

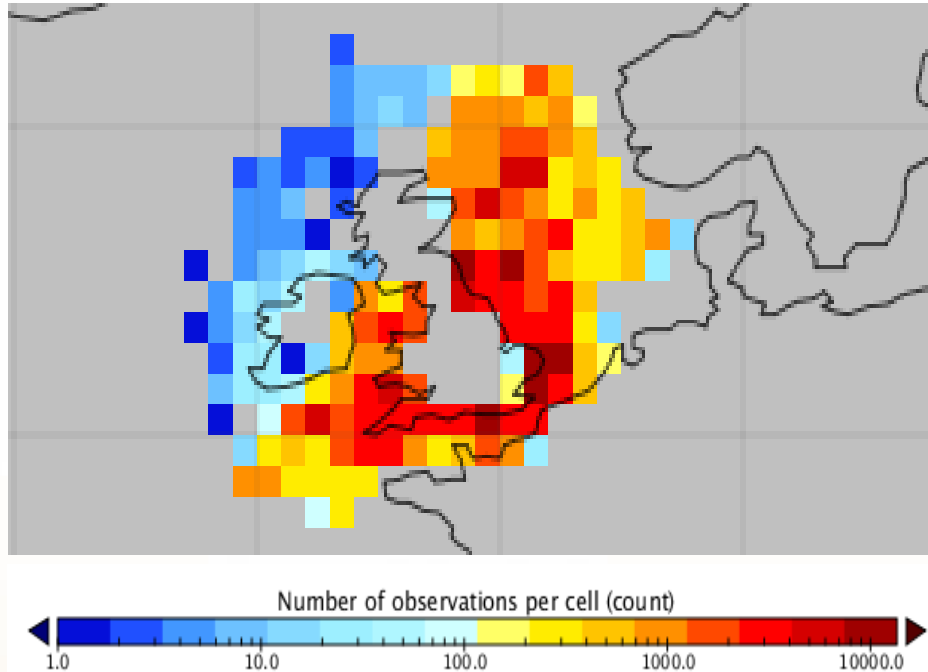


CANDYFLOSS Module 1 **Whole shelf sampling**

Sue Hartman (NOC) & Phil Nightingale (PML)

*Caroline Kivimae, Stuart Painter (NOC), Malcolm Woodward,
Vassilis Kitidis (PML), Matthew Humphreys (UoS), Naomi
Greenwood (CEFAS), Claire Mahaffey (Liverpool)*

Whole shelf sampling and WP1 objectives



Inorganic carbon pre-SSB shows
under-sampled regions

To produce **Seasonal Maps** of
Dissolved Inorganic Carbon
(DIC) and Total alkalinity (TA),
Dissolved Organic Carbon
(DOC), Nutrients and Carbon
dioxide

To get a more coherent picture
of the carbonate system on the
NW European shelf.

To produce an estimate of the
European shelf net integrated
air-sea **CO₂ flux**

Shelf-wide whole-year bottle sampling

A large community effort



AFBI –
RV Corystes



Marine Science
Scotland - MRV Scotia



Marine institute -
RV Celtic
Explorer

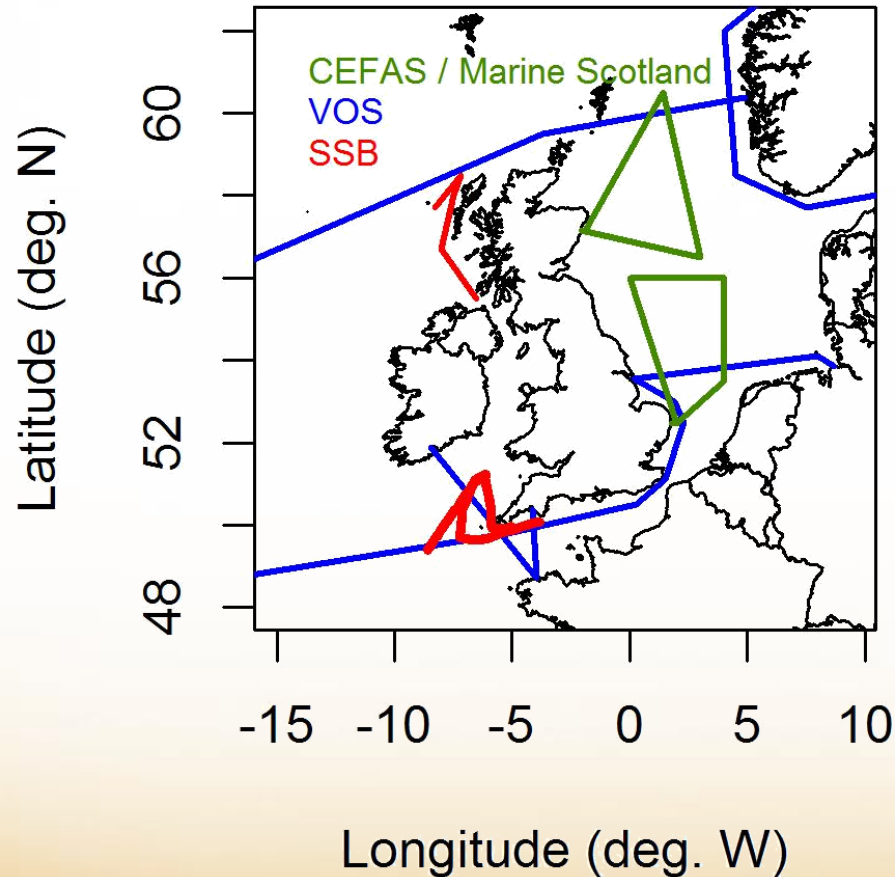


CEFAS –
RV Endeavour



NERC – RRS Discovery
& RRS James Cook

Shelf-wide whole-year bottle sampling and underway CO_2



Partner cruises: daily surface samples, profiles & CEFAS MSS underway CO_2

NOC & SSB cruises: underway CO_2 and full depth bottle samples

Volunteer Observing Ships – VOS: underway CO_2 (Norway, Germany, France, UK, Spain)

Sample collection and analysis



Dissolved Inorganic Carbon (DIC) -Total alkalinity (TA)

S.Hartman, C.Kivimae (NOC), M.Humphreys, A.Griffiths (UoS)

Nitrate, Nitrite, Phosphate, Silicate, Ammonium

Malcolm Woodward, Carolyn Harris (PML), Chris Daniels (NOC)

Partner cruises daily surface and some full depth sampling

N.Greenwood (Cefas), E.McGovern, T.McGrath (MI),

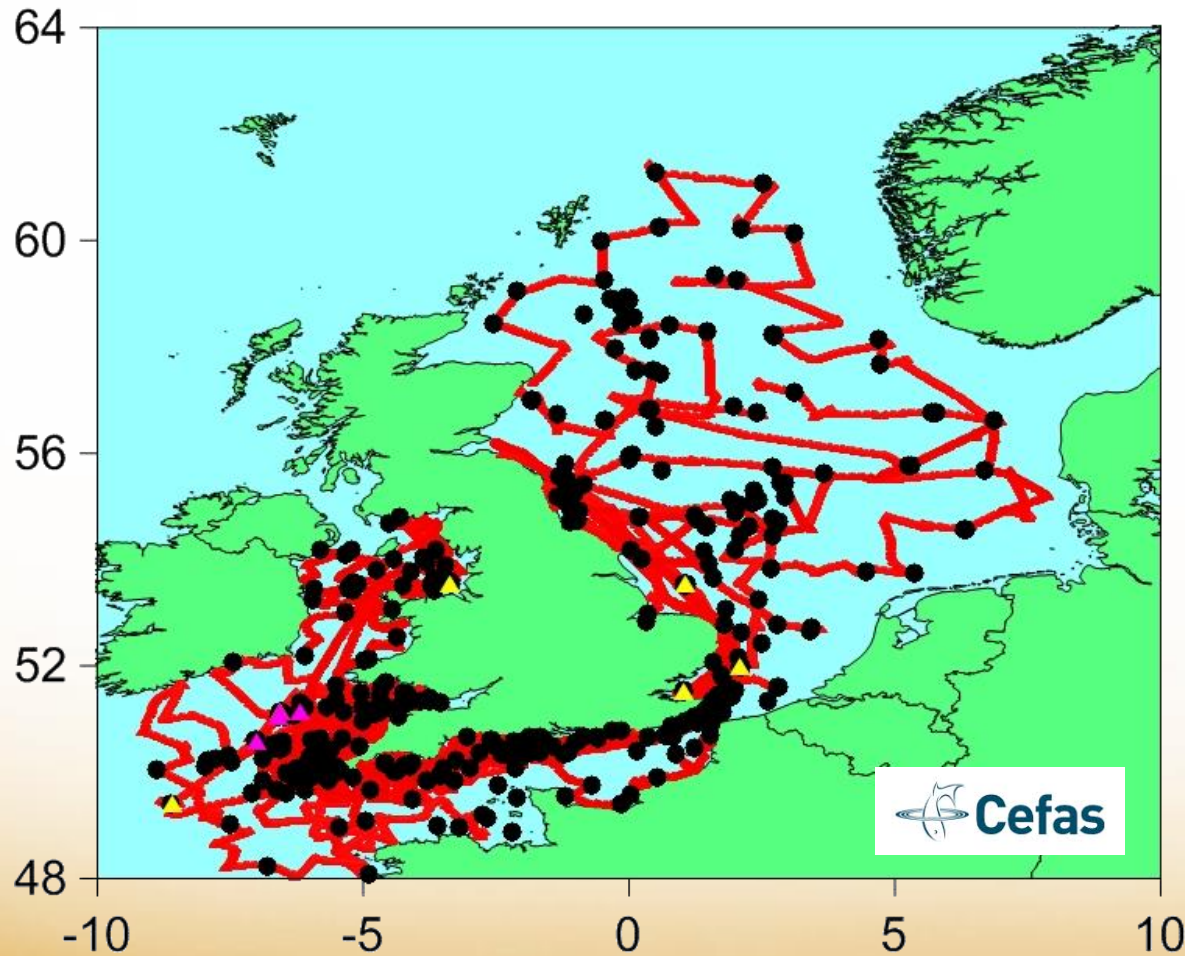
P.Walsham (MSS), B.Stewart (AFBI)

