

**Dave Reid, Caroline Cusack &
Glenn Nolan MI**

Woody Allen



**“Everything you
always wanted to know
About Climate Change ***

*** But were afraid to ask”**

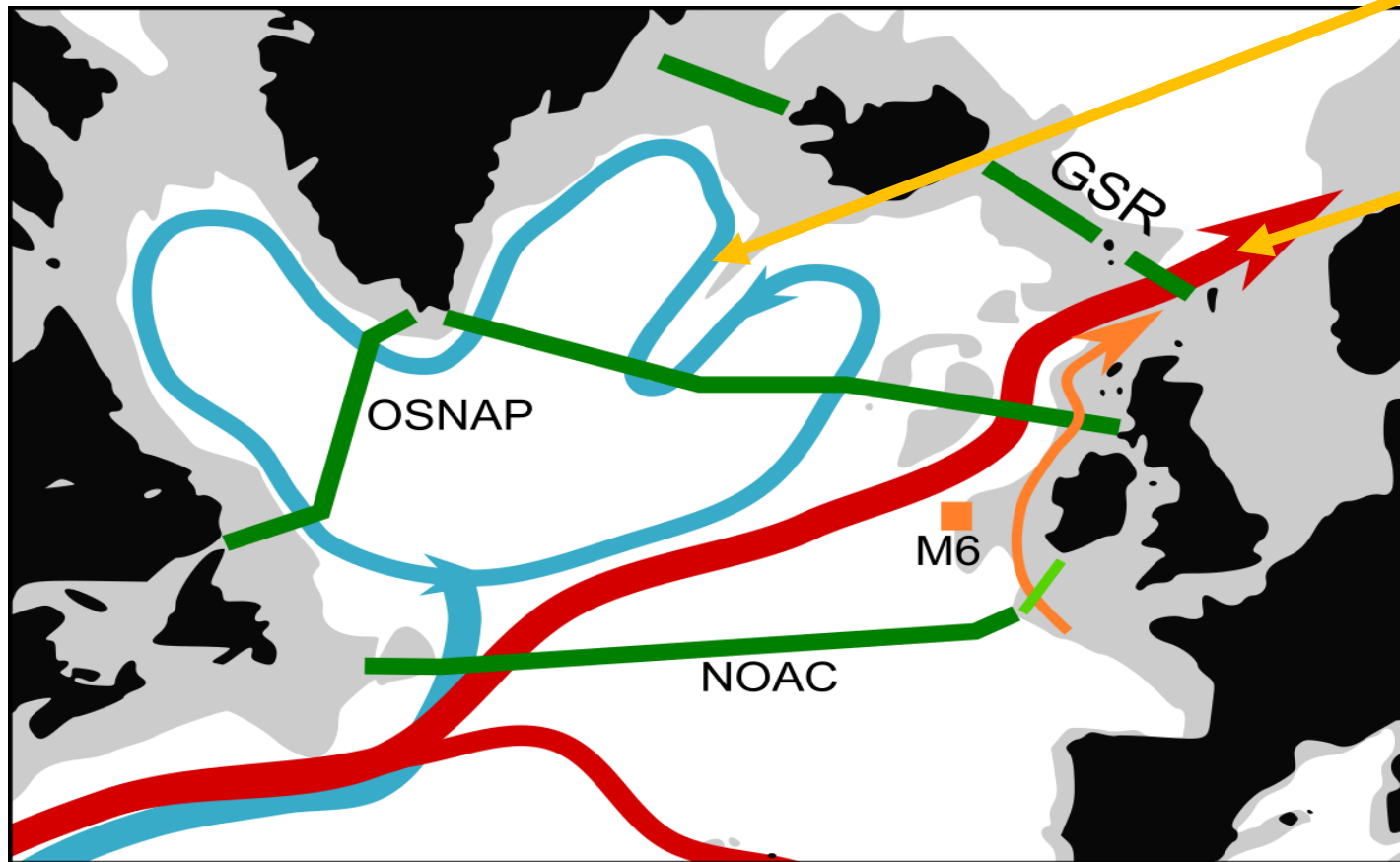


- **The Changing Atlantic**
- **Circulation**
- **Temperature**
- **Salinity**
- **Zooplankton**
- **Fish and Climate change**
- **Maximum Sustainable Yield**
- **Temperature Preference**
- **Cod Recruitment and cold years?**
- **Predicting blue whiting spawning**



The Changing Atlantic

- The subpolar gyre has not warmed as rapidly as the rest of the world.
- May be the signature of the Atlantic Overturning Circulation in decline.



In 2015, the **coldest ever** sea surface temperatures were recorded **south of Iceland**

Since 2015, the **freshest ever** values were recorded in the **Faroe Channel**

Future Climate projections for SW Ireland under 2 emission scenarios:

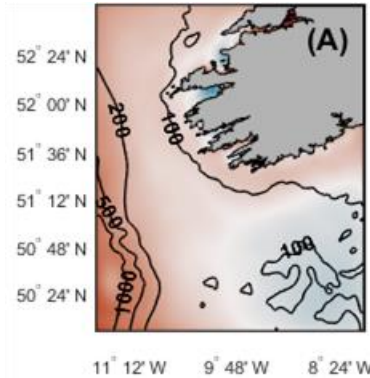
Message: Warmer and fresher by 2035



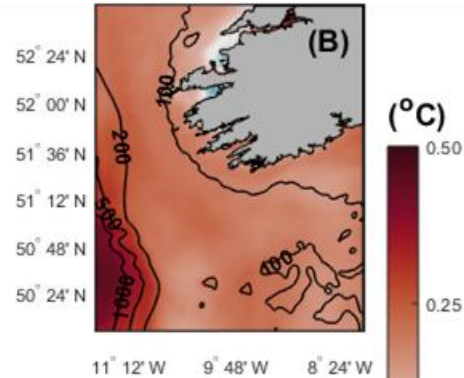
Anomaly Maps

**RCP 4.5
Emissions
peak in
2040**

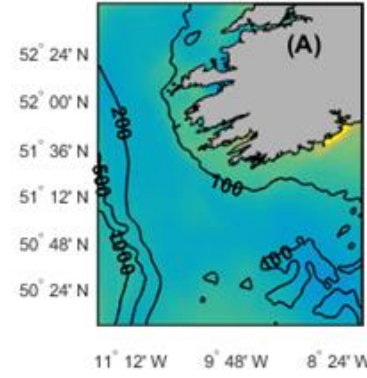
**Sea Surface
Temperature**



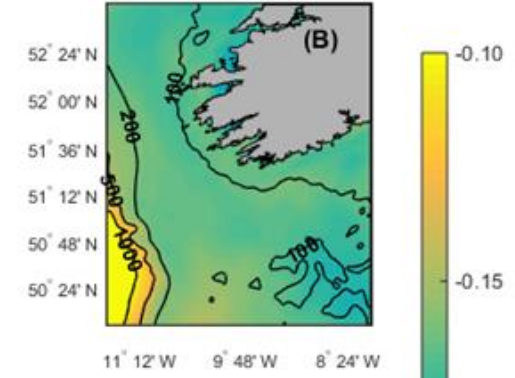
**Near Bottom
Temperature**



**Sea Surface
Salinity**

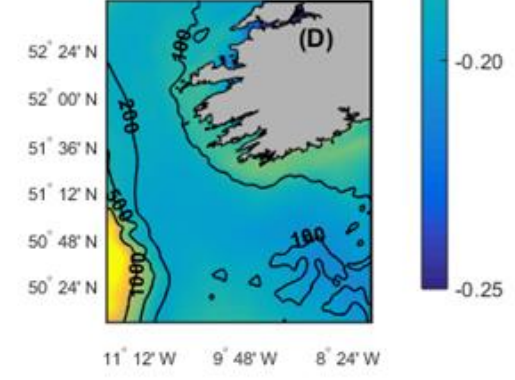
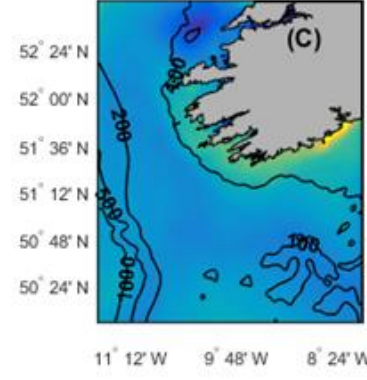
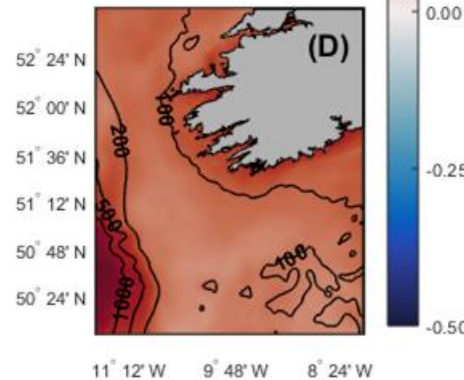
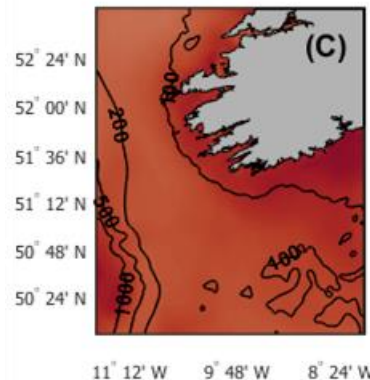


