

An oil pumpjack stands in a vast, arid desert landscape under a dramatic, cloudy sky. The pumpjack is a large, rusted metal structure with a long arm and a counterweight. The ground is dry and sandy, and distant mountains are visible on the horizon.

N|V|5

# UNLOCK OIL AND GAS INSIGHTS

*JP Metcalf & Drew Baustian*



**JP Metcalf**  
**Solutions Engineer**



**Drew Baustian**  
**Senior Account Executive**

# Today's Topics

NV5

## Intro to NV5 Geospatial

- NV5
- NV5 Geospatial
- NV5 Geospatial Software

## Geospatial Applications in Oil & Gas

- Detect and classify oil field infrastructure using deep learning
- Monitor ground deformation related to oil field injection and extraction with SAR analysis
- Identify pipeline instability through deformation analysis
- Automate workflows for continuous monitoring and reporting across large geographic areas

## Q&A

# Poll Time!

# N|V|5

NV5 provides solutions that help clients develop and deliver cost-effective, sustainable projects to improve lives.



**\$ 800M+**  
Revenue

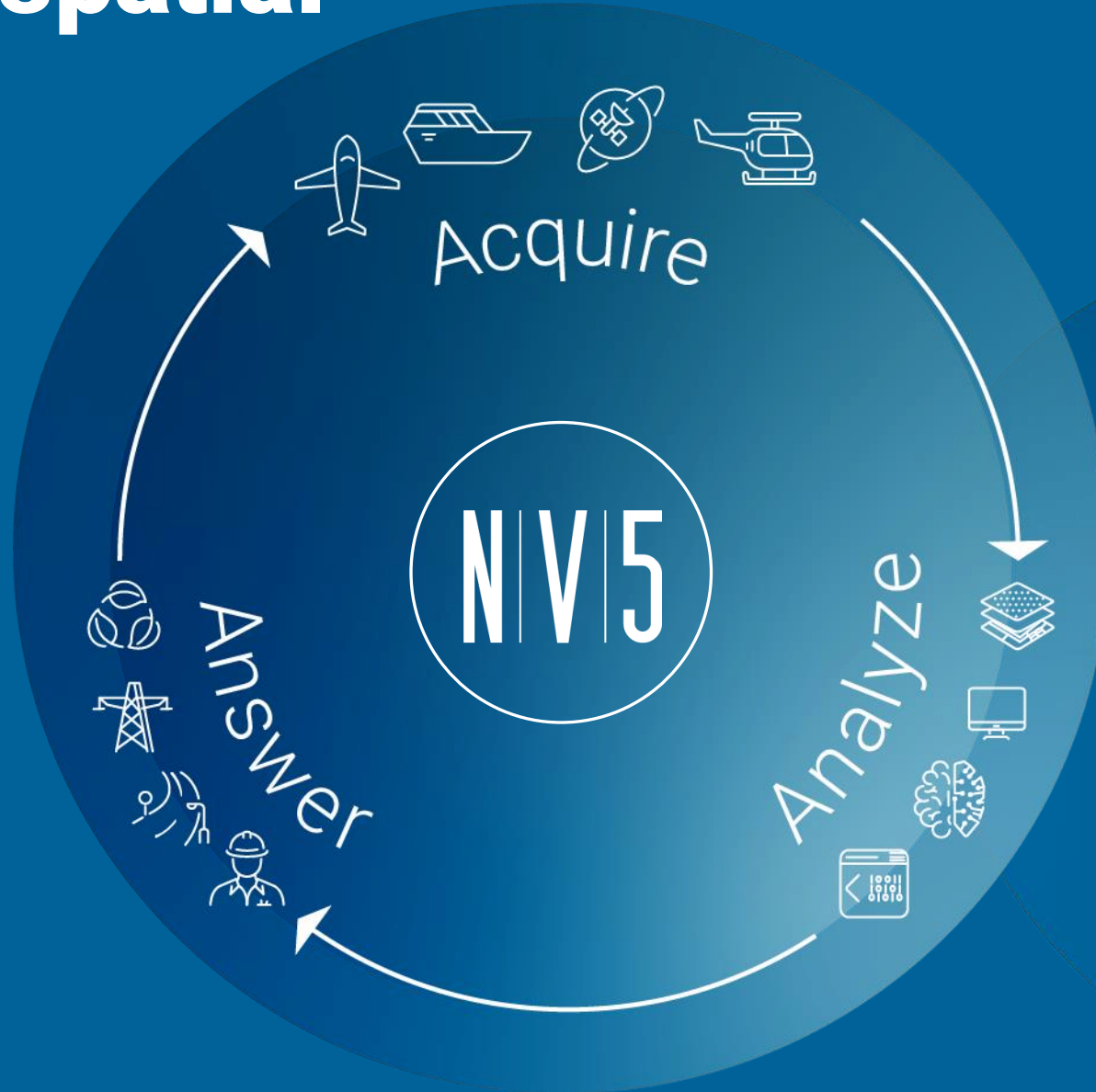
**100+**  
Offices  
Worldwide

**4K+**  
Employees

**12K+**  
Clients

**# 24** ENR Top  
500 Design  
Firms (2022)

# NV5 Geospatial



**1300+**

Worldwide  
Geospatial  
Professionals

Localized  
Contracts in All

**50** States

Completed  
Projects on all  
7 Continents +

**182**

Countries

**500K+**

Software Users  
Around the World

# NV5 Geospatial – Oil & Gas Services

NV5

**Digital Twin** - Optimize operations with a 'digital oil field' – an accurate, virtual model of both infrastructure and environment.

**Vegetation Management** - Identify vegetation hazards remotely to save time and costs, and deploy clearing crews more efficiently with customizable VM solutions

**HCA Analysis** - NV5 Geospatial uses 3D building models from LiDAR and imagery, enriched with parcel data and automated building counts for pipeline HCA and class location studies.

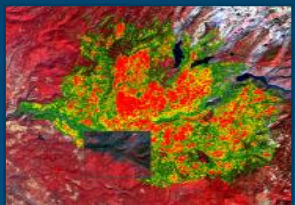
**Geohazards** - Detect and mitigate geologic hazards along pipelines and infrastructure using automated terrain failure and fault analysis powered by high-resolution LiDAR.

**Pipeline Integrity** - Monitor pipeline supports for movement and stress using high-density LiDAR, automated elevation analysis, and geodatabase tracking for integrity management.

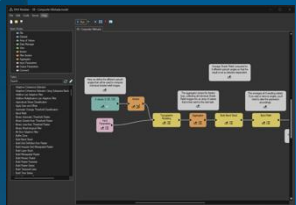


# NV5 Geospatial Software: Analytics to Answers

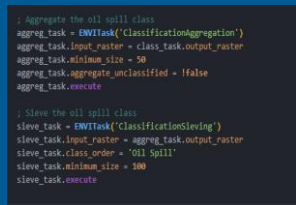
NV5



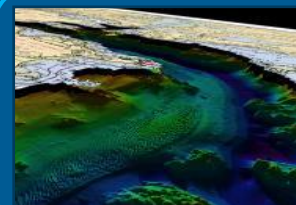
Spectral Analysis



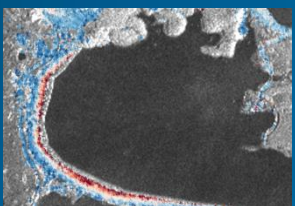
Automation



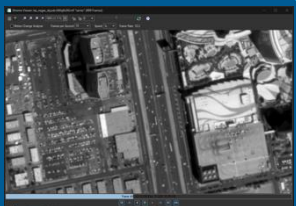
Extensible



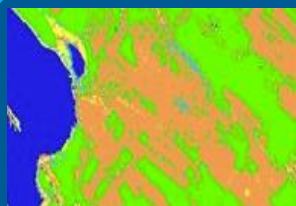
Atmospheric  
Correction



SAR Analysis



NITF



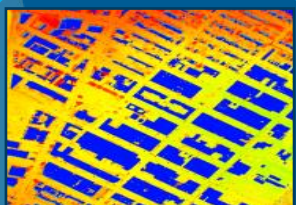
Machine Learning



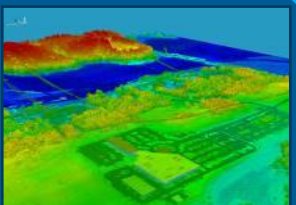
Deep Learning



DEM Extraction



Photogrammetry



Feature Extraction

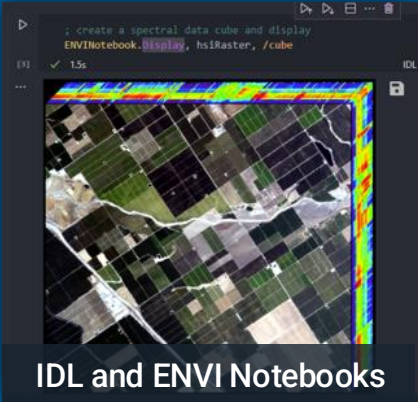
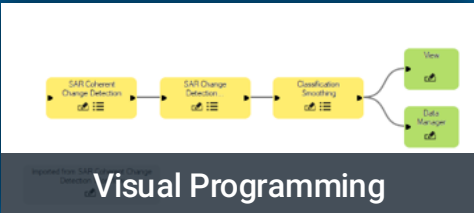
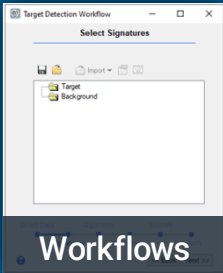
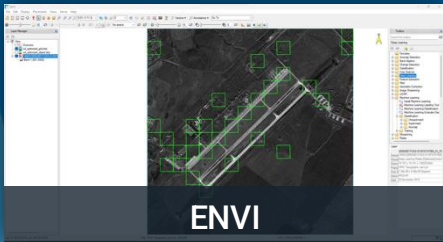
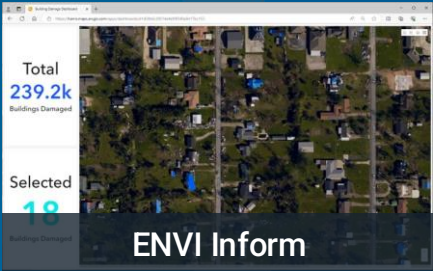
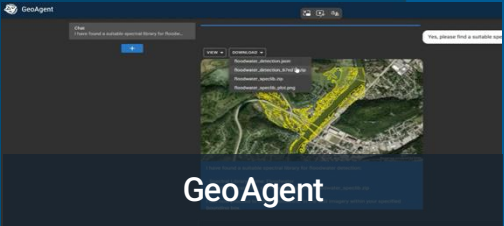


