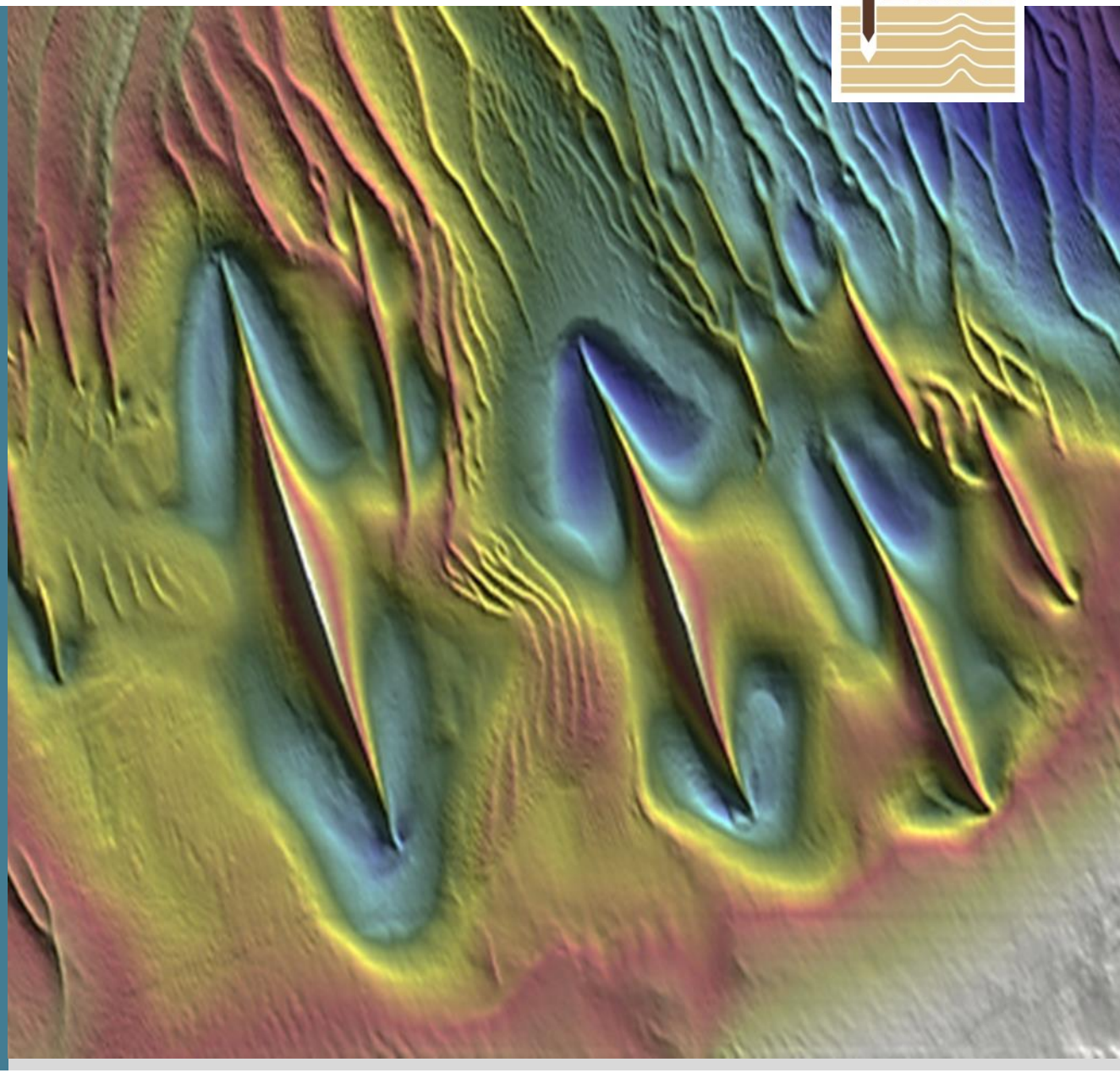
THE CHALLENGES OF A LARGE-AREA BATHYMETRIC SURVEY

32th NORTH SEA HYDROGRAPHIC COMMISSION MEETING

Dublin, 22 June 2016

Agenda:

