



Ordine degli Ingegneri
della Provincia
di Roma



Infrastrutture, Sistemi e Servizi GNSS per il settore Marittimo

Aula 3

17 Aprile 2024

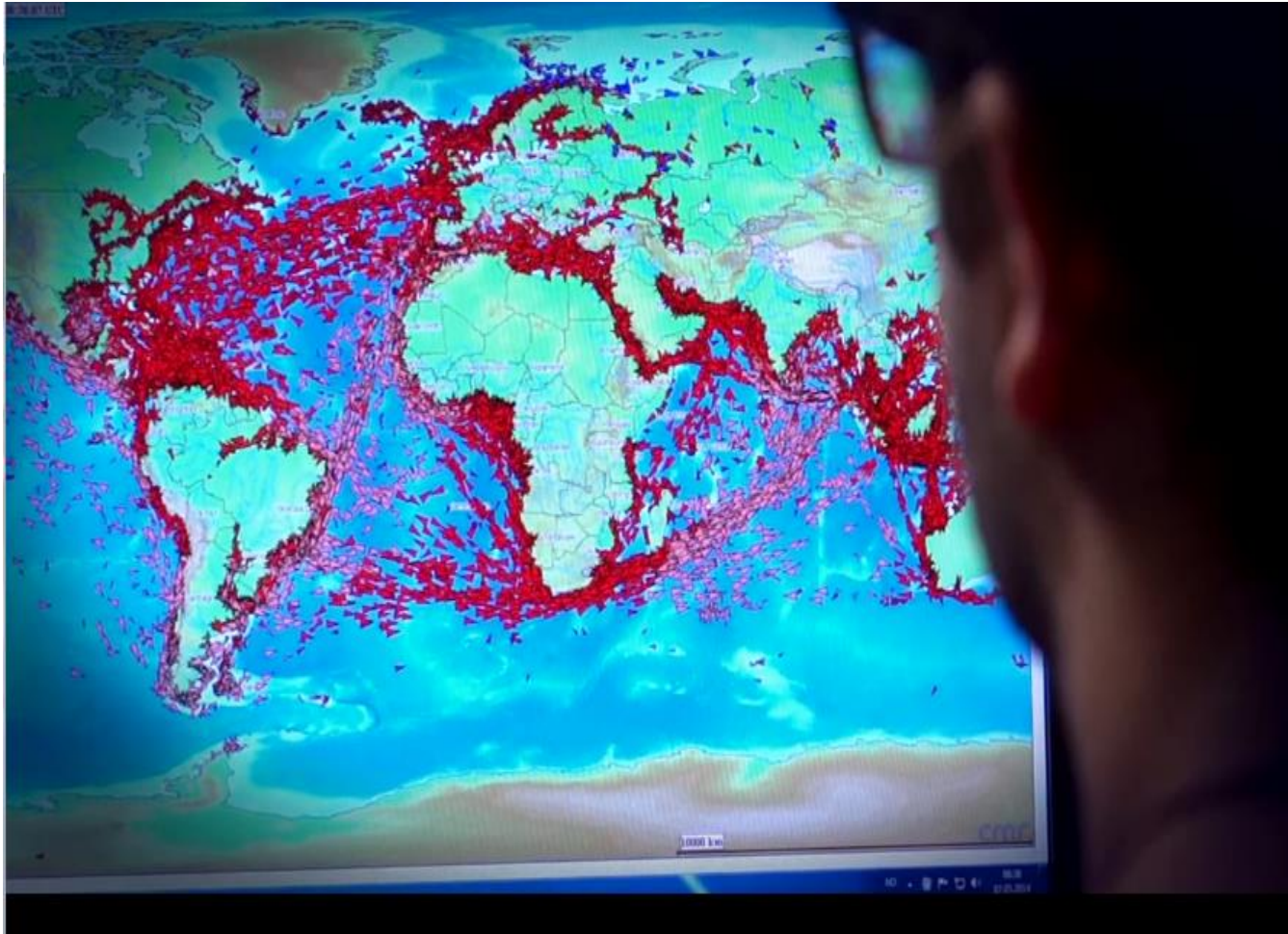
Ordine degli Ingegneri della Provincia di Roma
Piazza della Repubblica 59 Roma

Ore 16:00 – 16:30

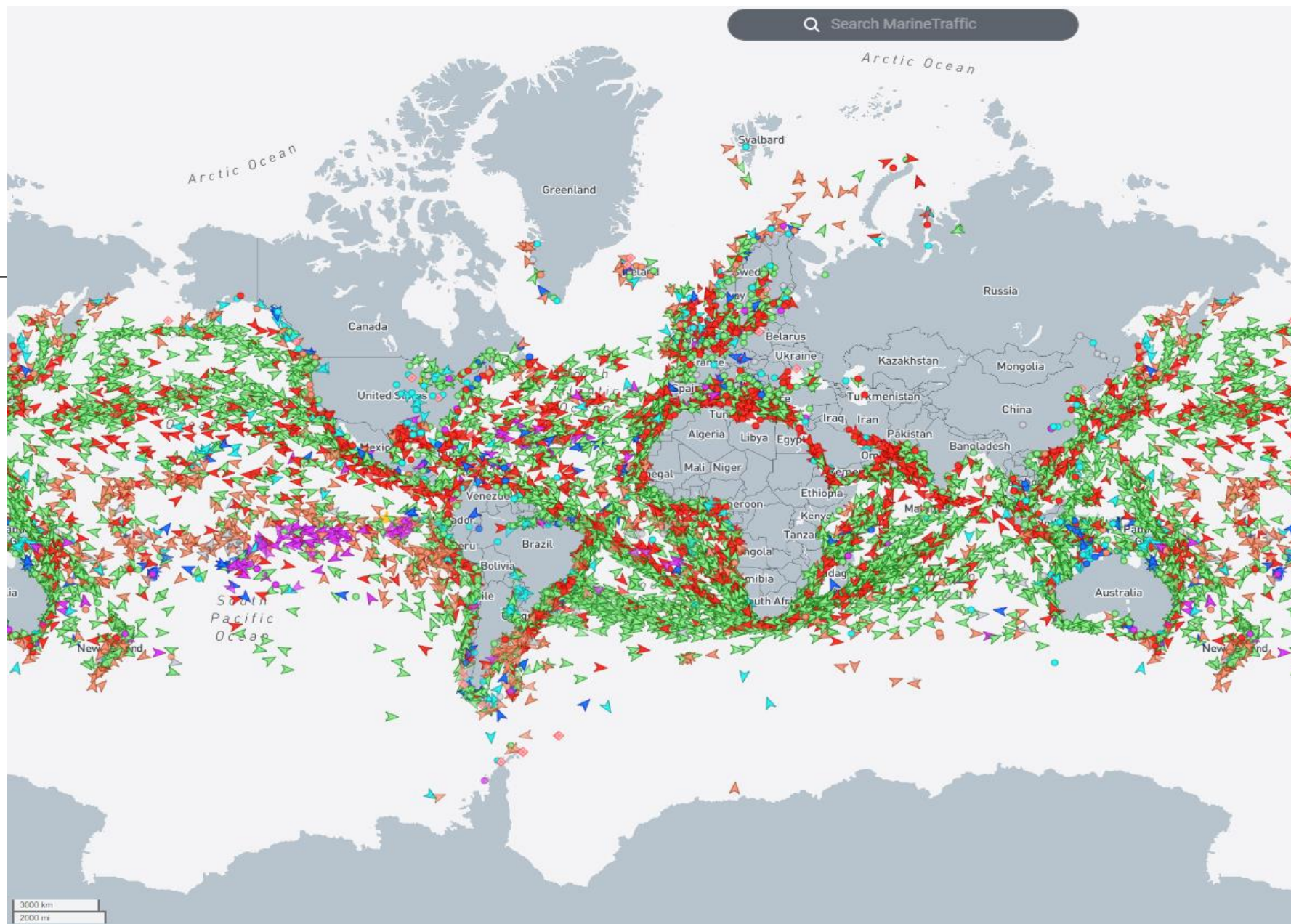
Ing. Michele Fiorini

Leonardo

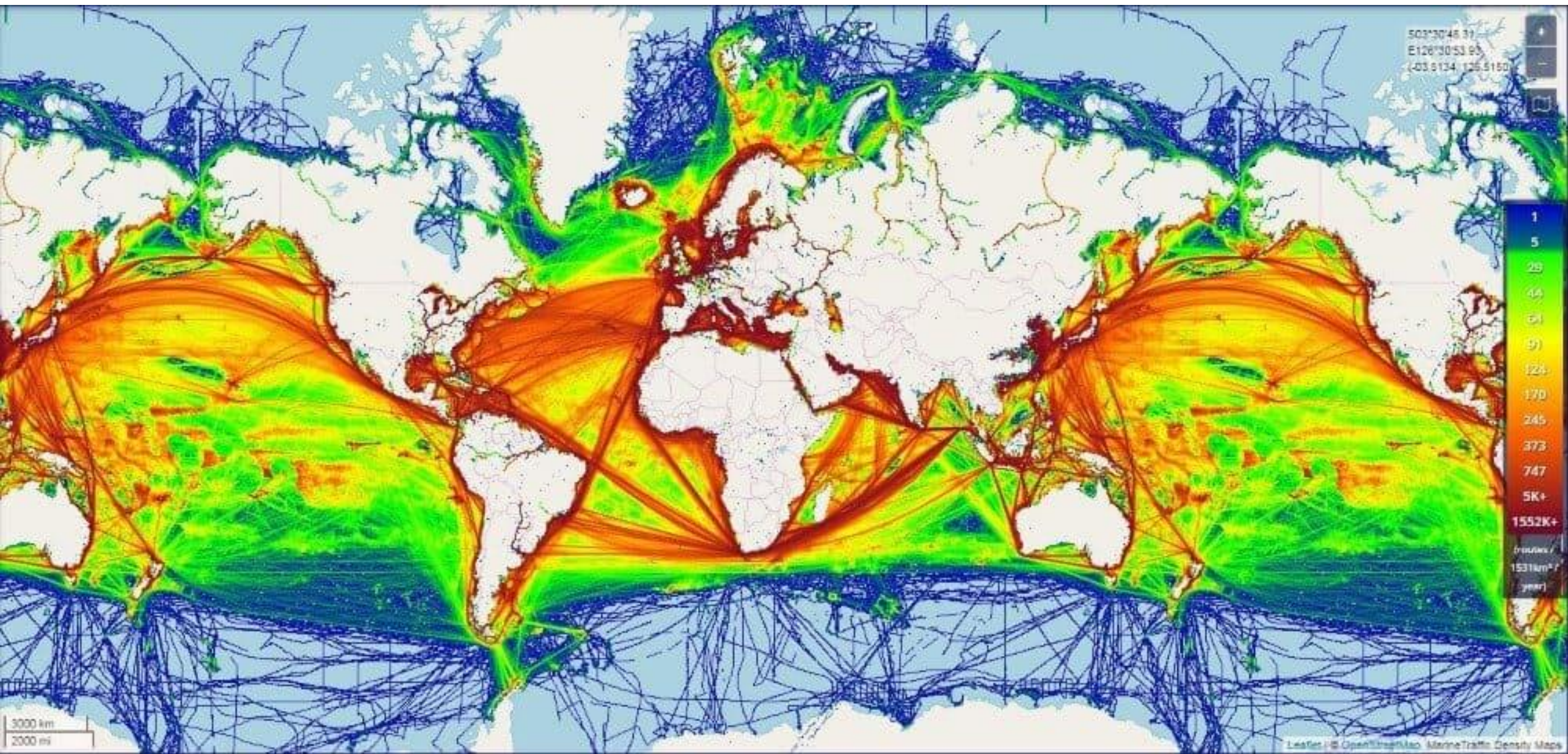
**“Digitalizzazione e servizi satellitari per il trasporto
marittimo”**



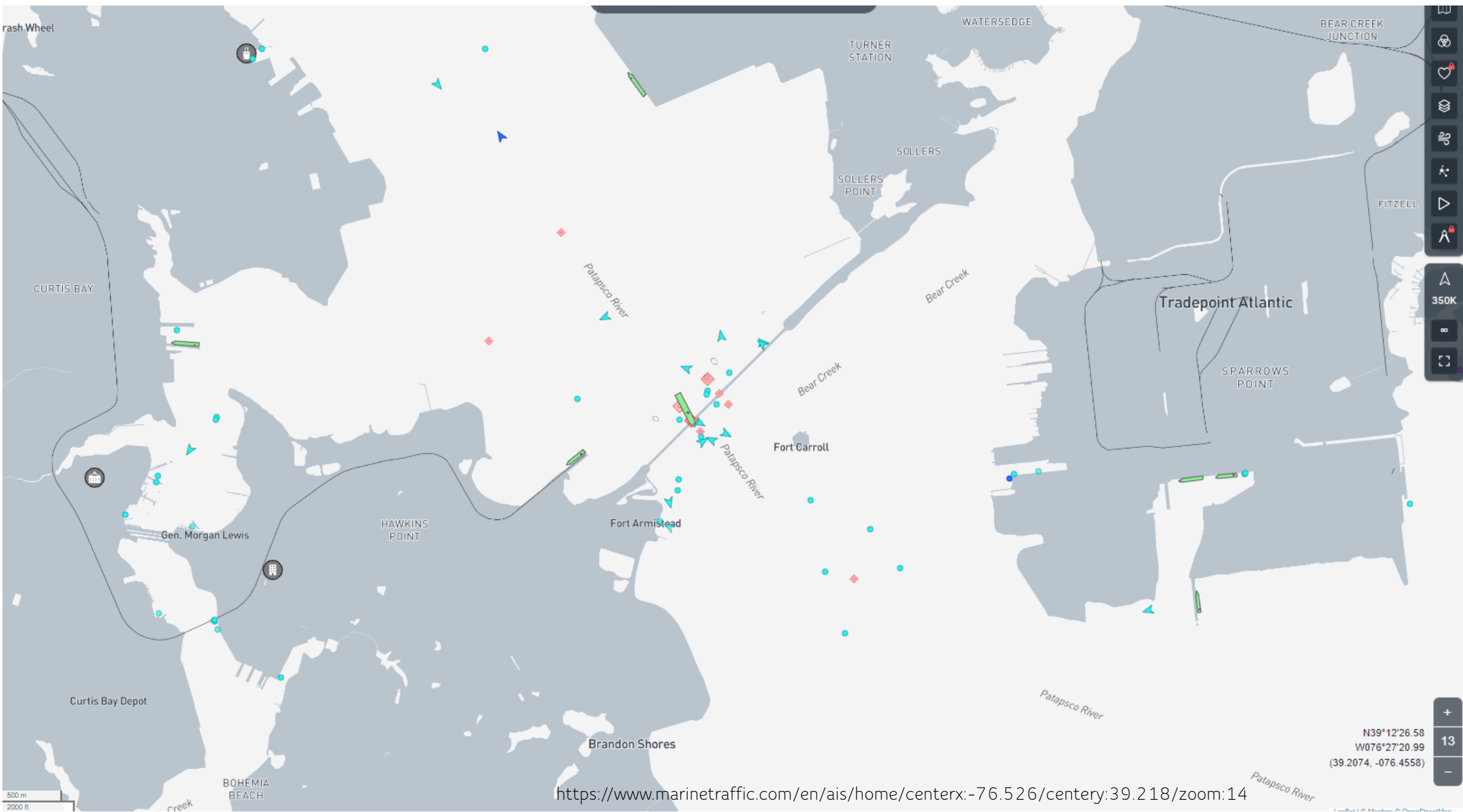
This study represents the opinions of the author and is the product of professional research. It is not meant to represent the position or opinion of the Leonardo S.p.A., nor the official position of any staff/employ members. Any errors are the fault of the author.



