Supplementary online material to EEA Report No 25/2018 *Contaminants in Europe's seas*

The following annexes were produced by ETC/ICM:

- Annex 1: Definition of assessment units
- Annex 2: CHASE+ R script
- Annex 3: Threshold values
- Annex 4: Normalization and aggregation methods
- Annex 5: Detailed description of data sources
- Annex 6: Summary of CHASE+ classifications
- Annex 7: Detailed maps per region
- Annex 8: Additional CHASE+ classifications with different groups of substances excluded
- Annex 9: Summary of 1511 individual CHASE+ classifications

The following ETC/ICM Technical Background Reports have been produced in preparation and support of this thematic report on contaminants in Europe' seas:

- Andersen, J.H., E. Kallenbach, C. Murray, N. Green & S. Korpinen (2016): Coding and initial testing of an indicator-based tool for integrated assessment of chemical status. Current status and next steps. ETC/ICM task 1.6.1.g deliverable 1. 40 pp.
- Green, N. & C. Murray (2016): Indicator-based tool for integrated assessment of chemical status: testing of CHASE. Norwegian contaminant data for biota. ETC/ICM task 1.6.1.g deliverable 5. 47 pp.
- Harvey, T, J.H. Andersen, E. Kallenbach, C. Murray, & N. Green (2016): Steps toward indicator-based assessments of 'environmental status' in European sea. ETC ICM task 1.6.1. g deliverable 4. 61 pp.
- Korpinen, S., T. Prins, N. Green, C. Spiteri, E. Magaletti, F. Giovanardi, M. Peterlin, I. Mitchell, U. Clausen & J.H. Andersen (2015): Review of thematic multi-metric indicator-based assessment tools. EEA/NSV/13/002 – ETC/ICM, 51 pp.

Annex 1: Definition of assessment units

All data and assessment results are spatially mapped into an assessment grid. This ensures that data are compared in a uniform way across the regional seas. The choosen assessment grid is based on the the EEA reference grid system.

The EEA reference is based on ERTS89 Lambert Azimuthal Equal Area projection with parameters: latitude of origin 52° N, longitude of origin 10° E, false northing 3 210 000.0 m, false easting 4 321 000.0 m. All grid cells are named with a unique identifier containing information on grid cell size and the distance from origin in meters (easting and northing). An important attribute of the EEA reference grid system is that by using an equal area projection all grid cells are having the same area for the same grid size.

The EEA reference grid is used in two grid sizes

- 100 x 100 km in offshore areas (> 20 km from the coastline)
- 20 x 20 km in coastal areas (<= 20 km from the coastline)

The grid sizes were choosen after an evaluation of data availability versus the need for sufficient detail in the resulting assessment. The resulting assessment grid is a combination of two grid sizes using the EEA reference grid system.

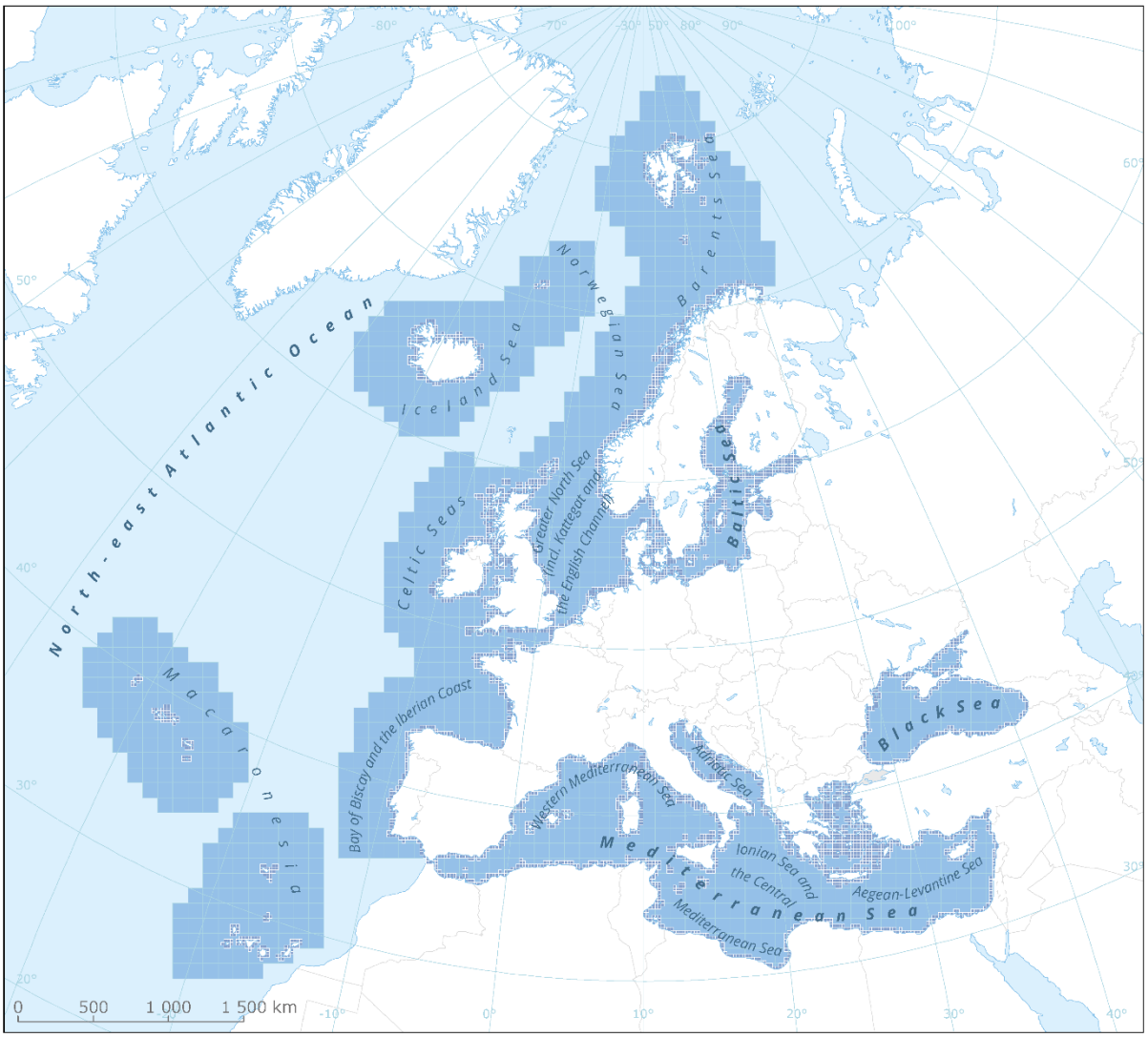
The overall area of interest used is based on the marine regions and subregions under the Marine Strategy Framework Directive. Additionally, Norwegian (Barent Sea and Norwegian Sea) and Icelandic waters ('Iceland Sea') have been added (see Surrounding seas of Europe). Note that within the North East Atlantic region only the subregions within EEZ boundaries (~200 nm) have been included.

The following procedure were followed when making the assessment grid. The coastal 20 x 20 km grid cells were identified by the distance of their mid point from the coastline (<= 20 km). All the 20 x 20 km grid cells located with the midpoint within 20 km distance from the coastline were included. For the remaining area of interest, the 100 x 100 km grid cells were included.

For 100 x100 km grid cells partly covered by 20 x 20 km grid cells only the exclusive non-overlapping part of the 100 x 100 km grid cells were included. For this reason, their areas are smaller than a non-modified 100 x 100 km grid cell. This was done to avoid overlaps in the assessment grid. In coastal areas, grid cells were included if their midpoint was within 20 km from the coast.

The resulting combined assessment grid fills the entire area of interest with grid cells without gaps and overlaps (Figure A1.1).

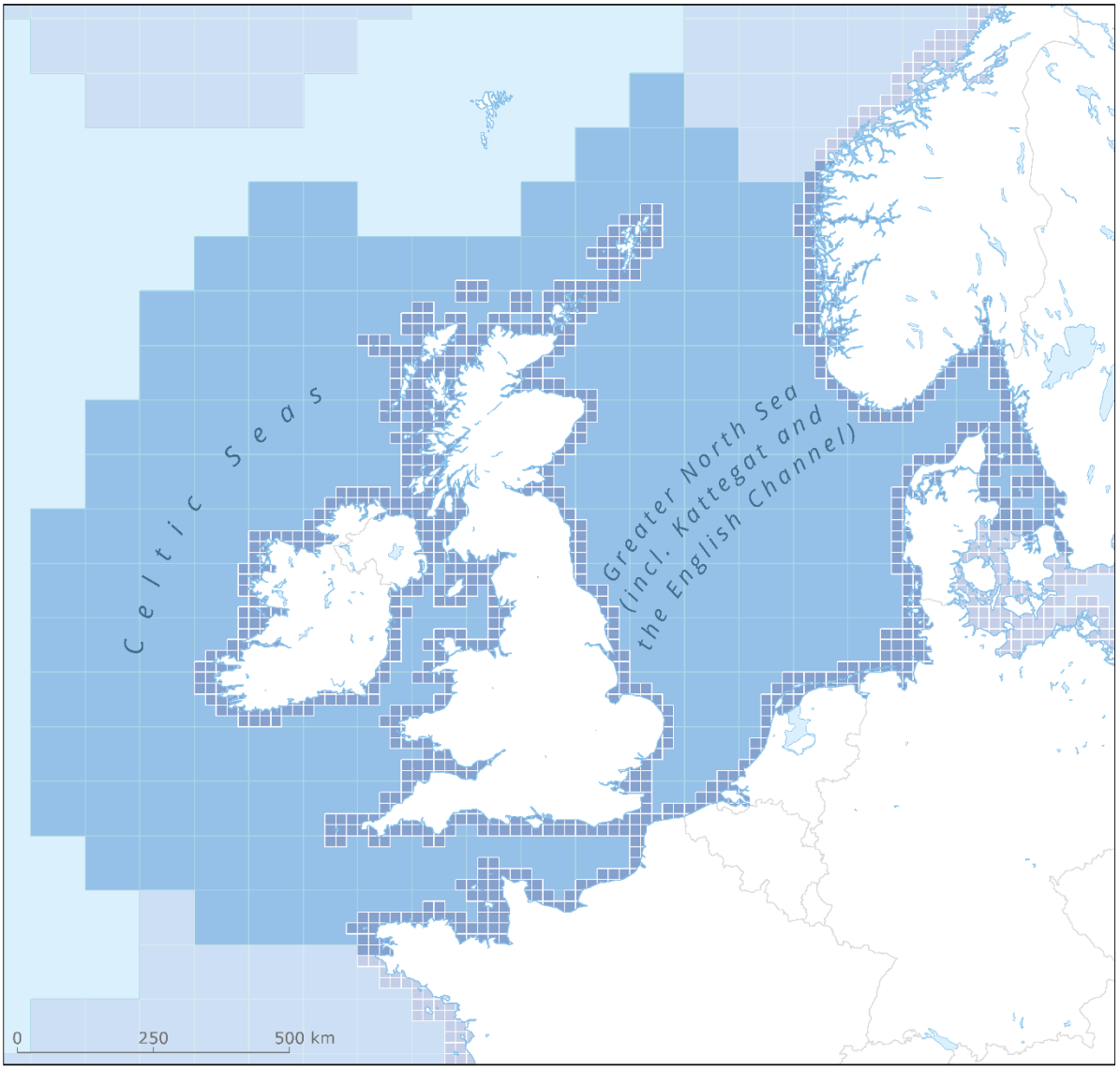
Figure A1.1 Assessment grid based on the EEA reference grid



European regional seas

The European regional seas divided into the Inspire compliant EEA reference grid cell system of 100x100 km in offshore areas (> 20 km from the coastline)

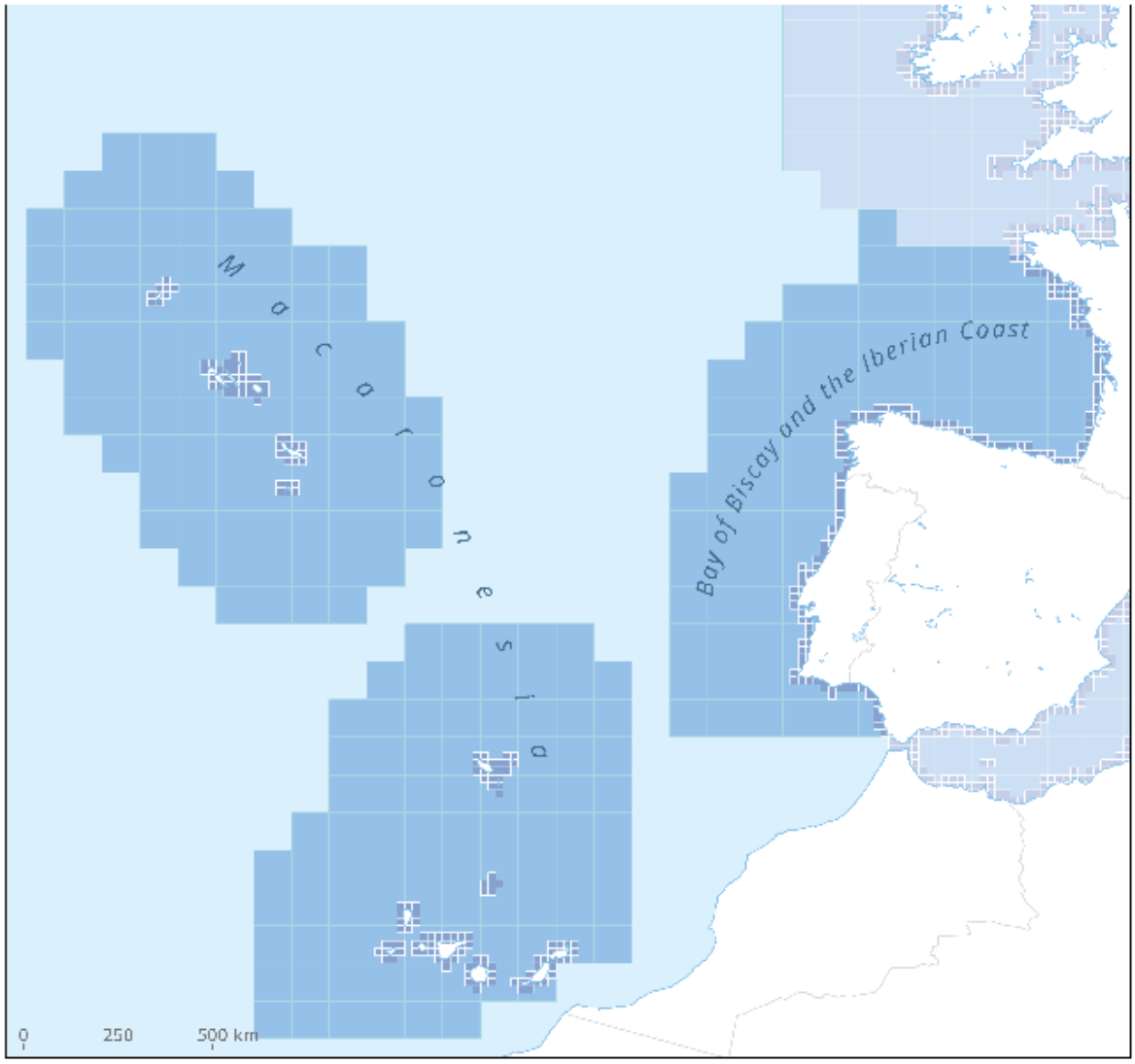
Figure A1.2 North Sea and Celtic Seas



Celtic Seas and the Greater North Sea

The European regional seas divided into the Inspire compliant EEA reference grid cell system of 100x100 km in offshore areas (> 20 km from the coastline) and 20x20 km in coastal areas (≤ 20 km from the coastline)

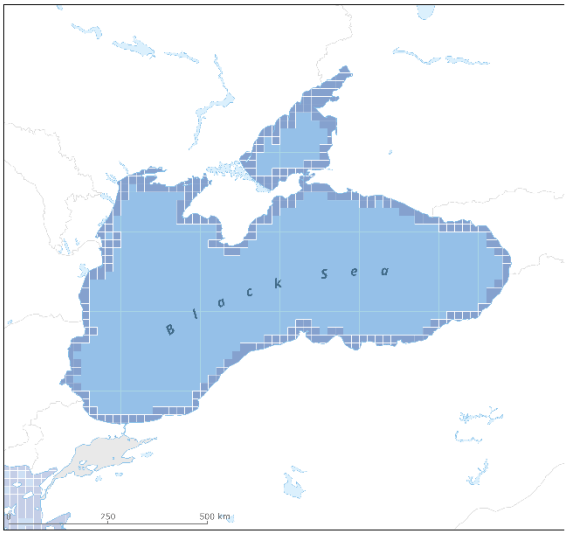
Figure A1.3 Bay of Biscay, Iberian coast and Macaronesia



Macaronesia, Bay of Biscay and the Iberian Coast

The European regional seas divided into the Inspire compliant EEA reference grid cell system of 100x100 km in offshore areas (> 20 km from the coastline) and 20x20 km in coastal areas (≤ 20 km from the coastline)

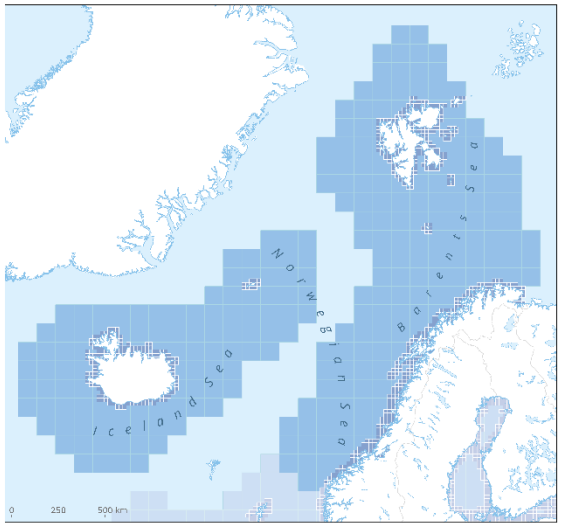
Figure A1.4 Black Sea



Black Sea

The European regional seas divided into the Inspire compliant EEA reference grid cell system of 100x100 km in offshore areas (> 20 km from the coastline) and 20x20 km in coastal areas (≤ 20 km from the coastline)

