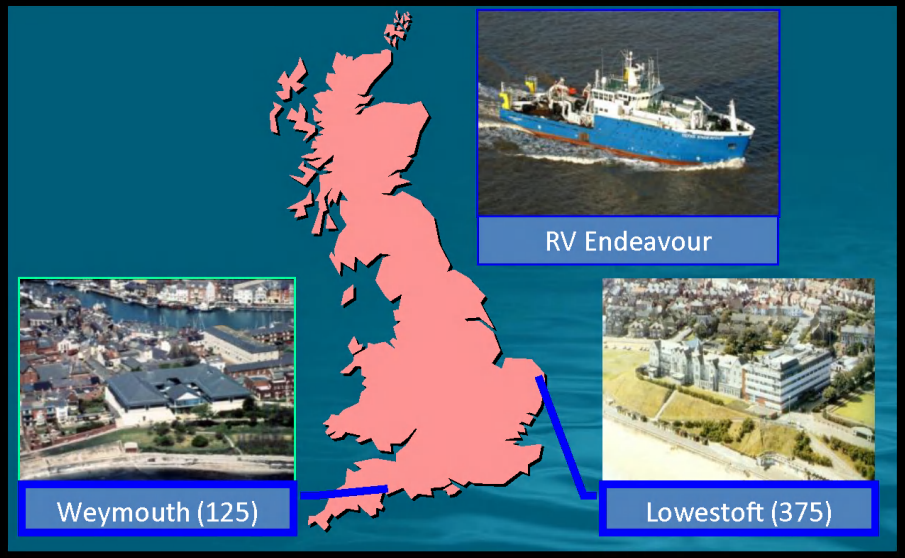
Eutrophication Monitoring
in situ



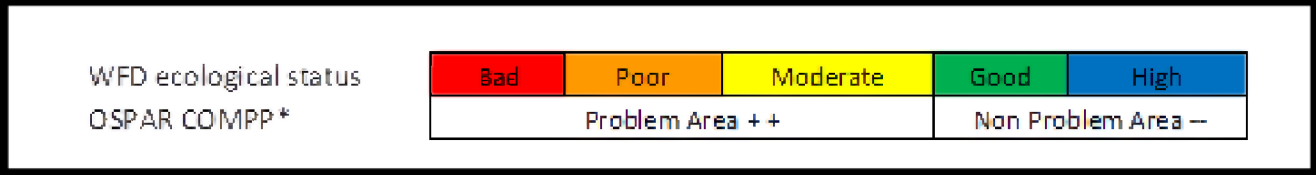
1- Monitoring requirements for eutrophication: what to measure

2-Design of an adaptive monitoring programme: how and where to measure

3- Synthesis of in situ, model and EO observations

Rodney Forster,
Cefas, Lowestoft, UK

Eutrophication indicators



Indicator	Non Problem Areas	Problem Areas
Criterion 5.1: *Nutrient levels*		
5.1.1 - Nutrients in the water column	Y	Y
5.1.2 - Nutrient ratios (silica, nitrogen and phosphorous), where appropriate	Y	Y
Criterion 5.2: *Direct effects of nutrient enrichment*		
5.2.1 - Chlorophyll concentration in the water column	Y	Y
5.2.2 - Water transparency	?	?
5.2.4 - Species shift in floristic composition	N/Y	Y
Criterion 5.3: *Indirect effects of nutrient enrichment*		
5.3.2 - Dissolved oxygen in bottom waters	N	Y
Benthic animal kills?	N	Y

“core” indicator set under OSPAR

Section 1 – OSPAR Common Indicators: proposed 2014 update

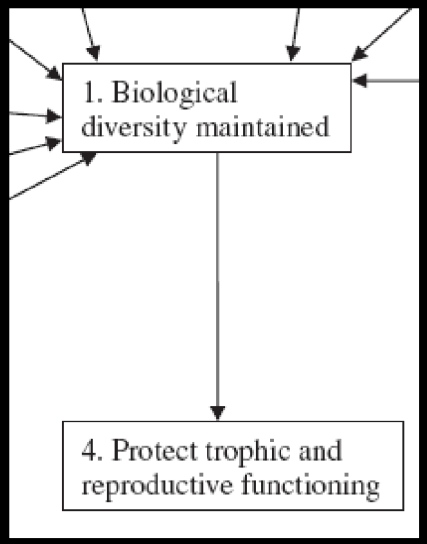
‘OSPAR-wide’ common indicators

D1/6 BentHab2	Multi-metric indices
D5 nutr conc	Winter nutrient concentrations
D5 chlorophyl	Chlorophyll concentration
D5 oxygen	Oxygen
D8 metals (biota)	Metal (Hg, Cd, Pb) concentrations in biota
D8 metals (sedim)	Metal (Hg, Cd, Pb) concentrations in sediment
D8 PCBs (biota)	PCB concentrations in biota
D8 PCBs (sedim)	PCB concentrations in sediments
D8 PAHs (sedim)	PAHs concentrations in sediments
D8 PAHs (biota)	*PAHs concentrations in biota other than fish*
D8 Organotin (sedim)	Organotin concentrations in sediments
D8 PBDE (biota)	PBDE concentrations in biota
D8 PBDE (sedim.)	PBDE concentrations in sediments
D8 imposex	Imposex/intersex
D10 on beach	Beach litter
D10 on seabed	*Litter on the seabed*
D11 impulsive noise	*Impulsive noise*