<https://www.marinetraffic.com/en/ais/home/centerx:-76.526/centery:39.218/zoom:14>

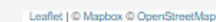


<https://www.marinetraffic.com>





mfiorini.eu





DUBAI, April 15 (Reuters) - A Portuguese-flagged container ship, the MSC Aries, was seized by Iran on April 13 for "violating maritime laws", Iran's foreign ministry said on Monday, adding that there was no doubt the vessel was linked to Israel. Iran's Revolutionary Guards seized the cargo vessel in the Strait of Hormuz days after Tehran vowed to retaliate for a suspected Israeli strike on its consulate in Damascus on April 1. Iran had said it could close the crucial shipping route. (Source: reuters.com)



MSC Aries (IMO 9857169), registered **Madeira**, flag of **Portugal**. Managed by MSC Ship Management (**Cyprus**) Ltd., which belongs to **Geneva**-based MSC, owned by **Italian** national Gianluigi Aponte. MSC has Chartered the ship from the company Zodiac Maritime Ltd., **London**. Owned by Eyal Ofer, born in **Israel** and based in **Monaco**. The ship was built in 2020 by Hyundai HI in Ulsan, Republic of **Korea**. It is classed by Lloyd's Register (**UK**) and has protection and indemnity (P&I) insurance from Steamship Mutual (UK). Last port was Khalifa (UAE), destination Jawaharlal Nehru (India). The crew (25) are from **India, Philippines, Pakistan** and **Russia**.

Credit to: Jan Hoffmann (Head, Trade Logistics at UNCTAD) with data by Clarksons Research, Shipping Intelligence Network (clarksons.net)

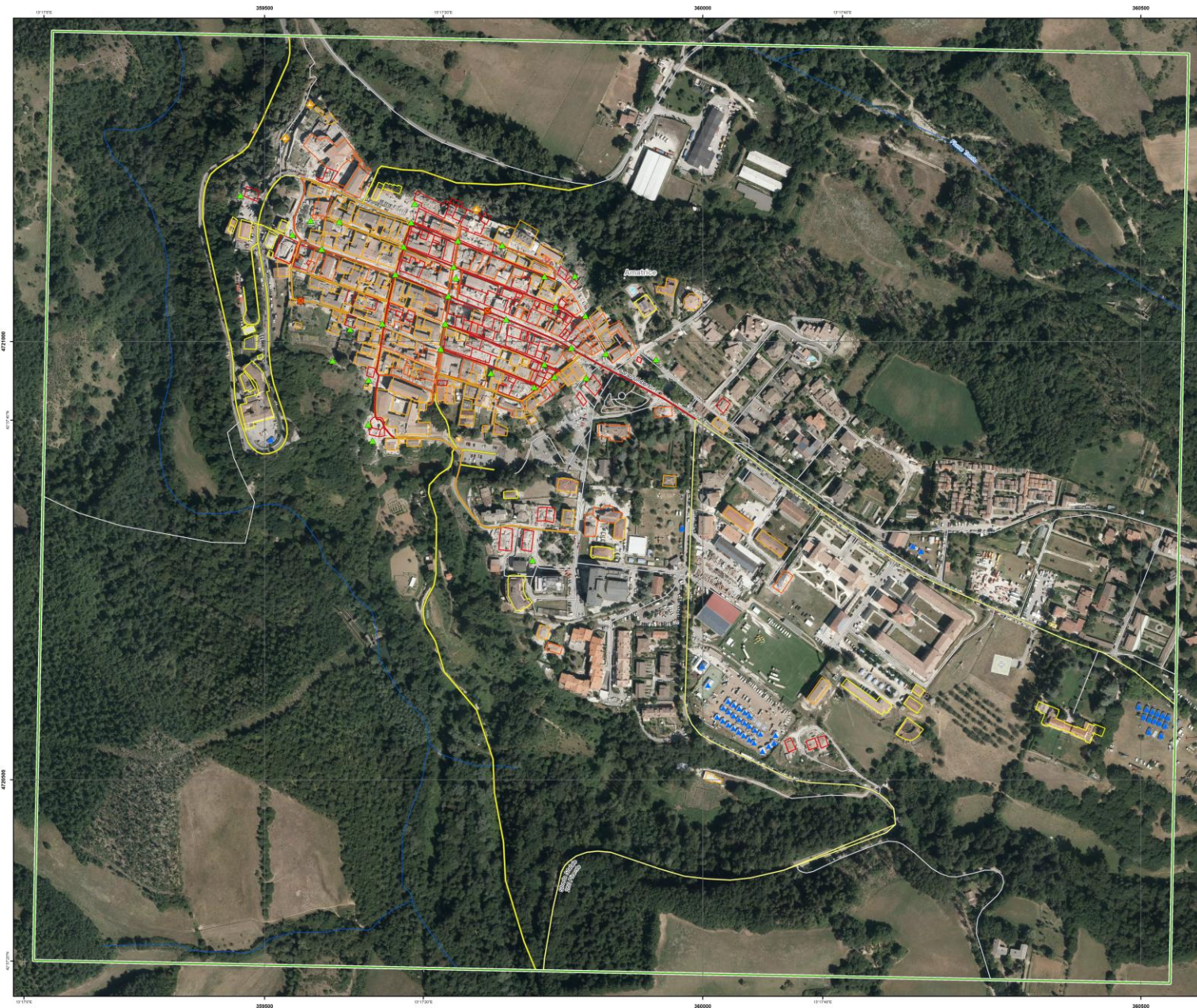
An official slides down a rope during a helicopter raid on MSC Aries ship at sea in this screen grab obtained from a social media video released on April 13, 2024. Video obtained by Reuters/via REUTERS/File Photo [Purchase Licensing Rights](#)

2024-04-14



Planet Satellite Imagery
(planet.com)

TankerTrackers.com



GLIDE number: EQ-2016-000095-ITA Activation ID: EMSR177
Product N.: 20MATRICEAERIAL_v3_English

Amatrice Aerial - ITALY **Earthquake - Situation as of 25/08/2016** **Grading Map**



Cartographic Information

1:2000 Full color ISO A1, high resolution (300 dpi)



Grid: WGS 1984 UTM Zone 33N map coordinate system
Tick marks: WGS 84 geographical coordinate system

Legend

- Crisis Information**
 - ▲ Test
 - ◆ Landslide
 - Road Block
 - ▲ Debris
- Building Grading**
 - Destroyed
 - Highly Damaged
 - Moderately Damaged
 - Negligible to slight damage
- Transportation Grading**
 - Road, Destroyed
 - Road, Highly Damaged
 - Road, Moderately Damaged
 - Road, Negligible to slight damage
- General Information**
 - Area of Interest
 - Populated Place
 - Hydrology**
 - Stream
 - Transportation**
 - Tunnel
 - Primary Road
 - Local Road
 - Land use - Land Cover**
 - Features available in vector data
 - Physiography**
 - Features available in vector data

Observations within the AOI									
Observed position	Observed date	Observed time	Observed location	Observed description	Observed status	Observed severity	Observed impact	Observed action	Observed result
Road block	Amatrice	25/08/2016	10:00	Road block	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road block	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road block	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road block	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road block	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road block	Blocked	High	100	100	100
Transportation	Amatrice	25/08/2016	10:00	Road, Highly Damaged	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road, Highly Damaged	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road, Highly Damaged	Blocked	High	100	100	100
Land use	Amatrice	25/08/2016	10:00	Road, Highly Damaged	Blocked	High	100	100	100
	Castelluccio	25/08/2016	10:00	Road, Highly Damaged	Blocked	High	100	100	100

Map Information

In the last hours of 2016 August 2016 an earthquake occurred in the north of Italy involving a very large territory including several Regions (Lazio, Abruzzo, Umbria) and Municipalities. After the main shock several others occurred in the area producing casualties and damages on structures and infrastructure. The Italian Civil Protection is currently in action and has requested support to various damage information in the affected areas.

The present map shows the earthquake damage grade assessment in the area of Amatrice (AOI). The satellite layer has been derived from post-event satellite image by means of visual interpretation. The estimated geometric accuracy is 5 m CE90 or better, from native positional accuracy of the background satellite image.

Relevant date records			
Event	25/08/2016	Execution as of	25/08/2016
Activation	25/08/2016	Map production	31/08/2016

Data Sources

Pre-event image: Orthophoto 30m/Orthophoto20m © 2014 CONSORZIO Tsk (formed by +GEOS S.p.A. - CDR S.p.A. - Amatrice Italia srl) - ALL RIGHTS RESERVED
Post-event image: Aerial data © European Commission (acquired on 25/08/2016 10:00 UTC, GSD 0.1 m, 0% cloud coverage) provided under COPERNICUS by Copernicus Emergency Response Team (ERT)

Style vector layer: OpenStreetMap © OpenStreetMap contributors, Wikimedia.org, GeoNames 2016, Geoparser Nazionale © Ministero dell'Interno (http://www.pia.internap.it), Infocad by the producer, Infocad by the producer
Inset maps: JNC 2011, © EuroGeographics, Natural Earth 2012, CCM River DB © EuroGeographics, GeoNames 2016

Disclaimer

Products elaborated in this Copernicus EMS Rapid Mapping activity are realized to the best of our ability within a very short time frame, optimizing the available data and information. All geographic information has limitations due to scale, resolution, date and interpretation of the original sources. The map and the information content are derived from satellite data without any validation by the producer, reflecting the contents of the data as they are received by the producer and by the European Union.

Map produced by +GEOS (member of +GEOS (EOO))
For the latest version of this map and related products visit
http://emergency.copernicus.eu/mapping/fat-of-components/EMSR177
ems-rapid-mapping@ec.europa.eu
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For full Copyright notice visit http://emergency.copernicus.eu/mapping/articles/copernicus-ems-mapping-portal/





This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 607821.



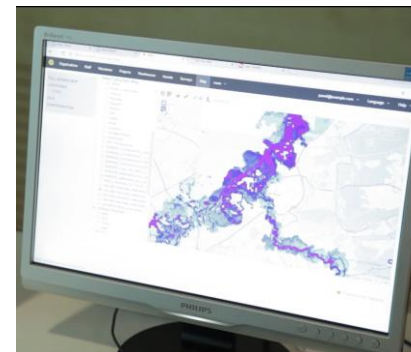
1. Leonardo S.p.A.
2. e-GEOS
3. Universidad Politecnica de Valencia
4. ASELSAN Elektronik Sanayi ve Ticaret A.Ş.
5. FOI Swedish Defence Research Agency
6. ITTI Sp. z o.o.
7. Consorzio Interuniversitario Nazionale per l'Informatica
8. Saadian Technologies Limited
9. Universitaet Stuttgart
10. THALES Research and Technology
11. Police Service of Northern Ireland
12. Institute of Security and Public Order - Police Academy in Szczytno
13. Inter Agency Emergency Management Office
14. Szkoła Główna Służby Pożarniczej
15. Stichting Studio Veiligheid
16. International Centre for Ethics in the Sciences and Humanities

Secure European Common information space for the interoperability of first Responders and police authorities

Importing Weather Maps



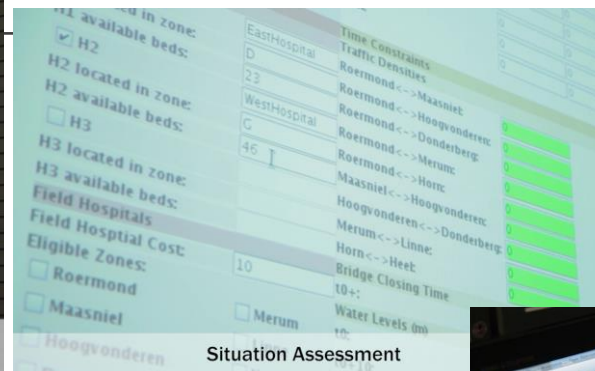
Loading COPERNICUS map of the possible affected area



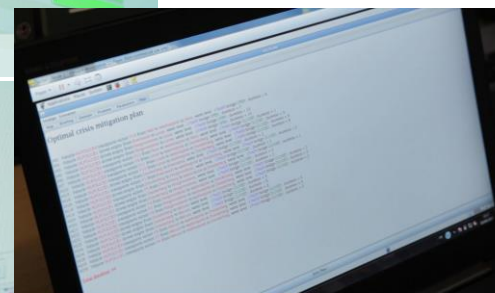
SECURE EUROPEAN COMMON INFORMATION SPACE
FOR THE INTEROPERABILITY OF FIRST RESPONDERS
AND POLICE AUTHORITIES



Rome, 5th april 2017
Final Demonstration



Situation Assessment



Elaboration of Crisis Mitigation Plans



Receive and display International Support Request



Receive and display International Support Request



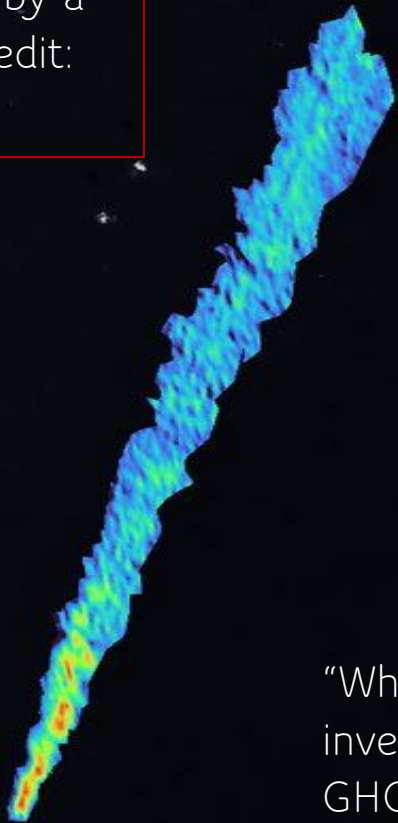


Gas leaking in the Baltic Sea from one of the damaged Nord Stream pipelines seen bubbling up to the surface by a Pléiades Neo satellite. (Image credit: Airbus/Pléiades Neo)



Baltic Sea

Gas leak detected by the GHGSat satellite



Canadian firm GHGSat used its satellite to measure the amount of greenhouse gas methane escaping from the broken pipelines. (Image credit: GHGSat)

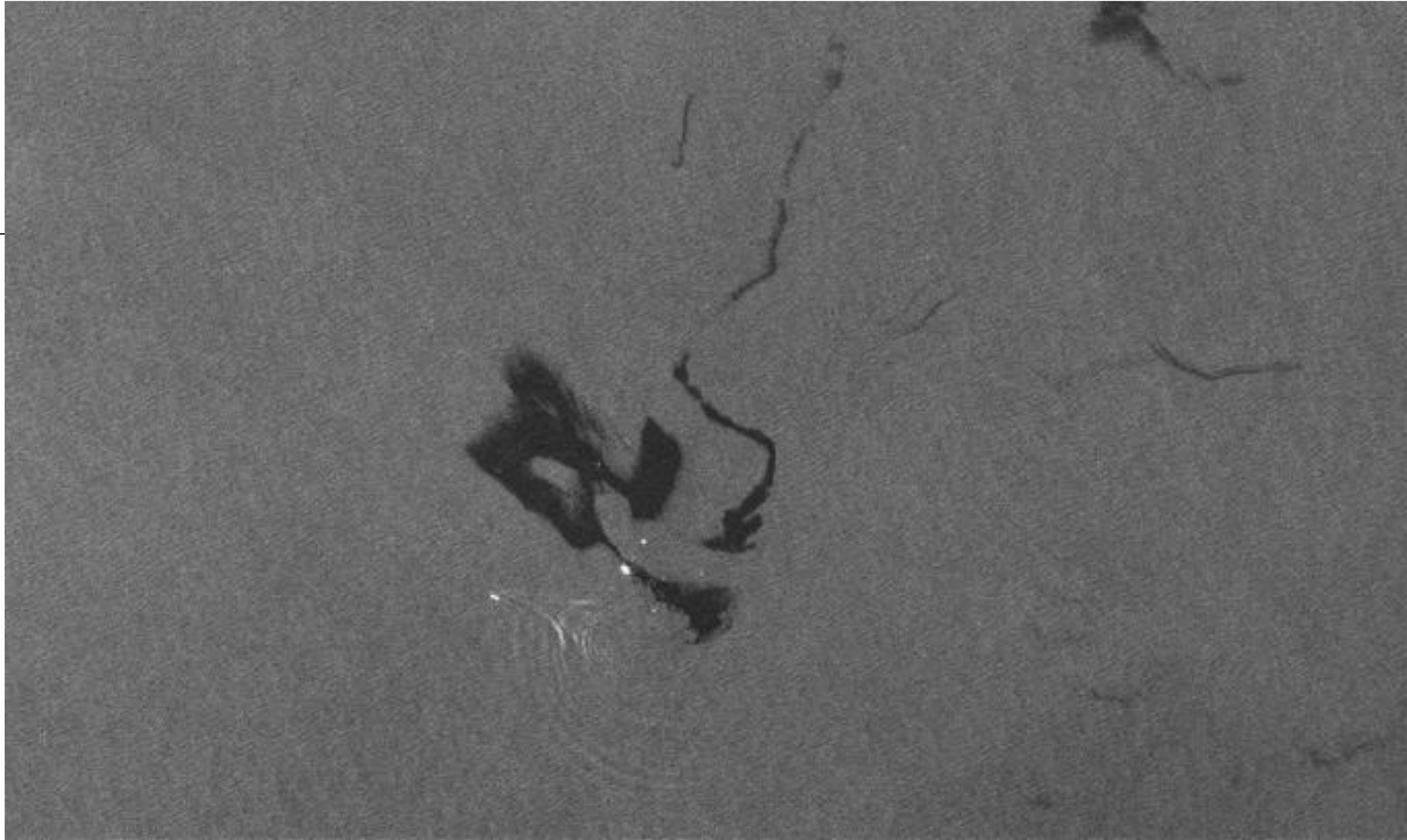
“While we await further investigation on the cause, GHGSat responded quickly, measuring 79,000 kg per hour of methane coming from the leaks.”



