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Primary production from ocean colour satellites: A key metric in biodiversity assessments.

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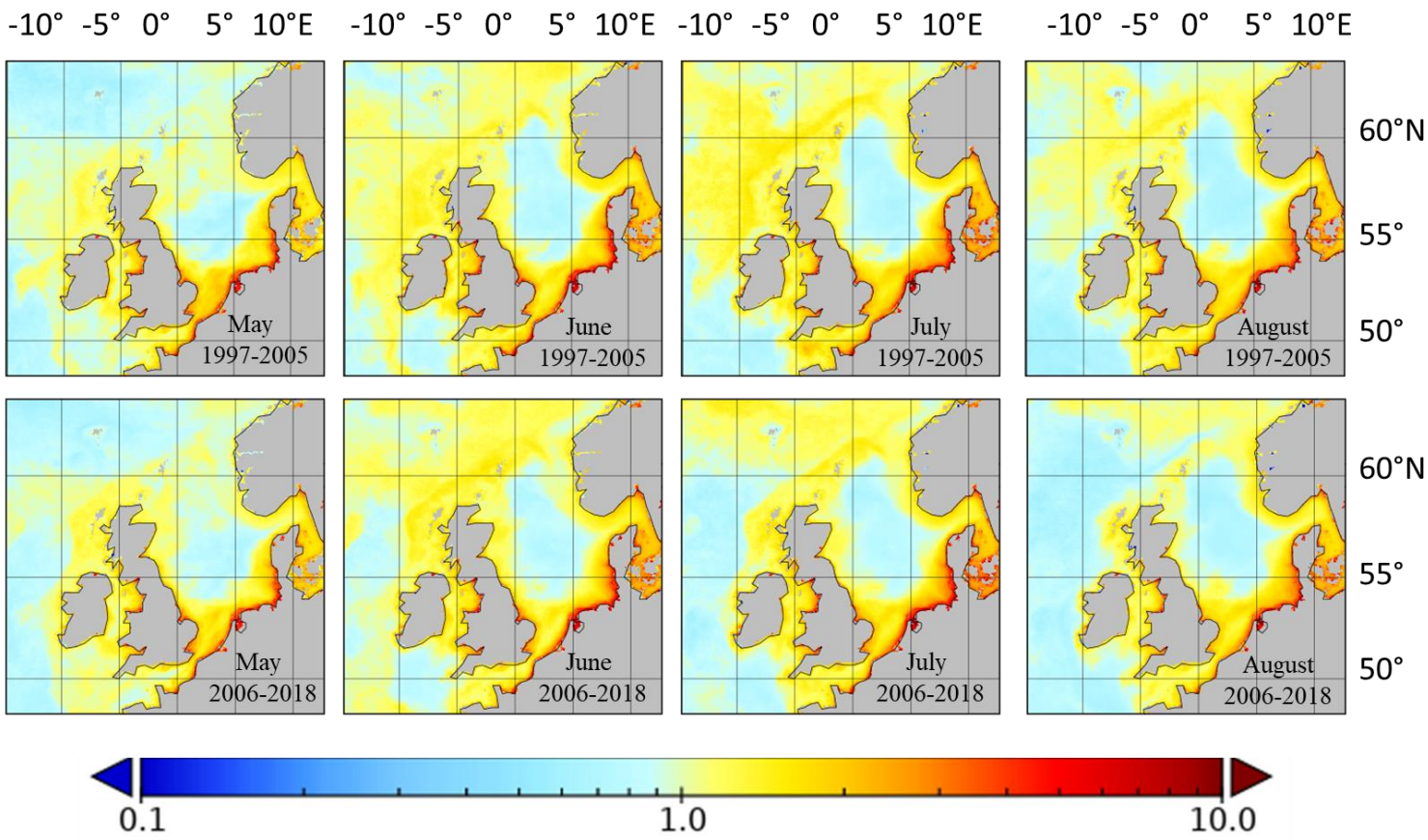
Primary production P90 for OSPAR area.

Marine Strategy Framework Directive Baseline indicator: FW2: Phytoplankton production reflects several environmental pressures (*e. g.* hydrological changes, contaminants, nutrient inputs or climate changes), which cannot necessarily be detected through changes in Chl *a*. **Historic thresholds determined that annual primary production should not exceed 300 gC m^{-2} yr^{-1}** and **daily values under 2-3 gC m^{-2} d^{-1}** when phytoplankton blooms occur.



