

FISHERIES RESEARCH SERVICES



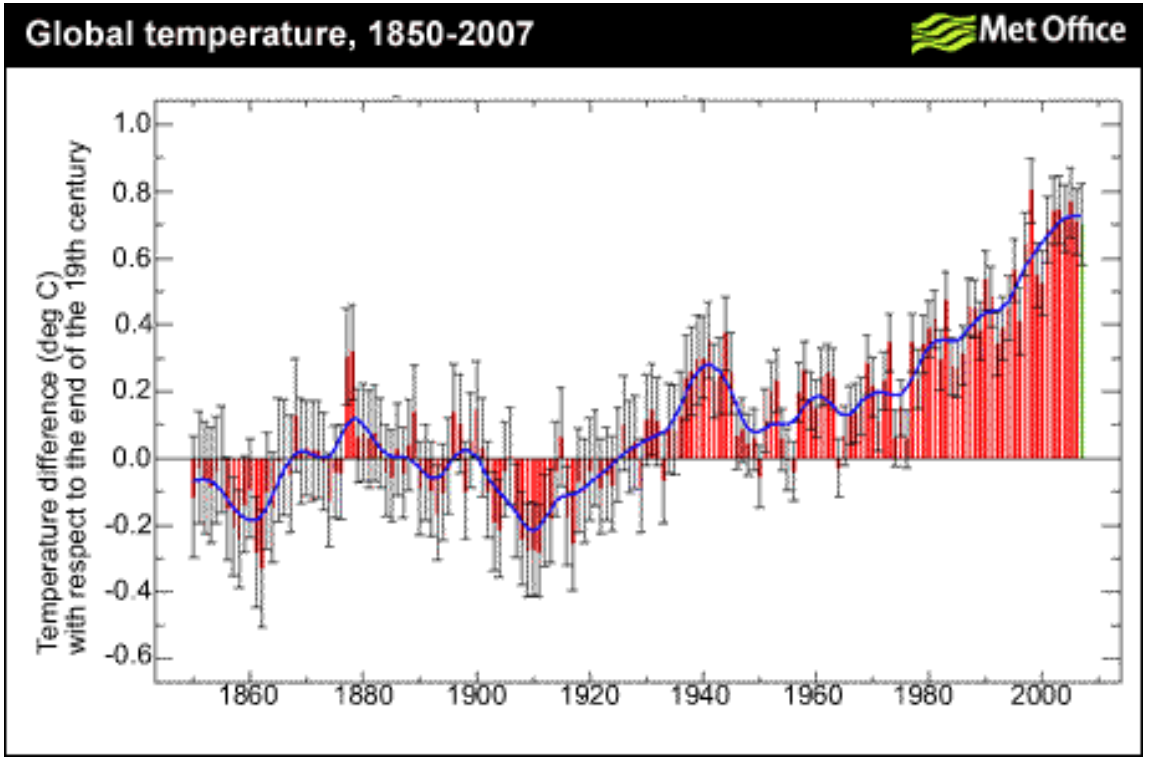
Climate Change, fisheries and the wider ecosystem

