6th IEEE/OES Baltic Symposium 2014

Tallinn, Estonia on 26-29, May 2014

"Remote Sensing Applications for the Ecosystem-based Management Process Implementation in the Romanian Black Sea Coastal Zone"

R.D. Mateescu, A. Spinu, L. Buga, D. Niculescu, E. Mihailov, E. Vlasceanu

N.I.M.R.D. "Grigore Antipa", Blvd. Mamaia, no.300, Constanta,

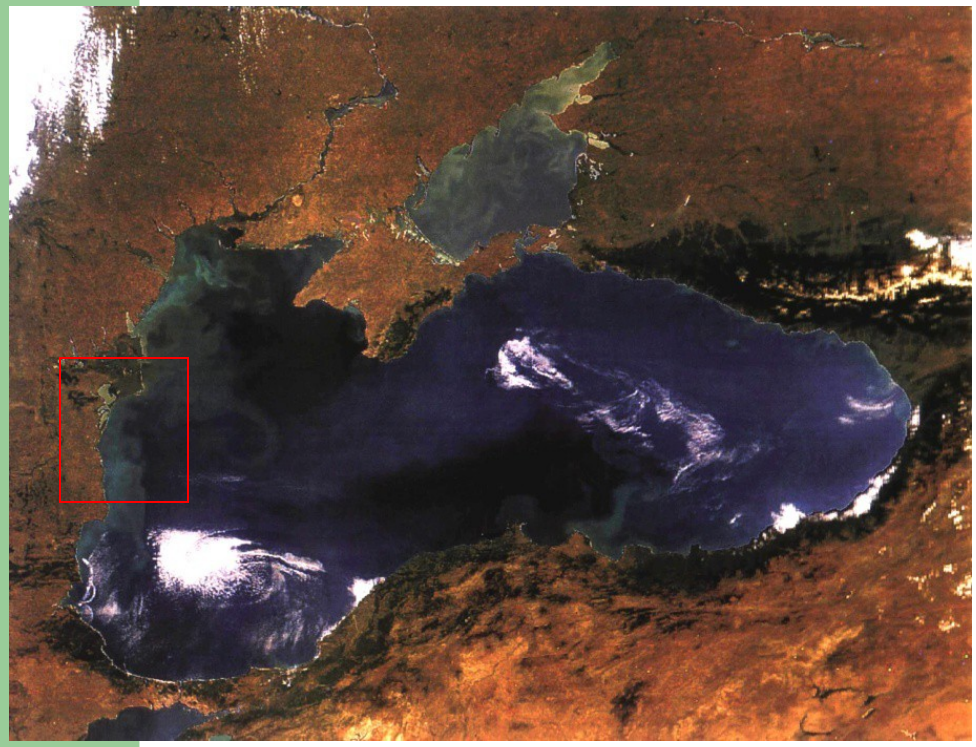
code 900581, ROMANIA

razvan_doru@yahoo.com

Overview

1. Introduction – Regional General Data
2. Romanian CZ - Danube Delta Coast
    - Geology and Geomorphology
    - Hydrology
    - Ecological Aspects
    - Sociology and Economy/Navigation
4. Ecological Impact – previews examples
5. RS for Ecosystem vs. Local development & ICZM implementations
6. Conclusions
7. Acknowledgements

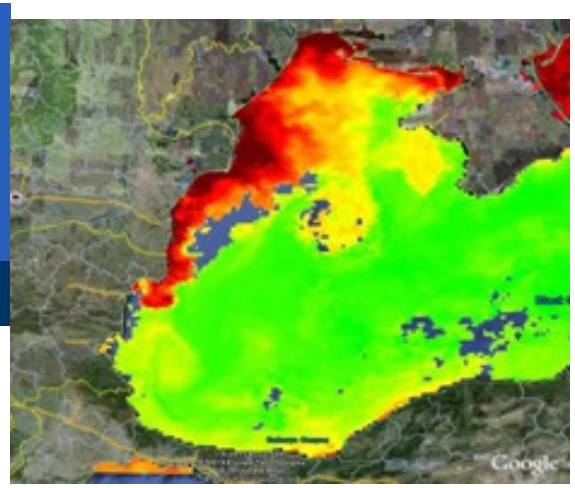
1. Introduction – Regional General Data



BLACK SEA BASIN

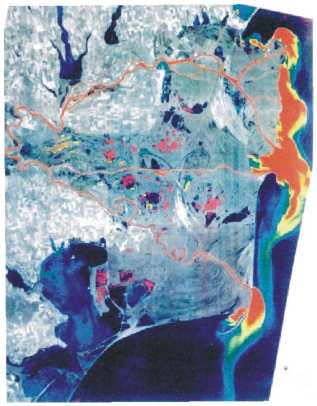
- Total area: 4.2 x 105 km2
- Total water volume: 547,015 km3
- Maximum depth: 2,212 m
- Drainage basin: > 2 million km2
- Shoreline length: > 4,100 km
- Population: > 160 million people
- Riparian countries: 6 (Bulgaria, Georgia, Romania, Russian Federation, Turkey, Ukraine)

NW Black Sea Basin



Romanian Shelf Waters (<200m)

- Highly dynamic system
- Most productive area of the Black Sea
  - strongly influenced by the Danube's discharges
  - climatic processes
- High temporal variability of optimal blooming conditions

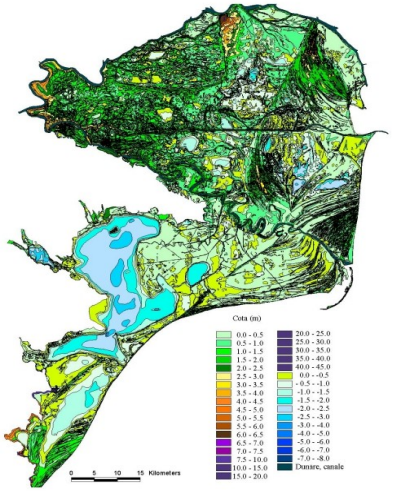


Open Waters

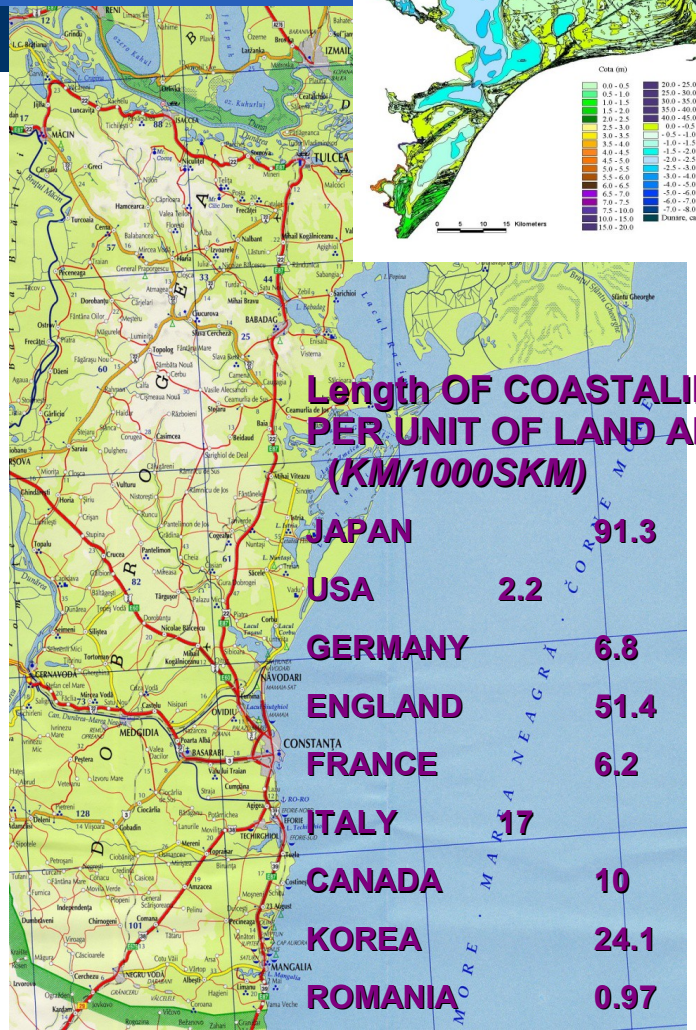
- Less productive system
- Less temporal variability of favorable blooming conditions
- Production mainly influenced by climatic processes which govern stratification, upwelling and water masses circulation[1]

1. McQUATTERS-GOLLOP, A., MEE, D., L., RAITSOS, D., E., SHAPIRO, D., I., 2008, Non-linearities, regime shifts and recovery: The recent influence of climate of Black Sea chlorophyll, *Journal of Marine Systems*, 74, 649-658

2. ROMANIAN COASTAL ZONE
Danube Delta Area



- Over 244 km length (between Musura Branch si Vama Veche). Represent 6% of total length of Black Sea shore
- **Geographically** is formed by:
  - Natural shore (beach and cliffs – circa 84%)
  - Artificial shore (ports, coastal structures for protection - circa 16%).
- **The charactheristical zones of the shore are divided in two geomorphological units:**
- ***Northern unit*** **(the Danube Delta and the Razim-Sinoe lagoon complex), stretching on 170 km, from Ucraina border to Midia and consist on shore with delats, lagoons and levees, been formed of marine-river accretions, recent shells sands, desposed under shapes of beach and litoral belts with relativelow cota, often less than 2m;**
- ***Southern unit*** **(Cap Midia - Vama Veche, at Bulgarian border), with a approximatelly length of 74 km, it is a relative high shore, with cliffs, mostlly active, of maximum high is ircca 35 m., and small beaches at basis**



MARINE PROTECTED AREAS

1 SITE UNDER BIRDS DIRECTIVE

ROSCI0 9 Danube Delta – marine zone (ov lapping on the marine zone of DBR - 103.000 ha)

ROSCI0237 Methanogenic Structures from Sfantu Gheorghe (co 6.000 ha)

ROSCI0197 Submerged Beach from Efori (140 ha)

ROSCI0273 Marine Zone from Cape Tuzl (1.790 ha)

ROSCI0094 Mangalia Underwater Sulphuro Springs (360 ha)

ROSCI0066 Vama Veche – 2 Mai marine zone: (overlapping on Marin Reserve, 5.000 ha)

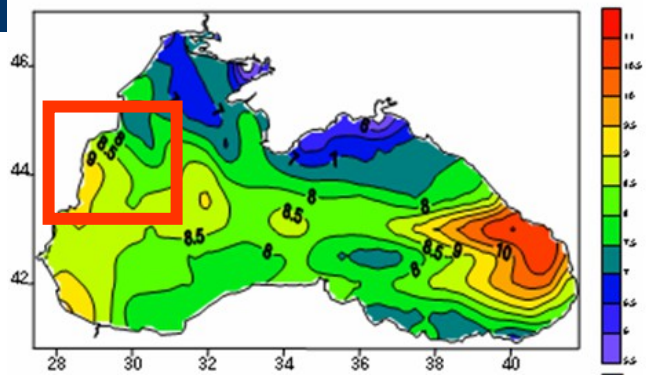
6 SITES UNDER HABITATS DIRECTIVE

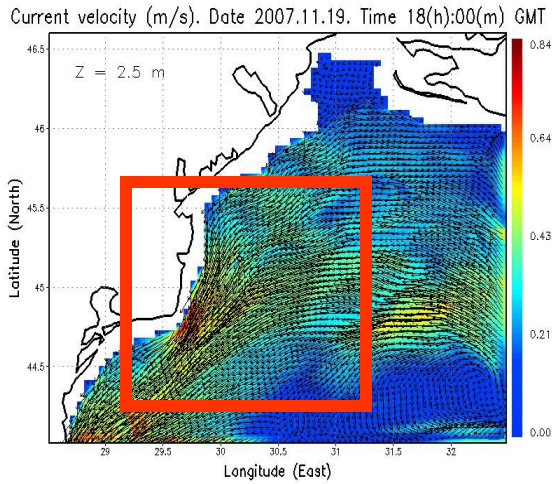
Danube Delta Coast - cont

Hydrology/Hydrodynamics

- Waves regime

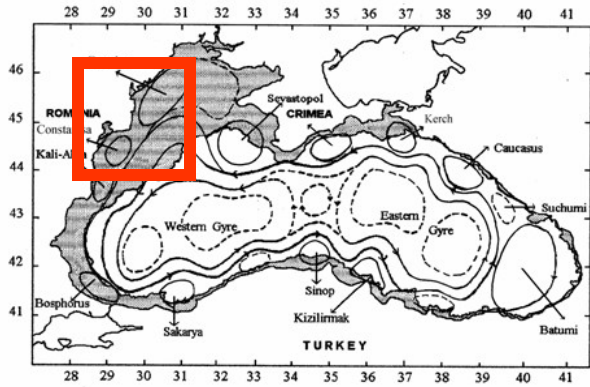
  (N. Valcev 2005)



