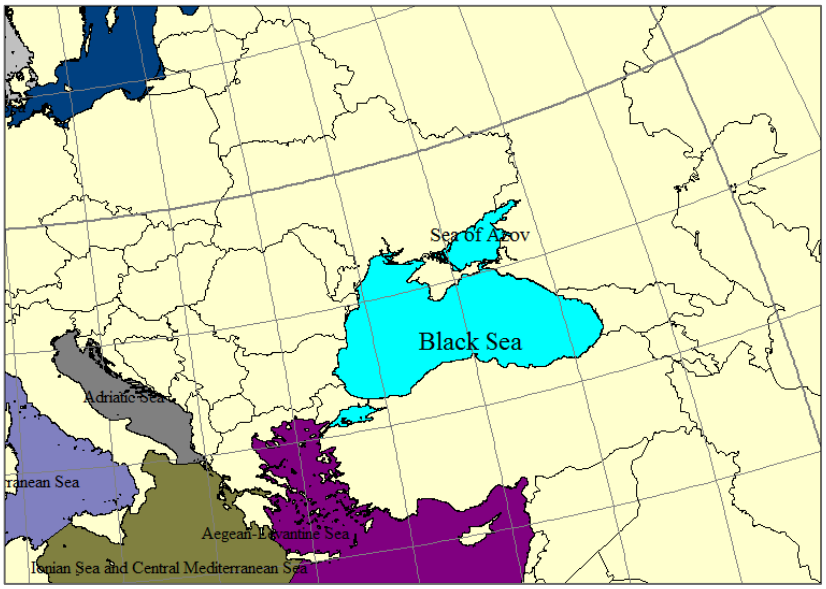
EMODnet
European Marine Observation and Data Network

EMODnet Thematic Lot n° 4 - Chemistry

Black Sea

Final Report – Draft v01

Quality control of nutrients data
DIVA products



Luminita Buga - NIMRD

INCDM

Contents

1. Introduction

1.1 Black Sea Data Set

On 28 October 2014, NIMRD - the Regional Leader for the Black Sea received the 2nd harvested (by robot/MARIS) ***nutrient data*** for the Black Sea which included a zip package containing multiple *SDN zip files* of maximum 10.000 ODV data files and the CSV files with the associated CDI metadata (data.csv).

In February 2016 NIMRD received two new harvested data collections. One contained datasets with ***Oxygen, Chlorophyll a, Acidity parameters*** which included **41532 files in ODV Spreadsheet format** (originated from 24 CDI-Partners distributed over 39 data originators). The second one contained datasets with ***Contaminants parameters (Hydrocarbons, Heavy metals, Polychlorinated biphenyls, Pesticides and biocides, Radionuclides) in water, sediment and biota*** which included **24343 files in ODV Spreadsheet format** (originated from 12 CDI-Partners distributed over 18 data originators) and the corresponding extended CDI metadata files (data.csv).

1.2 Black Sea data contributors

Table 1: Distribution of the *"nutrients data"* per originator (EDMO Code)

	Originator (EDMO Code)	No. of CDIs
1	Ankara University (2176)	24
2	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology (692)	474
3	CEREGE (560)	17
4	Danube Delta Biosphere Reserve Authority (2178)	4
5	Dokuz Eylul University, Institute of Marine Science and Technology (801)	76
6	Donskaya offing station North-Caucasus HMS (871)	266
7	Georgian Institute of Hydrometeorology of Georgian Technical University (2121)	53
8	Georgian Institute of Water Management of Georgian Technical University (2122)	68
9	Hellenic Centre for Marine Research, Institute of Oceanography (HCMR/IO) (164)	49
10	IFREMER / GM-MARINE GEOSCIENCES (485)	5
11	Institute of Biology of the Southern Seas, NAS of Ukraine (840)	868
12	Institute of Fishery Resources (IFR) (191)	257
13	Institute of Marine Sciences, Middle East Technical University (696)	2135

14	Institute of Oceanology, Bulgarian Academy of Sciences (IO-BAS) (1843)	149
15	Istanbul University, Institute of Marine Science and Management (802)	60
16	Iv.Javakhishvili TSU, (693)	163
17	Karadeniz Technical University, Faculty of Marine Sciences (732)	26
18	Kuban offing station, North-Caucasus HMS (891)	68
19	Laboratory of Marine Ecology-Central Laboratory of General Ecology (192)	600
20	Marine branch of Ukrainian Hydrometeorological Institute (841)	2034
21	Marine Hydrophysical Institute (727)	2384
22	Mariupol Marine Hydrometeorological Station, Ukrainian HMS (901)	26
23	National Institute for Marine Research and Development Grigore Antipa" (697)"	3911
24	North-Caucasus Regional Administration of Hydrometeorology of Roshydromet (910)	887
25	Nothern Regional Administration of Hydrometeorology of Roshydromet (913)	9
26	Odessa Branch of SOI (State Oceanographic Institute) (931)	3644
27	Odessa National I.I.Mechnikov University (1169)	825
28	P.P.Shirshov Institute of Oceanology, RAS (685)	414
29	Scientific - Research Firm GAMMA" (1265)"	206
30	Sinop University, Fisheries Faculty (733)	343
31	Southern Scientific Research Institute of Marine Fisheries and Oceanography (688)	13284
32	Specialized Center for Hydrometeorology and Monitoring of Environment of Black and Azov Seas (SC HME BAS) (2761)	16
33	State Oceanographic Institute (SOI) (723)	10246
34	Tuapse Hydrometeorological Bureau, North-Caucasus Centre (942)	75
35	Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)	6244

Table 2: Distribution of the *"nutrients data"* per CDI-Partner (EDMO Code)

	CDI-partner (EDMO Code)	No. of station
1	All-Russia Research Institute of Hydrometeorological Information - World Data Centre (RIHMI-WDC) National Oceanographic Data Centre (NODC) (681)	5321
2	Marine Hydrophysical Institute (727)	2384
3	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology (692)	623
4	National Institute for Marine Research and Development Grigore Antipa" (697)"	3915
5	IFREMER / IDM/SISMER (486)	22
6	P.P.Shirshov Institute of Oceanology, RAS (685)	10481
7	Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)	6238
8	Institute of Fishery Resources (IFR) (191)	257
9	Odessa National I.I.Mechnikov University (1169)	825
10	Iv.Javakhishvili TSU, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO) (693)	284
11	Scientific - Research Firm GAMMA" (1265)"	206
12	Sinop University, Fisheries Faculty (733)	343
13	National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences (961)	600

14	Institute of Marine Sciences, Middle East Technical University (696)	2135
15	Marine branch of Ukrainian Hydrometeorological Institute (841)	1936
16	Ankara University (2176)	24
17	Dokuz Eylul University, Institute of Marine Science and Technology (801)	76
18	Karadeniz Technical University, Faculty of Marine Sciences (732)	26
19	Southern Scientific Research Institute of Marine Fisheries and Oceanography (688)	13284
20	Institute of Biology of the Southern Seas, NAS of Ukraine (840)	821
21	Hellenic Centre for Marine Research, Hellenic National Oceanographic Data Centre (HCMR/HNODC) (269)	49
22	Istanbul University, Institute of Marine Science and Management (802)	60
	TOTAL	**49910**

Table 3: Distribution of the *"oxygen, chlorophyll a, acidity data"* per originator (EDMO Code)

	Originator (EDMO Code)	No. of stations
1	P.P.Shirshov Institute of Oceanology, RAS (685)	542
2	Odessa Branch of SOI (State Oceanographic Institute) (931)	3637
3	Marine branch of Ukrainian Hydrometeorological Institute (841)	17043
4	Institute of Biology of the Southern Seas, NAS of Ukraine (840)	868
5	Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)	4097
6	Marine Hydrophysical Institute (727)	2325
7	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology (692)	747
8	National Institute for Marine Research and Development Grigore Antipa" (697)"	3495
9	IFREMER / GM-MARINE GEOSCIENCES (485)	5
10	Institute of Oceanology, Bulgarian Academy of Sciences (IO-BAS) (1843)	149
11	IFREMER (1054)	24
12	Institute of Fishery Resources (IFR) (191)	257
13	Odessa National I.I.Mechnikov University (1169)	889
14	Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO) (693)	93
15	Scientific - Research Firm GAMMA" (1265)"	233
16	Sinop University, Fisheries Faculty (733)	343
17	Laboratory of Marine Ecology-Central Laboratory of General Ecology (192)	602
18	Institute of Marine Sciences, Middle East Technical University (696)	1792
19	Ankara University (2176)	24
20	Dokuz Eylul University, Institute of Marine Science and Technology (801)	76
21	Specialized Center for Hydrometeorology and Monitoring of Environment of Black and Azov Seas (SC HME BAS) (2761)	16
22	Karadeniz Technical University, Faculty of Marine Sciences (732)	240
23	Danube Delta Biosphere Reserve Authority (2178)	4
24	Georgian Institute of Water Management of Georgian Technical University (2122)	68
25	Georgian Institute of Hydrometeorology of Georgian Technical University (2121)	53
26	CEREGE (560)	17

27	Hellenic Centre for Marine Research, Institute of Oceanography (HCMR/IO) (164)	50
28	North-Caucasus Regional Administration of Hydrometeorology of Roshydromet (910)	887
29	Tuapse Hydrometeorological Bureau, North-Caucasus Centre (942)	75
30	Donskaya offing station North-Caucasus HMS (871)	266
31	Mariupol Marine Hydrometeorological Station, Ukrainian HMS (901)	26
32	Nothern Regional Administration of Hydrometeorology of Roshydromet (913)	9
33	Kuban offing station, North-Caucasus HMS (891)	68
34	Istanbul University, Institute of Marine Science and Management (802)	100
35	National Environmental Agency of the Ministry of Environment Protection and Natural Resources (2267)	26
36	State Oceanographic Institute (SOI) (723)	2325
37	Scientific Research Institute of Ecological Problems (USRIEP) (1168)	4
38	Taurida V.I. Vernadsky National University (2227)	55
39	National Science Foundation (NSF) (1381)	2

Table 4: Distribution of the *"oxygen, chlorophyll a, acidity data"* per CDI-Partner (EDMO Code)

	CDI-partner (EDMO Code)	No. of stations
1	All-Russia Research Institute of Hydrometeorological Information - World Data Centre (RIHMI-WDC) National Oceanographic Data Centre (NODC) (681)	5313
2	Marine Hydrophysical Institute (727)	2384
3	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology (692)	896
4	National Institute for Marine Research and Development Grigore Antipa" (697)"	3499
5	IFREMER / IDM / SISMER - Scientific Information Systems for the SEA (486)	46
6	P.P.Shirshov Institute of Oceanology, RAS (685)	364
7	Institute of Fishery Resources (IFR) (191)	257
8	Odessa National I.I.Mechnikov University (1169)	889
9	Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO) (693)	214
10	Scientific - Research Firm GAMMA" (1265)"	233
11	Sinop University, Fisheries Faculty (733)	343
12	National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences (961)	602
13	Institute of Marine Sciences, Middle East Technical University (696)	1792
14	Marine branch of Ukrainian Hydrometeorological Institute (841)	16945
15	Ankara University (2176)	24
16	Dokuz Eylul University, Institute of Marine Science and Technology (801)	76
17	Karadeniz Technical University, Faculty of Marine Sciences (732)	240
18	Institute of Biology of the Southern Seas, NAS of Ukraine (840)	821

19	Hellenic Centre for Marine Research, Hellenic National Oceanographic Data Centre (HCMR/HNODC) (269)	50
20	Istanbul University, Institute of Marine Science and Management (802)	100
21	National Environmental Agency of the Ministry of Environment Protection and Natural Resources (2267)	26
22	Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)	4091
23	State Oceanographic Institute (SOI) (723)	2325
24	PANGAEA - Data Publisher for Earth & Environmental Science (3234)	2
	TOTAL	**41532**

Table 5: Distribution of the *"contaminants data"* per originator (EDMO Code)

	Originator (EDMO Code)	No. of stations
1	Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO) (693)	141
2	Scientific - Research Firm GAMMA" (1265)"	930
3	National Institute for Marine Research and Development Grigore Antipa" (697)"	2340
4	Institute of Marine Sciences, Middle East Technical University (696)	32
5	Institute of Oceanology, Bulgarian Academy of Sciences (IO-BAS) (1843)	15
6	State Oceanographic Institute, Sebastopol Branch (SB SOI) (1680)	814
7	Specialized Center for Hydrometeorology and Monitoring of Environment of Black and Azov Seas (SC HME BAS) (2761)	16
8	Danube Delta Biosphere Reserve Authority (2178)	4
9	Marine Hydrophysical Institute (727)	1234
10	Karadeniz Technical University, Faculty of Marine Sciences (732)	3
11	Marine branch of Ukrainian Hydrometeorological Institute (841)	14417
12	Georgian Institute of Water Management of Georgian Technical University (2122)	8
13	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology (692)	258
14	Istanbul University, Institute of Marine Science and Management (802)	100
15	Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)	1626
16	State Oceanographic Institute (SOI) (723)	2228
17	Taurida V.I. Vernadsky National University (2227)	39
18	A.O. Kovalevsky Institute of Marine Biological Research - RAS (4483)	138

Table 6: Distribution of the *"contaminants data"* per CDI-Partner (EDMO Code)

	CDI-partner (EDMO Code	No. of stations
1	Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO) (693)	149
2	Scientific - Research Firm GAMMA" (1265)"	930
3	National Institute for Marine Research and Development Grigore Antipa" (697)"	2344
4	Institute of Marine Sciences, Middle East Technical University (696)	32
5	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology (692)	273
6	All-Russia Research Institute of Hydrometeorological Information - World Data Centre (RIHMI-WDC) National Oceanographic Data Centre (NODC) (681)	830
7	Marine Hydrophysical Institute (727)	1411
8	Karadeniz Technical University, Faculty of Marine Sciences (732)	3
9	Marine branch of Ukrainian Hydrometeorological Institute (841)	14417
10	Istanbul University, Institute of Marine Science and Management (802)	100
11	Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)	1626
12	State Oceanographic Institute (SOI) (723)	2228
	TOTAL	**24343**

1.3 Workflow

The special version Windows 64Bit ODV 4.6.3.3 was used to merge CDI metadata and ODV data files into metadata enriched ODV collections. Three types of ODV collection were created:

- ocean_depth_profiles
- ocean_pressure_profiles
- time_series

The following errors / problems occurred at importing in ODV 4.6.3.3:

ODV Format:

- Mismatches between semantic header and header
- Incorrect Semantic header format
- Invalid / wrong parameter code SDN:P01/SDN:P06
- Empty files
- Empty columns and / or extra columns
- Missing quality flag column for variable

- Missing Depth in Semantic header and / or in header and / or in values
- Locations on land
- Incorrect date format
- Duplicates: Multiple LOCAL_CDI_Id in one ODV file
- Mismatches between Local_CDI_Id in ODV file >> Local_CDI_Id in coupling

Errors were corrected (in collaboration with partners) and the a new import in ODV 4.6.3.3 was done. Then, the following procedure was applied:

