

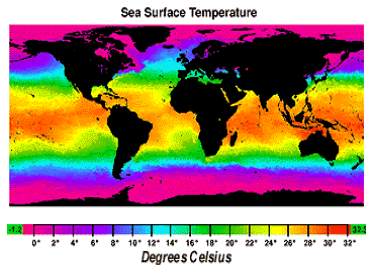
# The impact climate change is having in the water

John Pinnegar Principal Scientist & Lead Advisor



**SEAFISH - Fisheries Management and Innovation Group. Climate change impacts on the seafood sector. 10<sup>th</sup> June 2020**

# What do we mean by marine climate change?



**Rise in seawater temperature**



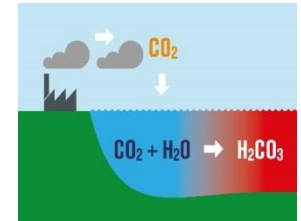
**Rise in sea level**



**Melting Arctic sea ice**



**Changes in storm frequency or severity (wind and waves)**



**Changes to ocean chemistry**

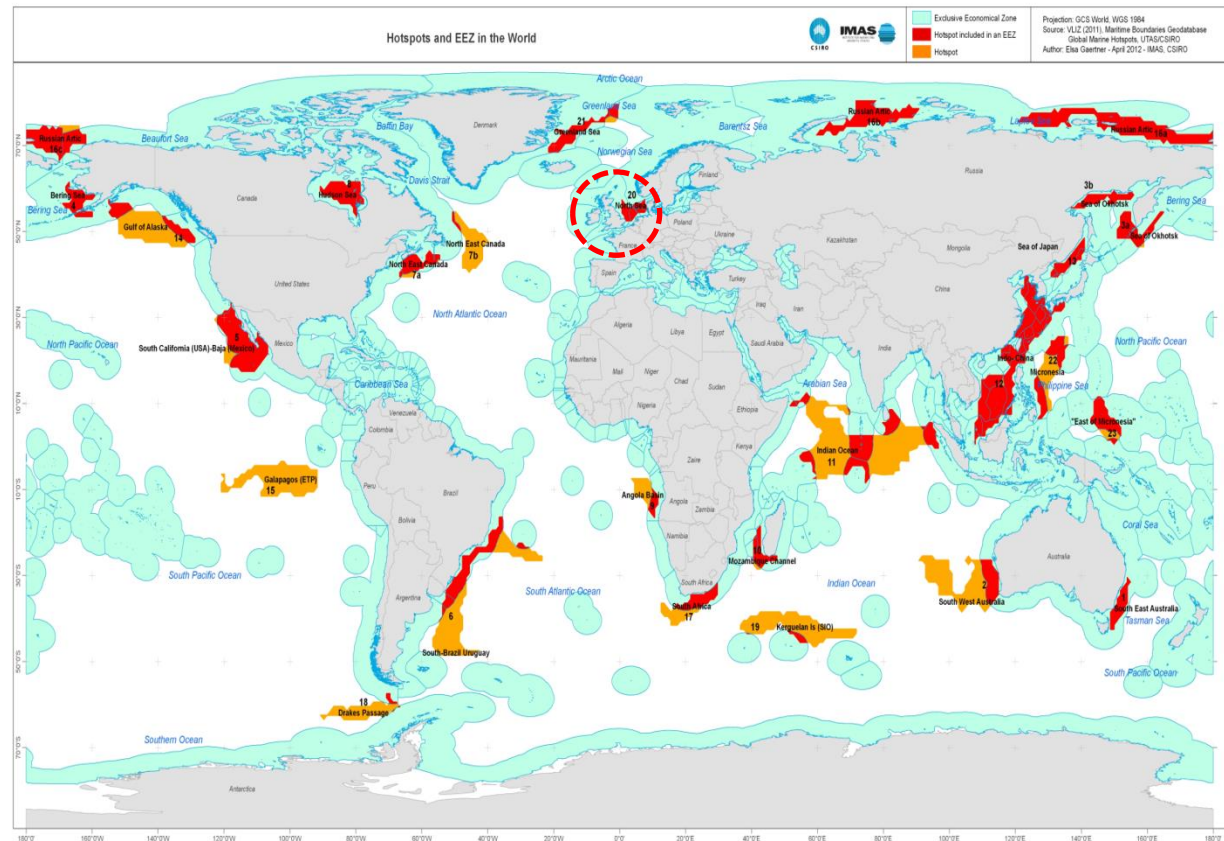
## UK Fisheries Bill (2020)

The “climate change objective” is that— (a) the adverse effect of fish and aquaculture activities on climate change is minimised, and (b) fish and aquaculture activities adapt to climate change.

# 24 Global 'hot spots' of marine climate change...

Hobday & Pecl (2013) identified 24 sites as having warmed the fastest based on 50 years of historical sea surface temperature data.

These sites have warmed by  $>1.48^{\circ}\text{C}$  over the past 100 years





# Major challenges to fishing communities posed by climate change:



Relocation of resources and replacement with less commercially valuable species requires diversification of fishing operations and markets.



Changes in the timing of fish spawning and recruitment will need adjustments to management interventions.



In areas where production is already limited by temperature (e.g. tropics) traditional productive areas may be reduced. Dependent communities will need to diversify their livelihoods.



