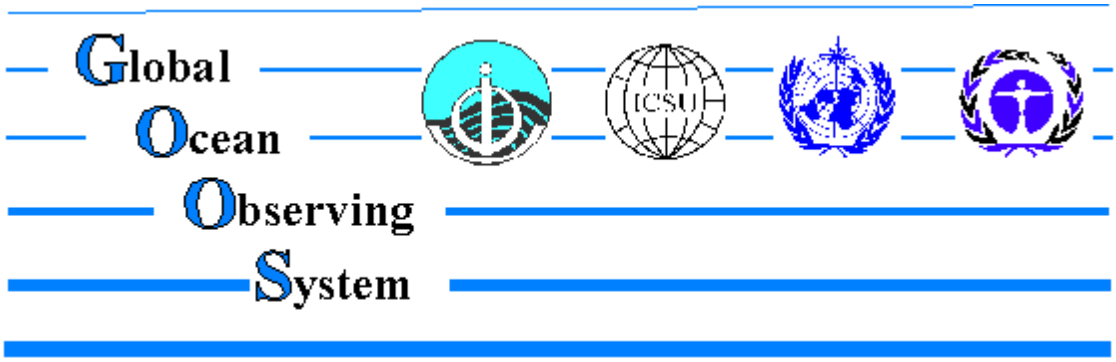

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

Black Sea GOOS Workshop

Second Session
Poti, Georgia
22-25 May 2001

GOOS Report No. 109

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IOC-WMO-UNEP-ICSU/Black Sea-GOOS II/3
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Abstract

This report presents the results of the second Black Sea GOOS workshop. The first Black Sea GOOS Workshop was held in Albena, Bulgaria, 11-15 October 1999. The purpose of the meeting was (i) to advance the strategy and implementation plans for Black Sea GOOS; (ii) to discuss user needs; and (iii) to establish a formal Black Sea GOOS Steering Committee to oversee the further implementation of an observing system for the Black Sea. Background information was provided on GOOS, EuroGOOS, Black Sea environmental programme, SeaNet, national observing activities/plans in the riparian countries, and user needs for marine products. The workshop approved in principle a draft science and implementation plan, and a memorandum of understanding that established a Black Sea GOOS Steering Committee.

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ANNEXES

1. OPENING

Professor Valery Eremeev, Chairman of the IOC Black Sea Regional Committee (BSRC) opened the meeting. He thanked Jemal Inaishvili and Devi Gvalia both of the Port Authority of Poti for the excellent arrangements made in preparation of the meeting and the generous hospitality. Valery Eremeev stressed that the principal aim of the meeting would be to develop a scientific organization and the financial base for an integrated operational oceanographic observing and forecasting system for the Black Sea. Such a system should be built in a cost-effective and on existing systems that would be adaptable to the changing understanding of the marine environment dynamics and evolving technologies. The specific objectives of the meeting would be to: (i) review national and international reports on the ongoing relevant activities; (ii) discuss and advance the science and implementation plans for Black Sea GOOS; (iii) establish a formal Black Sea GOOS Steering Committee; and (iv) discuss user needs and recommendations. In closing, he emphasized that all the Black Sea riparian countries should actively support, at governmental levels, the national marine observing systems and relevant forms of international regional cooperation.

Pata Shevardnaze, Co-ordinator of the UNESCO Caucasus Programme, welcomed the participants on behalf of the Director-General of UNESCO. The Caucasus project is a multidisciplinary project, which addresses sustainable development in the context of environmental problems. Social and economical acceptability of environmental decisions are tied with the history and culture of national and ethnics groups living in the Caucasus region. Pata Shevardnaze stressed that in developing high technology, construction of pipelines and renovation of port facilities one should not only try to preserve nature, but also attempt to make those projects in full harmony with social, economic and cultural acceptability of the population engaged in the development. In closing he noted that Black Sea GOOS would be an important contribution and tool for the sustainable development and management of the Black Sea and its coastal zone.

Jemal Inaishvili, General Manager of the Port of Poti, provided welcoming remarks. He provided a history of the Port of Poti and informed about the planned harbor expansion supported by the World Bank. In closing he expressed his best wishes for a productive meeting and generously offered logistic support and assistance during the meeting.

In his welcoming remarks Dr. Avto Koridze, Executive Director of Georgia International Agency for Sustainable Development, provided an enthusiastic recount on how *Jason* and the *Argonauts* embarked, according to the legend, to find the Golden Fleece in the land of Colchis, a kingdom at the sea's eastern tip (now Georgia). He then drew attention to the Georgian plans for a Centre for Sustainable development and Management of the Black Sea Coastal Zone in Poti and invited the meeting to consider a Georgian proposal for recommendation (Annex VII) of such a centre.

Additional welcoming remarks and support statements to the Black Sea GOOS effort were provided by Nic Flemming, Director of EuroGOOS, Sergei Khodkin, Vice–Chairman of IOC, Irakhli Khomeriki, Head of the UNESCO Centre at Tbilisi State University.

Thorkild Aarup thanked Jemal Inaishvili, Devi Gvalia and Avto Koridze for the fine meeting arrangements. Thorkild Aarup then informed that the European Commission Research Directorate (ECRD) had been invited to the workshop. Due to logistical reasons they were not able to send a representative. Thorkild Aarup read a statement (Annex III) from the Director of ECRD, Dr. Christian Patterman in support of the Black Sea GOOS activities. Additionally Thorkild Aarup informed about the invitation to a delegation of Black Sea GOOS representatives to attend the 3rd EU Operational Forecasting Cluster Workshop in Brussels, 18-20 June 2001. He also conveyed supporting statements for the Black Sea GOOS initiative from Torsten Kruuse, General Secretary of the International Association of Marine Aids to navigation and Lighthouse Authorities (IALA) which see Black Sea GOOS as a facility that will lead to safer seas and protection of the environment. Thorkild Aarup also conveyed greetings from Pierre Lasserre, Director of the UNESCO Regional Office for Science and Technology for Europe (UNESCO–ROSTE, Venice, Italy). UNESCO – ROSTE has been working on a programme initiative to address on "rebuilding Scientific Cooperation in South East Europe". An international conference was held from 24-27 March 2001 on this theme (the proceedings are available

from UNESCO-ROSTE; see also http://unesco.dyndns.org/article/articleview/68/1/29/). The conference stressed that priority be given to a series of activities and projects considered vital for the recognition and integration of national science and technology into the larger European research area, as well as for up-grading existing cooperation and promoting new ones. The main priorities identified are the following: (i) improvement of the communication and data handling infrastructures in South Eastern Europe; (ii) improvement of the research infrastructures available and of the relations to the large infrastructures existing elsewhere; (iii) joint work in multi-disciplinary problem oriented projects; (iv) training and fellowships; and (v) training of science managers. Some of the recommendations from the Venice conference are relevant to the Black Sea GOOS activities, i.e., rapid development of electronic networks to facilitate collaborative research projects between different research centres at national and regional levels; collaborative projects within the environmental sciences addressing transboundary environmental problems; and advanced training on sustainable development. A ministerial round table will take place at the UNESCO General Conference (24 October 2001) which is expected to recommend that a "Donor's Conference" be held in 2002.

2. ADMINISTRATIVE ARRANGEMENTS

2.1 ADOPTION OF THE AGENDA

The agenda was adopted as shown in Annex I.

2.2 DESIGNATION OF THE RAPPORTEUR

Alexander Postnov was elected Rapporteur for the meeting.

3. INTRODUCTION OF DOCUMENTS FOR MEETING

Valery Eremeev introduced the working documents that had been provided by IOC prior to the meeting.

4. STATUS OF GOOS

Thorkild Aarup provided an update on GOOS and the coastal module of GOOS.

The United Nations Conference on Environment and Development (UNCED) called in 1992 for the creation of a global system of ocean observations to enable effective and sustainable management and development of seas and oceans, and prediction of future change. The establishment of such a system was also urged by the Second World Climate Conference in 1990 to provide the oceanographic data needed by the Global Climate Observing System (GCOS).

The overall objectives of GOOS are:

- to specify in terms of space, time, quality and other relevant factors, the marine observational data needed on a continuing basis to meet the common and identifiable requirements of the world community of users of the oceanic environment and ocean knowledge;
- to develop and implement an internationally coordinated strategy for the gathering or acquisition and the archiving of these data and synthesizing them for common use and practical application;
- to facilitate the development of uses and products of these data, and encourage and widen their application in the sustainable use and protection of the marine environment;
- to facilitate means by which less developed nations can increase their capacity to contribute, acquire and use marine data.

GOOS measurements are characterized in that they are:

Long term	- continue indefinitely
Relevant	- selected with products and users in mind
Systematic	- scales, accuracy and precision aimed at specific objectives
Cost effective	- select efficient, economical methods
Routine	- carried out in operational manner

The planning and implementation of GOOS is being overseen by the GOOS Steering Committee (GSC). An Intergovernmental GOOS Committee (I-GOOS) assists in gaining intergovernmental support and approval for the design and implementation. Participation in the I-GOOS Committee is open to all countries, members of IOC.

The design of GOOS was initially carried in five modules under the GSC: Coastal (C-GOOS); Living Marine Resources (LMR); Health of the Ocean (HOTO); Climate (Ocean Observations Panel for Climate: OOPC) and ad hoc Marine Meteorological and Oceanographic Services (this ad hoc panel was terminated in 1998 at the GSC-I meeting as it was concluded that there was no need to establish a separate Services Module Panel and that the technical design panels (i.e. OOPC, HOTO, LMR and C-GOOS) should interact with their specific user communities to identify service requirements).

By the end of 2000, the initial strategic design plans for the C-GOOS, LMR and HOTO modules had been completed, at which time the GSC had determined that the HOTO, LMR and C-GOOS efforts should be merged to formulate an integrated design and implementation plan for all aspects of a coastal observing system. GOOS will then develop through two related and convergent components: (i) a basin-scale component concerned primarily with monitoring, forecasting and understanding marine surface conditions and climate variation (OOPC) and (ii) a coastal component concerned primarily with natural and anthropogenically-induced change in coastal and estuarine environments and their impacts on the ecosystems and people (Coastal Ocean Observations Panel). This approach is summarized in *The GOOS 1998* prospectus:

http://ioc.unesco.org/goos/Prospe98/Contents.html).

The Coastal GOOS Strategic Design Plan http://ioc.unesco.org/goos/CGOOSPLANver7.doc provides the framework for integrating the HOTO and LMR plans into a common framework. Highlights of the plan are as follows:

Design Considerations. The knowledge gained from oceanographic and ecological research is the foundation for coastal GOOS. Four important generalizations will guide the design of the system: (i) most of the changes occurring in coastal ecosystems are local in scale and are globally ubiquitous; (ii) such changes are often local expressions of larger scale changes in coastal drainage basins, airsheds, basin scale oceanic regimes, or some combination thereof; (iii) physical processes structure the pelagic environment and are of fundamental importance to changes in the biological and chemical characteristics of coastal ecosystems; and (iv) changes in these characteristics are related through a hierarchy of interactions that can be represented by robust models of ecosystems dynamics (e.g., numerical models of physical processes and coupled physical-biological models). Thus, it is likely that there is a relatively small set of core variables that, if measured with sufficient resolution, for extended periods over large scales, will provide the data and information required to detect and predict changes in coastal ecosystems that benefit a broad spectrum of user groups.

Design Framework. The observing system is conceived as a global network for the measurement and analysis of a common set of key variables that is regionally and locally customized (e.g., more variables, greater resolution, additional products) to address those issues that are of greatest concern to participating countries. The global network is the focus of the C-GOOS design strategy. Linking user needs to measurements to form an end-to-end, user-driven system requires a managed, two-way flow of data and information among three essential subsystems: (i) the observing subsystem (detection); (ii) the communications network and data management subsystem (integration); and (iii) the modelling (prediction) and applications subsystem. The observing subsystem consists of the global infrastructure required to measure the common variables and transmit data to the communications network and data management subsystem.

Recommended common variables are surface winds, air pressure and temperature, precipitation, sea level, bathymetry, temperature, salinity, surface currents and waves, turbidity, sediment type, dissolved nutrients, phytoplankton pigments, and water clarity. The infrastructure must incorporate the mix of platforms, samplers, and sensors required to measure the common variables with sufficient spatial and temporal resolution to capture important scales of variability in 4 dimensions. This will require the assimilation of data from remote sensing and *in situ* measurements involving six interrelated categories of observing elements: (i) coastal observing networks for the near shore (CONNS); (ii) global network of coastal tide gauges (GLOSS); (iii) fixed platforms, moorings and drifters; (iv) ships of opportunity (SOOP) and voluntary observing ships (VOS); (v) remote sensing from satellites and aircraft; and (vi) remote sensing from land-based platforms (e.g., high frequency radar).

Data communications and management link measurements to applications. The objective is to develop a system for both real-time and delayed mode data transmission that allows users to exploit multiple data sets from disparate sources in a timely fashion. A hierarchical system of local, national and supra-national organizations is envisioned to provide data, information, and access to users at each level. Some national and supranational organizations will also become synthesis centres that will provide highly processed products (e.g., assimilating data from remote and *in situ* sources for numerical model predictions requiring substantial computing power). High priority should be placed on the design and implementation of this subsystem.

Data assimilation and modelling are critical components of the observing system. Real-time data from remote and *in situ* sensors will be particularly valuable in that data telemetered from these sources can be assimilated to (i) produce more accurate estimates of the distributions of state variables (for both validation and assimilation), (ii) develop, test and validate models, and (iii) initialize and update models for improved forecasts of coastal environmental conditions and, ultimately, changes in measures of ecosystem health and living resources. A variety of modelling approaches (statistical, empirical, theoretical) will be required. The challenge of developing a cost-effective observing system underscores the importance of the interaction between measurements and modelling. Due to the complexity of coastal ecosystems and the cost of observing them, Observation System Simulation Experiments (OSSEs) will become increasing valuable as tool for assessing the efficacy of different sampling schemes and the value of measuring different variables.

Building C-GOOS. Coastal GOOS will come into being in step-by-step fashion by selectively incorporating, networking, enhancing, and supplementing existing programmes. It is recognized that many of the elements required for a comprehensive, fully integrated, multi-disciplinary observing system are not operational, that much work is needed to develop and determine those products that are most useful, and that capabilities and resources vary enormously among nations. In these regards, the importance of national and regional GOOS programmes cannot be overemphasized. These programmes are the vehicles for implementation. They provide an important means for facilitating the user input required to implement and enhance the core programme and for institutionalizing mechanisms for sustainable funding.

The successful development of C-GOOS depends on broad-based international support and ongoing sponsorship by nations and private institutions. The annual operating cost of the World Weather Watch in 1992 was about $2 billion U.S. The annual cost of a GOOS at that time was also about $2 billion U.S., most of which was for satellites. Although a cost analysis has yet to be performed for C-GOOS, these figures provide an order of magnitude estimate of the investment that will be required to initiate the core network proposed here. Although government funding will be essential, especially for large capital-intensive components of the observing system such as satellites, funding from the private sector will be required in the long term.

5. EuroGOOS AND Black Sea GOOS

Nic Flemming provided an overview of EuroGOOS. EuroGOOS is an association of agencies, founded in 1994, to further the goals of GOOS, and in particular the development of Operational

Oceanography in the European sea areas and adjacent oceans.

Members of EuroGOOS cooperate to establish a concerted European approach to the following:

- identifying European priorities for operational oceanography, promoting the development of the scientific, technology and computer systems for operational oceanography, and its implementation, assessing the economic and social benefits from operational oceanography.
- contributing to international planning and implementation of GOOS and promoting it at national, European and global level.

EuroGOOS activities are designed to collaborate with and maximize the benefits from existing activities in operational oceanography, promoting the integration of these activities within the framework of GOOS. Members of EuroGOOS collaborate and support the following groups of activities:

- advancing European operational oceanography in GOOS;
- promoting development of European regional and local operational oceanography, taking into account the modules of GOOS for the Coastal Zone, Health of the Ocean, Living Marine Resources, Climate, and Ocean Services;
- promoting development of common European operational data procedures and services, including data quality control and data management for operational oceanography;
- promoting research and pre-operational research, which will solve problems relating to operational oceanography;
- promoting development of common infrastructure and major systems or capital installations required to support European operational oceanography;
- promoting pilot studies in GOOS operations, local, regional, or global;
- promoting development of common European operational oceanographic services and products of maximum value to European governments and agencies, furtherance of European industries and service companies, and the protection of the environment and health in the European coastal and shelf seas.

Historically there has been a phased development of EuroGOOS where the focus has been on:

1995-1996	Development of Strategy
1997-1998	Science and technology assessment
1999-2000	Regional implementation projects
2000-2003	Products

Five regional task teams have been formed (Arctic, Baltic, Mediterranean, North Atlantic and North West Shelf), several projects have been launched among the EuroGOOS members and a total of about 50 million Euro have been raised for these activities since the launch of EuroGOOS in 1994.

As an example of a regional task team the Baltic Operational Oceanographic System (BOOS) was mentioned (www.boos.org). BOOS is a cooperation between national governmental agencies in the countries surrounding the Baltic Sea responsible for collection, model operations and production of forecasts, services and information for the marine industry, government and other end-users. Currently 13 institutions participate in BOOS.

BOOS is being built on existing systems and will develop mainly through commitments from the participating agencies. Already at present most of the components for an operational system are available within national or international programmes. The main tasks for BOOS will be to co-ordinate activities, develop operational routines, improve components and harmonize products based on user requirements. A BOOS Implementation Plan for 1999-2003 has been published http://www.eurogoos.org/Activities/Publications/BOOS%20Plan.pdf.

There are several already running BOOS projects including the high resolution operational model of the Baltic Sea (HIROMB), a water level web page, web based oil spill drift models, a wave buoy page, harmful algae bloom page, etc.

BOOS recognize different core users within the societies of the Baltic countries, including:

- HELCOM and its work done in the assessment of the Baltic Sea environment;
- BOOS members – operational agencies responsible for preparation of oceanographic products; including forecasts and warnings;
- marine transport industry – pilot work (especially in the Danish Straits) and ferry operations;
- pleasure boating, surfing – tourism in general;
- fisheries and aquaculture.

