



# SKYLIGHT

A product of AI2

# Skylight

Initial Demonstration / Training



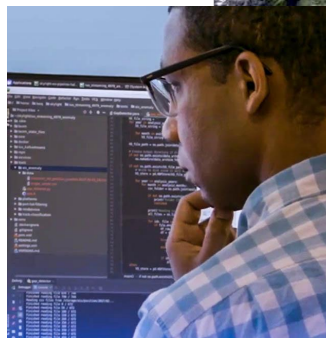
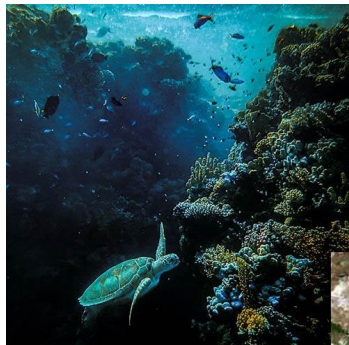
# Background

# Our Home

## ALLEN INSTITUTE FOR ARTIFICIAL INTELLIGENCE (AI2)

Non-profit based in Seattle, USA.

- Founded by the late Paul G. Allen, Microsoft Co-Founder, Technologist and Philanthropist.
- Allen family is passionate about reducing illegal fishing and improving ocean health. Out of this came Skylight.
- Our team is ~20 people!



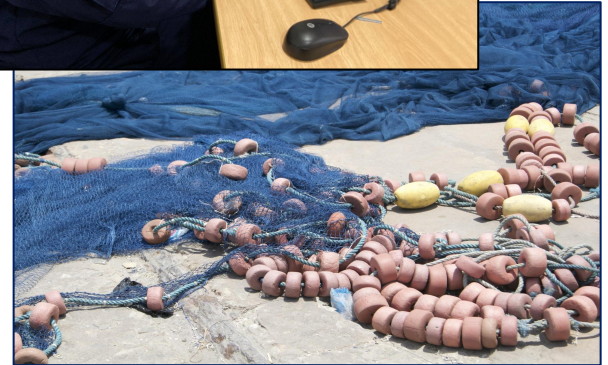
# What is Skylight?

A maritime analyst tool for identifying suspicious behavior that may be illegal or non-compliant with fisheries and other maritime regulations.

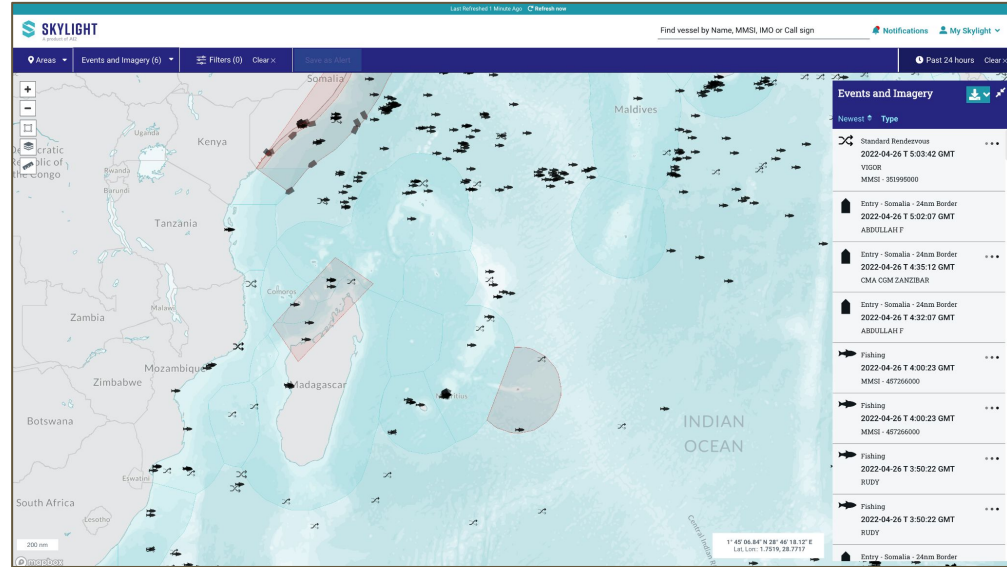
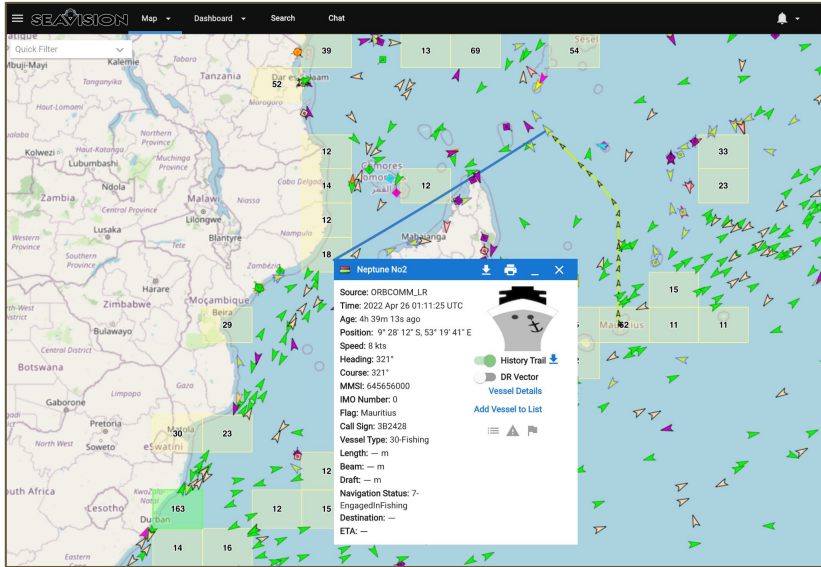
**VISION:** Healthy, productive, and resilient oceans where targeted monitoring and enforcement actions support transparency and effective governance of marine resources.

## KEY ELEMENTS

- 1 tool with 2 ways to **easily access**: web platform and API
- Analytic outputs have **no sharing restrictions**.
- Focus on application of **advanced technologies like AI**, to surface anomalous activity
- We ask for **regular feedback** to evaluate how useful the tool is and inform future enhancements
- **No cost** to national and regional agencies fighting maritime crime



# What makes Skylight unique: visualization solely based on suspicious events, rather than showing all vessels and their tracks



## Visualization based on **last known positions**

- E.g. MarineTraffic, VMS, SeaVision, etc.
- Foundational tools for monitoring vessels
- If EEZ is large or busy, can quickly become very time consuming for surfacing activities and vessels of interest.

