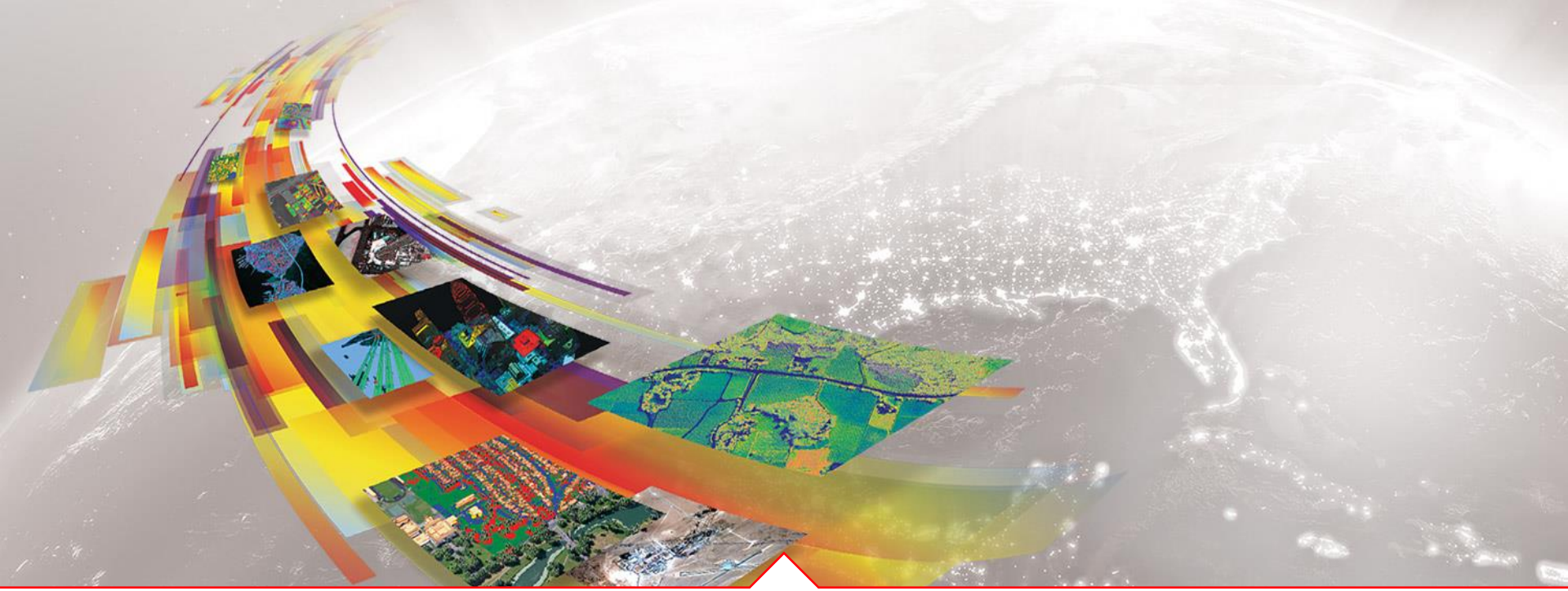


L3HARRIS™

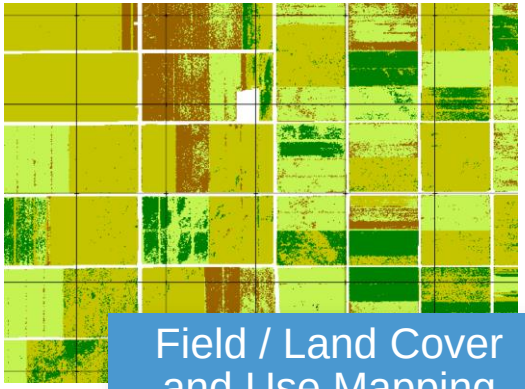
MONITORING AGRICULTURE & FORESTRY FROM SATELLITE AND UAV

How to Derive Accurate Vegetation Insights to Boost Profitability

February 27th, 2020

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

Remote Sensing in Agriculture and Forestry



Field / Land Cover and Use Mapping

Vegetation Health / Statistics

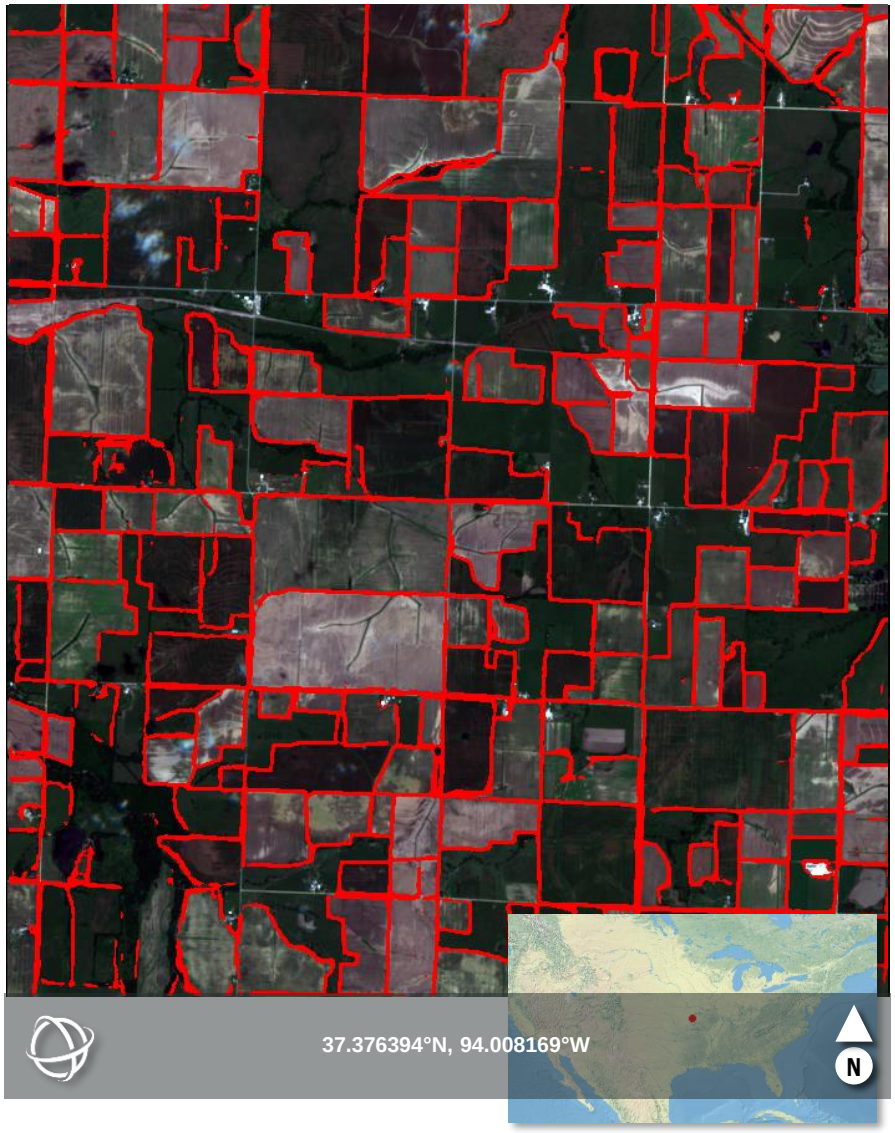
Damage / Anomaly Detection

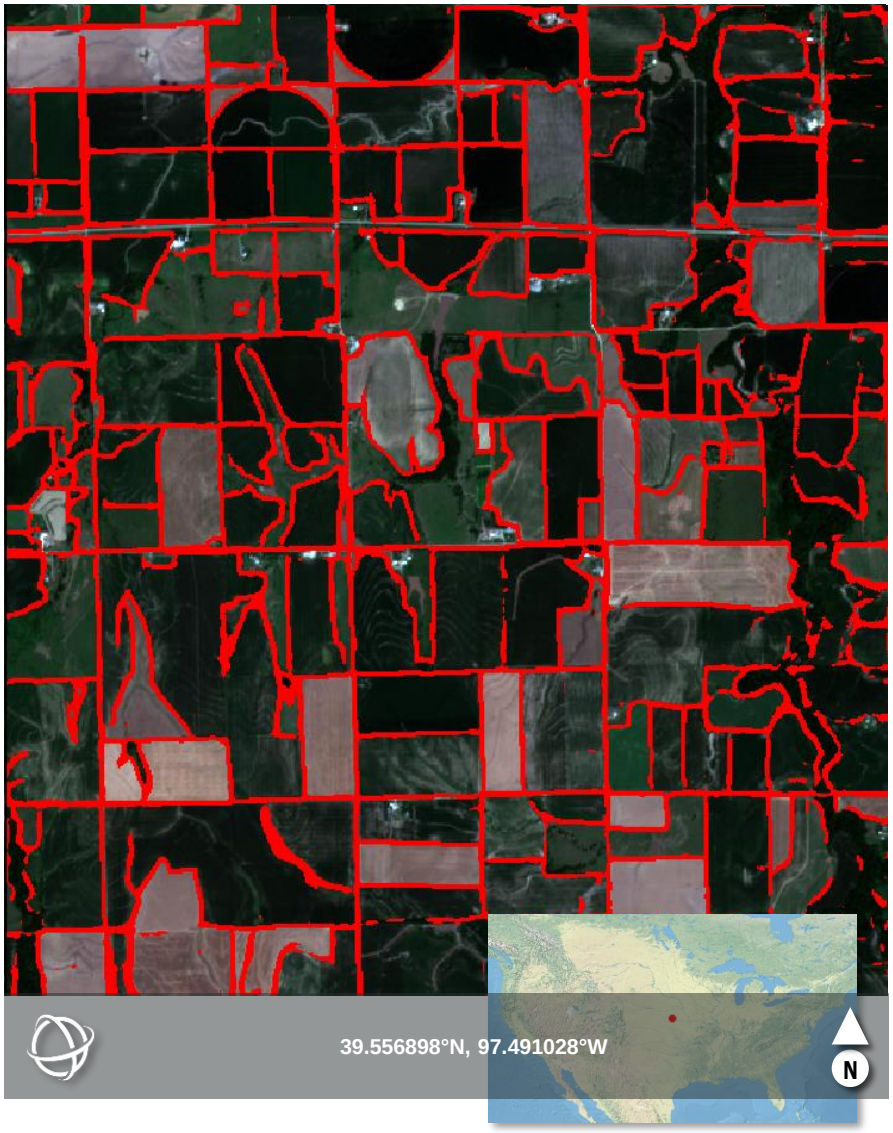
Changes / Evolving Hotspots Monitoring

Yield / Production Estimation

Deforestation / Wildfire Detection

Field Boundary Mapping (Deep Learning)

