



# THE PLACE AND ROLE OF THE CENTRE FOR ANALYSIS AND EVALUATION OF DATA FOR THE MINES WARFARE IN MAKING THE RECOGNIZED IMAGE IN THE MARITIME ENVIRONMENT

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**Abstract:** *The image of the recognized marine environment, RMEP "Recognized Marine Environmental Picture" is part of the Recognized Environmental Picture, REP, and it represents maps with data and information about the combat environment in the maritime area.*

*To achieve the required RMEP, the collecting, processing, analysis and integration of marine data (hydrographic and oceanographic data, survey data on coastal and port development area) and the identification of all submerged objects (wrecks, pipelines, mines etc.) are needed.*

*RMEP aims to increase the safety at sea in peacetime, crisis and war, as well as provide useful information about the physical field of battle in case of rapid intervention of NATO forces, NRF's Maritime Organization (NATO Response Force Maritime Organization); also RMEP information is essential for the structures that plan and execute mine counter combat actions MCM (Mine Counter Measures).*

**Keywords:** *recognized picture, maritime security, planning, mines warfare.*

The detailed description of the physical battle field needed to support military operations was described as the Recognized Environmental Picture (REP). As defined by NATO, REP is "a full and continuous description of the geospatial, meteorological and oceanographic information (GEOMETOC) for the planning and waging of the joint operations in a specific area at a specific time, and supporting unity of effort in the battlefield"<sup>1</sup>.

The concept REP was developed by NATO out of the need to support, with information about the combat environment, the NATO Response Forces (NRF) as their fast intervention, that *can be deployed within five days of notification*<sup>2</sup>, requires an available and updated data set in order to plan

and execute missions anywhere in the world in the area of responsibility of NATO. Although the concept of REP is mainly targeted at strategic and operational levels, it needs to be extended to all levels of command, including interoperability with the national forces at the tactical structures. Given the fact that to achieve REP is quite costly and the NATO responsibility area is quite large, the achievement of the recognized environmental picture for the area where the NRF act must be made by the State in support of which it intervenes. This "local REP" may include information from the local environment such as local weather forecasts, detailed information about buildings, port facilities or other facilities or obstacles that may affect the military actions.

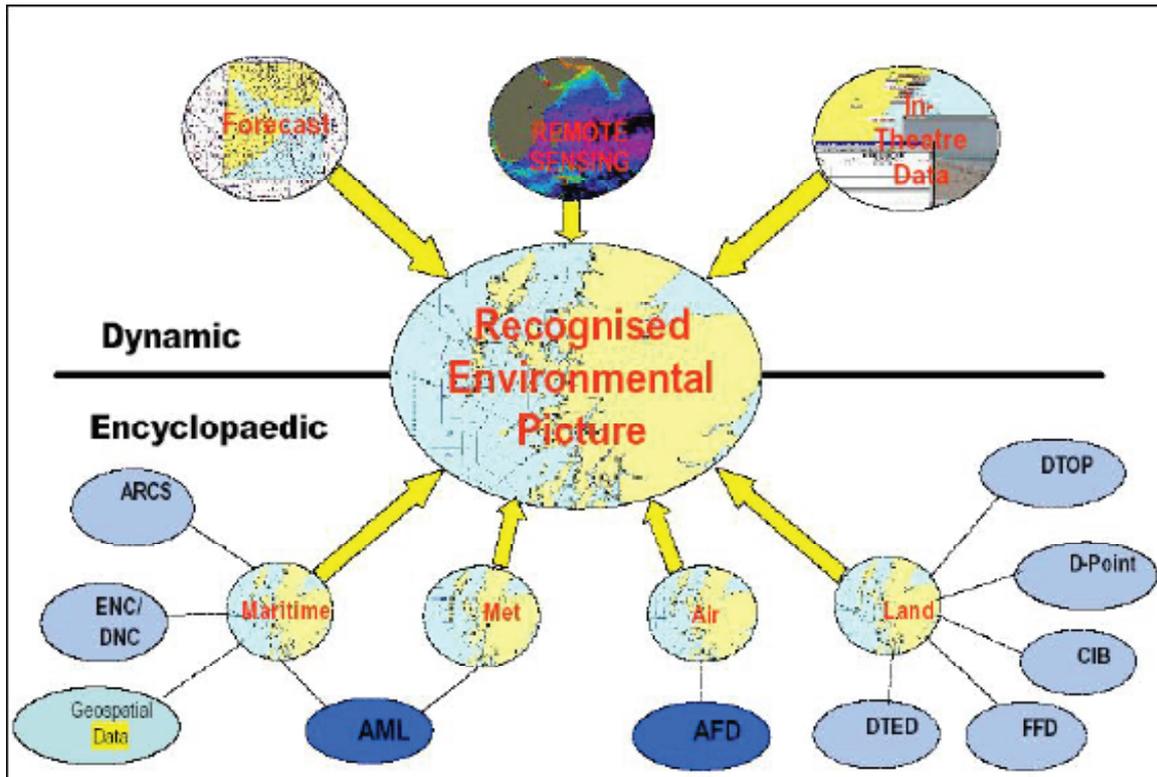
Based on these needs to achieve a local REP, to convey information in a particular area of interest, as it can be seen in Figure no. 1, the Romanian state must collect, store, process and analyze data from all backgrounds including the maritime area, called "the Recognized Marine Environmental Picture – RMEP".

