



# SKYLIGHT

A product of AI2

# AI for Maritime Domain Awareness

6th HIGH-LEVEL MEETING ON THE IMPLEMENTATION OF THE JEDDAH AMENDMENT TO THE  
Djibouti Code of Conduct  
24 October 2023

# What is Skylight?

## ALLEN INSTITUTE FOR ARTIFICIAL INTELLIGENCE (AI2)

Non-profit organization in Seattle, USA

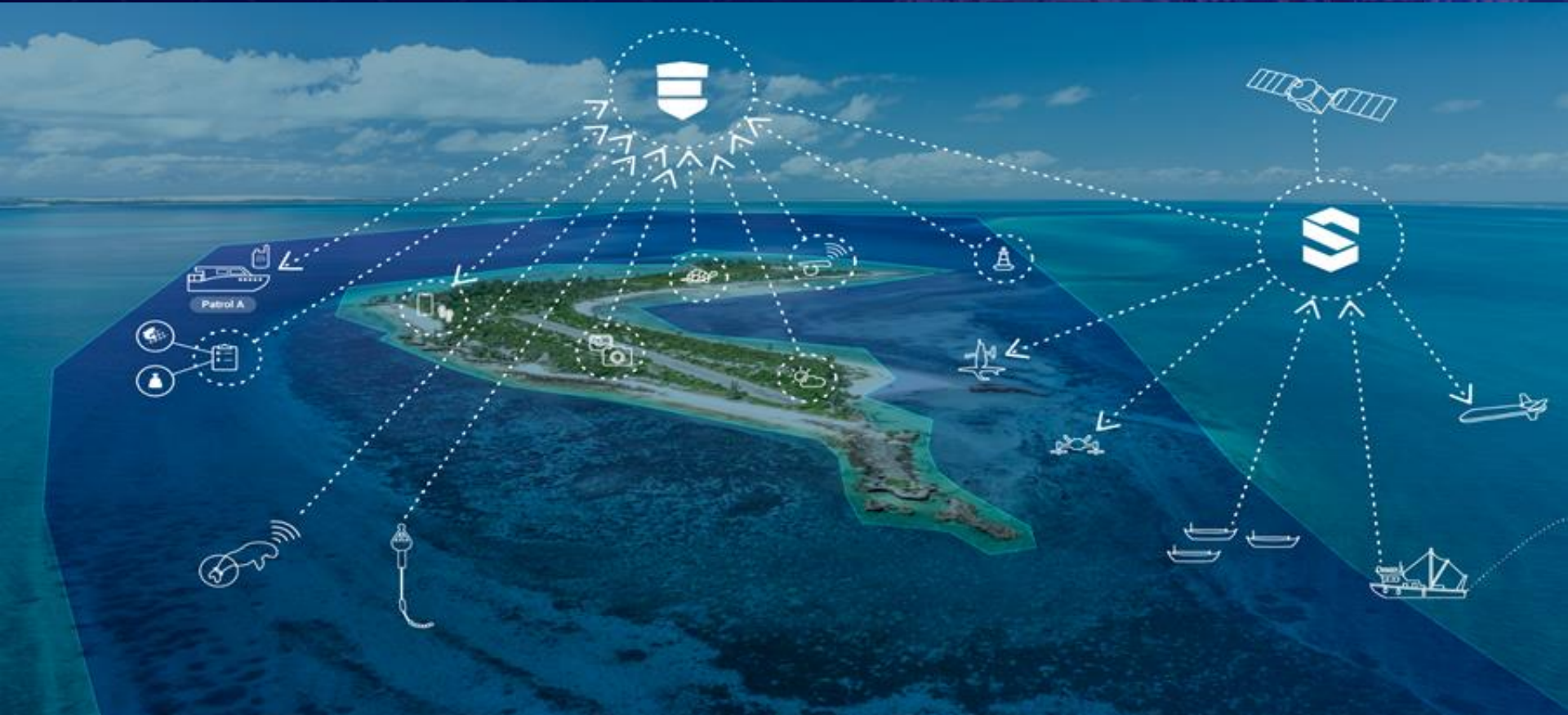
**SkyLight's Mission** - *To deliver premier data and analytics in order to support enforcement and compliance actions toward reducing IUU fishing and other maritime crimes.*

### KEY ELEMENTS

- Focus on application of **advanced technologies like Artificial Intelligence** to surface anomalous activity
- **No cost** to national and regional agencies fighting maritime crime.
- Outputs **integration** into platforms such as SeaVision and IORIS, as well as a stand-alone UI



