
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

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

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

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Introduction to commercial remote sensing

*This presentation contains **commercial** imagery and information. The visual contains no "Technical Data". It contains information that is only representative of information that can be produced from the use or operation of a Defense Article.*

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

© 2022 HawkEye 360 Inc. HawkEye 360 and the sphere logo are registered trademarks of HawkEye 360, Inc.

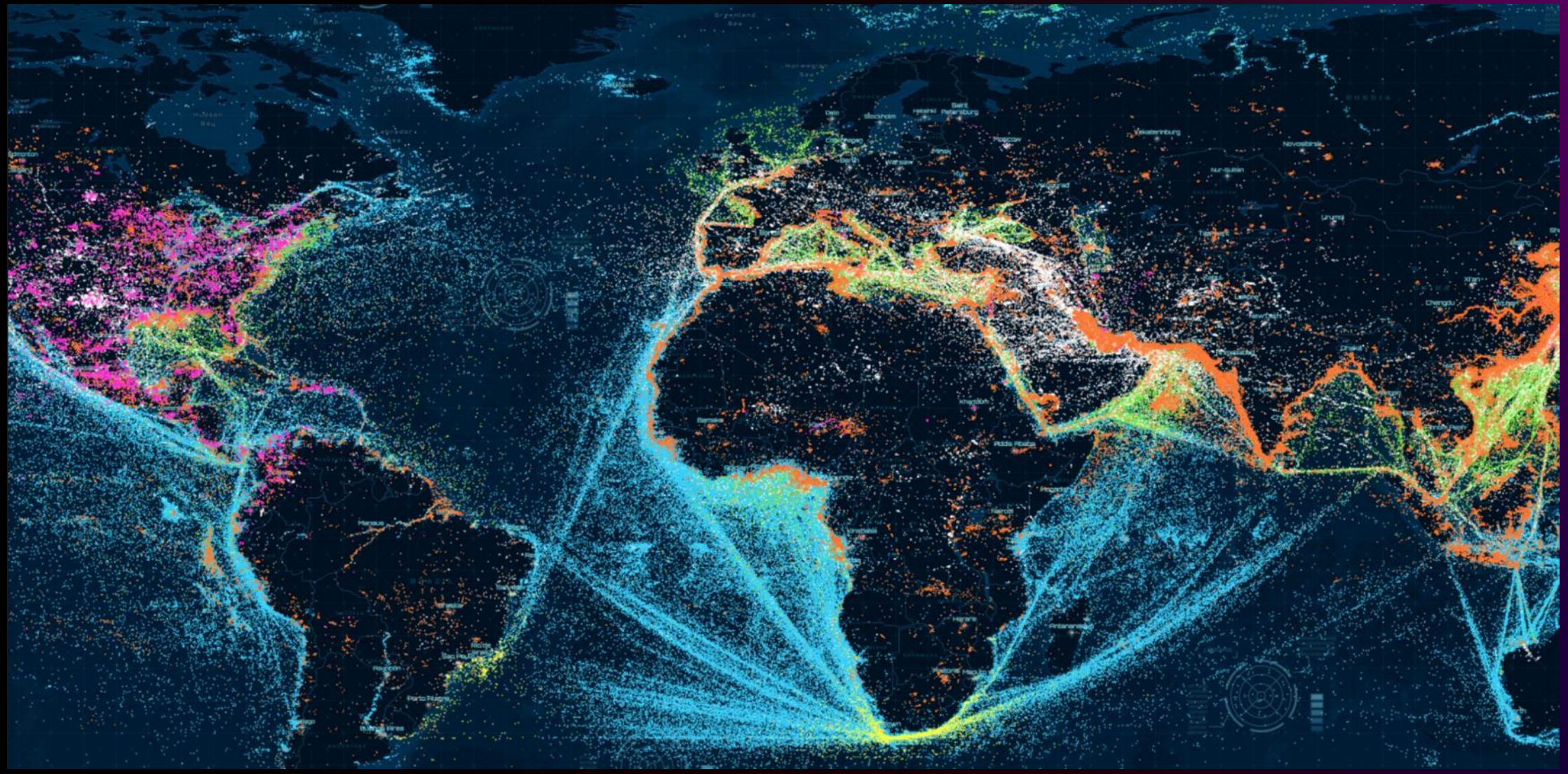
What is remote sensing?

