
AWS
re:Invent
NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

AER202

Solving big data challenges for identifying illegal fishing activity

Tim Pavlick (he/him/his)

VP of Product
HawkEye 360

Kate Zimmerman (she/her/hers)

Chief Data Scientist
HawkEye 360

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Agenda

- Introduction to commercial remote sensing
- Applying remote sensing to Maritime Domain Awareness (MDA)
- Introduction to HawkEye 360’s commercial radio frequency (RF) data and analytics
- The big data challenge: Applying analytics to MDA
- Our big data architecture
- Results

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Introduction to commercial remote sensing

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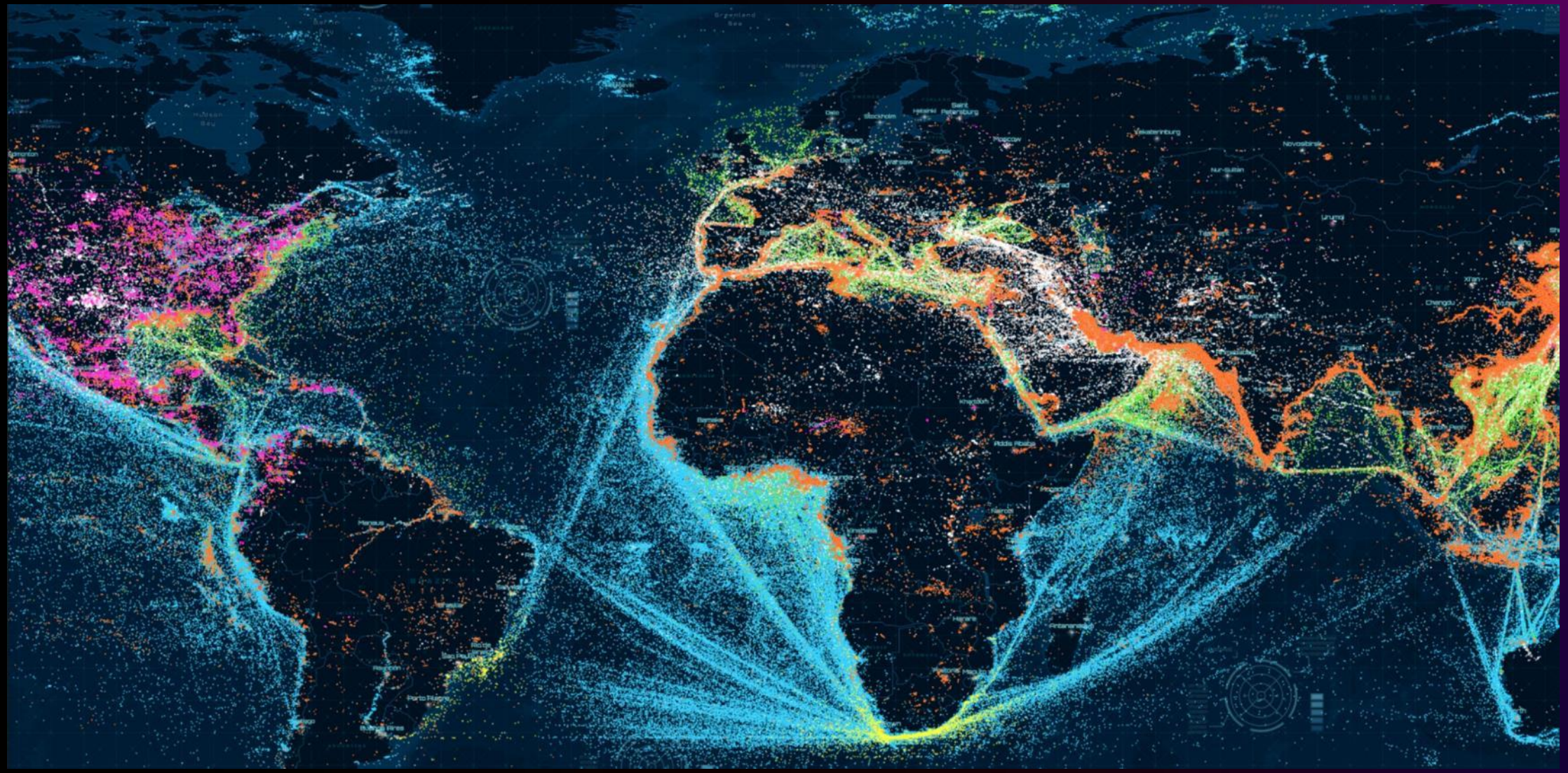
What is remote sensing?

Collecting information about an object without being in direct physical contact with it



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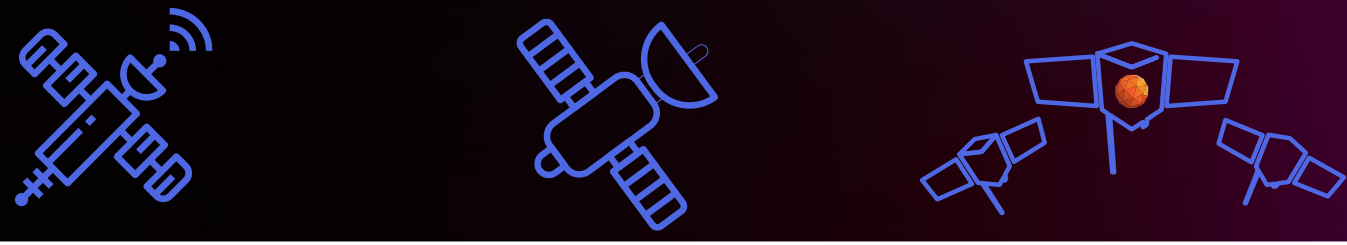
RF – The last commercial space frontier



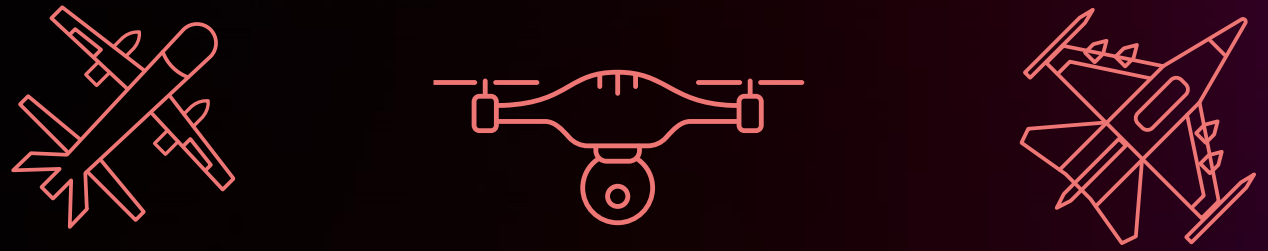
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Remote sensing platforms