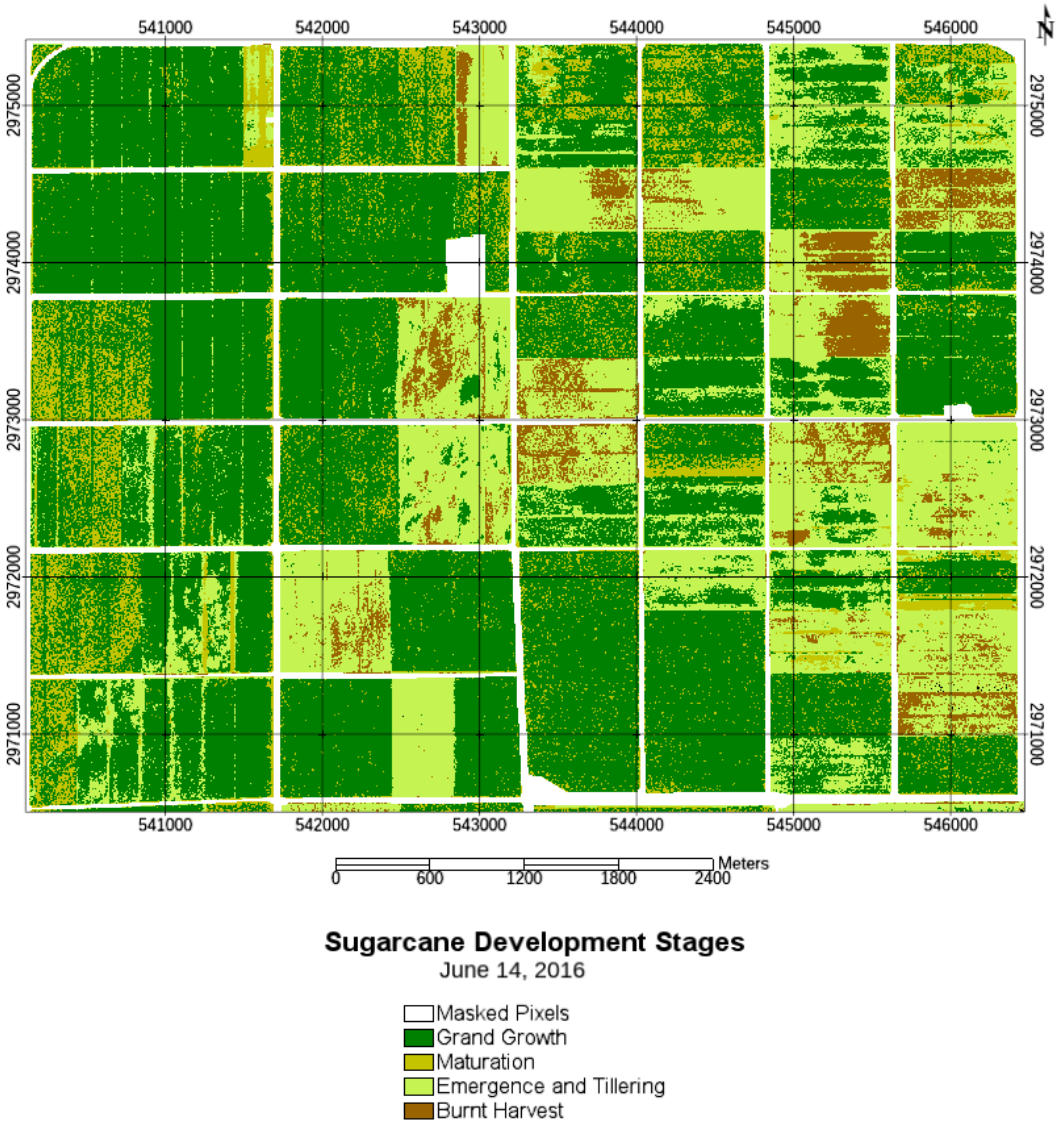


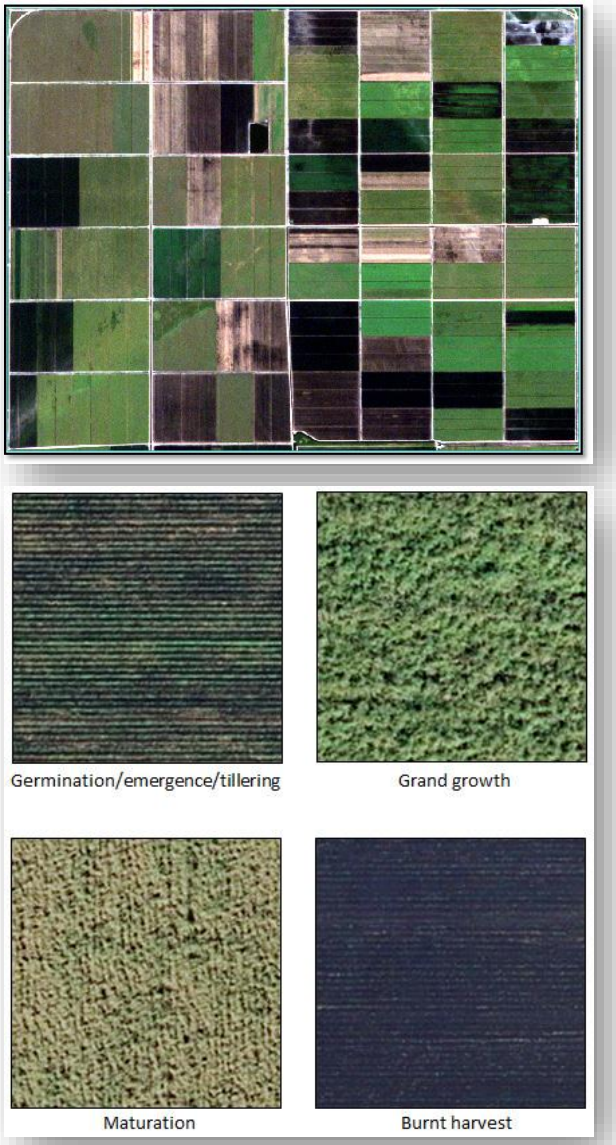


Circular Irrigation Fields Extracted from Sentinel-2 Imagery Using ENVI Deep Learning

GEO: 39.262823°N/100.991677°W

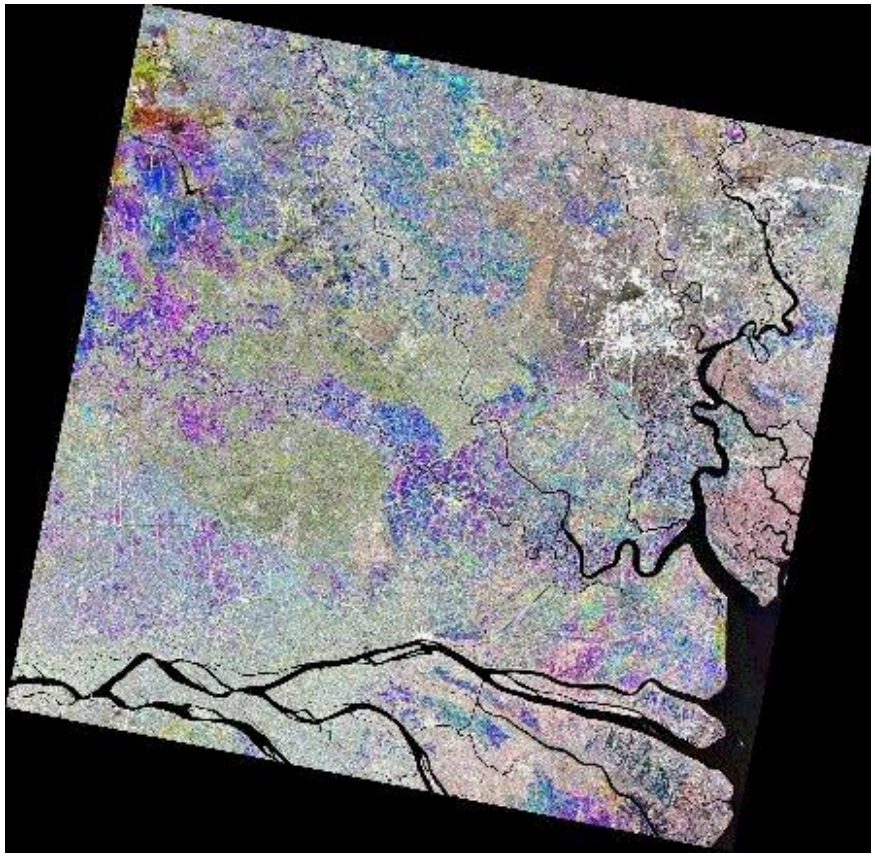
Optical Remote Sensing of Sugarcane Development



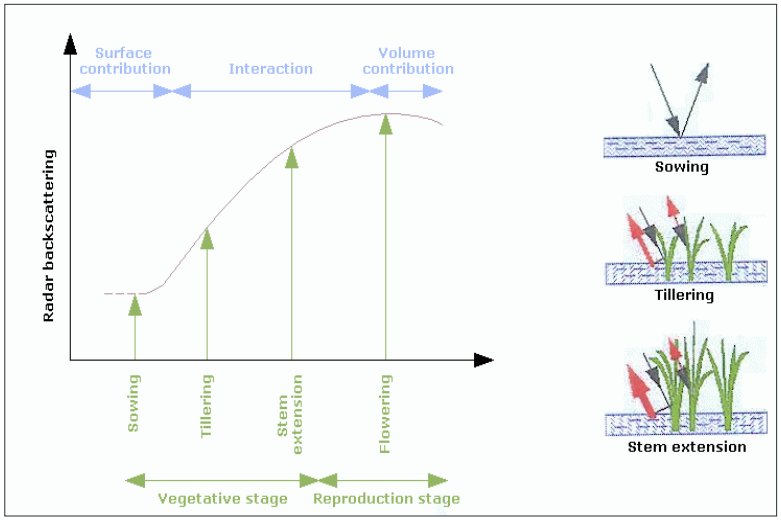


Time-Series Analysis for Rice Production Estimation

Synthetic Aperture Radar – Temporal Data



Ideal Rice SAR Temporal Signature



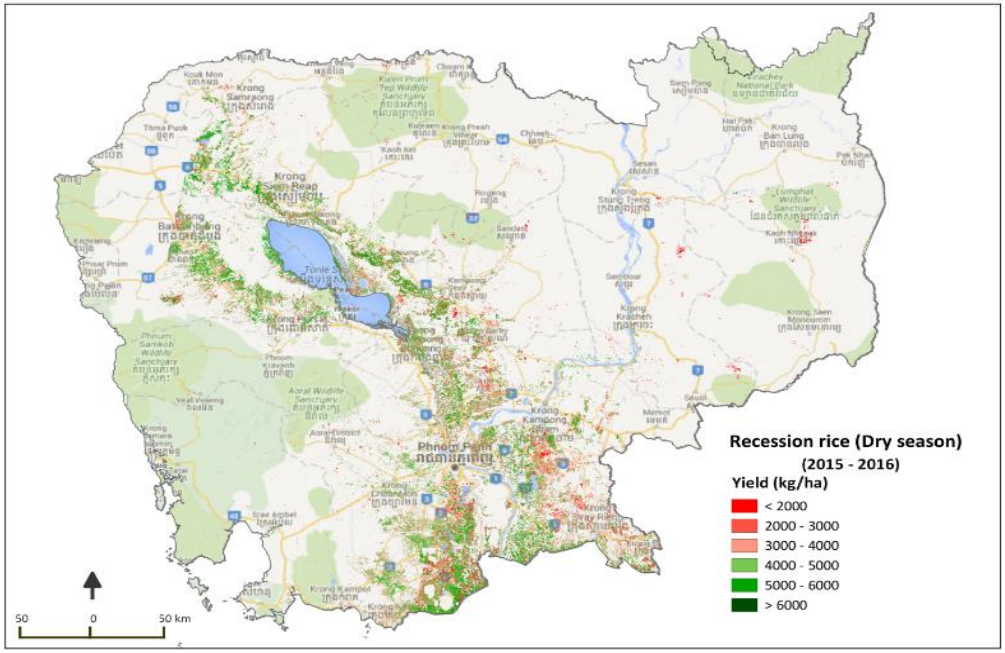
Temporal signature depends on:

- Field preparation
- Crop practices
- Crop establishment method
- Rice cycle duration
- Rice biomass & moisture
- Climatic conditions

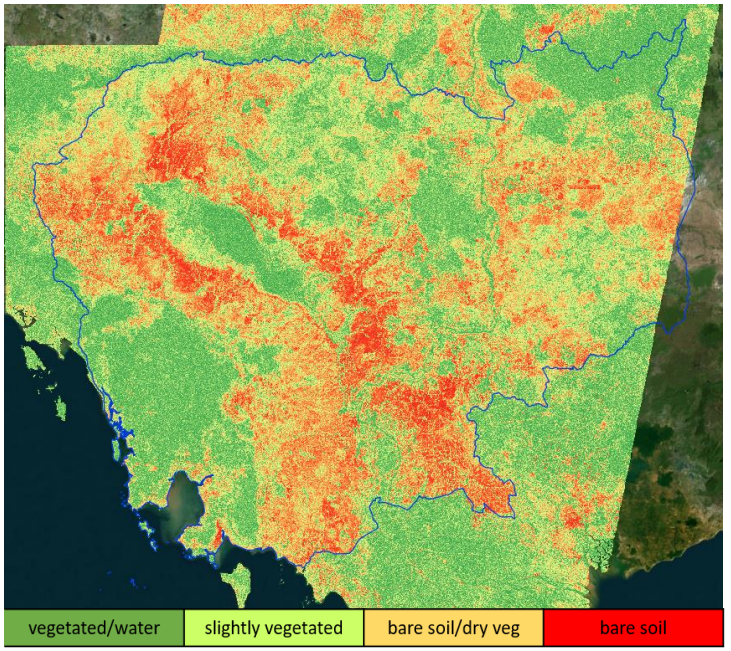
Remote sensing based Information and Insurance for Crops in emerging Economies (RIICE)

Data courtesy sarmap

Time-Series Analysis for Rice Production Estimation



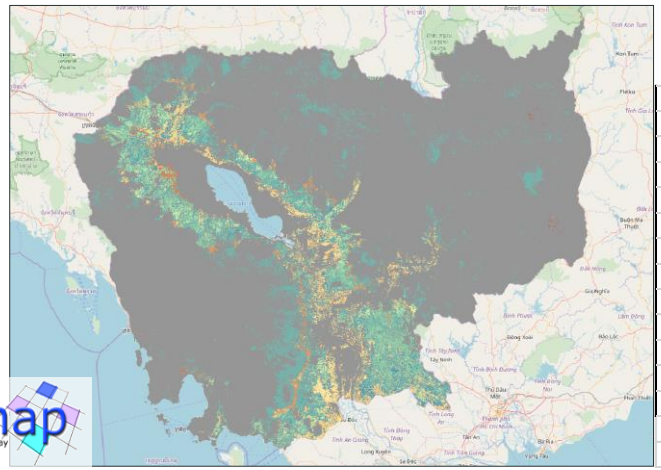
Yield Map



Drought Map (early wet season 2016)