- Introduction
- Tender
- Project Planning
- Survey
- Processing
- Delivery
- Conclusion



Introduction

“We know less of the oceans at our feet, where we came from, than we do of the sky above our heads”

(US President John F. Kennedy, 1963)

“There are higher resolution maps of the Moon and Mars than most of the world’s sea and ocean areas”

(IHO 2013)

Introduction

Different hydrographic survey campaigns tendered out by national hydrographic agencies and other governmental institutions, energy providers and exploration and exploitation companies usually fall into one of the following categories:

- Safety of navigation

  "... that hydrographic surveying is carried out, as far as possible, adequate to the requirements of safe navigation" SOLAS

- Strategic environmental assessments

  "to increase the coverage of hydrographic information on a global basis, especially in areas of international navigation and ports and where there are vulnerable or protected marine areas".

The overarching goal is the development of successful and environmentally sustainable human activities in the seas and oceans as part of: **The Blue Economy.**

Introduction

Common to all these hydrographic survey projects are survey specifications in compliance with (or even exceeding) the Standards for Hydrographic Surveys of the IHO (IHO 2008).

Often the time frame for the execution of the survey and the range of water depths in the survey areas demand the deployment of multiple survey sensors. Either the combination of MBES and ALB systems, or several of either sensor may be deployed at the same time in one field campaign.

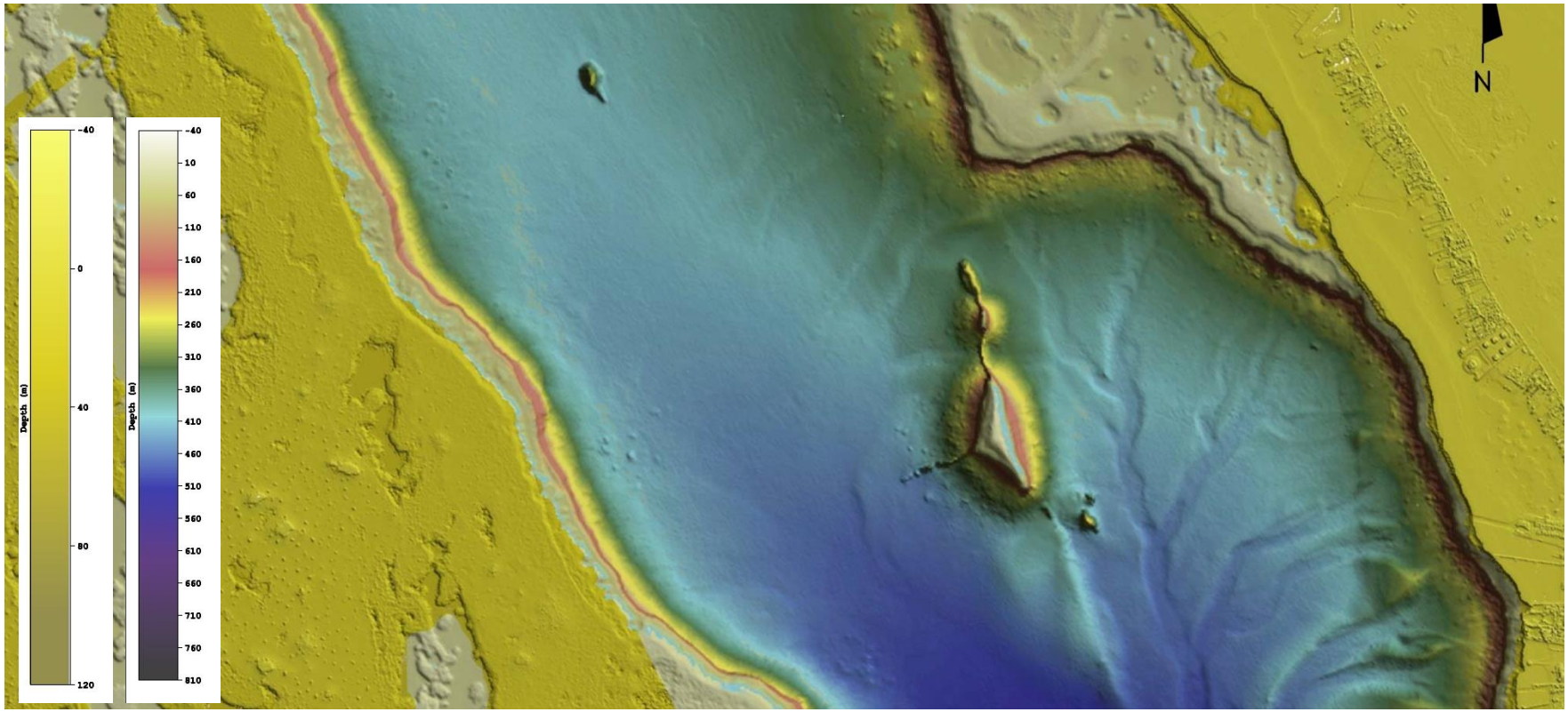
<u>This framework of requirements is quite demanding for the planning, execution and control of this type of hydrographic survey project.</u>