Crop Science

## ENVI Ecosystem

- Integrated tools for image analysis and geospatial workflows
- Scalable from desktop to enterprise and cloud environments
- Built for automation, extensibility, and interoperability
- Supports advanced analytics: AI, machine learning, and deep learning
- Designed to turn raw data into actionable answers

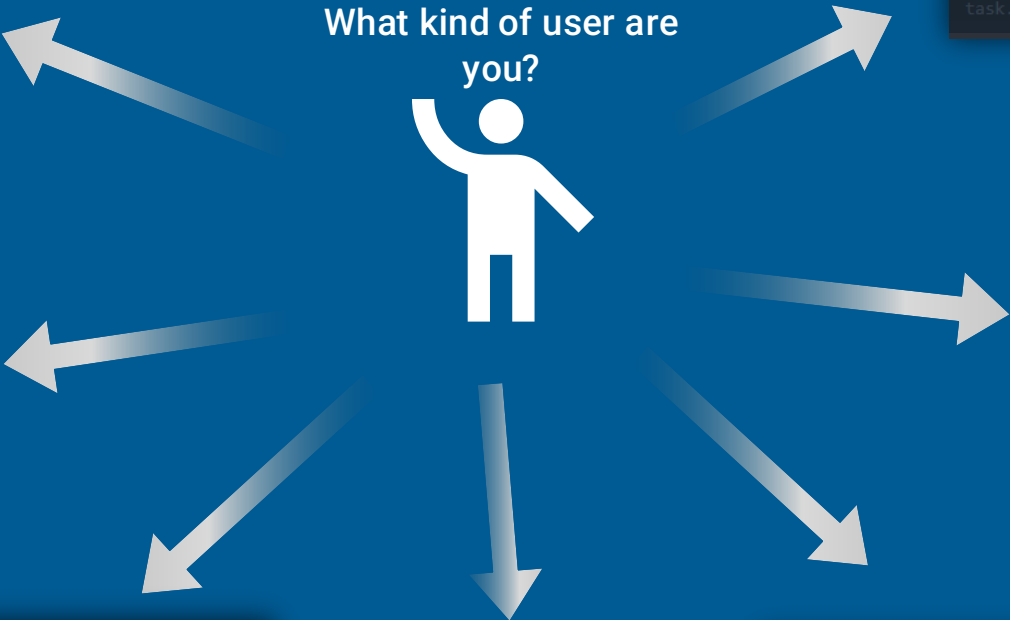
# ENVI Ecosystem - Enabling all Organizations



```
; open our data
raster = e.openRaster(rasterFile)

;+ make our task to classify
task = ENVITask('MachineLearningClassification')
task.input_raster = raster
task.input_model = ENVIMachineLearningModel(modelFile)
task.execute
```

IDL (and the ENVI API)



What kind of user are you?

A large black corrugated pipe is being laid in a deep trench. The trench is dug into reddish-brown soil. To the left of the trench is a field of green corn. To the right is a line of trees. The sky is a mix of purple and blue, suggesting dusk or dawn. The pipe is the central focus, stretching from the foreground into the distance.

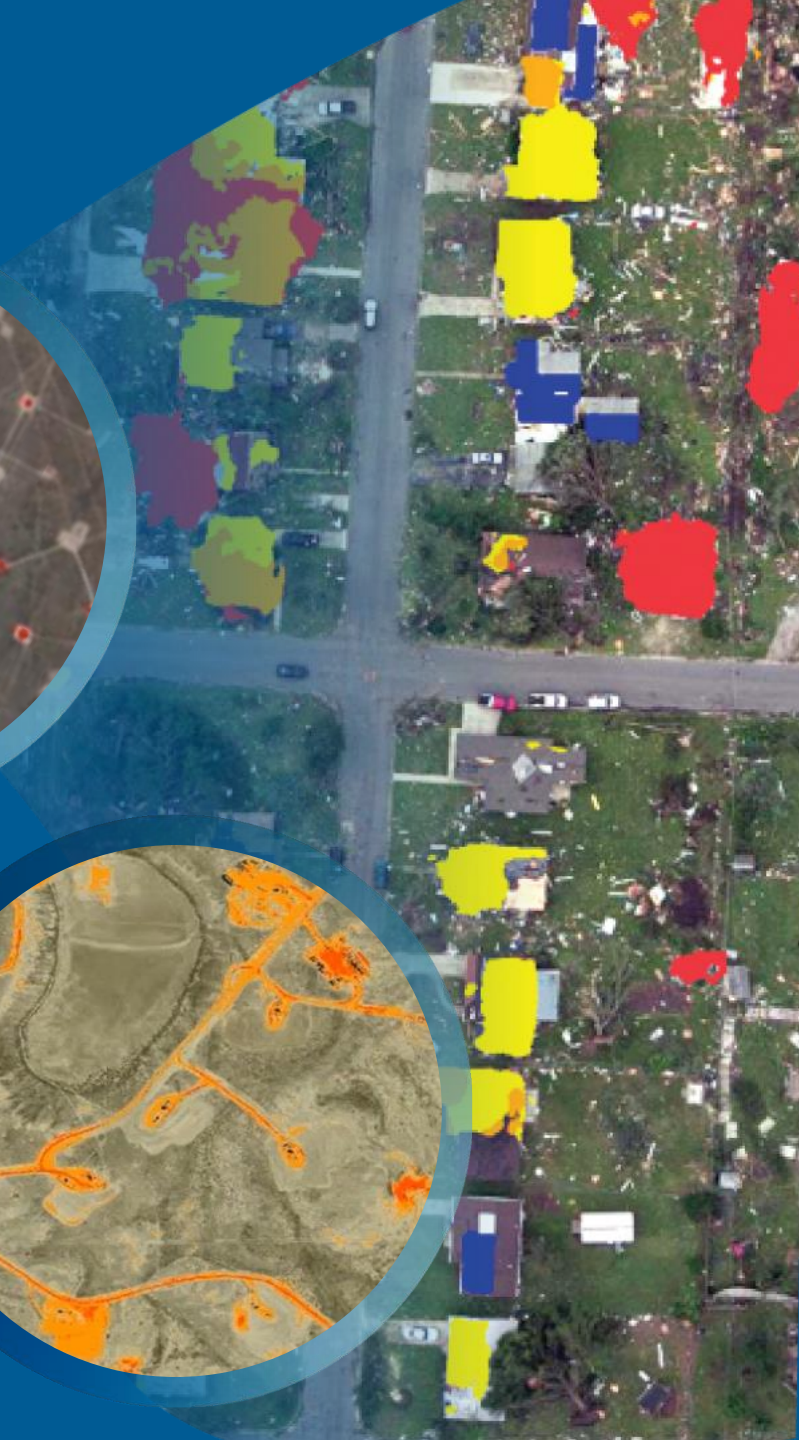
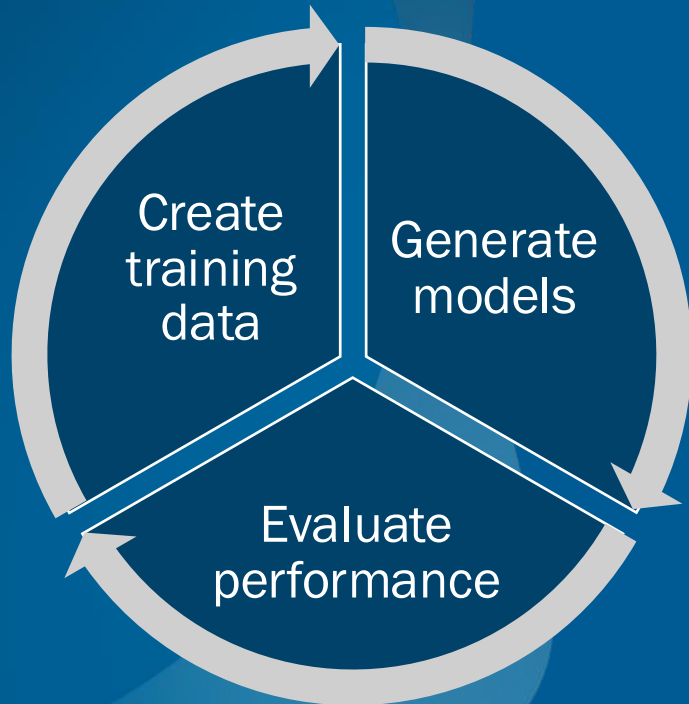
N|V|5

Detect and Classify Infrastructure

# ENVI<sup>®</sup> Deep Learning

Automate analytics with deep learning and machine learning for faster, and more accurate, results.

No programming required.



