



# SAR BROKERAGE

ONE-STOP SOURCE FOR COMMERCIAL SAR



## URSA SPACE SYSTEMS: REVEALING GLOBAL CHANGES

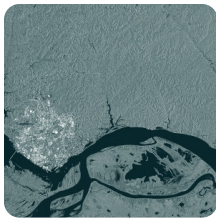
Ursa Space Systems (Ursa) is a U.S.-based satellite intelligence company that provides business and government decision-makers a streamlined solution for rapid access to radar satellite data and on-demand, at-scale analytic solutions. Through our synthetic aperture radar (SAR) satellite network and data fusion expertise, we detect real-time changes in the physical world, with no geographic, political, or weather-related limitations. At Ursa, our goal is to help you understand how the events of the world impact you and your mission.



### SAR BROKERAGE

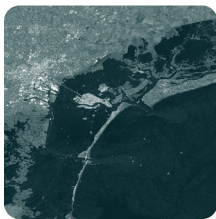
STREAMLINE YOUR ACQUISITION OF COMMERCIAL SAR DATA THROUGH OUR VIRTUAL CONSTELLATION MARKET

Ursa leverages the world's largest, most progressive commercial satellite network and advanced analytics to offer standardized SAR data, imagery, and derived products. Our Virtual Constellation aggregates top-performing low earth orbiting X, C, and L band SAR satellites from foreign and domestic SAR vendors, for unprecedented coverage, resilience, and reliability.



#### SAR BROKERAGE FEATURES:

- Unique all-weather, 24/7 detection capability
- Enhanced coverage and re-visit, reducing time to results
  - 18 – 45 min global revisits depending on latitude
  - 24 hr collection to delivery as a standard service; reduced turnaround available at additional charge
  - 0.25 – 100 m (X, C, L bands) spatial resolution
- Broad / focused coverage with unparalleled imaging reliability & consistency
- Advanced data fusion capabilities, with EO & RF fusion to provide context
- Automated TCPED Cycle (Tasking → Collection → Processing → analytics Extraction → report Dissemination) to hyper-enable the Analyst / Operator
- Standardized product formats, metadata catalog, and pricing
- Data delivery through multiple methods
- Secure Data DMZ with evolving security



## VENDORS



Ursa makes it easy for you to access cutting-edge SAR-related technology in a user-friendly way.  
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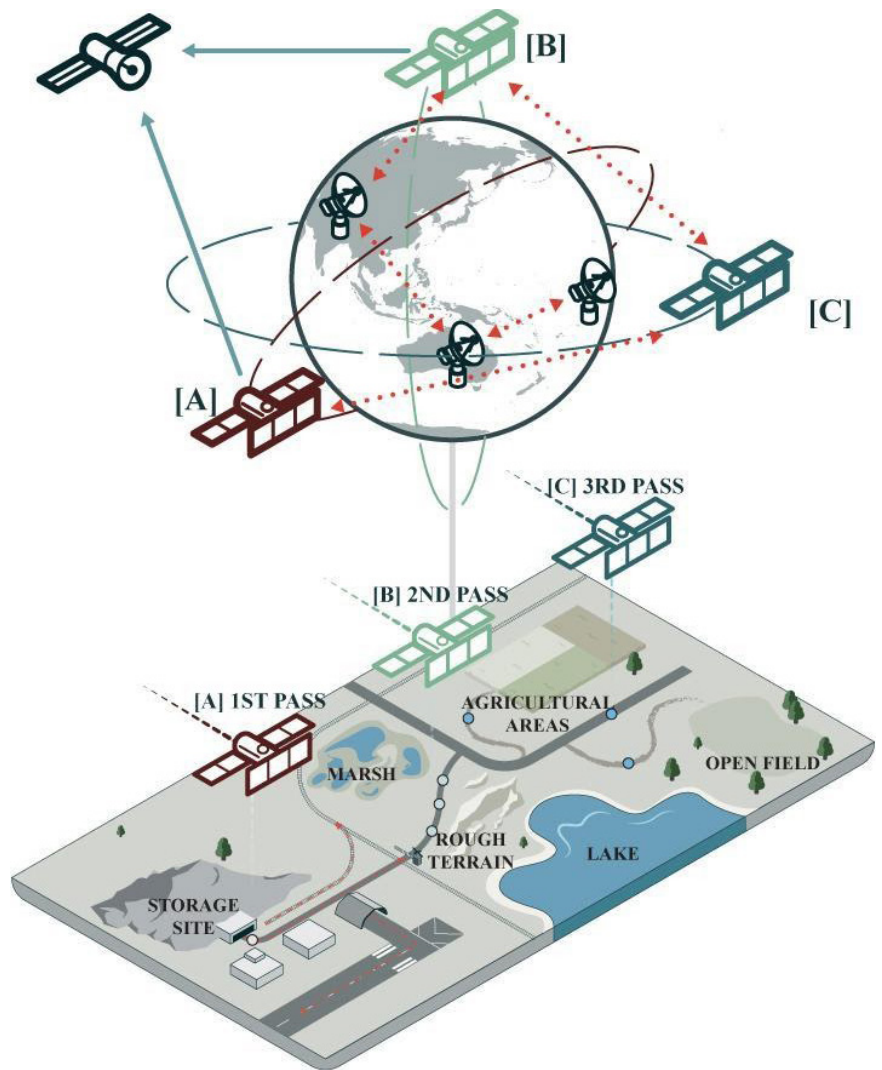
## SAR BROKERAGE: A CLOSER LOOK