21 yrs of ocean colour data used to determine Mean monthly primary production (gC m^{-2} d^{-1}) from May to August using CMEMS Ocean Colour data using a Wavelength Resolving model (Morel, 1991; Smyth et al. 2005) for the north-east Atlantic Case 2 water type areas masked.

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Primary Production P90: Climatological classes.

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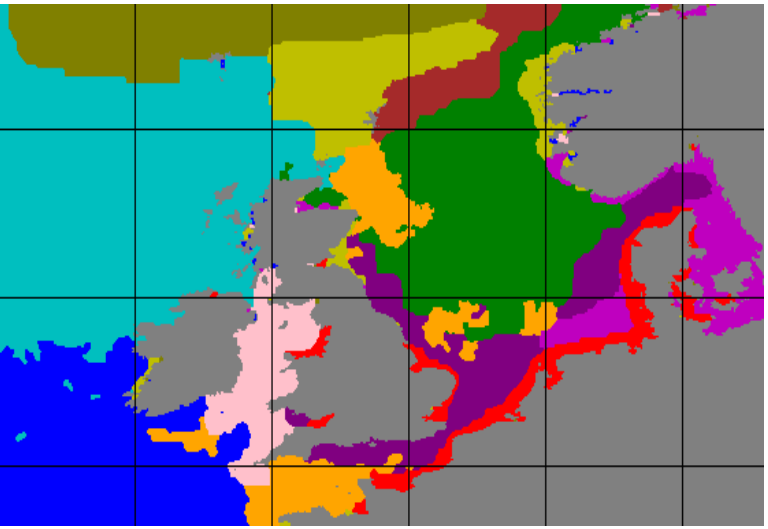
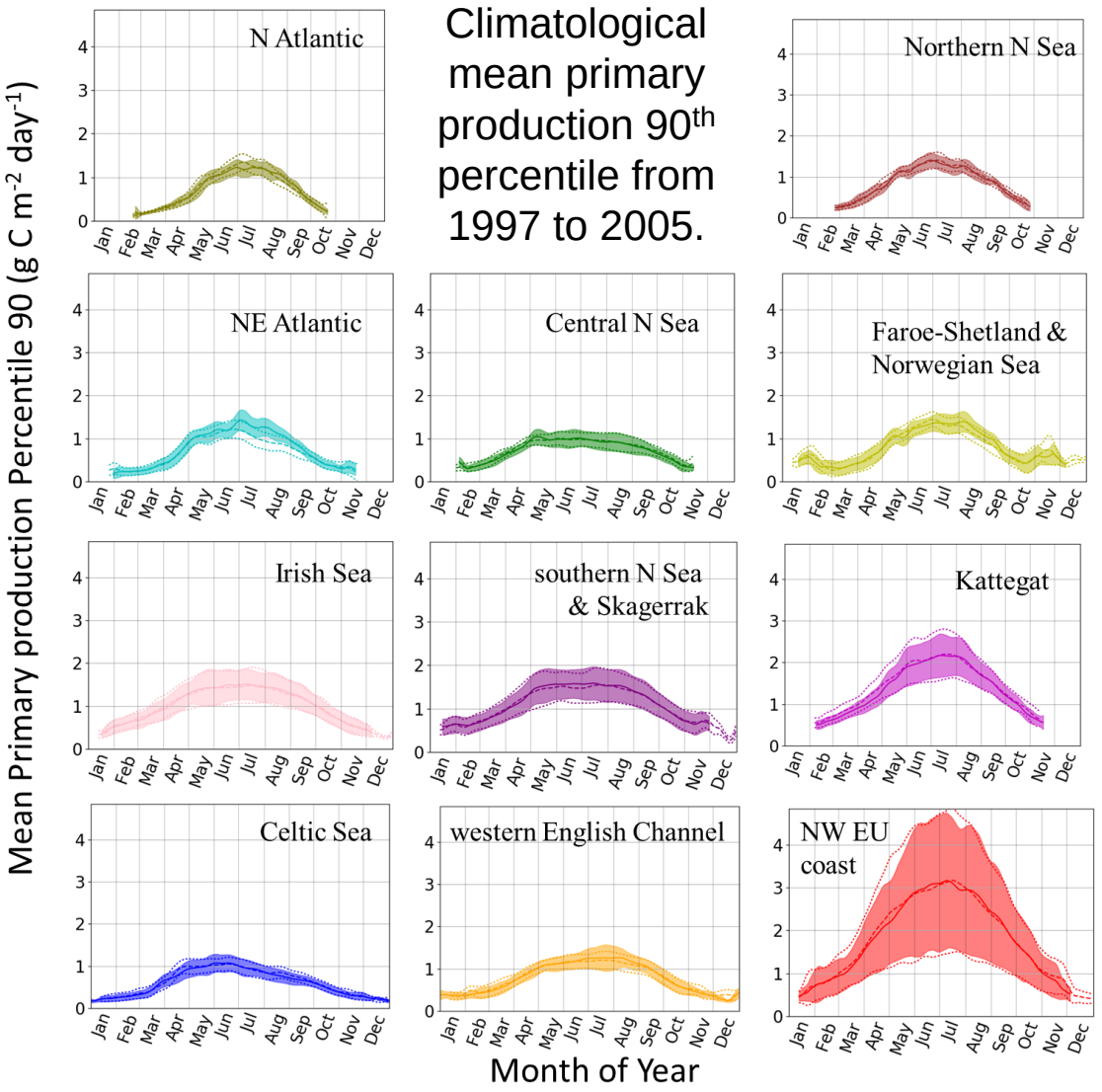


