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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
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Mr. Chairman, your invitation to participate in the International Panel of the Ocean Policy Commission, gives me the opportunity, first to thank the United States of America for its constant support to the work of the Intergovernmental Oceanographic Commission of UNESCO (IOC). As you know, on September 12, President Bush in his speech to the General Assembly of the UN announced the return of the USA to the United Nations Educational, Scientific and Cultural Organization (UNESCO), which the USA abandoned many years ago. We in the IOC are very happy of this decision that gives UNESCO a significant and deserved backing for the fulfilment of its very important Mission. But, Mr Chairman, it is important to recall here, for the record, that the USA is returning to UNESCO but not to the IOC, because the USA never left the IOC. The USA has provided during 42 years constant leadership in support of the development of Ocean Science and Ocean services through international cooperation in IOC. The USA during all these years of absence from UNESCO has been a full and very active member of the IOC, electing and being elected in the Governing bodies, providing much needed additional resources, and personnel to serve at the secretariat of IOC in Paris. In 1987 the delegation of the USA joined others in proposing the development of a Global Ocean Observing System. For all this the member states of the IOC and the professionals that work in the Secretariat of IOC are extremely grateful.

Mr. Chairman, your invitation asked me to give our view on *"how the United States can best preserve and enhance its role as a leader in ocean and coastal activities"*. I will do this from the perspective that I know best, that of international cooperation. I will briefly summarize the achievements of the last decades, and then pass review to the current challenges; finally I would offer my views on the future.

In 1960 the creation of the IOC was agreed and endorsed by the First Oceanographic Conference gathered in Copenhagen. During the preparatory meeting for that Conference that took place in Paris in March 1960, the USA delegation was presided by Dr. Roger Revelle, then Director of Scripps Institution of Oceanography in La Jolla. Dr. Revelle summarized in a brief statement what in the view of the USA Delegation were the purposes of this new UN organization, let me offer to the Commission a brief excerpt from the transcripts of that meeting, and I quote

> "In considering the needs for international co-operation in the marine sciences, it is convenient to divide the problem into three parts: **research, oceanic surveys and assistance to underdeveloped countries**
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> By oceanographic research we mean: attempts to discover new principles, testing of hypotheses, development of new techniques, conduct of experiments, and exploration of unknown areas in order to define scientific and technical problems. In general, oceanographic research like many other kinds of research, is best done by individuals or small groups working independently. However, there are some research problems that require international co-operation. For example, the exploration of an almost unknown area such as the Indian Ocean

can be accomplished more rapidly and more effectively by the co-operative efforts of ships and scientists from many countries. Scientific problems that require nearly simultaneous observations over a wide area or over the entire ocean also demand international co-operation in taking the observations, and close co-ordination to ensure comparability of results. An example is the present attempt to determine the total carbon dioxide content in the atmosphere and the change in this content with time as a result of the input from fossil fuel combustion and the loss to the ocean and biosphere. One of the questions we are asking is: Where is the carbon dioxide absorbed by the ocean? Does it remain in the surface layers or does it extend throughout the ocean volume? Another example is the proposal to study the transient state of the sub-surface currents in the Indian Ocean under the action of the changing monsoon winds. To attack this problem, synoptic observations made by many ships in a relatively short period of time are needed.

By oceanic surveys we mean the systematic collection of data which will enable us to make maps. Three kinds of surveys can be envisaged:

1.- Bathymetric, magnetic and gravimetric surveys of the deep sea floor and the sediments and rocks beneath the sea. Except for the shallow rims of the oceans, our maps of the ocean basins today have about the same accuracy and detail as maps of the land areas of the earth made in 1720. Thus, in our oceanic maps we are about 250 years behind the maps of the land. One of the reasons for this is that the techniques for making maps of the deep sea floor have been developed only within the last twenty years, and the needs for making such maps have evolved only very recently.

2.- Measurements of the properties of the ocean waters, temperature, salinity, oxygen, plant nutrients, and density and currents where possible. We want to know not only the average annual conditions, but also the seasonal variation in these conditions, and to obtain synoptic pictures which can be compared from year to year.

3.- Surveys of the biological conditions and the rates of organic production in the ocean. No one knows at present how many fishes there are in the sea, and experts differ in their estimates of the total organic production in the oceans - Because of differences in the methods used and in the interest of the scientists involved, biological data from different areas cannot now be compared. Consequently, it is important to make meaningful biological maps of the ocean as a whole."

Revelle's statement defined a true "program" for the newly created IOC This program has relentlessly been carried out through international cooperation.

In the sixties the International Indian Ocean Expedition gave a significant push to the oceanographic knowledge of the then less well-known Ocean basin of the world.

