GMES INITIAL OPERATIONS / COPERNICUS LAND MONITORING SERVICES – VALIDATION OF PRODUCTS

TECHNICAL SUPPORT FOR THE IMPROVEMENT OF PAN-EUROPEAN AND LOCAL COMPONENT PRODUCTS INCLUDING IN-SITU DATA, IN VIEW OF THEIR INTEGRATION IN A FULLY OPERATIONAL AND HIGH QUALITY COPERNICUS LAND SERVICE (LOT 2)

Framework Service Contract EEA/MDI/14/010 – LOT 2 – SPECIFIC CONTRACT

Technical report for Generation of boundary layers for 39 EEA member countries

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Document Issue: 1.0
Date: 20/7/21

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Executive Summary

JOANNEUM RESEARCH is leader of the consortium for the framework service contract awarded for the Validation Services for the geospatial products of the Copernicus land Continental and local components including in-situ data (Lot 2) in response to the call for tenders n° EEA/MDI/14/010 Framework service contract for the GMES Initial Operations / Copernicus Land monitoring services. This document covers the elements related to the specific contract for generation of boundary layers for 39 EEA member countries.

For the production of the CLMS HRL's, and other pan-European products, a consistent, stable, sufficiently detailed boundary layer is necessary, which provides both a "land mask" for the area that needs to be produced, as well as national boundaries for the delivery of national projection products. Details including description of tasks, deliverables and deadlines are specified in the Request for Service. This is the final technical report.

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List of Abbreviations

CFA	EEA coastline for analysis V2
DEM	Digital Elevation Model
DSM	Digital Surface Model
DTM	Digital Terrain Model
DZRO	Observable Riparian Zone
EBM	EBM-V12
EC	European Commission
EEA	European Environment Agency
ESA	European Space Agency
ESTAT	Eurostat
EU	European Union
GAF	GAF AG
GIO	GMES Initial Operations
GISC	GMES In Situ Coordination
GISCO	GISCO 100K
GMES	Global Monitoring for Environment and Security
GSHHG	a Self-consistent, Hierarchical, High-resolution Geography Database
GSW	Global Surface Water
HYBRID	EBM GISCO Hybrid Layer
HYDRO	EU-Hydro Coastline V3
IBLayer	Improved Boundary Layer
IRS-P5	Indian Space Research Organization CartoSat 1 satellite mission
JR	Joanneum Research
JRC	Joint Research Centre
N/A	Not Available
RZ	RZ-AOI
SIRS	Systèmes d'Information à Référence Spatiale
SPOT	Satellite Pour l'Observation de la Terre/Satellite for observation of Earth
SRTM	Shuttle Radar Topography Mission
VHR	Very High Resolution
WAW	WaW HRL2015

1. Introduction

JOANNEUM RESEARCH is leader of the consortium for the framework service contract awarded for the Validation Services for the geospatial products of the Copernicus land Continental and local components including in-situ data (Lot 2) in response to the call for tenders n° EEA/MDI/14/010 Framework service contract for the GMES Initial Operations / Copernicus Land monitoring services. This document covers the elements related to the specific contract offer for generation of boundary layers for 39 EEA member countries. Details including description of tasks, deliverables and deadlines are specified in the Request for Service [AD 13].

Applicable Documents:

[AD 1] Contract Notice[1]
[AD 2] Invitation to Tender[1]
[AD 3] Annex I – Tender Specifications[1]
[AD 4] Annex 1: Tender Submission Form[1]
[AD 5] Annex 2: Declaration on Exclusion Criteria[1]
[AD 6] Annex 3: Legal Entity Form[1]
[AD 7] Annex 4: Financial Identification Form[1]
[AD 8] Annex 5: Price Quotation[1]
[AD 9] Annex 6: Draft Framework Service Contract[1]
[AD 10] Annex 7: Reimbursement of Travel Expenses[1]
[AD 11] Consortium Technical, Financial & Administrative Offer1
[AD 12] EEA/MDI/14/010 – Signed Framework service contract1
[AD 13] Request for Services, EEA, 22-Aug-2018 under FWC EEA.MDI.14.010.Lot 2.pdf
[AD 14] EBM_v12_QualityReport V1.0 15.01.2018

[1] Part of the Open Call for Tenders n° EEA/MDI/14/010 - Framework service contract for the GMES Initial Operations / Copernicus Land monitoring services – Technical support for the improvement of Pan-European and local component products including in-situ data, in view of their integration in a fully operational and high quality Copernicus land service (Lot 2).

2. Task 1 - Evaluate available datasets

A number of datasets is used for the improved layers, and were evaluated in Task 1 in detail, taking into account regional quality and the best potential for the reduction of omitted landmass areas.

Following input GIS data were provided by the EEA at project start:

- EU-Hydro Coastline V3 (HYDRO)
- EEA coastline for analysis V2 (CFA)
- EBM-V12 (EBM)
- GISCO 100K (GISCO)
- EBM GISCO Hybrid Layer (HYBRID)
- WaW HRL2015 (WAW)
- JRC Water Layers Global Surface Water Layers[2]
- RZ-AOI (RZ): The RZ-AOI provides a hybrid layer between GISCO and EU-Hydro at the eastern EEA land border. The GISCO border has been modified in areas where rivers constitute the border to assure that the border runs in the middle of the river.

In a first step, EBM line segments were compared and the best national border data selected (from EBM, GISCO, HYBRID and RZ) (see 6.1).

The EBM “national border” is corrected in Task 2, based on the analysis results which are summarized in the next section.

[2] The JRC Global Water Surface Layers were downloaded from the Global Surface Water Explorer.

2.1. Datasets Evaluation

The following table summarizes the results of the analysis.

Table 2-1: Evaluation of datasets

Layer	EU-Hydro Coastline	EEA coastline for analysis V2	EBM-V12
Abbreviation	HYDRO	CFA	EBM
Producer	-	-	EuroGeographics
Source	EEA	EEA	EEA
Main Reference	EEA, 2015 a. Copernicus Land Monitoring Service - Local Component: EU-Hydro https://land.copernicus.eu/imagery-in-situ/eu-hydro EEA, 2017 b. Technical Note to Consultancy Task 4 Investigation of a standardized fresh water – sea water boundary to clearly define a delineation between these classes.	EEA, 2017 d. EEA coastline for analysis https://www.eea.europa.eu/data-and-maps/data/eea-coastline-for-analysis-1 EEA, 2017 a. Technical Note to Consultancy Task 3 Investigation of geometric EBM_v11 Issues. EEA, 2017 b. Technical Note to Consultancy Task 4 Investigation of standardized fresh water – sea water boundary to clearly define delineation between these classes.	EuroGeographics, 2018 a. EuroBoundaryMap Data product specification. Refers to production of v12 product. EuroGeographics, 2018 b. EuroBoundaryMap Technical Giude. EuroGeographics, 2018 c. EBM Data Quality Report. EEA, 2017 a. Technical Note to Consultancy Task 3 Investigation of geometric EBM_v11 Issues. EEA, 2017 b. Technical Note to Consultancy Task 4 Investigation of a standardized fresh water – sea water boundary to clearly define a delineation between these classes. United Nations Convention of the Law of the Sea (UNCLOS) see UNITED NATIONS 1982.
EPSG / CRS	3035 / ETRS-LAEA	3035 / ETRS-LAEA	3035 / ETRS-LAEA
Data format	Geodatabase	Shapefile	Geodatabase, Shapefile, Related Tables
Geometry	Polygon	Line, Polygon	Point, Line, Polygon, Tables
Level of Detail (Degree of Generalisation)	2.5 m (SP05 and SP06) 1:50 000	1:100 000	1:100 000 Positional accuracy varies. For some countries the accuracy is lower than 50 m e.g. (like Belgium, Estonia, Finland, Luxembourg or Portugal). In other cases it is higher: 75 m (Slovakia e.g.) – 125 m (Greenland, Spitsbergen e.g.) is also possible for some areas throughout Europe. In some Swedish areas up to 300 m are possible (see Quality Report EBM-V12 [AD14]).
Thematic Content	Coastal polygons of EEA member and collaborating countries; coastlines and shorelines	Coastline for EEA member and collaborating countries	"(…) European reference database of administrative units and boundaries (…)" (EUROGEOGRAPHICS 2018).
Coastline definition	N. A. Interpreted as land – sea border, the coastline is used	„(…) line separating water from land" (EEA 2017).	United Nations Convention of the Law of the Sea (UNCLOS) see UNITED NATIONS 1982.

	as feature to classify inland waters (EEA 2015 a).		

Layer	EU-Hydro Coastline	EEA coastline for analysis V2	EBM-V12
Spatial Extent	**EEA members and collaborating countries:** Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark **(excluding Greenland),** Estonia, Finland, France **(including French DOM's: Guadeloupe, Martinique and French Guiana as well as Reunion and Mayotte)**, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, the former Yugoslavian Republic of Macedonia, Malta, Montenegro, Netherlands, Norway, Poland, Portugal (including Azores and Madeira), Romania, Serbia, Slovakia, Slovenia, Spain (including Canarias), Sweden, Switzerland, **Turkey**, United Kingdom; **excluding Spitsbergen.**	**EEA members and collaborating countries:** Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark **(excluding Greenland),** Estonia, Finland, France **(including French DOM's: Guadeloupe, Martinique and French Guiana as well as Reunion and Mayotte)**, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, the former Yugoslavian Republic of Macedonia, Malta, Montenegro, Netherlands, Norway, Poland, Portugal (including Azores and Madeira), Romania, Serbia, Slovakia, Slovenia, Spain (including Canarias), Sweden, Switzerland, **Turkey**, United Kingdom; **excluding Spitsbergen.**	**Core Europe, A:** Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark (including Faroe Islands) Estonia, Finland, France (including Monaco), Germany, Greece, Hungary, Ireland, Italy (including San Marino and Vatican City), Kosovo, Latvia, Lithuania, Luxembourg, the former Yugoslavian Republic of Macedonia, Malta, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain (including Andorra and Gibraltar), Sweden, Switzerland (including Liechtenstein), United Kingdom, Ukraine. **B:** Iceland, Greenland (part of Denmark). **C:** Canary Islands (part of Spain), Azores and Madeira (part of Portugal). **D:** French oversea territories – Guadeloupe, French Guiana, Martinique, Saint Barthélemy, Saint-Martin. **E:** French oversea territories – Reunion and Mayotte. The letters A to E refer to the 5 EBM_V12 bounding boxes. **Spitsbergen is excluded from the product. Placeholders** on country level derived "(…) from freely available small-scale data" (EUROGEOGRAPHICS 2018) are included for **Montenegro, Belarus, Russian Federation, Georgia, Turkey, Isle of Man, Jersey and Guernsey as well as Falkland Islands** (EUROGEOGRAPHICS 2018).
MMU	1 ha	-	4 ha (with exception for main areas < 4 ha and small islands or exclaves of major importance).
MMW	-	-	30m (MMLength of linear features)
Reference Year	2006, 2009 and 2012	2015 (created)/2017 (last modified)	2017
Reference	HR image data	EU-Hydro and GSHHG (=a Self-consistent, Hierarchical, High-resolution Geography Database)	National source databases from European National Mapping and Cadastral Agencies, members of EuroGeographics, freely available small-scale datasets for placeholders of potential EBM countries.
Islands	Comprehensive delineation of islands, see Archipelago of the Finish coast, less generalization.	Good delineation of islands; omission and commission errors observed; the configuration of the islands form is not always accurate.	Clear omission, see Archipelago of the Swedish or Finnish coast. Generalization due to a political coastline definition.
Omission of	Land-area cut-offs observed, landmass omission is	Land-area cut-offs observed, landmass omission more	Land-area cut-offs observed, landmass omission more

Landmass	manageable.	severe than in EU-Hydro.	severe than in EU-Hydro.
Coastline	Fewer generalisations.	Quite accurate, artefacts observed, more generalized than EU-Hydro.	Deviation from the actual coastline according to the VHR reference data or other more detailed datasets, EU-Hydro e.g.

Layer	**GISCO100K**	**HRL Water and Wetness Layer**	**JRC-Global Surface Water Layers**
Abbreviation	GISCO	WAW	GSW
Producer	EC, Eurostat (ESTAT), GISCO	GeoVille, GAF, SIRS	JRC
Main Reference	GEOPORTAL OF THE EUROPEAN COMMISSION (EUROSTAT). Territorial Units for Statistics (NUTS) 2016 – Statistical Units Data set – Metadata. EEA, 2017 a. Technical Note to Consultancy Task 3 Investigation of geometric EBM_v11 Issues. UNITED NATIONS 1982.	EEA, 2018 a. Copernicus Land Monitoring Service – High Resolution Layer Water and Wetness. Product Specifications. EEA, 2018 b. Technical Note to Consultancy Task 7 Development and set-up of a production chain and processing of national and aggregated products to establish 20m and 100m products in national projection. EEA, 2018 c. Technical Note to Consultancy Task 9 Additional adaptions of the HRL Water and Wetness to avoid exclusion of landmass beyond the EBM-hybrid boundary.	EC/JRC, 2018 b. Global Surface Water – Data Users Guide (v2). EC/JRC, 2018 a. Global Surface Water Explorer https://global-surface-water.appspot.com/
Source	EC, Eurostat (ESTAT), GISCO	EEA	EC JRC/Google
EPSG / CRS	3035, ETRS-LAEA	3035, ETRS-LAEA	4326, WGS 84
Data format	Shapefile	TIF	TIF
Geometry	Polygon	Pixel	Pixel
Level of Detail (Degree of Generalisation)	1:100 000	20m x 20m full spatial resolution and aggregated to 100m x 100m spatial resolution	Raster layer with 1 arc second resolution.
Thematic Content	Boundaries according to NUTS regions at level 1, 2 and 3 for 2016.	Water and wet areas in Europe.	**Global surface water:** **Occurrence:** presence of surface water between 1984 and 2015 (EC, JRC 2018).
Layer	GISCO100K	HRL Water and Wetness Layer	JRC-Global Surface Water Layers
Coastline definition	N. A. As the layer is based on EBM-V12 it can be assumed that the coastline definition follows the United Nations Convention of the Law of the Sea (UNCLOS) see UNITED NATIONS 1982.	Sea water is classified as outside the production unit. The Water and Wetness Layer of 2015 shows „(…) the occurrence of water and wet surfaces over the period from 2009 to 2015“ (EEA 2018). It focuses on inland waters. Sea and ocean were therefore excluded from the HRL Water and Wetness product. An indirect definition approach is thereof possible. The separation of land and permanent water in this case sea or ocean results from the definition of inland waters.	N. A.

		The coastline was represented by the EEA coastline for analysis V2. In French DOMs the EBM boundary V.11 was used.	
Spatial Extent	**Economic territory of the EU, EFTA countries and candidate countries as in 2013.** Albania, Austria, Belgium, Bulgaria, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain (including Canaries), Finland, France (including French Guiana, Guadeloupe, Martinique, St. Martin, Reunion and Mayotte) United Kingdom, Greece, Croatia, Hungary, Ireland, Iceland, Italy, Liechtenstein, Lithuania, Luxembourg, Latvia, Montenegro, the former Yugoslavian Republic of Macedonia, Malta, Netherlands, Norway, Poland, Portugal (excluding Azores and Madeira), Romania, Serbia, Sweden, Slovenia, Slovakia, Turkey. **Excluding:** Bosnia and Herzegovina, Kosovo, Greenland, Spitsbergen, Andorra, San Marino, Vatican City, St. Bartélemy, Guernsey, Jersey, the Isle of Man and the Faroe Islands.	**EEA:** Albania, Austria, Bosnia and Herzegovina, Belgium, Bulgaria, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain (including Andorra), Finland, France, United Kingdom, French Guiana, Guadeloupe, Greece, Croatia, Hungary, Ireland, Isle of Man, Iceland, Italy, Liechtenstein, Lithuania, Luxembourg, Latvia, Montenegro, Macedonia, Republic of, Martinique, Malta, Netherlands, Norway, Poland, Portugal, Réunion, Romania, Serbia, Sweden, Slovenia, Slovakia, **Turkey**, Kosovo, Mayotte; **excluding Greenland and Spitsbergen.**	Layer is available on global scale between (80N and 50S). **Greenland and Spitsbergen** are only partly covered (https://global-surface-water.appspot.com/download).
MMU	0.02 ha	400m^2	pixel size 1 arc second
MMW	N.A.	N. A.	N. A.
Reference Year	2016	2009 - 2015	1984 – 2015
Reference	NUTS, EBM-V12 (Rectification of errors in the NUTS/Statistical regions geometry of Scotland), Global Administrative Unit Layer (GAUL) 2015, country data from UN/FAO and data from the National Statistical Institute of Turkey (TurkStat).	EO data sources from USGS Landsat programme and Copernicus DWH HR_Image_2012.	Landsat imagery provided by USGS and NASA
Islands	Clear omission of islands, Finish Archipelago e.g.	Indirect from elements excluded / included from / in the product (see definition). The accuracy due to aggregation has to be considered.	Depends on the threshold which is applied to derive a land mask product.
Omission of Landmass	Identical to EBM-V12	Less land mass omission than the EBM-V12.	Depends on the threshold which is applied to derive a land mask product.
Coastline	Identical to EBM-V12	Indirect from elements excluded / included from / in the product (see definition). The accuracy due to aggregation has to be considered.	Depends on the threshold which is applied to derive a land mask product.

