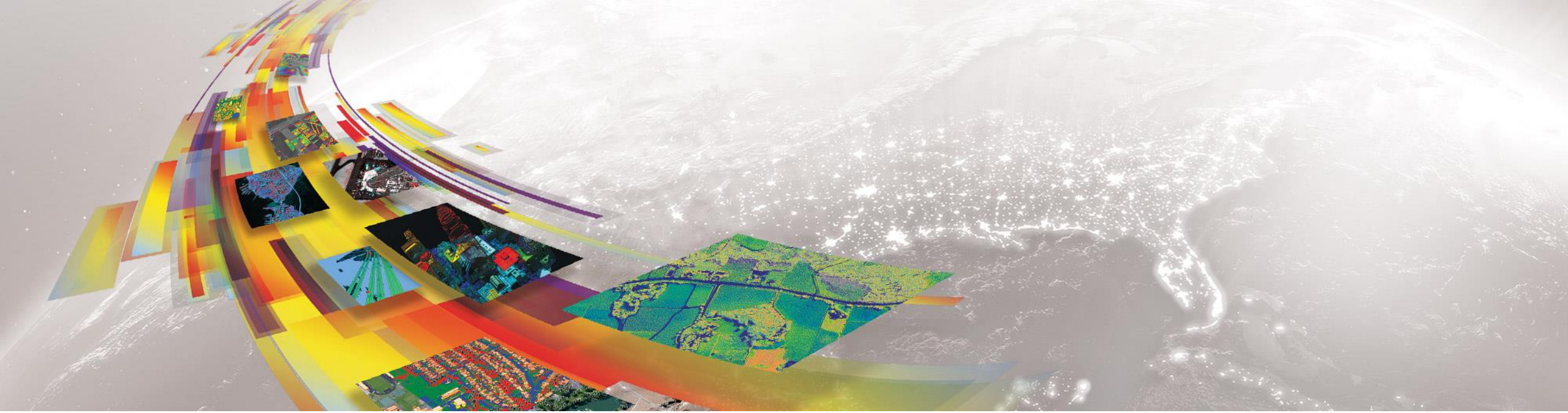


L3HARRIS™

BUILDING ANALYTIC SOLUTIONS WITHOUT CODING

JAMES LEWIS-LEAD SOLUTIONS ENGINEER D&I / SOF / SPENCER WAHRMAN-INTEL ACCOUNT MANAGER

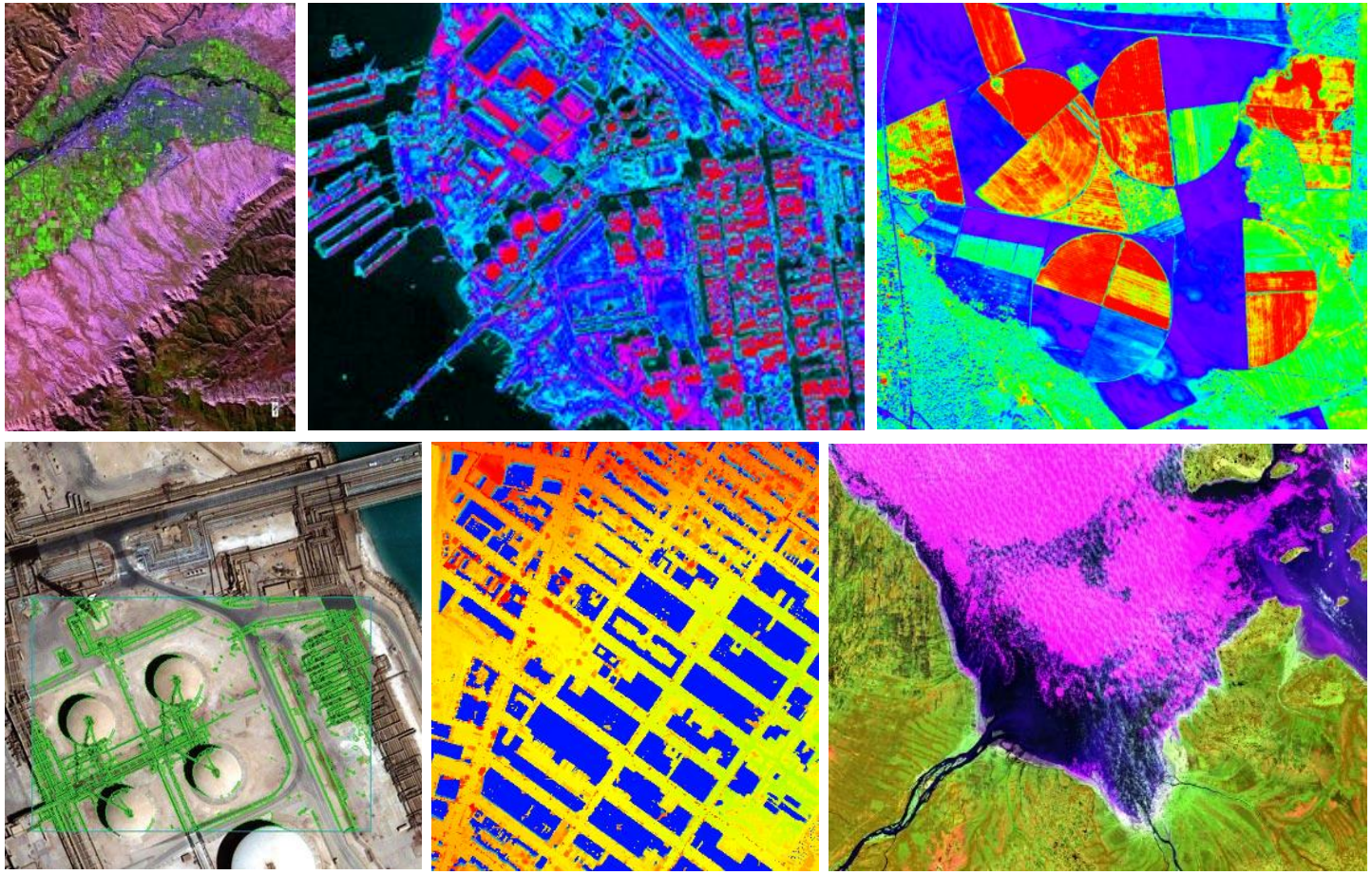
Agenda

- Introductions
- What’s New in ENVI
- ENVI Modeler
- Quick walk through
- Questions

ENVI - The leader in image science

ENVI image analysis software is used by GIS professionals, scientists, and image analysts to extract meaningful information from imagery to make better decisions.

ENVI can be deployed and accessed from the desktop, in the cloud, and on mobile devices, and can be customized through an API to meet specific project requirements.



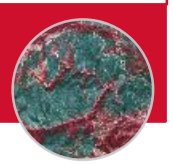
What's New?

ENVI 5.5.2-3 adds support for new earth observation satellites and cutting edge geospatial data formats. It also has new analysis capabilities and updated Esri Integration

New supported Sensors and Data Types

- ADS80
- Gaofen-2
- GOES-R
- TripleSat
- Himawari-8
- NetCDF-3
- KOMPSAT-3A
- PeruSat-1
- WorldView-4

New Sensor Support



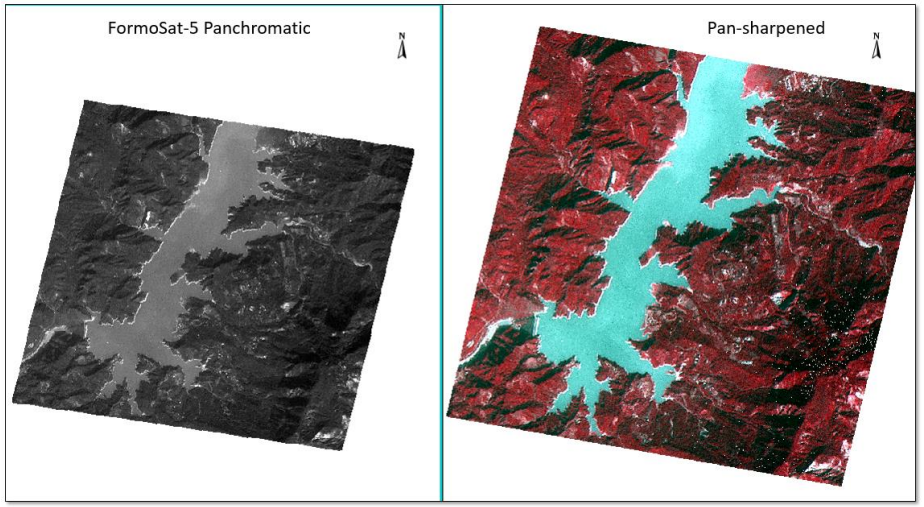
- National security
- Weather forecasting
- Climate monitoring
- Natural disasters

Data for a variety of applications

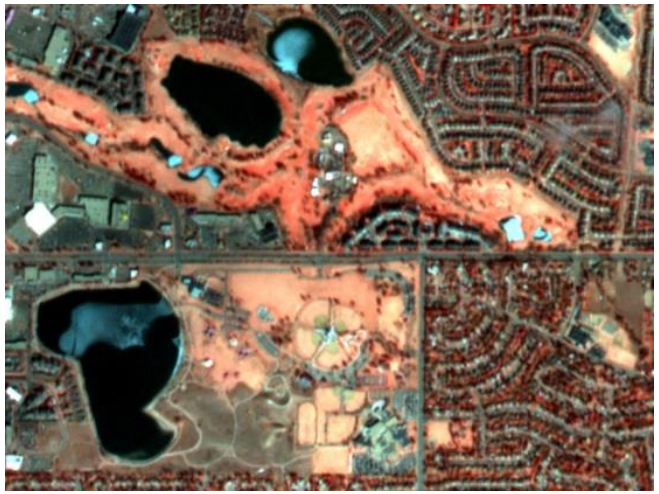
ADS 80 Data

New Earth Observation Satellite Support

Alsat-1B is an Algerian satellite for agricultural and disaster monitoring



Formosat-5 is an Earth observation satellite operated by the National Space Organization of Taiwan

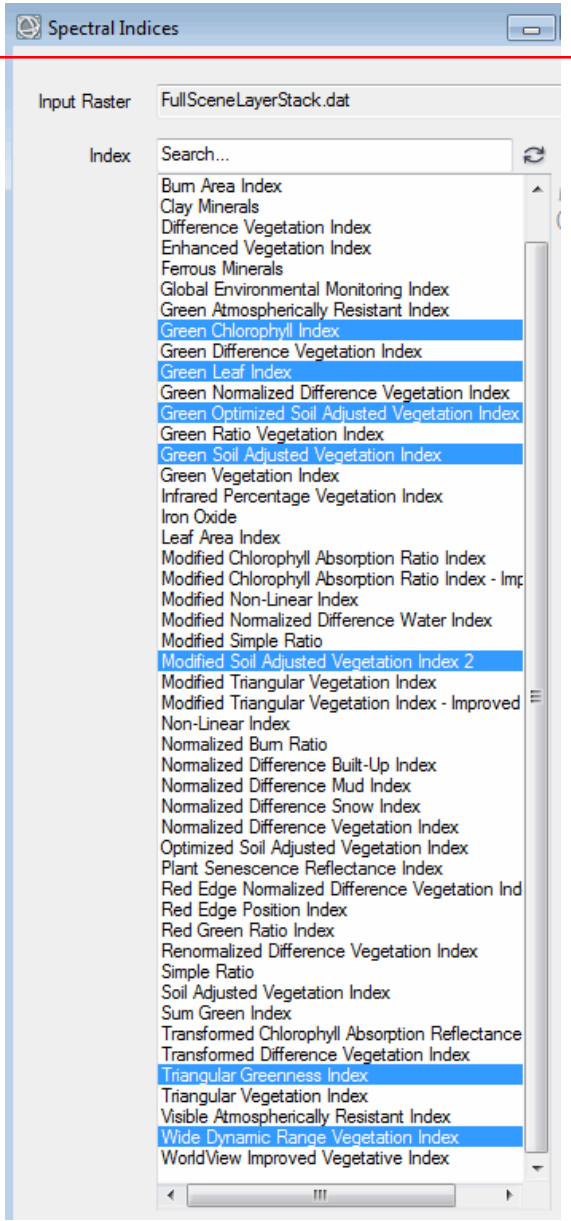


Analysis-ready PlanetScope Reflectance Data support

Spectral indices

New spectral indices

- For use with the Spectral Indices tool and API
- Broadband indices
  - Green Chlorophyll Index
  - Green Leaf Index
  - Green Optimized Soil Adjusted Vegetation Index
  - Green Soil Adjusted Vegetation Index
  - Modified Soil Adjusted Vegetation Index 2
  - Triangular Greenness Index
  - Wide Dynamic Range Vegetation Index
- Lignin Cellulose Absorption narrowband index

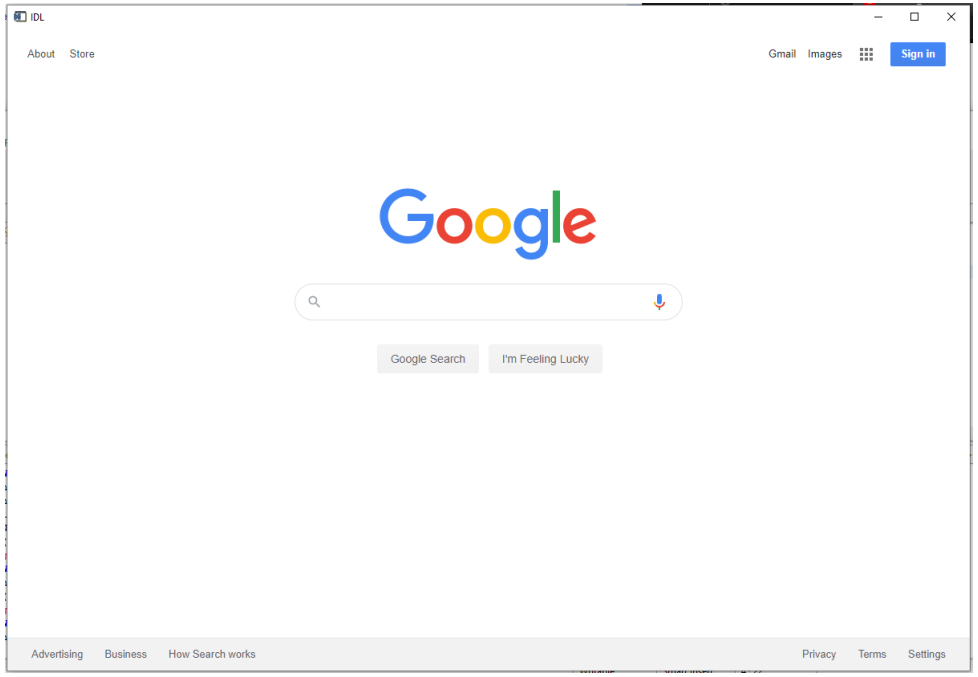


IDL Widget Browser and Download Web Data in ENVI

Create and interact with web pages in IDL

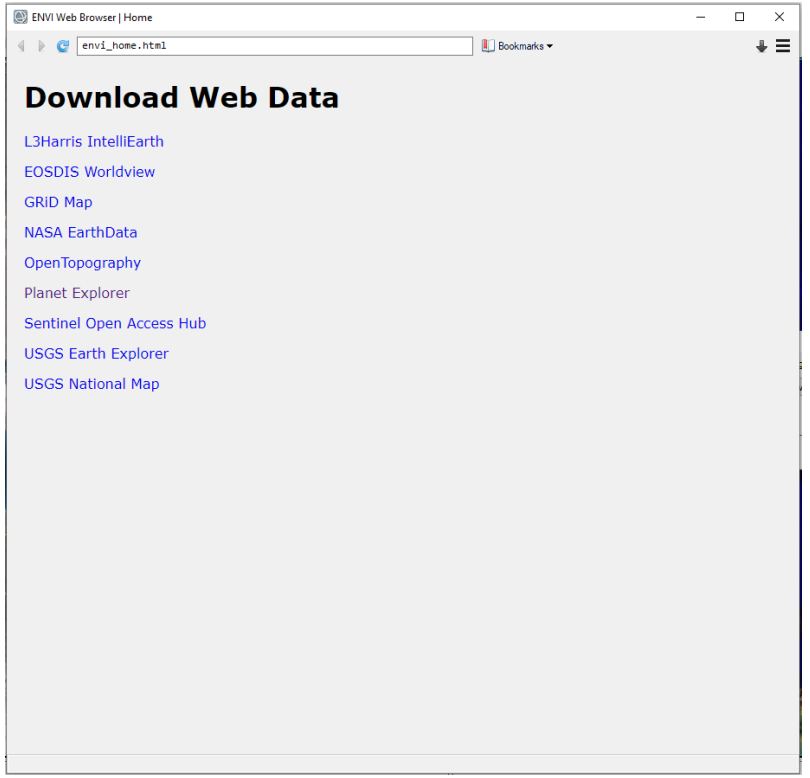
Communicate with the web-page in the browser to send commands or messages back and forth to IDL

```
wParent = WIDGET_BASE()
url = "http://www.google.com"
wBrowser = WIDGET_BROWSER(wParent, VALUE=url, XSIZE=900, YSIZE=600)
WIDGET_CONTROL, wParent, /REALIZE
```

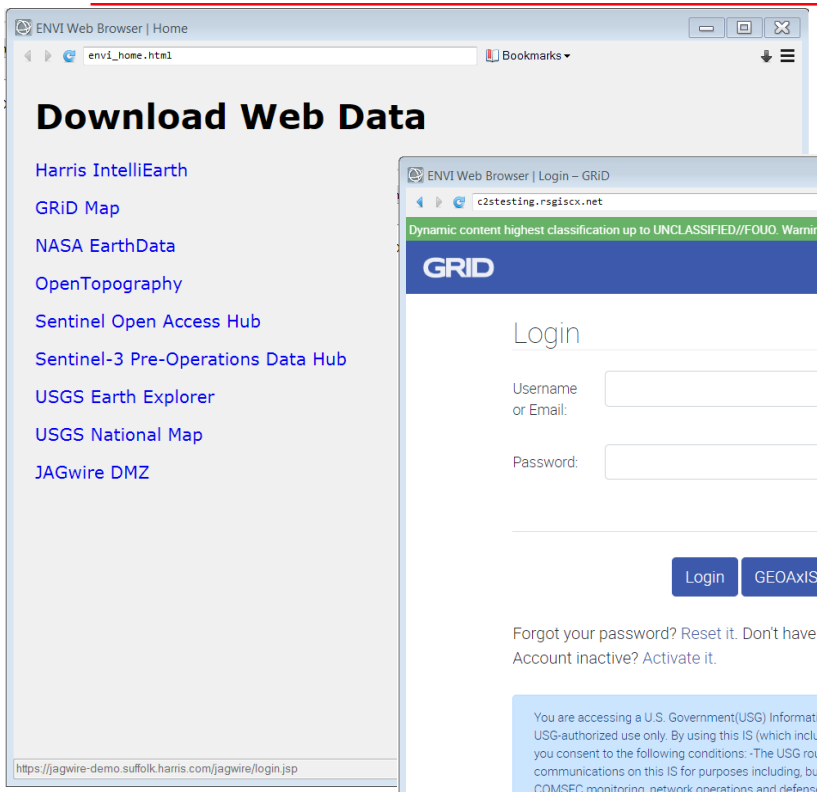


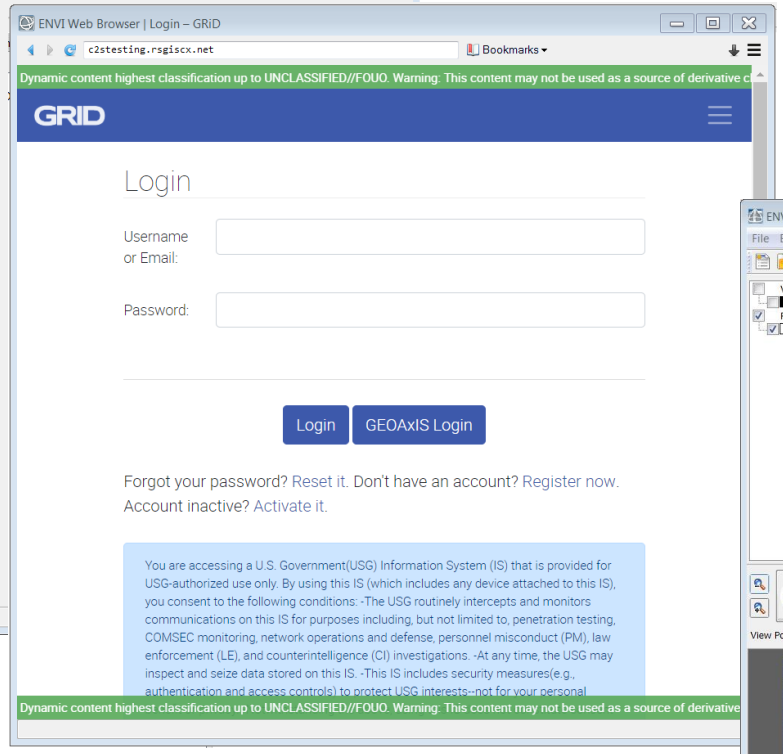
Seamlessly access and download data from the web