Pelagic & Benthic cruises:

With thanks to many PIs and samplers.

For Dissolved Organic sampling see **C. Mahaffey**

Shelf-wide whole-year bottle sampling and underway CO_2



RV Endeavour:
Underway CO_2 and
sampling of dissolved
organics, nutrients and
carbon variables (527
occasions 2014 & 2015)

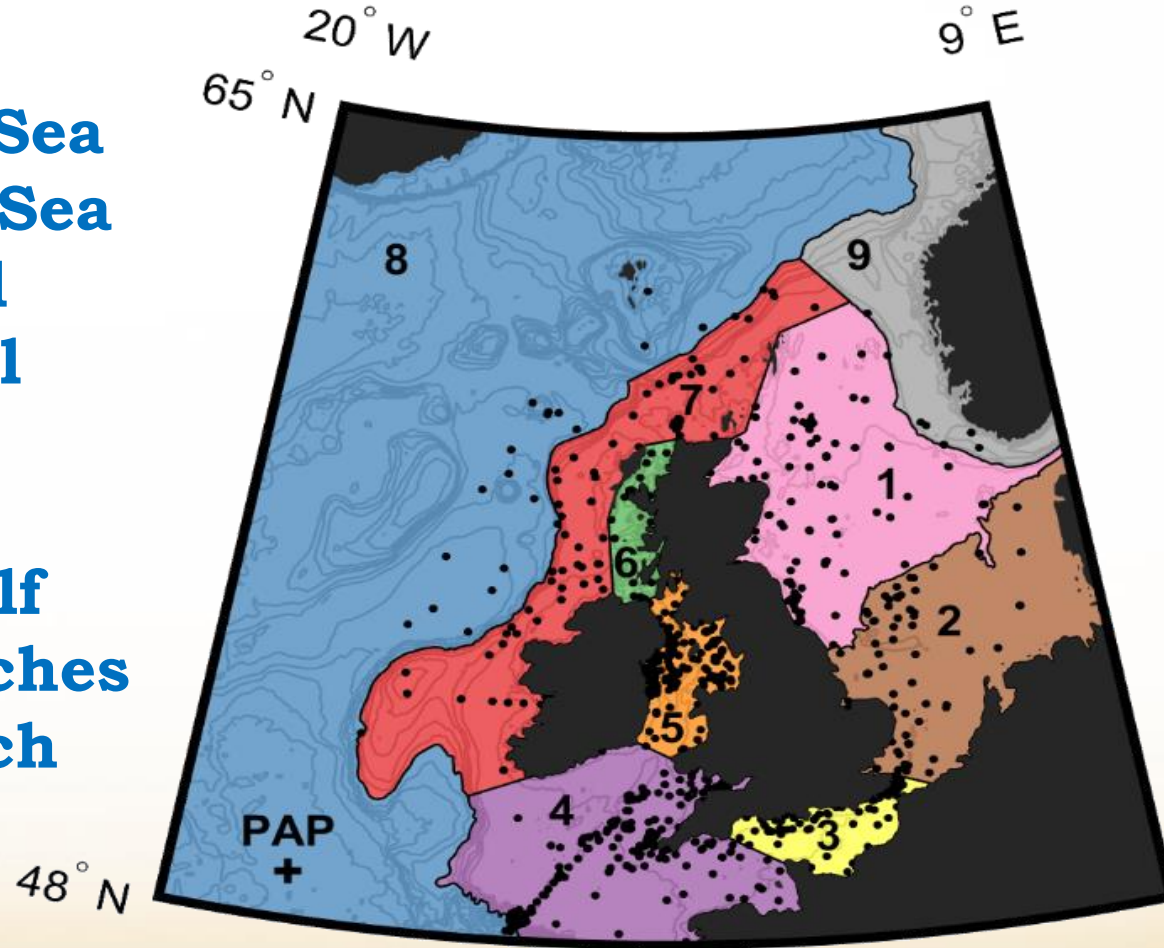
Naomi Greenwood

- ▲ Cefas landers
- ▲ Cefas SmartBuoys
- ▲ Cefas pCO_2 data
- Samples: DIC/TA,
nutrients, DOM

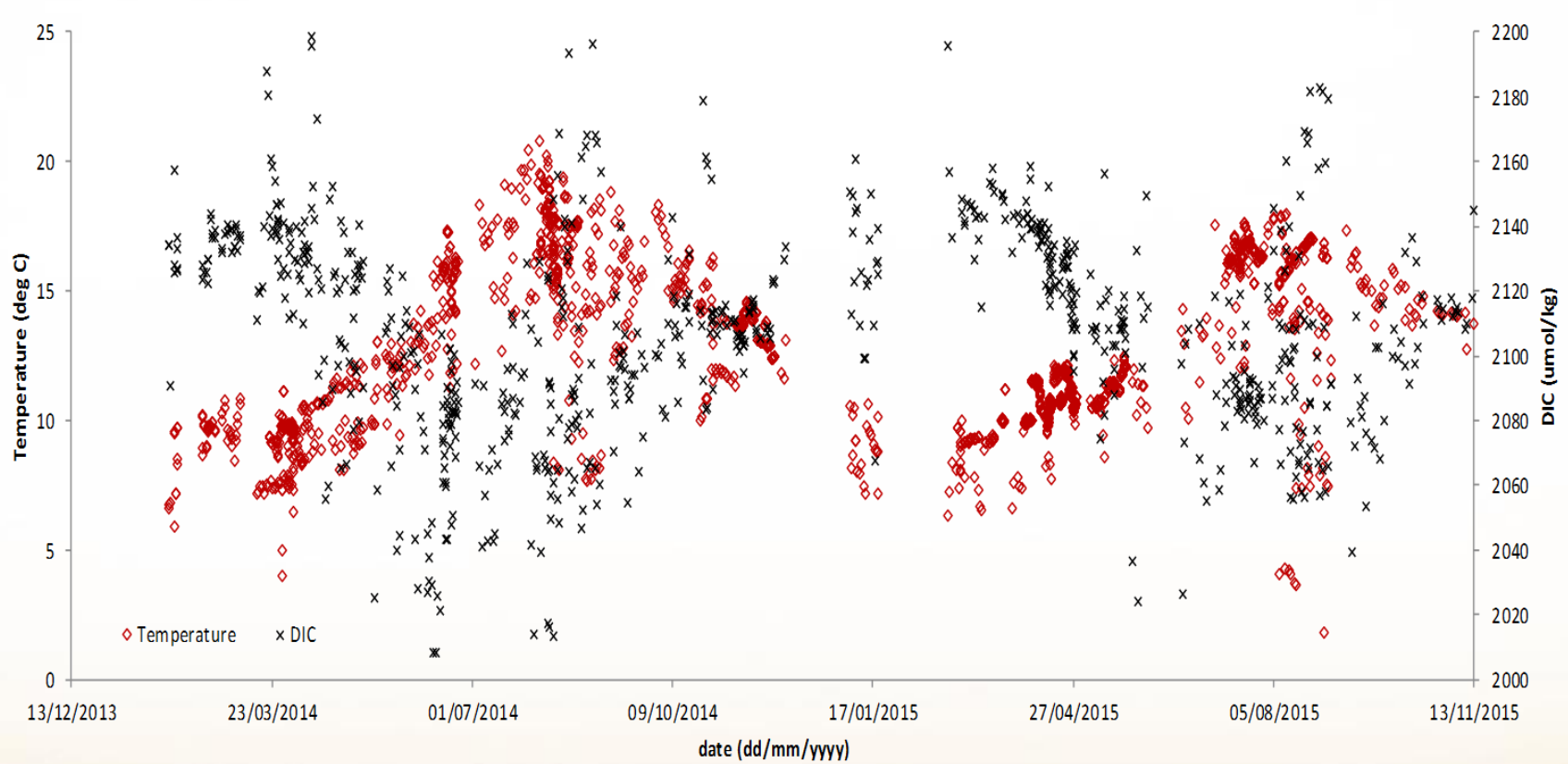
Ecohydrodynamic regions

(after MSFD, Bresnan 2015)

