



**United Nations
Environment Programme
Mediterranean Action Plan**

Distr.: General
17 February 2023
Original: English only

Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring

Athens, Greece 1-2 March 2023

Agenda Item 3: 2023 Mediterranean Quality Status Report (QSR) - Pollution Ecological Objectives (EO5, EO9)

The Updated GIS - based Layers for the Finest Areas of Assessment and the Areas of Assessment Nested to the Levels of Integration that are Considered Meaningful for Their Use Within Application of the NEAT GES Assessment Methodology for IMAP Common Indicators 13, 14 and 17 in the Adriatic Sea Sub-region

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List of Abbreviations / Acronyms

CDR	Central Data Repository
CPs	Contracting Parties
EU	European Union
GES	Good Environmental Status
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
MAP	Mediterranean Action Plan
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
MSFD	Marine Strategy Framework Directive
MRU	Marine Reporting Unit
MSs	Member States
NEAT	Nested Environmental status Assessment Tool
SAU	Spatial Assessment Unit

1. Introduction

For a harmonized and homogenized application of the Nested Environmental Status Assessment Tool-NEAT for GES assessment related to Ecological Objectives 5, 9 and 10, the Adriatic Sea Subregion was selected. The work undertaken included consideration of monitoring stations distribution in order to recognize the spatial coverage of the areas of monitoring and from there to set the areas of assessment. Briefly that work included the following phases:

- Analysis and preparation for further use the GIS layers providing distribution of the monitoring stations i.e., areas of monitoring for Ecological Objectives 5, 9 and 10 i) as provided in the National IMAPs of Albania, Bosnia and Herzegovina and Montenegro; or ii) as defined in MSFD monitoring programmes for Greece, Croatia, Italy, and Slovenia, and/or reported into IMAP Information System. In the case GIS-based layers were not available, their preparation was undertaken based on input information on the distribution of monitoring stations.
- Setting of the spatial coverage of the areas of assessment for their insertion into the application of NEAT tool for GES assessment related to Ecological Objectives 5, 9 and 10. To that purpose
 - o the GIS-based layers were prepared for i) the finest scales of assessment of the national parts of three subdivisions in the Adriatic Sea Subregion; ii) the scales of assessment nested to the level of integration that are considered meaningful for specific IMAP Common Indicators. That work included use of free open GIS information on national administrative units and application of the criteria for coupling the geographical information to define the appropriate areas of assessment, in line with the methodology defined in UNEP/MED WG. WG.509/Inf. 10/Rev.2¹.
 - o the GIS-based layers of the areas of assessment defined for the Contracting Parties of the Barcelona Convention that are the Member States of EU, were used as available in relevant and reliable sources (EEA; the EC financed projects i.e., MEDREGION, MEDCIS, HARMONIA, ADRION, etc.).

2. How to use this document

This document is accompanied with the collected geospatial data. Open access sources and relevant research projects have been analyzed and exploited regarding the suitability of their use for setting of the areas of assessment. The geospatial data are organized per each Contracting Party. The geospatial data are in ESRI shapefile format, open access format, readable from all available GIS software and applications. The coordinate reference system (CRS) is ETRS89-LAEA Europe, also known in the EPSG Geodetic Parameter Dataset under the identifier: EPSG:3035. The Geodetic Datum is the European Terrestrial Reference System 1989 (EPSG:6258). The Lambert Azimuthal Equal Area (LAEA) projection is centered at 10°E, 52°N. Coordinates are based on a false Easting of 4321000 meters, and a false Northing of 3210000 meters. The data can be used by various software applications, either commercial (i.e., ESRI ArcGIS Desktop and ArcGIS Pro, ERDAS, ENVI, GlobalMapper) or of open access like QGIS, Google Earth, SAGA GIS, R, etc.

3. Geospatial Data Sources for the Adriatic Sea Subregion

In the view of open data and well documented use of data based on FAIR principles (Findability, Accessibility, Interoperability, and Reuse), official data sources have been explored. In some cases, data from regional projects have been considered to complement data from open access sources. The portals with accessible data that have been explored and further analysed for the countries of the Adriatic Sea Sub-region are the following:

- The European Environment Agency (EEA) is an agency of the European Union, whose task is to provide sound, independent information on the environment. The EEA aims to support sustainable development by helping to achieve significant and measurable improvement in Europe's environment,

¹ For the purpose of building the methodology for aggregation and integration rules contained in this document only the scientific elements have been considered from any reference included in this document. Legal considerations are out of the scope of the present document, which serves exclusively scientific purposes.

through the provision of timely, targeted, relevant, and reliable information to policymaking agents and the public.

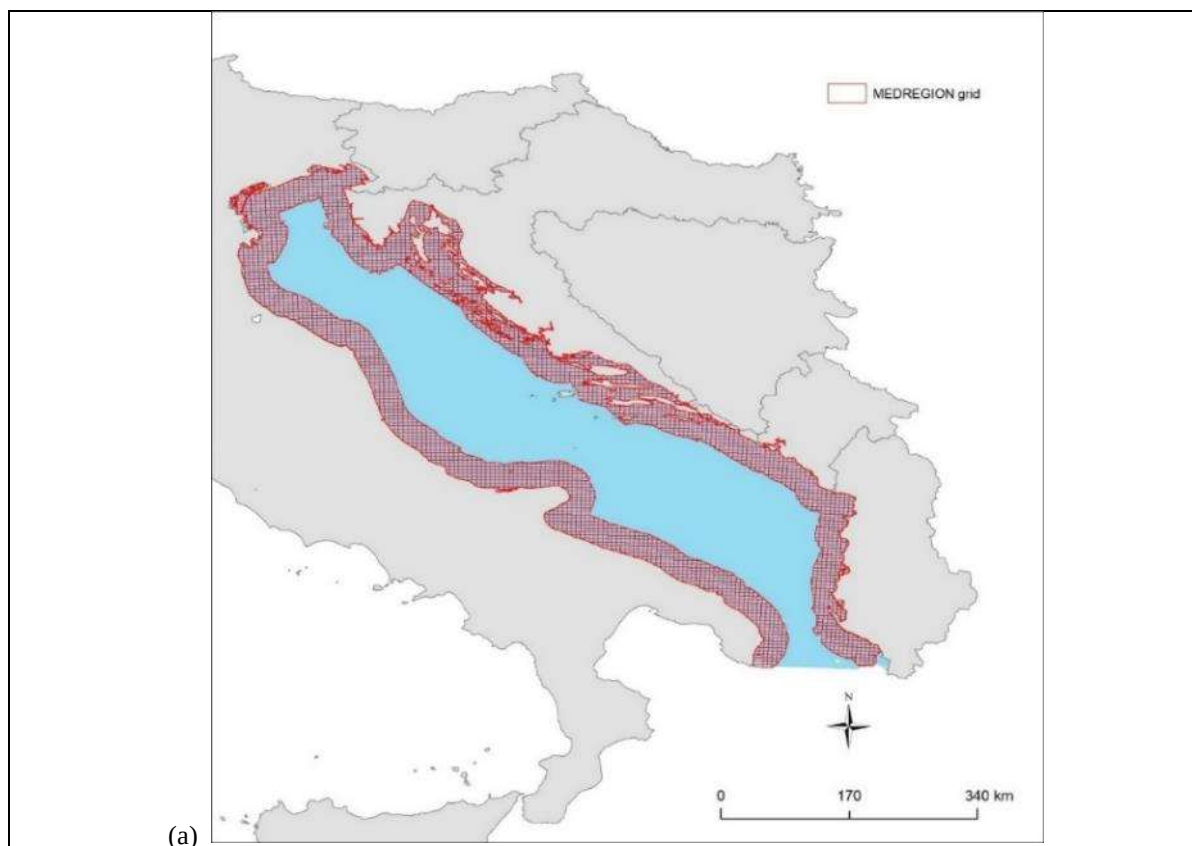
- The European Environment Information and Observation Network (Eionet) is a partnership network of the European Environment Agency (EEA) and its 38 member and cooperating countries. The EEA is responsible for developing Eionet and coordinating its activities together with National Focal Points (NFPs) in the countries. The NFPs are responsible for coordinating networks of National Reference Centres (NRCs), bringing together experts from national institutions and other bodies involved in environmental information. Eionet also includes seven European Topic Centres (ETCs). They are consortia of institutions across EEA member countries dealing with a specific environmental topic and contracted by the EEA to perform specific tasks of its work programme.
- MEDCIS project is a follow up of the previous two calls from DG Environment that dealt with Joint Monitoring proposals and provision of the assistance to the Member States to develop Action Plans for Integrated Monitoring Programmes, Programmes of Measures and Data Management, under the obligations of the Marine Strategy Framework Directive (MSFD). From there, the layers on the 12 nautical miles have been further used in the analysis:
- GEF Adriatic project. The overall objective of the project was to restore the ecological balance of the Adriatic Sea through implementation of the Ecosystem Approach (EcAp as applied by UNEP/MAP) and improve management capacity at a subregional level through Marine Spatial Planning (MSP) as a viable management tool for the marine environment. In so doing, the project supported integration of the Ecosystem Approach into management tools such as Marine Spatial Planning (MSP), Integrated Coastal Zone Management (ICZM), Marine Protected Areas (MPAs), and provided technical assistance to Albania and Montenegro to strengthen their management capacity. All other countries of the Adriatic sub-region, namely Italy, Slovenia, Croatia, Bosnia and Herzegovina, while not being direct beneficiaries of this project, indirectly benefit of its implementation as the Contracting Parties to the Barcelona Convention. The geospatial data of the project are not available as of open access and FAIR principles available resources. The data have been provided by the national official representatives in UNEP/MAP and representatives of the executing agencies of the project.
- Database of Global Administrative Areas - GADM aims to map the administrative areas of all countries, at all levels of sub-division. It provides data at high spatial resolutions that includes an extensive set of attributes. The data are organized per country and are available for download as Geopackage, Shapefile and R files.
- Discomap portal from where, detailed MRUs and subMRUs are available for Italy
- The VLIMAR Gazetteer is a database with geographic, mainly marine names such as seas, sandbanks, seamounts, ridges, bays, or even standard sampling stations used in marine research (used for the Adriatic Sea Sub-region).
- The Spatial Data Infrastructure of European Environment Agency includes a variety of environmental data for the EU member states. Datasets are updated regularly, and the majority of the available resources are available as open access to the public domain.
- Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020 (used for the Adriatic Sea).

In addition, geospatial data produced in the framework of the two European research projects were used:

- **The MEDREGION and MEDCIS geospatial data.** The MEDCIS and MEDREGION DGENV projects have created several geospatial data that are available for further testing and use in research issues. Both projects are meant as supporting activities within the second cycle of the MSFD Implementation with a strategic role in the frame of the Common Implementation Strategy (CIS) of the MSFD. This institutional and strategic connotation was underlined by the Commission during the presentation of the Call for Proposal, at the Marine Strategy Coordination Group held last 23 of April 2018, where it was emphasized that the Member States are the main beneficiaries of the project. This is also reflected in the text of the proposal, where the involvement of at least 2 National Competent Authorities for the MSFD Implementation was indicated as a key parameter for the participation.

A proposal for finer scales of assessment using a *newly developed spatial assessment grid* has been developed and disturbed among partners of the project. The grid has a dimension of 4.5x4.5 km and has been designed to capture the breath and influence of the marine environment to the monitoring stations. However, the visual examination of the grid overlaid with the monitoring stations` positions as provided in national IMAPs and reported into the IMAP Information system shows that the distribution of the monitoring stations covers quite small spatial assessment units that can be used for setting IMAP areas of assessment and their further nesting within application of NEAT in the Adriatic Sea Sub-region (figure 3.1.1).

The spatial assessment units have been found either quite small in the case of MEDREGION proposal or quite large in terms of spatial extend in the case of major MRUs or quite scattered with shapes in the case of subMRUs of Italy, that are beyond the 12 nautical miles and the EEZ of Italy, as it is defined in the Marine Regions portal. Therefore, the dataset of MEDCIS, namely 12 nautical miles and coastal waters (figure 3.1.2.) have been used to further define the IMAP spatial assessment units of Italy. Namely, the MEDREGION grid does not provide information on either the 1 nautical mile or the 12 nautical miles offshore waters delimitation. This information was better illustrated by the GIS-based layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase) by the MEDCIS project and used for the present work for Slovenia, Croatia and Italy. For Albania and Montenegro, MEDCIS maps were not accurate or do not include the relevant information and therefore were replaced/corrected in line with relevant national sources i.e. results of GEF Adriatic Project and provisions of relevant national legal acts. The MEDCIS work takes into consideration the existence of bays and inlets which are numerous in particular in the east part of the Adriatic Sea and calculates the baseline using the straight baseline method by joining appropriate points. The breadth of the offshore waters up to 12 nautical miles from the straight baseline is set (Figure 1).



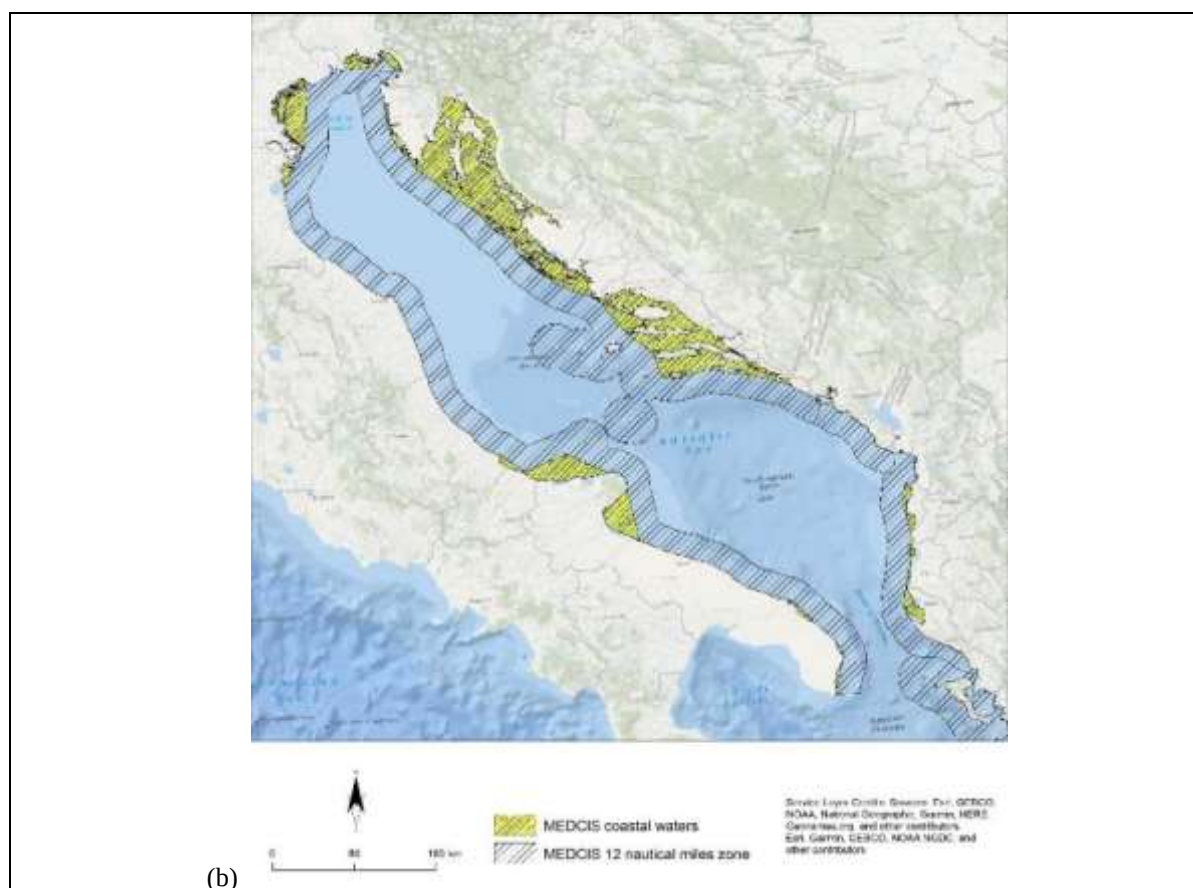


Figure 1. (a) The MEDREGION grid used as the spatial basis for setting the IMAP areas of assessment in Adriatic Sea region. (b) The MEDCIS layers that have been elaborated for further use. In line with available sources as elaborated above, the 4 general working steps were followed in order to define the IMAP spatial assessment units (SAUs) from the areas of monitoring recognized from distribution of the monitoring stations and other relevant details as elaborated here-below per each country.

4. The steps for defining the IMAP Spatial Assessment Units

The following working steps have been followed to accomplish the objectives of the current work.

Step 1 Defining coastal and offshore waters. By using the information from the MEDCIS project, it was possible to define the two zones i.e. the coastal zone and the offshore zones for the purposes of the present work in the Adriatic Sea Subregion. Given the distance of the monitoring stations defined by the CPs in the offshore waters and ecological and hydrographic characteristics, the breadth of the marine waters up to 12 nautical miles from the straight baseline is then set. The layers provided by the MEDCIS project correspond to i) a layer that includes all indentations i.e. inlets, gulfs and bays and ii) the layer of marine waters up to 12 nautical miles. Based on these data the two zones have been defined for the purpose of the present work: 1) the coastal zone: including all indentations (inlets, bays, gulfs) from the straight baseline landward, as well as the 1 nautical mile zone from the straight baseline seaward (in different literature sources, this 1 nautical mile zone is also called the buffer zone); 2) the offshore zone: including the area beyond the 1 nautical mile seaward and up to 12 nautical miles. It was found however that this MEDCIS datasets had errors for the case of Montenegro and Albania. Therefore, for these two countries data from the GEF Adriatic project were used as well as the national legislation of Albania and Montenegro (*Albania*: Degree No. 4650 of March 1970 and the Decree on a Modification to Decree No. 4650, dated 9 March 1970, on the State Border of the People's Socialist Republic of Albania, 1990; ; *Montenegro*: Decree on the Proclamation of the Law on the Sea "Official Gazette of Montenegro", No. 17/07 date on 31.12.2007, 06/08 dated on 25.01.2008, 40/11 dated on 08.08.2011). In addition, the MEDCIS data do not include any information for Greece, however the number and position of monitoring stations were pointed in the offshore waters only, as explained below in detail.

Step 2 “Recognizing scope of IMAP areas of monitoring”: In the absence of monitoring areas reported by the CPs, the distribution of monitoring stations was investigated by considering the coordinates of their positions provided by the CPs in the IMAP Info System. IMAP monitoring stations (i.e., hotspot, coastal, offshore stations) are grouped under the two zones coastal up to 1nm and offshore from 1 nm and up to 12 nm, following the IMAP methodology as described in UNEP/MED WG. 509/Inf.10/Rev.2. This was followed by the preparation of relevant GIS layers/maps containing positions of IMAP monitoring stations in the two zones; this included recognition of the monitoring areas based on distribution of the monitoring stations in the absence of the areas of monitoring (i.e., monitoring transects) defined by the CPs. As explained above, spatial coverage of the coastal waters and the offshore marine waters is based on available data from MEDCIS and the GEF Adriatic Projects. For Greece only one monitoring station exists in South Adriatic waters at a distance 6 nm from land. In the absence of any known pollution sources in this area, for this country only the offshore monitoring area is considered.

Step 3 “Setting IMAP area of assessment”: This step included defining the IMAP areas of assessment (IMAP SAUs) based on the anticipated areas of monitoring. To recognize the areas of monitoring, the criteria already set for that purpose in UNEP/MED WG. WG.509/Inf.10/Rev.2 were applied to the largest possible extent. Namely, the following criteria were applied to recognize the scope of the areas of monitoring: i) spatial distribution of monitoring stations was compared with the sufficiency of quality-assured data as collated for NEAT application in order to ensure a due consideration is given to the risk-based principle; ii) representativeness/importance of the areas of monitoring for setting of the areas of assessment; iii) in the case of Montenegro, information available regarding the presence of impacts of pressures in monitoring areas was also taken into account; to that purpose the cumulative pressures layer from GEF Adriatic Project has been used. In addition, the interrelation of the MRUs for the CPs that are EU MSs with the IMAP monitoring areas was investigated and whether these fit for their use as IMAP SAUs, following the criteria described previously. Final results are GIS layers/maps of IMAP SAUs prepared per country from the GIS layers providing the positions of monitoring stations in recognized areas of monitoring. This was followed with equalization of the areas of monitoring with the SAUs for Albania and Montenegro, while for Slovenia, Croatia, and Greece the SAUs are equalized to the MSFD MRUs. For Italy, the approach followed is slightly different because its MRUs do not fit the purposes of the IMAP. Details per each country separately are presented here - below. Final results are GIS layers/maps of IMAP SAUs prepared per country from the GIS layers. They also provide the positions of monitoring stations in the areas of monitoring that were recognized within present work. This was based on the equalization of the areas of monitoring with the SAUs for Albania and Montenegro, while for Slovenia, Croatia and Greece the SAUs uses to the extent possible the areas already set by the CPs. For Italy, the approach followed is slightly different because its MRUs do not fully fit the purposes of the IMAP. Details per each country separately are presented here - below.

Step 4 “Nesting of the areas of assessment within application of NEAT tool”: For the step of nesting, the areas of assessment were first classified under the 3 subdivisions of the Adriatic Sea (i.e. North, Central, South); then a nesting scheme approach was followed. The delimitation of the three Adriatic subdivision was made according to Cushman-Roisin et al, (2001)². The approach followed for the nesting of the areas is 4 levels nesting scheme where 1st level is the finest and 4th level is the highest:

- 1st level provided nesting of all national IMAP SAUs and subSAUs within the two key IMAP assessment zones per country i.e., coastal and offshore zone;
- 2nd level provided nesting of the assessment areas set in IMAP assessment zones i.e., coastal and offshore, on the subdivision level i.e., i) NAS coastal, NAS offshore; ii) CAS coastal, CAS offshore; iii) SAS coastal, SAS offshore);
- 3rd level provided nesting of the areas of assessment within the 3 subdivisions (NAS, CAS, SAS);
- 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub-region.

After setting of the finest IMAP areas of assessment, similarly the integration of the assessment results is conducted: following the 4 levels nesting approach:

² Cushman-Roisin, B., Gačić, M., Poulain, P-M., Artegiani, A., 2001. Physical Oceanography of the Adriatic Sea, Past, Present and Future, Springer Science + Business Media, Dordrecht, 312 pp

- 1st level: Detailed assessment results provided per subSAUs and SAUs;
- 2nd level: Integrated assessment results provided per: i) NAS coastal, NAS offshore; ii) CAS coastal, CAS offshore; iii) SAS coastal, SAS offshore;
- 3rd level: Integrated assessment results provided per subdivision NAS, CAS, SAS;
- 4thlevel: Integrated assessment results provided for the Adriatic Sea Sub-region.

The description of the IMAP SAUs and details on specificities for each country are provided here-below.

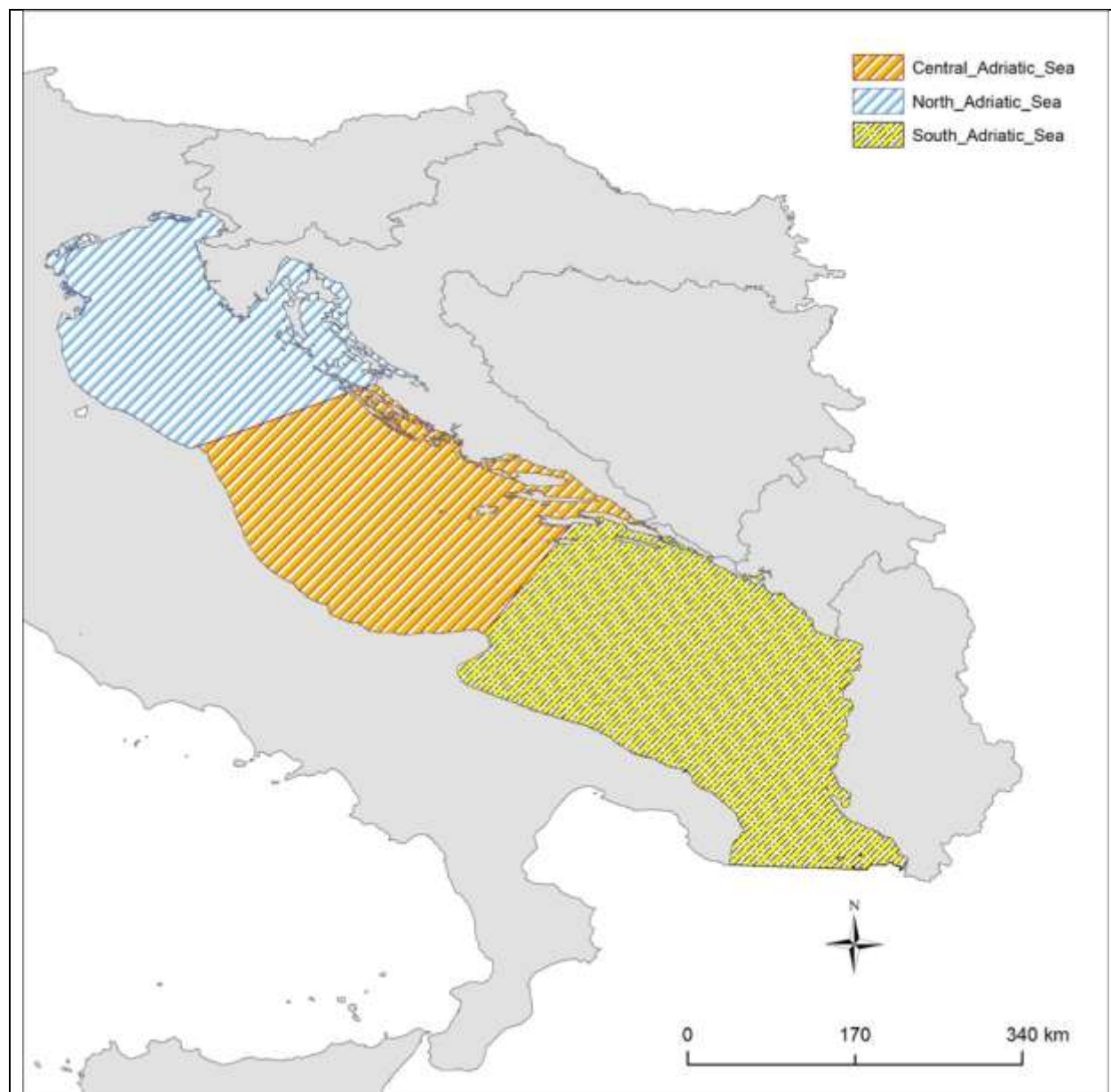


Figure 2. The division of Adriatic Sea according to Cushman-Roisin et al. (2001). The description of the final delimitation of the IMAP SAUs and details on specificities for each country are provide here-below in chapter 5.

5. Defining the IMAP areas of assessment (IMAP SAUs) for the Adriatic countries

Italy

IMAP Common Indicator 17

In Figure 3 the distribution of monitoring stations of Italy is shown and in Figure 4 their relation to the two coastal and offshore zones as defined using the MEDCIS data. Italy has officially declared Marine Reporting Units at 3 levels. The latest dataset is available in the relevant folder of EIONET, accessible from the following weblink as ESRI shapefiles with the associate metadata. For the Adriatic subMRU, 3 subMRUs are available namely IT-NAS-001, IT-CAS-001 and IT-SAS-001 (Figure 4).

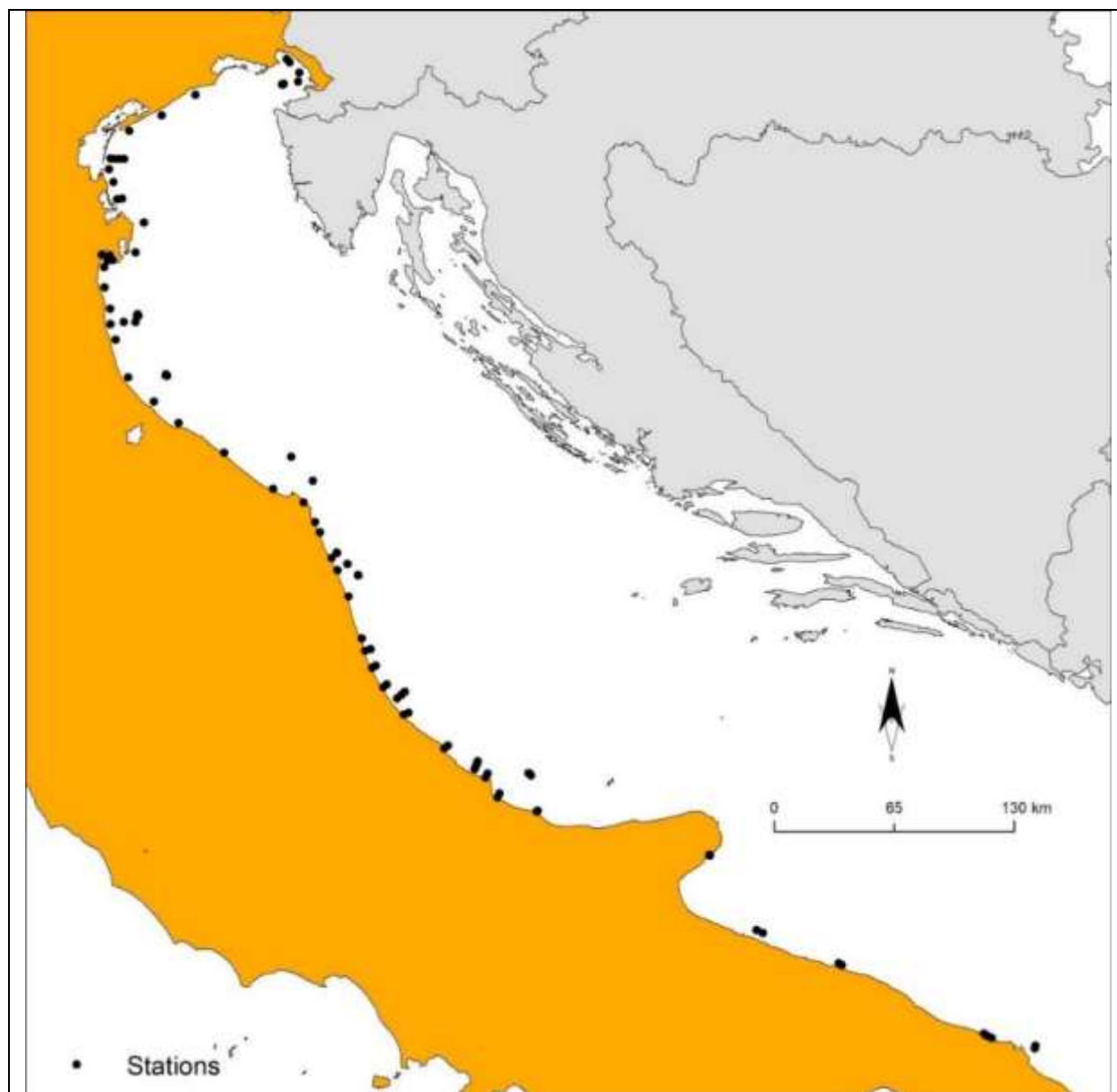


Figure 3. The distribution of the monitoring stations of Italy for IMAP CI 17. The coordinates of the monitoring stations are as reported in IMAP IS.

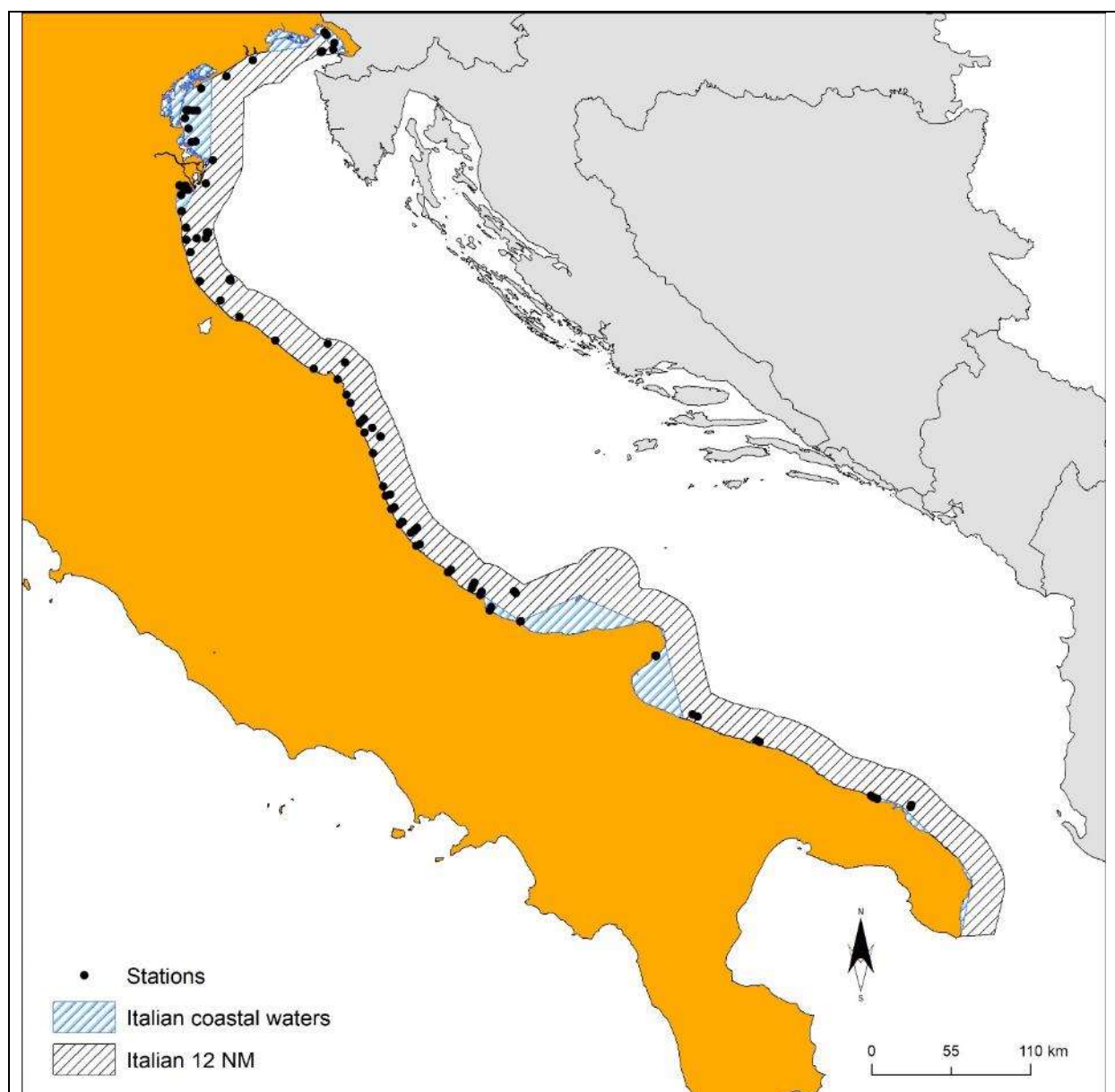


Figure 4. The MEDCIS coastal and the offshore zones of Italy overlaid on the monitoring stations network. The data source is the MEDCIS project. The positions of the monitoring stations are as reported to IMAP IS.