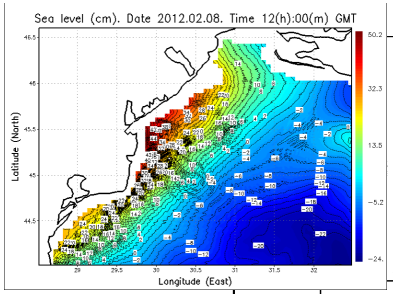


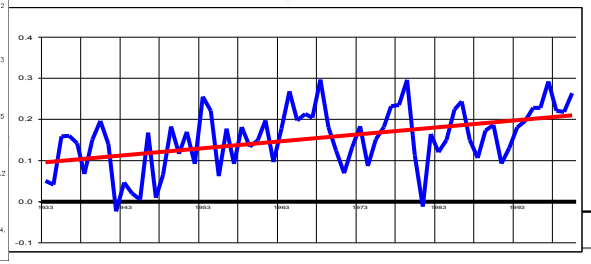
- Currents regime

(http://www.rmri.ro/RMRI/Forecasts/ForecastsRO.php)

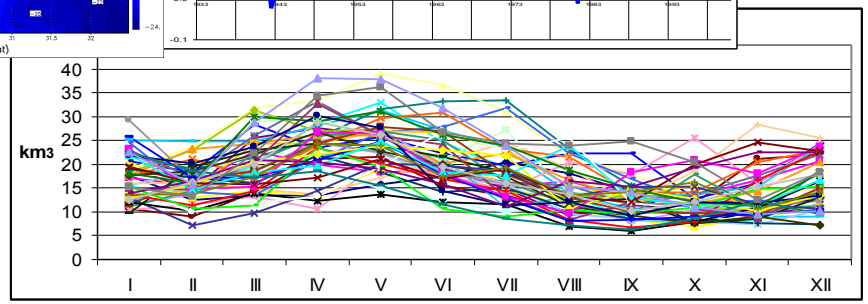


- Sea-level variability
- (Eurogoos-IOC site)

