

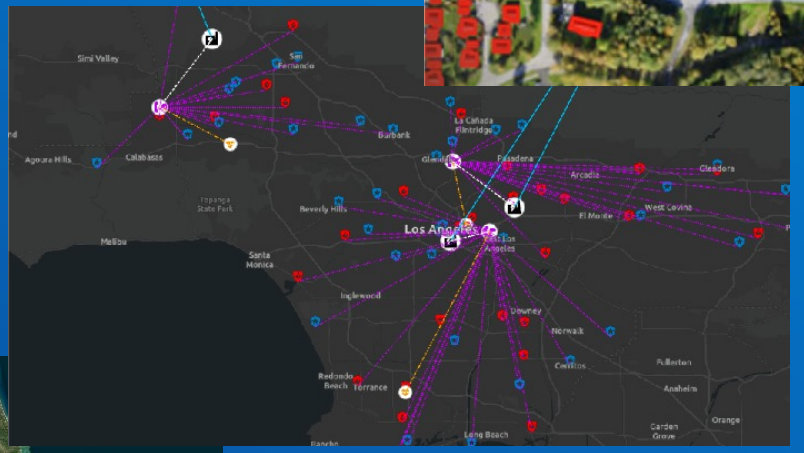
Geospatial Artificial Intelligence (GeoAI)

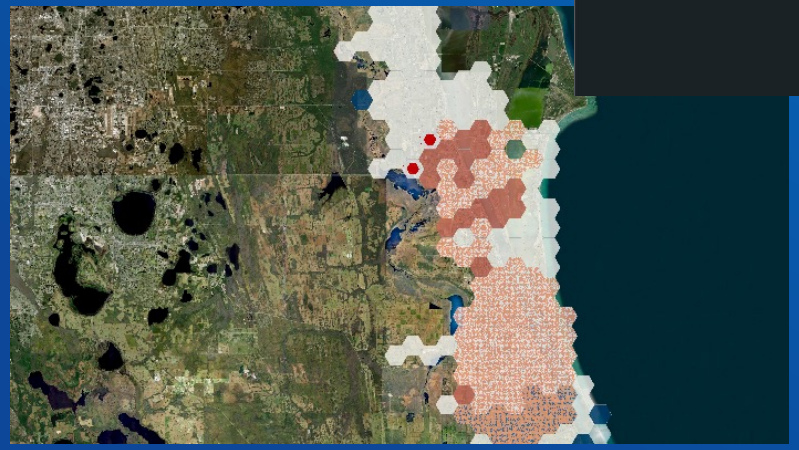
John Beck
Brady Cline
Jeff Baranyi
Patrick O'Brien

Introducing New Tools for Advanced Spatial Analysis

- **Part 1: Geospatial Artificial Intelligence (GeoAI)**
- Part 2: Graph Analytics in ArcGIS
- Part 3: Spatial Statistics with Machine Learning and AI







Housekeeping

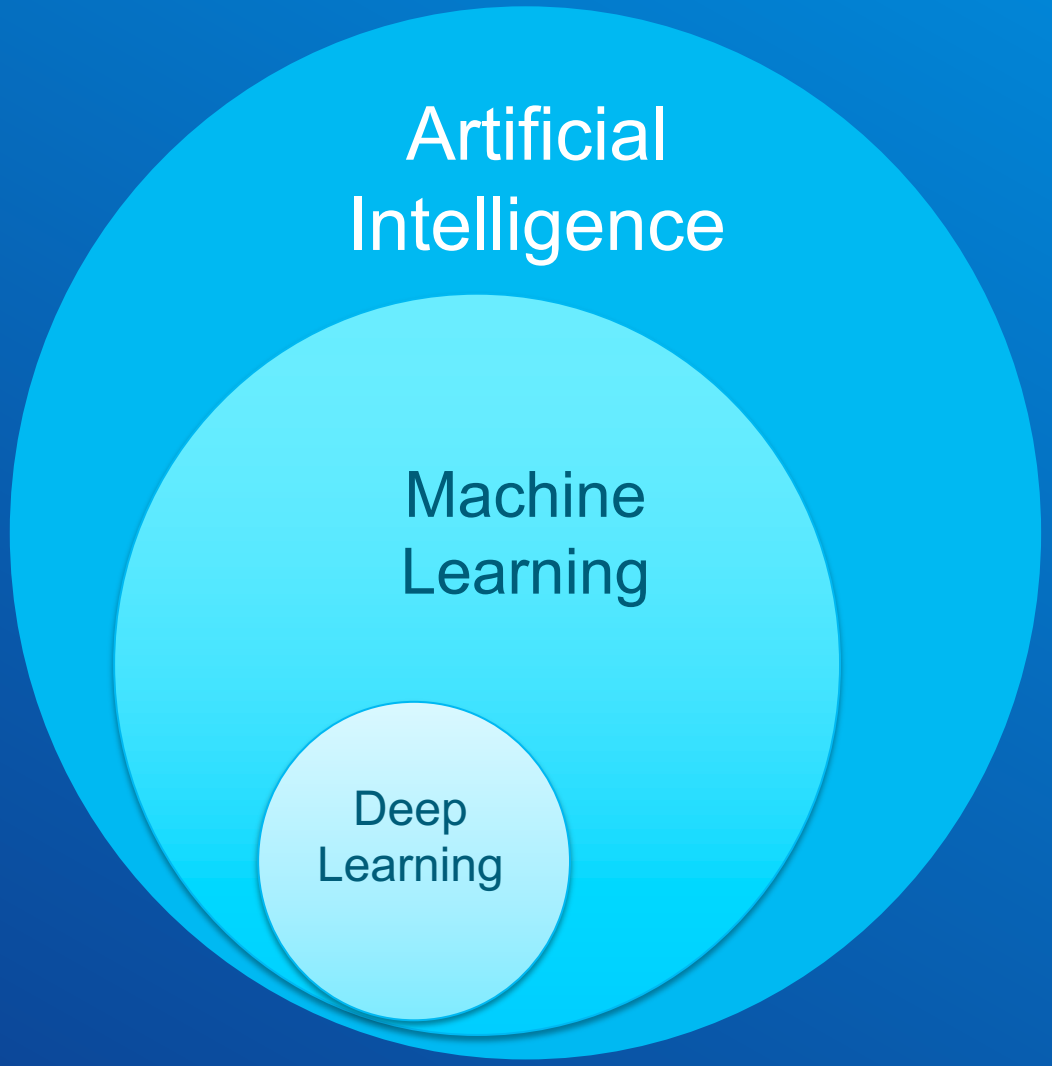
- Please use the attendee panel to submit your questions
- A recording and resources will be emailed to you after the webinar
- You can also download today’s resources from the attendee panel
- Please provide us with feedback!

Agenda

- What is GeoAI?
- GeoAI in ArcGIS
- Conducting an AI-Based Damage Assessment in ArcGIS Pro and ArcGIS Online
- Deep Learning Pool Detection for Search and Rescue
- Getting Started



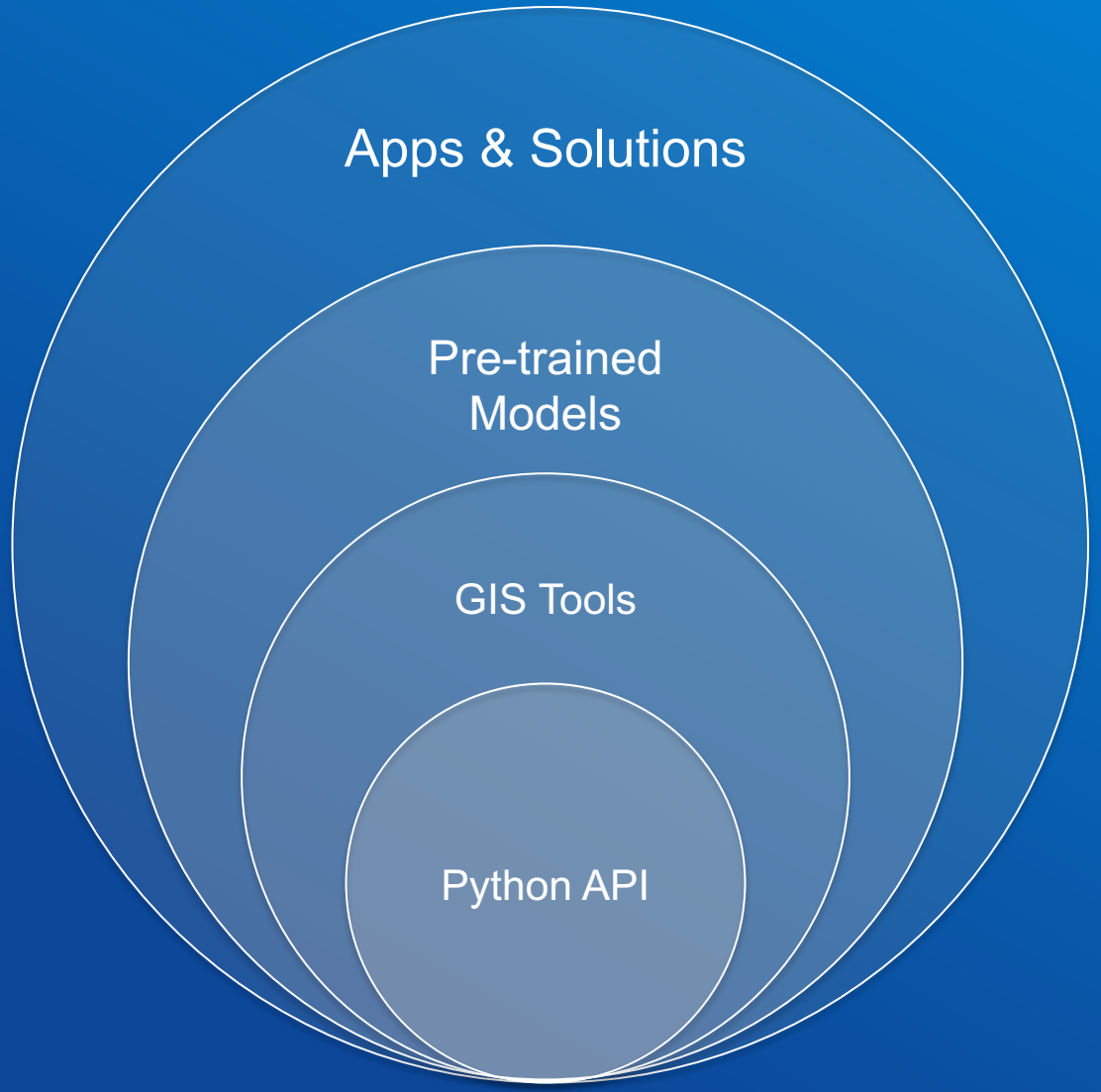
What Is GeoAI?



