MEDITERRANEAN AND BLACK SEAS HYDROGRAPHIC COMMISSION XXIV CONFERENCE

CONTRIBUTION BY MONTENEGRO

INSTITUTE OF HYDROMETEOROLOGY AND SEISMOLOGY

SECTOR FOR HYDROGRAPHY

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1. HYDROGRAPHIC OFFICE

Montenegrin Hydrographic Office was initiated as the Sector for Hydrography (SH) within the Institute for Hydrometeorology and Seismology (IHMS) in 2009. IHMS is under the Ministry of Tourism, Ecology, Sustainable development and Northern Region Development and conducts hydrographic and topographic survey of the sea and internal navigation routes, gathering of hydrographic data, navigation, geology, and geophysics (changes in sea level), production of charts and publications is mostly in line with recommendations of International Hydrographic Organisation (IHO) and International Maritime Organisation (IMO).

SH comprise two departments: Department for hydrography and oceanography and Department for geodesy and cartography. Department for hydrography and oceanography performs activity of bathymetric survey, side scan sonar survey, magnetometry and all other hydrographic surveys, it is also responsible for sea level observation, tidal analysis and prediction, sea current measurements and modeling, wave measurements and chemical oceanography (temperature, conductivity and salinity). Department for geodesy and cartography conduct topographic surveys for hydrographic purposes, it is also responsible for nautical chart production and ENC production.

The precondition for the achievement of effectively management of the territorial waters of Montenegro implies the building and improvement a national infrastructure (premises, vessels, equipment, software). Sector for Hydrography has basic infrastructure (premises and ship), equipment, software and small number of staff (5 people) necessary for execution of the basic tasks.

The trained personnel are essential for good hydrographic services. SH plans activities related to the further development of the Sector, which include improvement the knowledge of the staff through professional courses, seminars and trainings. All staff members will be included in the training program depending of type of work.

2. HYDROGRAPHIC SURVEY

Hydrographic surveys conducted along the Montenegrin coast in recent years were limited to the marinas and small ports. This selective parts of the coast were surveyed and nautical plans were produced. Based on these surveys, for marinas and some ports, new ENCs were released.

The last systematic survey of Montenegrin near shore waters was performed in the period from 1951 to 1954. The strong earthquake in 1979 partially changed pattern of the coast-line and topography of the sea bottom, especially within Boka Bay and in proximity of the coastline.

2.1. Coverage of new surveys

Hydrographic surveys conducted along the Montenegrin coast since XXIII MBSHC Conference were limited to selective parts of the coast and to main ports and passages.

Port of Kotor and port of Bar were surveyed, west part of Boka bay, several small piers and marinas, the coastal area of Ulcinj and two underwater installations were resurveyed and checked.