11 Regions identified using k-means cluster analysis on peak, timing, location and annual primary production data.



Upper limit of climatology used as the threshold to assess environmental disturbances.

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PP P90 thresholds: Proof of concept.

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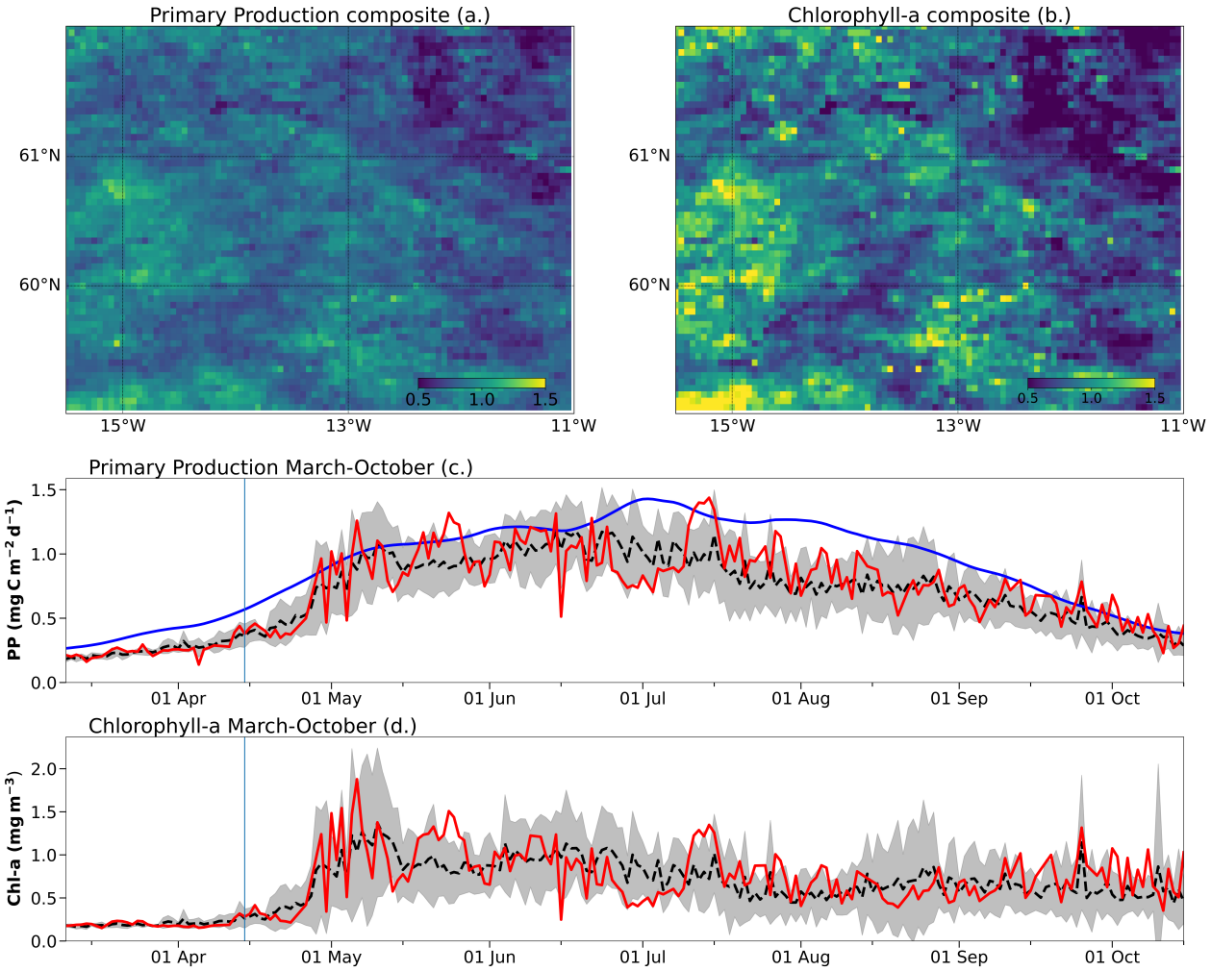