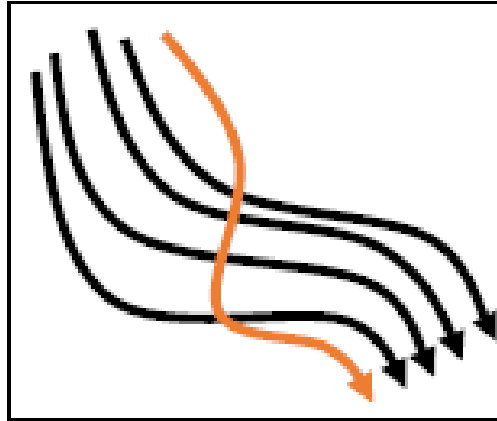
2 km

Oil Spill

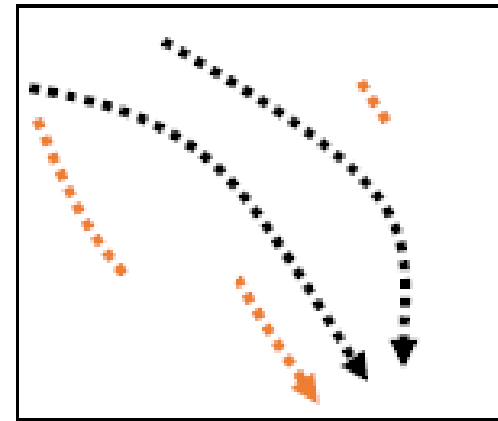
G. Soldi *et al.*, "Space-Based Global Maritime Surveillance. Part I: Satellite Technologies," in *IEEE Aerospace and Electronic Systems Magazine*, vol. 36, no. 9, pp. 8-28, 1 Sept. 2021, doi: 10.1109/MAES.2021.3070862.



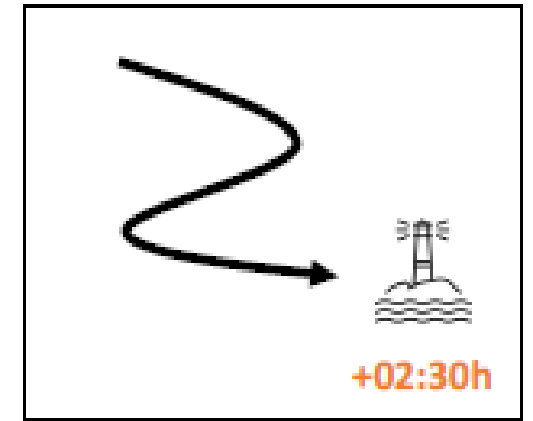
Anomalous behaviors



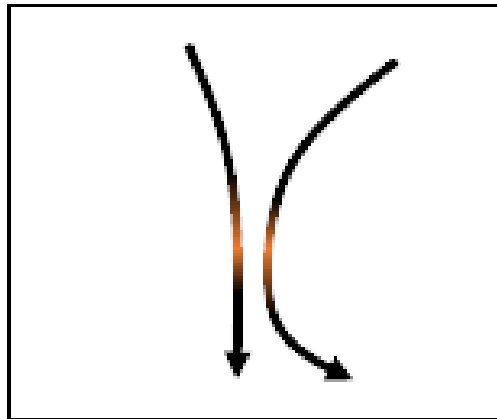
(a) Route Deviation



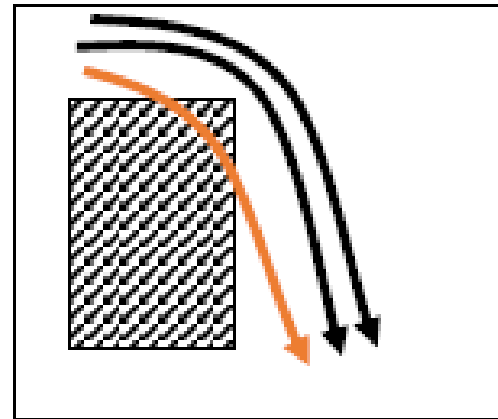
(b) Unexpected Activity



(c) Port Arrival



(d) Close Approach

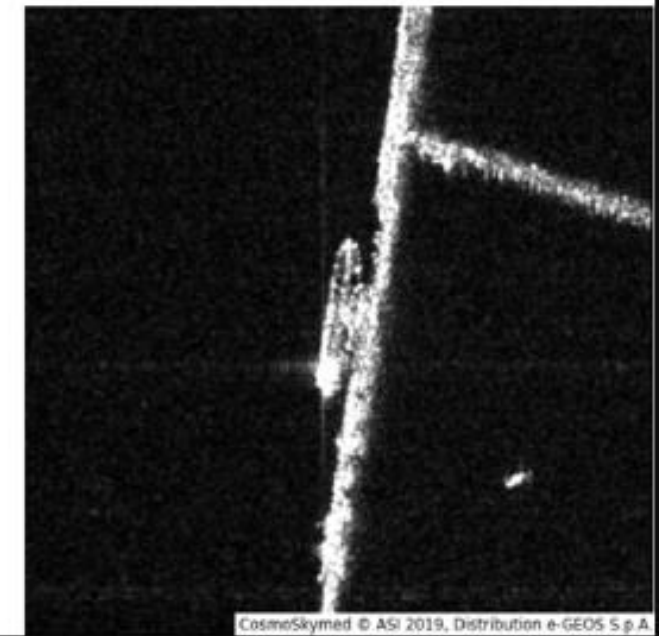
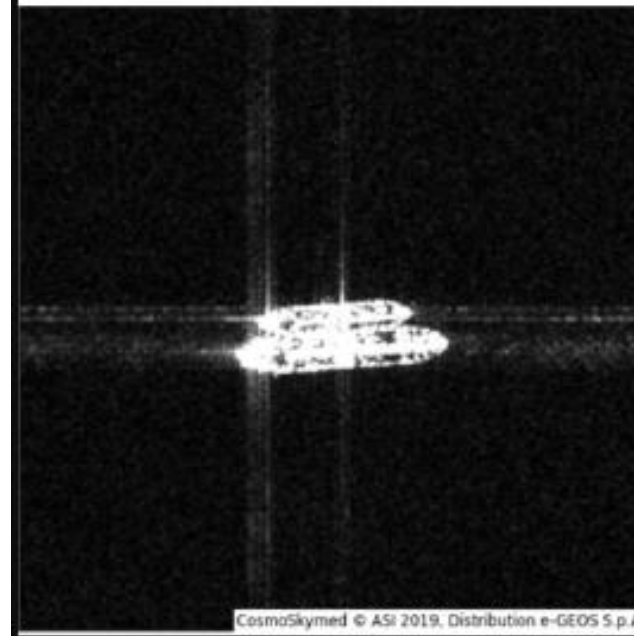
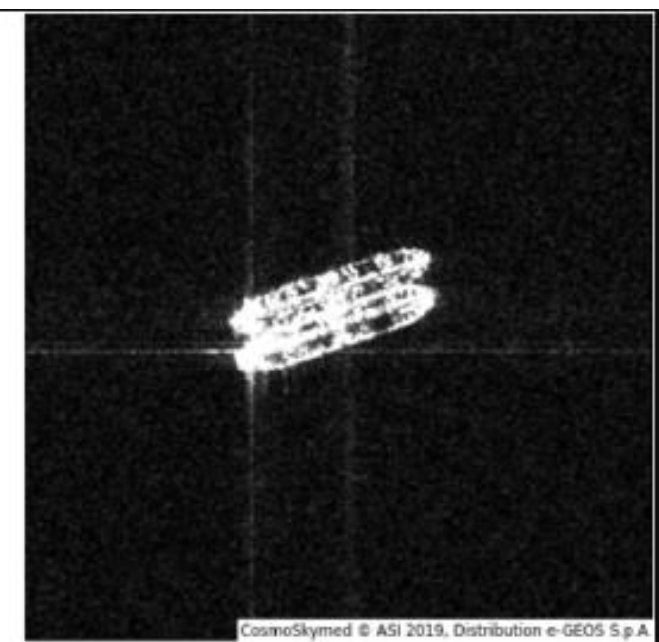
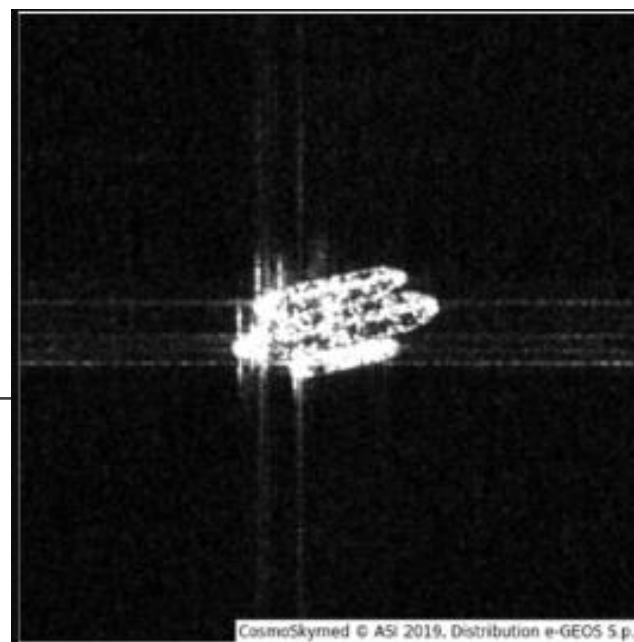


(e) Zone Entry

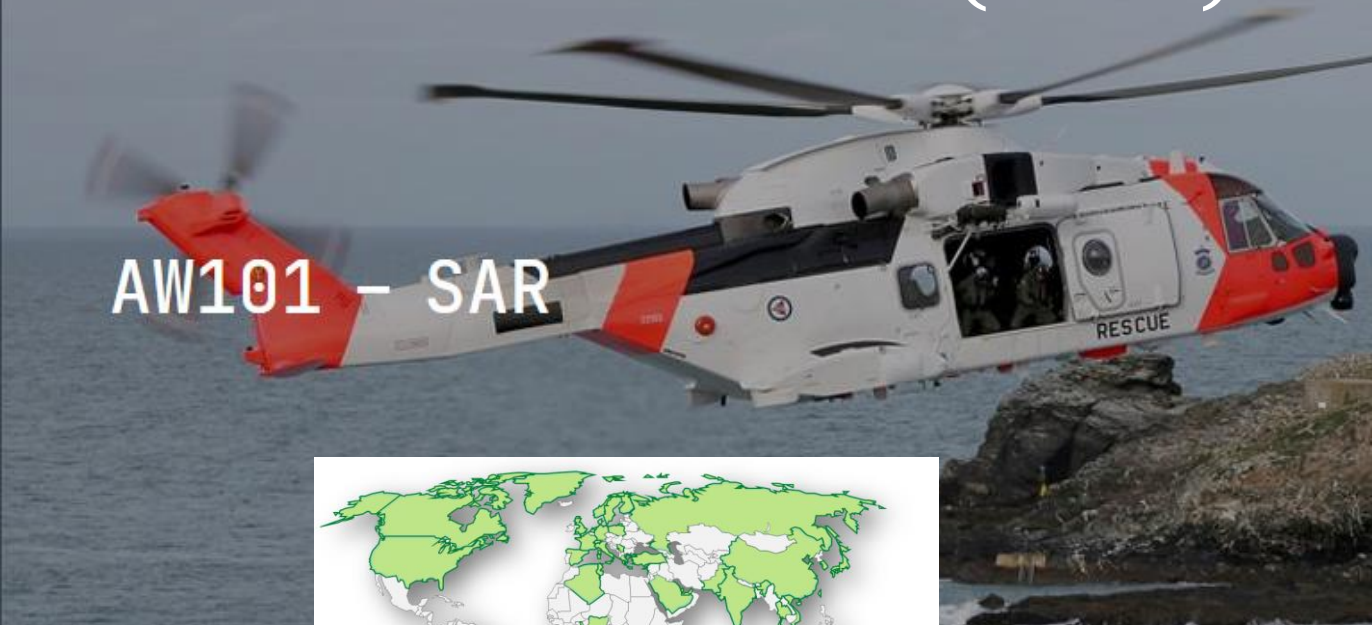
Wolsing, K.; Roepert, L.;
Bauer, J.; Wehrle, K. Anomaly
Detection in Maritime AIS Tracks:
A Review of Recent Approaches. J.
Mar. Sci. Eng. 2022, 10, 112. <https://doi.org/10.3390/jmse10010112>