# The Maritime Domain



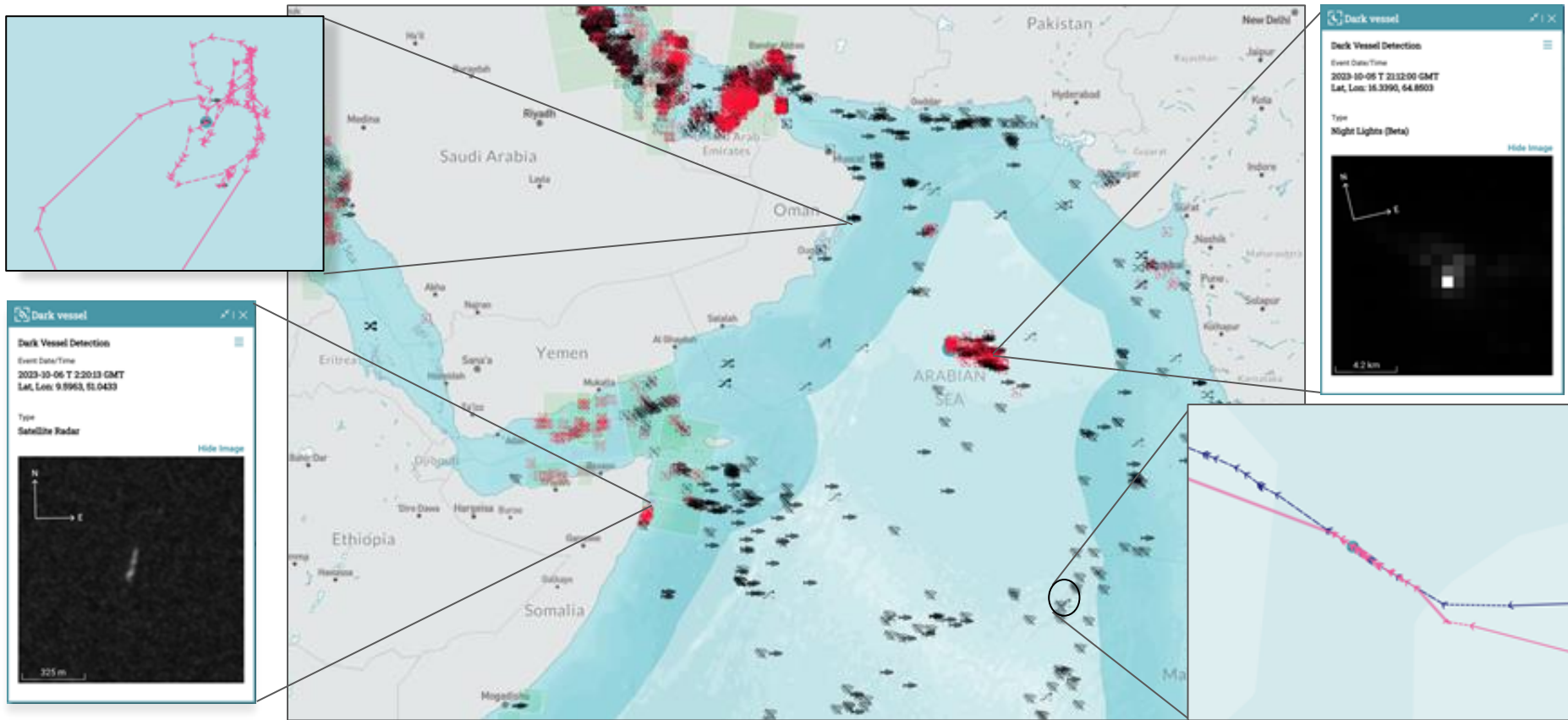
# Vision of AI at Skylight

Build the **most advanced maritime artificial intelligence data platform in the world.**

We are uniquely suited to couple the latest deep learning research from the world's leading computer vision research scientists to the highest standard of machine learning operations.

**Make Skylight data outputs widely available** through integration with national and global maritime platforms, such as SeaVision and IORIS.

