

Development of a Port ENC Standard

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Overview

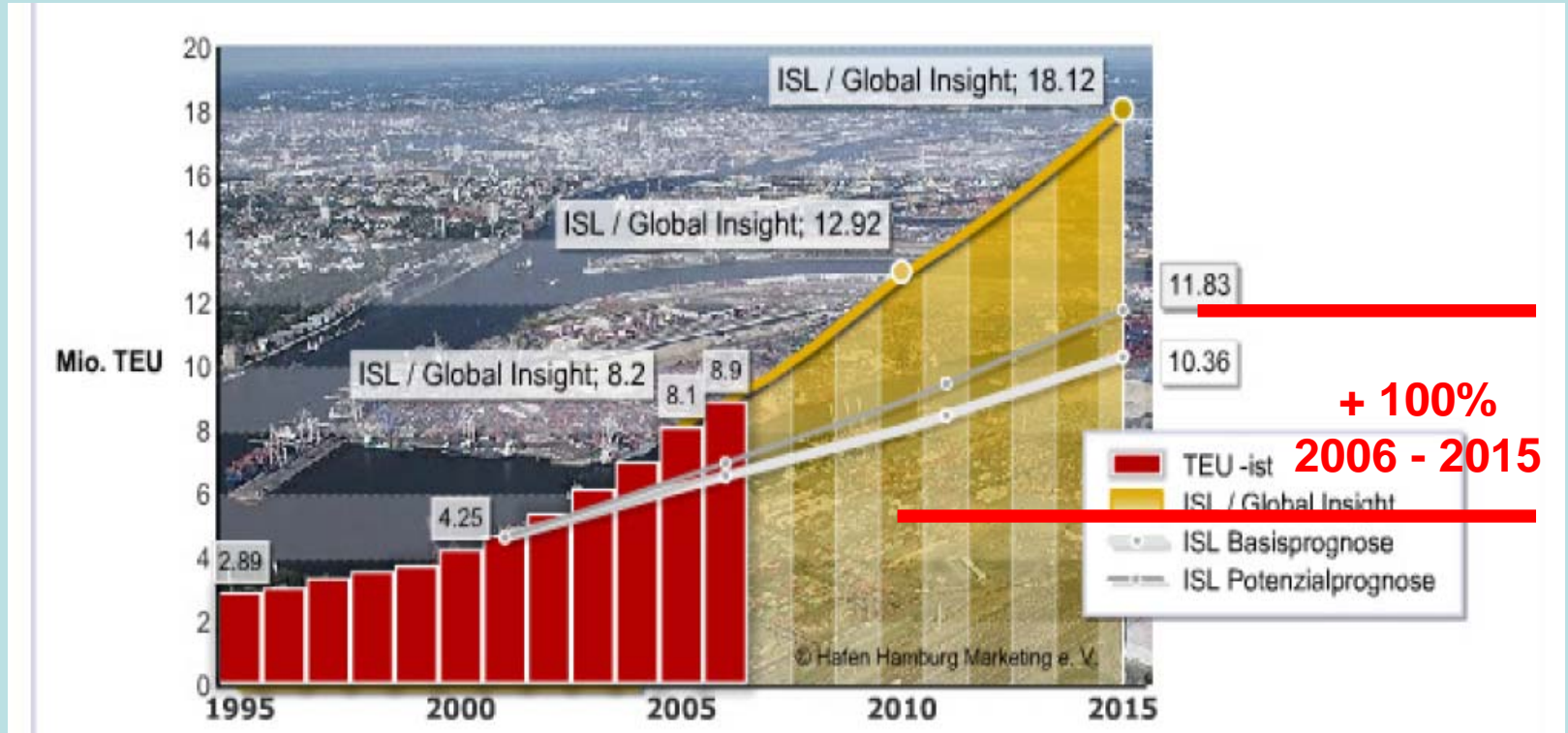
1. Why Port ENC? - motivation
2. ECDIS / Inland ECDIS status in the Port of Hamburg
3. IHO – standards (S-44 & S-57)
4. Port ENC for Port of Hamburg
5. Special port requirements
6. EFFORTS Project

Why Port ENC?

- Ports are the hubs for global maritime trade.
- Efficient arrival/departure for ships and their cargo is crucial.
- There are special navigational and manoeuvring requirements.

Increasing global trade

(ISL-forecast 2003 and ISL/Global Insight 2004) related to the Port of Hamburg)



Development of the container handling for the Port of Hamburg (in Mio. TEU = Twenty Feet Equivalent Unit)
 Source: Hafen Hamburg Marketing e.V. C

Very large vessels (VLCCs)



Increasing ship operations in ports



Motivation

Masters and pilots approaching a seaport usually use an Electronic Chart Display and Information System (ECDIS)

But the current ECDIS and Inland ENC standard cannot fulfill requirements in ports for:

- **precise maneuvering**
- **berthing**
- **turning**
- **docking**



Need for:

- Best available information for safe and efficient operations
- Large-scale data for docking, berthing, & turning manoeuvres
- Up-to-date:
 - hydrographic data (bathymetry)
 - topography (geographic)

ENC requirements for maneuvering big ships in harbour access channels, turning basins, berths, locks and for the port maintenance go far beyond the current ECDIS / Inland ECDIS standards for:

- **up-to-date**
- **quality**
- **accuracy**
- **scale**
- **chart features/objects and attributes**
- **reliability**



Hasenpusch / Hafen Hamburg

Maritime vs. Inland ENC

- The IMO **ECDIS** performance standard using an **ENC** supports maritime navigation in the open sea and coastal areas.
- The **Inland ENC** Standard is based on IMO and IHO ECDIS-related standards, but is refined for navigation on inland waterways.
 - Defines further extensions for river navigation

At present, there is no standard or extensions to specifically meet the requirements of port operations.

Why Port ENC?

For Port operations, there are special requirements for vertical and horizontal accuracy. This is achieved by using modern sensor technology.

This type of source data (e.g., topography and hydrographic data) should be made available by port authorities.

One example is the **official ENC of Hamburg.**

- Produced and issued by BSH, it meets all the relevant ENC related standards and **fulfills the requirements for maritime navigation.**
- But, the ENC too small in scale, does not have any bathymetric detail and poorly defined horizontal accuracy for topographic features such as quay walls, piers, pontoons, etc.

Result: Not suitable for special operations within the port area.

Why Port ENC?

The development of a **Port ENC standard** focuses on high precision operations in ports.

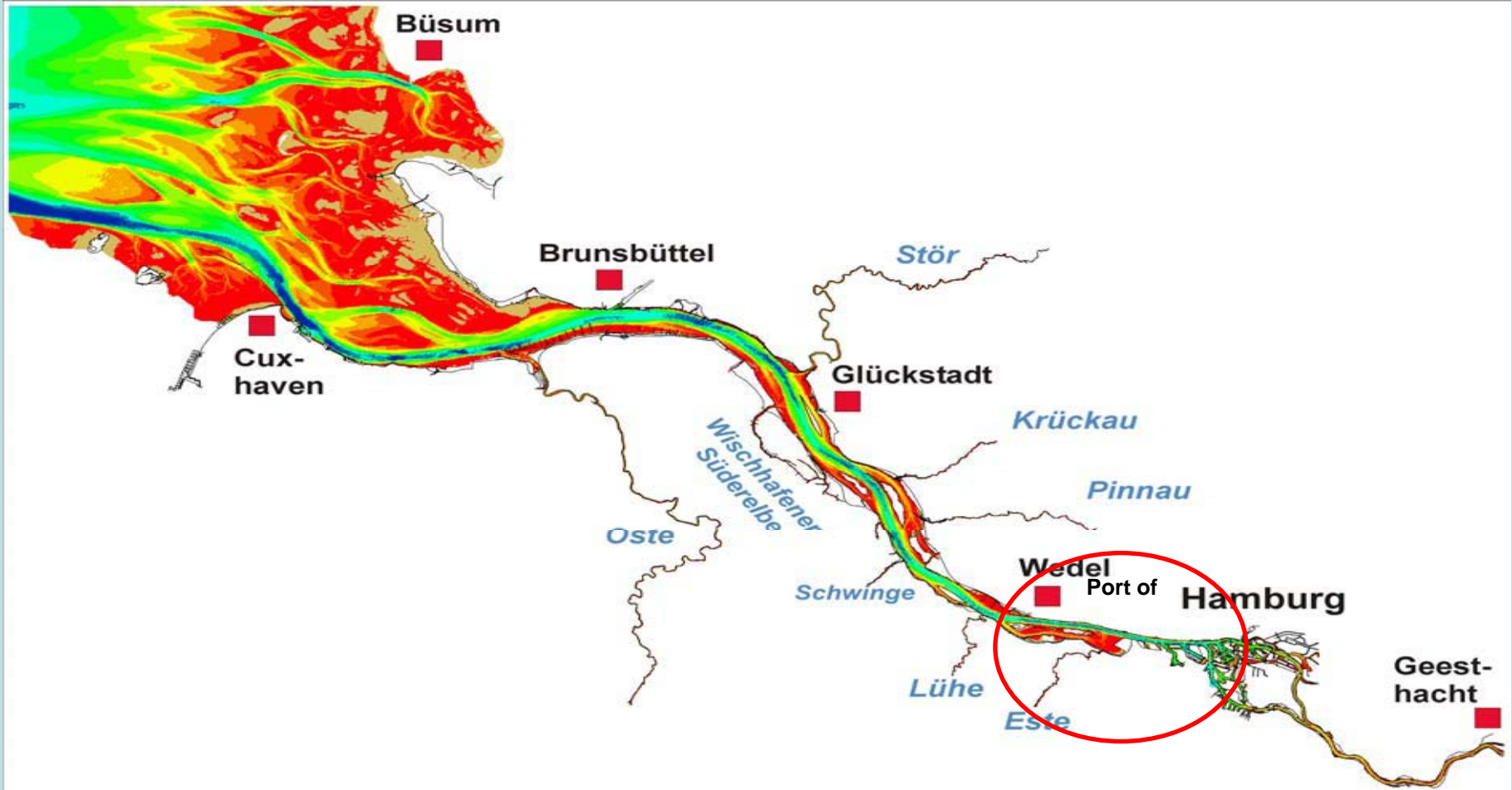
- an independent but complementary standard to “maritime” ECDIS and Inland ECDIS.