<sup>1</sup> Marin ALNIȚEI, *Imaginea recunoscută a mediului în războiul viitorului*, "INFOSFERA", anul II, nr. 3, Bucharest, Trustul de Presă al Armatei, 2010, p. 47.

<sup>2</sup> *Ibidem*.

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**Figure no. 1** *Recognized Environmental Picture components (REP)*  
 Source: www.ukho.gov.uk, AML Handbook, UKHO, 2012, p. 21.



**Figure no. 2** *Establishing the maritime borders between Romania and Ukraine, the claims of the two countries and the border established by the International Court of Justice*

Source: [http://arhiva.euractiv.ro/uniunea-europeana/articles%7CdisplayArticle/articleID\\_16280/Curtea-Internationala-trage-o-linie-intre-pretentiile-romanesti-si-cele-ucrainene.html](http://arhiva.euractiv.ro/uniunea-europeana/articles%7CdisplayArticle/articleID_16280/Curtea-Internationala-trage-o-linie-intre-pretentiile-romanesti-si-cele-ucrainene.html), accessed on 05.08.2015/22.00

**The importance of achieving RMEP**

The achievement of RMEP has a strategic importance, being part of the local REP belonging to the Romanian state, and it contributes to regional security in the Black Sea, providing the information support describing the battlefield in the maritime area. If we analyze Romania's national security in the sense of the contemporary definition, we

will find out that out of the five dimensions of security (political, military, economic, social and environmental), achieving RMEP influences directly and essentially four of five dimensions, namely:

- Influence on **political dimension** the delimitation of maritime borders: in 2009 the maritime border between Romania and Ukraine



was established (see Figure no. 2) and currently negotiations are carried out to establish the maritime border between Romania and Bulgaria:

- influence on the **military dimension** the achievements of the navigational charts with complete information necessary for carrying out the battle;

- influence on the **economic dimension** providing a complete set of data about the ports facilities, the configuration of the coast and marine resources;

- influence on the **environmental dimension** in the Black Sea area - providing a set of data needed to ensure a safe navigations to avoid natural disasters and ensuring environmental data necessary for the intervention to reduce the negative effects of pollution.

In conclusion, we can affirm that RMEP essentially contributes to the achievement of the national security in the Black Sea, even with a strategic value by providing the information needed for the local REP NRF's intervention, but also with a major contribution to economic and trade benefits. It is difficult to quantify the economic and commercial benefits arising from a national hydrographic program, but several studies of the Member States of the *International Hydrographic Organization (IHO)* indicate that the cost / benefit ratio is at least 1:10 for the most nations dependent of maritime trade worldwide or for which the maritime trade is of prime concern<sup>3</sup>, given that the volume of maritime trade worldwide is growing and in the future, the sustainable development and the national use of sea areas will become a major concern of governments and maritime industry.