# AI for Maritime Domain Awareness



# Data Sources

**AIS** - Near real time detection of vessel behaviors

**Open-Source Satellite Data** to identify dark vessels

- Satellite Radar
- Night Lights (VIIRS)
- Optical Imagery

**Commercial Satellite Data** for operational and other compliance support

- Radio Frequency
- Satellite Radar
- Optical Imagery



# Standard Rendezvous Events

Bunkering, transshipment, and other rendezvous events

Rules-based algorithm

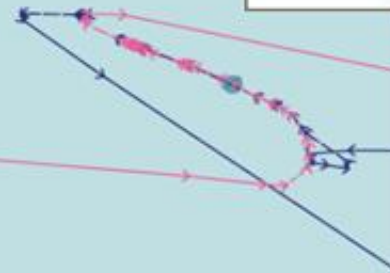
- Within 250m
- >30min



## Tracks Legend



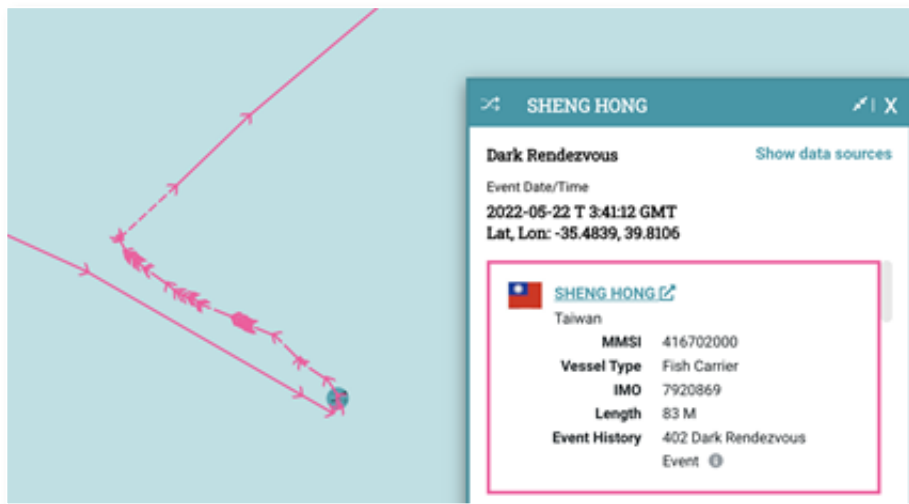
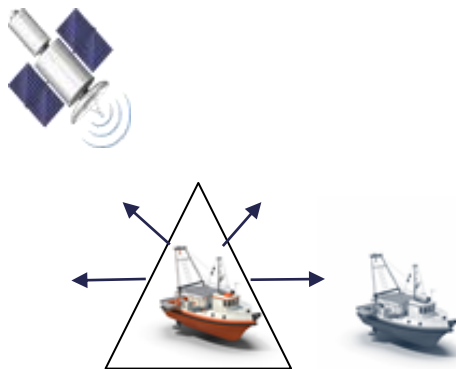
Tracks display 48 hours prior to the event and up to 48 hours after the event



# Dark Rendezvous Events

One vessel transmitting AIS with anomalous movement, including rendezvous behavior

- Skylight uses a **machine learning model** to detect potential rendezvous behavior.
- A potential second vessel that is not transmitting AIS is not visible to Skylight