These groups of users are being served through the following information distribution means:

- Internet – web pages, ftp, web-based applications;
- phone and fax services;
- media broadcasting.

The most popular one is the Internet – for example – the BOOS home page (www.boos.org) was visited more than 3000 time during December 2000, the Danish water level page was visited more than 17000 times and the wave forecast was visited 8300 times in the same period.

More information about BOOS can be found in the BOOS implementation plan (BOOS Plan – Baltic Operational Oceanographic System 1999-2003; see also http://www.eurogoos.org/Activities/ActivitiesFrameSet.html).

Nic Flemming also drew attention to some ongoing EuroGOOS activities which might be relevant for the Black Sea GOOS observing activities and which might be basis for further collaboration between Black Sea GOOS and EuroGOOS:

Ferry Box project. More than 800 ferry boats routinely operating in the coastal waters of Europe with frequencies varying between once a week to several times a day. By developing and installing an operational autonomous ship-borne instrument package (”Ferry Box” in analogy to the ”black box” of a commercial airliner) the following set of variables could be measured *en route* with no additional platform costs: sea surface temperature, salinity, oxygen, nitrate, sound velocity, fluorescence, light attenuation and light scattering. Currently there are four national Ferry Box activities:

- German Blue Box Project (University of Kiel)
- Finnish Algaline Project (Finnish Institute of Marine Research)
- English Ferrybox Project (Southampton Oceanography Centre)
- Dutch Ferrybox Project

More information is available at http://www.eurogoos.org/Whatis/WhatisFrameset.html.

Argo/drifting buoys. Within the Global Ocean Data Assimilation Experiment (GODAE) a special project – Argo – is being developed which will utilize up to 3000 automated profiling floats to measure the temperature and salinity profile of the upper 2000 m of the ocean on a global scale. Typically the floats will remain “parked” at a prescribed depth and drift, surfacing every 10 days and transmitting the profile data back to shore by the Argos satellite. Several EuroGOOS member agencies are participating in a North Atlantic pilot project, GYROSCOPE, to deploy 80 floats in the Atlantic as part of the Argo during the next 3 years. There are currently plans to also use Argo floats in the second phase of the Mediterranean Forecasting System Pilot Project (MFSPP). Deployment of for instance 5 floats in the deeper parts of the Black Sea could be a useful supplement to observations that typically would need to be made by research vessels.

EDIOS. The aim of the EDIOS project is to build a metadatabase that includes information on all European ocean-observing sites/devices in routine and repeated operation and to use this directory to define the Initial European Ocean Observing System. Under this project information will be gathered on all European ocean-observing sites/devices currently in repeated and routine use (stations, sections, repeat samples, buoys, platforms, etc.), their geographical location, characteristics, and frequency of observations and transfer this information into a searchable database (Directory). This will make it possible to define the Initial European Global Ocean Observing System by classification of ocean observing sites/devices in use. The inventory will have a visual user interface to facilitate accessibility of the Directory to all kinds of potential users.

Nic Flemming mentioned that as all the countries bordering the Black Sea are Members of the Council of Europe, in principle the agencies from these countries could apply for Membership of EuroGOOS. This suggests that some sort of "twinning" relationship would be appropriate, with special status linking the Members of Black Sea GOOS with EuroGOOS. Links will also be important to MedGOOS. (Additional information about EuroGOOS, projects and documents can be found at http://www.eurogoos.org). In closing Nic Flemming warmly welcomed the formation of Black Sea GOOS and expressed his hopes for future collaboration between Black Sea GOOS and EuroGOOS.

6. BLACK SEA ENVIRONMENTAL PROGRAMME

Sema Acca gave a historic overview of the international environmental programmes in the Black Sea.

In 1992 the Black Sea countries signed the (Bucharest) *Convention on the Protection of the Black Sea Against Pollution* and its three Protocols on Land-based sources, dumping and cooperation in emergency situations. Pending the entry into force of the Convention/related Protocols and the establishment of the *Permanent Secretariat of the Black Sea Commission* to facilitate their implementation on the regional scale, the coastal countries decided to launch *the Black Sea Environmental Programme (BSEP)* in 1993. Through assistance provided by the GEF and other donors, in particular the European Union, they implemented this programme aimed at implementing the Convention and formulating a longer-term Black Sea Strategic Action Plan. One of the main tasks of BSEP was to help create a strong international network of institutions, specialists and other stakeholders. Under this programme whose co-ordinating unit was in Istanbul, a system of Advisory Groups on six thematic areas lead by one *Regional Activity Centre* (each country agreed to sponsor one of its existing institutions as a regional centre for a particular field of expertise) was devised in order to spread the technical responsibilities of the programme throughout the region and to make best use of the excellent specialists in the region. The groups completed a series of thematic studies (monitoring and assessment, land based sources of pollution, ICZM, biodiversity, fisheries, oil pollution, etc.), that were later synthesized in a Transboundary Diagnostic Analysis (TDA) (1996), on the basis of which the Contracting Parties to the Convention signed the *Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (BS-SAP)* on 31 October 1996. The BSSAP provides a modern approach to environmental policy making, and among others agrees on the following key matters:

- that the principle cause for the decline of the Black Sea ecosystem is eutrophication;
- that without full cooperation with riparian countries of the main tributary rivers (such as the Danube, Dnieper, etc.), this problem cannot be addressed;
- that an adaptive management approach should be adopted for the control of pollution in the Black Sea;
- that biological diversity and fisheries concerns should be part of the future agenda.

Although the Black sea environmental initiative was sustained, or rather continued at a lower level for some years to allow for only a limited amount of regional coordination, it was possible to draft National Black Sea Strategic Action Plans and to carry out preliminary work for launching a wider Black Sea basin programme to address the problem of eutrophication together with the Danube riparian countries.

Finally in October 2000, the Permanent Secretariat of the Black Sea Commission was established in Istanbul. At present it is a core unit in charge of facilitating the overall process of implementing the Convention and the BSSAP with the assistance of the Advisory Groups of the Commission. The management and coordination responsibilities cover a large range of issues including policy making, legislative reforms, institutional and administrative support, technical cooperation, financing, public participation and others.

Monitoring and assessment framework. Although some of the coastal countries have been carrying out environmental monitoring in the Black Sea, and "Article XV of the Bucharest Convention on scientific and technical cooperation and monitoring" calls for the establishment of a system for observing, measuring, evaluating and analyzing the risks or effects of the pollution of the marine environment of the Black Sea, a regionally coordinated system does not exist yet.

Black Sea Regional Environmental Monitoring Programme. In response to the Commission request to elaborate a regional monitoring programme, the Advisory Group on Pollution Monitoring and Assessment (AG PMA) (lead by the Activity Centre in Odessa-Ukraine) has suggested that the regional monitoring programme should integrate all components of the environment of the Black Sea (ecological monitoring), and should be elaborated in cooperation with other advisory groups, within a step–by-step approach taking into account the limited national resources available for monitoring and assessment of regional problems. The following steps are proposed:

- initiate a preliminary regional programme for the year 2001-2002 by including the list of parameters, frequencies and sites indicated by each countries according to the best national judgment and the experience of the members of the advisory group in previous work carried under the Black Sea Environmental Monitoring Programme;
- elaborate the criteria for selection of the monitoring sites, frequencies and indicators of regional importance during the Black Sea monitoring research cruises and assess the correspondence of the proposed national monitoring sites to these criteria;
- while elaborating the regional integrated monitoring programme, take into account the requirements of the European Water Framework Directive to the monitoring and assessment practices ;
- implement a regionally coordinated monitoring programme.

The AG PMA decided to take the Joint Assessment and Monitoring Strategy of OSPAR Convention as a guiding document with necessary changes to be made by the Activity Centre on the Monitoring and Assessment by 31 July 2001. The draft Black Sea Monitoring and Assessment Strategy shall be circulated to the countries for their comments by the Activity Centre through the Permanent Secretariat and shall be finalized for approval of 8th Meeting of the Black Sea Commission.

It is suggested that the Black Sea be divided into seven regions, six of which are the territorial waters of Bulgaria, Georgia, Romania, Russian Federation, Turkey, Ukraine and the open sea. In the territorial waters of the Black Sea countries the regional monitoring programme will be incorporated into national monitoring programmes. As for the open sea, assistance will be sought from:

- Black Sea Environmental Programme;
- International Atomic Energy Agency;
- NATO;
- Black Sea GOOS;
- Other international or national programmes or projects.

This regional division will last until the economic zones of the littoral States will be agreed upon and legally established. The Black Sea countries are encouraged to conduct monitoring activities beyond their territorial waters if they are willing to allocate additional national resources or attract international funding to these activities. The information on the regional monitoring programme for radioactivity and other pollutants was prepared and proposed to be included in the Regional Integrated Assessment and Monitoring Strategy and Programme by the IAEA, RER/2/003 Technical Cooperation

Project for " Environmental Assessment in the Black Sea Region". Taking into account the developed institutional capacity, establishes quality assurance/quality control system, background information, and future cooperation, the AG PMA requested from the Activity Centre to integrate the proposed network to the Regional Integrated Monitoring Programme and circulate it to the focal points for comments by 1 August 2001.

Black Sea Environmental Programme. Based on the work previously done under the BSEP, a new project on the "Control of eutrophication, hazardous substances and related measures for rehabilitating the Black Sea ecosystem: Phase 1" was drafted and has recently been approved by GEF. A parallel effort for the Danube river basin also exists. The new GEF programme consists of 2 regional projects in the Black Sea and the Danube, and will be supported by an additional investment facility. Phase 1 will be a 2 year (4 M US$ approx.), project which will be followed by a second phase of 3 years. Its objective is to assist the coastal countries in developing and implementing action plans to prevent and remedy nutrient releases, through:

- reduction of the nitrogen and phosphorus loads to the Black Sea;
- enhancement of the service function of wetlands and benthic (seabed) plant communities for the assimilation of nutrients;
- improved management of fisheries to permit their economic recovery in parallel with improvements to the ecosystem.

In addition to the above, attention will also be given to transboundary contamination by hazardous substances, and to risks.

The project will comprise of the following components:

- coordination, institutional capacity building and legal reform;
- sectoral, legal and policy reforms, monitoring and evaluation of nutrient control measures and reviewing targets for adaptive management;
- supporting public involvement in nutrient control;
- innovative economic instruments for the control of eutrophication;
- sustainable exploitation of fish stocks as part of an ecosystem approach.

The first two components are of significance in terms of the coordinating arrangements under the Black Sea GOOS, as under these components the following activities are going to be supported/ initiated:

- assistance to countries to improve their knowledge of the process of eutrophication in the Black Sea;
- development of a system of process, stress reduction and environmental status indicators for monitoring the effectiveness of measures to control eutrophication (and hazardous substances where appropriate). In the first phase work will focus on the development of environmental status indicators (of eutrophication).

In order to be able to assist the coastal countries to meet their agreed first target (maintenance of nutrient loads at their 1997 levels) and to set the subsequent target using the best available scientific information, the state of the Black Sea will be assessed and reported at the beginning and completion of the 5-year project. Studies have clearly demonstrated that: (i) existing information on the nutrient load to the Black Sea and the response of the system is insufficient to enable more concrete goals to be set, and (ii) the countries do not have a mechanism for monitoring and evaluating indicators that will enable the measurement of achievement of eutrophication control targets (including nutrient reduction measures). Therefore the assessment will be based on new information gathered from remote sensing and conventional measurements and a comprehensive system of indicators of environmental status, stress reduction and process will be developed.

The new GEF project will assist countries to improve their knowledge of the process of eutrophication in the Black Sea. Despite compelling evidence of eutrophication and the degradation of

marine habitats and communities, there have been no system-wide studies of this problem in the Black Sea. Evidence has been pieced together from fragmentary studies but there are huge gaps and uncertainties. This makes it difficult to convince non-coastal States of the need for response or to measure future changes. Joint studies at the beginning of the five-year period will correct this situation and better define subsequent monitoring needs. Work will focus on the most impacted areas (e.g. the NW Shelf) and will make extensive use of remote sensing. The assessment will be completed May 2003 through integration of international study group, elaboration of a study plan; completion of 2 surveys in 2002-2003, and studies of nutrient sources, sinks and fluxes. The information obtained will be used in setting new adaptive management goals. The two surveys will enable the report to be made despite the absence of a well functioning regional monitoring network that is currently being developed under the aegis of the Black Sea Commission. In order to implement this objective, an "International Study Group" will be formed on an *ad-hoc* basis in order to consolidate the best available expertise. Specialists will be appointed to the group by the BSEP-PIU on the basis of their scientific merits and institutional capacity (this is not a capacity building exercise) and will be drawn from government institutions, academies of science and overseas institutions with a proven track record of studying the Black Sea. The initial work will consist of consolidating existing information and formulating a one-year study plan for further monitoring. Assistance will be provided to coastal countries for a one-year pilot nutrient monitoring programme. This will be reviewed and approved by the participating governments and the donor community. Continuation of the programme beyond the first year is considered to be a national responsibility for each country and a joint responsibility for the Black Sea Commission. The two seasonal surveys will focus on the most impacted areas. An example of the need for this work is that there is no information as to whether the massive Zernov red algal field (the "keystone" species in the NW Black Sea benthic system) has shown any recovery as a result of decreasing nutrient loads and accurate information is lacking on the loads themselves. In addition to the surveys, a regional satellite tracking station will be used to download interpret and freely distribute color scan data regularly over the entire project period. This will enable real-time analysis and decision making regarding seasonality and exceptional algal blooms. Another large gap in existing knowledge is that regarding airborne nutrient inputs. Existing meteorological observation networks will be capacitated to conduct these studies and an estimate of the total annual load and its distribution will be made. The results of all of these observations will be employed for the preparation of a new *State of the Black Sea* Report to be completed by May 2003. This will also include information on hazardous substances.

7. SeaNET

Frans van Dongen provided an overview of SeaNet - a European organization concerned with monitoring networks from fixed structures in the North Sea region. The SeaNet organization is a cooperation between nine North Sea monitoring agencies. Nearly every country around the North Sea has its own monitoring activities at sea and the coastline. The collected monitoring data fulfils operational needs as well as temporary demands for, for example, scientific research and calamity prevention. However as the scale of the ocean phenomena that are typically modelled, the observation activities cannot be restricted to national ocean areas.

The objectives of SeaNet are:

- a homogenous distribution of fixed monitoring sites;
- promotion of on-line data exchange between fixed monitoring networks;
- standardization of data collection, processing methods and validation techniques;
- cooperation in the development of new measuring techniques and sensors, and testing of existing sensors;
- exchange of experience in data communication;
- exchange of experience in data collection, particularly on fixed structures.

The long term objective of SeaNet is to establish a North Sea monitoring system based on fixed monitoring networks which will contribute to an integrated European marine monitoring and forecasting system.

SeaNet has developed an inventory of the fixed monitoring stations in the North Sea. The types of variables that are measured in the SeaNet network range from the hydrometeorological ones (such as water level, wind speed, wind direction etc.) over to biological ones (such as pH, chlorophyll, nutrients etc.). Currently most of the measurements are in the hydrometerological category.

Figure 1 shows a map of the fixed stations where oceanographic parameters are measured. Additional information about the inventory can be found at http://www.minvenw.nl/rws/projects/seanet.

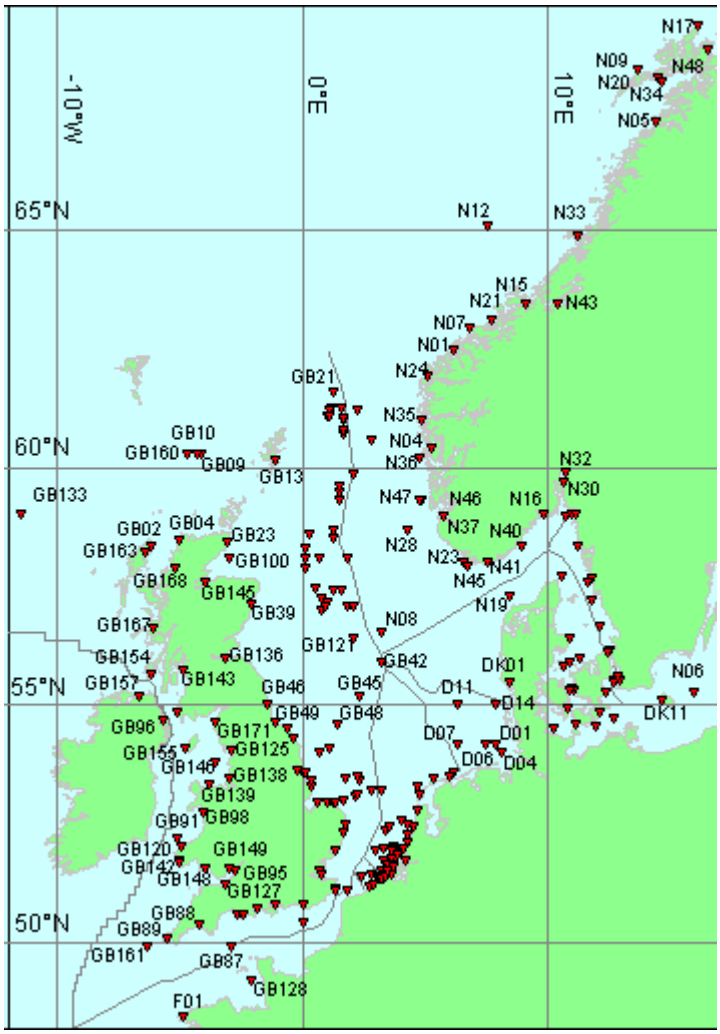


Figure 1. Oceanographic stations in the SeaNet network in the North Sea.

SeaNet has carried out a survey on the needs of information and opportunities of the fixed monitoring network. The results indicated that *in situ* maintain their importance in the future, in spite of the growing importance of remote sensing and operational modelling.

