

Change detection in the Humber using satellite remote sensing

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Caveat:
Satellites cannot measure
everything.

THE HUMBER: UK'S ENERGY ESTUARY

Our Energy WE ARE A VITAL ENERGY PROVIDER IN THE UK

We import **1/3** of the UK's oil and a significant amount of biomass

We lead **1/5** of the UK's natural gas

3 of the world's largest wind farms are in our area and form some of the largest engineering projects in the world

Which half of the UK's electricity is produced in the Humber?

17%

We reduce **1/3** of the UK's CO2 emissions

We're **No 1** in the UK for total production

Add on to your fuel! Our region's 25,000 wind turbines generate power for over 100,000 UK homes

Considerable carbon capture (CC) emissions from the energy-intensive oil and gas sector in the Humber will be captured, safely transported, then stored in depleted gas fields in the North Sea

The scale of our energy means demand is high for engineering support and top talent. We're already welcomed newcomers from CLS OFFSHORE, WALDECK ENGINEERING, SPENCER GROUP, ERKS and CIFEELY FABRICOM O&F SUEZ.

Our helicopters make 70,000 passenger journeys in the North Sea each year, carrying everyone from oil rigs to riggers to divers to engineers to seawater to analysts to mechanics...

£7bn

Land rearing has been awarded offshore wind farms off the Humber estuary

Chemicals

We have the UK's 2nd largest chemical cluster with pipelines to the North Sea oil and gas fields and a demand for utilities, services and engineering support. We make everything from bulk chemicals and paints, to pharmaceutical ingredients and household products - all markets with an increasing need for innovation and sustainable feedstocks. Solvent Chemicals Park hosts eight chemical and energy businesses including BP. And there's room for more!

£7bn

Land rearing has been awarded offshore wind farms off the Humber estuary

We import more of the UK's oil than any other part - so the UK's leaders can keep building homes.

Hidden connections... LANDED is one of the world's largest offshore gas pipelines, bringing 20% of the UK's gas demand from Norway.

On a cold day 30% of the UK's gas is landed and processed here at GASSCO, CENTRICA and PERenco and distributed throughout the UK.

Our marine engineers, including B&E SHIPPING, have awarded over £50m in locally built boats for the oil rigs from support vessels.

ROUGH is the UK's biggest gas storage facility meeting approx 10% of UK's peak day demand. The storage is built into the sandstone rock, 1,000 feet under the bed of the North Sea.

Our Ports

WE ARE THE UK'S BIGGEST PORT COMPLEX

and there's again to grow... We have the UK's largest port-side development's this - easily within an Enterprise Zone.

And here's another way we help keep the UK's lights on... 3/5 of the UK's coal and new sustainable biomass comes in through the Humber to make energy.

The power by WHITE ROSE POWER-STATION will be on the front line of the industrial revolution. Its CO2 emissions will be captured and stored in depleted gas fields beneath the North Sea, cutting UK's CO2 emissions while creating jobs and investment.

At CRAX, we are the UK's largest single producer of electricity. We are investing into a production capacity expansion - bringing new capacity - bringing new investment for engineering, design for more savings, energy and attracting investment to bring in business from overseas.

Home to B&E Systems' Heath Higher Training air unit, the new Humber ENTERPRISE PARK is attracting more main industrial engineering businesses.

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More than just a pinch of salt! An SSE in Aker you'll find gas can also be used in the underground. The caverns are hollowed out of a large salt deposit stretching from here to Denmark.

Our REAL VENTURES business platform provides green financing for 74,000 SMEs. We're building another one just off it in Birmingham.

EDWINGHAM

At EDWINGHAM power station we are getting on the back of the burning biomass alongside coal.

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Our Location and Connectivity

Not only do we have Northern Europe, we are midway between London and Edinburgh, making us a critical transport and logistics hub.



4 hour drive gives you access to

75% of UK manufacturing

320m customers accessible across mainland Europe within 24 hours

Greenfield at TARA Steel, Europe is used all over the world, from the Pelicans Towers in Malaysia and the T'ing Yu Bridge in Hong Kong to wind turbines and paper mills!

Powering cars from green! GREENEY is Europe's largest fuel cell Hydrogen facility, supplying 500 to 100000 vehicles, to many of the world's leading car manufacturers.

Thanks to our rail crossing through by rail we produce 70% less CO2 than the equivalent journey by road! At our 1000+ acres, we handle an average of 40,000 rail freight journeys.

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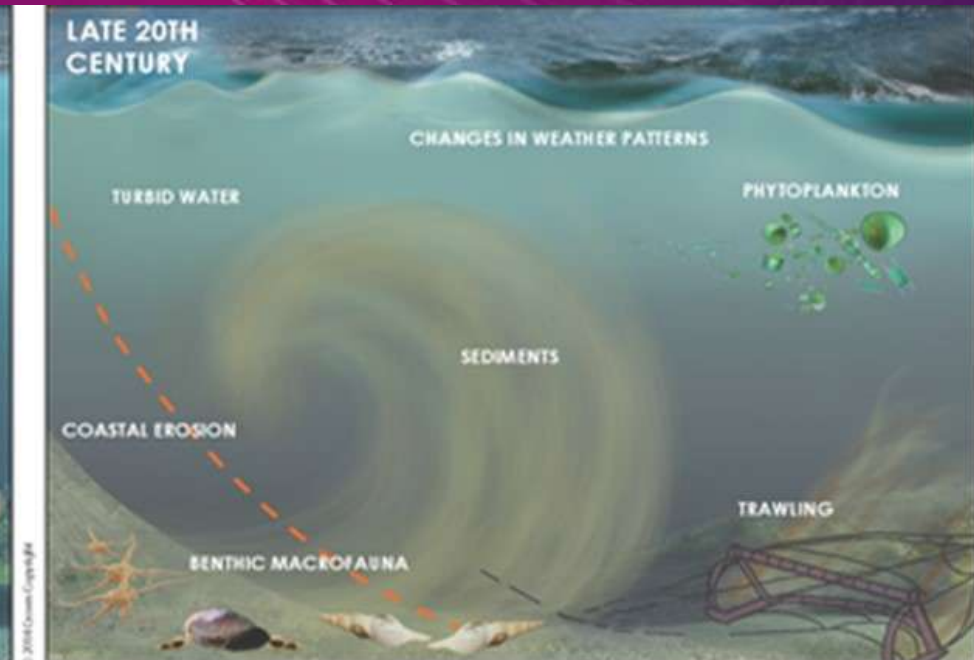
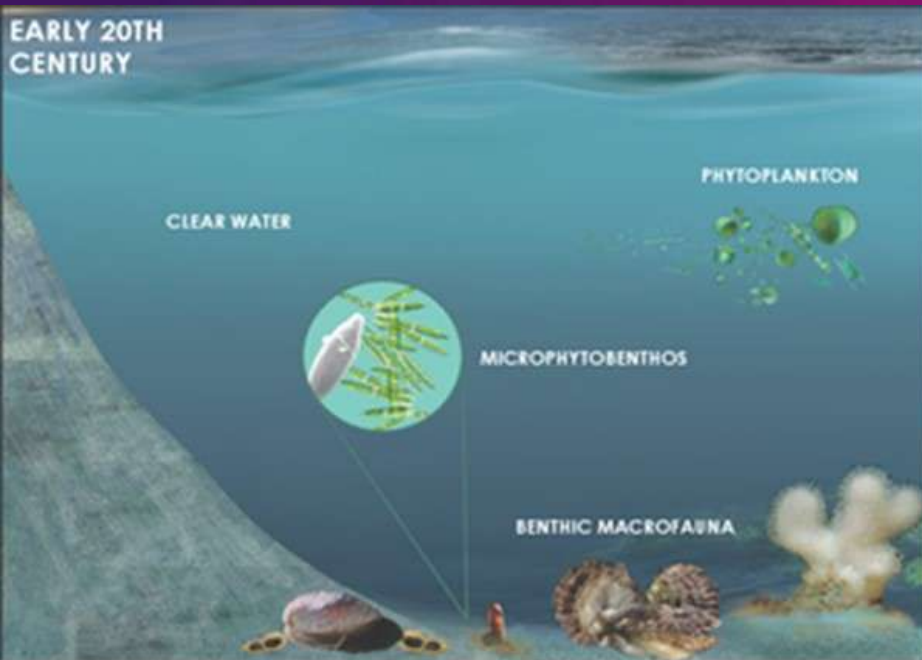
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HUMBERSIDE INTERNATIONAL AIRPORT is the UK's 2nd busiest (second only to Gatwick), serving 10 million passengers annually and the new BAE Systems National Training Academy will support 1000+ jobs in Lincolnshire.