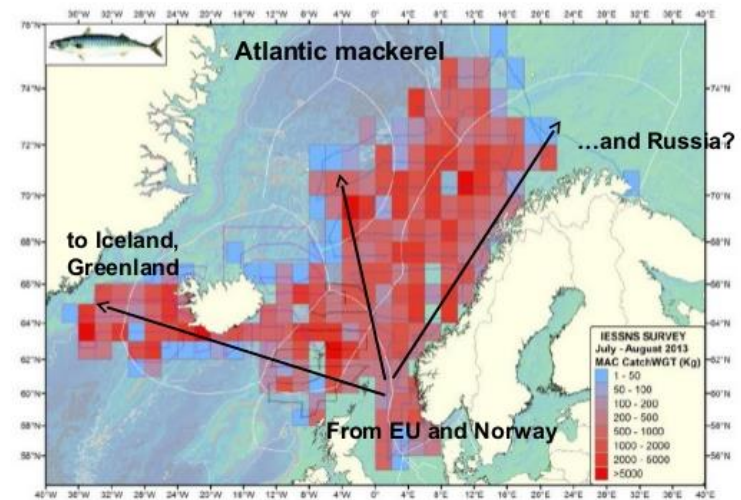
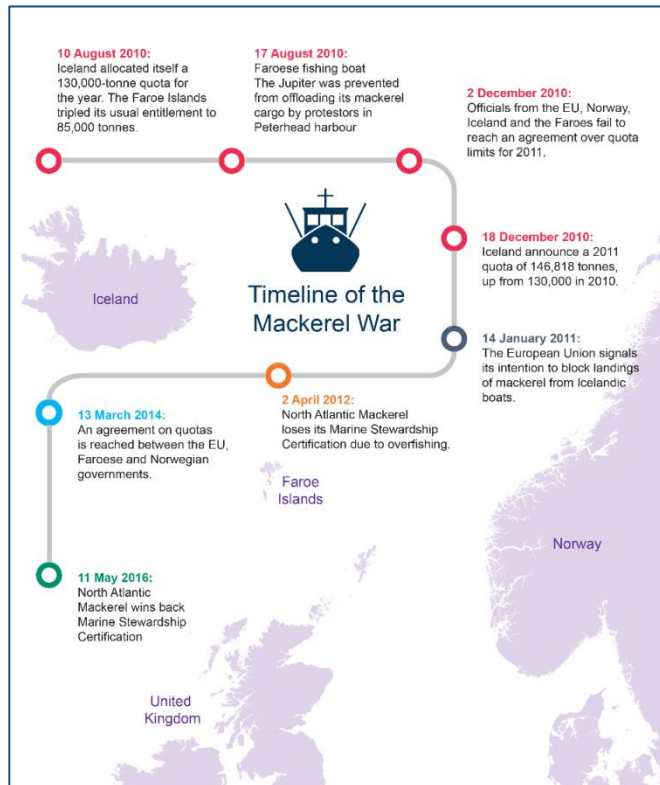
Increases in the frequency and severity of storms may affect infrastructure, both at sea and on shore.



The impact of ocean acidification may be locally significant, for example in activities dependent on coral reefs.

**All fishing policies must address these issues and help fishing communities adapt to the changes they are experiencing as a result of climate change. FAO, member countries and partners must work together to strengthen the resilience of fishing communities in areas most affected by climate change.**

# North Atlantic Mackerel...



Changes in mackerel distribution have been linked to **warmer seas**, **changes in food availability** and a **density-dependent expansion of the stock**.

... a warning about what can happen when species shift across political boundaries

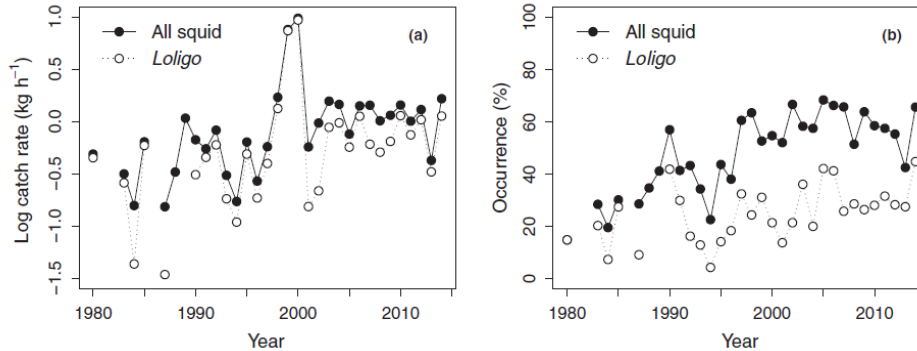
# Bluefin tuna?



- The number of Atlantic Bluefin Tuna (ABFT) in UK waters is **increasing based on evidence from both scientific observations and anecdotal reports.**
- Bluefin Tuna are **of interest to both commercial and recreational fishers,** but the UK does not currently have access to quota.
- Management of bluefin tuna falls under the remit of the **International Commission for the Conservation of Atlantic Tunas (ICCAT).**
- However, **the United Kingdom does not currently possess any share of quota**



# Squid?



- **Squid catches from Cefas trawl survey data in the North Sea (1980–2014); collected during late summer (August–September).**
- Squid distribution across the North Sea **increased dramatically over the 35-year time series, occurring at only 20% of survey stations in 1984, compared to 60% in 2014.**
- Significantly positive relationships were found between this increase and **climate** variables (including seawater temperature etc.).



# Squid?

Summer **squid fisheries** have **expanded rapidly** in the **Moray Firth**

Provides income given restrictions preventing vessels from pursuing more traditional species such as haddock and cod.

## THE MORAY FIRTH SUMMER SQUID FISHERY

SEASONAL INSHORE ACTIVITY OFFERS A MUCH NEEDED ALTERNATIVE FOR SKIPPERS AND CREWS

For some years now, trawling for squid on hard ground close in the Moray Firth has provided an important safety valve, albeit a challenging one, for a small group of skippers and their crews in North-East Scotland. **David Linkie** reports after being given an opportunity to view the full-on fishery on the Peterhead trawler Benarkle II

**S**mall but gradually increasing consignments of squid sold on Peterhead fishmarket from the beginning of July, indicated that the seasonal summer fishery in the Moray Firth was beginning to come on. After amounting to 150-200 boxes in the first two weeks, with boats typically landing around 10 boxes for a day's work, the level of supplies for fresh squid, for which there is a relatively small but well-established demand, gradually increased towards 400-500 boxes.

