

# National report of Montenegro on ocean observation

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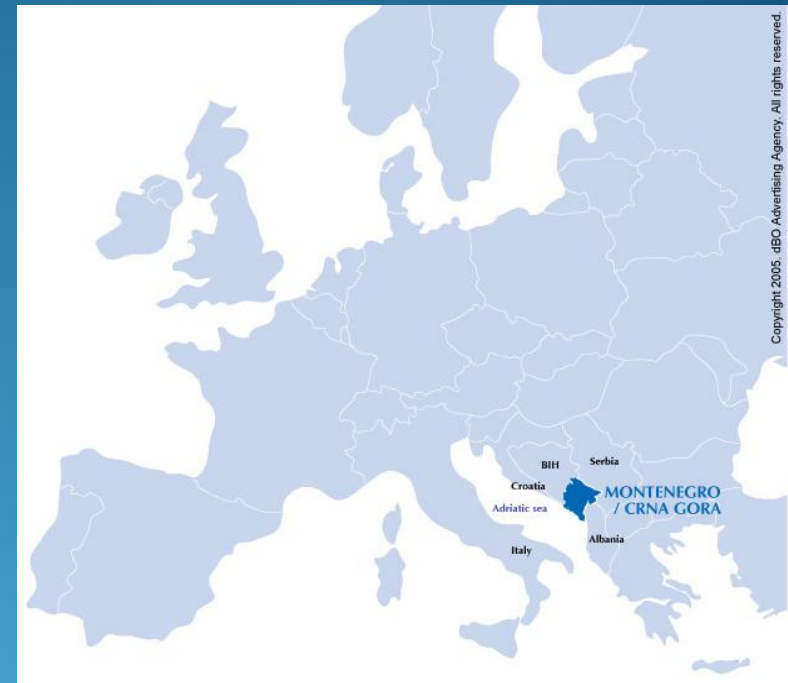
Meeting on "The Operational Oceanography of IOC (for Group II)  
Varna, Bulgaria, 20-22 March 2012

Montenegro is located in south-eastern Europe on the coast of the Adriatic Sea.

Geographical coordinates of the final points of Montenegrin territory are  $43^{\circ} 32' \text{ N}$ ,  $41^{\circ} 52' \text{ N}$  and  $18^{\circ} 26' \text{ E}$ ,  $20^{\circ} 21' \text{ E}$ .

The total area of the country is  $13,812 \text{ km}^2$  of which  $13,452 \text{ km}^2$  is land and marine maritime zone is  $2540 \text{ km}^2$  (internal waters and territorial sea).

Total coastal line is 293 km.



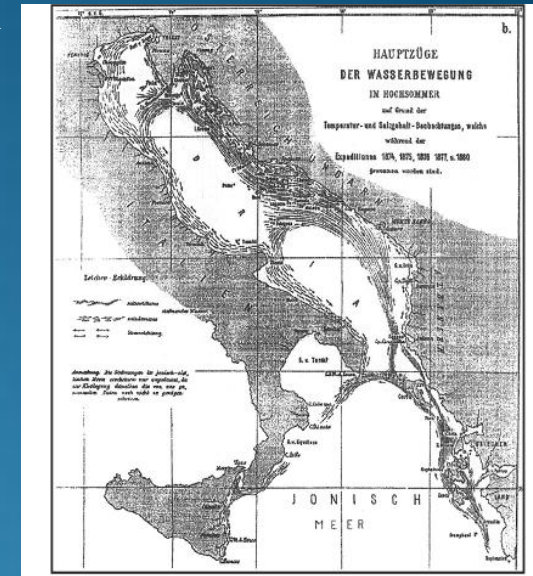
# Historical background of ocean observations in Montenegro

The development of oceanography in the eastern Adriatic Sea is connected with historical changes and influences in this area.

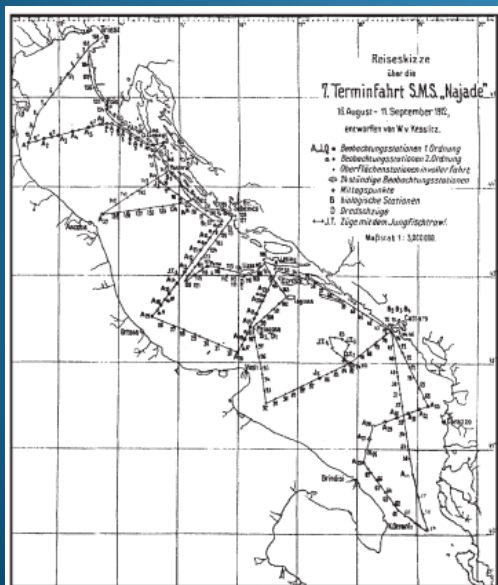
In the 1880' first systematic oceanographic investigations of the open Adriatic Sea :  
Nautilus (1874), Deli (1875, 1876, 1877) and Nertha (1880).  
Organizator: Austrian naval authorities

1911-1914 cruises with Najade (12) and Cyclope (10)  
Organizator: The International Commission for Adriatic Sea (Italy, Austria)

1908-1909 Danish expedition Thor (Mediterranean Sea/South Adriatic)



Map of surficial currents in summertime Wolf and Luksch (1)



Map of the 7th cruise of Najade (1)

After II World War a lot of cruises were organized in the former Yugoslavia with domestic and foreign expeditions.