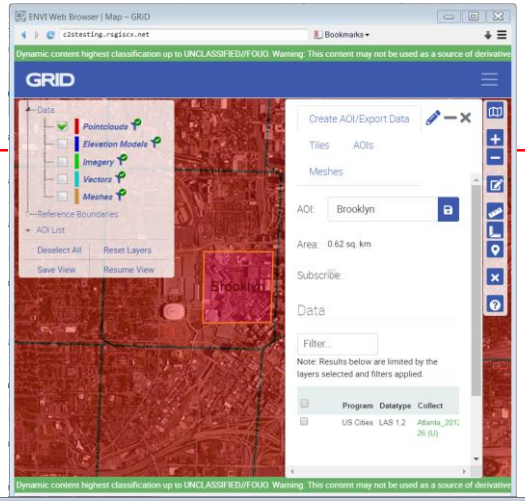
Automatically open and display the data in ENVI once available

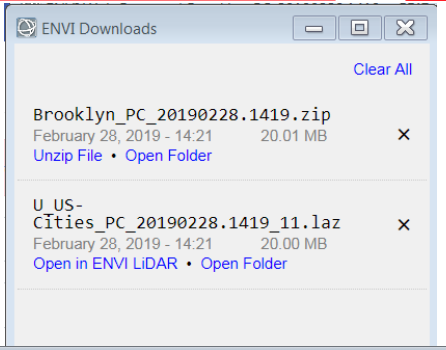


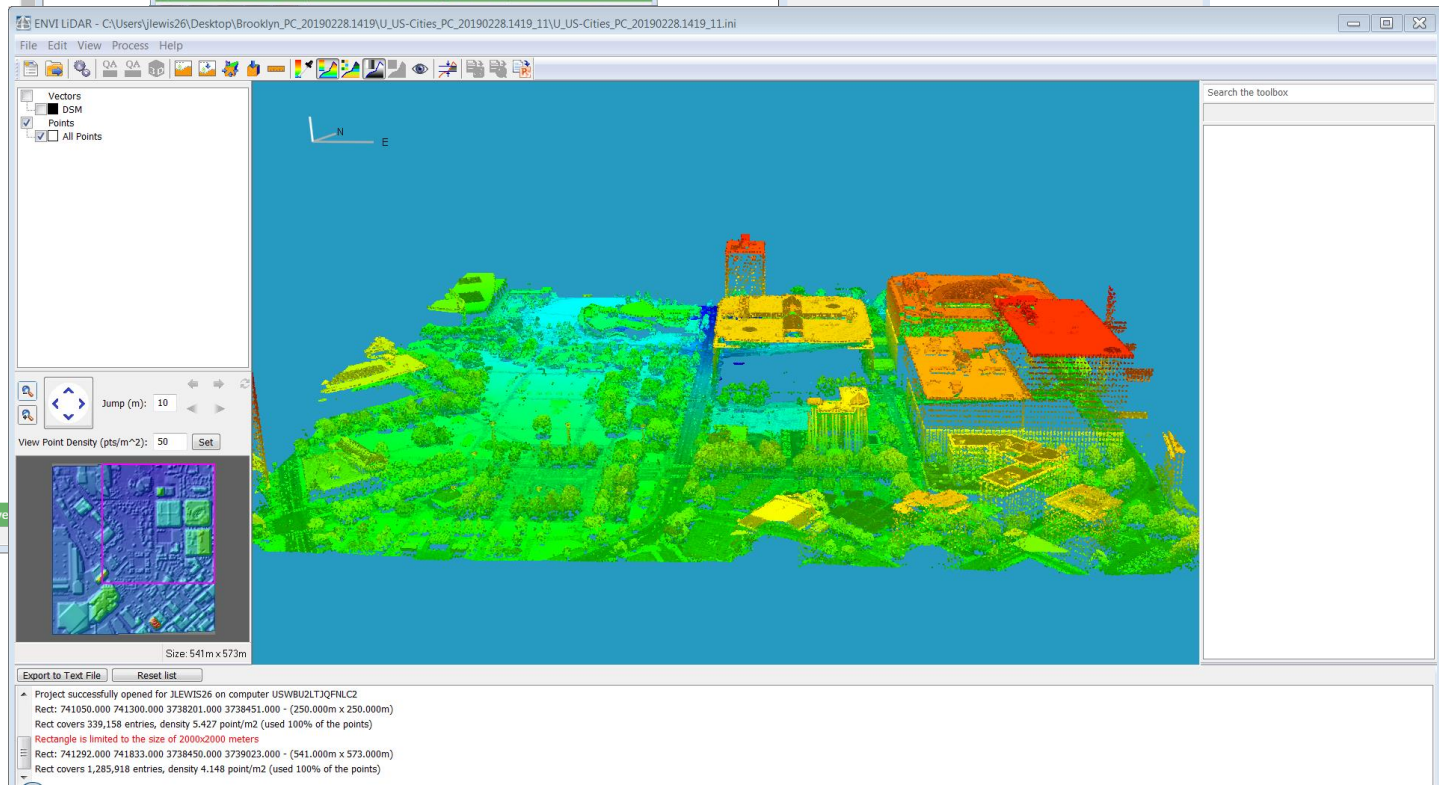
Native Support For GRiD







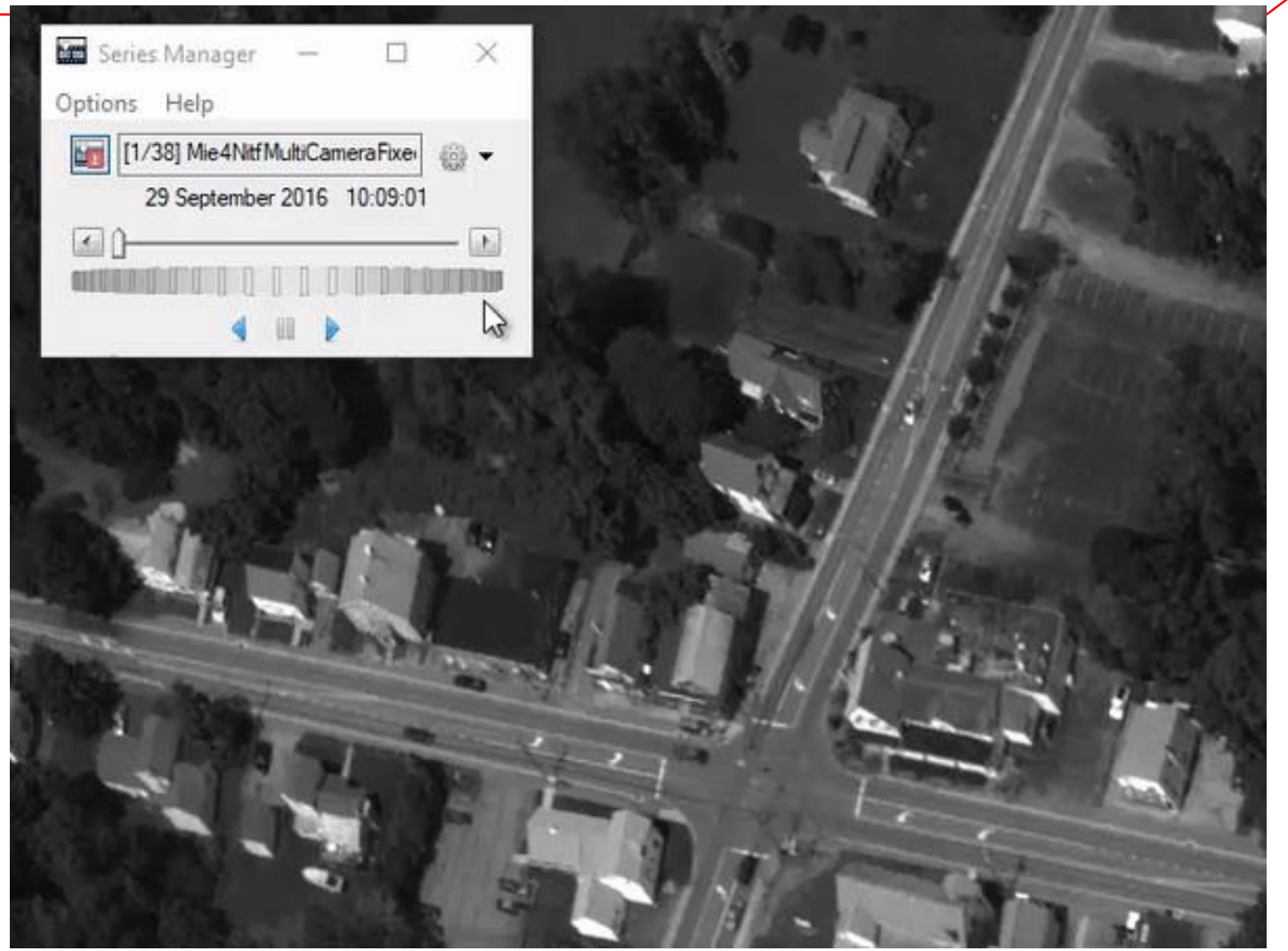




MIE4NITF: Time-Series Enabled NITF Imagery

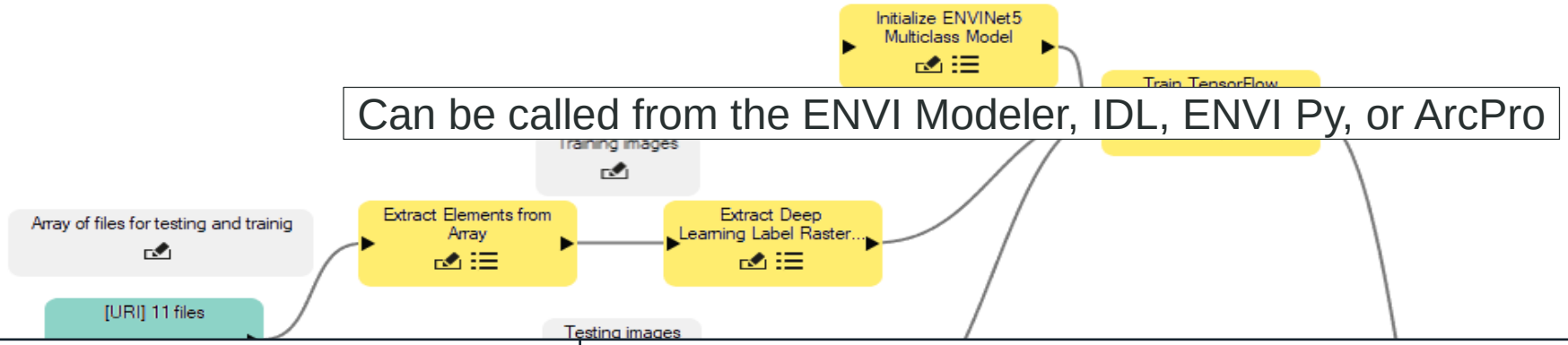
View and analyze time series of images for change detection, tracking patterns and movement, and activity-based intelligence.

MIE4NITF promises HD resolution, high frame rates, and rich metadata content.



ENVI is one of the first commercial software products to support the newest standard, MIE4NITF.

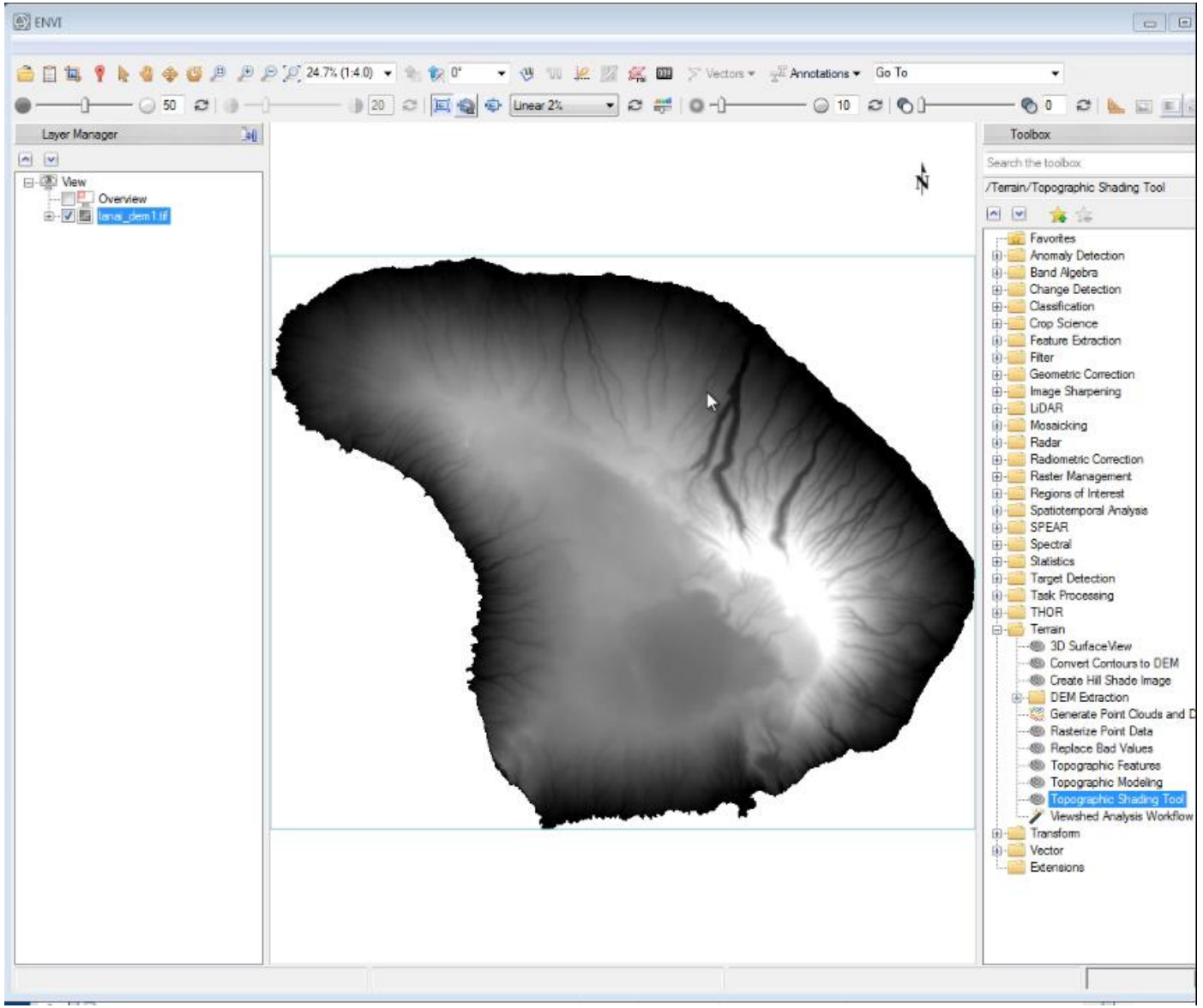
New ENVI Tasks!



Task	Description
ASCIIToROI	Create an ROI layer from ASCII data
ASCIIToVector	Create a vector layer from ASCII data
ConvertInterleave	Convert the interleave of a raster
ExtractGeoJSONFromFile	Open and parse a GeoJSON string from an input URI
GenerateMaskFromVector	Generate a mask from a rasterized polyline or polygon vector layer
ReprojectVector	Reproject vector records from one coordinate system to another
ROIToGeoJSON	Convert geometry-based ROIs to GeoJSON features
VectorToFeatureCount	Convert vector records to a feature counting layer

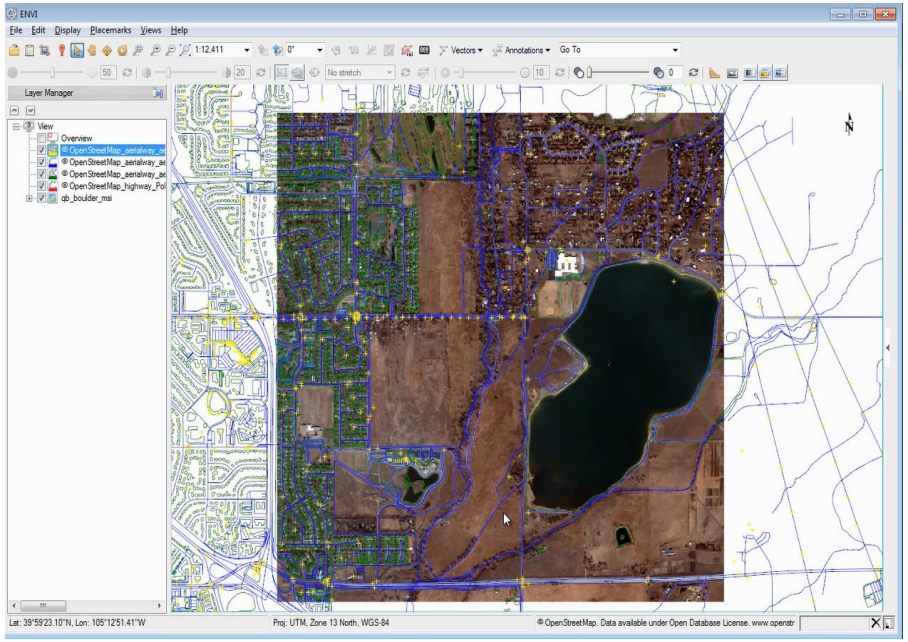
New Topographic Shading Tool

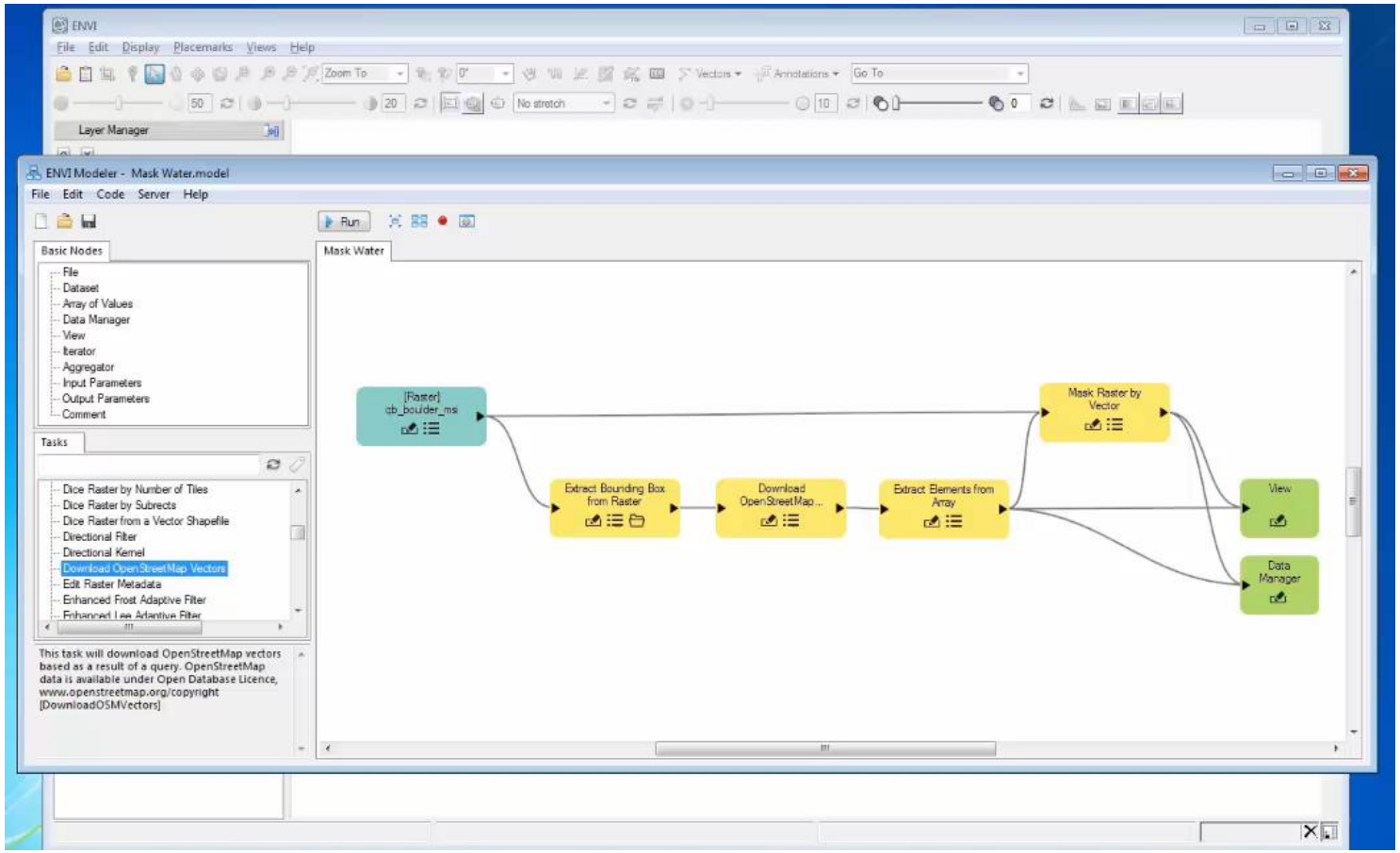
- Blend topographic features with a DEM: slope, aspect, profile convexity, plan convexity, longitudinal convexity, and more
- Choose a predefined color ramp or create your own.
- Can use red/green/blue (RGB), hue/lightness/saturation (HLS), or hue/saturation/value (HSV) color models



New Open Street Maps Capability in ENVI

Download, open, and display OpenStreetMap vectors within ENVI.

