

FORCOAST



Earth Observation Services For Wild Fisheries, Oystergrounds
Restoration And Bivalve Mariculture Along European Coasts

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Deliverable Title: Sector-specific Marine
information requirements including
physico-chemical threshold for biological
processes relevant to targeted sectors

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Executive Summary

This document is the result of the analysis of the data available for the execution of the FORCOAST Project. We have divided this analysis by Pilot and coordinated ourselves with those responsible for each of them; the information used during the Project has been detailed.

In the first section or Introduction the purpose of this deliverable is described, the main intention is a detailed analysis of the needs but also to serve as a reference during the development of the Project.

The second section explains the different types of data use. When a piece of information is detailed in each pilot, the type of use that will be given is specified.

The following types of use have been established:

- Direct Information Service System: Direct data visualization and alert generation.
- Model Forcing: Data used to feed the FORCOAST models developed by each Pilot, with the aim of creating higher resolution information.
- Model Validation: Data used to validate the results returned by an experimental model.

After identifying the different types of data use, the document describes the different datasets that fall into each of those categories. Within each pilot, the following structure is followed:

- A small introduction.
- A summary table with the datasets, the boundaries of each geographical area and the type of use that will be given to the dataset. After this table, a list of the variables used in each dataset along with its time resolution is shown.
- Identified threshold. Threshold values detected in advance in data variables that will be decisive for the activities in which this data is crucial.
- Identified Gaps. Data gaps, risks or deficiencies found after the data analysis necessary for each Pilot.

The previous section gives the opportunity to notice the variety of data to be used throughout the Project. During the implementation of the service, data must be read from different sources with different formats.

The conclusions are discussed in the final section, after the analysis and compilation of all the data. Reflecting on the use of this data, we see that most will be used directly for service issue, or validation. The gaps found or threshold values to be used are also collected.



Table of Contents

Executive Summary	5
Table of Contents	6
1 Introduction	11
2 Types of Data Uses in FORCOAST	11
2.1 Direct information service system	11
2.2 Model forcing	11
2.3 Model validation.....	11
3 Data Uses in FORCOAST	13
3.1 Pilot 1: Sado Estuary, Portugal (Atlantic Ocean) - Bivalve mariculture sector (Oysters)	13
3.1.1 GLOBAL_ANALYSIS_FORECAST_PHY_001_024.....	14
3.1.2 GLOBAL_ANALYSIS_FORECAST_BIO_001_028	15
3.1.3 OCEANCOLOUR_GLO_CHL_L4_NRT_OBSERVATIONS_009_033	15
3.1.4 OCEANCOLOUR_GLO_OPTICS_L4_NRT_OBSERVATIONS_009_083	15
3.1.5 SST_ATL_SST_L4_NRT_OBSERVATIONS_010_025.....	15
3.1.6 OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037	15
3.1.7 OCEANCOLOUR_EUR_CHL_L3_NRT_OBSERVATIONS_009_050	16
3.1.8 OCEANCOLOUR_ATL_OPTICS_L3_NRT_OBSERVATIONS_009_034	16
3.1.9 IBI_ANALYSIS_FORECAST_PHYS_005_001	16
3.1.10 IBI_ANALYSIS_FORECAST_BIO_005_004.....	16
3.1.11 Identified Threshold Values.....	17
3.2 Pilot 2: Bay of Biscay, Spain (Atlantic Ocean) – Wild Fisheries.....	17
3.2.1 IBI_ANALYSIS_FORECAST_PHYS_005_001	18
3.2.2 IBI_ANALYSIS_FORECAST_WAV_005_005	19
3.2.3 IBI_ANALYSIS_FORECAST_BIO_005_004.....	19
3.2.4 SST_ATL_SST_L4_NRT_OBSERVATIONS_010_025.....	19
3.2.5 SST_EUR_SST_L3S_NRT_OBSERVATIONS_010_009_a.....	19
3.2.6 OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037	20
3.2.7 OCEANCOLOUR_EUR_CHL_L3_NRT_OBSERVATIONS_009_050	20
3.2.8 SEALEVEL_EUR_PHY_L4_NRT_OBSERVATIONS_008_060.....	20
3.2.9 INSITU_GLO_UV_NRT_OBSERVATIONS_013_048	20
3.2.10 Identified Threshold Values.....	20



3.3 Pilot 3: Bulgaria (Black Sea) – Wild Fisheries.....	21
3.3.1 INSITU_BS_NRT_OBSERVATIONS_013_034	22
3.3.2 OCEANCOLOUR_BS_CHL_L4_NRT_OBSERVATIONS_009_045	23
3.3.3 OCEANCOLOUR_BS_CHL_L3_NRT_OBSERVATIONS_009_044	23
3.3.4 OCEANCOLOUR_BS_OPTICS_L3_NRT_OBSERVATIONS_009_042.....	23
3.3.5 SST_BS_SST_L4_NRT_OBSERVATIONS_010_006.....	24
3.3.6 BLKSEA_REANALYSIS_WAV_007_006	24
3.3.7 BLKSEA_REANALYSIS_PHYS_007_004	24
3.3.8 WAVE_GLO_WAV_L3_SWH_NRT_OBSERVATIONS_014_001	24
3.3.9 BLKSEA_ANALYSIS_FORECAST_PHYS_007_001	24
3.3.10 BLKSEA_ANALYSIS_FORECAST_WAV_007_003	25
3.3.11 BLKSEA_ANALYSIS_FORECAST_BIO_007_010	25
3.3.12 Identified Threshold Values.....	25
3.4 Pilot 4: Belgium (Southern North Sea) - Oyster, mussel and seaweed farming – an Integrated Multi-Trophic Aquaculture (IMTA) system	26
3.4.1 INSITU_NWS_NRT_OBSERVATIONS_013_036	27
3.4.2 NORTHWESTSHELF_ANALYSIS_FORECAST_PHYS_004_013.....	28
3.4.3 NORTHWESTSHELF_REANALYSIS_PHY_004_009.....	28
3.4.4 SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001	28
3.4.5 NORTHWESTSHELF_ANALYSIS_FORECAST_WAV_004_014	28
3.4.6 Harmonic Astronomical Tide - Continental Shelf – COHERENS	28
3.4.7 Physical State of the Sea - Belgian Coastal Zone - COHERENS UKMO.....	29
3.4.8 Physical State of the Sea - North Sea - COHERENS UKMO	29
3.4.9 Tide - Continental Shelf - COHERENS UKMO	29
3.4.10 Wave field - North Sea - WAM ECMWF.....	29
3.4.11 Wave field - North Sea - WAM UKMO.....	29
3.4.12 Seasonal forecast of ECMWF	30
3.4.13 Mapping of all river data available from all national INSPIRE data portals.....	30
3.4.14 Identified Threshold Values.....	30
3.4.15 Identified Gaps.....	31
3.5 Pilot 5: Galway Bay, Ireland (Atlantic Ocean) - Bivalve mariculture sector and wider fisheries sector	31
3.5.1 IBI_REANALYSIS_PHYS_005_002	32

3.5.2 IBI_ANALYSIS_FORECAST_BIO_005_004.....	33
3.5.3 INSITU_IBI_NRT_OBSERVATIONS_013_033.....	33
3.5.4 INSITU_IBI_TS_REP_OBSERVATIONS_013_040.....	33
3.5.5 OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037.....	33
3.5.6 MI Inner Galway Bay model (under development).....	33
3.5.7 MI Connemara biogeochemical model (under development).....	34
3.5.8 Sub 300m resolution SST.....	34
3.5.9 Sub 300m resolution chlorophyll.....	34
3.5.10 Galway Bay Observatory ADCP data.....	34
3.5.11 Galway Bay Observatory CTD data.....	34
3.5.12 Galway Bay Observatory Fluorometer Data.....	34
3.5.13 Other satellite data requests from the ESA Data Warehouse.....	35
3.5.14 Identified Gaps.....	35
3.6 Pilot 6: Denmark (Baltic-North Sea Transition) - Bivalve mariculture (oysters), oysterground restoration.....	36
3.6.1 INSITU_NWS_NRT_OBSERVATIONS_013_036.....	37
3.6.2 NORTHWESTSHELF_ANALYSIS_FORECAST_PHYS_004_001_b.....	37
3.6.3 NORTHWESTSHELF_REANALYSIS_PHY_004_009.....	37
3.6.4 SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001.....	38
3.6.5 BALTICSEA_ANALYSIS_FORECAST_PHY_003_006.....	38
3.6.6 BALTICSEA_REANALYSIS_PHY_003_011.....	38
3.6.7 INSITU_BAL_NRT_OBSERVATIONS_013_032.....	38
3.6.8 Overfladevandsdatabasen ODA (Aarhus university).....	38
3.7 Pilot 7: Romania, Bulgaria, Ukraine (Black Sea) - Bivalve mariculture sector, oysterground restoration.....	39
3.7.1 BLKSEA_ANALYSIS_FORECAST_PHYS_007_001.....	40
3.7.2 BLKSEA_ANALYSIS_FORECAST_WAV_007_003.....	40
3.7.3 BLKSEA_ANALYSIS_FORECAST_BIO_007_010.....	40
3.7.4 INSITU_BS_NRT_OBSERVATIONS_013_034.....	40
3.7.5 OCEANCOLOUR_BS_CHL_L4_NRT_OBSERVATIONS_009_045.....	40
3.7.6 OCEANCOLOUR_BS_CHL_L3_NRT_OBSERVATIONS_009_044.....	40
3.7.7 OCEANCOLOUR_BS_OPTICS_L3_NRT_OBSERVATIONS_009_042.....	41
3.7.8 SST_BS_SST_L4_NRT_OBSERVATIONS_010_006.....	41