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



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

RF – The last commercial space frontier

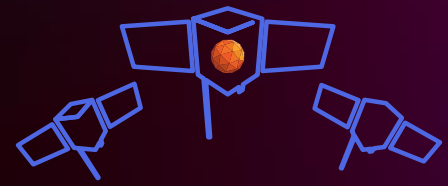


© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Remote sensing platforms

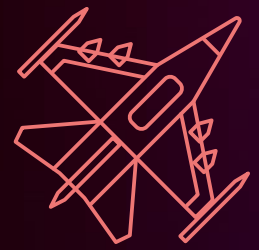
Satellite sensors



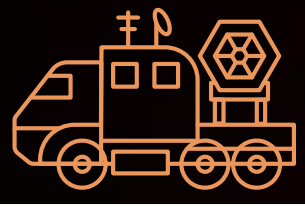


Airborne sensors





Ground-based sensors





aws

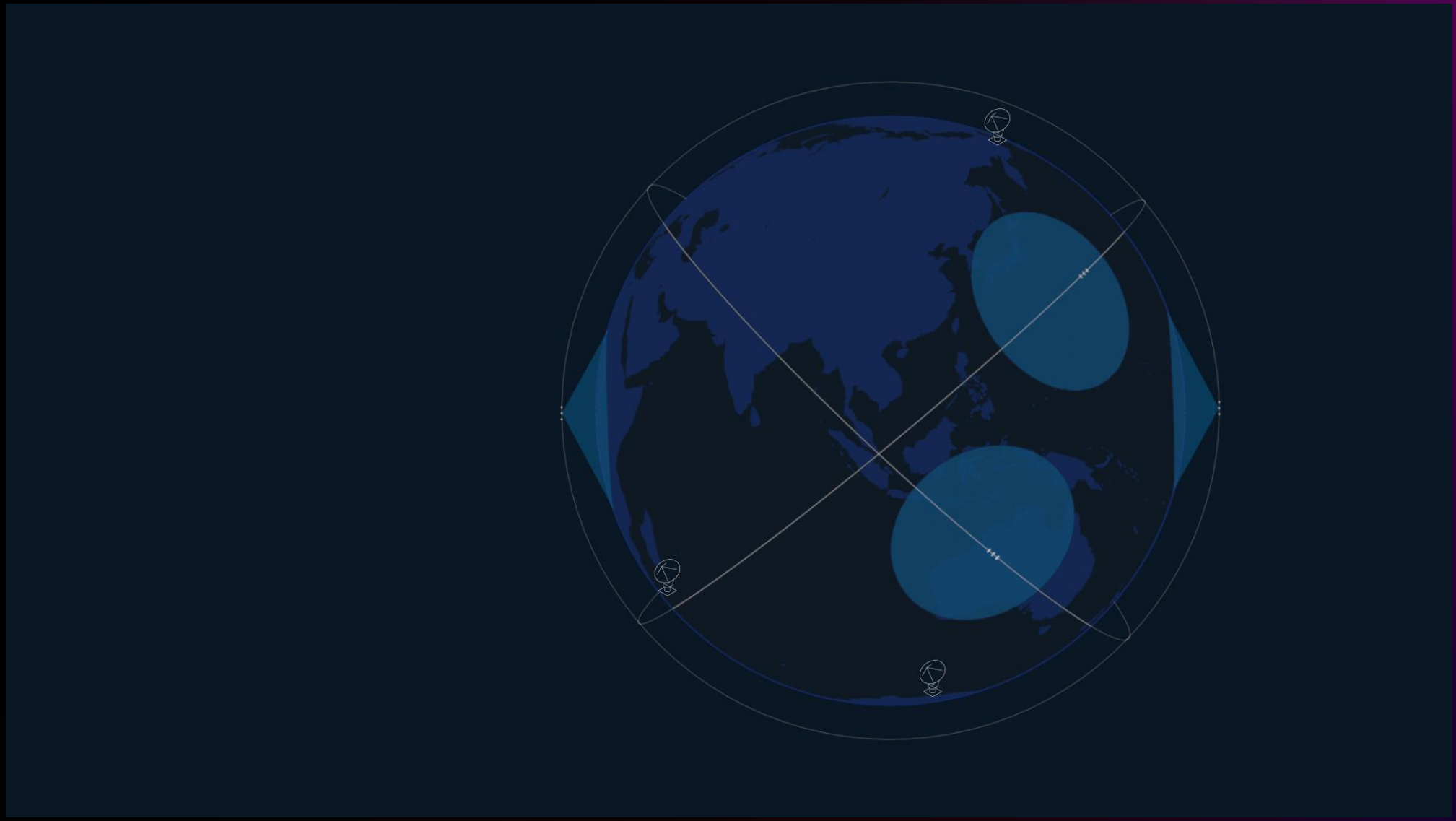
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

HawkEye 360

Introduction to HawkEye 360

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

The HawkEye 360 Constellation



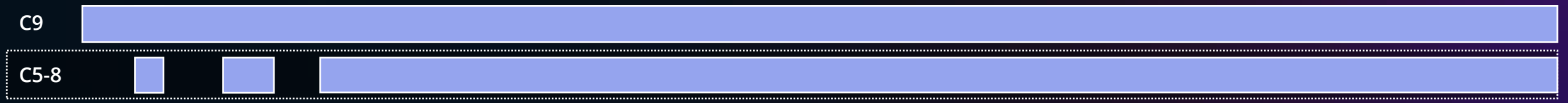
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

© 2022 HawkEye 360 Inc.