Airborne Lidar Bathymetry aircraft

MV Fugro Helmert

Tender Phase

The most important – and sometimes most challenging – task is to obtain reliable information about the distribution of water depths in the survey area in order to calculate a realistic length (survey kilometers) to cover the survey area with the quoted MBES or ALB system(s) according to the specifications.



Tender Phase

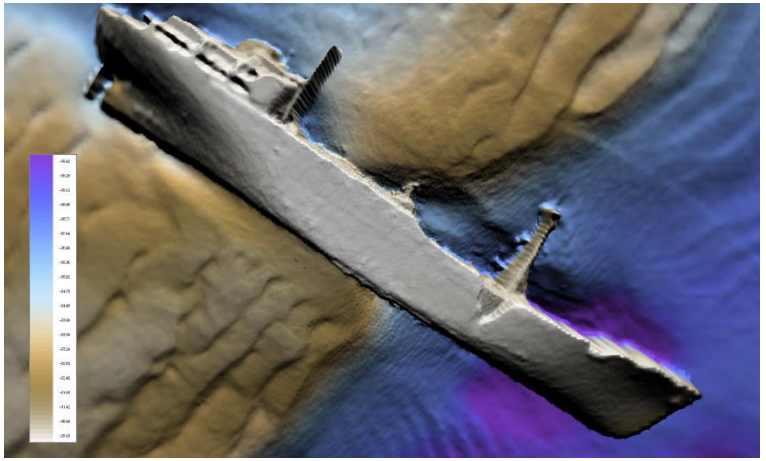
Potential sources of bathymetric information of the seabed are:

- Nautical charts (although even the latest revision can be based on old data);
- free or commercial data sets (e.g. GEBCO, ETOPO for global coverage) based on ship depth soundings and satellite-derived gravity data.

Aerial photographs and satellite images can serve to assess the distribution of shallow water areas and map potential shoals, which pose a risk to navigation and are specifically important for an estimate of the coverage that can be achieved by ALB.

The resulting number of survey line-kilometres and the survey duration, together with the survey specifications, are the basis for estimating the data storage equirements for the vessels and the processing centre. The provision of suitable data storage facilities can contribute significantly to the infrastructure costs of a project.

The wreck of the MV »Höegh Aigrette« depicted by multibeam bathymetry data.



Tender Phase

Other information relevant for compiling a tender for a hydrographic survey in a specific area are:

- the weather and climate conditions;
- oceanographic restrictions (the current and wave climate, the formation of distinct thermohaline layers and strong turbidity in the water column);
- the legal framework for vessel operations in territorial waters;
- operational costs for vessels (permitting costs, port and harbor fees, bunker costs, travel and visa costs for the vessel and survey crew, etc).

For surveys with a longer duration:

- repair and shipyard facilities

in-country processing of all data (or when in-country processing offers an operational advantage), local facilities and staff accommodation costs can contribute significantly to the overall operational expenditure.

Project Planning Phase

A complete project planning shall include:

- The permitting application procedures;
- The line plan;
- The identification of potential risks to navigation (uncharted shoals);
- Personnel planning (key people, qualified people, Category A surveyors, Visa, working restriction);
- Data Management;
- Tide method to be applied (covering seasonal changes, tide gauges, tide watches);
- Vessel / Aircraft mobilization.