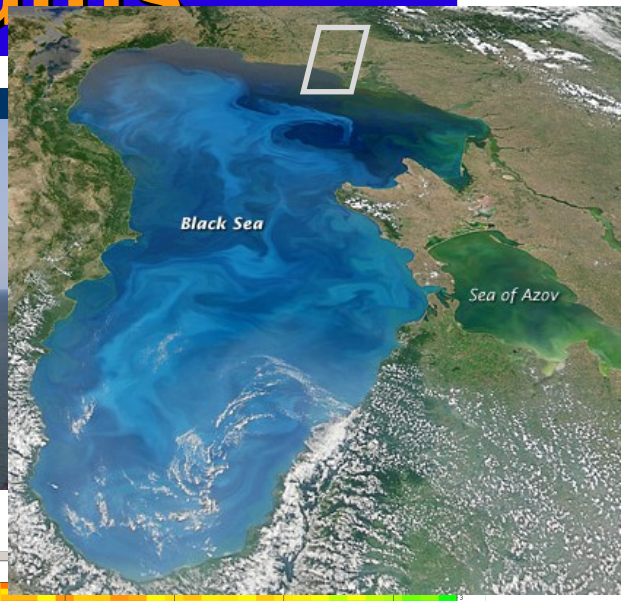


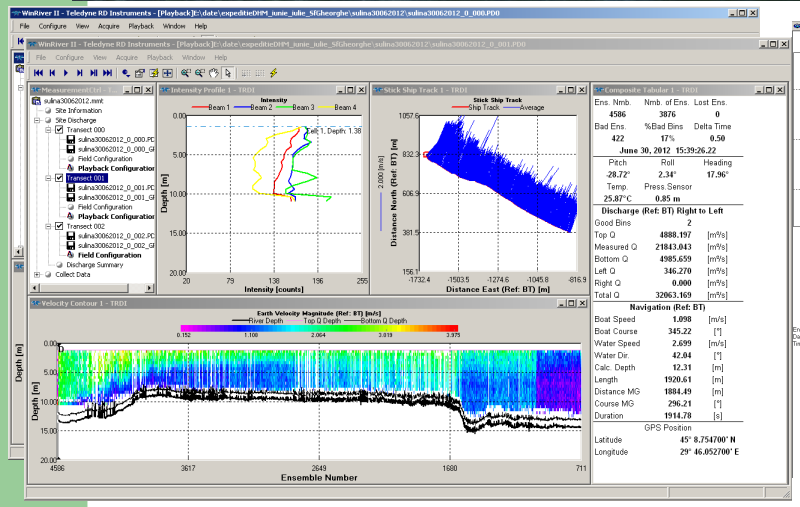


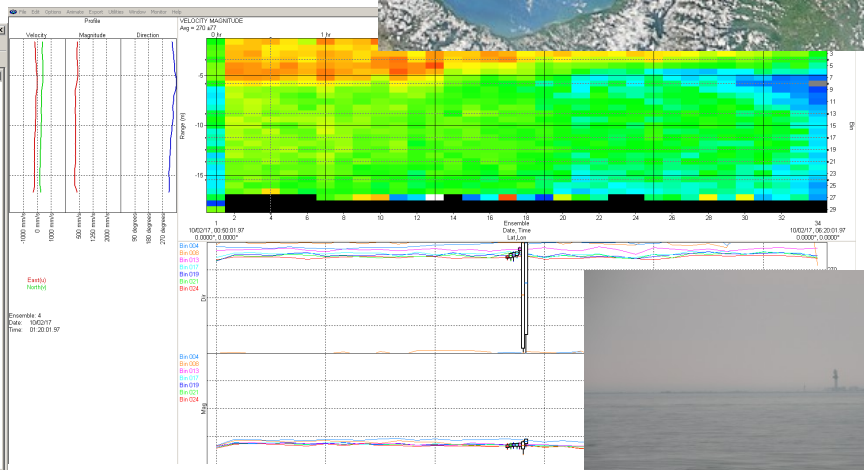
- Danube river discharge



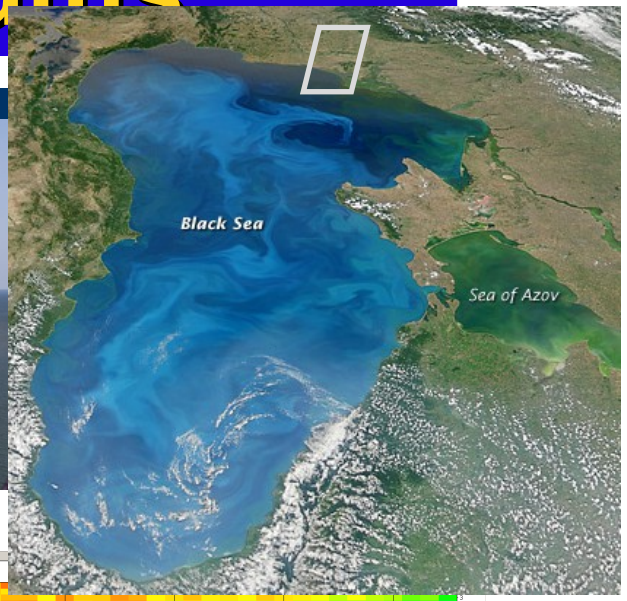
Water fronts in front of Danube Mouths

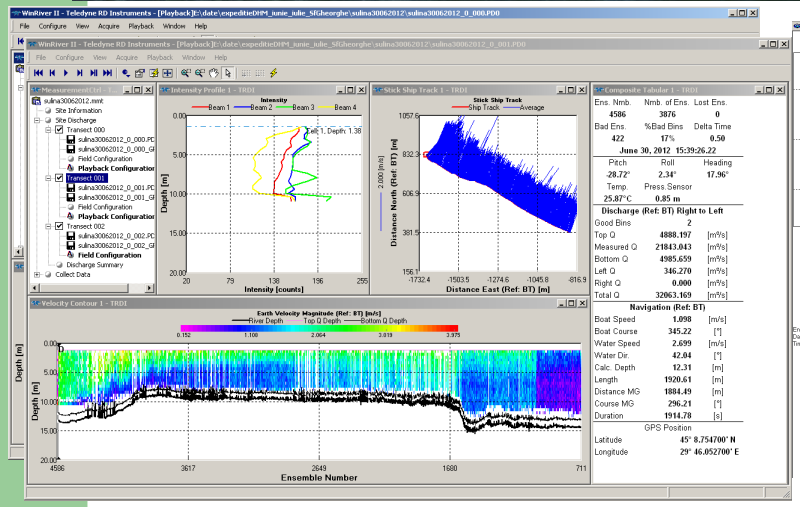


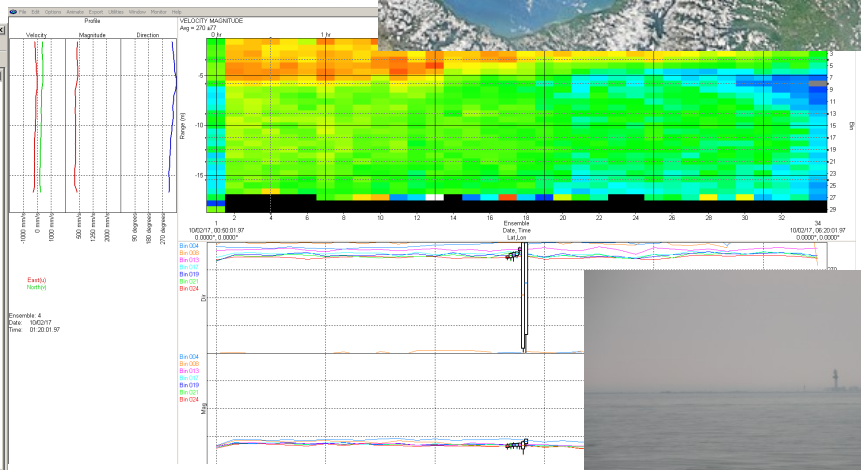




Water fronts in front of Danube Mouths



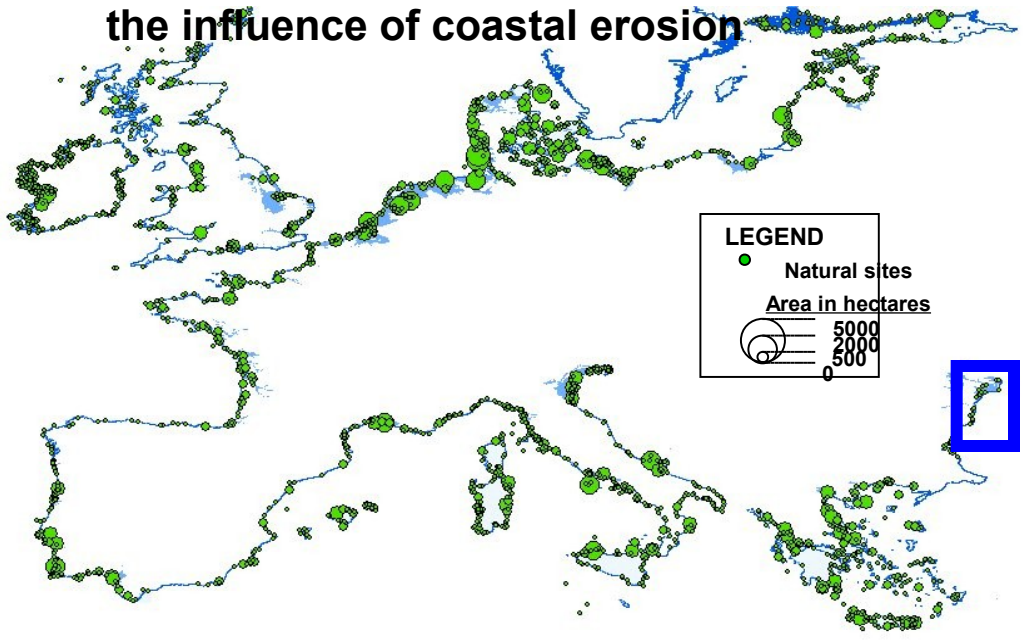


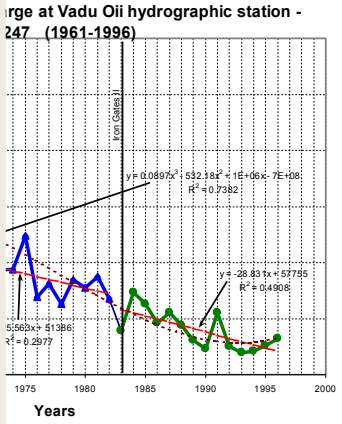


Danube Delta Coast

Human Intervention affecting Geomorphology

-
-
-





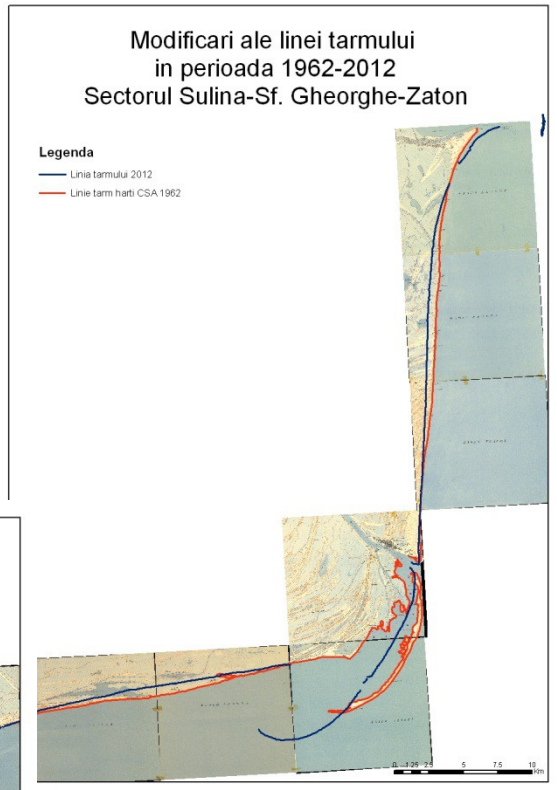
3. Geomorphological changes 1962-2012

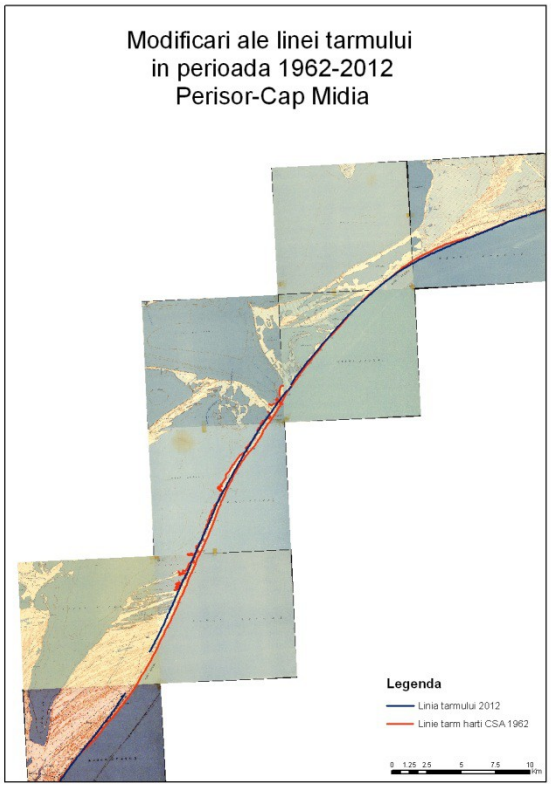
Shoreline retreat, it were affect the norther littoral in more that 70%,

- land losses cumuled for all coast a surface more than 2600 ha (between average values of 45 - 55 ha/an).

- accretions registered less than 350 ha (7 ha/an),

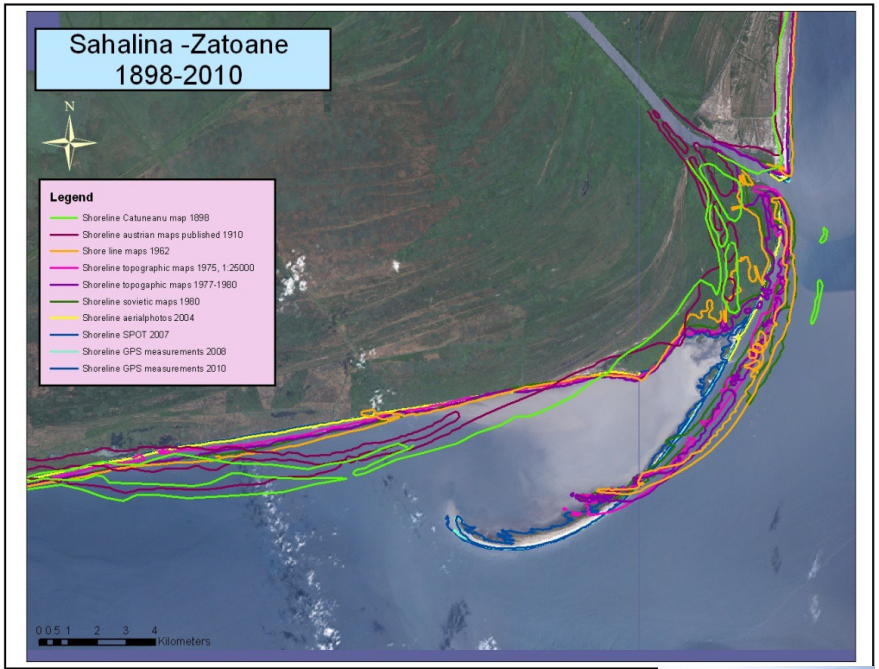
- erosion/deposition being of 7.5% (2300 ha loss)

