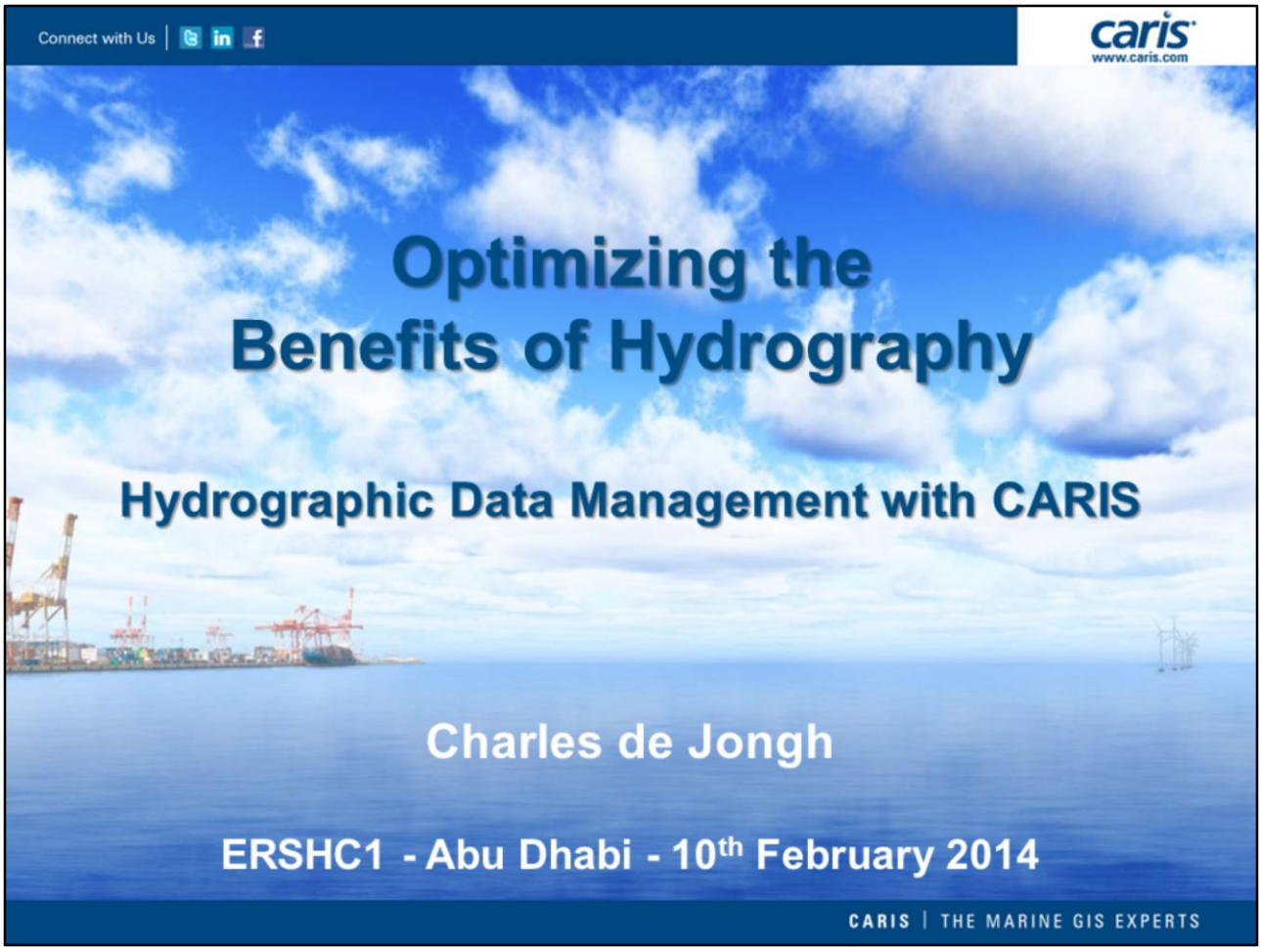


Good morning, My name is Charles de Jongh and I am the CARIS account manager for the ROPME sea area.

Let me start by thanking the chair, Dr. Adel al Shamsi, as well as the organization for giving me the opportunity to speak at this meeting.

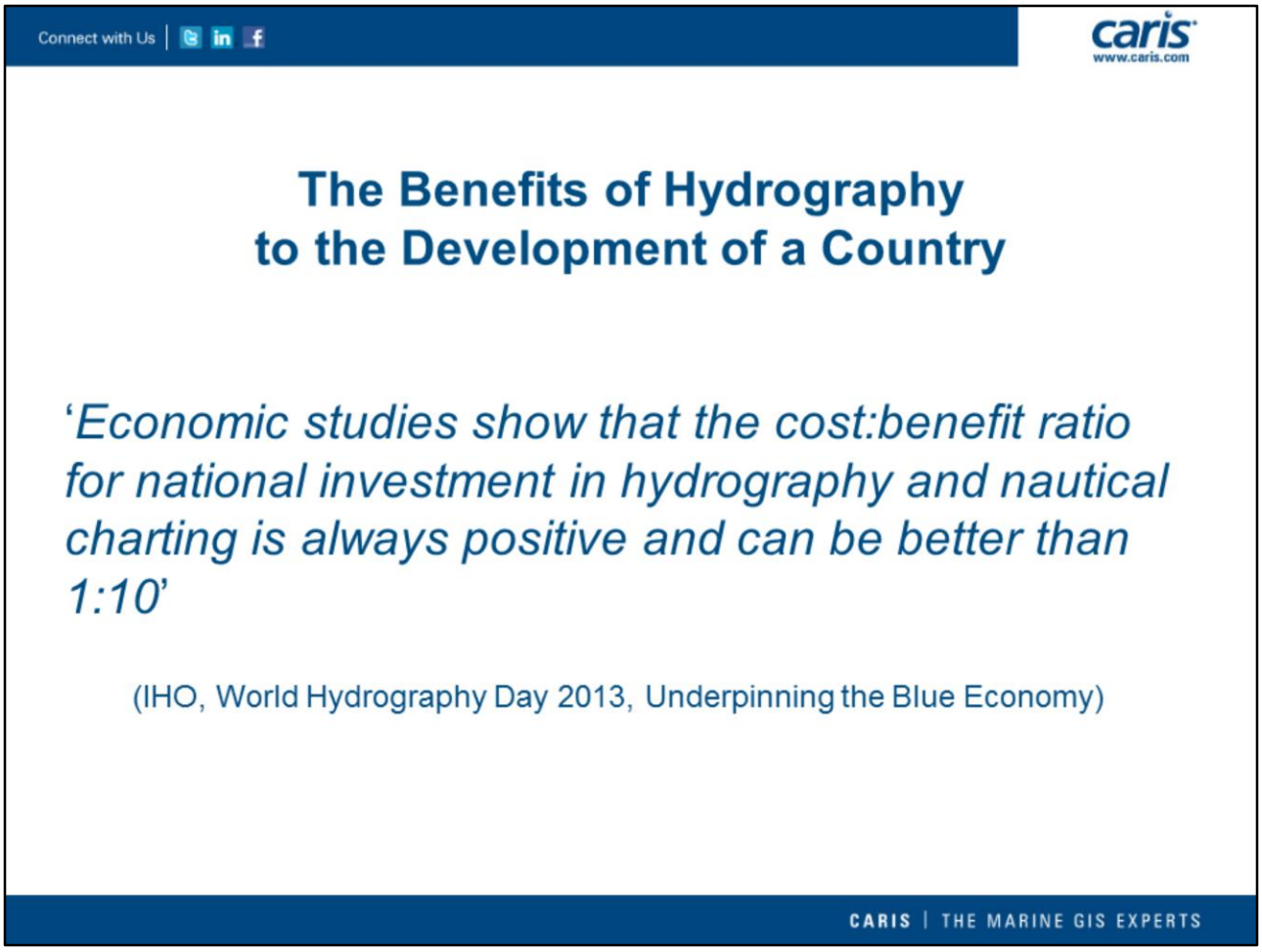
As you probably know CARIS is a software company specialized in the creation of marine GIS solutions, which means we create applications to process, visualize and manage hydrographic information.

Having our own R&D department, we are at the forefront of technology and cooperate with organisations like the IHO in defining future standards for hydrography, like S-100.

So hydrographic offices, like yours, are our main stakeholders and we develop our solutions in cooperation with you.

As such it is good to know that many, if not all of you, are using CARIS applications within your workflow.

What I would like to talk about today are the benefits that hydrography has to the economic development of a country and also how to optimize those benefits by efficiently managing hydrographic data, using CARIS solutions.



Even though it's not easy to quantify the actual benefits of hydrography to this development, attempts have been made.

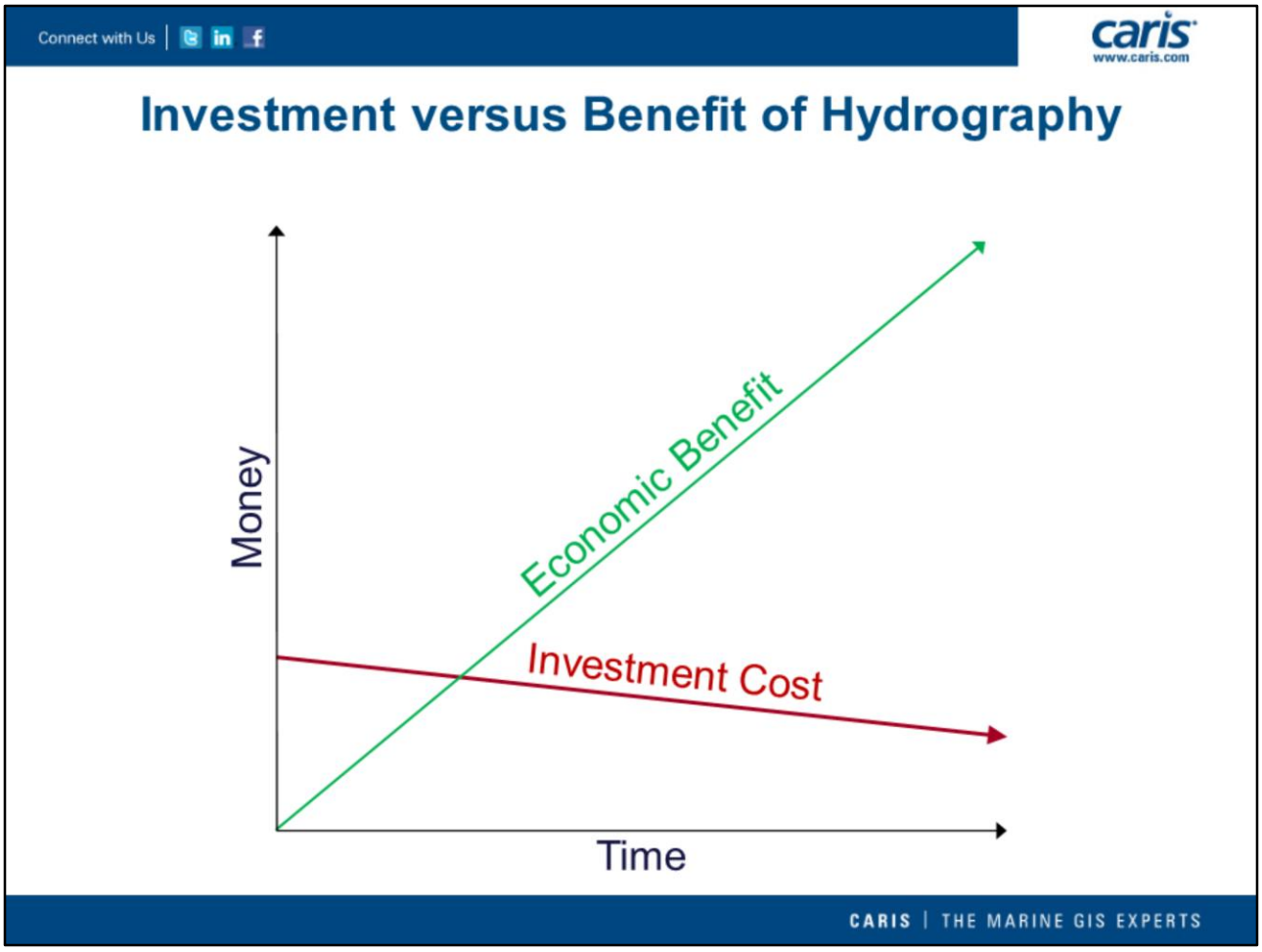
Therefore I would like to show a recent statement from the IHO, that economic studies have shown that 'the cost versus benefit ratio for national investment in hydrography and nautical charting is always positive and can be better than 1 to 10'.

So hydrography seems to have the potential to contribute a lot to the economic development of a country.

However it is also true that executing a good hydrographic survey is not cheap, nor easy, if you think of all the equipment and knowledge that is needed to do this.

It also requires a significant level of investment and continuous effort to set up and maintain a hydrographic office and a related national hydrographic program, including trained hydrographers, oceanographers and cartographers.

Nevertheless, while the initial investments can be high, the benefits are more for the long term.



