

MARITIME INSIGHTS™

Using Space-Based Technology for Dark Fleet Monitoring

Michel Dionne

March 2026

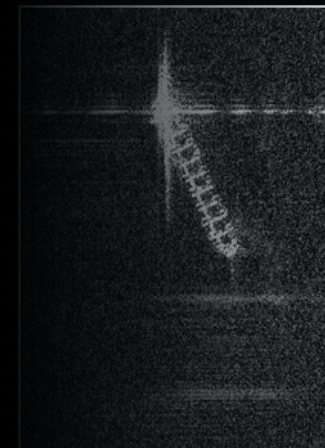
Product Manager, Maritime Insights

MDA Space, Geointelligence

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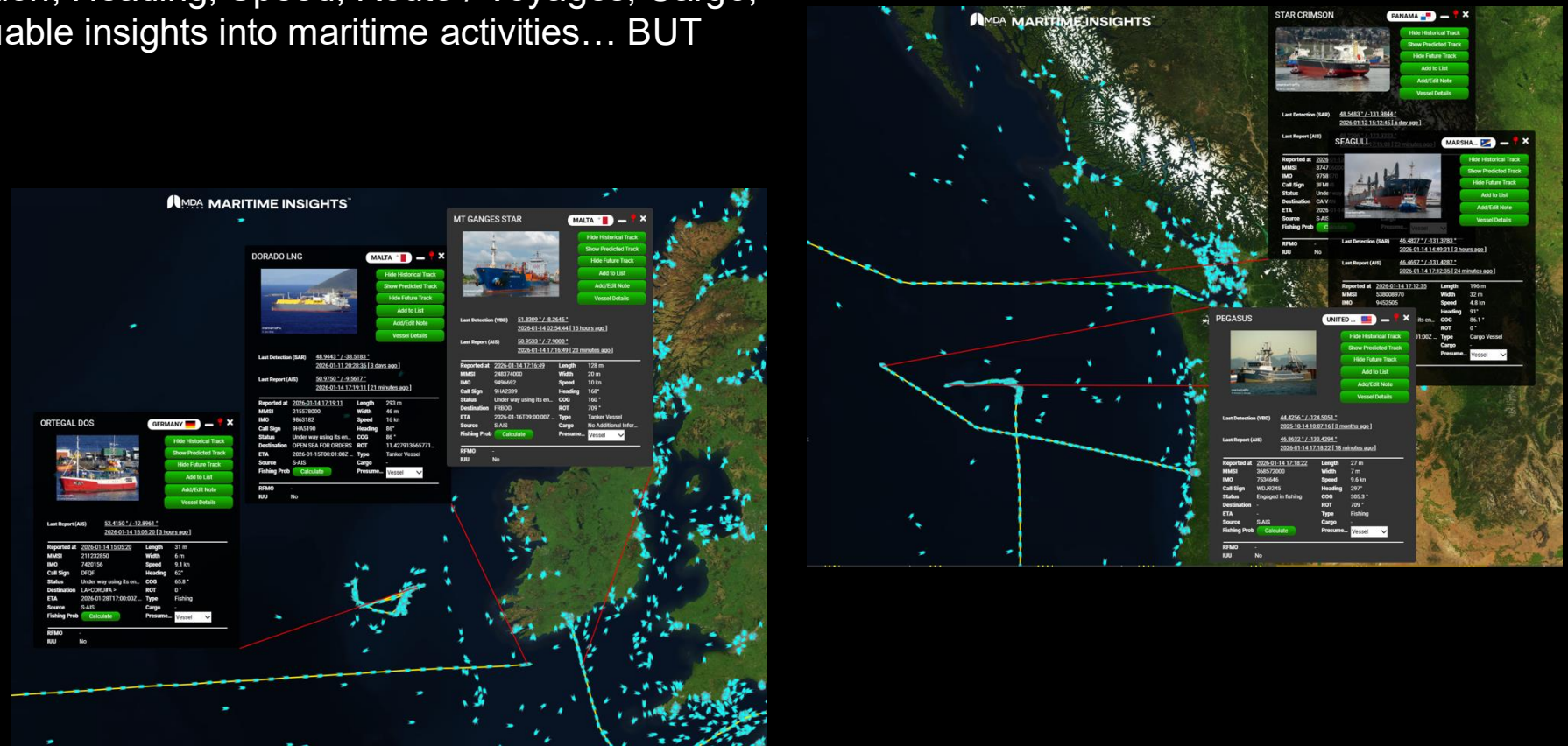
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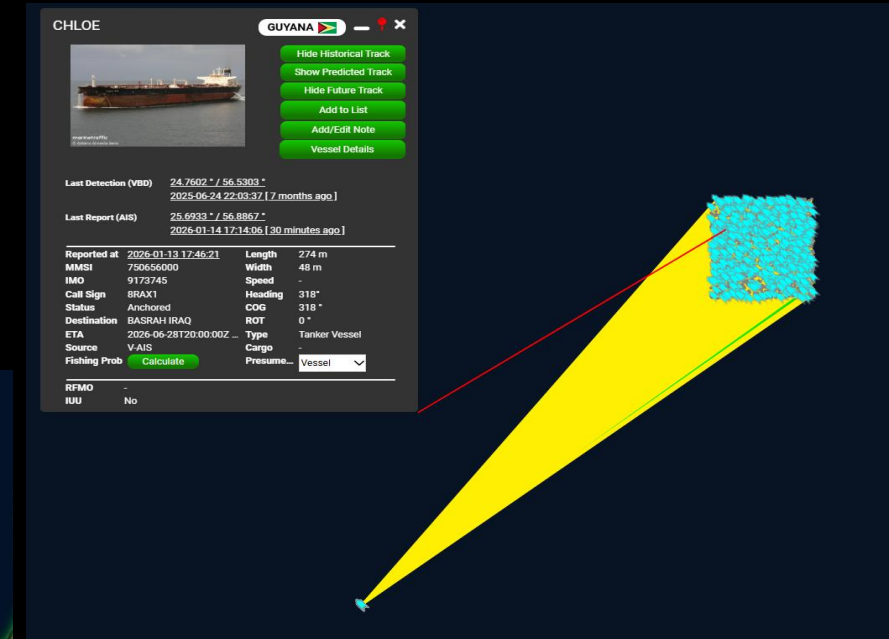
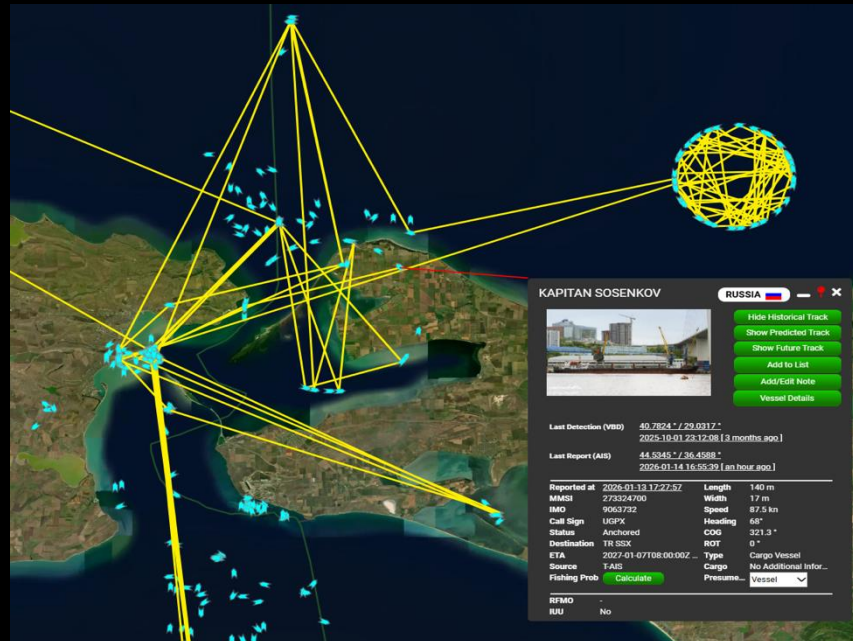
Space-Based, Terrestrial, Vessel AIS – Critical Information

- Combined with vessel registry information, AIS provides a wealth of information
- MMSI, IMO, Size, Type, Position, Heading, Speed, Route / Voyages, Cargo, and Ownership data give valuable insights into maritime activities... BUT



Space-Based, Terrestrial, Vessel AIS – Easily Manipulated!

- The self-reporting nature of AIS easily leads bad actors to multiple positional strategies
- Going “Dark” can mean turning off the transponders
- It can also mean fixing, or manipulating a position report



Space-Based Sensors – Starting to Address the Problem

- This is where the addition of multiple space-based sensors can start to make a difference
- A combination of Synthetic Aperture Radar, Electro-Optical, Radio-Frequency and Infrared sensors can provide multiple times daily coverage and enable a view of the maritime activity that is:
 - Available throughout the day... and night
 - Unhindered by cloud
 - Cannot be manipulated



CHORUS - Changing How & When you see the World

Dual Satellites:

X-Band & C-Band in an inclined orbit; cover age +/-62 deg coverage day/night; all weather

Innovations:

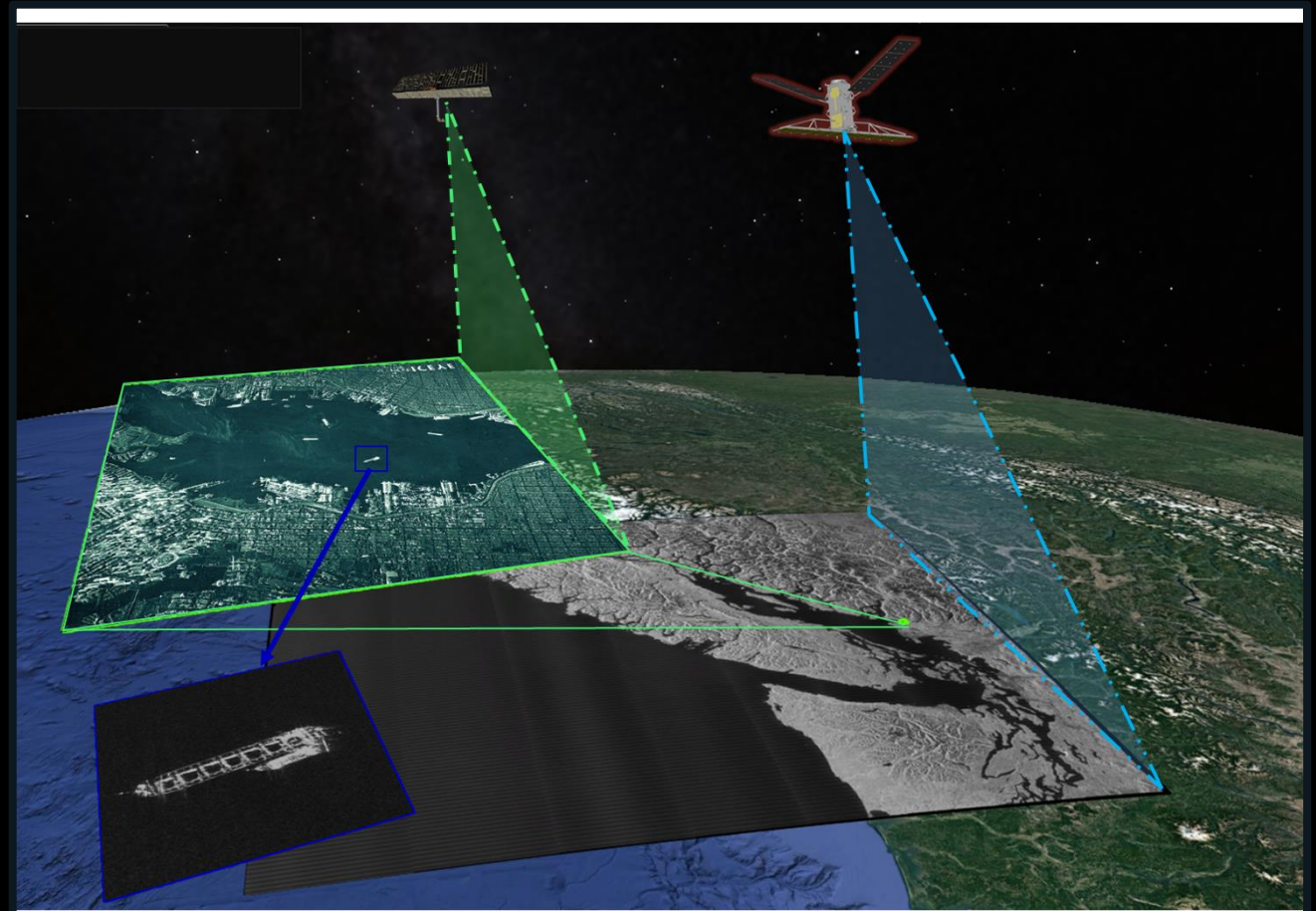
More coverage; better access; revisit; less noise; faster data rates; 20 mins duty cycle