Bill Turrell

turrellb@marlab.ac.uk

Temperatures are rising

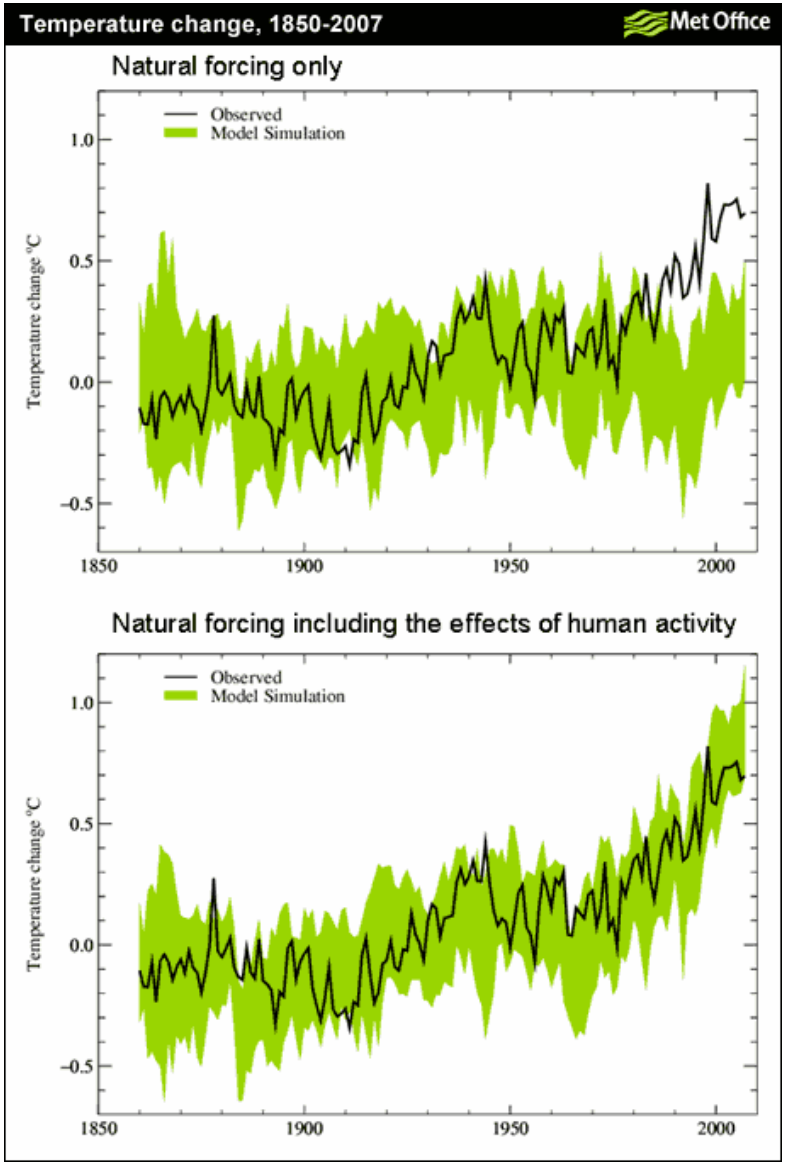




Met Office

Climate change is happening and humans are contributing to it

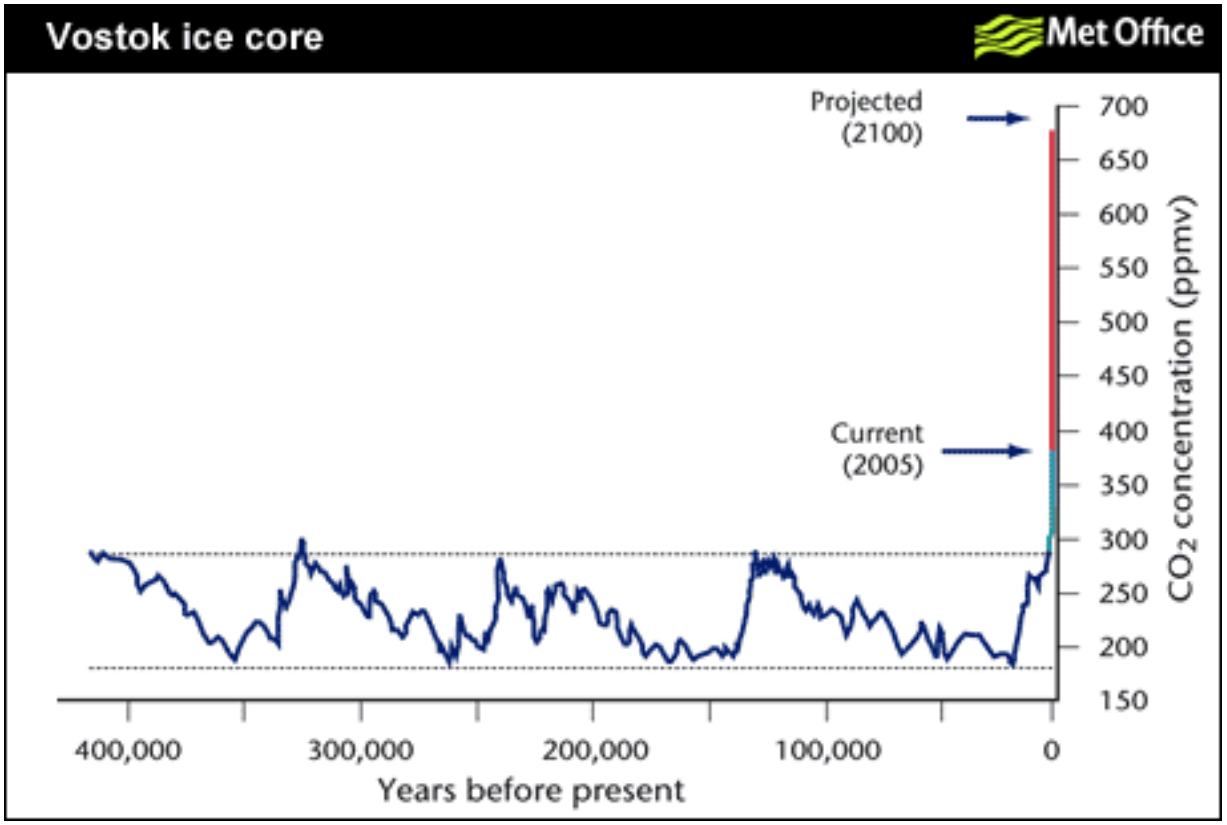




Met Office

The current climate is not just part of a natural cycle





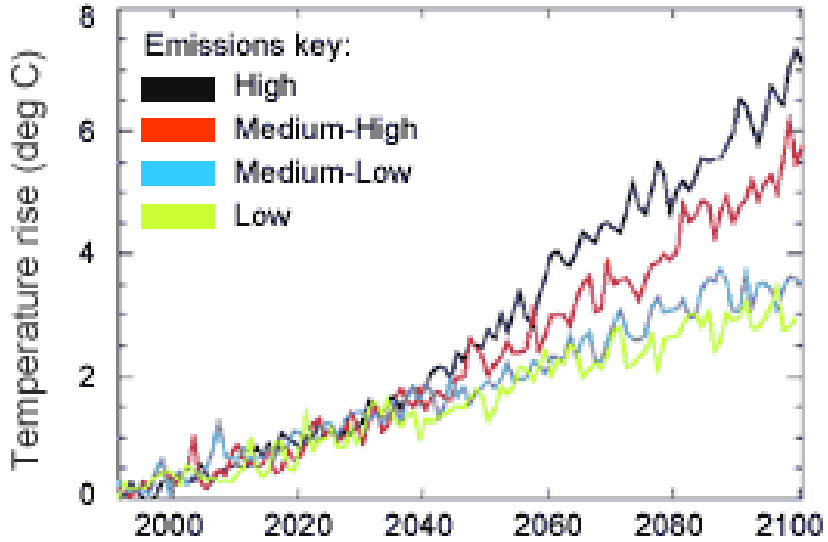
Met Office

If we continue emitting greenhouse gases - warming will continue



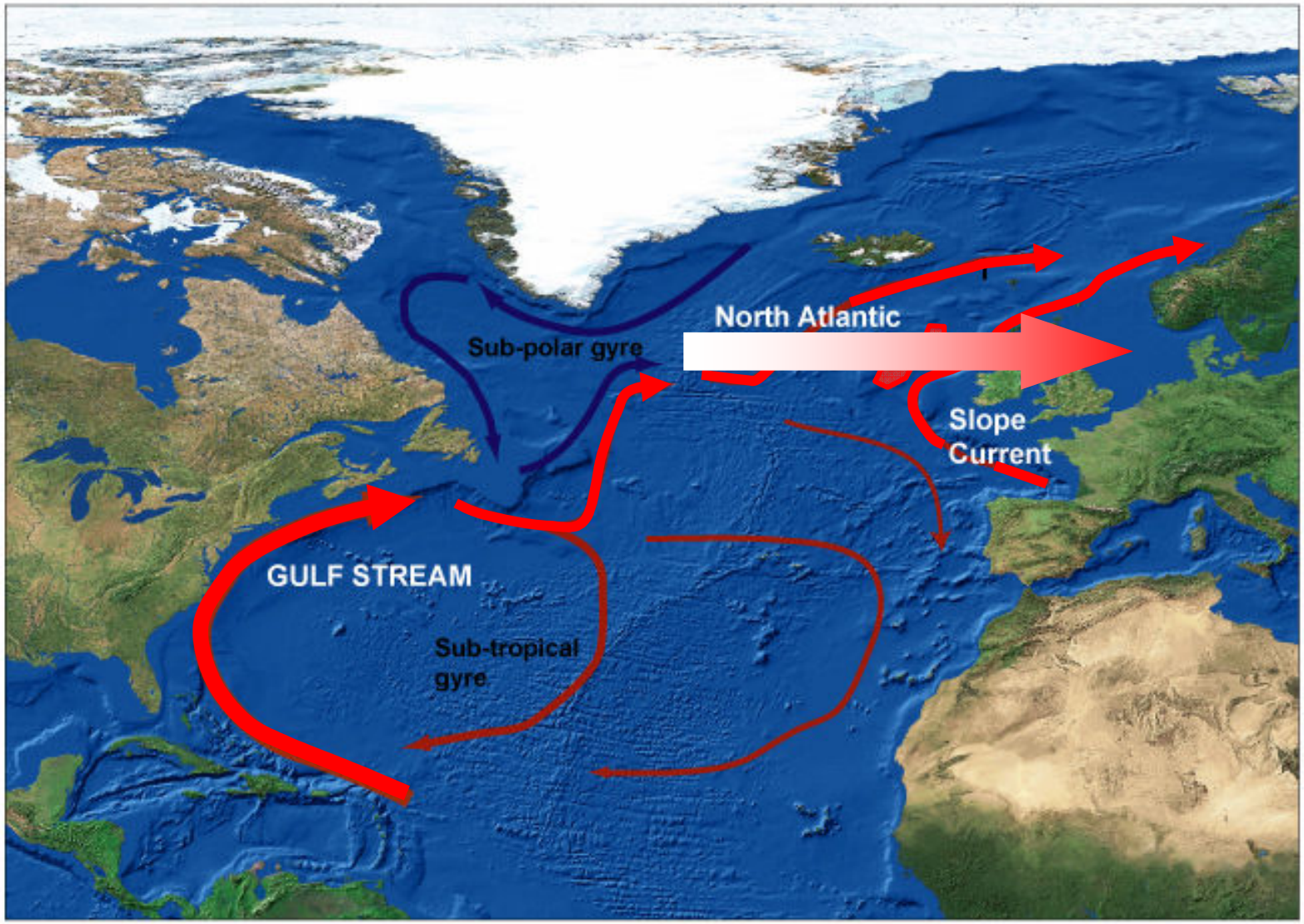
Projected annual mean temperature rise, 2000-2100

