Naval Information Warfare Center PACIFIC

SEAVISION

SeaVision Data Sources

Lesson 1.4

09/24/2020

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

Naval Information Warfare Center PACIFIC

Lesson 1.4 Learning Objectives

Upon successful completion of this lesson, the student will be able to:

- Identify the capabilities and information provided from the following SeaVision data sources:
  - Automatic Identification System (AIS)
  - Fairplay by IHS Markit
  - Coastal Radar
  - Satellite Synthetic Aperture Radar (SAT-SAR)
  - Visible Infrared Imaging Radiometer Suite (VIIRS)

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

SeaVision Data Sources

- SeaVision integrates multiple government and commercial data sources to aid in developing a Regional Maritime Picture (RMP)
  - Maritime Safety & Security Information System (MSSIS)
    - Terrestrial Automatic Identification System (AIS)
    - Satellite AIS
  - Fairplay by IHS Markit
    - World Registry of Ships (WROS) Data
    - Vessel Details
  - Coastal Radar
  - Satellite Synthetic Aperture Radar (SAT-SAR)
  - Visible Infrared Imaging Radiometer Suite (VIIRS)

3

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Maritime Safety and Security Information System (MSSIS): developed by Department of Transportation (DOT) Volpe Center. MSSIS is a freely shared, unclassified, near-real-time data collection and distribution network. MSSIS promotes collaboration and data sharing amongst international participants through sharing of Automatic Identification System (AIS) position reports
- Learn more about MSSIS here: https://mssis.volpe.dot.gov/Main/

Automatic Identification System (AIS)

- AIS
  - Transmitted over marine VHF radio frequencies
  - AIS is a system that allows a vessel to automatically report their position and navigational information as well as receive other vessels' positions within range
- Terrestrial AIS
  - The AIS base station is located at a coastal ground site
  - Allows for real-time AIS data collection
  - Allows users to connect to the MSSIS network via the internet
  - Data is free with purchase of AIS receiver/antenna/GPS
- Satellite AIS
  - Collected by low Earth orbit satellites
  - Requires a down-link station
  - Latencies and sparsity in AIS tracks
  - Data must be purchased

4

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Automatic Identification System (AIS) is a maritime navigation safety communications system standardized by the International Telecommunication Union (ITU) and adopted by the International Maritime Organization (IMO)
- The primary intent of AIS is to aid in the avoidance of vessel collisions by providing positional data (latitude and longitude) and attributes (such as speed, name, size, type, etc.) of equipped vessels. AIS plays an increasingly important role in enhancing the Maritime Domain Awareness (MDA) of many countries around the world. AIS allows the automatic exchange of real-time vessel movement data, including static and voyage-related information, between ships or between ships and shore stations

Automatic Identification System (AIS) (Cont.)

- AIS automatically provides:
  - Vessel identity
  - Vessel type
  - Position
  - Course/Speed
  - Other safety-related information
- AIS data is provided to SeaVision from the following sources:
  - MSSIS network
  - ORBCOMM – Satellite AIS
  - ORBCOMM_T – Terrestrial AIS
  - ORBCOMM_LR – Long-Range AIS

5

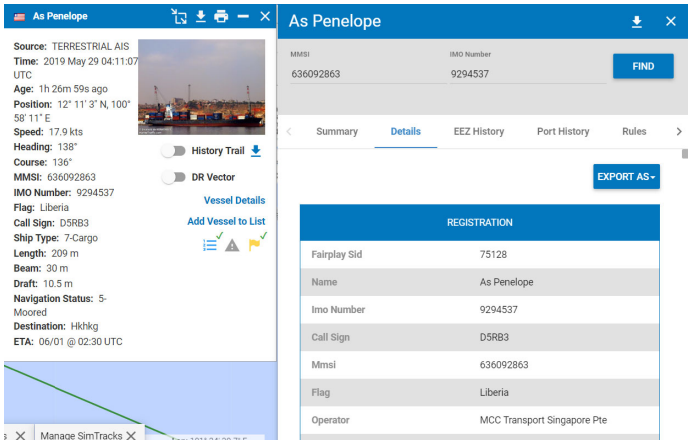
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Key Types of Automatic Identification System (AIS) Data Include:
  - Vessel Name/Vessel Type
  - International Maritime Organization (IMO) Number
  - Maritime Mobile Service Identity (MMSI) Number
  - Vessel Call Sign
  - Length, Beam, Draft
  - Ship Position (Latitude and Longitude)
  - Speed Over Ground (SOG)/Course Over Ground (COG)
  - Heading/Rate of Turn (ROT)
  - Estimated Time of Arrival
- The Maritime Safety and Security Information System (MSSIS) is a freely shared, unclassified, near-real-time data collection and distribution network. Its member countries share data from AIS
- ORBCOMM – A commercial company that provides terrestrial AIS information and operates a fully populated, AIS-enabled satellite constellation