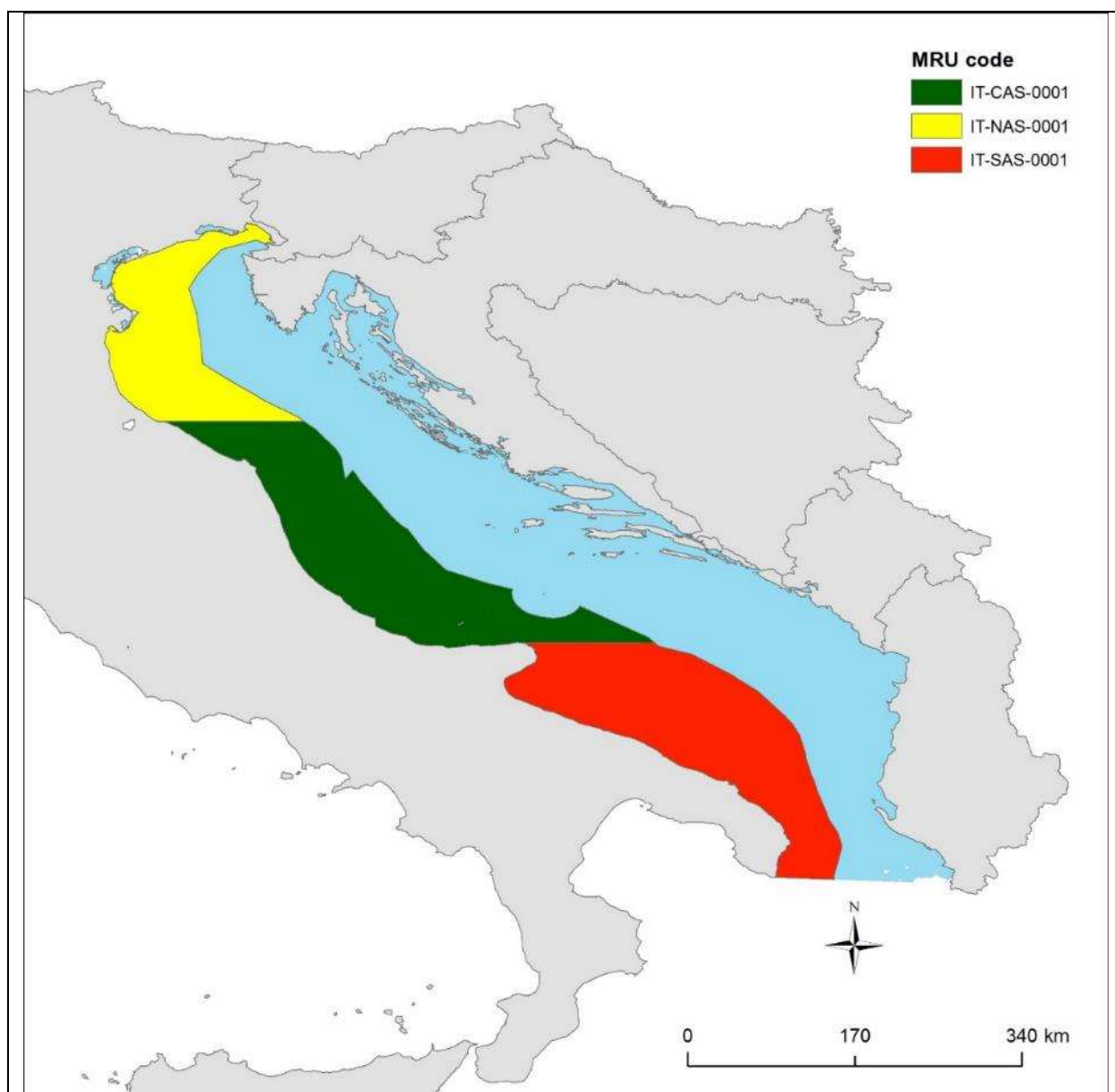


Figure 5. The official subMRUs of Italy IT_MRU_SUBDIV_2018 is further subdivided into 3 subMRUs in the Adriatic Sea. The data come from the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020 (used for the Adriatic Sea Sub-region).

The relation of the monitoring stations network to the MEDCIS coastal-offshore zones and the 3 sub-MRUs of Italy for the Adriatic Sea are shown in Figure 6.

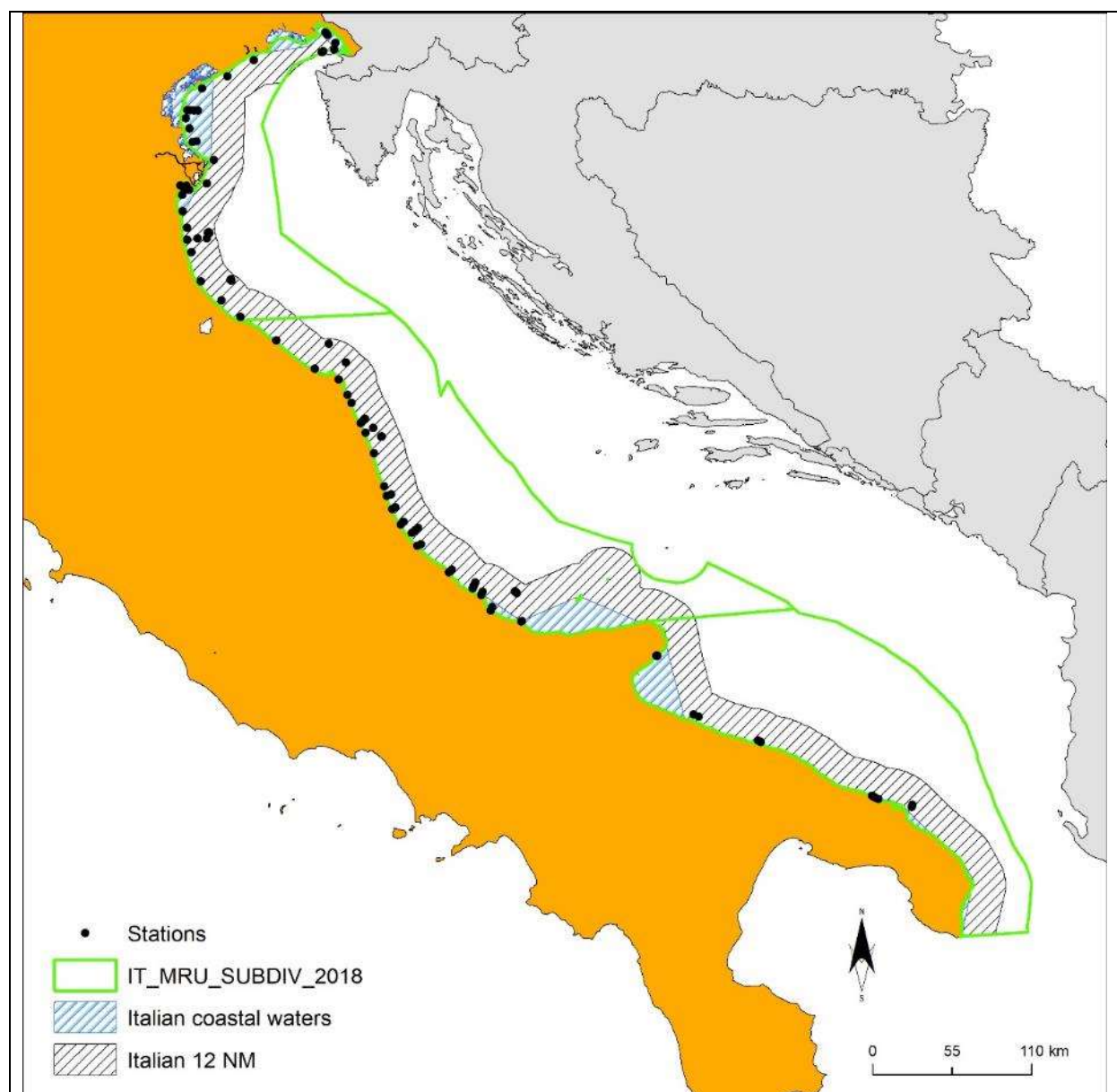


Figure 6. The official subMRUs of Italy overlaid on the MEDCIS coastal-offshore zones and monitoring stations network are marked in green. The data source is the MEDCIS project. The position of monitoring stations are as reported to IMAP IS. MRUs come from the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020 (used for the Adriatic Sea Sub-region).

Although the areas IT-NAS-0001, IT-CAS-0001, IT-SAS-0001 are defined as subMRUs, they represent quite large spatial areas, incompatible with the requirements for setting and nesting IMAP areas of assessment i.e. the methodology described in the UNEP/MED WG. WG.509/Inf.10/Rev.2.

Other official finer spatial areas of assessment declared by the country, are available, but each of them has been defined for different scope of monitoring and not all are joined and create a spatial coherent distribution. The following maps (Figures 7 to 12) provide an overview of these smaller Marine Reporting Units, as these have been defined by the Italy and are available by the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020 (used for the Adriatic Sea Sub-region).

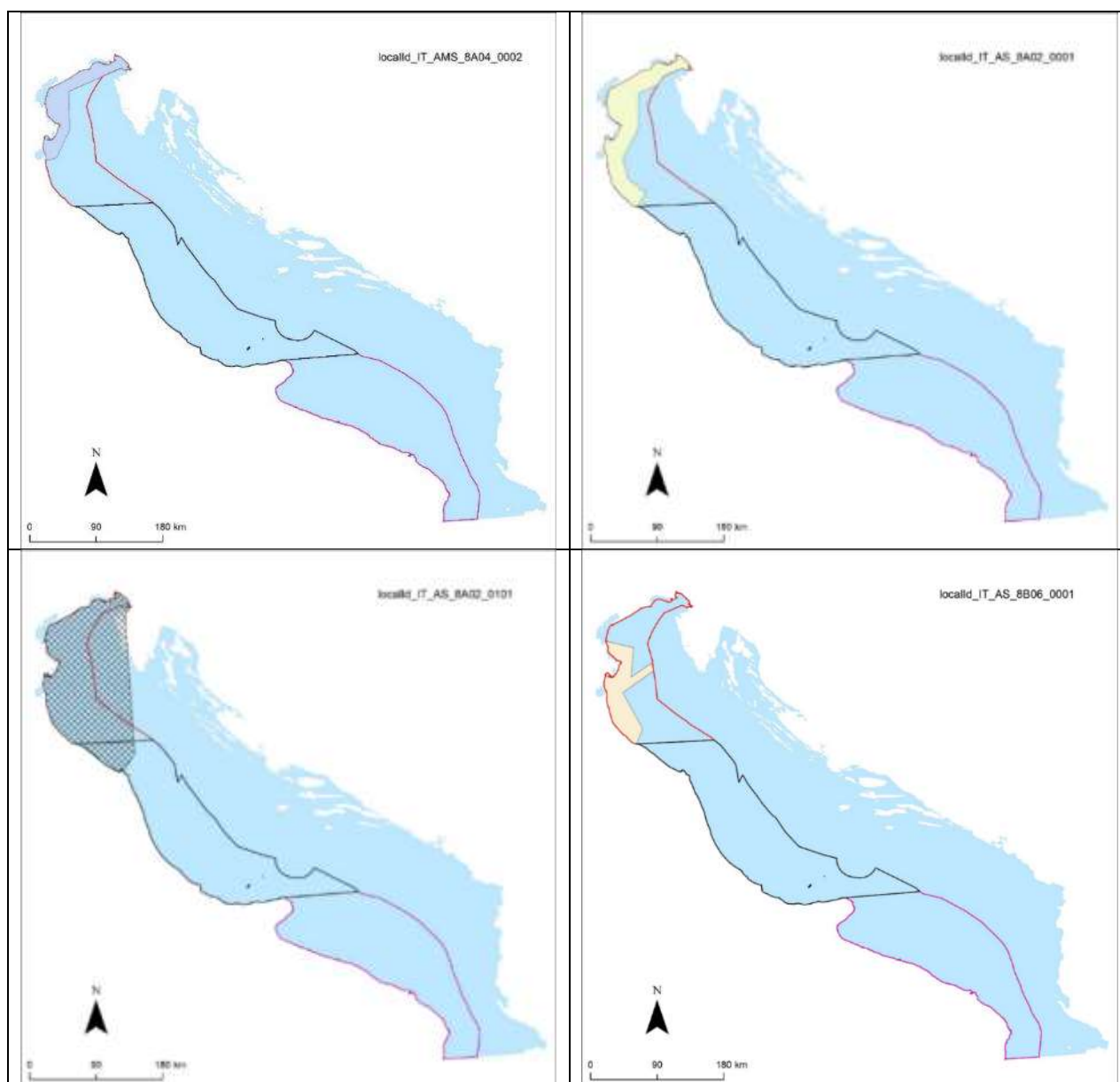


Figure 7. SubMRUs under the IT-NAS-001 for purpose of monitoring as have been designed and declared by Italy. Data are available in the latest version of data for Italy in the Spatial Data Infrastructure of the European Environment Agency., the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020. The code of the subMRU is stated in the map (top right corner).

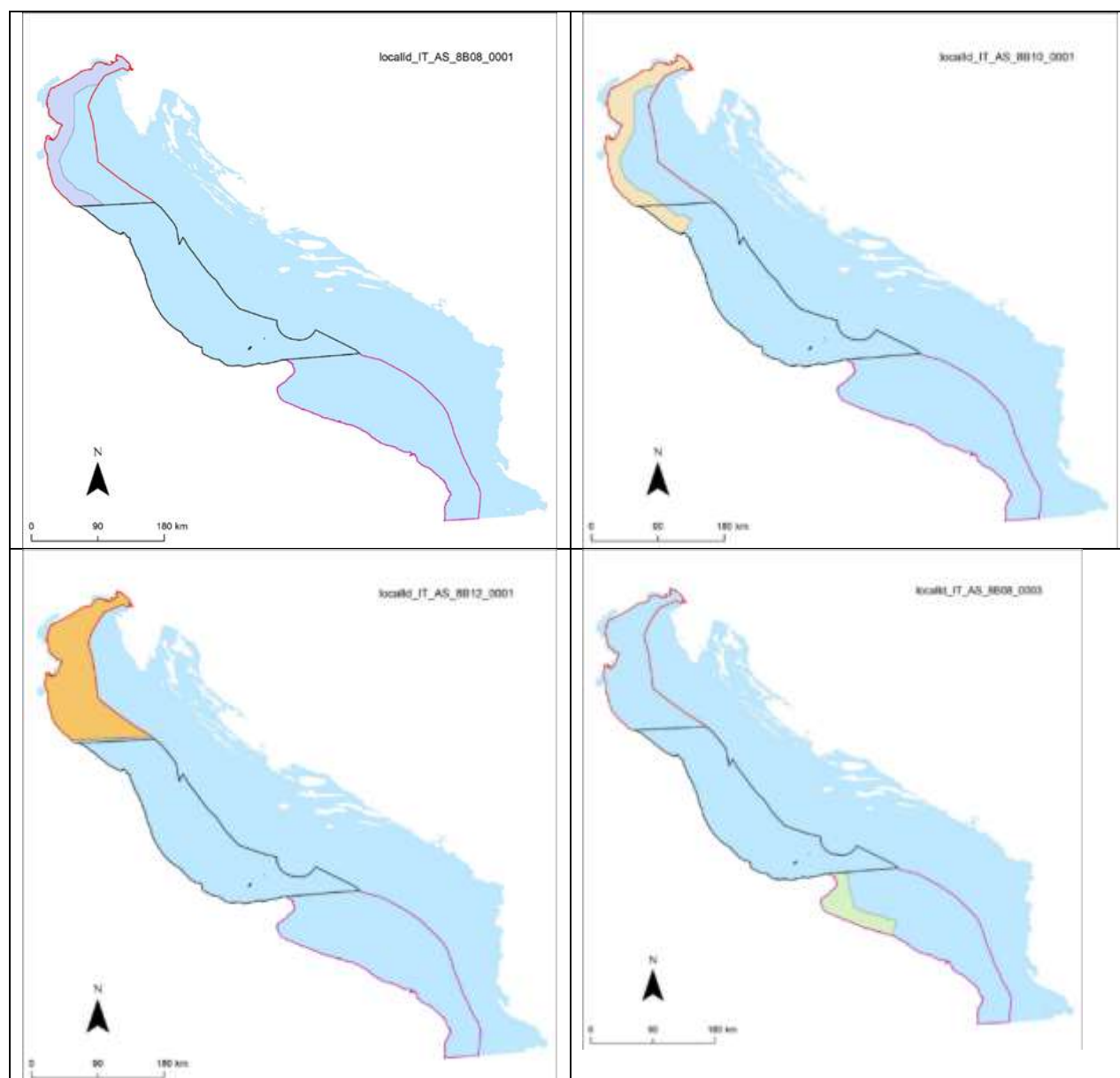


Figure 8. SubMRUs under the IT-NAS-001 for purpose of monitoring as have been designed and declared by Italy. Data are available in the latest version of data for Italy in the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020. The code of the subMRU is stated in the map (top right corner).

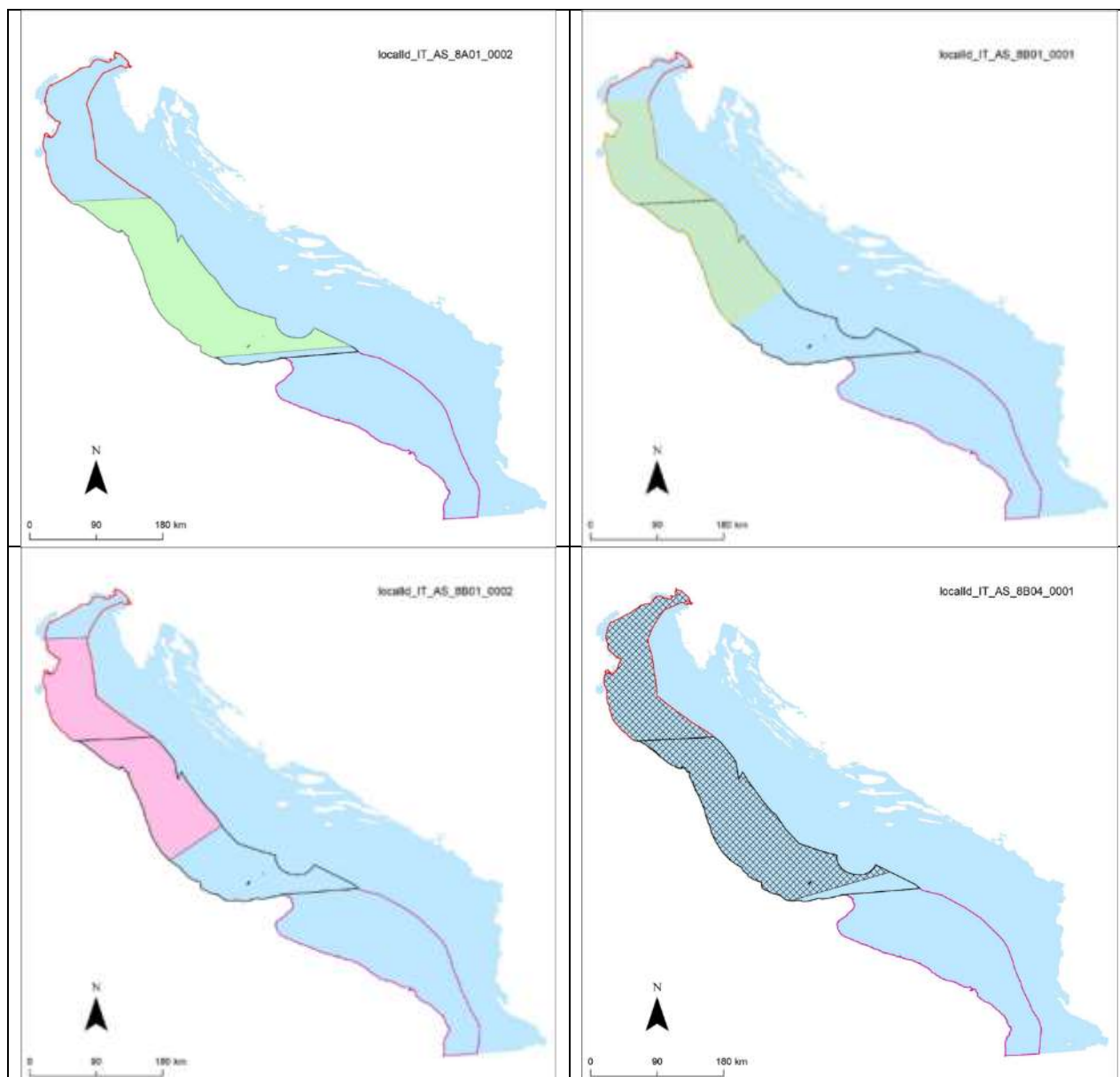


Figure 9. SubMRUs under the IT-CAS-001 for purpose of monitoring as have been designed and declared by Italy. Data are available in the latest version of data for Italy in the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020. The code of the subMRU is stated in the map (top right corner).

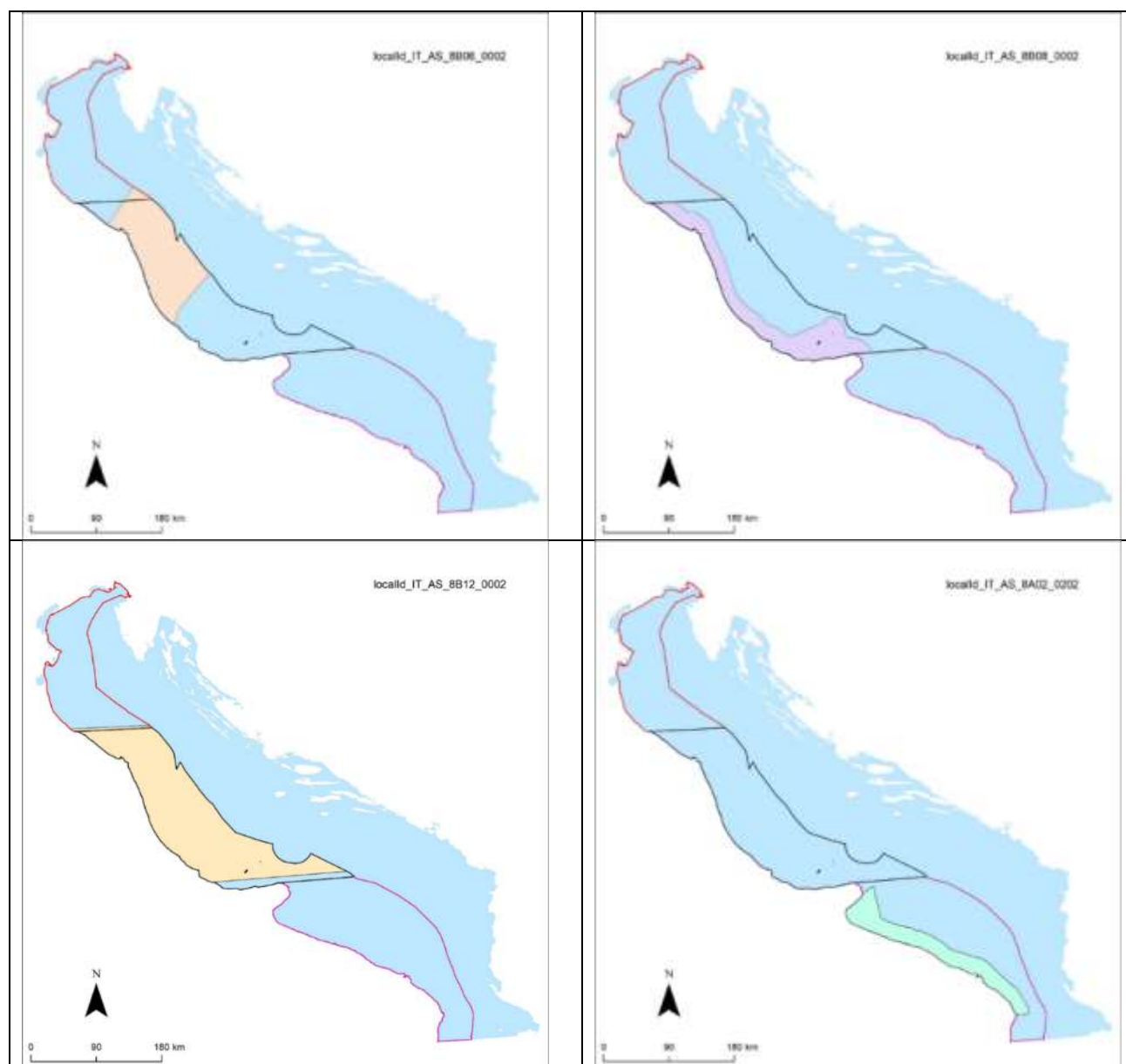


Figure 10. SubMRUs under the IT-CAS-001 for purpose of monitoring as have been designed and declared by Italy. Data are available in the latest version of data for Italy in the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020. The code of the subMRU is stated in the map (top right corner).



Figure 11. SubMRUs under the IT-SAS-001 for purpose of monitoring as have been designed and declared by Italy. Data are available in the latest version of data for Italy in the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020. The code of the subMRU is stated in the map (top right corner).

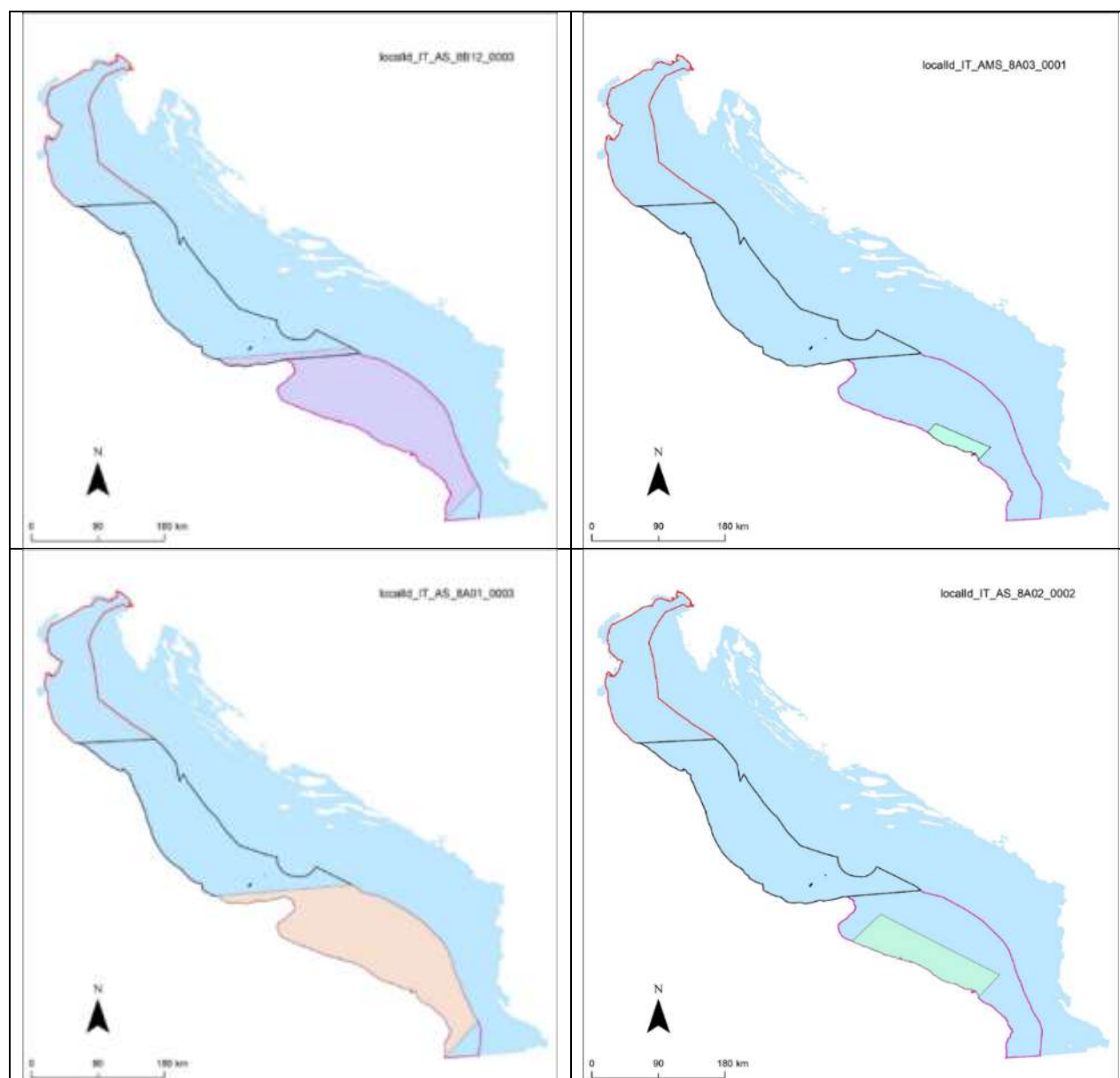


Figure 12. SubMRUs under the IT-sAS-001 for purpose of monitoring as have been designed and declared by Italy. Data are available in the latest version of the CP available by the data for Italy in Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020. The code of the subMRU is stated in the map (top right corner).

It becomes apparent from the maps of Figures 7 to 12 that these smaller areas in many cases are either overlapping to one another or cover areas in more than one of the 3 larger Italian sub-MRUs (IT-NAS-001, IT-CAS-00011, IT-SAS-0001). They do not serve the purposes of setting the areas of assessment for IMAP Ecological Objective 5 -Eutrophication, Ecological Objective 10 - Pollution and Ecological Objective 10 - Marine Litter Cluster for the IMAP Pollution and Marine Lotter Cluster, and hence they were not used in the present analysis. They cannot be related to the monitoring stations within the 2 coastal and offshore zones and structured nesting scheme.

To reach a common, harmonized IMAP spatial scale among all Adriatic countries, the Italian coastal zone was further subdivided. In the absence of ecological characterization of the area, this was done according to the Regional/Administrative subdivision of Italy. The first level of administrative division of Italy is provided by the Database of Global Administrative Areas - GADM (Figure 13). The coastal zone was further sub-divided into finer IMAP SAUs according to the administrative units of Italy (Figure14). This was then followed by

derivation of the IMAP assessment areas (IMAP SAUs) of the offshore waters of Italy from the official subMRUs (IT-NAS-001, IT-CAS-001, IT-SAS-001), by excluding the coastal part, i.e. the surface area in km² for the IMAP SAUs in the offshore zone is calculated by subtracting the surface of area of the coastal zone from the surface of the 3 official subMRUs (IT-NAS-0001, IT-CAS-0001, IT-SAS-0001).

The offshore zone was not further subdivided due to the overall limited number of monitoring stations set there. For Italy the proposal of the IMAP SAUs includes the coastal units based on i) the MEDCIS coastal zone and the country's administrative division and ii) the offshore units based on the official Adriatic sub-MRUs excluding the surface area of the coastal subSAUs (Figure 13). In total 10 of IMAP SAUs have been proposed for Italy.

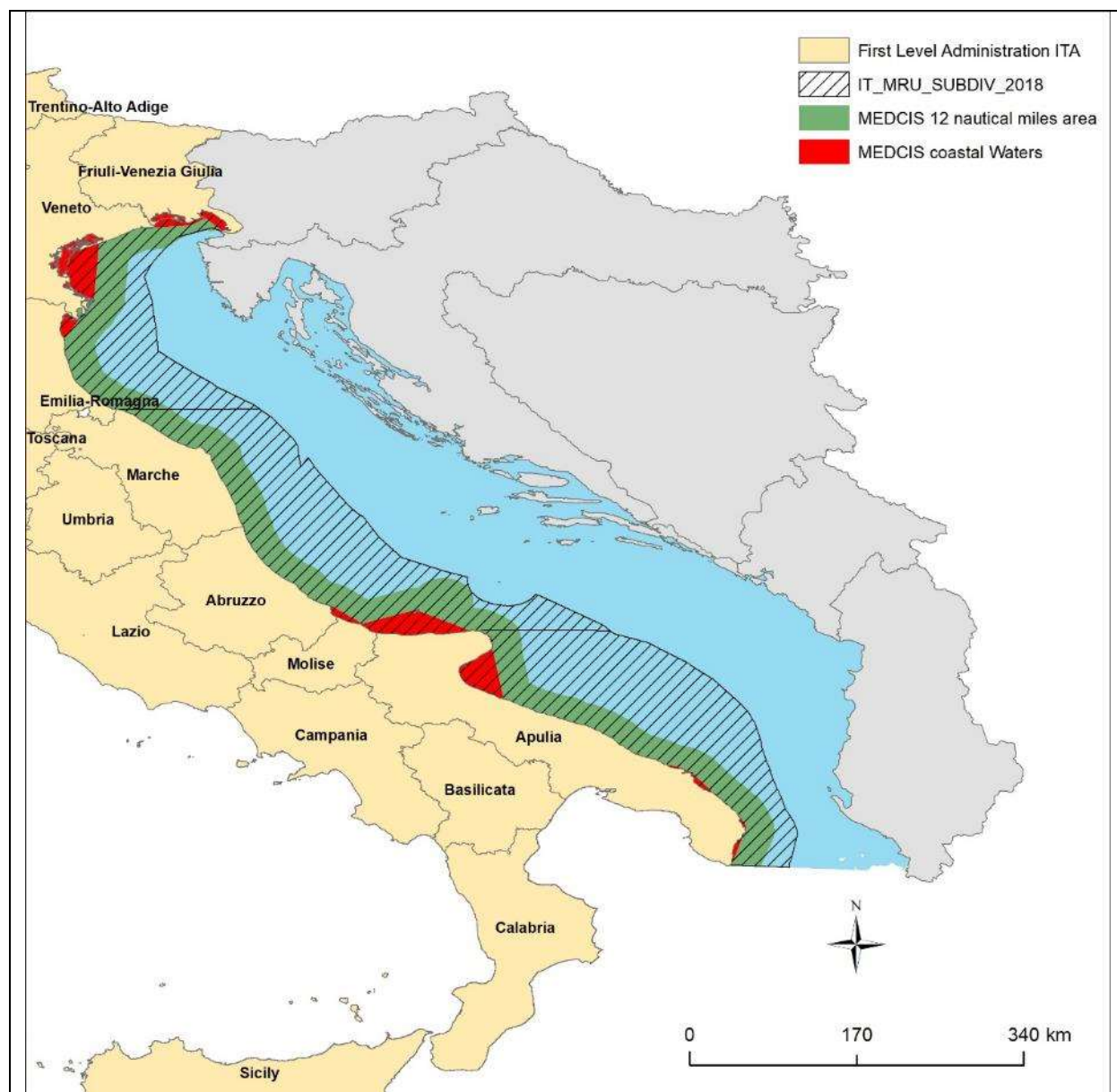


Figure 13. The administrative boundaries for Italy and their relation to the MEDCIS coastal-offshore zones and MSFD subMRUs of Italy.

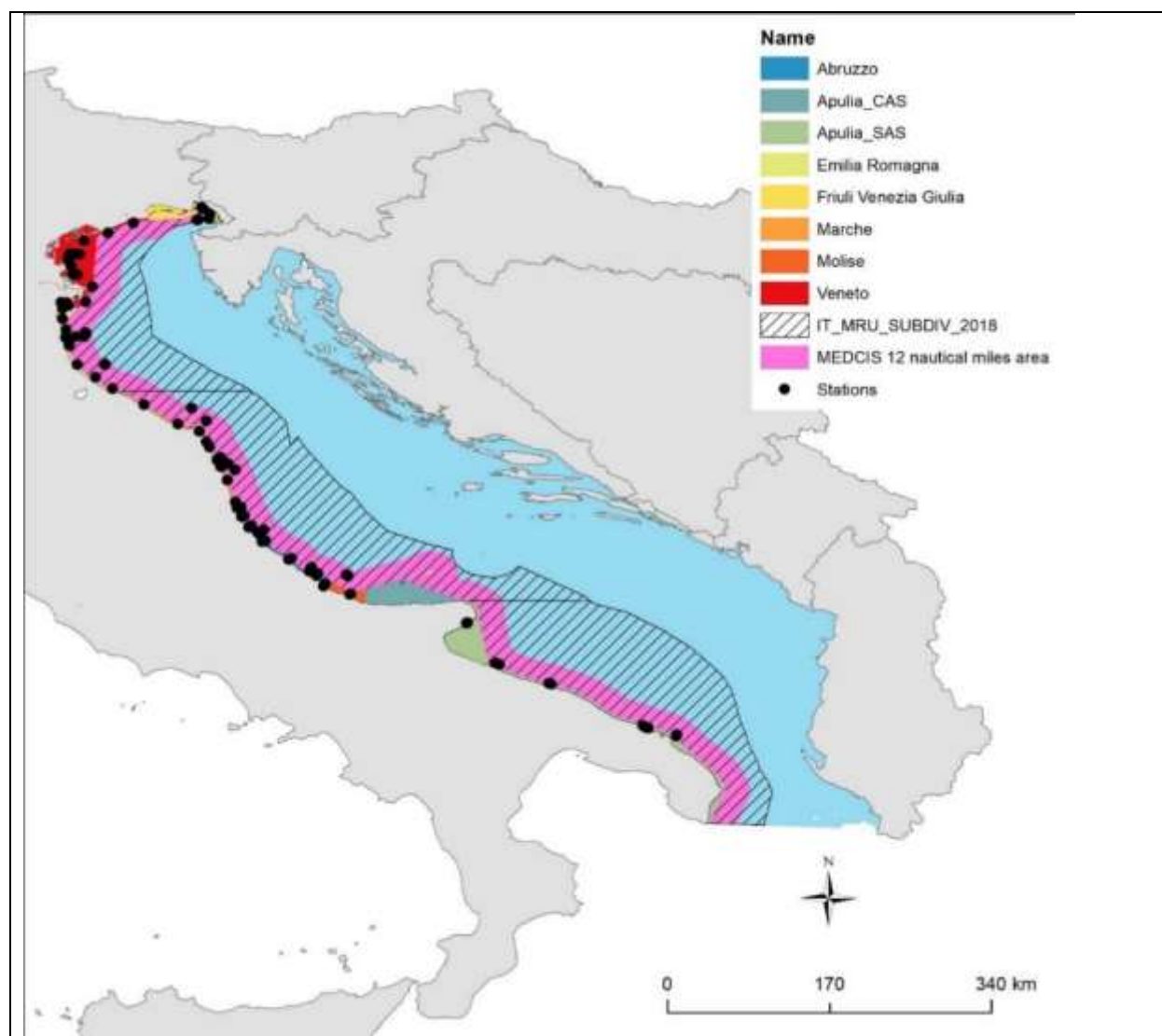


Figure 14. The IMAP finest areas of assessment of Italy (IMAP subSAUs) produced for the coastal zone of Italy and used for testing of the NEAT application in the Adriatic Sea sub-region. It is based on the administrative division (i.e. the coastal zone has been divided at the limits of each first-level Administrative Divisions layer of Italy (source of the First-level Administrative Divisions, Italy, 2015 and overlaid on the monitoring stations network. The stations in the offshore zone (in purple) are representative of broader assessment units (IMAP SAUs) derived for the MSFD MRUs (shaded areas).

