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G. L. Holland
(Slide 1)
My talk today is about the growth of operational oceanography and is also to commemorate the fifty year anniversary of the IOC, which occurs next year. I have been associated with that organization for about forty of those years and will give you some of my recollections of events and people over that time. It is important to build the future on the lessons learnt from the successes and failures of the past. Remember, experience should not be neglected.

I once asked an acquaintance, who was a much more eloquent speaker than myself, how he managed to engage his audience and he said to me, "always open with a story". Thinking about the interaction between past and future operational systems I recalled a story I heard several years ago that seemed appropriate and I apologise to those who may have heard this one before.

The story is set in North America, where an old Indian chief had passed away and was replaced by his son who had recently graduated from college. The young man was initially somewhat overwhelmed by this unexpected responsibility, but over the following months began to enjoy his status as the new chief. He was taken aback however, when the elders asked him his predictions for the coming winter. The tribe would need to gather fuel and if the winter was going to be long and cold, the tribe would have to start gathering wood early. The young man said he would consider the matter and when they had gone he got out his laptop and consulted the weather channel. He found the winter was forecast to be moderate so he recalled the elders and gave his prediction. Suitably impressed, the tribe began to make the necessary preparations. He was somewhat dismayed a few weeks later when his laptop revealed a more severe forecast so he called in the elders again and told them they must work a little harder. He was embarrassed when the following month the forecast was once again downgraded and he again needed to tell the tribe to increase their efforts. Not wanting to have to change his prediction a fourth time, he rang the regional weather office to find out why the predictions were changing. He was told that although the computer models seemed relatively stable, it had been reported that the Indians were gathering fuel like crazy and they were seldom wrong.

The moral of the story could be that the interaction of both experience and knowledge must be used when producing information services.

Coming back to my topic, the IOC met for the first time in October, 1961, incidentally over half a century later than the establishment of the International Meteorological Organization, which was the forerunner of the WMO. Internationally renowned oceanographers of the time had realized that gathering information and knowledge on ocean processes demanded large scale ocean expeditions and, for this task, intergovernmental cooperation was a necessity. Champions of ocean science present at the initial meeting included Roger Revelle, Warren Wooster, Henri Lacombe, Jacques

Cousteau, George Deacon, Konstantin Federov and N. Pannikar. As expected, the emphasis of the discussions was on research cooperation. However, the strategic importance of operational oceanography in the military arena had become established during the war years and many delegations included admirals and other senior naval officers. Personally, I suspect that their presence was more to ensure military intelligence was protected, rather than to discuss global cooperation.

At the first meeting little attention was directed towards operational oceanography, although attention was given to intergovernmental data collection and exchange. The formation of the IOC Working Committee on International Ocean Data Exchange was an early and very important step. Nevertheless, at this time, the focus was on data for science rather than on its use in the development of operational services.

In the early sixties an unlikely champion emerged to set the IOC on its course towards operational oceanography. Dr. Jim Snodgrass was an oceanographer working at Scripps Institute of Oceanography and he raised the concern that the increasing use and allocations of radio frequencies would inhibit the future development of the automated transmission of ocean data. In those days competition for the use of radio frequencies was a serious problem and the allocation was closely monitored by the International Telecommunications Union to avoid interference and disruption of services. How could automated ocean instruments be developed if there were no available frequencies for the transmission of data? The discussion led to a successful approach to the ITU to have a band of frequencies reserved for the purposes of ocean data transmission. I have no idea whether that allocation still exists or is even relevant in today's world, but at that time the idea of synoptic ocean data transmission was very new and the debate helped to jump start the planning processes that would lead to the later creation of the Integrated Global Ocean Station System (IGOSS).

There was some reluctance by parts of the ocean research community to embrace synoptic ocean observations and the reasons were clearly articulated. At that time ocean observations were almost entirely carried out by research scientists from research vessels. The most valuable data sets were those that had been made by individual scientists with carefully calibrated instruments, using their own methodologies and with painstaking quality control. It took months before results appeared in the scientific literature. Scientists argued that the access to synoptic data would lead to this careful research being pre-empted by others using unreliable information. These fears were compounded by concerns over the arrival of automated technology that allowed ocean observations by non-scientific personnel from ships of opportunity and that raised issues of calibration, quality and continuity.

It was the research programs that were generating the majority of ocean observations and therefore a genuine concern existed that the funds required for continuous synoptic ocean systems would be taken out of research budgets, because operational ocean agencies capable of assuming this task did not exist.

