



Arab Academy

for Science , Technology and Maritime Transport



The International Maritime Transport
and Logistics Conference

“MARLOG 13”

**Towards _____
Smart Green Blue
Infrastructure**

3-5 March 2024 - Alexandria, Egypt





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Ports & Terminals
DHI Group

NCOS ONLINE and the Future of Port Operations: Insights from The Digital Integration at The Port of Hamburg, Germany

Hisham Elsafti, Stefan Leschka, Prema S. Bhautoo, and Christian Heitmann



Outline

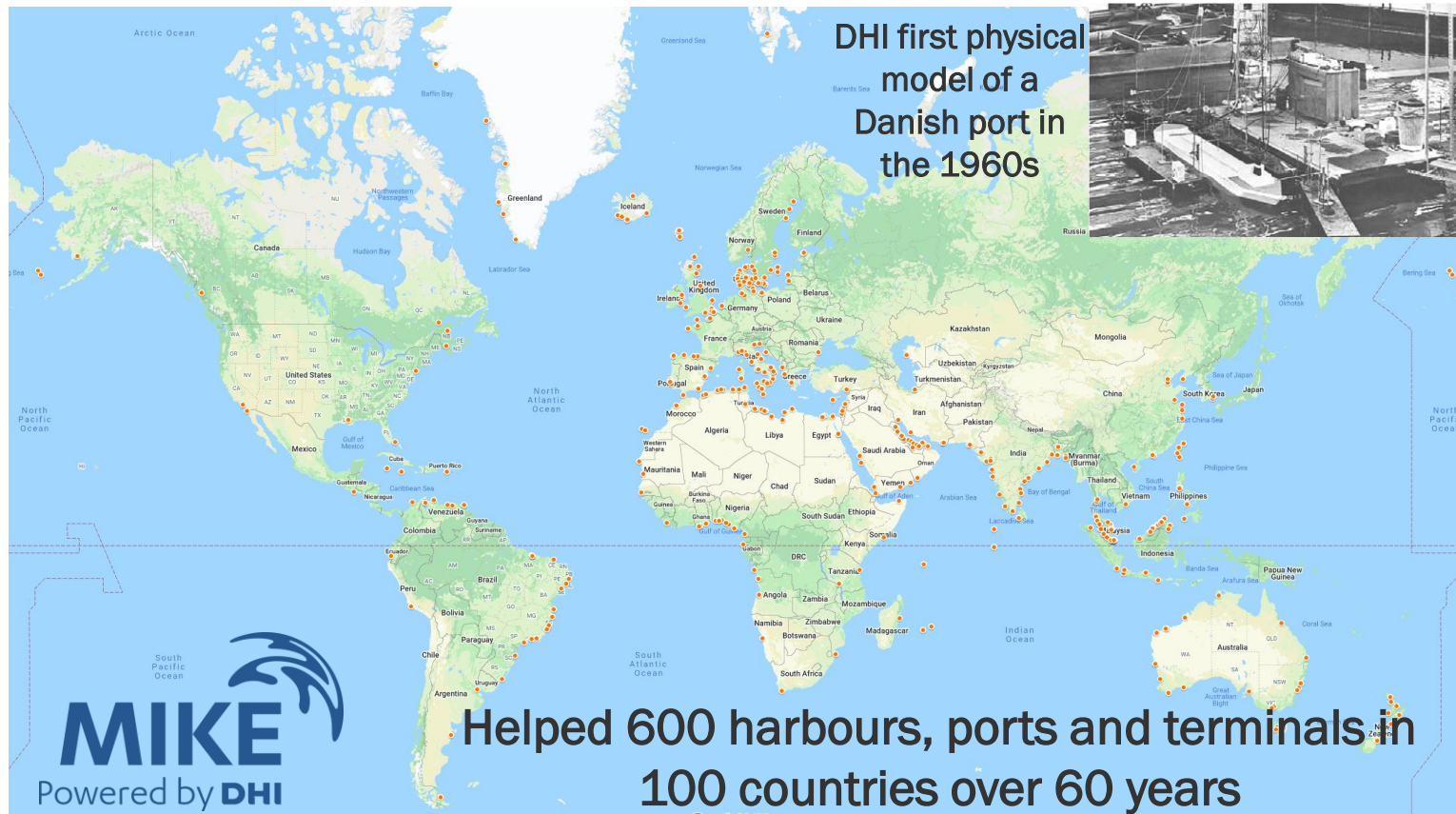
- DHI at a glance
- NCOS ONLINE port operating system from DHI
- Digital support/advisory to modern ports & terminals
- Dynamic Mooring Analysis (DMA)
- Mooring Program for The Port of Hamburg
- Concluding remarks



DHI at a Glance



DHI at a glance



Our services

Consulting

- Engineering consultancy and advisory services (e.g., consultant to the HPA)
- Efficient and goal-oriented numerical and physical modelling, remote sensing, field surveys/monitoring
- Participation/leading research projects



Software

- World leader in providing integrated numerical modelling software for engineering in water environments
- Providing professional support and training tailored to your projects



Operational platforms

- Digital twin of your facility/asset running 24/7 and on demand
- Intuitive and customer-specific user interface
- Professional training
- 24/7 professional support



DHI Profile



- Fields of services:
 - Ports & Terminals
 - Coast & marine
 - Energy: e.g., offshore wind, wave, etc.
 - Climate change
 - Aquaculture & agriculture
 - Surface & groundwater
 - Urban water
 - Environment & ecosystems
 - Ballast water
 - Product safety & environmental risk
- Present in more than 29 countries worldwide
- Non-for-profit: we reinvest in R&D
- DHI is:
 - Collaborating Centre for the World Health Organisation (WHO) and the United Nations Environmental Programme (UNEP).
 - An Advisory Centre for the Global Water Partnership (GWP).