Ship Meeting

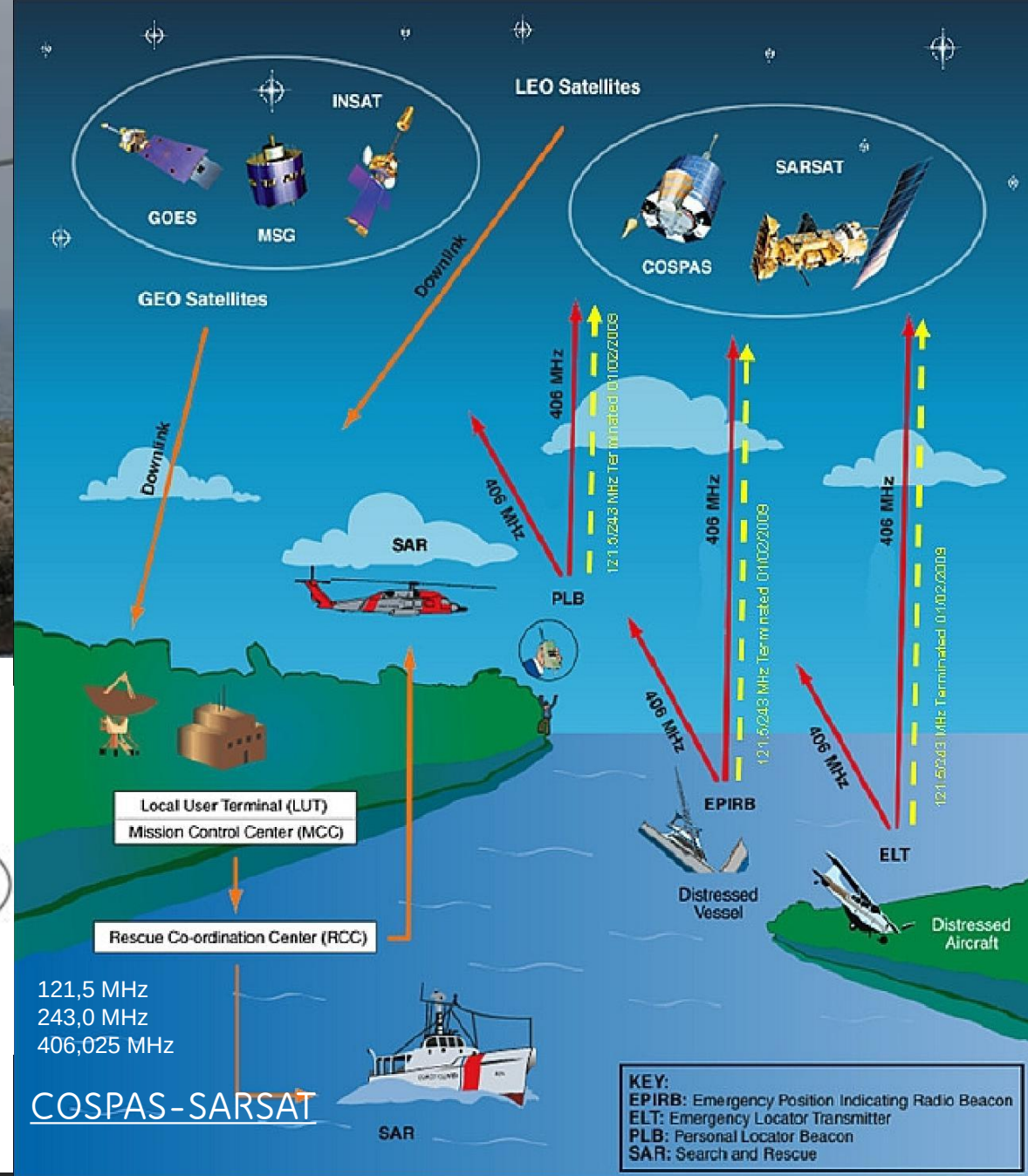
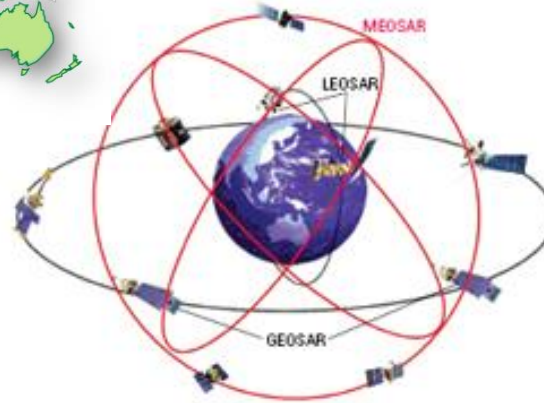
G. Soldi *et al.*, "Space-Based Global Maritime Surveillance. Part I: Satellite Technologies," in *IEEE Aerospace and Electronic Systems Magazine*, vol. 36, no. 9, pp. 8-28, 1 Sept. 2021, doi: 10.1109/MAES.2021.3070862.



Search And Rescue (SAR)



COSPAS is an acronym for the Russian words "*Cosmicheskaya Sistema Poiska Avariynyh Sudov*", which translates to "Space System for the Search of Vessels in Distress".
SARSAT is an acronym for Search And Rescue Satellite-Aided Tracking

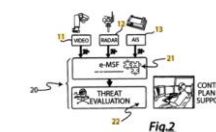
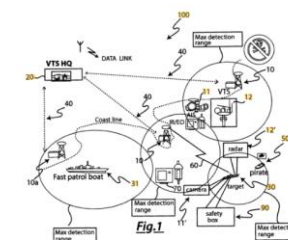




US009183711B2

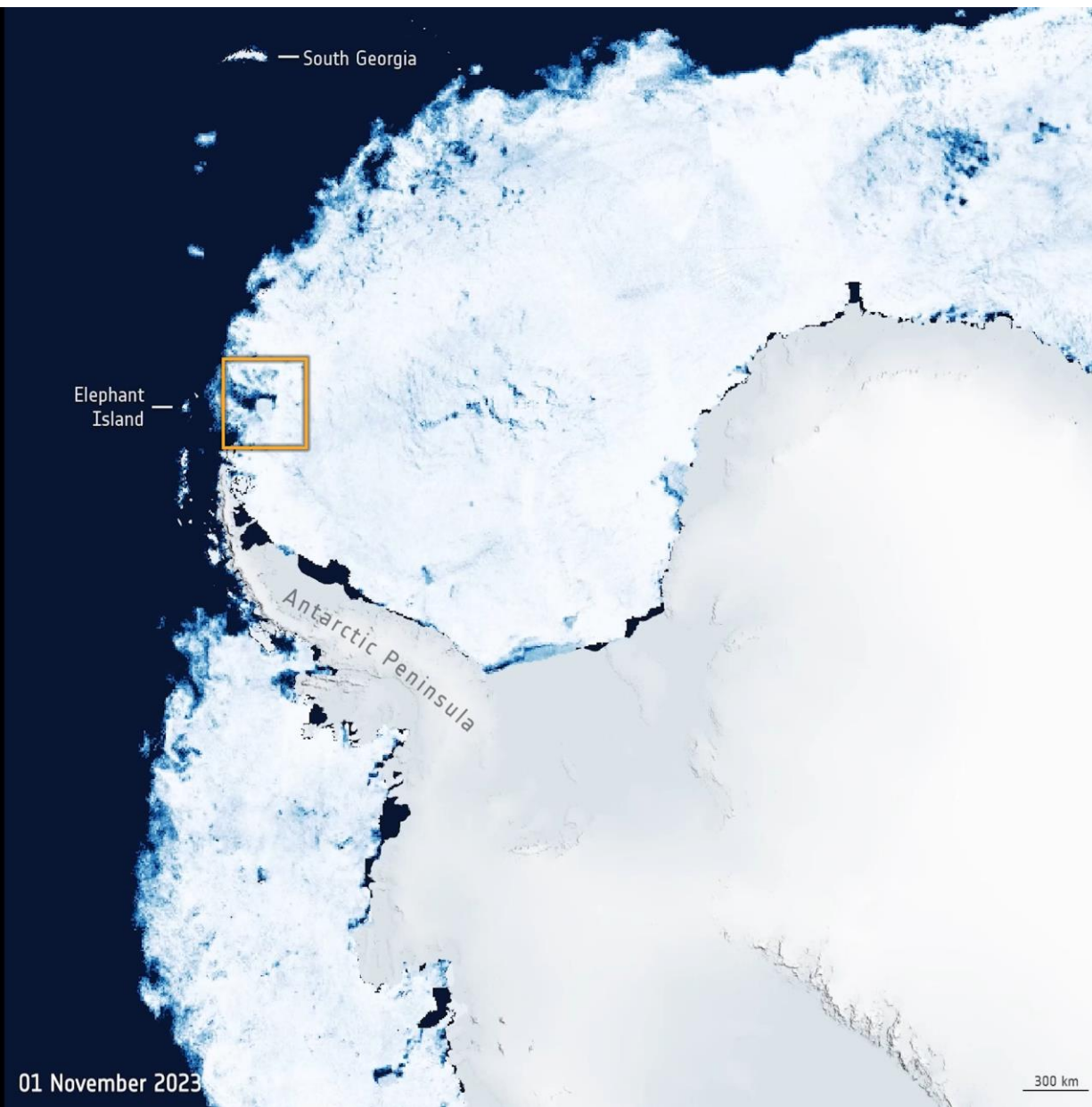
(12) **United States Patent**
Fiorini et al.

(10) **Patent No.:** **US 9,183,711 B2**
(45) **Date of Patent:** **Nov. 10, 2015**





The A23a mega iceberg 4000 sq km in area, (more than four times the size of New York City), and just over 280 m thick.

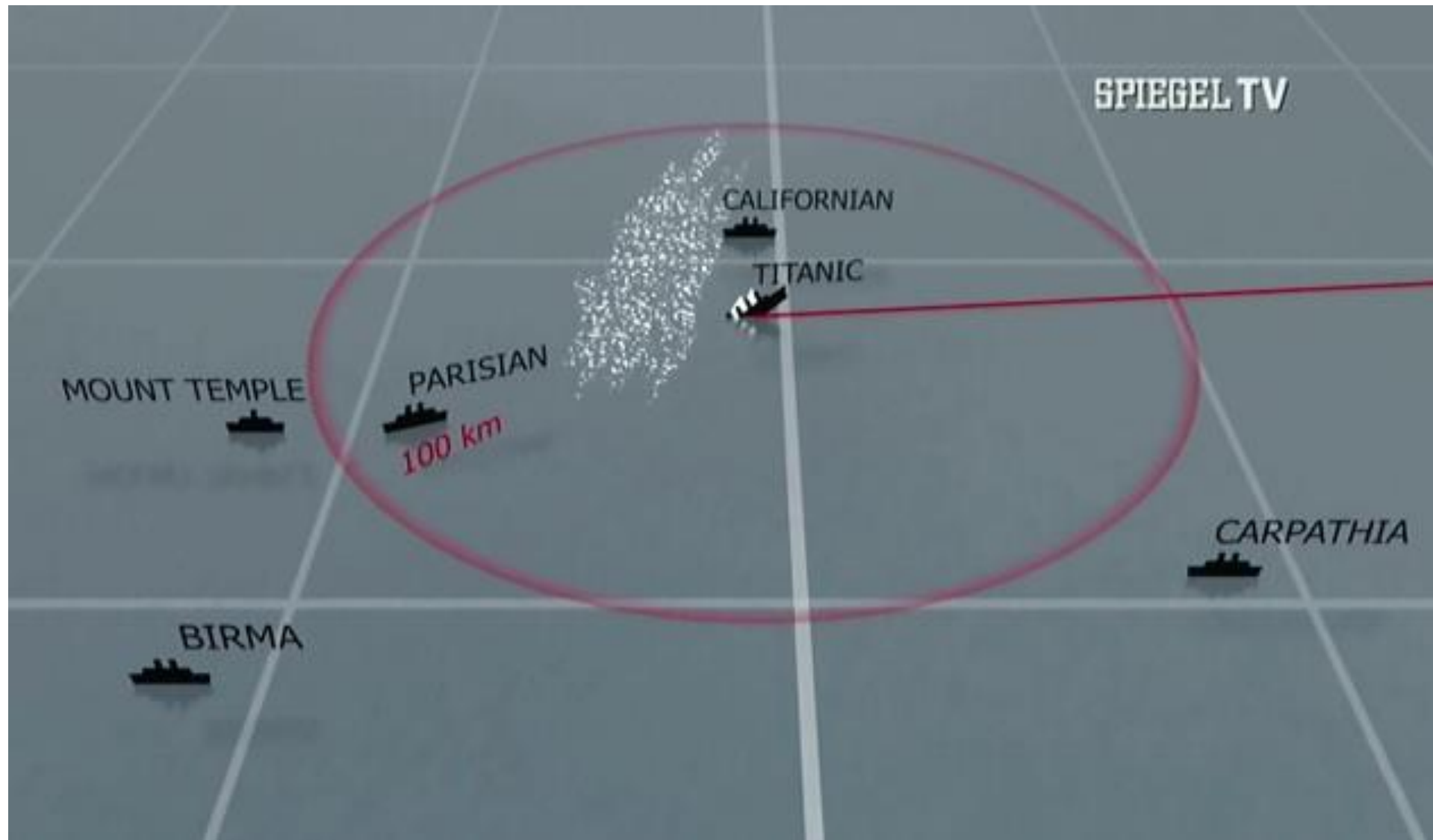




ANSA FOTO
Gallurainformazione.it

14 April 1912





At 11:40 p.m. 14-Apr-1912 Titanic struck an iceberg about 400 miles off Newfoundland, Canada.

At the beginning crew underestimates the damage.

At 12.15 a.m 15-Apr-1912 Cpt Edward Smith orders Jack Phillips (radio operator) begins transmitting "CQD MQY" (MQY were Titanic's call letters). Fellow radio operator Harold Bride suggest also to begin sending "SOS MQY"

The *Californian* does not respond: switched off radio 10 min before Titanic's accident.

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SPIEGEL TV



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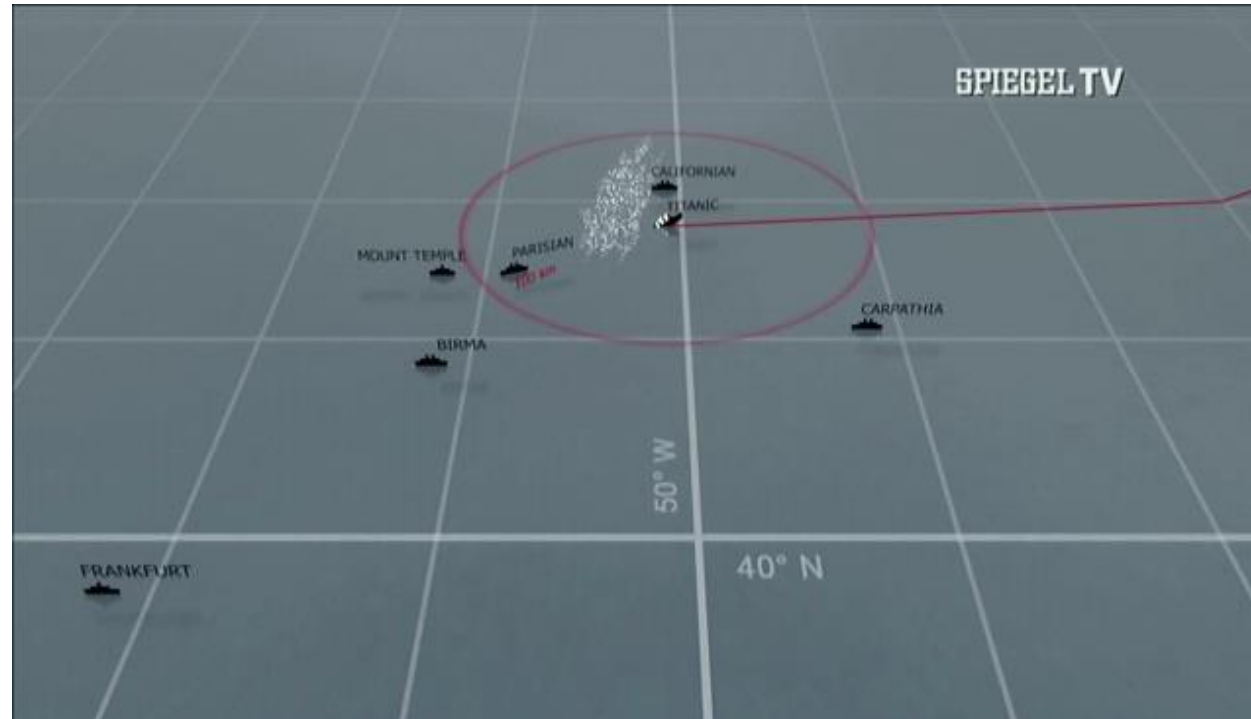
Fellow radio operator Harold Bride suggest also to begin sending "SOS MQY"

Who answers *Titanic's* distress call?

1. The *Frankfurt*
2. The *Olympic* (Titanic's sister ship)
3. The *Carpathia*
4. The *Baltic*, etc...

Titanic sinks at 02:20 a.m. Carpathia arrives at 04:00 a.m. Rescuing about 700 of the 2200 passengers and crew. Carpathia arrives in New York City on 18 April.

