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Welcome to Today's Webinar!

***Cutting-Edge Technologies Transforming Environmental
Practice: AI, IoT, Geospatial Technology, and Digital Twins***

Presented by:

**Erin Koch, GISP
Mehmet Secilmis
Meredith Parkin, J.D., PMP**



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NAEP Virtual Project Management Series – Module 5
Wednesday, October 7, 2026 (Eastern Time Zone)

NAEP National Environmental Policy Act (NEPA) Workshops – In Person
Essentials - Wednesday, October 21, 2026 (Boston, MA)
Advanced – Thursday, October 22, 2026 (Boston, MA)

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With co-hosts Nic Frederick & Laura Thorne



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Speakers



Erin Koch, GISP
*Environmental & Geospatial
Section Manager
HDR*



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*Environmental Consulting Lead,
Esri*



Meredith Parkin, J.D., PMP
*Vice President, Environmental
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Agenda

- Overview of Cutting-Edge Technologies Transforming Environmental Practice: AI, IoT, Geospatial Technology, and Digital Twins
- AI in Environmental Documentation
- Geospatial AI (GeoAI)
- AI and Automation in Data Collection and Analysis
- Environmental Concerns
- Risks, Defensibility, and Professional Judgment
- Panel Discussion

Overview of Cutting-Edge Technologies

Definitions

What are these technologies in simple terms?

AI or Artificial Intelligence

- The capability of a machine to imitate intelligent human behaviors like learning, reasoning, problem-solving, and making decisions

IoT or Internet of Things

- The networking capability that allows information to be sent to and received from objects and devices using the Internet

GeoAI or Geospatial Artificial Intelligence

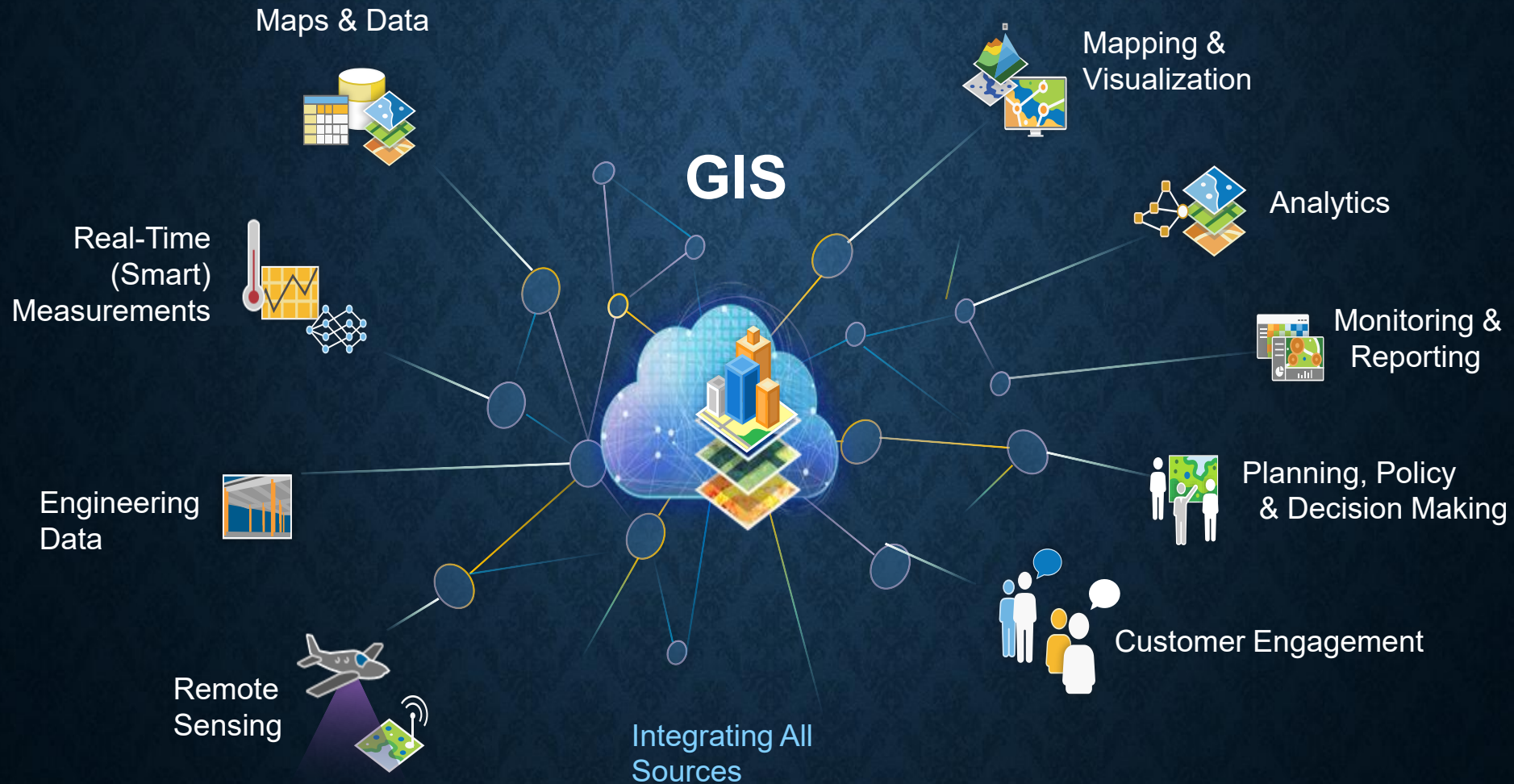
- The integration of AI with location-based data to automatically detect patterns, map features, and make predictions about the physical world