The expert in **WATER ENVIRONMENTS**

NCOS ONLINE port operating system from DHI



NCOS ONLINE



Planning & Operational modes

Strategic Planning (One-Off)

Input design vessel
and select berth
configuration

Specify design
environmental
conditions (waves,
winds, tides)

One-off mooring
assessments

Specify operational
thresholds

Operational Mode (24/7 Planning & Ops System)

Input berth plan
for inbound
vessel

Environmental
conditions from
7-day forecast

Issue mooring
advisory to
vessel master

Update actual
mooring
configurations

Issue warnings if
required



The expert in **WATER ENVIRONMENTS**

Digital support/advisory to modern ports & terminals (Selected Cases)



Port Traffic Scheduling

Port of Vancouver, Canada

Port Rule Exceptions Edit

Edit a current port rule exception using the below fields.

Port Rule Exception Id: C

Description
TC2-2 No Daylight Restrictions for Container vessels < 230m LOA and Beam < 35m (Table 1, page 88)

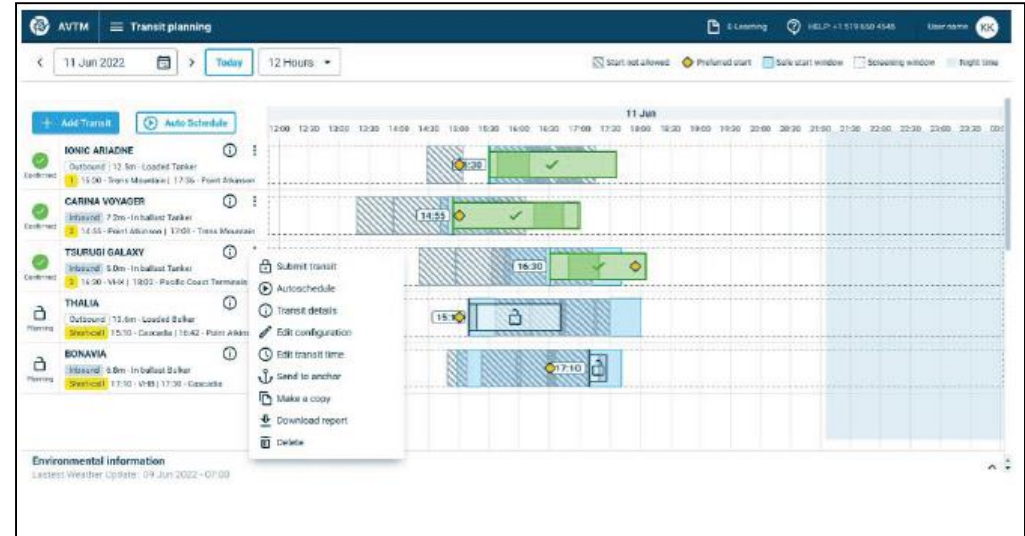
Vessel Definition
VesselType= Container Vessel AND Loa <= 230 AND Beam <= 35

Exceptions:
Set the port rules that exceptions should be made to below and the override value to be used

Port Rule Id and Type	Operator	Threshold	Start Waypoint	End Waypoint
Port rule id and type 1 - Current Speed Following Rule	Operator <	Threshold 0.5	Second narrows Rail Bridge	Icon Workers Bridge
Port rule id and type 2 - Daylight Only Rule	Operator =	Threshold False	Berry Point 2nd Narrows	Terminal Dock Light 2nd Narrows
Port rule id and type 4 - Current Speed Opposing Rule	Operator <	Threshold 2	Second narrows Rail Bridge	Icon Workers Bridge

[Add new Exception to Port Rule](#)