A Port ENC intended to align with the ongoing developments for maritime and Inland ENC.

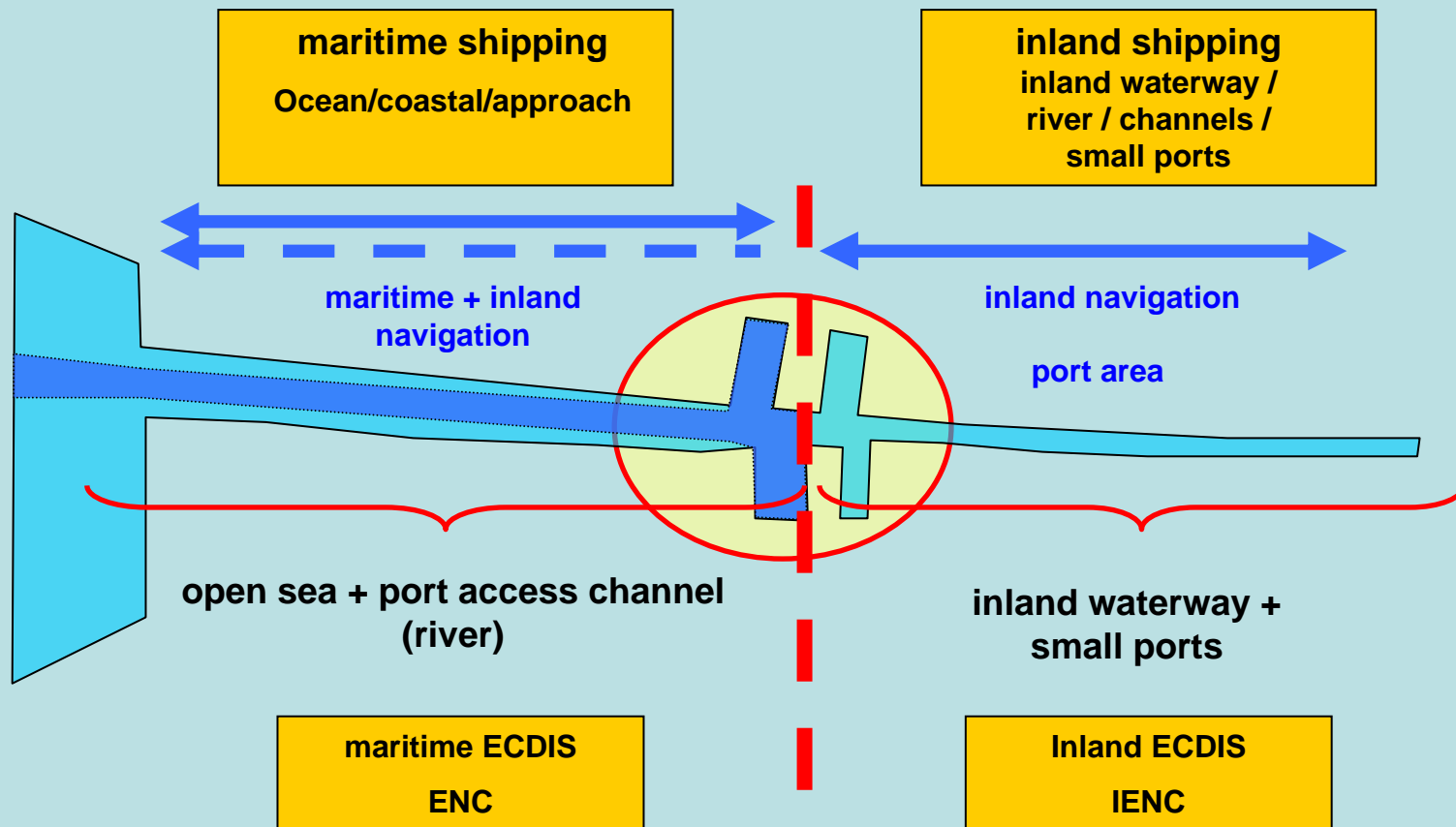
IHO S-100 Geospatial Standard

- The new IHO geospatial data standard that will be in addition to (not replace) S-57
- Implementation to occur in 2010/2011.
- S-101 will be the product specification for the next-generation ENC. An improved ENC Product Specification (S-101) will not come into force until at least 2012!

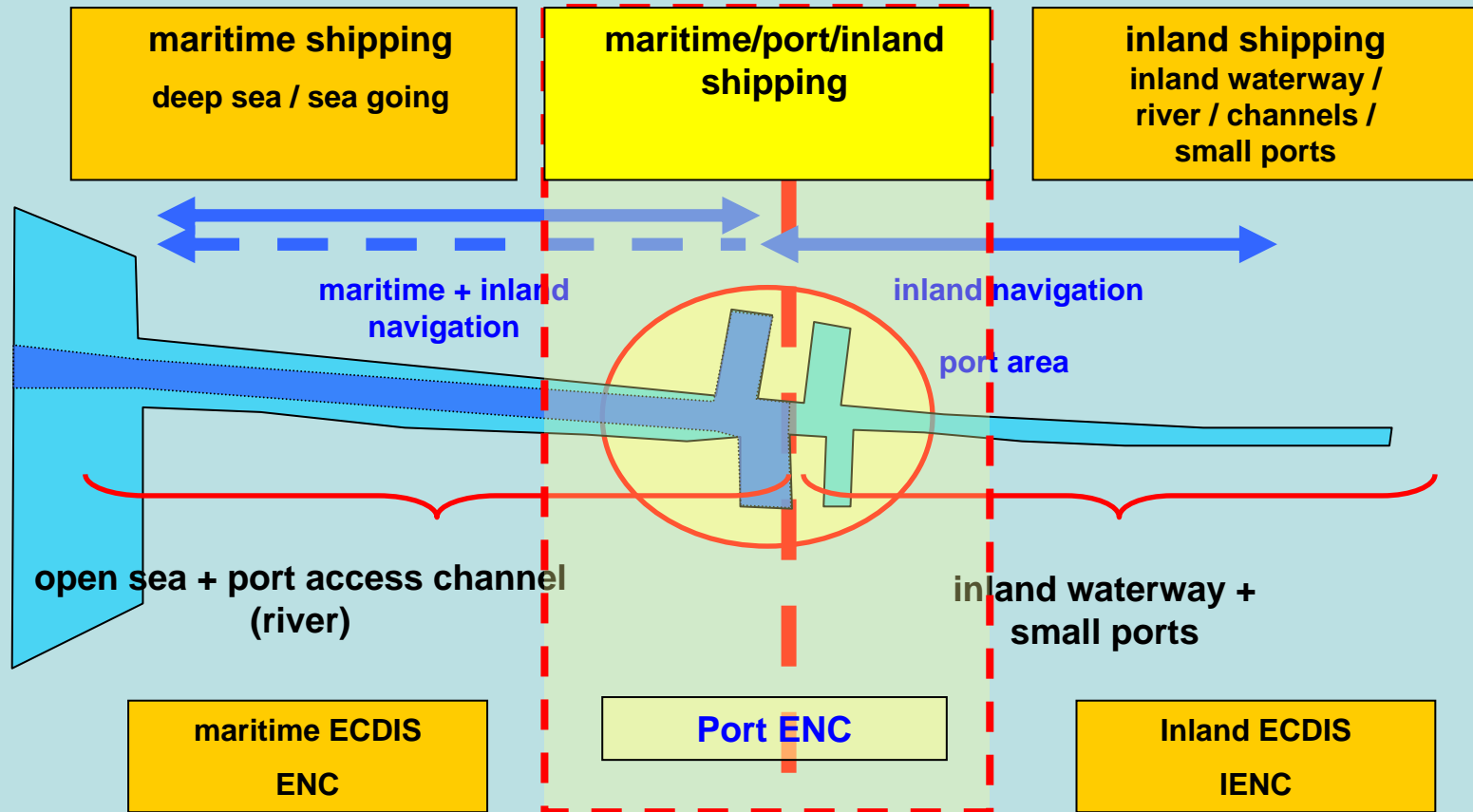
With the special navigational and maneuvering requirements in ports, there is a need to develop a Port ENC without delay.



ENC / Inland ENC status in the Port of Hamburg



Adding a Port ENC



IHO Standards (S-44 & S-57)

- Do not provide significant topographic source data for integration in ENC.
- No dedicated accuracy requirements that apply for different navigational purposes / categories (e.g., port operations)

With ENCs and Inland ENCs, the IHO S-57 **Zone of Confidence (ZOC)** assessment used to assess the quality of **bathymetric data**.