# Deep Learning Object Detection – Well Pads

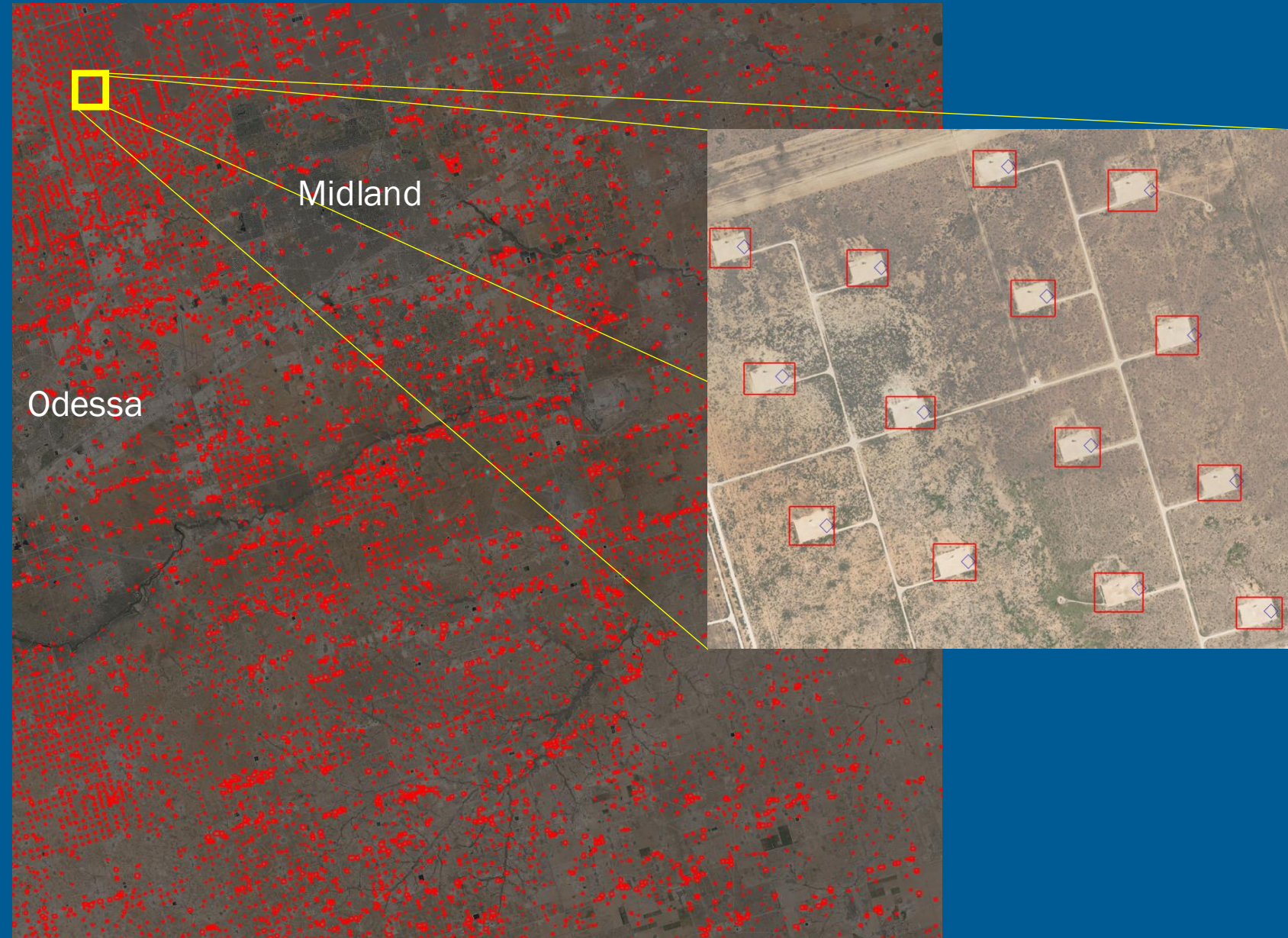
NV5

- Image Training

- RGBNIR NAIP 2024
- 5 tiles over Texas
  - Midland / Ector / Andrews / Scurry / Ward
- 60 cm GSD
- Each tile 57 x 57 km
  - Portions of each tile labeled
- ONNX model

- Image Classification

- 6000 well pads detected in Midland tile
- Bounding box shapefile output



# Methane Plume Detection Indices

Pads identified and mapped using deep learning

Use multispectral and hyperspectral radiance imagery to monitor for methane leakage



An aerial photograph of a landscape, possibly a coastal or urban area, with a network of colored lines overlaid. The lines are primarily green and blue, with some red and yellow segments, indicating areas of ground deformation or subsidence. The background is a grayscale aerial image showing terrain features and some structures.

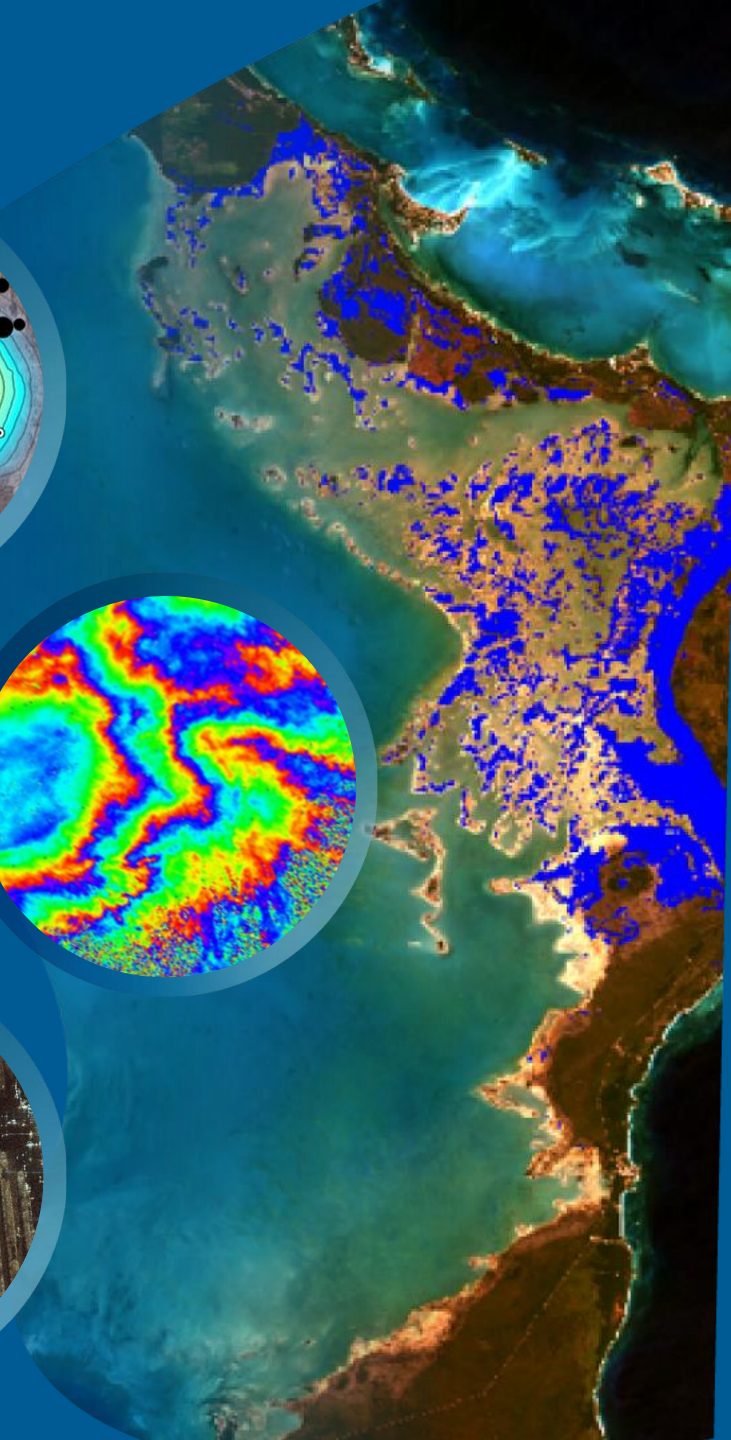
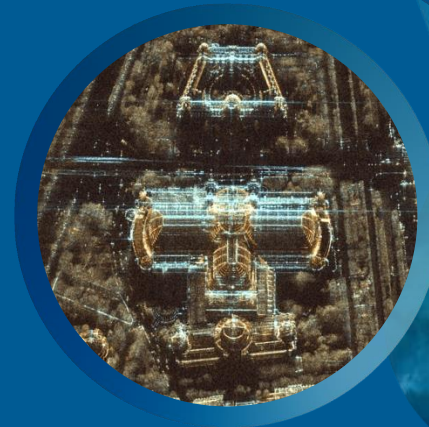
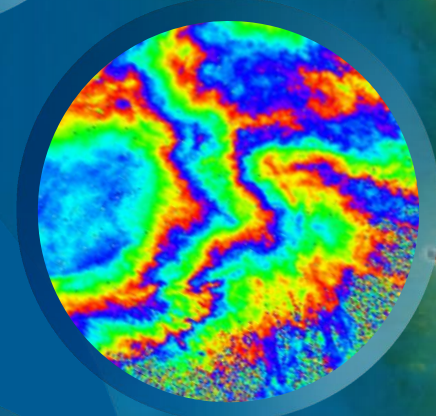
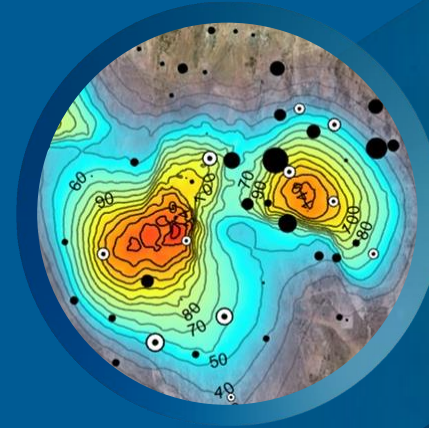
N|V|5

Monitor Ground Deformation

# Synthetic Aperture Radar Processing in ENVI

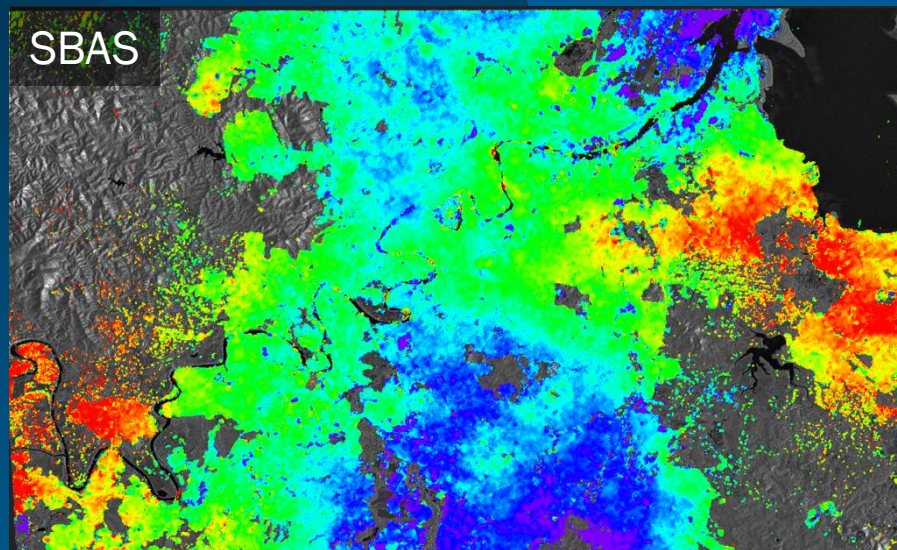
ENVI SARscape leverages Interferometric Stacking to transform complex SAR data into actionable business intelligence

- **Millimeter-Scale Precision:** Detect ground movement down to millimeters per year
- **Time Series Monitoring:** Filter atmospheric noise and measure cumulative deformation over years
- **Proactive Risk Assessment:** Early warning signs of pipeline instability
- **Large Area Scalability:** Map assets and monitor integrity across 1000s of square km