Near-Real Time:

Shorter tasking timelines and low latency; Global Network, with AI for automation

Multiple Use Cases & Flexible ConOps:

Maritime, Land Monitoring; both systematic and taskable collections



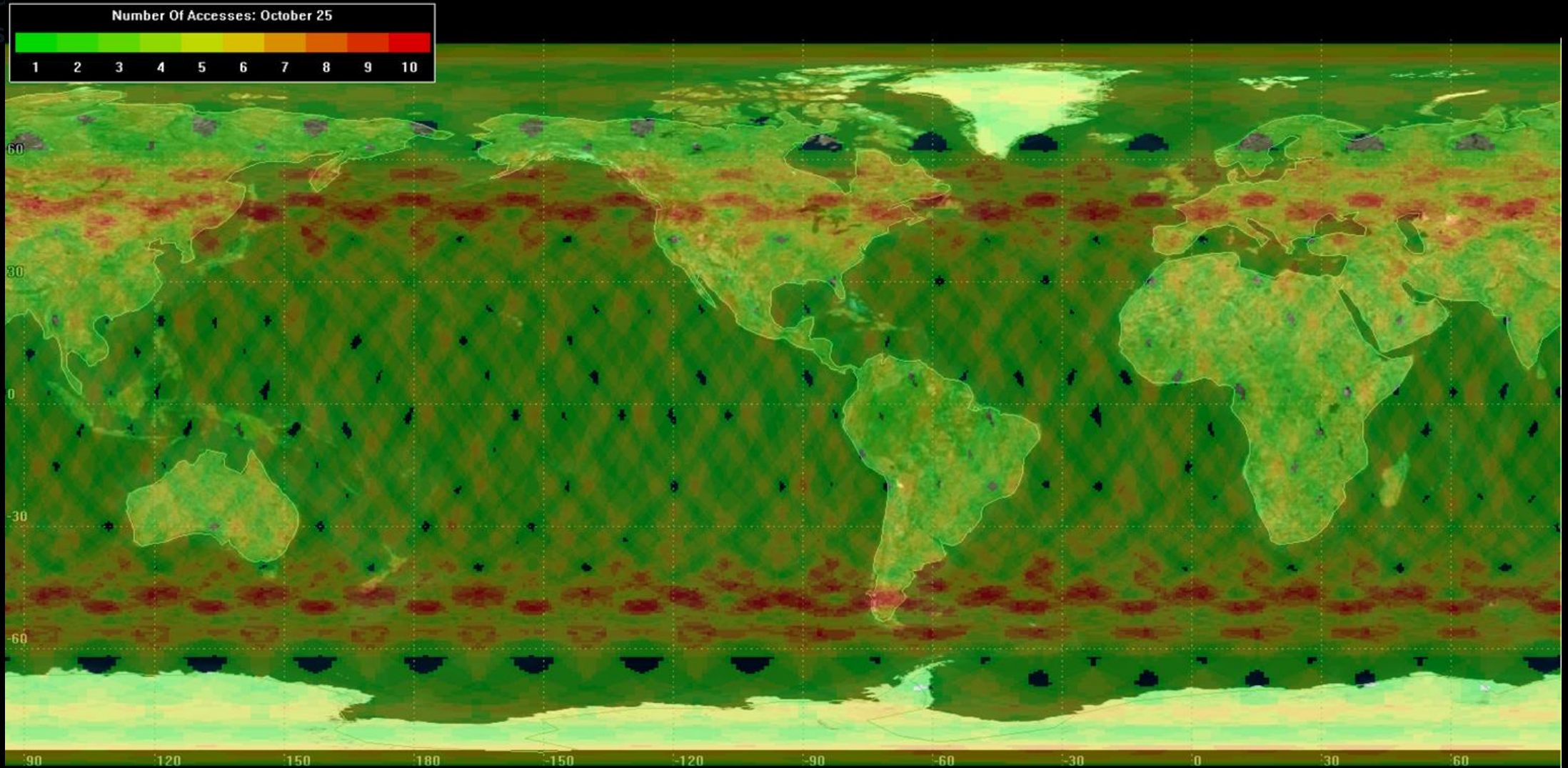
Next Generation SAR constellation empowering effective Land and Maritime surveillance in support of addressing critical operational issues

CHORUS C + X and RADARSAT-2 – One Day Access

Global Access:

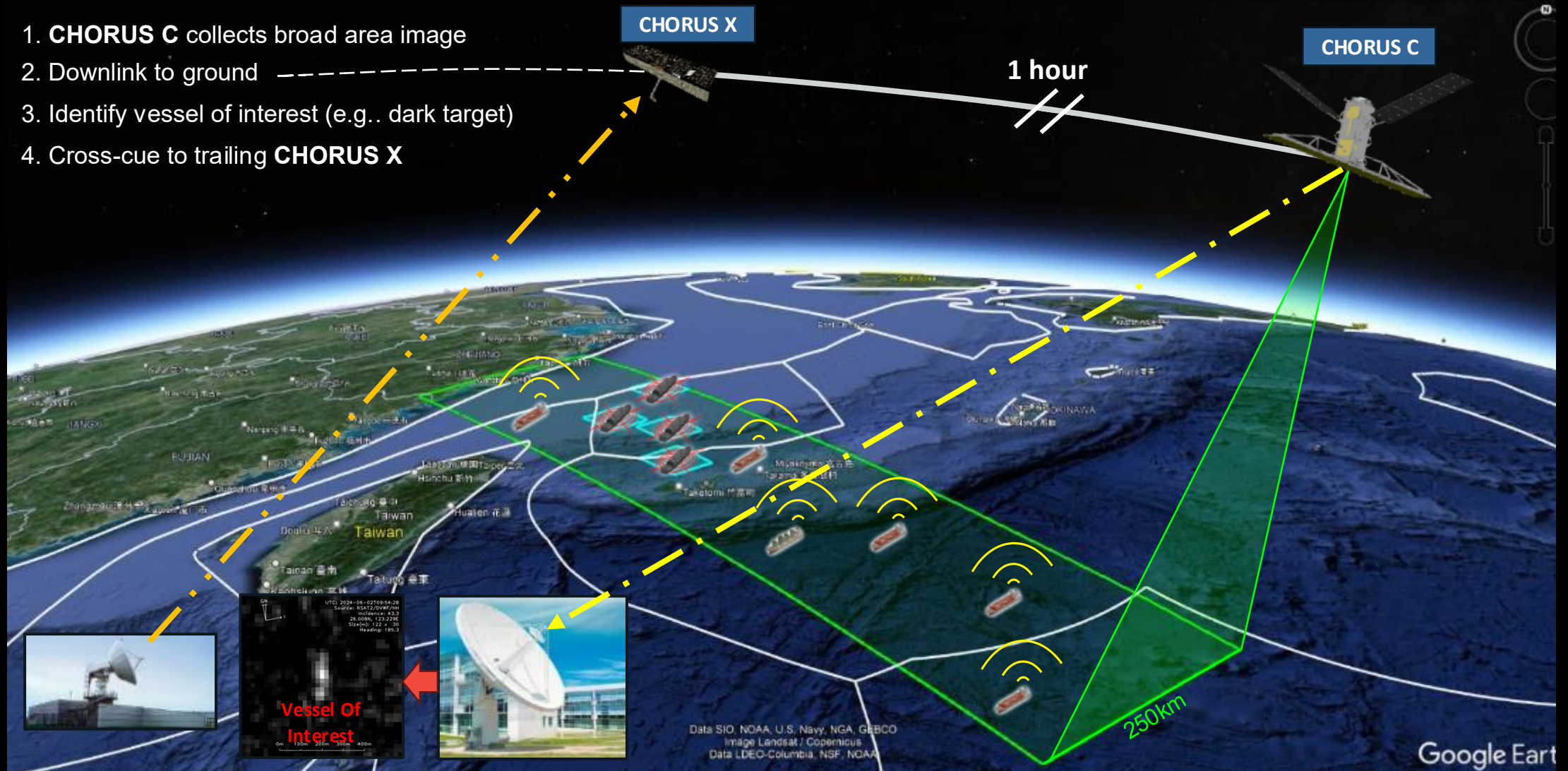
98.5%

Access



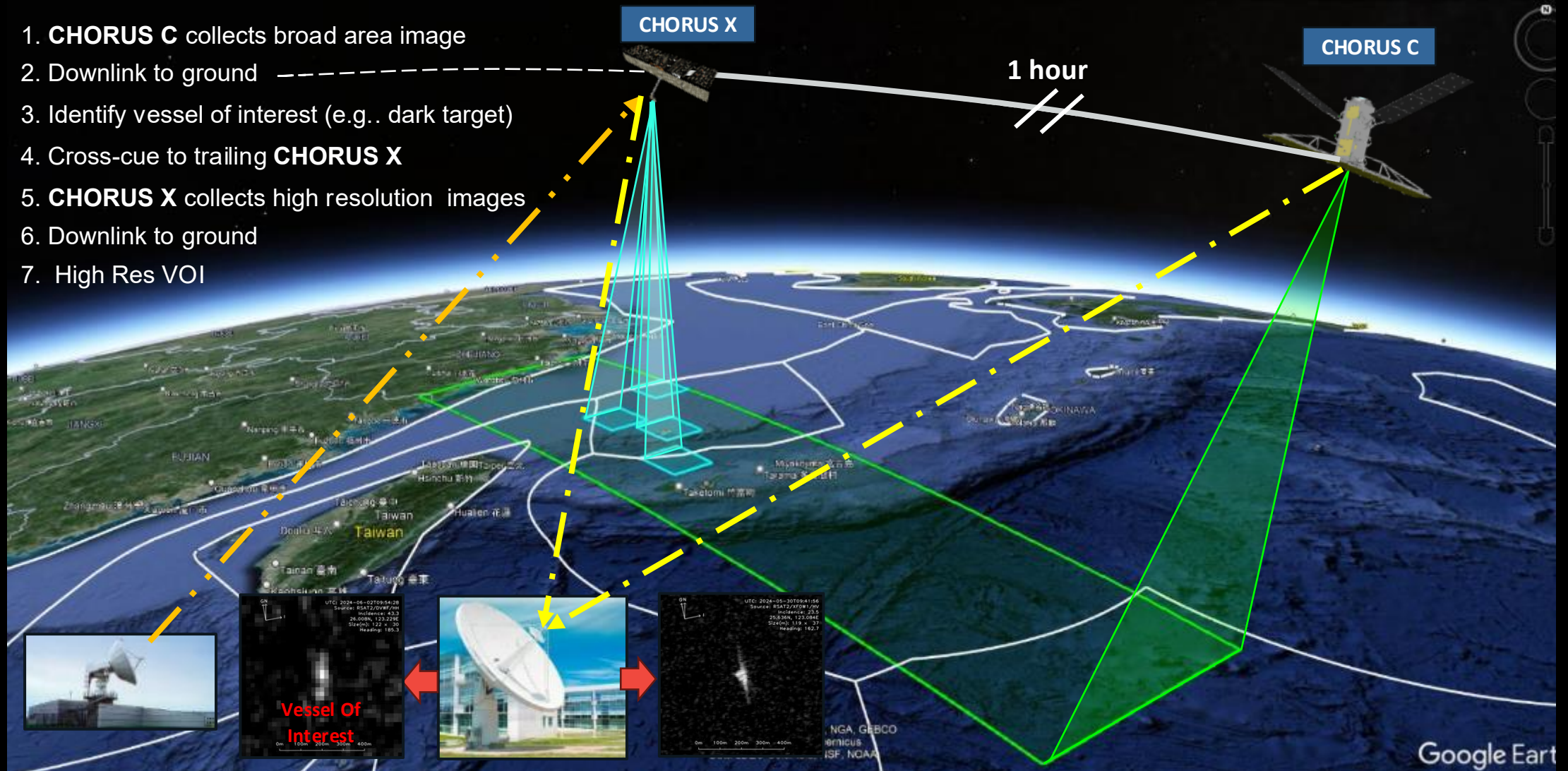
CHORUS Cross Cue

1. CHORUS C collects broad area image
2. Downlink to ground
3. Identify vessel of interest (e.g.. dark target)
4. Cross-cue to trailing CHORUS X