GeoAI in ArcGIS



GeoAI in ArcGIS



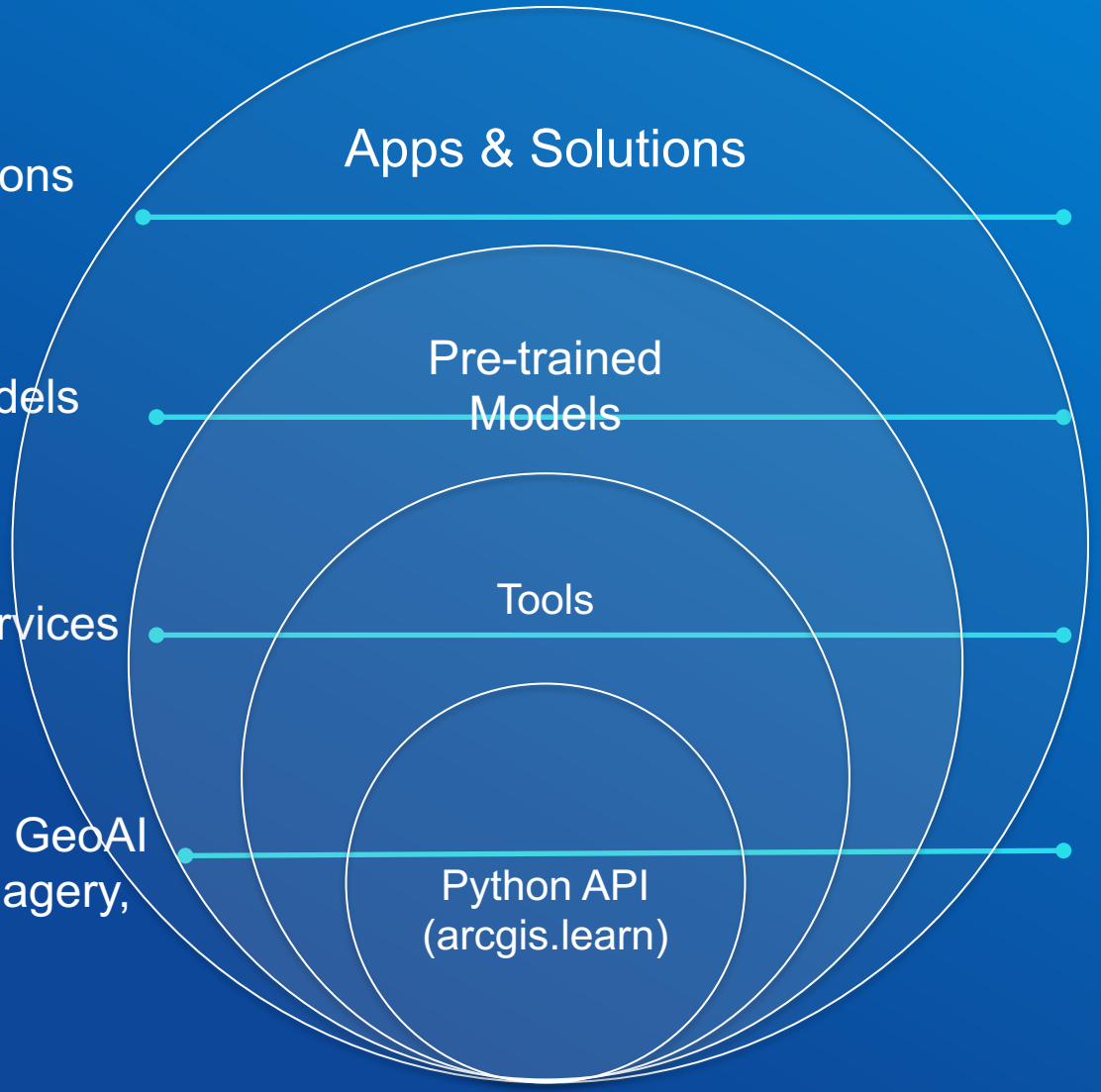
GeoAI in ArcGIS

GeoAI powered applications

Ready-to-use GeoAI models

Geo AI tools and web services

Extend and build custom GeoAI models for 3D, Video, Imagery, Vector and Text



GeoAI in ArcGIS

Unlock the power of AI in GIS

Advancing capabilities

- GeoAI toolbox
- Pretrained models
- Ethical & Explainable AI

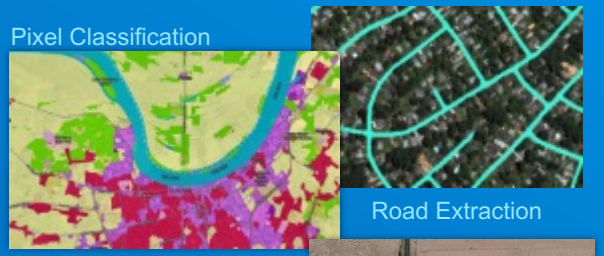
Simplifying workflows

- Automated machine learning
- Automated deep learning
- AI Assisted Labelling

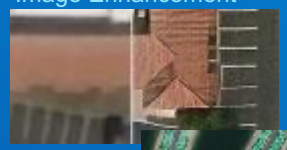


Accelerating intelligent decision-making

GeoAI: Imagery


Pixel Classification

Road Extraction


Image Enhancement


3D Object Detection


Object Detection


Edge Detection


Change Detection


Object Classification

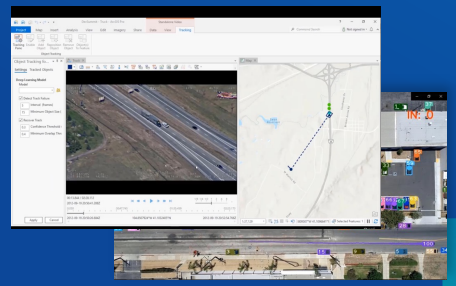

Point Cloud Classification

Overhead Imagery

3D Point Clouds


Crop classification

Time-series


Multi Object Tracking

Motion Imagery


Asset mapping

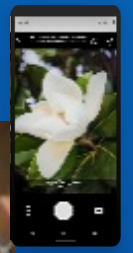
Oriented Imagery


Interactive Object Detection

3D Scenes

Field Images


Field Surveying


Edge Inferencing

Pretrained AI Models

Making AI approachable

Highlights

- 65 models
  - 20 new models
    - Segment Anything Model (SAM) – foundation model
  - 10 updated models



Elephant Detection

Solar Park Classification



Wind Turbine Detection





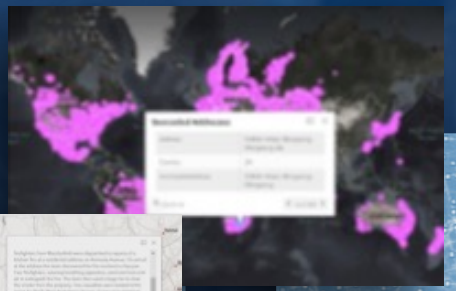
Road Extraction (Global)



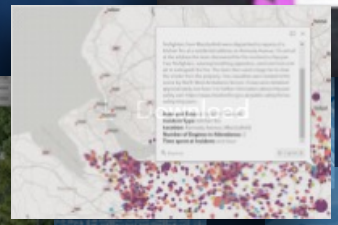
Cloud Mask Generation



Building Footprints (Australia)



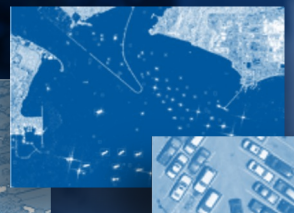
Country Classification



Entity Extraction



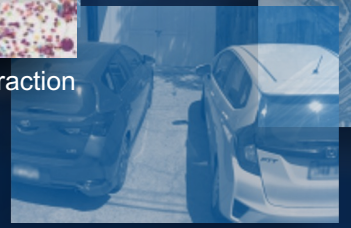








Scene Text Parsing





Land Cover Classification

Where can you access these tools?