Met Office

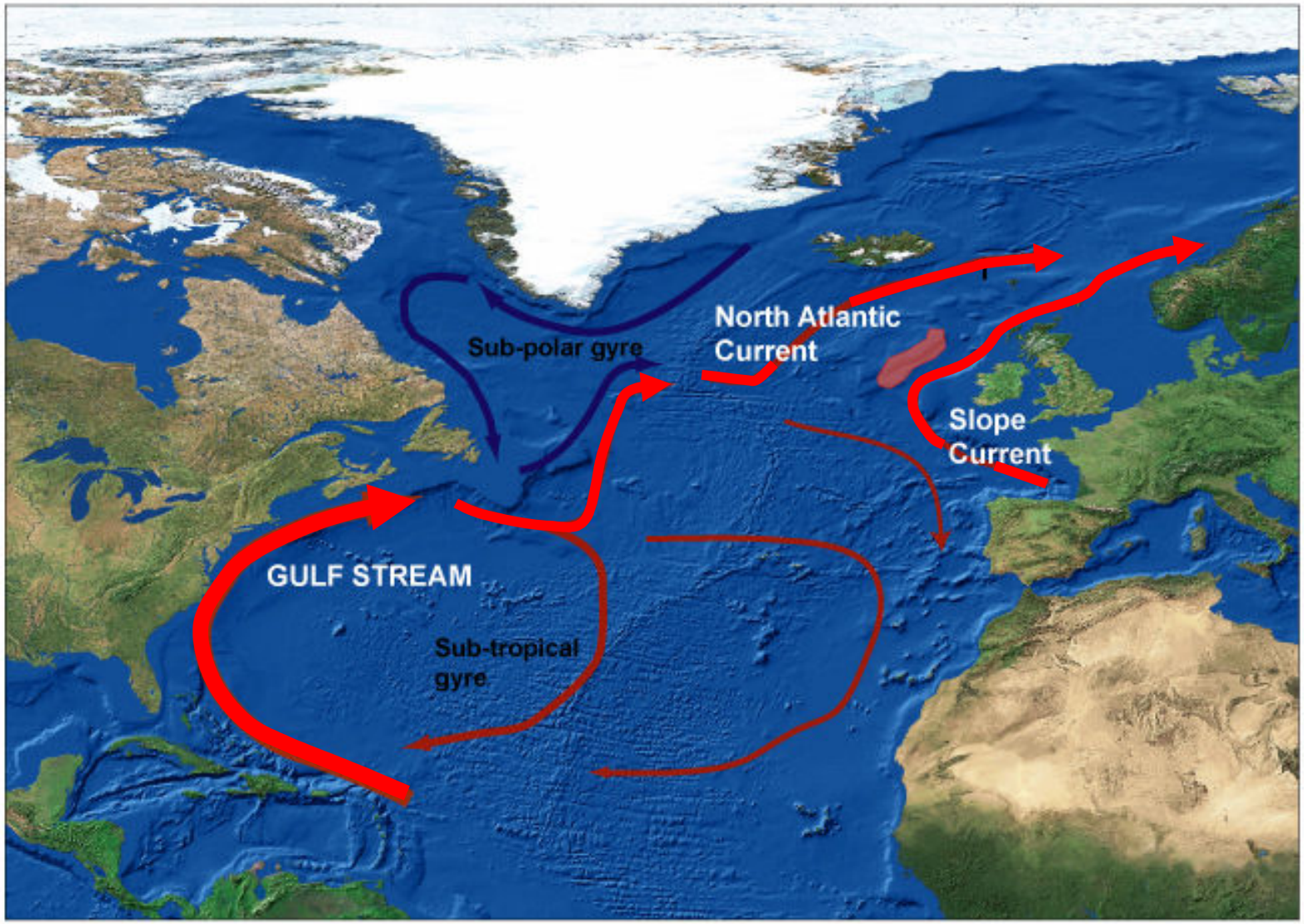


Met Office

Scotland – the effect of the ocean

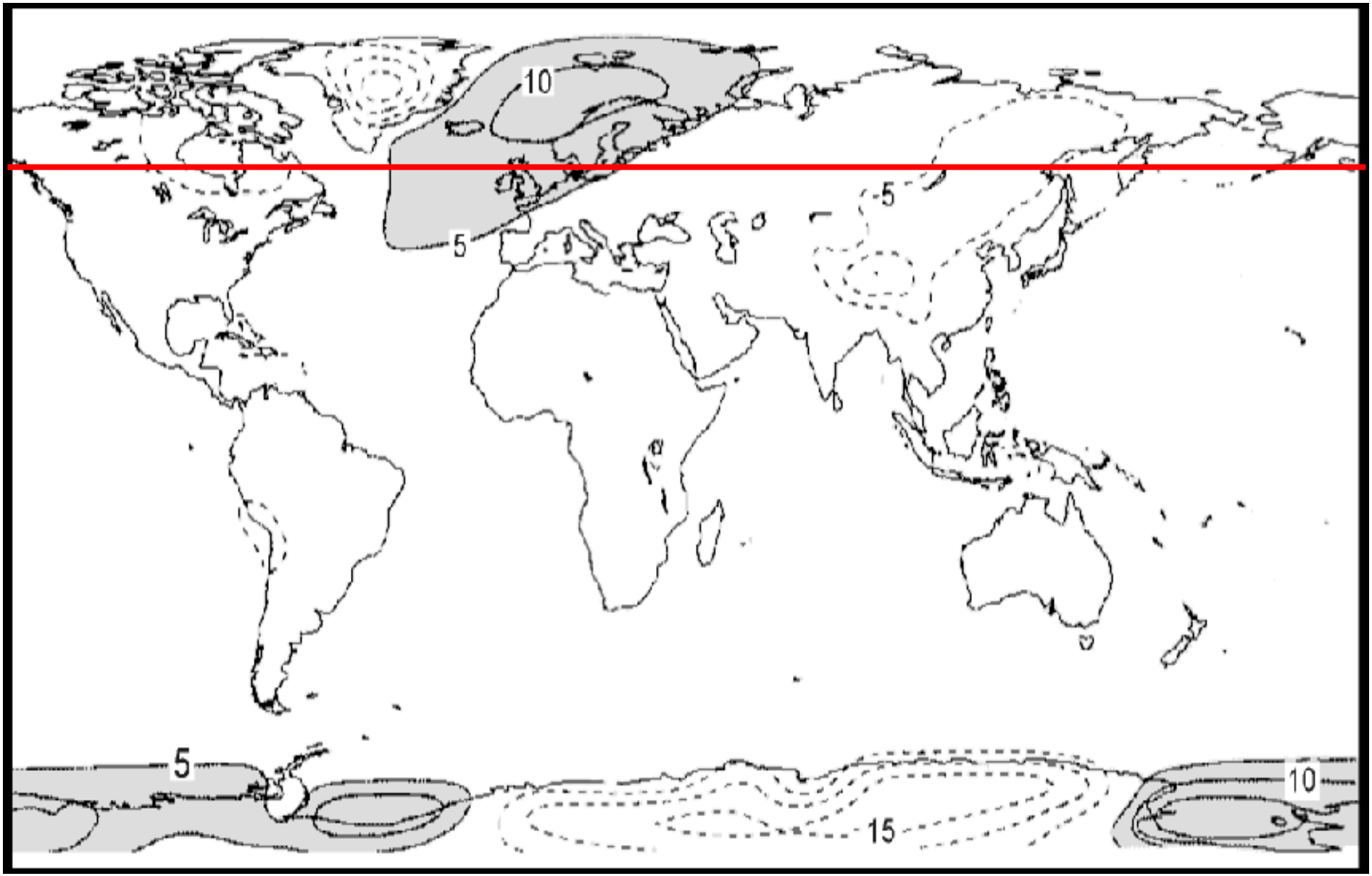


Scotland – the effect of the ocean

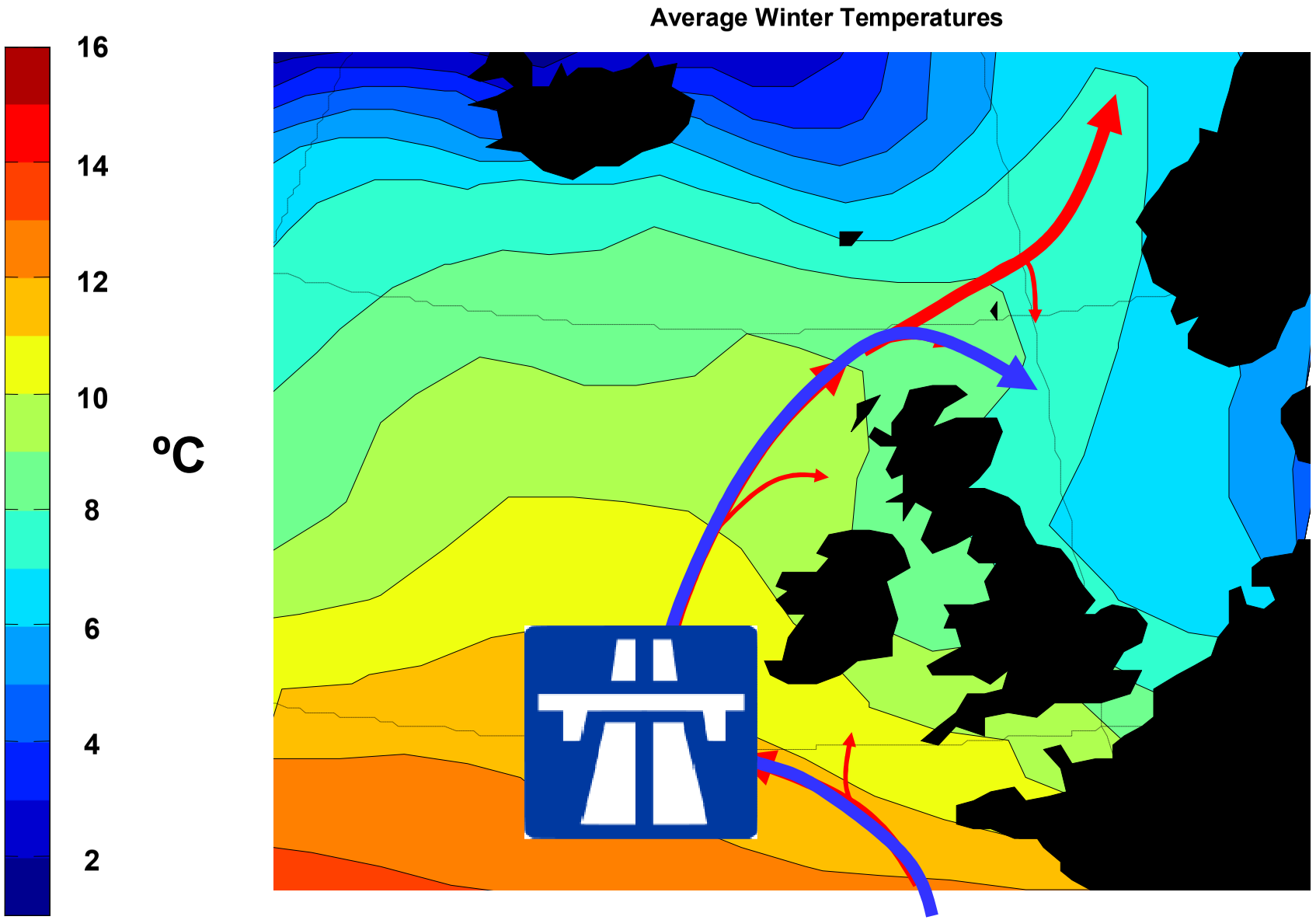


Met Office Diag ?