Digital Twin

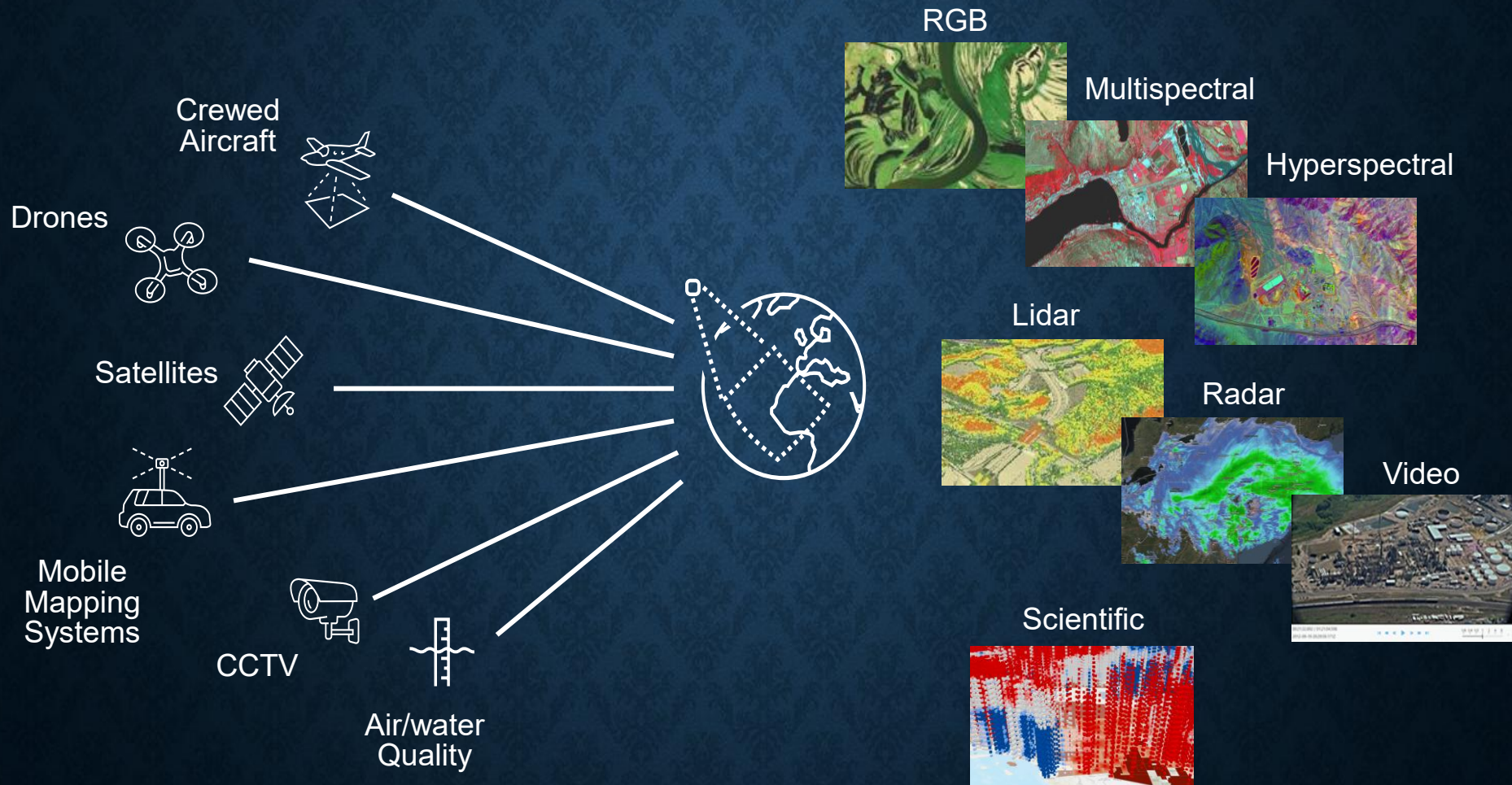
- The dynamic, virtual representation of a physical asset, system, or process, synchronized in real time using IoT sensor data, machine learning, and software analytics

What Is a GIS?

A System for Managing, Sharing, and Applying Geographic Information



Remote Sensing and Imagery



Field, Reality, Real-time

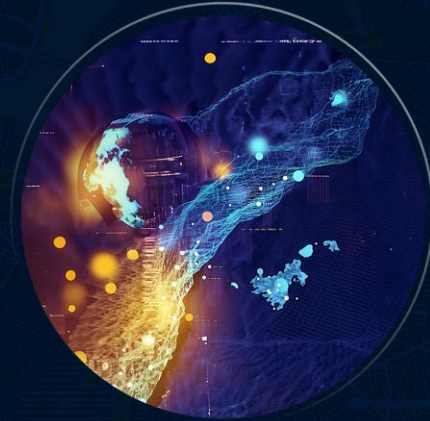
Three legs of the table



Field Mapping



Reality Mapping



Real-time

1:49

Palms Springs Bike Parking Inspection

Bike Parking Asset ID

2425

Inspection Date and Time

Wednesday, May 21, 2025

1:47 PM

Location

33°50'N 116°33'W

Palms Springs

Type of Bike Rack

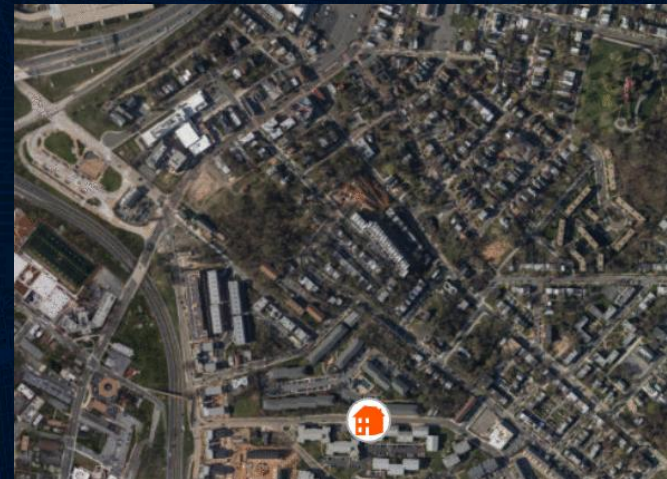
☒ Bike Shape ☐ Hitch

☐ Bike Corral ☐ Spring Shape

Number of Bikes Currently Parked

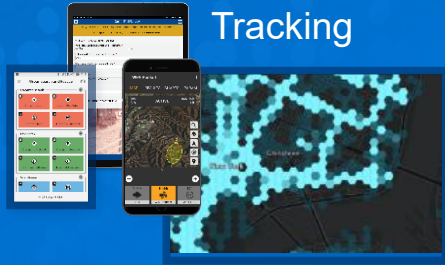
3

Is a repair station present?