As July drew to a close, a brief email to skippers Shaun Paterson and Mark Addison confirmed the summer fishery was starting, and led to the opportunity of a trip on Benarkle II PD 400, which was one of a small fleet of trawlers fishing squid out of Buckie.

Benarkle II towing for squid along the Moray coast.

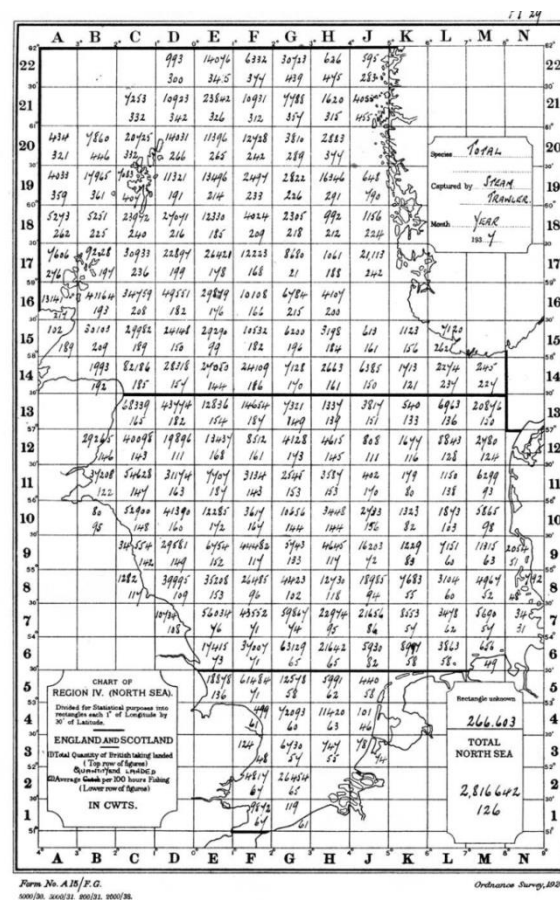
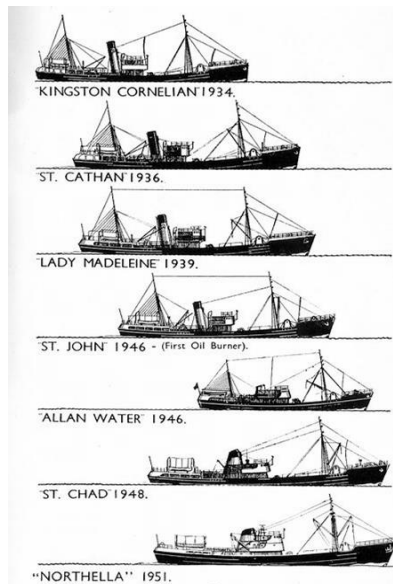
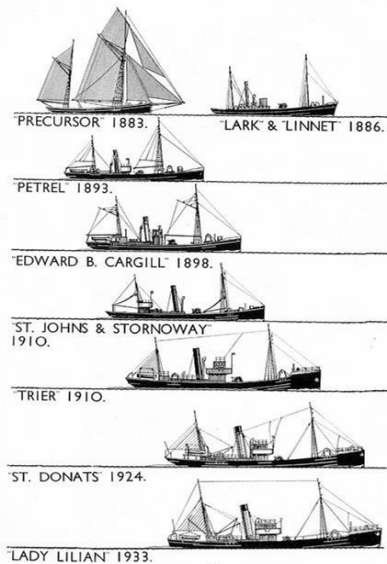




# What can fishery landings data tell us?

A 97 year (1913-2010) spatial time series of commercial **catch-per-unit-effort** data

Data from 37,000 statistical charts

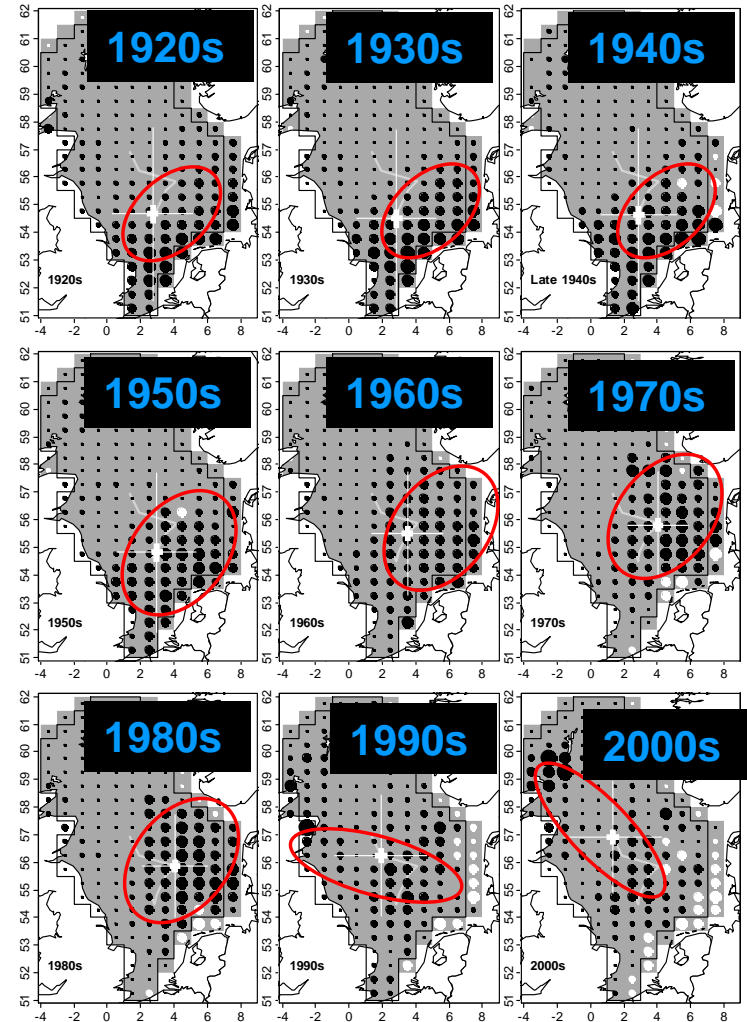


# 100 years of plaice distribution shifts



Plaice were constrained to the SE of the North Sea for much of the 20<sup>th</sup> Century