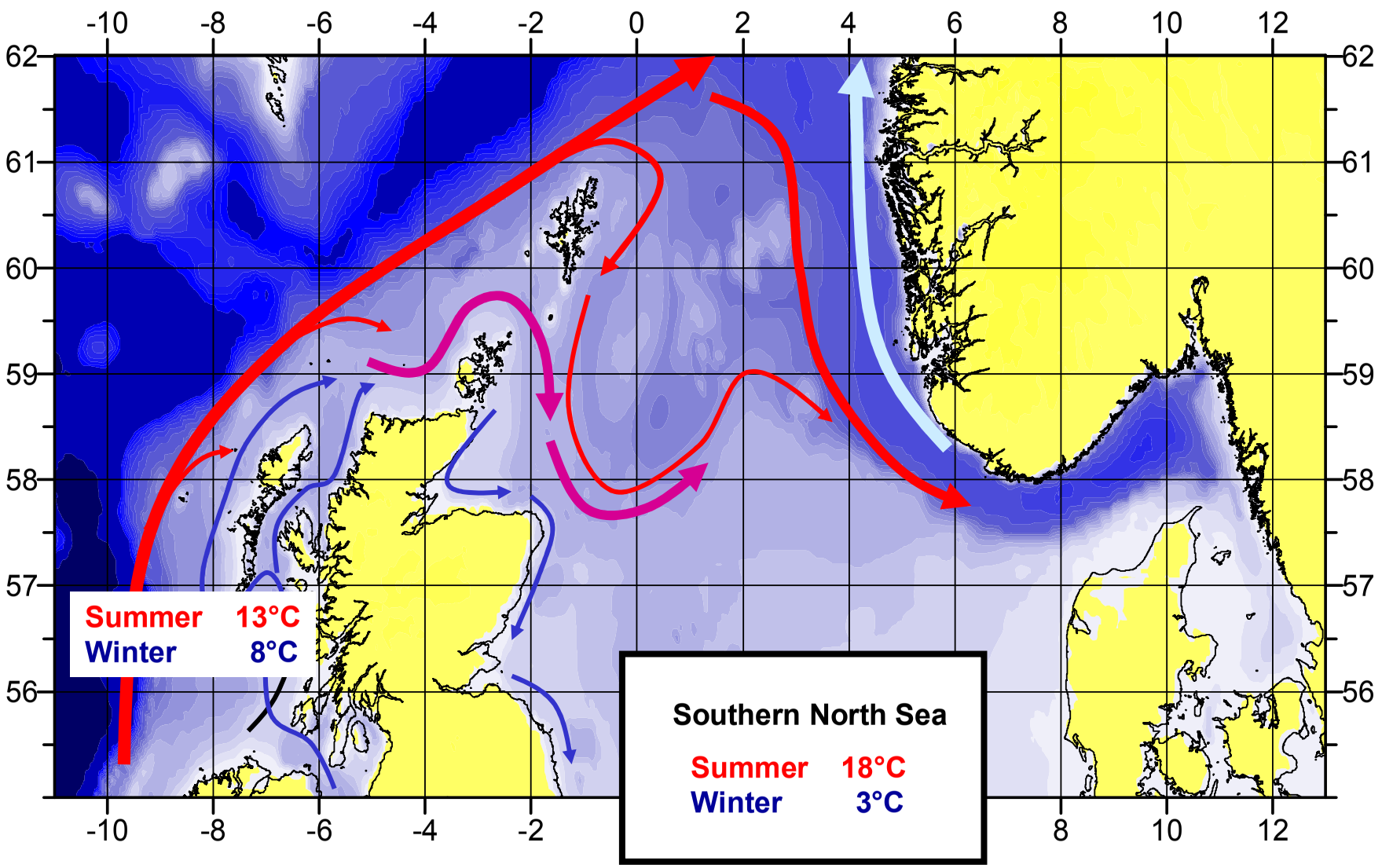
The effect of the ocean's warmth



Effect of the Slope Current



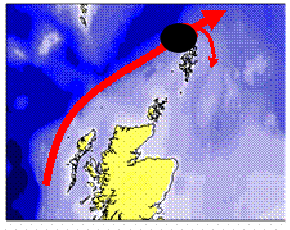
Currents around Scotland

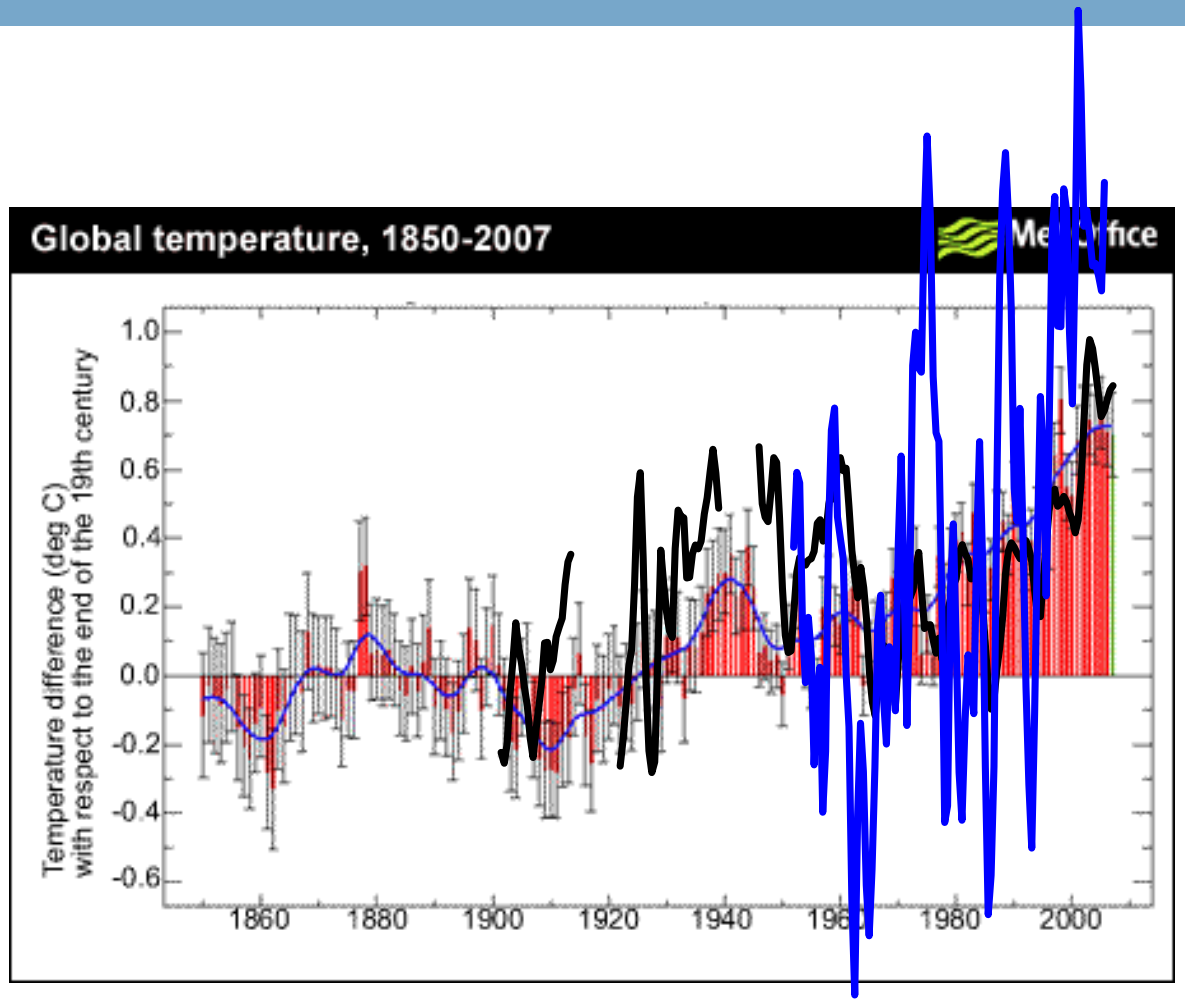


Global Warming - Scotland is no exception







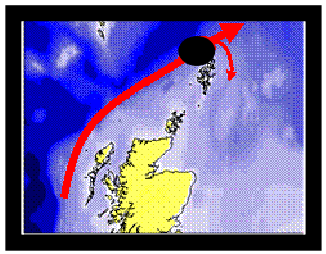


Met Office

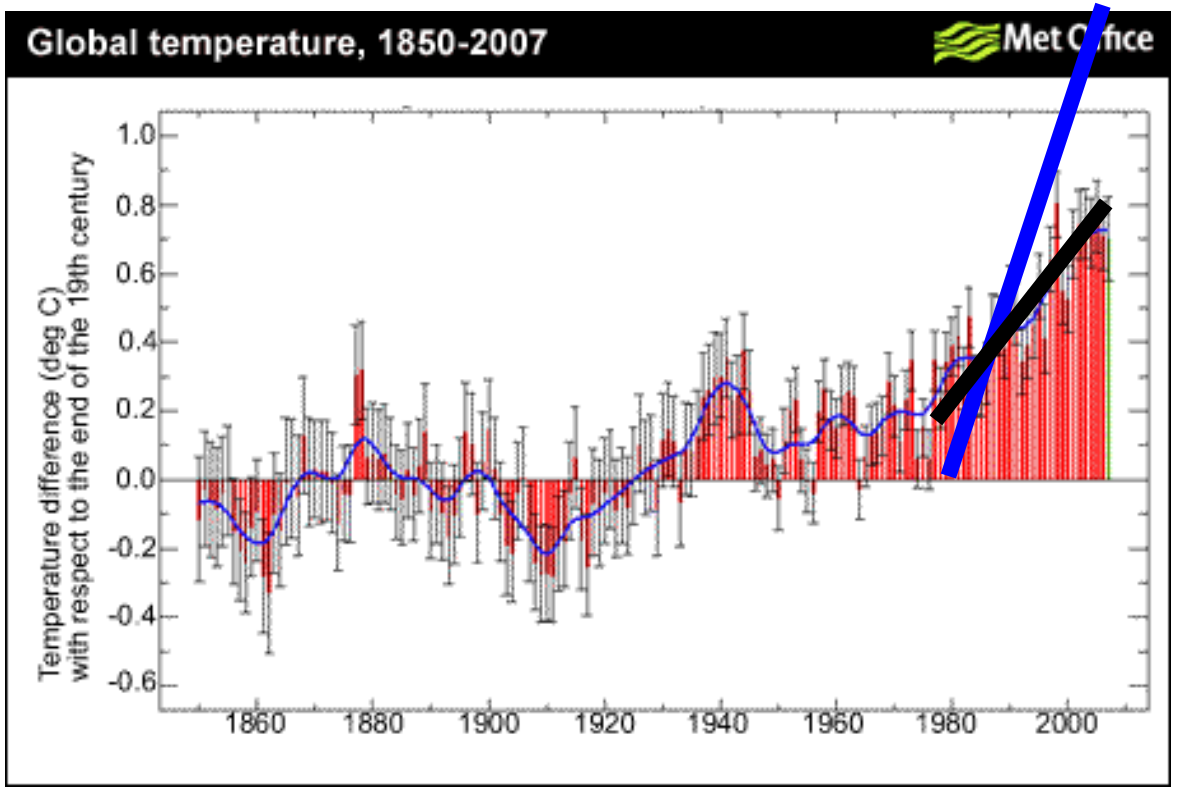
Global Warming - Scotland is no exception







Clyde +0.5ºC / decade



Atlantic Water +0.2ºC / decade

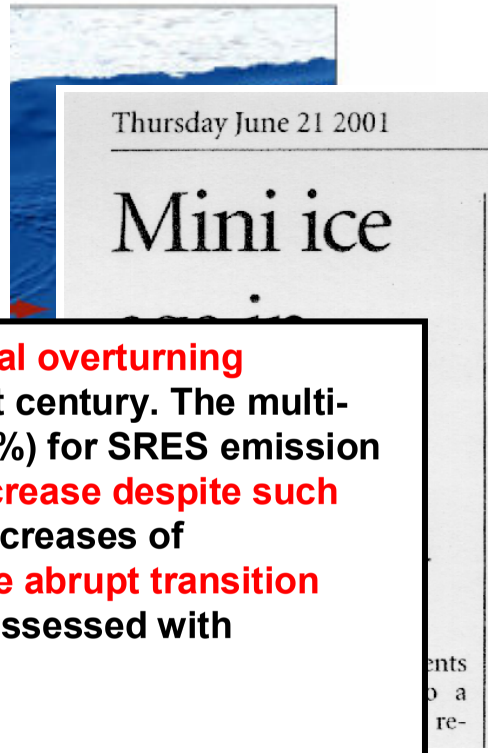
The North Atlantic … rapid change ?






THE TIMES THURSDAY NOVEMBER 25 1999

Britain faces big freeze as world heats up


Thursday June 21 2001

Mini ice

Based on current model simulations, it is very likely that the meridional overturning circulation (MOC) of the Atlantic Ocean will slow down during the 21st century. The multi-model average reduction by 2100 is 25% (range from zero to about 50%) for SRES emission scenario A1B. Temperatures in the Atlantic region are projected to increase despite such changes due to the much larger warming associated with projected increases of greenhouse gases. It is very unlikely that the MOC will undergo a large abrupt transition during the 21st century. Longer-term changes in the MOC cannot be assessed with confidence.

IPCC 4th Report Summary for Policy Makers




MAMMOTH IMPACT: Scotland could suffer the effects of a mini Ice Age caused by the melting of the polar icecaps

is almost the same distance from the equator as Glasgow. The result will be that

will rise by 20 feet, flooding many parts of the country.

now we will have colder winters, like Central Europe."

Dr Warchams said the Ice

Scottish skiing industry can look forward to winter bene-fits, with snow covered High-

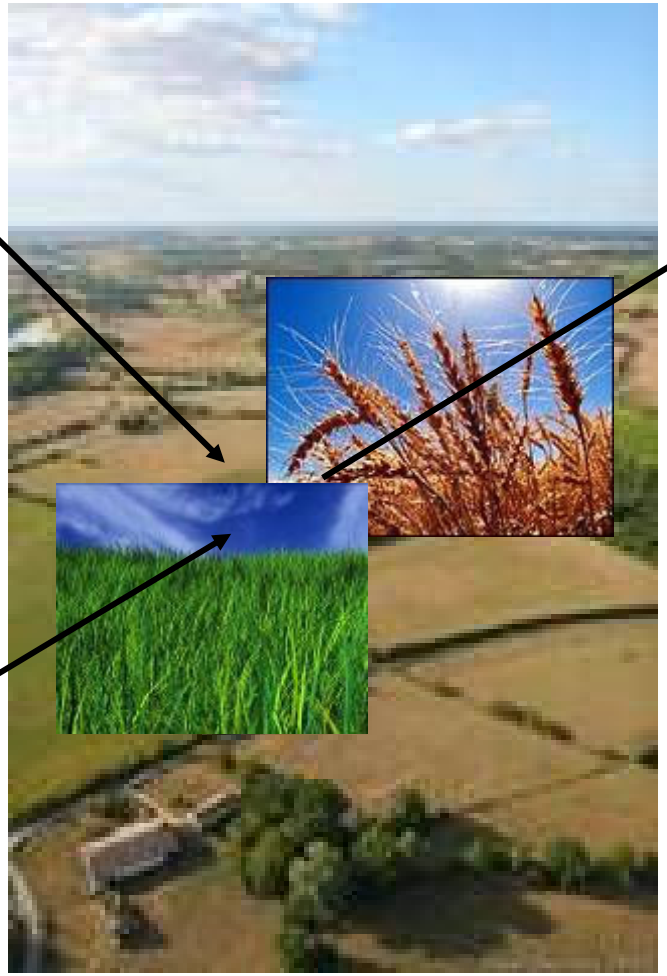


Summary - oceanography

- **Scotland is warmer than we should be due to our latitude**
  - Milder and more moderate annual cycle
  - More productive
- **Our waters are warming**
  - Clyde faster than offshore
- **Slope Current !**
  - Source of our waters
  - Supplies warm-water species
  - Is not going to switch off
- **What has happened to marine ecosystems?**