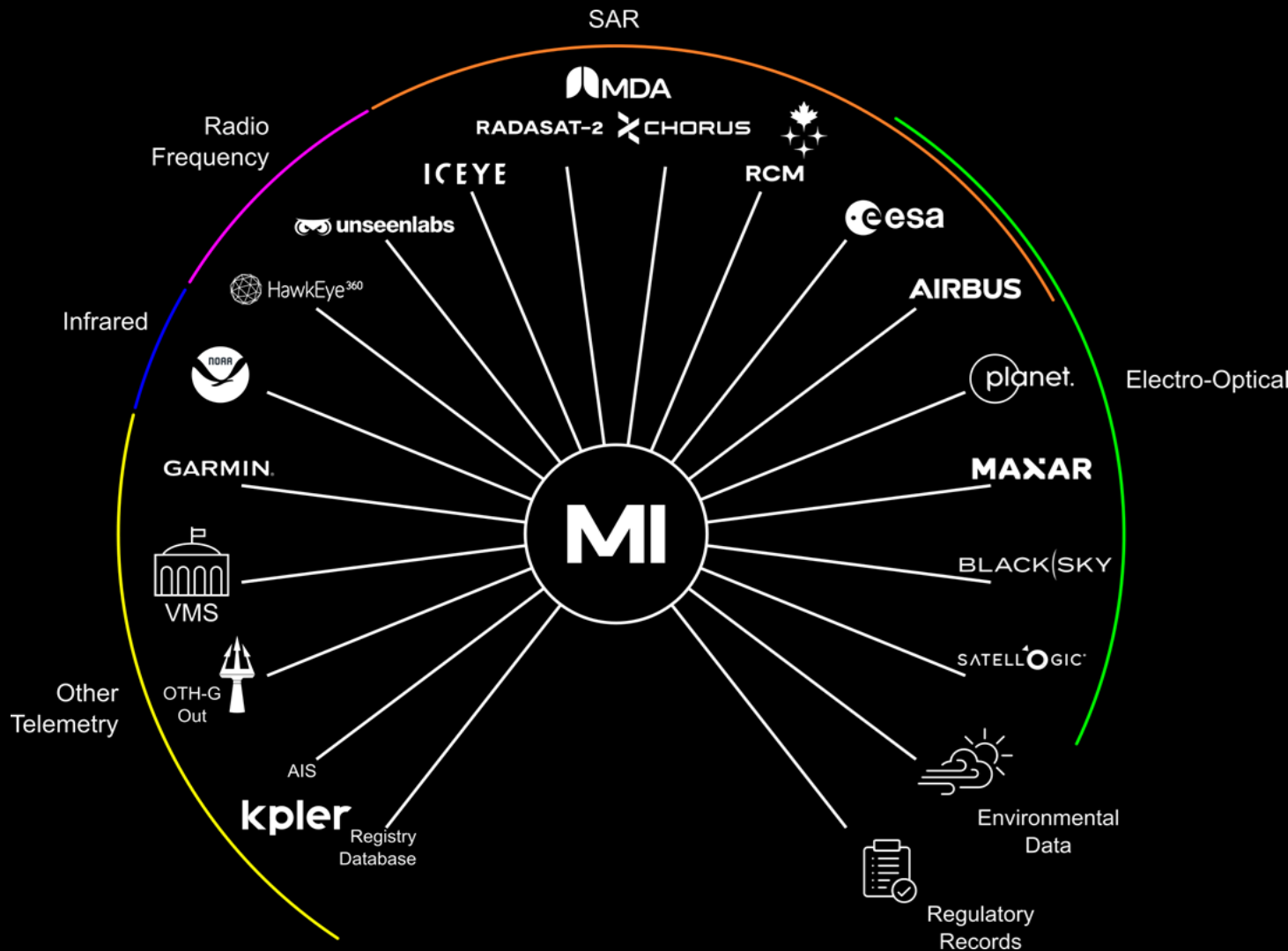


CHORUS Cross Cue

1. **CHORUS C** collects broad area image
2. Downlink to ground
3. Identify vessel of interest (e.g.. dark target)
4. Cross-cue to trailing **CHORUS X**
5. **CHORUS X** collects high resolution images
6. Downlink to ground
7. High Res VOI



Maritime Insights – The World’s Largest Sensor Suite



SAR Detections

- Active sensing with synthetic aperture radar is used to detect vessels through clouds / day or night

Optical Detections

- Multi-source optical sensing is used to detect, classify and identify vessels of interest

RF Detections

- Passive space-based sensing is used to detect common maritime RF transmitters (S- and X-Band navigation radars, VHF and Sat phones)

VIIRS Detections

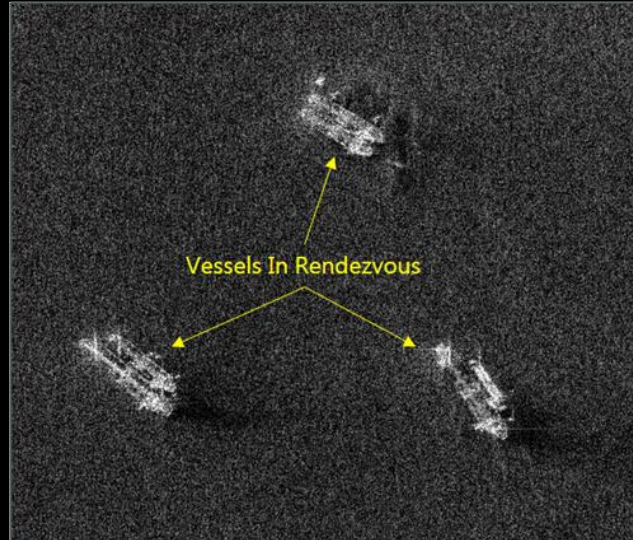
- EO from NASA / NOAA is used to detect vessels from their emitted lights



Maritime Insights - Multi-Source Sensor Fusion

SAR Vessel Detection

- Advanced Signal processing capabilities driven by 17-years of development in SAR Science
- Developing AI augmentation

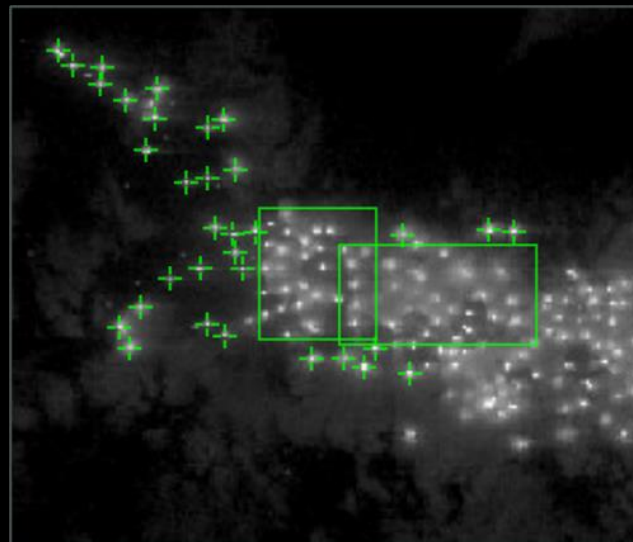


Electro-Optical AI Insights

- Diverse vendor, multi-resolution model built for many partners across the whole market
- Effective detection of vessels across varied marine environments

Infrared AI Analytics for VIIRS

- Noise-resistant AI analytic originally designed for detecting squid fishing vessels
- Enhanced to now detect relatively faint lights



Radio Frequency Detection & Identification

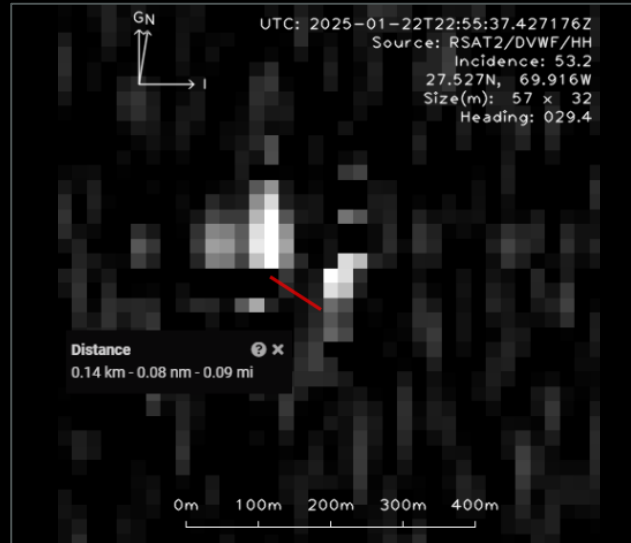
- RF detection reports are fused into tracks with other data sources.
- Partner-provided insights on emitter fingerprinting



Maritime Insights - Multi-Source Analytics

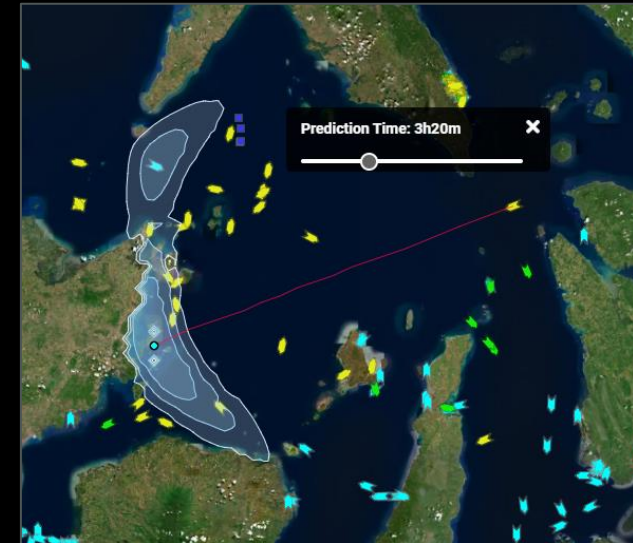
Dark Rendezvous

- Vessels in class proximity trigger alerts



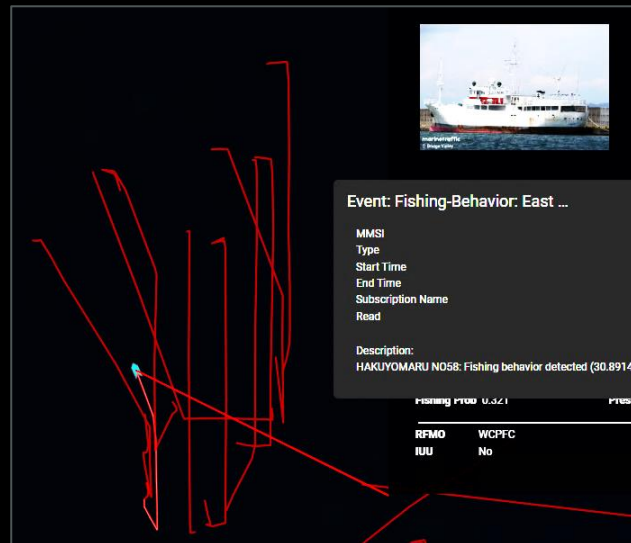
Statistical Prediction

- Large dataset informed prediction of where a vessel will move based on class and size.



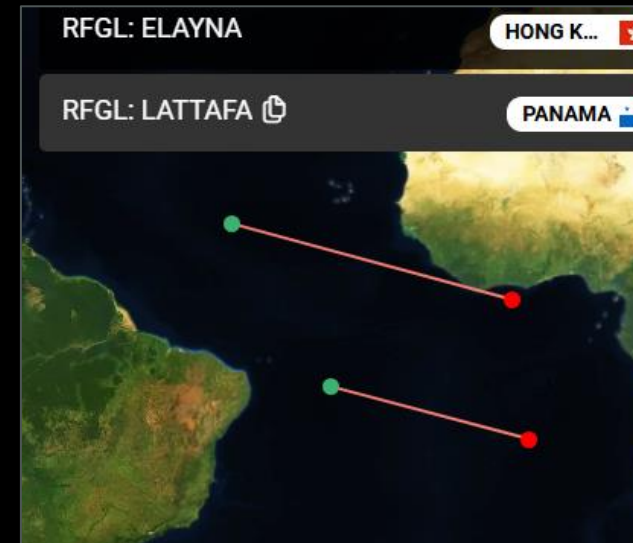
Behavior Classification

- Vessel movements are monitored to identify when fishing is taking place



AIS Manipulation Alerts

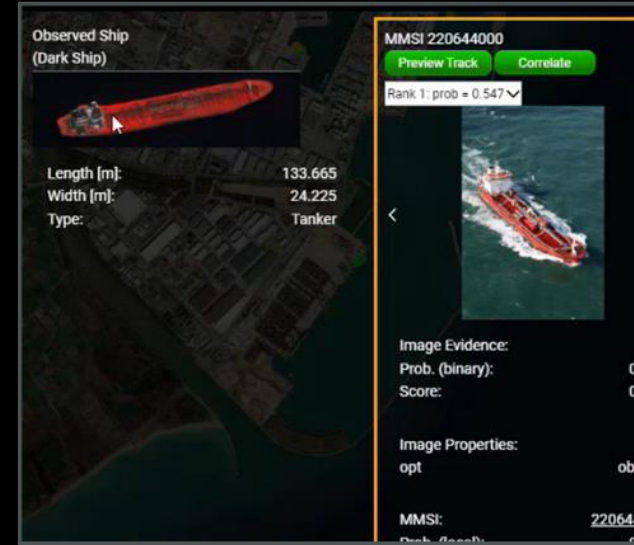
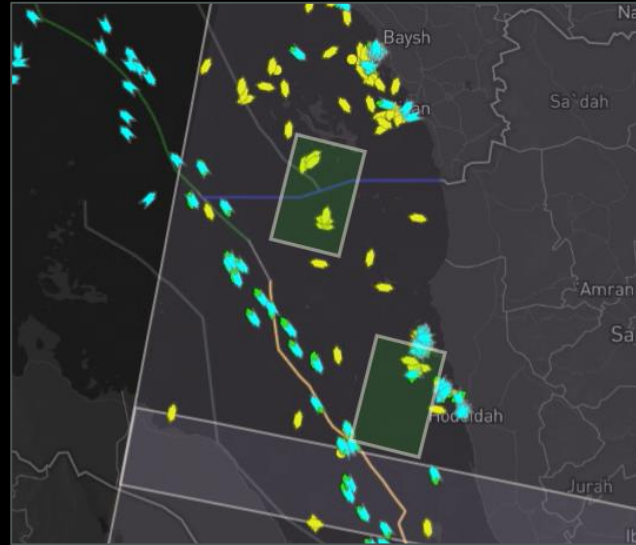
- Where AIS positions don't align with the satellites receiving their transmissions