Change to North Sea state



Received: 13 May 2017 | Revised: 27 August 2017 | Accepted: 29 August 2017
DOI: 10.1111/gcb.13976

PRIMARY RESEARCH ARTICLE

WILEY *Global Change Biology*

A decline in primary production in the North Sea over 25 years, associated with reductions in zooplankton abundance and fish stock recruitment

Elisa Capuzzo¹ | Christopher P. Lynam¹ | Jon Barry¹ | David Stephens² | Rodney M. Forster² | Naomi Greenwood^{1,4} | Abigail McQuatters-Gollop² | Tiago Silva¹ | Sonja M. van Leeuwen¹ | Georg H. Engelhard^{1,4}

Global Change Biology

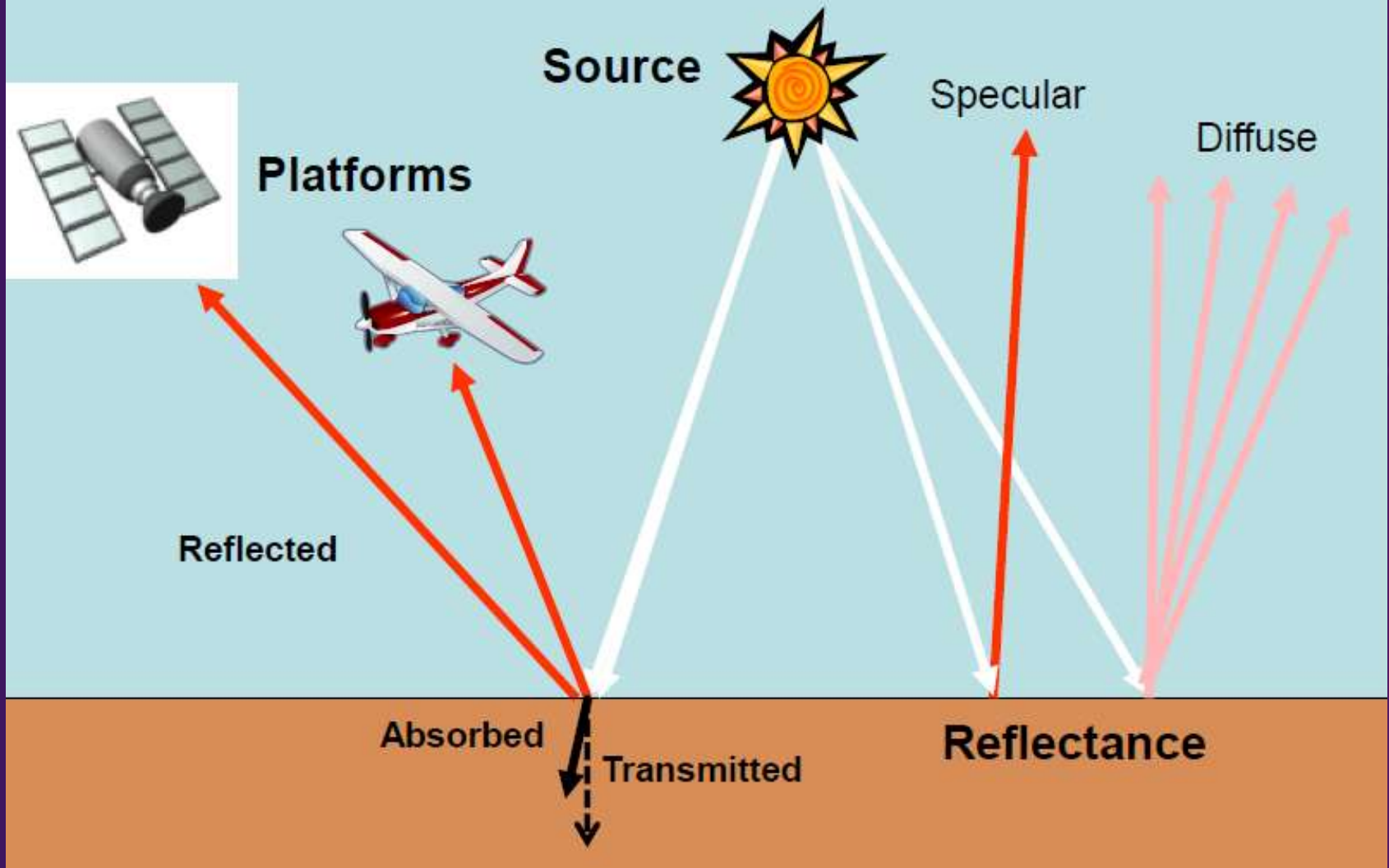
Global Change Biology (2018) 24, 2206–2214, doi:10.1111/gcb.13854

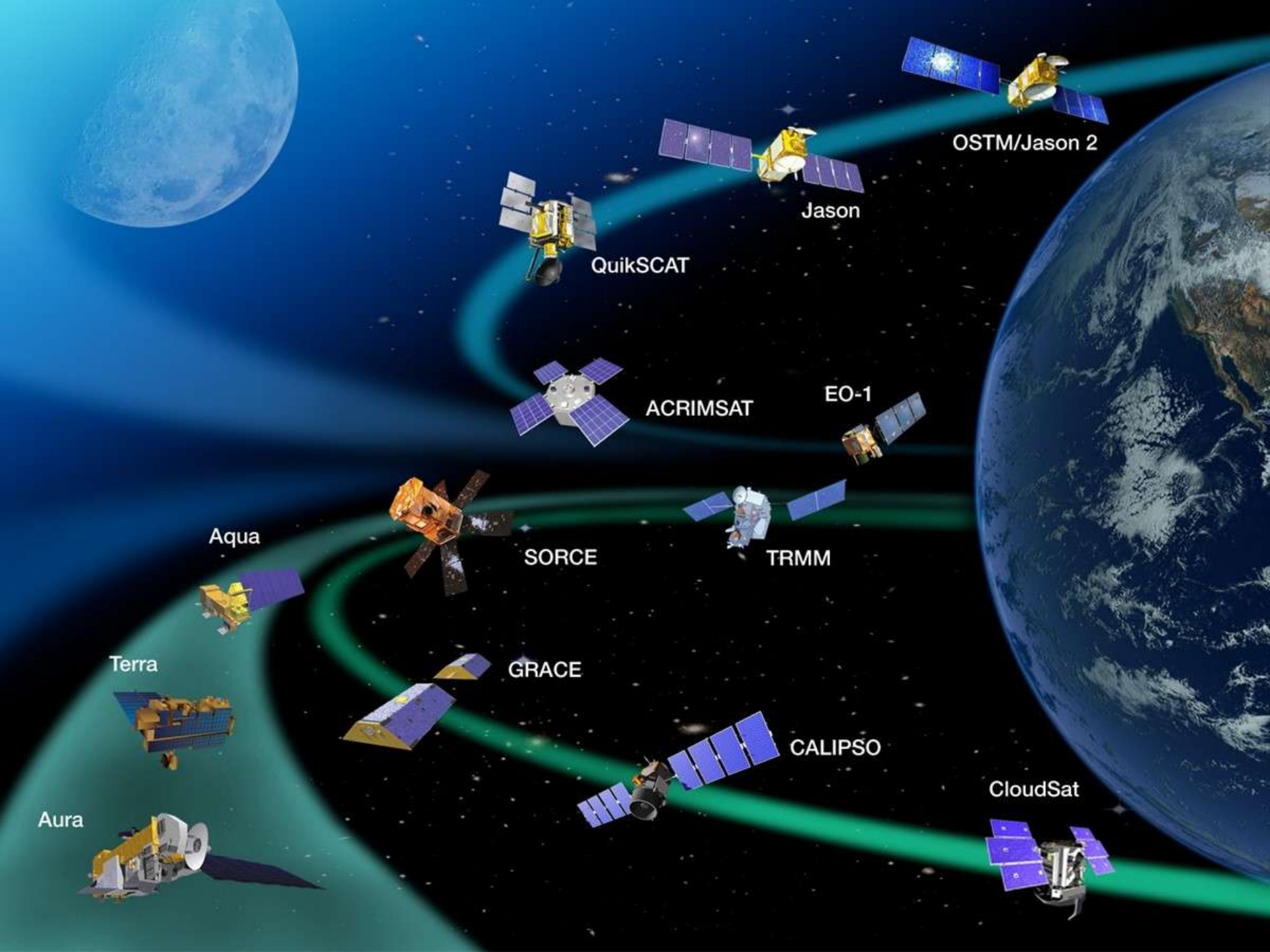
Decrease in water clarity of the southern and central North Sea during the 20th century

