OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic

Meeting of the Task Group for the revision and application of the Common Procedure (TG-COMP)
Videoconference: 8 June 2021

Annexes to the Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area

Presented by the Co-convenors of ICG-Eut

Actions requested

1. TG-COMP is invited to further develop the Annexes to the Common Procedure Agreement 2013-08

Background

2. ICG-Eut and the Task Group for the revision and application of the Common Procedure (TG-COMP) have been revising the Common Procedure Agreement 2013-08 towards a more harmonised approach, using new ecologically coherent assessment areas, and establishing robust threshold values. The most recent versions of the revised Annexes to the Agreement are below.

Annex 3: Methods for delineation of assessment units ~~in the North Sea (and adjacent waters)~~

A. Method for delineation of assessment units in the North Sea (and adjacent waters)

Overview

The EU project Joint Monitoring Programme of the Eutrophication of the North Sea with Satellite data (JMP-EUNOSAT) developed an assessment framework for the Greater North Sea based on the eutrophication indicator *chlorophyll a*. Part of this work is identifying cross-border assessment areas with similar ecological and physical functioning (Blauw et al., 2019). This approach has been adopted for the application of the Common Procedure. However, during a joint workshop of ICG-EMO and TG-COMP in Hamburg (Sept. 2019) it was decided that further refinements would be made to the assessment areas proposed by JMP-EUNOSAT, based on requests by OSPAR Contracting Parties.

JMP-EUNOSAT proposal for assessment areas

The assessment framework for the Greater North Sea is based on the eutrophication indicator *chlorophyll a*; identifying cross-border assessment areas with similar ecological and physical functioning. Relevant environmental conditions for defining assessment areas include physical (depth, salinity and stratification), chemical and biological factors and anthropogenic pressures.

In JMP-EUNOSAT the areas with similar phytoplankton dynamics were derived from cluster analysis of satellite data of chlorophyll-a and primary production. Boundaries between the areas found in the cluster analysis could often be related to physical variables in the JMP-EUNOSAT oceanographic model. Therefore, boundaries between assessment areas were defined using the physical variables best explaining the clusters found in the phytoplankton data. For example, areas were subdivided along 32 psu salinity and 35 m depth contours. Additionally, geographical areas were distinguished, such as the Channel, Irish Sea and Kattegat.

For the cluster analysis the chlorophyll signal from satellite data was decomposed into an interannual signal, a seasonal signal and a residual signal. The interannual signal can indicate long-term trends or regime shifts. The seasonal signal is an indication whether the blooms occur each year systematically in the same season or not. The residual signal gives an indication of the remaining variability and can give an indication of strongly varying conditions between years and seasons. With a statistical analysis using the various signals, areas with similar patterns can be identified and merged (Figure A.1). Largely similar areas appeared in an analysis of patterns in primary production derived from satellite data.

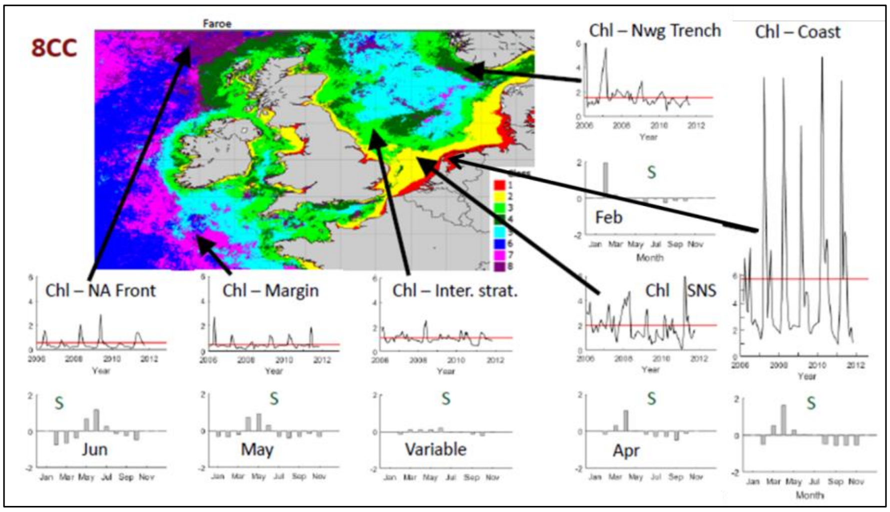

Figure A.1: Areas with similar phytoplankton dynamics in satellite data.

In JMP-EUNOSAT Deltares used the hydrodynamic model DCSMv6 FM (Dutch Continental Shelf model version 6) to model stratification and salinity and those results were combined with data on bathymetry. The DCSMv6 FM model has a spatial resolution (model grid size) of 1 nautical mile for all areas that are less than 100 m deep and covers the Greater North Sea and part of the NE Atlantic Ocean and Baltic Sea. Satellite data, in-situ data and FerryBox data were used for the model validation. Stratification was determined based on the modelled monthly averaged density difference between the top and bottom layer in the model. A grid cell was classified as stratified when the density difference was larger than 0.75 kg m^{-3} similar to van Leeuwen et al. (2015). Areas that are almost always stratified are the Norwegian Trench and the waters off the French Atlantic coast. The Northern North Sea is only stratified in summer and mixed in winter. The shallow areas of the Dogger Bank and the Southern North Sea are always mixed. The Atlantic Ocean seems never to be stratified in the model, although in reality the ocean is permanently stratified. To differentiate the type of stratification (permanently, seasonally or intermittently) the number of consecutive months, in which grid cells are either mixed or stratified is calculated. The areas are then classified as shown in Figure A.2 and Table A.1.