Maritime Insights - Sensor Exploitation (in progress)

CHORUS Cross-Cue

- Targeting points of interest within a CHORUS-C collection to image using CHORUS-X

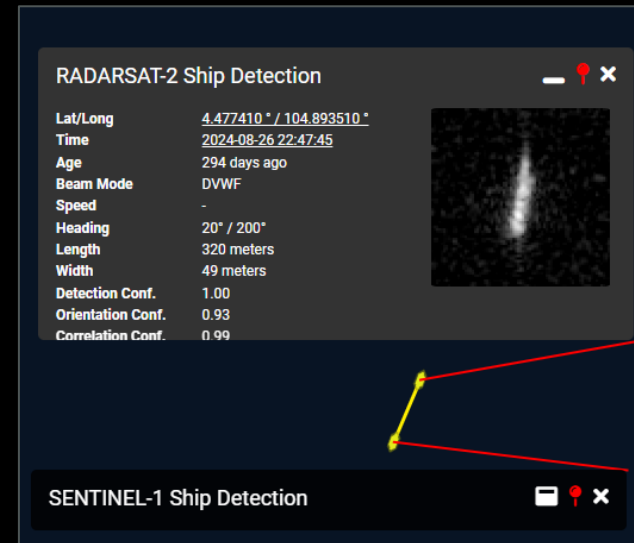
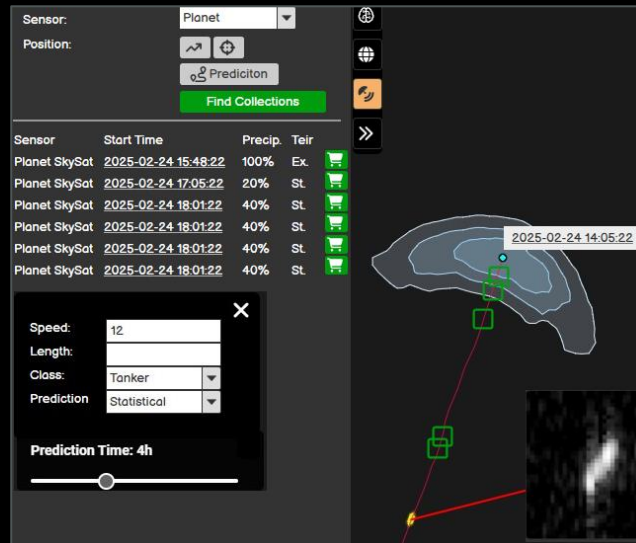


Dark Ship Identification

- AI is used to recognize a vessel in an Earth observation image
- Matches a given image against a database of other EO and photographic resources

In-Platform Tasking

- The predicted passage of a vessel is polled against vendor API's to determine upcoming imaging opportunities



Dark Tracks

- Detections from multiple sources are linked regardless of AIS
- Allows a dark vessel to be tracked
- Extracting speed and heading





**DARKVESSEL
DETECTION**

Canada

DFO International Fisheries Enforcement Canada – Dark Vessel Detection Platform Overview

Dustin De Gagne
Senior Program Officer



Government
of Canada

Gouvernement
du Canada



CONSERVATION AND PROTECTION



CONSERVATION ET PROTECTION

Canada's Dark Vessel Detection Program - Overview

- A near real-time, **multi-source satellite maritime surveillance capability** that detects and tracks vessels
- Automatically **identifies non-AIS broadcasting "dark" vessels** detected in satellite imagery.
- Canada's government-owned **RadarSat Constellation Mission (RCM)** and a suite of commercial satellite sources for ship detection.
- Deployed internationally by Fisheries and Oceans Canada to combat IUU fishing, enhance maritime domain awareness, and counter maritime security challenges.



Global AIS
coverage



Multi-source
satellite
data access



Highlights non-
broadcasting
"dark vessels"



Near-real time
data delivery



Auto-correlation of
satellite data with AIS



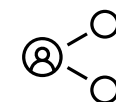
Web-based



Vessel behavior
detection and
alerts



Vessel registry and
historical data



Sharing and
export
functions



Fisheries and
Oceans Canada

Pêches et Océans
Canada

Canada

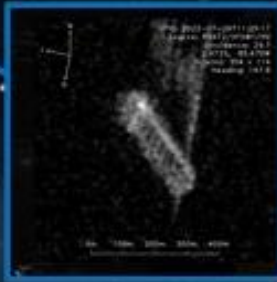


DARKVESSEL DETECTION

Data Types

Synthetic Aperture Radar (SAR)

- Sources:
- RADARSAT Constellation Mission (RCM)
 - RADARSAT 2



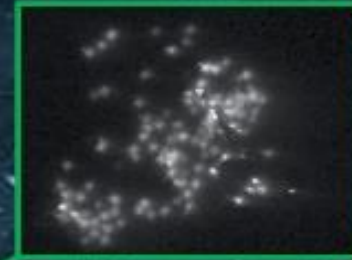
Radio Frequency (RF)

- Sources:
- UnseenLabs
 - Hawkeye360



VIIRs

- Sources:
- NASA/NOAA



MMSI	548946000
IMO	9761231
Call Sign	DUBN
Type	Cargo Vessel
Length	180 meters
Width	30 meters

- Sources:
- IHS Fairplay

Vessel details

Environmental Data

- Sources:
- Openweathermap.org (Wind Speed and Direction, Cloud Cover, Precipitation, Sea surface temp)

Optical

- Sources:
- MAXAR
 - Blacksky
 - Satellogic



Voluntary Signals

S-AIS

- Sources (AIS):
- Spire Maritime (formerly exactEarth)

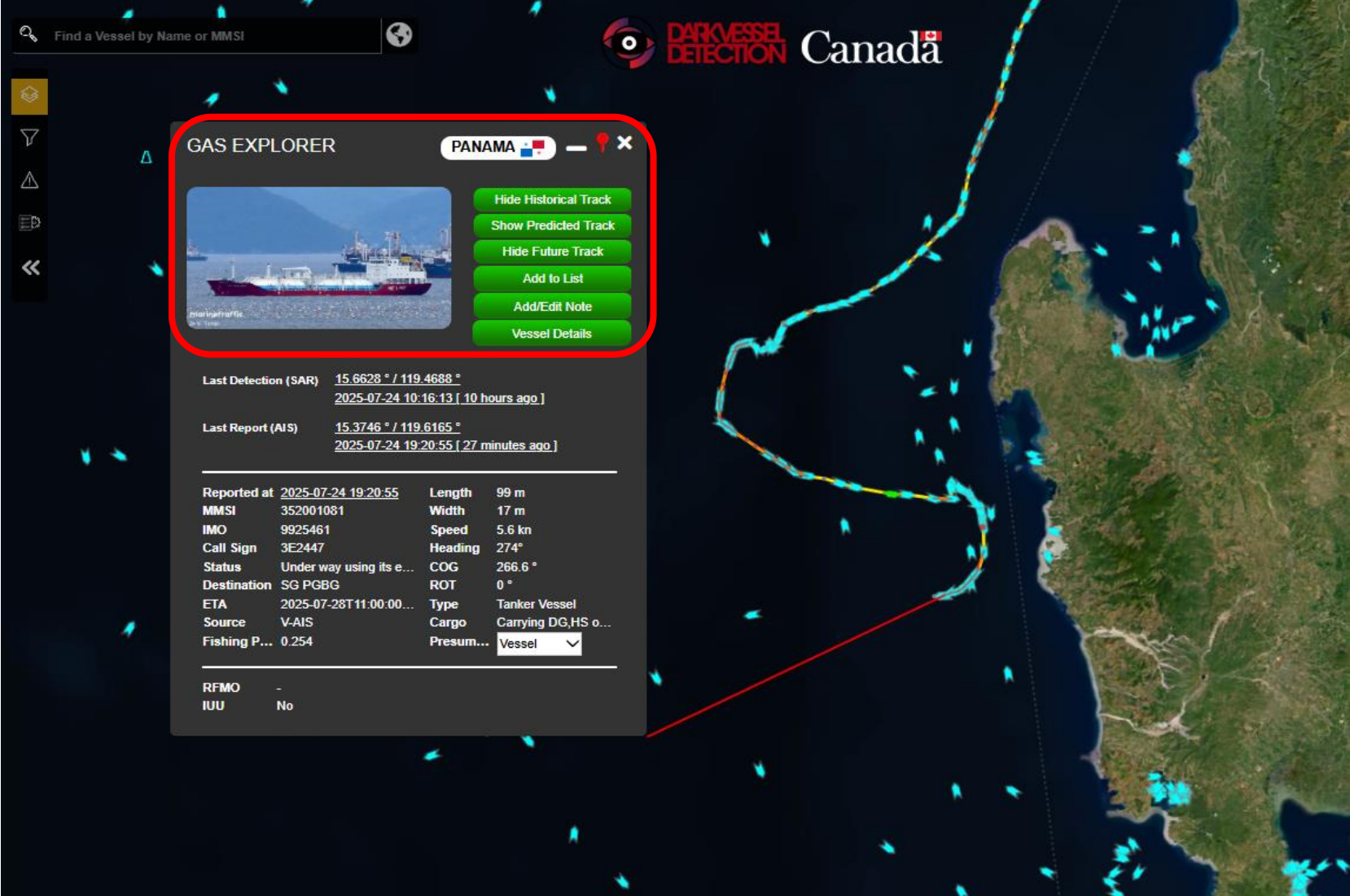
VMS

- Sources (VMS):
- Various



Examining Vessels and Tracks

- All transponder data is listed in here
- **Historical / Future Track:** clicking this will display the vessel's historical AIS track / movement history (up to 160 days)
- **Add to List:** marks this position on the map for future reference
- **RFMO/IUU:** Indicates if the vessel is registered for fishing or has been recorded in IUU activities before.
- **Fishing Probability:** likelihood the vessel's movement is indicating fishing practices.
- **Vessel Details:** is linked to registry information



The screenshot shows the DARKVESSEL DETECTION Canada interface. A search bar at the top left contains the text "Find a Vessel by Name or MMSI". The main map area displays a satellite view of the ocean with a red vessel icon and a track of blue and yellow arrows. A red box highlights a pop-up window for the vessel "GAS EXPLORER" (PANAMA). The pop-up window contains a photo of the vessel, a "Hide Historical Track" button, a "Show Predicted Track" button, a "Hide Future Track" button, an "Add to List" button, an "Add/Edit Note" button, and a "Vessel Details" button. Below the pop-up window, the following information is displayed:

Last Detection (SAR) [15.6628 ° / 119.4688 °](#)
[2025-07-24 10:16:13 \[10 hours ago.\]](#)

Last Report (AIS) [15.3746 ° / 119.6165 °](#)
[2025-07-24 19:20:55 \[27 minutes ago.\]](#)

Reported at	2025-07-24 19:20:55	Length	99 m
MMSI	352001081	Width	17 m
IMO	9925461	Speed	5.6 kn
Call Sign	3E2447	Heading	274°
Status	Under way using its e...	COG	266.6 °
Destination	SG PGBG	ROT	0 °
ETA	2025-07-28T11:00:00...	Type	Tanker Vessel
Source	V-AIS	Cargo	Carrying DG,HS o...
Fishing P...	0.254	Presum...	Vessel <input type="text"/>

RFMO -
IUU No



Analytics, behavior detection, alerts

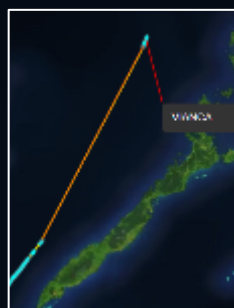
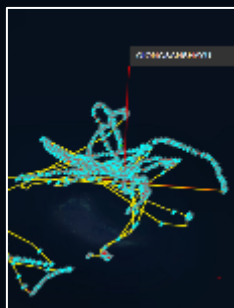
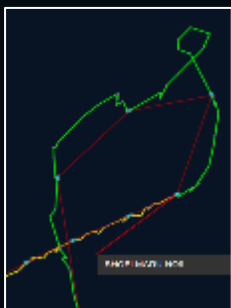
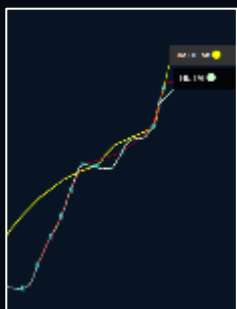
Rendezvous Detection

Fishing Behavior

Loitering Detection

AIS reporting Interruptions

Geofence Enter/exit



Event: Rendezvous: Squid R...