Another issue which is related to the nesting of the SubMRUs of Italy is the delimitation of the IT-NAS-001, IT-CAS-0001, IT-SAS-0001. *This division is slightly different from the one used in the present work for the 3 subdivisions of the Adriatic Sea*, as described above and shown in Fig 2.

The differences are related to the limits between the Central and the North Adriatic Sea, and the Central and the South Adriatic Sea, as can be seen by comparing Figure 2 and Figure 4. The surface area of the Italian IT-CAS-0001 MRU is larger than the surface area of the Central Adriatic subdivision as shown in Figure 2.

The two parts of the IT-CAS-0001 overlapping with the North and the South Adriatic subdivisions are considered small. In the north overlapping part only 3 stations exist in the Marche subMRU while in the south overlapping part no monitoring stations are present. Hence for the present work, all monitoring data in the subMRU IT-CAS-0001 of Italy were aggregated under the Central Adriatic subdivision (CAS).

IMAP Common Indicators 13 & 14

In Figure 15 the distribution of monitoring stations related to IMAP CIs 13 &14 of Italy is shown and in Figure 16 their relation to the two coastal and offshore zones as defined using the MEDCIS data. Italy has officially declared Marine Reporting Units at 3 levels. The latest dataset is available in the relevant folder of EIONET, accessible from the following weblink as ESRI shapefiles with the associate metadata.

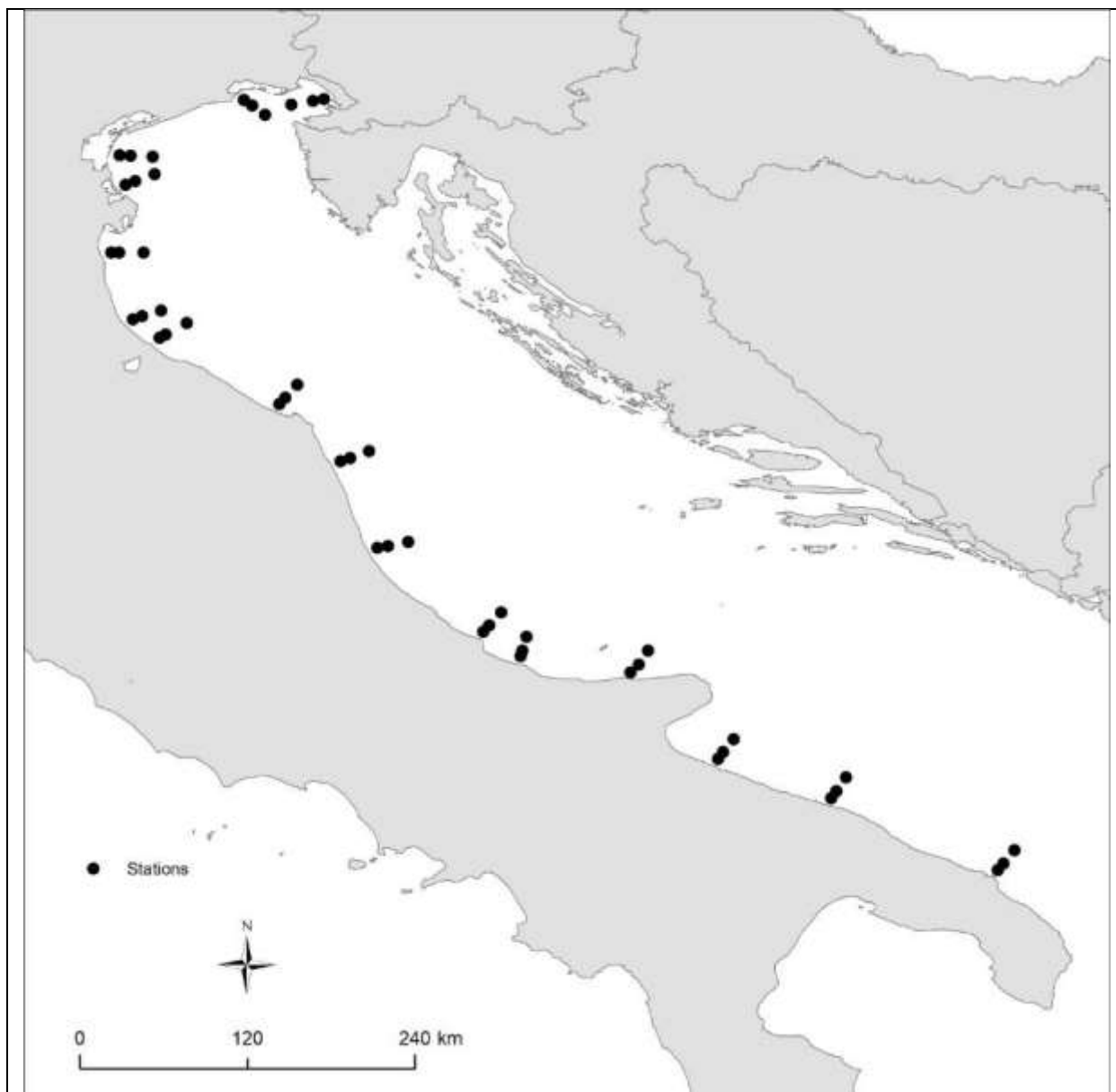


Figure 15. The distribution of the monitoring stations of Italy for IMAP CIs 13 and 14. The coordinates of the monitoring stations are as reported in IMAP IS.

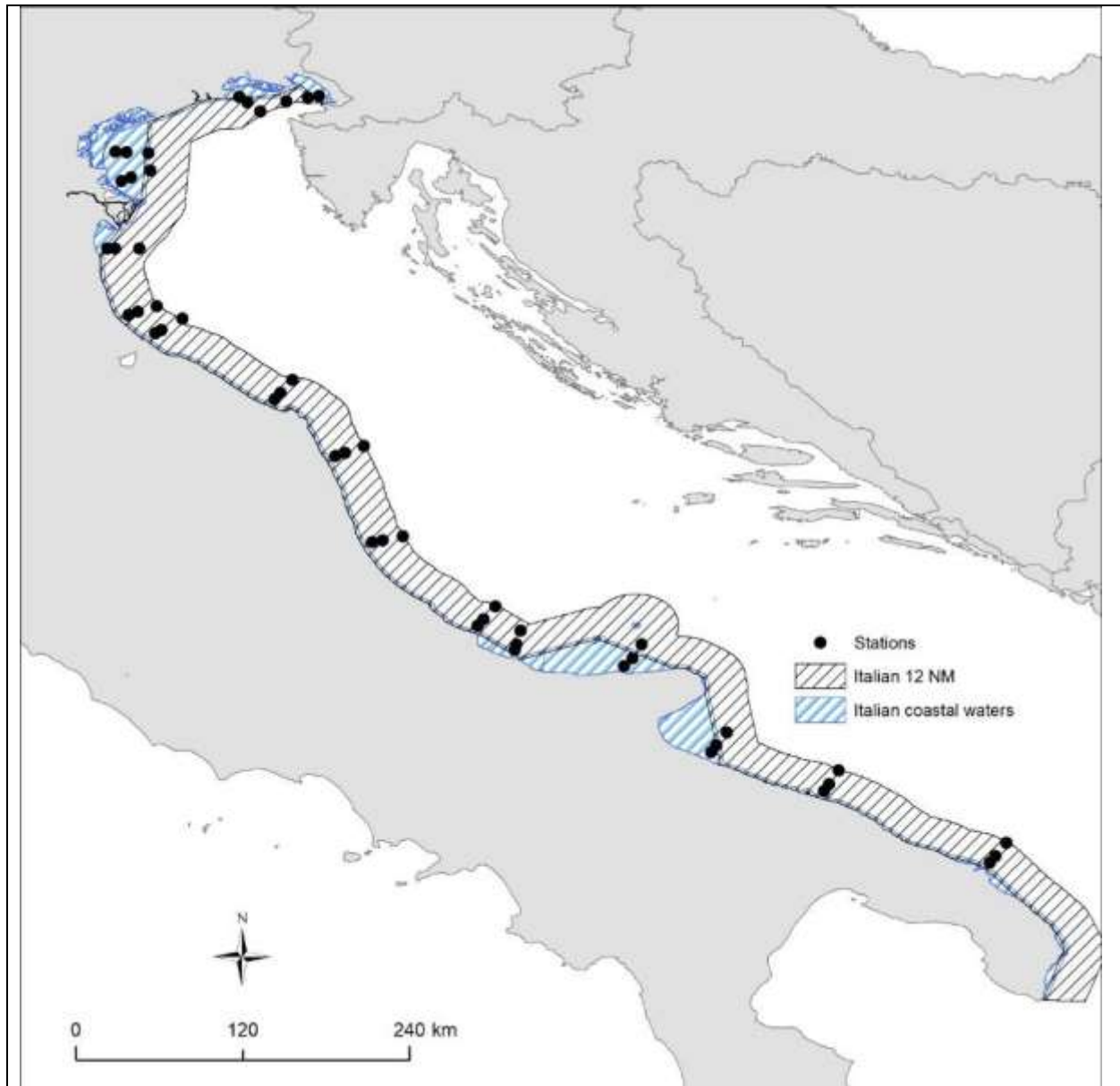


Figure 16. The MEDCIS coastal and the offshore zones of Italy overlaid on the monitoring stations network for IMAP CIs 13&14. The data source is the MEDCIS project. The positions of the monitoring stations are as reported to IMAP IS.

The relation of the monitoring stations network to the MEDCIS coastal-offshore zones and the 3 sub-MRUs of Italy for the Adriatic Sea (figure 5) are shown in Figure 17.

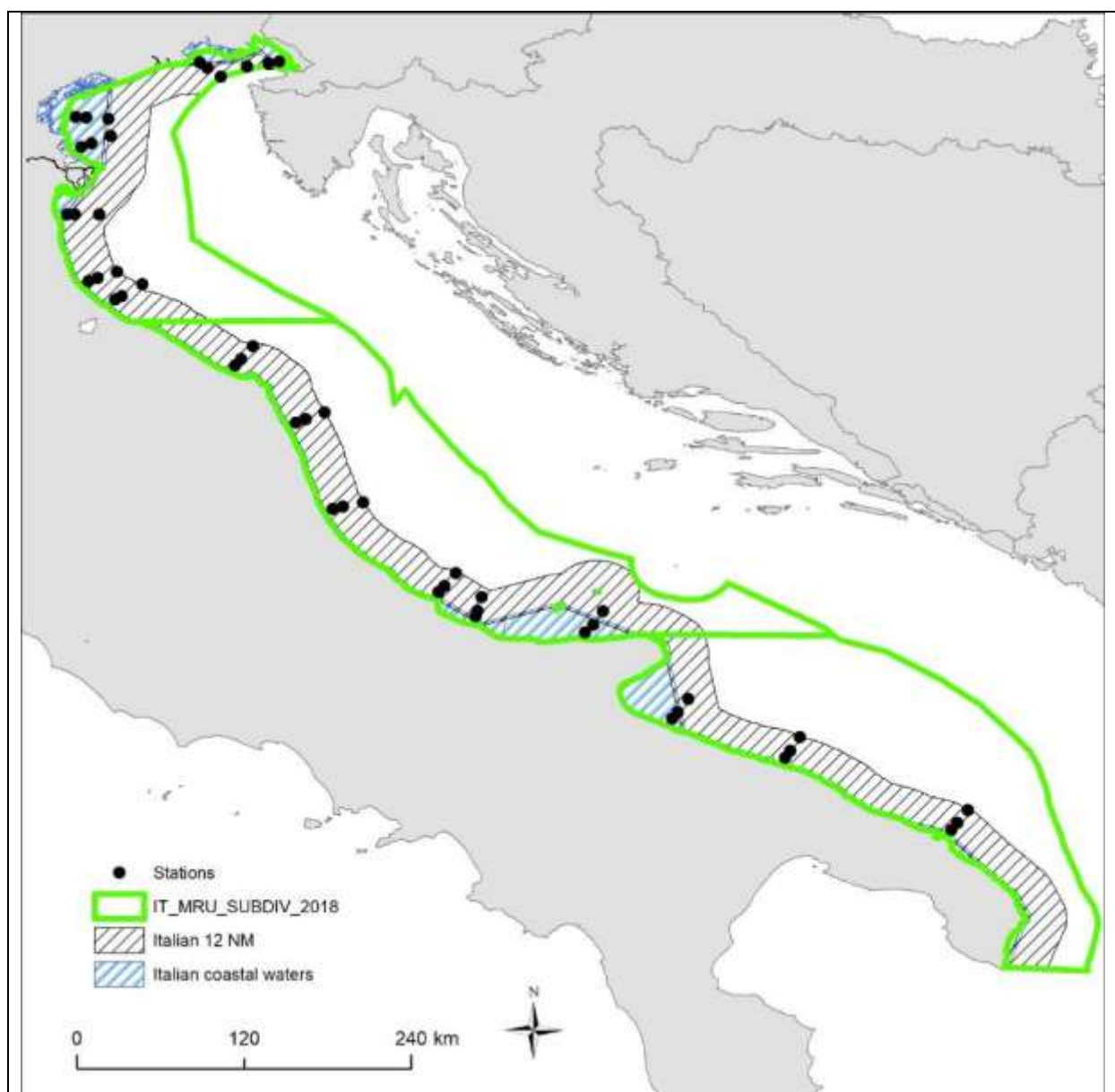


Figure 17. The official subMRUs of Italy overlaid on the MEDCIS coastal-offshore zones and monitoring stations network related to IMAP CIs 13 &14 are marked in green. The data source is the MEDCIS project. The position of monitoring stations is as reported in IMAP IS. MRUs come from the Spatial Data Infrastructure of the European Environment Agency, the layer on the Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020 (used for the Adriatic Sea Sub-region).

For Italy, as explained above within elaboration for CI 17, the proposal of the IMAP SAUs includes i) the coastal units based on the MEDCIS coastal zone and the country's administrative division and ii) the offshore units based on the official Adriatic sub-MRUs excluding the surface area of the coastal subSAUs. For CI 13 & 14, following the workflow of CI 17, for Italy, in total a number of 8 MRUs were defined based on the availability of the monitoring stations in the IMAP Info System and the related data (Figure 18).

In order to reach a common, harmonized IMAP spatial scale among all the Adriatic countries for EO5 and EO9, the Italian coastal zone was further subdivided. In the absence of ecological characterization of the area this was done according to the Regional/Administrative subdivision of Italy. The coastal zone was further subdivided into finer IMAP SAUs (subSAUs) according to the administrative units of Italy (Figure 18b).

This was then followed by derivation of the IMAP assessment areas (IMAP SAUs) of the offshore waters of Italy. They were derived from the official subMRUs (IT-NAS-001, IT-CAS-001, IT-SAS-001) by excluding the coastal part. In addition, for the purpose of EO5 assessment, these three areas are split in two offshore areas. The first one is the part of the offshore zone that is set outward of the coastal zone to roughly 20 km where the most of the national monitoring activities is performed, and abbreviated MC. The second one is the remaining part of the marine water of Italy in the Adriatic Sea, and can be identified as the offshore open waters, abbreviated MO. This part coincides with the epicontinental zone of Italy, where the monitoring programme has not yet been implemented.

Both, the coastal and offshore zone was further subdivided, based on expert knowledge, taking into account the distribution of the monitoring station profiles as they extend outward, the distribution of water types and the distribution of freshwater plumes. On the Figure 18.b showing the finest subSAUs for IMAP CIs 13 and 14, the position of the monitoring stations and water types are also shown. The subSAU code is built from 1) the short name of the administrative division (Regione) (Friuli Venezia Giulia – FVG, Veneto – VE, Emilia Romagna – ER, Marche – MA, Molise – MO, Abruzzo – AB and Puglia – PU), 2) progressive number of subdivision in the administrative region, and 3) type of assessment zone (Coastal – C, Offshore up to 20 km – MC, and Offshore open waters – MO), resulting at the end in the code FVG-1-C for Friuli Venezia Giulia for the area related to the first profile in the administrative division and coastal assessment zone.

This represents only a finer net of subSAUs for EO5, set at a lower level of the subSAUs compared to EO9 (CI17).

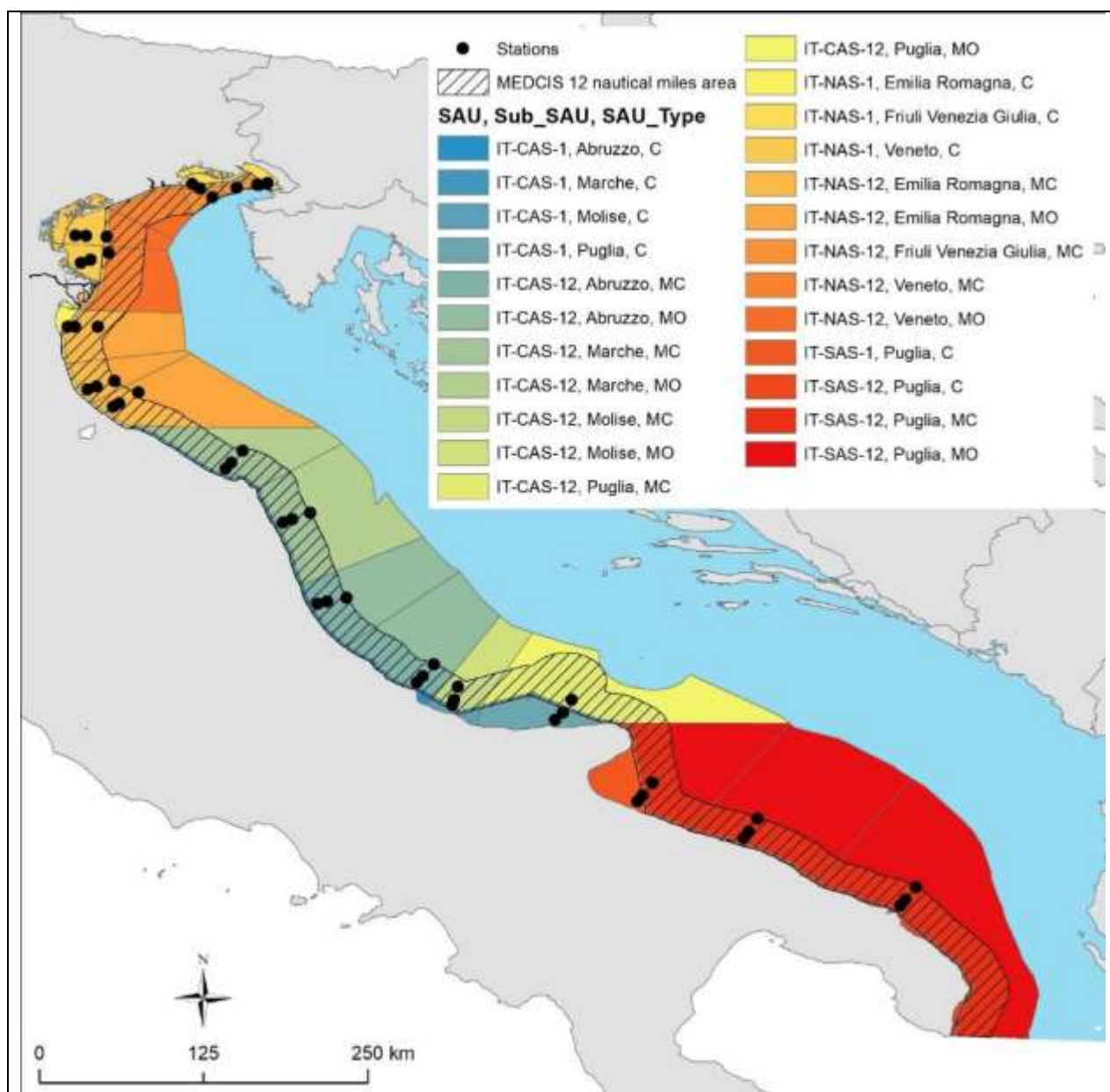


Figure 18a. The IMAP finest areas of assessment of Italy (IMAP subSAUs) produced for the coastal zone of Italy and used for testing of the NEAT application in the Adriatic Sea Sub-region. This figure shows the finest areas of assessment for IMAP CIs 13&14 which differ from those set for IMAP CI 17 regarding the number of SAUs and the split into three sublevels: 1) 2) Offshore Coastal (zone that is set outward of the coastal zone to roughly 20 km where the most of the national monitoring activities is performed, and abbreviated MC); 2) Offshore Open (the remaining part of the marine water of Italy in the Adriatic Sea, and can be identified as the offshore open waters, abbreviated MO; this part coincides with the epicontinental zone of Italy, where the monitoring programme has not yet been implemented), and 3) Coastal. By that there are 17 SAUs as Coastal and 32 as Offshore. From them, 17 are in the sublevel “Offshore Coastal” and 15 as “Offshore Open”. This was decided since the spatial distribution of the stations cover various distances from the coast, and they have sufficient information for the areas of assessment. The boundaries are based on the administrative division (i.e., the coastal zone was divided at the limits of each first-level Administrative Divisions layer of Italy (source of the First-level Administrative Divisions, Italy, 2015) and overlaid on the monitoring stations network.

The Figure 18b provides an overview of the typology of the stations according to the Water Type (I, IIA and IIIW) in regard to the spatial distribution of them along with the overlaid with the defined SAUs of Italy for CIs 13 and 14.

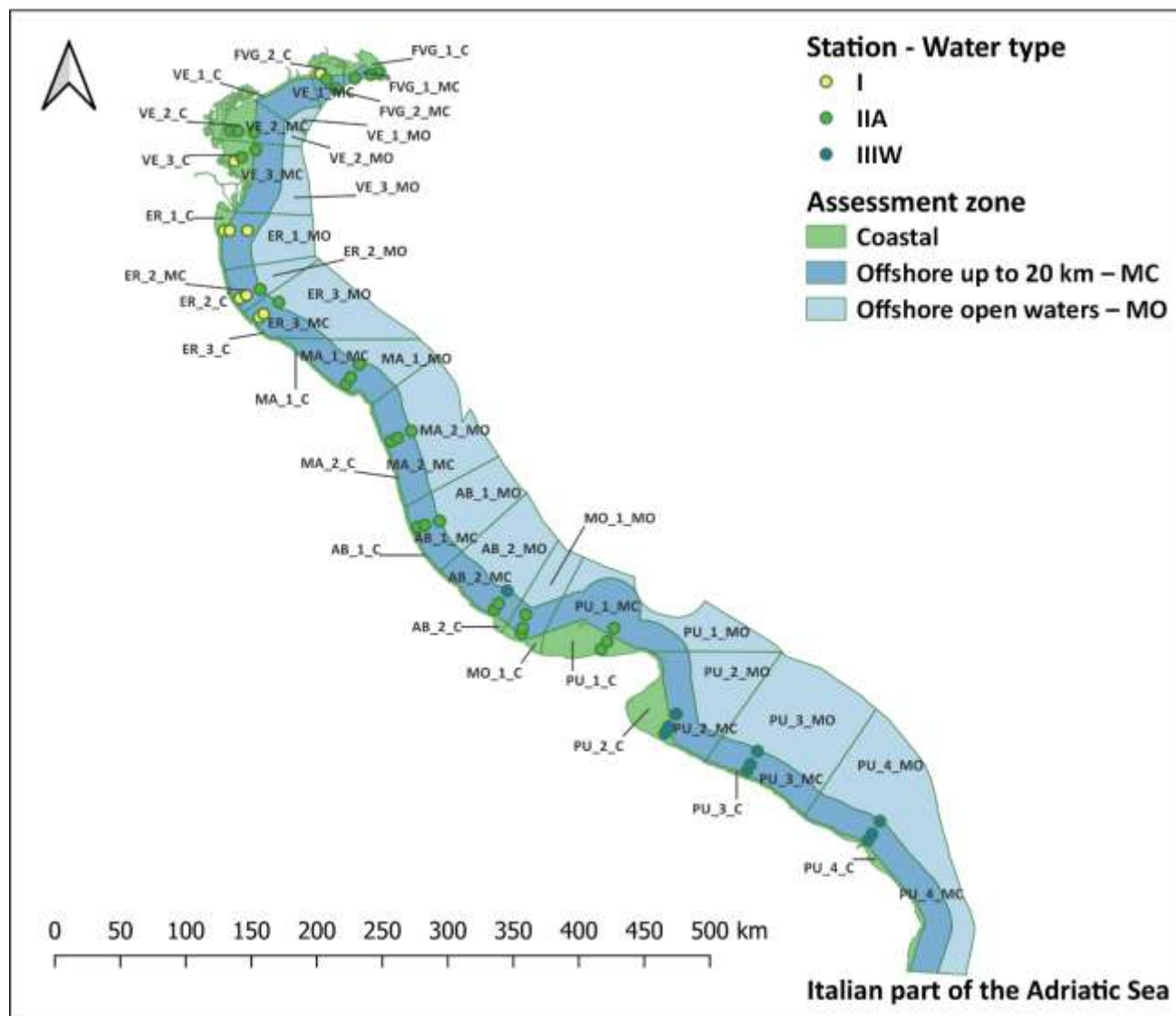


Figure 18b. The IMAP subSAUs for CIs 13 and 14 in the water of Italy in the Adriatic Sea Sub-region, as shown in Figure 5, including the codes assigned to IMAP subSAUs.

Slovenia

IMAP Common Indicators 17

In Figure 19 the distribution of monitoring stations of Slovenia for IMAP CI 17 is shown.



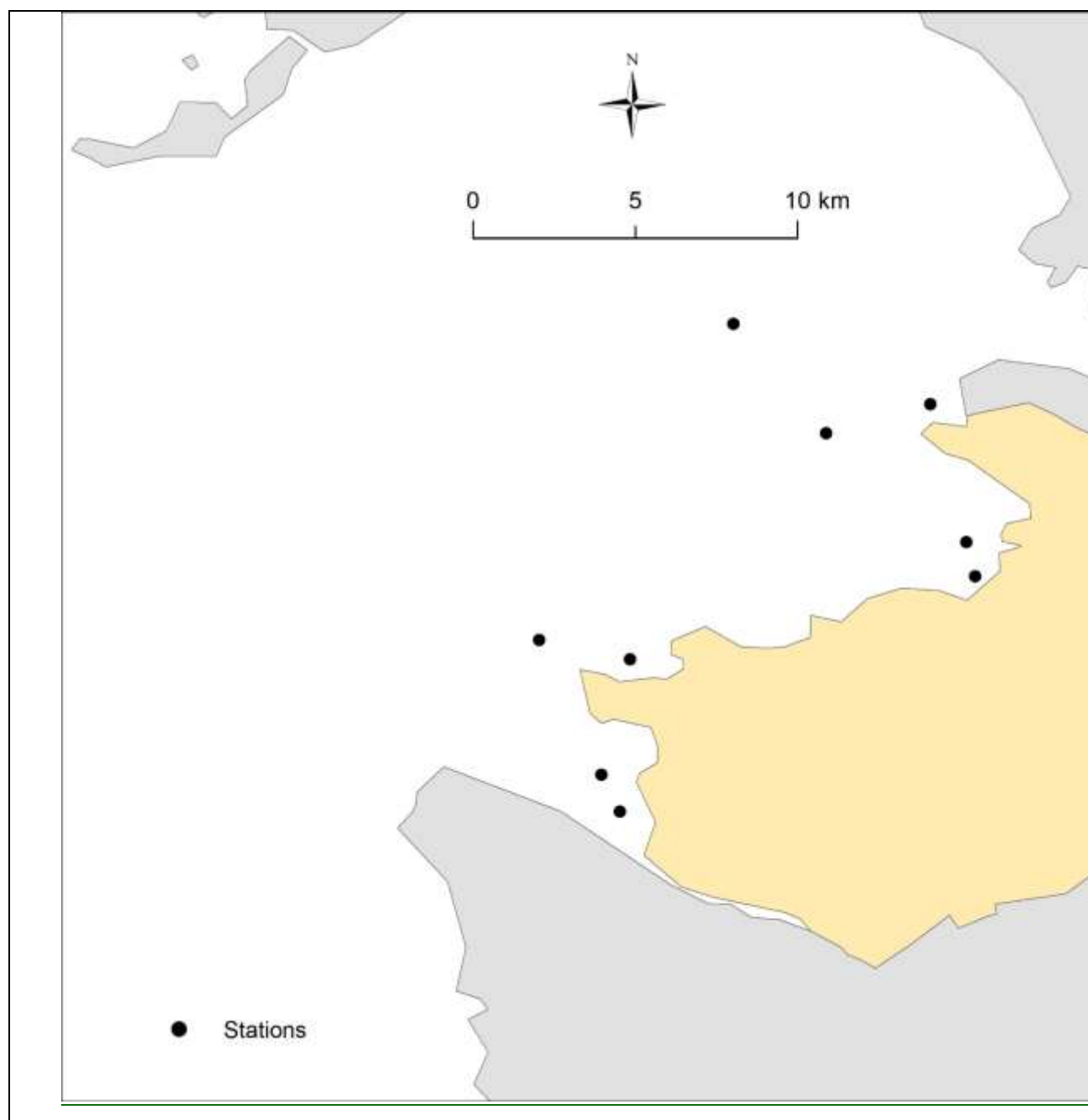
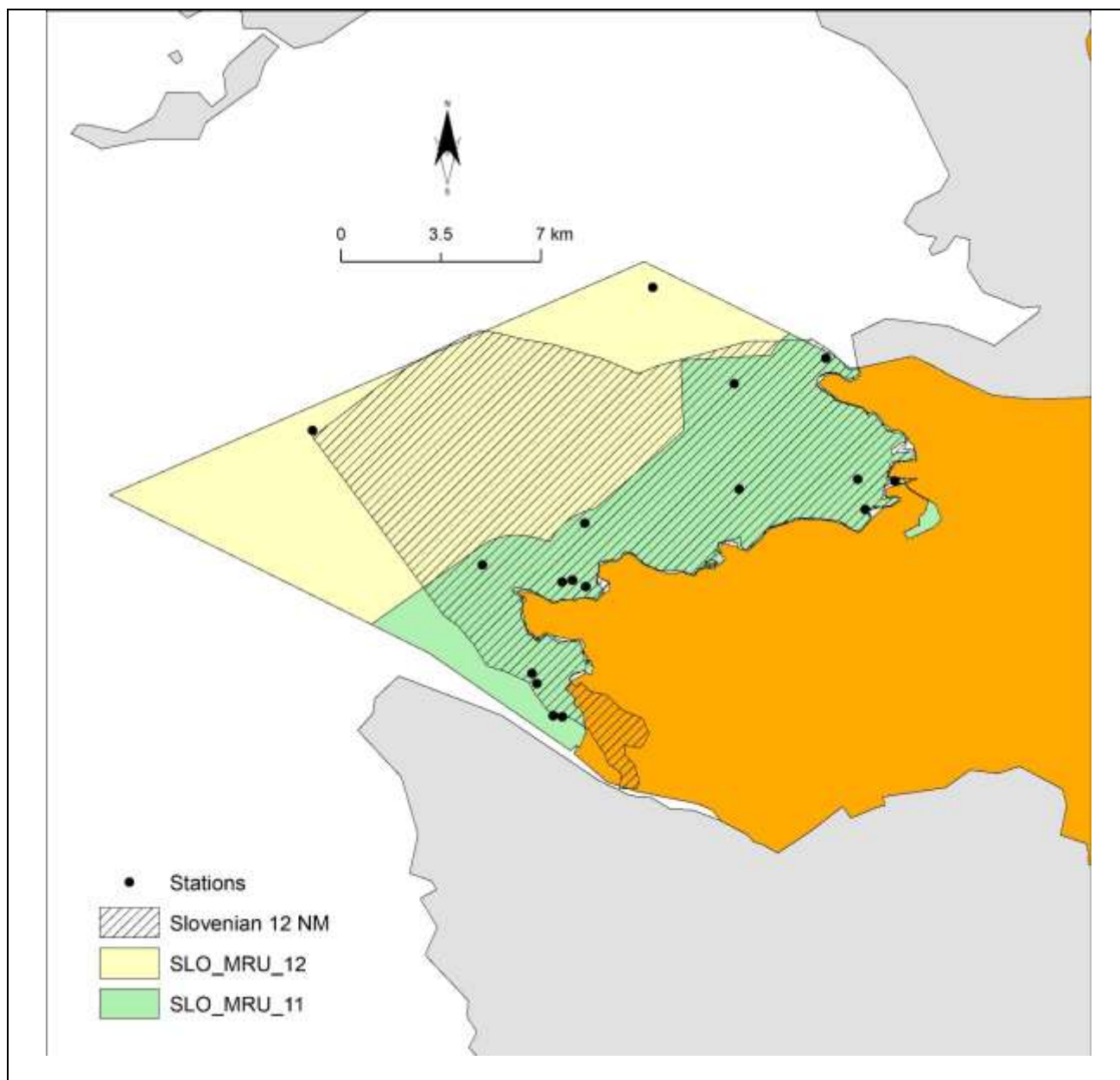


Figure 19. The distribution of the monitoring stations of Slovenia for IMAP CI 17. The coordinates of the monitoring stations are as reported in IMAP IS.

Two official MRUs i.e., MAD-SI-MRU-11 and MAD-SI-MRU-12 are declared by Slovenia in the EIONET data portal. These do not exactly correspond to coastal and offshore waters as shown by the MEDCIS zones and most monitoring stations are positioned beyond the 1 nautical mile distance from land (Figure 20). In order to ensure compatibility with Slovenian national assessments, the MAD-SI-MRU-11 was considered in the coastal IMAP SAU and the MAD-SI-MRU 12 in the offshore IMAP SAU.