Table A.1 Stratification classes

Stratification class	**Number of consecutive months stratified**	**Number of consecutive months mixed**
Permanently stratified	≥ 8	<8
Seasonally stratified	≥ 3 and <8	≥ 6
Intermittently stratified	≥ 1 and <3	≥ 6
Permanently mixed	= 0	≥ 10

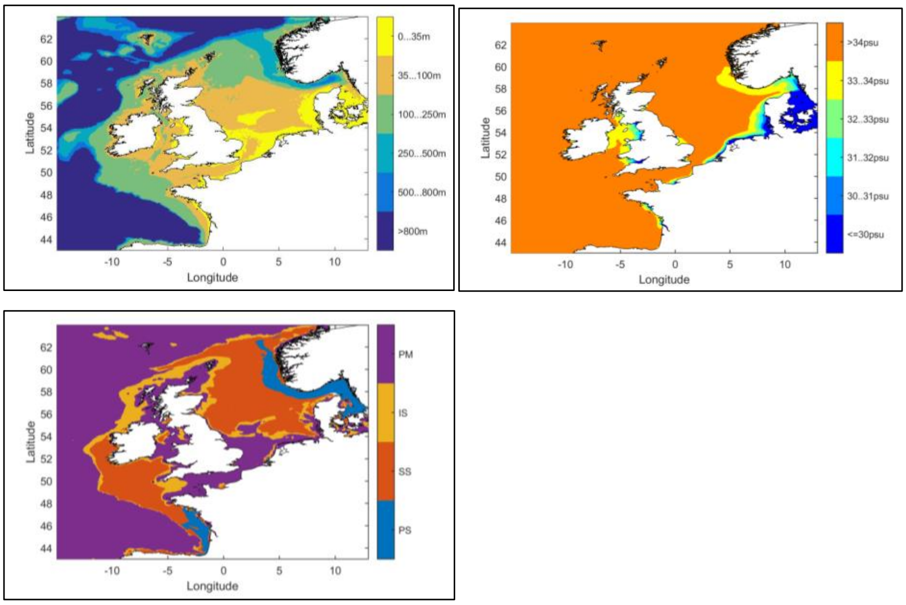

Figure A.2: Physical conditions used to determine ecologically coherent assessment areas. Top left (a): Depth contours; top right (b): Salinity contours of the modelled salinity in the top layer; bottom (c): Stratification classes: Permanently stratified (PS), seasonally stratified (SS), and intermittently stratified (IS) or permanently mixed (PM)

Some of the features in the spatial chlorophyll patterns are consistent with the bathymetry of the North Sea, namely the Dogger Bank, the Southern North Sea and the Norwegian Trench. Those features are best depictured by the 35 m (Dogger Bank and Southern North Sea) and the 250m depth contour (Norwegian Trench, Figure A.2). The deep Atlantic is also separated by the 250 m depth contour. A salinity threshold of 32 psu was chosen to best approximate the coastal water type (Figure A.2).

Figure A.3 and A.4 show the resulting assessment areas proposed by JMP-EUNOSAT. When comparing these assessment areas with the assessment areas used for the previous OSPAR assessment report (Figure A.3) the main difference is that different water types in the North Sea stand out clearly in the new approach and different water types (for example 'coastal waters' or 'Dogger Bank') are defined in the same way across national borders and form a coherent sub-area.

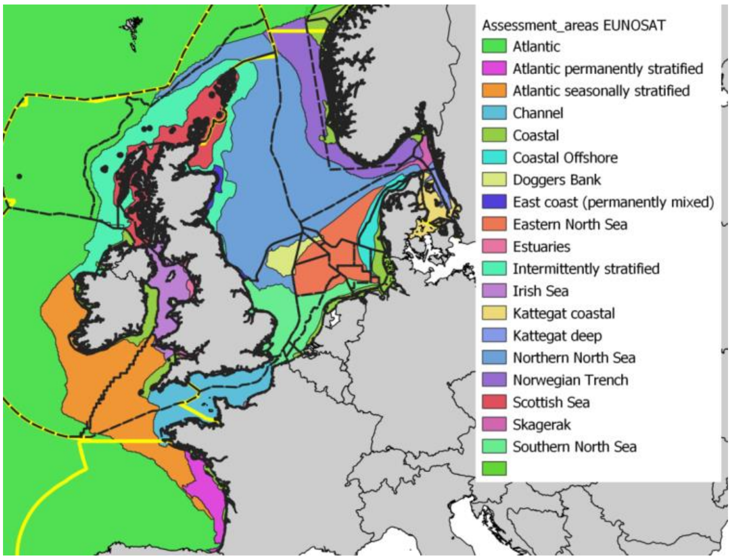

Figure A.3: Comparison of 'new' assessment areas developed by JMP Eunosat with COMP3 assessment areas (indicated with black broken lines). Borders between MSFD subregions are shown by yellow lines

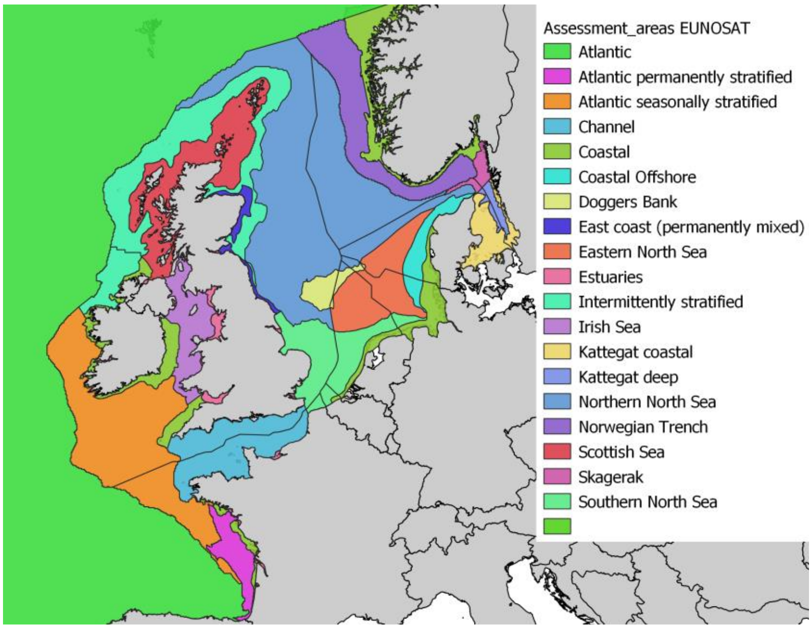

Figure A.4: JMP-EUNOSAT proposal for ecologically relevant assessment areas based on phytoplankton dynamics, duration of stratification, mean surface salinity and depth, with borders between EEZs projected on the assessment areas as black lines.