Growing capabilities

INCREASING SPECTRUM COLLECTION TO EXPAND DETECTION AND GEOLOCATION







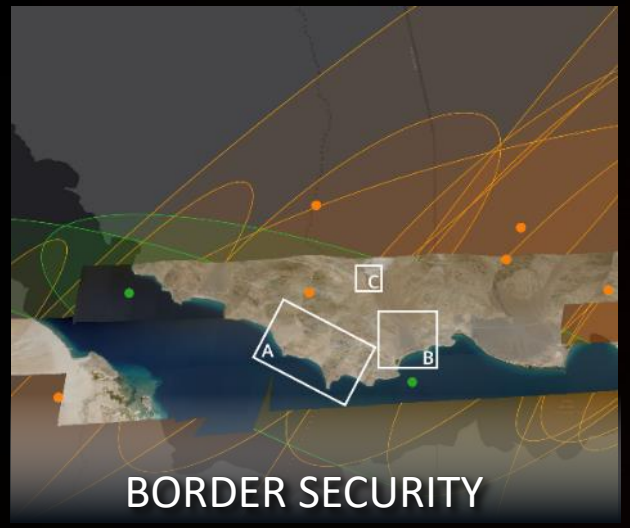
aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.
HawkEye 360
© 2022 HawkEye 360 Inc.

Multi-use mission applications

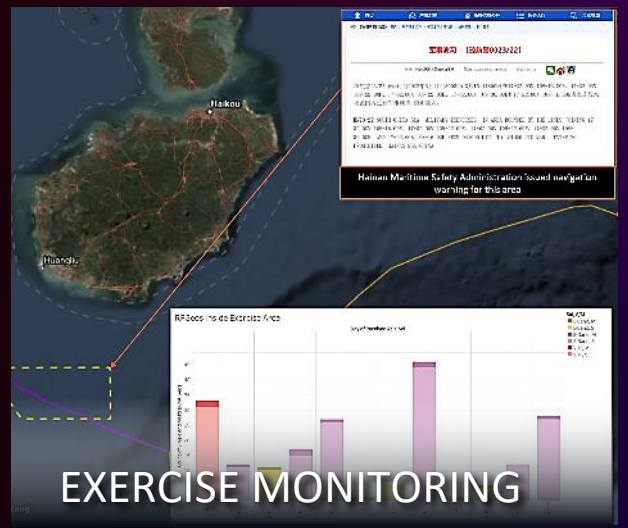










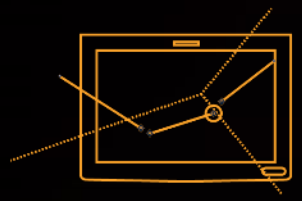


© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Signal of interest catalog



VHF
Marine radios



Automatic
identification
systems



L-band
mobile sat devices



UHF
push-to-talk
radios

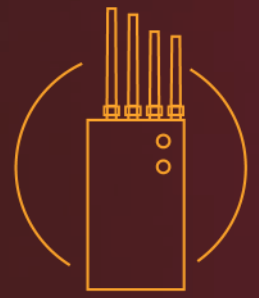


S-band marine
navigation radar

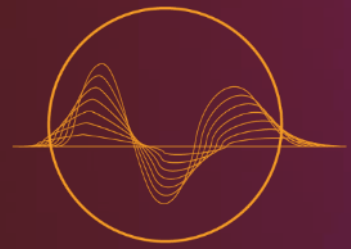


X-band marine
navigation radar

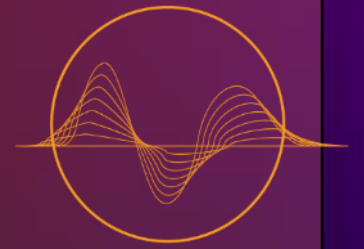
NEW SIGNALS



GPS Interference
(GPS L1)



UHF Flex



VHF Flex

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Applying remote sensing to Maritime Domain Awareness (MDA)

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Challenges in the maritime domain



Limited view
of vessel positions



Voluntary position
transmission



Vast areas
of interest



Deploying patrol
confidently

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Our approach

Step 1. Geolocate maritime radars from HawkEye 360 satellites



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Our approach

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



Bob1234



Joe4612



Betty8382





Amy0912

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Our approach

Step 3. Flag vessels without identifiers



Bob1234



Joe4612



Betty8382





Amy0912

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

HawkEye 360

Our approach

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



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Our approach

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



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Our approach

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



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Our approach

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



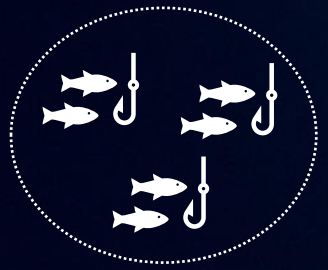
Bob1234



Joe4612



Betty8382







Amy0912

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Maritime Domain Awareness: A Big Data Challenge