**Near Bottom
Salinity**



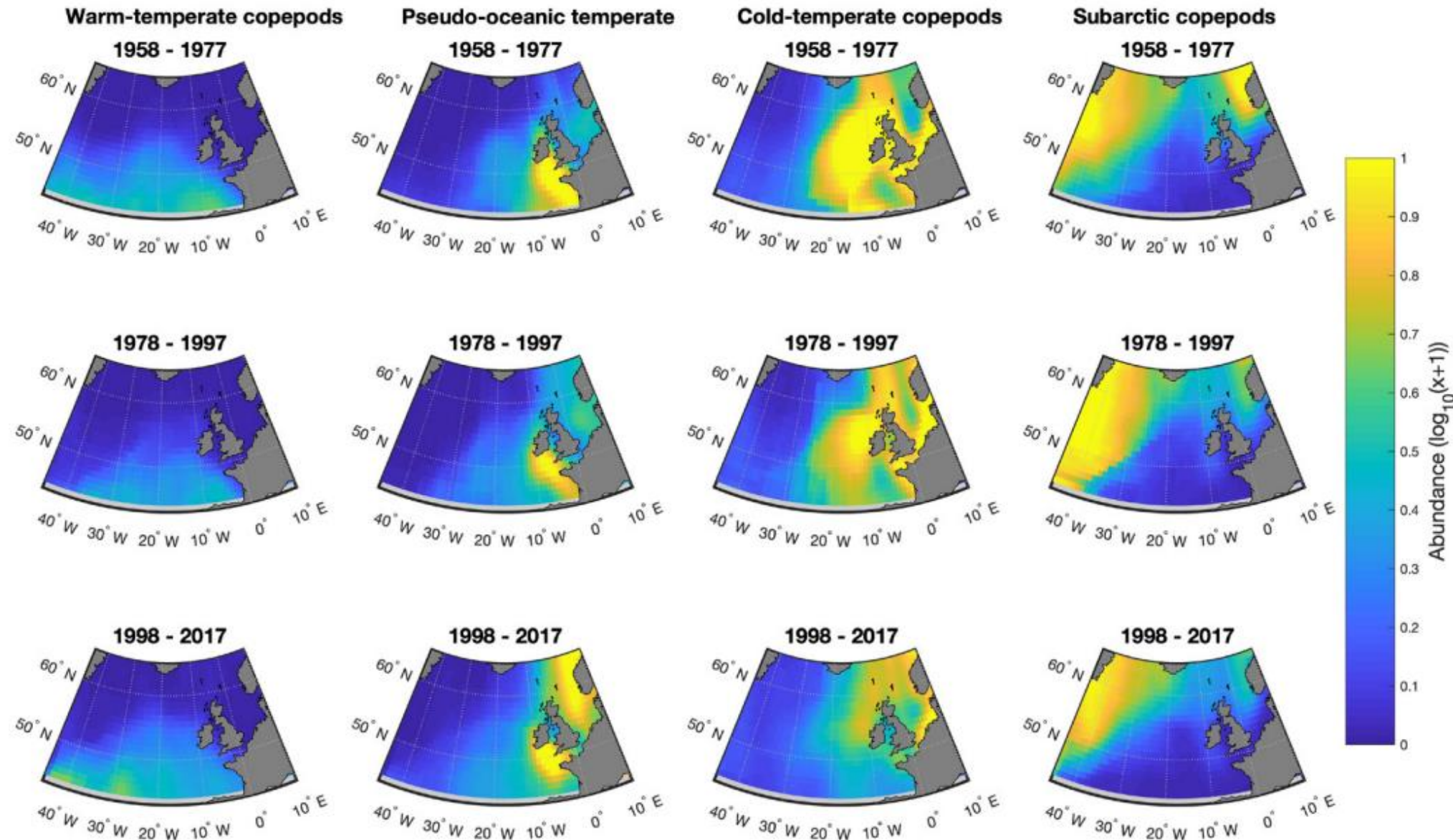
RCP 4.5

**RCP 8.5
Emissions
continue to
year 2100**

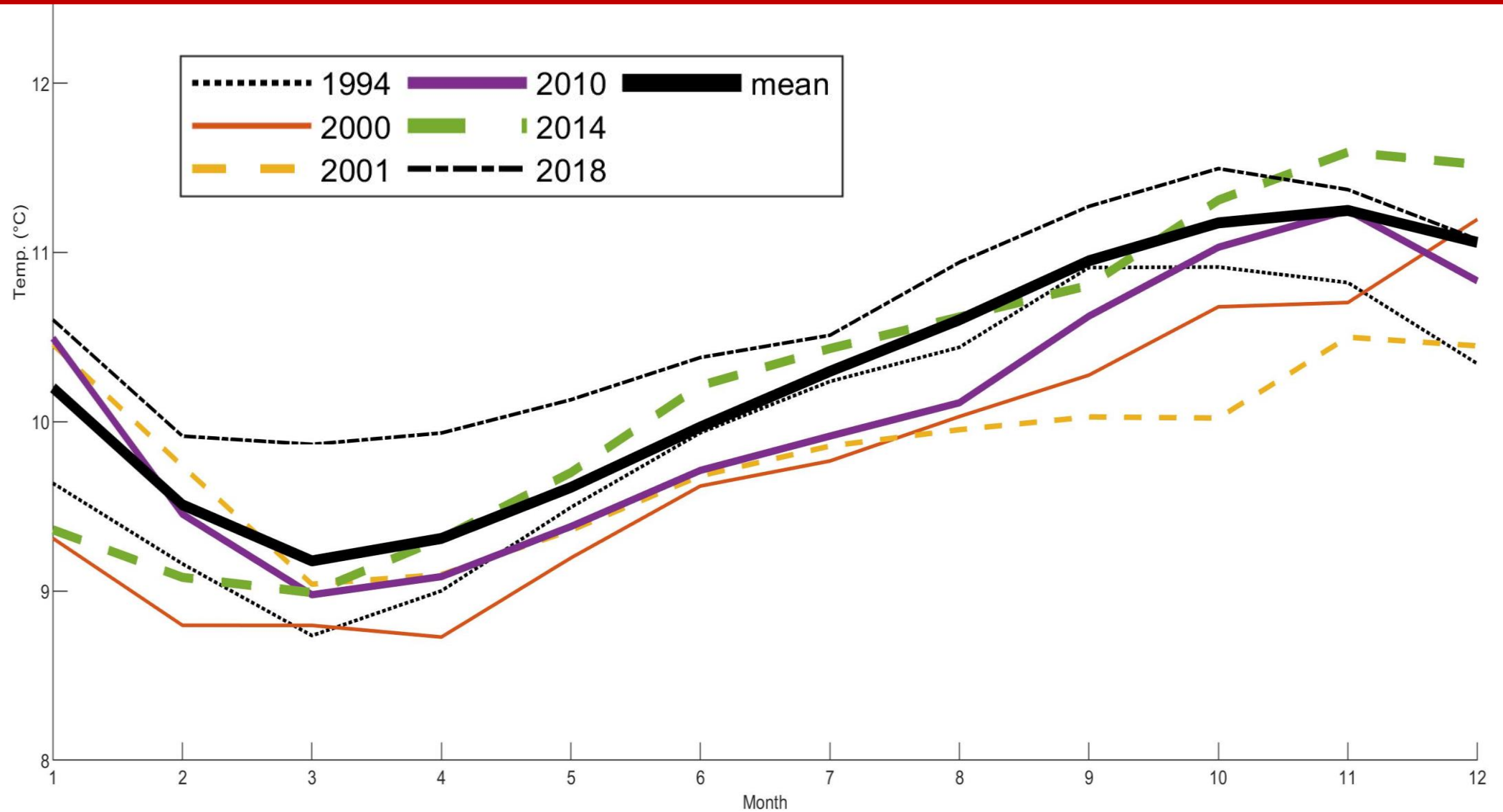


RCP 8.5

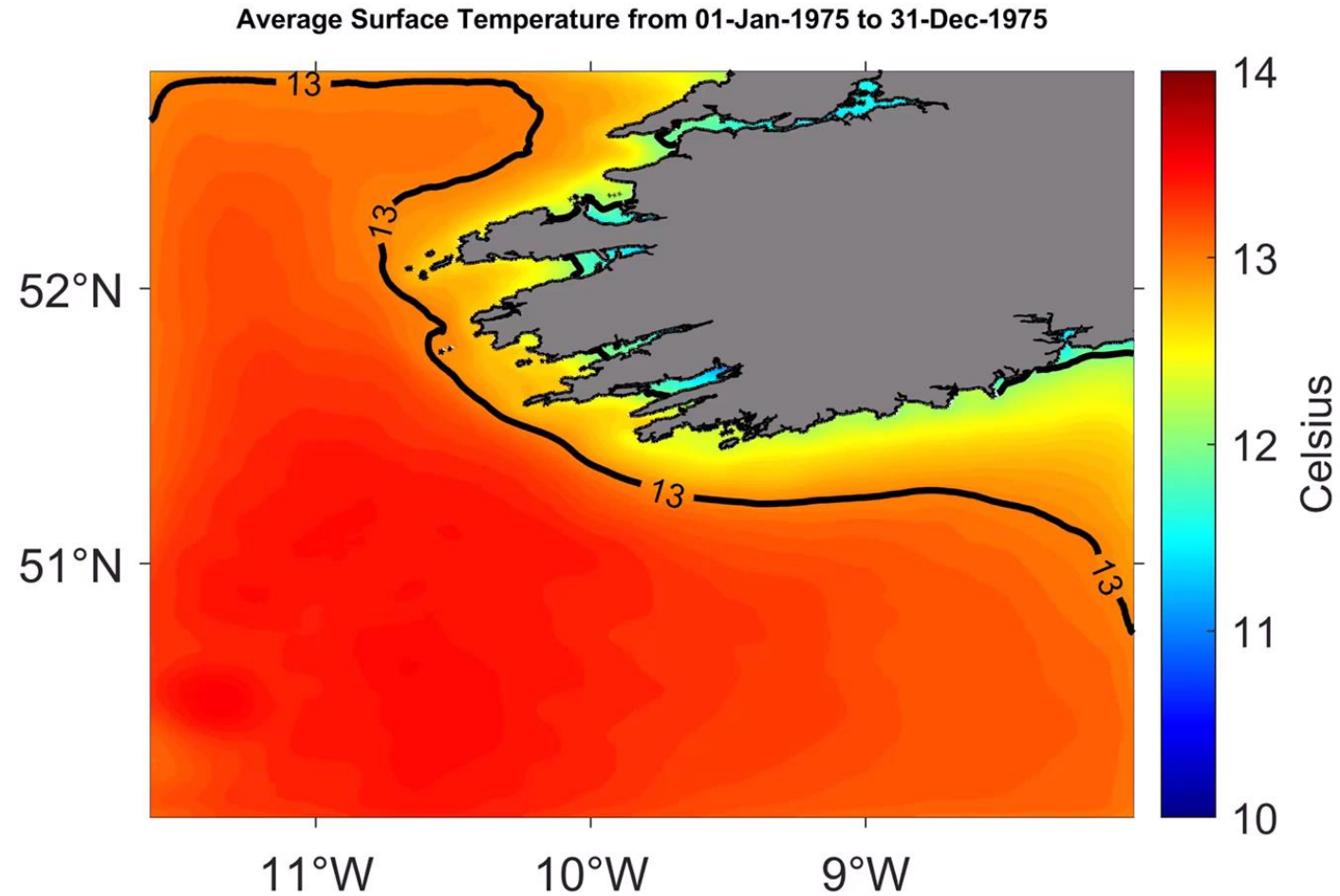
Plankton: spatial distributional change: driven by temperature changes



Annual bottom temperature cycle in the Celtic Sea



Changes in surface temperature in the Celtic Sea 1975 - 2035



Climate Change Impacts on Fish and Fisheries

Distribution:

- **Northern species reduce - Southern species increase**

Phenology

- **Timing of spawning, maturing etc, get earlier – mismatch with food?**

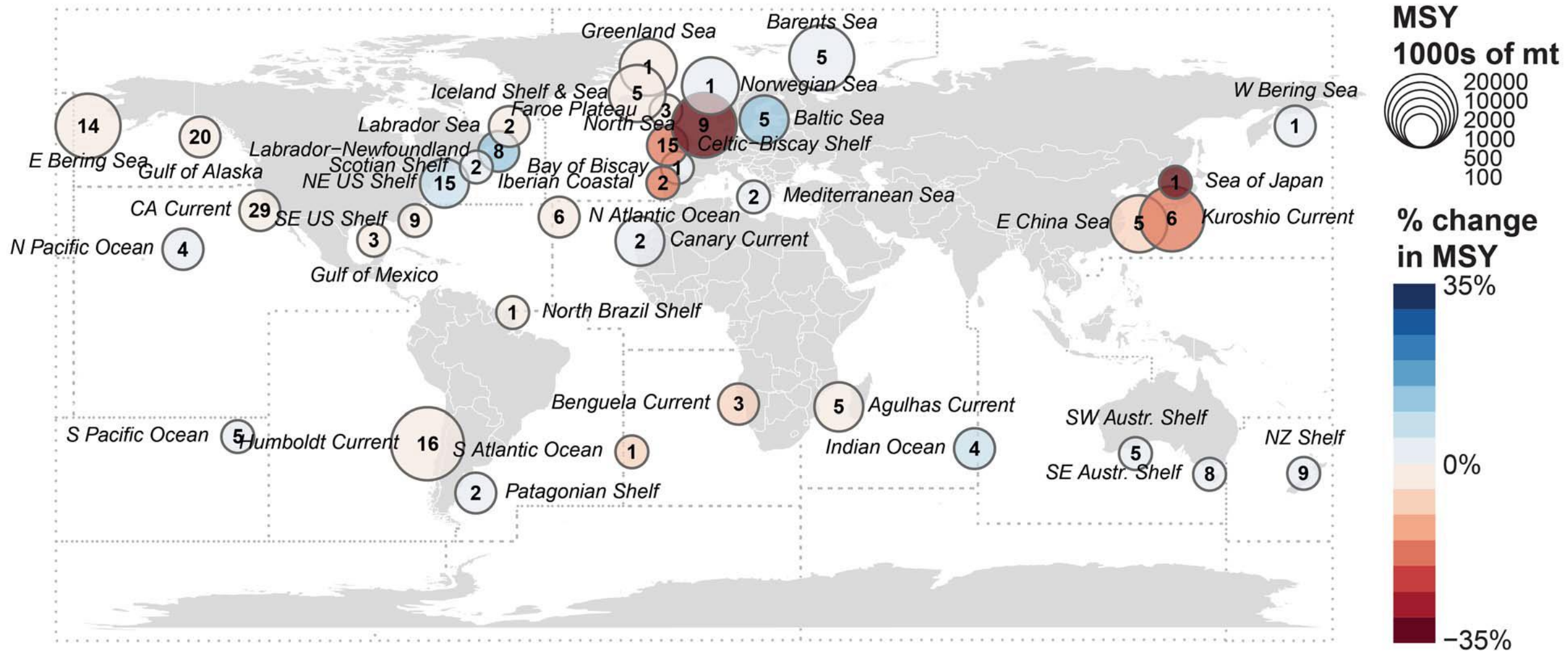
Body size

- **fish tend to mature earlier and at smaller sizes in warm water**

Energy for life

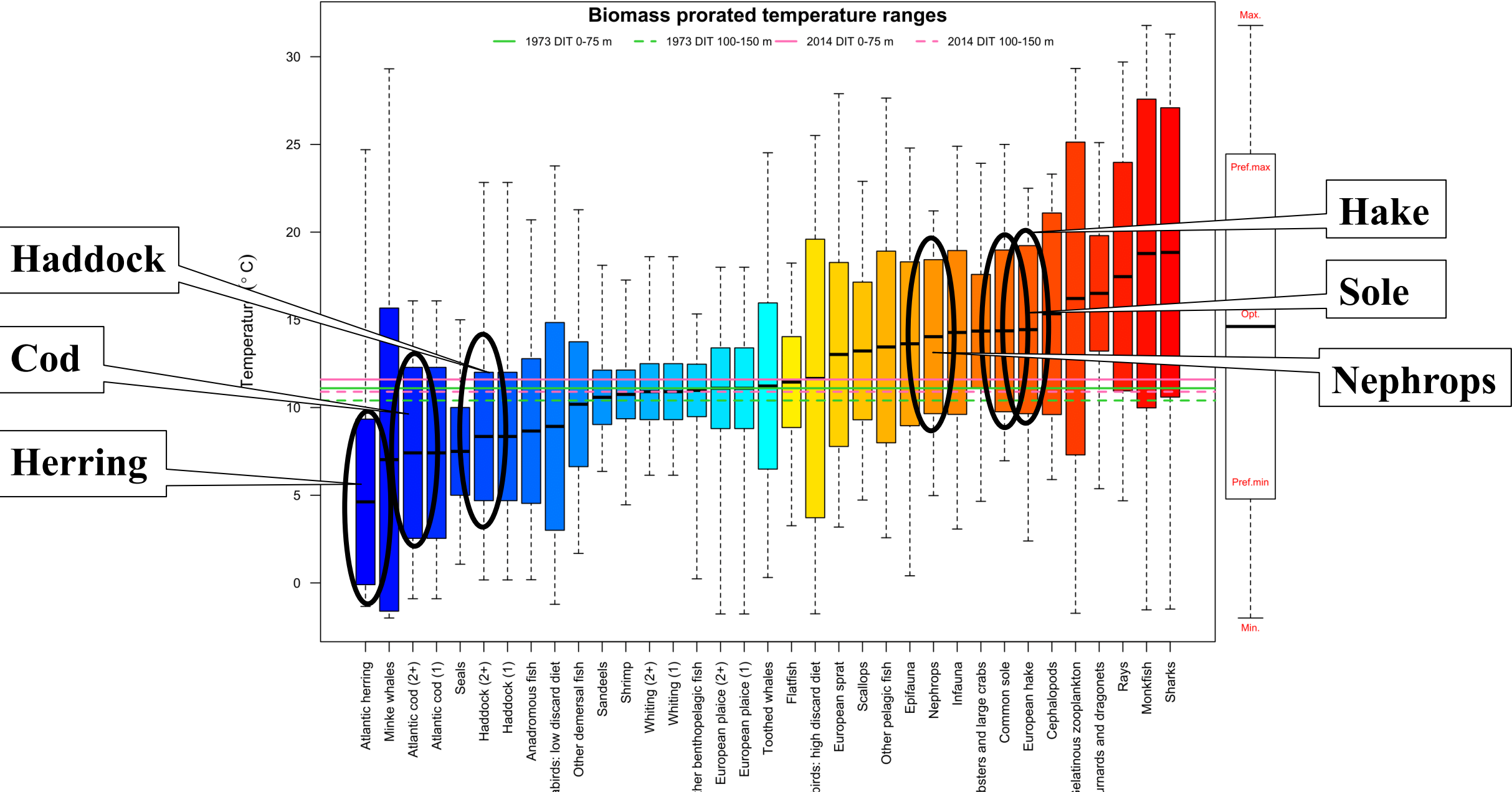
- **Fish respire – use more energy – in warm water**
- **Acidification may also increase energy use**