3.7.9 ECMWF ERA5	41
3.7.10 Identified Gaps.....	41
3.8 Pilot 8: Italy (Northern Adriatic Sea) - Bivalve mariculture sector	42
3.8.1 MEDSEA_REANALYSIS_BIO_006_008	43
3.8.2 MEDSEA_REANALYSIS_PHYS_006_004	43
3.8.3 OCEANCOLOUR_MED_CHL_L3_REP_OBSERVATIONS_009_073.....	44
3.8.4 MEDSEA_ANALYSIS_FORECAST_BIO_006_014	44
3.8.5 MEDSEA_ANALYSIS_FORECAST_PHY_006_013.....	44
3.8.6 OCEANCOLOUR_MED_CHL_L3_NRT_OBSERVATIONS_009_040	44
3.8.7 SST_MED_SST_L4_REP_OBSERVATIONS_010_021	44
3.8.8 SST_MED_SST_L4_NRT_OBSERVATIONS_010_004	45
3.8.9 OCEANCOLOUR_MED_CHL_L4_NRT_OBSERVATIONS_009_041	45
3.8.10 CoastColour_L2W_conc_chl_nn.....	45
3.8.11 CoastColour_L2W_conc_tsm.....	45
3.8.12 Identified Gaps.....	45
3.8.13 Identified Threshold Values.....	46
4 Conclusions	47
4.1 Data Gaps	47
4.2 Threshold Values	48
5 References	49



Table of Tables

Table 1: Data sources used by Pilot 1.....	13
Table 2: Data sources used by Pilot 2.....	18
Table 3: Threshold values identified for each dataset by Pilot 2.	21
Table 4: Data sources used by Pilot 3.....	22
Table 5: Threshold values identified for each dataset by Pilot 3.	25
Table 6: Data sources used by Pilot 4.....	26
Table 7: Threshold values identified for each dataset by Pilot 4.	30
Table 8: Data sources used by Pilot 5.....	31
Table 9: Data sources used by Pilot 6.....	36
Table 10: Data sources used by Pilot 7.....	39
Table 11: Data sources used by Pilot 8.....	42
Table 12: Threshold values identified for each dataset by Pilot 8.	46



1 Introduction

This deliverable presents a list of Earth Observation (EO) data each partner will use throughout the entire duration of the project, as well as a list of EO datasets together with a small description. Data usage in FORCOAST can serve different purposes, in particular, as a direct source to services provision, boundary conditions for FORCOAST pilot models, or as a validation for FORCOAST pilot models.

The different types of used data include satellite observations, marine circulation models, atmospheric predictions, land discharge or in situ observations, among others.

In this document, the datasets that were used to begin the service development are collected and summarized. A detailed analysis of each pilot with its particularities and needs was carried out, which implies that the following list of datasets may increase during the project lifetime. The idea is that this document continues to be updated, serving as a reference for the products used at all times.

At the time of technical implementation, it will serve to estimate the volume of data to be processed and the different services that must be consulted to support the setup and deployment of the central FORCOAST platform.

For each pilot, the different products that will be used, the type of use that will be given, the variables and the threshold values detected beforehand are detailed throughout this document.

2 Types of Data Uses in FORCOAST

The data acquired during the project will be used in the following ways:

2.1 Direct information service system

Direct data visualization and alert generation.

FORCOAST exploits CMEMS data sources to build services for offshore and coastal sectors. The project involves local high resolution models to enrich this information, but in some places or for specific variables, CMEMS data can be exploited directly to build user-requested services.

2.2 Model forcing

Data used to feed the FORCOAST pilot models, with the aim of creating higher resolution information.

Most FORCOAST Pilot models depend on boundary conditions to run, which requires dedicated forcing products at a corresponding forecasting time (e.g. 3 days in advance). This concerns marine conditions at the model's open boundary, but also atmospheric conditions and land discharges for coastal domains.

2.3 Model validation

Data used to validate the results returned by an experimental model.



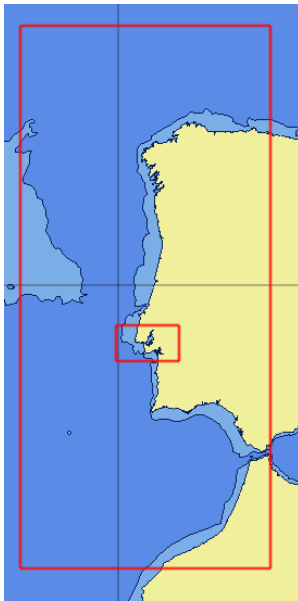
From a market perspective, it is essential to the success of FORCOAST to be able to demonstrate the accuracy of the proposed services. Regarding services based on model products, it means that the uncertainty associated with predictions should be described in the best possible ways. It is foreseen within FORCOAST to operate both centralised validations based on standardized large marine databases, and to achieve local validation efforts (at pilot level) according to central guidelines. This data use concerns datasets and databases to be used in this regard.



3 Data Uses in FORCOAST

In this section we show the data currently used by each pilot. As we have previously commented, this data list will be updated during the Project, completing or discarding data.

3.1 Pilot 1: Sado Estuary, Portugal (Atlantic Ocean) - Bivalve mariculture sector (Oysters)



Currently, products from the Portuguese regional model PCOM are already being used in this area, which is a derivative product started from the GLOBAL_ANALYSIS_FORECAST_PHY_001_024 CMEMS dataset.

FORCOAST will use the products detailed below in this pilot area for direct use, model validation and model forcing.

Figure 1: Study area (Pilot 1).

Table 1: Data sources used by Pilot 1.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
GLOBAL_ANALYSIS_FORECAST_PHY_001_024	Lon: -12.6 to -5 Lat: 33 to 45		X	
GLOBAL_ANALYSIS_FORECAST_BIO_001_028	Lon: -12.6 to -5 Lat: 33 to 45		X	

OCEANCOLOUR_GLO_CHL_L4_NRT_OBSERVATIONS_009_033	Lon: -12.6 to -5 Lat: 33 to 45	X		X
OCEANCOLOUR_GLO_OPTICS_L4_NRT_OBSERVATIONS_009_083	Lon: -12.6 to -5 Lat: 33 to 45	X		X
SST_ATL_SST_L4_NRT_OBSERVATIONS_010_025	Lon: -12.6 to -5 Lat: 33 to 45	X		X
OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037	Lon: -12.6 to -5 Lat: 33 to 45	X		X
OCEANCOLOUR_EUR_CHL_L3_NRT_OBSERVATIONS_009_050	Lon: -10 to -8 Lat: 38 to 39	X		X
OCEANCOLOUR_ATL_OPTICS_L3_NRT_OBSERVATIONS_009_034	Lon: -10 to -8 Lat: 38 to 39	X		X
IBI_ANALYSIS_FORECAST_PHYS_005_001	Lon: -12.6 to -5 Lat: 33 to 45		X	
IBI_ANALYSIS_FORECAST_BIO_005_004	Lon: -12.6 to -5 Lat: 33 to 45		X	
AROME (2.5km - IPMA) / WRF3km (IST) (Atmospheric forcing)	Lon: -12.6 to -5 Lat: 33 to 45		X	
MM5 (9km - IST) / WRF (3km - IST) (Atmospheric forcing)	Lon: -12.6 to -5 Lat: 33 to 45		X	
MOHIDLand or climatological monthly average (Land forcing)	Lon: -12.6 to -5 Lat: 33 to 45		X	

3.1.1 GLOBAL_ANALYSIS_FORECAST_PHY_001_024

This dataset contains 3D potential temperature, salinity and currents from top to bottom and 2D sea surface level, bottom potential temperature, mixed layer thickness and sea ice thickness defined on a standard grid at 1/12-degree resolution and on 50 standard depth levels.