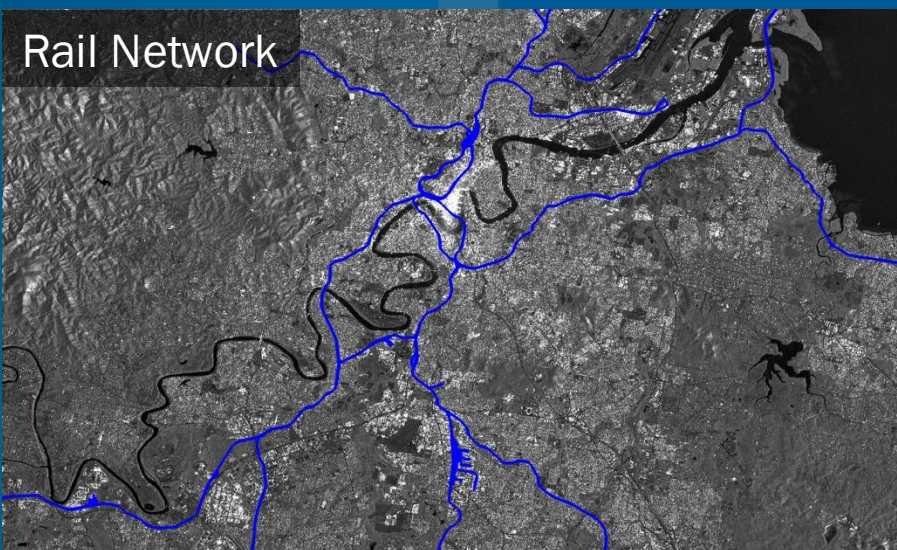


# Interferometric Stacking in SARscape

NIV5



Brisbane AU  
Sentinel 1 - VV - Jan 2024 to March 2025



Velocity mm/yr  
-30.0 30.0

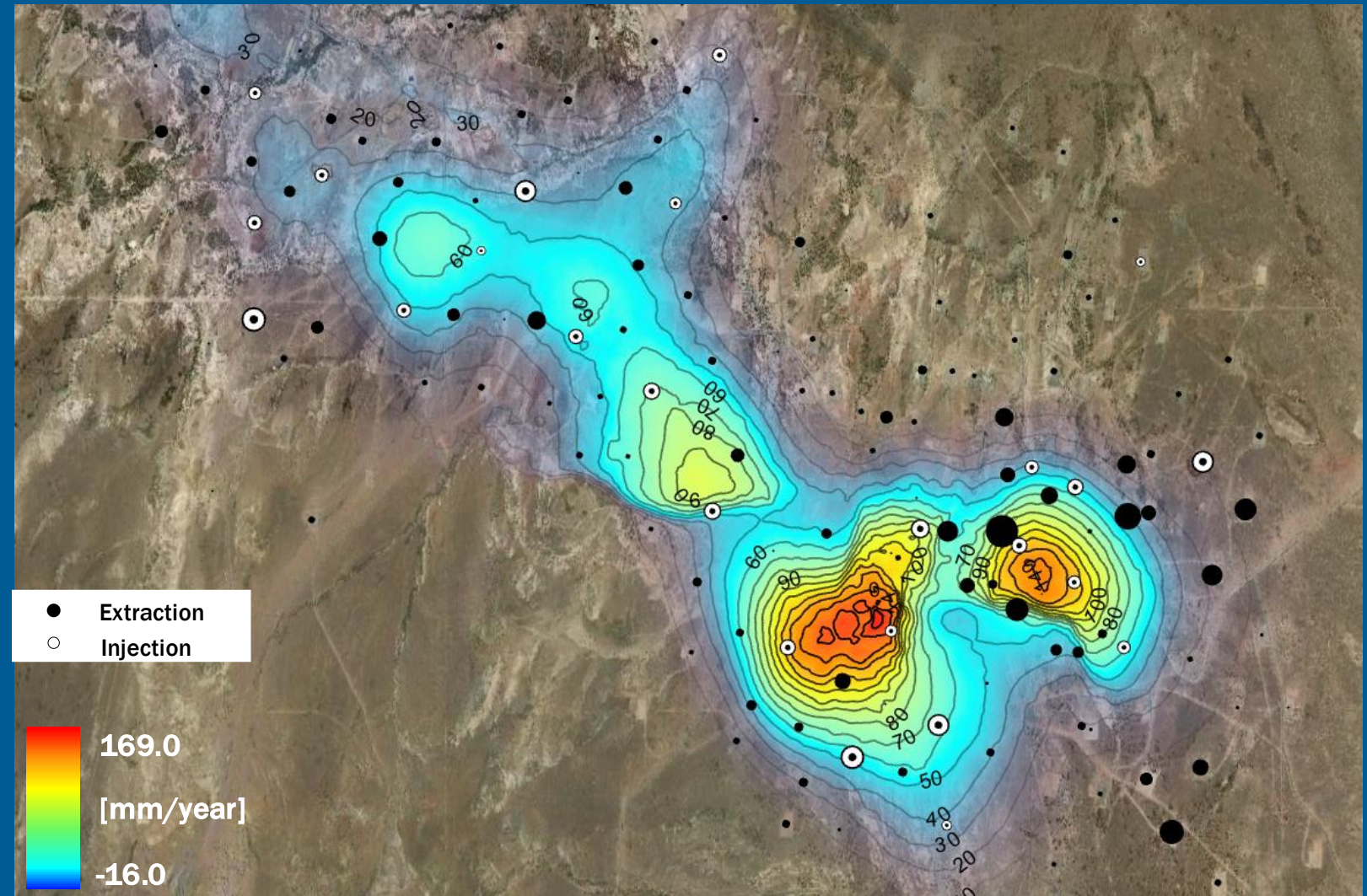
# Oil Field Average Deformation Mapping

## Integrity Risk:

Large spatial variations in deformation rates (where colors change rapidly) increase stress and strain on well casings and boreholes, risking failures and collapses.

## Operational Insight:

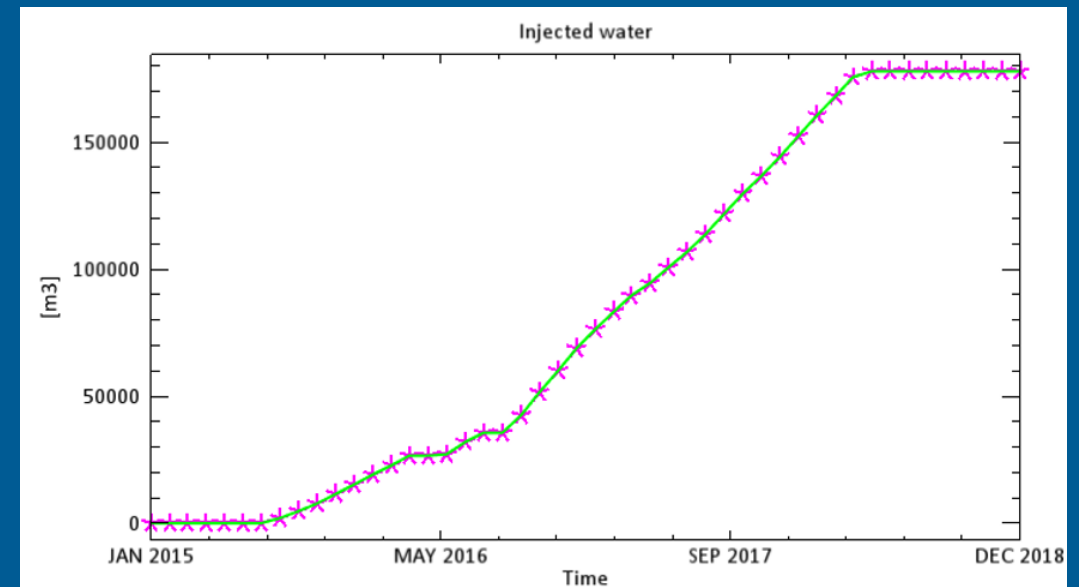
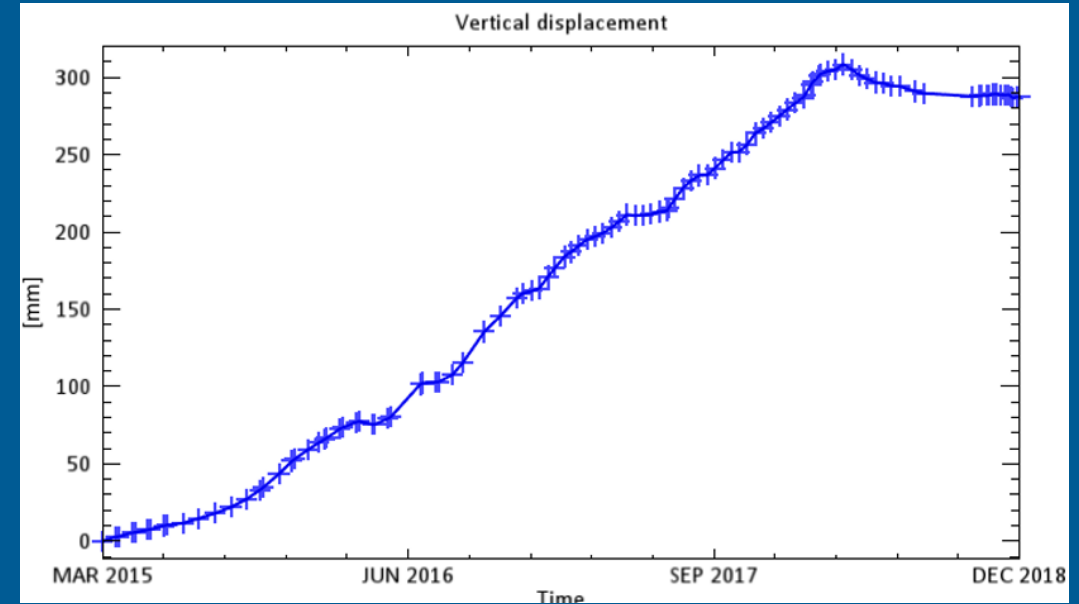
Low or negative uplift rates in injection areas can indicate inefficient injection processes.