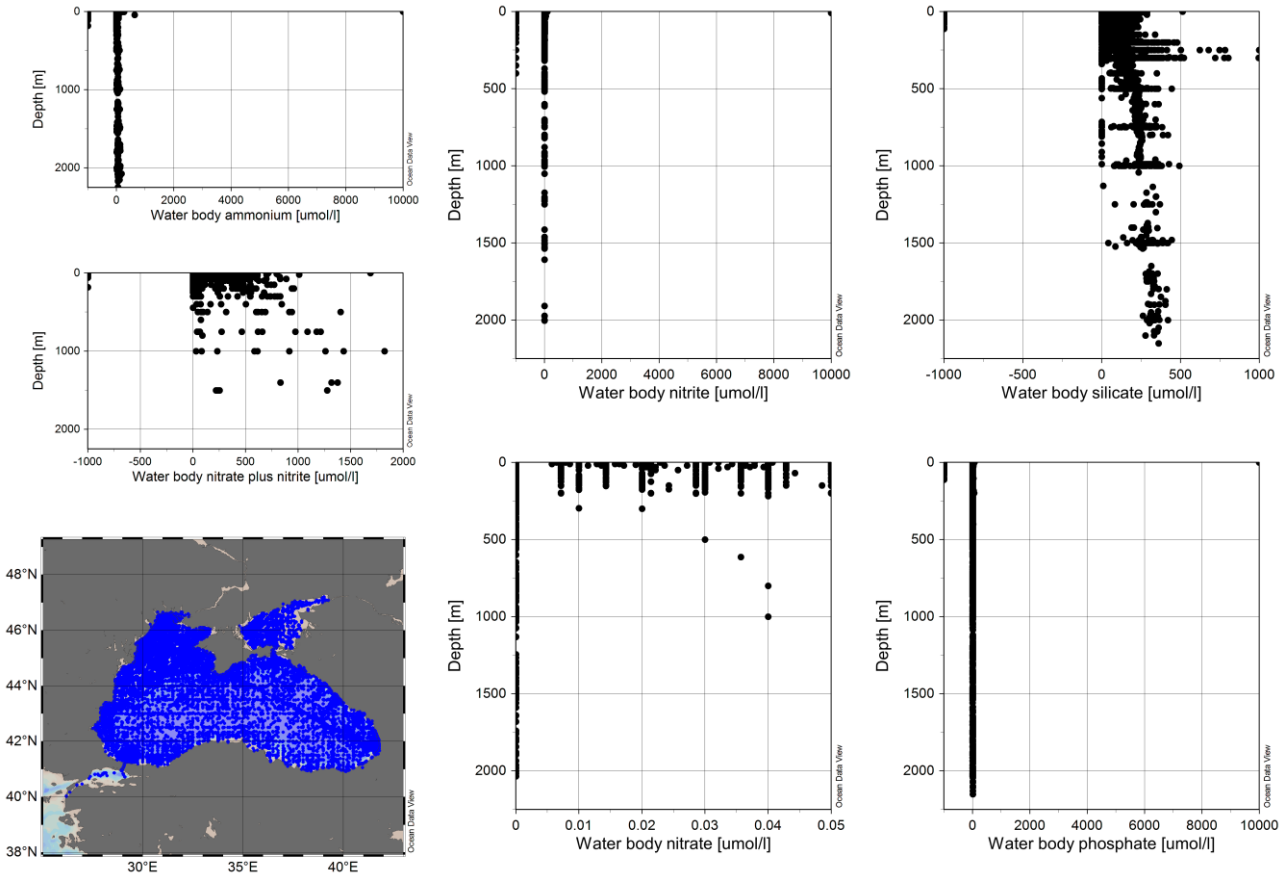
1. Each ODV Collection (ocean_depth_profiles, ocean_pressure_profiles) was exported (using the built-in export method) as ***SDN Aggregated ODV Collection;*** (Parameter aggregations were made automatically: variables codes from P01 to P35 and units to μmol/l)
2. ***Each SDN Aggregated ODV Collection*** imported in ODV 4.6.5
3. Check for possible not aggregated variables
4. *ocean_pressure_profiles* merged (after calculating Depth as Derived variable) with *ocean_depth_profiles*
5. After last step the ***BS_Aggregated_Data_ODV Collection*** was obtained
6. Preliminary QC on the ***BS_Aggregated_Data_ODV*** Collection was done (see below)
7. Export each priority parameter*:*
   - Station Selection Criteria / Availability/ one parameter
   - Export /Station Data/ ODV Spreadsheet with selection on Depth and only one parameter
   - Data Filter: ***QV=1, 2, 6***
   - Reimport individual ODV Spreadsheets in ODV 4.6.5 and further applied broad range QC

2. Black Sea aggregated data collection & Quality Control

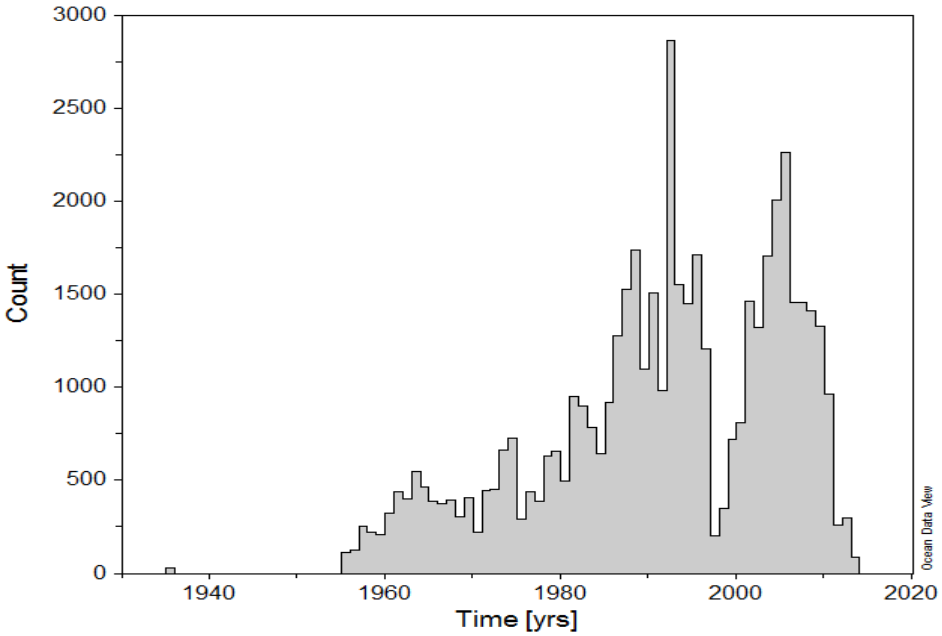
BS_Aggregated_Data ODV "Nutrients" Collection contains:

- ***49573 vertical profiles / chemistry***

BS_Aggregated_Data Spatial coverage and plots of variables *(not QC applied):*

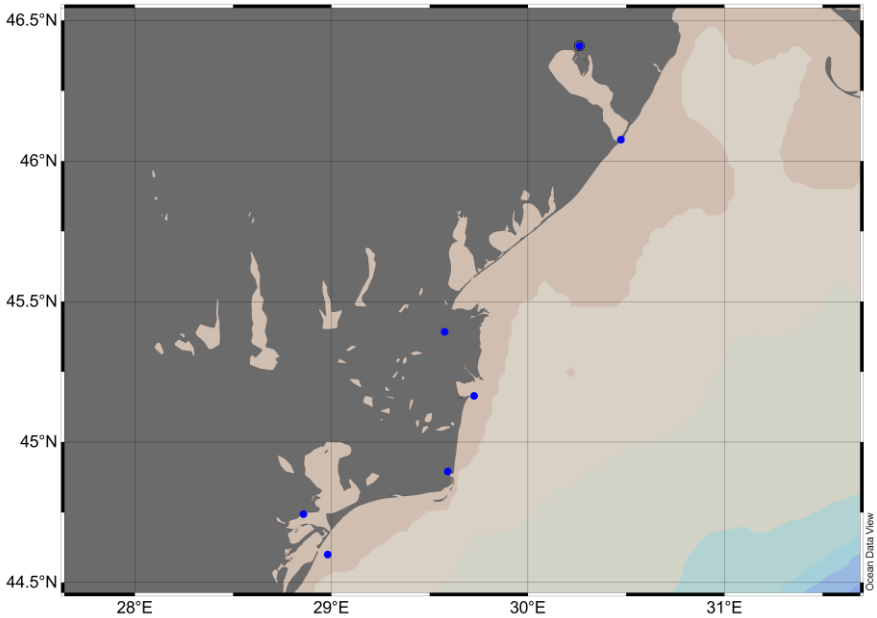


BS_Aggregated_Data Temporal coverage: 1935 - 2013



- ***7 stations - time series***

Spatial coverage

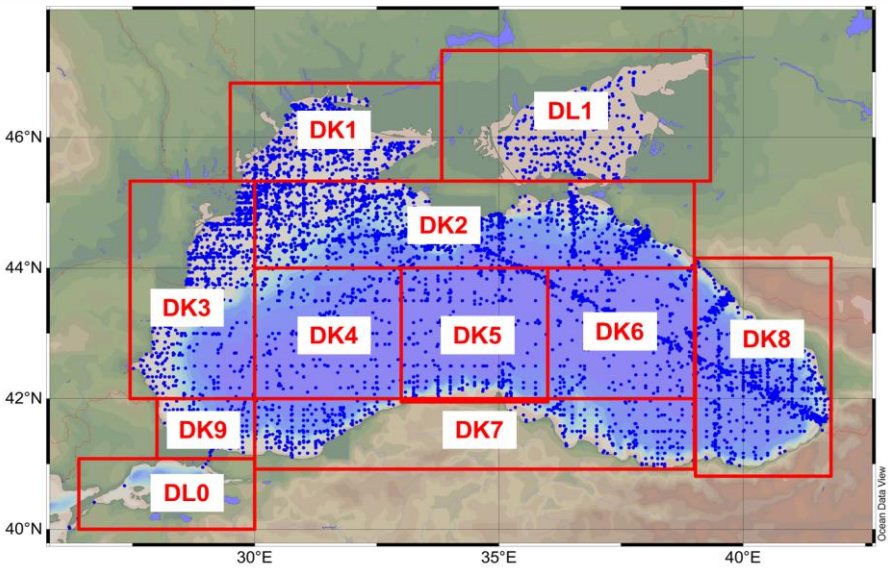


Preliminary QC on the BS_Aggregated_Data_ODV Collection

- Zero values confirmed (by partners) as missing value were flagged with 5
- Zero values originally flagged with 6 were kept with flag 6
- Obvious bad data , default values (-999.999, 999.999, 99.99, etc), all profile with same value were flagged to 4
- For impossible data (too high) the units were checked with data providers and, when confirmed by data providers, the units were corrected
- All data originally flagged with 0 (no QC applied) were flagged to 1 (good data) and further subject to broad range QC

Further, QC of each parameter was done using the broad-range check values in the Black Sea as described in "Methodology for data QA/QC and DIVA products" (http://nodc.ogs.trieste.it/doi/documents/EMD2chem_QCreport_V8-072015.pdf)

MEDAR/MEDATLAS Sub-domains for Black Sea



The metadata enriched QC ODV collections sent to Central Buffer and used in the visualization services developed by DELTARES and ULG within the framework of the WP4 activities **EMODNET Chemistry - Dynamic Plots /Observation density (http://oceanbrowser.net/emodnet/)**

3. Water body ammonium

The Water body ammonium dataset contains the following related parameters:

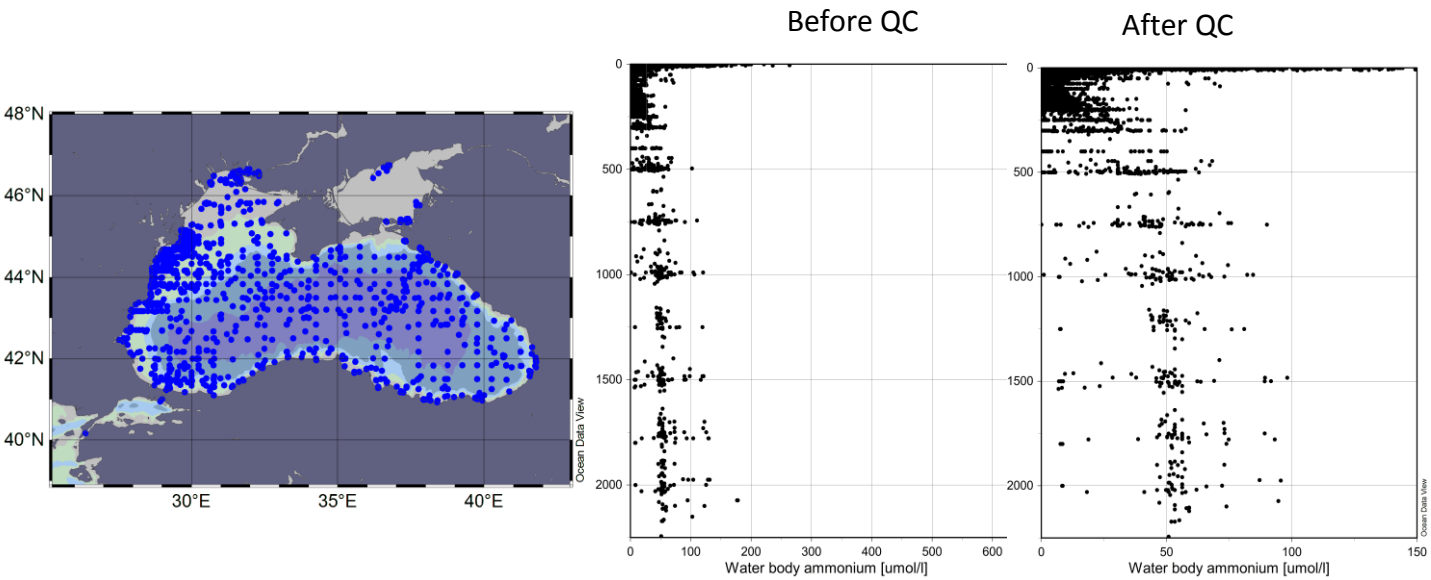
SDN:P35::EPC00009: Water body ammonium [µmol/l]

- AMON [umol/l] Codes: SDN:P01::AMONZZXX SDN:P06::UPOX | SDN:P01::AMONAAZX SDN:P06::UPOX
- AMON [mol/m^3] Codes: SDN:P01::AMONAAZX SDN:P06::MLM3
- N_NH4 [mg/l] Codes: SDN:P01::AMONMATX SDN:P06::UMGL
- WC_NH4 [umol/l] Codes: SDN:P01::AMONMATX SDN:P06::UPOX
- AMON [ug/l] Codes: SDN:P01::MDMAP004 SDN:P06::UGPL
- AMON [umol/l] Codes: SDN:P01::AMONZZXX SDN:P06::UPOX | SDN:P01::AMONAAZX SDN:P06::UPOX
- Ammonium [ug/l] Codes: SDN:P01::AMONZZXX SDN:P06::UGPL
- AMON [mg/l] Codes: SDN:P01::AMONZZXX SDN:P06::UMGL
- NH4 [umol/l] Codes: SDN:P01::AMONZZXX SDN:P06::UPOX
- AMON [umol/l] Codes: SDN:P01::AMONZZXX SDN:P06::UPOX
- Ammonium [umol/l] Codes: SDN:P01::AMONZZXX SDN:P06::UPOX