3.1.1.1 Used variables

- sea_water_potential_temperature
- sea_water_salinity
- sea_surface_height_above_geoid
- eastward_sea_water_velocity
- northward_sea_water_velocity



Temporal Resolution: Hourly

3.1.2 GLOBAL_ANALYSIS_FORECAST_BIO_001_028

3.1.2.1 Used variables

- mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water
- mole_concentration_of_dissolved_molecular_oxygen_in_sea_water
- mole_concentration_of_phosphate_in_sea_water
- mole_concentration_of_silicate_in_sea_water
- mole_concentration_of_dissolved_iron_in_sea_water
- mole_concentration_of_ammonium_in_sea_water
- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Daily

3.1.3 OCEANCOLOUR_GLO_CHL_L4_NRT_OBSERVATIONS_009_033

3.1.3.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Daily

3.1.4 OCEANCOLOUR_GLO_OPTICS_L4_NRT_OBSERVATIONS_009_083

3.1.4.1 Used variables

- mass_concentration_of_suspended_matter_in_sea_water

Temporal Resolution: Daily

3.1.5 SST_ATL_SST_L4_NRT_OBSERVATIONS_010_025

3.1.5.1 Used variables

- sea_surface_temperature

Temporal Resolution: Daily

3.1.6 OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037

3.1.6.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Daily



3.1.7 OCEANCOLOUR_EUR_CHL_L3_NRT_OBSERVATIONS_009_050

3.1.7.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Daily

3.1.8 OCEANCOLOUR_ATL_OPTICS_L3_NRT_OBSERVATIONS_009_034

3.1.8.1 Used variables

- mass_concentration_of_suspended_matter_in_sea_water

Temporal Resolution: Daily

3.1.9 IBI_ANALYSIS_FORECAST_PHYS_005_001

This dataset provides a 5-day hydrodynamic forecast that allows to characterize regional scale marine processes. The system is based on an eddy-resolving NEMO model application run at 1/36° horizontal resolution.

3.1.9.1 Used variables

- sea_water_potential_temperature
- sea_water_salinity
- eastward_sea_water_velocity
- northward_sea_water_velocity

Temporal Resolution: Hourly

3.1.10 IBI_ANALYSIS_FORECAST_BIO_005_004

3.1.10.1 Used variables

- mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water
- mole_concentration_of_dissolved_molecular_oxygen_in_sea_water
- mole_concentration_of_phosphate_in_sea_water
- mole_concentration_of_silicate_in_sea_water
- mole_concentration_of_dissolved_iron_in_sea_water
- mole_concentration_of_ammonium_in_sea_water
- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Hourly



3.1.11 Identified Threshold Values

At this stage no threshold values have been identified by this pilot, although there are plans to identify thresholds for the following variables:

3.1.11.1 Phytoplankton

Phytoplankton concentration threshold is going to be investigated with the help of these two datasets:

- GLOBAL_ANALYSIS_FORECAST_BIO_001_028
- IBI_ANALYSIS_FORECAST_BIO_005_004

3.1.11.2 Sea Surface Temperature

A threshold value for the sea surface temperature is expected to be found with the following dataset:

- SST_ATL_SST_L4_NRT_OBSERVATIONS_010_025

3.2 Pilot 2: Bay of Biscay, Spain (Atlantic Ocean) – Wild Fisheries

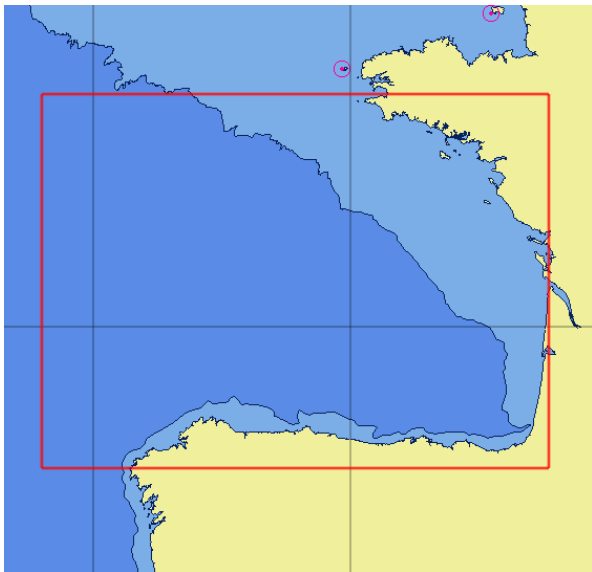


Figure 2: Study area (Pilot 2).

Currently, there is the EusKOOS (i.e. Basque coastal operational oceanography system), comprising different in-situ observing marine platforms in the area. This includes a network of coastal stations, one operational deep-sea buoy and a HF Radar system. One of the main needs in this area is working towards an integrated management of commercial fishing species (e.g. anchovy, hake, tuna, etc.). This pilot project will provide information needed to understand physical drivers of recruitment, biomass and distribution of these species towards more accurate stock models.

Table 2: Data sources used by Pilot 2.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
IBI_ANALYSIS_FORECAST_PHYS_005_001	Lon: -11 to -1 Lat: 43 to 48	X		X
IBI_ANALYSIS_FORECAST_WAV_005_005	Lon: -11 to -1 Lat: 43 to 48	X		X
IBI_ANALYSIS_FORECAST_BIO_005_004	Lon: -11 to -1 Lat: 43 to 48	X		
SST_ATL_SST_L4_NRT_OBSERVATIONS_010_025	Lon: -11 to -1 Lat: 43 to 48	X		
SST_EUR_SST_L3S_NRT_OBSERVATIONS_010_009_a	Lon: -11 to -1 Lat: 43 to 48	X		
OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037	Lon: -11 to -1 Lat: 43 to 48	X		X
OCEANCOLOUR_EUR_CHL_L3_NRT_OBSERVATIONS_009_050	Lon: -11 to -1 Lat: 43 to 48	X		X
SEALEVEL_EUR_PHY_L4_NRT_OBSERVATIONS_008_060	Lon: -11 to -1 Lat: 43 to 48	X		
INSITU_GLO_UV_NRT_OBSERVATIONS_013_048	Lon: -11 to -1 Lat: 43 to 48	X		
WRF model (Atmospheric forcing)	Lon: -11 to -1 Lat: 43 to 48		X	
Meteogalicia (12 km) (Atmospheric forcing)	Lon: -11 to -1 Lat: 43 to 48		X	
Euskalmet (1 km) (Atmospheric forcing)	Lon: -11 to -1 Lat: 43 to 48		X	

3.2.1 IBI_ANALYSIS_FORECAST_PHYS_005_001

This dataset provides a 5-day hydrodynamic forecast that allows to characterize regional scale marine processes. The system is based on an eddy-resolving NEMO model application run at 1/36° horizontal resolution.



3.2.1.1 Used variables

- sea_water_potential_temperature
- sea_water_salinity
- ocean_mixed_layer_thickness_defined_by_sigma_theta (MLD)
- eastward_sea_water_velocity
- northward_sea_water_velocity

Temporal Resolution: Hourly

3.2.2 IBI_ANALYSIS_FORECAST_WAV_005_005

3.2.2.1 Used variables

- sea_surface_wave_significant_height
- sea_surface_wave_mean_period_from_variance_spectral_density_inverse_frequency_moment
- sea_surface_wave_from_direction
- sea_surface_wind_wave_significant_height
- sea_surface_wind_wave_mean_period
- sea_surface_wind_wave_from_direction

Temporal Resolution: Hourly

3.2.3 IBI_ANALYSIS_FORECAST_BIO_005_004

3.2.3.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water
- mole_concentration_of_dissolved_molecular_oxygen_in_sea_water
- net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water
- euphotic_zone_depth

Temporal Resolution: Hourly

3.2.4 SST_ATL_SST_L4_NRT_OBSERVATIONS_010_025

3.2.4.1 Used variables

- sea_surface_temperature

Temporal Resolution: Hourly

3.2.5 SST_EUR_SST_L3S_NRT_OBSERVATIONS_010_009_a

3.2.5.1 Used variables

- sea_surface_temperature



Temporal Resolution: Hourly

3.2.6 OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037

3.2.6.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Hourly

3.2.7 OCEANCOLOUR_EUR_CHL_L3_NRT_OBSERVATIONS_009_050

3.2.7.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Hourly

3.2.8 SEALEVEL_EUR_PHY_L4_NRT_OBSERVATIONS_008_060

3.2.8.1 Used variables

- sea_surface_height_above_geoid
- sea_surface_height_above_sea_level
- surface_geostrophic_eastward_sea_water_velocity
- surface_geostrophic_northward_sea_water_velocity

Temporal Resolution: Hourly

3.2.9 INSITU_GLO_UV_NRT_OBSERVATIONS_013_048

3.2.9.1 Used variables

- surface_eastward_sea_water_velocity
- surface_northward_sea_water_velocity

Temporal Resolution: Hourly

3.2.10 Identified Threshold Values

The identified threshold values for this Pilot correspond to those usually found during the spring and the summer, which is when the Pilot takes place. The following table shows those values:



Table 3: Threshold values identified for each dataset by Pilot 2.