1. Northern North Sea
2. Southern North Sea
3. Eastern Channel
4. Western Channel
5. Irish Sea
6. Minches
7. Continental Shelf
8. Atlantic Approaches
9. Norwegian Trench

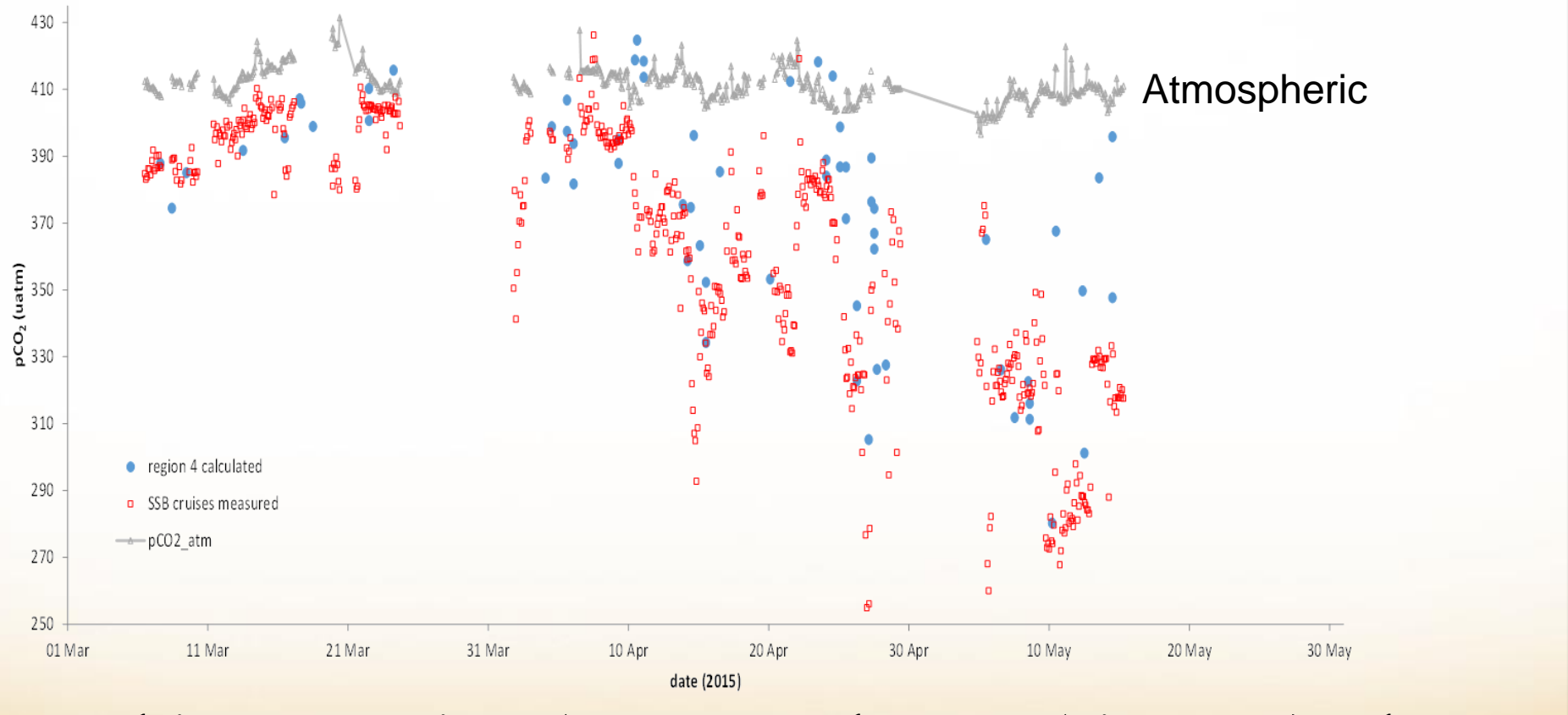


Temporal coverage



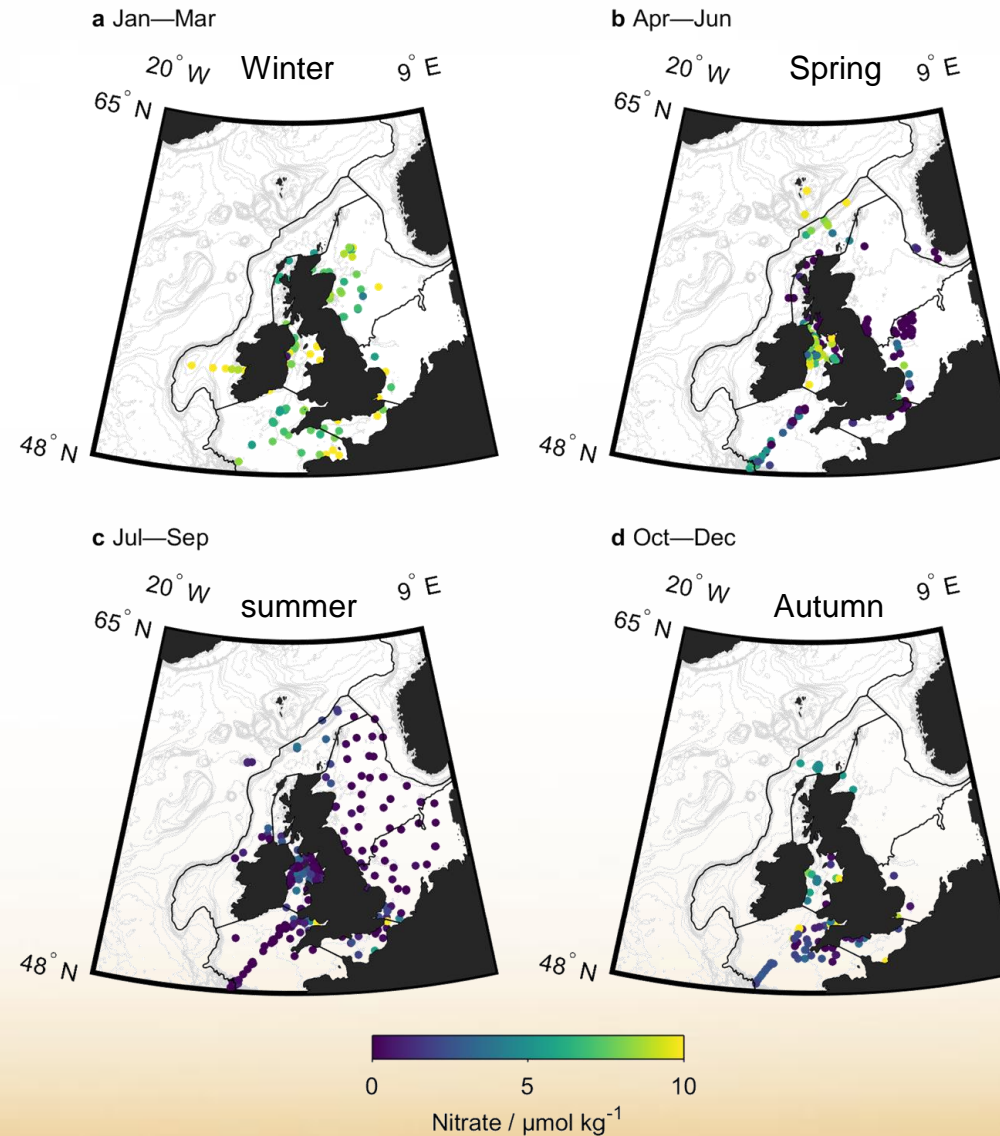
Example shown is **DIC** and **Temperature**;
good temporal coverage all variables