## Visualization based on **suspicious events**

- This is Skylight!
- Screen should help analyst focus on only suspicious activities of interest
- Still requires tools like left to more deeply investigate behaviors - Skylight is **not** a replacement

# Our Data Sources

**AIS** (real-time) to help analysts quickly identify and focus on suspicious events. Source is SPIRE.

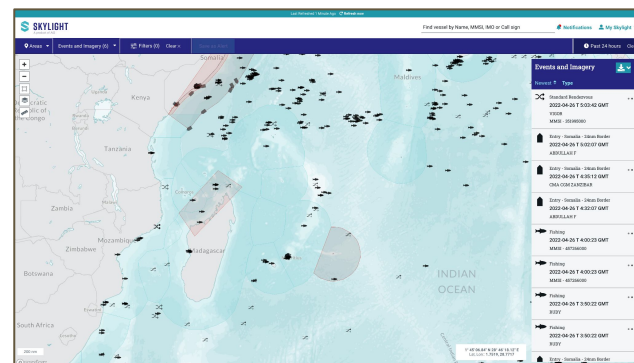
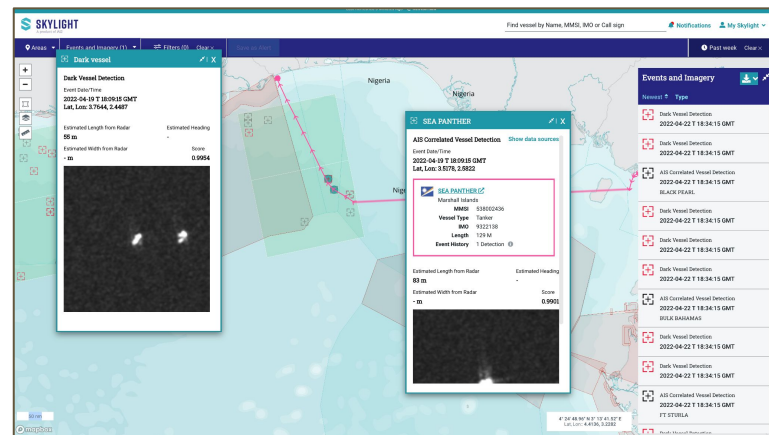
**Satellite Radar** (2-12 hour delay) to help authorities identify the presence of dark vessels in areas of interest.

- RADARSAT-2 - Custom requests for IUU Fishing operations
- SENTINEL-1 - Regular imagery in most EEZs

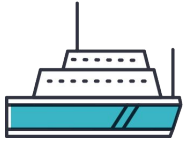
**Vessel Data** such as gear type and ownership information from FishSpektrum and public records.

**Other sources we are exploring**

- Optical imagery
- VIIRS (Visible Infrared) for night light activity
- Radio Frequency (RF)



# Common Skylight Use Cases



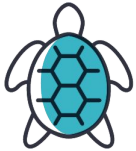
## Exclusive Economic Zones (EEZ)

Provide Coast Guards and Navies with domain awareness of a country's territorial waters



## Regional Enforcement Operations

Coordinate and target planned inter-agency, multi-country action on the water



## Marine Protected Areas (MPA)

Enable National Park Services to secure and actively manage the "parks of the oceans"



## Port State Measures Agreement (PSMA)

Supply intelligence to Port Authorities selecting vessels for inspections based on risk profiles



## National Fleet Management

Support Fisheries Ministries tracking compliance with regulatory requirements

# Types of Events

**Standard Rendezvous (AIS)** - Auto-generated detection of plausible transshipment when both vessels are using AIS

**Dark Rendezvous (AIS)** - Auto-generated detection of plausible transshipment when only 1 vessel is using AIS

**Entry (AIS)** - Monitoring vessel entry into any user-defined custom Area of Interest

**Fishing (AIS)** - Auto-generated, global detection of fishing activity

**Speed Range (AIS)** - Enforcing speed regulations or monitoring behavior not on 'innocent' passage

**Radar Detection (Satellite Radar)** - Detection of non-AIS transmitting (dark) vessels upon request for targeted areas and dates

Method: Rules

Method: Machine Learning



# Standard Rendezvous Events

# Standard Rendezvous Events

An event where two vessels transmitting AIS come close together.

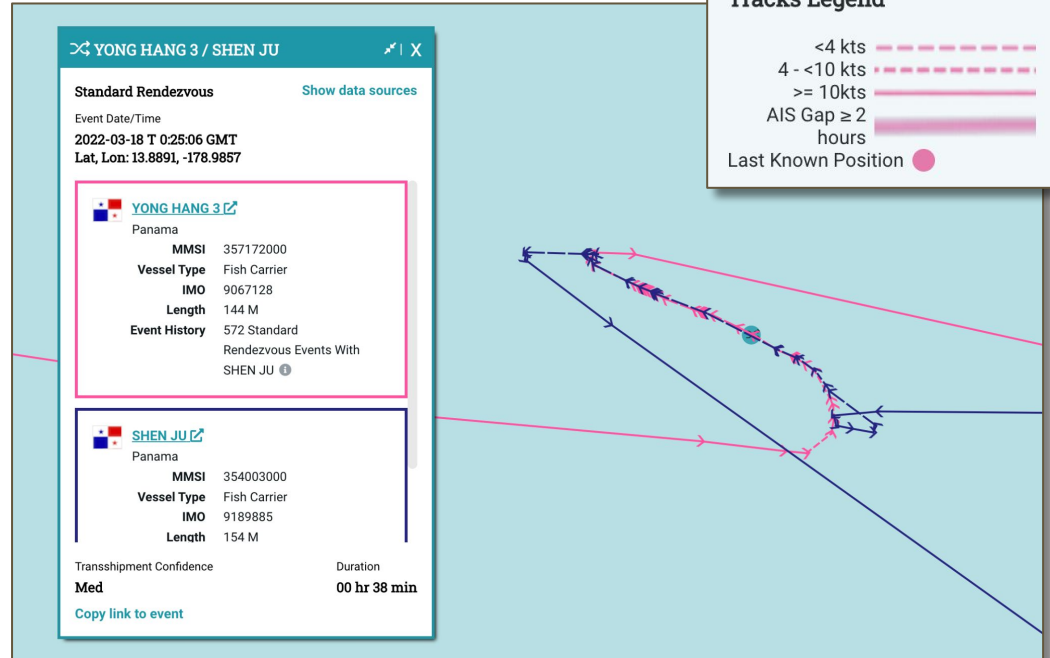
These events can support monitoring potential bunkering events, fish transshipments, and narcotics trafficking.

The parameter is ~within 250 meters of each other for at least 30 minutes.