Cambodia

Rice Ecosystem Map

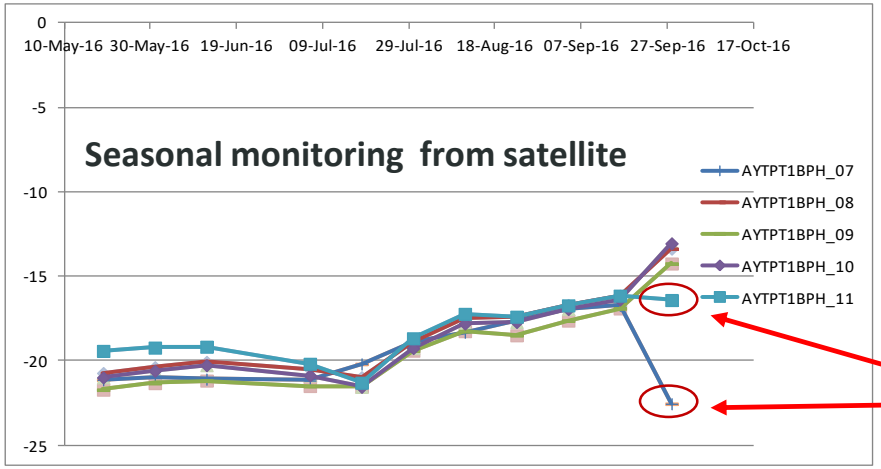


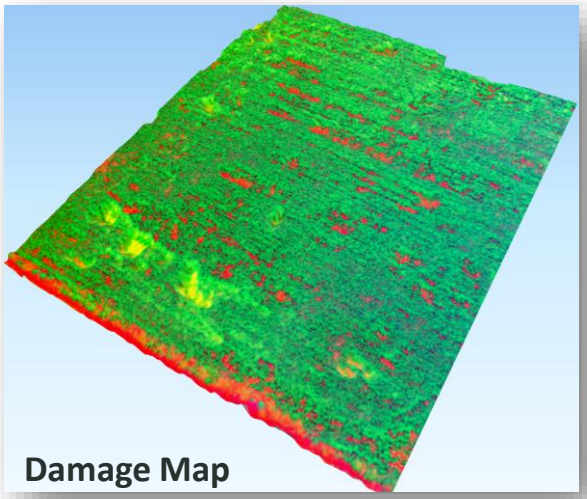
0	No classified
1	Upland Rice (1)
2	Deepwater or Floating Rice (3)
3	Early Wet Season Rice (2.2; 2.4; 2.6)
4	Pre-rising EWS Rice (2.7)
5	Recession DS Rice (4.1)
6	Irrigated DS Rice (4.2)
7	Upper field RLR (2.2) - double crop
8	Medium field RLR (2.4) - double crop
9	Lower field RLR (2.6) - double crop
10	Upper field RLR (2.2) - single crop
11	Medium field RLR (2.3) - single crop
12	Lower field RLR (2.6) - single crop
13	(4.1 or 4.2) + (2.2 or 2.3 or 2.6)
14	(4.1 or 4.2) + (2.7)

Data courtesy sarmap

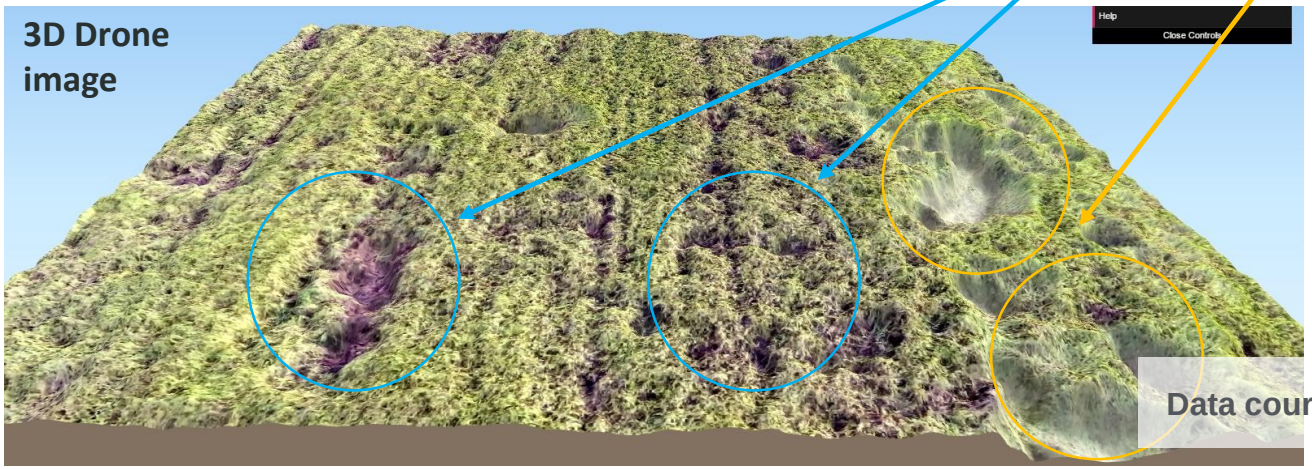
Time-Series Analysis for Rice Production Estimation

Thailand 2018 – Damages due to brown hoppers and strong wind





Anomalies = disease and wind lodging



Identifying and Mapping Weeds (Deep Learning)

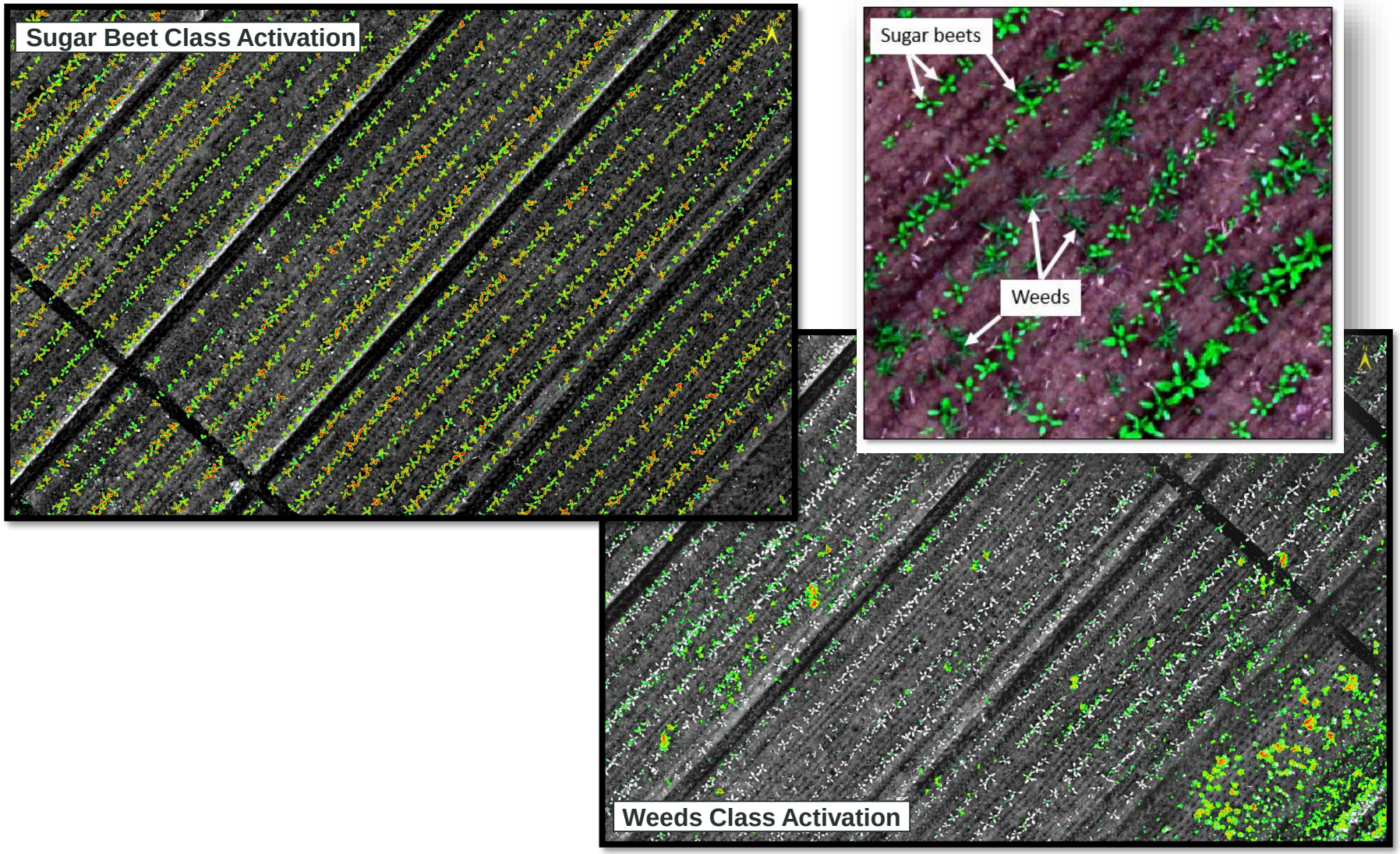
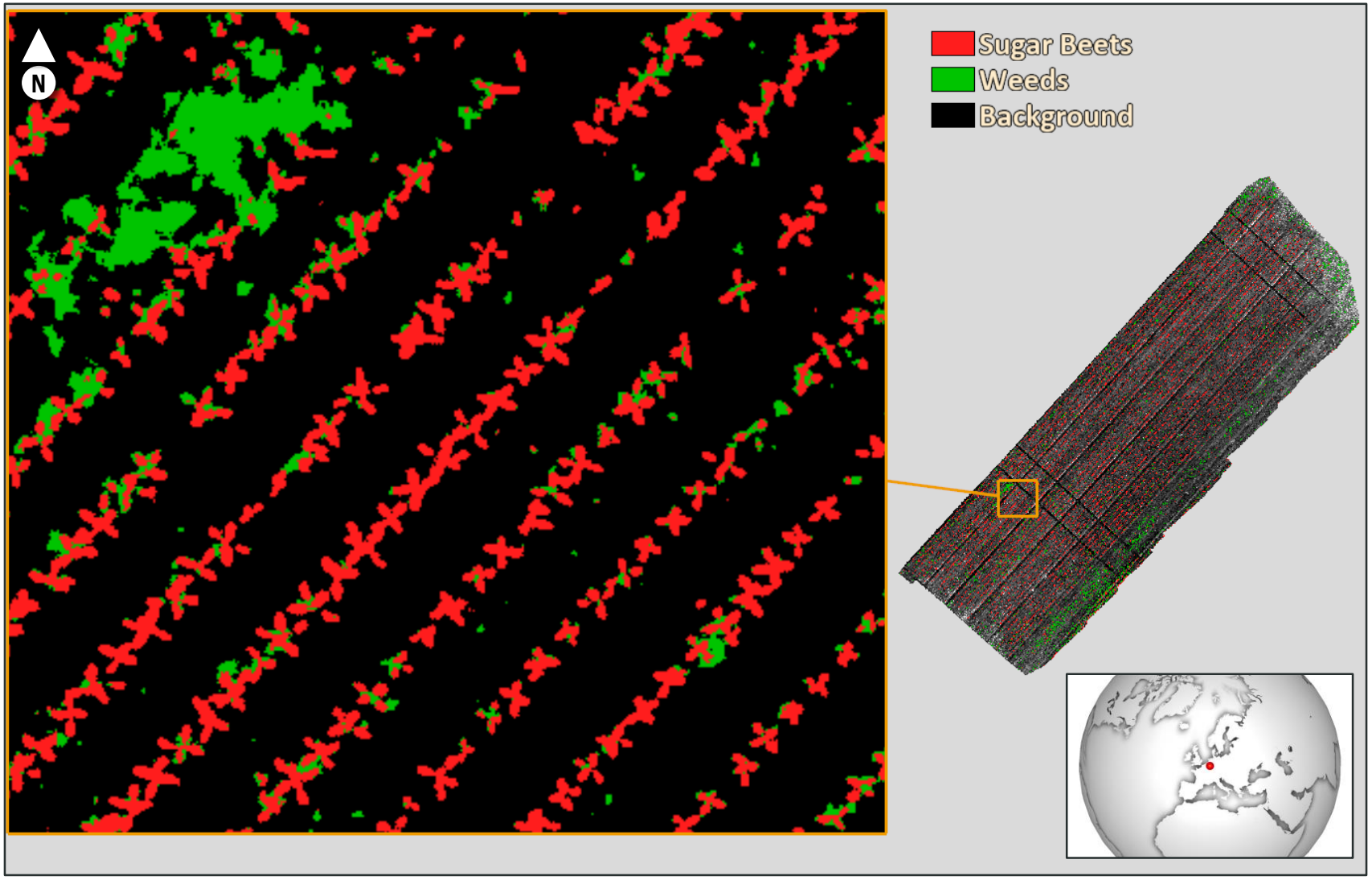


Figure: UAV image of sugar beet plants and weeds, from Sa et al. (2018). Dataset available from https://projects.asl.ethz.ch/datasets/doku.php?id=weedmap:remotesensing2018weedmap.