# Time Series of Deformation

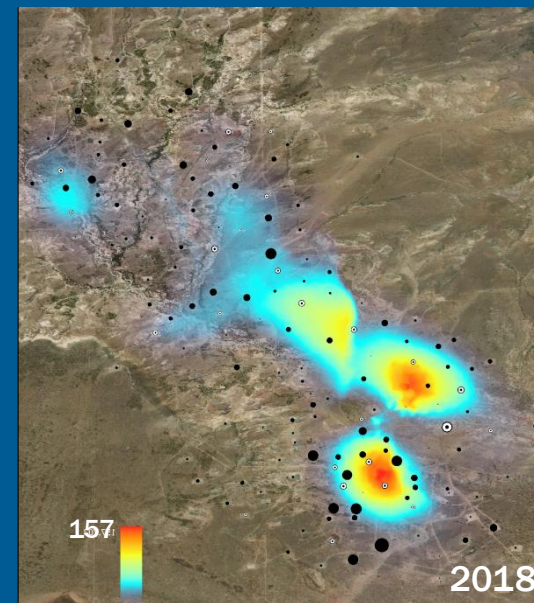
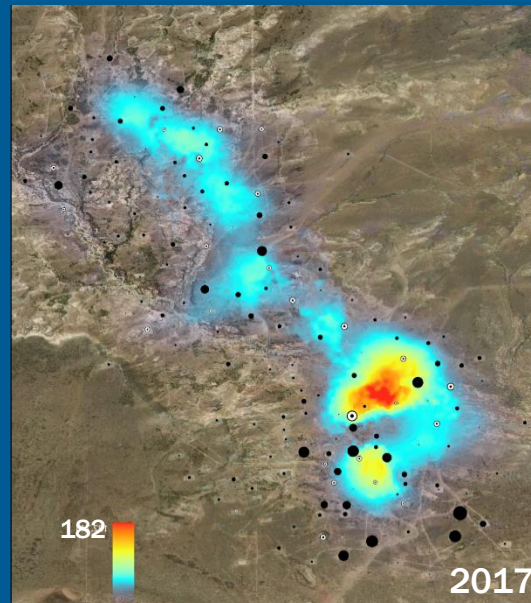
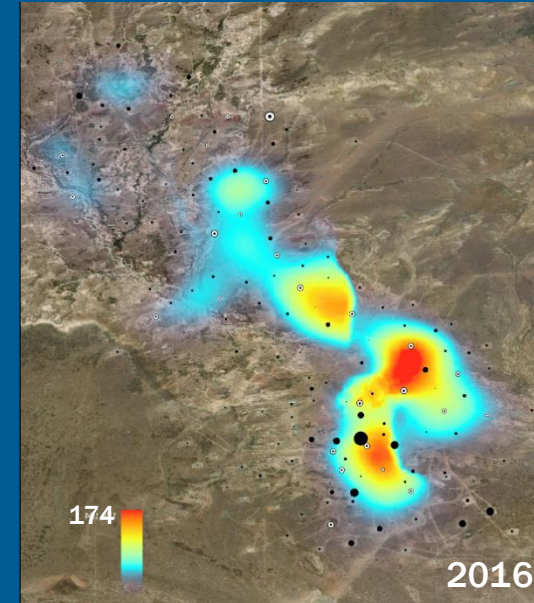
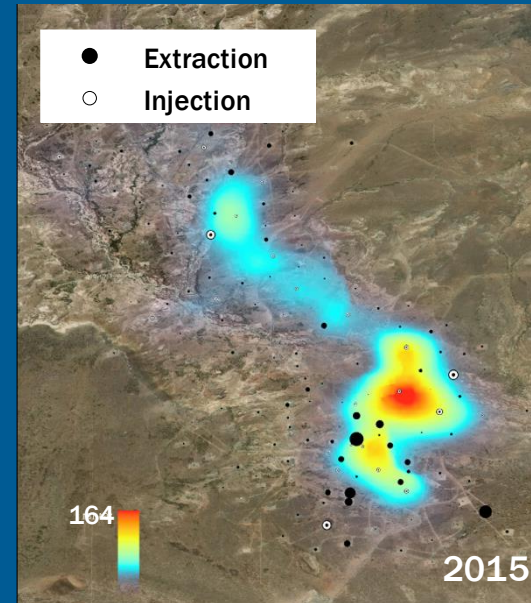
## Displacement Time Series

- Variation over time of the terrain position [mm] for each pixel measured in the AOI and for each available input date.
- Comparison of the displacement time series for one point close to an injection well in an oil field with injected water volume in the same period.
- High correlation between the two curves hints that the strongest effect of water injection is in terrain uplift



# Yearly Cumulative Displacement Per Period

Total variation  
of terrain position  
[mm] each year for the  
entire observation  
interval.



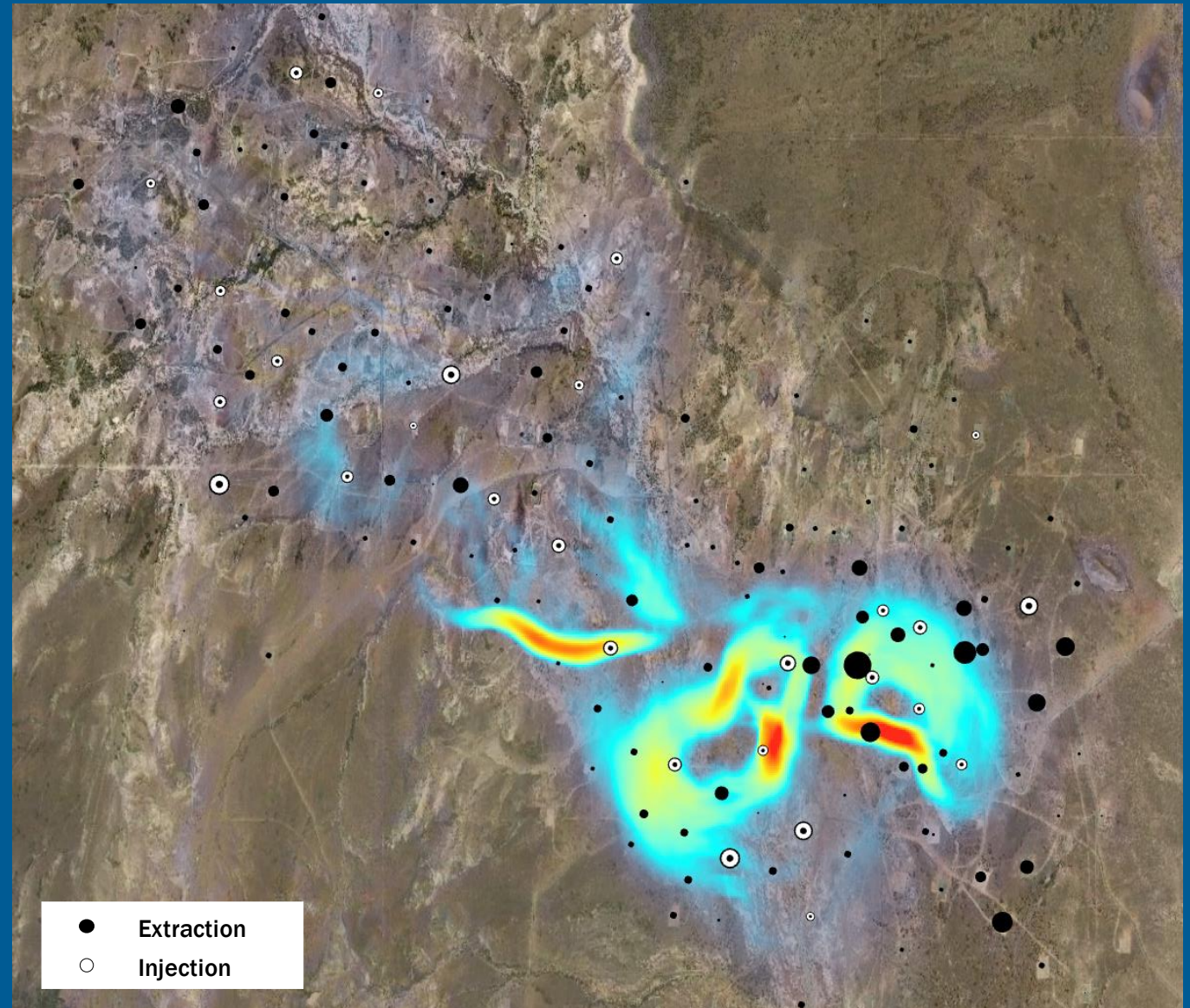
# Deformation Rate Spatial Gradient

**What it Measures:** The rate at which the ground movement is *changing* over a short distance (**Differential Movement**).

**Significance:** It is a direct proxy for **Geological Strain** acting on the well casing and subsurface infrastructure.

**The Danger Zone:** Red and Yellow areas indicate **High Strain** where the ground is tearing or shearing, putting structural stability of wells in critical danger.

**Actionable Insight:** Use this map to **prioritize wells** for high-resolution inspection, maintenance, or pressure adjustments based on maximum internal geological stress.



The background image shows a long pipeline stretching across a grassy field. The pipeline is supported by numerous vertical metal posts. The sky is dark and cloudy, suggesting an approaching storm. The overall scene is industrial and somewhat somber.

N|V|5

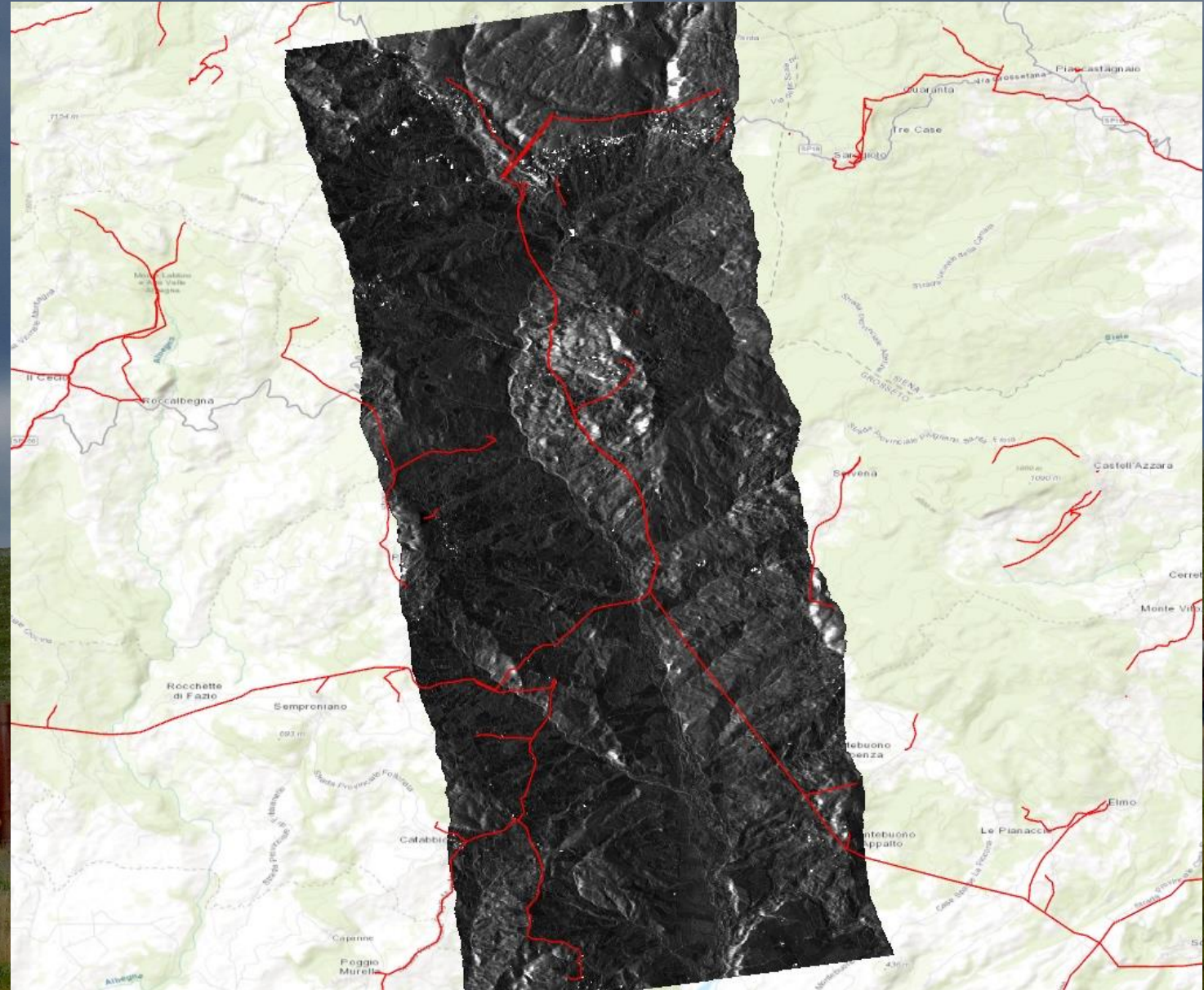
# Pipeline Stability Assessment

# Pipeline Monitoring

Sarmap performed a study on pipeline stability in Tuscany Italy between 2014 and 2018 using Sentinel 1 imagery

