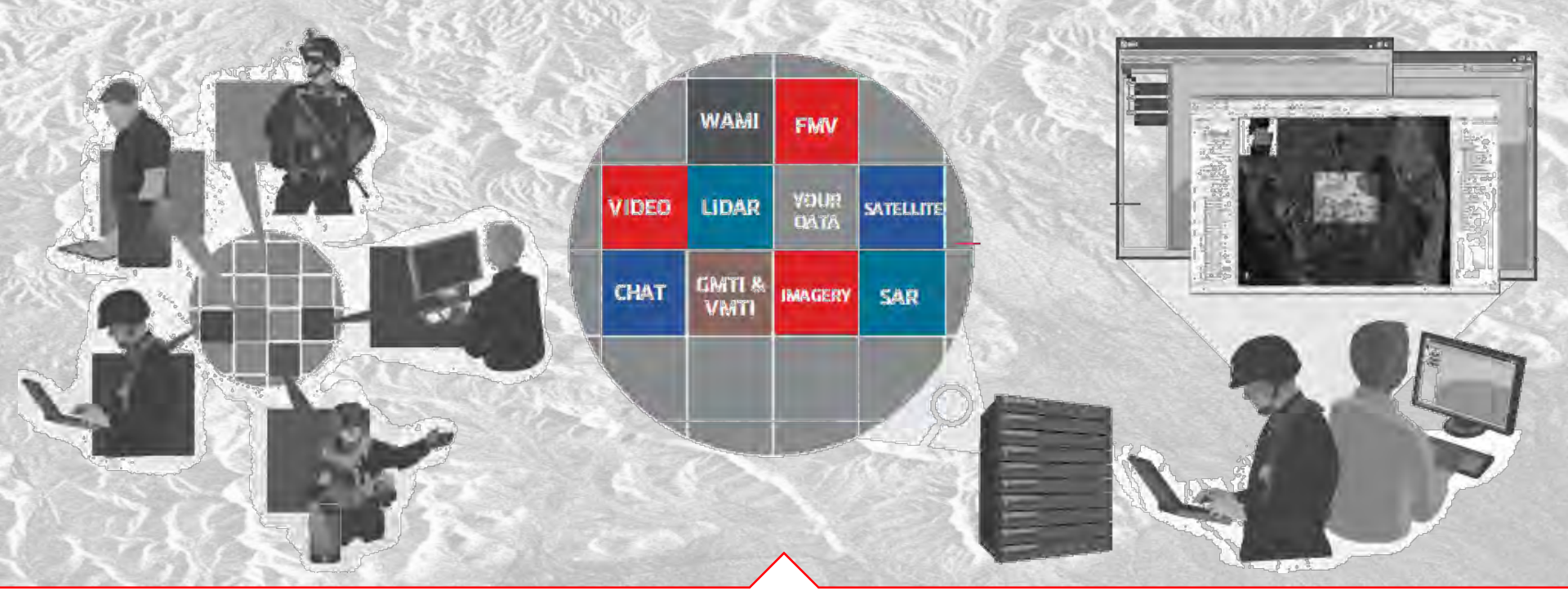

L3HARRIS™

REMOTE SENSING SOLUTIONS FOR DEFENSE AND SECURITY

Turn Geospatial Imagery and Data into Timely, Accurate, and Actionable Intelligence

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November 28th, 2019

JAMES SLATER | L3HARRIS GEOSPATIAL | CHANNEL MANAGER EMEA
NICOLAI HOLZER | L3HARRIS GEOSPATIAL | SALES ENGINEER EMEA

Agenda

L3Harris Geospatial
Company Presentation

Examples and Use Cases
Imagery and LiDAR
Synthetic Aperture Radar (SAR)

L3Harris Geospatial
Capabilities and Solutions

L3Harris Geospatial

Company Presentation

L3Harris – Committed to Excellence

L3HARRIS™

L3Harris Technologies is an agile global aerospace and defense technology innovator, delivering end-to-end solutions that meet customers' mission-critical needs.

~400 LOCATIONS

CUSTOMERS IN ~130 COUNTRIES

~50K EMPLOYEES

~20K ENGINEERS

Integrated Mission Systems	Space & Airborne Systems	Communication Systems	Aviation Systems
$4.9B	$4.0B	$3.8B	$3.8B
			
Leading technology integrator to U.S. and international militaries for Intelligence, Surveillance and Reconnaissance, airborne and maritime platforms	Mission solutions for space and airborne domain with defense, intelligence and commercial applications	Ground and airborne communications and network systems for U.S./International militaries, and commercial customers	Commercial and military aviation solutions, systems, networks and pilot training

L3Harris Geospatial – Defense and Intelligence

L3Harris Geospatial Partners and Customers

L3Harris Geospatial delivers software solutions to government organizations worldwide, helping them to use satellite and other geographically contextual data to make higher confidence decisions. Our products enable the defense and intelligence chain – from the command center to the tip of the spear – with the most advanced software technology available today to effectively manage and exploit geospatial data.

AIRBUS · aws · cloudeo · DigitalGlobe A MAXAR COMPANY · esri THE SCIENCE OF WHERE · HySpeed COMPUTING

Malvern Panalytical · NVIDIA · Optensity · planet. · PRECISIONHAWK · sarmap

BAYER · iridium · Spacemetric · Spectral Sciences Inc. · Hawaiian Electric Maui Electric Hawai'i Electric Light · SDGE A Sempra Energy utility

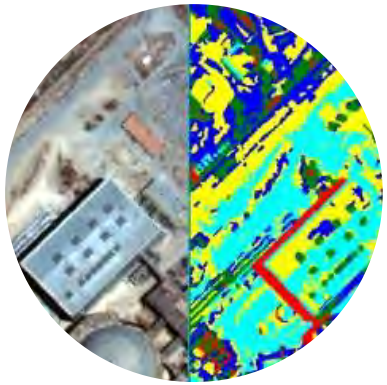
U.S. Civil and Intelligence Community

U.S. Department of Defense

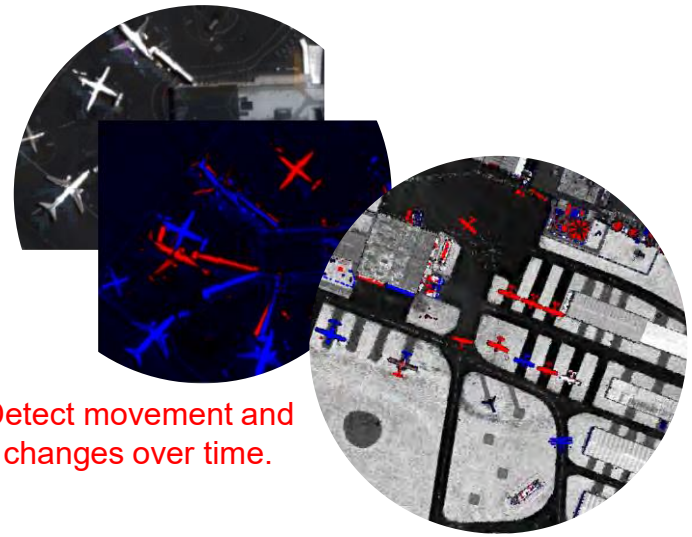
Examples and Use Cases

Imagery and LiDAR

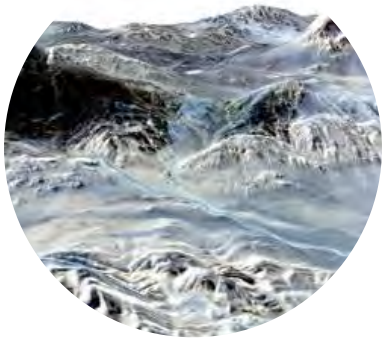
Using Imagery & LiDAR for D&I Applications



Categorize terrain to understand land use.

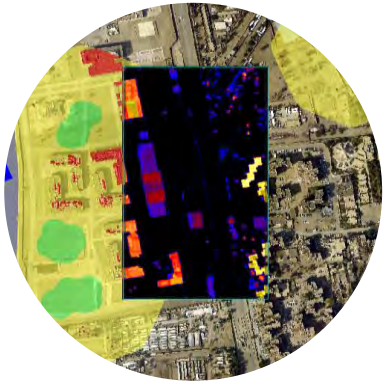


Detect movement and changes over time.

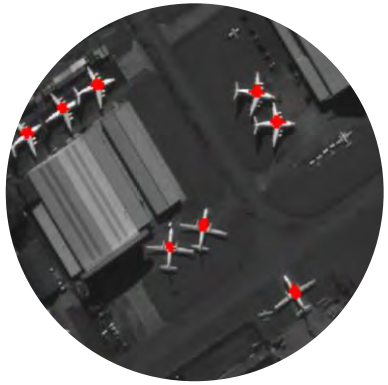


Visualize terrain to plan troop activities.

Detect anomalies to uncover hidden targets.



Fuse Imagery & LiDAR for multi-INT products.

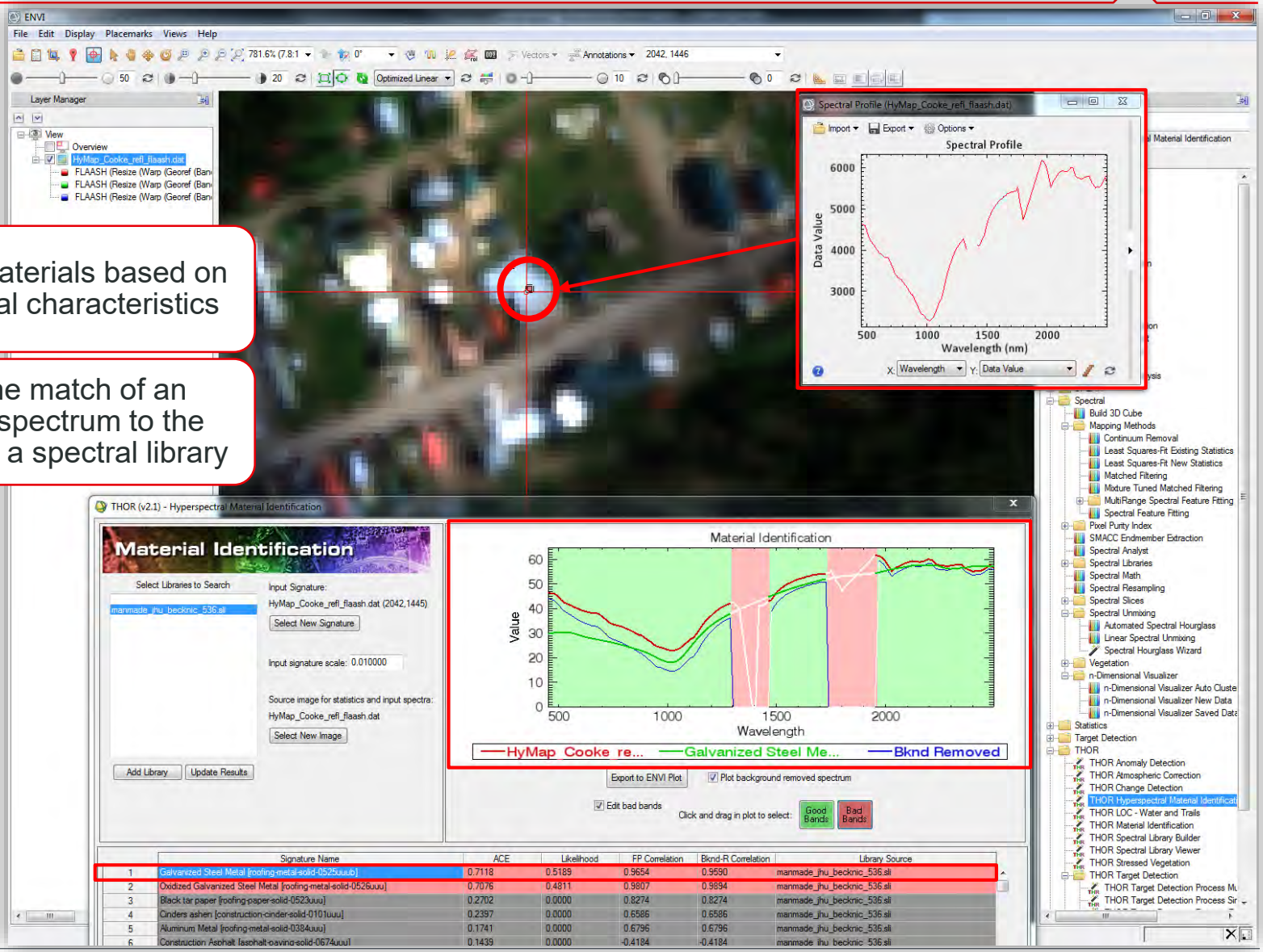


Extract features of interest and save directly to a GIS.