ELISA CAPUZZO¹, DAVID STEPHENS¹, TIAGO SILVA¹, JON BARRY¹ and RODNEY M. FORSTER^{1,2}

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Remotely-sensed data





OSTM/Jason 2

Jason

QuikSCAT

ACRIMSAT

EO-1

Aqua

SORCE

TRMM

Terra

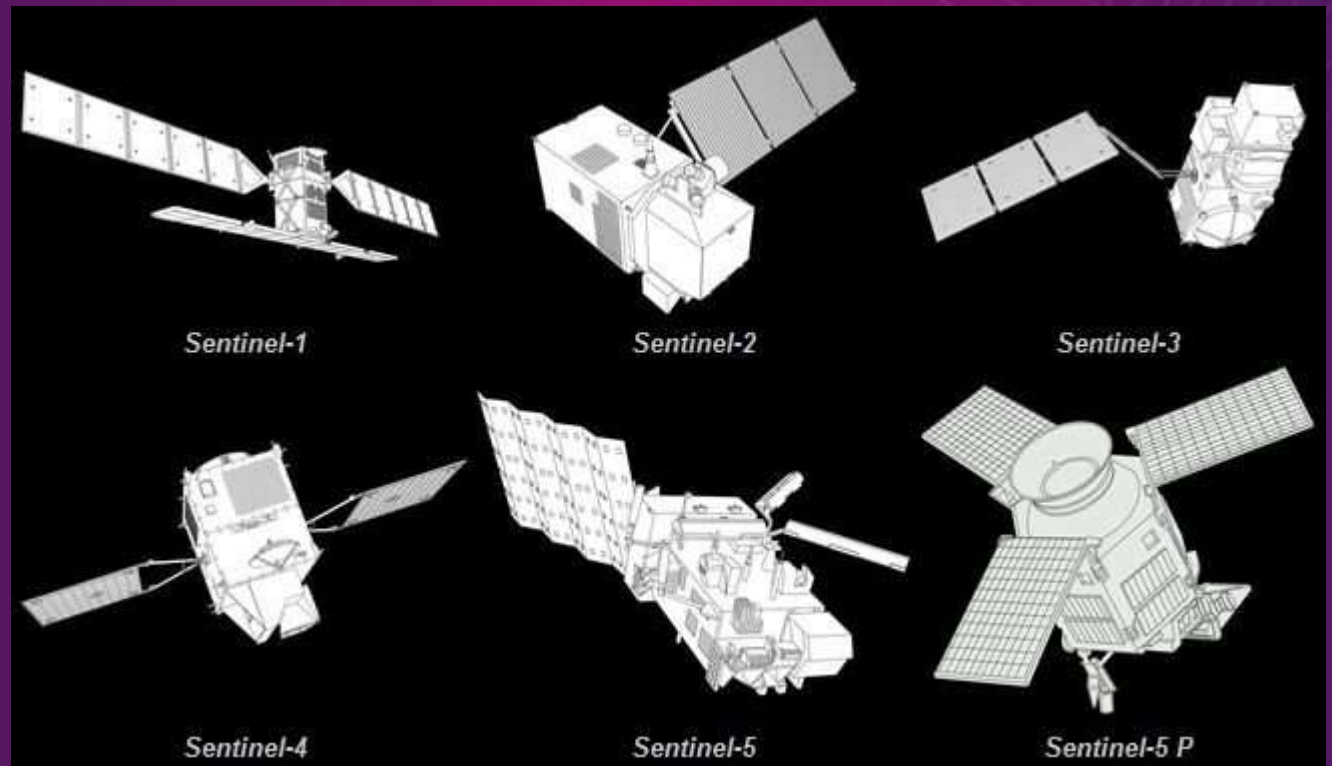
GRACE

CALIPSO

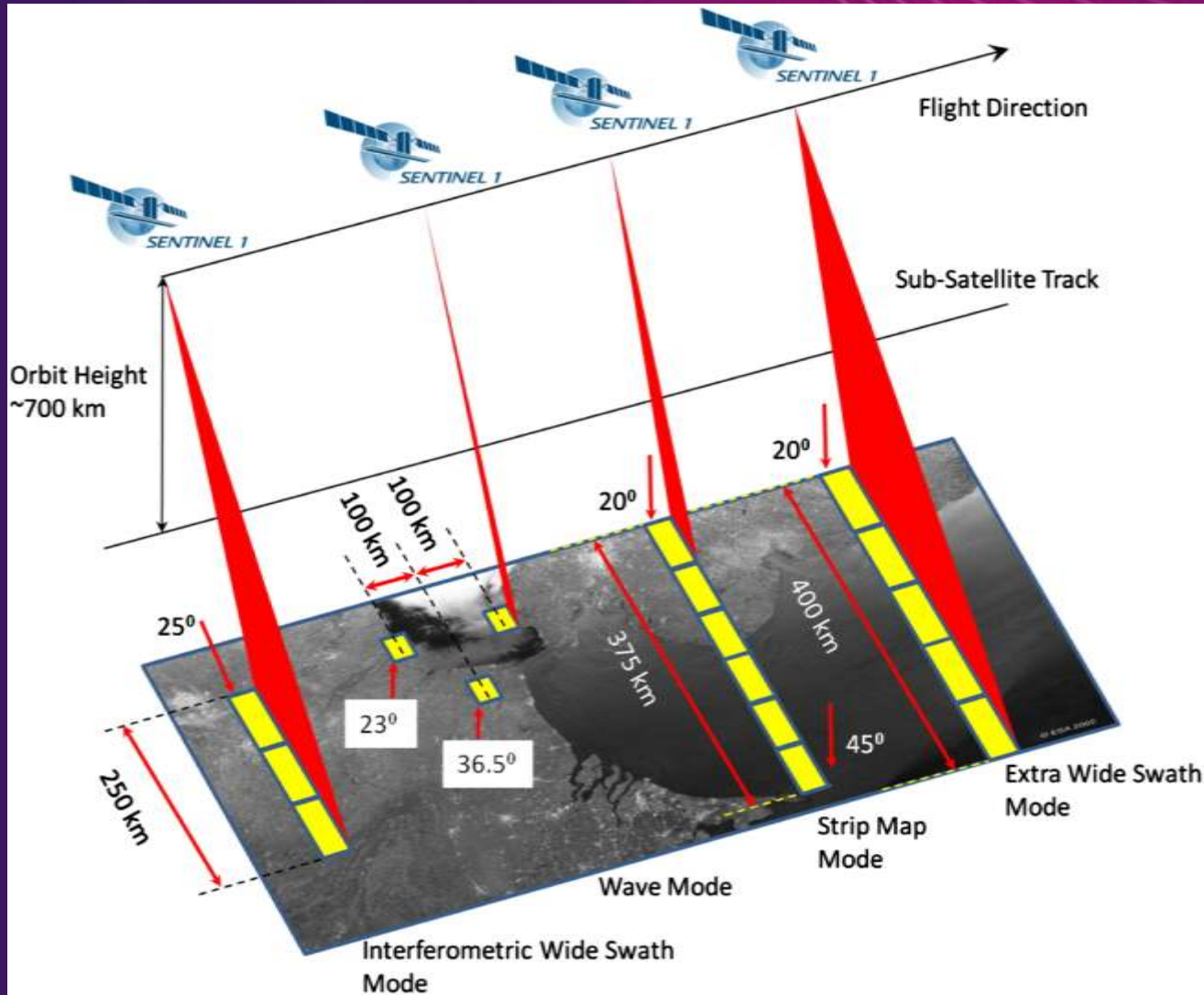
