A satellite image of the United Kingdom coastline, showing the English Channel, the North Sea, and the Irish Sea. The water is colored in shades of green and blue, indicating ocean color data. The land is shown in brown and green tones. The text is overlaid on the image.

Using ocean colour products for monitoring and
assessment
of UK marine waters

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Science and monitoring is driven by government needs

- Urban Waste Water Treatment Directive (91/271/EEC)
 - Nitrates Directive (91/676/EEC)
 - Environmental Impacts Assessment Directive 85/337 as amended by 97/11
 - Bathing Waters Directive (76/160/EEC)
 - Integrated Pollution Prevention and Control Directive (96/61/EEC)
 - Water Framework Directive (2000/60/EC)
 - *European Marine Strategy (2007/8)*
 - *Marine and Coastal Access Bill (2009)*
-
- Policy support requires firm evidence base
 - Timely, focussed and understandable results
 - Robust – able to stand up to scrutiny

Most important target for Cefas is the MSFD

■ Marine Strategy Framework Directive (2010)

This implements the whole ecosystem approach to monitoring and requires 'Good Ecological Status' of the marine environment to be achieved by 2020.

Descriptors include: biodiversity, fish stocks, food web structure, eutrophication, seabed integrity, contamination, litter, underwater noise, hydrography.

Recording of these descriptors for the UK's marine waters is a new challenge, requiring an integrated observing strategy of ships, remote vehicles, autonomous instruments, remote sensing and ecosystem models.

“ By applying an ecosystem-based approach to the management of human activities while enabling a sustainable use of marine goods and services, priority should be given to achieving or maintaining **good environmental status** in the Community's marine environment, to continuing its protection and preservation, and to preventing subsequent deterioration”

History of UK water quality monitoring (1990-2000)

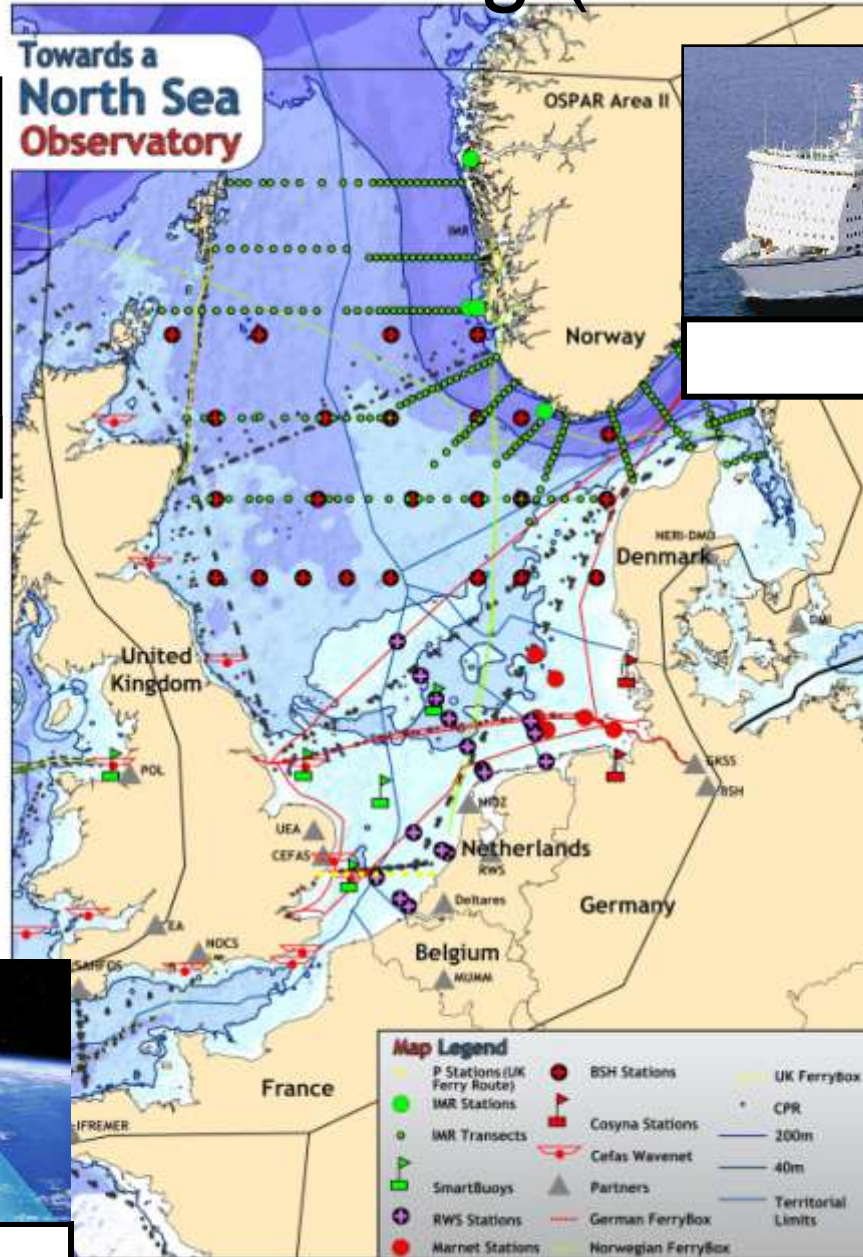
- Reporting to OSPAR
- Ship based observations
- Good spatial coverage
- Poor temporal resolution
 - Annual winter nutrient survey
 - Occasional summer survey
- Limited biological data
 - Chlorophyll, oxygen
- Labour intensive (expensive)



Operational monitoring (2000 - 2010)