In 1948 started continuous observations on the open Adriatic including southern part, with R/V Bios and Predvodnik

Organizator: Hydrographic Institute - Split

The trans-Adriatic cruises of the former Yugoslav N/R vessel "Andrija Mohorvicić" (Hydrographic Institute Split) :

1974 - 1976 (five seasonal cruises, chemical and physical oceanographic measurements)

1980-1990 (8 cruises)

In 1961. the Institute of Marine Biology was founded in Kotor (Montenegro) with the main objective to study the marine food web in the southern Adriatic. Over time its activities has been expanded and now IMB in Kotor is the only institution in Montenegro dedicated to the research of the sea.

Establishment of the IBM enabled organized oceanographic investigation of the Montenegrin part of southern Adriatic for the first time in history.



The old R/V of the Institute of Marine Biology



Institute of Marine Biology Kotor

Since 1975 the research and pollution monitoring along the eastern Adriatic coast has been organized at the national level. In 1976, the Government of the former Yugoslavia signed and ratified in 1977, the Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention).

Like part of the former common state SFRY, Montenegro was included into realization of this convention and its protocols from the start.

1975-1980, Montenegro has begun the realization of the monitoring programme - MEDPOL I phase

1983-1992 MEDPOL II Phase

The former Yugoslav National Monitoring Program started in 1983 under the auspices of the UNEP Mediterranean Action Plan.

Institute for Marine Biology, Kotor and Institute for Subtropical Cultures and Environment Protection, Bar (ISCEP-B) were included in this National Monitoring Program from 1985.

After the decomposition of former Yugoslavia in 90', Republic hydrometeorological Institute from Podgorica was formed the program of the coastal waters monitoring, in aim of inclusion in the MED POL phase II.

During several years (1994., 1996., 1997., 1998.) HMI done the one day lasting researches of the water quality on the surface (0,5m) and on maximal depth, on 19 measure profiles along whole Montenegrin coast and in Boka Kotorska bay. The program has realized in cooperation with Hydrographic institute of the SRY Army (Tivat, Montenegro).

Due to objective reasons, in 1999, Medpol activities has stopped and a lot of important elements of coastal monitoring from Medpol III phase (1996-2005) has never realized.

From 1998-2003 Hydro-meteorological Institute (HMI), Centre for Eco-toxicological Research (CER) have implemented water monitoring programs including sea water quality (coastal waters).

Since 2003, the program continued (implemented by HMI) in limited form. In addition, CER (1998-2003, 2003-) and IMB (after 2003) took part in some monitoring activities.

After the independence , in October 2007 Montenegro has ratified Barcelona Convention and four of its Protocols.



Implementation of the Programme of Coastal Ecosystem Monitoring, harmonized with the criteria of the MED POL Programme and requirements of the European Environment Agency, started in 2008.

From 4<sup>th</sup> October 2011, Montenegro became a member state of IOC-UNESCO

## National policy and regulation

Relevant ministries for the sea protection and management are:

Ministry of Sustainable Development and Tourism,  
Ministry of Transport and Maritime Affairs  
Ministry of Agriculture and Rural Development



The fundamental institutional framework for environmental protection is located within the Ministry of Sustainable Development and Tourism and institutions active in this sector are:

Environment Protection Agency of Montenegro,  
Hydro-meteorological Institute,  
Public enterprise National Parks of Montenegro,  
Public Institution Center for Eco-toxicological Research of Montenegro-CETI,  
Public enterprise for Management of Marine Zone “Morsko dobro” and others.

In addition to this environmental institutions, Institute of Marine Biology (University of Montenegro) is scientific institution devoted to the research and investigation of the sea.

Environmental Protection Agency of Montenegro - EPA Montenegro, was established in by the State. The Agency has been established in order to perform activities related to environmental monitoring, collection and dissemination of data and coordination and management of the national information system of environmental protection. Licensing and inspection are within the competence of the Agency

Following the Parliamentary Declaration on the Ecological State of Montenegro from September 1991, a provision "ecological state" is included in the Montenegrin Constitution.

On December 2010, Montenegro became an official EU candidate country. In that context, the main activities should provide harmonization of national legislation with those of EU.

