# Hydrographic Data at the Foundation of a Marine SDI

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## Abstract

In the 21st. Century, hydrographic data can't be excluded from the "geospatial evolution" and its use beyond nautical charts is becoming more demanded by a larger marine and coastal community. The International Hydrographic Organization recognizes that and we can see today a renewed effort to advice its member states to join their national Spatial Data Infrastructure with the Marine component, through the Marine SDI Working Group. With the advancements in GIS technology and the introduction of the new S-100 Universal hydrographic data model, the door is open to make this data really GIS enabled. Nautical Charts is not the only way to disseminate and exploit hydrographic data anymore. Collecting water column and seabed data in hydrographic surveys represent a tremendous and costly effort, and almost all of the collected parameters can be used beyond the single purpose of correcting soundings for safety of navigation purposes. Traditional centralized databases that manage hydrographic data have the primary purpose of producing a navigational database from which only S-57, raster and hardcopy chart products can be created. All this data and the rest of the ancillary parameters collected, such as sound velocity profiles, Conductivity-Temperature-Depth (CTD) casts, tidal information, sediment classification, currents, turbidity, etc. can also be reused in many different ways. In order to enable multiple uses of hydrographic data, it would be necessary to build a proper management and production system and cloud services. This paper tries to explain how hydrographic data is becoming the foundation of a Marine SDI.

## Introduction

Hydrographic data is changing, our user base is growing, and more people are requesting and using hydrographic data for many different applications in the oceans. And GIS is integrating hydrography for all these new applications. GIS is Transforming Our World. If you look at this word *transformation*, it has something really profound. It basically means *change*. Changing in two ways, however, changing both the physical but also the perception of what we see. And GIS has a lot of relevance to both of those. Today's hydrographic work is helping to physically changing the world through all kinds of maritime activities. But it's also changing the perspective of things. It's a way of communication, a kind of medium.

Our world is facing serious challenges: a faster than usual climate change, sea level rise, extreme pollution, over exploitation of resources, more maritime traffic and bigger ships, international border disputes, just to mention a few. Collectively we need to create a better future.

If we are to solve the kinds of complex problems we face today, we have to work across disciplines and industries. Hydrography is not exempt of those challenges. While it has been present and will continue to be for the shipping industry and safety of navigation, its usage is becoming more relevant everyday. And hydrographic conferences and regional and local events provide a unique opportunity to come together and discuss and learn from each other what we are doing and what else we can do with Hydrographic Data.

I have no doubt that together the hydrographic community can make hydrography a better discipline to face our world challenges. Particularly in the coast and oceans.

If we think of hydrography in its geospatial information context, beyond any specific product, we would be entering into the GIS realm, and GIS provides a platform to understand our world. Providing the practical means for geo-empowering design, integrating our hydrographic expertise.

## A Spatial Data Infrastructure

When GIS is implemented for a wide audience, connecting many entities and joining forces to serve people better, with standard technology, under specific rules and procedures, the GIS platform becomes a SDI. Which in our case, it is a Marine SDI.

So what hydrographic data would be part of this MSDI? Our hydrographic assets include: Bathymetry, which represents the main purpose of a hydrographic survey, and probably the most important foundational data for any activity at sea; then the Water Column Data, as a result of new ways to interpret acoustic data now we can see what's in the water column; the Sound Velocity Profiles, normally used to do the acoustic ray correction only based on water temperature, density and salinity, this information can be very useful for oceanographic purposes such as thermocline behaviour; the CTD Casts (Conductivity-Temperature-Depth) which again, are very important oceanographic parameters to obtain the water column temperature, hydrostatic pressure and salinity; Tides, which give the astronomical influence on the water level, that in combination with other values such as currents can be used to determine ocean dynamics and coastal erosion and accretion; Aids and Hazards to Navigation, the coastline and the navigational charts, provide a geographic framework for all other data contained in a marine environment and for mission planning and operations reference.

## The Universal Hydrographic Data Model

Commonly known as the S-100 standard, this new model brings the opportunity to exploit hydrographic data beyond its traditional use for safety of navigation; it gives all the necessary instructions, based on the Open Geospatial Consortium standards such as XML and GML and ISO standards for Geographic Information such as TC-211 and the ISO19100 series.

With all that, the S-100 not only becomes an S-57 replacement, but a new way to develop hydrographic data, based on a new series of product specifications, of which today we have the S-101 for Electronic Navigational Charts and S-102 for Bathymetry; in that sense S-1xx will be used for any other derived product from the S-100 model.

