iFADO
INNOVATION IN THE FRAMEWORK OF THE ATLANTIC DEEP OCEAN

Final Workshop
Instituto Superior Técnico, Lisboa, Portugal
1st June 2023

WP6 Remote Sensing of the Atlantic in iFADO

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PML | Plymouth Marine Laboratory

Interreg Atlantic Area
European Regional Development Fund

EUROPEAN UNION

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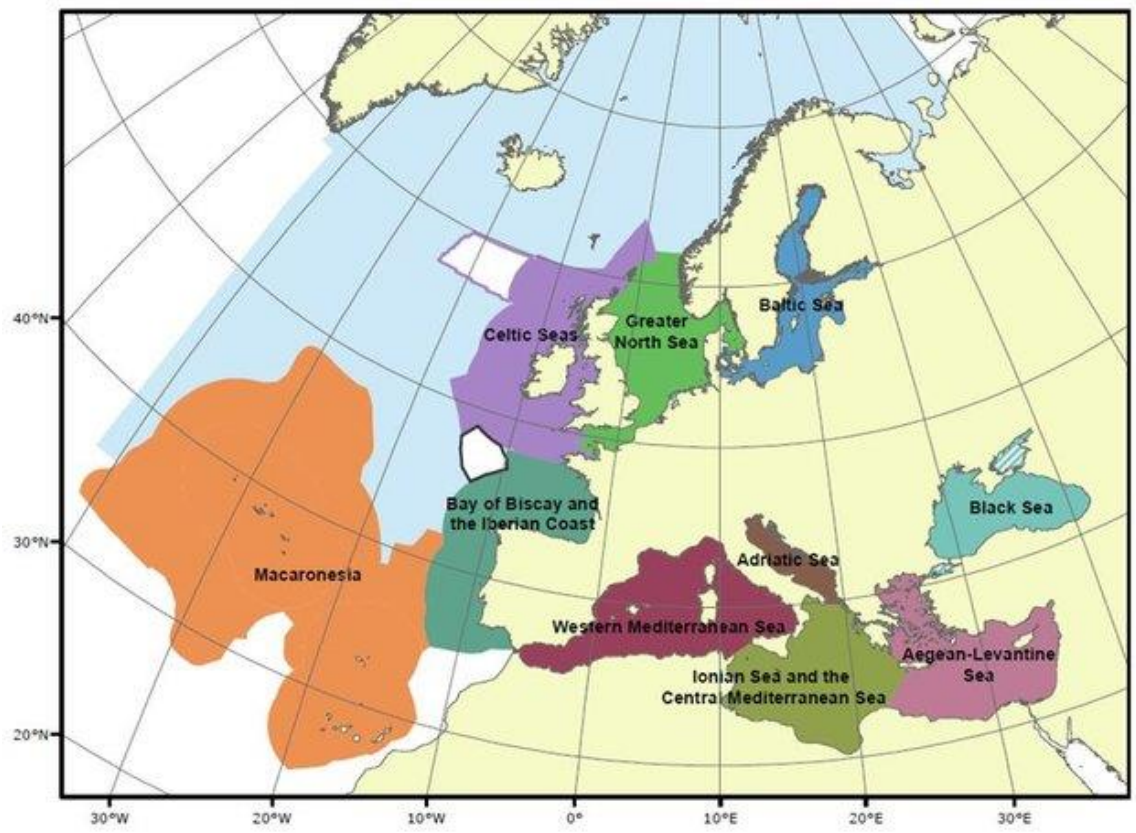
Introduction: Earth Observation

- Marine Strategy Framework Directive monitoring is required over large areas away from the coast, not feasible purely with ships
- Satellite remote sensing (or Earth Observation, EO) can *complement* in situ observations with synoptic-scale, daily near-surface data (depending on cloud cover)
- The EC's Copernicus programme includes EO data services but further developments of products is needed



Introduction: iFADO WP6 Actions

- Action 1: Coordination
- Action 2: Data gathering and harmonisation
  - Accessing EO data for iFADO project
  - Supporting iFADO cruises with near-real time data
  - Use of iFADO data for satellite cal/val
  - Upwelling off the Portuguese coast- Pedro
- Action 3: Novel EO derived products for marine litter accumulation - Elise
- Action 4: Novel EO derived products for Phytoplankton
  - Size fractionated phytoplankton (MSFD biodiversity indicator) - Vanda
  - Primary production (MSFD biodiversity indicator) and water classes
- Action 5: Novel high resolution MSFD monitoring products