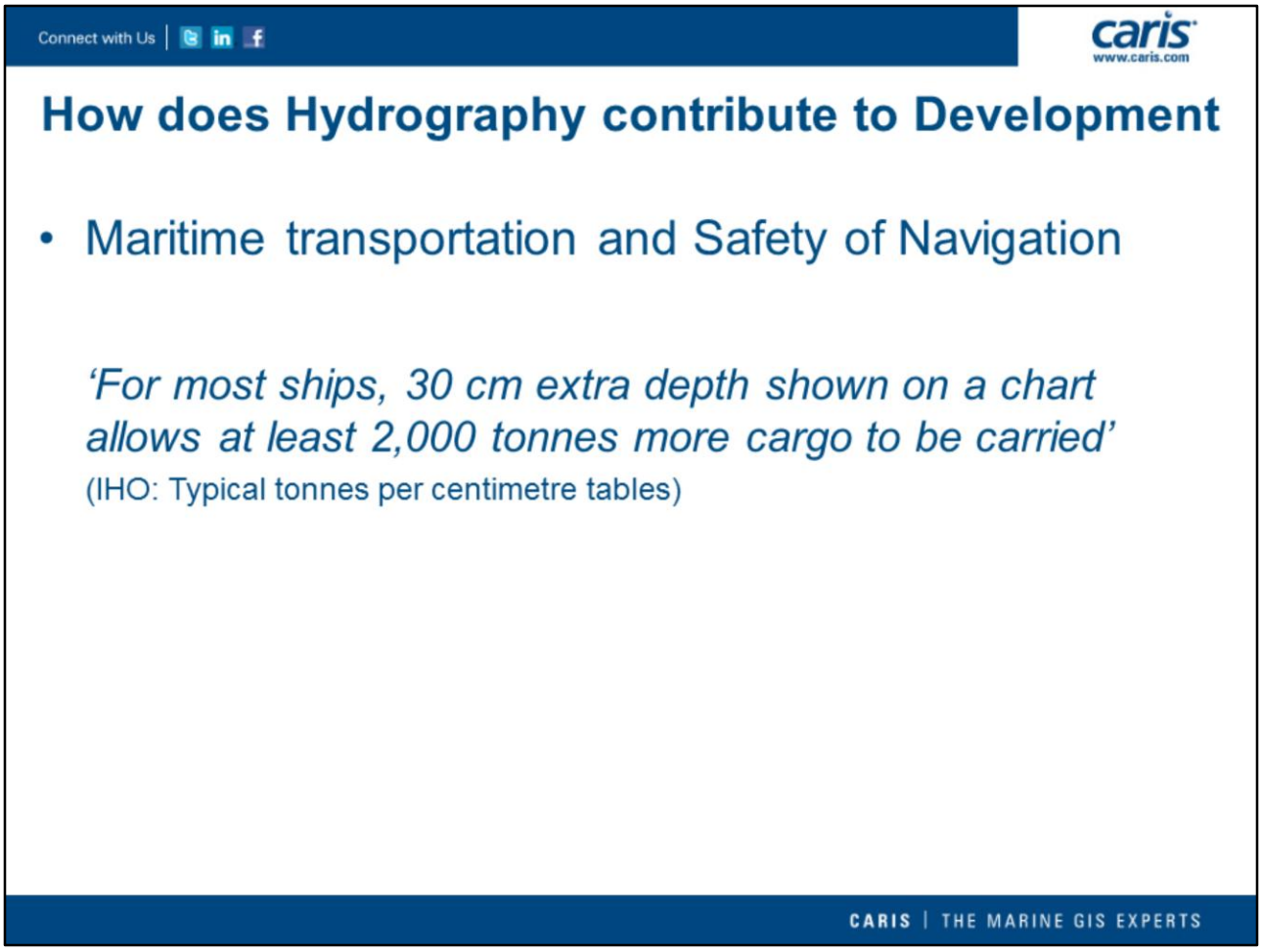
In this graph, I tried to schematically show, how the 'hurdle' **of investment costs** in hydrography has to be taken first before the **economic benefits** of hydrography start to pay off.

In this presentation I would like to start by mentioning a number of areas where hydrography contributes to or even lies at the basis of economic development.

With this I hope to convincingly show the critical value of hydrography and hydrographic services as an essential element of national infrastructure and as an important driver of economic growth.

Thereafter I will continue to argue that to increase the benefits of hydrography the hydrographic information should be well managed and be accessible for use and re-use.

In other words: I hope to show in this presentation that the investment in hydrography is worth it and how I think you can make most out of it.



A first area where the benefit of hydrography is obvious is maritime transportation and safety of navigation.

Maritime transport remains the backbone of international trade with over 80 per cent

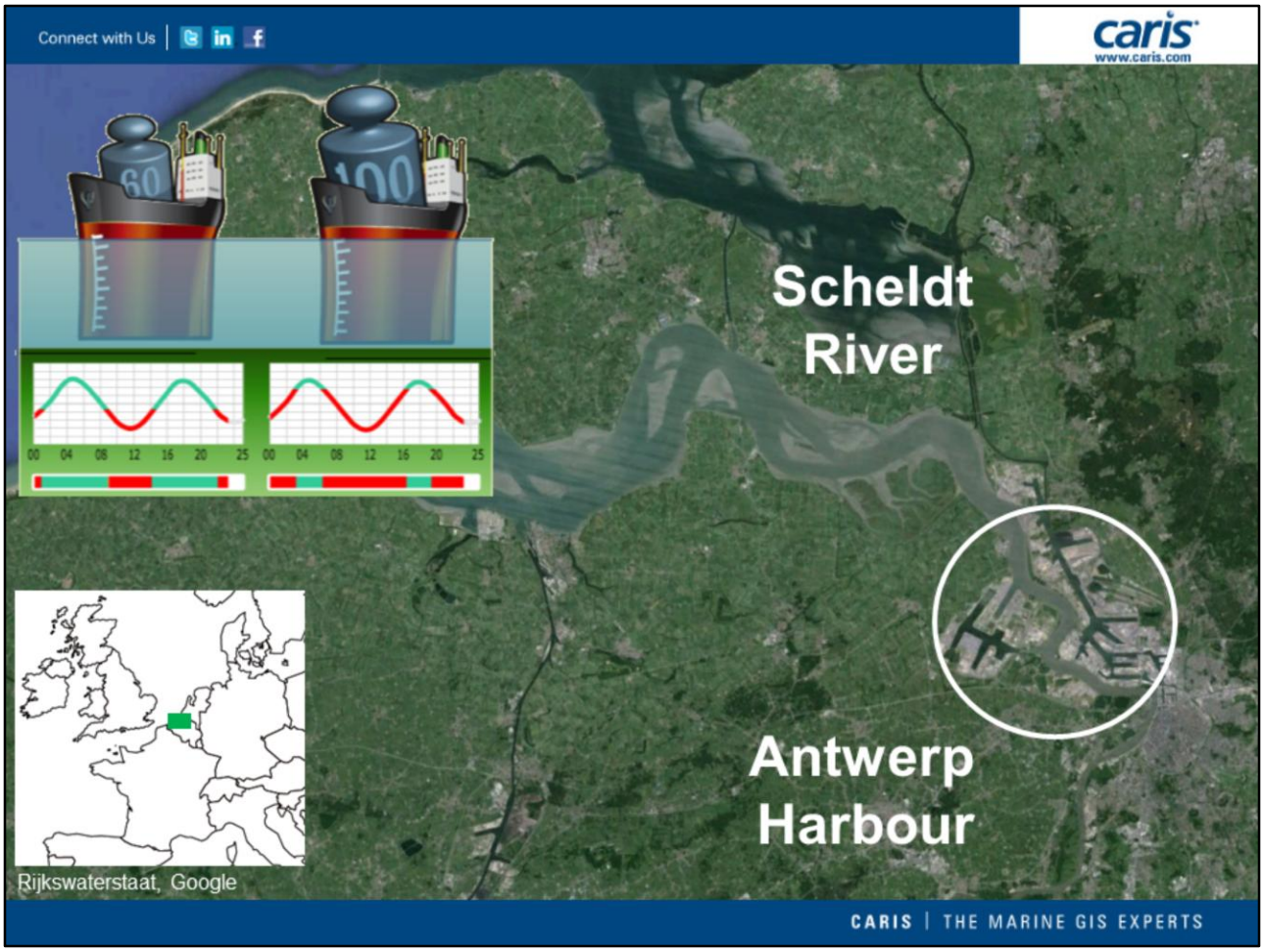
of world trade by volume being carried by sea. Global shipping fully relies on good and up to date nautical charts, with all information necessary for the mariner, including of course the depth of the water.

Not having adequate bathymetric information can lead to groundings, loss of life and money as well as environmental disasters, which is not exactly a contribution to development.

And not only for safety it is important to know how deep the water under a ship is, but also for optimal route planning and cargo loading.

Regarding cargo loading: 'For most ships, 30 cm extra depth shown on a chart allows at least 2,000 tonnes more cargo to be carried'.

So there is a direct relationship between having better knowledge of the bathymetry of an area and the economic benefit of a deeper draft, which means loading more containers on a ship.



An example of how optimal use is made of the available amount of water can be found in the Scheldt river, which is leading up to the Antwerp harbour in Belgium, the second biggest harbour in Europe.

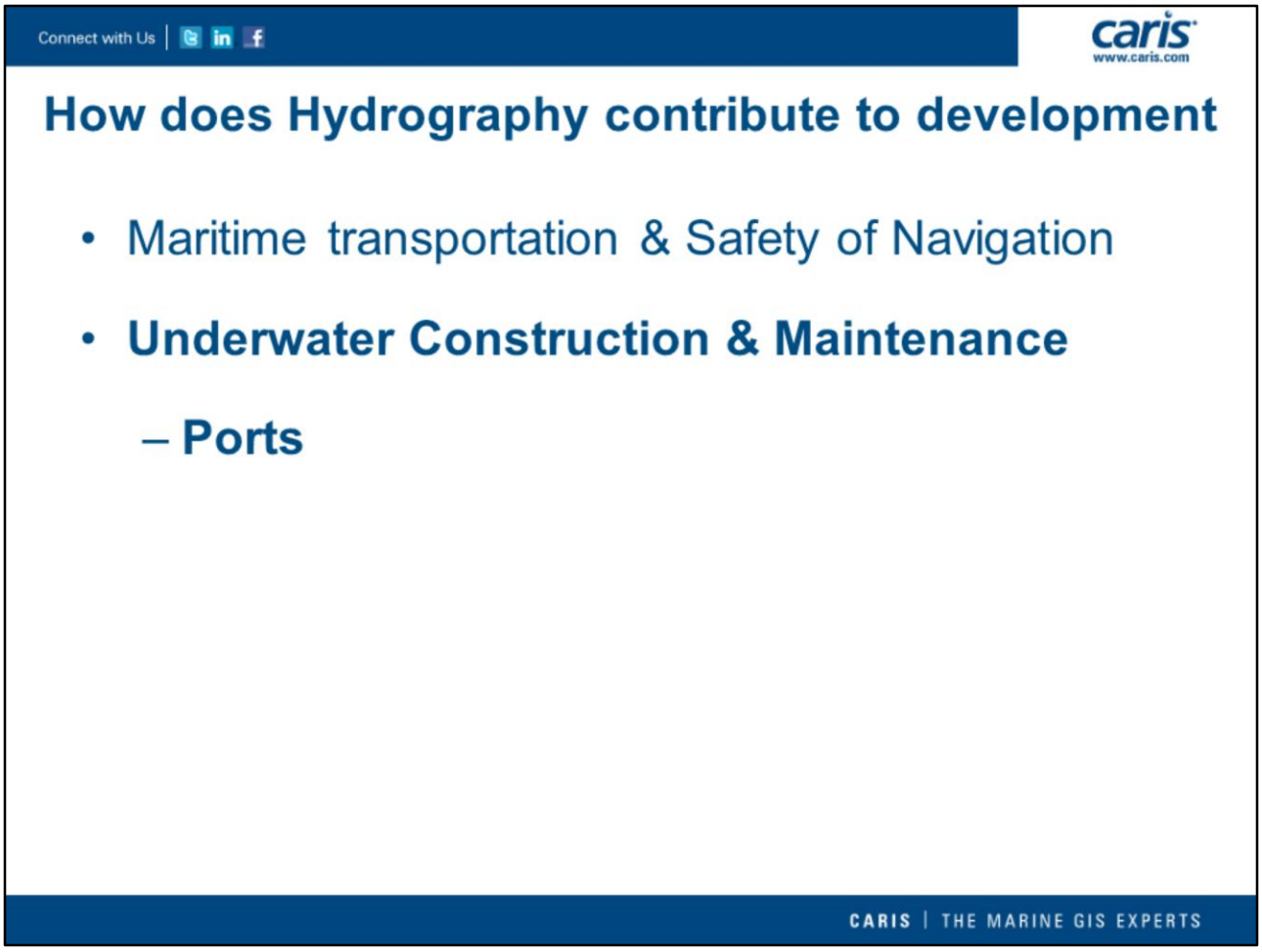
In this picture you can see the Scheldt river and its location in Europe. This tidal river is very shallow and has a very dynamic sandy bottom.

So the depths are changing all the time and therefore the river is constantly being surveyed and dredged.