MMSI	351537000_412331037
Type	Rendezvous
Start Time	2025-05-25T19:55:23Z
End Time	2025-05-25T19:55:23Z
Subscription Name	Squid Rendezvous Test
Read	false

Description:
RUI SHENG, ZHOU YU 972: Rendezvoused in Squid Rendezvous Test

ZHOU YU 972 CHINA, ...

RUI SHENG PANAMA

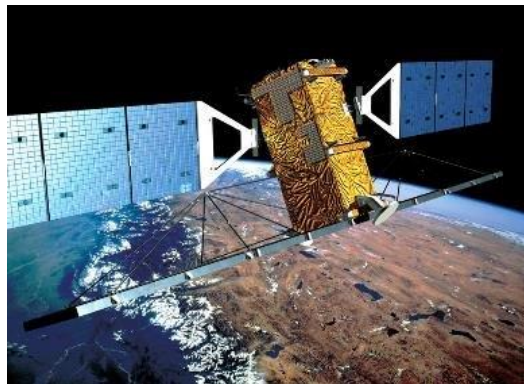
- Custom alerts for behaviors like loitering, rendezvous, AIS interruption, geofence entry/exit etc.
- Real-time email alerts and notifications for rapid response



SAR sources in DVD



RADARSAT Constellation Mission (RCM)



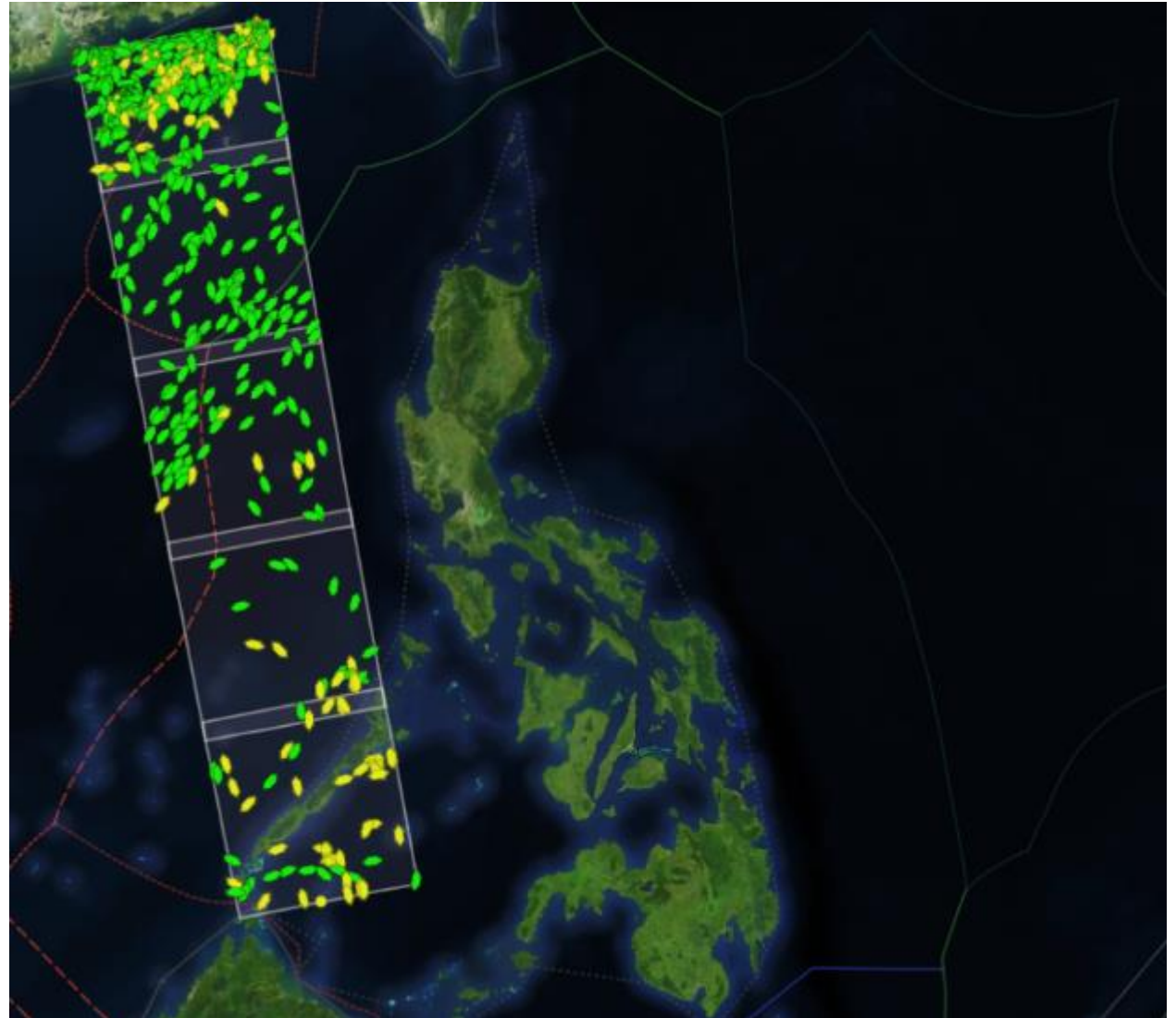
RADARSAT-2



ICEYE

RADARSAT Constellation Mission (RCM)

- Used and controlled by Government of Canada
- Approximately +15 swaths per day in Philippines
- Exact orientation of swaths depends on orbit of satellite
- Large imaging capacity for broad area detection
 - Can detect metal vessels 30-40m+ in length
- Provides frequent SAR broad area ship detections over the AOIs and can validate detections from other sources



Name or MMSI



DARKVESSEL DETECTION

SAR Detections - Use Case



DARKVESSEL
DETECTION

EDISON

UNITED ...



ANTONIO H

ECUADOR

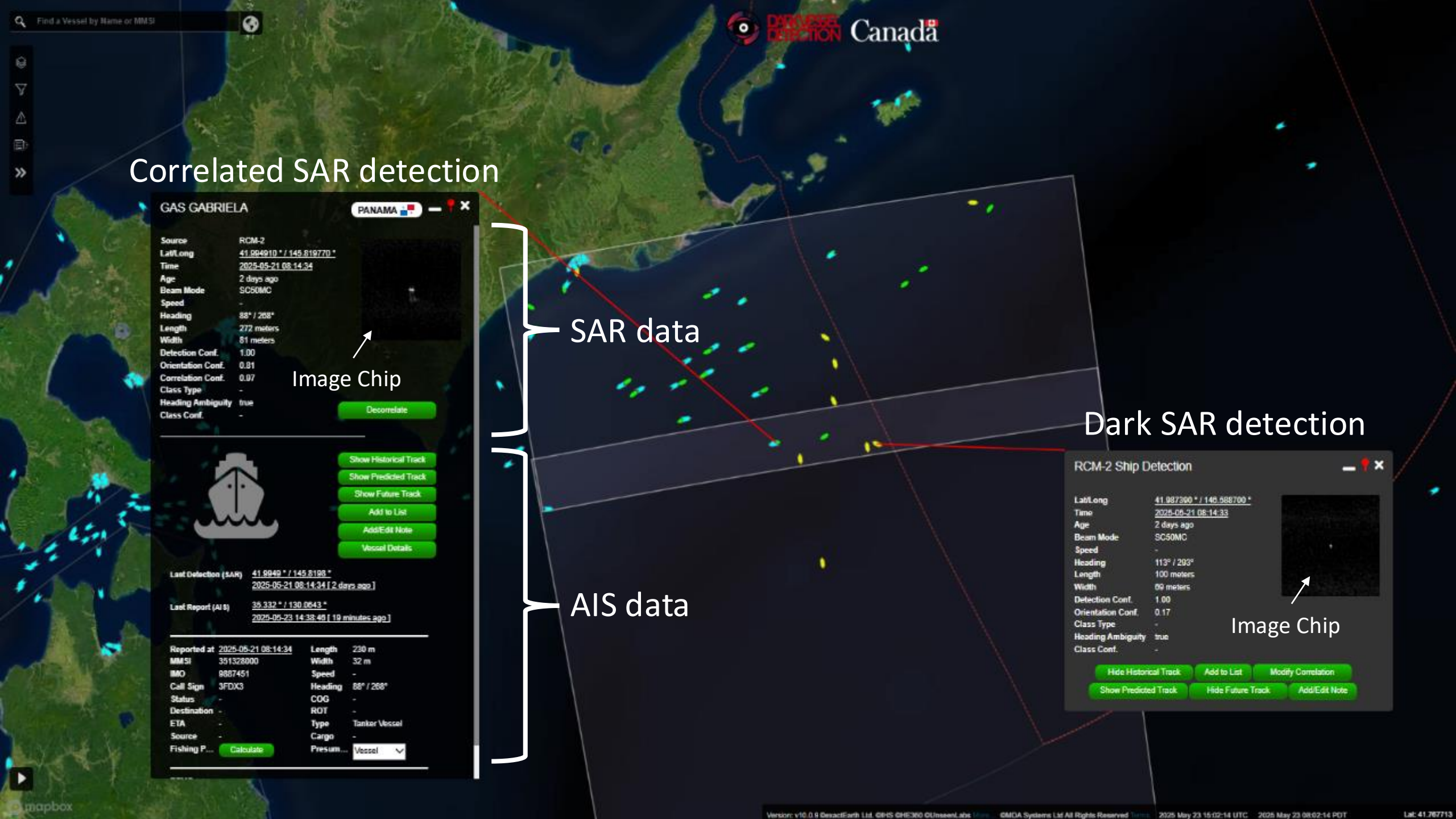


SPIRIT OF MELBOURNE

ISLE OF ...



Uncorrelated SAR contacts –
“Dark” Vessels



Correlated SAR detection

GAS GABRIELA PANAMA

Source	RCM-2
Lat/Long	41.994910° / 145.819770°
Time	2025-05-21 08:14:34
Age	2 days ago
Beam Mode	SC50MC
Speed	-
Heading	88° / 268°
Length	272 meters
Width	81 meters
Detection Conf.	1.00
Orientation Conf.	0.81
Correlation Conf.	0.07
Class Type	-
Heading Ambiguity	true
Class Conf.	-

Image Chip

Decorrelate

Show Historical Track
Show Predicted Track
Show Future Track
Add to List
Add/Edit Note
Vessel Details

Last Detection (SAR) 41.9949° / 145.8198°
2025-05-21 08:14:34 [2 days ago]

Last Report (AIS) 35.332° / 130.0643°
2025-05-23 14:38:46 [19 minutes ago]

Reported at	2025-05-21 08:14:34	Length	230 m
MMSI	351328000	Width	32 m
IMO	8887451	Speed	-
Call Sign	3FDX3	Heading	88° / 268°
Status	-	COG	-
Destination	-	ROT	-
ETA	-	Type	Tanker Vessel
Source	-	Cargo	-
Fishing P...	Calculate	Presum...	Vessel

SAR data

AIS data

Dark SAR detection

RCM-2 Ship Detection

Lat/Long	41.987360° / 145.588700°
Time	2025-05-21 08:14:33
Age	2 days ago
Beam Mode	SC50MC
Speed	-
Heading	113° / 203°
Length	100 meters
Width	09 meters
Detection Conf.	1.00
Orientation Conf.	0.17
Class Type	-
Heading Ambiguity	true
Class Conf.	-

Image Chip

Hide Historical Track
Add to List
Modify Correlation
Show Predicted Track
Hide Future Track
Add/Edit Note

Find a Vessel by Name or MMSI

Map navigation icons: Home, Layers, Full Screen, Print, Refresh, Close

DARKVESSEL DETECTION

Ship detection using VIIRS - Example

Showing VIIRS detections “bright lights”
on the night of 17 Dec 2024

- VIIRS detection correlated to AIS
- Dark VIIRS detection

VIIRS Detection

Moon Fraction	93
Moon Illumination	0.41e-6 Lux
Source	MDA
Platform	JPSS-2
Lat/Long	29.472126 ° / 127.171112 °
Time	2024-12-17 17:43:03
Age	2 days ago
Quality Flag	Strong Detection
Radiance	25.3 nWatts/cm ² /sr
Class Type	-
Heading Ambiguity	-
Class Conf.	-



