# CLEANING THE OCEANS WITH EDGE AI: THE OCEAN CLEANUP'S SMART CAMERA TRANSFORMATION

ROBIN DE VRIES, THE OCEAN CLEANUP

3 MARCH 2026 | EDGE AI AND VISION ALLIANCE ONLINE

## FOUNDED 2013

Dutch inventor Boyan Slat founded The Ocean Cleanup at the age of 18 in his hometown of Delft, the Netherlands.

## NON-PROFIT FOUNDATION

We are fully reliant on donations from individuals, corporations, governments and institutions.

## HQ ROTTERDAM

The Ocean Cleanup's team consists of more than 150 professionals with different backgrounds and expertise; all bound together to one vision: rid the world's oceans of plastic.

# BIG PROBLEMS REQUIRE **BIG SOLUTIONS**

Every year, hundreds of thousands of tons of plastic enter the oceans, primarily from rivers. And the plastic that's afloat within the oceans isn't going away by itself. To effectively solve the problem, we need to both **halt the trash flow from rivers**, and **remove legacy plastics from the oceans** at the same time.

The Ocean Cleanup, a non-profit organization, is developing and scaling technologies to rid the world's oceans of plastic. Our aim is to put ourselves out of business once the oceans are clean.

*https://theoceancleanup.com/about/*

# THE OCEAN CLEANUP IN 2025

*Interceptor in Kingston Bay, Jamaica*

*Interceptor in Rio Abajo, Panama*

*Drifter release for Ocean Plastic Research*

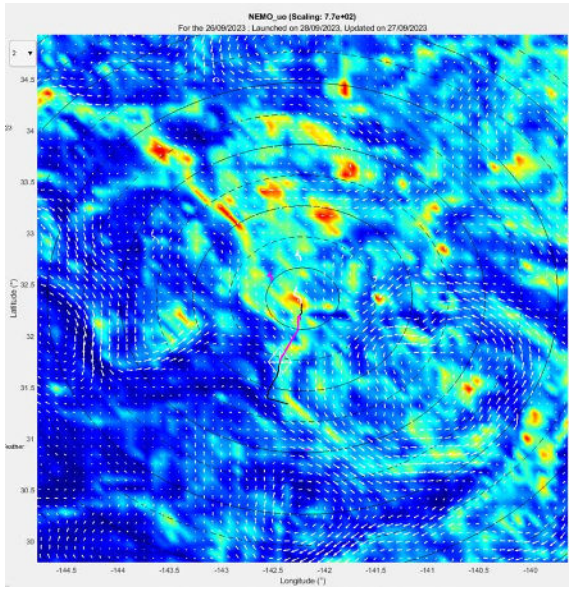

*Total catch (metric tonnes) in 2025 is more than double that of 2024*

https://theoceancleanup.com/dashboard/

# OCEANS AND HOTSPOTS: THE DATA CHALLENGE

- Quantifying total stock of floating plastic
- Monitoring our cleanup progress
- Effective routing towards **hotspots**

- How to regularly scan an area of this size?

*Cleanup System route optimization using dispersal modeling*

# KEY PRINCIPLES

- To get us to the next level of efficiency, we need data on the GPGP…
  - At continuous rate, and
  - At much larger volume than we ever had before
- The power of slow but steady
- Minimalism for scalability

# POTENTIAL: GLOBAL VESSEL FOOTPRINTS

THE OCEAN CLEANUP®

# APPROACH

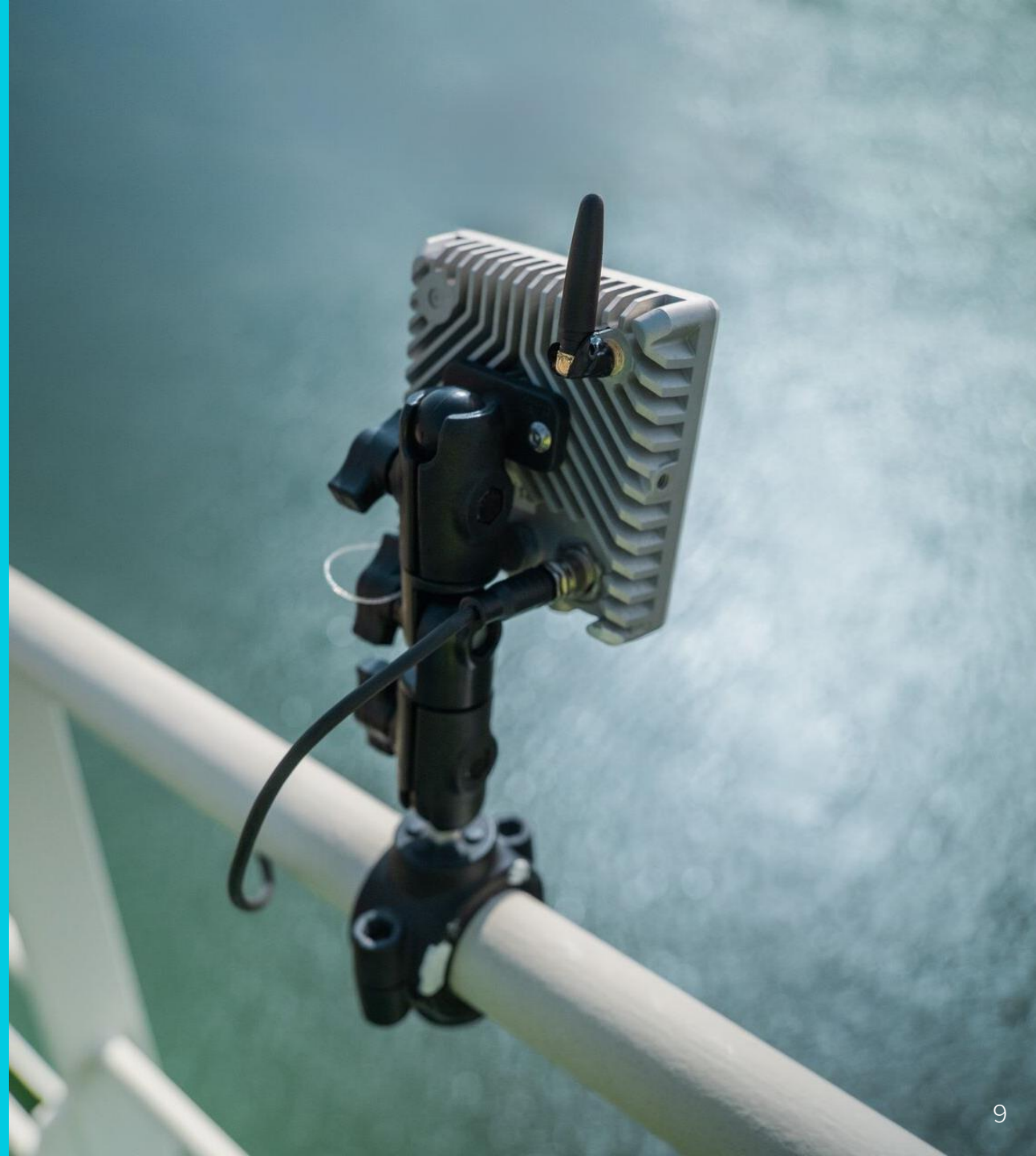
- Central idea: Help The Ocean Cleanup's mission by collecting lots of observations from ships of opportunity
- Challenges:
  - Rough environment
  - Almost no expert supervision
- Opportunities:
  - Onboard power supply
  - Low risk of theft
- So: simple, minimalistic, 'self-contained'
  - Standardization as a unit
  - Minimize modules & interfaces
  - Eliminate work onboard ships (independent from maintenance)

# WHAT IS ADIS

- **A**utomated **D**ebris **I**maging **S**ystem;
- Detect plastic from images of the ocean,
- By running AI live;
- On a high-resolution RGB camera;
- Results are uploaded to the cloud from each individual camera by 3G/4G;
- Mapping & quantification of floating mega plastics > 50 cm around the world;
- Collaborations with vessel owners: cargo ships, research vessels, cruise ships, etc;