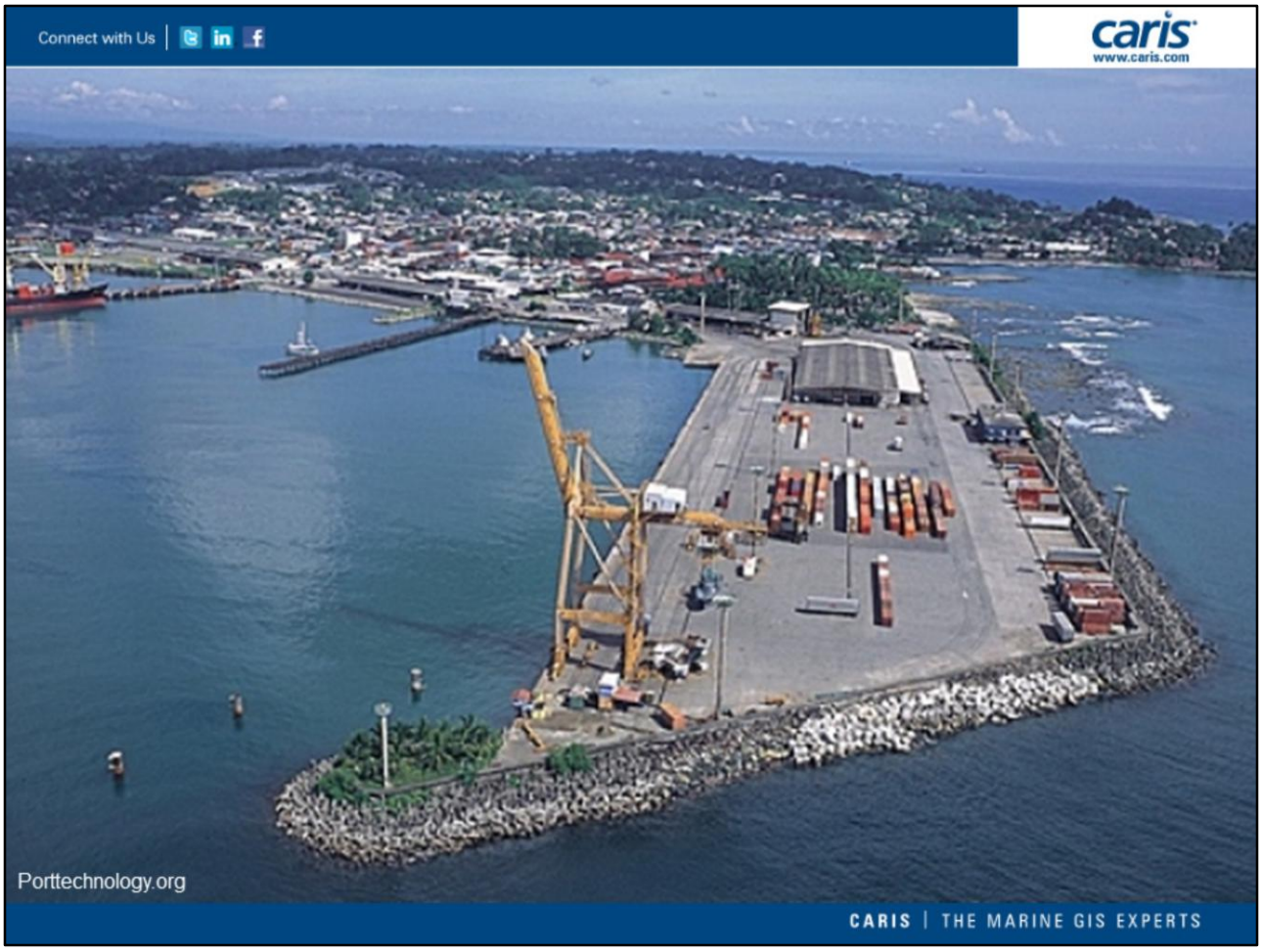
Based on this the Belgian Hydrographic office makes electronic charts with depth contours that have a decimetre precision, these are used by pilots.

In this picture it can be seen in green that this precision, combined with tidal information and information about the draft and weight of a vessel, leads to a system that exactly computes the period within which a ship can approach the harbour and thus make optimal economic use of the river.

Very precise hydrographic information is enabling this.



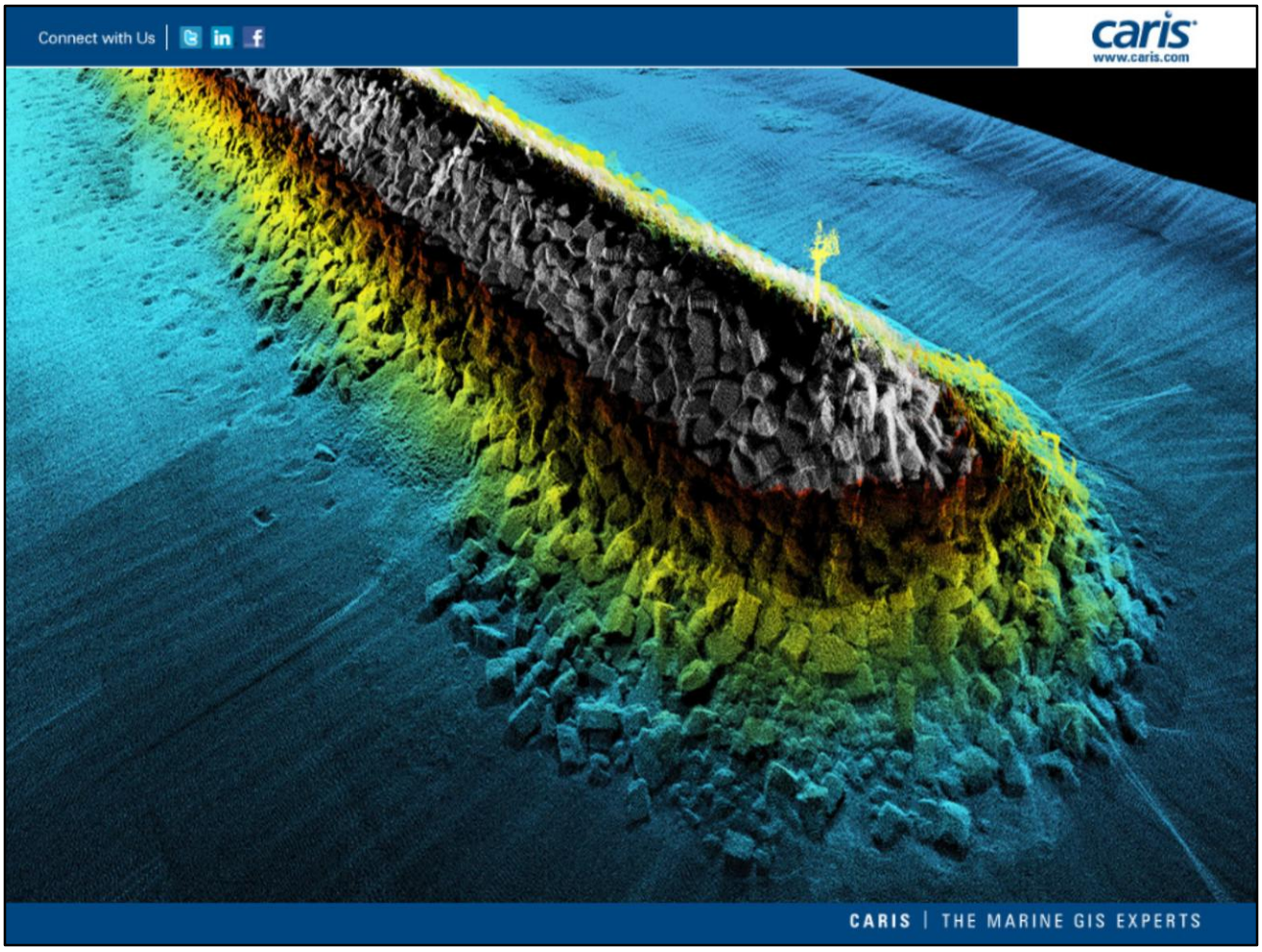
Another area where hydrography contributes to development is underwater construction and maintenance. Port construction is an example of this.



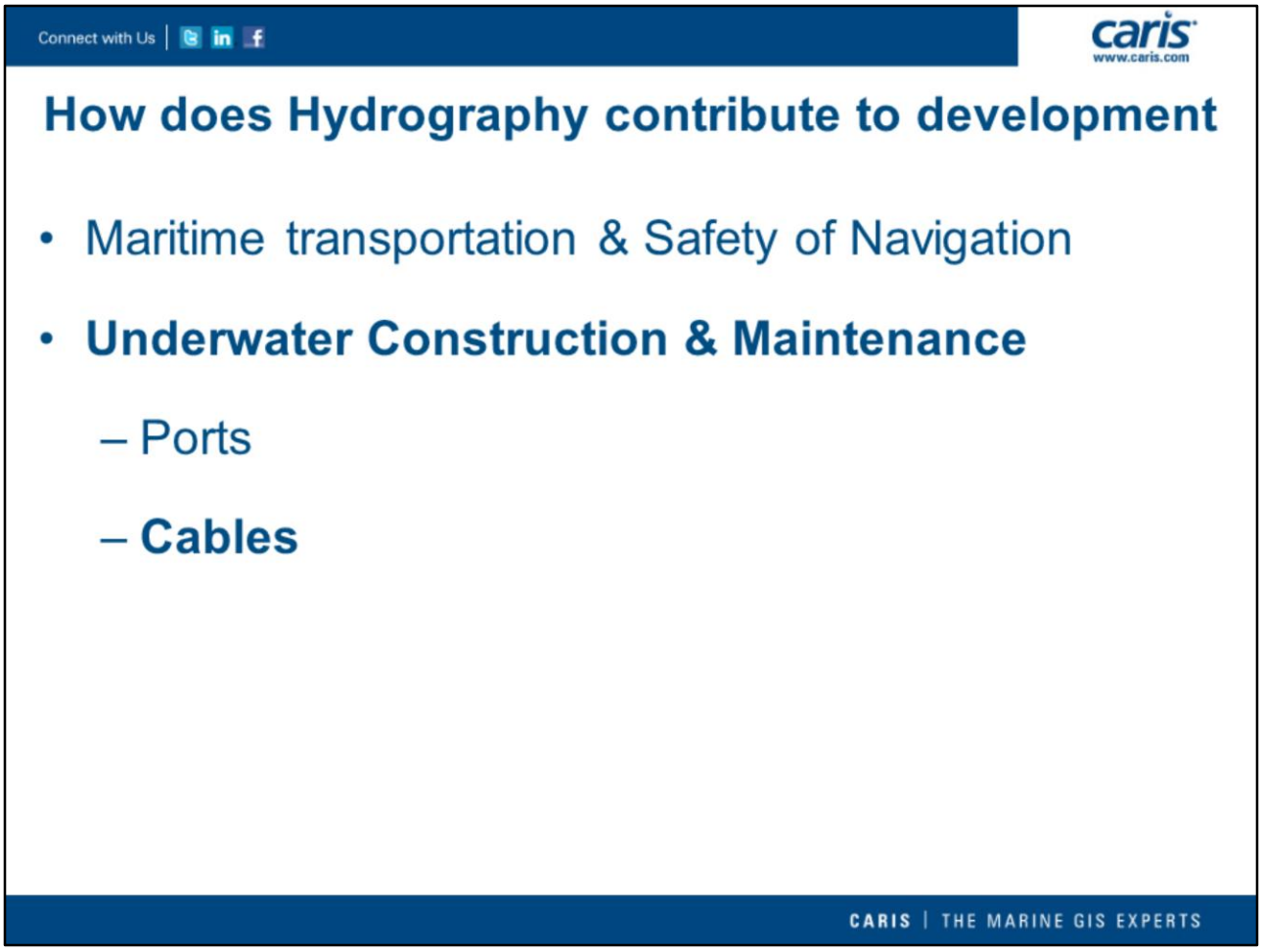
Studies have shown for example that one of the main barriers to economic growth is the lack of adequate port facilities and infrastructure. With a lot of trade going by sea this makes sense.

So the creation, expansion and good maintenance of ports is paramount for development.

Hydrographic surveys are needed before and during port construction.



Also after port construction maintenance surveys are needed, for example to inspect the state of quays, as is seen here, or to make an assessment of the port areas that need to be dredged. The underwater part of the quay shown here is based on data processed in CARIS HIPS and SIPS.