### Achieving RMEP

The US Navy Forces want dominate in the counter mine war and, to achieve this end, undertake this war very well documented, using RMEP information as planning tools. Therefore, they pay particular attention to the collection of meteorological and oceanographic parameters which are important for MC war operations, activities deployed by the Naval Oceanographic Office (NAVOCEANO) and forces running Mine Actions, "Mine Counter Measures" forces. The US

Navy put great emphasis on RMEP in decision-making in MC war operations, especially in the coast, where oceanographic parameters are of great complexity and greatly influence MCM operations. The data sets from NAVOCEANO, available in various mathematical models, help the control structures COMINEWARCOM, Mine Warfare Command in mine counter planning operations<sup>4</sup>.

Similarly the US, Romania created a specialized structure in MWDC "Mine Warfare Data Center" (Centre for the analysis and assessment of the mine-counter data) in the Directorate of the Maritime Basin of the Romanian Navy, which is capable of generating RMEP in the area of responsibility. The information collected from different sources, specialized forces within the Directorate of the Maritime Basin, the divers' Center, Division of mining-mine removal or private companies that have as the research domain hydrography and oceanography, reaches MWDC through communication systems, where they are processed, analyzed and finished products are generated about the marine environment; these finished products are necessary for the command structures in the mine-counter fight. This marine environmental information goes to specialized structures within Navy, where they are used in decisions taking process on planning mining and de-mining operations.

So we can define MWDC as the specialized structure of the Navy which aims to build a database with information about the marine environment and to achieve the local RMEP which is necessary for the national and allied forces in war operations planning, especially mining and de-mining.

In MWDC, through RMEP, it is performed for the first time the integration of different types of digital, environment information that was created for certain specialized fields into a single system. Given that information arises from various sources, there are some problems in integrating environmental information. They concern mainly data formats which are from different sources, of different generations and therefore the challenge is to find an integration platform to generate a consistent image in a single system, to which we can add other useful information, from other sources of information, so this RMEP be useful for a wide range of users.

<sup>3</sup> IHO Publication M2-National Maritime Polices and Hydrographic Service, versiunea 3.0.3 - march 2015, pp. 16-17.

<sup>4</sup> [http://www.nap.edu/openbook.php?record\\_id=9773&page=28](http://www.nap.edu/openbook.php?record_id=9773&page=28)

<p>SOURCES OF INFORMATION</p>	<p>MWDC - Analysis and assessment center for the fight against mines</p>			<p>MWC - Command mine warfare center</p>
<p>1. DATA AQUISITION</p>	<p>2. DATA PROCESSING</p>	<p>3. Layers Construction</p>	<p>4. RMEP Distribution</p>	
<ul style="list-style-type: none"> <li>• Topographies data acquisition from coastal zone</li> <li>• Port design</li> <li>• Hydrographic&amp;oceanographic data</li> <li>• underwater contact information</li> <li>• Historical information about mine</li> <li>• Sea mine data base</li> <li>• meteorology</li> <li>• Other information (about population s.o)</li> </ul>	<ul style="list-style-type: none"> <li>• Verifying the validity of information, eliminating redundant data</li> <li>• Checking positioning, correlating information from multiple sources</li> <li>• Linking data about each point that defines a point on the map</li> <li>• Identifying submerged objects</li> </ul>	<ul style="list-style-type: none"> <li>• Making maps in coastal areas, topographic data integration, port development;</li> <li>• Making sea maps, oceanographic, hydrographic data integration;</li> <li>• Making maps with submerged objects, large and small objects</li> <li>• Making RMEP and areas of operation</li> </ul>	<ul style="list-style-type: none"> <li>• Data transformation into final products that can be transmitted by means of communications and information</li> </ul>	<p style="text-align: center;"><b>REP INTEGRAL TO JOP</b></p>
<p>5. RMEP Reconstruction</p>				

Figure no. 3 Scheme for achieving RMEP information flow

So we can conclude that to achieve a RMEP there are two types of challenges:

- integration of a wide range of environmental information, of different types of formats;
- a diversity of ways in which environmental information should be recognized, viewed and understood.