Six agencies within the SeaNet Organization and four companies have also developed a data exchange system – the SeaNet Data Interface (SNDI). The project comprises the definition, development and implementation of a data interface that facilitates real-time data exchange between national monitoring networks. A distributed database with restricted access is available in each of the participating countries. The system is about to go into operation and more information is available at http://www.minvenw.nl/rws/projects/seanet/.

In summary SeaNet provides an organizational framework for observations from fixed stations. A similar system could be the building blocks for an integrated observation system for the Black Sea.

8. HISTORY OF Black Sea GOOS

Ilkay Salihoglu provided a brief historic summary of the development of the Black Sea GOOS.

The Cooperative Marine Science Programme for the Black Sea (CoMSBlack) (1991) is the first multinational programme implemented in the Black Sea. It was supported by the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The participating countries in CoMSBlack were Bulgaria, Romania, Russian Federation, Turkey, Ukraine and USA.

In 1994 IOC sponsored a workshop on regional Black Sea cooperation in marine research and systematic observation (Varna, Bulgaria 14-16 September 1994) which proposed a regional programme. This programme was subsequently endorsed by an Intergovernmental meeting (IOC, Paris, France, 7-9 June 1995) and adopted by the Eighteenth Session of the IOC Assembly (1995) in Resolution XVIII-17, which established the IOC Black Sea Regional Committee (BSRC). In September 1996 the first session of the IOC Black Sea Regional Committee was held in Varna (Bulgaria). The important consequence of the Varna meeting was the agreement for the formation of two pilot projects (i) Black Sea GOOS and (ii) Black Sea Fluxes. The meeting also defined the initial tasks of the BSRC for the period 1996-1997. The second session of the BRSC was held in Istanbul (Turkey, 5-6 May 1999) where Terms of References for the BSRC were finalized. These ToRs were later approved by the Twentieth Session of the IOC Assembly (1999) through Resolution XX-18.

The first workshop of Black Sea Fluxes was held in Istanbul (Turkey, May 1997) which was followed by the International Conference "Black Sea 1997" in Varna (Bulgaria, May 1997).

9. NATIONAL REPORTS ON BLACK SEA OBSERVING ACTIVITIES

9.1 BULGARIA

Hristo Slabakov gave an overview of the monitoring activities in the Bulgarian part of the Black Sea.

The objectives of the Bulgarian Black Sea monitoring activities are: (i) to establish a coordinated, integrated, scientifically based system for observation and prediction of some common indicator variables on regional and national scale; (ii) to ensure long-term and regular observations of the physical, chemical and biological parameters and states of the marine environment and biota; and (iii) to provide relevant information to the governmental institutions for making decisions concerning protection and mitigation activities for the sustainable development of the Black Sea.

The legal basis for the Bulgarian monitoring programmes are the following agreements and conventions:

- International Convention for Protection of the Black Sea from Pollution, 1994;
- Declaration for Protection of the Black Sea, signed by the Ministers of Environmentfrom the Black Sea Countries in Odessa, Ukraine, 1993;
- Strategy Plan for Recovery and Protection of the Black Sea, signed at the Conference of the Ministers of Environment from the Black Sea Countries in Istanbul, Turkey, 1996;
- MARPOL Convention 43/78;
- United Nations Convention of Sea Law, 1982;
- Law of the Sea, Bulgaria, 2000.

Users of the monitoring products are ministries, maritime organizations and coastal municipalities for the purpose of their best functioning, environmental protection, rational use of marine resources, and development of the recreational and socio-economic infrastructure of the Bulgarian Black Sea Region.

Current monitoring activities are rooted in the following systems/programmes:

- *National System for Ecological Monitoring (NSEM) subsystem "Water" – Ministry of Environment Protection and Waters;*
- Monitoring of petrol carbohydrates – Ministry of Transport and Communication (MTC - MAV);
- Monitoring of hydrometeorological processes and pollution of the Black Sea coastal zone – National Institute of Meteorology and Hydrology (NIMH);
- Hydrological monitoring of the Black Sea water - Hydrographic Service of the Navy (HS – NAVY);
- Ecological monitoring of the Black Sea - Institute of Oceanology (IO);
- Monitoring performed by the Institute of Fisheries and Aquaculture (IFA);
- Beach monitoring of swimming areas - Hygiene and Epidemic Institutes ;
- Monitoring of the landslide and abrasive processes in the Bulgarian Black Sea coastal zone performed by Geozashtita, ltd.

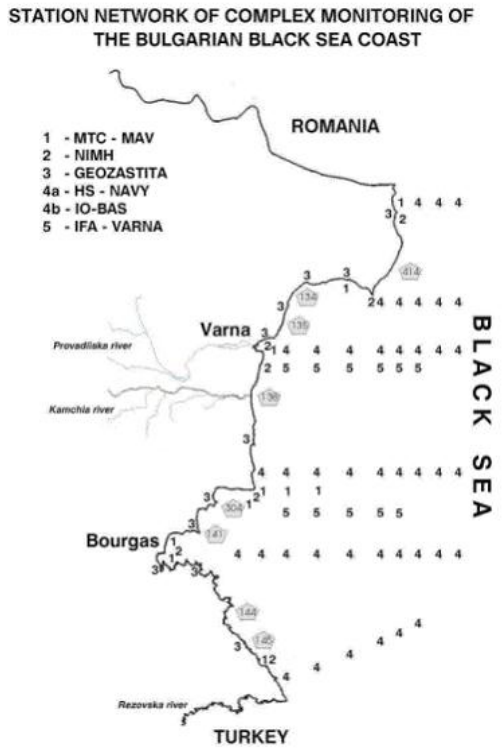


Figure 2. Bulgarian station network.

The implementation of an integrated system for national monitoring of the Black Sea currently depends on international programme assistance for provision of contemporary equipment and technologies. Some of the coordination activities for the integrated monitoring system have been carried out under the CESUM project (Centre for Sustainable Development and Management of the Black Sea Region) funded by the European Union, and hosted by the Institute of Oceanology. For more information on the CESUM project see http://www.maris.nl/frames.asp?projects.htm.

9.2 GEORGIA

N. Beradze, G. Metreveli, J. Dolidze, K. Bilashvili, G. Kordzakhia provided the following report on Georgian observing plans.

From ancient time the Black Sea has had great importance for Georgia. It provides for contact and trade not only with riparian States but also with the rest of the world. In addition the Black Sea influences the local climate and provides recreational resources of west Georgia.

The Georgian Coastal Zone has a length of 326 km and spans from the mouth of the River Psou (state border with the Russian Federation) to Kelenderi Cape (border with Turkey) (Figure 3). Its sea boundary passes mostly along the 130-m isobath and deflects to the sea only in the mouths of large rivers. The land border represents an imaginative limit up to which the sea water action is spreading during its high activity. The area of this zone is about 2600 km^2-, from which sea part makes up 2200 km^2 (85 %). The Average width of this zone is about 8 km and largest width reaches 25 km (Gudauta sand bank).

The region is located in the tectonic zone of the Caucasus, characterized by high activity, lines of latitudinal fractures, large rates of secular fluctuations and drastic change of the trend of vertical movement along coastal line.

In the region the horizontal sea circulation is created by wind-drift and river currents. Vertical circulation is originated by the Black Sea central divergence and peripheral convergence. The main drift current is predominant here, passing round the sea and creating in the area of its contact with shelf descending rings of hurricane type. Such rings are arising periodically along the axis of the Main Black Sea Current and are accompanying with rotating movements of this current.

Divergence and convergence dynamics of the Black Sea together with wind-drift and river currents stipulate the system of vertical four-cycle water circulation, marginal cycles of which cover the coastal zone and the central cycles - the rest of the sea.

In the coastal zone of Georgia there were until the early 1990s 32 meteorological stations, 6 tide gauges, ship observations on 35 hydrographic stations and 45 observation stations in regards to marine pollution monitoring. Collection, systematization and processing of data from this network was carried out in the Hydrometeorological Observatory of Batumi, which also had a coastal research ship, a hydrochemical laboratory and communication means. This observatory was responsible for providing marine forecasts to the Georgian Marine Shipping Company, navigation ships and other users of operational hydrometeorological information. From this Observatory the observation products were sent to the Information Centres of the former USSR.

At present, past oceanographic observations from the Georgian Coastal Hydrometeorological Network and associated marine synoptic products are stored at the marine data centres in Obninsk and Sevastopol. It is hoped that copies of these data can be returned.

Since the 1990s the economical and social-political situation in Georgia has made it very difficult to operate the hydrometeorological observation network. Presently only 5 meteorological stations and 3 tide gauges are functioning (see Figure 4). The ship observations have almost stopped and the hydrochemical measurements are only carried out episodically.

Georgia is slowly recovering from the financial problems mentioned above. The pipeline Baku-Supsa is in operation. As the seaport in Supsa is not built yet, the transportation of oil is carried out by means of the marine oil buoy and tankers. At the mouth of the river Khobi in Kulevi, a terminal and seaport is being constructed in connection with the reestablishment of the historical "Silk Route" in the frames of the EU project Transport Corridor Europe-Caucasus-Asia (TRACECA). Poti and Batumi, which are the main ports of TRACECA, have increased the shipments significantly. Ferryboat lines from Batumi to Ilichevsk and Poti to Ilichevsk and Varna are now in operation and marine transportation is increasing. At the coast of the Ureki-Shekvetili a health resort complex is under construction.

The TRACECA route is of strategic importance to Eastern Europe (including the Black Sea countries), the Caucasian States and Central Asia. At the Black Sea marine part of the route there are often storms, destructive waves, violent storms, surges and other disasters that create emergency and dangerous situation for transportation.

The safety of transportation in the TRACECA route is determined by the specialized hydrometeorological operational information provided, since it affects the effective functioning, the

security of shipment and the prevention of losses resulting from transportation delays due to unfavorable weather and marine conditions.

Georgia, as an independent State by the UN convention of December 1982 holds an exclusive economic zone of about 27 000 sq. miles of the Black Sea. Ecological monitoring of this zone is the responsibility of Georgia. Accordingly, permanent legal monitoring of this area is necessary. There are several occasions when the ballast and municipal sewage water and other polluted substances from the ships are dropped in the Georgian exclusive economic zone including its seaports. In order to prevent lawlessness it is necessary to establish some ecological monitoring and also the hydrometeorological observational programme.

An oceanographic and marine meteorological observational network should be reestablished to provide:

- hydrometeorological products to the ships of the Georgian shipping company and others in the Black Sea area of the water;
- oceanographic and meteorological forecasts for other users (fishing, recreation, seaports, coastal engineering and construction etc.);
- ecological monitoring.

In order to process data from this network the information centre in Batumi should be reestablished, and this centre should also have the historic hydrometeorological data bank. The duplicate of that centre must be established in Poti. Such centres provide the operational service for users and informational exchange with foreign centres.

Presently Georgia lacks the resources to create such centres. There may be users (institutions, organizations, and private companies) which could provide financial assistance to establish the network. At the same time such a network could be part of GOOS. Accordingly, sponsors of such network must be the organizations that are in need of marine hydrometeorological information.

They are as follows:

- Georgian Shipping Company (GSHC);
- Sea ports of Batumi and Poti;
- Georgian International Oil Company (GIOC);
- Georgian Pipeline Company (GPC);
- Building Company of Kulevi Terminal.

It is preferable that the Georgian National Oceanographic Committee (NOC) together with the State Department on Hydrometeorology of Georgia should carry out a programme to fund the Georgian Black Sea GOOS's network. With the assistance of the ports of Batumi and Poti and the Georgian Shipping Company, an upgrade and modernization of informational analysis centres and tide gauges of Kobuleti and Poti. A hydrometeorological station in Ureki or in the mouth of the river Supsa should also be established preferably by GIOC or GPC.

An oil pipeline to the Black Sea is currently under construction and it will be extended three km offshore to an oil buoy.

Squalls, which traditionally occur in this region are dangerous for this module, and during tanker loading accidents can take place. An accident would be disastrous not only for this region. Satellite observations can provide operational information that may help provide such accidents and it is essential to establish operational hydrometeorological stations that can provide boundary conditions to operational forecasting. Oceanographic and tide gauges in the mouth of the river Rioni and the Poti port are essential. A hydrometeorological station at Kulevi is also essential – cofunding may be provided by the owner of the terminal company. A Georgian GOOS observation network should, in future, include the hydrometeorological stations of Abkhazeti: Sokhumi, Bichvinta and Gagra. At present provision of these modern systems can only be done with the support of international organizations (EU, WMO, IOC of UNESCO, etc.) and donor countries.

Figure 3.
Black Sea Georgian Coastal Hydrometeorological Observation Network (situation for 1988)

Figure 4.
Black Sea Coastal Hydrometeorological Observation Network (situation for 2000)

9.3 ROMANIA

Alexandru Bologa and Viorel Malciu provided an overview of the observing activities undertaken by the National Institute for Marine Research and development in Romanian waters. Elena Cordoneanu provided an overview of developments of the marine service products from the National Institute of Meteorology and Hydrology.

National Institute for Marine Research

These activities can be summarized as follows:

Coastal stations: Sulina, Constantza:

Sea level, hourly, at Constantza that is also a MedGLOSS station with quasi real time data transmission;

Hydrophysical and hydrochemical observations, every day.

Phytoplankton sampling at Constantza, twice a week.

Offshore stations: ten stations on three sections in the Danube mouth area: hydrological, hydrographic, hydrochemical and biological parameters, twice a year.

A second network of fourteen transects perpendicular on the shore with stations on 5 and 20 m depth. The network has 40 permanent sampling stations (Table 1) in order to cover the entire littoral. As a general rule, sea trips will be carried out seasonally. (However, available funding has restricted the sampling). During the summer season (May-August) sampling will be monthly). On special occasions (accidental pollution, exceptional biological phenomena), profiles and stations will be multiplied, function of phenomena's amplitude and extension.

Sampling parameters on the above mentioned network are the following:

A. *Physical:* seawater temperature, pH, transparency, suspended load;

B. *Chemical:* Water: salinity, dissolved oxygen, $N\text{-}NO_2$, NO_3, NH_4, $P\text{-}PO_4$, P_{org}, SiO_4, biochemical oxygen demand, detergents, total hydrocarbons, radionuclides;
Sediments: nutrients, heavy metals, total hydrocarbons, organic pollutants, and radionuclides;
Biota: heavy metals, organic pollutants, and radionuclides;

C. *Biological:* phytoplankton, zoobenthos, phaecal colliforms;

D. *Biomarkers*: toxicity tests, specific markers.

Coastal erosion monitoring**:** shore profiles and sectorial bathymetry at least once a year with denser profiles in the areas where advanced erosion is recorded.

Table 1. List of Romanian sampling stations

Station	Names of Sampling Locations	Co-ordinates
1	Sulina – (before entering the sea)	
2	Sulina – discharging point	$45^0$08'N; 29^o47E
3	Sulina – 20 m isobath	$45^0$08'$_1$N; 29^o47E
4	Mila 9 – 5 m isobath	$45^0$01'N; 29^o39E
5	Mila 9 – 20 m isobath	$45^0$01'N; 29^o44E
6	Sf. Gheorghe – 5 m isobath	44^o53'N; 29^o38E
7	Sf. Gheorghe – 20 m isobath	44^o53'N; 29^o40_7E

Station	Names of Sampling Locations	Co-ordinates
8	Portita – 5 m isobath	44°40'$_6$N; 29°00$_4$E
9	Portita – 20 m isobath	44°40'$_6$N; 29°02$_4$E
10	Buhaz – 5 m isobath	44°24'N; 28°45$_2$E
11	Buhaz – 20 m isobath	44°24'N; 28°50$_6$E
12	Navodari - beach	deleted
13	Navodari – 5 m depth	deleted
14	Navodari – 20 m dept	deleted
15	Mamaia - beach	44°14'N; 28°37$_9$E
16	Mamaia – 5 m isobath	44°14'N; 28°35$_1$E
17	Mamaia – 20 m isobath	44°14'N; 28°42$_7$E
18	Constantza N - beach	deleted
19	Constantza N – 5 m isobath	44°12$_8$N; 28°39$_6$E
20	Constantza N – 20 m isobath	44°12$_6$N; 28°42 E
21	Constantza S – 5 m isobath	44°05 N; 28°38$_8$E
22	Constantza S – 10 m isobath	deleted
23	Constantza S – 20 m isobath	44°05 N; 28°41$_3$E
24	Constantza E – 1 nautical miles	deleted
25	Constantza E – 5 nautical miles	44°10'N; 28°47'E
26	Constantza E - 10 nautical miles	44°10'N; 28°54'E
27	Constantza E - 20 nautical miles	44°10'N; 29°08'E
28	Constantza E - 30 nautical miles	44°10'N; 29°22'E
29	Eforie Sud - beach	44°02'N; 28°39$_4$E
30	Eforie S – 5 m isobath	44°02'N; 28°39$_8$E
31	Eforie S –20 m isobath	44°02'N; 28°40$_5$E
32	Costinesti - beach	43°57'N; 28°38$_5$E
33	Costinesti - 5 m isobath	43°57'N; 28°38$_6$E
34	Costinesti - 20 m isobath	43°57'N; 28°41$_1$E
35	Mangalia - beach	43°49'N; 28°35$_4$E
36	Mangalia – 5 m isobath	43°49'N; 28°38'E
37	Mangalia – 20 m isobath	43°49'N; 28°38'E
38	Vama Veche - beach	43°45'N; 28°34$_6$E
39	Vama Veche - 5 m isobath	43°45'N; 28°35$_2$E
40	Vama Veche – 20 m isobath	43°45'N; 28°37$_1$E

National Institute of Meteorology and Hydrology

The National Meteorological Observing Network in Romania contains:

- 140 surface station;
- 3 vertical sounding stations;
- 5 analogical radars and 2 Doppler radars;
- More than 600 precipitation measurement points.

There are five meteorological coastal stations on the Romanian Black Sea side (Sulina, Sfantul Gheorghe Delta, Gura Portitei, Constantza and Mangalia) and one station placed on the oil platform Gloria, 50 km Northwest from Constantza. The six-hourly SYNOP messages of these stations contain information about sea state:

- sea surface temperature;
- wind wave height and period (visual estimation);
- swell height, period and direction (visual estimation).