The food chain … on land











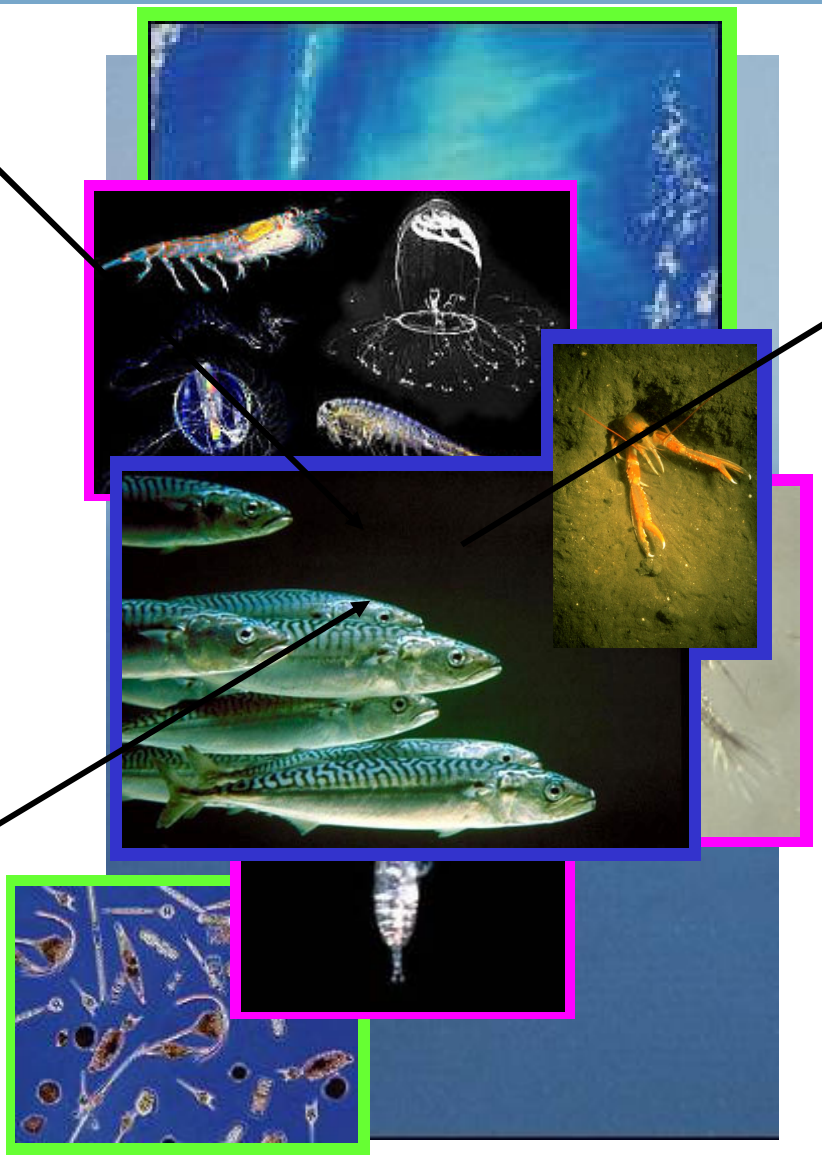




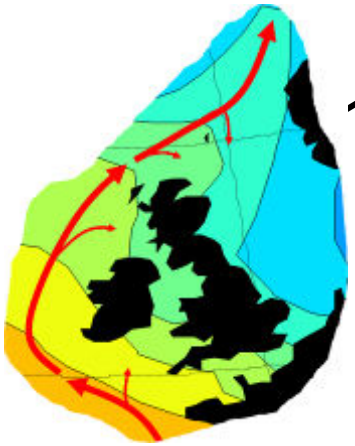


The food chain … at sea









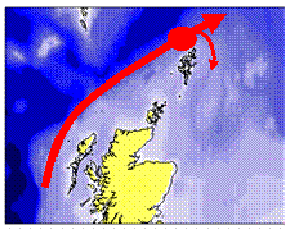


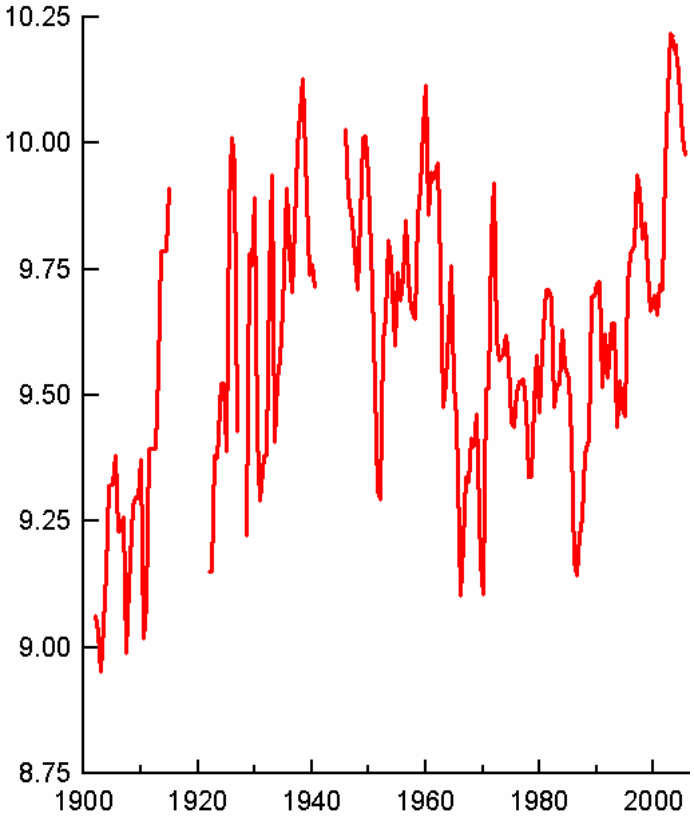
PHYTOPLANKTON ZOOPLANKTON FISH / SHELLFISH

Ocean climate

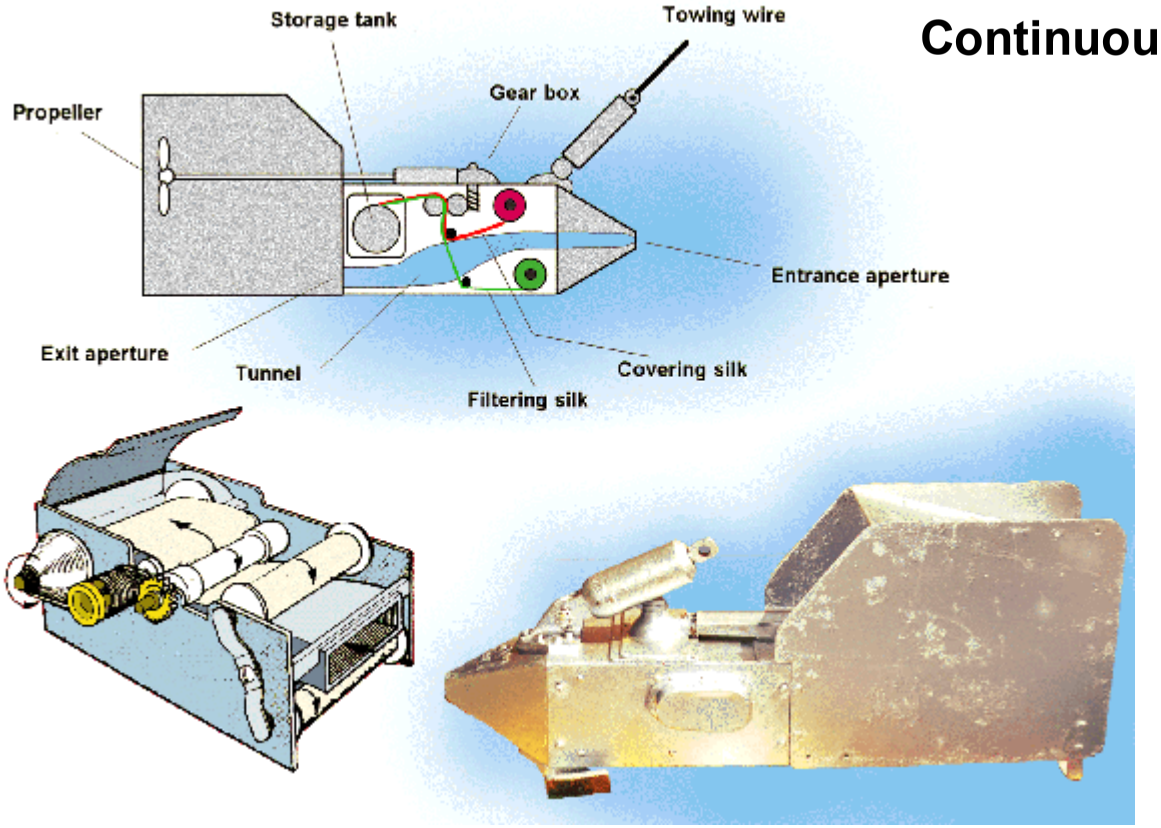
	Change
Winds and Storms	↑ Small
Waves	↑ Small
Sea Temperatures	↑