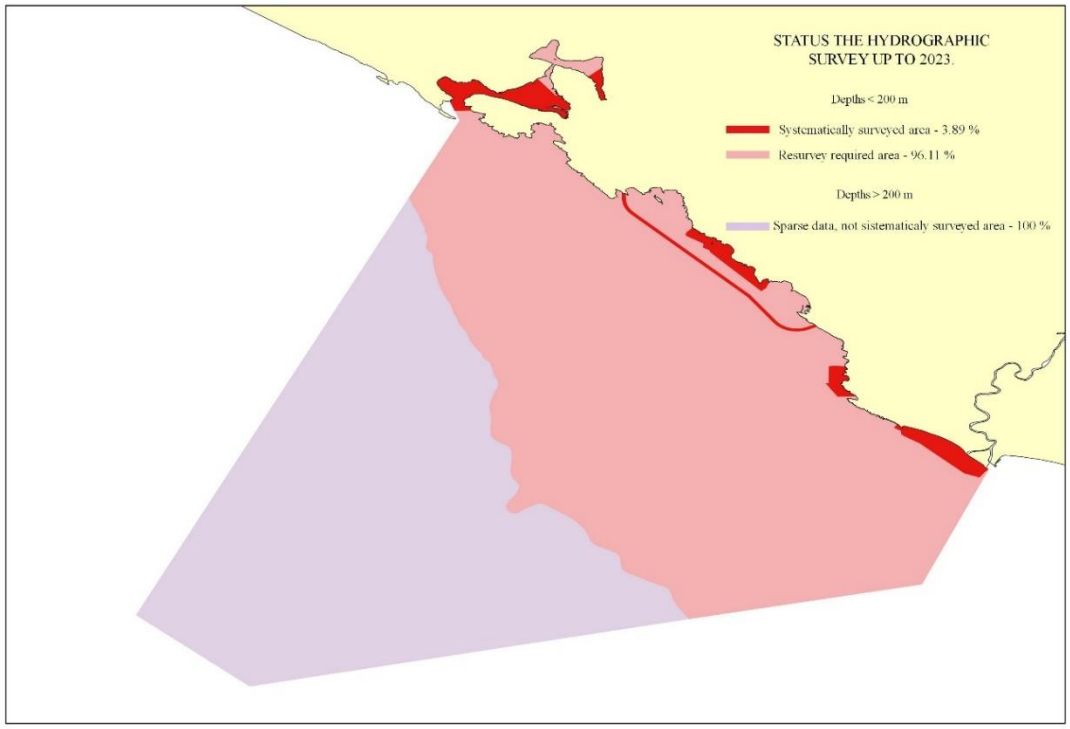

Figure 1. Status of hydrographic survey of Montenegrin waters

2.2. New equipment

Since last MBSHC Conference new SBES system was purchased. SH acquire new Teledyne Echotrac E20 singlebeam.

Figure 2. New SBES Echotrac E20

Purchased SBES has following specifications:

	Single channel	Dual channel	Dual channel Extended Range
Operating frequency	HF channel 10 to 250Khz, optimized for 50-250kHz		
	LF channel 10 to 250khz, optimized for 10-50kHz		
Channels	Single[1]	Dual	Dual
Accuracy and Resolution			
200kHz	1cm resolution and 2cm +/- 0.1% of depth accuracy		
33kHz	5cm resolution and 10cm +/- 0.1% of depth accuracy		
12kHz	15cm resolution and 15cm +/- 0.1% of depth accuracy		
Depth Range[2]			
200kHz	0.5 to 250m		0.5 to 400m
33kHz	1.0 to 1,000m		1.0 to 3,000m
12kHz	3.0 to 1,000m		3.0 to 6,000m
Max ping rate	50Hz		
Pulse type	CW	CW	CW and FM (chirp)
Output power	Typically max output power varies between 1 and 3kW, depending on transducer		
Input power	10-30VDC, 100-230VAC[3] , max 50W		
Data output	Via LAN interface: For each channel the measured depth and full amplitude-time echogram, passed through auxiliary sensor data, s7k data protocol. Via serial port: For each channel the measured depth		
Transducer interfaces	Impedance: minimum 50 Ohm, Max power: 15W per channel RMS		
	• Single-connector TX1 for dual transducer		
	• Two separate connectors TX1 and TX2 for separate transducer cables		
Interfaces	3 serial connectors (RS-232):		
	• Input: GPS position and time, heave, motion, heading		
	• Output: depth		
	1 Ethernet LAN connector		
	1 sync connector		
Dimensions H x W x D	83.0mm x 300.0mm x 221.0mm		
Weight	5.7kg (excl. external cables and transducers)		
Environmental conditions and ingress protection	Temperature Operation (Storage): -20°C to +55°C (-30°C to +70°C)		
	IP67, Vibration, Drop: Complies with standard EN 60945 §8.7 and §8.6		

This instrument was mainly used in the operations of conducting new surveys in the last two years.