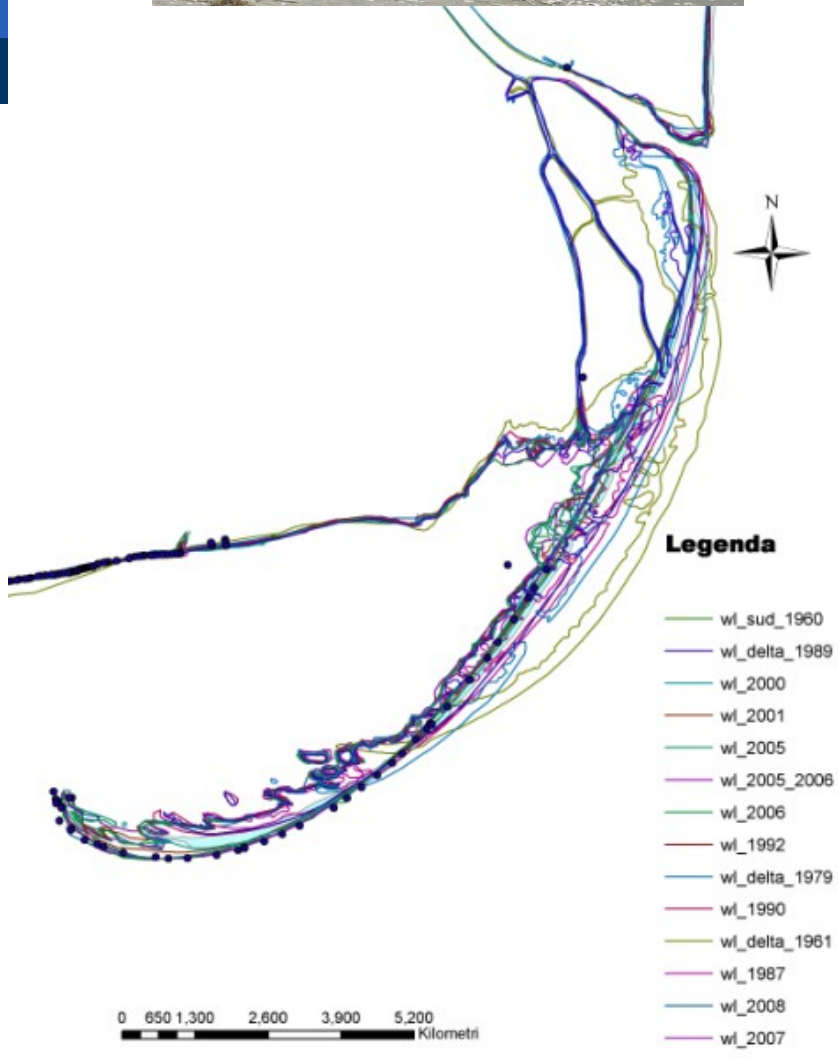


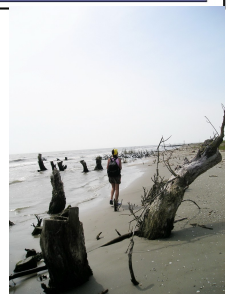


Method(s): map vectorization, and GPS Measurements

Shoreline Mapping

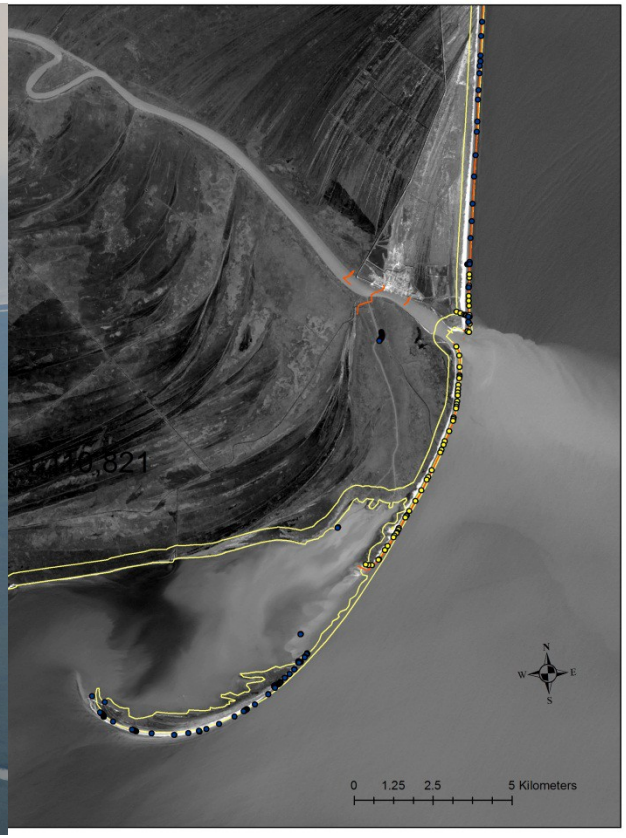






Sahalin Island:
sand spit surface variability

Sahalin Island - may 2013

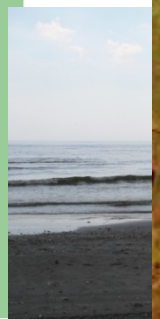


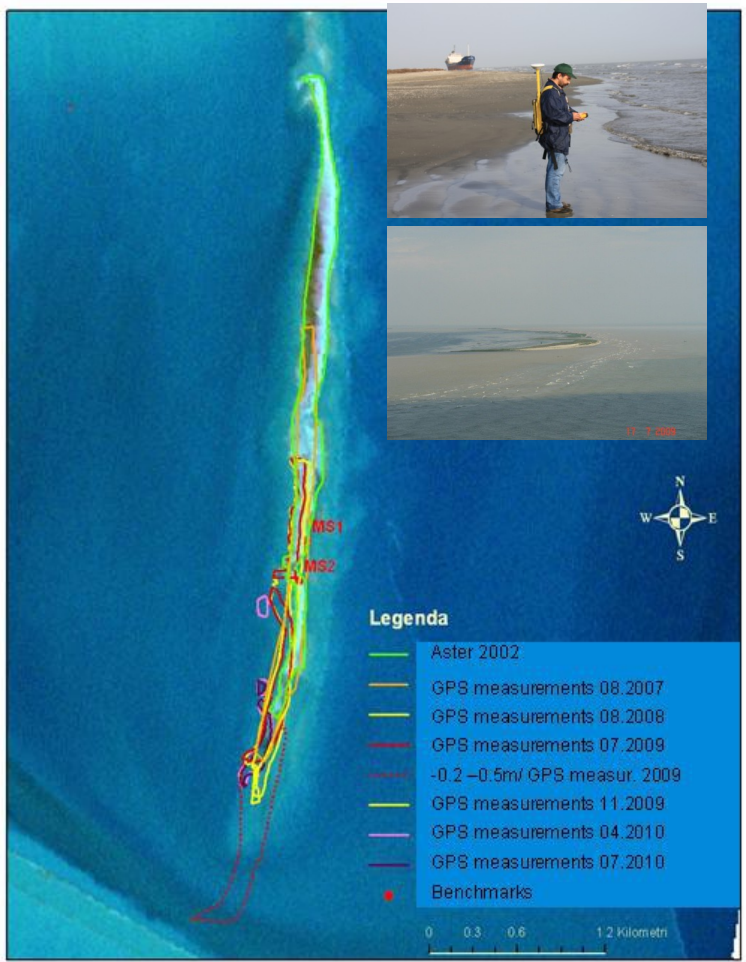
Musura Bay

Shoreline Mapping

Island Musura Bay
Shoreline 2002-2010

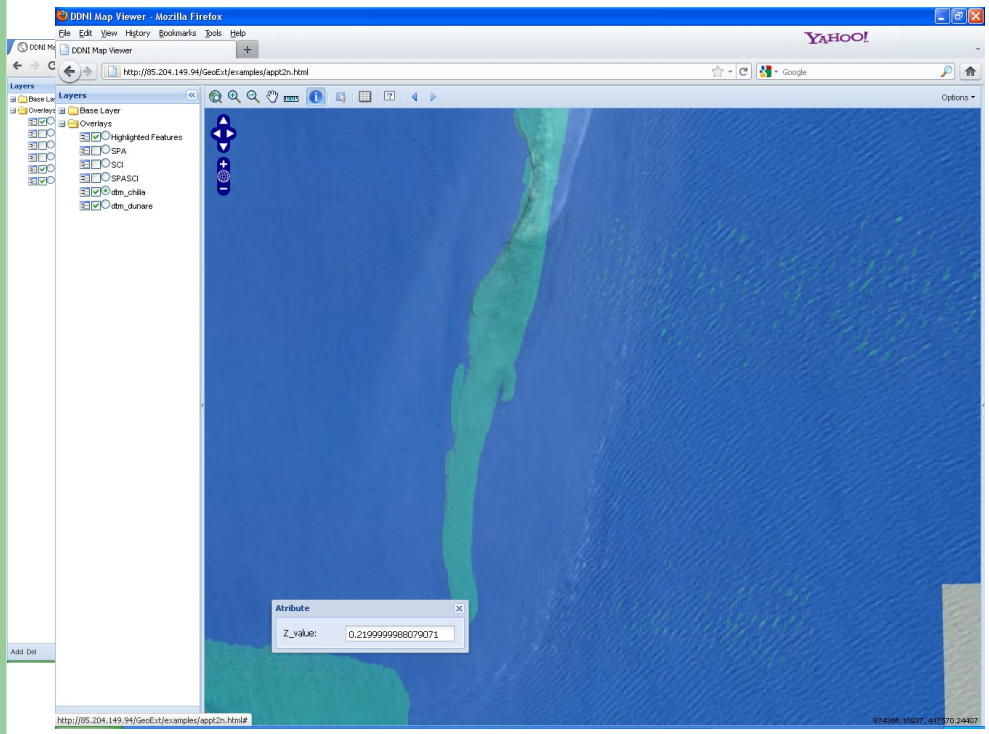
- Shoreline position: aerial photography, historical maps, satellite images, recent GPS measurements: 2005 - 2011

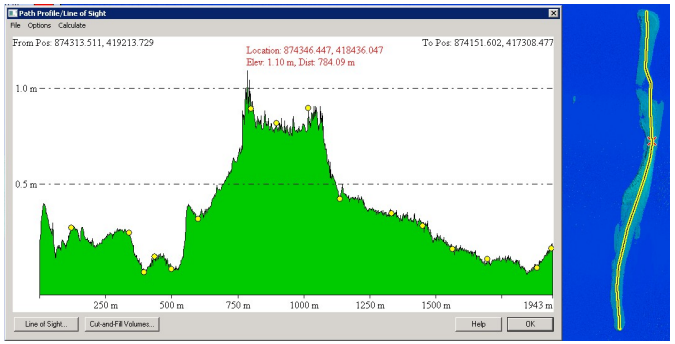




Musura Bay: sand spit geomorphology

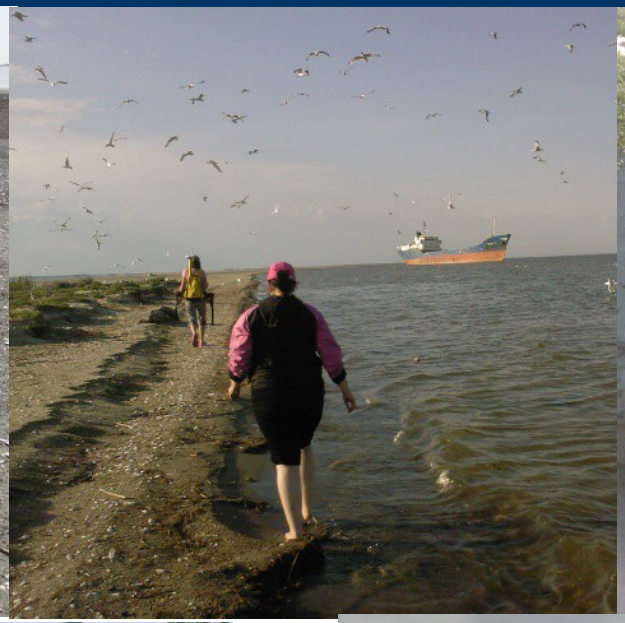
- DTM obtained by LIDAR measurements



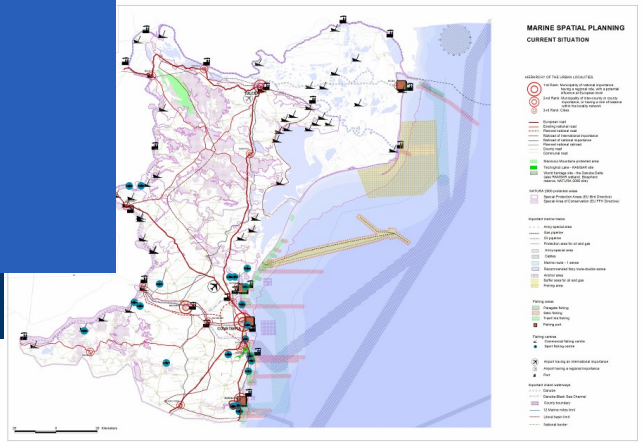


4. Ecological Aspects

Sulina/Musura Area

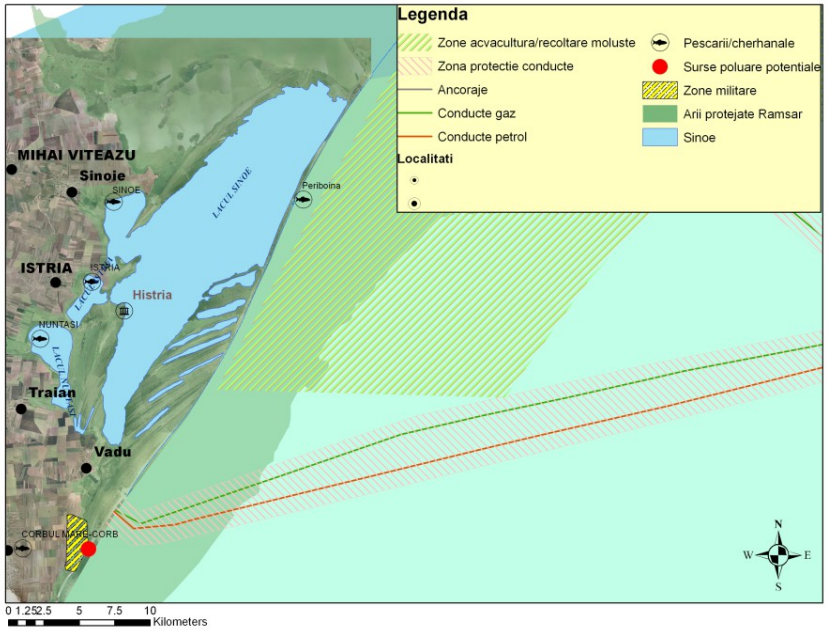


Socio-Economical Aspects



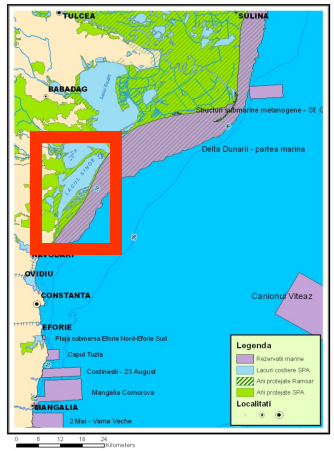
Ecological Impact

Similarities with Sinoe Lagoon - Protected Reserves and special zones (for Conservation Bird and Habitat Directives) PART OF DDNBR SINCE 1993



Sinoe Lagoon was ecologically unbalanced, and its aquatic environment was degraded due to the inlets closing through hydrotechnical constructions

MPAs



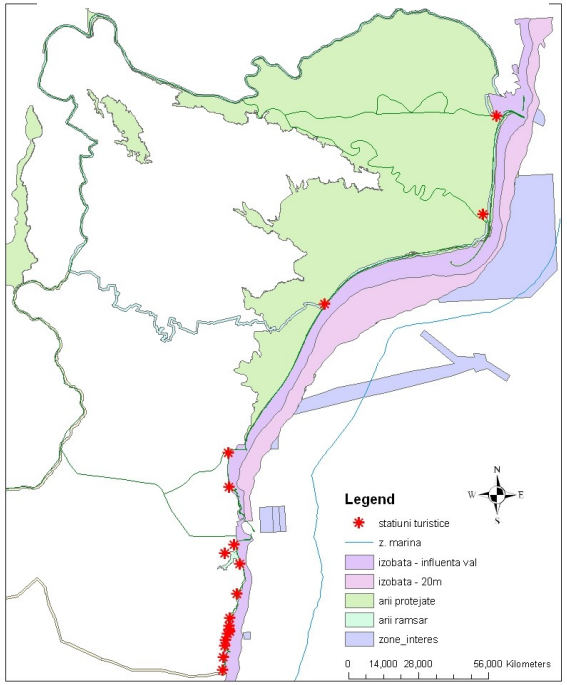
Changing habitats: lagoon => lake

5. Ecosystem vs. Local Development/ICZM implementations

Ongoing Projects in the Danube Delta Area:

- **Implementation of the Masteplan for coastal protection/Halcrow 2011**
- **Danube Delta Master Plan**
- **Law projects: Musura Bay Dredging**
- **Sulina – spatial planning**
- **Razim-Sinoe Complex – ecological rehabilitation**