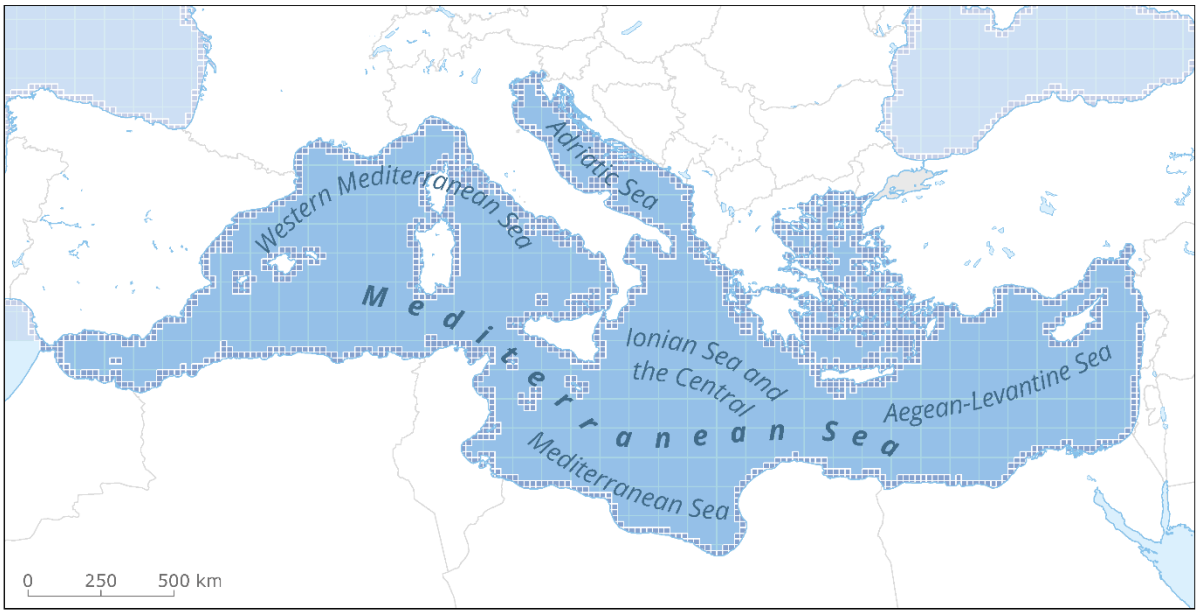
Figure A1.5 Norwegian Sea, Barents Sea and Iceland Sea



Iceland Sea, Norwegian Sea and Barents Sea

The European regional seas divided into the Inspire compliant EEA reference grid cell system of 100x100 km in offshore areas (> 20 km from the coastline) and 20x20 km in coastal areas (≤ 20 km from the coastline)

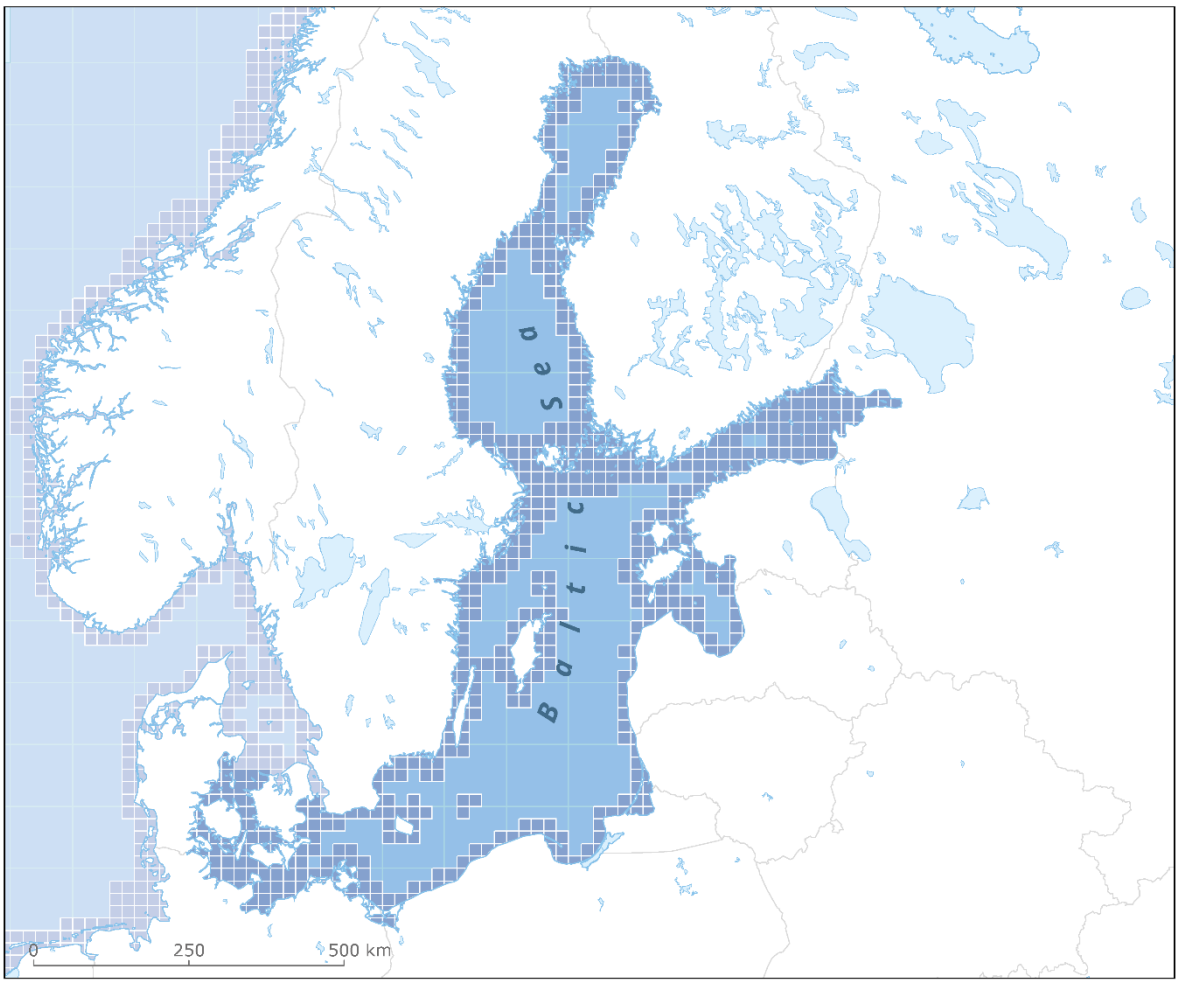
Figure A1.6 Mediterranean Sea



Mediterranean Sea

The European regional seas divided into the Inspire compliant EEA reference grid cell system of 100x100 km in offshore areas (> 20 km from the coastline) and 20x20 km in coastal areas (≤ 20 km from the coastline)

Figure A1.7 Baltic Sea



Baltic Sea

The European regional seas divided into the Inspire compliant EEA reference grid cell system of 100x100 km in offshore areas (> 20 km from the coastline) and 20x20 km in coastal areas (≤ 20 km from the coastline)

References

EEA 2014: http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2

EEA 2015: http://www.eea.europa.eu/data-and-maps/data/eea-coastline-for-analysis-1

EEA 2017: http://www.eea.europa.eu/data-and-maps/data/msfd-regions-and-subregions

EEA 2017: http://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/metadata/1982384c-d6fb-42dd-92e7-408bd88b783c

Annex 2: CHASE+ R script

```
library("dplyr")
library("tidyr")
#=================================================================
# function Assessment
Assessment<- function(assessmentdata,summarylevel=1){

  requiredcols <- c("Matrix","Substance","Threshold","Status")
  extracols <- c("Waterbody","Response")

 #Check column names in the imported data
 cnames<-names(assessmentdata)
 nimp = ncol(assessmentdata)
 nreq = length(requiredcols)
 nextra = length(extracols)

 ok <- rep(0, nreq)
 okextra <- rep(0, nextra)
 foundresponse=FALSE

 for (i in 1:nimp){
  for (j in 1:nreq){
   if(toupper(requiredcols[j])==toupper(cnames[i])){
    names(assessmentdata)[i] <- requiredcols[j]
    ok[j]=1
   }
  }
  for (j in 1:nextra){
   if(toupper(extracols[j])==toupper(cnames[i])){
    names(assessmentdata)[i] <- extracols[j]
    okextra[j]=1
   }
  }
 }

 for(j in 1:nextra){
  if(okextra[j]==0){
   assessmentdata[[extracols[j]]]<-1
  }
 }

 n<-sum(ok, na.rm = TRUE)

 if(n<nreq){
  # The required columns were not found in the input data
  message("Error in CHASE Assessment. Required column(s) were not found in the input data:")
  for (j in 1:nreq){
   if(ok[j]!=1){
    message(paste("    ",requiredcols[j]))
   }
  }
  return(NA)
 }else{
  # The required columns are present - do the assessment

  # Change order of matrices factors
  mat1<-data.frame(unique(assessmentdata$Matrix))
```

```
  names(mat1)[1] <- 'Matrix'
  mat1$char<-as.character(mat1$Matrix)
  mat1$len<-nchar(mat1$char)
  mat1<-arrange(mat1,len)

  assessmentdata$Matrix <- factor(assessmentdata$Matrix, levels = mat1$char)

  # All combinations of matrices and waterbodies
  # This is used to ensure that a NA is returned where the combinations are missing
  waterbodies<-unique(assessmentdata$Waterbody)
  matrices<-unique(assessmentdata$Matrix)
  matrices<-expand.grid(waterbodies, matrices)
  names(matrices)[1] <- 'Waterbody'
  names(matrices)[2] <- 'Matrix'

  assessmentdata$CR<-
ContaminationRatio(assessmentdata$Threshold,assessmentdata$Status,assessmentdata$Response)

  QEdata<-summarise(group_by(assessmentdata,Waterbody,Matrix), sumCR=sum(CR), Count=n())
  QEdata$ConSum<-QEdata$sumCR/sqrt(QEdata$Count)

  QEdata$sumCR <- NULL
  QEdata$Count <- NULL
  QEspr<-spread(QEdata,Matrix,ConSum)

  QEdata$QEStatus<-CHASEStatus(QEdata$ConSum)
  QEdata<-left_join(matrices,QEdata,c('Waterbody','Matrix'))
  QEdata<-arrange(QEdata,Waterbody,Matrix)

  CHASE<-summarise(group_by(QEdata,Waterbody), ConSum=max(ConSum, na.rm = TRUE))
  CHASE$Waterbody<-NULL
  CHASEQE<-inner_join(QEdata, CHASE, 'ConSum')
  CHASEQE<-rename(CHASEQE,Status=QEStatus,Worst=Matrix)
  assessmentdata<-left_join(assessmentdata,QEdata,c('Waterbody','Matrix'))
  QEspr<-inner_join(QEspr, CHASEQE, 'Waterbody')

  if(summarylevel==2){
    return(QEspr)
  }else if(summarylevel==3){
    return(QEdata)
  }else if(summarylevel==4){
    return(CHASEQE)
  }else{
    return(assessmentdata)
  }
 }
}
#==========================================================================
# function ContaminationRatio
ContaminationRatio<- function(threshold, status, response=1){
 # If response is not specified, it will be assumed to be positive
 # i.e. ContaminationRatio increases (worsens) with increasing status value
 if (missing(response)){
  response=1
 }
 response<-ifelse(is.na(response), 1, response)

 # ContaminationRatio calculated depending on Response direction
 cr<-ifelse(response>0, status/threshold, threshold/status)
  return(cr)
```

```
}
#=========================================================================
#Function CHASEStatus
CHASEStatus<-function(CRsum){
  status<-ifelse(CRsum>0.5, "Good", "High")
  status<-ifelse(CRsum>1, "Moderate", status)
  status<-ifelse(CRsum>5, "Poor", status)
  status<-ifelse(CRsum>10, "Bad",status )
  return(status)
}
```

Annex 3: Threshold values

Threshold values for substances in Water	Unit	Value	Reference
1,2-Dichloroethane	µg/l	10	2013/39/EU AA-EQS Marine
Aclonifen	µg/l	0.012	2013/39/EU AA-EQS Marine
Alachlor	µg/l	0.3	2013/39/EU AA-EQS Marine
Anthracene	µg/l	0.1	2013/39/EU AA-EQS Marine
Arsenic (As)	µg/l	3.5	OSPAR 2004 Lower EAC
Atrazine	µg/l	0.6	2013/39/EU AA-EQS Marine
Benzene	µg/l	8	2013/39/EU AA-EQS Marine
Benzo(a)pyrene	µg/l	0.00017	2013/39/EU AA-EQS Marine
Bifenox	µg/l	0.0012	2013/39/EU AA-EQS Marine
C10-13 Chloroalkanes	µg/l	0.4	2013/39/EU AA-EQS Marine
Cadmium	µg/l	0.2	2013/39/EU AA-EQS Marine
Carbon-tetrachloride	µg/l	12	2013/39/EU AA-EQS Marine
Chlorfenvinphos	µg/l	0.1	2013/39/EU AA-EQS Marine
Chlorpyrifos (Chlorpyrifos-ethyl)	µg/l	0.03	2013/39/EU AA-EQS Marine
Chromium (Cr)	µg/l	25	OSPAR 2004 Lower EAC
Copper (Cu)	µg/l	0.02	OSPAR 2004 Lower EAC
Cybutryne / Irgarol	µg/l	0.0025	2013/39/EU AA-EQS Marine
Cyclodiene pesticides: Aldrin, Dieldrin, Endrin, Isodrin	µg/l	0.005	2013/39/EU AA-EQS Marine
Cypermethrin	µg/l	0.000008	2013/39/EU AA-EQS Marine
DDT total	µg/l	0.025	2013/39/EU AA-EQS Marine
Di(2-ethylhexyl)-phthalate (DEHP)	µg/l	1.3	2013/39/EU AA-EQS Marine
Dichloromethane	µg/l	20	2013/39/EU AA-EQS Marine
Dichlorvos	µg/l	0.00006	2013/39/EU AA-EQS Marine
Diuron	µg/l	0.2	2013/39/EU AA-EQS Marine
Endosulfan	µg/l	0.0005	2013/39/EU AA-EQS Marine
Fluoranthene	µg/l	0.0063	2013/39/EU AA-EQS Marine
Heptachlor and heptachlor epoxide	µg/l	0.00000001	2013/39/EU AA-EQS Marine
Hexabromo- cyclododecane (HBCDD)	µg/l	0.0008	2013/39/EU AA-EQS Marine

Threshold values for substances in Water	Unit	Value	Reference
Hexachloro- cyclohexane	µg/l	0.002	2013/39/EU AA-EQS Marine
Isoproturon	µg/l	0.3	2013/39/EU AA-EQS Marine
Lead	µg/l	1.3	2013/39/EU AA-EQS Marine
Naphthalene	µg/l	2	2013/39/EU AA-EQS Marine
Nickel	µg/l	8.6	2013/39/EU AA-EQS Marine
Nonylphenols (4-Nonylphenol)	µg/l	0.3	2013/39/EU AA-EQS Marine
Octylphenols ((4-(1,1',3,3'-tetramethyl- butyl)-phenol))	µg/l	0.01	2013/39/EU AA-EQS Marine
p p'-Dicofol+o p'-Dicofol	µg/l	0.000032	2013/39/EU AA-EQS Marine
para-para-DDT	µg/l	0.01	2013/39/EU AA-EQS Marine
PCB-101	µg/l	0.00002	proposed EAC, OSPAR SIME 2008
PCB-118	µg/l	0.000026	proposed EAC, OSPAR SIME 2008
PCB-138	µg/l	0.00002	proposed EAC, OSPAR SIME 2008
PCB-153	µg/l	0.001	proposed EAC, OSPAR SIME 2008
PCB-180	µg/l	0.0002	proposed EAC, OSPAR SIME 2008
Pentachloro- benzene	µg/l	0.0007	2013/39/EU AA-EQS Marine
Pentachloro- phenol	µg/l	0.4	2013/39/EU AA-EQS Marine
Perfluorooctane sulfonic acid and its derivatives (PFOS)	µg/l	0.00013	2013/39/EU AA-EQS Marine
Phenanthrene	µg/l	1.3	firm EAC (OSPAR SIME 2008
Pyrene	µg/l	0.023	firm EAC (OSPAR SIME 2008)
Quinoxyfen	µg/l	0.015	2013/39/EU AA-EQS Marine
Simazine	µg/l	1	2013/39/EU AA-EQS Marine
Terbutryn	µg/l	0.0065	2013/39/EU AA-EQS Marine
Tetrachloro-ethylene	µg/l	10	2013/39/EU AA-EQS Marine
Tributyltin compounds (Tributyltin- cation)	µg/l	0.0002	2013/39/EU AA-EQS Marine
Trichloro-benzenes, sum of	µg/l	0.4	2013/39/EU AA-EQS Marine
Trichloro-ethylene	µg/l	10	2013/39/EU AA-EQS Marine
Trichloro-methane (chloroform)	µg/l	2.5	2013/39/EU AA-EQS Marine
Trifluralin	µg/l	0.03	2013/39/EU AA-EQS Marine
Zinc (Zn)	µg/l	1	OSPAR 2004 lower EAC