Satellite sensors



Airborne sensors



Ground-based sensors

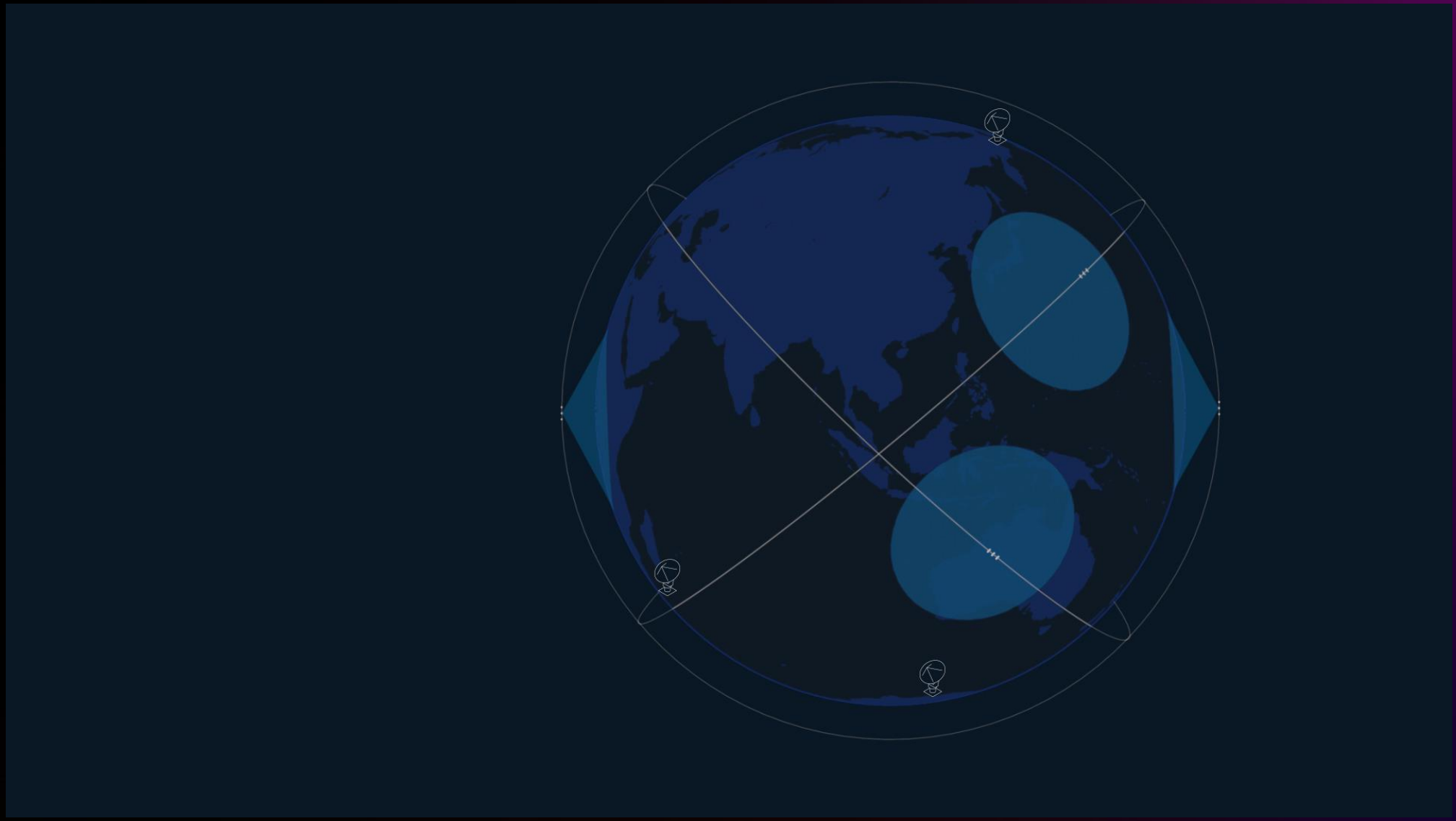


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Introduction to HawkEye 360

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The HawkEye 360 Constellation

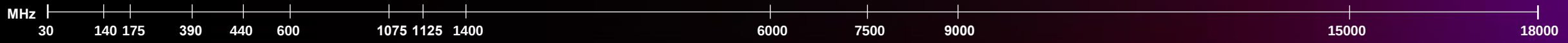


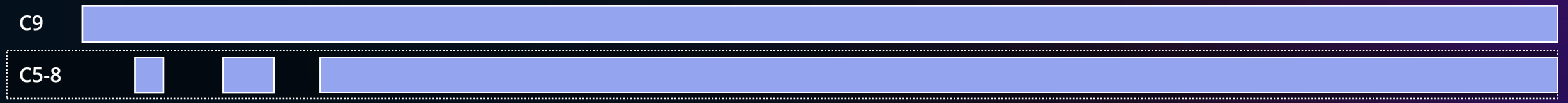
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Growing capabilities

INCREASING SPECTRUM COLLECTION TO EXPAND DETECTION AND GEOLOCATION





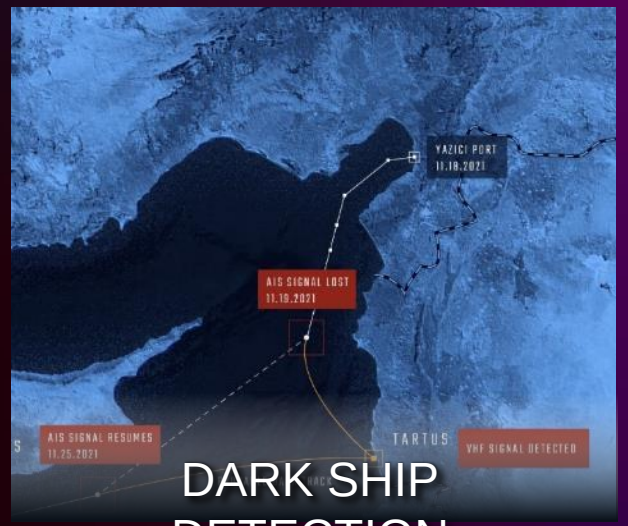


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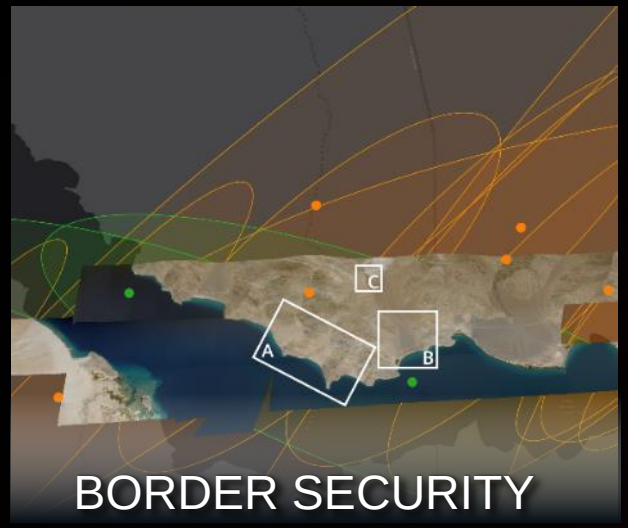
Multi-use mission applications