- not used for topographical data

S44 Ed. 5 new - Minimum Standards for Hydrographic Surveys - February 2008

Reference	Order	Special	1a	1b
Chapter 1	Description of areas.	Areas where under-keel clearance is critical	Areas shallower than 100 metres where under-keel clearance is less critical but features of concern to surface shipping may exist.	Areas shallower than 10 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.
Chapter 2	Maximum allowable THU 95% Confidence level	2 metres	5 metres +	used for the Port of Hamburg
Para 3.2 and note 1	Maximum allowable TVU 95% Confidence level	a = 0.25 metre b = 0.0075	a = 0.5 metre b = 0.013	
Glossary and note 2	Full Sea floor Search	Required	Required	Not required
Para 2.1 Para 3.4 Para 3.5 and note 3	Feature Detection	Cubic features > 1 metre	Cubic features > 2 metres, in depths up to 40 metres; 10% of depth beyond 40 metres	Not Applicable
Para 3.6 and note 4	Recommended maximum Line Spacing	Not defined as full sea floor search is required	Not defined as full sea floor search is required	3 x average depth or 25 metres, whichever is greater. For bathymetric lidar a spacing of 5 x 5 metres
Chapter 2 and note 5	Positioning of fixed aids to navigation and topography significant to navigation. (95% Confidence level)	2 metres	2 metres	2 metres
Chapter 2 and note 5	Positioning of the Coastline and topography less significant to navigation (95% Confidence level)	10 metres	20 metres	20 metres
Chapter 2 and note 5	Mean position of floating aids to navigation (95% Confidence level)	10 metres	10 metres	10 metres

S57 ECDIS definitions (Zone of Confidence)

5

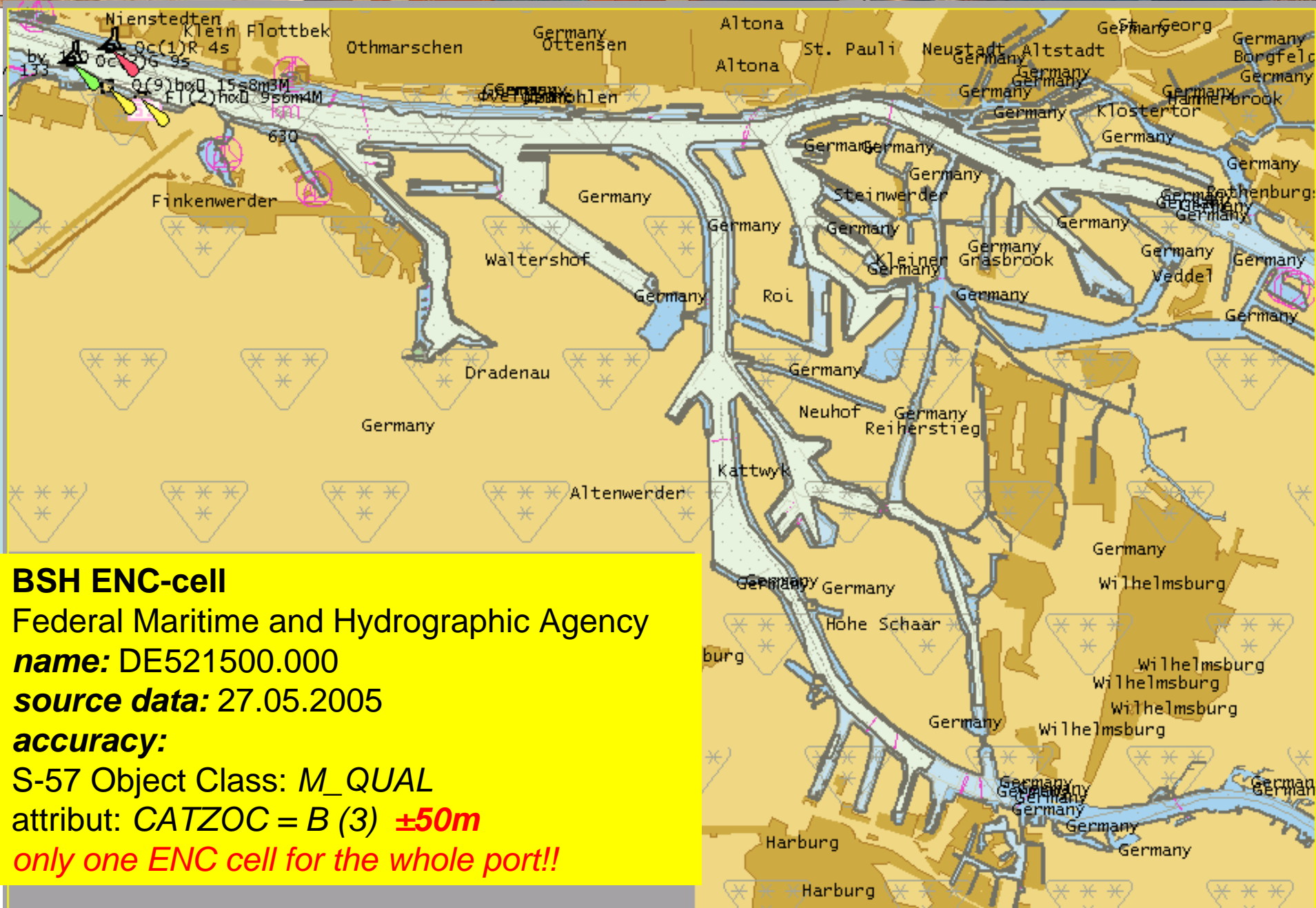
ZOC	<u>Position Accuracy</u>	<u>Depth Accuracy</u>	Seafloor Coverage	<u>Typical Survey Characteristics</u>
A1	± 5 m	a = 0.5 b = 1	Full seafloor ensonification or sweep. All <u>significant seafloor features</u> detected and depths measured.	Controlled, systematic high accuracy Survey on WGS 84 datum; using DGPS or a minimum three lines of position (LOP) with multibeam, channel or mechanical sweep system.
		Depth (m)		
		Accuracy (m)		
		10		
		± 0.6		
A2	± 20 m	a = 1.0 b = 2	Full seafloor ensonification or sweep. All <u>significant seafloor features</u> detected and depths measured.	Controlled, systematic survey to standard accuracy; using modern survey echosounder with sonar or mechanical sweep.
		Depth (m)		
		Accuracy (m)		
		10		
		± 1.2		

S57 ECDIS definitions (Zone of Confidence)

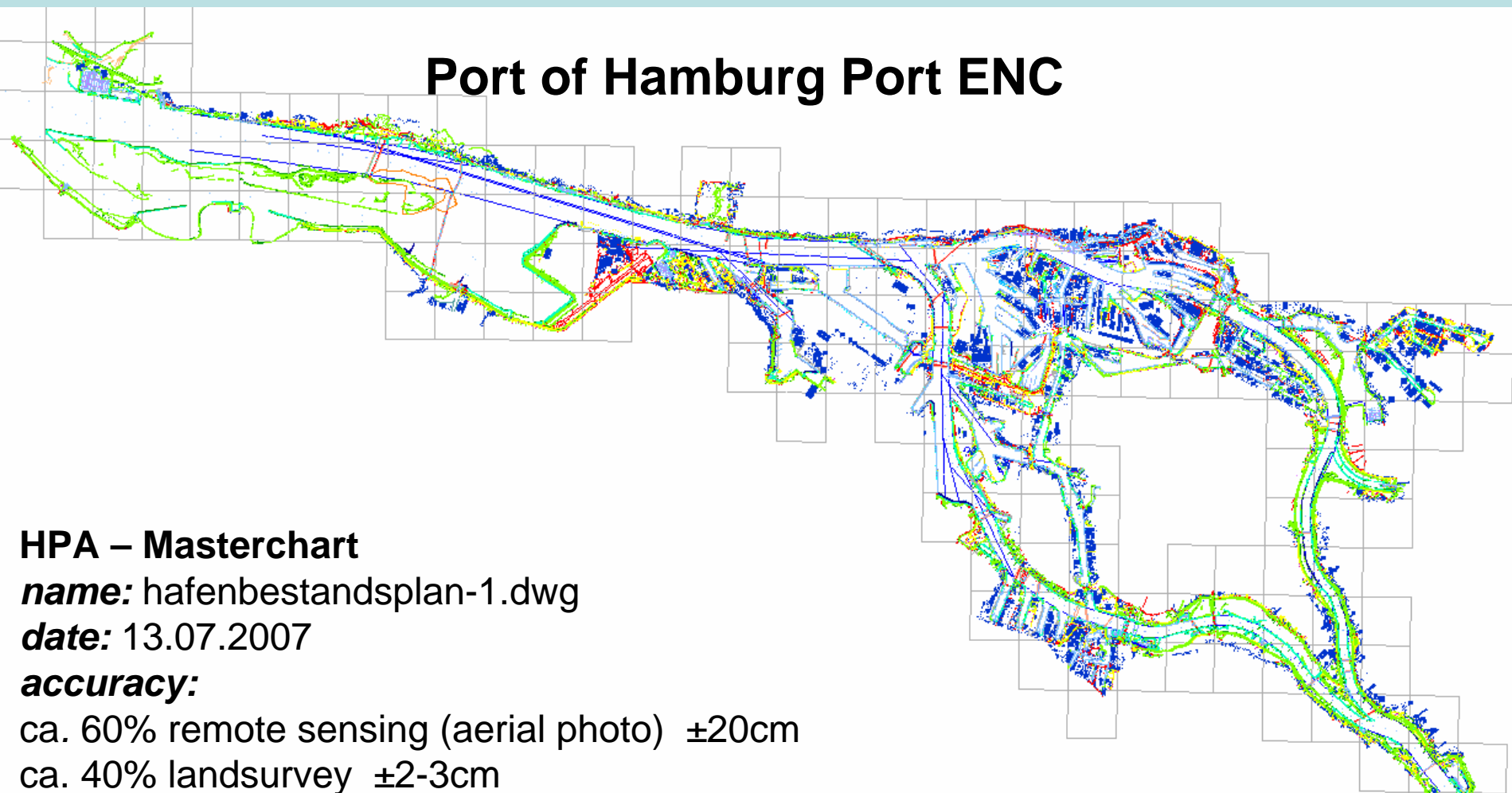
S57 ECDIS definitions (Zone of Confidence)					5
ZOC	<u>Position Accuracy</u>	<u>Depth Accuracy</u>		Seafloor Coverage	<u>Typical Survey Characteristics</u>
A1	± 5 m	a = 0.5 b = 1		Full seafloor ensonification or sweep. All <u>significant seafloor features</u> detected and depths measured.	<div>IHO S-44 Special Order +/- 2m versus ENC ZOC +/- 5m</div> <div>Mismatch between IHO S-44 Special Order and S-57 ENC</div>
		Depth (m)	Accuracy (m)		
		10	± 0.6		
		30	± 0.8		
		100	± 1.5		
1000	± 10.5				
A2	± 20 m	a = 1.0 b = 2		Full seafloor ensonification or sweep. All <u>significant seafloor features</u> detected and depths measured.	<div>ZOC (Zone of Confidence) for the Port of Hamburg B (3) = +/- 50m !!</div>
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
1000	± 21.0				