SPIEGEL TV

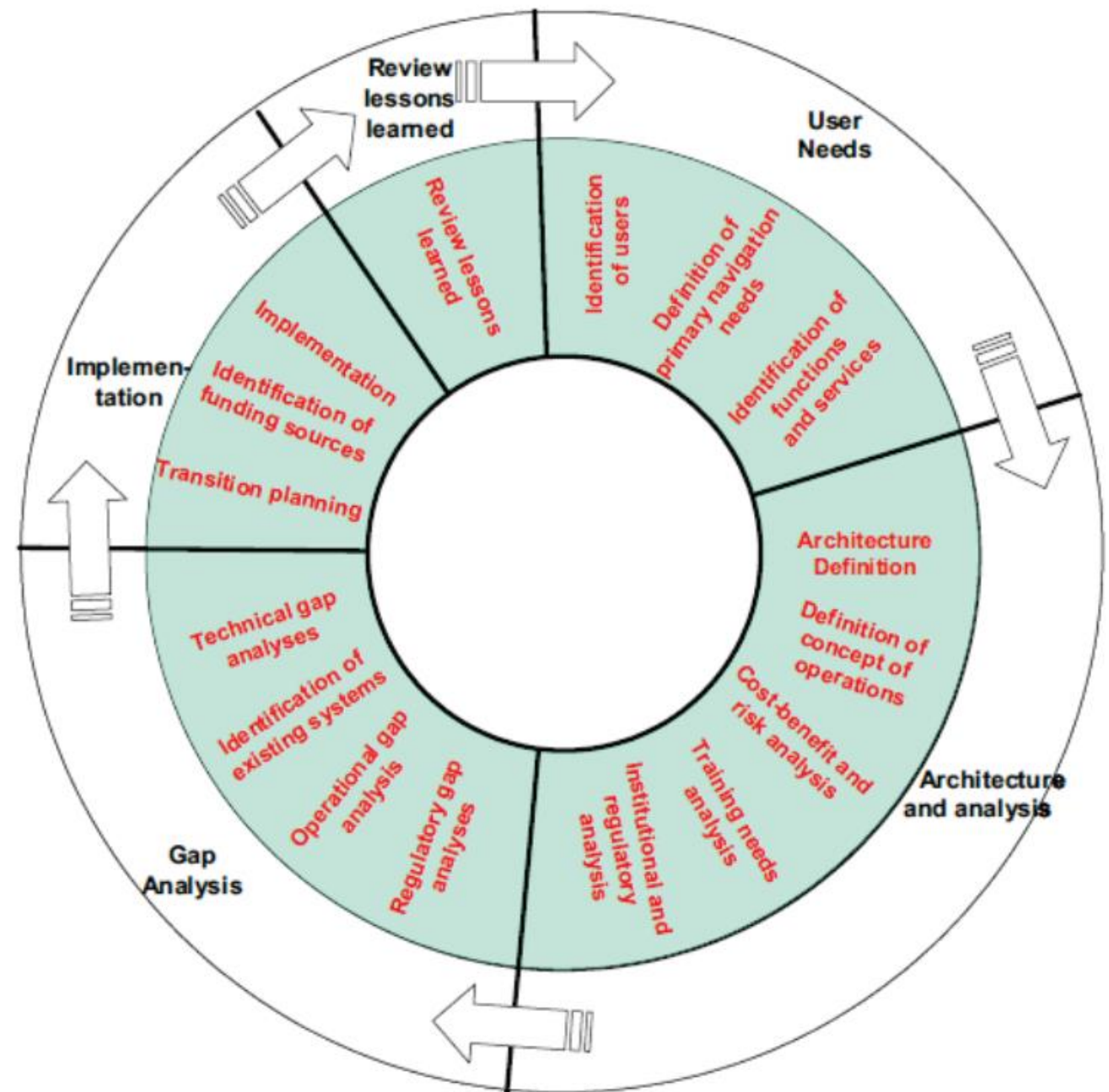


E-navigation implementation process

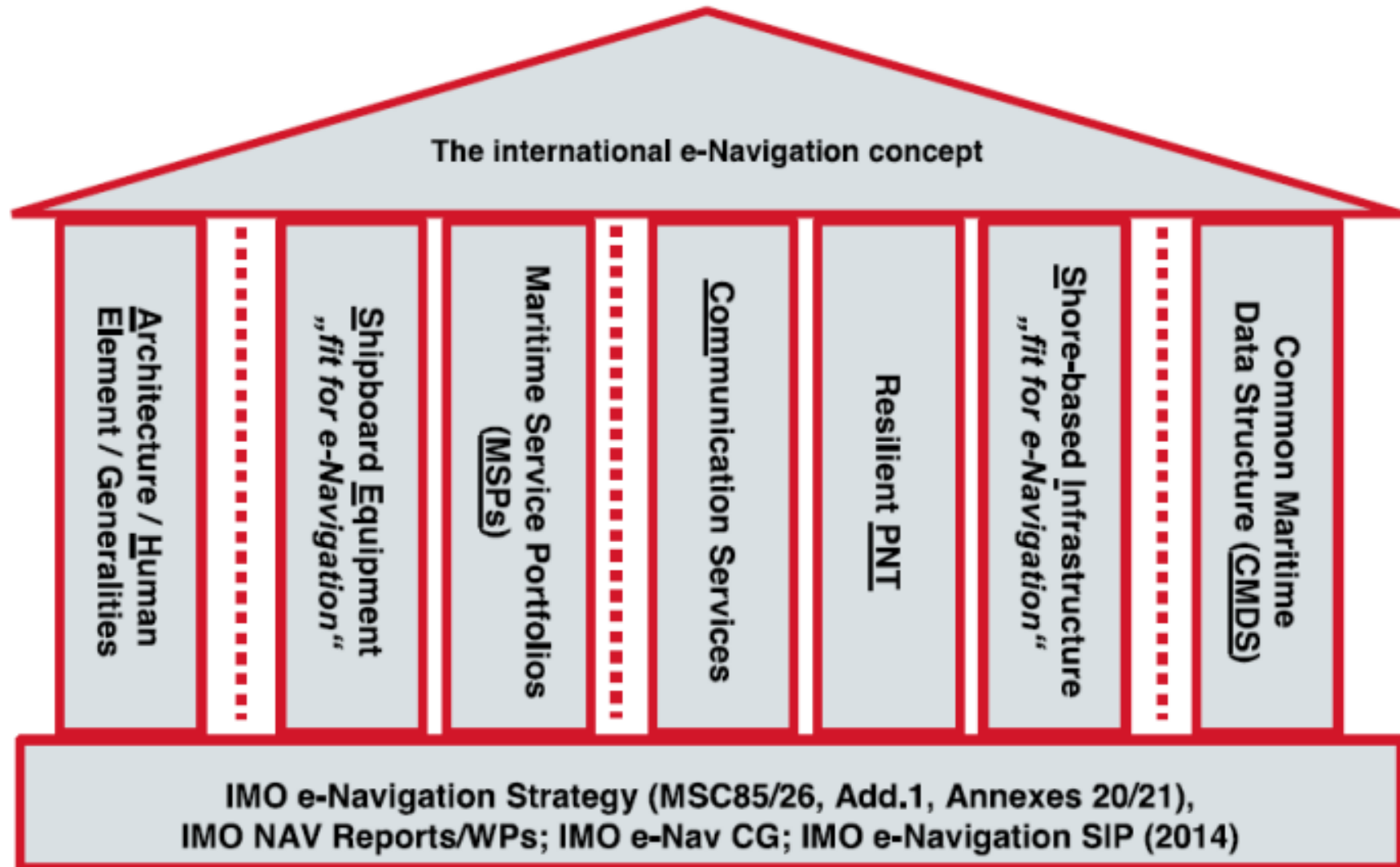
The Organization defines e-navigation as "the **harmonized** collection, integration, **exchange**, presentation and analysis of marine information on board and ashore **by electronic means** to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment."

International Maritime Organization (IMO), MSC 85/26, Strategy for the development and implementation of e-navigation, London 2008

[E-navigation \(imo.org\)](http://imo.org)



E-navigation 7 pillars



Overarching e-navigation architecture

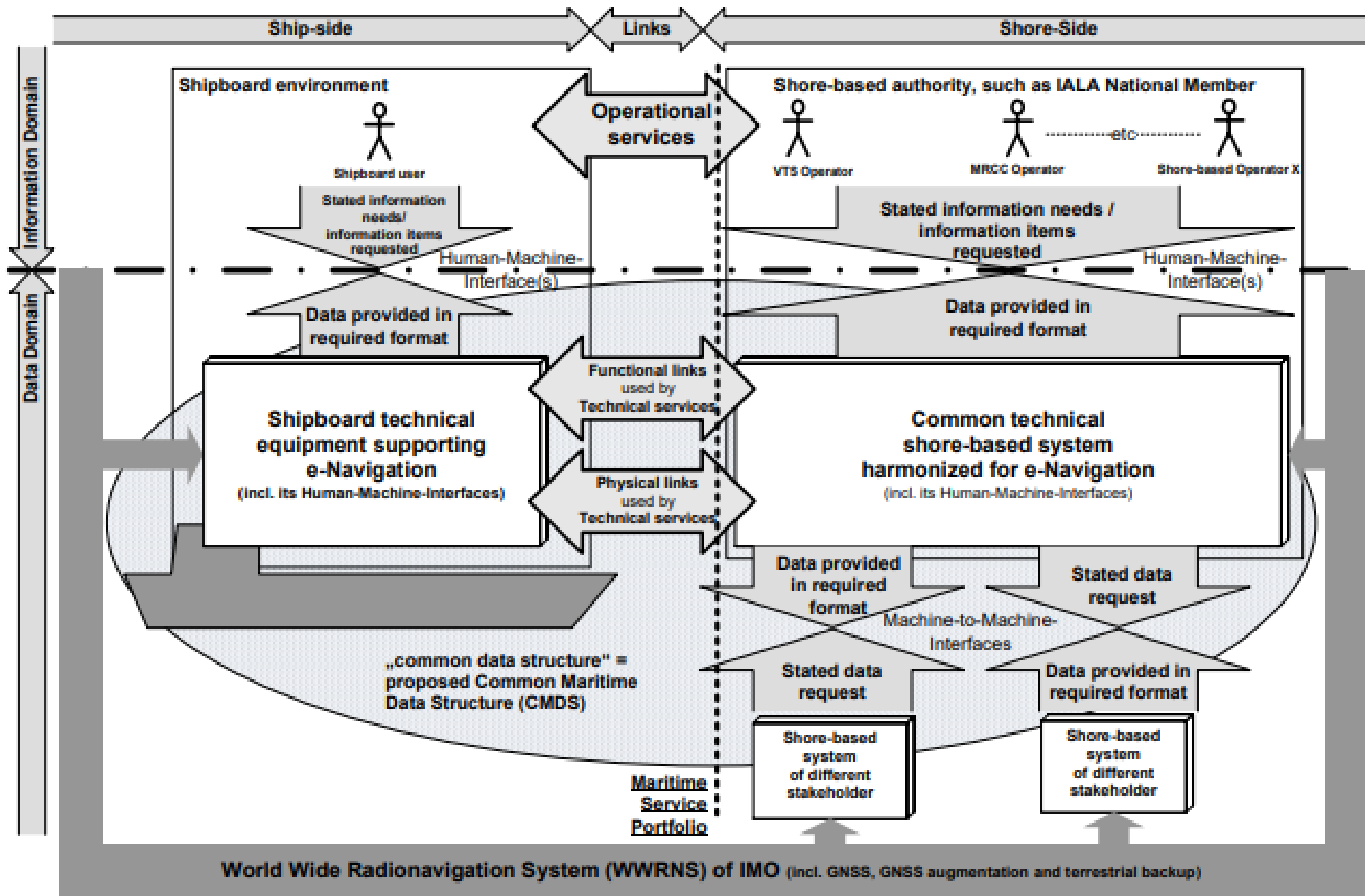


Table 3.2(a) List of maritime services in the context of e-navigation (2019)

Maritime service in the context of e-navigation	Responsible domain coordinating body
MS 1 VTS Information Systems	IALA
MS 2 VTS Navigational Assistance Service	IALA
MS 3 VTS Traffic Organisation Service	IALA
MS 4 Port Support Service	IMO FAL Committee
MS 5 Maritime Safety Information	IHO, WMO
MS 6 Pilotage Service	IMPA, IMO FAL Committee
MS 7 Tug Service	IMO FAL Committee
MS 8 Vessel Shore Reporting	IMO FAL Committee
MS 9 Telemedical Assistance Service	IMHA
MS 10 Maritime Assistance Service	IMO FAL Committee
MS 11 Nautical Chart Service	IHO
MS 12 Nautical Publication Service	IHO
MS 13 Ice Navigation Service	WMO
MS 14 Meteorological Service	WMO
MS 15 Real-Time Hydrographic and Environmental Information Service	IHO
MS 16 Search and Rescue Service	Open (potentially SAR experts)

IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities)
 IMO FAL (International Maritime Organization, The Facilitation Committee)
 IHO (International Hydrographic Organization)
 WMO (World Meteorological Organization)
 IMPA (International Maritime Pilots' Association)
 IMHA (International Maritime Health Association)
 IHO (International Hydrographic Organization)



M. Fiorini and N. Gupta,
“ICT Solutions and Digitalisation in Ports and Shipping”, The IET Transportation Series, ISBN 978-1-83953-086-9, London, 2021