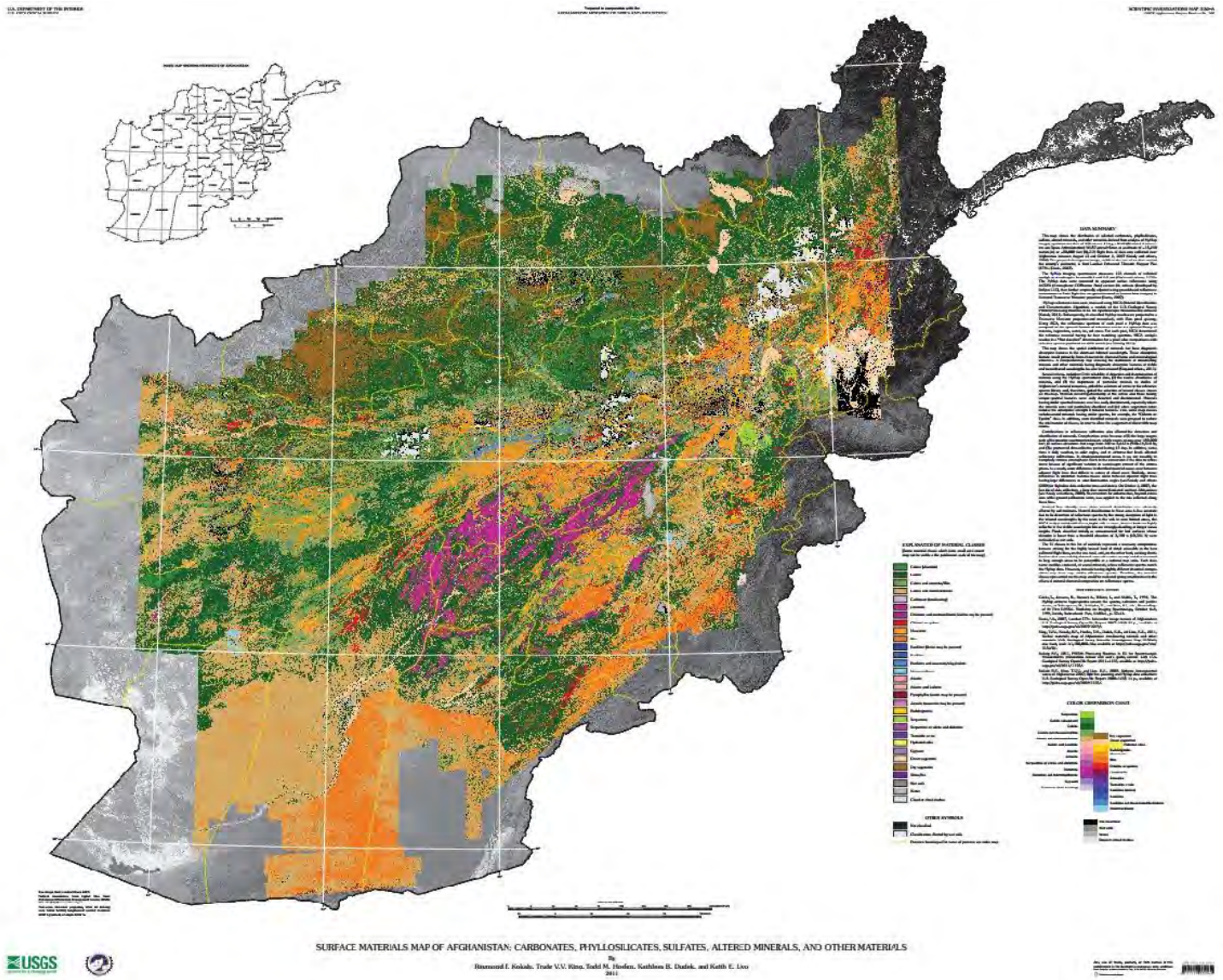
Spectral Material Identification

Identifies materials based on their spectral characteristics

Ranks the match of an unknown spectrum to the materials in a spectral library



Afghanistan – Hyperspectral Mineral Mapping

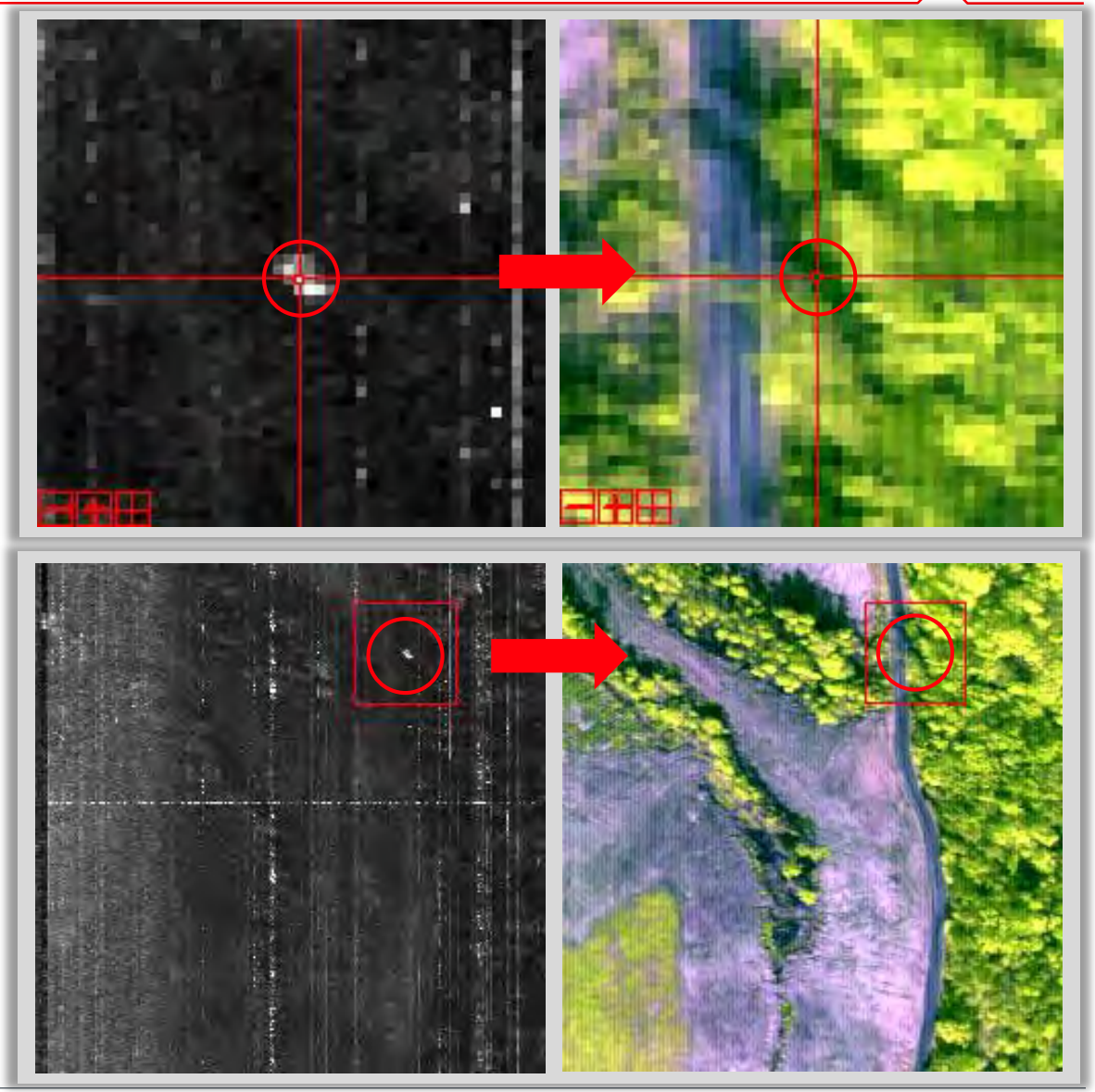


Spectral Anomaly Detection

Extracts anomalous targets spectrally distinct from the image background that could be hidden from the human eye

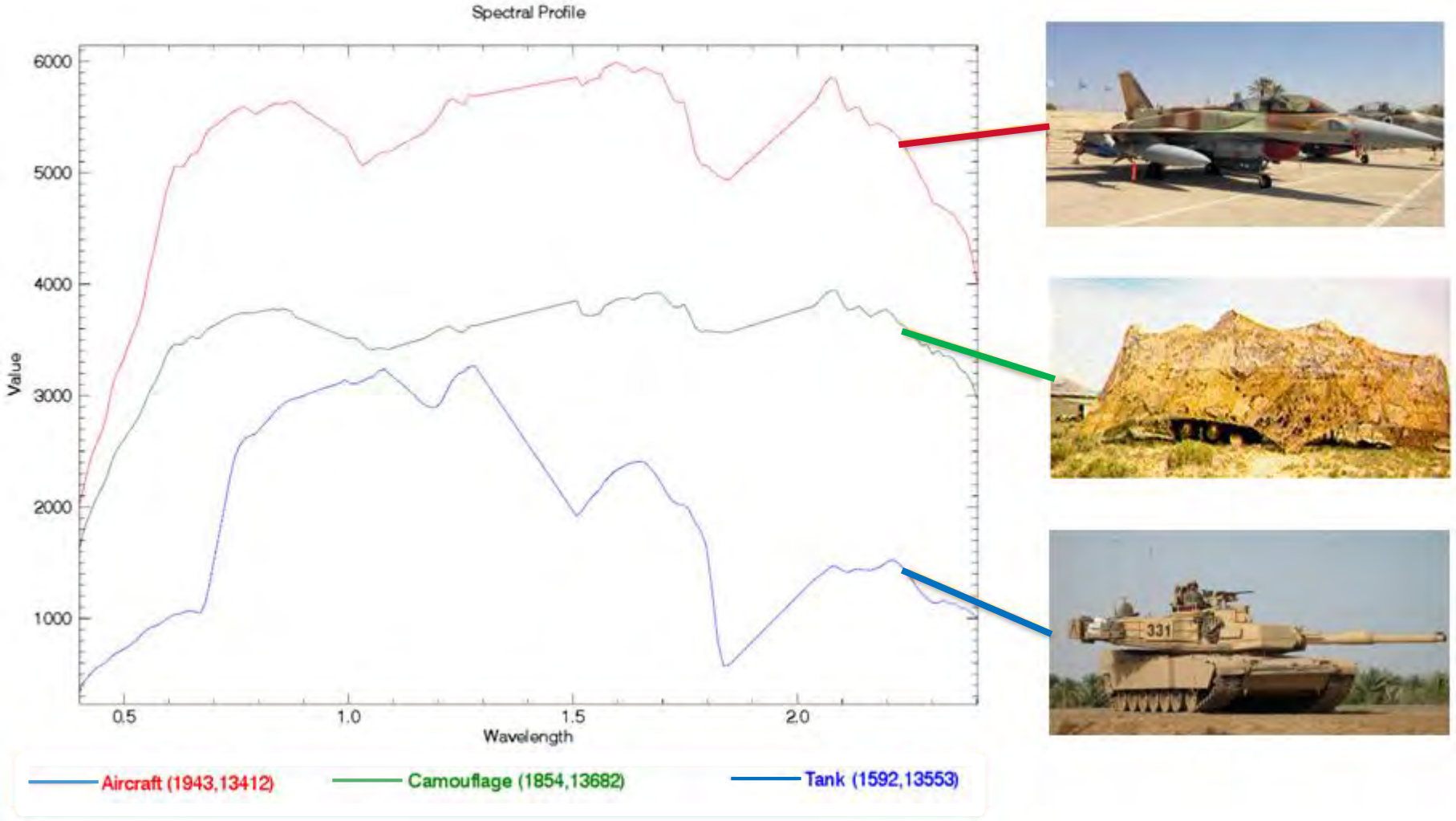
Identifies subtle spectral features such as partly concealed targets by tree canopy, camouflaged military vehicles, disturbed earth, stressed vegetation, etc.

Focus on spectrally anomalous areas that might indicate potential threats

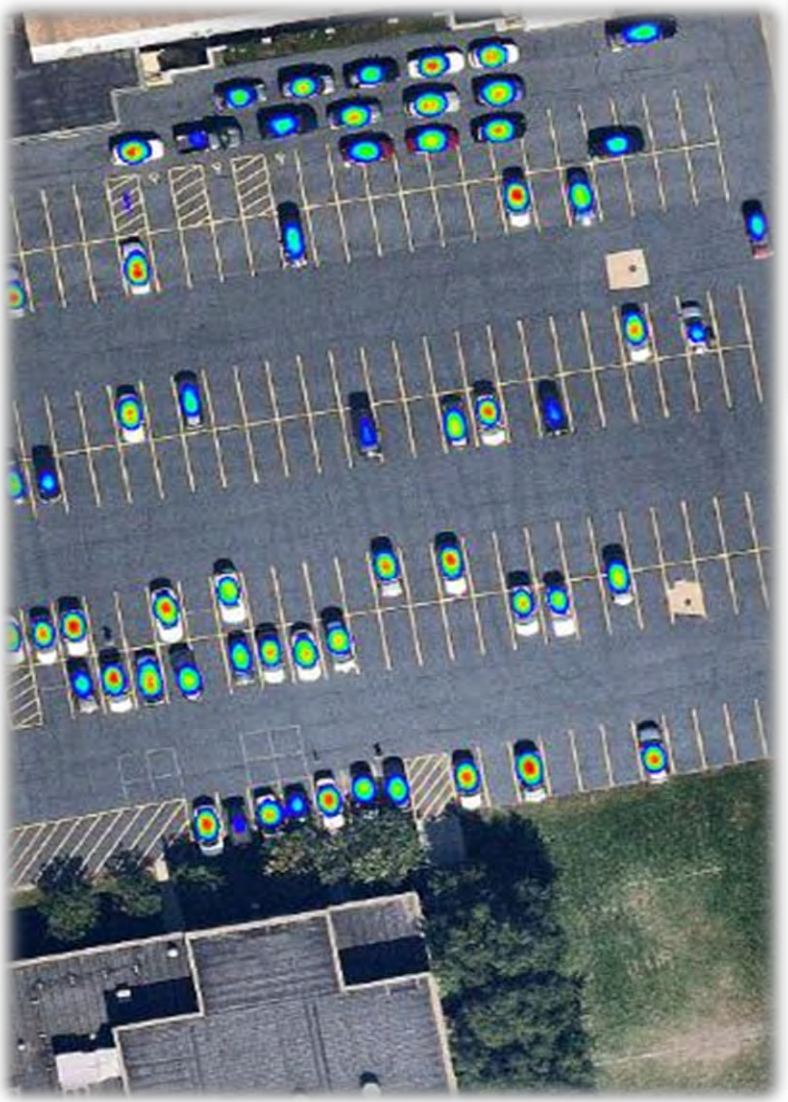


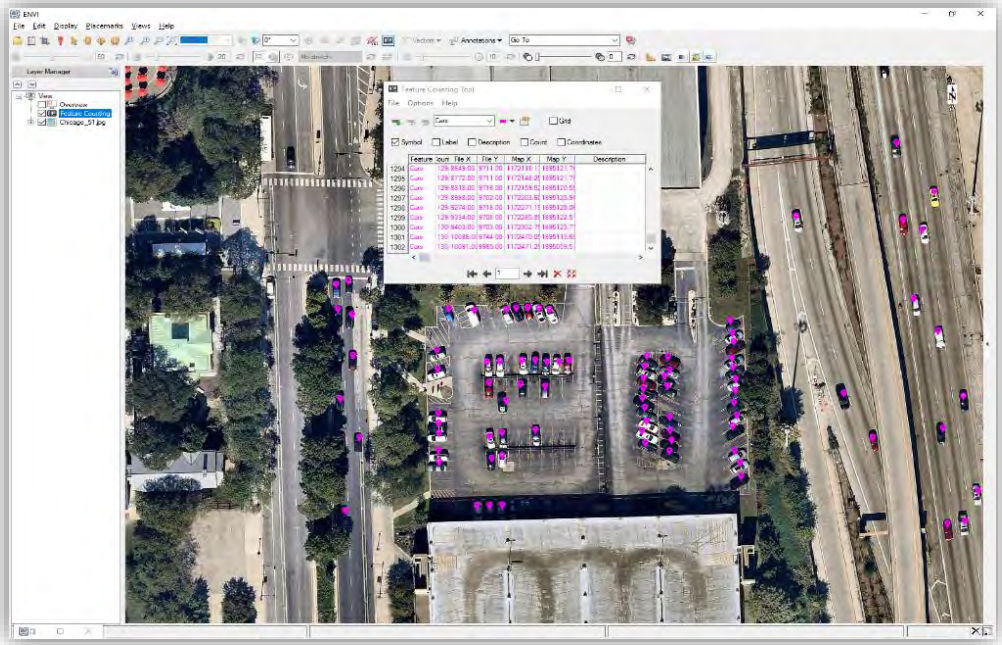
Spectral Target / Object Detection

Finding targets at the sub-pixel level using spectral signatures



Deep Learning Car Detection

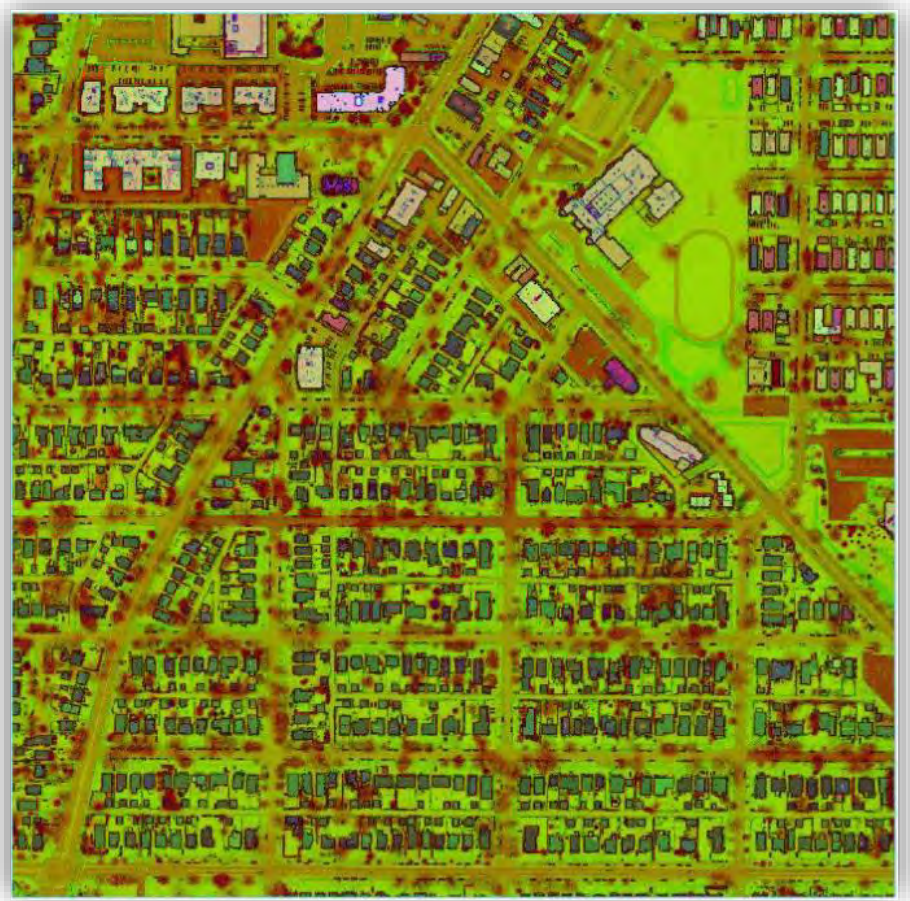




ENVI Feature Counting tool used to label the centers of cars

Deep Learning Road Network Extraction

- LiDAR derived input converted to raster:
  - Height, intensity, shaded relief
- Results with ENVI Deep Learning
  - Extracted road network