Region II – Greater North Sea

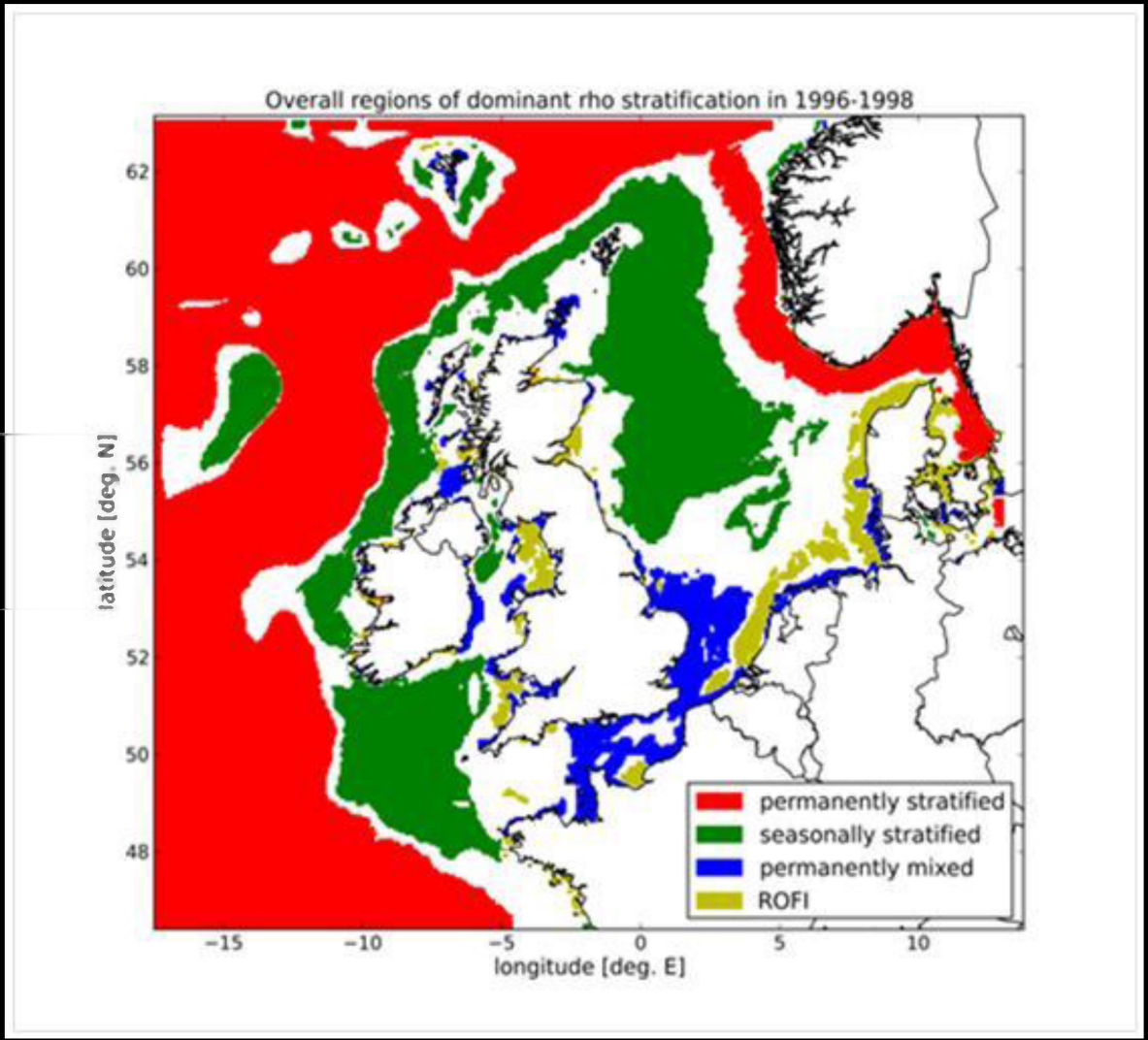
D1 Mammals 2[1]	*Distributional range and pattern of cetaceans species regularly present*
D1 Mammals 3	Abundance of grey and harbour seal at haul-out sites & within breeding colonies
D1 Mammals 4[1]	*Abundance at the relevant temporal scale of cetacean species regularly present*
D1 Mammals 5	Harbour seal and Grey seal pup production
D1 Mammals 6	Numbers of individuals within species being bycaught in relation to population
D1 Birds 1	Species-specific trends in relative abundance of non-breeding and breeding marine bird species
D1/6 Birds3	*Breeding success/failure of marine birds*
D1 Fish Ceph 1	Population abundance/biomass of a suite of selected species
D1 Fish Ceph 2	OSPAR EcoQO for proportion of large fish (LFI)
D1 PelHab 2	Plankton biomass and/or abundance
D5 input water	Waterborne nutrient inputs
D5 input air	Atmospheric nutrient inputs
D5 Phaeocystis	Species shift/indicator species: Nuisance species Phaeocystis
D8 input metal	Inputs of Hg, Cd and Pb via water and air
D10 in Fulmar	Fulmar litter ingestion (impact and floating litter)

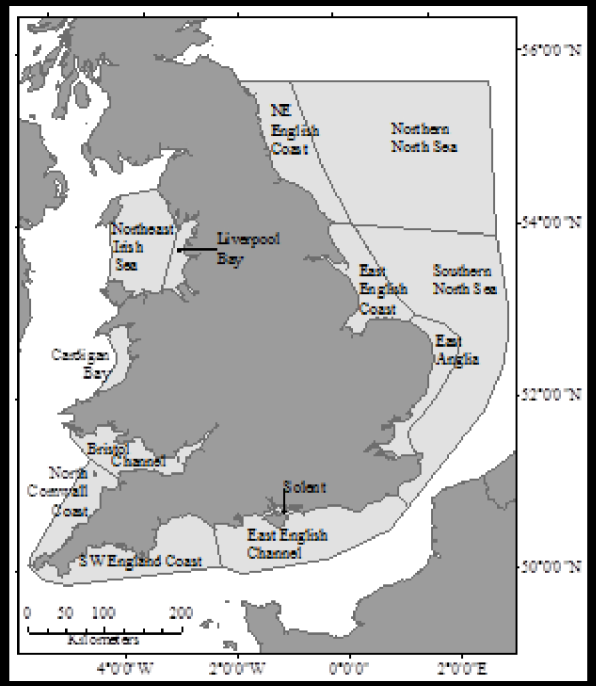
Broader sets of pelagic indicators under MSFD



Structure	Function
4.3. Abundance/distribution of key trophic groups/species (includes 4.2. Proportion of selected species at the top of the foodweb)	4.1. Productivity (production per unit biomass) of key species or trophic groups
i. *Biomass of trophic guilds* *ii.* *Mean weight of zooplankton* Integrated size-based indicators *iii.* *Proportion of large fish (large fish indicator, LFI)* *iv.* *Mean length of surveyed community*	*v.* *Primary production* *vi.* *Seabird breeding success* *vii.* *Mean weights at age of predatory fish*

Where to measure





How to measure

Period

From 1913-07-09 ?

To 2013-07-09 ?

Area

90

-180 Map 180

-90 ?

Parameter

CTD
Temperature/Salinity
Oxygen
Phosphate
Total.Phosphorus ?

Other

Country Any

Ship Any

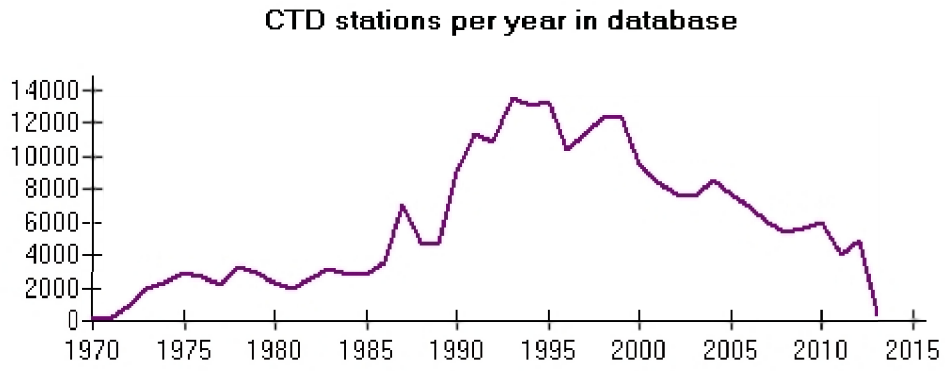
Submit

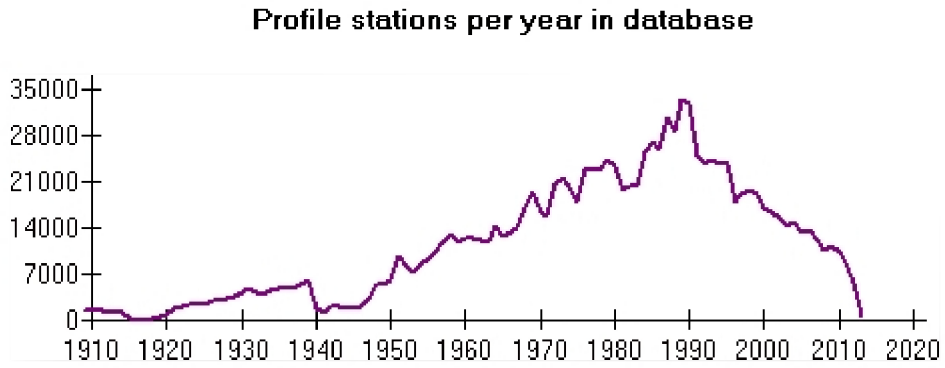
Reset Submit

Search results

Select period, area, parameter(s), country and ship and click 'Submit'

