LEGAL MEANS FOR UNDERSTANDING
THE MARINE AND CLIMATIC CHANGE ISSUE

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Introduction top

In the recent debate on global warming and climatic changes, the oceans have played only a marginal role, with the 1982 UN Convention on the Law of the Sea (UNCLOS) playing none at all. The center of interest has been the atmosphere. Continental thinking formed the background of the 1992 Earth Summit. Although the crucial role of the oceans in controlling climate variability is now widely acknowledged[1], the general acceptance of a theory that climate is the blueprint of the oceans seems to require further time. UNCLOS can accelerate the process for understanding the oceans.

While there is agreement that a Global Climate Observing System (GCOS) must include monitoring of the oceans[2], little has yet been said about using UNCLOS as a means of planning, implementing, and operating an effective system. Instead, Agenda 21, a principal document of the 1992 Earth Summit[3], asks States to consider their support of the Intergovernmental Oceanographic Commission (IOC) in a Global Ocean Observing System (GOOS)[4]. But the oceans are simply too big to monitor reliably absent legal obligations or without UNCLOS. Any consideration of the measures to be taken in the

marine field depends on formulating the questions with utmost precision. Agenda 21 is unlikely to be much help on the ocean issue[5].

As UNCLOS obliges all states to protect and preserve the marine environment[6], marine technology must be developed and used to meet this requirement. In this respect, binding law and appropriate marine technology form the principles for greater understanding of climate. The future of the global natural commons depends primarily on the "behavior" of the oceans. Climate, marine scientific research, marine technology, and UNCLOS form an integral unit and provide an understandable strategic concept for sustainable commitment by all governments and minimize the threat of climatic changes.

Ocean, Climate, Earth Summit 1992: Approaches, Background, Goals

What is Climate?[7] top

A simple definition of climate is average weather[8]. Surprisingly, the Convention on Climate Change[9] has no definition of the term climate at all, but defines "climate change" and "climate system". These terms contribute little to understanding the meaning of climate. The definition of "climate change"[10] is flawed in two ways. First, it states that "'climate change' means a change of climate" and, second, it compares two things that have nothing in common: atmospheric pollution by humans and statistical weather records[11]. The definition of "climate system"[12] is also nonsensical as its meaning boils down to "interactions of the natural system"[13].

Climate is a matter of water (in the air, ice, soil, and ocean) and its thermal efficiency and heat contribution. The factors related to quantity, aggregate, and temperature of water is the most influential ones. In every respect the sea governs the global natural commons. Thus, climate is the blueprint of the oceans[14] or as the speaker before me, Dr. Hans-Jurgen Krock, put it: The ocean is the principal actor in the global climate and weather drama[15]. A simple definition could therefore be: climate is the continuation of the oceans by other means[16]. The oceans run the global climate system, while the continents do little more than slow down "climatic dynamics". Land areas, in particular if dry, are anticlimate. A simple demonstration is the well known sea wind emerging only a few hours after sunset. Correspondingly, the oceans could have kept the climate and temperature stable after Krakatoa erupted in 1883 and reduced average global sun radiation by 10 percent over 3 years[17]. The basic factors for the development of the

global climate are sketched in the sea on a time scale ranging from a few seconds to many hundreds of years. Thus, the oceans are like a magnifying glass for long-term tendencies.

Discussing the problem top

Until now the climate change issue has been presented with little regard to the sea. Just four years ago it was difficult even to attract attention to the role of the oceans in climate change. John S. Gray, for example, observed that there is a risk that the large and powerful World Meteorological Organization (WMO) simply will ignore the oceans or not give them the scientific priority that they need in the future[18]. The documents approved and signed at the Earth Summit fully reflect the atmospheric approach. The Climate Change Convention only indirectly acknowledges the oceans as a "reservoir" or "sink" or "source" for greenhouse gases[19]. In recognizing that "the marine environment is vulnerable and sensitive to climate and atmospheric changes[20]", Agenda proves its limited scope by reducing the oceans to an attenuating potential of climate change[21]. Thus, both Agenda 21 and the Convention on Climate Change fail to acknowledge the overriding and principal importance of the sea. In this respect, there seems to be a considerable gap between the "facts" and the "real" picture. At the Second World Climate Conference, governments expressed their belief that a well-informed public is essential for addressing and coping with climate change[22]. Meanwhile the general public seems to be more confused then ever.

It might even be necessary to ask the question on the possible results of climatic changes more fundamentally, whether the earth is faced, as alleged, with a threat of becoming "warmer" or the opposite alternative of growing "colder". As the oceans have an average temperature of just +5°C[23], even "minor" alterations in the flow and behavior of the oceanic water masses can trigger a new ice age. A dramatic decrease in average global temperatures can occur within a few years. A political strategy as expressed in Agenda 21 for "preparing the world for the challenges of the next century[24]" might prove shortsighted if reduced to curbing the emission of carbon dioxide (greenhouse gases). The threat of "global cooling" is at least as good a bet as "global warming", but with much harsher consequences. Only the oceans may provide the clue as to what direction climate is heading.

Ocean Dimension -- Ocean Observation top

Observing a natural system of oceanic dimensions requires appropriate technology. While instrumental or observational technology is clearly available for thorough analysis of a small part of the system, the means for the systematic observation of many micro parts of the seas on a local, regional, or global level and their interaction within the oceanic system including the climate are still extremely limited. In this respect the development of marine technology is a technical question within a complex process in a global society governed by political strategies and commitments.

If the ocean is taken seriously as the principal body of global climatic affairs, one quickly realizes that climatic oceanography has hardly even begun, at least when compared with the atmosphere. Over the last three decades, 22,000 observations and analyses of the atmosphere have been made twice a day. Every day more data are collected about the atmosphere than the entire volume of research on the oceans put together. The largest data collecting effort by far is the World Ocean Circulation Experiment (WOCE, 1990-1997) which aims to collect 23,000 observations by the end of the project in 1997[25]. The project purportedly provides a "snapshot" forming the baseline against which future measurements of the state of the ocean can be assessed and the possible impact of climate change can be measured[26]. Yet, a true snapshot, i.e., on every 200 square kilometers and every 500 meters of water depth, requires more than 10 million observations[27], ideally all taken at the same time. And snapshots are of little use if not taken frequently, simultaneously, and at the same location. Only then and after many years of observation can they provide the means for detecting anthropogenic causes and for evaluating the implications and the potential threats.