The messages are collected by Constantza Regional Centre and sent to Bucharest; only two of them (Constantza (15480) and Sulina (15360)) are posted to the Global Telecommunication System (GTS). At the NIMH there is an Automatic Message Switching System (MESSIR-COM); data communication with the Regional Centres is assured via satellite.

An autonomous wind-wave station, which supply, process and accumulate wind-wave data in real-time mode, has been installed on the Gloria oil platform since 1997 (inside NATO-TU Waves/Black Sea Project). The station includes the wave and wind sensor and a PC with uninterrupted power supply. In the end of each month the data are saved on a floppy disk; they are used in statistical study and wave model verification.

There are also seven points on the Romanian Black Sea side where measurements of fresh water input, sea level, sediment transport, deep sea currents, temperature and salt content and coastal line data are done irregularly.

A new satellite reception station for numerical data provided by NOAA satellite has been installed in the beginning of 2000 at NIMH-Bucharest; which provides Black Sea surface temperature in operational mode.

Forecast Products. The Numerical Weather Prediction system at the National Institute of Meteorology and Hydrology in Bucharest is based on the ALADIN model. This model has been in operational mode since January 1997. The ALADIN model, a spectral limited area model, is integrated twice per day for 48 hours range, on an ALPHA Station; initial and boundary conditions are provided by the ARPEGE global model integrated in Toulouse, and provided via the Internet. The ALADIN integrating domain, covering Romania and its neighbours, has a horizontal resolution of 10.2 km. There is a dissemination system for the numerical ALADIN output, first to the forecaster office in Bucharest and then to the 6 Regional Centres in Romania (including R.C. Constantza-regional centre for marine forecast); the numerical field visualisation is performed by MESSIR-VISION systems.

Other applications using the input from the atmosphere have been developed for the exploitation of the operational model numerical output. It concerns the diffusion and transport of pollutants, flash flood and Black Sea waves.

At the NIMH – Bucharest, two wave models, WAM and VAGROM, have been integrated operationally for the Black Sea since 1 February 1999; the atmospheric model ARPEGE (integrated at Meteo-France) supplies the 10 m forecast wind at each 6 hours interval for the computation of the source term in the energy balance equation. Both models use the same topographic data set and a latitudinal/longitudinal grid, 60 x 28 points with 0.25 x 0.25 degrees spatial resolution including 819 sea grid points. The numerical output (wind wave and swell parameters for 48 hours range) are sent to the Regional Centre Constantza where the marine forecast is prepared and in the same times they are stored for the verification against observational estimated and instrumental real data.

Figure 5 shows a comparison of the results of the models against ERS2 altimeter data during the Black Sea storms in the period March 1999-February 2000 (Kortcheva and Stefanescu, 2000; Comparison of the VAG model results obtained during the storm situations occurred in the Black Sea against ERS-2 altimeter data, Meteo-France internal report).

Since February 2000 the VAGROM model has also been integrated operationally on a higher resolution domain (5'x 5' latitude/longitude grid) nested on the coarser grid over the western Black Sea basin. For this integration the wave model uses the ALADIN forecast wind (available to a higher horizontal resolution than ARPEGE model) every 3 hours. The sea state is much better described (Figure 6a, b).

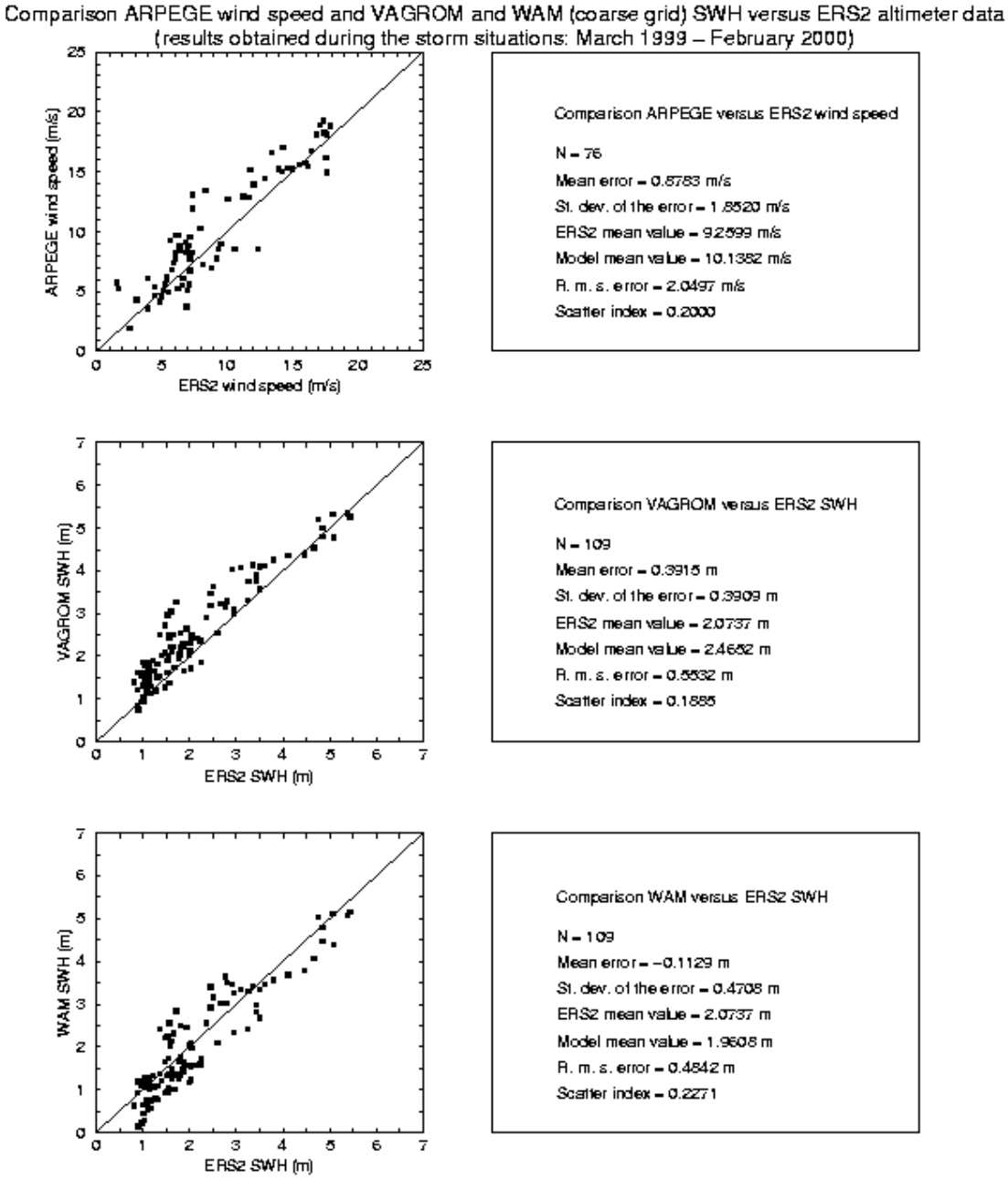


Figure 5. Comparison of forecast wind, VAGROM and WAM SWH against ERS2 altimeter data (March 1999-February 2000)

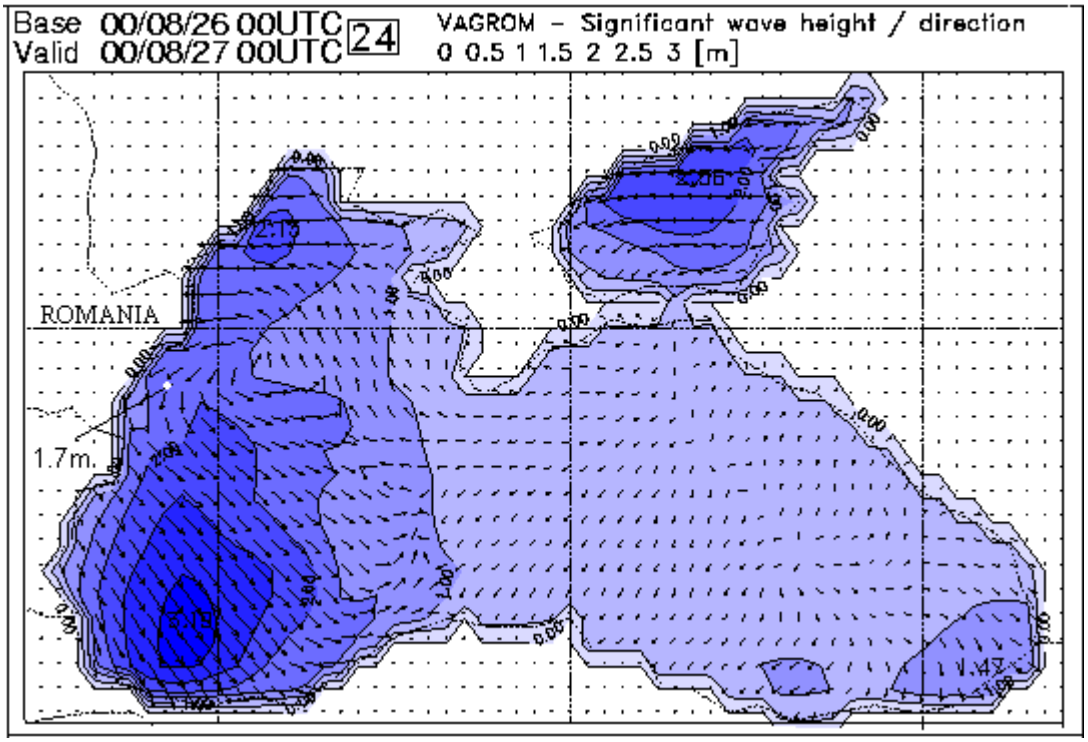


Figure. 6a: VAGROM, significant wave forecast (0.25 x 0.25 degrees latitude/longitude grid)

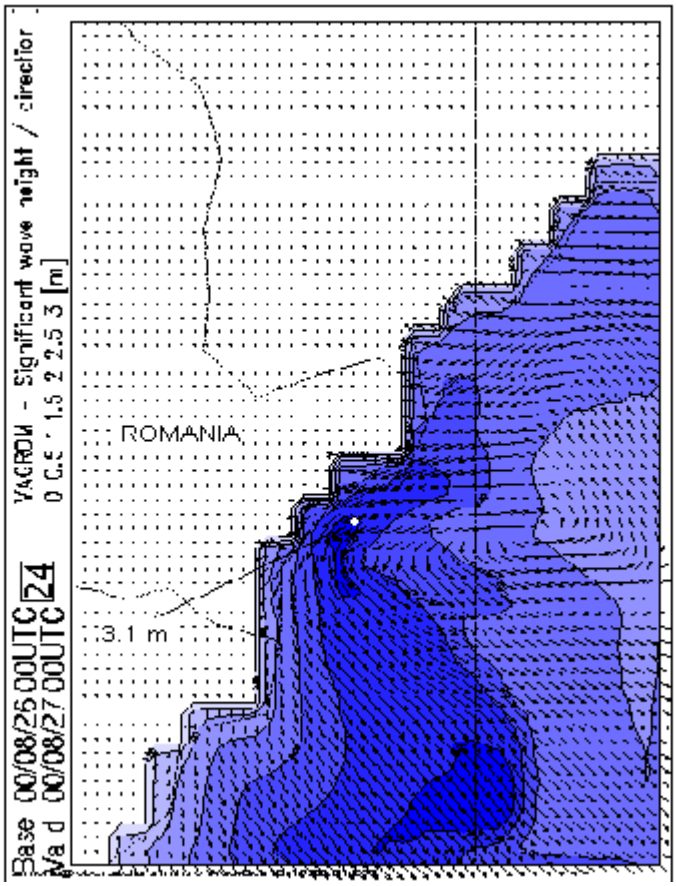


Figure 6b: VAGROM, significant wave forecast (5'x 5'latitude/longitude grid)

9.4 RUSSIAN FEDERATION

Alexander Postnov gave an overview of the Russian observing activities in the Black Sea.

Despite the economical difficulties, the Russian hydrometeorological and oceanographic activities (including monitoring of contaminants and living resources) in the Black Sea continue. Several national agencies are involved in the activities, including Rushydzomet, Russian Academy of Sciences, Russian Committee for Fisheries, Defense Ministry. Recently, the federal support for these activities have somewhat increased which is attributed to the commencement of the Target Federal Programme "The World Ocean". This programme includes, in particular, the sub-programmes "Development of an integrated informational system on the state of the World Ocean (ISWO)" and "Studies of the World Ocean nature". The objectives and tasks of ISWO are very similar to these of GOOS. In particular, ISWO aims at providing support to decision-making in the sea-related activities including those unfolding in the Black Sea. The sub-programme "Studies of the World Ocean nature" allocates funds for the research ship cruises in the Black Sea which provides an informational basis for improvement of analysis and forecasting technologies.

National Observation Systems in the Black Sea

Coastal observational facilities include:

- *five hydrometeorological stations* (4-time-a-day observations of standard meteorological parameters, sea level, water temperature, waves, salinity);
- *a waverider buoy* stationed off the coast of Gelendzhik continuously since 1996; the buoy measures the wave parameters, including propagation direction and temperature and transmits the data to the coastal reception station every three hours (or every hour if the wave height exceeds 1.5 m/s); the buoy is insensitive to the sea currents of a speed less than 2.5 m/s;
- *automated systems* for measuring meteorological parameters, sea level, water temperature, waves in the coastal area, current speed and direction, temperature at the depths; measurements are made every 3 hours and transmitted to the collecting centre via the satellite channels. The systems are being tested.

Open sea observational facilities

VOS meteorological observations are very sparse, with only 200-300 ship weather reports available every year.

Ship deep-sea observations are performed at the standard sections only in the eastern part of the sea using R/V *Aquanavt* (of a 270-tonn water displacement*)*. During November 1997 through April 2000, a total of 20 cruises, each 3-7 days long were accomplished. Spacing between stations is 2-3 miles on the shelf, 5 miles in the 20-mile coastal area and 10-15 miles in the sea interior. The measurements are normally made down to 500 m, some sections in the sea interior being sampled to the bottom (about 2000 m).

Drifting buoys allow determination of water mass trajectories, air temperature and pressure in the entire Black Sea and transmit it to a collecting centre via satellite channels. Tests performed in 1999 – 2000 in cooperation with the Ukrainian scientists yielded promising results.

Satellite observations involve Okean01, Sich, Meteor-3 and Resurs-01 satellites. Remotely measured are surface temperature, ocean color, and ice coverage.

Operational services (Current status). The products are prepared and meteorological services offered in the zone of responsibility. The products include analysis and forecast of wind and waves, water and air temperature, ship-icing warnings, recommended routes and time of departure. However great difficulties exist resulting in lower quality of products. The difficulties are as follows:

- a poor coverage of the open sea with meteorological and hydrological data while the coastal observations do not represent the state of the open sea;
- the data exchange with the Black Sea countries (except for Ukraine) is limited;
- the data analyses and data sets remain inaccessible by the majority of users;
- poor telecommunication facilities produce a most negative effect in emergency situations when a phenomenon is developing faster than the information reaches the analyzing centre.

On the other hand, computerization has made it possible to use more sophisticated models for forecasting, with more data coming from remote observations. The Hydrometeocentre produces large-scale prognostic fields which are transmitted to the regional centres and used there for forecasting. Within the framework of the Black Sea GOOS, the Hydrometeocentre of Russian is proposed to serve as a regional centre producing analyses and forecasted fields on the regional scale (150 by 150 km mesh). This information could then be disseminated among the national and local centres.

Sea climate and climate change. The information on climate and climate change is being prepared in the electronic form by the State Oceanographic Institute based on earlier hard-copy monograph published in the early 1990s. It is planned that in 2001-2002 a regional centre on the southern seas including the Black Sea will be established whose responsibility will be provision of various reference documents on the long-term state of the sea and its change.

The centre will also run a hydrodynamic model of the Black Sea developed in the SOI and assimilating the various kinds of observations (sea-, coast- and space-borne) and compute mutually adjusted oceanographic fields.

Pollution monitoring. There are two scales of monitoring – local (near the sources of pollution) and background (in the open sea). The local monitoring is made at 24 stations at five sites. The water is sampled for salinity, dissolved oxygen, total alkalinity, pH, hydrocarbons and some specific chemicals. The open sea monitoring is made during the ship cruises. A complex structure of currents in the region makes monitoring a very complicated task.

Research activities. The R/V *Akvanavt* is of 270 tons displacement, its crew consists of 12 members, scientific personnel include 10 members. The ship is equipped with a winch for lowering oceanographic probes and devices to the depth of 2500 m. It is based in Gelendzhik where the Southern Branch of P.P. Shirshov Institute of Oceanology is located.

In the period from November 1997 till April 2000 20 expeditions aboard this ship were carried out within the Russian sector of the Black Sea, their durations being from 3 to 7 days. Oceanographic measurements were carried out along the cross-sections «shore - sea centre», within the oceanographic polygon in the near shore zone and during oceanographic surveys in 40-mile near shore zone from the Kertch Strait to Sochi.

All the sections were normal to the shore, the stations along them being 2-3 miles apart on the shelf, 5 miles apart in 20-mile near shore zone and 10-12 miles apart in the deep basin. Spacing between the sections within the oceanographic polygon was 10 miles, and during the oceanographic surveys within 40-mile near shore zone it was 15 miles. Measurements were carried out to 500 m level, but along some cross-sections «shore - sea centre» they were performed down to the bottom (~2000 m) at all the stations. A hydrophysical probe «Sea Bird» with a holder for twelve 5-litre bathometers was used for oceanographic measurements and water sampling. The following parameters were determined: hydrophysical, i.e. pressure (depth), temperature, salinity, density and water transparency; hydrochemical, i.e. dissolved oxygen, hydrogen sulfide, dissolved manganese, biogenous elements (phosphate - phosphorus, siliceous acid, ammonia - nitrogen, nitrate - nitrogen and nitrite - nitrogen).