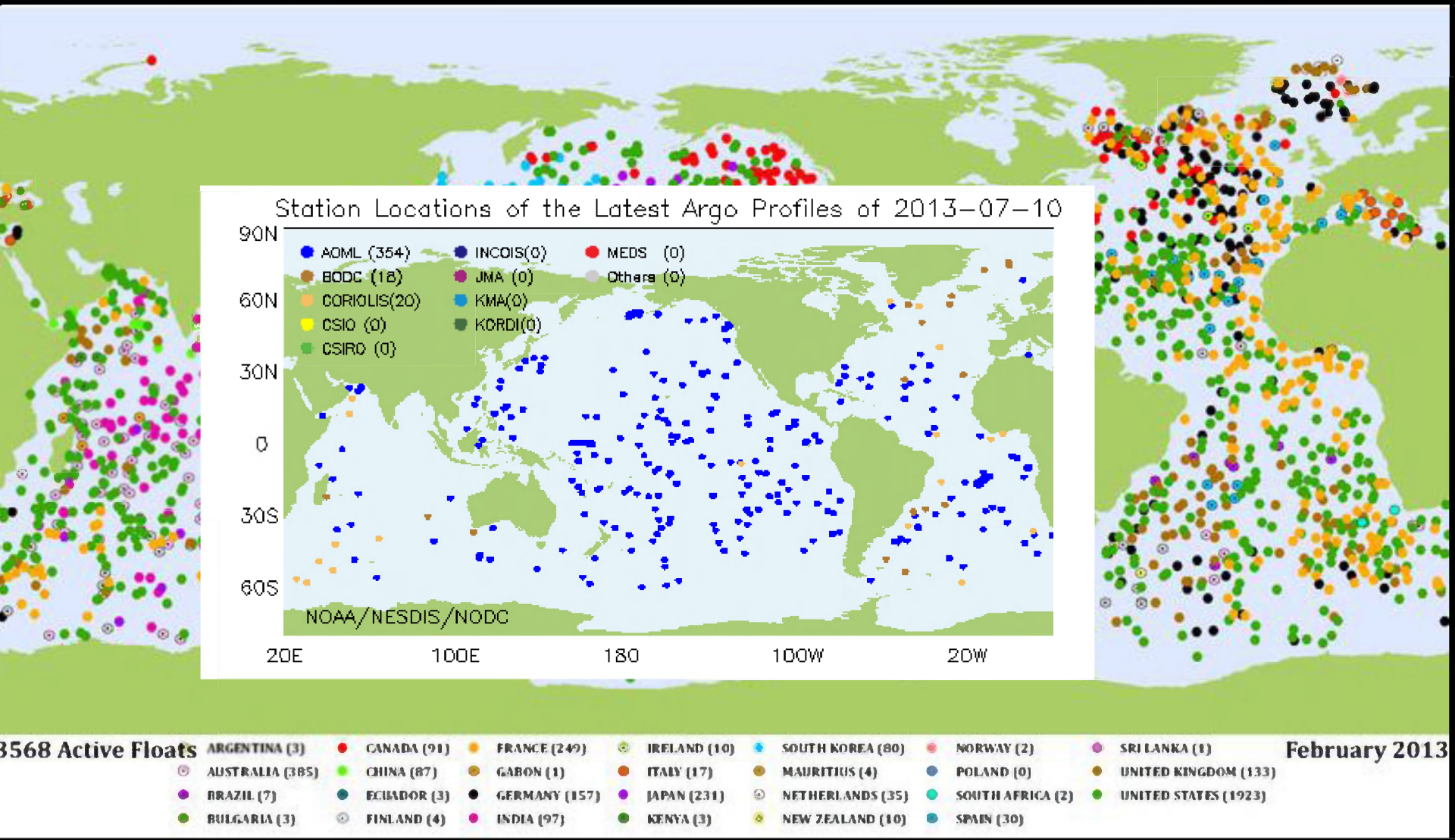
Statistics



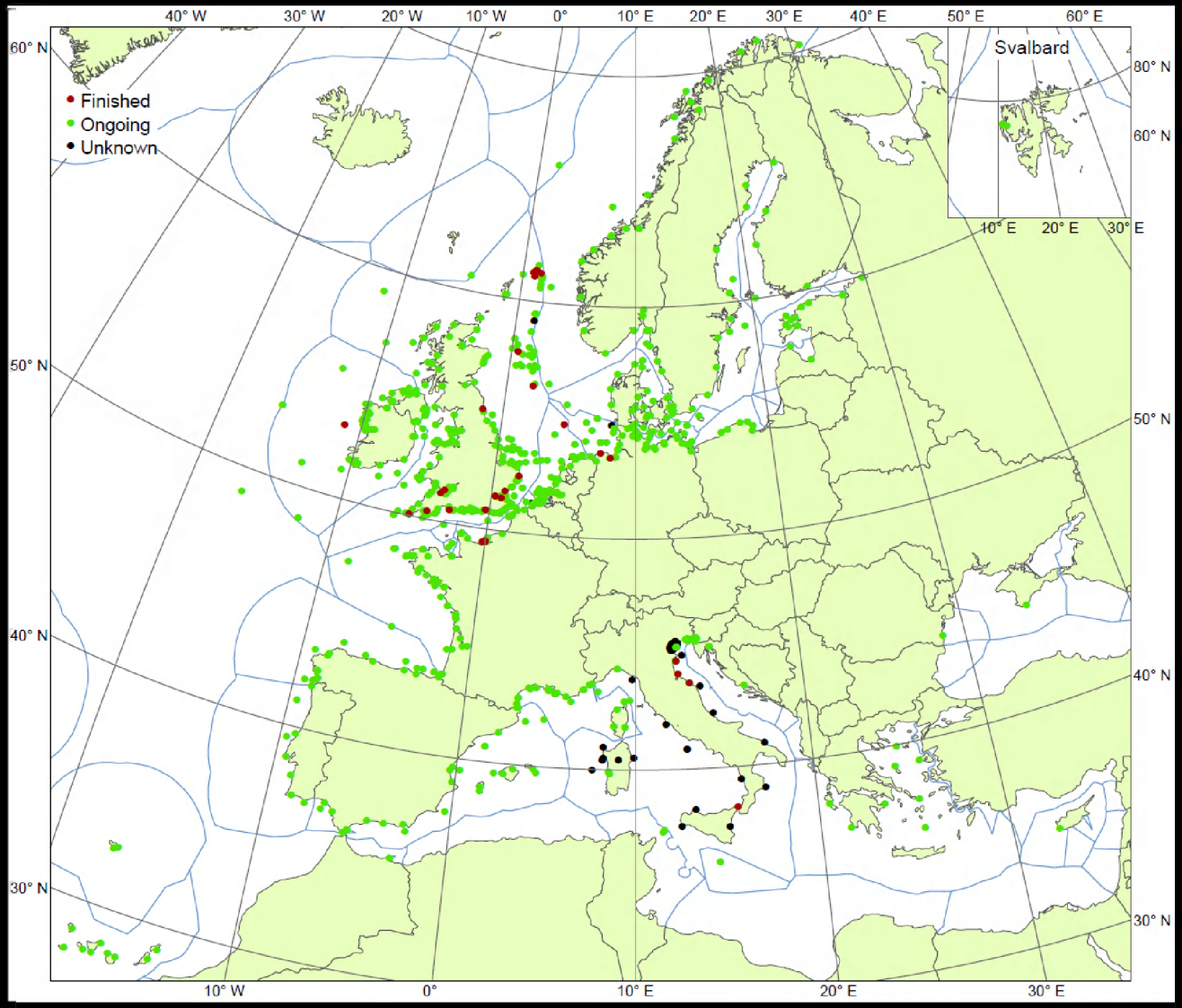


Traditional oceanographic measurements are declining

In situ marine monitoring