Eyjafjallajökull volcanic Eruption, 2010.

Composite images of (a.) primary production (g C m^{-2} d^{-1}) and (b.) Chlorophyll-*a* (mg m^{-3}) from April to May 2010. Time series of (c.) primary production (g C m^{-2} d^{-1}) and (d.) Chlorophyll-*a* (mg m^{-3}) from March to October 2010. Black dashed line - mean daily climatology 1997-2016; grey shaded area - standard deviation; red line is the mean daily value for 2010.

After the eruption of the volcano, primary production goes above the climatological threshold of PP P90 for the NE Atlantic (solid blue line).

Summary.

- Historic **threshold values of primary production for the region** defined **daily values <2-3 gC m^{-2} d^{-1}** when phytoplankton blooms, **annual rates <300 gC m^{-2} yr^{-1}**.
- **~25 years of satellite ocean colour primary production data** available for **assessing environmental disturbances.**
- **Primary Production** computed from an 8 yr reference period over the phytoplankton growing season (March to October) to determine **new thresholds** based on **90th percentile** (P90) climatology for regions with similar peak, timing, location and annual production.
- **Methodology could detect the effects of** the dust plume from **Icelandic volcano** Eyjafjallajökull **in 2010**, and high nutrient input in the coastal zone (not shown).

Knowledge gaps and priorities.

The method could be further improved by using:

- **Higher spatial resolution satellite data** (e.g. 300m Sentinel-3 OLCI);
- **Uncertainties in the PP and PP P90 data on a per pixel basis**, in association with the thresholds;
- **Other satellite data** (e.g. SST, SSS, SSH) and other parameters available from ocean colour (e.g. size specific Chl *a* or PP) **to further refine the region definitions**.

Thank you!

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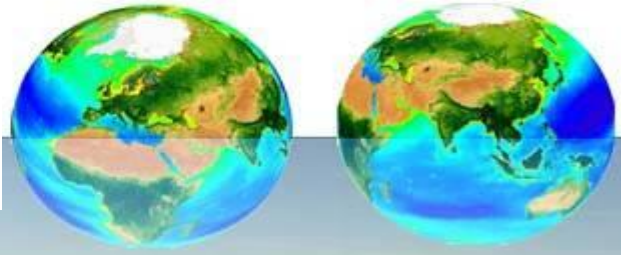

Funded by **European Commission DG Environment** Contracts:

- **JMP EUNOSAT** - Joint Monitoring Programme of the Eutrophication of the NOrth Sea with SATellite Data (Contract No. 11.0661 / 2017 / 750678 / SUBIENV.C2).
- **NEA PANACEA** - North East Atlantic project on biodiversity and eutrophication assessment integration and creation of effective measures (Contract No. 31167499).
- **S3-EUROHAB** (Sentinel-3 products for detecting EUtROphication and Harmful Algal Bloom events) from the European Regional Development Fund through the INTERREG France-Channel-England.