ILLEGAL FISHING

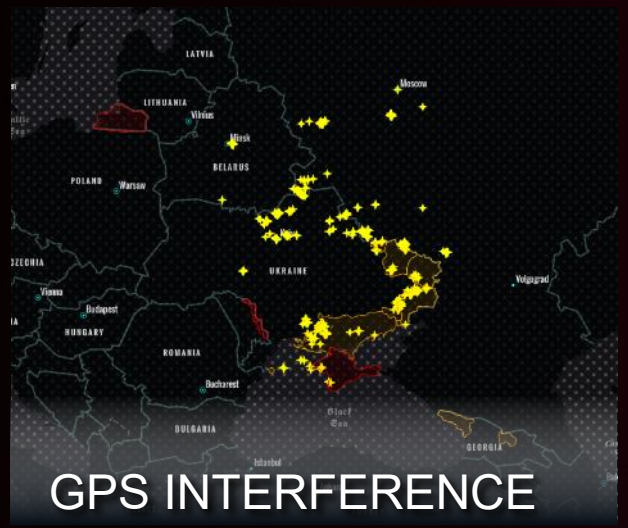

ANTI-POACHING



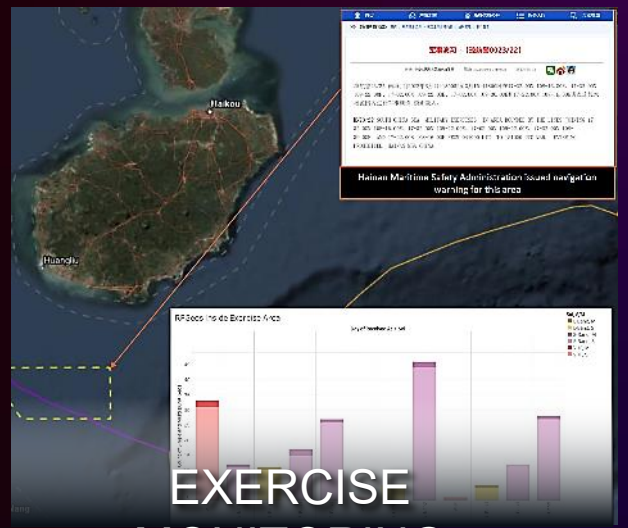
DARK SHIP DETECTION



BORDER SECURITY



GPS INTERFERENCE



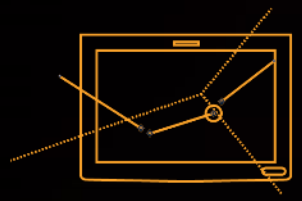
EXERCISE MONITORING

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Signal of interest catalog



VHF
Marine radios



Automatic
identification
systems



L-band
mobile sat devices



UHF
push-to-talk
radios

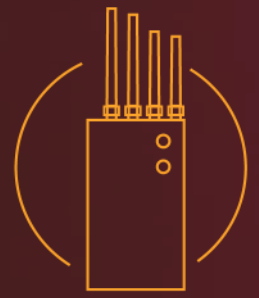


S-band marine
navigation radar

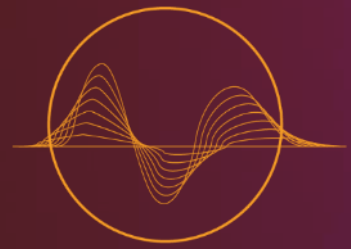


X-band marine
navigation radar

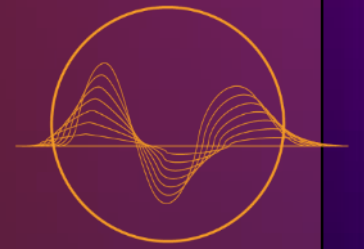
NEW SIGNALS



GPS Interference
(GPS L1)



UHF Flex



VHF Flex

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Applying remote sensing to Maritime Domain Awareness (MDA)

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Challenges in the maritime domain



Limited view
of vessel positions



Voluntary position
transmission



Vast areas
of interest



Deploying patrol
confidently

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Our approach

Step 1. Geolocate maritime radars from HawkEye 360 satellites



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Our approach

Step 2. Fuse RF collections with AIS data to get identifiers



Bob1234



Joe4612



Betty8382





Amy0912

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Our approach

Step 3. Flag vessels without identifiers



Bob1234



Joe4612



Betty8382





Amy0912

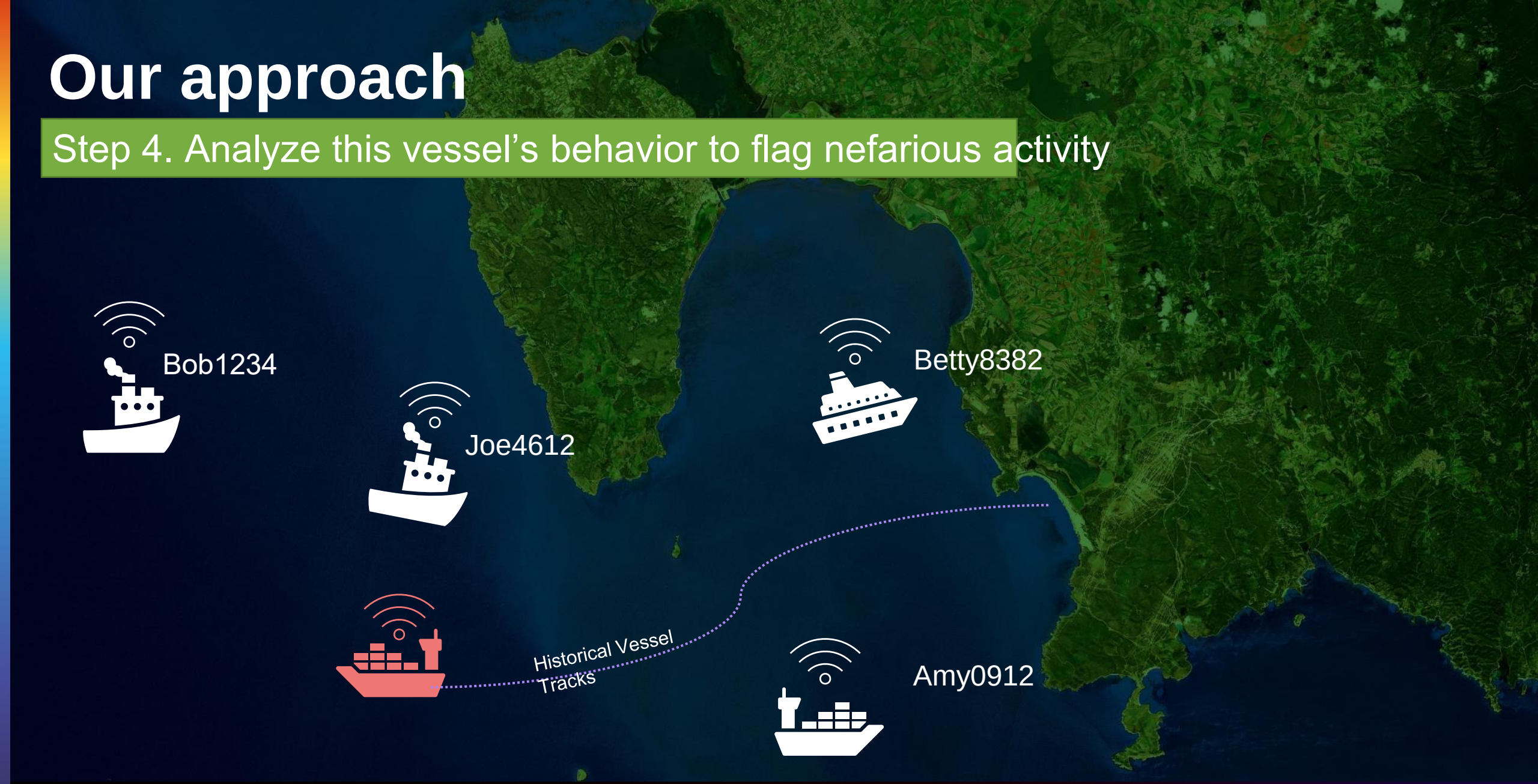
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Our approach