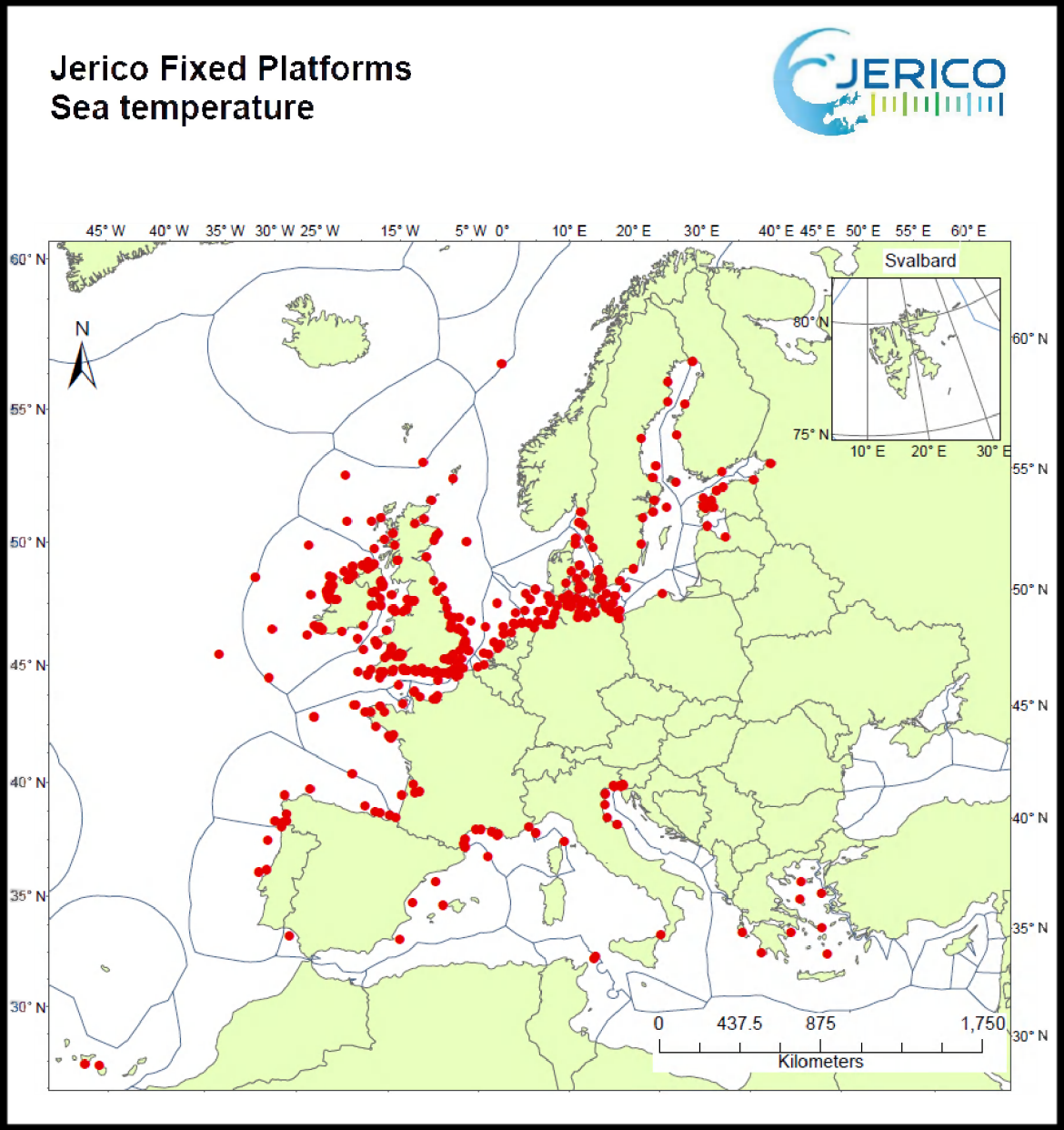
European in situ monitoring systems



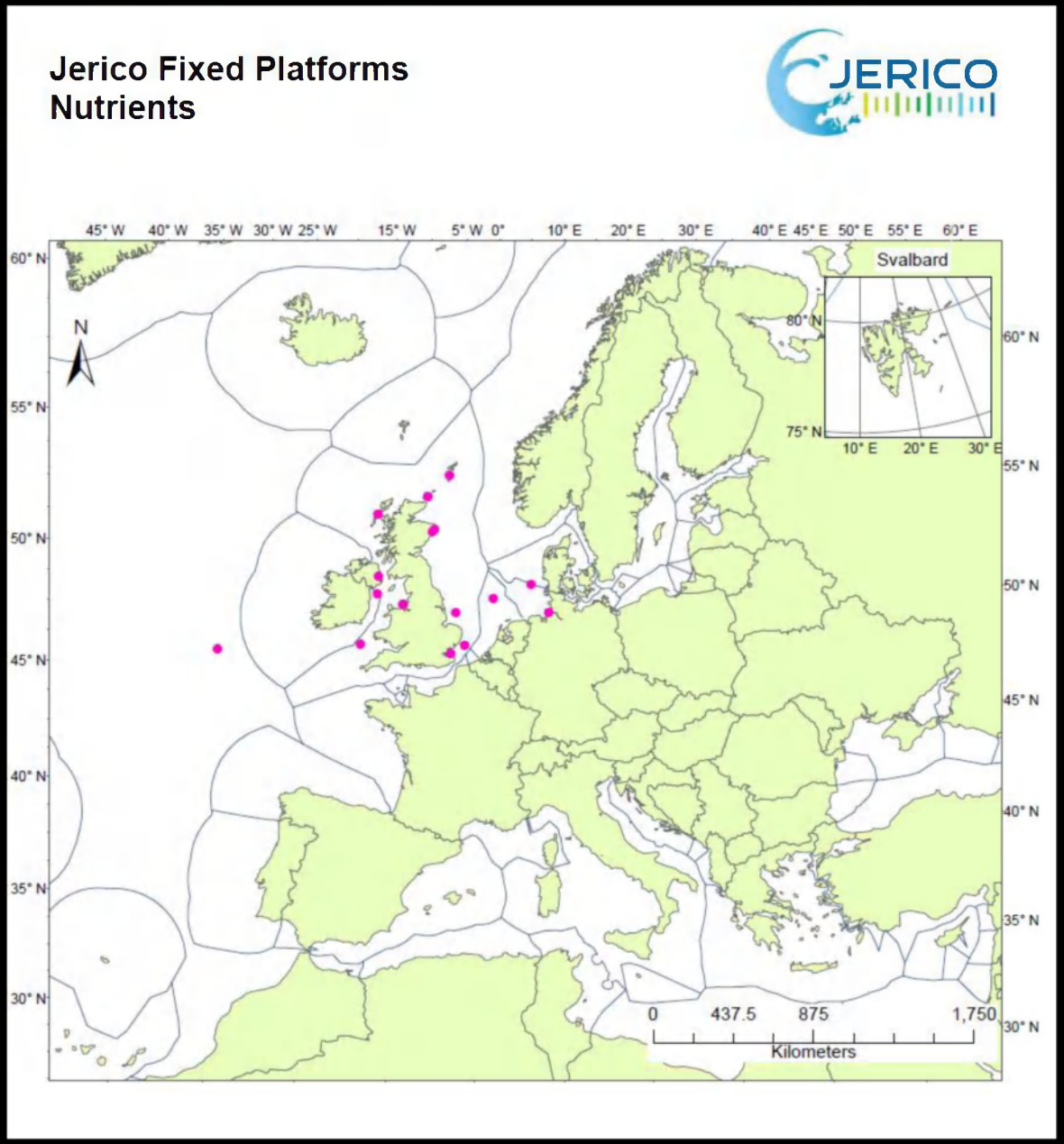
EMODNET-Physics + SeaDataNet + MyOcean in situ TAC + national

Kate Collingridge (Cefas)