World wide fish productivity changes due to warming

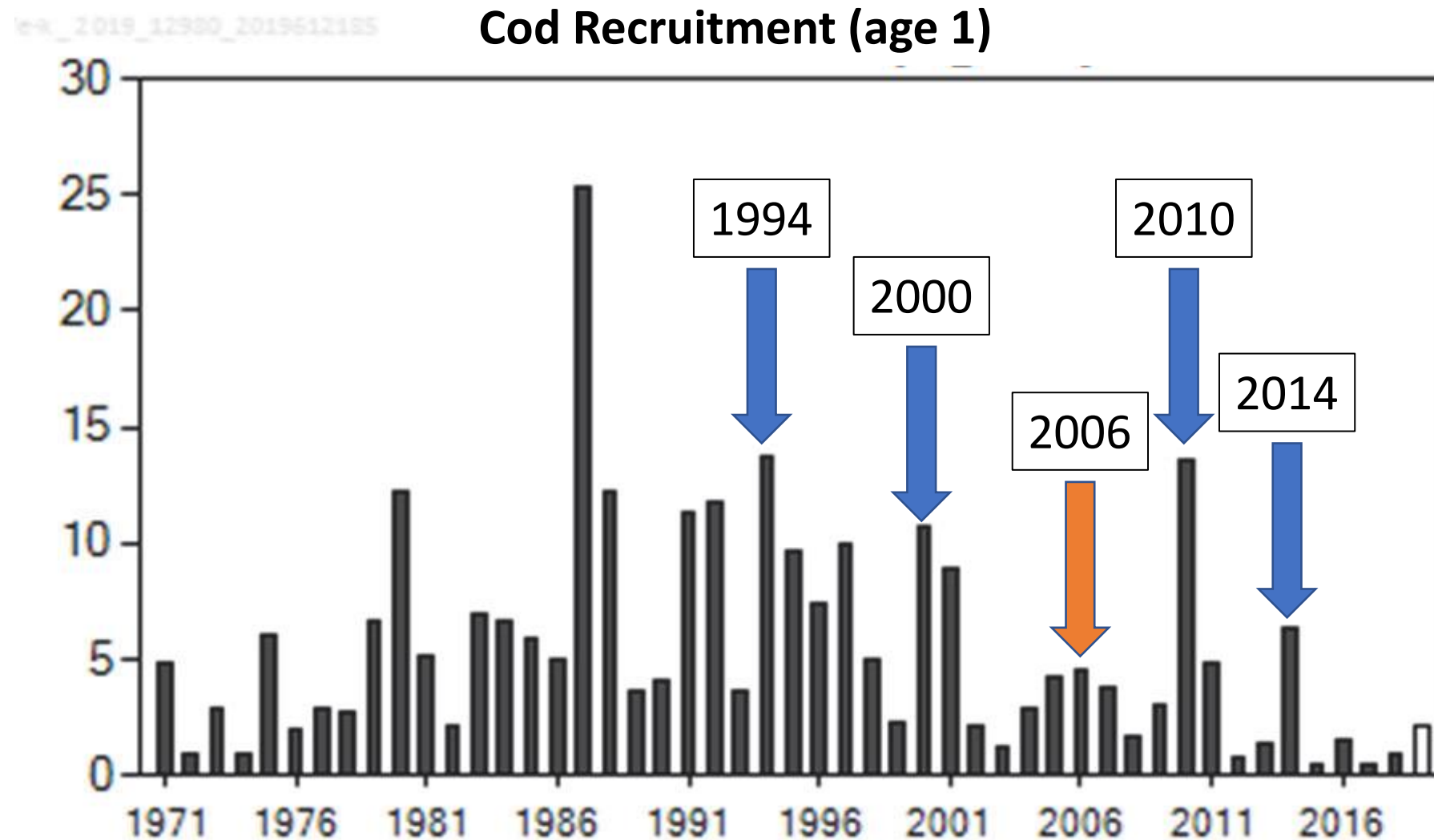


Free, C. M., J. T. Thorson, et al. (2019). "Impacts of historical warming on marine fisheries production." Science 363(6430): 979-983.