Ursa is uniquely positioned to broker the best collections for a given imaging requirement, ensuring over **97% success rate** for planned collections.

Ursa's SAR-based Virtual Constellation overcomes the limitations of EO imagery by providing **100% coverage 99.99% of the time** versus coverage at 25% of the time for EO sensors.

Ursa tasks **multiple types of collections through one interface**, thanks to our partnerships with leading SAR vendors.

Ursa's format for open standard metadata translates common elements from each vendor's proprietary schema into a normalized representation, enabling **sensor-agnostic data processing**. Ursa uses NGA's Sensor Independent Complex Data (SICD) format for uniform data handling across different satellite providers.



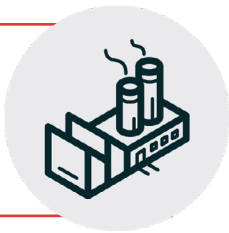
### COLLECTIONS PROCESS

- [ A ] Broad Area Search & Activity Baseline
- [ B ] Broad Area Search & Activity Anomaly Detection
- [ C ] Rapid Tip & Cue Higher Resolution SAR / EO / RF Collects



# ACTIVITY MONITORING

MONITOR GLOBAL EVENTS AS THEY UNFOLD



## URSA SPACE SYSTEMS: REVEALING GLOBAL CHANGES

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### ACTIVITY MONITORING

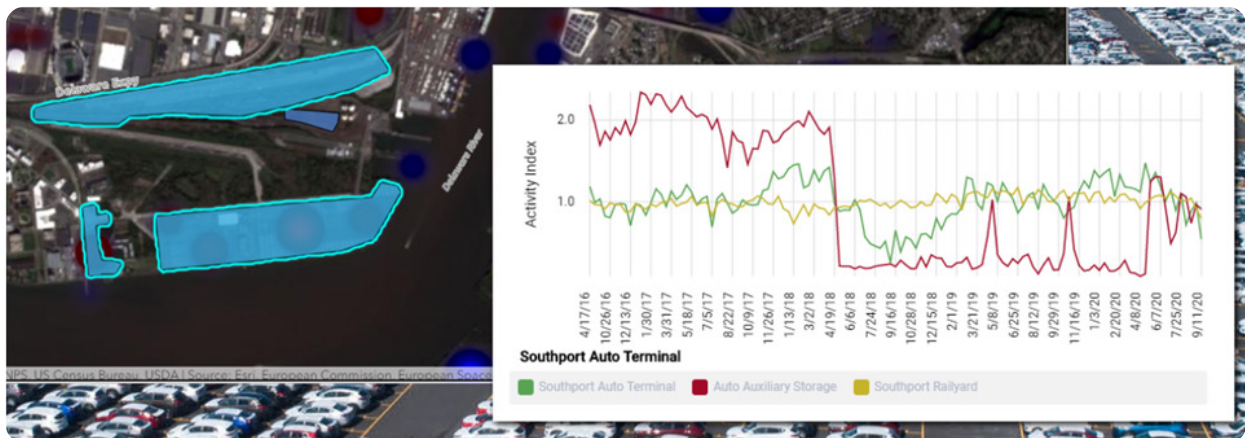
#### VISUALIZE ACTIVITIES THROUGH EVENT HISTORY TIMELINES AND ACTIVITY INDICES

Ursa leverages the world's largest, most progressive commercial satellite network and advanced analytics to detect and monitor activities on the ground with confidence and accuracy. We track locations over time to understand patterns of life, and flag abnormal activities as they emerge. We further enhance our analysis by putting the information into context, fusing our data with global economic indicators, ship traffic, open-source intelligence, and news to provide tailored information such as activity classification, extent, and direction of change.