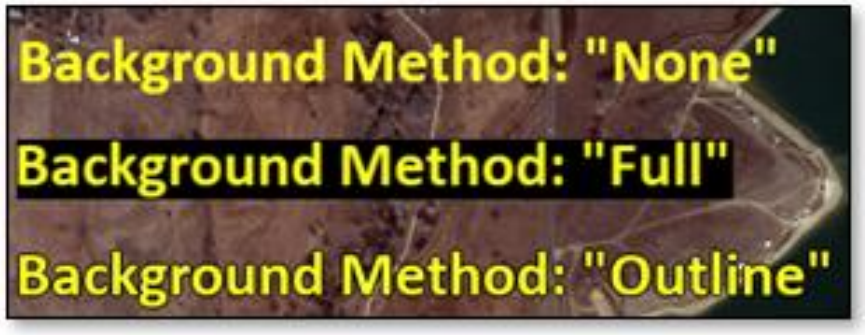




Use vectors for water features and mask out water in a scene.

Annotations Improvements

Updated visualization of text and symbols in ENVI which allows for:

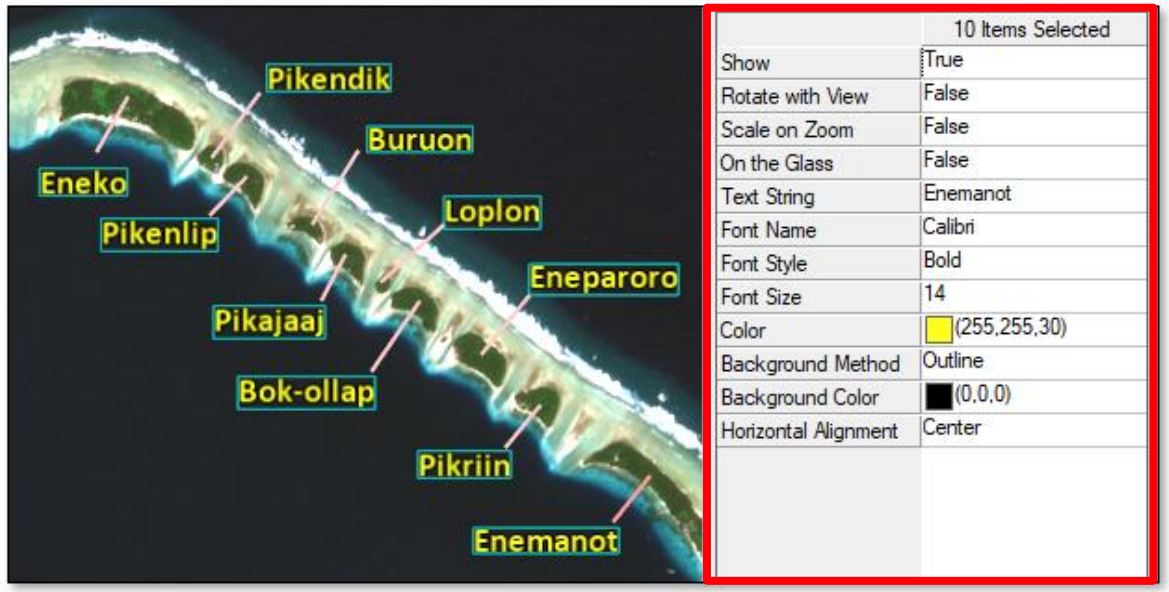


Example annotations showing text, symbols, and the North Arrow with this new styling

Annotations Improvements (contd.)

New, image magnifier annotation that allows you to zoom into areas of your image at full-resolution.

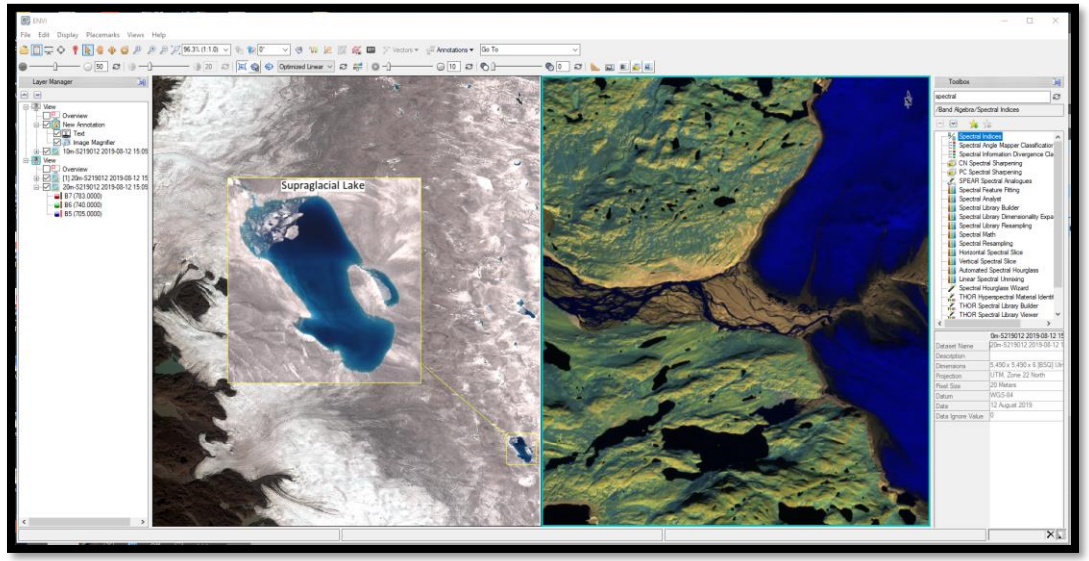
Access this new and exciting tool from: Annotations -> Image Magnifier



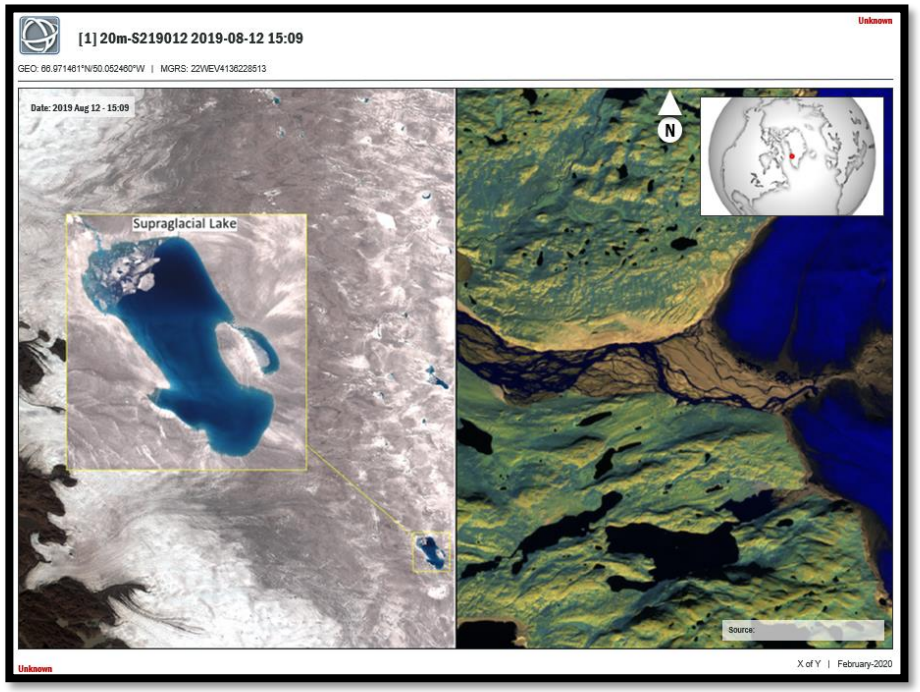
New, metadata panel in the lower-right corner of ENVI. Allows for quick access to any selected item, including changing the properties of annotations!

PowerPoint Report Generation

ENVI's Display



PowerPoint Slide



Seamlessly capture ENVI's display and generate high-quality presentation content with a single click

Anything in ENVI's display can go to PowerPoint

Append to existing PowerPoint presentations or create a new one

Once in PowerPoint, can edit text boxes natively

Add custom content and access all of PowerPoint's tools

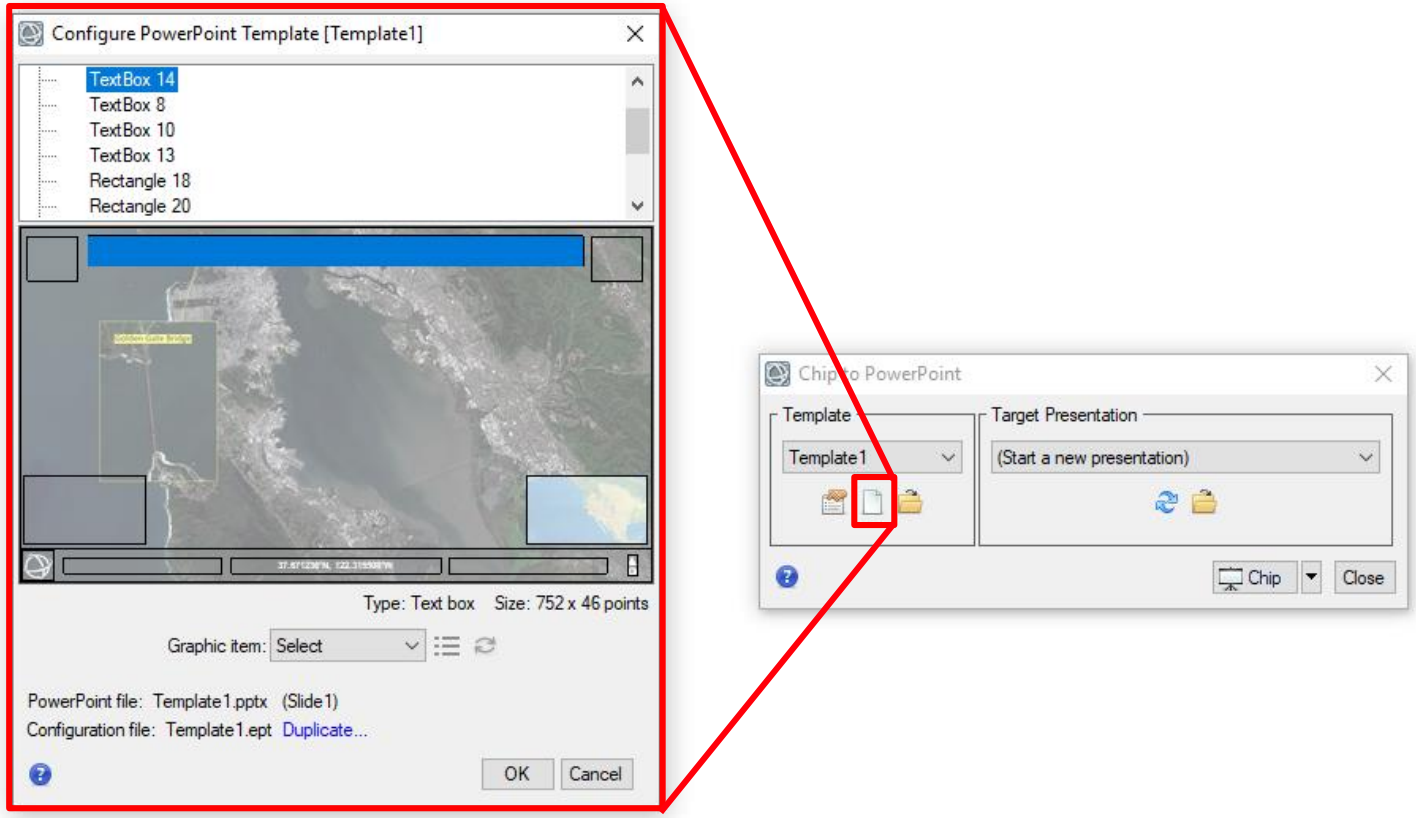
Ability to import PowerPoint templates into ENVI

PowerPoint Importer

Use the interactive template creator to select elements from your PowerPoint and designate what they become

Template importer allows you to add image metadata, map previews, custom text, and more

Saving the template creates a JSON file on disk that you can share with coworkers



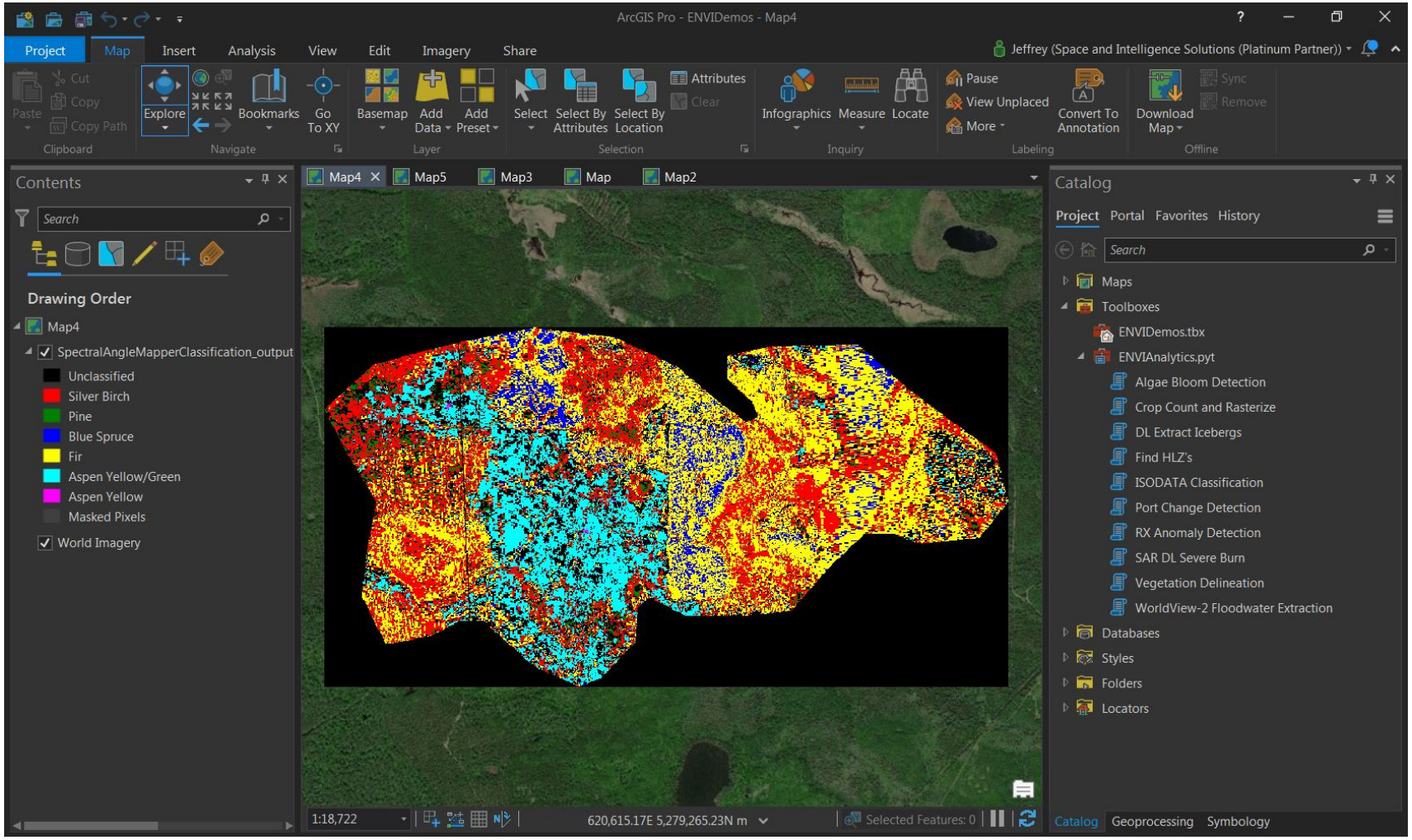
ArcGIS Integration Updates

L3Harris and Esri are close partners to bring trusted ENVI analytics into ArcGIS

The ENVITask API enables ENVI analytics to run in ArcPro 2.4 or ArcMap 10.7

ENVI Modeler makes it very easy to create and publish custom ENVI workflows to ArcGIS

ENVI Py leverages the ArcGIS Python support for this integration



Hyperspectral image classification and the ENVI starter toolbox in ArcPro 2.4

ENVI Py 1.3.1 for ArcGIS Desktop / Pro

What is it?
A windows installer to deploy our Python client libraries (envipy, envipyengine, envipyarc) to ArcGIS Pro to run ENVI analytics via python toolboxes (GPTools). In addition provides an ENVI Analytics toolbox in ArcGIS Pro.