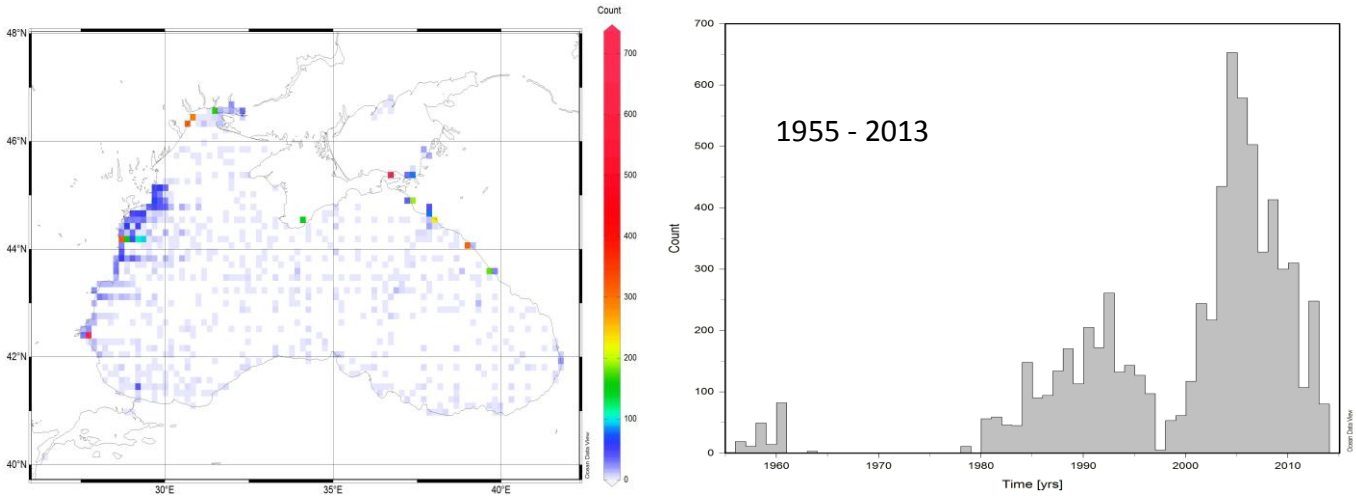
Water body ammonium data set contains (after broad range QC):

- No. of profiles (stations): **6935**
- No. of measurements: **24843**
- Detection limits (QV= 6)
  - 0.00
  - 0.001
  - 0.02
  - 0.04
  - 0.05

Spatial coverage and plot of **Water body ammonium** data set:



Water body ammonium Stations density distribution & Temporal coverage



4. Water body silicate data set

The Water body silicate dataset contains the following related parameters:

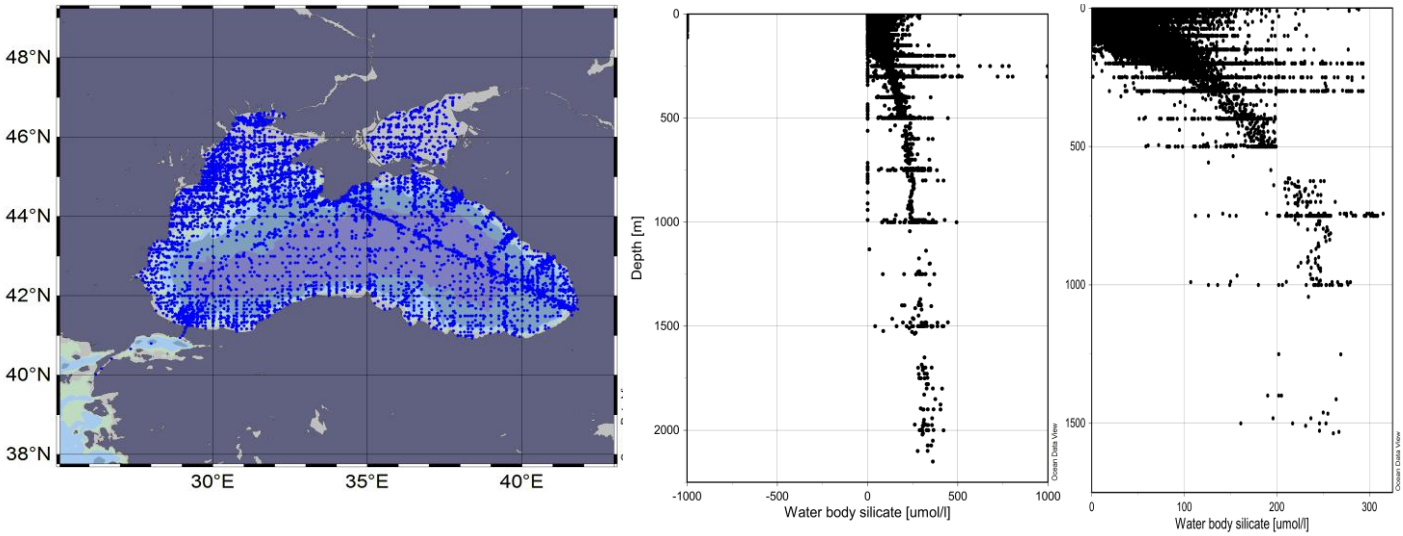
SDN:P35::EPC00008: Water body silicate [µmol/l]

- SLCA [umol/l] Codes: SDN:P01::SLCAZZXX SDN:P06::UPOX | SDN:P01::SLCAMAZX SDN:P06::UPOX
- SiO3 [umol/l] Codes: SDN:P01::SLCAZZXX SDN:P06::UPOX
- Silicate [ug/l] Codes: SDN:P01::SLCAZZXX SDN:P06::UGPL
- SLCA [umol/l] Codes: SDN:P01::SLCAZZXX SDN:P06::UPOX | SDN:P01::SLCAMAZX SDN:P06::UPOX
- SLCA [umol/l] Codes: SDN:P01::SLCAZZXX SDN:P06::UPOX
- Silicate [umol/l] Codes: SDN:P01::SLCAZZXX SDN:P06::UPOX
- Si [umol/l] Codes: SDN:P01::SLCAZZXX SDN:P06::UPOX
- Si [mg/l] Codes: SDN:P01::SLCAMATX SDN:P06::UMGL
- WC_SiO4 [umol/l] Codes: SDN:P01::SLCAMATX SDN:P06::UPOX

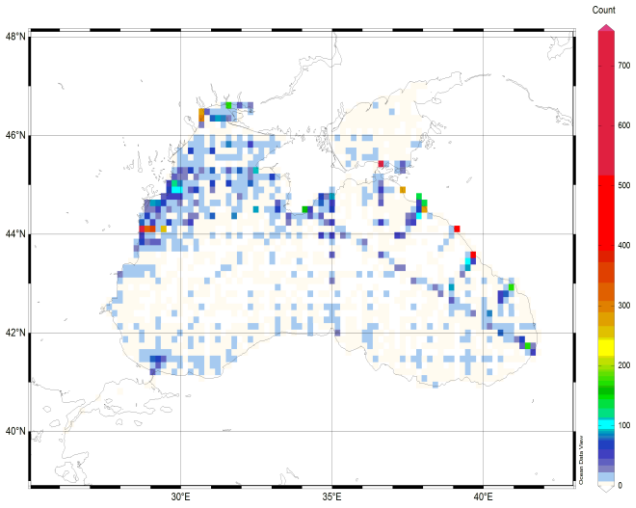
Water body silicate data set contains (after broad range QC):

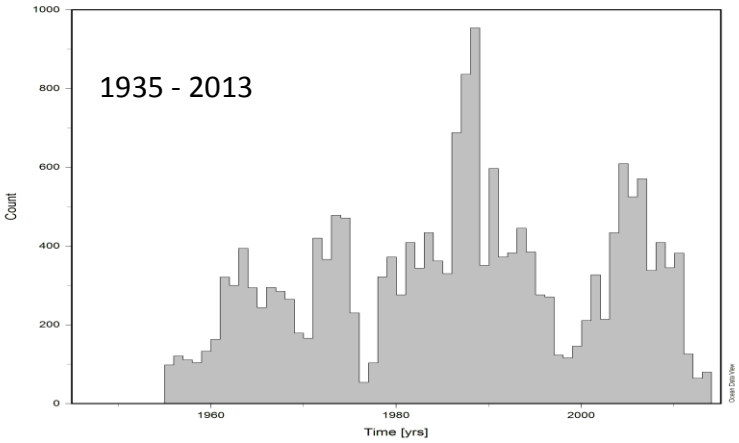
- No. of profiles (stations): **19024**
- No. of measurements: **105669**
- Detection limits (QV= 6)
  - 0.0
  - 0.2
  - 0.5

Spatial coverage and plot of **Water body silicate** data set



Water body silicate Stations density distribution & Temporal coverage





5. Water body phosphate data set

The Water body phosphate dataset contains the following related parameters:

SDN:P35::EPC00007: Water body phosphate [µmol/l]

- P_PO4 [mg/l] Codes: SDN:P01::PHOSMATX SDN:P06::UMGL
- WC_PO4 [umol/l] Codes: SDN:P01::PHOSMATX SDN:P06::UPOX
- PO4 [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX | SDN:P01::PHOSMAZX SDN:P06::UPOX
- PHOS [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX | SDN:P01::PHOSAAZX SDN:P06::UPOX
- Phosphate [ug/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UGPL
- PHOS [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX
- Phosphate [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX
- P total [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX
- Phosphates [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX
- PHOS2 [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX
- Phosphate [umol/kg] Codes: SDN:P01::PHOSZZXX SDN:P06::KGUM
- PO4 [umol/kg] Codes: SDN:P01::MDMAP906 SDN:P06::KGUM
- PHOW [umol/kg] Codes: SDN:P01::MDMAP906 SDN:P06::KGUM
- PHOS [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX | SDN:P01::PHOSAAZX SDN:P06::UPOX
- PHOS1 [umol/l] Codes: SDN:P01::PHOSAAZX SDN:P06::UPOX
- PO4 [umol/l] Codes: SDN:P01::PHOSZZXX SDN:P06::UPOX | SDN:P01::PHOSMAZX SDN:P06::UPOX
- PHOS0 [umol/l] Codes: SDN:P01::PHOSAADZ SDN:P06::UPOX

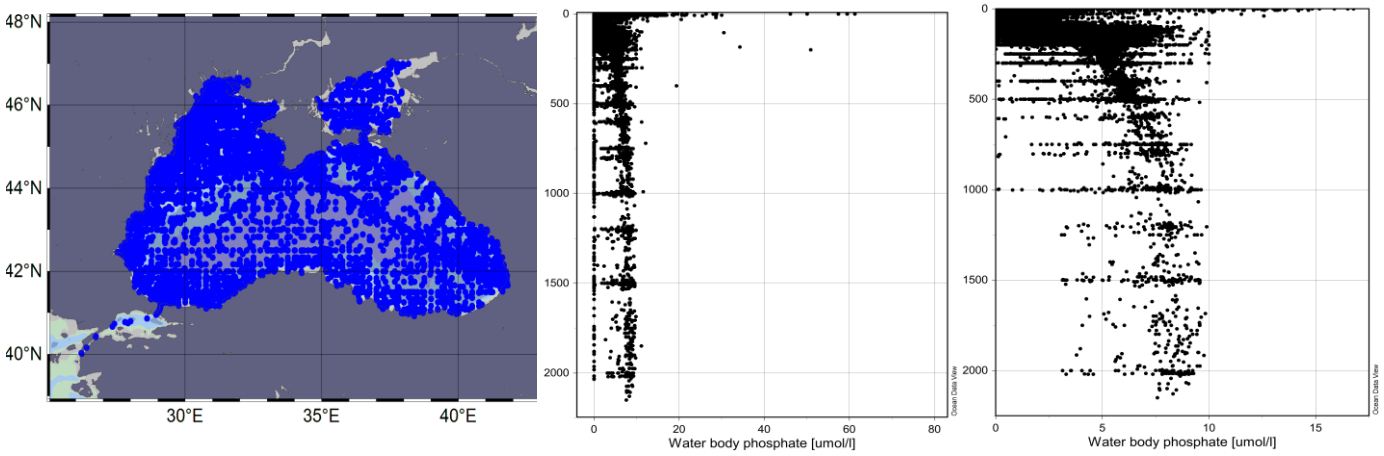
Water body phosphate data set contains (after broad range QC):

- No. of profiles (stations): **22728**
- No. of measurements: **128266**
- Detection limits (QV= 6)
  - 0.00
  - 0.01
  - 0.02

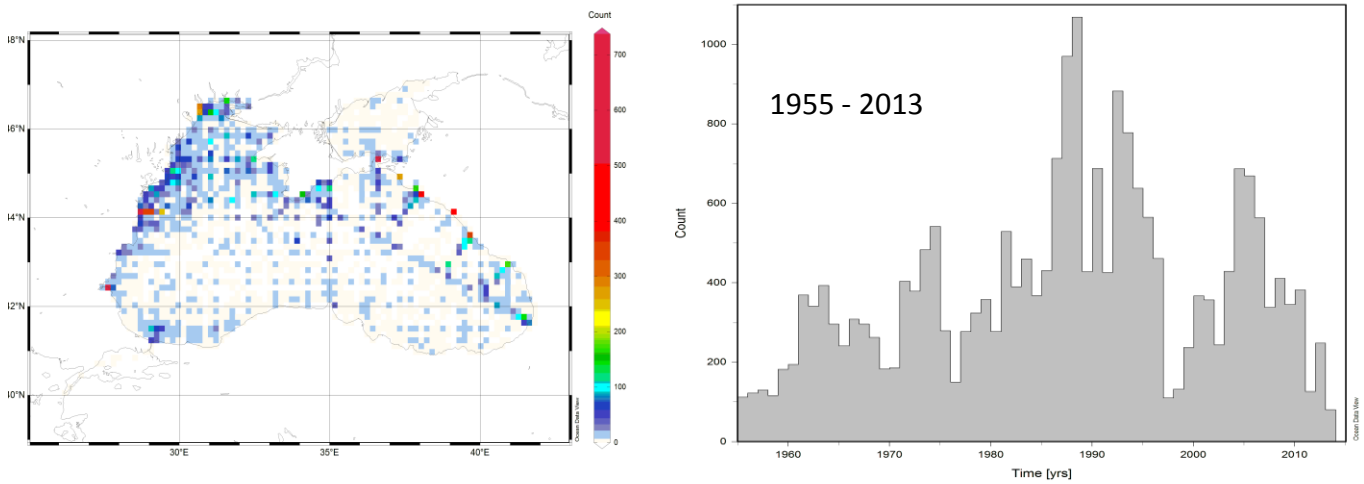
Spatial coverage and plot of **Water body phosphate** data set

Before QC

After QC



Water body phosphate Stations density distribution & Temporal coverage



6. Water body nitrite data set

Water body nitrite dataset contains the following related parameters:

SDN:P35::EPC00004: Water body nitrite [µmol/l]