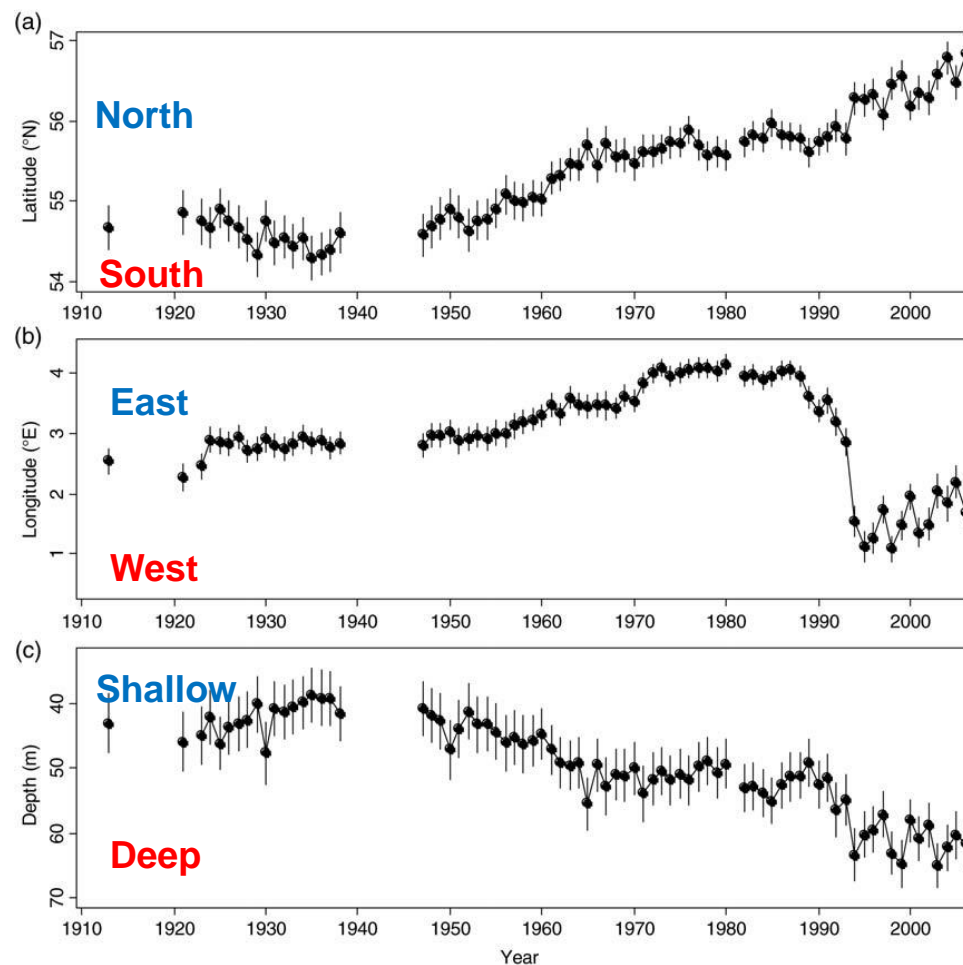
In recent years their distribution has shifted towards the Dogger Bank and NW