Port of Hamburg

Comparison between the maritime ENC and Port ENC



Port of Hamburg Port ENC



HPA – Masterchart

name: hafenbestandsplan-1.dwg

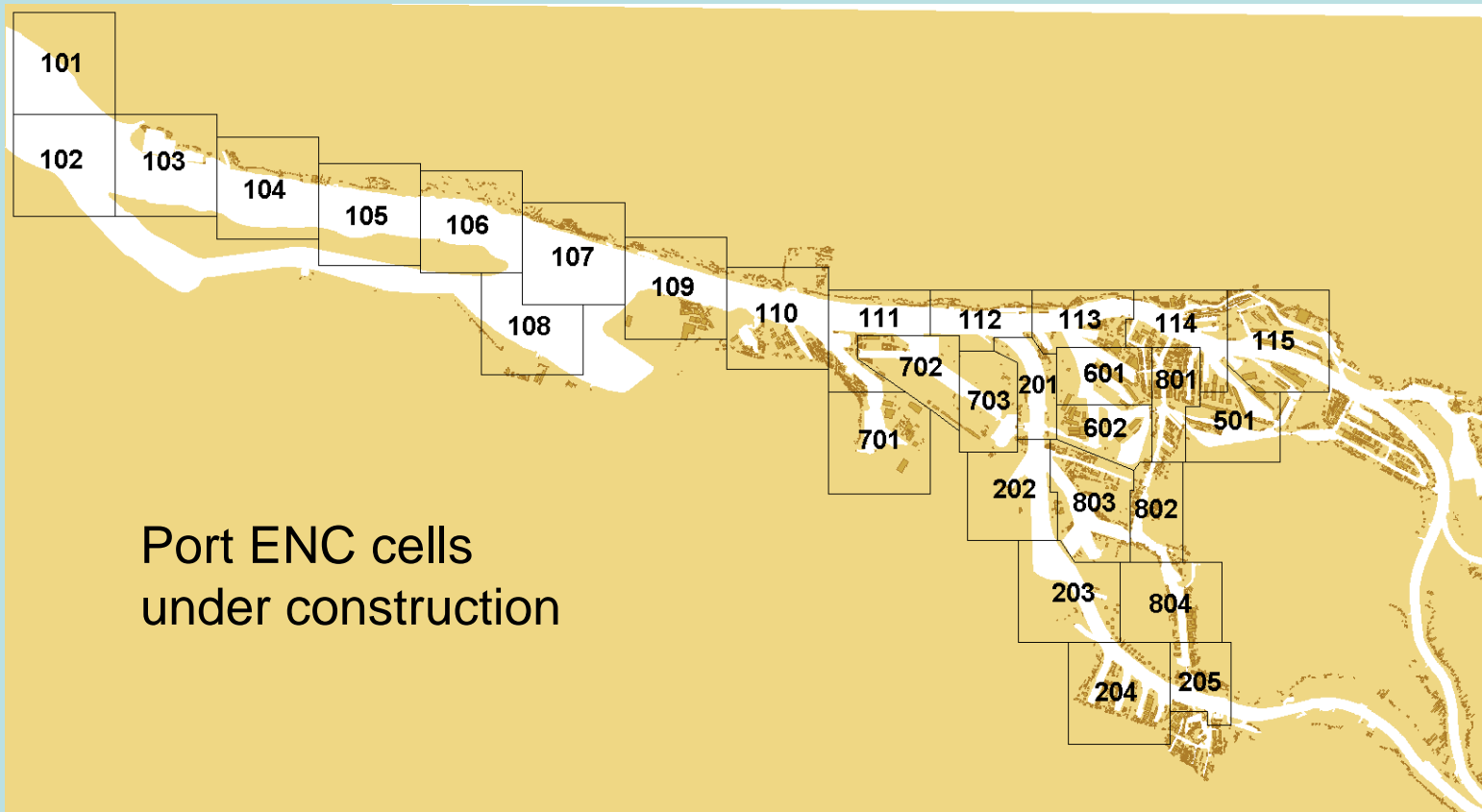
date: 13.07.2007

accuracy:

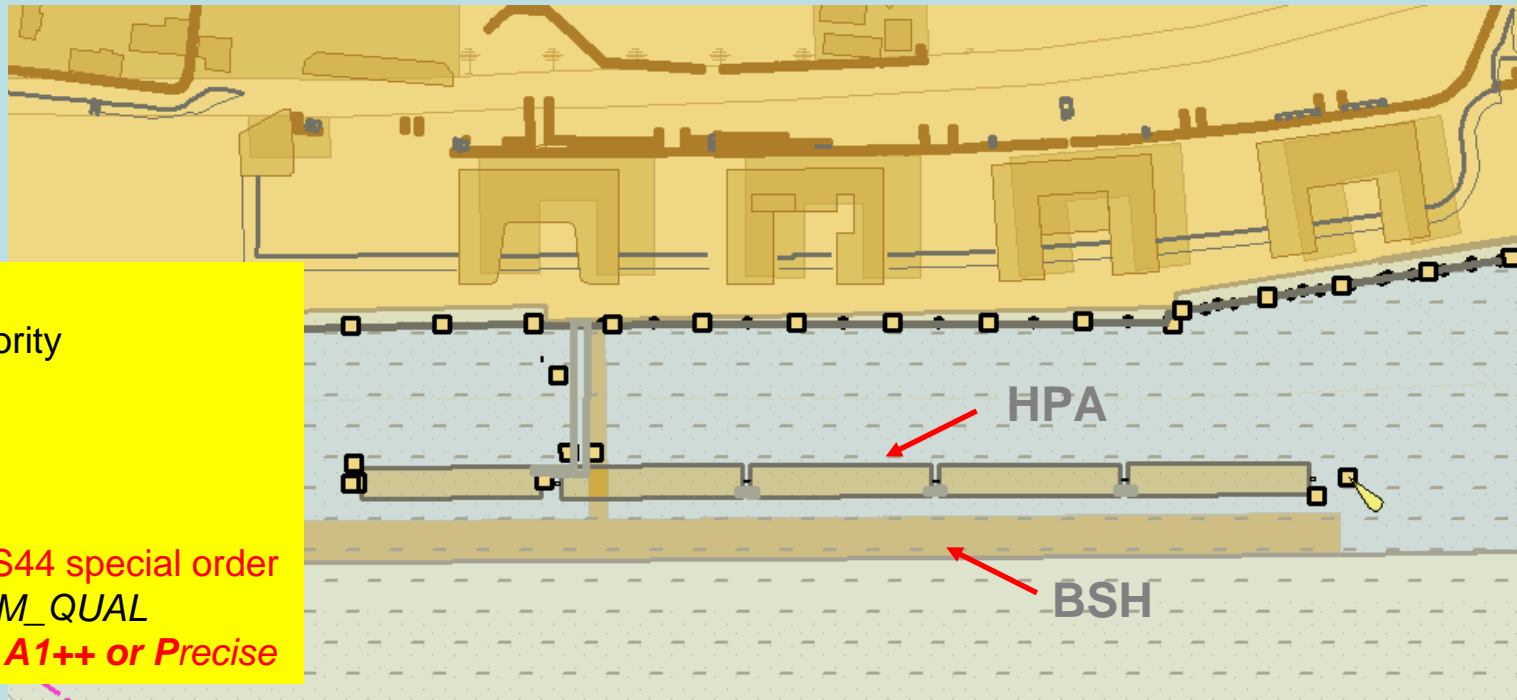
ca. 60% remote sensing (aerial photo) $\pm 20\text{cm}$

