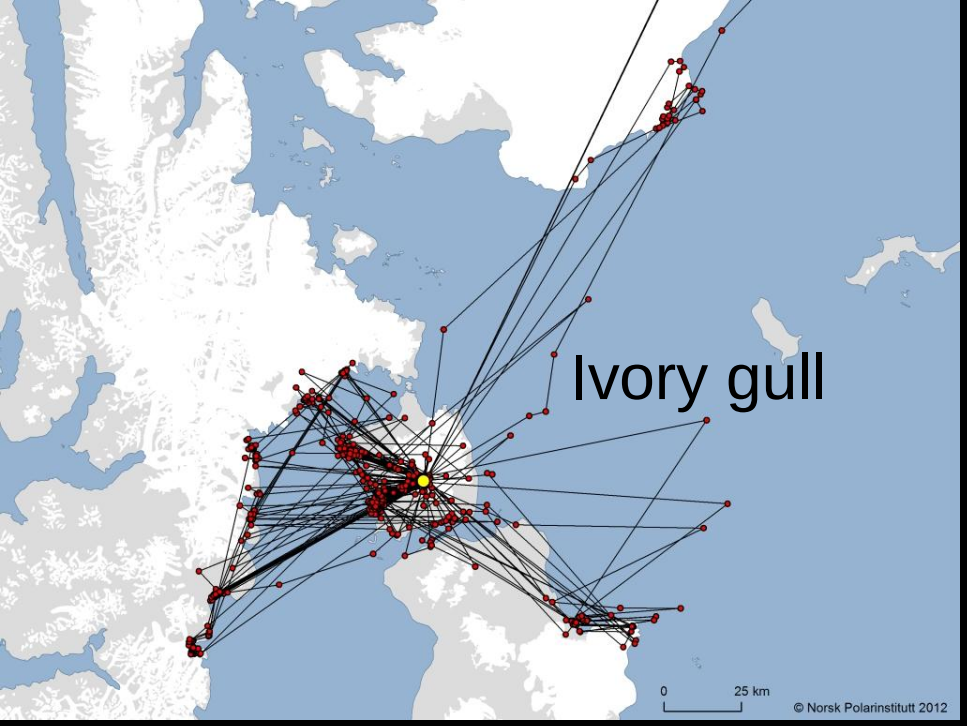
# IMPACTS OF A WARMING ARCTIC

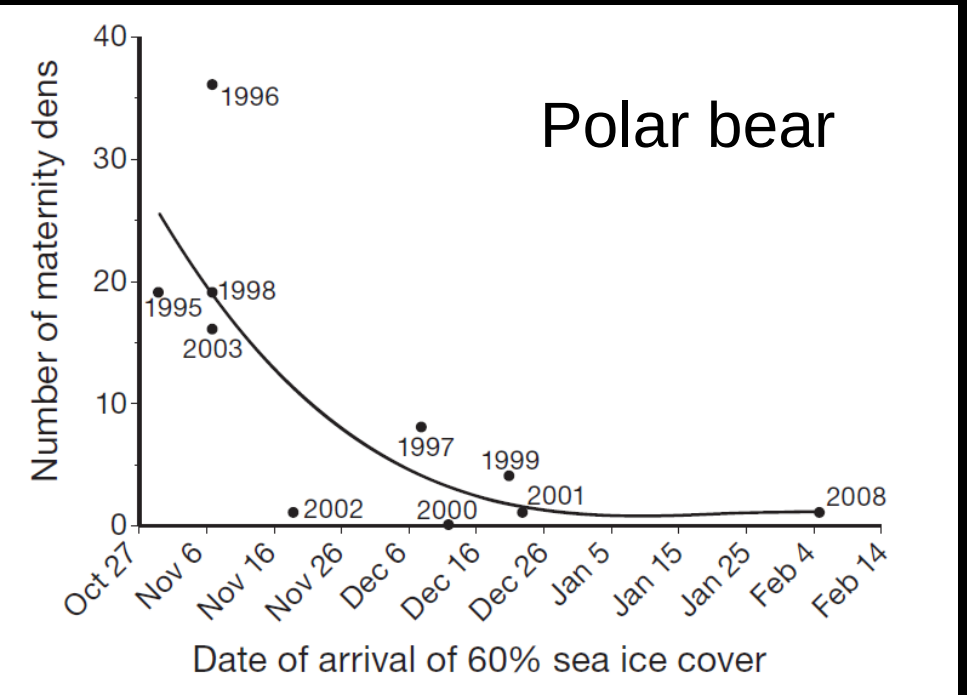
## Possible Changes in Fish Distribution

Climate driven changes in marine ecosystems.