The objectives of the expeditions were to study:

- role of near-shore anti-cyclonic eddies (NAE) in forming the regime of nearshore currents;

- formations of the cold intermediate waters (CIW) in the zone of cyclonic vorticity of the deep inter-annual variability in ventilation of the cold intermediate layer (CIL), upper pycnocline and upper boundary of hydrogen sulfide zone;
- influence of mesoscale eddy structures of different sigh upon the distribution, transport and transformation of chemical sea parameters;
- biochemistry of the areas with interaction of aerobic and anaerobic waters in dynamically various zones of the sea (central divergence zone and nearshore convergence zone) including the eddy structures of different sign and chemical exchange at the boundary «water - bottom».

9.5 TURKEY

Ilkay Salihoglu summarized the Turkish activities in the Black Sea relevant to Black Sea GOOS.

Background. Turkey has in the recent years devoted funding for the activities leading to modelling and forecasting in the Black Sea. In 1997 Turkey revised the marine science policy and improved the National Marine Research Programme, which ended up with equally weighted research driven and activities leading to end product(s). The recent GOOS type activities in Black Sea basically are (i) general and process oriented surveys, (ii) time series studies and (iii) modelling activities for near real time and/or real forecasting.

Time Series Studies. The changes in the quality and quantity of nutrients, phytoplankton and zooplankton are being monitored at two stations (one inshore station and one offshore station) at two-week intervals during one year. The time-series data is used to study the biogeochemical processes of the Black Sea. At the end of this study some important biological characteristics (e.g., rates and period of growth, death and reproduction) of a few key species (the copepod Calanus euxinus, the ctenophore Mnemiopsis etc.) are also expected to be disclosed.

This study is the extension of a similar project started last year. However, a few changes have been made to the sampling programme based on the results obtained so far. Previously (during 1998) 4 stations off Sinop in the central southern Black Sea were being monitored for a few oceanographic parameters over monthly intervals. Since January 1999, two stations (one shallow ~75m and one deep ~400 m) are being sampled for their basic pelagic biological (chlorophyll, phytoplankton and zooplankton) and physical-chemical characteristics (temperature, salinity, nitrate, phosphate, silicate, Secchi disk depth etc.) with biweekly intervals. Thus the seasonality of these parameters will be obtained for the 2-year sampling programme period.

At these two stations, chlorophyll, phytoplankton and nutrients (nitrate, phosphate and silicate) are being sampled from 7 different water depths (surface, 10 m, 20 m, 30 m, 40 m, 50 m and 60 m). Phytoplankton and nutrient samples will be analyzed at the METU-Institute of Marine Sciences. For the measurement of basic oceanographic parameters (i.e., temperature and salinity), METU-IMS loaned an Acoustic Doppler Current Profiler to the Sinop Institute.

Zooplankton samples are being obtained by one vertical tow from bottom to surface at the shallow station and from the lower border of the oxic zone (approx. 150 m) to the surface at the deep station. Following net towing, gelatinous organisms, which are retained on a sieve, are counted and weighed individually for determination of their biomass. This is necessary for understanding the population dynamics of gelatinous organisms (mainly Aurelia aurita, Mnemiopsis leidyi, Pleurobrachia pileus and the new alien ctenophore Bero*e sp.*), the information which is not known and yet is very important for the understanding and modelling of the pelagic ecosystem of the Black Sea.

The proposed project is expected to result in the creation of a time-series of basic oceanographic parameters. Due to practical difficulties, unfortunately such a time-series was not available until now. Therefore, from the sporadic studies performed up to now, we have only a limited and very general understanding of the Black Sea ecosystem. By combining the data from such short-

term sampling studies, this general knowledge on the Black Sea ecosystem could be utilized to explain spatial and temporal characteristics as well as for better modelling of this ecosystem.

This project will also help, through transfer of technology and experience, from the METU-IMS, to the development of a new Institute (Ondkuz Mayis University, Sinop Faculty of Aquatic Products).

The location of the time series stations is given in Figure 7. The properties of the stations and information gathered are shown in Tables 2-4.

Table 2. Stations summary

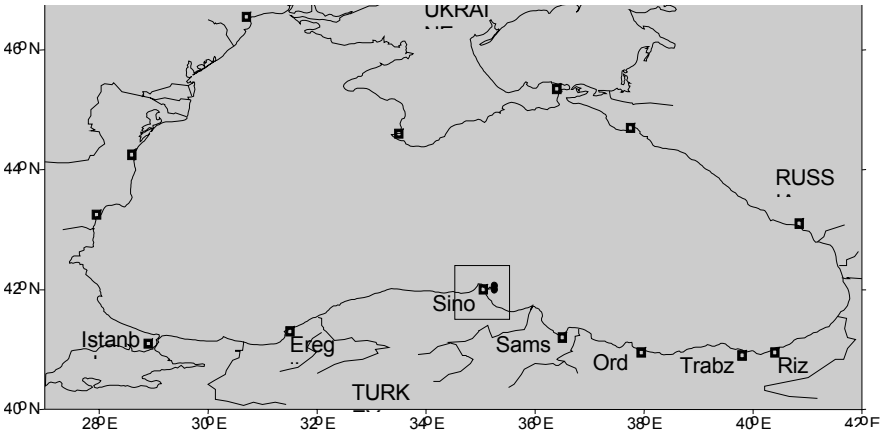
Station name	**Sta A**	**Sta B**	**Sta C**	**Sta D**
Longitude	35°09'30"N	35°09'30"N	35°09'30"N	35°09'30"N
Latitude	41°59'45"E	42°00'00"E	42°03'12"E	42°04'05"E
Longitude	35°09'30"N	35°15'00"N	35°15'00"N	35°15'00"N
Sea depth	55	73	93	>200
Start	29-May-1998	29-May-1998	03-Jun-1998	03-Jun-1998
Finish	09-Sep-1998	30-Oct-2000	09-Sep-1998	30-Oct-2000
Number of processed samples	4	22	3	23

Table 3. Measured parameters

Station name	**Sta A**	**Sta B**	**Sta C**	**Sta D**
Zooplankton	4	30	3	30
Phytoplankton	4	14	3	13
Physical (T, S, pH, Secchi Disk, Conductivity, Turbidity)	4	19	3	19
Bio-chemical (PO4, NO2+NO3, Si, Chl-a, DO)	1	23	1	24

Table 4. List of sampling dates (total 38)

29.05.1998	26.01.1999	12.05.1999	02.11.1999	25.06.2000
03.06.1998	11.02.1999	31.05.1999	22.11.1999	25.06.2000
08.07.1998	01.03.1999	09.06.1999	28.03.2000	06.07.2000
14.07.1998	09.03.1999	05.07.1999	05.04.2000	07.08.2000
26.08.1998	23.03.1999	28.07.1999	02.05.2000	17.10.2000
09.09.1998	12.04.1999	10.08.1999	05.05.2000	30.10.2000
15.10.1998	28.04.1999	02.09.1999	23.05.2000	
11.01.1999	30.04.1999	28.09.1999	24.05.2000	



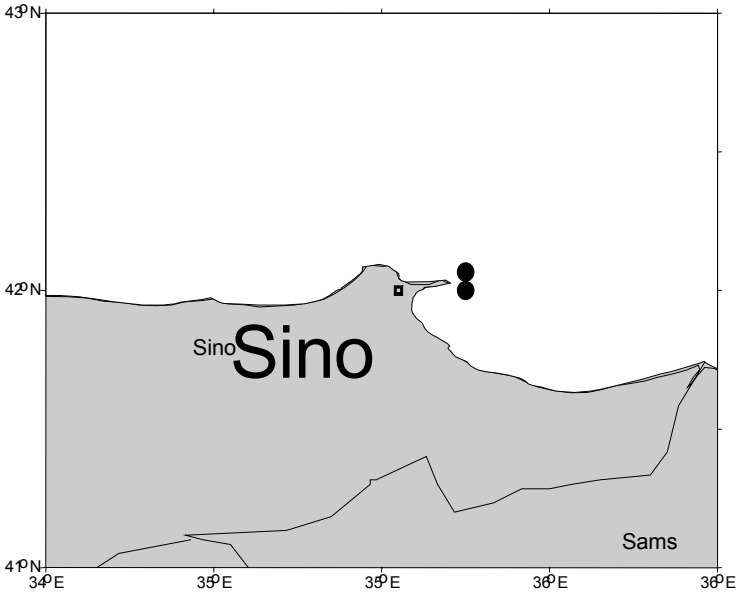


Figure 7. Station locations for Turkish process and time series studies

<u>*Modelling the response of top-down control exerted by gelatinous carnivores*</u>. Recent changes in structure and functioning of the interior Black Sea ecosystem are studied by a series of simulations using a one dimensional, vertically resolved, coupled physical-biochemical model. The simulations are intended to provide a more definitive understanding for how the pelagic food web structure responds to increasing grazing pressure by gelatinous carnivores (*medusae Aurelia aurita,* and ctenophore *Mnemiopsis leidyi*) during its last two decades of evolution. The pelagic food web is represented by two groups of phytoplankton (diatoms and dinoflagellates), bacterioplankton, microzooplankton, *Aurelia, Mnemiopsis* and the giant omnivorous dinoflagellate *Noctiluca scintillans*. Dissolved and particulate organic nitrogen as well as nitrate, nitrite and ammonium constitute its other components.

This study demonstrates the paramount role of top-down control by gelatinous predators on the Black Sea plankton system. Addition of the gelatinous species into the ecosystem is shown to reduce mesozooplankton grazing and lead to increased phytoplankton blooms as observed throughout the 1980s and 1990s in the Black Sea. The model is first shown to reproduce reasonably well the observed planktonic food web structure at a particular location of the Black Sea for which a yearlong data set with 2-to-4 week intervals is available from 1978. This simulation represents the typical eutrophic ecosystem conditions of the late 1970s and early 1980s. Additional simulations are performed to explore the role of *Mnemiopsis* dominated ecosystem in the late 1980s. These simulations are also validated by extended observations from specific years.

The results indicate that the population outbreaks in the gelatinous species, either *Aurelia* or *Mnemiopsis,* lead to considerable modifications on the biomass of phytoplankton and

mesozooplankton communities during the year. The peaks of phytoplankton, mesozooplankton, Noctiluca and gelatinous predator biomass distributions march sequentially as a result of their prey-predator interactions. The late winter diatom bloom and the subsequent increase in the mesozooplankton stocks are the robust features, common for all simulations. The autotrophs and heterotrophs, however, attain different responses during the rest of the year depending on the nature of grazing pressure exerted by the gelatinous predators. In the presence of *Mnemiopsis*, phytoplankton also reveals distinct and pronounced bloom episodes during the spring and summer seasons. These events appear with two months time shift in the ecosystem prior to introduction of *Mnemiopsis*.

Temel Oguz, Hugh W. Ducklow, Jennifer E. Purcell, Paola Malanotte-Rizzoli carried out this study

Modelling the summer mesoscale variability of the Black Sea. The evolution of the Black Sea temperature, salinity and circulation from large to mesoscale are studied using a basin wide hydrographic data, ADCP data obtained in the multi-national CoMSBlack'92 experiment; wind stress derived from analyses of the Sevastopol Hydrometeorological Office; and climatological heat and water fluxes. Hydrographic data gridded through objective analysis and adjusted dynamically with a primitive equation model provides a snapshot of the circulation at mesoscale resolution for mid July 1992. A 50-day primitive equation model data driven simulation, taking into account atmospheric and riverine fluxes, is used to examine the evolution and dominant variability and its dependencies during this summer period. The large-scale upper layer is characterised by, a generally cyclonic circulation over the deep portion of the basin with a system of anticyclonic eddies in its periphery. The largest anticyclonic gyre lies east of 38^{o}E. An inertial jet dominates the edge of the cyclonic circulation: the Rim current. As the Rim current transverses the edge of the deep basin, the meandering and secondary circulation of the jet varies according to its interaction with the topography and shelf waters. The north western shelf circulation is populated with (anticylonic) eddies and a near coastal buoyancy flow of riverine origin. The seasonal thermocline is strengthened during this period and a zonal large-scale temperature gradient is supported by the observed relatively weak/strong winds/net heat fluxes in the east with respect to west. The layers with potential density $\sigma_g > 14.1 kg/m^3$ are partially in contact with the atmosphere. The deep basin main pycnocline σ_g[14.2 - 16.2] intersects the bottom in the range of 35 – 120 m. Temperature and salinity on isopycnals surfaces with $\sigma_g > 14.3$ are essentially homogenised. The data driven simulation predicts an active circulation below 500 m. The major circulation elements described above are partially verified using qualitative comparisons with summer 1992 data, historical data; both *in* situ and infrared and colour remotely sensed data. The Rim current meander shape and propagation parameters, eddy size and distribution and the generation of rapid surface bound jets, squirts are found to be good agreement with the observations.

This work was carried out by Sukru Besiktepe, Carlos J. Lozano, and Allan R. Robinson.

9.6 UKRAINE

Gennady Korotaev provided an overview of observing activities and enabling research activities mainly carried out at the academic institutions in Ukraine. The Hydrometeorological Service of Ukraine provided a separate report.

Observing activities by academic institutions in Ukraine

A national Black Sea GOOS programme was established in Ukraine in 1998. The objectives were to:

- establish an integrated comprehensive and sustained programme to document the Black Sea system on a broad scales;
- conduct exploratory studies to improve understanding of the physical, chemical, biological and social processes that influence Black Sea system changes and trends;
- develop integrated, conceptual and predictive Black Sea system models.

The programme has to provide regions with information by means of monitoring, estimation, and further prognosis of ecological and climatic changes on regional and sub-regional levels, propagation of data and results of data analysis urgently required for effective and rational use of sea resources, scientific and technical support of industrial projects of regional, sub-region and local scales and investigations aimed at better understanding, modelling and prediction of sea state as the most important resource forming factor. The Black Sea GOOS programme joins efforts of institutions from the National Academy of Sciences, Hydrometeorological, Ecological and Fisheries Services.

Basic observations. Elements of observation and data management systems, climatic analyses and development of near-operational products are carried out in the framework of programmes funded by Ministry of Education and Science, National Academy of Sciences and State Hydrometeorlogical Service. National funding is restricted and therefore the work is in progress. A significant part of the system development is done with support of the Science and Technology Centre in Ukraine (STCU), EU programmes INTAS and INCO-COPERNICUS, USA programme Civilian and Research Development Foundation (CRDF) and other international collaboration.

Standard hydrographyc/hydrochemical observations. A system of 36 shore stations located along the Ukrainian coast of the Black Sea and Sea of Azov carry out regular observations and operational information transmission. Seven stations possess vessels, which conduct regular oceanographic and chemical observations in coastal areas up to 10 miles offshore. Regular coastal ship observations are carried out in few areas. (See further details in section on Observing activities by the Hydrometeorological Service of Ukraine).

Survey of 30 casts within 5-miles zone from the city of Alushta to the city of Alupka, 10-miles standard section of 5 casts SE-ward from Yalta and standard station one mile off Yalta are carried out near the southern coast of the Crimea.

Surveys of 15-30 casts within 5-miles zone from the cape Lukull to the Cape Sarych, survey of Sevastopol Bay (10-25 casts) or along bay section of 5-7 casts are carried out near south-western coast of the Crimea.

The pollution monitoring within 10-miles of the coastal zone is performed near Danube mouth. Surveys of the Dnieper-Boug estuary of 25-30 casts and surveys in coastal waters 3-9 casts.

The list of measured variables during a survey includes temperature, salinity, color and transparency of seawater, standard meteorology, currents (occasionally), water samples for chemistry and pollution. Surveys and standard sections are sampled seasonally (four times per year). Information from the coastal network is collected and used for scientific analysis and end-user services.

Sea level data. The Black Sea level observations in Katsively are prepared to be included in the MedGLOSS system and the equipment has been set up according to recommendations by MedGLOSS. The signal from the equipment is registered in the personal computer and is available for further transfer through the Internet. The sea level observations in the settlement Katsively are available in electronic form since 1949.

Long-term data sets from stable platform. Data sets are available from two platforms. One platform is situated in the open sea in the North-Western Shelf of the Black Sea. The platform is equipped with the set of instruments for measurements of wind and wave characteristics including one-dimensional wave gauge, near surface wind profile measurements, standard hydro and meteorological parameters.

The second platform is situated in the settlement Katsively near the coast. Long-term observations of water temperature profile to a depth of 25 m, air temperature, wind speed and direction are available from the beginning of 1980s.

Ships of Opportunity measurements. The Institute of Biology of the Southern Seas of National Academy of Science (IBSS) has carried out *in situ* measurements from ships of opportunity since 1998 with support of CRDF programme. The monitoring of bio-optical parameters of phytoplankton is

performed in central part of the Black Sea and over the bottom slope near Sevastopol. The measured parameters include: chlorophyll *a* and phaeophytin *a* concentration, phytoplankton abundance and their species structure, light absorption spectra by phytoplankton and suspended particles. *In situ* measurements are carried out every one- two weeks. For this aim the ships of weekly route from Sevastopol to Istanbul are used. The database is created based on more than one hundred measurements of bio-optical parameters.

Determination of light absorption properties of suspended particles is carried out for the first time in the Black Sea. The database of bio-optical parameters will be used for development of regional models of pigment and primary production estimation based on remote sensing of water-leaving radiance.

Drifting buoy programme. One of the best modern tools to study the real trajectories of water particles in the upper mixed layer is the satellite tracked lagrangean drifter. Two drifting buoy experiments were carried out by the P.P. Shirshov Institute of Oceanology (Moscow), the Marine Hydrophysical Institute, the Ukrainian National Academy of Sciences (Sevastopol), and the Department of Oceanography, Naval Postgraduate School (Monterey, USA). Six drifters were launched in the eastern part of the Black Sea in September 1999 in order to study large scale and mesoscale features of basin dynamics and circulation. The strategy of the Black Sea '99 expedition was based on the joint application of satellite imagery, the Argos tracked SVP drifters and hydrographic, chemical and biological survey of the selected mesoscale structures.