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

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/

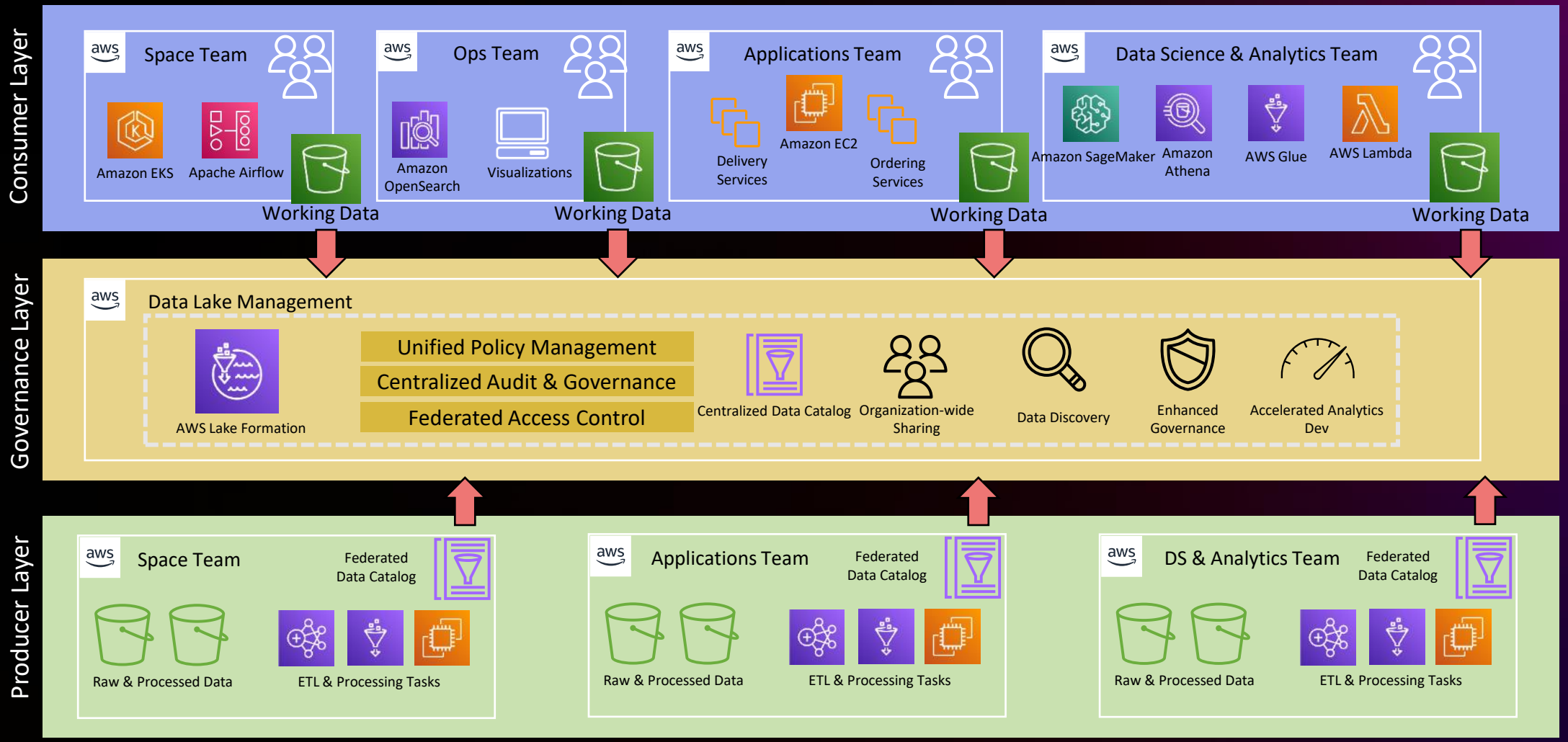
** https://www.foodnavigator.com/Article/2021/12/03/Illegal-unreported-and-unregulated-fishing-Companies-exploit-the-weakness-of-the-system