These shifts are governed by (1) changes in oceanic temperatures, (2) salinity, (3) nutrients, (4) changing patterns in North Atlantic Deep Water formation, and (5) interspecies interactions.


Ivory gull
0
25 km
© Norsk Polarinstitutt 2012


Polar bear
Number of maternity dens
40
30
20
10
0
1996
1995
1998
2003
1997
1999
2001
2002
2000
2008
Oct 27
Nov 6
Nov 16
Nov 26
Dec 6
Dec 16
Dec 26
Jan 5
Jan 15
Jan 25
Feb 4
Feb 14
Date of arrival of 60% sea ice cover


Zooplankton
Arctic Ocean
85°
80°
75°
Franz Josef Land
Dry weight (g m-2)
30
25
20
15
10
5
0
1000
400
300
200
100
Kvitøya
Sofiadjupet
Nordaust-
landet
Hinlopen
Erik Eriksen strait
Spitsbergen
Fram Strait
Polar Fr
Stations:
May
August
December
Dry weight m-2:
C. finmarchicus
C.glacialis
C.hyperboreus
Currents:
Atlantic
Arctic

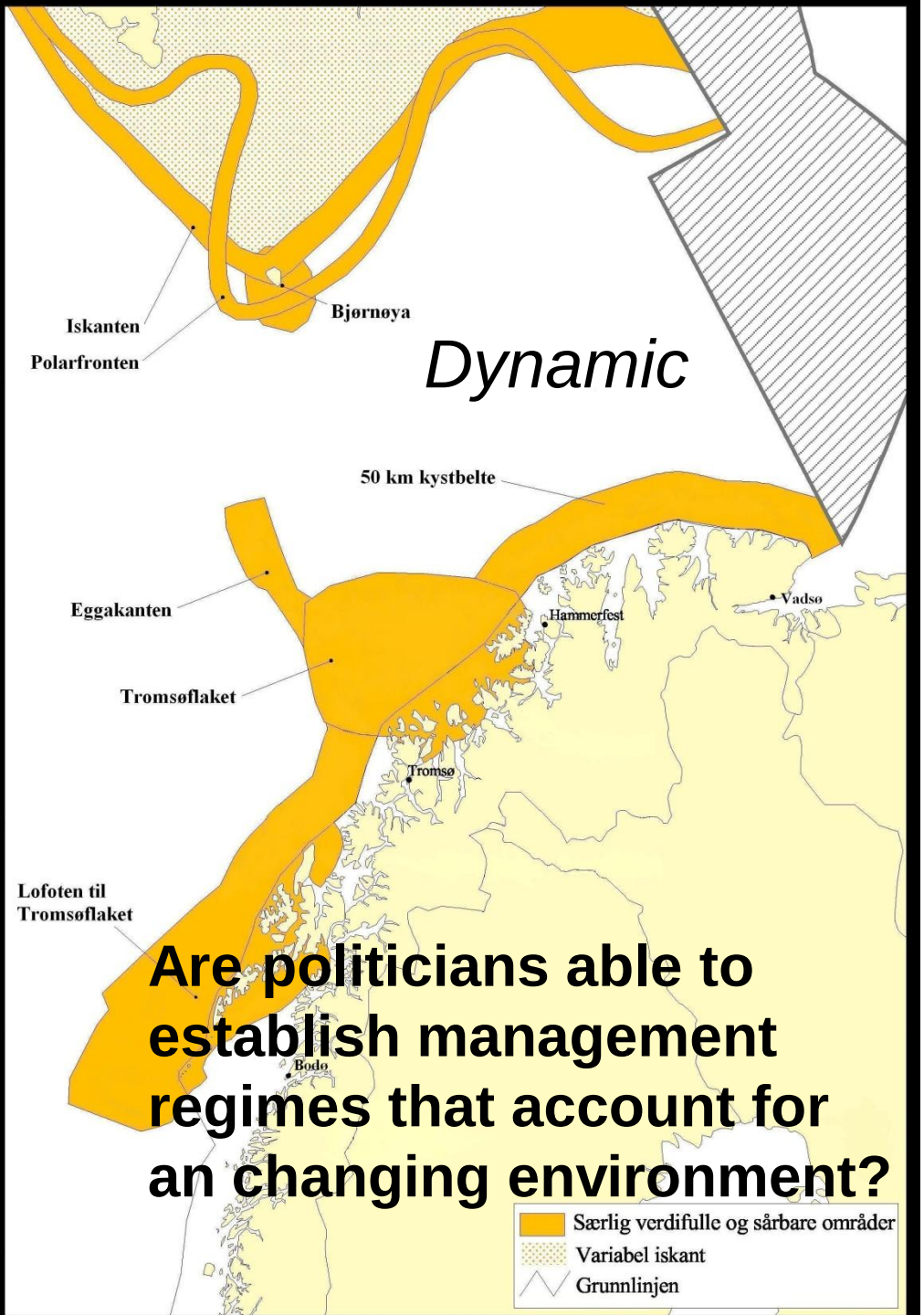
# Management plan for the Norwegian sector of the Barents Sea