Defining the problem and the goal top

The problem goes far beyond the usual understanding of what constitutes the oceans and common scientific research. Concerned with climate change, we are not primarily after a general understanding of a system but urgently need to find and distinguish between natural and anthropogenic causes of changes in ocean structures and behavior that are changing the climatic pattern. The number of man-made causes may run up into the dozens and not be limited to carbon dioxide. Only if all major ocean changes are identified can any evaluation of the potential threat be made, strategies employed, and

political decisions made. This is not a question that can be answered at a green table or by computer models regardless of how much information may be stored or how powerful the computer is[28]. In this respect, it is necessary to acknowledge that the oceans are too big, too complicated, too independent a system, and too liable to be penetrated suddenly by "external" causes (e.g., meteorites, volcanoes, sunspots, and, last but not least, human activities) to be simulated by technical means. No status of the earth has ever repeated itself. Moreover, the oceanic status has never been penetrated by man before. The best one can hope for is to detect trends and to have sufficient data for investigating their origin. Computers are certainly necessary to analyze past oceanic processes, but attempts to outdo "natural processes" should not be taken too seriously[29]. Actually, WOCE 1990-1997 was initiated to improve ocean circulation models. Midway through the program, calls for large-scale ocean models 100 times larger than the storage capacity of comparable atmospheric models and 100 times larger than computing power were made[30]. Further calls for an increase of many thousand times seem inevitable, but predicting climate still has little chance of becoming reliable and being of any serious help. What is required is the formulation of the primary task on understanding and the defining and selection of the appropriate technology for getting a reliable picture. To this extent, the use of computers for forming an image of the oceans is paramount as well as storing the images for comparisons, thus providing the means for analyzing the changes in the marine environment. Only then can the research for the origin of change, natural or anthropogenic, begin. Computer models cannot make up for a lack of hard data.

Actions for Climate Research top

Until now climate research and marine technology have been notions rarely used in tandem. The Climate Change Convention requires states only to promote systematic observation and development of data archives related to the climate system[31]. But common ocean research, even if intensified, is not necessarily climate research, at least not with the quantity, quality, and speed required for understanding an actual problem and to act responsibly.

General Overview top

Until recently, the scientific view on the oceans was based on the assumption that the bulk of the oceans was in a steady state, with annual variability in the surface layers. Scientific knowledge of the sea therefore tended to be exploited locally rather than globally[32]. Systematic observation only started with sea surface monitoring by satellites. Of the $10 billion spent by the G7 countries on all aspects of marine and technology research, only one eighth is dedicated to environmental research, monitoring and process studies[33]. A significant part is spent on about 200 civilian research vessels[34] with construction costs per unit of between $30 million and $120 million and operating costs of $3-10 million per year[35]. For cost-benefit reasons alone research vessels can never be used for any large scale observation. An example given by Carl Wunsch may illustrate the situation[36]. For more than 40 years weather ships in the middle of the North Atlantic conducted permanent observations down to water depths of 1,500 meters without showing any secular trends in ocean conditions. Even many thousands of such vessels would probably fail to reveal trends within an acceptable period of time and with the necessary accuracy.

Planning for GOOS top

Efforts have been underway since the First World Climate Conference in 1979[37]. More than ten years after the World Climate Research Programme was established to discover "to what extent climate is predictable", the Intergovernmental Panel on Climate Change (IPCC) recommended the establishment of a Global Ocean Observation System (GOOS) as part of a Global Climate Observing System (GCOS[38]). But governments left the subject to the World Meteorology Organization (WMO) and IOC[39]. In June 1992, GOOS was included in Agenda 21, requesting states to consider, *inter alia*:

> [s]upporting the role of the IOC in cooperation with WMO, UNEP and other international organizations in collection and distribution of data and information from the oceans and all seas, including as appropriate, through the Global Ocean Observing System.....[40]

This recommendation is neither a plan nor a mandate. Furthermore, at the time of the Earth Summit an official concept was not available. Actually the first report, "The Case

for GOOS" was prepared in the second half of 1992[41], recognizing that GOOS in 1993 was at the stage of concept evaluation and feasibility study[42]. The IOC's plan on GOOS is certainly an interesting document with the vision that "many millions of observations are required each day, with extensive global coverage and continuing over decades[43]", but does little more than to call for more activities and cooperation in the most general terms. It widely fails to describe clearly and verifiably a reasonable system, the list of priorities, and clear indications on goals, technology, time, and costs-result analyses[44]. According to the preface of the report, it was reviewed by a hundred leading oceanographers. Generally speaking, the "Case for GOOS" is a concept developed by a scientist, designed for scientists, reviewed by scientists and "approved" by scientists. A wide range of ocean activities should benefit[45], thus demonstrating a somewhat confused strategic concept, as not one concentrates on understanding the climate change issue. Furthermore, until now the plans have been made by industrialized countries[46] and have paid little attention to a concept on how to engage and include all coastal states in planning and executing a concept on a climate/ocean change observation system, in developing countries in particular. Little has been achieved since its adoption[47].

Basic observation concept top

In order to identify oceanic changes and to trace natural and anthropogenic causes and to analyze their impact on the climate, information on three oceanic conditions is necessary: temperature, salinity, and current profiles. The collection of this data is a logistical problem and as such has little to do with scientific research. What is required is a system that is able to produce, install, and serve several million stations throughout the oceans and to transfer the data for processing. Actually, it is a technical undertaking to make ocean space visible in the same way the atmosphere is. To achieve this end, it will be necessary to look for possible e solutions in the not too distant future. The following criteria should be given due attention:

> The task of collecting basic ocean data could be divided into fundamental parts: production, handling of devices, and data processing. A system of such scope and magnitude is an undertaking to be planned and executed by the manufacturing, marine, and service industries on economic terms.

> There is no need to invent anything totally new. The measuring devices and service means should be "simple". What is required is cheap and reliable mass production. Neither instruments nor the necessary boats or ships need to be "high tech". Crews need to be available in sufficient numbers, but could be trained "on the job" and, thus, not necessarily on a professional basis. Distances to stations should be short. Not all data collected need be available immediately, but on a monthly or yearly basis.