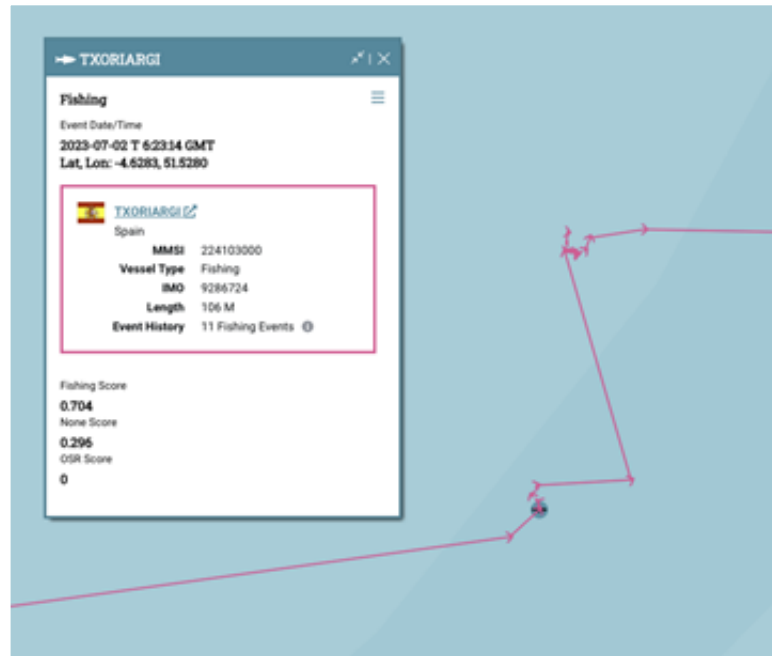
# Fishing

Machine Learning model developed from observer data

Fishing behaviors detected globally and automatically

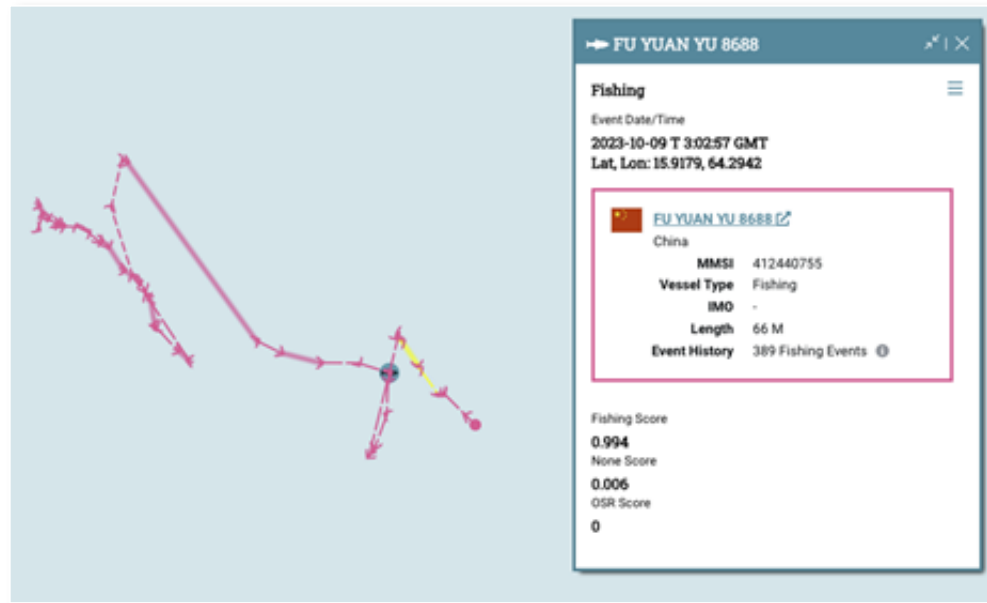


Longline fishing

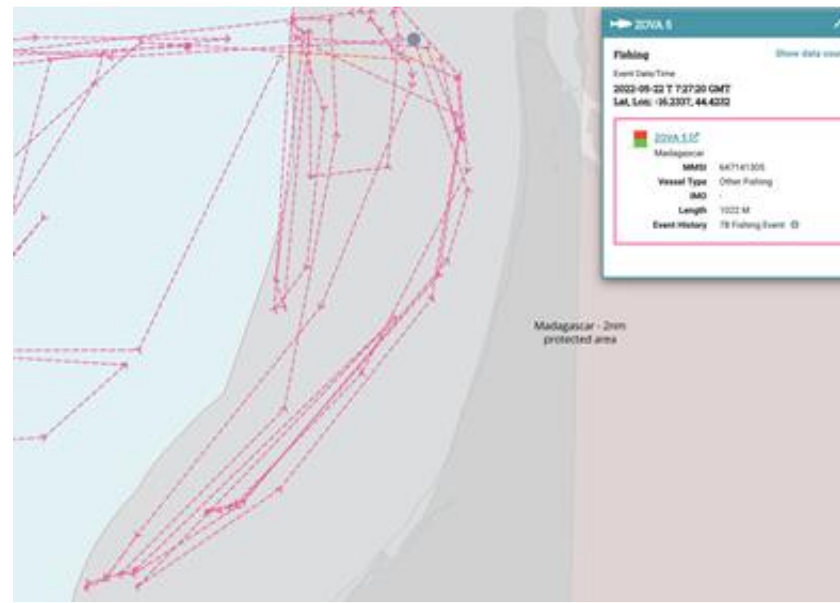


Purse Seine

# Fishing



Squid Jigging



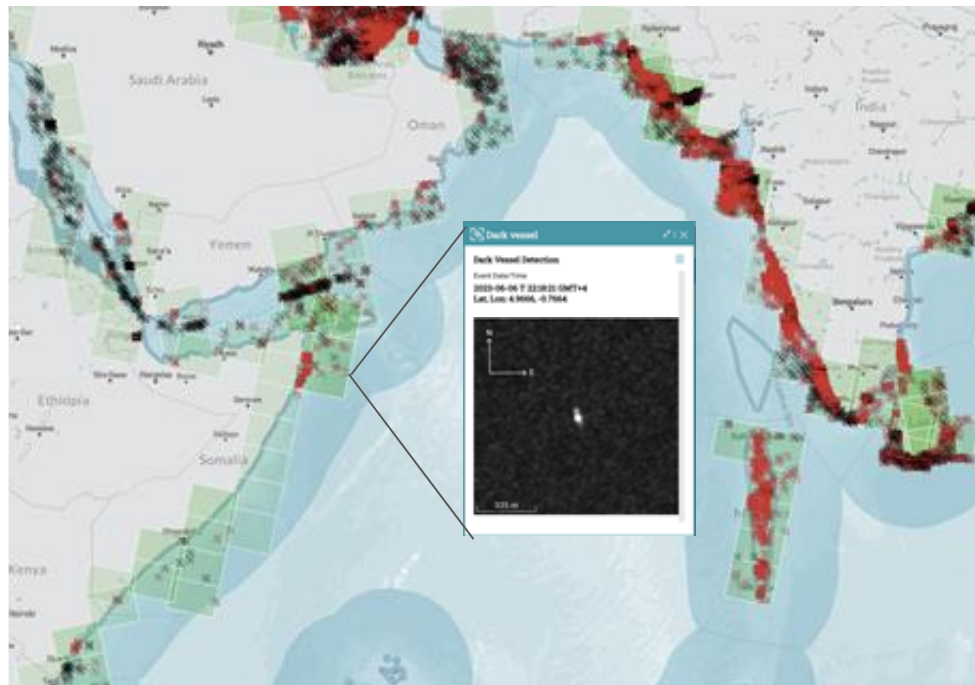
Trawling

# Satellite Radar

**Computer vision model** to detect vessels from public Satellite Radar (“Synthetic Aperture Radar” or “SAR”)

Data from the Sentinel-1 satellites processed in near real time (2-8 hours).