Activity Based Intelligence – Airport Monitoring

Requirement
- Monitor activities at London Southend Airport

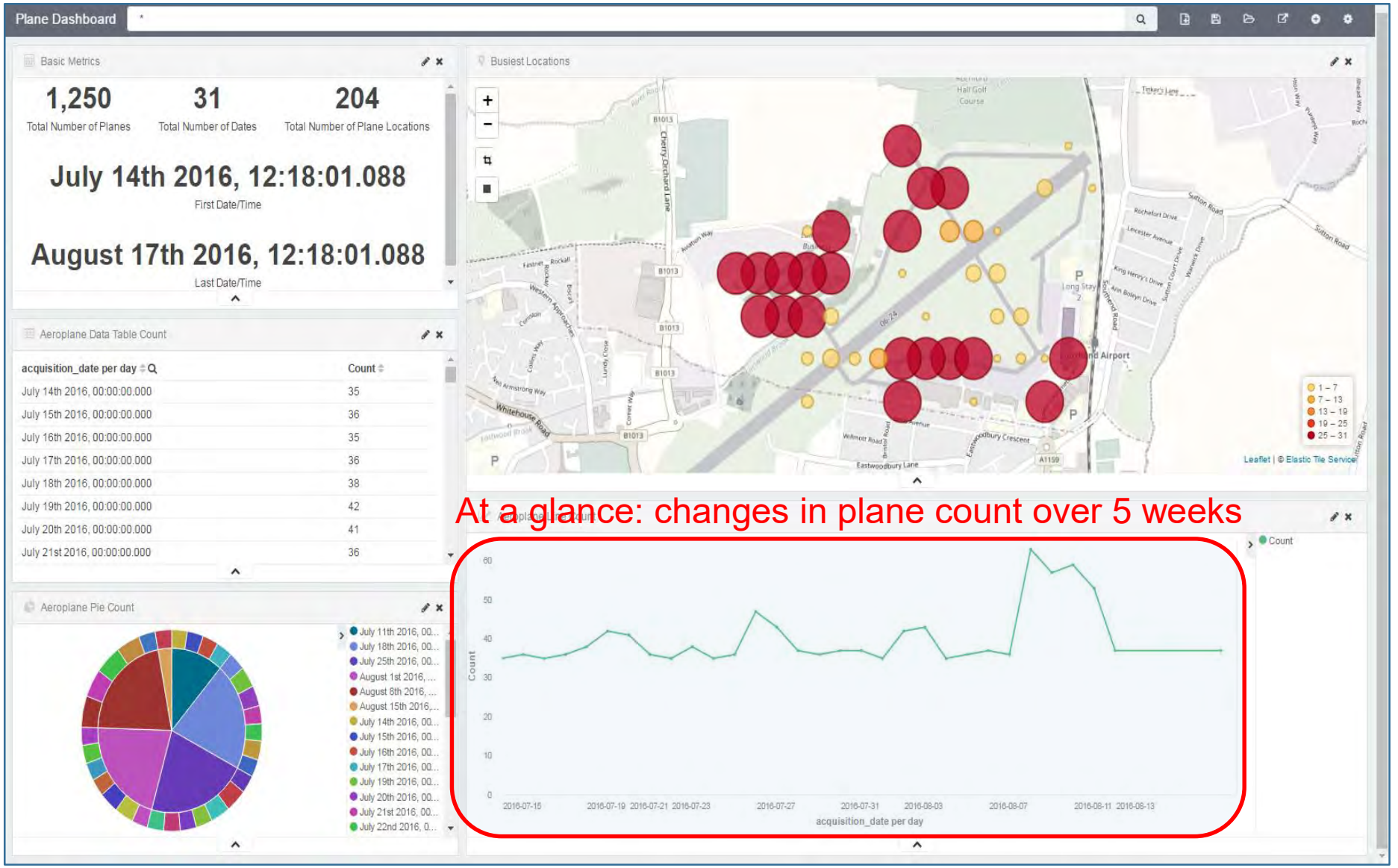
Develop
- Scientist writes an algorithm to meet requirement.

Deploy
- Algorithm is uploaded to the system.
- Algorithm is configured for task.

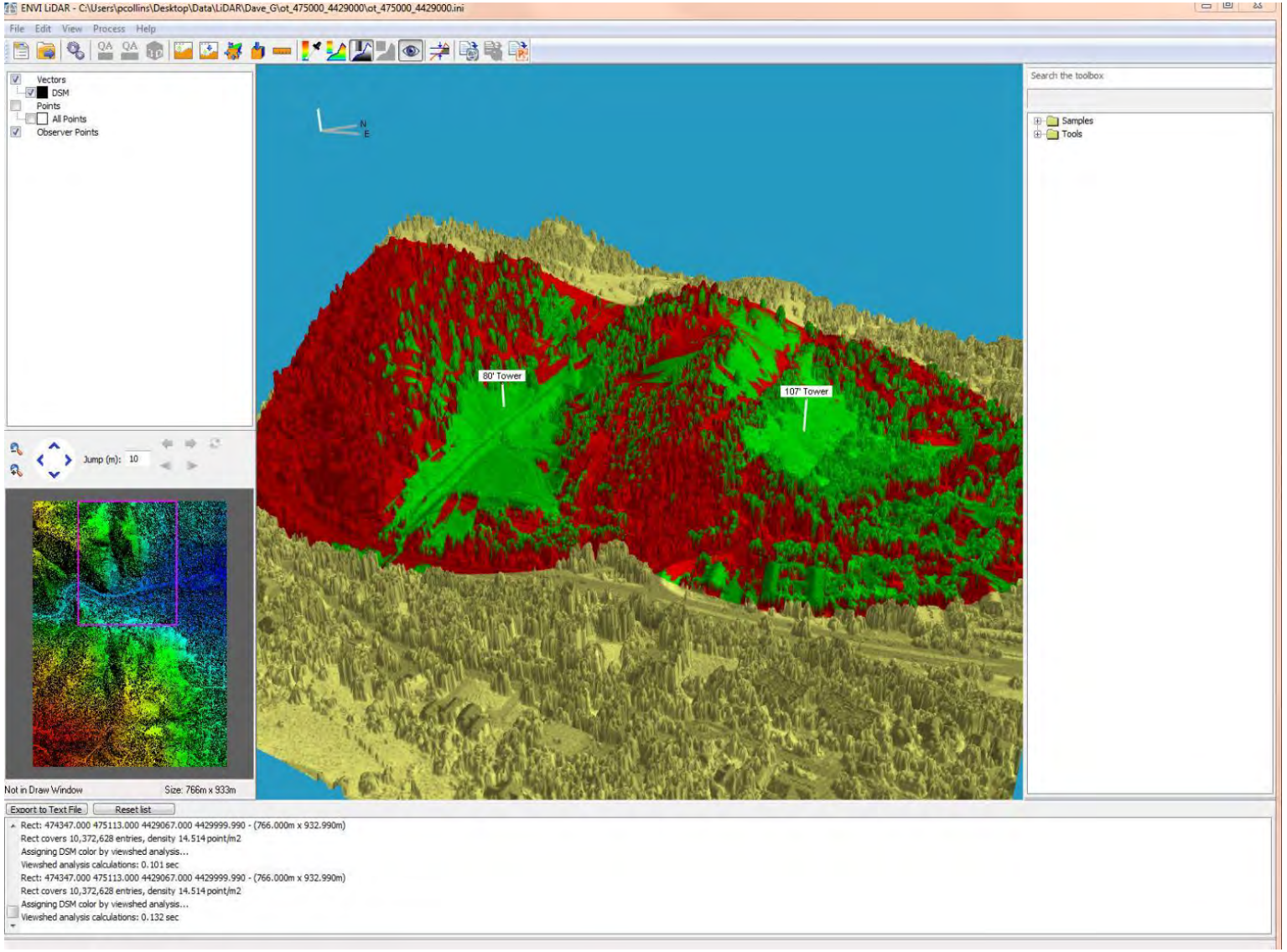
Tasked
- Data comes into the system and is processed if applicable.

Analysis
- Analyst can view output on dashboard.
- Analyst can be alerted to new output.

Activity Based Intelligence – Airport Monitoring



Viewshed Analysis



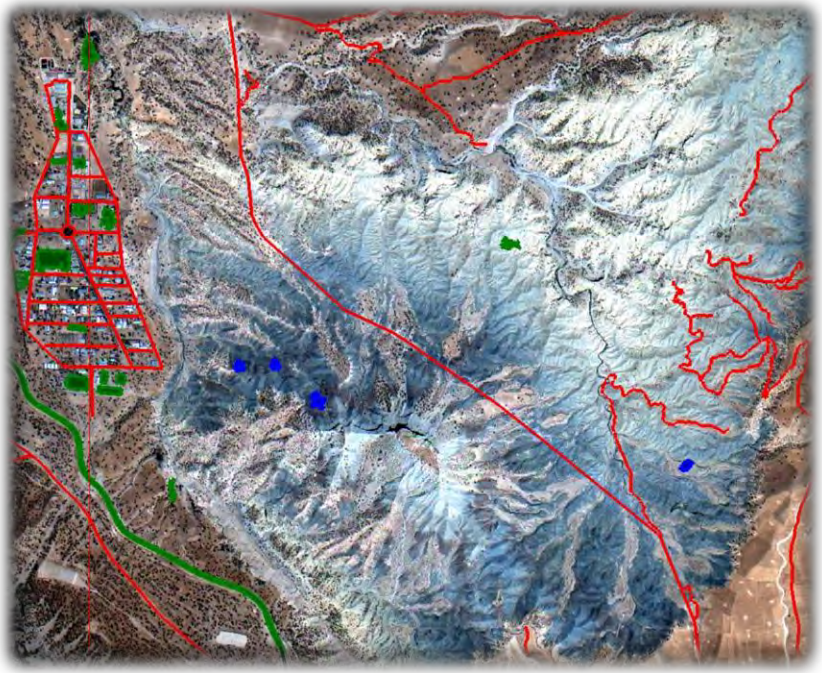
Report Suspicious Activities

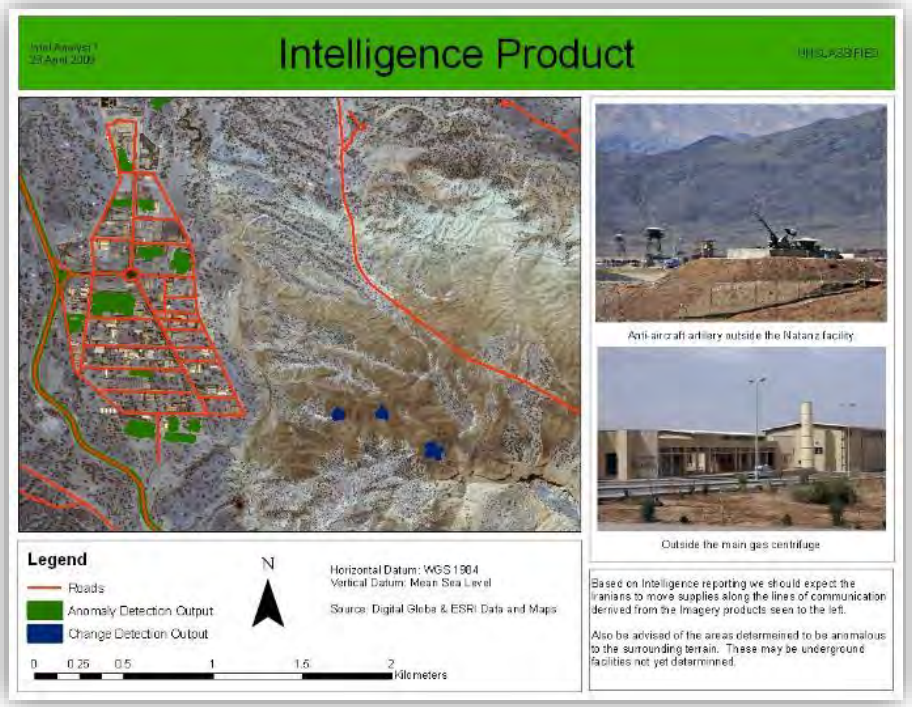
1. Quickly extract critical information from imagery
2. Identify areas that both have changed and became anomalous
3. Generate Intelligence Report to share insights

Lines of Communication (LOCs) – Roads

Change Detection

Anomaly Detection

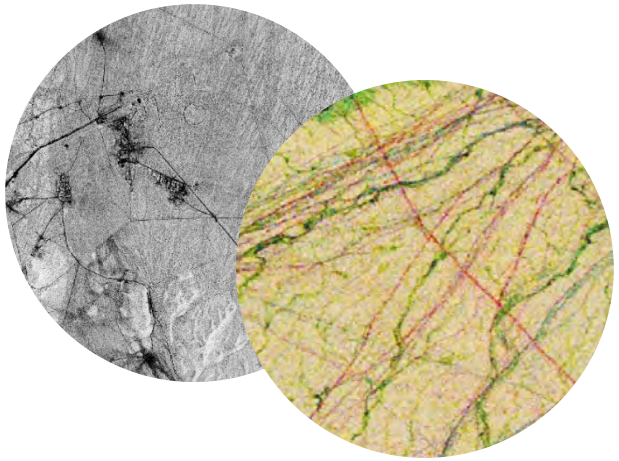




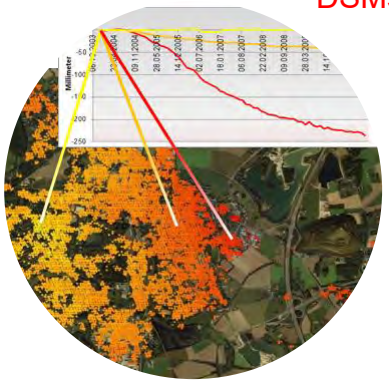
Examples and Use Cases

Synthetic Aperture Radar (SAR)

Using SAR for D&I Applications

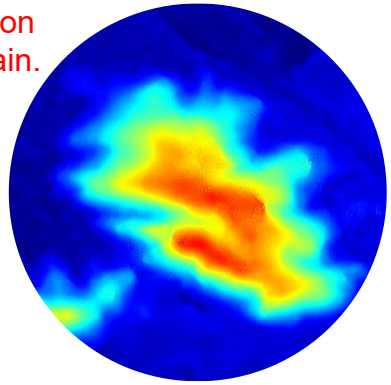


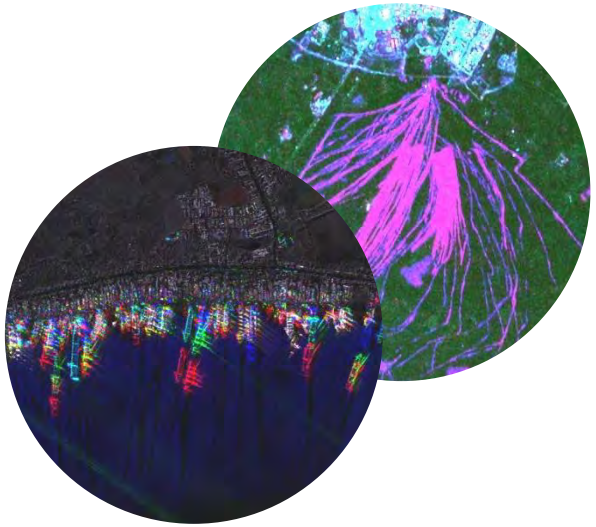
Detect minute changes between two subsequent images.



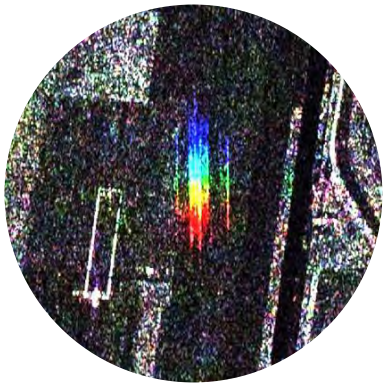
Monitor underground movement to reveal secret constructions.

Generate high resolution DSMs to visualize terrain.