Research vessels



Ferries



Towed bodies



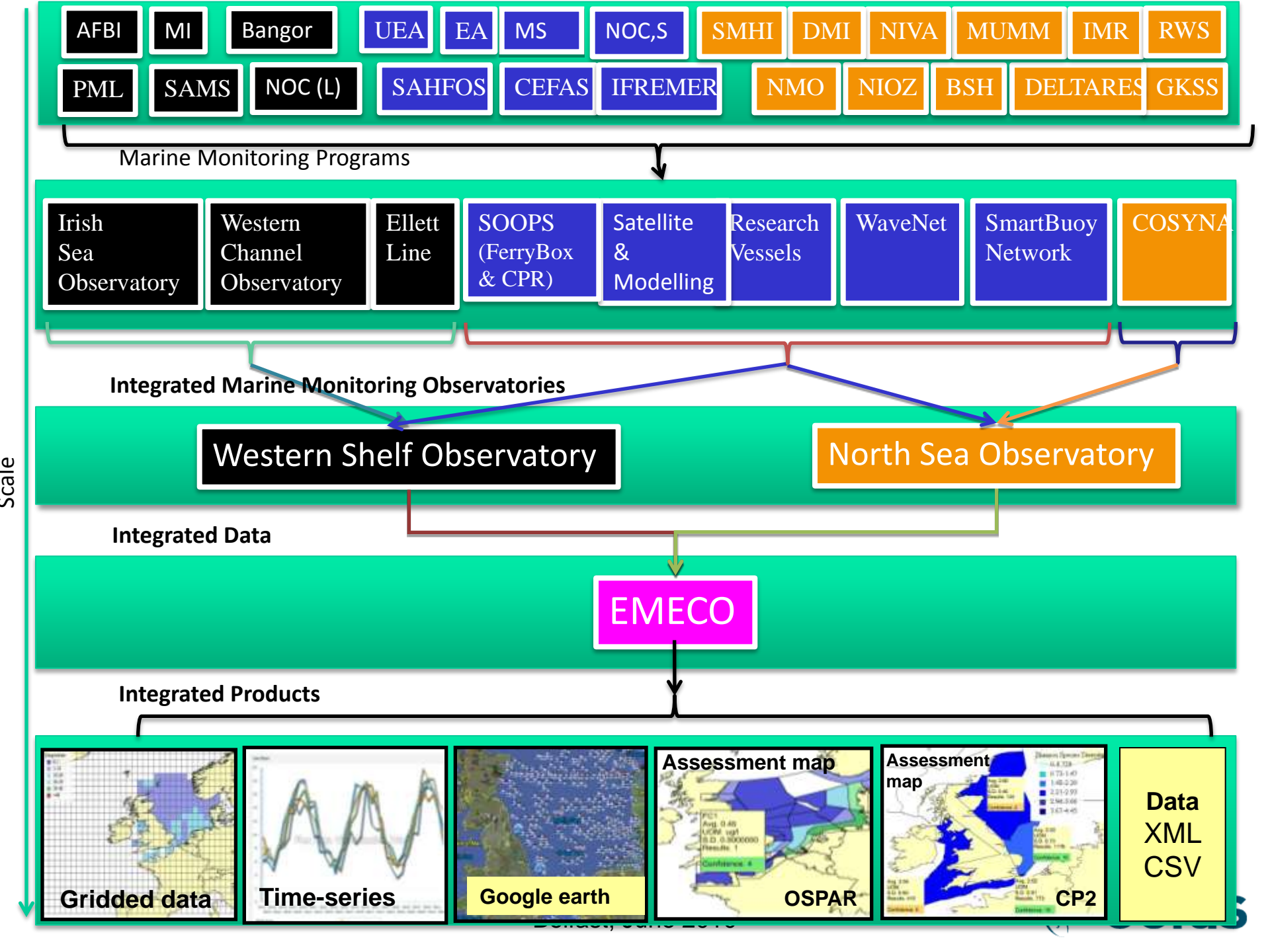
Gliders



Satellites



Buoys



Autonomous pelagic observations – Cefas SmartBuoy

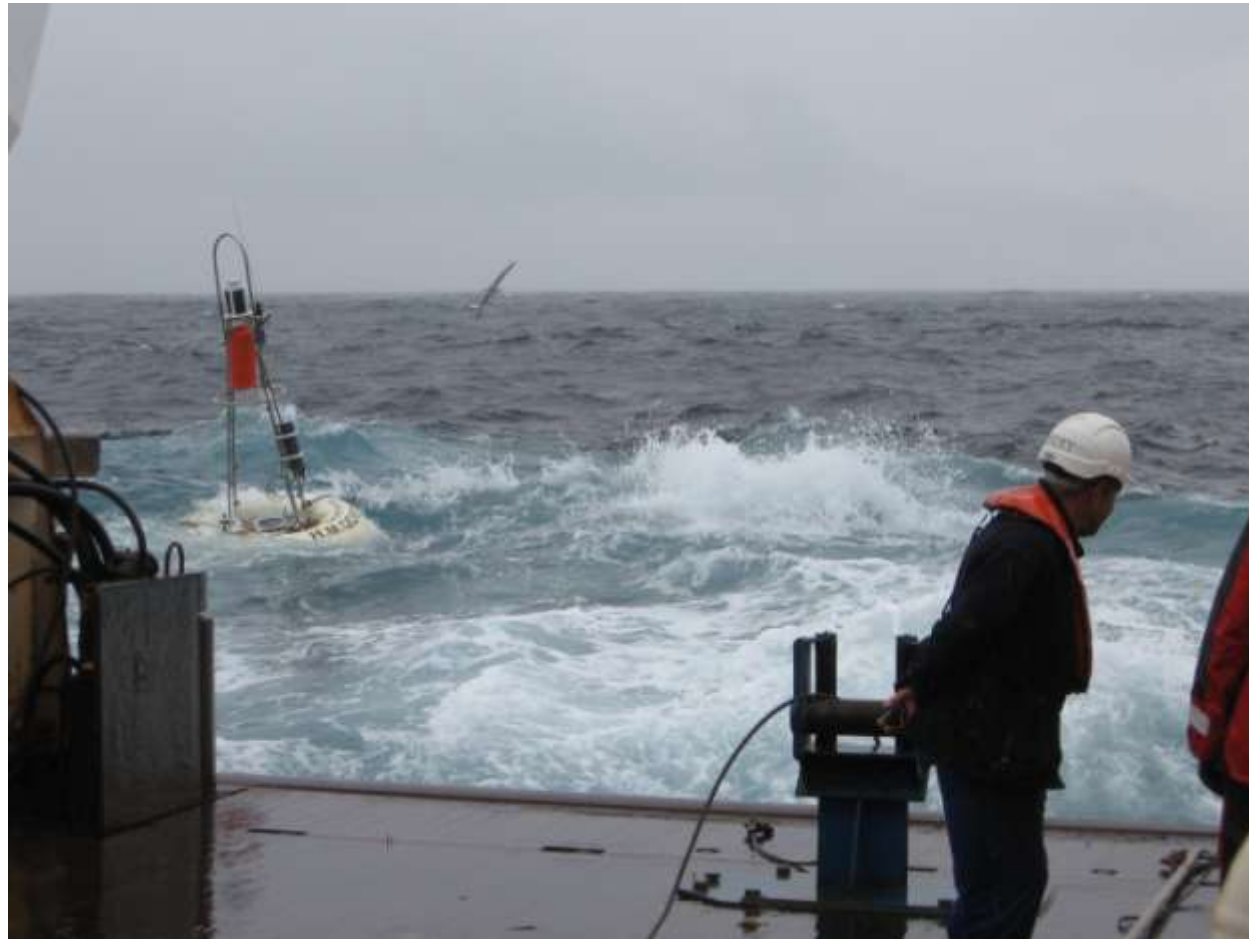
Instrument	Measurement
CT sensors	Salinity, temperature
PAR irradiance sensors	Ed at 1.5 and 2.5 m depth
Optical backscatter sensor	Turbidity – suspended particle concentration
Chlorophyll fluometer	Chlorophyll fluorescence (chlorophyll ?)
Oxygen sensor	Dissolved oxygen
In situ nutrient analysers	ToXN concentration (Nitrate + nitrite) [NAS2E]
Automated water sampler (50 x 150 ml samples)	Samples preserved with mercuric chloride for ToXN or Lugols iodine for phytoplankton cell numbers and species composition [Aqua Monitor]