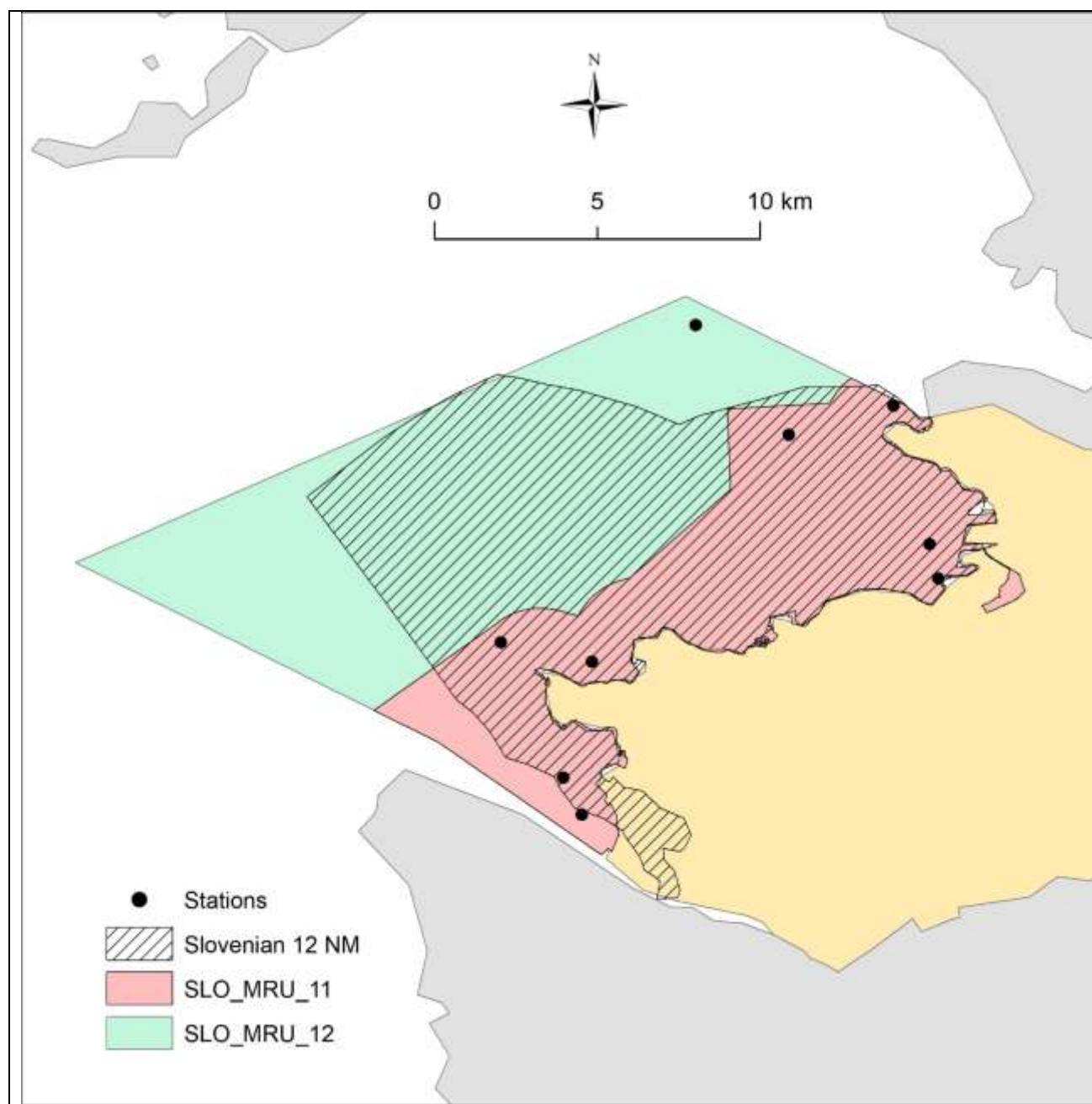


Figure 20. The finest IMAP SAUs for Slovenia, used for the NEAT application in the Adriatic Sea Sub-region, proposed in line with the officially declared MRUs. The MEDCIS offshore zone is also shown.

For Slovenia the two IMAP SAUs used are MAD-SI-MRU11 representative of the coastal IMAP SAU and MAD - SI-MRU -12 representative of the offshore IMAP SAU.

IMAP Common Indicators 13 & 14

In Figure 21 the distribution of monitoring stations related to IMAP CIs 13 &14 of Slovenia is shown and in Figure 22 their relation to the two coastal and offshore zones as defined using the MEDCIS data. Slovenia has officially declared Marine Reporting Units at 2 levels. The latest dataset is available in the relevant folder of EIONET, accessible from the following weblink as ESRI shapefiles with the associate metadata.

In Figure 21 the distribution of monitoring stations of Slovenia for IMAP CI 13 & 14 is shown.

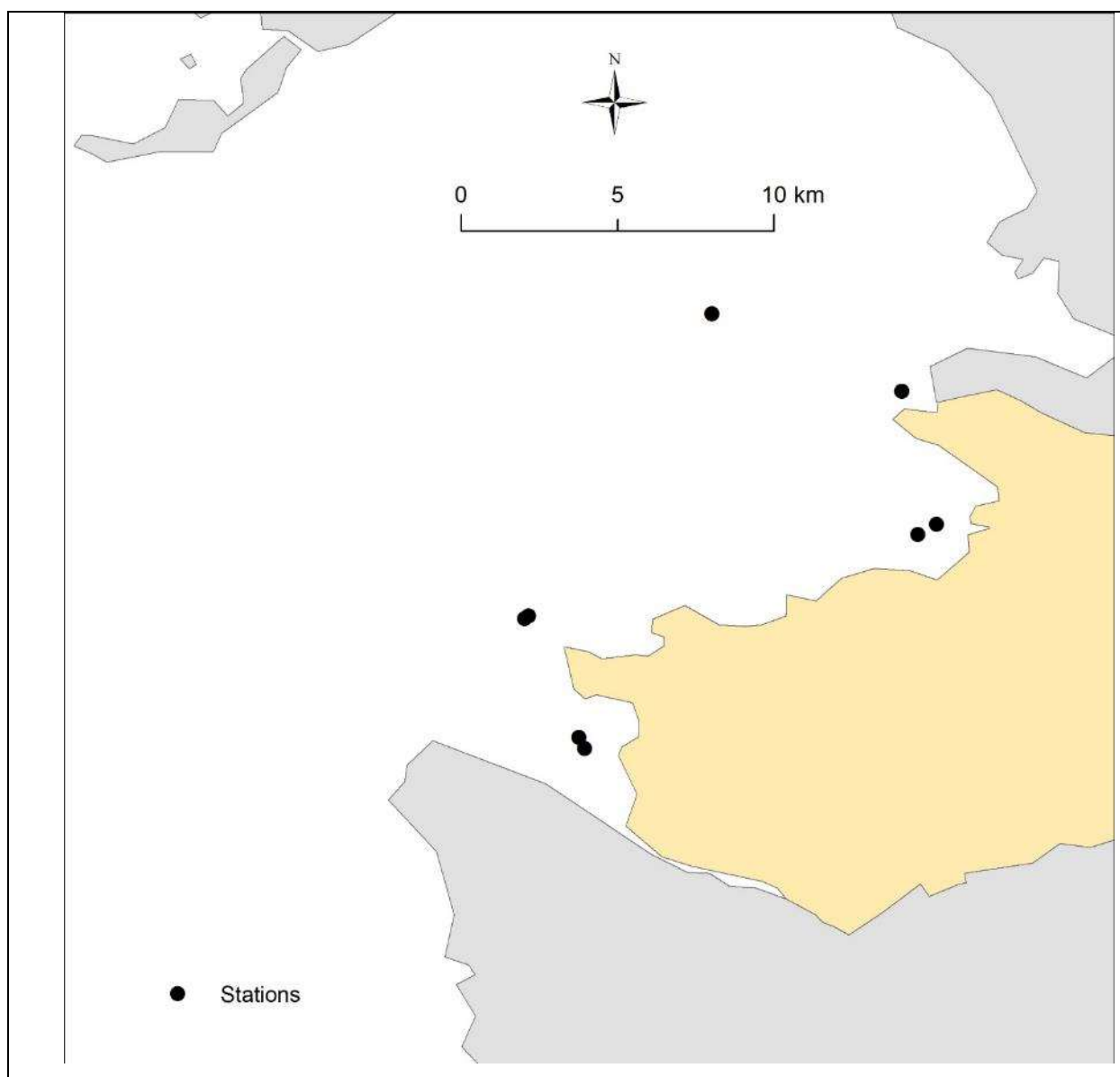


Figure 21. The distribution of the monitoring stations of Slovenia for IMAP CI 13 & 14. The coordinates of the monitoring stations are as reported in IMAP IS.

Two official MRUs i.e., MAD-SI-MRU-11 and MAD-SI-MRU-12 are declared by Slovenia in the EIONET data portal. These do not exactly correspond to coastal and offshore waters as shown by the MEDCIS zones and most monitoring stations are positioned beyond the 1 nautical mile distance from land. In order to ensure compatibility with Slovenian national assessments, the MAD-SI-MRU-11 was considered in the coastal IMAP SAU and the MAD-SI-MRU 12 in the offshore IMAP SAU (Figure 22a).

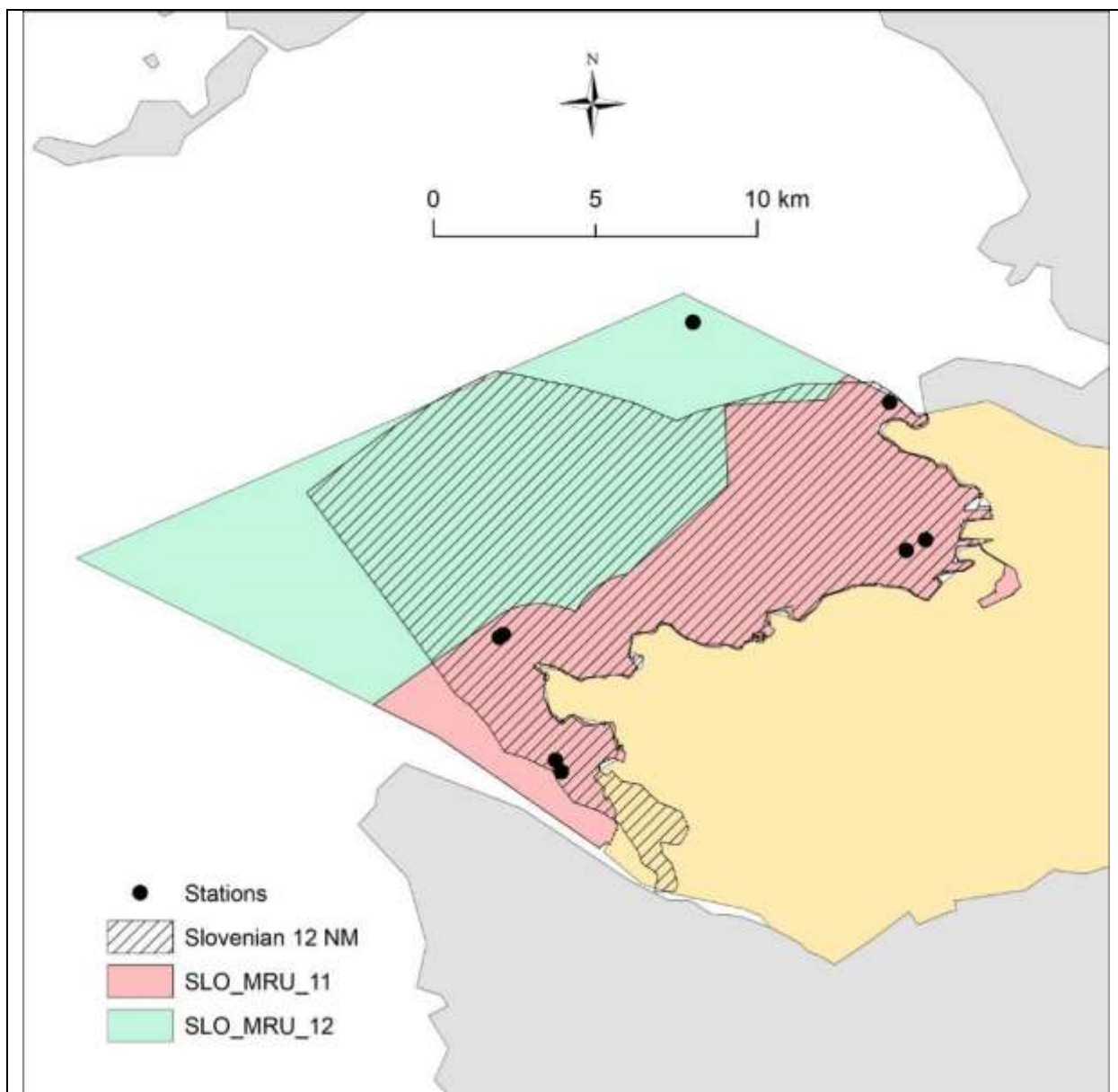


Figure 22a. The finest IMAP SAUs for Slovenia, used for the NEAT application in the Adriatic Sea Sub-region, proposed in line with the officially declared MRUs. The MEDCIS offshore zone is also shown.

For Slovenia the two IMAP SAUs used are MAD-SI-MRU11 representative of the coastal IMAP SAU and MAD - SI-MRU -12 representative of the offshore IMAP SAU.

Since all stations belong to the water type IIA, no adjustments have been performed from the SAUs designed for CI 17 and therefore SAUs for CIs 13 and 14 are common also for CI 17.

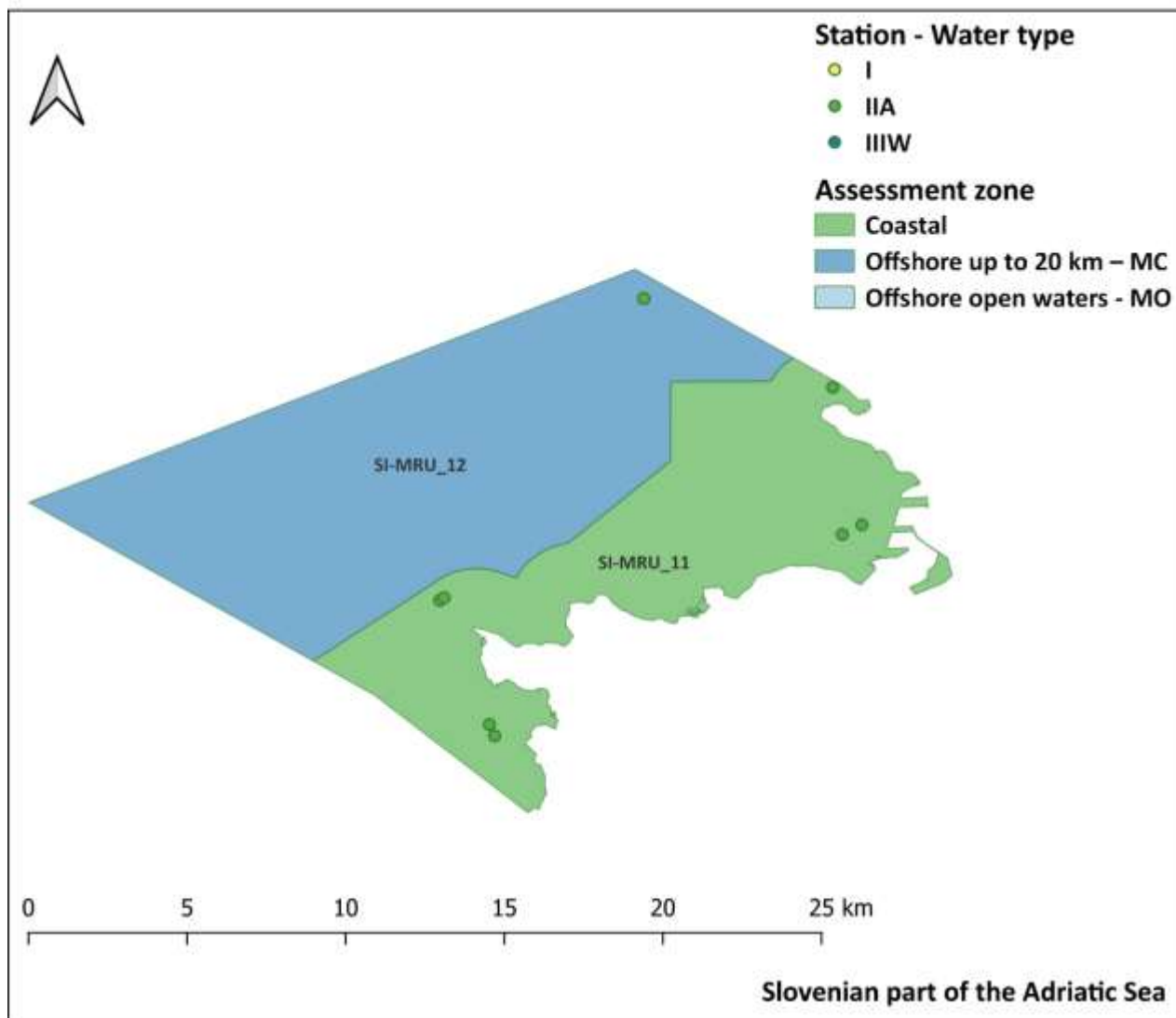


Figure 22b. The IMAP SAUs for CIs 13 and 14 in marine waters of Slovenia, used for the NEAT application in the Adriatic Sea Sub-region, including the positions of monitoring stations.

Croatia

IMAP Common Indicator 17

The network of monitoring station of Croatia for IMAP CI 17 and their relation to the coastal and offshore zones is shown in Figure 23, while their relation to the MEDCIS coastal and offshore zones is shown in Figure 17.

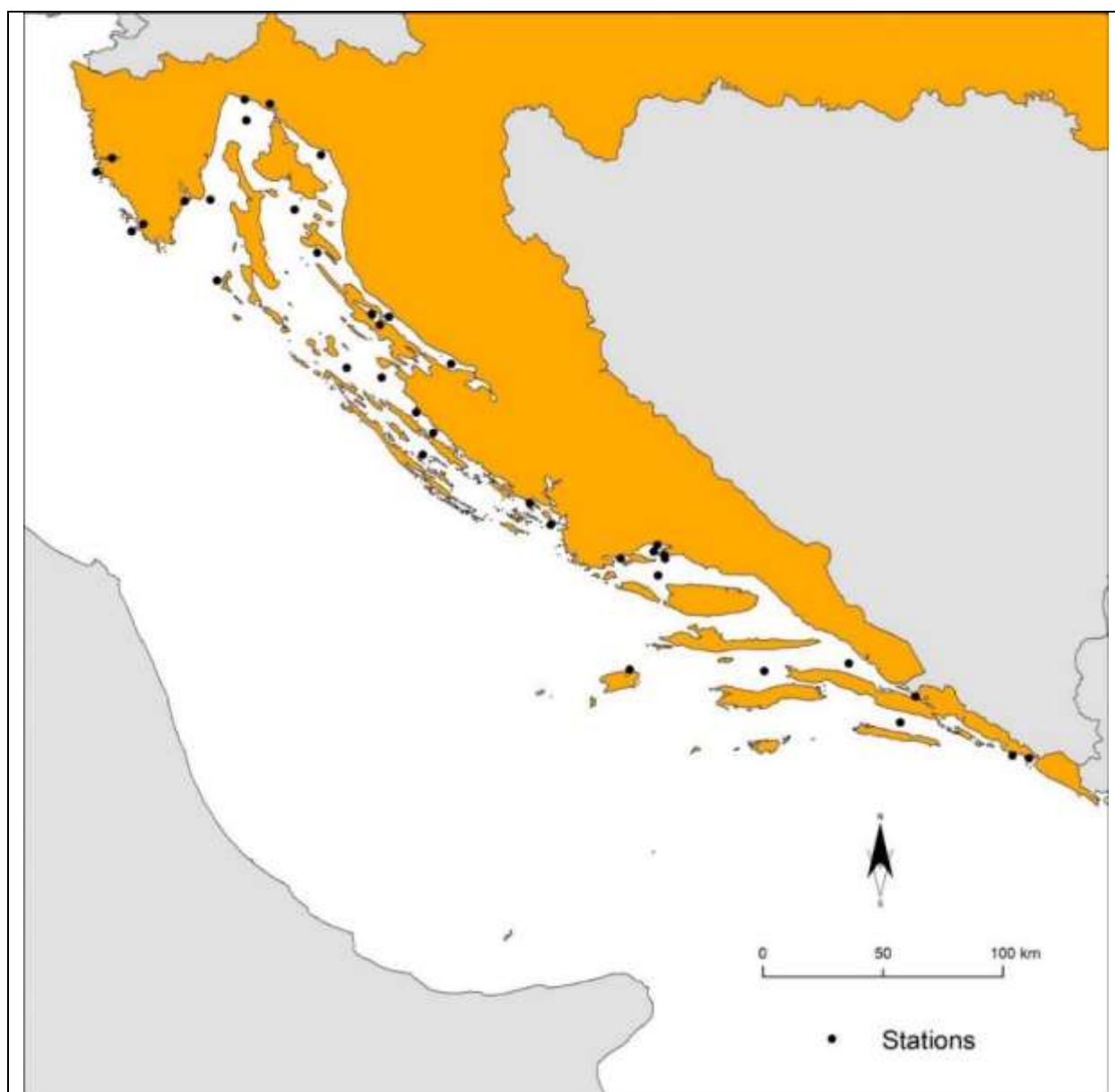


Figure 23. The distribution of the monitoring stations of Croatia for IMAP CI17. The coordinates of the monitoring stations are as reported in IMAP IS.

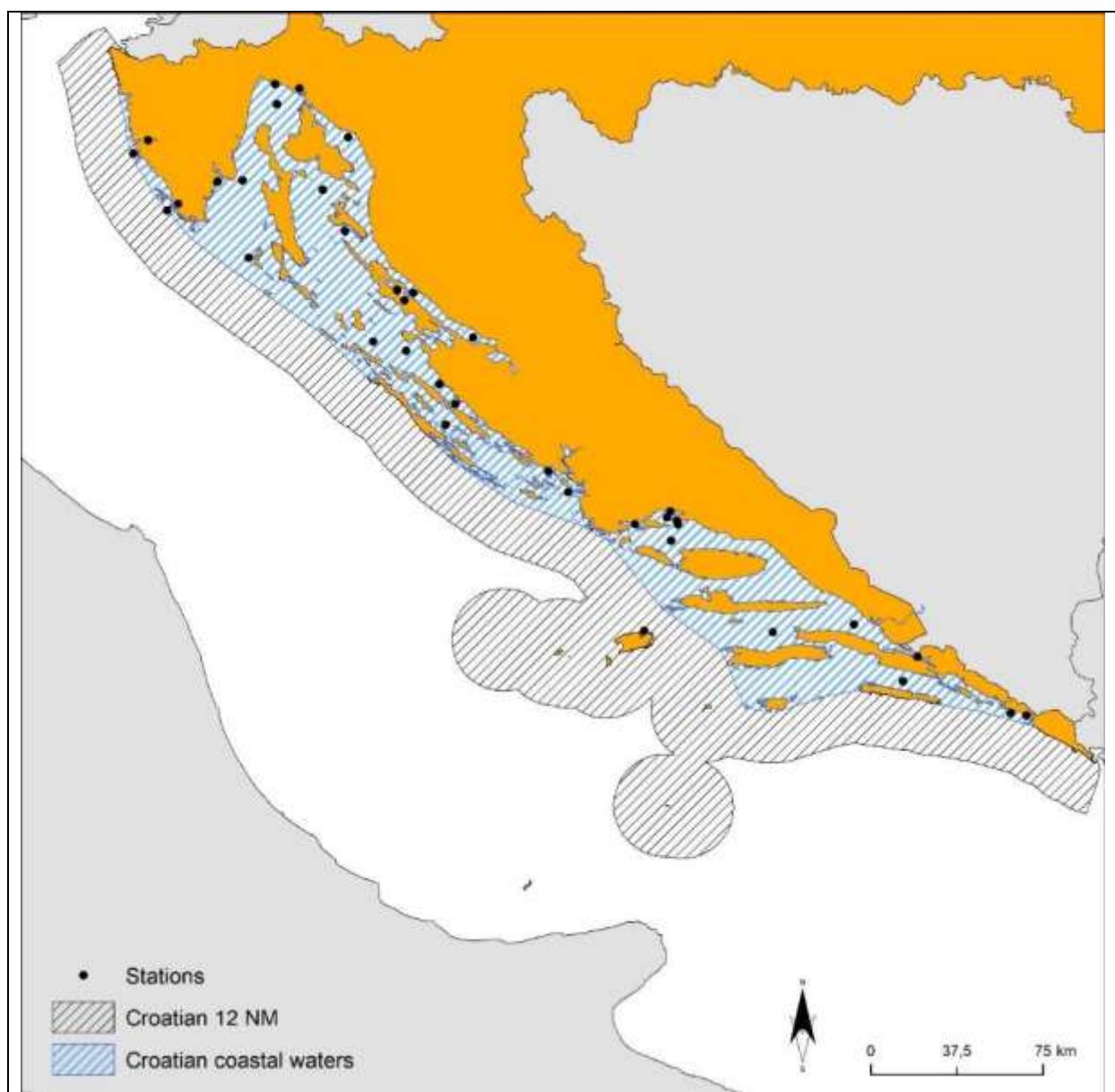


Figure 24. The coastal and the offshore zones for Croatia overlaid on the network of monitoring stations.

For Croatia the two zones of coastal and offshore waters based on data from the MEDCIS project comply well with the 4 officially declared MRUs for the purposes of the MSFD implementation (Figure18). Two MRUs namely MAD_HR_MRU_4 and MAD_HR_MRU_5 correspond to the offshore zone and are considered as IMAP SAUs in the offshore assessment zone, while MAD_HR_MRU_2 and MAD_HR_MRU_3 correspond to the coastal zone and are considered as IMAP SAUs (Figure19). In addition, the country has officially defined subMRUs for the purposes of the implementation of the WFD and the MSFD. The WFD delimitations are used in present work for setting the areas of assessment for IMAP Ecological Objectives 5 and 9. In particular, the MAD_HR_MRU_2 and the MAD_HR_MRU_3 are further divided to 15 and 26 WFD subMRUs respectively as shown in Figure 20. All these subMRUs are considered as the finest IMAP subSAUs. Most areas are nested under the Central Adriatic Sea (CAS). There was a need to split MAD_HR_MRU_2 between the Central and South Adriatic subdivisions in order to comply with the nesting of areas in the Adriatic Sea sub-divisions. SubMRUs HRO_3132_ZUC and HRO_423_MOP are nested under the South Adriatic Sea (SAS). The surface area (km²) of the SAUs correspond to the official MRUs areas. Geographical data for Croatia are obtained from the EOINET data portal. The correctness of the coastal waters and offshore/open sea was checked in relevant legal acts.

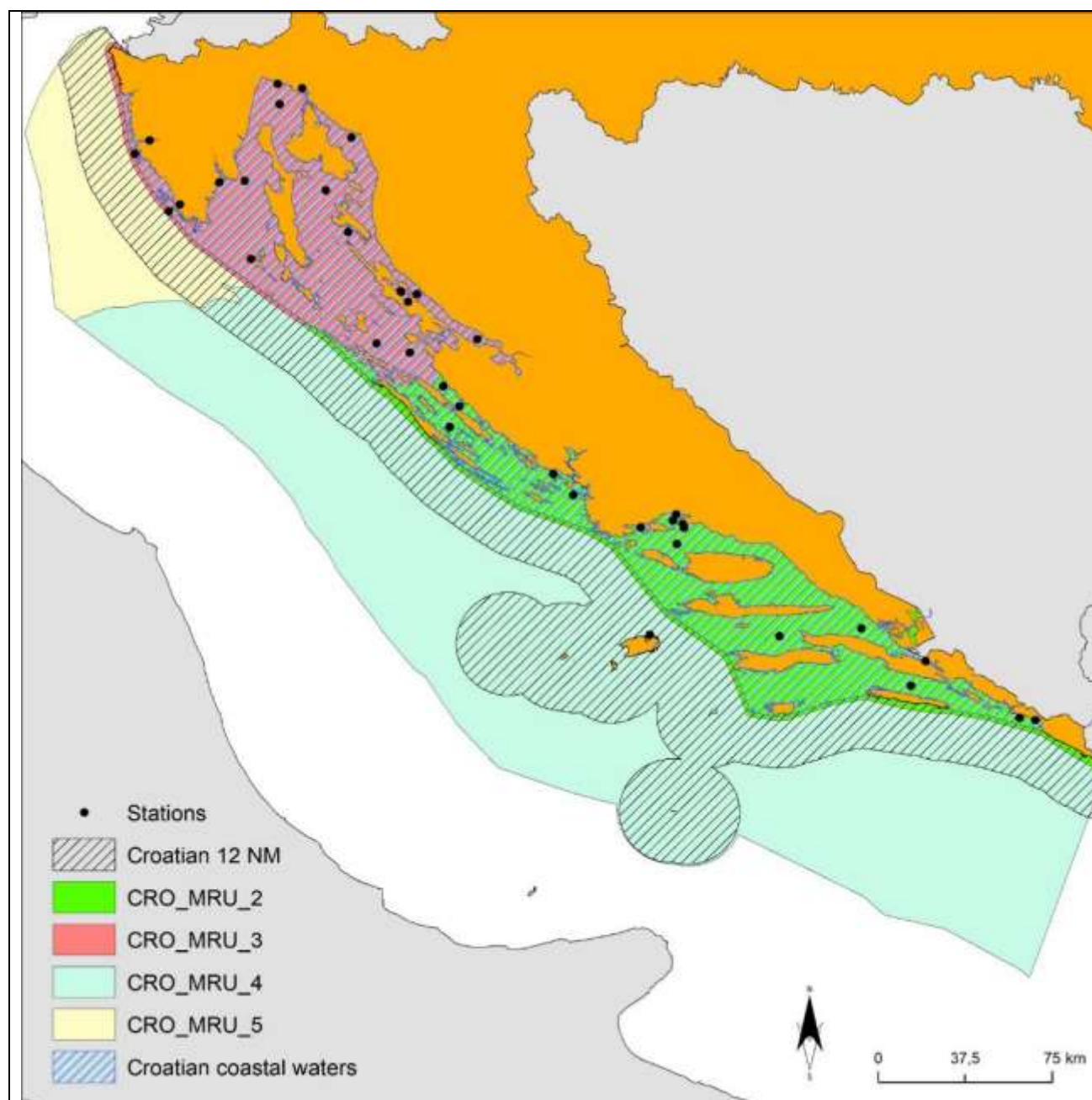


Figure 25. The four official MSFD MRUs of Croatia overlaid on the MEDCIS coastal and offshore zones and the network of monitoring stations. The source of data for MRUs is the EIONET folder of Croatia.

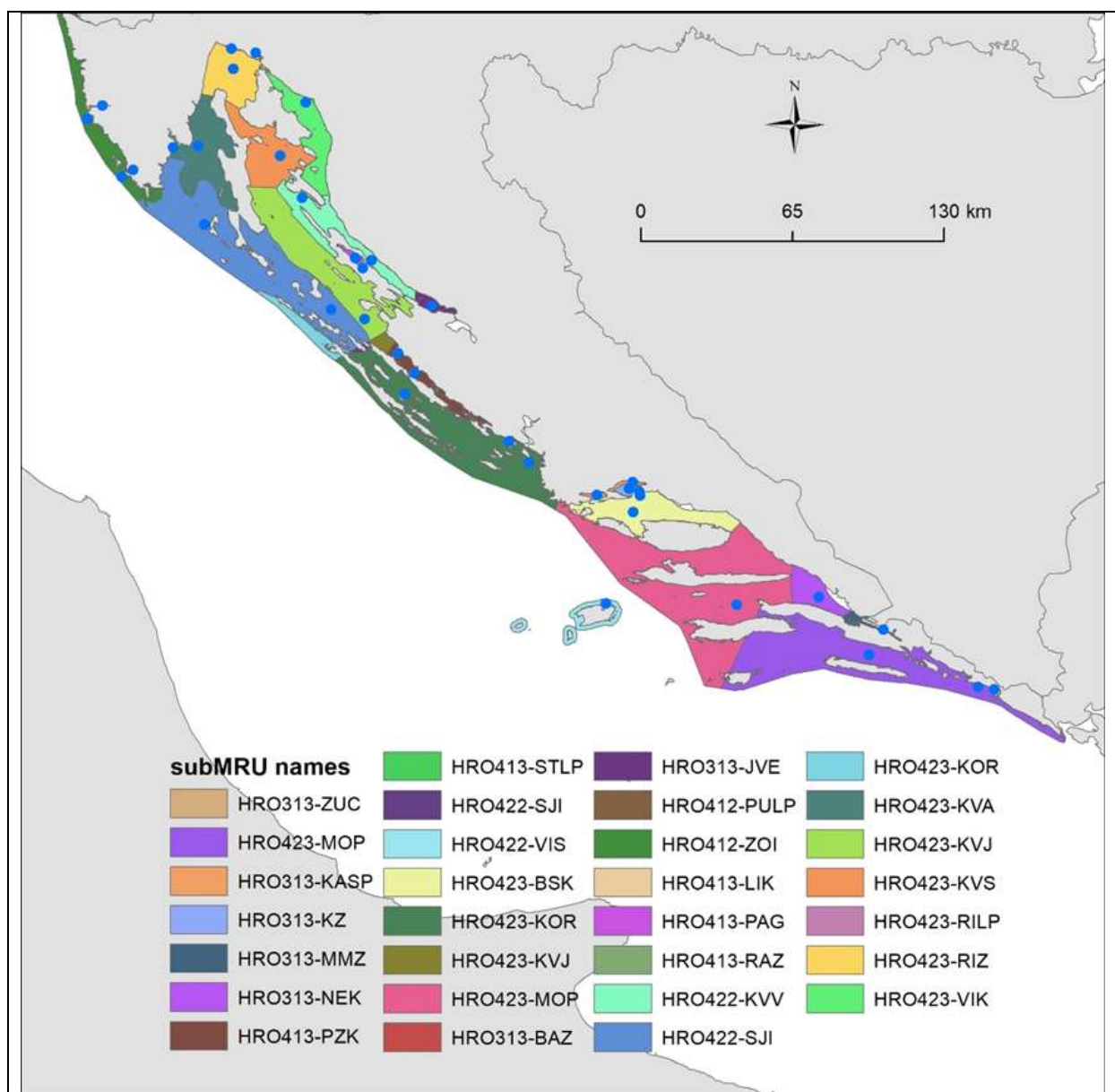


Figure 26. The water bodies of Croatia as used for the needs of Water Framework Directive and reporting obligations. The source of data is EEA SDI. For the purpose of present work, a further update of the dataset was undertaken by including a buffer zone around the Vis Island in order to ensure use of monitoring data for NEAT application from the monitoring station set in the area, given it was included in data reported to IMAP IS.

IMAP Common Indicators 13 & 14

In Figure 27 the distribution of monitoring stations related to IMAP CIs 13 & 14 of Croatia is shown and in Figure 28 their relation to the two coastal and offshore zones as defined using the MEDCIS data. Croatia has officially declared Marine Reporting Units at 3 levels. The latest dataset is available in the relevant folder of EIONET, accessible from the following weblink as ESRI shapefiles with the associate metadata.

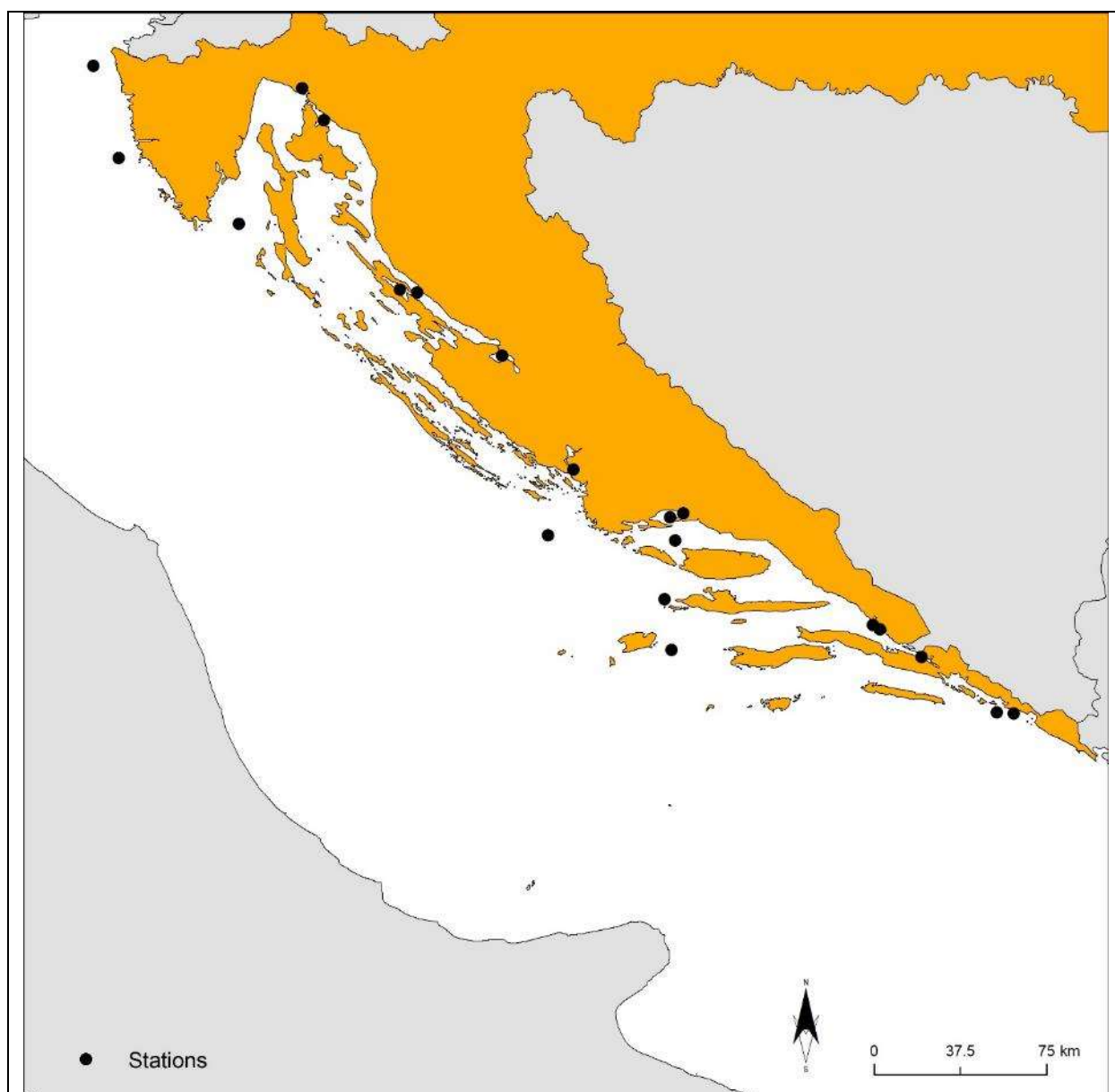


Figure 27. The distribution of the monitoring stations of Croatia for IMAP CIs 13&14. The coordinates of the monitoring stations are as reported in IMAP IS.