Layer	EBM-GISCO hybrid dataset (100m re-buffered)	RZ-AOI (DRZO)
Abbreviation	HYBRID	RZ
Producer	GeoVille, GAF, SIRS	GAF, indra, metria, GeoVille
Main Reference	EEA, 2017 b. Technical Note to Consultancy Task 4 Investigation of a standardized fresh water – sea water boundary to clearly define a delineation between these classes. EEA, 2017 c. Technical Note to Consultancy Task 5 Adaption of processing chain and additional manual efforts (adaption of HRL products) for the implementation of a defined fresh water – sea water boundary and the EBM-GISCO hybrid dataset well after production begin. EEA, 2018 c. Technical Note to Consultancy Task 9 Additional adaptions of the HRL Water and Wetness to avoid exclusion of landmass beyond the EBM-hybrid boundary.	EEA, 2015 b. RZ Product Specifications (short version). EEA, 2018 d. Riparian Zones https://land.copernicus.eu/local/riparian-zones *(EEA 2015 b).*
Source	EEA	EEA
EPSG / CRS	3035, ETRS-LAEA	3035, ETRS-LAEA
Data format	Shapefile	Shapefile / TIF
Geometry	Polygon	Polygon
Level of Detail (Degree of Generalisation)	1:100 000	Thematic Raster: 25 m Vector: 1:50 000
Thematic Content	Boundaries according to GISCO 100K. The layer was improved with EU-Hydro data.	*"Riparian zones represent transitional areas occurring between land and freshwater ecosystems, characterised by distinctive hydrology, soil and biotic conditions and strongly influenced by the stream water. They provide a wide range of riparian functions (e.g. chemical filtration, flood control, bank stabilization, aquatic life and riparian wildlife support, etc.) and ecosystem services" (EEA 2015 b).* **The current production used the Observable Riparian Zones (DRZO).**
Coastline definition	See EU-Hydro	No coastlines included, only inland waters.
Spatial Extent	Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark (excluding Faroe Islands and Greenland) Estonia, Finland, France (including Monaco), Germany, Greece, Hungary, Iceland, Ireland, Italy (including San Marino and Vatican City), Kosovo, Latvia, Lithuania, Luxembourg, the former Yugoslavian Republic of Macedonia, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain (including Andorra and Gibraltar), Sweden, Switzerland (including Liechtenstein), Turkey, United Kingdom (including the Isle of Man, Jersey and Guernsey), Canary Islands (part of Spain), Azores and Madeira (part of Portugal), French oversea territories (including Guadeloupe, French Guiana,	Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark (without Faroe Islands, Greenland), Estonia, Finland, France (without DOMs), Germany, Greece, Hungary, Iceland, Ireland, Italy, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, the former Yugoslavian Republic of Macedonia, Malta, Montenegro, Netherlands, Norway (without Spitsbergen), Poland, Portugal (without Azores, Madeira), Romania, Serbia, Slovakia, Slovenia, Spain (without Canaries), Sweden, Switzerland, Turkey, United Kingdom. **Included in the dataset are: Andorra and Vatican City, excluded are: Monaco, San Marino, the Channel Islands – Guernsey and Jersey - and the Isle of Man.**

	Martinique, Reunion and Mayotte; excluding Saint Barthélemy and Saint-Martin), **Spitsbergen is excluded from the product.**	
MMU	N. A.	-
MMW	N. A.	-
Reference Year	N. A.	2010 - 2014
Reference	N. A.	Riparian Zone LC/LU product, NDVI and NDWI derived from Landsat 8 from 2013/2014.
Islands	Broad coverage of islands, but not as detailed as in the EU-Hydro coastline.	N. A.
Omission of Landmass	Observed in coastal regions, estuaries and lagoons.	N. A.
Coastline	Deviation to the actual coastline which leads in extreme cases to an offset off up to 5 km.	N. A.

The results of the evaluation show that there are obvious differences between the evaluated layers respectively to the applied criteria. The differences range from MMU and level of detail to spatial extent, reference year or thematic content and so on. Additionally, a visual evaluation of the layers was done on country level (see Annex). The results are discussed in detail in the following sections. Thereby it was distinguished between national borders between countries (2.2) and coastline (2.3).

Table 2-2-2: Layers used in task 1 and task 2

Layer	Use within Task 1: Generation of the EEA39 border product.	Use within Task 2: Production of the EEA39 border expert product.
EBM-GISCO hybrid dataset (100m re-buffered)	Segments are used to delineate the border to the EEA neighbouring countries where EBM-V12 is not suitable. Possible better representation of parts of the eastern EEA borderline in Turkey due to the more accurate delineation of borders along border rivers.	The final EEA39 Border Product is used instead.
RZ-AOI (DRZO)	No major improvement potential could be determined.	The final EEA39 Border product is used instead.
GISCO100K	Nearly ident to EBMv12. No major improvement potential could be determined.	The final EEA39 Border product is used instead.
HRL Water and Wetness Layer	-	The layer is used in the automatic coastline determination.
JRC-Global Surface Water Layers	-	The layer is used in the automatic coastline determination.
EU-Hydro Coastline	-	The layer is used in the automatic coastline determination.
EEA coastline for analysis V2	-	The layer is used in the automatic coastline determination.
EBM-V12	The EBMV12 is used as base layer for the EEA39 Border product.	The EBMV12 is used as base layer for the EEA39 Border product.

2.2. National borders – EEA39 border product

The respective layers for the evaluation of the national borders on land were assessed at country level (see Annex 6.1). The EBM (EBM-V12) was compared to the GISCO (GISCO100K) and the HYBRID (EBM-GISCO hybrid dataset (100m re-buffered) dataset. The RZ-AOI (RZ) layers were evaluated in border regions, between national boundaries within the EEA territory as well as at the eastern EEA border to other countries.

The criteria taken into account were:

- data format,
- geometry,
- level of detail,
- thematic content,
- MMU and MMW,
- reference year,
- reference dataset and
- the omission of landmass.

The results have shown that EBM and GISCO are nearly ident. A difference layer was processed. The main differences within the eastern EEA border were visually checked to verify the results from the visually based evaluation process. Further differences observed refer to the different delineation between land and water in transitional zones like estuaries or landmass emerged from low tide elevations as well as missing islands.

Figure 2-1: Differences in the delineation of estuaries in Germany at the rivers of Weser, Elbe and Ems. GISCO 100K shows omission of islands or low tide elevations in parts of the North Sea tideland e.g. (see red circle) partially caused by a different interpretation of boundaries at statistical and administrative levels. The yellow polygon represents EBM-V12.

Differences are also caused by shallow water areas especially in the tideland and land reclamation due to varying reference years of the datasets. The EBM layer classifies more shallow water areas as land compared to GISCO layer.

Additionally, to EBM and GISCO the RZ is evaluated. The RZ provides a hybrid between GISCO and HYDRO (EU-Hydro) at the eastern EEA land border. The GISCO border has been modified in areas where rivers constitute the border to assure that the border runs in the middle of the river.

As expected, that in few cases the GISCO, the HYBRID line segments are used (e.g. for parts of Turkey). The delineation of the national border following rivers is more detailed in the RZ-AOI and GISCO contains furthermore statistical data from the National Statistical Institute of Turkey (TurkStat). For the evaluation the Observable Riparian Zone (DZRO) for each available region were used. The DZRO were included in the evaluation because the datasets map the effectively observed Riparian Zones.

A different delineation of the national border lines has been observed at the eastern border of Turkey to Armenia and Iran as well as Syria and Iraq. GISCO and EBM are both highly generalized and do not follow the respective border rivers: Aras (Turkey – Armenia) and Karasu Cayi (Turkey – Iran) or the river Tigris (Turkey – Syria, Turkey – Iraq). Therefore, the HYBRID dataset has been re-buffered with 100m and included in the evaluation process. The evaluation was done in two steps visually and based on a difference layer created from EBM and the HYBRID dataset (see Figure 2-2).

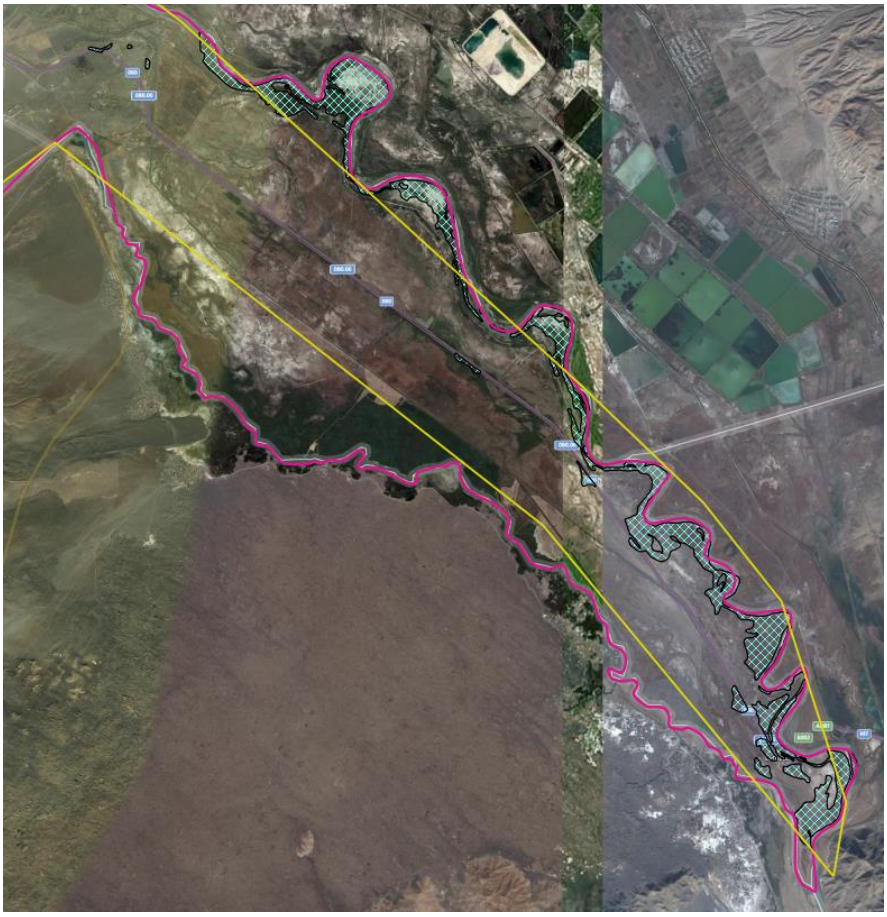


Figure 2-2: EBM and GISCO (not visible, ident with EBM) are highly generalized at the eastern Turkish as well as EEA border to Armenia. The RZ (turquoise) is a hybrid of GISCO and HYDRO. HYDRO was used to modify borders when following rivers. In this case the modified border is represented by the re-buffered HYBRID layer which is more detailed in this section. The border shows a more accurate delineation along the river Aras than EBM and GISCO.

A different situation is presented in other sections of the eastern EEA border (see Figure 2-3, Figure 2-4). GISCO (not visible, ident with EBM) as well as EBM follow the border rivers and are delineated with a high level of detail along the Observable Riparian Zones.

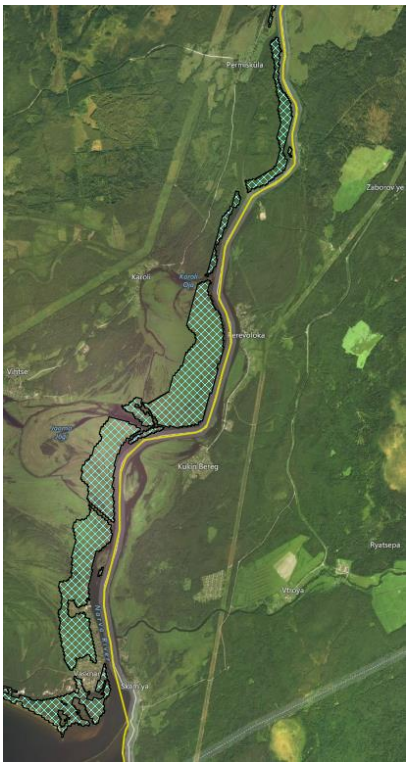


Figure 2-3: The Narva as border river between Estonia and Russia represents furthermore the eastern border of the EEA in this section. EBM (yellow) and GISCO (not visible, ident with EBM) are situated in the middle of the river respectively along the observed riparian features (turquoise).

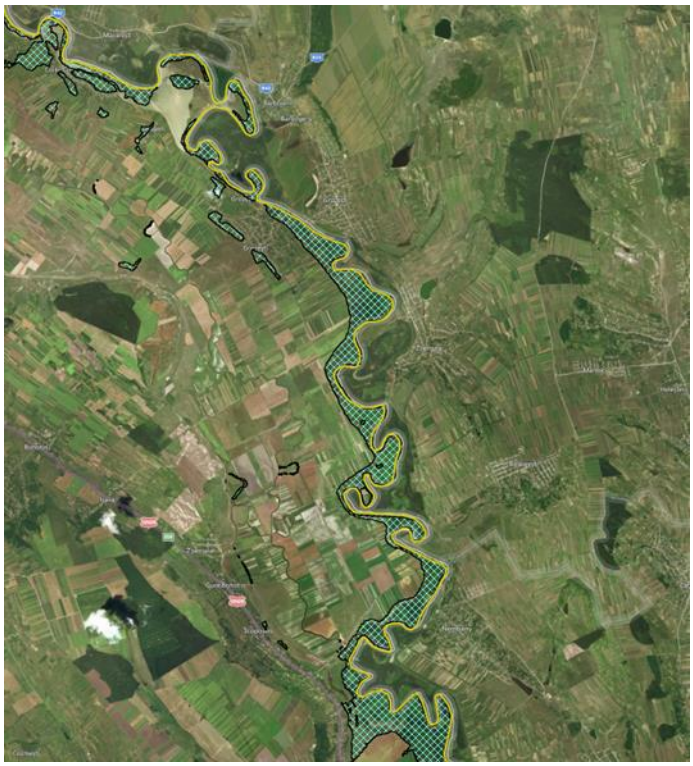


Figure 2-4: The Prut river as border river between Romania and Moldova represents furthermore the eastern border of the EEA in this section. EBM (yellow) and GISCO (not visible, ident with EBM) are situated in the middle of the river respectively along the observed riparian features (turquoise).

It was, furthermore, assumed that the integration of the HYBRID layer leads to improvements in the delineation of the coastline and the inclusion of islands on small scale level. These assumptions were proofed during the evaluation process, visually and based on the processed difference layer mentioned above.

Improvements of the EBM with the hybrid dataset on land can be expected especially in following cases:

- Delineation of borders between EEA countries and their neighbours, when the course of the border rivers meander permits a different border configuration. Due to their little occurrence the differences were neglected.
- More detailed delineation of the eastern and southern Turkish border in general and especially concerning cases where rivers function as borders.