Sugar Beet Classification Image Created with ENVI Deep Learning

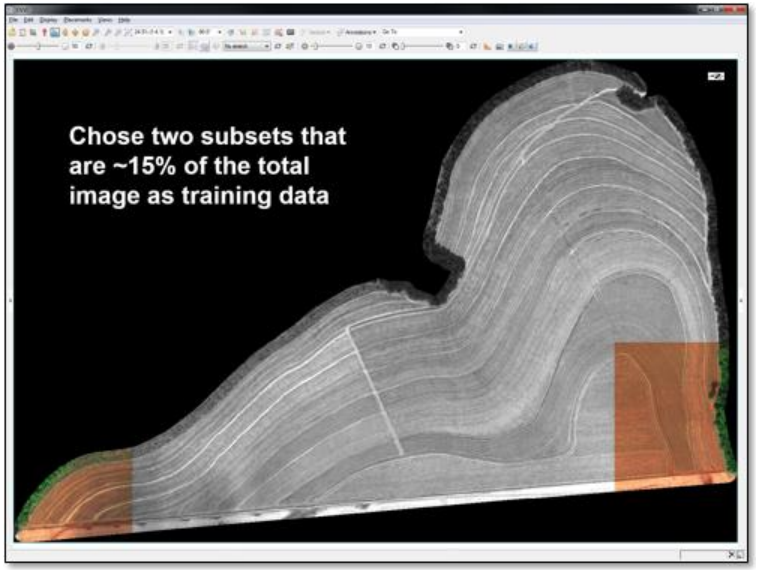
GEO: 50.614780°N/6.989323°E



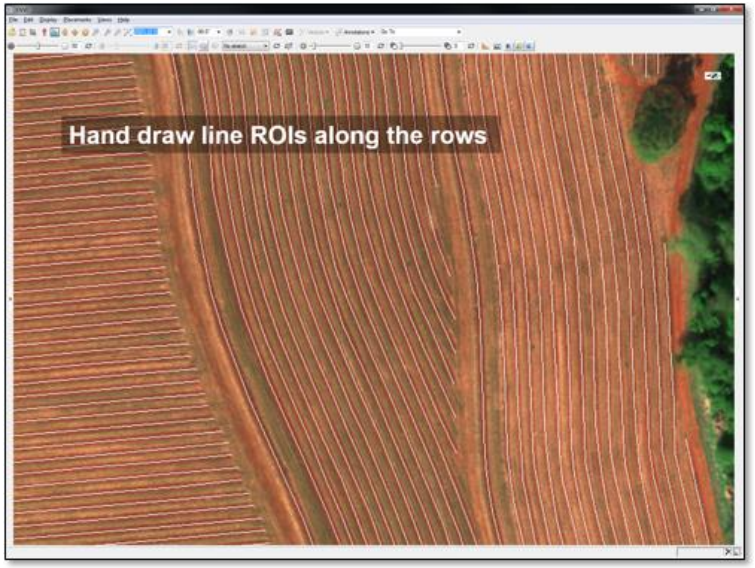
Source: Remote Sensing 2018 Weed Map Dataset, available from https://projects.asl.ethz.ch/datasets/doku.php?id=weedmap:remotesensing2018weedmap.

Identifying Rows of Agricultural Crops (Deep Learning)

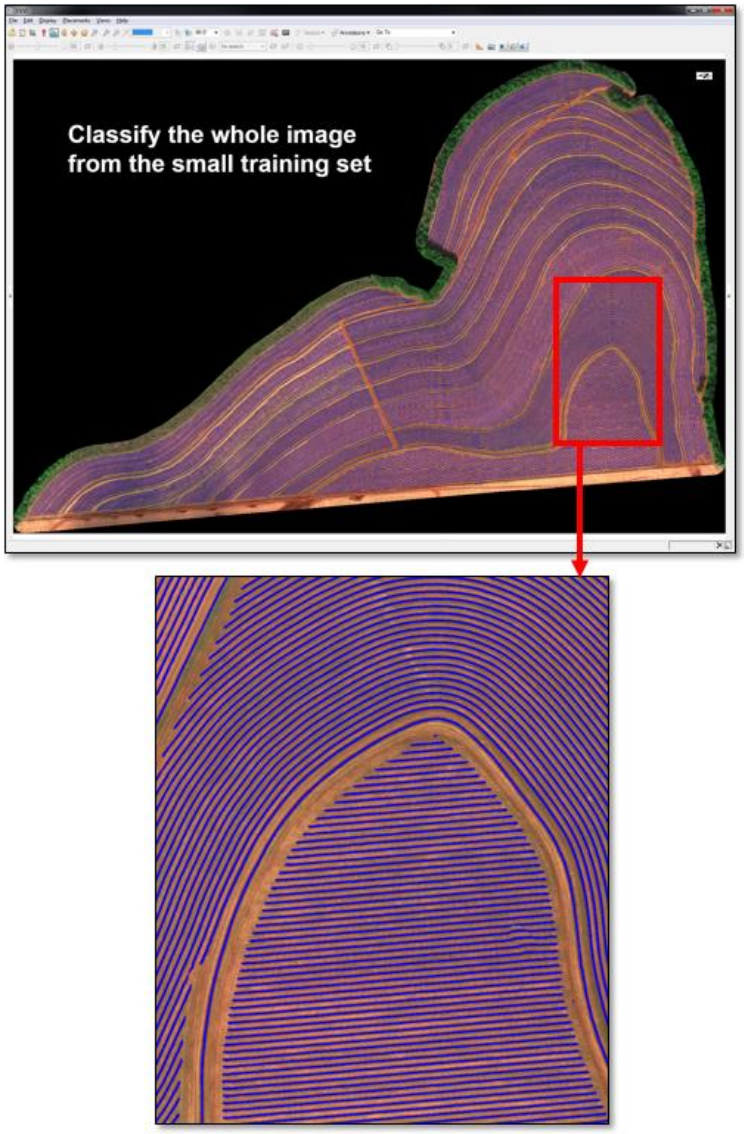
1



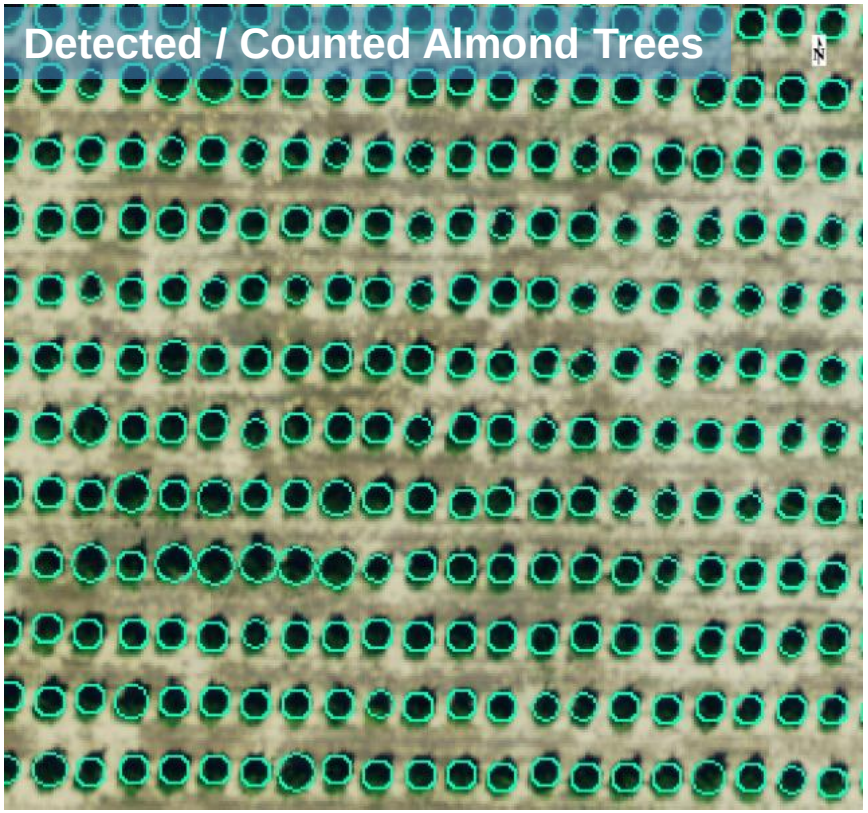
2

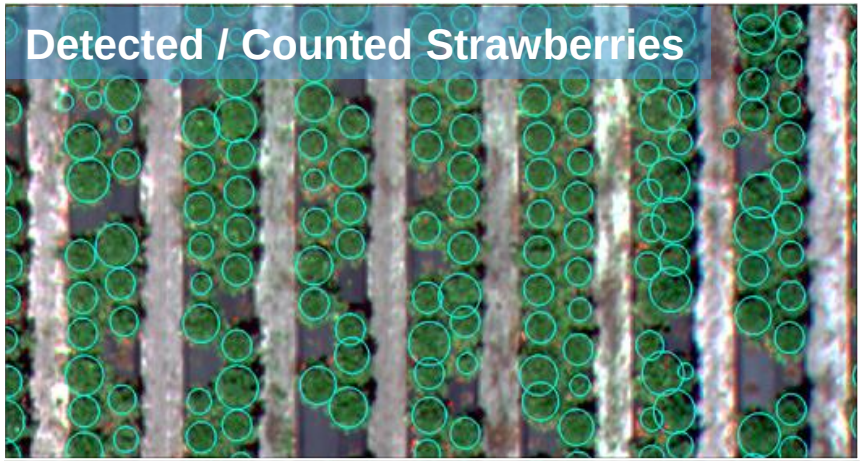


3



Identifying and Counting Crops / Trees

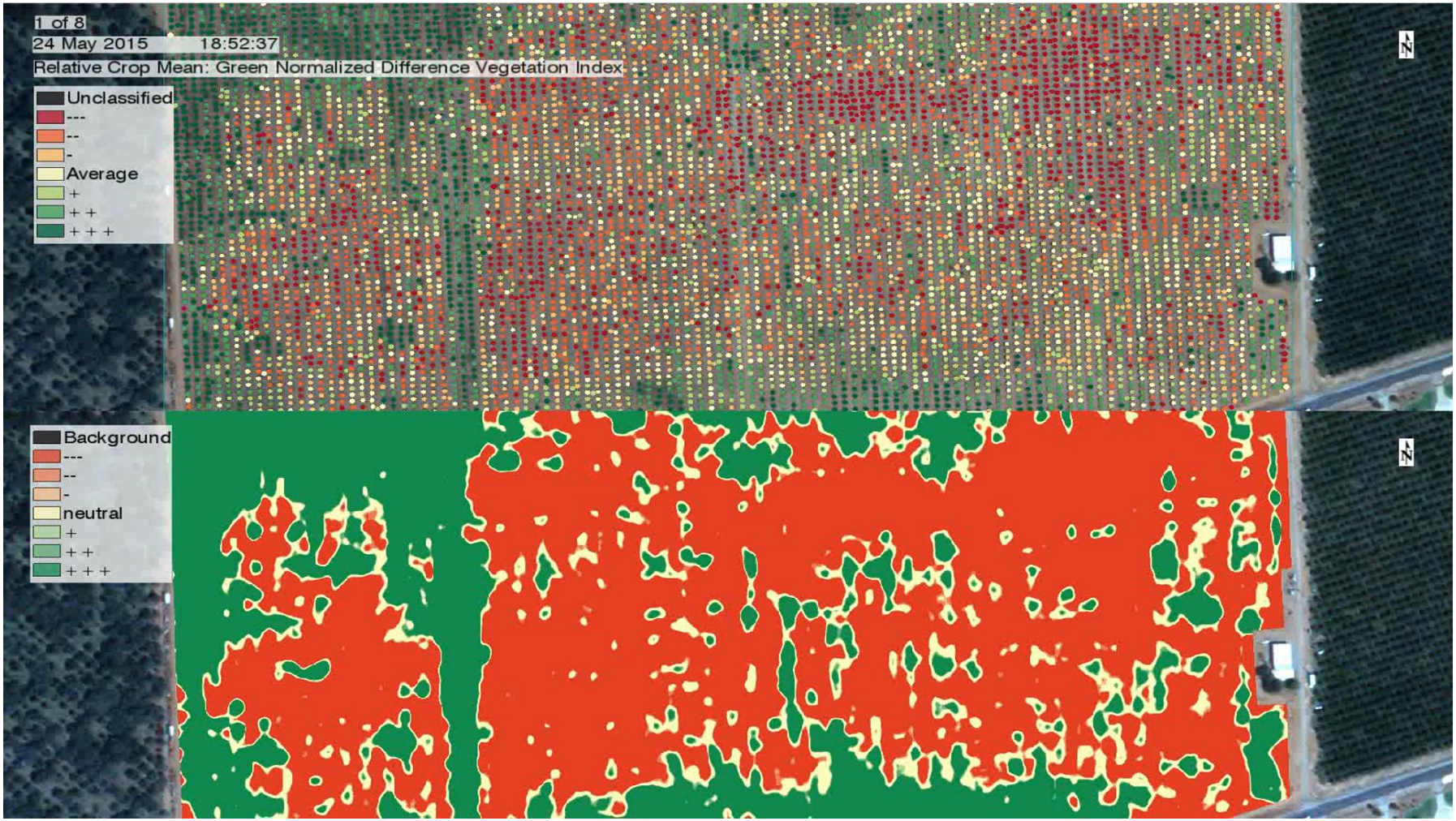




Get the total count of crops / trees along with their locations and sizes

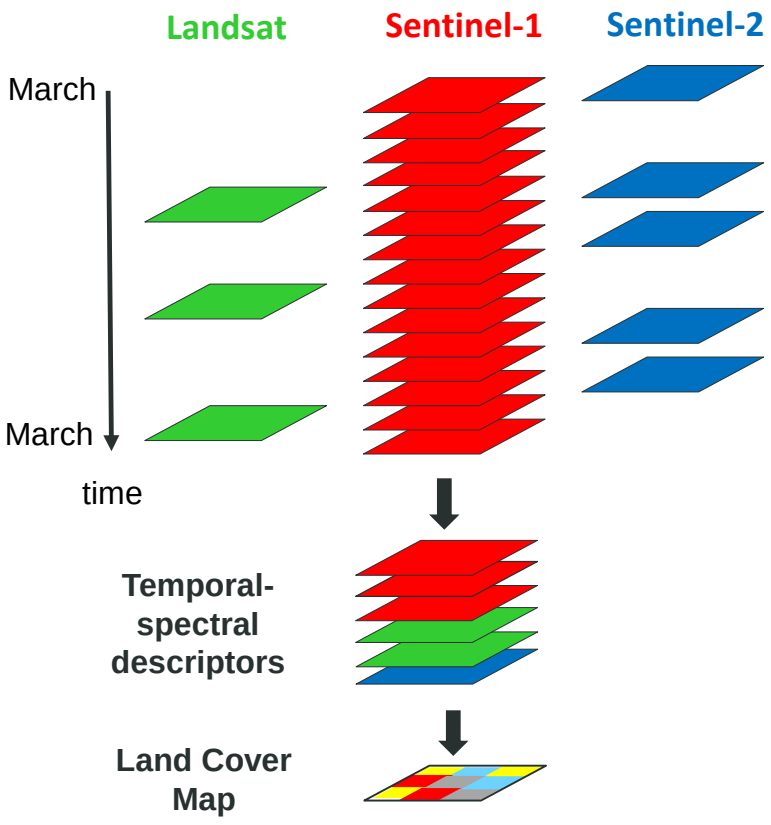
Derive estimates for yield, average plant size, and plant health