Threshold values for substances in Sediment	Unit	Value	Norm	Reference
Anthracene	µg/kg (dw)	85	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Benz[a]anthracene	µg/kg (dw)	261	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Benzo[a]pyrene	µg/kg (dw)	430	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Benzo[ghi]perylene	µg/kg (dw)	85	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Cadmium	µg/kg (dw)	1200	5% Al	OSPAR ERL (CEMP 2008/2009)
Chrome	µg/kg (dw)	81000	5% Al	OSPAR ERL (CEMP 2008/2009)
Chrysene (Triphenylene)	µg/kg (dw)	384	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Copper	µg/kg (dw)	34000	5% Al	OSPAR ERL (CEMP 2008/2009)
DDE (p,p')	µg/kg (dw)	2.2	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Dibenzothiophene	µg/kg (dw)	190	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Dieldrin	µg/kg (dw)	2	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Fluoranthene	µg/kg (dw)	600	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
gamma-HCH	µg/kg (dw)	3	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Hexachlorobenzene	µg/kg (dw)	20	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Indeno[1,2,3-cd]pyrene	µg/kg (dw)	240	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Lead	µg/kg (dw)	47000	5% Al	OSPAR ERL (CEMP 2008/2009)
Mercury	µg/kg (dw)	150	5% Al	OSPAR ERL (CEMP 2008/2009)
Naphthalene	µg/kg (dw)	160	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
PCB-28	µg/kg (dw)	1.7	2.5% Corg	OSPAR EAC (CEMP 2008/2009)
PCB-52	µg/kg (dw)	2.7	2.5% Corg	OSPAR EAC (CEMP 2008/2009)
PCB-101	µg/kg (dw)	3	2.5% Corg	OSPAR EAC (CEMP 2008/2009)
PCB-118	µg/kg (dw)	0.6	2.5% Corg	OSPAR EAC (CEMP 2008/2009)
PCB-138	µg/kg (dw)	7.9	2.5% Corg	OSPAR EAC (CEMP 2008/2009)
PCB-153	µg/kg (dw)	40	2.5% Corg	OSPAR EAC (CEMP 2008/2009)
PCB-180	µg/kg (dw)	12	2.5% Corg	OSPAR EAC (CEMP 2008/2009)
Phenanthrene	µg/kg (dw)	240	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
Pyrene	µg/kg (dw)	665	2.5% Corg	OSPAR ERL (CEMP 2008/2009)
TBTIN	µg/kg (dw)	1.6	5% Corg	HELCOM

Zinc	µg/kg (dw)	150000	5% Al	OSPAR ERL (CEMP 2008/2009)

Threshold values for substances in Biota	Species / Biota type	Unit	Value	Reference
Anthracene	Shellfish	µg/kg (dw)	290	OSPAR EAC (CEMP 2008/2009)
Benzo[a]pyrene	Biota	µg/kg (ww)	5	2013/39/EU EQS Biota
PCB-28	Biota	µg/kg (dw)	67	OSPAR EAC (2017)
PCB-52	Biota	µg/kg (dw)	108	OSPAR EAC (2017)
PCB-101	Biota	µg/kg (dw)	121	OSPAR EAC (2017)
PCB-118	Biota	µg/kg (dw)	25	OSPAR EAC (2017)
PCB-138	Biota	µg/kg (dw)	317	OSPAR EAC (2017)
PCB-153	Biota	µg/kg (dw)	1585	OSPAR EAC (2017)
PCB-180	Biota	µg/kg (dw)	469	OSPAR EAC (2017)
Cadmium	Fish	µg/kg (ww)	26	OSPAR BAC (CEMP 2008/2009)
Cadmium	Shellfish (Mytilus)	µg/kg (dw)	960	OSPAR BAC (CEMP 2008/2009)
Cadmium	Shellfish (Oysters)	µg/kg (dw)	3000	OSPAR BAC (CEMP 2008/2009)
DDE (p,p')	Shellfish	µg/kg (dw)	0.63	OSPAR BAC (CEMP 2008/2009)
DDE (p,p')	Fish	µg/kg (ww)	0.1	OSPAR BAC (CEMP 2008/2009)
Fluoranthene	Shellfish	µg/kg (dw)	110	OSPAR EAC (CEMP 2008/2009)
Hexabromo cyclododecane (HBCDD)	Biota	µg/kg (ww)	167	2013/39/EU EQS Biota
Hexachlorobenzene	Biota	µg/kg (ww)	10	2013/39/EU EQS Biota
Hexachlorobenzene	Shellfish	µg/kg (dw)	0.63	OSPAR BAC (CEMP 2008/2009)
Hexachlorobenzene	Fish	µg/kg (ww)	0.09	OSPAR BAC (CEMP 2008/2009)
Hexachloro-butadiene	Biota	µg/kg (ww)	55	2013/39/EU EQS Biota
alpha-HCH	Shellfish	µg/kg (dw)	0.64	OSPAR BAC (CEMP 2008/2009)
gamma-HCH	Shellfish	µg/kg (dw)	1.45	OSPAR EAC (CEMP 2008/2009)
gamma-HCH	Fish liver	µg/kg (lw)	11	OSPAR EAC (CEMP 2008/2009)
Heptachlor and heptachlor epoxide	Biota	µg/kg (ww)	0.0067	2013/39/EU EQS Biota
Mercury	Biota	µg/kg (ww)	20	2013/39/EU EQS Biota
Naphthalene	Shellfish	µg/kg (dw)	340	OSPAR EAC (CEMP 2008/2009)
Phenanthrene	Shellfish	µg/kg (dw)	1700	OSPAR EAC (CEMP 2008/2009)

Threshold values for substances in Biota	Species / Biota type	Unit	Value	Reference
Lead	Fish	µg/kg (ww)	26	OSPAR BAC (CEMP 2008/2009)
Lead	Shellfish	µg/kg (dw)	1300	OSPAR BAC (CEMP 2008/2009)
Sum 6 BDEs (Polybrominated biphenyl ethers)	Biota	µg/kg (ww)	0.0085	2013/39/EU EQS Biota
Perfluorooctane sulfonic acid and its derivatives (PFOS)	Biota	µg/kg (ww)	9	2013/39/EU EQS Biota
Pyrene	Shellfish	µg/kg (dw)	100	OSPAR EAC (CEMP 2008/2009)
WHO-TEQ Dioxins	Biota	ng/kg (ww)	3.5	European Commission 2011

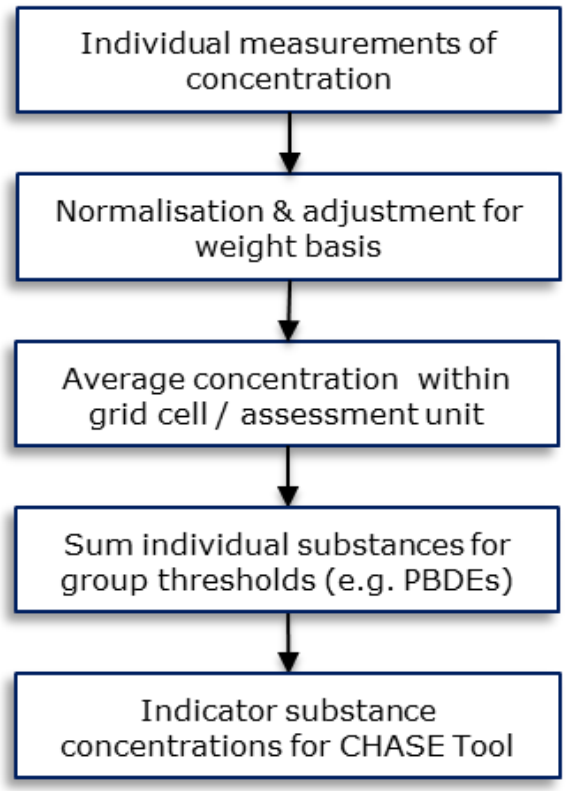
Threshold values for Biological Effects	Species / Biota type	Unit	Value	Norm	Reference
Lysosomal membrane stability (LMS)		mins	10		ICES, 2012
Vas Deferens Sequence Index (VDSI)	Littorina littorea	VDSI	0.3		OSPAR EcoQO
Vas Deferens Sequence Index (VDSI)	Buccinum undatum	VDSI	0.3		OSPAR EcoQO
Vas Deferens Sequence Index (VDSI)	Nassarius reticulatus	VDSI	0.3		OSPAR EcoQO
Vas Deferens Sequence Index (VDSI)	Neptunea antiqua	VDSI	2		OSPAR EcoQO
Vas Deferens Sequence Index (VDSI)	Nucella lapillus	VDSI	2		OSPAR EcoQO
Vas Deferens Sequence Index (VDSI)	Peringia ulvae	VDSI	0.1		OSPAR EcoQO

Annex 4: Normalization and aggregation methods

The CHASE+ method described in Chapter 3.2 calculates status within each assessment grid cell (Annex 1). The tool does not make use of "raw" measurements. Within each cell, a single representative indicator value is used to compare concentrations of substances or groups of substances (e.g. dioxins and dioxin-like substances) with available threshold values.

The preprocessing steps by which we arrive at the indicator values used by the CHASE+ tool are outlined in Figure A4.1.

Figure A4.1 Preprocessing steps



Sediment concentrations

Where possible, measured concentrations of substances in sediment were normalised to relevant reference contents of organic carbon or aluminium.

Threshold values for organic substances in sediment can are defined with reference to a sediment having a specific total organic carbon (C_{org}) content, for example 2.5% by weight for OSPAR threshold values.

Where the concentration of an organic substance is recorded together with an associated measurement of C_{org}, then the original concentration was normalised to the reference organic content $C_{org,REF}$ specified in the threshold This was done by multiplying the measured concentration by a factor equal to C_{org} / $C_{org,Ref}$.

Similarly, concentrations of metals in sediment are defined regarding a specific sediment content of aluminium (Al). Typically, and in the case of all thresholds used in this work the reference content of Al is 5%.

Where possible, measured metal concentrations were normalised to the reference Al content That is, where the concentrations are recorded together with Al content. Normalisation was done by multiplying the measured concentration by a factor equal to Al / Al_{Ref}.

Where the content of the relevant reference material (C_{org} or Al) was not available, then measured values were not adjusted.

Biota concentrations

Thresholds for concentrations of substances in biota can be specified with reference to wet weight, dry weight or lipid weight and as concentrations in specific tissues, for example fish liver, or as a concentration of the whole organism.

Where the threshold concentration for a substance was specified relative to dry weight and the measured concentration given relative to wet weight, then the measured concentration was converted to a dry weight concetration by multiplying by the measured dry weight fraction of the organism.

$$c_{dry} = c_{wet} / f_{dry}$$

And similary to convert from dry weight measurement to wet weight measurement:

$$c_{wet} = c_{dry} \times f_{dry}$$

where:

c_{wet} = concentration of substance relative to wet weight

c_{dry} = concentration of substance relative to dry weight

f_{dry} = dry weight fraction of measured organism/tissue

In the absence of a measurement of dry weight fraction for a given measured concentration, we used an average dry weight taken from all measurments for the same species. If no measurements of dry weight fraction were found for the same species, then an average dry weight for the same biota "type" was used. For example, the average dry weight fraction across all measurements for fish was 20.8%.

In a similar way to wet/dry weight conversion, we can convert between wet weight and lipid weight concentrations by using the measured lipid fractional weight.

$$c_{lipid} = c_{wet} / f_{lipid}$$

$$c_{wet} = c_{lipid} \times f_{lipid}$$

where:

c_{wet} = concentration of substance relative to wet weight

c_{lipid} = conc. of substance relative to lipid weight

f_{dry} = lipid weight fraction of measured organism/tissue

Aggregation

For each available measured substance within an assessment grid cell (see Annex 1), the CHASE method compares a single representative indicator value with a relevant threshold value.

After the concentrations, were normalised according to the methods described, the indicator value was derived by taking the average of all available measured concentrations within a grid cell.

For BDEs (polybrominated biphenyl ethers) in biota, the indicator value was calculated as the sum of values for individual substances. For Dioxins (WHO-TEQ) each substance concentration was multiplied by the applicable factor before the sum is calculated.

If a substance had threshold values for different organisms and there are measurements for more than one of the organisms, then the indicator with the highest contamination ratio (CR = measured concentration / threshold) was selected and the values for concentrations in other organisms were discarded from the CHASE+ calculations.

Annex 5: Detailed description of data sources

Data Provider	Datatype	Data Source	RLABO	Description
BE	Seawater	EIONET		Vlaamse Overheid - Vlaamse Milieumaatschappij
BE	Sediment	EIONET		Vlaamse Overheid - Vlaamse Milieumaatschappij
BG	Seawater	EIONET		Bulgarian Executive Environment Agency (BExEA)
BG	Sediment	EIONET		Bulgarian Executive Environment Agency (BExEA)
CY	Biota	EIONET		Department of Fisheries and Marine Research,Ministry of Agriculture, Rural Development and Environment
CY	Seawater	EIONET		Department of Fisheries and Marine Research,Ministry of Agriculture, Rural Development and Environment
CY	Sediment	EIONET		Department of Fisheries and Marine Research,Ministry of Agriculture, Rural Development and Environment
EE	Biota	EIONET		Estonian Environment Agency
ES	Biota	EIONET		Ministerio de Agricultura, Alimentación y Medio Ambiente
ES	Seawater	EIONET		Ministerio de Agricultura, Alimentación y Medio Ambiente
ES	Sediment	EIONET		Ministerio de Agricultura, Alimentación y Medio Ambiente
FR	Biota	EIONET		Ministère de l'Environnement, de l'Énergie et de la Mer
FR	Seawater	EIONET		Ministère de l'Environnement, de l'Énergie et de la Mer
FR	Sediment	EIONET		Ministère de l'Environnement, de l'Énergie et de la Mer
GR	Biota	EIONET		Ministry for the Environment, Energy and Climate Change, Special Secretariat for Water
GR	Seawater	EIONET		Ministry for the Environment, Energy and Climate Change, Special Secretariat for Water
GR	Sediment	EIONET		Ministry for the Environment, Energy and Climate Change, Special Secretariat for Water
HR	Biota	EIONET		Croatian Agency for the Environment and Nature
HR	Sediment	EIONET		Croatian Agency for the Environment and Nature
IT	Biota	EIONET		ISPRA - Istituto Superiore per la Protezione e Ricerca Ambientale
IT	Seawater	EIONET		ISPRA - Istituto Superiore per la Protezione e Ricerca Ambientale
IT	Sediment	EIONET		ISPRA - Istituto Superiore per la Protezione e Ricerca Ambientale
LT	Biota	EIONET		Environmental Protection Agency
LT	Seawater	EIONET		Environmental Protection Agency

LT	Sediment	EIONET		Environmental Protection Agency
LV	Biota	EIONET		Latvian Institute of Aquatic Ecology
LV	Seawater	EIONET		Latvian Institute of Aquatic Ecology
LV	Sediment	EIONET		Latvian Institute of Aquatic Ecology
ME	Biota	EIONET		Environmental Protection Agency of Montenegro
ME	Seawater	EIONET		Environmental Protection Agency of Montenegro
ME	Sediment	EIONET		Environmental Protection Agency of Montenegro
MT	Seawater	EIONET		Malta Environment and Planning Authority
MT	Sediment	EIONET		Malta Environment and Planning Authority
NL	Seawater	EIONET		Netherlands Environmental Assessment Agency
NL	Sediment	EIONET		Netherlands Environmental Assessment Agency
NO	Biota	EIONET		Miljødirektoratet, Arts- og vannavdelingen
PL	Biota	EIONET		Chief Inspectorate for Environmental Protection Department of Environmental Monitoring, Assessment and Outlook
PL	Seawater	EIONET		Chief Inspectorate for Environmental Protection Department of Environmental Monitoring, Assessment and Outlook
PL	Sediment	EIONET		Chief Inspectorate for Environmental Protection Department of Environmental Monitoring, Assessment and Outlook
RO	Biota	EIONET		National Institute for Marine Research Grigore Antipa
RO	Seawater	EIONET		National Institute for Marine Research Grigore Antipa
RO	Sediment	EIONET		National Institute for Marine Research Grigore Antipa
SE	Biota	EIONET		Swedish Meteorological and Hydrological Institute
SE	Seawater	EIONET		Swedish Meteorological and Hydrological Institute
SE	Sediment	EIONET		Swedish Meteorological and Hydrological Institute
SI	Biota	EIONET		Ministry of Agriculture and the Environment
SI	Seawater	EIONET		Ministry of Agriculture and the Environment
SI	Sediment	EIONET		Ministry of Agriculture and the Environment
TR	Biota	EIONET		Ministry of Environment and Urbanization/Section Chef of Environment Agency
TR	Sediment	EIONET		Ministry of Environment and Urbanization/Section Chef of Environment Agency
DE	Biota	ICES	BFGG	Bundesanstalt für Gewässerkunde, Federal Institute of Hydrology
DE	Sediment	ICES	BFGG	Bundesanstalt für Gewässerkunde, Federal Institute of Hydrology
DE	Water	ICES	BFGG	Bundesanstalt für Gewässerkunde, Federal Institute of Hydrology
DE	Biota	ICES	BFRG	Bundesforschungsanstalt für Fischerei, Institut für Fischereiökologie, Hamburg

DK	Biota	ICES	BIOS	Aarhus University, Department of Bioscience, Marine Ecology Roskilde
UK	Biota	ICES	BODC	British Oceanographic Data Centre
UK	Sediment	ICES	BODC	British Oceanographic Data Centre
UK	Water	ICES	BODC	British Oceanographic Data Centre
DE	Sediment	ICES	BSHG	Bundesamt für Seeschiffahrt und Hydrographie
DE	Water	ICES	BSHG	Bundesamt für Seeschiffahrt und Hydrographie
PT	Biota	ICES	DGAP	Direccao Geral do Ambiente
EE	Biota	ICES	EERC	Estonian Environmental Research Centre
FI	Biota	ICES	SYKE	Finnish Environment Institute (Helsinki)
PL	Water	ICES	GDPP	Regional Inspectorate of Environmental Protection in Gdansk
FR	Biota	ICES	ICNF	IFREMER Nantes
FR	Sediment	ICES	ICNF	IFREMER Nantes
ES	Biota	ICES	IEOV	Instituto Español de Oceanografia Vigo
ES	Sediment	ICES	IEOV	Instituto Español de Oceanografia Vigo
IS	Biota	ICES	IFLI	Icelandic Fisheries Laboratory
DE	Sediment	ICES	IFOG	Institut für Ostseeforschung
EE	Biota	ICES	IMRE	Estonian Marine Institute
PL	Biota	ICES	IMWP	Institute of Meteorology and Water Management
PL	Sediment	ICES	IMWP	Institute of Meteorology and Water Management
DE	Biota	ICES	LALG	Landesamt für Landwirtschaft, Lebensmittelsicherheit
DE	Water	ICES	LNUG	State Agency for Agriculture, Environment and Rural Areas Schleswig-Holstein
DE	Biota	ICES	LUNG	Landesamt für Umwelt, Naturschutz und Geologie in Mecklenburg-Vorpommern
DE	Water	ICES	LUNG	Landesamt für Umwelt, Naturschutz und Geologie in Mecklenburg-Vorpommern
IS	Biota	ICES	MATI	Icelandic Food and Biotech R&D
IE	Biota	ICES	MICG	Marine Institute (Chemistry) Galway
IE	Water	ICES	MICG	Marine Institute (Chemistry) Galway
LT	Biota	ICES	MRLT	Environmental Protection Agency, Department of Marine Research, Klaipeda
LT	Sediment	ICES	MRLT	Environmental Protection Agency, Department of Marine Research, Klaipeda
LT	Water	ICES	MRLT	Environmental Protection Agency, Department of Marine Research, Klaipeda
BE	Biota	ICES	MUMM	Management Unit of the North Sea and Scheldt Estuary