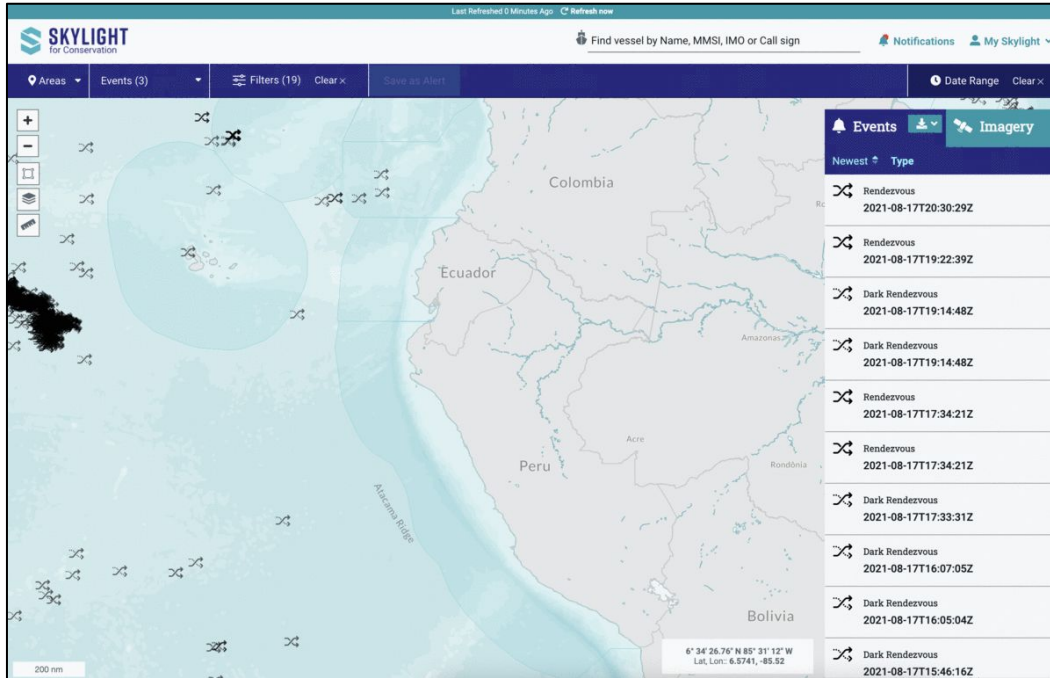
## How does this compare to other tools, like Global Fishing Watch?

Encounters in GFW are similar to Standard Rendezvous in Skylight. In general, we are very complementary!

GFW looks for 2+ hours for <500m (more time & more distance)  
Skylight Standard Rendezvous appears with minimal delay (as soon as activity has been occurring for 30 minutes)



# Standard Rendezvous - Galapagos



**Example: Monitoring the network of vessels supporting distant water fishing fleets**  
// Aug - Sept 2021

By filtering standard rendezvous events for fish-related vessel types (e.g. refrigerated cargo vessels, fish research vessels, and fishing vessels), Skylight provides real-time monitoring of the Chinese Distant Water Fishing Fleet operating south of the Galapagos to Peru.

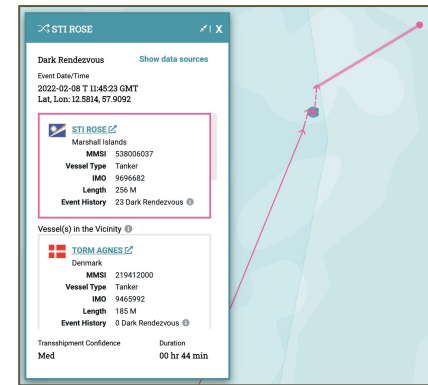
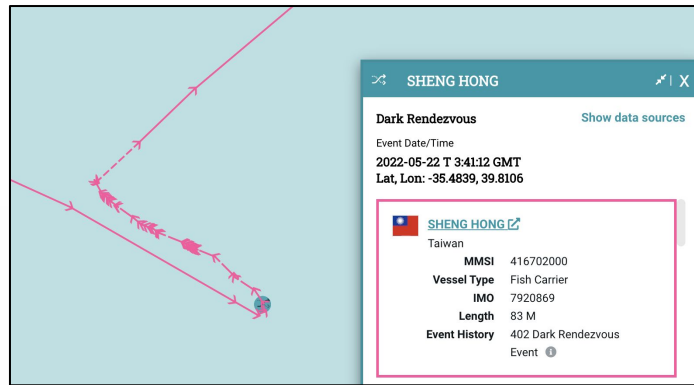
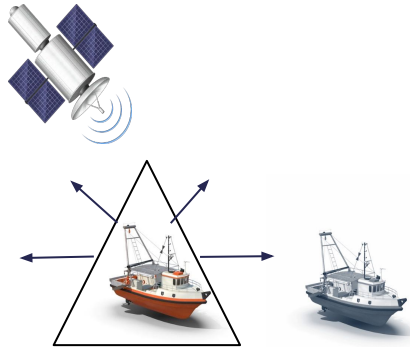
These events affirm that it takes a network of reefers and refuelers to support distant water fishing fleets. They can also show when the fleet is moving to the next part of their route.

# Dark Rendezvous Events

# Dark Rendezvous Events

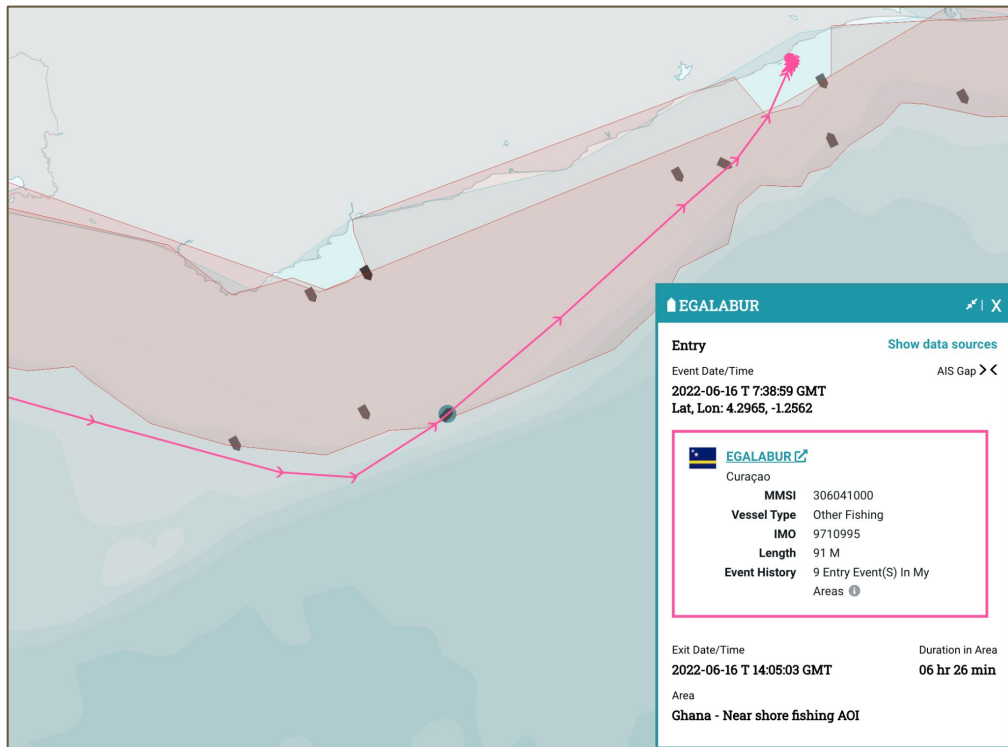
An event where **one vessel is transmitting AIS** and has tracks indicative of a meeting with a dark (non-AIS) vessel. This second vessel is not visible to Skylight.

- Skylight uses a **machine learning model** based on a database of expert-annotated examples to look for rendezvous behavior in incoming AIS tracks.
- A Dark Rendezvous event does not guarantee that a rendezvous with a non-AIS transmitting vessel occurred. It just means that the tracks are **exhibiting** characteristic behavior (e.g. slow speeds, turning).



# Entry Events

# Entry Events



This is a straightforward functionality for **monitoring vessels entering any Area of Interest**.