- N_NO2 [mg/l] Codes: SDN:P01::NTRIMATX SDN:P06::UMGL
- WC_NO2 [umol/l] Codes: SDN:P01::NTRIMATX SDN:P06::UPOX
- NO2 [umol/l] Codes: SDN:P01::NTRIZZXX SDN:P06::UPOX
- NTRI [umol/l] Codes: SDN:P01::MDMAP007 SDN:P06::UPOX | SDN:P01::NTRIZZXX SDN:P06::UPOX
- Nitrite [ug/l] Codes: SDN:P01::NTRIZZXX SDN:P06::UGPL
- NTRI [mg/l] Codes: SDN:P01::NTRIZZXX SDN:P06::UMGL
- NTRI [umol/l] Codes: SDN:P01::NTRIZZXX SDN:P06::UPOX
- Nitrite [umol/l] Codes: SDN:P01::NTRIZZXX SDN:P06::UPOX | SDN:P01::NitriteZZXX SDN:P06::UPOX
- NTRI [umol/l] Codes: SDN:P01::MDMAP007 SDN:P06::UPOX | SDN:P01::NTRIZZXX SDN:P06::UPOX

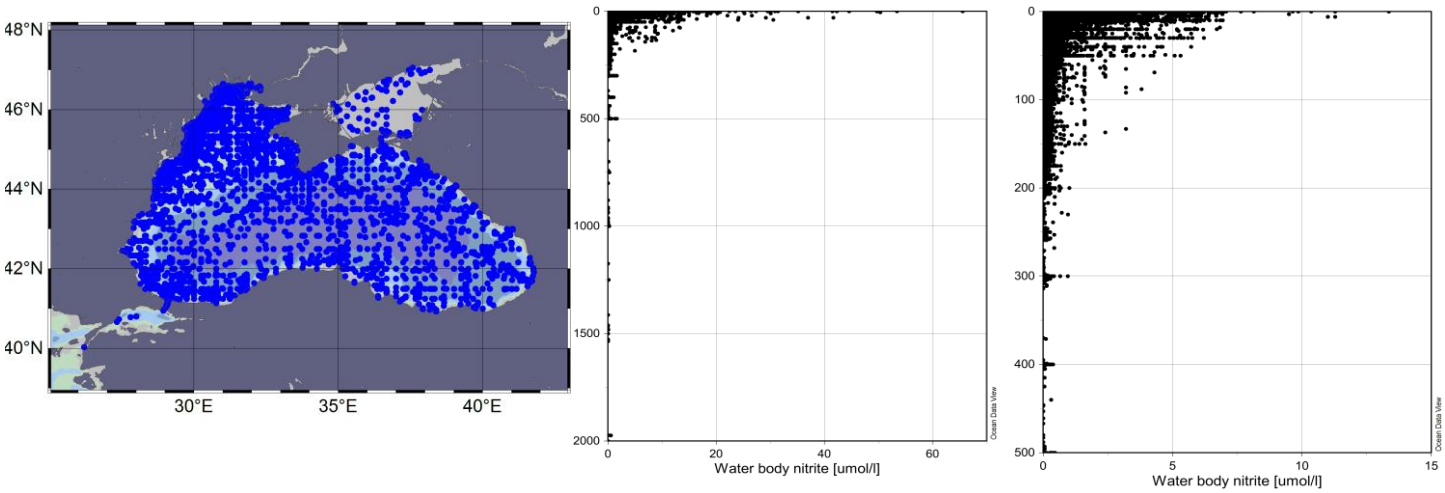
Water body nitrite data set contains (after broad range QC):

- No. of profiles (stations): **11619**
- No. of measurements:**50975**
- Detection limits (QV= 6)
  - 0.00
  - 0.01
  - 0.02
  - 0.03

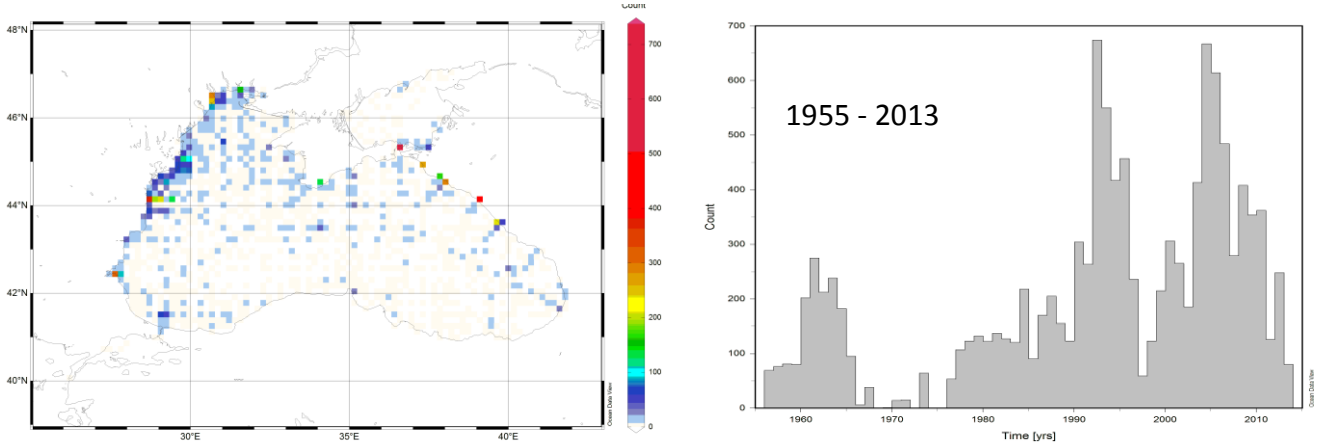
Spatial coverage and plot of **Water body nitrite** data set

Before QC

After QC



Water body nitrite Stations density distribution & Temporal coverage



7. Water body nitrate data set

Water body nitrate dataset contains the following related parameters:

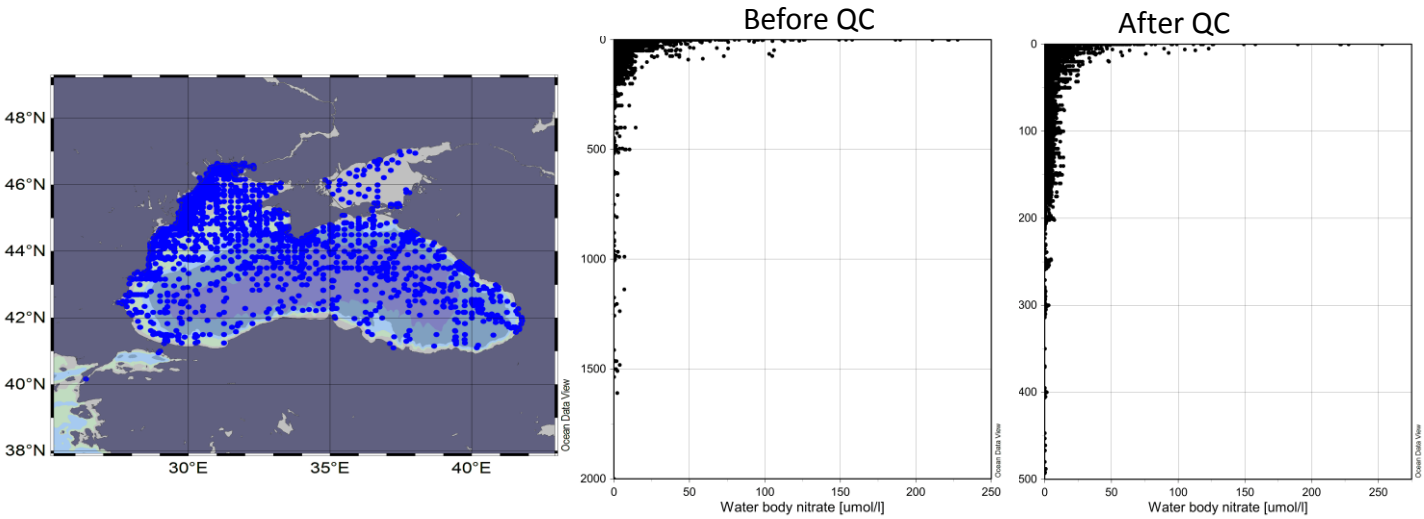
SDN:P35::EPC00004: Water body nitrate [µmol/l]

- N_NO3 [mg/l] Codes: SDN:P01::NTRAYYDZ SDN:P06::UMGL
- NTRA [mol/m^3] Codes: SDN:P01::CHEMM012 SDN:P06::MLM3
- NO3 [umol/l] Codes: SDN:P01::NTRAZZXX SDN:P06::UPOX
- NTRA [umol/l] Codes: SDN:P01::MDMAP005 SDN:P06::UPOX | SDN:P01::NTRAZZXX SDN:P06::UPOX
- Nitrate [ug/l] Codes: SDN:P01::NTRAZZXX SDN:P06::UGPL
- NTRA [mg/l] Codes: SDN:P01::NTRAZZXX SDN:P06::UMGL
- NTRA [umol/l] Codes: SDN:P01::NTRAZZXX SDN:P06::UPOX
- Nitrate [umol/l] Codes: SDN:P01::NTRAZZXX SDN:P06::UPOX
- Nitrates [umol/l] Codes: SDN:P01::NTRAZZXX SDN:P06::UPOX
- Nitrate [umol/kg] Codes: SDN:P01::NTRAZZXX SDN:P06::KGUM
- NTRA [umol/l] Codes: SDN:P01::MDMAP005 SDN:P06::UPOX | SDN:P01::NTRAZZXX SDN:P06::UPOX
- WC_NO3 [umol/l] Codes: SDN:P01::NTRAMADZ SDN:P06::UPOX | SDN:P01::NTRZMATX SDN:P06::UPOX

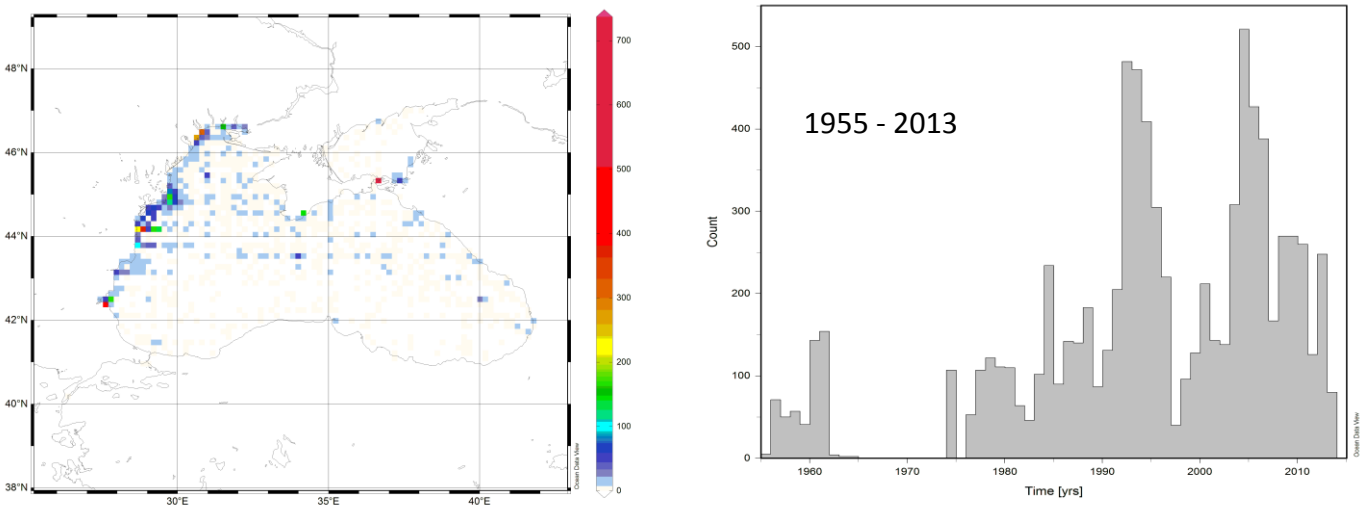
Water body nitrate data set contains (after broad range QC):

- No. of profiles (stations): **8274**
- No. of measurements: **34797**
- Detection limits (QV= 6)
  - 0.00

Spatial coverage and plot of **Water body nitrate** data set



Water body nitrate Stations density distribution & Temporal coverage



8. Water body nitrate plus nitrite data set

Water body nitrate plus nitrite dataset contains the following related parameters:

SDN:P35::EPC00005: Water body nitrate plus nitrite [μmol/l]

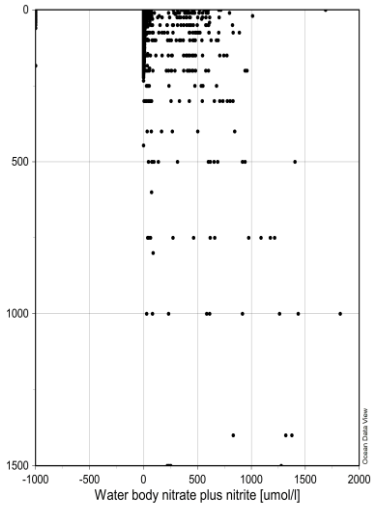
- NTRZ [umol/l] Codes: SDN:P01::NTRZZZXX SDN:P06::UPOX
- Nitrate+nitrite [umol/l] Codes: SDN:P01::NTRZZZXX SDN:P06::UPOX
- NO3_NO2 [umol/l] Codes: SDN:P01::NTRZZZXX SDN:P06::UPOX

Water body nitrate plus nitrite data set contains (after broad range QC):

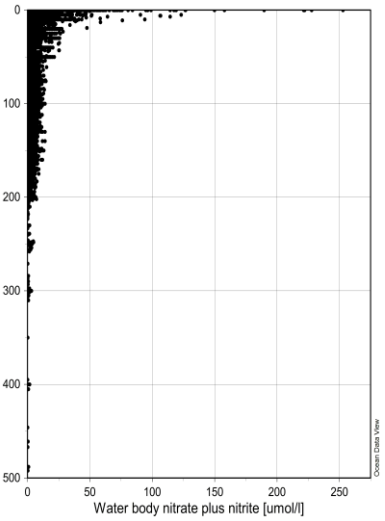
- No. of profiles (stations): **9354**
- No. of measurements: **44319**
- Detection limits (QV= 6)
  - 0.00
  - 0.05
  - 0.1

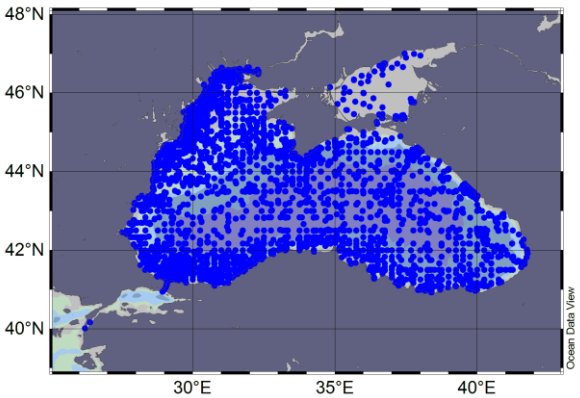
Spatial coverage and plot of **Water body nitrate plus nitrite** data set

