Commercial shellfish and changing pH: will fisheries be affected by projected changes or are species already adapted?

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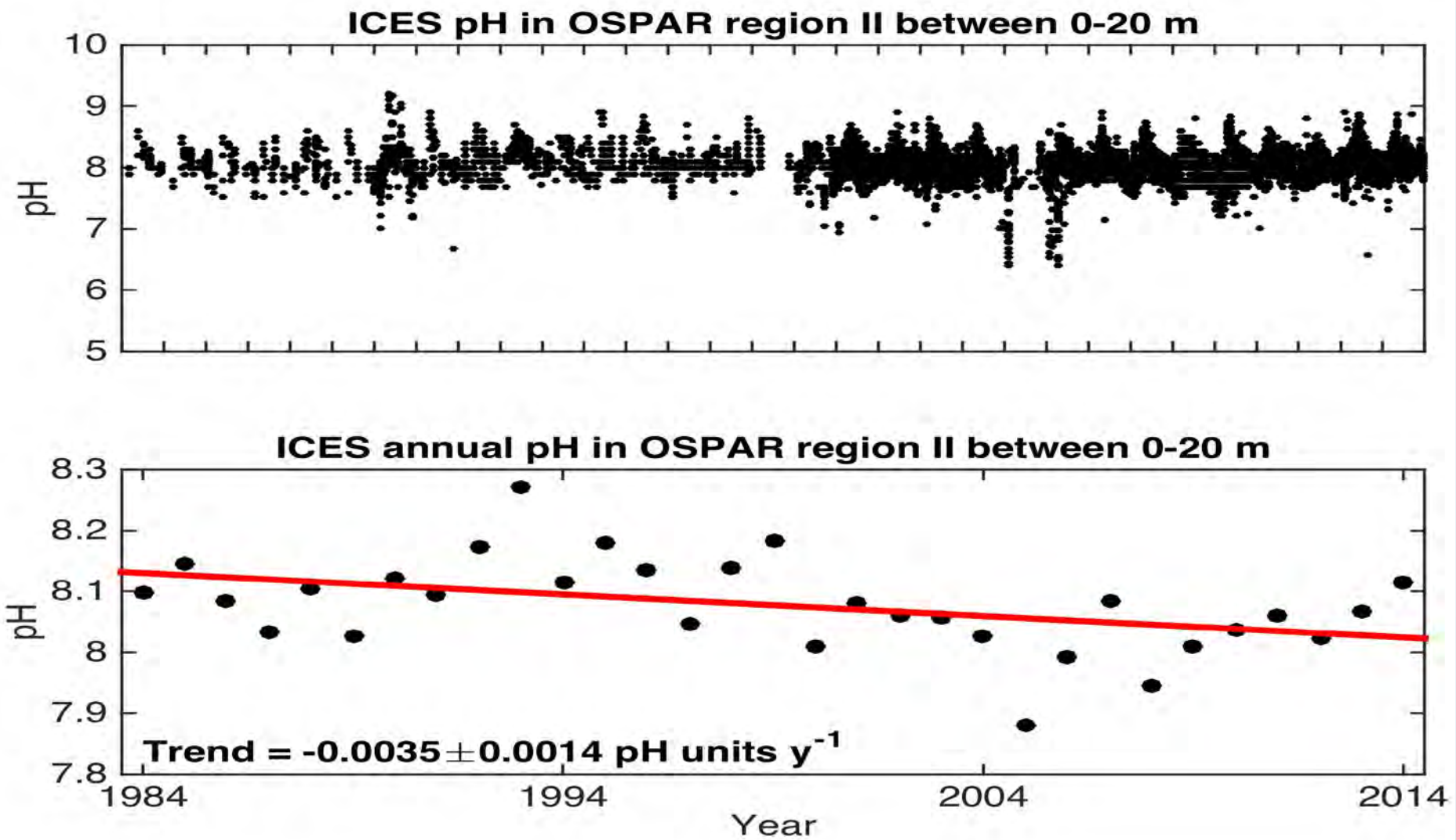
Cefas