Often used for monitoring important EEZ borders, territorial seas, ports, and parks where all traffic is strictly regulated.

# Fishing Events



# Fishing Events

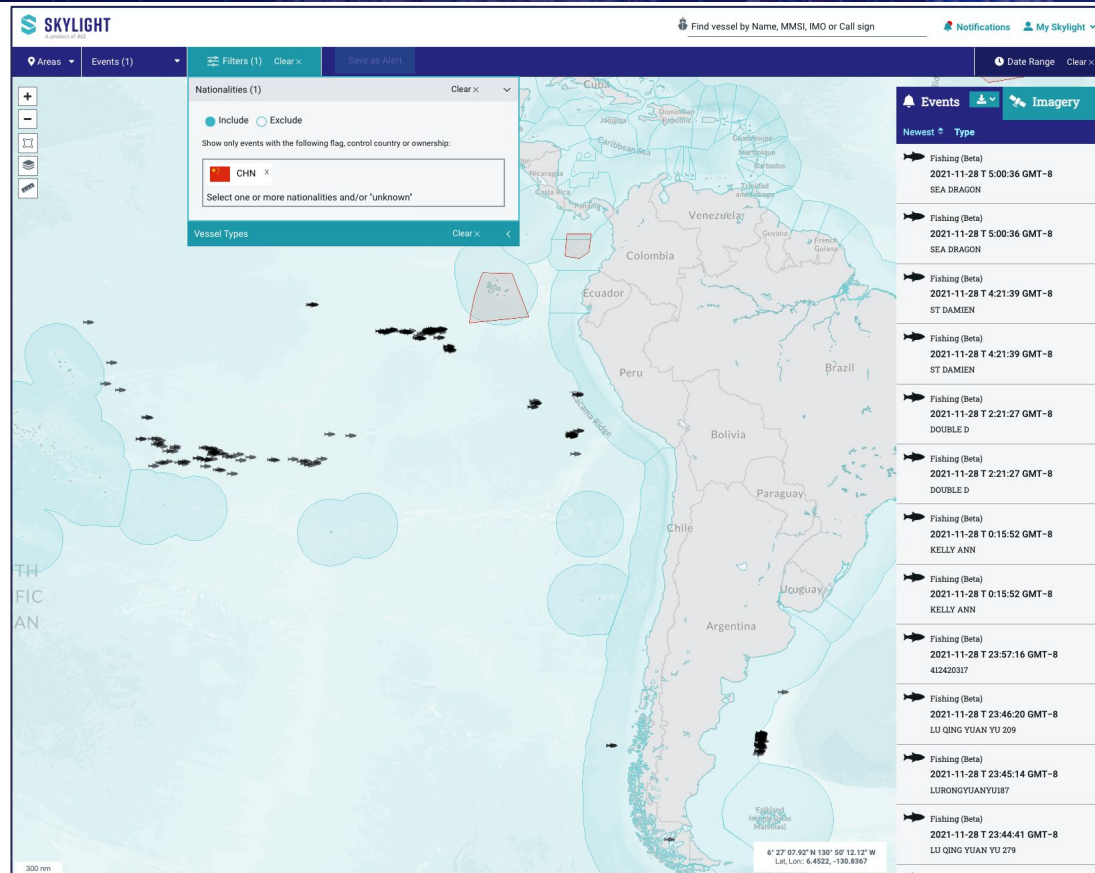
An event where a vessel transmitting AIS has **tracks indicative of fishing behavior**.

Skylight uses a **machine learning model** to detect this behavior globally and automatically.

Can be helpful for identifying:

- Industrial vessels fishing inside artisanal-only zones
- Foreign vessels fishing across the EEZ border
- Assessing the recent locations of distant water fishing fleets

Fishing events are generated **once per day per vessel** (Skylight will not show more than one event in one day for the same vessel).



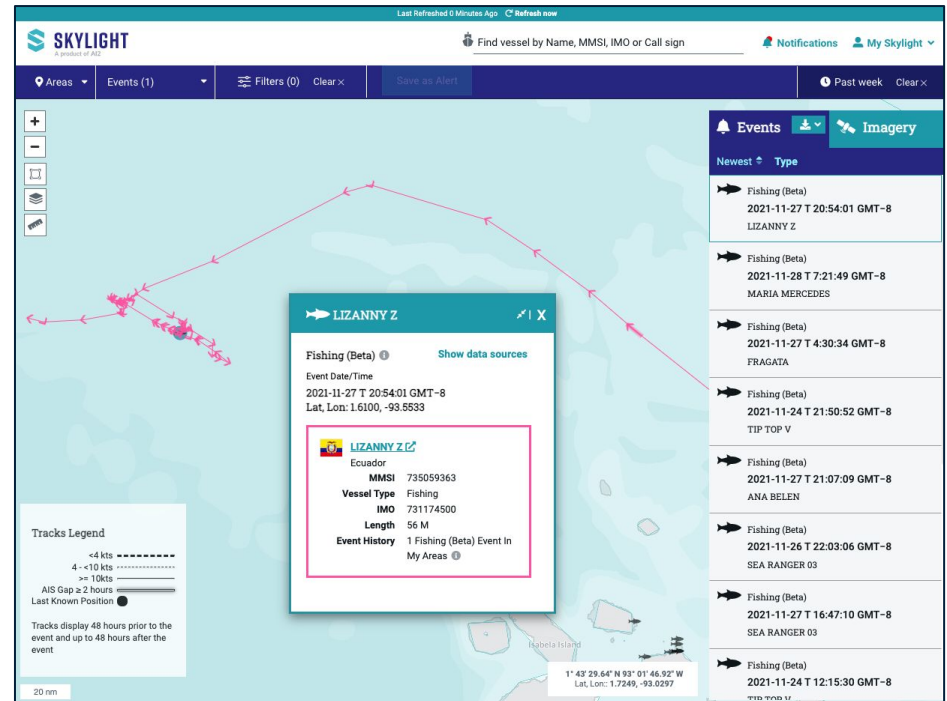
# Fishing Events

The was model was trained on **many types of fishing** behavior: trawling, seining, longlining, and squid jigging.

- It was not trained on trolling, pole-and-line, gill netting, or other fishing types

The model **does not take vessel type into account** to detect fishing vessels that are not transmitting themselves as fishing vessels.

There are also some known false positives generated by seafloor operations (e.g. dredging) and close to ports or busy channels.