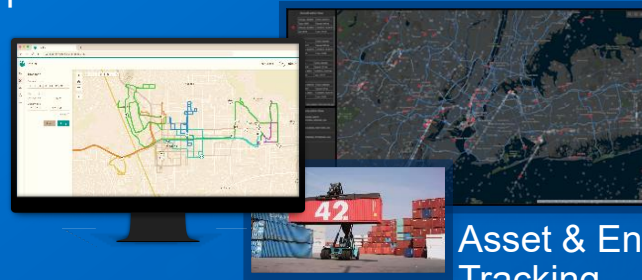


Real-Time in the Real World - IoT

Personnel Tracking

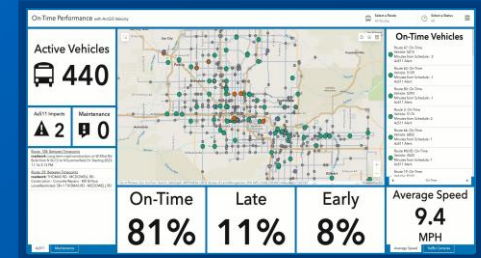


Resource Optimization

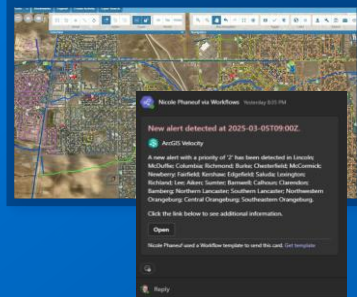


Asset & Entity Tracking

Traffic & Connected Cars



Work Order Automation



Infrastructure Protection



Security Operations Monitoring



Soil & Crop Monitoring



Air Quality Monitoring

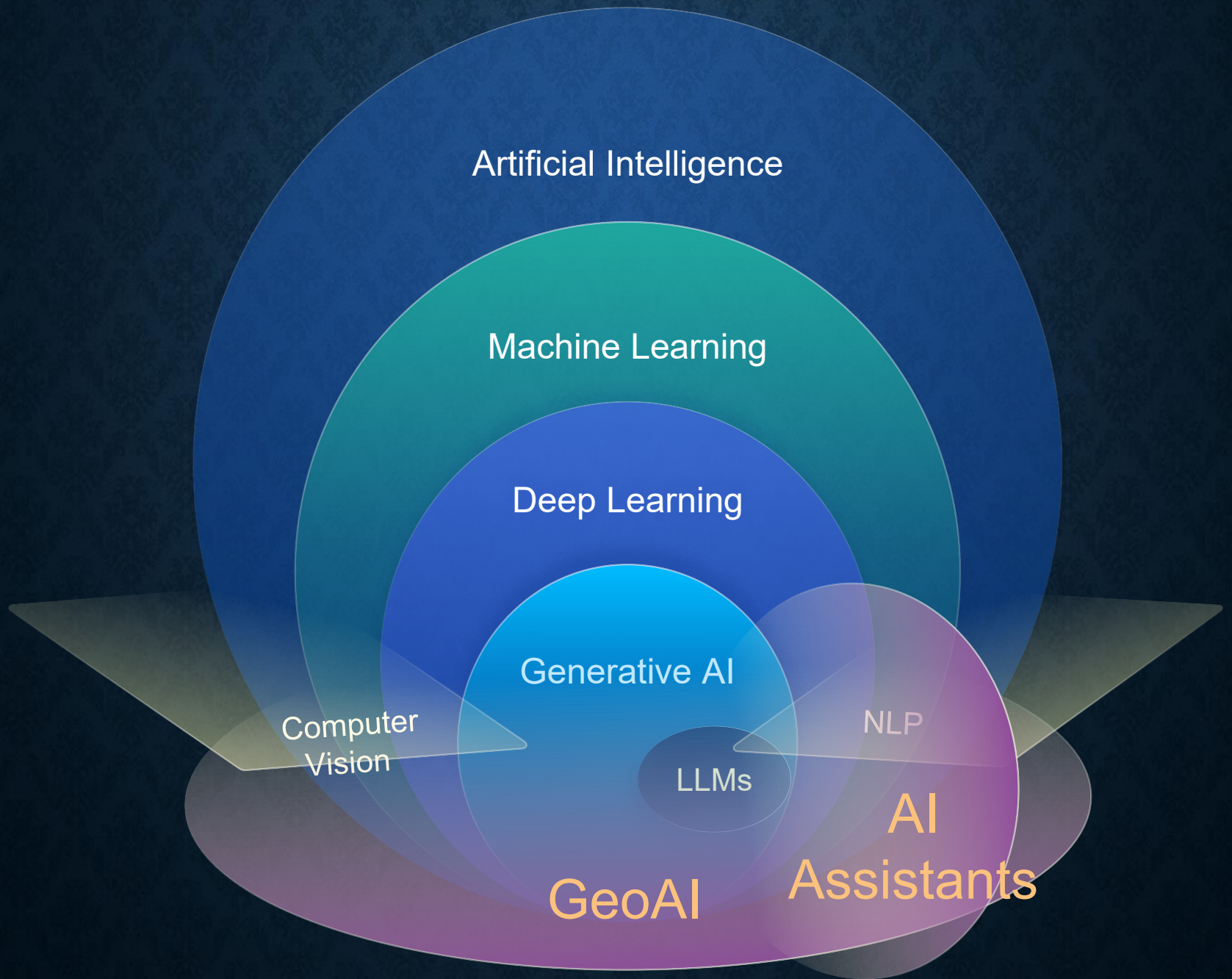


Anomaly Detection



Digital Twins





What is a Digital Twin?



A data-driven virtual representation of real-world entities and processes, synchronized at a specified frequency and fidelity.

Understanding, Decision Making & Action

Transform businesses by accelerating and automating holistic understanding, optimal decision-making, and effective action.

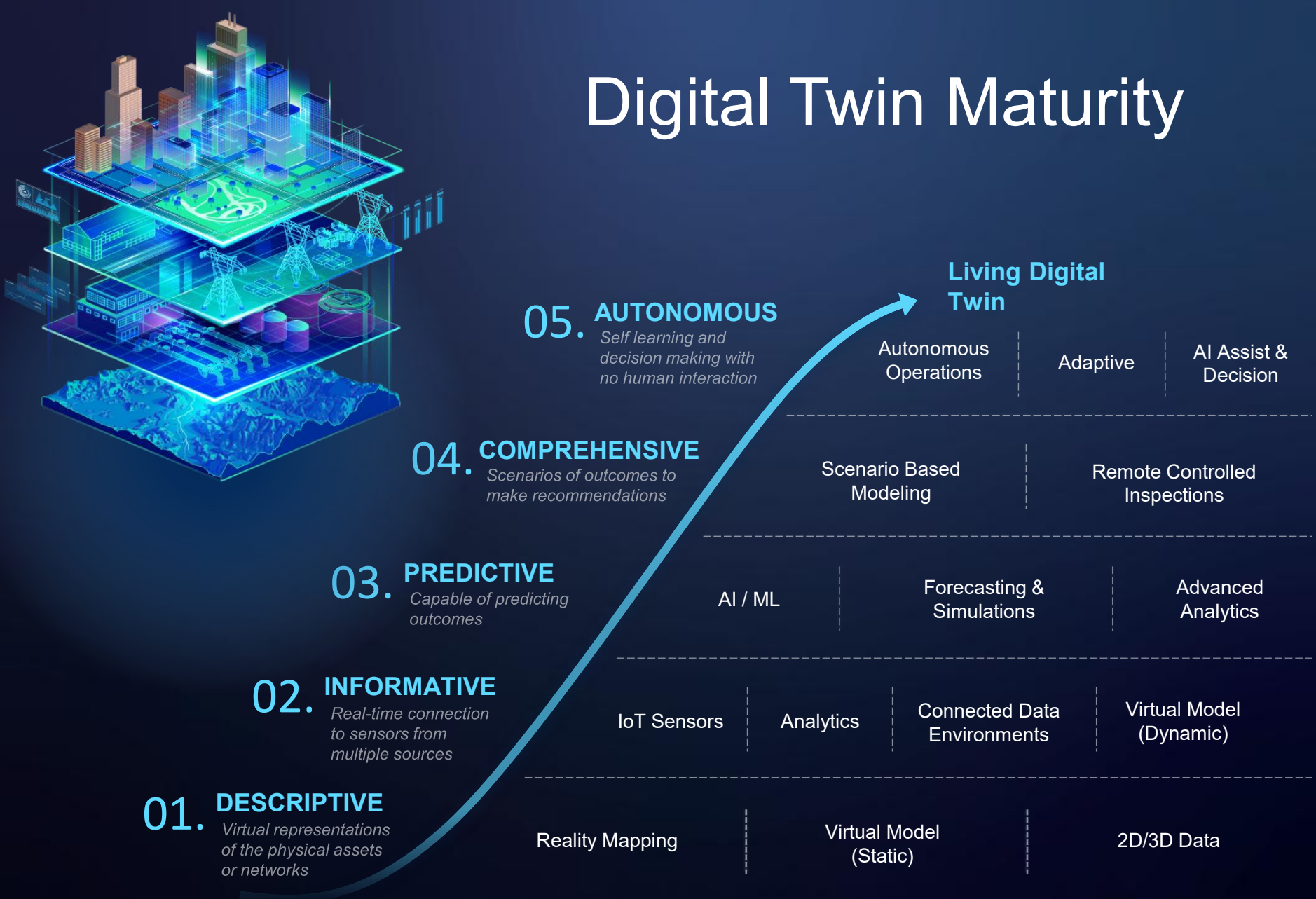
Outcomes, Use cases, Integrations

Are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT/ET systems.