Dataset	Threshold Values
IBI_ANALYSIS_FORECAST_PHYS_005_001	T = [11, 25] °C MLD = [0, 100] m
IBI_ANALYSIS_FORECAST_BIO_005_004	CHL = [0, 3] mg/m ³ ZEU = [0, 100] m
SST_EUR_SST_L3S_NRT_OBSERVATIONS_010_009_a	SST = [11, 25] °C
SEALEVEL_EUR_PHY_L4_NRT_OBSERVATIONS_008_060	SSH (above geoid) = [0, 25] cm SSH (above sea level) = [-15, 15] cm

3.3 Pilot 3: Bulgaria (Black Sea) – Wild Fisheries

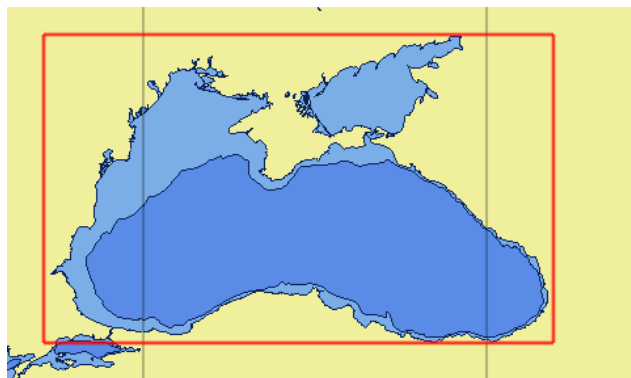


Figure 3: Study area (Pilot 3).

Current operational activities addressing fisheries activities in the Black Sea region, based on Earth Observation data do not exist. The SkyFISH platform is the only initiative to this respect and it is envisaged to be fully operational by 2020. It is based on CMEMS derived information and represents a technological starting point for the current pilot case.

This pilot model consists in a high resolution system that includes waves, atmosphere, hydrodynamics, biogeochemistry and transport modelling and will provide multi-scale integrated information for the Black sea. This will be additionally enhanced through application of advanced data assimilation. We will ensure an integration of EO data and products that are made available via the Copernicus services. Development of added value products will be based on EO data for fisheries sectors for the Black Sea region. EO products (satellite derived, modelled, in-situ) will be integrated into dissemination/exploitation platforms.

Table 4: Data sources used by Pilot 3.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
INSITU_BS_NRT_OBSERVATIONS_013_034	Lon: 27.42 - 41.90 Lat: 40.86 - 46.90	X		X
OCEANCOLOUR_BS_CHL_L4_NRT_OBSERVATIONS_009_045	Lon: 26.45 - 42 Lat: 40 - 48	X		X
OCEANCOLOUR_BS_CHL_L3_NRT_OBSERVATIONS_009_044	Lon: 26.45 - 42 Lat: 40 - 48	X		X
OCEANCOLOUR_BS_OPTICS_L3_NRT_OBSERVATIONS_009_042	Lon: 26.45 - 42 Lat: 40 - 48	X		X
SST_BS_SST_L4_NRT_OBSERVATIONS_010_006	Lon: 26.37 - 42.38 Lat: 38.75 - 48.82	X		X
BLKSEA_REANALYSIS_WAV_007_006	Lon: 27.32 - 41.96 Lat: 40.86 - 46.80	X	X	
BLKSEA_REANALYSIS_PHYS_007_004	Lon: 27.32 - 41.96 Lat: 40.86 - 46.80	X	X	
WAVE_GLO_WAV_L3_SWH_NRT_OBSERVATIONS_014_001	Lon: 27 - 42 Lat: 40 - 47	X		X
BLKSEA_ANALYSIS_FORECAST_PHYS_007_001	Lon: 27.42 - 41.90 Lat: 40.86 - 46.90	X	X	
BLKSEA_ANALYSIS_FORECAST_WAV_007_003	Lon: 27.32 - 41.96 Lat: 40.86 - 46.80	X	X	
BLKSEA_ANALYSIS_FORECAST_BIO_007_010	Lon: 27.32 - 41.96 Lat: 40.86 - 46.80	X		

3.3.1 INSITU_BS_NRT_OBSERVATIONS_013_034

These in situ data are collected from the Black Sea GOOS members and complemented by the observation collected by the Global INS TAC in the area. It is updated continuously and provides observations within 24-48 hours from acquisition in average.



3.3.1.1 Used variables

- sea_water_temperature
- sea_water_practical_salinity
- sea_water_speed
- mass_concentration_of_chlorophyll_a_in_sea_water
- moles_of_oxygen_per_unit_mass_in_sea_water
- sea_surface_wave_significant_height
- sea_surface_wave_mean_period
- sea_surface_wave_from_direction
- direction_of_sea_water_velocity
- sea_surface_height_above_sea_level

Temporal Resolution: Instantaneous

3.3.2 OCEANCOLOUR_BS_CHL_L4_NRT_OBSERVATIONS_009_045

Level 4 chlorophyll data with 1km spatial resolution.

3.3.2.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Hourly

3.3.3 OCEANCOLOUR_BS_CHL_L3_NRT_OBSERVATIONS_009_044

Level 3 chlorophyll data with 1km spatial resolution.

3.3.3.1 Used variables

- mass_concentration_of_chlorophyll_a_in_sea_water

Temporal Resolution: Hourly

3.3.4 OCEANCOLOUR_BS_OPTICS_L3_NRT_OBSERVATIONS_009_042

1km resolution Inherent Optical Properties, diffuse attenuation coefficient of light at 490 nm, Secchi depth, spectral Remote Sensing Reflectance, Coloured Dissolved Organic Matter and the non-organic Solid Particulate Matter (SPM).

3.3.4.1 Used variables

- All available

Temporal Resolution: Hourly



3.3.5 SST_BS_SST_L4_NRT_OBSERVATIONS_010_006

Sea Surface Temperature daily gap-free maps (L4) at high (HR 0.0625°) and ultra-high (UHR 0.01°) spatial resolution over the Black Sea.

3.3.5.1 Used variables

- Sea_surface_temperature

Temporal Resolution: Hourly

3.3.6 BLKSEA_REANALYSIS_WAV_007_006

Reanalysis hourly wave dataset at 1/36°x1/27° horizontal resolution, forced by wind fields obtained from the ERA-interim reanalysis wind data.

3.3.6.1 Used variables

- All available

Temporal Resolution: Hourly

3.3.7 BLKSEA_REANALYSIS_PHYS_007_004

Reanalysis daily mean dataset at 1/36° x 1/27° horizontal resolution, which uses NEMO v3.6 as its hydrodynamics source. The model solutions are corrected by currents observations, including in-situ profiles and along-track sea level anomalies (SLA), as well as SST provided by the U.K. MetOffice Hadley Centre and the Copernicus TACs.

3.3.7.1 Used variables

- All available

Temporal Resolution: Hourly

3.3.8 WAVE_GLO_WAV_L3_SWH_NRT_OBSERVATIONS_014_001

Mono-mission satellite-based along-track significant wave height. Only valid data are included, based on a rigorous editing combining various criteria such as quality flags (surface flag, presence of ice) and thresholds on parameter values.

3.3.8.1 Used variables

- All available

Temporal Resolution: Hourly

3.3.9 BLKSEA_ANALYSIS_FORECAST_PHYS_007_001

This model displays T, S, SSH and U,V at a horizontal grid resolution of 1/36° in zonal resolution, 1/27° in meridional resolution (ca. 3 km) and has 31 unevenly spaced vertical levels.



3.3.9.1 Used variables

- All available

Temporal Resolution: Hourly

3.3.10 BLKSEA_ANALYSIS_FORECAST_WAV_007_003

0.037x0.028 degrees resolution Black Sea wave model (wave height, period, Stokes drift), with 10 days forecast and a one-hourly output once a day.

3.3.10.1 Used variables

- All available

Temporal Resolution: Hourly

3.3.11 BLKSEA_ANALYSIS_FORECAST_BIO_007_010

Biogeochemical model with a 28-variable pelagic component and a 6-variable benthic component, with a 0.037x0.028 degrees resolution.

