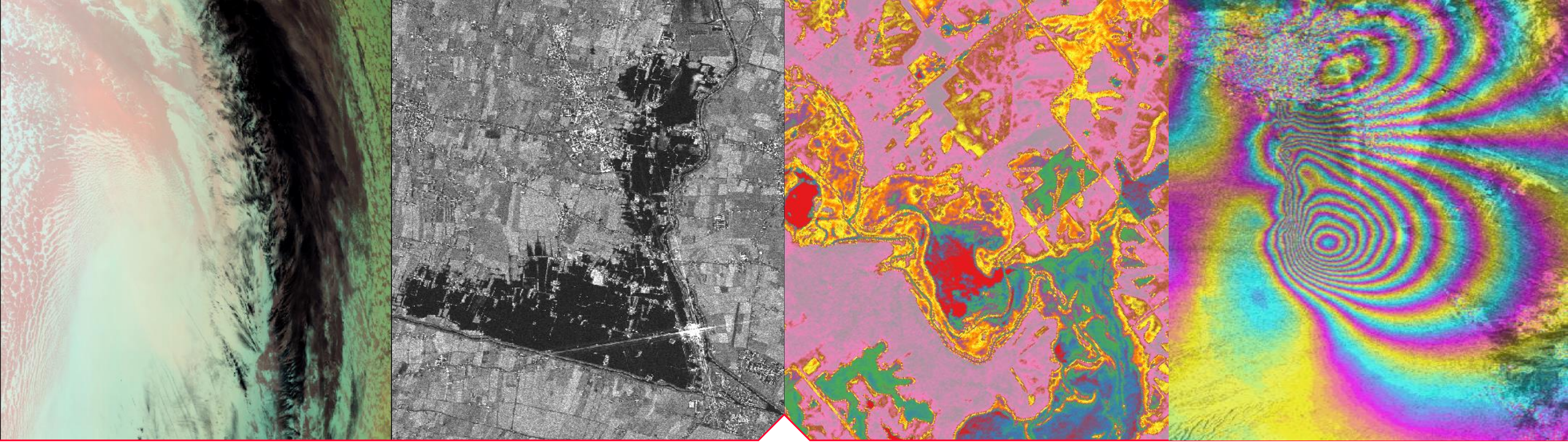


L3HARRIS™

REMOTE SENSING SOLUTIONS FOR DISASTER MANAGEMENT & EMERGENCY RESPONSE

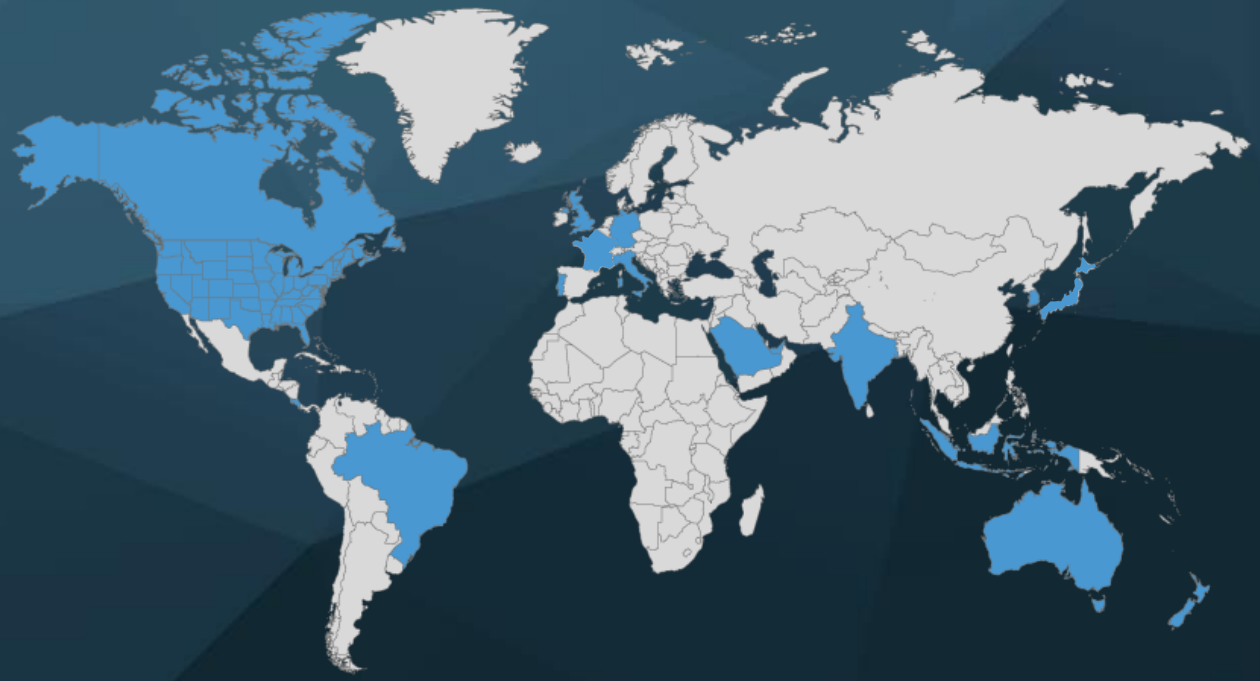
Achieving Rapid, Actionable Decisions in Disaster Assessment & Response

November 28th, 2020

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

L3HARRIS

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



+350
LOCATIONS

CUSTOMERS IN
+100
COUNTRIES

~20k
ENGINEERS

~48K
EMPLOYEES

L3HARRIS
FAST. FORWARD.

L3HARRIS GEOSPATIAL SOLUTIONS

INGEST DATA & IMAGERY

BIG DATA

PROCESS & ANALYZE

Extract contextual, meaningful information from all types of data and imagery

- ENVI
- Custom Solutions
- IDL
- Deep Learning
- Jagwire
- GSF

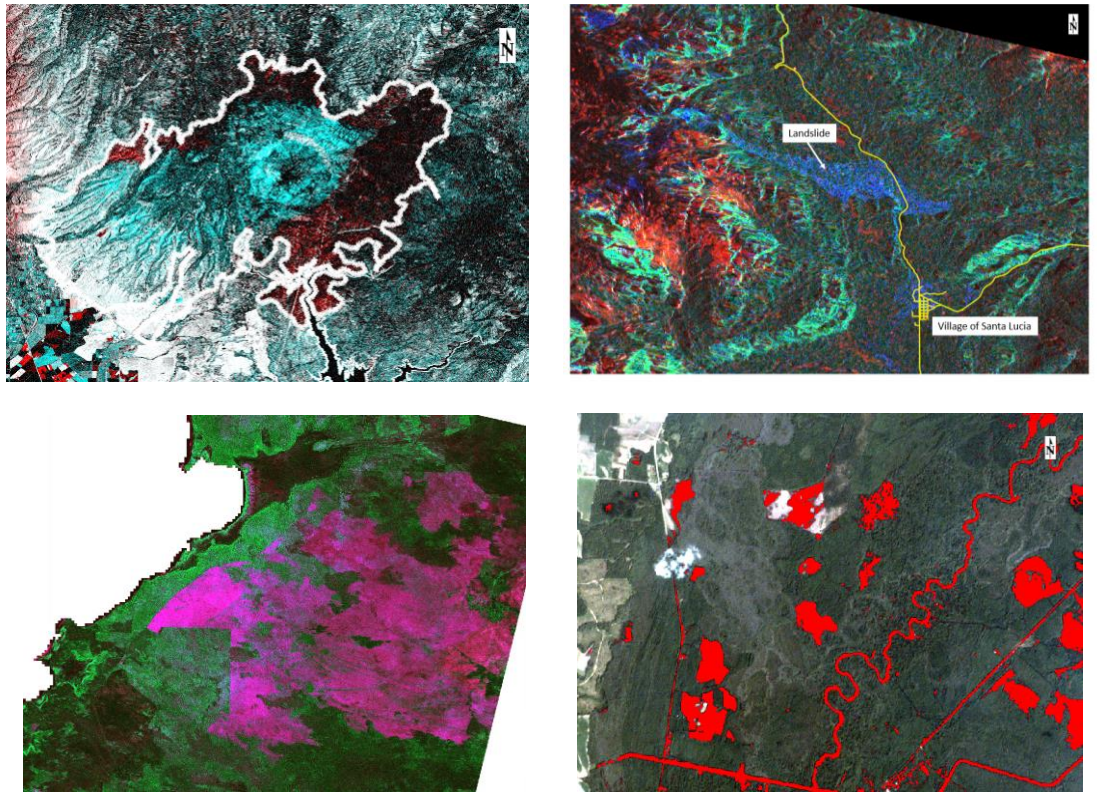
DISSEMINATE & ACT

UTILITES	DEFENSE AND INTELLIGENCE	PRECISION AGRICULTURE	TRANSPORATION
Asset Management Storm Damage Response Vegetation Management	Mission Planning On-Demand GEOINT Exploitation Tools Image Processing Workflows	Image Analytics Crop Counter Hot Spot Analysis	Asset Management Infrastructure Assessment Vegetation Management

Scenarios on Disaster Management & Emergency Response

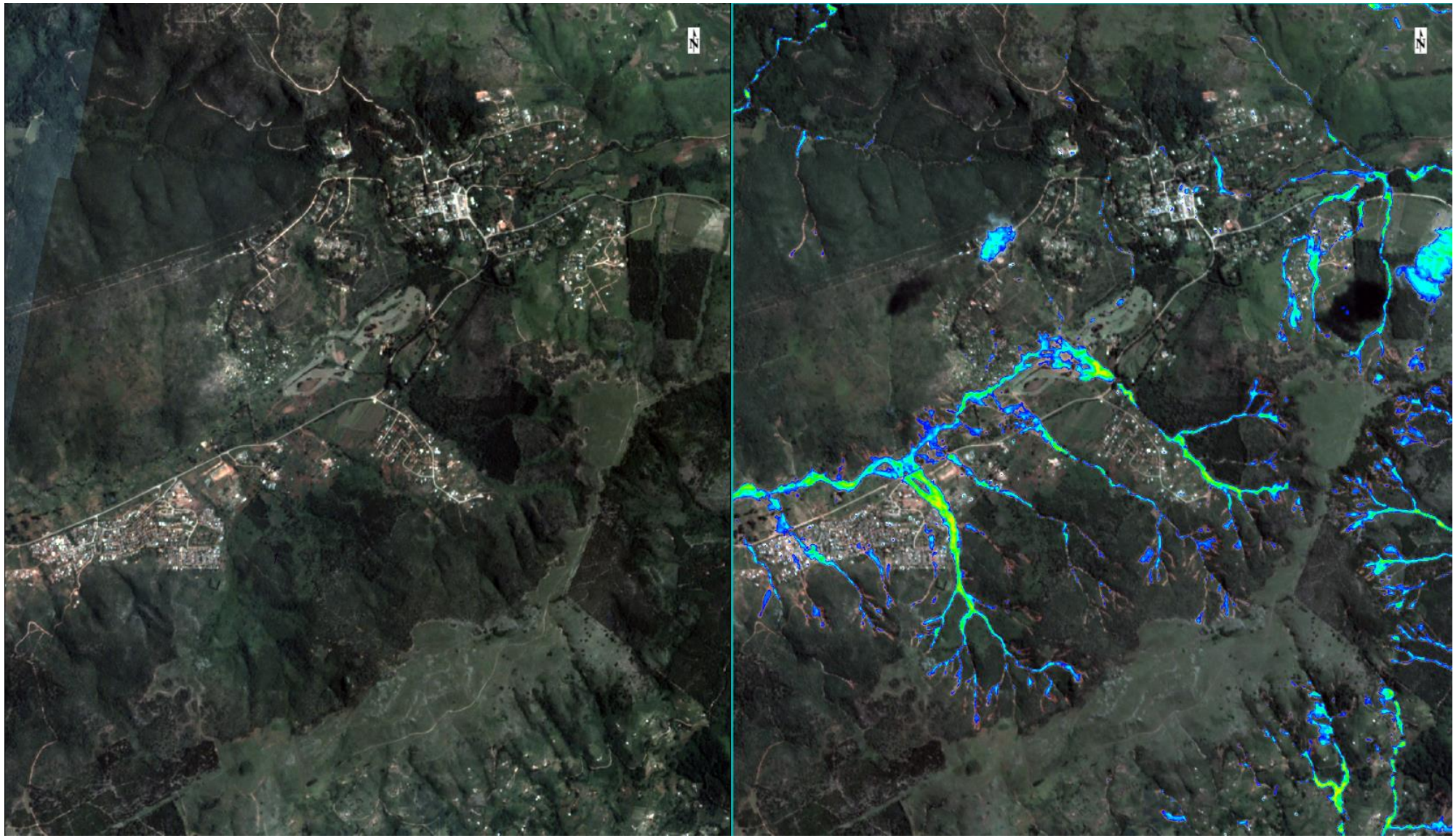
Disaster Management & Emergency Response