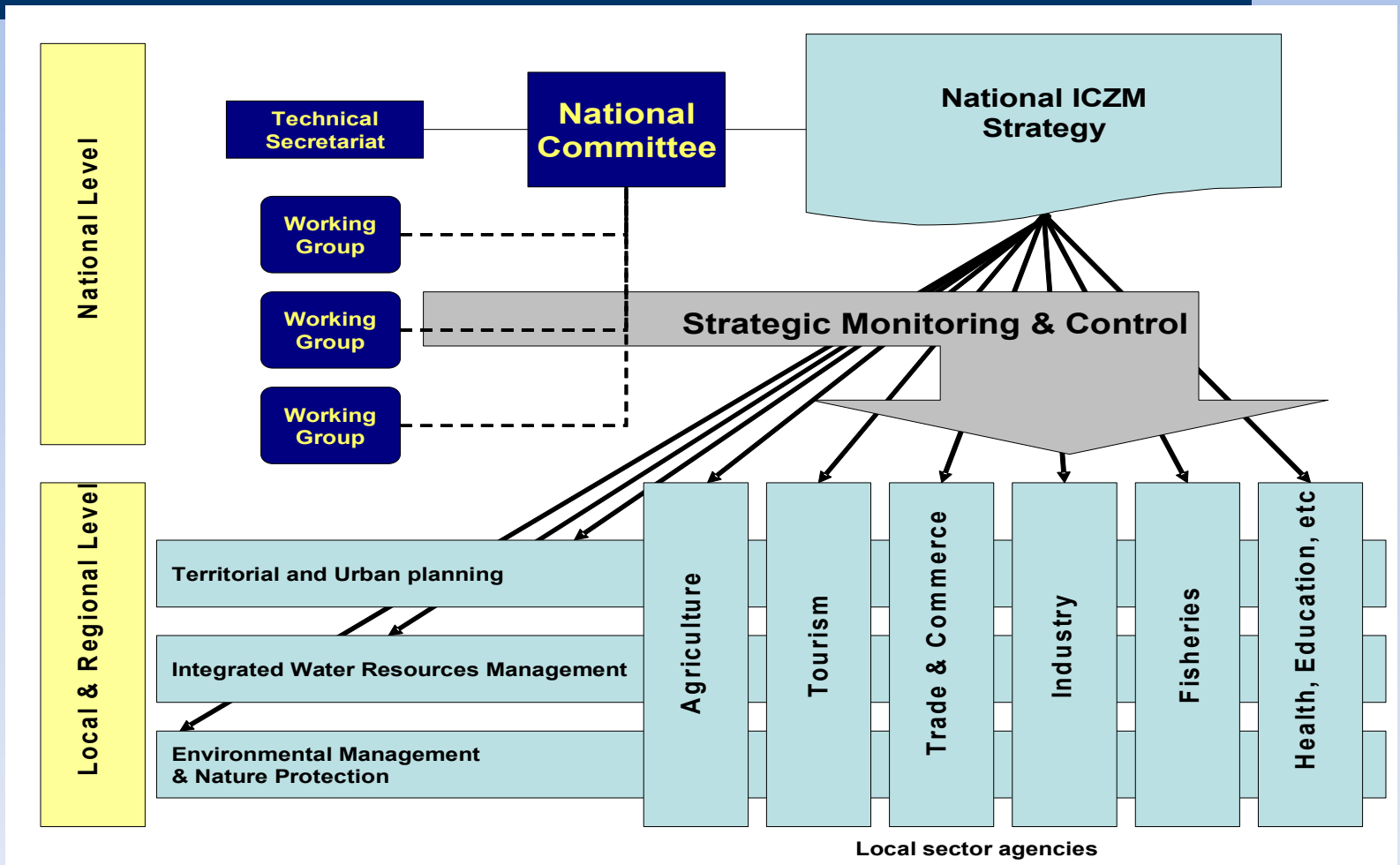
Romanian Coastal Zone



Institutional and legislative measures

- underlined in Coastal Law

- Specific **legislation** in course of updating - coastal zone law or development - ICZM Strategy& Action Plan
- **Institutional structure**: National Committee, Working Groups &Technical Secretariat



SUPPORT of the MARINE INTEGRATED MONITORING (SUB)SYSTEMS:

1. Marine pollution monitoring ;

2.Shellfish water monitoring;

3. Monitoring and control of dangerous substances in dredged sediments from ports and maritime shipping channels;

4. Monitoring of ballast waters;

5. Monitoring of coastal erosion;

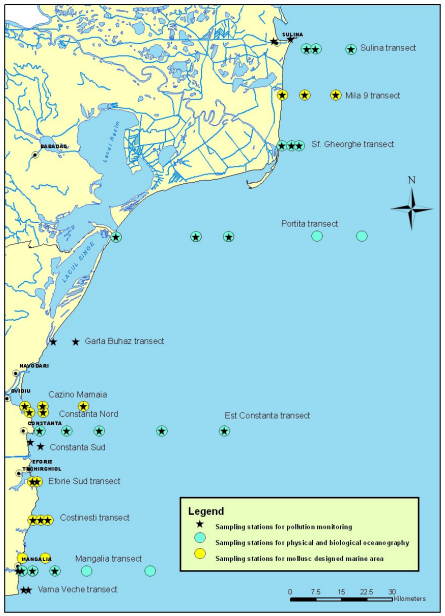
6. Monitoring of the biological diversity, including marine mammals populations and marine habitats in the protected areas;

7. Monitoring of dolphins' accidental catches and stranding;

8.Monitoring of the bathing waters and beaches quality (collaboration with Sanitary Directorate);

9. Monitoring of extreme marine phenomena (extreme surges, tsunamis);

10. Monitoring of accidental oil pollution (when needed).



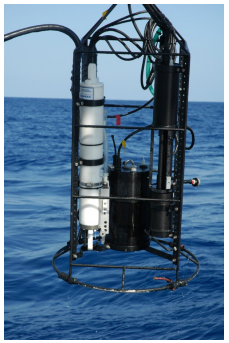
Marine Integrated Monitornig System

Support of RS projects

« MyOcean », a project *for ocean monitoring and forecasting in Europe*

"Bio-Optical Characterization of the Black Sea for Remote Sensing Applications" (Bio-Optical) *NATO SfP project # 982678*

"Ocean colour – Application for the Western Black Sea"
(ROSA/ESA support) Period of development: 2010 – 2013




RO-NODC

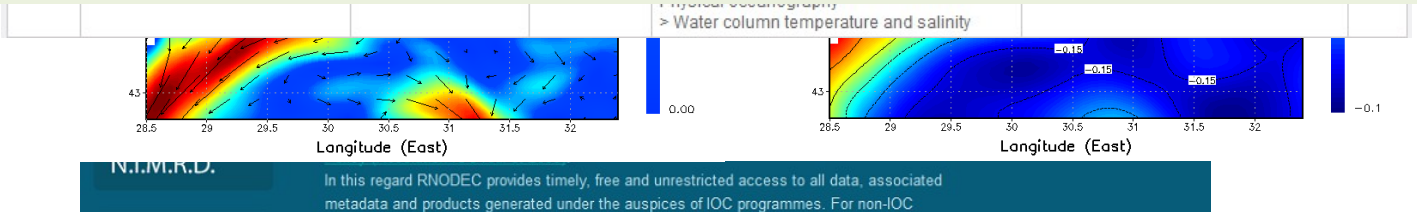
www.nodc.ro

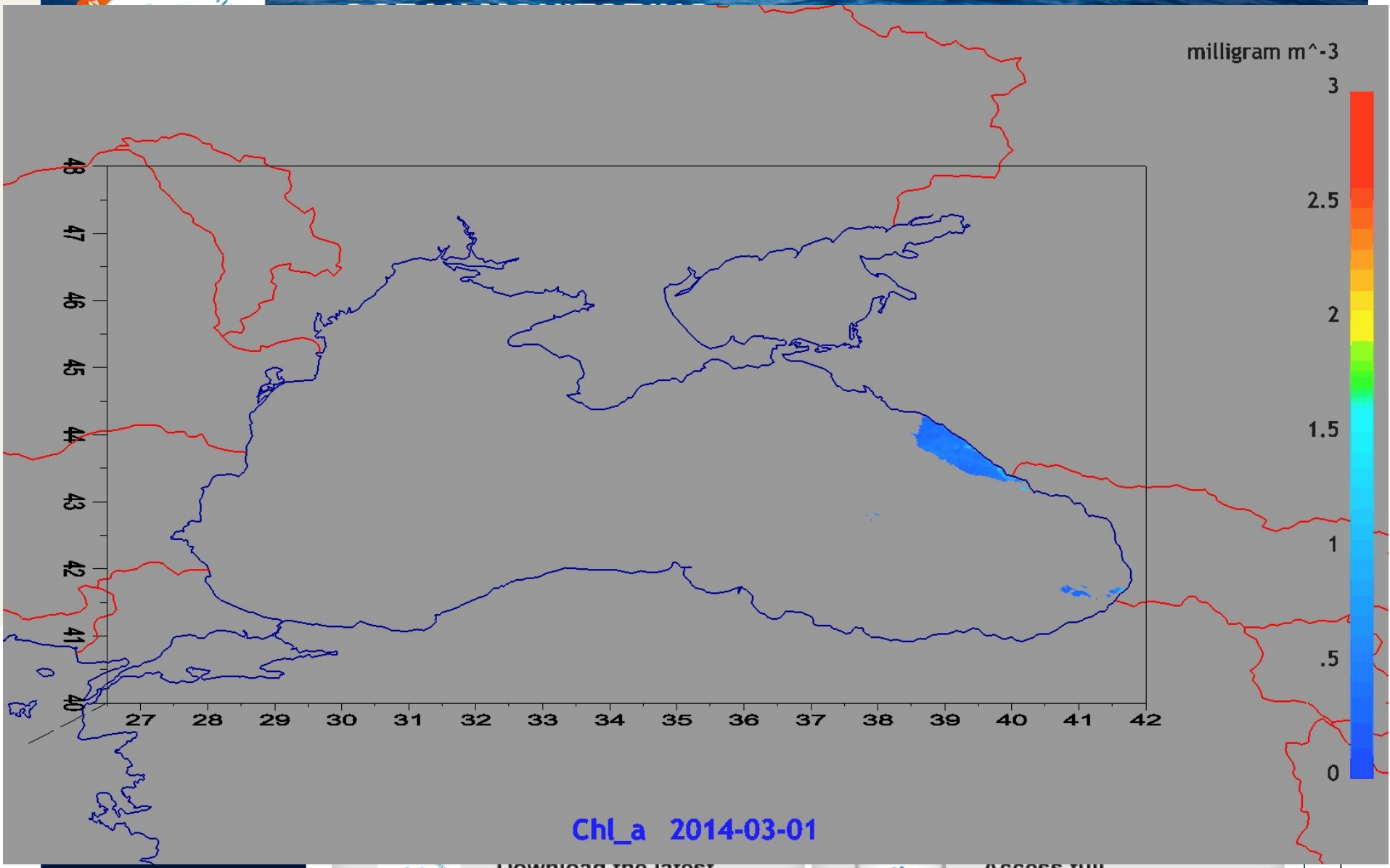
Oceanograohic database

Oceanographic forecast

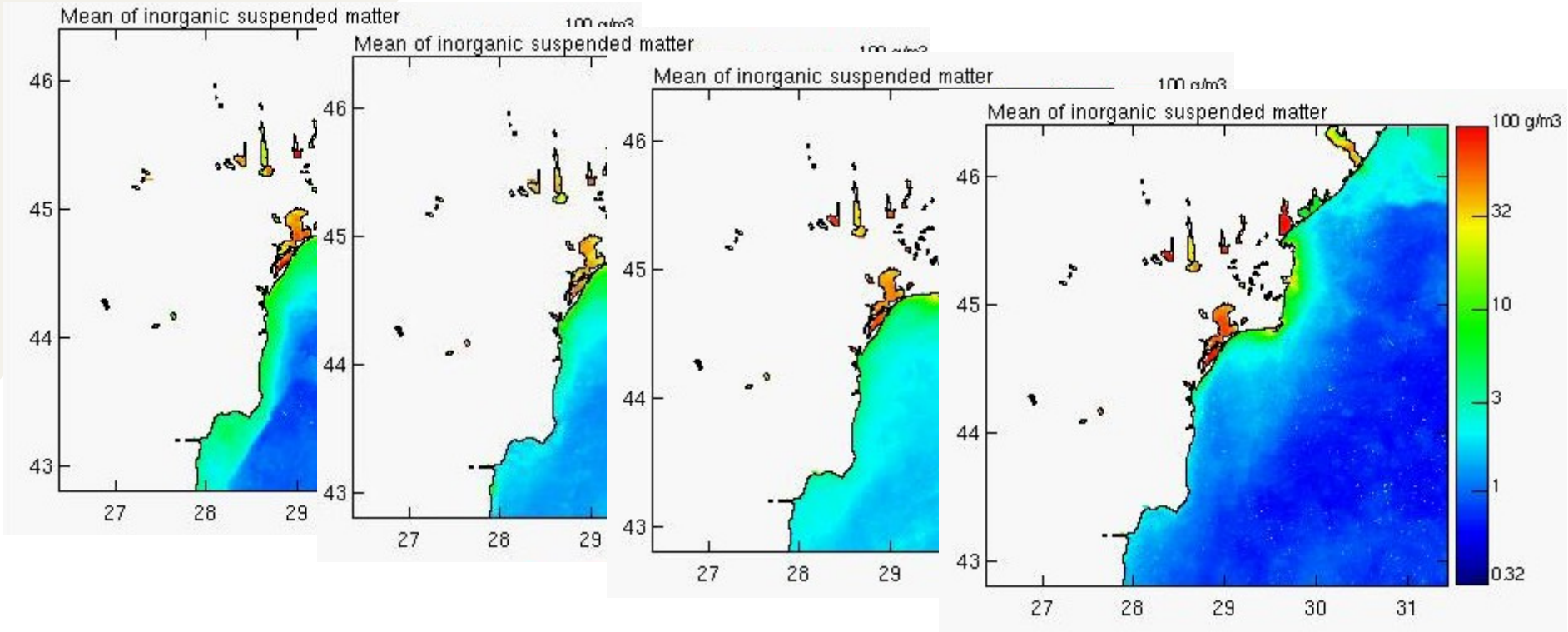
Strategic Objectives:

- To collate oceanographic data, archive, store it and maximize its utilization;
- To enhance the availability of high quality oceanographic data for a wide group of users;
- To promote data exchange on national/international level.