3.3.11.1 Used variables

- All available

Temporal Resolution: Hourly

3.3.12 Identified Threshold Values

3.3.12.1 INSITU_BS_NRT_OBSERVATIONS_013_034

Only quality checked data (QC=1) should be used.

3.3.12.2 WAVE_GLO_WAV_L3_SWH_NRT_OBSERVATIONS_014_001

Minimum SWH value of 0.2: It has been recommended by CMEMS colleagues to delete data below 0.2m because the quality of the satellite observations is not very good in this range. However, for some purposes those data can be still included.

Table 5: Threshold values identified for each dataset by Pilot 3.

Dataset	Threshold Values
---------	------------------

INSITU_BS_NRT_OBSERVATIONS_013_034	QC = 1
WAVE_GLO_WAV_L3_SWH_NRT_OBSERVATIONS_014_001	QC SWH min 0.2

3.4 Pilot 4: Belgium (Southern North Sea) - Oyster, mussel and seaweed farming – an Integrated Multi-Trophic Aquaculture (IMTA) system

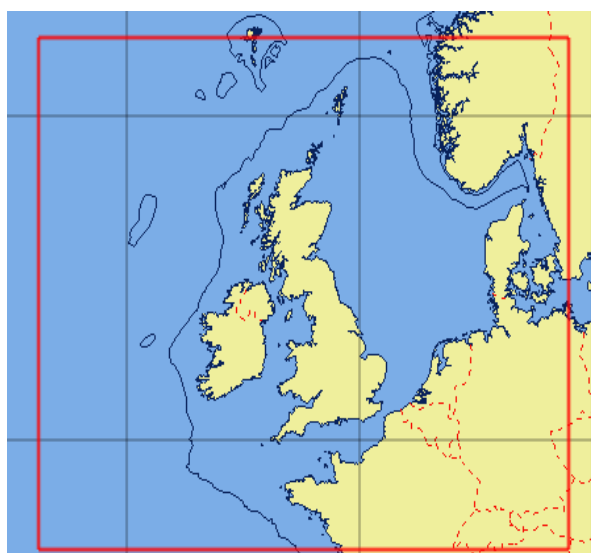


Figure 4: Study area (Pilot 4).

In the framework of FORCOAST the objective of this pilot is to develop, test, calibrate and validate the current information products. Additionally, we would like to incorporate daily observation and/or forecast values from some hydrological forecast model for freshwater discharges. The method of disseminating information to the users will also be formalized. For future commercial bivalve (mussel and flat oyster) farming it would be very helpful to develop an early warning system for toxic algal blooms and influence of river plumes (harmful bacteria) by remote sensing, in-situ measurements and models. The information system developed in the project could be a precursor for such an early-warning system.

Table 6: Data sources used by Pilot 4.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
INSITU_NWS_NRT_OBSERVATIONS_013_036	Lon: -20 to 13 Lat: 48 to 62			X

NORTHWESTSHELF_ANALYSIS_FORECAST_PHYS_004_013	Lon: -16 to 13 Lat: 46 to 62.75	X	X	
NORTHWESTSHELF_REANALYSIS_PHY_004_009	Lon: -20 to 13 Lat: 40 to 65	X		
SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001	Lon: -180 to 180 Lat: -90 to 90			X
NORTHWESTSHELF_ANALYSIS_FORECAST_WAV_004_014	Lon: -16 to 13 Lat: 46 to 62.75	X	X	
Harmonic Astronomical Tide - Continental Shelf – COHERENS	Lon: -12 to 13 Lat: 48 to 62	X	X	
Physical State of the Sea - Belgian Coastal Zone - COHERENS UKMO	Lon: 2.1 to 4.2 Lat: 51 to 51.9	X	X	
Physical State of the Sea - North Sea - COHERENS UKMO	Lon: -4 to 9 Lat: 48.5 to 57	X	X	
Tide - Continental Shelf - COHERENS UKMO	Lon: -12 to 13 Lat: 48 to 62	X	X	
Wave field - North Sea - WAM ECMWF	Lon: -4 to 9 Lat: 48.5 to 57	X	X	
Wave field - North Sea - WAM UKMO	Lon: -4 to 9 Lat: 48.5 to 57	X	X	
Seasonal forecast of ECMWF	Lon: -4 to 9 Lat: 48.5 to 57		X	
Mapping of all river data available from all national INSPIRE data portals	Lon: -4 to 9 Lat: 48.5 to 57		X	
UKMO, ECMWF (Atmospheric forcing)	Lon: -4 to 9 Lat: 48.5 to 57		X	
Weekly climatology of river discharge (fresh water only) computed on period 1990-2010 (Land forcing)	Lon: -4 to 9 Lat: 48.5 to 57		X	

3.4.1 INSITU_NWS_NRT_OBSERVATIONS_013_036

In situ observations of temperature, salinity, currents, sea level, biogeochemical variables and wave data.



3.4.1.1 Used variables

- Sea wave height (SWH)
- Sea surface elevation

Temporal Resolution: Instantaneous

3.4.2 NORTHWESTSHELF_ANALYSIS_FORECAST_PHYS_004_013

3.4.2.1 Used variables

- Current
- Salinity
- Temperature
- Sea surface elevation

Temporal Resolution: Hourly

3.4.3 NORTHWESTSHELF_REANALYSIS_PHY_004_009

3.4.3.1 Used variables

- Salinity
- Temperature

Temporal Resolution: Daily

3.4.4 SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001

3.4.4.1 Used variables

- Sea surface temperature

Temporal Resolution: Daily

3.4.5 NORTHWESTSHELF_ANALYSIS_FORECAST_WAV_004_014

3.4.5.1 Used variables

- Significant waves height
- Mean waves direction
- Zero-up crossing period

Temporal Resolution: Hourly

3.4.6 Harmonic Astronomical Tide - Continental Shelf – COHERENS

3.4.6.1 Used variables

- Sea surface elevation



Temporal Resolution: Hourly

3.4.7 Physical State of the Sea - Belgian Coastal Zone - COHERENS UKMO

3.4.7.1 Used variables

- Current
- Salinity
- Temperature
- Sea surface elevation

Temporal Resolution: Hourly

3.4.8 Physical State of the Sea - North Sea - COHERENS UKMO

3.4.8.1 Used variables

- Current
- Salinity
- Temperature
- Sea surface elevation

Temporal Resolution: Hourly

3.4.9 Tide - Continental Shelf - COHERENS UKMO

3.4.9.1 Used variables

- Sea surface elevation

Temporal Resolution: Hourly

3.4.10 Wave field - North Sea - WAM ECMWF

3.4.10.1 Used variables

- Significant waves height
- Mean waves direction
- Zero-up crossing period

Temporal Resolution: Hourly

3.4.11 Wave field - North Sea - WAM UKMO

3.4.11.1 Used variables

- Significant waves height
- Mean waves direction
- Zero-up crossing period



Temporal Resolution: Hourly

3.4.12 Seasonal forecast of ECMWF

3.4.12.1 Used variables

- Wind at 10m
- Air temperature at 2m
- Atmospheric pressure at MSL
- Relative humidity or dew point at 2m
- Cloud coverage
- Total precipitation

Temporal Resolution: Hourly

3.4.13 Mapping of all river data available from all national INSPIRE data portals

3.4.13.1 Used variables

- River discharges

Temporal Resolution: Hourly

3.4.14 Identified Threshold Values

Both datasets in the following table share the same water temperature threshold value of 14°C, as it represents the temperature above which seaweeds start degrading, which may cause the production to be lost.

Table 7: Threshold values identified for each dataset by Pilot 4.

Dataset	Threshold Values
NORTHWESTSHELF_ANALYSIS_FORECAST_PHYS_004_013	T = 14°C
NORTHWESTSHELF_REANALYSIS_PHY_004_009	T = 14°C

3.4.15 Identified Gaps

The main gap found in the pilot is to obtain long term trends and correct river inputs, which are currently based on climatology. It is the reason why the pilot is interested in obtaining updated river load and seasonal forecasts.

On the other hand, seasonal forecasts are also associated with an important level of uncertainty.

3.5 Pilot 5: Galway Bay, Ireland (Atlantic Ocean) - Bivalve mariculture sector and wider fisheries sector

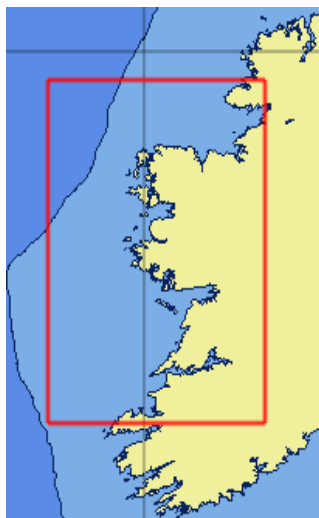


Figure 5: Study area (Pilot 5).