Monitoring Crop Health and Hotspots

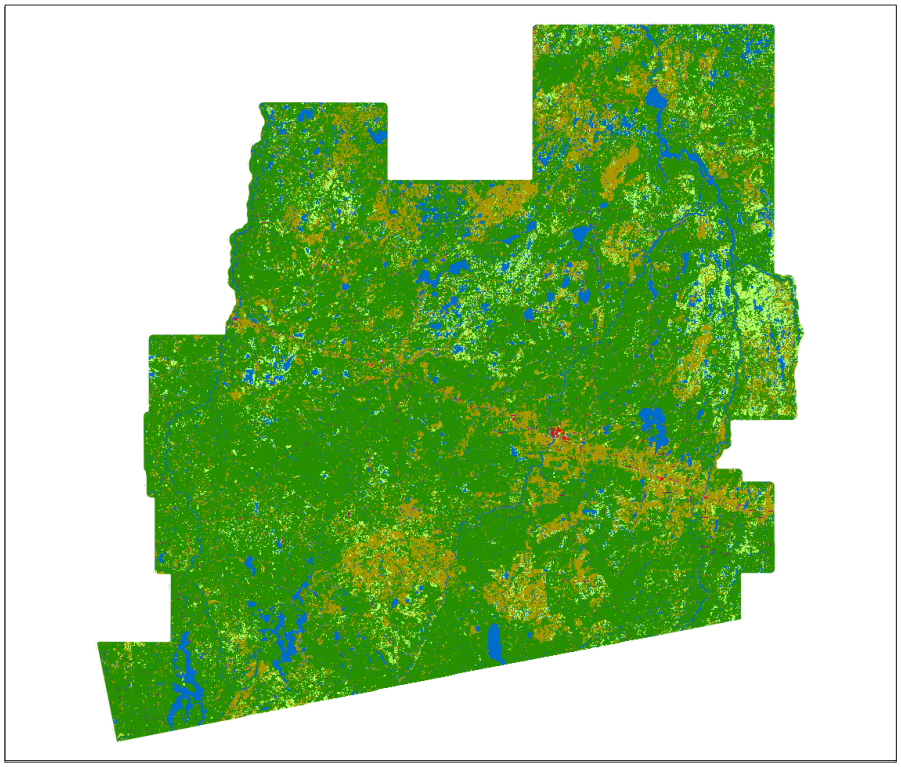


Multi-Sensor Time-Series Analysis for Forest Certification

Multi-temporal Multi-Sensor Approach



Example: Canada – Land Cover Map

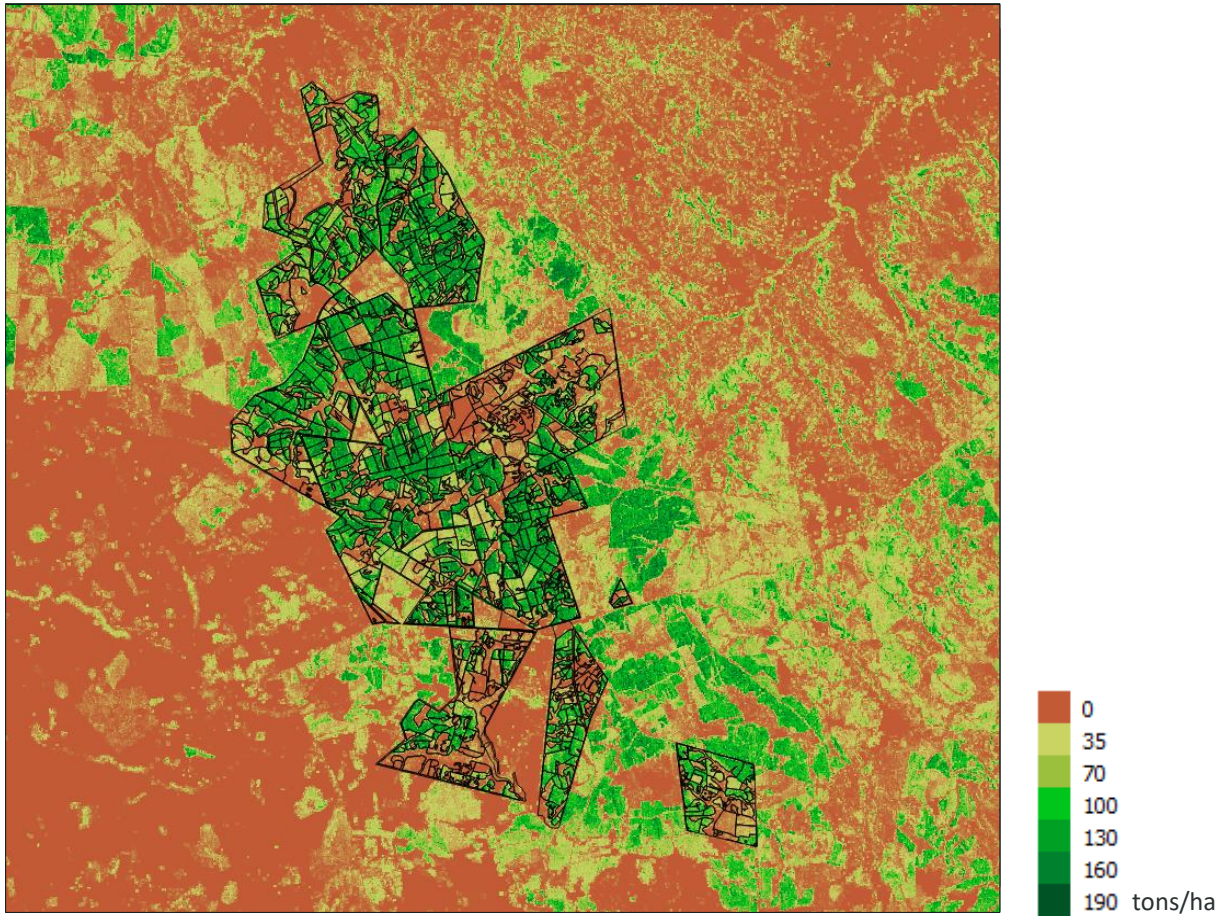


Natural Forest Scattered Trees, bushland, shrubs Water
Bare soil, agriculture, grassland Infrastructure Road

Data courtesy sarmap

Multi-Sensor Time-Series Analysis for Forest Certification

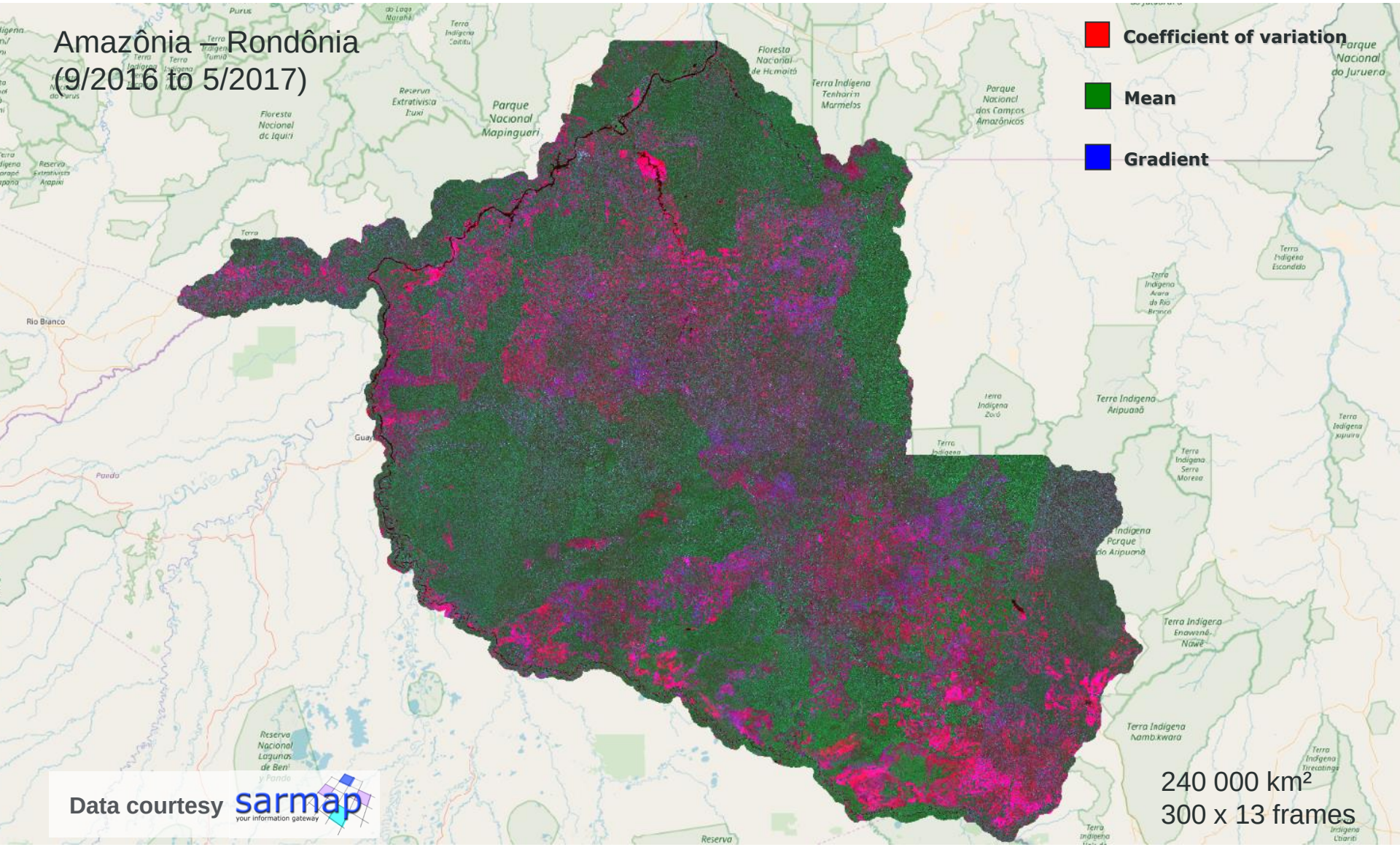
South Africa – Land Cover Map / Timber Volume



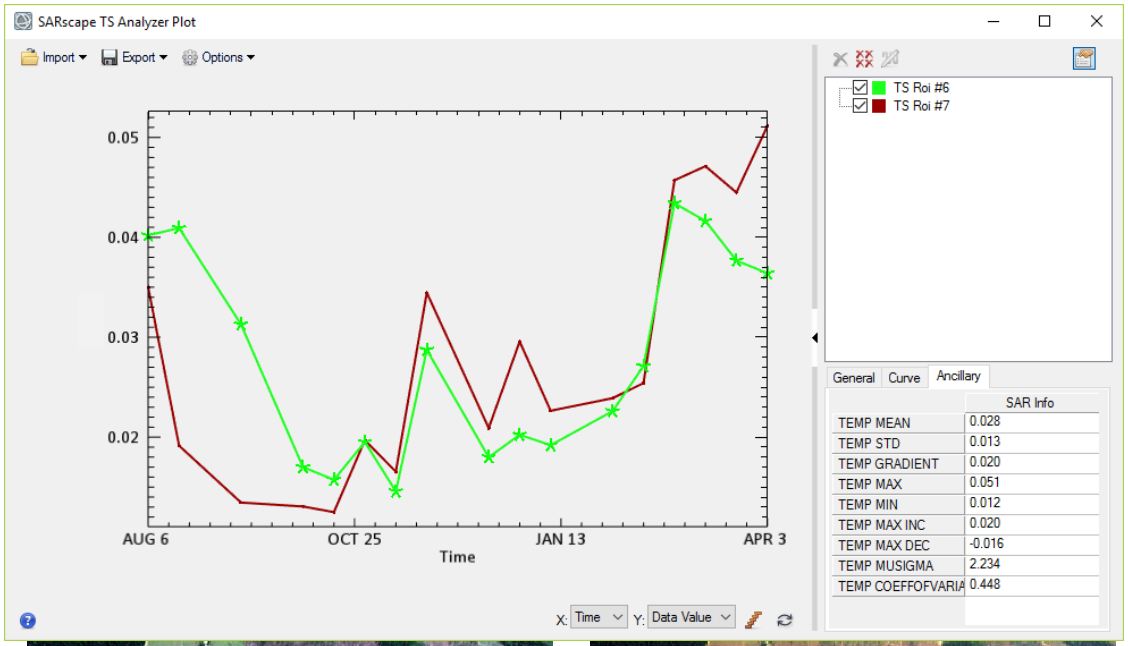
ALOS-2, 10m – Timber volume

Data courtesy sarmap

Sentinel-1/2 Illegal Deforestation Monitoring – Amazonas (Brazil)