pCO₂ data comparison



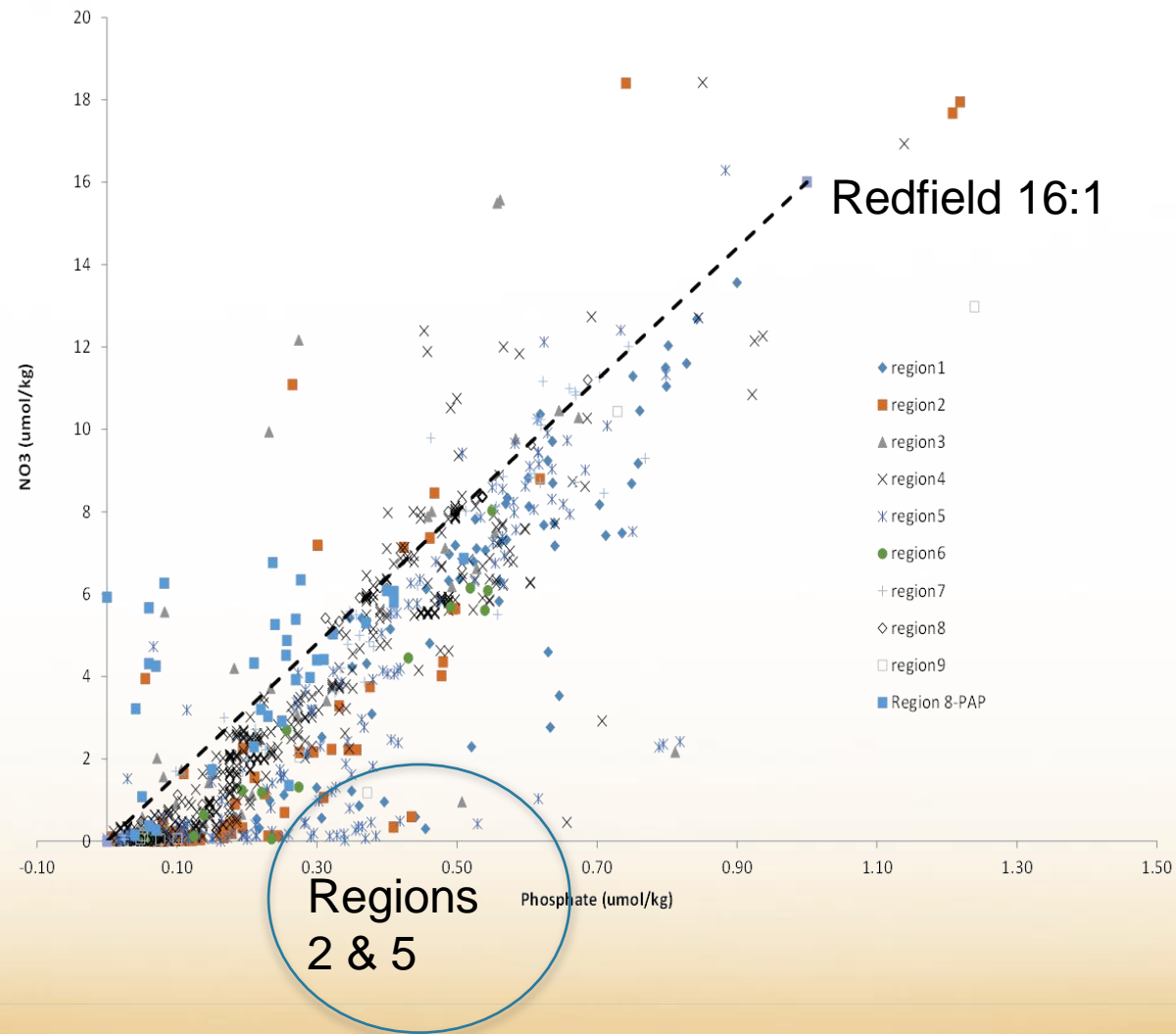
2 Celtic Sea cruises (DY021 and DY029) in 2015: shows a close agreement between **underway CO₂** data from the Dartcom system and **calculated CO₂** from bottle DIC/TA

NO₃



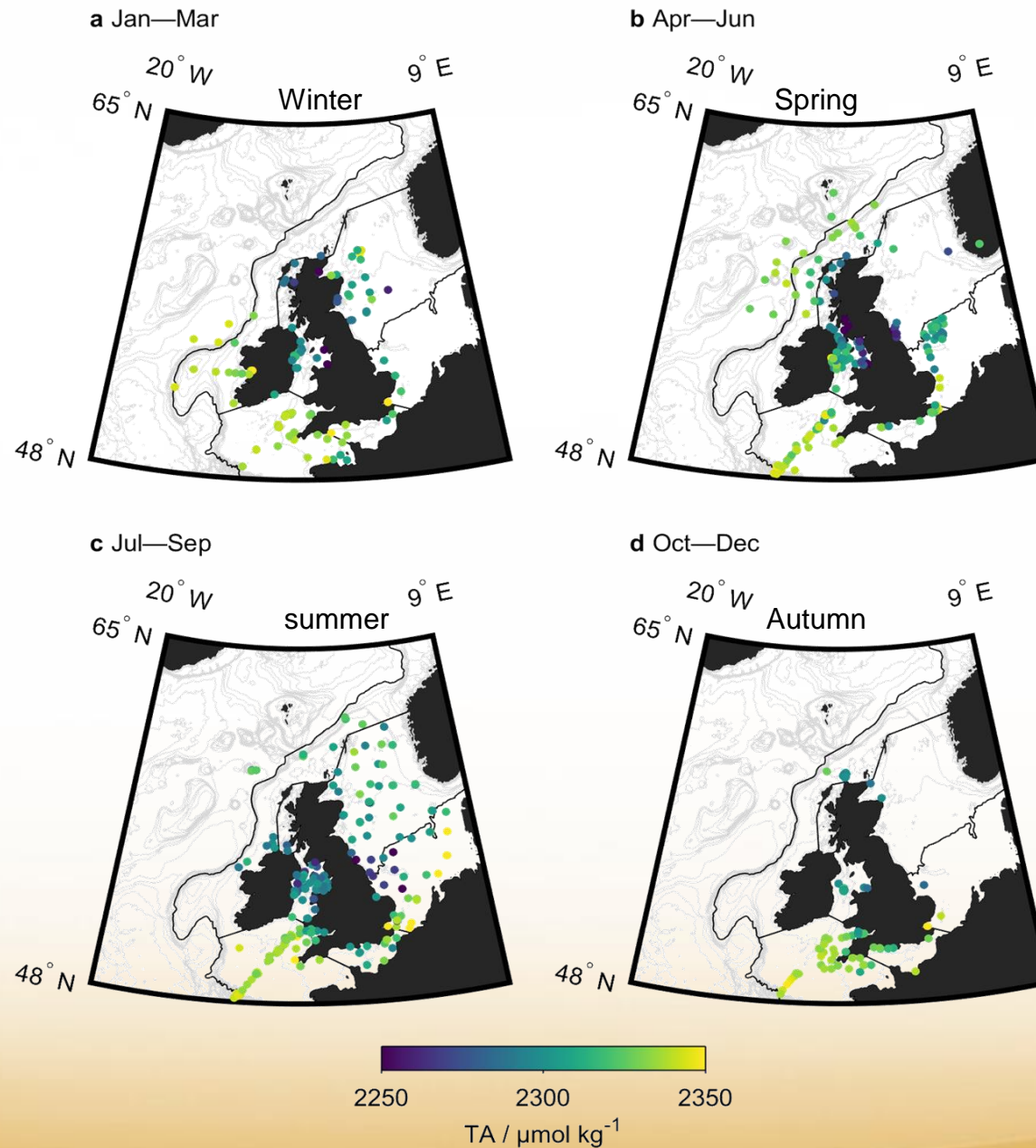
Seasonal SSB maps of surface dissolved inorganic nitrate
M Humphreys

N:P



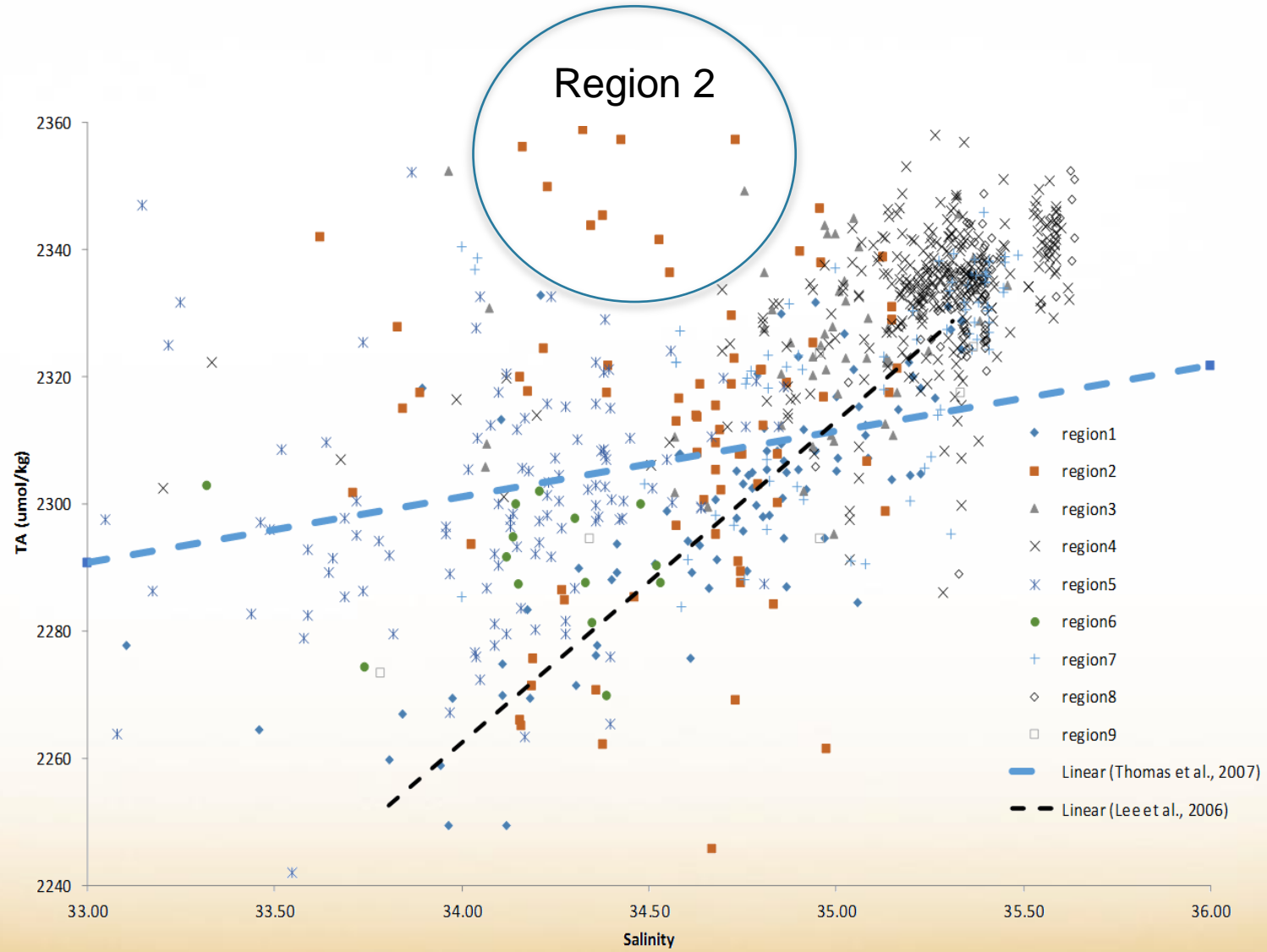
Denitrification SN.Sea & Irish Sea (regions 2 & 5) Low N:P