BE	Sediment	ICES	MUMM	Management Unit of the North Sea and Scheldt Estuary
BE	Water	ICES	MUMM	Management Unit of the North Sea and Scheldt Estuary
DK	Biota	ICES	NERI	National Environmental Research Institute
DK	Sediment	ICES	NERI	National Environmental Research Institute
NO	Biota	ICES	NIVA	Norwegian Institute for Water Research
NO	Sediment	ICES	NIVA	Norwegian Institute for Water Research
DE	Sediment	ICES	NLKG	Niedersächsischer Landesbetrieb für Wasserwirtschaft
DE	Water	ICES	NLKG	Niedersächsischer Landesbetrieb für Wasserwirtschaft
PL	Water	ICES	OWMP	Regional Inspectorate of Environmental Protection in Olsztyn
NL	Biota	ICES	RWSW	Rijkswaterstaat, Lelystad
NL	Sediment	ICES	RWSW	Rijkswaterstaat, Lelystad
NL	Water	ICES	RWSW	Rijkswaterstaat, Lelystad
SE	Biota	ICES	SERI	Swedish Environmental Research Institute
SE	Sediment	ICES	SGUS	Geological Survey of Sweden
PL	Water	ICES	SZPP	Regional Inspectorate of Environmental Protection in Szczecin

Annex 6: Summary of CHASE+ classifications

The results of the CHASE classifications – same as Figure 3.2 but presented as a Table:

Matrix	Class	Region								Total
		Baltic Sea		Black Sea		Mediterranean Sea		Northeast Atlantic Ocean		
		n	%	n	%	n	%	n	%	
Water	H	3	4.8%	12	21.4%	1	0.4%	14	5.1%	30
	G	1	1.6%			4	1.6%			5
	M			3	5.4%	22	8.9%	55	20.0%	80
	P	1	1.6%			87	35.2%	51	18.5%	139
	B	58	92.1%	41	73.2%	133	53.8%	155	56.4%	387
	Total	63		56		247		275		641
Sediment	H	13	13.4%	5	26.3%	74	48.4%	195	38.2%	287
	G	9	9.3%	3	15.8%	30	19.6%	95	18.6%	137
	M	53	54.6%	7	36.8%	34	22.2%	186	36.4%	280
	P	8	8.2%			5	3.3%	22	4.3%	35
	B	14	14.4%	4	21.1%	10	6.5%	13	2.5%	41
	Total	97		19		153		511		780
Biota	H	4	2.0%			5	3.1%	3	0.6%	12
	G	17	8.6%			12	7.5%	34	7.1%	63
	M	75	37.9%	4	33.3%	64	39.8%	183	38.0%	326
	P	33	16.7%	1	8.3%	35	21.7%	116	24.1%	185
	B	69	34.8%	7	58.3%	45	28.0%	146	30.3%	267
	Total	198		12		161		482		853
Bioeffect	H							46	39.0%	46
	G	2	12.5%					28	23.7%	30
	M	9	56.3%					34	28.8%	43
	P	5	31.3%					8	6.8%	13
	B							2	1.7%	2
	Total	16						118		134
Integrated	H	8	2.9%	12	19.4%	14	4.0%	104	12.2%	138
	G	10	3.6%			10	2.8%	78	9.2%	98
	M	92	33.5%	5	8.1%	42	11.9%	261	30.7%	400
	P	41	14.9%			108	30.5%	125	14.7%	274
	B	124	45.1%	45	72.6%	180	50.8%	282	33.2%	631
	Total	275		62		354		850		1541

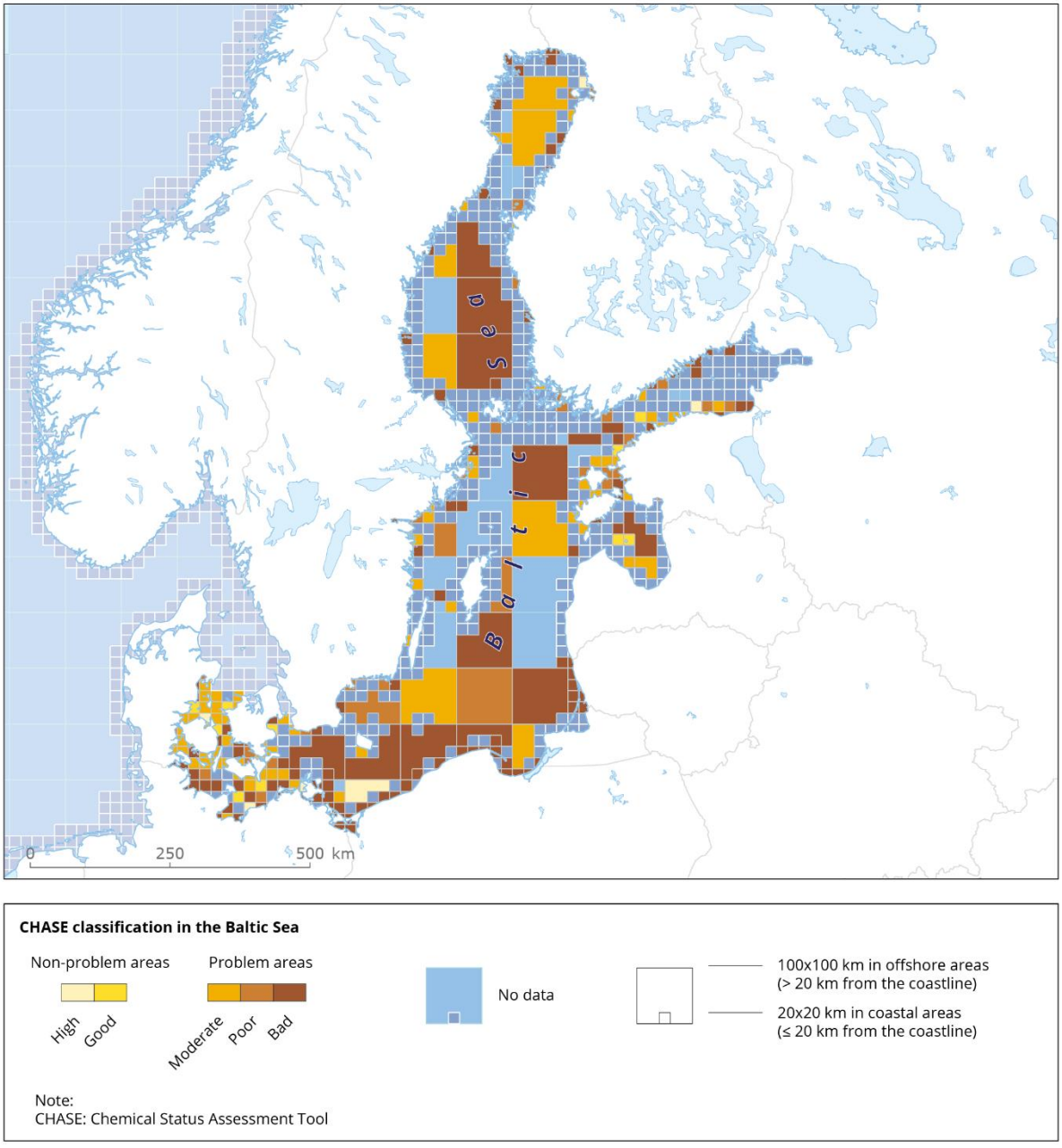
Detailed maps for the integrated assessment of contamination status are presented on the following pages for these marine regions sub-regions:

- Baltic Sea
- Black Sea
- Eastern Mediterranean Sea
- Western Mediterranean Sea
- North Sea and Celtic Sea
- Norwegian Sea and Barents Sea

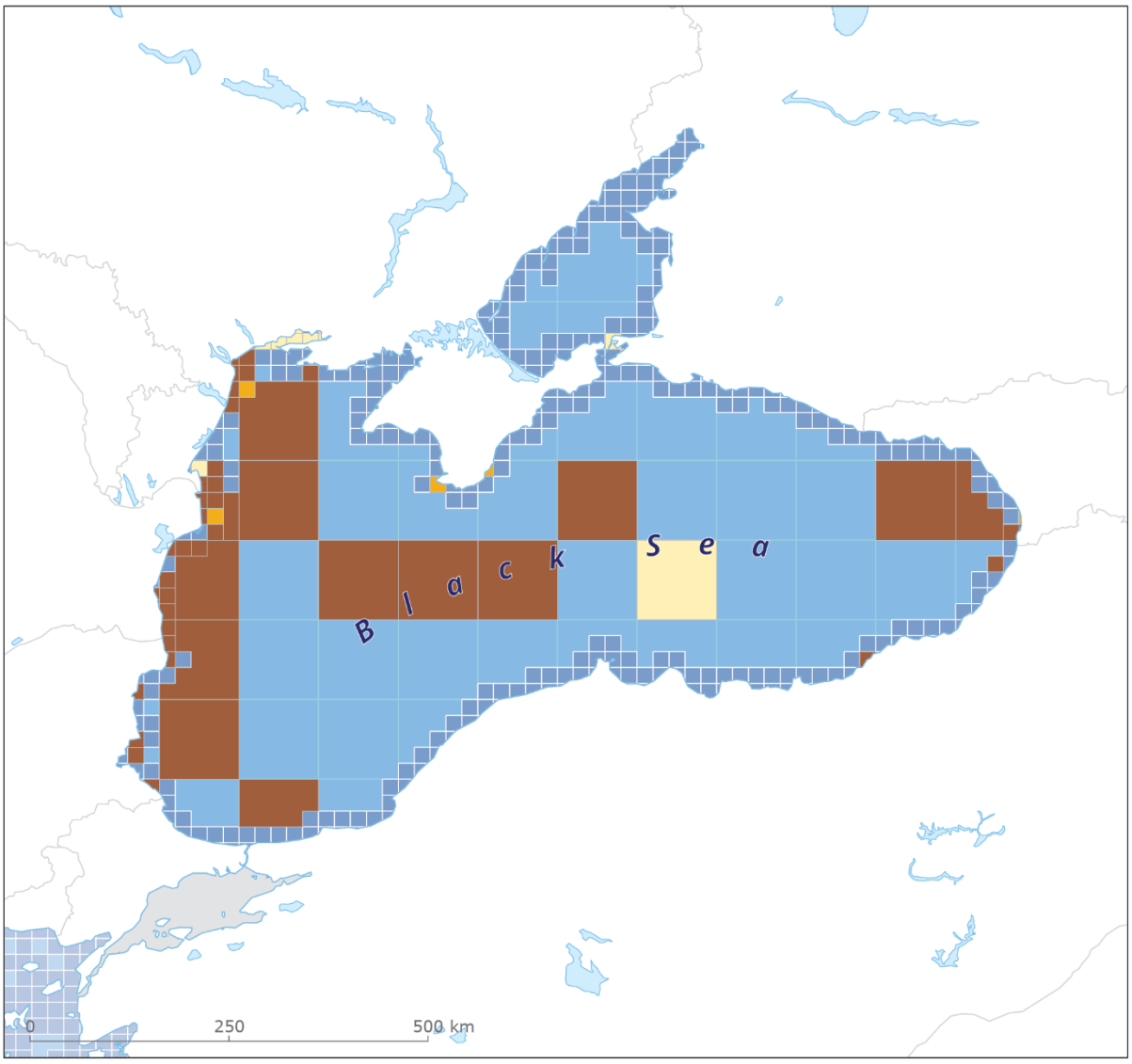
- Europe North
- Europe South

Annex 7: Detailed maps of CHASE+ classification by regions

Baltic Sea



Black Sea



CHASE classification in the Black Sea

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

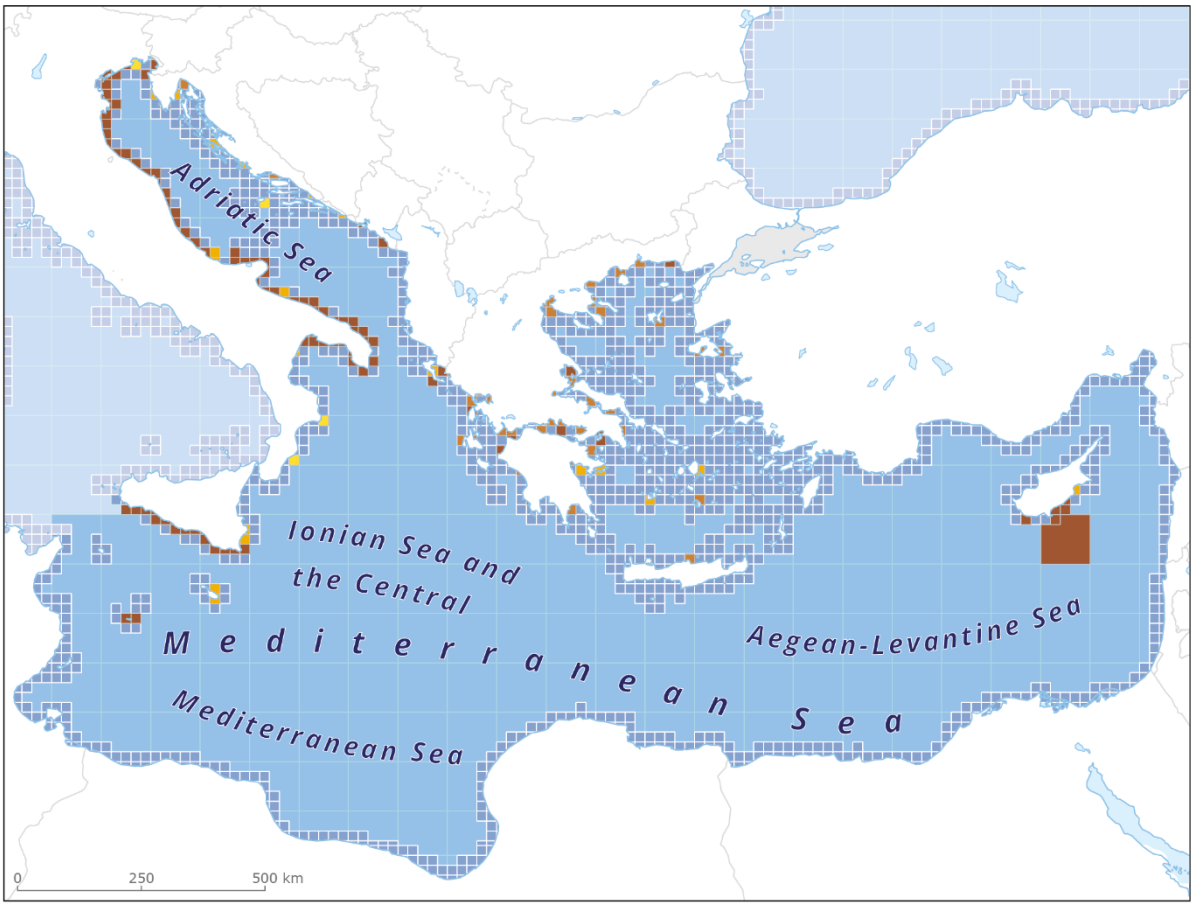
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Eastern Mediterranean Sea



CHASE clasification in the Eastern Mediterranean Sea

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

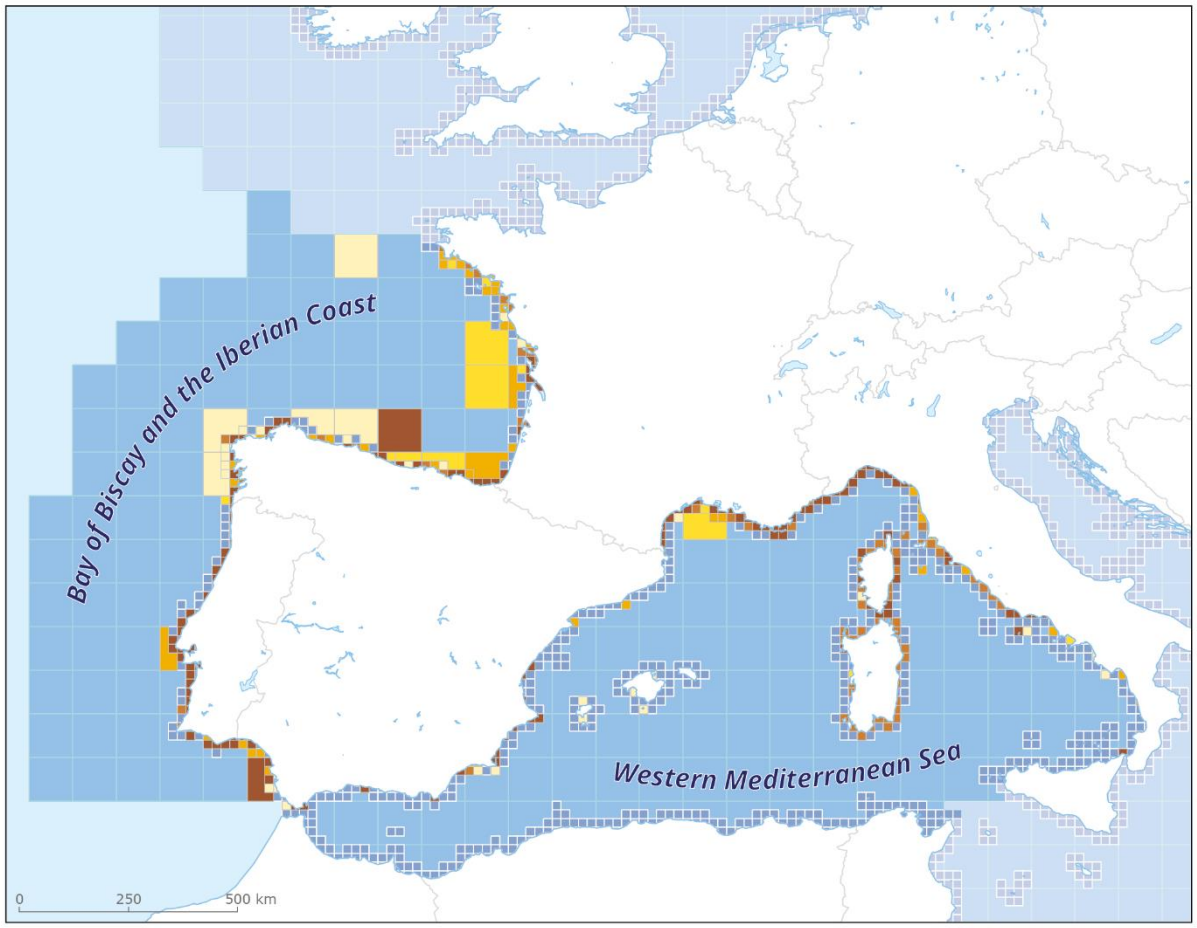
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Western Mediterranean Sea