The most important legal acts, which regulate the area of the protection of coastal area and the sea are:

Water Law (Official Gazette, No 27/07):

Environmental Law (Official Gazette, No 48/08):

Nature protection Low (Official Gazette, No 51/08):

Law on Protection of Sea from Pollution (in the form of proposal) from Vessels

Law on Sea Fishing (Official Gazette, No. 55/03);

## Financial and organizational frameworks

Monitoring program of the ecosystem status of the coastal sea was implemented in Montenegro for the first time in 2008.

In accordance with obligations from the Barcelona Convention and implementation of the Medpol monitoring, in 2009, the Program of Monitoring of the State of the Coastal Sea Ecosystem was implemented as a part of the National Environmental Monitoring of Montenegro.

The EPA of Montenegro allocates funds for implementation of the project. Assets that are used for projects and other activities aimed at environmental protection are provided from the Environmental Protection Fund.

The following institutions are involved in its realization:

Hydrological and Meteorological Service of Montenegro,  
Institute of Marine Biology Kotor  
Center for Eco-toxicological Research of Montenegro,  
Public enterprise for Management of Marine Zone "Morsko dobro".



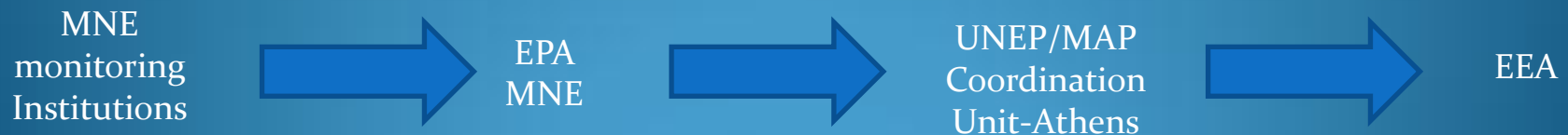
# Implementation of R&D and monitoring programmes

Monitoring program of the ecosystem status of the coastal sea complies with the requirements of national legislation, the requirements of relevant EU directives, the Guide of the European Agency for the Environment (EEA) on the transition, coastal waters and the sea (Eurowaternet Technical guidelines), and following instruction for Reporting (WISE-SoE Reporting: Transitional, Coastal and Marine Waters) and requirements of the MEDPOL program.

Programme is consisted of the following complementary programmes:

Programme of the general quality of coastal water,  
Monitoring of water quality of port sea surfaces, Monitoring of eutrophication,  
Water quality monitoring program for aquaculture and fish eco-toxicology,  
Monitoring of biomarkers,  
Monitoring of inputs through rivers and through effluents,  
Monitoring of bathing water quality.

Data of implementation of the Medpol monitoring are updated in the database established in the Coordination unit of the UNEP/MAP in Athens and forwarded to the European Environmental Agency, following their validation. Results of implementation of the Medpol programme in Montenegro will represent the basis in defining the good environmental status of the marine waters in accordance with the Article 9 of the EU Marine Strategy Framework Directive.

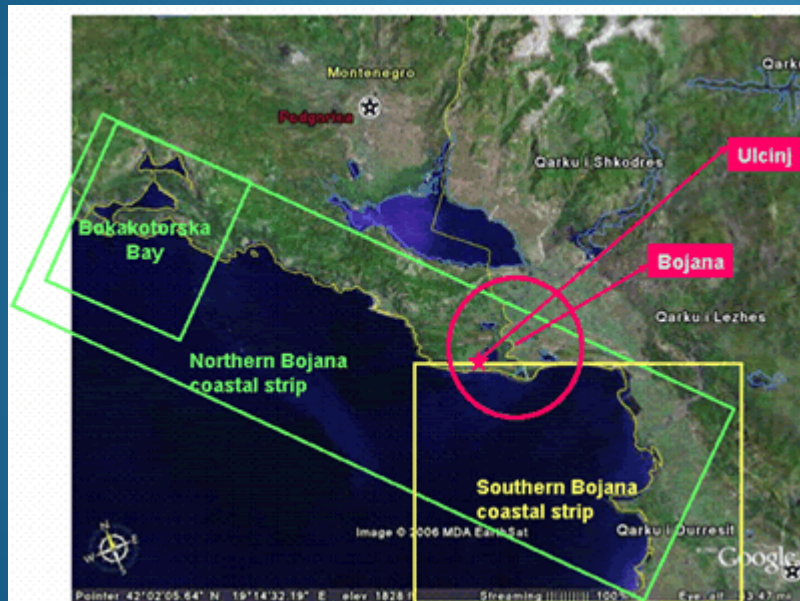


Research activities are reflected through the implementation of national and international projects.

Within the ADRICOSM Partnership launched as a Type II Initiative at the World Summit on Sustainable Development (WSSD) in Johannesburg in September 2002., Montenegro took part in two projects.

**ADRICOSM EXTension** from 2005-2006. The Project was financed by the Italian Ministry of Foreign Affairs and implemented by IOC-UNESCO (Intergovernmental Oceanographic Commission).