- Top priorities after a disaster are to:
  - Rapidly assess and quantify damage extent
  - Locate and identify hazards
  - Evaluate access to infrastructure
  - Task resources to help in the recovery effort based on where, and how severe, the damage is
- Imagery is a unique and valuable source of data for
  - Response efforts
  - Recovery
  - Impact analysis
- Respond quickly and effectively with remote sensing technology following natural and human-generated disasters:
  - Damage assessment: Oil spills, forest-/ wildfires, landslides, storms, floods, tsunamis, volcanoes, earthquakes, …
  - Hazard monitoring, road network identification, …
  - Minimizing time lag to first responders and planning for response



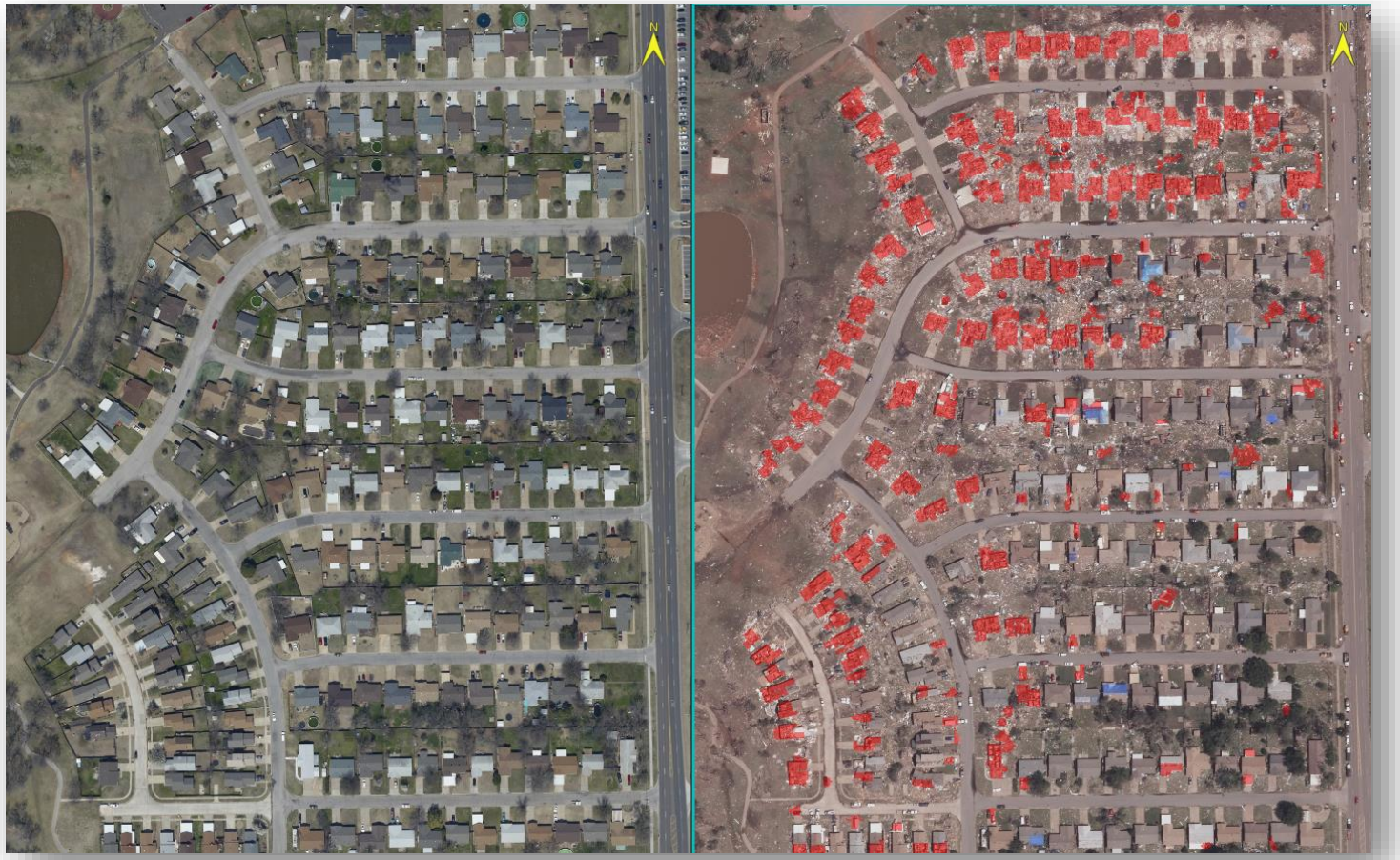
Examples of different natural disasters and how you can see them with remotely sensed data. Examples: Fire extent (top-left and lower-left), landslides (top-right), flooding (lower-right)

Deep Learning Landslide Mapping

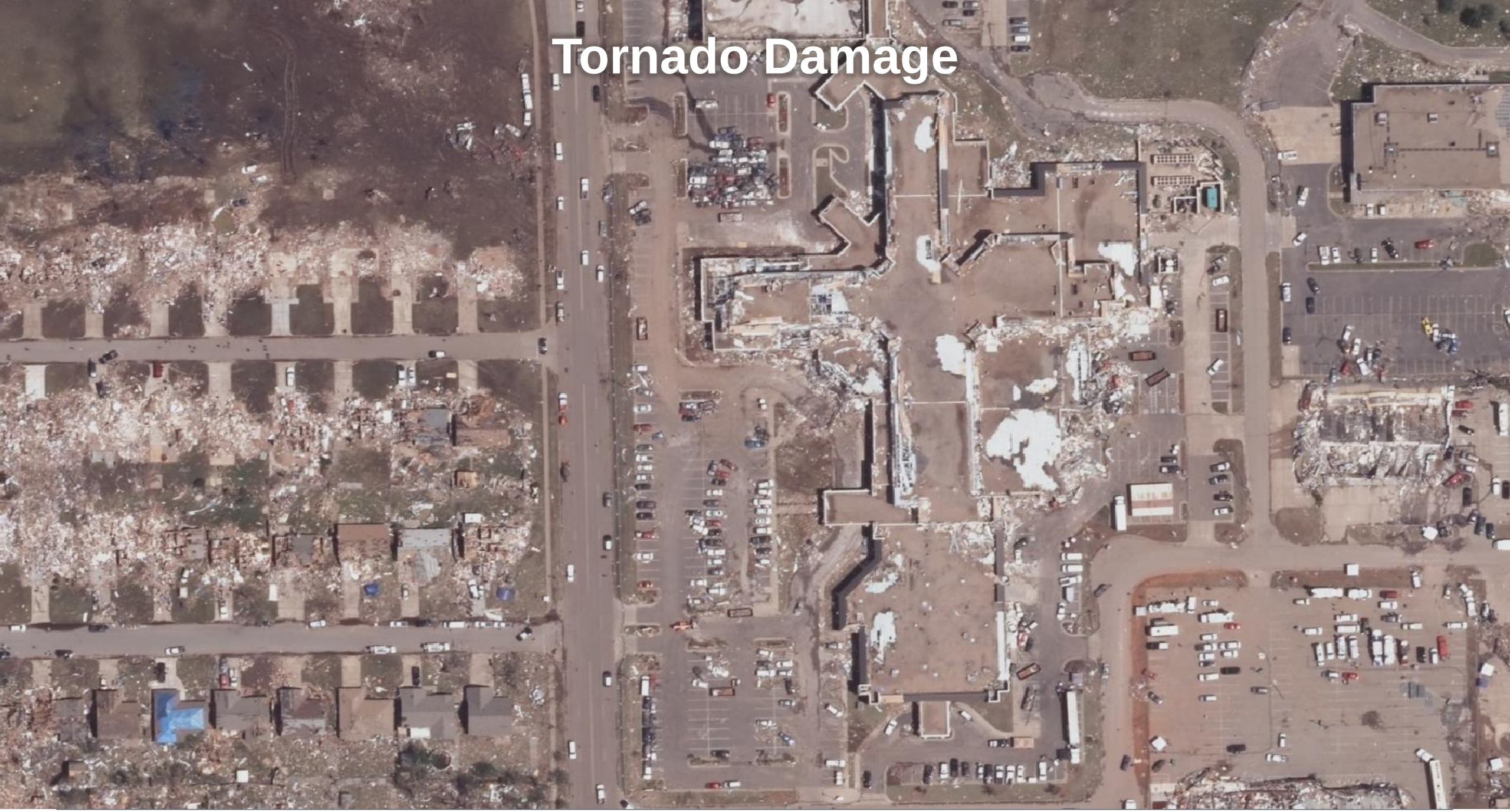


Deep Learning Landslide Mapping

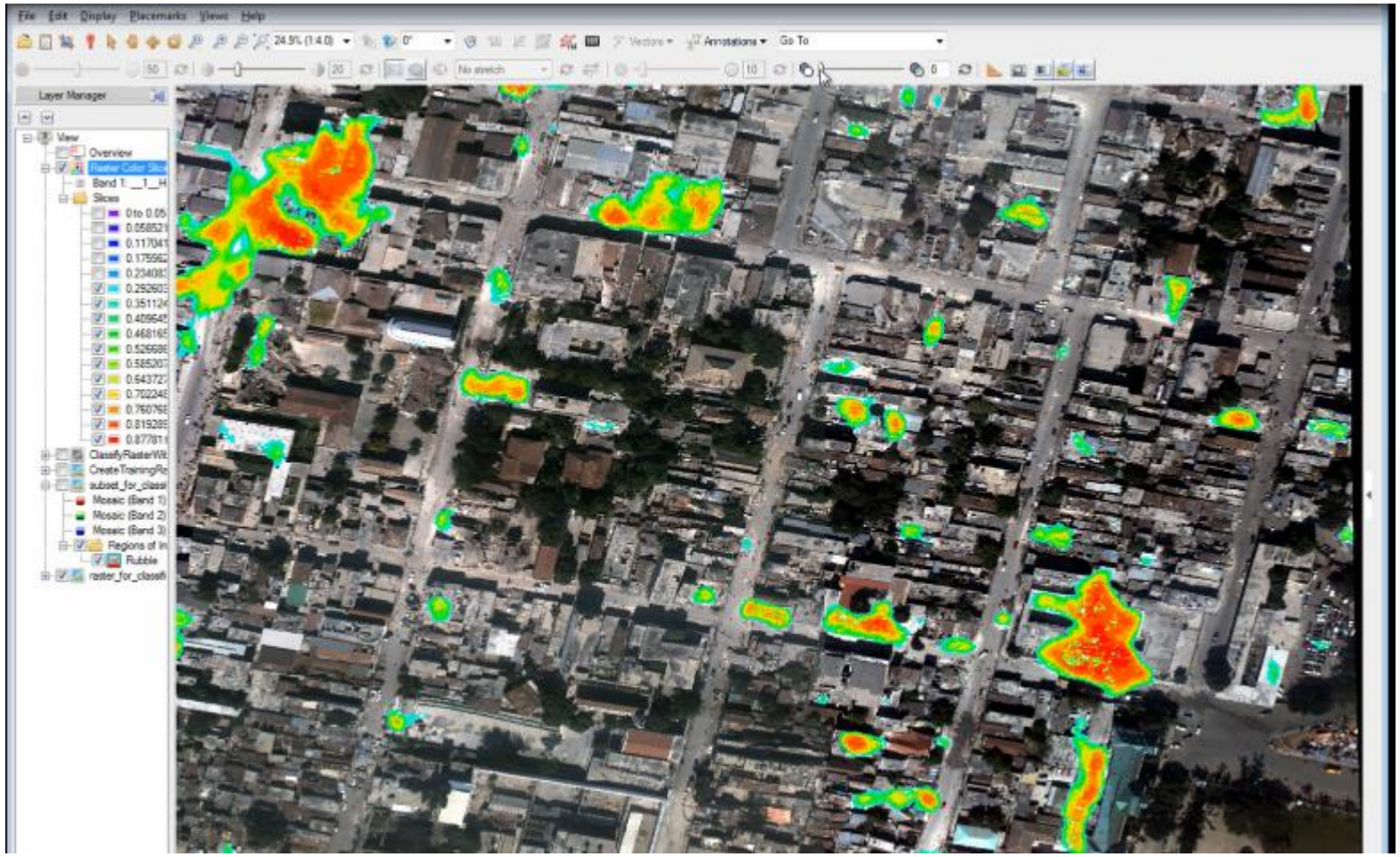
Deep Learning Building and Damage Detection