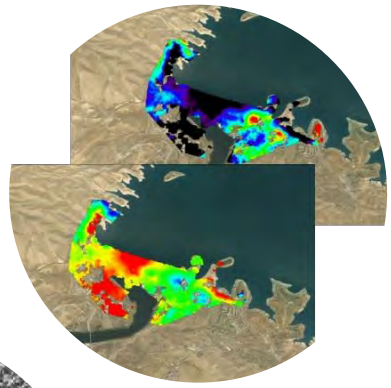


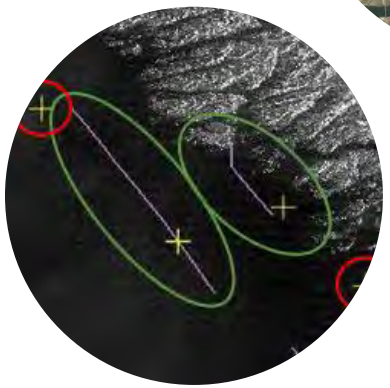
Detect movement and changes over time.



Highlight moving objects.

Monitor critical infrastructure.





Detect ships and classify with AIS information.

SAR Ship Detection (Feature Extraction)

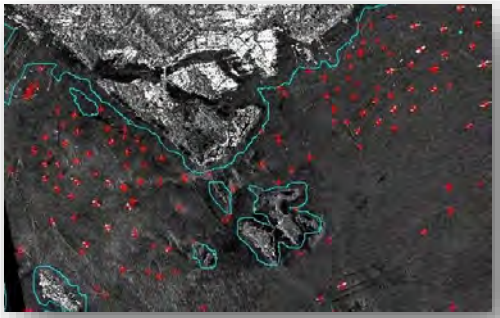
AIS marine traffic information and SAR ship detection

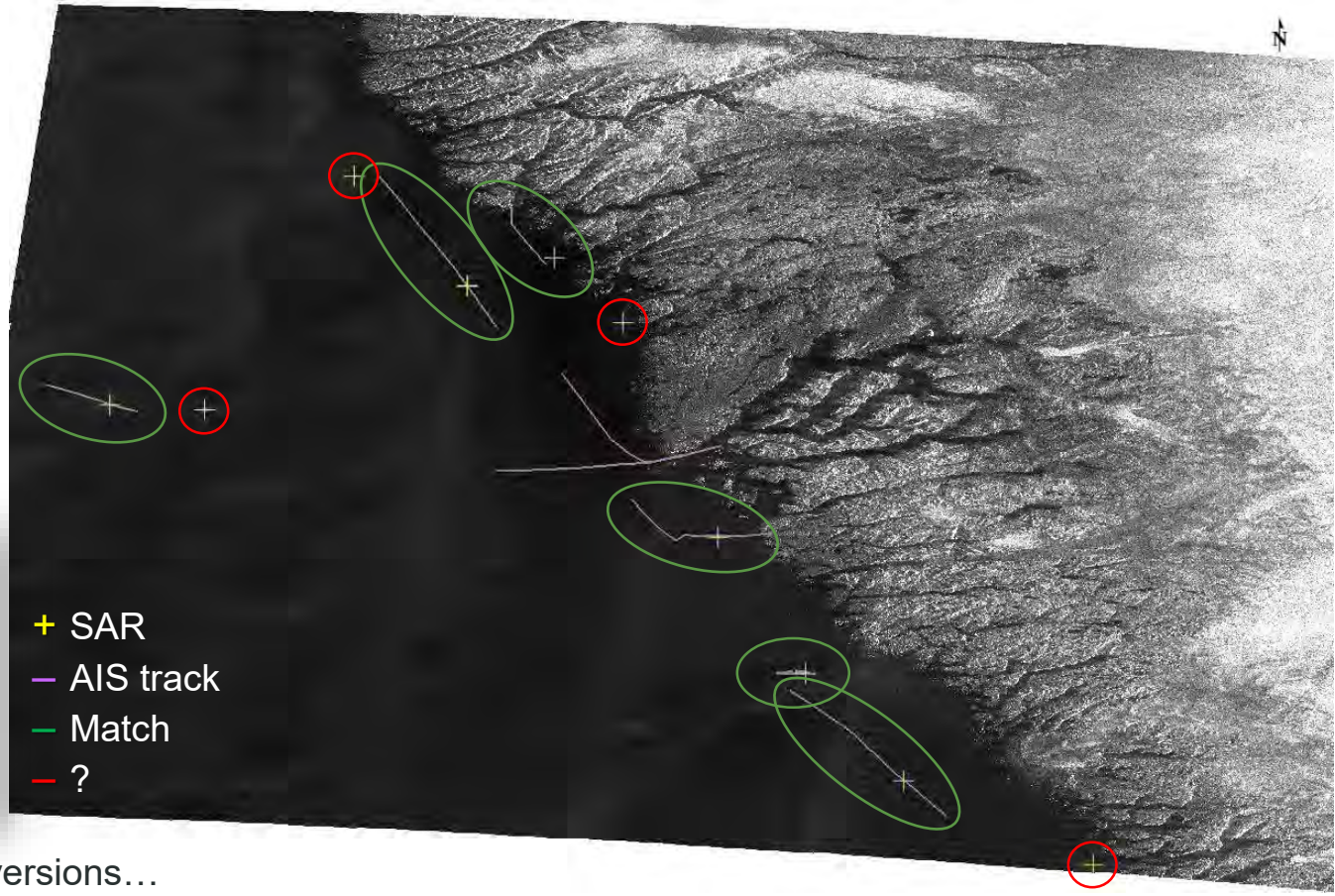
Correlate AIS data with satellite radar imagery to identify "dark targets"

Example: Nuuk (Greenland)

RADARSAT-2

- Frequency: C-band (5.6 cm)
- Mode: ScanSAR (100 m GSD)
- Revisit time: 24 days





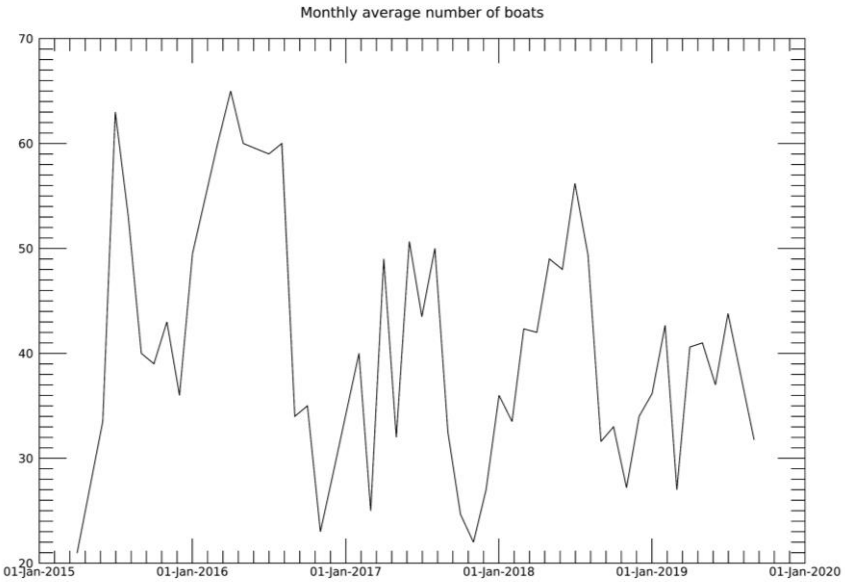
- Support of all AIS formats / versions…
  - Plain NMEA 0183, AISSat, AUSAT3, ORBCOMM, ExactEarth, CSV

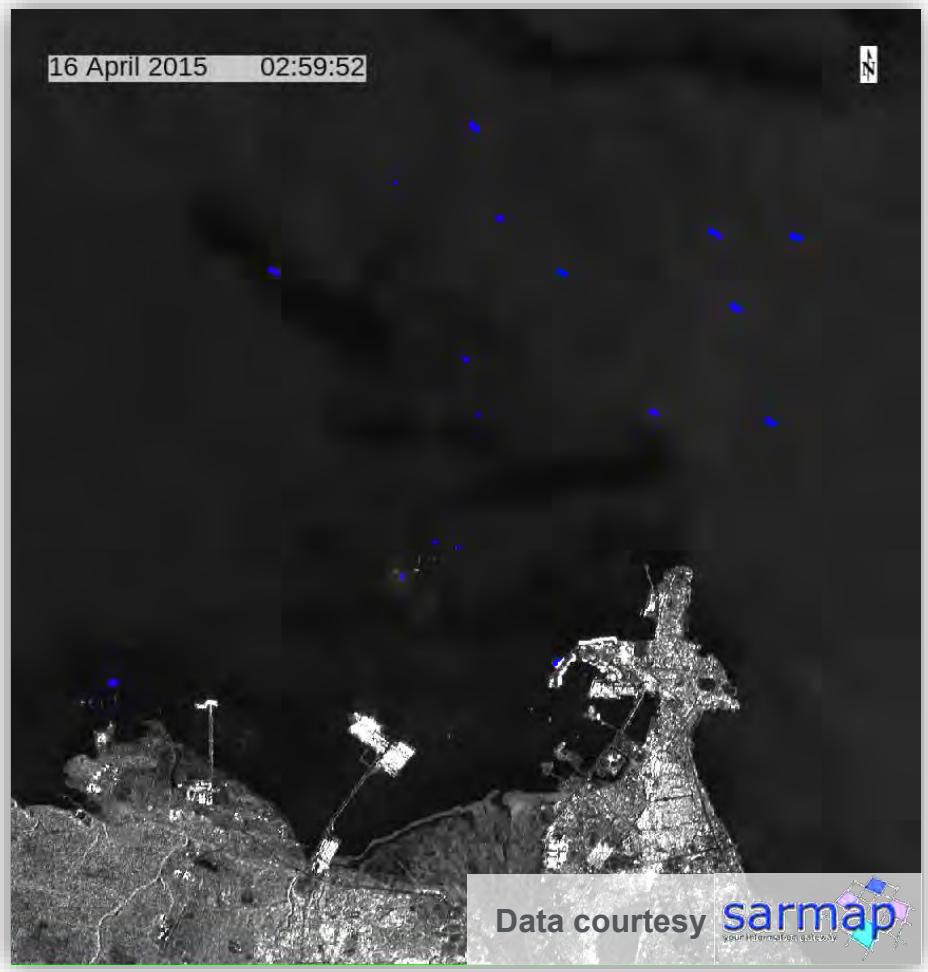
  …from all platforms with AIS receivers
  - PAZ, NovaSAR, ALOS 2&4, Capella, OptiSAR, Radarsat CM, Sentinel-1 C&D

Data courtesy sarmap

Port Activity Monitoring with SAR

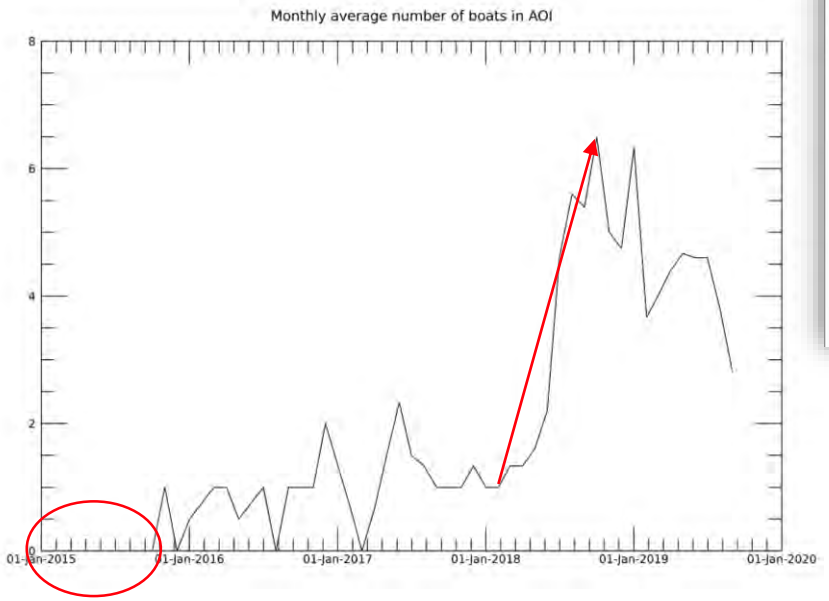
- Case Study: Monitor port installations at Doraleh new container terminal (Djibouti)
  - Single ships can be automatically detected date-by-date based on parameters like length / width / heading measured
  - Statistics about the average monthly activity can then be estimated, and seasonal / yearly trends detected

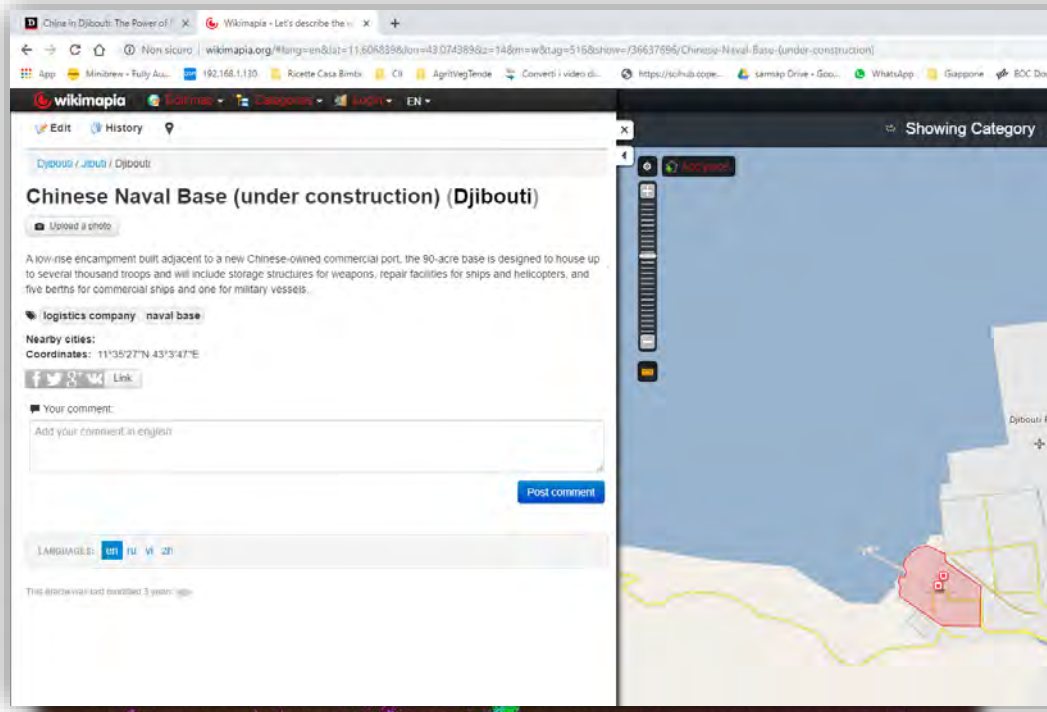


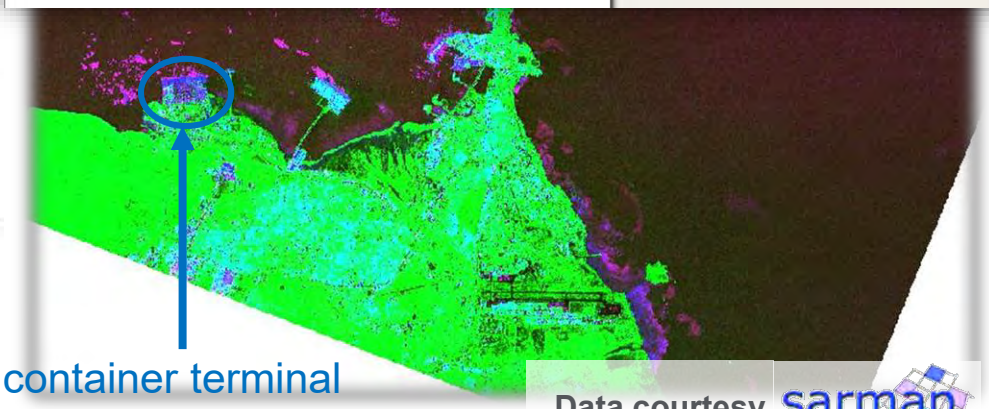


Port Activity Monitoring with SAR

– Statistics for a sub-region, here the new container terminal…
– …that has been partly identified as a naval military base under construction, completed and active since 2018