Fortunately there were other voices that argued that ocean knowledge could not progress without an expansion in the amount and coverage of ocean observations, and that the use of such knowledge and data would yield ocean information products of significant value to society. Therefore, despite some reluctance from within the research ranks, the planning for the establishment of IGOSS went ahead.

At the 1965 Assembly the impetus for operational ocean observations began to gather momentum. An increasing number of governments at the IOC began to see advantages in converting ocean knowledge into information useful for marine applications. The IOC established a Working Group on Ocean-Atmosphere interaction to complement similar groups being set up by the WMO. The WG was to consider ways in which intergovernmental action could strengthen the forecasting of sea surface conditions and assist transportation and fisheries. (Slide 2) The Assistant DG for Science at UNESCO, Professor Matveyev, showed considerable foresight when he told the participants that "*…even if one day the Commission succeeded in covering the whole ocean with a network of systematic observations it would still have tasks to fulfil….*"

By 1967, the Commission was calling for an increase of 50 per cent in its budget to deal with its growing range of issues and priorities, which now, jointly with WMO, included the development of real-time data observation systems,. The World Weather Watch had been recently established and the WMO Secretary-General, D.A. Davies, attended the IOC Assembly to outline what was happening in that regard. During his opening statement he pointed out (Slide 3) "*the influence of the oceans upon the atmospheric processes is so significant as to make a study of certain aspects of oceanography essential to a full study of meteorology.*" He also stated (Slide 4) that, "*…it is in fact difficult to draw a line of demarcation between the two sciences. The two sciences not only have much scientific ground in common but they are basically the same kind of science, and the problems to be solved are, in many respects, of a similar character*." It was at this session that the Working Committee for IGOSS was established and the planning for its implementation and development progressed rapidly thereafter.

In the United Nations there was a growing governmental interest in the importance of oceans. The IOC Resolution establishing IGOSS recalled no less than eight relevant Resolutions by the General Assembly over the preceding years. One of which called for an extended world wide exploration of the oceans with the concurrent need for improved data collection and processing.

The establishment of IGOSS was critical to the development of operational oceanography and to the early cooperation between the WMO and the IOC. In those early days of IGOSS, the complementary committee within the WMO was the Executive Panel on the Marine Aspects of Ocean Affairs (MAOA). IGOSS and the MAOA met together in sessions termed IPLAN, shorthand for IGOSS Planning meetings. This is a slide of an early IPLAN meeting and I can be seen hiding at the back.(Slide 5)

In 1969 the IOC and the WMO approved the General Plan and Implementation program for phase I of IGOSS. In the introduction the purpose and values of IGOSS were listed

and reading them again, forty years later, I could not help but be impressed by the foresight shown by those early pioneers.

For example the original 1969 document on the purpose and values of IGOSS (Slide 6) stated

"The purpose of IGOSS is to provide more extensive and timely information on, and prediction of, the state of the ocean and its interaction with the atmosphere, and to support research on the processes of the ocean, so that nations can provide improved oceanographic services to increase the safety and efficiency of their marine activities."

I took over the position of Canadian delegate when Neil Campbell became the IGOSS Chair. For an inexperienced newcomer the interagency cooperation process was certainly an eye opener. The subject of my own post graduate studies had been storm surge propagation and, although working in marine sciences, I felt an affinity with the meteorological community. Looking back, I remember my surprise at the high level of competition, and on occasion friction that was present between the respective secretariats. The format for these sessions was that the two groups would meet separately for three days before coming together as IPLAN, under the co-chairmanship of the respective groups, for the final two days of the week's session to discuss a mutual agenda. It seemed to me at the time that the object of the separate meetings was to discuss how each could obtain the upper hand in the joint discussions. Presumably funding pressures and the protection of jurisdictional responsibilities were the basis for the friction between secretariats although personalities did play a role, and I can vouch for the fact that the blame was on both sides of the house. Nevertheless, there were many individuals who worked hard during the meetings and the intersessional periods to achieve cooperation, and slowly progress was achieved.

By the early seventies, IGOSS was gaining support and respectability. It had its objectives established but the plan was not yet fully underway. The links between the IOC and WMO were strengthening and the mutual benefits of cooperation were recognized. As a well established operational agency, the WMO and its member national agencies desired better ocean surface information to extend and improve the long range weather forecasts. A basic requirement for the IOC and its ocean delegates was access to the WMO Global Telecommunication System, the GTS. Those of you familiar with that period will recall that the GTS was by no means perfect and had its own issues with reliability and quality, but for the IOC, a non-operational organization with no capacity to set up a real-time global data exchange system of its own, access to the GTS was the only solution.