Without the involvement and commitment of all coastal states, in particular the developing countries and a worldwide production capacity of "simple" devices, the prospect of a reliable ocean (climate) observing system within the next decades is bleak. A delegation of tasks could enhance the efficiency of the system, e.g., financing and data processing by industrialized countries and serving and data collecting from the stations by manpower from developing countries. One could even think of creating a market for trading data as merchandise, oceanic (climate) information as a commodity[48]. With political commitment such a system could be installed and operating within this decade. Furthermore such a system, once in operation, would have an immense effect on all kinds of marine research world wide, the use and exploitation of the sea and the sea floor, and for "understanding" the oceans. Anything less is counterproductive with many incalculable risks.

A basic ocean observing system requires concepts, market forces, and leadership. If political forces are not, or only reluctantly, available, legal means may help to spur activities for transferring concepts into undertakings readily available for many years under the UNCLOS. It is the strongest comprehensive global environmental treaty negotiated to date[49].

A Legal Concept for Marine Technology and Research top

Although UNCLOS does not use the term climate once, it is the appropriate legal framework for dealing with the climate change issue. The oceans hold the answer to the development and appearance of climate. UNCLOS holds the key for responding reasonably. The obligation of States under Article 192 "to protect and preserve the marine environment" cannot be rated highly enough against those nonbinding declarations of Agenda 21. According to J.R. Stevenson and Bernard Oxman, an

environmental norm in such direct and unqualified form as in Article 192 is difficult to achieve[50]. If it is assumed that climate is the blueprint of the oceans, then Article 192 of UNCLOS implies that States have the obligation to protect and preserve the global climate.

The application of UNCLOS as a treaty on climate change could force the international community to think more in oceanic terms. A consideration of the development of appropriate marine technology by a more stringent analysis and scrutiny of the applicable provisions and legal guidelines of UNCLOS would be helpful. The world lacks understanding of the natural oceanic commons, joint commitment by all states, political leadership, and strategic thinking. These shortcomings may best be overcome by well thought-out law, applicable on a global basis, and a willingness and obligation to use it.

Principal Approach of UNCLOS[51] top

Preamble and Article 192 top

Although one-third of the Convention's provisions are directly related to the marine environment, they do not comprise a precisely described conceptual strategy on marine technology and research. But the preamble states that through this convention the establishment of a legal order for the study of the marine environment was desired and, according to Article 192, States are obliged to protect and preserve the marine environment. Preservation implies active measures to maintain or improve the present conditions of the marine environment. To meet their obligations, States are required to obtain the knowledge of what actions need to be taken. Thus, efforts and advances in marine technology and research is a principal goal of UNCLOS, and its application and interpretation has to follow this intended concept. The task is addressed to all States as "the problems of ocean space are closely interrelated and need to be considered as a whole"[52]. Once UNCLOS enters into force, however, its text has to be assessed on its own merits. The fact that the Third UN Conference on the Law of the Sea (1973-1982) neither foresaw nor even thought of the climate change issue does not prevent UNCLOS from taking the role of a climate change treatise.

Part XII -- Marine Environment[53] top

UNCLOS is strict on monitoring pollution and environmental assessment. If pollution is applied in a wide sense, including the effect of greenhouse gases on the marine

environment[54], the installation of an ocean observing system is demanded as follows: States shall (1) observe, measure, evaluate, and analyze the risk and effect of pollution, (2) keep under surveillance the effect of any activities which they permit or in which they engage, and (3) assess the potential effect when they have reasonable grounds for believing that activities under their control may cause significant and harmful changes to the marine environment[55]. In addition States shall prevent, reduce, and control pollution from and through the atmosphere[56].

Part XIII -- Marine Scientific Research top

This part is basically only concerned with the rights and obligations of coastal States[57]. States are obliged to facilitate the development and conduct of marine scientific research and actively to promote the flow of scientific data and information and the transfer of knowledge resulting from marine scientific research including -- inter alia -- the strengthening of the autonomous marine scientific research capabilities of developing States[58]. The strong effect UNCLOS will have on. Marine scientific research does not come from this part, but from the other parts of the convention, ironically, while the goal of marine scientists was to keep the oceans "free" for scientific studies[59].

Part XIV -- Development of Marine Technology[60] top

Although voluntary, Part XIV has a concept for and an impact on all countries once the need to understand ocean affairs emerges as a principal task. Two principal objectives of Part XIV go beyond the original intention. One can be attributed to the fact that Part XIV applies to all States that may need and request technical assistance in the marine scientific and technological field[61]. The other overall objective derives from the legal requirement to influence "the development of appropriate marine technology"[62]. The term appropriate is not connected to other subjects, but is of fundamental importance to be interpreted according to the particular circumstances of individual countries and types of technology[63]. Thus, any country which does not have the marine technology to fulfill its obligation to study and protect the marine environment, could in this respect be regarded as a "developing country", and either subject to receive "appropriate marine technology" or required to develop such technology.

Part XI -- The Area[64] top

Signatory states assembled in the Sea-Bed Authority may soon realize the obligations and/or the opportunities of Part XI of the Convention. Although "Area" means the seabed and ocean floor beyond the limits of national jurisdiction[65], the marine environment is foremost in the water column above, representing possibly as much as 90 percent of the total water mass of the oceans, i.e., most of the global climate machine. Deep sea mining without a thorough knowledge and understanding of its impact on the water above the mining zone seems hardly acceptable. In particular, if judged on the basis of the "precautionary principle"[66], a comprehensive observation system must be in operation for a considerable time prior to any commencement. Of immense potential in this respect is the legal responsibility of the International Sea-Bed Authority to encourage, manage, and control research, technology, and marine protection. The Authority may conduct research on its own and enter into contracts for that purpose. It may be held liable for any damage arising out of wrongful acts in the exercise of its powers and functions[67].

Part XV -- Settlement of Dispute top

UNCLOS provides the first compulsory international judicature for any dispute concerning the interpretation or application of all provisions concerning the marine environment (Part XII) and marine technology (Part XIV), but is limited with respect to marine research (Part XIII)[68]. Although only Part XII contains legal obligation, the general clause of Article 192 covers the development of marine research and technology whenever the "protection and preservation" of the sea or the climate is at stake. Considering a dispute on climate change (e.g., sea level rise or desertification) in terms of burden of proof, the case of the defendant (the polluter) may depend on his ability to show that he has acted reasonably to obtain the best possible knowledge. The elementary principle that a State may not knowingly permit its territory to be used to inflict serious injury on other States includes efforts of understanding causes and interactions. Developments in environmental protection depend on a process of judicial reasoning well recognized by courts and lawyers[69].