- Single point mooring
- Near surface measurements
- Burst sampling
- Frequency (1 Hz – 1 day)
- mid water and bottom measurements in stratified waters



Autonomous pelagic observations – Cefas SmartBuoy

Deployment of a mooring in the North Sea, February 2007

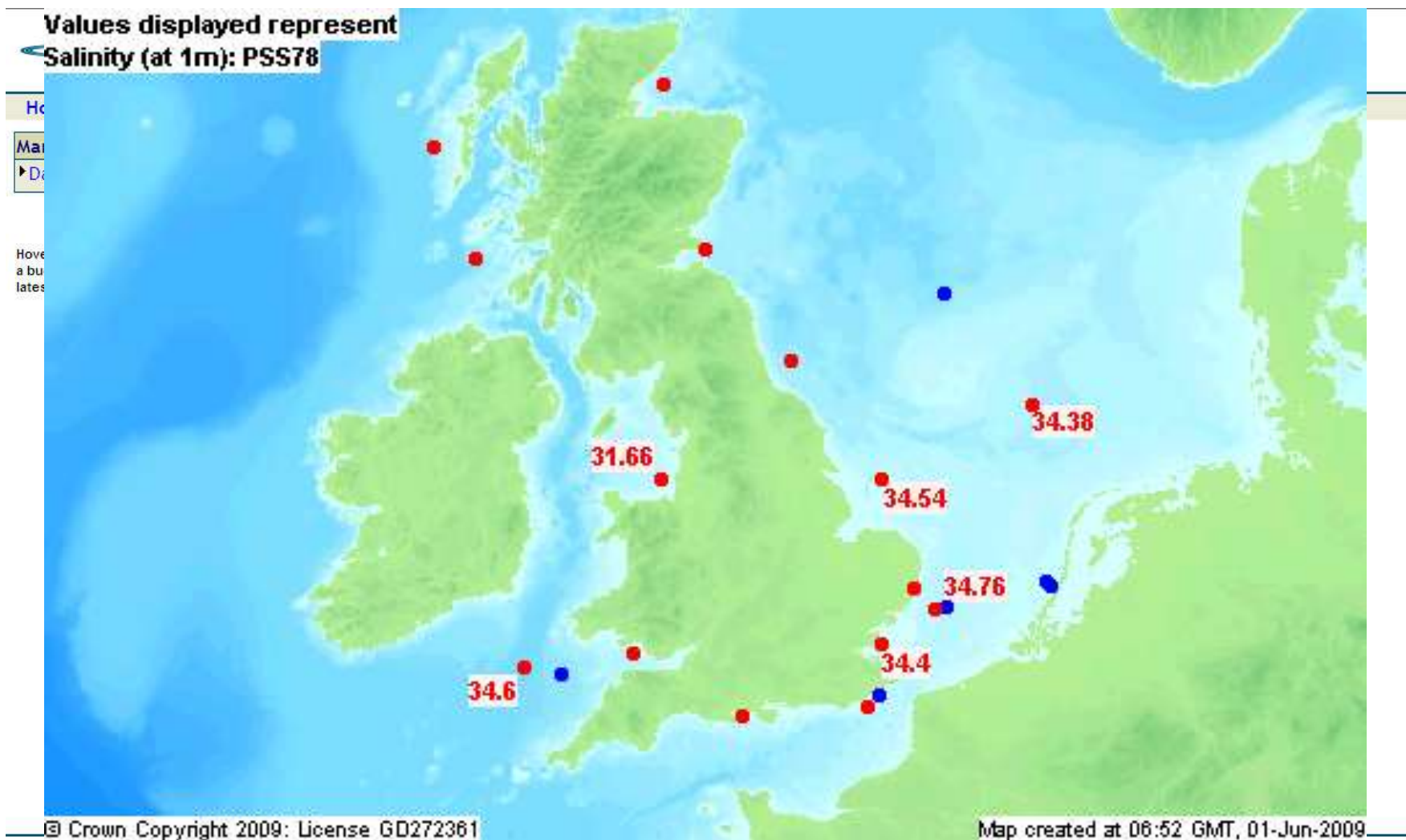


Sensor packs at surface, midwater (30 m) and seabed (85 m)