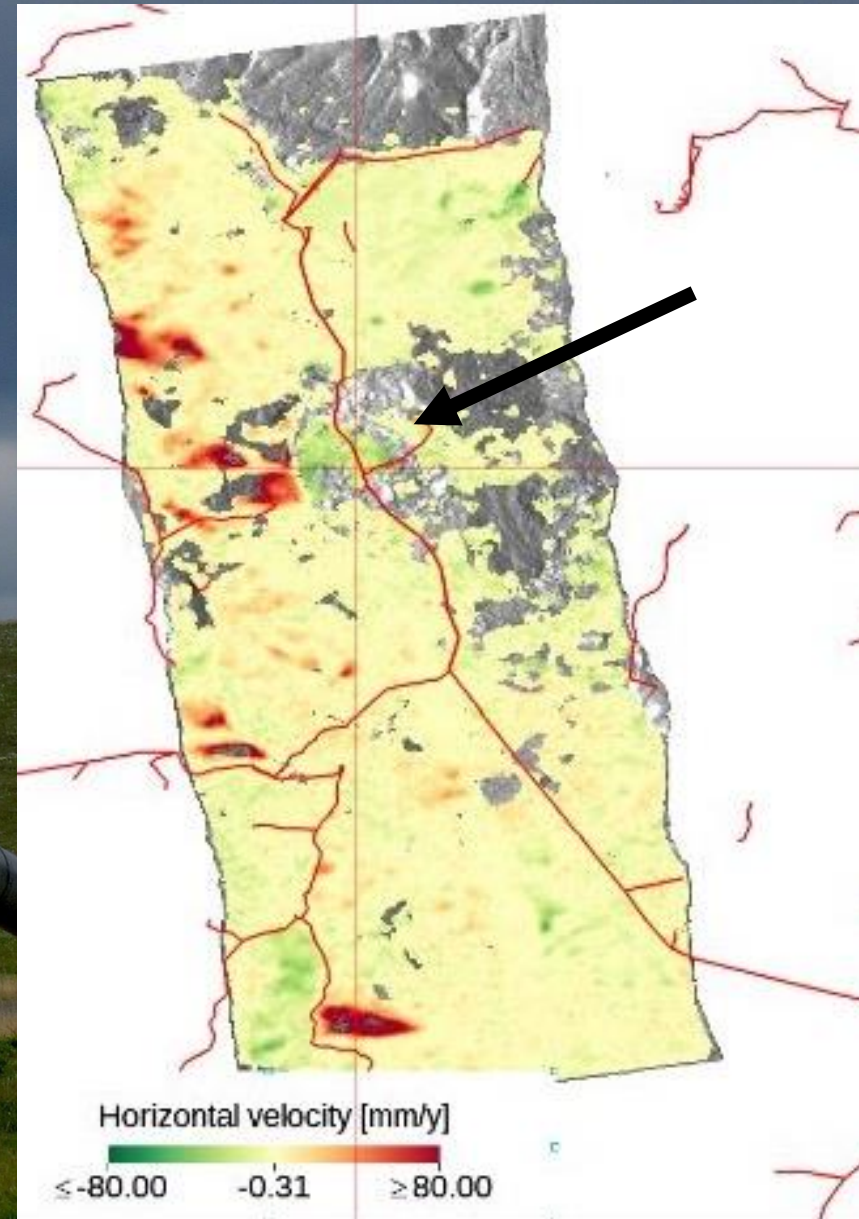
Key concerns for pipeline managers:

- **Safety:** Ground movement can snap or strain a pipe
- **Leakage:** Leaking liquid can affect the surrounding slope increasing ground stability

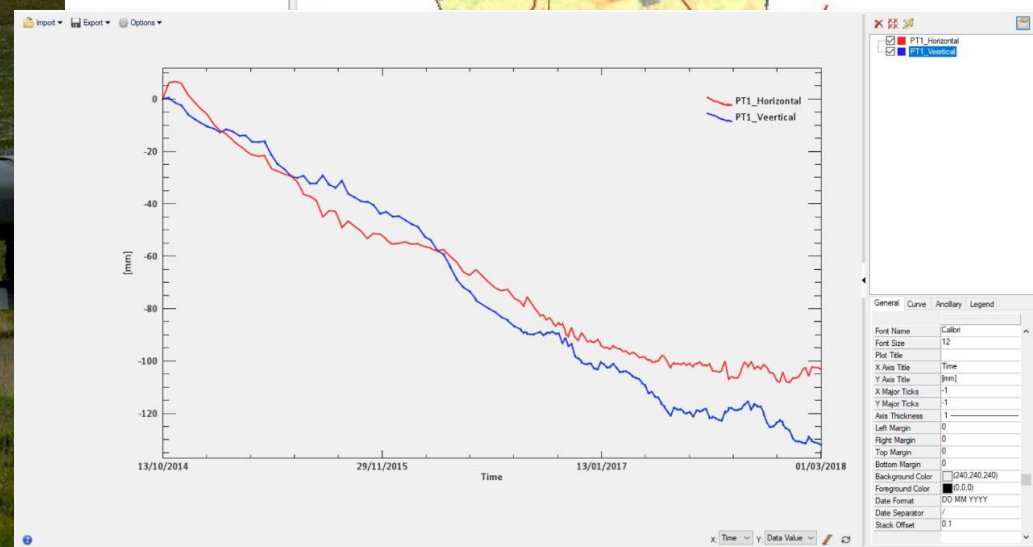
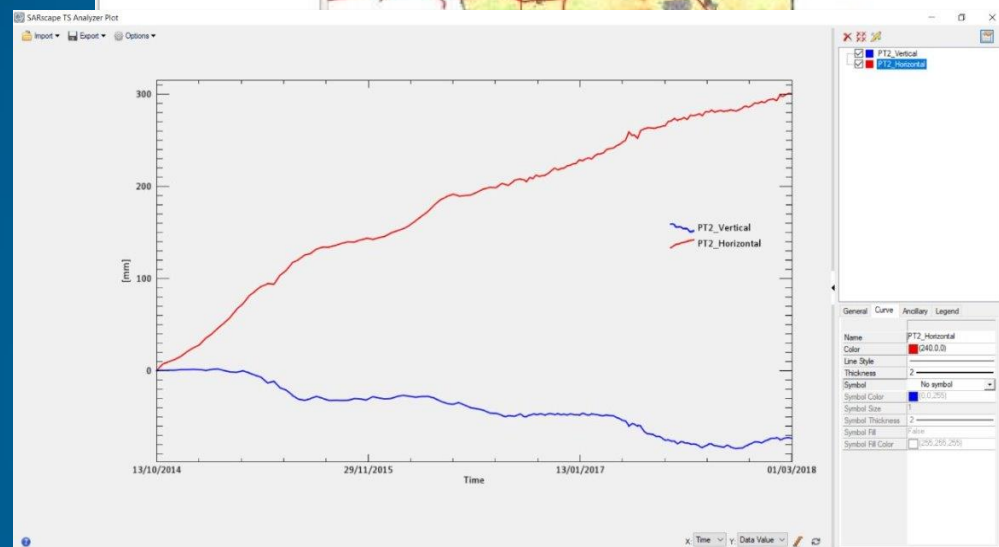
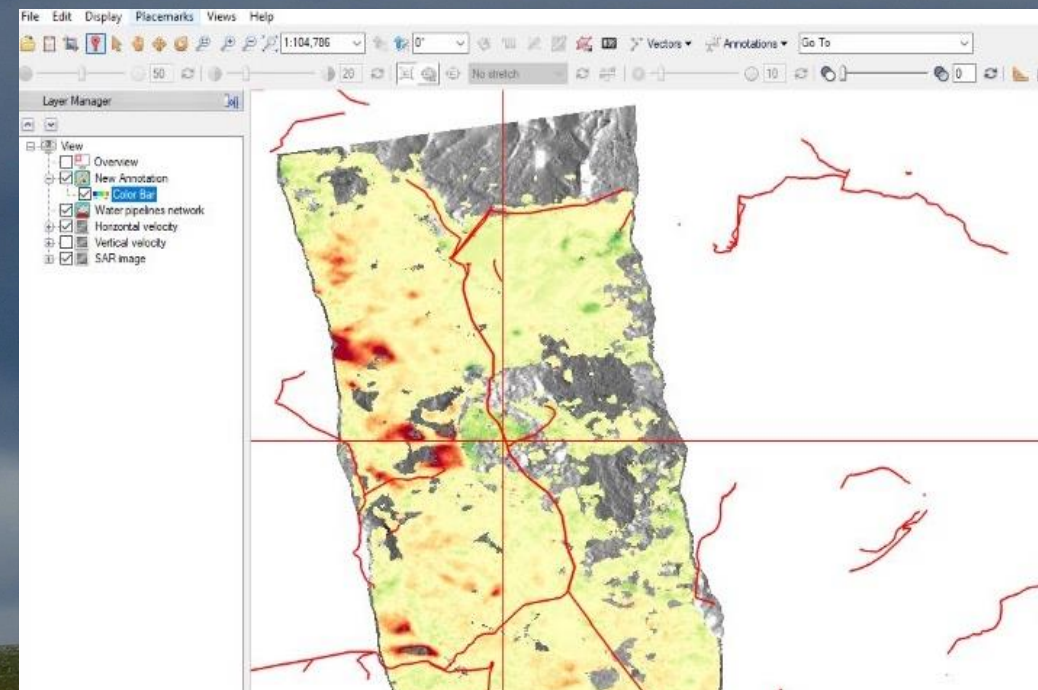
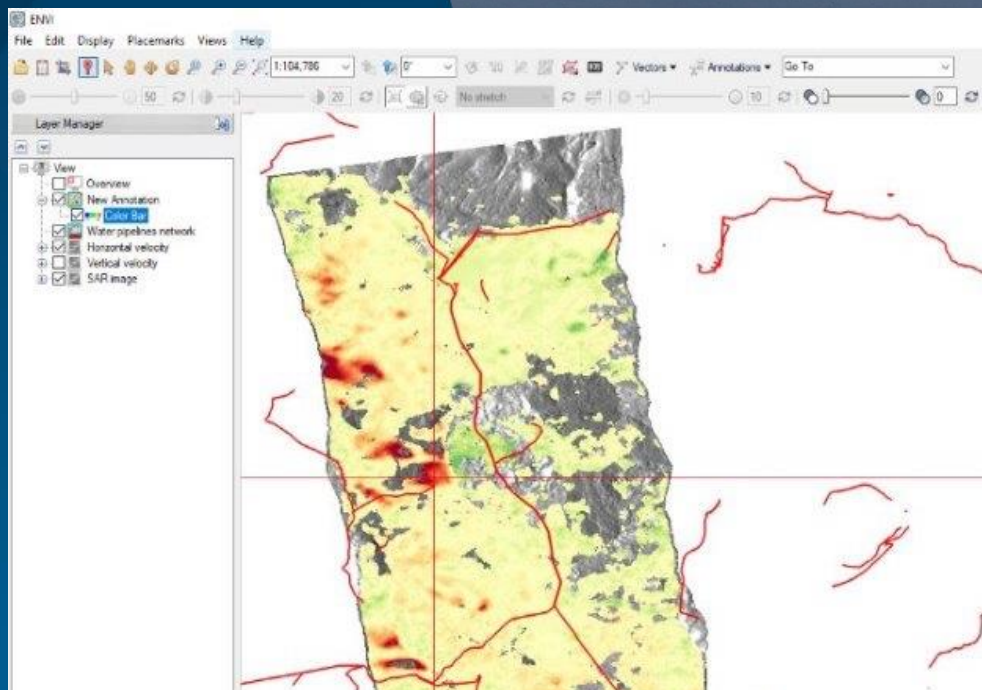