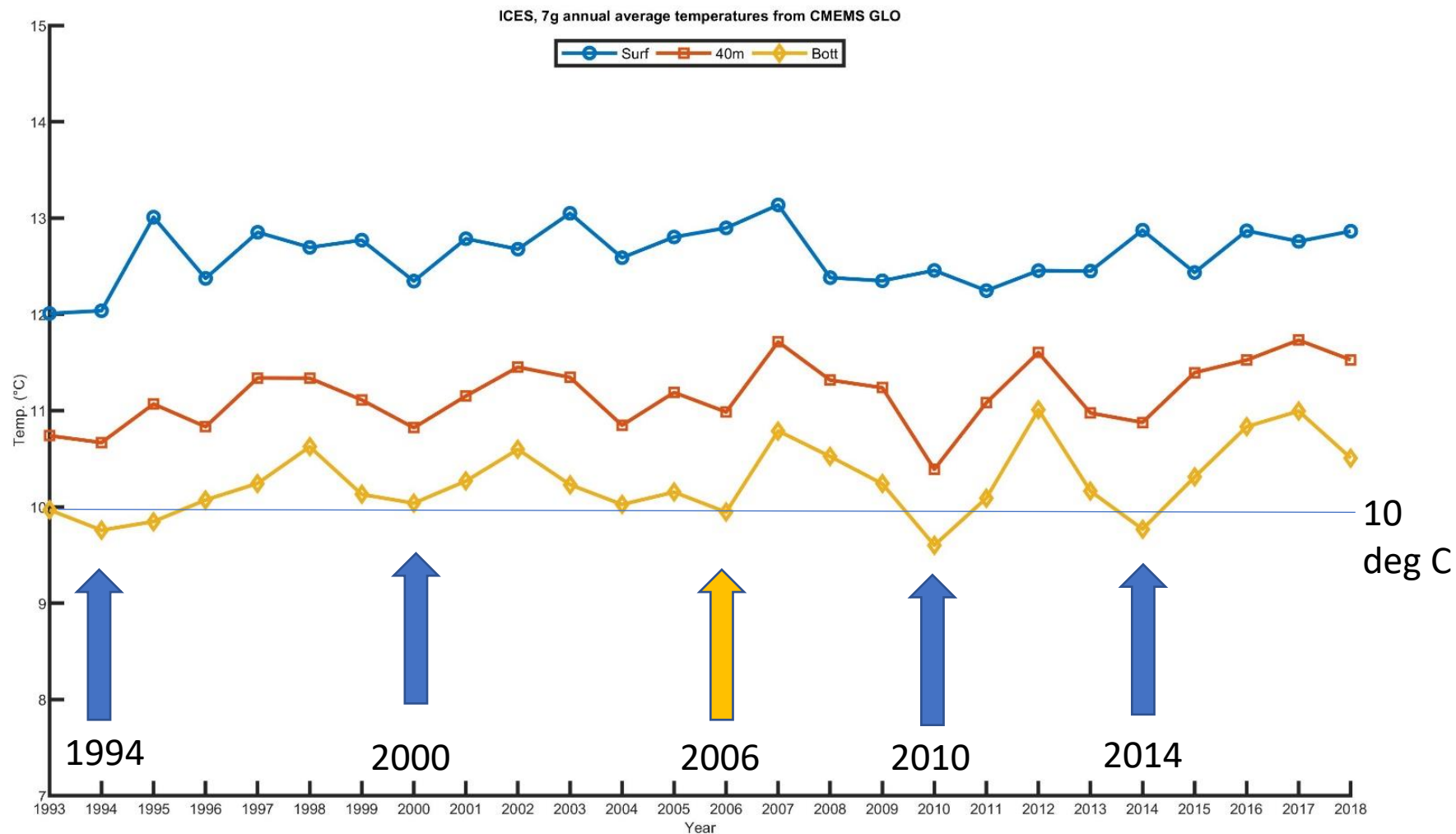
Fish temperature ranges



Cod Recruitment in the Celtic Sea



Surface, mid-water and bottom temperature: Celtic Sea (1993-2018)



Predicting blue whiting spawning distribution from oceanography

The ocean is not predictable everywhere, but, the NE Atlantic, i.e., the European sector, is the most Predictable on the Planet on Decadal Timescales