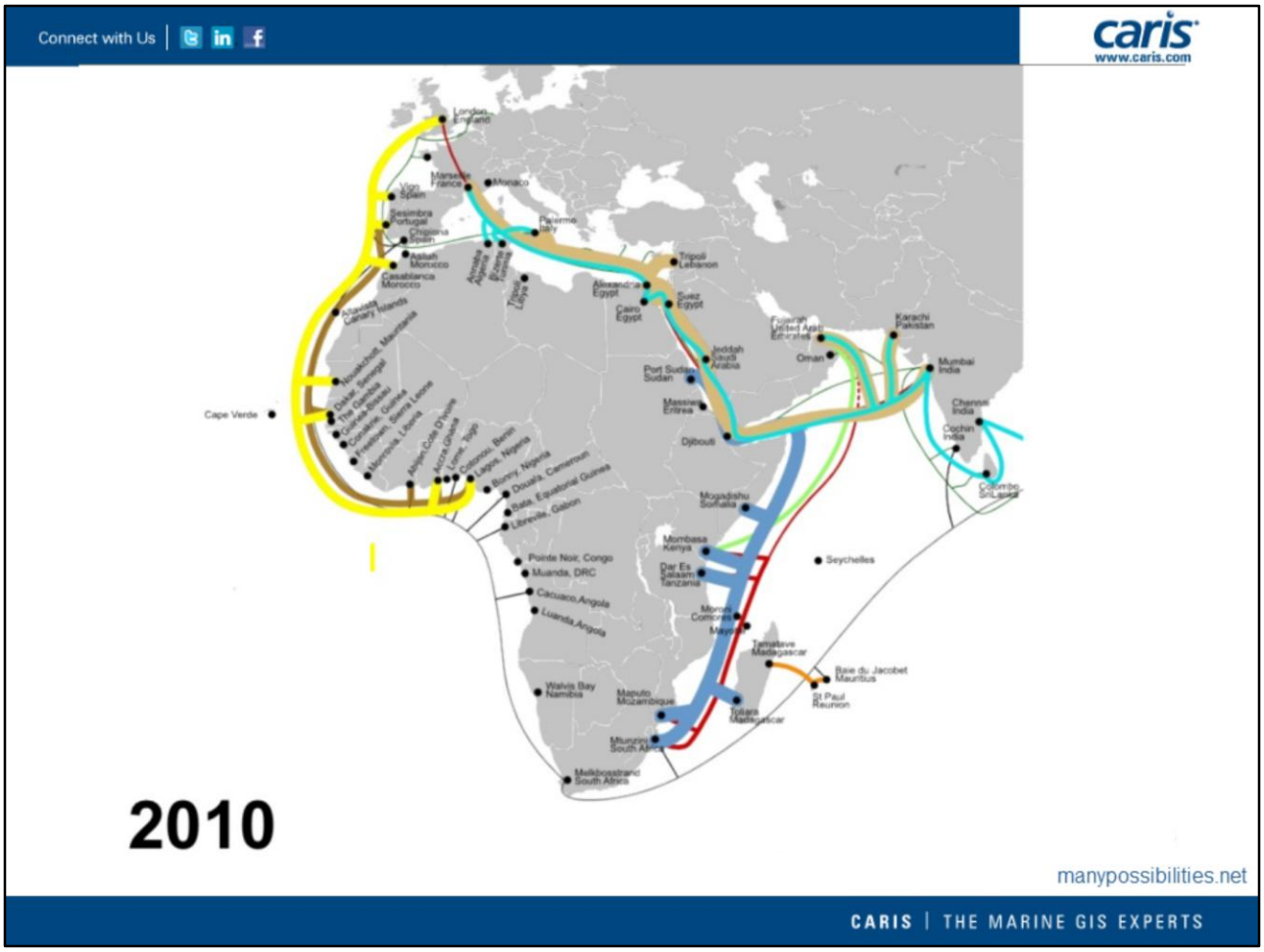


Another example of underwater construction is the laying of undersea cables.

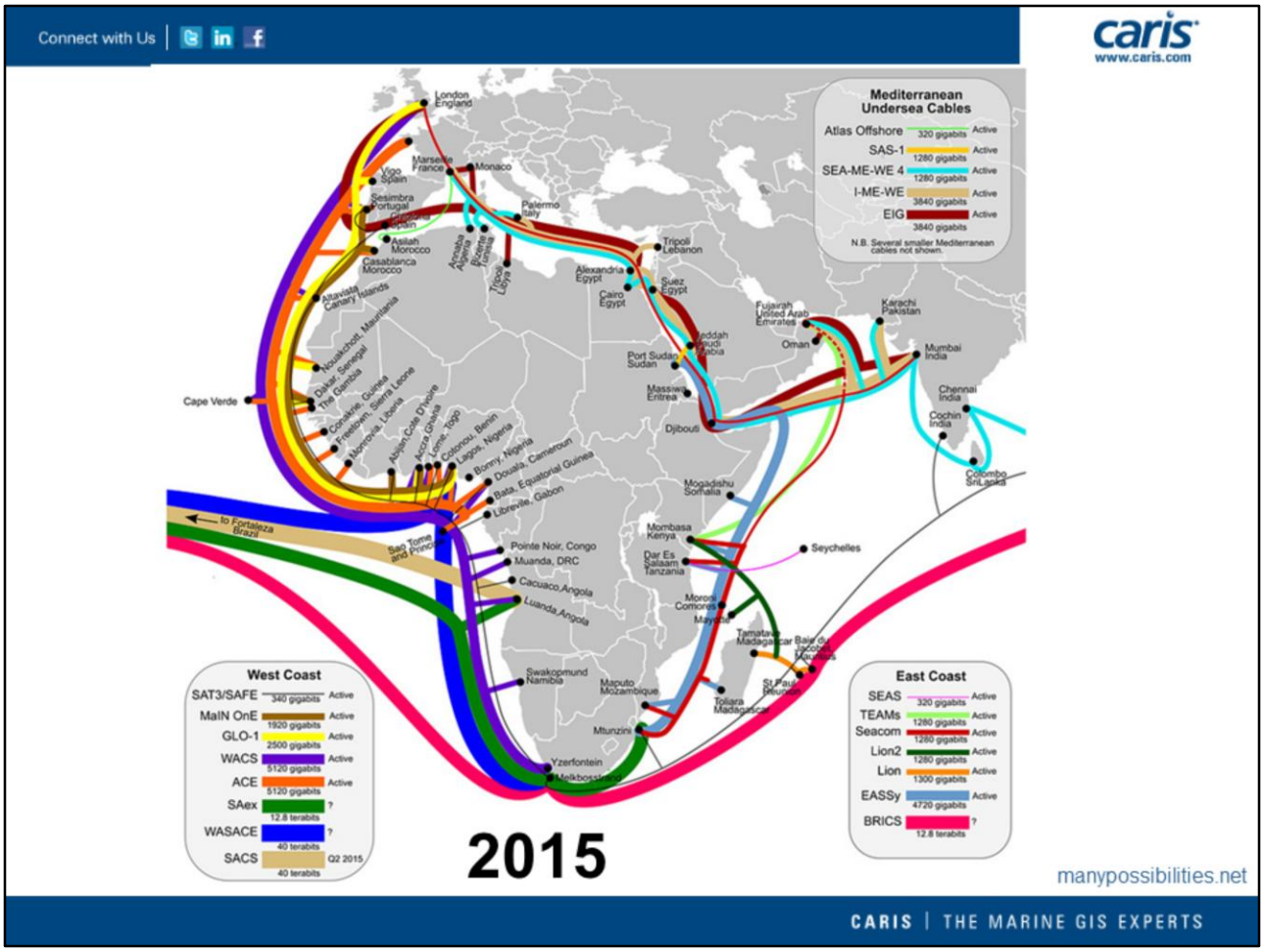
As over 95% of the world's intercontinental data and telephone traffic is passed by these cables, they are essential for global communication in our digital age.

Hydrography is critical in the selection of proper routes for undersea cables.

On this map you can see a map of Africa and the Middle East, showing undersee cables in 2005, less than 10 years ago. As can be seen there were two undersea cables, but they were of very limited bandwidth and there were no connections in East Africa.



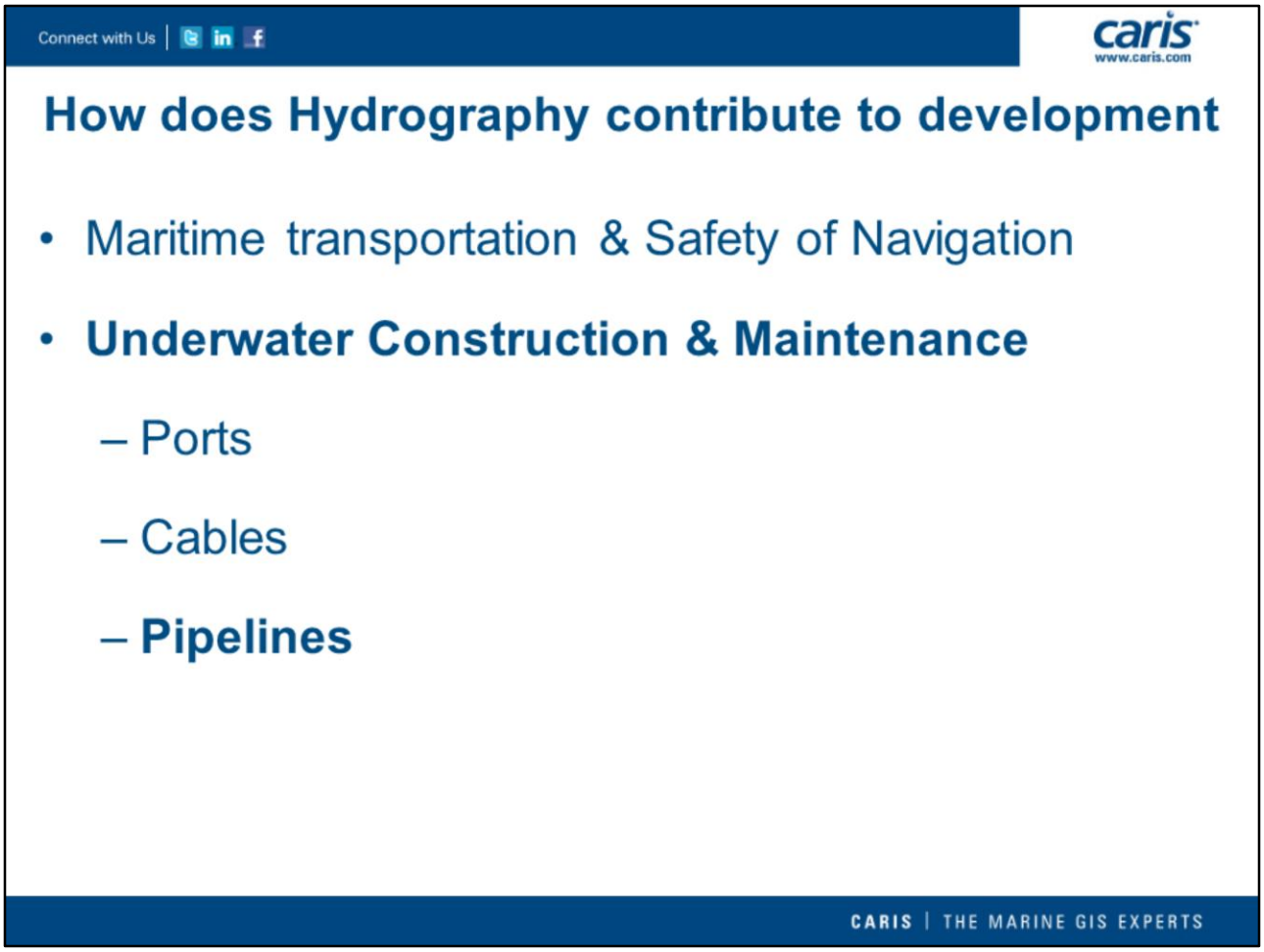
Five years later, in 2010, things changed for the better. Thanks to hydrographic surveys, more undersea cables were in place and West, North and East Africa were now connected with fast fibreoptic cables, thus allowing much greater Internet speeds.



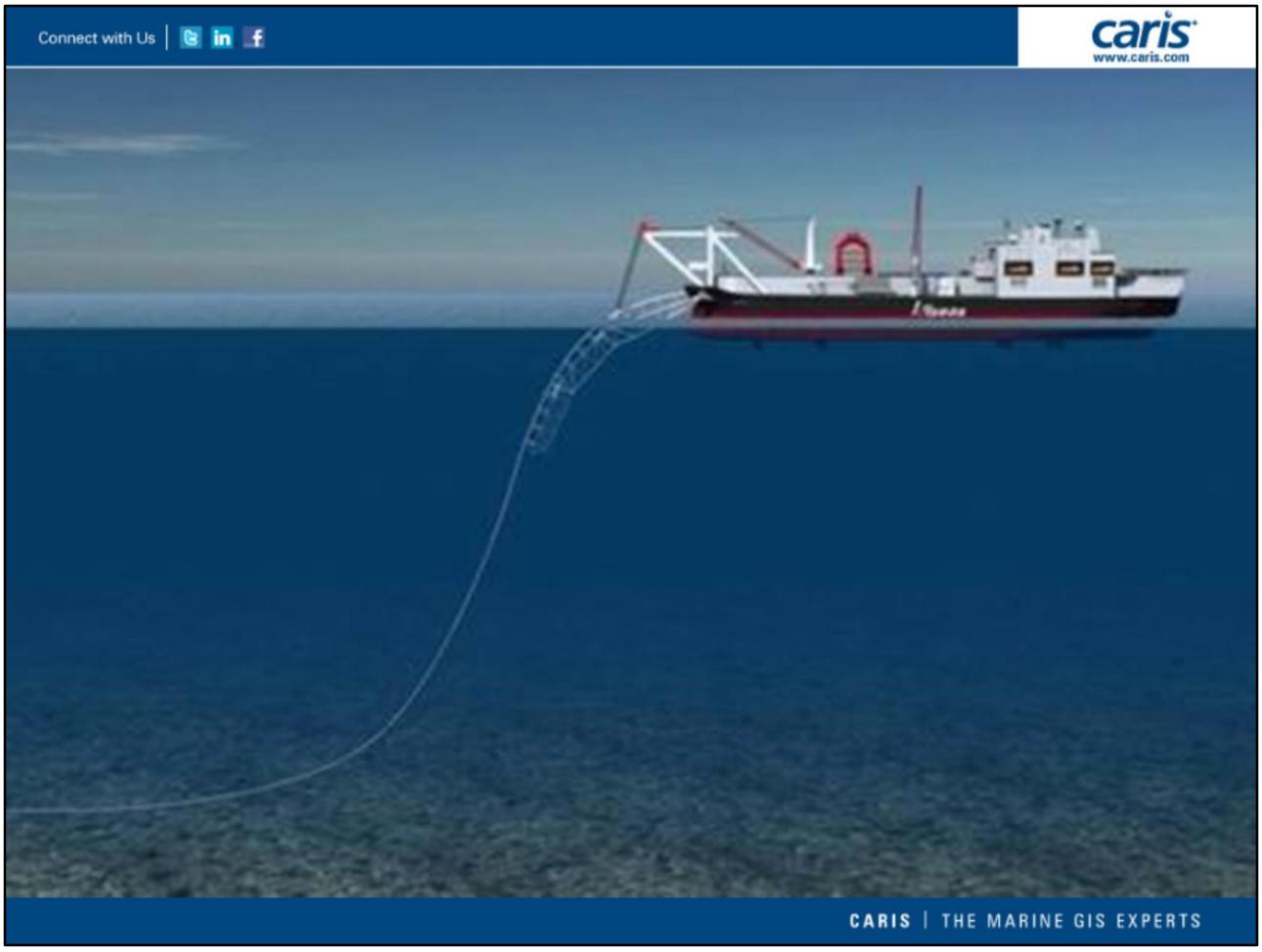
The next slide is looking at the near future, with cables planned or operational in 2015.