The answer to these challenges is to achieve RMEP using the concept AML (Additional Military Layers). "AML is a unified product range

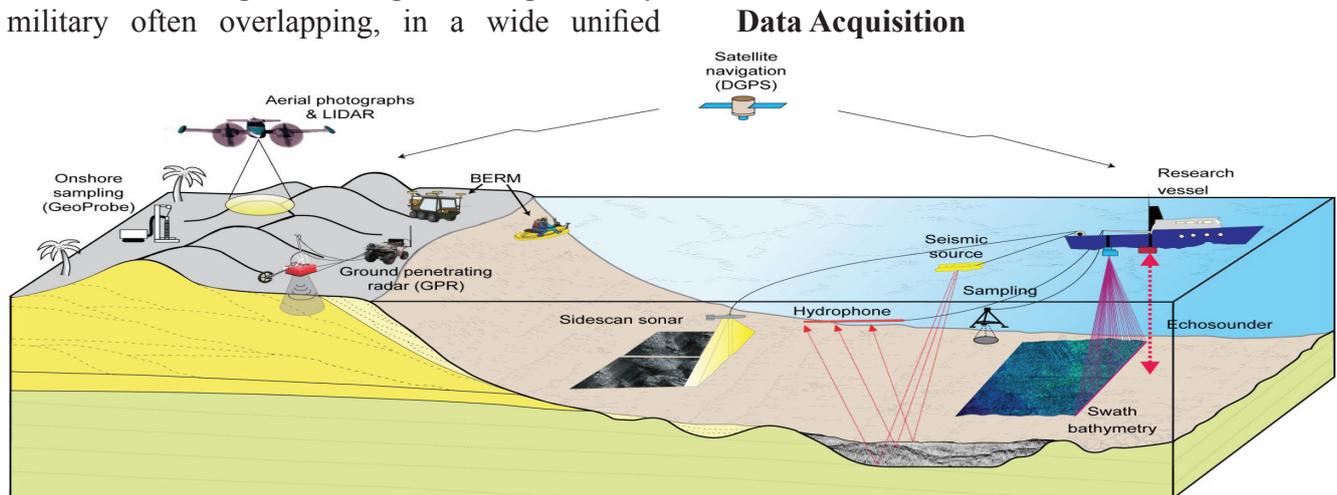
encompassing digital geospatial data to satisfy all the requirements for NATO non-military maritime navigation"<sup>5</sup>. This concept was developed by UK, early in the '90s as a support for ECDIS (Electronic Chart Display and Information System) military systems and in 1997, at the British

<sup>5</sup> Emil DOBRESCU, *Reprezentarea situațiilor tactice pe hărți electronice*, SMFN, Buletinul Forțelor Navale nr. 5/2006, p. 47.

Defense Ministry's proposal to NATO Geographic Conference, the project was continued as a NATO initiative, the ad hoc task group working on issues of hydrography (now called the Marine Geospatial Working Group).

This definition was developed starting from the AML objective, set at the same meeting, which is to "provide all the information that exists today in the form of maps or other products specifically military often overlapping, in a wide unified

MWDC occupies a central position between the sources of information gathering and recipients of information, MDWC structure being responsible for RMEP processing, construction and distribution, moreover, according to military requirements, MWDC structure being able to reshape RMEP products so that they can be useful in planning military action.



**Figure no. 4** Schematic diagram of the various techniques used for gathering data and information in order to achieve RMEP

**Source:** [http://pubs.usgs.gov/of/2008/1206/html/figs/fig2\\_1.html](http://pubs.usgs.gov/of/2008/1206/html/figs/fig2_1.html), accessed on 05.08.2015/18<sup>15</sup>

product that ensures the elimination of information replication“.