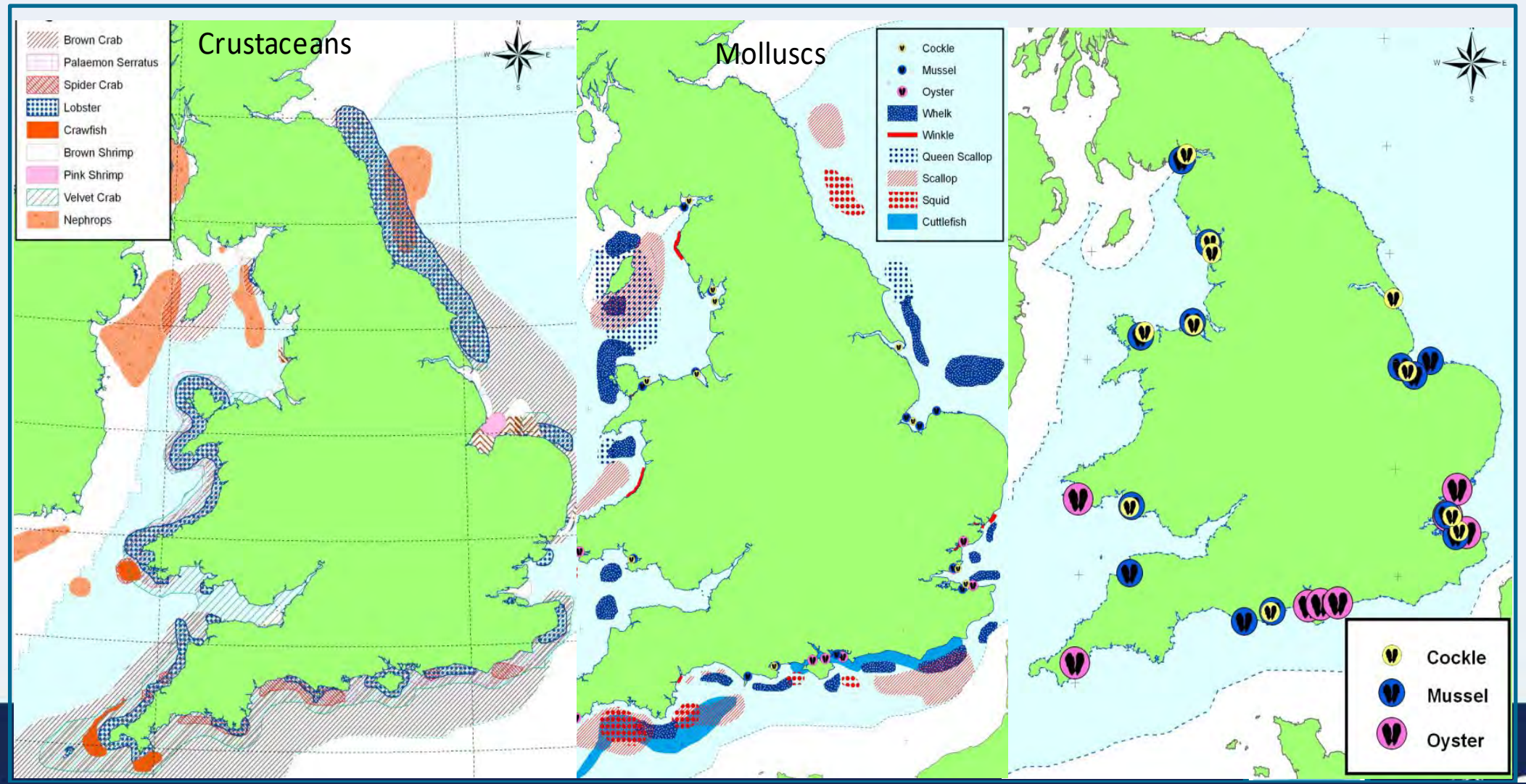
Context

- Experimental results show some species more affected by pH than others
  - Physiology, current exposure, adaptive capacity
- Past pH levels oscillate naturally in many areas
- Decreasing trend in recent years
- Many studies on effects on individuals
- Some studies on commercial species
- Relatively few studies on spatial implications

pH trends – Greater North Sea



Shellfish in England and Wales



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Aims

- Combine experimental results and pH projections to investigate:
  - Whether commercial shellfish already exposed to low pH around UK
  - How future projections would impact shellfish areas
    - Geographical extent
    - Biological effects in these areas
  - How this can be used in policy and management

Methods

- Recent high resolution projections of pH on NW European shelf
- Map future projections of pH, based on European Project on Ocean Acidification (EPOCA) control, medium and high pH levels
- Determine effects sizes on crustaceans and molluscs around England and Wales

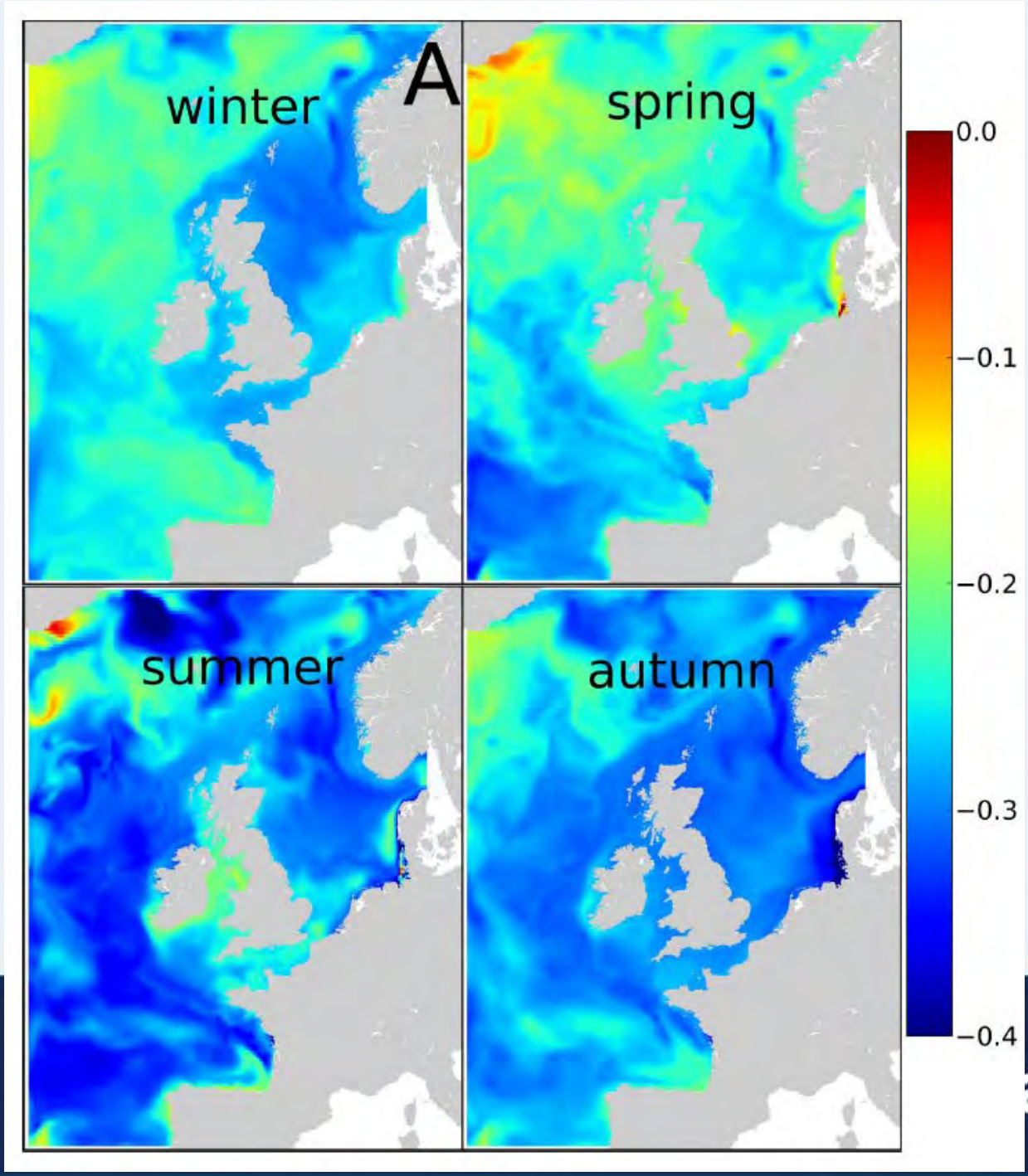
pH and pCO_2 projections

Artioli, Y. *et al*. (2014) Heterogeneity of impacts of high CO_2 on the North Western European Shelf. *Biogeosciences* 601–612

