HYDRO INTERNATIONAL INTERVIEWS REAR ADMIRAL CHRISTIAN ANDREASEN, NOAA (RET.)

Mariners Need More Current Hydrographic Data

Almost 50 years in hydrography gives you insight and authority to talk about the field and the changes it has gone through in half a century. Rear Admiral Christian Andreasen talks about his career. He is certainly not somebody who only looks back, but is still looking into the future, sharing strong ideas about where hydrography will need to go: â€˜Mariners do not understand why hydrographic offices are not more supportive. Finding ways of providing mariners with more current data is an issue.â€™

Since the 1960s, when you became a hydrographer up to the present, the means and techniques for surveying and charting have changed considerably. What in your opinion did not change?

Nearly all aspects of hydrographic surveying have changed, but the difficulties have not changed. RADM Angrisano, also a past president of the Directing Committee, always said that hydrographic surveyors are ‘blind’ in that they can seldom see the seafloor they are mapping. The physics of remote sensing into the oceans is a serious challenge, and NGA recently asked top physicists in the US to investigate whether or not we might be missing some phenomenology for ocean remote sensing. It was concluded that we must continue to adapt light and sound technologies. In addition, the physical challenges of working in the often harsh ocean environment are also often daunting. The technological aspects of hydrography will continue to change to help us confront the unchanging physical challenges.

In a presentation to the 1988 Canadian Hydrographic Conference you said that, “Only 5 percent of the world’s oceans have been surveyed to GPS accuracy.” How can we reach 100 percent in a reasonable time-frame?
Unfortunately, I do not believe that 100 percent can be reached for many decades. National hydrographic offices are focused on the nearshore navigation areas that are most important for navigation safety, and many hydrographic offices no longer have deepwater survey systems. Deepwater surveys are now focused on the delineation of the 2,500 metre isobath for maritime claims, postage stamp scientific investigations, mineral resources and military surveys. National hydrographic offices seldom conduct systematic surveys of the deep ocean, so we might know the surface of our own planet as well as we know that of our moon. Ship operations have become too expensive and the number of hydrographic ships is declining. We recognised this problem when one of our submarines collided with an unknown pinnacle. It will be decades before our military surveys reach this area of the Pacific, so we used satellite-predicted bathymetry, i.e. gravity information, to predict where seamounts might exist. This technique, developed by Dr. Smith and Dr. Sandwell, has proven very valuable for directing survey ships to potential hazards. Many of these investigations of predicted features have proven to be significant actual features and, as such hazards are mapped by hydrographic ships, we issue Notices to Mariners for charting. The major hope for the future is extension of ship capabilities through the use of autonomous underwater vehicles (AUVs).

When you started as a surveyor at the beginning of 1963, what positioning and echo sounding systems did you use? Is the accuracy of those systems still acceptable by the present e-navigation requirements?
I do not want to answer this question; it shows that I really have been in hydrography for nearly 50 years! When I first went to sea, single beam fathometres and precision depth recorders for deepwater survey had been deployed. The captain of my first ship did not yet trust sonar depth measurements and we were simultaneously slinging the lead, with a leadsman on the bow throwing the lead, and another amidships to bring the line vertical and read the depth to compare with the sonar. Positioning was by visual horizontal sextant angles, SHort RANge Navigation (SHORAN), from World War II, and LORAN A. During that first sea tour, we received the first LORAN C unit for a survey across the Atlantic to guide laying the ‘hot line’ telephone cable from President Kennedy in the US to Premier Khrushchev in Russia. Beyond the range of LORAN C, we took celestial fixes. The depths from sounding machines, sonar and lead lines are all good information. The problem is that we had no means for accurate positioning beyond line of sight to the coast and this caused the data to be inaccurate and in need of resurveying with GPS navigation. When I was chief of the Exclusive Economic Zone mapping group at NOAA, we had three NOAA ships with multi-beam systems survey the offshore region of Monterey Bay, California, and then cartographically combined these data with the nearshore surveys conducted by single beam and lead-line surveys. The data were joined with little problem, proving that lead-line, single beam, and differing multi-beam systems data could be combined successfully. It also proved that accurately positioned historic data is still very good data. That said, one never knows for certain what hazards may exist between the measured points of lead-line and single beam surveys and, over time, full bottom coverage must be achieved.