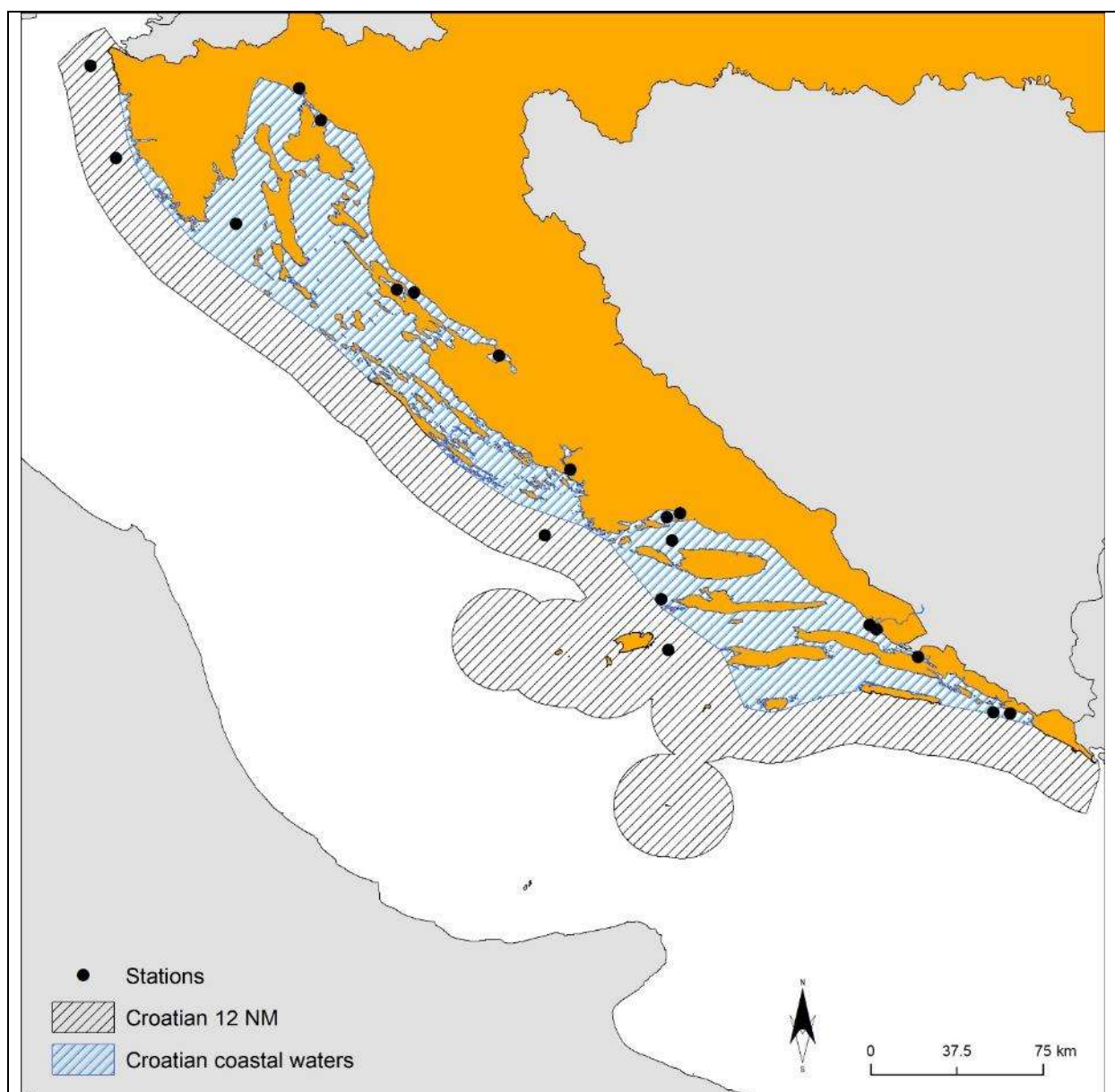


Figure 28. The coastal and the offshore zones for Croatia overlaid on the network of monitoring stations.

As found during a harmonized and homogenized application of the NEAT tool for GES assessment of IMAP CI 17 in the Adriatic Sea Subregion (UNEP/MED WG.533/10, Appendix III; UNEP/MED WG.533/Inf.4/Rev.1 and UNEP/MED WG.533/Inf.5/Rev.1 (amended for the purpose of CIs 13 and 14)), the two zones of coastal and offshore waters set for Croatia based on data from the MEDCIS project comply well with the 4 officially declared MRUs for the purposes of the MSFD implementation (Figure 28). These follow the methodology described for CI 17 and remain the same as the spatial distribution of the IMAP Info System stations is well placed and no changes from the SAUs of CI 17 are required to be introduced for the assessment work under NEAT. MAD_HR_MRU_2 and MAD_HR_MRU_3 correspond to the coastal zone and are considered as IMAP SAUs (Figure 30b). In addition, the country has officially defined subMRUs for the purposes of the implementation of the WFD and the MSFD. The WFD delimitations, that corresponds with water bodies, are used for setting the areas of assessment for EOs 5 and 9. In particular, the MAD_HR_MRU_2 and MAD_HR_MRU_3 are further divided to 15 and 26 WFD water bodies respectively as shown in Figure 30b. All these water bodies are considered the finest IMAP sub SAUs for IMAP CIs 13 and 14 in coastal waters.

Two MRUs namely MAD_HR_MRU_4 and MAD_HR_MRU_5 correspond to the offshore zone as developed for IMAP CI 17 (UNEP/MED WG.533/Inf.5/Rev.1 (amended for the purposed of CIs 13 and 14)). For the purpose of EO5 assessment, these two areas are unified and split in the two offshore areas. The first one is the part of the offshore zone that is set outward of the coastal zone to roughly 20 km where the most of the national monitoring activities is performed, and abbreviated MC. The second one is the remaining part of marine waters of Croatia in the Adriatic Sea, and can be identified as the offshore open waters, abbreviated MO. This part coincides with the epicontinental zone of Croatia where the monitoring of marine environment has not yet been implemented. These subSAUs are mainly related to the hydrographical conditions and characteristics relevant for the EO5 in the offshore marine waters of Croatia. The areas are then divided based on the Adriatic Sea assessment zones (NAS, CAS, and SAS) and where needed, based on the expert knowledge, even on smaller units as given in Figure 30b.

Geographical data for Croatia are obtained from the EOINET data portal. The correctness of the coastal waters and offshore/open sea was checked in relevant legal acts.³

³ Maritime Code (Pomorski Zakonik – PZ) of Republic of Croatia, Off. Gazette, No. 26/01, 12 Apr 2001
Barić Punda, V., Filipović, V. 2015. Protocol on the interim regime along the southern border (2002) with special regard to the decisions of the governments of the Republic of Croatia and Montenegro on the exploration and exploitation of hydrocarbons in the Adriatic., PPP 54 (2015), 169, pp. 73–88.

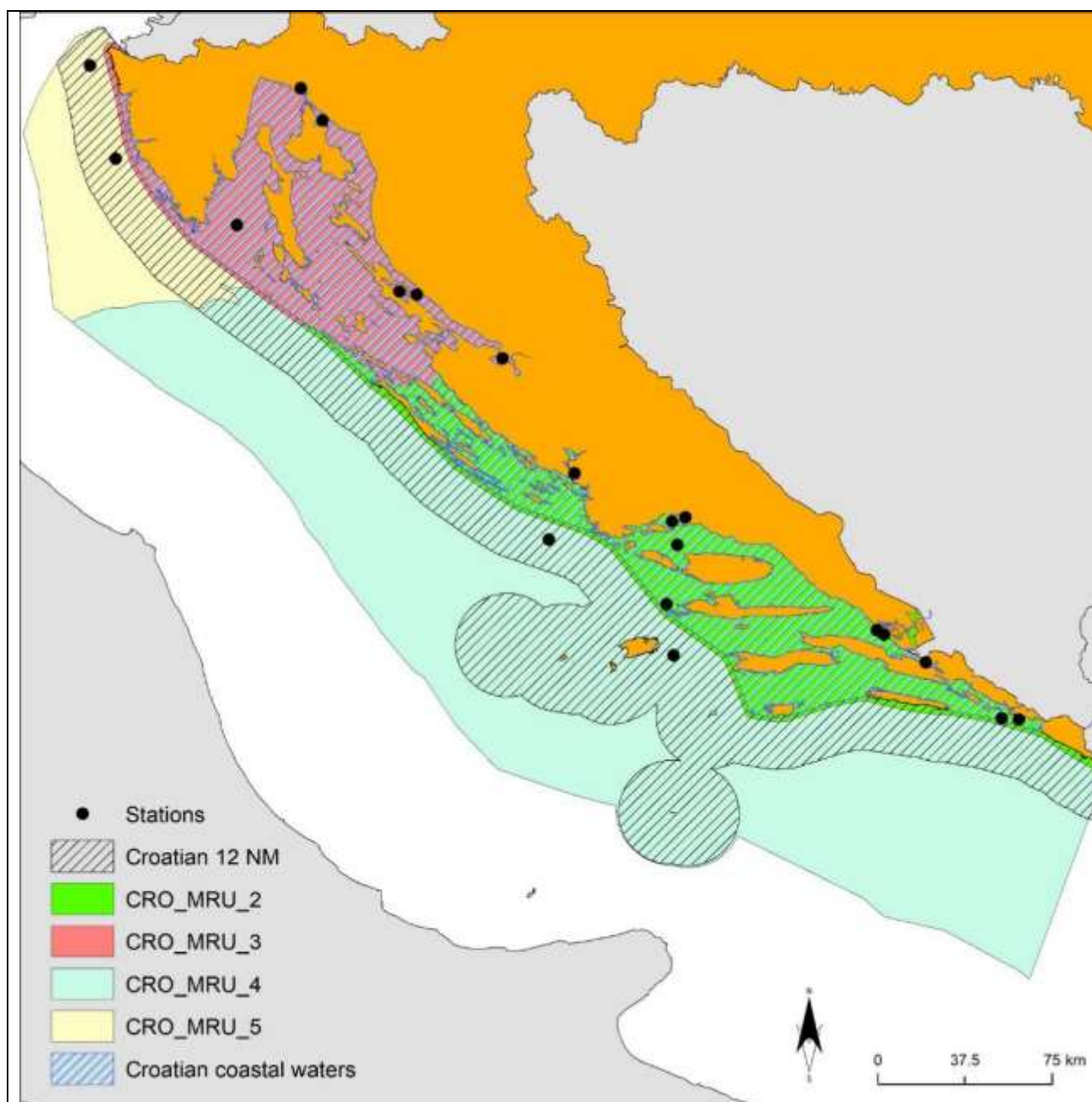


Figure 29. The four official MSFD MRUs of Croatia overlaid on the MEDCIS coastal and offshore zones and the network of monitoring stations. The source of data for MRUs is the EIONET folder of Croatia.

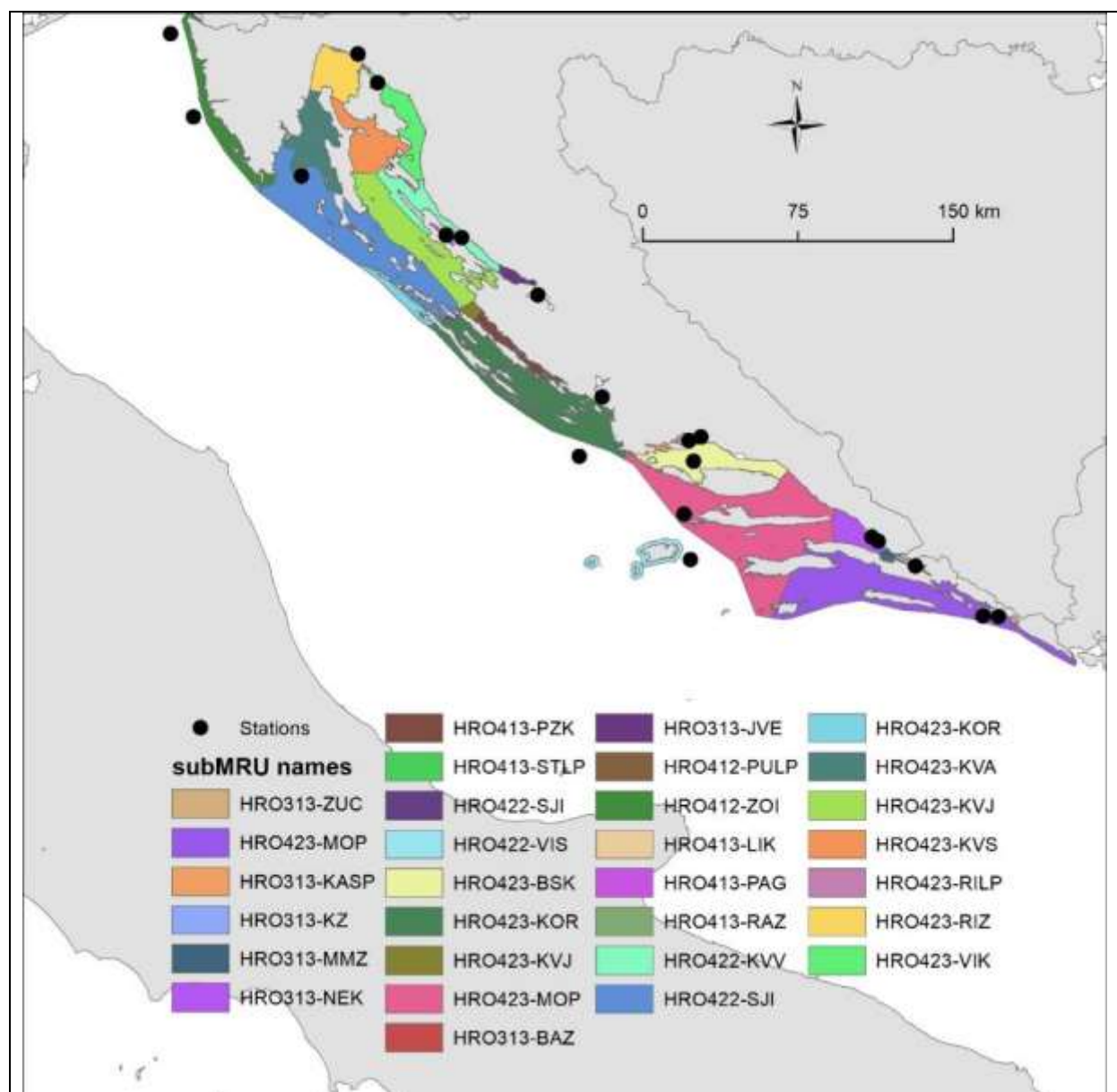


Figure 30a. The water bodies of Croatia as used for the needs of Water Framework Directive and reporting obligations. The source of data is the same as for CI 17 explained and stated above in the CI 17 chapter of Croatia.

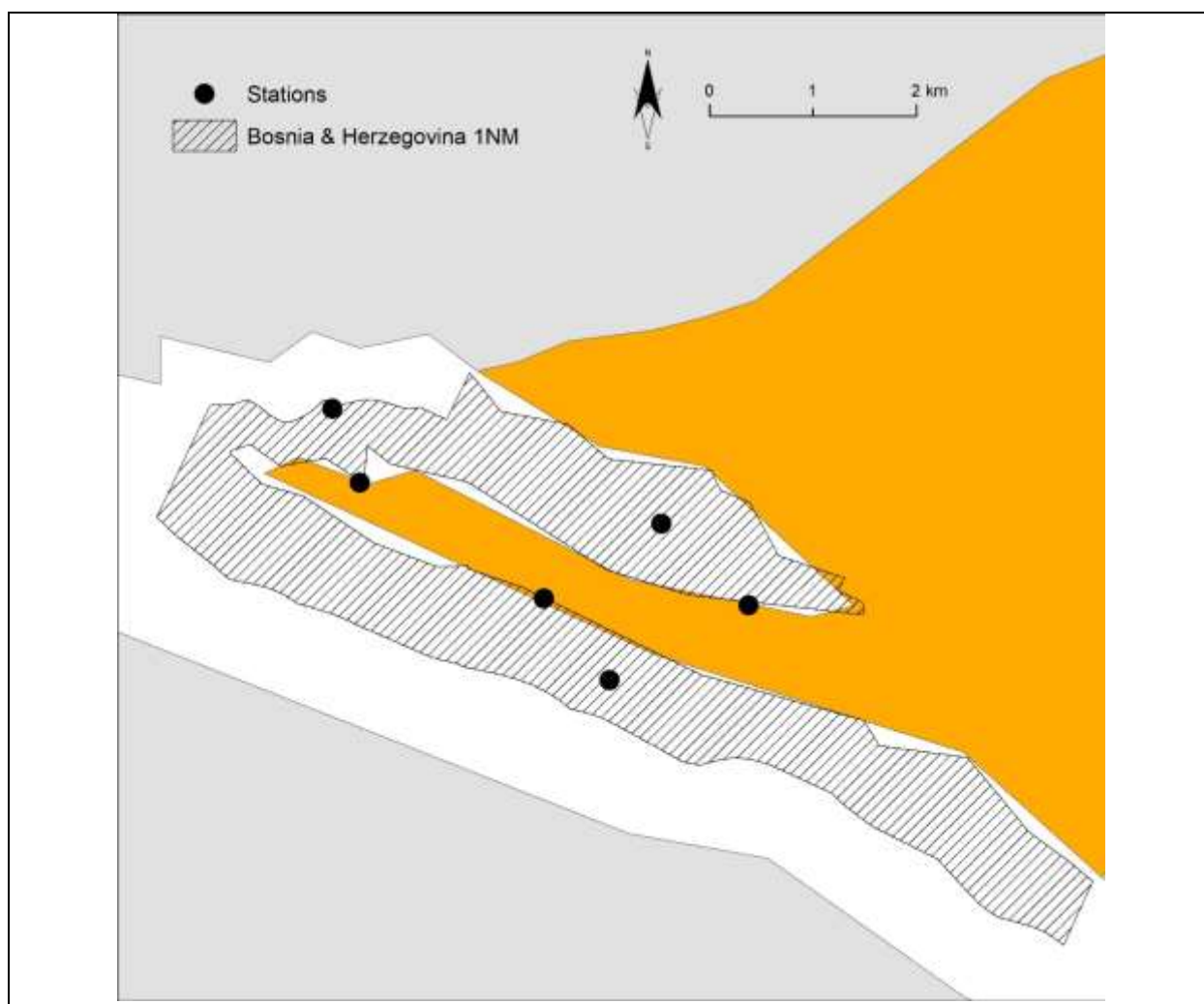


Figure 31a. The distribution of the monitoring stations of Bosnia and Herzegovina for IMAP CI 17.

IMAP Common Indicators 13 & 14

The below shown map provided the position of the monitoring station as defined for IMAP CIs 13 and 14 in National IMAP of Bosnia and Herzegovina from 2019.

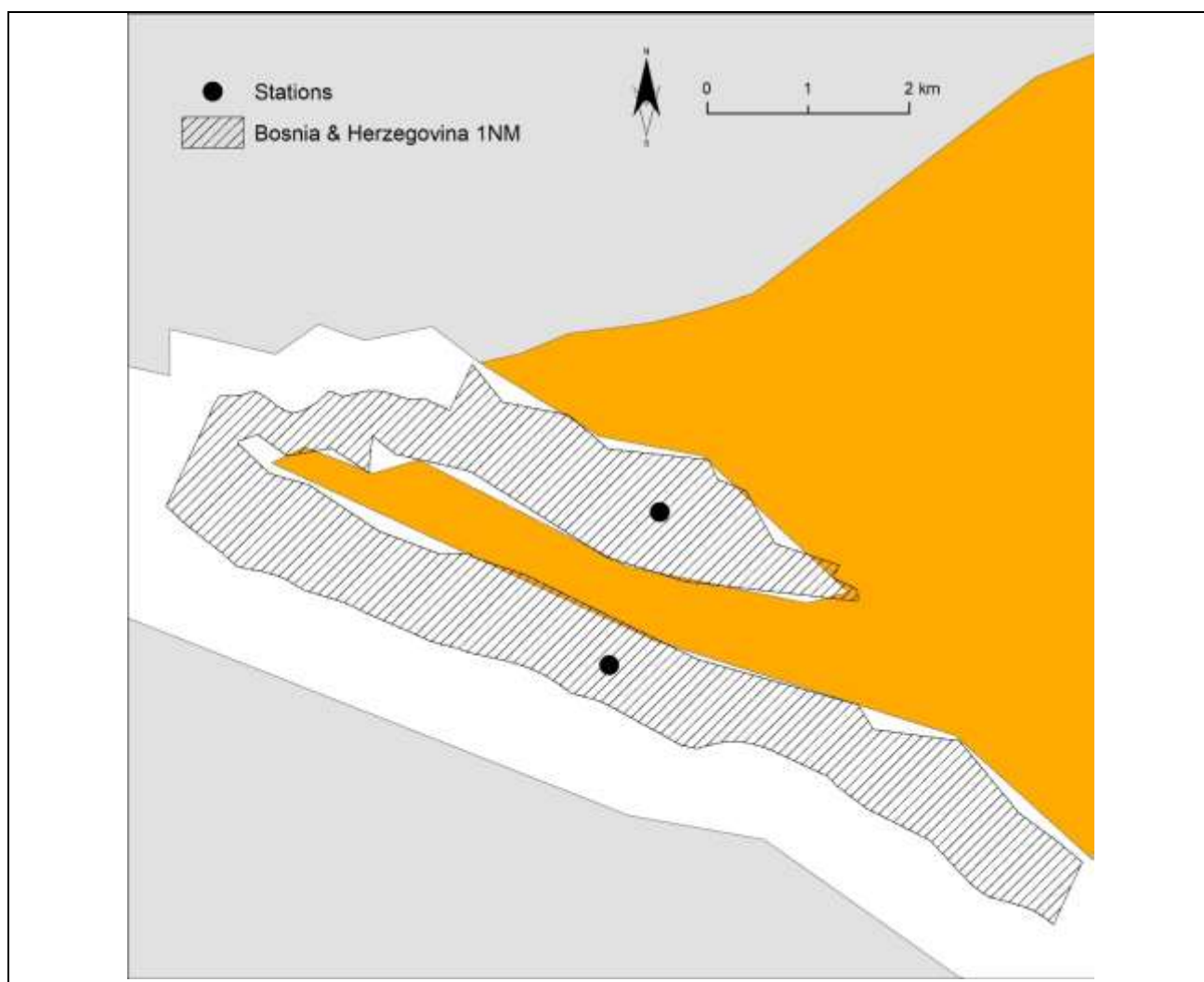


Figure 31b. The monitoring station of Bosnia and Herzegovina for IMAP CIs 13 and 14.

Montenegro

IMAP Common Indicator 17

The monitoring areas have not been defined in the National IMAP of Montenegro prepared in the framework of the GEF Adriatic Project. Within testing of NEAT application, the IMAP areas of assessment are proposed considering distribution of monitoring stations (Figure 32), as provided in National IMAP. MEDCIS zoning was not found useful due to lack of coherence with the nationally defined maritime boundaries as shown in Figure 33. To overcome these inaccuracies, a relevant and available expert knowledge of the ecosystem characteristics was considered, including the results of the GEF Adriatic Project and findings from literature cited in this document⁴. The main data that have been used are spatial data from the GEF Adriatic Project. Three following main assessments zones have been set: the Boka Kotorska bay, the coastal waters and the offshore sea zone. For the purpose of setting the finest areas of assessment, the two latter have been splitted

⁴ Cushman-Roisin, B., Gačić, M., Poulain, P.-M., ARTEGIANI, A., 2001. Physical Oceanography of the Adriatic Sea, Past, Present and Future, Springer Science + Business Media, Dordrecht, 312 pp.
Gaytan Aguilar, S., Verlaan, M., 2018. EMODnet High Resolution Seabed Mapping (HRSM), EMODnet Phase III, National coastlines and baselines – data set collection for European countries, 32 pp. www.emodnet-bathymetry.eu
Suárez de Vivero, J. I., 2010, Jurisdictional Waters in the Mediterranean and Black Seas, Directorate General for Internal Policies, Policy Department B: Structural and Cohesion Policies, Fisheries, 140 pp.

into the North, the Central and the South areas (Figures 34 to 36) by considering ecological and hydrological characteristic as found in scientific literature used for preparation of this document.

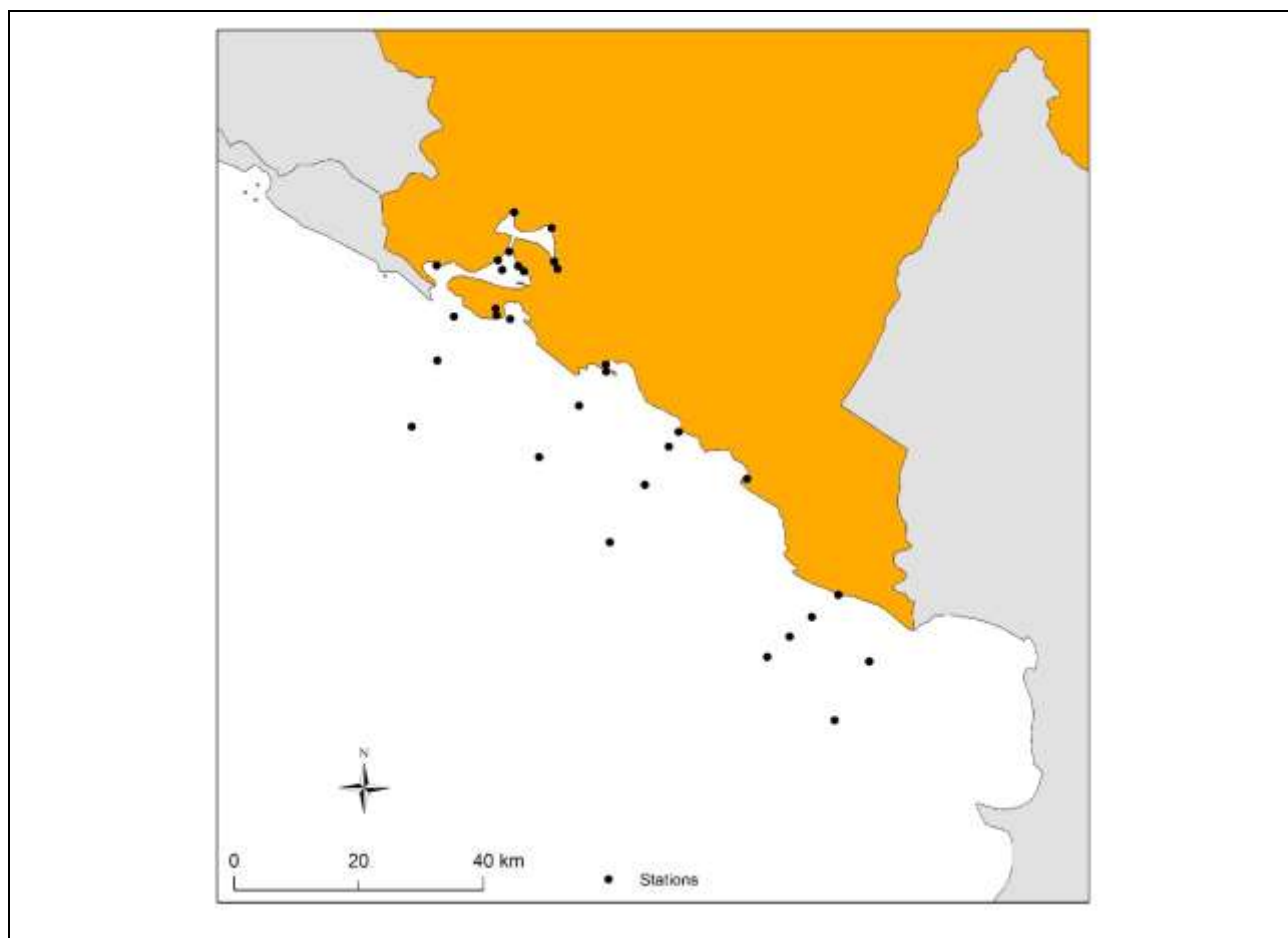


Figure 32. The distribution of the monitoring stations of Montenegro for IMAP CI 17. The coordinates of monitoring stations are as defined in the National IMAP.

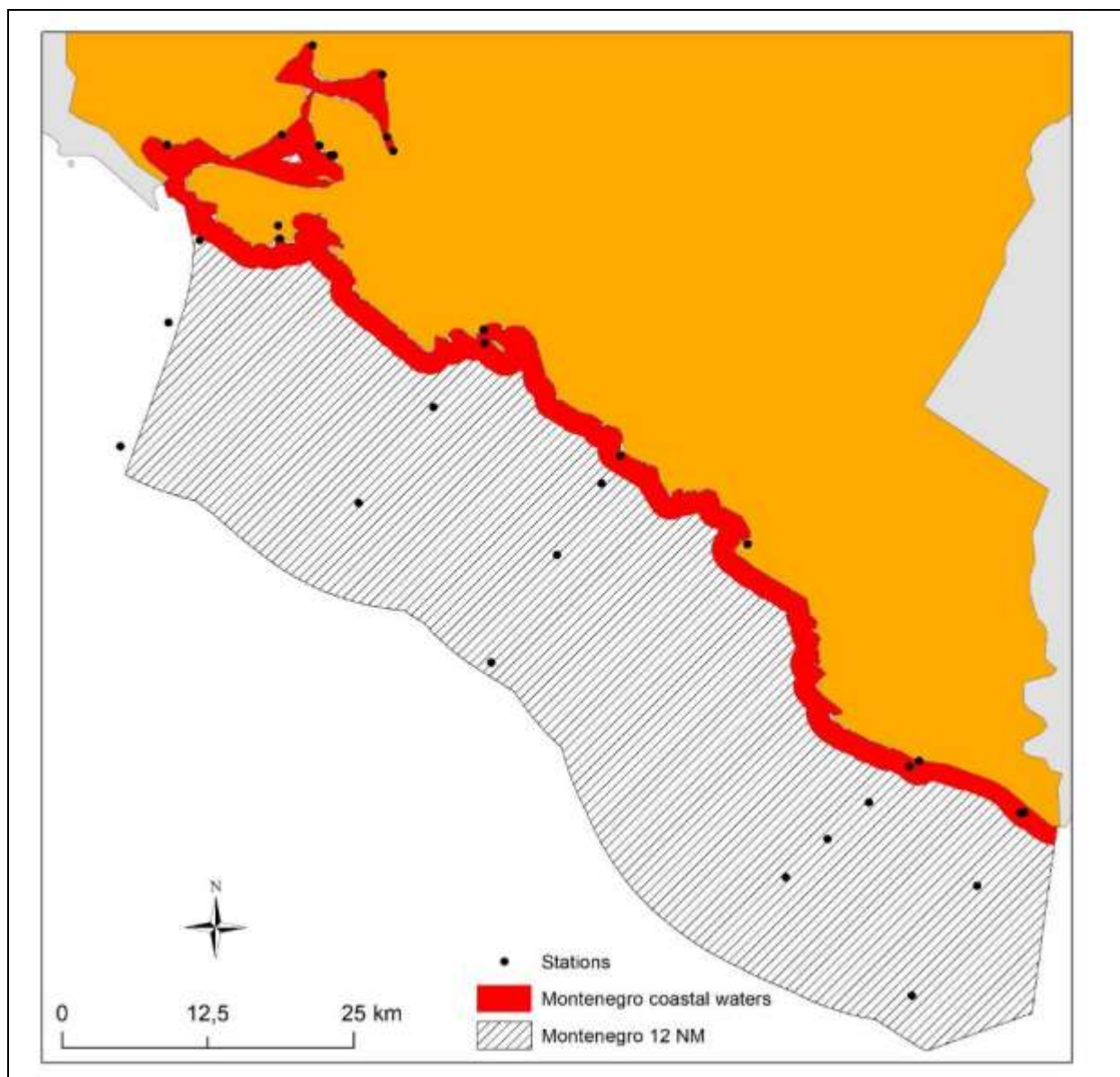


Figure 33. Map showing the inaccuracies of the MEDCIS coastal and offshore zones for the marine waters of Montenegro⁵, as several monitoring stations fall beyond 12 nm zone. The coordinates of monitoring stations are as defined in the National IMAP.