Autonomous pelagic observations – Cefas SmartBuoy

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	

www.cefas.co.uk/monitoring



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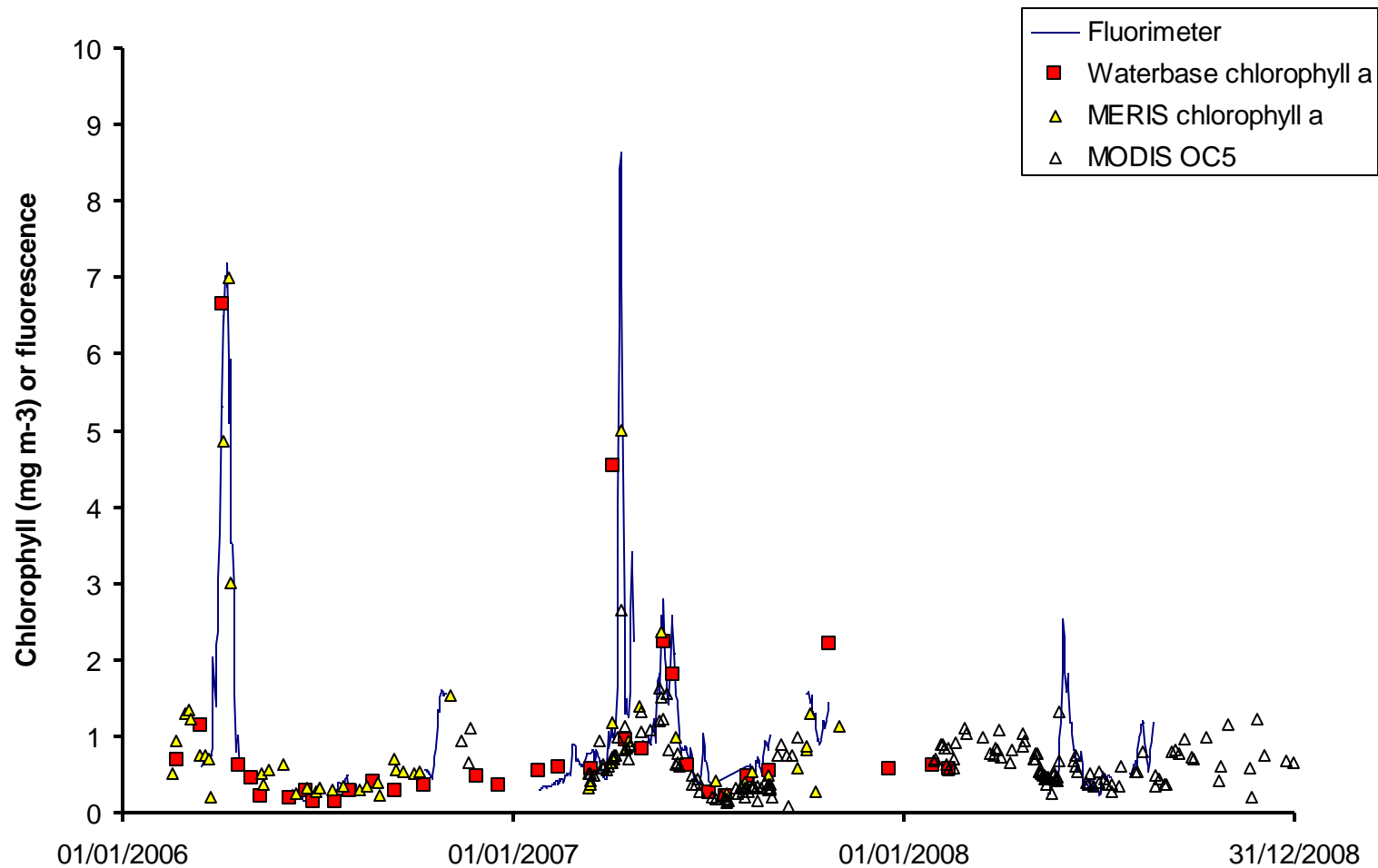
Centre for Environment, Fisheries & Aquaculture Science (Cefas)