It can be noticed that NATO has continuous concerns to RMEP knowledge and, in the recent years, they have developed software that allows the processing of marine environmental information and they “stratified” it into maps with information relevant to military action.

To achieve RMEP as shown in Figure no. 3 we must go through five stages:

1. Data acquisition;
2. Data processing: verification, data processing and identifying underwater objects;
3. Construction of RMEP layers;
4. RMEP distribution RMEP to users, mainly the command center of the war with mine;
5. RMEP reconstruction according to special requirements for the planning and conduct of operations and its redistribution to users.

Analyzing Figure no. 3 “Scheme for achieving RMEP information flow”, we can see that for Romania’s area of responsibility at the Black Sea

To collect the data necessary to achieve RMEP a series of instruments of the highest technology and precision are necessary. These data and information, after being analyzed and integrated, can be used to produce and update maps, resulting in increased safety at sea and a sustainable marine environment protection, but also contribute to the development of other elements of economic and national infrastructure that can bring the already described benefits.

Analyzing the schematic diagram in Figure no. 4 we can say that to achieve a RMEP we need:

*a. An accurate positioning*

A very precise positioning system so that information of a point, from different sources or from different intervals of time, to be associated to that point. In the recent decades the ability to accurately position the data has grown enormously through the availability of satellite global positioning systems, particularly when using differential techniques (DGPSs) - Differential Global Positioning Systems.

*b. Gathering information from the sea*

First of all, for this activity you must have



hydrographic ships, where one can install equipment that can sail offshore in deep waters, but also in the coastal zone or ports, in very small waters. The equipment used is of the latest generation, costs are very high but the quality of information is essential in defining precisely the points, with full details and the vector maps.

*c. Collecting the topographic information from the coastal area and the port development information.*

The knowledge of the morphological parameters of the beach areas is of particular importance in the management of risk generated by extreme natural events such as severe storms, floods and even tsunamis. Based on morphological characteristics, such as the backshore area, one can trace some safety margins in order to reduce the potential material losses. Also, the information about beaches is essential to landing military operations.

To this hydrological, oceanographic and topographic information we can add meteorological information and other data that can completely picture the recognized image of the marine environment.

with information the research structures for the hydrographic and oceanographic planning campaign. As we can see in Figure no. 4, to achieve RMEP we need data about:

a) Marine environment factors: both from the littoral and from the water and on the bottom of water;

b) Submerged obstacles : both large ones, which can be dangers to navigation , but especially the small ones, which can be sea mines and represent a real danger , in peacetime, crisis or war.

The main marine environment factors on which general staffs have to focus attention in planning military actions are:

- and elements: landscape, rivers, soil and vegetation, settlements, demography, communications network, coast and the shores appearance, port facilities;
- marine elements: the level oscillations, waves, sea currents, temperature, salinity, density, color and sea water transparency, seabed topography and nature.

Legend: 3 - huge importance, 2 – medium importance, 1 – small importance, 0 – insignificant

	Depths very small (0-3m)	Depths small (3-12m)	Depths medium (12-60m)	Depths large (>60m)
Bathymetry	3	3	3	2
The sediment particle size	2	3	3	2
Seabed diversity	2	3	3	1
Seabed roughness	2	3	3	1
Burying mines	3	3	3	1
Currents / waves	3	3	2	1
Water clarity	1	3	3	2
Temperature and salinity	1	2	3	2
Acoustic properties	0	3	3	3

**Figure no. 5** The importance of hydrographic and oceanographic factors on mining, mine removal actions.

**Source:** Grecu Sorin, *Acțiunile centrului de analiză și evaluare date pretru lupta antimină în sprijinul misiunilor de minare – deminare*, Bucharest, "Carol I" National Defence University Publishing House, 2013, p. 78.

As it can be seen in Figure no. 3, the MWDC structure is not directly responsible for data acquisition. The MWDC structure centralizes information from all structures with responsibilities on different areas or from the private firms that perform research in the Black Sea and supports

Given that the Romanian continental shelf depths are prevalent between 12 and 60 meters, we can see that many submerged objects influence MCM actions at the Romanian seaside. To "take stock" of submerged objects we need the following data:



- Historical data about mine dams, wrecks and submerged obstacles from the II World War;
- Technical and tactical characteristics of foreign and own mines;
- Data on submerged objects: shipwrecks, pipelines and small objects (mines, barrels, metal objects, etc.).