⁵ Barić Punda, V., Filipović, V. 2015. Protocol on the interim regime along the southern border (2002) with special regard to the decisions of the governments of the Republic of Croatia and Montenegro on the exploration and exploitation of hydrocarbons in the Adriatic., PPP 54 (2015), 169, pp. 73–88.
Protocol between the Government of the Republic of Croatia and the Federal Republic of Yugoslavia on the Interim Regime along the Southern Border between the Two States, 10 Dec 2002.
Law on the Sea, Official Gazette, No. 17/07 of 31 Dec 2007, 06/08 of 25 Jan 2008, 40/11 of 8 Aug 2011

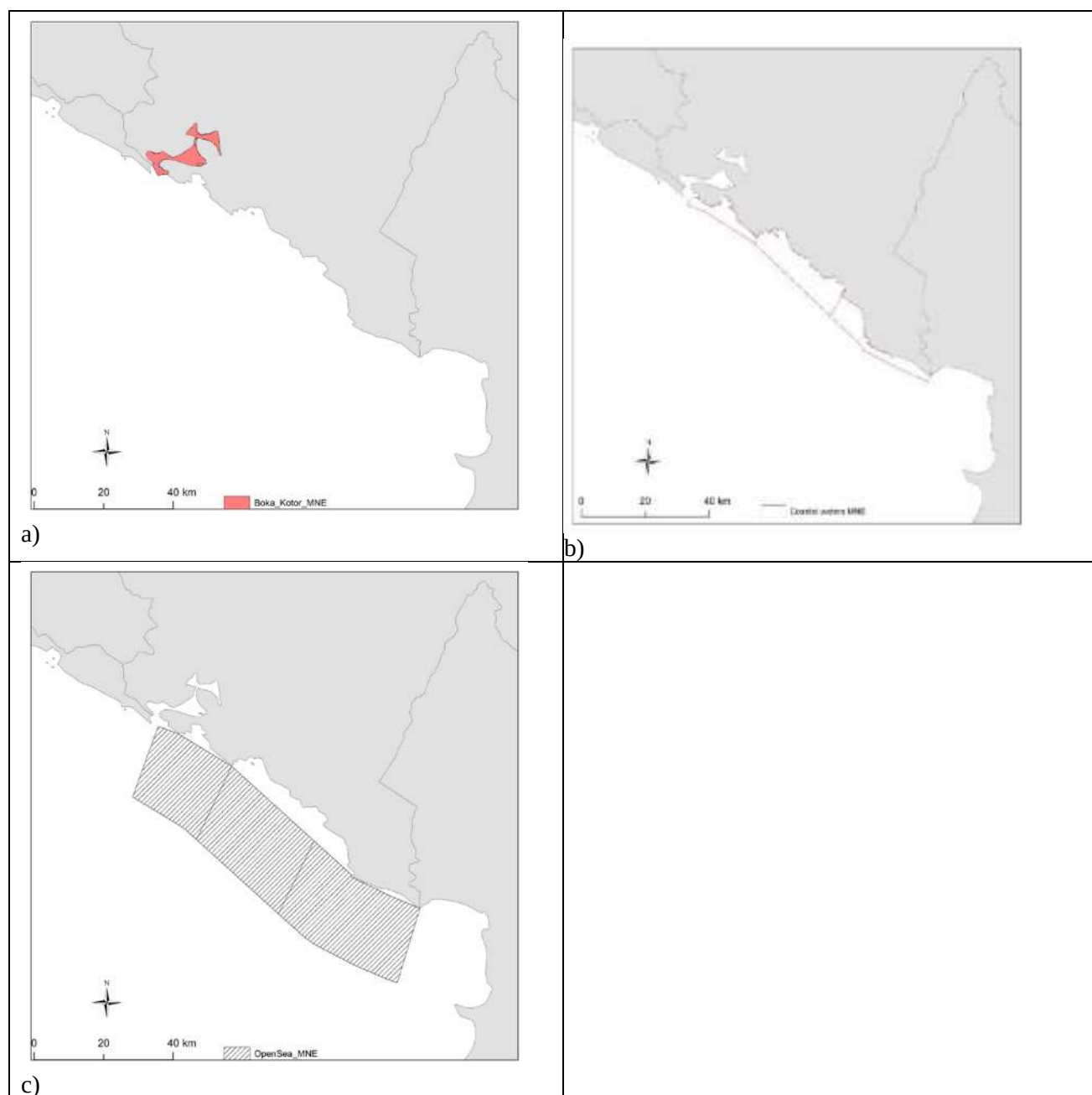


Figure 34. (a) Boka Kotorska Bay. The spatial area has been defined by using the spatial file from the GEF Adriatic Project on the maritime space of Montenegro and the delimitation of Boka Kotorska bay is based the RAC/SPA 2015 publication on the Biodiversity of the Bay. (b) Coastal waters divided in 3 smaller areas by using the spatial file from the GEF Adriatic Project on the maritime space of Montenegro. (c) Offshore waters divided in 3 smaller areas by using the spatial file from the GEF Adriatic Project on the maritime space of Montenegro. The source of all data is the GEF Adriatic Project.

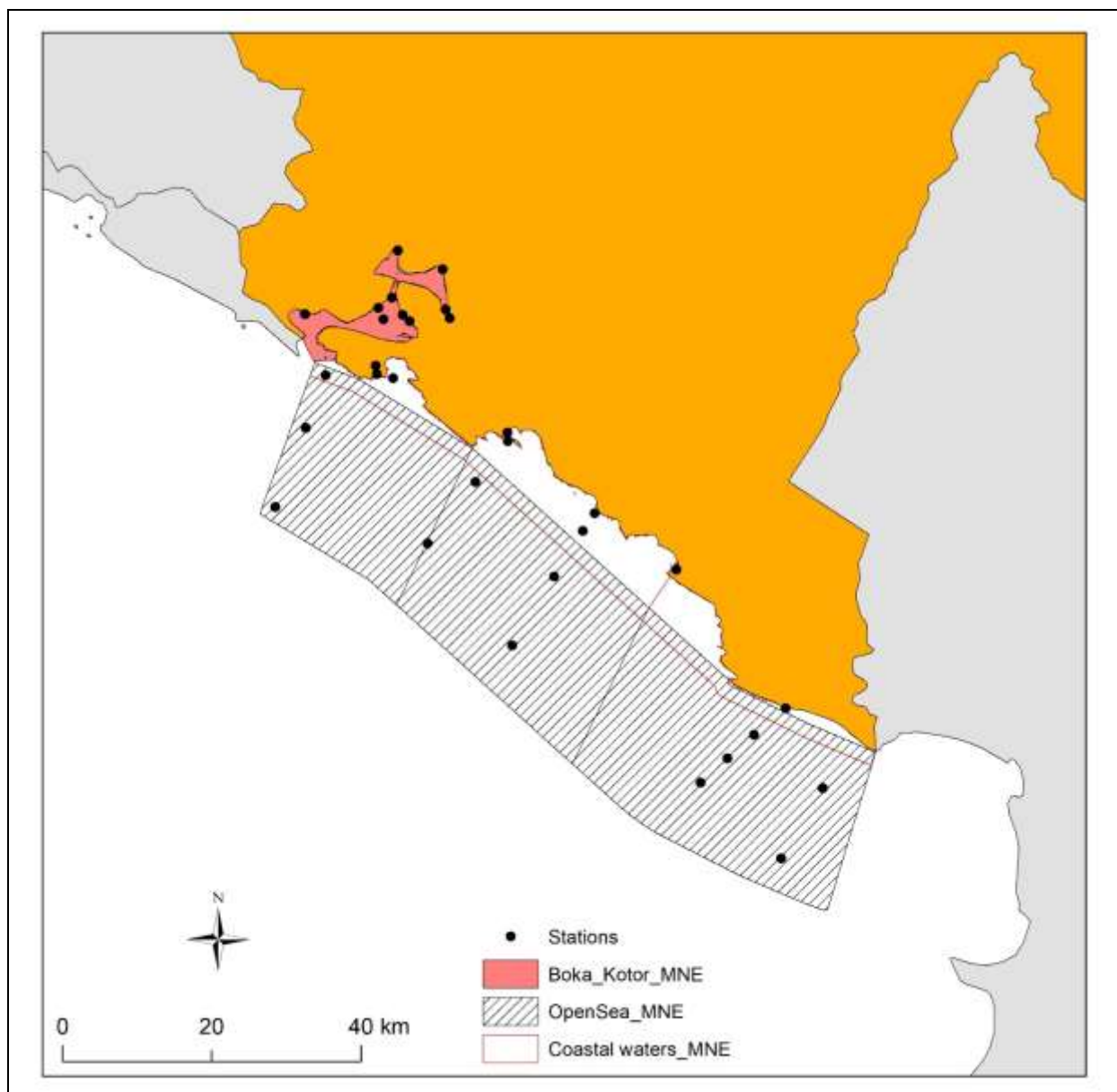


Figure 35. The 7 IMAP SAUs defined for Montenegro based on results of the GEF Adriatic Project. The coordinates of monitoring stations are shown.

The above Figure 25 shows the IMAP areas of assessment for the purpose of NEAT piloting in Montenegro within the Adriatic Sea Sub-region. The final dataset has been created by utilizing the spatial files from the GEF Adriatic Project and by further improvements of the spatial files related to the delineation of the Boka Kotorska bay as an indented area of assessment, as well as by the delineation of the coastal area of monitoring based on the straight baseline and the 1 nautical mile and the offshore waters area. The last two have been further delimited into three zones due to their large spatial coverage. By that, three areas of monitoring for the coastal waters i.e. the North, the Central, the South and three for the open sea-offshore waters were recognized i.e. the North, the Central and the South. From such recognized areas of monitoring, seven areas of assessment were proposed for Montenegro. Namely, the IMAP SAUs for Montenegro include: 4 in the coastal waters (Kotor, MNE1-N, MNE-1-C, MNE-1-S) and 3 defined in the 12 nautical miles offshore zone (MNE-12-N, MNE-12-C, MNE-12-S). The spatial layer of the GEF Adriatic Project providing the potential cumulative pressures from pollution in the marine area of Montenegro (Figure 26) was used as a source to support present expert work that resulted in recognition of the areas of monitoring further to the distribution of the monitoring stations and from there proposing the areas of assessment from the areas of monitoring.

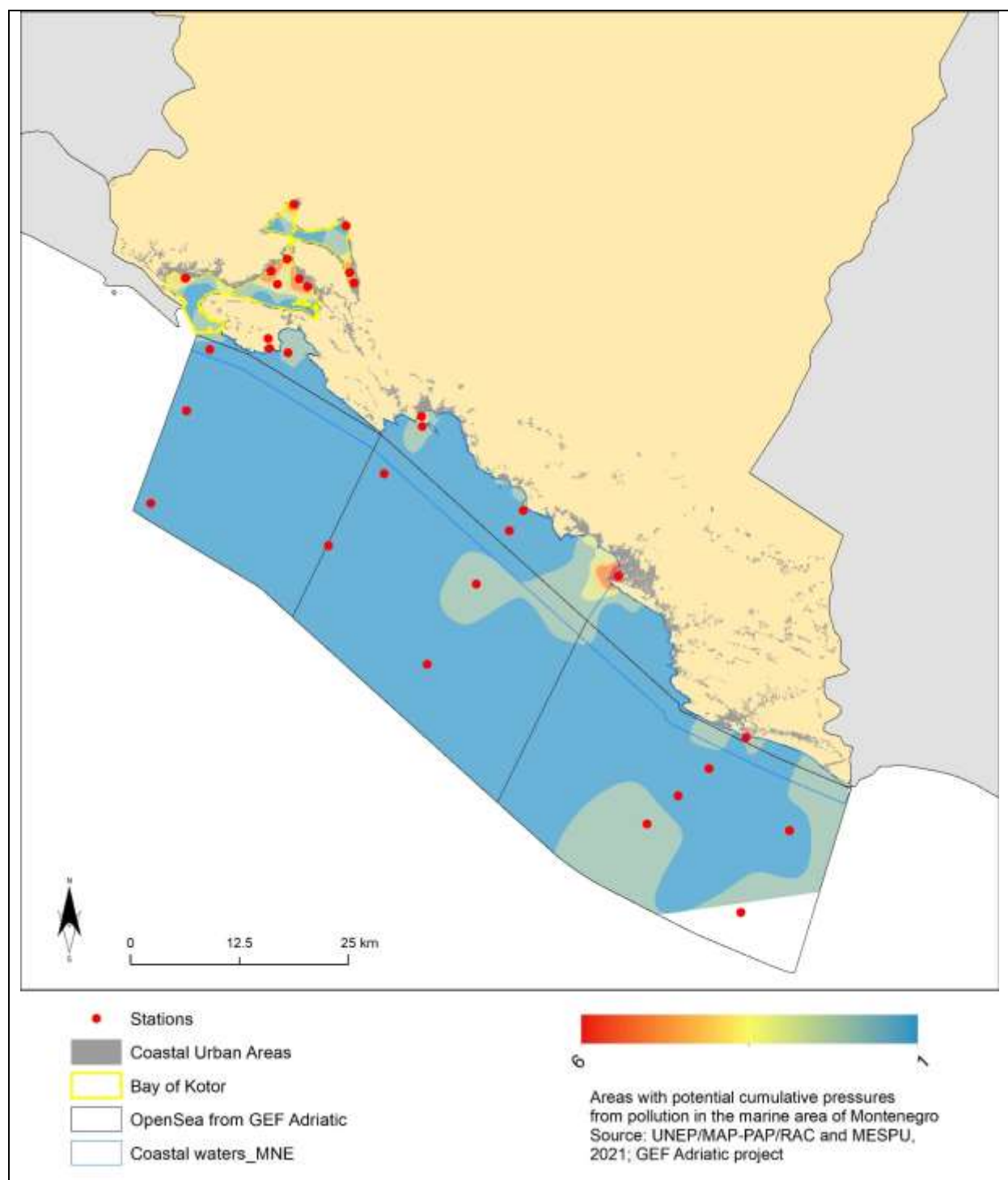


Figure 36. The network of monitoring stations of Montenegro, superimposed on the geospatial layer providing potential cumulative pressures from pollution sources in the marine waters of Montenegro (source: the GEF Adriatic Project).

IMAP Common Indicators 13 & 14

The monitoring areas have not been defined in the National IMAP of Montenegro prepared in the framework of GEF Adriatic Project. The IMAP areas of assessment were proposed considering the distribution of monitoring stations (Figures 37), as provided in National IMAP. Following the approach developed for CI 17,

the spatial assessment units for Montenegro regarding CIs 13 and 14 were defined considering the monitoring stations as reported to the IMAP Info System (Figure 37).

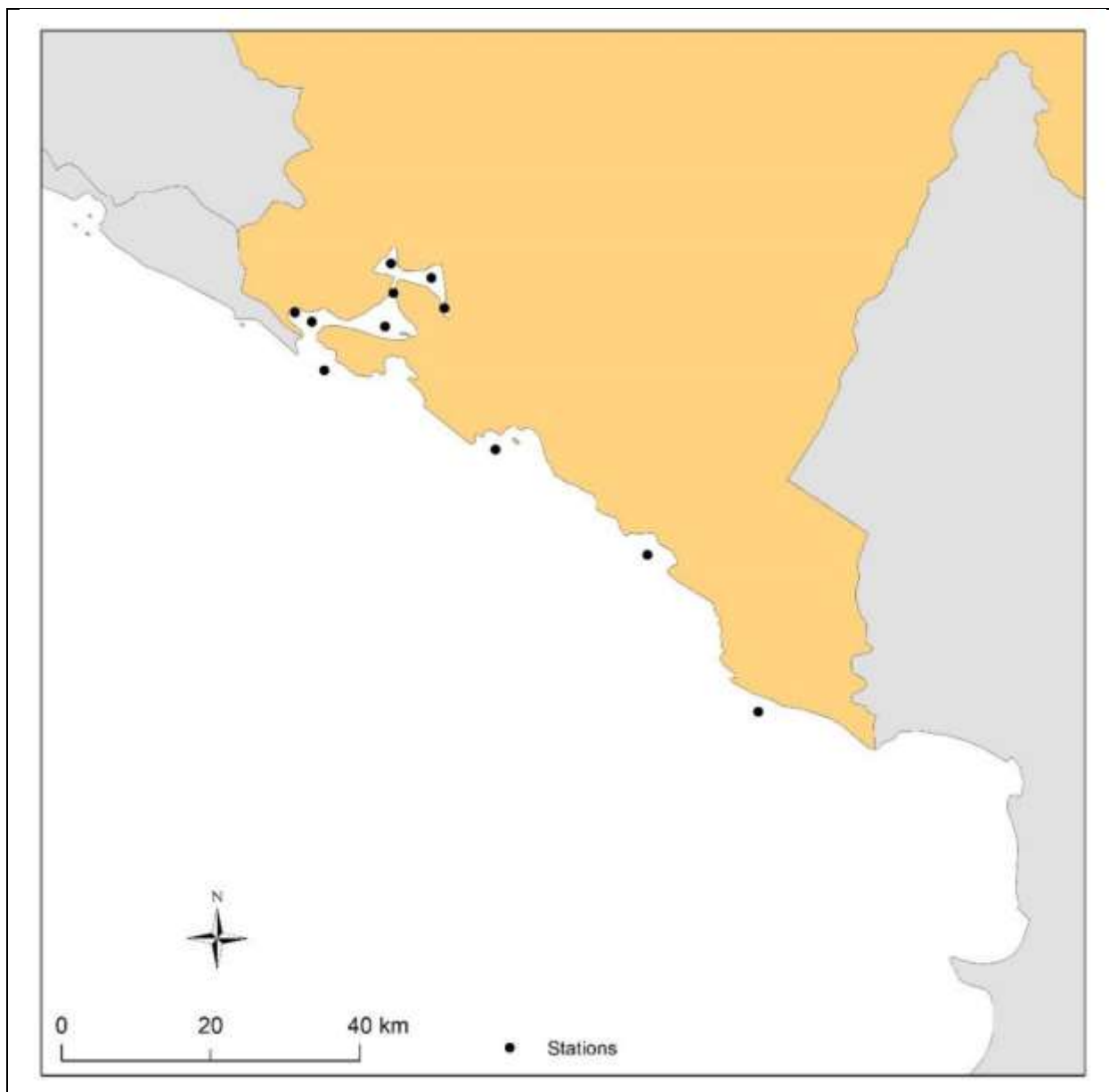


Figure 37. The distribution of the monitoring stations of Montenegro for IMAP CIs 13 and 14. The coordinates of monitoring stations are as defined in the National IMAP.

MEDCIS zoning was not found useful due to lack of coherence with the nationally defined maritime boundaries as shown in Figure 38. To overcome these inaccuracies, a relevant and available expert knowledge of the ecosystem characteristics was considered, including the results of the GEF Adriatic Project and findings from literature cited in this document⁶. The main data that were used are spatial data from the GEF Adriatic Project.

⁶ Cushman-Roisin, B., Gačić, M., Poulain, P-M., ARTEGIANI, A., 2001. Physical Oceanography of the Adriatic Sea, Past, Present and Future, Springer Science + Business Media, Dordrecht, 312 pp.
Gaytan Aguilar, S., Verlaan, M., 2018. EMODnet High Resolution Seabed Mapping (HRSM), EMODnet Phase III, National coastlines and baselines – data set collection for European countries, 32 pp. www.emodnet-bathymetry.eu

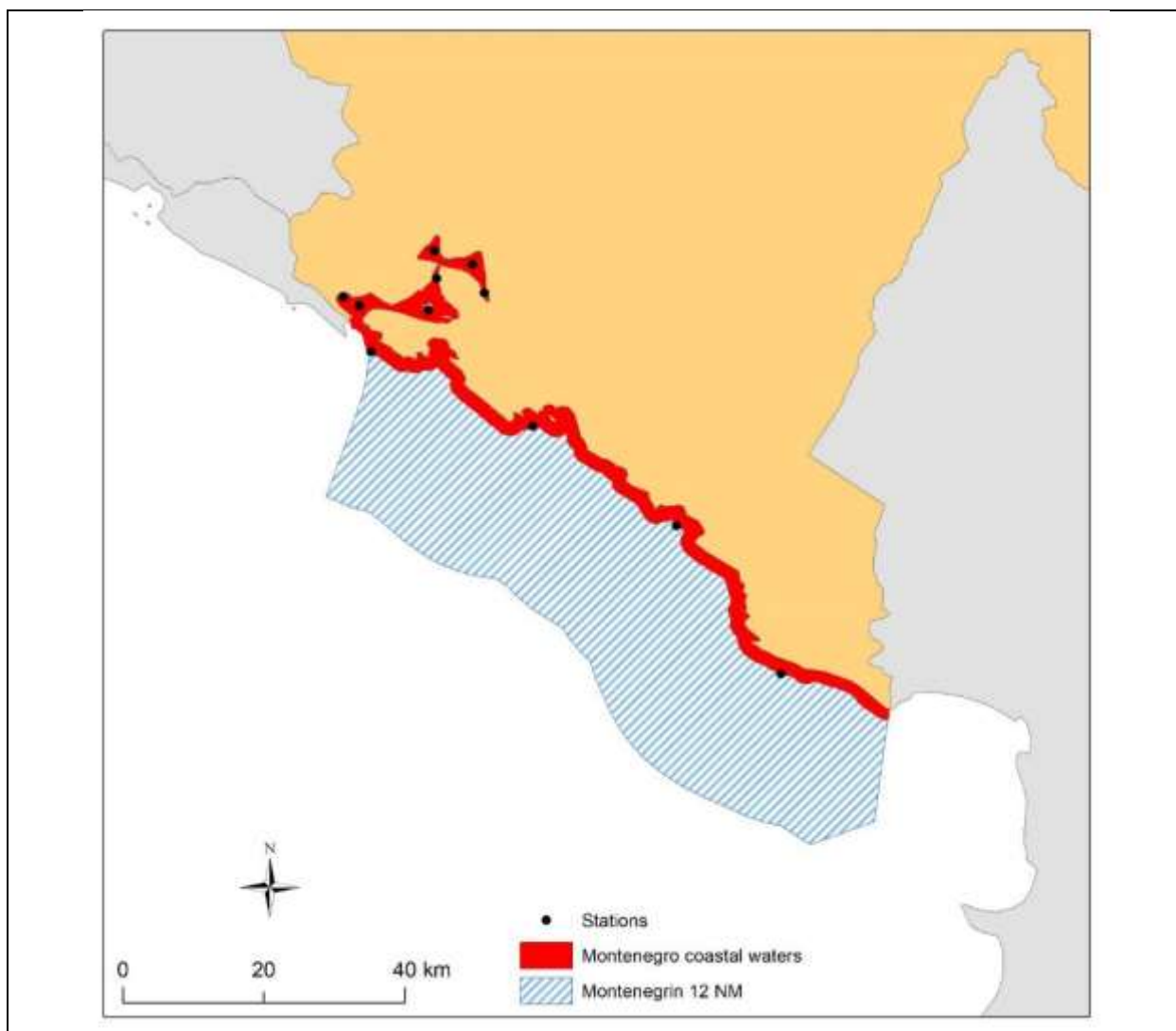


Figure 38a. Map showing the inaccuracies of the MEDCIS coastal and offshore zones for the marine waters of Montenegro⁷, as several monitoring stations fall beyond 12 nm zone. The coordinates of monitoring stations are as defined in the National IMAP.

Suárez de Vivero, J. I., 2010, Jurisdictional Waters in the Mediterranean and Black Seas, Directorate General for Internal Policies, Policy Department B: Structural and Cohesion Policies, Fisheries, 140 pp.

⁷ Barić Punda, V., Filipović, V. 2015. Protocol on the interim regime along the southern border (2002) with special regard to the decisions of the governments of the Republic of Croatia and Montenegro on the exploration and exploitation of hydrocarbons in the Adriatic., PPP 54 (2015), 169, pp. 73–88.

Protocol between the Government of the Republic of Croatia and the Federal Republic of Yugoslavia on the Interim Regime along the Southern Border between the Two States, 10 Dec 2002.

Law on the Sea, Official Gazette, No. 17/07 of 31 Dec 2007, 06/08 of 25 Jan 2008, 40/11 of 8 Aug 2011

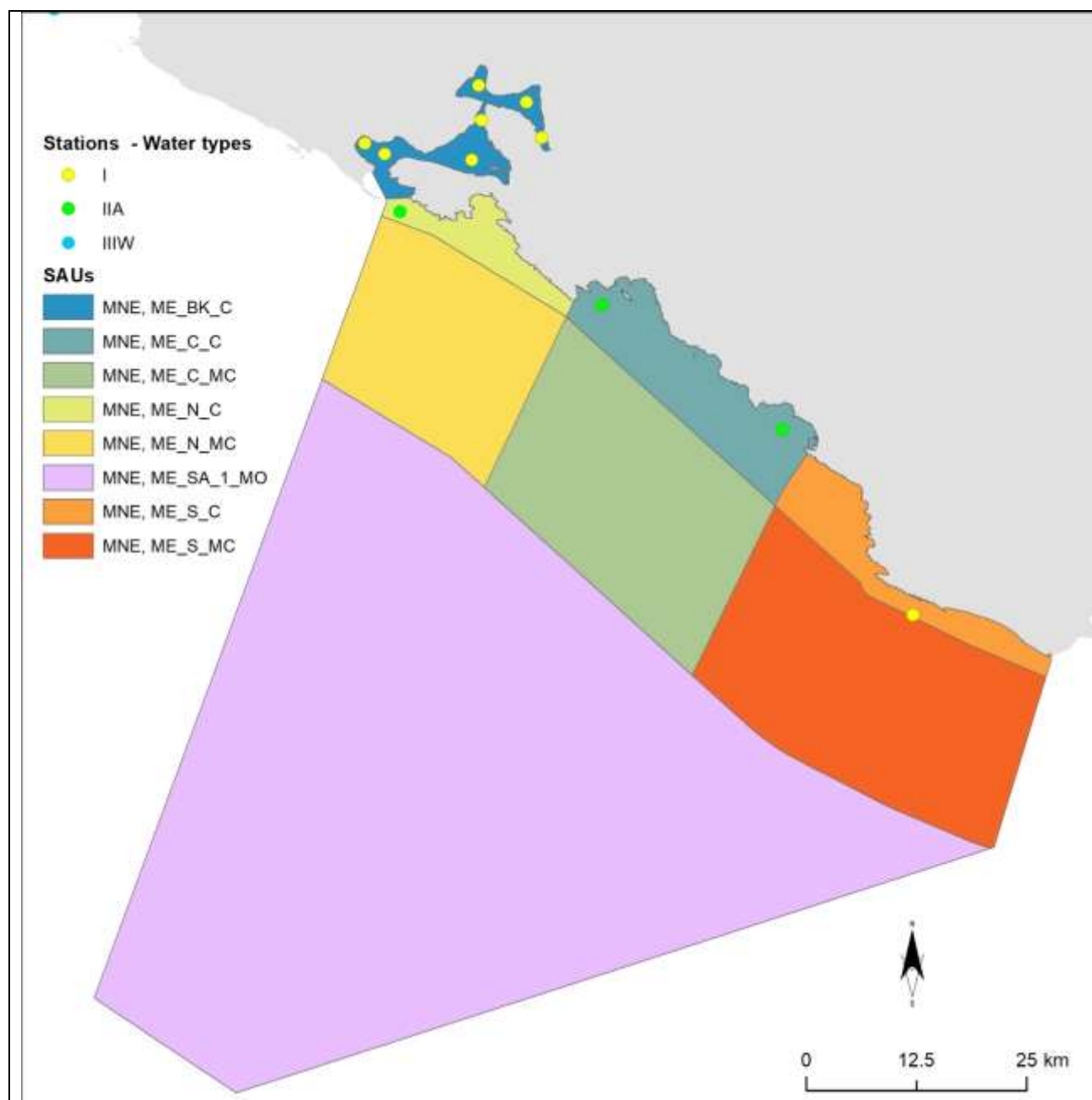


Figure 38b. The IMAP subSAUs for CIs 13 and 14 in the marine water of Montenegro overlaid on the positions of monitoring stations classified according to the water type, showing also the codes assigned to IMAP subSAUs.

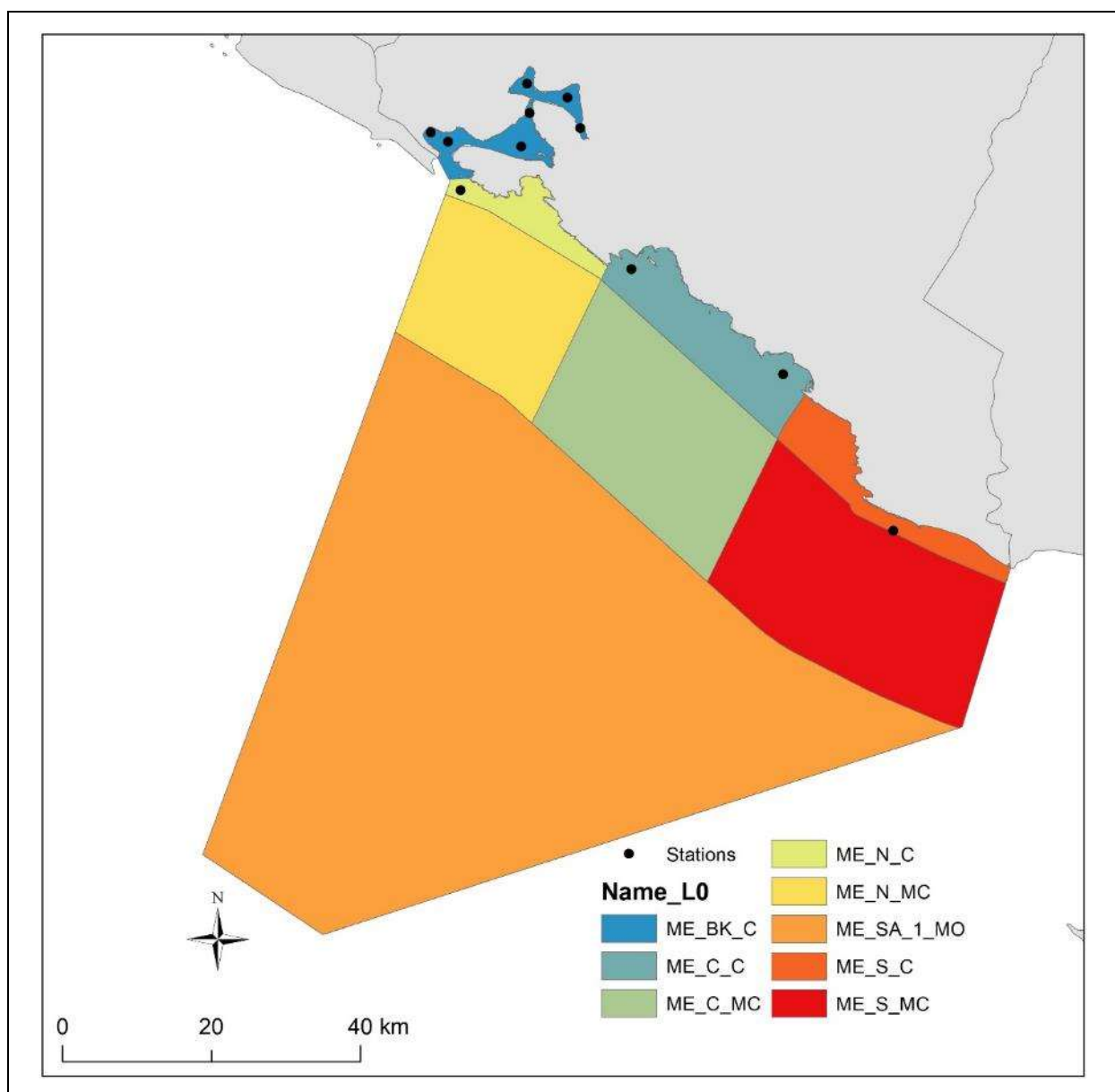


Figure 39. The IMAP subSAUs for CIs 13 and 14 in the marine water of Montenegro overlaid on the positions of monitoring stations, showing also the codes assigned to IMAP subSAUs.

The above Figure 39 shows the IMAP areas of assessment for the purpose of NEAT piloting in Montenegro within the Adriatic Sea Sub-region. Three main assessments zones have been set, the Boka Kotorska Bay, the coastal waters, and the offshore zone. For the purpose of setting the finest areas of assessment, the two latter have been split into the North, the Central and the South by considering ecological and hydrological characteristic as found in the scientific literature used to support NEAT GES assessment application. These IMAP SAUs are shown below in Figure 39. By that, three areas of monitoring for the coastal waters i.e. the North, the Central, the South and three for the open sea-offshore waters were recognized i.e. the North, the Central, the South. For the purpose of EO 5 assessment, a fourth area is added and coincide with the epicontinental zone of Montenegro. The area is beyond the 20 km line where usually the national monitoring activities are not performed and in future will be part of the open waters monitoring. From such recognized areas of monitoring, eight areas of assessment were proposed for IMAP CIs 13 and 14 assessment in marine waters of Montenegro as shown on Figure 8 and given in Table 1.

The spatial layer of the GEF Adriatic Project providing the potential cumulative pressures from pollution in the marine area of Montenegro (Figure 40) was used as a source to support present expert work that resulted in recognition of the areas of monitoring further to the distribution of the monitoring stations and from there proposing the areas of assessment from the areas of monitoring.

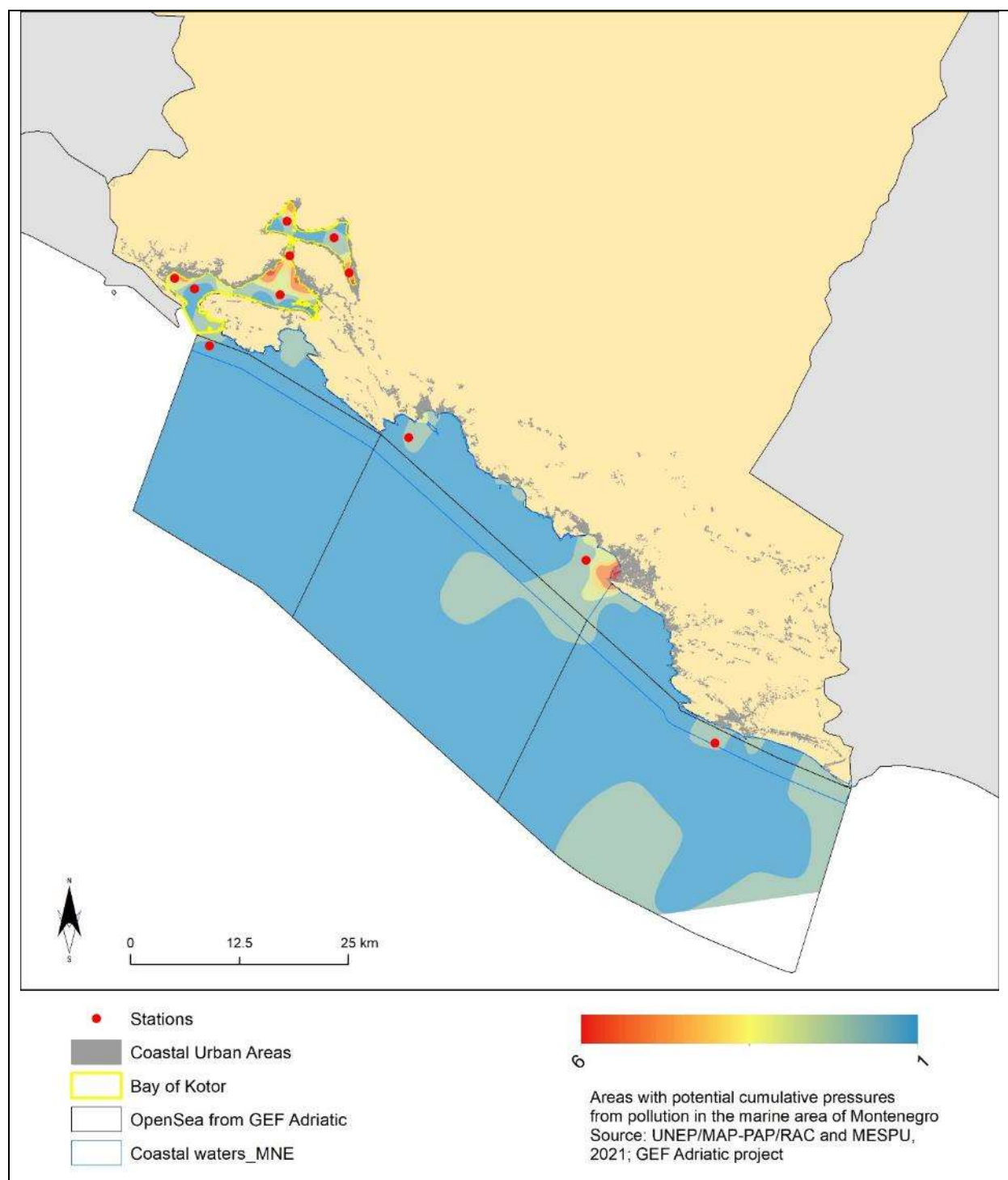


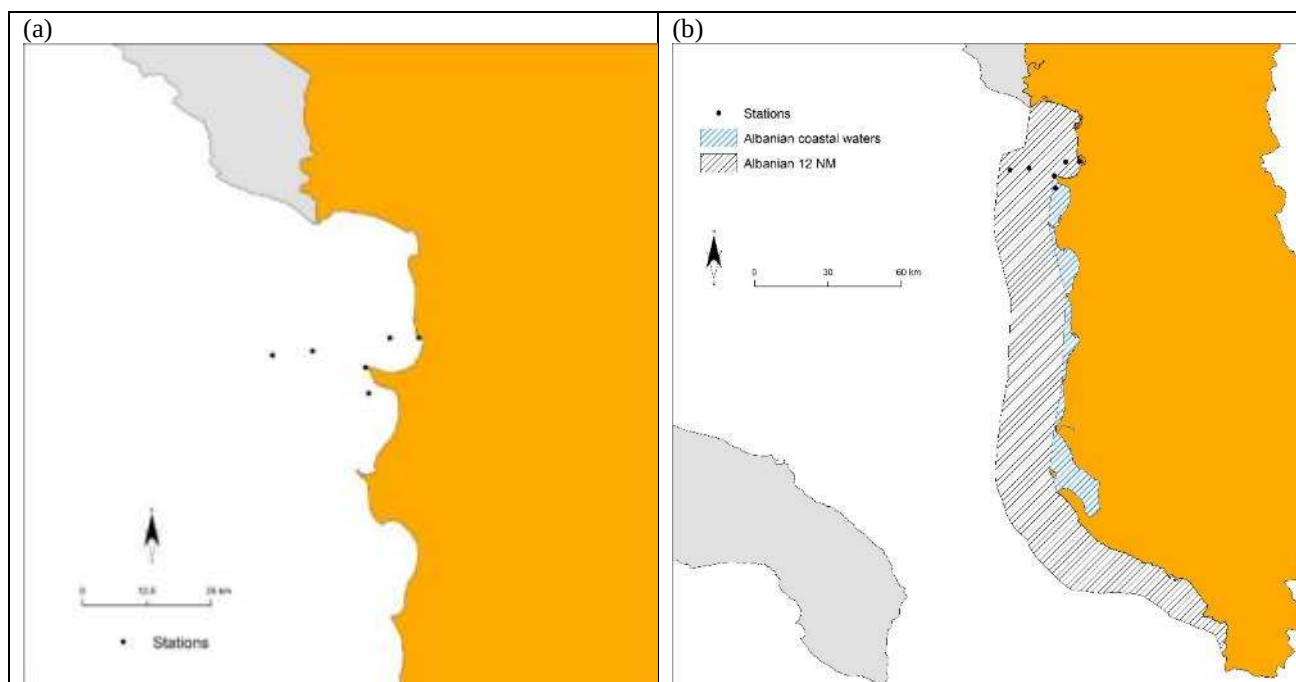
Figure 40. The network of monitoring stations of Montenegro, superimposed on the geospatial layer providing potential cumulative pressures from pollution sources in the marine waters of Montenegro (source: the GEF Adriatic Project).