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

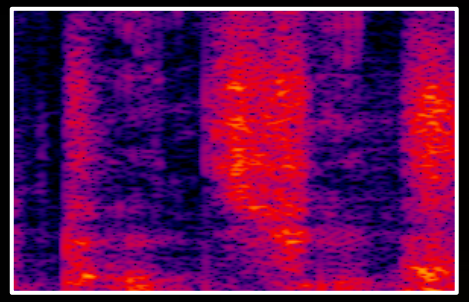
HawkEye 360

Our Big Data Analytics Architecture



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Simplifying data discovery



Raw data for vessel of interest

Energy detection

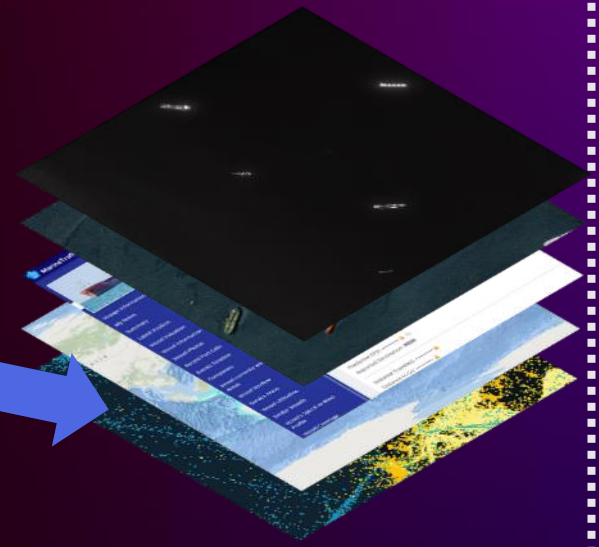
Characterization

Pattern detection

Intermediary processing results



Final geolocation





Centralized data catalog

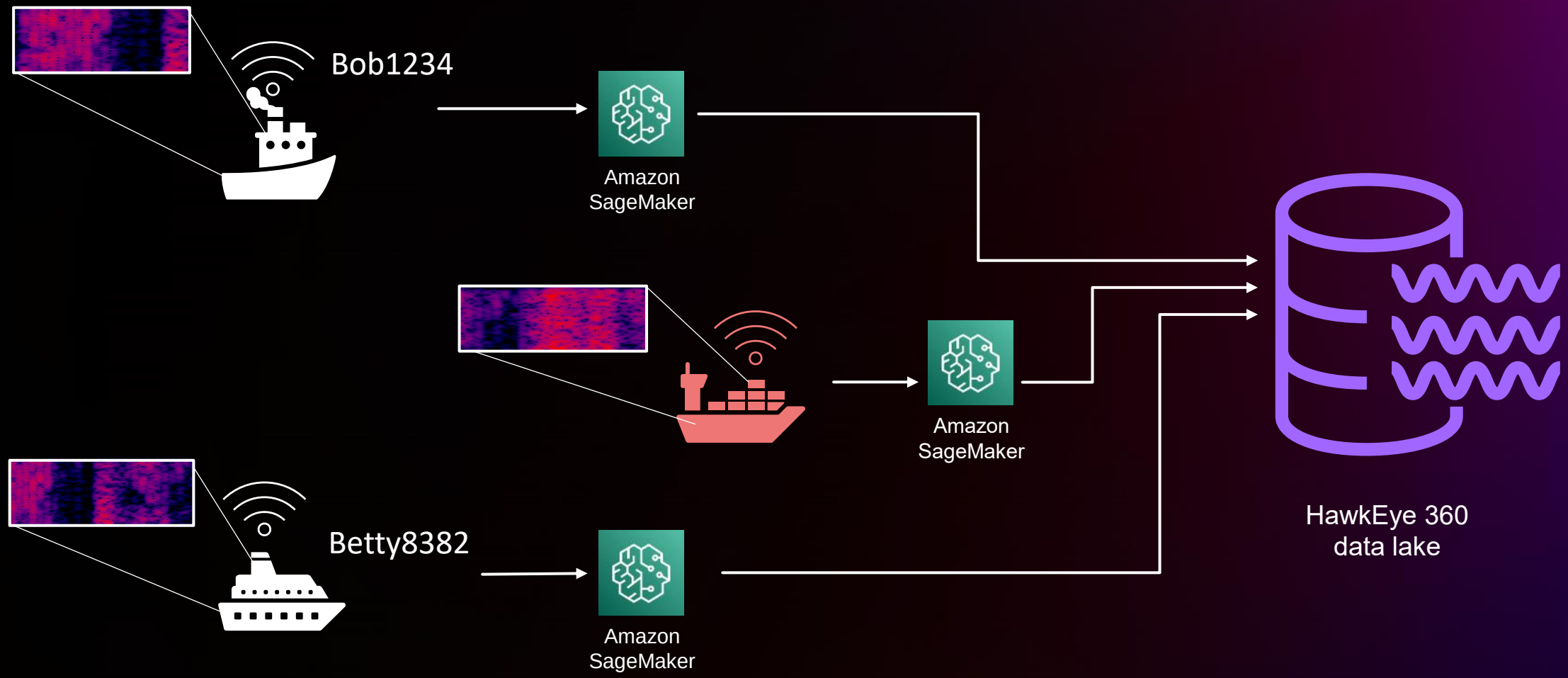
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Let us exploit complex data patterns



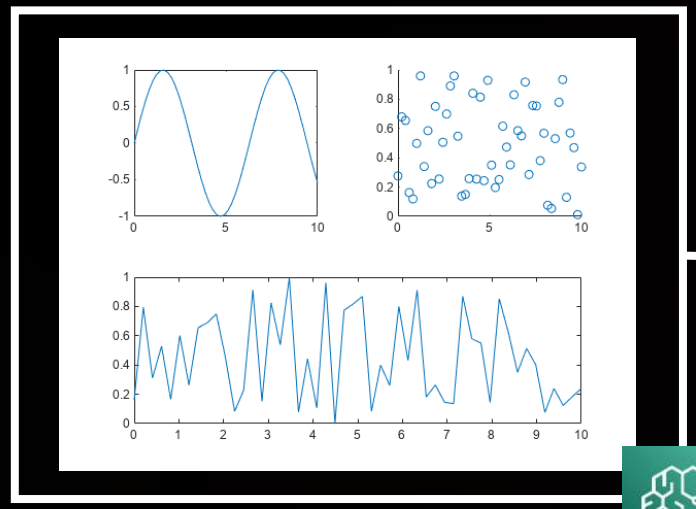
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