X

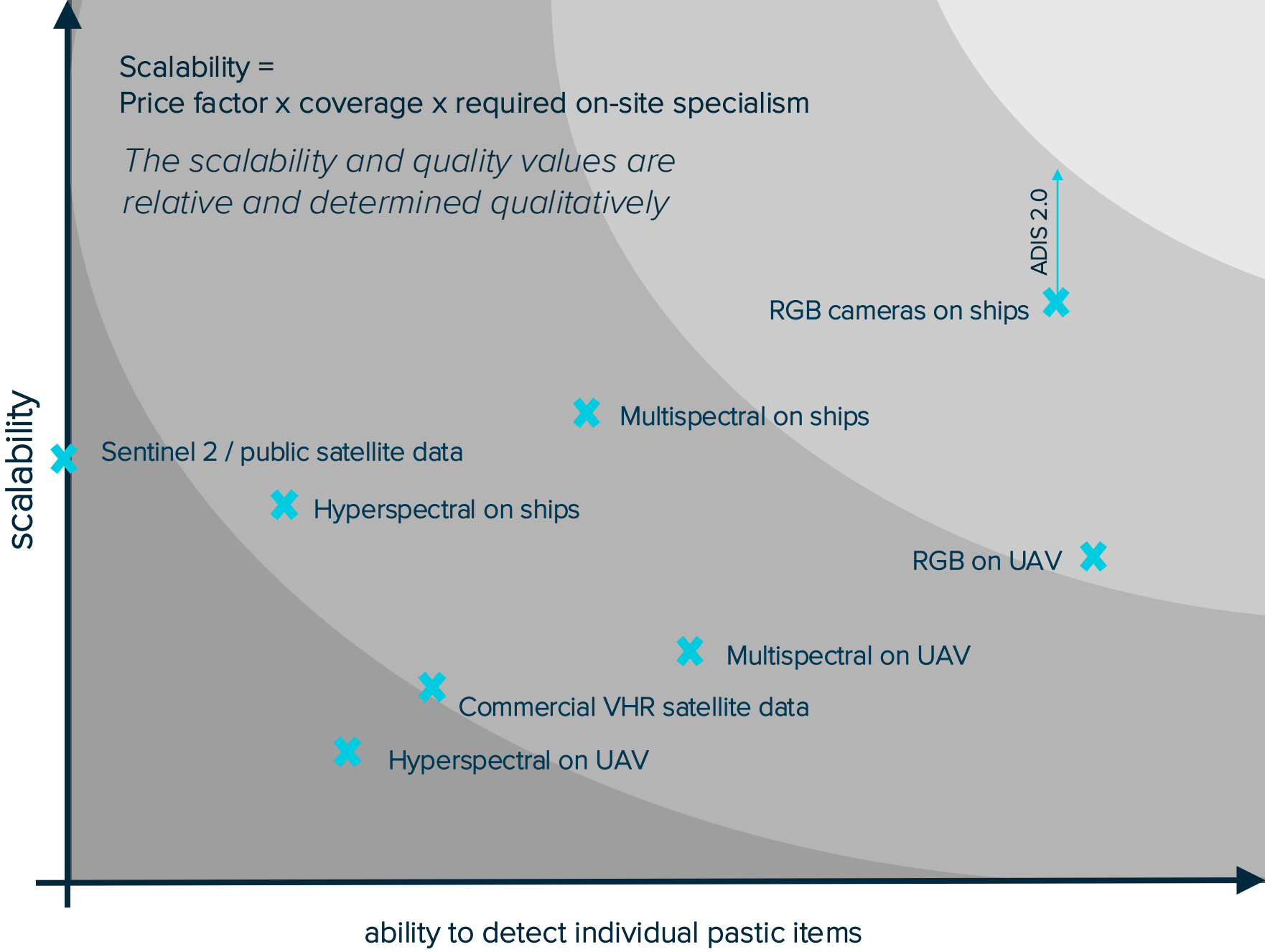
# TECHNOLOGY



# REMOTE SENSING APPROACHES TRIED IN THE OPEN OCEAN (PLATFORM VS SENSOR):

| | UAV/Aerial | Ship | Satellite |
|---|---|---|---|
| Multispectral | Yes, 2018 | No | Yes, 2018 - 2021 |
| Hyperspectral | Yes, 2016 & 2021 | No | No |
| RGB | Yes, 2016 - 2022 | Yes, 2018 - now | Yes, 2018 - 2022 |
| Lidar | Yes, 2016 | No | No |

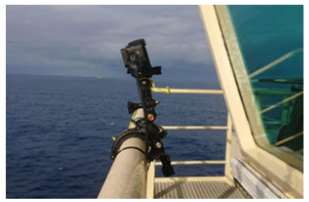
# COMBINE BETWEEN SCALABILITY AND QUALITY



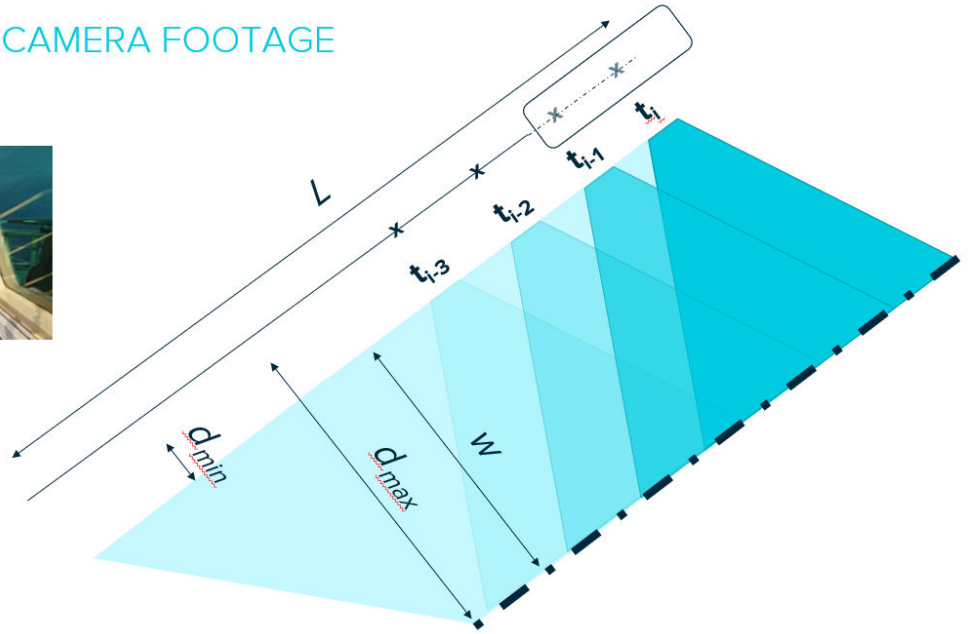
# KEEPING THINGS SIMPLE AND SCALABLE;

# 2021 PROOF OF CONCEPT STUDY WITH GOPRO CAMERAS

## **AUTOMATED** CAMERA FOOTAGE TRANSECTS



$$\hat{D} = \frac{fn}{Lw}$$




**Quantifying Floating Plastic Debris at Sea Using Vessel-Based Optical Data and Artificial Intelligence**

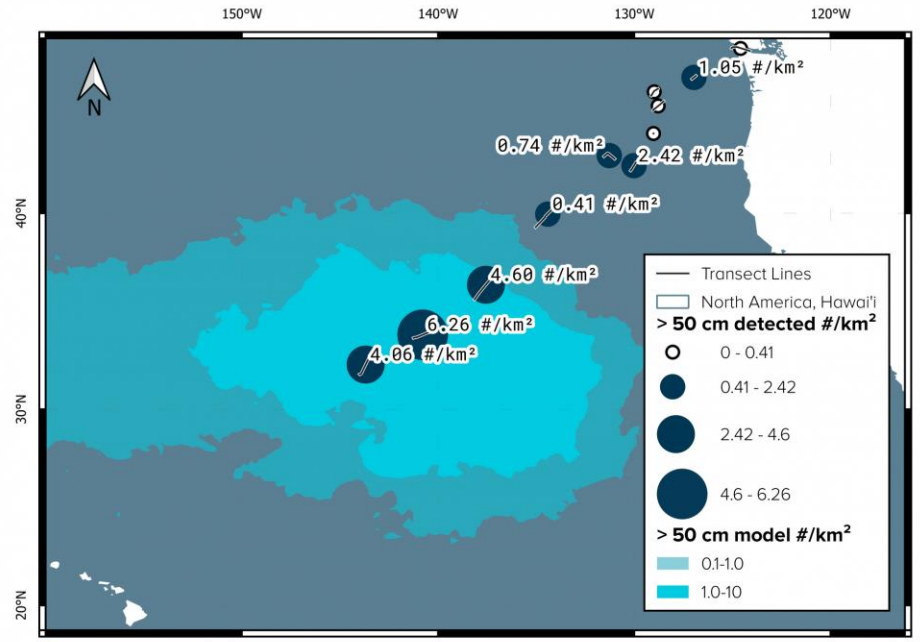
by Robin de Vries [1,*], Matthias Egger [1,2], Thomas Mani [1] and Laurent Lebreton [1,3]

[1] The Ocean Cleanup, Batavierenstraat 15, 3014 JH Rotterdam, The Netherlands
[2] Egger Research and Consulting, 9000 St. Gallen, Switzerland
[3] The Modelling House, Raglan 3225, New Zealand
* Author to whom correspondence should be addressed.

*Remote Sens.* **2021**, *13*(17), 3401; https://doi.org/10.3390/rs13173401

**Received: 30 June 2021 / Revised: 14 August 2021 / Accepted: 19 August 2021 / Published: 27 August 2021**

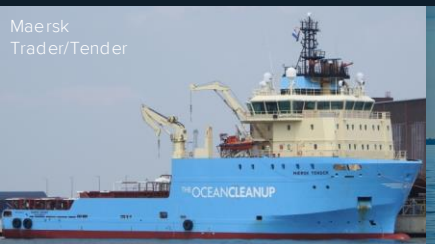
*GPGP outline:*
*Lebreton, L., Slat, B., Ferrari, F. et al. Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. Sci Rep 8, 4666 (2018). https://doi.org/10.1038/s41598-018-22939-w*



# OBSERVATIONAL **EFFORT** 2018 - 2022

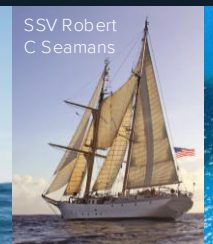
Acknowledgements to:

- Maersk
- SEA expedition
- Gennady Kankatov, FEEC Ltd.
- Bark Europa
- NIOZ, Erik Zettler, NL











# **ADIS1 TECHNOLOGY**: SEMI-AUTOMATED PROCESSING

Data collection

↓

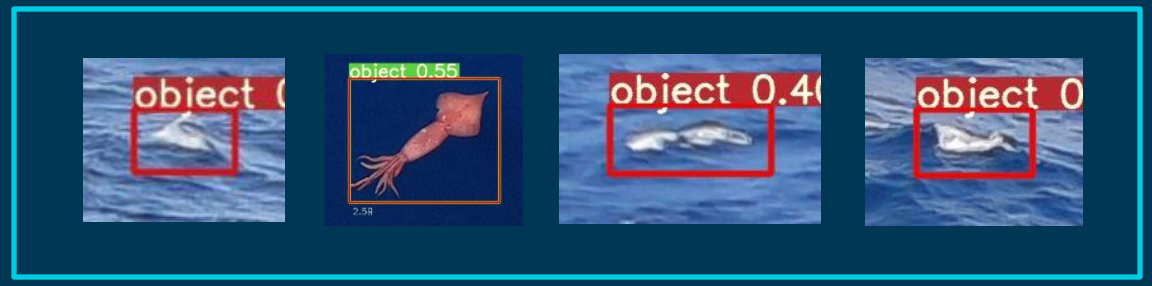
Deep Learning anomaly detection + geometric computations