Before QC

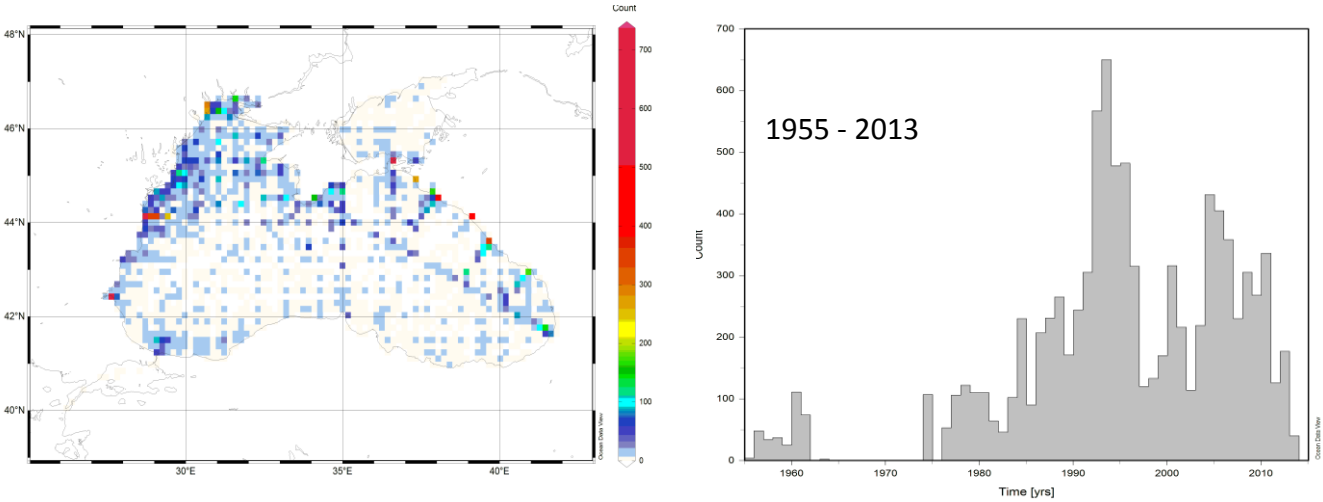


After QC





Water body nitrate plus nitrite Stations density distribution & Temporal coverage



9. Water body total phosphorus data set

Water body total phosphorus dataset contains the following related parameters:

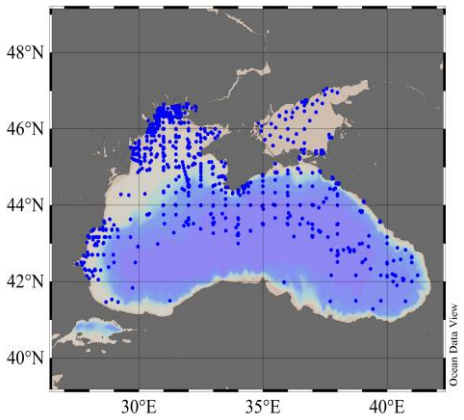
SDN:P35::EPC00135: Water body total phosphorus [µmol/l]

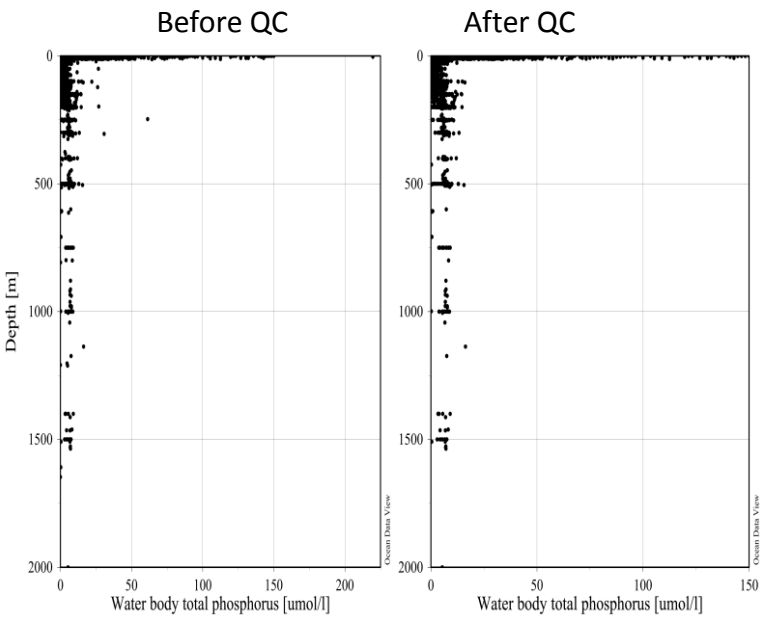
- TPHS [umol/l] Codes: SDN:P01::TPHSZZXX SDN:P06::UPOX
- Total phosphorus [ug/l] Codes: SDN:P01::TPHSZZXX SDN:P06::UGPL
- Total Phosphorus [umol/l] Codes: SDN:P01::TPHSZZXX SDN:P06::UPOX
- Phosphorus [umol/l] Codes: SDN:P01::TPHSZZXX SDN:P06::UPOX

Water body total phosphorus data set contains (after broad range QC):

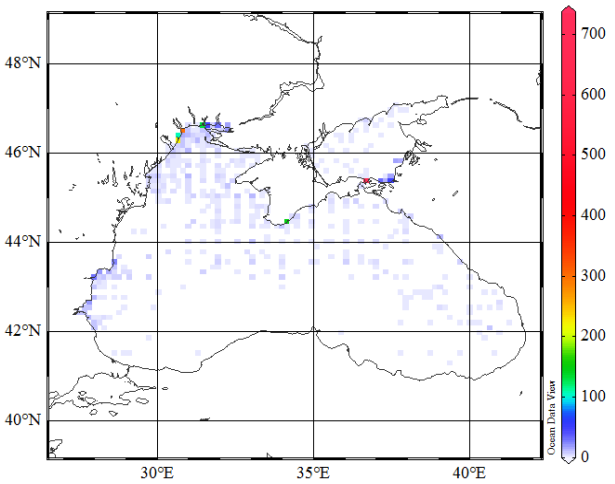
- No. of profiles (stations): **3186**
- No. of measurements: **9957**
- Detection limits (QV= 6)
  - Not found

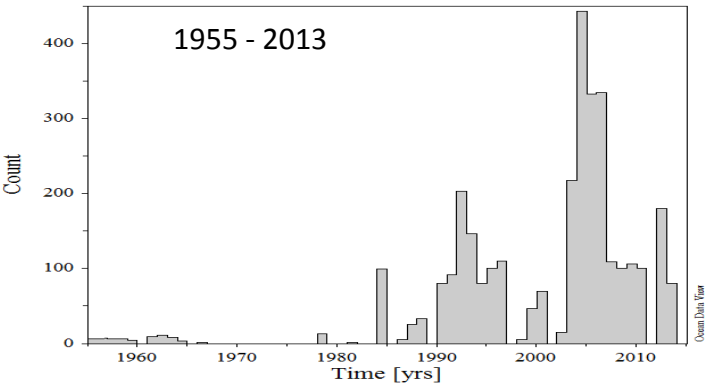
Spatial coverage and plot of **Water body total phosphorus** data set





Water body total phosphorus Stations density distribution & Temporal coverage





10. Water body total nitrogen data set

Water body total nitrogen dataset contains the following related parameters:

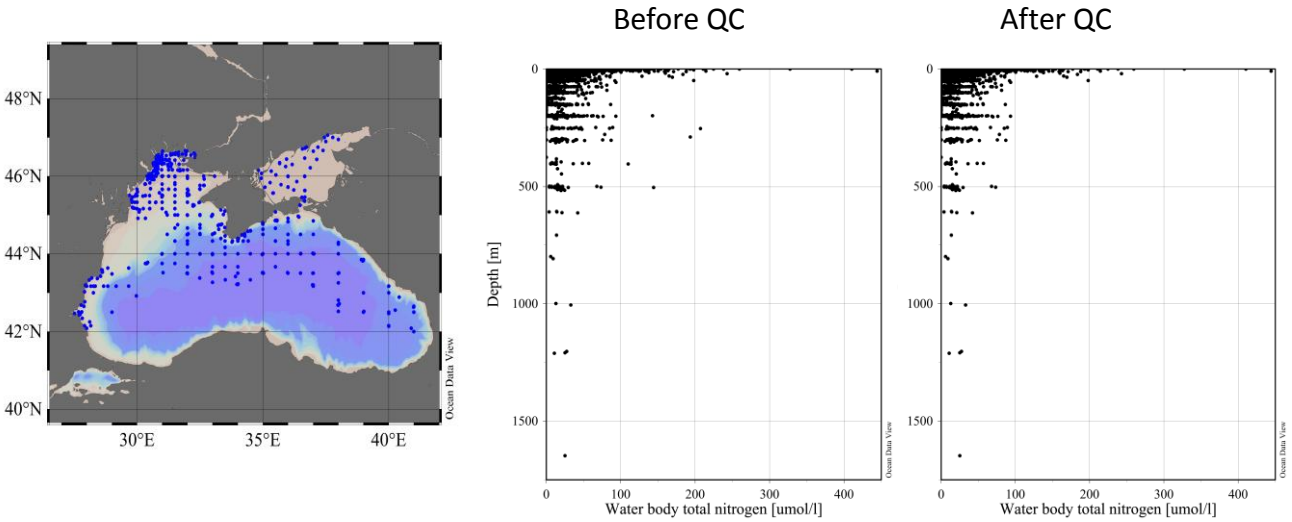
SDN:P35::EPC00134: Water body total nitrogen [µmol/l]

- Ntot [umol/l] Codes: SDN:P01::NTOTZZXX SDN:P06::UPOX
- NTOT [umol/l] Codes: SDN:P01::NTOTZZXX SDN:P06::UPOX
- Total nitrogen [ug/l] Codes: SDN:P01::NTOTZZXX SDN:P06::UGPL
- N total [umol/l] Codes: SDN:P01::NTOTZZXX SDN:P06::UPOX

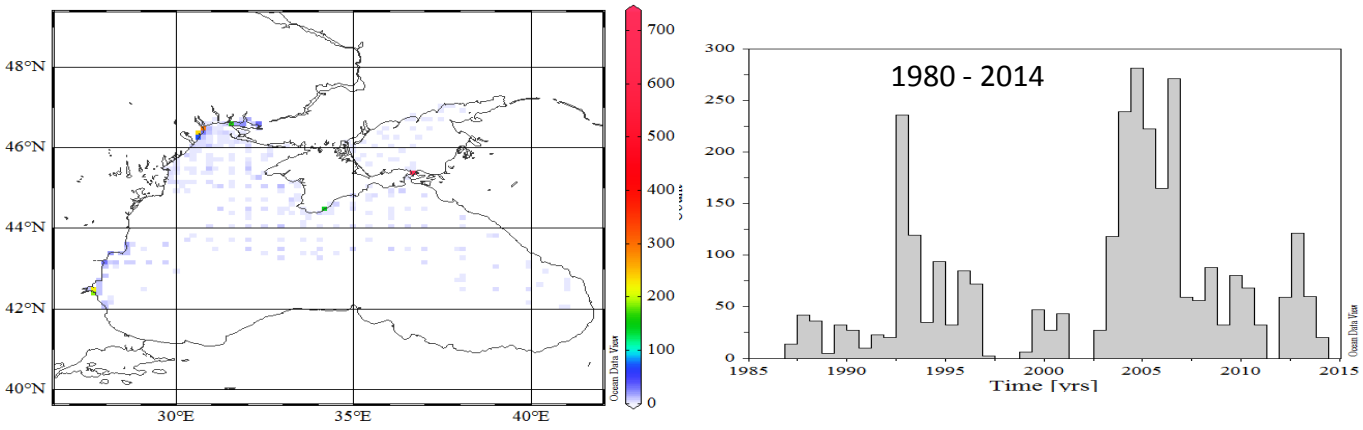
Water body total nitrogen data set contains (after broad range QC):

- No. of profiles (stations): **3005**
- No. of measurements: **7834**
- Detection limits (QV= 6)
  - 0.00

Spatial coverage and plot of **Water body total nitrogen** data set



Water body total nitrogen Stations density distribution & Temporal coverage



11. Water body dissolved oxygen concentration data set

Water body dissolved oxygen concentration dataset contains the following related parameters:

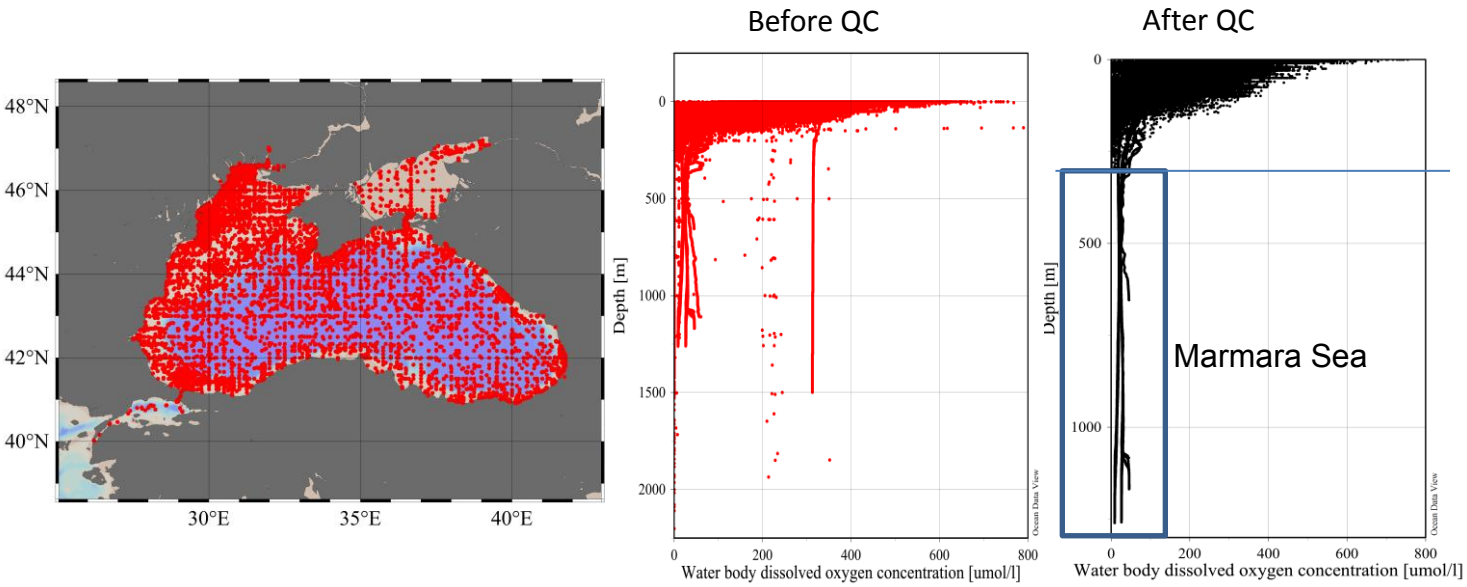
SDN:P35::EPC00002: Water body dissolved oxygen concentration [µmol/l]

- Oxygen [mg/l] Codes: SDN:P01::DOXYCZ01 SDN:P06::UMGL
- DOX1 [umol/kg] Codes: SDN:P01::DOXYWITX SDN:P06::KGUM
- DOX2 [ml/l] Codes: SDN:P01::DOXYWITX SDN:P06::UMLL
- WC_O2 [umol/l] Codes: SDN:P01::DOXYWITX SDN:P06::UPOX
- DOX1 [ml/l] Codes: SDN:P01::DOXYWITX SDN:P06::UMLL
- DOX2 [umol/kg] Codes: SDN:P01::DOXYWITX SDN:P06::KGUM | SDN:P01::DOXMZZXX SDN:P06::KGUM
- DOXY [ml/l] Codes: SDN:P01::DOXYZZXX SDN:P06::UMLL | SDN:P01::DOXYWITX SDN:P06::UMLL
- SDO2 [mg/l] Codes: SDN:P01::DOXYWITX SDN:P06::UMGL | SDN:P01::SDOXWITX SDN:P06::UMGL
- DO [mg/l] Codes: SDN:P01::DOXYWITX SDN:P06::UMGL
- O2 [umol/l] Codes: SDN:P01::DOXYZZXX SDN:P06::UPOX
- DOXY_ml [ml/l] Codes: SDN:P01::DOXYZZXX SDN:P06::UMLL
- DissO2_Mass [mg/l] Codes: SDN:P01::DOXMZZXX SDN:P06::UMGL
- DOXY_mg [mg/l] Codes: SDN:P01::DOXMZZXX SDN:P06::UMGL
- WC_dissO2_YSI [mg/l] Codes: SDN:P01::DOXYSE01 SDN:P06::UMGL