As can be seen the last 10 years the number of undersea cables has been exploding and Africa and the Middle East are now well connected to the rest of the world.

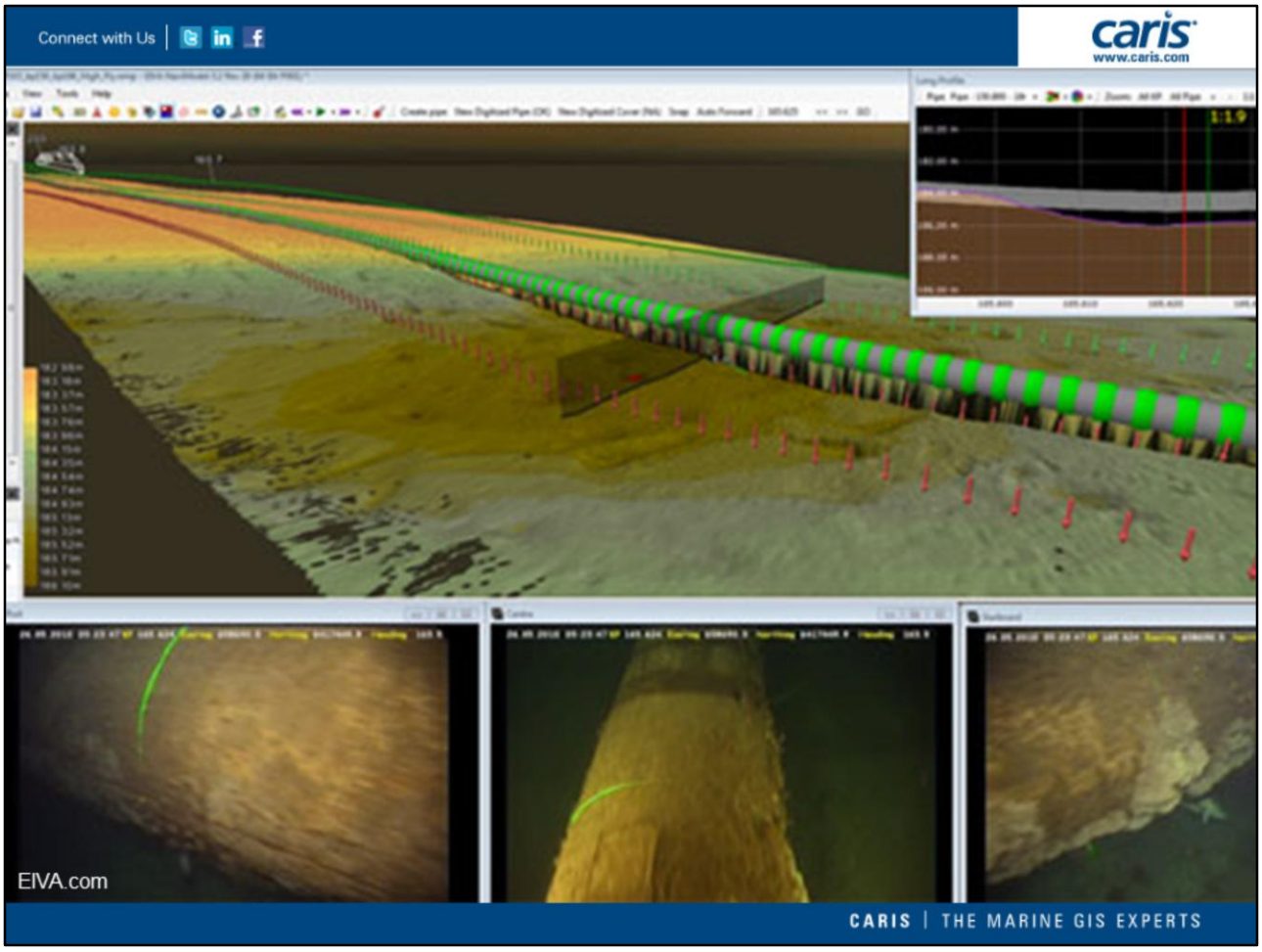
Undoubtedly these cables allowing fast internet are an important driver for economic growth and hydrography is literally at the basis of this development.



In the oil and gas industry hydrographic surveys are used to define suitable routes for pipelines as well.

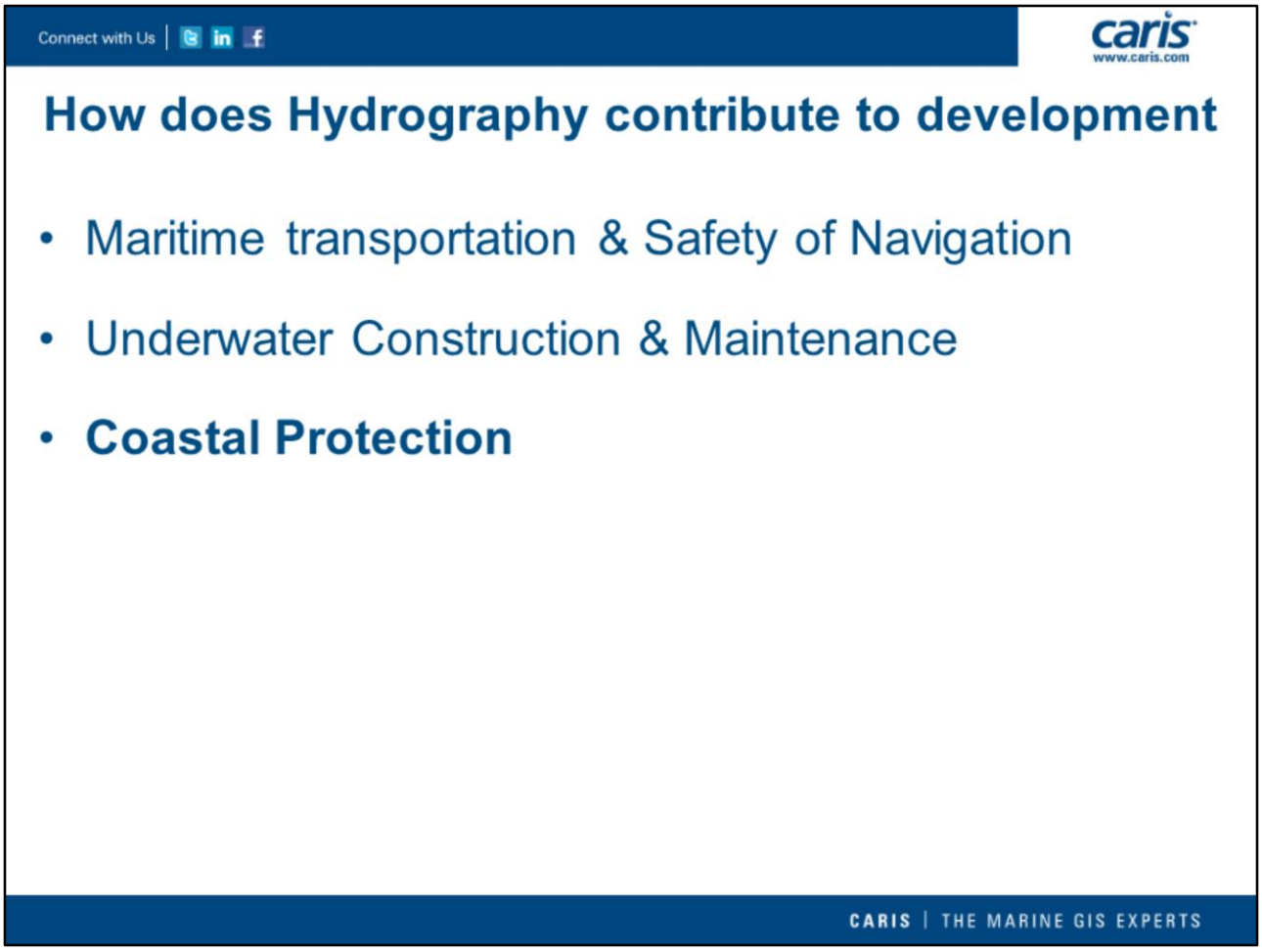


The more detailed and reliable the bathymetry of an area is mapped, the more optimised construction design and operations can be, thereby positively effecting construction safety as well as total project cost.



Once a pipeline is laid, the operator has a big interest in keeping the line in good condition, because if they don't the contents may stop flowing or even leek out.

Therefore hydrographic surveys are also needed used for pipeline inspection, as can be seen in this picture.



I would like to give a last example where hydrography contributes to development, which is protection of the coastal zone.

About 40% of the worldwide population lives within 100 kilometres from the coast, which also means there is a lot of economic activity in these regions.

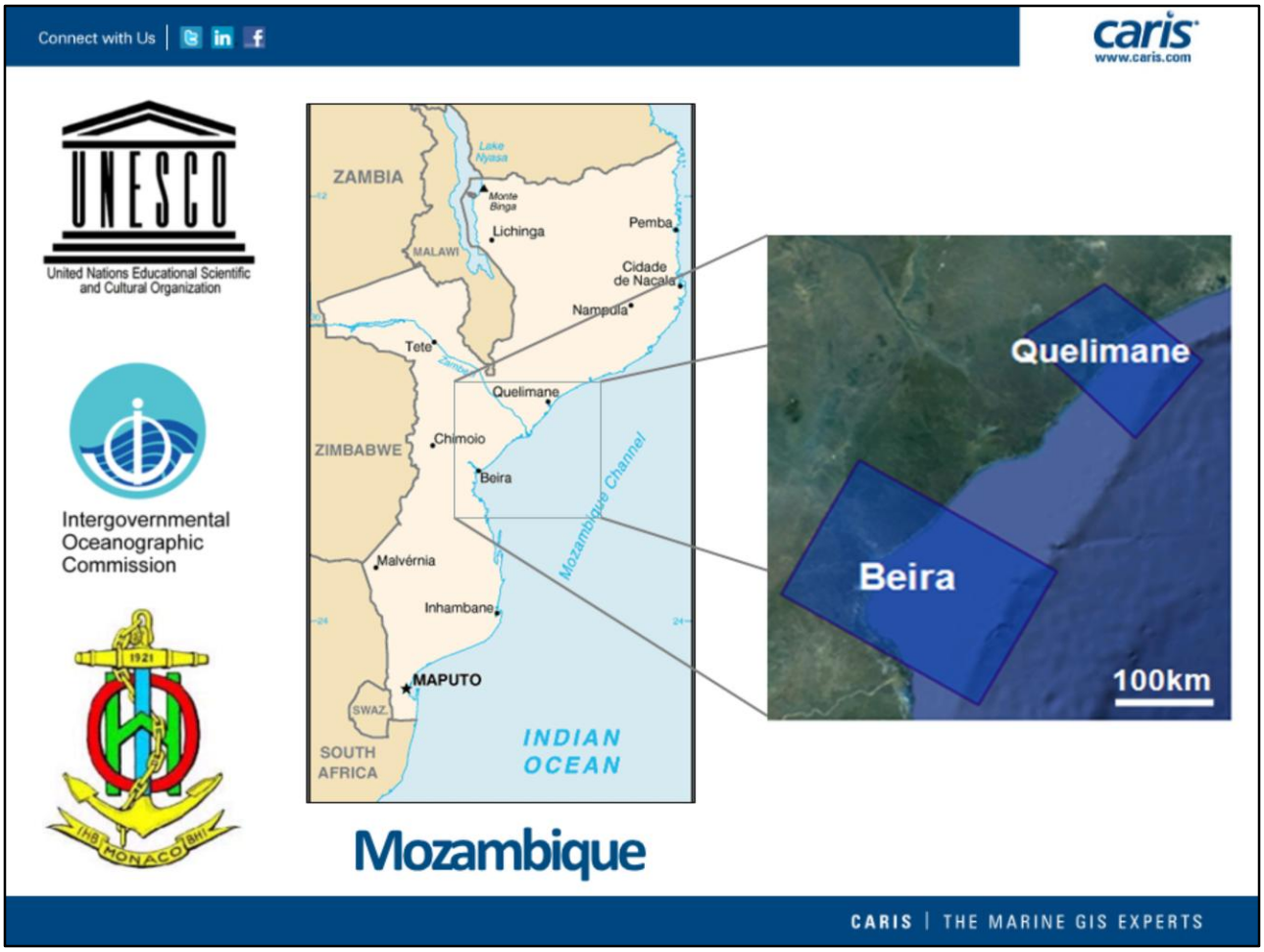
In recent years floodings caused by rivers, hurricanes, earthquakes and tsunamis have led to enormous loss of live as well as loss of valuable economic assets. I think we all have images in front of us of floodings in for example Bangladesh or New Orleans and the devastating effects of the Indian Ocean tsunami of 2004 and the one of 2011 in Japan.