2.3. New ship

New surveying boat Sejong was acquired as a donation by the Republic of Korea. Main characteristics of the surveying vessel Sejong are:

- displacement: 5 t
- length: 10.5 m
- draft: 0.8 m
- accommodation capacities:
  - 4 crew members
  - 4 members of survey team

Figure 3. Hydrographic boat Sejong

3. NEW CHARTS AND UPDATES

SH produces official paper and electronic navigational charts (ENCs) covering the waters within the national responsibility.

Currently, two people are employed and responsible for production of ENC cells. Both employees also have other roles and responsibility in Sector for Hydrography.

SH is using S-58 for ENC Validation Checks in CARIS Composer and SevenCs ENC Analyzer.

SH has produced 26 navigational ENC cells of different usage band. Depending on the navigation purpose, SH has released following ENC cells:

- ✓ 2 coastal (ME3CMNE1, ME3CMNE2);
- ✓ 3 approach (ME4ABOKA, ME4BARAN, ME4BDV01);
- ✓ 4 harbour (ME5HKOTR, ME5BAR01, ME5HZELN, ME5HBUDV);
- ✓ 17 berthing (ME6BAD42, ME6BBIGV, ME6BBONC, ME6HNV01, ME6BLAZR, ME6BLUST, ME6BMBAR, ME6BMGRN, ME6BOSNK, ME6NPETR, ME6BPOIN, ME6BPTIN, ME6BPTNV, ME6BRISN, ME6BROSE, ME6BULCN, ME6BUTJH)

Since last MBSHC Conference five new berthing ENC cells were created ME6BAD42, ME6BLAZR, ME6BMBAR, ME6BPTIN, ME6BPOIN.

Montenegro does not have regulation base which describe and regulate process of creation ENCs.

3.1. ENC Coverage, gaps and overlaps

SH with issued ENCs and paper charts completely covers territorial waters of Montenegro.

Our cells have overlap with Croatia and Albania in usage band zone 3.