Source	Avg delay from collection to delivery	Revisit rate	Geographic Coverage
Sentinel-1	2-6 hours	1-3 times per week	Near shore for most continental coastlines
Commercial	90 min (best case scenario)	N/A	Custom



# Night Lights

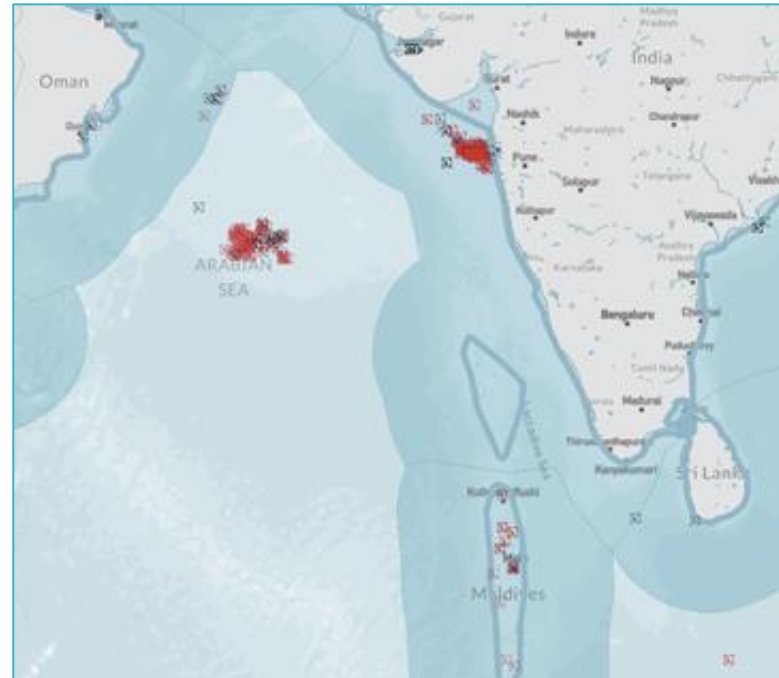
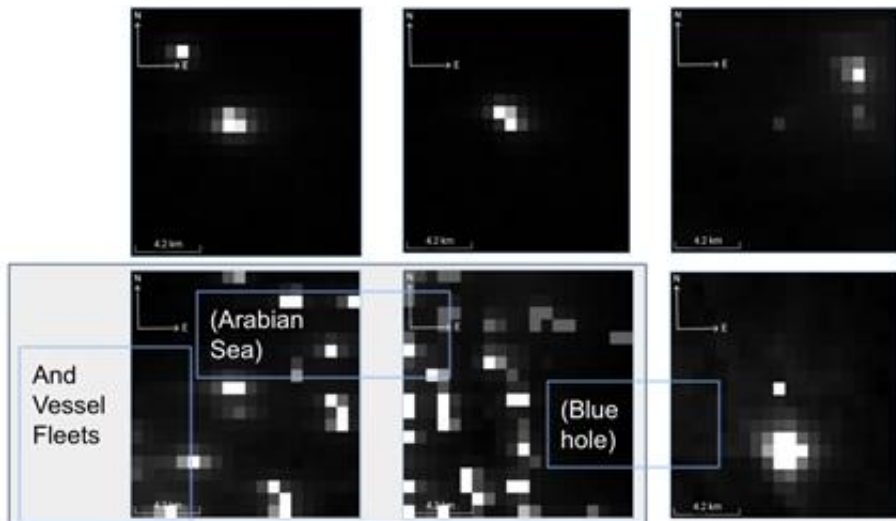
Another **Computer Vision model** to detect vessels using bright lights at night

- Two nightly collections from two satellites detect images of nocturnal lights. The sensors are also known as Visible Infrared Imaging Radiometer Suite (VIIRS).
- Any vessel types with bright lights can be detected through Night Lights