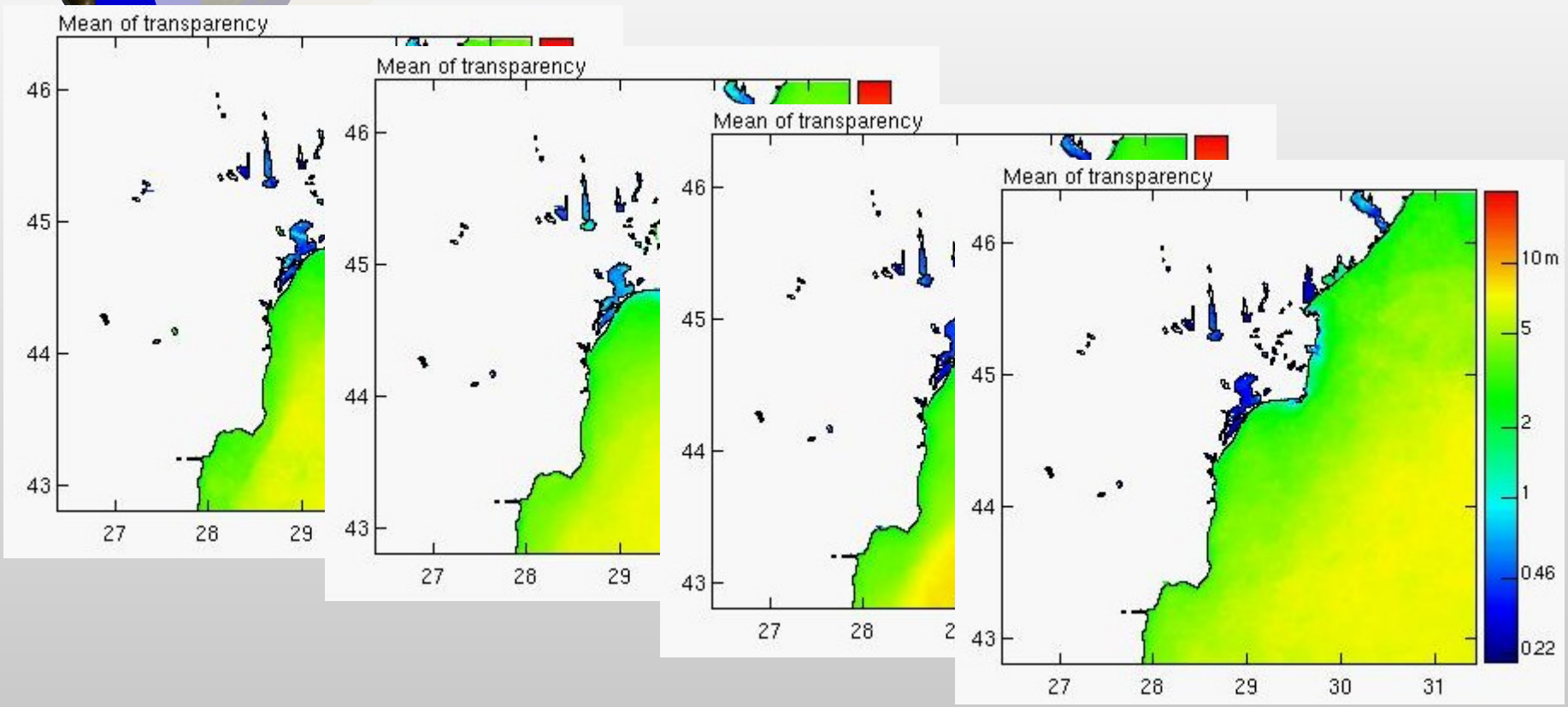


Seasonal distribution of WQ Parameters



Mean inorganic suspended matter

Seasonal distribution of WQ Parameters



Transparency

Algorithms developments – 2012 by JRC, Ispra, within NATO SfPS project "Ocean color"

Rationale and Justification

Current limitation in the operational use of satellite ocean color data in the Black Sea and in other marginal seas is the *lack of regional bio-optical algorithms linking the satellite signal to the specific water quality indicators*.

Main aim: the development of specific regional bio-optical algorithms on the basis of comprehensive data sets of statistically *representative in situ measurements.*

Multi Layer Perceptron (MLP) neural networks algorithm

This section summarizes the specific application of Multi Layer Perceptron (MLP) neural networks developed to derive Chlorophyll-a concentration $C_{hl\text{-}a}$, absorption of the yellow substance at 412 nm $a_{ys}(412)$ and concentration of the total suspended matter TSM from remote sensing reflectance R_{RS} spectral values for the Western Black Sea (D' Alimonte et al. 2011)

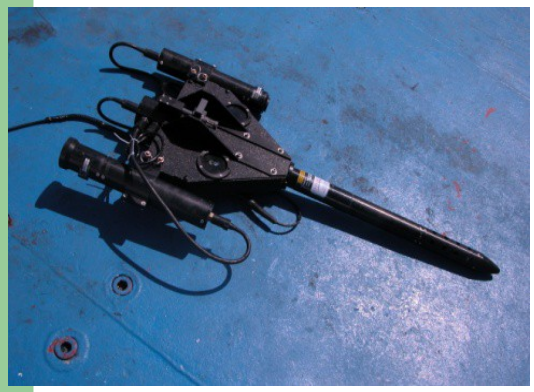
The applicability of *regional* bio-optical algorithms has been verified with the Medium Resolution Imaging Spectrometer (MERIS) remote sensing reflectance R_{RS} (see Kajiyama et al. 2012)

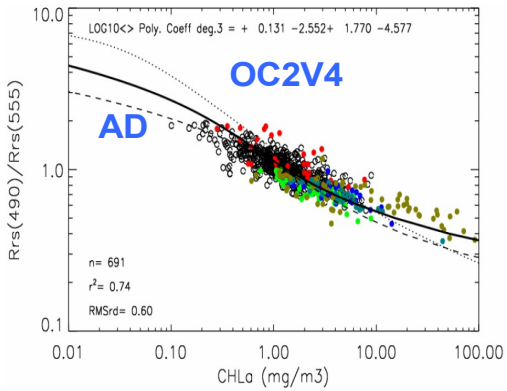
Specific objectives

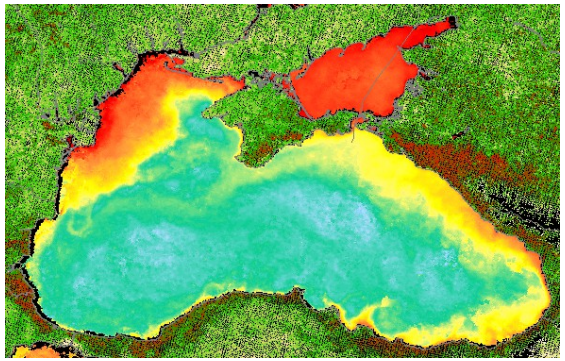
Creation of an in situ data set of optical proerties (inherent and apparent) and concentration of constituents

Development of bio-optical algorithms for the determination of optically significant seawater constituents

Generation of satellite ocean color products of the Black Sea freely accessible through web interface







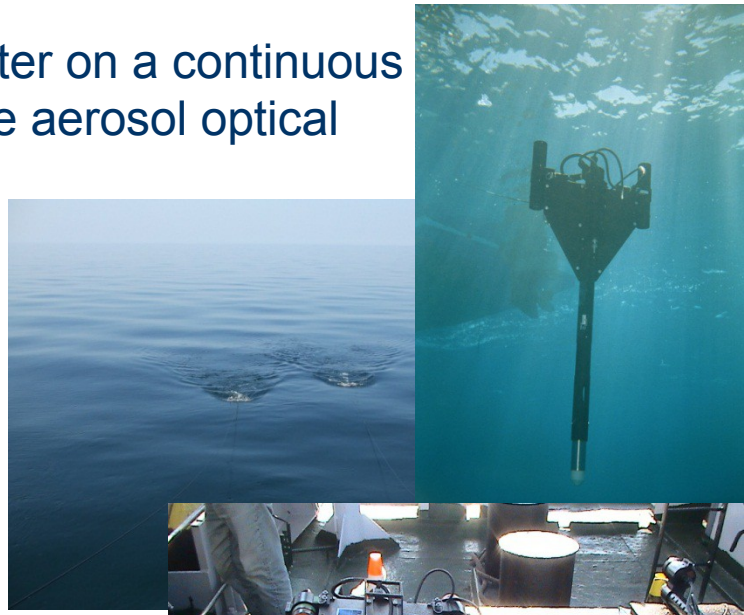
The project realization

- operating an autonomous above-water radiometer on Gloria Oil platform in front of the Romanian coast/Danube Delta Biosphere Reserve
- producing data for the continuous assessment of the atmospheric correction process of current satellite ocean colors sensors
- part of the international AERONET-OC network.
- long-term operation: NIMRD with the support of the JRC > ensuring real-time data, available from the AERONET-OC data base and also from the ESA MERMAID server.

In situ Data collection

- within the framework of the series of oceanographic cruises:
  measurements of *apparent and inherent optical properties of seawater*, in addition to the concentration of optically significant constituents

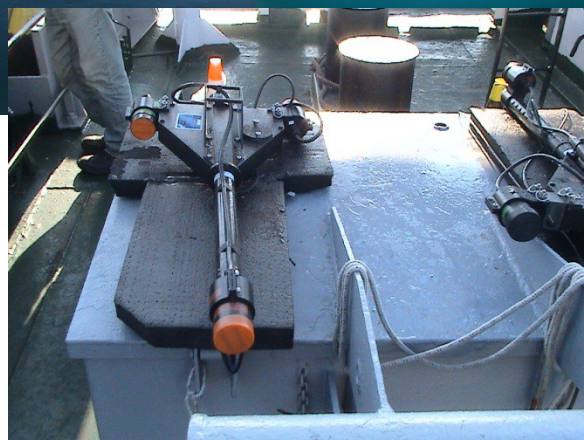
- with the autonomous above-water radiometer on a continuous basis: the remote sensing reflectance and the aerosol optical thickness



AOP: the remote sensing reflectance and the diffuse attenuation coefficient
(all determined through in-water radiometric profiling).

IOP: the absorption, scattering and back-scattering coefficients (determined through in-water profiling).

Concentrations of specific seawater suspended constituents include those of pigments and total suspended matter
(determined from laboratory analysis of water samples).