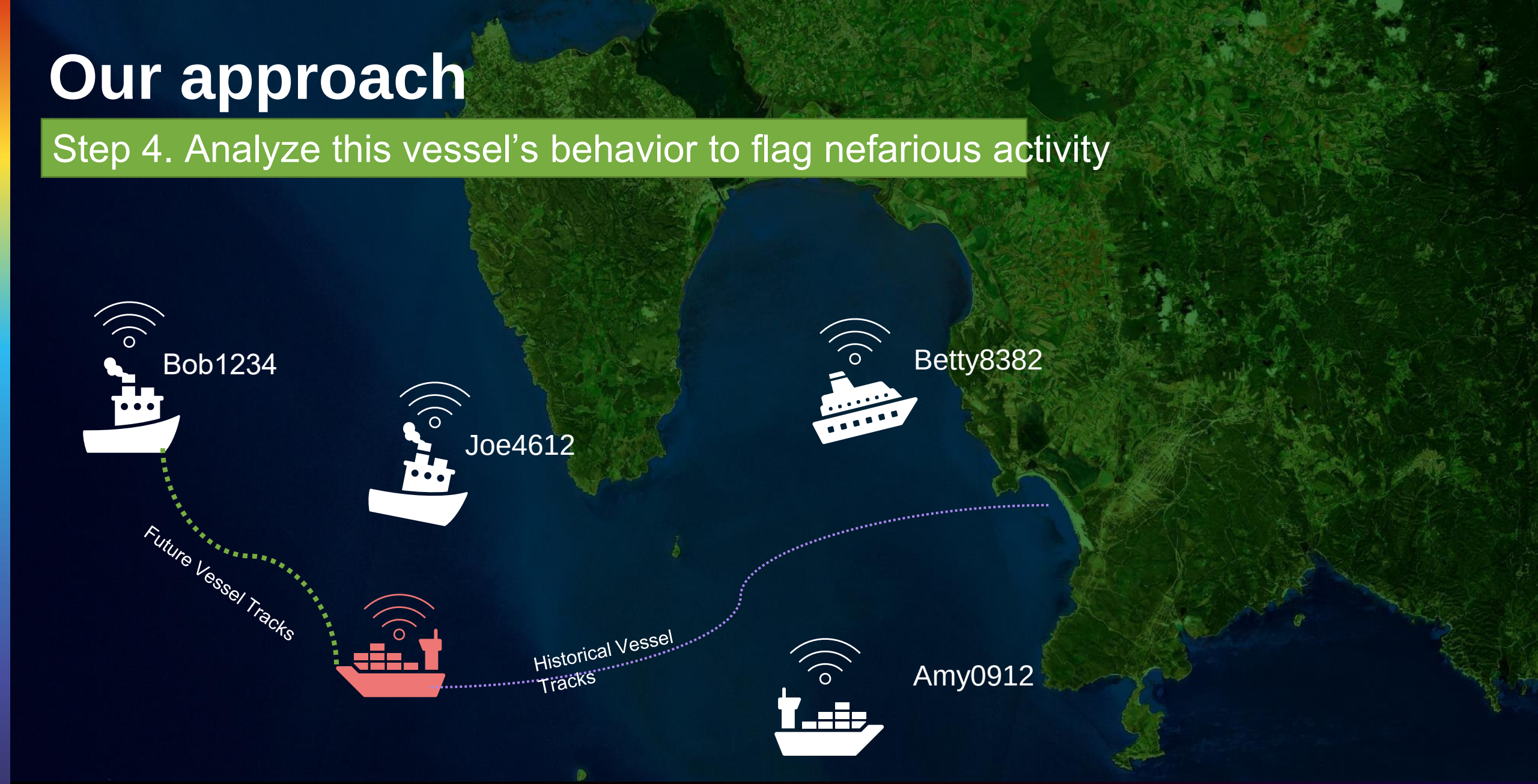
Step 4. Analyze this vessel's behavior to flag nefarious activity



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Our approach

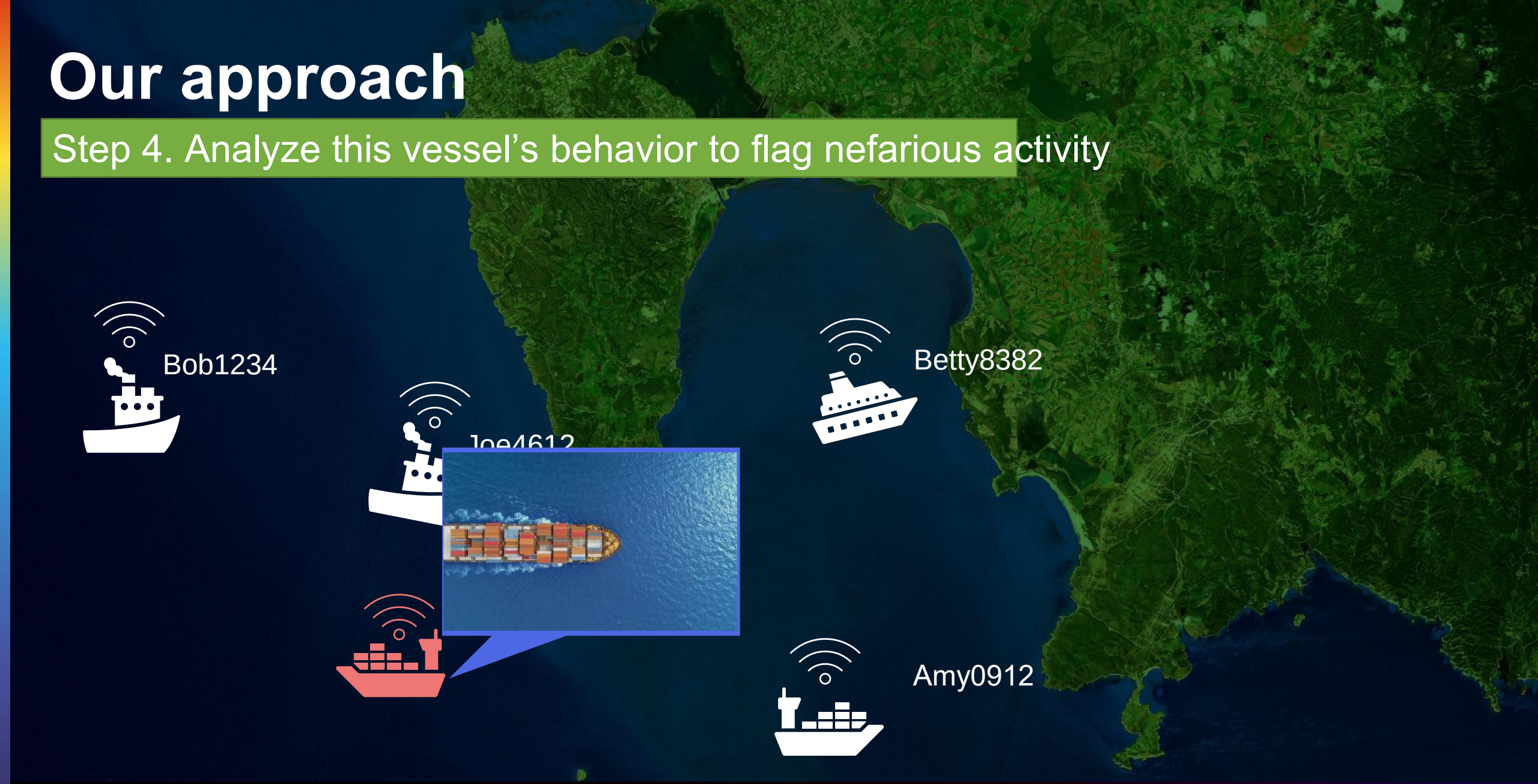
Step 4. Analyze this vessel's behavior to flag nefarious activity