Further development of the OSPAR assessment areas after JMP-EUNOSAT

The original proposal by the JMP-EUNOSAT project was to carry out assessments at three levels of spatial detail:

1. Areas defined based on similar ecological and physical functioning throughout the North Sea, based on spatial and seasonal patterns of chlorophyll and primary production in satellite data;

2. Subdivision of cross-border coherent areas into national sub-areas, so countries can take responsibility for their own part of the cross-border assessment areas;

3. National sub-areas further subdivided into smaller areas, depending on preferences and practical considerations of countries. This would allow e.g., to assess changes in areas that are affected by specific river catchments.

For practical reasons, such as easy implementation of the assessment procedure in the COMPEAT tool, it was decided at the September 2019 TG COMP/ICG EMO meeting in Hamburg that OSPAR will only perform assessments at one level of spatial detail. There was no need to separate assessment areas along country boundaries. But it was considered important that individual large river catchments would be represented as distinct assessment areas. Furthermore, it was decided that the OSPAR assessment areas should not overlap with the WFD assessment areas. Therefore, the WFD assessment areas were cropped out of the OSPAR assessment areas.

Based on requests by Contracting Parties the following changes were made to the assessment areas as originally proposed by the JMP-EUNOSAT project:

- The area 'coastal waters' along the Belgian, Dutch, German and Danish coasts has been split up along river catchments, following the same delineations as used by the WFD. So, the boundaries perpendicular to the coast that split up the 1 nautical mile area (WFD water bodies) along the coast have been extended further offshore. This resulted in the following areas, representing major river inflows: Scheldt plume, Meuse plume, Rhine plume, Ems plume and Elbe plume (all the way up along the Danish coast). We have considered to include the Weser as separate river plume but abandoned this idea to avoid a very small assessment area. We also considered changing the boundaries between the Scheldt, Meuse and Rhine plumes to better represent that, in reality, the coastal waters are dominated by fresh water inputs from the Rhine and, to a lesser extent, Meuse rivers (already mixed in the Dutch delta area) rather than the Scheldt (that has a relatively small discharge and nutrient load). For coherence with the WFD we have so far used the WFD boundaries between the Scheldt, Meuse and Rhine catchments (Figure A.5).

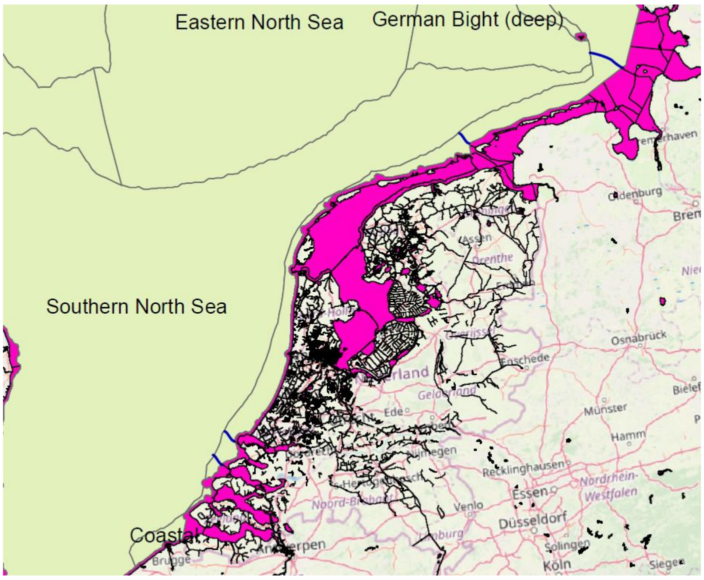

Figure A.5: WFD assessment areas (pink), JMP-EUNOSAT assessment areas (green with grey borders) and the proposed cut-up of the coastal water assessment area into river catchments (dark blue) by extending WFD boundaries further offshore.

- In UK coastal waters river plumes of the Humber, Thames and Liverpool Bay were defined as separate assessment areas. After some discussion with the Environment Agency, it was decided to include some of the outer WFD areas in the Thames and Liverpool Bay areas as the areas extend quite a bit into the plume and it was preferred to assess it as one area. The Thames plume follows the 25mg/l SPM contour, Liverpool Bay follows 10 mg/l SPM and Humber follows 11 mg/l SPM, based on a 10-year average (Greenwood et al., 2019).

- In French coastal waters also major river plumes were used as assessment areas: Adour plume, Gironde plume, Loire plume and Seine plume. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019 and Tew-Kai et al., 2020).
- In French coastal waters also new area boundary definitions have been defined based on the same work by SHOM: Bay of Biscay shelf waters, Bay of Biscay coastal waters and Channel coastal waters.
- Based on the same SHOM work and discussions between UK and France both CPs agreed on new cross-boundary sub-areas within the Channel.
- Germany proposed a new subarea in the eastern North Sea for a better representation of the salinity gradient. This has been implemented as German Bight central (Figure A.6).

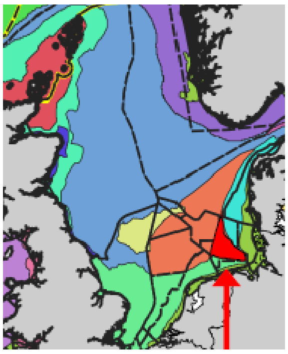

Figure A.6: The newly proposed sub-area in the German Bight as red area projected on the original JMP-EUNOSAT assessment areas.

Furthermore, some smaller polishing edits were made such as: removing small leftover polygons after cropping out WFD areas and splitting up some assessment areas into separate areas:

- Removed coastal offshore area splitting up Skagerrak
- Moved boundary between Eastern North Sea and German Bight to align with 34psu salinity contour.
- Moved boundary between Coastal UK1 and Irish Sea to align with old OSPAR boundary.
- Extended outer boundaries to encompass all of UK and Irish EEZs.
- Removed a fragment polygon in Coastal Offshore region (merged with German Bight)
- Split the intermittently stratified region into two along the boundary between the Celtic Seas and Greater North Sea (purple dashed line in Figure A.7).
- Scottish WFD areas outside 3nm boundary were reinstated to unify Scottish Sea into one assessment area.
- Merged Coastal IRL 1 and Scottish Sea 1 (highlighted in pink in Figure A.7)

The resulting new proposal for assessment areas for OSPAR eutrophication assessments is shown in Figure A.8.