The same group deployed four meteorological SVP-b drifters in central part of Black Sea in October 2000. All drifters and other data are organized in a common database. A new drifting buoy experiment optionally with up to 30 drifters is planned for the year 2001. Collaborators consider the experiment of this year as the step toward implementation of a Black Sea buoy programme to the Black Sea global oceanographic observing system.

Remote sensing IR and visible band observations. The Marine Hydrophysical Institute (MHI) is the leading Ukrainian organization with 20 years experience in ocean remote sensing and has software and hardware for receiving and processing of satellite information which includes:

- 1.7 Ghz HRPT digital station for NOAA, SeaWifs data;
- 1.7 Ghz analog data station for METEOSAT;
- 137 Mhz APT station for NOAA, OCEAN, Sich, Meteor.

MHI has a data archive for the Black Sea and the East Mediterranean regions for the last 6 years containing more than 3000 images. Satellite imagery is used for mapping of SST and surface radiation, analysis of mesoscale variability and joint (satellite imagery and SVP drifters) analysis of the Black Sea circulation.

Satellite altimetry sea level data set. The altimeter sea level data based on ERS and TOPEX/Poseidon (T/P) measurements are available for the Black Sea for 1992-2000. The work is a result from collaboration of NASA GSFC and MHI NANU in frame of STCU project N 1547.

The altimeter data is pre-processed by the NASA Ocean Altimeter Pathfinder Project at Goddard Space Flight Centre with all the necessary corrections for transmission effects and the geoid. Pre-processing of altimeter data also included filtration of errors according to the two-sigma criterion. In additions, the points located a distance of less than 30 km from the coast were excluded to eliminate uncertainties caused by the influence of storm surges, shallow water tides, and coastal trapped waves.

Theoretical analysis shows that the response of the sea level to the low-frequency variability of the water budget should be spatially uniform and almost instantaneous (order of a day) as the size of the Black Sea is smaller than the barotropic deformation radius. Therefore the spatially averaged altimeter data describes variation of the basin volume.

The spatial uniformity of the sea level oscillations induced by the volume variation permit to retrieve the dynamic sea level from altimeter data. Altimeter derived dynamic sea level is validated against the dynamic topography calculated from the hydrography of the CoMSBlack programme. Statistics of the comparison of altimeter and hydrography sea level shows that the rms error of altimeter sea level is equal 3.04 cm. Topography for the altimeter and hydrography sea levels corresponding to the periods of CoMSBlack surveys is in good qualitative agreement.

Spacecraft "Sych-1M". The significant part of the National Space Programme of Ukraine is devoted to Earth observations. The spacecraft "Sych-1M" is scheduled for the launch in July 2002. The spacecraft will be equipped with the Radio-Physical Complex containing from Side Looking Radar and Microwave Radiometer, High Resolution Visible Band Scanner and Microwave/IR/Visible Band Radiometer.

The Side Looking Radar has real aperture, a swath 400 km, and a resolution of 1.3 km x 2.5 km and operates with a wavelength of 3 cm. The microwave radiometer of the Radio-Physical Complex operates on the wavelength 0.8 cm with a swath width of 550 km and resolution 25 km x 25 km.

The High Resolution Visible Band Scanner has three channels 0.5-0.59 μm, 0.6-0.69 μm and 0.8-0.92 μm with the swath 48-105 km and resolution 24 m x 35 m. Microwave/IR/Visible Band Radiometer has frequencies from 6.9 till 183.31 KHz and wave lengths 0.37-0.45 μm, 0.45-0.51 μm, 0.58-0.68 μm, 0.68-0.78 μm, 10.4-11.5 μm, 11.5-12.6 μm. The "Sych-1M" satellite has an improved data transmission system, which permits to receive the significant portion of the data through standard HRPT station.

The scientific programme of experiments with the "Sych-1M" spacecraft contains the section devoted to the use of the Side Looking Radar for mapping of the Black Sea Wind. The analysis of "Sych-1" wind retrieved from the Side Looking Radar and the wind obtained by NSCAT and ERS scatterometer has manifested good consistency of overlapped data sets. However relatively high spatial resolution of the Side Looking Radar allows mapping mesoscale structure of the wind field, which is significant for the Black Sea basin.

Data management systems. Few approaches are made now for the development of data management systems for the Black Sea region. The most developed is the data management system of the NATO TU-Black Sea project. The software permits to extract and analyze the broad data set of hydrographic and hydrochemical parameters.

The State Hydrometeorology Service has another version of the data management system that supplements the NATO TU-Black Sea product. Their database contains more historical observations, particularly about the Black Sea pollution.

The most complete database is in the National Oceanographic Data Centre of Ukraine, which is compiled from different national and international sources. Among the products of the Centre are the Black Sea multidisciplinary Digital Atlas, Information & Analytical System on the Black Sea Level Investigations, Black Sea Information System. The Data Centre plans to improve the database by including more biochemical and geological data. The database inventory is prepared in the frame of the MedAtlas project and should be available soon.

Climatic analyses. A broad climatic analysis of Black Sea fields till the mid 1980s is available from a published monograph of the Hydrometeorological Service of FSU. A set of new products is prepared for the 1990s including hydrographic, biochemical and hydro-optical analysis. This product now also includes maps of the upper boundary of the Hydrogen Sulfide Contamination Zone.

Monthly climatic arrays of temperature and salinity based on all available hydrographic observations available have also been prepared.

A new approach has also been developed for the reconstruction of the four dimensional climate of the Black Sea basin based on assimilation of monthly climatic hydrography into a general circulation model (GCM). Continuous annual cycles of the temperature, salinity and all three components of current velocity are simulated.

Near operational products. A set of up-to-date near-operational products is available now for the Black Sea area. Continuous maps of the surface dynamic topography and surface mesoscale currents are simulated now in frame of CRDF project UG2-2041 for 1992-1998 based on assimilation of altimetry sea level in the model of the Black Sea circulation. Mesoscale features manifested in the sea current maps explain abnormal transport of Danube water to the Crimea coast, which is seen from AVHRR visible band imagery in June of 1993.

The regional mesoscale model with spatial resolution 0.33° and 15 non-uniformly spaced depth levels is realized for the Black Sea area. The model is adopted for the PC and can be used for the regional weather forecast and estimation of the pollution transport. The model is tuned to the region based on the use of the NCEP data as the boundary conditions.

The WAM model is adopted for the Black Sea area for nowcasting and forecasting (based on the atmospheric regional model wind prediction) evolution of the Black Sea wave field. The model is tuned based on estimation of the wave amplitude during strong storms passing through the Black Sea.

Observing activities by the Hydrometeorological Service of Ukraine

The Ukrainian national system of marine coastal observations consists of 36 hydrometeorological stations of different class situated on Ukrainian shores of the Black Sea, the Sea of Azov, in marine straits and mouths of rivers. Observed variables are as follows: routine meteorology, river run-off, sea level, water temperature, salinity, waves and ice conditions, marine chemistry and pollutants.

List of Ukrainian shore hydrometeorological stations

Alushta	Mysovoye	Feodosiya
Belgorod-Dnestrovsky	Nikolayev	Kherson
Berdyansk	Odessa	Khersonessky mayak
Genichesk	Opasnoye	Khorly
Geroyskoye	Ochakov	Tsaregradskoye girlo
Izmail	Paromnaya pereprava	Chernomorskoye
Evpatoriya	Parutino	Chongarsky most
Zavetnoye	Primorskoye	Port Yuzhny
Ilyichevsk	Sevastopol	Yalta
Kasperovka	Skadovsk	Stereguschiy
Kertch	Stanislav	Strelkovoye
Mariupol	Ust-Dunaysk	Reny

Seven stations have small research vessels implementing the regular hydrometeorological and chemical observations in coastal waters within the distance from 1-2 to 5-10 miles. Regular ship observations are executed in following regions (Figure 8).

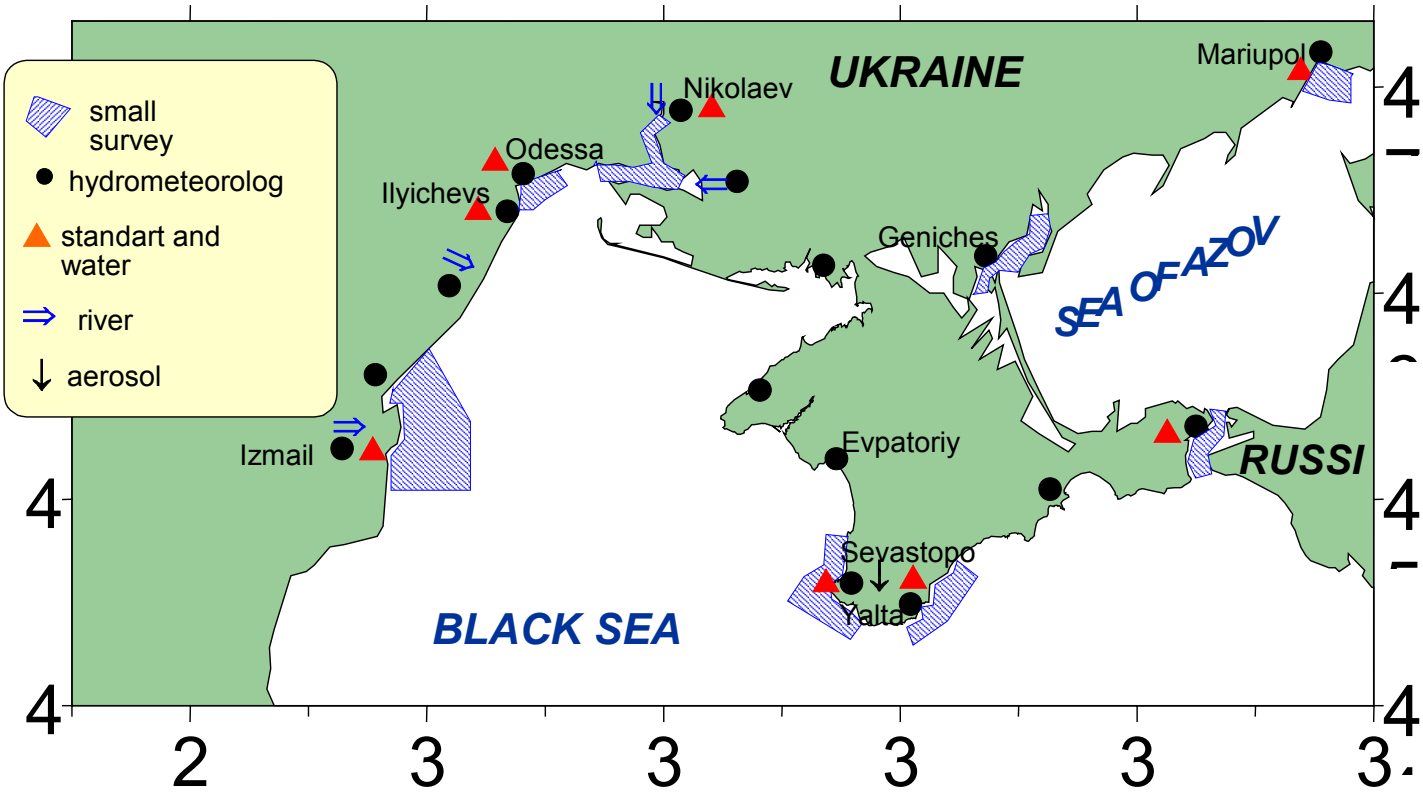


Figure 8. Ukranian sampling locations

The Marine observations network (main components) of the Ukrainian Hydrometeorological Service consists of:

- *Southern seashore of Crimea, port of Yalta.* Oceanographic surveys on 30 stations in the 5-miles band of coastal waters between the towns Alushta and Alupka; 10-miles "secular" sections from the port of Yalta towards the south-east; "secular" roadstead station on the distance 1 mile from Yalta. R/V *Neptun*.
- *Southwestern coast of Crimea, port of Sevastopol*. Oceanographic surveys on 15-30 stations in 5-miles coastal waters between the cape Lukull and cape Sarytch; surveys of Sevastopol bight on 10-15 stations or the cross-sections on 5-7 stations along the bight's axis. R/V *Poriv*.
- *Region of the Danube river mouth, port of Izmail*. Oceanographic surveys on 50 stations in 50-miles coastal waters from the Danube's mouth to the island Zmeiny; 20-miles "secular" sections on 9 stations along the latitude 45°20' N. R/V *Meridian.*
- *Dnieper-Bug estuary and marine coastal waters, port of Nikolaev*. Surveys in the Dniper-Bug estuary on 25-30 stations and 3-9 stations within the marine coastal waters. R/V *Typhoon*.
- *Kertch Strait, village Opasnoye*. Surveys of the Kertch Strait on 15-20 stations; "secular" section across the strait on 8 stations; "secular" roadstead station in the centre of the strait. R/V *Burun*.
- *Northern seashore of the Taganrog Bay in the Sea of Azov, port of Mariupol*. Surveys of coastal waters near Mariupol on 15 stations; 8-miles "secular" section from the port of Mariupol towards the south-south-east on 6 stations; "secular" roasted station in 1 mile of Mariupol. R/V *Shkval*.
- *Western seashore of the Sea of Azov, city of Genichesk*. Surveys of the Utliuk's firth and the lake Sivash on 12 stations; "secular" roadstead station in the Tonkiy strait. Water temperature, salinity, respective transparency (Secchi depth) and colour (in the standard scale) is measured, as well as standard meteorological observations are executed during

the near-shore oceanographic works on small vessels. Occasionally, marine current speed and direction are registered. Distributions of oceanographic properties with depth are taken by means of Nansen's bottle series or CTD-probes (the lasts are used occasionally, during joint works with research institutes). Water samples are taken for chemical analyses and pollutants control. Oceanographic and meteorological observational data are processed using standard methods.

Regular roadstead observations are executed every 10 days all the year round with intermissions under hard meteorological conditions. Oceanographic and chemical surveys for water quality control as well as "secular" sections are executed, basically, once per season (4 times per year). Exception is Yalta where such surveys and sections are executed every month. Intermissions occur because of insufficient funding.

Operational forecasting and information marine services. Four forecasting units of National Hydrometeorological Service carry out operational marine services for the Black Sea:

- *Hydrometeorological Centre for the Black Sea and the Sea of Azov in Odessa* is the main marine forecasting and methodological organization. It prepares and transmits one- and two-day weather and wave forecasts, storm and gale warnings for the Black Sea, short-term sea water temperature and ice forecasts for the north-western coast of the Black Sea and Kertch Strait, weather and wave forecasts for waterways in the Black Sea, Sea of Azov, Mediterranean and Red Sea, provides ship navigation by recommended courses for the Atlantic and Indian oceans, forecasts and real-time information for ports of Odessa, Nikolayev and Yuzhny.
- *Hydrometeorological Bureau of Ilyichevsk* prepares one-day weather and wave forecasts, storm warnings for the Ilyichevsk area, forecasts for the ferry route Ilyichevsk - Varna.
- *Danube Observatory in Izmail* prepares weather forecasts and storm warnings for the Danube region of Ukraine including ports of Reni, Izmail, Kiliya and Ust-Dunaysk.
- *Hydrometeorological Bureau of Sevastopol* prepares one-day weather and wave forecasts, storm warnings for the Sevastopol area, ports of Evpatoriya, Yalta, Feodosiya, offshore oil and gas platforms in Karkinitskiy and Kalamitskiy Bays.

Shortcomings in observational network functioning. There are two main obstacles preventing proper functioning of the observational network: outmoded facilities and lack of funding to substitute broken equipment, to carry out oceanographic cruises and to exchange data in a timely fashion.

Tide gauges, wave meters were produced in 1950s, geodesic equipment, current meters in 1960s, wind-gauges and oceanographic equipment in 1970s. 11 stations have only weathercocks for wind observations. There are no CTD-probes, so Nansen bottles, reversed thermometers and salinometers are used during research cruises.

Absence of equipment substitution lead in interruption of observation series such as: sea level in Evpatoriya, Chernomorskoye, Khorly, Mysovoye; water salinity in Sevastopol, Khorly, Chernomorskoye; wave instrumental measurements in Odessa, Opasnoye, Feodosiya Chernomorskoye; water temperature in Stereguschiy. Oceanographic surveys and sections are hardly ever carried out except R. V. *Neptun* (Station of Yalta) due to lack of funding for ship operation and fuel.

Annual station data reports are available mainly in paper format with large delay. Suspense of state border issues leads to partial implementation of oceanographic cruises. Hydrometeorological Service of Ukraine has to implement only a half of sections in Kertch Strait (Russian border) and in Danube (Romanian border).

Development of observational network. To promote quality of marine observational network operating it is necessary to solve several financial and legal problems:

1. Technical retrofitting of shore hydrometeorological stations and research vessels especially:

    - Sea-level gauges
    - Shore temperature and salinity meters
    - Wind gauges
    - Wave meters
    - Current meters
    - CTD-probes

2. Regular implementation of near-shore oceanographic surveys and "secular" sections. Three primary sections were well sampled from 1960-1980s connected to Crimea peninsula (Cape Chersonese – Bosphorus, Yalta – Batumi, to South of Cape Sarych) and can be provided, at least, once per season.

3. Development of operational data exchange system via Internet or Intranet with clear agreement on data accessibility and appropriate computer equipment.

4. Measurements in EEZ or territorial waters of bordering States to implement full spatial observation coverage.

10. NATIONAL REPORTS ON USER NEEDS

Bulgaria, Romania, Russian Federation and Ukraine had prepared statements of Black Sea GOOS user needs.

10.1 BULGARIA

Nikolai Simeonov provided an overview of the needs for oceanographic information by the Bulgarian Maritime administration. Four areas were mentioned in particularly: (i) operational ocean state and surface meteorology information for navigation; (ii) ocean current maps for search and rescue and oil spill modelling; (iii) signatures of oil products and a system to assess claims in regard to oil spill and pollution dumping at sea; (iv) “policing tools” in regards to monitoring and mitigation of ballast water dumping.