↓

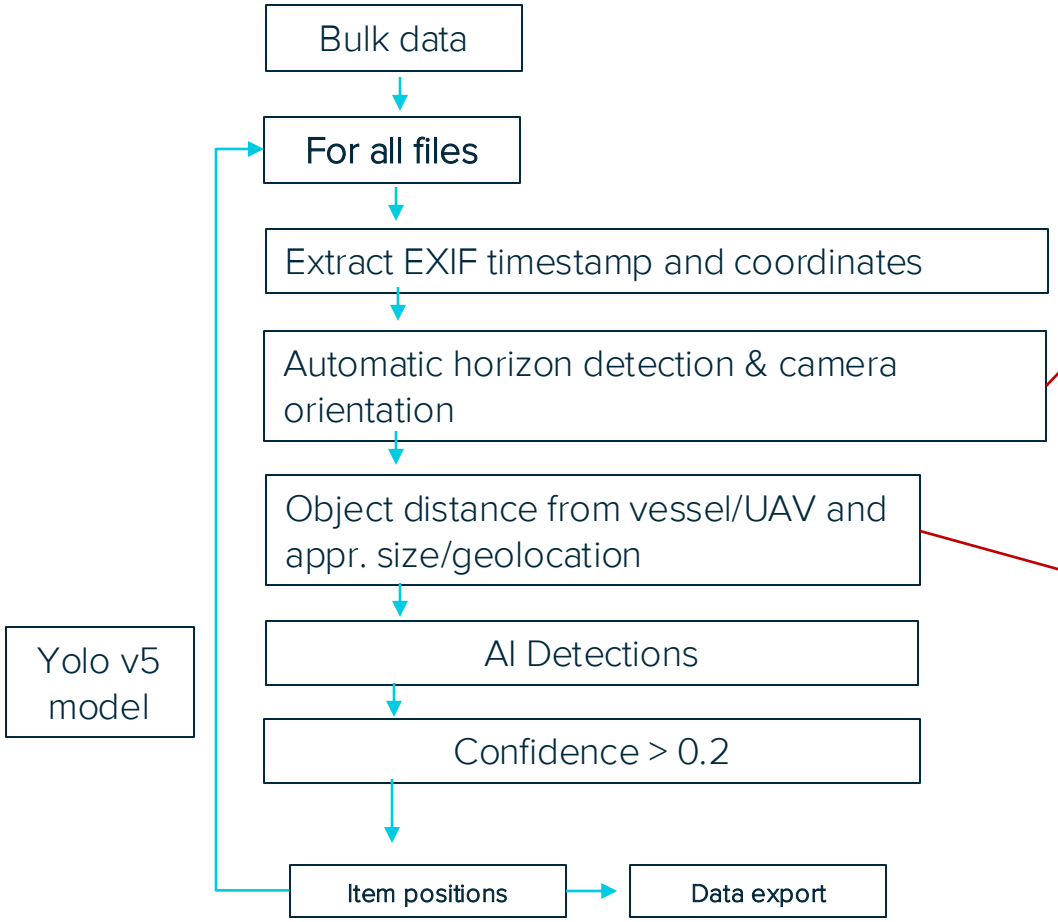
Human validation

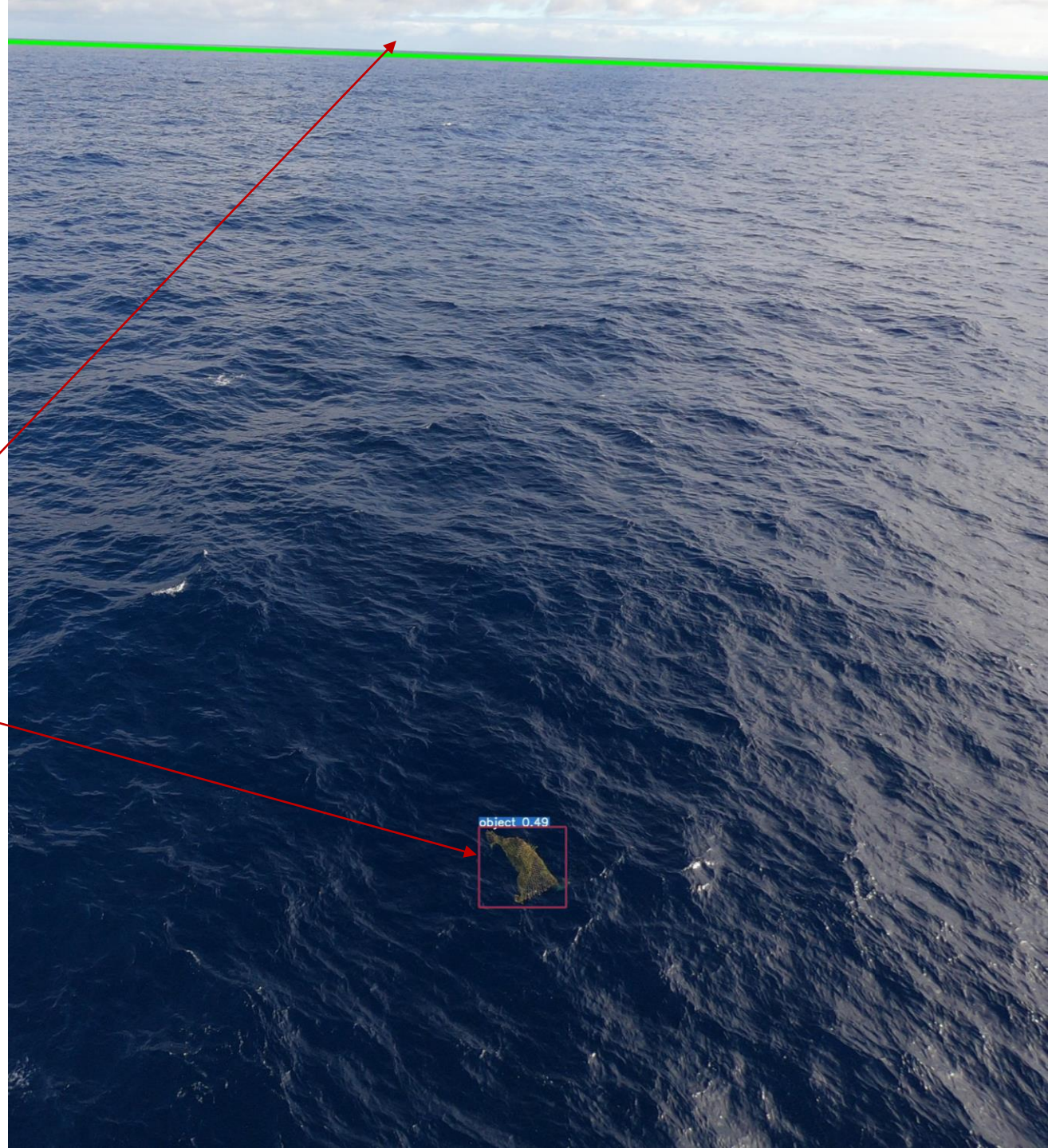
↓

Mapping and aggregation



# PROCESSING **METHOD**



# TOWARDS A **SMARTER** EMBARKED CAMERA SYSTEM

**Storing and uploading raw data (full 4K dataset) volume:**

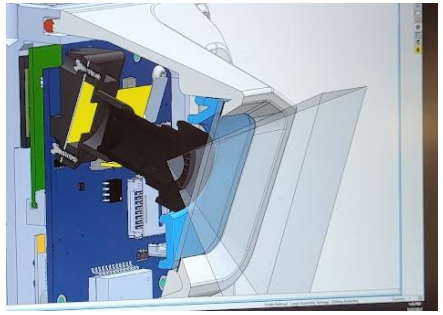
- 2 TB per month per camera
- Satellite or 4G/5G port uploads not feasible

**Storing and uploading detected objects only:**

- ~ 0.0005 TB (500 MB) per month per camera (400 x less)
- Data uploads feasible

# ADIS2 DEVELOPMENT AND TESTING

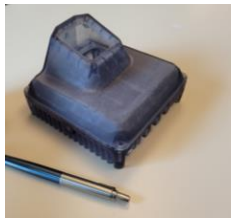
- Regular deployment of new types on Tender and Trader since March 2023
- Optimal opportunity for weather exposure testing
- Datasets used for diagnosis and further improvements



August 2022
**Prototype**

March 2023
**Prototype + improved image sensor**

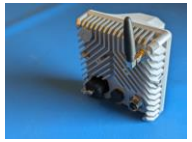
June 2023
**Development agreement**

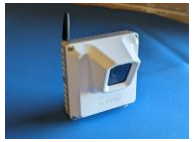


August 2023
**ADIS Alpha**

October 2023
**ADIS Alpha, + GPS, + LTE**

February 2024
**ADIS Beta**



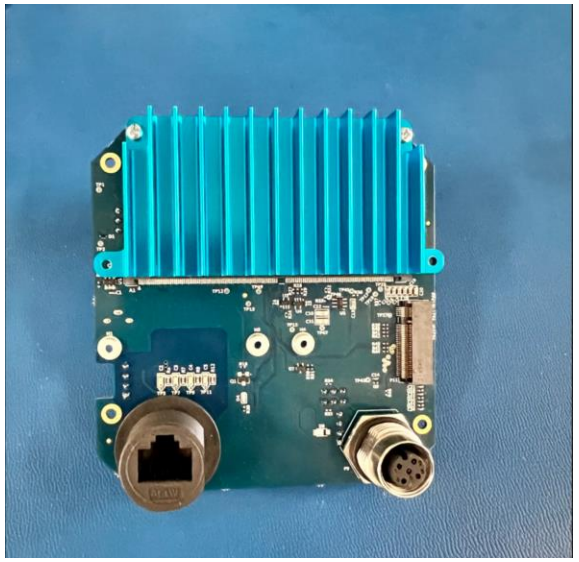


2025
**ADIS**

# HIGH-LEVEL REQUIREMENTS

- Image quality: 4K
- Processing: Quick enough for 1 frame per second inference
- Power: Low enough for passive cooling
- Wide field of view
- IP67
- Remotely configurable
- Autonomous data transfers
- Easy installation