Survey Phase

Safety is the utmost priority during survey operations and it will verify the efficiency of planning.

For efficient management of the operation the survey teams on board the vessels and aircraft should make sure that:

- the survey data they acquire are of the required quality and cover the specified area;
- no gaps are left within the designated survey area, and within the capabilities of vessel and equipment;
- other vessels and aircraft operating in the same or neighboring areas receive the information necessary to operate safely, avoid excessive overlaps and close all gaps left by other survey platforms because of limitations in their capabilities.

A great deal of background management is required, both in the head office and on board, to ensure the data flow between the survey platforms and the processing centers and to ascertain the availability of qualified personnel on board.

The most efficient way to cover areas in a multi-sensor survey operation is usually developed in close cooperation between the project manager, the party chief(s), the chief surveyor(s) and the processing and reporting manager.

Processing

Important steps in the processing procedure are:

- the filtering and editing of data;
- the integration and merging of data from different platforms and sensors;
- the tidal correction of the final edited data set;
- the shift of bathymetric data to the required datum,
- the systematic check of the data set with regard to compliance with the specifications and finally
- the creation of the deliverables.

On-board processing – which is only possible on larger vessels – happens much closer to data acquisition and therefore identifies issues (such as technical problems, too much or insufficient overlap, or even gaps) much sooner than land-based processing can. On-board processing can also easily take advantage of 24-hour processing to achieve more efficiency and faster processing progress.

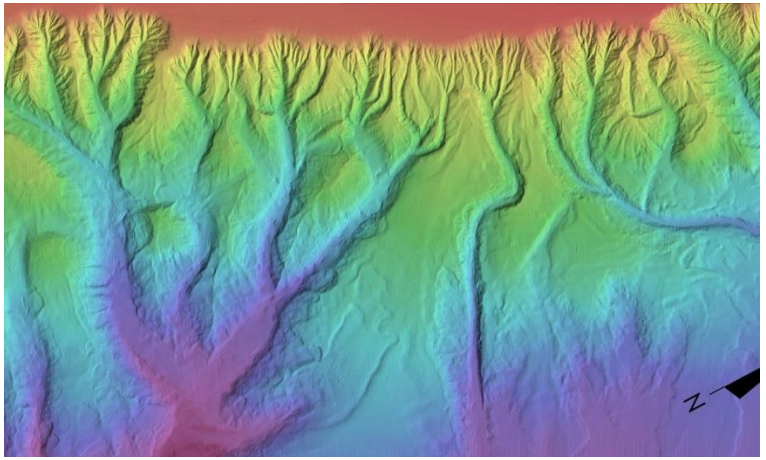
For large survey projects the data processing ideally is supervised by a dedicated data manager dealing with structuring and apportioning data for the editing, merging and QC process.

Delivery

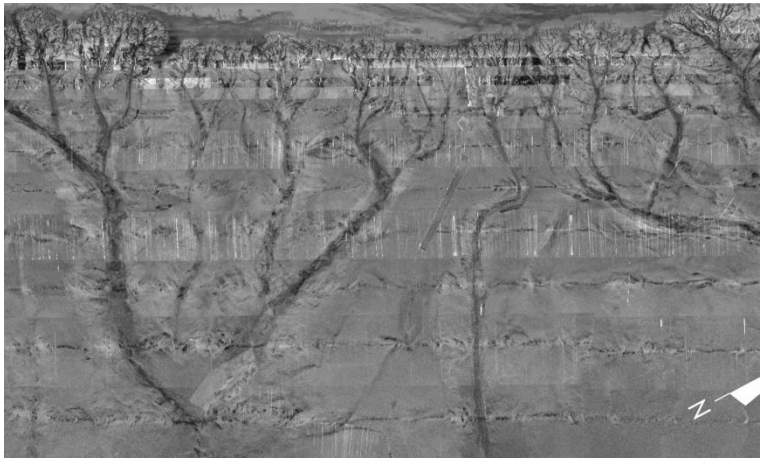
The creation of the specified deliverables is the last step in the project. Deliverables are created based on the final processed data.