#### BE THE FIRST TO KNOW AND MAKE AN IMPACT

#### ACTIVITY MONITORING FEATURES:

- Consistent monitoring of places of interest, day or night, regardless of weather
- Activity classification, including extent and direction of change
- Activity indices generation for easy visualization of results
- Micro and macro views, including deep-dives for single locations or multiple location combinations to create a single index
- Enhanced analysis, fusing satellite imagery with other sources, such as economic indicators, ship traffic data and open-source intelligence, for added context
- Alerts for detected anomalies or trends
- Regularly scheduled reports or API



Ursa Activity Index for the Southport Auto Terminal in Philadelphia, showing activity change over time. Image courtesy of Esri.



# ACTIVITY MONITORING

MONITOR GLOBAL EVENTS AS THEY UNFOLD



## ACTIVITY MONITORING USE CASE: AUTOMOBILE MANUFACTURING FACILITIES

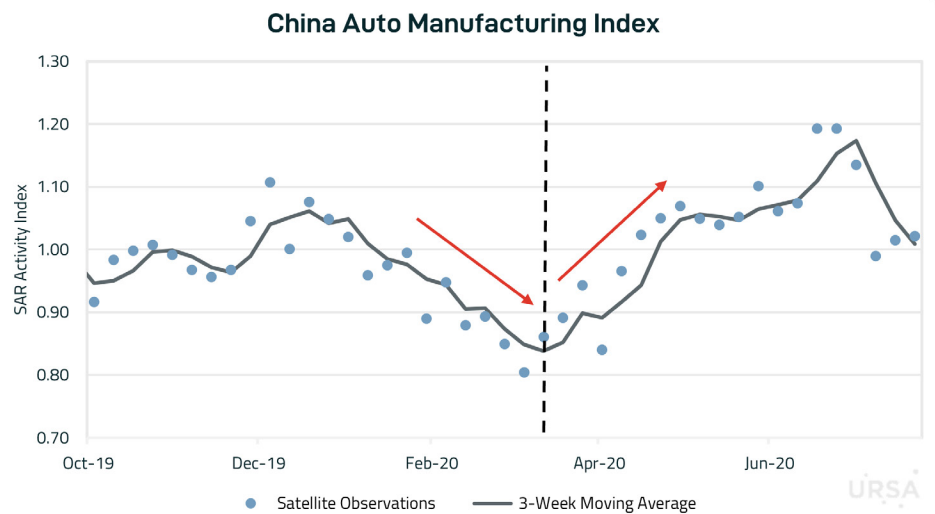
Monitoring automobile manufacturing facilities for observable, physical activity **can signal changes in production**. Automobile manufacturers often store finished cars in lots adjacent to the factories in which they were produced. Tracking the number of cars in these lots over time **can indicate a factory's production level**.

Ursa's global analysis of automobile manufacturing includes **over 60 facilities** located in the **US, Brazil, China, France, Germany, India, Italy, Japan, South Korea, Spain, and the UK**.

As an example, shown here are data from China, suggesting the sector experienced a V-shaped recovery from the impacts of the COVID-19 pandemic.

**Top:** SAR images and data of finished cars (colored in red) held in lots adjacent to a Volkswagen manufacturing plant in Tianjin, China.

**Right:** China Auto Manufacturing Index, October 2019 - August 2020.



Activity Indices such as this provide information on the amount of activity at a given time point, and how much that activity has changed over time. **Once an index is established, it can be scaled to multiple locations, creating a macro view of trends within industries such as auto manufacturing, emergency response, shipping, and logistics.**

We enhance our analysis by putting the information into context, fusing our data with other sources of information to provide enhanced activity classification, extent, and direction of change.