Hide Historical Track Add to List Modify Correlation

Hide Future Track Add/Edit Note

June 10, 2024



RF Signal Mapping

- DVD utilizes data from commercial SIGINT RF vendors, including UnseenLabs, to geolocate RF signals of interest (SOIs)
- **VHF 30MHz-300MHz**
 - 49 VHF Marine Communications Channels, includes AIS
- **L-Band 1GHz-2GHz**
 - L-Band Mobile Satellite devices from Inmarsat and Thuraya (phones, data), FADs, VMS devices, Iridium phones
- **S-Band 3GHz**
 - Marine Navigation Radars, used especially when in rain or fog as well as for identification and tracking
- **X-Band 8GHz-12GHz**
 - Marine Navigation Radars used for a sharper image and better resolution (and smaller antenna)



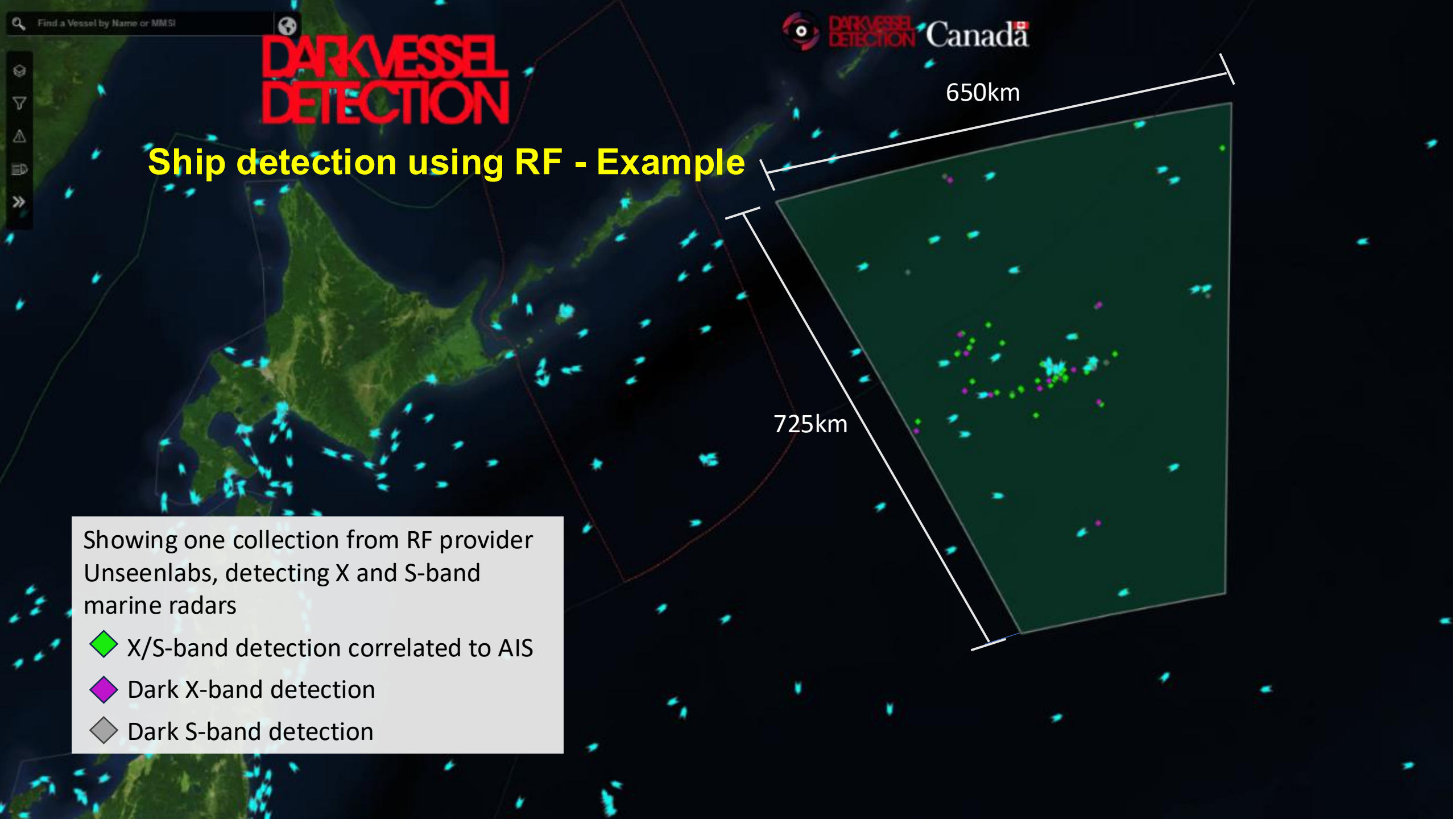
Ship detection using RF - Example

650km

725km

Showing one collection from RF provider
Unseenlabs, detecting X and S-band
marine radars

- ◆ X/S-band detection correlated to AIS
- ◆ Dark X-band detection
- ◆ Dark S-band detection



Electro-optical Ship Detection



- High-resolution imagery (up to ~30 cm) from multiple commercial providers
- Time-sensitive tasking
- Visual confirmation of behaviors such as transshipment, gear deployment, or rendezvous
- Object-level detection (e.g., fishing gear) enables validation of suspected IUU activity

BARTOLOMEU DIAS LUXEM...

Source	WW03
Lat/Long	-2.979274 ° / -80.226970 °
Time	2025-05-15 15:58:08
Age	7 days ago
Heading	15.4°
Length	134 meters
Width	31 meters
Detection Conf.	0.98
Correlation Conf.	0.26
Class Type	Cargo Ship
Heading Ambiguity	-
Class Conf.	1.00







Last Detection (Optical) [-2.0755 ° / -80.2263 °](#)
2025-05-16 15:52:09 [7 days ago]

Last Report (AIS) [-3.2079 ° / -80.0164 °](#)
2025-05-23 14:53:20 [29 minutes ago]

Reported at 2025-05-15 15:58:08	Length	152 m	
MMSI	253384000	Width	32 m
IMO	9618901	Speed	-
Call Sign	LXDI	Heading	15.4°
Status	-	COG	-
Destination	-	ROT	-
ETA	-	Type	Dredging
Source	-	Cargo	-
Fishing P...		Presum...	<input type="text" value="Vessel"/>

RFMO -
 IUU No

Collected image

WW03 Ship Detection

Source	WW03
Lat/Long	-2.653484 ° / -80.173378 °
Time	2025-05-15 15:58:08
Age	7 days ago
Heading	138.5°
Length	13 meters
Width	4 meters
Detection Conf.	0.12
Class Type	Cargo Ship
Heading Ambiguity	-
Class Conf.	1.00











Collected image

WW03 Ship Detection

Source	WW03
Lat/Long	-2.878117 ° / -80.197275 °
Time	2025-05-15 15:58:08
Age	7 days ago
Heading	90°
Length	7 meters
Width	3 meters
Detection Conf.	0.62
Class Type	Cargo Ship
Heading Ambiguity	-
Class Conf.	1.00












SSC2 Ship Detection


Source SSC2
Lat/Long 22.9314 ° / 120.0931 °
Time 2026-02-09 23:28:34
Age 20 days ago
Heading 134.8°
Length 18 meters
Width 9 meters
Detection Conf. 0.50
Class Type Fishing Vessel
Heading Ambiguity -
Class Conf. 0.42



[Hide Historical Track](#)
[Add to List](#)
[Modify Correlation](#)
[Show Predicted Track](#)
[Hide Future Track](#)
[Add/Edit Note](#)

SSC2 Ship Detection

Source SSC2
Lat/Long 22.8190 ° / 120.0743 °
Time 2026-02-09 23:28:34
Age 20 days ago
Heading 86.6°
Length 7 meters
Width 5 meters
Detection Conf. 0.64
Class Type Other
Heading Ambiguity -
Class Conf. 0.86




[Hide Historical Track](#)
[Add to List](#)
[Modify Correlation](#)
[Show Predicted Track](#)
[Hide Future Track](#)
[Add/Edit Note](#)




VICTOR

Source SSC2
Lat/Long 22.8545 ° / 120.0925 °
Time 2026-02-09 23:28:34
Age 20 days ago
Heading 2.4°
Length 43 meters
Width 15 meters
Detection Conf. 0.60
Correlation Conf. 0.24
Class Type Other
Heading Ambiguity -
Class Conf. 0.99



[Decorrelate](#)



[Show Historical Track](#)
[Show Predicted Track](#)
[Show Future Track](#)
[Add to List](#)
[Add/Edit Note](#)
[Vessel Details](#)

Last Detection (SAR) 24.6623 ° / 120.4985 °
2026-02-12 10:10:53 [18 days ago]

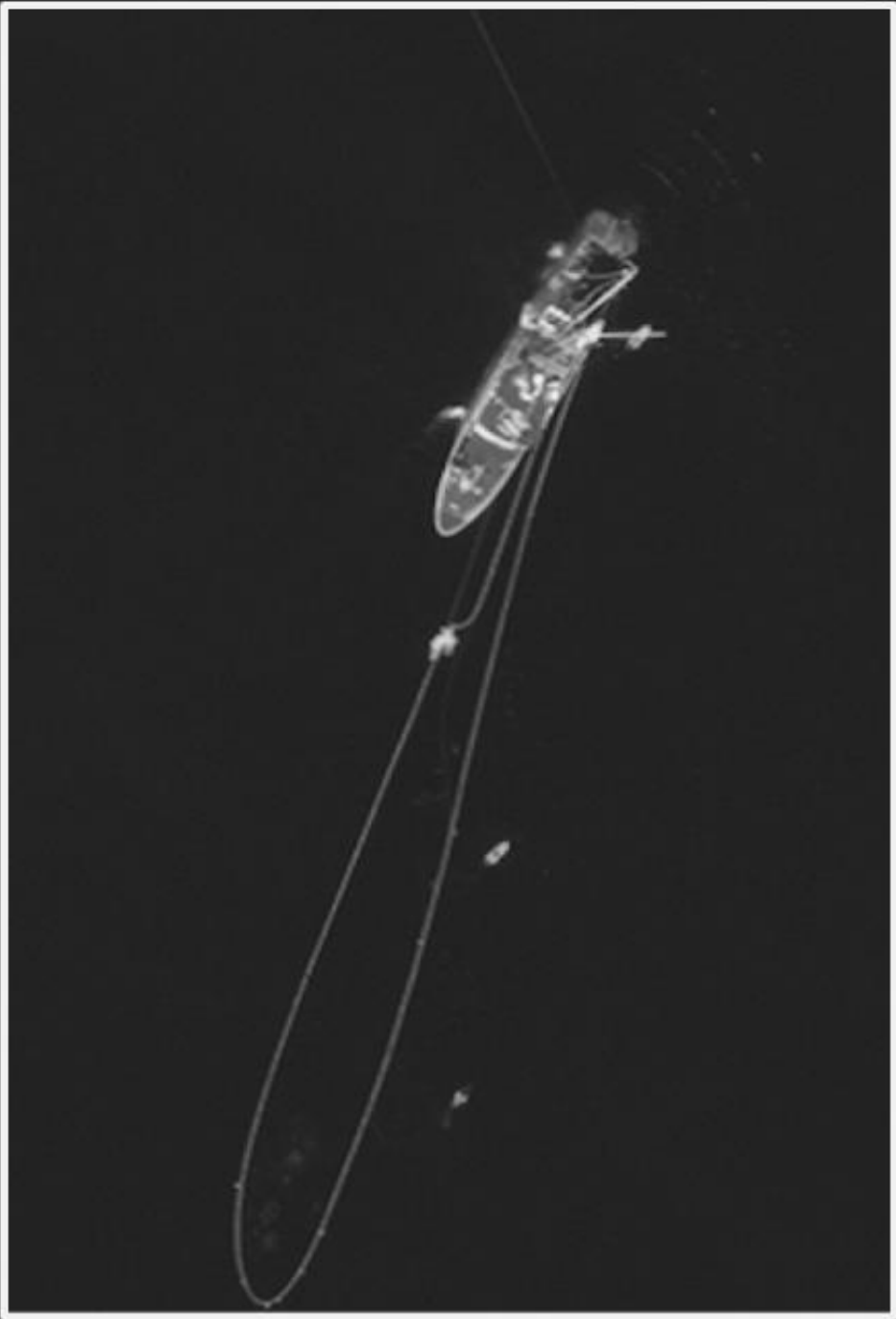
Last Report (AIS) 25.3213 ° / 121.2769 °
2026-03-02 10:09:02 [3 hours ago]