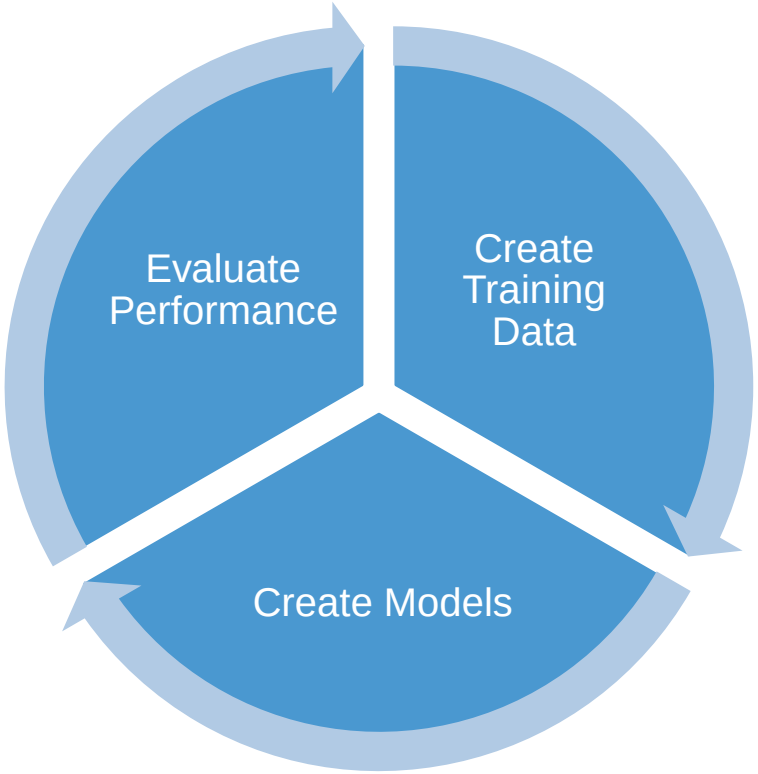
Software Requirements
ENVI 5.3 SP1 or above
ArcGIS Pro 1.3 or above

Licensing
ENVI Engine (envi-te)
To development new tasks or models you need ENVI Desktop as well
ArcGIS / Pro license

History – Released Feb 2018
Available through Harris Download and License Center under ENVI for Windows (5.X) or the ENVI 5.5 DVD

ENVI Deep Learning Module – 1.1 Tech Preview

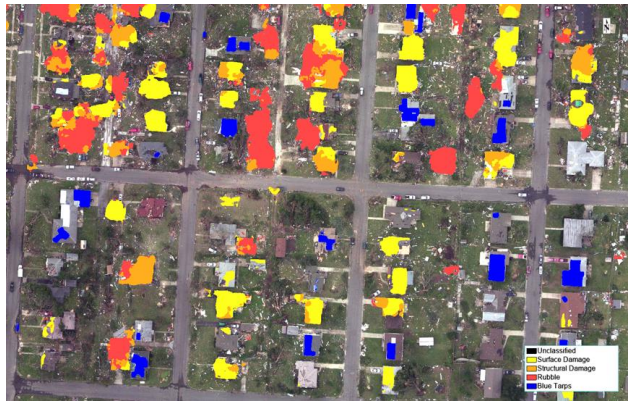
Applied deep learning for geospatial imagery in ENVI



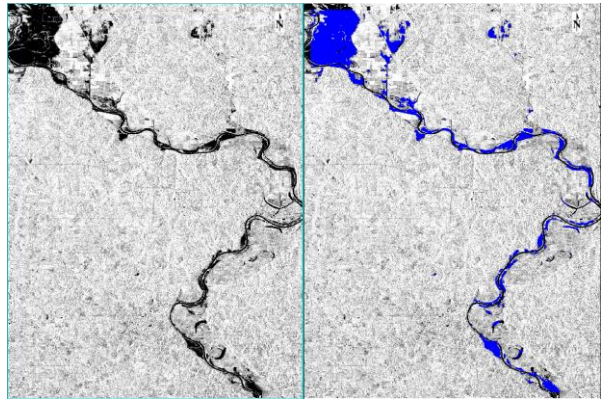
Deep learning workflow in ENVI, built on TensorFlow and Keras

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



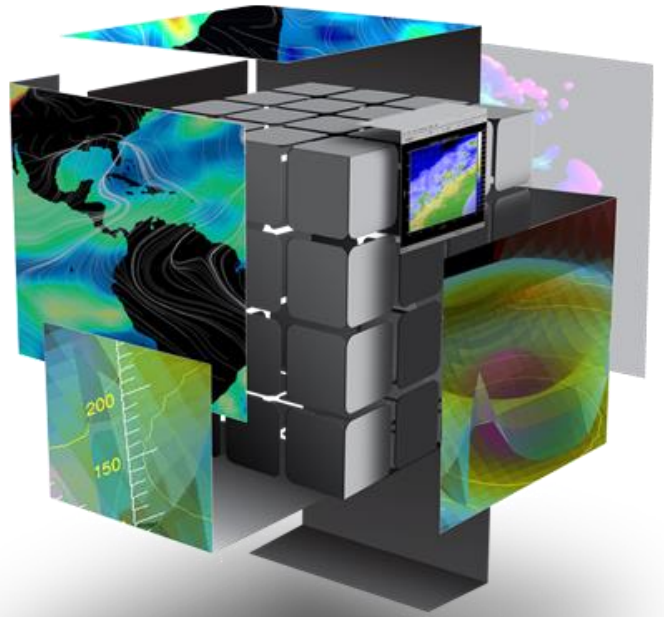
Assess building damage after hurricanes and tornadoes



Automated flood detection using SAR

Presenting the ENVI Modeler

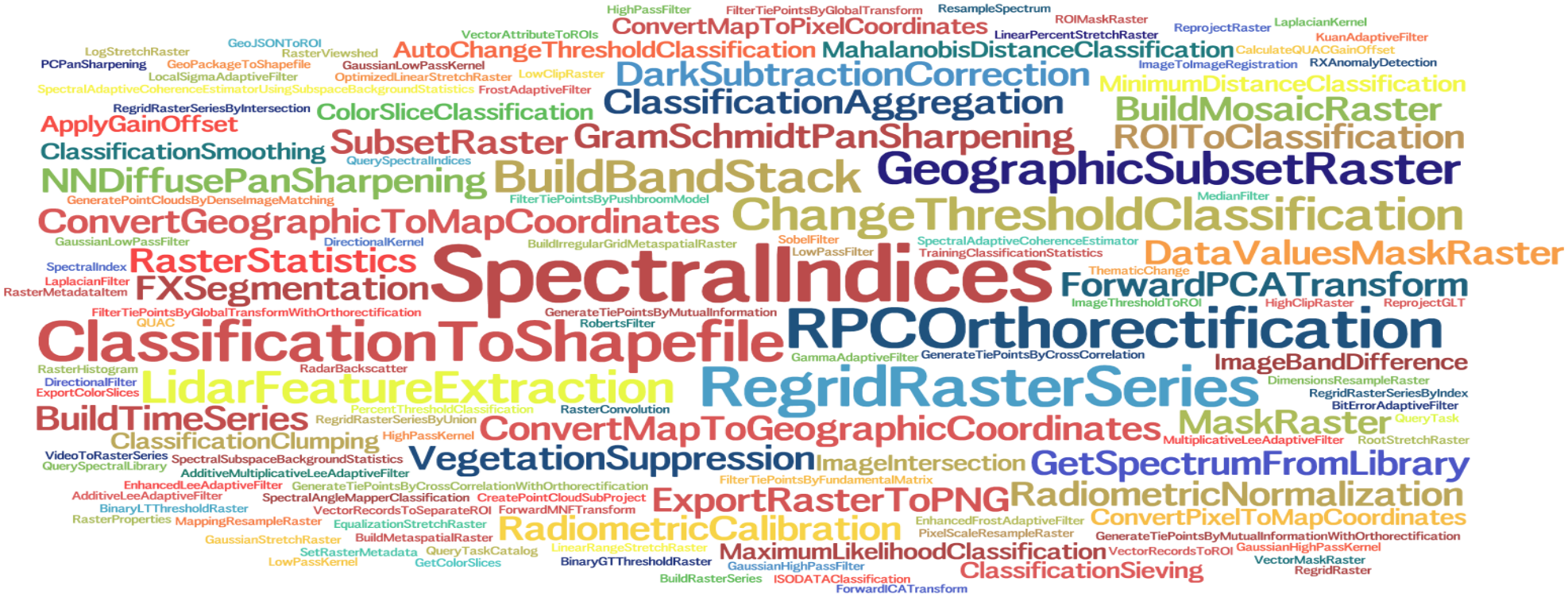
- Objective(s):
  - **Answer the following questions:**
    - What is the ENVI Modeler?
    - Why should it be used?
    - What kind of applications can it be used in?



Access to ENVI Analytics

ENVI Tasks

- ENVI ships with > 240 pre-built Tasks
- Easy to use API
- Extensible – meaning: “create your own!”



Presenting the ENVI Modeler

A visual programming tool to create custom task-based workflows in ENVI

Combines the power of the ENVI API with a simple and intuitive user interface

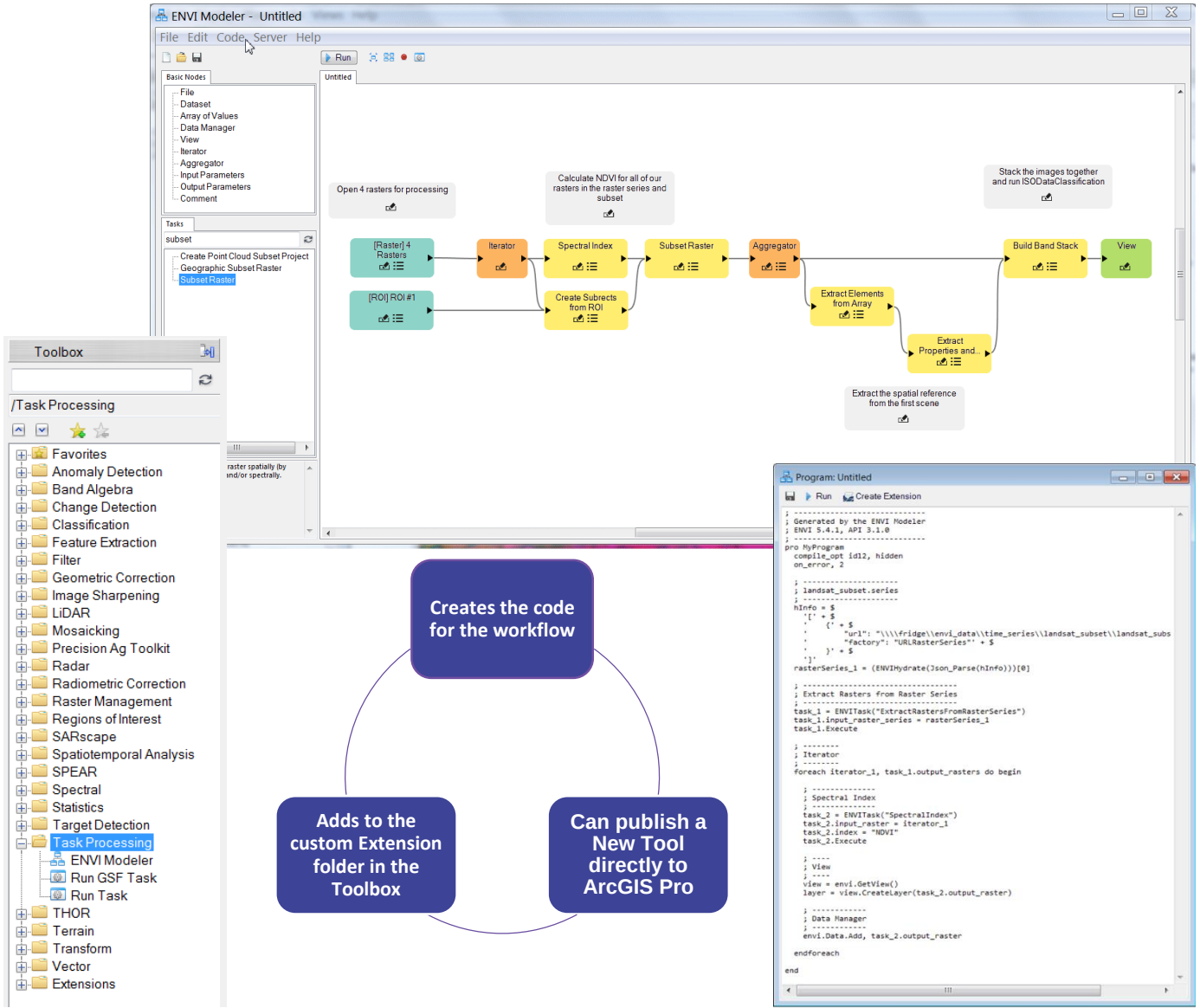
- Build workflows without any knowledge of ENVI programming

Batch-process data

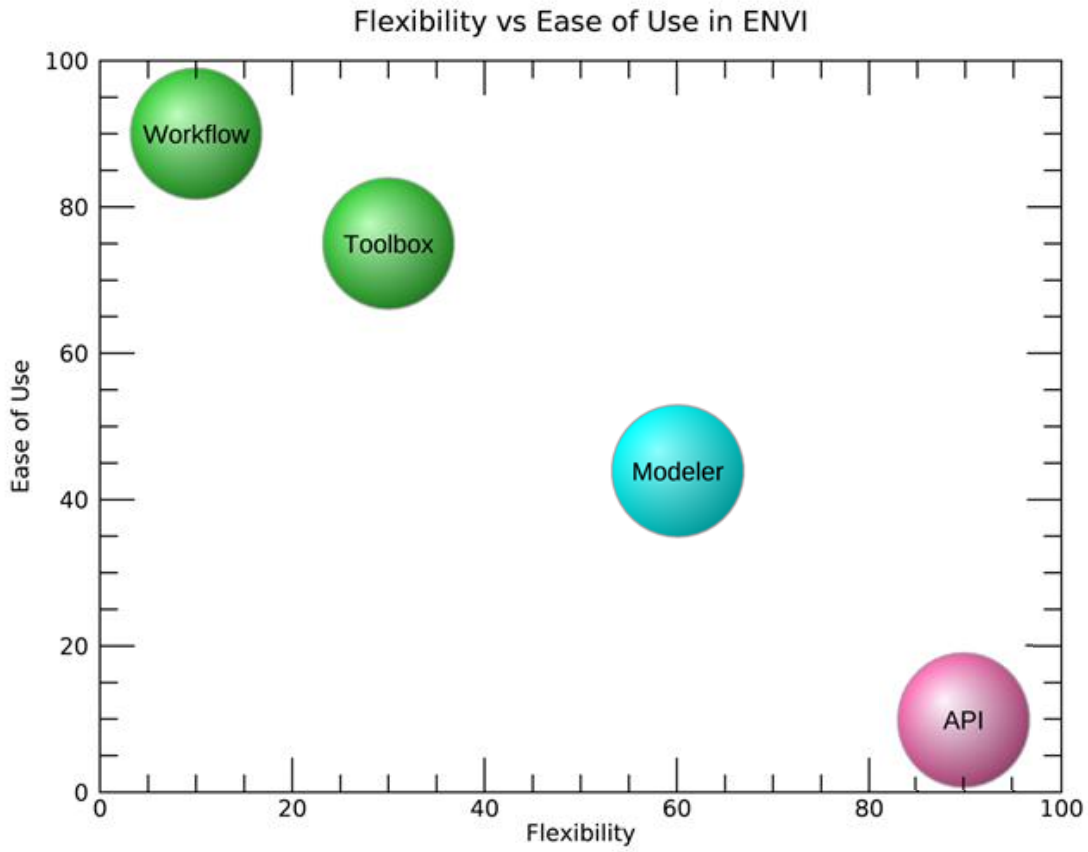
Run tasks remotely on a GSF server

Generate IDL and Python programs from models

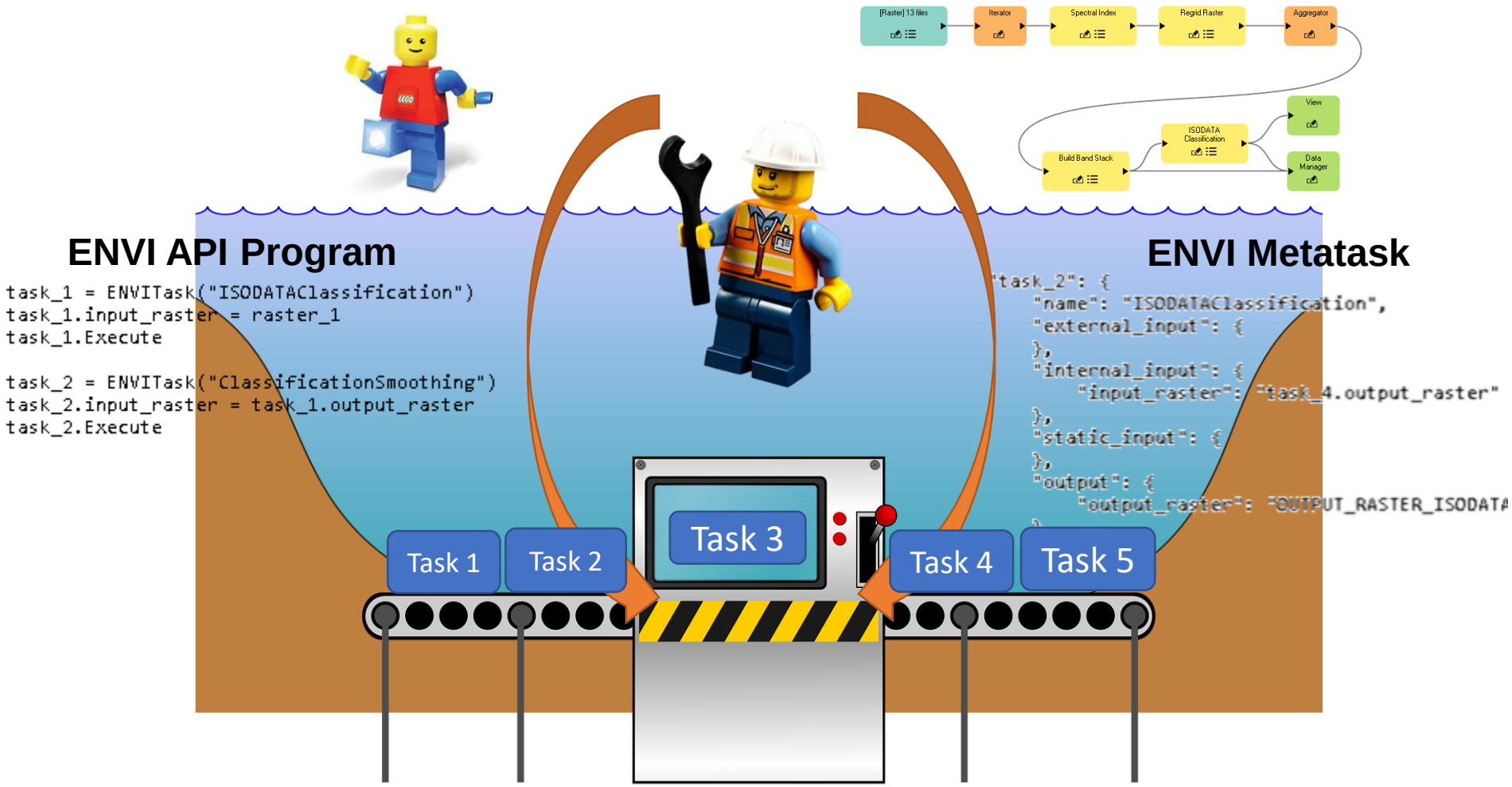
Create custom tools to run within the ESRI platform