# CHANGE MONITORING

## DETECTING PATTERNS OVER TIME



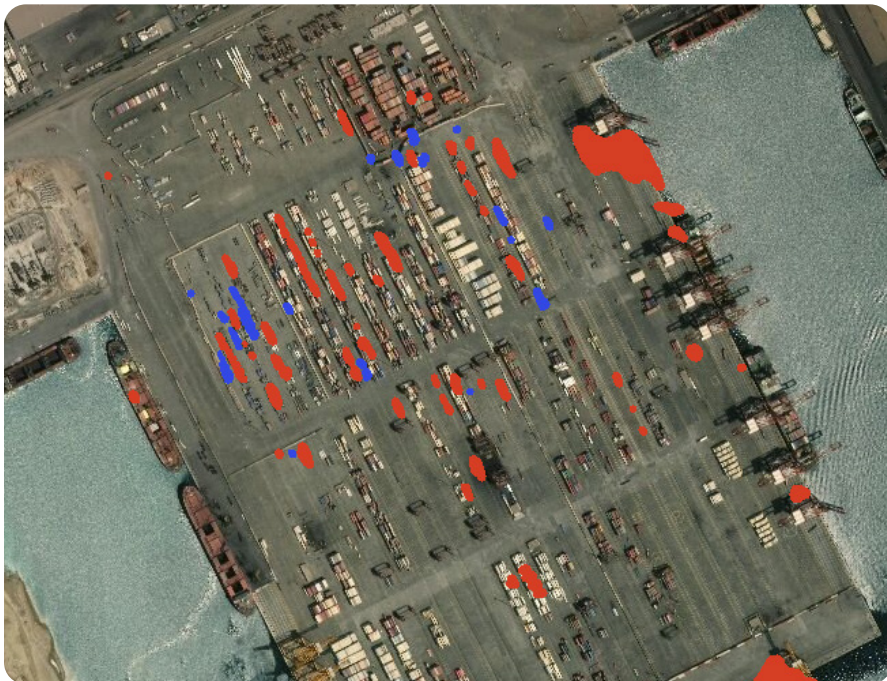
## URSA SPACE SYSTEMS: REVEALING GLOBAL CHANGES

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## CHANGE MONITORING

### IDENTIFY CHANGES THAT HAVE OCCURRED IN A SPECIFIC LOCATION OVER TIME

Ursa leverages the world's largest, most progressive commercial satellite network and advanced analytics to identify hotspots for additive and subtractive change in both broad and small focal areas, day or night, regardless of weather, with high accuracy and reliability. The changes are geospatially referenced such that they can be combined with other modalities of remote sensing, such as AIS (Automated Identification System) or multispectral (MSI) imagery.



Broad area change detection map with blue "new," red "fled" color coding at Port Rajaei, the busiest export terminal in Iran, 11/18/18 - 12/02/18. Image courtesy of Esri and Maxar.

### HOW IT WORKS:

- You define the area of interest and timeframe of interest
- Two or more SAR collections are made within these specifications
- Ursa's advanced analytics identify changes over time
- Overlay images reveal changes:
  - Blue = "new" (additive change)
  - Red = "fled" (subtractive change)
- **Result delivery:** Choose from API, standard or custom reports, dashboards, & integration with other platforms. Analytic results are also exportable for further fusion.

In addition to broad area monitoring, Ursa can detect small changes or anomalies using our innovative analytic, Finder™.

We'll help you identify man-made objects that might otherwise go unnoticed.



## CHANGE MONITORING: TOOLS & CAPABILITIES

OUR APPROACH TO CHANGE MONITORING CREATES DECISION ADVANTAGE

### TOOLS:

#### FINDER

Ursa's innovative analytic, Finder, can detect small changes or anomalies, enabling tipping and queuing of other orbital assets. **Finder can:**

- Identify man-made objects that may otherwise go unnoticed
- Detect objects through foliage and canopy when used with higher resolution SAR imagery
- Reduce the clutter within a SAR image by focusing on objects that show the most change
- Highlight small changes that would likely be left out in a final image

#### MULTISPECTRAL IMAGERY (MSI) IMAGE CLASSIFICATION ANALYTIC

This tool uses a sophisticated Neural Network to train on and to find objects or features of interest, extract them and identify their positions and outlines on the Earth.

The MSI Image Classification analytic provides situational awareness, especially in denied areas where other methods of detection are not viable. It also aids in discovering very early indicators of construction and development.