CANCEL SAVE EXCEPTION

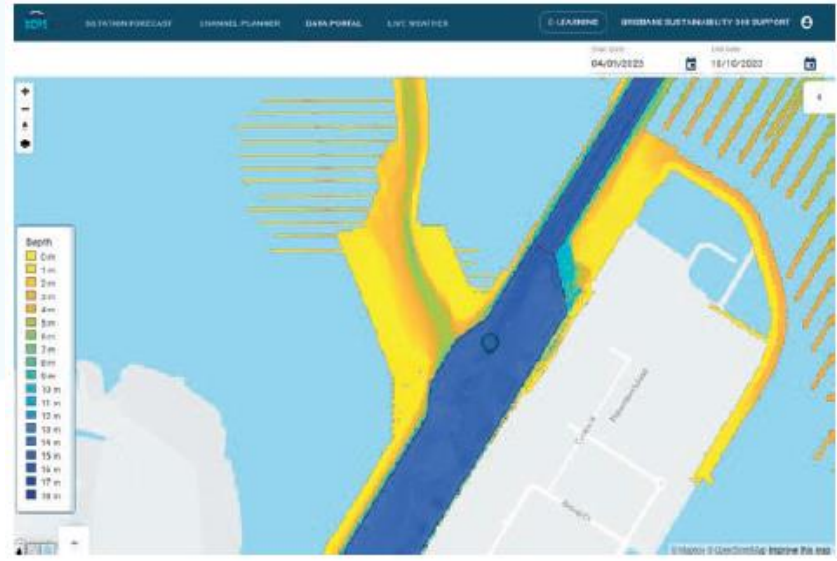


Digital Port Rule Management

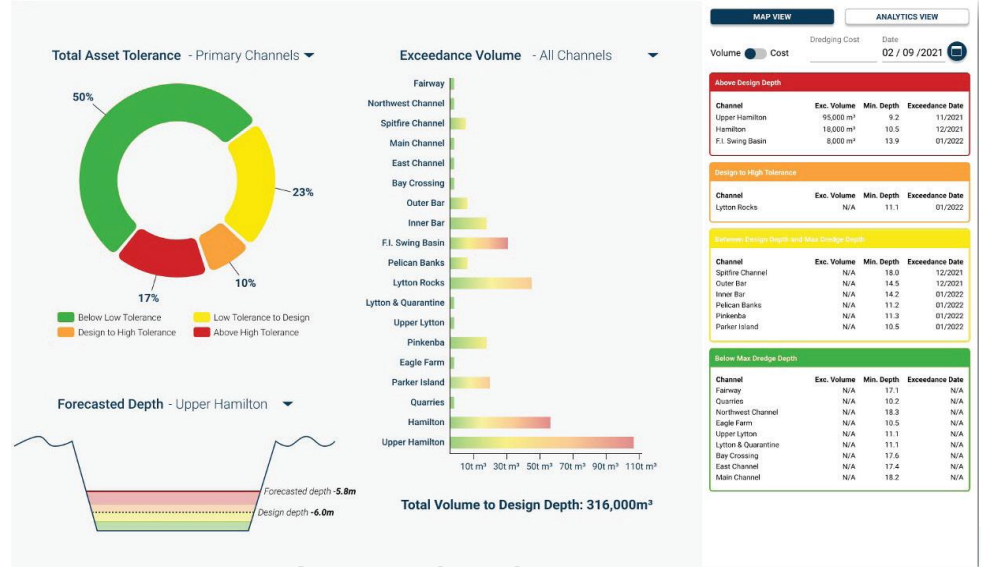
Integrated Scheduling Environment

Larger Vessels & Optimize Dredging

Port of Brisbane, Australia



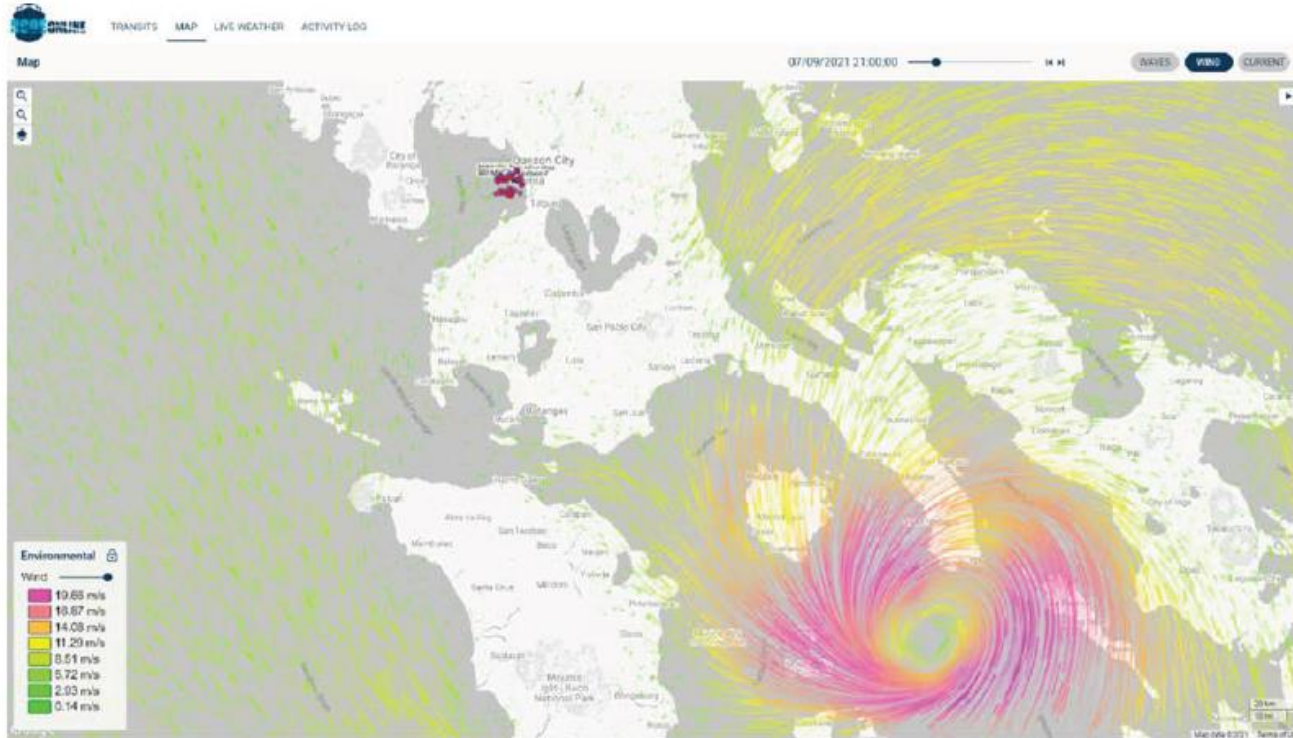
Instantaneous water depth



Asset depth manager

Safe Navigation & Weather Warning

Manila International Container Terminal (MICT) in the Philippines



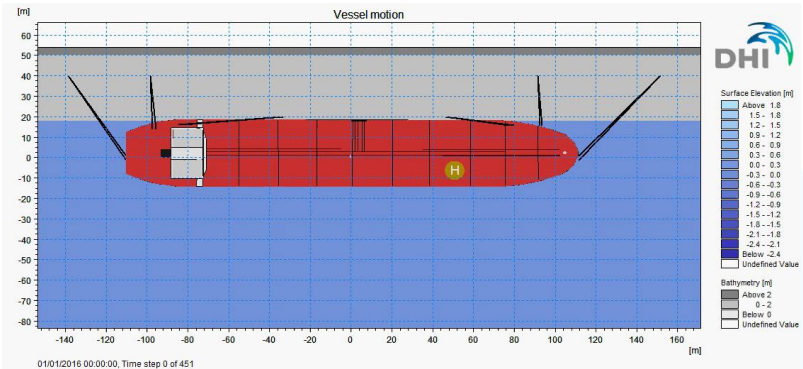
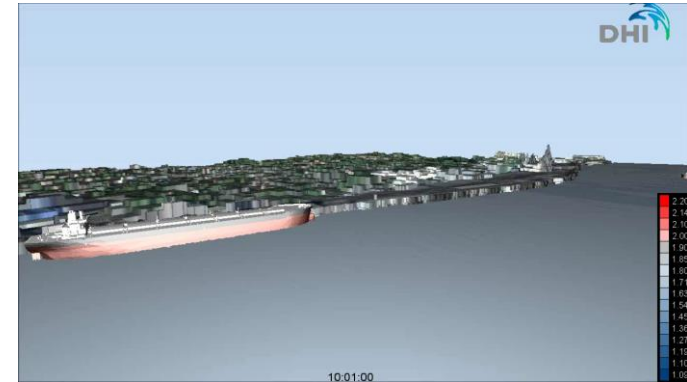
A typhoon weather system as viewed on NCOS dashboard



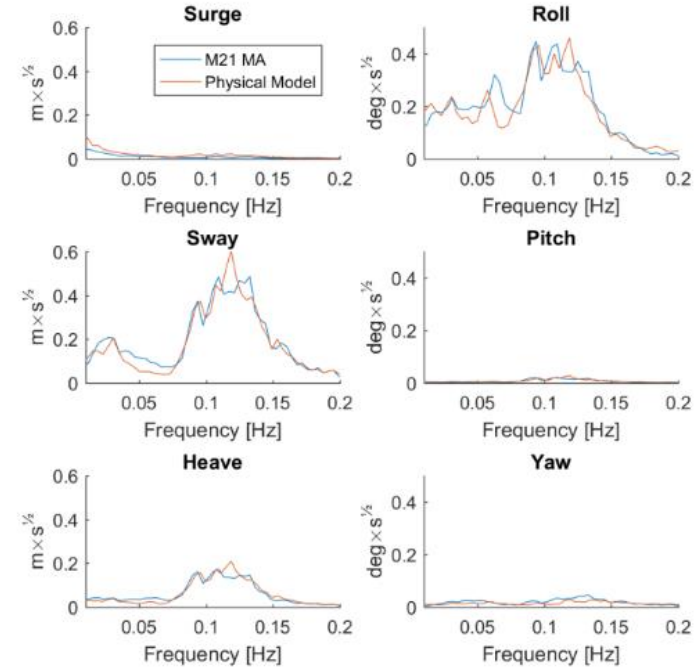
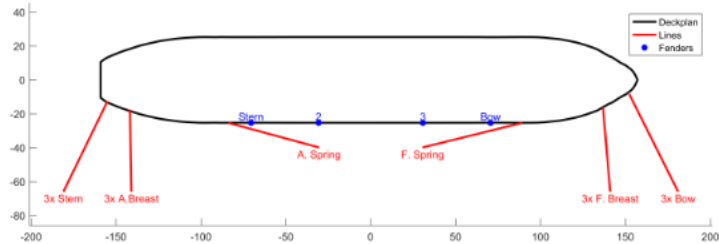
Dynamic Mooring Analysis (DMA)

MIKE21 MA

- Part of the MIKE software suite
- 3D vessel-water interaction and 6-DoF dynamic ship response
- Coupled with other MIKE models for accurate site-specific loading: wind, wave and currents
- Accurate definition of mooring elements
- Assess safety of mooring system under extreme conditions
- Define limits of permissible operational conditions



Validation of MIKE21 MA



Harkin, A., Mortensen, S.B., Dixen, M. “Validation of Moored Vessel Response Simulator with Physical Model Comparisons.” *Coasts & Ports Conference* – Cairns, Australia, 21-23 June 2017