Albania

IMAP Common Indicator 17

The monitoring units have not been defined in the National IMAP of Albania prepared in the framework of the GEF Adriatic Project. Within testing of NEAT application, the IMAP areas of assessment are proposed

considering distribution of 6 monitoring stations only as they were defined in the National IMAP within the GEF Adriatic Project. Therefore, the only one area of monitoring is recognized between the river Buna/Bojana flows into the Adriatic Sea and the cape of Rodon. This area of monitoring was also considered as the area of assessment. The main data inputs were spatial data from the MEDCIS project. Since these data do not cover the north marine area, between the river Buna/Bojana flows into the Adriatic Sea and the cape of Rodon, improvement of the spatial data was undertaken in order to set the area of assessment. For the current work, the available monitoring stations are at the north part, in proximity the border with Montenegro. Two IMAP assessment zones have been set, i.e., the coastal waters AL-1 and the offshore waters AL-12. The correctness of the spatial coverage of the zones based on the straight baseline and the 1 nautical mile, and 12 nautical miles offshore waters was checked against relevant national legislation⁸. No further split into finer areas of assessment was made; however, when new monitoring stations will be established, further work will be needed to tune and further define the areas of assessment, both in the small area tested for NEAT application and in the entire marine waters of Albania (Figure 41).



⁸ Decree No. 4650 of March 9, 1970, of the Borders of the People's Republic of Albania; ANNEX, Decree on a Modification to Decree No. 4650, dated 9 March 1970, on the State Border of the People's Socialist Republic of Albania, 1990

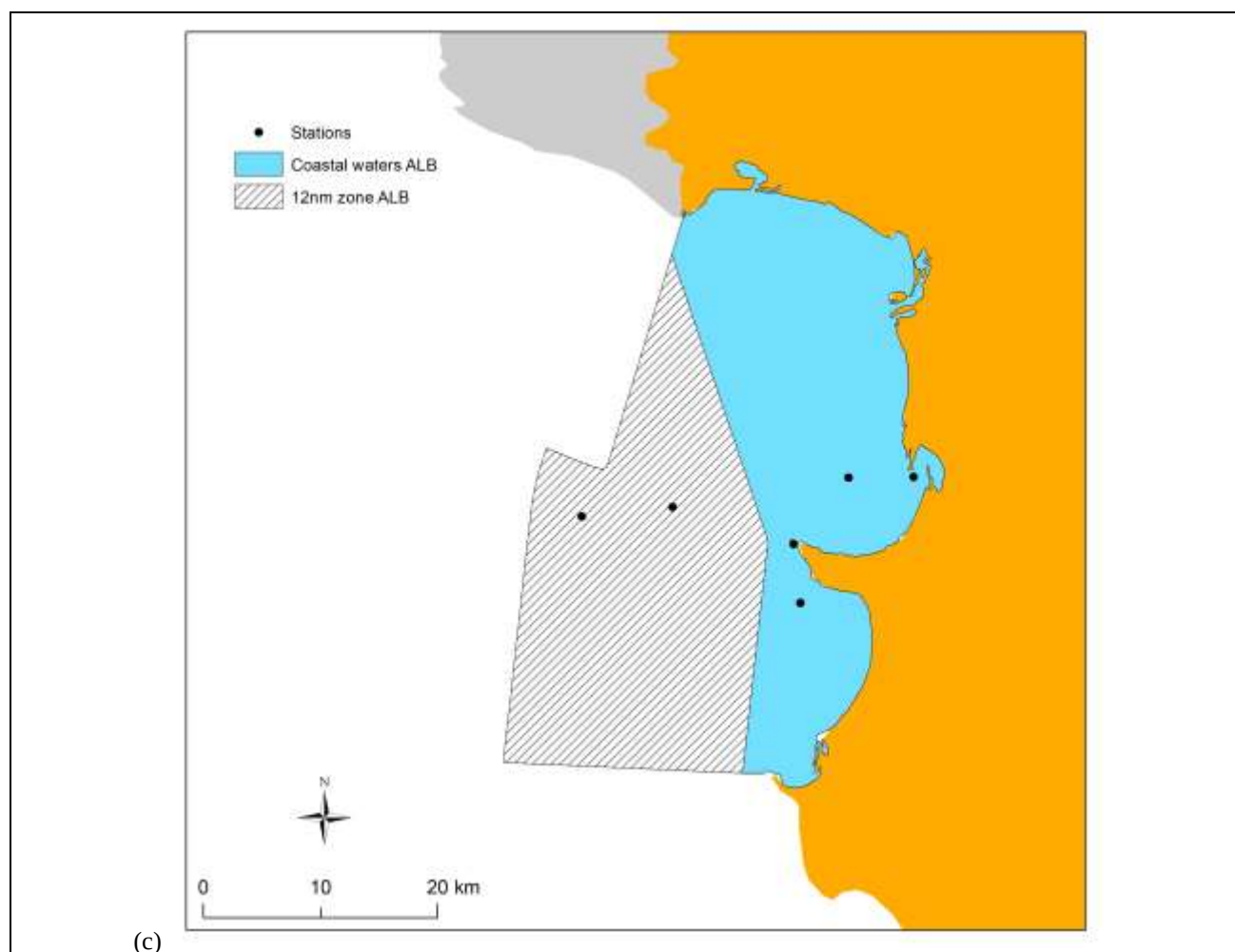


Figure 42. (a) The distribution of the monitoring stations for IMAP CI 17 in the northern part of the marine waters of Albania. The coordinates of the monitoring stations are as defined in the National IMAP within GEF Adriatic Project. (b) The coastal and offshore zones as provided by the MEDCIS project and checked against relevant national legal acts. (c) The IMAP areas of assessment (IMAP SAUs) of Albania, proposed within present NEAT testing in the Adriatic Sea. The resulting IMAP SAUs for Albania are coastal AL-1 and offshore AL-12.

IMAP Common Indicators 13 & 14

In the view lack of the availability of monitoring stations for the CI 13 and 14 in the IMAP Info System for Albania, no NEAT assessment of CIs 13 and 14 was possible now. However, the same SAUs as set for CI 17 can be used for the NEAT assessment of CIs 13 and 14, when monitoring data will be available.

Greece

IMAP Common Indicator 17

One official MRU of Greece related to the MSFD implementation falls within the South part of the Adriatic (SAS) (MAD-EL-MS-AD) with one offshore monitoring station at a distance of 6 nm from the closest land. This MRU is detached from the Greek mainland, and the coast therein corresponds to areas with no pollution pressures. Therefore, it is considered as representative of offshore waters and considered as an IMAP SAU in the offshore zone.

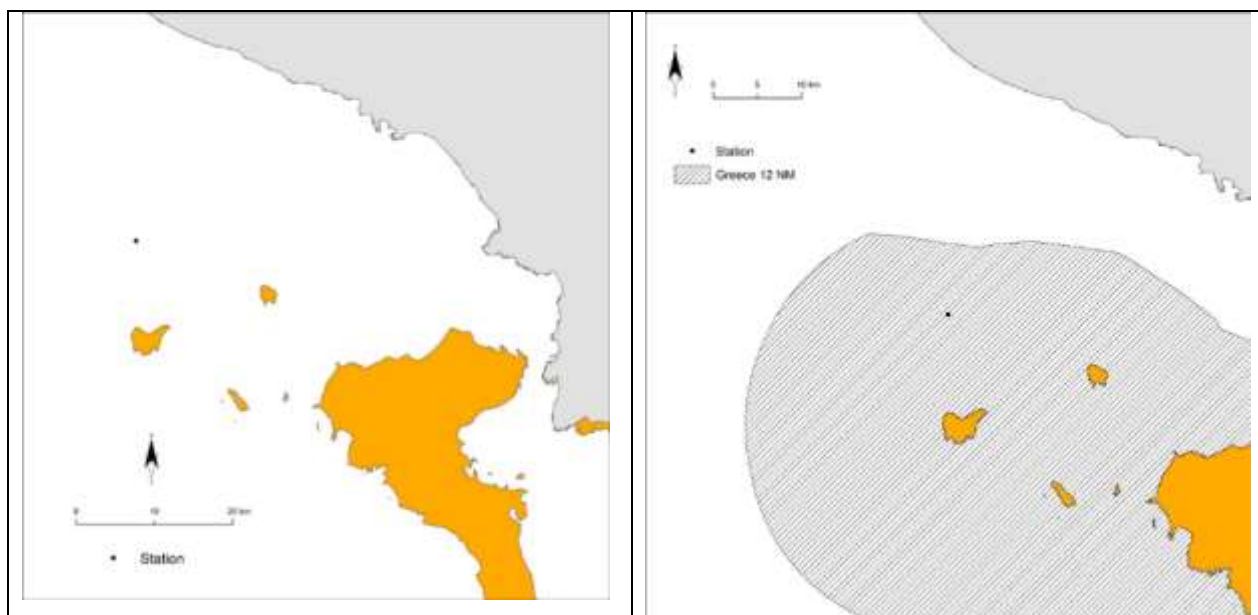


Figure 43. The distribution of the monitoring stations of Greece for IMAP CI 17. The coordinates of monitoring stations are from the Greek monitoring programmes for the MSFD implementation, Gov. Gazette No 3799/25-11-16.

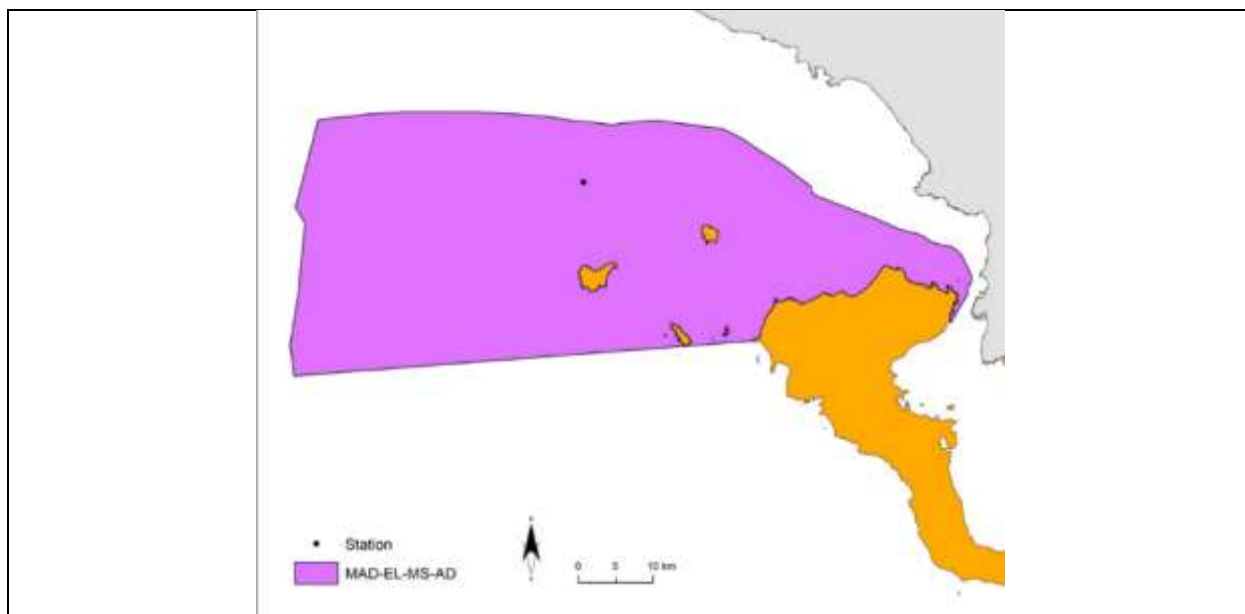


Figure 44. The Greek official MSFD MRU in the South part of the Adriatic Sea used as offshore IMAP SAU. The source of data for MRUs is the EIONET folder of Greece. The coordinates of monitoring stations are from the Greek monitoring programmes for the MSFD implementation, Gov. Gazette No 3799/25-11-16.

IMAP Common Indicators 13 & 14

In the view of the lack of data on monitoring stations for CI 13 and 14 reported in IMAP Info System for Greece, no assessment was possible now. However, the same SAUa as set for CI 17 can be used for the NEAT assessment of CIs 13 and 14, when monitoring stations and suitable data will be available.

6. The nesting approach for SAUs in the Adriatic Sea

IMAP Common Indicator 17

After setting of the finest IMAP areas of assessment, their nesting within three sub-divisions of the Adriatic Sea sub-region was undertaken. As it is explained above in chapter 2, the approach followed for the nesting of the areas is 4 levels nesting scheme (1 - being the finest level, 4 - the highest):

- 1st level provided nesting of all national IMAP SAUs & subSAUs within the two key IMAP assessment zones per country i.e., coastal and offshore zone;
- 2nd level provided nesting of the assessment areas set in IMAP assessment zones i.e., the coastal and offshore zones, on the subdivision level i.e., i) NAS coastal (NAS-1), NAS offshore (NAS-12); ii) CAS coastal (CAS-1), CAS offshore (CAS-12); iii) SAS coastal (SAS-1), SAS offshore (SAS-12);
- 3rd level provided nesting of the areas of assessment within the 3 subdivisions (NAS, CAS, SAS);
- 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub-region.

The following maps show the nested approach per sub-divisions of the Adriatic Sea Sub-region. For each sub-division, the IMAP SAUs of every country have been selected and showed in Figures 45, 46 and 47.

Furthermore, the maps provided in the figures 48, 49 and 50 depict the integrated NEAT value for each SAU (i.e., aggregated value for all contaminants as provided in the 4th column of Table 11 in UNEP/MED WG. 533/Inf.4/Rev.1). In the North Adriatic Sea (Figure 30), Italy has 1 offshore SAU and 3 coastal SAUs, Slovenia has 1 offshore SAU and 1 coastal SAU and Croatia has 2 offshore SAUs and 16 coastal SAUs.

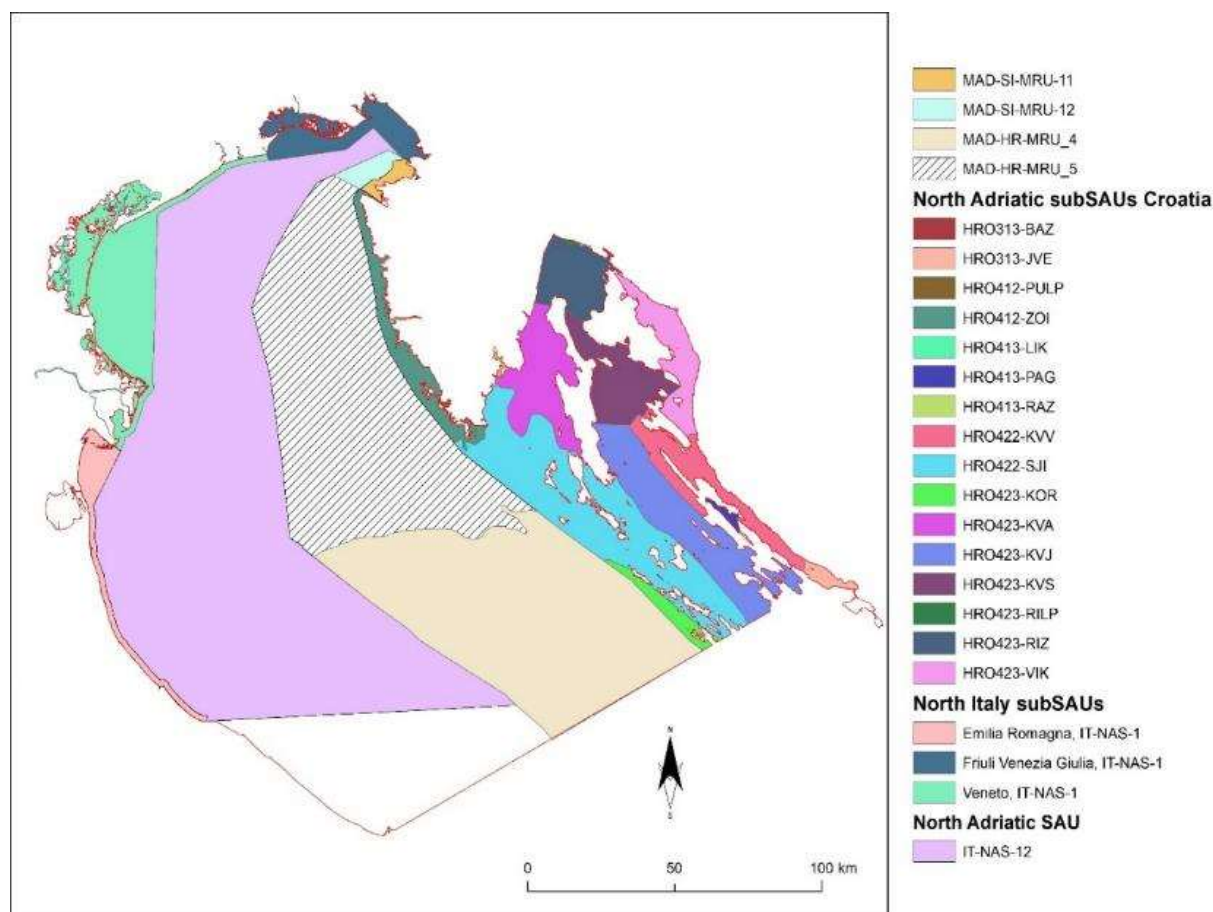


Figure 45. The nesting approach of the IMAP SAUs in the North Adriatic Sea based on spatial assessment units defined for testing of NEAT application in the Adriatic Sea Sub-region.

In the Central Adriatic Sea (Figure 46), Italy has 1 offshore SAU and 4 coastal SAUs, Croatia has 1 offshore SAU, and 12 coastal SAUs and Bosnia and Herzegovina has one coastal SAU. In Italy the offshore SAU of the Central Adriatic Sea has a different shape. Namely, Italy defined a shape for its Central Adriatic Sea MRU based on own delineation, as explained above in chapter 5 in section related to Italy. Therefore, data from monitoring stations of Italy falling into the NAS are aggregated under CAS.

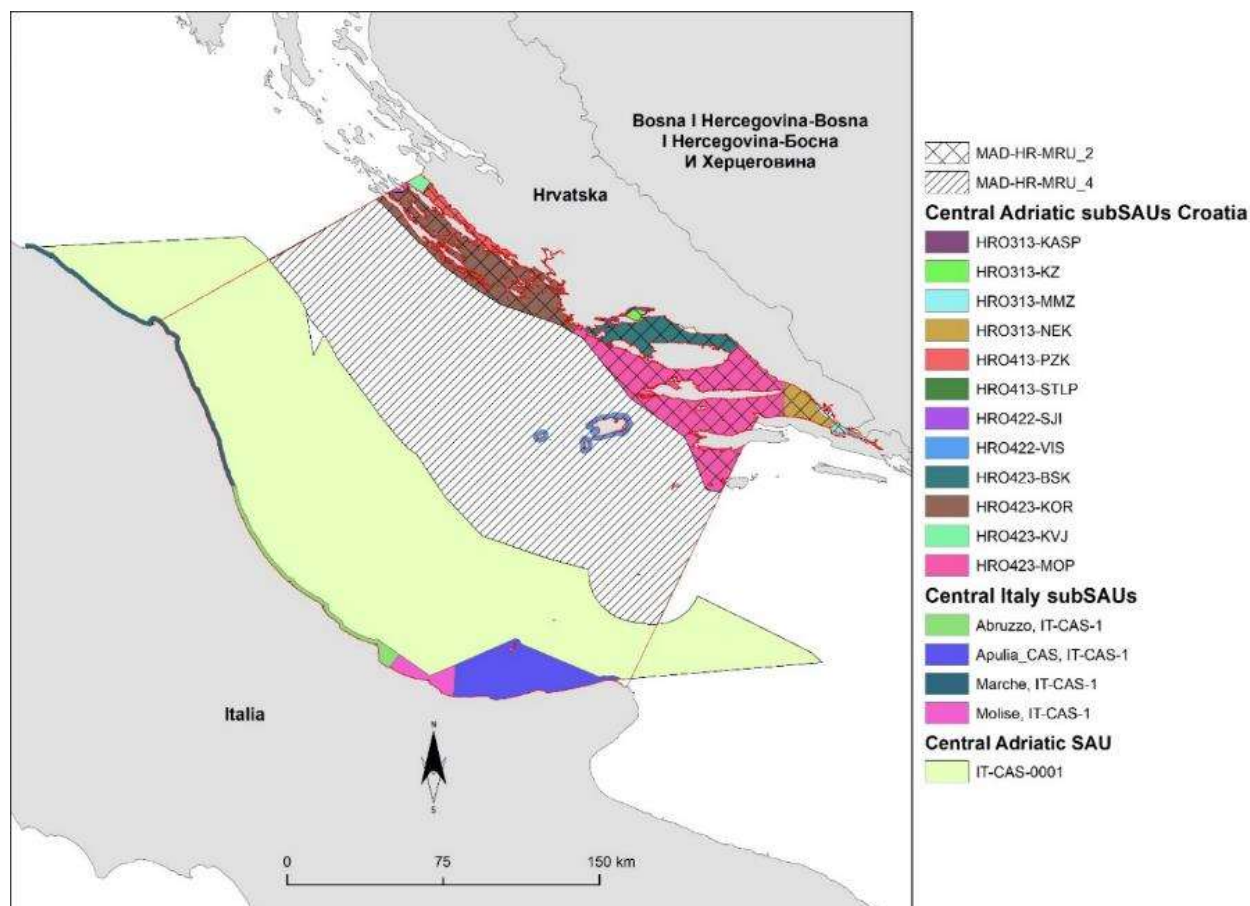


Figure 46. The nesting approach of the SAUs in the Central Adriatic Sea based on the spatial assessment units defined within testing of NEAT application in the Adriatic Sea Sub-region.

In the South Adriatic Sea (Figure 47), Italy has 1 offshore SAU and 1 coastal SAU, Croatia has 1 offshore SAU and 2 coastal SAUs, Montenegro has 3 offshore SAUs and 4 coastal SAUs, Albania has 1 offshore SAU and 1 coastal SAU and Greece 1 offshore SAU.

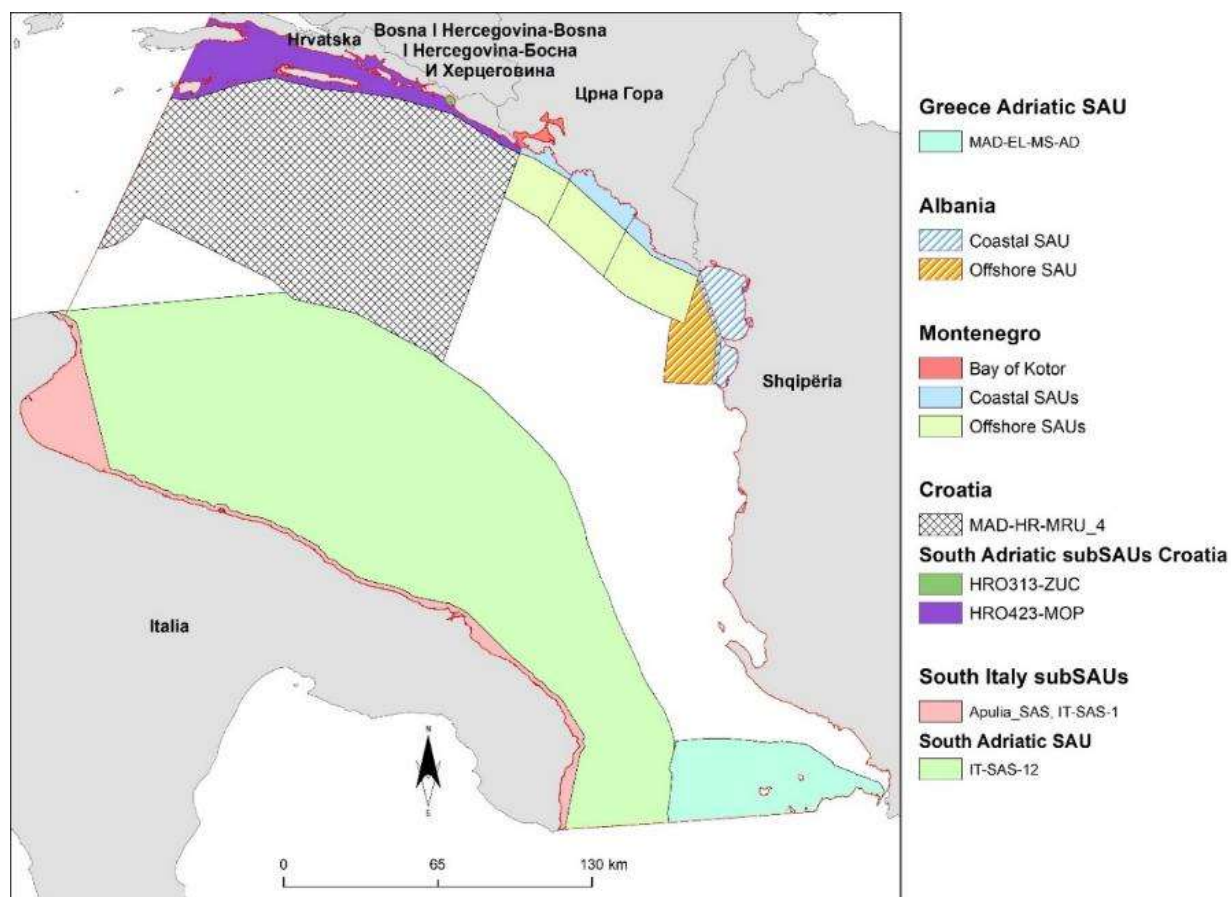


Figure 47. The nesting approach of the IMAP SAUs in the South Adriatic Sea based on the spatial assessment units defined within testing of NEAT in the Adriatic Sea Sub-region.

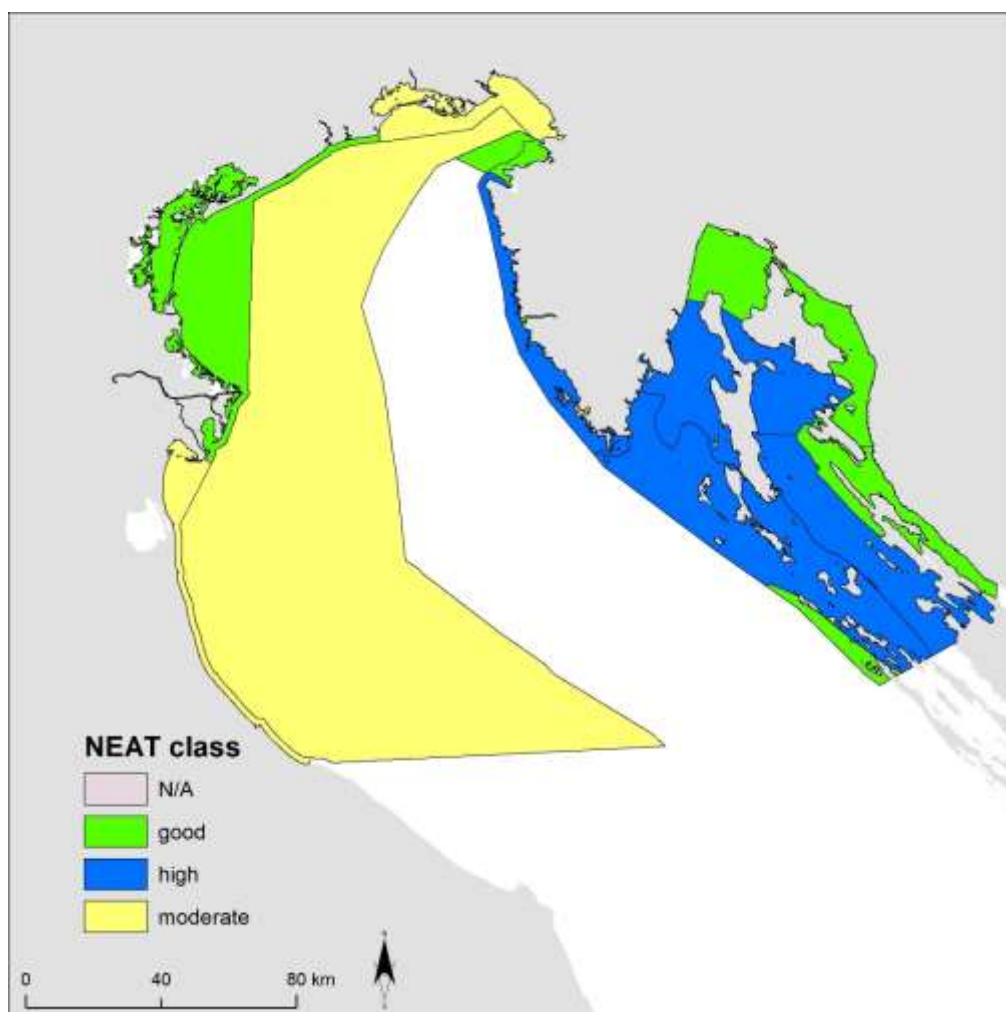


Figure 48. The NEAT application results of the IMAP SAUs in the North Adriatic Sea based on the spatial assessment units defined within testing of NEAT in Adriatic Sea Sub-region.

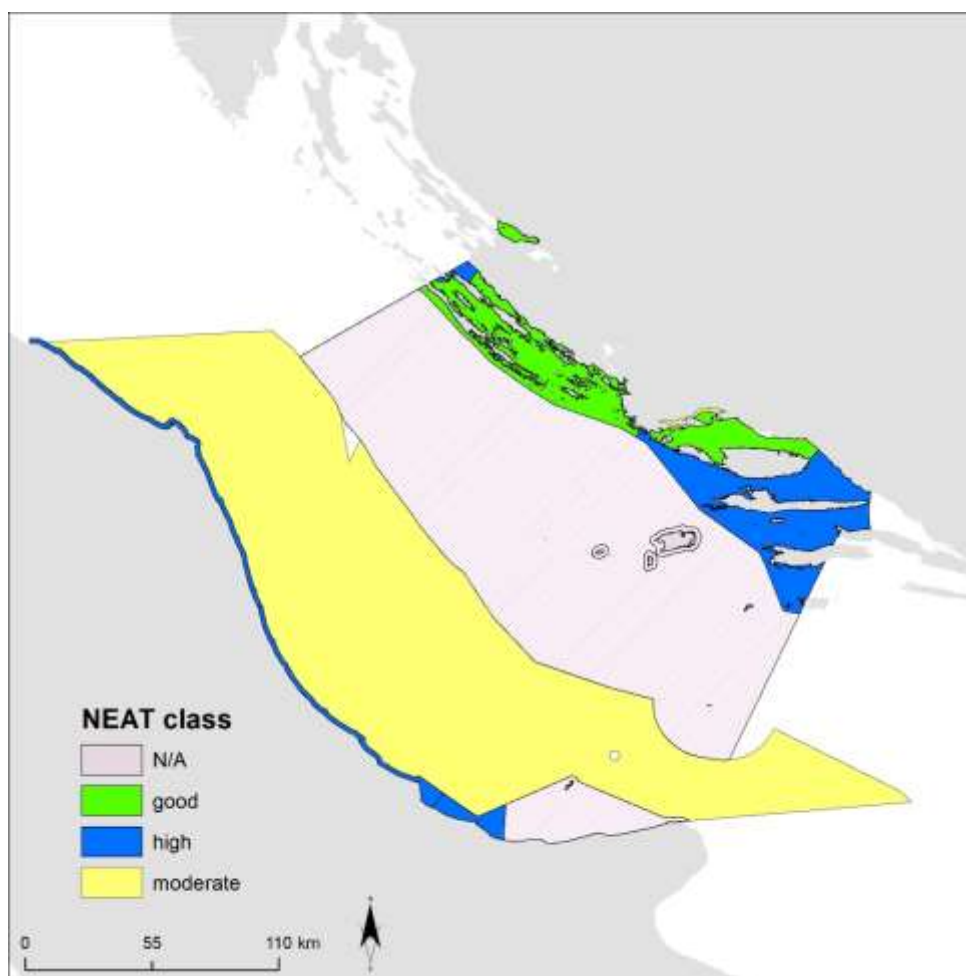


Figure 49. The NEAT application results of the IMAP SAUs in the Central Adriatic Sea based on the spatial assessment units defined within testing of NEAT in Adriatic Sea Sub-region.

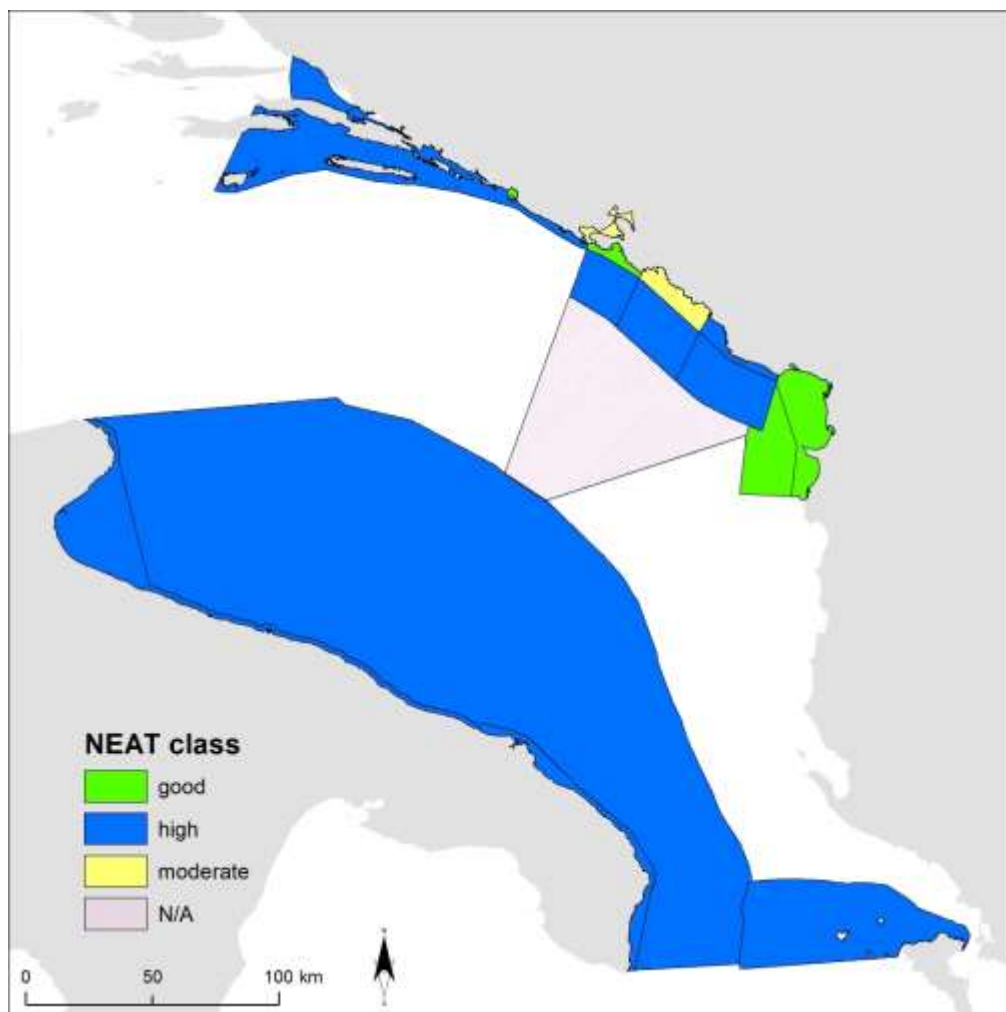


Figure 50. The NEAT application results of the IMAP SAUs in the South Adriatic Sea based on the spatial assessment units defined within testing of NEAT in Adriatic Sea Sub-region.