ca. 40% landsurvey $\pm 2\text{-}3\text{cm}$

Port of Hamburg Port ENC

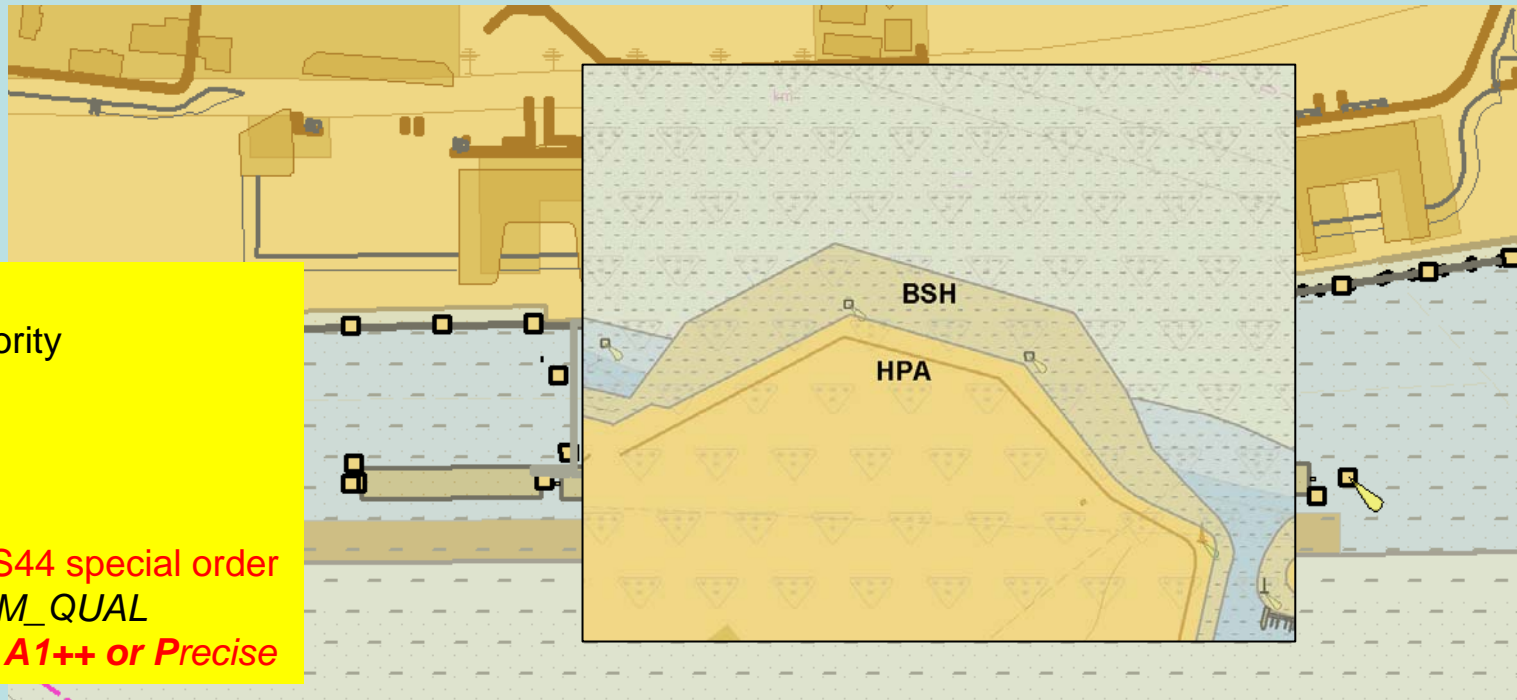


Comparison between maritime ENC (from BSH) and Port ENC (from HPA)



HPA Port ENC-cell
Hamburg Port Authority
name:
date: March 2008
accuracy:
horizontal +- 0,25m
vertical better than S44 special order
S-57 Object Class: *M_QUAL*
attribut: CATZOC = **A1++ or Precise**

Comparison between maritime ENC (from BSH) and Port ENC (from HPA)



HPA Port ENC-cell

Hamburg Port Authority

name:

date: March 2008

accuracy:

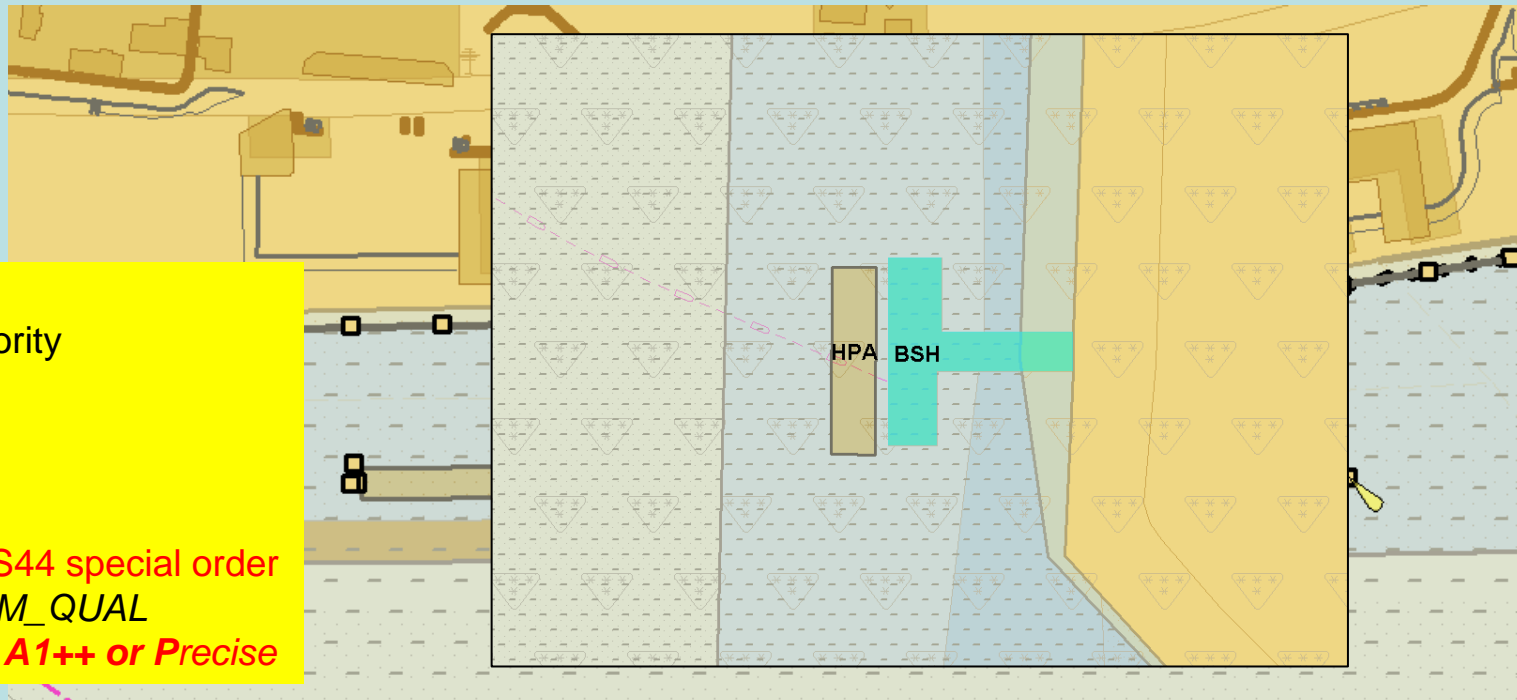
horizontal $\pm 0,25m$

vertical better than S44 special order

S-57 Object Class: *M_QUAL*

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Comparison between maritime ENC (from BSH) and Port ENC (from HPA)



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attribut: CATZOC = **A1++ or Precise**

Comparison between maritime ENC (from BSH) and Port ENC (from HPA)

fixed aids to navigation

differences HPA-BSH

East	North	Dist.
average	-0,01	0,01
min	-0,19	-0,62
max	0,15	0,56

topography significant to navigation

quay wall corner

differences HPA-BSH

East	North	Dist.
average	-4,75	-3,66
min	-13,93	-17,15
max	6,84	4,35

pontoon corner

differences HPA-BSH

East	North	Dist.
average	-1,60	-2,89
min	-11,00	-11,69
max	10,42	19,74

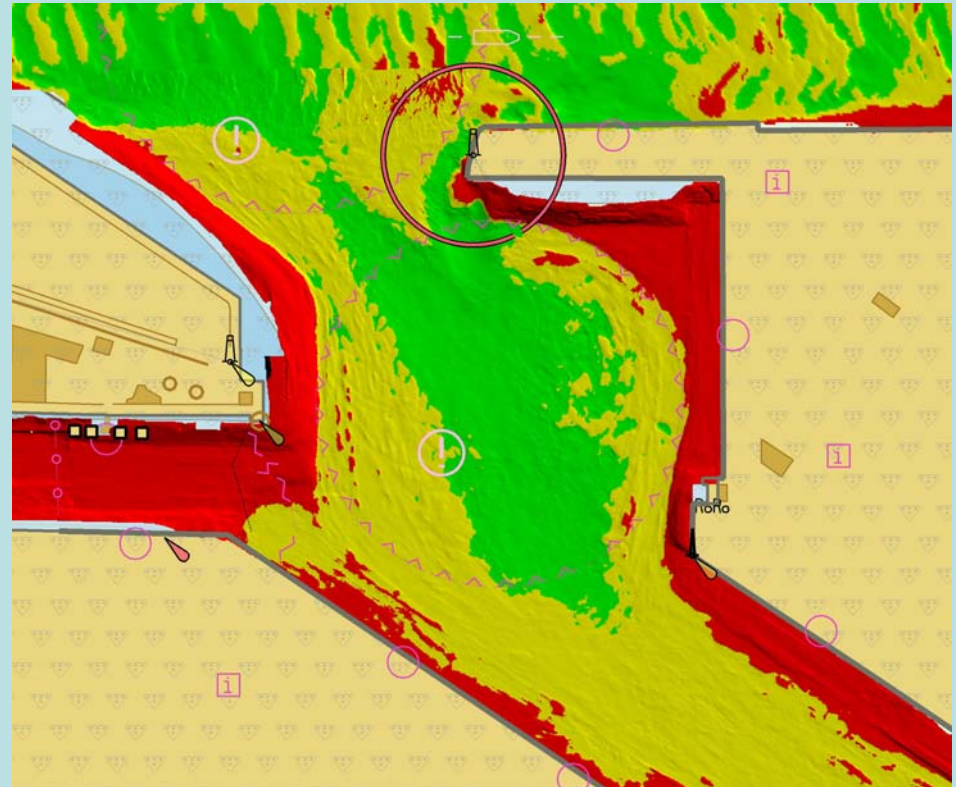
surveyed by HPA

Special port requirements

A Port ENC includes extensions additional objects / features or information.