Pro
Available through extensions

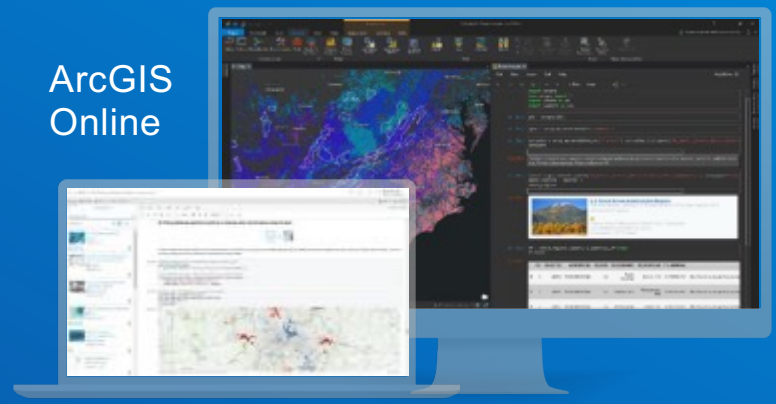
Enterprise
Available through the image server role

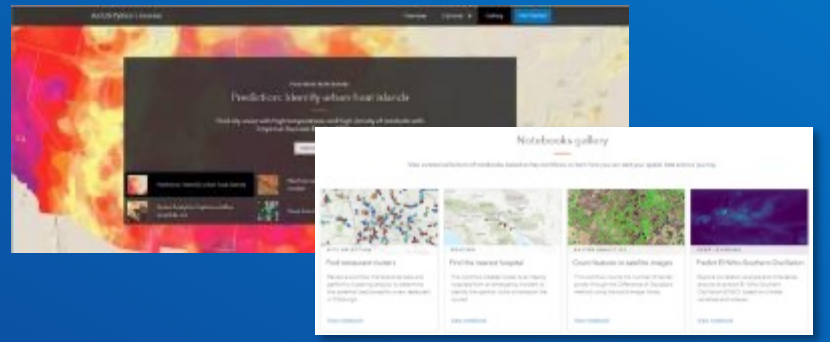
Online
Available as an Extension



ArcGIS Pro

ArcGIS Online



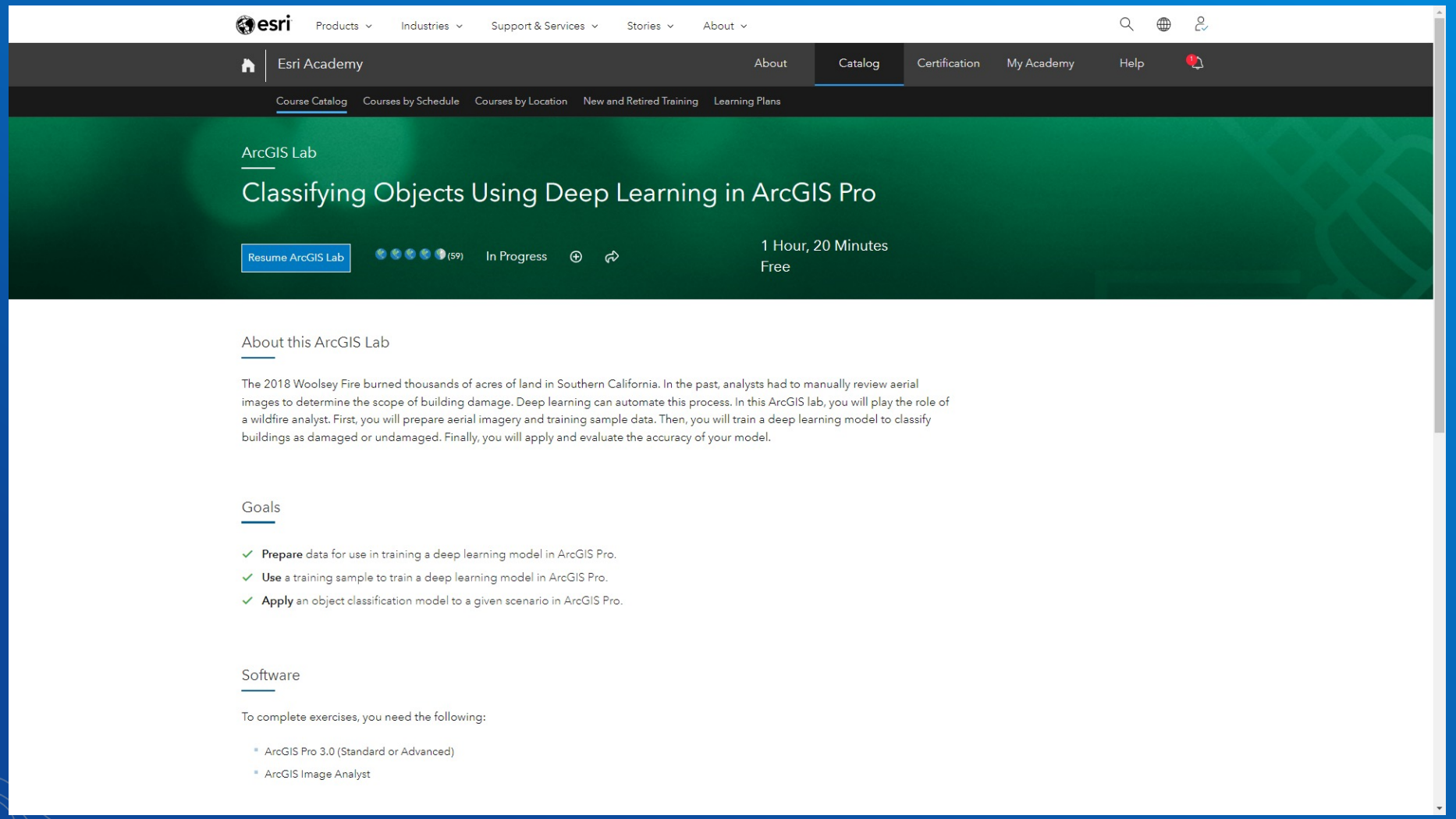


ArcGIS Notebooks

Classifying Objects Using Deep Learning in ArcGIS Pro and ArcGIS Online

Jeff Baranyi

Classifying Objects Using Deep Learning in ArcGIS Pro



Deep Learning Installers for ArcGIS

Preview | Code | Blame | 627 lines (575 loc) · 59.9 KB | Raw

Deep Learning Libraries Installers for ArcGIS



ArcGIS Pro, Server and the ArcGIS API for Python all include tools to use AI and Deep Learning to solve geospatial problems, such as feature extraction, pixel classification, and feature categorization. This installer includes a broad collection of components, such as PyTorch, TensorFlow, Fast.ai and scikit-learn, for performing deep learning and machine learning tasks, a total collection of 99 packages. These packages can be used with the Deep Learning Training tools, interactive object detection, by using the `arcgis.learn` module within the ArcGIS API for Python, and directly imported into your own scripts and tools. Most of the tools in this collection will work on any machine, but common deep learning workflows require a recent NVIDIA graphics processing unit (GPU), and problem sizes are bound by available GPU memory, see the requirements section.

This installer adds all the included packages to the default `arcgispro-py3` environment that Pro and Server both ship with, and no additional environments are necessary in order to get started using the tools. If you do create custom environments, these packages will also be included so you can use the same tools in your own custom environments as well.

For an example of the kinds of workflows this installer and ArcGIS enables, see the AI & Deep Learning in the UC 2020 Plenary video