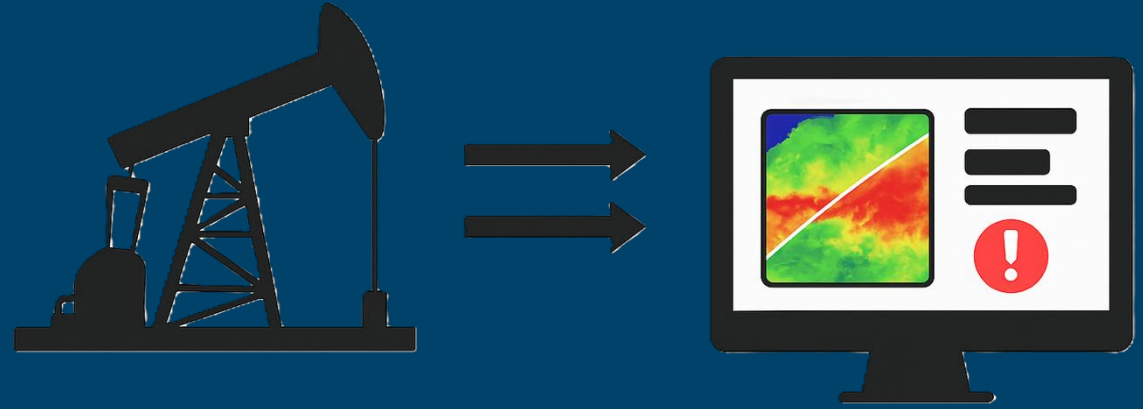
# Pipeline Monitoring Results

- ~300 Sentinel-1 SLC images processed over a four-year period
- Interferometric stacking used to extract long-term, mm-scale deformation trends
- Identification of uplift, subsidence, and slope movement affecting pipeline corridors
- Early indicators of strain, stress, or instability along buried and exposed segments
- Supports proactive integrity management with data-driven inspection prioritization



# Horizontal and Vertical Displacement

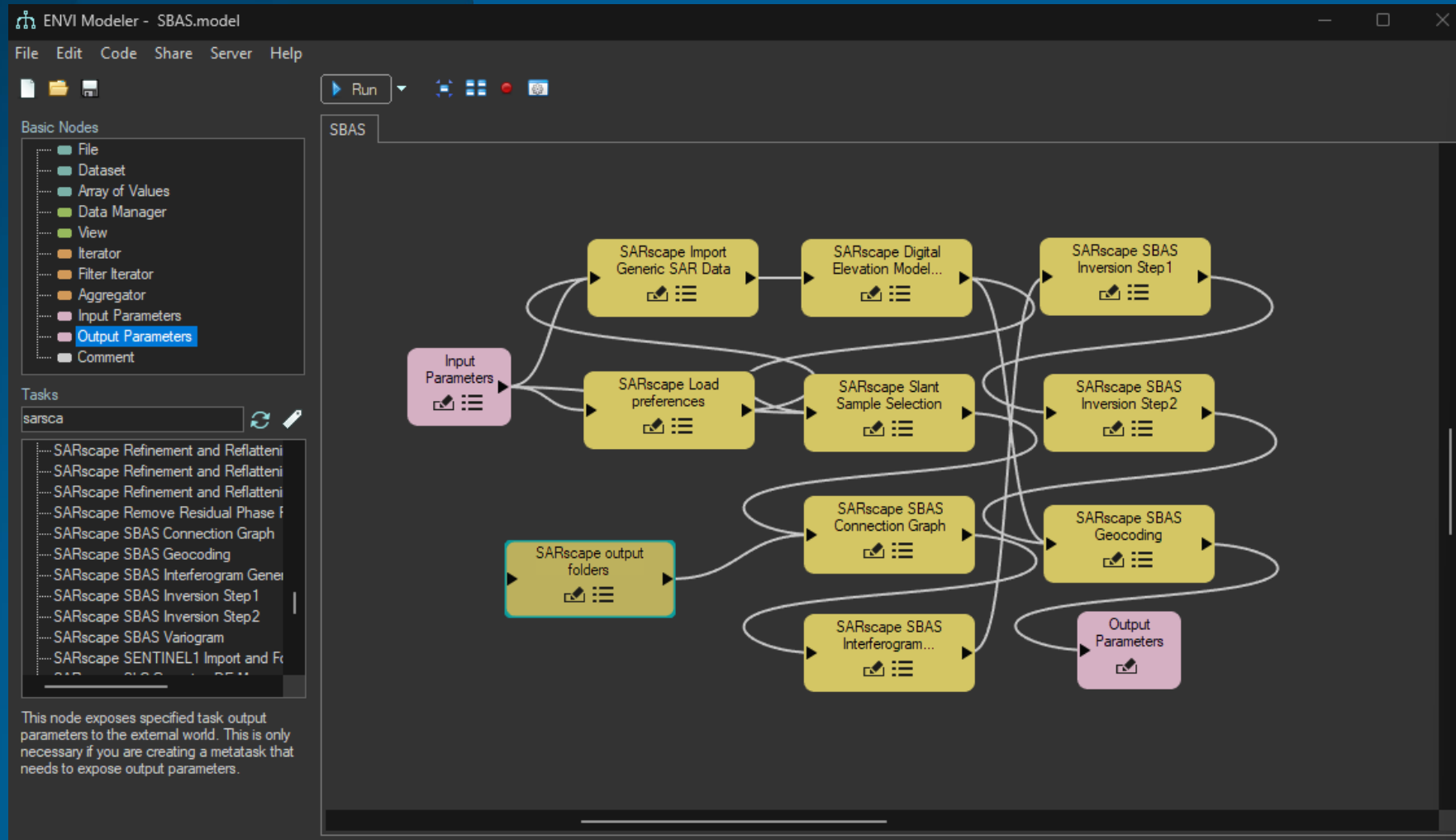




# Efficiencies & Automated Monitoring

# Task Automation with ENVI Modeler

NIV5



IDL Program: SBAS

Run Create Extension

```
; -----  
; Generated by the ENVI Modeler  
; ENVI 6.2  
; -----  
pro MyProgram  
  compile_opt idl2, hidden  
  on_error, 2  
  
  ; -----  
  ; SARscape output folders  
  ; -----  
  task_2 = ENVITask('SARscape_setting_output_folders')  
  task_2.sub_1_folder = 'interferogram'  
  task_2.sub_2_folder = 'fint_cc'  
  task_2.sub_3_folder = 'upha'  
  task_2.sub_4_folder = 'refinement'  
  task_2.create_working_folder = 'true'  
  task_2.Execute  
  
  ; -----  
  ; Input Parameters  
  ; -----  
  parameters_1 = Obj_New('ENVITask', DISPLAY_NAME='SBAS  
hInfo = $  
{'  
  'name': 'input_file_list', '  
  'keyword': 'INPUT_FILE_LIST', '  
  'display_name': 'Input File List', '  
  'type': 'ENVIURIARRAY', '  
  'direction': 'INPUT', '  
  'required': true, '  
  'description': 'Input File List', '  
  'hidden': false, '  
  'dimensions': '[*]', '  
  'fold_case': true, '  
  'is_directory': false, '  
  'is_temporary': false' + $  
  }'  
oParameter = IDLHydrate(TYPE='ENVIPar  
parameters_1.AddParameter, oParameter  
hInfo = $  
{'  
  'name': 'in_triggering_execution_option', '  
  'keyword': 'IN_TRIGGERING_EXECUTION_OPTION', '  
  'display_name': 'Input triggering execution op  
  'type': 'STRING', '  
  'direction': 'INPUT', '  
  'required': false, '  
  'description': 'Input triggering execution opt  
  'hidden': false, '  
  }
```