Past, Current & Future

Use real-time and historical data to represent the past, present and simulate predicted futures.

Digital Twin Maturity



Geospatially Digital Twins

Location is foundational for digital twins



Continuously inform the virtual representation



Provide insights from the virtual environment to guide better real-world decisions

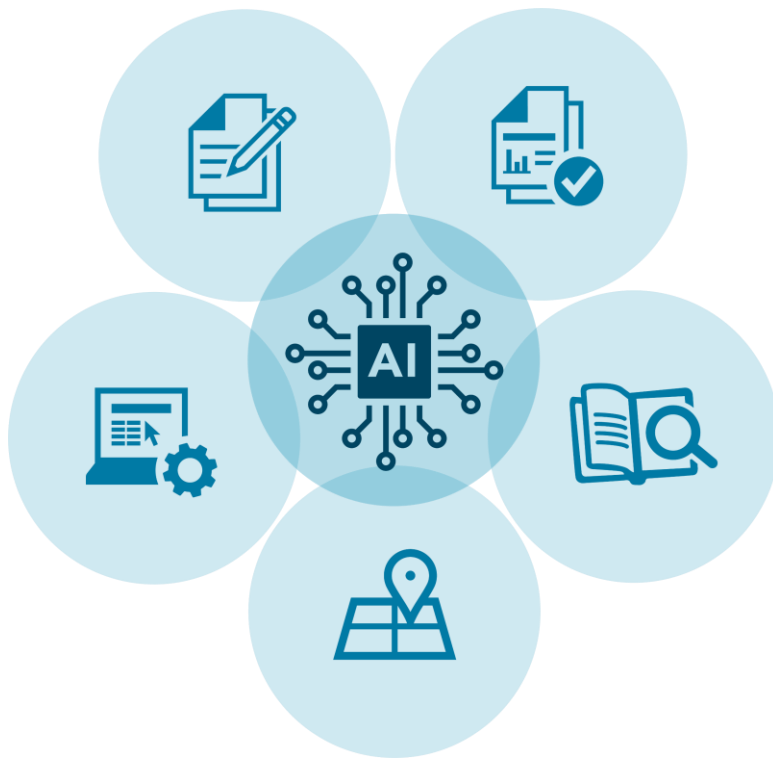
AI in Environmental Documentation:

Use Cases, and Future Potential

AI in Environmental Documentation

- What we mean by environmental documentation
- The problem AI is solving
- The AI technology landscape
- How AI is applied in practice

How AI is Being Used in Environmental Documentation



- Draft environmental documents (NEPA, permit applications, technical reports)
- Synthesize and summarize environmental data
- Analyze regulatory requirements
- Screen sites for risk
- Support permitting and workflow Processes

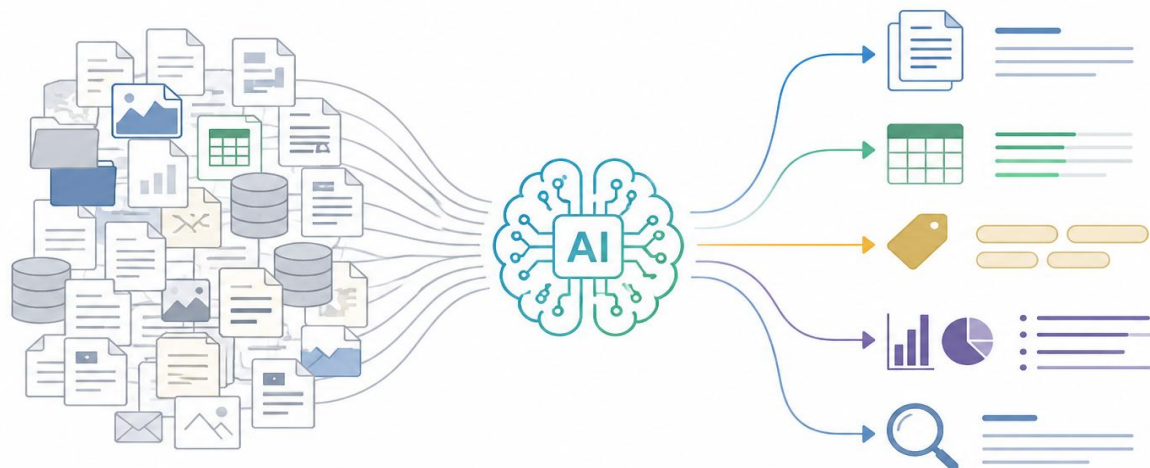
Why Practitioners are Turning to AI

- Work is text-heavy, iterative, and deadline-driven
- Risk often comes from process — not just conclusions
- Increasing data volume and complexity
- AI can improve efficiency — or amplify mistakes



Where AI Adds Value

- Early issue spotting and risk framing
- Organizing large volumes of information
- Improving clarity and consistency across documents
- Supporting, not replacing, professional judgment

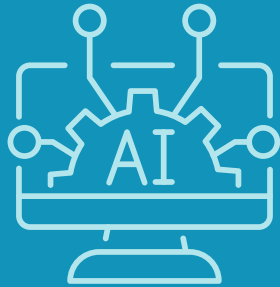


Where AI Should NOT Be Used

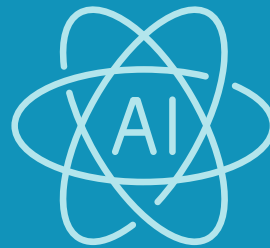
- Make regulatory or legal determinations
- Determine significance of impacts
- Select methodologies or thresholds
- Replace professional judgment



AI Technology Landscape



General AI
Platforms
(LLMs)



Enterprise/
Workflow AI
(e.g., Copilot,
internal tools)



Specialized
Environmental
AI Tools

General AI Platforms (LLMs)

- ChatGPT (OpenAI) – drafting and structuring content
- Perplexity AI – research and sourcing information
- Claude – reviewing and summarizing long documents
- Others



OpenAI



perplexity



Claude

Enterprise & Workflow AI

- Microsoft Copilot (Word, Excel, Teams)
- ChatGPT Enterprise
- Internal knowledge systems (firm-specific tools)
- Integrated with project data and documents