Resulting from the evaluation of the input layers GISCO, EBM and the RZ as well as the HYBRID dataset, EBM turned out as the best available layer representing national borders within the EEA territory and to the EEA neighbouring countries. The main reasons are the spatial coverage and the thematic content of the dataset. EBM covers the whole EEA territory and beyond and was produced to represent national borders throughout Europe. The predominant sources are national source databases from European National Mapping and Cadastral Agencies. Thereof, the positional accuracy is generally high. Furthermore, GISCO is in most parts nearly identical with EBM and the visual evaluation showed no severe differences apart varying spatial coverage, which leads to landmass omission in the GISCO layer. A comparison with VHR data showed although a delineation of EBM in the middle of river borders, which helps to fix the outermost EEA border as well as borders between EEA member and collaborating countries.

Nevertheless, at the eastern border between Turkey and its neighbouring countries the EBM shows strong delineation to the actual border and has to be improved. The Turkish border to its eastern and southern neighbours is thereof, delineated with segments of the re-buffered HYBRID dataset, which shows a very well configuration of the national border at the respective border rivers, Tigris or Aras e.g.

Figure 2-5: Used line segments from the Re-buffered EBM-GISCO hybrid dataset. EBM V12 in green. Re-buffered EBM-GISCO hybrid dataset line segments in red.

In cases where the EBM-GISCO hybrid dataset line segments are used, instead of the EBM–V12 the line segments, those are connected in order to provide the EEA39 border product in polygon topology.

2.3. Coastline – EEA39 improved boundary product

In section 2.1 the respective layers for the evaluation of the coastline were assessed on European level. Following layers were involved in the evaluation process:

- EU-Hydro Coastline (HYDRO)
- EEA coastline for analysis V2 (CFA)
- Combined product of EBM V12 and EBM-GISCO hybrid ("BNB" = EEA39 border product)
- WaW HRL2015 derived land mask product (WAW)
- Re-buffered EBM-GISCO Hybrid layer (HYBRID)
- JRC Global Surface Water Layers - Occurrence derived land mask products (O70)

The RZ has been excluded from the evaluation process because no coastline is represented. Due to the fact, that GISCO is ident with EBM, resulting from the evaluation of national borders on land and random samplings along the coast, no further evaluation for the coastline was necessary.

To improve the EEA39 border product and create the EEA39 Improved Boundary Product the all above listed layers were assessed on sub-country level (see 6.2), based on the following criteria:

- data format,
- geometry,
- level of detail,
- thematic content,
- coastline definition,
- MMU and MMW,
- reference year,
- reference dataset,
- the delineation of the coastline,
- the omission of landmass and
- the omission of islands.

The visual evaluation pointed out, that for the bigger part of the coastal states observed, the coastline is well represented by the HYDRO. In comparison to the other layers it shows least generalization, islands are comprehensively delineated and landmass omission is manageable. However, partly, other layers represent the coastline better.

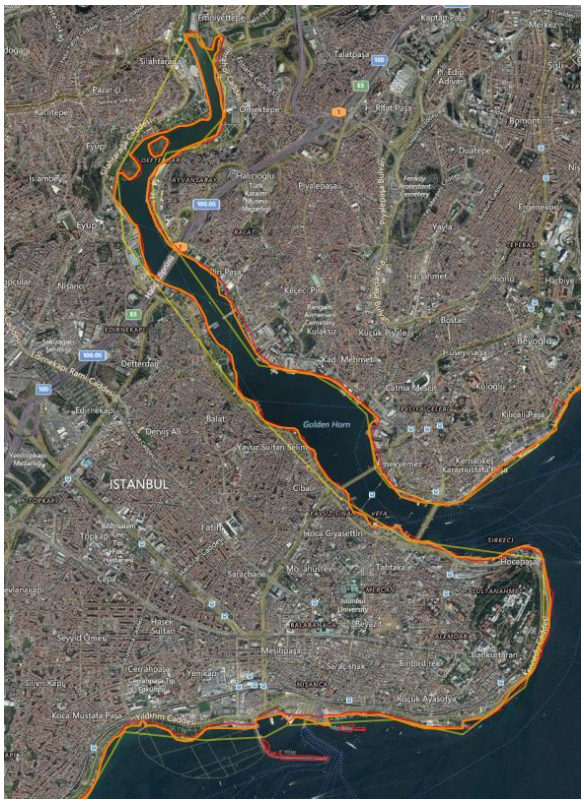


Figure 2-6: Delineation of the coastline in EU-Hydro, EBM-V12 (GISCO 100K is ident to EBM-V12) and the EEA coastline for analysis V2 at the historic centre of Istanbul. The figure shows a very detailed representation of the coastline by the EU-Hydro dataset, land-area cut-offs by the EEA coastline for analysis V2 and EBM-V12.

Figure 2-7: Delineation of the coastline at Cape Antibes (France) in EU-Hydro, EBM-V12 (GISCO 10 K is ident to EBM-V12) and the EEA coastline for analysis V2. The figure shows a very detailed representation of the coastline by the EU-Hydro dataset. Land-area cut-offs are observed in the EEA coastline for analysis V2 and landmass commission errors in EBM-V12. Both are clearly more generalized than EU-Hydro.

For Poland, the Faroe Islands, French Guiana, Madeira, Mayotte and the Isle of Man the EBM shows better results. The CFA better separates land from water at the Azores. For some countries the HYDRO should be supported by EBM in specific areas.

It was observed that in shallow water areas, fjords or tideland the delineation of the coastline is more accurate in EBM. In all of these areas the coastline is well represented by HYDRO but could be improved with EBM in some sections. For Greenland, part of Denmark, the coastline has been updated with EBM, due to limited spatial coverage of other layers.

The visual interpretation showed although some interesting differences between the EBM and the re-buffered HYBRID dataset. The processed difference layer of EBM and HYBRID was again used for a more profound evaluation of the coastline.

The main differences observed throughout the investigation area, aside the spatial coverage (few countries / territories were excluded by the hybrid dataset, see Annex 6.2: coastline evaluation), were:

- Omission of islands by EBM, see Finish Archipelago
- Delineation of the coastline. The HYBRID includes waterways between islands in the land class. This issue was observed for several countries in Northern Europe, like Finland, Norway, Sweden, Ireland or the United Kingdom.
- Different delineation of the coastline in transitional zones, like coastal wetlands, intertidal areas (including sand beaches and rocky coasts), tideland or shallow water areas and river mouths.
- Differences in the delineation of the coastline at ports.

3. Task 2: Generate the EEA39 border expert product and the EEA39 boundary product

In Task 1 the "EEA39 Border" product has been generated. As expected, in most cases the EBM provides the most suitable national border, but in few cases (e.g. for parts of Turkey) the HYBRID layer is used to improve the product. The line segments are connected in order to provide the national boundary layer in polygon topology. Appropriate attribute data is provided in the EEA39 Expert Product Source file (line topology), which provides for each line segment the information on the data source (e.g. if the data source is EBM or GISCO or HYBRID or newly digitized connection segments). Further, for each polygon of the EEA39 expert product (polygon topology), attribute data is provided such as e.g. country code according to ISO 3166. The national border polygon data is included in the expert product without further change and without generalization.

Abbreviations for the different layers:

- (Best) automatic derived coastline
- (BNB) "EEA39 Border" product
- (HYD) EU-Hydro Coastline V2
- (CFA) EEA coastline for analysis V2
- (HYB) EBM GISCO Hybrid Layer
- (WAW) WaW HRL2015
- (O70) JRC water occurrence 1989 – 2015, threshold = 70%

3.1. Workflow: Automatic derivation of the improved boundary product

The "EEA39 Border" product is automatically compared at the local level (sub-country level) with all available coastline layers to complement the "EEA39 Border" product polygons and generate the "EEA39 Improved Boundary" product. Regarding the comparison three cases can be distinguished: (i) national boundary coincides with the other coastline layers; (ii) national boundary layer includes non-land areas; and (iii) national boundary layer excludes land-areas. In case (iii), polygons are generated which complement the national boundary layer by taking into account a minimum mapping unit (MMU) of 0.5 ha and a minimum mapping width (MMW) of 10 meters.

To generate the "EEA39 Improved Boundary" product an automated rule-based model is introduced. The aim of the automated model is to generate a potential land mass polygon on sub-country level. Therefore, all available layers are pre-processed to generate harmonised land mask products in polygon topology. In the case of the JRC water occurrence layer several thresholds have been applied to generate the land mask products. The most promising threshold can vary from sub-country to sub-country, but in most countries a threshold of 70% water occurrence is applied. The "EEA39 Border" product generated in Task 1 is taken as basis layer. This layer is merged with the derived land mask layers of all other available input products (WAW, HYDRO, CFA, HYB, O70).

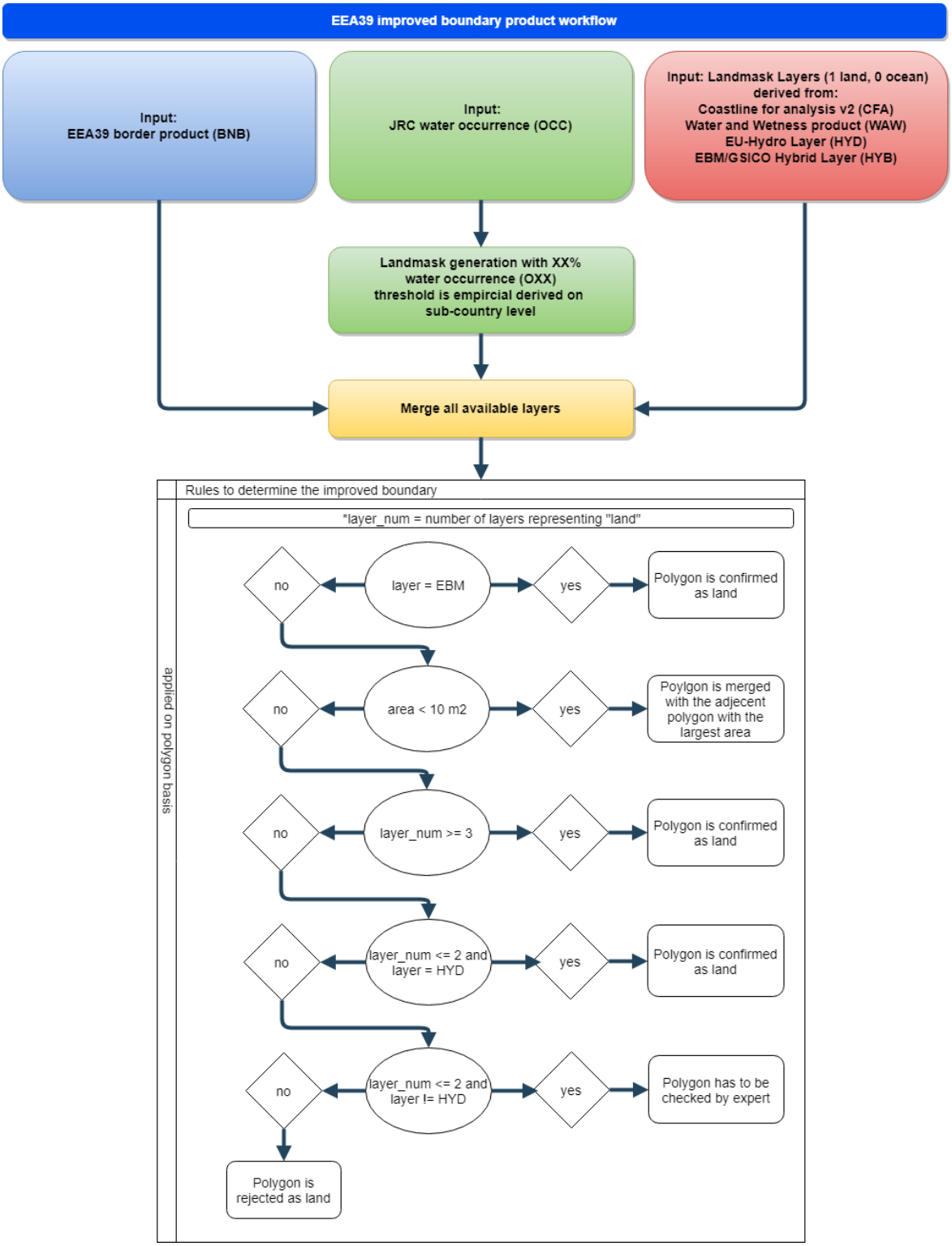


Figure 3-1: Workflow: boundary layer determination.

3.2. Visual Modification

In a third step, the coastline which results from the second step is visually checked on-screen in those areas which were identified as problematic and edited where necessary to minimize the occurrence of land area cut-offs. Further, missing islands are added, where at least those missing islands are added, which have an area larger than 0.5 ha. However, islands with an area below 0.5 ha, which are included within the EBM, GISCO, OCC or the WAW layer, is kept in the resulting dataset. In some countries like Norway, Sweden, Finland etc. the Open Street Map is used to derive missing islands.

In cases (ii) and (iii), polygons are generated and modified by taking into account a minimum mapping unit (MMU) of 0.5 ha and a minimum mapping width (MMW) of 10 meters. For above case (iii) or in case of missing islands, the country code is derived from the HRL2015 products or the EBMV12 and the respective polygons are flagged accordingly.

- The polygon segments which are marked as “check” are either confirmed or rejected.
- If none of the polygons can be confirmed but it is still a case of land area cut-off/missing islands the expert digitalizes a new polygon segment.

In the following, critical points are shown and how the automatic workflow determines the boundary. In some examples the boundary have to be edited by the experts.

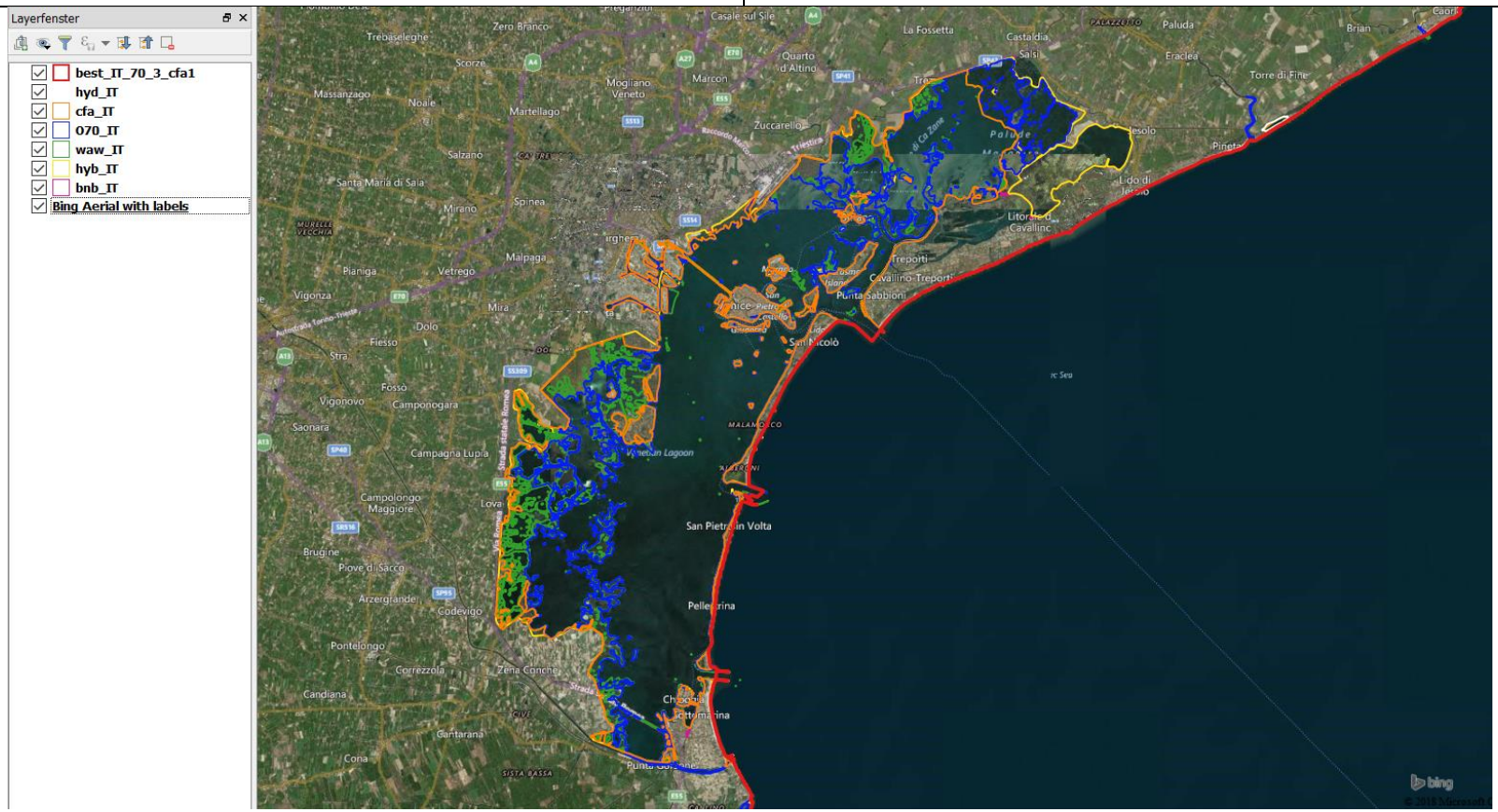
3.3. Examples of the automatically derived boundary

In the following examples, the automatically derived boundary is drawn in red (see legend in the map examples)

Example 1	
<code> or <sub-code>	**location**
IT	Lagoons of Grado and Marano

Source: **Automatically derived boundary** at the coastline of the Lagoons of Grado and Marano (own figure, background: bing © Microsoft).