To take these tsunamis as an example: there are scientific models that compute how a tsunami wave propagates after an earthquake in the sea.

How a wave develops is fully depending on the bathymetry of an area. So the better knowledge of bathymetry you have, the better the model is and the better you know what the impact zones will be.

This knowledge allows countries to assess how and where to protect coastal areas. It helps determining where to build protection against the sea or actually where to *not* build anything, to make sure people stay away from vulnerable areas.

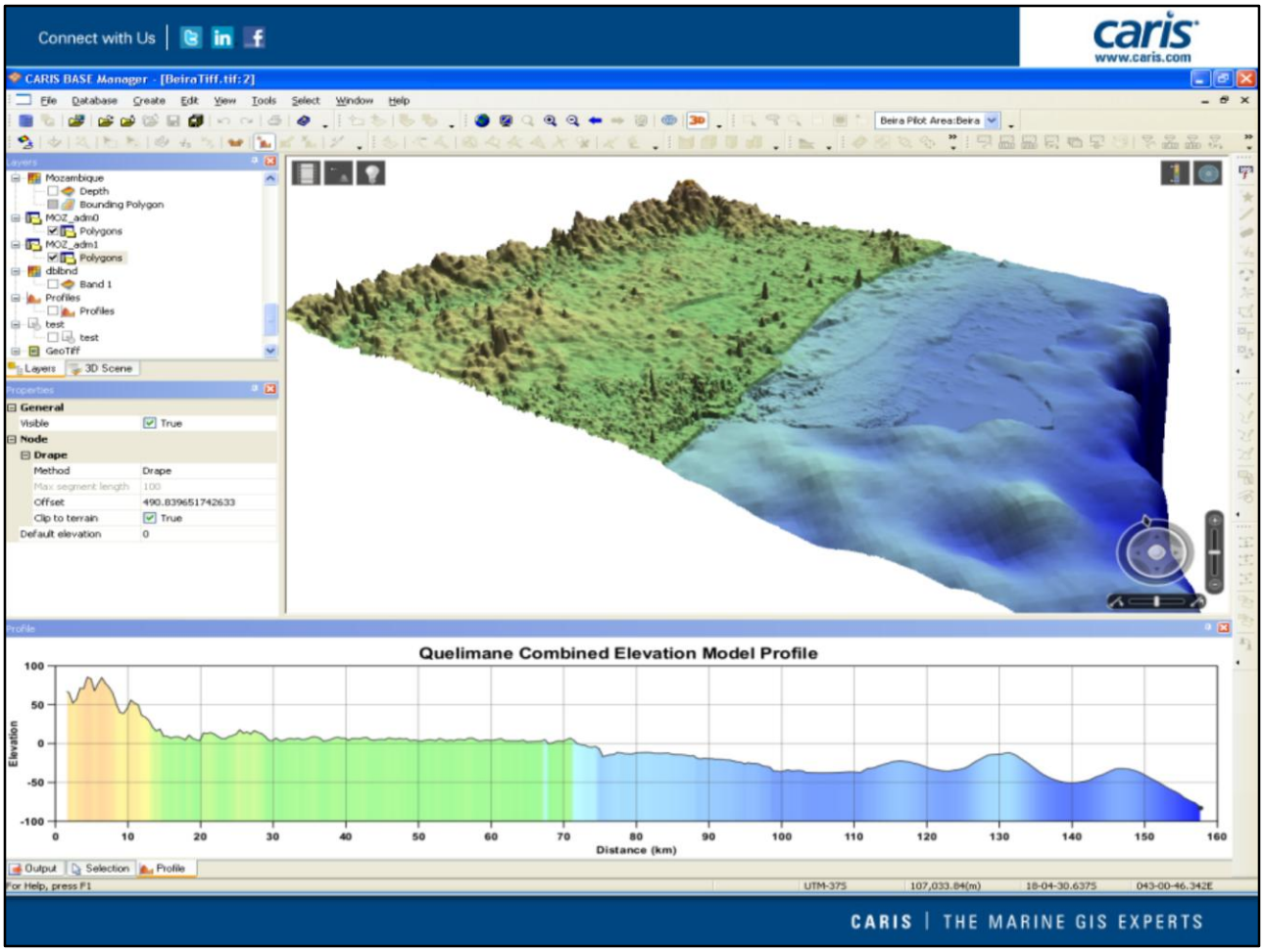
So good knowledge of bathymetry is an important basis for the protection of human lives and economic assets.



Related to this: in 2012 I was in Mozambique for CARIS to do a project together with INAHINA, the national institute of hydrography and navigation. This capacity building project was done based on recommendations of the Intergovernmental Oceanographic Commission of UNESCO, the IOC, and the IHO, to help protect the country better.

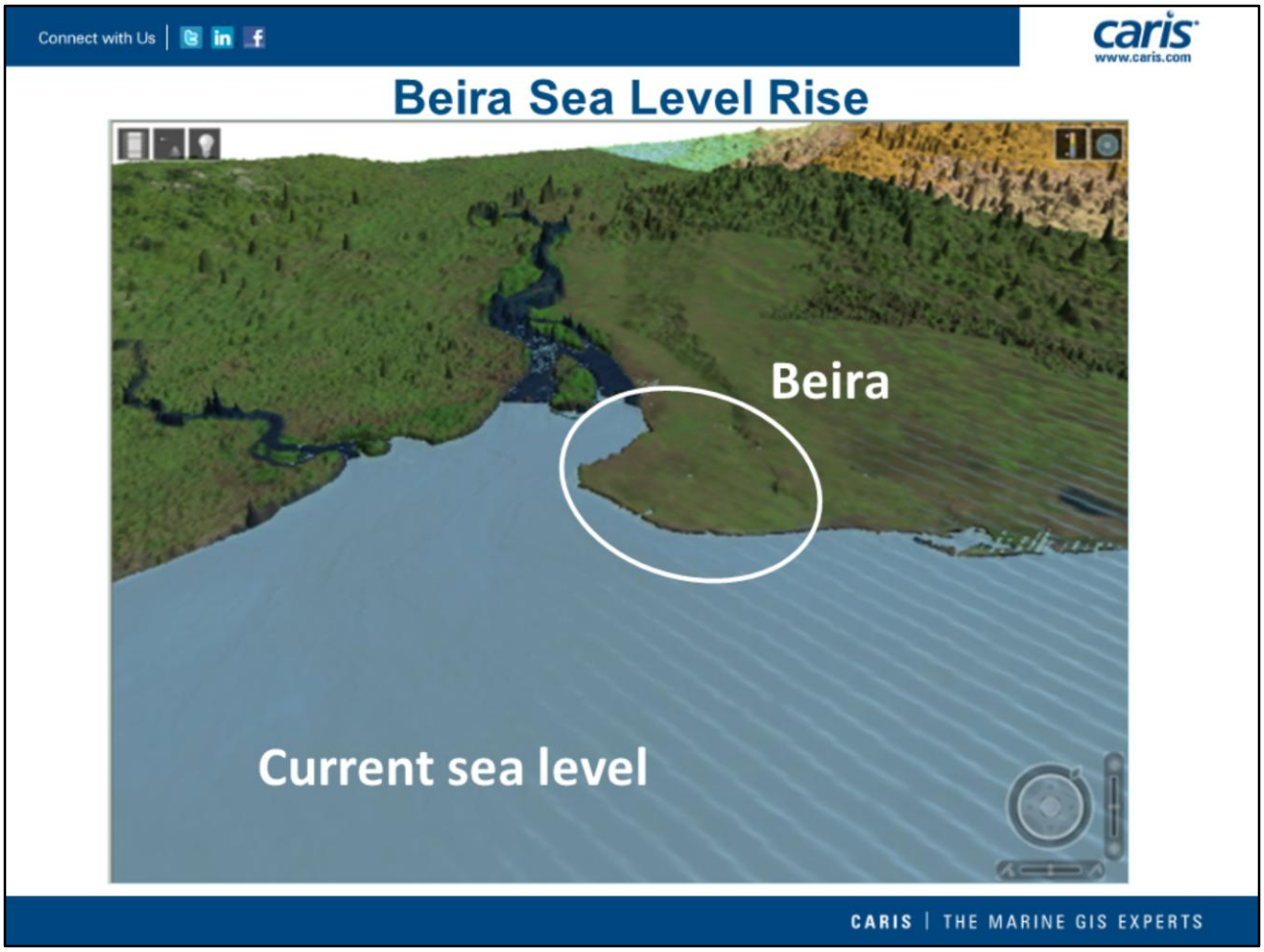
Mozambique is a country that has about 2.700 kilometres of coastline and a low lying hinterland, which is vulnerable to natural disasters. We implemented a CARIS database to store both topographic and bathymetric elevation datasets and combine them into one elevation model.

We started doing this for the **areas around the cities Beira and Quelimane**. Those are both coastal cities that are very vulnerable for flooding.



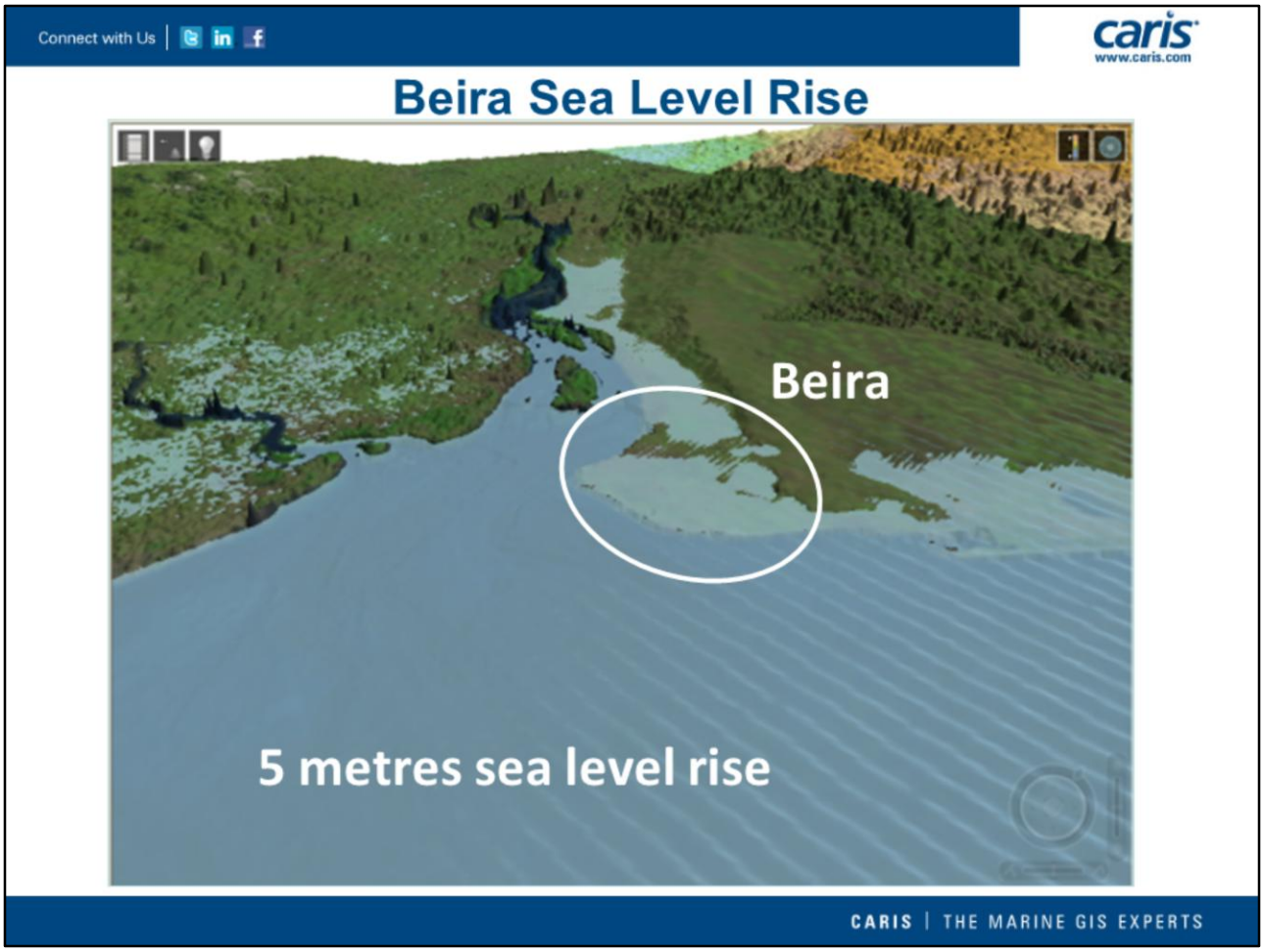
We used different sources for this so called TopoBathy database, from hydrographic surveys and land elevation data, to satellite derived land elevations and bathymetry and merged them in the database into one combined elevation model.