Coefficient of variation

Mean

Gradient

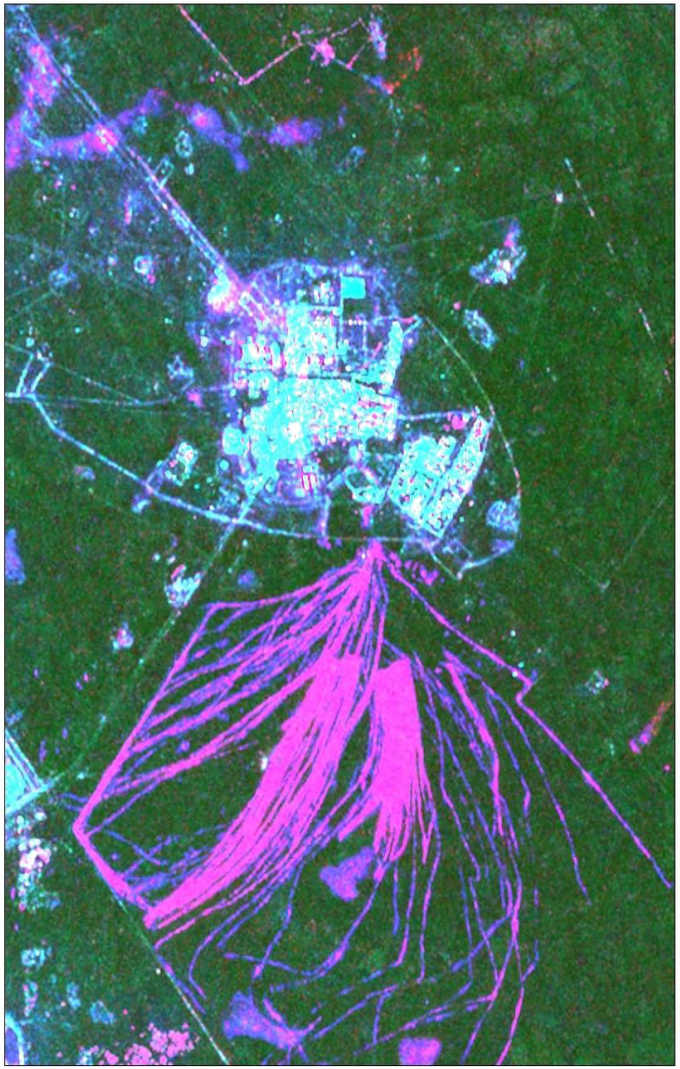
Data courtesy sarmap

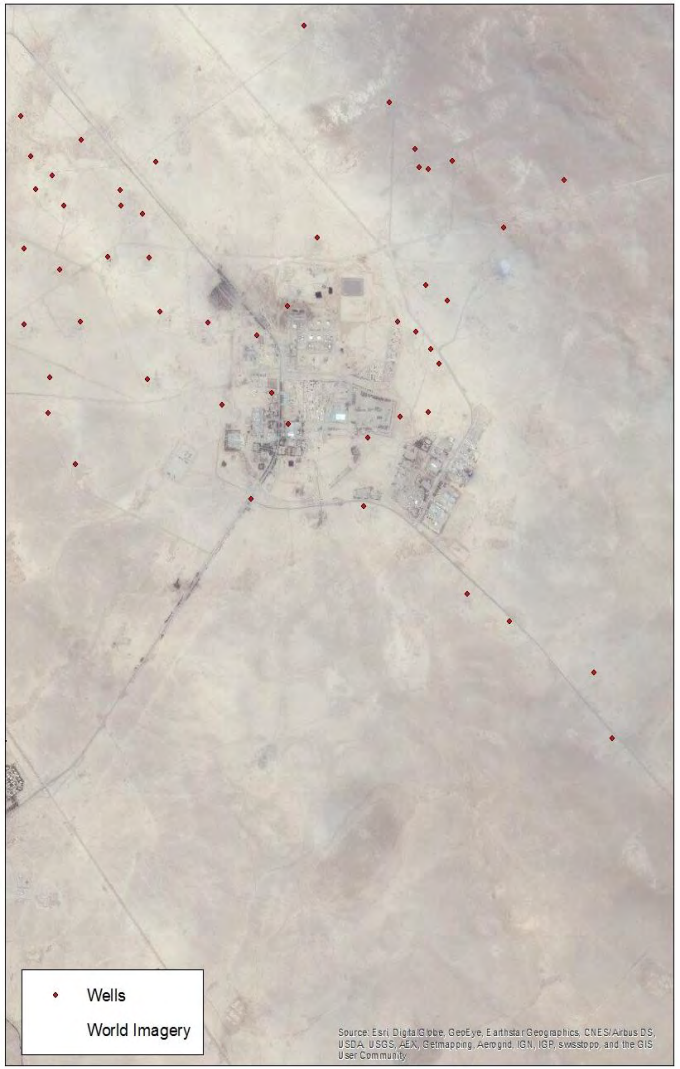
Oil Smuggling – SAR Change Detection

Amplitude change detection (ACD)

al-Omar oilfields (Syria)

- 2014 – Dec 2015: Controlled by IS → oil smuggling.
- Intensity time series analysis
- Time line of 88 Sentinel-1 images (2015 –2016)





Coefficient of Variation
Minimum
Gradient

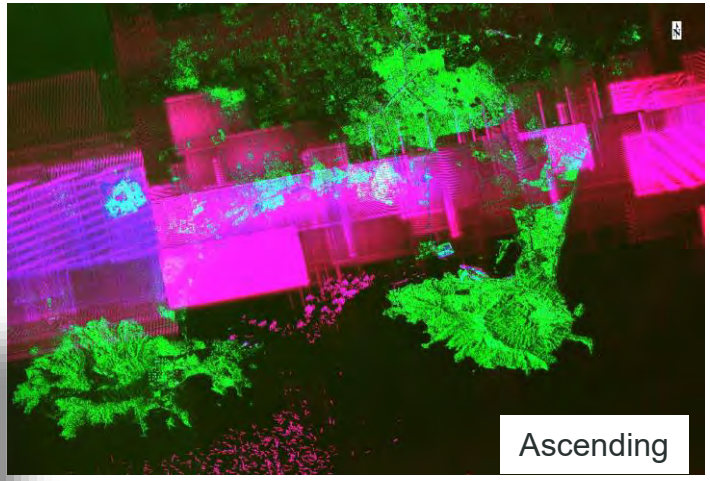
Data courtesy sarmap

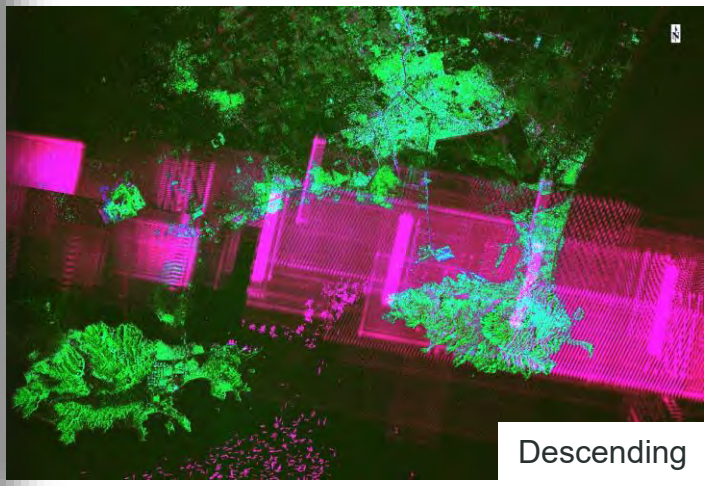
Monitoring Ground Activities with SAR

Data courtesy

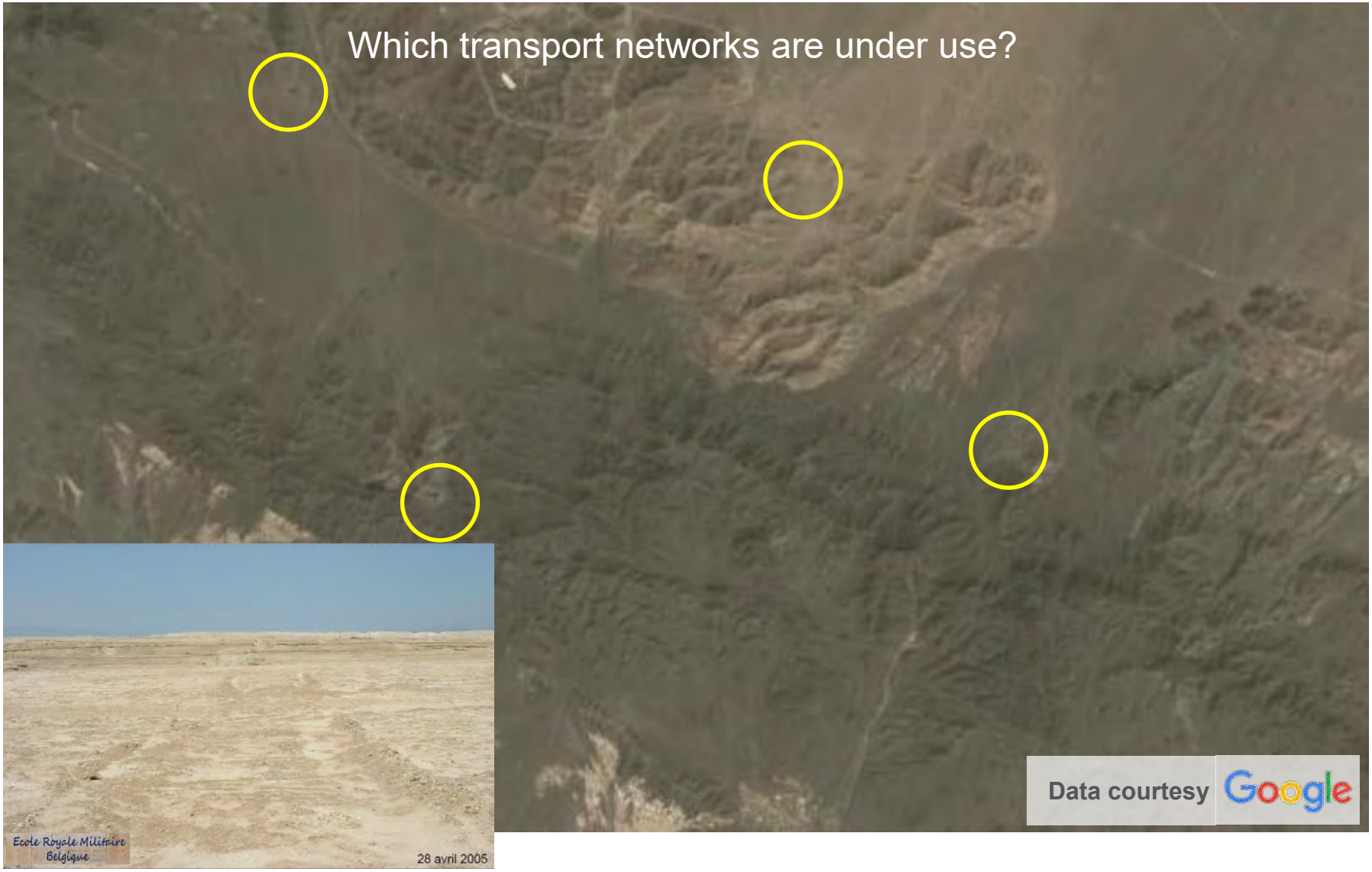
- Case Study: Monitor airfields / ground activities: Aden – Yemen
  - Strong Radio Frequency Interferences in both geometries, and not constant over time