Reported at <u>2026-02-09 23:28:34</u>	Length 89 m
MMSI 667001260	Width 10 m
IMO 8204729	Speed -
Call Sign 9LU2063	Heading 2.4°
Status -	COG -
Destination -	ROT -
ETA -	Type Tanker Vessel
Source -	Cargo -
Fishing Prob Calculate	Presume... <input type="text" value="Vessel"/>

RFMO -
IUU No



**DARKVESSEL
DETECTION**



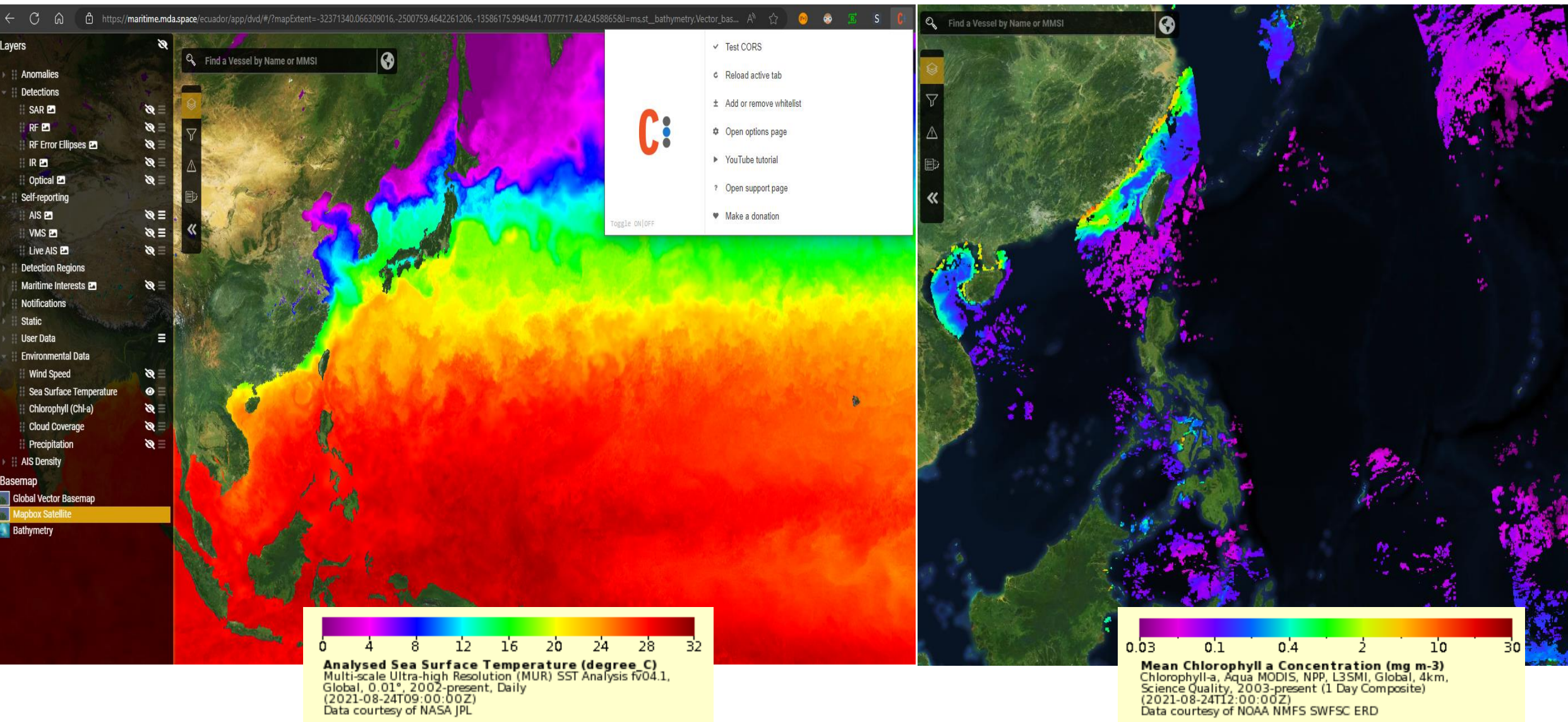
Fisheries and Oceans
Canada

Pêches et Océans
Canada



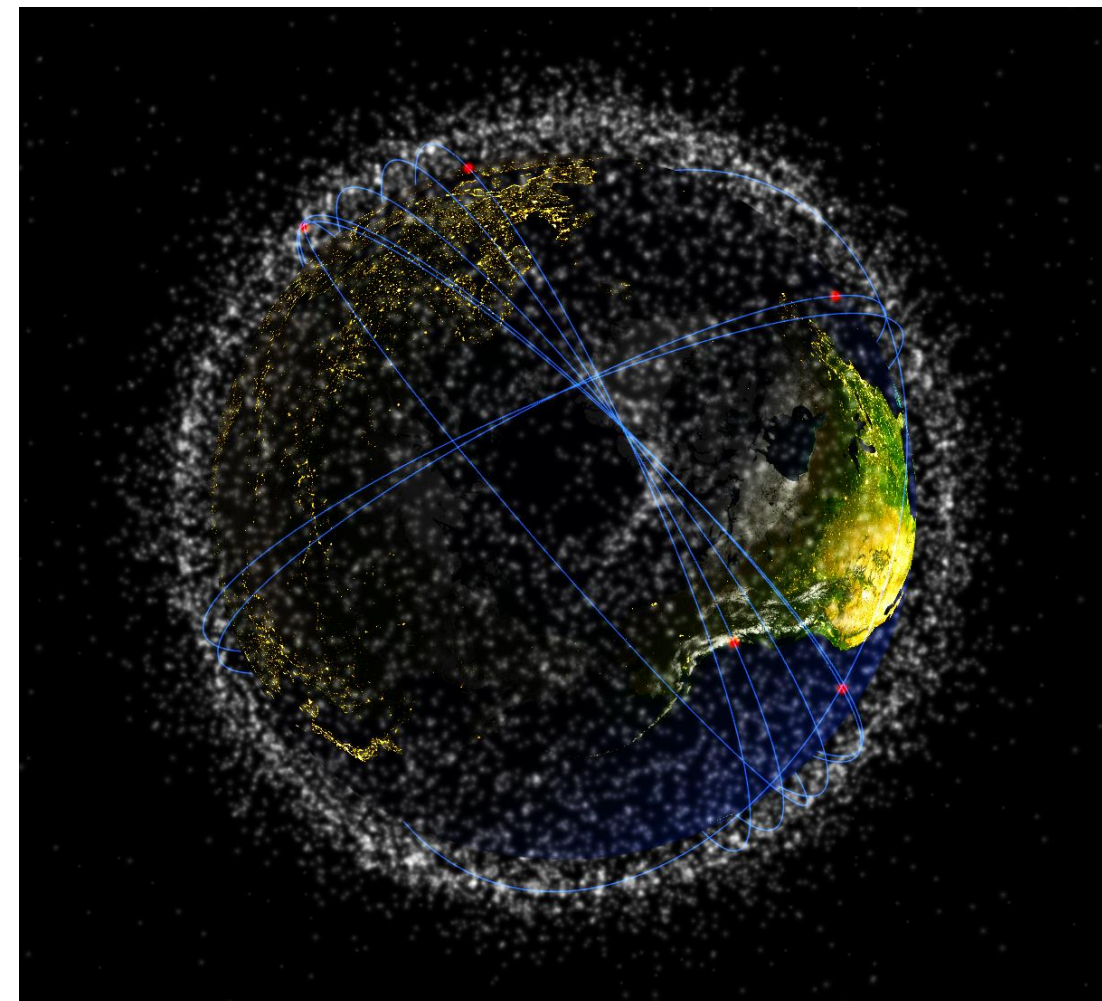


Environmental Layers



Operationalizing Data

Sensor	UTC	UTC-8
RADARSAT-2	17:30 01:30	10:30 22:00
UNSEENLABS	18:00 – 21:00 06:00 – 09:00	14:00 – 17:00 02:00 – 05:00
HawkEye360	02:00 – 04:00 14:00 – 16:00	22:00 – 02:00 10:00 – 14:00
Planet	14:30 18:00	10:30 13:00
Maxar	13:30 14:00 21:00	10:30 11:00 17:00
Blacksky	12:30 20:00	9:30 15:00



Sensor Coverage





30 May 08:28H Z

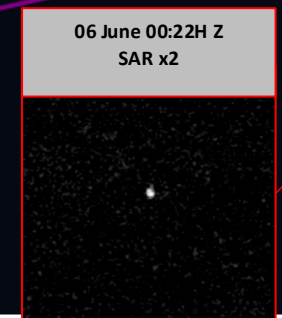
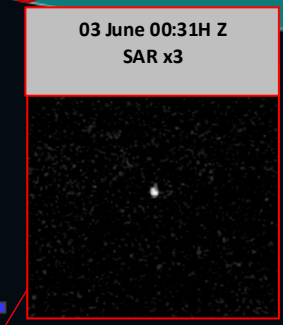
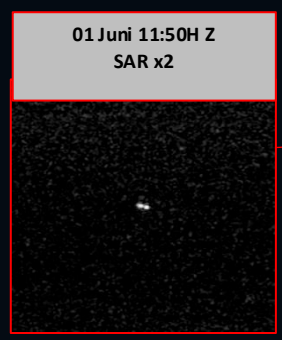
NINGTAI601 ● CHINA, ...

30 May 16:30H Z

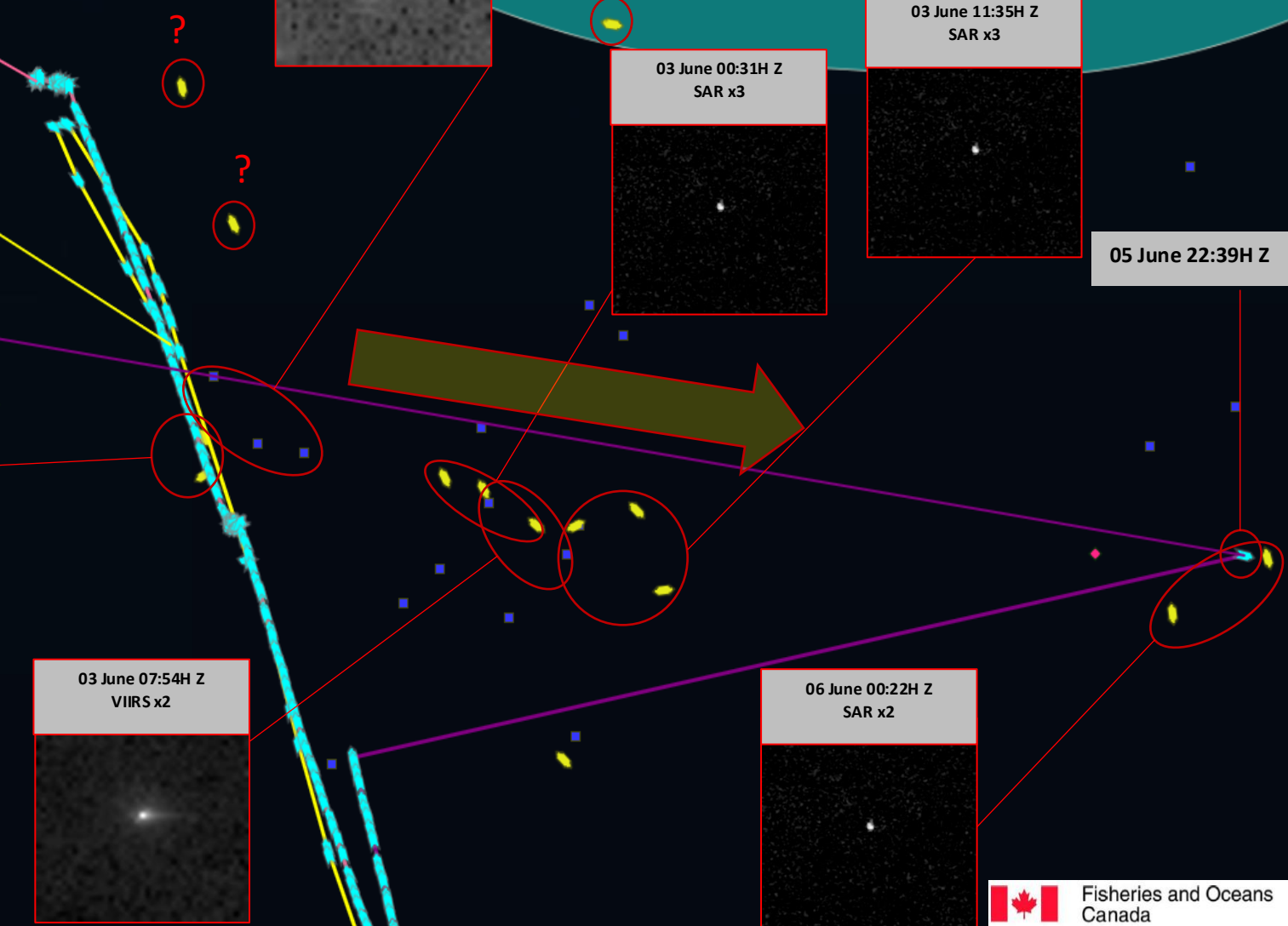
HUAYING811 ● CHINA, ...