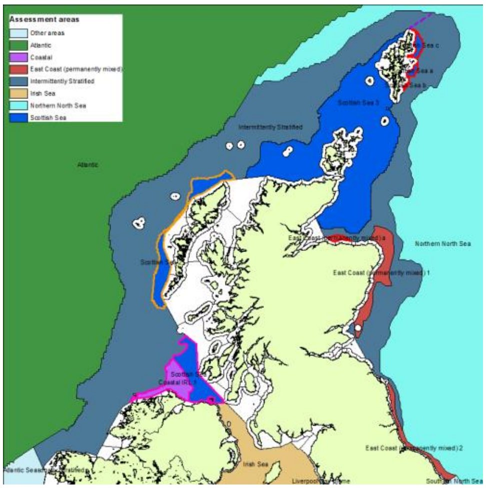

Figure A.7: Illustration of some small edits in Scottish waters

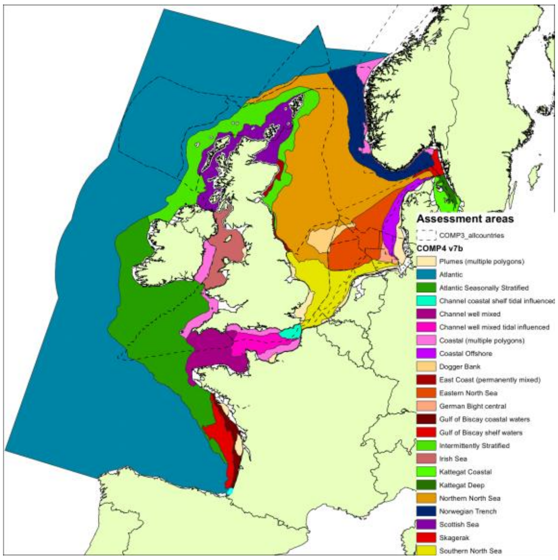

Figure A.8: Proposal for ecologically relevant assessment areas based on duration of stratification, mean surface salinity and depth

After the ICG-EUT meeting in January 2020 in Dublin, countries within the OSPAR area but outside the EUNOSAT project area were contacted to ask if they had assessment regions they would like to be included. Portugal and Spain both responded and their areas were added. The definition of these areas was based on physical characteristics (Portugal) and phytoplankton dynamics (Spain).

Commented [FG1]: Spain used the method described in https://doi.org/10.1016/j.rse.2016.08.011 as in the MSFD, and resumed in section b.

B. Method for delineation of assessment units in the Spanish waters

Rationale

The conceptual model of coastal eutrophication proposed by Cloern (2001) suggests that the effects of nutrient pollution on phytoplankton productivity (direct effects) in a given marine area are conditioned by its physical and/or biological characteristics including optical properties of the water column and/or horizontal transport processes that depend on several factors like wind, bathymetry, basin geography and river flow. These attributes that vary among marine systems act as filters that modulate (i.e., do amplify or mitigate) the impacts of nutrient enrichment. Consequently, the response to changing signals in nutrient load within a given marine region might spatially differ depending on the operation of these *filters* (following the Cloern's terminology) which additionally would act at different time scales, i.e., seasonal, decadal or inter-annual; Li et al. 2010). This theoretical framework guided the objective of delimiting relevant areas in eutrophication assessment for the Spanish Atlantic marine waters.

Available dataset about physical variables, nutrients and chlorophyll a in the water column coming from *in situ* samplings is fairly reduced for wide areas of the Atlantic Spanish waters. In contrast, satellite provides with information at high temporal and spatial resolution, which is suitable to identify spatial distribution patterns of the chlorophyll attributable to hydrological variability and/or anthropogenic impact (Gohin et al. 2008) as well as to detect algal blooms and shifts in dominance patterns of some phytoplankton taxonomic groups (Hu et al. 2005, Ahn and Shanmugam 2006, Carvalho et al. 2011, Shanmugam et al. 2008, Jackson et al. 2011). If this satellite information is appropriately analysed for a given marine region, areas distinguishable according to the particular mechanisms that control the nutrient-driven chlorophyll dynamics would be identified (for instance, upwelling areas, anticyclonic gyres or zones affected by river discharge; Klemas 2011). Consequently, Spain based its task of delimiting relevant areas regarding to eutrophication on the analysis of satellite chlorophyll a time series.

Procedure

MODIS-Aqua Level-2 images covering the Spanish waters of the Cantabrian Sea and Galician coast (Spanish Northern-Atlantic waters) and the Gulf of Cadiz (Southern-Atlantic waters) for 2002-2013 were downloaded from the NASA website (http://oceancolor.gsfc.nasa.gov/) in June 2014 (MODIS-Aqua reprocessing 2013.1). The supplier provides a daily scene of chlorophyll for the study area with a spatial resolution of 1.1x1.1 Km^2. Satellite chlorophyll *a* (C_{SAT}) was calculated from reflectance values by using the global algorithm OC3M v.6 based on NOMAD v.2 database (O'Reilly et al. 2000, Werdell and Bailey 2005). Daily data of satellite surface temperature were also retrieved from the images of MODIS-Aqua. The time series of C_{SAT} for each pixel were processed in order to compose climatological monthly maps.

The monthly means of C_{SAT} were used for identifying contrasting areas with respect to their chlorophyll *a* annual cycle. For this objective, all pixels were grouped by means of the statistical technique of non-hierarchical clustering analysis (*k-means* clustering analysis). *k-means* clustering analysis classifies objects (pixels) into a pre-defined number of clusters unrelated hierarchically. In our analysis, each pixel was assigned to a particular group according to the features of its annual cycle of C_{SAT} as determined by the climatological monthly means. Note that this procedure classified the pixels mainly according to pixel-to-pixel relative differences more than based on the absolute values of C_{SAT}. Independent analyses were performed for the Spanish Northern- and Southern-Atlantic sub-areas. The clustering analyses were performed with monthly means calculated for different duration time periods within 2002-2013. For each assayed time period, the analyses were carried out for pre-defined different number of clusters (*k*, ranging from 2 to 10). The optimal number of clusters for each assayed time period was determined by using the RS index (R-squared; Halkidi et al. 2001). The clustering algorithms were run 100 times for each combination of time interval and *k* values.