# 100 years of plaice distribution shifts



Latitude, temperature and depth are highly correlated in the North Sea



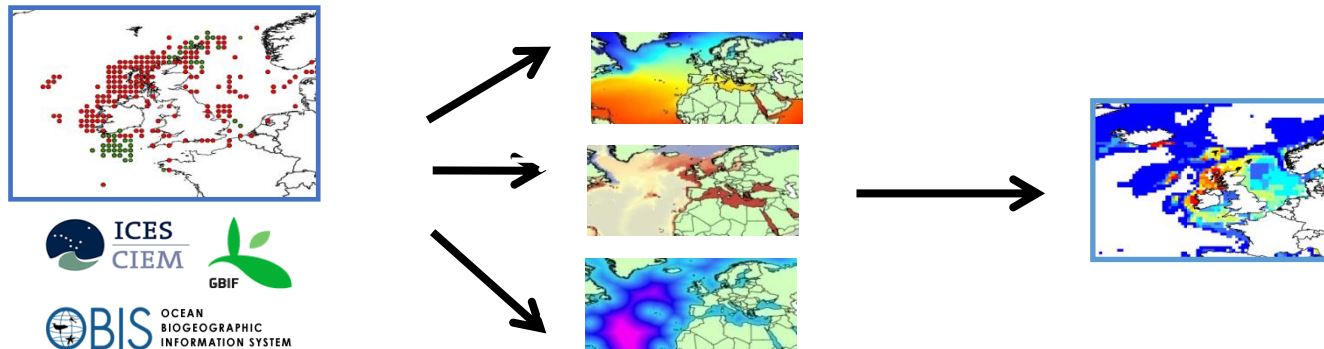


# Projecting into the future....

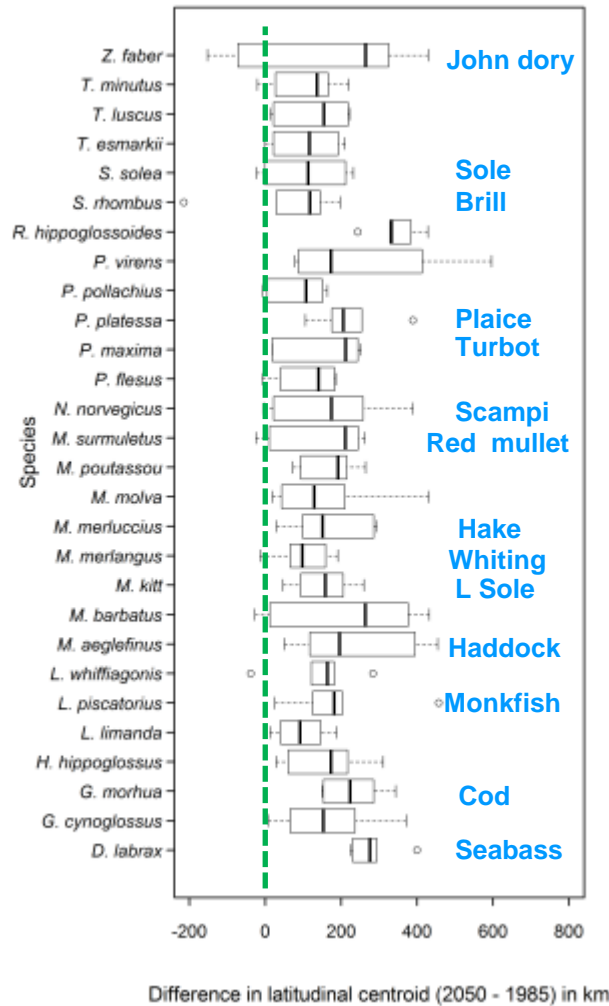
Habitat models have been developed to **predict future changes in distributions** of many marine species

Such models examine the **relationships between key climatic variables and species distributions**, mostly based on historical distributional data.

Some of the more commonly applied techniques include **Maxent, BioMapper, the genetic algorithm GARP, GLMs, GAMs, Aquamaps etc.**



# Heading North...



The ensemble projections suggest northward shifts in distribution at an average rate of 27 km per decade

(the current rate is around 20km per decade for fish in the North Sea

Overall, median projected rates of shift were greater for pelagic than demersal species at 277 compared to 168 km respectively over the next 65 years

# Winners & Losers

## Winners...



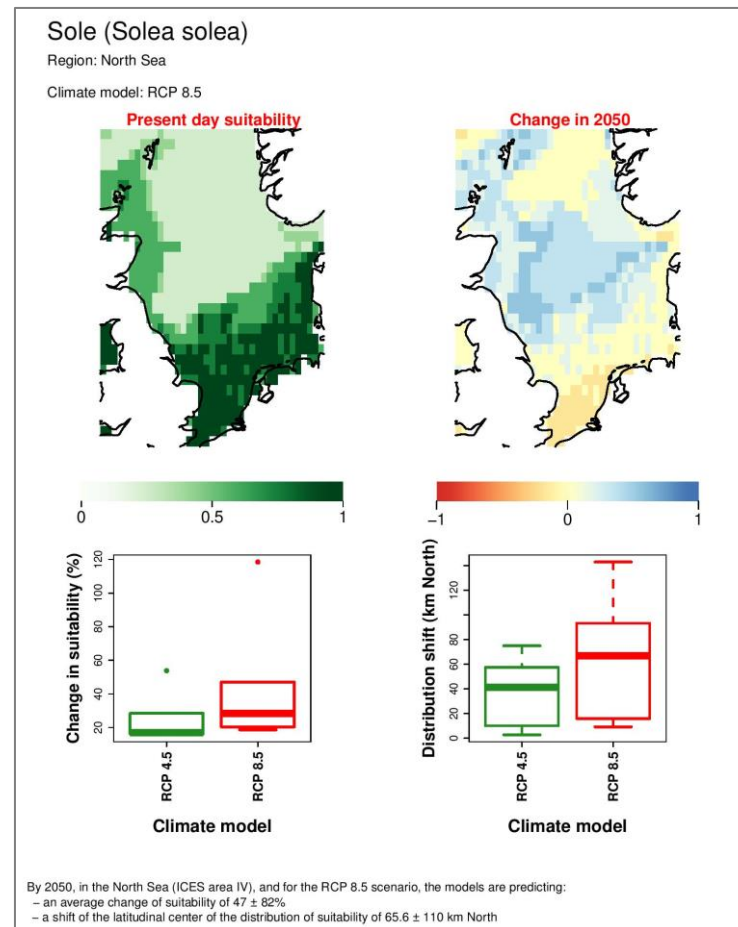
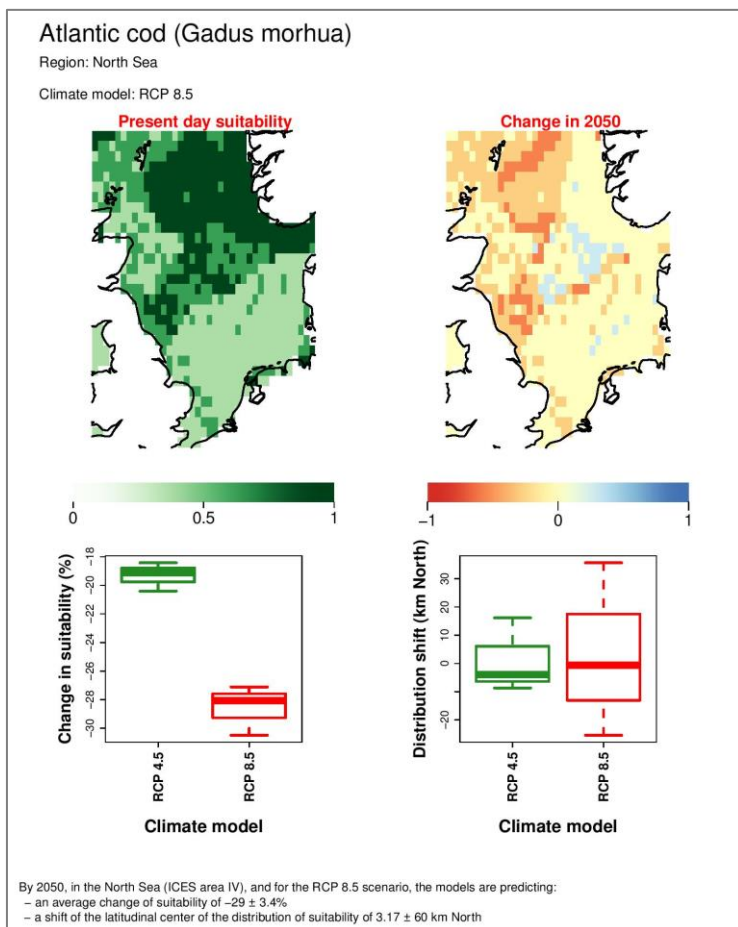
## Losers...