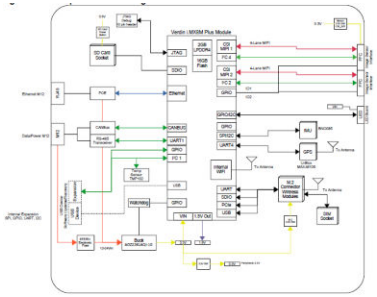
# SPECS



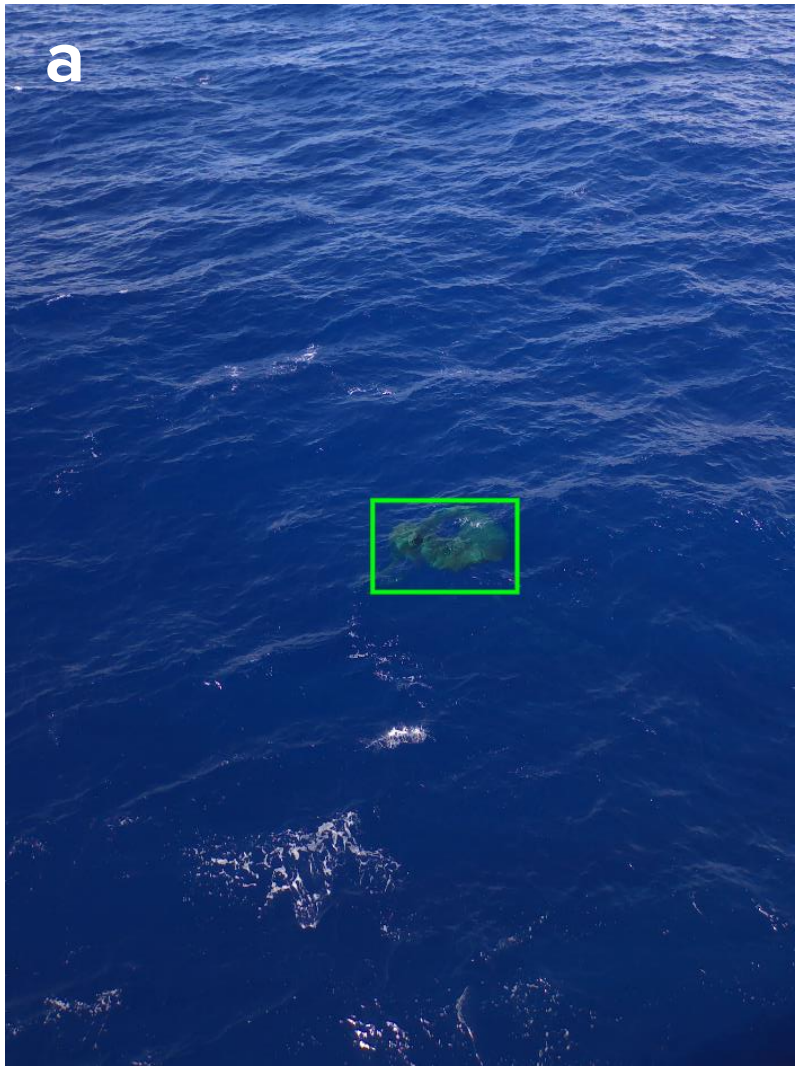
| | |
|---|---|
| Perception Latency | 2 fps – 30 fps (depending on resolution of model) |
| Field of View | 84° ↔ 52° ↕ 105°⤢ |
| Detection Range | 1 - 100m ( 3 - 300ft) |
| Resolution | 4K / 8MP (3840x2160) CMOS Sensor<br>2 µm x 2 µm pixels for low light sensitivity |
| AI Processors<br>Integrated Peripherals | i.MX8M Plus (Quad A53 + 2 TOPS NPU), optional 26 TOPS AI Accelerator<br>LTE Modem, GNSS, 9 axis IMU, internal temp & humidity sensors |
| Environmental | -40°C to +65°C Industrial Temp, passive cooling<br>IP67 rated enclosure |
| Electrical | RJ45 IP67 waterproof Ethernet with optional POE<br>M12 10 - 27VDC (7W), RS-485/CANbus<br>2 SMA connectors for external GPS + LTE antennas |
| Mechanical | 110x115x90mm (4 ¼ x 4 ½ x 3 ½ in) | 450g (16 oz)<br>Multiple ¼ - 20 mounting points |

# SENSOR SCIENCE, DESIGN AND SPECIFICATIONS

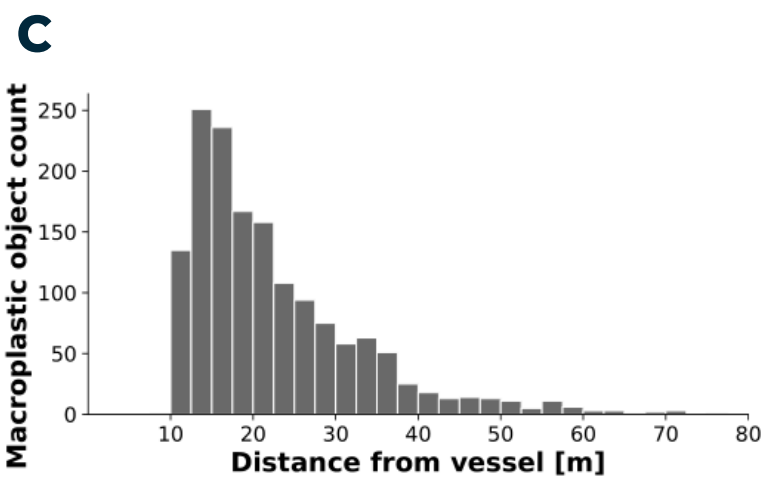
- 4K image sensor
- Size: ~ 10 x 10 x 8 cm
- Edge Processing
- Transmission of image snippets and metadata by LTE networks in ports of call
- Affordable unit cost
- Easy installation
- Only a power source is needed (6 Watt)
- Long-term deployment scale: 100 stations



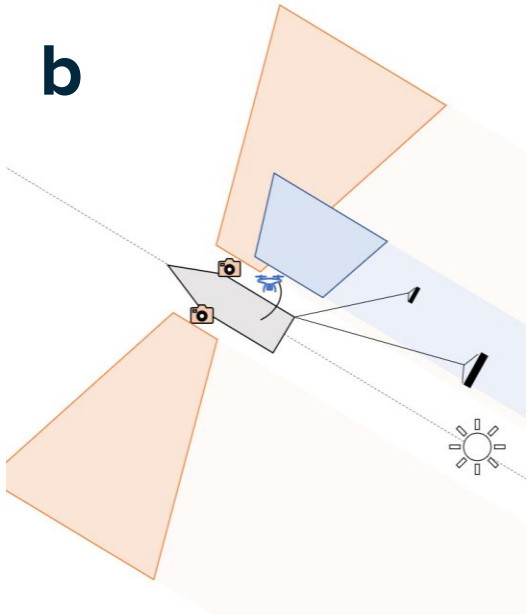
# DETECTION, TRACKING AND POSITIONING

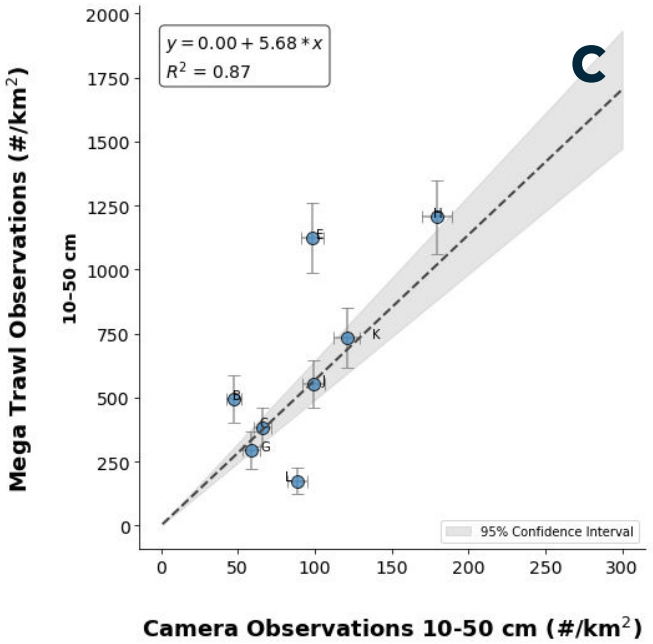


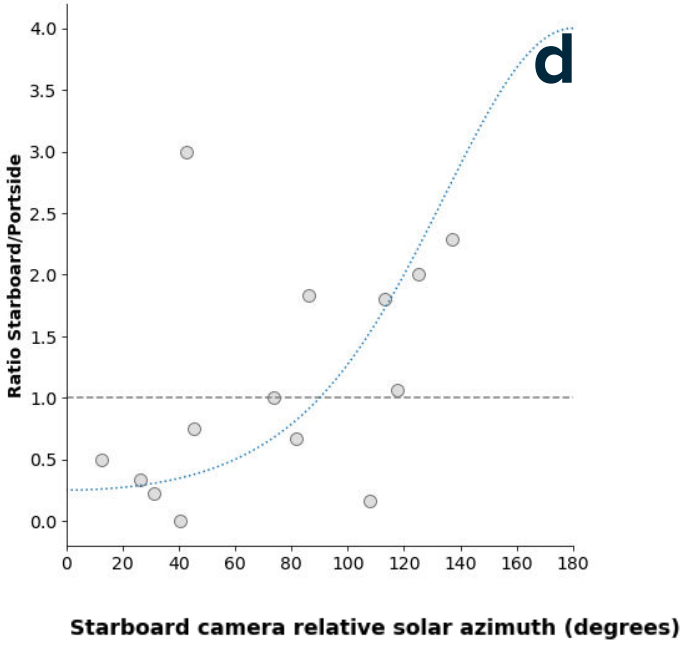




# CALIBRATION AGAINST PHYSICAL SAMPLING (GROUND TRUTHING)

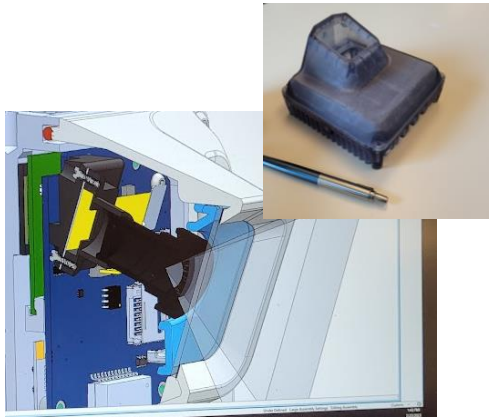



# DEPLOYMENTS

# BRIEF HISTORY

| | |
|---|---|
| 2018 – 2022 | Experimentation, proof-of-concept and ADIS1 |
| 2022 – 2024 | Development phase |
| 2024 | ADIS launch, standardization |
| 2025 | Scaling, delivering first impacts |



# PARTNERSHIPS & ENDORSEMENTS

SWIRE SHIPPING

EASTERN CAR LINER, LTD.