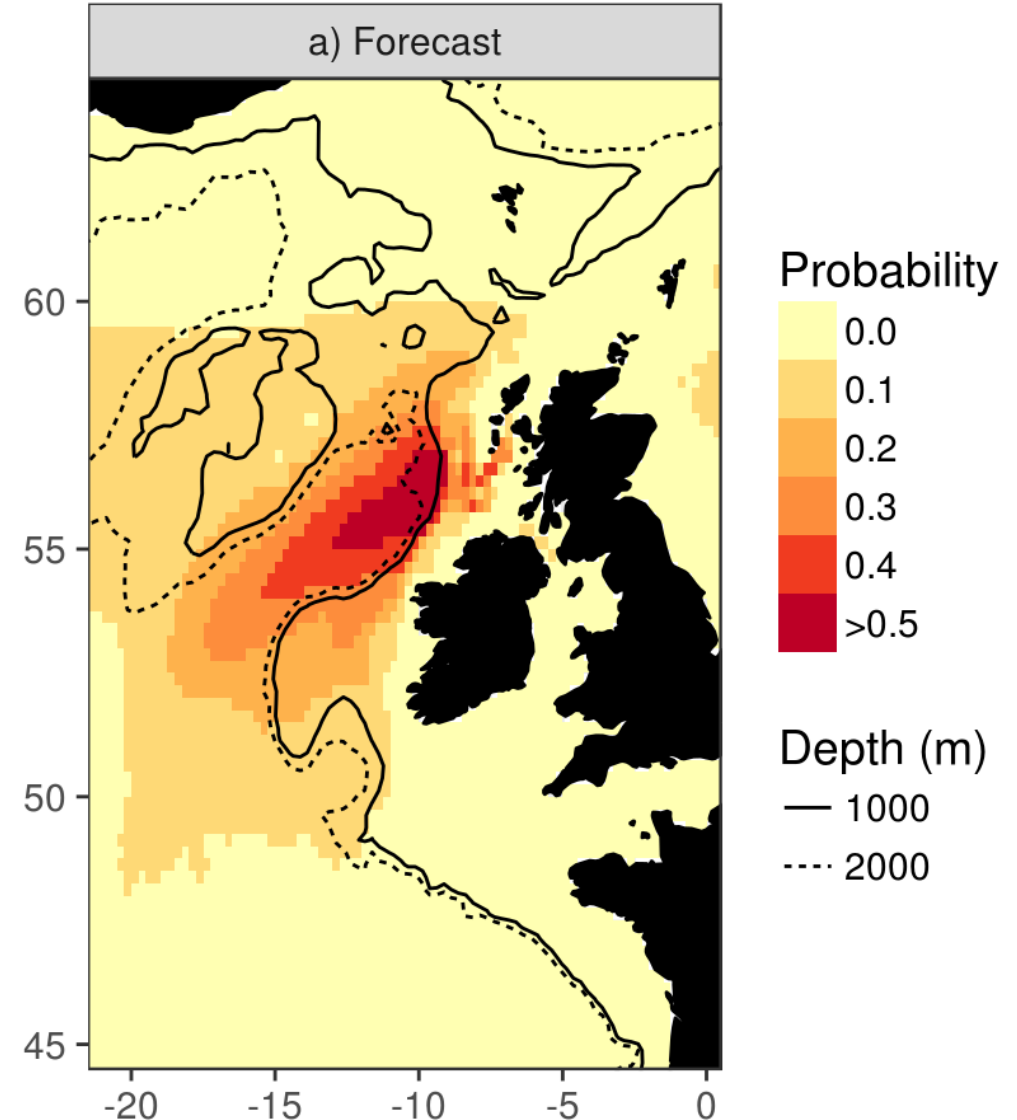


Image created by Mark R. Payne, DTU Aqua, Copenhagen, Denmark
. https://rpubs.com/markpayne/WGS2D_01_blue_whiting_spawning

ClimFish - Impacts of Climate Change on Commercial Fish Stocks in Irish Waters MI & GMIT

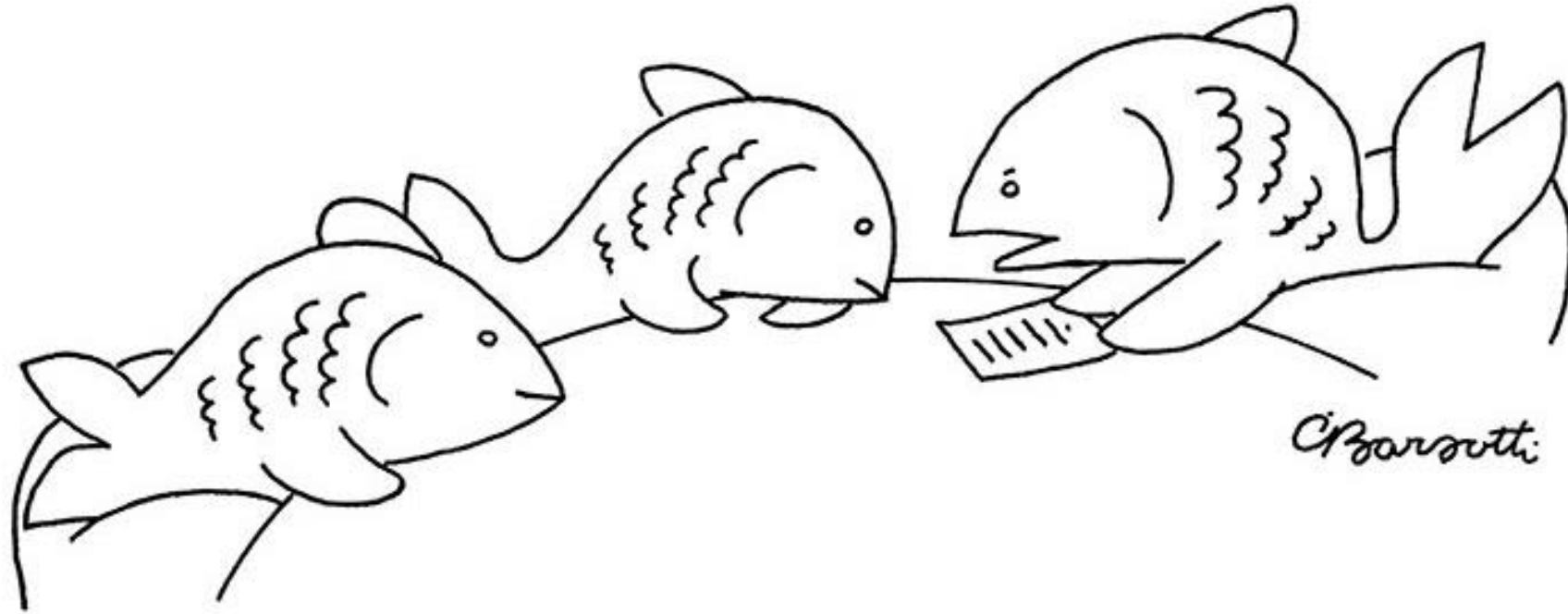
- Impacts of climate change on Ireland's marine ecosystems –a synthesis
- Dispersal and delivery to nursery areas (herring)
- Investigating the effects of climatic drivers on selected adult fish distribution and migration
- Linking a changing climate to recruitment productivity of key species

MISSION ATLANTIC

Towards the Sustainable Development of the Atlantic Ocean: Mapping and Assessing present and future status of Atlantic Marine Ecosystems under influence of Climate Change and Exploitation

- **Integrated Ecosystem Assessment Framework**
- **Mapping Pelagic Ecosystem and Resources of the Atlantic**
- **Seabed Bathymetry & Benthic Habitat and Biodiversity Mapping**
- **State Drivers and Tipping Points**
- **Modelling dynamics of the Atlantic Ocean ecology, past present and future climate and resource exploitation**
- **Ecosystem risks and vulnerabilities**

Thank You



"OCEANS ARE RISING, LANDMASS IS SHRINKING~
SO FAR SO GOOD."