**ADRICOSM-STAR** project from 2007 -2010 (Montenegro coastal Area and Bojana river catchment basin) was supported by the Italian Ministry for Environment and Territory.



The area of investigation was the Bojana river Delta and the whole Montenegrin Adriatic coast

Partners from Montenegrin side were Institute of Marine Biology Kotor, Hydrological and Meteorological Service of Montenegro, Center for Eco-toxicological Research of Montenegro.

The coordinating Institution was the Centro Euro-Mediterraneo per i Cambiamenti Climatici and the scientific coordinator was Prof. Nadia Pinardi of INGV and University of Bologna

The Activities of the ADRICOSM-STAR Project included:

Development of the ADRICOSM forecasting system for the Adriatic Sea and its coastal areas with particular emphasis for the Montenegro coastal area;

Design and partial implementation of a monitoring system for the surface water cycle, the river runoff and the coastal area of Montenegro;

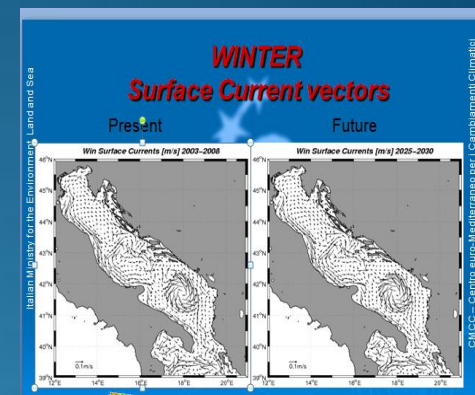
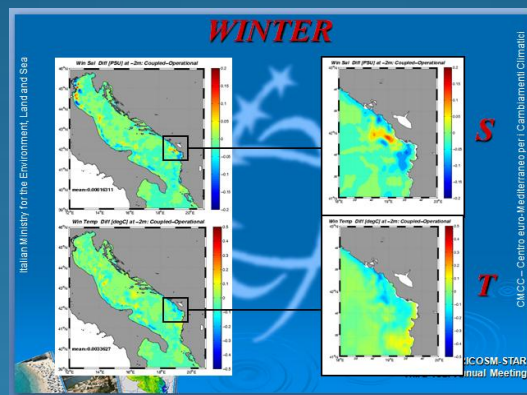
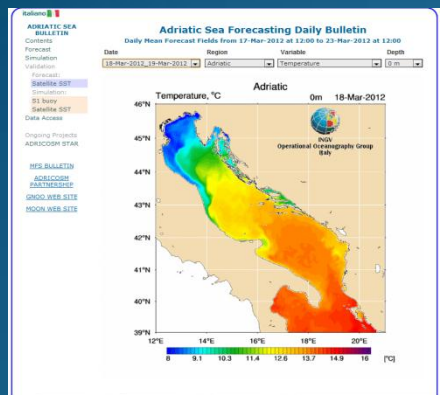
Development and validation of modeling tools for the urban, surface, underground water and coastal currents in the Bojana river catchment and Montenegro coastal area, considering the trans-boundary nature of the system;

Development of a short term (several days) forecasting capability for hydrology, coastal currents and river basin runoff;

Develop the high resolution non-hydrostatic meteorological model and the modeling of the surface water cycle;

Production of a IPCC climate change scenario impact studies for the next decades in connection with the water and sediment quality in the Bojana river and the Montenegro coastal area

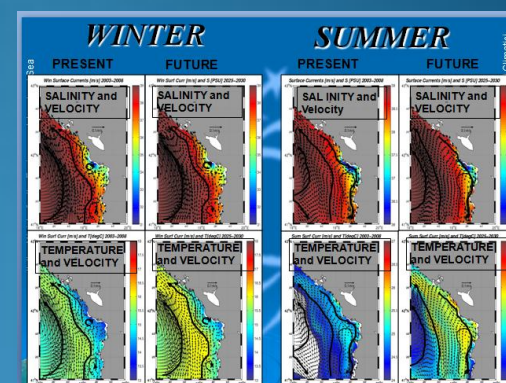
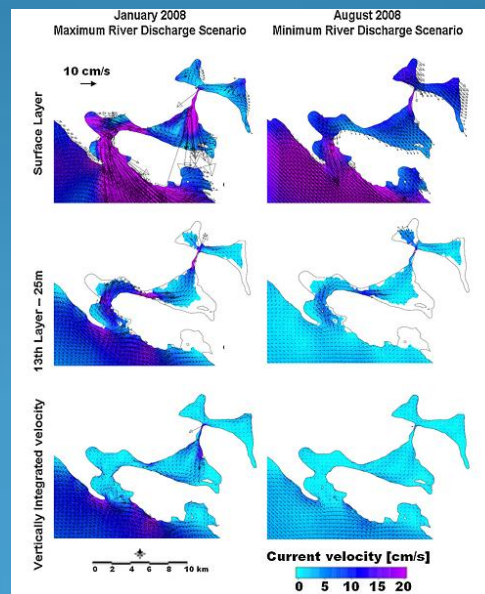
Within ADRICOSM a near real time monitoring system and a near real time basin-shelf marine forecasting system have been implemented and run in operational mode for the Adriatic Sea. The Adriatic Sea Marine Forecasting System releases weekly forecasts of marine currents, temperature, salinity and other physical parameters



Three different oceanographic models have been implemented in the coastal area of the Montenegrin and Albanian regions at different resolutions.