Naval Information Warfare Center PACIFIC

Fairplay by IHS Markit

- Fairplay is a repository for International Maritime Organization (IMO) ship registry data
  - Vessel Details
  - Crew
  - Inspections
  - Port History



6

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Fairplay by IHS Markit brings the largest maritime database in the world covering ship characteristics, movements, ownership, casualties, ports, news, and research
- Fairplay is the sole issuing and reference authority of both the Document of Compliance (DOC) company number and the Registered Owner company number on behalf of International Maritime Organization (IMO)
- The information enables SeaVision (SV) to track ship positions with Automatic Identification System (AIS) coverage and analyze the risk profiles of ships entering the user's area of operation
- Provides SV with the characteristics of 180,000 ships, and over 200,000 maritime company records, including ship owners, managers, operators, and shipbuilders
- SV integrates World Registry of Ships (WROS) data with incoming positional reports to provide extensive vessel information to the user via Vessel Details
- The data is searchable and can be used as criteria in user-defined, automated search rules
- This dataset is the basis for the automatically calculated safety and security risk scores in Warnings

Fairplay Information Provided to SeaVision

- Registered Owner (operator)
  - Refers to the current registered name of the ship owner
- Hull Number
  - Allocated by the shipbuilder/outfitter
- Official Number
  - Issued by the registration or flag authority
- Classification
  - Tanker, cargo, fishing, etc.
- Double Hull
  - Yes or no (ships heading into areas with ice)
- Classification Society
  - Organization that inspects and certifies vessels for safety
- Gross Tonnage
  - The gross tonnage of a vessel
- Ice Classification
  - 1A, 1B, etc.
- Propulsion Type
  - Propeller, azimuth thruster, etc.
- Maximum Speed
  - In knots
- Beneficial Owner
  - Country of economic benefit

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

Coastal Radar

- Radar tracks are sourced from a SeaVision participant nation's shore-based sea Radar network
- Tracks may be correlated with AIS positional reports for individual vessels
- This data source is under development for future deployment

8

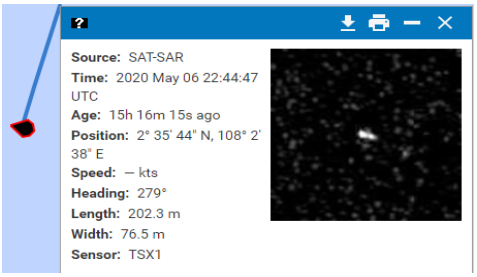
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

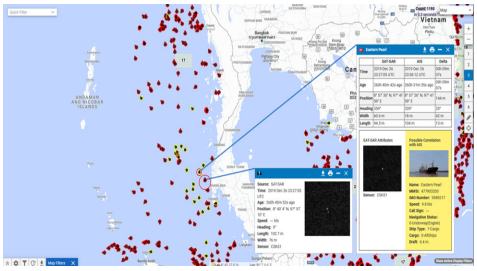
- This data source is under development for future deployment

Naval Information Warfare Center PACIFIC

Satellite Synthetic Aperture Radar (SAT-SAR)

- Benefits
  - Very large coverage area
  - Works in all weather, day or night
  - Well suited for ship detection
  - Able to see through clouds
- Limitations
  - Does not look like a picture
  - Ships need to have a reflective surface
  - Lower resolution than electro-optical imagery
- Results
  - Ships detected in the image are displayed as position reports in SeaVision





9

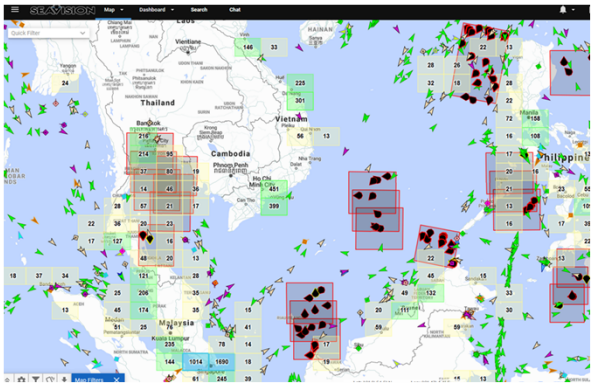
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Synthetic Aperture Radar (SAR) is a form of radar that is used to create two-dimensional images or three-dimensional reconstructions of objects
- Satellites with Synthetic Aperture Radar (SAT-SAR) orbit the Earth in a sun-synchronous, polar orbit and data acquisitions can be made during the day or night, independent of cloud coverage
- SeaVision displays satellite imagery data provided by the Naval Research Laboratory (NRL) and can correlate this data with AIS positional reports