The outcomes of the clustering analyses were validated by comparing the pixel grouping patterns with the spatial structure expected according to available data of *in situ* chlorophyll *a* (C_M) and nutrients in the two sub-areas. For this purpose, *in situ* data obtained from multiple research cruises performed by the Spanish Institute of Oceanography from 1992 to 2012 were gathered. Most data were obtained during quarterly or monthly samplings carried out in several fixed stations (http://www.ieo-santander.net/seriestemporales/). Only data obtained in the upper 20 m depth layer were used. The sampling stations were projected onto the clustering map to assign them to one particular pixel grouping area (or assessment area). Afterwards, monthly and yearly means of nutrients (nitrate and phosphate) and C_M were calculated for each pixel grouping area and the statistical significance of the differences among areas was tested.

A complete description of the methodology for analysis of satellite images, clustering and validation can be found in Mercado et al. (2016).

Spanish assessment areas

In the Spanish North Atlantic waters, six pixel-groups with marked differences in the C_{SAT} annual cycle shape were identified. The most productive waters (i.e., with higher C_{SAT} and C_M) were located in the Galician Rias (NorC1/NAAC1) and the surrounding environments (NorC2/NAAC2). The Iberian Peninsula northwest coast, which is frequently affected by intensive upwelling, was also discriminated (NorC3/NAAC3). For the rest of Spanish northern-Atlantic waters, the pixels were grouped following the gradient from coast (NorP2/NAAP2) to open sea (NorO1/NAAO1). These differences among grouping areas were also obtained when C_M and nutrients concentrations are compared. Consequently, the grouping of pixels based on satellite data reflected reasonably the underlying mechanisms that control the phytoplankton biomass in the study area (Figure A.9).

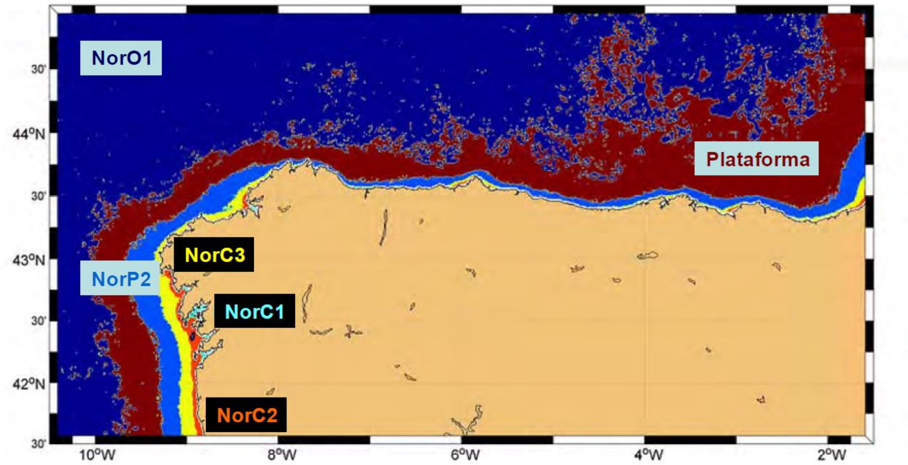

Figure A.9: Resulting assessment areas in the North Atlantic Spanish waters.

In th~~T~~he South Atlantic waters we found also different areas. The most coastal SUR-C1(SAAC1) and SUR-C2 (SAAC2) with the highest chlorophyll concentrations, and very influenced by the river discharges. We also find 2 areas of transition between the coastal and the open ocean (SUR-OCEAN/SAAOC), one of them also very influenced by the rivers (Guadalquivir and Guadiana, Tinto-Odiel, Guadalete) SUR-P1 (SAAP1), and another more external SUR-P2 (SAAP2) (Figure A.10).

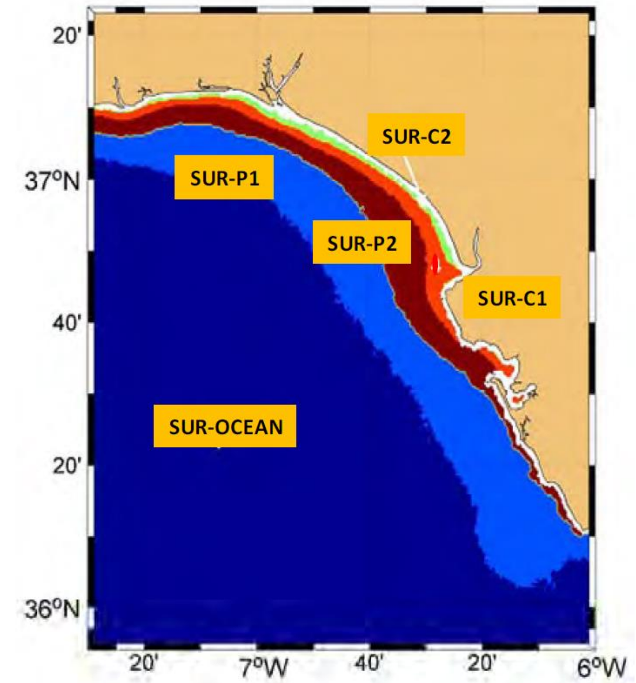

Figure A.10: Resulting assessment areas in the South Atlantic Spanish waters.

These units can be used for spatial aggregation of eutrophication indicators, e.g., data collected from *in situ* samplings, as well as for calculating robust reference values and time trends (see Mercado et al. 2016). Furthermore, the pixel grouping is useful for optimising the pre-existing monitoring programs as it facilitates the aggregation, selection, and location of sampling stations in order to avoid collection of redundant and/or pointless information. Also, this method is useful to decide when is preferable to sample as the centroides of each cluster are the characteristic annual cycle of surface chlorophyll *a* concentration in the corresponding assessment area (Figure A.11).