CloudSat

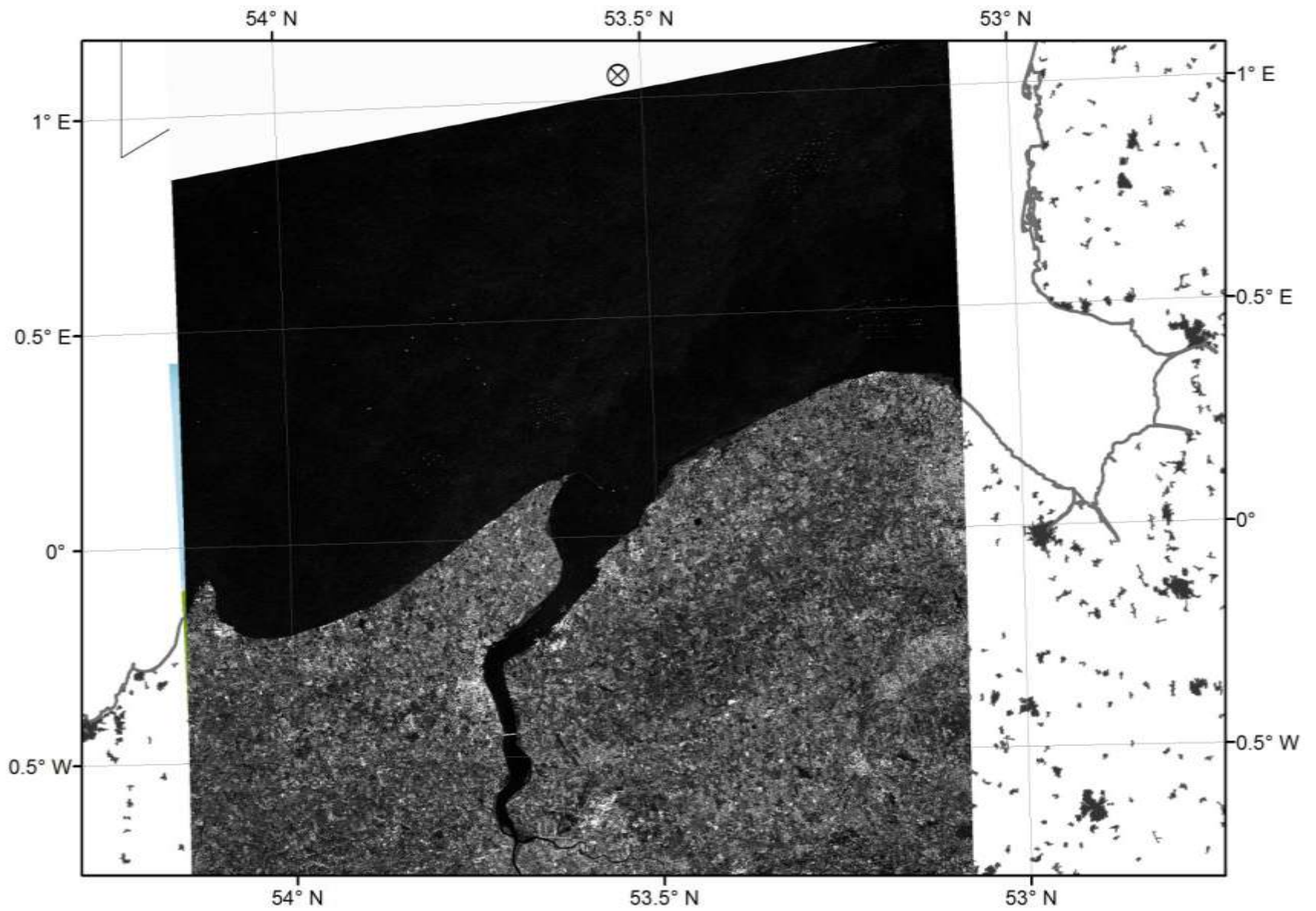
Aura

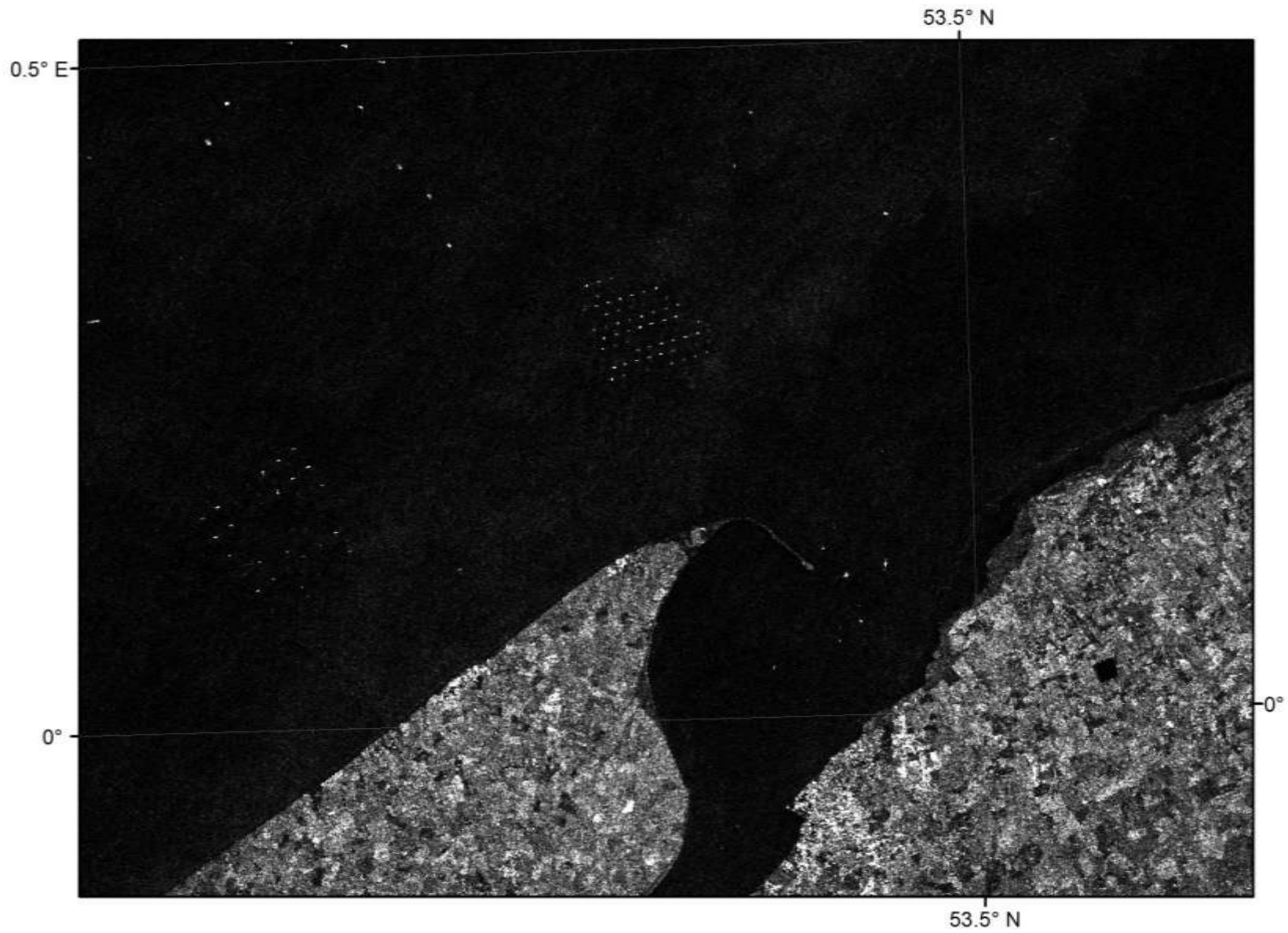
Europe's Earth Observing missions



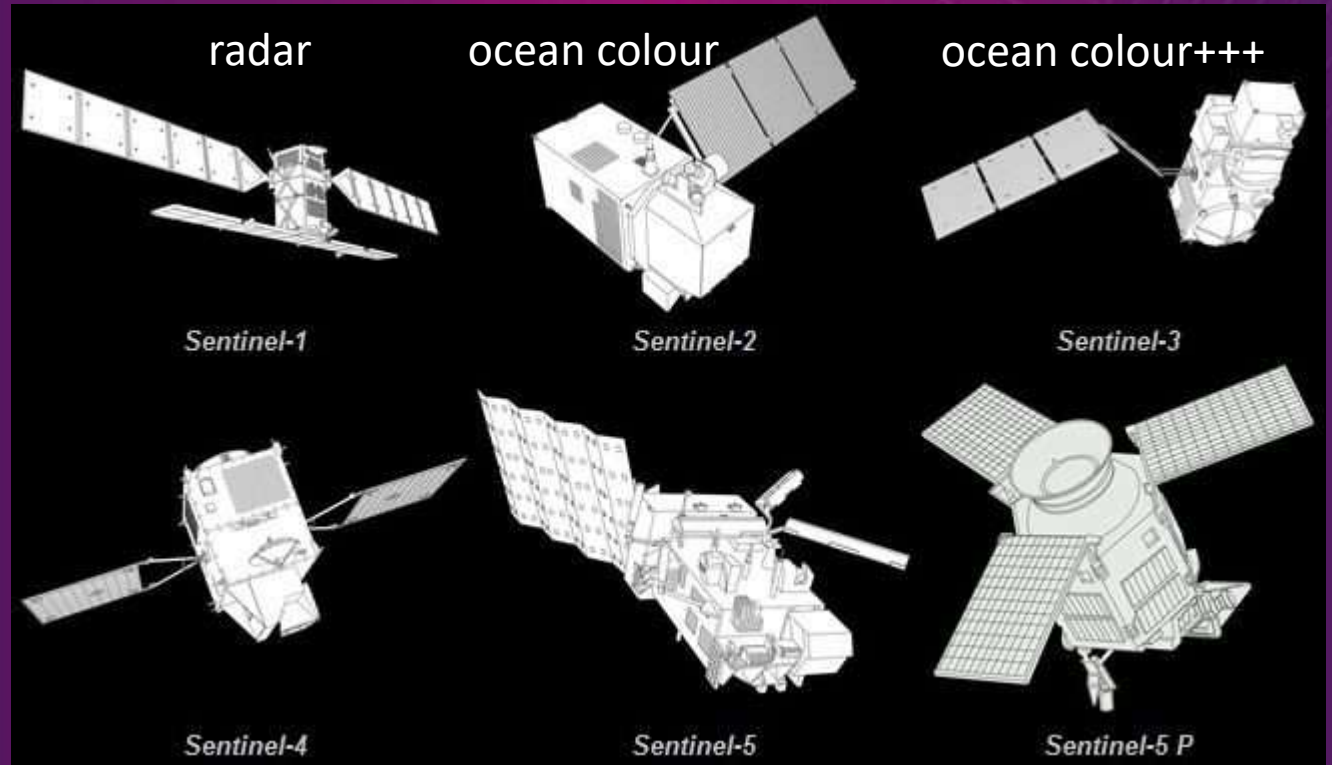
Sentinel-1 radar







Europe's EO missions

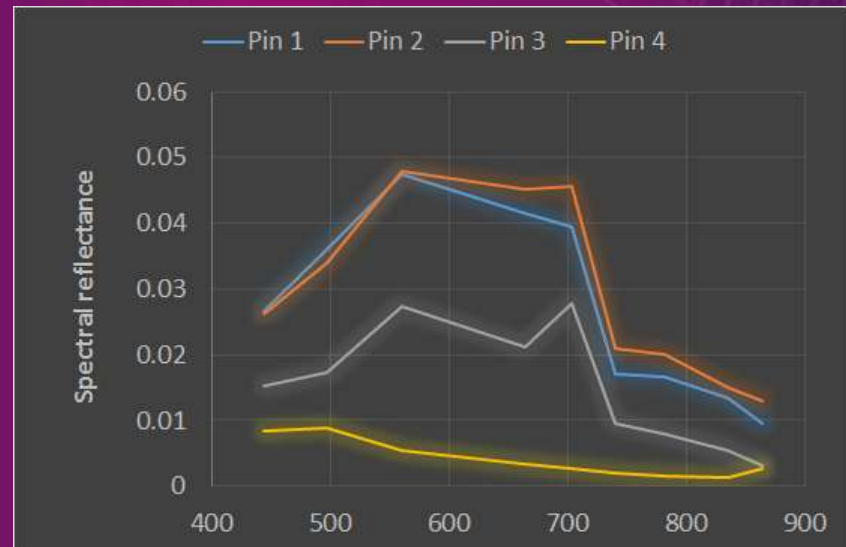
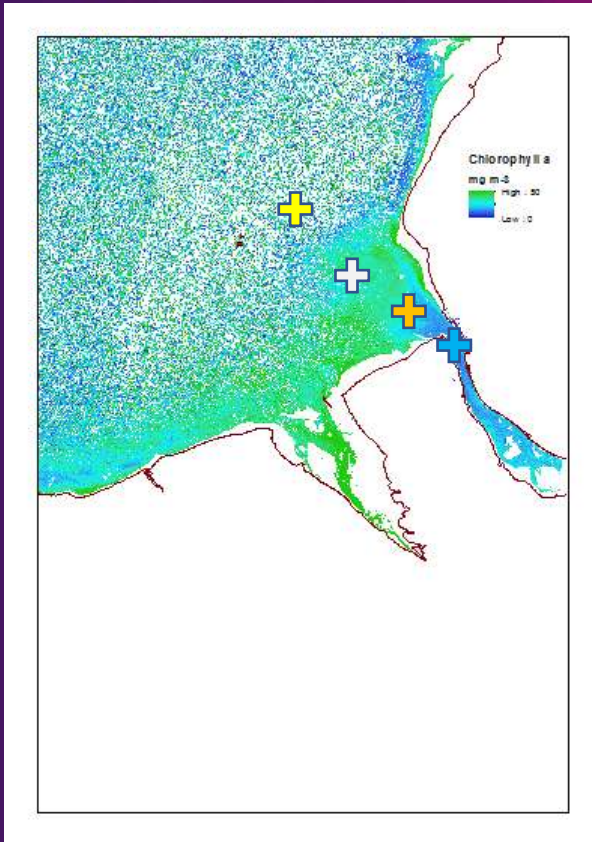