Information about submerged objects can be obtained from specialized forces which operate the following equipment: side scan sonar and magnetometer. To be useful this information, to analyze a submerged contact, the equipment must use the same positioning system. An error of a few centimeters can create the confusion of 2 contacts instead of one and it would be very difficult to achieve RMEP.

Essential information for these MWDC is the prints of these small objects; they are required to identify potential dangerous contacts and start planning for identification. These databases on mines fingerprints should be established in peacetime, which is a lengthy process, the information is of paramount importance in times of crisis and war.

### Data processing

In order to sustain an action plan on MCM line in different areas or districts it is necessary that each national MWDC presents NMWMSIDS (Naval Mine Warfare Mission Specific Information Data Sets).

Data processing is performed in three steps:

- Data collection;
- Data storage;
- Data fusion.

- *Data collection* involves the introduction of the raw data acquired from different equipment, from Step 1 of the process of making RMEP. This involves the acquisition and primary processing of data on the marine environment in the area of responsibility of the FN through hydrographic and oceanography research in collaboration with specialists from the DHM hydrography and oceanography department or other contributors. The primary processing of raw data has minimum degree of processing so as to eliminate errors, being checked by experts who operate equipment.

- *Data storage* involves creating specialized databases on information necessary for the MC fight: geographical coordinates of possible mines

left over from World War II on the seabed in the Romanian seaside, of the wrecks of ships and aircraft under the seabed, the rocks, wires, pipes submarines etc.

- *Data fusion* is the most important step in the data processing stage and involves the following activities:

- Positioning checking and correlating information from multiple sources;
- Linking data about each point that defines a point on the map;
- Identification of submerged objects.

Usually, your contact information is obtained from a single source: side scan sonar, magnetometer and other equipment. To identify contacts, one can start with simple information obtained from a single source, which leads us to believe there is a possible object. The contact information can be from submerged objects or from various forms of submarine relief that produce different reflections.

There follows a planning process developed by other research in the area, with other equipment for collecting additional data. This raises issues about data fusion about contacts because of problems in the locating systems. It might have been ideal that the equipment be on the same vector, with the same geo-referent and the signals be integrated on a single processing software platform. Unfortunately, because the equipment is very expensive, sometimes of different generations, they have not been purchased as a system, the purchase being made in stages, which makes it very difficult to integrate it into a single system.

The additional information about the possible object is analyzed and can lead to conclusions, increasingly arguing that a contact found by a device may or may not be a submerged object.

In order to identify submerged objects it is just sufficient the analysis of the signals obtained from the equipment; they can lead to the classification of objects with a certain degree of probability, based on: the quality of the data obtained, the number of information obtained from different equipment, the fingerprints of the submerged contacts in databases and, not least, the training of personnel that analyzes the information.

For a reliable identification of the submerged contacts there must be used visual information by filming these contacts by specialized divers or



ROV "Remotely operated underwater vehicle", otherwise there will always be a higher or lower probability of identification and classification of objects submerged.

**The construction of the layers**

MWDC must be able, as after making the database, the operating system of recording and cataloging database of all submarines and mines obstacles, and processing information, to produce tactical and special maps on AML starts (Additional Military Layers) on the restrictive areas and information datasets for combat missions against mines, in accordance with STANAG 1116, NMWMSIDS (Naval Mine Warfare Mission Specific Information Data Sets), based on hydrographic, oceanographic, topographic and geophysical data.

Making marine charts with general data about the coastline and sea area, topographic and hydrographic data and port development, is the activity which is carried by the cartography department of the Maritime Basin Directorate. MWDC task is to complete these electronic maps with relevant environmental information to assist the command structures in planning the mine – mine removal actions.