Coupled hydrodynamic-ecosystem-carbonate model POLCOMS-ERSEM

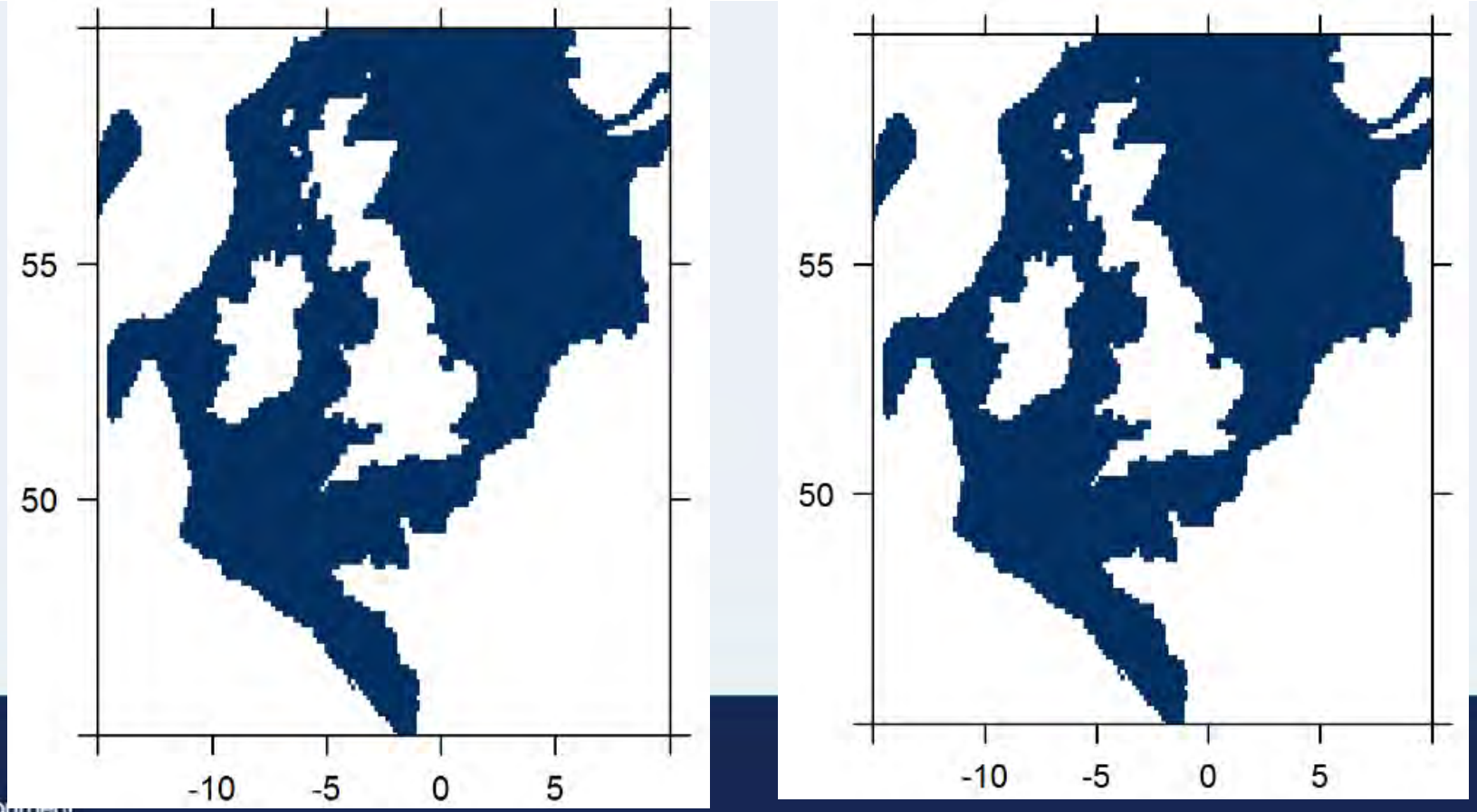
Absolute difference in surface pH
2080-2099 compared to the present-day.