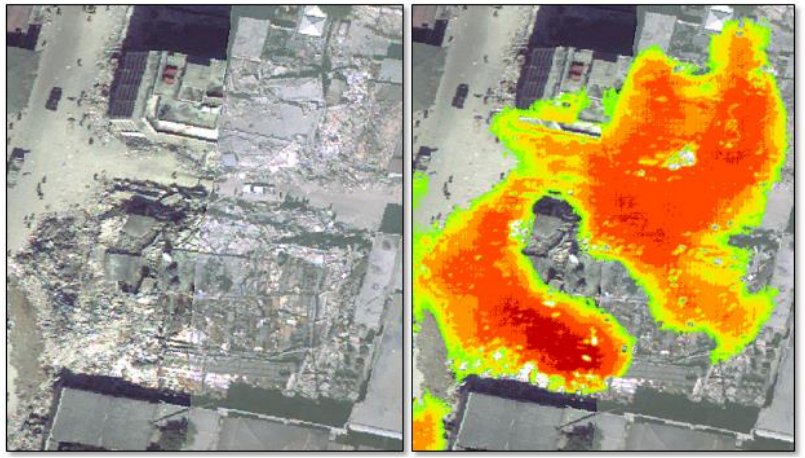


Tornado Damage



Deep Learning Rapid Disaster Assessment





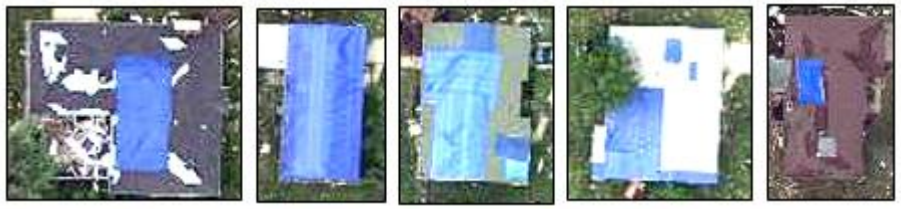
Source: Applying ENVI Deep Learning for Disaster Response: https://www.l3harrisgeospatial.com/Learn/Case-Studies/Case-Studies-Detail/ArtMID/10204/ArticleID/23776/Applying-ENVI-Deep-Learning-for-Disaster-Response

Deep Learning Building Damage Labeling

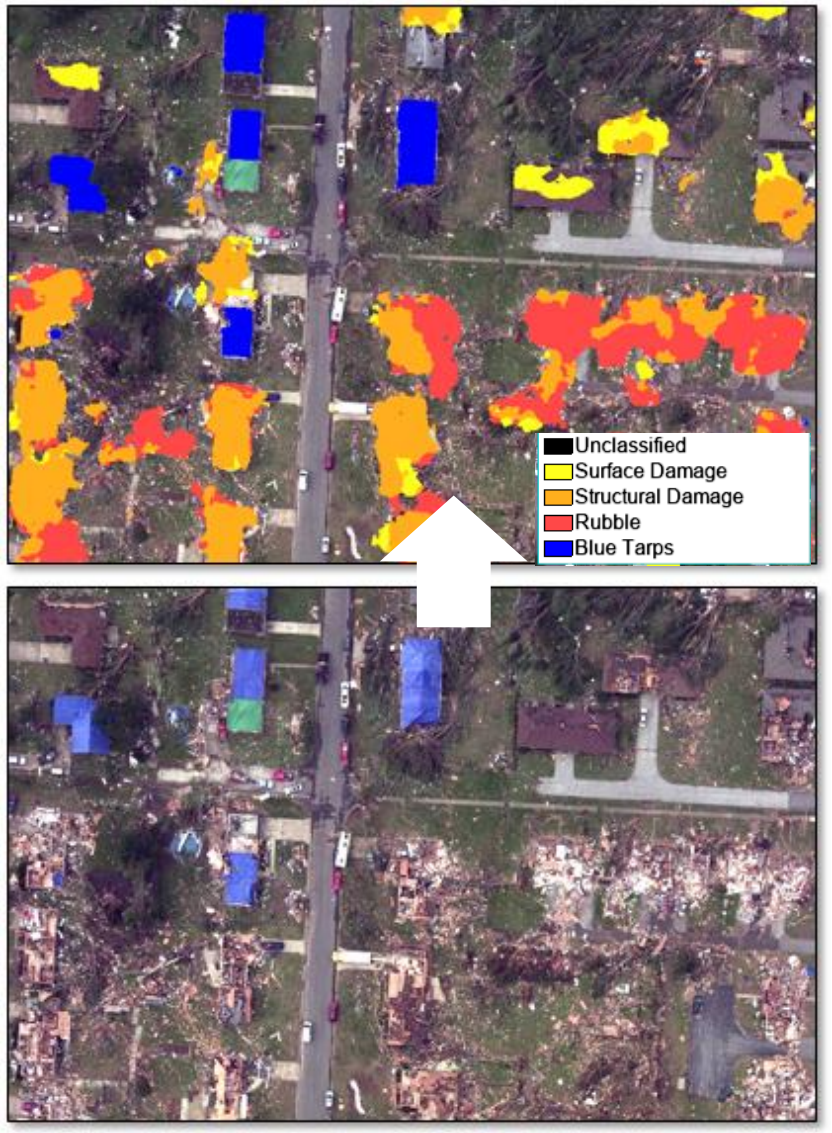
Roof / Surface Damage

Structural Damage

Rubble



Blue Tarp



Deep Learning Building Damage Classification

Deep Learning Damage and Blue Tarp Detection

36.181392°N, 86.611502°W

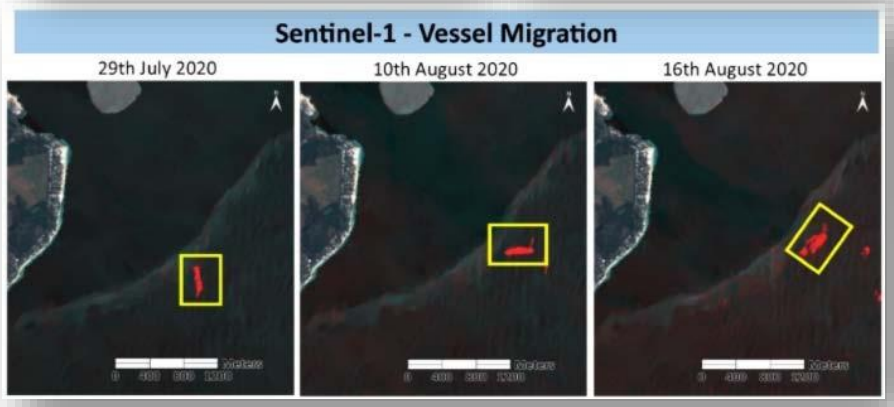
Tornado Path

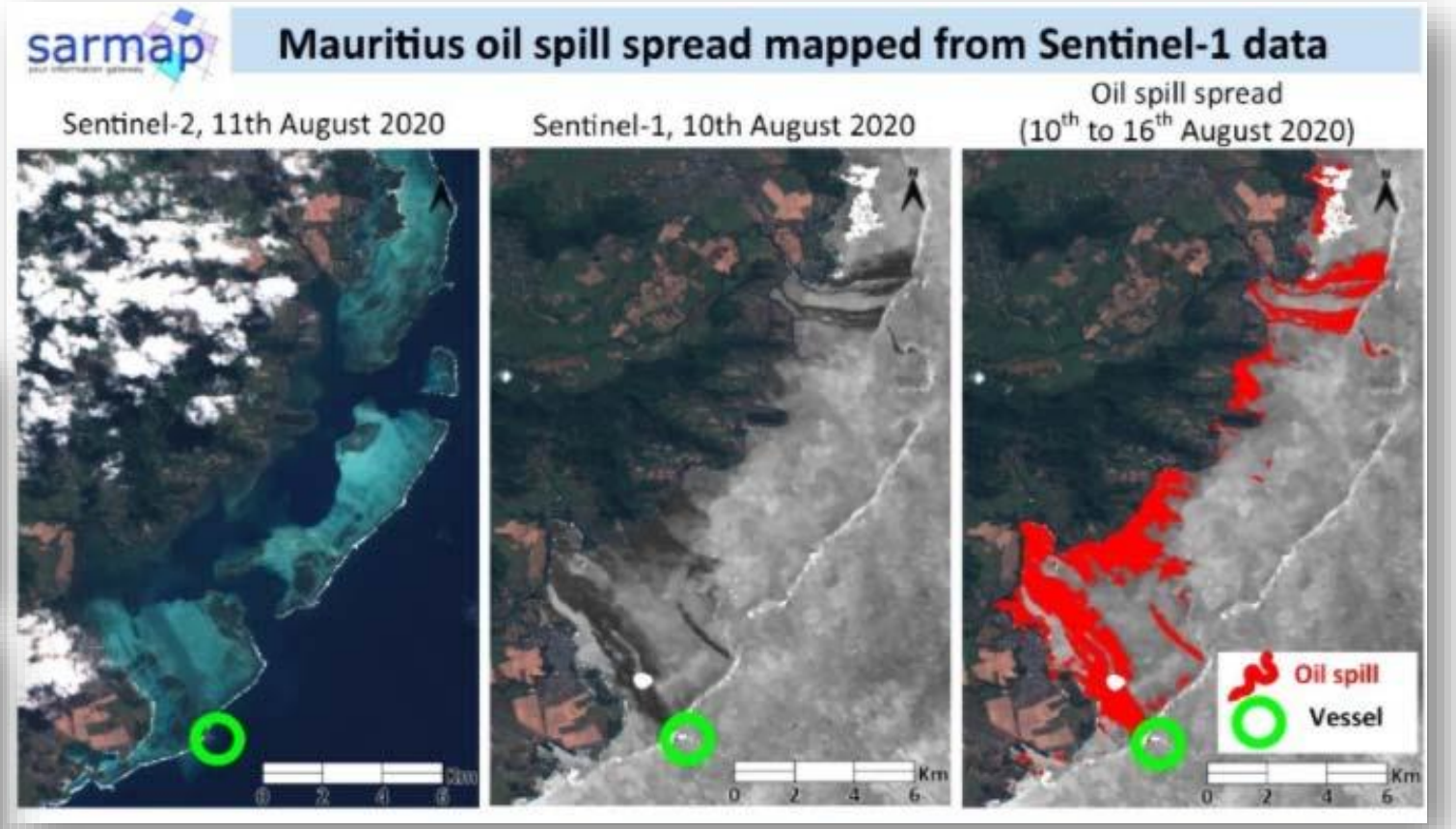
36.178104°N, 86.647217°W

Synthetic Aperture Radar (SAR) – All-Weather Earth Observation Data

Using SAR to Accurately Map Oil Spills

- Map oil leakage and the environmental catastrophe after MV Wakashio hit a coral reef on July 25, 2020, near Mauritius