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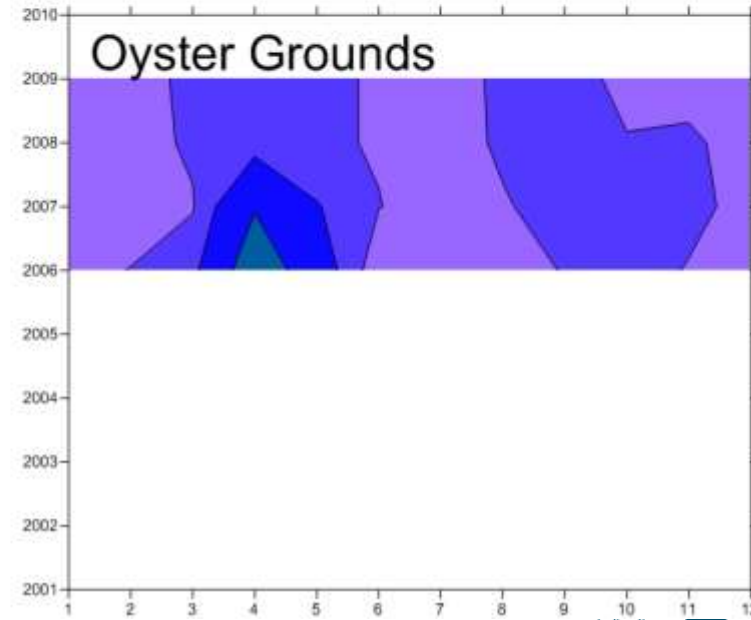
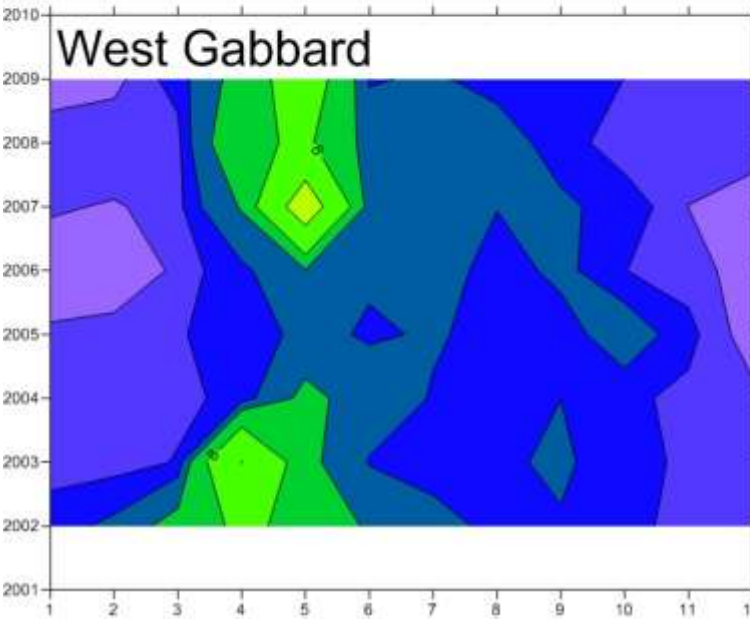
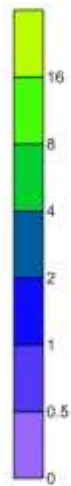
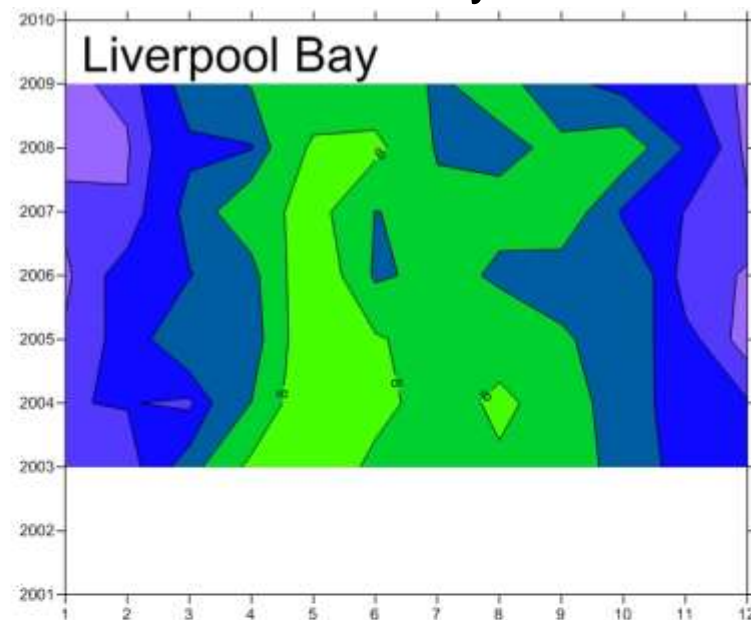
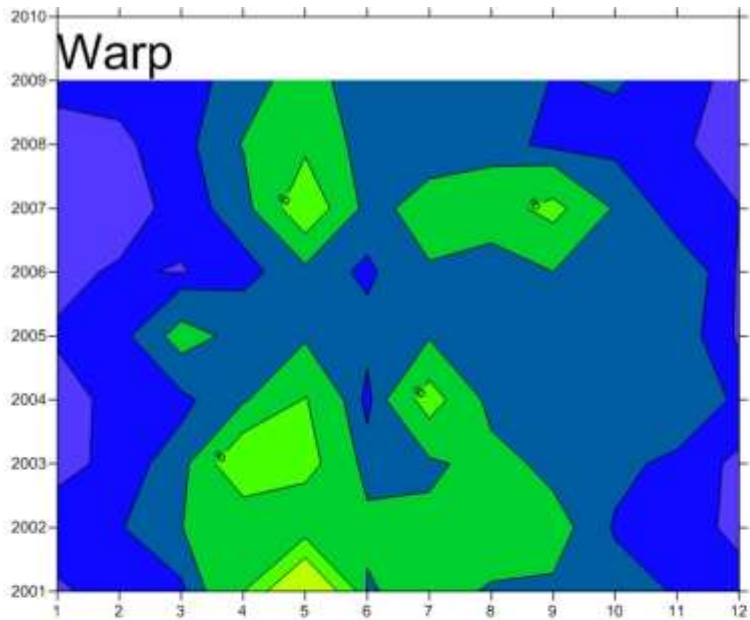
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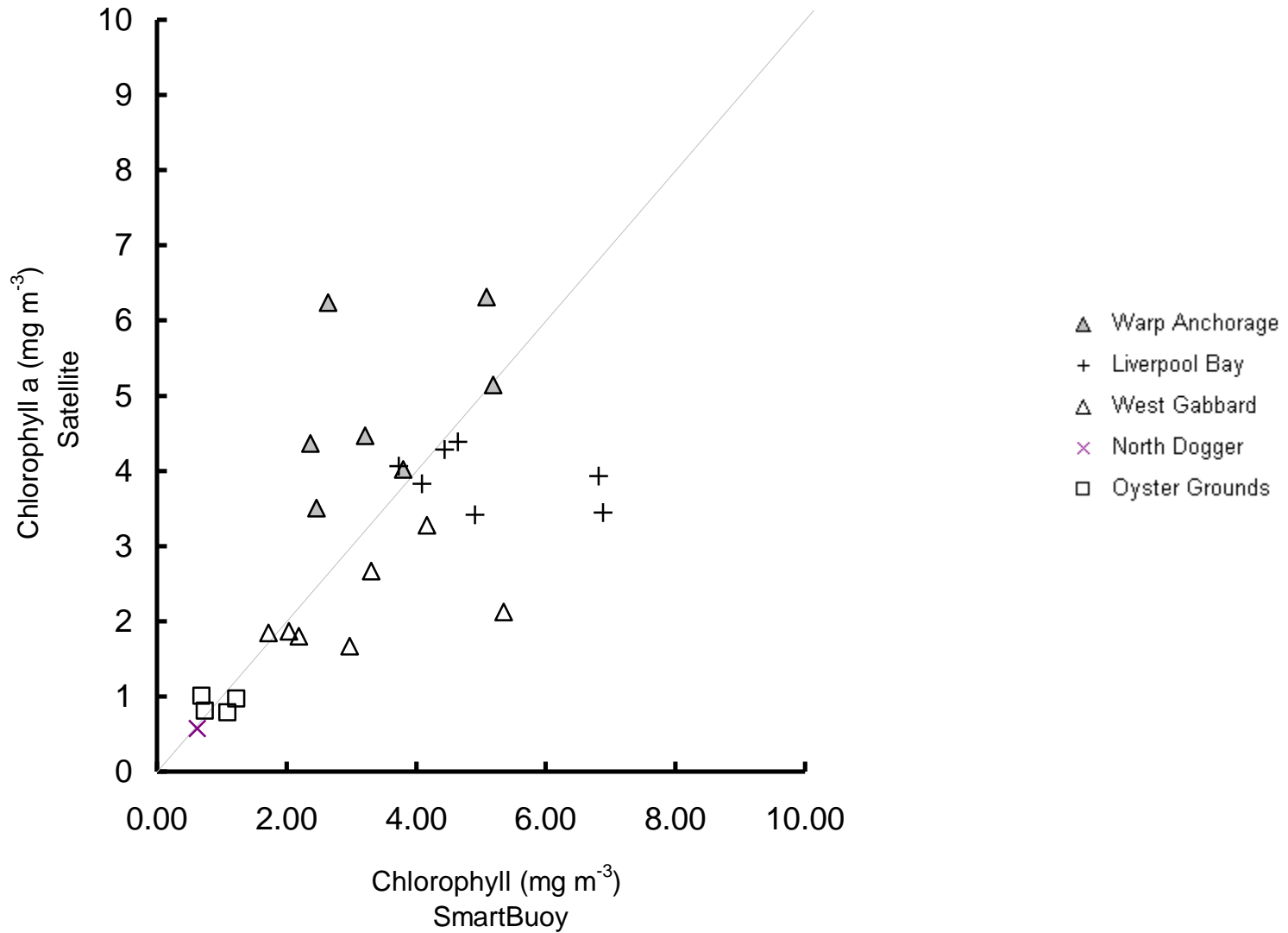
Intercomparison of methods at the Oyster Grounds mooring site