Total Alkalinity



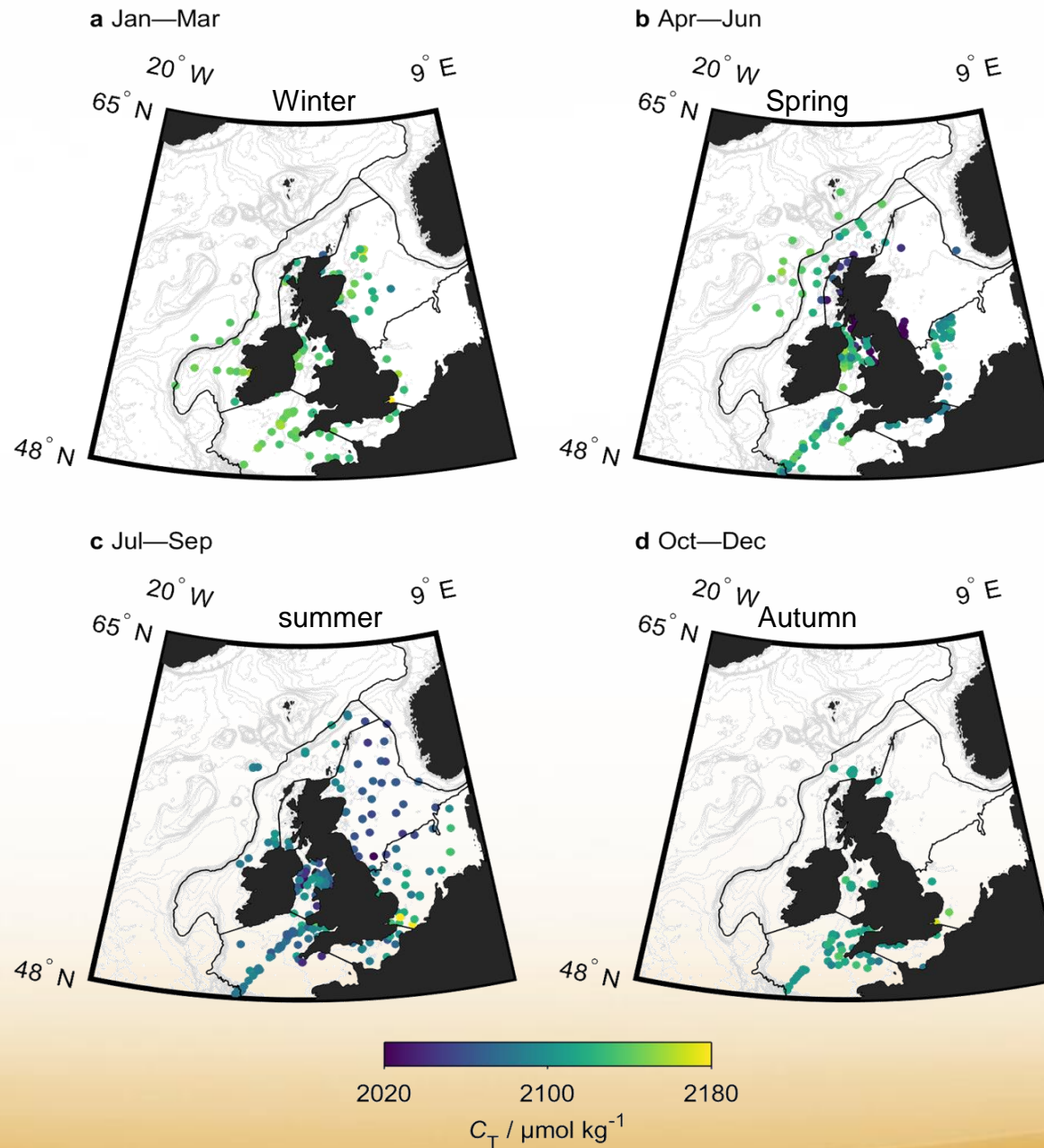
Regional rather than seasonal variation in surface TA

TA:S



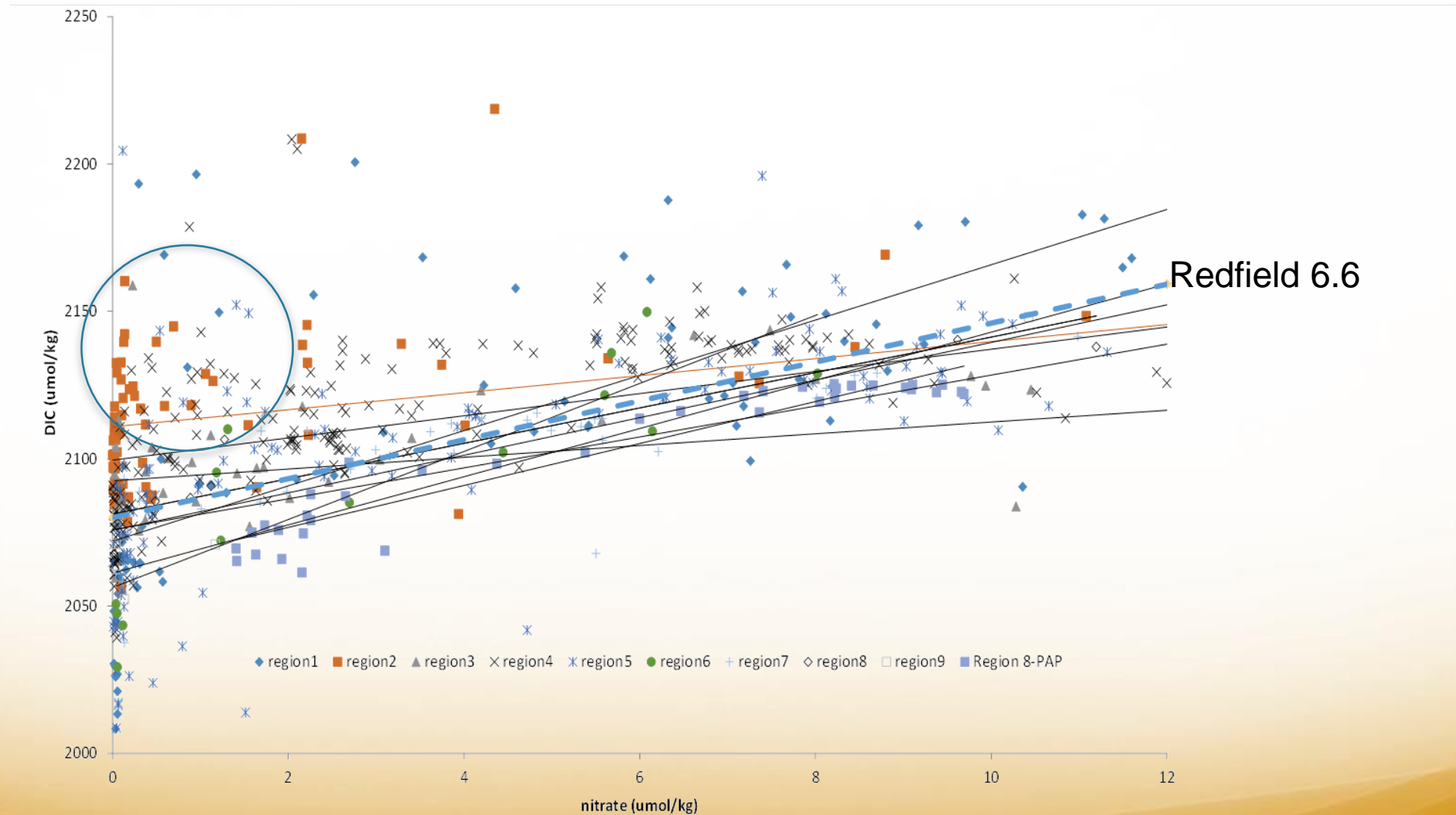
High TA in Southern North Sea (Region 2), OM oxidation