Here this model is shown in three dimensions within the graphical user interface of the CARIS database, together with an elevation profile.



This also allowed us to make visible what would happen in Beira if the sea level rises 5 metres, for example caused by a tsunami wave.

In this picture the current sea level is shown.



In the next picture it is shown in blue that the city of Beira would be fully under water if the sea level rises five metres.

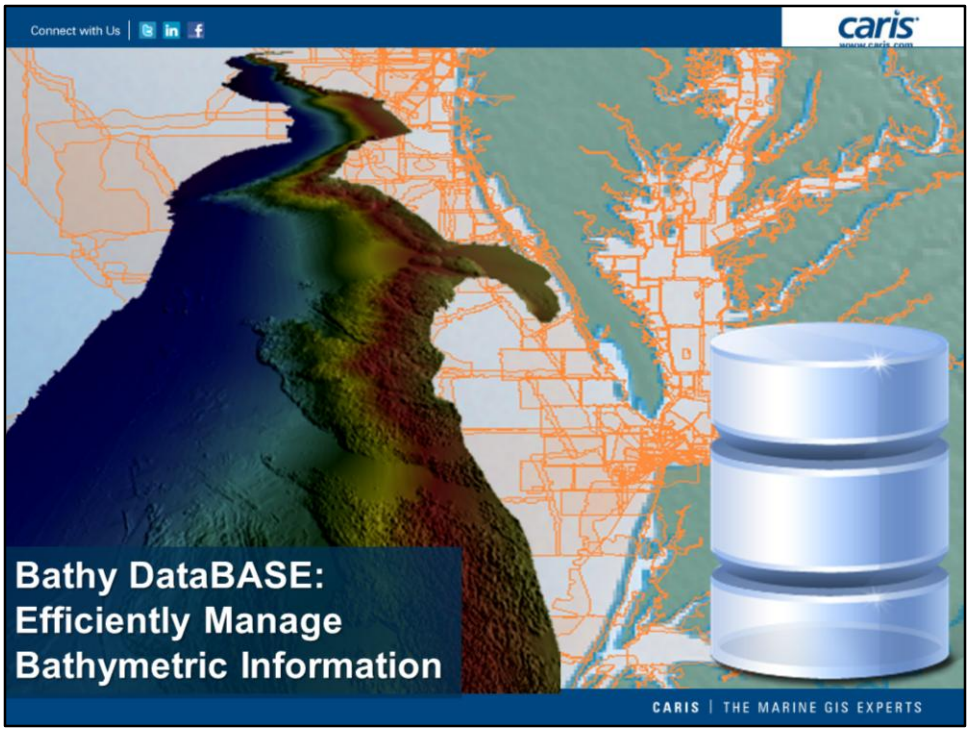
This is clearly showing that some coastal protection is needed there, which is actually something that is being worked on in Beira.

For Mozambique this database with combined elevation models can be the basis for better protection of the coastal area, as the models, maps and general knowledge based on the database can be used for tsunami wave prediction models and for further coastal protection and management.

On top of this the elevation data in the database can also be the basis for nautical charts.

This example of the database that is implemented in Mozambique brings me to an important general point that I would like to make, which is that as hydrographic surveys are expensive and as spatial data is valuable, it is important to make optimal use of the resulting information.

So I would like to continue by showing you how CARIS solutions can help your organisation to optimize the benefits that hydrography has, by efficient data management.



It used to be the case, and often still is, that the hydrographic information available in a country, is stored at different government and commercial organisations in separate digital files or even only on paper.

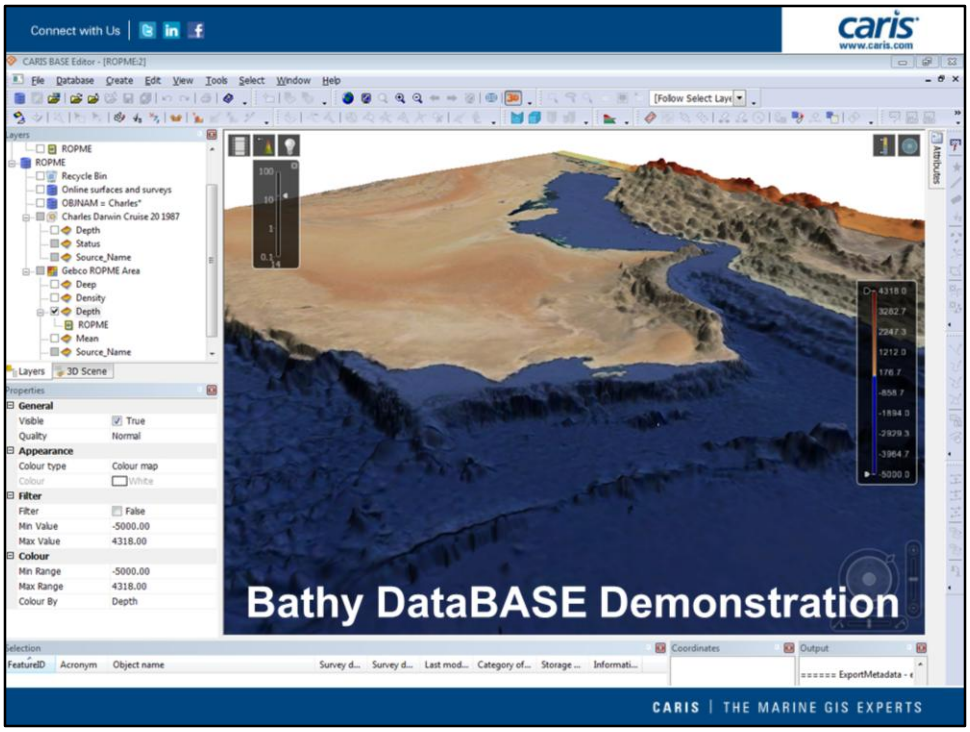
Quite often an overview of the available hydrographic information is lacking and access to it is therefore not easy. This is a waste of valuable and useful resources.

Also, specifically with the introduction of multibeam echo sounders, the volume of hydrographic data has exploded the last decades, so it becomes increasingly challenging to efficiently manage these datasets.

Based on demand for a solution for this issue, CARIS has developed the Bathy DataBASE.

This database is specifically designed to store and manage very large hydrographic datasets in one central location.

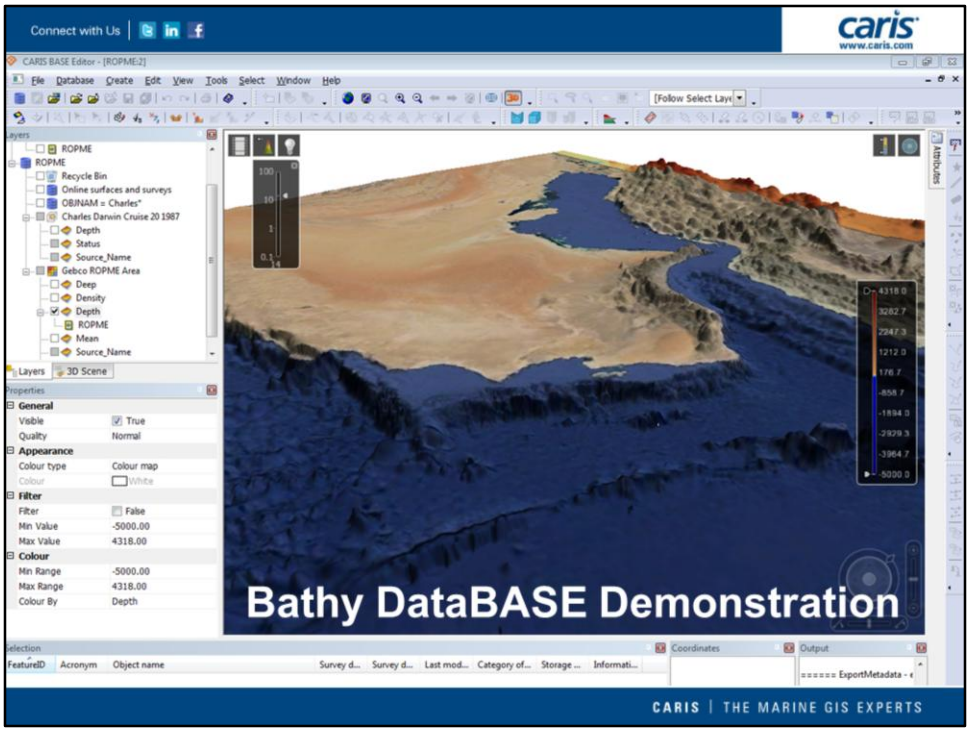
Storing all datasets in a database and attaching relevant meta information allows the survey data in the database to be queried and found back easily. So it gives a good overview of what is available and it allows optimal management of these valuable datasets.



What I would like to show you now is a short live demonstration of the CARIS Bathy DataBASE, filled with some survey data in the ROPME area, that is available on the Internet.

- I will start by showing the user interface of the Bathy DataBASE, displaying the boundaries of ROPME countries.
- Log in to the database backend, in which all the bathymetric data from your organisation will be stored in one central location. Different user roles allow you to control who has access to the data and who can view and edit it.
- Select all surfaces and look at selection window. All this data is trackline hydrographic survey data that I could download from NOAA's National Geophysical Data Centre in the USA.
- Open Charles Darwin Cruise and look at attributes. This is where all metadata is filled in.
- Show that a query can be done, to only show some data: OBJNAM is Charles*
- Open Lamont Doherty
- Open all trackline surveys. Medium point size. This gives an impression of the depth already.
- Another dataset I could download is the GEBCO dataset, the general bathymetric chart of the oceans maintained by the IHO and the IOC. This is a dataset of 30 by 30 arc seconds, meaning about one datapoint every kilometre. While the previous datasets I showed where so called point clouds, this is gridded information, showing both the depth of the sea bottom, as well as heights above sea level in a regular grid.
- When I show this in 3D you see nicely visualized the whole ROPME area and see that the whole Gulf is quite shallow. It only gets deeper in the Gulf of Oman and into the Arabian sea.
- I can overlay images as well, so for example I can overlay a Google Earth picture, that I

georeferenced, which is showing a nice picture of the area.



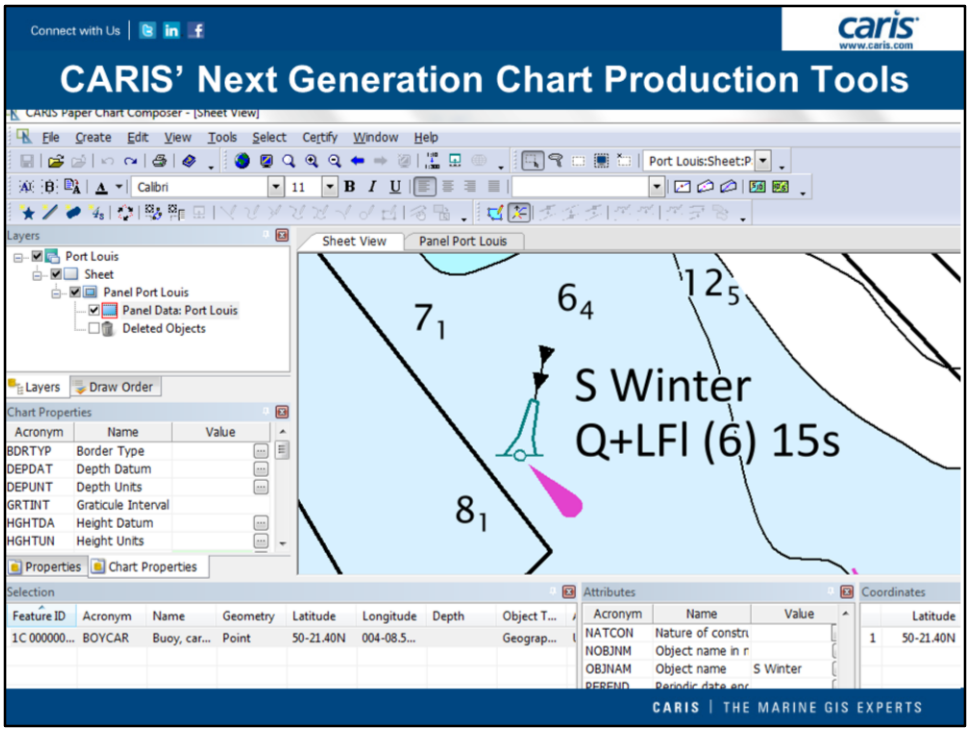
My point in giving you this quick demonstration of the CARIS Bathy DataBASE is that it gives you **full control** over your data: it allows you to store all your elevation data holdings in one central database location, so you can easily make backups and it allows you to decide who has acces to it using different user roles

The CARIS Bathy DataBASE allows you to add all required metadata to each dataset, which in turn enables searching for specific datasets.

As we have seen, you can easily visualize them in 2D or 3D, which gives you a good overview over and insight in the bathymetric data that you have.

All the elevation data can of course be exported as well, to other grid formats, like for example to the the new IHO S-102 format, which some hydrographic offices like GCS are already using. So sharing of the information is easy too.

What many hydrographic organisations do with this gridded elevation data is to convert it to vector object information, being soundings, depth contours, areas, as well as metadata, usually in S-57 format (and in the future in S-101). This is to be able to create nautical charts later.