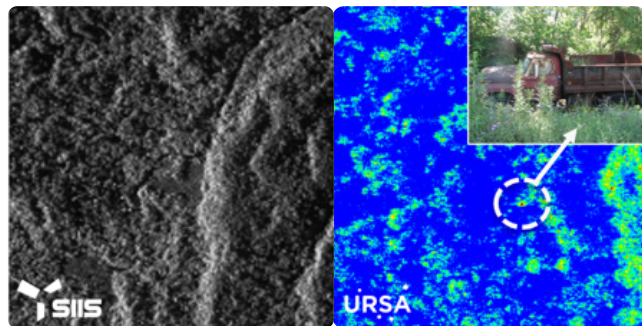
### CAPABILITIES:

**Broad area monitoring:** Continually monitor areas of interest for broad area changes over time, and receive alerts if a potential need arises to investigate further.

**Event triggered monitoring:** Rapidly determine the extent of impact during and after unexpected events such as hurricanes, earthquakes, and wildfires.

**Infrastructure and construction monitoring:** Verify the construction progress of large infrastructure projects and key buildings.

**Situational awareness:** Identify destruction in risk prone areas where facilities are susceptible to attack.



Ursa Finder (right) applied to standard SAR image from SIIS (left) to detect vehicle.

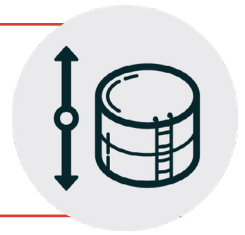
#### MARKET APPLICATIONS:

- Defense & Civil Sectors
- Maritime Awareness
- Financial Sector
- Environmental & Disaster Response
- Land Management & Infrastructure
- Asset & Risk Management
- Energy & Natural Resources



# DIRECT MEASUREMENTS

OBTAIN MEASUREMENTS FOR OBJECTS OF INTEREST



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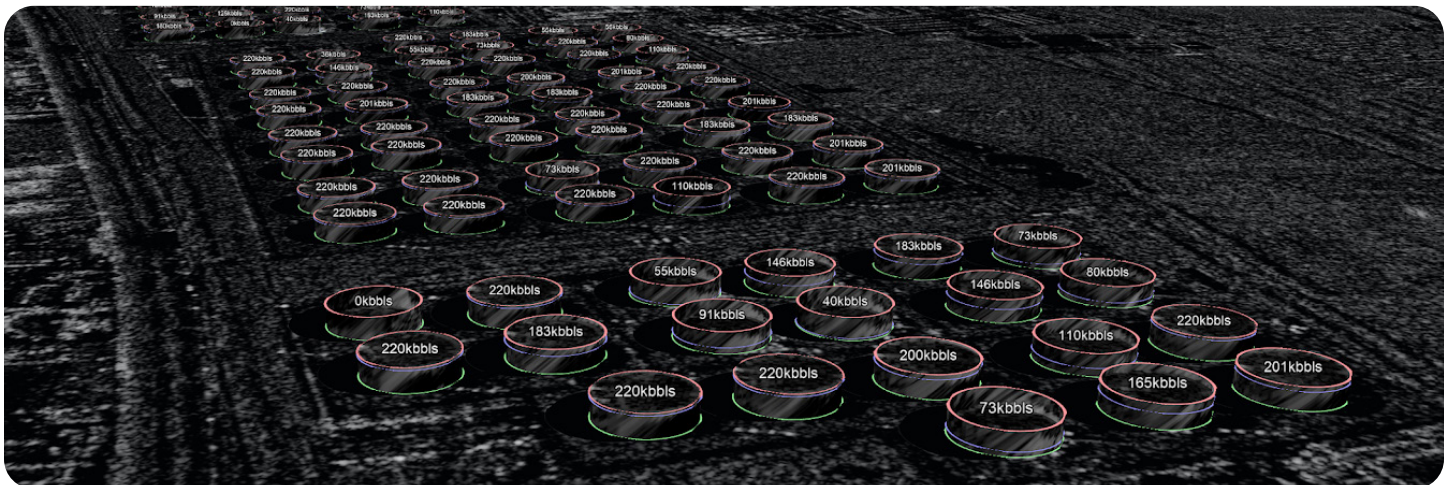
### DIRECT MEASUREMENTS

UNDERSTAND THE SPEED, DISTANCE, DIRECTION, OR PRESENCE OF OBJECTS OF INTEREST

Ursa leverages the world's largest, most progressive satellite network and advanced analytics to provide you with scalable, repeatable, high precision direct measurement results. Our Virtual Constellation encompasses 20+ different multi-national SAR architectures for unprecedented coverage, resilience, and reliability. This translates to a +97% success rate in collecting planned measurements.