The delivery of the final bathymetric product ranges from ASCII grids of specific resolutions to full delivery of the processing software file structure including raw data.

Often the list of deliverables comprises data which are not directly of hydrographic nature but can be derived from the MBES or ALB data set, e.g. maps or geotiff files of the MBES backscatter.



multibeam bathymetry data



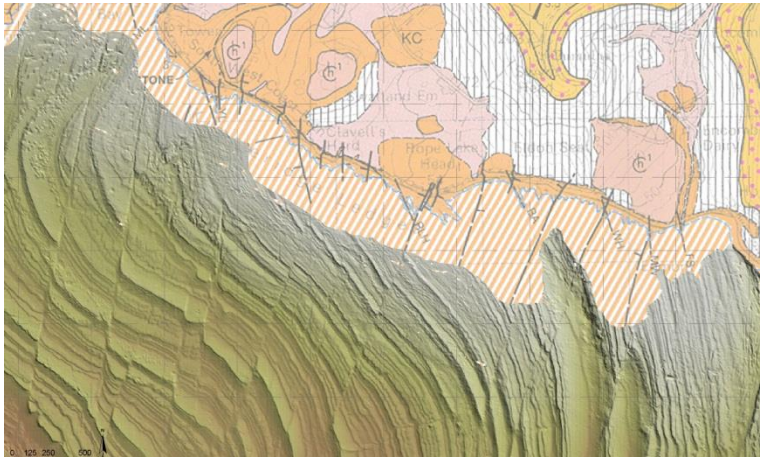
backscatter data from a continental slope with a dendritic channel system.

Delivery

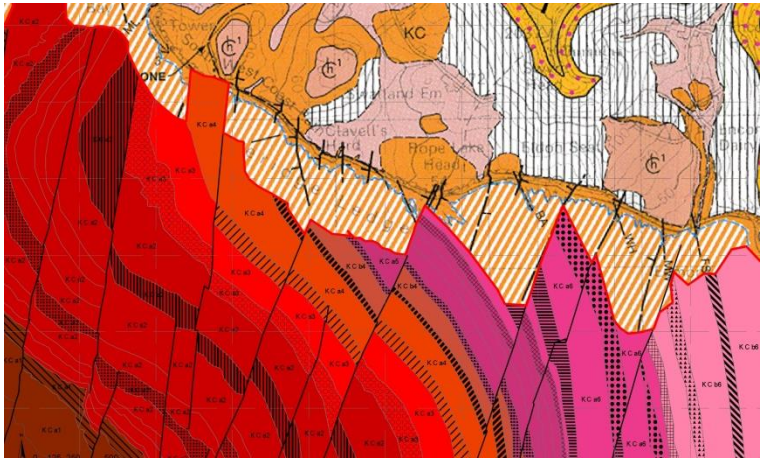
Often this information is used in addition to the bathymetry to conduct initial habitat mapping and undertake the planning for a dedicated habitat survey and sampling campaign.

A rapidly increasing demand exists for GIS compatible deliverables from hydrographic and bathymetric surveys.

This is regarded as a result of the same hydrographic and bathymetric data being used for several different purposes at the same time.



Bathymetric coastal data shown on top of a geological map



geological map of the seabed

Conclusion

Generally speaking the request for hydrographic and bathymetric data increases with an increasing use of the oceans, further powered by the demands of The Blue Economy.

Hydrographic and bathymetric surveys can provide the coverage of large areas within fairly short timeframes. The challenges of such surveys need to be managed in a suitable way especially when multiple survey platforms (vessels, aircraft, launches) and multiple sensor types (MBES, ALB) contribute to data acquisition.

Identifying the main challenges at the different stages of the projects – the tender, planning, survey, processing and delivery phases – and managing their completion in accordance with the available resources and contractual requirements is key to success.

The current survey status of the world's oceans leaves ample room for many more large area hydrographic and bathymetric survey campaigns.

Big Data will continue to play an essential role in these campaigns.

THANK YOU

m.filippone@fugro.com