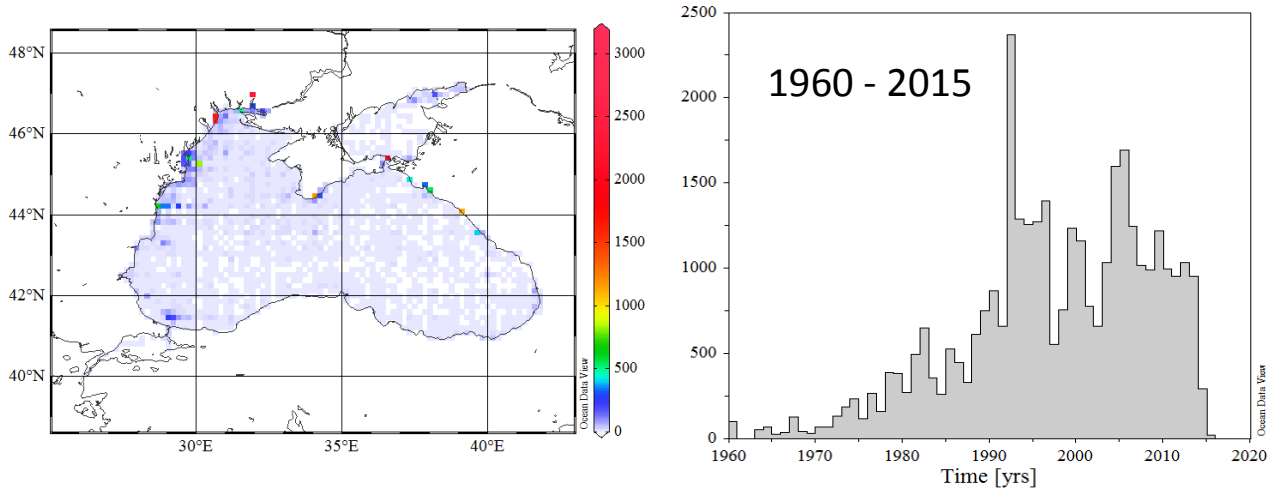
Water body dissolved oxygen concentration data set contains (after broad range QC):

- No. of profiles (stations): **34383**
- No. of measurements: **212821**
- Detection limits (QV= 6)
  - 0.00
  - 0.02
  - 2.00

Spatial coverage and plot of **Water body dissolved oxygen concentration** data set



Water body dissolved oxygen concentration Stations density distribution & Temporal coverage



12. Water body chlorophyll-a data set

Water body chlorophyll-a dataset contains the following related parameters:

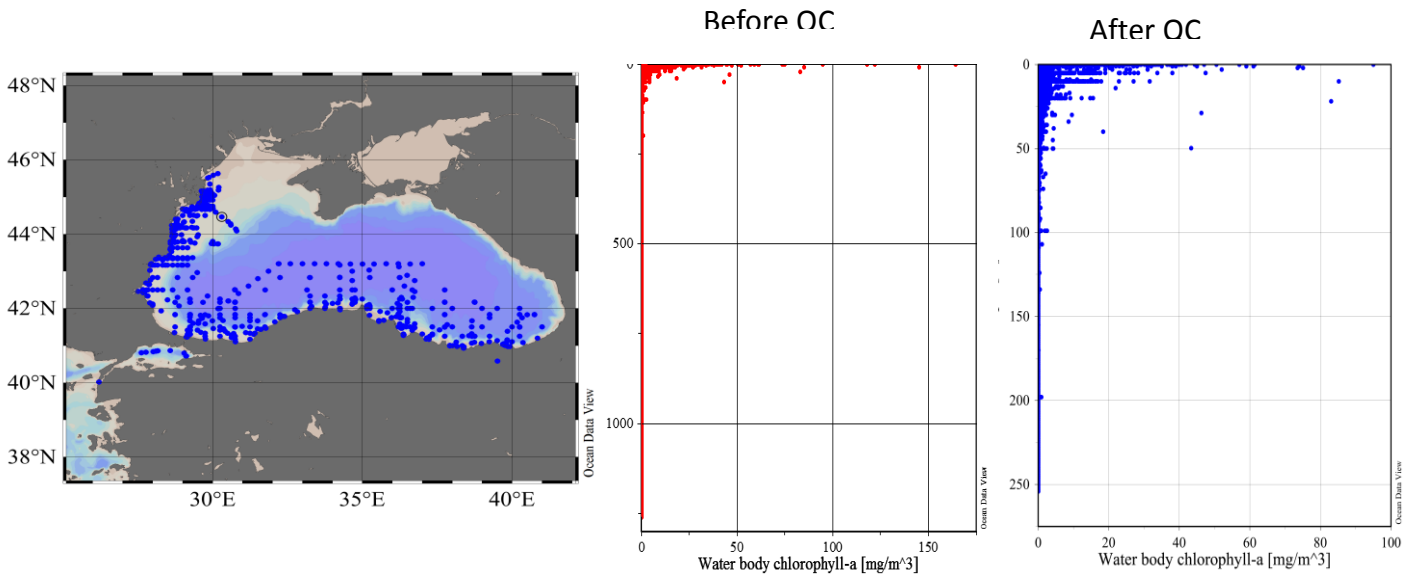
SDN:P35::EPC00105: Water body chlorophyll-a [mg/m^3]

- Chl_a [ug/l] Codes: SDN:P01::CPHLZZXX SDN:P06::UGPL
- Chlorophyll-a [ug/l] Codes: SDN:P01::CPHLZZXX SDN:P06::UGPL
- CPHL [mg/m^3] Codes: SDN:P01::CPHLZZXX SDN:P06::UMMC
- CHL-F [mg/m^3] Codes: SDN:P01::CPHLFLPZ SDN:P06::UMMC
- Chl [mg/m^3] Codes: SDN:P01::CPHLFLPZ SDN:P06::UMMC
- Chl A [ug/l] Codes: SDN:P01::CPHLSSP1 SDN:P06::UGPL

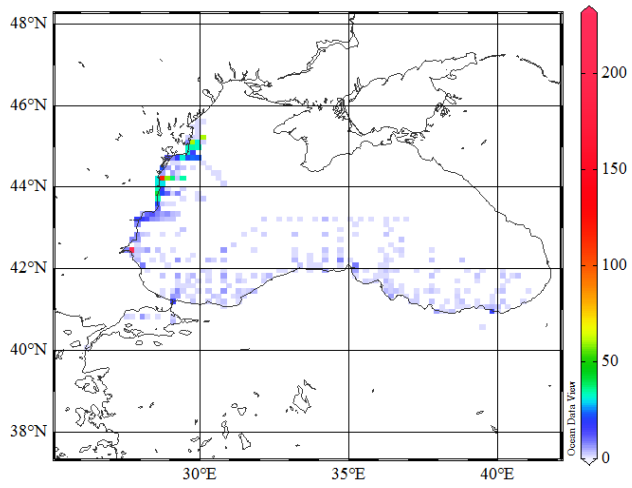
Water body chlorophyll-a data set contains:

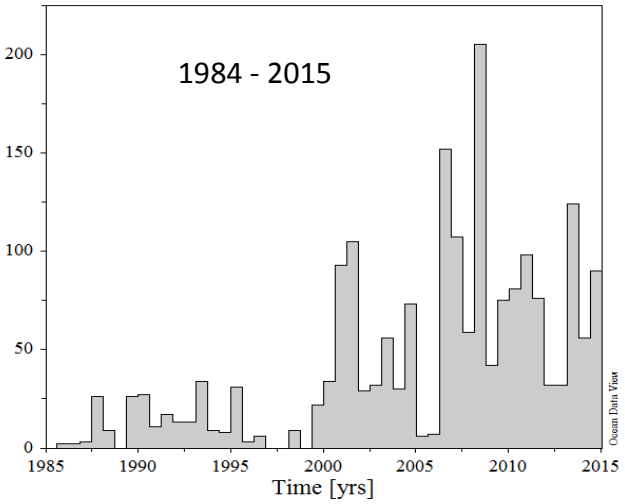
- No. of profiles (stations): **1965**
- No. of measurements: **20077**
- Detection limits (QV= 6)
  - Not found

Spatial coverage and plot of **Water body chlorophyll-a** data set



Water body chlorophyll-a Stations density distribution & Temporal coverage

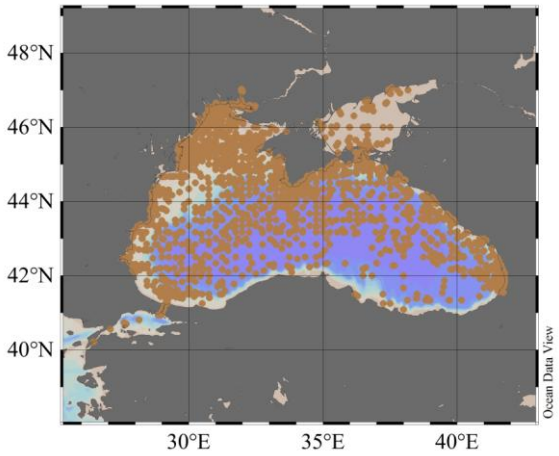


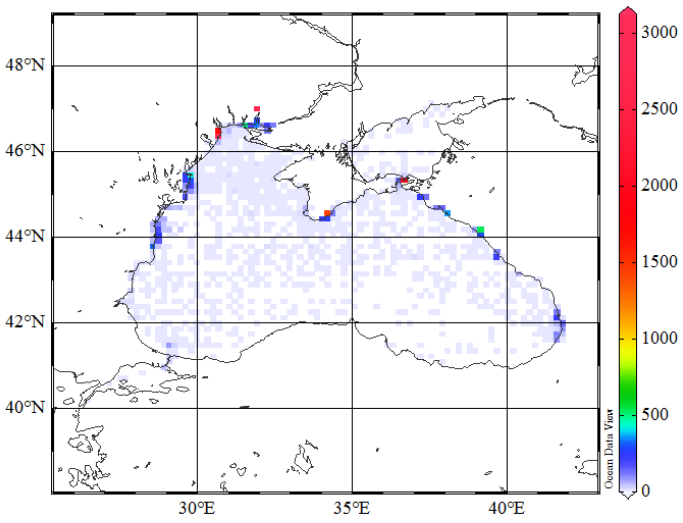


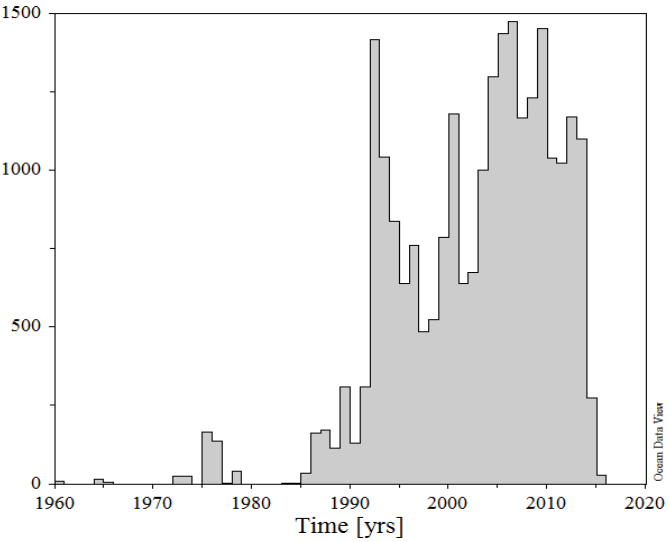
13. Contaminants data set

Contaminants
Spatial & Temporal coverage, Stations density distribution (all P01 codes, all matrixes)

- No. of profiles (stations): **24296**

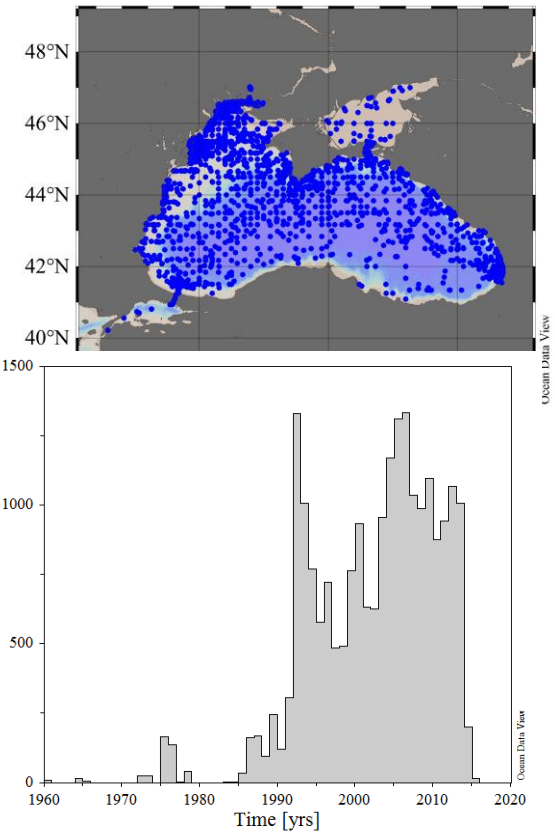


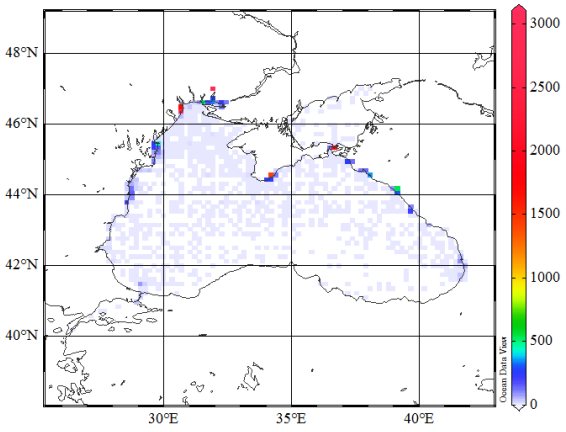




Contaminants
Spatial & Temporal coverage, Stations density distribution (all P01 codes, ***water*** matrix)