For instance:

- gridded bathymetry
- special structures



Special port requirements

3-D bridge / lock passages information (air draft)

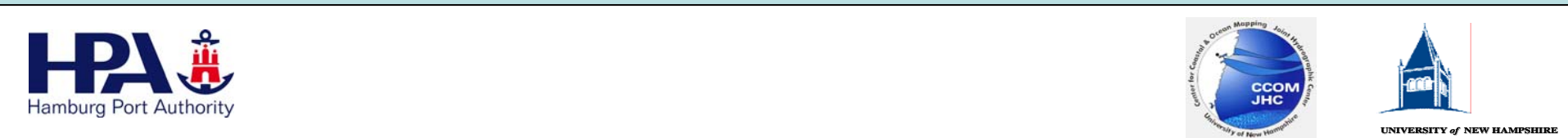


Special port requirements

Sub-surface or underwater structures

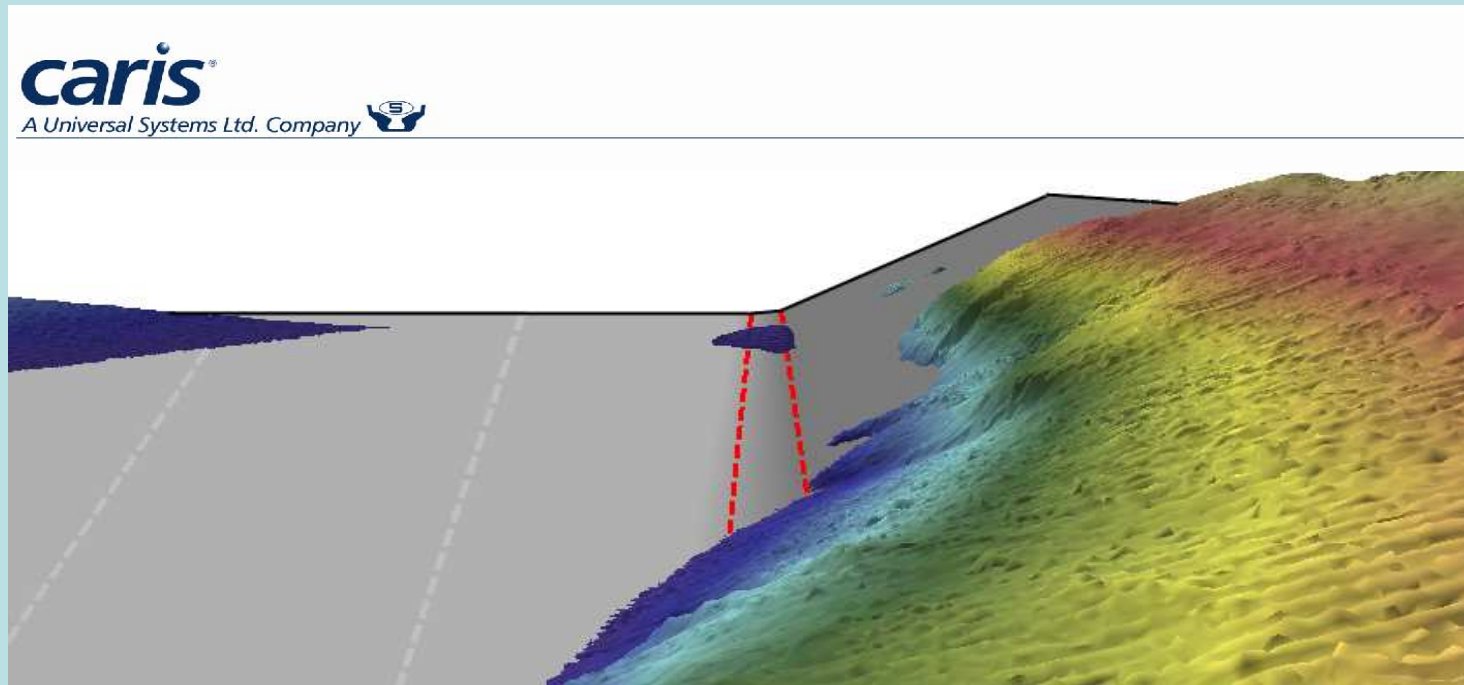


Sub-surface or underwater structures



Special port requirements

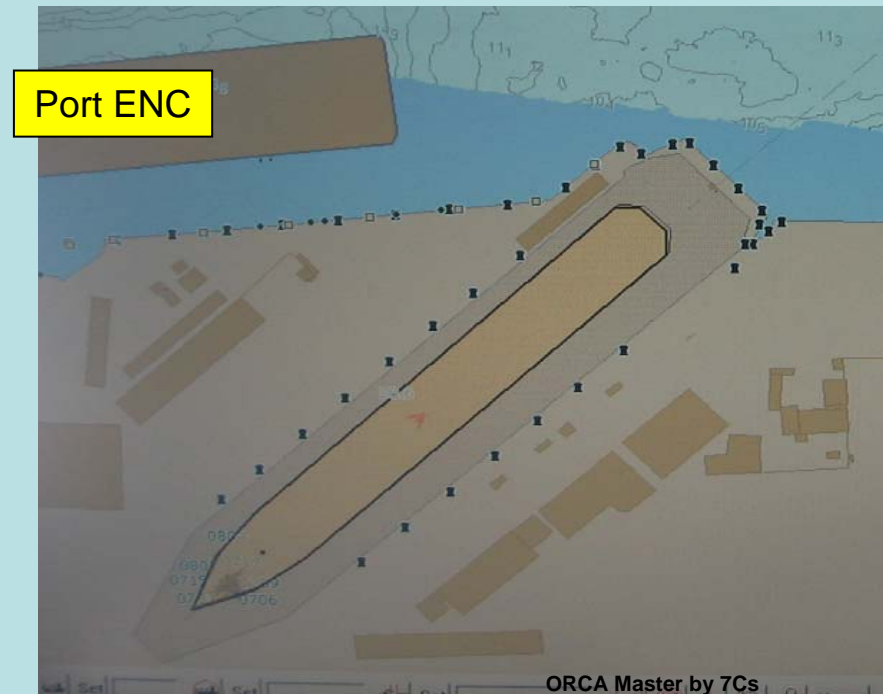
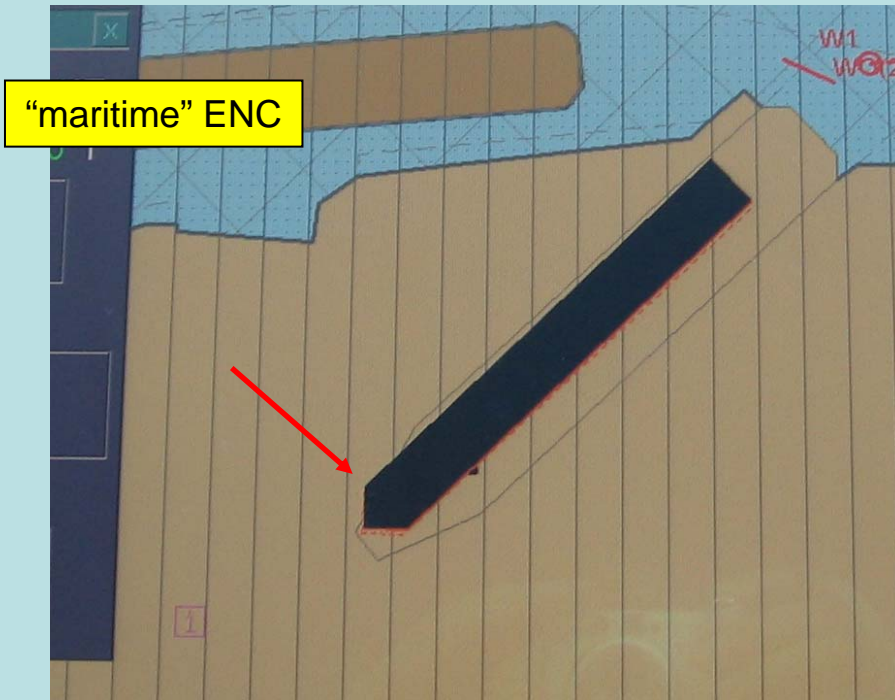
3-D channel model / reference model