Example 2	
<code> or <sub-code>	**location**
IT	Lagoon of Venice

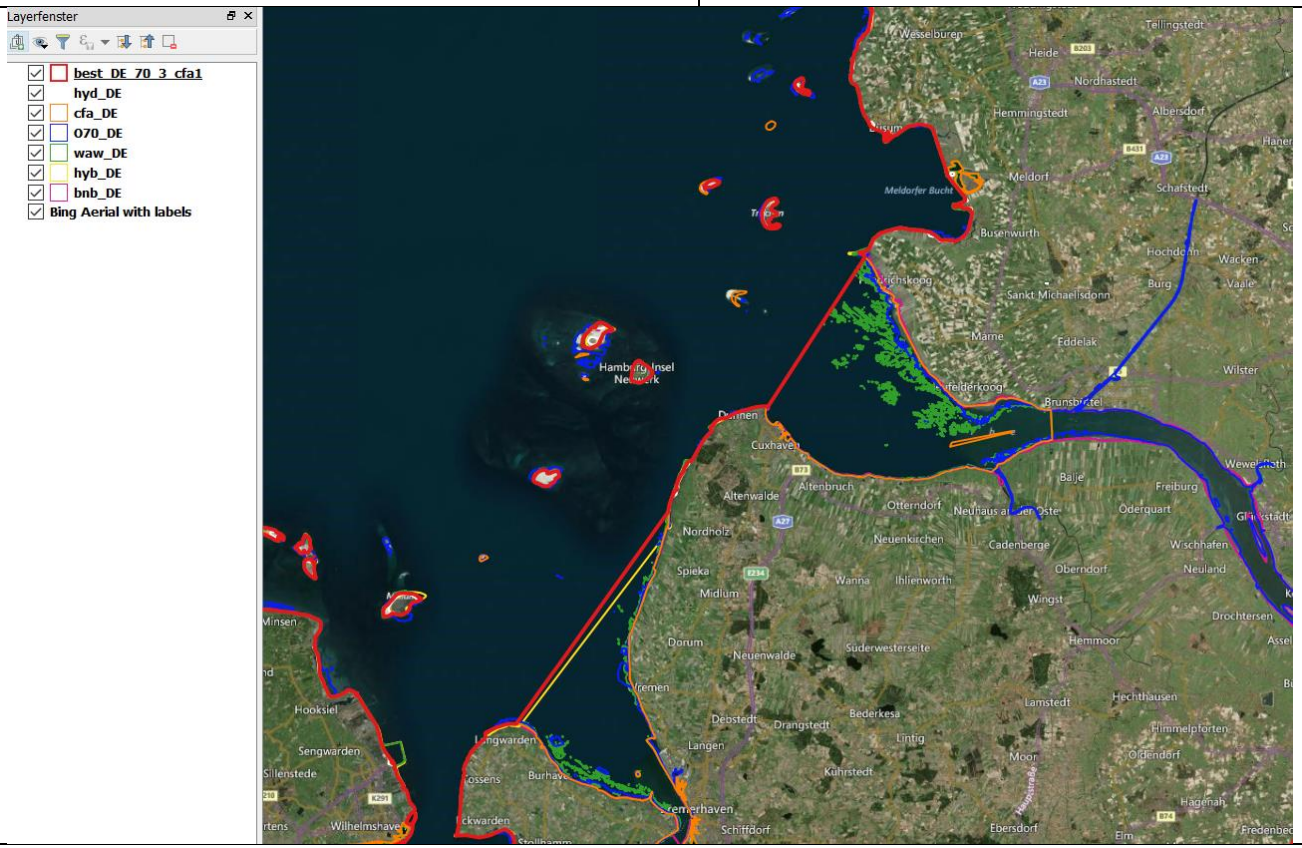


Source: **Automatically derived boundary** at the coastline of the Lagoon of Venice (own figure, background: bing © Microsoft).

Example 3	
<code> or <sub-code>	**location**
UK	Thames estuary

Source: **Automatically derived boundary** at the coastline of the Thames estuary (own figure, background: bing © Microsoft).

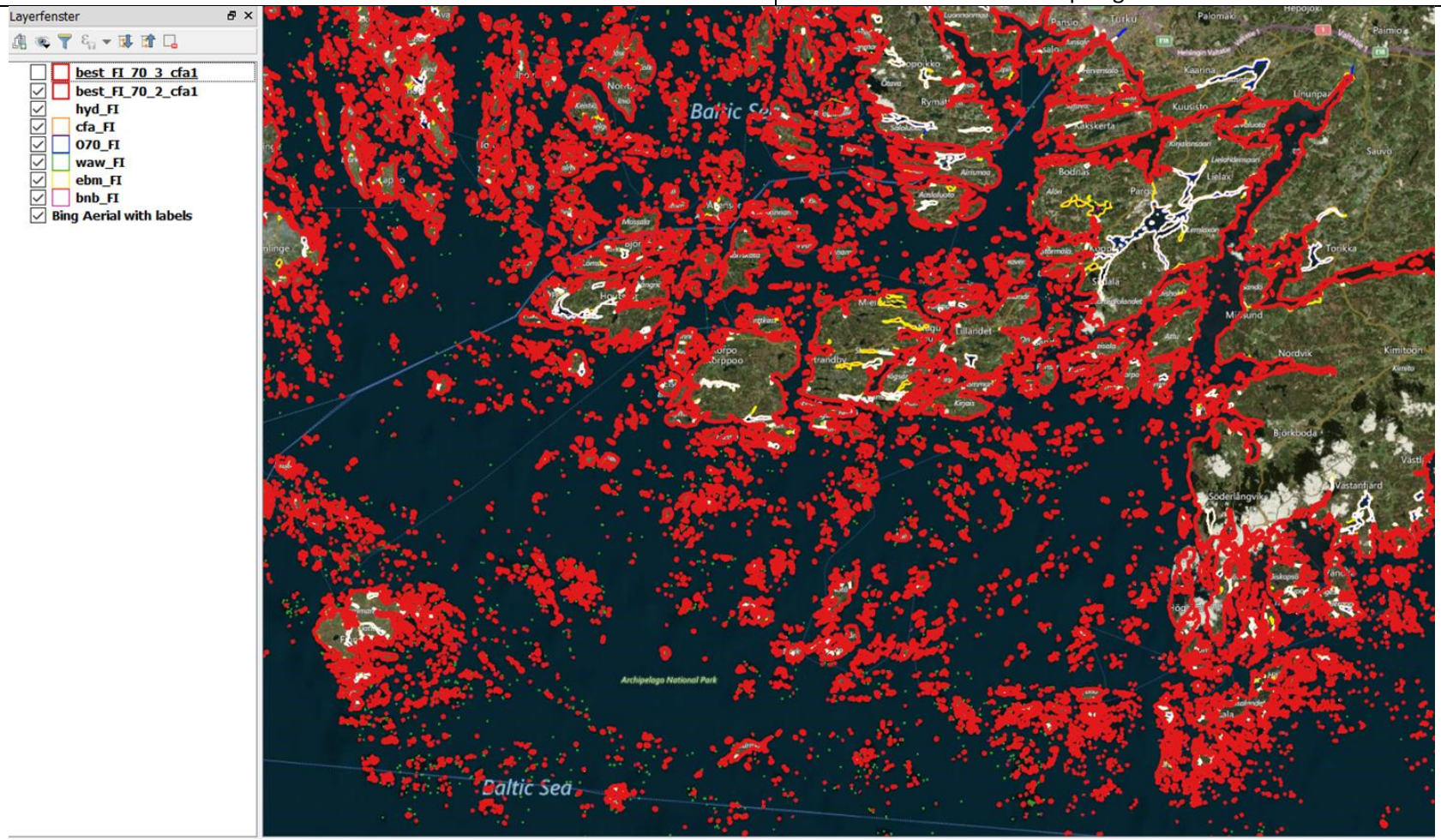
Example 4	
<code> or <sub-code>	**location**
DE	Elbe and Weser estuaries



Source: **Automatically derived boundary** at the coastline of the Elbe and Weser estuaries (own figure, background: bing © Microsoft).

Example 5

<code> or <sub-code>	location
FI	Archipelago of the Finish Sea



Source: **Automatically derived boundary** at the Archipelago of the Finish Sea (own figure, background: bing © Microsoft).

Example 6

<code> or <sub-code>	location
UK	St. Martin’s, Atlantic Ocean, English Channel

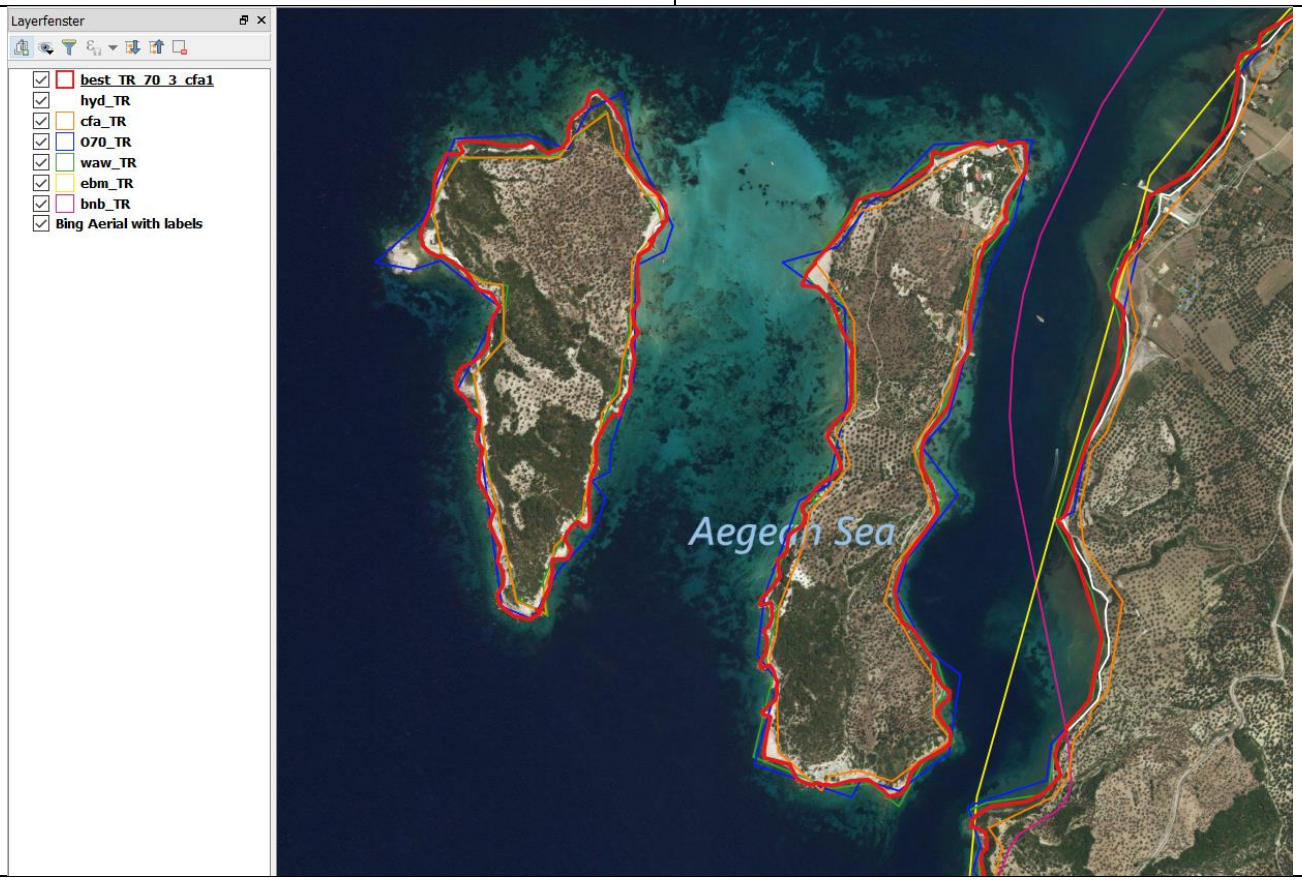
Source: **Automatically derived boundary** at St. Martin’s, Atlantic Ocean, English Channel (own figure, background: bing © Microsoft).

Example 7

<code> or <sub-code>	location
DE	North Sea, Niedersächsiches Wattenmeer

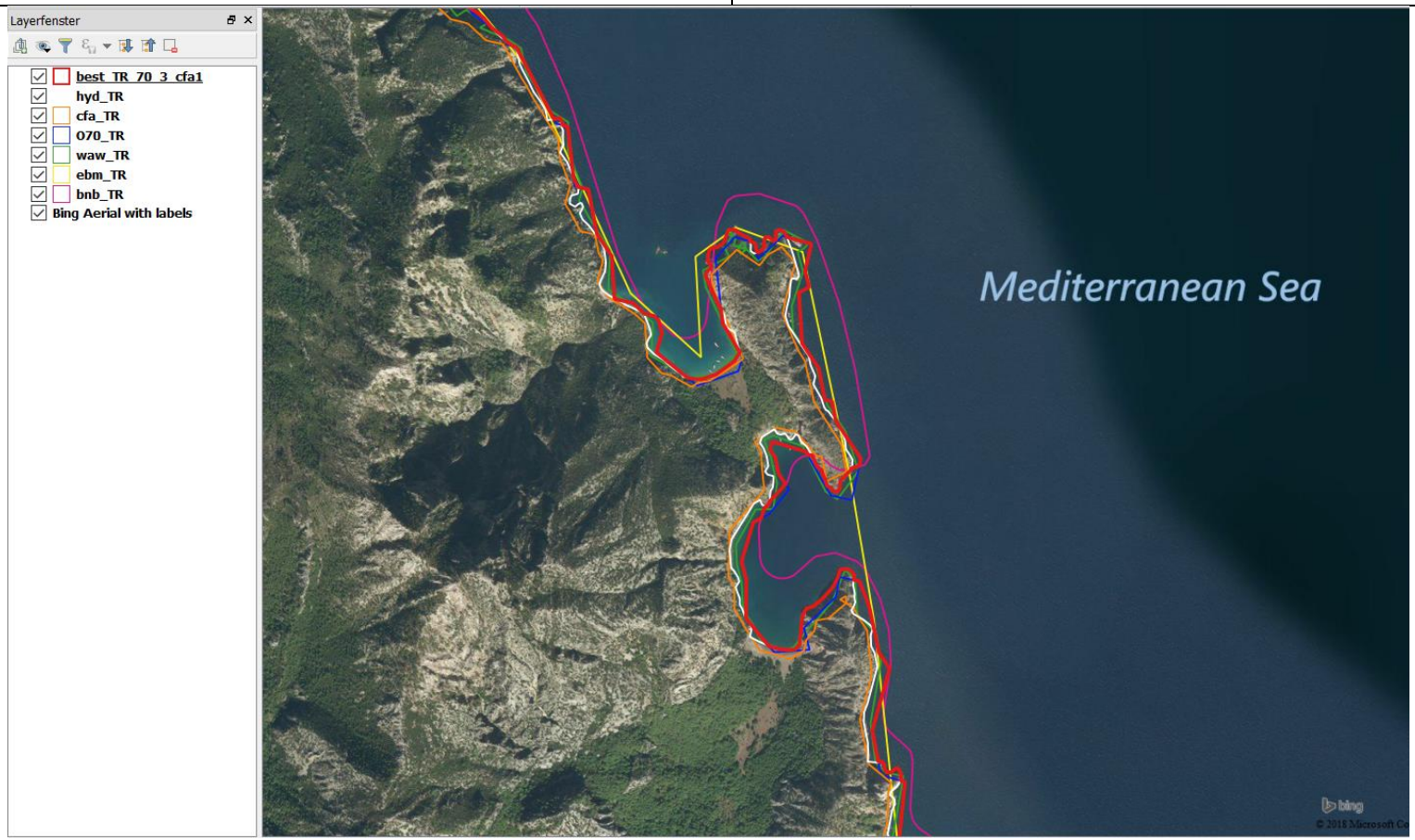
Source: **Automatically derived boundary** at the coast of the North Sea, Niedersächsiches Wattenmeer (own figure, background: bing © Microsoft).