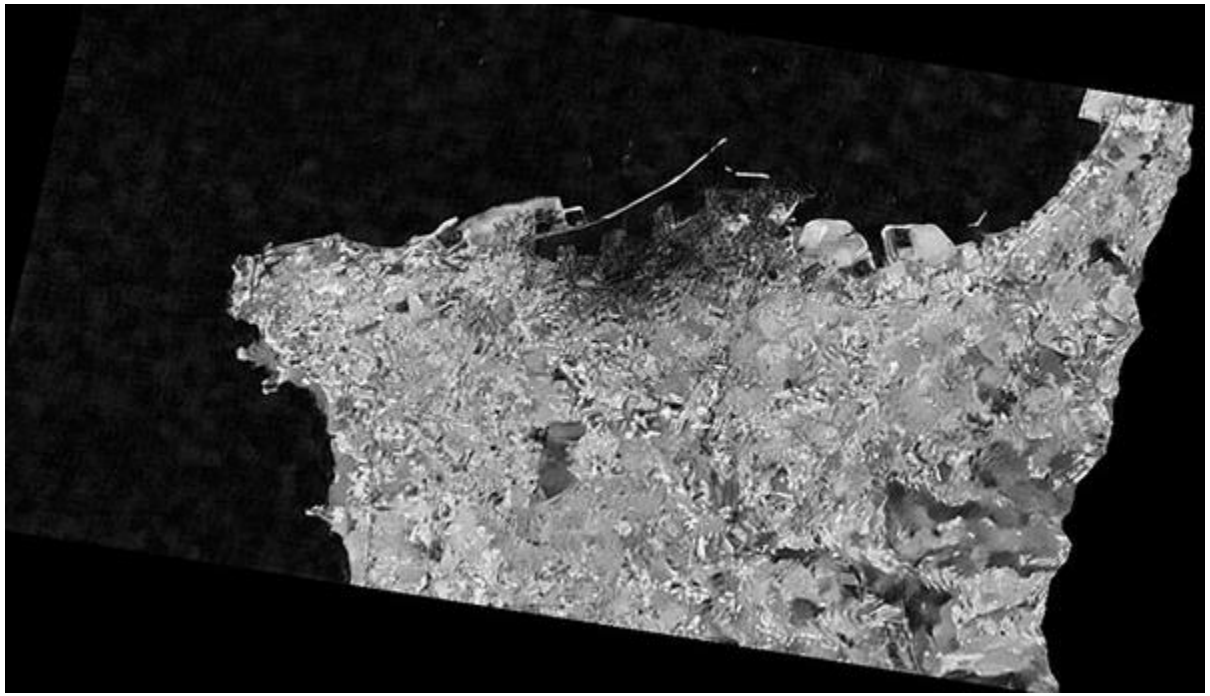


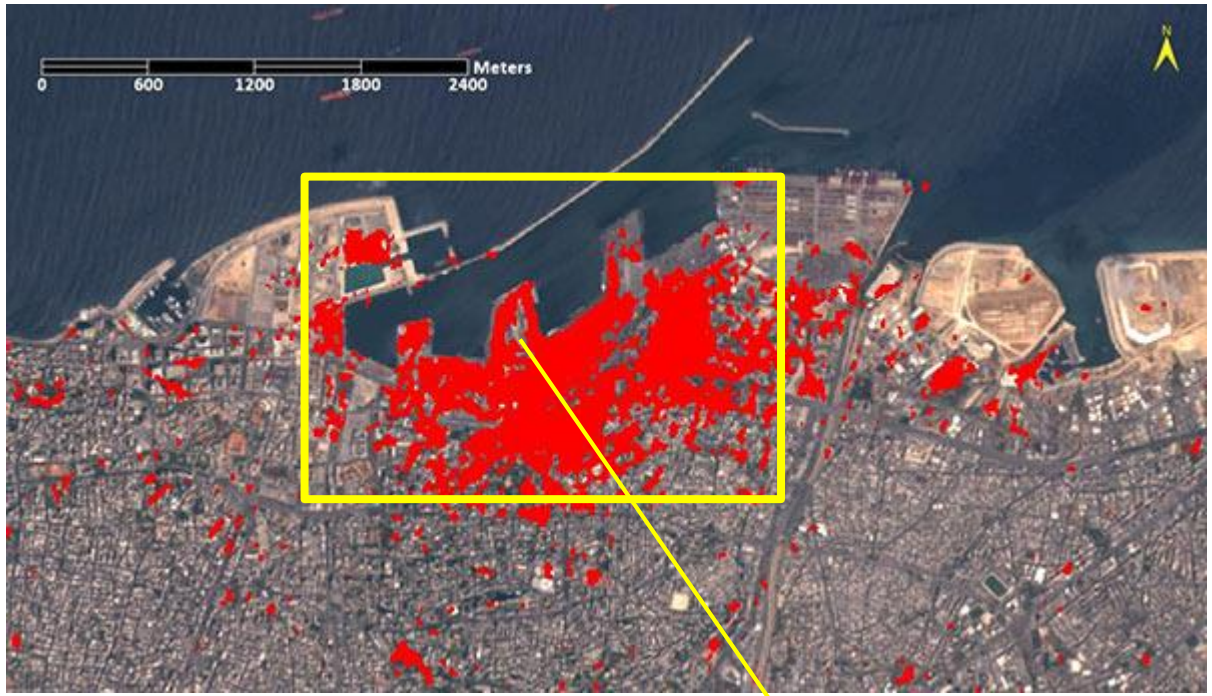


Data courtesy sarmap

Source: Using SAR to Accurately Map an Oil Spill: https://www.l3harrisgeospatial.com/Learn/Blogs/Blog-Details/ArtMID/10198/ArticleID/23952/Using-SAR-to-Accurately-Map-an-Oil-Spill

Extract Damage from 2020 Beirut Explosion using SAR





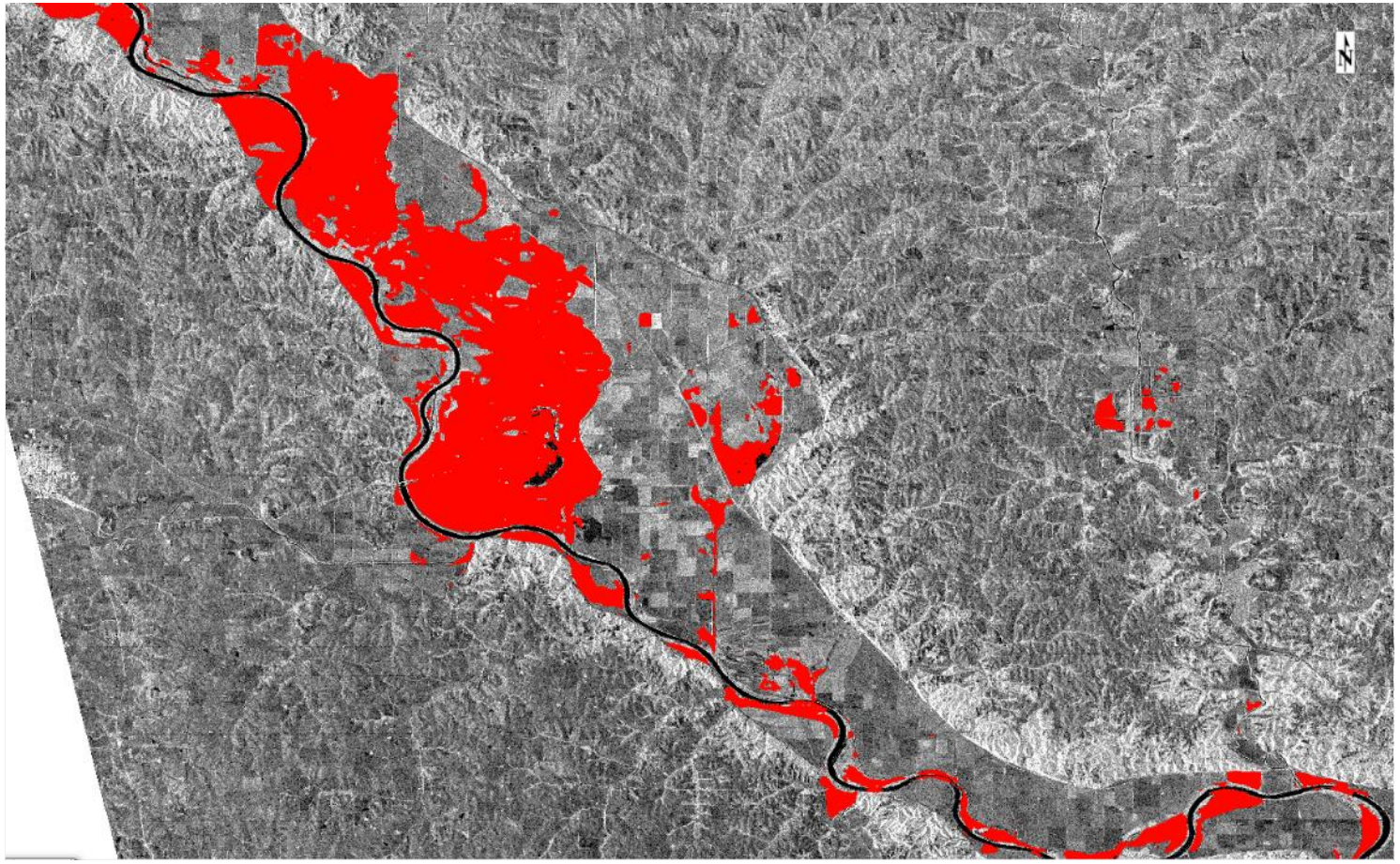
- On August 4, 2020, a huge explosion devastated the port area of Beirut, Lebanon
- SAR sensors and analytics can provide actionable information before smoke has cleared to assess destruction, guide aid and route emergency services, even with clouds and at night

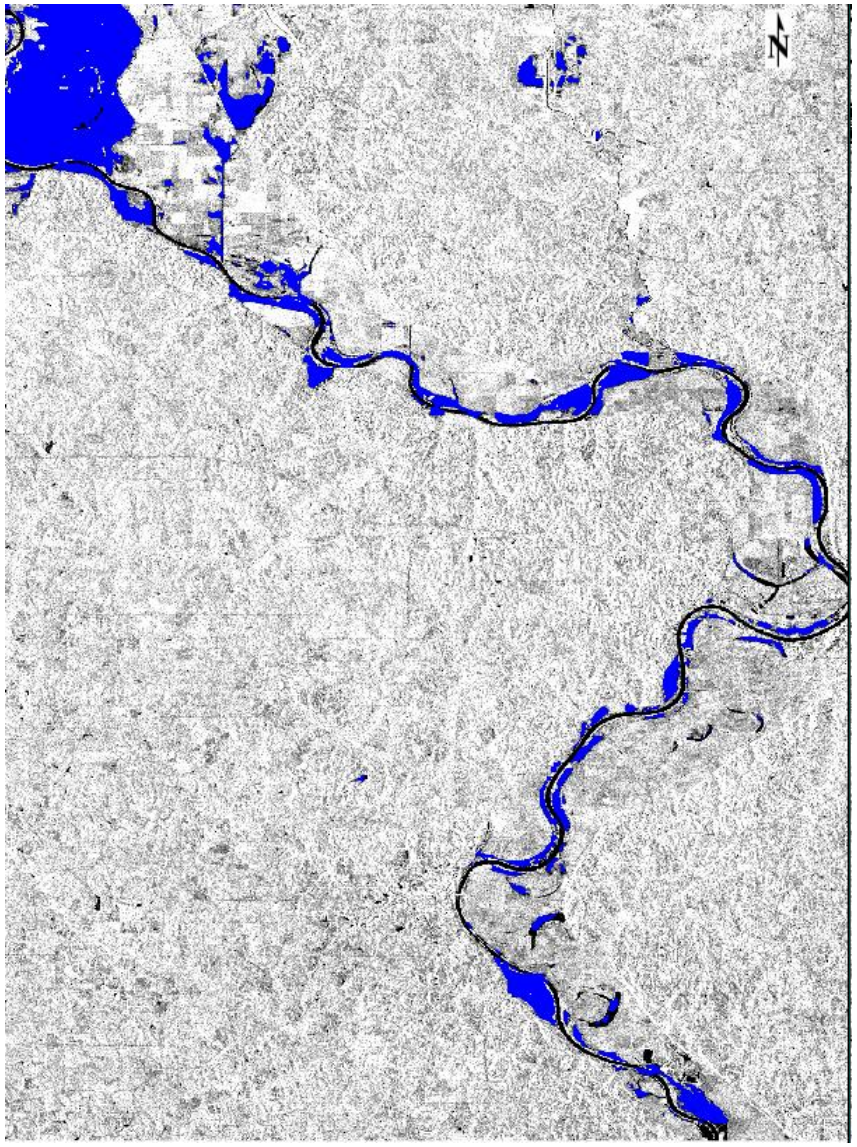
Source: SAR Data Used to Extract Damage From Beirut Explosion: https://www.l3harrisgeospatial.com/Learn/Blogs/Blog-Details/ArtMID/10198/ArticleID/23935/ENVI-SARscape-Extracts-Damage-from-Beirut-Explosion

Flood Mapping Nebraska, U.S.A., 2019, using SAR

- A large late season snow pack and sudden heating caused massive floods throughout the Midwestern United States in March 2019
- SAR is well known to be able to detect floodwater

Flood Mapping Nebraska, U.S.A., 2019, using SAR





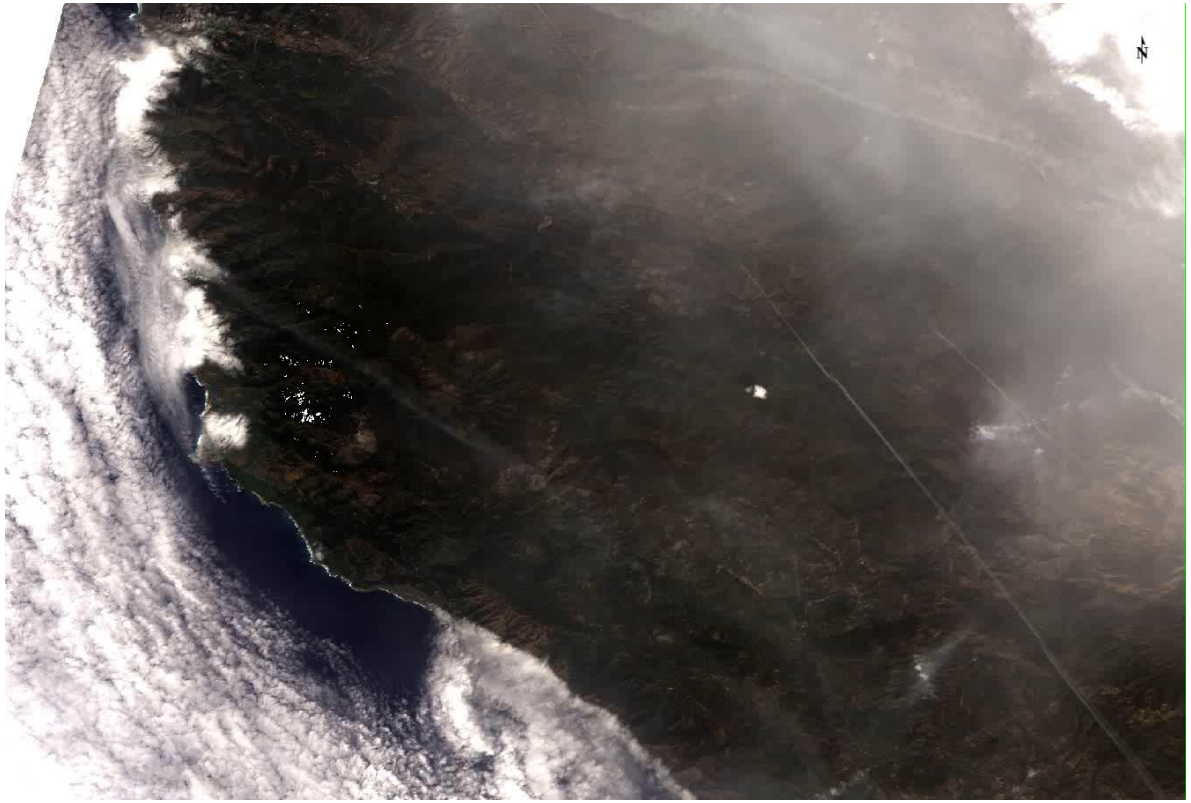
- 2x Sentinel-1 scenes (2019-02-22 and 2019-03-18) with VV polarization
- These images were stacked and run through ENVI Deep Learning