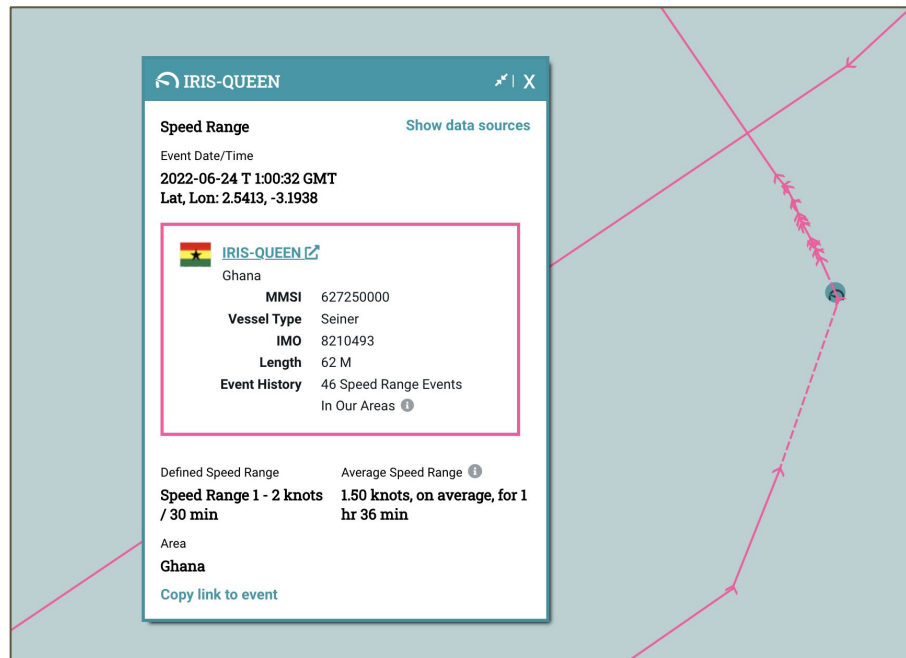
# Speed Range Events

# Speed Range Events

An event where a vessel transmitting AIS **breaks a user-defined speed threshold**.

Skylight uses a **rules-based model** to detect this behavior for user-defined areas. There must be at least 2 conditions:

1. Speed Configuration
  - From what speed to what speed must the vessel have been traveling
2. Distance OR Time Parameters
  - How far or how long did the vessel have to be traveling at that speed



# Dark (Non-AIS) Vessel Detections

# Dark (Non-AIS) Vessel Detections

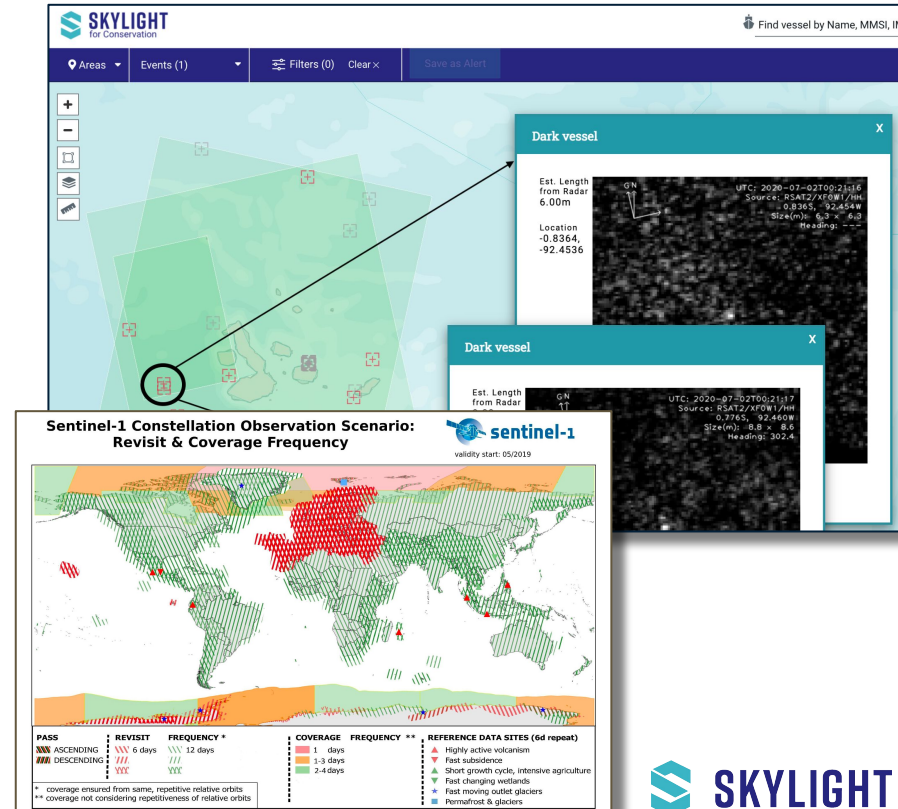
**Problem:** Vessels conducting illegal activity often turn their AIS off or do not carry AIS.

- Skylight uses Satellite Radar (“Synthetic Aperture Radar” or “SAR”) to look for vessels that are not transmitting AIS.

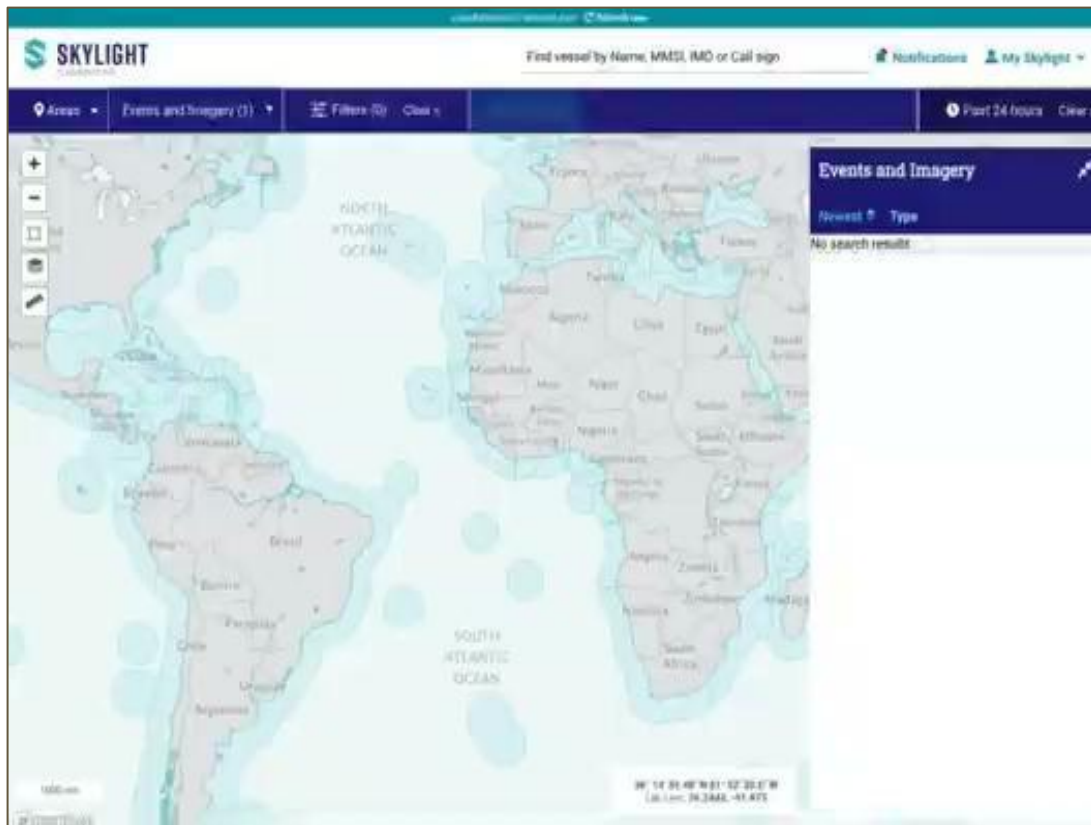
Currently, Skylight has 2 sources of satellite radar:

Source	Requires user to make an order	Minimum vessel size detectable	Avg delay from collection to delivery	Coverage areas
Sentinel-1	No	10m	7-14 hours	Only near-shore (see picture right)
Radarsat-2	Yes	6m	4-6 hours*	Anywhere

Sentinel should be 1st choice; if it doesn't meet your needs (eg. aoi outside coverage area), we can order radarsat



# Dark (Non-AIS) Vessel Detections



# Dark (Non-AIS) Vessel Detections

## *What can be done with satellite radar data?*

Satellite Radar data can be very useful despite the delay in delivery and limited information about dark vessels. Consider these use cases:

- A group of dark vessels in an area the morning of an operation happening later that afternoon can help **target assets toward areas with higher risk**, and thus higher likelihood of catching illegal activity.
- **Retroactively confirm partners in Dark Rendezvous Events** with satellite radar. Then, the user can conduct a boarding at port with the identified (correlated) vessel to investigate the potential transfer.
- Dark detects with relatively small estimated lengths are likely fishing vessels. If they appear to have been actively **fishing inside a restricted fishing area** at the time of the collection, then there is a good chance they are still in the general area even if the data is 6-7 hours delayed.
- Use dark vessel presence of small vessel size as a proxy for **regularly monitoring illegal fishing potential inside marine protected areas**. Then share this information with the broader community to generate more funding/will power to fund enforcement efforts there.
- **NOT RECOMMENDED:** Use estimated length to help **identify missing vessels that need search-and-rescue** or trying to **identify specific vessels generally**.



# How to View Satellite Radar Data

## Source: Sentinel-1 & Radarsat-2

The screenshot displays the Skylight web interface with a map of the Caribbean region. The left sidebar contains a 'Filters (1)' panel with the following settings:

- Standard Rendezvous:
- Dark Rendezvous:
- Fishing (Beta):
- Entry:
- Speed Range:
- Satellite Radar Imagery:

Below the 'Satellite Radar Imagery' filter, there are options for 'Correlation with AIS' (Yes/No) and 'Radar Source' (RADARSAT-2 and SENTINEL-1). The 'SENTINEL-1' option is selected. A blue callout box points to this selection with the text: "Users will be able to separate pre-ordered radar data (RADARSAT) from automatically loaded radar data (SENTINEL) with this filter".

On the map, a blue callout box points to the filter settings with the text: "How to view radar detections on the map".

Two vessel detection detail panels are shown:

- Dark Vessel Detection:**
  - Event Date/Time: 2022-04-03 T 11:11:26 GMT
  - Lat, Lon: 21.6808, -79.8959
  - Estimated Length from Radar: 38 m
  - Estimated Heading: -
  - Estimated Width from Radar: - m
  - Score: 0.9984
- SINGAPORE AIS Correlated Vessel Detection:**
  - Event Date/Time: 2022-04-05 T 10:55:15 GMT
  - Lat, Lon: 20.6239, -74.5286
  - Vessel Type: Cargo
  - IMO: 9255050
  - Length: 172 M
  - Event History: 1 Detection
  - Estimated Length from Radar: 92 m
  - Estimated Heading: -
  - Estimated Width from Radar: - m
  - Score: 0.9956

Annotations on the map include "Example dark detection" pointing to a red square and "Example AIS-correlated detection; tracks will be visible" pointing to a red track with a square. A bottom status bar shows coordinates: 25° 12' 48.24" N 85° 14' 16.44" W, Lat, Lon: 25.2134, -85.2379.

# How to Order Satellite Radar Data

## Source: Radarsat-2

The screenshot shows the Skylight interface with several key elements:

- Top Left:** Navigation icons for 'Areas', 'Events and Imagery', and a sidebar with options: 'Draw Shape', 'Enter Coordinates', and 'Upload KML / KMZ File'. A yellow circle '1' highlights the 'Draw Shape' option.
- Central Panel:** A 'Save alerts for colombiaEEZ' form. It includes a 'Filters (0) Clear x' section, three alert configuration sections (Rendezvous, Entry, and Satellite Radar Imagery), and a 'Save as Alert' button. A yellow circle '1' highlights the 'Save as Alert' button.
- Right Panel:** A 'My Dashboards (66)' list showing various regions like ARG - EEZ - Argentina, AUS - EEZ - Australia, etc. Below it, an 'Alerts (19)' list shows active alerts like 'Foreign fishing vessels in Natuna', 'Indonesia - Eastern', and 'Indonesia - Indian Ocean'. A yellow circle '2' highlights the 'Request Satellite Radar Collection' link in the 'User Profile' section.
- Bottom Left:** A map view showing a green polygon representing the area of interest. A yellow circle '4' highlights the map area.
- Bottom Right:** A 'Dark vessel' detection event details panel showing event date/time (2022-02-16 T 10:48:07 GMT), coordinates (Lat: 9.5906, Lon: -75.9945), and estimated dimensions from radar.

Most useful for: looking for hot spots of dark vessels 1-2 days ahead of a anti-IUUF patrol

Automated Process

Fully managed in Skylight platform

1. Agency creates area of interest in an account and sets up email notifications for radar imagery in that area
2. Agency submits formal request for radar using the name of the area **(>2 weeks ahead of time)**
  - a. Skylight can make 1-5 collections; depends on how many other requests we have that month
3. Confirmation email is sent with when the radar collections should be expected
4. Collections are delivered to the platform after the collection occurs, which sends an instant email to the account
  - a. ~2 hour delay for 'accelerated' delivery. Skylight will only pay for this (on behalf of the agency) if agency confirms there is an active operation.
  - b. ~4-6 hour delay standard.

Skylight can repeat this process on an ongoing basis, as long as the organization shares continuous feedback.

# Skylight's Vessel Database

# How to Search Skylight's Vessel Database

Show data sources

## General Vessel Information



**TORNG TAY NO. 1**  
Seychelles

MMSI 664210000

IMO 8651154

Call Sign S7QV



## Vessel History



- Standard Rendezvous (0)
- Dark Rendezvous (5)
- Port Visits (14)
- Entry Events In My Areas (1)



SKYLIGHT for Conservation

torng tay

Filters (0) Clear x

TORNG TAY NO. 1  
664210000, S7QV

Event	Start/Arrival Date	Duration	Location
Port Visit	2021-09-03 T 14:06:07 GMT-5	5h 12m	South Africa DURBAN
Dark Rendezvous	2021-08-02 T 20:18:30 GMT-5	3h 59m	33.3975, -34.9005
Dark Rendezvous	2021-07-17 T 20:56:49 GMT-5	1h 35m	32.6979, -36.4811

## Ownership

Registered New Century Ocean

# Application Programming Interface (API)

# Skylight API

Skylight offers an **Application Programming Interface (API)** to agencies who want to analyze Skylight data on the same screen as another application.