SRES A1B – medium emissions



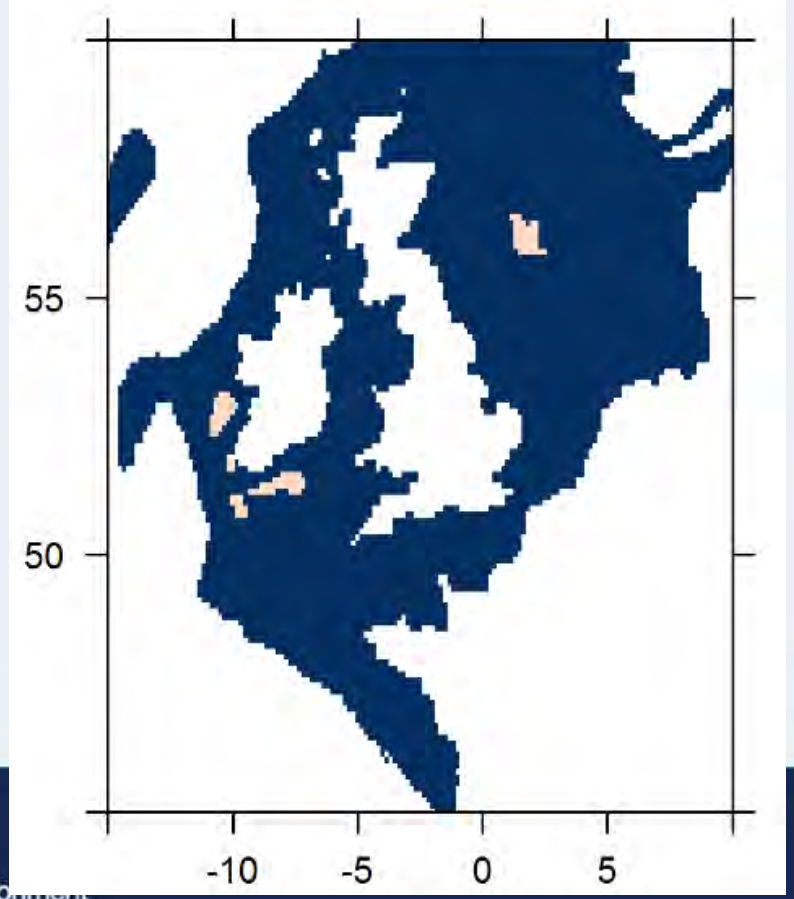
1981 – 2000 – monthly maximum

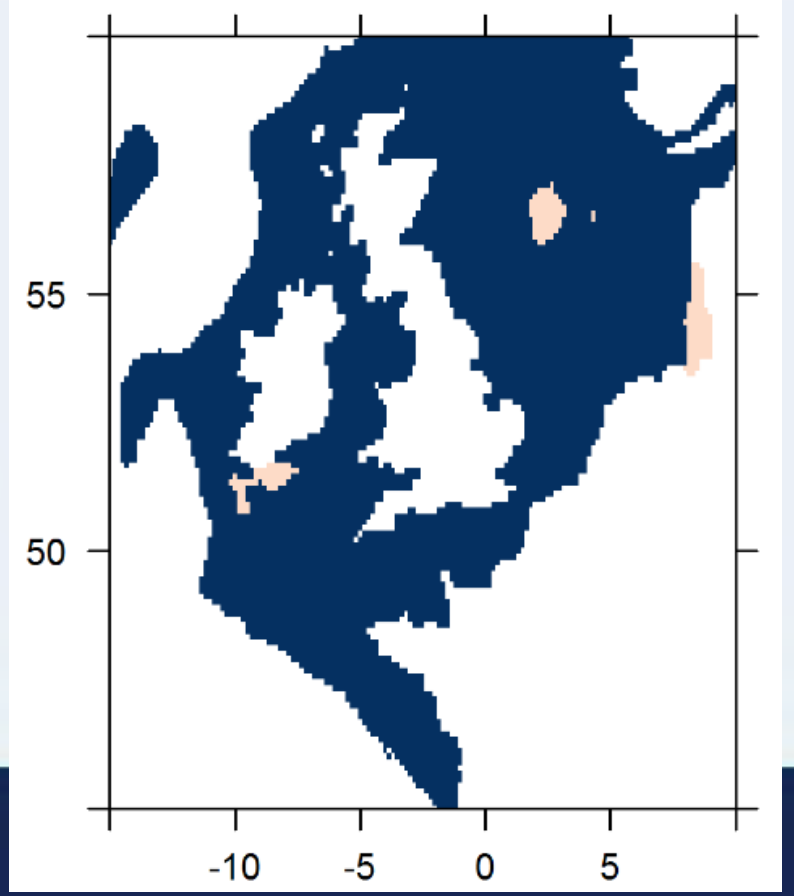
	November	December

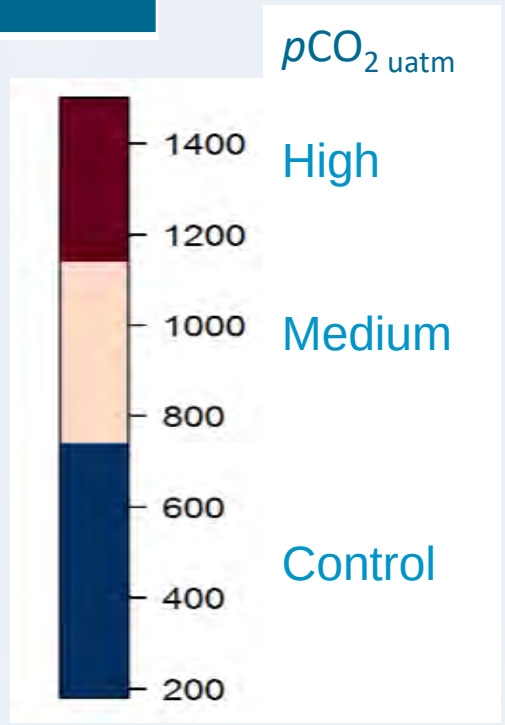


2031 - 2040 – monthly maximum

	November	December