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Our approach

Step 4. Analyze this vessel's behavior to flag nefarious activity



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Our approach

Step 4. Analyze this vessel's behavior to flag nefarious activity



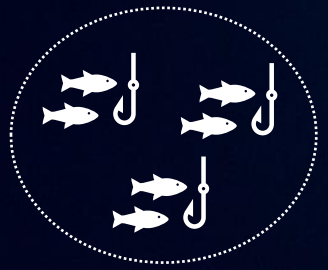
Bob1234



Joe4612



Betty8382







Amy0912

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Maritime Domain Awareness: A Big Data Challenge

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By the numbers

100M+

Over 100,000,000 RF Geolocations

350M+

Over 350,000,000 AIS messages daily*

250k+

Over 250,000 vessels operating in the ocean daily*

$23B

Illegal fishing industry is worth around $23B/year**

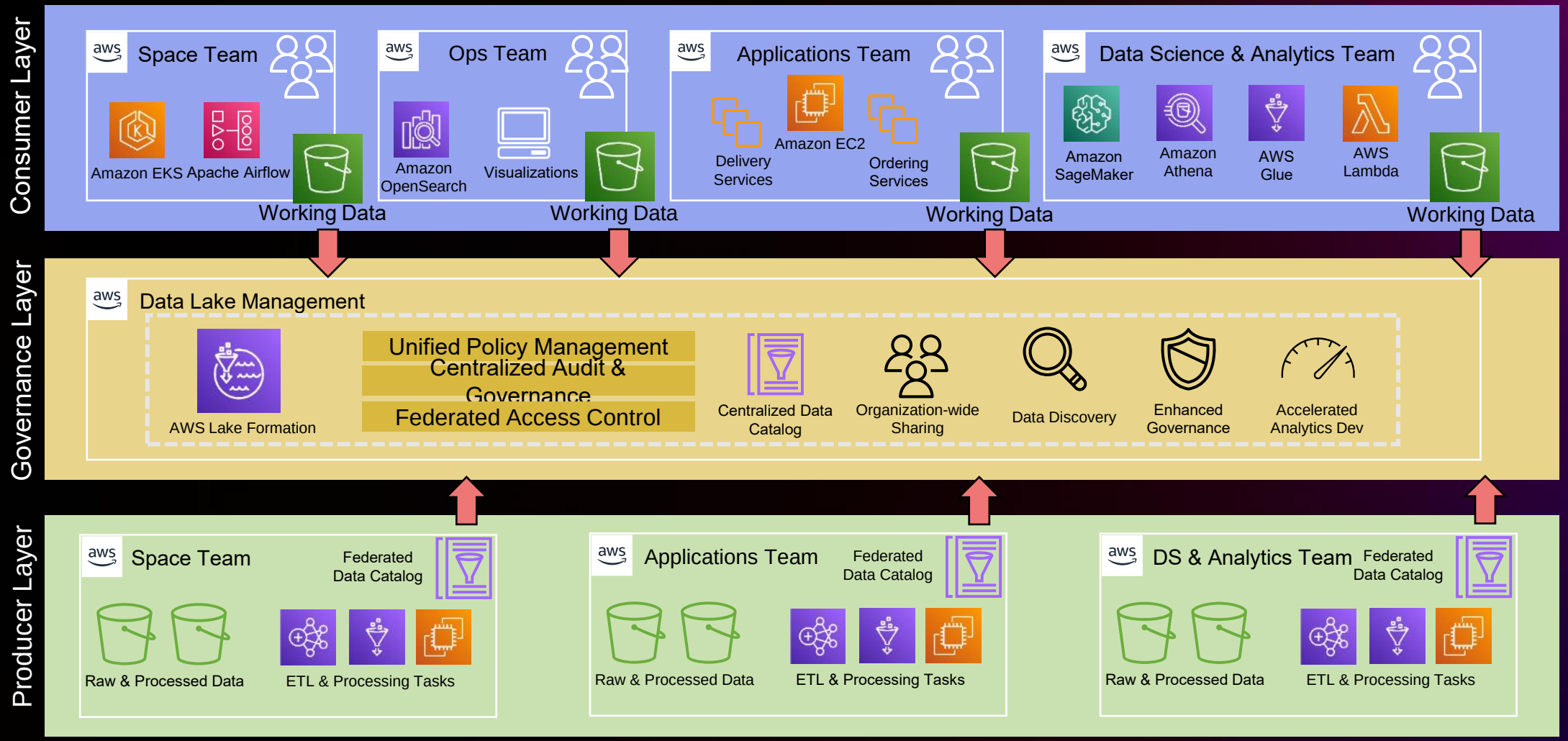
20%

Illegal fishing represents up to 20% of the world's total catch**

* https://spire.com/maritime/
** https://www.foodnavigator.com/Article/2021/12/03/Illegal-unreported-and-unregulated-fishing-Companies-exploit-the-weakness-of-the-system

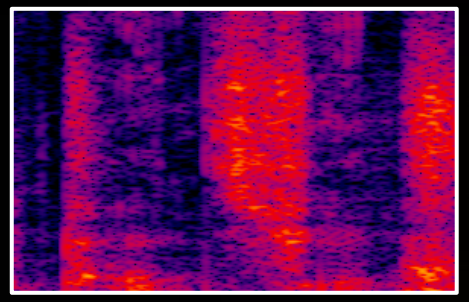
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Our Big Data Analytics Architecture