Storm Surges

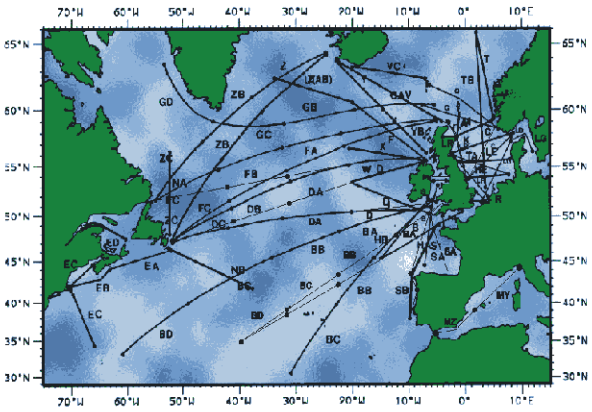




Plankton

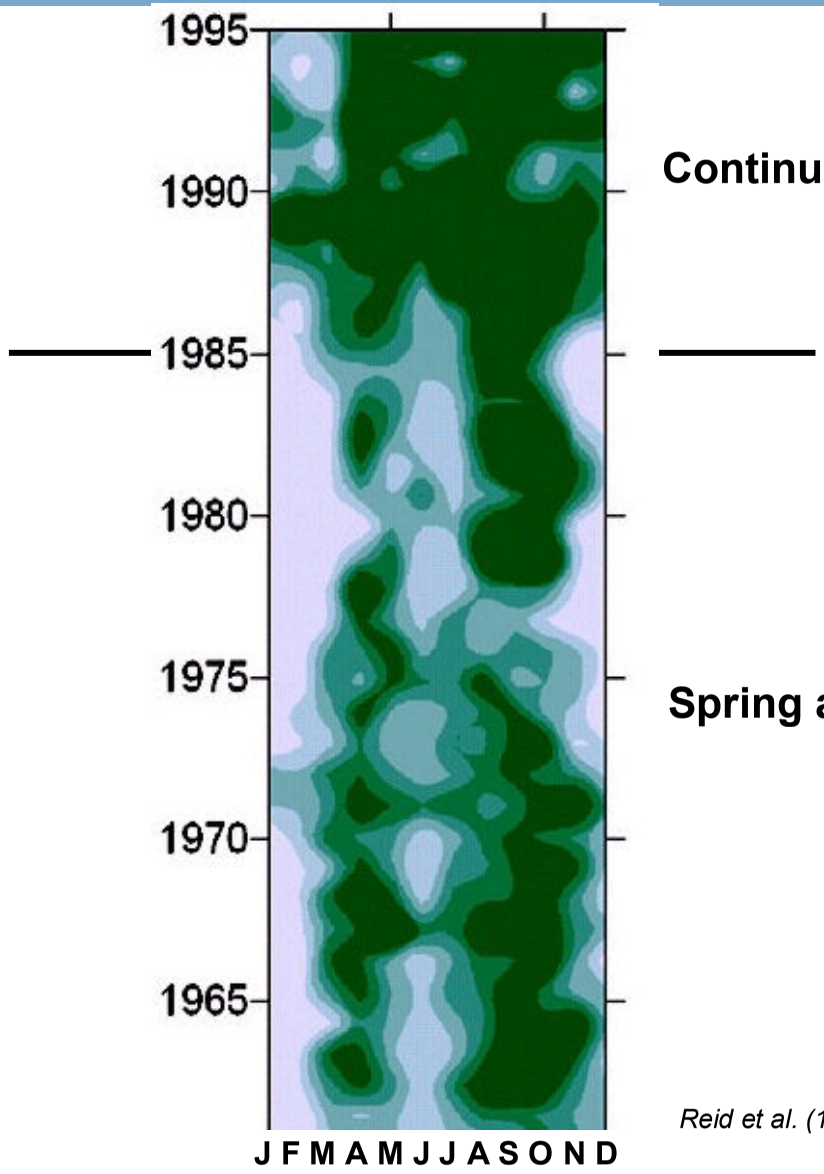


Continuous Plankton Recorder (CPR)



CONTINUOUS PLANKTON RECORDER SURVEY
SAHFOS

Phytoplankton



Continuous bloom

Spring and autumn bloom

Reid et al. (1998). Nature, 391, 546-547

North Sea

1973 to 2000

Primary production increased

Production of fish decreased

?

Heath (2005). ICES J. Mar.Sci., 62, 847-868

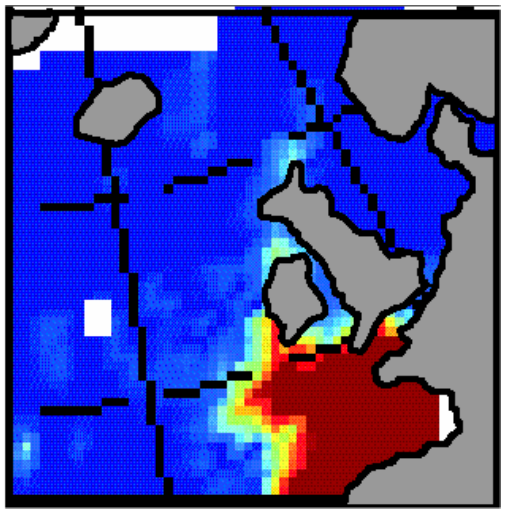
CONTINUOUS PLANKTON RECORDER SURVEY

SAHFOS

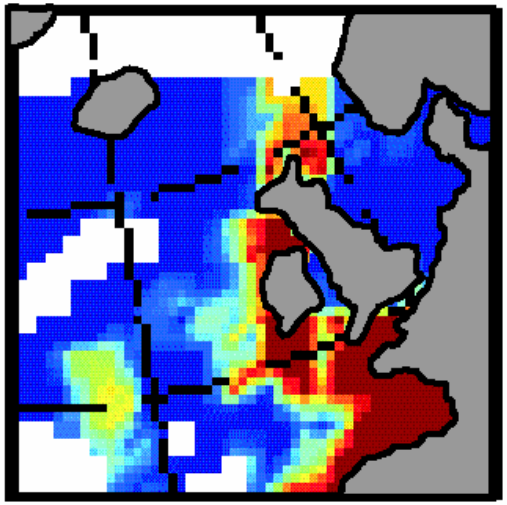
Zooplankton

Southern shelf edge species

1960-1975



1996-1999



Beaugrand et. A. (2002).
Mar. Ecol. Prog. Ser., 232, 179-195

North Sea
1973 to 2000

Production of zooplankton remained constant

?

Heath (2005). ICES J. Mar.Sci., 62, 847-868

What has happened ? (1970s cf. 2000)

Sea Surface

Climate

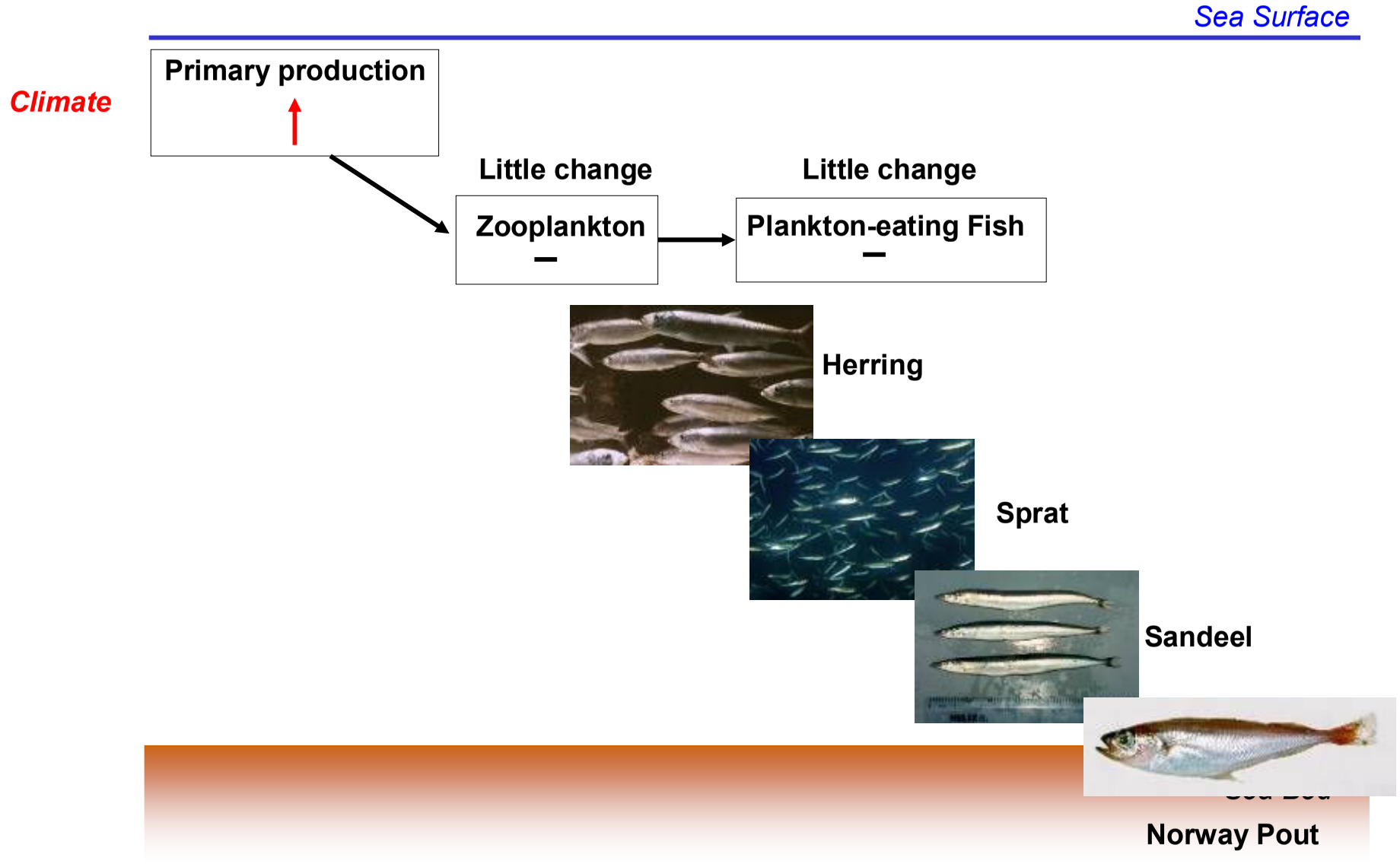
Primary production

↑

Sea Bed

Heath (2005). ICES J. Mar.Sci., 62, 847-868

What has happened ? (1970s cf. 2000)



Heath (2005). ICES J. Mar.Sci., 62, 847-868

What has happened ? (1970s cf. 2000)