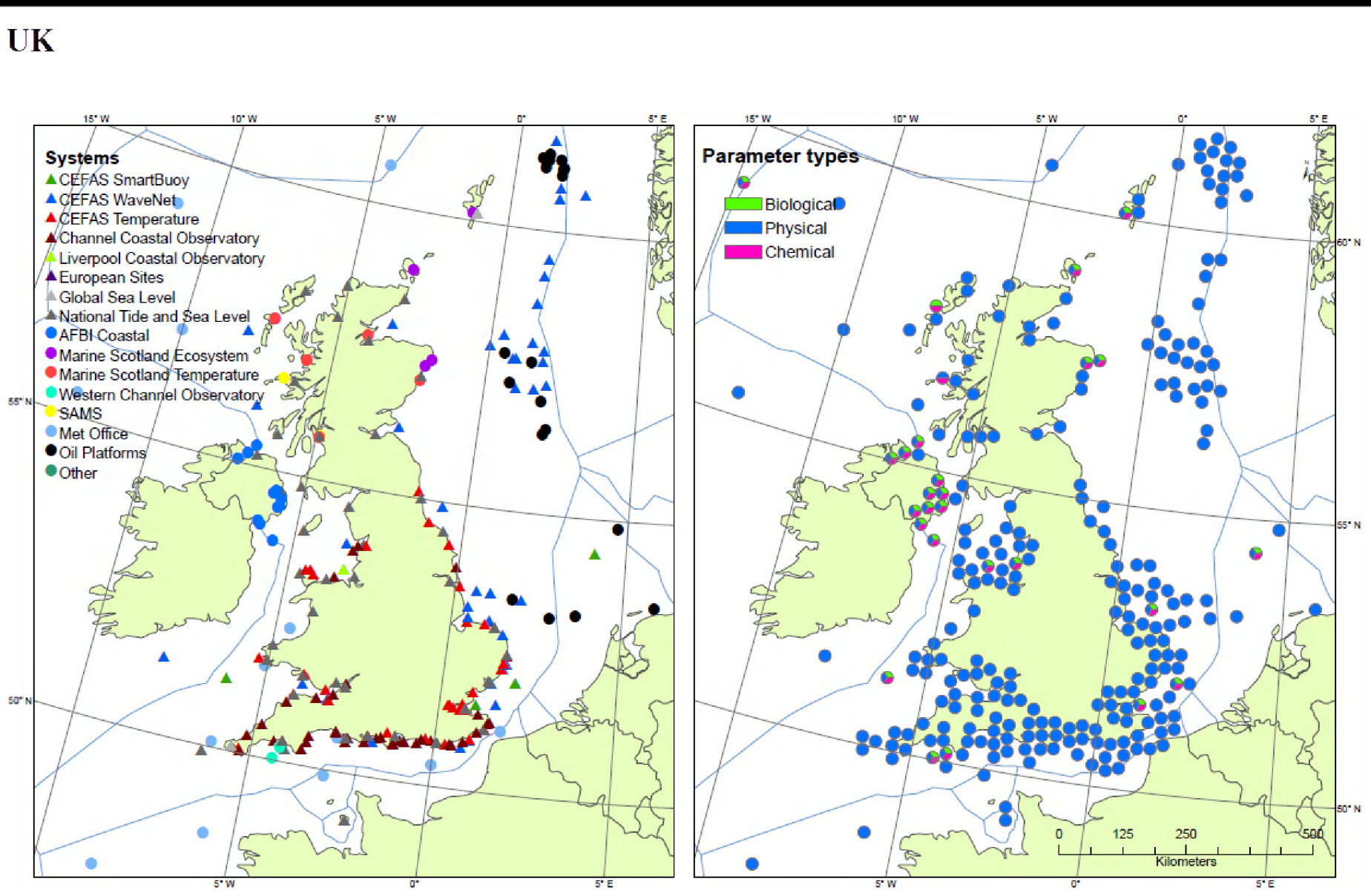
European in situ monitoring systems



European in situ monitoring systems



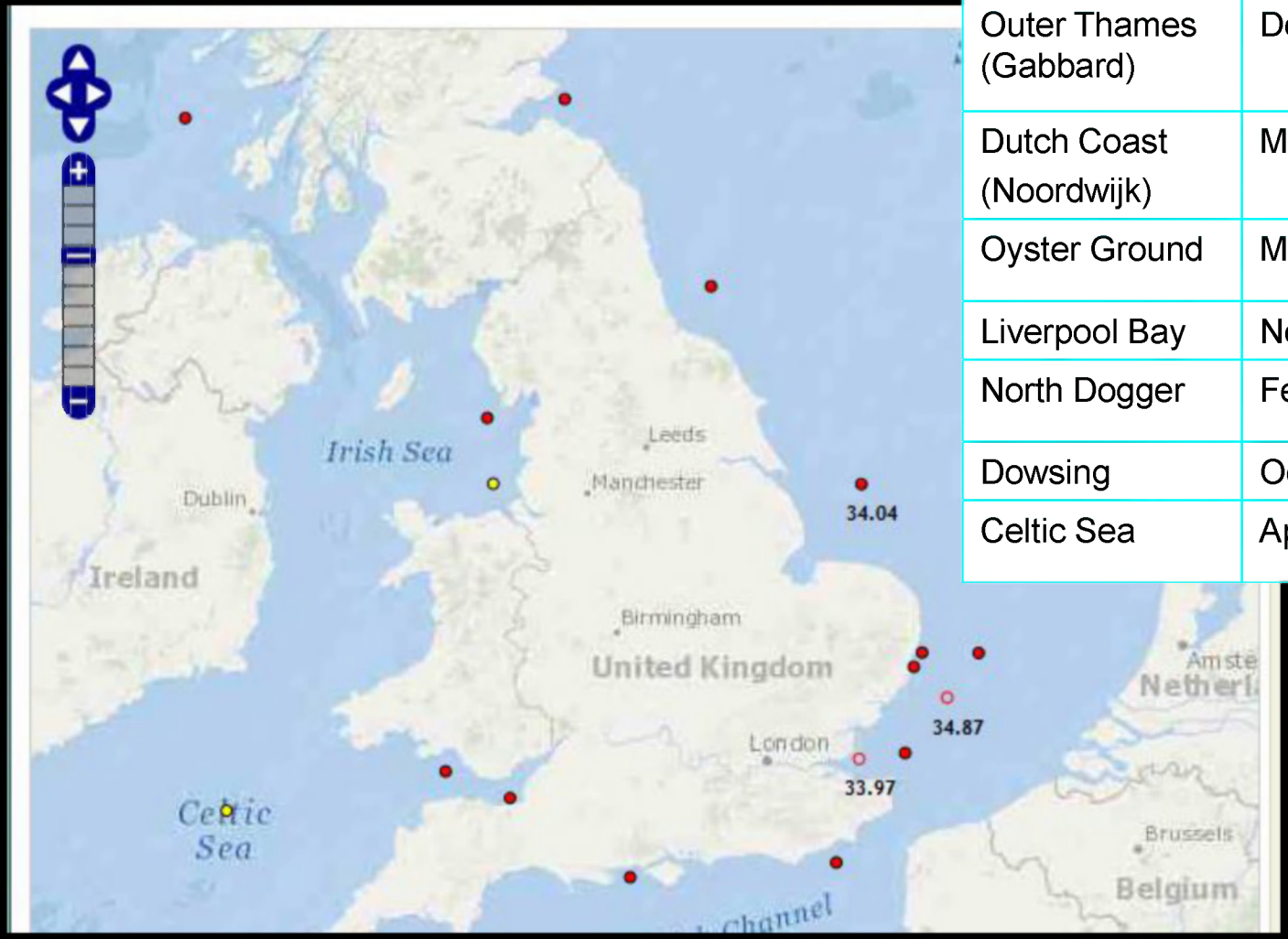
UK in situ monitoring systems



in situ monitoring systems: SmartBuoy

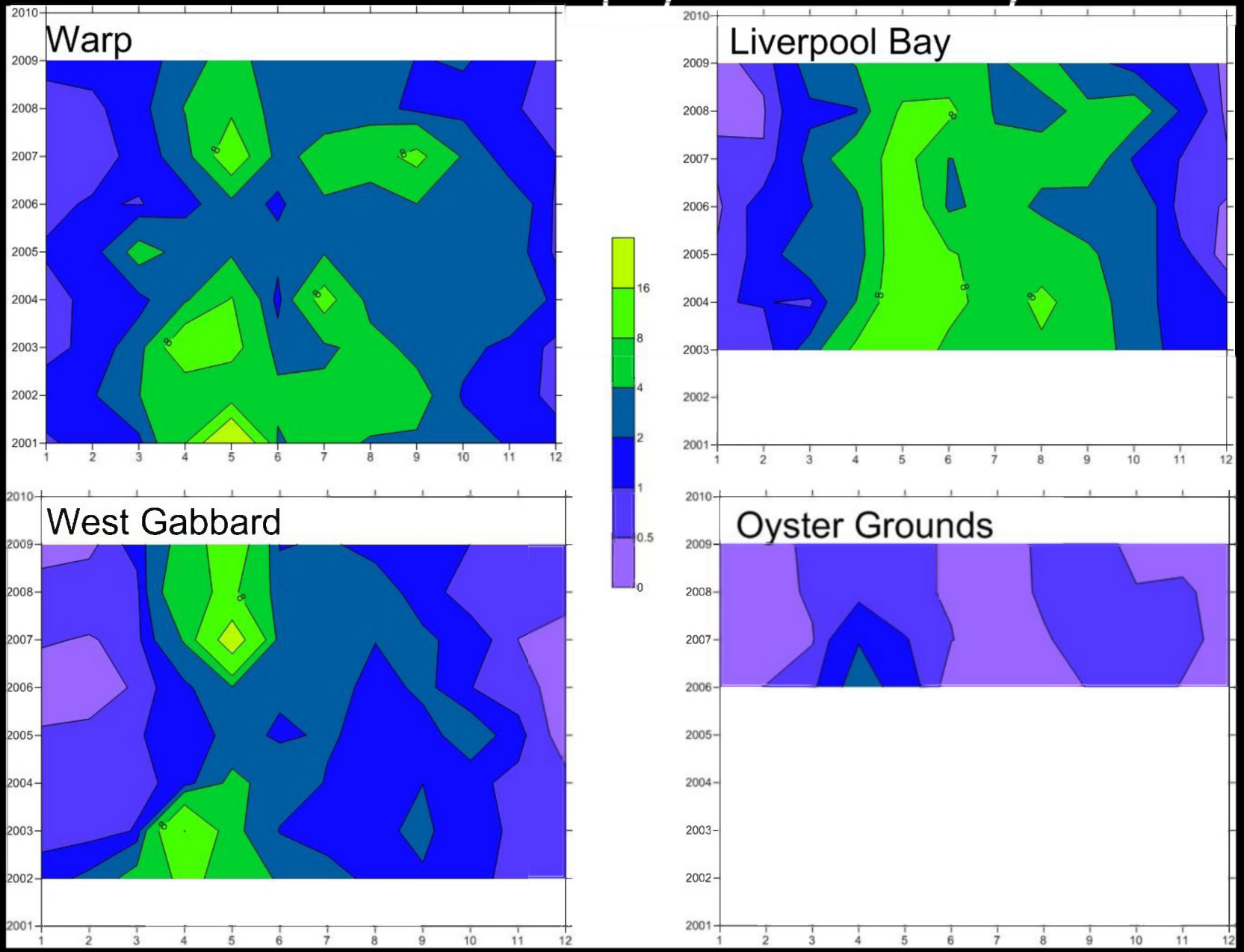
- Fibreglass hull
- 316 Stainless Steel Frame
- Instruments
  - ESM2 logger (CT, OBS, Flu, PAR, DO, etc…)
  - NAS-3X Nutrient Analyser
  - WMS-2 Water sampler
  - ORBCOMM telemetry
  - GPSMML mooring locator
  - Echomax Radar Reflector
  - Navigation Light (5 yellow/20 seconds)
- Mooring – single point below buoy, wire/chain, 900kg sinker