Sentinel -2 and 3 ocean colour





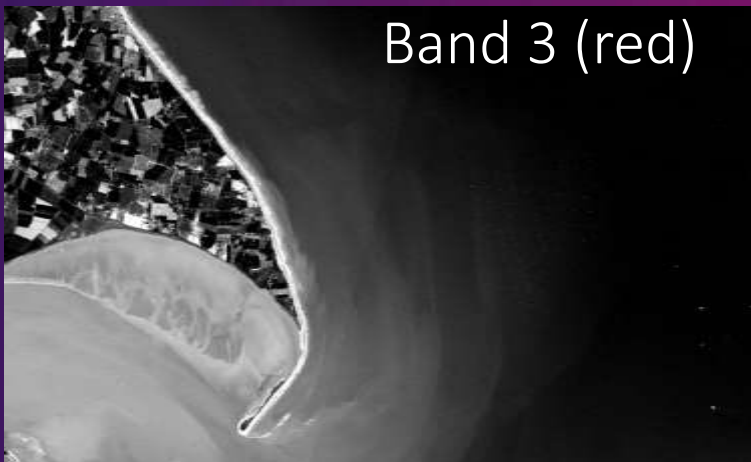
Near-shore spectral differences

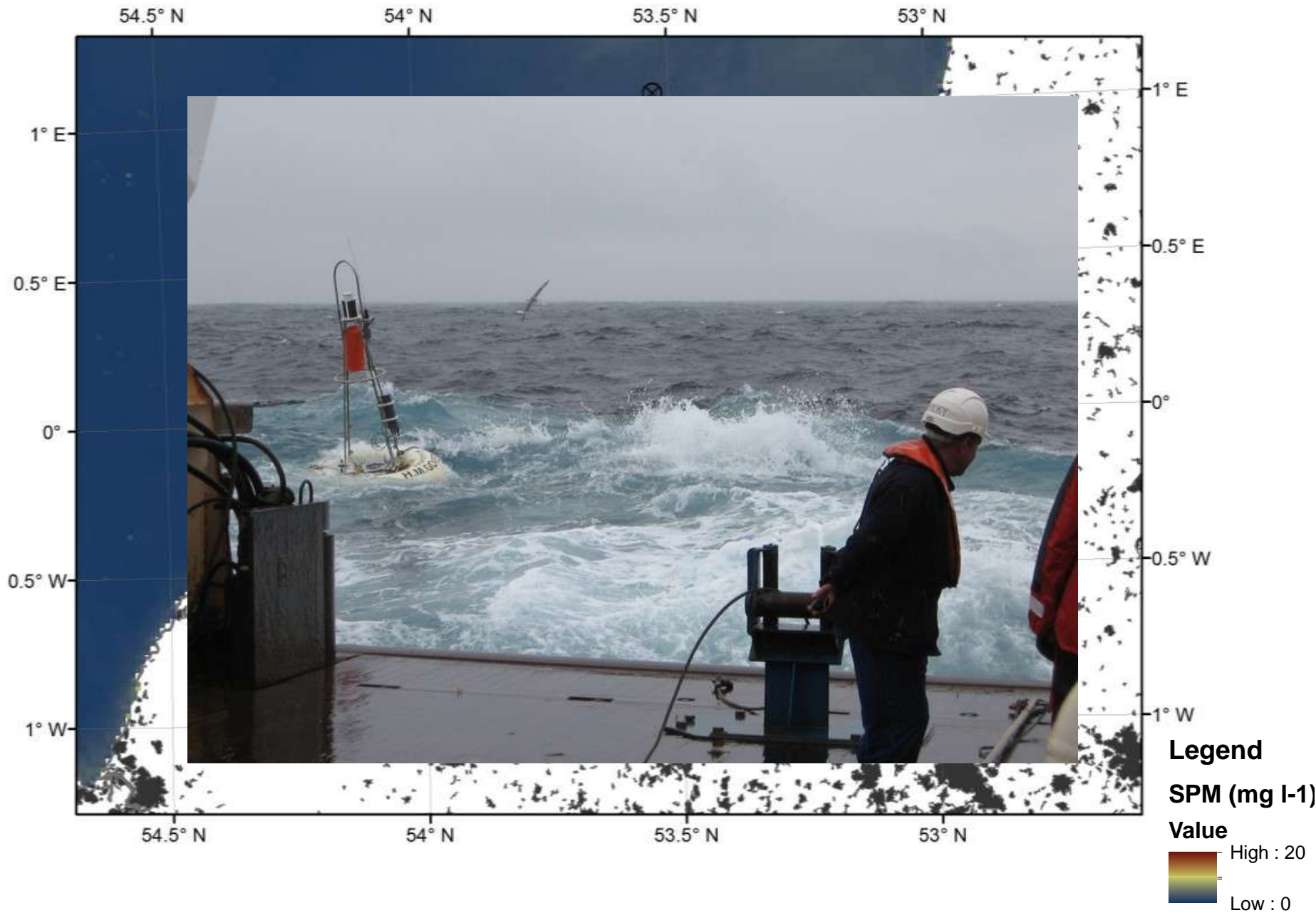




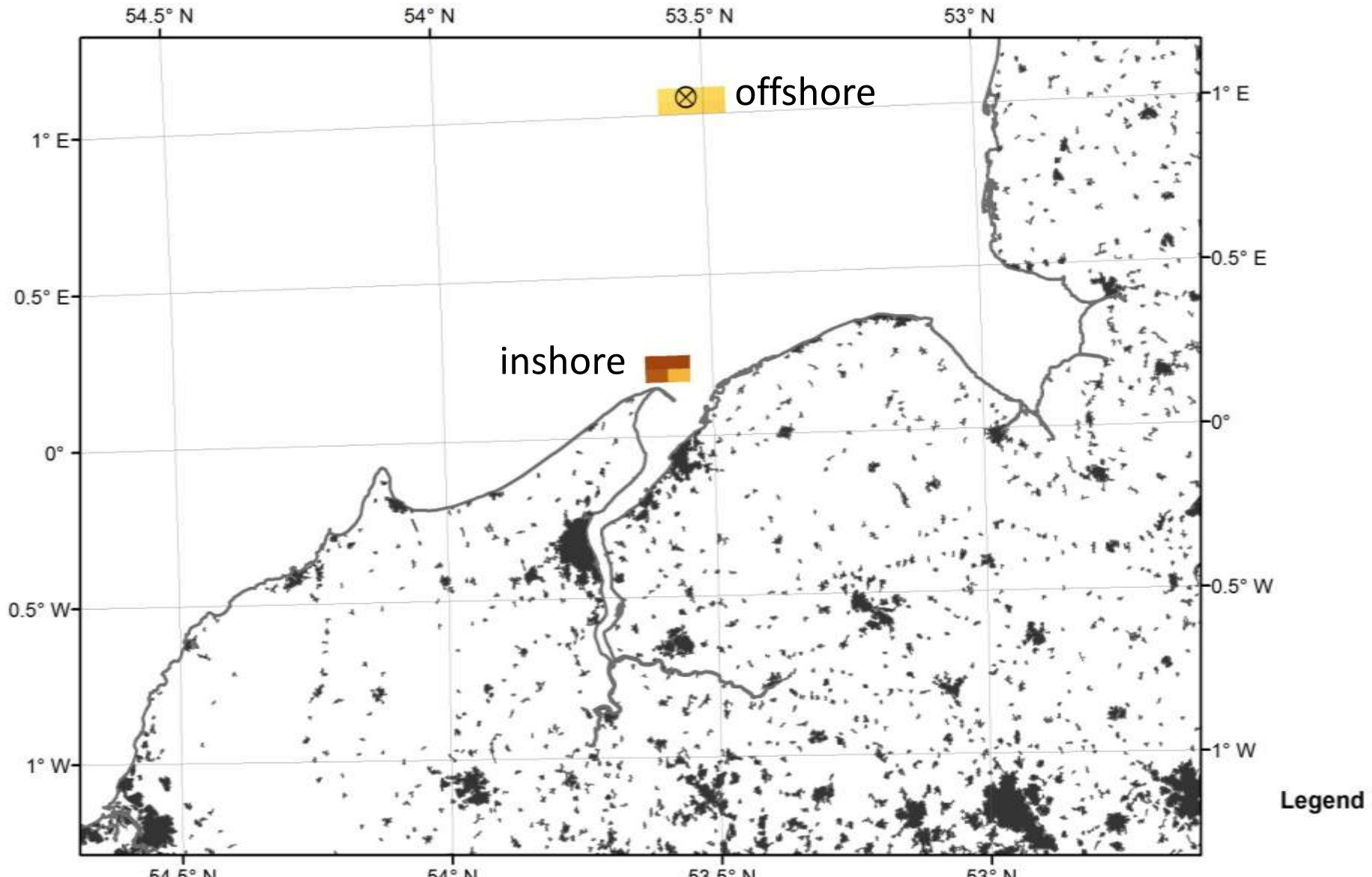
UNIVERSITY