CHASE clasification in the Western Mediterranean Sea and the Bay of Biscay

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

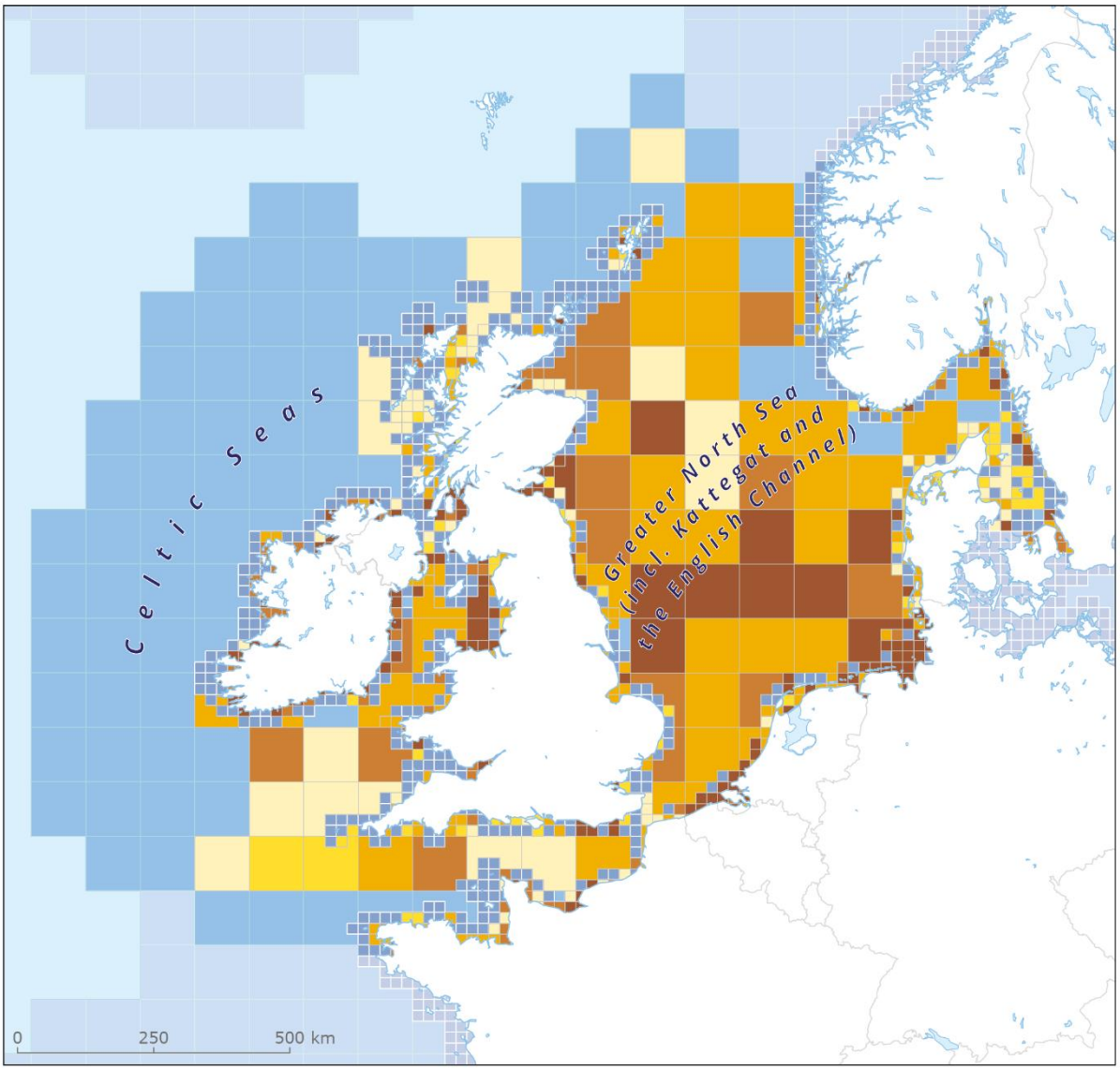
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

North Sea and Celtic Seas



CHASE clasification in the Celtic Seas and the North Sea

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

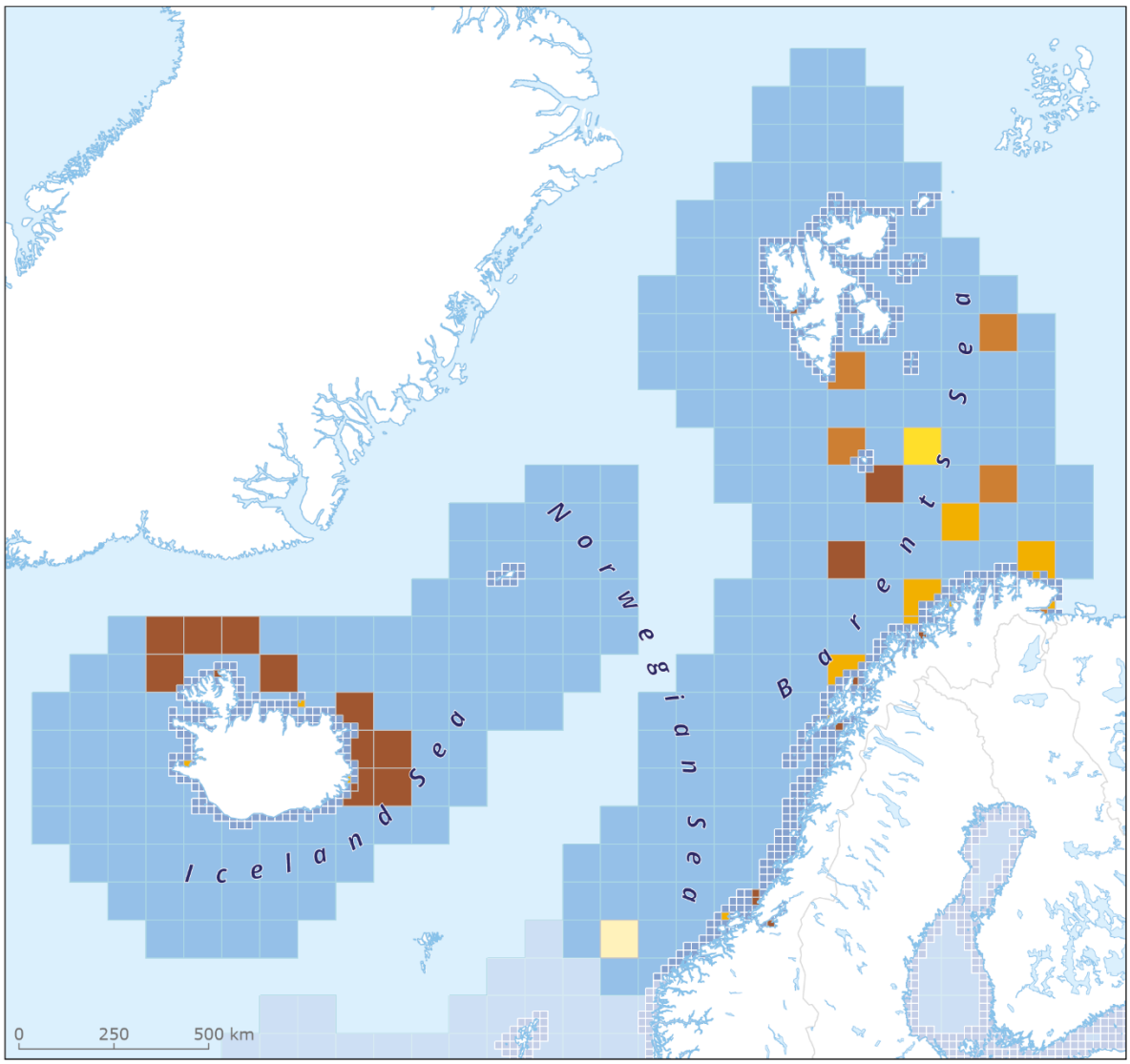
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Norwegian Sea and Barents Sea



CHASE classification in the Iceland Sea, Norwegian Sea and Barents Sea

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

No data

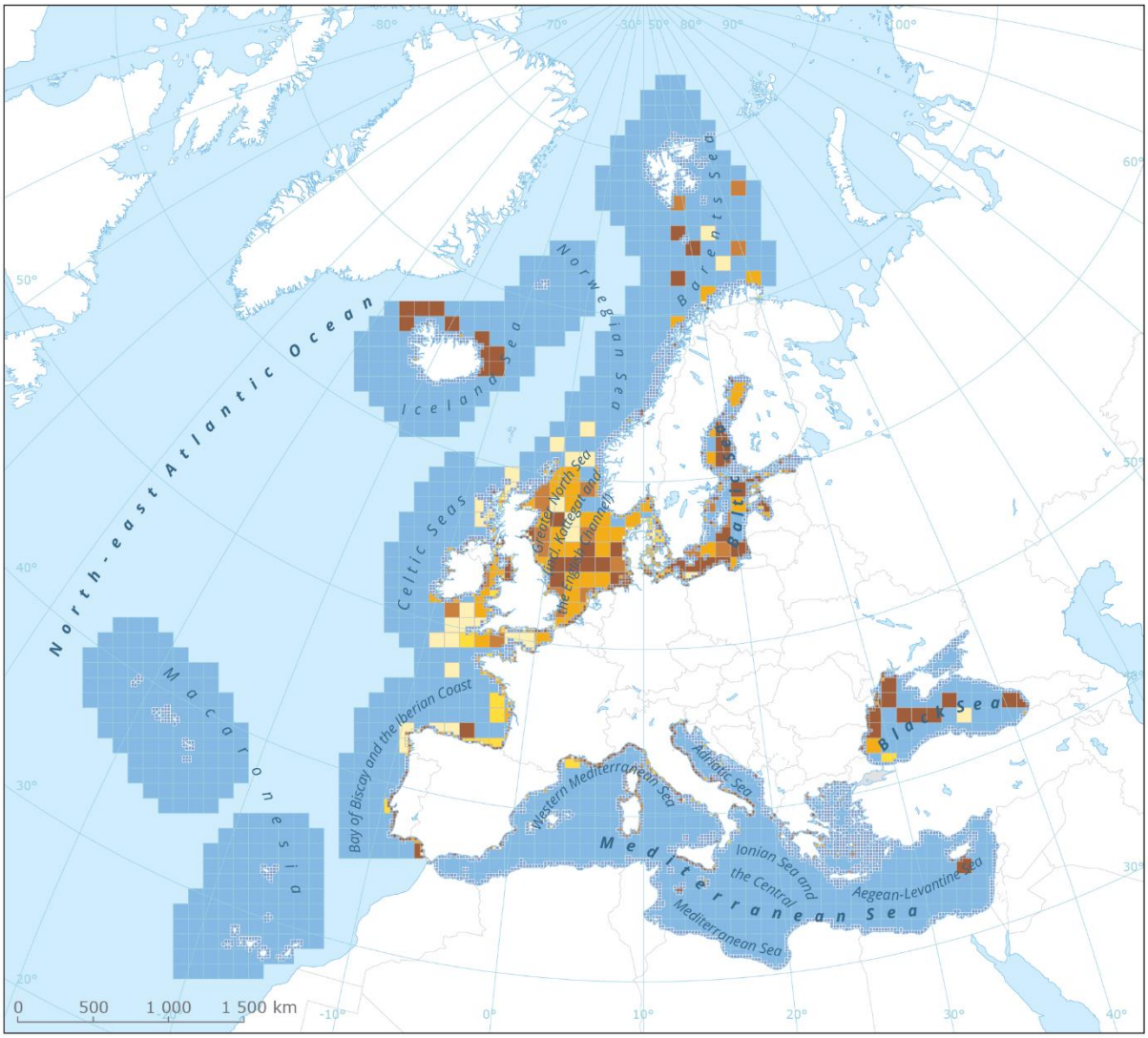
100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

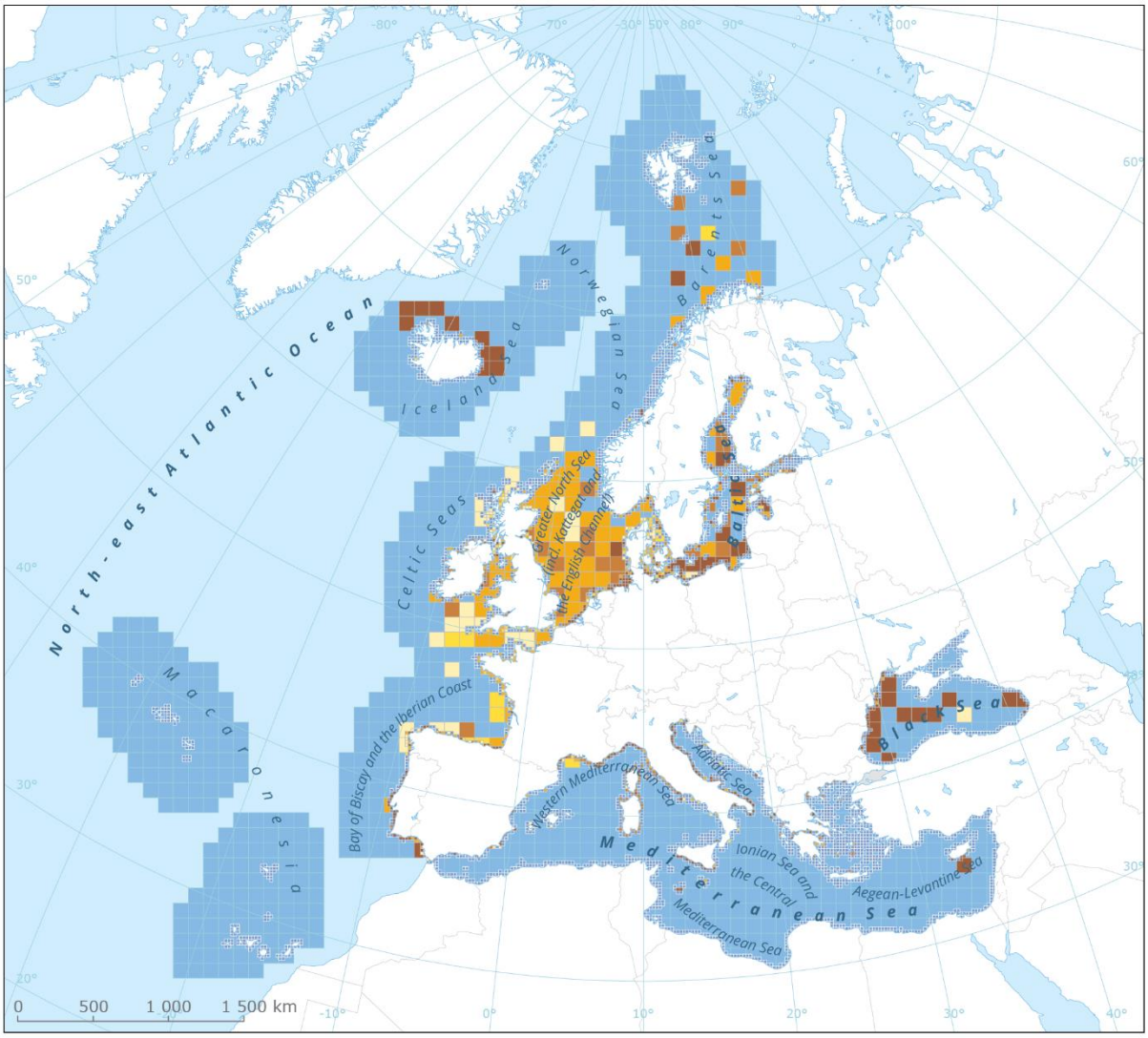
Note:
CHASE: Chemical Status Assessment Tool