FORCOAST will provide invaluable help in aspects such as:

- Modelling services to map distribution of salinities, temperature, nutrients and siltation under different meteorological forcing and tidal conditions
- Laboratory tests of tolerance of oysters to a range of temperatures and salinities
- Mapping of suitable habitat for oysters based on salinity, temperature and turbidity
- Larval dispersal modelling to optimize the location of spawning stocks and deliver higher rates of settlement
- Habitat modification to enhance larval settlement

Table 8: Data sources used by Pilot 5.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
IBI_REANALYSIS_PHYS_005_002	Lon: -11 to -8 Lat: 52 to 54	X		
IBI_ANALYSIS_FORECAST_BIO_005_004	Lon: -11 to -8 Lat: 52 to 54		X	

INSITU_IBI_NRT_OBSERVATIONS_013_033	Lon: -11 to -8 Lat: 52 to 54	X		X
INSITU_IBI_TS_REP_OBSERVATIONS_013_040	Lon: -11 to -8 Lat: 52 to 54	X		X
OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037	Lon: -11 to -8 Lat: 52 to 54	X		X
MI Inner Galway Bay model (under development)	Lon: -11 to -8 Lat: 52 to 54	X		
MI Connemara biogeochemical model (under development)	Lon: -11 to -8 Lat: 52 to 54	X		
Sub 300m resolution SST	Lon: -11 to -8 Lat: 52 to 54	X		X
Sub 300m resolution chlorophyll	Lon: -11 to -8 Lat: 52 to 54	X		X
Galway Bay Observatory ADCP data	Lon: -11 to -8 Lat: 52 to 54	X		X
Galway Bay Observatory CTD data	Lon: -11 to -8 Lat: 52 to 54	X		X
Galway Bay Observatory Fluorometer Data	Lon: -11 to -8 Lat: 52 to 54	X		X
Other satellite data requests from the ESA Data Warehouse	Centred at 53.2°N, 9°W Dims: 36 x 20 km	X		X
ECMWF (Atmospheric forcing)	Lon: -11 to -8 Lat: 52 to 54		X	
The main river NRT discharge data, other rivers monthly climatologies (Land forcing)	Lon: -11 to -8 Lat: 52 to 54		X	

3.5.1 IBI_REANALYSIS_PHYS_005_002

3.5.1.1 Used variables

- Currents
- Temperature
- Salinity
- Sea water level



Temporal Resolution: Hourly

3.5.2 IBI_ANALYSIS_FORECAST_BIO_005_004

3.5.2.1 *Used variables*

- Chlorophyll
- Nitrates
- Ammonia
- Phosphates

Temporal Resolution: Daily

3.5.3 INSITU_IBI_NRT_OBSERVATIONS_013_033

3.5.3.1 *Used variables*

- All available

Temporal Resolution: Hourly

3.5.4 INSITU_IBI_TS_REP_OBSERVATIONS_013_040

3.5.4.1 *Used variables*

- All available

Temporal Resolution: Hourly

3.5.5 OCEANCOLOUR_ATL_CHL_L4_NRT_OBSERVATIONS_009_037

3.5.5.1 *Used variables*

- Chlorophyll

Temporal Resolution: Daily

3.5.6 MI Inner Galway Bay model (under development)

3.5.6.1 *Used variables*

- Currents
- Temperature
- Salinity
- Water level
- Coliforms and/or tracer

Temporal Resolution: Daily

3.5.7 MI Connemara biogeochemical model (under development)

3.5.7.1 Used variables

- Chlorophyll
- Nitrates
- Ammonia
- Phosphates

Temporal Resolution: Daily

3.5.8 Sub 300m resolution SST

3.5.8.1 Used variables

- Temperature

Temporal Resolution: Daily

3.5.9 Sub 300m resolution chlorophyll

3.5.9.1 Used variables

- Chlorophyll

Temporal Resolution: Daily

3.5.10 Galway Bay Observatory ADCP data

3.5.10.1 Used variables

- Currents

Temporal Resolution: Hourly

3.5.11 Galway Bay Observatory CTD data

3.5.11.1 Used variables

- Temperature
- Salinity

Temporal Resolution: Hourly

3.5.12 Galway Bay Observatory Fluorometer Data

3.5.12.1 Used variables

- Chlorophyll



Temporal Resolution: Hourly

3.5.13 Other satellite data requests from the ESA Data Warehouse

Other satellite data include 24 scenes from the study area, as shown in the table at the start of this section.

3.5.14 Identified Gaps

The service currently does not exist for our pilot. Identified risks:

- The pilot area is very local and most of the gridded datasets listed are too coarse. They are still useful though as it is of interest to get a bigger picture, i.e. what is happening in waters surrounding the pilot area
- Numerical models providing inaccurate information (as can be the case with every numerical model)
- Lack of in-situ data in the area covered by the pilot
- Unavailability of accurate real-time freshwater inputs for inclusion in the model resulting in inaccurate representation of salinity, with salinity being a key parameter of interest.



3.6 Pilot 6: Denmark (Baltic-North Sea Transition) - Bivalve mariculture (oysters), oysterground restoration



Figure 6: Study area (Pilot 6).

ForCoast will try to develop and provide tailored products for real-time oyster farming operations. Environmental service for oyster restoration needs high quality data. Currently, no such service exists in the Limfjord, as CMEMS MFCs do not provide forecasts for the Limfjord region. Only SST and chl-a from remote sensing are provided by CMEMS TACs. Model products from CMEMS NWS MFC and BAL MFC will be used as a boundary condition to create a downscaled Limfjord model system. CMEMS SST and chl-a will be used as validation and/or assimilation data.

Table 9: Data sources used by Pilot 6.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
INSITU_NWS_NRT_OBSERVATIONS_013_036	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2			X
NORTHWESTSHELF_ANALYSIS_FORECAST_PHYS_004_001_b	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	
NORTHWESTSHELF_REANALYSIS_PHY_004_009	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	
SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2			X
BALTICSEA_ANALYSIS_FORECAST_PHY_003_006	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	
BALTICSEA_REANALYSIS_PHY_003_011	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	
INSITU_BAL_NRT_OBSERVATIONS_013_032	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2			X
Overfladevandsdatabasen ODA (Aarhus university)	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	X

DMI-Harmonie atmospheric moder, 2.5km resolution (Atmospheric forcing)	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	
HBM (Atmospheric forcing)	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	
Europe HYPE river discharge (Land forcing)	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	
SWAT (Land forcing)	Lon: 7.8 to 10.5 Lat: 56.4 to 57.2		X	

3.6.1 INSITU_NWS_NRT_OBSERVATIONS_013_036

In situ observations of temperature, salinity, currents, sea level, biogeochemical variables and wave data.

3.6.1.1 Used variables

- All available

Temporal Resolution: Hourly

3.6.2 NORTHWESTSHELF_ANALYSIS_FORECAST_PHYS_004_001_b

This NW European shelf dataset includes 3D daily mean fields of sea surface height, temperature, salinity, zonal velocity, meridional velocity, Mixed Layer Depth and Temperature at the sea floor, at a 7km resolution.

3.6.2.1 Used variables

- Salinity
- Temperature
- Sea level
- Currents

Temporal Resolution: Hourly

3.6.3 NORTHWESTSHELF_REANALYSIS_PHY_004_009

This NW European shelf reanalysis dataset includes the same variables as the previous dataset.

3.6.3.1 Used variables

- Salinity
- Temperature
- Sea level
- Currents

Temporal Resolution: Daily



3.6.4 SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001

Global sea surface temperature near real time dataset at a 0.05 degrees resolution.