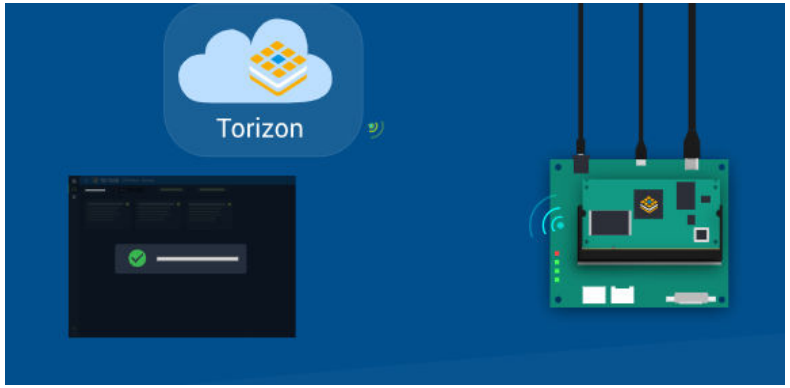
HYUNDAI GLOVIS

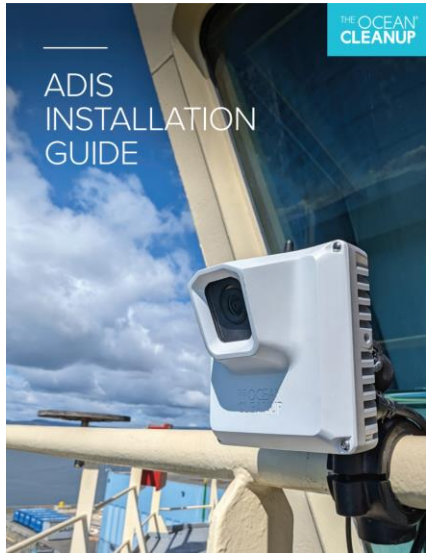

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

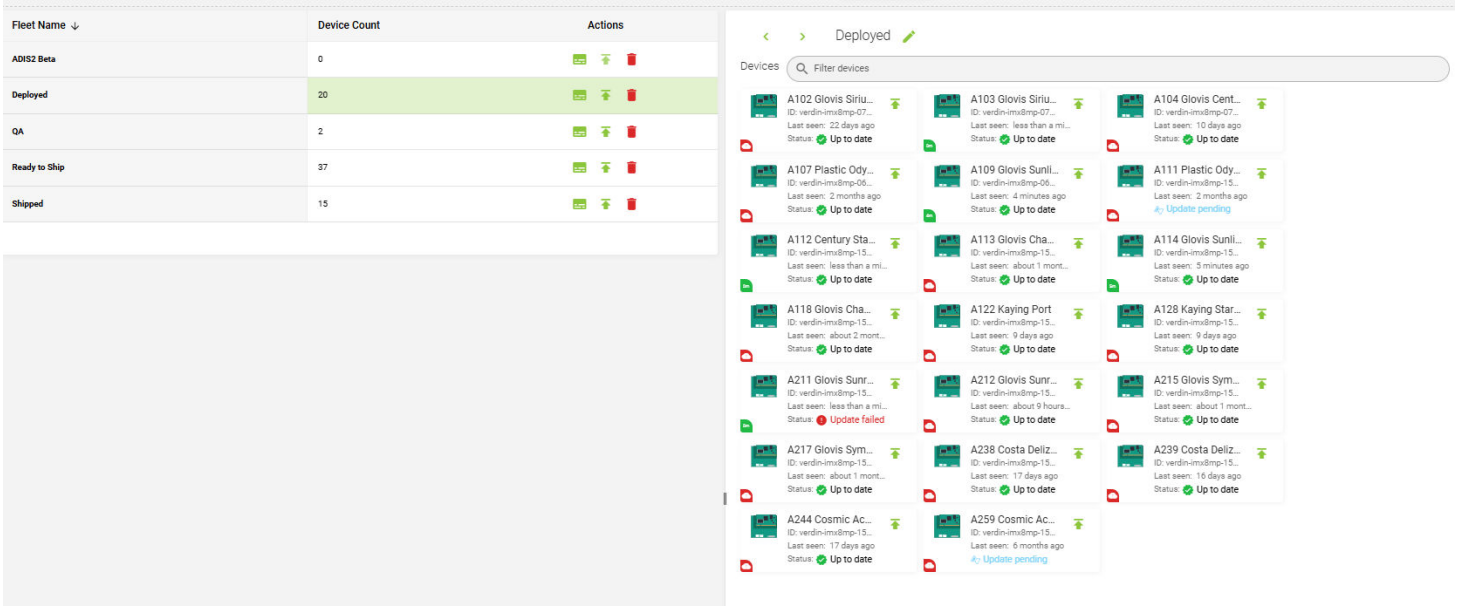
# DEPLOYMENT AND DEVICE MANAGEMENT

Designed to eliminate dependency on vessel crews:

- Low-no maintenance
- Units swappable
- Remote diagnostics
- Remote configuration