Annex 8: Status excluding specific substance groups

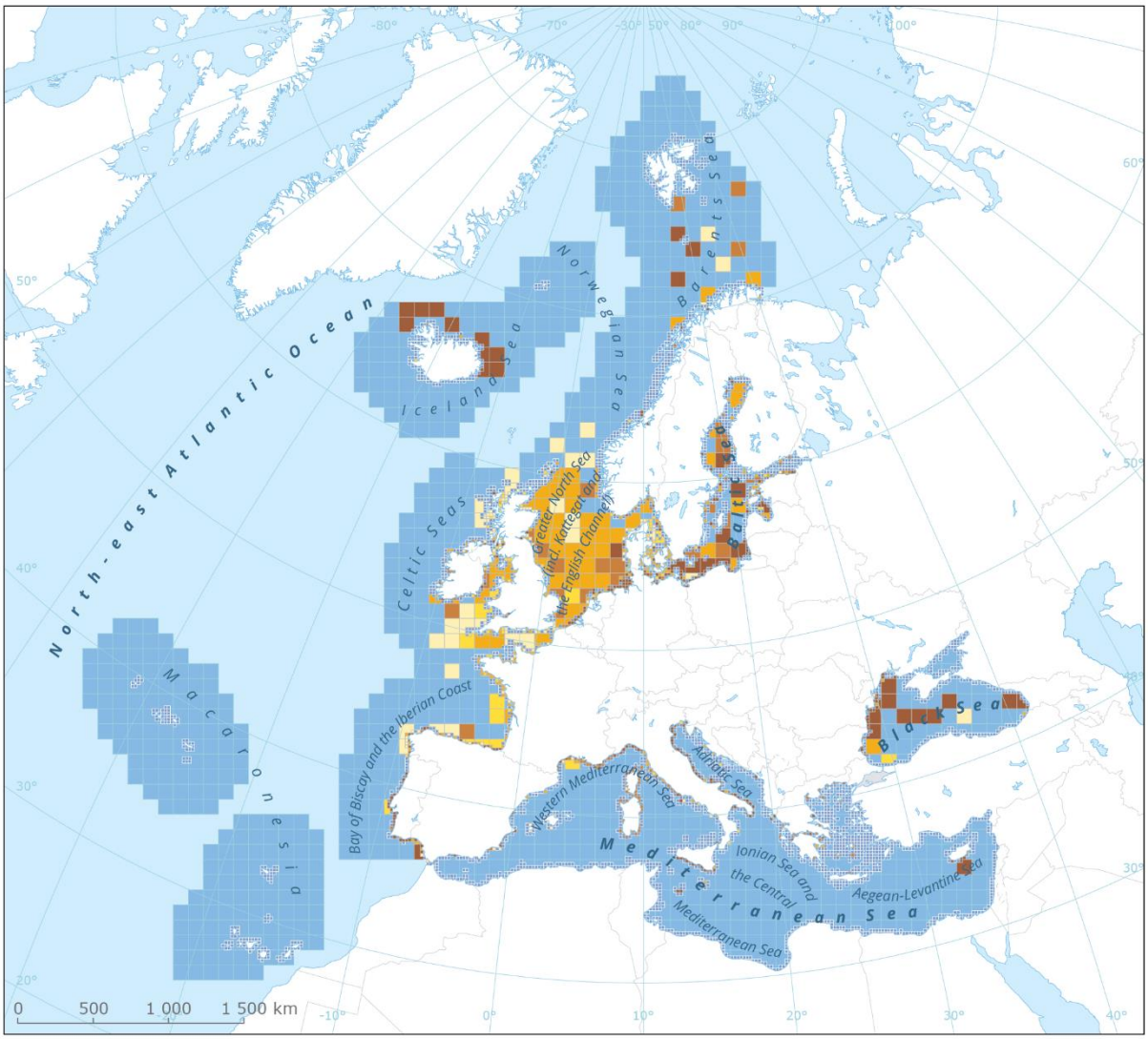
CHASE Excluding mercury (Hg)



CHASE Excluding brominated flame retardants (PBDEs)



CHASE Excluding mercury (Hg) and brominated flame retardants (PBDEs)



CHASE classification excluding Hg and PBDEs

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

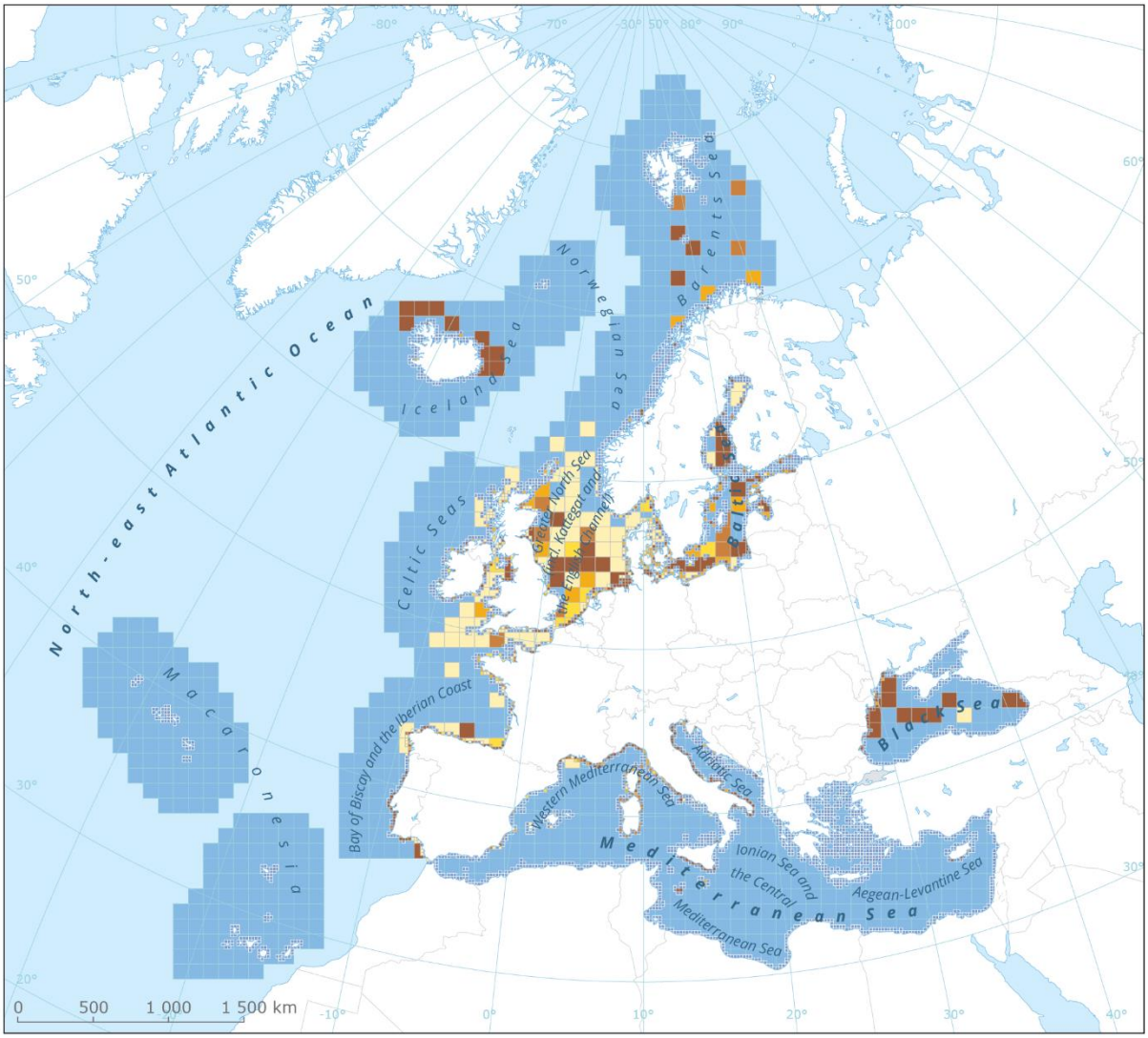
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

CHASE Excluding metals



CHASE classification excluding metals

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

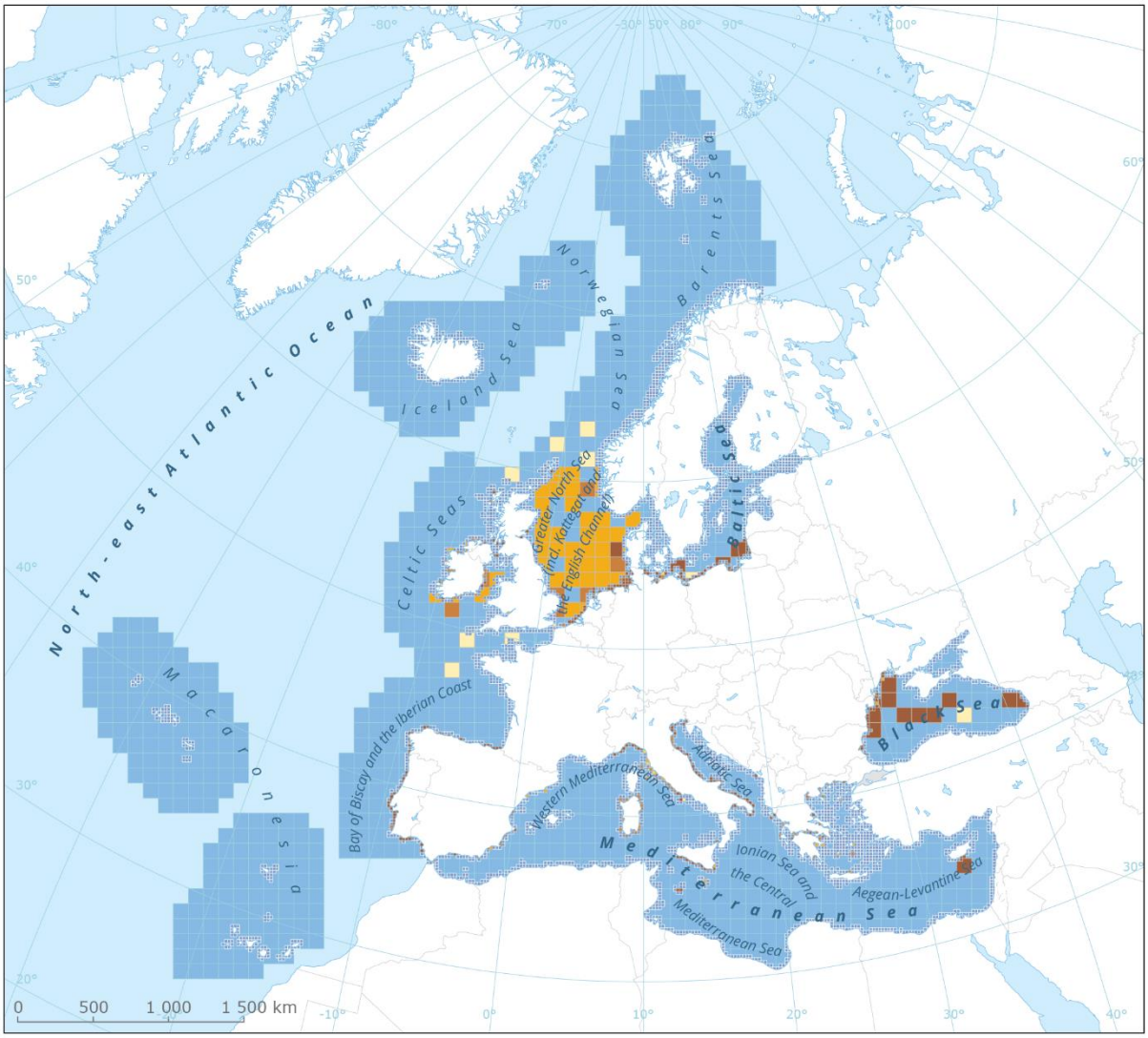
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Seawater Excluding mercury (Hg)



CHASE classification in seawater, excluding Hg

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

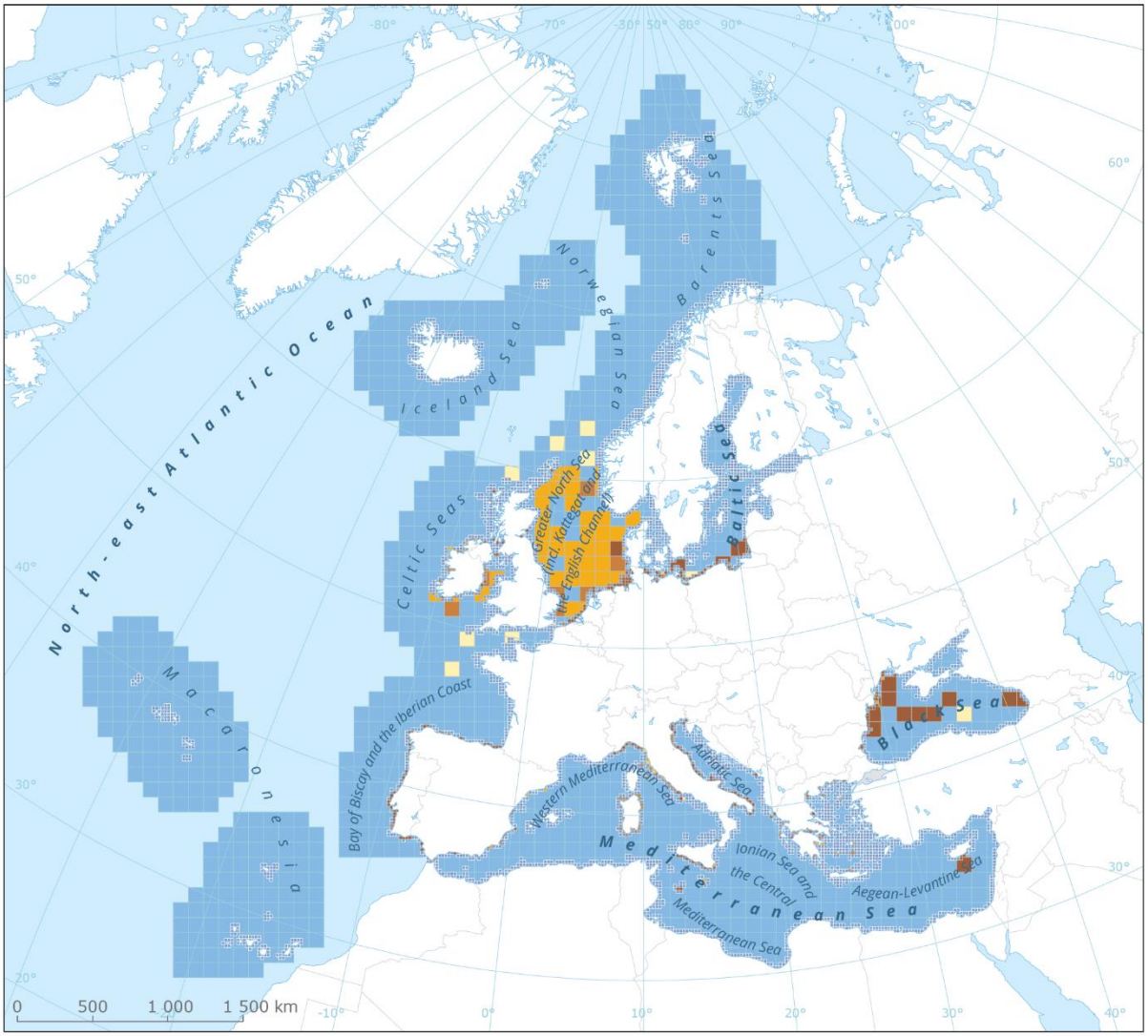
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Seawater Excluding brominated flame retardants (PBDEs)



CHASE classification in seawater, excluding PBDEs

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

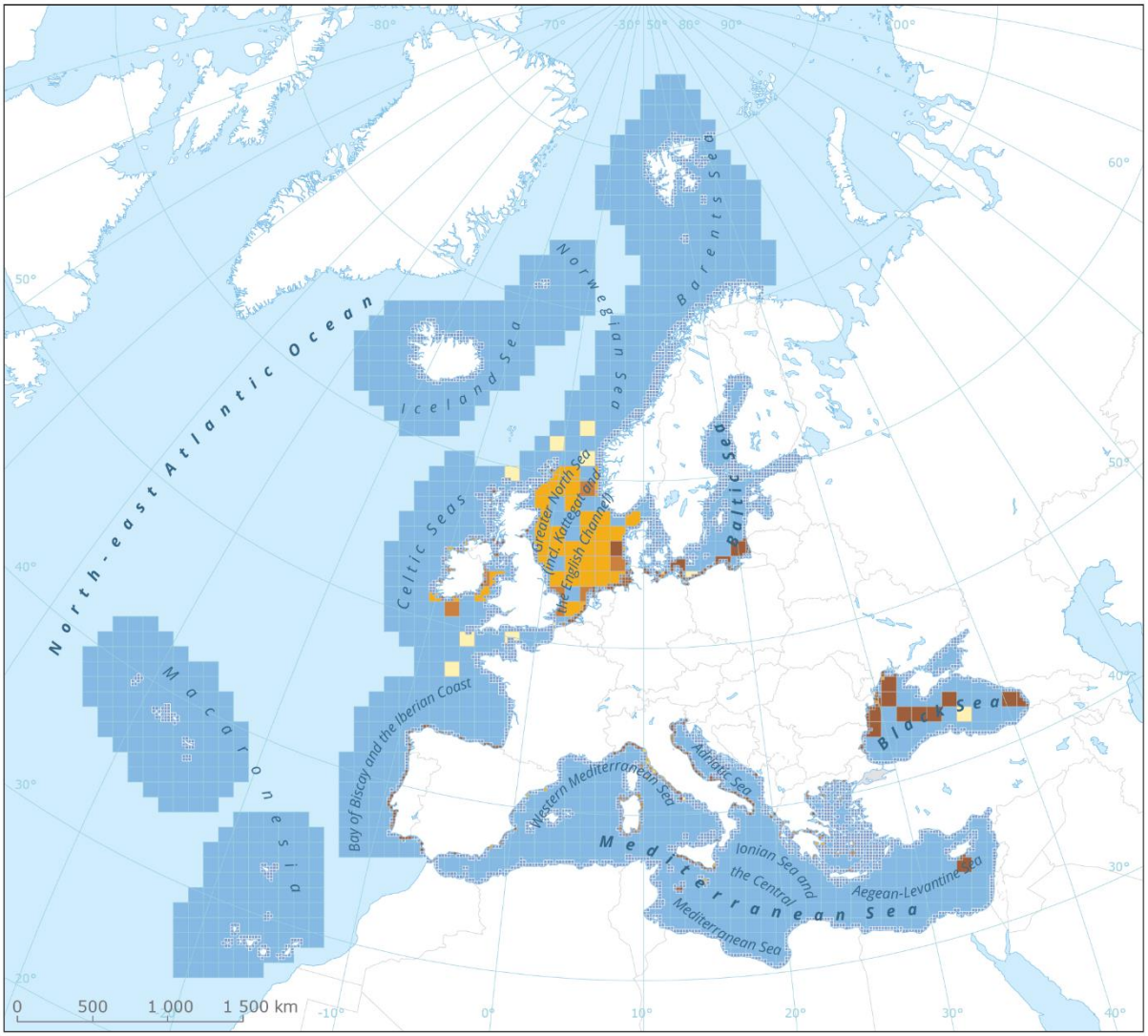
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Seawater Excluding mercury (Hg) and brominated flame retardants (PBDEs)