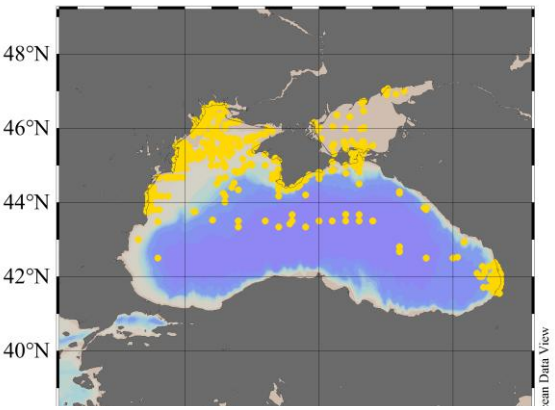
- No. of profiles (stations): **21854**

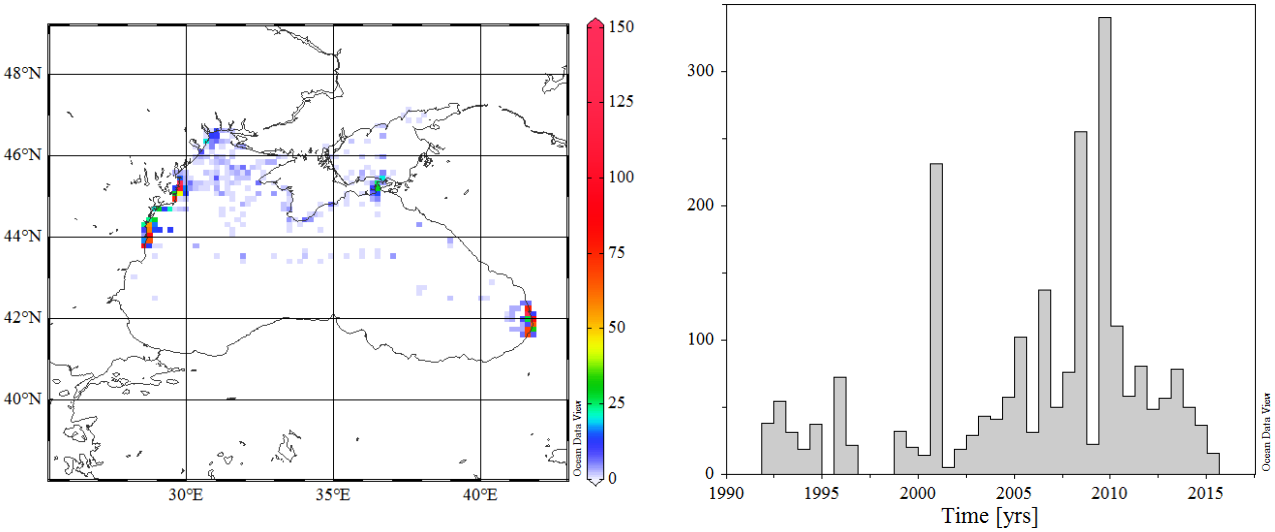




Contaminants
Spatial & Temporal coverage, Stations density distribution (all P01 codes, ***sediment*** matrix)

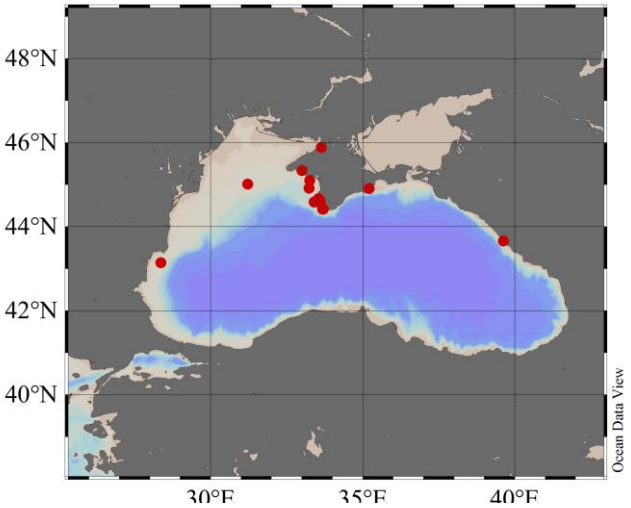
- No. of profiles (stations): **2305**

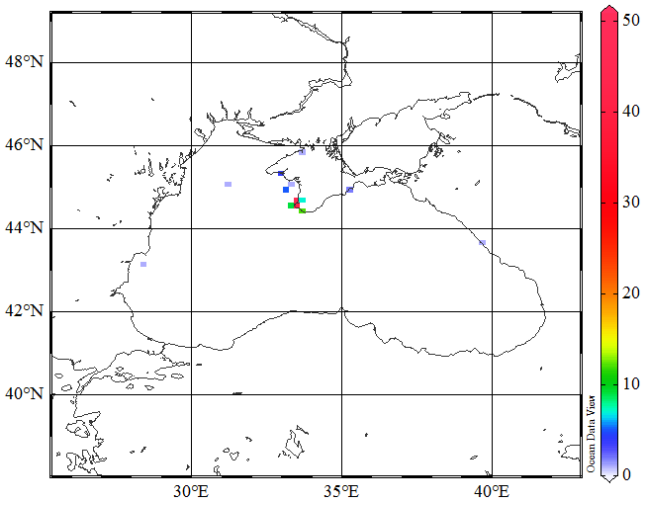


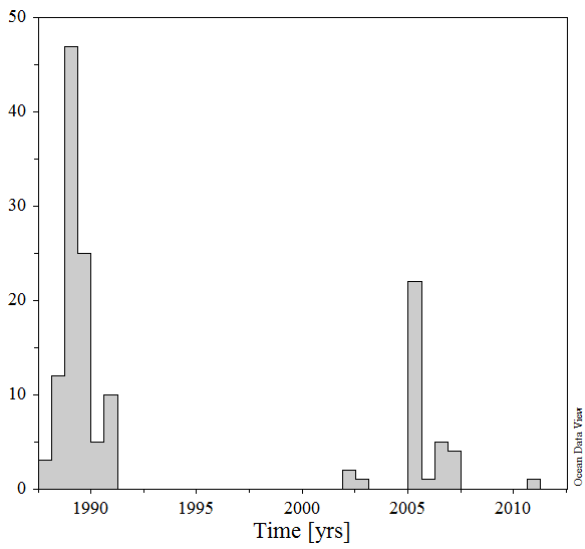


Contaminants
Spatial & Temporal coverage, Stations density distribution (all P01 codes, ***biota*** matrix)

- No. of profiles (stations): **138**







14. DIVA Analysis and Products generation

DIVA maps have been prepared for Water body nitrate, Water body phosphate and Water body silicate data. DIVA analysis and parameters optimization was done following the project specifications described in the "Methodology for data QA/QC and DIVA products" document (http://nodc.ogs.trieste.it/doi/documents/EMD2chem_QCreport_V8-072015.pdf) :

- **Seasons for Black Sea:**
  - Winter: December - February
  - Spring: March - May
  - Summer: June – August
  - Autumn: September - November
- **10-years running averages**
  - Water body phosphates: 1960-1969, 1961-1970,..,2003 – 2012, 2004-2013
  - Water body silicate: 1960-1969, 1961-1970,..,2003 – 2012, 2004-2013
  - Water body nitrate: 1975-1984, 1976 – 1985,…, 2003 – 2012 , 2004-2013
  - Water body ammonium: 1980-1989, 1981-1990,..,2003 – 2012, 2004-2013
  - Water body NO3+NO2: 1976-1985, 1977-1986,..,2003 – 2012, 2004-2013
  - Water body dissolved oxygen concentration: 1970-1979,…, 2004 – 2013 , 2005-2014
- **IODE standard levels, depending on data availability for every parameter and every season:**
  - Water body phosphates: up to -300 m
  - Water body silicate: up to -200 m
  - Water body nitrate: up to -150 m
  - Water body ammonium: -100 m (Black Sea Western slope _ DK3)
  - Water body NO3+NO2: -150 m
  - Water body dissolved oxygen concentration: -250 m
- **Quality flags (SDN): 1, 2, 6**

DIVA settings

- Initial Lc: correlation: 1.5
- Initial Signal to noise ratio of the whole dataset: 0.5
- ireg: mode selected for background field: mean of data
- Cleaning data on mesh: cleaning data out of the mesh & outliers elimination
- Parameters estimation and vertical filtering: both correlation length and signal-to-noise ratio parameters estimated using data mean distance as a minimum (for L), and both parameters vertically filtered

- Analysis and reference field: analysis with data transformation: log(data)-exp(analysis)
- Detrending of data: no

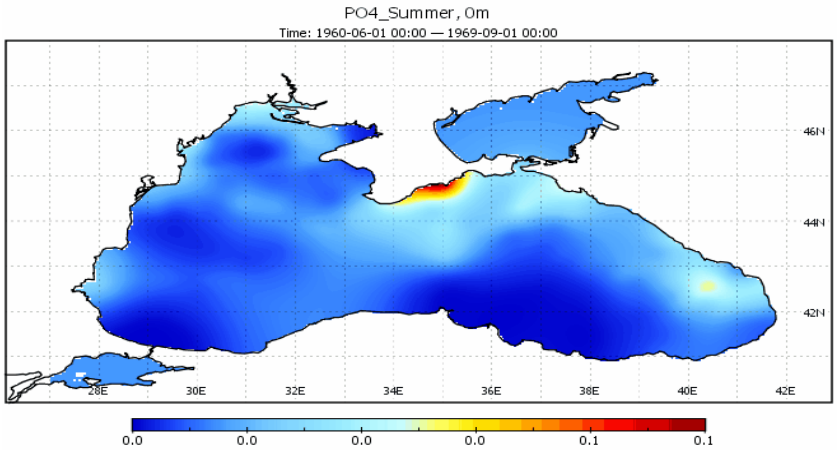
In total, 12 DIVA products in SeaDataNet NetCDF format were prepared and uploaded to the OceanBrowser Viewing Service **EMODNET Chemistry Map Server** (http://oceanbrowser.net/emodnet/).

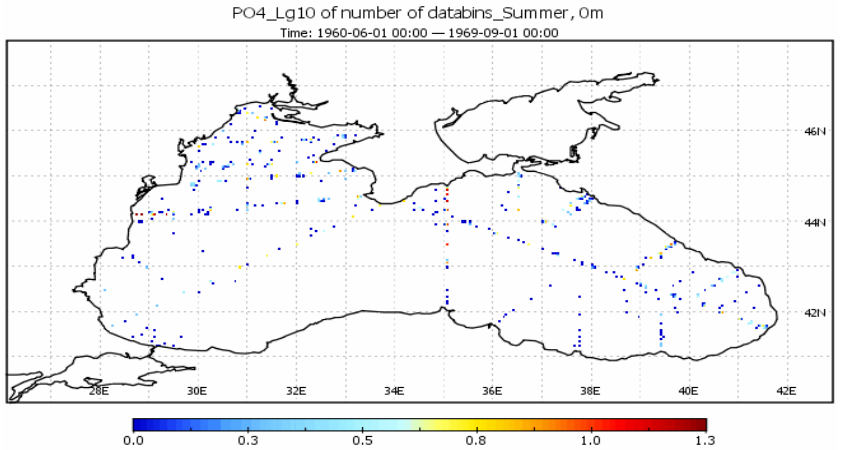
The metadata XML files have been prepared and loaded in Sextant discovery catalogue (http://sextant.ifremer.fr/en/web/emodnet_chemistry/catalogue).

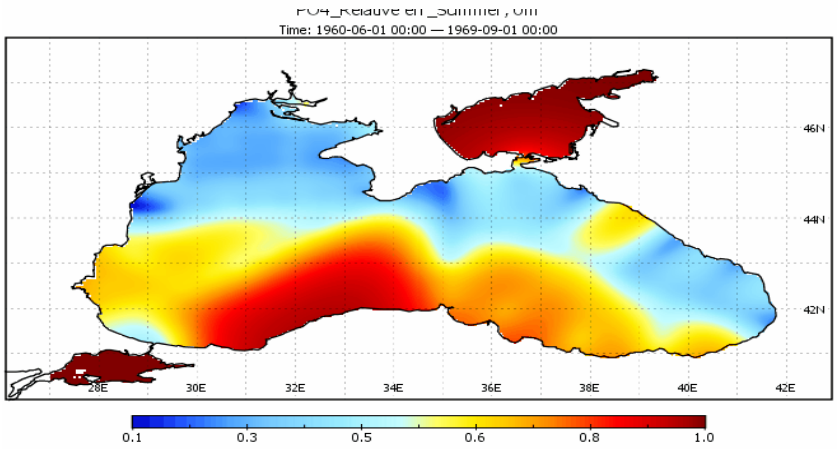
EMODnet

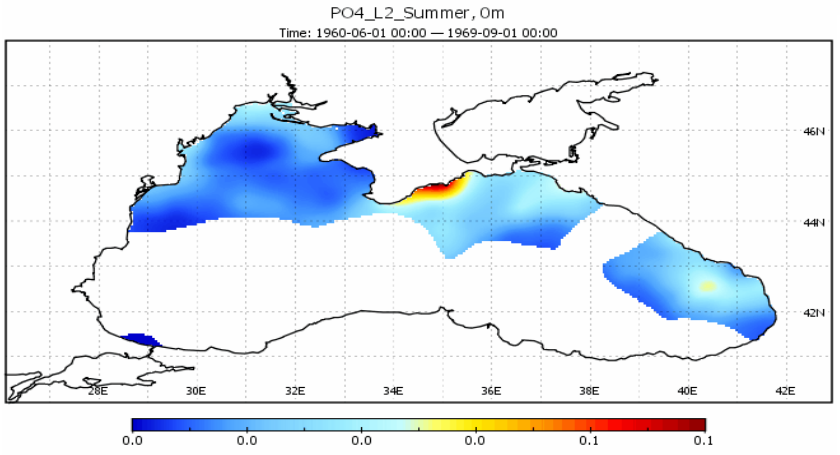
European Marine Observation and Data Network