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Simplifying data discovery



Raw data for vessel of interest

Energy detection

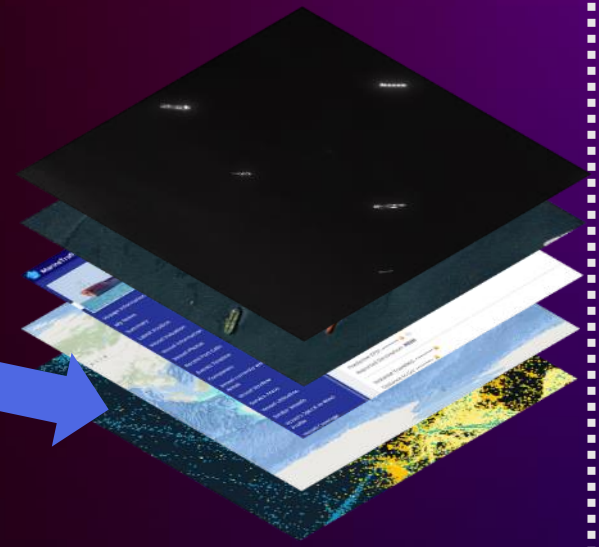
Characterization

Pattern detection

Intermediary processing results



Final geolocation





Centralized data catalog

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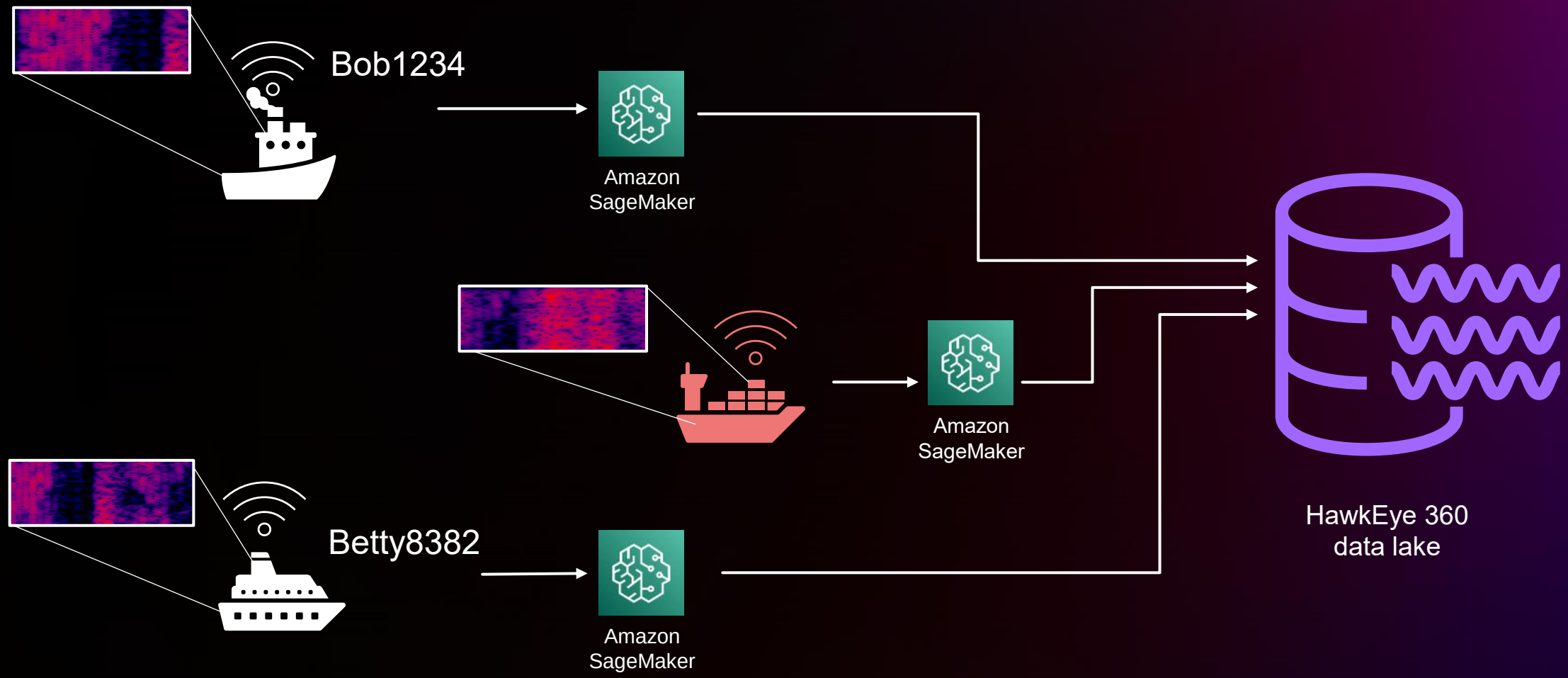
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Let us exploit complex data patterns



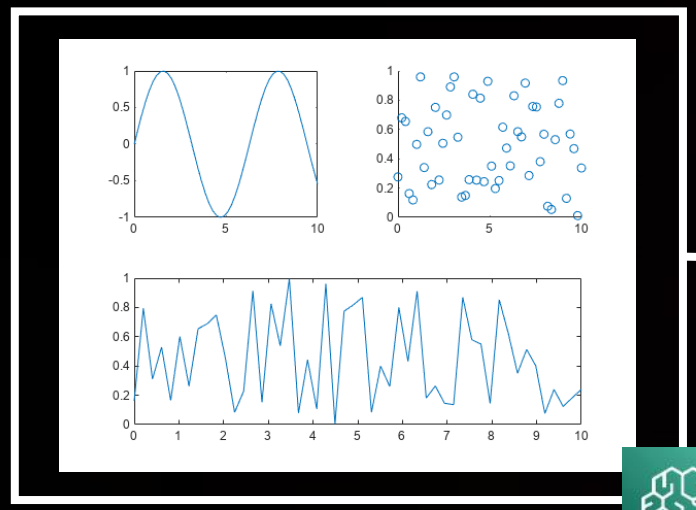
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To identify unique signals



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And understand more context



Unique Signal Recognition



Object Recognition

Opportunity Regions

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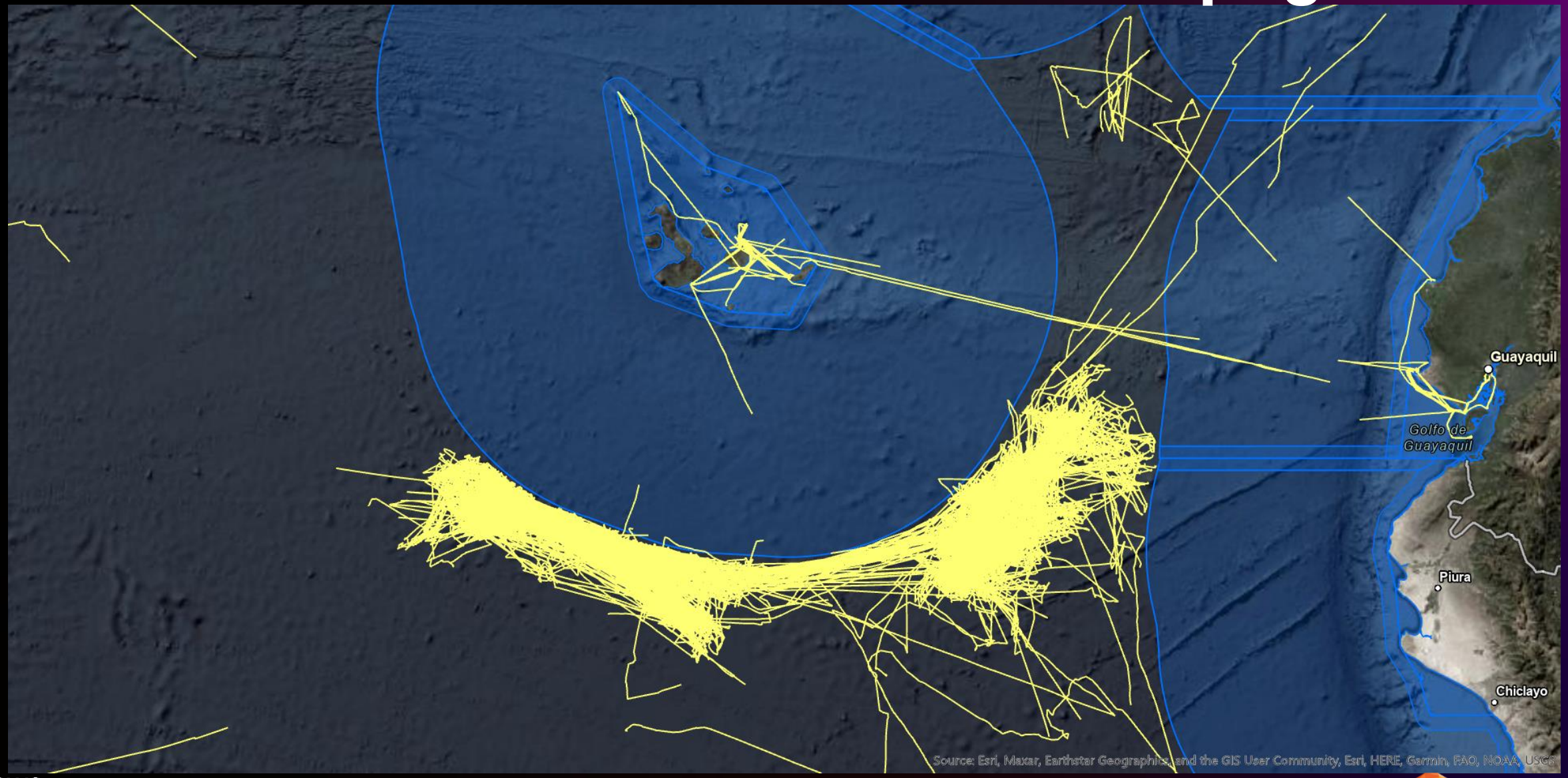
And understand more context