Wildfire Monitoring using SAR – Camp Fire, California, 2018

Wildfire Monitoring – SAR vs. Optical Sensors

- **Soberanes wildfire (California):** July 22 – October 12, 2016 (82 days)

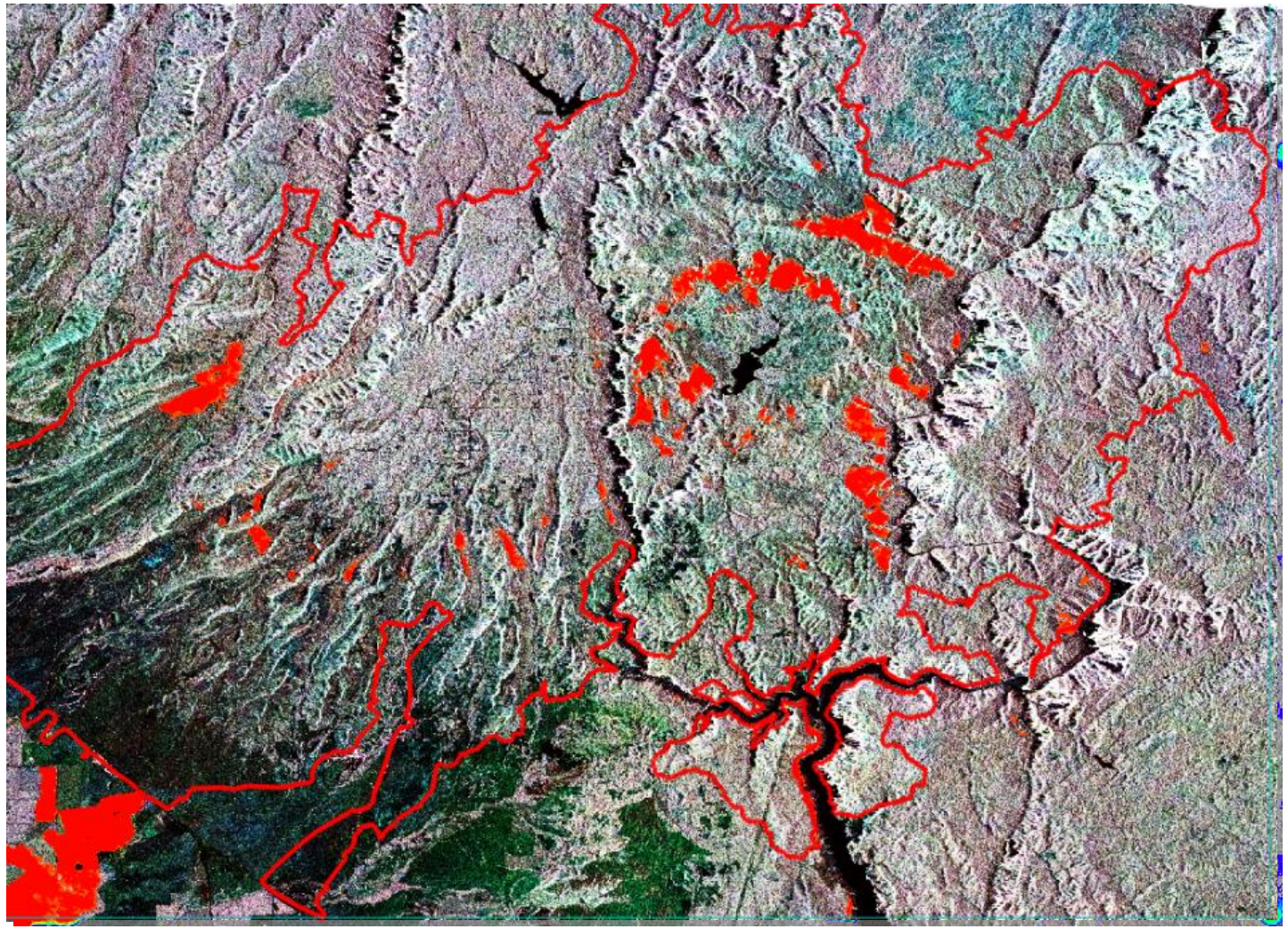
Landsat-8

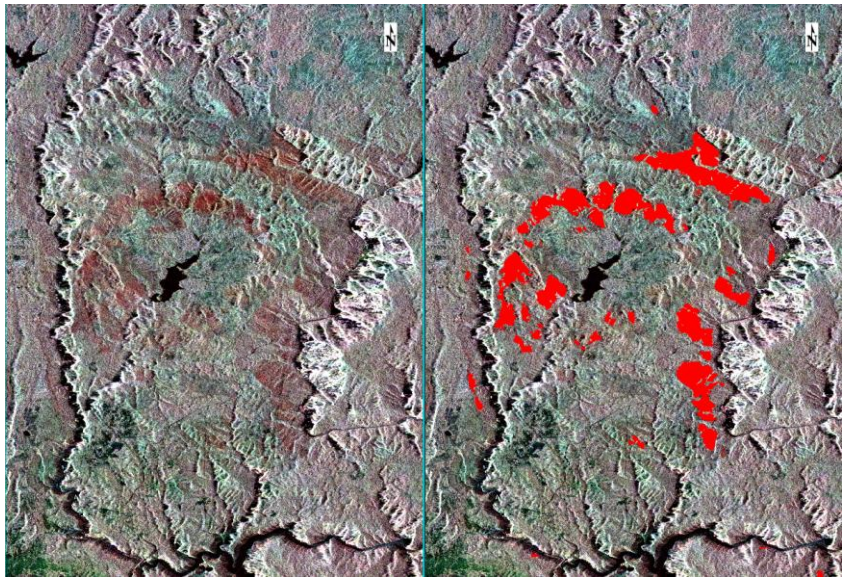


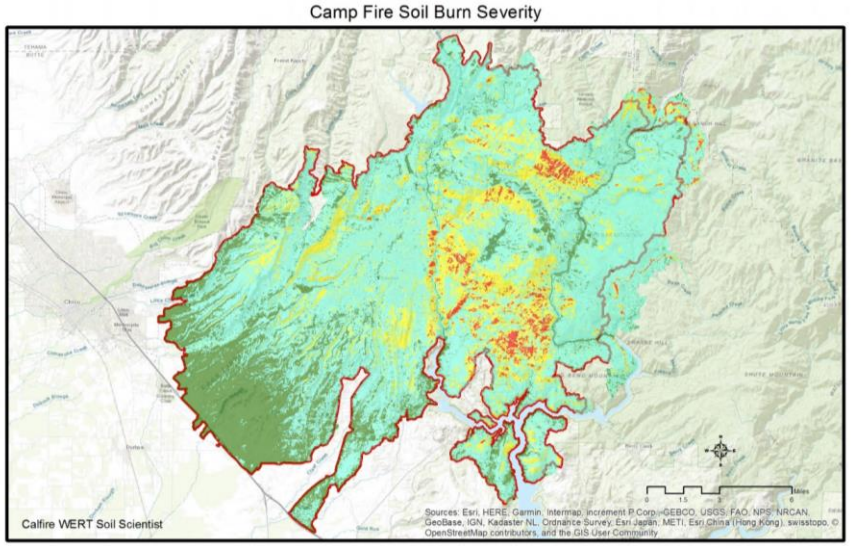
Sentinel-1

Data courtesy sarmap

Wildfire Monitoring using SAR – Camp Fire, California, 2018



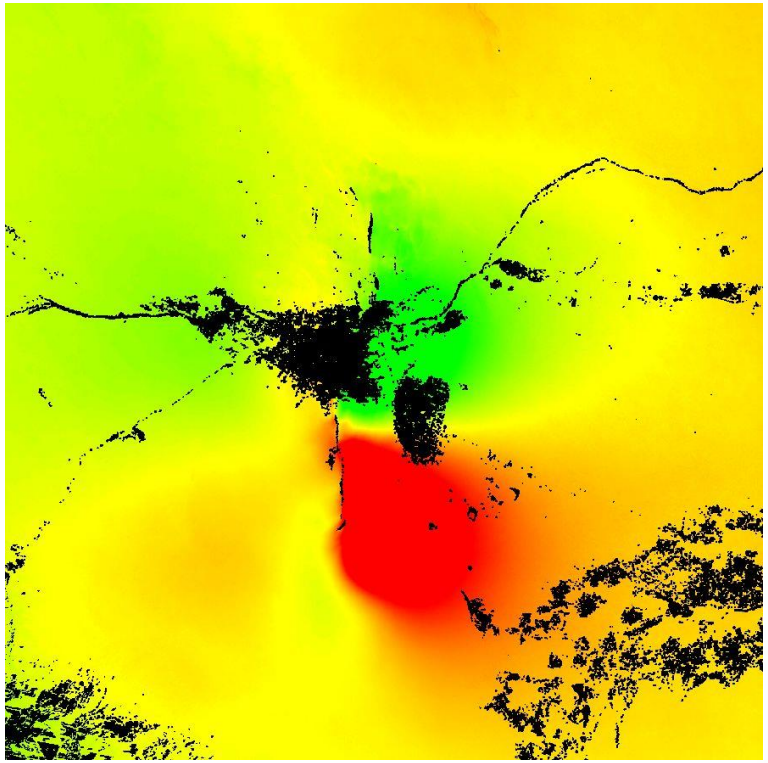


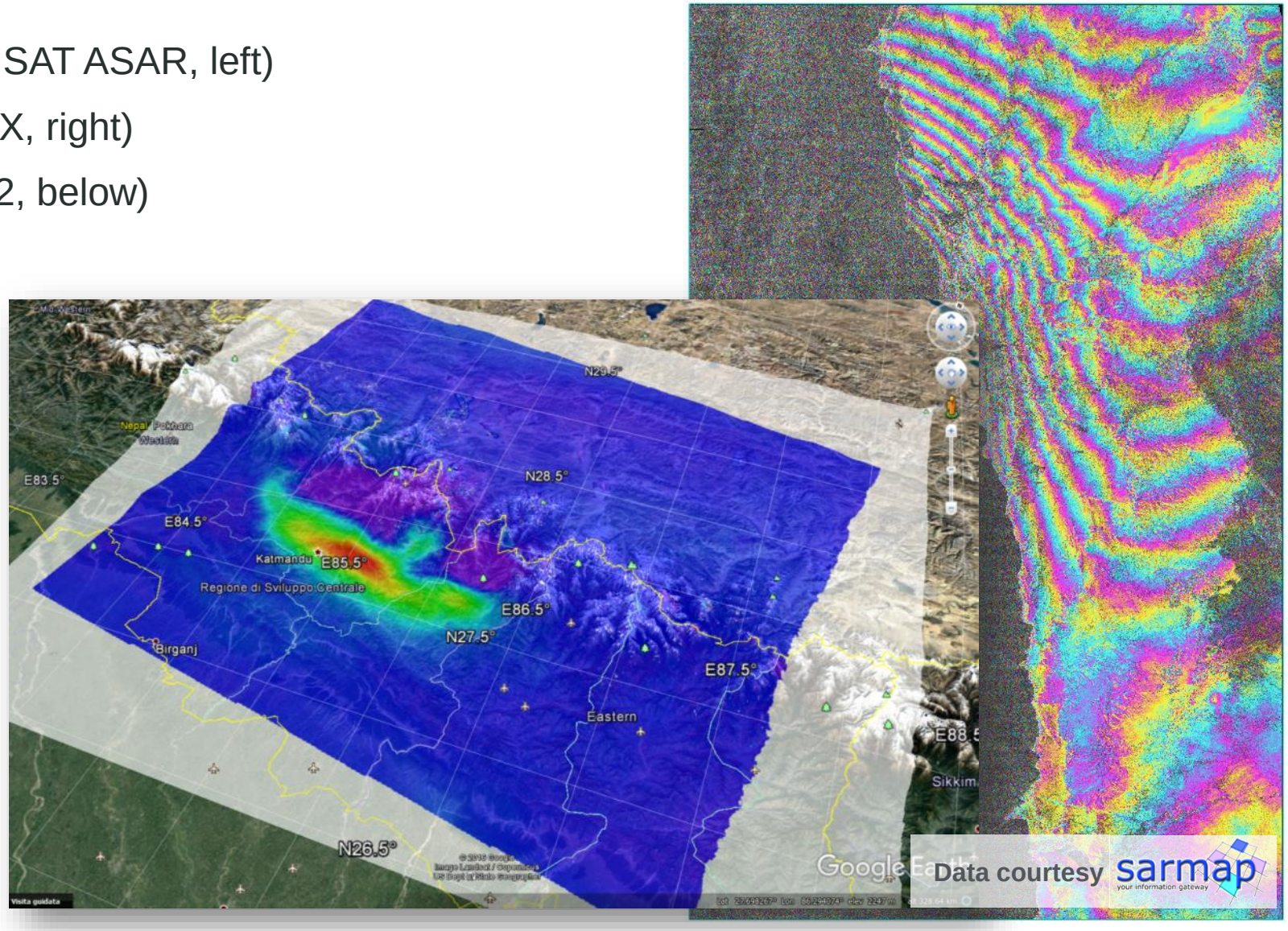


Areas of high intensity burn during Camp Fire detected by ENVI Deep Learning

Earthquake Mapping using SAR Interferometry

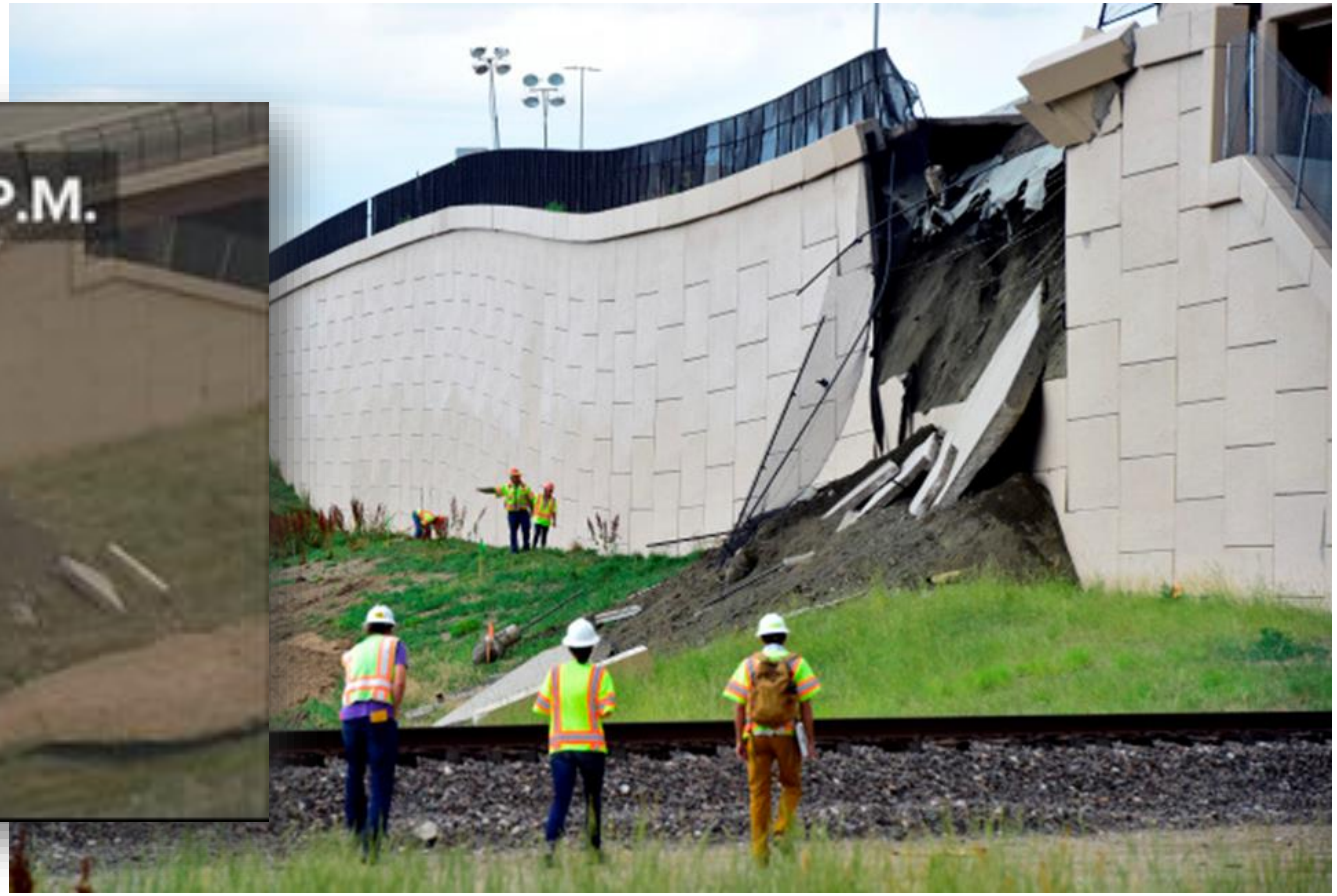
- Iran (Bam) 2003 earthquake (ENVISAT ASAR, left)
- Chile 2016 earthquake (TerraSAR-X, right)
- Nepal 2015 earthquake (PALSAR-2, below)





Highway 36 Collapse – Colorado, USA