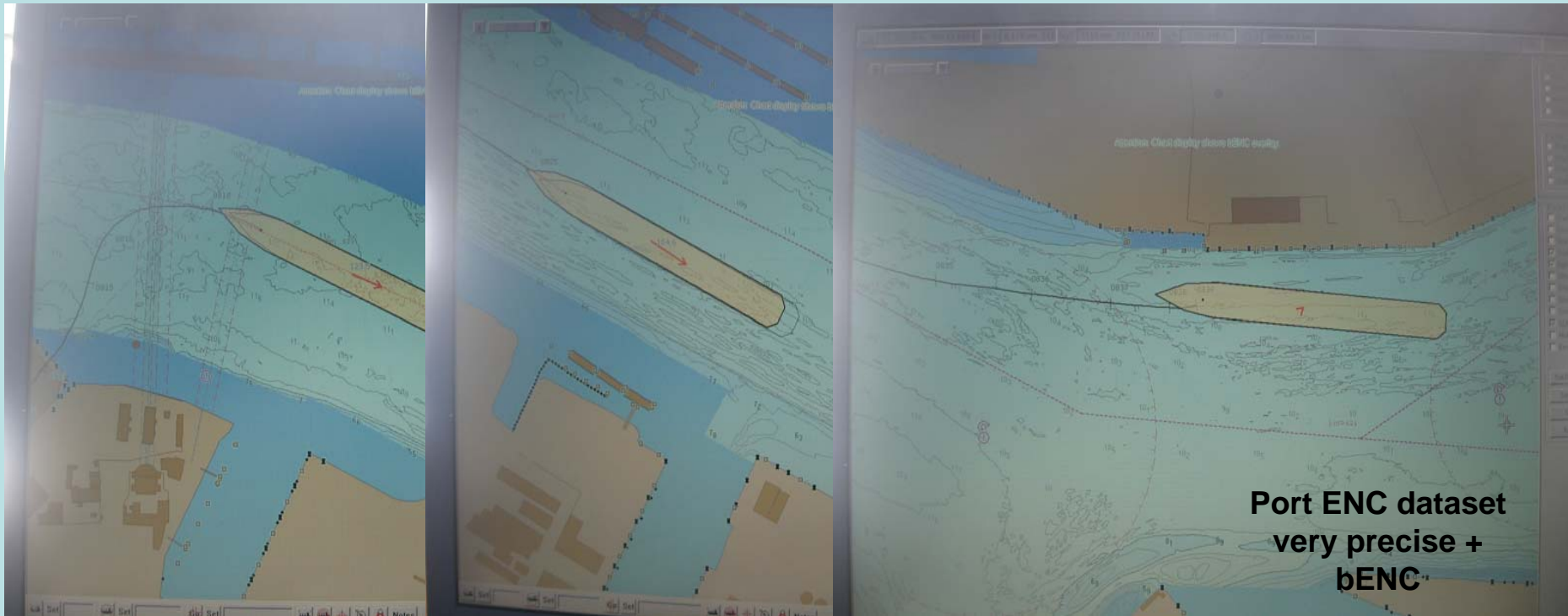
Docking maneuver of the "Brilliance of the Seas",
Dock Elbe 17, Port of Hamburg, 13 May 2008



Docking maneuver of the "*Brilliance of the Seas*", Dock Elbe 17, Port of Hamburg, 13 May 2008



Docking maneuver of the "Brilliance of the Seas", Dock Elbe 17, Port of Hamburg, 13 May 2008



Docking maneuver of the "Brilliance of the Seas", Dock Elbe 17, Port of Hamburg, 13 May 2008



EFFORTS Project

The European FP-6 DG Research Integrated Project "Effective Operations in Ports (**EFFORTS**)"

- Aims to improve the competitiveness of European port operations and the quality of the ports labour conditions and market
- Started on 1 May 2006 and lasting for 42

<http://www.efforts-project.org/cms/>

EFFORTS Project

Three main parts:

SP 1 Navigation in Ports

3 work packages dealing with safe and efficient approach and berthing of vessels

WP1.1: Tug Assistance

WP1.2: Precise Navigation and Manoeuvring in Ports

WP1.3: Port ECDIS

SP 2 Ports and Environment

4 work packages covering the most relevant environmental areas related to port operation

SP 3 Port Organisation

2 work packages providing an overall architecture, and software tools for operational support and risk assessment/management.

EFFORTS Project

WP1.3: Port ECDIS

Using ECDIS as the base, overlay other types information to improve the interoperability of harbour-related tasks.

Ships – maneuvering and docking by Pilots using Portable Piloting Units (PPUs) with Port ENC's

Port Authority – dredging and maintenance activities at piers and terminal facilities



WP 1.3 Port ECDIS		May 2006																																										Oct. 2009			
Timetable		Version 2 final, 2008-03-01																																													
		Projekt Month																																													
		Month																																													
		Year																																													
		2006				2007				2008				2009																																	
Tasks		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4																															
WP 1.3.0	Verification phase	verification phase																																													
WP 1.3.1	Potential users and requirements (questionnaire, interview, study)									User input questionnaire / requirements																																					
WP 1.3.2	Port ECDIS specification (document)									Specification Phase 1				Specification Phase 2																																	
WP 1.3.2.1	Specification of bathymetric data									1.) bathymetric																																					
WP 1.3.2.2	Specification of reference model									2.) channel / reference model																																					
WP 1.3.2.3	Specification of additional requirements									3.) add. requirem.																																					
WP 1.3.3	Port ECDIS prototype (software and dataset)					collect basic data				software + prelim. dataset (basic data)				software + extended dataset (incl. bathym., channel model)																																	
WP 1.3.3.1	Port ECDIS prototype (basic dataset)																																														
WP 1.3.3.2	Port ECDIS prototype (preliminary dataset)																																														
WP 1.3.3.3	Port ECDIS prototype (extended dataset)																																														
WP 1.3.4	Tests with Port ECDIS prototype and evaluation of tests (report)													prototyping and first trials				PPU?																													
WP 1.3.5	Port ECDIS follow-up requirements (document)																					follow up				2. follow up																					
WP 1.3.6	Defining cost and business related figures																													costs																	

EFFORTS Project

WP1.3: Port ECDIS

Interviewed different users / stakeholders

(e.g., harbourmasters, masters, pilots, water police, ECDIS and Inland ECDIS experts, marine consultancies)

Efforts WP 1.3 Port ECDIS Workshop Questionnaire

8.April2008

Hafenklub - Hamburg

Name:

Organisation:

Job / function:

1 Questions about group membership

What Group do you belong to? (Choose from the list of groups)

1.1 Group A - main user

1.1.1 Group A1

- ☐ Harbour master
- ☐ Harbour pilots
- ☐ VTMS
- ☐ ...

EFFORTS Project

WP1.3: Port ECDIS

Researched data quality aspects of IHO standards.