- Operated By: Shipping Company Y
- Potential Risk Score: 80
- Previous Ports: [Tartus, Singapore]
- Etc...



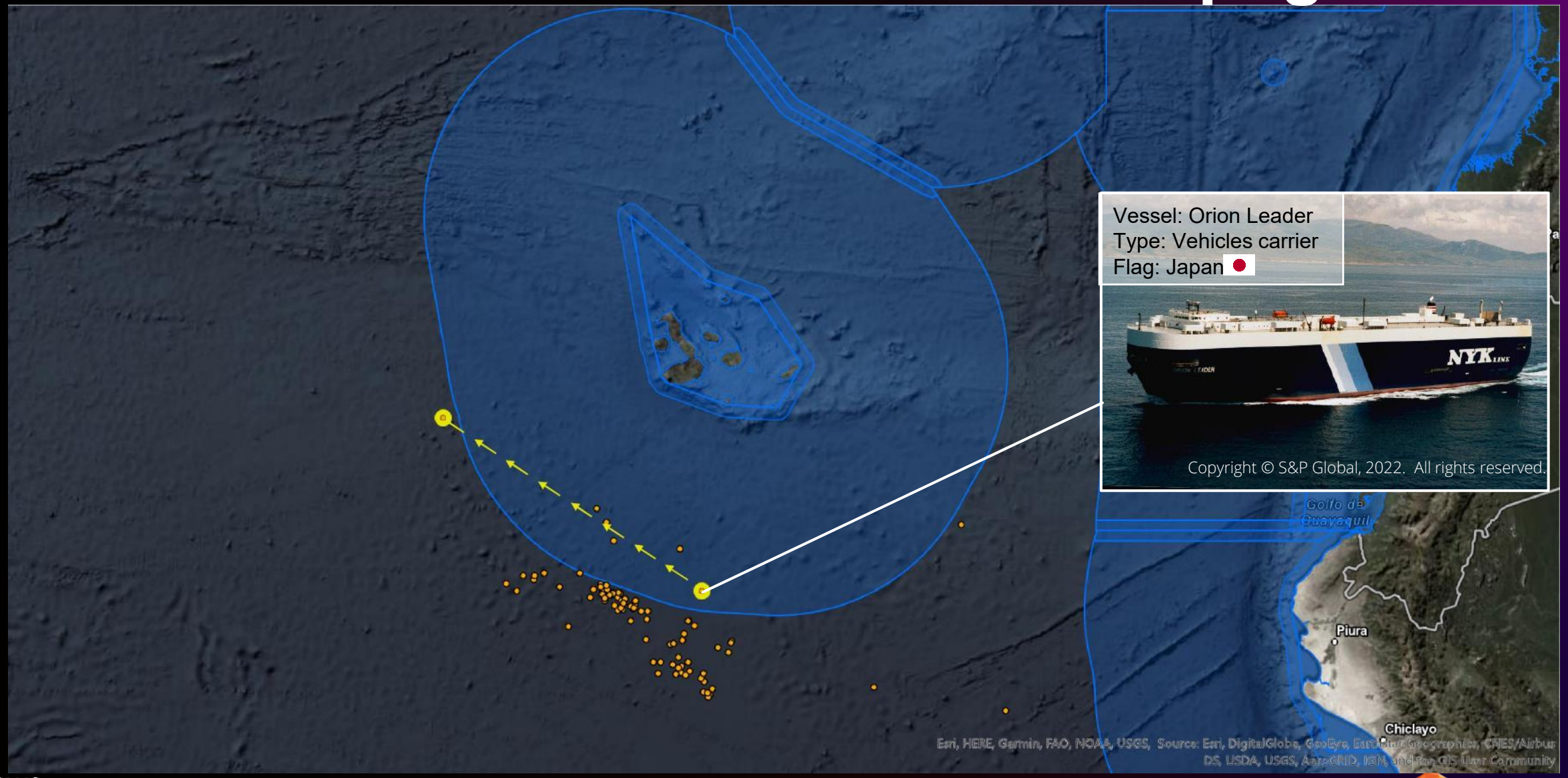
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Potential encroachment on the Galapagos EEZ