Today the precision of the maps of the bottom of the Ocean is orders of magnitude better what they were when Revelle was speaking in Paris. Not only they have improved but also by turning new geophysical tools to survey the bottom of the sea, we were able to map its geological history. By drilling into the marine sediments and Ocean bottom, science gave us the confirmation of Plate Tectonics the theory about the changing nature of the Earth crust, perhaps one of the deepest Scientific Revolutions of the second half of the twentieth century.

Several major international ocean research programmes were undertaken in the last three decades. The comparative studies of the major coastal upwelling systems of the world, the CUEA project during the International Decade of Ocean Exploration.

The physical oceanography of the Equatorial Oceans during the Tropical Ocean Global Atmosphere (TOGA) project that created the understanding and the capabilities to forecast the El Niño and La Niña oscillation.

These successful projects were followed by the World Ocean Circulation Experiment (WOCE) and by the Joint Global Ocean Flux Study (JGOFS) studying the role of the ocean in the global balance of carbon and by GLOBEC studying the structure and changes in marine ecosystems.

Today we are actively engaged in the planning of CLIVAR the Climate Variability and Predictability Study, the newest and most wide-ranging component of the World Climate Research Programme (WCRP), jointly co-sponsored by the WMO, IOC and ICSU. CLIVAR´s objective is to move the forecasting window for Weather and Climate from days and weeks, to seasons and into the inter-annual range.

CLIVAR would have been unthinkable without the significant progress achieved in Ocean Sciences, the development of new technologies available to collect data and information in the ocean and from space, and the constant progress of computer technology that has enable the use of numerical models integrating all this new information into meaningful projections and forecasts.

All these research projects have left behind a legacy of permanent Ocean Services, that is, ensemble of automatic instruments operating over vast extensions of oceans deployed to optimally acquire data and information on a specific set of properties of the world ocean.

These Ocean Services, coordinated by the IOC in cooperation with the World Meteorological Organization, are fulfilling the second programmatic goal of Revelle, *"surveying the oceans"* but with a big difference of what he had in mind in 1960. The Ocean Services that we have developed are s*urveying the ocean on real-time*. If oceanographers of the sixties were restricted to the use of dedicated vessels to go out at sea to collect the information, the oceanographers of today can arrive in the morning to their offices and open their computer, download the new information available in the web and run their models to see the changing ocean conditions and to produce an updated forecast. Not all oceanography can be done this way, but we cannot underestimate this major change.

The integration of the data streams provided by these Ocean services together with that coming from space satellites has "e*nabled a new engineering, that of global observing systems.* This is changing forever the way we do oceanography and is bringing into being for the first time a true Operational Oceanography. The change is so deep that in order to move forward, the obstacles that we face are mostly cultural. Is the lack of any previous experience in oceanography that would serve as a convincing case to show that this can be done.

Operational Oceanography is being made possible by the development of the *Global Ocean Observing System, GOOS*: the integrated operation of a series of Ocean Services covering the world Ocean. GOOS was proposed for the first time in IOC in 1987 and was officially endorsed as a programme of the Commission in 1989. The IOC took the blueprint of GOOS to Rio de Janeiro in 1992, to the UN Conference on

Environment and Development, where it became the *Ocean Component of the Global Climate Observing System*. As such GOOS is sponsored by the World Meteorological Organization (WMO), the United Nations Environmental Programme (UNEP), the International Council of Science (ICSU), and by the IOC that acts as the lead agency. Since then, and thanks in not a minor part to the active participation of scientists and technicians of the USA, we have now an *Initial GOOS*, contributing to the daily world data stream coming from the oceans.

The Ocean services integrated into GOOS were developed during the last three decades as independent systems. GLOSS for sea-level and IGOSS for the collection of data on the vertical structure of the upper layer of the ocean and the International Tsunami Warning System, are examples of permanent Ocean Services developed by IOC, composed by tide-gauges, vertical probes launched by commercial ships, fixed and drifting buoys, bottom seismometers, and backed by orbiting and stationary satellites. Moving an engineering system from prototype and research status to operational imply significant changes. Operations require dedicated specialists and careful plans to deploy, maintain and constantly upgrade the systems. You also need to have a system of quality control of the output, to detect early any sign of degrading elements in the system.

In an unprecedented step forward in inter-agency co-operation, the 13th Congress of the World Meteorological Organization (WMO) and the 20th Assembly IOC of UNESCO, approved the fusion of several long standing independent committees belonging to both organizations into a single body: *The Joint Technical Commission for Oceanography and Marine Meteorology (J-COMM)*. After two years of preparation J-COMM held its first official meeting in Akuyreri, Iceland in June 2001. JCOMM is charged with the supervision of all the technical groups in charge of the operational systems for the Global Ocean Observing System.