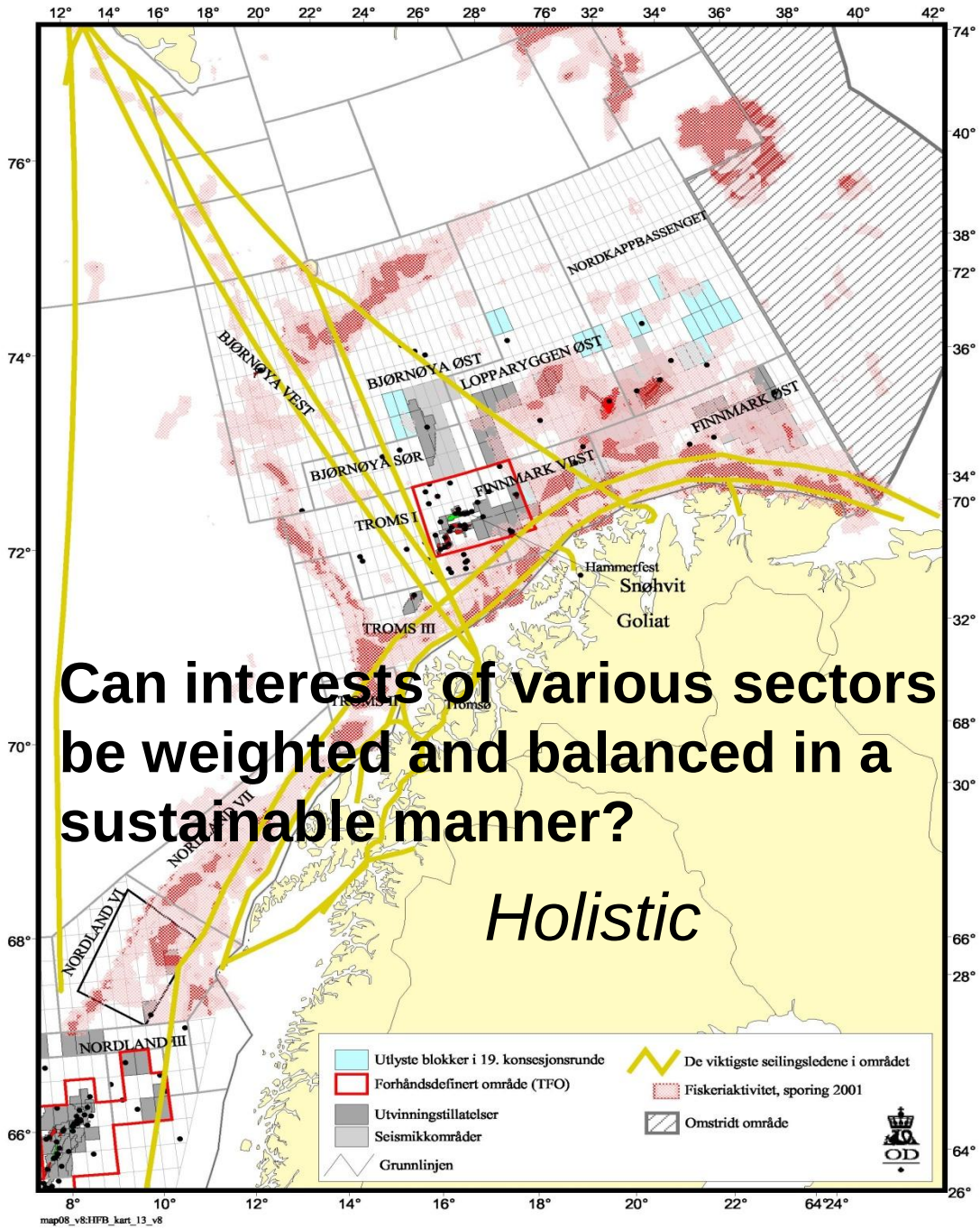
**Principles**:

- Assessment of various sectors (oil/gas, shipping, fisheries, environment)
- Balancing sector interests
- Integrated management

**Challenge**:

* Dynamic system (climate change)


Iskanten
Polarfronten
Bjørnøya
Dynamic
50 km kystbelte
Eggakanten
Tromsøflaket
Hammerfest
Vadsø
Tromsø
Lofoten til Tromsøflaket
Bodø
Are politicians able to establish management regimes that account for an changing environment?
Særlig verdifulle og sårbare områder
Variabel iskant
Grunnlinjen

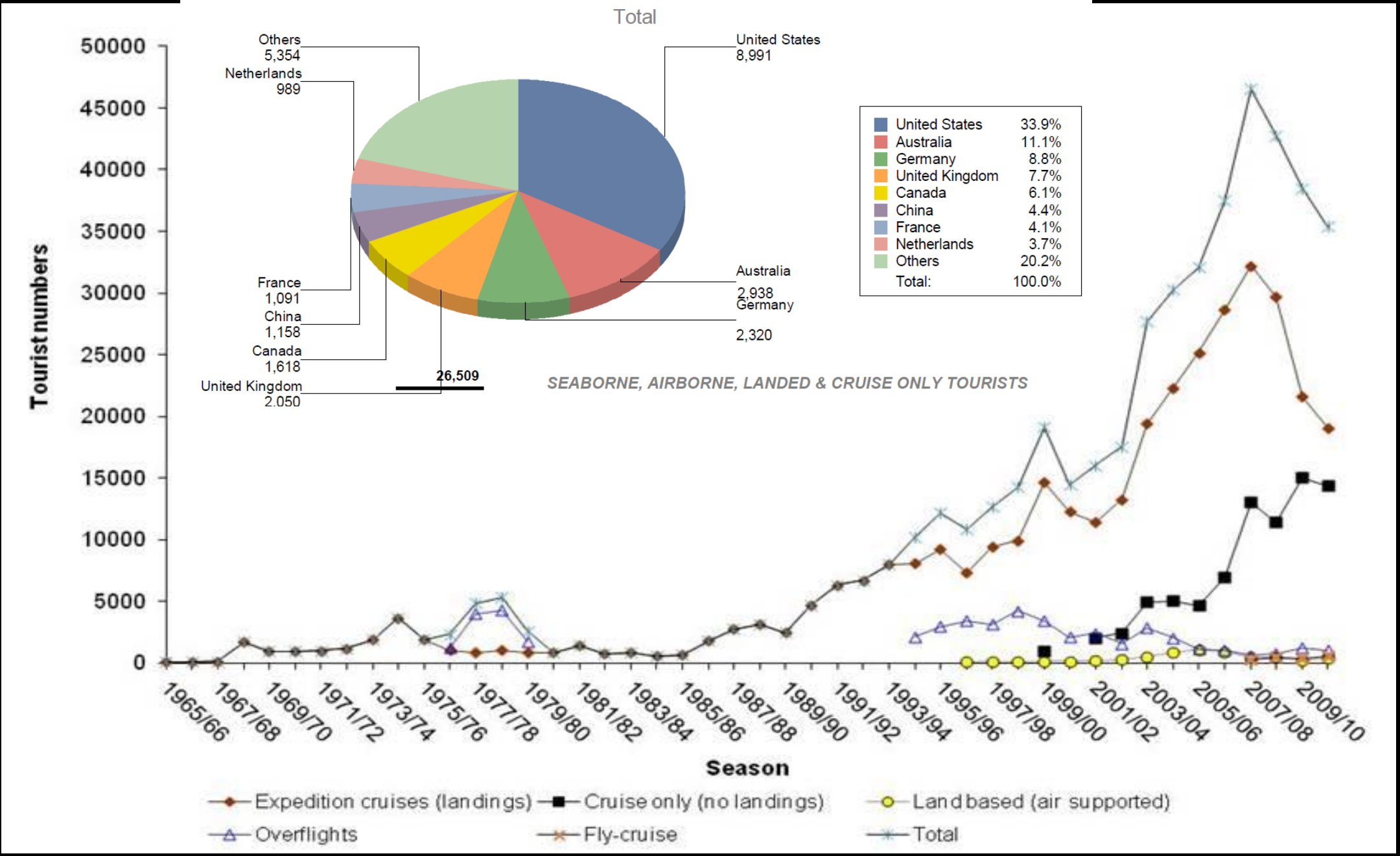

BJØRNØYA VEST
BJØRNØYA ØST
LOPPARYGGEN ØST
NORDKAPPBASSENGET
FINNMARK ØST
BJØRNØYA SØR
FINNMARK VEST
TROMS I
TROMS III
Hammerfest
Snøhvit
Goliat
Tromsø
NORDLAND VII
NORDLAND VI
NORDLAND III
Can interests of various sectors be weighted and balanced in a sustainable manner?
Holistic
Utlyste blokker i 19. konsesjonsrunde
Forhåndsdefinert område (TFO)
Utvinningstillatelser
Seismikkområder
Grunnlinjen
De viktigste seilingsledene i området
Fiskeriaktivitet, sporing 2001
Omstridt område
OD
map08_v8:HFB_kart_13_v8