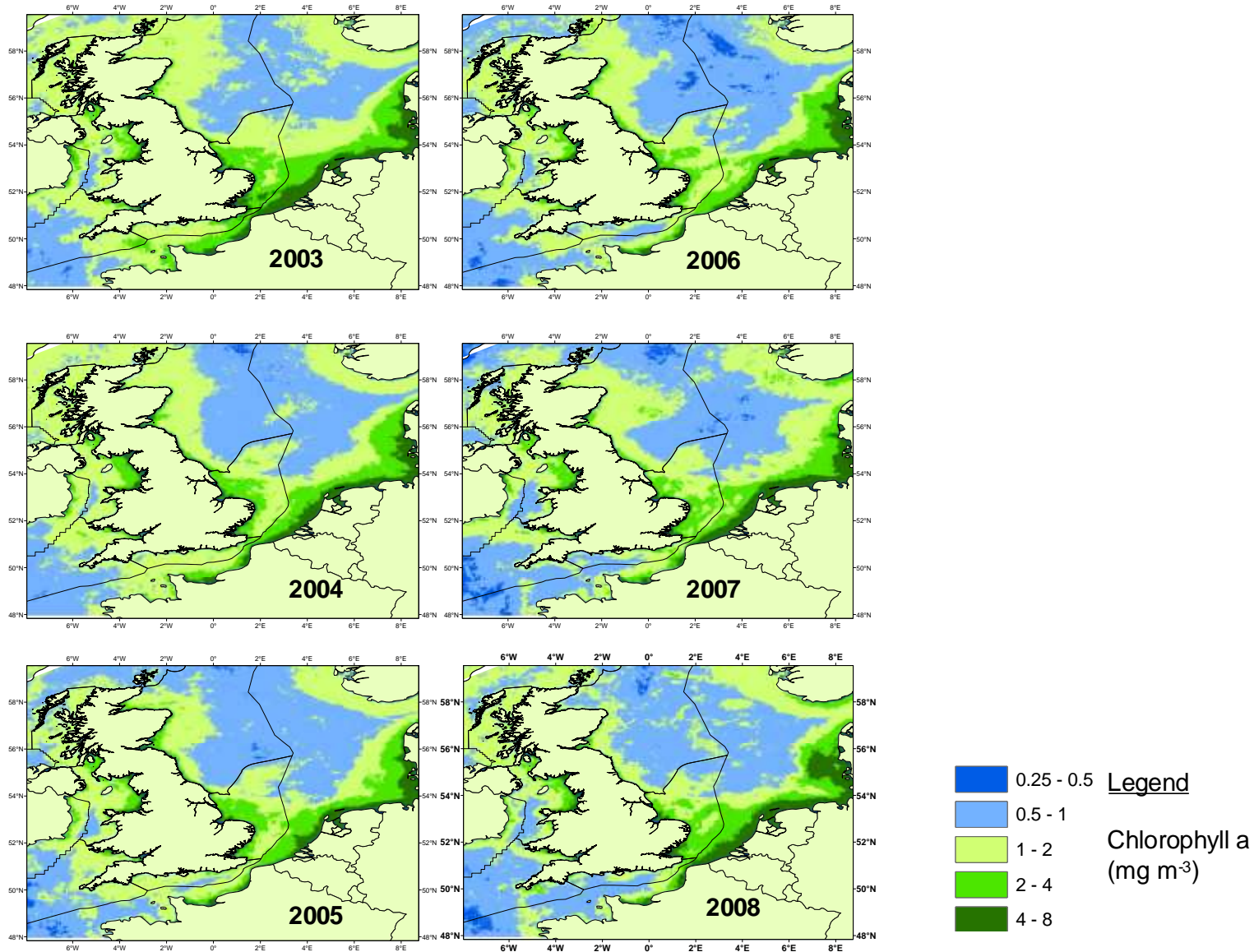
Time series of chlorophyll at coastal SmartBuoy sites



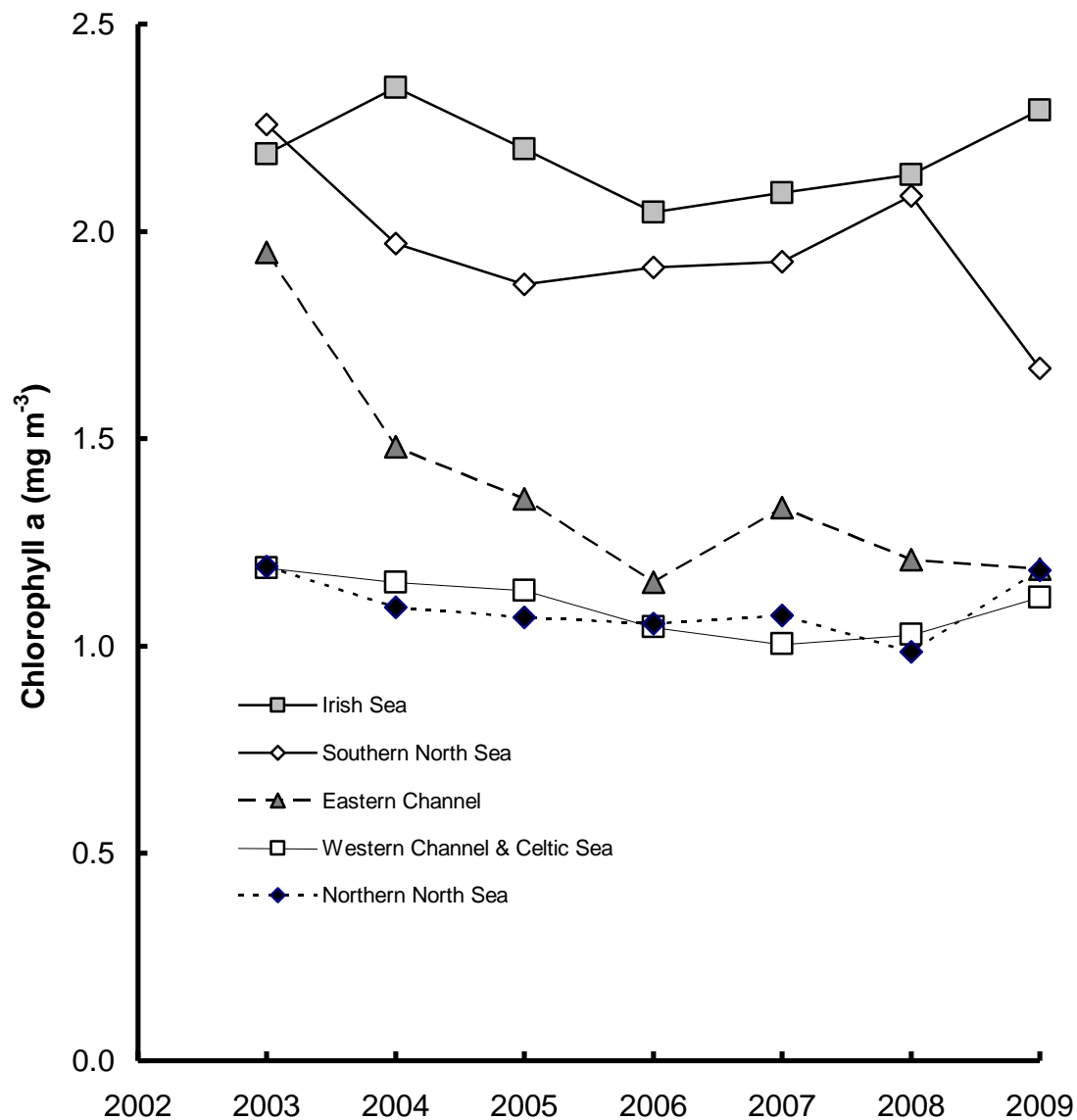
Comparison of growing season chlorophyll from MERIS and SmartBuoy



Mean growing season surface chlorophyll from MERIS



Trends in mean growing season surface chlorophyll from MERIS



What can CoastColour do for me (and what can I do in return)?