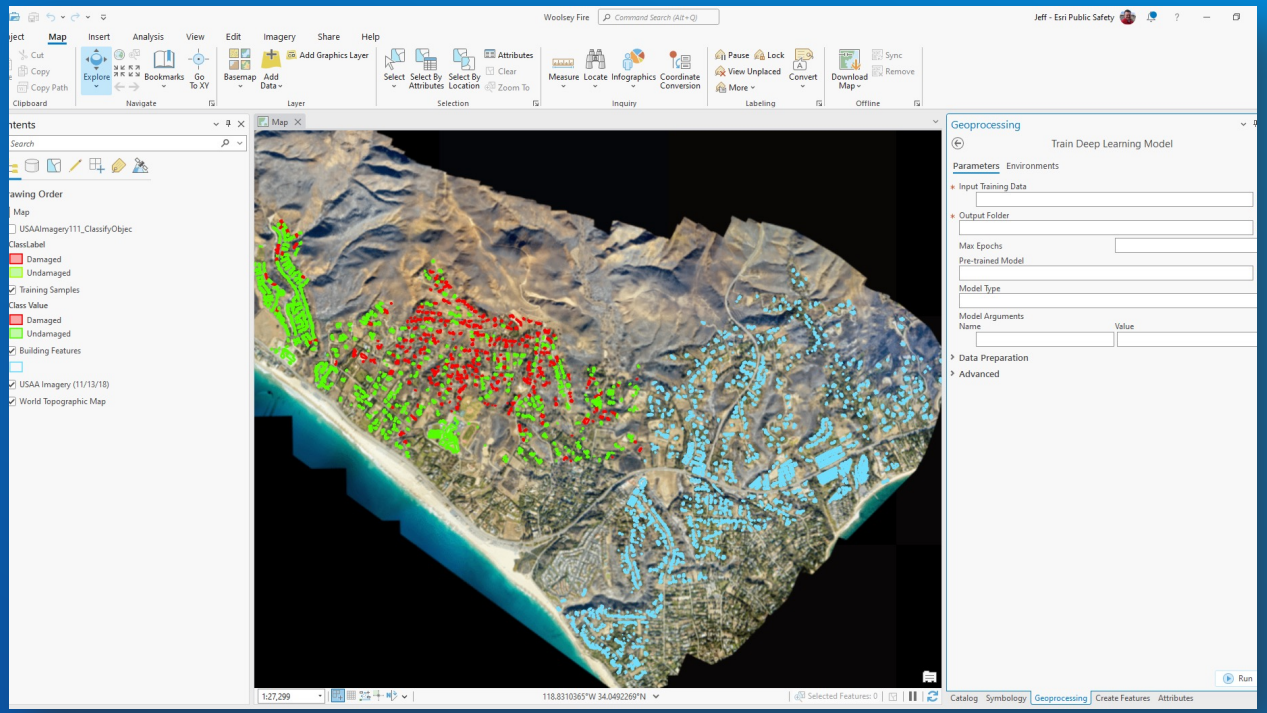
Download

DOWNLOADS 52K

ster/include/included-frameworks.png

Conducting an AI-Based Damage Assessment in ArcGIS Pro

Jeff Baranyi

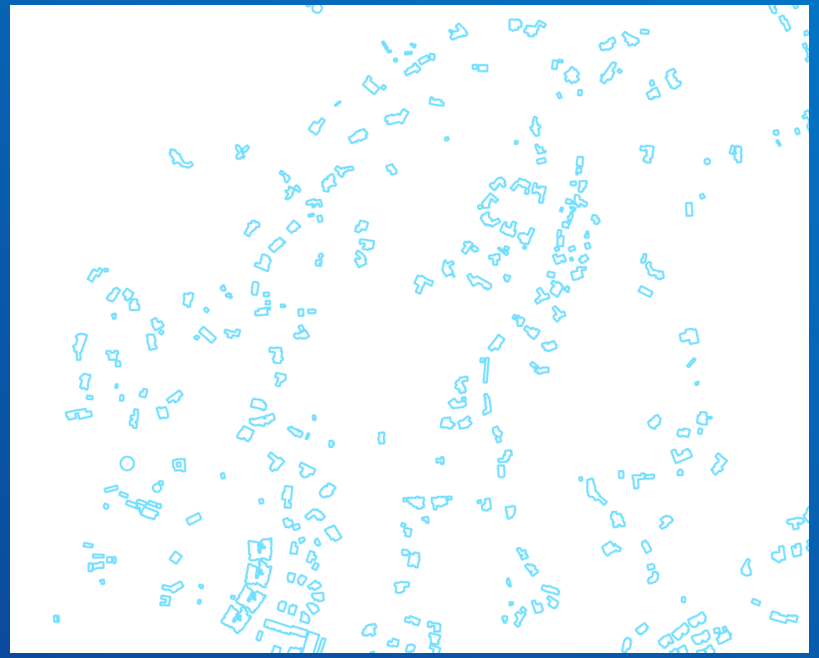


AI-Based Damage Assessment Process Summary

Pixels +



Polys (building footprints) =



Power of Location Intelligence and GeoAI



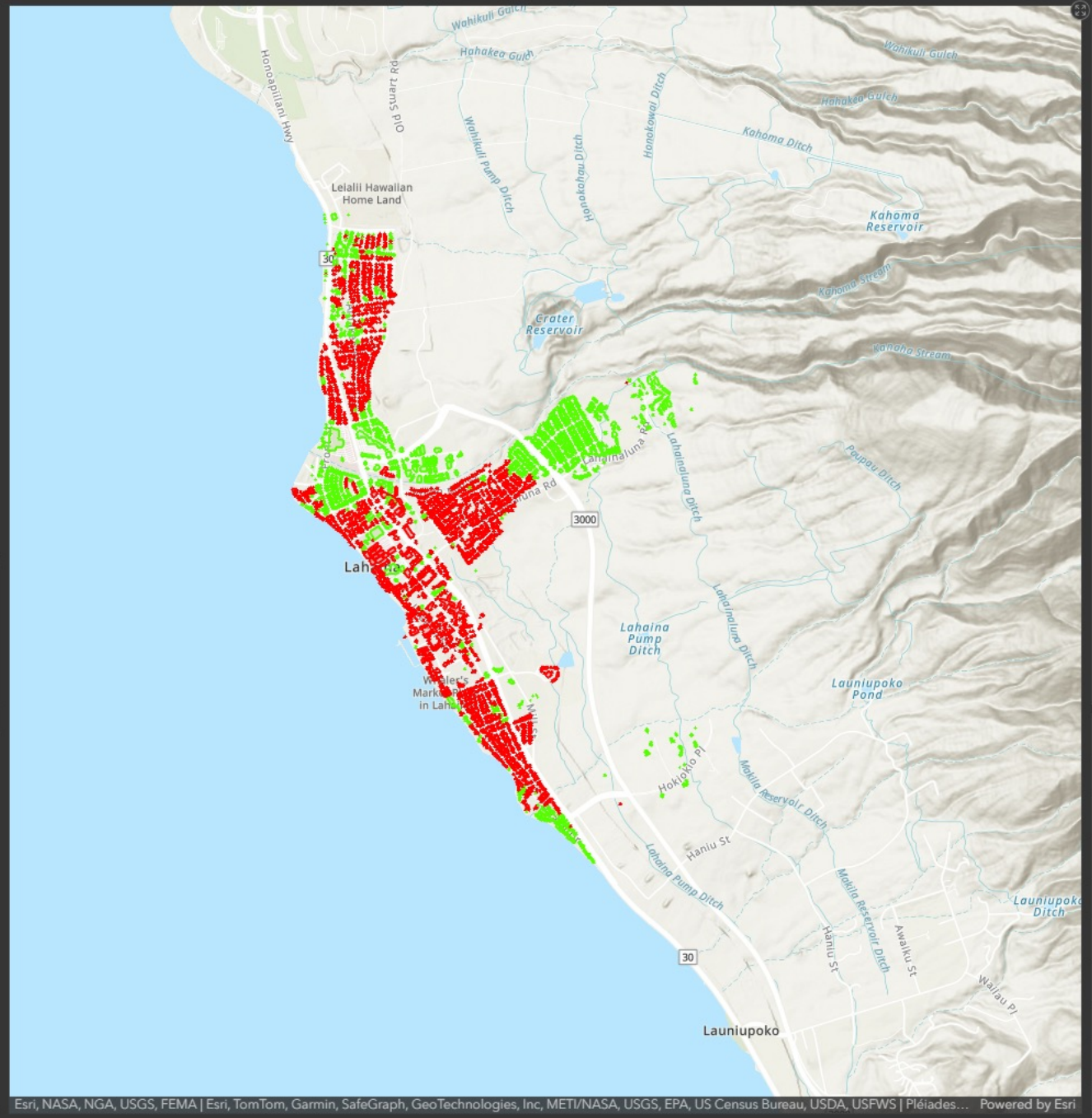
Maui Fires Damage Assessment - Data derived from Airbus imagery distributed through SkyWatch