    → Clear indication of periods of ground activities

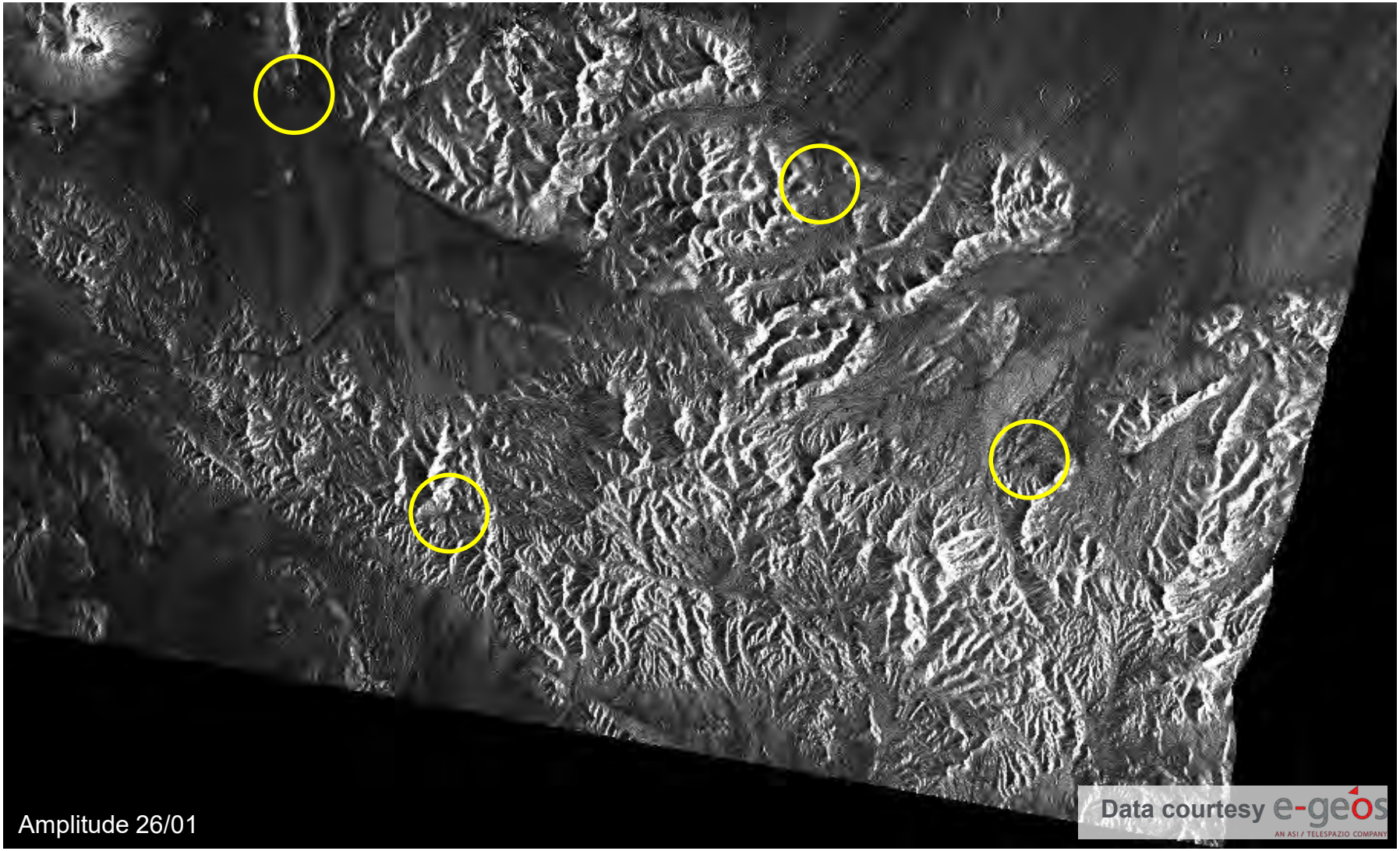




Coherence Change Detection

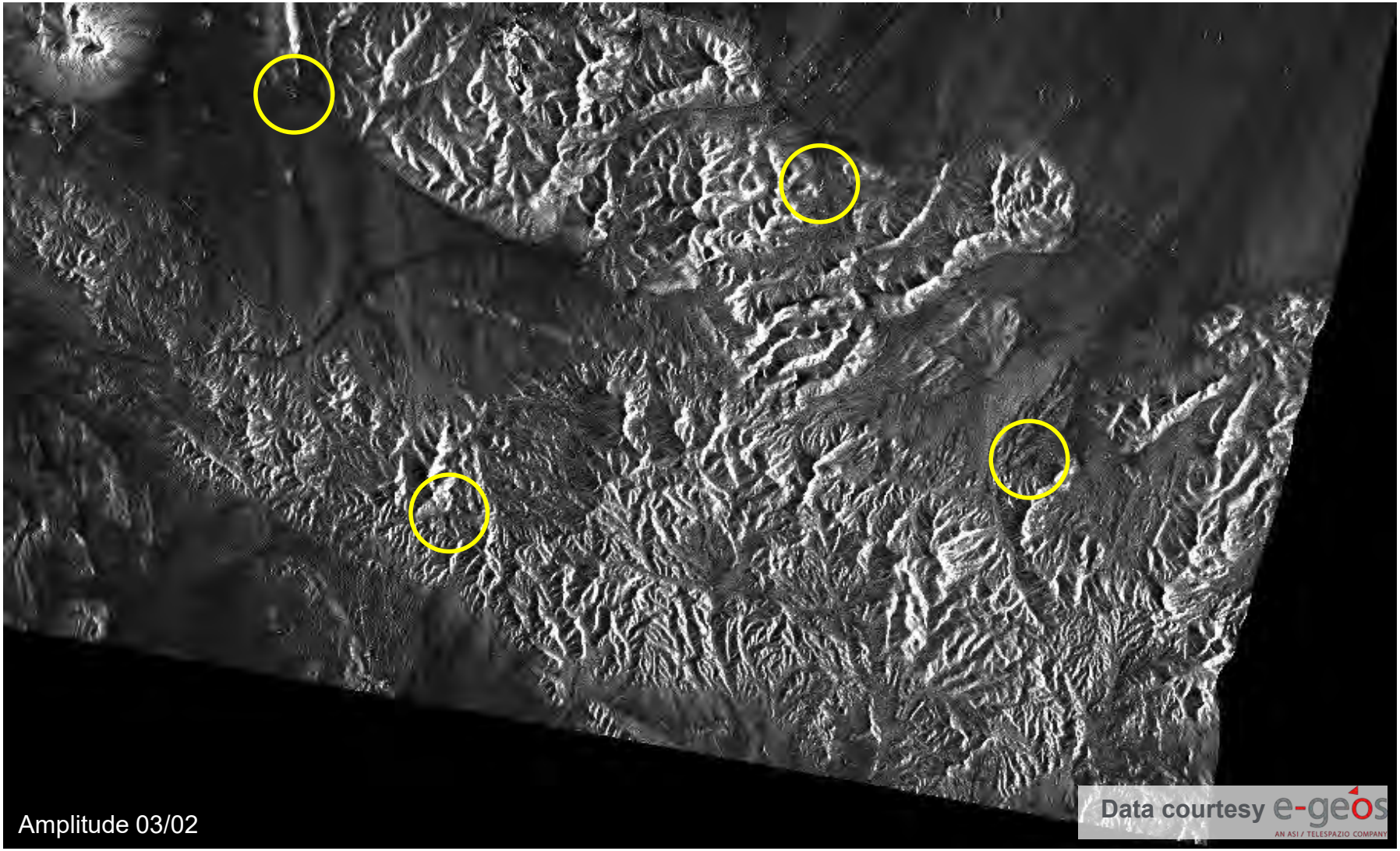


Coherence Change Detection



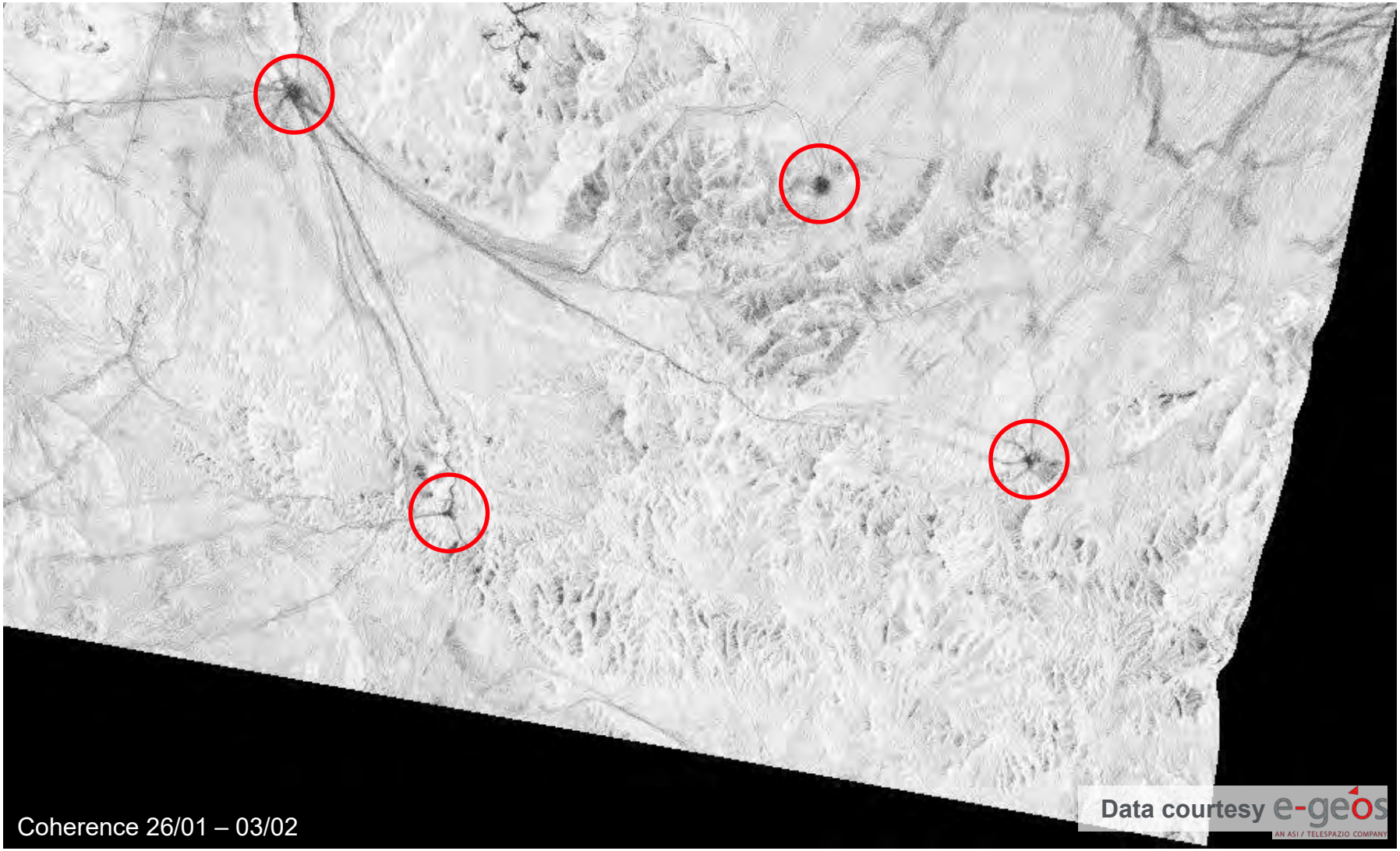
Acquisition date: January 26, 2010

Coherence Change Detection



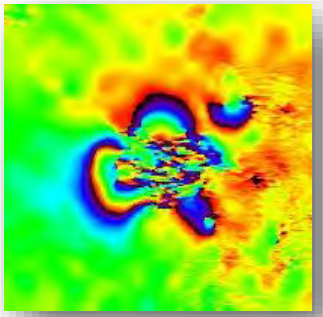
Acquisition date: February 03, 2010

Coherence Change Detection



Monitoring Nuclear Experiments with SAR

- Case Study: Monitor activities at the U.S. Nevada Nuclear Experiment Test Site using SAR interferometry
- Estimate the impact of operation Julin's "Divider" detonation on September 23, 1992 (currently final nuclear test detonation at the site)

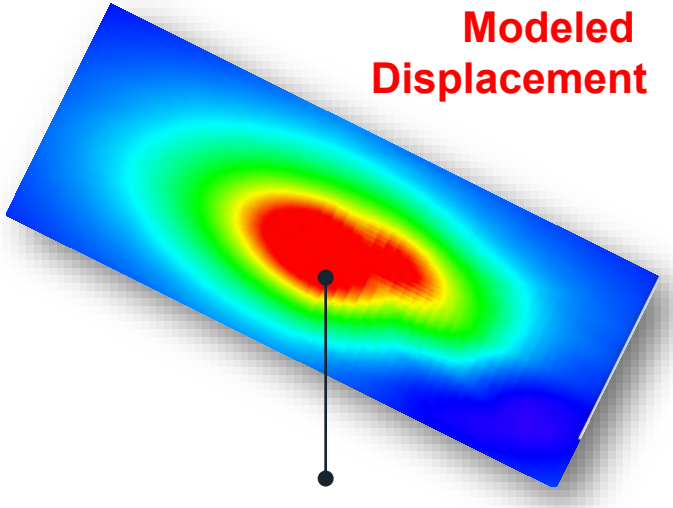


Interferometric fringes showing the terrain deformation caused by the underground explosion

Pre-event SAR amplitude

Post-event SAR amplitude

Modeled Displacement



Estimate position, depth and power of the explosion (~20 Ktons)

Data courtesy sarmap

Sentinel-1 and ENVI SARscape

Interferometric Time Series Analysis for Stability Monitoring of Infrastructure

Monitoring of critical infrastructure exemplified by the Mosul dam

Completed 1986.
Endangered by internal erosion.

sarmap project for dam monitoring with the missions ENVISAT-ASAR and Sentinel-1.

Evidence of an accelerated lowering of the earth dam.

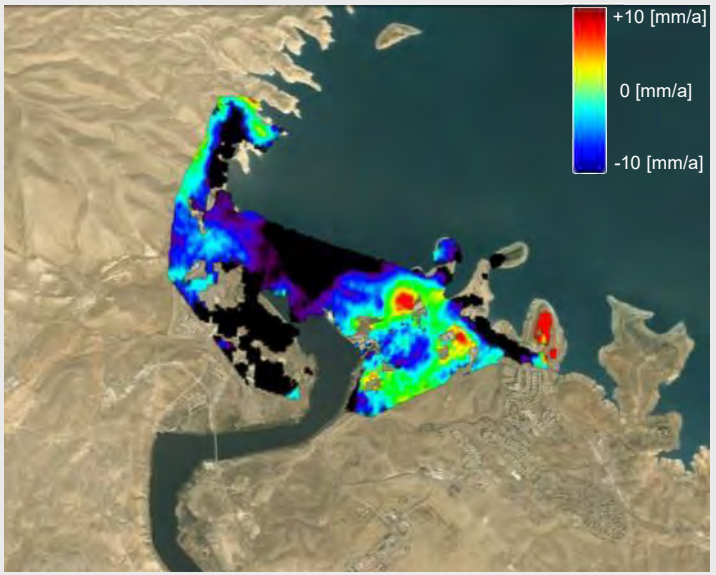
Confirmed by AIRBUS DEFENCE & SPACE with simultaneous TerraSAR-X data.

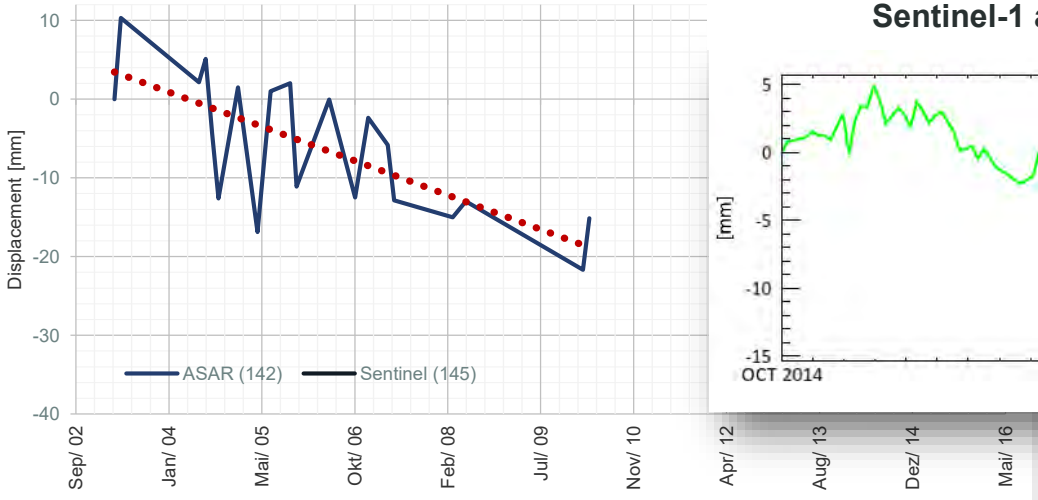
Method

Small Baseline Subset (SBAS).
SARscape cluster solution.

Top right: Vertical component of displacement.
Bottom right: Horizontal component of displacement.
Bottom: Dam deformation along the sensor line-of-sight.

Data courtesy sarmap





Sentinel-1 average displacement rate 2014-2019

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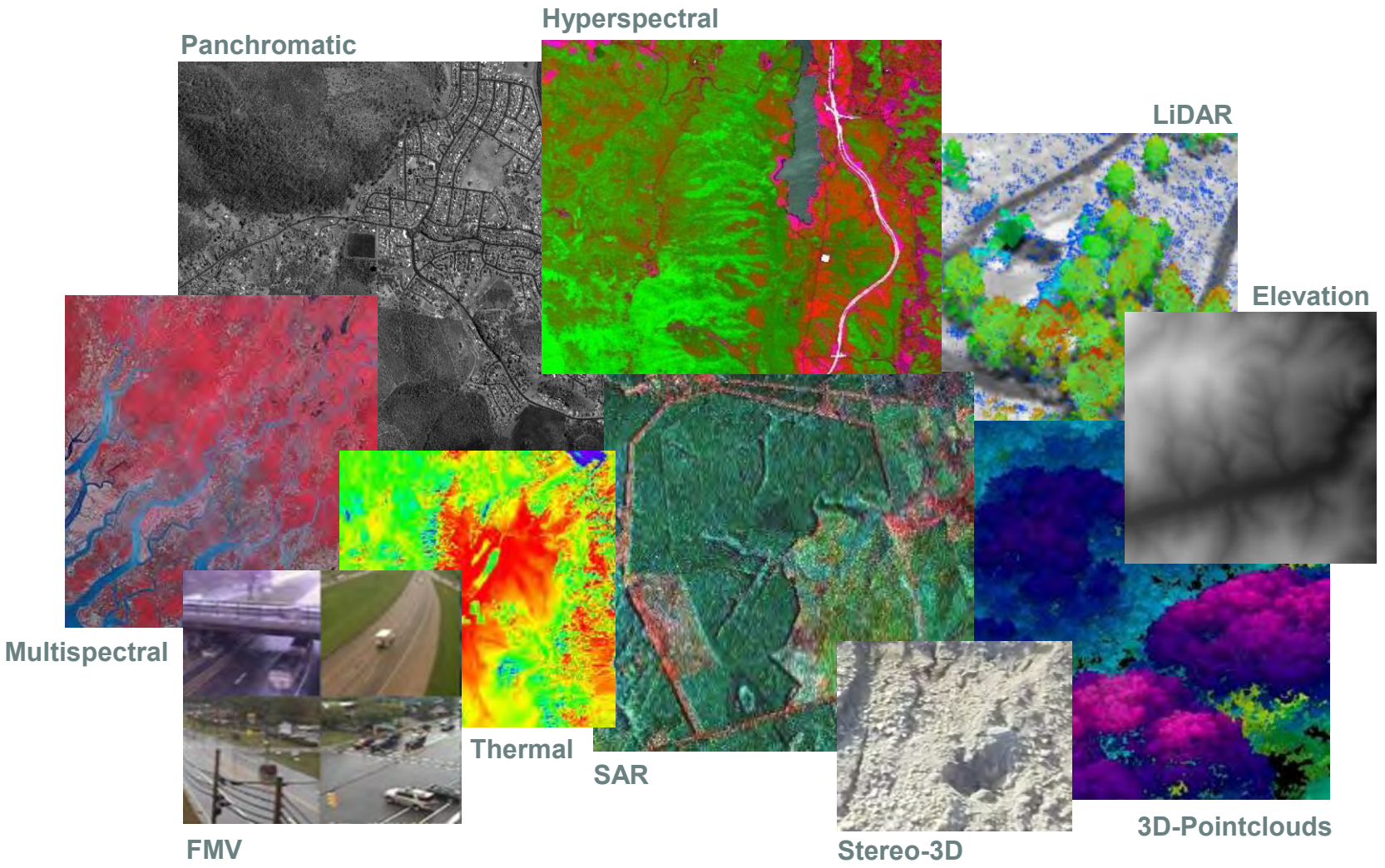
Capabilities and Solutions