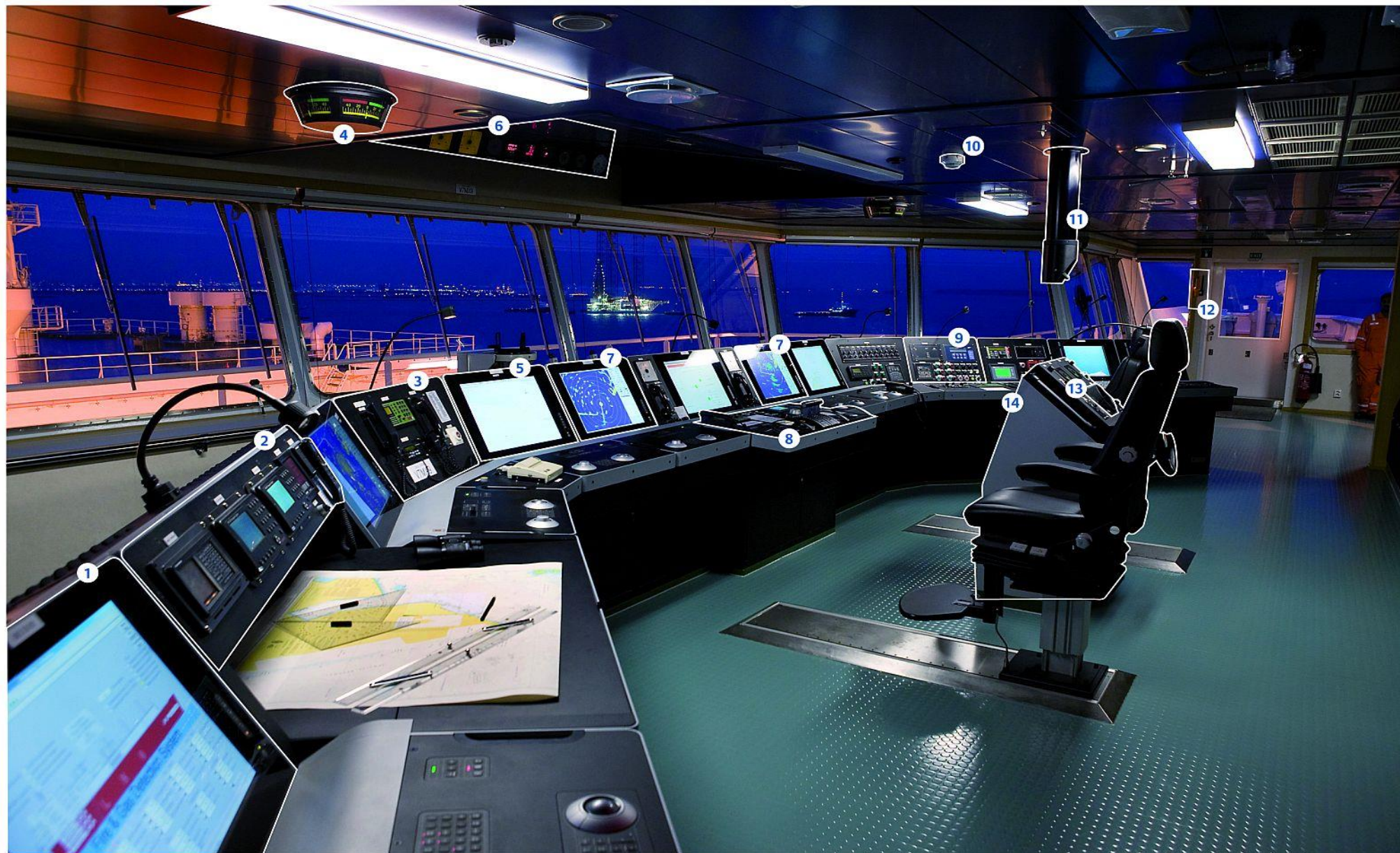
Moving into the Digital Age



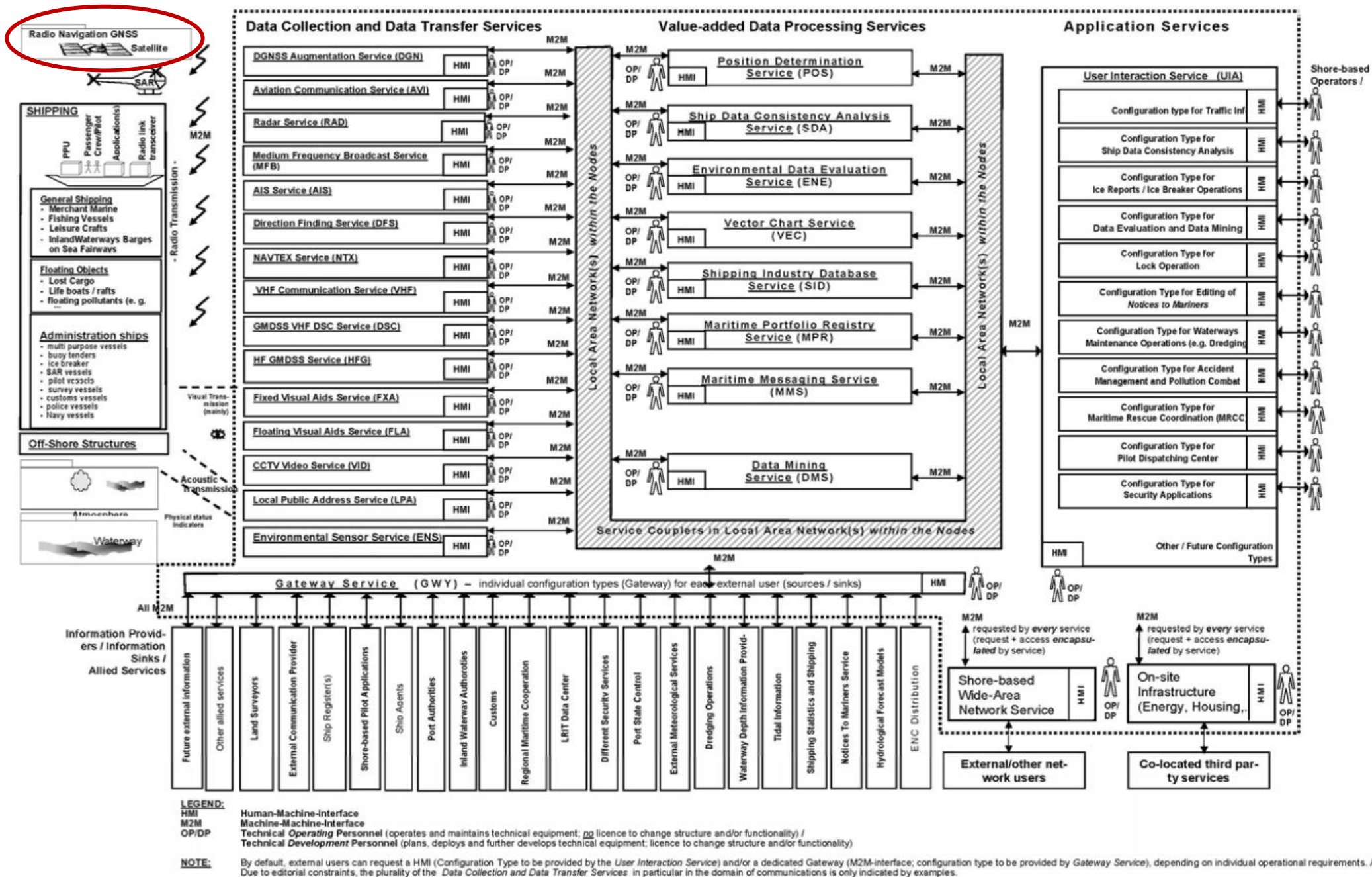
Digital Ship Certification Workflow - Open Cascade

Modern day bridge

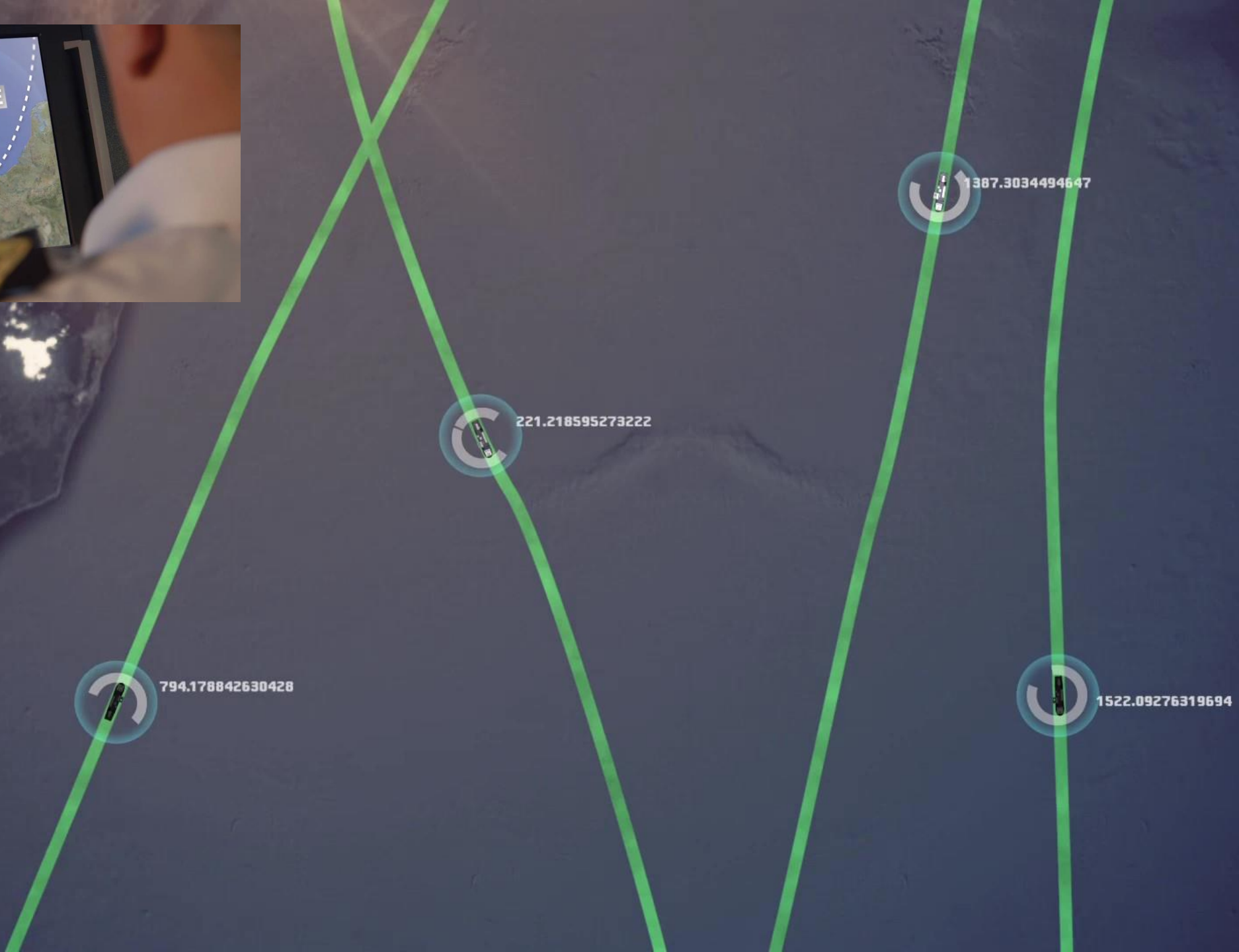
1. Fire Detection Panel
2. GPS, AIS and Speed Log Display
3. VHF radio
4. Rudder angle indicator
5. Electronic Charts Display & Information System (ECDIS)
6. Clinometer, Anemometer, Tachometer, Echo sounder
7. Radars (10cm and 3cm)
8. Engine controls
9. Switch panel (lighting etc)
10. Smoke alarm
11. Magnetic compass display
12. Search and Rescue transponder
13. Gyro compass
14. Steering stand



Modern ship's bridge
Photo: Courtesy
Kongsberg Maritime







Smart Ships

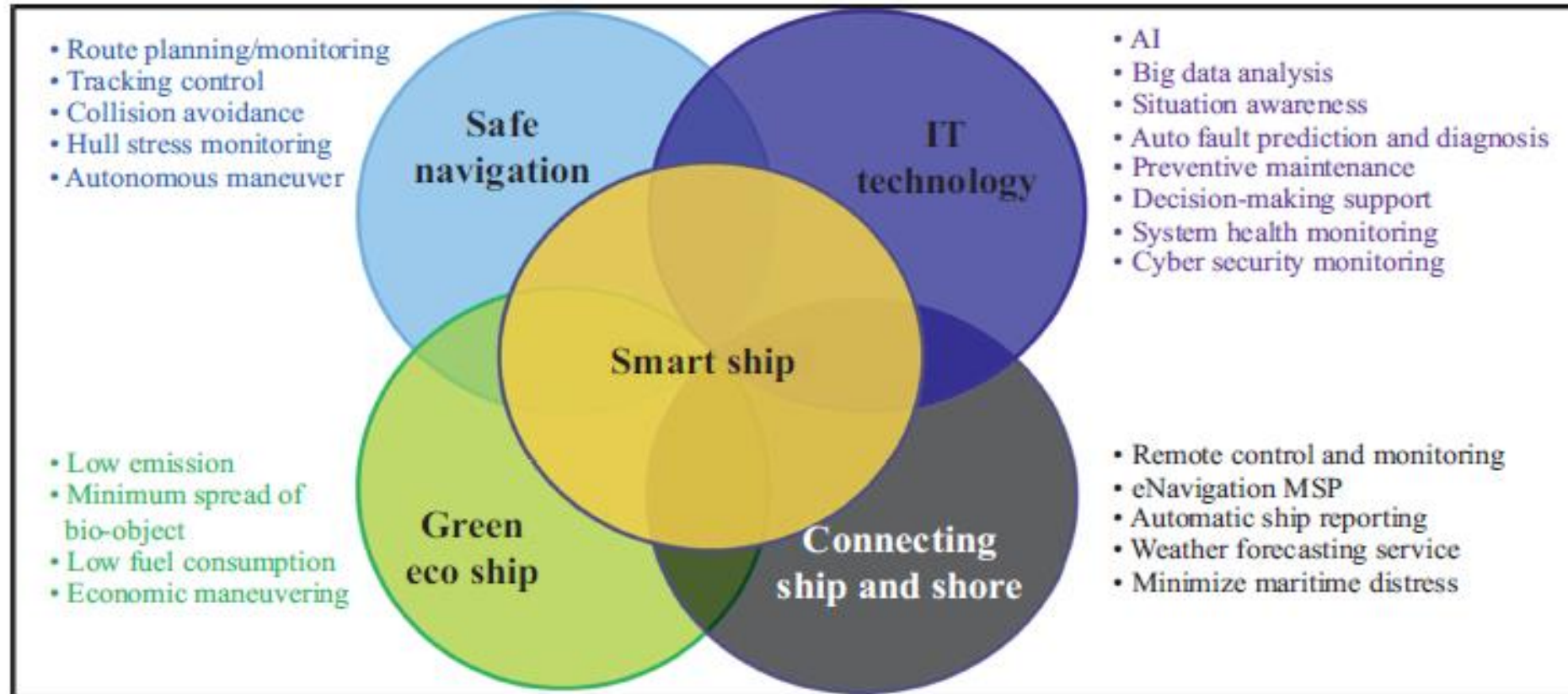
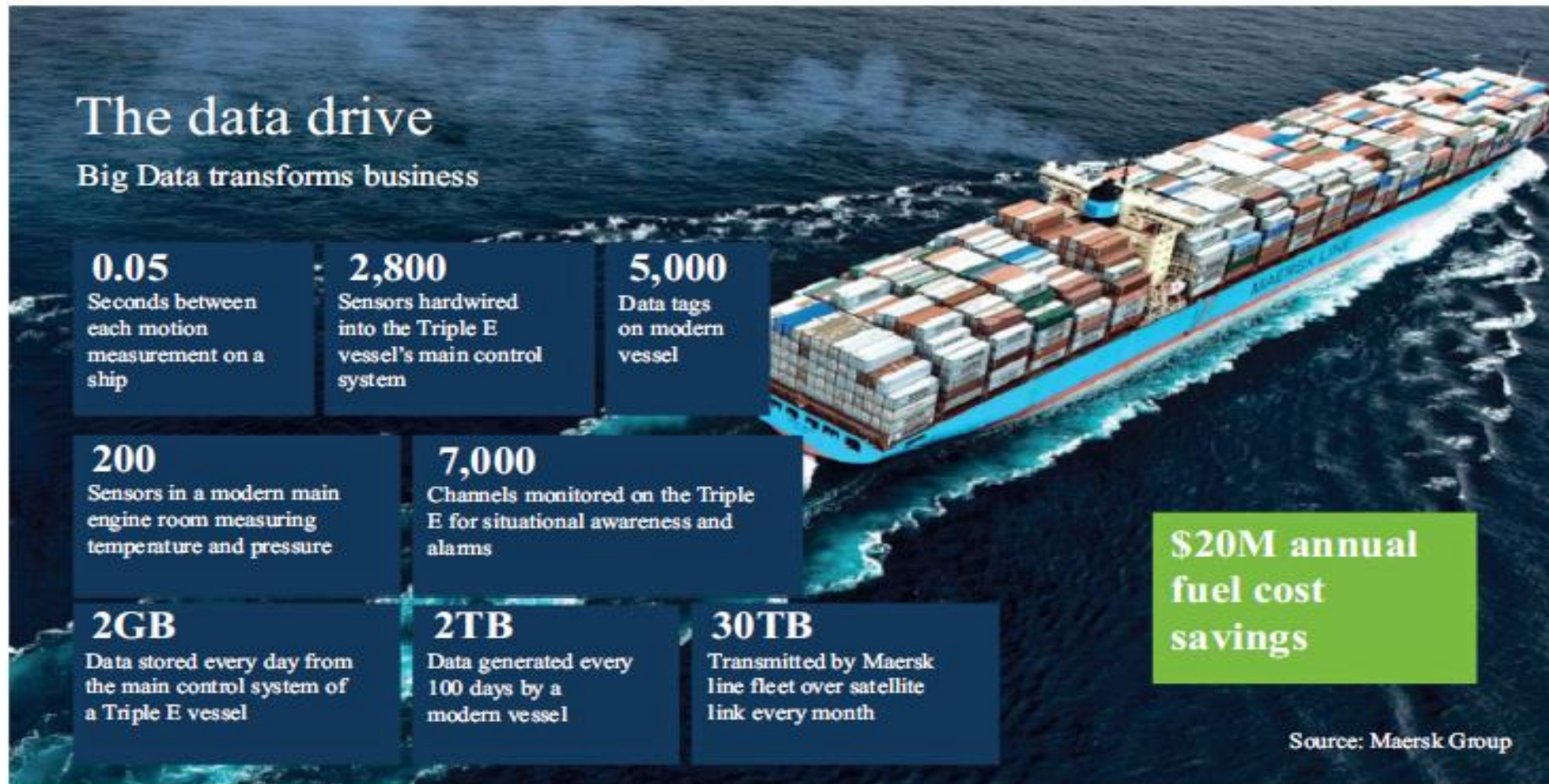


Figure 5.6 Technology categorized for smart ships (cf. [8])



M. Fiorini and N. Gupta,
“ICT Solutions and Digitalisation in Ports and Shipping”, The IET Transportation Series, ISBN 978-1-83953-086-9, London, 2021