#### DIRECT MEASUREMENTS FEATURES:

- Efficient and accurate coverage of huge geographical spans, day or night, regardless of cloud cover, air pollution, or other meteorological obstacles
- Reliable, repetitive, precision measurements across global supply chains
- SAR-based algorithms and analytics to derive measurements
- SAR-specific, internally developed analyst tools for verification, validation, and calibration of sites
- Measurement types include speed, distance, direction, or presence of objects

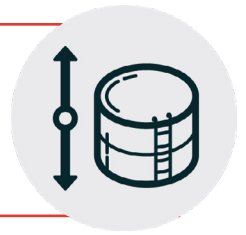


This SAR image shows an oil storage tank farm. For each tank, Ursa detects the base (green), top (red), and position of the floating roof (blue).



# DIRECT MEASUREMENTS

OBTAIN MEASUREMENTS FOR OBJECTS OF INTEREST



## DIRECT MEASUREMENTS USE CASE: GLOBAL OIL STORAGE

URSA'S GLOBAL OIL STORAGE REPORT, OFFERED TO SUBSCRIBERS ON A WEEKLY BASIS, IS THE EARLIEST AND MOST ACCURATE AVAILABLE

Our pre-packaged oil monitoring service offers weekly insights into crude oil inventory levels worldwide, a feat not possible a few years ago. Ursa's virtual constellation of radar satellites takes direct measurements of more than 11,000 tanks each week, representing 198 unique global sites, and more than 4.0 billion barrels of capacity. An interactive globe displays the oil storage sites Ursa monitors, visualizing the capacity and fill level for each.

### EACH WEEK URSA MONITORS OVER:

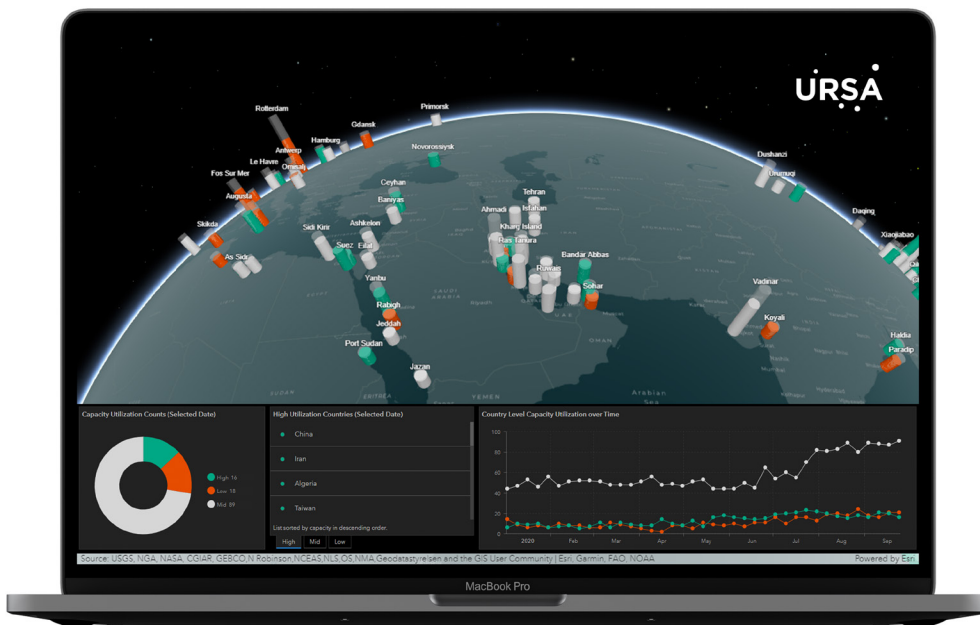
- 11,000 tanks
- 198 sites
- 4 billion bbls of capacity

Color key for crude storage capacity utilization levels, based on the utilization level compared to the empirical distribution for each site (i.e. mean & standard deviation):

**Green**: Utilization levels higher than one standard deviation above the mean

**Orange**: Utilization levels within one standard deviation of the mean

**White**: Utilization levels lower than one standard deviation below the mean



Global crude oil inventory reports are delivered weekly on Thursdays and are accessible via **API in PDF, CSV, and secure FTP formats**, and data is available in **near real-time API**.

We offer a high level of accuracy: our measurements have **97% absolute correlation to EIA Cushing figures**.