Up to this time ocean data exchange had been an archival system, relying on the individual researchers, and their institutions, to submit quality controlled data in the required format to the ocean data exchange network. The time interval between observation and the arrival of data into the global data archives was typically a year or more, and many data sets remained on laboratory shelves.

The IOC and WMO put together a small working group to prepare a global plan for the collection and exchange of real-time ocean temperature data. The IGOSS Pilot project to collect and exchange real-time bathythermograph data was adopted by the IOC in 1971, and its success very much depended on the assistance of the WMO and the use of its GTS.

If the initial interest of meteorologists with operational oceanography was the result of the need to extend the length and accuracy of weather forecasts, an even bigger impetus arrived in the seventies with the debate and concern on climate change, a concern that was to be equally compelling to meteorologists and oceanographers alike. Climate and its implications for ocean data and research appeared in the discussions at the IOC in the early seventies. Professor Kort of the USSR, in 1973, drew attention to the role of ocean currents in the transfer of heat and emphasized "*.. the probable importance of this transfer to long-term weather forecasting and climate changes..*" The El Nino event and its implications to global weather patterns were also discussed and climate was accepted as being of fundamental concern to the Commission.

By the mid seventies ocean services under IGOSS had achieved respectability. The Bathy Project became operational and several manuals and guides were published. Ocean services began to have wider implications, including many of less direct interest to the meteorological community. After some initial concerns with quality, salinity had been added to the range of automated instruments and TESAC messages were now part of the real-time suite of observations. FAO requested IGOSS to look at the provision of ocean services to the fishing industry and ocean pollution became a priority issue, largely due to the Stockholm Conference on the Environment in 1972.

Around this time IGOSS was requested to coordinate the real-time data exchange of ocean data during the First GARP Global Experiment, an invitation, which gave IGOSS an opportunity to show its potential in an operational mode. During this large and successful experiment in the Atlantic, 260 ships from 21 countries contributed to the 46,000 Bathy and TESAC reports received. In addition IGOSS coordinated the data received from the 360 drifting buoys deployed during the experiment. This demonstration of IGOSS usefulness marked a clear maturing and consolidation of ocean data and services.

The end of the seventies saw climate considerations become the main driver for ocean observations. Increased use of computer modelling also demanded timely availability of the observed data. The operational partnership between the IOC and the WMO was further consolidated with the agreement between the two organizations to co-sponsor IGOSS as a Joint Working Committee, thus laying the foundation for the present joint Technical Commission. The IOC/SCOR Committee on Climate Change and the Ocean was established and the planning started for the World Ocean Circulation Experiment, which was to become the largest ocean research program ever undertaken. The link between climate change and ocean observations was cemented by Roger Revelle in addressing the Assembly as (slide7) Chairman of the Committee. With typical clarity he outlined the future requirements for ocean monitoring and stated the four prime

considerations to be followed were: - data accuracy; data coverage; data timeliness and the economy of data retrieval. I believe these to be equally true today.

In 1980 I was elected Chairman of IGOSS, having been Canadian delegate for many years. I truly enjoyed my time working with and chairing this committee as it struggled to find its way. It was a time when much could be done with little more than an idea and the willing cooperation of colleagues around the world. I have already mentioned the IGOSS involvement with fisheries, marine pollution and the coordination of buoy data. Another important initiative, with the assistance of Klaus Wyrtki in the University of Hawaii, was the establishment of a real-time IGOSS Sea Level Pilot Project, which produced weekly charts monitoring the El Nino event. However, rather than keeping these various ocean services within IGOSS, decisions were later to be taken that would transfer the sea level marine pollution and buoy data responsibilities to other IOC committees.

As IGOSS Chairman, I reported annually to the governing bodies of both parent organizations and I remember clearly the on-going arguments over the use of the GTS for real-time ocean data communication. A particular sticking point was the definition of real-time. Much of the ocean data was still collected and compiled on board research vessels and not available until the ship reached port. To overcome this problem IGOSS had asked for the assistance of Port Meteorological Officers to meet vessels on their return and place the ocean data onto the GTS. This was hardly real-time data, especially in the eyes of meteorologists. However in terms of the time scales for most ocean processes this delayed mode data was needed for the understanding of ocean processes and the request was made to extend the acceptance of real-time ocean data by the GTS up to thirty days after it was observed. It proved to be quite a hard sell. In particular many of the meteorological delegates were worried that opening up their communication network to the extended Bathy and TESAC data would overcome the capacity of the GTS. On my part, the idea of IGOSS contributing enough data to overload the system was something I could only dream about. Around this time, IGOSS changed its name from the original Integrated Global Ocean Stations System to the Integrated Global Ocean Services System, to reflect better its operational status.