Damaged Buildings

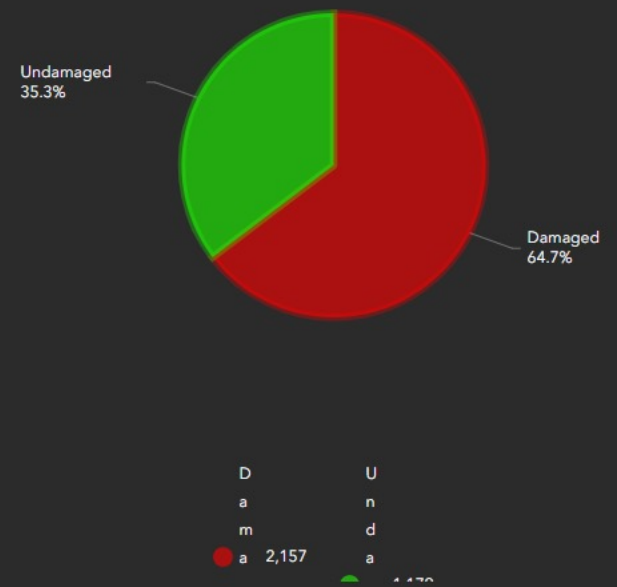
2,157

Undamaged Buildings

1,179

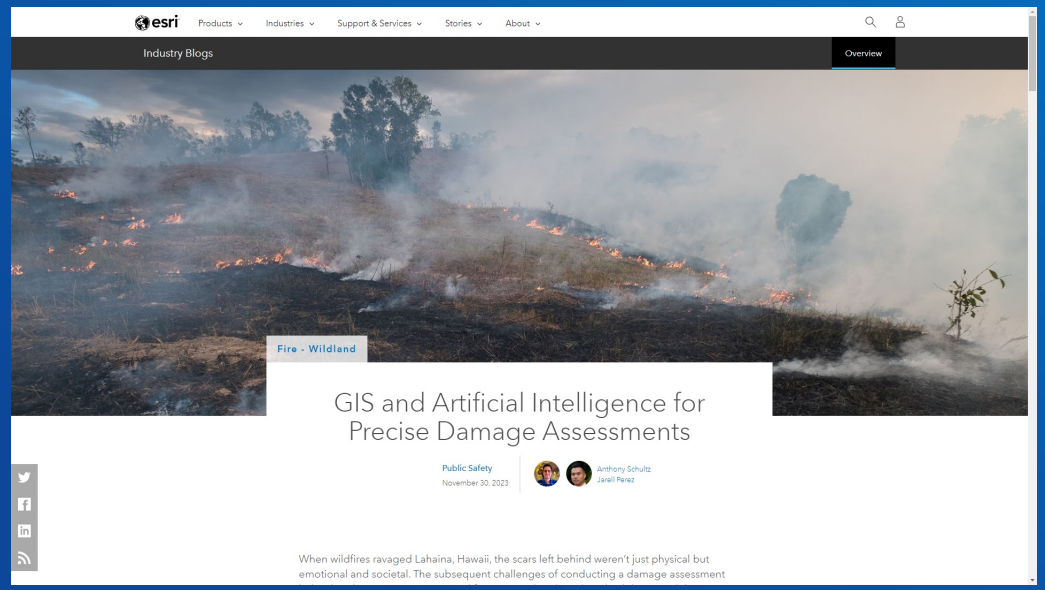


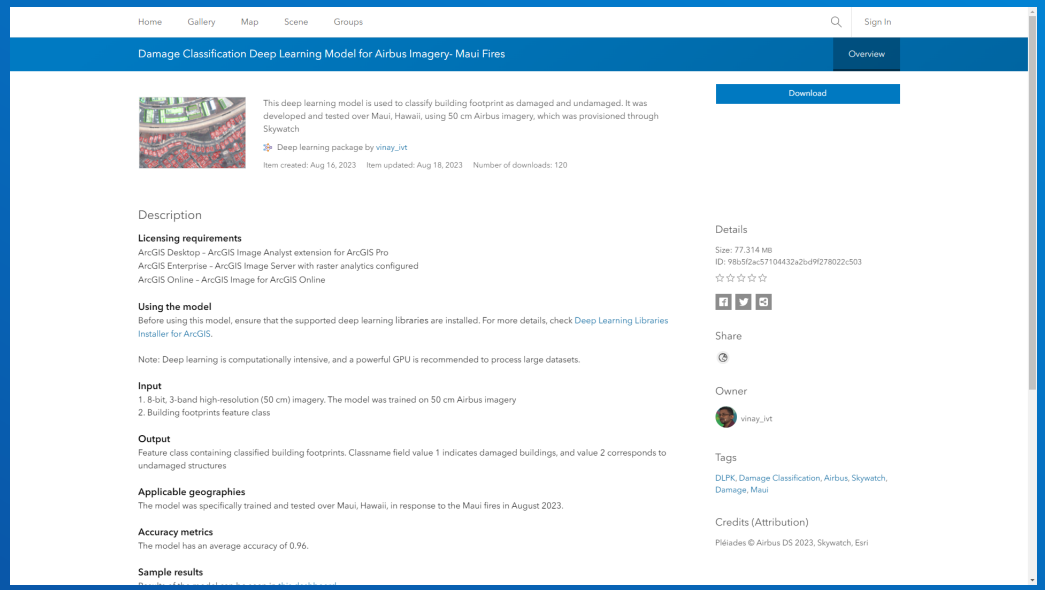
Building Damage



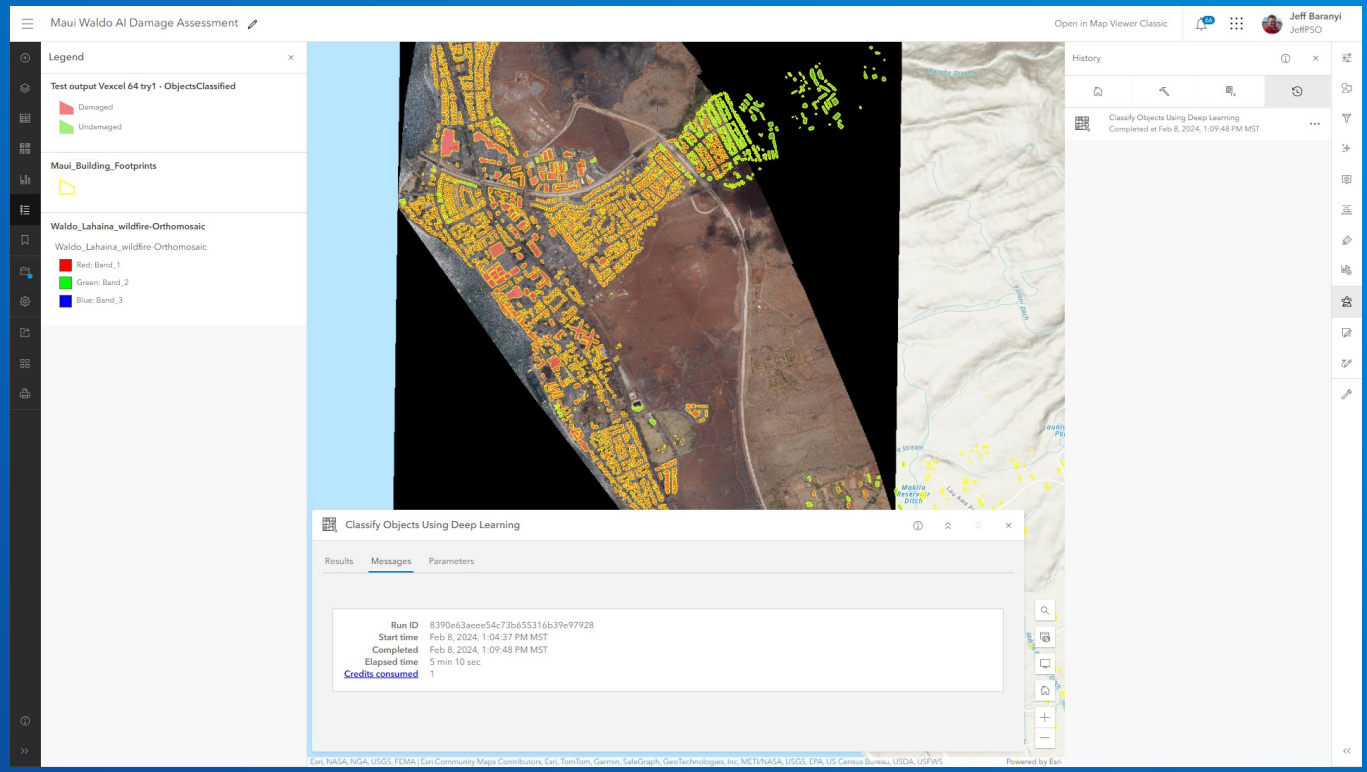
Amenities	Count
bank	1
bench	10
bicycle_parking	2
cafe	3
car_rental	1
charging_station	1
doctors	2
fast_food	1
fuel	4

GIS and Artificial Intelligence for Precise Damage Assessments





Conducting an AI-Based Damage Assessment in ArcGIS Online



Legend

Test output Vexcel 64 try1 - ObjectsClassified

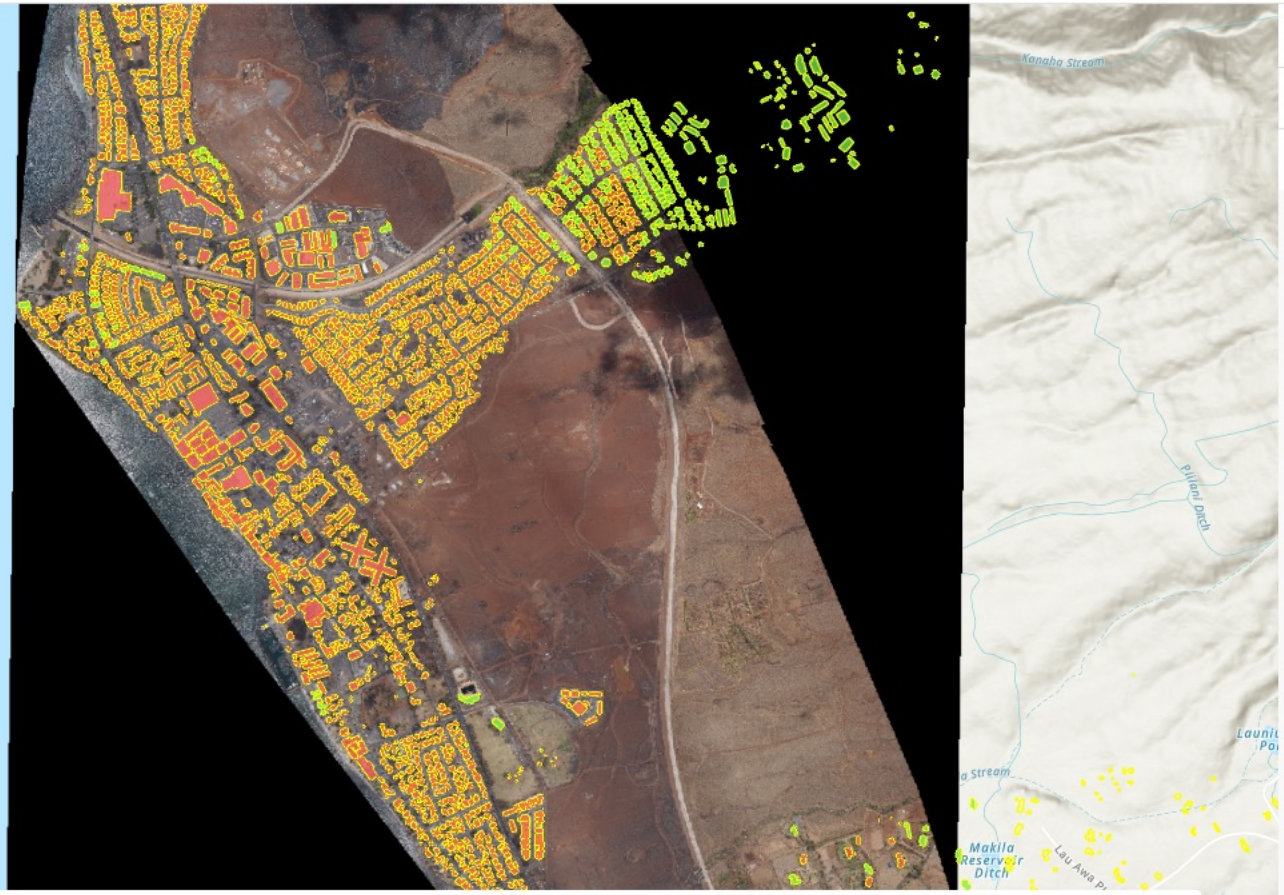
- Damaged
- Undamaged

Maui_Building_Footprints

Waldo_Lahaina_wildfire-Orthomosaic

Waldo_Lahaina_wildfire-Orthomosaic

- Red: Band_1
- Green: Band_2
- Blue: Band_3



History

Classify Objects Using Deep Learning
Completed at Feb 8, 2024, 1:09:48 PM MST

Classify Objects Using Deep Learning

Results | Messages | Parameters

Run ID	8390e63aeee54c73b655316b39e97928
Start time	Feb 8, 2024, 1:04:37 PM MST
Completed	Feb 8, 2024, 1:09:48 PM MST
Elapsed time	5 min 10 sec
Credits consumed	1

Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, US Census Bureau, USDA, USFWS
Powered by Esri

Hurricane Ian Post Storm Damage Assessment

Arcadia Parcels

Lake Placid Parcels

Sebring Parcels

Wauchula Parcels

Arcadia Inferenced Buildings
- Damaged
- Undamaged

Placid Inferenced Buildings
- Damaged
- Undamaged

Sebring_Inferenced_Buildings
- Damaged
- Undamaged

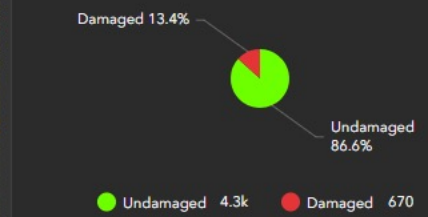
Wauchula Inferenced Buildings
- Damaged
- Undamaged

County Roads

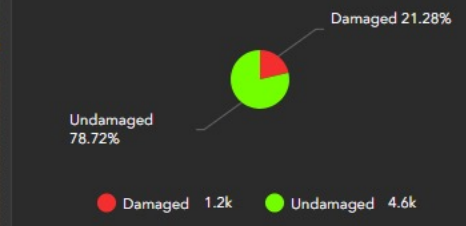
State Roads



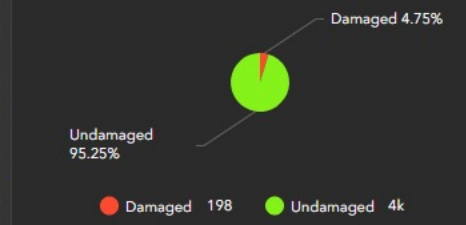
Arcadia Damaged and Undamaged Buildings



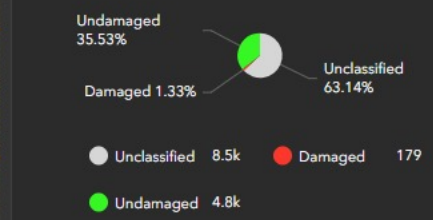
Lake Placid Damage and Undamaged Buildings



Wauchula Damaged and Undamaged Buildings



Sebring Damaged and Undamaged Buildings



FEMA USA Structures

Overview Pricing Map Scene Help Sign In

USA Structures

Overview Data Visualization



This feature layer, utilizing Federal Emergency Management Agency data, displays footprints for all structures (buildings) greater than 450 square feet in the United States and its territories.

Feature layer by Esri_US_Federal_Data

Item created: Mar 28, 2022 Item updated: Feb 1, 2024 View count: 1,384,712

Living Atlas

Open in Map Viewer

Open in Scene Viewer

Open in ArcGIS Desktop

Description

USA Structures

This feature layer, utilizing Federal Emergency Management Agency (FEMA) data, displays footprints for all structures (buildings) greater than 450 square feet in the United States and its territories. Per FEMA, "It provides cartographic context for urban density, patterns of use, visual reference, and navigation support."

Note:

- As of November 2023, all states and territories include occupancy type.



Assembly Building in Dallas County, Texas

Details

Source: Feature Service
Data updated: Dec 5, 2023, 10:00 AM
Schema updated: Feb 1, 2024, 2:18 PM
Size: 0 KB
ID: 0ec8512ad21e4bb987d7e848d14e7e24

Share

Owner

Esri_US_Federal_Data

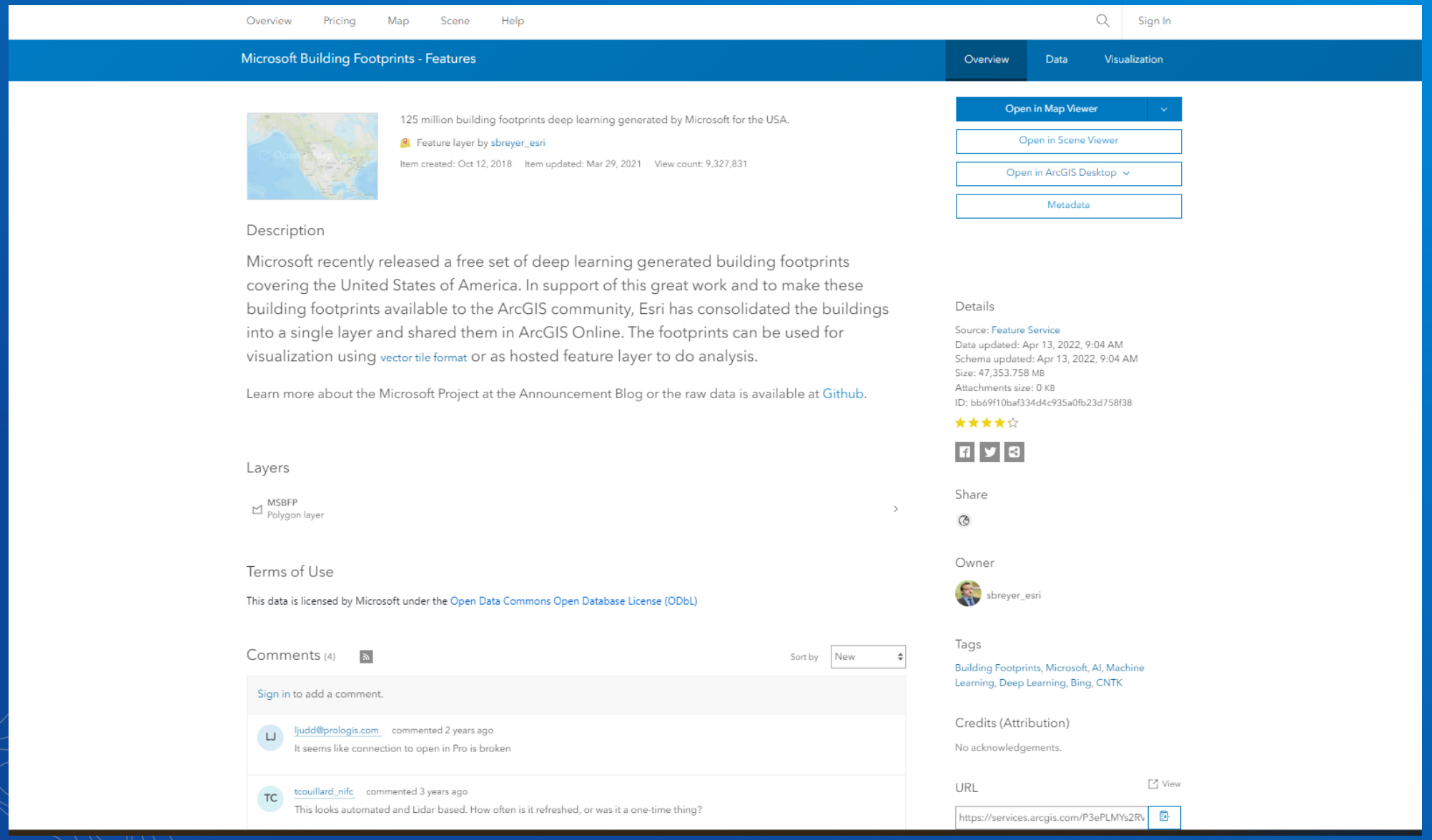
Tags

homeland security, homeland defense, emergency response, structures, building outlines, USA structures, buildings, FEMA, Federal Emergency Management Agency, ORNL, Oak Ridge National Laboratory, federal, industrial, education, assembly, residential, commercial, U.S. Department of Homeland Security, Department of Homeland Security, DHS, USDHS

Credits (Attribution)

Oak Ridge National Laboratory (ORNL); Federal Emergency Management Agency (FEMA) Geospatial Response Office

Microsoft Building Footprints - Features



OpenStreetMap Buildings for North America

Home Gallery Map Scene Groups Sign In

OpenStreetMap Buildings for North America | Overview | Data | Visualization



This feature layer provides access to OpenStreetMap buildings data for North America, which is updated frequently. Zoom in to large scales (e.g. 1:10k) to see the building features display. Click on feature for popup.

Feature layer by smoore_osm

Item created: Jul 18, 2022 Item updated: Jul 21, 2022 View count: 150,260

Living Atlas

Open in Map Viewer Classic

Open in Scene Viewer

Open in ArcGIS Desktop

Description

This feature layer provides access to OpenStreetMap (OSM) buildings data for North America, which is **updated every 1 minute** with the latest edits. This hosted feature layer view is referencing a hosted feature layer of OSM polygon (closed way) data in ArcGIS Online that is updated with minutely diffs from the OSM planet file. This feature layer view includes building features defined as a query against the hosted feature layer (i.e. building is not blank).

In OSM, a building is a man-made structure with a roof, standing more or less permanently in one place. These features are identified with a building tag. There are thousands of different tag values for building used in the OSM database. In this feature layer, unique symbols are used for several of the most popular building types, while lesser used types are grouped in an "other" category.

Zoom in to large scales (e.g. Streets level or 1:10k scale) to see the building features display. You can click on a feature to get the name of the building (if available). The name of the building will display by default at large scales (e.g. Buildings level of 1:2.5k scale). Labels can be turned off in your map if you prefer.