Example 8	
<code> or <sub-code>	**location**
TR	Aegean Sea



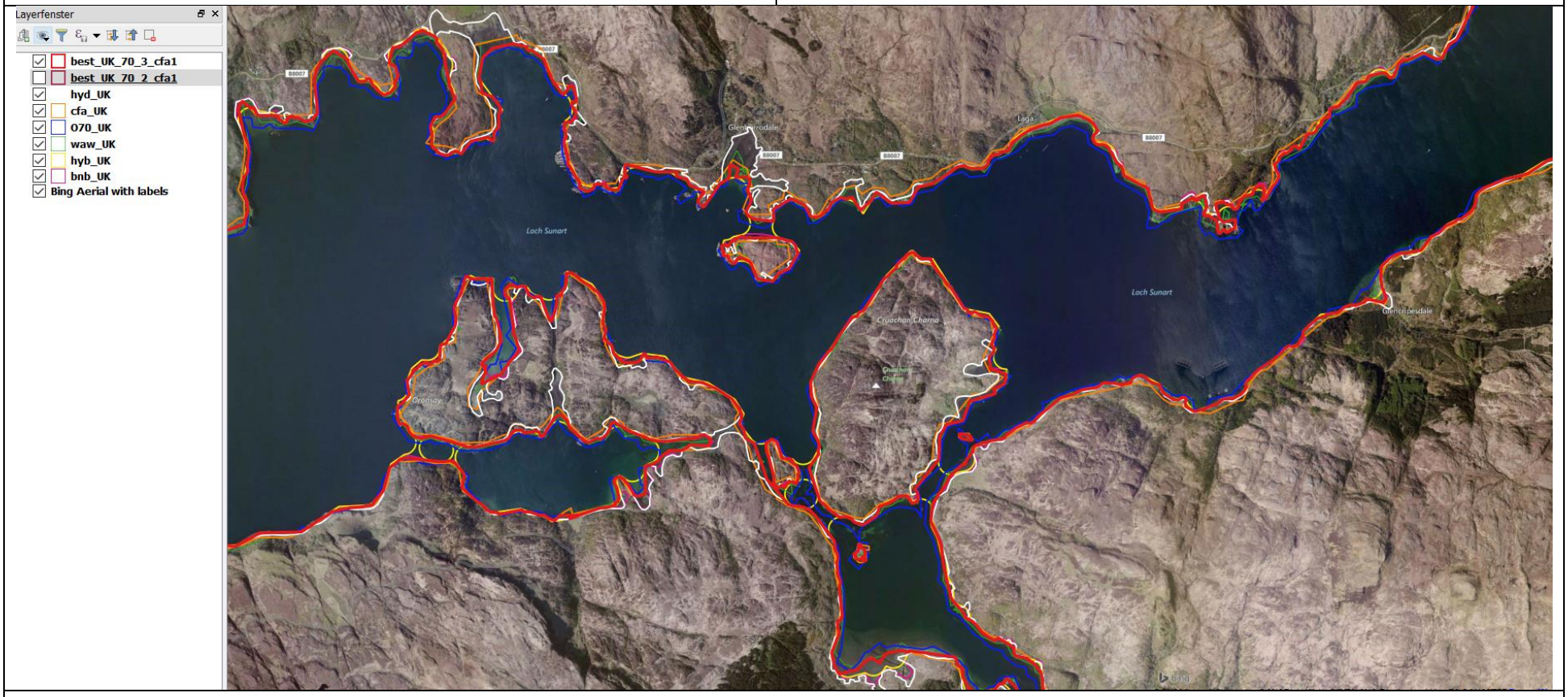
Source: **Automatically derived boundary** at the coast of the Aegean Sea (own figure, background: bing © Microsoft).

Example 9	
<code> or <sub-code>	**location**
TR	Mediterranean Sea, Aegean Sea



Source: **Automatically derived boundary** at the coast of the Mediterranean Sea, Aegean Sea (own figure, background: bing © Microsoft).

Example 10	
<code> or <sub-code>	**location**
UK	Loch Sunart

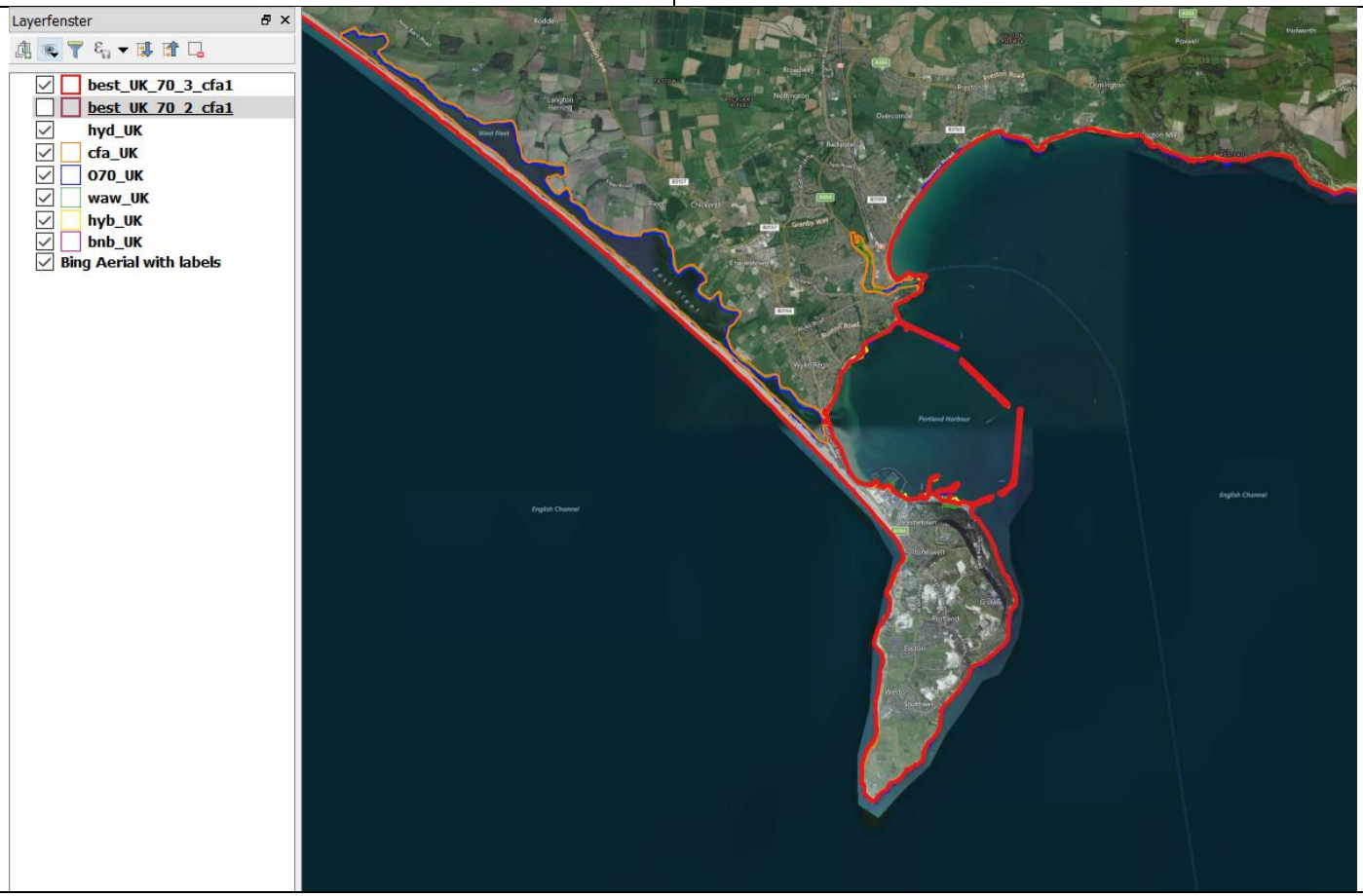


Source: **Automatically derived boundary** at Loch Sunart (own figure, background: bing © Microsoft).

Example 11	
<code> or <sub-code>	**location**
TR	Mediterranean Sea

Source: **Automatically derived boundary** at the coast of the Mediterranean Sea (own figure, background: bing © Microsoft).

Example 12	
<code> or <sub-code>	**location**
UK	English Channel, East Fleet



Source: **Automatically derived boundary** at the coast of the English Channel, East Fleet (own figure, background: bing © Microsoft).

Example 13	
<code> or <sub-code>	**location**
UK	Chichester Harbour

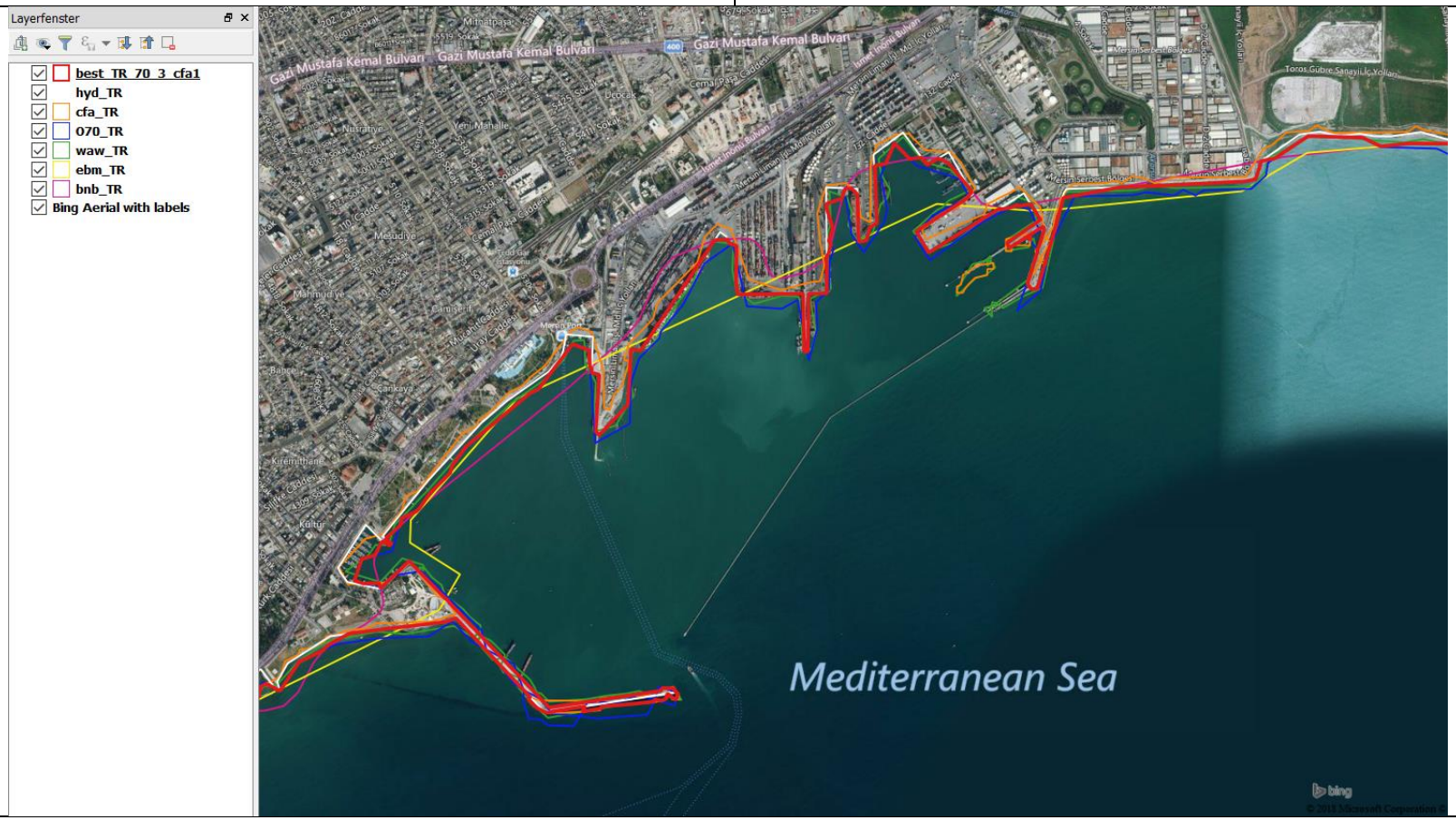
Source: **Automatically derived boundary** at Chichester Harbour (own figure, background: bing © Microsoft).

Example 14	
<code> or <sub-code>	**location**
IT	Sardegna, Golfo di Cugnana

.

Source: **Automatically derived boundary** in Sardegna, Golfo di Cugnana (own figure, background: bing © Microsoft).

Example 15	
<code> or <sub-code>	**location**
TR	Sea of Marmara



Source: **Automatically derived boundary** at the coast of the Sea of Marmara (own figure, background: bing © Microsoft).

3.4. Quality Control

A quality control that focused on the quality of the boundary lines and the quality of the island mapping according to the Request for Services was performed by the consortium.

The sampling has been derived from the Expert Product and a stratum file. The stratification is based on a 10 km by 10 km grid over the production area differing between:

- 0: Ocean
- 1: Not in the current production included
- 2: Land
- 3: non-problematic areas
- 4: problematic areas (e.g. inaccurate input data in Eastern Turkey, Missing Islands in Finland, highly structured boundary in Norway etc.)

The QC team distributed the sampling units across the 10km by 10km grid-cells and **stratification**:

- Stratum non-problematic: grid cells with Stratum 0 connected to grid cells with Stratum 3/4 and all grid cells with Stratum 3 (100 grid cells interpreted)
- Stratum problematic: all grid cells with stratum 4 (100 grid cells interpreted)

Further sampling units are distributed at the line of the boundary and the following stratification:

- Stratum Land boundary: grid cells with Strata 2 intersecting a boundary segment (Nb. Of grid-cells = 3,535 – Nb of sample units = 100)
- Stratum non-problematic coastline: all grid cells with Strata 3 (Nb. Of grid-cells = 10,824 - Nb of sample units = 100))
- Stratum problematic coastline: all grid cells with stratum 4 (Nb. Of grid-cells = 4,261 - Nb of sample units = 200)

The results were sophisticating. **83.25 %** of the expert products boundaries were within a tolerance of 10 m.

The results for the islands mapping were still higher. Only few islands above 0.5 ha were missing. **92.5 %** of the islands within a 10 km by 10 km frame were successfully mapped.