Sentinel-1/2 Illegal Deforestation Monitoring – Amazonas (Brazil)

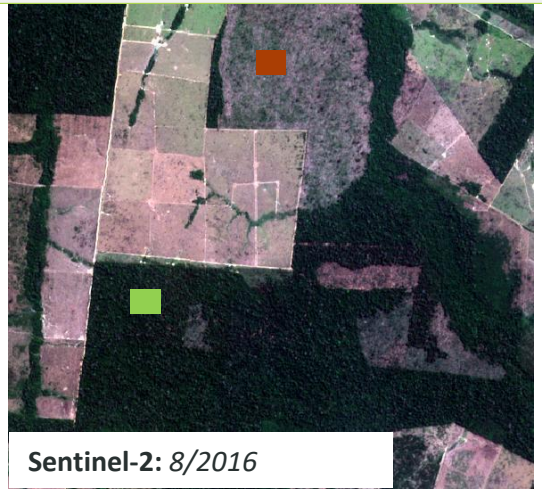


Coefficient of Variation

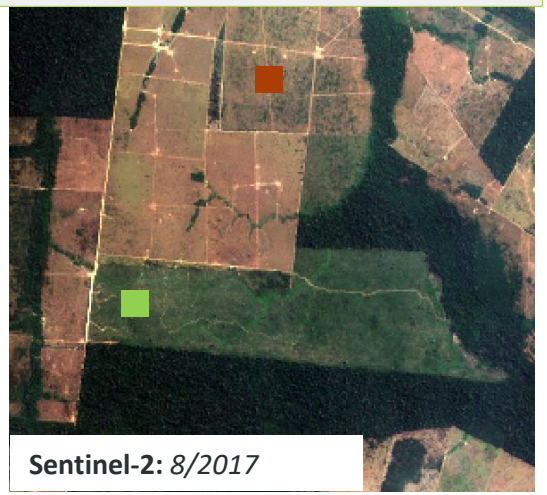
Mean

Gradient

Data courtesy sarmap



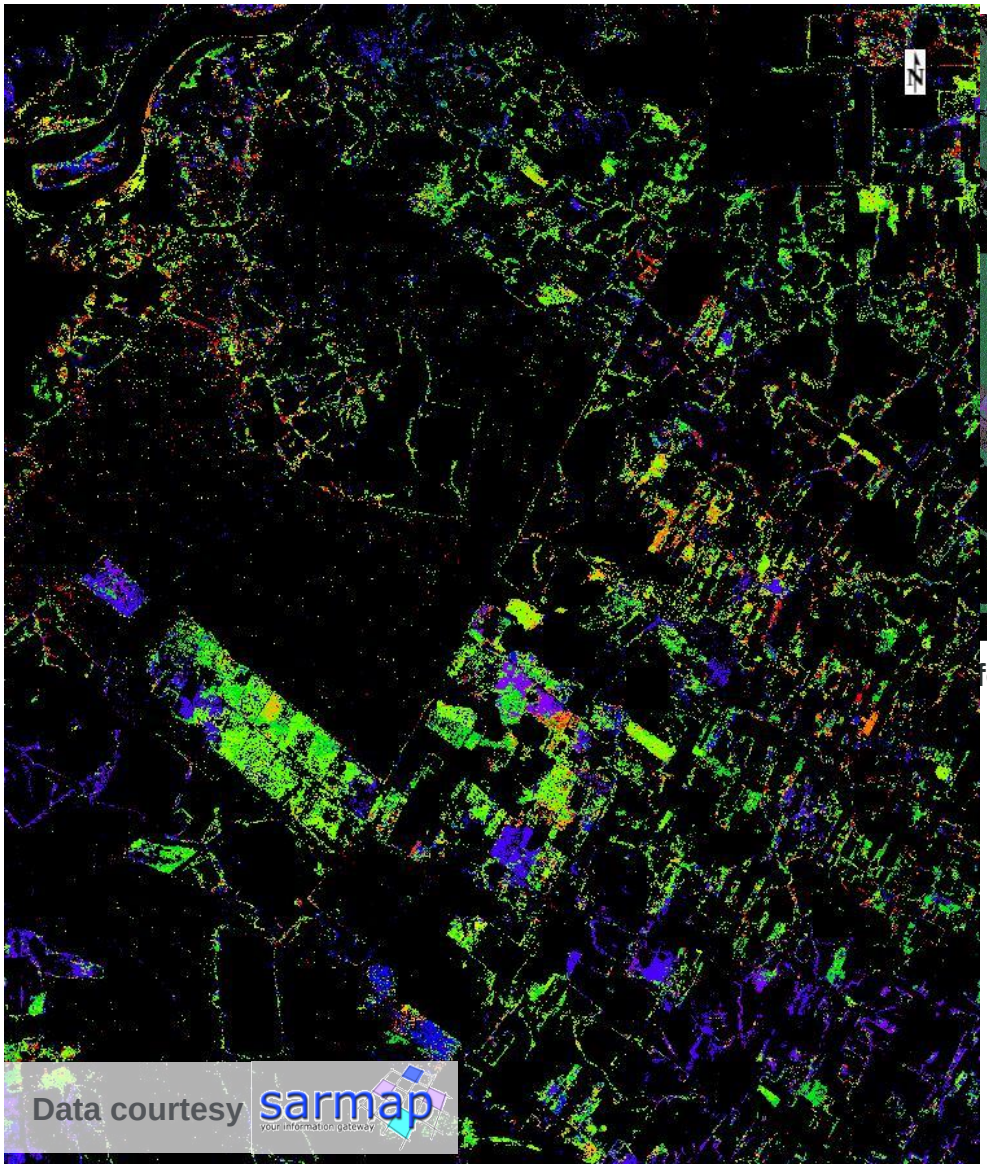
Sentinel-2: *8/2016*

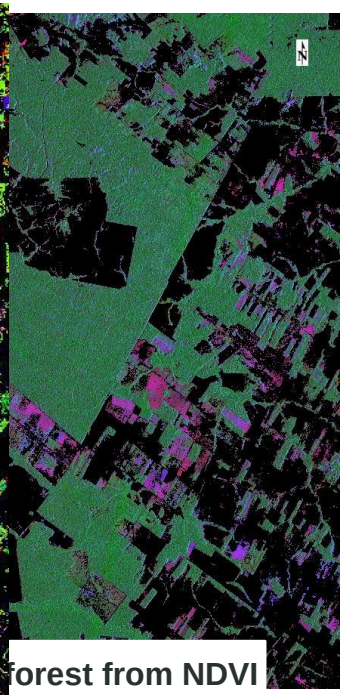


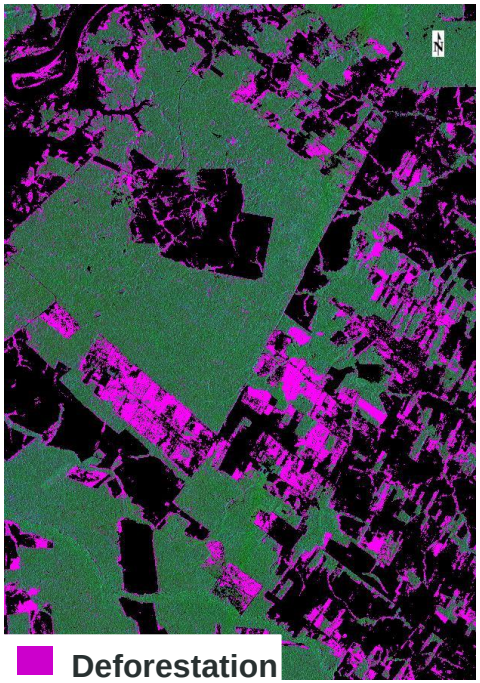
Sentinel-2: *8/2017*

17x **Sentinel-1:** *8/16 – 4/17*

Sentinel-1/2 Illegal Deforestation Monitoring – Amazonas (Brazil)



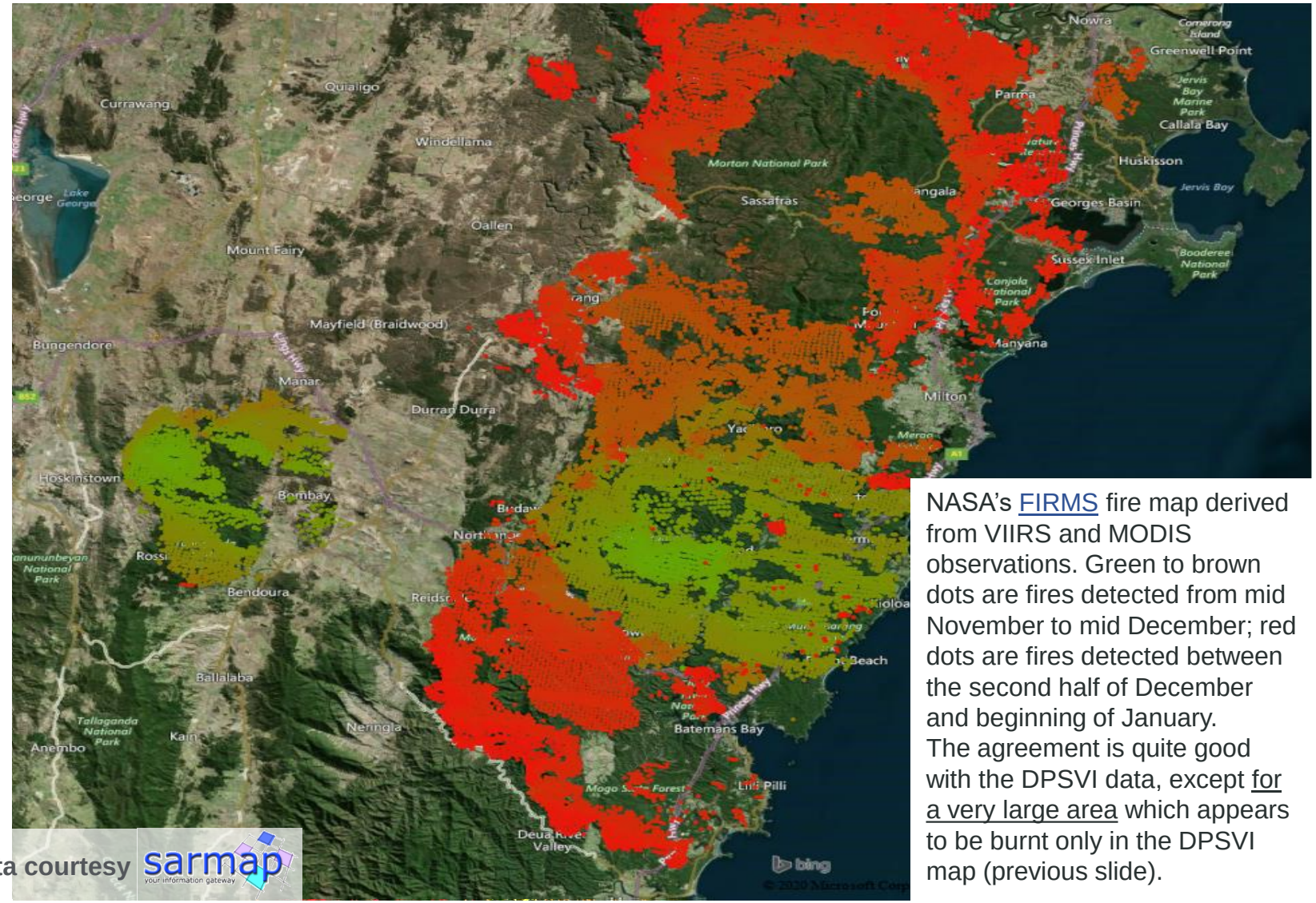




When deforestation occurred

- 0: Unclassified
- 1: 18-AUG-2016 09:56:57.61710299/06-AUG-2016 09:56:57.09052800
- 2: 11-SEP-2016 09:57:10.73546999/18-AUG-2016 09:56:57.61710299
- 3: 05-OCT-2016 09:57:00.06984300/11-SEP-2016 09:57:10.73546999
- 4: 17-OCT-2016 09:57:00.10247299/05-OCT-2016 09:57:00.06984300
- 5: 29-OCT-2016 09:57:00.26823400/17-OCT-2016 09:57:00.10247299
- 6: 10-NOV-2016 09:56:59.99791800/29-OCT-2016 09:57:00.26823400
- 7: 22-NOV-2016 09:56:59.86138000/10-NOV-2016 09:56:59.99791800
- 8: 16-DEC-2016 09:56:58.99469300/22-NOV-2016 09:56:59.86138000
- 9: 28-DEC-2016 09:56:58.72096800/16-DEC-2016 09:56:58.99469300
- 10: 09-JAN-2017 09:56:57.14071100/28-DEC-2016 09:56:58.72096800
- 11: 02-FEB-2017 09:56:56.50233699/09-JAN-2017 09:56:57.14071100
- 12: 14-FEB-2017 09:56:56.21764600/02-FEB-2017 09:56:56.50233699
- 13: 26-FEB-2017 09:56:56.14916100/14-FEB-2017 09:56:56.21764600
- 14: 10-MAR-2017 09:56:56.24990199/26-FEB-2017 09:56:56.14916100
- 15: 22-MAR-2017 09:56:56.42609799/10-MAR-2017 09:56:56.24990199
- 16: 03-APR-2017 09:56:56.88815299/22-MAR-2017 09:56:56.42609799