Create New Layer

If you would like to create a more focused version of this buildings layer displaying just one or two building types, you can do that easily! Just add the layer to a map, copy the layer in the content window, add a filter to the new layer (e.g. building is apartments), rename the layer as appropriate, and save layer. You can also change the layer symbols or popup if you like. Esri may publish a few such layers (e.g. parks) that are ready to use, but not for every type of building.

Important Note: if you do create a new layer, it should be provided under the same Terms of Use and include the same Credits as this layer. You can copy and paste the Terms of Use and Credits info below in the new Item page as needed.

Layers

Details

Source: Feature Service
Data updated: Feb 9, 2024, 2:49 PM
Schema updated: Feb 9, 2024, 2:49 PM
Size: 0 KB
ID: 2be4ad6652c649cbaea2be211555b1cf

Share

Owner

smoore_osm

Tags

osm, building, OpenStreetMap, North America

Credits (Attribution)

© OpenStreetMap contributors

Imagery AI: End-to-End Workflow

Extract Insights from Imagery at Scale, with High Speed and Accuracy

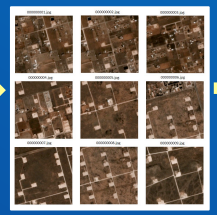
Image Management



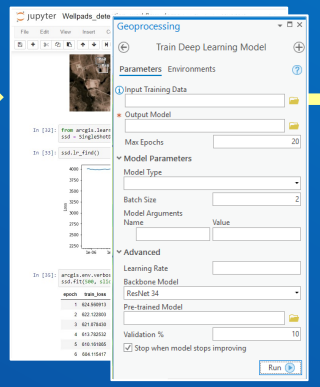
Labelling



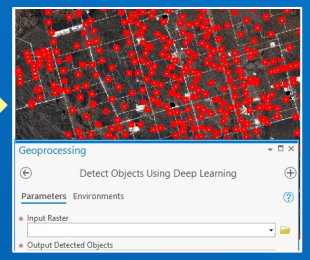
Data Prep



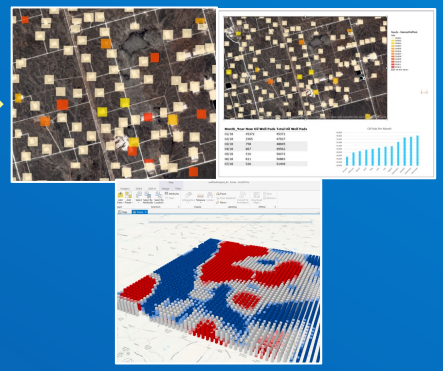
Model Training



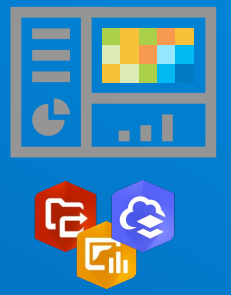
Inferencing



Analysis



Field Mobility, Monitoring



For Wide Range of Data Types

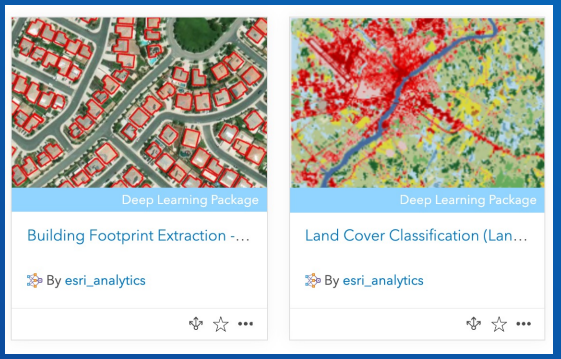
- Aerial
- Satellite
- Radar
- Lidar
- Motion imagery
- Bathymetry
- Point cloud
- Drone

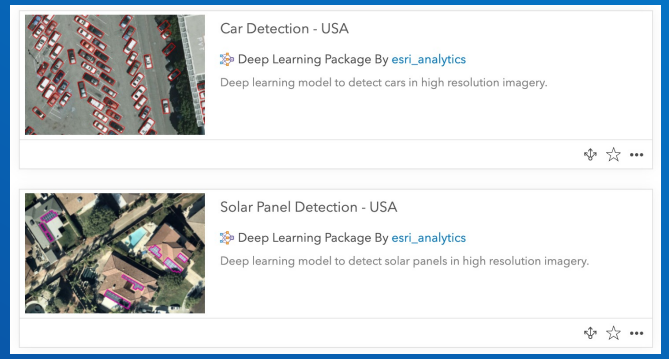
Implementing Many Tasks

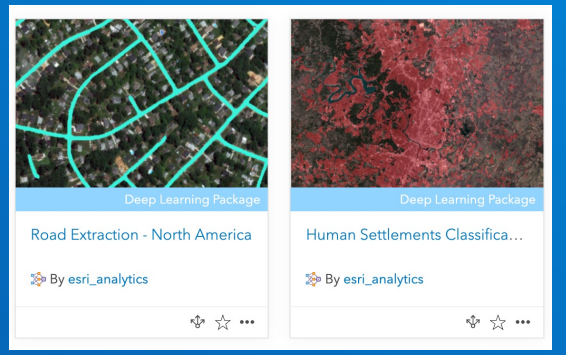
- Object classification
- Object detection
- Pixel classification
- Image translation
- Object tracking
- Scanned maps

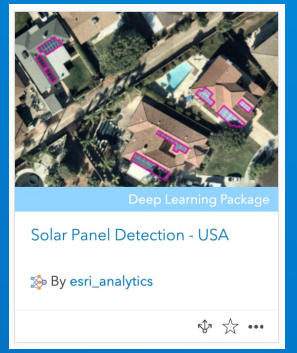
Pre-trained Models on ArcGIS Living Atlas

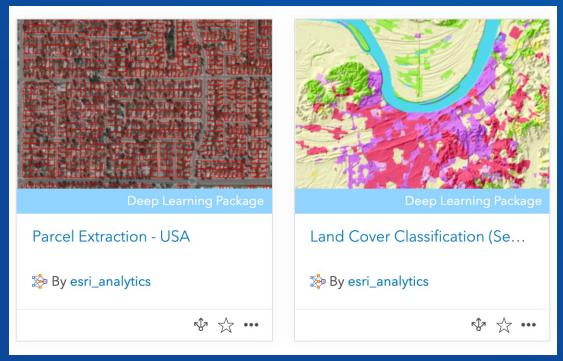
Plug-and-Play Models. No Training Needed. Easy Re-training Using Local Data