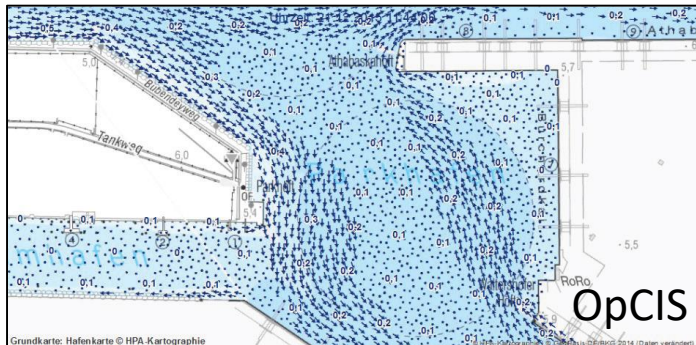


Mooring Program for The Port of Hamburg



NCOS ONLINE for Hamburg

- Challenges:
 - Development of shipping vessels
 - State of port infrastructure
 - Climate change
- Operational Current Information System for The Port of Hamburg (OpCIS), 2016
- Adoption of MIKE21 MA exclusively for DMA in the Port of Hamburg, 2017
- NCOS ONLINE MA module: the Mooring Program for the Port of Hamburg (VfHH), 2018



Dashboard for VfHH

VERTÄUBERECHNUNGEN

HAMBURG PORT AUTHORITY (HPA) PORT DHI TEST

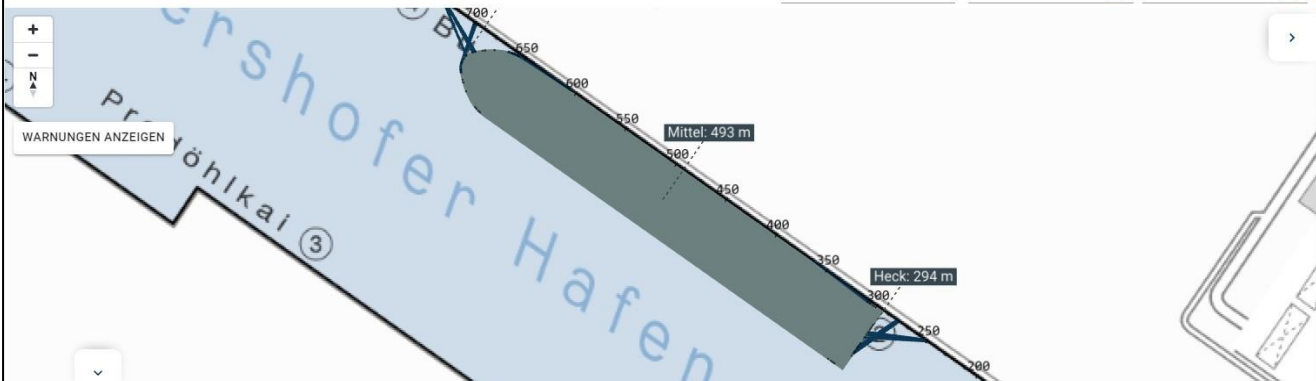
NUR ZU BEWERTUNGSZWECKEN.

Gehe zu: Europakai 5

Startdatum: 23/11/2023

Enddatum: 14/12/2023

Schiff: Emma



Szenario-Name *

Emma_20231130

Schiffsname / IMO

Emma Maersk

IMO-Nummer	Lukenhöhe über Hauptdeck [m] *
9321483	3.49
LOA [m] *	Schiffsbreite [m] *
397.7	56.4
	Brücke bis Bug [m] *
	141.2

Containerreihen über Deck [Lagen]

GMF [m] *

1

Leine	Festmacher	Klüse	Leinentyp	Vorläufertyp	Winschen
Alle Leinen setzen					
Alle Vorläufer setzen					
Alle Winschen					
⋮ Bug 1	↻ 38.2	↻ 2	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
⋮ Bug 2	↻ 38.1	↻ 3	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
⋮ Bug 3	↻ 38.1	↻ 4	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
⋮ Vordere Brust 4	↻ 36.1	↻ 1	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)

Tiefgang

Wert Bereich

Bug [m] *	Mittschiffs [m] *	Achtern [m] *
10	10	10

Statistiken

Verdrängung	149,591 tonnen
Container höhe über WSL	44,3 m

SPEICHERN & AUSFÜHREN

ABBRECHEN

NCOS Report

Effortless reporting:
streamlined DMA
results delivered
automatically to
Captains

Emma Meersk
IMO No. 9221463
Dynamic Mooring Analysis

Seaport OPX

Item	Specification	Item	Specification
IMO Number	Emma Meersk	Category	OTB
Class	Container Vessel	Amount of Berths	6
IMO No.	9221463	Bay	Burgholm 0-5
Length o. A.	300 m	Bay	042 036 m
Breadth o. A.	50 m	Mooring Arrangement	3-4-2
Depth	10.0 m	No. of Line Dials	18
Displacement	14950 t	Line MBL	120 kN
		Block BHC	90 t
		Block SWL	120 t
Turn on Deck	7	Gender Type	Cylindrical Header
Windage Area (A)	1770 m ²	Gender Diameter Length	1.8 x 2.0 2.2 x 2.5 m
Windage Area (D)	3320 m ²	Gender x Header Center	1100 1210 mm
		Gender's Max Deflection	0.5 0.6 m
Ballast Displacement	ND	Water Level	-1.55 - 2.50 m
		Windward	0° - 70°
		Direction of Wind	0° - 360°
		Current	Destroyed
		Wave	Destroyed
		Dynamic Concept	Destroyed

Results from Dynamic Mooring Analysis
First weak point of the mooring arrangement is reached during winds of 8 BR from 300-47.5°N
Weak Point: Berldr-08.2