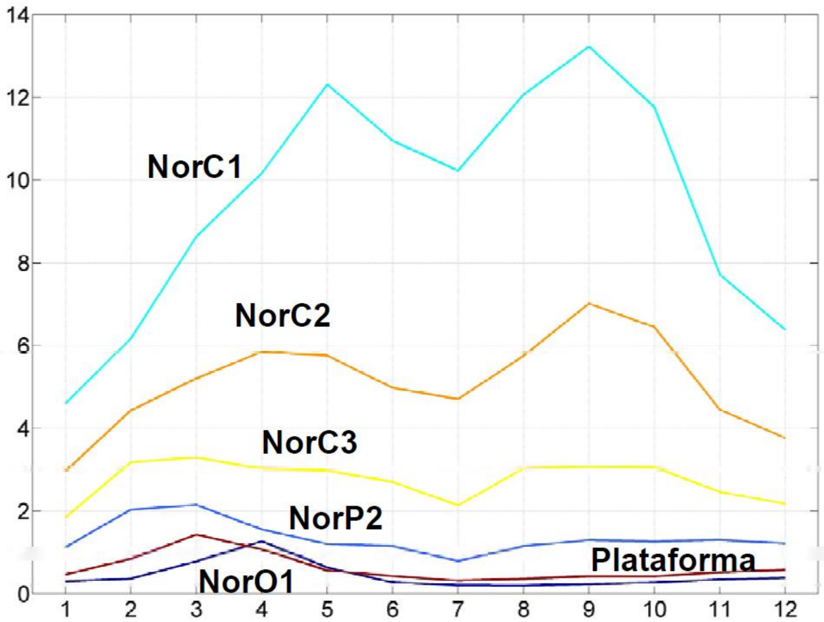

Figure A.11: Resulting centroides in the North Atlantic Spanish waters.

C. Additional edits

Additional edits were:

- Aligning boundaries in French waters
- Removing self-intersections and slivers from polygons
- Aligning Spanish and Portuguese assessment areas to ensure no gaps
- Simplifying Spanish assessment polygons and removing isolated fragments.

For a full history of edits to the shapefiles for the assessment areas, visit the COMPEAT github repository and view the commit history.

Figure A.9 shows the current version of proposed assessment areas. Table A.2 gives a summary of the characteristics of each assessment area.

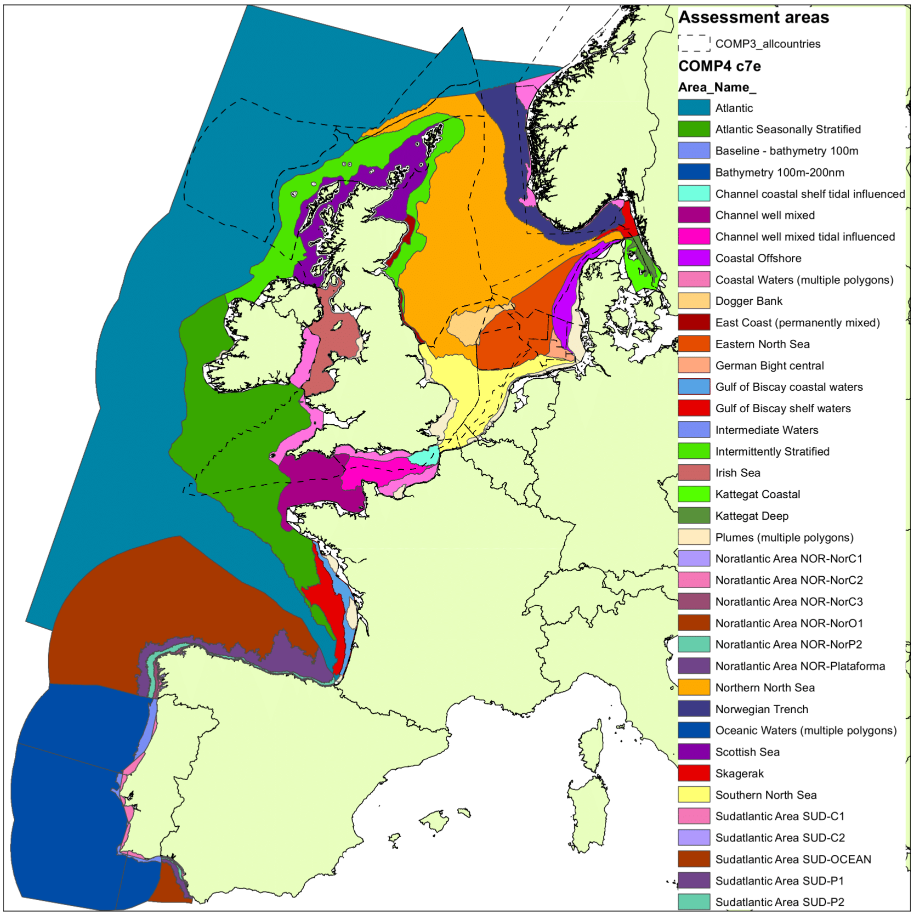

Figure A.~~9~~12. Proposal for ecologically relevant assessment areas based on duration of stratification, mean surface salinity, depth, suspended particulate matter and primary production.

Table A.2. Description of the assessment areas. WFD areas are excluded and the COMP4 assessment areas are only relevant to open waters beyond WFD

Area code	Area name	CPs involved	Description	Area (km^2)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
ADPM	Adour plume	FR	Plume of the Adour river (SW France). The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019)	283	34	33	35	87	37	174
ATL	Atlantic	ES, FR, IE, UK, NO	All areas west of 250 m depth line, separating deeper Atlantic Ocean from shallower areas in Bay of Biscay, Celtic Seas, Greater North Sea. Outer boundary undefined (outside of model domain)	934260	35	35	36	2291	320	4827
ASS	Atlantic Seasonally Stratified	FR, IE, UK	Area between 100-250 m dept line, seasonally stratified. NW part of Region IV, SW part of region III.	217301	35	35	35	134	90	174
CCTI	Channel coastal shelf tidal influenced	FR, UK	Eastern part of Channel. Not stratified, influenced by tidal mixing. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019) and discussions between FR and UK.	5081	35	35	35	40	26	55
CWM	Channel well mixed	FR, UK	Western part of Channel, extending into Bay of Biscay. Not stratified. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019) and discussions between FR and UK.	42015	35	35	35	77	43	106
CWMTI	Channel well mixed tidal influenced	FR, UK	Central part of Channel. Not stratified, influenced by tidal mixing. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019) and discussions between FR and UK.	20632	35	35	35	59	43	74
CFR	Coastal FR channel	FR, UK	Coastal waters with freshwater influence along the French coast in the E part of the Channel. The landward boundaries are the WFD water bodies and the Seine plume, the outer boundaries are the well mixed central waters of the Channel. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019).	7176	34	33	35	33	22	42