In what way might satellite bathymetry help in filling the gap between the adequately and inadequately surveyed areas?
Other than through the use of airborne Lidar, all means of remotely sensed bathymetry cannot achieve the accuracy required for safety of navigation, i.e. the IHO standards for hydrographic surveys of roughly 1 percent of depth. Wave kinematics can sometimes achieve 5 to 10 percent accuracy, but it fails by not having good resolution. Through the water bathymetry using ambient light has better resolution, but achieves accuracy on the order of 25 percent and other sensor approaches using inferred depths are more in the range of 30 percent accuracy. Only Lidar, which currently has object detection issues—which I believe eventually will be solved—and sonar systems achieve what is needed for nautical charting. The advantages of satellite and airborne remote sensing are economy, quick area coverage and safety; since the surveyors are not within the hazardous surf zone and the fact that we will eventually use the satellite remote sensing techniques for prediction of 'change' to help prioritise the ship, airborne Lidar, and AUV surveys.

At present, almost all marine navigation is assisted by the use of some form of electronic chart. These systems have been classified mainly into two categories: electronic navigational chart (ENC) and electronic chart system (ECS). Both are based on the official hydrographic data that national government hydrographic offices have produced. How do you see this distinction? Wouldn't it be better to have a single type of electronic chart capable of conducting safe navigation?
I think it is correct that the ships regulated by the Safety of Life at Sea (SOLAS) convention must be carefully regulated and that ENC is appropriate for this. The transition from paper to ENC has been slow and difficult but we are now transitioning towards the benefits of ENC for the mariner. Currently, ENC provides the mariner continuous knowledge of ship position, easy navigation on Great Circle routes, and weather routing; and, as the ENC evolves, I believe mariners will rapidly shift to ENC. Now that NGA is transitioning to the new S-100 format, we hope to help with data portrayal issues. The non-regulated vessels, as well as small commercial and recreational vessels, need many of the functionalities of ENC, including automated updating of their desired region of operations, but cannot handle the size and cost of the full ECIDS; they need differing levels of ECS, i.e. small-sized systems in laptops, iPods, and smaller hand-held systems. At NGA we have begun the transition of the smaller military units to such capabilities. Both national regulations and systems cost need to be flexible to provide the larger-than-SOLAS navigation community with a 'practical' and 'economic' means for safe navigation. We must recognise that getting charts into the hands of all mariners is important for safety and protection of the environment.

For military operations, interoperability of land, air, and sea data is a must. In what way has nautical cartography been arranged in order to favour this essential requirement?
This was the reason for NGA adoption of the vector product format (VPF) rather than the IHO S-57 format. NGA cartographers still find integration of topographic data with hydrographic data easier in the VPF format. NGA has recently reorganised to place topographic, aeronautical, and marine production within a single organisation, the NGA Source Directorate. Littoral products are generated by maritime and topographic offices, co-ordinating such that they each produce their respective areas and the Maritime Safety Office produces the final combined product. Now that IHO is moving to the new S-100 family of formats, the NGA will transition to use S-101, S-102, etc., rather than continue with a unique military format. We have never been totally supportive of the additional military layer (AML) concept in that we believe that overlays create too much clutter and conflicting data. NGA is transitioning to a conflated one-feature, one-time data and a widened display as an AML layer. We are not totally opposed to AMLs.

In the US Senate, from time to time, the benefits/non-benefits of ratification of the December 10, 1982, United Nations Convention on the Law of the Sea (UNCLOS) is considered, which was drafted with strong contributions from the US. Do you think an essentially maritime community like the US should ratify?
Ratification of UNCLOS is a political decision and recently Secretary of State Clinton stated that she believes the US will ratify it in the not too distant future. The Department of Defence supports ratification by the US, and one significant benefit is that the US could have a voice within related bodies, such as the Continental Shelf Commission. The US has been very actively conducting the deepwater surveys needed to submit its extended continental shelf claims; the US hydrographers are ready for ratification!