Emma Meersk
IMO No. 9221463
Dynamic Mooring Analysis

Seaport OPX

Mooring Lines, Winches and Buoys Operating Units - Wind Analysis

Line	WLL	MBL	BHC	SWL
22.1P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
40.1P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
40.2P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.1P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.2P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.3P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.4P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.5P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.6P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.7P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.8P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.9P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.10P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.11P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.12P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.13P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.14P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.15P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.16P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.17P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.18P	100% (9000)	100% (9000)	100% (9000)	100% (9000)

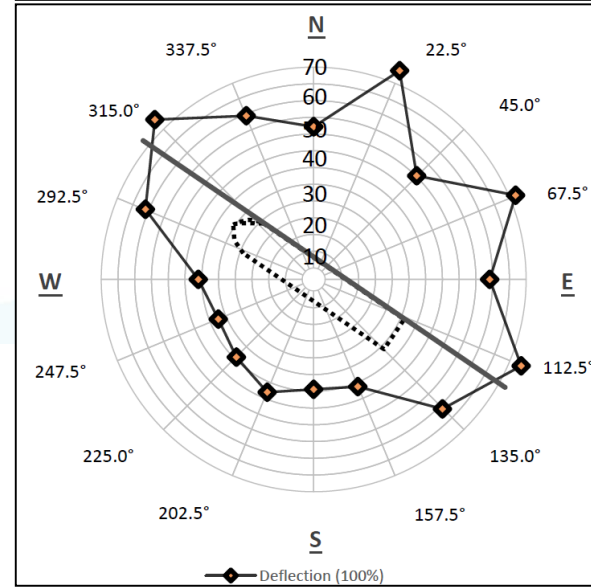
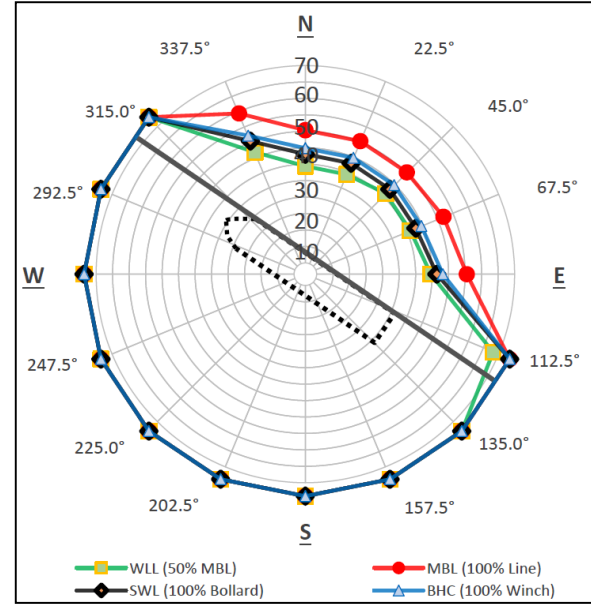
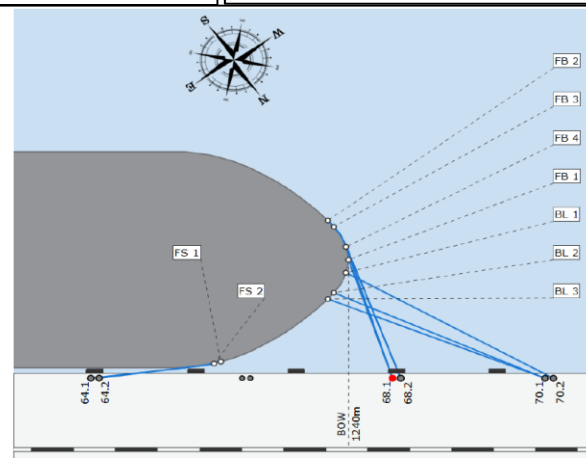
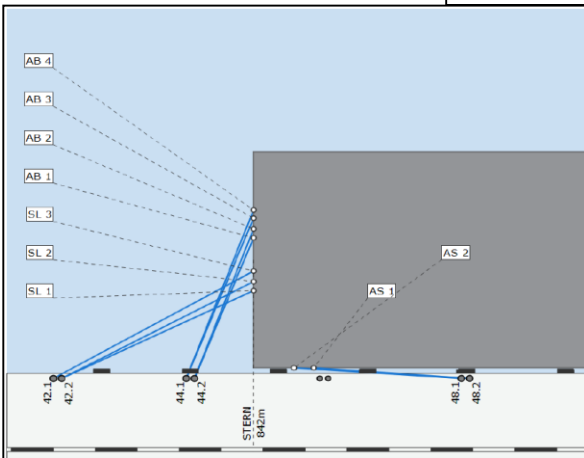
Header Operating Units - Wind Analysis

Header	WLL	MBL	BHC	SWL
40.1P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
40.2P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.1P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.2P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.3P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.4P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.5P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.6P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.7P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.8P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.9P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.10P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.11P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.12P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.13P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.14P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.15P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.16P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.17P	100% (9000)	100% (9000)	100% (9000)	100% (9000)
58.18P	100% (9000)	100% (9000)	100% (9000)	100% (9000)

WLL Working Load Limit, MBL Maximum Breaking Load, SWL Safe Working Load, BHC Brake Holding Capacity

Deflection (100%)

The information shown above is based on a single-buoy calculation model. Parameters such as the size and the location of the mooring equipment or the detailed size of the mooring area of the vessel could not be determined. The mooring line capacity MBL cannot be used for the vessel or mooring in regions that could not be verified with the provided information.