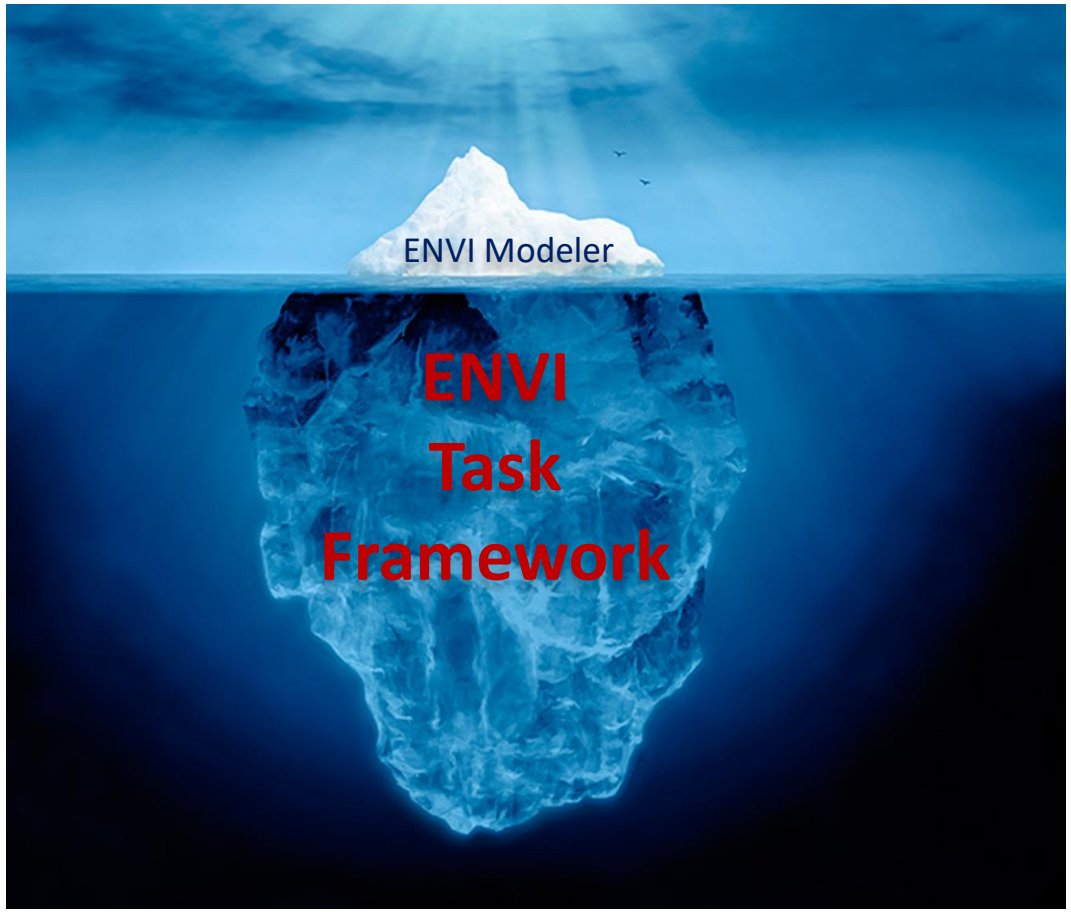
Filing The Gap Between UI and API



ENVI Metatask



Task Framework

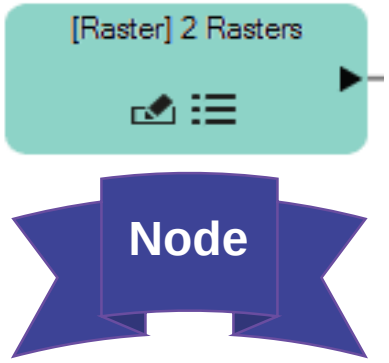


Basic Terminology

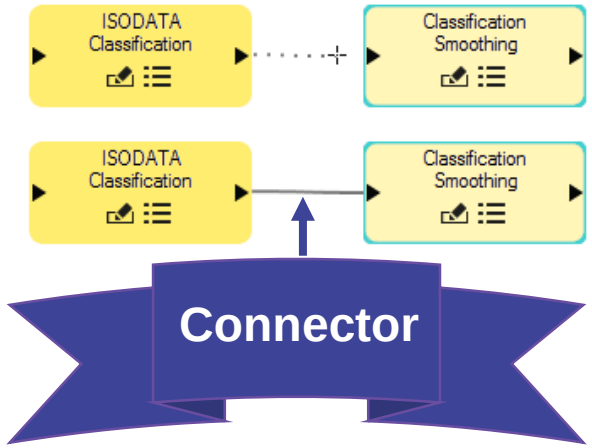
- Objective(s):
  - Define a few key terms that are useful to know when interacting with the ENVI Modeler such as:
    - **Node**
    - **Metatask**
    - **Connector**
    - **Breakpoint**
    - **Aggregator / Iterator Nodes**
    - **Task**

Basic Terminology

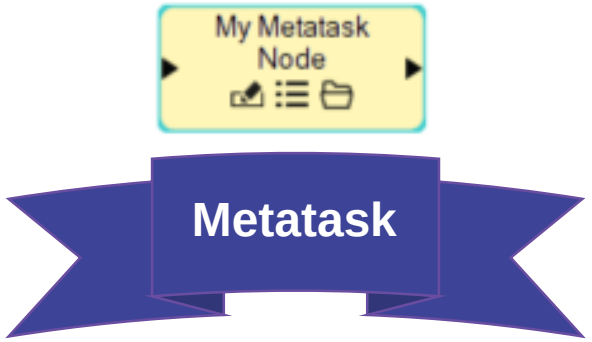
- Here are a few terms that one should be familiar with before using the ENVI Modeler.



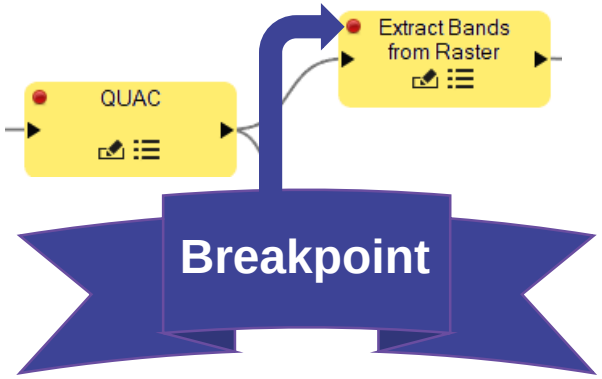
Definition: represents input data, tasks, or actions performed in ENVI



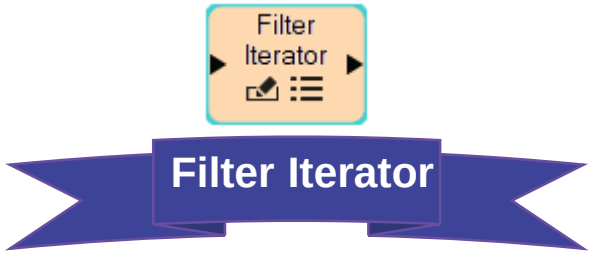
Definition: used to connect nodes together



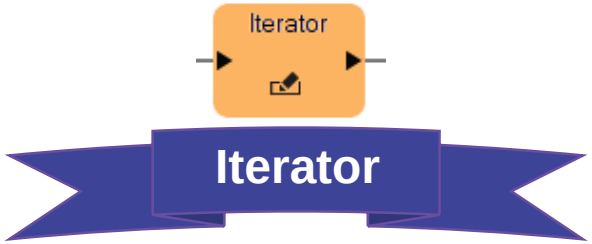
Definition: node containing 2 or more nodes.



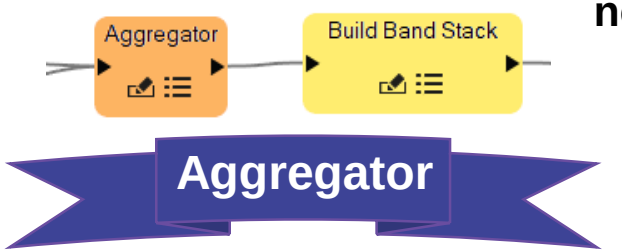
Definition: node marker that stops workflow model execution at when that node is reached.



Definition: node to apply a conditional statement so that an operation executes only when the statement is true.



Definition: provides the ability for batch processing a model



Definition: node that can collect multiple data items and add to an array.

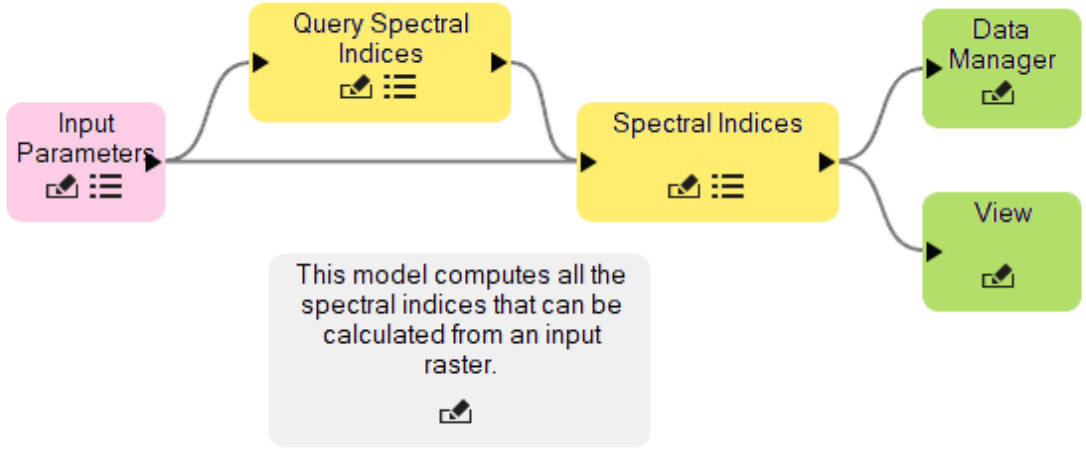
ENVI Modeler Features

- Objective(s):
  - Gain a deeper understanding of how to build workflow models by learning how to:

    - **Use different types of nodes: File, Task, Metatask, Input Parameters, Iterator, etc….**
    - **Extract metadata properties and elements from arrays**
    - **Add breakpoints in a model**
    - **Add workflow output to the ENVI Data Manager and display it in the ENVI layout window.**
    - **Validate, run, and import items into a model.**

Nodes and Connectors

- At the core of every model built in ENVI Modeler are nodes and connectors. Nodes provide the user the ability to specify data and tasks to use in a workflow while connectors allow a user to link tasks and data together to produce a useful output.

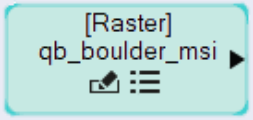
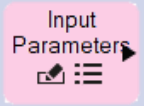
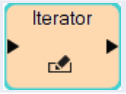
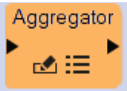
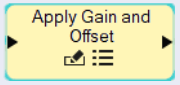
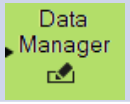
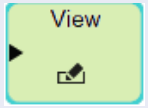


Several different of nodes allows for a variety of ways to customize your workflow model.

Node types in the ENVI Modeler include:

- **File Node**
- **Task Node**
- **Comment Node**
- **Data Manager Node**
- **Iterator Node**
- **Aggregator Node**

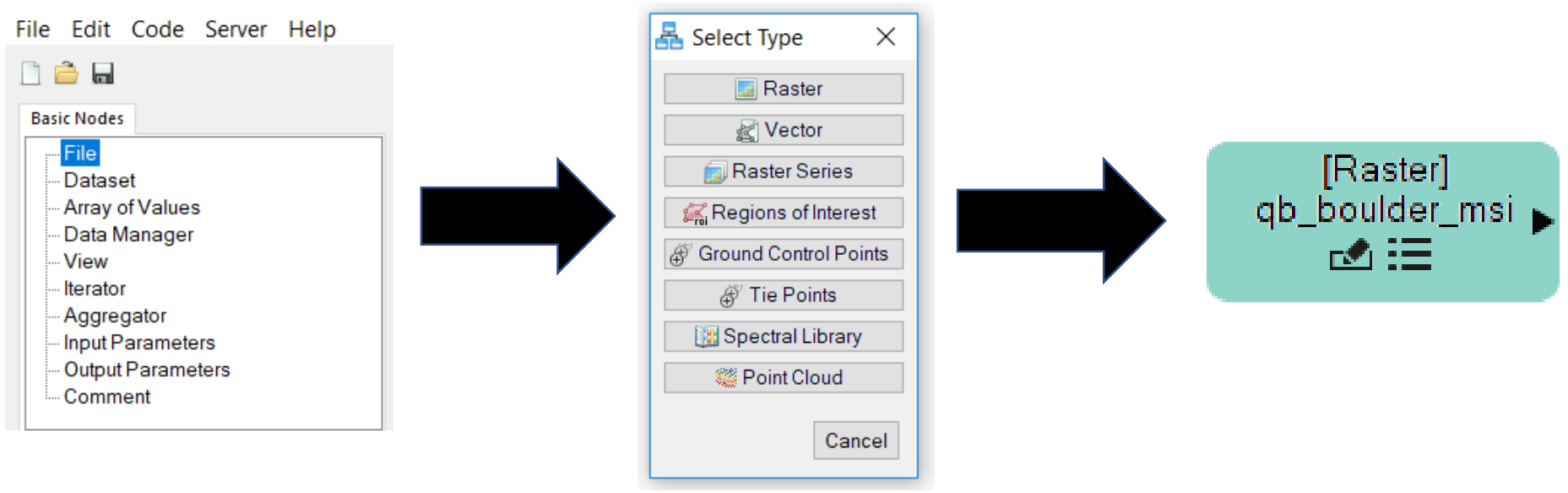
Node Type Overview

Node Type	Appearance	Description
File		Represents input data in a workflow
Dataset		Same function as file node, but describes data already loaded into ENVI.
Input Parameters		Allows a user to specify workflow parameters when a model is run.
Iterator		Allows for batch processing with a workflow
Aggregator		Reads multiple data items and adds them to an array
Task		Represents an ENVI task
Data Manager		Adds workflow output to the ENVI Data Manager
View		Displays the output of a workflow in the ENVI layout window

File/Dataset Node Overview

- To add a File/Dataset node to your workflow one can do the following:

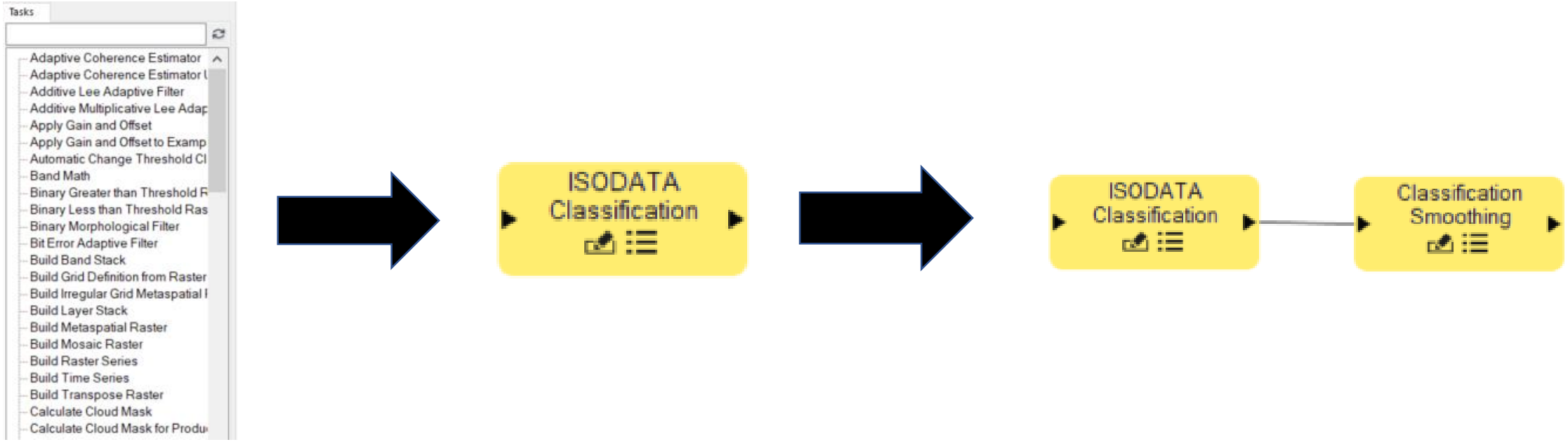
1. Locate the pane that is entitled **Basic Nodes**.
2. Double click or drag the option called **File** or **Dataset** into the ENVI Modeler window
3. Select your desired data type from the dialog and a node will be created for you.



Task Node Overview

- To add a Task node to your workflow one can do the following:

1. Locate the **Tasks** window in the ENVI Modeler
2. Double click on or drag the task name into the ENVI Modeler layout window.

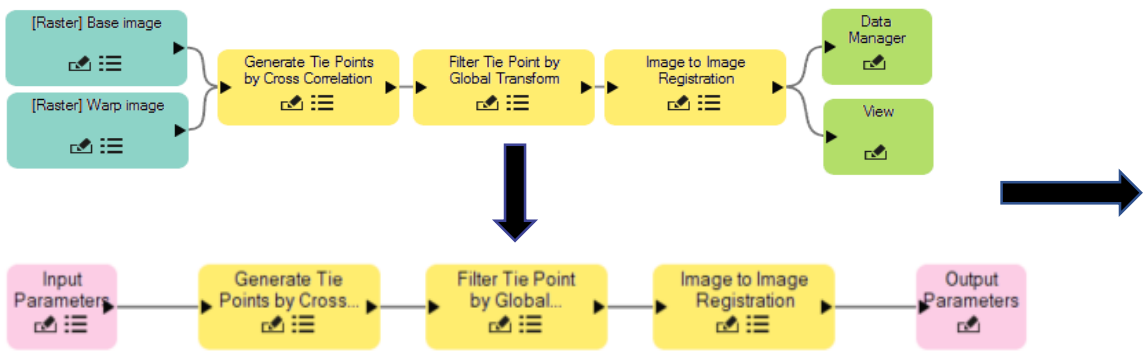


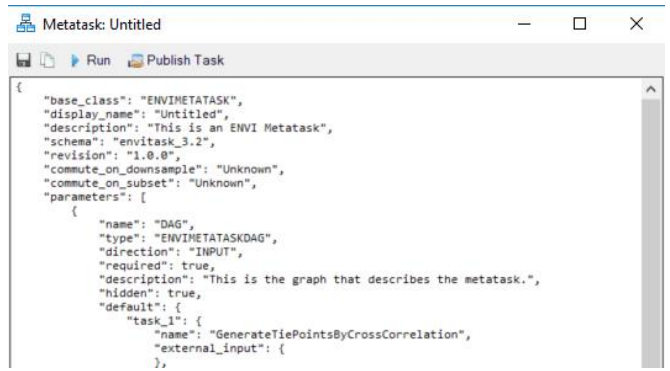
Metatasks Overview

- Metatasks represent entire workflows built in the modeler as one node. Useful for importing multiple workflows in a larger project with multiple steps. To generate a Metatask from a model one can do the following:

Approach (A)

1. Display your model in the ENVI Modeler layout window and add and Input Parameters and Output Parameters to the respective ends of the workflow model.
2. Select **Code** from the top of the toolbar and click **Generate Metatask** and.
3. In the dialog that pops up on your screen, select how you would like to export the Metatask.



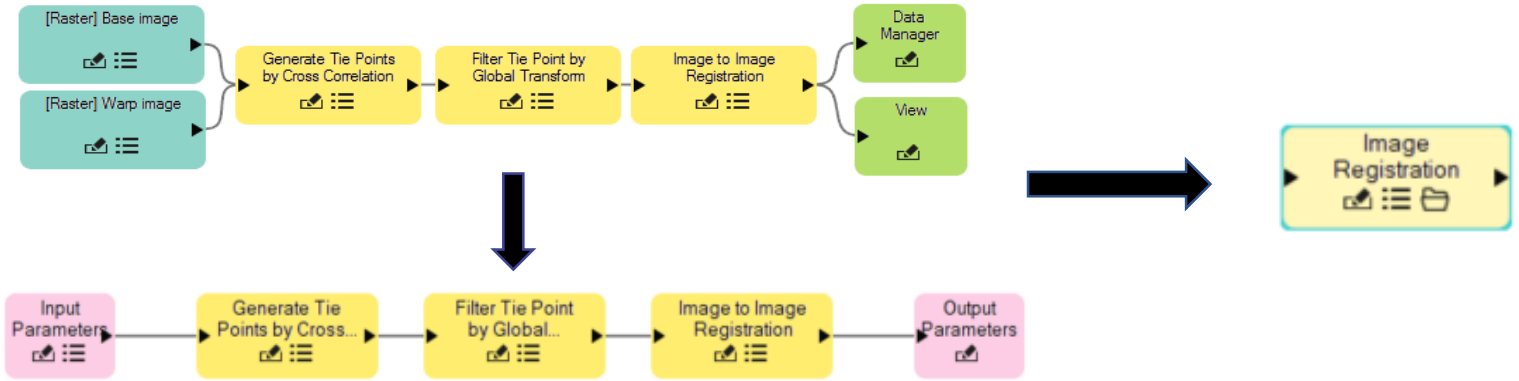


Metatasks Overview cont…

- To generate a Metatask from a model one can do the following:

Approach (B)

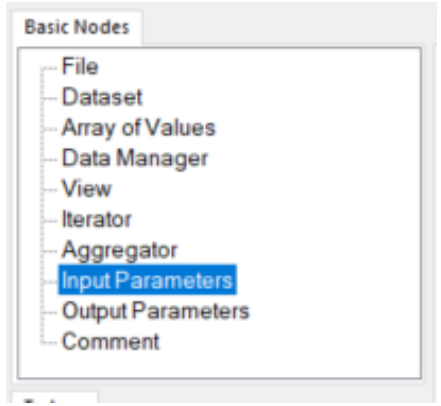
1. Display your model in the ENVI Modeler layout window and add and Input Parameters and Output Parameters to the respective ends of the workflow model.
2. Select **Edit** from the top of the toolbar and click **Create Task from Model** and.
3. In the dialog that pops up on your screen, select how you would like to export the Metatask.