Naval Information Warfare Center PACIFIC

SAT-SAR STATIC LAYERS Boundaries

- The red outlined rectangles represent satellite image chips where vessels were detected
- When the Boundaries layer is activated, the satellite data the user selected will appear in boxes
  - Correlated
  - Uncorrelated
  - Both



10

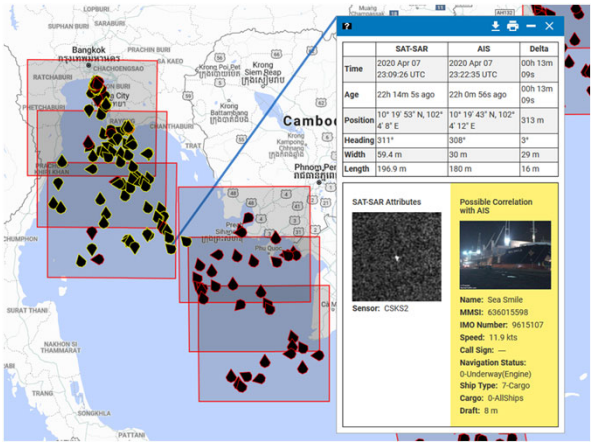
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Image chips are where the satellite has detected vessel activity
- Icons with yellow outlines indicate AIS correlated SAT-SAR detections
- Icons with red outlines indicate uncorrelated SAT-SAR detections

Naval Information Warfare Center PACIFIC

Correlated SAT-SAR Data

- Selecting a yellow outlined icon displays detailed vessel information:
  - SAT-SAR image chip
  - Photo of vessel if available
  - Name
  - MMSI
  - IMO Number
  - Speed
  - Call Sign
  - Navigation Status
  - Ship Type
  - Cargo
  - Draft



11

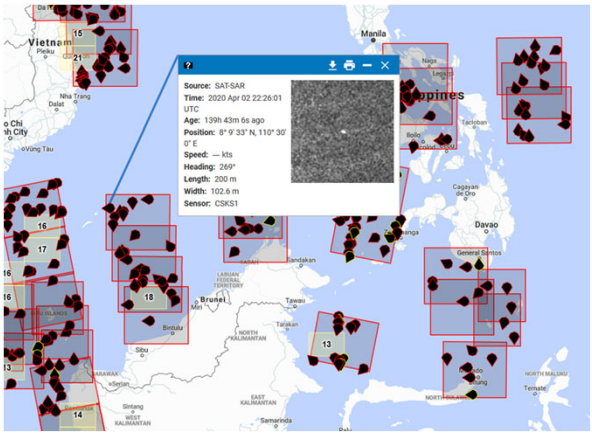
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Name: Vessel name
- MMSI: Maritime Mobile Service Identity (MMSI) nine-digit number
- IMO Number: International Maritime Organization (IMO) unique number
- Speed: Traveling speed in knots
- Call Sign: A unique alphanumeric identity that belongs to the vessel and acts in the same way as the registration number of a car
- Navigation Status: Current navigational status of vessel
- Ship Type: Vessel type
- Cargo: Cargo handling type
- Draft: Determines the minimum depth of water a ship or boat can safely navigate

Naval Information Warfare Center PACIFIC

Uncorrelated SAT-SAR Data

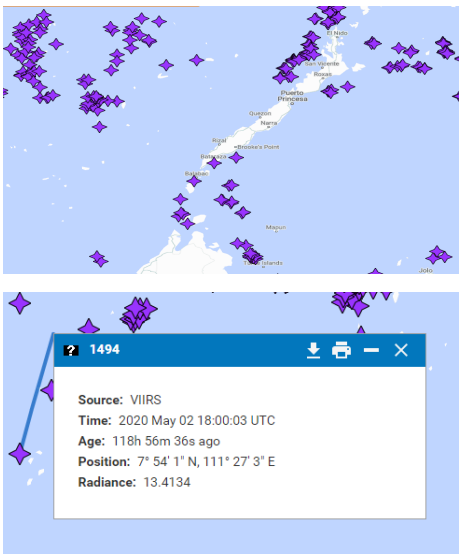
- Selecting a red outlined icon will bring up a view of the SAT-SAR image chip, depicting the vessel in the center, and partial vessel information:
  - Source
  - Time
  - Age
  - Position
  - Heading
  - Length
  - Width
  - Sensor



DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

Visible Infrared Imaging Radiometer Suite (VIIRS)

- Joint National Aeronautics and Space Administration (NASA)/National Oceanic and Atmospheric Administration (NOAA) project with the primary mission of weather tracking
- An algorithm developed for reporting the locations of boats based on satellite sensing of electric lighting
- Provides nighttime imagery of man-made light sources
- Cloud cover severely degrades probability of detection



13

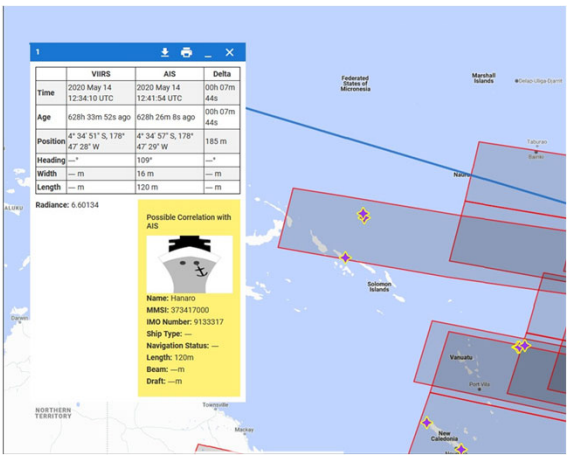
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- Joint program between NASA and NOAA
  - First VIIRS-equipped satellite launched in 2011 – usable data 2012 to present
  - Second VIIRS-equipped satellite launched 2017 – usable data 2018 to present
  - Three more instruments planned to ensure continuity past 2030
- Polar orbit – 100 minutes, 3000 km swath, 14 orbits per day, 22 spectral channels, near 1 km pixels
- Global coverage – always turned on
- Open access data

Naval Information Warfare Center PACIFIC

Correlated VIIRS Data

- Correlated with AIS data
  - Correlated data appears as yellow outlined purple crosses and provide the latest AIS data received



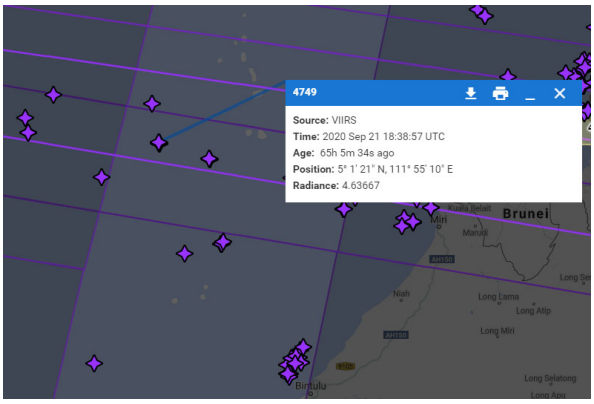
14

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- VIIRS satellite swaths will appear as red outlined footprints when correlated data is available
- VIIRS satellite swaths are only visible when the STATIC LAYERS Boundaries have been toggled on

Uncorrelated VIIRS Data

- Uncorrelated VIIRS data is displayed as black outlined purple crosses and provide limited vessel information:
  - Source
  - Time
  - Position
  - Radiance
- Since this VIIRS boat detection is not correlated to an AIS report, the name displayed is a non-unique ID assigned by VIIRS



15

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

- VIIRS satellite swaths will appear as purple outlined footprints when no correlated data is available
- VIIRS satellite swaths are only visible when the STATIC LAYERS Boundaries have been toggled on

SeaVision Data Sources

Data Source		Range	Delay into SeaVision
AIS	Terrestrial	20-40 NM	Near Real-Time (NRT) 30 sec - 3min
	Satellite	Footprint of Satellite	1-3 Hours
RADAR	Coastal/Vessel	20-60 NM	Near Real-Time (NRT) 30 sec - 3min
	SAT-SAR	Footprint Of Satellite	1-3 Hours
VIIRS		Footprint of Satellite	24 Hours

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

Naval Information Warfare Center PACIFIC

SeaVision Data Sources Summary

- SeaVision integrates multiple government and commercial data sources to aid in developing a Regional Maritime Picture (RMP)
  - Maritime Safety & Security Information System (MSSIS)
    - Terrestrial AIS
    - Satellite AIS
  - Fairplay by IHS Markit
    - World Registry of Ships (WROS) Data
    - Vessel Details
  - Coastal Radar
  - Satellite Synthetic Aperture Radar (SAT-SAR)
  - Visible Infrared Imaging Radiometer Suite (VIIRS)

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

Naval Information Warfare Center PACIFIC

Questions?

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.