Categorizing aims for understanding the marine environment top

Five principal steps can be discerned:

The "elementary" step top

UNCLOS is a constitution on ocean affairs and the marine environment, thoroughly elementary concerning all relevant questions. This involves the obligatory establishment of monitoring systems and assessment capabilities[70] and the more voluntary promotion of marine research and development of capacities of manpower, technological means, and infrastructure[71]. More specific are the obligations imposed on the deep sea Authority with respect to the area[72].

The "deepening" steps top

The signatory nations are asked to promote and facilitate the development and implementation of marine research (technology[73]) by all States, particularly supporting developing countries[74]. The convention pronounces the acquisition and evaluation of all kinds of marine environmental information and data and of marine technological knowledge[75].

The "propagation" steps top

State parties are required to disseminate their information, data, and knowledge including the notification of dangers[76].

The "cooperation" steps top

Probably no other appeal is repeated more frequently than that for cooperation[77]. Behind this appeal, however, structures for creating links and dependencies can be seen that, at least after an initial run up, are capable of developing their own dynamic effect.

The "consolidation" steps top

The basic element of these steps is to assign international organizations to the steps outlined above as a means of promoting the exchange and propagation of maritime knowledge and technology[78].

Appropriate Technology top

Recently W. Scherer and others expressed the view that it will not be possible to sample the ocean densely enough in time and space to provide an adequate description by measurements alone and only by using models will it be possible to make predictions[79]. Actually, given that it was possible to put a man on the moon, it should not be impossible to sample the oceans down to a diameter of a few hundred meters. This is a question of political will and/or of legal obligations. If the protection of the sea

and global climate requires the collection of 5, 10, or 30 million pieces of data per hour, day, or week, the governments must act, develop a solution, take all measures, and use all means possible and reasonable. But to achieve this end, the actions considered depend on the clarity with which the problem is presented to the governments, their administrations, and the general public.

Summary top

To date, the term "development of technology and research" has many aspects and can be defined as a product of intellectual processes resulting in enhanced material or programmatic capabilities in certain fields. The contribution may voluntarily come from numerous sources, e.g., from politicians, administrators, scientists, inventors, engineers, and mechanics alike. But only those who are under legal obligations must comply and provide contributions. And UNCLOS is a force to be reckoned with. Its legal concept goes considerably further than general appeals. The principal obligation of Article 192, the responsibilities of the Authority, and the influence of a judicature reduce sovereign power. States do not face single questions, but a network of requests, appeals, obligations, responsibilities, and even liabilities. By contrast, the Preamble of Agenda 21 states: "Its successful implementation is first and foremost the responsibility of Governments"[80], comprised of worthy appeals and wishful thinking, but little actual planning and means for implementation and enforcement. As indicated by the steps of influence, UNCLOS has the means of creating incentives or pressure for improving cooperation or, as Philip Allott put it recently, the Convention "can enter into the reality of international society as a powerful creative force, preparing the minds of all to manage a world in which global social problems call for solutions that far exceed the potentialities of traditional diplomacy and traditional international law”[81].

Formulating the Questions top

Introduction top

While the space race and the wars on poverty and cancer presented relatively identifiable "enemies”, observes Steven L. Rhodes, climate change does not[82]. The former President of the International Court of Justice, the late Manfred Lachs, expressed the opinion that "[w]henever law is confronted with facts of nature or technology, its

solution must rely on criteria derived from them"[83]. Unidentifiable criteria confuse international law and large-scale policy on climate change.

International politics acted swiftly when public interest in climate change grew and crystallized at the geopolitical level in 1988[84]. The meeting of the leading industrialized countries (G7) in Paris in July 1989 acknowledged "that the conclusion of a framework or umbrella convention on climate change to set out general principles or guidelines is urgently required"[85]. Leading politicians, recognizing that mankind had reached a "defining moment in history", were willing to support a "global contract" (Francois Mitterrand), a "new world order" (George Bush), the "preservation of creation" (Helmut Kohl), or a "Global Marshall Plan" (Al Gore). But their vision was closely confined to the common continental thinking. They failed to realize that the formulation of the World Climate Program was carefully orchestrated by the leaders of the WMO and International Council of Scientific Unions (ICSU) and their allies in national weather services and academics of science to attract the attention of governments and greater government resources[86]. The governments reacted superficially in requiring at least a minimum of proof of the climate expertise of those warning of global warming. Thus, even today, the oceans issue receives only third or fourth class attention.

First Question top

Before developing solutions and allocating resources, it is necessary to determine the "real" facts[87]. Who or what is responsible for climate? Certainly not any statistics on average weather[88]. If climate had been defined -- as it should have been many decades ago -- as the blueprint of the oceans, hardly any questions in current discussions of "the greenhouse effect" and of "global warming", would be asked concerning the necessity of an ocean observation system, its priority, its dimension, and its basic structure. Such a system would have long been in use if oceanic thinking had prevailed in atmospheric science.

Analyzing the Task top

Once this requirement for understanding climate is beyond dispute, conclusions on the following points need to be made:

(1) What image of the medium ocean must be obtained to make climate "visible"?

(2) What are the requirements for achieving the image?

(3) How can it be done quickly, economically, effectively, comprehensively (all coastal states), etc.?
(4) What needs to be done to ensure the widest possible support by all states, nongovernmental organizations, and the general public?
A problem becomes manageable when either the circumstances are such a serious threat that immediate actions are out of the question or `means` are available for forcing the concerned into action. An environmental challenge can and must be met by setting the rules, monitoring, and verifying compliance[89].