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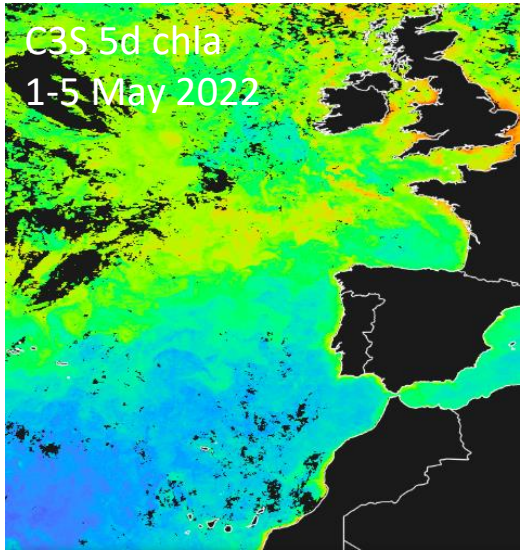
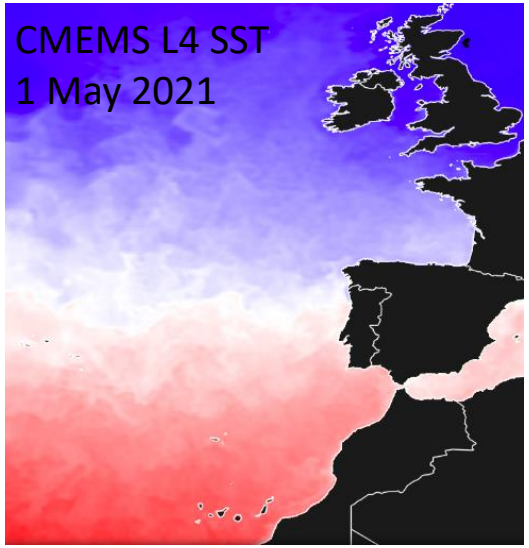
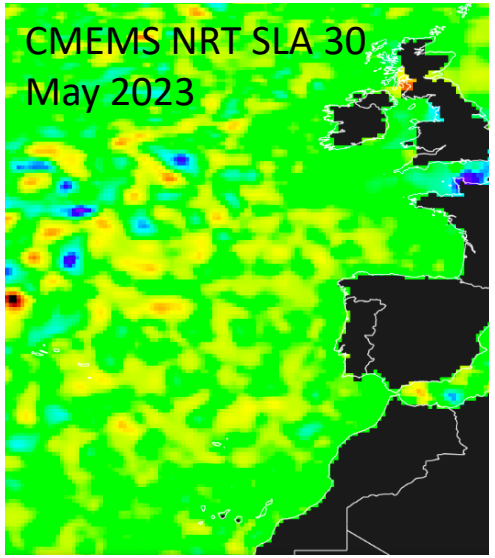
Action 2 Data Gathering and Harmonisation

- The EC Copernicus project provides EO data via services
  - Copernicus has developed during the 6+ years since iFADO was written