Although today Operational Oceanography is restricted mostly to the Physical aspects of Ocean dynamics, and in that sense is closely linked to the forecast of weather and climate, Operational Oceanography is evolving and will enlarge its current scope to incorporate the continuous monitoring of the chemical and biological environments of the Ocean. This development, driven by the growing use of the oceans and the ever-increasing impact of land activities on the Ocean, is taking place as we speak and will come to maturity in coming years.

These efforts are financed by the member states of the IOC and are clearly designed with a broad purpose of "public service" in mind. In this sense IOC has a clear advantage as an Intergovernmental organizations, because among other things it can guarantee the universal character of the system, facilitate the exchange of primary data and information and help in the development of capabilities around the world. Of course the information obtained from these systems, once in the public domain, can be used and is being used by specialized organizations to generate and provide a wide range of applications and services, both public and private.

There are several aspects to this challenge. The first one is institutional development. Member states, and the IOC, need to prepare themselves to absorb the needs posed by Operational Oceanography. It is here where salutary scepticism exists in the scientific community. The financing of Ocean Research has allowed the building of what we have. However the financing of Operational Oceanography cannot depend on the funding for Science. Since there isn't any other known source to fill the gap this is seen as a huge menace to the stability of the international research efforts.

But this analysis offers a very incomplete picture. The TAO array of 70 permanently moored buoys in the Equatorial Pacific, was science 15 years ago, but today is an operational array that is maintained regularly by NOAA and that in the IOC it has been pledged by the USA delegation as a contribution to build the Initial GOOS system.

The way forward is not simple and complex decision need to be adopted at the National level. In most countries the full scope of managing the opportunities and risks introduced by the rights and obligations agreed upon in United Nations Convention on the Law of the Sea, UNCLOS, are not dealt with by a single branch of the administration. On the contrary, reflecting the "functional" character of many of those rights and obligations (fisheries, environment, defence, transport, etc) usually they are delegated to a diversity of departments in the administration, with a weak coordination among them.

Only in very few countries exist highly technical and specialized departments in charge of ocean policy and ocean affairs that include ocean data collection and the support of ocean research in their Mission. Organizations like NOAA in the USA, which creation was recommended by the *Stratton Commission*, are an exception not the rule around the world. As the economic potential of the ocean is realized, more countries will devote increased resources to this end.

The second challenge makes reference to the use of the data and information generated by operational oceanographic services. Effective use requires the organization of sophisticated systems for processing, modelling and distributing the information. It is not just a matter of securing access to the data, important as this aspect is. It is necessary to establish a highly technical and dedicated organization with the Mission of using the data, produce and distribute final products. These organizations do exists today, both in the public and in the private sector.

There are different options here. Is this a development that each member state of the IOC wishes to face independently, or would it be a possible "joint" effort within IOC, organized at regional scale, for example? Could it be that the global observation of the ocean could be the goal of a private consortium? This brings me to the next point.

The third challenge is economic in nature. Global observations constitute a very particular case of all the observations that can be collected. The main feature is the very large scale at which they are collected. In the upper limit, GOOS will be sampling properties of a single system: the Global Ocean. The sample size is one.

At each spatial and temporal scale there are specific properties of the ocean that are related to that scale and others that "spill-over" to other scales. In theory, full forecasting capabilities would be available only if all scales are properly sampled. This is a huge technical requirement. Conceptually this is not a minor detail. In GOOS, what is a local observation collected in the East Coast of North America, becomes a “remote and distant” observation for a forecast in the North Sea, and vice-versa. If you want to extend weather forecast in the USA from 6 days to two weeks, you do not need only to build a USA-Coastal GOOS, you need information collected in and over the Pacific and Indian Oceans, you need a very clear picture of what is happening in and around the Indian sub-continent.

From a practical point of view, there are absolute limits (spatial scale) beyond which appropriability of data from private observation networks face diminishing returns and a point where profitability eventually breaks down. Data originating from the local scale, where it can be considered a “rival good”, start loosing its “rival” character, as they are collected at larger scales, becoming essentially “non-rival goods” at the global scale.

In my mind this a natural process. I cannot refrain to give you my hypothetical vision on how EuroGOOS was started. During the development of the offshore oil and gas exploitation in the North Sea, I imagine one day the “rendez-vous” of two vessels from two different R/D companies, deploying instruments in an area of the North Sea to provide services to oil companies operating, let’s say off the British Isles and off the coast of Norway. After avoiding interference with each other out at sea, back in port, senior officers of both companies got together and ask themselves what it would take to have an agreement to share the data from a single instrument array, saving the cost of the extra array (half a million USD for a moored array), or perhaps jointly deploy the extra array in an area in which neither of the two had the resources to invest if working alone.

They sat down, wrote the specifications, precision, accuracy, dynamic range of the linear response of the transducers, frequency of sampling, etc.; exactly what we have done in IOC to build GOOS, and they then agreed to share the data in a given format. The knowledge that allows them to be specialists and provide good advise to their clients it is not in the data, it is the knowledge to use that data. However they cannot use that knowledge without the data.