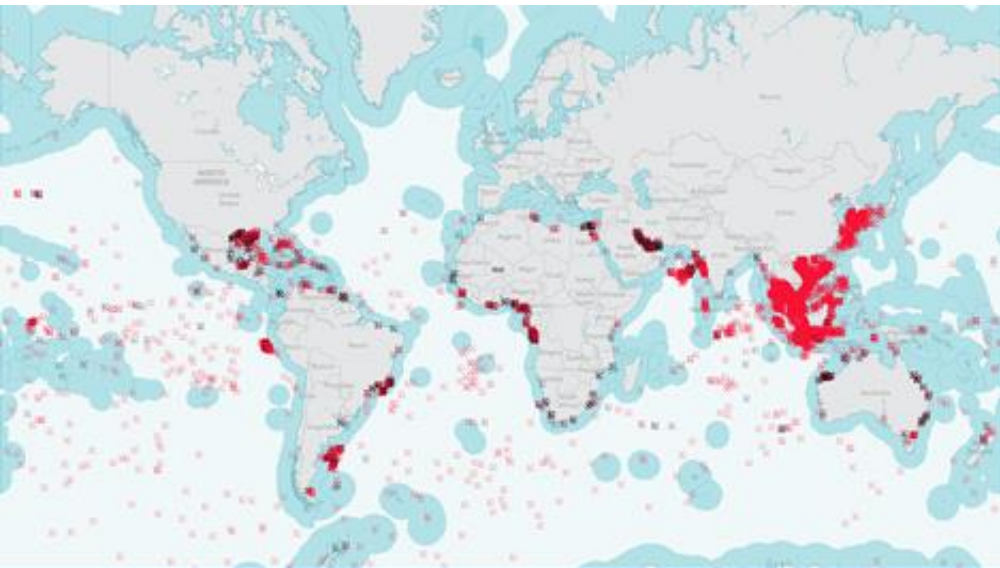


# Night Lights

What does a vessel look like in Night Lights data?



# VIIRS vessel detections in Skylight



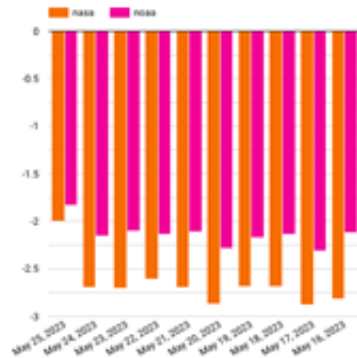
Latency of Frames from Collection to Creation

	collected_at (Date) *	LatencyFrame	Record C...
1.	May 25, 2023	-1.92	12
2.	May 24, 2023	-2.42	191
3.	May 23, 2023	-2.4	192
4.	May 22, 2023	-2.37	194
5.	May 21, 2023	-2.4	195
6.	May 20, 2023	-2.59	197

1 - 100 / 171 < >

**Notes:**

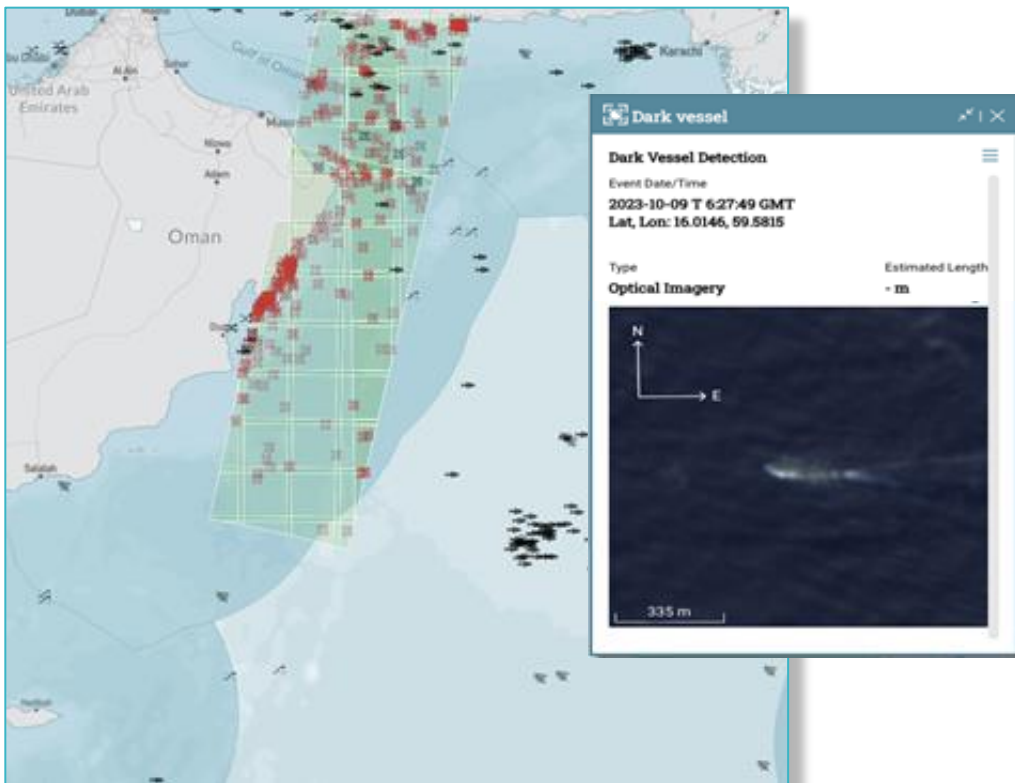
Latency is determined by subtracting Creation time (when loaded into Elastic search by Collection Time. Creation time can be affected by reloads, backloads, etc, so this can increase this number significantly, so only days that do not have any of these events should be used to determine latency.