10.2 ROMANIA

Alexandru Bologa mentioned that 15 user need questionnaires had been distributed and the results were available for the working group on user needs (WG II – see section 12).

10.3 RUSSIAN FEDERATION

No formal user report was presented from Russia. However two experts from the user community (Dr. Metrevelli from fisheries and Dr. Oparin from the Naval Hydrographic Office) took part in the discussions on the matter in WG-II. Sergei Khodkin stressed the need to focus on a few user products. He suggested that the data exchange to enable common products for the Black Sea should initially be based on the WMO model as adopted at the 12th congress.

10.4 UKRAINE

Yuriy Ilyin reported on user needs for marine service products in Ukraine.

GOOS is conceived as a “user driven” system in which its structure and tasks are defined with the objective of delivering a global resource of ocean data and “products” (syntheses and models) in the most efficient way to those who can use or apply them for any purpose of public benefit. Thus, existing and future marine observations and service systems within the Black Sea and Azov Seas should be aimed at satisfying different groups of user requirements.

Three main classes of users can be distinguished in Ukraine:

(i) *end-users,* which use marine and meteorological information for their routine activity (port operations and shipping, shore facilities construction and maintenance, fishery and aquaculture, recreation and tourism, marine mining, etc.).
(ii) *user-producers,* including marine services operators and expert groups, providing end-users and authorities with processed and generalized information on the base of initial observational data;
(iii) *user-scientists,* which prepare mostly, integrated and elaborate products on processes and changes within marine and coastal systems; additionally user-scientists develop new technologies for measurements and modelling.

Therefore, a prospective Black Sea GOOS should satisfy requirements of all listed user groups.

A preliminary analysis of the replies to the distributed Black Sea GOOS questionnaire shows users' interest primarily to data and products related to the *atmospheric boundary layer, sea surface and sea ice.* Besides, port authorities dealing with marine environment quality control (Ilyichevsk Merchant Port) expressed their interest in *marine chemistry and pollution data*. The same interests (sea level, winds, waves, air and water temperature, currents and sea ice statistics in coastal zone) are demonstrated by shore and shelf facility designers and constructors, as it follows from analysis of their requests. This kind of information can be produced based on marine hydrometeorological station data and some model calculations of waves and currents. The shore station network in Ukraine is also addressing water quality and bottom sediment studies, in addition to pollution source control provided by the State inspection on the sea protection. A description on this important component of the Black Sea observational system in Ukraine was presented at the previous Black Sea GOOS Workshop Report (Varna, Bulgaria, 1999).

Marine shipping and fishery companies (meteorology along ship routes, wave and current forecasts) use open sea operational data, first of all. A full set of open sea oceanographic observations is necessary for the scientific community dealing with monitoring and modelling long-term climate and ecological changes. Consumers of products based on this kind of data can be national and local authorities, environmental services and the recreation sector. To provide for their needs as well as needs of the scientific community itself, regular observations from research vessels should be reconstructed. This revival can be based on the new level of knowledge obtained during national and international studies in the 1980s and 1990s, as well as by integrating different sources of information. The components of such an integrated open sea observation system should consists of a number of long-term seasonal oceanographic sections, ship-of-opportunity observations (along newly stated ferry lines), drifting buoys and satellite data (see section 9.6). Three main oceanographic sections were well sampled from about 1960 to the 1980s. This system consisted of the transects Cape Chersonese – Bosphorus, Yalta – Batumi, to South of Cape Sarich, and these sections can be provided, at least, once per season by R.V. *Neptun* (Marine hydrometeorological station of Yalta).

11. WORKING GROUPS

Following the presentations the participants were divided into three working groups. Working Group I (WG I) was asked to review and discuss the draft Black Sea GOOS Strategy and Implementation Plan, the draft Black Sea GOOS MoU, the draft Black Sea GOOS – EuroGOOS MoU. Working Group II (WG II) was asked to review user needs and requirements in light of the results of the user survey that was initiated at the first session of the Black Sea GOOS Workshop (Albena, 11-15 October, 1999; Black Sea GOOS Report No. 1). Working Group III (WG III) was asked to draft a resolution for the XXI Session of the IOC Assembly (July 2001).

Members of Working Group I were: Korataev (Chair), Kubriakov, Khodkin, Postnov, Abuziyarov, Ganchev, Slabakov, Malciu, Cordoneanu, Altiner, Cubukcu, Kos'yan, Kordzakhia.

Members of Working Group II were: Salihoglu (Chair), Nikolaev, Bologa, Djaoshvili, Metreveli, Malciu, Metreveli, Oparin, Ylyin, Flemming and van Dongen.

Members of Working Group III were: Ganchev, Khomeriki, Postnov, Cubukcu, Eremeev and Travin.

12. RESULTS AND RECOMMENDATIONS FROM WORKING GROUPS

12.1 WORKING GROUP I

WG I reviewed the following documents:

- Draft Black Sea GOOS Strategy and Implementation Plan
- Memorandum of Understanding for Black Sea GOOS
- Memorandum of Understanding between Black Sea GOOS and EuroGOOS
- Capacity Building needs and funding opportunities

The members of the WG expressed their vision of the principles of the Black Sea GOOS science and implementation plan. Sergey Khodkin indicated that the implementation plan should be realistic and contain tasks that could be implemented under present financial constrains in the riparian countries. He suggested that the data exchange to enable common products for the Black Sea should initially be based on the WMO model as adopted at the 12th Congress.

After discussion it was recommended that the plan could be adopted in principle. It was recommended that an editing group would revise it and finalize it by mid-September 2001.

As the first steps to implementation of the Black Sea GOOS science and implementation plan the following measures were recommended:

- to request the Black Sea GOOS countries to investigate possibility of making several observed meteorological/oceanological parameters available to the Black Sea GOOS community via Internet on real or near real-time basis;
- to establish a group of experts to work out procedures for data exchange within Black Sea GOOS using the relevant principles adopted in EuroGOOS as guidelines;
- to prepare an application for EU funding of the Black Sea GOOS activities;
- to investigate the feasibility to start trans-national operational monitoring projects between two or more Black Sea GOOS countries to demonstrate the benefits to the end users;
- to draft an agreement among national hydrometeorological services aiming at a system of regional exchange of standard hydrometeorological data from coastal hydrometeorological stations;
- to include the planned cruises of R.V. *Knor*, *Vodganitskii, Academic Acvanavt*, *Rift* into the Black Sea GOOS science and implementation plan;
- to include the drifting buoy initiative into the Black Sea GOOS science and implementation plan with due account for the legal status of the drifting buoys in the territorial waters of the coastal States;
- to draft an application to secure support for activities of a Black Sea GOOS Secretariat;
- to establish a Black Sea GOOS web-page.

WG I reviewed the draft Black Sea GOOS Memorandum of Understanding, a document on capacity building needs, call for assistance and recommended these documents for adoption by the Workshop plenary session.

12.2 WORKING GROUP II

WG II addressed the following items during its session: (i) status of user need survey; (ii) outcome of survey; (iii) assessment of economic impact of Black Sea GOOS; (iv) evaluation of the

Black Sea GOOS (data and information) products; (v) inventory of suppliers and users of (data) products; (vi) recommendations/proposals.

At the First Black Sea GOOS workshop (Albena, 1999) it had been decided to do a survey of user needs and requirements for operational marine services in the Black Sea. A questionnaire, largely adopted from a similar one used by EuroGOOS (see EuroGOOS report No. 12; http://www.eurogoos.org/Activities/Publications/RequirementsSurvey.pdf) was sent out to 46 users of marine services. 30 of the questionnaires were returned. The status of the questionnaire is given below.

Status of the Survey	**Distributed**	**Answered**
BULGARIA	12	5
ROMANIA	18	15
UKRAINE	10	4
RUSSIA Hydrograhy	5	5
RUSSIA Fisheries	1	1
GEORGIA		
TURKEY		
TOTAL	**46**	**30**

A brief summary of the survey showed that the predominant request for data and products were related to environmental protection. Products needed by ocean services and transport followed this.

In the environmental category products targeted towards oil pollution control were the most sought after. The participants also found the services like weather forecasting and consultancy important. Among the other topics, port operations, environmental forecasts and shipping operations are listed by the survey participants as the most demanded data or products.

For the data variables, parameters, and products in the Black Sea GOOS, the participants were altogether focused on two topics: atmospheric boundary layers products and sea surface state products. The rest of the items were marked only by a small percentage of the contributors. The wind speed and the wind direction at 10 meters, along with air temperature are the most important atmospheric parameters and were selected by almost all the participants. Among the sea surface variables, all the participants required significant wave height. This was followed by sea surface temperature, swell, wave direction, and wave period.

The ranking of the variables remained almost the same when product needs were compared between the coastal and offshore zone. Coastal zone products were ranked of higher importance than offshore zone products.

The interest of the organizations that participated in the survey were concentrated on environmental protection, sea transport, oil pollution, weather forecast, atmospheric events at the lower layers and sea surface state. This seems to address oil traffic in the Black Sea and its impact on the Black Sea environment. As for the remedies, improved weather forecasting and other information on weather and sea state that can increase safety of the seafaring activities are noted.

Evaluation of the Black Sea GOOS products. WG2 recognized the importance of dissemination of the data and data products as soon as possible to promote the use of the system. In that context National Oceanographic Committees (like what has been established in Georgia) play an important role.

Inventory of suppliers and users of data and data products. (i) Black Sea GOOS should create an inventory of potential end users of GOOS data which can be used both to extend the survey questionnaire, and as a tool for marketing data products, (ii).the inventory of end users can be compiled from the following sources:

- UN Catalogue of surveys, ports, UNCTAD

- Attendance at trade of technical exhibitions
- Port authorities
- Oil and gas industry
- Shipping companies, ferry operators
- Fishing companies
- Marine equipment suppliers
- Coastal construction, companies
- Aquaculture, fish farmers
- Trade and engineering magazines
- Collect addresses from magazines
- Government environmental and regulatory agencies

(iii) Aim: to build a Black Sea end-user mailing list

Other Recommendations/proposals:

(i) the Georgian example of establishing a national oceanographic committee was recommended to other countries in order to provide efficient national coordination of Black Sea GOOS activities;
(ii) the national authorities were invited to pay attention to the marine operation data and data products;
(iii) the WG agreed on the importance of the data quality control.

13. ESTABLISHMENT OF A STEERING COMMITTEE FOR Black Sea GOOS

Ilkay Salihoglu introduced this item. Prior to the second Black Sea GOOS workshop there had been discussions via e-mail on how plans and implementation for a Black Sea GOOS could most effectively be taken forward. These discussions had concluded that a steering committee for Black Sea GOOS would be beneficial. This would also be in line with similar regional GOOS developments as seen in the Baltic, the Mediterranean, and the Caribbean, and also as encouraged by the policies set out by the GOOS Steering Committee, for regional development of GOOS.

The foundation for a Black Sea GOOS steering committee and the rules and procedures for such a committee would be based on a Black Sea GOOS Memorandum of Understanding (Annex IV). A draft version of the MoU had been circulated among all delegations. The MoU had also been discussed in WG I and minor modifications had been suggested. These suggestions were included in the version presented in Annex IV.

The meeting participants were invited to discuss the draft Black Sea GOOS MoU.

Nobody had any objections and the draft Black Sea GOOS MoU was approved. It was agreed that the Black Sea GOOS MoU should be put forward for formal adoption and signature by the participants to the 21st IOC Assembly (4-14 July 2001) in Paris. It was agreed that the participants to this workshop should take the necessary steps to make sure that their respective IOC Assembly delegations would be authorized to sign the Black Sea GOOS MoU at the 21st IOC Assembly

14. Black Sea GOOS – EuroGOOS COLLABORATION

Ikay Salihoglu introduced this item. Prior to the second Black Sea GOOS workshop there had been informal discussions regarding collaboration between Black Sea GOOS and EuroGOOS and a draft Black Sea GOOS – EuroGOOS MoU had been circulated. This MoU had been discussed in WG I and with Nic Flemming.

The meeting participants were invited to discuss the draft Black Sea GOOS-EuroGOOS MoU. Nobody had any objections and the Black Sea GOOS – EuroGOOS MoU was approved in principle. It was left for Ilkay Salihoglu and Nic Flemming to finalize the text.

Nic Flemming stated that following a formal adoption and signature of the Black Sea GOOS MoU, he would go ahead and present the draft Black Sea GOOS – EuroGOOS MoU to the Officers of EuroGOOS. The MoU could then be discussed and hopefully approved at the EuroGOOS annual meeting in November 2001 in Copenhagen.

15. LIST OF ACTIONS

Alexander Postnov and Thorkild Aarup presented a draft list of actions (Annex VI) based on the discussions and exchanges that took place during the meeting. The Group approved the draft list of actions.

16. CLOSURE

Valery Eremeev thanked all participants for their hard work and good spirit of collaboration. He also thanked the Port of Poti and the general manager and his staff for all their generous hospitality and assistance during the meeting. Sergei Khodkin seconded this and thanked the Chairman and the IOC for their efforts in making the meeting a success. The meeting was closed at 13:00 on 25 May 2001.

ANNEX I

AGENDA

1. OPENING

2. ADMINISTRATIVE ARRANGEMENTS
- 2.1 ADOPTION OF THE AGENDA
- 2.2 DESIGNATION OF THE RAPPORTEUR

3. INTRODUCTION OF DOCUMENTS FOR MEETING

4. STATUS OF GOOS

5, EuroGOOS AND Black Sea GOOS

6. BLACK SEA ENVIRONMENTAL PROGRAMMES

7. SeaNet

8. HISTORY OF Black Sea GOOS

9. NATIONAL REPORTS ON Black Sea OBSERVING ACTIVITIES
- 9.1 BULGARIA
- 9.2 GEORGIA
- 9.3 ROMANIA
- 9.4 RUSSIAN FEDERATION
- 9.5 TURKEY

10. NATIONAL REPORTS ON USER NEEDS
- 10.1 BULGARIA
- 10.2 ROMANIA
- 10.3 RUSSIAN FEDERATION
- 10.4 UKRAINE

11. WORKING GROUPS

12. RESULTS AND RECOMMENDATIONS FROM WORKING GROUPS
- 12.1 WORKING GROUP I
- 12.2 WORKING GROUP II

13. ESTABLISHMENT OF A STEERING COMMITTEE OF Black Sea GOOS

14. Black Sea GOOS – EuroGOOS COLLABORATION

15. LIST OF ACTIONS

16. CLOSURE

ANNEX II

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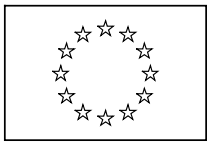
ANNEX III

MESSAGE FROM CHRISTIAN PATTERMAN



EUROPEAN COMMISSION
RESEARCH DIRECTORATE-GENERAL

Directorate I - Preserving the Ecosystem : environmental research
The Director

Brussels, 15 May 2001
DG RTD/ I/CP/AE/apds D(2001)

To the participants of
the Black Sea GOOS Workshop

Subject: **Black Sea GOOS Workshop, May 22-25, Poti, Georgia**

Dear Participants,

It gives me great pleasure to send this message to you from the European Commission's Research Directorate General.

As many of you will know, the European Research Framework Programmes have funded successful projects in the fields of operational oceanography and ocean observing systems for a number of years. It is pleasing for me to note that in the present Framework Programme the European Community has been able to support projects that are of interest to EuroGOOS. In addition, I am especially delighted that the MedGOOS proposal MAMA has recently been proposed for funding following the last round of evaluations. When the MAMA contract is finalized, this will extend European Community funding of operational oceanography over the entire Mediterranean basin.

In the near future, I understand that the Black Sea GOOS community may be in a position to submit a proposal to 5th Framework Programme (FP5). [Please note that the last open Call for proposals under FP5 has a deadline of 15 October 2001.] Should such a proposal be received and be positively evaluated by independent experts within the normal Commission procedures for open competition, then the Black Sea GOOS community would be in a position to enter into the overall framework of operational oceanographic projects funded at Community level, something that would be welcomed by everyone working in this field of research.

I therefore wish everyone taking part in the Black Sea GOOS Workshop every success in their endeavours.

Yours sincerely,

Signed

Christian Patermann

ANNEX IV

DRAFT MEMORANDUM OF UNDERSTANDING ABOUT Black Sea GOOS

Black Sea Global Ocean Observing System

The Black Sea GOOS Memorandum of Understanding (MoU)

This MoU serves as the initial document for Black Sea GOOS, as an informal association whose members seek to foster co-operation on the Global Ocean Observing System. Black Sea GOOS is established with the participation of Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine and the recognition of the importance of existing systems in research and operational oceanography and will also take full advantage of advances made by other regional GOOS groups such as EuroGOOS and Med-GOOS, and by the various GOOS design panels. By signing the MoU countries become members of Black Sea GOOS, and agree to co-operate in promoting GOOS in the Black Sea basin.

1. Aims of and Objectives

The aims and objectives of the Black Sea GOOS are:

- To contribute to international planning and implementation of GOOS and promoting it at national, regional and global level.
- To identify regional priorities for operational oceanography.
- To co-operate with the Black Sea Environmental Programme (BSEP) and Permanent Secretariat of the Black Sea Commission (secretariat for the Bucharest Convention) and other relevant bodies to harmonize the oceanographic activities in the region.
- To develop capacity of the regional countries and promote the level to sustain GOOS activities.
- To promote the development of the scientific, technology and computer systems for operational oceanography.
- To facilitate network for real and/or near time data exchange by the members.
- To provide high quality data and time series for a better understanding and improving of the Black Sea ecosystem.
- To find means to ensure the most effective use of existing technologies related to operational oceanography and marine meteorology.
- To assess the economic and social benefits from operational oceanography.

2. Activities

Black Sea GOOS activities will be designed to foster operational oceanography in the Black Sea basin collaborate with and maximise the benefits from existing activities of EuroGOOS and Med-GOOS, promoting the integration of these activities within the framework of GOOS.

Members of Black Sea GOOS will collaborate and support the following groups of activities.