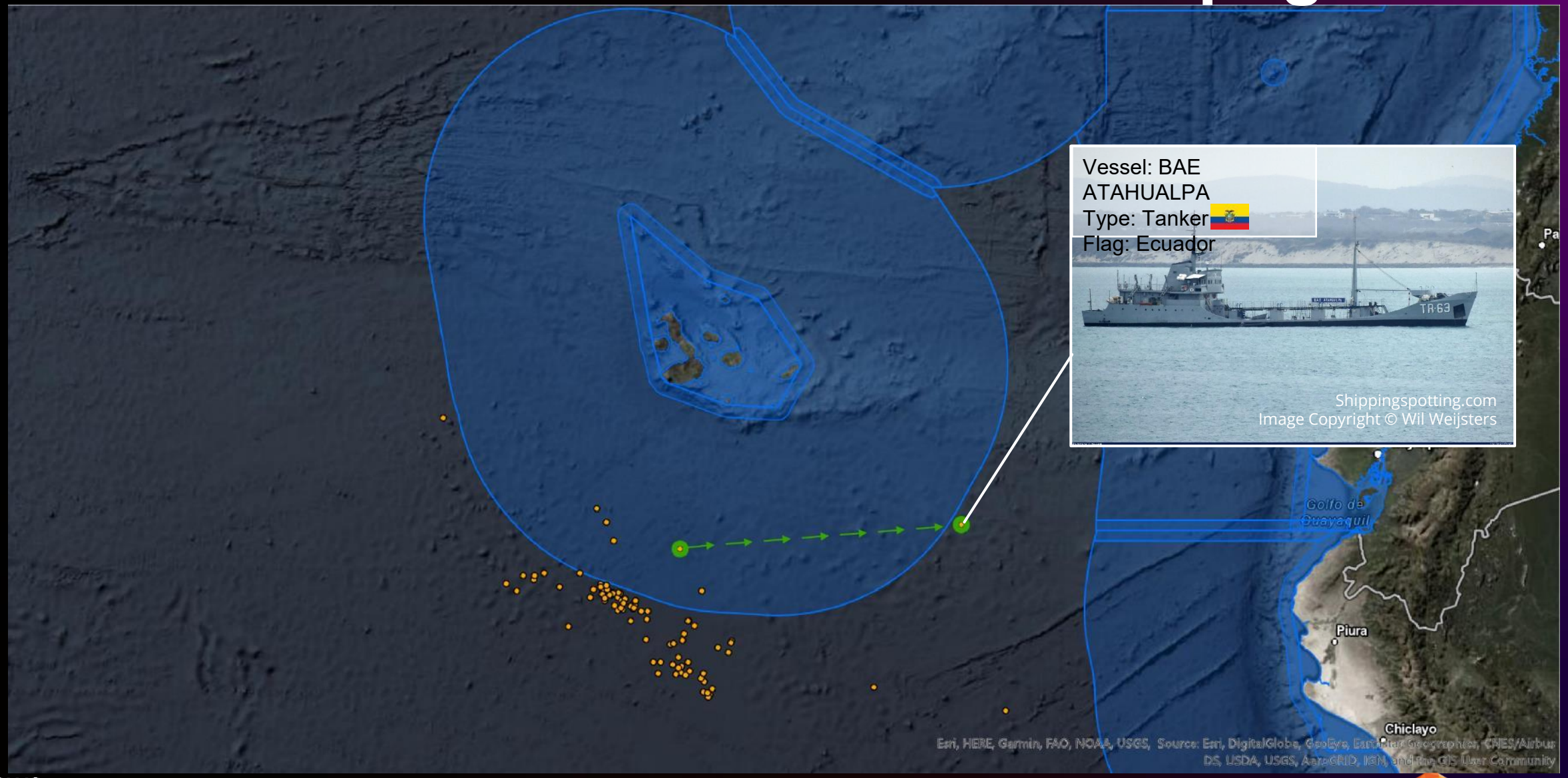
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Potential encroachment on the Galapagos EEZ



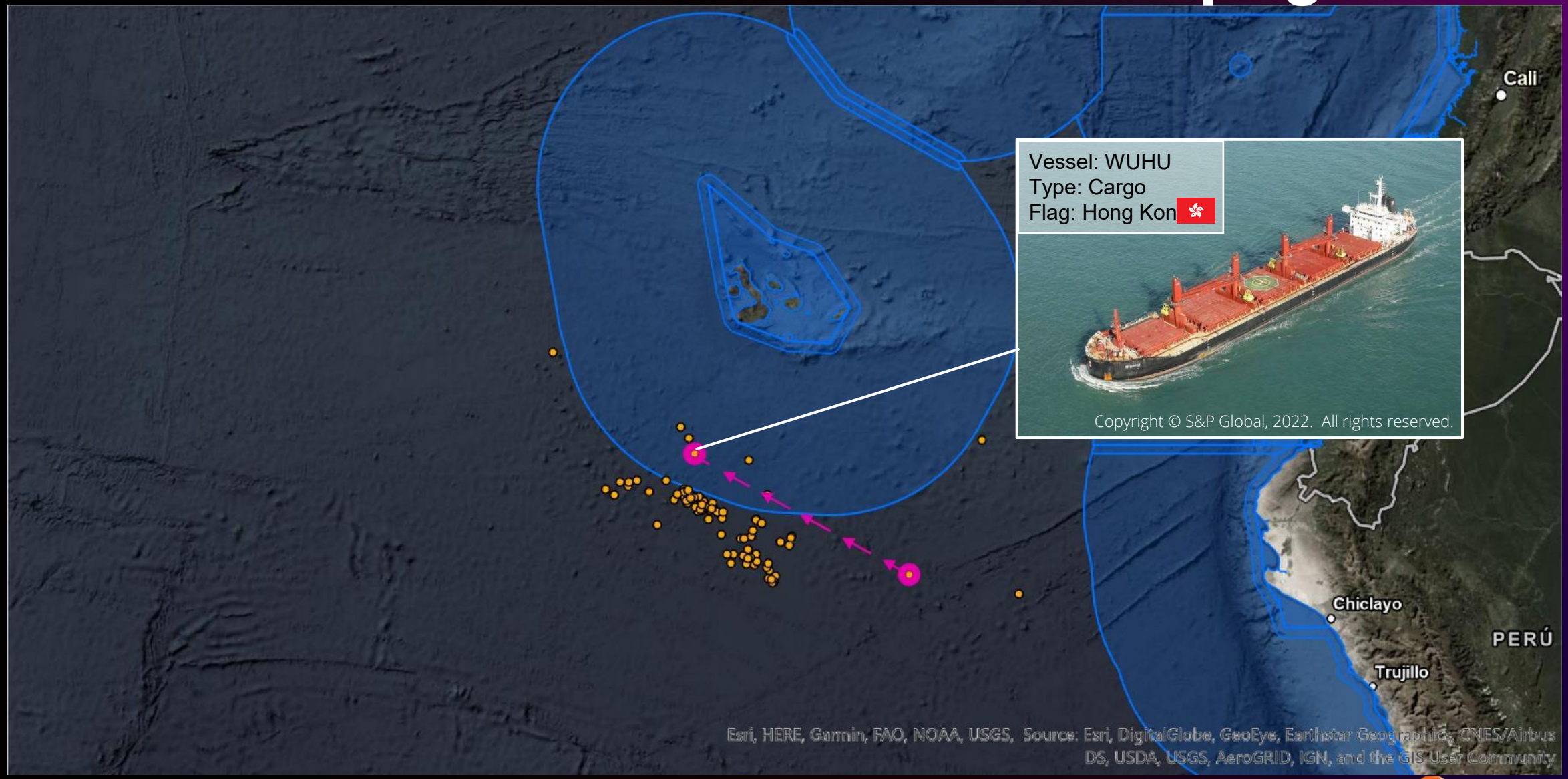
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Potential encroachment on the Galapagos EEZ



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Potential encroachment on the Galapagos EEZ



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Conclusion

- The data mesh architecture design empowers our individual development teams
- Having a data lake has allowed us to accelerate our analytics development
- AWS Lake Formation greatly simplifies the management of our complex data lake
- Space-based RF remote sensing provides an early indicator of activity
- Correlating RF characteristics can provide awareness of dark vessel patterns
- RF-based data fused with additional data sources can help maintain chain of custody of bad actors

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Thank you!

Tim Pavlick
VP of Product
HawkEye 360

Kate Zimmerman
Chief Data Scientist
HawkEye 360

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