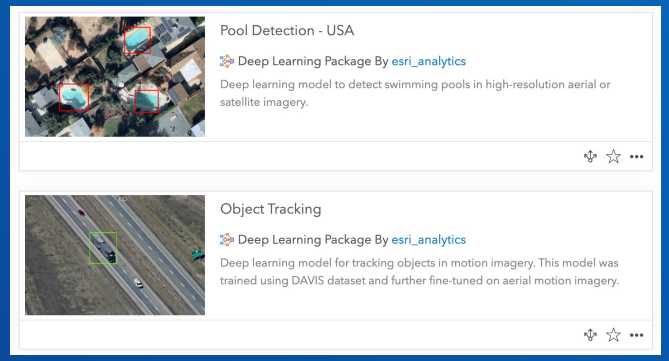








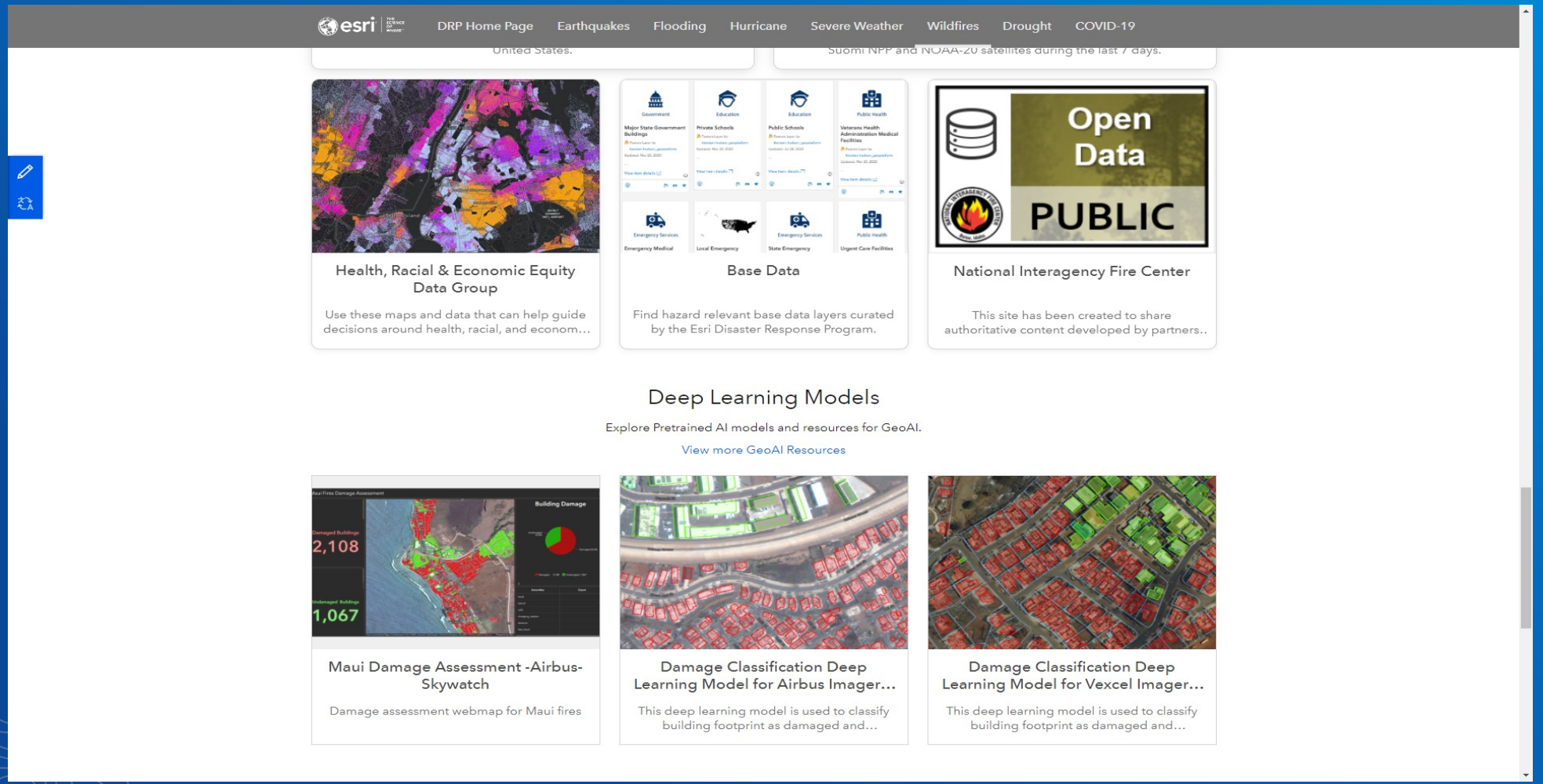




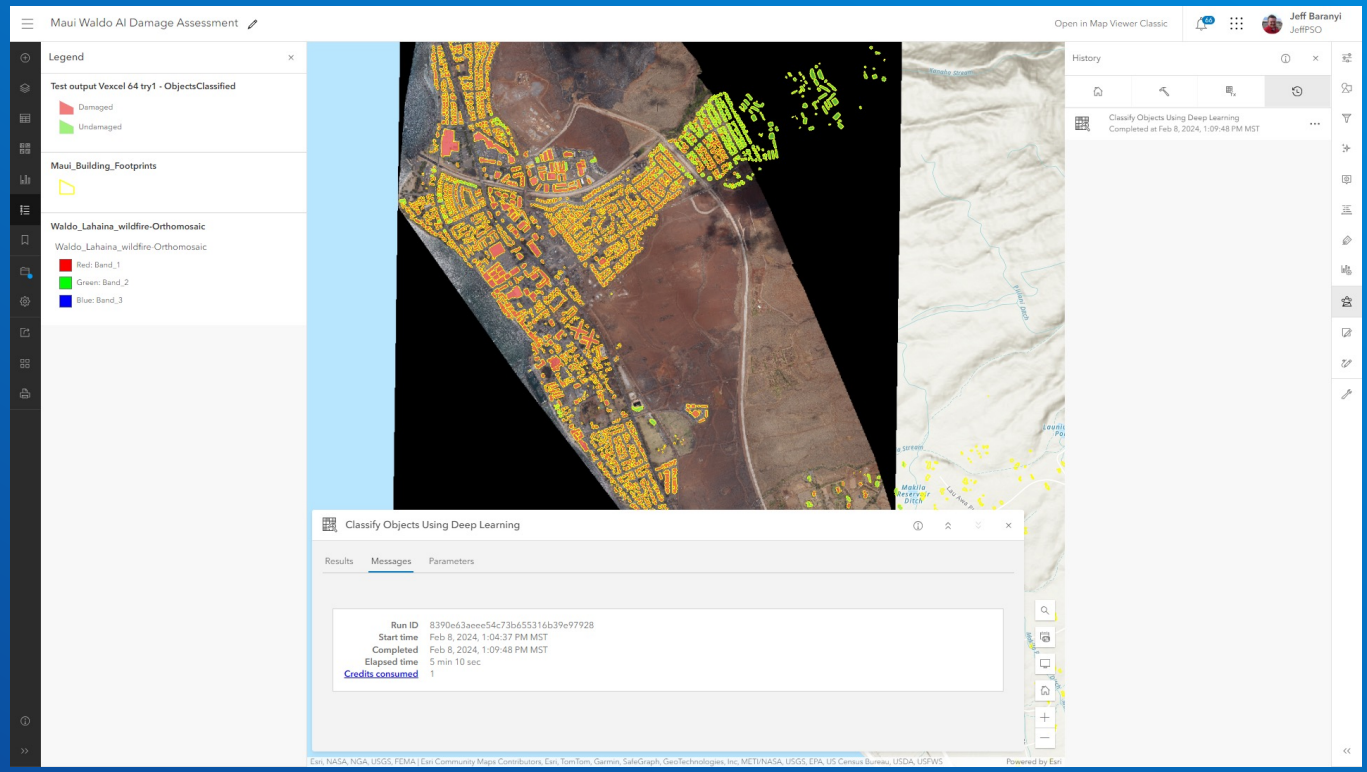
Use Models Within

- ArcGIS Pro (+ Image Analyst Extension)
- ArcGIS Enterprise (+ Image Server)
- ArcGIS Online (+ ArcGIS Image)

Leverage and Organize Deep Learning Models and AI just like your other GIS data, maps, and apps!



Conducting an AI-Based Damage Assessment in ArcGIS Online

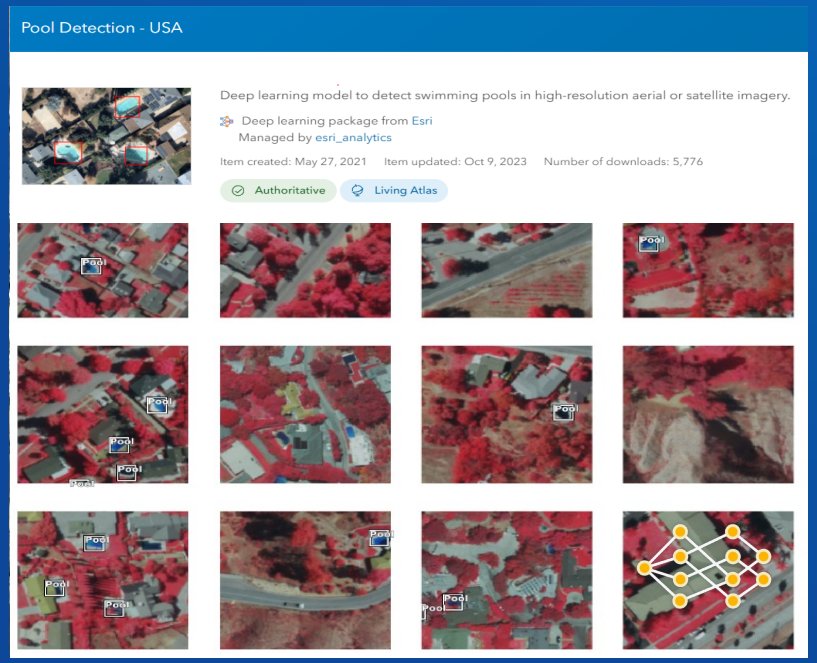


GeoAI Pool Detection for Search and Rescue

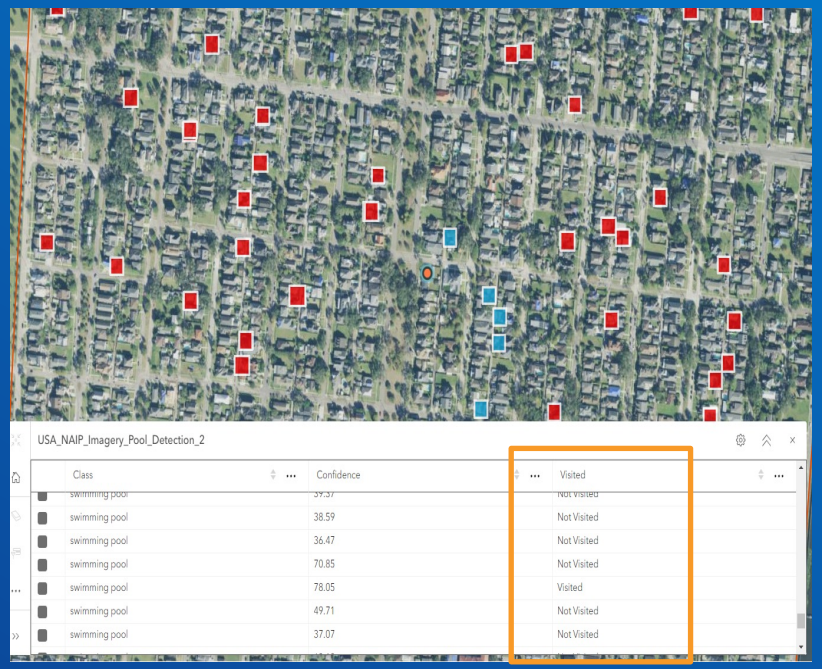
Patrick O’Brien

AI-Based SAR Process Summary

Deep Learning Model



Enrich the Results



Enable Field Mobility



Getting Started

AI-Based Damage Assessment in ArcGIS Pro

- Classifying Objects Using Deep Learning in ArcGIS Pro
- Deep Learning Libraries Installers for ArcGIS
- GIS and Artificial Intelligence for Precise Damage Assessments

Building Footprint Data Sources for AI-Based Damage Assessment in ArcGIS

- FEMA USA Structures
- Microsoft Building Features – Footprints
- OpenStreetMap Buildings for North America

Upcoming Webinars

- Graph Analytics in ArcGIS, April 2024
- Spatial Statistics with Machine Learning and AI, May 2024

Upcoming Events

- Safety and Security Summit @ Esri UC, July 13-14, San Diego
- Esri User Conference, July 15-19, San Diego

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