Mapping the identified submerged obstacles is the most important activity to achieve RMEP. This map includes information on the sub-structured layers, about:

- LBO ("Large Bottom Objects") on the seabed for ASW (Anti-submarine warfare) and MCM;
- SBO (Small Bottom Objects) small - objects seabed for MCM;
- QRT (Q-Routes) - Q routes, access passes;
- MWDC is responsible for producing and updating these NMWMSIDS data sets. Also, after creating such datasets, national MWDC, by designated officers, participate in predefining Q routes.

Achieving these maps with data about submerged objects is essential for:

- Defining dangerous navigating districts because of the large objects on the seabed;
- Defining dangerous districts because of the mines danger. This danger exists in peacetime, especially because the districts mined in the Second World War have not been thoroughly cleaned, but especially in wartime, when certain areas will be mined by the own forces and areas mined by the enemy;
- The safe accomplishment of the "leads through" missions. Having a RMEP with identified submerged objects is easier if from the last update of the map were no changes; in this way we can tell if there were executed missions for mining routes Q by the enemy and we can eliminate the mine danger with MCM and EOD specialized forces (specialized forces in defusing explosive devices).

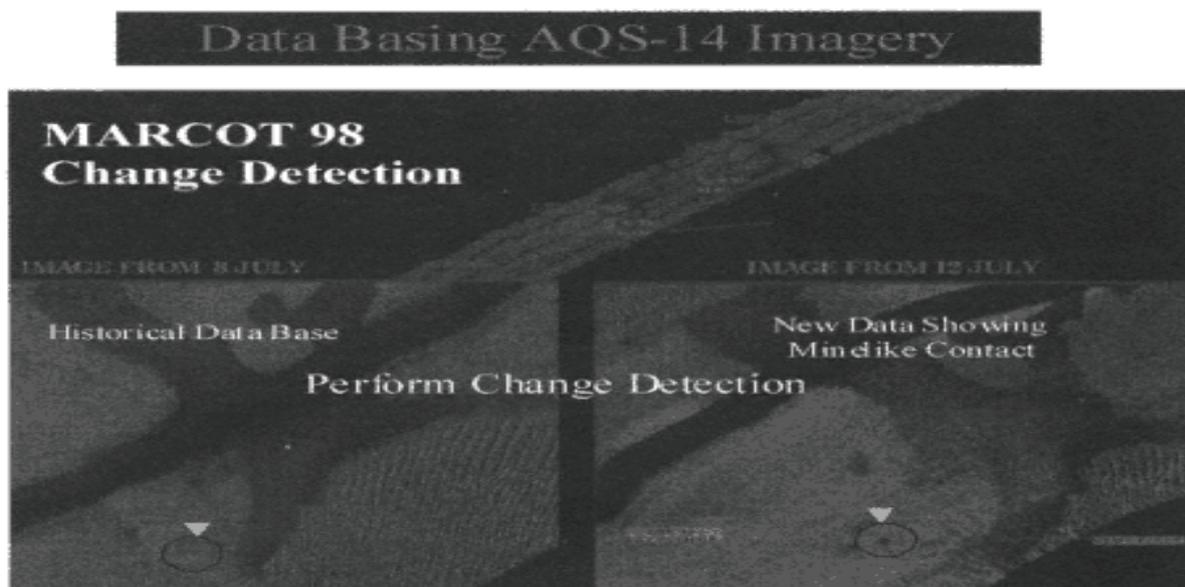


Figure no. 6 Comparison of the images in the database

Source: [http://www.nap.edu/openbook.php?record\\_id=9773&page=28](http://www.nap.edu/openbook.php?record_id=9773&page=28), Oceanography and Mine Warfare, accessed on 06.08.2015/10<sup>00</sup>



In Figure no. 6 we can see that, in the right side, a small object appeared and that it was not discovered and identified in a previous research. For such missions, especially in times of crisis and war, UUV's would be very useful; these Unmanned Underwater Vehicles, equipped with Side Scan Sonar and magnetometer, could be programmed to execute research on routes Q for access ports without being detected by the enemy, thereby ensuring secrecy of access passes.