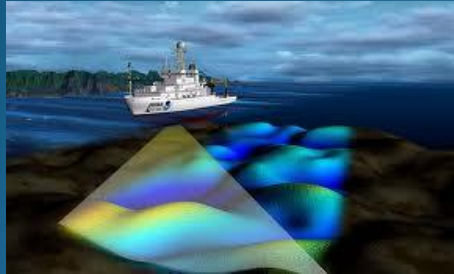
Two of them (AREG<sub>2</sub> and SHYFEM) are nested one into another, providing operational forecast at a regional and coastal scale.

The third has been implemented for non operational purposes in the Bokakotorska Bay, mainly with water quality aims.

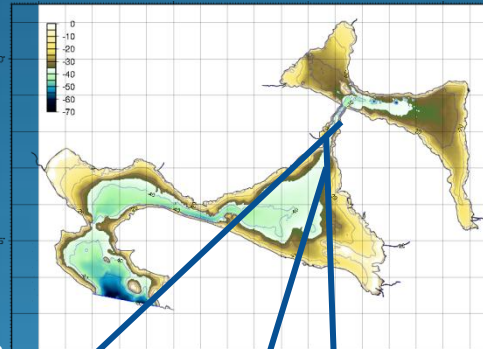




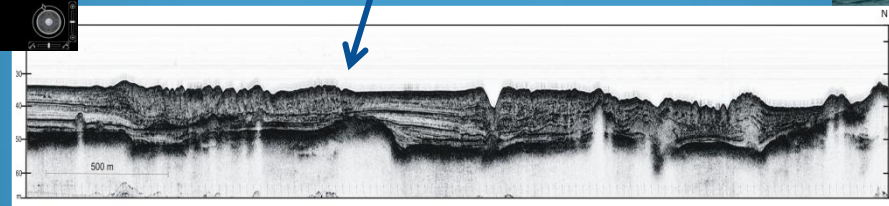
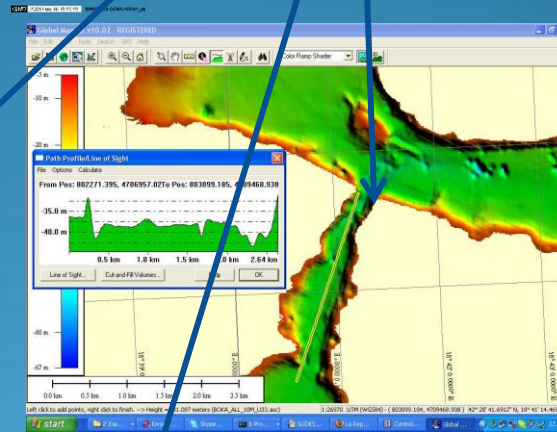
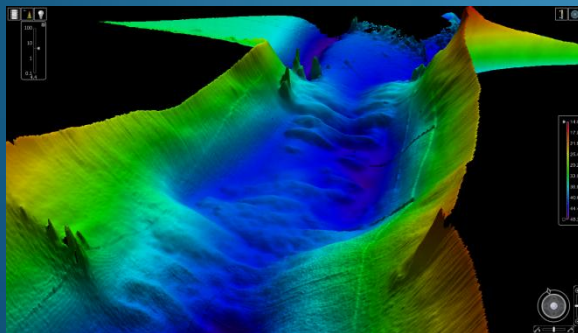
Several seasonal and mesoscale cruises has been carried out for physical, bathymetrical and seismological purposes, collecting important data on bottom topography, T, salinity, chlorophyll-a, CDOM, total suspended matter, turbidity and dissolved oxygen.