OF HULL

Sensitivity to suspended sediment load



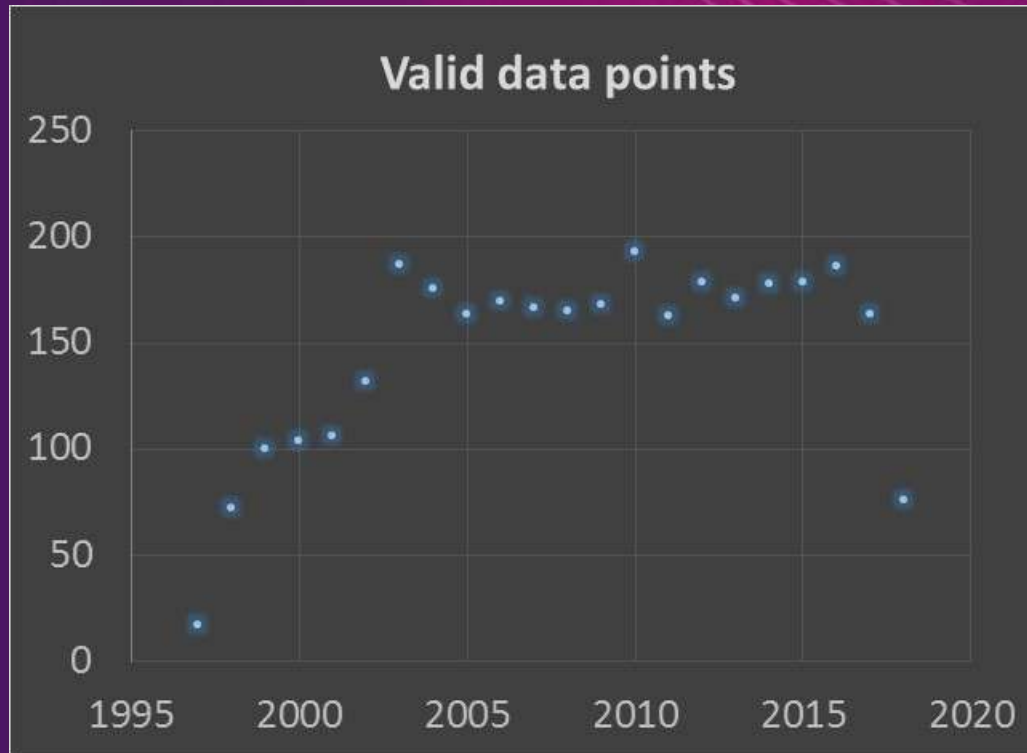


SPM time series extraction





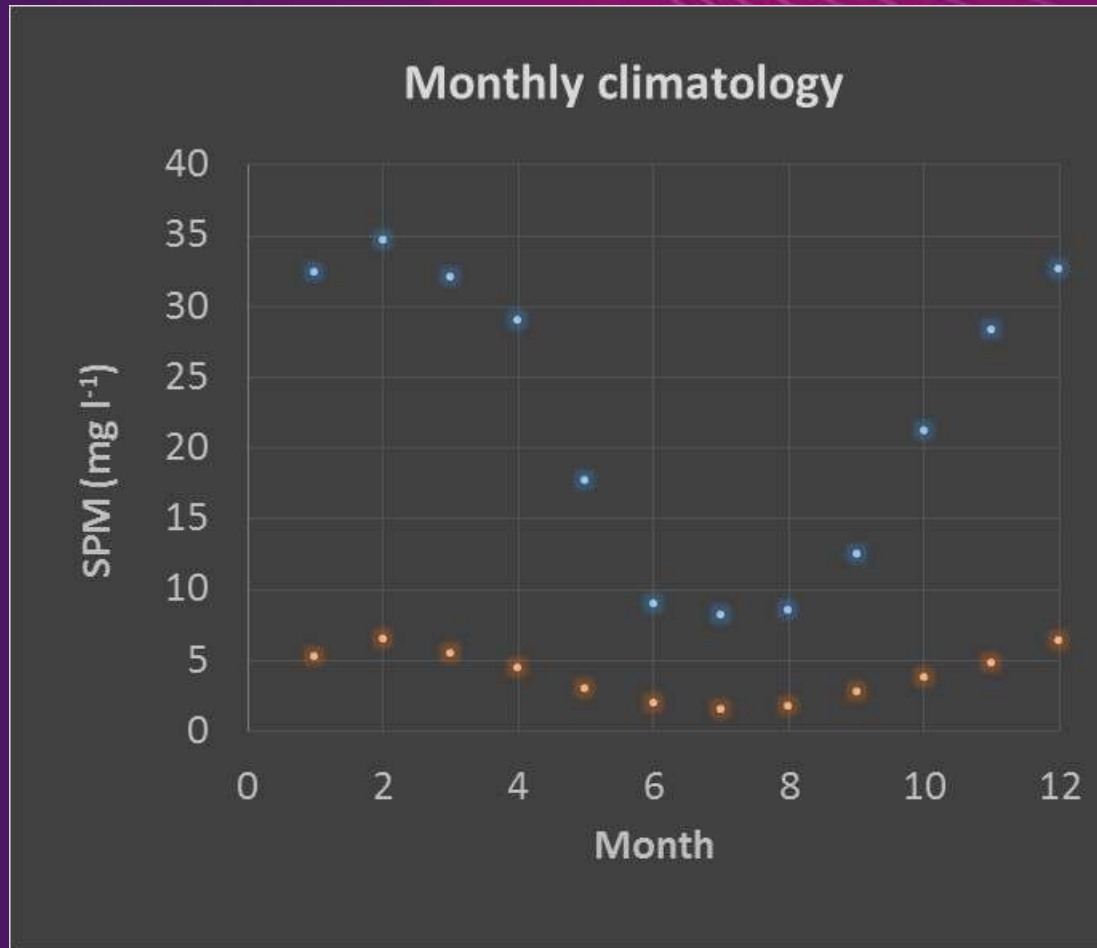
Inshore (Humber mouth) SPM analysis