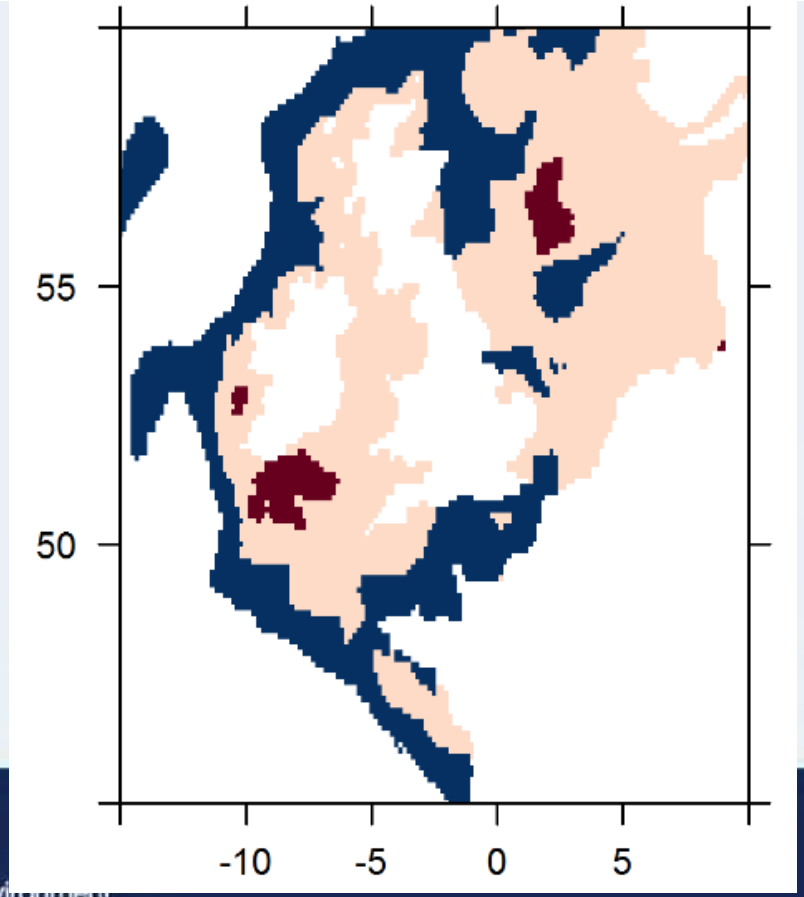


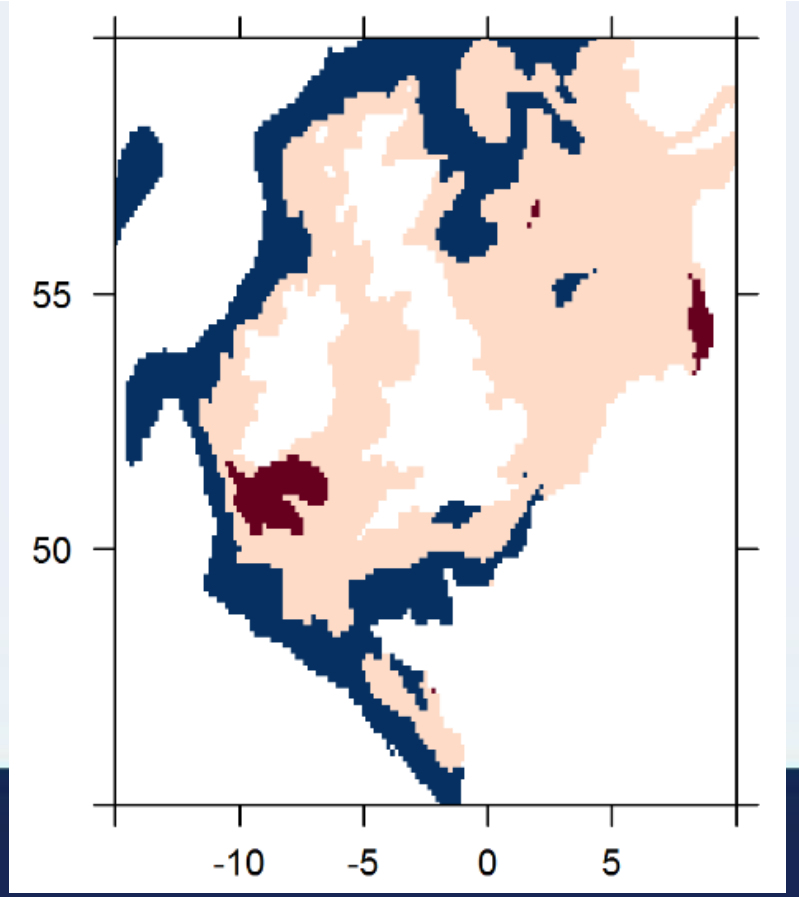


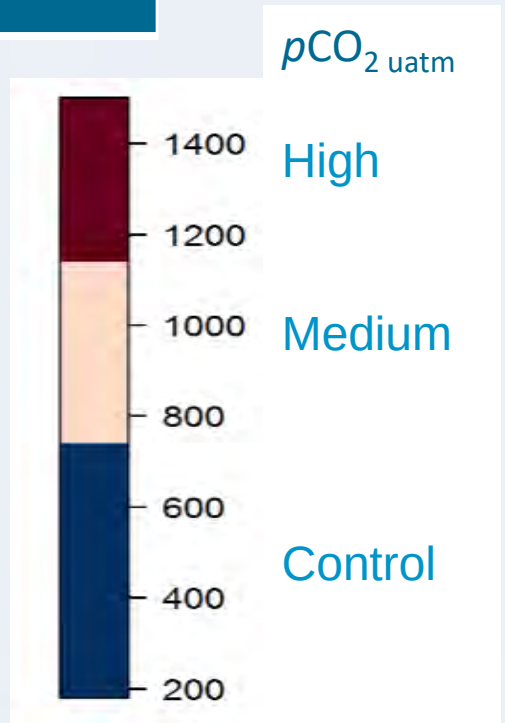


2080 - 2099 – monthly maximum

	November	December

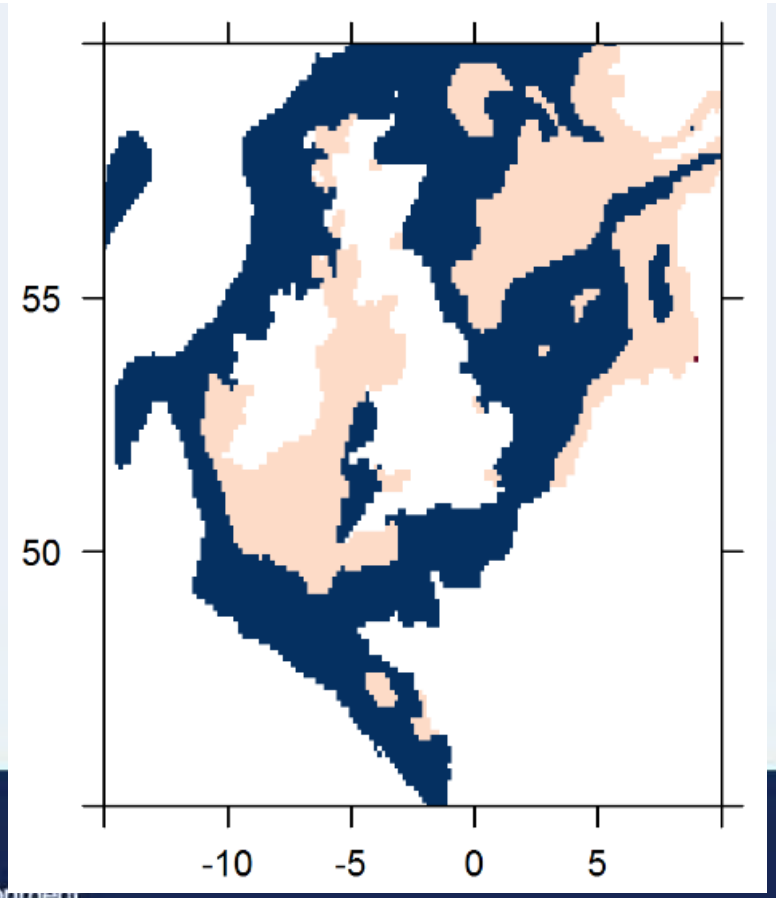


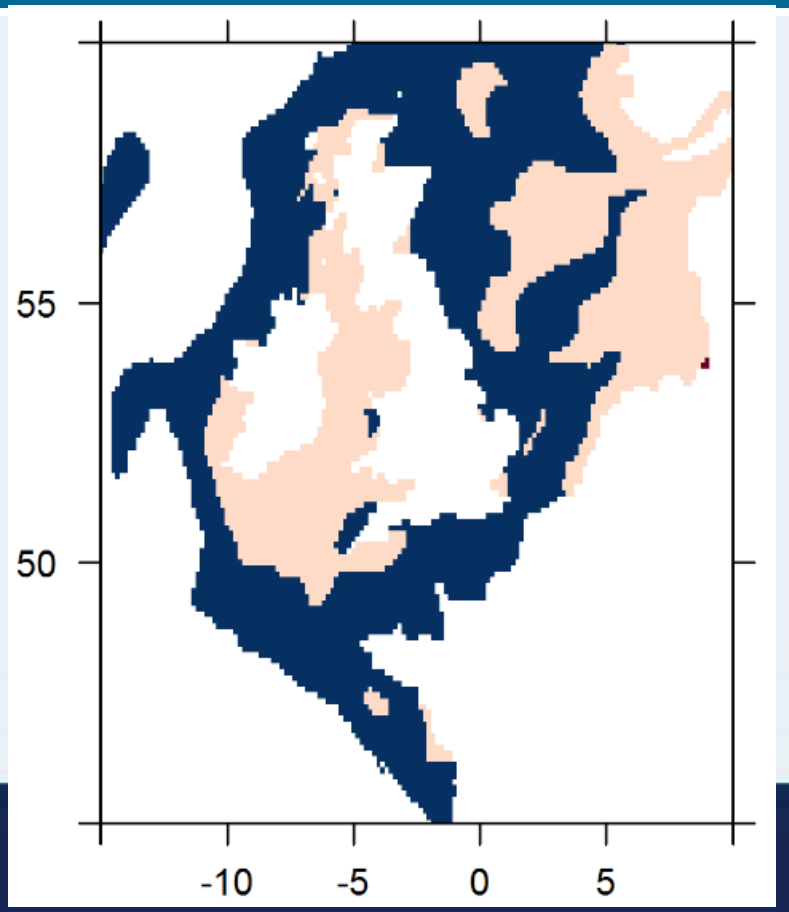