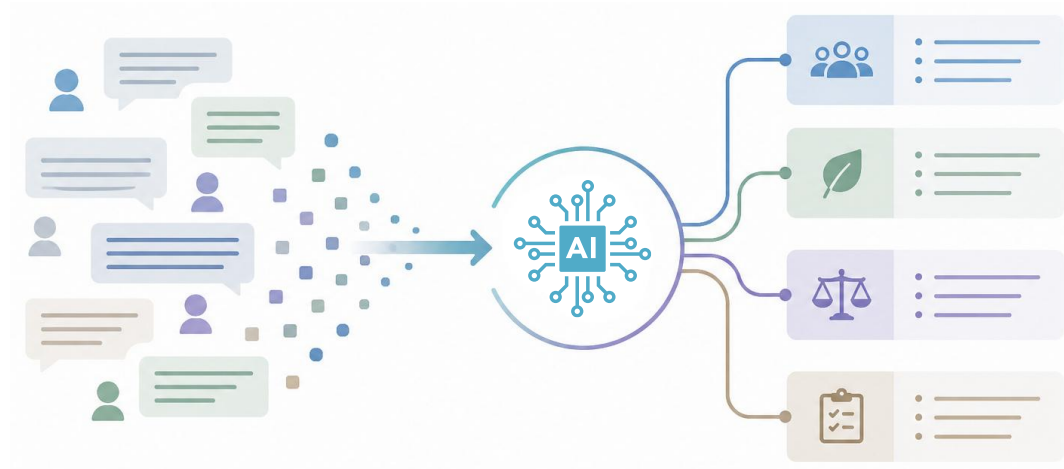


Specialized Environmental AI Tools — Examples

- Full stack permitting platforms
- Site due diligence tools
- AI review, drafting and regulatory intelligence
- Niche tools

Example Use Cases

- NEPA drafting support
- Public comment organization and response support
- Environmental screening
- Mitigation Tracking and Reporting



ChatGPT and Similar Chat Tools



Strengths

- ✓ Summarizing text
- ✓ Drafting content
- ✓ Rewriting content
- ✓ Brainstorming
- ✓ Explaining



Weaknesses

- ✗ Reasoning over a problem
- ✗ Formulating solution strategies
- ✗ Taking actions
- ✗ Connecting to your data and systems
- ✗ Iterating and adjusting to new information

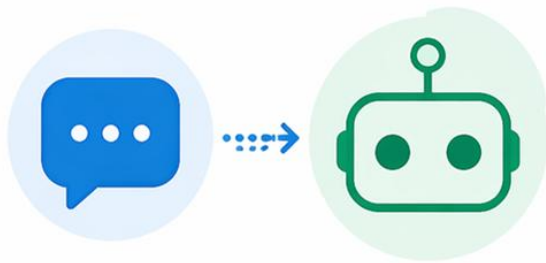


Great at working with content.

Not designed to reason, act, or adapt on your behalf.

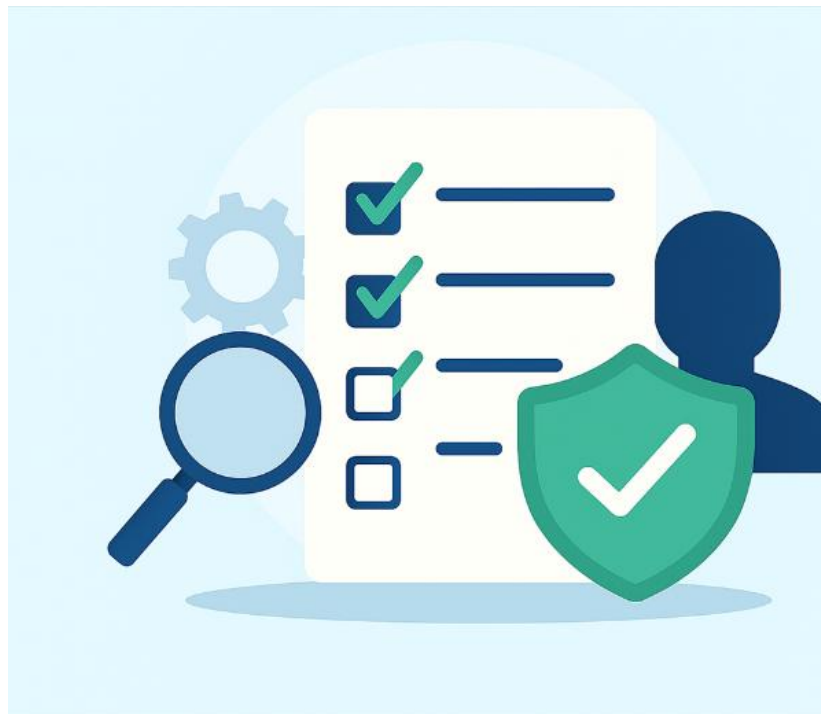


How Chatbots Differ from Agents



TOPIC	 CHATBOT	 AI AGENT
 Main job	Generate responses from prompts based on model training	Work toward a goal across multiple steps
 Tool use	Usually limited	Depends on tools to gather information and take actions
 Memory	Often short-lived and session based	Tracks task state, intermediate results, and next actions
 Best use	Writing, summarization, ideation	Workflow support, coordination, document-heavy processes
 Main risk	Wrong or nonsensical answers	Bad decisions, wrong actions

AI Benefits to Environmental Planning

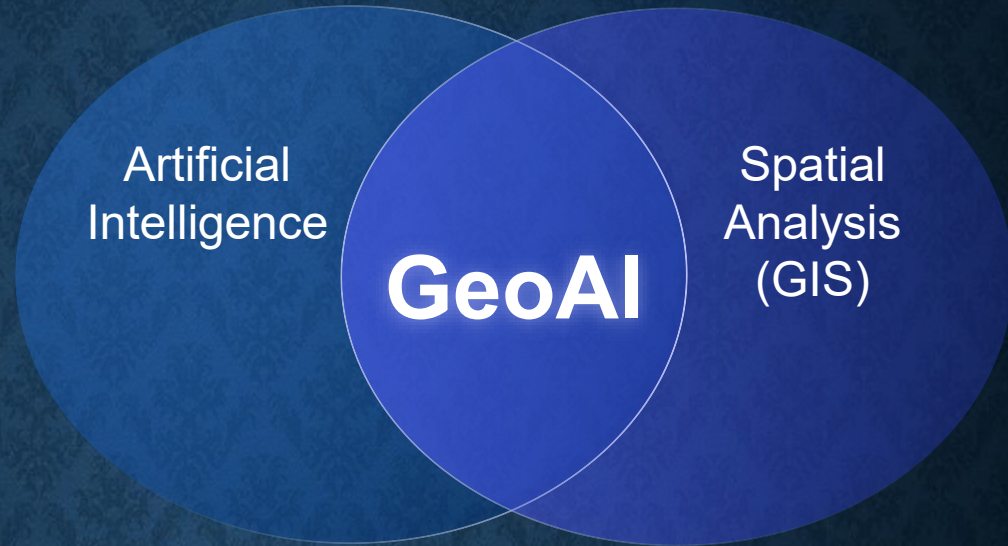


- Faster drafts
- Improved consistency across documents
- More time for QA/QC and technical review
- Stronger focus on defensibility and strategy