**Multibeam echo sounder** Simrad EM710 and EM3002D



**Chirp sub-bottom profiler** Benthos CHIRP (3.5Khz)



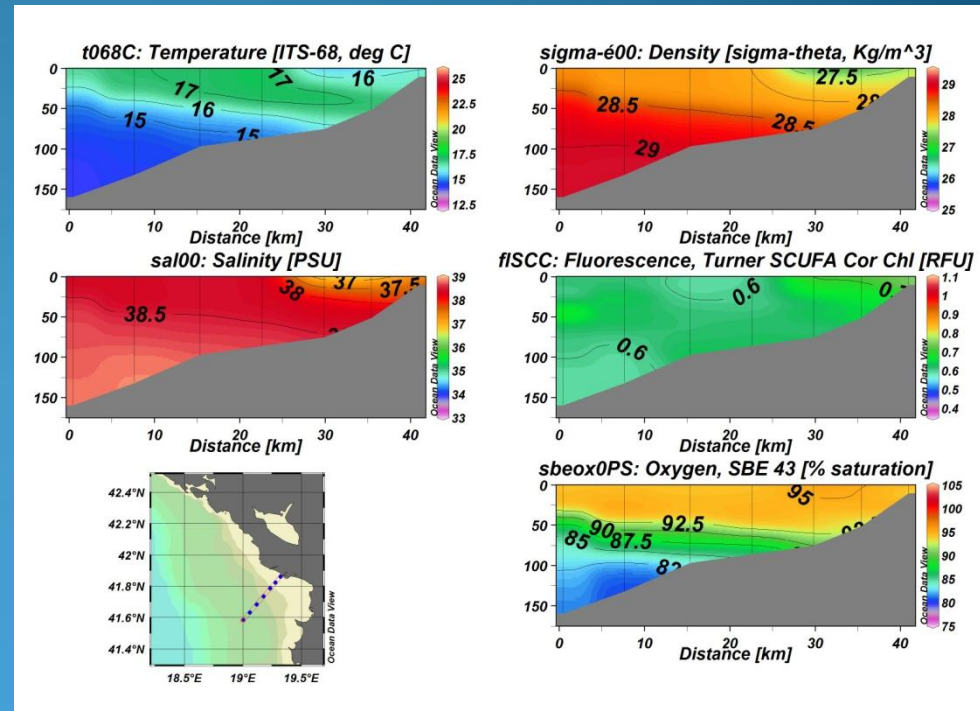


## Sediment sampling

- box corer
- gravity corer
- grab



## CTD probe with carousel





Institute of Marine Biology was a member of MAMA project-Mediterranean network to Assess and Upgrade Monitoring and Forecasting Activity in the basin (2002-2005), funded under the EC Programme, and conducted by MedGOOS.

MAMA has served to enable the sharing of experiences and the transfer of expertise, to reduce gaps in capacities for operational oceanography in the region, and provide a stepping stone towards an integrated plan and design of the initial ocean observing and forecasting system in the Mediterranean.

EuroGOOS, UNESCO/IOC and UNEP-MAP –international institutions as participants of MAMA project

Institute of Marine Biology was a scientific partner of the FAO-AdriaMed Project (Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea) from 2001-2011, funded by the Italian Ministry of Agriculture, Food and Forestry Policies and since 2007 by the European Commission.

AdriaMed aims were: to contribute to enlarge the scope of information on the Adriatic Sea, related to shared fishery resources, to support international processes aimed at fishery management, to reinforce the scientific coordination among the different institutions interested in fishing activity, to establish a permanent network among the main institutions present in the Adriatic that are involved in fishery management activities.



## Future perspectives for operational oceanography

Beside routine measurements that are performed within national monitoring program, it can be said that other activities in the field of sea observation are provided only through international projects and collaborations with research institutions from abroad.

Monitoring institutions have already participated in some international projects and monitoring programs relevant for coastal area, but there is no institutional network within which obtained data would be disseminated.

Capacities of the existing institutions for ocean observing are limited in terms of human and technical resources, financial resources, knowledge and practical experiences.

Participation in projects concerning the ocean observing can provide:

- training of young researchers and qualified personnel
- research institutions will improve their methods and standards of environmental investigation and research
- better dissemination of obtained scientific results
- strengthening further investigation within domestic institutions
- way to provide modern monitoring equipment.

There is need to strengthen institutions in ocean research instruments, particularly for getting real time data.

**Institute of Marine Biology (IMB)** has the potential to provide scientific and research functions. It has a long tradition in working with marine ecosystem.

OTT automatic station for water quality  
(provided within Ecoport 8 project 2009-)



Institute participate in SEADATANET II project. The SeaDataNet infrastructure links 40 national oceanographic data centres and marine data centres from 35 countries riparian to all European seas.

The data centres manage large sets of marine and ocean data, originating from their own institutes and from other parties in their country.

A major objective of the SeaDataNet II is to provide an integrated and harmonized overview and access to these data resources, using a distributed network approach.