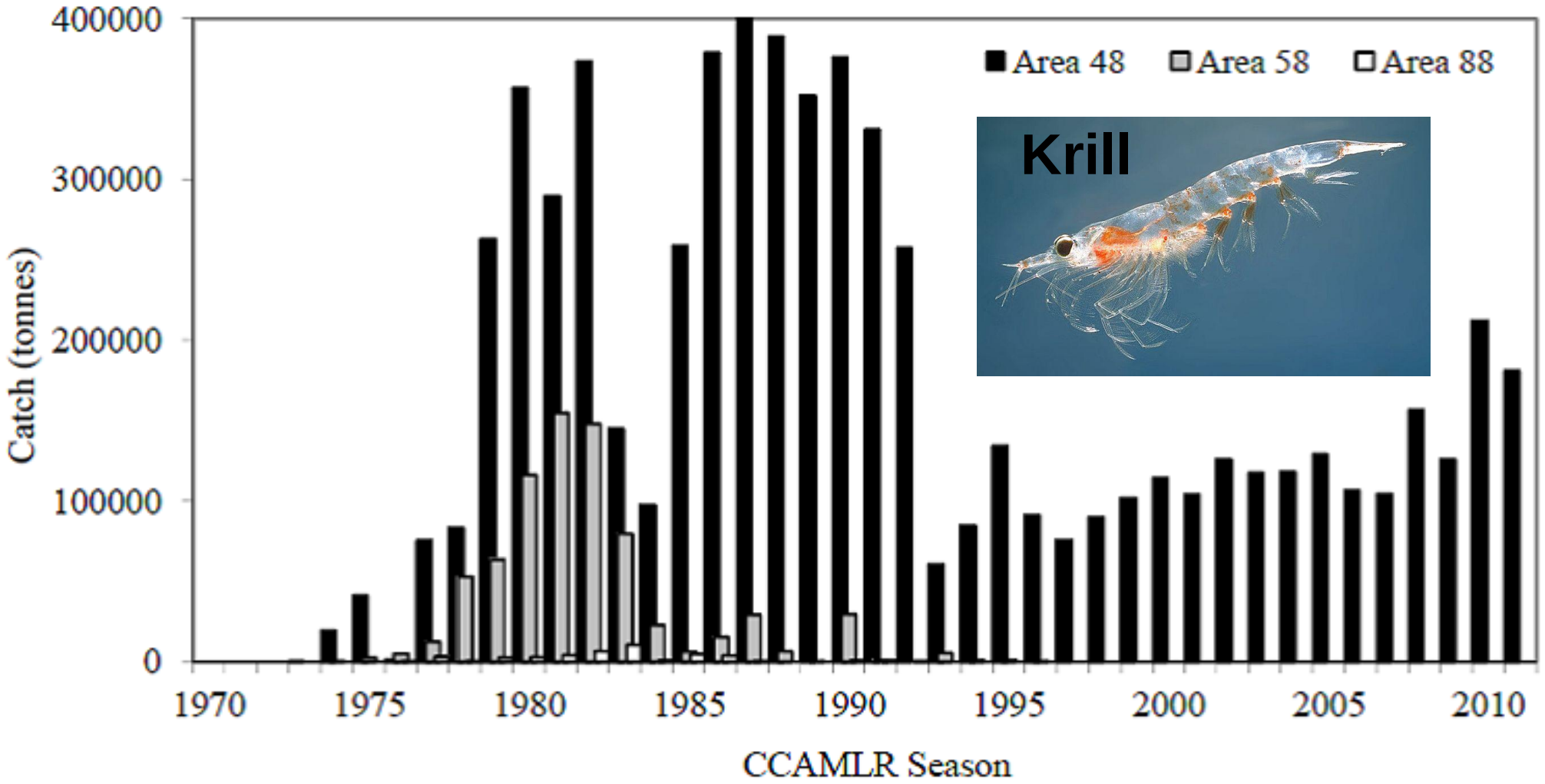

Atlantic Ocean
60°S
0°
Southern Ocean
Indian
Kong Håkon VII Hav
Dronning Maud Land (NO)
75°S
Weddell Sea
Antártida Argentina (AR)
British Antarctic Territory (GB)
Ronne
Ice Shelf
ANTARCTICA
Territorio Antártico Chileno (CL)
90°W
South Pole
90°E
Amundsen
Sea
Ross
Ice Shelf
Ross Sea
Australian Antarctic Territory (AU)
Terre Adélie (FR)