Fulfilling basic legal requirements top

With the enforcement of the 1982 UNCLOS on 16 November 1994, signatory states have to consider their obligation in the spirit of the treaty. They are required to plan to protect and preserve the sea, The necessity to do this thoroughly and urgently derives from the possible threat of climatic changes that may make the world colder or warmer, either likely to originate in the oceans. To this end they need to obtain the knowledge necessary to meet these requirements. Parties anxious to fulfill the principal obligation according to Article 192 of UNCLOS may seek to realize three steps of activity:
(1) What is the status that might be affected?
(2) What is causing the change toward this status?
(3) What has to be done to keep the status or to minimize any anthropogenic effect?
The prime task is to concentrate on recording the status of the oceans frequently over space and time. Only with comprehensive pictures of the oceans space over considerable periods of time will reasonable climate change research on detecting anthropogenic causes and their impact on climatic trends show reliable results. As the ocean space is not as easily visible and accessible to us as the atmosphere, the true image of this medium must be obtained by technical means and regardless of whether, and to what extent, it might be useful and necessary for abstract science.

Organizing a maritime climate observing system top

Law is an ultimate planning tool. In this respect a basic ocean observation system is a purely organizational and technical undertaking and does not require the involvement of the scientific community at all. By contrast, GOOS is designed by scientists to meet the wishes of scientists without proof of expertise, without a clear mandate, without

independent control, and without rules on accountability. GOOS and Agenda 21 are little more than mere notions, not plans. A binding international commitment is a different matter[90]. The willingness, however, to understand, acknowledge, and accept that the oceans play a decisive role in human destiny -- and that Article 192 is the key for acting responsibly --must emerge and exist in the first place. Since climate can easily be defined, and the preservation of the oceans and climate is a cause worthy enough to generate popular backing[91], widespread support for an ocean observing system is more a question of the appropriate presentation of the problem than a technical, economic, or a scientific one.

Using the oceans top

A most basic, but "complete", observation system should be available. Many solutions will depend upon the pace of development and the value placed on marine scientific research[92]. Regardless of whether fisheries, shipping, seabed mining, or pollution is the subject of concern, sufficient ocean management is necessary. Sea space management needs to be based on sound and reliable facts and on legal accountability[93]. If costly measures later prove to have been unwise or unnecessary, the public may lose trust in scientific analyses essential to sustaining long-term environmental protection[94]. No single group, institution, organization, or state alone is capable of planning the use, exploration, exploitation, protection, or understanding of the seas. Universal problems increasingly require solutions in international law[95] and more social and legal accountability. The international law of the sea offers eloquent testimony in favor of fundamental changes[96].

Conclusion top

The ultimate question on global environmental concern is the ability to distinguish between natural and anthropogenic causes affecting the natural commons. Only the oceans can reveal to the keen observer whether we are faced with "global warming" or a return to the ice age and the extent of shifts between the opposite trends. The development of marine technology and research towards a global observation system requires neither high-tech nor scientific input. Reasonable quantity and frequency of observations of temperature, salinity, and current, as well as a comprehensive coverage of ocean space, would fully satisfy a basic observation system. The system would

consist of stationary devices and small units, e.g., commonly used sailing and fishing boats. The manpower can be instructed and trained on the job as the skill required relates only to handling the boat and the technical devices installed. It would in particular be of benefit to developing countries to increase ocean consciousness. Improving ocean understanding and experience would meet the expectations of UNCLOS on international cooperation among all states in the marine field. Although UNCLOS is far from being the most demanding law one could think of, it does provide a convincing concept for enhancing the principal goal of protecting and preserving the marine environment. And this is an obligation by law, which cannot be brushed aside, by describing it as a simple declaration without legal effect. One need only consider a case on sea level rise before a tribunal by an island State, on the grounds that global warming is heating and expanding the sea and, thus, the country risks the danger of being submerged. State parties must act and fulfill the legal concept of the UNCLOS. Furthermore, in contrast to Agenda 21, there is a clear mandate on monitoring the oceans and an obligation to develop marine technology and research. It is inevitable that the signatory states and the Sea-Bed Authority must rely on an observation system, and they are well advised to use the means of the UNCLOS for setting up and operating a comprehensive observation system to ensure participation of all states and the preservation and protection of the marine environment for the sake of the oceans and the global climate. "Whatever else it may be", reasons Allott[97], "the 1982 Convention is an education, for governments and citizens alike, in the new demands of the new world in which we live".

Footnotes

[1] Satya N. Nandan, United Nations Office for Ocean Affairs, Marine Scientific Research: A Guide to the Implementation of the Relevant Provisions of the UN Convention on the Law of the Sea, (New York: United Nations, 1991), p. vii (hereafter cited as Marine Scientific Research). Cf. also IOC, The Oceans and Climate: A Guide to Present Needs, IOC technical series No. 38, UNESCO, 1991; and R.T. Pollard, 'Megachallenges in Physical Oceanography", Oceanography (Paris: OECD, 1994), pp. 27-48 (hereafter cited as "Mega-challenges").

[2] W. Scherer et al., "The Approach to the Global Ocean Observing System (GOOS)", WMO Bulletin, Vol.42, No. 2, 1993, pp. 118-123 (hereafter cited as "Approach to

GOOS,' WMO Bulletin). Compare for a general overview 11. Van Dop, Analytical Report, Global Change of Planet Earth, (Paris: OECD, 1994), pp. 69-105, and N.C. Flemming, Analytical Report, Oceanography (Paris: OECD, 1994), pp. 71-126 (hereafter cited as "Analytical Report").

[3] Agenda 21, in "Report of the UN Conference on Environment and Development", Annex II, United Nations, A/Conf.151/26 (Vol.1-111); in "United Nations, Agenda 21: Programme of Action for Sustainable Development", (New York: UN Dept. of Public Information, New York, 1993); in Nicholas A. Robinson, ed., Agenda 21 & The UNCED Proceedings, vol. 4, (New York: Oceana, 1992) (hereafter cited as Agenda 21 & UNCED).

[4] Ibid., Agenda 21, sections 17.102 & 17.109.

[5] Cf. for different views and detailed discussion, e.g. in (1) Lee Kimball, et al., Marine Policy, pp. 491-572, 1993; (2) Robert Knecht, et al. Ocean & Coastal Management, Vol.19 pp. 75-86 & Vol.21, pp. 1-352, 1993; (3) A. Barcena, Marine Pollution Bulletin, pp.107-111; Ong, pp. 583-586, 1992; (4) Biliana Cicin-Sain and Robert Knecht, Ocean Development and International Law, pp. 323-353, 1993.