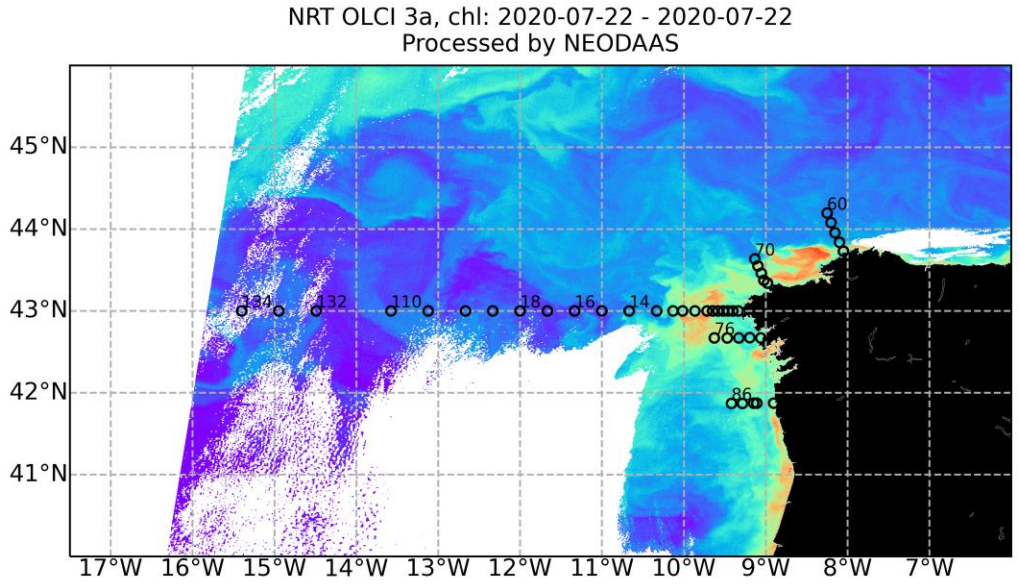




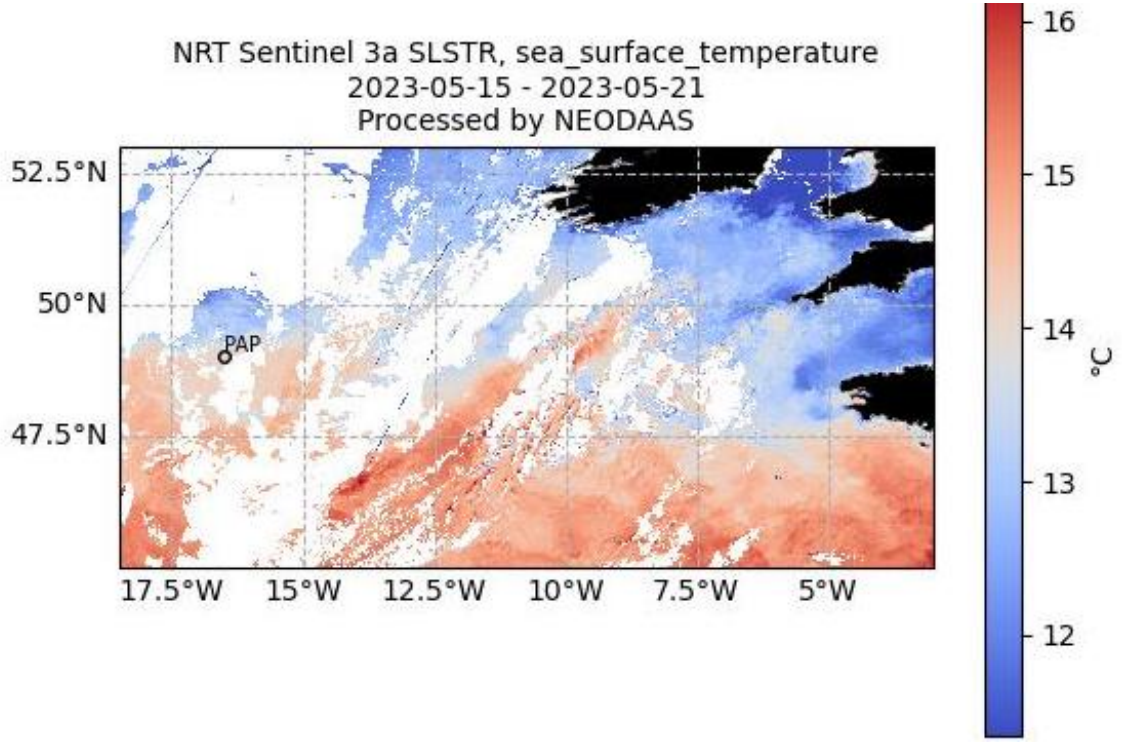
  - In iFADO this was complemented with bespoke data processing or services not available from Copernicus
    - Near-real time support of cruises – guidance to features of interest
    - Validation of EO data – important for Copernicus
    - Higher resolution data

EO data sent to research ships

- RADPROF20 July 2020 IEO cruise, with IPMA onboard (for samples inc. HPLC by FCUL)
- Satellite data provided in near-real time during cruise by PML



- JC247 May 2023, to PAP-SO (samples inc. HPLC by FCUL)
- Satellite data provided in near-real time during cruise by PML