CHASE classification in seawater, excluding Hg and PBDEs

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

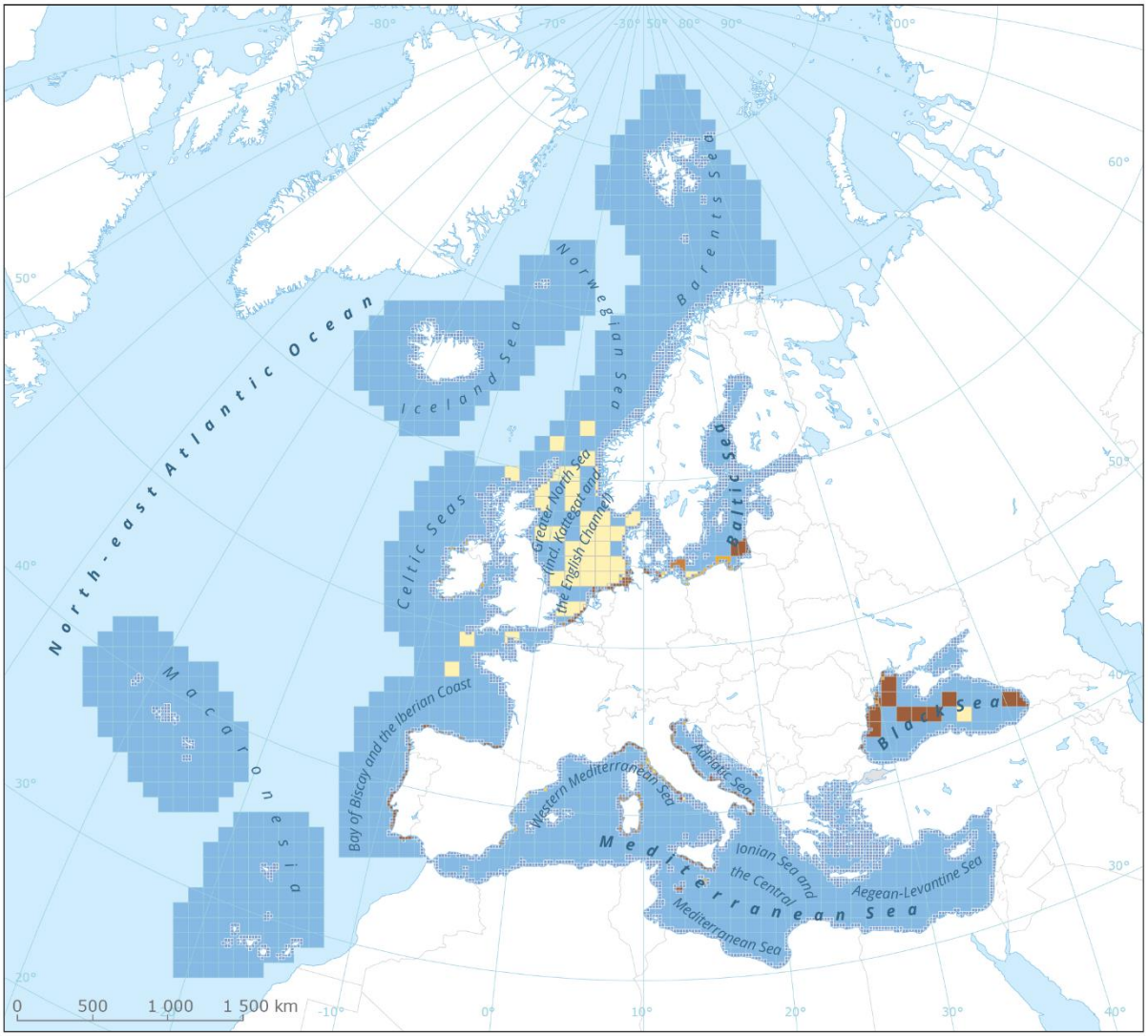
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Seawater Excluding metals



CHASE classification in seawater, excluding metals

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

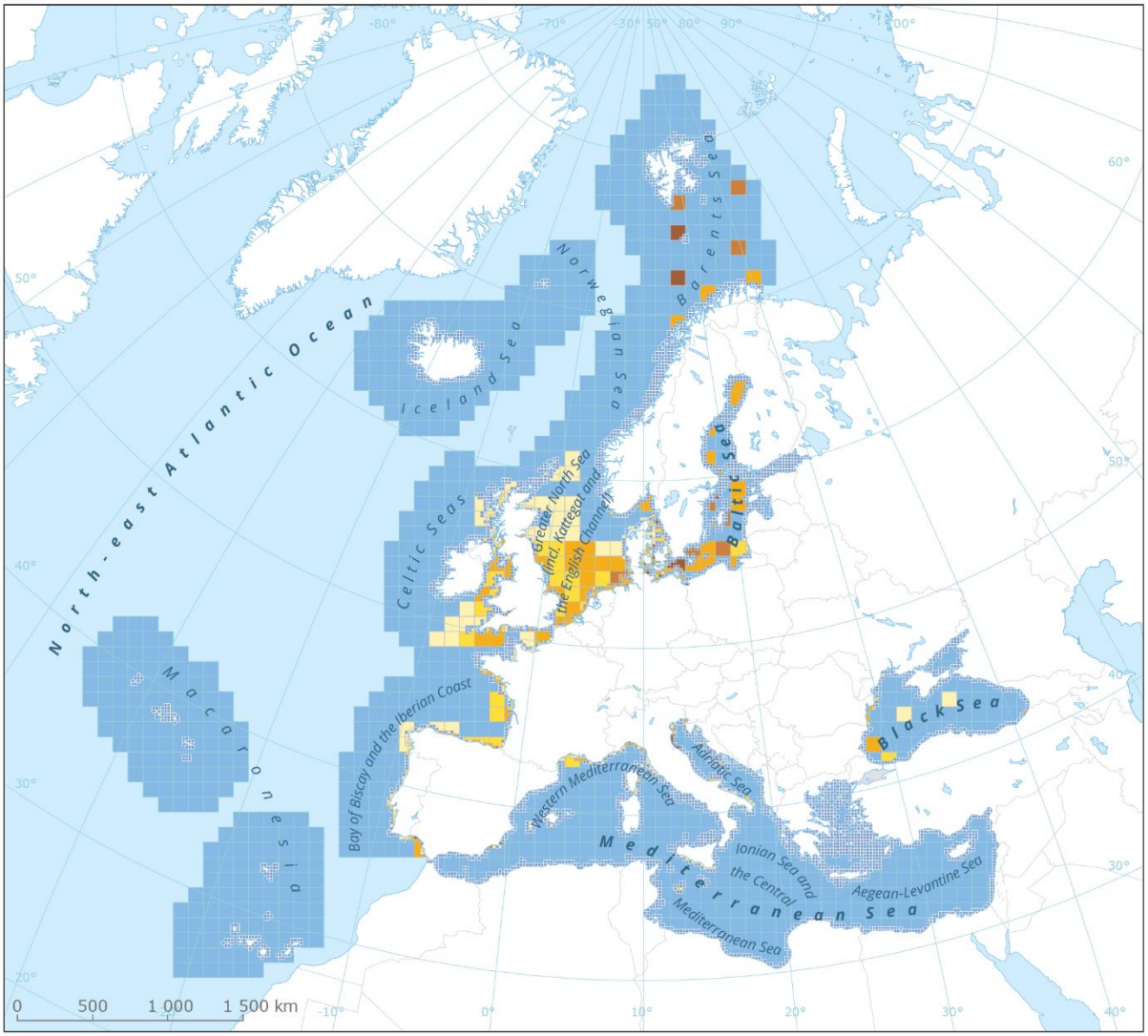
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Sediment Excluding mercury (Hg)



CHASE classification in sediments, excluding Hg

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

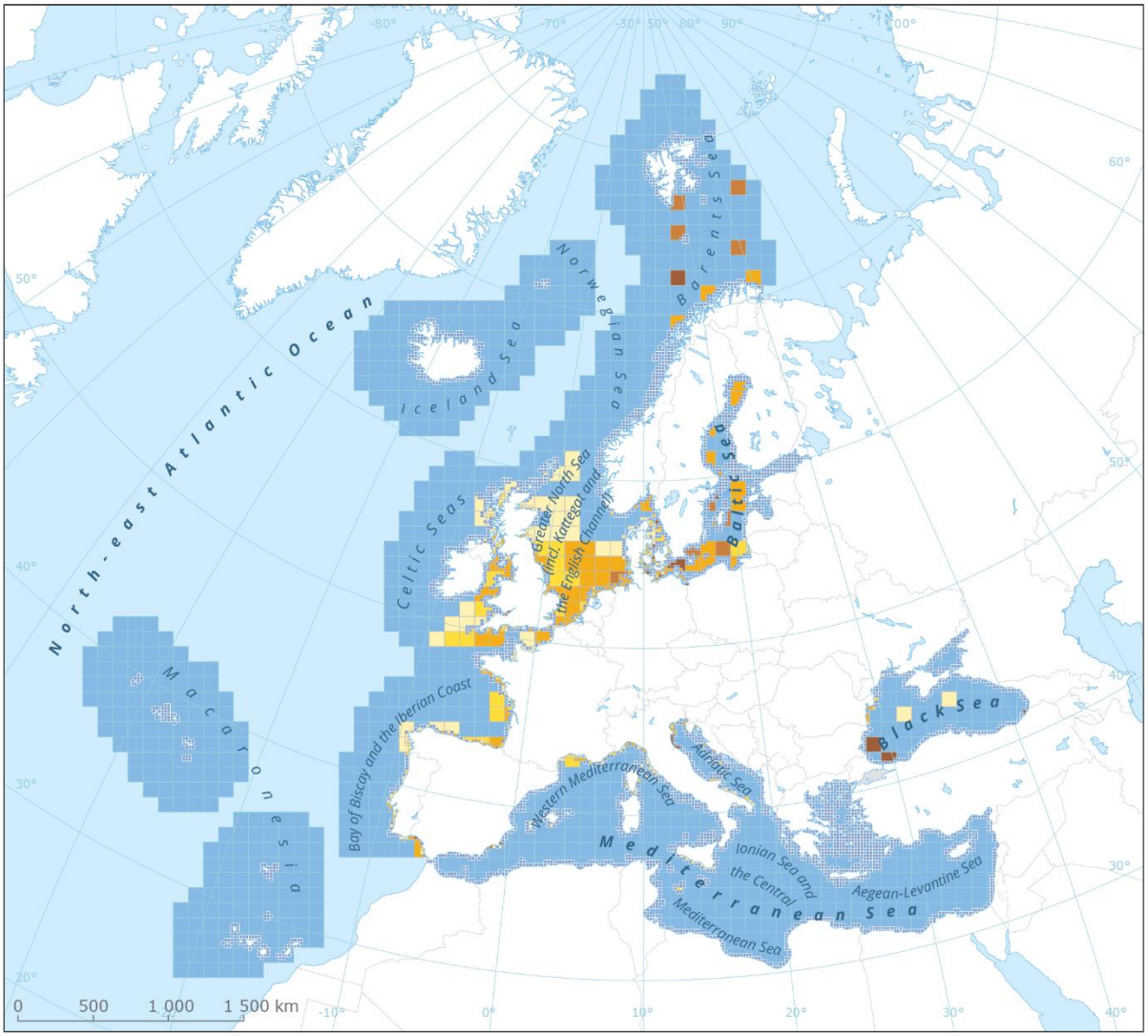
No data

100x100 km in offshore areas (> 20 km from the coastline)

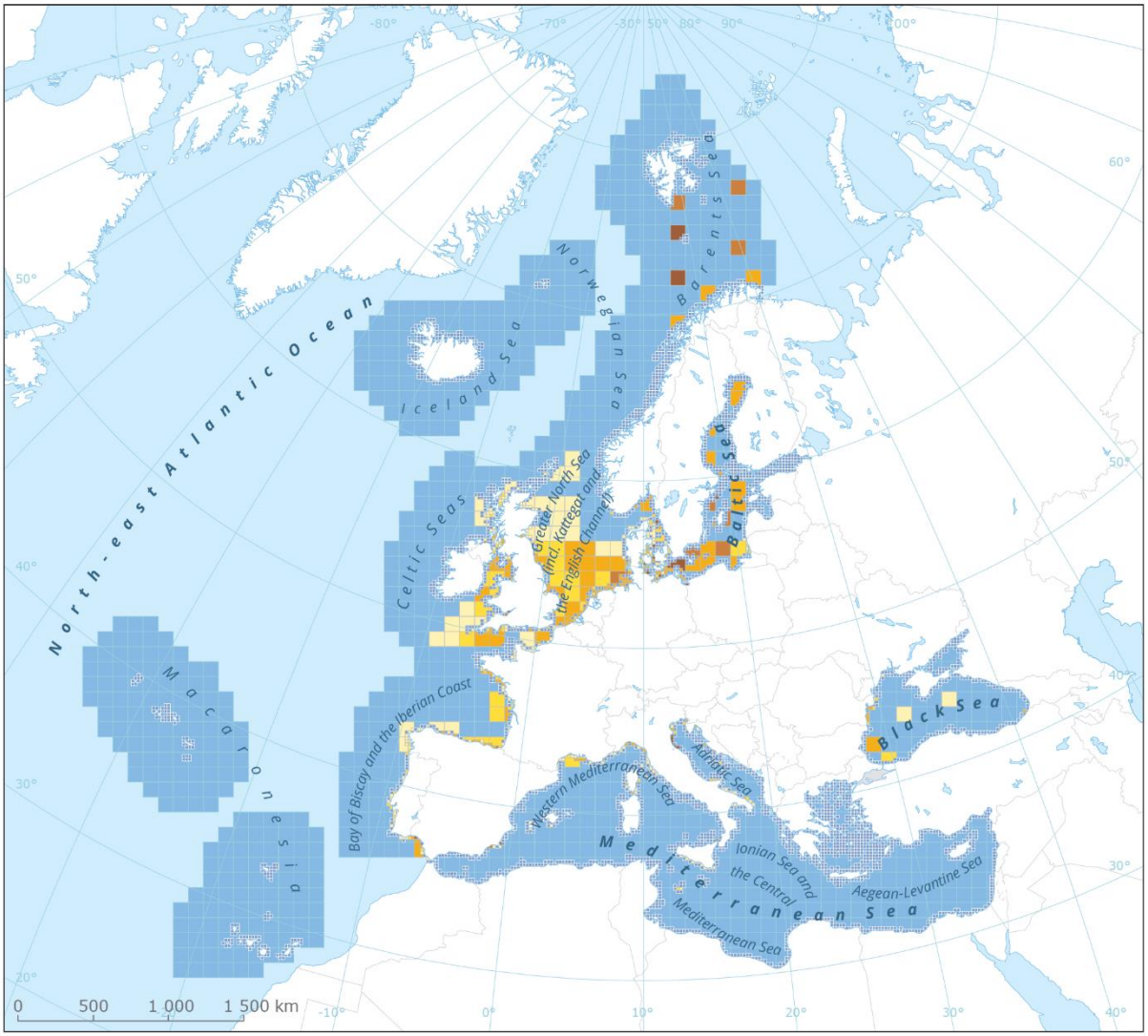
20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Sediment Excluding brominated flame retardants (PBDEs)



Sediment Excluding mercury (Hg) and brominated flame retardants (PBDEs)



CHASE classification in sediments, excluding Hg and PBDEs

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

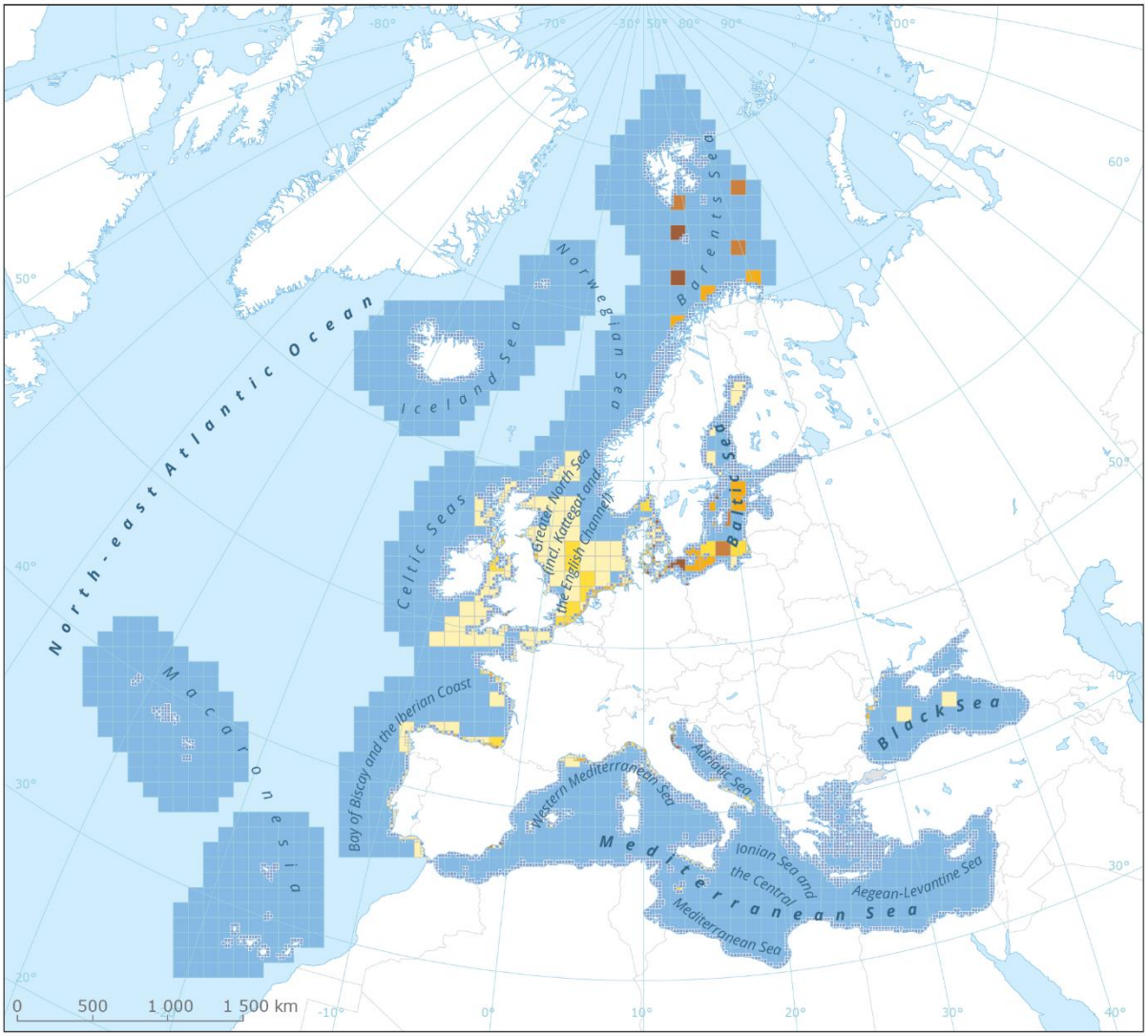
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Sediment Excluding metals