CMEMS/GlobColour merged product



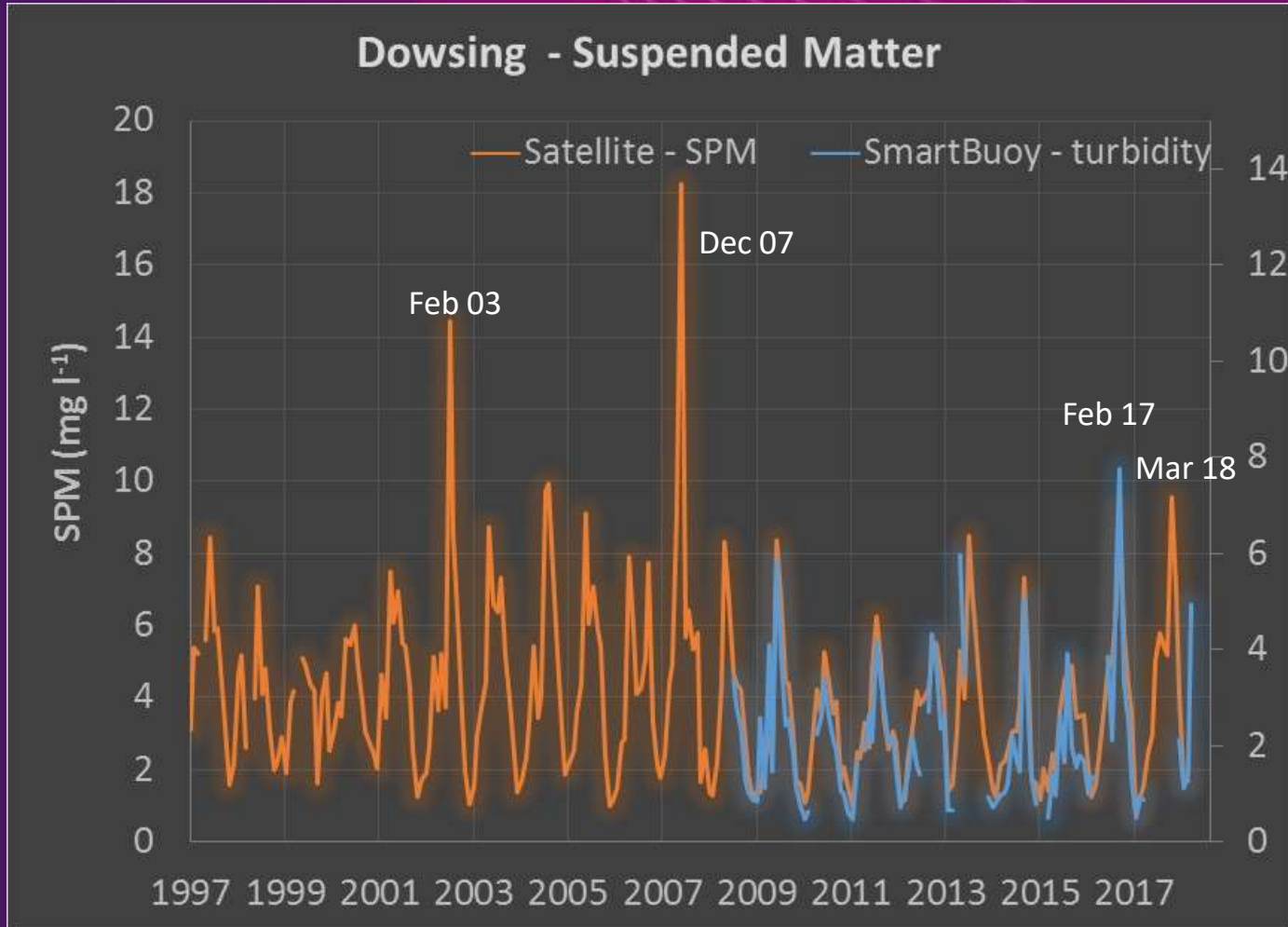
Inshore (Humber mouth) SPM analysis



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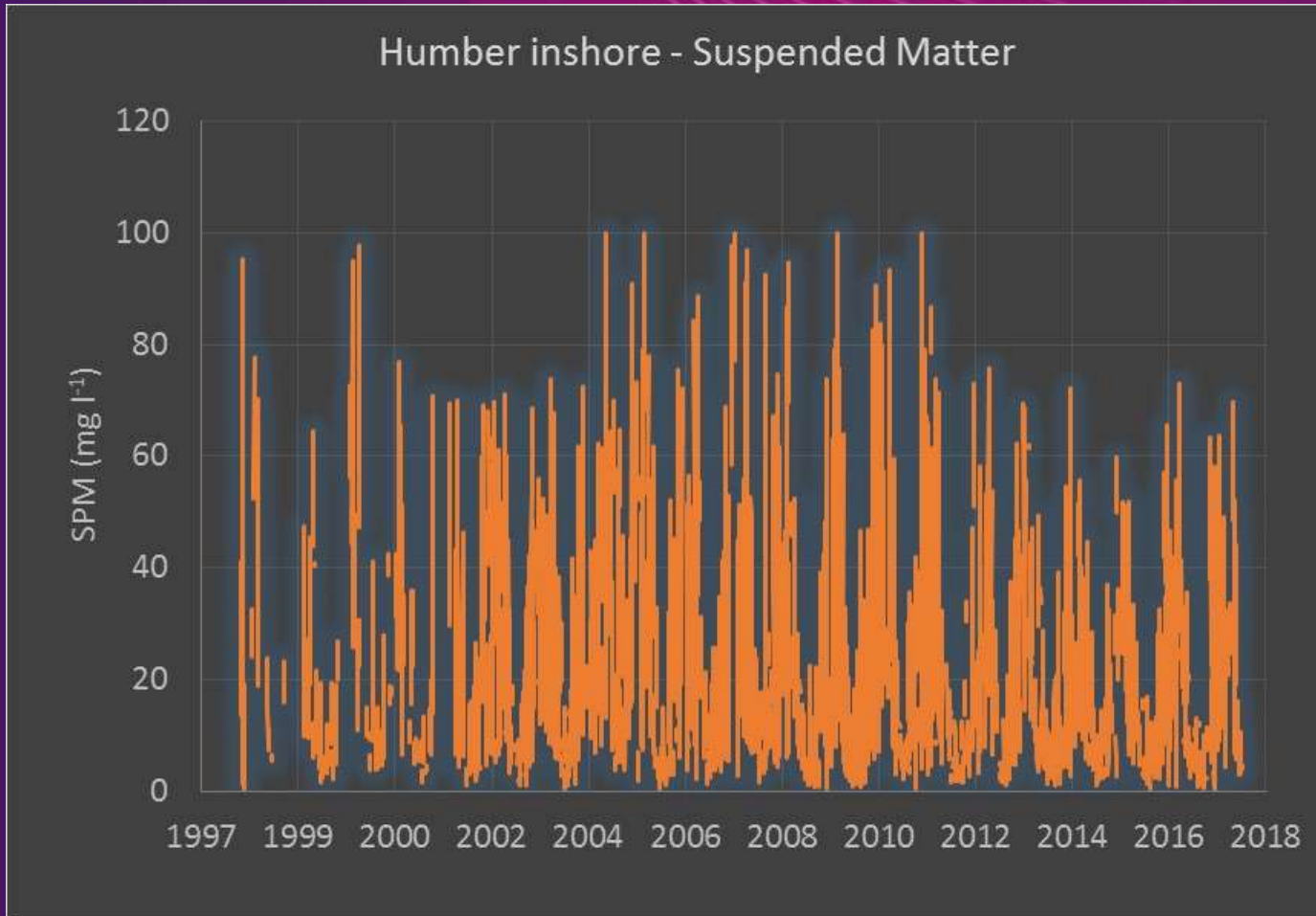