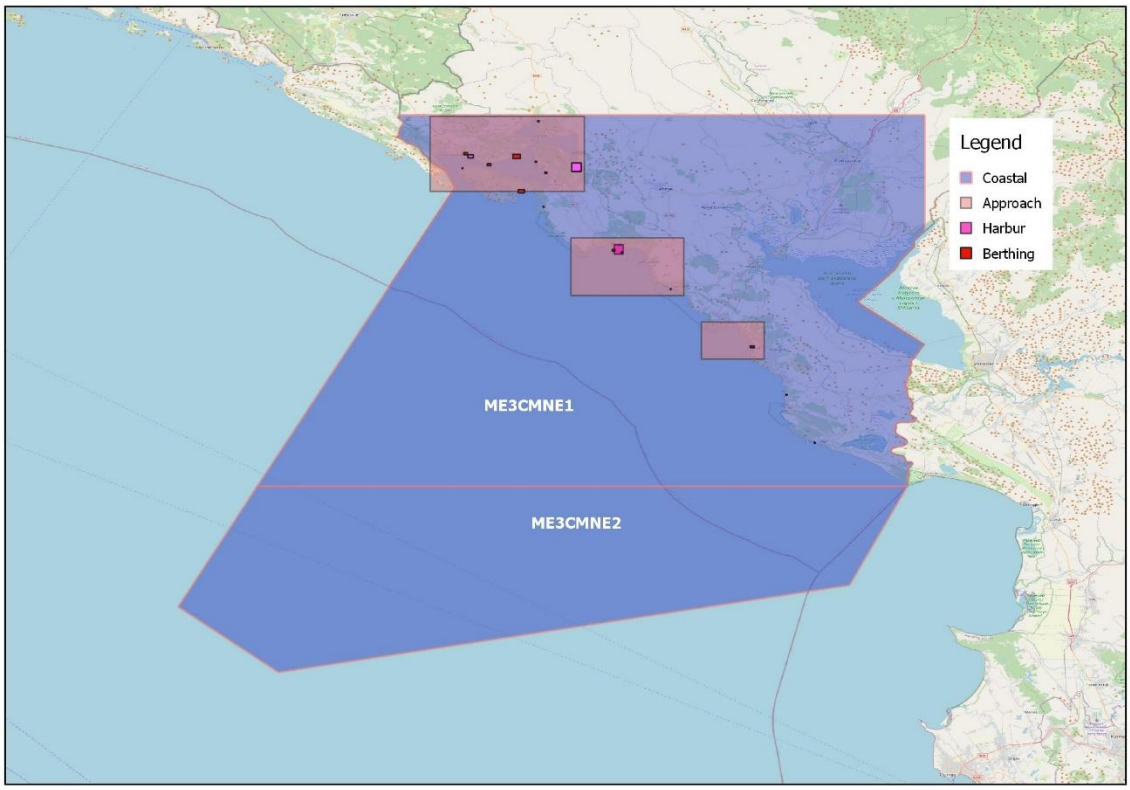

Figure 4. Coverage of released ENCs

3.2. ENC Distribution method

SH distributes its ENCs through the IC-ENC and ChardWorld GmbH. We are members of IC-ENC and ChardWorld GmbH since 2021. SH has produced and published 26 ENCs so far.

3.3. National Paper Charts

In the portfolio SH posses some charts which are inherited from former Yugoslavia: one general chart in the scale 1:300 000, two coastal charts in the scale 1:100 000 issued in 2002 year (100-28 and 100-29).

Chart of Boka Bay in the scale 1:25000 was issued in 2010 with latest edition in 2024.

Coastal navigation charts 100-28 and 100-29, were replaced with new coastal Electronic Navigation Chart, produced in 1:90 000 scale, ME3CMNE1, which covers most of the Montenegrin territorial waters. It has been created using available data from already existing nautical chart, partly updated with new survey in shallow waters, and using topographic data, provided from national Cadastre.

Long term plan is to create three more approach ENC cells and ENCs of small piers and marinas (usage band 5 and mostly 6) to raise quality of ENC coverage. With issuing ME3CMNE3 cell, whole aquatory of Montenegro is covered with ENCs.

Based on ENC cell ME3CMNE1, SH has recently created paper chart, using Caris Paper Chart Composer in scale 1:100000.

3.4. Challenges and achievments

Taking in account all circumstances, we are very proud what we have achieved so far. With 2 people related to cartography and 3 people involve in hydrographic surveys, we completed all basic tasks important for our country.

There are no schools in the field of hydrography and oceanography in Montenegro, so training and educating personnel is main challenge. It is evident lack of trained people.

Furthermore, it is necessary to resurvey almost complete area of the responsibility in accordance with IHO Standards for Hydrographic Surveys (S-44).

4. NEW PUBLICATIONS AND UPDATES

SH nautical publications includes the following documents:

- Notices to Mariners
- Sailing Directions (issued in national language - edition in English language is in preparation)
- Pilot (Montenegrin and English language)
- Lists of Lights (Montenegrin and English language)

Publications are delivered in paper form only.

Figure 5. List of Lights and Pilot issued by Montenegrin HS

Pilot of Montenegrin coast of the Adriatic sea was issued recently (late 2023) and includes all new updates and changes.

5. MARITIME SAFETY INFORMATION (MSI)

Promulgation of navigational information and the GMDSS implementation is the responsibility of another governmental agency - Maritime safety department of Montenegro.

There is no NAVTEX station in Montengreo. The closest ones are in Croatia and Greece.

NAVIGATIONAL INFORMATION

SERVICE	YES	NO	Partial	NOTES
LOCAL WARNINGS	x			
COASTAL WARNINGS	x			
NAVAREA WARNINGS		x		
INFORMATION ON PORTS AND HARBOROUS			x	

GMDSS IMPLEMENTATION

SERVICE	YES	NO	Partial	NOTES
Master Plan		x		
A1 Area	x			
A2 Area	x			
A3 Area		x		
NAVTEX		x		
SafetyNet		x		

6. CAPACITY BUILDING

Since last MBSHC Conference one training was recived through IHO Capacity Building program. Our employee attended *Workshop on MSI Development and Implementation* in Istanbul, Turkiye from 07/05/2024 to 09/05/2024.