2.1 Policy In Promoting GOOS

- To develop policies for the enhancement of GOOS and co-ordinating the best Black Sea participation in GOOS, identifying where greatest value is added by collaboration.
- To promote collaboration between the existing regional multi-national agencies programmes, organisations, and initiatives having expertise in oceanography, operational systems, and remote sensing of the ocean.
- To promote collaboration with EuroGOOS through bilateral concurrence.
- To promote collaboration with EuroGOOS and Med-GOOS through joint projects and activities.
- To promote capacity building and exchange of know-how and personnel to the IOC.
- To promote studies and evaluation of the economic and social benefits produced by operational oceanography.
- To co-operate as appropriate with organisations concerned with rapid assessment of climate change, global environmental research and the impacts of climate variability and climate change.
- To provide, as appropriate, expertise, WGs, consultants, etc., to IOC, SC GOOS, I-GOOS and other relevant organisations.
- To provide, as appropriate, expertise, WGs, consultants, etc., to Black Sea Environmental Programme (BSEP) and Permanent Secretariat of the Black Sea Commission.
- To publish findings of meetings, workshops, studies, and other documents commissioned by the Black Sea GOOS members, joint representation at and submission of documents to international meetings related to GOOS, and collective representation of GOOS to regional and national Agencies, when requested by members.
- To co-ordinate GOOS data acquisition with existing regional and national data gathering under Agreements and Conventions.
- To promote consulting to regional personnel.

2.2 Advancing Black Sea Operational Oceanography

- Promoting development of Black Sea regional operational oceanography, taking into account the Modules of GOOS (1) The Ocean Observations Panel for Climate (OOPC), and (2) The Coastal Ocean Observations Panel (COOP).
- Promoting development of common operational data procedures and services, including data quality control and quality assurance, and data management for operational oceanography.
- Promoting research and pre-operational research that will solve problems relating to operational oceanography.
- Promoting development of common infrastructure to implement Black Sea operational Oceanography.
- Promoting pilot studies in GOOS operations, local, regional, or global.
- Promoting development of common Black Sea operational oceanographic services and products of maximum value to the Black Sea countries to attain sustainable development.

2.3. Promotion Of Instrumentation And Technology

- To promote the development of low cost enhanced operational instrumentation, observing systems, data acquisition and data management systems, processing and interpretation systems, as well as data exchange.

- To support operational oceanography and services in collaboration with public and private sector organizations, NGOs and programmes concerned with ocean technology in the Black Sea.

2.4 Aid and Capacity Building

- To promote aid, technology transfer, and collaboration among Black Sea Countries within the framework of GOOS.
- To strengthen the collaboration with EuroGOOS working group on capacity building and with similar work stimulated through Med-GOOS.

3. Membership

Black Sea GOOS members will be organisations, preferably authorities willing to advance GOOS in their country and actively contribute to fulfilling the aims and objectives of the Black Sea GOOS. Maximum number of the members per country shall be agreed by the Annual Meeting.

Multi-national organisations of the Black Sea region and NGOs with a Black Sea emphasis, or components or subsidiaries of such organizations, provided that they have aims and objectives consistent with this MoU, may be invited to become Observers at the discretion of the Members.

4 Management of Black Sea GOOS

4.1 Black Sea GOOS Steering Committee

The Black Sea GOOS *Ad Hoc* Steering Committee is the body appointed by Black Sea GOOS Workshop in Poti (Georgia) on May 2001. Each Black Sea country is represented by one member in the *Ad Hoc* Steering Committee designated by the country delegation of Poti workshop. IOC Black Sea Regional Committee chairperson is the chairperson of the *Ad Hoc* Steering Committee. The Steering committee will serve to:

- continue and strengthen links with IOC;
- finalise and bring to the attention of the Black Sea countries IOC Twenty-first Session of the Assembly (Paris, 3-13 July 2001) delegation of the for approval and signature of the Black Sea MoU;
- appoint and authorize a Black Sea delegation to participate and contact EU meeting on 18-20 June 2001 in Brussels;
- appoint and authorize a Black Sea Scientific Committee to prepare and submit a joint Black Sea GOOS proposal to EU;
- develop links with the existing relevant organisations, programmes, projects and subsidiary bodies;
- make decisions for the set up of the Black Sea GOOS office;
- collaborate with IOC to organise a meeting for the election of the regular Black Sea GOOS Executive Committee upon the signing of the Black Sea GOOS MoU and transfer all responsibilities and relevant documentation to the elected Black Sea GOOS Executive Committee.

4.2 Black Sea GOOS Executive Committee

The first Black Sea GOOS Executive Committee will be appointed on the final meeting of the Steering Committee for two years. Each Black Sea GOOS country will be presented on the Executive Committee and will have one vote. The Executive Committee will appoint a Chairperson and an Executive Secretary. All decisions of the Executive Committee are taken on a consensus basis.

The Chairperson and the Executive Committee members will serve for two years, and be responsible for all Black Sea GOOS activities between Annual Meetings. The committee will meet as necessary. They will be eligible for re-appointment for up to a maximum of three successive turns.

The Executive Secretary will report to the Chairperson and to the committee. He/she will prepare papers for all meetings and represent Black Sea GOOS at international organizations as required by the Committee. The GOOS Project Office Director and the EuroGOOS Director will be invited to attend the Black Sea GOOS committee meetings. The EuroGOOS Chairperson and Director will be also invited to provide continuity in the action of EuroGOOS for the Black Sea and co-ordination in the activities of the two organisations.

The Executive Committee group will meet once a year, on additionally upon the request from one member.

The Executive Committee will:

- execute the decisions of the Annual Meeting,
- prepare matters for Annual Meeting and make an annual report with relevant background material about each running project,
- prepare cooperation plans and propose activities to the Annual Meeting,
- propose activities related to other frameworks outside this cooperation,
- decide on additional member meetings when necessary

4.3 Annual Meeting

Black Sea GOOS can organise regular Annual Meetings in December in order to define the overall policy of Black Sea GOOS, review the progress of ongoing activities and advise modern operational programmes, and to decide on new projects and activities related to other frameworks outside Black Sea GOOS. Black Sea GOOS members at the Annual Meetings will take decisions jointly.

The attendance at the Annual Meeting will consist of one representative per country, being the designated Black Sea GOOS Member for that country agreed by the Associate Members from that country. Each representative at the Annual Meeting will act as the intermediary between Black Sea GOOS and the Associate Black Sea GOOS Members in his/her country. For meetings other than Annual Meeting the Associate Members may participate in the proceedings directly. Efforts should be made to associate the Annual meetings with any other Black Sea GOOS international/national activities.

5. Data Policy

Exchange of data and products within agreed procedures is a key element of the Black Sea GOOS activities. The Black Sea GOOS data policy shall comply with the IOC and WMO data policy but this cannot contradict the laws of the member states.

6. Black Sea GOOS Funding

Members and Associate Members shall bear their own costs for attending meetings and participation in the activities of Black Sea GOOS. They could on voluntary basis support the commissioned reports and surveys, the organisation of meetings or Workshops, the hosting of WWW sites, consulting services to national and multinational bodies, financing publications etc. Whenever possible external funding shall be pursued. External money is administrated according to the application and the rules of the funding organisation.

7. Entry Into Force

This MoU enters into force for its signatories once it has been signed by at least half of the member countries. After that it enters into force at the time of signature for each successive signatory.

8. Duration

Black Sea GOOS will continue until the decision of the Executive Committee.

ANNEX V

Draft Memorandum of Understanding between the proposed Black Sea GOOS and EuroGOOS

AN INFORMAL ASSOCIATION FOSTERING COOPERATION ON THE GLOBAL OCEAN OBSERVING SYSTEM BETWEEN ASSOCIATIONS OF MARINE OPERATIONAL AND RESEARCH AGENCIES IN THE BLACK SEA AND EUROPEAN REGIONS

The Black Sea GOOS - EuroGOOS Memorandum of Understanding

This Memorandum of Understanding (to be known in brief as the Black Sea GOOS – Euro GOOS MoU) serves as the initial document for co-operation between EuroGOOS and Black Sea GOOS, both of which are informal associations whose members seek to foster co-operation on the Global Ocean Observing System, respectively in the European and Black Sea regions. Both the Black Sea GOOS and EuroGOOS are established with the recognition of the importance of existing systems in research and operational oceanography at national and regional scales and both will take full advantage of the advances made mutually by each other, by other regional GOOS groups such as Med-GOOS, and by the various GOOS design panels. By signing the MoU, parties and their member agencies agree to co-operate in promoting GOOS in the Black Sea and European regions, and to co-operate towards joint actions and interactions as needed.

Aims of the co-operation between Black Sea GOOS and EuroGOOS

In agreeing to co-operate through this MoU, Black Sea GOOS and EuroGOOS co-operate will aim to establish means for: joint international planning and implementation of GOOS on national, regional and global levels; mutually co-ordinating their actions related to operational oceanography, including ocean monitoring, promoting the development of the scientific, technological means to carry out joint programmes and concerted actions common to their respective regions of interest, and comparatively assessing the economic and social benefits and impacts of their activities on the region as a whole. They will also aim to bring the coverage and scientific expertise to the same level in both regions, and use the synergism of their combined efforts to build a functional, co-operative network.

Noting the development of a Regional Policy by I-GOOS, the signatory parties will promote collaboration between the Regions, and with other components of GOOS, within the framework of that policy.

Activities

Joint activities of the EuroGOOS and Black Sea GOOS will be designed to foster collaboration in operational oceanography in the entire region to maximise the benefits derived from their individual activities, promoting the integration of these activities within the framework of GOOS.

Activities

Through mutual collaboration and support, Members of EuroGOOS and Black Sea GOOS will seek to:

Promote collaboration between the existing regional multi-national agencies programmes, organizations, and initiatives having expertise in oceanography, operational systems, and remote sensing of the ocean.

Promote collaboration between EuroGOOS, Black Sea GOOS and Med-GOOS through joint projects and activities.

Promote comparative studies and evaluation of the economic and social benefits produced by operational oceanography in the European and Black Sea regions.

Co-operate as appropriate with organizations concerned with rapid assessment of climate change, global environmental research and the impacts of climate variability and climate change.

Establish joint Task Teams to address problems identified in the development of a potential oceanography.

Produce and publish syntheses of findings of meetings, workshops, etc. Resulting from either coordinated or individual EuroGOOS or Black Sea GOOS activities, to enable joint interpretation of results for better understanding of scientific aspects or for evaluation of impacts.

Co-ordinate inter-regional GOOS data acquisition based on existing regional and national data gathering under Agreements and Conventions.

Promoting development of common operational data procedures and services, including data quality control and data management for operational oceanography.

Promote pilot studies in GOOS operations, at inter-regional and global levels.

Promote and approach based on common Instrumentation and Technology of common Instrumentation and Technology.

Promote the development of low cost alternatives for operational instrumentation, observing systems, data acquisition and data management systems, processing and interpretation systems, as well as for data exchange.

Support operational oceanography and services in collaboration with public and private sector organizations, NGOs and programmes concerned with ocean technology in the Black Sea and European regions.

And in the area of Aid and Capacity building will seek, in particular, to:

Promote aid, technology transfer, and collaboration between Black Sea and European Countries within the framework of GOOS.

Compensate for the socio-economic differences between the Black Sea and European regions through scientific collaboration, and in order to build a uniform, functional network covering both regions in an effective manner.

ANNEX VI

LIST OF ACTIONS

1. Frans van Dongen to explore funding opportunities through development of assistance programmes in the Netherlands and report to Black Sea GOOS Steering Committee.

2. Sema Acca to inform the Black Sea GOOS Steering Committee with details of the Regional Coordinated Environmental Monitoring Programme, which will be launched by the Black Sea Istanbul Commission. This Programme will contain a special component on monitoring of nutrients in the Black Sea. BSEP and Black Sea GOOS to closely collaborate in the design and implementation of the two specific cruises planned for Fall 2001 and Spring 2001 by BSEP. BSEP to communicate information on the funds available under the EU TACIS interstate programme for ecological monitoring, coastal zone management and biodiversity fields for the Black Sea.

3. Nic Flemming to provide contact point for Ferry-box project and to explore a possibility for further collaboration between Black Sea GOOS and EuroGOOS with the aim of establishing ship-of-opportunity observations in the Black Sea.

4. Draft resolution covering Black Sea GOOS activities to be prepared by correspondence before 15 June 2001 for the 21st IOC Assembly.

5. Black Sea GOOS Steering Committee to inform the I-GOOS at its 5th Session about present status of and future prospects of Black Sea GOOS.

6. Establish formal link with the EuroGOOS EDIOS project in order to facilitate compilation of an inventory of existing observation infrastructure (fixed stations and long term sustained individual stations/sections). (Lead: Black Sea GOOS Steering Committee).

7. Black Sea GOOS countries to investigate possibility of making several observed meteorological/oceanological parameters available to the Black Sea GOOS community via GTS and other existing telecommunication systems including Internet on real or near real-time basis (Lead: Black Sea GOOS Steering Committee).

8. To establish a group of experts to work out procedures for data exchange within Black Sea GOOS using the relevant principles adopted in EuroGOOS as guidelines (Lead: Black Sea GOOS Steering Committee).

9. To solicit financial assistance from:

(a) European Union through a concerted action application - this would mainly be targeted for logistic support of Black Sea GOOS activities (Lead: Black Sea GOOS Steering Committee/Professor Salihoglu);

(b) UNESCO - ROSTE for enhancing and strengthening network for data exchange, possibly to be based on previously developed proposal to the NATO Partnership for Peace Programme. This proposal may also be of relevance as a continuation of the ongoing MEDAR/MEDATLAS project (ending late 2001);

(c) UNESCO - ROSTE for co-funding of a Black Sea GOOS Secretariat.

10. To investigate the feasibility to start trans-national monitoring projects between two or more Black Sea GOOS countries to demonstrate the benefits to the end users.

11. To draft agreements, if necessary, between National Hydrometeorological Services aiming at a system of regional exchange of standard hydrometeorological data from coastal hydrometeorological stations.

12. To consider relevant nationally and internationally funded cruises of research vessels as contributions to Black Sea GOOS implementation activities. (Black Sea GOOS Steering Committee to compile list of cruises on annual basis).

13. To include the drifting buoy initiative into the Black Sea GOOS Implementation Plan with due account for the legal status of the drifting buoys in the territorial waters of the coastal states.

14. To establish a Black Sea GOOS web page (Lead: G. Korataev).

15. Black Sea GOOS Steering Committee to revise and formally submit the Black Sea GOOS MoU approved in principle by the delegates of the all the would-be Black Sea GOOS riparian countries.

16. Black Sea GOOS Steering Committee to establish a drafting group which will finalize the draft Strategy and Implementation Plan by 1 September 2001.

17. User survey results (based on questionnaire developed at the Varna Workshop, Black Sea GOOS Report No. 1) to be summarised and submitted to the drafting group and Thorkild Aarup (IOC) for inclusion in the workshop report by June 5 (Lead: Professor Salihoglu).

18. Participants to initiate establishment of National GOOS coordinating committees, which are to bring together both organizations, involved in observation activities and users of marine products at the national level.

19. To compile an inventory of users of data and information products (Lead: Members of Black Sea GOOS Steering Committee to report to Executive Secretary).

20. Georgian representative to investigate feasibility of establishment a National Centre for Sustainable Development and Management of the Coastal Zone as a contribution to Black Sea GOOS Implementation.

21. The Black Sea GOOS Steering committee to draft the final version of the MoU between EuroGOOS and Black Sea GOOS subject to endorsement by the would-be Black Sea GOOS riparian countries.

22. The Black Sea GOOS Steering Committee will present information about the results of its activity and proposal for future implementation of its Black Sea GOOS programme to the IOC Black Sea Regional Committee.

ANNEX VII

PROPOSAL FOR A CENTRE FOR SUSTAINABLE DEVELOPMENT AND MANAGEMENT OF THE BLACK SEA COASTAL ZONE

Submitted by the Georgian Delegation to the
Second Black Sea GOOS Workshop

Taking into consideration the present state of the east coastal zone of the Black Sea, which is impacted by (i) increasing sea level and erosion of the coasts, (ii) ecological degradation of the region from economic development in the coastal zone,

Recognizing the lacking ability to gather and process data from the Black Sea coastal zone, and noting the need for such data in Black Sea GOOS related activities,

Invites the Black Sea Regional Committee (BSRC) to support the idea of establishing in Poti a Centre for Sustainable Development and Management of the Black Sea Coastal Zone;

Requests the BSRC to apply to relevant institutions of Georgia and International Organizations to find possibilities for provision of functioning of this Centre.

ANNEX VIII

LIST OF ACRONYMS

BOOS	Baltic Operational Oceanographic System
BSEP	Black Sea Environmental Programme
BSRC	Black Sea Regional Committee of IOC (UNESCO)
CESUM	Centre for Sustainable Development and Management of the Black Sea Region (EU project**)**
C-GOOS	Coastal GOOS
CNES	Centre national des Etudes Spatiales, France
CoMSBlack	Co-operative Marine Science Programme for the Black Sea
CONNS	Coastal Observing Networks for the Near Shore
COOP	Coastal Ocean Observations Panel
ECRD	European Commission Research Directorate
EU	European Union
EuroGOOS	European Component of GOOS
GCOS	Global Climate Observing System
GCM	General Circulation Model
GLOSS	Global Sea Level Observing System
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GSC	GOOS Steering Committee
GTS	Global Telecommunication System
HIROMB	High Resolution Operational Model of the Baltic Sea
HOTO	Health of the Ocean
IALA	International Association of Marine Aids to navigation and Lighthouse Authorities
IOC	Intergovernmental Oceanographic Commission
LMR	Living Marine Resources
MFSPP	Mediterranean Forecasting System Pilot Project
OOPC	Ocean Observations Panel for Climate
OSSE	Observation System Simulation Experiments
ROSTE	Regional Office for Science and Technology for Europe (UNESCO)
SOOP	Ships of Opportunity
TDA	Transboundary Diagnostic Analysis
ToR	Terms of References
TRACEA	Transport Corridor Europe-Caucasus-Asia
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
VOS	Voluntary Observing Ships
WMO	World Meteorological Organization