CHASE classification in sediments, excluding metals

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

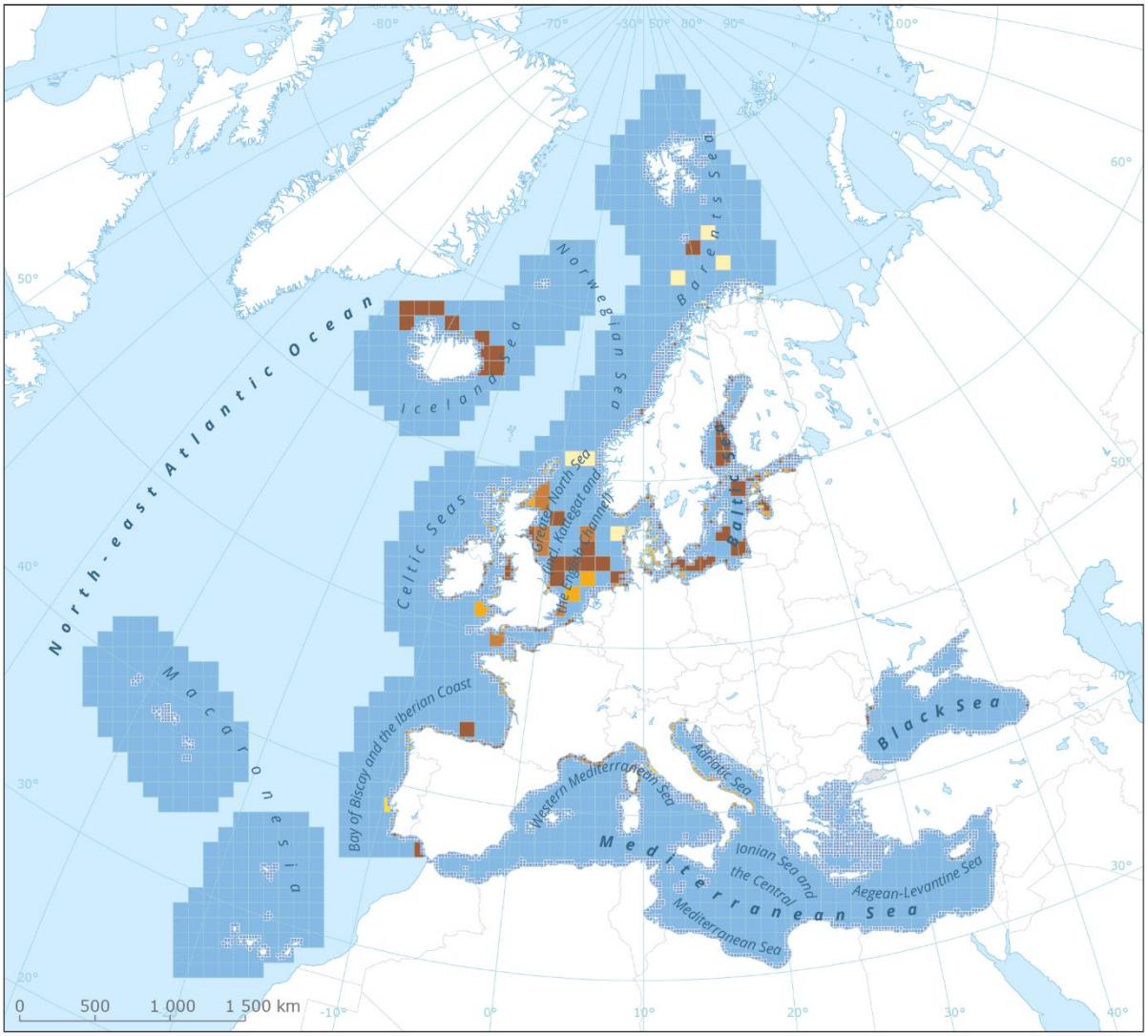
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Biota Excluding mercury (Hg)



CHASE classification in biota, excluding Hg

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

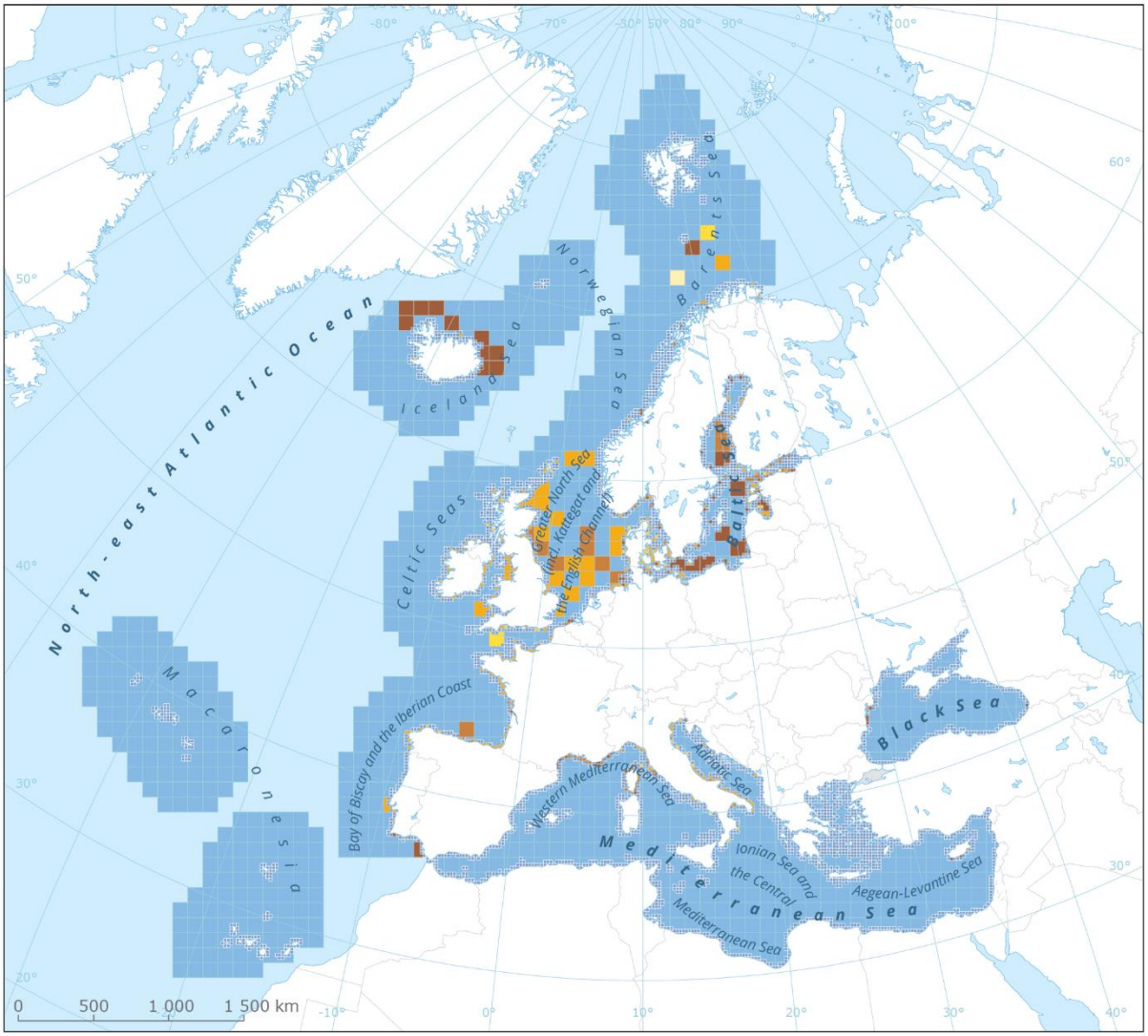
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Biota Excluding brominated flame retardants (PBDEs)



CHASE classification in biota, excluding PBDEs

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

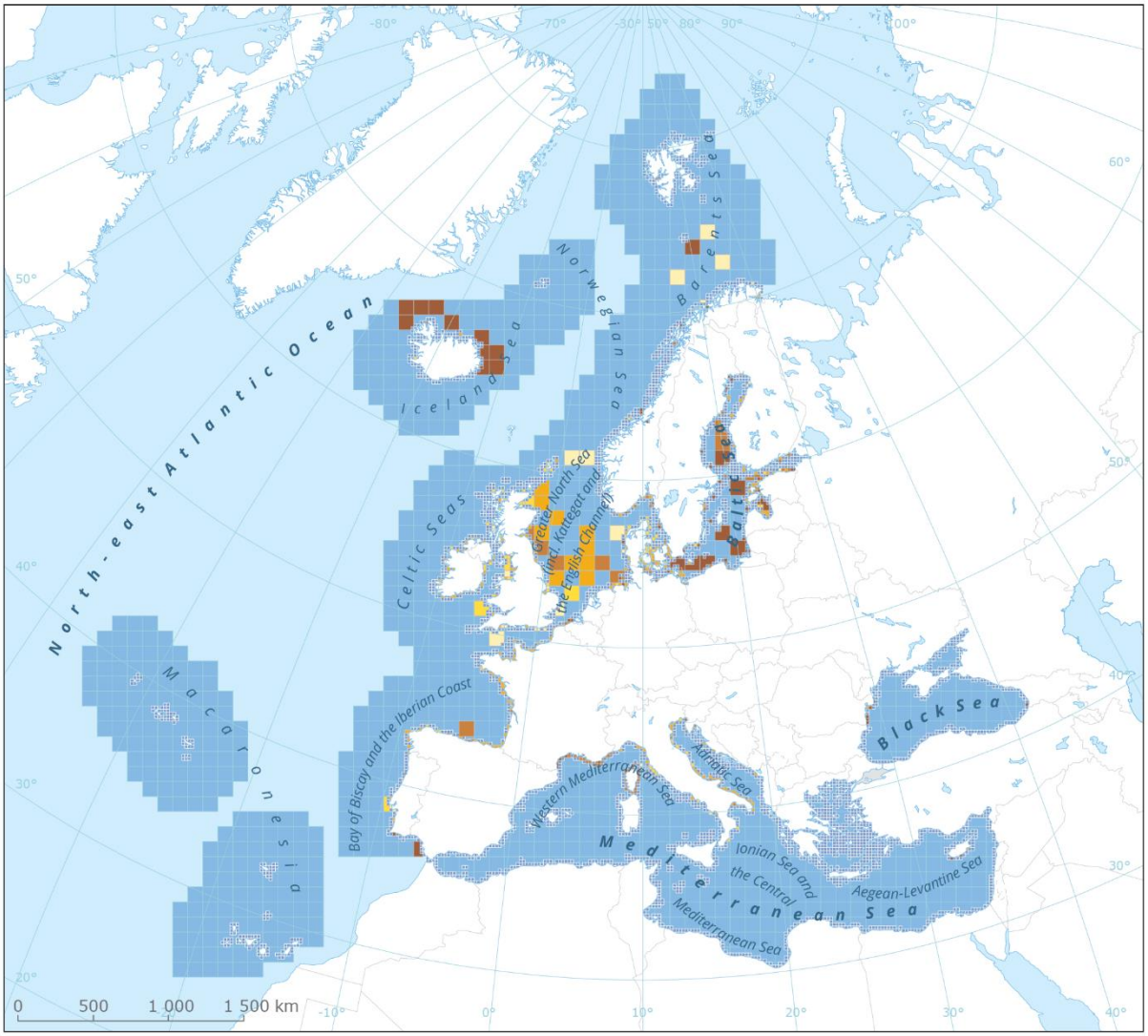
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Biota Excluding mercury (Hg) and brominated flame retardants (PBDEs)



CHASE classification in biota, excluding Hg and PBDEs

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

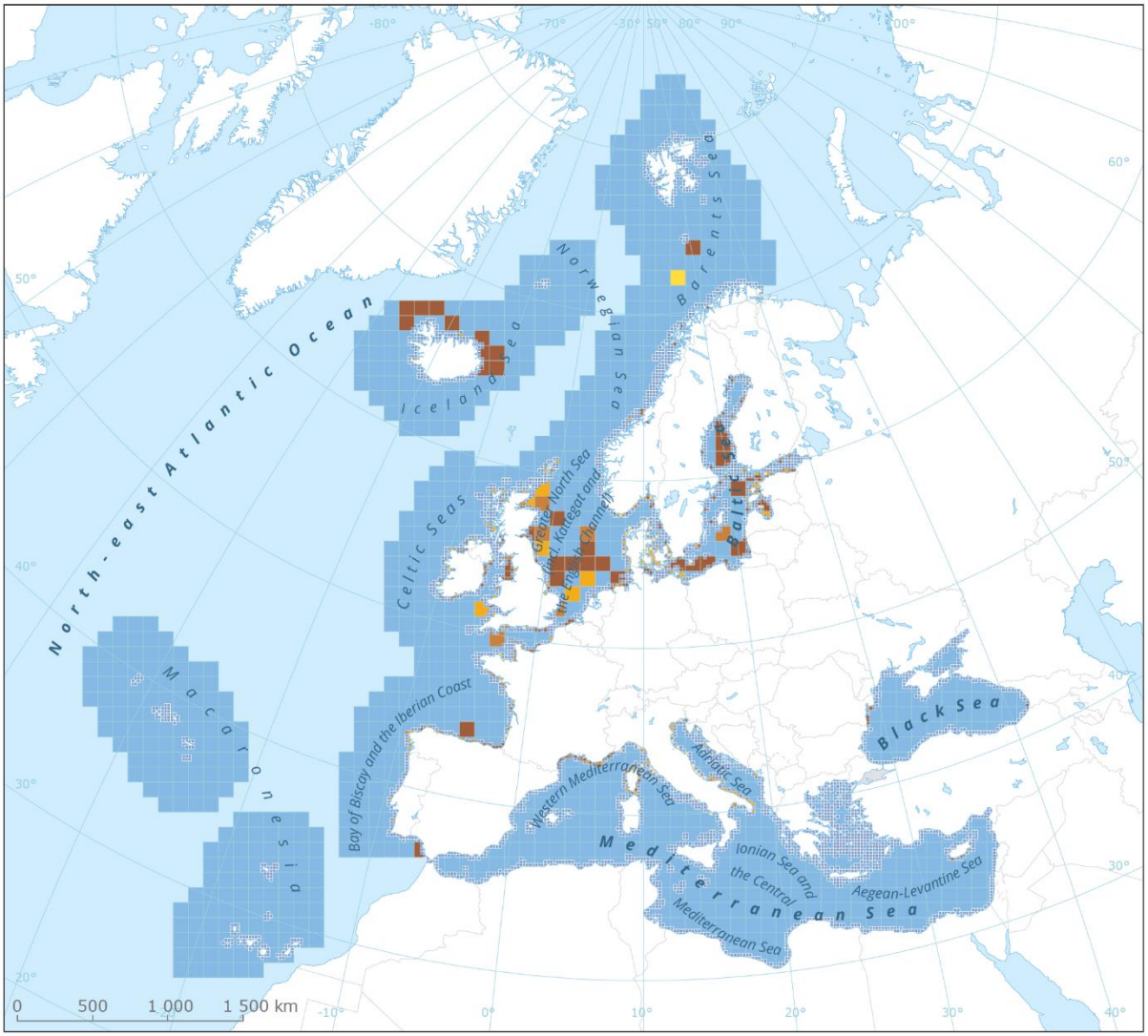
No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Biota Excluding metals



CHASE classification in biota, excluding metals

Non-problem areas: High, Good

Problem areas: Moderate, Poor, Bad

Outside coverage

No data

100x100 km in offshore areas (> 20 km from the coastline)

20x20 km in coastal areas (≤ 20 km from the coastline)

Note:
CHASE: Chemical Status Assessment Tool

Annex 9: Individual CHASE+ classifications

The following files, based on the CHASE+ calculations, are available for consultation via the EEA at: https://www.eea.europa.eu/data-and-maps/data/chase-contaminants-assessment/

- Table of CHASE+ results per assessment unit, showing Contamination Score for each of the four Categories (Biota, Sediment, Water and Biological Effects) as well as the overall CHASE+ score.

- Table of CHASE+ inputs, showing the individual indicators with their contamination ratios. These indicator scores are aggregated within Categories (Biota, Sediment, Water and Biological Effects), according to the method describe in section 3.2 to give the Contamination Scores seen in the results file.