Remarks by the QC:

- Missing islands
- Complex situation of boundaries in estuaries or along beaches in Netherland, England or Denmark
- Inland boundaries outside the tolerances, e.g. between Turkey and Syria or Turkey and Bulgaria
- Geometry issues

Solutions:

- *Complex situation of boundaries in estuaries or along beaches in Netherland, England or Denmark:* Regarding the issue related to boundaries located around the estuaries and along the beaches, we were very careful to avoid cut-offs of COPERNICUS production areas, specifically to avoid production area cut-offs related to the HRL2018 Water and Wetness products. As the available input data sets are often based on information up to 2012 only, the interpretation experts took into account also recent imagery e.g. from google / bing /

WMS / ESRI-Basemap / Sentinel-2 or other data in the interpretation process to include such highly dynamic areas. Therefore it has been decided to keep these areas.

- *Inland boundaries outside the tolerances, e.g. between Turkey and Syria or Turkey and Bulgaria:* For the inland boundaries the provided input data sets have been used and the best available boundary data set has been selected. This is also highlighted in the interim reports, e.g. problems for parts of Turkey remain.

- *Geometry issues:* this can result in exceptional cases depending on input data sets complexity. We checked the data wall-to-wall however in general in a scale above 1:50.000 which does not allow solving all small geometric inconsistencies.

- *Missing islands:* in countries like Norway, Sweden and Finland it has been decided to use the Open Street Map Layers and national Elevation model if available to improve the product.

Final corrections based on the findings of the QC were implement in the final products.

3.5. Deliverables

The result of steps 1 to 3 is an "EEA39 Border Expert" product, which includes the national borders and the combined coastline in polygon topology. Please note, that this "EEA39 Border Expert" product includes un-generalized data e.g. from EBMv12 for which strict licensing conditions apply. Further an expert product source file in line topology is generated to provide the source information for each line segment.

The "EEA39 Boundary" layer is derived from the Expert product by selecting the outline and applying a buffer of 250m.

Delivered products:

- EEA39 Border Expert product for which strict licensing conditions apply (polygon topology)

- EEA39 Border Expert product source for which strict licensing conditions apply (line topology)

- EEA39 Boundary Product (250 m buffered product) (polygon topology)

  - Country codes are according to ISO 3166.
  - Products are delivered in following formats: ArcGIS Geodatabase, ESRI-Shapefile, GeoTiff rasters with 10 m, 20 m and 100 m resolution.

-Technical report

Naming Convention:

<name>	product name
<extent>	spatial extent
<version>	counter to permit multiple versions in case of necessary reprocessing, 2 digits, with leading zeros if required, starting with '00'
<EPSGC>	EPSG code of the projection, 5 digits, with leading zeros if required.
<sub-country>	sub-country code as defined in Table 4-2 (only for national layers) using "-" instead of "_".
<resolution>	Spatial resolution (only for raster files)
<buffer>	buffer size (only for boundary layer)
<tile>	tile identifier
<tile-size>	size of tiling grid

3.5.1. EEA39 Border Expert product

Metadata file	Format:	XML
Image file	Format: Spatial resolution: EPSG:	ArcGIS Geodatabase, ESRI-Shapefile, GeoTiff raster 10m, 20m and 100m 3035
Naming Convention	Base directory: <name>_<extent>_<EPSGC>_<version>/ Metadata file: <name>_<extent>_<EPSGC>_<version>_metadata.xml ESRI-Shapefile: <name>_<extent>_<EPSGC>_<version>.shp ArcGIS Geodatabase: <name>_<extent>_<EPSGC>.gdb/<name>_<extent>_<EPSGC>_<version> GeoTiff raster: <name>_<extent>_<EPSGC>_<tile-size>_<resolution>/ <name>_<extent>_<EPSGC>_<resolution>_<version>_<tile>.tif	

Naming Example	Base directory: BorderExpert_EEA39_03035_v01/ Metadata file: BorderExpert_EEA39_03035_v01.xml ESRI-Shapefile: BorderExpert_EEA39_03035_v01.shp ArcGIS Geodatabase: BorderExpert_EEA39.gdb/BorderExpert_EEA39_03035_v01 GeoTiff raster: BorderExpert_EEA39_03035_100x100km_010m/ BorderExpert_EEA39_03035_010m_v01_E30N20.tif

The French Oversea Departments are provided in a separate folder “BorderExpert_DOMS” following the naming convention defined above. Each DOM is represented in separate raster file independent from the tiling grid and national projection instead of LAEA.

The “EEA39 Border Expert” product is a unified product between the EBM and the “EEA39 Improved Boundary” product. The attributes “EBMV12” and “IBLayer” are introduced to differentiate between landmass loss and land reclamation between the EBMV12 Layer and the “EEA39 Improved Boundary” layer.

Fields

Table 3-1: Example EEA39 Expert Product Fields.

BorderExpert_EEA39_03035_v03

OBJECTID_1 *	Shape *	ICC	IBLayer	EBMV12	SubCountry	EEA_39	OBJECT_ID	ID	INSPIREID	beginLife	PERIMETER	POLY_AREA	Shape_Length	Shape_Area
1	Polygon ZM	AD	1	1	AD	0	AD111000001	1000001	EEA39Boundary:AD1110000	2019-04-11T11:38:41.770000	119,917371	46534,580807	119917,371021	465345808,065363
2	Polygon ZM	AL	0	1	AL	1	AL011000002	1000002	EEA39Boundary:AL0110000	2019-04-11T11:38:41.770000	0,951103	0,874997	951,10295	8749,973129
3	Polygon ZM	AL	1	0	AL	1	AL101000003	1000003	EEA39Boundary:AL1010000	2019-04-11T11:38:41.770000	823,102683	1794,881753	823102,682606	17948817,532289
4	Polygon ZM	AL	1	1	AL	1	AL111000004	1000004	EEA39Boundary:AL1110000	2019-04-11T11:38:41.770000	1244,400453	2879121,304828	1244400,452556	28791213048,284809
5	Polygon ZM	AT	1	1	AT	1	AT111000005	1000005	EEA39Boundary:AT1110000	2019-04-11T11:38:41.770000	2627,63885	8394413,284346	2627638,850294	83944132843,456665
6	Polygon ZM	BA	0	1	BA	1	BA011000006	1000006	EEA39Boundary:BA0110000	2019-04-11T11:38:41.770000	38,369434	1311,198879	38369,434492	13111988,791161
7	Polygon ZM	BA	1	1	BA	1	BA111000007	1000007	EEA39Boundary:BA1110000	2019-04-11T11:38:41.770000	1640,296947	5120254,559934	1640296,946866	51202545599,337807
8	Polygon ZM	BE	1	0	BE	1	BE101000008	1000008	EEA39Boundary:BE10100000	2019-04-11T11:38:41.770000	139,969002	1996,640092	139969,001703	19966400,922948
9	Polygon ZM	BE	1	1	BE	1	BE111000009	1000009	EEA39Boundary:BE11100000	2019-04-11T11:38:41.770000	1483,20141	3066741,578999	1483201,40981	30667415789,994377
10	Polygon ZM	BG	1	0	BG	1	BG101000010	1000010	EEA39Boundary:BG1010000	2019-04-11T11:38:41.770000	313,402473	736,770925	313402,473214	7367709,247815
11	Polygon ZM	BG	1	1	BG	1	BG111000011	1000011	EEA39Boundary:BG1110000	2019-04-11T11:38:41.770000	2289,988568	11099444,248597	2289988,568492	110994442485,96704

Table 3-2: EEA39 Expert Product Fields.

Fieldname	Type	Possible Values	Description	Comments
IBLayer	Long	1: Improved Boundary Layer Land Polygon 0: Improved Boundary Layer Water Polygon	The user is able to determine land area differences between the EBMV12 and the IBLayer using a combined query.	Example: "EBMV12" = 1 and "IBLayer" = 0 → EBMV12 includes non-land areas "EBMV12" = 0 and "IBLayer" = 1 → EBMV12 excludes land areas "EBMV12" = 1 and "IBLayer" = 1 → EBMV12 coincides with the IBLayer
EBMV12	Long	1: EBMV12 Land Polygon 0: EBMV12 Water Polygon		
OBJECT_ID	String	Unique	ICC+ IBLayer + EBMV12 + ID	
ID	Long	Unique	FID + 1000000	
INSPIREID	String	Unique	Namespace:localid: versionid	Namespace = “EEA39Boundary” localid = OBJECT_ID versionid = “beginLife”
beginLife	String	Date/Time	ISO 8601 format	
ICC	String		ISO 3166-1 Alpha-2	

			code	
SubCountry	String	Defined in Table 4-2: <sub-country>		
EEA39	Short	1: the country belongs to EEA39 0: the country does not belong to EEA39		
PERIMETER	Double		Perimeter in km	
POLY_AREA	Double		Area in ha	
Shape_Leng	Double		Perimeter in m	
Shape_Area	Double		Area in m^2	

The raster product represents the boundary of the Improved Boundary Layer (IBLayer). The raster files derived from the vector layers are delivered using a tiling system. Each tile has an extent of 100 x100 km. Furthermore, a pan-European mosaic is provided. The French oversea departments are excluded from the pan-European raster products and separately delivered in the corresponding national projection. A tile identifier is created based on the coordinates of the lower-left corner of each tile. The identifier is defined as follows:

Tile ID = ExxNyy

E … East

xx … x-coordinate of the lower-left corner divided by 100,000

>N … North yy … y-coordinate of the lower-left corner divided by 100,000

3.5.2. EEA39 Boundary Layer

The Boundary layer is derived from the Expert product including only EEA39 countries and the four states Città del Vaticano, San Marino, Andorra and Monaco. Based on the Expert product a buffer of 250m is applied. Before buffering a MMU of 0,1 ha has been applied to exclude islands smaller than the MMU. Regarding the raster files the DOM's were delivered separately in national UTM projection instead of LAEA.

Metadata file	Format: XML
Image file	Format: ArcGIS Geodatabase, ESRI-Shapefile, GeoTiff raster Spatial resolution: 10m, 20m and 100m EPSG: 3035

Naming Convention	Base directory:
	`<name>_<extent>_<EPSGC>_<buffer>_<version>/`
	Metadata file:
	`<name>_<extent>_<EPSGC>_<buffer>_<version>.xml`
	ESRI-Shapefile:
	`<name>_<extent>_<EPSGC>_<buffer>_<version>.shp`
	ArcGIS Geodatabase:
	`<name>_<extent>_<EPSGC>.gdb/`
	`<name>_<extent>_<EPSGC>_<buffer>_<version>`
	GeoTiff raster:
	`<name>_<extent>_<EPSGC>_<tile-size>_<resolution>/`
	`<name>_<extent>_<EPSGC>_<buffer>_<resolution>_<version>_<tile>.tif`

Naming Example	Base directory: Boundary_EEA39_03035_250m_v01/ Metadata file: Boundary_EEA39_03035_250m_v01.xml ESRI-Shapefile: Boundary_EEA39_03035_250m_v01.shp ArcGIS Geodatabase: Boundary_EEA39_03035.gdb/Boundary_EEA39_03035_250m_v01 GeoTiff raster: Boundary_EEA39_03035_100x100km_100m/ Boundary_EEA39_03035_250m_010m_v01_E01N02.tif

The French Oversea Departments are provided in a separate folder "Boundary_DOMS" following the naming convention defined above. Each DOM is represented in separate raster file independent from the tiling grid and national projection instead of LAEA.

Table 3-3: EEA39 Boundary Product Fields.

Fieldname	Type	Possible Values	Description	Comments
OBJECT_ID	String	Unique	"EEA39"+ID	
ID	Long	Unique	FID + 1000000	
INSPIREID	String	Unique	Namespace:localid: versionid	Namespace = "EEA39Boundary" localid = OBJECT_ID versionid = "beginLife"
beginLife	String	Date/Time	ISO 8601 format	
PERIMETER	Double		Perimeter in km	
POLY_AREA	Double		Area in ha	
Shape_Leng	Double		Perimeter in m	
Shape_Area	Double		Area in m^2	

4. Task 3: Generate the national boundary layers

Based on the EEA39 Border Expert product, national boundary layers were derived for each of the 39 EEA countries. The national boundary layers are thereby derived by applying a buffer of 250m and selecting the outline. This data will then be projected to the respective national systems which are specified together with the EEA.

4.1. Country codes, sub-country codes and projections

The layers evaluated vary in their spatial extents. The current production includes the countries listed in Table 4-2 corresponding to EEA member and collaborating countries. It was furthermore decided that countries included in EBM within the eastern EEA border (like Andorra or Vatican City) were kept and incorporated in this new layer. Russia, Belarus or the Ukraine are not included in the production. Territories, part of EEA member countries but not considered in diverse layers, Greenland (Denmark) e.g., are furthermore not included in the EEA39 products.

Table 4-2 shows additionally the proposed projections for each sub-country. Country codes which are not defined in ISO 3166-1 are flagged orange.

Table 4-1: Country codes and national projections.

Country	<country id>	<sub-country>	<ebm_code>	ISO 3166-1 Alpha-2 code	EEA39	EPSG code
Albania	AL	AL	AL	AL	1	2462
Austria	AT	AT	AT	AT	1	31287
Bosnia and Herzegovina	BA	BA	BA	BA	1	3908
Belgium	BE	BE	BE	BE	1	3812
Bulgaria	BG	BG	BG	BG	1	32635
Switzerland	CH	CH	CH	CH	1	2056
Cyprus	CY	CY	CY	CY	1	32636
Czech Republic	CZ	CZ	CZ	CZ	1	5514
Germany	DE	DE	DE	DE	1	32632
Denmark	DK	DK	DK	DK	1	25832
Estonia	EE	EE	EE	EE	1	3301
Spain	ES	ES	ES	ES	1	25830
Spain, Canaries	ES	ES_CA	ES	-	1	32628
Finland	FI	FI	FI	FI	1	3067
France, French Guiana	GF	FR_GF	FR	GF	1	32622
France, Guadeloupe	GP	FR_GP	FR	GP	1	32620
France, Martinique	MQ	FR_MQ	FR	MQ	1	32620
France, Mayotte	YT	FR_YT	FR	YT	1	32738
France, Reunion	RE	FR_RE	FR	RE	1	32740
France	FR	FR	FR	FR	1	2154
Greece	GR	GR	GR	GR	1	2100
Croatia	HR	HR	HR	HR	1	3765
Hungary	HU	HU	HU	HU	1	23700
Ireland	IE	IE	IE	IE	1	2157
Iceland	IS	IS	IS	IS	1	5325
Italy	IT	IT	IT	IT	1	32632
Kosovo	KS	KS	KS	-	1	3909
Liechtenstein	LI	LI	LI	LI	1	2056
Lithuania	LT	LT	LT	LT	1	3346
Luxembourg	LU	LU	LU	LU	1	2169
Latvia	LV	LV	LV	LV	1	3059
Montenegro	ME	ME	ME	ME	1	25834

North Macedonia (Republic of)	MK	MK	MK	-	1	6204
Malta	MT	MT	MT	MT	1	23033
Netherlands	NL	NL	NL	NL	1	28992
Norway	NO	NO	NO	NO	1	25833
Poland	PL	PL	PL	PL	1	2180
Portugal	PT	PT	PT	PT	1	3763
Portugal, Azores	PT	PT_AZ	PT	-	1	5014/5015
Portugal, Madeira	PT	PT_MA	PT	-	1	5016
Romania	RO	RO	RO	RO	1	3844
Serbia	RS	RS	RS	RS	1	25834
Sweden	SE	SE	SE	SE	1	3006
Slovenia	SI	SI	SI	SI	1	3912
Slovakia	SK	SK	SK	SK	1	5514
Turkey	TR	TR	TR	TR	1	code missing
United Kingdom of Great Britain without Northern Ireland	GB	GB	GB	GB*	1	27700
Guernsey	GG	GB_GG	GG	GG	1	3108
Isle of Man	IM	GB_IM	IM	IM	1	27700
Jersey	JE	GB_JE	JE	JE	1	3109
Northern Ireland	GB	GB_ND	ND	-	1	29903
Inlcuded in the EEA39 products:						
Andorra	AD	AD	AD	AD	0	N/A
Monaco	MC	MC	MC	MC	0	N/A
Vatican	VA	VA	VA	VA	0	N/A
San Marino	SM	SM	SM	SM	0	N/A
Gibralta	GI	GI	GI	GI	0	N/A
only included in the FULL products:						
Falkland Islands	FK	FK	FK	FK	0	N/A
Greenland	DK	GL	GL	GL	0	N/A
Saint Barthélemy	BL	FR_BL	FR	BL	0	N/A
Saint Martin (French part)	MF	FR_MF	FR	MF	0	N/A
Belarus	BY	BY	BY	BY	0	N/A
Georgia	GE	GE	GE	GE	0	N/A
Moldova (Republic of)	MD	MD	MD	MD	0	N/A
Russia	RU	RU	RU	RU	0	N/A
Ukraine	UA	UA	UA	UA	0	N/A

Faroe islands	FO	FO	FO	FO	0	N/A
*United Kingdom of Great Britain and Northern Ireland						
	not ISO compliant					

Table 4-2: Country codes and projections.