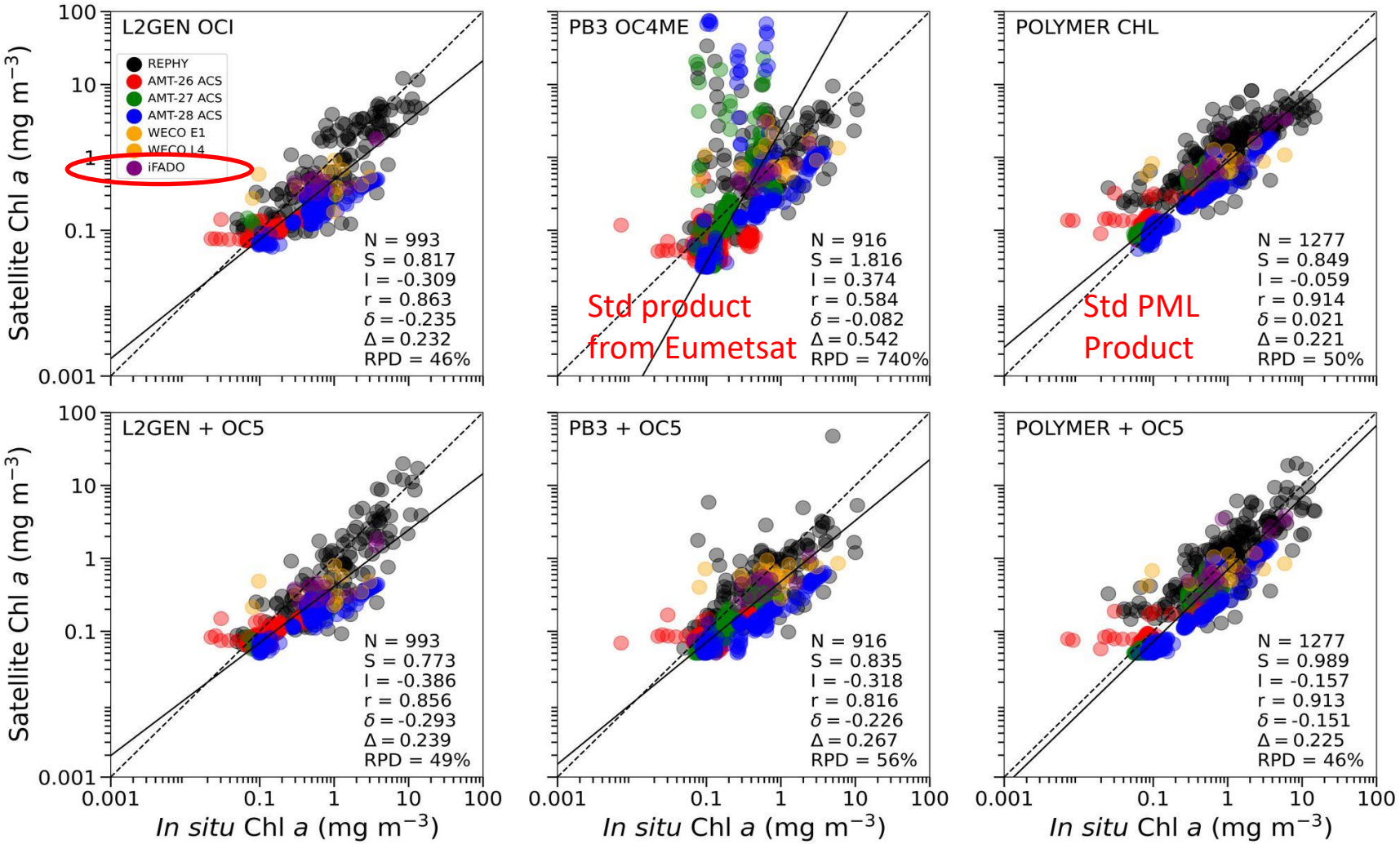


iFADO cruises with HPLC

	Iberian Cruises	Date	HPLC (nº surf and DCM)
1	DEPM2019	01/2019 to 02/2019	47
2	PELAGO2019	04/2019 to 05/2019	36
3	PELAGO2020	05/03/2020 to 09/03/2020	43
4	RADPROF2020	07/ 2020	59
5	RADPROF2021	08/ 2021	7
6	DEMP2022	03/2022 to 04/2022	15
7	PELAGO2022	01/03/2022 to 29/03/2022	22
8	RADIALES22	29/03/2022 to12/07/2022	8
9	PELACUS0322	27/04/2022 to 30/04/2022	60
10	RADPROF0622	15/06/2022 to 22/06/2022	12
11	CARBO-ACID	08/ 2022	19
12	DEPM23	10/02/2023 to 21/02/2023	20
13	PELACUS23	02/03/2023 to 29/03/2023	22
		Total	**370**