## Hydrographic Data in GIS

What could you do with hydrographic data in a GIS platform?

Besides making charts, there are two important things you could do:

1. Create overlays for visual analysis (this is something that any basic software can do)
2. But most importantly, perform spatial analysis through modeling.

And perhaps the most important software development in the 21st. Century so far, is the creation of a system that doesn't need to be installed locally.

The spirit of SDI is data sharing, and the web is the most efficient mechanism for that. A Web GIS allows users to do that kind of analysis WITHOUT software installed in a machine.

A Marine SDI, through its governance, would provide the structure to perform all these activities across organizations and even across boundaries with other countries.

ArcGIS Online is a completely Software as a Service (SaaS) solution. But it's also a complement to the on-premise systems, which is the way that most organizations are using it today. They have their main system, and then they use some online. This hybrid approaches seem to be the way of the future.

Esri is developing more and more analytics put into this environment. Which, is not just in the cloud, it can also be on-premise. There will be changes in workflows. It's a new kind of approach for GIS and for Hydrographic Data usage. It's interactive, real-time, and more.

Through an SDI, all hydrographic data produced by a myriad of agencies, even crowdsourcing and social media, can be integrated and synthetized for further analysis. When GIS evolves into an infrastructure, it becomes a SDI. And for Hydrographic Data, this would be a Marine SDI.

Once the information is integrated, it would be ready to be shared, breaking down barriers within and outside the organization and connecting with different audiences, from other spatial data producers to enrich products and services to general users or data consumers.

## A GIS Platform

A GIS platform capable of supporting a SDI should be able to support all possible patterns. ArcGIS is now a web GIS. It still can make charts and maps. It analyzes data. It manages information, but it's in a far simpler form. It's integrated all the pieces, and it's also open. This

environment is accessible from any client, desktop, web, or device. It's fed by, or powered by, services like organizations' servers or services coming from the cloud like maps or models or other sorts of things.

It is all about organizing the content and managing access. Enabling users to easily find what they are looking for. Portal for ArcGIS lives inside of ArcGIS Online for organizing content and allowing sharing of it.

Altogether, these pieces represent a platform, enabling web GIS everywhere, not only in the cloud. The cloud is very exciting. People talk a lot about it, but there are also constraints there. With Portal for ArcGIS, all of the cool ArcGIS Online stuff that many people have been attracted to can now be implementable on-premises.

Web GIS is being used for implementing the open sharing and collaboration concepts of "SDI". GIS in a web environment, can represent all the data types. It can represent certainly charts and maps, designed to do that, and imagery, and different kinds of services. But it's increasingly able to bring in all kinds of tabular data, enterprise data, spreadsheet data, big old SAP databases. It can also integrate social media and sensor networks, real-time information, and especially more recently, the whole world of big data, providing a new sort of medium to work with.

## A Marine SDI: the mean to exploit Hydrographic Data

I know today we already use hydrographic data for many purposes; there is no question about it. The question here is not what else we can do with our data, but how can we make it available to more users and more efficiently, to make hydrography pervasive in any oceans and coastal activities.

So, how can we exploit Hydrographic Data beyond charts efficiently? I mean, for charting, we have the Regional ENC Centers (RENC) through Value Added Resellers (VAR) already providing an efficient mechanism to disseminate Nautical Charts and updating services for the mariner; but what about the rest? There is a pretty wide marine audience out there. Some activities where hydrographic data is being used are:

1. Analyzing the Oceans and Climate Change,
2. Managing, Conserving and Developing Natural Resources,
3. Advancing Geographic Science,
4. Managing Maritime Transportation,
5. Planning for and Managing Emergencies (Tsunamis, hurricanes, flooding, any coastal situation),
6. Maritime Defense,
7. Supporting National Security,
8. Supporting Humanitarian Missions, and
9. Enabling Citizen Engagement and Crowdsourcing.

Web GIS can be considered an essential part of an SDI and when Hydrographic Data is at its foundation, it becomes a Marine SDI.

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## Author biography

Rafael Ponce is a Cat. A Hydrographer and MsSc. From the University of Southern Mississippi, former Deputy Director of Hydrography and Cartography and CO of a Hydrographic ship in the Mexican Hydrographic Office. He retired from the Mexican Navy after 24 years of service and became Global International Maritime Business Development Manager at Esri since 2007.