- July 12, 2019 a large crack began to spread across east bound lanes of Highway 36 between Denver and Boulder, Colorado, USA
- On July 13th, the highway ultimately collapsed



Source: Highway Collapse: Monitoring Subsidence Using ENVI SARscape: https://www.l3harrisgeospatial.com/Learn/Case-Studies/Case-Studies-Detail/ArtMID/10204/ArticleID/23954/Highway-Collapse-Monitoring-Subsidence-Using-ENVI-SARscape

Highway 36 Subsidence measured from SAR

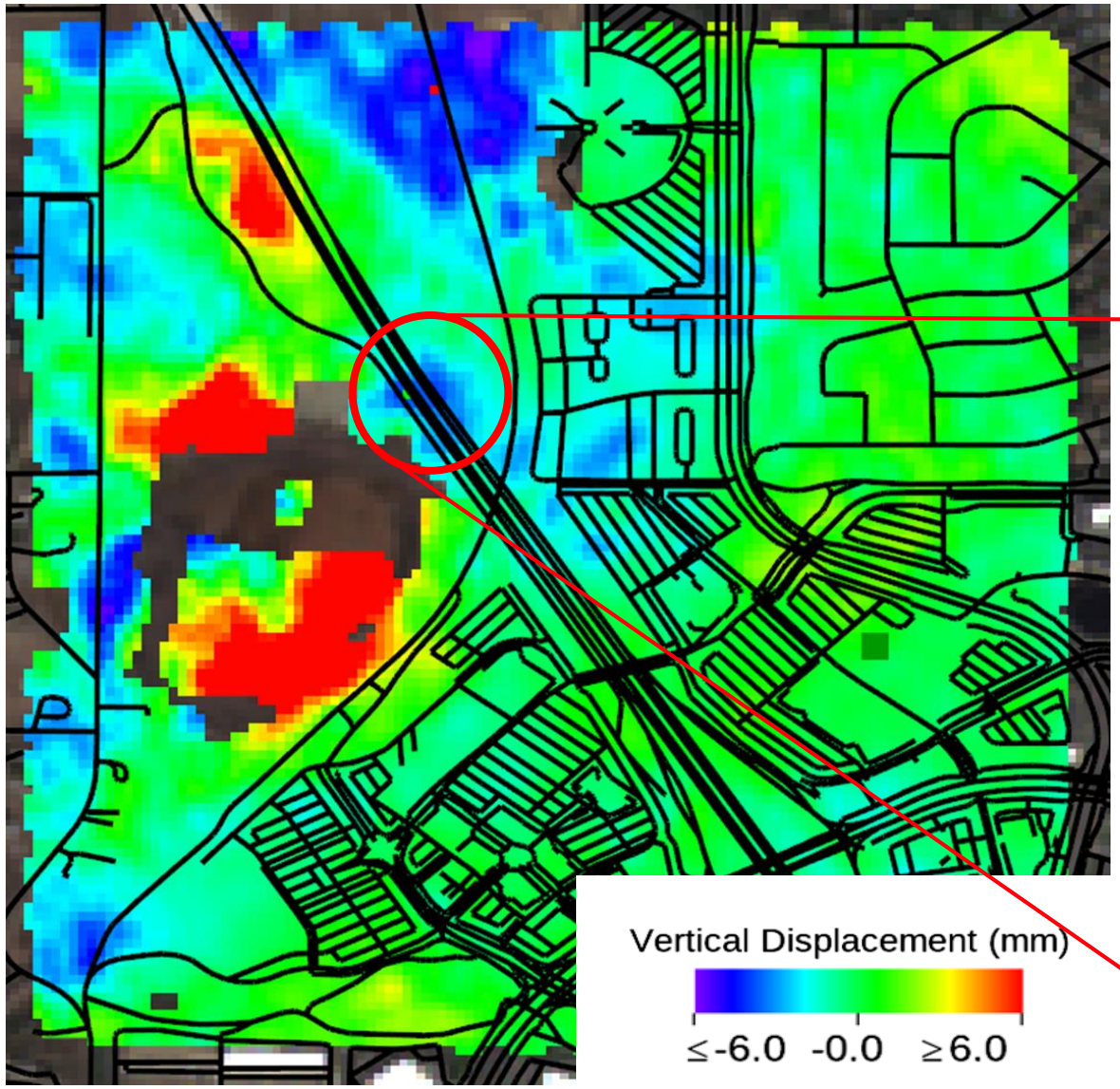
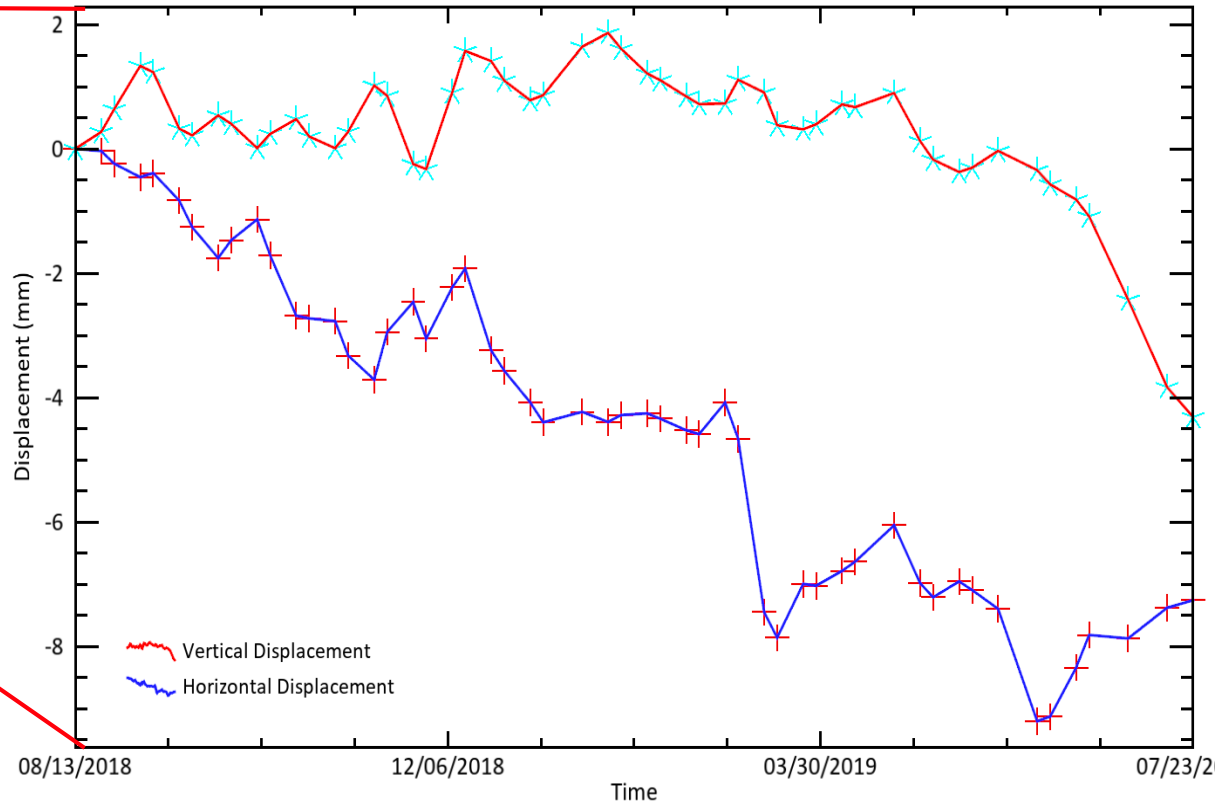


Figure (left): Vertical displacement over the region around the Highway 36 collapse

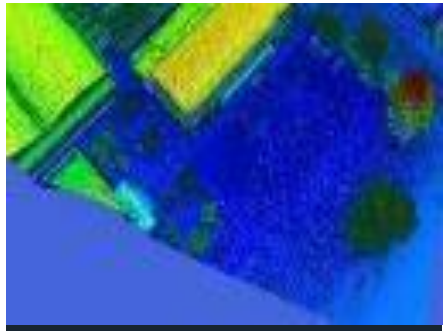
Graph (bottom): Vertical & horizontal movement at Highway 36 collapse



Technical Brief

ENVI

ENVI image analysis software uses scientifically-proven analytics to deliver expert-level results.