Concluding Remarks

Concluding Remarks

- NCOS ONLINE is an award-winning operational platform for port operations from DHI
- It assists ports/canals/terminals to increase safety, reduce/manage risks and increase capacity: service larger vessels with minimal/without extra dredging
- Acts as a virtual environment to test new developments and increase efficacy of investments
- We work together with the port/canal authorities and terminal operators to develop the most efficient solution for their needs



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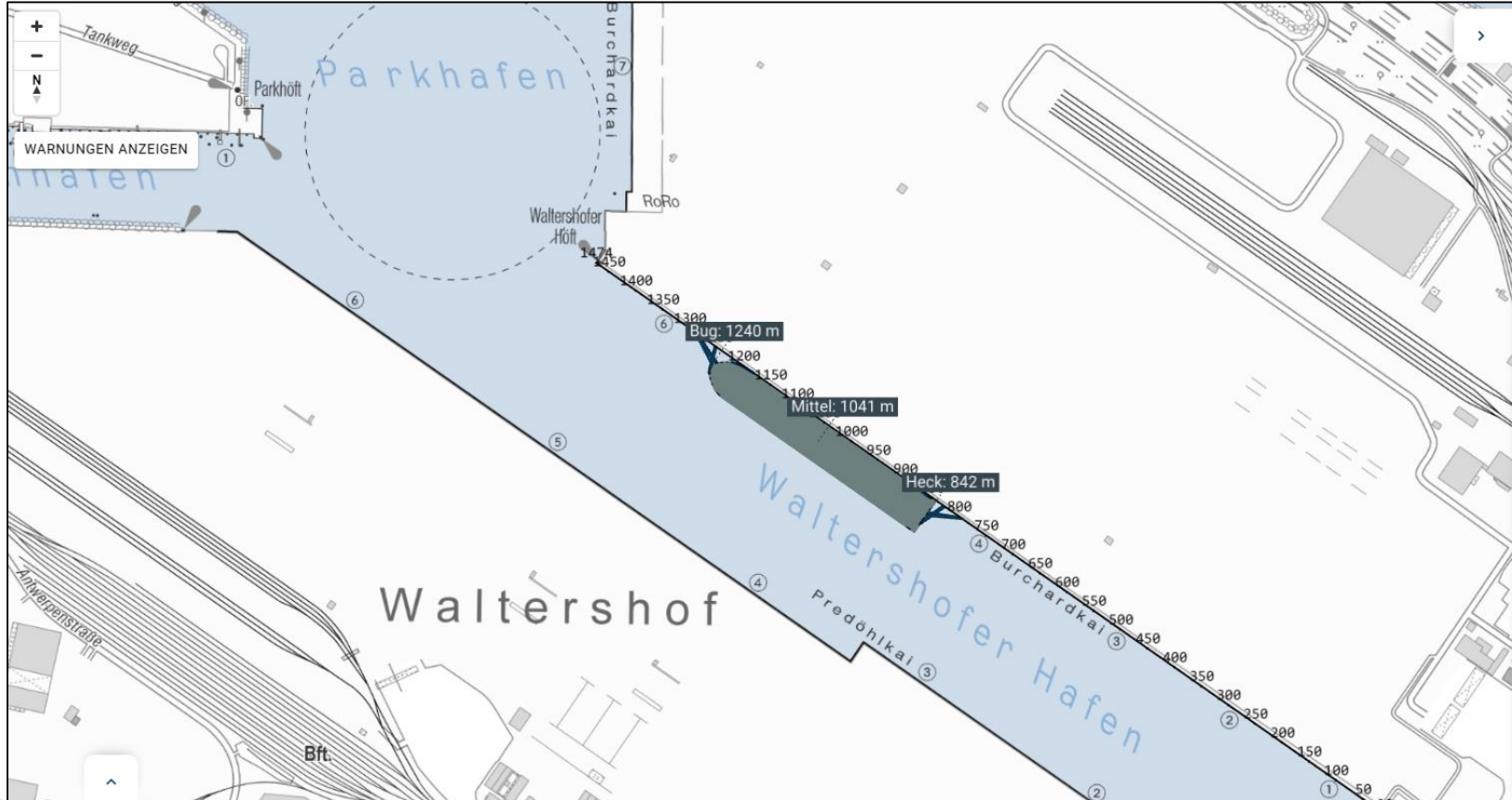
Thank You