[6] Article 192 (General obligation) of the 1982 United Nations Convention on the Law of the Sea holds that "States have the obligation to protect and preserve the marine environment."

[7] Actually, to Kenneth Hare, climate is a layman's word not used professionally until recently. Cf. Kenneth F. Hare, 'The Vaulting of Intellectual Barriers: The Madison Thrust in Climatology", Bulletin American Met. Society, 60 (1979): 1171-1174, and H.H. Lamb, "The New Look of Climatology", Nature, 223 (1969): 1209-1215.

[8] J.T. Houghton, G.J. Jenkins, and J.J. Ephraums, (eds.), Climate Change - The IPCC Scientific Assessment (Cambridge: Cambridge University Press, 1990), p. xxxv (hereafter cited as Houghton, Climate Change).. According to W. Scherer et al., "Approach to GODS", WMO Bulletin, climate may also be defined as: "the synthesis of weather conditions in a given area, characterized by long-term statistics (such as mean values, variances of the variables of the state of the atmosphere in the area". Cf. for further climate definitions: Landoll-Börnstein, Meteorology/Climatology, Vol.4, subvol.c, (Berlin: 1987): 1-5.

[9] United Nations Framework Convention on Climate Change, May 9, 1992 (UN Doc. A/AC 237/18 (Part II) AMA), (hereafter cited as UN Framework); in 31 I.L.M. 849; in Robinson, (ed.), Agenda 21 & UNCED, Vol.3, pp. 1685-1713.

[10] Ibid., Article 1, para. 2: "Climate change' means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

[11] The background of the "new" climate change definition follows the first World Climate Conference 1979 definition of climate change as "the difference between long term mean values of a climatic parameter or statistic, where the means is taken over a specified interval of time, usually a number of decades", see W. John Maunder, Dictionary of Global Climate Change (London: Chapman & Hall, 1992), p. 34. Now "one long term mean value" was replaced by "a human activity that alters the atmosphere". While the 1979 definition was clear but useless, the 1992 definition is nonsensical and ridiculous.

[12] Article 1, para. 3 of the UN Frame-work Convention on Climate Change, "Climate system" means the totality of the atmosphere, hydrosphere, biosphere, and geosphere, and their interactions.

[13] A. Bernaerts, "Climate Change", Nature 360 (1992): 292. A. Bernaerts, "Warming tip–Science or Climate", in L.O.S. Lieder, Vol.5, No.5, Honolulu 1993, p. 6.

[14] Ibid.

[15] Cf. Victor D. Phillips, et al., "Oceans — A Global Thermostat", Sea Technology, (September 1992): 29-35. R.W. Stewart, 'The Role of the Oceans in Climate and Climate Change", in K Takeuchi and M. Yoshino, The Global Environment, (Berlin: SpringerVerlag, 1991), pp.118-126.

[16] A. Bernaerts, "Climate Change,' Nature 360 (1992): 292.

[17] A. Bernaerts, "Voraussetzungen für den globalen Klimaschutz aus der Sicht eines Nautikers und Juristen", Heft 4, Freunde und Förderer des GKSS-Forschungszentrums e.V. (1992): 1-42.

[18] John S. Gray, "Climate Change", Marine Pollution Bulletin 22 (1991): 169-171.

[19] Article 1, para. 7, 8, and 9 of the United Nations Framework on Climate Change. Cf. Agenda 21„ Chapter 2, paragraph 17.101, requiring countries to carry out the "...systematic observation of the role of oceans as a carbon sink".

[20] Agenda 21, Chapter 2, para. 17.96.

[21] This conclusion is defensible even though section 17.96 of Agenda 21 (first sentence) states, inter alias "In order to determine the role of the oceans and all seas in the driving global system and to predict natural and human-induced changes in the marine and coastal environment, the mechanisms to collect... information... need to be restructured and reinforced considerably."

[22] Ministerial Declaration, Second World Climate Conference, Geneva, 7 Nov. 1990 in J. Jager and H.L. Ferguson, (eds.), Climate Change: Science, Impact and Policy (Cambridge: Cambridge University Press, 1991), pp. 535-539 (hereafter cited as Jager, Climate Change: Science).

[23] The sea surface temperature is +15° Celsius (C). The average temperature of the atmosphere is -17°C, raising the overall difference between the two media to 32° Celsius. The thermal efficiency of a surface layer of the oceans of three meters depth is as high as the, efficiency of the whole atmosphere.

[24] Agenda 21, Chapter 1, Preamble, para. 1.3.

[25] Cf. ICSU/SCOR/IOC/WMO, WOCE (World Ocean Circulation Experiment), World Climate Research Programme, December 1991, pp.1-29; George T. Needier, WOCE, Oceanus, Vol.35, No.2, pp. 74-77.

[26] John W. Gould, "Update: World Ocean Circulation Experiment (New Results Owe Much to Technology Developments – Nearing the Mid-Point of Intense Observation Period)", Sea Technology (February 1994): 25-32 (hereafter cited as "Update").

[27] A. Bernaerts, "Time to Adopt a Constitution for the Oceans", Fair Play Int. Shipping Weekly 21 (September 1989): 17, and, "Peace to the Oceans", Newsletter No. 2, Moscow 1990, pp. 37-39. Cf. Pollard, "Megachallenges", p. 46, who seems to assume that about 100,000 stations would be enough to resolve ocean weather. Cf. Flemming, "Analytical Report", p. 81, indicating that this number is needed "to resolve the ocean eddies, which are the equivalent of 'weather.'"

[28] For the opposite view see: IOC-Report No.38, UNESCO, p. 15, stating inter alias The behavior of the ocean will be understood only through an interplay between modeling and observation. See also W. Scherer et al., "Approach to GODS", WMO Bulletin, p. 121, expressing the view that "only by using models will it be possible to make predictions". Cf. for present state of art, R. Sadourney, "Modeling the Physical Ocean-Atmosphere System and its Response to External Radiative Perturbations", in Global Change of Planet Earth (Paris: OECD, 1994), pp. 21-35.

[29] Remark: It is felt that a very clear distinction has to be made between the already 'existing motor' of the oceans already predesigned (coded) for many decades if not centuries. In other words: if something is or could be made 'visible' there remains little to predict. Actually many scientists seem to have no problems admitting that weather computers cannot provide reliable forecasts for more than a few days, but are convinced that the climate computers produce usable results and would become capable of predicting well into the future. Cf. Richard A. Kerr, "Climate Modeling's Fudge Factor Comes Under Fire", Science, 265 (1994): 1528.