**This innovative solution ensures our customers have access to the most reliable, consistent data on the market.**





# MOVING TARGETS

MAINTAIN VISUAL CUSTODY OF OBJECTS OF INTEREST



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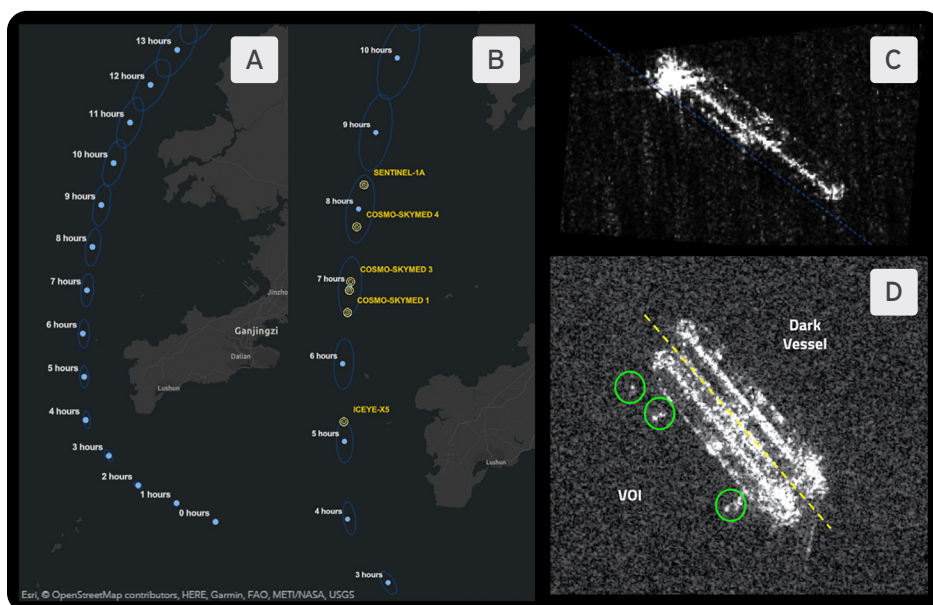
### MOVING TARGETS

#### GAIN AWARENESS OF A VESSEL'S HISTORICAL MOVEMENTS AND PREDICTED PATHS

Ursa leverages the world's largest, most progressive satellite network and advanced analytics to provide you with novel insights into moving objects of interest. Ursa's innovative suite of services allows you to craft monitoring scenarios to maintain control over your assets or review suspicious activity, without divulging confidential information.

#### MOVING TARGETS FEATURES:

- Vessel monitoring for a unique scenario
- Path forecasting
- **Rapid on-demand imagery tasking** over the forecasted locations
- Fusion of SAR with rapid data streams, such as Spire AIS
- Algorithms and tip & cue based on position interpolation and path prediction
- **Service alerts:** Ship to ship transfers, dark ship detection (alpha)
- Wake detection / small non-metal bodied vessel detection



#### SHIP TRACKING

- [ A ] Path forecasting
- [ B ] Path forecasting with orbitology overlay
- [ C ] Moving target capture
- [ D ] Ship-to-ship transfer detection

Imagery and data courtesy of e-Geos, ICEYE, and Spire, 2020.