http://cefasmapping.defra.gov.uk/Smartbuoy/Map

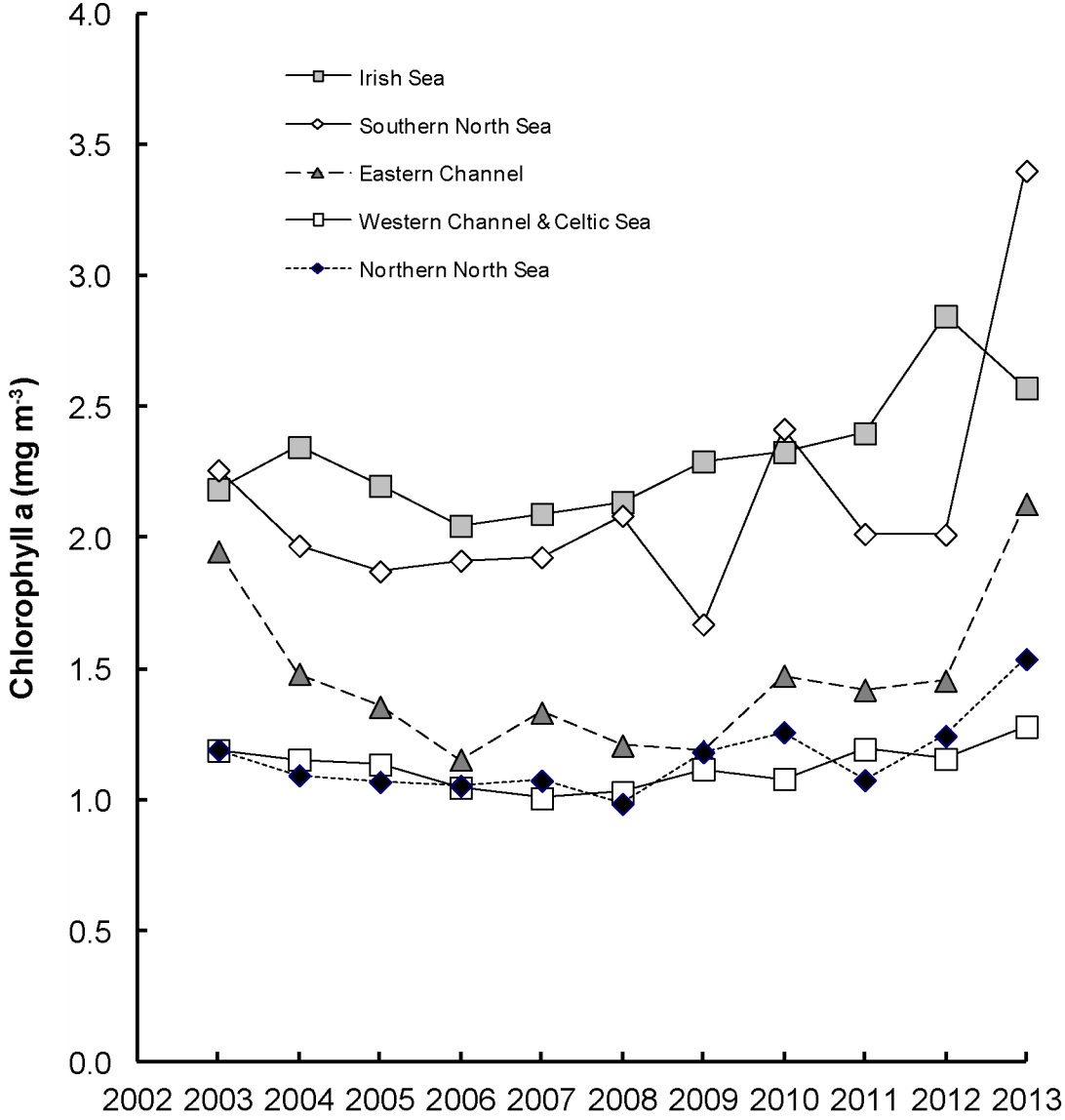


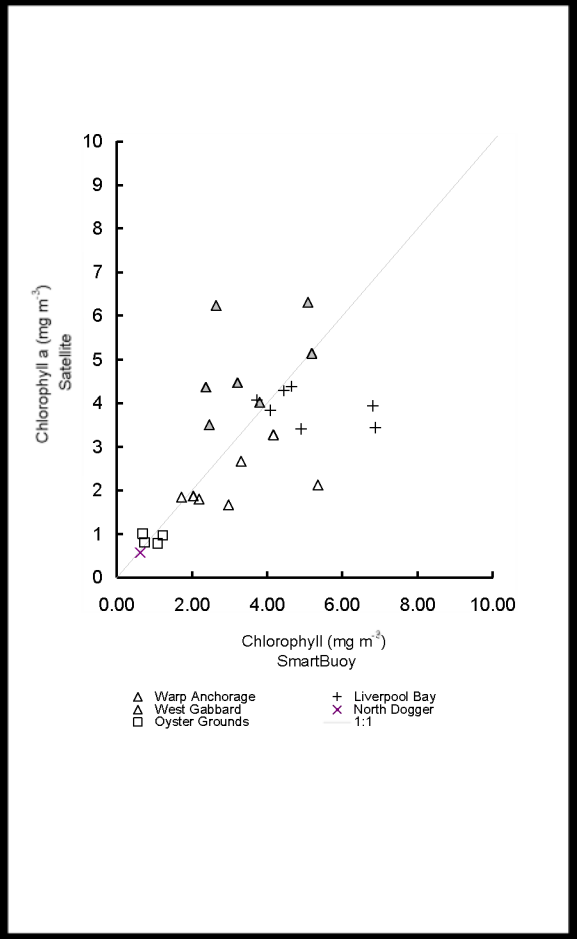
Location	Start	End
Thames (Warp)	Nov 2000	Ongoing
Outer Thames (Gabbard)	Dec 2000	Ongoing
Dutch Coast (Noordwijk)	Mar 2000	April 2002
Oyster Ground	Mar 2006	Ongoing
Liverpool Bay	Nov 2002	Ongoing
North Dogger	Feb 2007	Sept 2008
Dowsing	Oct 2008	Ongoing
Celtic Sea	April 2009	Ongoing

Time series of chlorophyll at SmartBuoy sites



SmartBuoy for satellite validation





Validated chlorophyll time series using mix of satellite (MERIS, MODIS, Sentinel) and in situ (buoys, ferrybox, ships, CPR)