To identify unique signals



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

And understand more context



Unique Signal Recognition



Object Recognition

Opportunity Regions

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

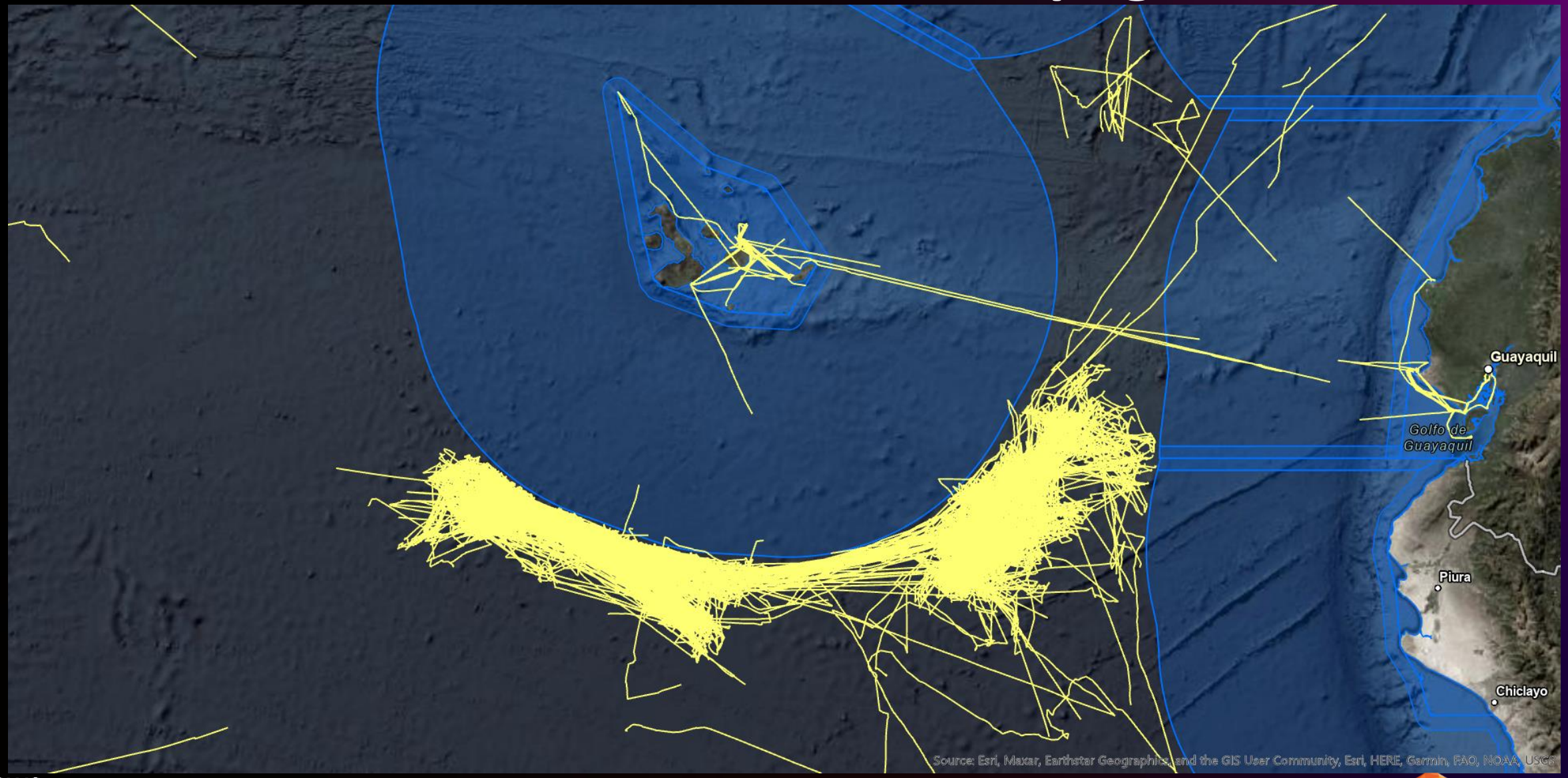
And understand more context