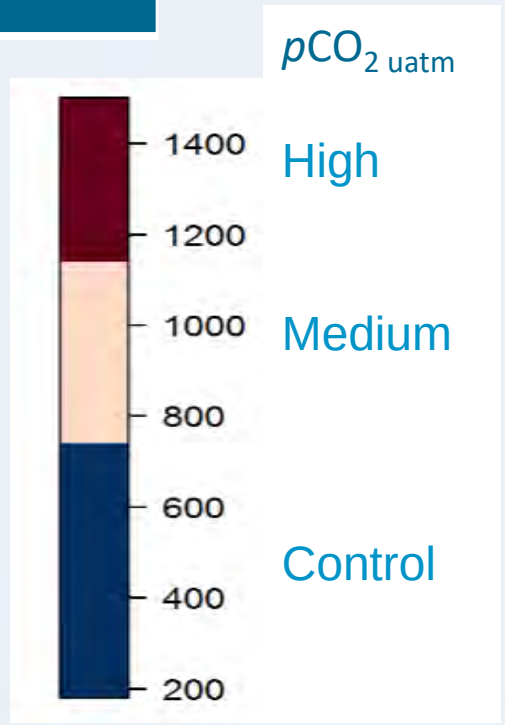


2080 - 2099 – monthly mean

	November	December

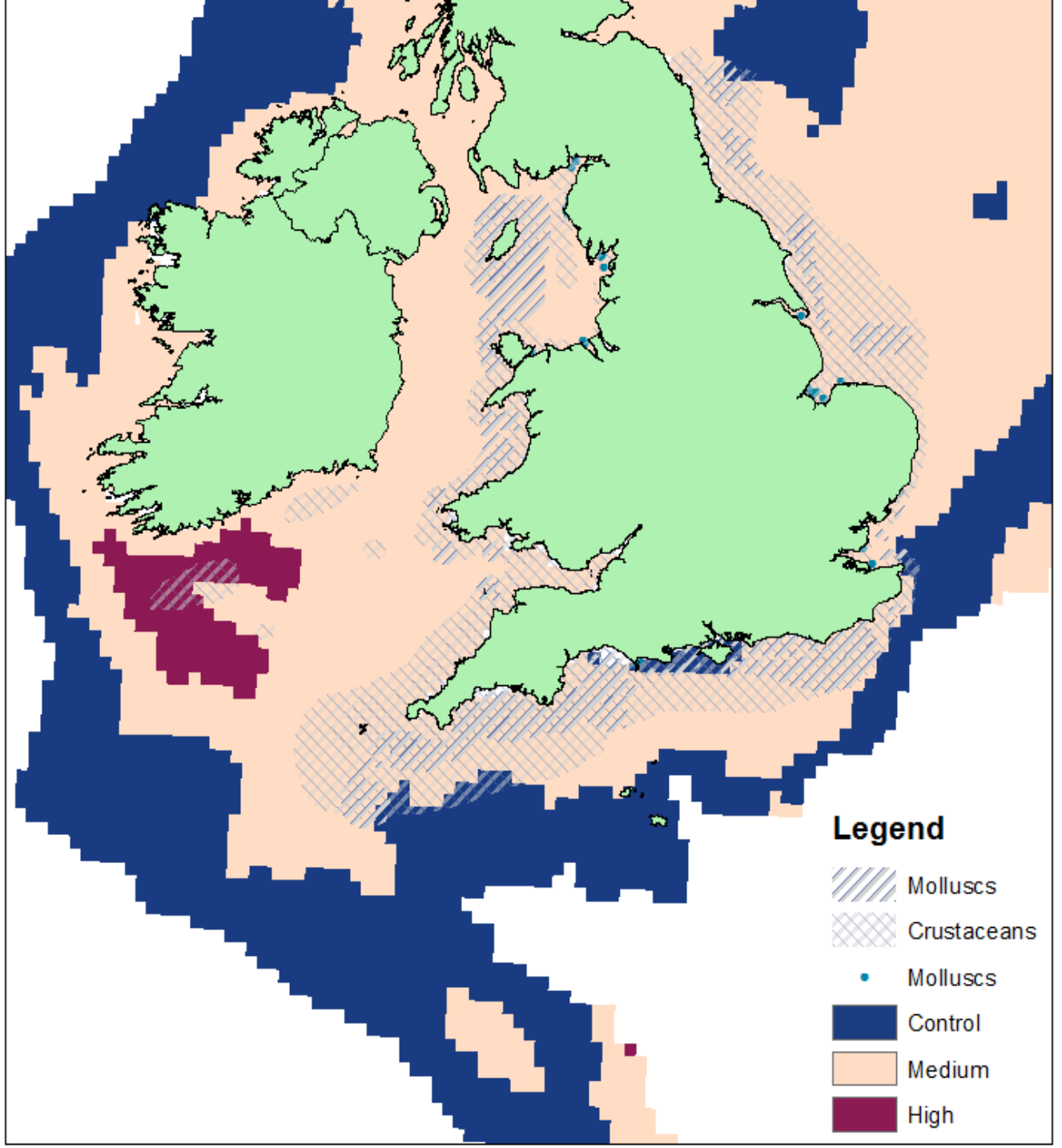






2080-2099
December Maximum

- South of Ireland – Nephrops (*Nephrops norvegicus*) area - high
- Most others medium levels