3.6.4.1 Used variables

- Sea surface temperature

Temporal Resolution: Daily

3.6.5 BALTICSEA_ANALYSIS_FORECAST_PHY_003_006

3.6.5.1 Used variables

- Salinity
- Temperature
- Sea level
- Currents

Temporal Resolution: Hourly

3.6.6 BALTICSEA_REANALYSIS_PHY_003_011

3.6.6.1 Used variables

- Salinity
- Temperature
- Sea level
- Currents

Temporal Resolution: Daily

3.6.7 INSITU_BAL_NRT_OBSERVATIONS_013_032

3.6.7.1 Used variables

- All available

Temporal Resolution: Hourly

3.6.8 Overfladevandsdatabasen ODA (Aarhus university)

3.6.8.1 Used variables

- All available

Temporal Resolution: Variable



3.7 Pilot 7: Romania, Bulgaria, Ukraine (Black Sea) - Bivalve mariculture sector, oysterground restoration

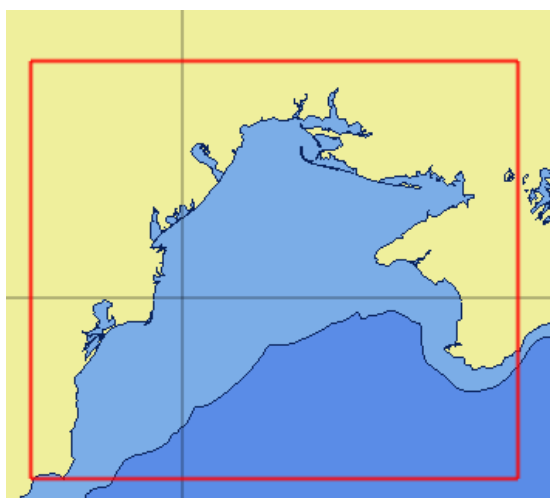


Figure 7: Study area (Pilot 7).

A downscaling of the existing CMEMS BS-MFC-BIO forecast to 1km resolution will be developed and validated, focusing on the North-western and eventually western Bulgarian shelves (depending on user interests). Of great interest is the spatial distribution of the Danube tributaries and their share in water flow and nutrient loads. Tailored information products combining model and earth observation will be proposed, matching user requirements to be identified in consultation with ADC-S. Target TRL for the service is 7, provided those products can be distributed on the project’s common platform.

Table 10: Data sources used by Pilot 7.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
BLKSEA_ANALYSIS_FORECAST_PHYS_007_001	Lon: 25.52 to 33.75 Lat: 44 to 46.67		X	
BLKSEA_ANALYSIS_FORECAST_WAV_007_003	Lon: 25.52 to 33.75 Lat: 44 to 46.67	X		
BLKSEA_ANALYSIS_FORECAST_BIO_007_010	Lon: 25.52 to 33.75 Lat: 44 to 46.67		X	
INSITU_BS_NRT_OBSERVATIONS_013_034	Lon: 25.52 to 33.75 Lat: 44 to 46.67			X
OCEANCOLOUR_BS_CHL_L4_NRT_OBSERVATIONS_009_045	Lon: 25.52 to 33.75 Lat: 44 to 46.67			X (Also assimilation)
OCEANCOLOUR_BS_CHL_L3_NRT_OBSERVATIONS_009_044	Lon: 25.52 to 33.75 Lat: 44 to 46.67			X (Also assimilation)
OCEANCOLOUR_BS_OPTICS_L3_NRT_OBSERVATIONS_009_042	Lon: 25.52 to 33.75 Lat: 44 to 46.67			X

SST_BS_SST_L4_NRT_OBSERVATIONS_010_006	Lon: 25.52 to 33.75 Lat: 44 to 46.67			X
ECMWF ERA5	Lon: 25.52 to 33.75 Lat: 44 to 46.67		X	
PERSEUS + hidro.ro (Land forcing)	Lon: 25.52 to 33.75 Lat: 44 to 46.67		X	

In the following CMEMS datasets, all the available variables are used.

3.7.1 BLKSEA_ANALYSIS_FORECAST_PHYS_007_001

This model displays T, S, SSH and U,V at a horizontal grid resolution of 1/36° in zonal resolution, 1/27° in meridional resolution (ca. 3 km) and has 31 unevenly spaced vertical levels.

3.7.2 BLKSEA_ANALYSIS_FORECAST_WAV_007_003

0.037x0.028 degrees resolution Black Sea wave model (wave height, period, Stokes drift), with 10 days forecast and a one-hourly output once a day.

3.7.3 BLKSEA_ANALYSIS_FORECAST_BIO_007_010

Biogeochemical model with a 28-variable pelagic component and a 6-variable benthic component, with a 0.037x0.028 degrees resolution.

3.7.4 INSITU_BS_NRT_OBSERVATIONS_013_034

These in situ data are collected from the Black Sea GOOS members and complemented by the observation collected by the Global INS TAC in the area. It is updated continuously and provides observations with 24-48 hours from acquisition in average.

3.7.5 OCEANCOLOUR_BS_CHL_L4_NRT_OBSERVATIONS_009_045

Level 4 chlorophyll data with 1km spatial resolution.

3.7.6 OCEANCOLOUR_BS_CHL_L3_NRT_OBSERVATIONS_009_044

Level 3 chlorophyll data with 1km spatial resolution.

3.7.7 OCEANCOLOUR_BS_OPTICS_L3_NRT_OBSERVATIONS_009_042

1km resolution Inherent Optical Properties, diffuse attenuation coefficient of light at 490 nm, Secchi depth, spectral Remote Sensing Reflectance, Coloured Dissolved Organic Matter and the non-organic Solid Particulate Matter (SPM).

3.7.8 SST_BS_SST_L4_NRT_OBSERVATIONS_010_006

Sea Surface Temperature daily gap-free maps (L4) at high (HR 0.0625°) and ultra-high (UHR 0.01°) spatial resolution over the Black Sea.

3.7.9 ECMWF ERA5

Used variables:

- Air temperature and Dew point temperature at 2m
- Zonal and meridional winds at 10 m
- Cloud cover
- Precipitation
- Mean sea level pressure

3.7.10 Identified Gaps

There is an important gap in relation to riverine and land discharge data, both for freshwater discharge and load and their impact in nutrients and organic matter. This may be critical for accurate prediction, not only in terms of biogeochemistry but also as an important factor affecting vertical stratification in the estuarine area.

3.8 Pilot 8: Italy (Northern Adriatic Sea) - Bivalve mariculture sector

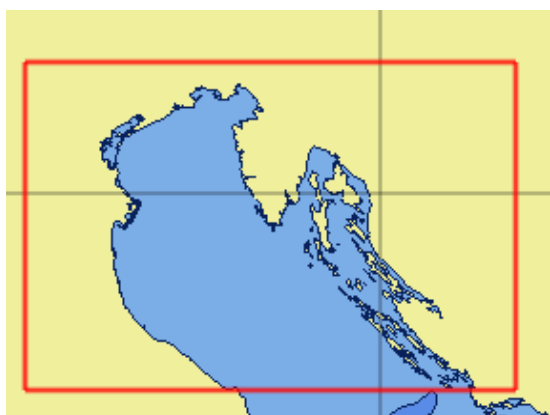


Figure 8: Study area (Pilot 8).

This Pilot builds on already existing products, developed at the COPERNICUS Mediterranean Marine Service and COPERNICUS User Uptake project CADEAU, in order to:

- i. Assess status and evolution of both physical and biogeochemical variables that affect mariculture activities
- ii. Provide hazard maps, related to the potential occurrence of phenomena impacting on aquaculture (e.g., heat waves, hypoxia, spreading of pollutants)
- iii. Perform short to medium term analysis and forecasts of these specific products.

The modelling part will improve the representation of the runoff and nutrients input from rivers and benefit from the data assimilation scheme that integrates high-resolution remote sensing products based on regional algorithms for optically complex waters.

Table 11: Data sources used by Pilot 8.

Dataset	Area	Type of use in FORCOAST		
		Direct Use	Model Forcing	Model Validation
MEDSEA_REANALYSIS_BIO_006_008	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
MEDSEA_REANALYSIS_PHYS_006_004	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
OCEANCOLOUR_MED_CHL_L3_REP_OBSERVATIONS_009_073	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
MEDSEA_ANALYSIS_FORECAST_BIO_006_014	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
MEDSEA_ANALYSIS_FORECAST_PHY_006_013	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		

OCEANCOLOUR_MED_CHL_L3_NRT_OBSERVATIONS_009_040	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
SST_MED_SST_L4_REP_OBSERVATIONS_010_021	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
SST_MED_SST_L4_NRT_OBSERVATIONS_010_004	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
OCEANCOLOUR_MED_CHL_L4_NRT_OBSERVATIONS_009_041	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
CoastColour_L2W_conc_chl_nn	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
CoastColour_L2W_conc_tsm	Lon: 12.22 16.08 Lat: 43.47 to 45.81	X		
ALADIN (4.4 km) / COSMO (2.2 km) (Atmospheric forcing)	Lon: 12.22 16.08 Lat: 43.47 to 45.81		X	
Real-time discharge data for the main river (Po), climatologies for other minor rivers (Land forcing)	Lon: 12.22 16.08 Lat: 43.47 to 45.81		X	

3.8.1 MEDSEA_REANALYSIS_BIO_006_008

Mediterranean Sea biogeochemistry reanalysis dataset at 1/16-degree resolution. It includes CHL, phytoplankton, O₂, NO₃, PO₄ concentrations, as well as primary production.