Data support

Hyperspectral, multispectral, SAR, LiDAR, radar, FMV, panchromatic and more

ArcGIS integration

Workflows and automated tools to execute ENVI analytics and access results within any ArcGIS environment

Automated workflows

Change detection, anomaly detection, viewshed analysis and more

Extensible modules

Deep learning, SAR analytics, feature extraction, DEM extraction, atmospheric correction, photogrammetry and NITF

Accessible

Accessible when and where you need in enterprise, partner platforms and in the cloud

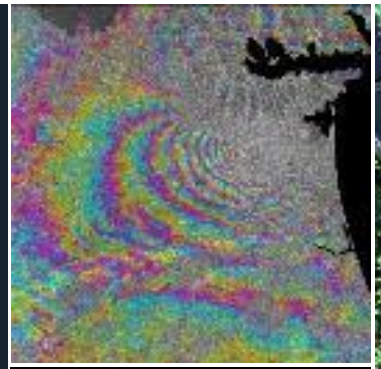
ENVI SARscape

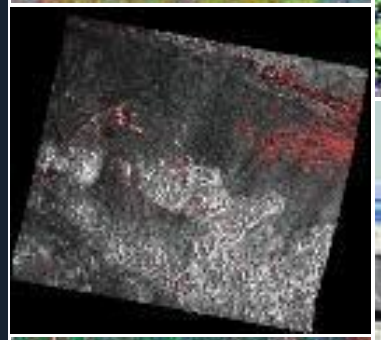
Easily process and analyze SAR data

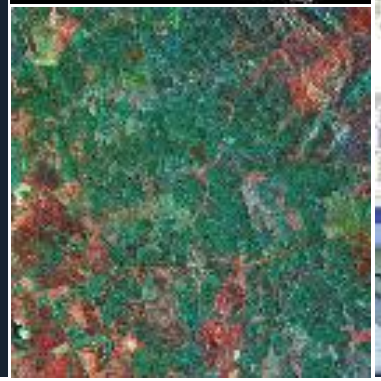
ENVI integration brings advanced image processing and analysis together with SAR processing in one package

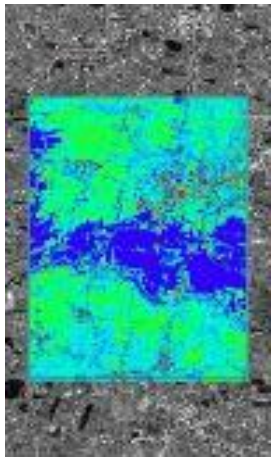
Generate products (like DEMs or surface deformation maps) that can be integrated with other geospatial products

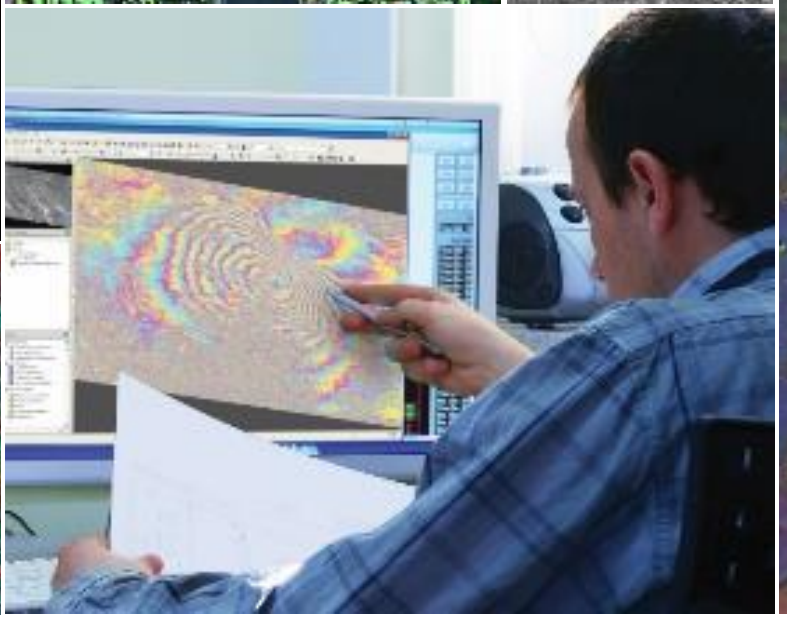
Built-in workflows and modules simplify processing and can be customized



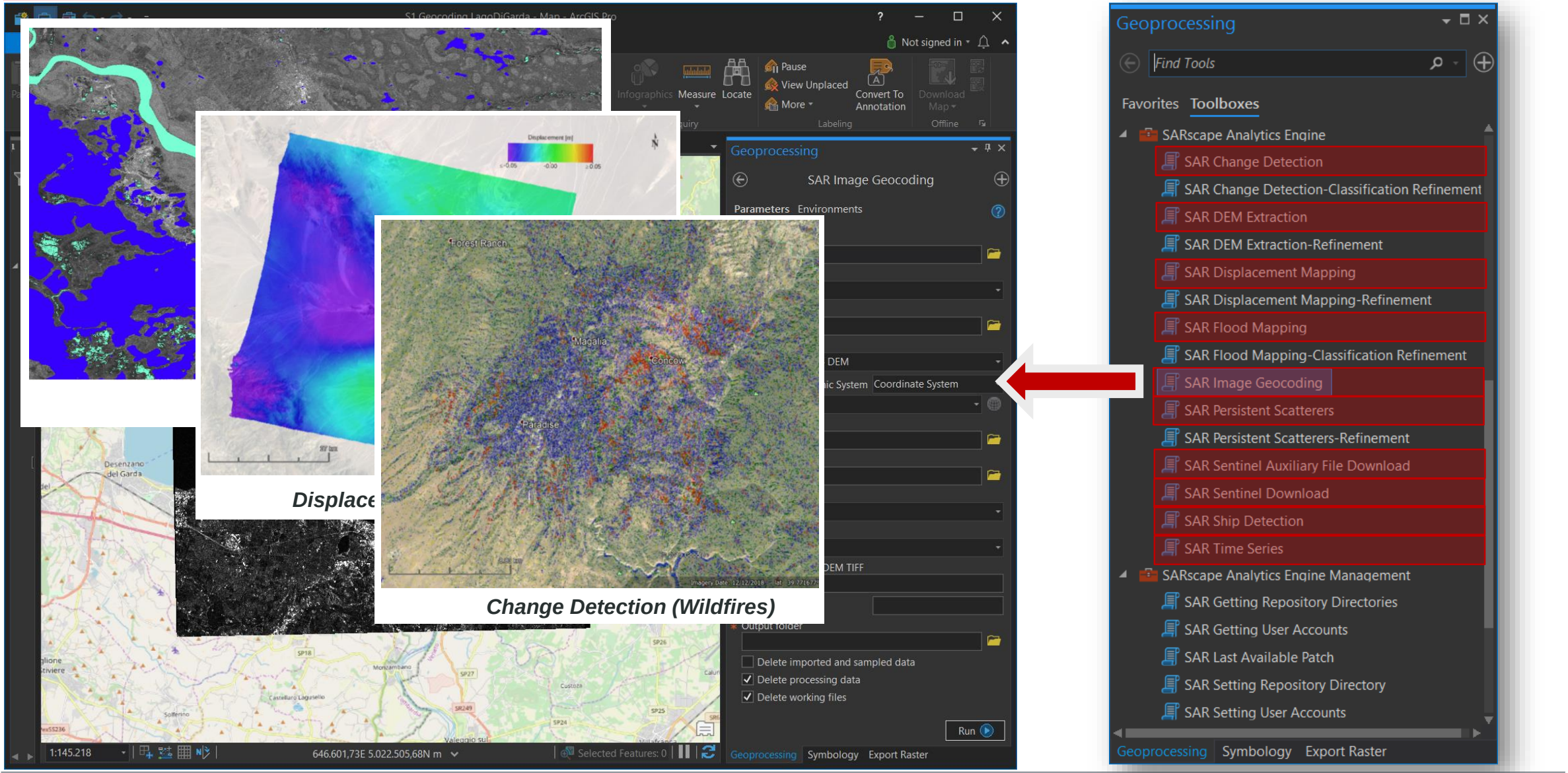






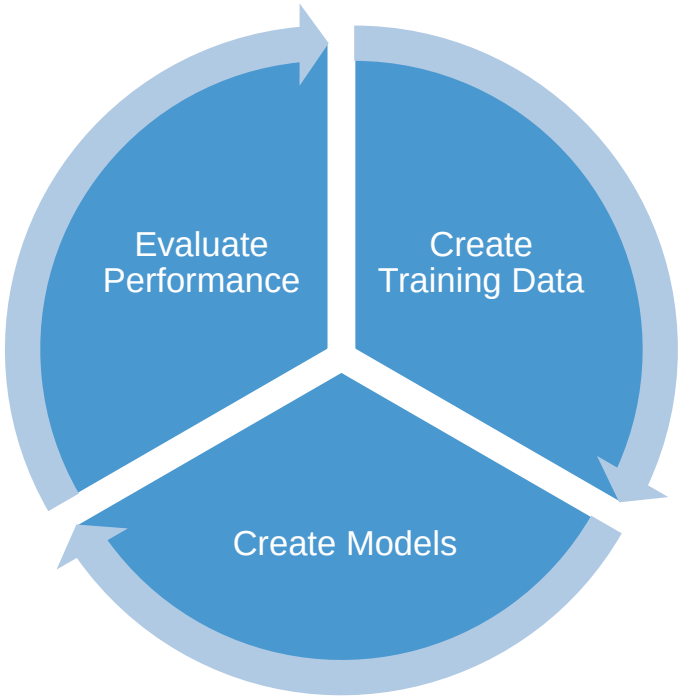


ENVI SARscape Analytics in ArcGIS Pro



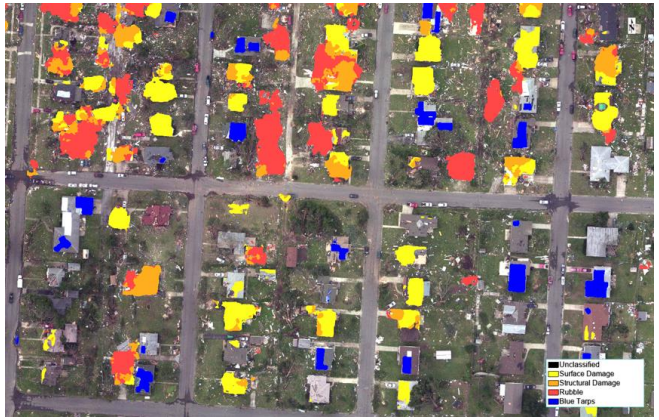
ENVI Deep Learning Module

- Applied Deep Learning for geospatial imagery in ENVI, the leading remote sensing and image analysis software