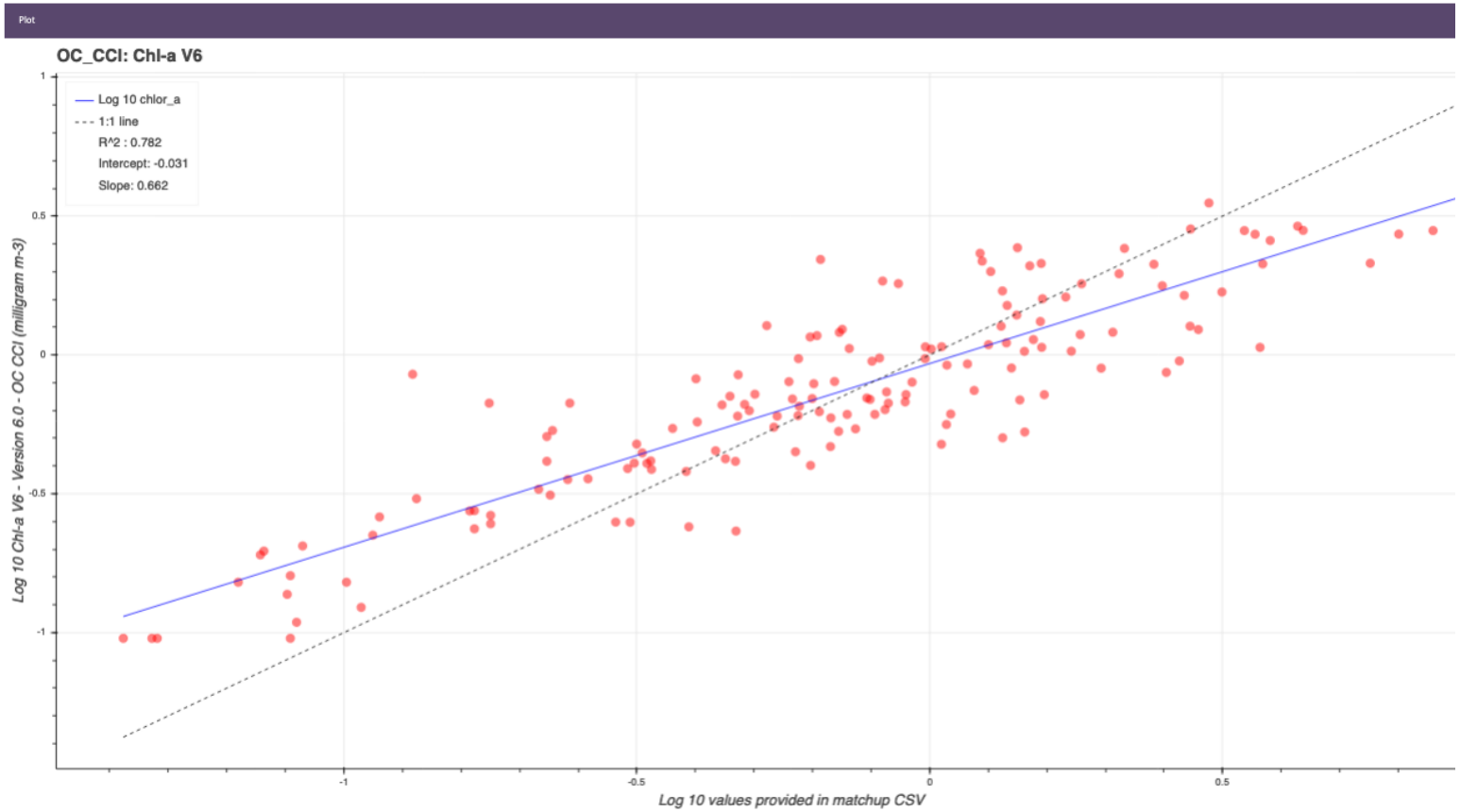
	AMT/PAP Cruises	Date	HPLC (nº surf/DCM)
1	AMT28	23/09/2018 to 30/10/2018	66
2	AMT29	13/10/2019 to 25/11/2019	62
3	PAP JC231	01/05/2022 to 20/05/2022	12
4	AMT30	March – April 2023	64?
5	PAP	May 2023	12?
		Total	**216**

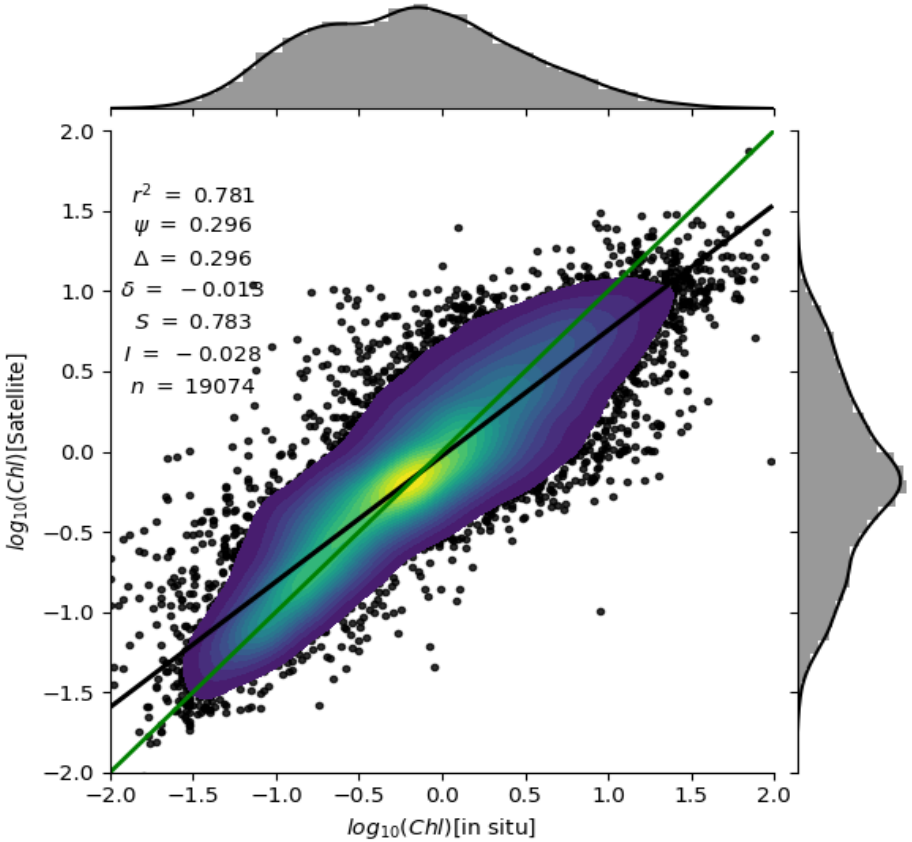
Sentinel 3 validation with iFADO data



Ocean Colour CCI validation with iFADO data

- ESA Ocean Colour CCI data are provided to CMEMS/C3S Multiple sensor, merged; 4km; daily
- iFADO data provide independent validation