4.2. Deliverables

4.2.1. EEA39 National Boundary layers in LAEA

The BoundaryCountry layers are derived from the Expert product for all EEA39 countries including the four states Città del Vaticano, San Marino, Andorra and Monaco. Based on the Expert product a buffer of 250m is applied around each Sub-Country.

Metadata file	Format: XML
Image file	Format: ESRI-Shapefile Spatial resolution: EPSG: 3035
Naming Convention	Base directory: <name>_<EPSGC>_<version>/ ESRI-Shapefile: <name>_<sub-country>_<EPSGC>_<version>.shp
Naming Example	Base directory: NationalBoundary_03035_v01/ ESRI-Shapefile: NationalBoundary_PT-AZ_03035_v01.shp

Table 4-3: EEA39 National Boundary Fields.

Fieldname	Type	Possible Values	Description	Comments
ICC	String		ISO 3166-1 Alpha-2 code	
SubCountry	String	Defined in Table 4-2 : <sub-country>		
OBJECT_ID	String	Unique	"ICC"+ID	
ID	Long	Unique	FID + 1000000	
INSPIREID	String	Unique	Namespace:localid: versionid	Namespace = "EEA39Boundary" localid = OBJECT_ID versionid = "beginLife"
beginLife	String	Date/Time	ISO 8601 format	
PERIMETER	Double		Perimeter in km	
POLY_AREA	Double		Area in ha	
Shape_Leng	Double		Perimeter in m	
Shape_Area	Double		Area in m^2	

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6. Annex

6.1. National border evaluation

Table 6-1: National border evaluation.

sub-country	EBM_v12	GISCO100K	RZ-AOI	GISCO_EBM_HYBRID	most promising layers
AL	basic layer	ident to EBM	small area affected; national border is delineated in the middle of the riparian zone	see coastline evaluation	EBM and EEA39 border expert product
AT	basic layer	ident to EBM		not significant	EBM
BA	basic layer	not available		see coastline evaluation	EBM and EEA39 border expert product
BE	basic layer	ident to EBM		see coastline evaluation	EBM and EEA39 border expert product
BG	basic layer	ident to EBM		see coastline evaluation	EBM and EEA39 border expert product
CH	basic layer	ident to EBM, deviation to EBM concerning lakes (shore; EBM → water and land border)		not significant	EBM
CY	basic layer	ident to EBM		see coastline evaluation	EEA39 border expert product
CZ	basic layer	ident to EBM		not significant	EBM
DE	basic layer	ident to EBM, differences in the delineation of the coastline observed especially in estuaries and shallow water areas; Minsener Ogg is excluded --> different delineation of statistical and administrative boundaries.		see coastline evaluation	EBM and EEA39 border expert product

DK	basic layer	ident to EBM, excluding Greenland	not affected	excluding Greenland, see coastline evaluation	EBM and EEA39 border expert product
EE	basic layer	ident to EBM, land-area cut-off once	if affected it can be assumed that the national border is delineated in the middle of the riparian zone, there is not mapping of the RZ outside EEA 39	see coastline evaluation	EBM and EEA39 border expert product
ES	basic layer	ident to EBM; Andorra and Gibraltar are excluded		see coastline evaluation	EBM and EEA39 border expert product
ES_CA	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
FI	basic layer	ident to EBM	if affected it can be assumed that the national border is delineated in the middle of the riparian zone, there is not mapping of the RZ outside EEA 39	see coastline evaluation	EBM and EEA39 border expert product
FO	basic layer	not available	not available	not available	EEA39 border expert product
FR_GF	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
FR_GP	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
FR_MQ	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
FR_YT	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
FR_RE	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
FR	basic layer	ident to EBM		see coastline evaluation	EBM and EEA39 border expert product
GR	basic layer	ident to EBM; Mount Athos excluded → differences in the		see coastline evaluation	EBM and EEA39 border expert product

		delineation of boundaries at statistical and administrative level.			
HR	basic layer	ident to EBM, EBM shows additional border lines in the East		see coastline evaluation	EBM and EEA39 border expert product
HU	basic layer	ident to EBM	if affected it can be assumed that the national border is delineated in the middle of the riparian zone, there is not mapping of the RZ outside EEA 39	not significant	EBM
IE	basic layer	ident to EBM	national border is mainly formed by the coastline, border to North Ireland: if affected border is delineated in the middle of the riparian zone	see coastline evaluation	EBM and EEA39 border expert product
IS	basic layer	ident to EBM	national border is formed by the coastline	see coastline evaluation	EEA39 border expert product
IT	basic layer	ident to EBM, EBM shows additional border lines; San Marino and the Vatican City are excluded.	if affected national border is delineated in the middle of the riparian zone, huge parts of the national border are affected by the coastline	see coastline evaluation	EBM and EEA39 border expert product
KS	basic layer	not available		not significant	EBM
LI	basic layer	not available		not significant	EBM
LT	basic layer	ident to EBM	if affected it can be assumed that the national border is delineated in the middle of the riparian zone, there is not	see coastline evaluation	EBM and EEA39 border expert product

			mapping of the RZ outside EEA 39		
LU	basic layer	ident to EBM		not significant	EBM and EEA39 border expert product
LV	basic layer	ident to EBM	if affected it can be assumed that the national border is delineated in the middle of the riparian zone, there is not mapping of the RZ outside EEA 39	see coastline evaluation	EBM and EEA39 border expert product
ME	basic layer, outlines are derived from freely available small scale data	ident to EBM		see coastline evaluation	EBM and EEA39 border expert product
MK	basic layer	ident to EBM		not significant	EBM
MT	basic layer	ident to EBM		see coastline evaluation	EEA39 border expert product
NL	basic layer	ident to EBM		see coastline evaluation	EBM and EEA39 border expert product
NO	basic layer	ident to EBM, excluding Spitsbergen		see coastline evaluation	EBM and EEA39 border expert product
PL	basic layer	ident to EBM		not significant, few sections with differing course of border river, EBM seems to be accurate, coastline see detailed evaluation	EBM and EEA39 border expert product
PT	basic layer	ident to EBM, different delineation in estuaries		see coastline evaluation	EBM and EEA39 border expert product
PT_AZ	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
PT_MA	basic layer	ident to EBM	not available	see coastline evaluation	EEA39 border expert product
RO	basic layer	ident to EBM		not significant, few sections	EBM and EEA39

				with differing course of border river, EBM seems to be accurate, coastline see detailed evaluation	border expert product
RS	basic layer	ident to EBM		not significant	EBM
SE	basic layer	ident to EBM		see coastline evaluation	EBM and EEA39 border expert product
SI	basic layer	ident to EBM		see coastline evaluation	EBM and EEA39 border expert product
SK	basic layer	ident to EBM		not significant	EBM
TR	basic layer, outlines are derived from freely available small scale data; more generalized than RZ-AOI	ident to EBM, more generalized than RZ-AOI	Accurate delineation of riparian zones along border rivers → useful to delineate national borders at rivers, not available for the border between Turkey and Iran.	more detailed delineation of national along rivers, Tigris, Aras e.g. at the borders to Iraq and Syria as well as Armenia, RZ are not available for the border of Turkey and Iran but the border is delineated along the respective border river, coastline see detailed evaluation	EBM and EEA39 border expert product updated with segments of the EBM-GISCO hybrid dataset at the eastern and southern borders on land
GB	basic layer	ident to EBM	national border is mainly formed by the coastline, border to Ireland: if affected border is delineated in the middle of the riparian zone	see coastline evaluation	EEA39 border expert product
GB_GG	basic layer, outlines are derived from freely available small scale data	not available	not available	see coastline evaluation	EEA39 border expert product
GB_IM	basic layer, outlines are derived from	not available	not available	see coastline evaluation	EEA39 border expert product

	freely available small scale data				
GB_JE	basic layer, outlines are derived from freely available small scale data	not available	not available	see coastline evaluation	EEA39 border expert product
explanatory statement	**Reference dataset for the delineation of national borders within in the EEA territory and to EEA neighbouring countries.**	**Only small not significant improvements, regarding the representation of the EEA39 national borders, could be found.**	**Only small not significant improvements, regarding the representation of the EEA39 national borders, could be found.**	**Segments are used to delineate the border to the EEA neighbouring countries where EBM is not suitable. Better representation of parts of the eastern EEA borderline.**	

6.2. Coastline evaluation

Table 6-2: Coastline evaluation.

sub-country	EU-Hydro Coastline v3	EEA Coastline for analysis v2	WAW landmask	JRC-occurrence	EBM_v12	EBM-GISCO-hybrid (re-buffered)	comments
AL	least land-area cut-offs	land-area cut-offs	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than Hydro, land area cut offs	similar to EBM, differences in transitional zones, coastal wetlands, few deviation to EBM caused by generalization	
AT	x	x	x	x	x	x	
BA	least generalization, nearly no landmass omission	land-area cut-offs, more generalized than HYDRO	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	high degree of generalization	no differences to EBM observed	
BE	least land-area cut-offs	landmass omission	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	landmass omission	no differences to EBM observed	
BG	least generalization and land-area cut-offs	more generalized than HYDRO, land-area cut-offs, artefacts	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	high degree of generalization, landmass omission	no differences to EBM observed	
CH	x	x	x	x	x	x	
CY	least land-area cut-offs	land-area cut-offs, commission of landmass within islands, small islands mapped, more generalization	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	land-area cut-offs but less generalization than HYDRO, due to MMU no omission of islands, partially	differences to EBM in the delineation of port areas	

		than HYDRO and EBM_V12			very accurate delineation of the coastline, but less consideration of landmass in shallow water.		
CZ	x	x	x	x	x	x	
DE	land-area cut-offs, least generalization, few islands exceeding the MMU of 1ha are missing	land-area cut-offs, artefacts, no consideration of shallow water, islands are missing, high degree of generalization, commission of islands	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	potential commission of landmass in port areas, land-area cut-offs, more generalization than HYDRO, good results considering shallow waters and tidelands	differences to EBM were observed in port areas, tideland, bays and shallow water areas	
DK	least generalization, adequate separation of fresh and salt waters (fjords e.g. are classified as inland waters), not available for Greenland	landmass omission, more generalization than HYDRO and EBM, no consideration of shallow waters, different separation of salt and fresh waters than HYDRO, artefacts, not available for Greenland	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, consideration of shallow waters, different separation of salt and fresh waters than HYDRO, the coastline is also available for Greenland	excluding Greenland, differences in the delineation of islands to EBM → waterways in fjords, port areas and inner city regions included, few differences to EBM in coastal wetlands	
EE	land-area cut-offs concerning shallow water areas	most islands mapped, land-area cut-offs, more generalized than HYDRO and EBM	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	omission of islands over MMU of 4 ha, good delineation of shallow waters	differences to EBM concerning the delineation of the coastline in bays as well as coastal wetlands and or shallow water areas	

ES	least generalization, least land-area cut-offs	more generalized than HYDRO and EBM, land-area cut-offs	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, land-area cut-offs than HYDRO	few differences to EBM in port areas and bays observed	
ES_CA	least generalization	omission of islands, land-area cut-offs more generalized than EBM and HYDRO	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO	no noticeable deviations to EBM except few differences in shallow water areas and a harbour	
FI	good delineation of islands, least generalization	omission of islands and landmass, more generalized than HYDRO and EBM	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	omission of islands exceeding MMU of 4 ha, land-area cut-offs, more generalized than HYDRO	**more islands detected than EBM** (exceeding MMU), less islands mapped than HYDRO, differences in the delineation of islands to EBM → waterways between islands and in bays are included, deviation to EBM caused by generalization	Special emphasis is drawn on the HYBRID dataset, which includes more islands
FO	omission of few islands exceeding MMU, less generalization	land-area cut-offs more generalized than EBM and HYDRO	N/A	N/A	seems to be least generalized	N/A	WAW,CFA and HYBRID are not available
FR_GF	land-area commission, higher degree of generalization than EBM	N/A	N/A	artefacts from raster to polygon conversion; inland water included	less generalized than HYDRO	differences to EBM in shallow water areas, less generalization than EBM	WAW,CFA are not available

FR_GP	few landmass commission	N/A	N/A	artefacts from raster to polygon conversion; inland water included	omission of islands, inland waters, partially included	differences to EBM in the delineation of ports, bays and waterways	WAW,CFA are not available
FR_MQ	least generalization, areas with landmass commission reasonable (shallow water)	N/A	N/A	artefacts from raster to polygon conversion; inland water included	omission of islands	few differences to EBM in bays and shallow water areas observed	WAW,CFA are not available
FR_YT	N/A	N/A	N/A	artefacts from raster to polygon conversion; inland water included	few differences to HYBRID in transitional zones, mangrove forests or shallow water areas observed	few differences to EBM in transitional zones, mangrove forests or shallow water areas observed	HYDRO,WAW,CFA are not available
FR_RE	land-area cut-offs in deltas	N/A	N/A	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, landmass omission	few differences to EBM in port areas observed	WAW,CFA are not available
FR	least generalization, classification of lagoons as land, landward delineation of the coastline concerning beaches (mostly sand)	more generalization than HYDRO and EBM, land-area cut-offs, artefacts, classification of lagoons unclear, classification as water is probable	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, classification of lagoons as land, omission of islands	differences to EBM in shallow water areas, river mouths and intertidal areas (more seaward delineation of the coastline than EBM in some areas→more shallow water included) or coastal wetlands;	Special emphasis is drawn on EBM and HYBRID
GR	least generalization and land-area cut-offs	land-area cut-offs, more generalized than HYDRO	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	land-area cut-offs, more generalized than HYDRO	few differences to EBM observed, especially concerning coastal	

						wetlands and canals, bays	
HR	least generalization and land-area cut-offs	artefacts, more generalization than HYDRO and EBM, land-area cut-offs	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, land-area cut-offs	only few differences to EBM concerning bays	
HU	x	x	x	x	x	x	
IE	least generalization, land-area cut-offs, more suitable delineation of fresh and salt water than EBM and EEA Coastline for analysis v2	land-area cut-offs, small islands < 1 ha mapped	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	land-area cut-offs, more generalized than HYDRO, better results concerning shallow waters, coastal wetlands and intertidal areas than HYDRO	differences in the delineation of bays and islands to EBM --> waterways between islands included, differences in coastal wetlands observed	
IS	omission of few islands exceeding MMU, least generalization and land-area cut-offs	omission of landmass, more generalization than EBM and EEA Coastline for analysis v2, omission of islands	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	omission of landmass and islands exceeding MMU of 4 ha, more generalized than HYDRO, good results concerning land reclamation	differences in the delineation of islands to EBM --> waterways between islands included	
IT	classification of lagoons as land, least land-area cut-offs and generalization	landmass omission, classification of lagoons as water, more generalized than HYDRO and EBM	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	classification of lagoons as land, land-area cut-offs, more generalized than HYDRO	nearly no differences to EBM observed, aside in some bays of Sardegna	
KS	x	x	x	x	x	x	
LI	x	x	artefacts from raster to vector	artefacts from raster to polygon	x	x	

			conversion	conversion; inland water included			
LT	least land-area cut-offs and generalization, classification of lagoons as land	land-area cut-offs	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	land-area cut-offs, classification of lagoons as land not clear	no differences to EBM observed	
LU	x	x	x	x	x	x	
LV	least generalization	more land-area cut-offs than HYDRO, more generalization than HYDRO and EBM	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	land-area cut-offs	no differences to EBM observed	
ME	least generalization and land-area cut-offs	more generalization than EBM and HYDRO, land-area cut-offs	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, land-area cut-offs, landmass commission in Gulf area; outlines are derived from freely available small scale data	no noticeable differences to EBM observed	
MK	x	x	x	x	x	x	
MT	least generalization and landmass omission	more generalization than EBM and HYDRO, land-area cut-offs, approximately 100m offset in east-west direction	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, omission of islands exceeding MMU of 4 ha	nearly no differences to EBM observed, aside in a harbour area	
NL	least generalization and land-area cut-offs	land-area cut-offs, more generalized than HYDRO and EBM	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, land-area cut-offs	few deviations to EBM on tidal areas and the Ems estuary	
NO	not available for	only available	artefacts from	artefacts from	not available for		