Record Count  
112,435

The VIIRS vessel detections (aka Night Lights) are already available in our API, which we make available at global scale, in near real time, and at no cost

# Optical Imagery

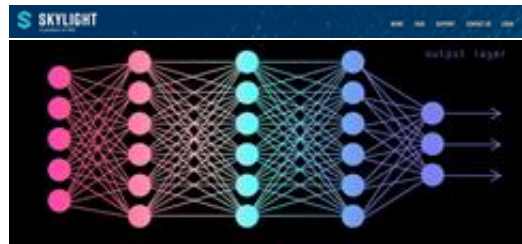


**Computer vision model** to detect vessels from public Optical Imagery

Data from the Sentinel-2 satellites processed in near real time (2-8 hours)

Source	Avg delay from collection to delivery	Revisit rate	Geographic Coverage
Sentinel-2	2-8 hours	1-3 times per week	Near shore for most continental coastlines
Commercial	90 min (best case scenario)	N/A	Custom

# VIIRS vessel detections and Skylight



light

Downlink

Data copied to  
Skylight's servers

Computer vision model  
detects vessels

API



2 hrs between  
ship's light and our  
users.

Latency is dominated  
by downlink—our  
processing is  
negligible.



# A variety of data sources are needed

The screenshot shows the EarthData website for the Visible Infrared Imaging Radiometer Suite (VIIRS). The page title is "Visible Infrared Imaging Radiometer Suite (VIIRS)". Below the title, there is a section titled "VIIRS Land Data and Information" which lists several data products. A table is visible with the following columns: Description, Download, Version, and Date. The table contains several rows of data products, including VIIRS Land Data and Information, VIIRS Land Data and Information, and VIIRS Land Data and Information. The table is partially obscured by a sidebar on the right side of the page.

Description	Download	Version	Date
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01
VIIRS Land Data and Information	Download	1.0	2014-01-01

In addition to the raw light data ( $W\cdot cm^{-2}\cdot sr^{-1}$ ), we use:

- Geolocation data
- High resolution land - sea arrays
- Cloud coverage
- Other bands besides the wattage (for gas flare/oil platform identification).

All of this data is provided in near real time simultaneously (for free).

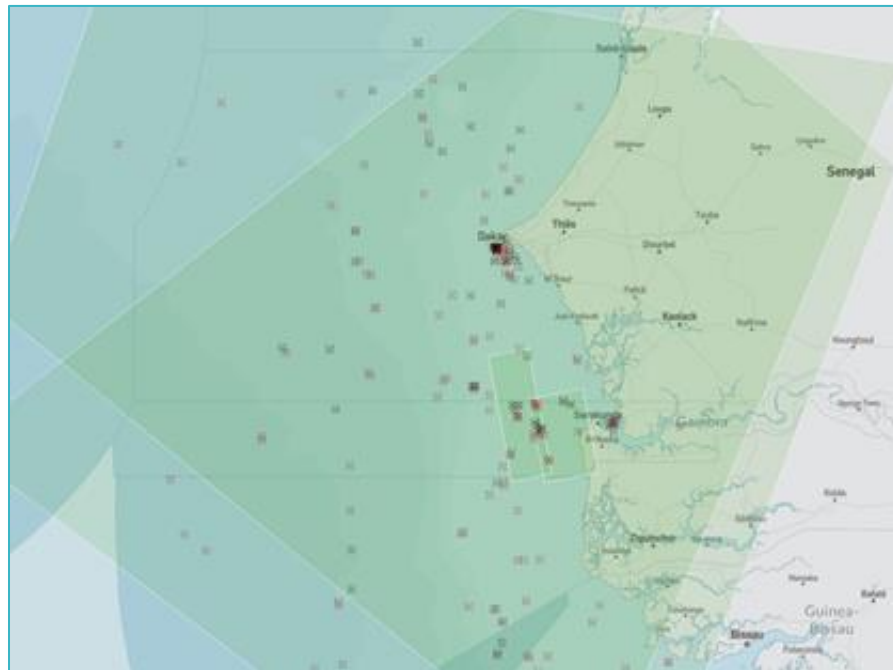
A single frame from one satellite requires approximately 150 MB of data. (241 frames/day\*2 satellites ~ 26 TB/year)

# Operational Support

Skylight provides vessel detections for IUUF related operations under contract from commercial providers.