Sea Surface



Mackerel

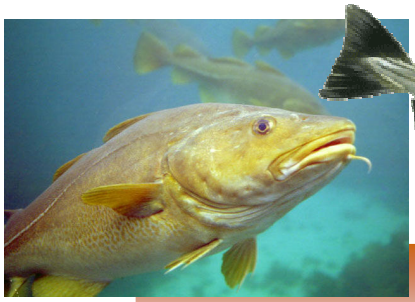


Horse Mackerel

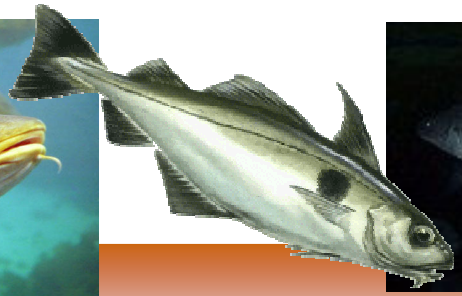
Fishing
Climate

Predator Fish ↓

Decrease of 60%



Cod



Haddock



Saithe



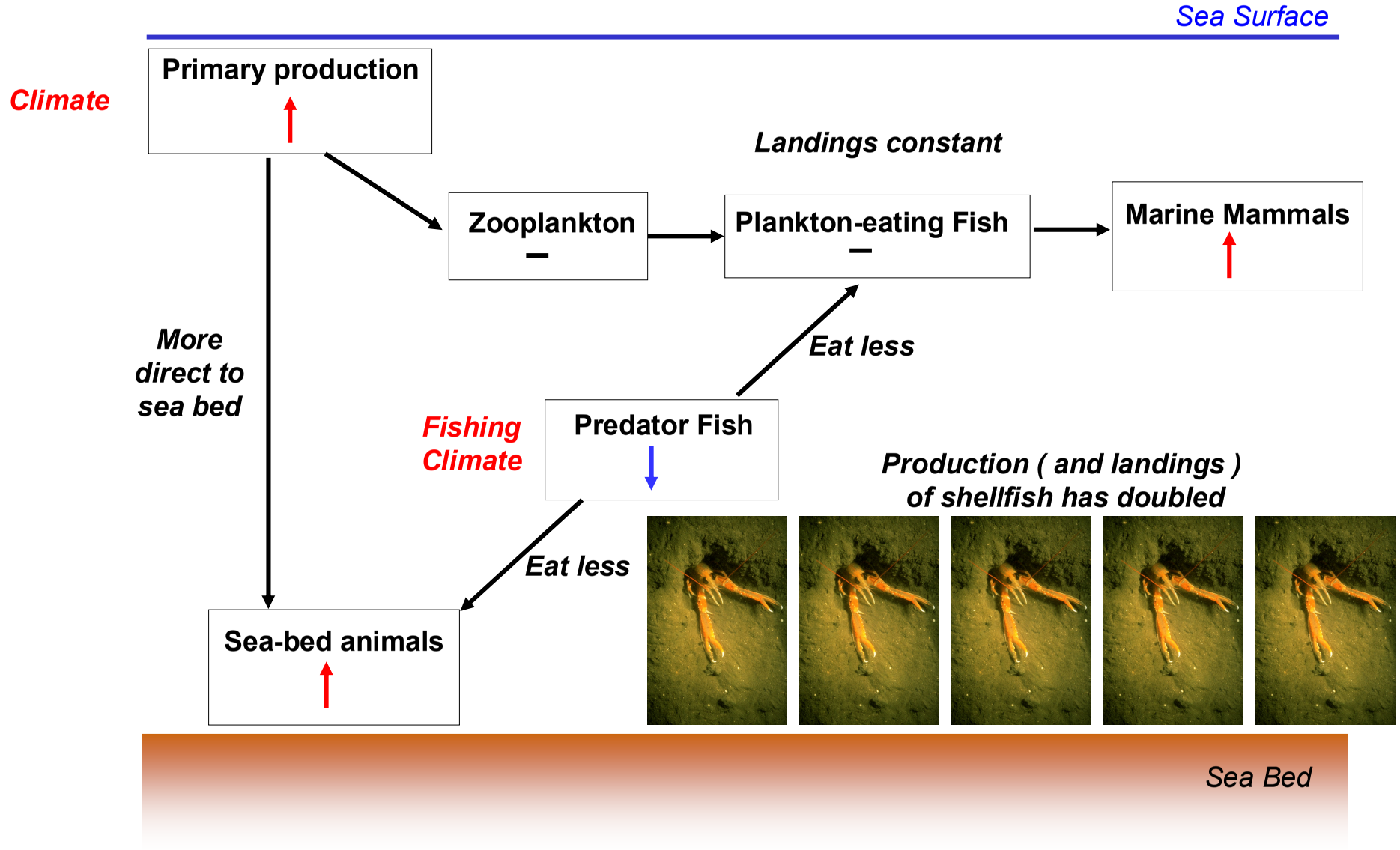
Whiting

Monkfish

Sea Bed

Heath (2005). ICES J. Mar.Sci., 62, 847-868

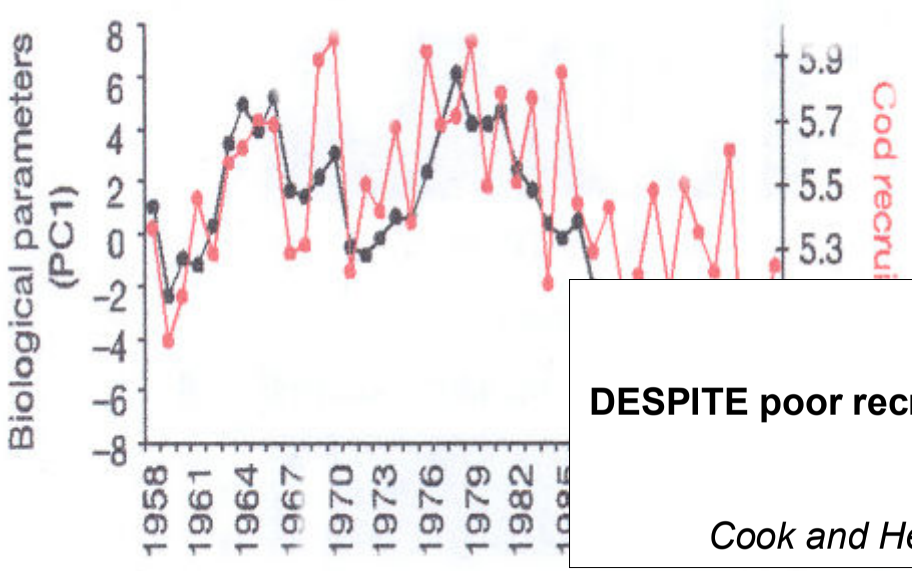
What has happened ? (1970s cf. 2000)



Heath (2005). ICES J. Mar.Sci., 62, 847-868

Fishing or climate?

Sea Surface



Climate

Cod recruitment has become worse due to changes in plankton

Beaugrand et. al. (2003). Nature, 426, 661-664.

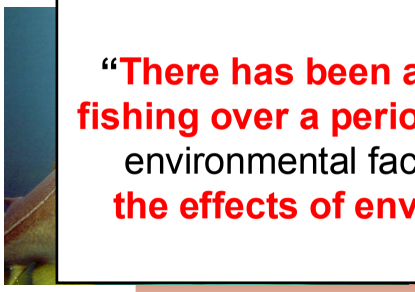
Fishing

DESPITE poor recruitment, could have a cod stock of >250,000 tonnes (presently 50,000 tonnes)

Cook and Heath (2005). ICES J. of Mar. Sci., 62, 1322-1326.

North Sea RAC (Cod Symposium, March 2007)

"There has been a decline in cod, and there is a consensus that it has been **caused by heavy fishing over a period when the recruitment of young cod to the stocks was poor** as a result of environmental factors. **There is little point in trying to separate the effects of fishing from the effects of environmental change. It is now clear that they can act together to damage cod stocks."**



Sea Bed

North Sea Cod

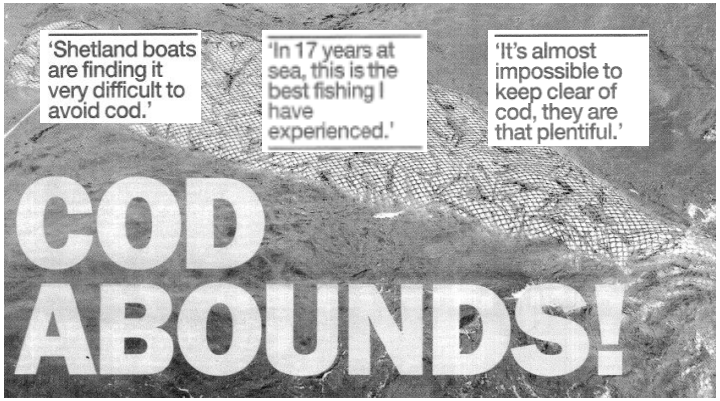
Heath (2005). ICES J. Mar.Sci., 62, 847-868

Conclusions - ecosystems

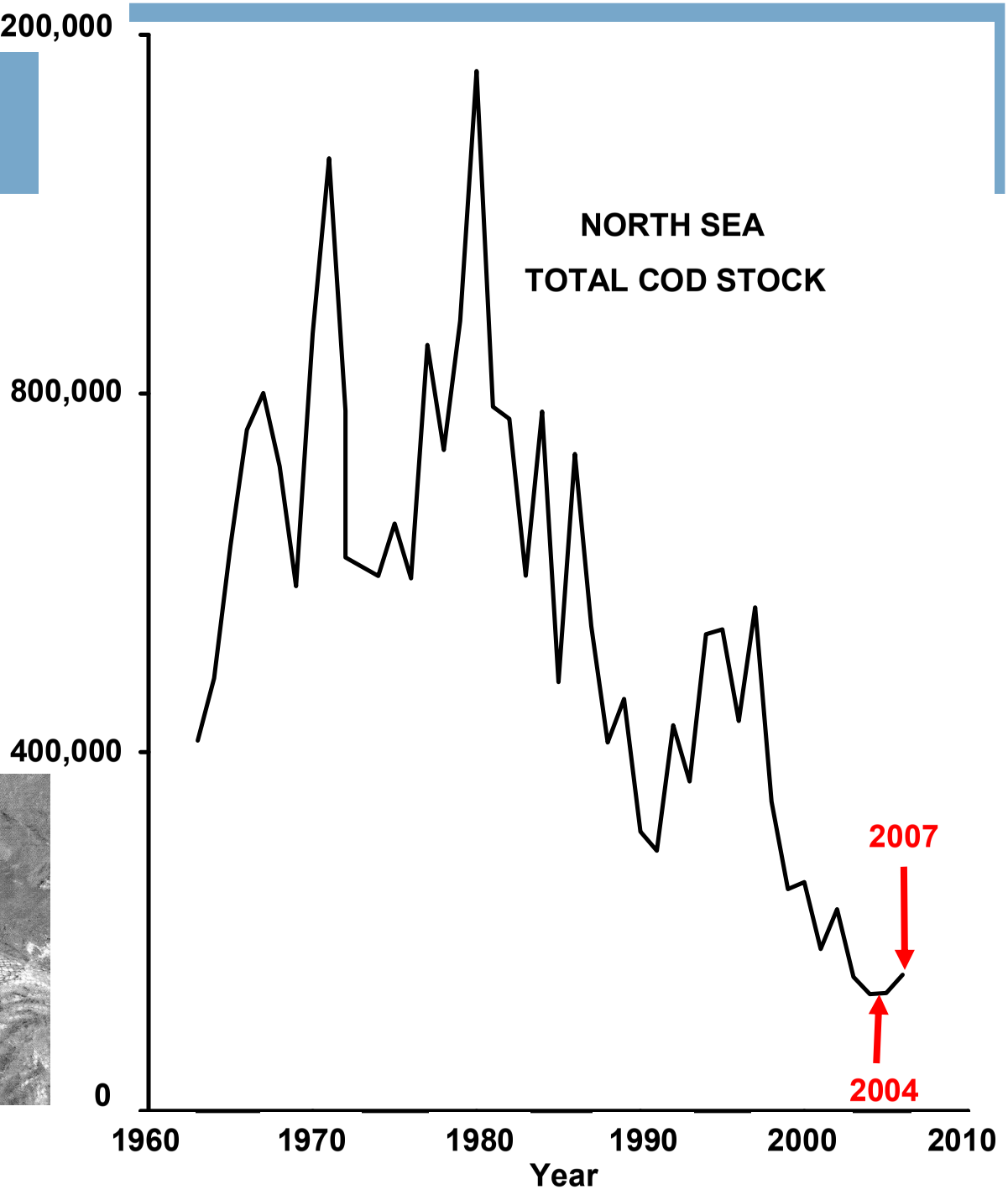
- **Fishing is still principle pressure on Scottish marine ecosystems**
- **Despite warming to date, depleted species can recover**
- **A diverse ecosystem can better adapt to a changing climate**