Common Name	Change in habitat suitability across the UK EEZ (1985-2050)	
	Median of three models	Range of three models
European squid	31%	+9 to +53%
European sea bass	20%	-9 to +24%
European pilchard	17%	+2 to +30%
European sprat	13%	+4 to +21%
Veined squid	7%	+4 to +11%
John Dory (Atlantic)	7%	-16 to +17%
European anchovy	5%	+1 to +7%
Common sole	2%	-18 to +18%
European plaice	2%	+1 to +8%
Whiting	1%	-14 to +4%
Atlantic cod	0%	-12% to +3%
Atlantic Herring	-2%	-20 to -1%
Atlantic mackerel	-3%	-7 to 0%
Atlantic halibut	-4%	-15 to +1%



49 species (65 model runs per species) =  
3185 simulations





# Climate Vulnerability Assessment (CVA)

Coastal Communities  
(NUTS2)

## **Hazard**

How much are stocks expected to be impacted, based on their biological and temperature traits?

+

## **Exposure**

How sensitive are communities or fleets to stock changes, based on either a wide diversity or narrow range of species caught?

+

## **Vulnerability**

How resilient are communities or fleets, how is their adaptive capacity to mitigate?

=

## **Risk**

Based on hazard, exposure and vulnerability, what is the risk to communities or fleets?