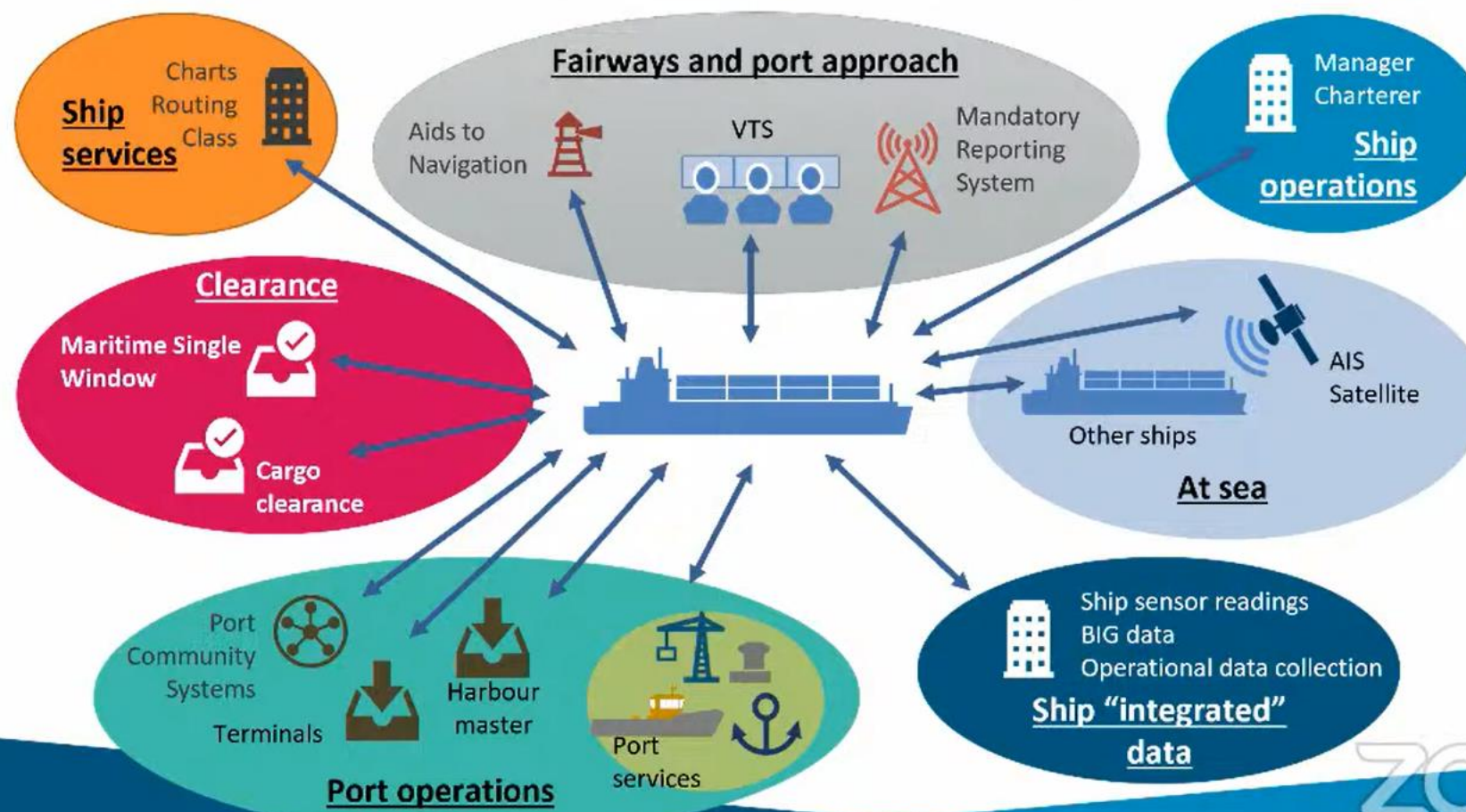
Big Data



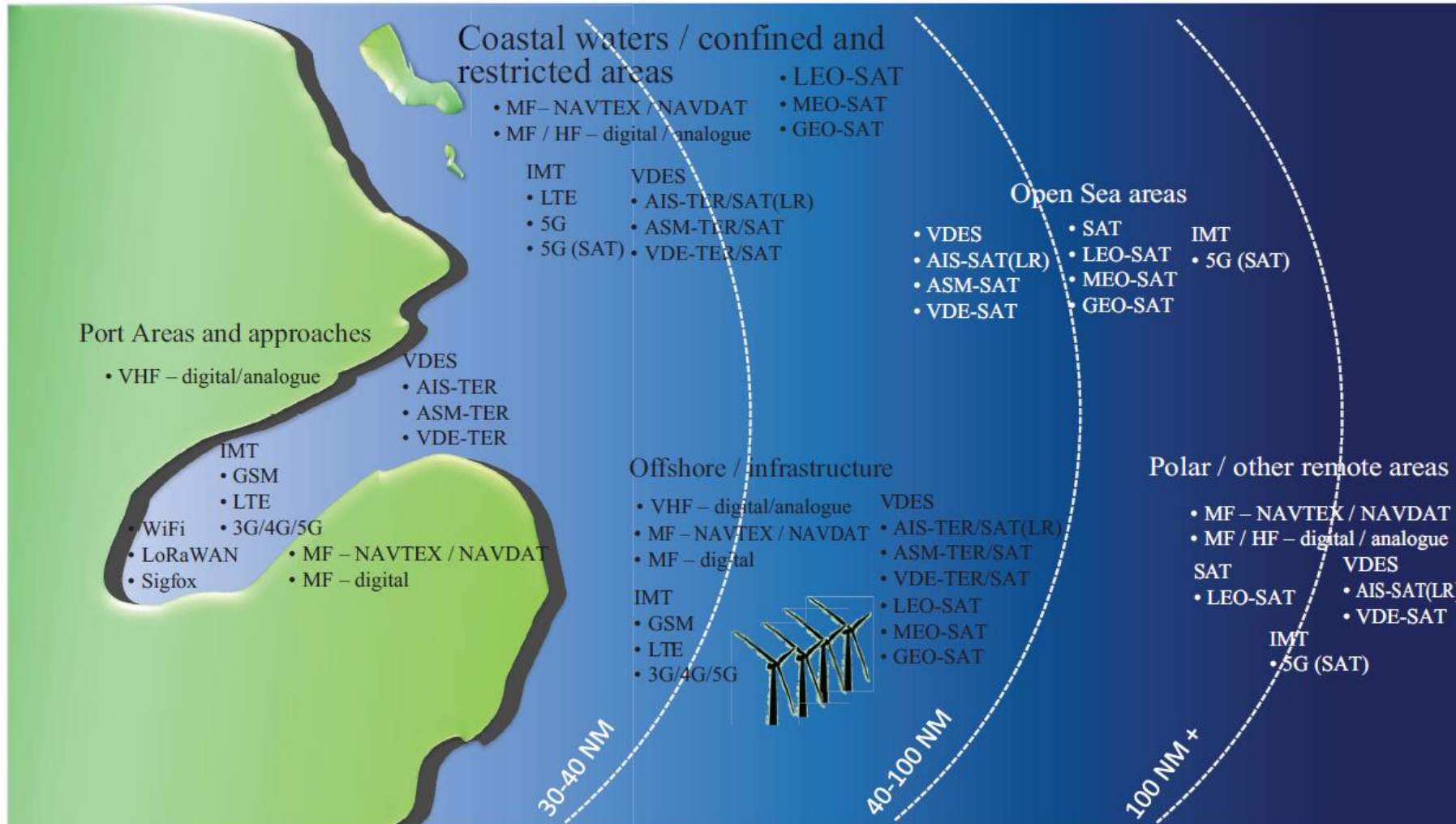
M. Fiorini and N. Gupta, "ICT Solutions and Digitalisation in Ports and Shipping", The IET Transportation Series, ISBN 978-1-83953-086-9, London, 2021

Figure 5.5 Data aggregation from smart ship

Digital exchange between ship and shore



zoom



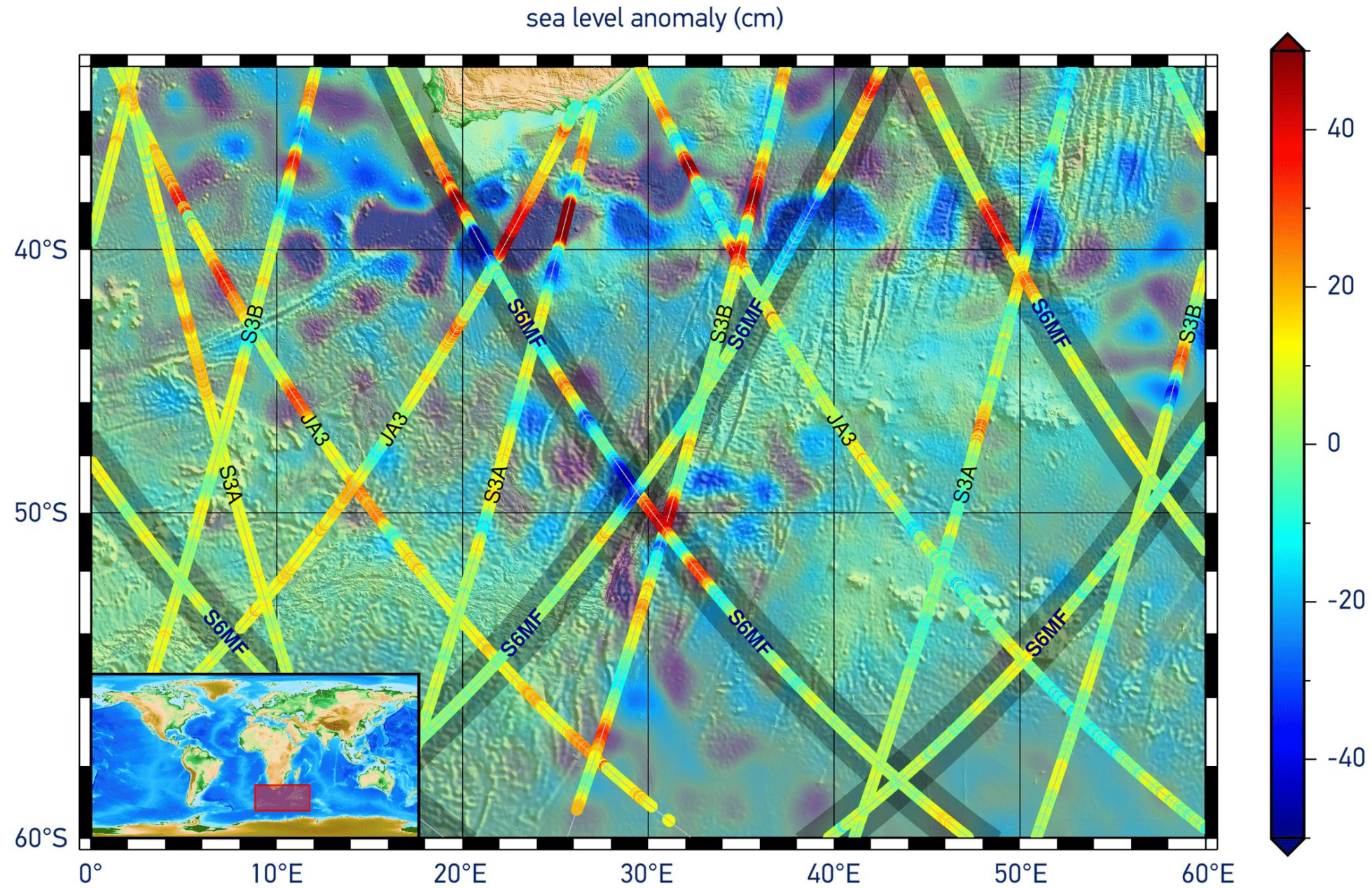
M. Fiorini and N. Gupta, “ICT Solutions and Digitalisation in Ports and Shipping”, The IET Transportation Series, ISBN 978-1-83953-086-9, London, 2021

Figure 6.3 Graphic of maritime communications options for IMO areas

Sea-level_height_results_from_Copernicus_Sentinel-6

Copernicus Sentinel-6 sea-level anomaly data, overlaid on a map showing similar products from all of the Copernicus altimetry missions: Jason-3, Sentinel-3A and Sentinel-3B. The background image is a map of sea-level anomalies from satellite altimeter data provided by the Copernicus Marine Environment Monitoring Service for 4 December 2020. The data for this image were taken from the Sentinel-6 'Short Time Critical Level 2 Low Resolution' products generated on 5 December.

CREDIT:
Copernicus Sentinel data (2020), processed by Eumetsat



GNSS reflectometry (or GNSS-R)

Mission	Organization (Country)	Launch year	GNSS tracked	Number of satellites	Receiving channels	Size [cm ³]	Mass [kg]
UK-DMC	BNSC (UK)	2003	GPS	1	1	60×60×60	~ 90
TDS-1	UKSA (UK)	2014	GPS, Galileo	1	4	77×50×90	~ 157
CYGNSS	NASA (USA)	2016	GPS	8	4	163.5×52.1×22.9	~ 29
Spire Batch-1	Spire Global (USA)	2019	GPS, QZSS, Galileo, SBAS	2	16 – 24	10×10×30	5
³ Cat-5/A	ESA (Europe) - UPC (Spain)	2020	GPS, Galileo	1	1	12×24×36	~ 8
PRETTY	RUAG GmbH (Austria)	2021	GPS	1	-	30×10×10	< 6
GEROS-ISS	GFZ (Germany)	2022	GPS, Galileo, GLONASS, BeiDou	1	4	117×155×86	376
G-TERN	GFZ (Germany) - IEEC (Spain)	2025	GPS, Galileo, GLONASS, BeiDOu	1	12	150×110×110 – 200×120×200	800