Ocean
Ross Dependency (NZ)
Antarctic Circle
Pacific
180°
Ocean
Sources: ADD, SCAR, RAMP, GEBCO. Cartography: Norwegian Polar Institute, 2008

# 6D-angle to the Antarctic Conservation Strategy issue

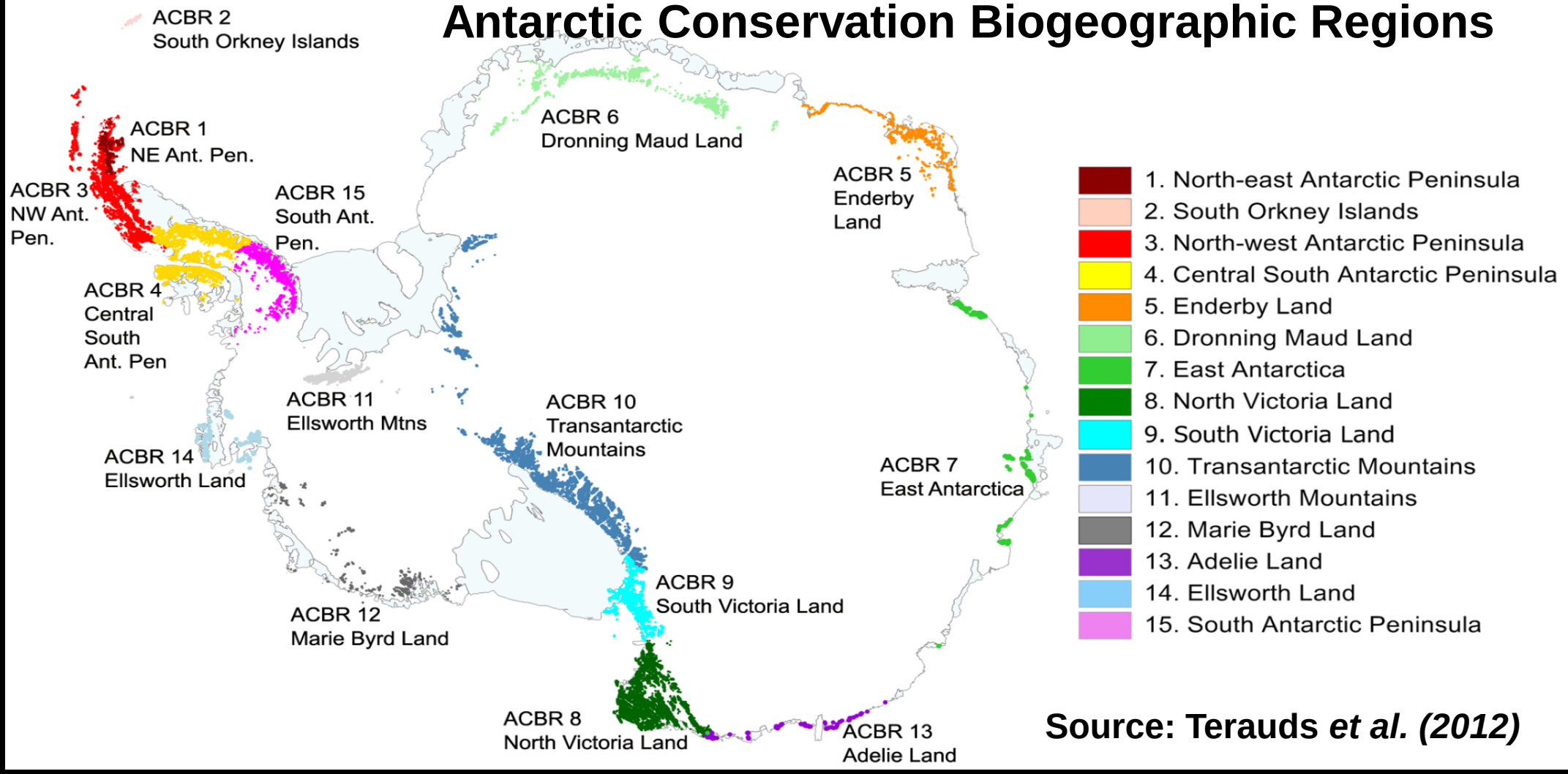
- Long-term and large-scale
- Global relevance
- Dynamic
- Holistic
- Cumulative effects
- Science used for policy-shaping