ENVI – Environment for Visualizing Images

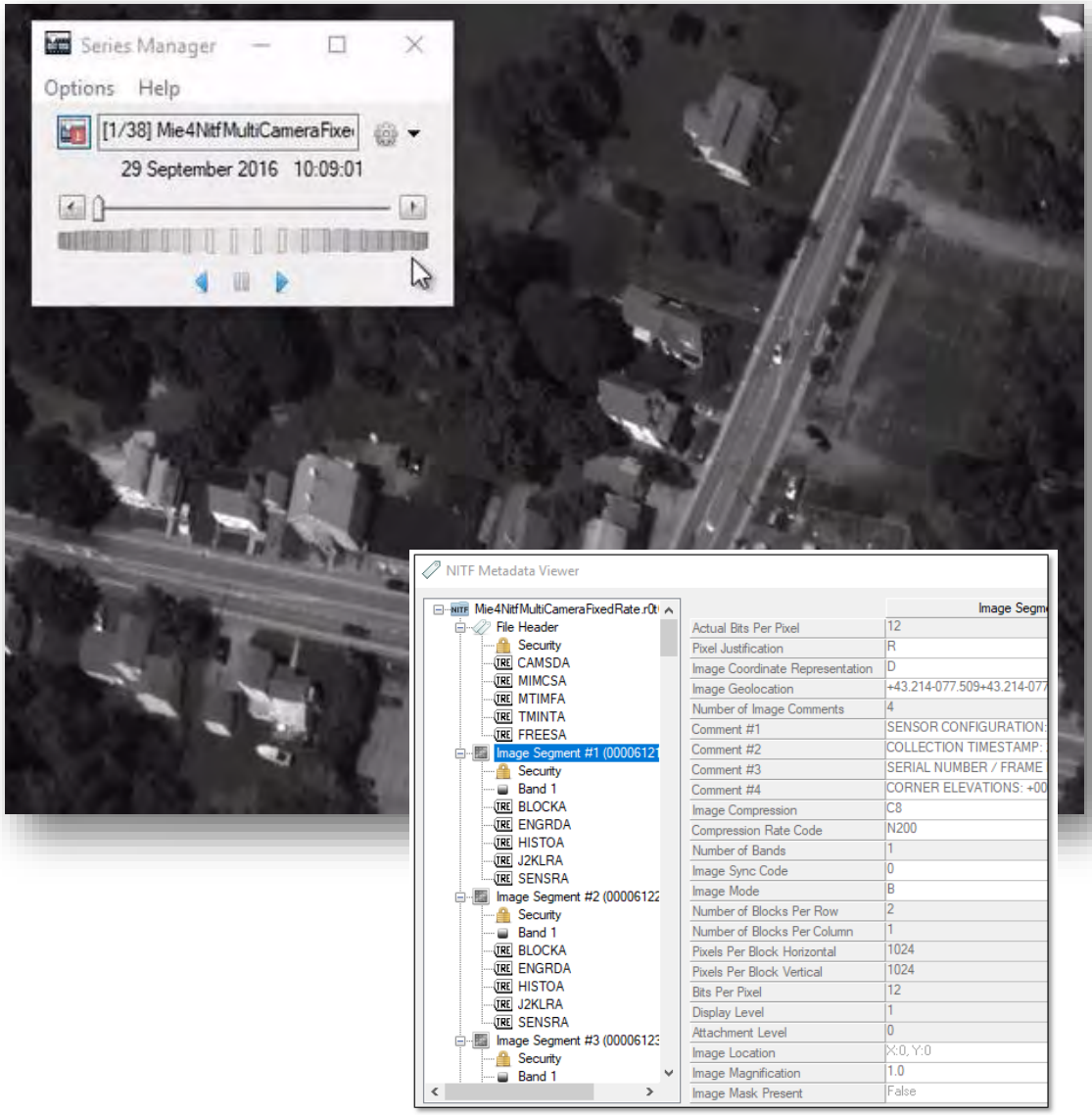


One solution for all the data types you use

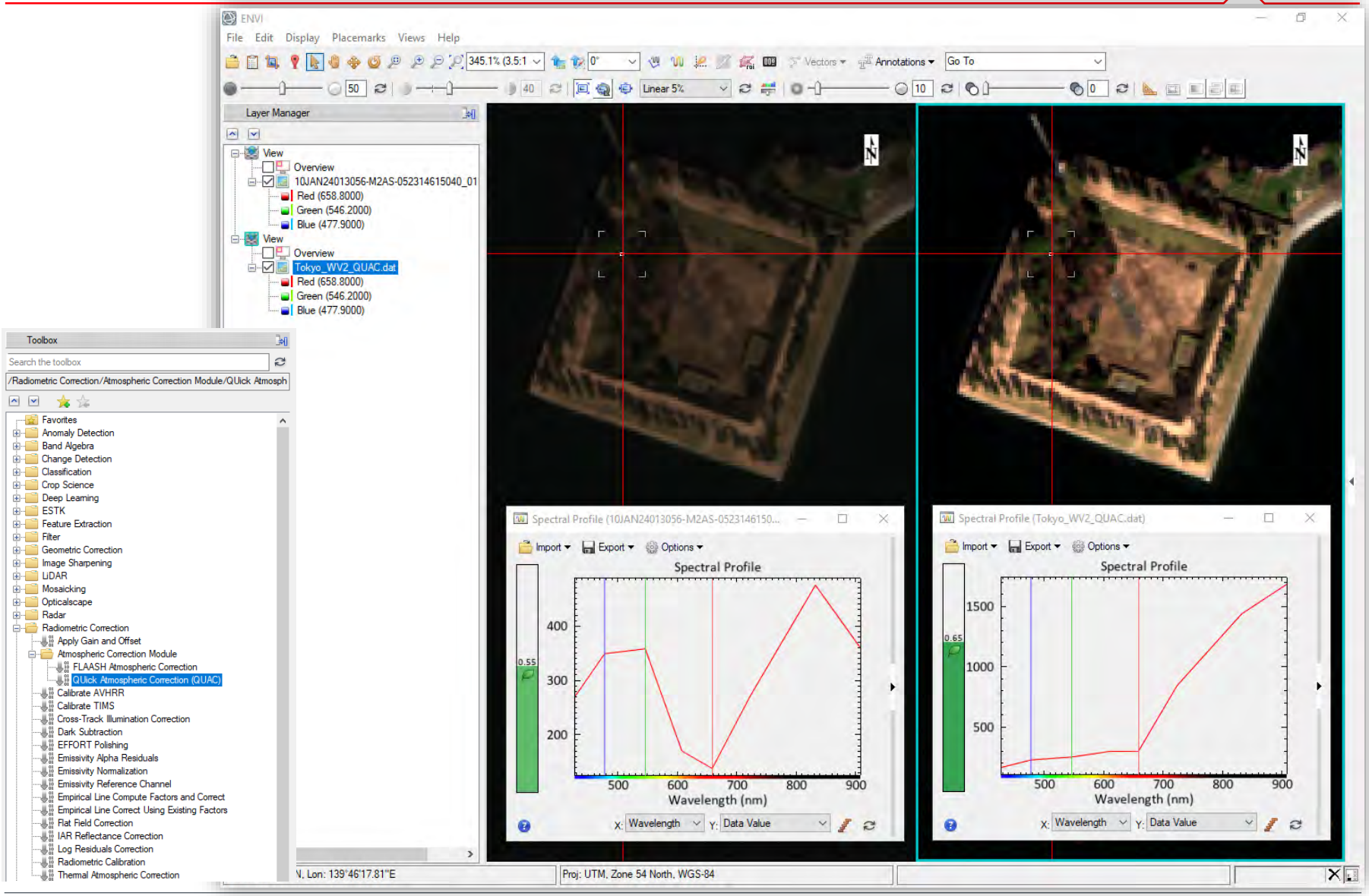
MIE4NITF: Time-Series Enabled NITF Imagery

- Standard for creating time series of NITF images
- Combines rich metadata support in NITF with time-series information from Wide Area Motion Imagery (WAMI) and Full Motion Video (FMV) systems
- Change detection, tracking patterns, movements, and activity-based intelligence purposes

ENVI is one of the first commercial software products to support MIE4NITF



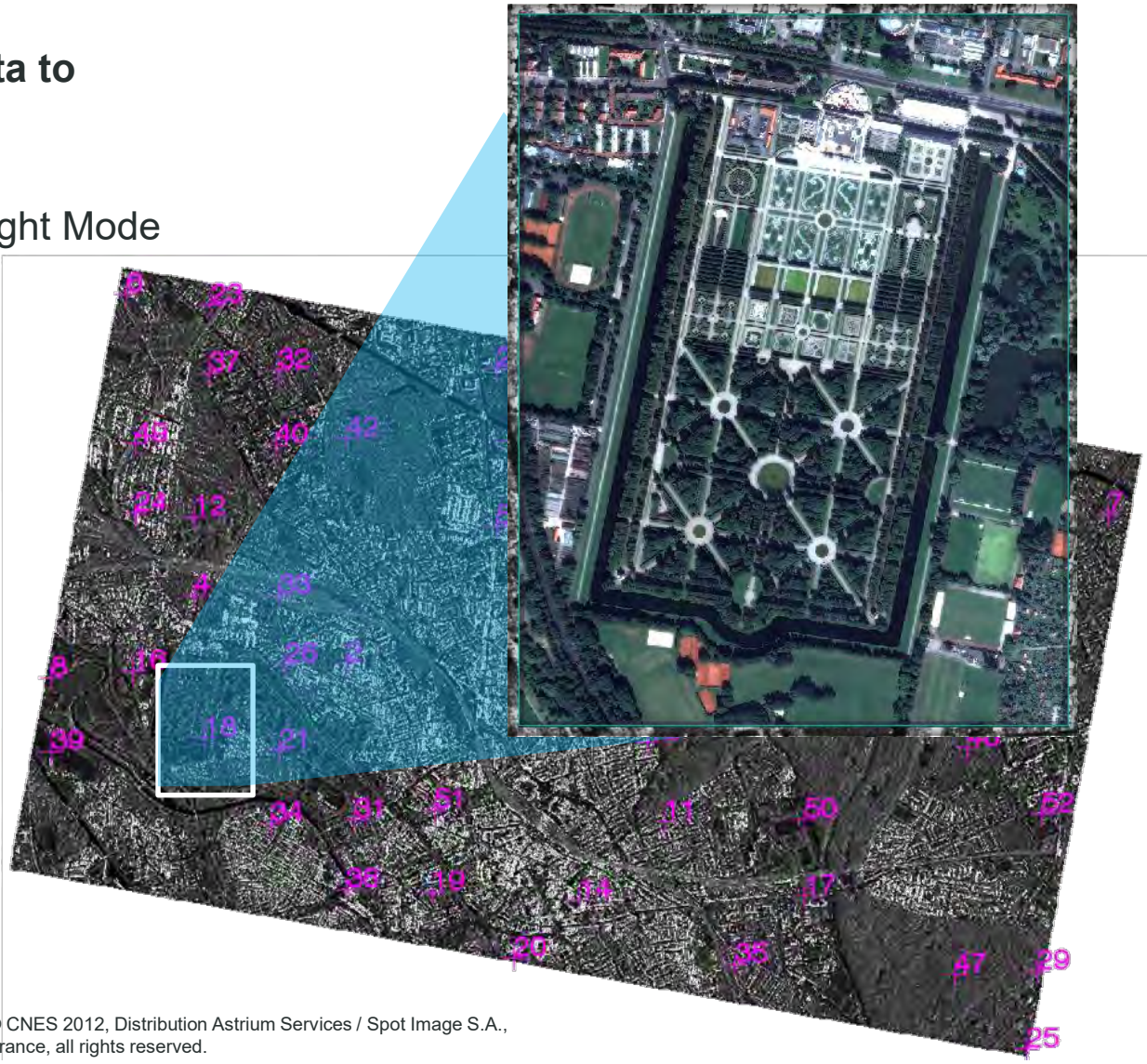
ENVI Atmospheric Correction



ENVI Multi-Sensor Image Registration

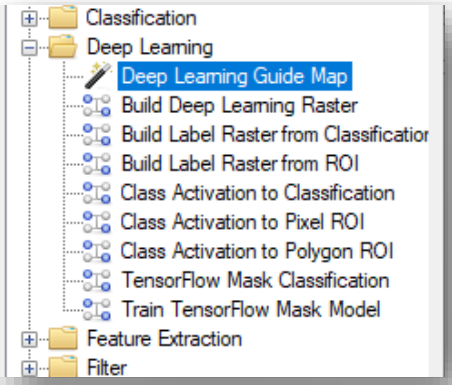
Registration of optical data to high-resolution SAR-data

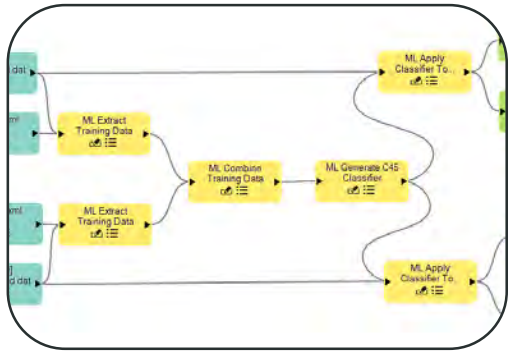
- Hannover, Germany
- Base: TerraSAR-X SpotLight Mode
- Warp: Pléiades-1a
- Method: Mutual Information
- Geometric model: Fitting Global Transform
- 3 seed / 53 tie points

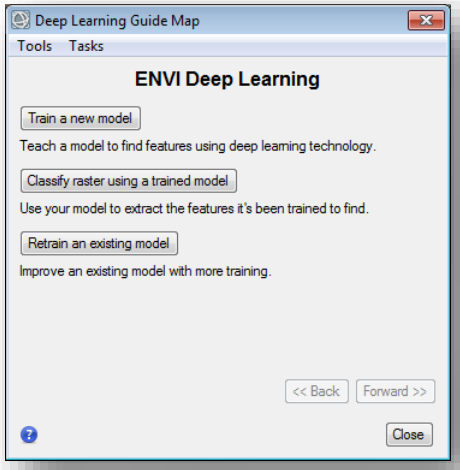


ENVI Deep Learning Module

Removes the barriers to performing Deep Learning with geospatial data and plugs directly into the ENVI interface – no programming.



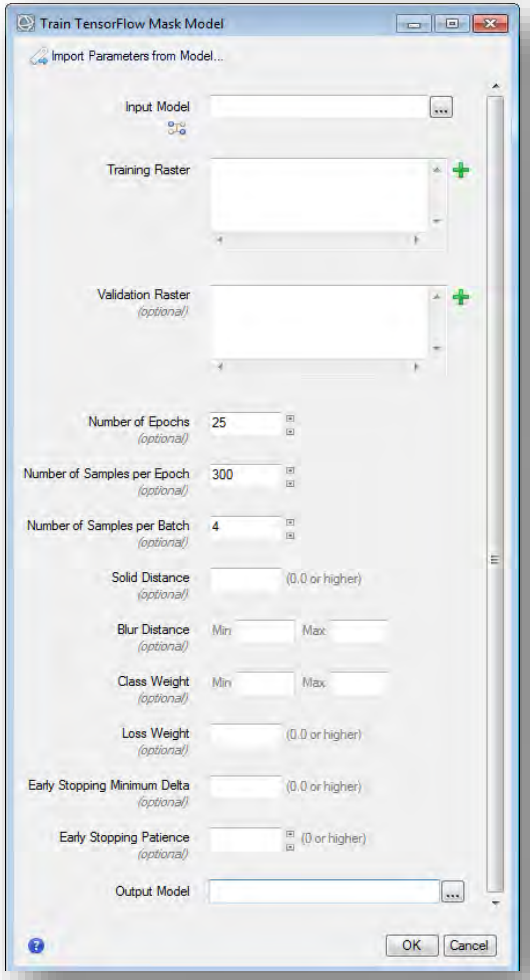




Based on the TensorFlow Deep Learning Framework and designed for object identification from geospatial imagery

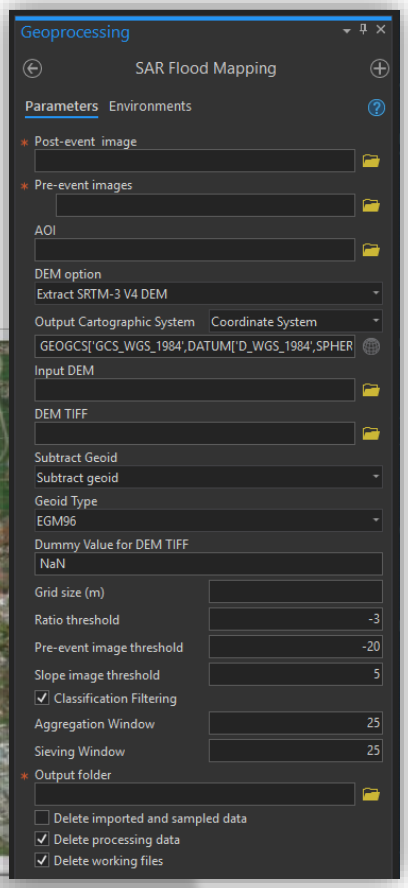
Integrated in ENVI with easy to use GUI for all processing steps including labelling, training and inference – no programming!