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



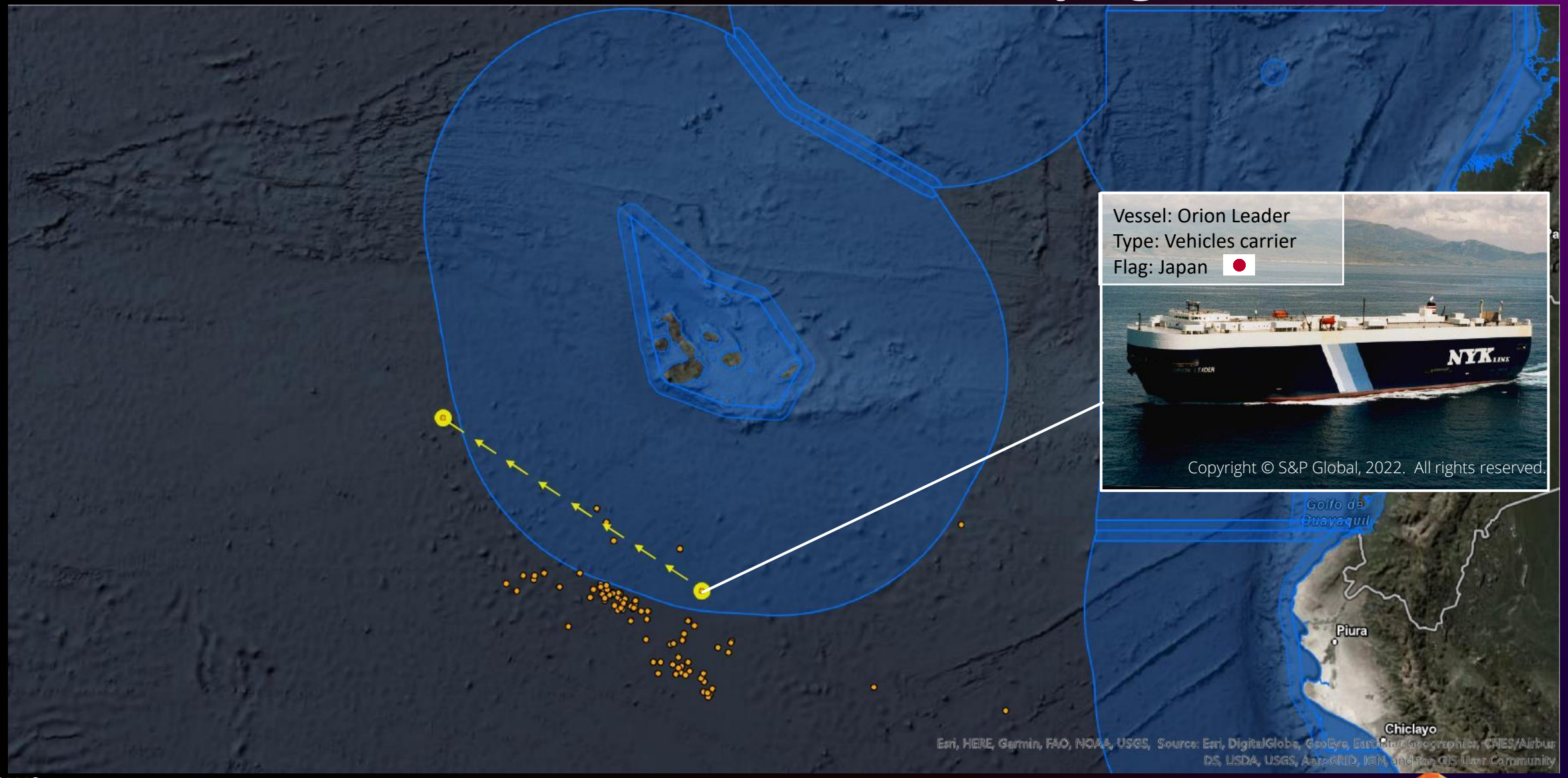
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Potential encroachment on the Galapagos EEZ



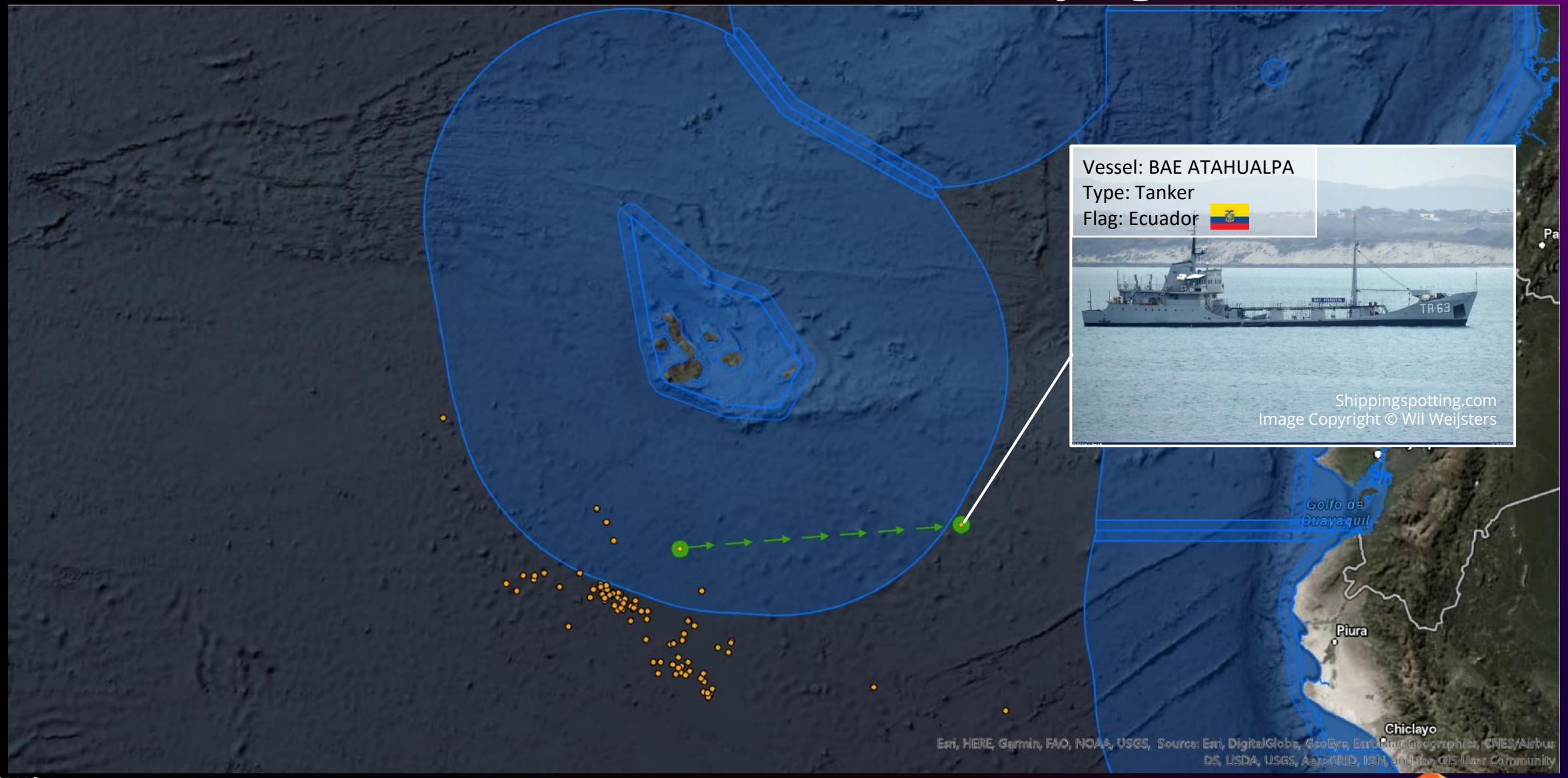
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Potential encroachment on the Galapagos EEZ