It is expected for IMB to become NODC for Montenegro.



seadatanetII partners map

**SEA ODC South-East Adriatic Oceanographic Data Center**

Search filters:

- Project:** FAO AdriaMed, ADRICOSM-EXT, ADRICOSM-STAR, IBMK internal, Calypso, IAEA, MytiAd, IRSN, MED POL, ECOPORT 8, ENVEurope
- Instrument:** box corer, corer, CTD, diving grab, net, rosetta, Shipek grab
- Period:** From 2002 Aug 21, Until 2011 Apr 19
- Season:** From Jan 01, Until Dec 31
- Time of day:** From 00:00, Until 23:59

Map data: 42.60000 N, 18.00000 W, 20.00000 E, 41.40000 S, 42.00000 N, 19.00000 E

1130 samples in-situ / 821 samples in database

Logos: SeaDataNet, ecoport, AdriaCom, IMB, HMZCG, LUKA BAR, JPOMD, Ministarstvo nauke i Crne Gore

v2.6 [2011-11-30 02:05]  
Design by: Aleksandar Jovicic

Institute of Marine Biology has its own data base. This data base is suitable for storage of meta-data and in-situ measurements.

The data base contain oceanographic data collected since 2002 in the area of south-east Adriatic.

In order to make these data available, the web oceanography.me was developed and data are accessible by using various filters (spatial, temporal, by project and/or by sampling instruments).



Project: **PAO AdriMed**  
**ADRICOSM-EXT**  
**ADRICOSM-STAR**  
**IBIM internal**  
**Calypso**  
**IAEA**  
**MyriAd**  
**IRSN**  
**MED POL**  
**ECOPORT 8**  
**ENVEurope**

Instrument: **Box corer**  
**CTD**  
**diving**  
**grab**  
**net**  
**rosetta**  
**Shipek grab**

Period: from **2002** **Aug** **Jan**  
**21** **01**  
 to **2011** **Dec**  
**19** **31**

Season: from **Jan**  
**01**  
 to **Dec**  
**31**

Time of day: from **00**  
**00**  
 to **23**  
**59**

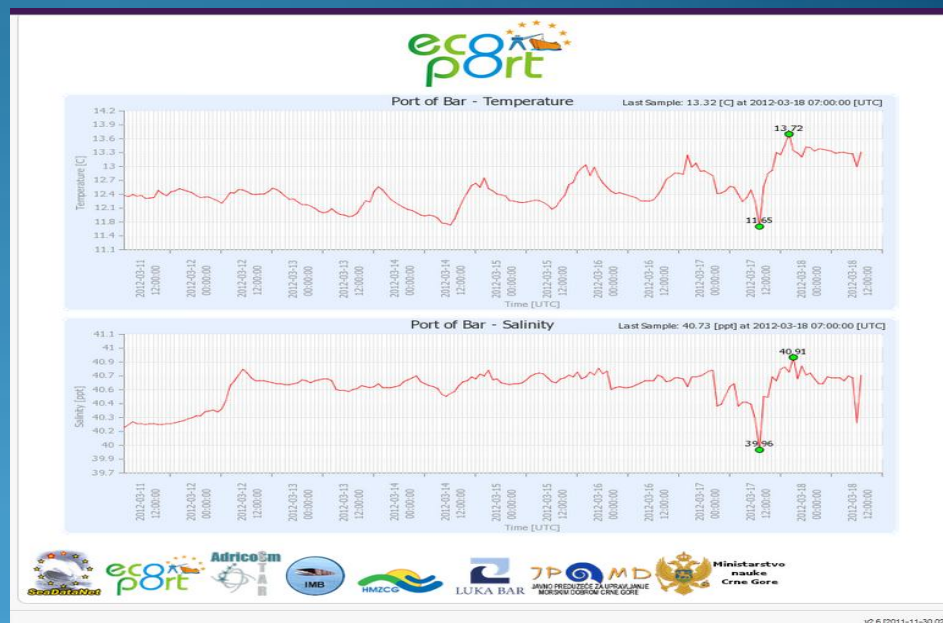
W: **18.00000** E: **20.00000**  
 S: **42.00000** N: **19.00000**

☐ Count ☒ Meta-data / Download

Datasets are freely available for research community only (i.e. for registered and previously authorized users).