Results: Action 4 – Novel algorithms

- Valente et al (2021) Linking ocean colour features in the western Iberian margin to wave-induced sediment resuspension and coccolithophore patches Continental Shelf Research 225, 104482
- Brotas et al., (2022) Complementary Approaches to Assess Phytoplankton Groups and Size Classes on a Long Transect in the Atlantic Ocean, Frontiers in Marine Science, 8, 10.3389/fmars.2021.682621
- Quartly et al., The link between surface and sub-surface chlorophyll in the centre of the Atlantic subtropical gyres: A comparison of observations and models (submitted to Frontiers in Marine Science)
- Han et al., Contrasting phytoplankton response to mesoscale eddies in the subtropical and mid-latitude North Atlantic (resubmission, prob. to JGR or IEEE Geosci. & Rem. Sens)
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- Tilstone and Land Contrasting patterns in primary production in the Atlantic Ocean over the past two decades in prep for Biogeosciences

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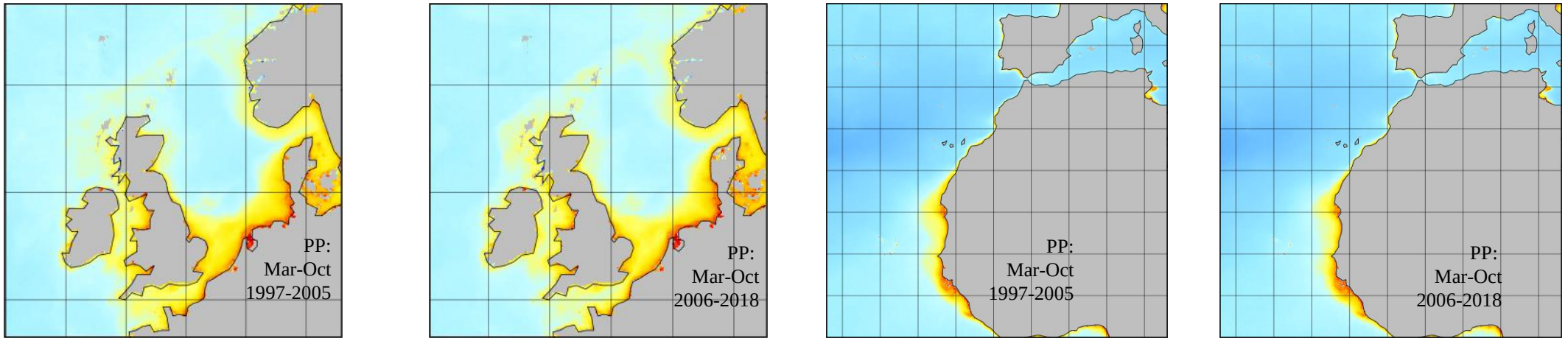
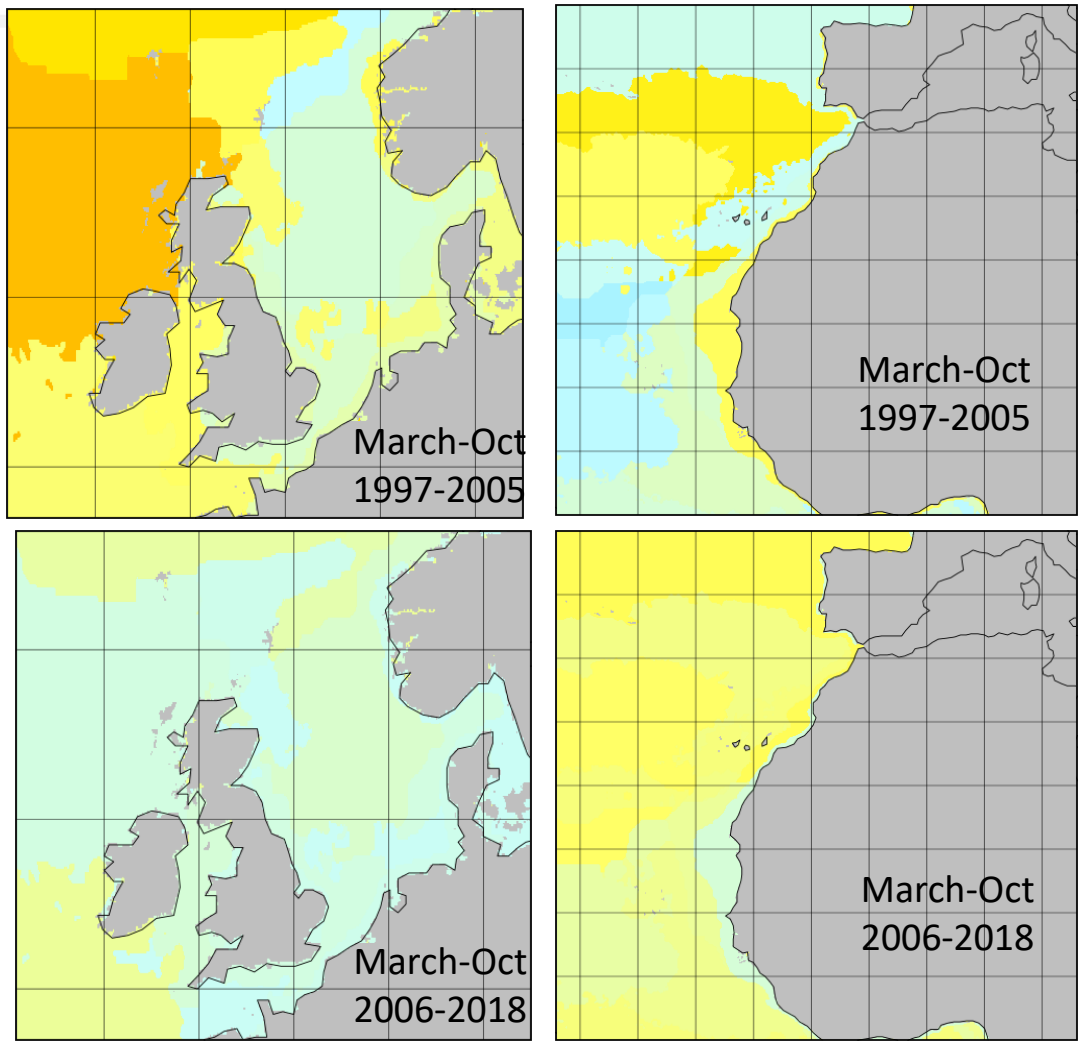
Primary production in the Atlantic