To do this CARIS offers the standalone file based paper chart and S-57 Composer and our full database solution the Hydrographic Production Database or HPD.

I think I can say that we have the most modern solution on the market for the creation of nautical charts, with sophisticated digitizing and object creation tools as well as an intuitive user interface and they are used by most hydrographic offices worldwide.

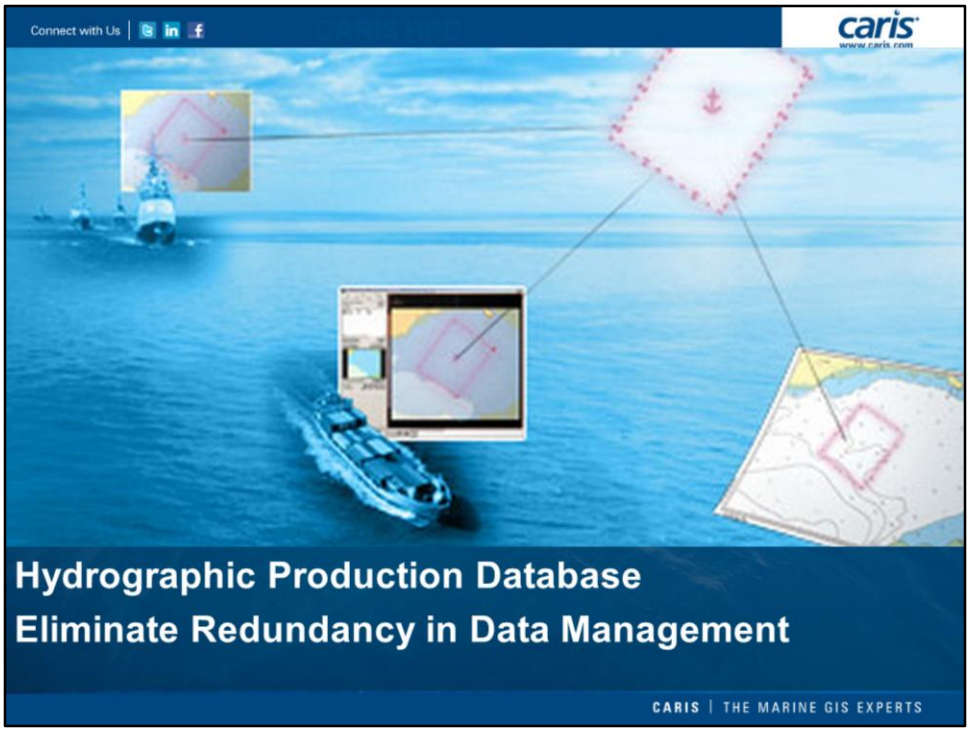
All editing is done based on an S-57 object oriented design and data from a wide range of GIS sources can be opened and integrated.

There are many advanced quality control tools incorporated in the software to easily create high quality paper and electronic charts.

It is maybe important to mention here that all these chart production solutions are positioned to adopt the new S-100 product specifications once they are finalized by the IHO.

As I said we have different chart production tools available, as there is both a desktop and a database enterprise solution to cater for different needs.

For organisations that have a smaller product portfolio and a limited IT infrastructure it might be better to at least start with our desktop solutions.



However, there are two main advantages of the HPD database approach: one is the ‘one feature, multiple product approach’ and the other is much better data management.

To start with data management: like with Bathy Database, storing data in a database environment allows better data security and backup.

Another data management advantage is that in HPD there is full user and project management , so that all changes to the S-57 objects are done by specific users, within specific projects.

On top of that a full history is maintained, so you can always see what happened to a specific buoy in the past and for what reason.

As hydrographic offices are usually legally responsible for the information that is shown in the chart, having the tools to exactly know where that information comes from is a great asset.

The other big advantage of using HPD comes into play when multiple products are created from the same source. A specific buoy can reappear on different scale paper charts of the same area, as well as on the ENC equivalents.

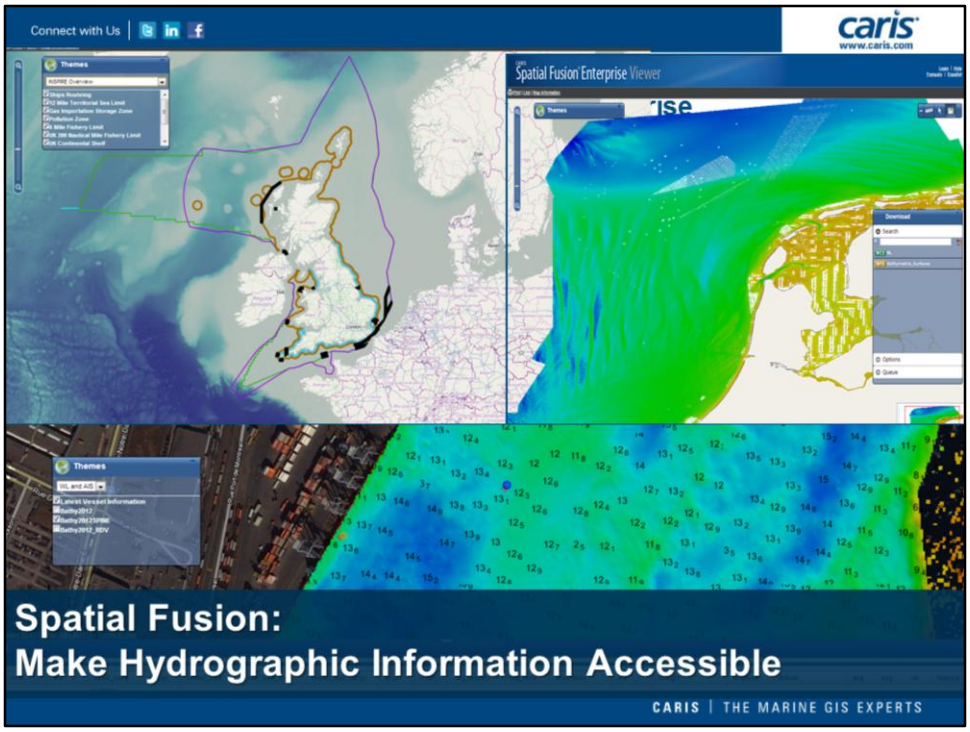
It used to be the case that when this buoy was moved this change had to be executed by cartographers in each different source file.

However, the advantage with HPD is that you have one source database where the change is done and this is reflected on all different paper and electronic chart products where this buoy appears.

This is not only saving the cartographers time, there is also less risk that a mistake is made, as the action only needs to be executed once.

CARIS has developed HPD in cooperation with several hydrographic offices around the world and more and more of them are implementing the solution, like for example the UKHO and SHOM who are both represented here, as it’s the best way to manage hydrographic object

information in a safe and efficient way.



Next to good management of hydrographic information, another important factor is the accessibility of it, both internally within an organisation, but also between government organisations or even externally to the general public.

Making hydrographic information available for general use has the advantage that the same survey information can be re-used, potentially for a whole other purpose.

In many cases a hydrographic survey that has been done for one reason, let's say pipeline laying, can also be used to improve depth information on a nautical chart or for oceanographic research. At the same time this information can be used to update and improve bathymetric models used for coastal protection, like what is done in Mozambique.

Of course there can be commercial or military reasons not to share certain information, but thanks to technological advancements there are nowadays at least possibilities for organisations to make hydrographic information available through the internet.

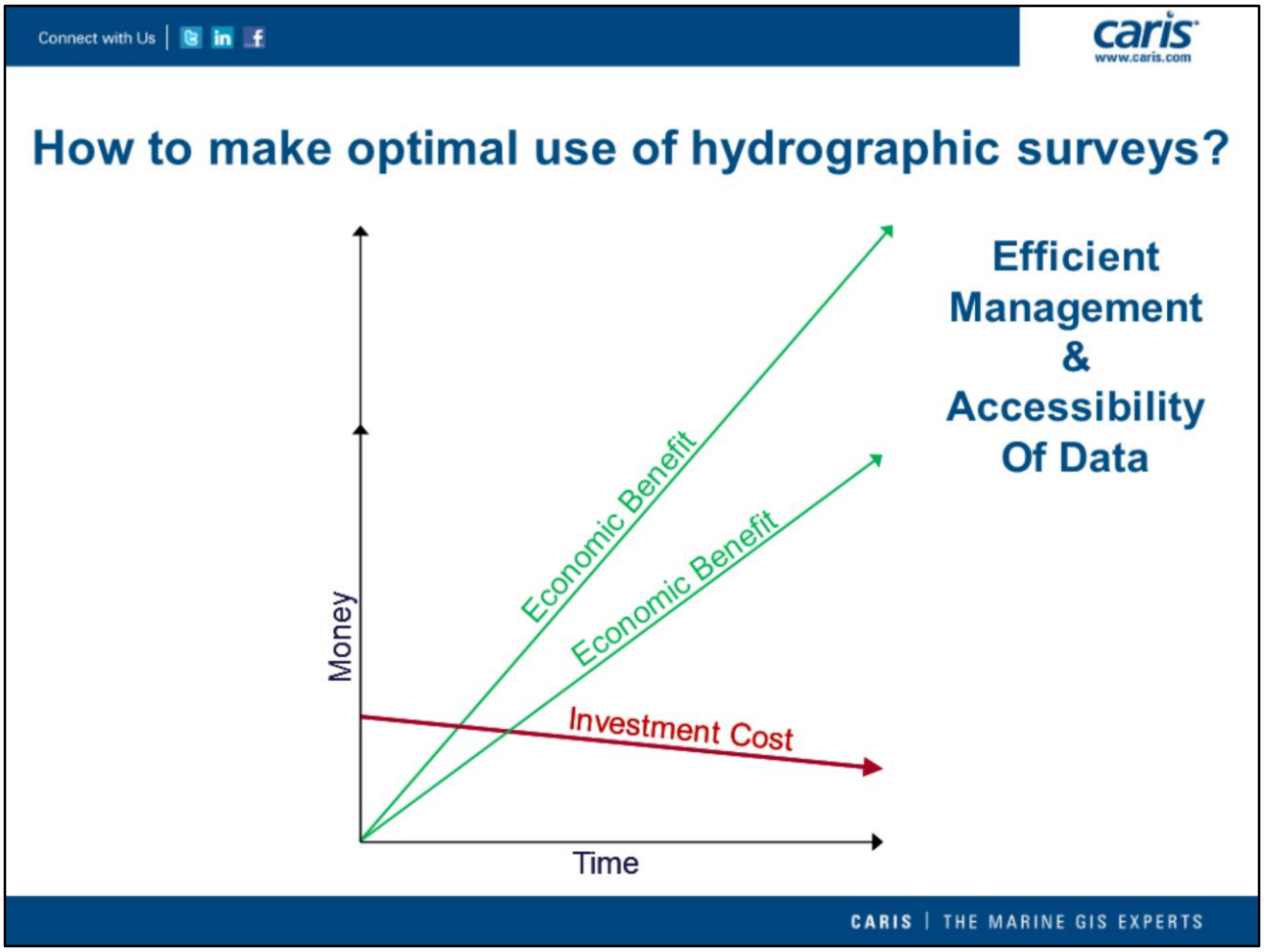
An interesting development here is that many countries are working on building a national marine spatial data infrastructure, an MSDI. Last december for example I was at the General Commission for Surveys, GCS in Saudi Arabia with my colleague Peter Schwarzberg to give an MSDI course together with OceanWise. This course is all about the management and sharing of spatial information.

To enable the sharing of spatial information CARIS has developed Spatial Fusion which is serving spatial data according to standards of the Open Geospatial Consortium, the OGC.

In practice this means for example that if an hydrographic office is working with CARIS Bathy DataBASE and HPD, or any type of spatial data for that matter, they can easily share their data holdings directly through the Spatial Fusion webserver, using the widely used OGC standards, so that for example a land based topographic office is able to see the same data in an ESRI application. Also here the organisation has full control over which data is shared and who can access it.

In the pictures on this slide two example websites are shown from the United Kingdom and The Netherlands hydrographic offices, that recently started to make hydrographic information available for download.

So potentially all hydrographic survey information that has ever been gathered can be stored in databases and that data can be made accessible to everybody that wants to make use of it, for any reason.



Coming back to the schematic graph I showed in the beginning of my presentation: this is a way to **increase the multiplier** of investing in hydrography, so that the same investment contributes even more to the economic development.

With this presentation I therefore hope to have shown convincingly that hydrography is contributing a lot to the economic development of a country and that investment in hydrography is therefore well worth it, specifically if the resulting hydrographic survey data is managed well and is made accessible for re-use.

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One last thing I would like to mention, before I give the floor to the next speaker, is that we have our CARIS conference in France this year, from the 2nd until the 5th of June. Our conference theme is 'developing the blue economy'.

There will be user group meetings for users of HIPS and SIPS, Bathy DataBASE and HPD. At these meetings users can discuss the use of the software and drive the direction of future developments.

There will also be a boot camp where you can learn about S-100, the new IHO universal hydrographic data model, which CARIS is busy implementing, and a boot camp about the latest developments in CARIS HIPS and SIPS.

Of course there is also a conference where users present their work and where you can share experiences. Actually we still accept abstracts for presentations, so if you're interested in coming and also giving a presentation please let me know!

So I hope to see you again in France in June and I would like to thank you very much for listening to my presentation!