Since the potential users of these products come from a wide range of public and private activities, most of them on land, it is necessary to efficiently segment the markets between public and private agents, with the goal of maximizing total economic benefits to society. Although society might wish to directly recover the cost of collecting the data by selling the data itself, I am firmly convinced that is the wrong approach. The benefits to society are increased by the free and open exchange of primary data and by allowing the development of a variety of specialists that can tailor their products to the specific needs of their clients. These extra layers of specialist provide jobs, generate revenues and taxes and secure efficient servicing of final users. The specialists might as well develop additional observing networks to improve their products. Think the detailed forecasting of the atmospheric circulation for purposes of Air-quality control and air-pollution mitigation.

Outlook.

In the origin of GOOS in the eighties the dominant preoccupation was Climate Change. We wanted to ascertain the role of the Ocean in Climate Change. We still are, as I will mention below in connection to the Global Carbon Observing system.

However, today the concern has shifted to Sustainable Development in a more general and comprehensive way: *to improve all the economic operations by taking into account the limits set up by our natural boundaries.* Nations have agreed on the need to protect the global ecosystems, from which integrity depends the stability of the life-support system of the planet.

The building of GOOS until now has been the result very much from ¨science pushing". That is why one of my first priorities as Executive Secretary of the IOC is to enlarge the "societal pull" for the completion of the effort. IOC has started to work directly with a variety of private users that are interested in trying the new information in their own daily management operations. Companies and agencies involved in Energy, Power, Tourism, Building Regulation, Insurance and Financial sector have all expressed interest in working with us to better specify their needs of information. It is not that we are asking them to finance directly the investment, although some have demonstrated willingness to do so, but we want them to demonstrate the utility of this information to their activities and to show the real values involved.

Quoting the last paragraph of the "Outlook" section of the Biennial Report of the IOC to the 31st General Conference of UNESCO:

> *52. The long-term challenge for IOC is to define a global framework in which the development of GOOS as a single, permanent, global, public-oriented service, can be achieved, with the active contribution of different segments of the society, including the private sector. This requires demonstration of the economic benefits of a common shared strategy between the public and private sector, the identification of the public and private services that can be derived and/or shared through a common observing platform and the appropriate segmentation of public and private products and users. Achieving this new vision will require the development, negotiation and adoption of international norms and agreements, especially in the area of data and information exchange and sharing.*

Other developments are taking place very fast. In 1999 and 2000 the IOC has been engaged in the development of the first blueprint for a Global Carbon Observing system. The reasons for doing this are obvious. The Global Terrestrial Observing System, lead by FAO, is actively improving the measurement of terrestrial carbon fluxes. We have published the work of several groups of experts defining the initial Carbon observing system for the Ocean. We see this development as an integral part of GOOS.

During 1998 the agencies involved in the UN sponsored Observing Systems and CEOS the Committee for Earth Observation Satellites agreed to unite their two strategies into a common *Integrated Global Observing Strategy (IGOS)*. IGOS is being managed by an IGOS Partners Forum, which will further the definition, development and implementation of a unifying strategy. IGOS involves the major space-based and *in situ* systems for global observations of the Earth, including, in particular, the climate and atmosphere, oceans, land surface and Earth interior. IGOS should improve Governments' understanding of global observing plans; provide a framework for decisions on the continuity of observation of key variables; reduce duplication; help to improve resource allocation; and assist the transition from research to operations.

Mr Chairman, my answer to the question *"how the United States can best preserve and enhance its role as a leader in ocean and coastal activities"* is bluntly simple: recognize and consistently support what the USA has been leading in the International arena to build a Global Ocean Observing System. This initiative was born international, its very nature and large scale of coverage requires of the cooperation of all the countries of the world.

I hope that the US version of GOOS does contain plans for deploying instruments not only off the West and East coasts of the continental USA, and in the Arctic Ocean, but also in partnership with other agencies and countries deploy instruments and platforms around the Antarctic continent and help to secure the future Missions of the Operational Satellites devoted to ocean observations.

Mr Chairman, In IOC in our efforts to raise public awareness about what we do, we have been using as our motto the phrase *"One Planet one Ocean"*.

In the last WSSD in Johannesburg we presented the work of the IOC in six languages under this motto. This is an abbreviation of a much more fundamental one: *"One Life, One Planet one Ocean"*.

The only planet with life in the known universe is the Earth.

Earth is the only planet with water in liquid state.

97% of this water is in the Ocean.

Life originated in the primordial Ocean.

A better motto would be from now on: *"One Planet one life-giving Ocean"*

Thank you.

Washington DC, 30 of October 2002 (final)