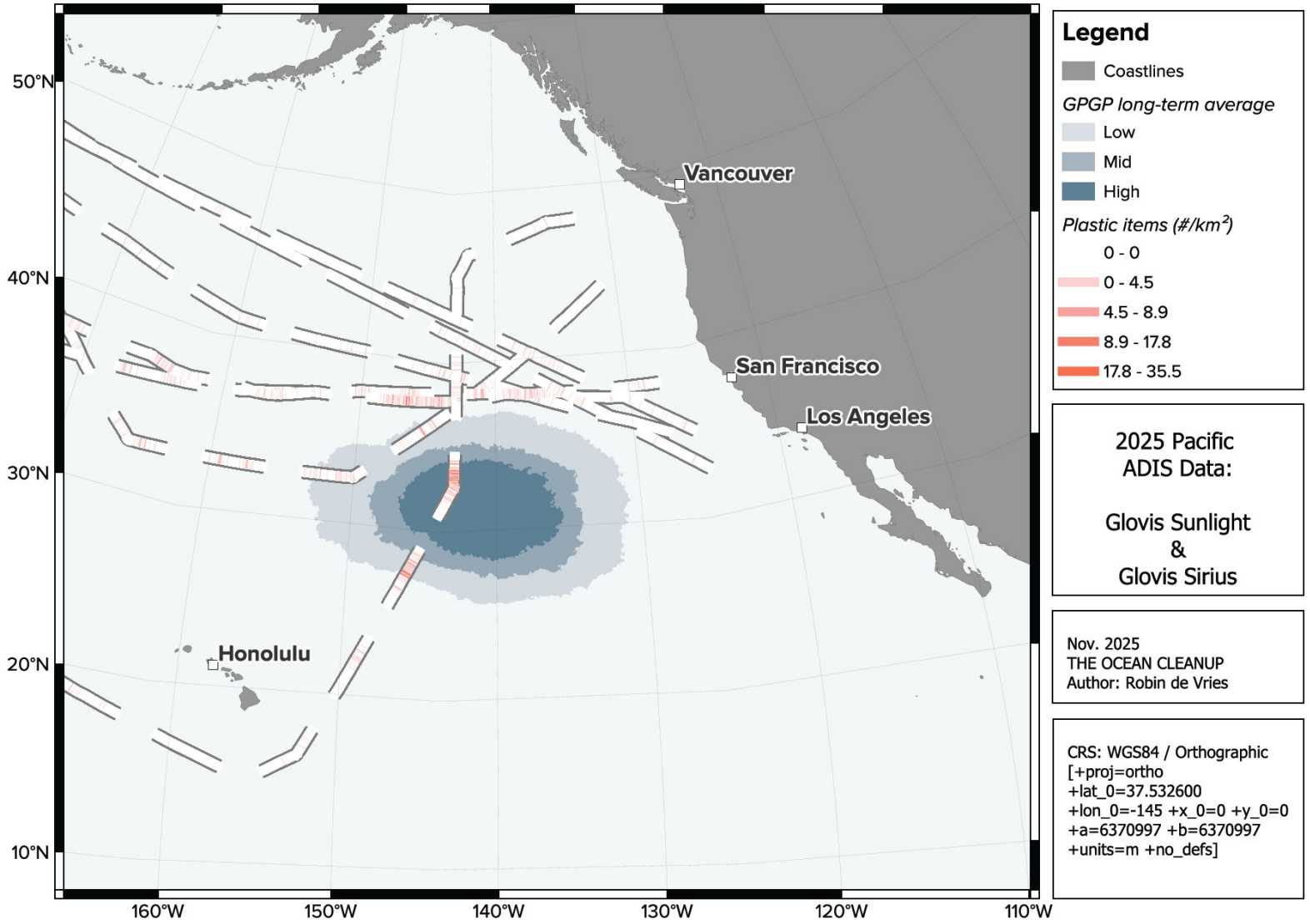


# OUTCOME

# MAPPING NEW REGIONS OF THE GPGP WITH ADIS




THE OCEAN CLEANUP®

# EXCERPT: DETECTED **HARD PLASTIC ITEMS**

*Great Pacific Garbage Patch 2025*

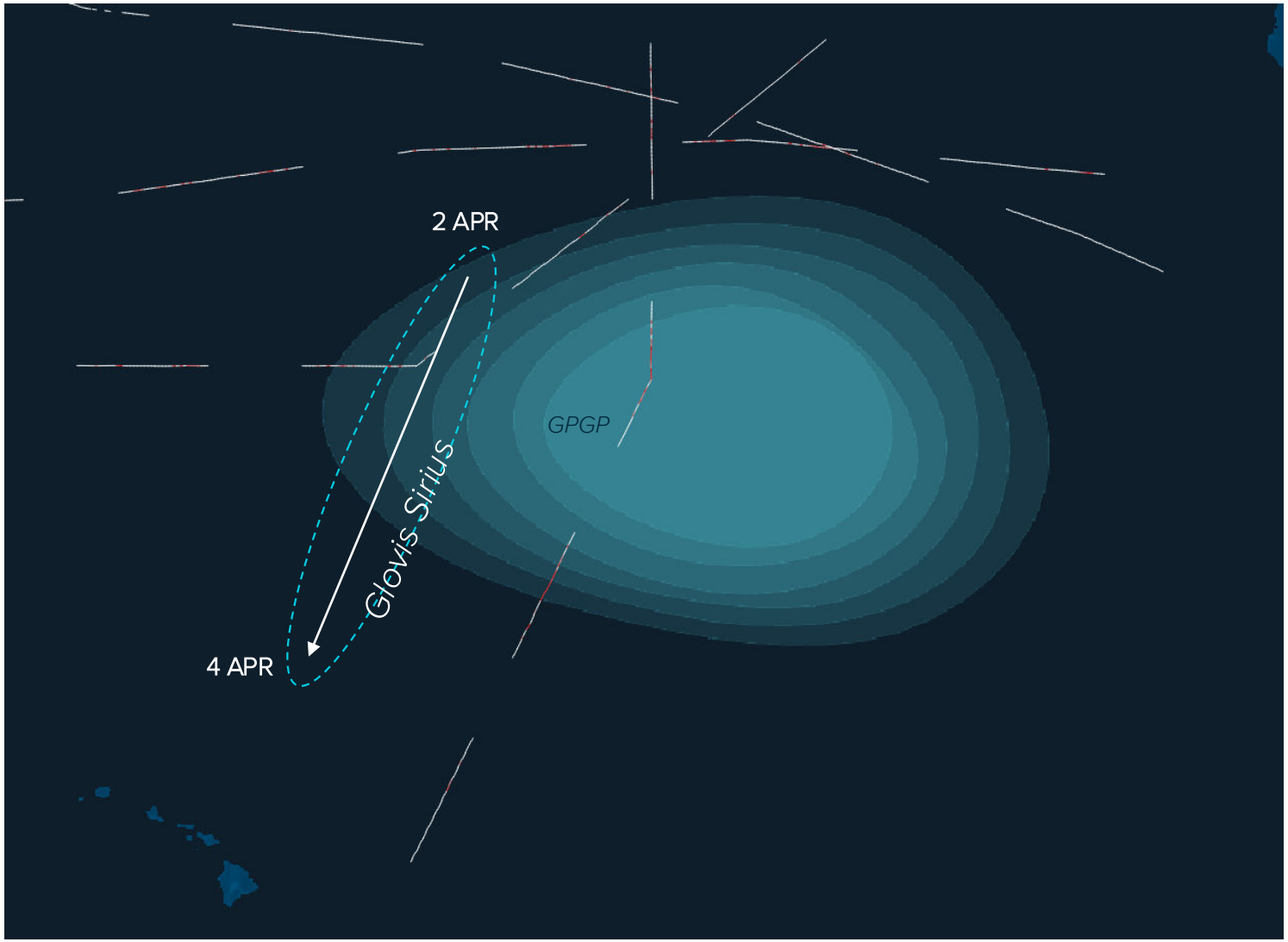




# COLLECTED ADIS DATA: **CASE STUDY**

**Glovis Sirius**

*2 apr 2025 - 4 apr 2025*



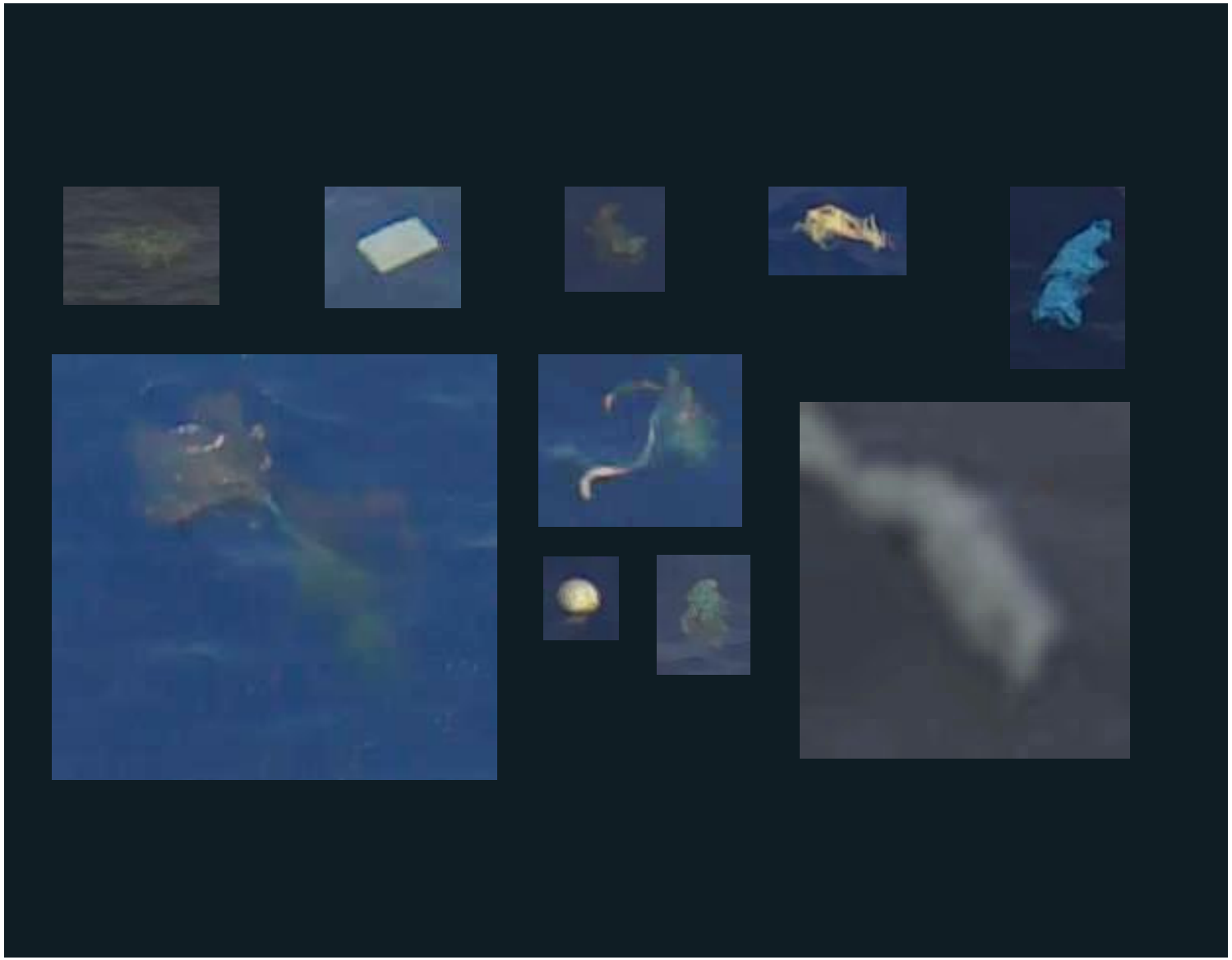

*Geographical position of the data subset from Glovis Sirius, taken between 2nd and 4th April 2025 while traveling North-South through the GPGP.*

THE OCEAN CLEANUP®

# COLLECTED ADIS DATA: **CASE STUDY**

**Glovis Sirius**

*2 apr 2025 - 4 apr 2025*

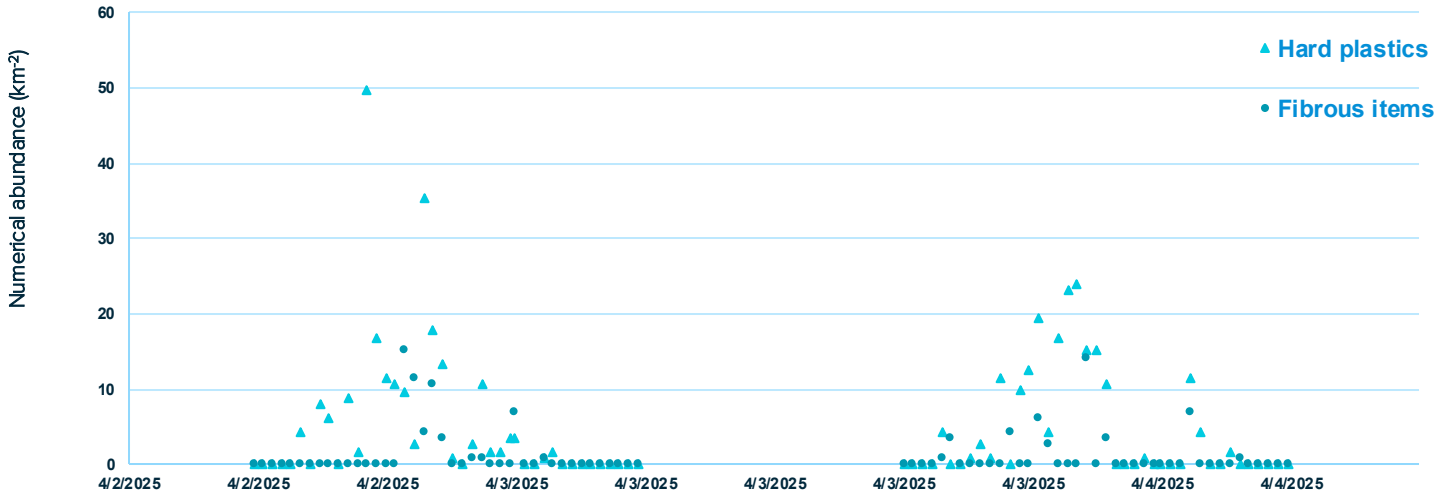


*A subselection of sightings by ADIS from Glovis Sirius between 2nd and 4th of April 2025. Sometimes, a wave is being detected.*