- **Sat-SAR** - variable resolution
- **Radio Frequency** - X and S band
  - Detects vessel radar systems

Data only available to national agencies otherwise unable to purchase this data



# Tip-and-Cue w/ High Resolution Imagery

- Visual **evidence collection of detected behaviors**
- Requires request from a national/regional agency as part of a compliance enforcement operation.



Skylight Standard Rendezvous event “tip”



Rendezvous imaged by the satellite

# Skylight in IORIS

Skylight area creation demo

Regional Map Q 31%

- Base Layer Standard
- Overlay Nautical Map
- Show EEZ Layer
- Draft Markers
- AIS Layer
- AIS Trace Layer

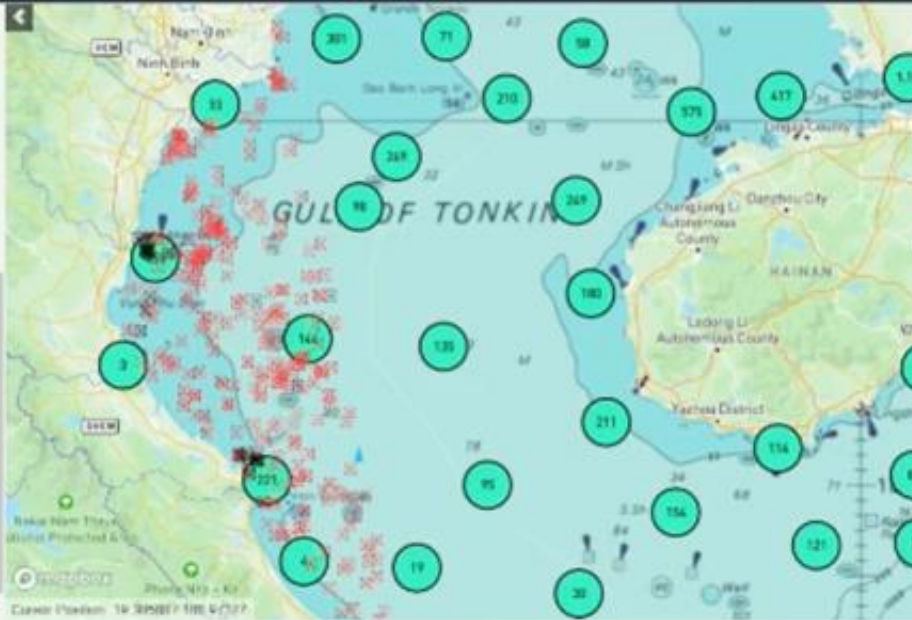
AIS Data Filters

Skylight Layers

- Show Fishing Events
- Show Dark Rendezvous Events
- Show Satellite Radar Images
- Show Tracks
- Show Satellite Frames

Marker Time Filters

Range Indicators



The map displays the Gulf of Tonkin region, including parts of Vietnam and Hainan Island, China. Numerous AIS data points are visible, with several highlighted by green circular skylight markers. The markers contain numerical values such as 301, 71, 98, 210, 375, 477, 134, 144, 135, 180, 211, 154, 154, 121, 19, 30, 3, 33, 209, 100, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500. The map also shows various geographical features, including coastlines, islands, and cities like Hanoi and Haikou. The text 'GULF OF TONKIN' is prominently displayed across the water area.

# Skylight in SeaVision

The screenshot displays the SeaVision interface with two side-by-side views of a vessel's movement path on a map. The vessel 'Hong Rong' is highlighted in green. A red dot on the map indicates a specific event. Below the map is a control panel with various settings and a detailed event log for 'Fishing - Skylight'.

**Vessel Details (Hong Rong):**

- Source: DRBCOMM
- Time: 2023 Oct 11 18:18:59 UTC
- Age: 3h 9m 24s ago
- Position: 8° 57' 48" S, 63° 33' 50" E
- Speed: 6.5 kts
- Heading: 91°
- Course: 91.2°
- MMSI: 416228600
- IMO Number: 0
- Flag: Taiwan
- Call Sign: RJ5011
- Vessel Type: 30-Fishing
- AIS Class: B
- Length: 60 m
- Beam: 6 m
- Draft: -- m
- Navigation Status: 15 NotDefined
- Destination: --
- ETA: --

**Event Log:**

- Type: Fishing - Skylight
- Start Time: 2023 Oct 11 00:10:42 UTC
- End Time: 2023 Oct 11 00:34:33 UTC
- Click for more information

**Event Properties:**

- Type: Fishing - Skylight
- Flag: Taiwan
- Vessel Type: None Selected

**Event Details (Hong Rong):**

- MMSI: 416228600
- IMO Number: --
- Flag: Taiwan
- Call Sign: RJ5011
- Vessel Type: 30-Fishing



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