Dissolved Inorganic Carbon



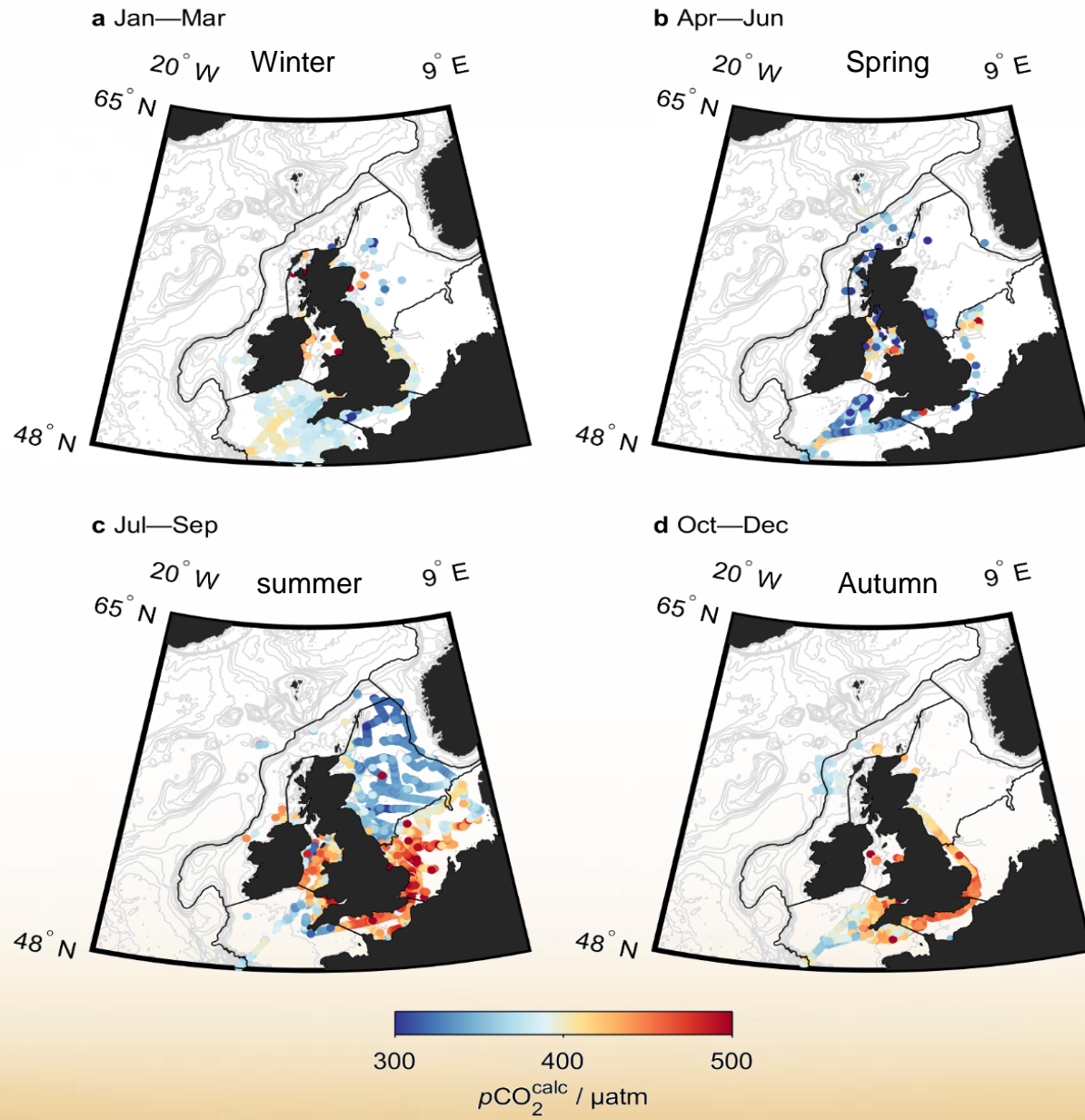
Seasonal surface Dissolved Inorganic Carbon similar to NO_3

DIC:NO₃



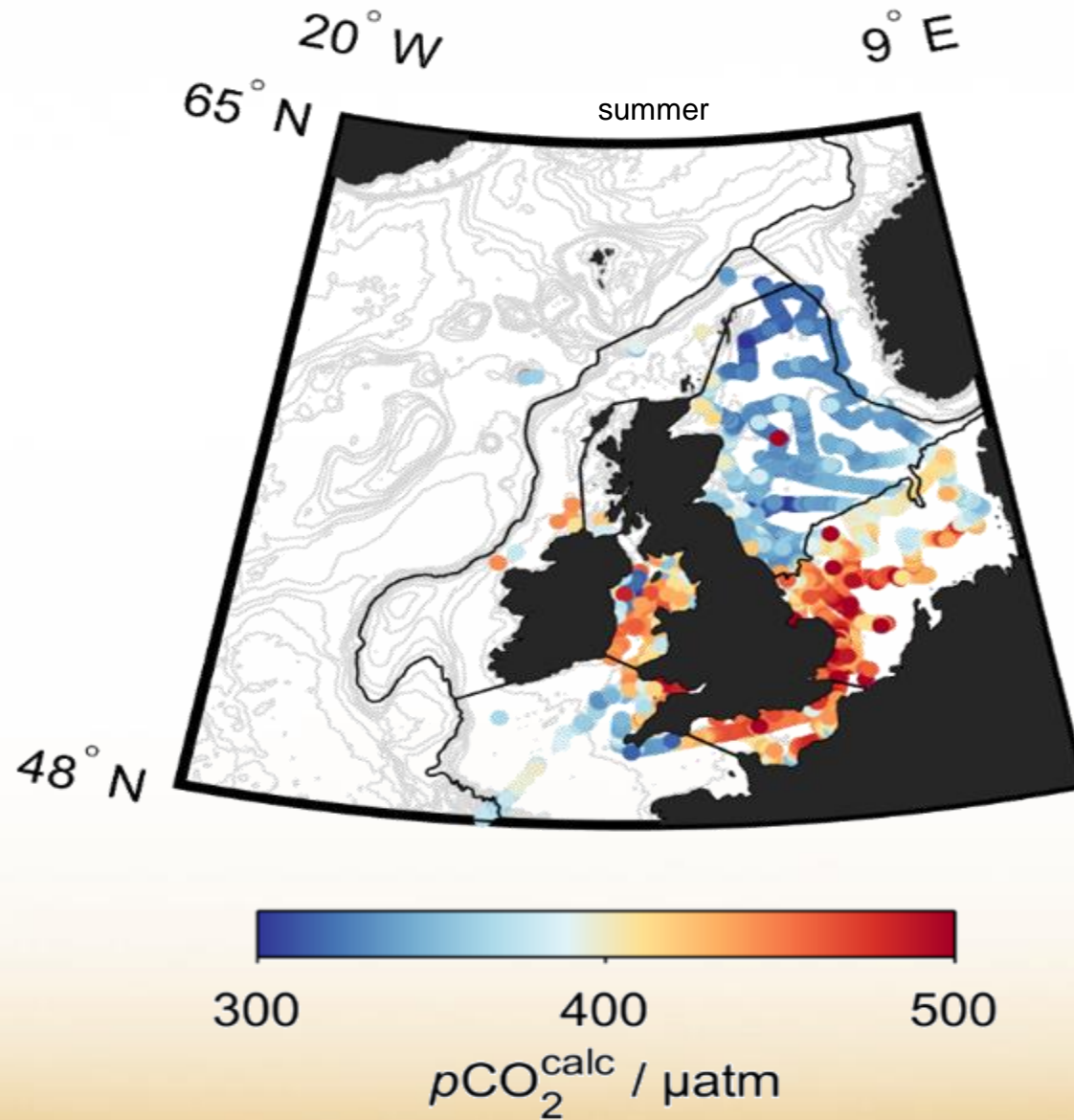
Increased DIC (at low NO₃) in Southern North Sea (Region 2)

