

The Next Challenge of the International Hydrographic Organisation And Hydrographic Offices: "Green" ECDIS For the Protection and Monitoring of the Marine Environment.

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Abstract

The introduction of a technologically advanced navigational tool such as ECDIS (the electronic chart display and information system), could easily be expanded from a strictly navigational purpose to provide a more direct benefit to the protection and monitoring of the marine environment. When coupled with marine environmental information "green" navigation through the use of a "green" ECDIS would be a reality. The introduction of a "green" ECDIS would be timely given the impending mandatory carriage requirements for ECDIS. However, a collective effort by hydrographic offices will be a necessary key factor in achieving such a development. This paper considers why and how hydrographic offices should be actively involved in the next challenge of developing a "green" ECDIS, and examines the present level of knowledge and expertise available that could turn this into a reality.



Resumé

L'introduction d'un outil de navigation techniquement avancé tel que l'ECDIS (système de visualisation des cartes électroniques et d'information) pourrait facilement être développé en partant d'un strict objectif de navigation jusqu'à fournir un avantage plus direct en terme de protection et de gestion de l'environnement marin. Associée à des informations sur le milieu marin, la navigation « verte » grâce à l'utilisation d'un ECDIS « vert » deviendrait réalité. L'introduction d'un ECDIS « vert » serait opportune compte tenu des prescriptions imminentes en matière d'emport obligatoire d'ECDIS. Toutefois, un effort collectif de la part des Services hydrographiques sera un facteur clé nécessaire pour aboutir à un tel développement. Cet article examine comment et pourquoi les Services hydrographiques devront participer activement au prochain défi du développement d'un ECDIS « vert » et le niveau actuel des connaissances et des compétences disponibles qui pourront permettre de le réaliser.



Resumen

La introducción de un instrumento de navegación técnicamente avanzado como el ECDIS (el Sistema de Visualización de la Carta Electrónica y de Información), podría desarrollarse fácilmente a partir de un objetivo estricto de navegación para proporcionar un beneficio más directo en términos de protección y gestión del medio ambiente marino. Asociada a la información sobre el medio ambiente marino, la navegación "verde" sería una realidad gracias al uso de un ECDIS "verde". La introducción de un ECDIS "verde" sería oportuna teniendo en cuenta las prescripciones inminentes en materia de transporte obligatorio de ECDIS. Sin embargo, un esfuerzo colectivo por parte de los servicios hidrográficos será un factor clave necesario para lograr un desarrollo similar. Este artículo considera porqué y cómo los servicios hidrográficos deberán participar activamente en el próximo desafío del desarrollo de un ECDIS "verde", y examina el nivel actual de conocimientos y competencias disponibles que podrían permitir que esto se convirtiese en una realidad.

Introduction

1. Awareness and concerns over the protection of the marine environment is not a recent phenomenon; the International Hydrographic Organization¹ is an inter-governmental consultative and technical organization that was established in 1921 to support the safety in navigation and the protection of the marine environment.

2. Traditionally, hydrographic offices have played a significant role in enhancing navigational safety mainly through the publication of nautical charts showing a 3-dimensional information base. In other words, x (latitude), y (longitude) and z (depth). In simple terms, well-charted waters lead to safer navigation. This is commonly understood to mean the prevention of vessel grounding, and thus indirectly protecting the marine environment.

3. The introduction of a technologically advanced navigational tool such as ECDIS (the electronic chart display and information system), could easily be expanded from a strictly navigational purpose to provide a more direct benefit to the protection and monitoring of the marine environment. Unlike the paper chart, an ECDIS could be easily transformed from a static to dynamic system by introducing the 4th dimension of "Time". This can be achieved through the introduction of time variable data and information such as tidal levels, current, and wind and wave information. When coupled with marine environmental information such as the location of migratory fish species, seasonal changes affecting seabed topography or areas of clean water for ballast water intake, "green" navigation through the use of a "green" ECDIS would be a reality. The environmental awareness of seafarers and other seaborne users could thereby be significantly and usefully increased.