Fishing News, 19 March 2004



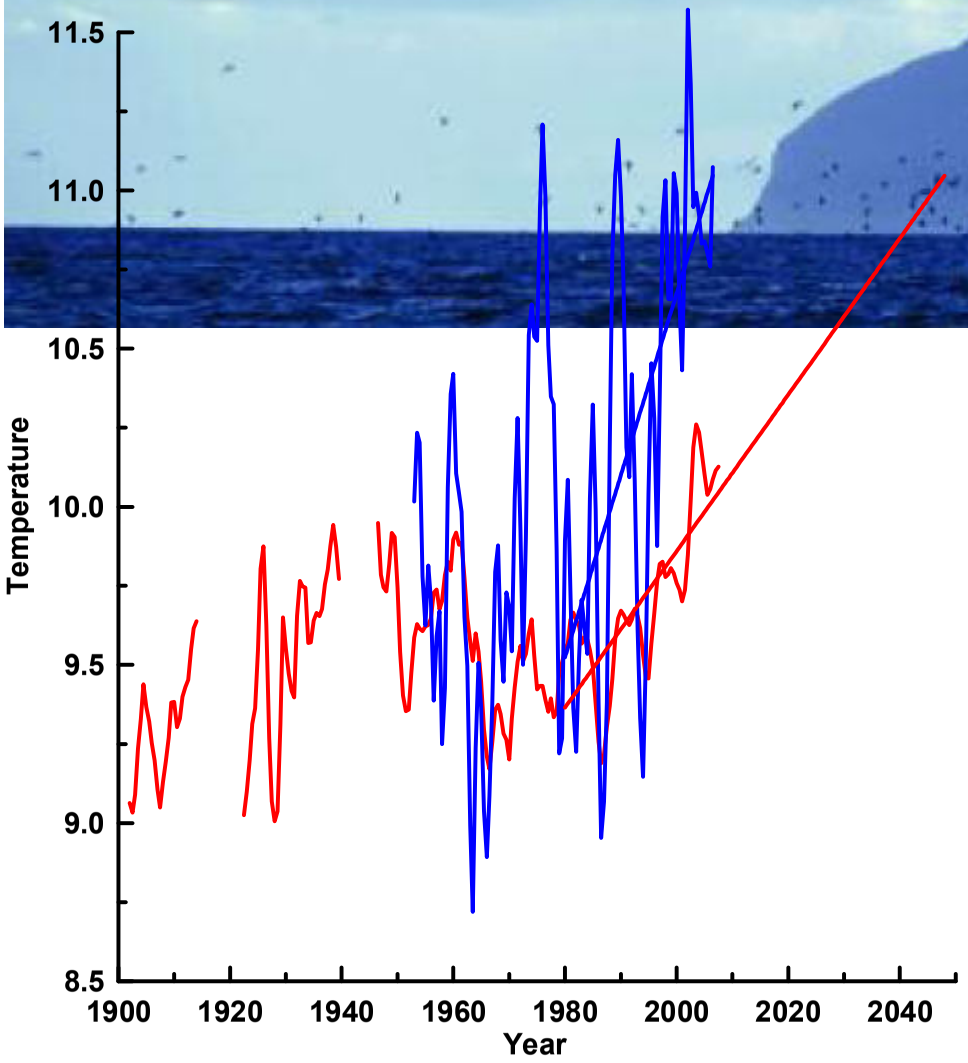


Fishing News, 4 May 2007



Conclusions - Clyde





A Unique Resource

Managing marine ecosystems in 2050?

Contents lists available at ScienceDirect

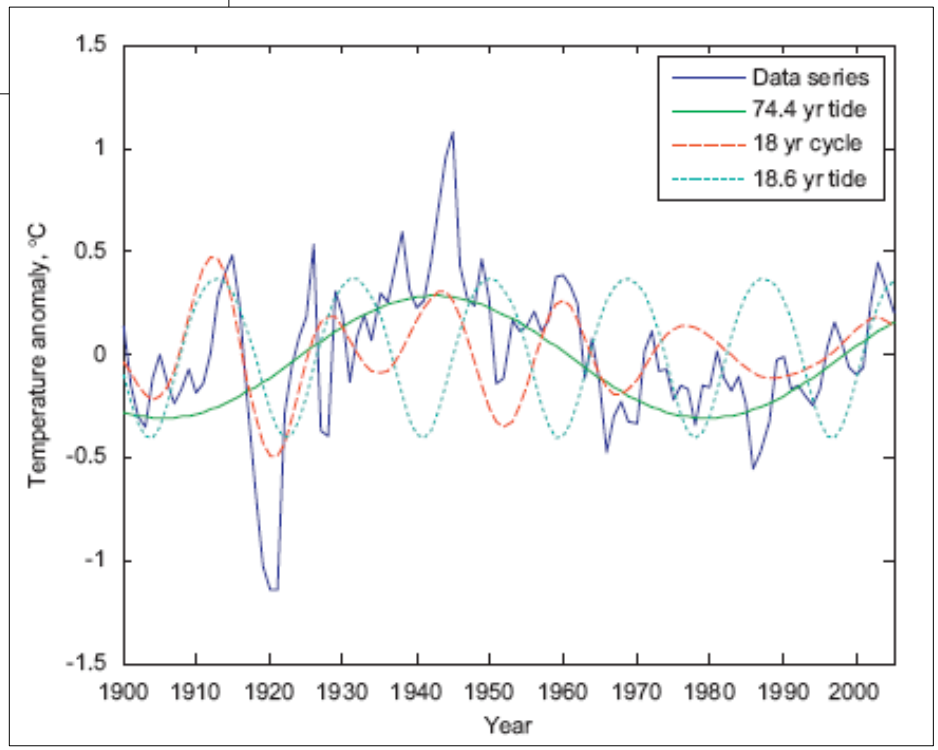
Deep-Sea Research I

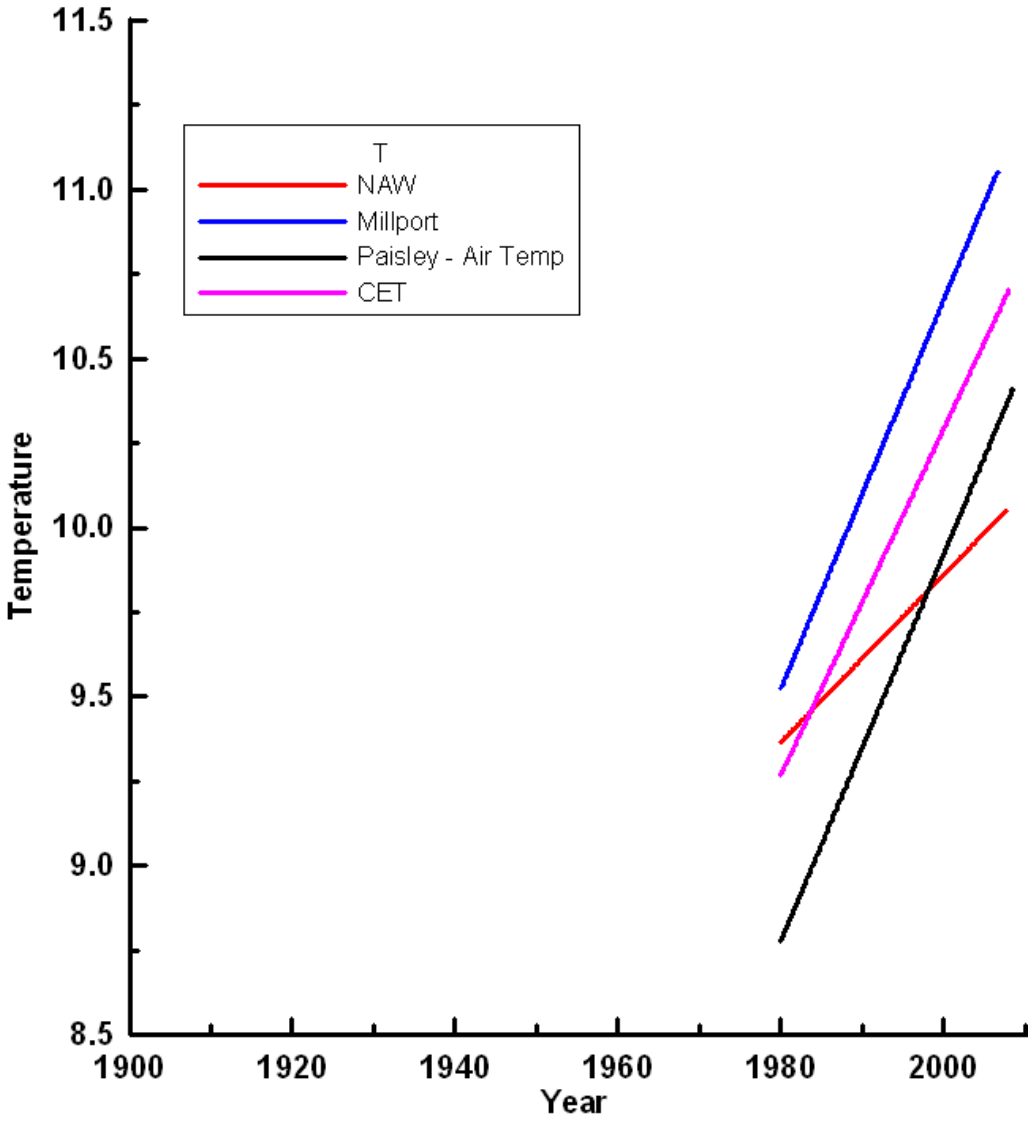
journal homepage: www.elsevier.com/locate/dsri

Lunar nodal tide effects on variability of sea level, temperature, and salinity in the Faroe-Shetland Channel and the Barents Sea

Harald Yndestad [a,*], William R. Turrell [b,1], Vladimir Ozhigin [c,2]

[a] Aalesund University College, N-6025 Aalesund, Norway
[b] FRS Marine Laboratory Aberdeen, PO Box 101, Victoria Road, Aberdeen AB11 9DB, Scotland
[c] Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich St., Mermansk 183763, Russia





+0.57ºC / decade

+0.51ºC / decade

+0.57ºC / decade

+0.25ºC / decade