Area code	Area name	CPs involved	Description	Area (km^2)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
CIRL	Coastal IRL 3	IE	Coastal waters on E coast of Ireland (Irish Sea). The landward boundaries are the WFD water bodies, the outer boundary is the Irish Sea assessment area.	9583	34	34	34	65	25	99
CNOR1	Coastal NOR 1	NO	The landward boundary is the WFD water bodies. Seasonally stratified coastal waters, outer boundary is the 250m depth contour.	8741	34	34	34	190	123	238
CNOR2	Coastal NOR 2	NO	The landward boundary is the WFD water bodies. Seasonally stratified coastal waters, outer boundary is the 250m depth contour.	2606	34	34	34	217	131	250
CNOR3	Coastal NOR 3	NO	The landward boundary is the WFD water bodies. Seasonally stratified coastal waters, outer boundary is the 250m depth contour	1733	32	32	33	171	113	233
CO	Coastal Offshore	DE, DK	Coastal waters along the coast of DE and DK. The landward boundary is formed by WFD water bodies and the 32 psu salinity level. The outer boundary is ...	18540	33	33	34	27	21	33
CUK1	Coastal UK 1	UK	Coastal waters SW of England, permanently mixed (Nr of consecutive months stratified = 0, Nr of consecutive months mixed >= 10) and intermittently stratified (Nr of consecutive months stratified >=1 and < 3, Nr of consecutive months mixed >= 6). The landward boundary is the WFD water bodies, the outer boundary are the seasonally stratified waters in the Celtic Seas.	10697	35	34	35	60	40	80
CUKC	Coastal UK channel	UK	Coastal waters with freshwater influence along the English coast in the E part of the Channel. The landward boundaries are the WFD water bodies, the outer boundaries are the 50 m depth contour.	6305	35	35	35	37	23	51
DB	Dogger Bank	NL, DE, DK, UK	Permanently mixed waters less than 35 m deep in the Dogger Bank area.	14750	35	35	35	28	20	34

Area code	Area name	CPs involved	Description	Area (km^2)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
ECPM1	East Coast (permanently mixed) 1	UK	Permanently mixed coastal waters. The outer boundary are the intermittently stratified waters	3519	35	35	35	73	45	94
ECPM2	East Coast (permanently mixed) 2	UK	Permanently mixed coastal waters. The outer boundary are the intermittently stratified waters	1444	34	34	35	43	30	53
ENS	Eastern North Sea	NL, DE, DK	Seasonally stratified, east of the Dogger Bank, West of the 35m depth contour and the 34 psu contour	60634	35	34	35	43	37	49
ELPM	Elbe plume	DE, DK	Plume of the Elbe river. The landward boundary is the WFD water bodies, the outer boundaries are defined by the 32 psu salinity contour.	7837	31	29	32	18	12	23
EMPM	Ems plume	DE	Plume of the Ems river. The landward boundary is the WFD water bodies, the outer boundaries are defined by the 32 psu salinity contour.	1445	31	31	32	19	11	25
GBC	German Bight central	DE	Seasonally stratified	4554	33	33	34	39	36	41
GDPM	Gironde plume	FR	Plume of the Gironde river (SW France). The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019)	2828	33	32	34	34	17	51
GBCW	Gulf of Biscay coastal waters	FR	Coastal waters along the French coast (SW France). The landward boundaries are the WFD water bodies and the river plumes of Adour, Gironde and Loire. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019).	10846	35	34	35	53	30	73

Area code	Area name	CPs involved	Description	Area (km^2)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
GBSW	Gulf of Biscay shelf waters	FR	Permanently stratified shelf waters in Gulf of Biscay. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019).	21008	35	35	35	106	77	133
HPM	Humber plume	UK	Plume of the Humber river. The outer boundary follows the 11 mg/l contour, based on a 10-year average (Greenwood et al., 2019).	1368	33	33	34	16	10	24
IS1	Intermittently Stratified 1	UK		73501	35	35	35	138	88	177
IS2	Intermittently Stratified 2	IE, UK		26517	35	35	35	102	57	141
IRS	Irish Sea	IE, UK	Permanently mixed central part of the Irish Sea. Landward boundaries are the WFD water bodies and coastal waters of Ireland.	32691	34	33	34	65	27	119
KC	Kattegat Coastal	DK, SE	Kattegat shallower than 35m	9632	26	23	28	21	11	32
KD	Kattegat Deep	DK, SE	Kattegat deeper than 35m	4958	28	26	29	50	36	69
LBPM	Liverpool Bay plume	UK	Plume of Liverpool Bay. The outer boundary follows the 10 mg/l contour, based on a 10-year average (Greenwood et al., 2019).	1361	31	29	32	15	8	22
LPM	Loire plume	FR	Plume of the Loire river. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019)	1495	34	33	34	38	23	50
MPM	Meuse plume	NL	Plume of the Meuse river. The landward boundary is the WFD water bodies, the outer boundaries are defined by the 32 psu salinity contour. The boundary between the Rhine and the Meuse plume is based on an extension of the WFD water body boundaries.	206	29	27	31	16	10	22

Area code	Area name	CPs involved	Description	Area (km^2)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
NNS	Northern North Sea	UK, DK, SE, NO, DE	Seasonally stratified waters deeper than 35 m	264253	35	35	35	121	57	170
NT	Norwegian Trench	NO, SE, DK?	Deeper than 100 m, permanently stratified	59124	34	33	35	349	269	453
RHPM	Rhine plume	NL	Plume of the Rhine river. The landward boundary is the WFD water bodies, the outer boundaries are defined by the 32(?) psu salinity contour. The boundary between the Rhine and the Meuse plume is based on an extension of the WFD water body boundaries.	2279	31	30	32	17	12	22
SCHPM1	Scheldt plume 1	BE, NL	Southern part of the plume of the Scheldt river. The landward boundary is the WFD water bodies, the outer boundaries are defined by the 32 psu salinity contour.	582	31	31	32	13	8	18
SCHPM2	Scheldt plume 2	NL	Northern part of the plume of the Scheldt river. The landward boundary is the WFD water bodies, the outer boundaries are defined by the 32(?) psu salinity contour. The boundary between the Scheldt and the Meuse plume is based on an extension of the WFD water body boundaries.	95	31	30	32	15	8	22
SS	Scottish Sea	UK	Waters surrounding Scotland. Landward boundary defined by the 3nm WFD boundaries. Outer boundaries defined by stratification and old OSPAR boundary	53273	35	35	35	89	55	124
SPM	Seine plume	FR	Plume of the Seine river. The area boundaries were based on combined modelling and data analysis work by SHOM (Cachera et al., 2019)	1115	32	30	33	25	15	35
SHPM	Shannon plume	IE	Plume of the Shannon river.	380	34	34	34	61	38	83
SK	~~Skagerak~~Skagerrak	DK, SE	Salinity and geography	5759	32	30	33	134	63	215