The main problem in the work of our SH is the lack of trained personnel. For this reason we have a need for all types of training, especially for hydrographic courses and marine cartography courses.

7. OCEANOGRAPHIC ACTIVITIES

Regarding oceanographic activities SH does not have capabilities to collect and analyze data, except the vertical movement of sea level and observations of the sea level rising. SH does not have necessary infrastructure for observations of sea currents and waves, nor trained oceanographers.

7.1. Tidal gauge network

Institute of Hydrometeorology and seismology of Montenegro monitors vertical sea movement on two permanent tidal stations in port of Bar and port of Kotor (Figure 6). Data acquisition and transfer to the central computers have been performed by using HYDRAS III software. For harmonic analyze and prediction it is used TASK software. The same software was used for calculation of the LAT and other vertical referenced planes for each station.

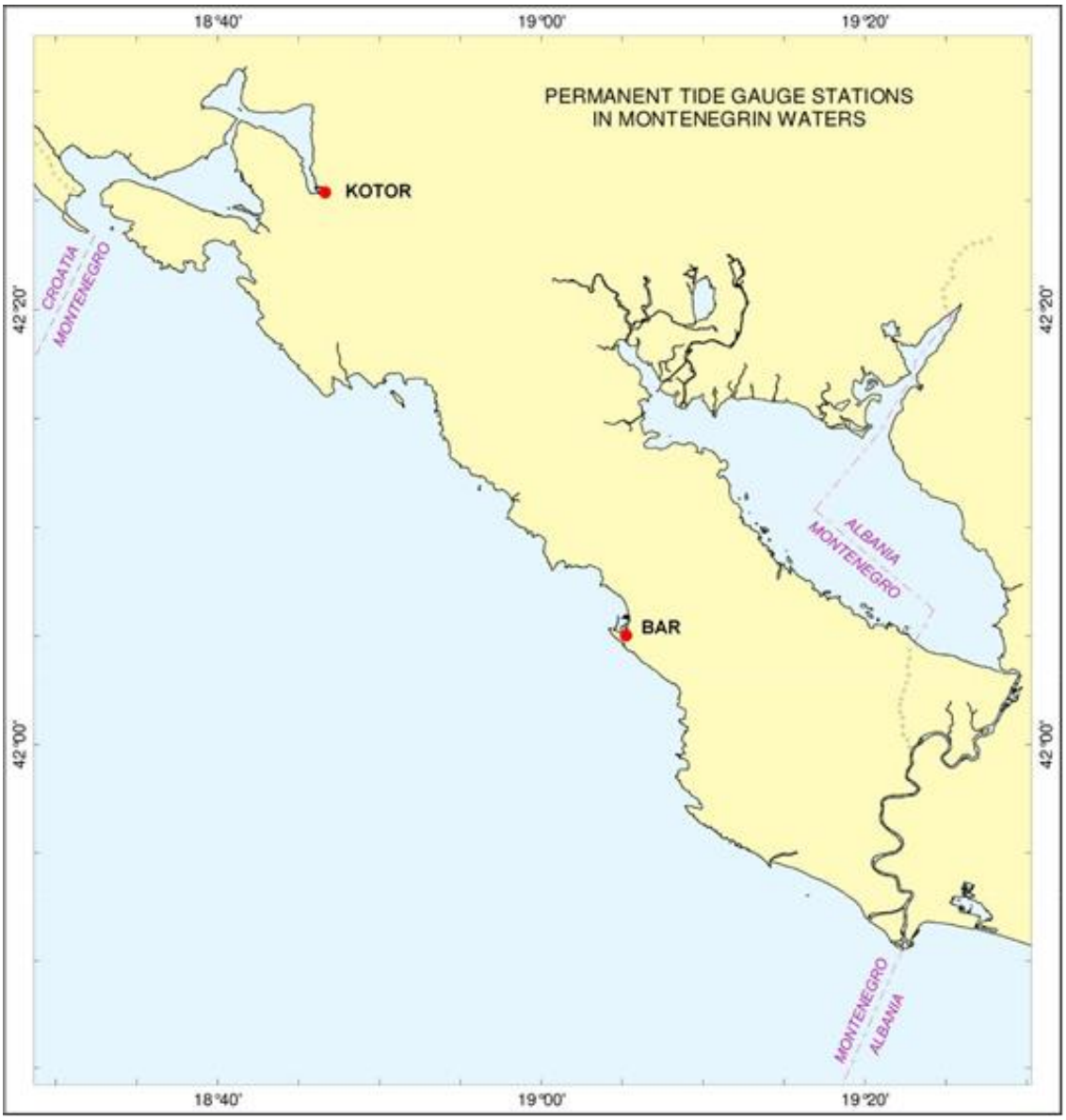

Figure 6. Permanent tidal stations in Montenegrin waters

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. Conclusions

1. **Strategic Importance**: The hydrographic service of Montenegro is of strategic importance for the country's maritime activities, including navigation, maritime safety, environmental protection, and economic development. Enhancing this service is crucial for Montenegro's maritime infrastructure and international maritime obligations.
2. **Current Capabilities**: The current capabilities of Montenegro's hydrographic service are limited in terms of technological resources, trained personnel, and data management systems. This impacts the efficiency and accuracy of hydrographic surveys and charting activities.
3. **Technological Gaps**: There is a significant gap between Montenegro's existing hydrographic technologies and those used by leading hydrographic services worldwide. Modern technologies such as multibeam sonar, satellite imagery, and advanced GIS systems are underutilized.
4. **International Standards**: The service currently does not fully comply with international hydrographic standards set by International Hydrographic Organization (IHO). This can affect the country's reputation and operational effectiveness in international waters.
5. **Collaboration and Training**: There is a lack of collaboration with international hydrographic institutions and limited opportunities for training and development for the hydrographic service personnel.