28 May 19:19H Z

HUA YING 821 ● CHINA, ...

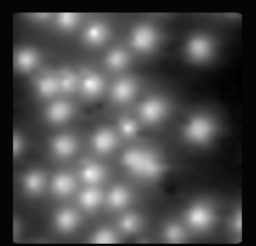


05 June 22:39H Z

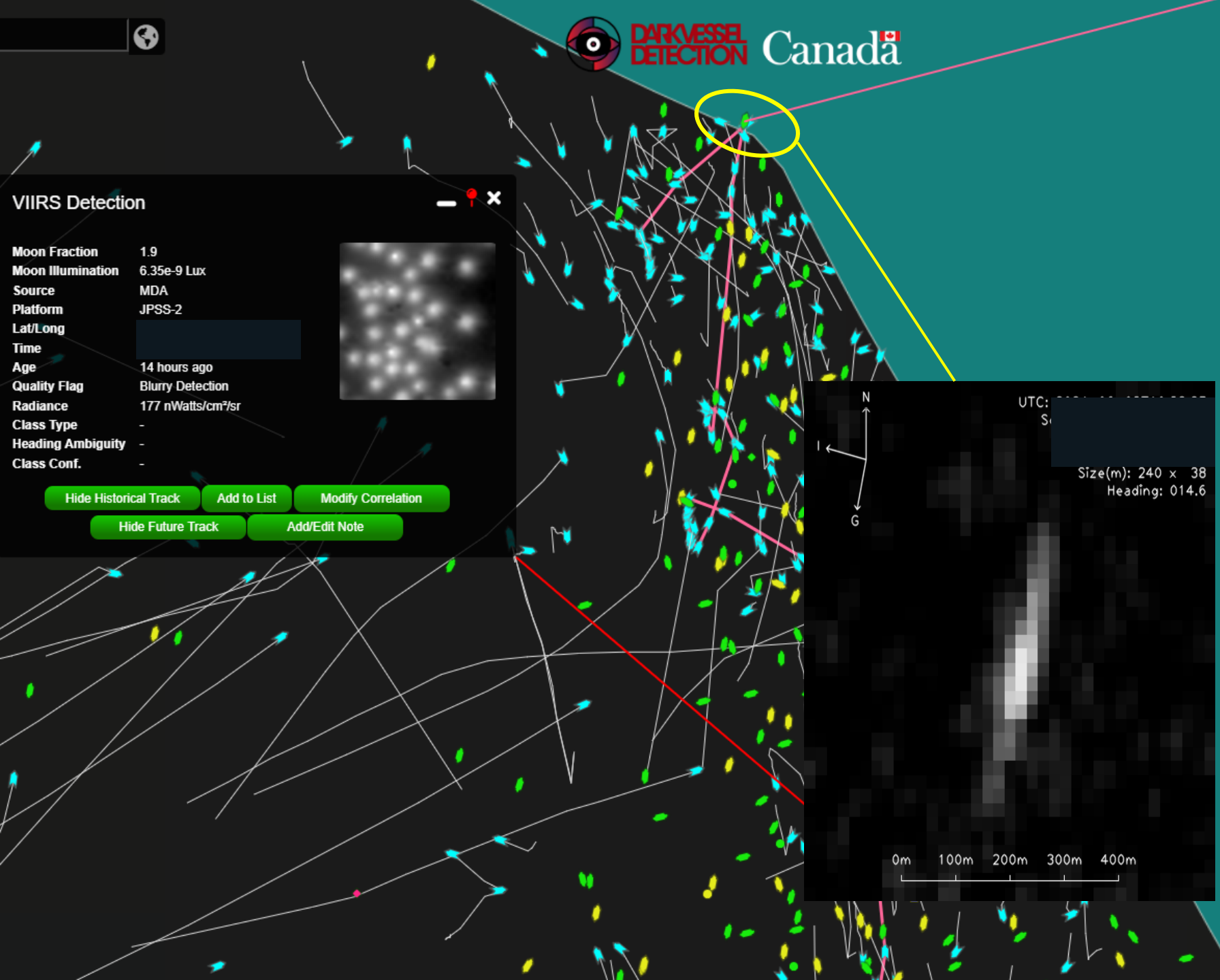


VIIRS Detection

Moon Fraction 1.9
 Moon Illumination 6.35e-9 Lux
 Source MDA
 Platform JPSS-2
 Lat/Long [Redacted]
 Time [Redacted]
 Age 14 hours ago
 Quality Flag Blurry Detection
 Radiance 177 nWatts/cm²/sr
 Class Type -
 Heading Ambiguity -
 Class Conf. -



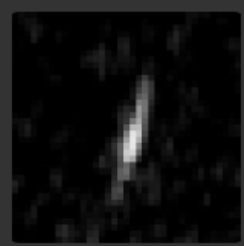
- Hide Historical Track
- Add to List
- Modify Correlation
- Hide Future Track
- Add/Edit Note



UTC: [Redacted]
 Size(m): 240 x 38
 Heading: 014.6

0m 100m 200m 300m 400m

Source RSAT2
 Lat/Long [Redacted]
 Time [Redacted]
 Age 10 hours ago
 Beam Mode DVWF
 Speed -
 Heading 15° / 195°
 Length 240 meters
 Width 38 meters
 Detection Conf. 1.00
 Orientation Conf. 0.92
 Correlation Conf. 0.97
 Class Type -
 Heading Ambiguity true
 Class Conf. -



Decorrelate

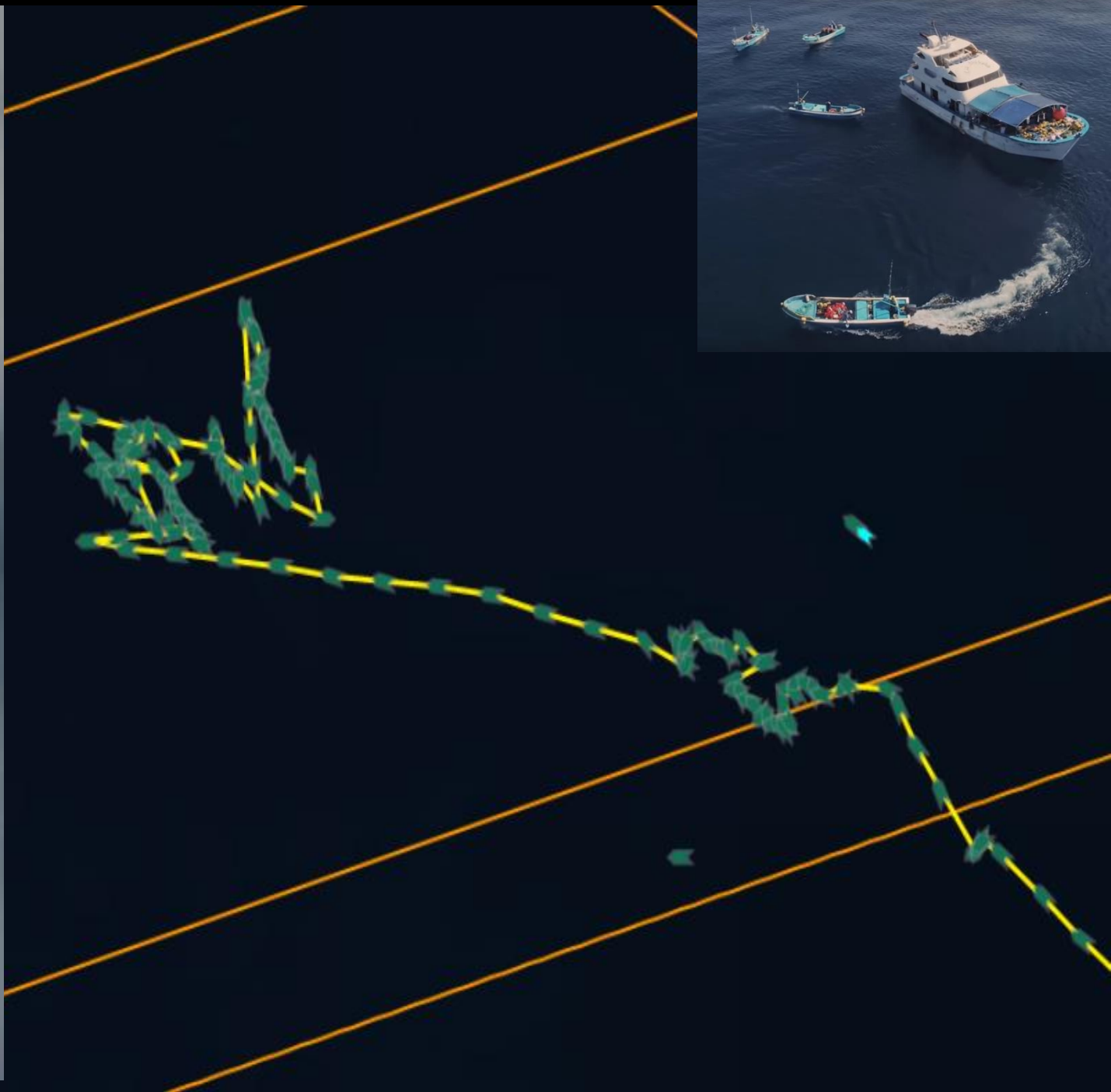


- Hide Historical Track
- Show Predicted Track
- Hide Future Track
- Add to List
- Add/Edit Note
- Vessel Details


Last Detection (SAR) [Redacted]
 Last Report (AIS) [Redacted]

Reported at	[Redacted]	Length	66 m
MMSI	412440659	Width	11 m
IMO	9874131	Speed	-
Call Sign	BZUZ	Heading	15° / 195°
Status	-	COG	-
Destination	-	ROT	-
ETA	-	Type	Fishing
Source	-	Cargo	-
Fishing P...	Calculate		


RFMO -




Lat/Long	<u>2.641374 ° / -90.245347 °</u>
Time	<u>2023-01-18 16:32:08</u>
Age	29 days ago
Heading	-
Length	-
Width	-
Detection Conf.	1.00
Class Type	Barge
Class Conf.	-



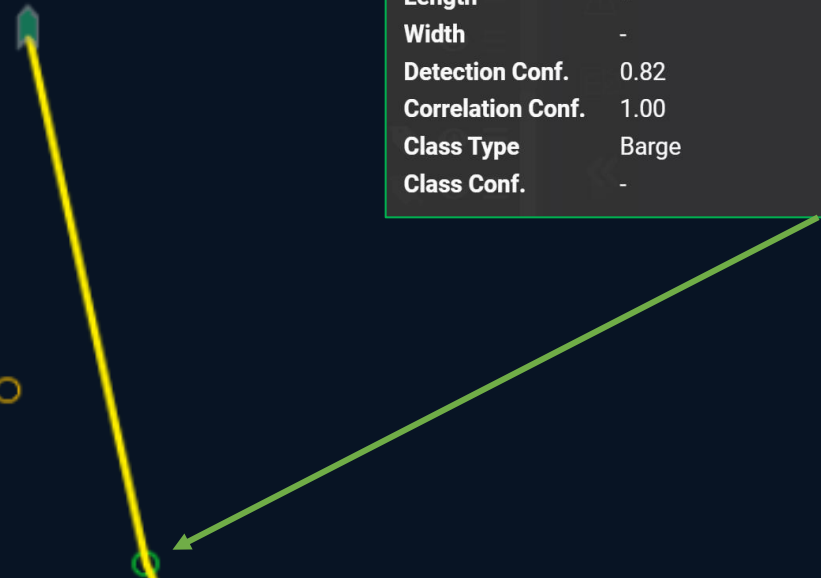
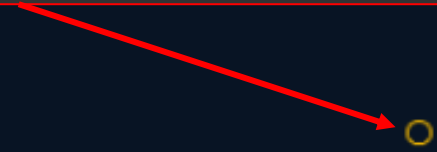
Lat/Long	<u>2.640854 ° / -90.244812 °</u>
Time	<u>2023-01-18 16:32:08</u>
Age	29 days ago
Heading	-
Length	-
Width	-
Detection Conf.	0.82
Correlation Conf.	1.00
Class Type	Barge
Class Conf.	-



Lat/Long	<u>2.641233 ° / -90.245145 °</u>
Time	<u>2023-01-18 16:32:08</u>
Age	29 days ago
Heading	-
Length	-
Width	-
Detection Conf.	1.00
Class Type	Barge
Class Conf.	-



Lat/Long	<u>2.641041 ° / -90.244954 °</u>
Time	<u>2023-01-18 16:32:08</u>
Age	29 days ago
Heading	-
Length	-
Width	-
Detection Conf.	0.64
Class Type	Barge
Class Conf.	-



Thank you!