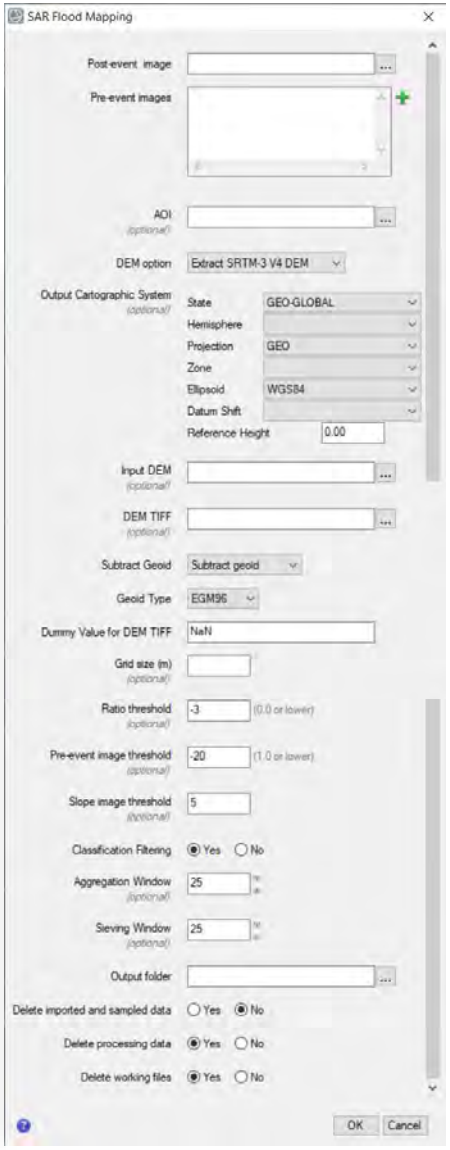
Commercial off-the-shelf (COTS) product



SARscape Analytics in ENVI and ArcGIS Pro

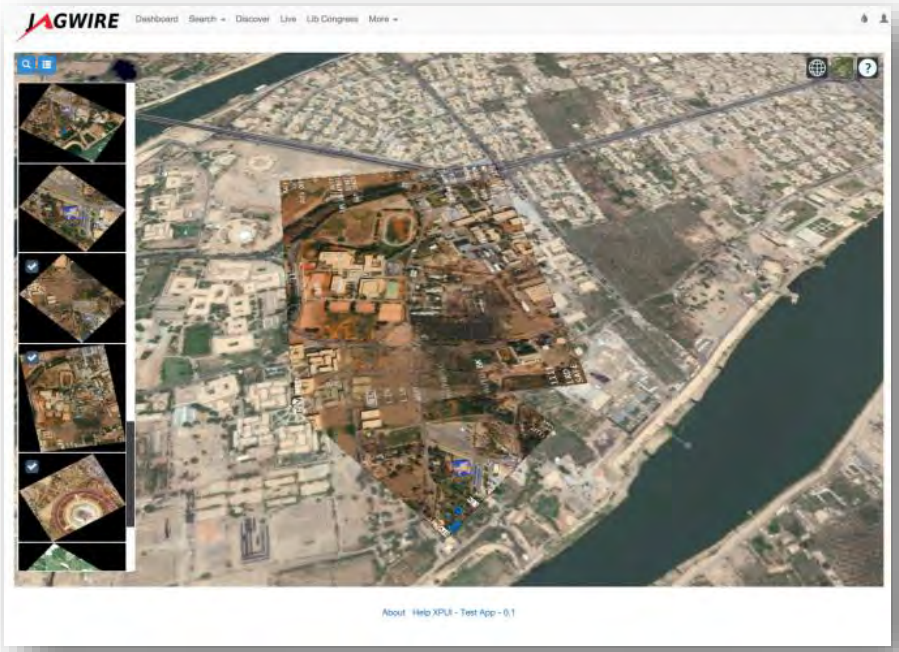
- Easy-to-use tools for the data analyst to obtain ready-to-use products from SAR
  - Supports SAR SICD and SIDD formats for military users
- Includes 10 of the most requested SAR analytics that are now available in ENVI and ArcGIS Pro toolboxes
  - Example: SAR Flood Mapping
    Creates a classification raster product that shows flooded areas





Jagwire – Remote Sensing Data Management

- Web-enabled solution that delivers an integrated platform for processing, storing, and exploiting remote sensing data in near real-time, on demand
- Example Customers
  - **US Army (PMUAS)**
    - Full Motion Video (FMV) delivered in austere environments
    - Ensures eyes-on-target with real time data
  - **US Air Force (AFSOC)**
    - Federated imagery delivered seamlessly to forward deployed analysts
    - Maximizes access to data throughout the enterprise
  - **Hawaiian Electric Company**
    - Enterprise solution for video and imagery-based maintenance activities
    - Real-time access to support disaster response scenarios



Jagwire supports fielded Shadow

Jagwire supports commercial platforms such as the DJI Inspire and Phantom used by Hawaii Electric

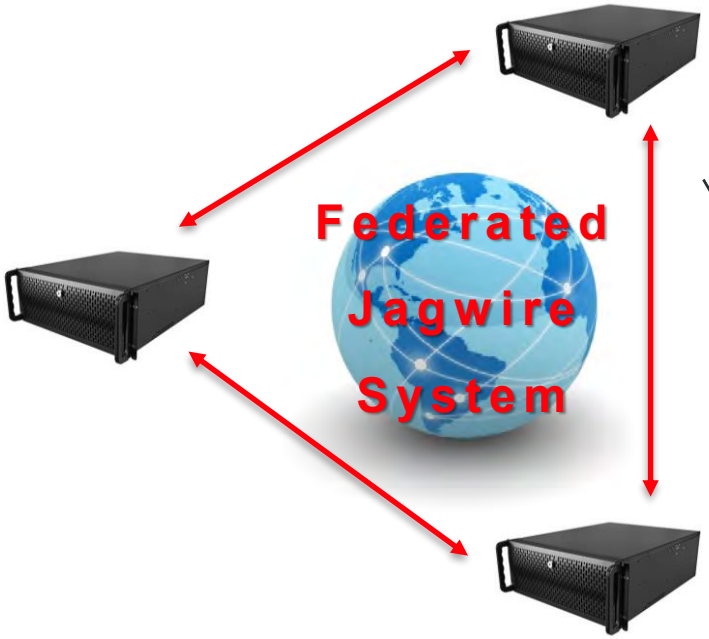
Open Architecture	Multi-Source | Modal	Standards Support	Storage, Search, Discovery & Enrichment
> Service Oriented Architecture	> Imagery Products	> MISB	> Architected to manage and exploit "Big Data"
> Extensible platform	> FMV & WAMI	> STANAG	> Powerful tools to help find data rapidly
> Built to scale	> SAR, GMTI & LiDAR	> OGC	> User-based product generation

Jagwire in a Nutshell

Ingest
- Multi-Modal
- Multi-Source
- Compression

Real-time Federation
- Ingest
- Search & Discovery
- Advanced Analytics
- Dissemination

- FMV
- WAMI
- Imagery
- Imagery products
- Multispectral
- Hyperspectral
- Detected SAR
- LiDAR
- GMTI & VMTI



Lower Resolution & Bit-Rate

Native Resolution (HD)

Transformed Data - Standards Compliant

Tactical User

Operations Center

Enterprise System

Search & Discovery
- Enterprise-wide
- Advanced cataloging
- Quickly locate critical content

Advanced Analytics
- Architecture to support “Big Data”
- On-demand Analysis
- Multi-INT fusion for Intel product generation

Dissemination
- JPIP Streaming
- Selectable FMV profiles
- Normalization to standards

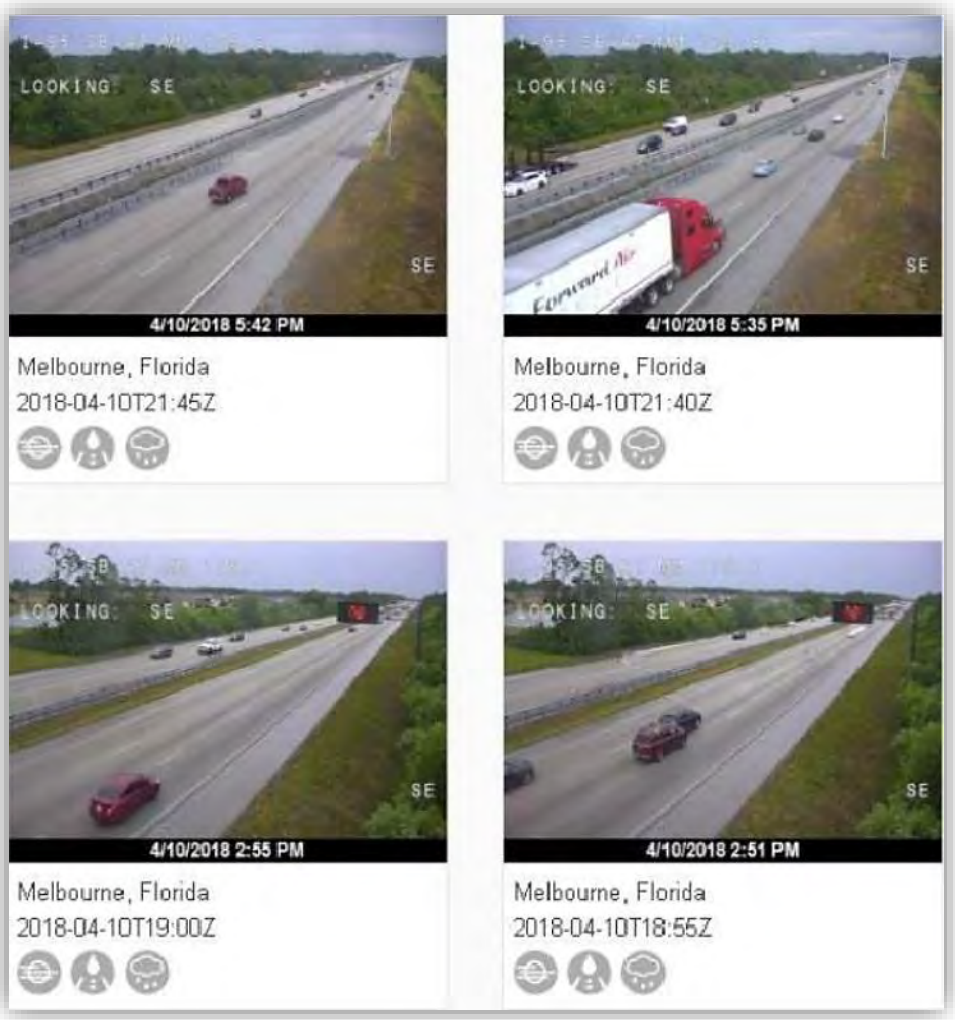
Helios – ARGOS Red Vehicle Finder

Background

- Helios 40,000 terrestrial network of CCTV traffic cameras used to analyze content using machine learning to provide unique hyper-local intelligence.
- Low resolution, high compressed, highly disparate imagery.

Detection Use Case

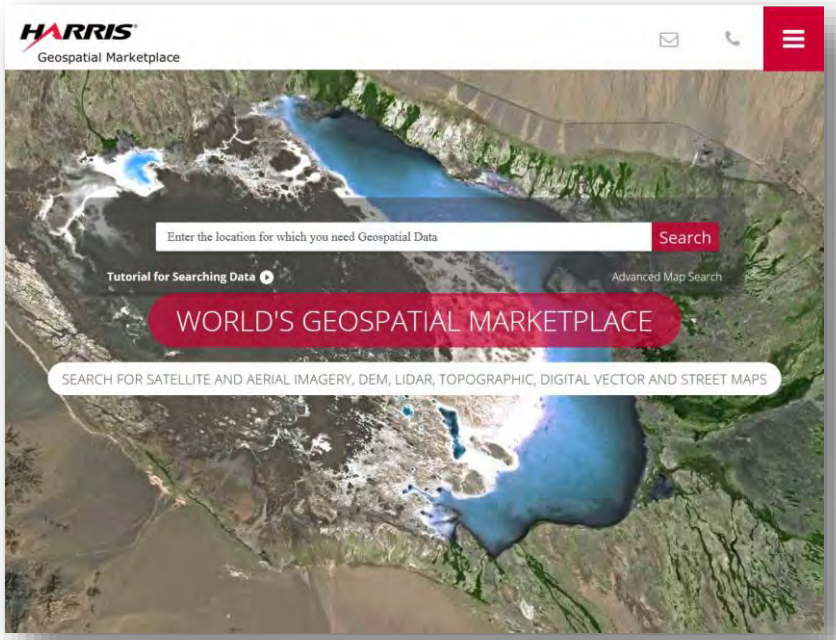
- Re-purpose “dumb” traffic cameras into “smart” tracking cameras using machine learning technologies, e.g. Deep Learning.
- To focus search, detect possible red vehicles on interstates used in criminal activity fleeing.

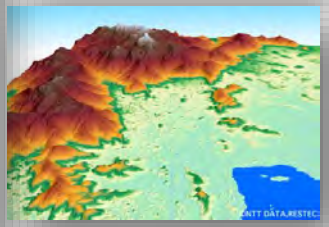


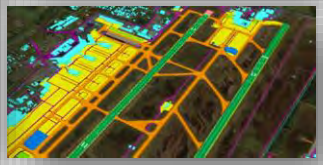
L3Harris Geospatial Data & Imagery

L3Harris Geospatial Marketplace

L3Harris offers a large selection of geospatial products worldwide including satellite imagery, aerial maps, digital elevation model (DEM) data, vector and lidar data, topographic maps, and more.

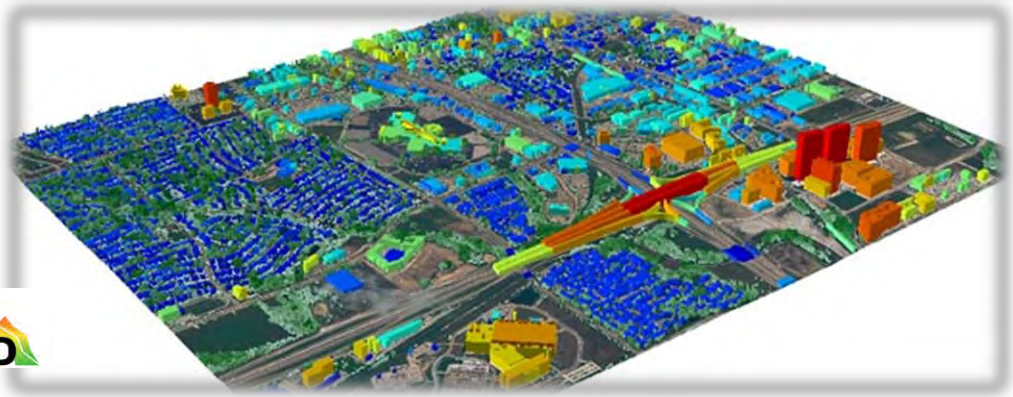






Geospatial services

Creation of custom solutions for highly automated information extraction supported by a broad portfolio of professional software technologies and knowledge transfer.



DigitalGlobe
A MAXAR COMPANY
AIRBUS
planet.
AW3D

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