## Current Skylight API Projects

- **EarthRanger** - a monitoring system for protected parks globally (**implemented**)
- **SeaVision** - a maritime domain awareness system by the US Government provided to national and international partners (**implemented**)
- **YARIS** - an information-sharing system used by the Yaounde Architecture in the Gulf of Guinea (**in progress**)
- **Dark Vessel Detection (DVD)** - a maritime domain awareness system being developed by the Canada Department of Fisheries and MDA (**in progress**)

API is offered at no cost if the connecting platform...:

- ...has been requested directly by a country or regional partner OR is specified in the terms and conditions of a bilateral agreement/MOU/contract
- ...is made available at no monetary cost to countries or regional partners
- ...is provided by an organization whose mission is to reduce IUU fishing, maritime crimes, and/or improve ocean health
- ...has staff with technical capacity to do integration with minimal assistance from Skylight
- ...is willing to provide country-level metrics about usage (**more on future slide**)

# Upcoming / Future Work

# Dark (Non-AIS) Vessel Detections

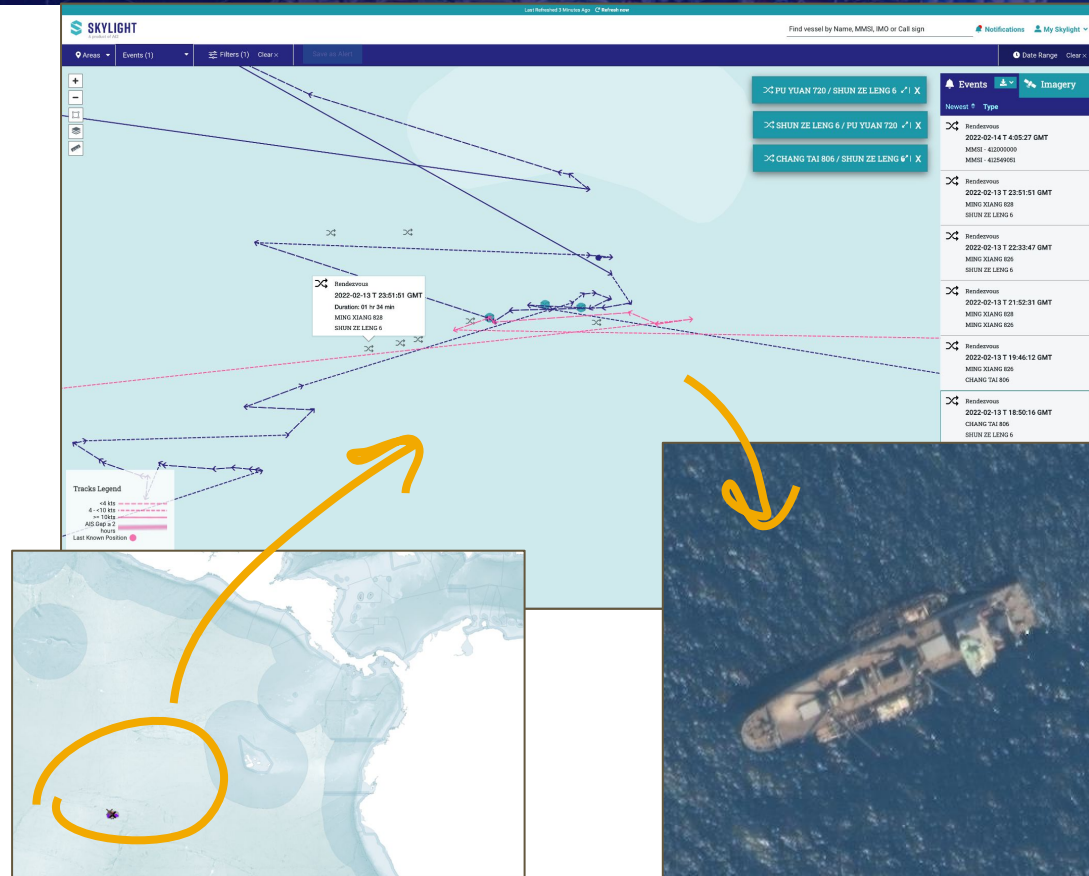
These are the sources of imagery that Skylight is considering adding to the platform in the near future:

Source	Type of Imagery	Requires user to make an order	Minimum vessel size detectable	Avg delay from collection to delivery	Coverage areas	In Skylight, as of May 17, 2022
Sentinel-1	Satellite Radar	No	10m	7-14 hours	Only near-shore (see picture right)	Yes
Radarsat-2	Satellite Radar	Yes	6m	4-6 hours*	Anywhere	Yes
Sentinel-2	Optical Imagery	No	10m	TBD	TBD	No, actively annotating
VIIRS	Infrared	No	N/A	TBD	TBD	No, working on this summer
Landsat-8 & 9	Optical Imagery	No	15m	TBD	TBD	No



# Research & Development: Cueing Imagery in Near-Real-time

- Skylight has a partnership with **MAXAR** that allows us to cue imagery for special projects.
- Recently we built a technical connection together to **automatically task imagery** based on Skylight events meeting specific criteria.
- In this example, Skylight generated a Standard Rendezvous event southwest of Galapagos that was confirmed by optical imagery by MAXAR.
- What is most important is that no money was spent on a plane nor were there any people in-the-loop for tasking and processing the imagery.



# Appendix

# Contact Information

Team email address (fastest response): [support@skylight.global](mailto:support@skylight.global)

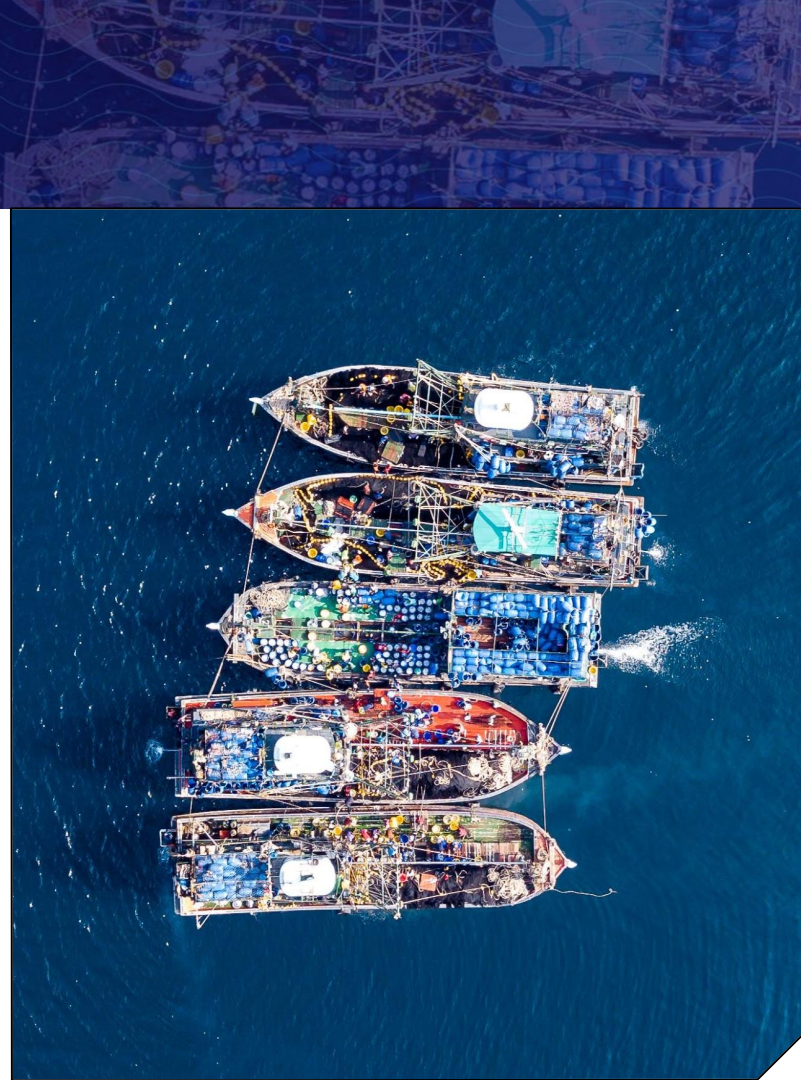
Ted Schmitt, Skylight Director, [teds@allenai.org](mailto:teds@allenai.org)