During my time as chair of IGOSS I was fortunate to have the support of many well known ocean scientists. Ferris Webster, Roger Revelle and Henry Charnock all took turns in chairing the IGOSS research group. My Vice chair was Konstantin Vasiliev who was also chair of the WMO Commission on Marine Meteorology. Dick Stoddart, who worked with me back in Canada, was my dependable workhorse and the Secretariats of Bert Thompson in the IOC and Ichiro Mizuno at the WMO gave me wonderful support.

1985 marked the halfway point to this fifty year anniversary for the IOC. Certainly things were changing. The number of Member States to the Commission had increased to 112, with the concurrent expansion of priorities, requirements and national policies to be satisfied. By the mid eighties governments were realizing that timely information made economic sense and led to more effective management of marine activities. Operational oceanography was broadening its impact and the rapid growth in

technological capability was certainly helping to increase the quantities and timeliness of data observations. The emphasis on climate continued to grow and the IOC's Technical Committee for Ocean Processes and Climate (OPC) met for the first time under the Chairmanship of Jim Baker.

Despite much rhetoric, the lack of global participation by Member States was still a problem and, during the next few years, the competing demands for national and regional priorities seemed to lead to a loss of focus on the global system. At the Assembly, discussions on ocean observations took place under a broad suite of regional and programme activities. The interdisciplinary nature of ocean processes added to the complexity and needed to be addressed. In 1987, the recognition of the importance of including biology led to the establishment of the Joint Global Ocean Flux Study.

However, amongst all the competing national priorities, climate concerns proved to be a vehicle for refocusing ocean observations into a global perspective. The essential role of the ocean in climate models through its ability to store and transport huge quantities of heat and in its capacity to absorb carbon dioxide had been firmly established. The Ocean Processes and Climate Committee made the first suggestion for the creation of a system for global ocean observing in the late eighties, in order to bring some order to the various activities dealing with ocean observations. The vision of this committee for a global ocean observing system recognized that the understanding and forecasting of climate change would require something more than the time-limited experiments of the WCRP such as WOCE. What was contemplated was an ocean observing system akin to the World Weather Watch and in March 1988, the 21st IOC Executive Council created an ad hoc expert group (led by Jim Baker) to prepare proposals for the development of a global ocean observing system. The planning process for the design and implementation of this system was endorsed by the IOC and WMO in 1989. In a parallel activity, an Ocean Observing System Development Panel was set up to specify the requirements for ocean measurements in support of climate observation.

The first 'official' use of the phrase "Global Ocean Observing System" came at the 23rd IOC Executive Council in March 1990, and in September the Second World Climate Conference endorsed the concept of GOOS as a major component of the proposed Global Climate Observing System (GCOS). By September, a Strategy for GOOS had been produced and the following year GOOS was established as a system not only for climate, but including physical, chemical and biological coastal and ocean monitoring. It was agreed that existing observing system activities such as GLOSS, IGOSS, the Ship-of Opportunity Programme and the Data Buoy Cooperation Panel should be fundamental building blocks of GOOS. The WMO Congress accepted the invitation to co-sponsor GOOS and by the end of the year a Draft GOOS Development Plan was prepared.

Quoting from the IOC's website (Slide 8) on the development of GOOS "The *creation of GOOS in this form and at that time reflected the desire of many nations to establish systems of ocean observations dealing with environmental, biological and pollution aspects of the ocean and coastal seas, to raise the capacity of less well developed nations*

to acquire and use ocean data effectively and to integrate existing systems of observation and data management within a coherent framework."

An important endorsement of GOOS arose from its recognition in the blueprint that emerged from the United Nations Conference on Environment and Development in June 1992.

To implement the actions of the various GOOS planning bodies, the GOOS Project Office was set up with part-time staff within the IOC Secretariat in 1992. During the rest of the decade, the implementation of GOOS proceeded through the work of specific panels addressing the health of the ocean, living resources and coastal requirements. The first regional GOOS bodies NEARGOOS and EUROGOOS appeared in 1994 and these early successes spawned interest in other regions of the world. On the climate side, the Ocean Observing System Development Panel completed its work in 1995 and was succeeded by an Ocean Observations Panel for Climate jointly sponsored by GOOS, GCOS and the WCRP. In terms of the GOOS structure, in 1997 a GOOS Steering Committee co-sponsored by IOC, WMO, UNEP and ICSU, was given the responsibility for all aspects of GOOS planning requiring scientific and technical expertise. The Steering Committee, under the chairmanship of Worth Nowlin, was responsible for publishing the GOOS Strategic Plan and the GOOS Prospectus. Colin Summerhayes, was appointed full time GOOS Director and provided excellent leadership in this growth period.