The US is one of the nations that contributed to the creation of IHO and, as said before, you were president of the IHB from 1992 to 1997. How do you see the IHO acting in the present international environment? If you were called to be IHB president today, what particular action would you initiate?
The US values the role of standards setting and co-ordination by IHO. The US participates in nearly every IHO committee and working group as well as many of the regional hydrographic commissions. One of the issues for IHO in the international arena is the gradual move toward increased IHO membership, i.e. towards that of the twice-as-large International Maritime Organization (IMO). It is easier for states to participate in IMO than IHO. To be in IHO as a truly functional member state, there needs to be a functional national hydrographic office which is not practical for many small nations. IHO needs to establish certain criteria for an associate membership category with lower fees and lesser rights.

If I were called to IHB again, I would like to work on the means for integration of remotely sensed data that is not as accurate as the hydrographic data acquired to IHO navigation standards. In the electronic age we need to communicate the more up-to-date data to the mariner, even though non-standard data, in addition to the tidally controlled IHO standard hydrographic data, may be 100 or more years old. Resurveying of 100-year-old hydrography is so difficult, slow and expensive that we will have 200-year or older hydrography on our government charts, if we are not careful. Mariners do not understand why hydrographic offices are not more supportive. Finding ways of providing mariners with more current data is an issue.

Hydrographic surveys and nautical charting have, since the beginning, been flanked by private industry. How do you see the participation of the industry in the fields of the standardisation of these two main activities? Moreover, in what way might the presence of private industry speed up the production of both surveys and charting?
Until IHO began the transition to electronic charting, industry had no direct interface with IHO charting activities, particularly since IHO is an inter-governmental organisation (IGO). With the evolution of electronic charting, it has become essential that IHO and the marine electronics industry develop a close relationship. ECDIS with a vector chart displayed is a complex system requiring careful testing to ensure correct display. When mariners encounter errors, IHO, the national hydrographic offices, the industry system producers and data resellers need to work jointly to quickly resolve every problem. As we proceed towards additional integrated displays, things are going to get more complex and standardisation will become even more important. The maritime electronics industry is not large and IHO needs to keep them involved in its committees and working groups. While government hydrographic offices fund technology developments, industry is at the heart of the developments that improve hydrography and nautical cartography and their competition drives refinements that are extremely valuable to hydrography and cartography. The increased volume and accuracy of hydrographic data and improved display options are founded on a healthy marine electronics industry working with hydrographers; our speed forward depends on this relationship and the vision of technologists.

Your career in hydrography can be an example for many young people. Would you suggest that they enter this field? What satisfaction can be obtained?

The oceans cover seven tenths of our planet and are the one place where one can still make significant discoveries. Our coastal zones are in continuous change due to things like port development and natural changes like sediment transport or storms; there is no end to the need for hydrographic surveyors. We often characterise hydrography as boring cruising back and forth never going anywhere interesting. That is what my recruiter told me and a few months later I was en-route to the Azores Islands and France and then the next season off to Puerto Rico and the Virgin Islands. The young people of today are very computer literate and more typically have an oceanographic background that is more relevant than the civil engineering route that I took to become a hydrographer. Horizontal positioning, including triangulation, was the problem during my career, but GPS has cured that problem. Ocean monitoring and modelling along with basic hydrography are the future. The hydrographers and nautical cartographers of the future need to understand ocean modelling, acoustics and remote sensing; and more time is likely to be spent deploying AUVs that do the back and forth surveying. Many hydrographers in the future will work from coastal vessels and mobile party shore sites deploying autonomous systems. The hard technical R&D challenges for the future are to achieve accurate underwater navigation without deployment of numerous acoustic positioning arrays, how to measure gravity in the nearshore from AUVs, how to improve real-time tides worldwide coverage, and tides modelling, and remote sensing and modelling of currents in relation to the tidal cycle. The future will lead to increased interfaces with marine environmental scientists, fisheries management and the fishing community, coastal developers, etc. It is a great life with worthwhile challenges and I highly recommend it!

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https://www.hydro-international.com/content/article/mariners-need-more-current-hydrographic-data