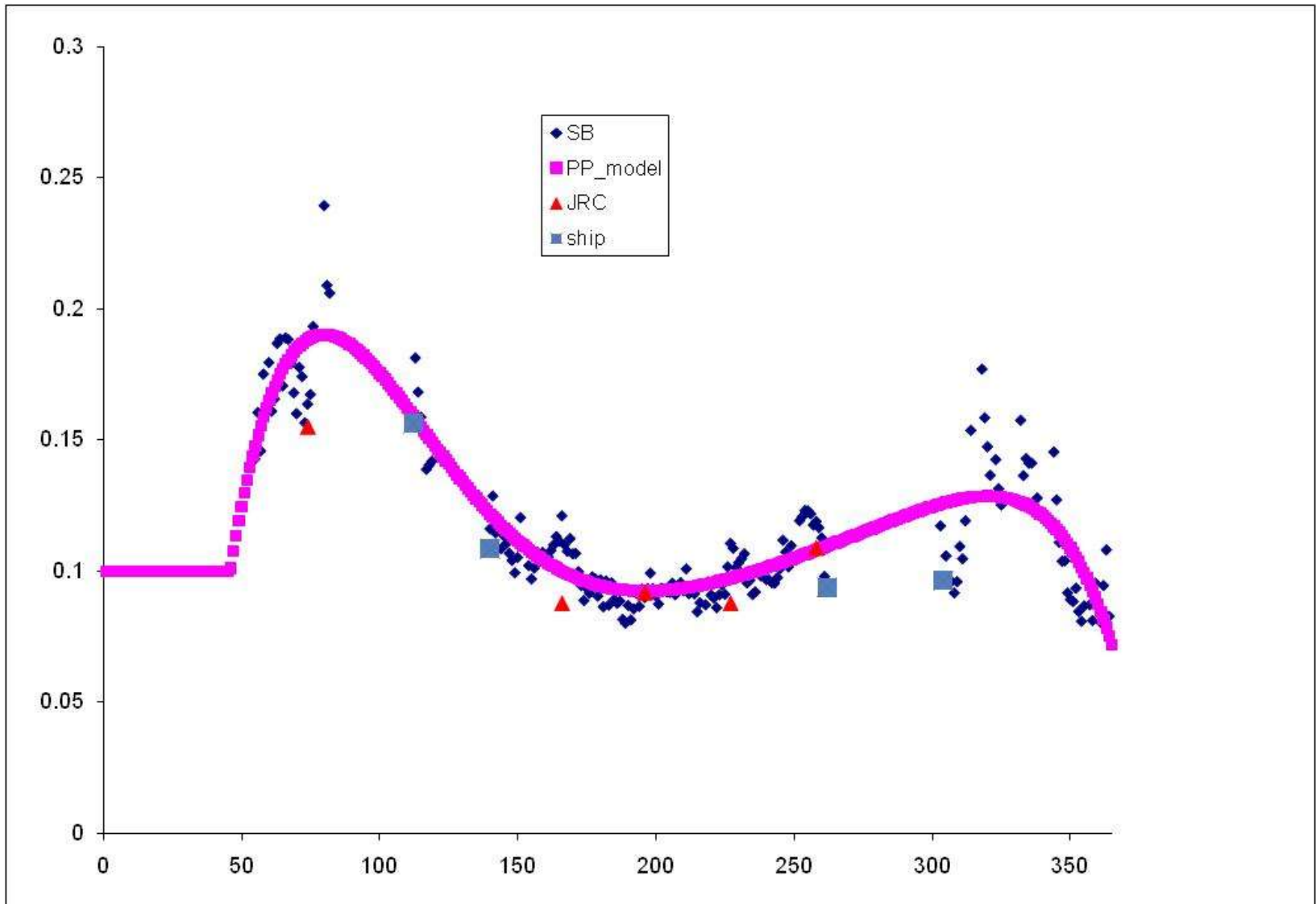
- ❑ Continuation and improvement of existing OC products
 - Merged products (as produced by GlobColour, Giovanni..)
 - High resolution coastal products
 - Chlorophyll, SPM, K_d

- ❑ Primary production product for European seas to use in MSFD

- ❑ Cefas would like to participate in CoastColour by providing in situ data for comparison...
 -ship, Buoy, Ferrybox will be made available via www.emecodata.net