Water body phosphate - Summer, 0m

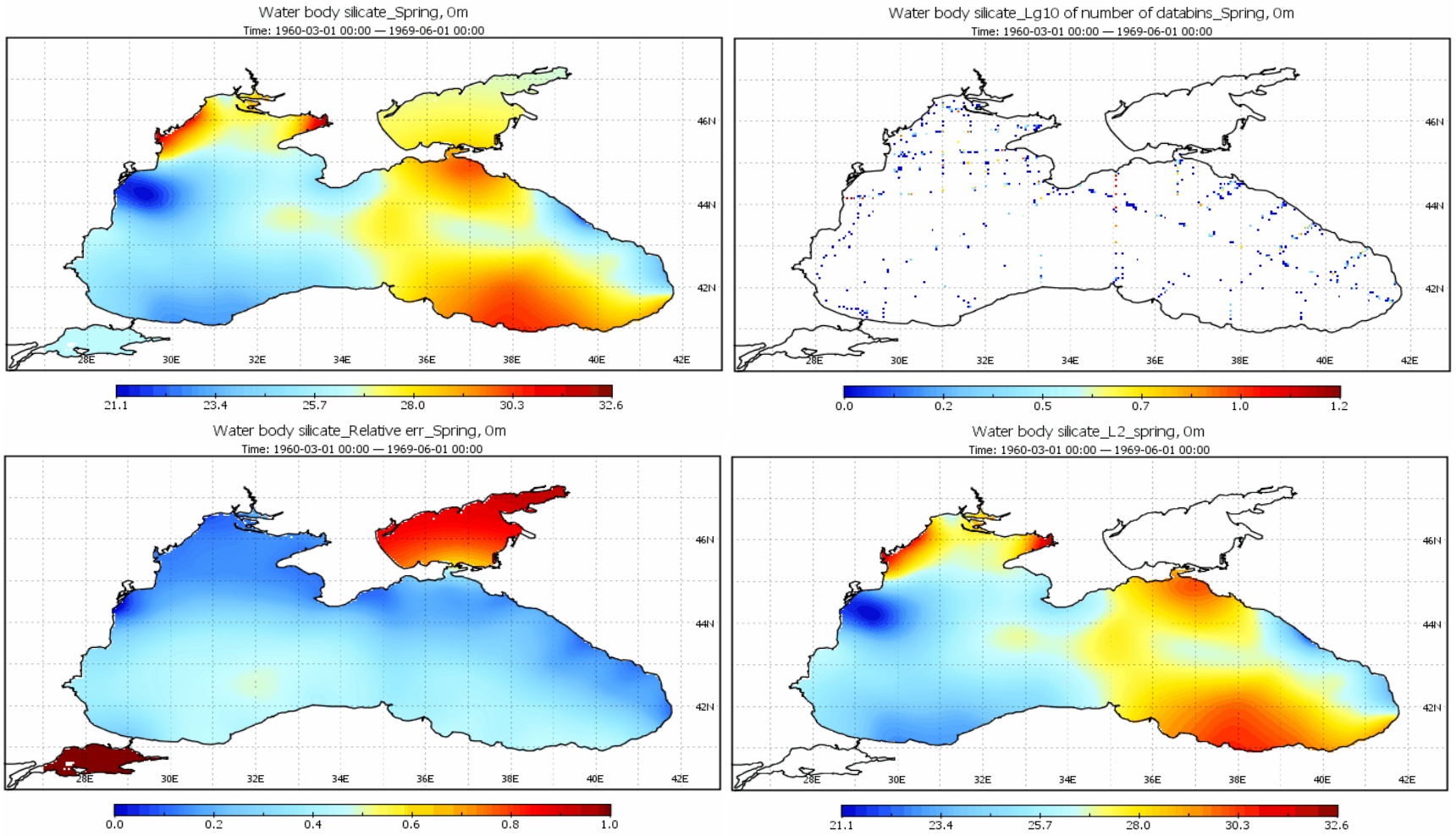




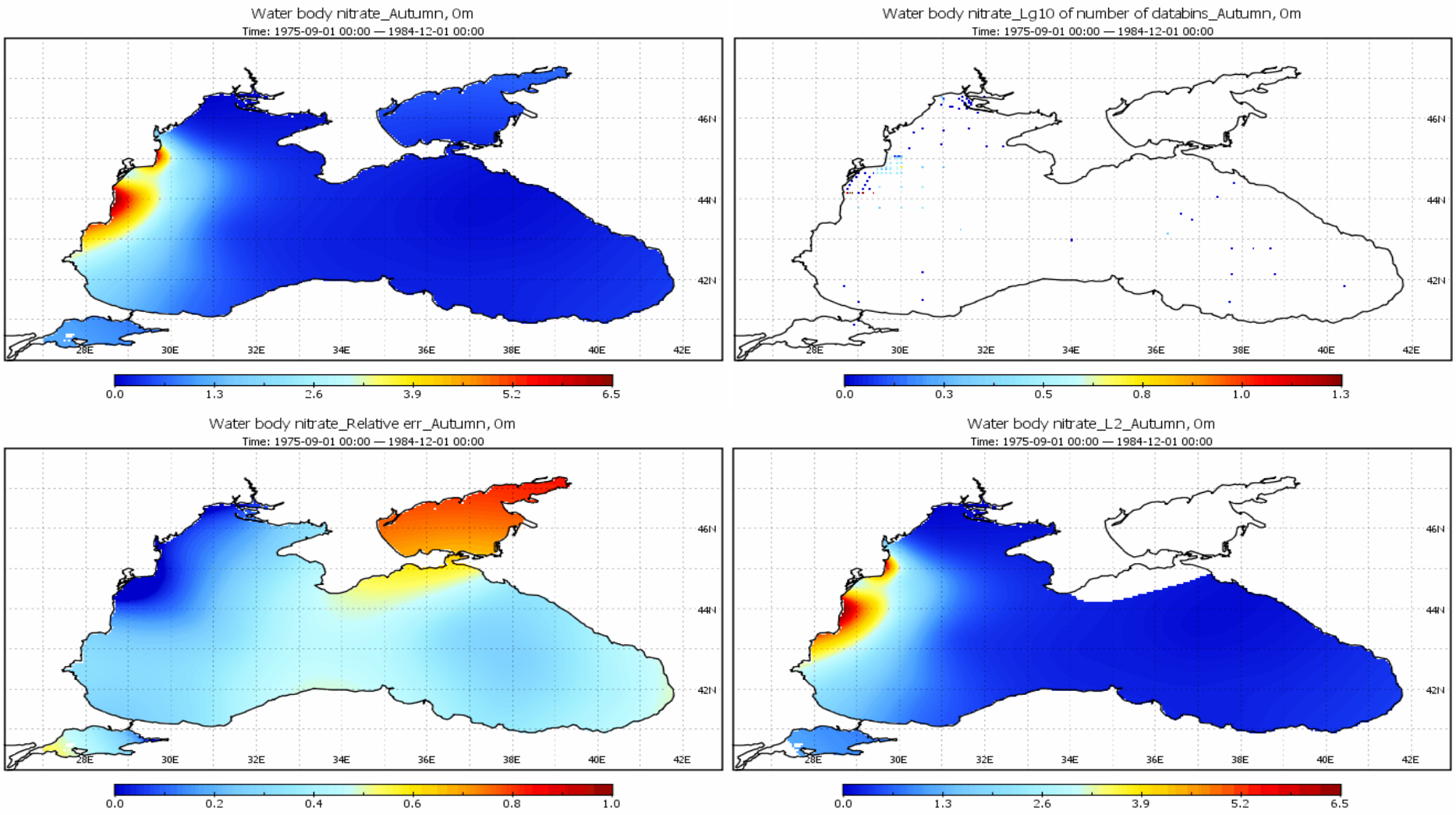




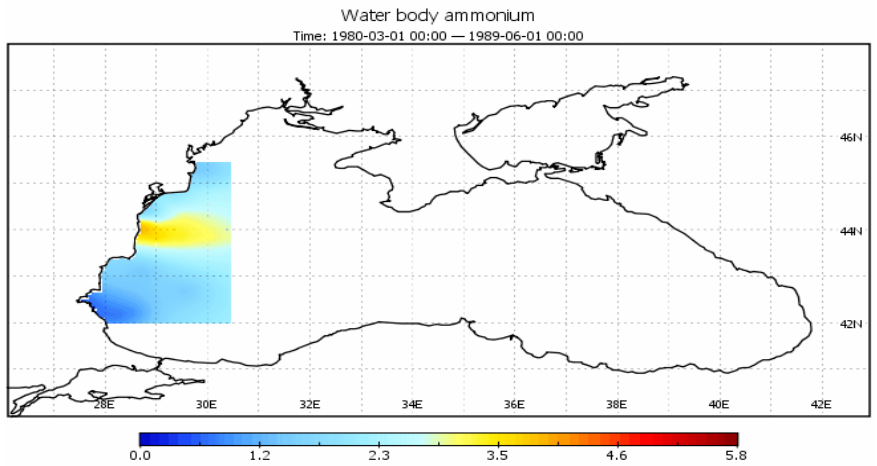
Water body silicate - Spring, 0m

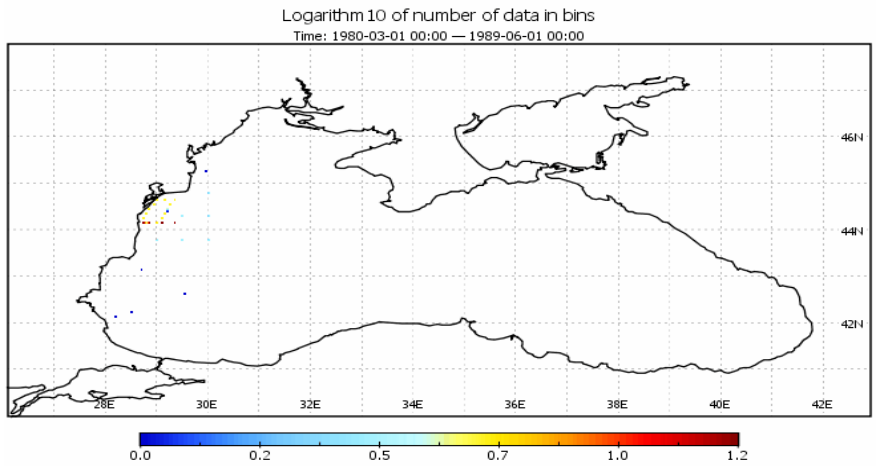


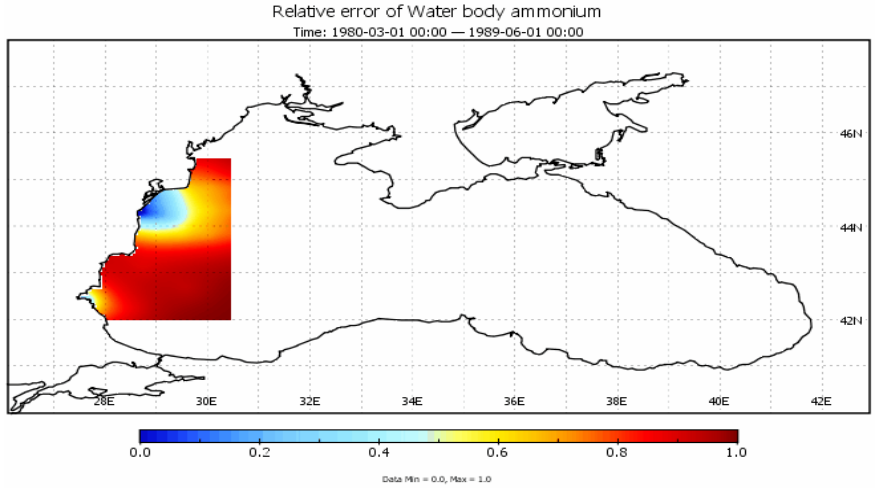
Water body nitrate - Autumn, 0m

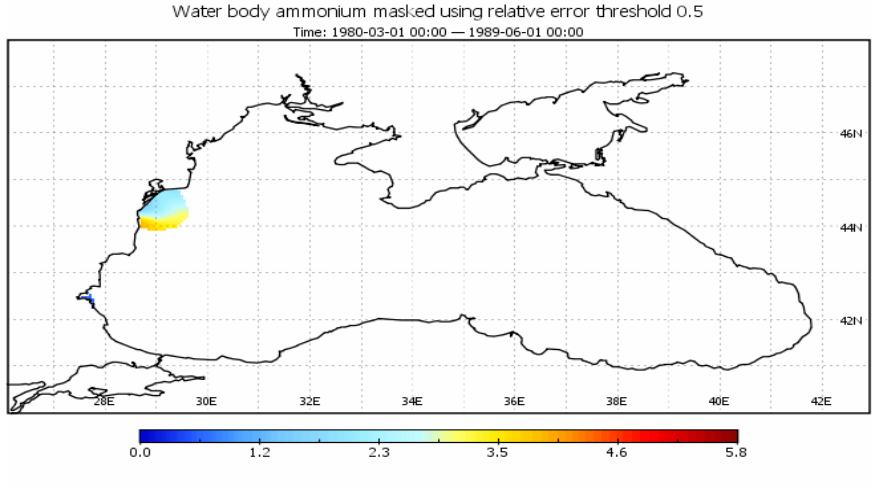


Water body ammonium - Spring, West slope (DK3), 0m

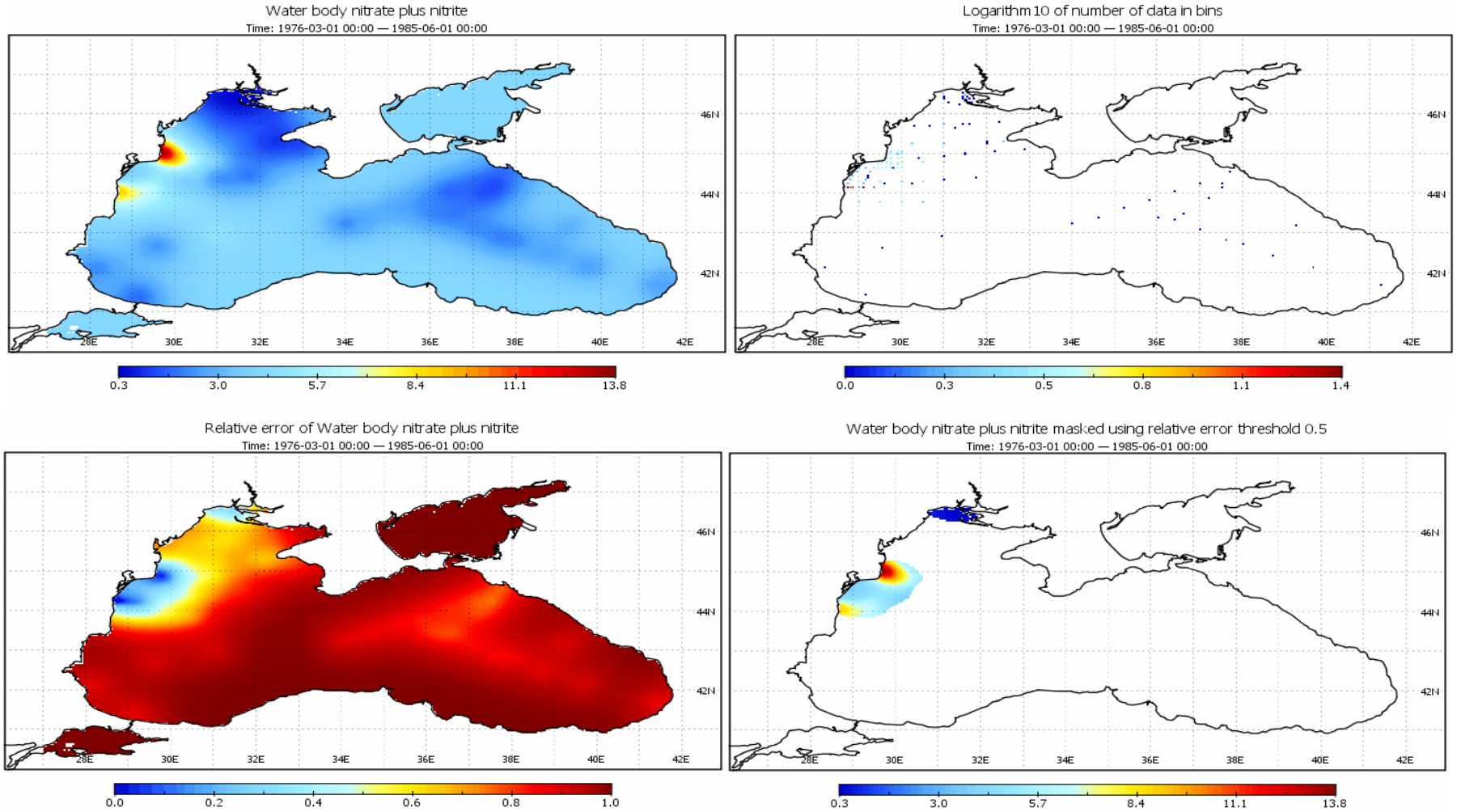








Water body nitrate plus nitrite – Spring, 0m



Water body dissolved oxygen concentration - Summer, 75m