Geospatial AI – GeoAI

Generating Rich
Spatial Data

Solving Complex
Spatial Problems



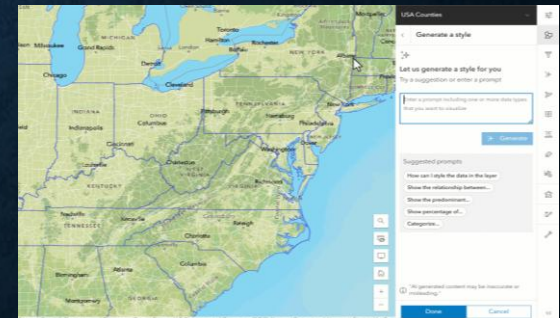
Automation



Analysis



Productivity



GIS Is Being Enhanced with AI

Integrating the Power of GIS and AI

Advancing Science



*Foundation,
Vision Language Model
& Embedding*

*100+ Pretrained Models
... Open & Extendable*



GeoAI
(Tools & Models)



Productivity



AI Assistants
(Improve Access
& Efficiency)

Natural Language

**Secure &
Trustworthy**

Supporting

- **Documentation**
- **Tech Support**
- **Mapping & Analysis**
- **Code Generation**
- **App & Solution Creation**
- **Translation**

*Making GIS easier
... and more intelligent*

Pretrained GeoAI Models

Streamlining workflows across industries



State & Local Government



Land Cover Classification



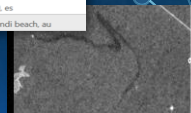
Pool Segmentation (SAM)



Optical Character Recognition

10, cl gujanak, 21668, es
26, cl palmitos, 4130, es
campbellparade, bondi beach, au

Address Correction



Oil Spill Detection (SAR)

Public Safety



Human Detection (Drone Imagery)



Optical Character Recognition



Parking Spot Detection



Parking Lot Detection

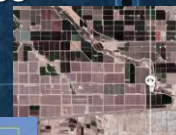
Utilities



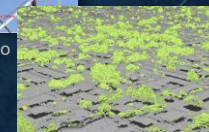
Insulator Defect Detection



Transmission H-Structures



Solar Photovoltaic Park Classification (Global)



Tree Point Classification

Conservation



Waterbody Extraction (USA)



Seabird Detection

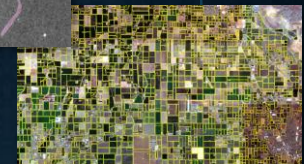


Elephant Detection

Natural Resources



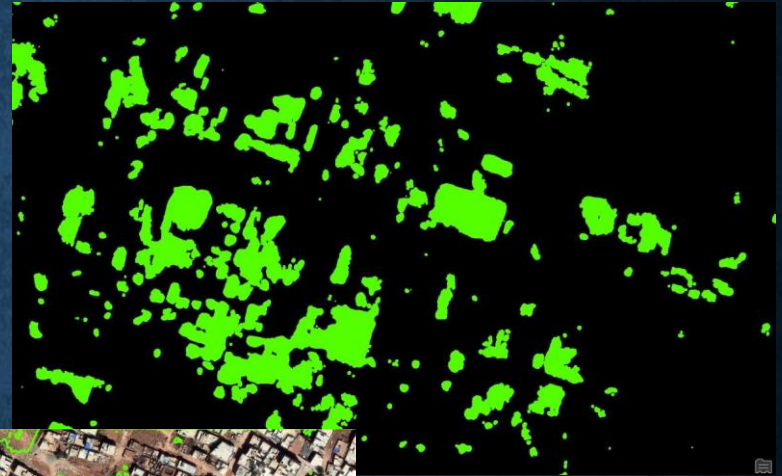
Oil Spill Detection (SAR)



Agricultural Field Boundary



Flood Impact Analysis – Lost Green Space Extraction with GeoAI



The approximately lost area of 105.6 square kilometers of 927.2 A lost area of ~ 11.3%.



- Satellite Imagery
- Image feature extraction
- Deep Learning, GeoAI
- Green Spaces Damage Assessment

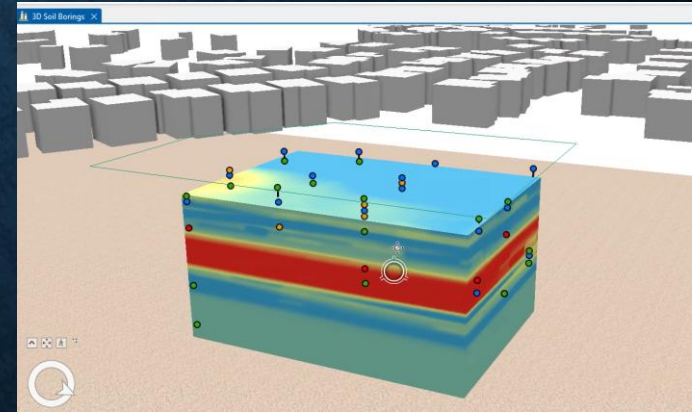
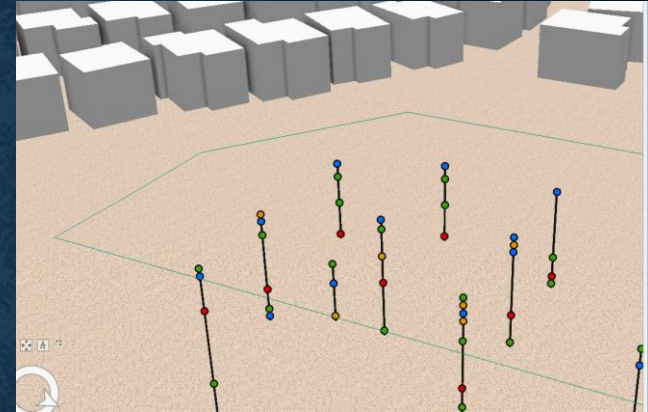
GeoAI for Unstructured Text