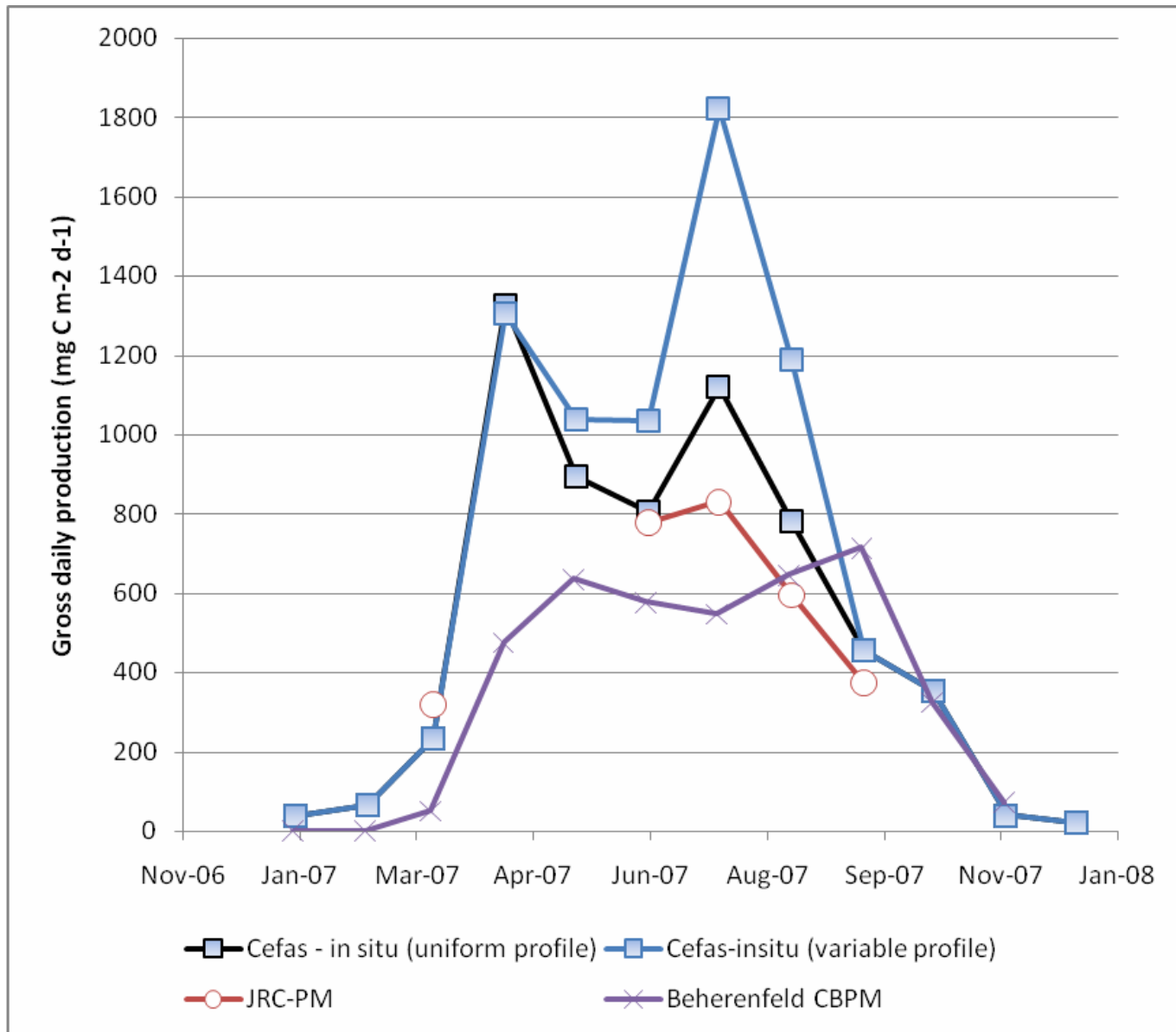
Attenuation coeff. required for various MSFD descriptors

Attenuation coefficient for PAR (K_d)



Day of year (2007)

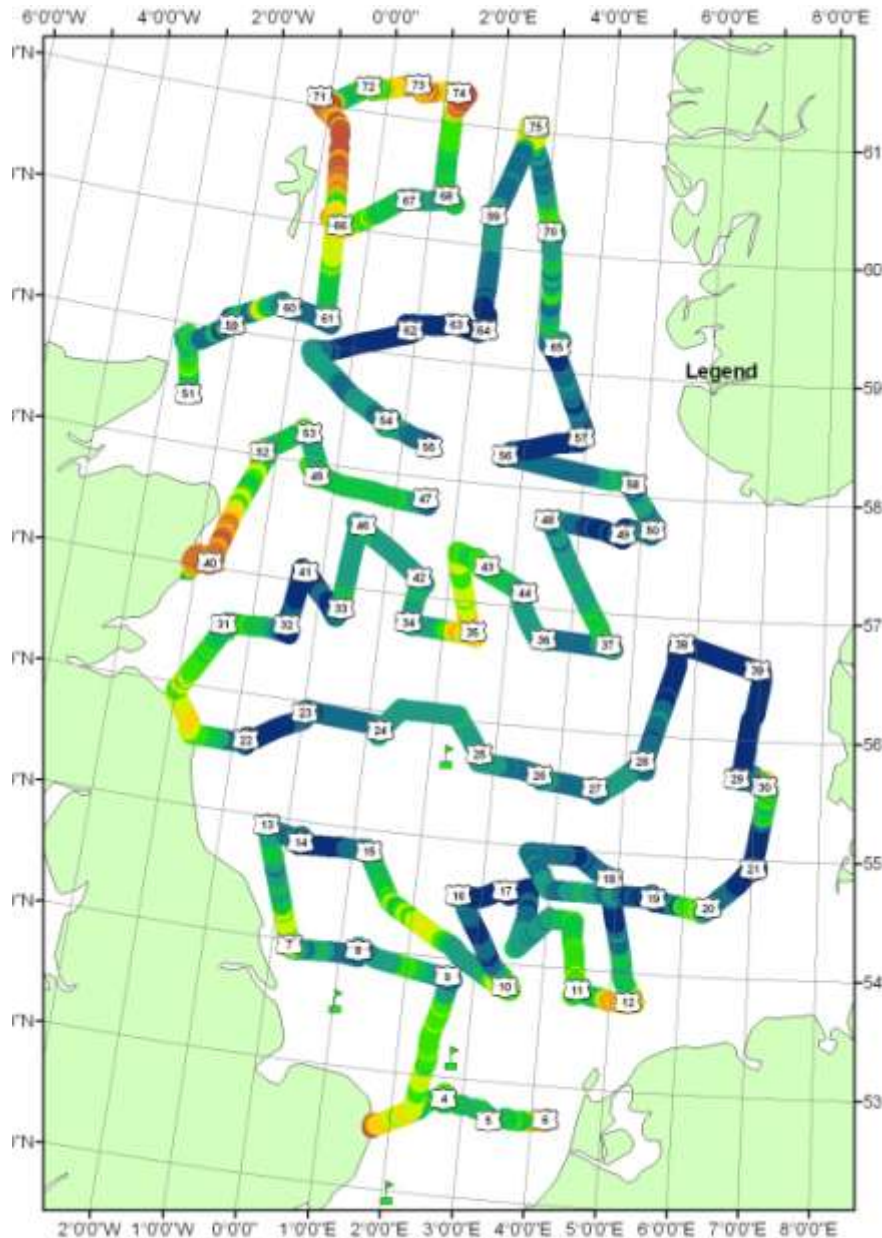
Primary production required for various MSFD descriptors



Autonomous pelagic observations – Cefas FerryBox



Autonomous pelagic observations – Cefas FerryBox



Fisheries cruise track with surface chlorophyll fluorescence logging



2007-2009 – addition of K_d
2010 – addition of HPLC pigments, flow cytometer, FRRF.
2011 – addition of spectral optics?

Summary

- ❑ Monitoring of the marine environment is required by law
- ❑ The traditional ship-based approach to assessing water quality produced high quality data, but at a very low frequency
- ❑ Automated platforms, remote sensing can produce data at very high frequency, of equal quality which can be assimilated into ecosystem models
- ❑ We are moving towards a data-rich environment where the challenges will no longer be to measure, but to understand ecosystem function
- ❑ Cefas would like to participate in CoastColour by guiding the development of products, giving feedback, and providing in situ data for comparison