Biological effects sizes

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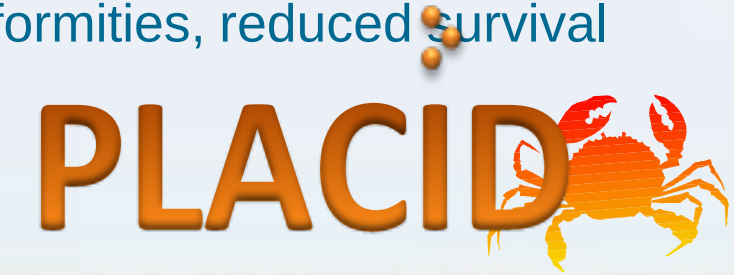
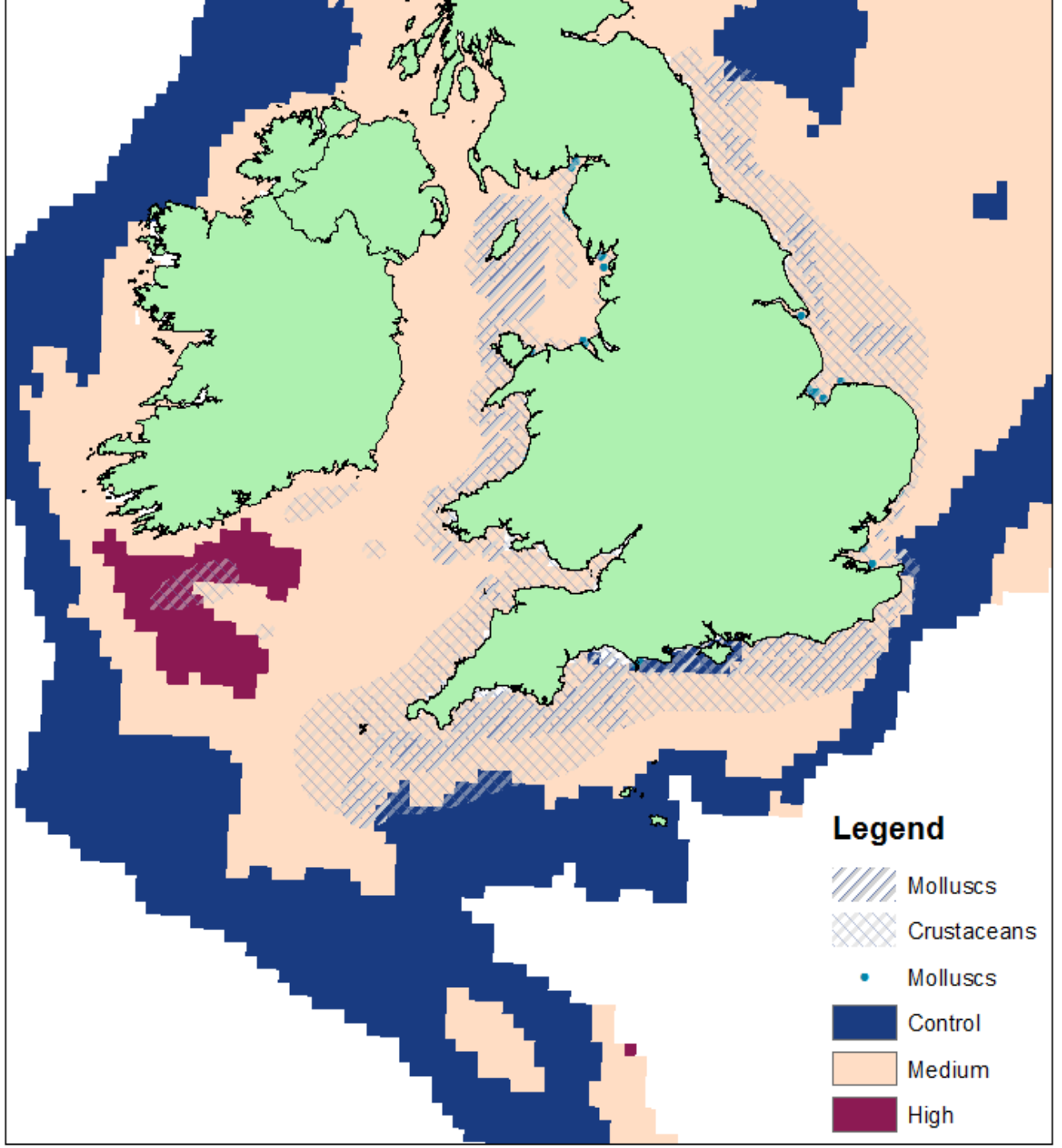
- 11 experimental studies on commercial species
- Log-transformed response ratio (LnRR) (Hedges et al. 1999)
- Medium - Slower growth, reduced calcification, vulnerability to temperature increases
- High - Deformities, reduced survival



*p*CO2 scenario	Effect size - Crustaceans	Effect size - Molluscs
Control	0	0
Medium	-0.3	-0.4
High	-0.6	-0.8

2080-2099
December Maximum

- South of Ireland – Nephrops - Deformities, reduced survival
- Most others medium levels - Slower growth, reduced calcification, vulnerability to temperature increases