- Contrasting patterns in primary production in the Atlantic Ocean over the past two decades.
- Computed a 21 year time series of PP using Ocean Colour data (September 1997-December 2018) for areas of similar phenology, climatology, and annual production in the north-east Atlantic Ocean, the Iberian Peninsula and Mauritania.



- Mean monthly PP from March to October using OC-CCI Ocean Colour data (provided by CMEMS) from 1997-2005 and 2006-2018 for the north-east Atlantic, Iberian peninsula and Mauritania.

Primary production in the Atlantic

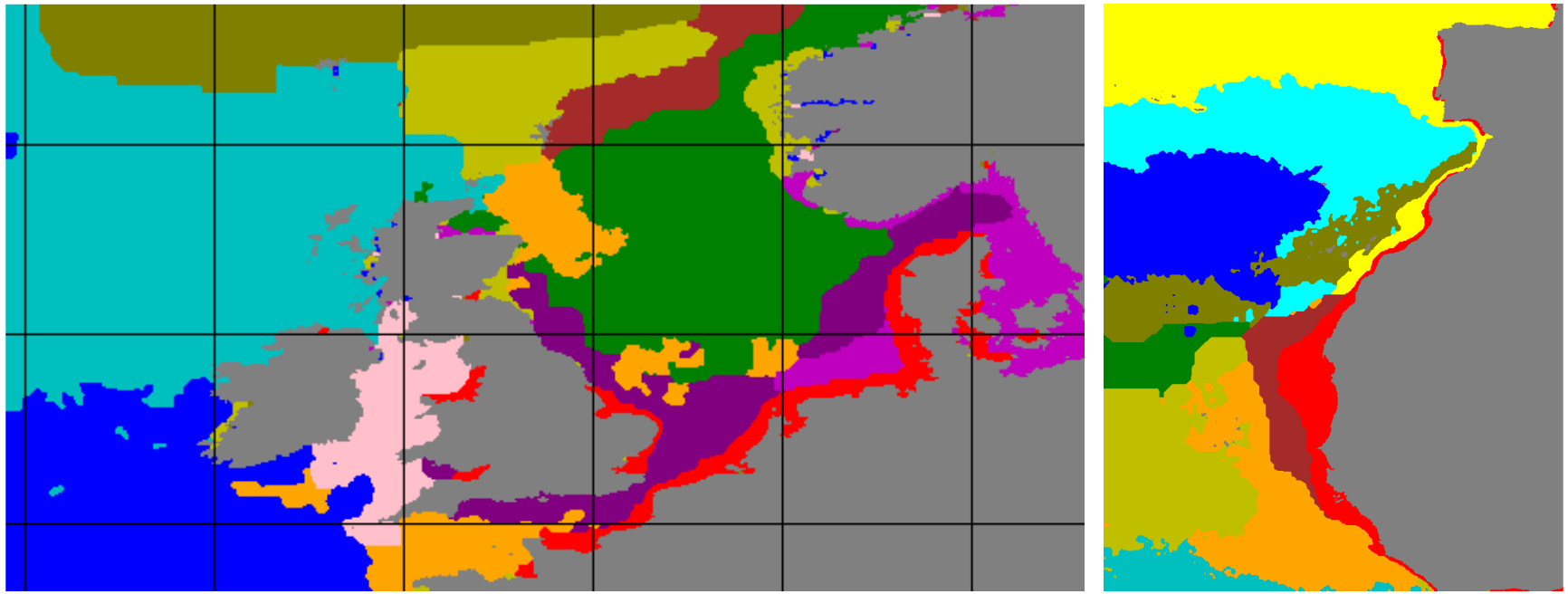


PP-based regional March-October significant anomaly trend 1997-2005 and 2006-2018 for north-east Atlantic, Iberian peninsula and Mauritania.