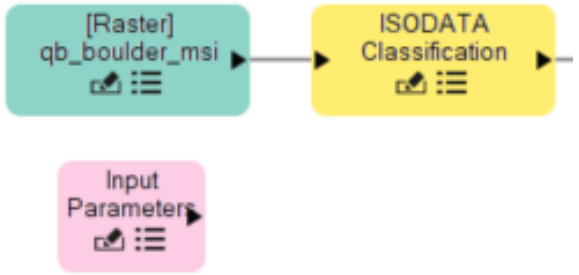


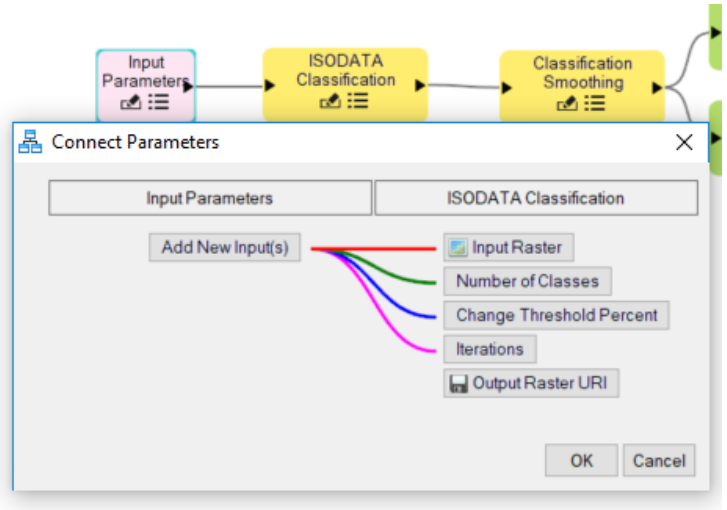
Input Parameters Node Overview

- To add a Input Parameters node to your workflow one can do the following:

1. Locate the pane that is entitled **Basic Nodes**.
2. Double click or drag the option called **Input Parameters** into the ENVI Modeler window
3. Draw a connector between the Input Parameters node and the first Task node in your model
4. Use the **Connect Parameters** dialog to set up parameters that the end user should specify when running the model.





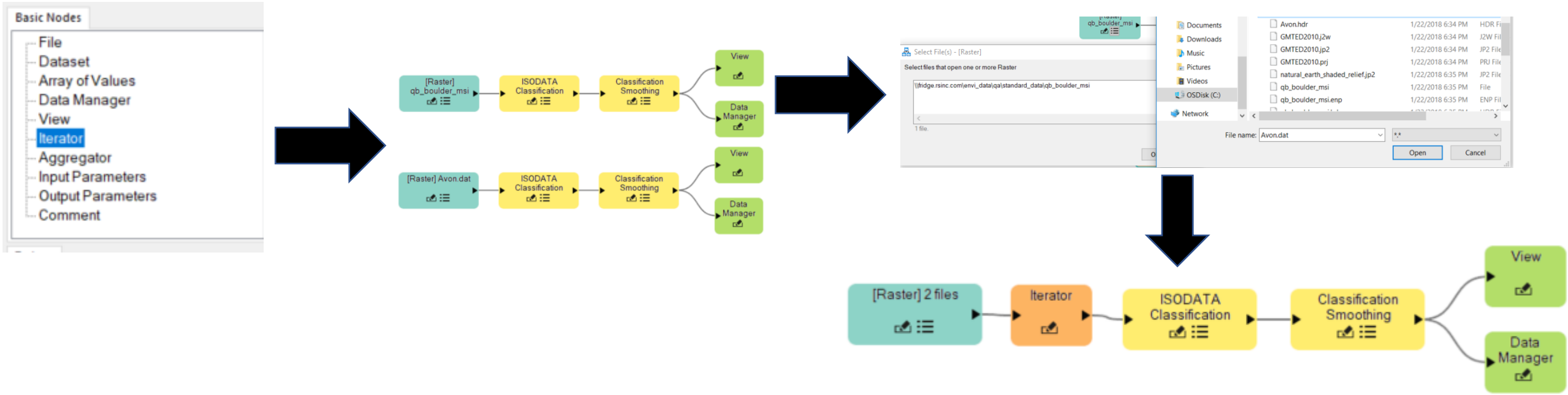


Use a Input Parameters node to allow the user to specify what is input to the workflow each time it is run via a dialog window.

Iterator Node Overview

- To add an Iterator node to your workflow one can do the following:

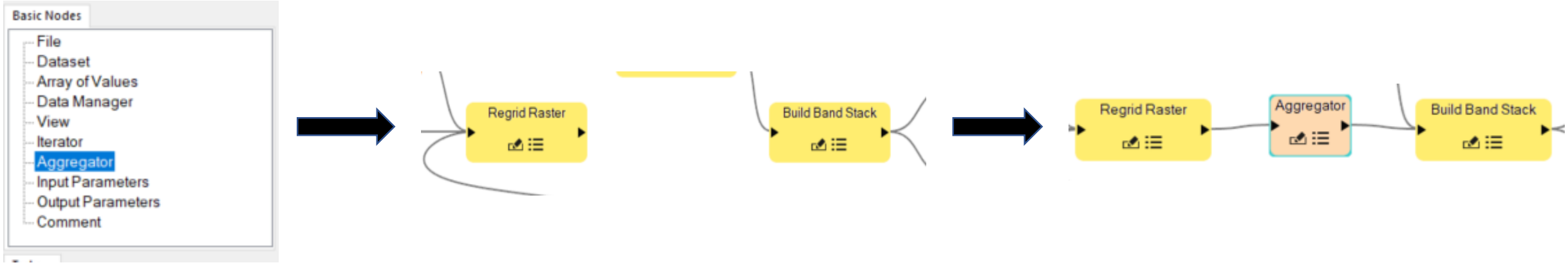
1. Locate the pane that is entitled **Basic Nodes**.
2. Double click or drag the option called **Iterator** into the ENVI Modeler window
3. Draw a connector between the Iterator node and the first Task node in your model
4. Use the **Connect Parameters** dialog to set up the necessary parameters needed to run the model properly.



Aggregator Node Overview

- To add an Aggregator node to your workflow one can do the following:

1. Locate the pane that is entitled **Basic Nodes**.
2. Double click or drag the option called **Aggregator** into the ENVI Modeler window
3. Draw a connector between the Iterator node and the first Task node in your model
4. Use the **Connect Parameters** dialog to set up the necessary parameters needed to run the model properly.

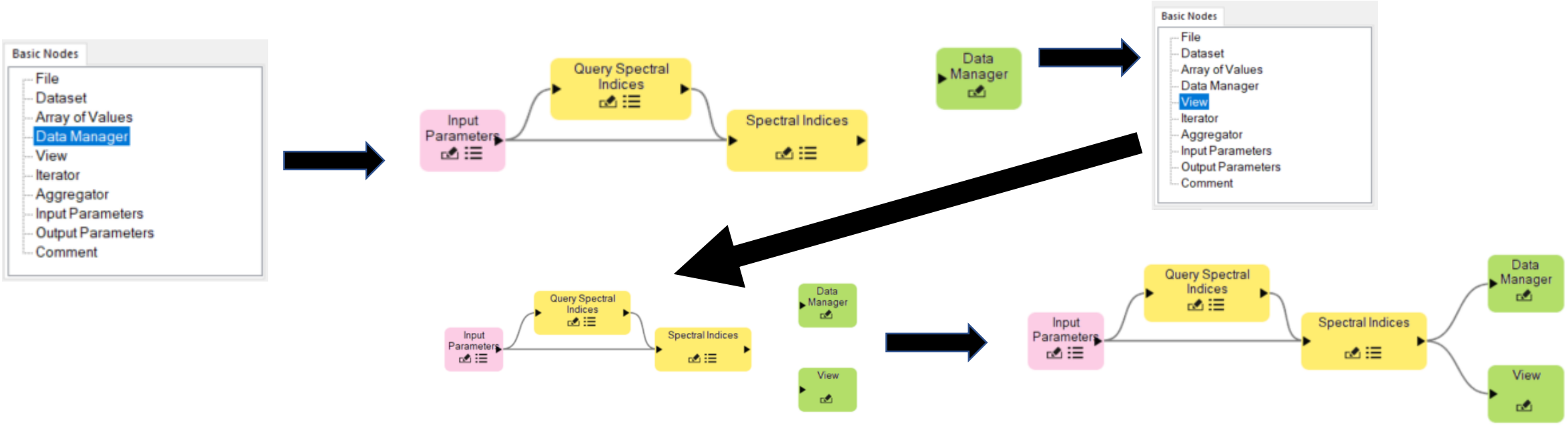


Use an Aggregator node to take a collection of items and feed them as input to a task that takes an array as input.

Data Manager/View Node Overview

- To add an Data Manager/View Node node to your workflow one can do the following:

1. Locate the pane that is entitled **Basic Nodes**.
2. Double click or drag the option called **Data Manager/View** into the ENVI Modeler window
3. Draw a connector between the node and the output of the last Task node in your model

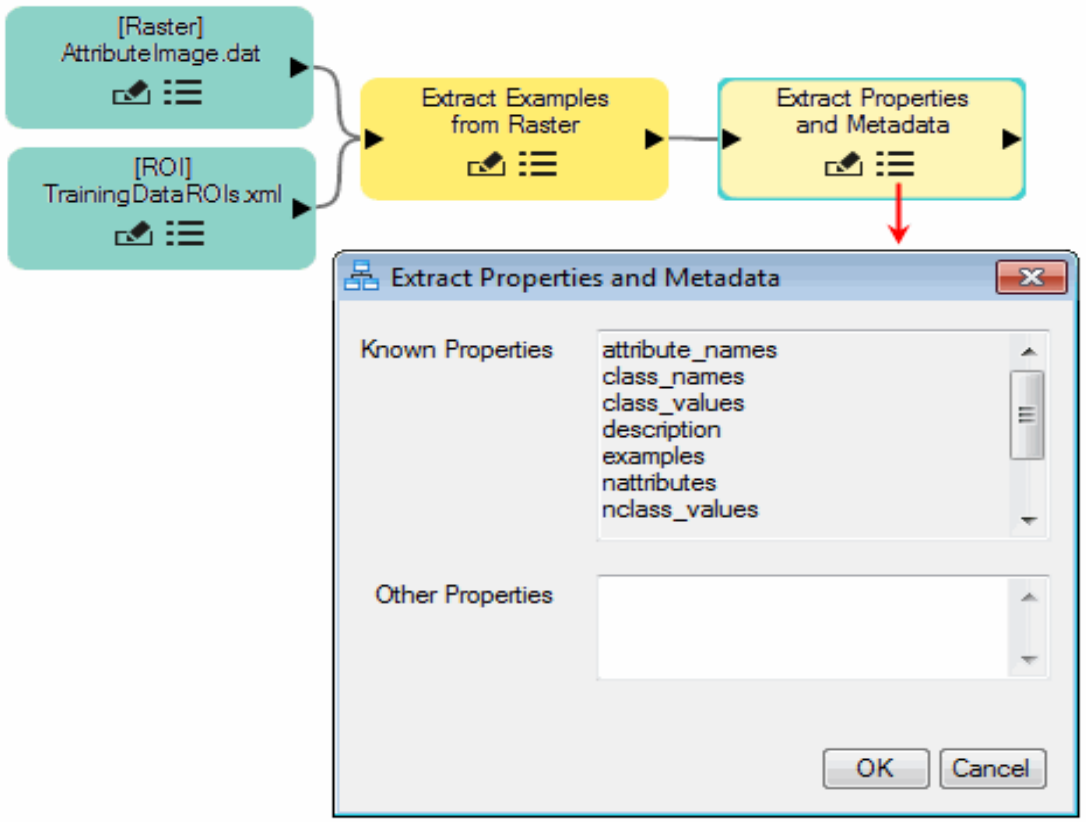


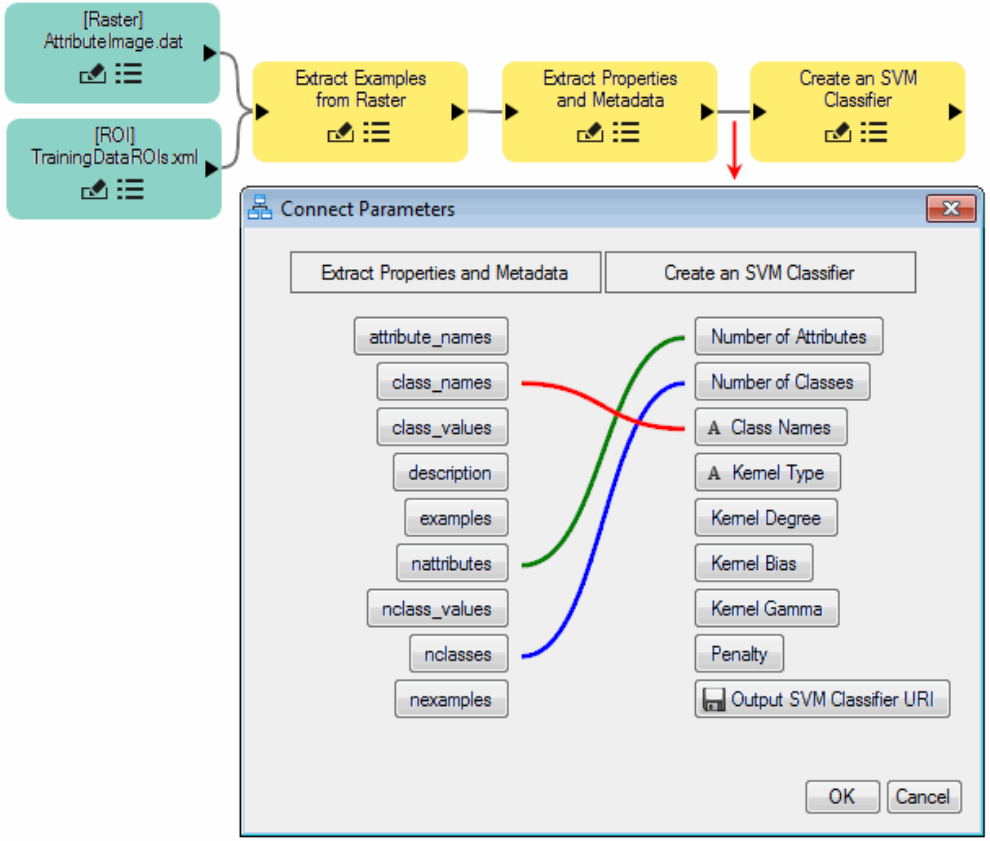
Extracting Metadata

- You can add a node to extract metadata properties from an object to use as input by performing the following steps:

1. Double-click the **Extract Properties/Metadata** option in the Tasks list.
2. Draw a connector between the output of a task and the Extract Properties and Metadata node.
3. Click the ⁝≡ button in the Extract Properties and Metadata node and a Extract Properties and Metadata dialog will appear on your screen. Inspect which properties are available click OK when done.
4. Connect the Extract Properties and Metadata node to a Task node that will accept its input
5. Match the metadata items with the corresponding inputs for the connected Task node.

Extracting Metadata cont …

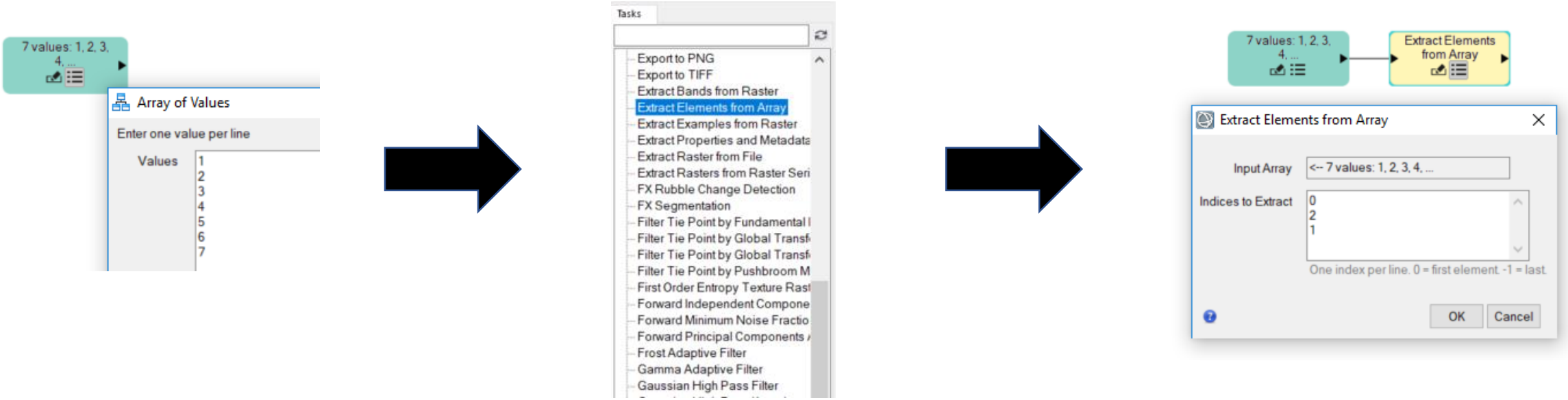




Extracting Elements from Arrays

- Add a node to extract elements from a 1D or multi dimensional array by performing the following steps:

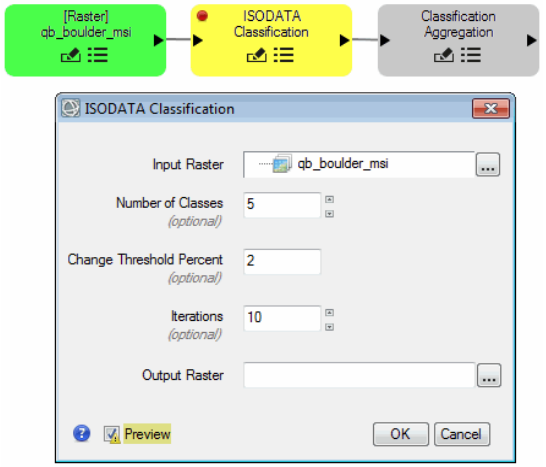
1. Double-click the **Extract Elements from Arrays (EEA)** option in the Tasks list.
2. Draw a connector between a node that produces an array as output and an EEA node.
3. Click the ☰ button on the EEA node and an dialog will appear. Here you can specify which elements of the input array should be selected in the **Indices to Extract** field.



Adding Breakpoints

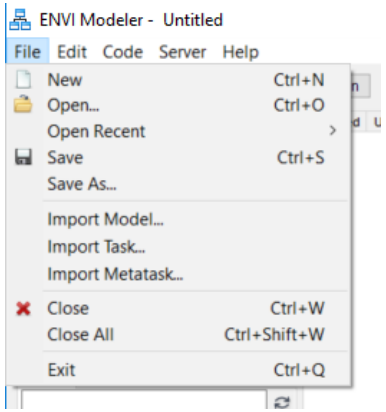
- Add a breakpoint to your workflow so that you can stop execution at certain points and preview output data or make adjustments as needed by performing the following steps.

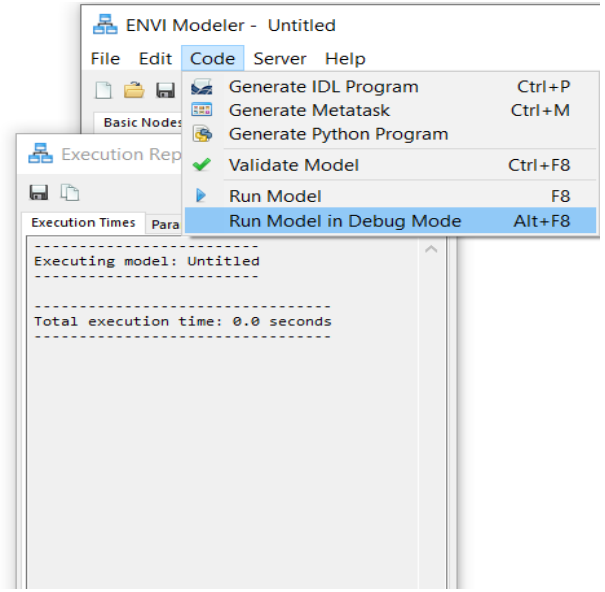
1. Click on a Task node in the ENVI Modeler layout window. You can tell if the node is selected if a cyan border appears around the Task node.
2. Click the button in the ENVI Modeler Toolbar.
3. Repeat steps 1 and 2 to remove a breakpoint if necessary.