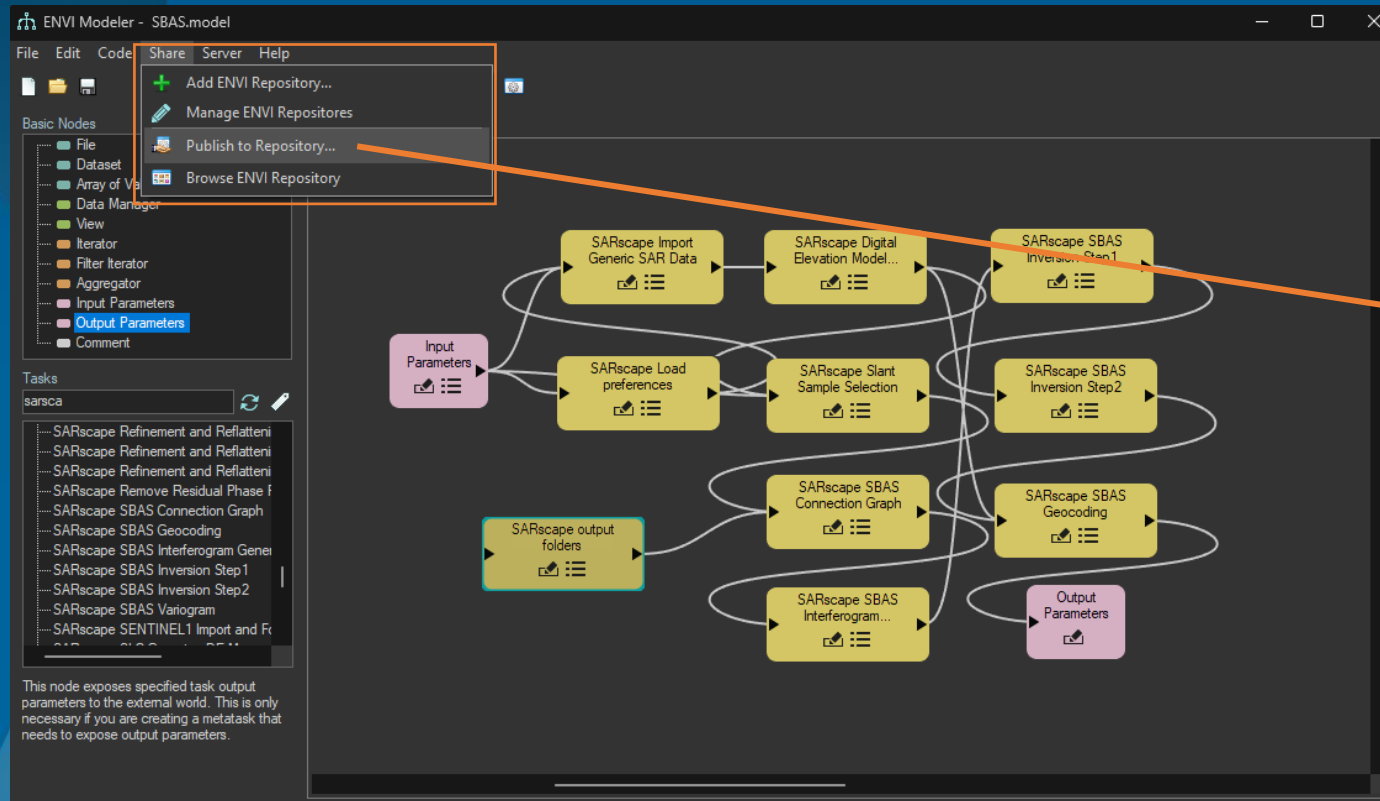
# Analytics Repository: Sharing ENVI Modeler Workflows

N|V|5

Standardization

Collaboration

Efficiency



The 'Publish to Repository' dialog box contains the following fields:

- Name: SBAS
- Display Name: SBAS
- Description: Imports SAR SLC imagery and performs SBAS processing all the way through geocoding.
- Version: 1.0.0
- Tags: Workflow, Comma separated
- Dependencies: (empty field)
- Repository: http://localhost:9194

Buttons: OK, Cancel

Populate Publish dialog with basic information about content you are sharing

Create ENVI Modeler Workflow with "Input Parameters" and "Output Parameters"

# Analytics Repository Web UI

NV5



ENVI Repository

Basic web UI to discover, install, and manage packages

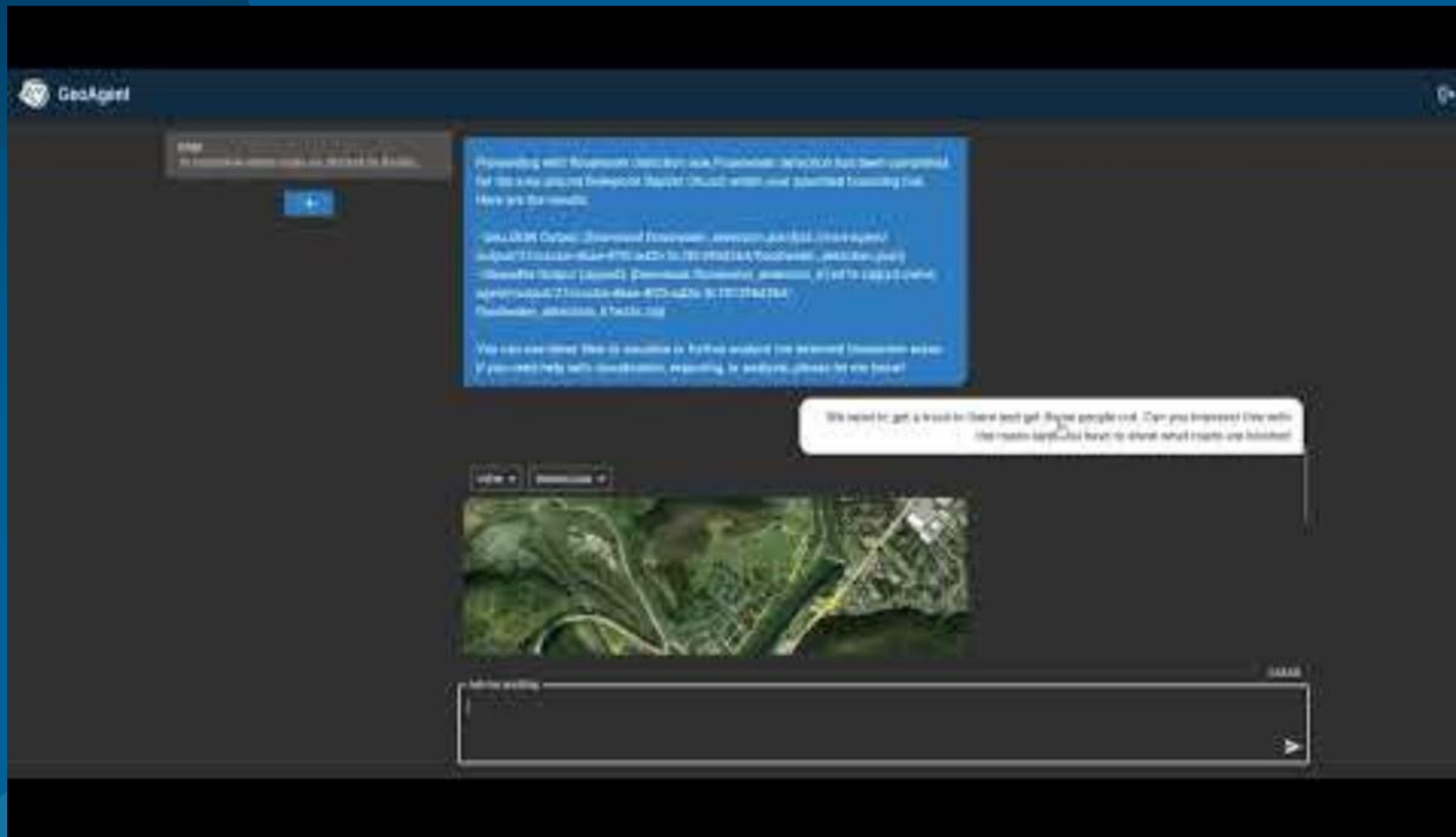
| Name                             |         | Types                                           |                 | Tags          |                     |                    |         |
|----------------------------------|---------|-------------------------------------------------|-----------------|---------------|---------------------|--------------------|---------|
| Name                             | Version | Description                                     | Author          | Type          | Date                | Tags               | Actions |
| SkySat Aircraft Det...           | 1.0.0   | Workflow that prepares and processes a Sk...    | Zachary.Norman  | enviworkfl... | 08/11/2025 17:40:26 | Workflow           |         |
| External Aircraft De...          | 1.0.0   | 3rd party aircraft detector model trained ou... | Zachary.Norman  | envideeple... | 08/11/2025 17:06:20 | Object Detection   |         |
| Wind Turbine Dete...             | 1.0.0   | Example AI model that detects wind turbine...   | Zachary.Norman  | envideeple... | 08/11/2025 16:48:45 | Object Detection   |         |
| Search and Rescue                | 1.0.0   | AI model that detects people from aerial/dr...  | Zachary.Norman  | envideeple... | 08/11/2025 16:46:32 | Object Detection   |         |
| SAR Aircraft Detect...           | 1.0.0   | AI model that detects aircraft in SAR magni...  | Zachary.Norman  | envideeple... | 08/11/2025 16:44:21 | Object Detection   |         |
| Landcover Vegetati...            | 1.0.0   | A model that detects different types of land... | Zachary.Norman  | envideeple... | 08/11/2025 16:41:58 | Pixel Segmentation |         |
| Boat Detector Pixel              | 1.0.0   | Boat detection pixel model trained with EN...   | Zachary.Norman  | envideeple... | 08/11/2025 16:40:30 | Pixel Segmentation |         |
| Aircraft Detector                | 1.0.0   | NV5 developed aircraft detection model          | Zachary.Norman  | envideeple... | 08/11/2025 16:35:53 | Object Detection   |         |
| SAR-Aircraft-Detect...           | 1.0.0   | SAR aircraft object detector                    | Gina.Gallentine | envideeple... | 08/06/2025 15:54:17 | Object Detection   |         |
| AIR person finder                | 1.0.0   | AIR person finder                               | Gina.Gallentine | envideeple... | 08/06/2025 15:52:21 | Object Detection   |         |
| Rows per page: 10 1-10 of 22 < > |         |                                                 |                 |               |                     |                    |         |

# SAR Monitoring Service – ENVI Inform



# GeoAgent: Agentic AI for Geospatial Analysis

N|V|5



# Takeaways

N|V|5

- NV5 Geospatial delivers end-to-end solutions
- ENVI Ecosystem offers flexibility for every user
- Advanced analytics drive smarter decisions
- Your choice: full-service support or self-service software

# Q&A

Contact us to get your project started:

[Geospatialinfo@nv5.com](mailto:Geospatialinfo@nv5.com)

[nv5geospatialsoftware.com/Oil-Gas](http://nv5geospatialsoftware.com/Oil-Gas)