	Spitsbergen, few islands exceeding MMU of 1 ha are missing, least generalization and land-area cut-offs	coastline for Spitsbergen, more generalized than HYDRO and EBM, land-area cut-offs	raster to vector conversion	raster to polygon conversion; inland water included	Spitsbergen, omission of islands exceeding MMU of 4 ha, more generalized than HYDRO	differences in the delineation of islands to EBM → waterways between islands and fjords included, deviation to EBM caused by generalization, excluding Spitsbergen	
PL	massive land-area cut-off leads to partially missing coastline	classification of inland waters as water, more generalization than HYDRO and EBM, artefacts	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	least land-area cut-offs	few deviations to EBM concerning the coastline delineation in various bays	
PT	least generalization	more generalization than HYDRO and EBM, land-area cut-offs, commission of islands	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, consideration of ports as landmass	differences to EBM in the delineation of coastal wetlands observed	
PT_AZ	more generalized than EBM and EEA Coastline for analysis v2, land-area cut-offs	commission of islands	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than EEA Coastline for analysis v2	no differences to EBM observed	
PT_MA	more generalized than EBM and EEA Coastline for analysis v2, land-area cut-offs, omission of islands exceeding MMU of 1 ha	more generalized than EBM, land-area cut-offs	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	least generalization and land-area cut-offs	no differences to EBM observed	

RO	least generalization and land-area cut-offs	land-area cut-offs, more generalized than HYDRO and EBM	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, land-area cut-offs	nearly no differences to EBM except in port areas	
RS	x	x	x	x	x	x	
SE	few islands exceeding MMU of 1 ha are missing, which appear in the EEA Coastline for analysis v2, least generalization and land-area cut-offs	high degree of generalization, land-area cut-offs	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	islands exceeding MMU of 4 ha are missing, more generalized than HYDRO, land-area cut-offs	differences in the delineation of islands to EBM --> waterways between islands and fjords included, deviation to EBM caused by generalization	
SI	significant land-area cut-offs in a few regions, least generalization	land-area cut-offs, more generalized than HYDRO and EBM	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalization than HYDRO and land-area cut-offs	no noticeable differences to EBM observed, except controversial area with Croatia	
SK	x	x	x	x	x	x	
TR	least generalization and land-area cut-offs	more generalized than HYDRO, land-area cut-offs, artefacts	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO and EEA coastline for analysis v2, landmass commission as well as omission; outlines are derived from freely availabe small scale data	differences to EBM in a high percentage of the Turkish Coast observed, EBM is more generalized than HYBRID dataset, less land-area cut-offs than in EBM in some regions, not equal for all sections → better results with	Special emphasis is drawn on EBM and HYBRID

						EBM, possibly resulting from an offset by the hybrid layer, also landmass commission observed, lakes	
GB	MMU 1ha therfore islands under MMU are missing, which apear in other layers	land-area cut-offs, more island than HYDRO	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, more coastal wetlands included than in HYDRO	differences in the delineation of bays and islands to EBM → waterways between islands included, differences in coastal wetlands observed	
GB_GG	least landmass omission, least generalization	landmass omission	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	landmass omission, more generalized than HYDRO; outlines are derived from freely available small scale data	differences to EBM observed in shallow water areas / sand beaches and at rocky coasts, less generalized than EBM	
GB_IM	land-area cut-offs, less omission than EEA coastline for analysis V2	landmass omission	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	more generalized than HYDRO, nearly no landmass omission; outlines are derived from freely available small scale data	no differences observed	
GB_JE	Missing islands	artefacts, land-area cut-offs, more generalized than HYDRO	artefacts from raster to vector conversion	artefacts from raster to polygon conversion; inland water included	Missing islands, land-area cut-offs, more generalized than HYDRO; outlines are derived	differences to EBM in transitional zones, coastal wetlands, sand beaches or shallow	

					from freely available small scale data	water areas e.g. as well as port areas and land reclamation zones, further differences due to a more generalized EBM observed	
explanatory statement	**Most detailed layer.**	**Generalized, but promising results in the representation of islands.**	**Artefacts from raster to vector conversion are present.**	**Artefacts from raster to vector conversion are present. More inland water is included.**	**Good results concerning shallow water.**	**The Layer shows more promising results at the Finish coast and the Archipelago of the Finish Sea, as well as the coast of the Asian part of Turkey and few sections of the French coast.**	
	x	No coastline					

6.3. National Projections and Transformation Parameters

Table 6-3: Projections

Country		*Projection Identification*					*Projection Parameters*									*Ellipsoid*			Comments
Name	Code	EPSG code	EPSG Name	EPSG code HRL 2015	EPSG Name HRL 2015	Type	Scale Factor	Longitude of Origin	Latitude of Origin	Azimuth Angle	Standard Parallel 1	Standard Parallel 2	False Easting	False Northing	Prime Meridian	Name	Semi Major Axis (Km)	Inverse flattening	
Albania	AL	2462	Albanian 1987 / Gauss-Kruger																

			zone 4																
Austria	AT	31287	MGI / Austria Lambert																
Belgium	BE	3812	ETRS89 / Belgian Lambert 2008																
Bosnia and Herzegovina	BA	3908	MGI 1901 / Balkans zone 6																
Bulgaria	BG	~~32634~~	~~WGS 84 / UTM zone 34N~~																
		32635	WGS 84 / UTM zone 35N																
Croatia	HR	3765	HTRS96 / Croatia TM																
Cyprus	CY	32636	WGS 84 / UTM zone 36N																
Czech Republic	CZ	5514	S-JTSK / Krovak East North																
Denmark	DK	25832	ETRS89 / UTM zone 32N																
		~~25833~~	~~ETRS89 / UTM zone 33N~~																
~~Denmark (Faroe islands)~~	~~DK~~	~~5316~~	~~ETRS89 / Faroe TM~~	-	-														Faroe Islands are not part of the EEA39 area.
Estonia	EE	3301	Estonian Coordinate System of 1997																
Finland	FI	3067	ETRS89 / TM35FIN(E,N)																

France	**FR**	2154	**RGF93 / Lambert-93**															
France (Guadelupe)	**FR**	32620	**WGS 84 / UTM zone 20N**															
France (Martinique)	**FR**	32620	**WGS 84 / UTM zone 20N**															
France (Guyane)	**FR**	32622	**WGS 84 / UTM zone 22N**	2972	RGFG95 / UTM zone 22N													
France (Mayotte)	**FR**	32738	**WGS 84 / UTM zone 38S**	4471	RGM04 / UTM zone 38S													
France (Reunion)	**FR**	32740	**WGS 84 / UTM zone 40S**	2975	RGR92 / UTM zone 40S													
FYR of Macedonia	**MK**	6204	**Macedonian State Coordinate System**															
Germany	**DE**	32632	**WGS 84 / UTM zone 32N**															
Great Britain	**GB**	27700	**OSGB 1936 / British National Grid**															
Northern Ireland	**NI**	29903	**TM75 / Irish Grid**	29902	TM65 / Irish Grid													
Jersey (Channel islands, British Crown Dependen	**GB**	3109	**ETRS89 / Jersey Transverse Mercator**															

cies)																			
Guernsey (Channel islands, British Crown Dependencies)	GB	3108	ETRS89 / Guernsey Grid																
Greece	GR	2100	GGRS87 / Greek Grid																
~~Greece – Kastellorizo~~	~~GR~~	~~code missing~~	-			TM	0.9996	27°	0°				500000	0		GRS80	6378137	298.257222101	Projection parameters for the area of Kastellorizo are the same as for the rest of Greece, except for the Longitude of Origin (which is 27° instead of 24°).
Hungary	HU	23700	HD72 / EOV																
Iceland	IS	5325	ISN2004 / Lambert 2004																ISN93 has been replaced by ISN2004
Ireland	IE	2157	IRENET95 / Irish Transverse Mercator																Replaces TM75 / Irish Grid (code 29903) from 1/1/2001
Italy	IT	32632	WGS 84 / UTM zone 32N																
		~~32633~~	~~WGS 84 / UTM zone 33N~~																
		~~32634~~	~~WGS 84 / UTM zone 34N~~																
Kosovo under UNSCR 1244/99	XK	3909	MGI 1901 / Balkans zone 7																
Latvia	LV	3059	LKS92 / Latvia TM																

Liechtenstein	**LI**	2056	**CH1903+ / LV95**															
Lithuania	**LT**	3346	**LKS94 / Lithuania TM**															
Luxembourg	**LU**	2169	**Luxembourg 1930 / Gauss**															
Malta	**MT**	23033	**ED50 / UTM zone 33N**															
Montenegro	**ME**	25834	**ETRS89 / UTM zone 34N**															
Netherlands	**NL**	28992	**Amersfoort / RD New**															
Norway	**NO**	~~25832~~	~~**ETRS89 / UTM zone 32N**~~															
		25833	**ETRS89 / UTM zone 33N**															
		~~25834~~	~~**ETRS89 / UTM zone 34N**~~															
		~~25835~~	~~**ETRS89 / UTM zone 35N**~~															
		~~25836~~	~~**ETRS89 / UTM zone 36N**~~															
Poland	**PL**	2180	**ETRS89 / Poland CS92**															
Portugal	**PT**	3763	**ETRS89 / Portugal TM06**															
Portugal (Azores Western Group)	**PT**	5014	**PTRA08 / UTM zone 25N**															
Portugal (Azores Central	**PT**	5015	**PTRA08 / UTM zone 26N**															

and Eastern Group)																			
Portugal (Madeira)	**PT**	5016	**PTRA08 / UTM zone 28N**																
Romania	**RO**	3844	**Pulkovo 1942(58) / Stereo70**																
Serbia	**RS**	25834	**ETRS89 / UTM zone 34N**																
Slovakia	**SK**	5514	**S-JTSK / Krovak East North**																
Slovenia	**SI**	3912	**MGI 1901 / Slovene National Grid**																
Spain (Canaries)	**ES**	32628	**WGS 84 / UTM zone 28N**																
Spain	**ES**	~~25829~~	~~**ETRS89 / TM zone 29N**~~																
		25830	**ETRS89 / TM zone 30N**																
		~~25831~~	~~**ETRS89 / TM zone 31N**~~																
Sweden	**SE**	3006	**SWEREF99 TM**																
Switzerland	**CH**	2056	**CH1903+ / LV95**																
Turkey	**TR**	code missing		5637	TUREF / LCC Europe	Lambert Conformal Conic		36°	0°		37°30'	40°30'	1000000	0		Hayford	6378388	297	It is advised that TR registers this CRS in the EPSG database (http://www.epsg-registry.org/)

Table 6-4: Transformation Parameters

Country		EPSG Code Coordinate Transformation Parameters*	EPSG Code Coordinate Transformation Method	Nr. Parameter	*Translation*			*Rotation*						*Scale*	Comments
Name	Code				dX [m]	dY [m]	dZ [m]	rx [']	rx [decimal]	ry [']	ry [decimal]	rz [']	rz [decimal]	m [ppm]	
Albania	AL	15999	9603												Coordinate transformation parameters towards WGS84
Austria	AT	1619	9606												
Belgium	BE	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Bosnia and Herzegovina	BA	3963	9607												Coordinate transformation parameters towards ETRS89
Bulgaria	BG	1149	9603												
		1149	9603												
Croatia	HR	15966	9603												HTRS96 is a regional realisation of ETRS89
Cyprus	CY	1149	9603												
Czech Republic	CZ	1622	9606												
Denmark	DK	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
~~Denmark (Faroe islands)~~	~~DK~~	~~N/A~~	~~N/A~~	-	-	-	-	-	-	-	-	-	-	-	~~Coordinate transformation parameters not necessary; based on ETRS89~~
Estonia	EE	1648	9603												
Finland	FI	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
France	FR	1591	9603												
France (Guadelupe)	FR	1149	9603												
France (Martinique)	FR	1149	9603												
France (Guyane)	FR	1149	9603												
France (Mayotte)	FR	1149	9603												
France (Reunion)	FR	1149	9603												
FYR of Macedonia	MK	code missing	9607	7	521.7476	229.4892	590.9207	-4.02	-0.0011	-4.488	-0.0012	15.52067	0.0043 11297	-9.78	

								878	19106	36	46767			03	
Germany	DE	1149	9603												
Great Britain	GB	1314	9606												Coordinate transformation parameters towards WGS84
Northern Ireland	NI	1953	9606												Coordinate transformation parameters towards ETRS89
Jersey (Channel islands, British Crown Dependencies)	GB	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Guernsey (Channel islands, British Crown Dependencies)	GB	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Greece	GR	code missing	9607	7	-203.4370	73.4610	243.5940	0.17000	0.0000 47222	0.06000	0.0000 16667	0.15100	0.0000 42	0.29400	Coordinate transformation parameters towards ETRS89
~~Greece - Kastellorizo~~	~~GR~~	~~code missing~~	~~9603~~	~~3~~	~~5.0200~~	~~19.8850~~	~~12.2440~~	-	-	-	-	-	-	-	~~Coordinate transformation parameters towards ETRS89~~
Hungary	HU	1449	9607												
Iceland	IS	1952	9603												Coordinate transformation parameters towards WGS84
Ireland	IE	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Italy	IT	1149	9603												
		~~1149~~	~~9603~~												
		~~1149~~	~~9603~~												
Kosovo under UNSCR 1244/99	XK	code missing	9607	7	574.02732	170.17492	401.5453	-4.88786	-0.0013 57739	0.66524	0.0001 84789	13.24673	0.0036 79647	6.88933	
Latvia	LV	N/A	N/A												Coordinate Transformation Parameters not necessary, because LKS92 is a realisation of ETRS89
Liechtenstein	LI	1647	9603												See also Swiss transformation EPSG codes
Lithuania	LT	N/A	N/A												Coordinate Transformation Parameters not necessary, because LKS94 is a realisation of ETRS89
Luxembourg	LU	1642	9606												
Malta	MT	1144	9607												
Montenegro	ME	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Netherlands	NL	4830	9607												
Norway	NO	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89

Poland	**PL**	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Portugal	**PT**	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Portugal (Azores Western Group)	**PT**	4905	9603												Coordinate transformation parameters towards WGS84
Portugal (Azores Central and Eastern Group)	**PT**	4905	9603												Coordinate transformation parameters towards WGS84
Portugal (Madeira)	**PT**	4905	9603												Coordinate transformation parameters towards WGS84
Romania	**RO**	15994	9607												Coordinate transformation parameters towards ETRS89
Serbia	**RS**	N/A	N/A												Coordinate transformation parameters not necessary; based on ETRS89
Slovakia	**SK**	code missing	9607	7	-485.0141	-169.47362	-483.84294	7.786255	0.0021628	4.3977089	0.001221586	4.102489	0.00113958	0	Coordinate transformation parameters towards ETRS89
Slovenia	**SI**	3914	9606												
Spain (Canaries)	**ES**	1149	9603												
Spain	**ES**	~~1149~~	~~9603~~												
		1149	9603												
		~~1149~~	~~9603~~												
Sweden	**SE**	1878	9603												
Switzerland	**CH**	1647	9603												
Turkey	**TR**	1783	9606												