The below Table 1 provides consolidated spatial information shown in the maps (Figures 45-47) for further use.

Table 1. The spatial assessment units (SAUs) for the Adriatic Sea Subregion and their respective surface area (km²) and number of monitoring stations located in the SAUs.

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP sub SAU	Area (km ²)	Total No stations	stations / area
North Adriatic (NAS)				31856	84	0.003
	NAS coastal			9069		
		MAD-HR-MRU_3		6422	19	0.003
			HRO3-0313-JVE	73	1	0.014
			HRO-O313-BAZ	4	1	0.259
			HRO-O412-PULP	7	1	0.149
			HRO-O412-ZOI	473	3	0.006
			HRO-O413-LIK	7	1	0.150
			HRO-O413-PAG	30	1	0.033
			HRO-O413-RAZ	10	1	0.097
			HRO-O422-KVV	494	2	0.004
			HRO-O422-SJI	1923	2	0.001
			HRO-O423-KVA	686	1	0.001
			HRO-O423-KVJ	1089	1	0.001
			HRO-O423-KVS	577	1	0.002
			HRO-O423-RILP	6	1	0.178
			HRO-O423-RIZ	475	1	0.002
			HRO-O423-VIK	455	1	0.002
		IT-NAS-C		2592	27	0.010
			Emilia Romagna	371	6	0.016
			Friuli Venezia Giulia	575	4	0.007
			Veneto	1646	17	0.010
		MAD_SI_MRU_11		55	78	0.127
	NAS offshore			22788		
		IT-NAS-O		10540	23	0.002
		MAD_SI_MRU_12		129	81	0.062
Central Adriatic (CAS)				63696	60	0.001
	CAS coastal			9394		
		MAD-HR-MRU-2		7302	14	0.002
			HRO-0313-NEK	253	1	0.004
			HRO-O313-KASP	44	2	0.045
			HRO-O313-KZ	34	1	0.029
			HRO-O313-MMZ	55	1	0.018
			HRO-O413-PZK	196	2	0.010
			HRO-O413-STLP	1	1	1.580
			HRO-O423-BSK	613	2	0.003
			HRO-O423-KOR	1564	3	0.002
			HRO-O423-MOP	2480	1	0.000

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP sub SAU	Area (km ²)	Total No stations	stations / area
		IT-CAS-C		2092	20	0.010
		Abruzzo		282	8	0.028
		Marche		319	8	0.025
		Molise		229	2	0.009
		CAS offshore		54303		
		IT-CAS-O		22393	25	0.001
		MAD-HR-MRU_4		18963	1	0.000
				44231	78	0.002
		SAS coastal		7276		
		MAD-HR-MRU_2		4252	3	0.001
South Adriatic (SAS)		HRO313-ZUC		13	1	0.078
		HRO423-MOP		1756	2	0.001
		IT-SAS-C (Apulia)		1810	8	0.004
		MNE-1		483	45	0.093
		MNE-1-N		86	5	0.098
		MNE-1-C		246	12	0.049
		MNE-1-S		151	7	0.046
		MNE-Kotor		85	21	0.247
		AL-C		646	4	0.006
		SAS offshore		36955		
		IT-SAS-O		22715	5	0.000
		MNE-O		2076	14	0.007
		MNE-12-N		513	4	0.008
		MNE-12-C		713	4	0.006
		MNE-12-S		849	7	0.008
		AL-O		716	2	0.003
		MAD-EL-MS-AD		2253	1	0.0004

IMAP Common Indicators 13 & 14

After setting of the finest IMAP areas of assessment, their nesting within three sub-divisions of the Adriatic Sea sub-region was undertaken. As it is explained above in chapter 2, the approach followed for the nesting of the areas of monitoring for CIs 13 & 14 is the same as one applied for IMAP CI 17, i.e. it is 4 levels nesting scheme (1 - being the finest level, 4 - the highest):

- 1st level provided nesting of all national IMAP SAUs & subSAUs within the two key IMAP assessment zones per country i.e., coastal and offshore zone;
- 2nd level provided nesting of the assessment areas set in IMAP assessment zones i.e., the coastal and offshore zones, on the subdivision level i.e., i) NAS coastal (NAS-1), NAS offshore (NAS-12); ii) CAS coastal (CAS-1), CAS offshore (CAS-12); iii) SAS coastal (SAS-1), SAS offshore (SAS-12);
- 3rd level provided nesting of the areas of assessment within the 3 subdivisions (NAS, CAS, SAS);
- 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub-region.

The following maps show the nested approach per sub-divisions of the Adriatic Sea Sub-region. For each sub-division, the IMAP SAUs for IMAP CIs 13 and 14 of every country have been selected and showed in Figures

51, 52 and 53. It must be noted that IMAP SAUs for CIs 13 and 14 are identical to those set for IMAP CI 17, with exception of SAUs for Italy, Croatia and Montenegro since these were adjusted to specifics related to water typology, as explained above in Section 5. Furthermore, the maps provided in the figures 54, 55 and 56 depict the integrated NEAT value for IMAP CIs 13 & 14 for each SAU (i.e. aggregated value for all chla and nutrients as provided in the 4th column of Table 11 in UNEP/MED WG. 556/Inf.3).

In the North Adriatic Sea (Figure 51), for CIs 13 and 14, Italy has 5 offshore SAU and 16 coastal SAUs, Slovenia has 1 offshore SAU and 1 coastal SAU and Croatia has 2 offshore SAUs and 18 coastal SAUs.

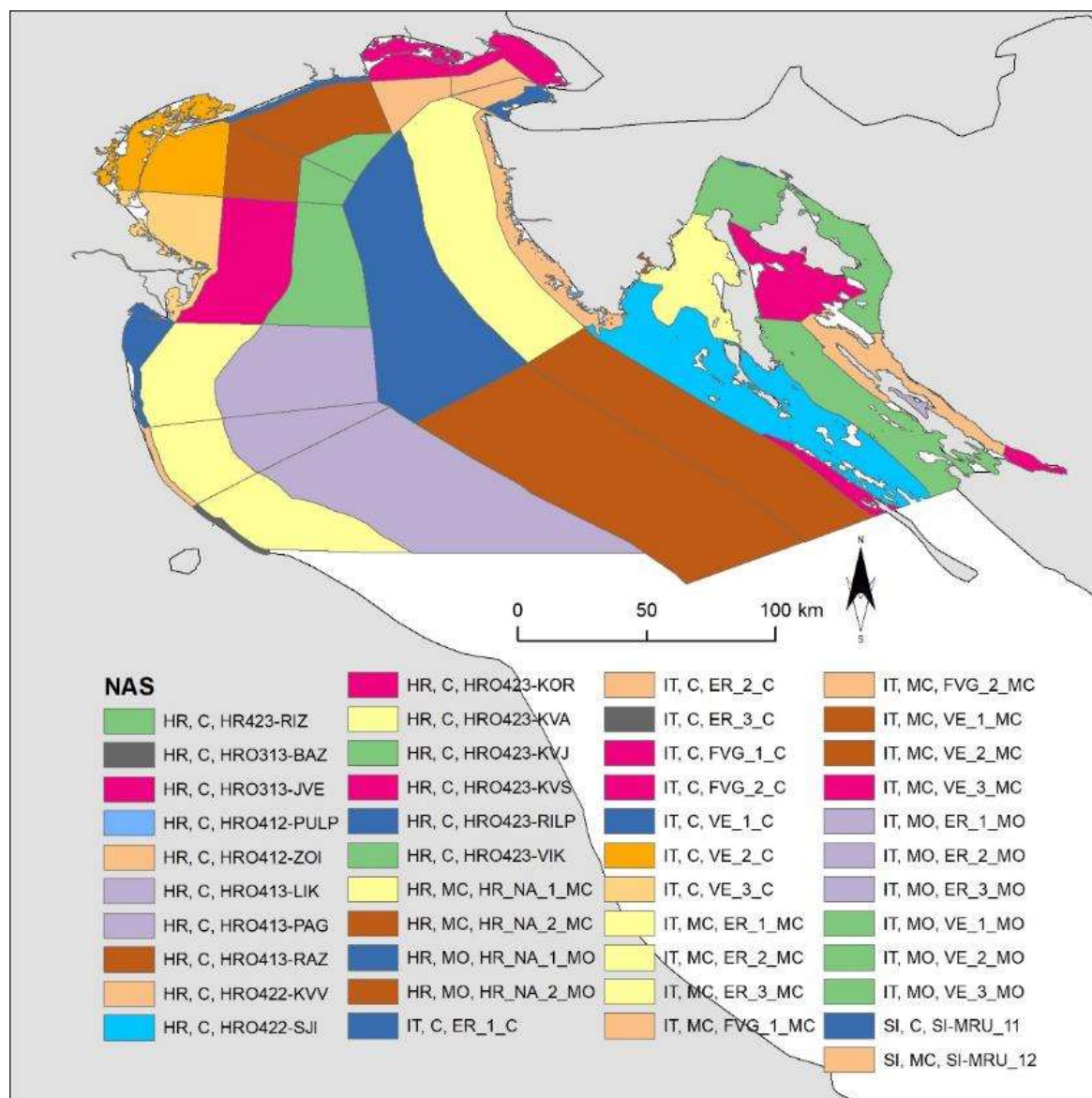


Figure 51. The nesting of the IMAP SAUs set for IMAP CIs 13&14 in the North Adriatic Sea. In the Central Adriatic Sea (CAS) (Figure 53), Italy has 1 offshore SAU and 4 coastal SAUs, Croatia has 1 offshore SAU, and 12 coastal SAUs⁹. In Italy the offshore SAU of the Central Adriatic Sea has a different shape defined by its official Central Adriatic Sea MRU as explained above in Section 5 related to Italy (amended for the purposed of CIs 13 and 14). Therefore, data from monitoring stations of Italy falling into the NAS are aggregated under CAS.

⁹ In Central Adriatic Sea (CAS), Bosnia and Herzegovina has 1 coastal SAU

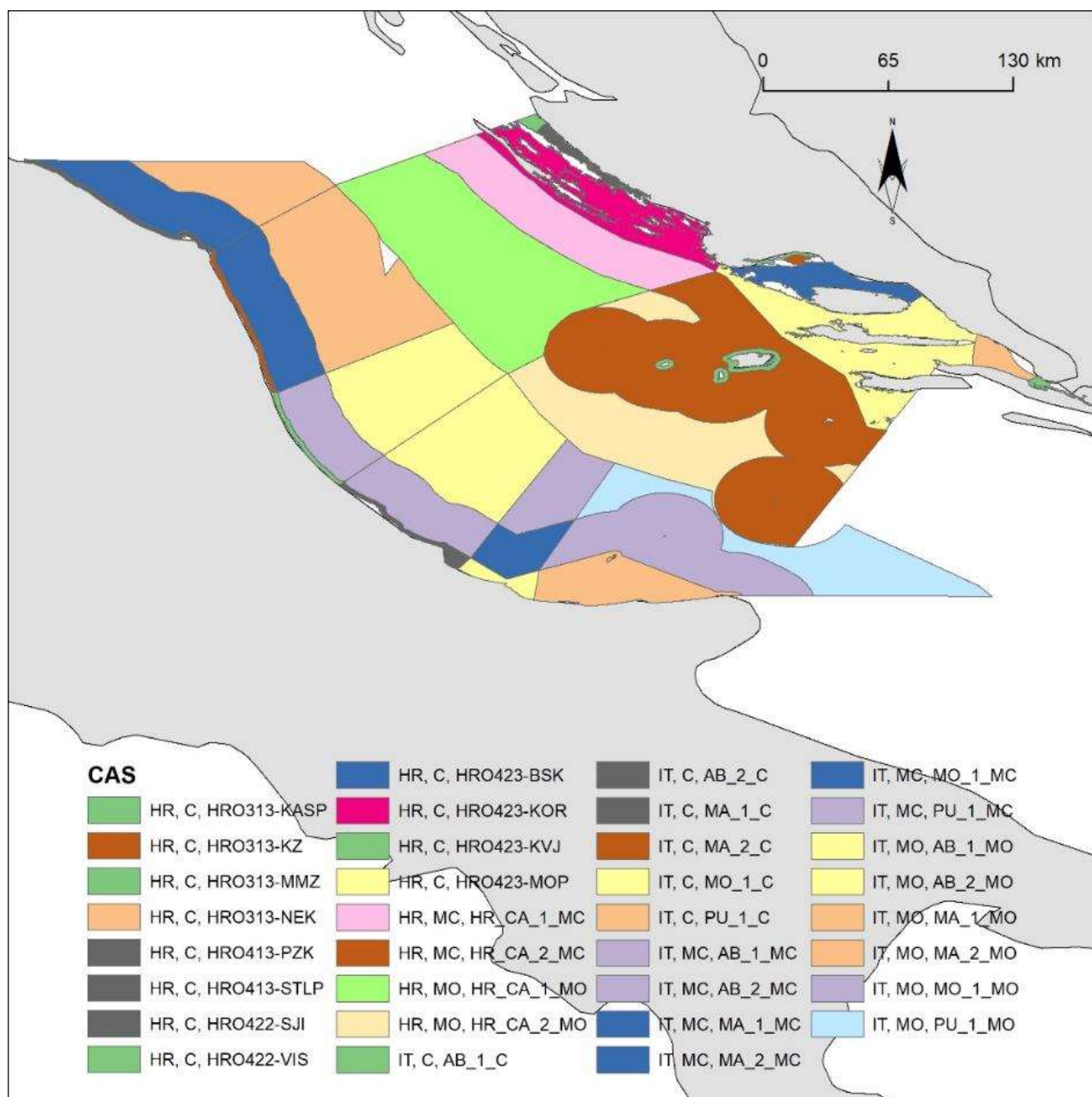


Figure 52. The nesting of the IMAP SAUs in Central Adriatic Sea.

In the South Adriatic Sea (SAS; Figure 53), Italy has 9 offshore SAU and 3 coastal SAU, Croatia has 2 offshore SAU and 2 coastal SAUs, Montenegro 4 offshore SAUs and 4 coastal SAUs, Albania has 1 offshore SAU and 1 coastal SAU and Greece 1 offshore SAU in absence of coastal stations.

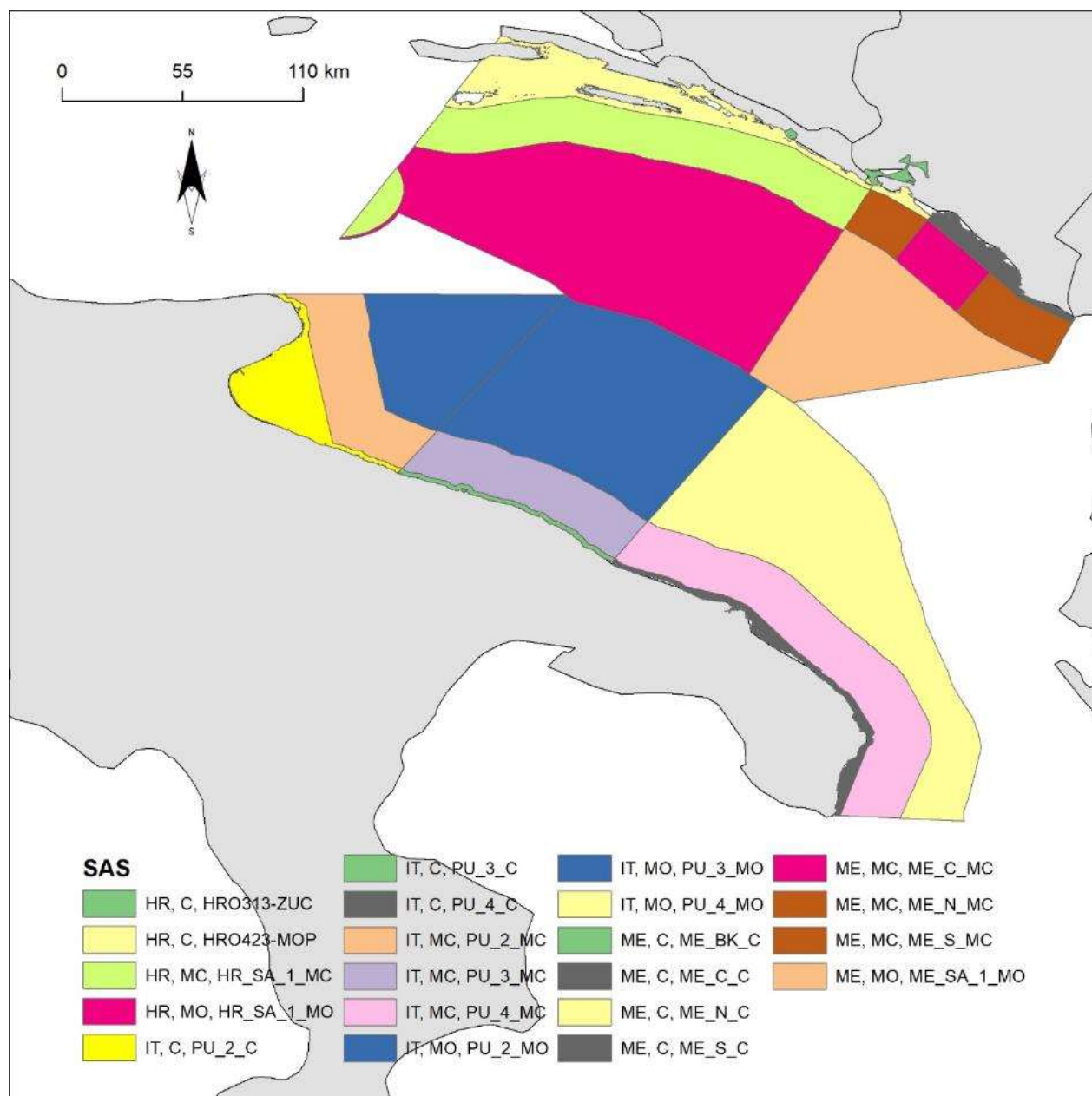
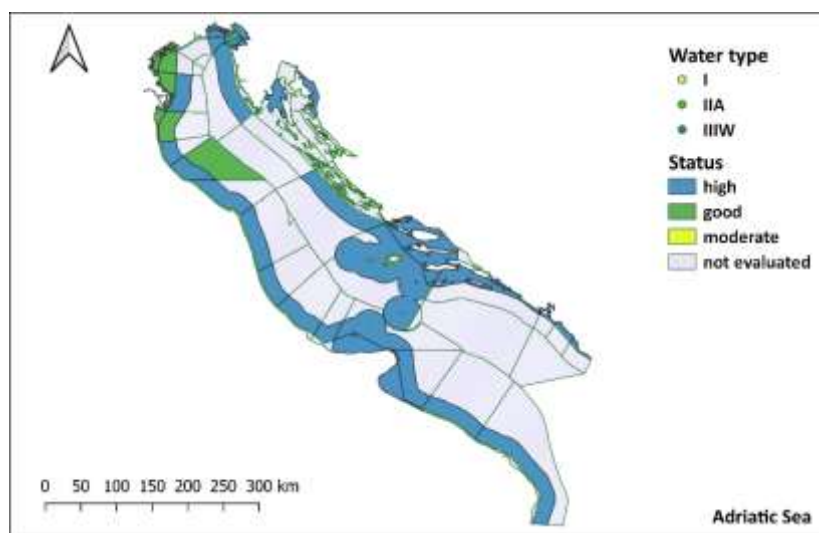
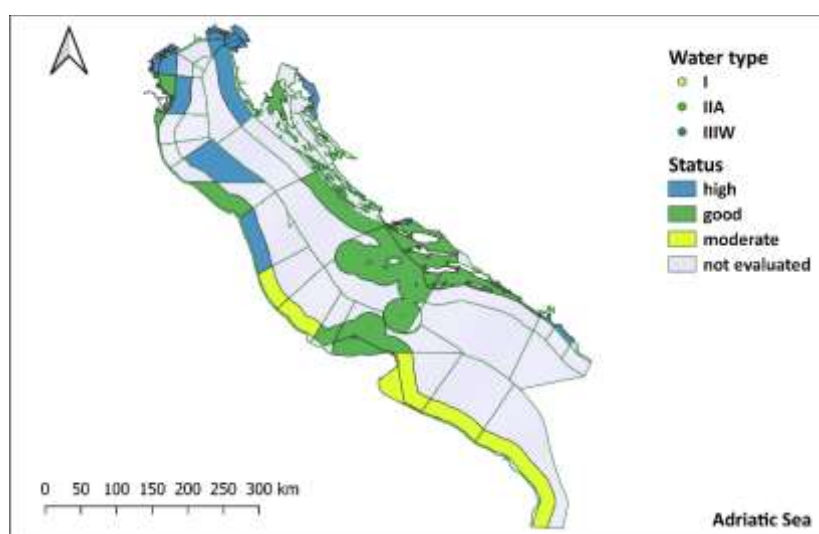


Figure 53. The nesting of the IMAP SAUs in South Adriatic Sea based on the spatial assessment units defined within testing of NEAT in Adriatic Sea.

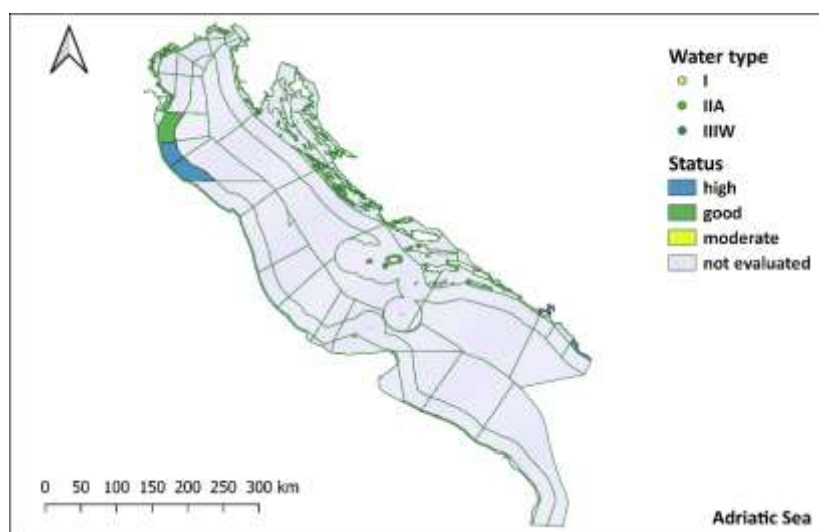
The results of the assessment findings provided per TP, DIN and chlorophyll a, as presented in UNEP/MED WG. 556/Inf 3 are shown by the respective colour in the maps included in the following Figures 33-36. The maps depict the integrated NEAT value for each SAU i.e. aggregated NEAT value for the three parameters assessed i.e. TP, DIN and chlorophyll a, as provided in Table 8.



Chl *a*



TP



DIN

Figure 33: The NEAT assessment results for IMAP CI13 (TP, DIN) and CI14 (Chl *a*), in the Adriatic Sea. Blank area corresponds to non-assessed subSAUs.

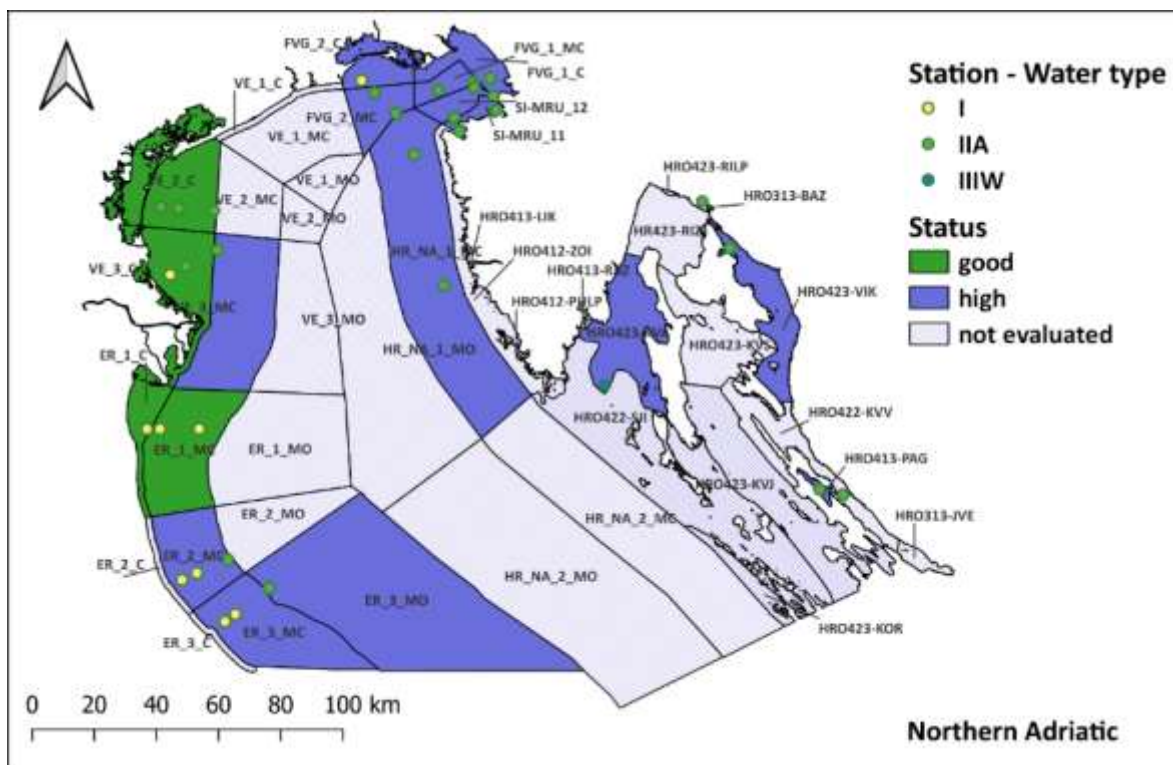


Figure 34: The NEAT assessment results for IMAP CIs 13 and 14 in the North Adriatic Sea. All IMAP SAUs are in GES characterized by High or Good status. Blank area corresponds to not evaluated subSAUs.

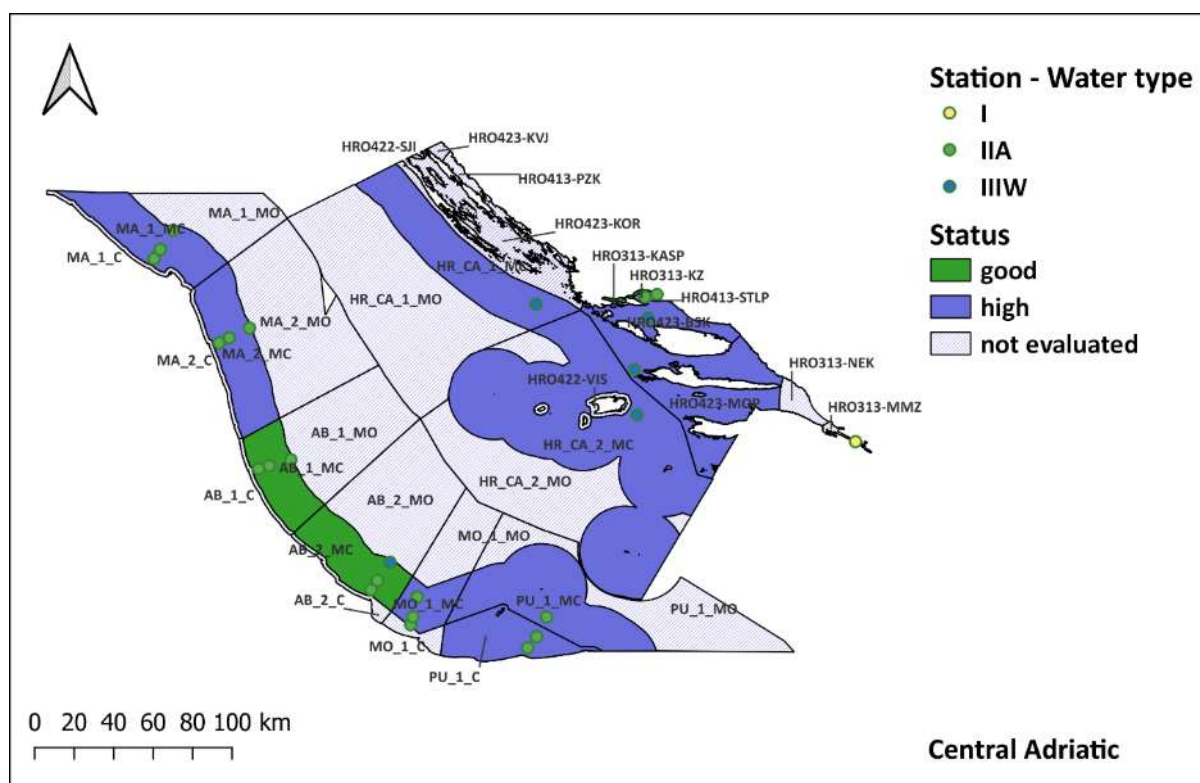


Figure 35: The NEAT assessment results for IMAP CIs 13 and 14 in the Central Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status.

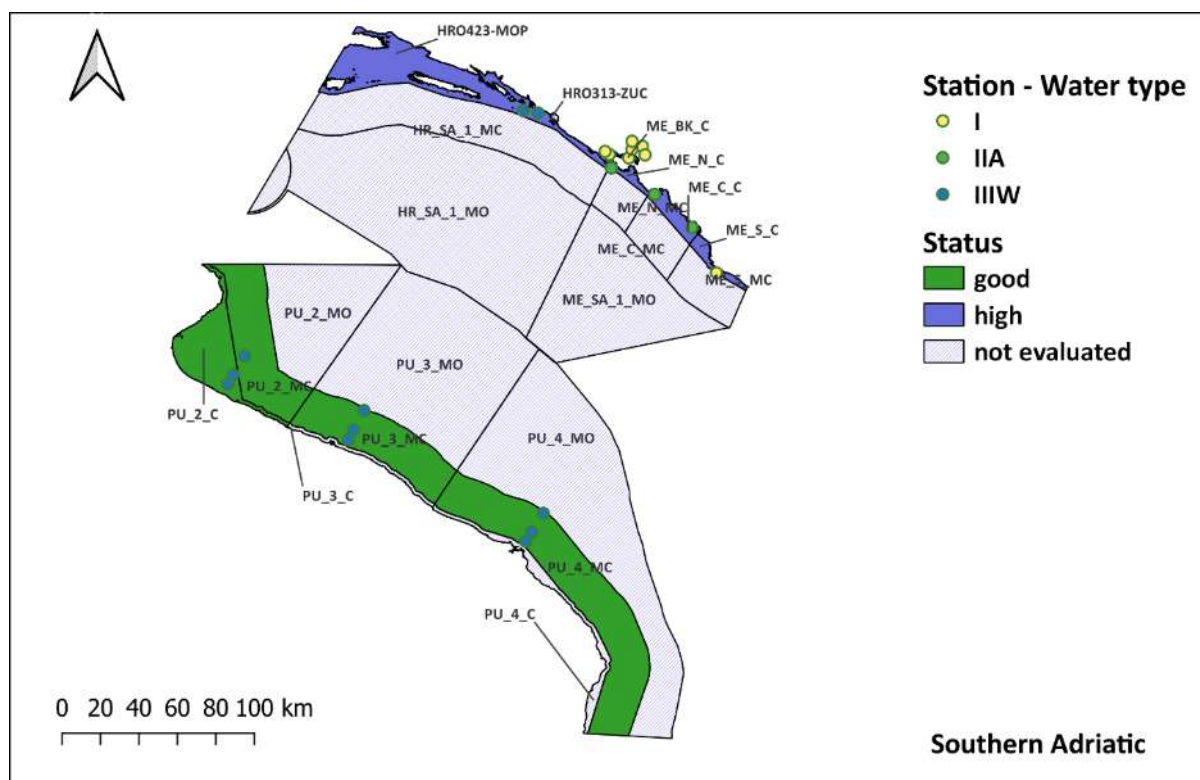


Figure 36: The NEAT assessment results for IMAP CIs 13 and 14 in the South Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status. Blank area corresponds to no available data.

7. Geospatial data

CI 17

For the setting of the areas of assessment, the source geospatial data were collated and used as explained above. These geospatial data have been collated along with the geospatial layers of the areas of assessment to support application of NEAT tool for generation of the GES assessment findings (UNEP/MED WG.533/10, Appendix III; UNEP/MED WG. 533/Inf.4/Rev.1). The data are in the EPSG:3035, ETRS89 / ETRS-LAEA, a single coordinate reference system (CRS) for the entire Europe which is used for statistical mapping at all scales and other purposes where true area representation is required.

The maps are organized into the following four geospatial datasets:

1. **Dataset A:** This folder contains one folder for each of the countries of the Adriatic Sea Sub-region: Albania, Bosnia & Herzegovina, Croatia, Greece, Italy, Montenegro and Slovenia. Every folder is composed of another two identical sub-folders:
 - Distribution of monitoring stations visualized in the shapefile format prepared in line with the coordinates that have been reported in the IMAP IS for each country;
 - Distribution of monitoring stations visualized in the high quality of JPEG image format (300 dpi image resolution); this JPEG format is designed to support use of shapefile format for NEAT tool application in order to ensure preparation of the GES assessment findings (UNEP/MED WG.556/Inf.6/Rev.1).

The data are available from the link: [Final Dataset A](#)

2. **Datasets B:** This folder contains data for each country organized in the two sub-folders:
 - The sub-folder containing the finest areas of assessment for each country in shapefile format, as elaborated in this document;
 - The sub-folder containing the shapefile and JPEG image format (300 dpi image resolution) of the finest areas of assessment prepared for each country to support use of shapefile format for NEAT tool application in order to ensure preparation of the GES assessment findings (UNEP/MED WG.556/Inf.6/Rev.1);

- The sub-folder containing the geospatial data that have been used as the source for setting of the spatial assessment units.

The data are available from the link: [Final Dataset B](#)

3. **Dataset C:** This folder contains in shapefile format and JPEG format (300 dpi image resolution) the maps of the spatial assessment units nested for NEAT application at the sub-division levels i.e. in the North, Central and South Adriatic. It also includes excel file containing information on the surface (km²) of SAUs/sub-SAUs and number of monitoring stations located in the SAUs

The data are available from the link: [Final Dataset C](#)

4. **Dataset D:** This folder contains in shapefile format and JPEG format (300 dpi image resolution) the maps of the integrated NEAT value for each SAU (i.e. aggregated value for all contaminants as provided in the 4th column of Table 11 in UNEP/MED WG.533/Inf.4/Rev.1), presented at the sub-division levels i.e. in the North, Central and South Adriatic.

The data are available from the link: [Final Dataset D](#)

CI 13 & 14

Common Indicators 13 & 14 datasets follow the same structure as of CI 17. Therefore, for each Dataset below, the relevant link with the data is provided.

1. **Dataset A:** The data are available from the link: [Dataset A](#)
2. **Dataset B:** The data are available from the link: [Dataset B](#)
3. **Dataset C:** The data are available from the link: [Dataset C](#)
4. **Dataset D:** The data are available from the link: [Dataset D](#)

The above geospatial datasets will serve as input in preparing the GIS catalog of the scales of monitoring and assessment for the IMAP Pollution Cluster.

Annex I

References

Albania: Decree No. 4650 of March 1970 and the Decree on a Modification to Decree No. 4650, dated 9 March 1970, on the State Border of the People's Socialist Republic of Albania, 1990

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Barić Punda, V., Filipović, V. 2015. Protocol on the interim regime along the southern border (2002) with special regard to the decisions of the governments of the Republic of Croatia and Montenegro on the exploration and exploitation of hydrocarbons in the Adriatic., PPP 54 (2015), 169, pp. 73–88.

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