[30] John W. Gould, "Update,* p. 25. Cf. Pollard, 'Megachallenges", p. 35, on ocean weather. "If ocean weather does need to be resolved, computers 1000 times more powerful than the supercomputer that generate atmospheric forecasts will be required".

[31] UN Framework, Article 4 para.1, subparagraph (g), Article 5.

[32] IOC, "The Case for GOOS", Report of the IOC Blue Ribbon Panel for a Global Ocean Observing System (GOOS), IOC/Inf.- 915, 23 Feb. 1993 (hereafter cited as IOC, "The Case for GOOS").

[33] Ibid., p. 1.

[34] Ibid. Cf. for further details, Couper, A.(ed), The Times Atlas of the Oceans (London: Times Books, Ltd., 1983), pp. 206-207.

[35] Carl Wunsch, "Marine Science in the Coming Decades", Science259 (1993): 296-97.

[36] Carl Wunsch, "Decade-to-Century Changes in the Oceans Circulation", Oceanography 5 (1992): 99-106.

[37] Cf. IOC, "Ocean Observing System Development Programme - A World Climate Research Programme Action Plan", IOC/Technical series No.27, UNESCO 1984, p. 9.

[38] Houghton, Climate Change, p. xxxii (Policymakers Summary); cf. James D. Baker, -."World Ocean Circulation and Climate Change: Research Programmes and a Global Observing System", in Jager, Climate Change: Science, pp. 195-201.

[39] Paragraph 6 of the Ministerial Declaration, November 7, 1990 at the Second World Climate Change Conference, in Jager, Climate Change: Science, p. 536. The Conference Statement (Nov. 7, 1990) on p. 499, however, mentions an Integrated Global Ocean Service System and refers to an ocean observing system of physical, chemical, and biological measurements.

[40] Agenda 21, Section 17.102.

[41] IOC, "The Case for GOOS". The document is based on a paper prepared by John Woods of the United Kingdom and circulated at the Second World Climate Conference in 1990 (John Woods, "A Global Ocean Observing System", prepared for the meeting of the WMO Commission for Basic Systems, London, 1 October 1990 [hereafter cited as Woods, "Observing System").

[42] IOC, "The Case for GOOS", p. 7.

[43] Ibid., p. 19.

[44] A clearer exposition, with examples to evaluate the conceptual approach, may be seen in John Woods' paper of 1990 (Woods, "Observing System") stating: "A global ocean observing system is a pre-requisite for operational climate forecasting". In contrast, the IOC "Case for GOOS", op.cit. p.1, states: "The transport of heat, water, gases and nutrients by the oceans and coastal seas largely determines the future weather, climate, and productivity of most of the earth's surface — land and sea", clearly avoiding a statement on the conditionality between forecasting and observation.

[45] IOC, "Case for GOOS,", p.32 (Conclusion and Recommendations), listing the following sectors: (i) The ocean floor, (ii) Coastal seas, (iii) Atmospheric climate; (iv) Science and technology, (v) Living resources; (vi) Health or the oceans, and (vii) Shipping and defense. Cf. IOC/UNESCO, "The Approach to GOOS", IOC-XVII/8 Annex 2 rev., March 1993; Cf. IOC/UNESCO, "Assessment and Monitoring of Large Marine Ecosystems", IOC/ITF-942, 1993.

[46] Ibid. Cf. Proceedings of GOOS Int. Symposium, March 23, 1993, Science and Technology Agency Tokyo, Japan. IOC/UNESCO, IOC Committee for the Global Ocean Observing System (GOOS), First Session, Paris, 16-19 February 1993, IOC/GOOS-1/3.
[47] For a general picture of GOOS, Cf. Flemming, "Analytical Report". Cf. various ECOPS (European Cooperation in Ocean and Polar Science) publications: (1) David Pugh, (ed.), Ocean Forecasting, Grand Challenges for European Co-operation in Forecasting the Behavior and Characteristics of the Ocean, ECOPS Euroconference held in Maratca, Italy, 22-27 April 1993; (2) ECOPS, The Oceans and the Poles, 2nd. edition, 1993; (3) ECOPS, Identifying priorities for investment in developing new technology for ECOPS Grand Challenges, Workshop Brighton, United Kingdom, 6-8 March 1994; (4) European Conference on Grand Challenges in Ocean and Polar Science (Lecture Abstracts), Bremen, Germany, 12-16 September 1994.
[48] Edward L. Miles, Science, Politics, & International Ocean Management, (Berkeley. U. of California, Institute of International Studies, 1987), pp. 1-70 (hereafter cited as Science, Politics).
[49] Panel on the Law of Ocean Uses (Bernard H. Oxman, Rapporteur), United States Interests in the Law of the Sea Convention, The American Journal of Int. Law, Vol.88, 1994, pp.167-178(169).
[50] J.R. Stevenson, B.H. Oxman, "'The Future of the United Nations Convention on the Law of the Sea", The American Journal of Int. Law 88 (1994): 488-499 (Footnote 9) (hereafter cited as The Future of UNCLOS").
[51] Some points of the following discussion have been taken from a lecture given by the author at the GKSS-Forschungszentrum in 1988, published by Verein der Freunde und Förderer des GKSS-Forschungszentrum c.V., Heft 1, "Der Einfluß der UN-rechtskonvention 1982 auf die maritime Technologieentwicklung and die Perspektiven für die Bundesrepublik Deutschland", Gccsthacht 1988.
[52] Preamble of UNCLOS.
[53] UNCLOS, Articles 192-196 (General Provisions); 197-201 (Global and Regional Co-operation); 202-203 (Technical Assistance & 204-206 (Monitoring and Environmental Assessment).

[54] The application of UNCLOS, Part XII (Article 193 following) generally depends on the term pollution as defined in Article 1, para. 1, subparagraph (4) of UNCLOS. According to OECD, Science and Technology Policy Review and Outlook 1991 (Paris: OECD, 1992), p.55: "It should be remembered that apart from global warming, CO2 is not a pollutant; it is a product of the most natural activities and, especially, of combustion of fossil fuels.' Particularly interesting, in this respect, is that the application of the general clause of Article 192 is not related to the term pollution.