4. The introduction of a "green" ECDIS would be timely given the impending mandatory carriage requirements for ECDIS. By 2018, almost all vessels engaged on international voyages will be equipped with ECDIS and it seems reasonable that a "green" ECDIS could easily be extended to other user groups such as research institutions, fisheries and oceanographers. However, a collective effort by hydrographic offices will be a necessary key factor in achieving such a development.

¹ *In 1919, twenty-four nations met in London for a Hydrographic Conference, during which it was decided that a permanent body should be created. The resulting International Hydrographic Bureau began its activity in 1921 with nineteen Member States. At the invitation of H.S.H. Prince Albert I of Monaco, a noted marine scientist, the Bureau was provided with headquarters in the Principality of Monaco.*

5. This paper considers why and how hydrographic offices should be actively involved in the next challenge of developing a "green" ECDIS for the display and update of marine environmental and hydrographic information. It also examines the present level of knowledge and expertise available that could turn this into a reality.

Potential New Area of responsibilities for the IHO and Hydrographic offices

6. The rapid growth in interest and concern for the marine environment highlights the need to identify the most appropriate organizations and parties that should lead the development and implementation of a "green" ECDIS. At the same time, it is important to recognize that the protection of the marine environment is a complex issue, covering such things as the management of migratory marine-species; the devastation of coastlines after maritime incidents; and the impact of rises in sea level. From that perspective, it is important that organizations are aware and equipped to meet the challenges by having all the relevant information to hand. But, as a note of caution, the situation of information overload must be avoided as it will, almost certainly, be counter-productive.

A Leading Role by the IHO and Hydrographic Offices

7. Despite the growing interest and concern over protecting the marine environment, there is no clear international effort to ensure that the mariner has the technology and relevant information at sea to help protect that environment. There are an increasing number of rules and regulations – but no coordinated way for the mariner to visualize and react to those rules in relation to his situation.

8. Perhaps, if we examine the number of major groundings and collisions at sea that result in extensive oil spills; and the consequential massive coastal clean-up, destruction and harm to marine life, then, hydrographic offices might be persuaded to consider the important role that they could play. In the case of a major oil spill, a "green" ECDIS could immediately display the environmentally vulnerable areas, such as marine parks, recreational beaches and desalination plants. Because the information would be standardized for use in ECDIS, it would be equally accessible to the relevant shore-based authorities and vessel owners, who could then be proactive rather than reactive to a developing situation. Immediate action could be taken by issuing advance warning to vulnerable areas, erecting oil booms based on predicted movement of the oil spill or towing a vessel to another less sensitive location to lessen any possible impact to the environment.

Hydrographic offices could also be consulted to recommend alternative shipping routes, based on underlying hydrographic information. In other words, where accidents have occurred a “green” ECDIS could be a significant mitigating factor in minimizing damage to the marine environment.

9. This is best illustrated with an example of an accident that occurred in the Singapore Strait in 1997. On 15 Oct 1997 the oil tanker *Evoikos* collided with another oil tanker, the *Orapin Global*. The *Evoikos* suffered severe damage to three of its cargo tanks, resulting in a spill of 28,500 tonnes of heavy marine fuel oil. The *Orapin Global* suffered some damage to its bow. Fortunately and because the Maritime and Port Authority’s (MPA) marine emergency plan was activated, all the relevant parties immediately responded and swift action was taken to combat the oil spill.

10. A total of 16 ministries and agencies, oil terminals, salvage companies and oil spill response companies were involved. Some 80 craft and 650 personnel were deployed. Swift and effective response could not have been achieved without immediate access to vital information on the predicted movement of oil spills. This allowed resources to be strategically deployed effectively. Coupled with the need to keep the port and its approaches opened, there was also a need to constantly integrate the tactical picture of resource deployment, sensitive marine areas and general navigation using the port and transiting the Strait. Experience from the incident has shown that an integrated information base is key reasons to the successful outcome in containing an oil spill. Such an integrated information base could be provided, particularly at sea, through a “green” ECDIS.