in situ monitoring systems: FerryBox_RV

pCO_2

Temperature

Salinity

Nutrients

Passive sampler

Flow Cytometer

Variable Fluorescence

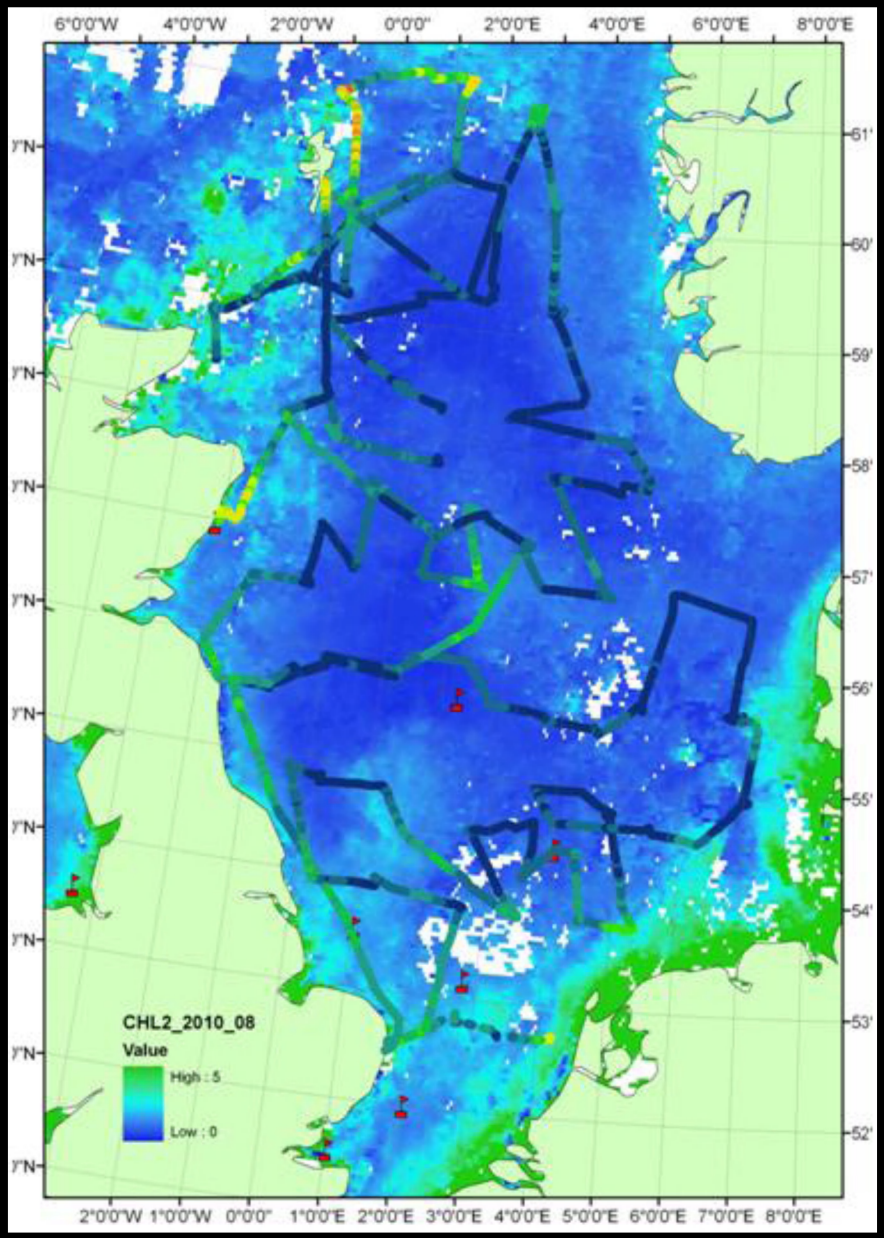
Acoustics: Fish +Zooplankton

Automatic plankton sampler

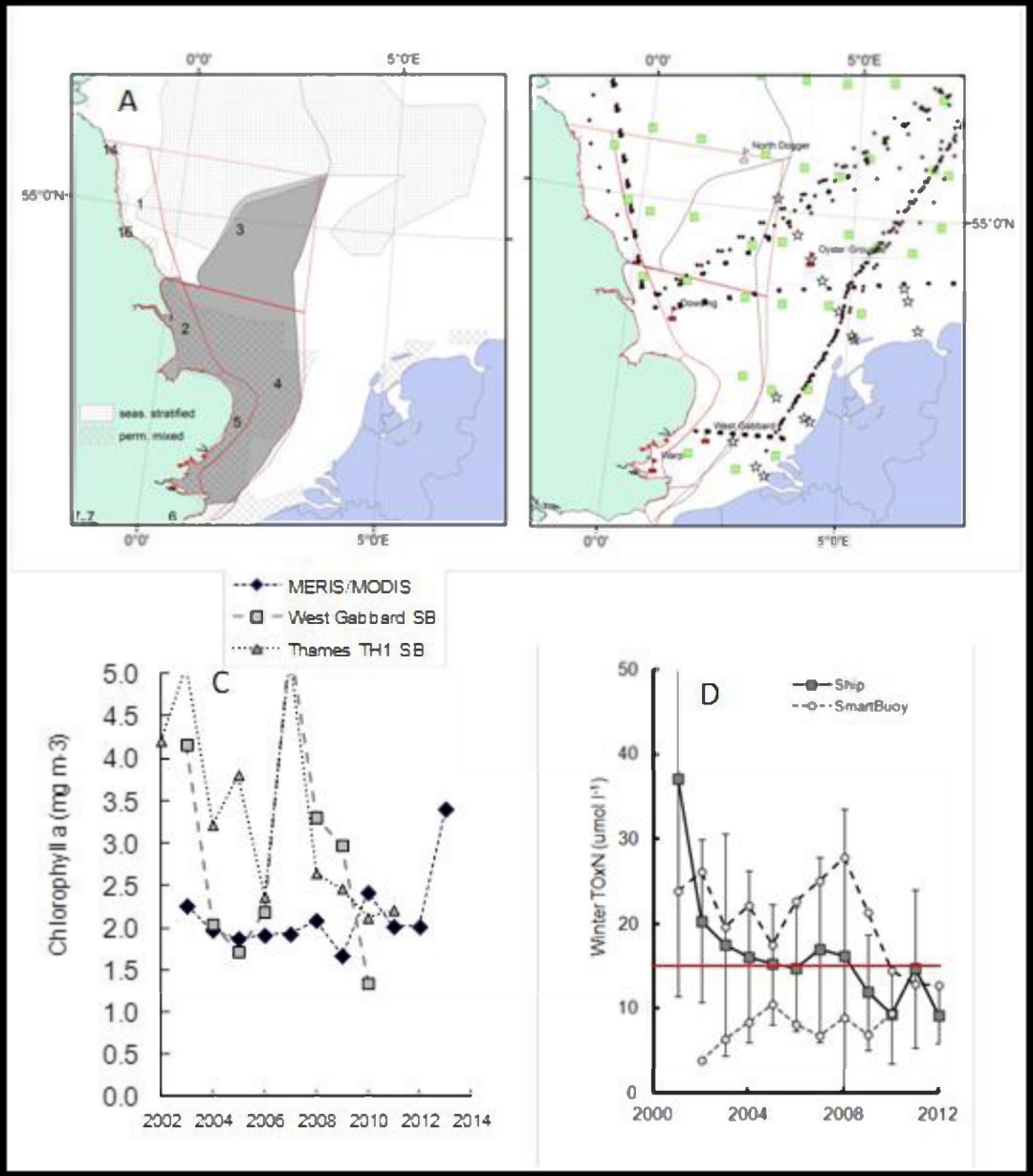
Properties of ideal indicators for ecosystem-based management of marine resources: quantifiable in unambiguous, standard units; measurable rapidly, low cost implementation; high repeat frequency; multiple uses for the same indicator; and capable of implementation in many locations using same methodology.

Platt and Sathyendranath (2008)

in situ monitoring systems: FerryBox_RV



Integrated assessment of water quality



In situ monitoring must be adaptive