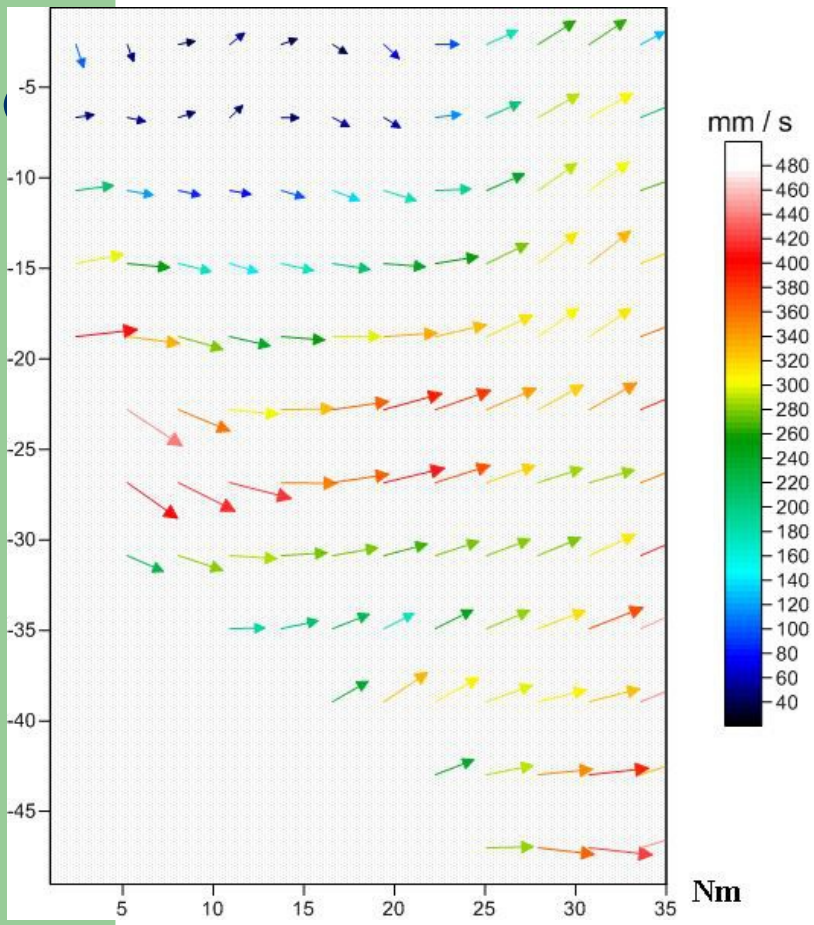


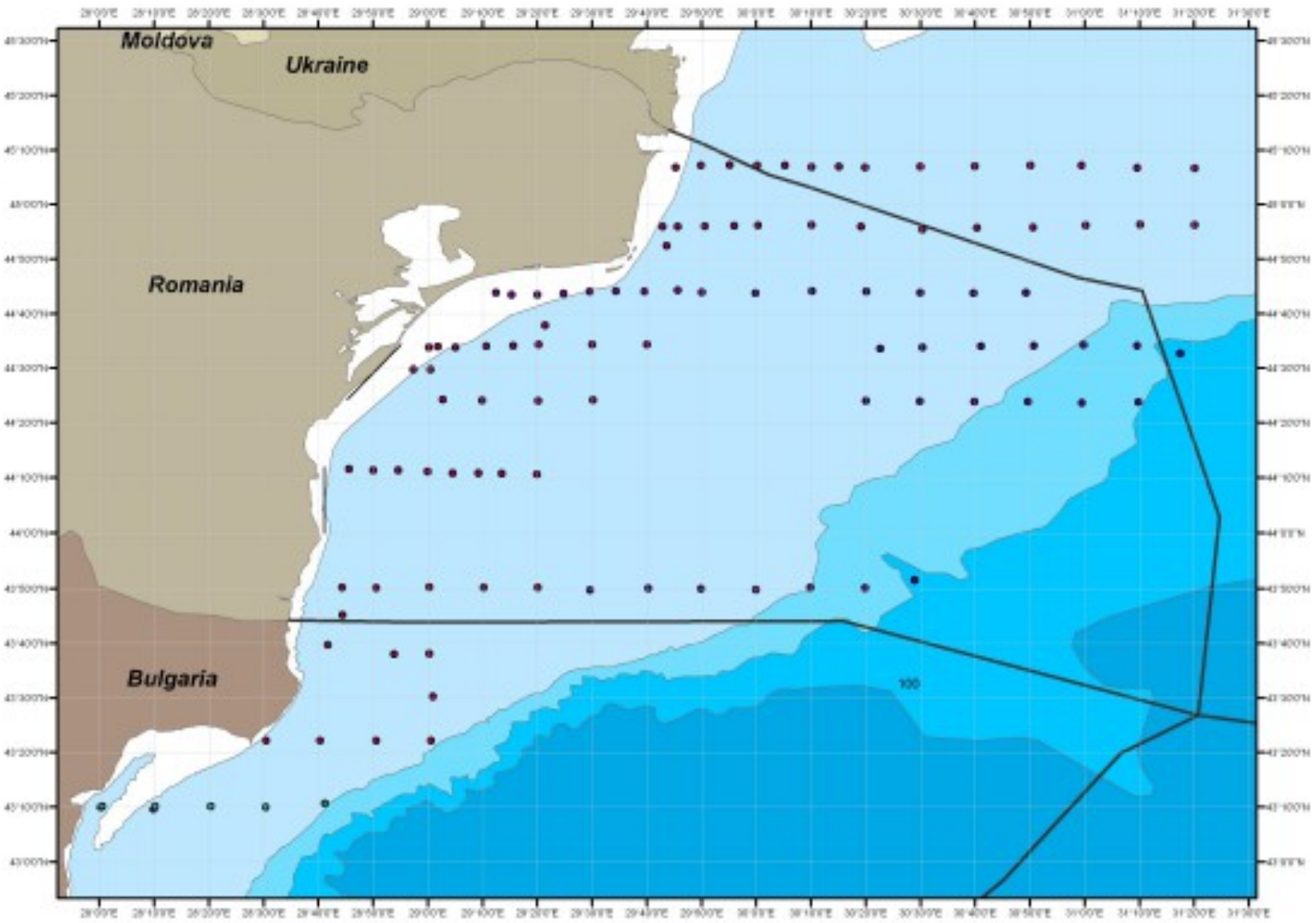
Parameters monitored *in situ* and remote sensing

- **Chlorophyll *a***
  - commonly used parameter for the estimation of phytoplankton biomass and primary production
  - included in the list of indicators of eutrophication within WFD
  - proposed indicator related to "Direct effects of nutrient enrichment" criteria (Descriptor 5) in the MSFD

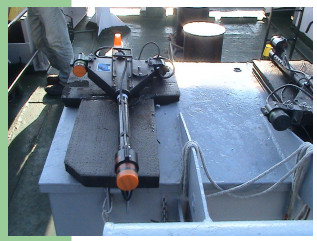
- **Transparency**
  - strongly related to the amount, size, composition of suspended material (sediments and organic material)
  - Transparency related to increase in suspended algae is proposed as MSFD's indicator (Descriptor 5)

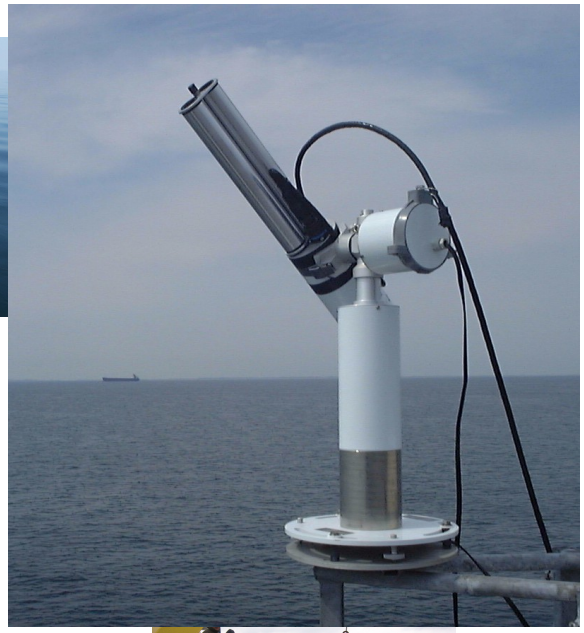
Academik Cruise - September 2012

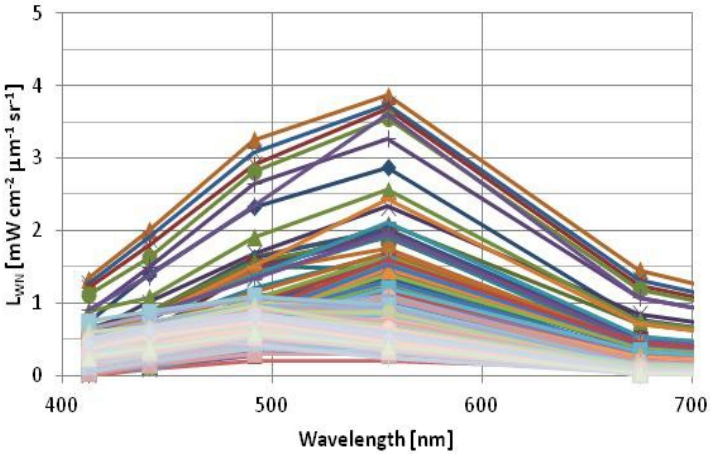



Moldova
Ukraine
Romania
Bulgaria
100

Gloria AeroNet-OC site - in order to sustain the continuous data acquisition - transmission, 6 expeditions for system maintenance were sustained, including wet sensor maintenance and battery changes and adding an extra solar-panel, as well.







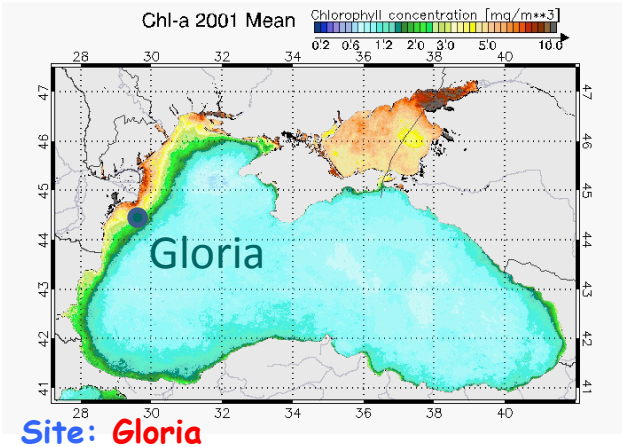
EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Gloria AeroNet-OC site