Offshore (Dowsing) time series for SPM

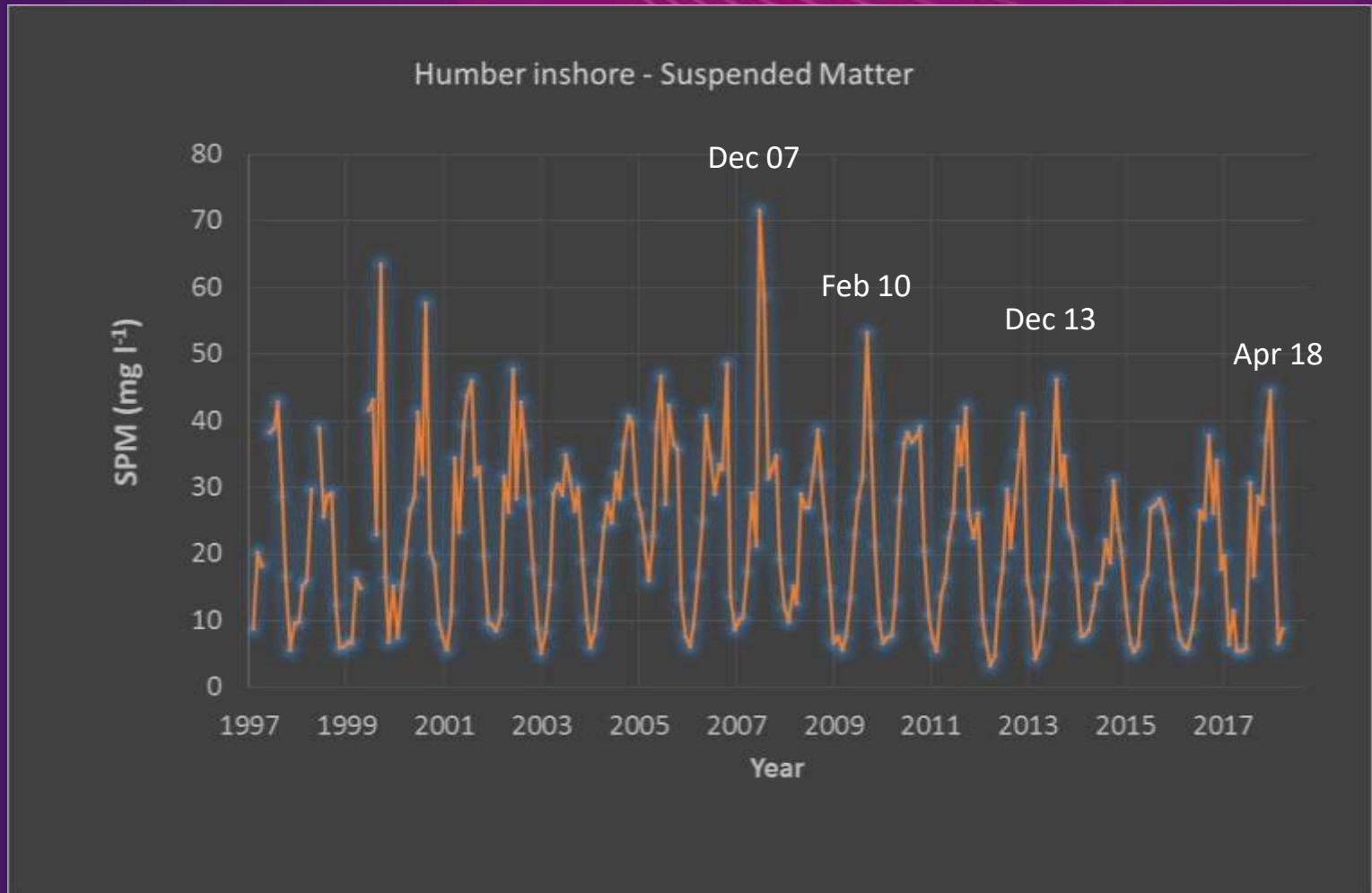




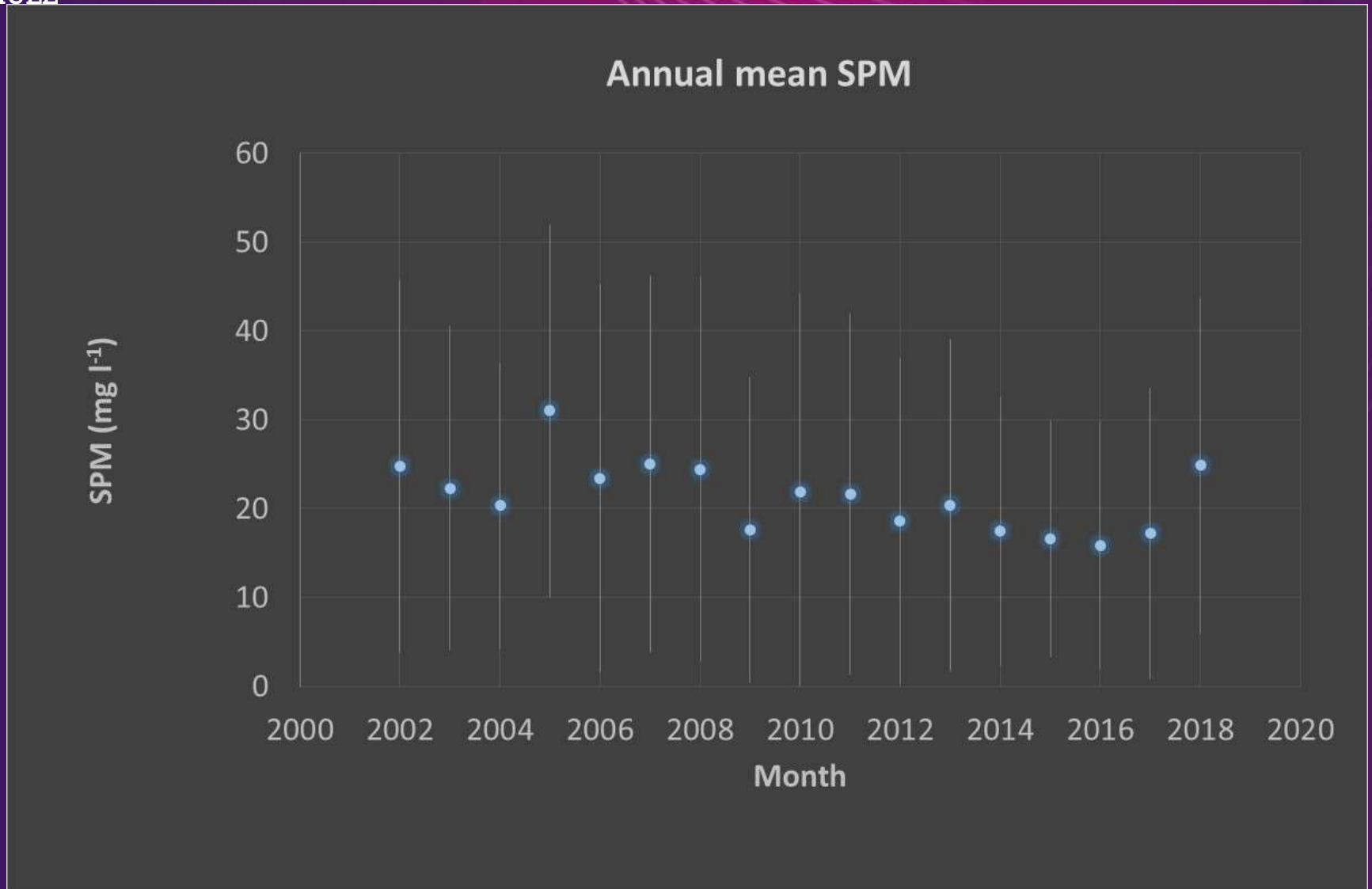
Inshore (Humber mouth) daily time series for SPM



Inshore (Humber mouth) monthly time series for SPM



Inshore (Humber mouth) annual time series for SPM



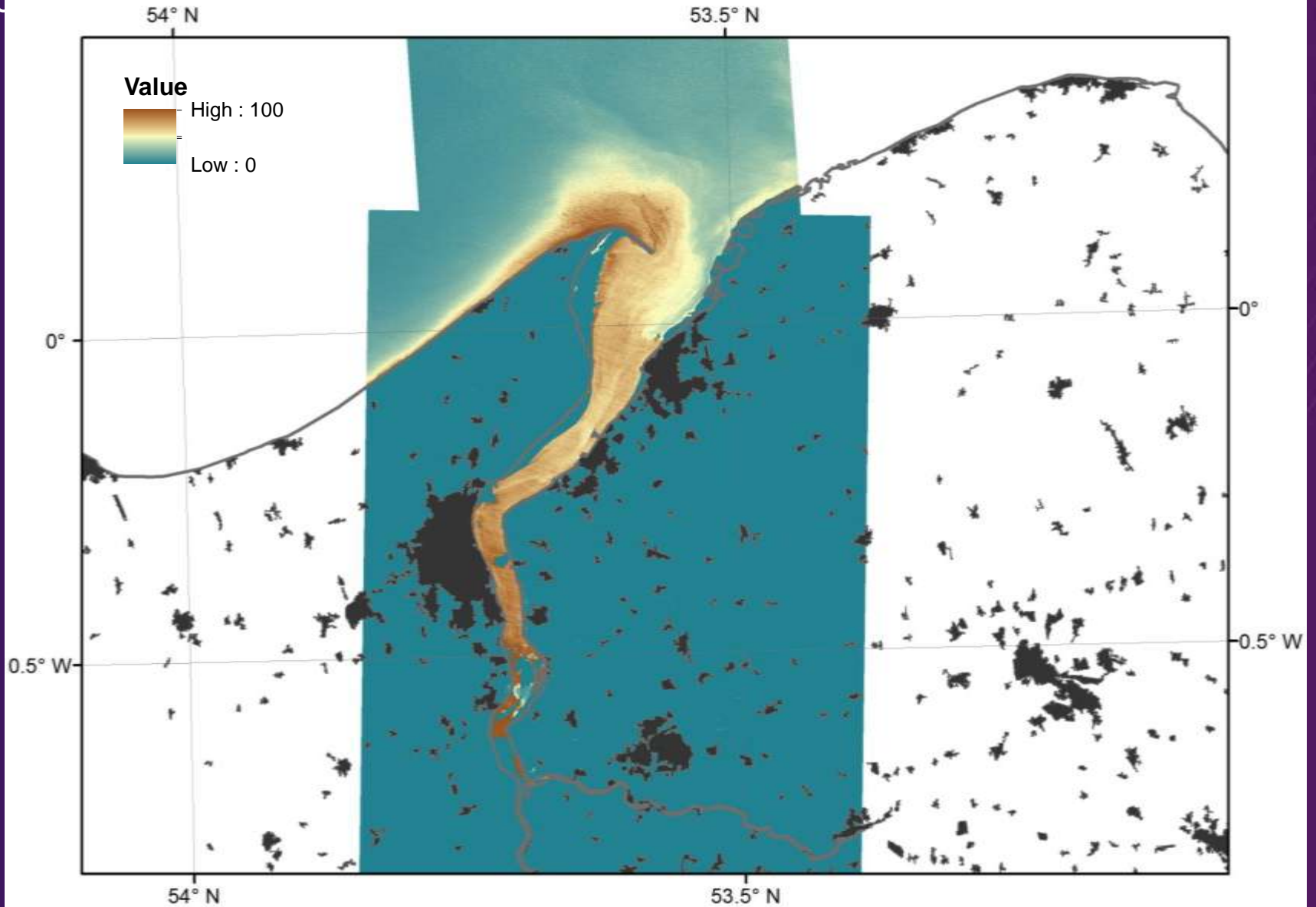
Compare with OPEG report – Charting Progress 19

Sentinel 2 Red-Green-Blue composite



Sentinel 2 Humber SPM


3rd November 2018




Sentinel 2 projects


Lucas Mander – Curlew habitat use

Tweets **Tweets & replies** **Media**


 **lucas mander** @LucasMander · Nov 26

Our 8 GPS tagged curlew #Humber continued to use tidal flats, but 2 birds are starting to make use of arable fields @IECS_UHULL @_BTO #HumberWaderRingingGroup



4 34 123 

lucas mander Retweeted

 **IECS_UHULL** @IECS_UHULL · Nov 23



Summary

Changes in suspended particulate matter over time arise as a result of physical and biological interaction:

- North Sea system - long-term trends
- Regional differences in sources and sinks of sediments

Satellite remote sensing can be used as an effective tool to monitor and interpret coastal change

Next steps – automated processing to create cubes of Analysis Ready Data



DataBee

Need for a Humber Observing System?