### RMEP Distribution

RMEP distribution involves the provision of products designed according to user's needs and the NEED TO KNOW principle. To transfer products, MWDC WILL use communications and ways to ensure data protection, appropriate to the level of secrecy.

The data is distributed over 3 levels, the classification level of information depends on the content of data and on the operational considerations. The distribution of information can be done through various channels, such as:

- unclassified channels, for level one information containing general information, useful information that can be used by civil society in economic or ecological activities;
- classified channels, its publication being made only by means ensuring the corresponding secrecy level, to the allied forces in NATO distribution being made on the network secret (NSWAN) for the information of levels 2 and 3 with structured data about environment on Q routes or on areas important for military action.

### RMEP Reconstruction

Depending on the specific area of operations and information needs for the command and planning structures, requests for information are issued, demands that are placed on the flow of the accomplishment of the RMEP in the 3rd stage of construction, showing a tactics map of the operating area of interest.

### Conclusions

Making RMEP as part of the local REP, to be conducted by the Romanian State and made available to NATO allied forces, has a strategic value in knowledge of the environment in which military operations are conducted. The RMEP

site provides information about the physical description of the battlefield in the sea contributing to the Concept of Joint Operation Picture / JOP (the overview of operation) and providing essential information for the placing in the operations area of NRF, in a fast way, especially considering that the NRF should be placed in combat within five days. For these to be useful information in RMEP, information from NMWMSIDS must be checked and updated continuously.

Besides the strategic value at NATO level that RMEP has, the Romanian state should acknowledge the contribution of RMEP to the achievement of national security in the maritime area, with a major contribution in 4 sizes from 5, and it should take steps to achieve this recognized image. The lack to achieve RMEP generates a real danger to the safety of navigation and economic activities, including the Romanian seaside tourist area. About 7,000 sea mines were launched by the own forces on the Romanian seaside in the World War II. There are no concrete data about the number of mines launched by the Soviet forces with aviation or offensive submarines mining shares, but there is reliable information that these missions occurred.

To confirm the above, I note that a number of mines were discovered, as follows:

- On the 15<sup>th</sup> of June 2013 ROMFISH, a fishing vessel, pulled a German mine of UMA type;
- In the summer of 2006, during the international exercise MCM slayers found a Russian mine from the WWII of M-08 type, buried almost 50% in sediment.

The discovery of new gas or oil fields in the north (Sulina- Sf. Gheorghe), center (across Tuzla, at sea) and south (across Mangalia, at sea) will make as numerous sea pipelines and oil installations to be installed. It is clear that all these pipelines will cross the old mine dams launched on the Romanian coastline, which could create real problems if these dams are not checked and cleaned of all underwater explosives.

MWDC can play an important role in achieving national security in the Black Sea and to restore the safety of marine resources exploitation to the economic environment.

The achievement of databases by MWDC, NMWMSIDS will be a permanent tool for planning, command and decision centers of their national or allied forces in the war with mines.

In order to train the structures that collect data,



Romanian Navy should build training ranges, one in shallow water and one in average water, with various metal objects (mines of various types, pipes, barrels, etc.) so that a data set can be created to be used for analyzing the signals obtained during the research. Also, for the staff which operates specialized technique mentioned in the previous lines, and in the light of enrollment on new hunting stations, which probably will be purchased and will be equipment with similar characteristics, the Navy would have to find different providing training courses and / or specialized meetings in educational institutions subordinated to Naval Academy and the School of Petty Officers, or by sending staff on training courses abroad at specialized institutions in order to certify specialists in hydrography, oceanography and cartography.

In conclusion, MWDC is central and essential to the achievement of RMEP and offers enough products (tactical maps, evolutions of environmental factors, information about routes Q, etc) needed both for the command structures, and the execution, for the mining – mine removal actions. Also, by making NMWMSIDS and using sub-layers, MWDC can provide a flexible concept in achieving products needed for planning and decision making actions, according to information requests from the operations area of interest and the type of assignment executed.

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