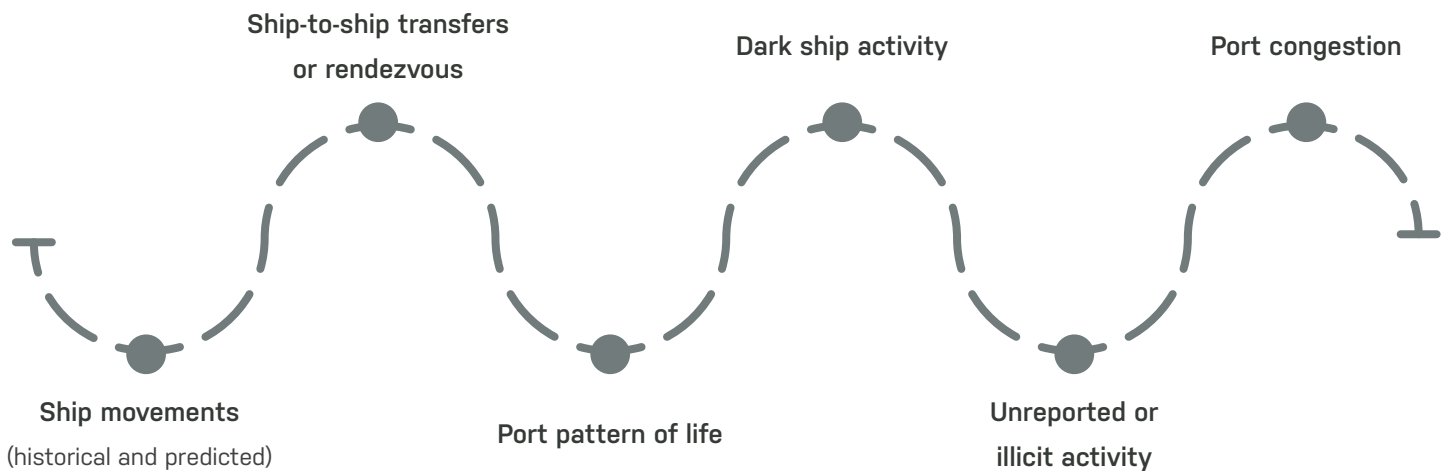
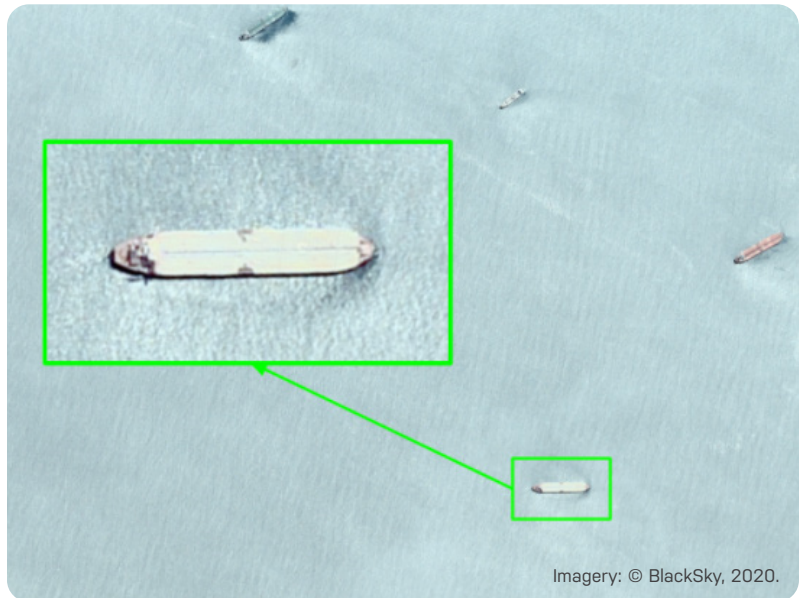
## MOVING TARGETS SAMPLE SERVICE: VESSEL TRACKING AND DARK VESSEL DETECTION

Moving vessels frequently go AIS-dark for either legitimate or illegitimate reasons. When this happens, the only way to verify a ship's location is to try to "see" it by using a high-resolution commercial satellite.

### VESSEL OF INTEREST TRACKING USING SAR DATA

**Our process:**

- Initial location with AIS
- Forecasted paths
- Tasked collections
- Location verification (dark ship)
- Wake detection
- Direction of movement estimation
- Trajectory re-estimation for re-tasking





# METADATA-AS-A-SERVICE

SEARCHABLE DATABASE OF SAR METADATA



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## METADATA-AS-A-SERVICE

### ACCESS ALL METADATA IN OUR VIRTUAL CONSTELLATION VENDOR ARCHIVE

Ursa maintains an archive library of data and imagery collected by our Virtual Constellation, a network of 12+ top-performing commercial SAR constellations from multiple foreign and domestic vendors.

By cataloging collections from a large number of satellites, Ursa's archive delivers unique breadth of coverage. Our Metadata-as-a-Service provides a means for customers to access, search, and retrieve descriptive metadata associated with the archive, simplifying data discovery.



### METADATA-AS-A-SERVICE FEATURES:

- Searchable database catalogue of metadata related to commercial SAR collections
- Unified format for metadata, translating common elements from each vendor's proprietary schema into a normalized representation.
- Common metadata field names (e.g., collection geometry, location, date, sensor, and sensor mode)
- Weekly, updated database push
- A variety of service offerings: including yearly subscription or weekly catalog delivery
- Developer-friendly APIs to be offered soon for catalog query, order requests, and data download

These capabilities allow customers to search the metadata for useful source or derived data sets, and support agnostic data processing. Ursa's Metadata-as-a-Service helps to unlock the full potential of SAR data for global discovery and new insights.