11. A review of current expertise and experience would indicate that national hydrographic offices, coordinated by the IHO, are well-placed to promote and support a “green” ECDIS concept and be more actively engaged in the protection and monitoring the marine environment. Their work would not depart far from their existing responsibilities in providing users with the data to provide a graphical presentation of seabed topography, coastlines, currents, aids to navigation and other useful information.

12. Hydrographic offices are already collectors and compilers of information for charting. They compile this information and provide it for ECDIS as Electronic Navigational Charts (ENCs). It is a logical extension of this role for hydrographic offices to provide users with additional environmental information about such things as seabed topography, coastlines, currents, and so on. The IHO standards and specifications that already exist to support ECDIS, such as S-57, and the IHO’s S-52 display standards adopted by the IMO can accommodate some, if not all of this additional environmental

information.

13. The IHO and its Member State hydrographic offices should therefore be more actively engaged in the protection and monitoring the marine environment than they are at present.

IHO’s S-100 Standards and Specifications for a “green” ECDIS

14. For the time-sensitive hydrographic information, the former IHO – IEC Harmonisation Group on Marine Information Overlays (HGMIO) has examined and worked extensively on the presentation of time-variable objects to further improve the situational awareness of users. This clearly illustrates that the subject of “green” ECDIS is neither new nor impossible to achieve. Moreover, under the auspices of the HGMIO, the Canadian Hydrographic Service and Canadian Industry has embarked on a project to provide sea-ice information for use in ECDIS as part of a St Lawrence Seaway Test Bed project. The aim is to enhance navigational safety in the St Lawrence seaway in winter months, which is a major concern due to the presence of ice sheets.

15. In protecting the most sensitive marine resources, it is obviously necessary to identify the most relevant and important assets such as desalination and power plants, recreational beaches, particularly sensitive sea areas (PSSAs), fishing areas, and so on. On this aspect, there may be a need to create some new symbols for ECDIS. This can be achieved very easily when the IHO S-100 geospatial information standard is introduced over the next few years.

16. IHO S-100 is the new geospatial standard for hydrographic data that will eventually replace the S-57 standards. S-100 It is aligned with the ISO 19100 series for geographical information standards and the plan is to introduce it progressively from 2010. S-100 is ideally suited to meet the challenge of providing a “green” ECDIS with capabilities to display time sensitive spatial objects.

Challenges confronting the development of “Green” ECDIS

Expanding Role of Hydrographic Offices to Marine Environment Protection

17. One of the principal challenges will be to convince hydrographic offices, and hence the IHO, to take a more proactive role in the provision of additional environmental information. At present, a number of hydrographic offices only focus on charting information for navigation safety. There is no unanimous agreement to take a leading role in providing more information that could directly help protect the marine environment.

18. But this does not mean that they do not have the capabilities or have not collected relevant information that could be used. Where hydrographic offices are hesitant in supporting a “green” ECDIS, perhaps a wider view is required. Their role would be to collect essential information from stakeholders and distribute it to users. The aim being to contribute to sustainable use of the sea by balancing commercial shipping / maritime development interests with the protection of the marine environment.

19. Some hydrographic offices may argue that such a role may encroach into another authority’s area of responsibility. However, it could be argued that it is no different from the present role as a middleman, in providing information on nautical charts. For example, some of the information shown on nautical charts comes from sources such as port authorities, meteorological services, land planning authorities and operators of marine facilities. It is clear that the hydrographic offices are suitably equipped and are appropriate technical authorities to embark on a transition that would lead to a “green” ECDIS.

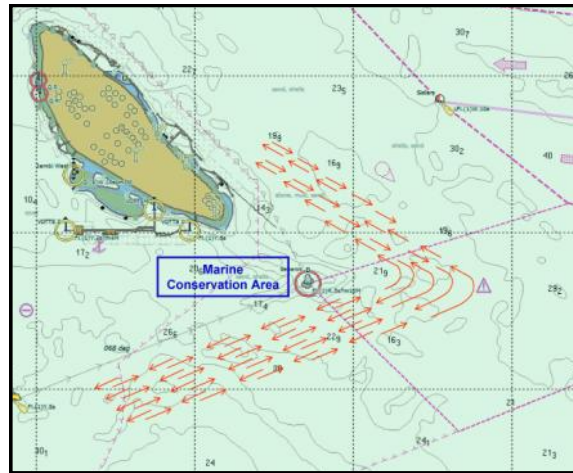
20. There are some HO’s that already see their roles as wider than just the provision of navigational information – but their numbers are relatively few. Lobbying and explanation will be required to overcome the hesitance of other hydrographic offices. More important than convincing HO’s will be to convince their controlling governments and authorities, who may need reminding of the changing attitude of mankind towards the protection of the marine environment and the benefits that will easily accrue from the development of a “green” ECDIS.