The obvious synergy between the IOC ocean services developments under GOOS, and the climate and atmospheric services programmes under WMO, led to a closer association of the two organizations. In 1999 the governing bodies of the two organizations, recognizing the increasing demand for integrated marine meteorological and oceanographic data and services, and the efficiencies achieved by combining the expertise and technological capabilities of the WMO and IOC systems, decided to establish the WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM).

This brings us full circle to today and JCOMM's third meeting. I won't apologise for giving the development and evolution of JCOMM scant attention, however I am sure that you are all familiar with that more recent history. So how do I close out this talk, perhaps to reiterate the statement of Prof. Matveyev nearly fifty years ago, that even when we have covered the ocean with observations there is still much to be done.

The task of this Technical Commission is to provide governments and managers of coastal communities and marine activities with the information they need to give an economical, safe and sustainable service to society.

- Economical, because priorities for ocean services have to compete with other societal benefits and they must be shown to be worthwhile.

- Safe, because the natural ecology and our own life and property must be protected.

- Sustainable, because protecting the health of the planet and the health of the ocean are one and the same goal.

Your task will certainly be an on-going one. There will be continual changes to technology that will increase the quality and quantity of observations and with it opportunities for new and more accurate and relevant predictions. More importantly there will be great changes in the way we use the ocean and its resources and the corresponding need for increased knowledge and information services.

Let me be realistic. The human race is no different from any other species in being willing to adapt their environment to better serve their needs. But we are unique. Firstly we have the technology to make changes large enough to affect the global environment and secondly, perhaps even more seriously, we rarely act together on a global scale. We humans are too often driven by motives of short term individual or corporate gain. Even national interests can transcend the more logical collective approach to long-term stability and survival. The two characteristics taken together make for a dangerous situation that needs to be recognized and addressed by our respective leaders.

What does this mean for the oceans? I like to compare the future of the oceans with what has happened with our terrestrial environment. On land, we have changed the face of the earth to suit our needs; other ecologies have been sacrificed for our sprawling cities, farmlands, transportation networks and even our prized parks and gardens. Over several thousand years we have adapted our earthly habitat. We have made and continue to make many mistakes in our land-management practices, but we may be slowly learning how to be sustainable, at least I hope so. Unfortunately, the land represents only a quarter of the earth's surface and I am sure that we will very soon be increasing our presence in the oceans.

As sea level rises we will be forced to protect low-lying lands and even build artificial islands to replace lost habitable space. We will require more food resources to be produced from the sea and the wild fishery will not suffice. Aquaculture issues in vulnerable coastal regions must be resolved by better technology and by the development of fish farming techniques offshore. Genetic and mineral resources of the oceans and sea bed will be further exploited and the ocean will become more important in terms of energy and freshwater production.

The promise of future ocean benefits also brings grave concerns. The rate of change of progress is much greater today than in the times when we were adapting our terrestrial environment. We no longer have the luxury of time to digest our actions and correct our mistakes. As a global community we are lagging in our responsibilities to the marine environment. As yet we have not adequately tackled the impact of our land-based activities on the ocean. Our wastes still pollute the productive coastal zones and the collective loss of coastal habitat through indiscriminate development and activities is as

serious to ocean biodiversity as the more publicized destruction of the rain forest. Increases in ocean activities must be carefully managed and the sustainability of our actions given priority attention. We can do many marvellous things, but we must do them right. The oceans are the lungs and life of the planet, but its processes are still relatively unknown. For the oceans of the future we will need a great deal more observations, knowledge and information than we now possess.

A world renowned author of science fiction, Michael Crichton, in his book entitled "Prey" said this in the frontispiece: (Slide 9)

"*The fact that the biosphere responds unpredictably to our actions is not an argument for inaction. It is however a powerful argument for caution, and for adopting a tentative attitude toward all we believe and all we do.*"

I will close with one final piece of advice and maybe the most important lesson from my forty plus years in international ocean affairs. Intergovernmental cooperation is essential, but intergovernmental meetings alone will neither develop needed policies nor provide the catalyst for change. The meetings are the vehicle, but it is the energy, creativity and dedication of the individual that provides the driving force. Attendance at a meeting such as this implies that each of you has something to contribute; it may be experience, knowledge, technical competence or management skills. It is up to each of us to use our talents individually and in cooperation with our colleagues to produce the required results from these meetings and continue to work vigorously on their implementation when we arrive back home. There have been many pioneers in the past, but their efforts have provided only the first step in what has still to be achieved. We also need you!

Thank You