EU Fishing Fleets

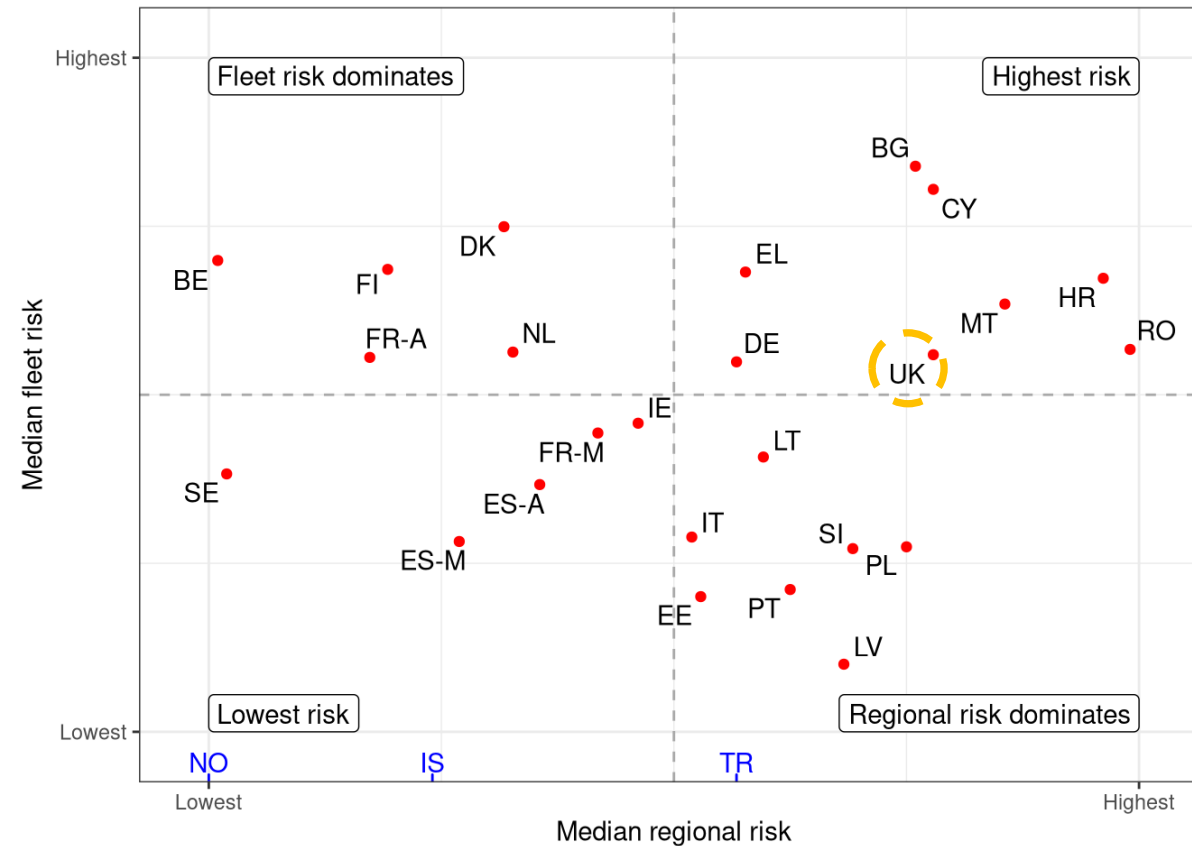


The fleet-based analysis ranked the climate-risks of 358 fleet segments

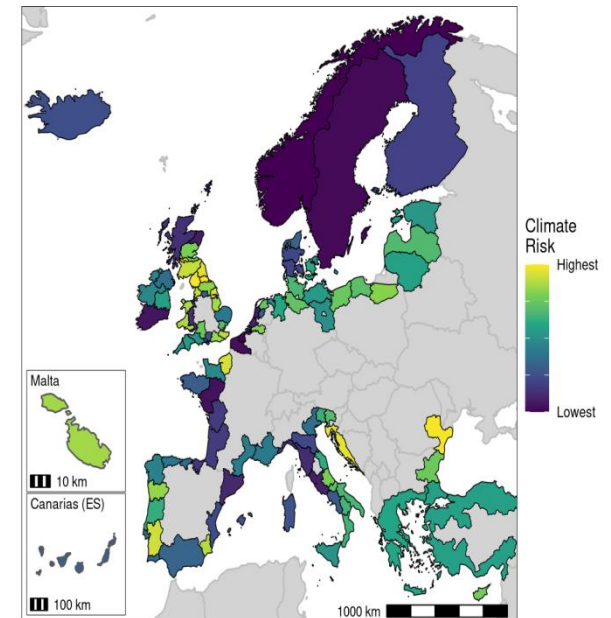
Regional analysis of 102 sub-national coastal regions across Europe (NUTS2)



# Climate Vulnerability Assessment (CVA)



## Overall climate change 'risk' by NUTS2 region





# Fisheries and storminess...



In December 2015, SeaFish, together with Cefas published a report on climate change impacts in the UK seafood sector.

Interviews with stakeholders revealed that:

*“taking action to adapt to [long term] climate change is not presently a priority for the majority of industry contributors.*

*Industry [instead], highlight the effect of near term events – severe storms affecting ports in Fraserburgh and Peterhead and in the South West, stormy conditions affecting crew safety, flooding of processing units, changing distribution of species for example — particularly in the domestic context”.*

# Climate change is not just about temperature...

During the **winter of 2013/2014** strong storm events had devastating consequences for the fishing industry.

Many vessels were tied up in port for more than 5 months, with implications for revenues, profits and local economies

Fishing remains **the most dangerous occupation in the UK**, the fatal accident rate is 115 times higher than that in the general workforce.



## Plymouth market closed as storms hit fishing



Huge waves have been pounding coastal towns such as Plymouth in Devon.

Plymouth Fish Market was closed on Monday because of a lack of fish from boats tied up in storms.

Market managers said that on Tuesday they only had two boxes of fish to sell and on Wednesday they would have only three boxes, equivalent to less than half a tonne of fish.

More than 15,000 tonnes of fish was landed in Plymouth in 2012.

But some fishermen have had their boats tied up for weeks as a result of poor weather.

### Related Stories

Rain brings fresh flooding fears

Before and after: Winter storms

'Record levels' of flood defence spending



## Storms send Newlyn fish prices rocketing



Prices of fish have been pushed up by the storms.

Fishermen who have been trapped on land as ferocious storms batter Cornwall's coast may risk sailing in dangerous conditions, a leading fishing organisation has warned.

Dwindling fish market stocks have led to soaring prices and the Cornish Fish Producers Organisation (CFPO) said that could tempt slippers to take risks.

Most of the Cornish fleet has been dodged for at least six weeks.

As a result some wholesale prices have nearly doubled.

### Related Stories

Market closed as storms hit fishing

Money 'no object' for flood relief

Fishermen count the costs of storms



## Cornwall fishermen make plea over lost lobster pots



Newlyn fisherman Robert Bradbury says replacing lost crab pots would cost him more than £25,000.

Fishermen in Cornwall are calling for help with the cost of replacing hundreds of crab and lobster pots missing or damaged in the storms.

Many have been resisted to just a few days fishing since December and now they face potentially crippling bills to replace their lost or damaged

### Related Stories

Fishermen count the costs of storms



## Storm-hit fishing fleets 'facing financial crisis'



Many fishermen have been unable to get out to sea for several weeks.

Relentless storms have left many fishermen facing desperate financial crisis, with some unable to work since Christmas, a charity has said.

Weeks of ferocious weather have forced many boats from the sea, particularly the inshore fleets in the South West.

The Fishermen's Mission, which provides emergency grants, said it was giving out "thousands of pounds every day".

The charity said the crisis was unprecedented and it has launched a new

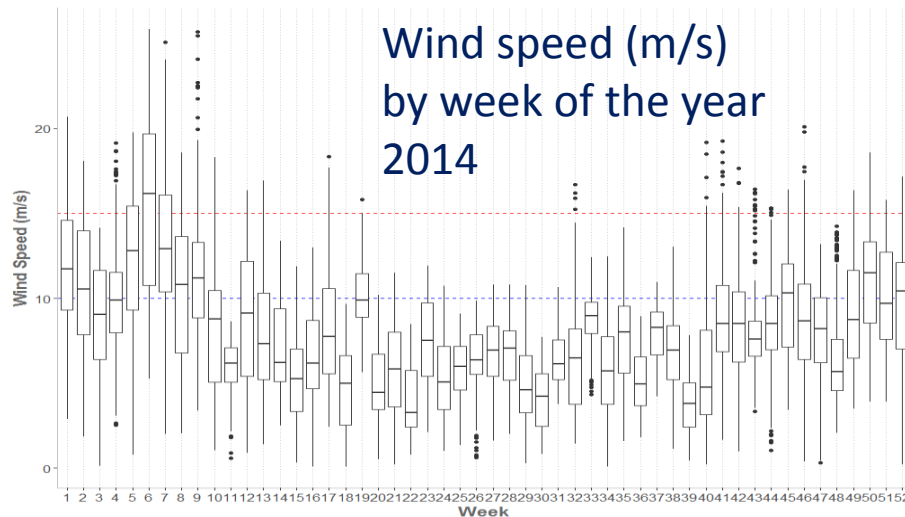
### Related Stories

Storms 'destroyed 22% of crab pots'

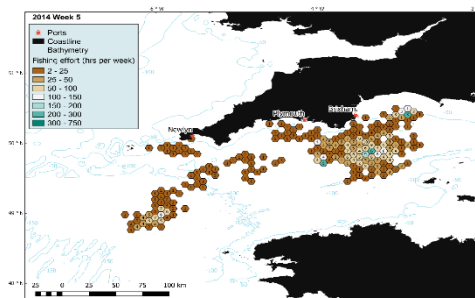
Fishermen count the costs of storms

Storms send fish prices rocketing

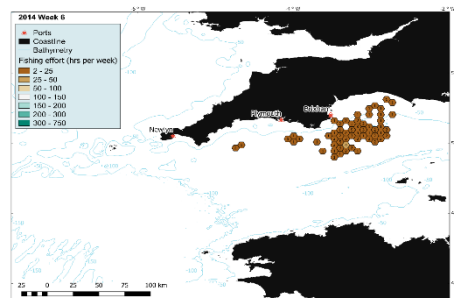
# Fisheries and storminess...