Development of Tools and Collation of Data for “Green” ECDIS

21. Another challenge will be the development of the necessary tools and symbols to present such things as marine sensitive areas, and dynamic time-variable information such as migratory fish patterns, contaminated waters affecting ballast water intake, seasonal effects on current, sand waves, oil spills and “red tides”. This would enable, for example, tidal current patterns to be displayed in an area which contains a sensitive marine asset, so that ships’ officers can constantly monitor the effects of the current and provide larger safety margins when necessary. This, in turn, would reduce the chances of a navigational mishap and consequential damage to the marine environment.



A Grounded vessel - damaging the coral reef below



Example Display of “green” ECDIS, highlighting Current Flow Overlay and a Marine Conservation Area

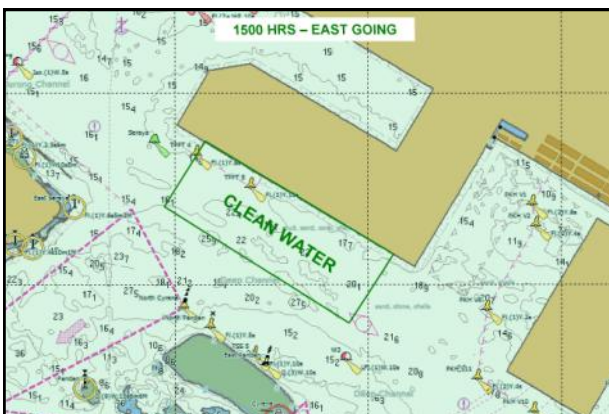
22. The IHO is already working towards some aspects of a “green” ECDIS, through its involvement with the International Maritime Organization’s Marine Electronic Highway (MEH) Demonstration Project for the Singapore and Malacca Straits. The MEH Demonstration Project seeks, amongst other things, to show that the availability and presentation of relevant environmental information via an integrated digital communications environment, is both feasible and beneficial. It has some parallels with the e-Navigation concept.

23. The IHO, represented by its secretariat, has already provided technical advice and suggestions to the MEH Project on how various ECDIS-based solutions, such as dynamic tidal and weather information, and emergency routing information could be integrated with the baseline chart information already shown in ECDIS as “Marine Information Overlays (MIOs).

24. Underlying the MEH project is the need to reduce the negative environmental impacts of shipping and coastal activities, and a strengthening of conservation and management of neighboring marine and coastal environments through the use of MIOs. The key process is to provide relevant information in suitable formats for use at sea with shipboard ECDIS and ashore with maritime safety and environmental monitoring technologies using geographical information system. Some of layers to be included for depiction are:

- a. sensitive habitats that are threatened by pollution or physical damage from marine transportation activities;
- b. Marine Protected Areas (MPA), user regimes, and related regulatory and/or sensitivity data;
- c. endangered species habitat;
- d. key habitat sensitivity information as related to oil spill contingency plans of the States bordering the Straits;
- e. other marine environmental protection best-practices/stewardship information; and;
- f. key technical and regulatory information as related to the International Convention for the Prevention of Pollution from Ships (MARPOL), the OPRC Convention and the OPRC-HNS Protocol, Ballast Water Management Convention 2004, Antifouling System Convention, and related resolutions, codes and guidelines.

25. Another example of how a “green” ECDIS could be used directly to benefit vessels, is in support of the forthcoming IMO Convention on Ballast Water. For example, vessels equipped with a “green” ECDIS taking in ballast water could be provided with the limits of “clean water”, which obviously changes according to the season and the tidal flow (*as shown below*).