# 2011-2012 TOURISTS BY NATIONALITY




Area 48
Area 58
Area 88
Krill
Catch (tonnes)
400000
300000
200000
100000
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
CCAMLR Season

# Antarctic Conservation Biogeographic Regions



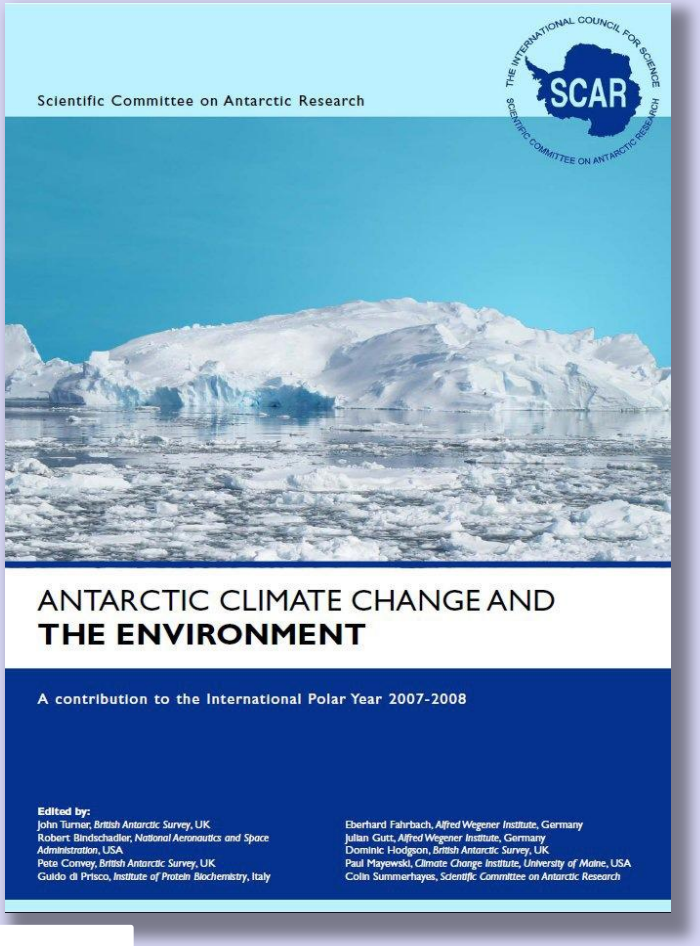

**Source: Terauds *et al. (2012)***

# Antarctic Climate Change and the Environment Advisory Group

***Aims:***

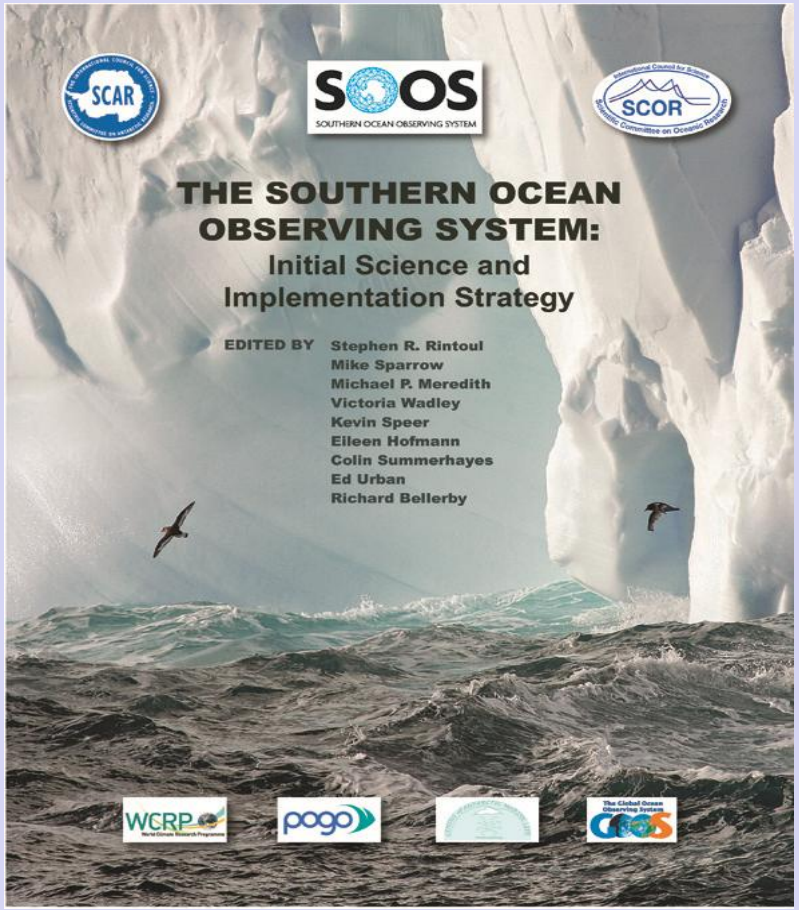
- Coordinate climate research across SCAR
- Produce annual Updates to ACCE
- Plan themed publications e.g. Recovery of the Ozone Hole, Southern Ocean Change…

- Significant 2013 update in Polar Record!




*http://www.scar.org/researchgroups/acce/*
*(jtu@bas.ac.uk)*

# The Southern Ocean Observing System




**MISSION: To establish a multidisciplinary system to deliver the sustained observations of the Southern Ocean that are needed to address key challenges of scientific and societal relevance, including climate change, sea-level rise and the impacts of global change on marine ecosystems.**

SOOS
SOUTHERN OCEAN OBSERVING SYSTEM

International Council for Science SCOR Scientific Committee on Oceanic Research
pogo
Climate Variability & Predictability CLIVAR World Climate Research Programme
clic
IMAS INSTITUTE FOR MARINE AND ANTARCTIC STUDIES
UTAS
Australian Government Australian Antarctic Division
Antarctica New Zealand

# Cumulative effects

Increasing ship-based and other tourism
Changes in sea-ice patterns alter marine system functioning
Accelerating ice-sheet loss and impacts of circulation change
Ocean acidification
Increasing terrestrial biological invasions
Climate change and ecosystem functioning
Increasing biotic homogenization
Increasing marine resource exploitation
Marine invasions
Research impacts on protected areas
Enhanced pollution threats

**Provocative question:** *Is this complexity scaring away scientists and managers from sticking their fingers into "cumulative affairs"?*

The climate and business potential are changing very rapidly in the polar regions – there is a strong need for responsible environmental management and sustainable governance

*Thank you for your attention!*