cnt.	Sample ID	Station label	Timestamp	Latitude	Longitude	Bottom	Instrument Model	Sample type	Reference Remarks	Cruise Vessel Flag	Project
1)	86	adr16	2005-11-04 20:49:00	41.450000	19.970333	117	CTD	SSE 19plus	data_from_adricosm1.txt 226 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
2)	87	adr17	2005-11-04 21:30:00	41.449333	19.970333	123	CTD	SSE 19plus	data_from_adricosm1.txt 247 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
3)	88	adr18	2005-11-04 22:36:00	41.450167	19.970333	122	CTD	SSE 19plus	data_from_adricosm1.txt 246 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
4)	89	adr19	2005-11-04 23:08:00	41.450000	19.970333	106	CTD	SSE 19plus	data_from_adricosm1.txt 216 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
5)	90	adr20	2005-11-04 23:50:00	41.451000	19.971167	53	CTD	SSE 19plus	data_from_adricosm1.txt 105 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
6)	91	adr21	2005-11-05 00:26:00	41.449333	19.410500	10	CTD	SSE 19plus	data_from_adricosm1.txt 20 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
7)	92	adr22	2005-11-05 07:25:00	41.429000	19.899000	188	CTD	SSE 19plus	data_from_adricosm1.txt 321 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
8)	93	adr23	2005-11-05 08:16:00	41.430167	19.899000	125	CTD	SSE 19plus	data_from_adricosm1.txt 244 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
9)	94	adr24	2005-11-05 09:10:00	41.430000	19.899000	97	CTD	SSE 19plus	data_from_adricosm1.txt 196 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
10)	95	adr25	2005-11-05 09:53:00	41.430333	19.899000	73	CTD	SSE 19plus	data_from_adricosm1.txt 150 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
11)	96	adr26	2005-11-05 10:32:00	41.430333	19.370500	45	CTD	SSE 19plus	data_from_adricosm1.txt 89 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
12)	97	adr27	2005-11-05 11:10:00	41.430500	19.460500	32	CTD	SSE 19plus	data_from_adricosm1.txt 63 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
13)	98	adr28	2005-11-05 11:44:00	41.430000	19.530333	20	CTD	SSE 19plus	data_from_adricosm1.txt 39 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
14)	99	adr29	2005-11-05 12:00:00	41.785000	19.519667	40	CTD	SSE 19plus	data_from_adricosm1.txt 72 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
15)	100	adr30	2005-11-05 13:00:00	41.780167	19.439167	40	CTD	SSE 19plus	data_from_adricosm1.txt 72 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
16)	101	adr31	2005-11-05 14:27:00	41.780333	19.329500	50	CTD	SSE 19plus	data_from_adricosm1.txt 95 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
17)	102	adr32	2005-11-05 15:25:00	41.780000	19.210333	78	CTD	SSE 19plus	data_from_adricosm1.txt 151 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT
18)	103	adr33	2005-11-05 16:00:00	41.789333	19.210333	78	CTD	SSE 19plus	data_from_adricosm1.txt 151 records	ADRICOSM-EXT cruise 1 O. Dellaporta (IT)	ADRICOSM-EXT

## Metadata



Real time data provided by permanent sensors from OTT probe

## Institutional capacity

Institutions have limited technical/financial capacities

### Institute of Marine Biology Kotor (IBM)

one fast 7m long boat, CTD probe, OTT automatic station for sea water quality in Bar, water and sediment sampling equipment, laboratory equipment).  
IMB is situated in Kotor.

### Hydrological and Meteorological Service of Montenegro (HMSM) - (Department for hydrography and oceanography - DHO in Tivat) :

hydrographic vessel 22.5m equipped for hydrographic measurements also for the open sea (portable and hull mounted single beam echosounders, high resolution Side Scan Sonar), survey equipment (CTD, ACDP current meter, sediment sampling equipment). DHO operates two permanent tide gauge stations (in port of Bar and in Kotor) and one mobile tide gauge.

DHO set up graphical tide prediction software (portalTide T@bles) that visualize tide prediction for ports Bar and Kotor,, allowing also correction by atmospheric pressure  
HMI has laboratory in Podgorica.

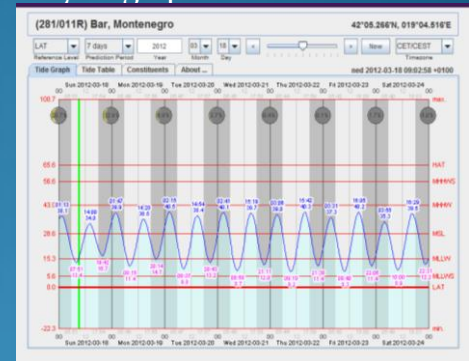
Graphical tide prediction software  
written in Java

### Centre for eco-toxicological testing (CETI)

CTD probe, OTT automatic station for sea water quality, equipment for water and sediment sampling, modern equipped laboratory for water and sediment analysis.  
CETI is situated in Podgorica



Hydrographic launch BH-12



Recently initiated project (in 2011): Master Plan for Integrated Montenegro coastal area monitoring program, within the framework of the Adricosm Partnership, will give as results:

Master Plan for the monitoring of the coastal area of Montenegro to be compliant with the WFD and MSFD requirements;

proposal of the proper Institutional network to sustain the monitoring program;

build database for EPA Montenegro for the management of the historical and new monitoring data.

The activities that concern rapid transmission of observational data to data assimilation centres, proceeding data through numerical forecasting models, remote sensing data, rapid warnings of coastal floods, storm damage, harmful algal blooms and contaminants, prediction of ocean currents, ocean climate variability and others activities related to the operational oceanography almost doesn't exist at national level, except activities that are implemented through various international project.

The further development of operational oceanography will depend on Government investments in the field of ocean research and monitoring, on participation of Montenegrin institutions in strategic projects, as well as on collaboration with oceanographic institutions, in the Adriatic or wider regional level.





Thank you for attention