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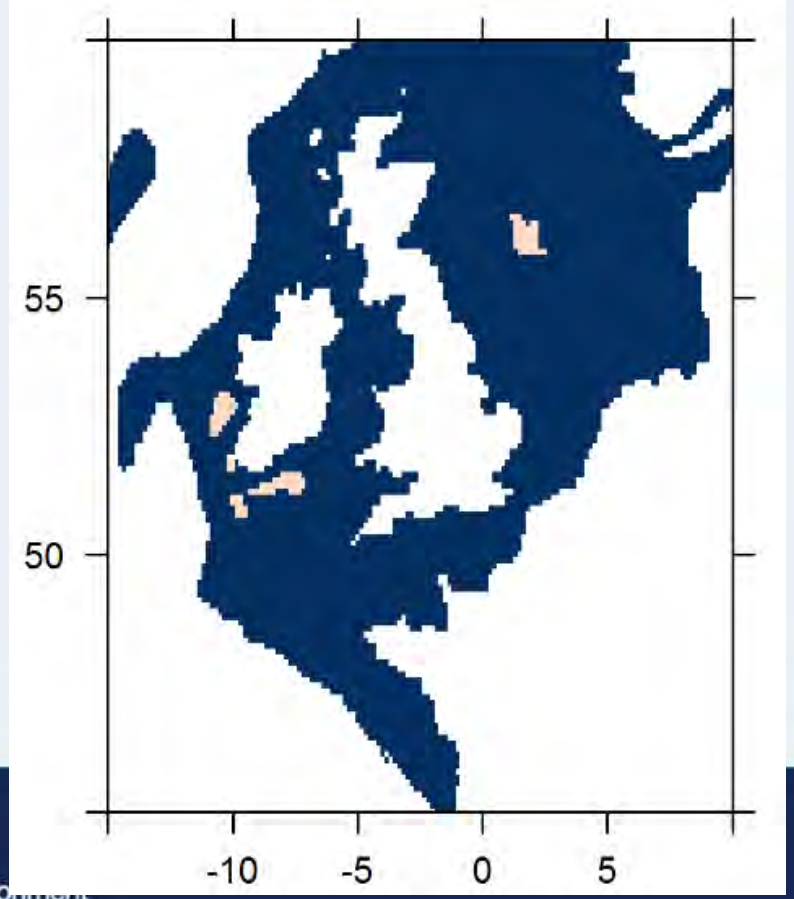
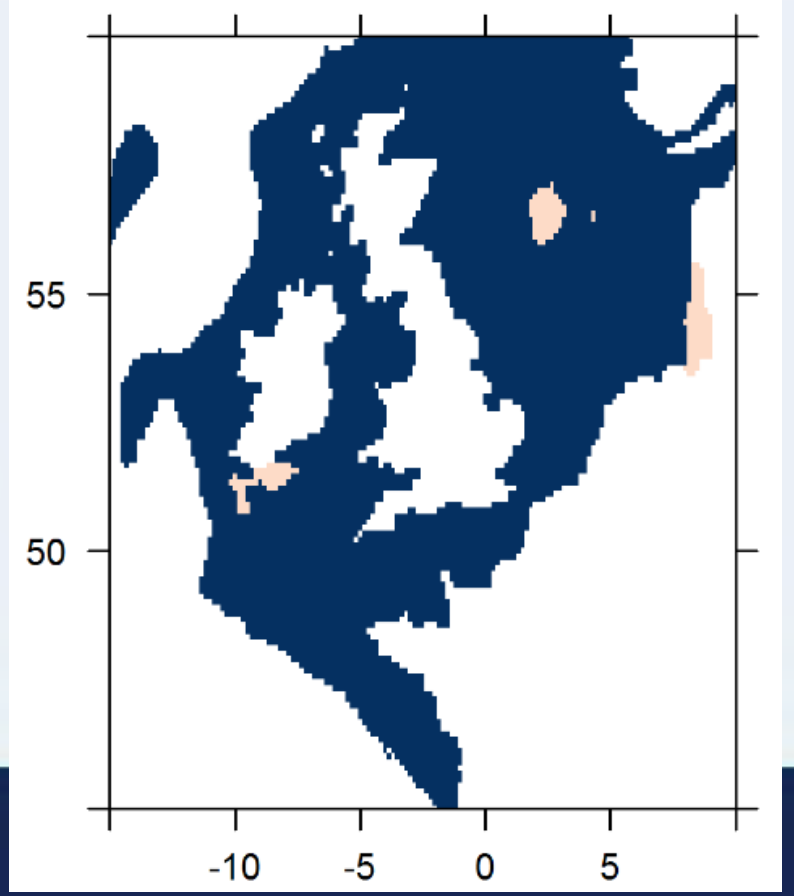
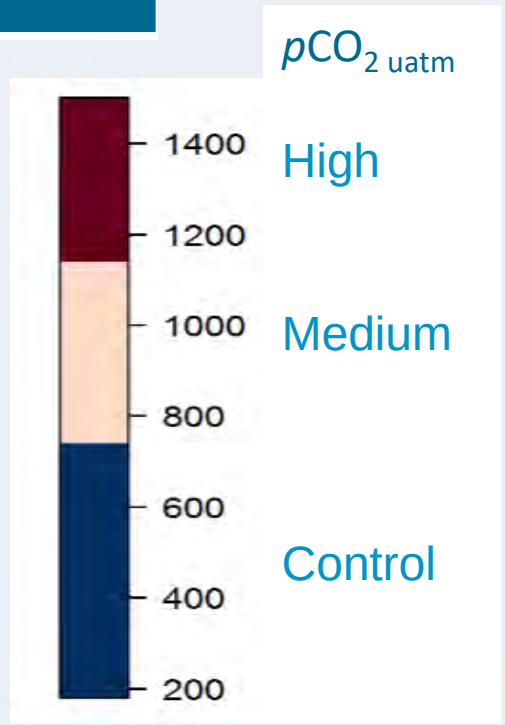
2031 - 2040 – monthly maximum

	November	December







Conclusions

We show that most areas of the North Sea will experience little effect on commercial shellfish.

Shell-fishing areas around the west coast of Great Britain and around Ireland are projected to experience some effects such as deformities and reduced survival, impacting shellfish production.

However, stresses from other factors such as temperature and food availability may have a greater effect on shellfish survival when compared acidification.

Why is this useful?

- Advance warning to help inform management measures and policy directions to increase shellfish resilience
- Marine spatial planning
- Abundant food counteracts effects of pH
- Target areas for monitoring
- Help inform economic studies

Questions?

Silvana Birchenough - Poster S3 P12 The economic impacts of ocean acidification on shellfish fisheries and aquaculture in the United Kingdom

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