Validate, Run, and Import Items into a Model.

- You can import task files, metatasks, and other model files into your project by performing the following steps:
    1. Select **File** from the tool bar and click the **Import** option.
    2. Alternatively, you can drag and drop items from the Data or Layer manger or even from disk into the ENVI Modeler layout window.
- Validation refers to ensuring that all of the nodes in your model are connected properly and all tasks have the required parameters filled otherwise your model will not run. Before you run your model you should always click the **Validate Model** option before pressing **Run Model.**



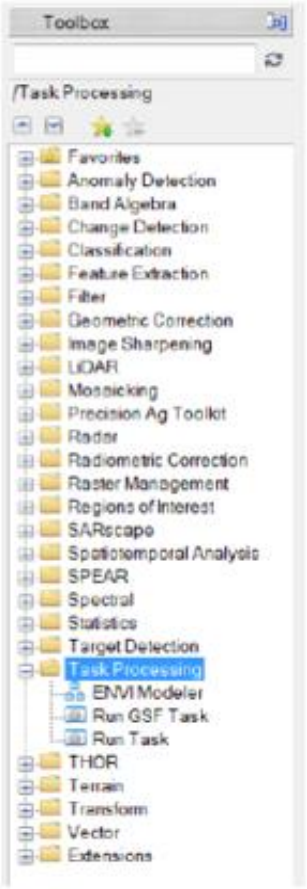


ArcGIS Integration

Creates the code for the workflow

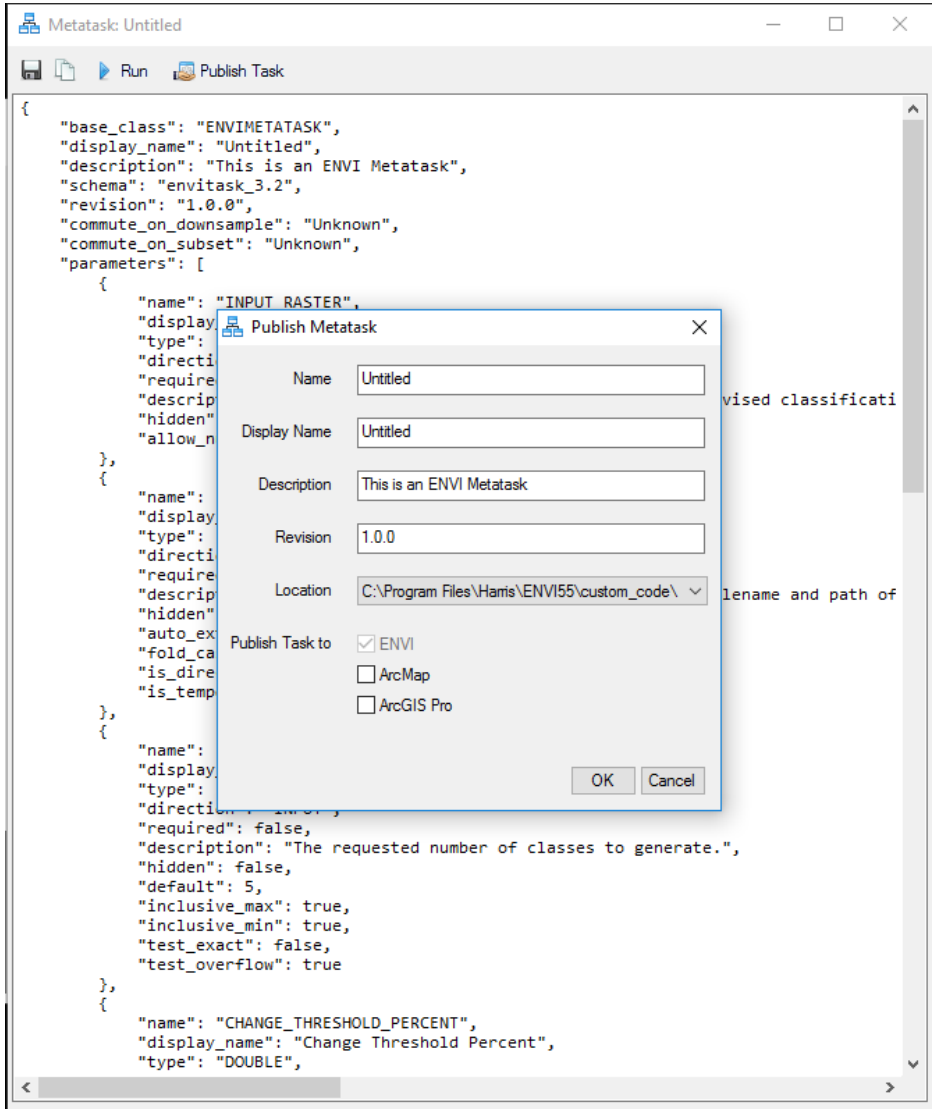
Adds to the custom Extension folder in the Toolbox

Can optionally publish a New Tool directly to ArcGIS Pro

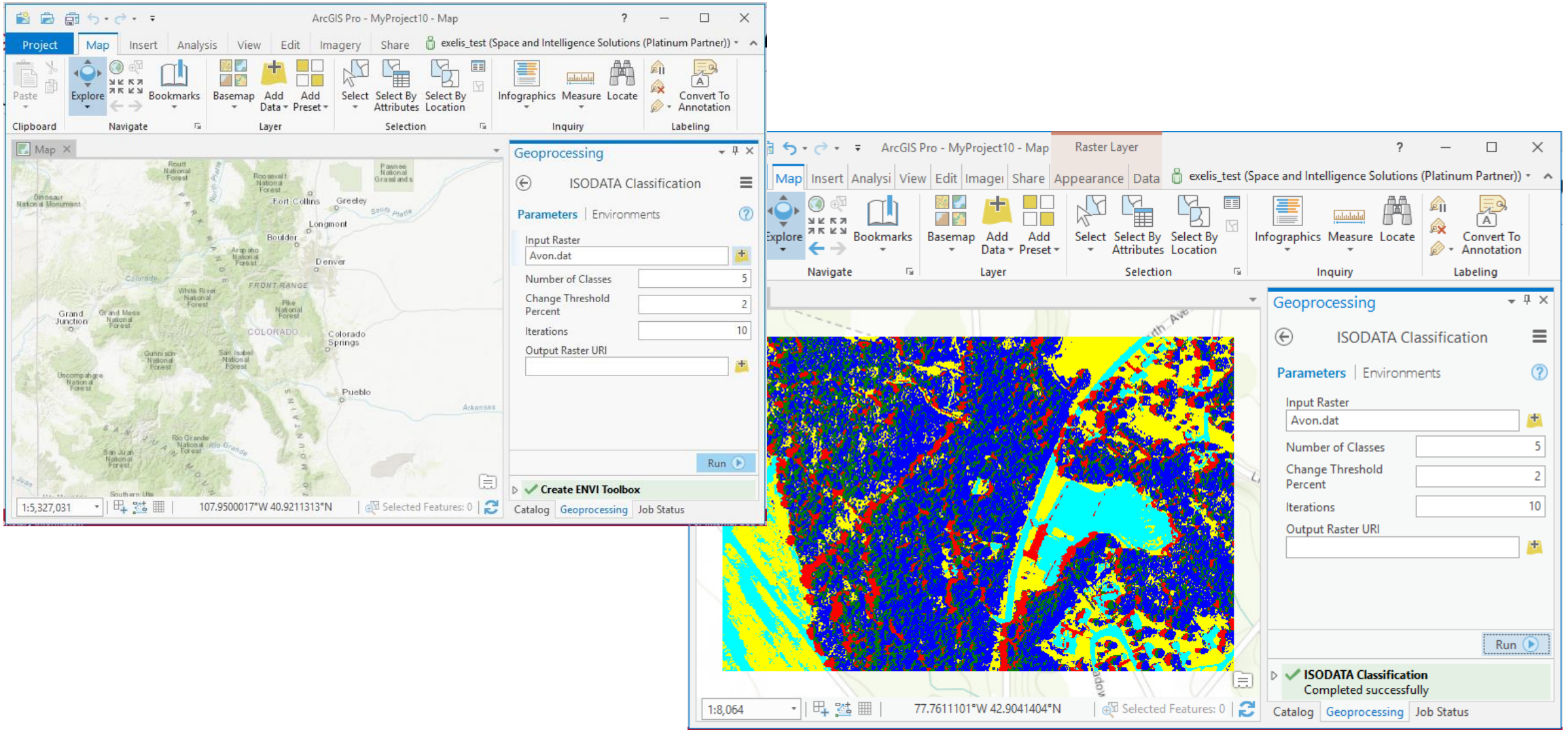


ArcGIS Pro/ENVI Modeler Workflow

- Fill in Name, Display Name, Description
- Select ArcGIS Pro
- You may also select ArcMap, if you want tool available in both

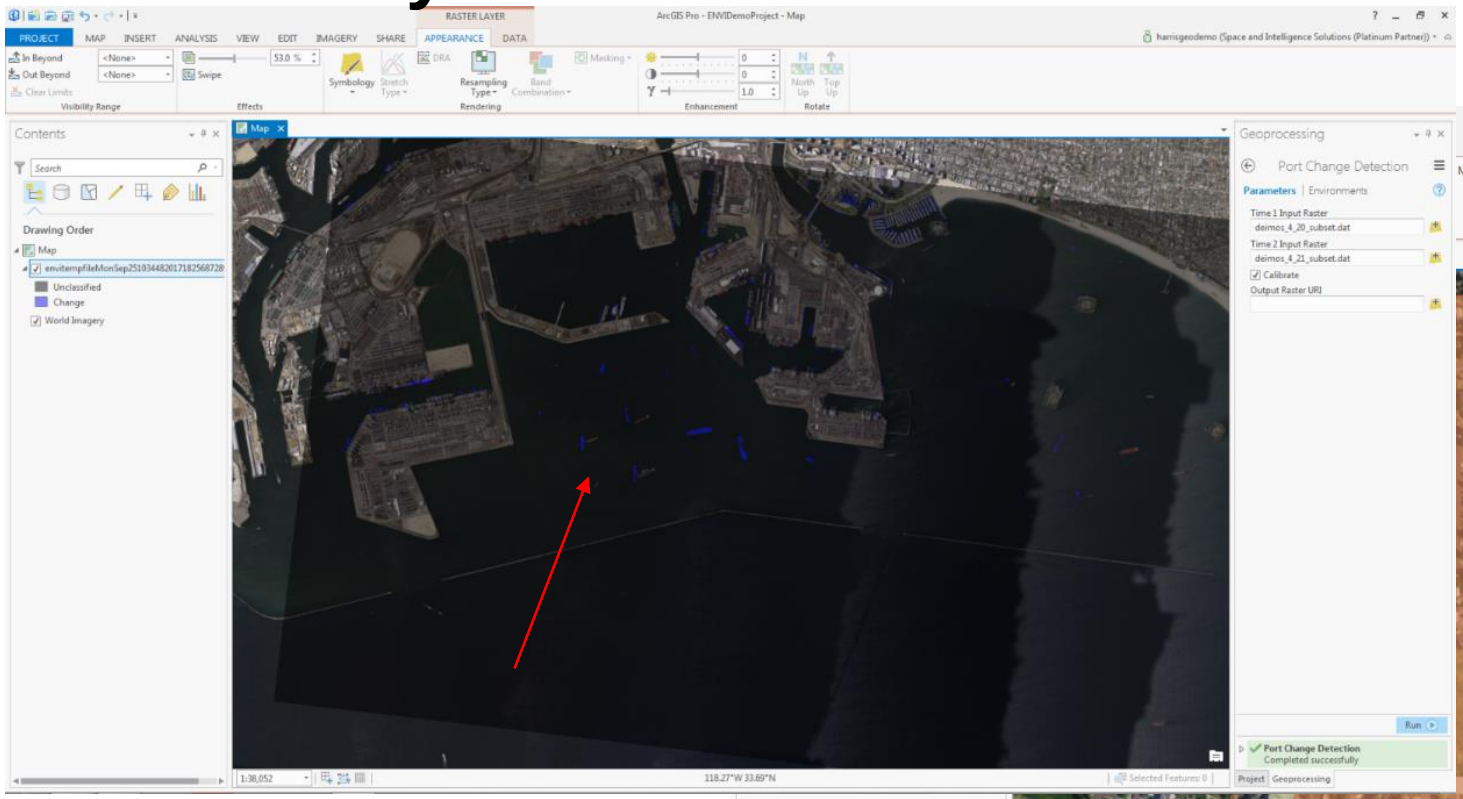


Run ENVI Analytics as new GPTools (ex: ISODATA Classification)

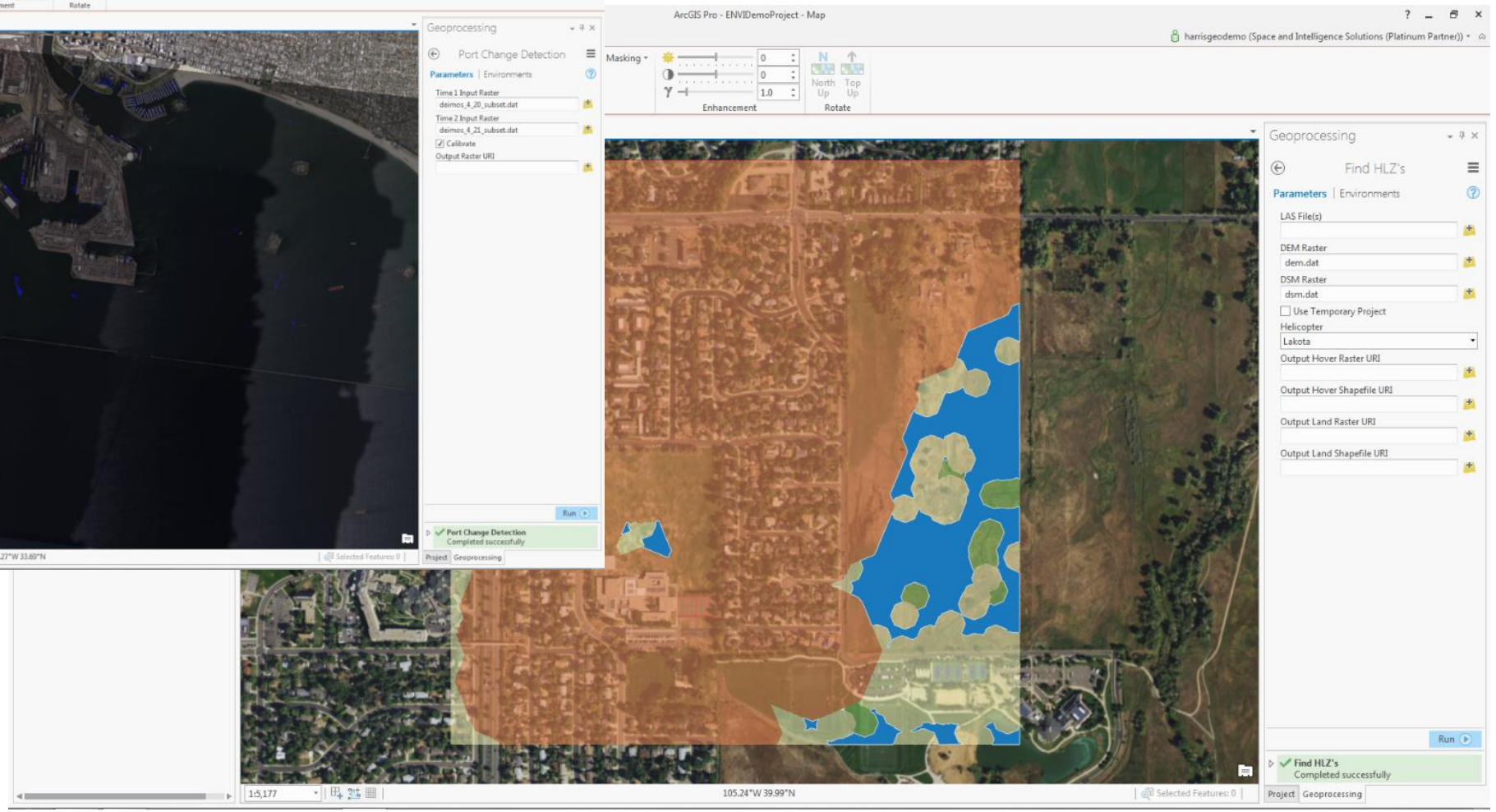


Analytic Examples of Custom Tasks

Port Activity



HLZ Finder



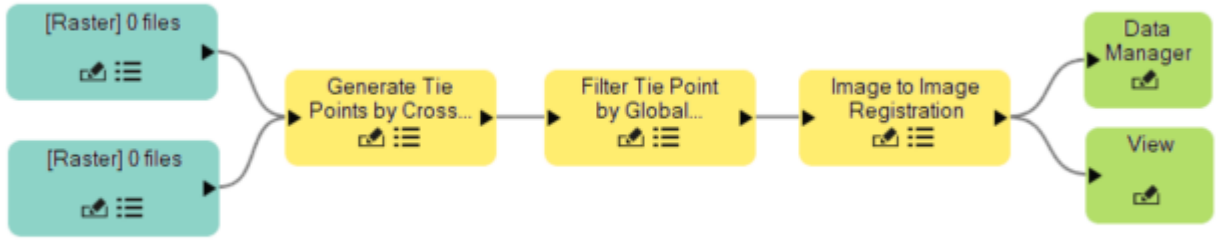
Exercises

- Objective(s):
  - Now it’s your turn! You have been walked through an example to help you get a better feel of using the ENVI Modeler. Hopefully these extra example workflows will assist you in obtaining an appreciation of the compact, intuitive, yet powerful ENVI Modeler by getting a hands on experience building models on your own.