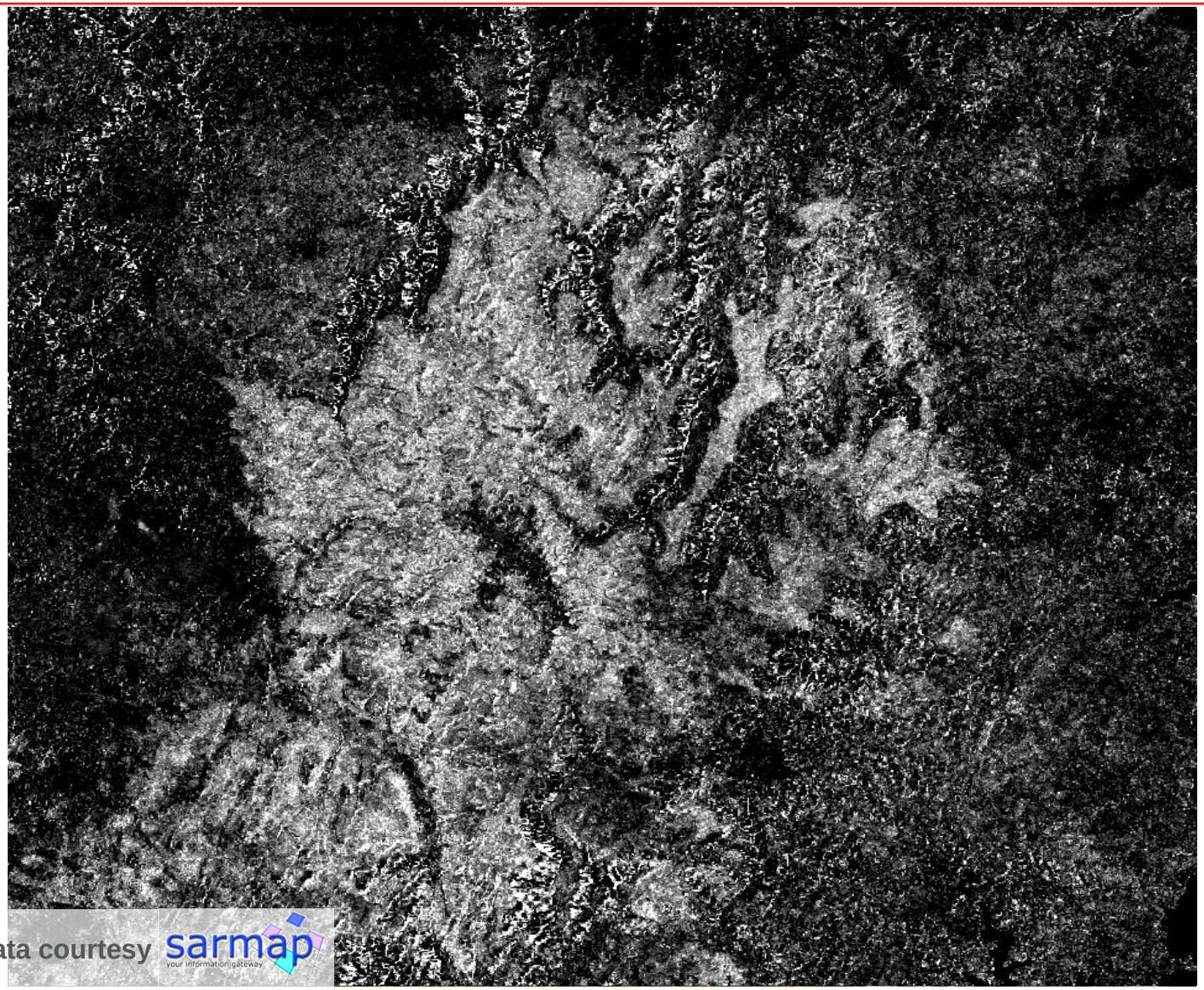
Sentinel-1/2 Burnt Area Detection – Australia Wildfires December 2019



Data courtesy sarmap

NASA's FIRMS fire map derived from VIIRS and MODIS observations. Green to brown dots are fires detected from mid November to mid December; red dots are fires detected between the second half of December and beginning of January.
The agreement is quite good with the DPSVI data, except for a very large area which appears to be burnt only in the DPSVI map (previous slide).

Sentinel-1/2 Burnt Area Detection – Australia Wildfires December 2019



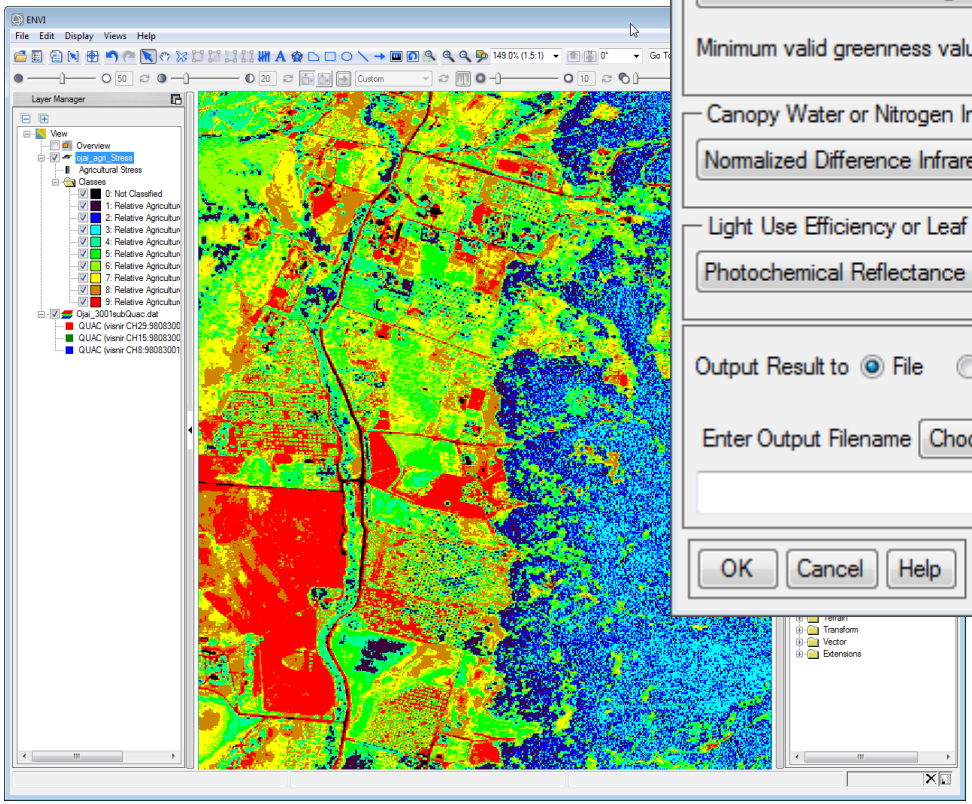
Difference between DPSVI measured in November and on 24 December 2019.
The very bright area represents a great and sudden drop of this index.

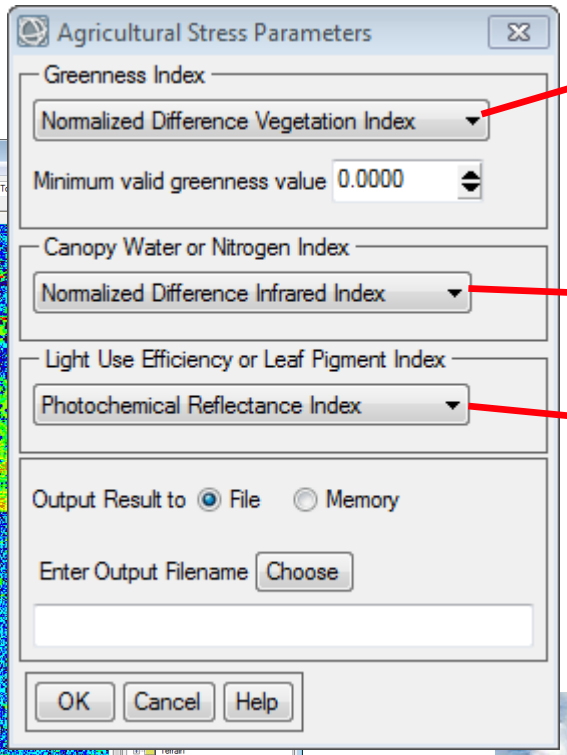
The very strong similarity between NDVI and DPSVI suggests that this area is actually burnt in the second half of December, although it is not reported in FIRMS database.

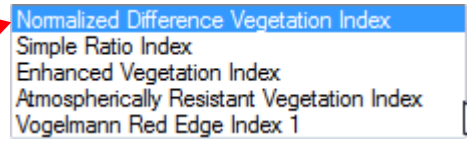
L3Harris Geospatial

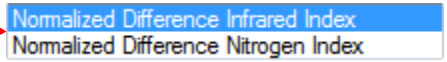
Capabilities and Solutions

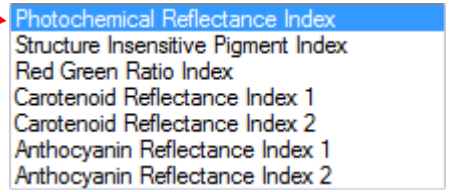
ENVI – Agricultural Stress Analysis Tool

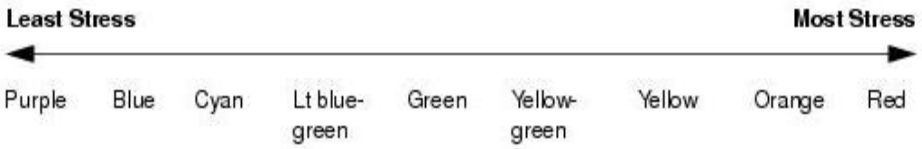








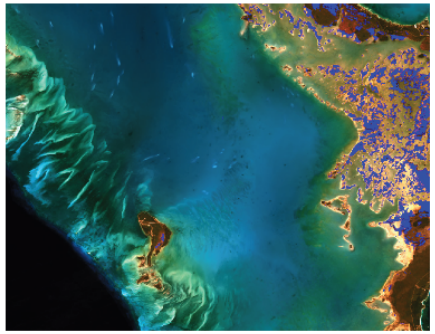




SARscape Analytics Engine Tools

FLOOD MAPPING

The Flood Mapping analytic uses images from before and after a flood and classifies areas of standing water.



The ENVI SARscape Flood Detection workflow uses one or more pre-flood images, a post flood image and a DEM to automatically create a classification of flooded areas by comparing the scenes.

DEM EXTRACTION

Two SAR scenes can be used to create a Digital Elevation Map by comparing and using the differences in the radar signal and viewing angle between the two images.

SENTINEL DOWNLOAD

Automatic download of Sentinel-1 and Sentinel-2 data. This workflow lets you choose an area of interest, dates, and other filters, and downloads multiple Sentinel-1 and Sentinel-2 scenes to use instead of having to manually download them one at a time from a web service.

SENTINEL AUXILIARY FILE DOWNLOAD

This analytic is used to download Sentinel-1 orbital files.

TIME SERIES

The Time Series analytic uses multiple SAR images to create informative layers facilitating land use analysis and change detection.

CHANGE DETECTION

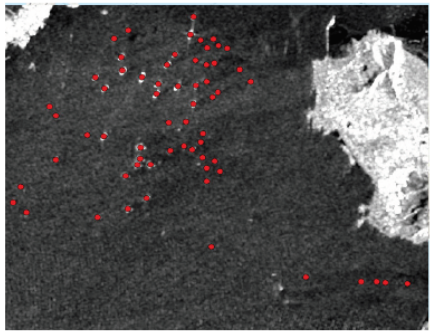
Change Detection uses the coherence and intensity between two scenes to track subtle changes in their structure and outputs a classification result. A secondary tool kit allows for classification refinement.

DISPLACEMENT MAP

The Displacement Map workflow uses a pair of SAR images to show the land motion over time from the first to the second image. This analysis, known as DinSAR, is commonly used after events such as earthquakes and volcanic eruptions.

SHIP DETECTION

Automatic Ship Detection uses a single scene to find ships on water. This can be paired with AIS data for ship monitoring.



The Ship Detection workflow is able to automatically detect ships on water, which can be used for a wide range of applications, such as tracking shipping lanes and monitoring protected areas.

PERSISTENT SCATTERERS

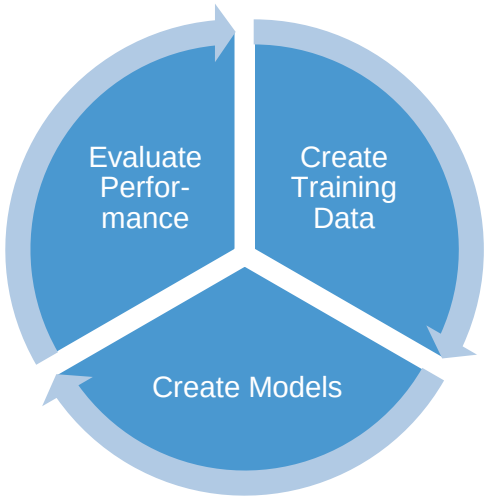
Persistent Scatterers uses time-series interferometry to track changes at millimeter scale and find areas where ground surface deformation has occurred.

IMAGE GEOCODING

Image Geocoding processes raw or satellite-view images into intensity images and geocodes them to map coordinates.