Sample Display on a “green” ECDIS of Designated Area for Ballast Water intake shown at 1400 to 1500 hrs. Size of area changed due to tidal flow

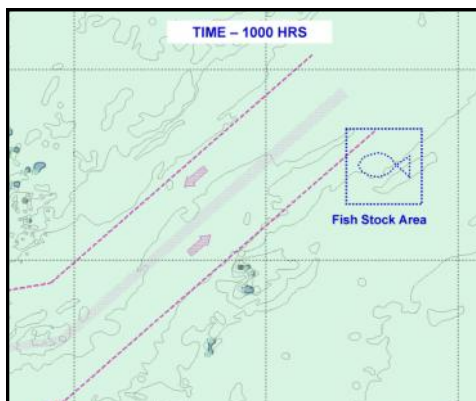
This would then eliminate the need for the vessel to carry out an exchange of ballast water en route to the next port. The operation of exchanging ballast water at sea inevitably carries certain risks to the vessel’s stability which would also be avoided..

Overlapping Jurisdictions and Conflict in Uses

26. A third challenge relates to overlapping data and jurisdictions. Based on the experience gained from the production of ENCs, it is likely that providing and updating environmental information in areas of disputed waters could be a problem. Unfortunately the domain of migratory fish-stocks or oil spills more often than not crosses national boundaries.

27. Introducing information that is both time and spatially variable is that it could develop into a conflict of use. For example, publishing the location of migratory fish-stocks could show that fishing grounds straddle navigational channels causing concerns over navigational safety (*as shown below*), as well as encouraging a concentration of fishers. Similarly, the near real-time display of oil spill tracks could expose trans-boundary sensitivities. Unless such concerns are identified and resolved in advance, this could result in no relevant information being provided at all, or updated across political boundaries.





Sample Display of "Green" ECDIS : Migratory Fish-Stock at 1000 hrs and 1100 hrs

28. In this regard, the fact that hydrographic offices must establish robust mechanisms for the exchange and use of ENC information across borders should set the way for other information, too. This should include real-time exchange of information such as tides, currents and environmentally sensitive shore-based assets.

Conclusion

29. The present level of technology is poised to accelerate the transition towards a "green" ECDIS. The next generation of ENCs will be based on the IHO S-100 standard which is about to enter force. S-100 will enable the marine information overlays which will be the critical features in realizing a "green" ECDIS.

30. A necessary precursor for a successful implementation of a "green" ECDIS will be the identification of the relevant information to be stored and displayed when needed. It is analogous to a life raft onboard a vessel: it is always there and ready for use in an emergency. The information needed to be populated and displayed have to carefully identify and liaise with potential stakeholders such as commercial shipping, pleasure and harbour craft, environmental agencies. The ultimate beneficiaries of a "green" ECDIS will be a wide spectrum of stakeholders including coastal States, user States, environmental groups, shipping and fishing industry.

31. What is needed now to ensure the success of a "green" ECDIS for protection of the marine environment is the identification of the **champion(s)** to drive this forward. Based on the available standards, expertise and experience, it could be concluded that the world's most prominent hydrographic offices, through the IHO, and are best placed to take on this responsibility and truly realize the IHO's 1921 vision of supporting the safety in navigation and the protection of the marine environment.

32. More importantly, those hydrographic offices should ensure that the IHO takes a proactive approach by recognizing that they could contribute equally to navigation safety and the protection of the marine environment by pursuing the development of a "green" ECDIS. This enhanced ECDIS would be used in both improving navigation safety and protecting the marine environment. The "green" ECDIS is a key development towards achieving a cleaner marine environment for our future generations.

Biography of the Author

Dr Parry Oei is the Chief Hydrographer in the Maritime and Port Authority of Singapore. He holds a post-graduate diploma in hydrographic surveying from Plymouth University in the United Kingdom and a Master's degree in Maritime Policy from University of Wollongong in Australia. He also received his Honorary Doctorate of Science from Plymouth University.