Definition of Data Quality in Standards used for ENC Data

EC FP6 project Efforts WP 1.3 Port ECDIS

EU project EFFORTS

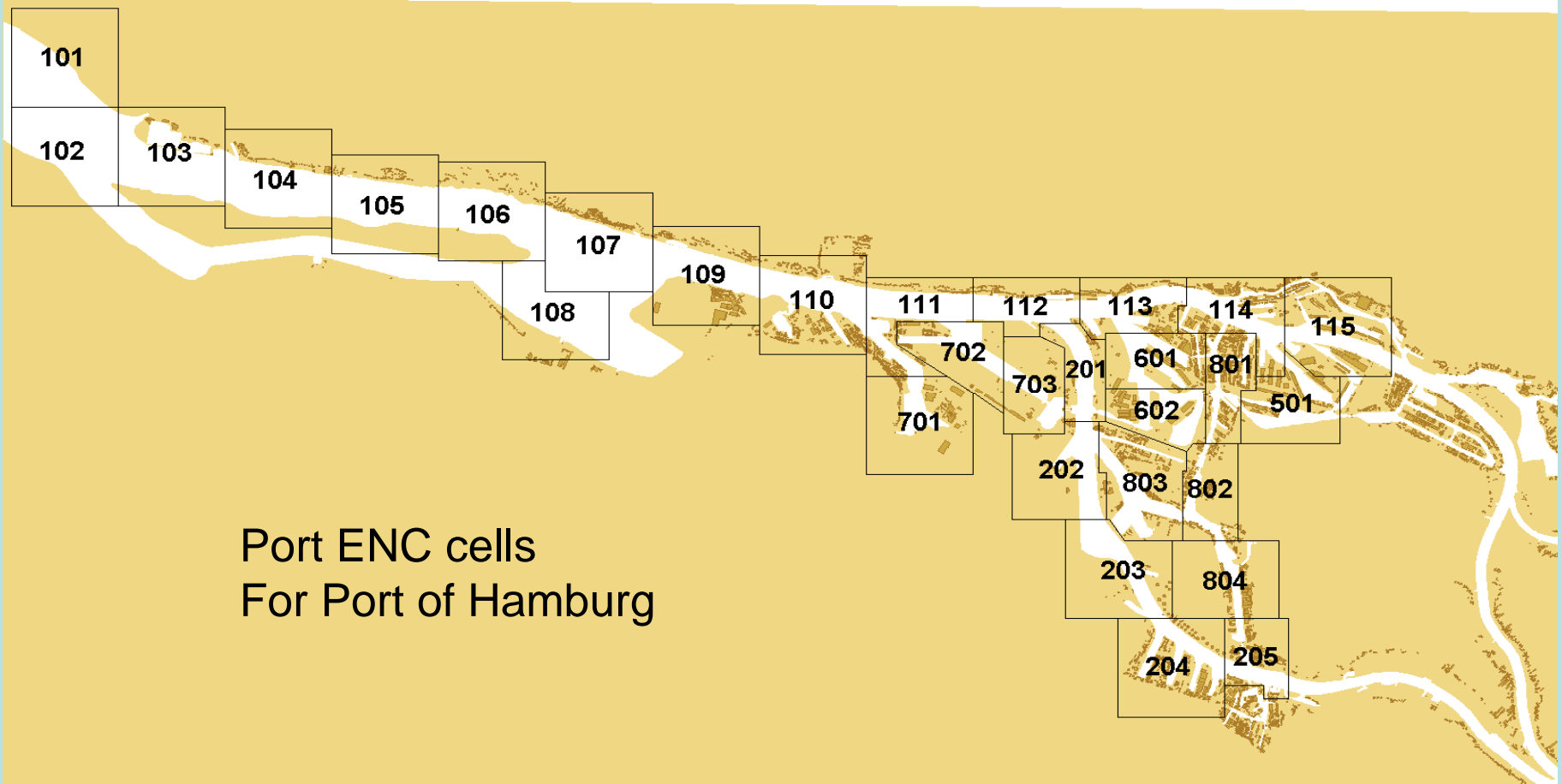
WP1.3: Port ECDIS

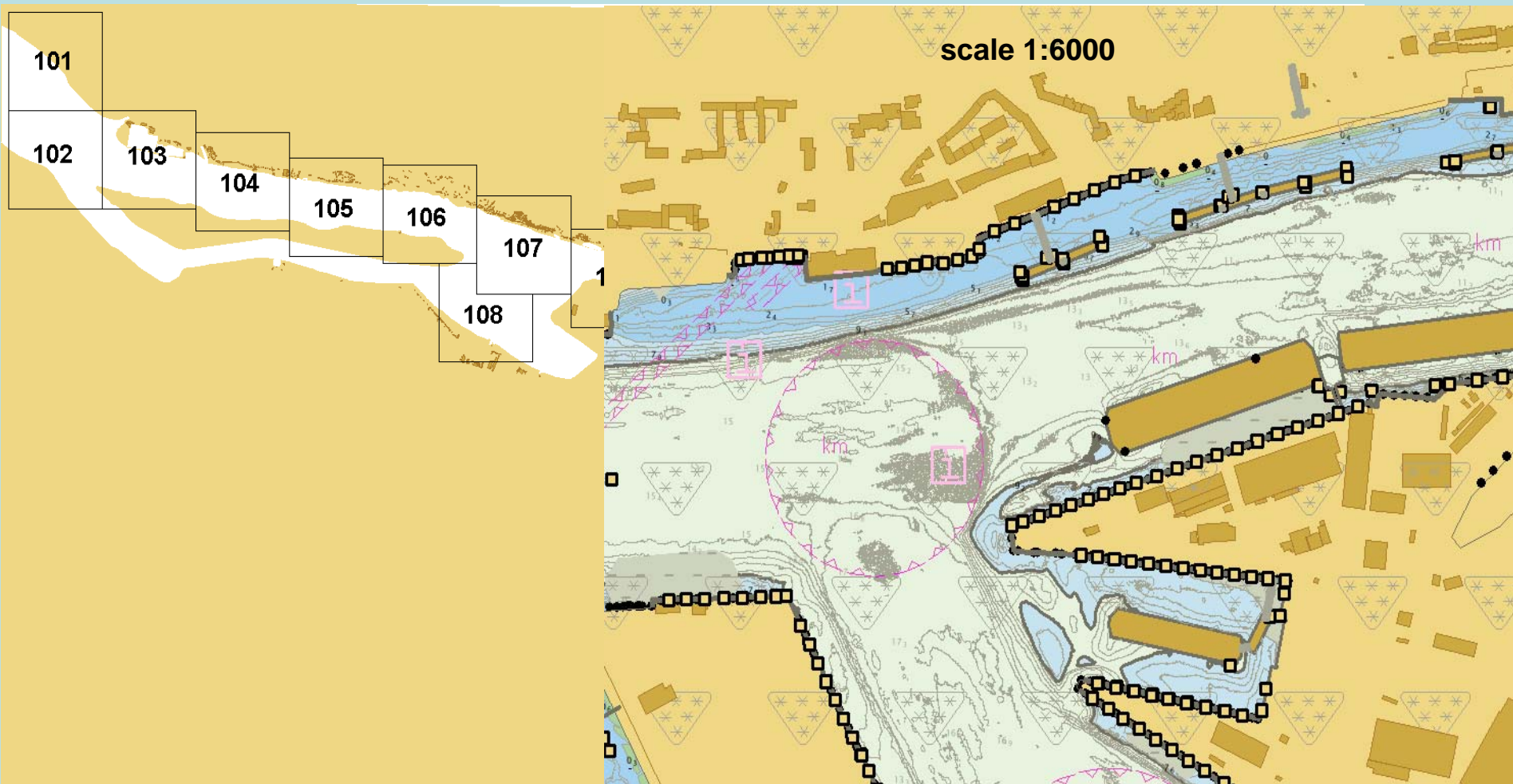
Developing a
Port ECDIS
specification;
under development,
living document

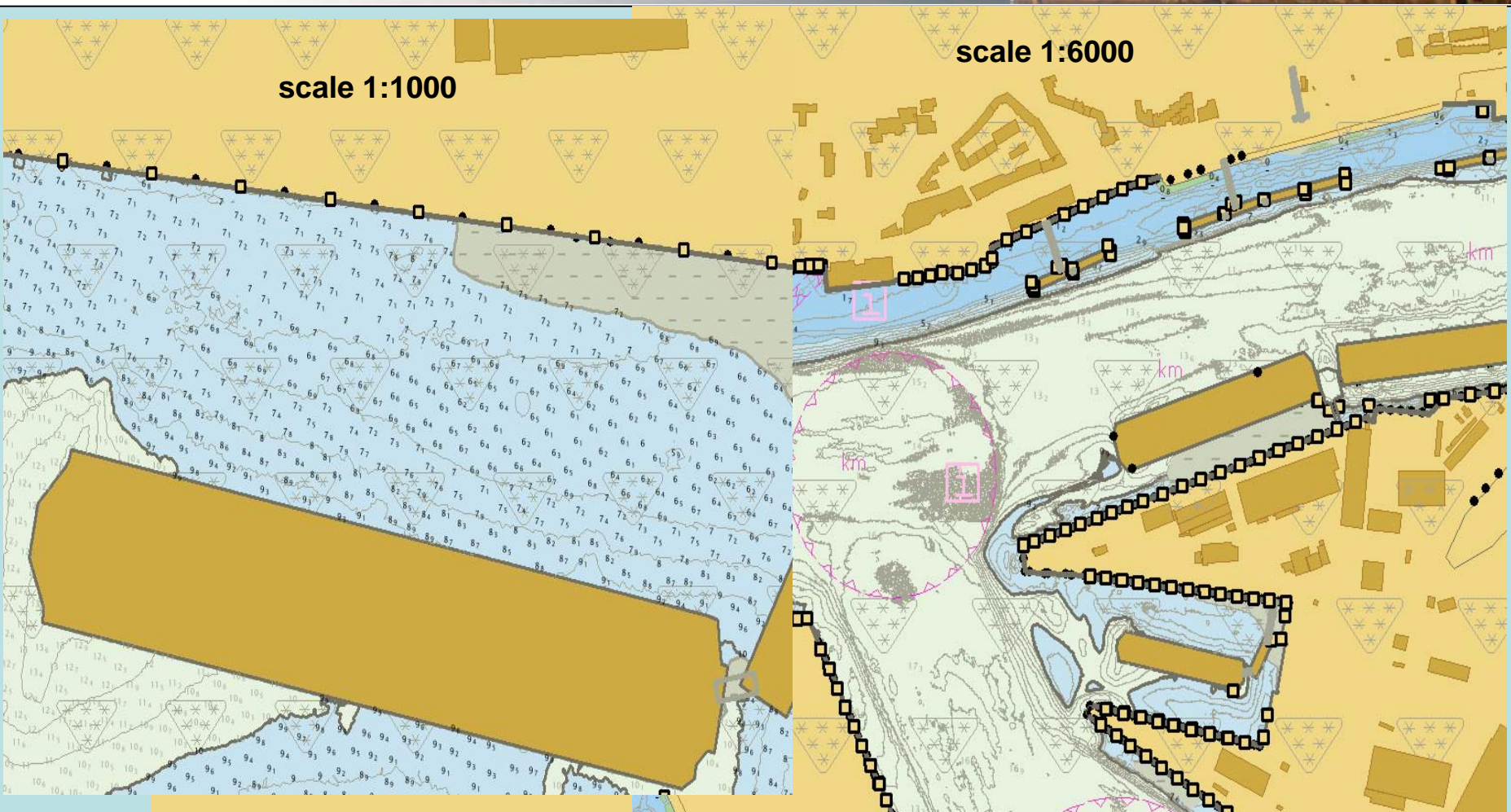
Task 2 – Port ECDIS specification under
development



Requirements for new objects in a
Port-ECDIS



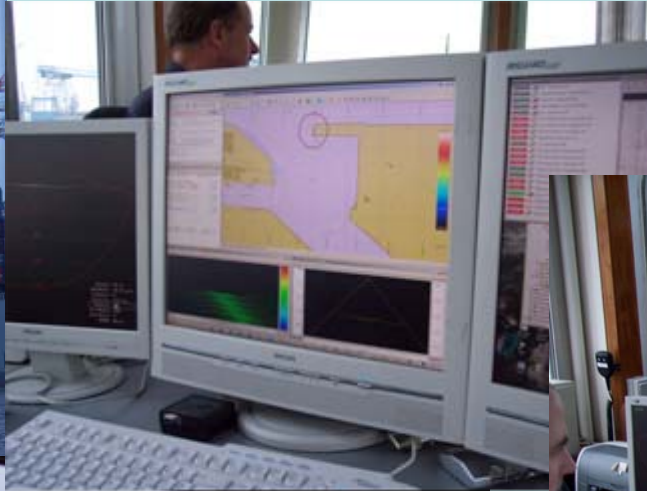




Summary

- In order to meet navigational, manoeuvring, berthing, turning requirements in ports there is a need for a **Port ENC**.
- A **Port ENC** dataset was produced for the Port of Hamburg including new objects and features like gridded bathymetry and channel model.
- A **Port ENC** tested during EFFORTS Project.
- The Port of Hamburg will continue to produce and use **Port ENCs**.

First trials on board of our survey vessel with a base Port ECDIS/ECS



Friday, 25th April 2008

Conclusion

Need for three different types of ENC data:

“maritime” ENC for open sea and coastal areas

Inland IENC for rivers/inland waterways

Port PENC for precision manoeuvring/docking in ports

Thank you for your attention



(C)Jan Svendsen