3.8.1.1 Used variables

- Biogeochemistry (51 BFM variables)

Temporal Resolution: Daily

3.8.2 MEDSEA_REANALYSIS_PHYS_006_004

Mediterranean Sea physical reanalysis dataset at 1/16-degree resolution. It includes temperature, salinity, sea surface height and water velocity.

3.8.2.1 Used variables

- Currents
- Temperature
- Salinity

Temporal Resolution: Daily



3.8.3 OCEANCOLOUR_MED_CHL_L3_REP_OBSERVATIONS_009_073

Mediterranean Sea level 3 chlorophyll dataset with 1km resolution.

3.8.3.1 Used variables

- Chlorophyll

Temporal Resolution: Daily

3.8.4 MEDSEA_ANALYSIS_FORECAST_BIO_006_014

Biogeochemical analysis and forecasts for the Mediterranean Sea at 1/24 degrees using the OGSTM-BFM model coupled with the 3DVarBio assimilation scheme.

3.8.4.1 Used variables

- Biogeochemistry (51 BFM variables)

Temporal Resolution: Daily

3.8.5 MEDSEA_ANALYSIS_FORECAST_PHY_006_013

Physical component of the Mediterranean Forecasting System (Med-Currents) with a 1/24-degree resolution.

3.8.5.1 Used variables

- Currents
- Temperature
- Salinity

Temporal Resolution: Daily

3.8.6 OCEANCOLOUR_MED_CHL_L3_NRT_OBSERVATIONS_009_040

Level 3 chlorophyll observations at 1km spatial resolution.

3.8.6.1 Used variables

- Chlorophyll

Temporal Resolution: Daily

3.8.7 SST_MED_SST_L4_REP_OBSERVATIONS_010_021

Level 4 sea surface temperature reprocessed observations at 1/24-degree resolution.

3.8.7.1 Used variables

- Sea surface temperature



Temporal Resolution: Daily

3.8.8 SST_MED_SST_L4_NRT_OBSERVATIONS_010_004

Same as the previous dataset, but near real time data.

3.8.8.1 Used variables

- Sea surface temperature

Temporal Resolution: Daily

3.8.9 OCEANCOLOUR_MED_CHL_L4_NRT_OBSERVATIONS_009_041

Level 4 chlorophyll observations at 1km spatial resolution.

3.8.9.1 Used variables

- Chlorophyll

Temporal Resolution: Daily

3.8.10 CoastColour_L2W_conc_chl_nn

The CoastColour project was launched by the European Space Agency to fully exploit the potential of the MERIS instrument for remote sensing of the coastal zone. More information can be found at <https://www.coastcolour.org/index.html>.

The L2W product provides information about water properties such as IOPs, concentrations and other variables. It also contains an ortho-corrected geo-coding and different flags characterizing pixels.

3.8.10.1 Used variables

- Full resolution surface chlorophyll

Temporal Resolution: Daily

3.8.11 CoastColour_L2W_conc_tsm

3.8.11.1 Used variables

- Full resolution surface total suspended matter

Temporal Resolution: Daily

3.8.12 Identified Gaps

SST from satellite not available at local-scale resolution (i.e., less than 1km) on coastal area; lack of continuous, synoptic data regarding water quality (i.e., nutrients such as phosphate and nitrates).



3.8.13 Identified Threshold Values

3.8.13.1 Surface Chlorophyll

A surface chlorophyll threshold of 15 mg m^{-3} has been identified. This magnitude shall be compared to the actual P90 value to determine eutrophication risk and non-risk areas; if trends are evaluated, 10% will be considered as the percentage corresponding to the dimensional trend [$\text{mg m}^{-3} \text{ y}^{-1}$] with respect to the climatological CHL concentration values.

3.8.13.2 Surface Temperature

Regarding sea surface temperature, two thresholds have been identified, one in the winter (6°C) and another one in the summer (28°C) (Malagoli et al., 2007).

3.8.13.3 Surface Total Suspended Matter

A final threshold of 4.5 mg L^{-1} is considered for surface total suspended matter (Brigolin et al., 2009).

Table 12: Threshold values identified for each dataset by Pilot 8.

Dataset	Threshold Values
OCEANCOLOUR_MED_CHL_L3_REP_OBSERVATIONS_009_073 OCEANCOLOUR_MED_CHL_L4_NRT_OBSERVATIONS_009_041 CoastColour_L2W_conc_chl_nn	Surface Chlorophyll = 15 mg m^{-3}
SST_MED_SST_L4_REP_OBSERVATIONS_010_021 SST_MED_SST_L4_NRT_OBSERVATIONS_010_004	SST (winter) = $6 \pm 1^\circ\text{C}$ SST (summer) = $28 \pm 1^\circ\text{C}$
CoastColour_L2W_conc_tsm	Surface total suspended matter = 4.5 mg L^{-1}

4 Conclusions

The purpose of this document has been to show the different CMEMS datasets currently used by the eight Pilots that are part of the FORCOAST project, as well as those produced by other Earth Observation data providers.

This list of required data will be the starting point for the next task of implementing the cloud service. As the necessary data and sources have been identified, the next phase of downloading, processing and making it available to the different Pilots can start.

We can see that the data sources will be quite abundant and heterogeneous. Regarding the type of use, we can see different ways of using the data depending on the Pilot: direct use, as input for their own models or to validate them.

Each Pilot has indicated what information is required to successfully complete each of their tasks, as well as the thresholds that must be considered in each measured variable that may limit the production or cause harm to the different species involved. In the following lines each of these two aspects is summarized.

4.1 Data Gaps

Three pilots explicitly mention river model forcings as a substantive gaps in data provision. This situation should be followed closely and any potential alleviation should be reported to updated version of this document.

In particular, this deficiency should be reported i) at pilot scale to local stakeholders who may be aware of local datasets and/or on the potential to establish monitoring framework, ii) at the project scales and scientific advisory board to identify European scale initiative aiming at that issue (eg. CMEMS-CLS common initiative).

Downscaled Atmospheric products (local atmospheric models) are considered in four pilots. This is probably relevant given the FORCOAST ambition of providing adequate services at a very local scale. It might be considered within the project lifetime to evaluate whether the lack of very high resolution atmospheric products in some pilots is prejudicial to service quality and to seek for alleviation tracks (eg. such as implementing local atmospheric models).

The very coastal character of FORCOAST pilots issues a concern regarding high resolution satellite products, in terms of spatial resolution and in terms of product quality in the vicinity of the coastline. This has been reported only for one pilot (Pilot 8), but may be relevant also to other areas.

Finally, there is a large inhomogeneity in terms of in-situ observation datasets being available for model validations, with several pilots not reporting validation datasets at all. This will be of concern, regarding the set-up of centralized (or at least standardized) model validation procedures. This being said, it is known that several pilots implement their own monitoring framework in the view of validating pilot models locally. It has to be decided with the consortiums whether such newly acquired datasets should make the object of some project scale inventory and/or data infrastructure.

4.2 Threshold Values

Some Pilots indicate provided threshold values that might affect mussel growth, such as sea surface temperature values, chlorophyll concentration and total suspended matter.

In the case of Pilot 4, which couples mussel and seaweed production, a temperature threshold of 14°C has been identified as an upper temperature limit, as temperatures above this value could cause seaweed degradation.

Finally, another Pilot (Pilot 8 – Italy) identifies a 15 mg m⁻³ chlorophyll concentration value above which eutrophication may occur.

This heterogeneity in reported information regarding biological thresholds, is comprehensible given the different local requirements, environmental conditions and considered sectors.

Nevertheless, if services such as alert systems are to be developed in a project-wide centralized way, it will probably be necessary to refine threshold value explicitly for selected services by involving local pilots stake holders.



5 References

Malagoli, D., Casarini, L., & Ottaviani, E. (2007). Monitoring of the immune efficiency of *Mytilus galloprovincialis* in Adriatic Sea mussel farms in 2006: regular changes of cytotoxicity during the year. *Invertebrate Survival Journal*, 4(1), 10-12.

Brigolin, D., Dal Maschio, G., Rampazzo, F., Giani, M., & Pastres, R. (2009). An individual-based population dynamic model for estimating biomass yield and nutrient fluxes through an off-shore mussel (*Mytilus galloprovincialis*) farm. *Estuarine, Coastal and Shelf Science*, 82(3), 365-376.

Other references:

- [CMEMS datasets catalogue](#)
- [CoastColour](#)
- [SMHI](#)
- [Overfladevandsdatabasen ODA \(Aarhus university\)](#)