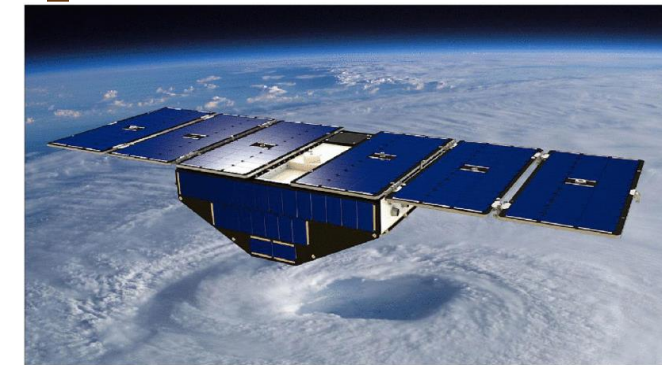
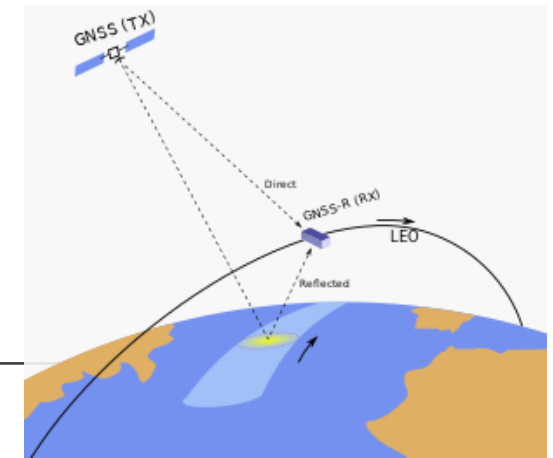
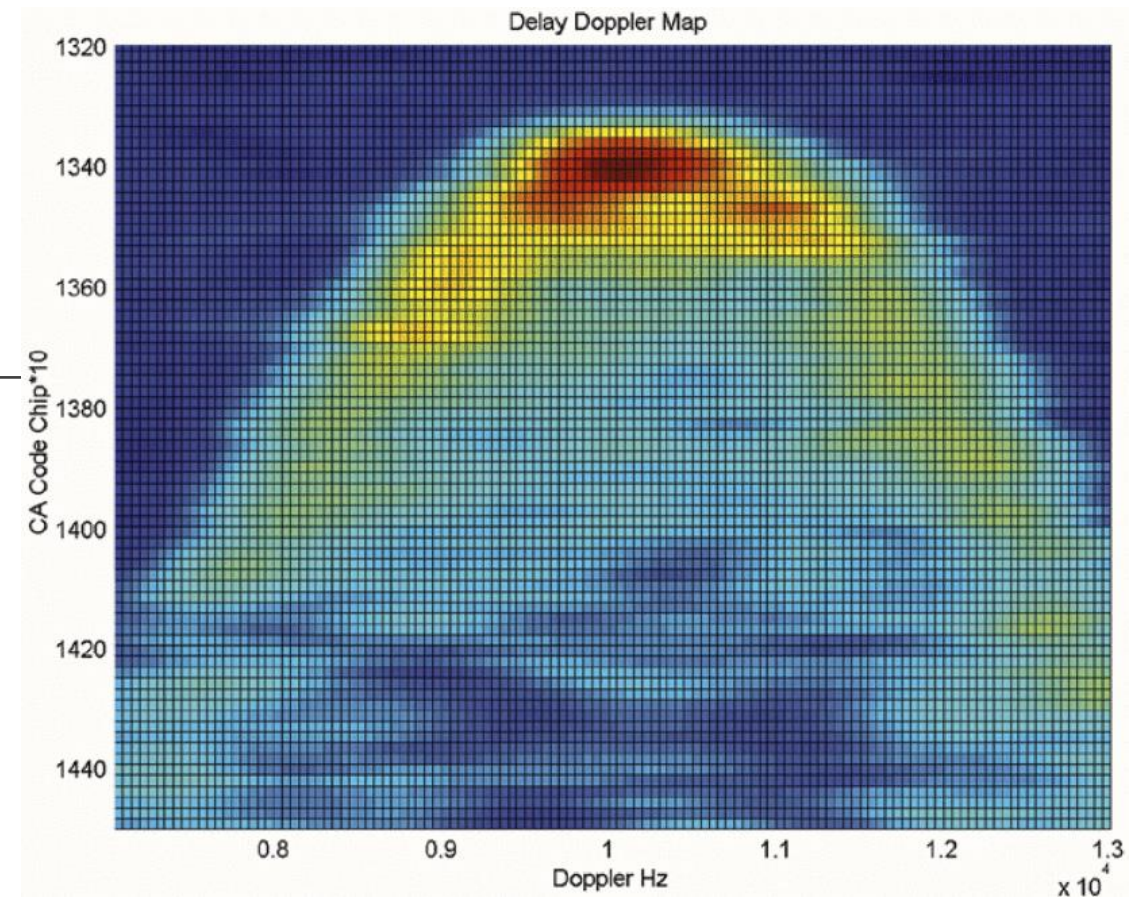
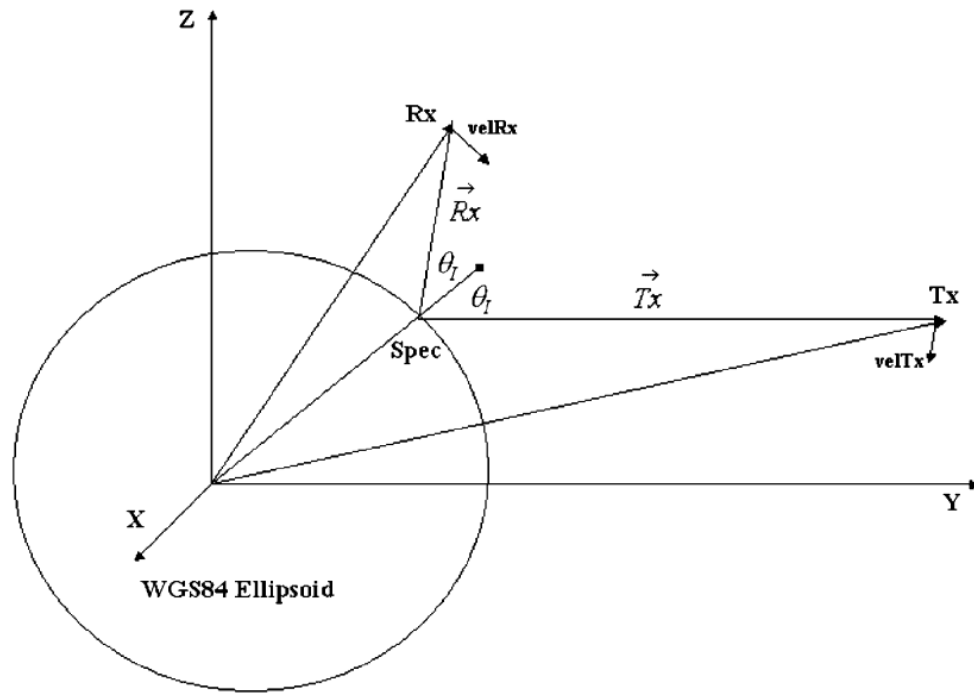


Image depicting a deployed CYGNSS microsatellite on orbit above a hurricane. (Image credit: NASA)

G. Soldi *et al.*, "Space-Based Global Maritime Surveillance. Part I: Satellite Technologies," in *IEEE Aerospace and Electronic Systems Magazine*, vol. 36, no. 9, pp. 8-28, 1 Sept. 2021, doi: 10.1109/MAES.2021.3070862.



S. Gleason *et al.*, "Detection and Processing of bistatically reflected GPS signals from low Earth orbit for the purpose of ocean remote sensing," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 43, no. 6, pp. 1229-1241, June 2005, doi: 10.1109/TGRS.2005.845643.

Delay-Doppler map of the ocean-reflected signal of GPS satellite PRN 26, found in the May 21 dataset. A coherent correlation time of 1 ms and an incoherent summation time of 1 s were used to calculate the correlation power shown in each delay-Doppler bin of this map

DAILY SEA SURFACE TEMPERATURE

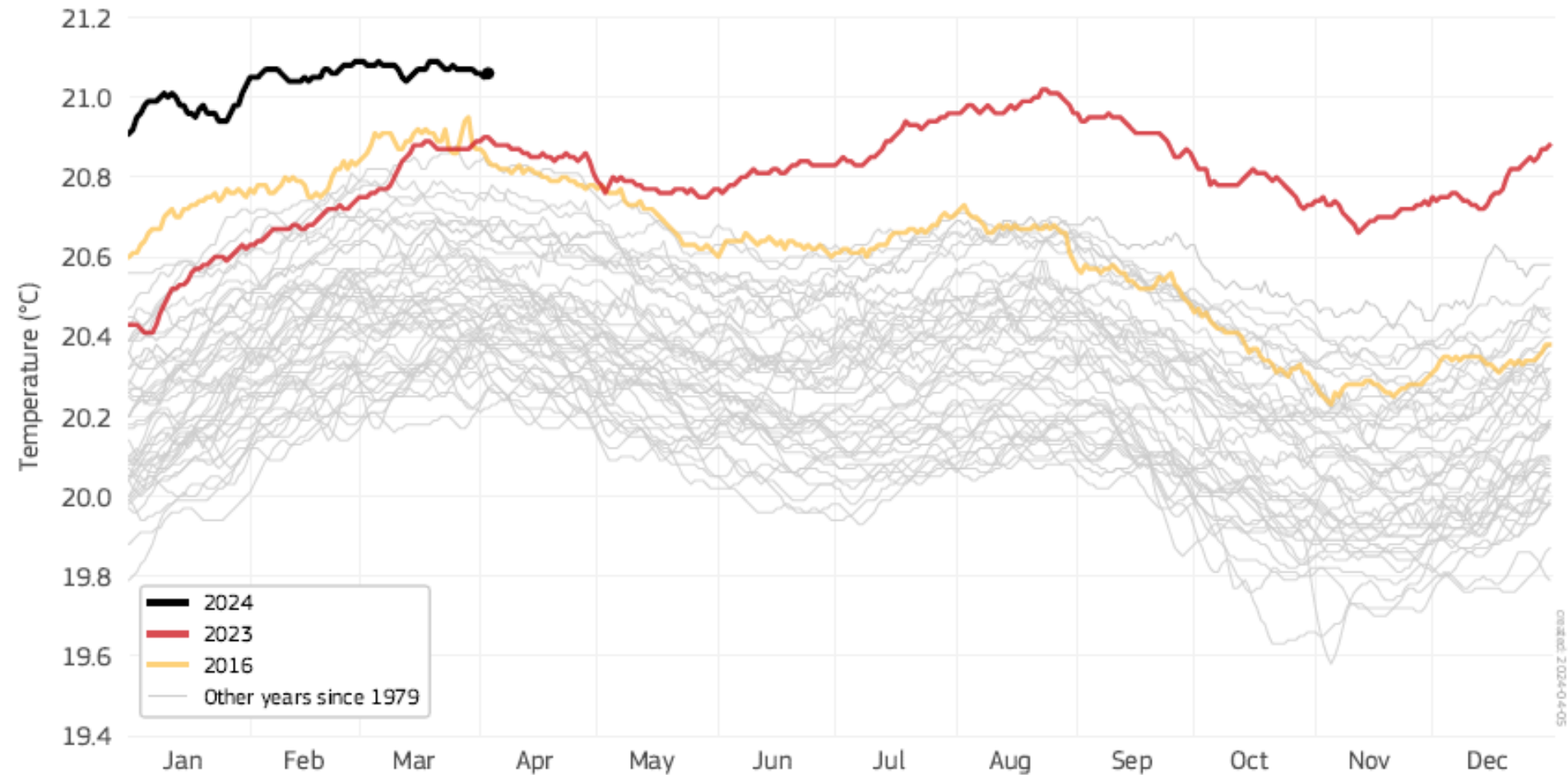
Extrapolar global ocean (60°S–60°N)

Data: ERA5 1979–2024 • Last data: 03 Apr 2024 • Credit: C3S/ECMWF



Climate
Change Service

climate.copernicus.eu

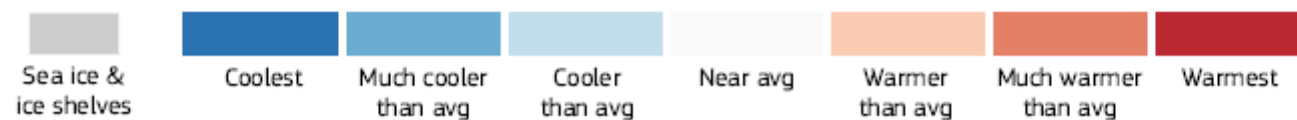
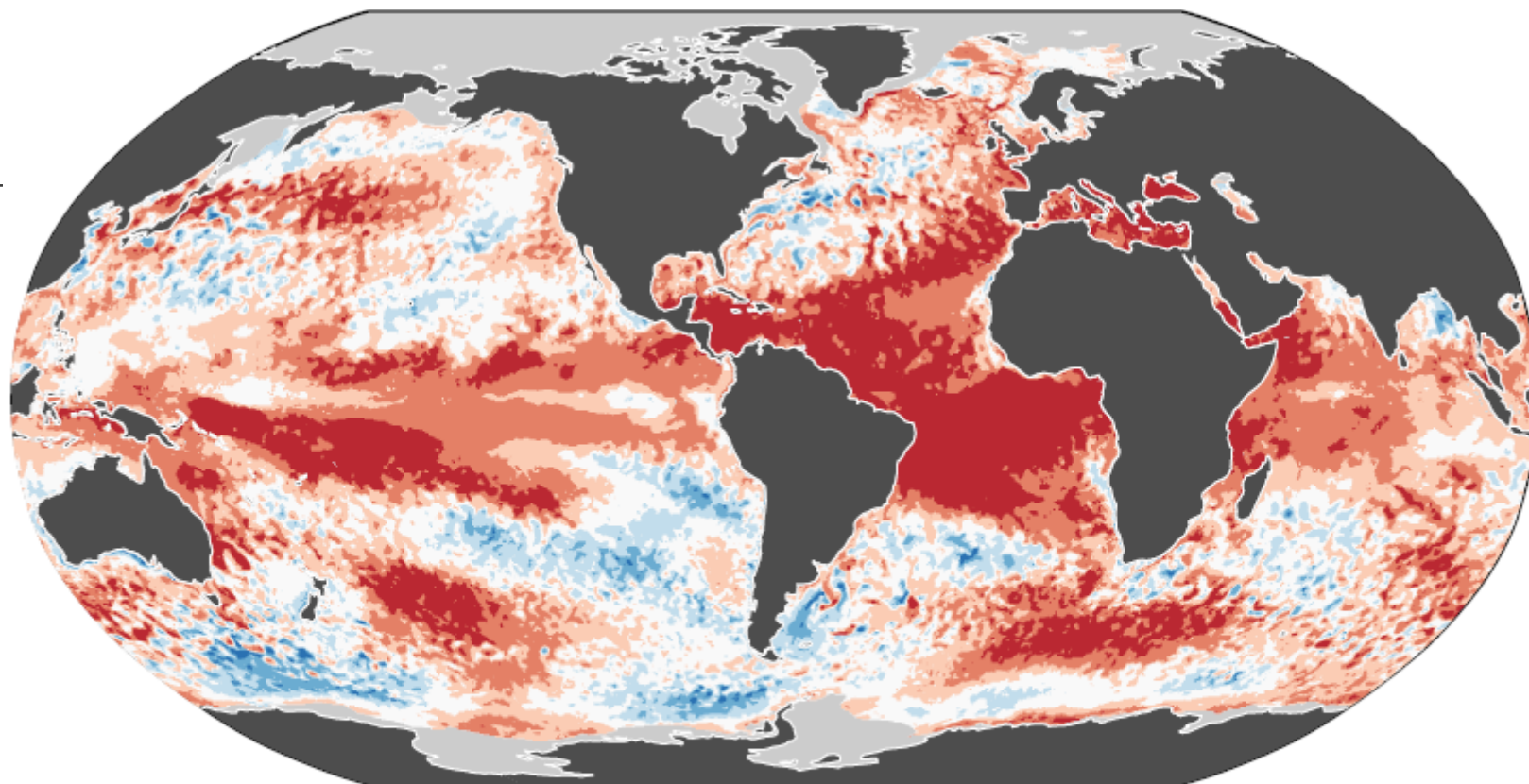


PROGRAMME OF
THE EUROPEAN UNION



Sea surface temperature percentiles for March 2024

Data: ERA5 1979-2024 • Reference period: 1991-2020 • Credit: C3S/ECMWF



PROGRAMME OF
THE EUROPEAN UNION



IMPLEMENTED BY



Yara Birkeland



Photo credits: Knut Brevik Andersen, Wilhelmsen Ship Service

World's first crewless, zero emissions cargo ship will set sail in Norway

By Rochelle Beighton, CNN
 Updated 1903 GMT (0303 HKT) August 27, 2021



Photos:
 The Yara Birkeland is what its builders call the world's first zero-emission, autonomous cargo ship. The ship is scheduled to make its first journey between two Norwegian towns before the end of the year. **Click through**

Yara Birkeland



MILESTONES

2017

- Design finalised. Design done by [Marin Teknikk](#), design MT 2007.
- Model towing tank testing. Testing at [SINTEF Ocean](#) in Trondheim Norway.

2018

- Delivering ship yard is decided to be Vard Brevik in Norway. The hull will be delivered by Vard Braila in Romania.

2019

- Testing of autonomous capability will be carried out.

2020

- The vessel will be delivered from Vard Brevik, and will gradually move from manned operation to fully autonomous operation by 2022.

- Length o.a.: 79,5 m
- Length p.p.: 72,4 m
- Width mld.: 14,8 m
- Depth shelter deck: 10,8 m
- Draught (full): 6 m
- Draught (ballast): 3 m
- Service speed: 6 knots
- Max speed: 13 knots
- Propulsion system: Electric
- Propellers: 2 Azimuth pods
- Thrusters: 2 Tunnel thruster
- Battery pack: 7 – 9 MWh
- Cargo capacity: 120 TEU
- Deadweight: 3 200 mt
- Radar
- Lidar
- AIS
- Camera
- IR camera
- Maritime Broadband Radio
- Satellite Communications
- GSM



Yara Birkeland | Yara International



LNG carrier used autonomous navigation systems for half its voyage between the US and South Korea (Hyundai) – Jun 2, 2022





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ICT Solutions and Digitalisation
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Edited by
Michele Fiorini and Natalie Gupta



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Leonardo

**“Digitalizzazione e servizi satellitari per il trasporto
marittimo”**