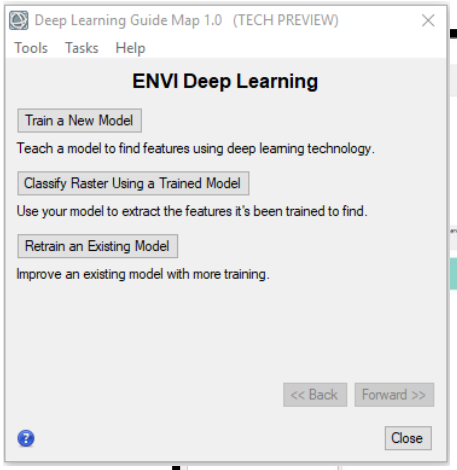
The ENVI Deep Learning Module

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

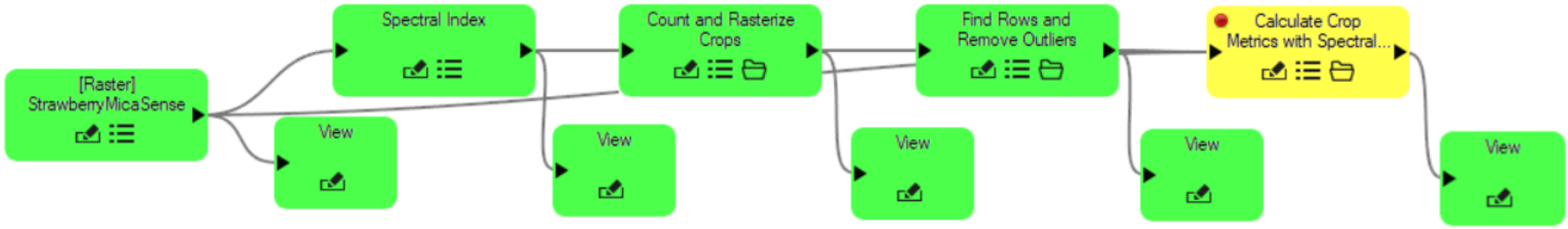


Deep Learning workflow in ENVI, built on TensorFlow and Keras

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



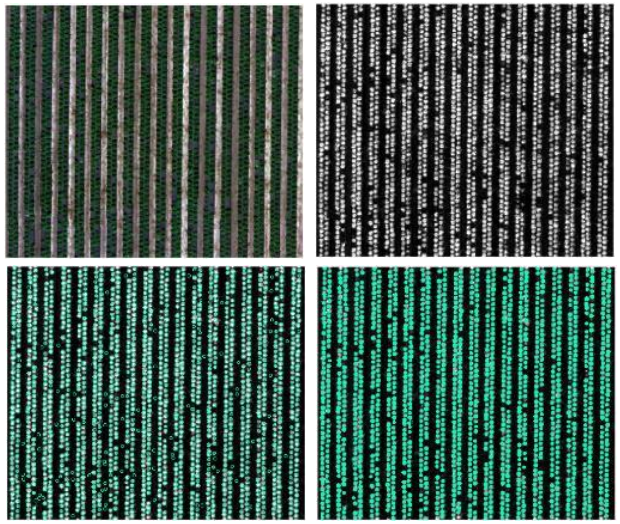
ENVI Crop Science – Modeler Workflow



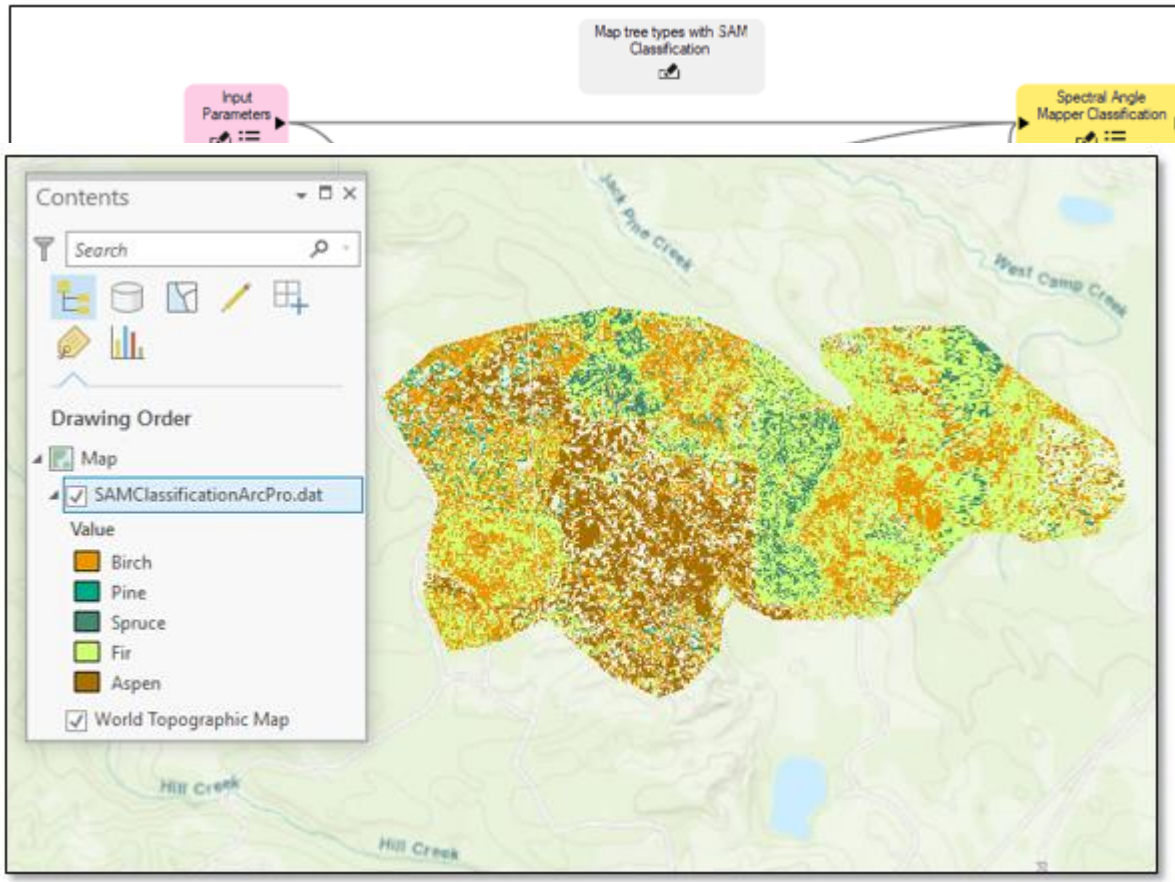
Visual programing tool to build data processing workflows in ENVI.

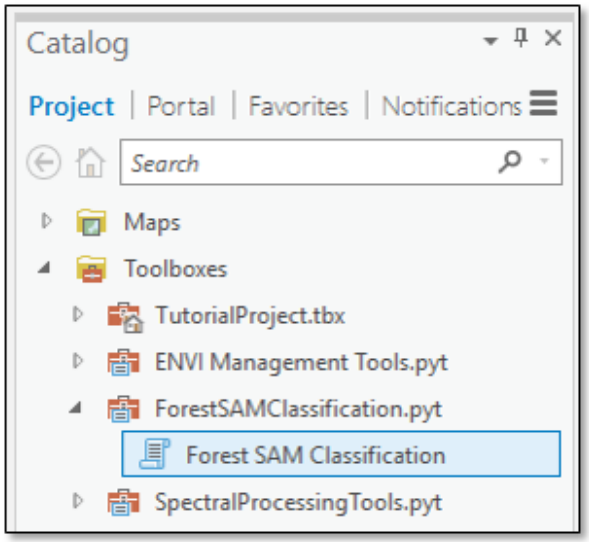
Process data in batch mode and deploy results to different environments (e.g. IDL, Python, ArcGIS,…).

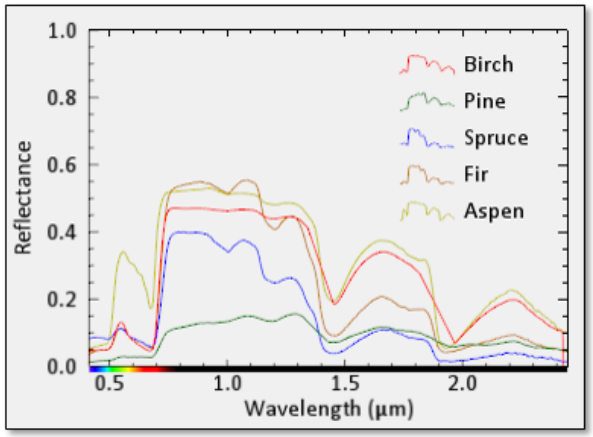
Analytics can be embedded in virtually any existing geospatial workflow for operational applications.

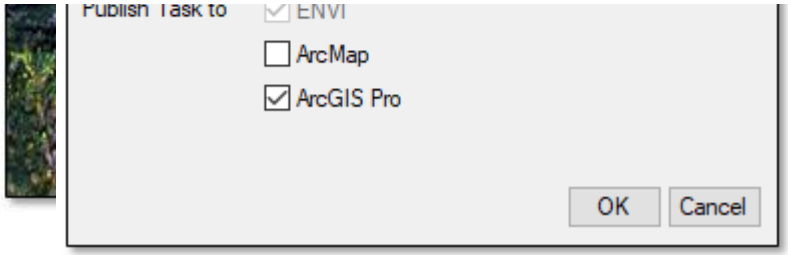


ENVI Hyperspectral Processing in ArcGIS







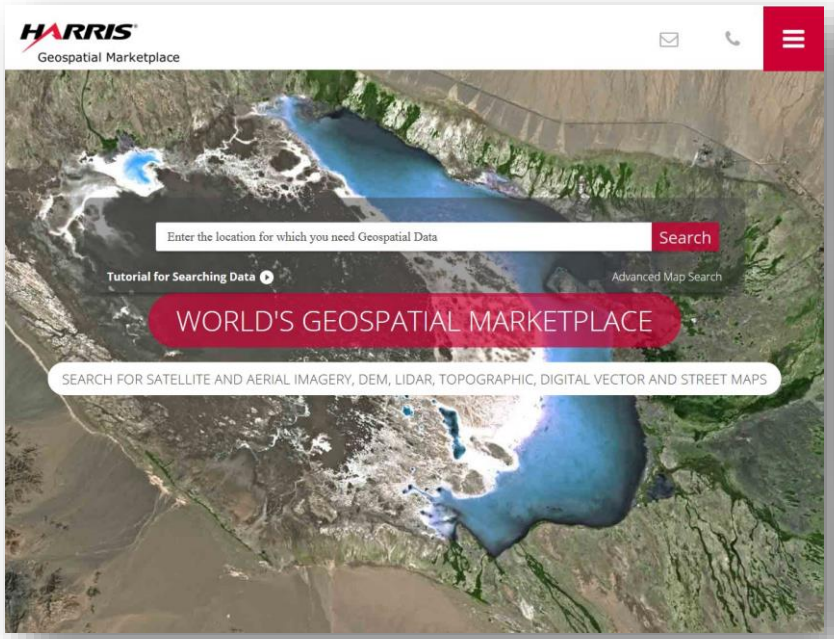


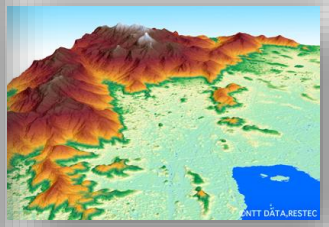
Reference: Unleashing the Power of Advanced Analytics in ArcGIS
eStudies-Detail/TabId/2717/ArtMID/10204/ArticleID/23452/Unleashing-the-Power-of-Advanced-Analytics-in-ArcGIS.aspx

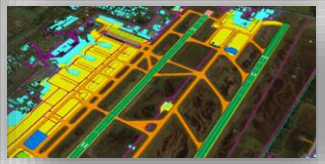
L3Harris Geospatial Data & Imagery

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.

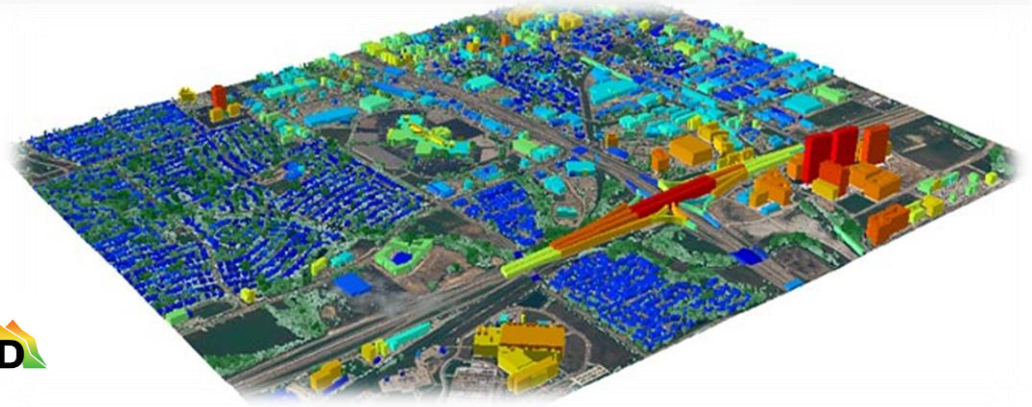






Geospatial services

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

Solutions Delivery

Customizing of software solutions using imagery, video, SAR, LiDAR hyperspectral, IR, and other big data sources.

- Requirement Management
- Agile Software Development
- Automated Software Solutions
- Quality Control
- Deployment and Integration
- Know How Transfer

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

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