[55] UNCLOS, Articles 204 para. 1; 204 para. 2; 206.

[56] UNCLOS, Articles 212 & 222.

[57] UNCLOS, Articles 245 - 255 (of section 3 - Conduct and Promotion of Marine Scientific Research). Cf. UN/Office for Ocean Affairs, Marine Scientific Research: A Guide to the Implementation of the Relevant Provision, UN/New York 1991, (cf. note 1).

[58] UNCLOS, Articles 239 and 244 para. 2. Cf. also Articles 202 & 203 (scientific and technical assistance to developing countries).

[59] John A. Knauss, 'The Effects of the Law of the Sea on Future Marine Scientific Research and Marine Scientific Research on the Future Law of the Sea", Louisiana Law Review 45 (1985): 1201-1219.

[60] UNCLOS, Part XIV (266-278) is the result of the North-South conflict that ultimately led the industrialized countries to agree, albeit reluctantly, to a voluntary scheme to support developing countries. The novelty of the topic and absence of reciprocal interests finally resulted in the general absence of true and Choate obligations in most of Part XIV (see: S. Rosenne and A. Yankow (eds.) L17V Convention on the Law of the Sea 198 A Commentary, vol. 4 (Dordrecht: 1991), p. 669.

[61] UNCLOS, Article 269, subpara. (a).

[62] UNCLOS, Article 268, subpara. (b).

[63] Cf. Bolcslaw A. Boczck, (1): "Transfer of Technology. and UNCLOS III Draft Convention", in Douglas M. Johnston & Norman G. Letalik, (eds.); Law of the Sea and Ocean Industries - New Opportunities and Restraints, (Honolulu: The Law of the Sea Institute, 1982) pp. 494-517; (2): 77w Transfer of Marine Technology to Developing Nations in International Law, Occasional paper No.32 (1-lonolulu: Law of the Sea Institute), pp.1-79.

[64] UNCLOS, Articles 143-147 (of Part XI) and Articles 256 and 257 (of Part XIII).
[65] UNCLOS, Article 1, para. 1, subpara. (1).
[66] André Nollkaemper, “The Precautionary Principle in International Environmental Law: What's New Under the Sun?” Marine Pollution Bulletin 22 (1991): 107-110. Cf., in this respect, the notion that research in the area must be conducted exclusively for peaceful purposes and for the benefit of mankind as a whole, Articles 143 and 256 of UNCLOS.
[67] UNCLOS, Article 22 of Annex III; Article 139, para. 2.
[68] UNCLOS, Articles 286 and 297.
[69] "The Role of the Int. Court of Justice in the Development of Int. Environmental Protection Law”, in Robinson, Agenda 21 & UNCED Proceedings, vol. 4, pp. 851-857. Robert Jennings, "Need for Environmental Court?" Environmental Policy and Law (1992): 312-314.
[70] UNCLOS, Articles 204 (Monitoring), 206 (Assessment), 200 and 244 (Information and Data).
[71] UNCLOS, Articles 269, subparas. (c), (d), (e), and 202 (manpower); 266, 268 (technology); 197, 242, 270 (infrastructure); 275-277' (training).
[72] UNCLOS, Article 140 (activities in the area shall be carried out for the benefit of mankind as a whole); Articles 143-147, 256-257, 274.
[73] UNCLOS, Articles 202-203, 242-243, 266-269; in regard to the Area: Article 274 subpara.(a) and (b).
[74] E.g., UNCLOS, Articles 202-203, 266-269.
[75] E.g., UNCLOS, Articles 200, 244, 266 and 268.
[76] Ibid. UNCLOS, Articles 198, 205, 206.
[77] E.g., UNCLOS, Articles 197, 242, 270-274; see also, for example, Articles 118 (living resources) and 123 (semi-enclosed seas).
[78] I.e., UNCLOS, Articles 247, 270-273, 275, and 278.
[79] Scherer, “Approach to GOOS”, TWO Bulletin, p.121.
[80] Agenda 21, Chapter 1, Preamble, paragraph 1.3.
[81] Philip Allott, "Marc Nostrum: A New International Law of the Sea",The American Journal of Int. Law, 86 (1992): 764-787 (hereafter cited as "Marc Nostrum").

[82] 82 Steve L. Rhodes, "Climate Change Management Strategies", Global Environmental Change (1992): 205-215 (hereafter cited as "Climate Strategies").
[83] Manfred Lachs, "Thoughts on Science, Technology and World Law", The American Journal of Int. Law 86 (1992): 673-699.
[84] INC/UNCED, Report of the Chairman of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change, Mr. Jean Ripert (France), on behalf of the Committee, Doc.:A/CONF.151/8, in Nicholas Robinson, (ed.), Agenda 21 & UNCED, Vol.III, 1715-1720.
[85] Paris Communiquè by the Group of Seven 1989, New York Times July 17, 1989, p. A7 (key sections).
[86] Miles, Science, Politics, p. 57. WMO is the acronym for the World Meteorological Organization; ICSU is the acronym for the International Council of Scientific Unions.
[87] L.D. Solomon and B.S. Freedberg, 'The Greenhouse Effect: A Legal and Policy Analysis", Environmental Law 20 (1990): 83-110. Cf. An Painter, "The Future of Environmental Dispute Resolution", Natural Resources Journal 28 (1988): 145-170, stating on p. 150: "For a true understanding of environmental conflict there must be a true understanding of the environment".
[88] Cf. footnotes 7 to 15.
[89] Cf. Geoffrey Palmer, "New Ways to Make International Environmental Law, The American Journal of Int. Law 86 (1992): 259-283.
[90] Stevenson and Oxman, "The Future of UNCLOS".
[91] Rhodes, "Climate Strategies", p. 210.
[92] Nandan, Marine Scientific Research.
[93] Allott, "Mare Nostrum", pp. 779-782.
[94] Eugene B. Skolnikoff, "The Policy Gridlock on Global Warming", Foreign Policy 79 (1990): 77-93.
[95] Jonathan I. Charney, "Universal International Law,* Vie American Journal of Int. Law 87 (1993): 529-551.
[96] Allott, "Mare Nostrum", p.781.
[97] Allott, "Marc Nostrum", p. 786.