# COLLECTED ADIS DATA: **CASE STUDY**

**Glovis Sirius**

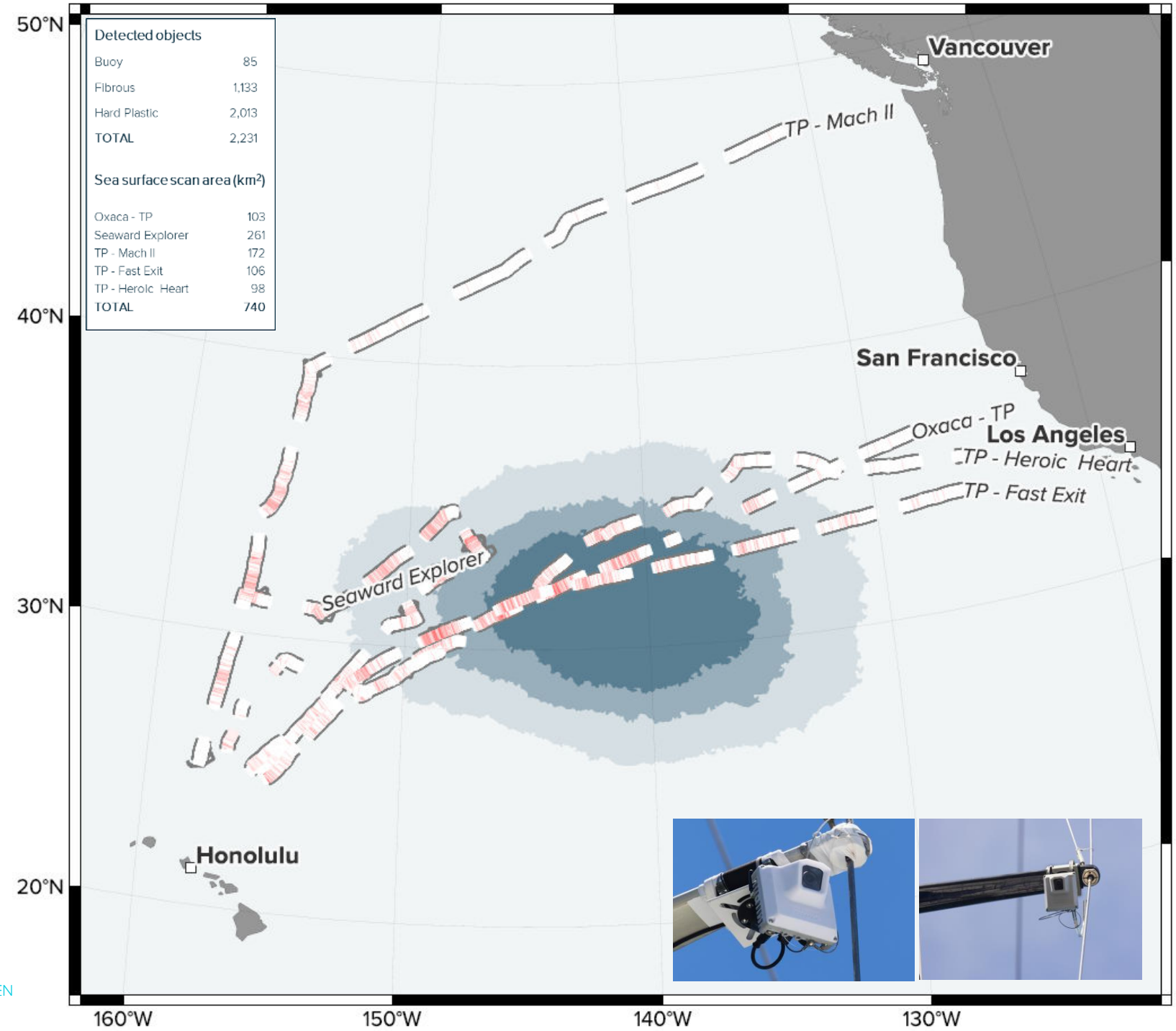
*2 apr 2025 - 4 apr 2025*




*Time graph of the estimated numerical abundance between 2nd and 4th of April 2025 on the journey of Glovis Sirius through the heart of the Great Pacific Garbage Patch (GPGP).*

*Each marker represents 10 km of travel distance, and roughly 1 km² of area scanned. The numerical abundance is often zero, but increases dramatically in the hotspot areas. This demonstrates that the GPGP is in fact a collection of hotspots.*