8.2. Recommendations

1. **Investment in Technology**: Montenegro should invest in modern hydrographic equipment and technologies, such as multibeam echosounders, autonomous survey vessels, and advanced GIS and data management systems. This will enhance the accuracy and efficiency of hydrographic surveys.
2. **Capacity Building**: Establish comprehensive training programs for hydrographic service personnel. This can be achieved through partnerships with international hydrographic organizations, attendance at international conferences, and participation in specialized training courses.
3. **International Collaboration**: Strengthen collaborations with international hydrographic organizations and neighboring countries. This can include joint surveys, data sharing agreements, and participation in regional hydrographic initiatives.
4. **Data Management and Sharing**: Develop robust data management systems to store, process, and share hydrographic data. Ensure that this data is accessible to relevant stakeholders, including maritime authorities, researchers, and commercial entities.
5. **Compliance with International Standards**: Work towards full compliance with international hydrographic standards and conventions. This includes adopting the standards of the International Hydrographic Organization (IHO) and ensuring regular updates and accuracy of nautical charts.

6. **Public Awareness and Stakeholder Engagement**: Increase public awareness about the importance of hydrography through educational campaigns and stakeholder engagement. Engage with maritime industries, environmental organizations, and local communities to foster support and collaboration.
7. **Sustainable Practices**: Ensure that hydrographic activities are conducted in an environmentally sustainable manner. Develop guidelines and best practices to minimize the environmental impact of hydrographic surveys and related activities.
8. **Funding and Support**: Secure adequate funding from the government and explore opportunities for international grants and assistance. This financial support is essential for the continuous development and maintenance of the hydrographic service.

By implementing these recommendations, Montenegro can enhance the capabilities of its hydrographic service, ensuring safer navigation, better environmental protection, and improved economic opportunities related to maritime activities.