Area code	Area name	CPs involved	Description	Area (km^2)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
SNS	Southern North Sea	FR, BE, NL, UK, DE	Mostly less than 35 m deep, permanently mixed	61758	34	33	35	32	23	44
THPM	Thames plume	UK	Plume of the Thames river. The outer boundary follows the 25 mg/l SPM contour, based on a 10-year average (Greenwood et al., 2019).	5523	34	34	35	22	9	34
IWAI	Intermediate Waters AI	PT	Intermediate waters from coastal to 100m contour	5515	tbd	tbd	tbd	tbd	tbd	tbd
OWAO	Ocean Waters AO	PT	Oceanic waters form 100m contour out to 200 nautical miles	96988	tbd	tbd	tbd	tbd	tbd	tbd
CWAC	Coastal Waters AC	PT	Coastal waters	2368	tbd	tbd	tbd	tbd	tbd	tbd
IWBI	Intermediate Waters BI	PT	Intermediate waters from coastal to 100m contour	1740	tbd	tbd	tbd	tbd	tbd	tbd
OWBO	Ocean Waters BO	PT	Oceanic waters form 100m contour out to 200 nautical miles	183660	tbd	tbd	tbd	tbd	tbd	tbd
CWBC	Coastal Waters BC	PT	Coastal waters	3394	tbd	tbd	tbd	tbd	tbd	tbd
IWCI	Intermediate Waters CI	PT	Intermediate waters from coastal to 100m contour	1246	tbd	tbd	tbd	tbd	tbd	tbd

Area code	Area name	CPs involved	Description	Area (km^2)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
OWCO	Ocean Waters CO	PT	Oceanic waters form 100m contour out to 200 nautical miles	18808	tbd	tbd	tbd	tbd	tbd	tbd
CWCC	Coastal Waters CC	PT	Coastal waters	763	tbd	tbd	tbd	tbd	tbd	tbd
NAAC1A	Noratlantic Area NOR-NorC1A	ES	Assessment area based on phytoplankton productivity: Inner Galician Estuaries (Rías Gallegas), water body A.	549	tbd	tbd	tbd	tbd	tbd	tbd
NAAC1B	Noratlantic Area NOR-NorC1B	ES	Assessment area based on phytoplankton productivity: Inner Galician Estuaries (Rías Gallegas), water body B.	88	tbd	tbd	tbd	tbd	tbd	tbd
NAAC1C	Noratlantic Area NOR-NorC1C	ES	Assessment area based on phytoplankton productivity: Inner Galician Estuaries (Rías Gallegas), water body C.	28	tbd	tbd	tbd	tbd	tbd	tbd
NAAC1D	Noratlantic Area NOR-NorC1D	ES	Assessment area based on phytoplankton productivity: Inner Galician Estuaries (Rías Gallegas), water body D.	12	tbd	tbd	tbd	tbd	tbd	tbd
NAAC2	Noratlantic Area NOR-NorC2	ES	Assessment area based on phytoplankton productivity: Coastal waters surrounding the Galician Estuaries (Rías Gallegas).	1662	tbd	tbd	tbd	tbd	tbd	tbd

Area code	Area name	CPs involved	Description	Area (km²)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
NAAC3	Noratlantic Area NOR-NorC3	ES	Assessment area based on phytoplankton productivity: NW Iberian Peninsula waters most strongly affected by upwelling that are especially intensive in spring and summer.	2609	tbd	tbd	tbd	tbd	tbd	tbd
NAAO1	Noratlantic Area NOR-NorO1	ES	Assessment area based on phytoplankton productivity: Oceanic area.	261727	tbd	tbd	tbd	tbd	tbd	tbd
NAAP2	Noratlantic Area NOR-NorP2	ES	Assessment area based on phytoplankton productivity: Transition area between the coast and open ocean, internal.	8327	tbd	tbd	tbd	tbd	tbd	tbd
NAAPF	Noratlantic Area NOR-Plataforma	ES	Assessment area based on phytoplankton productivity: Transition area between the coast and open ocean, external.	37101	tbd	tbd	tbd	tbd	tbd	tbd
SAAC1	Sudatlantic Area SUD-C1	ES	Assessment area based on phytoplankton productivity: Coastal area influenced by river discharges, internal.	405	tbd	tbd	tbd	tbd	tbd	tbd
SAAC2	Sudatlantic Area SUD-C2	ES	Assessment area based on phytoplankton productivity: Coastal area influenced by river discharges, external.	267	tbd	tbd	tbd	tbd	tbd	tbd
SAAOC	Sudatlantic Area SUD-OCEAN	ES	Assessment area based on phytoplankton productivity: Oceanic area	10076	tbd	tbd	tbd	tbd	tbd	tbd

Area code	Area name	CPs involved	Description	Area (km²)	Salinity mean	Salinity 10 %ile	Salinity 90 %ile	Depth mean	Depth 10 %ile	Depth 90 %ile
SAAP1	Sudatlantic Area SUD-P1	ES	Assessment area based on phytoplankton productivity: Transition area between coast and open sea, river influenced.	2467	tbd	tbd	tbd	tbd	tbd	tbd
SAAP2	Sudatlantic Area SUD-P2	ES	Assessment area based on phytoplankton productivity: Transition area between coast and open sea, external.	916	tbd	tbd	tbd	tbd	tbd	tbd

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