The expert in **WATER ENVIRONMENTS**



GIS system of the Port



Selection of Mooring Arrangements


VERTÄUBERECHNUNGEN

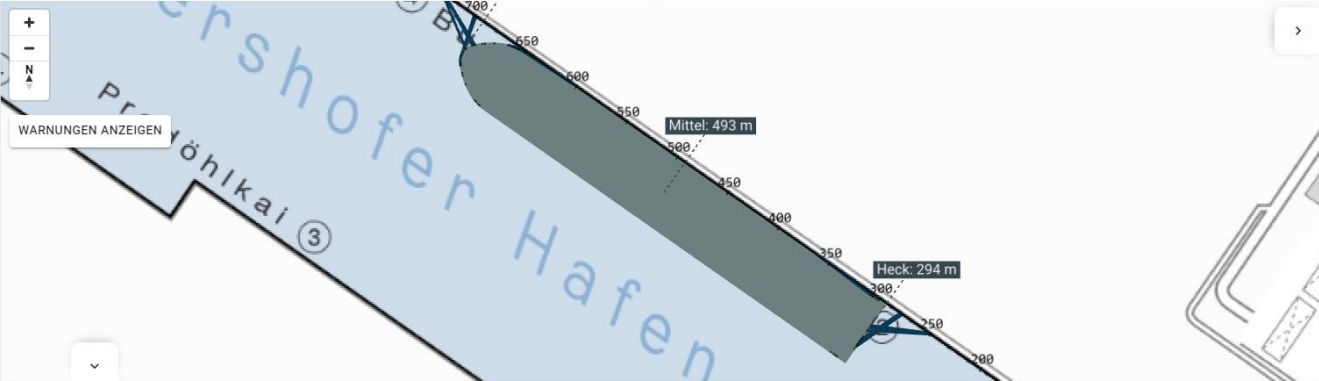
HAMBURG PORT AUTHORITY (HPA) PORT DHI TEST

NUR ZU BEWERTUNGSZWECKEN.

Gehe zu: Europakai 5

Startdatum: 23/11/2023

Enddatum: 14/12/2023



Schiff: Burchardkai 3

Liegeplatz: Burchardkai 3

Umweltbedingungen:

Liegeplatz*
Burchardkai 3

Liegeplatzmarkierungen

Bug [m]*	Heck [m]*
692	294

VERTÄUANORDNUNG

Vertäuanordnung* 3x4x2 Anleger Steuerbord

	Bug	Brust	Spring	Heck
Leinen	3	4/4	2/2	3

Trossenvorspannung

Wert Wertebereich

Trossenvorspannung [tonnes]

10

Statistiken

Reichweite überschreitet Schiffsbreite 1.1 m

Lichte Höhe unter dem Greifer 19.5 – 23.2 m

Kieflfreiheit 6.85 – 10.59 m


Deck über Kaje 12.6 – 16.4 m

Solltiefe INHNI 18.5 m

SPEICHERN & AUSFÜHREN
ABBRECHEN

Leine	Festmacher	Klüse	Leinentyp	Vorläufertyp	Winschen
<i>Alle Leinen setzen</i>			<i>Alle Vorläufer setzen</i>		
Bug 1	38.2	2	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
Bug 2	38.1	3	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
Bug 3	38.1	4	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
Vordere Brust 4	36.1	1	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)

Selection of Loading Conditions


VERTÄUBERECHNUNGEN


HAMBURG PORT AUTHORITY (HPA) PORT DHI TEST

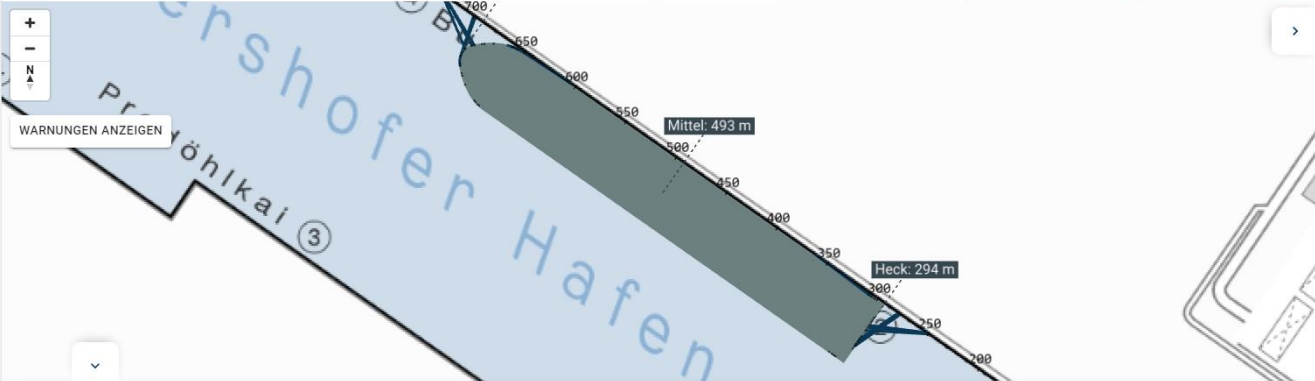
NUR ZU BEWERTUNGSZWECKEN.

Gehe zu
 Europakal 5

Startdatum
 23/11/2023

Enddatum
 14/12/2023





WARNUNGEN ANZEIGEN

Mittel: 493 m

Heck: 294 m

Schiff Liegeplatz Umweltbedingungen

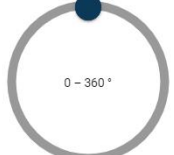
Wind

Wertebereich

Geschwindigkeit [kn]

0 — 10 — 70

Richtung [deg]



0 - 360°

(RICHTUNG "KOMMT AUS")

Tidewasserstand [NHN]

Wert Wertebereich

Vorhersage

Tidewasserstand [m]

-1.6 — 2.1

SPEICHERN & AUSFÜHREN
ABBRECHEN

Leine	Festmacher	Klüse	Leinentyp	Vorläufertyp	Winschen
			Alle Leinen setzen		
			Alle Vorläufer setzen		Alle Winschen
⋮ Bug 1	38.2	2	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
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⋮ Bug 3	38.1	4	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)
⋮ Vordere Brust 4	36.1	1	Polyester Polypropylen Polyethylen Polyolefin (used) (129t)	Polyester Polypropylen Polyethylen Polyolefin (used) (161t)	Electric (9)