Exercise #1: Image Registration Workflow

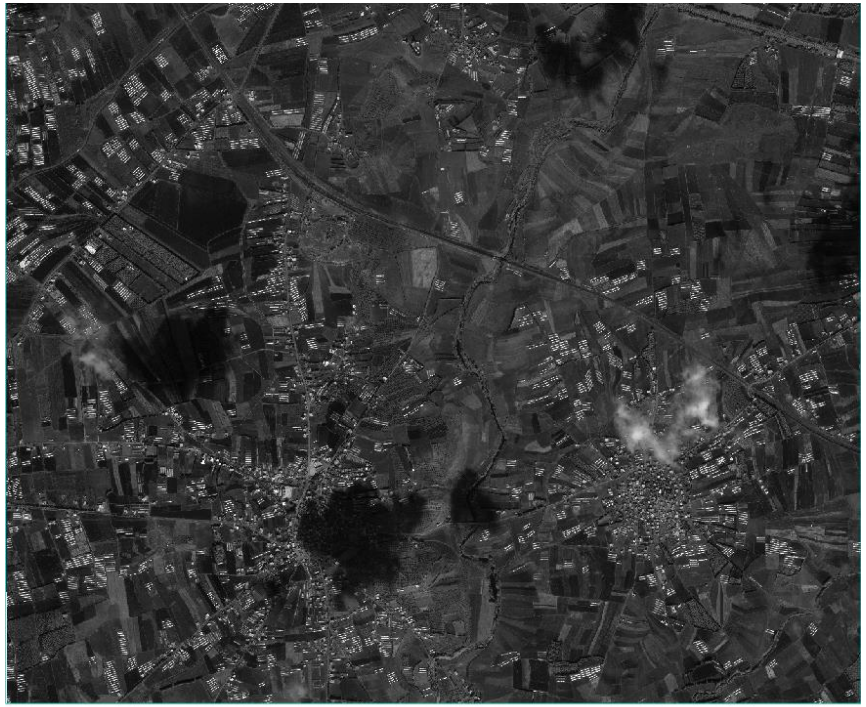
- In this first exercise, we will start with a simple Image Registration workflow model that has been pre built. You should perform the following steps:

1. Launch **ENVI 5.5 + IDL 8.7** on your machine and select **Display**, then **ENVI Modeler** from the top of the ENVI window.
2. Once the ENVI Modeler has been opened, bring the Image Registration Model into the workspace. Click **File** then **Open** or **Import Model** and browse the [**Insert Directory Name Here]** until you find the file **Automatic Image Registration.model**



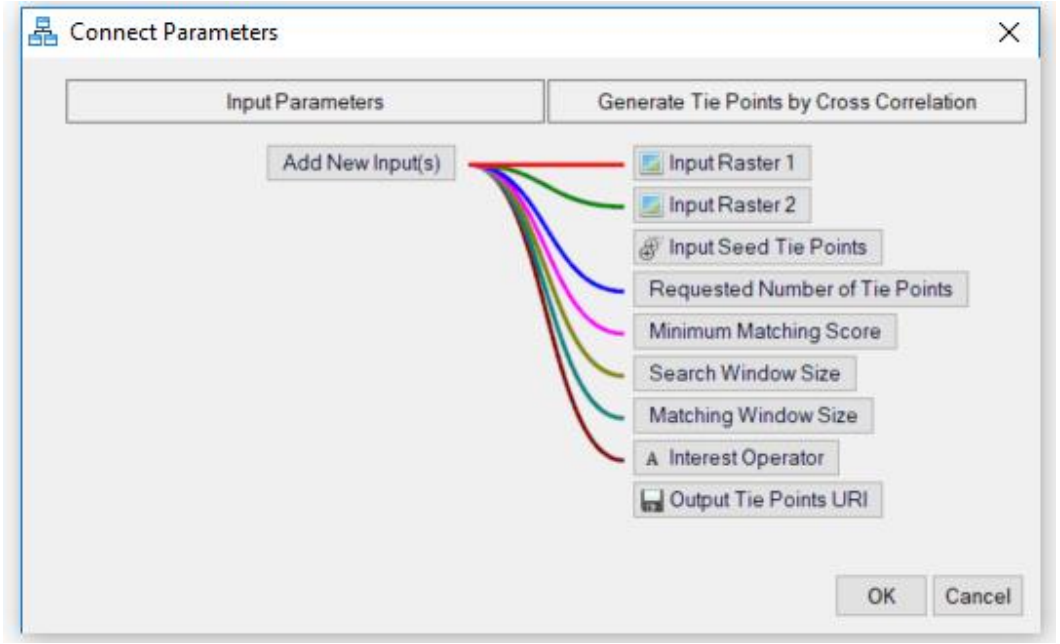
Exercise #1 cont…

3. Now click on a node representing a Raster, and then click the ≡ button and search for a file called **Syria_sam_pan.dat**
4. Repeat step 3 with the file called **Syria_sam_ms.dat**
5. Run validation on your model by clicking **Code** and then **Validate Model**.
6. Finally click the Run button and the output of the workflow should resemble figure below.



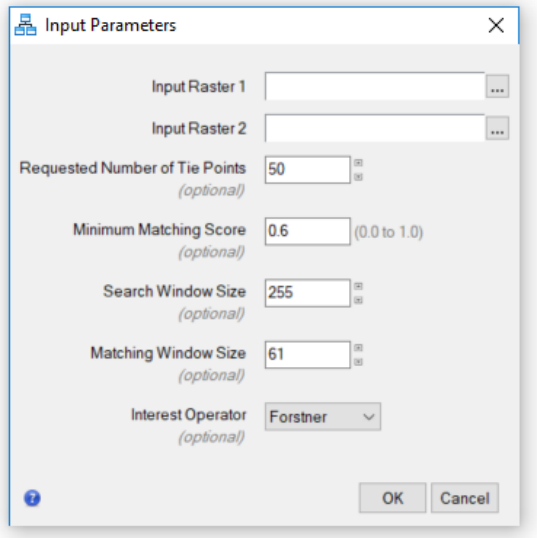
Exercise #1 cont…

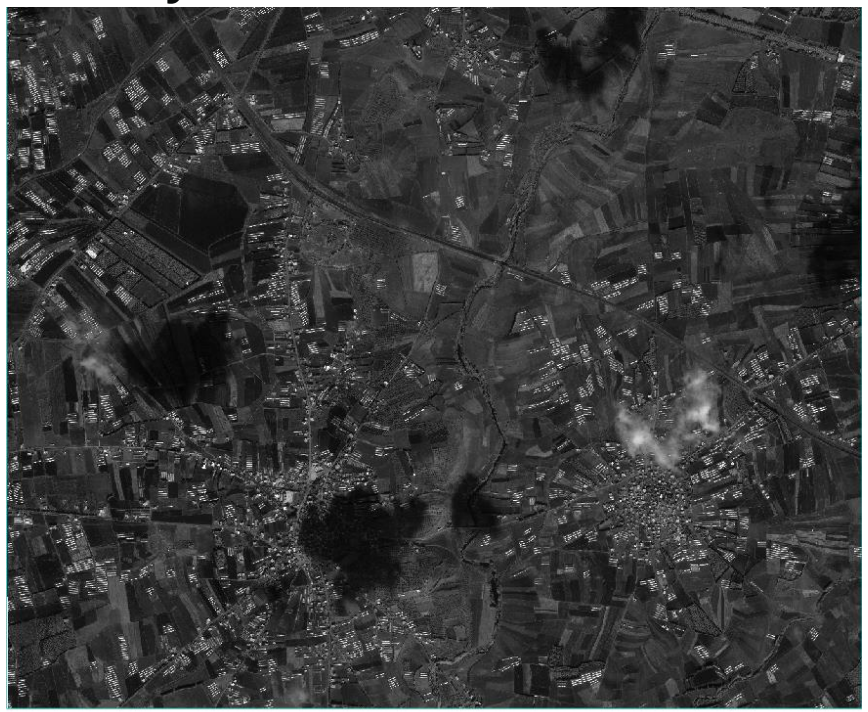
- As an extra bonus, let's add an Input Parameters node to the front of the workflow so that we can add all of our parameters once and let the ENVI handle the rest.
    1. Delete the 2 File nodes representing rasters from the model, by either right clicking on them and selecting **Delete.**
    2. Add an Input Parameters node to your model and connect it to the input of the first task in the workflow and setup your **Connect Parameters Box** as shown below.



Exercise #1 cont…

4. Now save this new model by clicking **File**, then **Save As**.
5. Click **Run** and a dialog will appear on your screen displaying the parameters of the workflow. Add the two scenes **Syria_sam_pan.dat** and **Syria_sam_ms.dat** to the **Input Raster 1** and **Input Raster 2** options and press **OK** and the output should be exactly the same as before shown below.

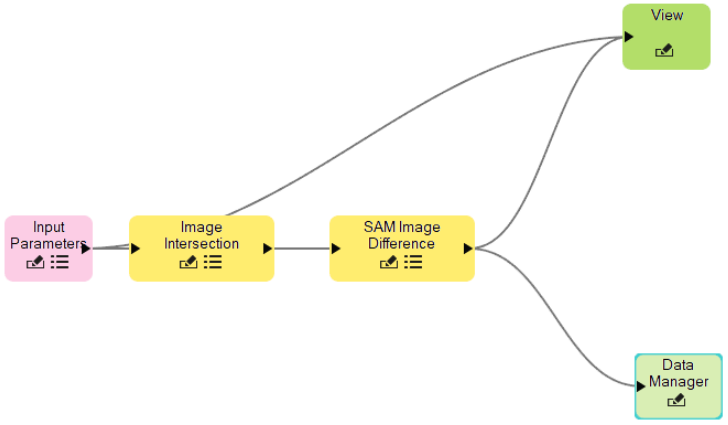


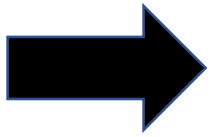


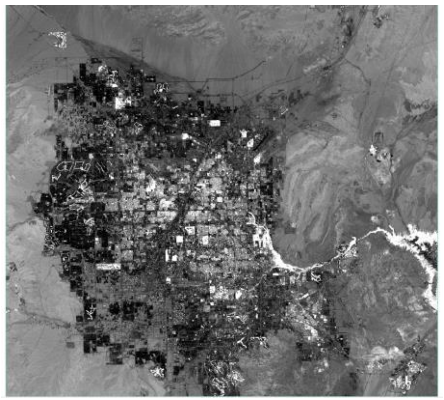
Exercise #2: SAM Image Difference Workflow

- In this exercise, we will work with another pre-built workflow model.

1. Go into the ENVI window and close all of the files from the Data Manager.
2. Locate the model file called **SAM_Image_Difference_with_Intersection.model** in the **SAM_Difference_Example** directory and drag and drop it into the ENVI Modeler layout window.
3. Click the button and locate the 2 rasters **LasVegas1985.dat** and **LasVegas2014.dat** and add t☰m as input via the input parameters dialog. Use the Spectral Subset... button and select bands 1-6 for the LasVegas2014.dat file to ensure that b(have the same number of bands before running the workflow.
4. After completing these 2 steps, you should see something resembling the right most figure below.

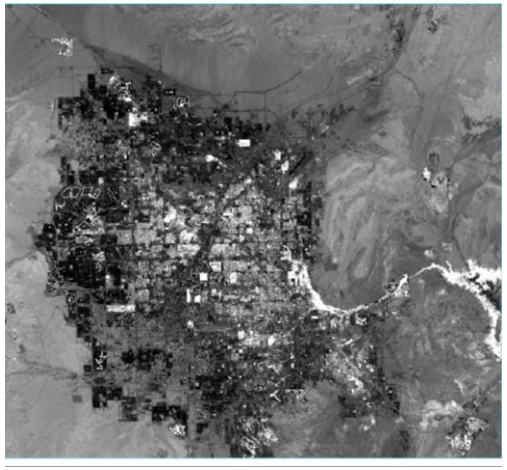


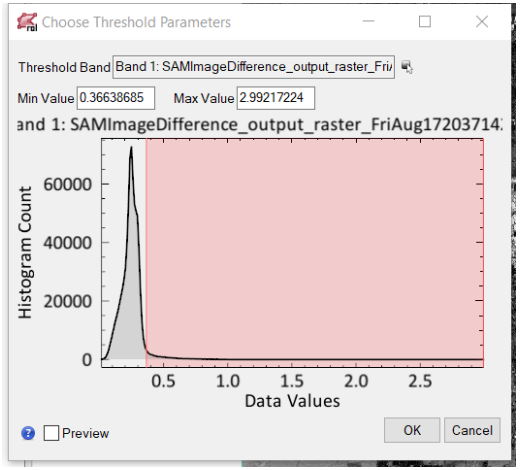


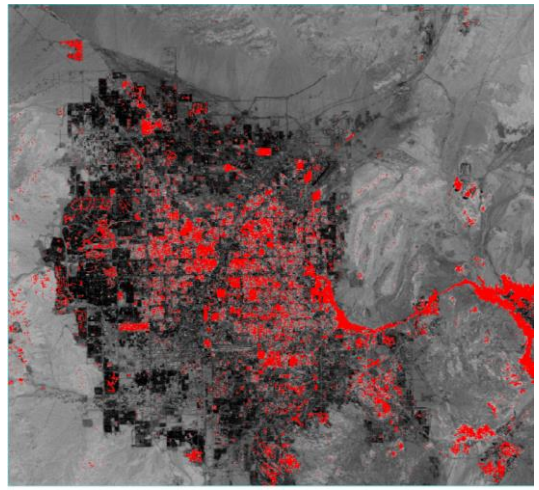


Exercise #2: SAM Image Difference Workflow cont…

- Now that the workflow is finished apply a threshold so that we can see the changes between the two scenes more clearly. To accomplish this, we do the following:
  1. Minimize the ENVI Modeler to bring your screen back to the ENVI layout window, and make sure the difference image is being displayed.
  2. Click the button to bring up the ROI (Region of Interest) Tool and then click the button to create a new ROI.
  3. Next click the **Threshold** option by clicking the button and select Band 1 of the output scene and apply a threshold to highlight the differences between the two input scenes as shown below.







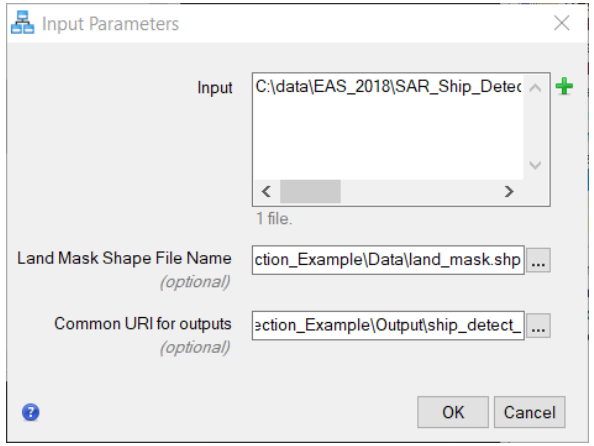
Exercise #3: SARscape Ship Detection Workflow

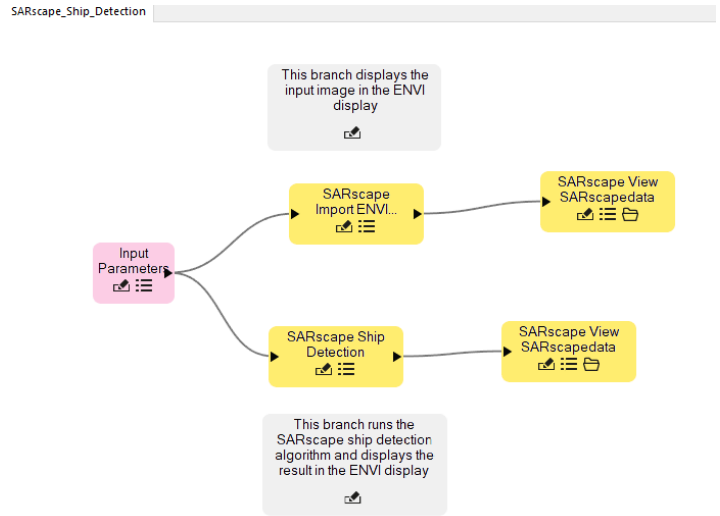
- In this exercise, we look at a ship detection workflow with SARScape.
  1. Go into the ENVI window and close all of the files from the Data Manager.
  2. In the **SARscape_Ship_Detection_Example** directory, the model file called **SARscape_Ship_Detection.model** in the **Models** directory and drag and drop it into the ENVI Modeler layout window.
  3. Click the Run button and set the input parameters as shown:

     Input: **TDX1_SAR_MGD_20170501T015125_20170501T015133_HH_gr_cut_geo**

     Land Mask Shape File Name: **land_mask.shp**

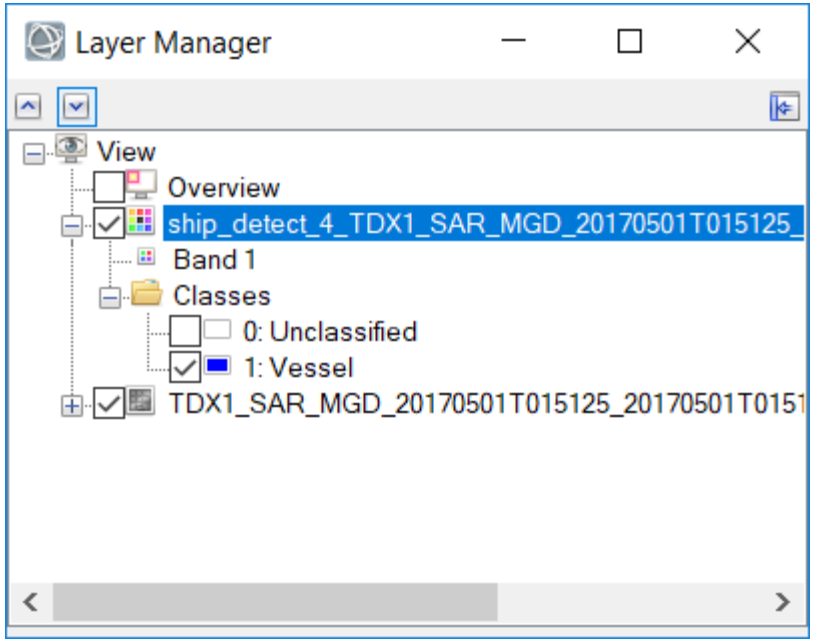
     Common URI for outputs: **ship_detect_** (create an output directory in the SARscape_Ship_Detection_Example directory called **output**.)

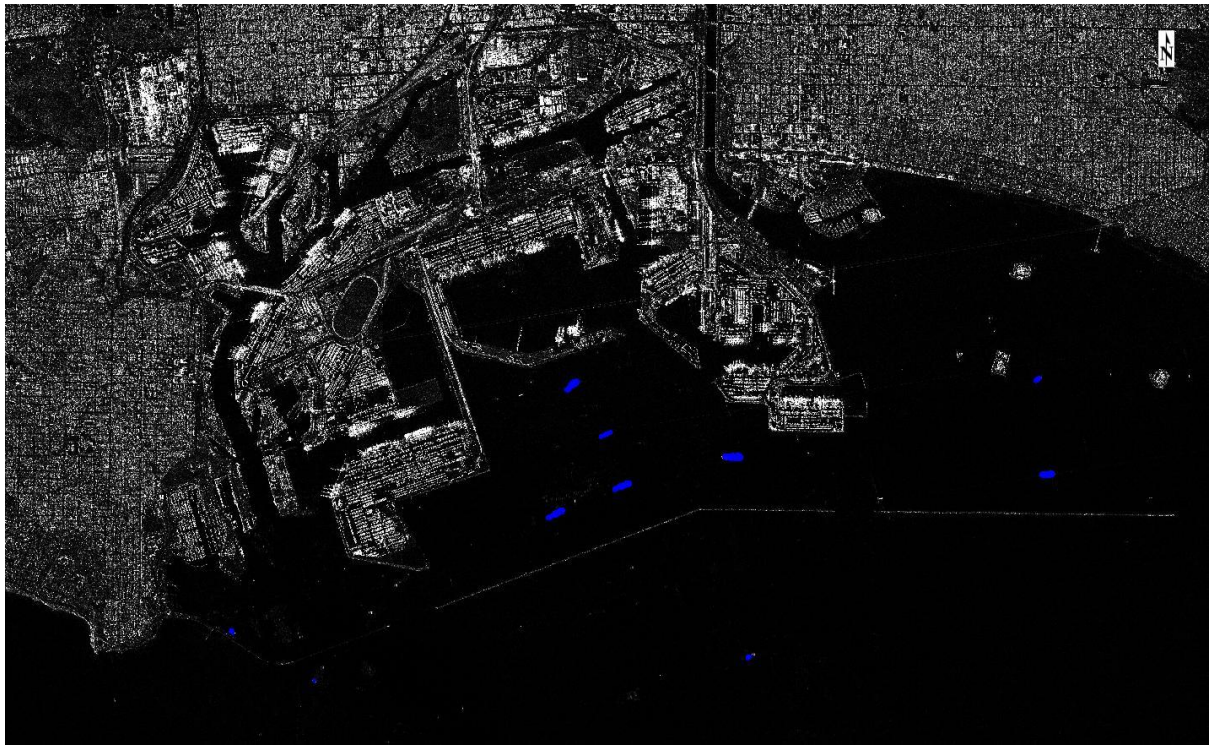




Exercise #3: SARscape Ship Detection Workflow cont..

4. When completed the original SAR image and the Ship Detection Results will appear in the ENVI display





Exercise #4: Build Your Own Model

- Its time to put your ENVI Modeler skills to the test! The previous 3 exercises dealt with pre-built models and there wasn't a lot of opportunity to explore. Now we want you to take some time create your very own model!

  - Go to the directory where you saved the workshop datasets and locate the subfolder called **Denver_BYO** data. In this directory, you will find a couple of Deimos 2 scenes over Denver, Colorado. We want you to use one or both of these scenes in your model.
  - Try experimenting with different features of the ENVI Modeler. For example, try adding a breakpoint on a task or creating a Metatask node for your model.

Thank You!!!!

Thank you to all who attend this workshop! We hope that you learned more about What's New in ENVI and the ENVI Modeler and have a deeper understanding of how it can be used to serve your project needs. ☺

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