pCO₂



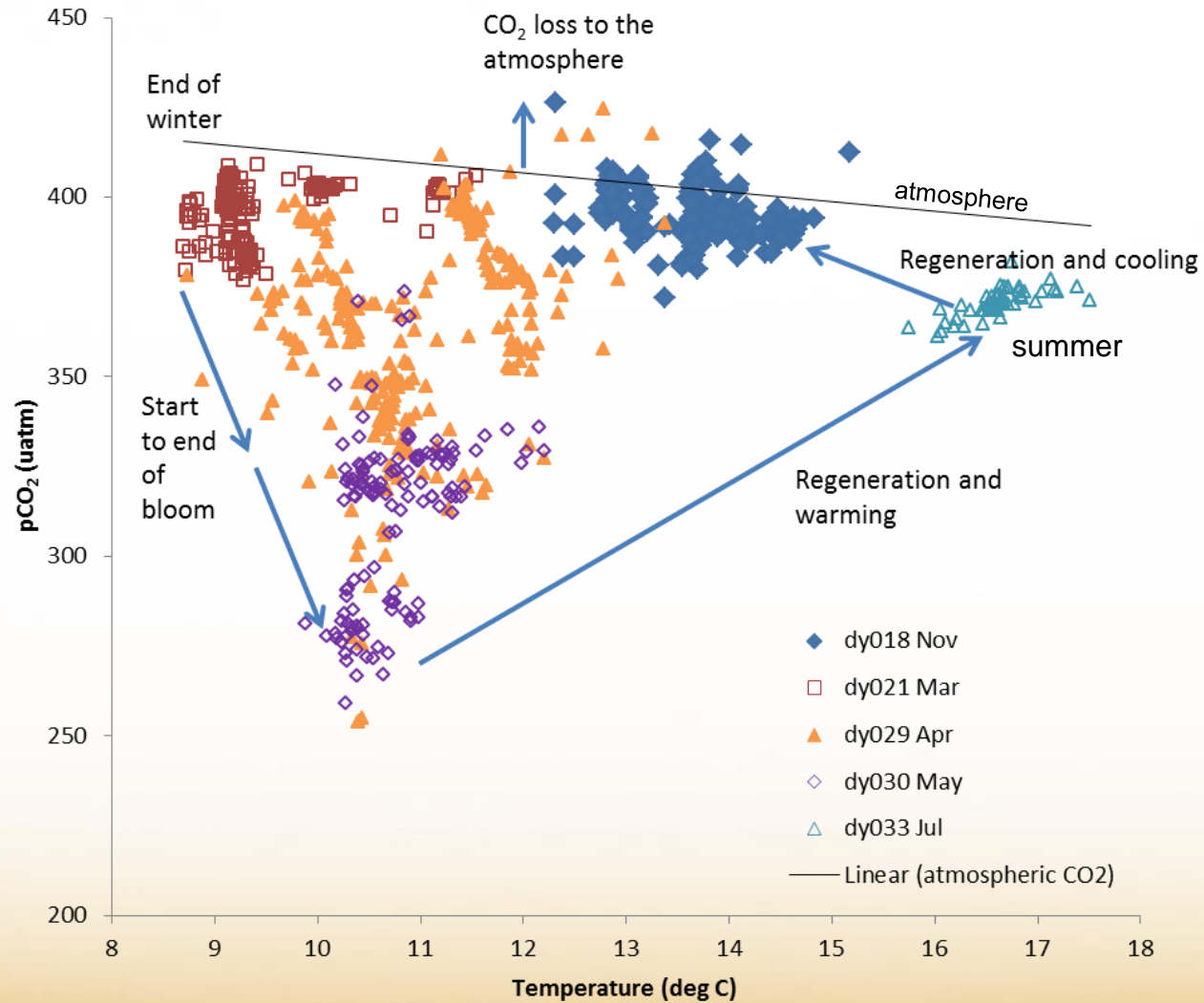
NB: Colour bar divides at atmospheric pCO₂. Seasonal decrease in spring (C. Sea) and regional variations (N. Sea)

pCO₂



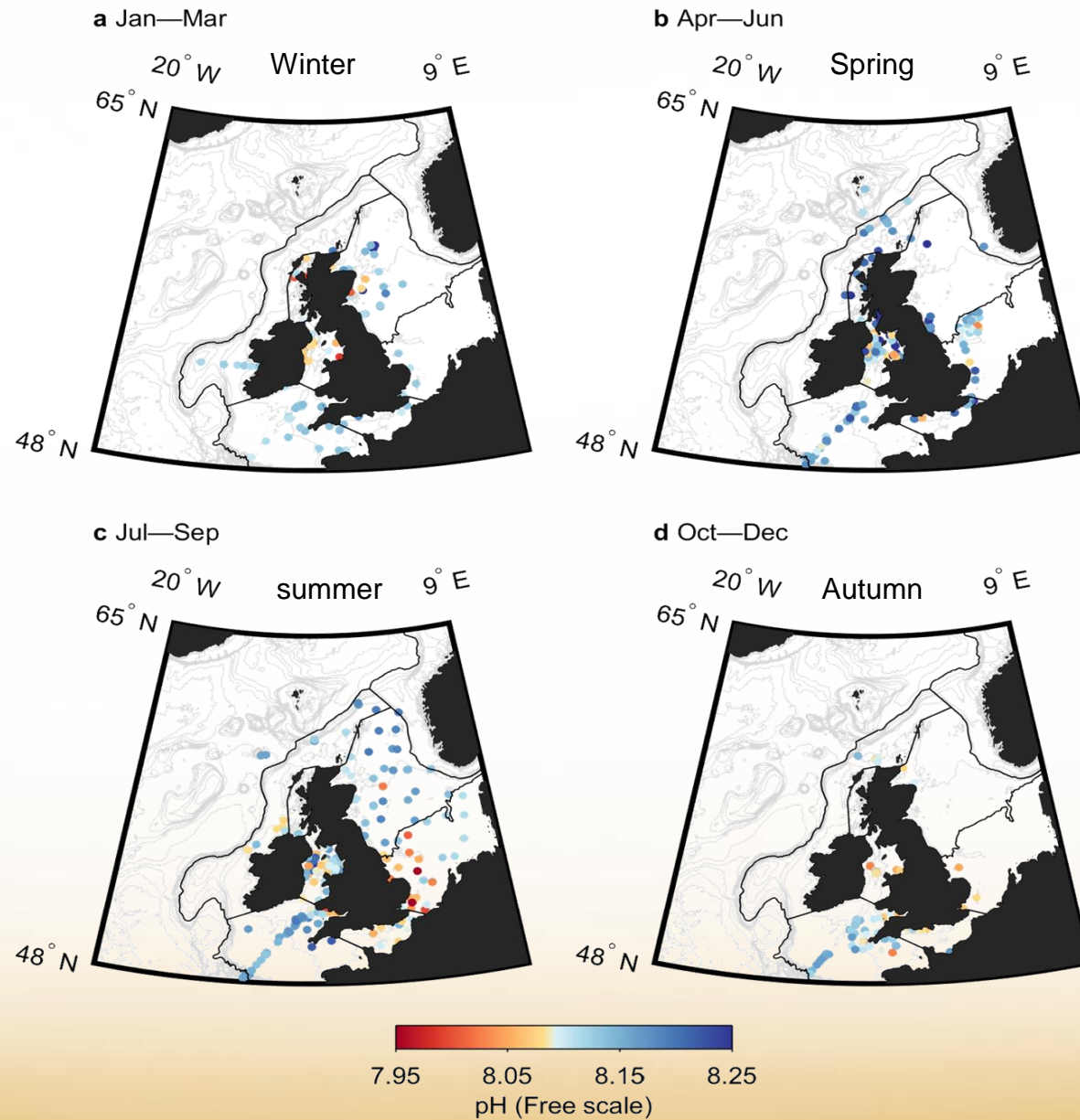
Shows large horizontal pCO₂ gradients in the North Sea in summer