Natural Language Processing Tools and Models

URS BORING LOG										BORING LOG: #1	
PROJECT: Miracle Mile LOCATION: Tucson, Arizona CLIENT: ADEQ					CONTRACTOR: Yellow Jacket DRILLER: Mark INSPECTOR:					SHEET 1 of 3 PROJECT #: Soil Borings and Sampling	
RIG TYPE: BK 81 DRILLING METHOD: Hollow Stem Auger HAMMER TYPE: Safety Hammer										REF. ALIGNMENT: STATION: See Figure 2 OFFSET:	
COMMENTS: Surface Condition: Asphaltic concrete parking lot										SURFACE ELEV.: DATUM: Ground Surface	
										START DATE: 5/18/2002 TIME: 0815 FINISH DATE: 5/19/2002 TIME: 0715	
GROUNDWATER DATA											
Type/Symbol	Casing	Split Spoon	Shelby Tube	Simulprobe	Ring Sample	Core Barrel	Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
I.D.		S 1.375"	U	SP	R	C					97.5
O.D.		2"									
Length		16"									
Hammer WT.											
Hammer Fall											
SAMPLE						SOIL (Blows/6 in.)			VISUAL MATERIAL CLASSIFICATION AND REMARKS		
DEPTH BELOW SURFACE (FT)	USCS	GRAPHIC	TYPE	NUMBER	DEPTH (FT) FROM TO	MOISTURE %	PD (ppm)	0/6 (in.)			
ROCK CORING											
								RUN (in.)	REC (in.)	REC L=4" (in.)	RQD (in.)
CL: SANDY CLAY with silt, brown, hard fine sand, low to medium plasticity index (PI), slightly moist											
5			SP	5-1	5 5.5		0.3 50/6			6	
SC: CLAYEY SAND with silt, trace angular gravels, brown, low PI, very dense, mostly fine, with coarse sand, slightly moist											
10			SP	10-1	10 10.75		1.3 32	50/3		9	
decrease in gravel											
SAMPLES SENT TO LAB											

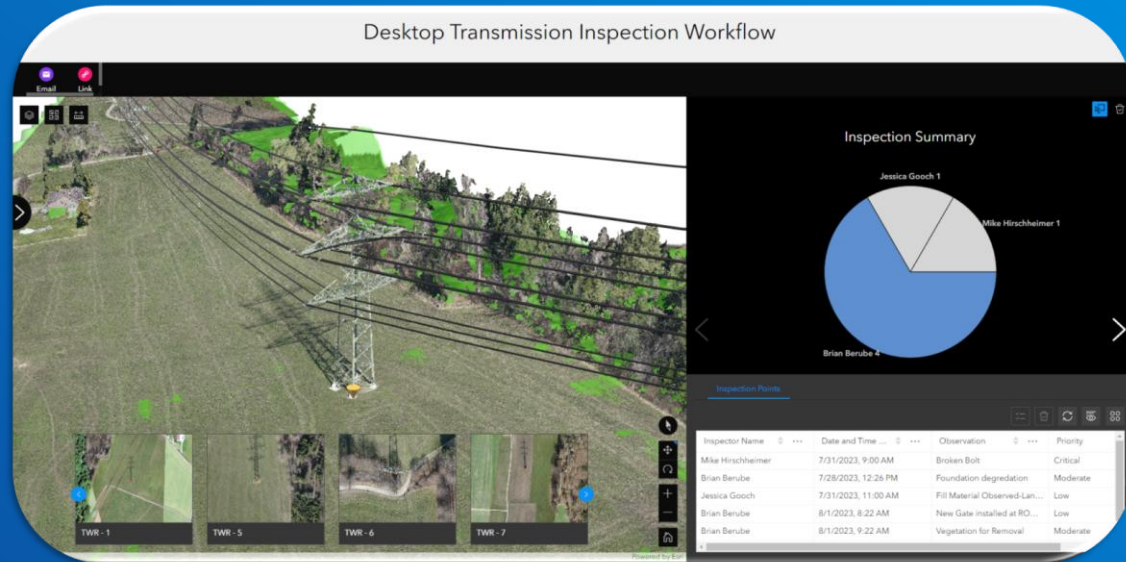
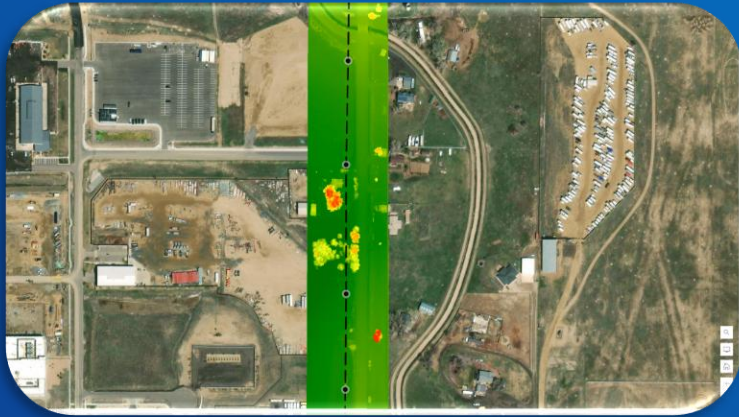


GeoAI Tools



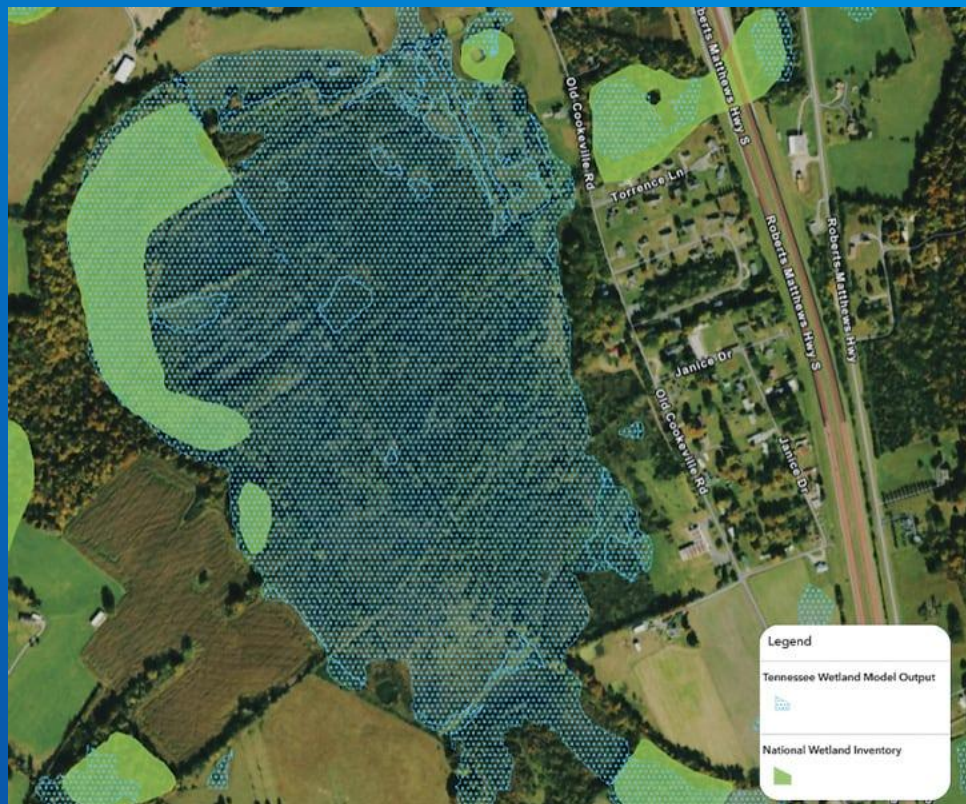
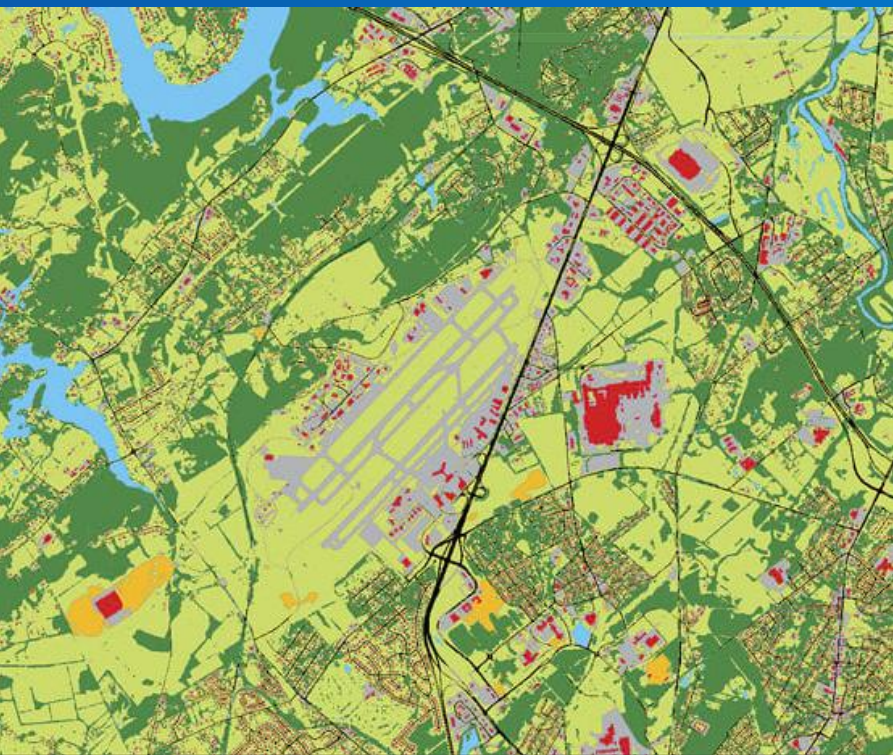