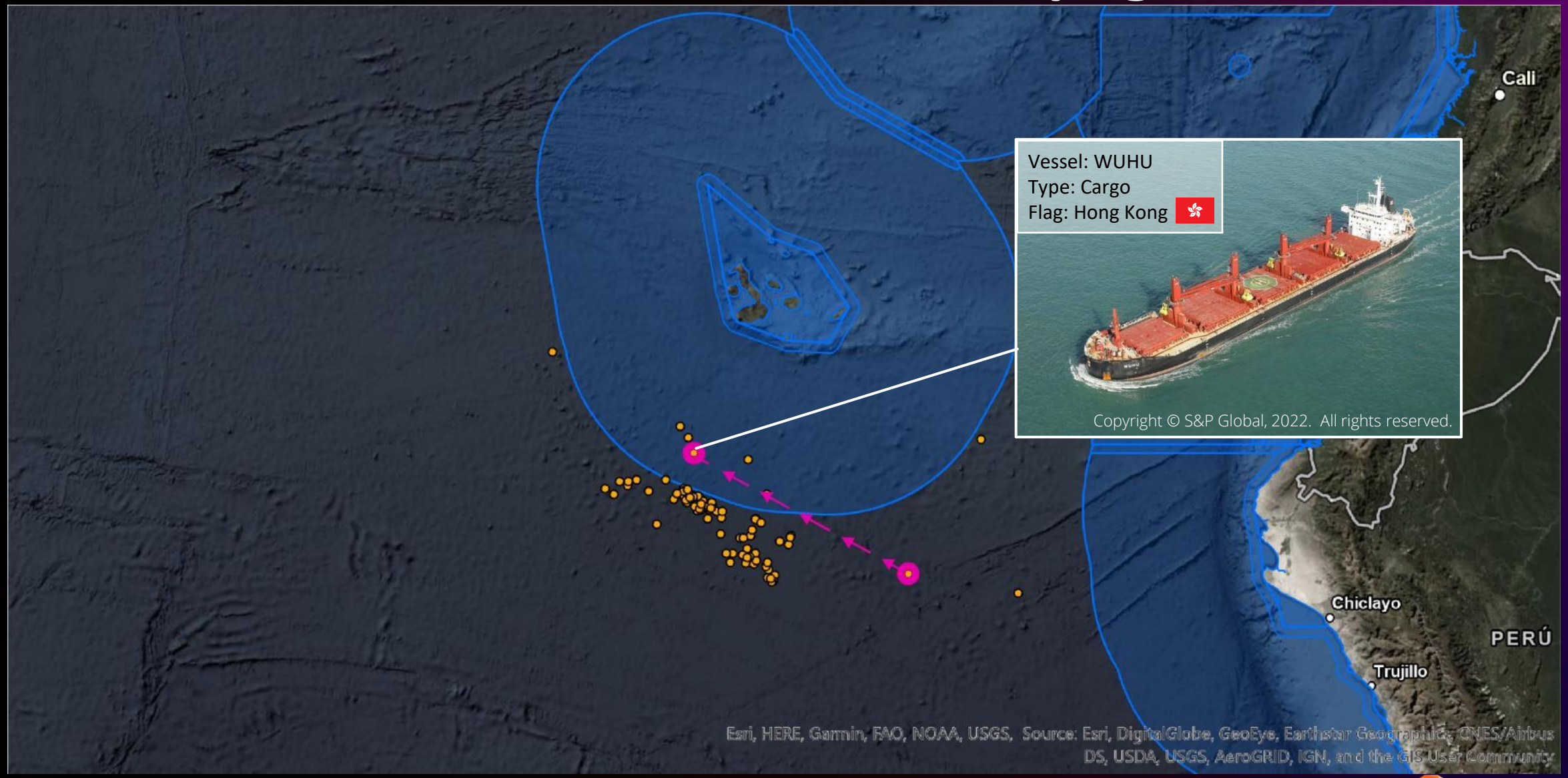
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Potential encroachment on the Galapagos EEZ



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Potential encroachment on the Galapagos EEZ



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

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

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Thank you!

Tim Pavlick
VP of Product
HawkEye 360

Kate Zimmerman
Chief Data Scientist
HawkEye 360

linkedin.com/company/hawkeye-360



Please complete the session survey in the **mobile app**

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.