Key processes



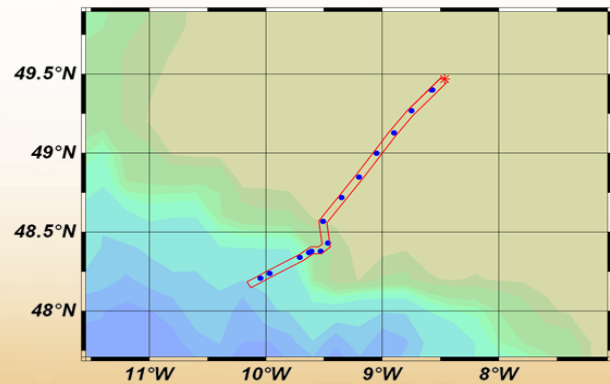
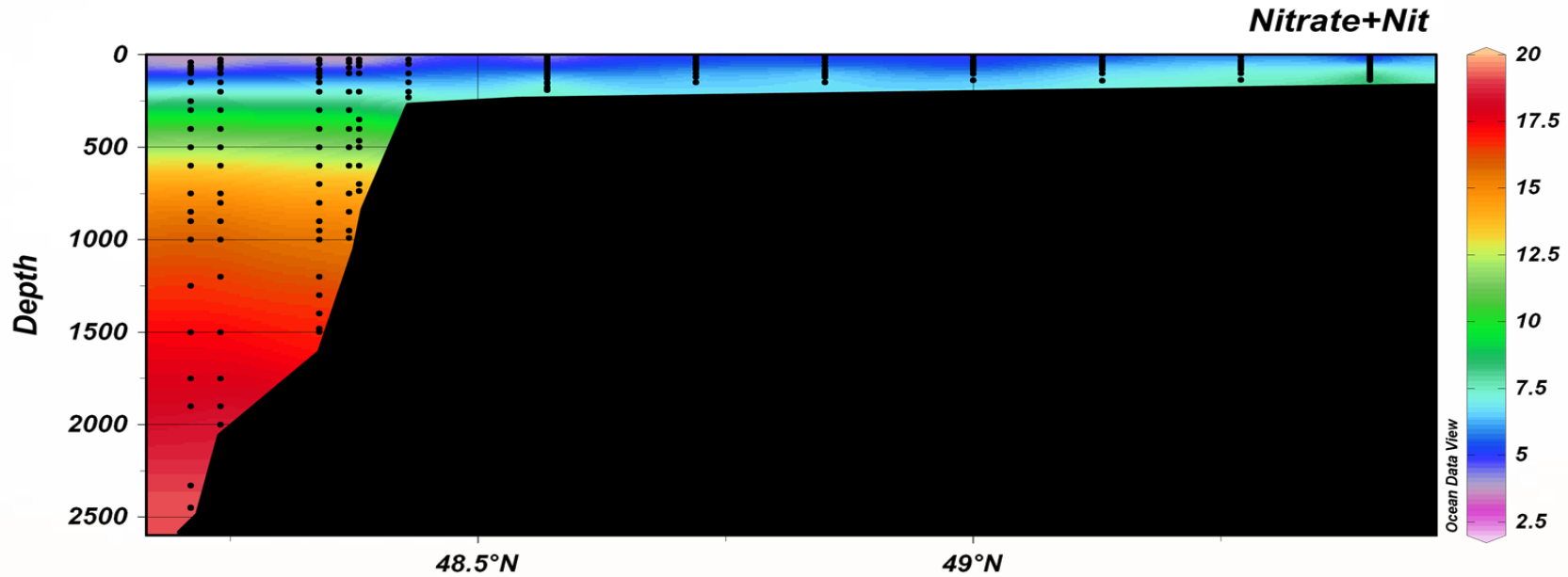
Seasonal variation in the underway pCO₂ and temperature for the Celtic sea

pH



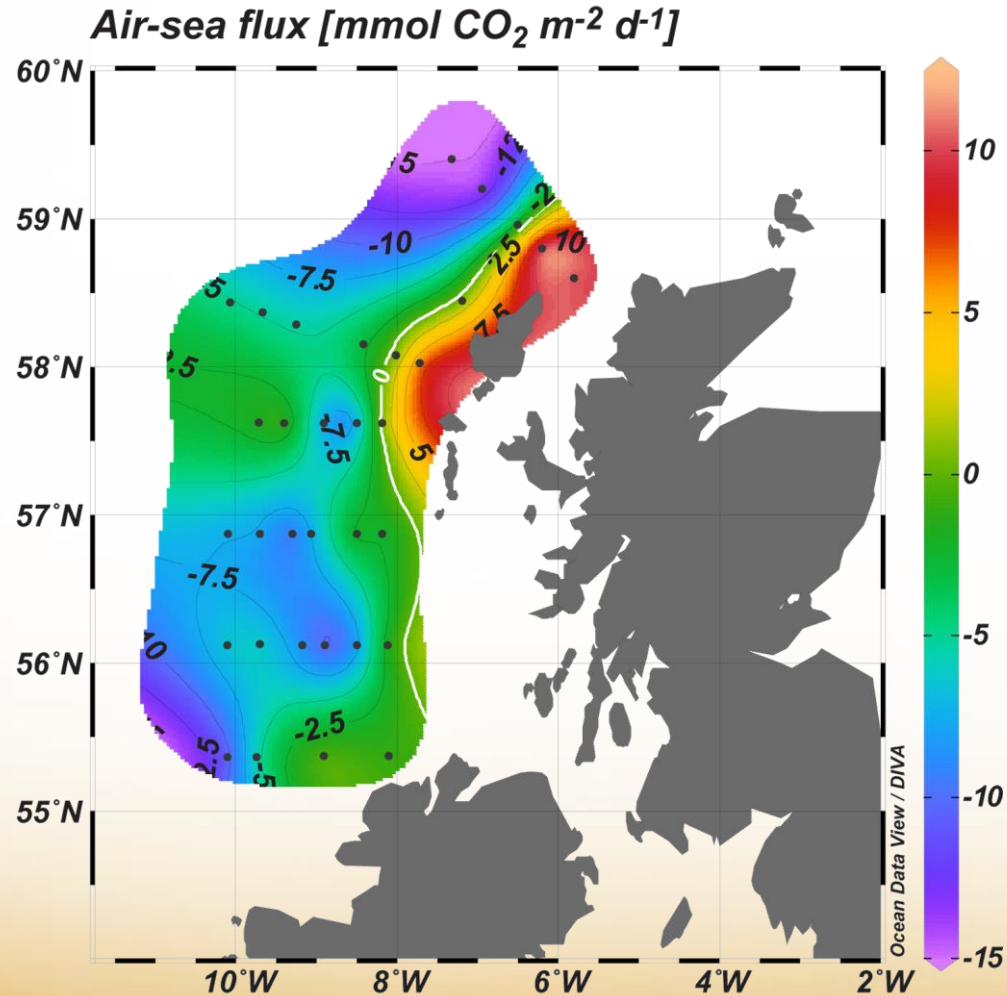
Future: compare with Ostle, 2016; DEFRA_{pH} and UK-OA

Further work: shelf exchange depth profiles



**See posters by
M. Humphreys &
M. Woodward**

CO₂ flux studies



Air-sea CO₂ flux
calculated from
DIC/TA bottle
samples on
process studies
eg: DY017

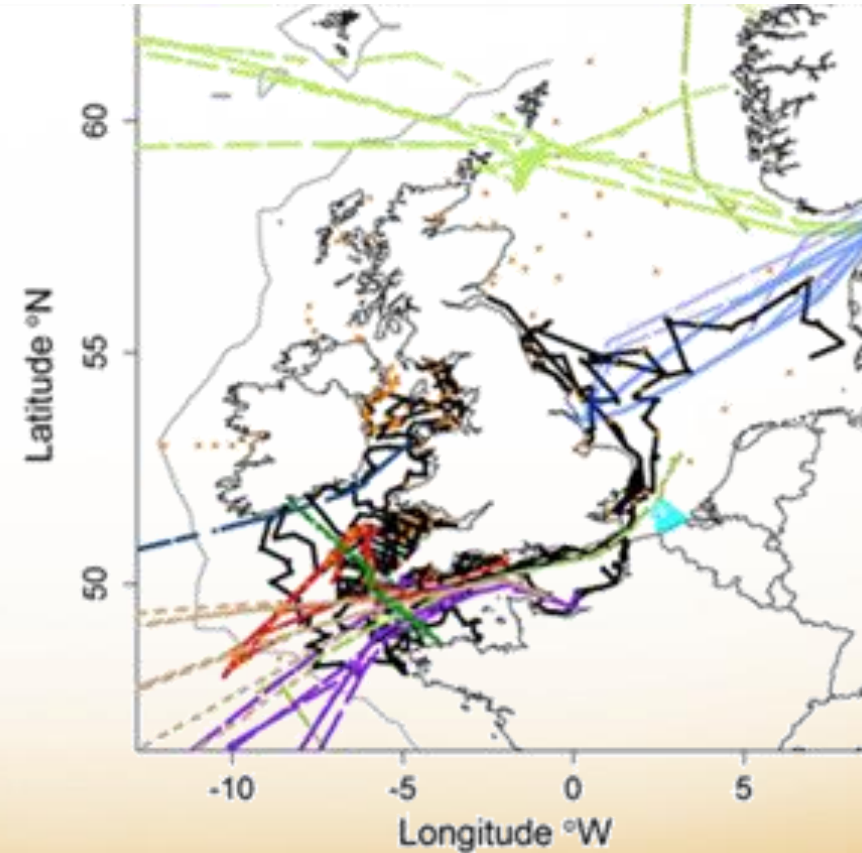
See poster by
Stuart Painter

European Shelf CO₂ sink estimate

**See V. Kitidis, J. Shutler
& P. Land**

calculated pCO₂ and VOS
data to calculate monthly
and annual integrated net
fluxes.

Using a range of definitions
of the NW European shelf



Key messages from Module 1



- We have presented seasonal surface data maps produced from 2 years of daily biogeochemical sampling around the shelf
- Combined with underway CO₂ data key processes and regional variations are identified
- The North-west European shelf is a weak CO₂ sink with regional variations

Acknowledgements

We would especially like to thank the shelf wide samplers
and Volunteer Observing Ship coordinators