Vegetation Encroachment Analysis





Tennessee Identifies Additional 800,000 Acres of Wetlands with GeoAI-Based Wetland Screening Tool



- Tennessee encompasses 27 million acres
- NWI had estimated 1 million acres of wetlands
- The model has since predicted nearly 800,000 more acres of wetlands
- The tool can help policymakers and developers, as well as farmers and landowners

Technology/Models: Skytec's Wetlands Predictive Model: Esri Wetland Identification Model (WIM), ArcGIS Online, ArcGIS Experience Builder, Deep Learning Models, Imagery

Automation, Data Collection, Analysis, and Reporting

AI and Automation in Field Data Collection Data Capture

How AI is Used

- Computer Vision
 - Auto-extract features from photos or video (e.g., erosion areas, vegetation type, damaged assets)
 - Identify objects (culverts, manholes, wetland boundaries)
- Speech-to-text
 - Field staff dictate observations hands-free

Example: A field worker takes a photo of a streambank; AI tags erosion severity, bank angle, and vegetation cover automatically.

AI and Automation in Field Data Collection Data Capture

How AI is Used

Real-Time Data Validation - AI checks data before the technician leaves the site. Resulting in fewer revisits, higher QA/QC compliance

- Detects missing fields
- Flags outliers (e.g., impossible pH values)
- Validates GPS accuracy and spatial consistency

AI and Automation in Field Data Collection Data Capture

How AI is Used

Automated Classification & Labeling - Instead of manual coding.

- Land cover classification
- Habitat or wetland type identification
- Damage severity scoring
- Asset condition grading

Example: AI classifies field photos into “intact,” “moderately degraded,” and “severely degraded” habitats using trained models.

AI and Automation in Field Data Collection Data Capture

How AI is Used

Edge AI (On-Device Intelligence) - Previously trained AI models run disconnected on tablets, phones, or sensors.

- Critical for rural or remote fieldwork
- Enables immediate feedback
- Reduces cloud dependency

Example: Wildlife or Wildfire detection on trail cameras

AI and Automation in Analysis Remote Sensing

How AI is used

- Change detection (deforestation, urban growth, wetland loss)
- Feature extraction from satellite and drone imagery
- Large-area mapping at high temporal frequency

Techniques

- Convolutional Neural Networks (CNNs)
- Random Forest, Gradient Boosting
- Transformer-based vision models

Operational examples

- Near-real-time deforestation monitoring
- Wetland and habitat mapping
- Shoreline and coastal erosion tracking

AI and Automation in Analysis Air Quality

How AI is used

- Interpolating between sparse monitoring stations
- Forecasting pollution events
- Street-level air quality mapping

Techniques

- Neural networks
- Spatiotemporal ML models
- Sensor + AI fusion

Operational examples

- Vehicle-mounted sensor networks producing block-by-block pollution maps
- Real-time AQI prediction for public alerts

AI and Automation in Analysis Water Resources

How AI is used

- Streamflow and flood forecasting
- Groundwater level predictions
- Water quality anomaly detection
- Rainfall–runoff modeling

Techniques

- LSTM and RNN time-series models
- Hybrid physics-informed ML models
- AI + IoT sensor integration

Operational examples

- Flood early-warning systems in ungauged basins
- Continuous water quality monitoring with automated alerts

AI and Automation in Analysis Ecology, Biodiversity & Habitat Assessment

How AI is used

- Species identification from images and audio
- Habitat suitability modeling
- Invasive species detection
- Vegetation health and biomass estimation

Techniques

- Computer vision
- Acoustic ML models
- Species distribution models

Operational examples

- Automated wildlife camera analysis
- Drone-based habitat condition surveys

AI and Automation in Analysis Compliance & Monitoring

How AI is used

- Automated QA/QC of monitoring data
- Outlier and anomaly detection
- Pattern detection across long time series
- Prioritization of inspections and enforcement

Techniques

- Anomaly detection models
- Rule-based AI + ML hybrids
- NLP for field notes and reports

Operational examples

- Early detection of permit exceedances
- Consistent interpretation of field observations

AI and Automation in Data Collection and Analysis

Key Takeaways

01

AI is no longer experimental

02

Handle data volumes and velocity

03

Improve consistency and reproducibility

04

Enable near real-time insight

05

Support (not replace) scientific and regulatory judgment

Environmental Concerns: AI vs. Traditional Methods



Energy Consumption & Carbon Footprint: AI, especially training large models, requires intense computational power.



Water Usage: Data centers that power AI require massive amounts of water for cooling, often straining resources in drought-prone areas.



Electronic Waste (E-Waste): The rapid advancement of AI hardware leads to short lifespans for GPUs and other components, increasing hazardous electronic waste.



Resource Extraction: Manufacturing AI hardware demands rare earth minerals and metals (e.g., cobalt, lithium), leading to increased mining, soil erosion, and pollution.



Intensity of Use: While traditional computing is static, AI runs 24/7 on high-power servers, making the total footprint exponentially higher over time

Risks and Defensibility & Professional Judgement

- Why AI creates risk
- Core rules for responsible use
- QA/QC framework
- Role of professional judgment



Q & A