Namrata Kolla, Skylight Product Manager and Lead for Latin America & Caribbean, Southeast Asia and Pacific, [namratak@allenai.org](mailto:namratak@allenai.org)

Andrew Howe, Skylight Program Manager and Lead for Gulf of Guinea, and Indian Ocean, [andrewhowe@allenai.org](mailto:andrewhowe@allenai.org)

Karen Farley, Skylight Technical Program Manager and Trainer, [karenf@allenai.org](mailto:karenf@allenai.org)

Gregg Casad, Skylight Consultant, [gregg@exulans.net](mailto:gregg@exulans.net)



# Active Global Engagements

## Latin America

- National Centers: Royal Bahamas Defense Force (RBDF), Ecuador Directorate of Aquatic Spaces (DIRNEA), Colombian Armada (ARC)
- Parks/NGOs: Revillagigedo NP (Mexico)

## West and Central Africa

- Regional Centers: CRESMAO, MMCC Zone E, MMCC Zone F
- National Centers: Cabo Verde Coast Guard; Côte d'Ivoire Navy; Ghana Navy; Gabon Navy; Liberian Coast Guard; Nigerian Maritime Authority; Sao Tome and Principe Coast Guard and Fisheries
- Parks: Gabonese Agency for National Parks

## Indian Ocean

- Regional Centers: Operations and Information Fusion Centers (RCOC, RMIFC)
- National Centers: Comoros Coast Guard; Kenya Coast Guard; Madagascar NMIFC; Maldives Coast Guard, Fisheries; Mauritius Coast Guard, Customs, Fisheries; Mozambique Navy, Police; Seychelles NISCC; Somalia Fisheries; Sri Lanka Navy
- Parks: Bazaruto National Park (managed by African Parks)

## Southeast Asia

- National Centers: Indonesian Maritime Security Agency (BAKAMLA); Philippines National Coast Watch Center; Thailand Office of Narcotics Control; Timor Leste Navy; Vietnam Directorate of Fisheries, Search & Rescue Coordination Centre

## Pacific

- Regional Centers: Pacific Islands Forum Fisheries Agency (FFA)
- National Centers: Australian Fisheries Management Authority; Cook Islands Police; Federated States of Micronesia Fusion Centre; Fiji Maritime Search and Rescue Coordination Center (FMSRCC); French Polynesia Fusion Centre; Kiribati Police; Nauru Police; Niue Customs; Palau Marine Law Enforcement; Pitcairn Islands Administrator; Samoa Police; Tonga Navy; Tuvalu Police
- Parks/NGOs: OceanMind (in Palau); Phoenix Islands Protected Area Implementation Office

**40+ Active Country Engagements**

**5+ Regional Organizations**

# Active Global Engagements



# Partners - Global

## Capacity Building Organizations

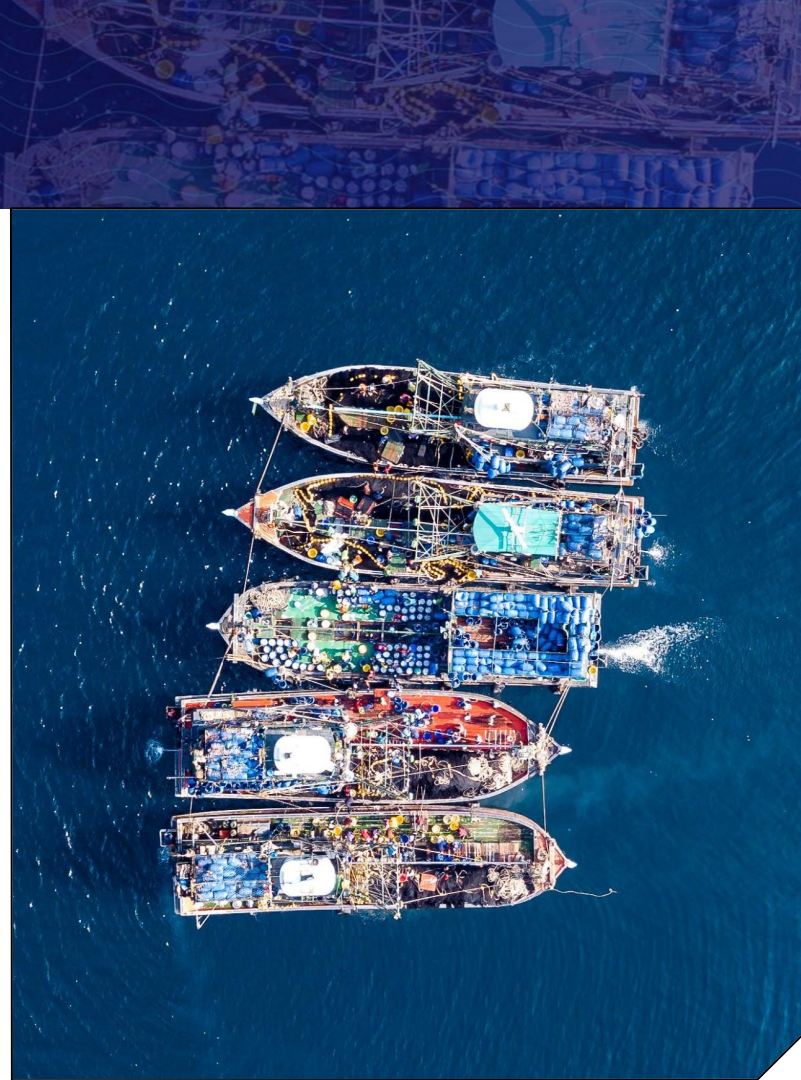
- United Nations Office of Drugs and Crime – Global Maritime Crime Programme
- Wildlife Conservation Society
- WildAid
- International MCS Network

## Funding Partners

- Oceans5
- Blue Nature Alliance
- National Geographic Society

## Technology Partners

- Global Fishing Watch
- Trygg Mat Tracking





# SKYLIGHT

A product of AI2