SeaPRISM

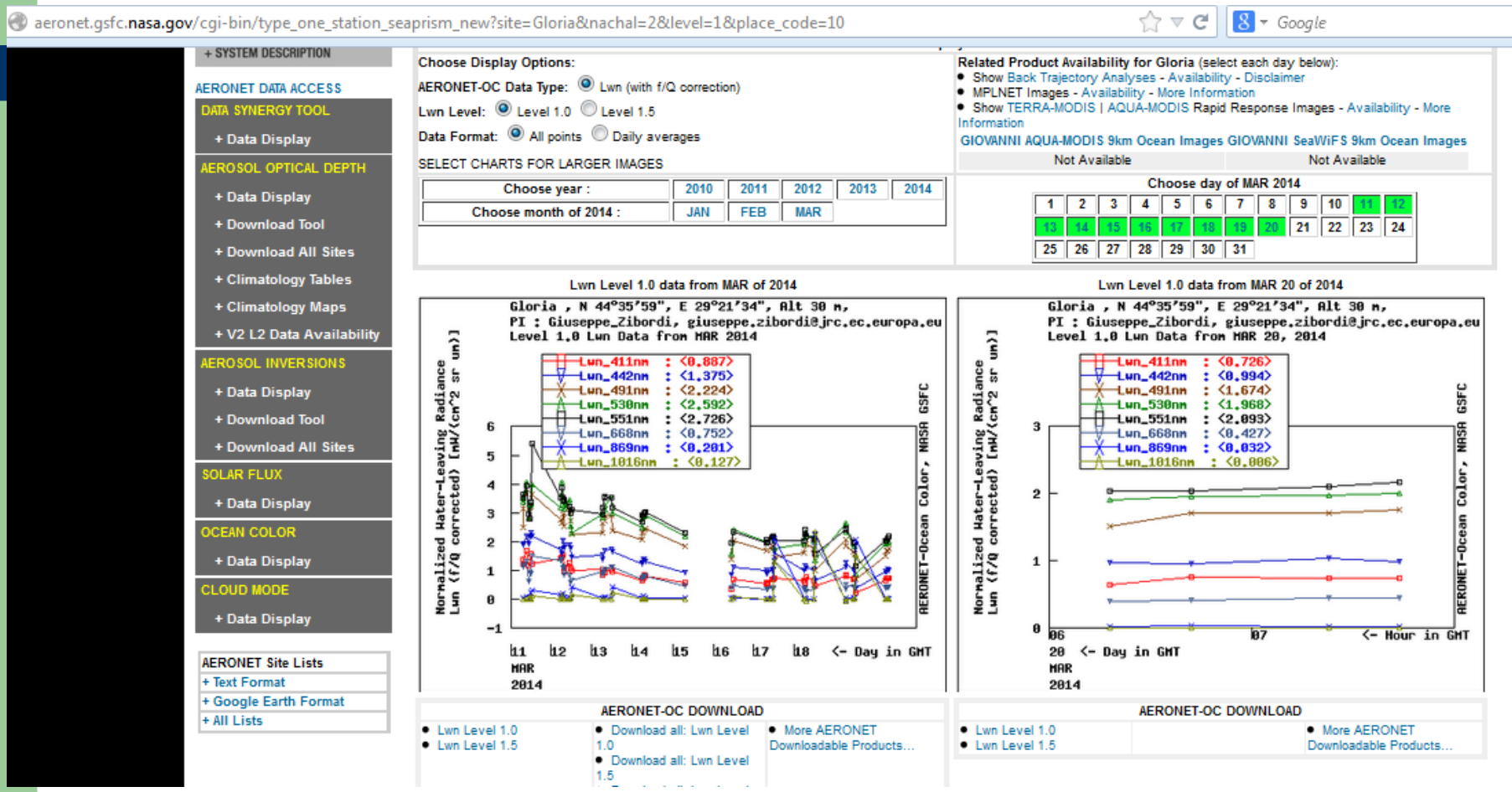
Gloria Platform

Complex Logistics



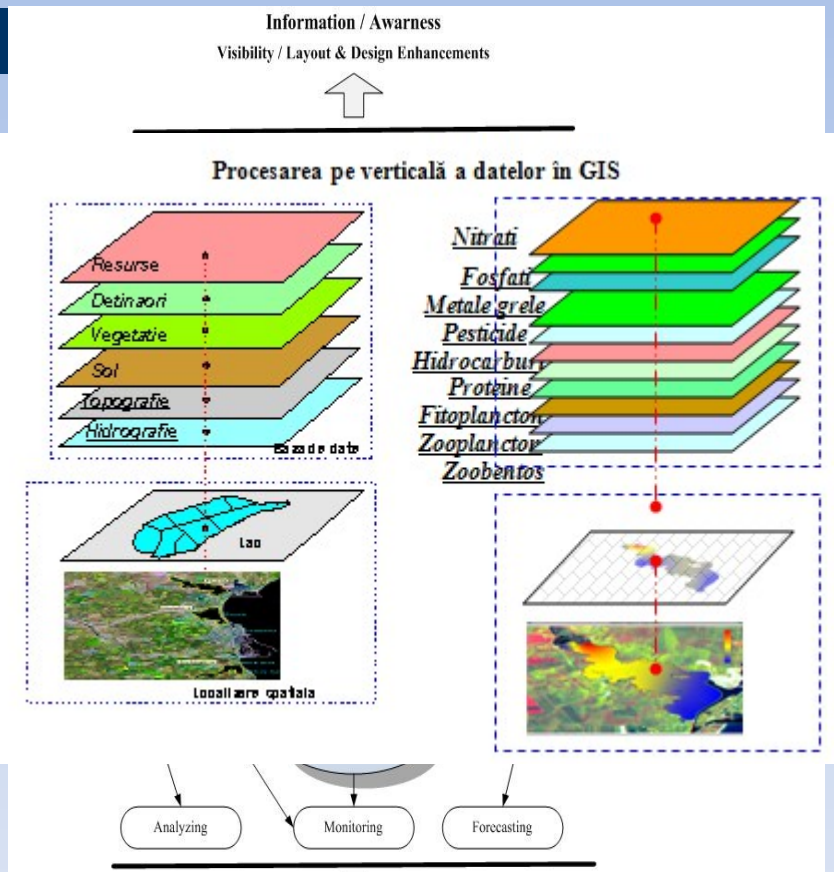
Site: Gloria
Location: Black Sea
Water type: Case-2 (sed. dom.)
Water depth: 50 m (height: 30 m)
Distance: ~20 nm
Period: 2010-present

Data from the SeaPrism Radiometer



Support activities for implementation: On-going national actions/projects

1. ECOMAGIS: **IMPLEMENTATION OF A COMPLEX GEOGRAPHIC INFORMATIC SYSTEM FOR ECOSYSTEM-BASED MANAGEMENT, THROUGH INTEGRATED MONITORING AND ASSESSMENT OF THE BIOCOENOSIS STATUS AND ITS EVOLUTION TRENDS IN A FAST CHANGING ENVIRONMENT AT THE ROMANIAN COASTAL ZONE OF THE BLACK SEA** considered as a continuation at a superior level of the PN2-32164/2008 project IMAGIS ”Complex system for the application of the GIS and remote sensing techniques to support the environmental quality monitoring and ICZM process implementation in the Romanian coastal zone”.



Supporting networking/collaboration, project developments and information access for marine and land use decision *within NCCZ*

WEB-GIS COMPONENT

The WEB-GIS component fulfils requirements of presenting relevant information in the scope of the project and raise awareness of professional partners/public regarding the evolution of marine and coastal environment indicators.

System Functionalities:

Spatial Data Access: WMS: Interactive, complex information within simple format

Documents and Processes Management: pdf fo

Support Information System for Analysis and S

and European data portal : SDN, BSFS, etc.

These functionalities allow achieving the following objectives:

1-GIS

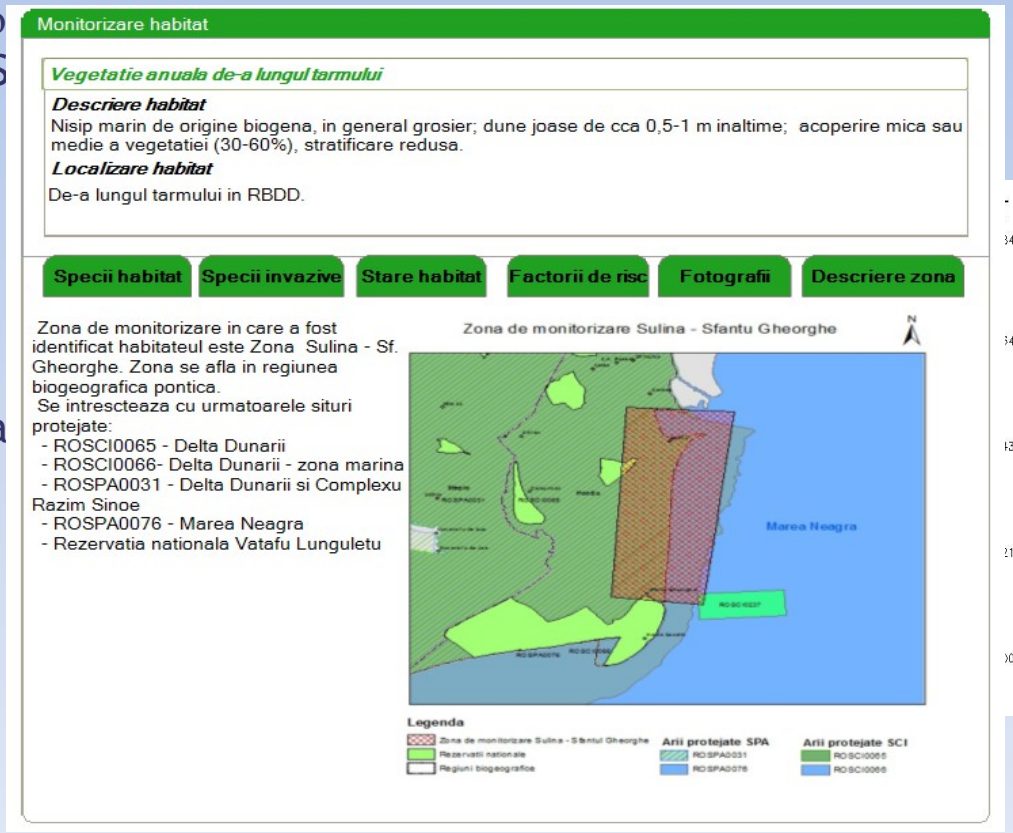
- Identify vulnerable and high risk areas
- Description of time evolution of monitored a
- Management of protected areas

2- Documents and Processes Management:

- Real – time data processing
- Data Analysis/ Auditing / Validation /
- Redundant information reduction

3- Analysis and simulation system:

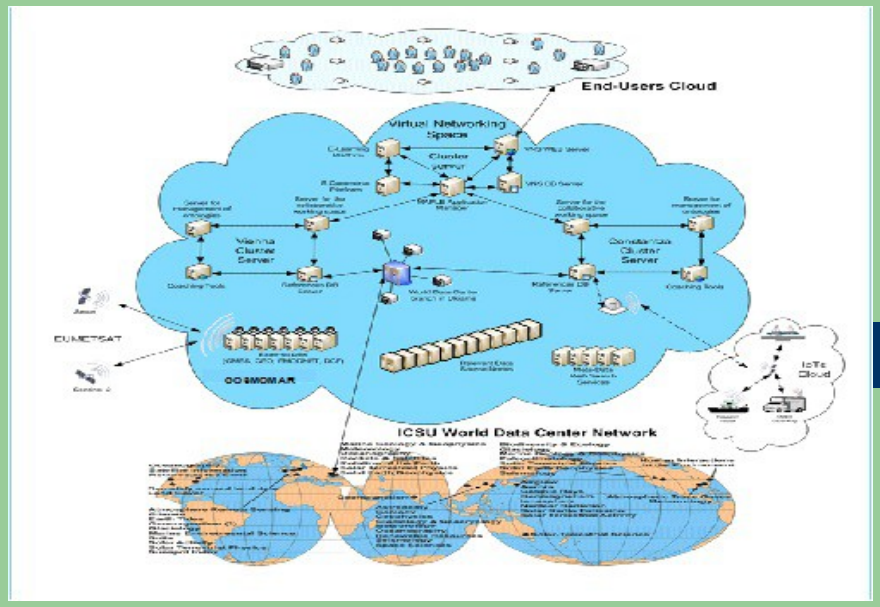
- Reports/Statistics
- Notifications/Alerts



"Constanta Space Technologies Competence Centre Dedicated to the Romanian Marine and Coastal Regions Sustainable Development"

Acronym: COSMOMAR

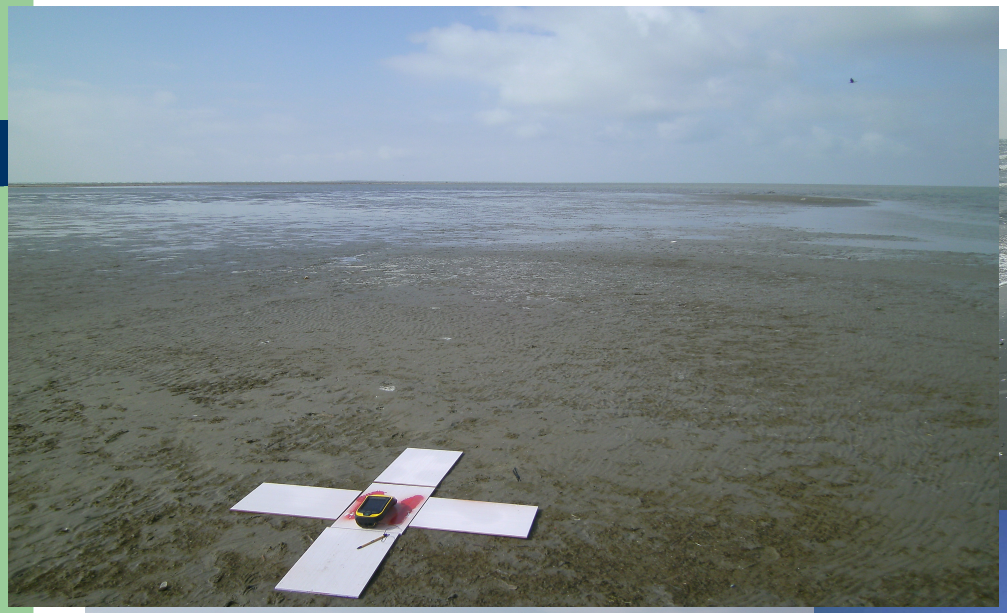
(Programme for Research-Development-Innovation for Space Technology and Advanced Research - STAR)



- Testing equipment / start the pilot studies
- Connection with RO-NODC and activities / services provided by COPERNICUS

- start of the Centre Arrangement/construction/renovation

Using of AUVs



Conclusions

- Romanian coastal area is confronting with a significant issues toward European WFD/ICZM/MSPD's Implementation and also:
- Implementation of the national coastal law/ICZM rules and regulations

Erosion control

- In the near future, the implementation of the conservation-rehabilitation measures outlined by the Masterplan for the erosion control/dredging activities

WQ – monitoring

- Developing a monitoring-modeling-management systems/tools for WQ control

❑ improved data validation

➢ extended coverage area for *in-situ* measurements through common cruises (future collaboration with other institutions)

collect discrete samples (spatial and temporal) – when is possible

❑ better use of GIS&RS products: web application support/WMS

➢ better dissemination (more papers based on these data)

➢ use data in more national and international projects

➢ use data in other research areas (i.e. fisheries, marine ecology)

➢ assimilation of technology of processing and delivery

Conclusion – cont.

- The CZ's ecological & physical condition: not optimal for the ecological integration, and it is crucial to consider the ecosystem based practices for Romanian BSCZ

- **Implementation of WEB-GIS** to support CZ/ICZM policies has great socio-economic importance for coastal stakeholders and contributes to the CZ protection and management, as well for the coastal delimitation/delineation policy and also contributes to the sustainable development of the CZ

7. Acknowledgments

The work was supported by the strategic grant of the Romanian Ministry of National Education, CNCS - UEFISCDI PN-II-PT-PCCA-2011-3.2 1427 (project ECOMAGIS/ no. 69/2012), and STAR/ROSA grant no.58/2013.

THANK YOU FOR YOUR ATTENTION !