- A preliminary analysis of fishery disruption in SW England used **VMS data**
- Fishing effort was greatly curtailed whenever wind speed exceeded 10 m/second, but particularly so when winds exceeded 15 m/second.
- By understanding how fisheries have responded to adverse weather in the past, we can try to anticipate how the industry might be impacted in the future.



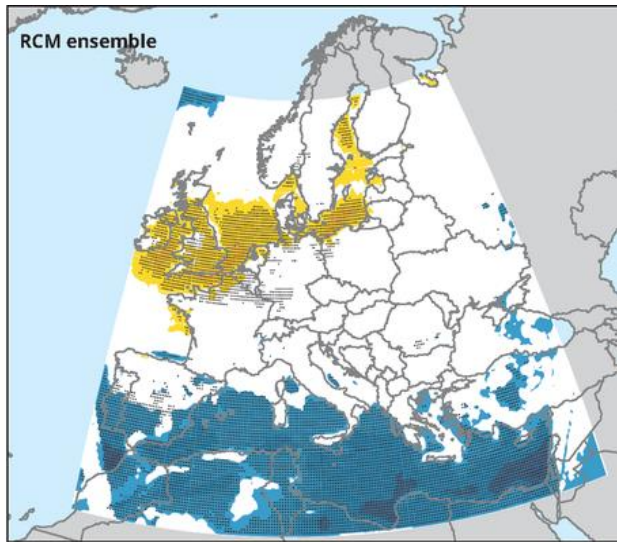
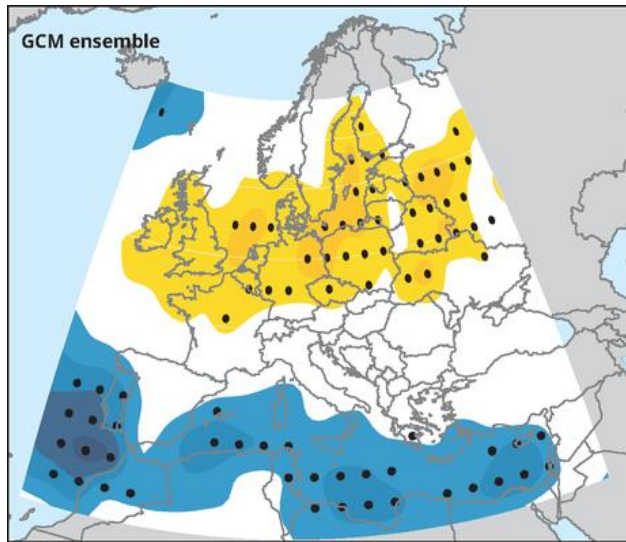
Week 5 2014



Week 6 2014

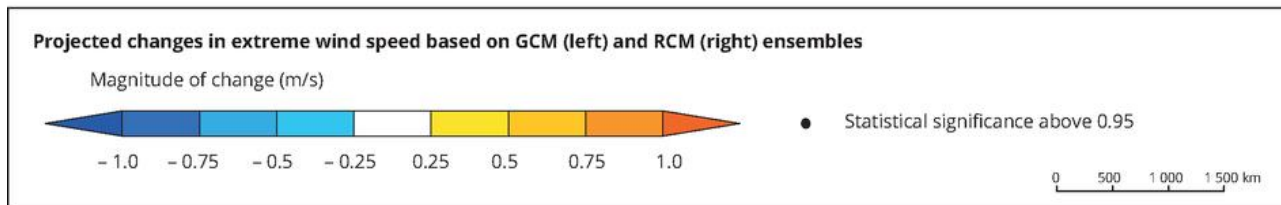


# Future changes in extreme storm events



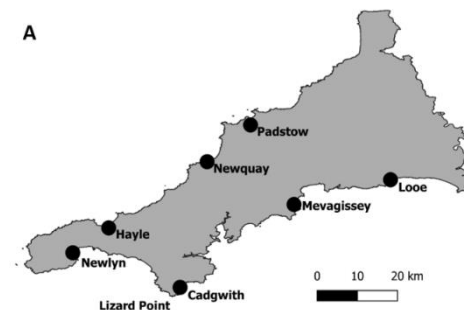
Ensemble mean of future changes in extreme wind speed (defined as the 98th percentile of daily maximum wind speed) for **A1B (2071–2100)** relative to 1961–2000.

Left: based on 9 GCMs. Right: based on 11 RCMs.





In total 80 skippers fishing in Cornwall responded to the survey.



Newlyn and Mevagissey contributed 32 and 27 responses respectively, with the remainder obtained from smaller ports.

The most frequently sampled gear type was passive nets (n=29), followed by pots (n=21), otter board trawl (n=17), hand lines (n = 9) and active nets (n = 4).



- Fishers preferred increased wind speed and wave height up to a threshold, after which they became increasingly averse to worsening conditions.
- Fishing gear, vessel length, use of crew, vessel ownership, age, recent fishing success and reliance on fishing income all influenced the skippers' trade-off decisions.



# Thank you for listening



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