# 2025 PACIFIC DATA EXPEDITION



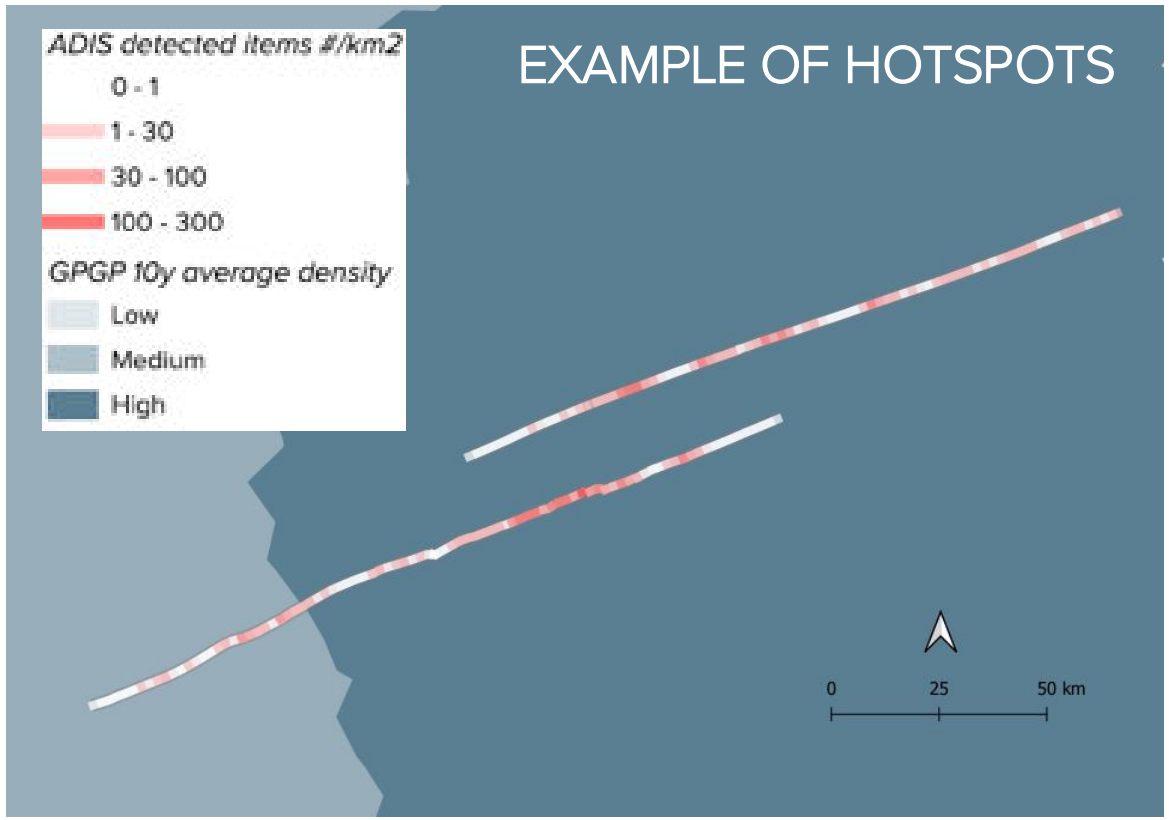

ADIS and Pacific Data Expedition: Transpac and Seaward Explorer Results

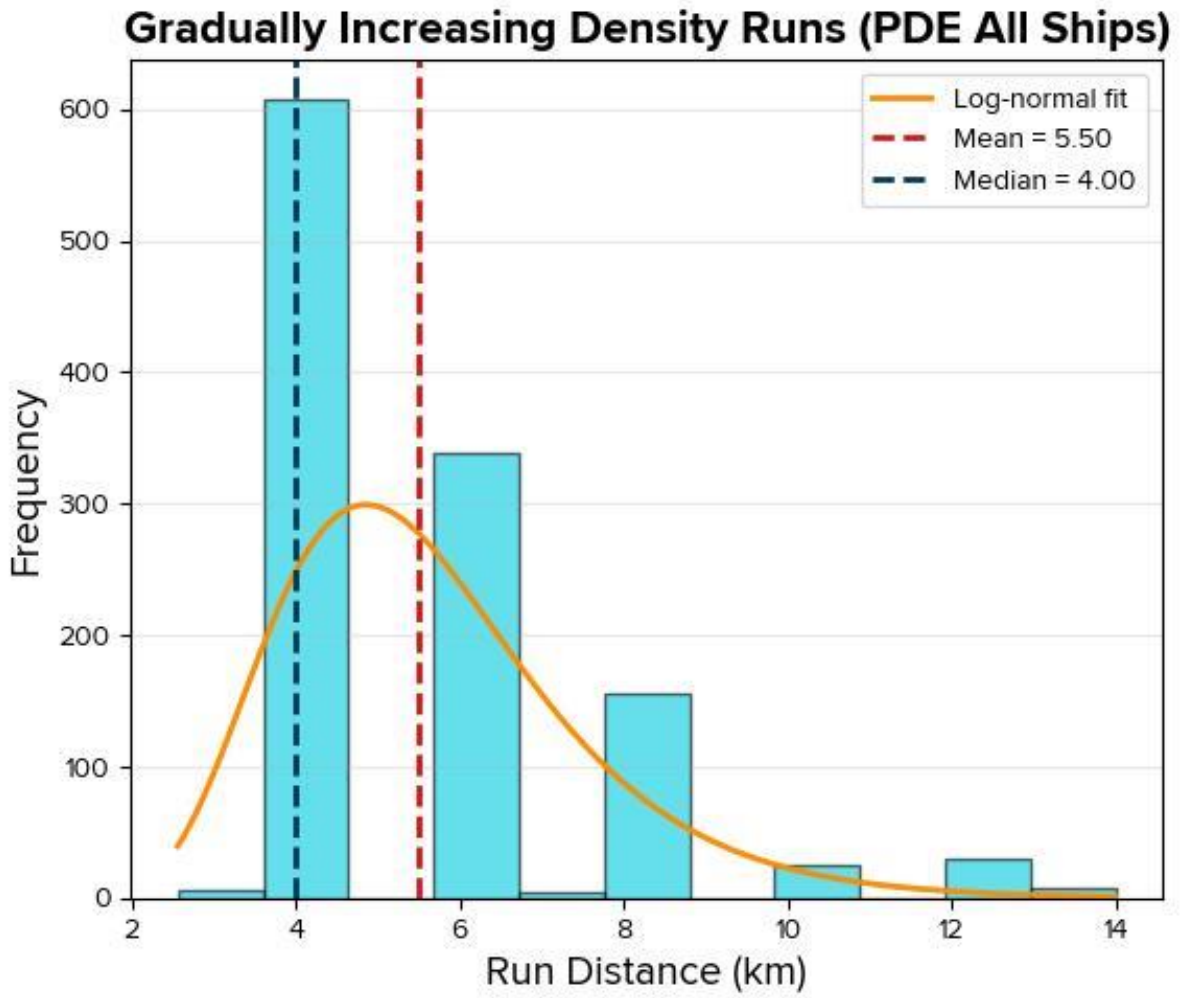
Jul - Oct 2025

Nov. 2025
THE OCEAN CLEANUP
Author: Robin de Vries

CRS: WGS84 / Orthographic
[+proj=ortho
+lat_0=37.532600
+lon_0=-145 +x_0=0 +y_0=0
+a=6370997 +b=6370997
+units=m +no_defs]

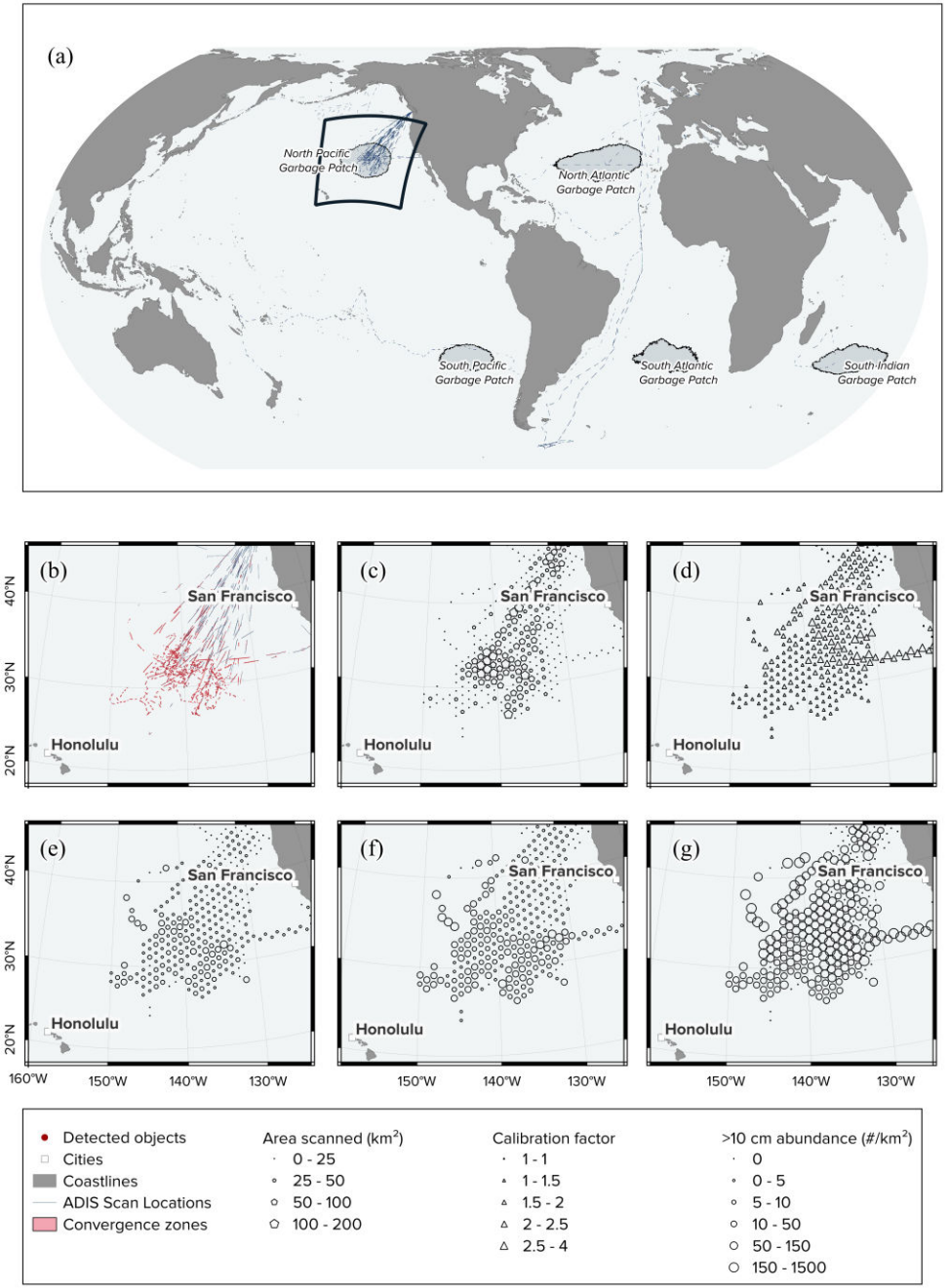
# HOTSPOTS CHARACTERISTICS



# ANIMATION: A GROWING NETWORK OF OBSERVATIONS (2021 – 2025)

# AGGREGATION: TOWARDS GRIDDED DATA PRODUCT



# THANKS TO ADIS, WE CAN NOW GATHER STATISTICS ABOUT HOTSPOTS CONTINUOUSLY

# SUMMARY

- The Ocean Cleanup uses observations of floating plastics to allow efficient and monitored cleanup operations;
- Getting enough data coverage is a true challenge;
- Following small scale proof of concept, ADIS was facing scalability issues;
- Thanks to embedded AI, ADIS has now developed into a fully automated, low-maintenance sensor;
- Currently deployed on 17 active vessels, scanned a total sea surface area of 65,660 $km^2$, traveled
- Early data is already providing unique insights into distribution and statistics of floating plastics.

THE OCEAN®
CLEANUP

**Robin de Vries**
ADIS Lead
robin.devries@theoceancleanup.com

# Embedded Vision Summit
# May 11-13, 2026

**The premier conference for innovators incorporating computer vision and physical AI in products**

Why Attend?:

- First rate speakers with practical knowledge.
- Relevant exhibitors who can help with your challenges.


**25% off** until March 13 with discount code:
**26EVSUM-WEBINAR**

**Register here:** embeddedvisionsummit.com

**99%**

**of attendees would recommend the event**

**"The Embedded Vision Summit offers a special and unique opportunity to foster knowledge sharing across the edge AI ecosystem."**

—Dan Teodorescu, Director of Product Architecture, Alcon

# The Edge AI and Vision Alliance

**Empower product creators to harness physical AI and vision**

The Alliance inspires and empowers system and solution creators to design better products that perceive and understand.


**Accelerate technology supplier success**

The Alliance helps companies that provide physical AI and vision building-block technologies, services and solutions to grow their businesses through leads, partnerships, and insights.

# Empowering Product Creators to Harness Physical AI and Vision

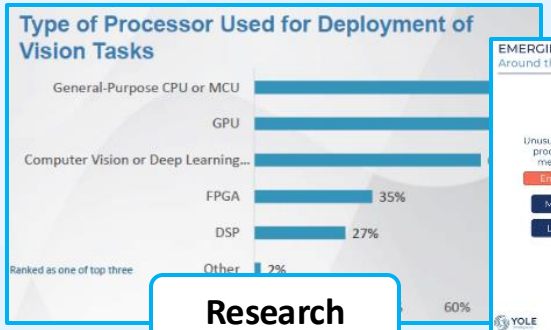
## Alliance Mission

The Alliance inspires and empowers system and solution creators to design better products that perceive and understand:

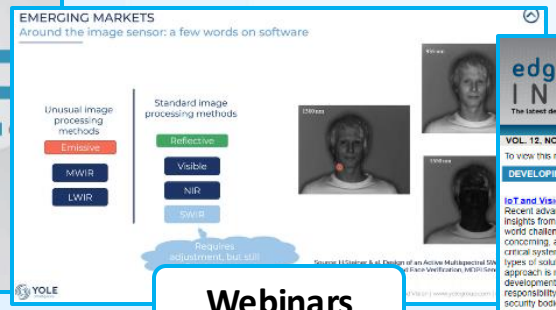
**Expand and sharpen your skills**

**Stay up to date**

**Connect with key technology suppliers**




Research




Webinars


Newsletter

Embedded Vision Summit

**Register for updates at [www.edge-ai-vision.com](http://www.edge-ai-vision.com)**