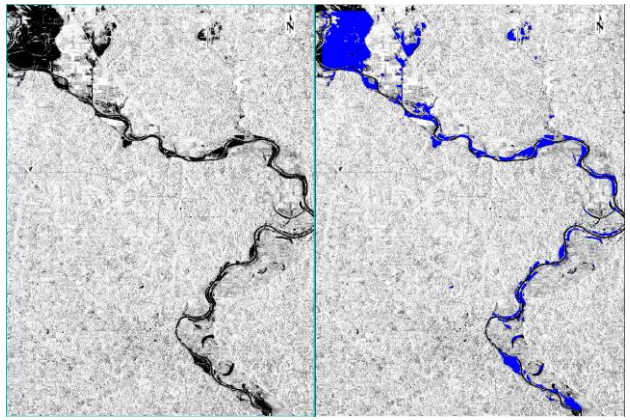


Deep Learning workflow in ENVI, built on TensorFlow and Keras

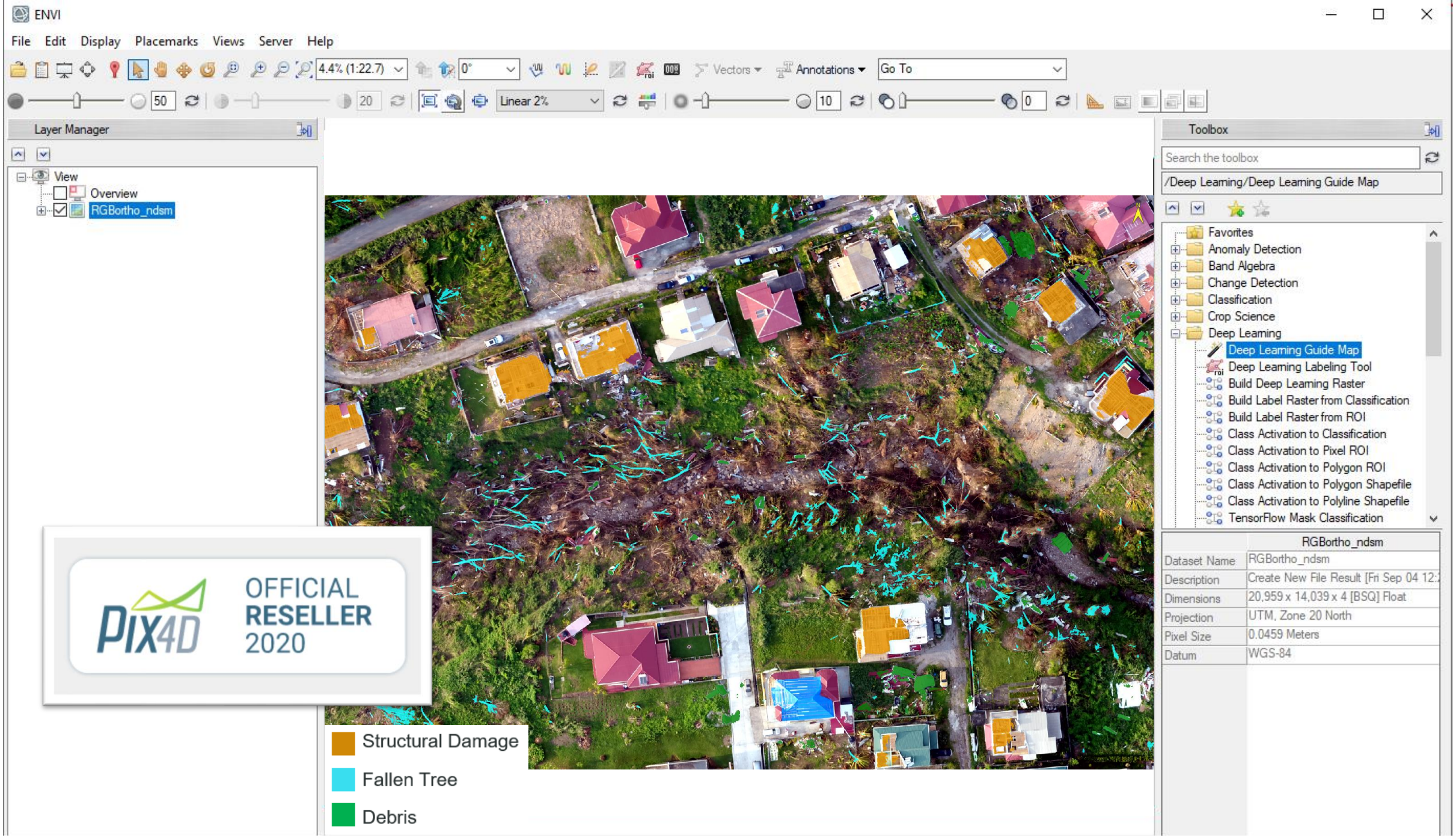
- Without needing to program, the capabilities include:
  - Object detection (e.g. cars or ships)
  - Linear feature extraction (e.g. roads)
  - Segmentation (e.g. buildings)
- Support for nearly any image format and data modality
  - Works with point, polyline, and polygon types of geometry
- Complete access to ENVI's suite of postprocessing tools
  - Easily create customized workflows



Assess building damage after hurricanes and tornadoes



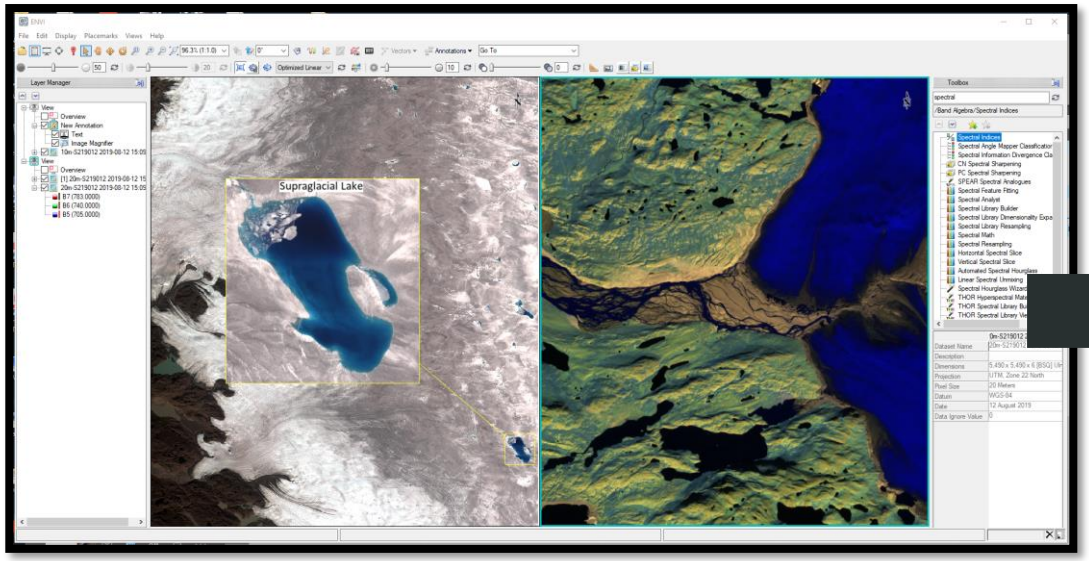
Automated flood detection using SAR

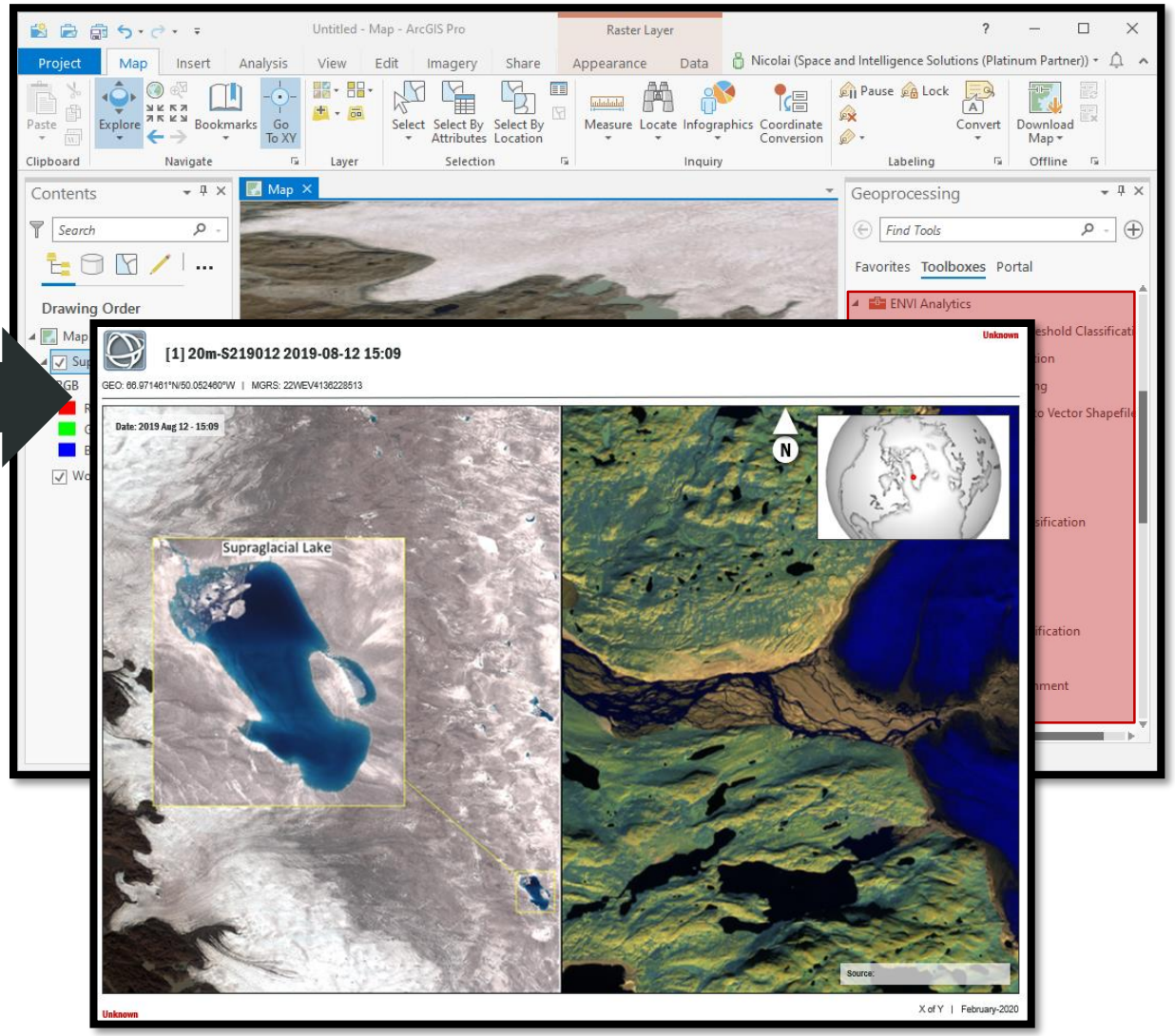


Source: Create Accurate Image Classification Products to Aid Disaster Response Efforts: https://www.l3harrisgeospatial.com/Company/Events/Webinar/Webinar-Detail/ArtMID/10251/ArticleID/23960/Create-Accurate-Image-Classification-Products-to-Aid-Disaster-Response-Efforts

Mapping and Report Generation for Analysis / Disaster Response

ENVI's Display





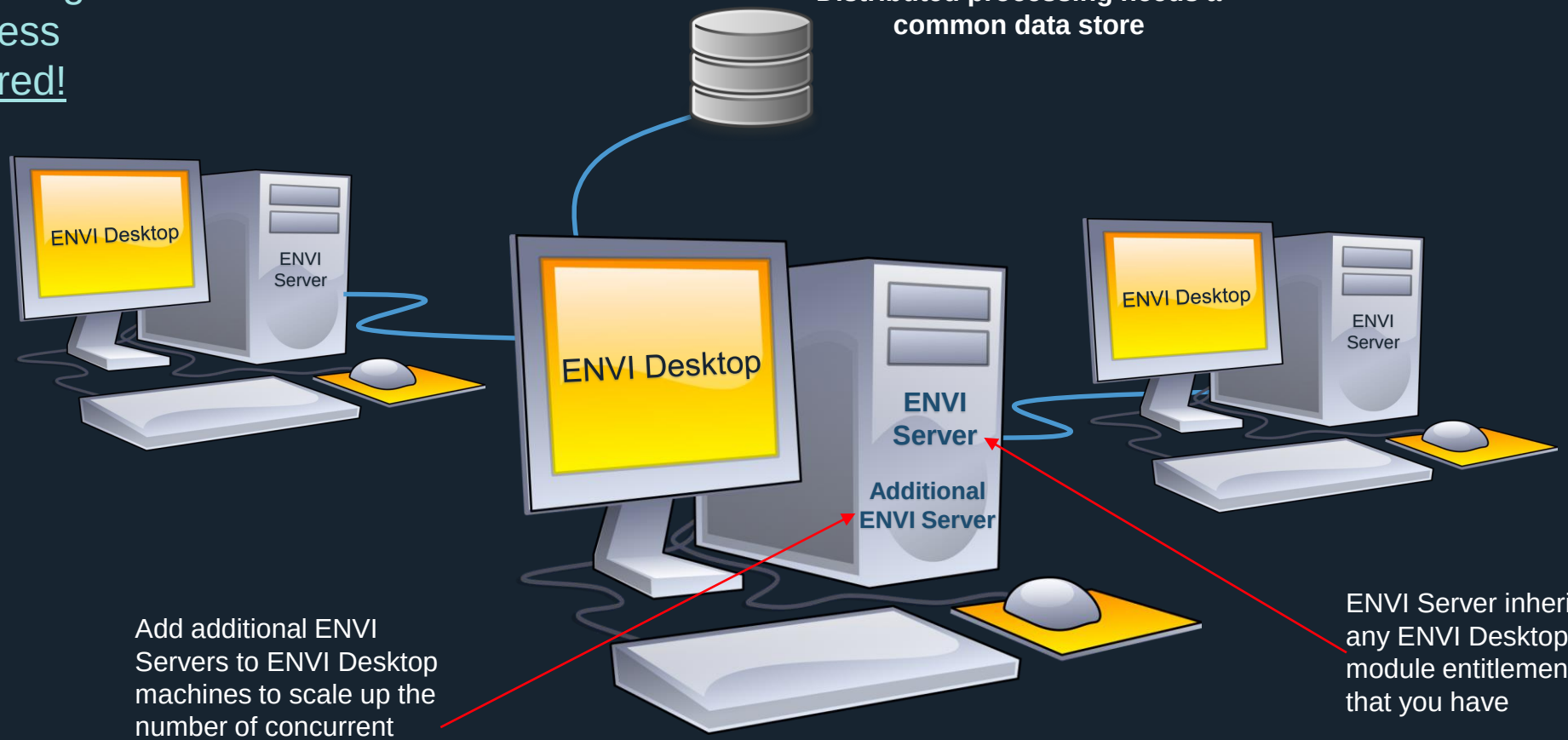
Run the advanced ENVI and SARscape analytics directly from the familiar ArcMap and ArcGIS Pro interface and quickly generate high-quality maps

Seamlessly capture ENVI's display and quickly generate high-quality presentation content in PowerPoint

Operational Implementation with ENVI Server / Enterprise

ENVI Server lets you run processing in parallel or in the background and allows you to take advantage of modern hardware.

- Easily distribute processing to local servers with common data access
- No programming required!



NICOLAI HOLZER | L3HARRIS GEOSPATIAL | SALES ENGINEER EMEA
Nicolai.Holzer@L3Harris.com

JAMES SLATER | L3HARRIS GEOSPATIAL | CHANNEL MANAGER EMEA
James.Slater@L3Harris.com