Primary production in the Atlantic

- Part of work was to classify Atlantic waters into regions of similar peak, timing, location and annual primary production

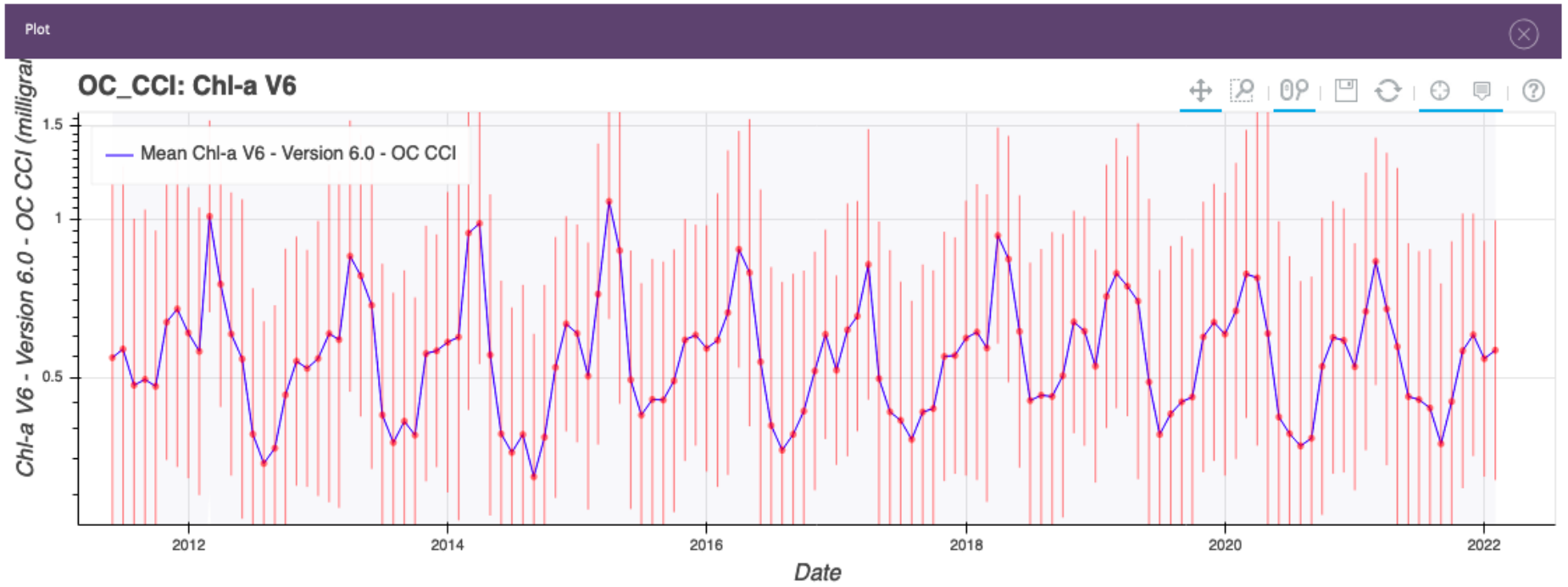
- Identified using k-means cluster analysis for the north-east Atlantic, Iberian peninsula and Mauritania.



Regions of similar peak, timing, location and annual primary production identified using k-means cluster analysis for the north-east Atlantic, Iberian peninsula and Mauritania.

How can you use these data?

- Most data are on open visualisation portals & iFADO portal



Metadata:

1) Chl-a V6 - Version 6.0 - OC CCI
Region: undefined
Confidence: undefined
Provider: OC_CCI
Interval: Monthly
Bounding Box: OSPAR_SpainPortugalFrance

Download

Time plot of monthly average chl-a in OSPAR Spain and Portugal area

Conclusions

- iFADO has made a contribution to, and benefitted from, EO
  - Guidance of research cruises with EO data
  - Contribution to satellite validation activities, important for Copernicus which relies on such research cruises

- Novel algorithms have produced data relevant to MSFD
  - Phytoplankton chl-a for eutrophication
  - Phytoplankton productivity
  - Phytoplankton size classes and diversity
  - Potential for monitoring plastic pollution

- Legacy of 6 papers published, in review or in prep
- Legacy of EO data available on visualisation portals

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Thank you for your attention!

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