

From data to decisions: building a practical Path to GeoAI

By Dan Gruidel

Artificial Intelligence (AI) is rapidly reshaping the geospatial landscape. For organizations that rely on geospatial data, the question is no longer whether to adopt AI, but how to do so effectively.



The opportunity is clear. Modern sensors, satellites, and airborne platforms generate unprecedented volumes of geospatial data. Yet as data collection has accelerated, a new challenge has emerged: turning that data into timely, usable insight. Across government agencies, utilities, and commercial organizations, analysts find themselves navigating complex workflows and fragmented systems, with valuable intelligence blocked by technical barriers.

The next phase of geospatial innovation will not be defined by better data collection alone, but by the ability to operationalize intelligence and transform data into decisions at the speed required by modern missions.

AI requires Architecture, not add-ons

A common misconception is that AI can simply be layered onto existing geospatial workflows. In practice, this approach rarely delivers meaningful results. AI creates value when it is designed to be part of an operational system, not bolted on as a feature.

Geospatial environments are inherently complex. They involve multi-modal data (imagery, lidar,

vector data, and sensor feeds) distributed across disconnected systems. Each system may serve a specific purpose, but few are designed to work together seamlessly. Adding AI to one part of this environment does little to address the broader fragmentation.

Organizations that succeed are shifting toward intelligence-centric architectures. In these environments, AI orchestrates data, workflows, and decisions across systems rather than operating in isolation. This architectural shift is what separates experimental AI projects from enterprise-scale transformation.

Start with the right questions, not the right tools

One of the most common reasons GeoAI initiatives fail is strategic. Organizations often start by evaluating tools rather than defining outcomes.

Some questions to start with are:

- What decisions need to be accelerated?
- Where are the current bottlenecks?
- Which workflows would benefit most from automation and augmentation?

Without clear answers to these questions, AI initiatives risk becoming fragmented experiments rather than cohesive programs. A consultative approach helps organizations slow down long enough to define objectives, align stakeholders, and prioritize high-value use cases. This often begins with a structured GeoAI readiness assessment. This process helps organizations translate high-level ambitions into defined, decision-driven use cases, evaluate readiness of their data and systems, and identify feasibility constraints early. The result is a prioritized road map grounded in real operational needs that guides where and how AI should be applied.

This early-stage clarity reveals critical dependencies, particularly around data readiness. AI models are only as reliable as the data structures that support them. Standardized schemas, consistent metadata, repeatable ingestions pipelines, and strong data governance are essential foundations for trustworthy geospatial intelligence. Once this foundation is established, organizations move into GeoAI enablement (preparing data, pipelines, aligning systems, and configuring workflows) so that AI can operate consistently and at scale. This step is critical in moving from conceptual use cases to operational capability.

From assistive AI to agentic intelligence

Most organizations begin their AI journey with assistive capabilities like embedded analytics, machine learning models, or conversational interfaces. While valuable, these approaches still rely heavily on analysts to design and manage workflows. A new class of systems, often described as agentic AI, is beginning to challenge this paradigm.

Rather than executing isolated algorithms, agentic systems can interpret intent, plan analytical steps, and execute workflows autonomously.

GeoAgent™, (<https://www.nv5.com/geospatial/solutions/geoagent/>) developed by NV5, provides an example of this emerging model. GeoAgent integrates adaptive AI reasoning with scientifically grounded remote sensing analytics. Users interact with the system through natural language, describing the outcome they want to achieve. The system determines how to get there, retrieving data, selecting analytics, executing workflows, and delivering results.

This represents a fundamental shift. Instead of asking “which tool should I use?”, users can focus on “What insight do I need”.

Bridging complexity across systems and data

One of the defining challenges of geospatial analysis is the diversity of data types and systems

involved. Optical data, hyperspectral data, synthetic aperture radar (SAR), lidar, and vector datasets each require different processing techniques and analytical approaches.

Agentic systems are particularly well suited to this environment because they can orchestrate workflows across these data types and systems. GeoAgent, for example, operates across existing geospatial platforms rather than replacing them. It integrates with established tools, data environments, and enterprise systems, preserving prior investments while enabling new capabilities. This interoperability is critical. The geospatial technology landscape is evolving too quickly for organizations to commit to a single vendor or platform. A technology-agnostic approach allows organizations to remain flexible as data sources, analytical methods, and mission requirements change.

In practice, this requires an enablement approach that is technology-agnostic by design. Enterprises rarely operate within a single geospatial stack. Instead, they rely on a combination of GIS platforms, data lakes, ELT pipelines, field systems and cloud environments. Effective GeoAI implementation much orchestrate across these systems, rather than forcing working into a single vendor. Expanding access to geospatial intelligence Another important implication of agentic AI is its impact on accessibility. Traditional remote sensing workflows often require deep technical expertise, limiting advanced analysis to a relatively small group of specialists.

By abstracting workflow complexity, systems like GeoAgent enable a broader range of users to engage with geospatial data. Less experienced users can describe their objectives in natural language and receive structured outputs, while experienced analyst can use the same system to automate repetitive tasks and accelerate complex analysis. This dual capability helps organizations scale their analytical capacity without proportionally increasing specialized staffing requirements.

Applications across industries

The value of this approach becomes clearer when applied to real-world challenges.

In transportation, AI-driven workflows can monitor infrastructure corridors, detect land-use changes, and support planning decisions.

In utilities, geospatial systems can integrate imagery, lidar, and historical data to track asset condition, identify risks such as vegetation encroachment, and support proactive maintenance strategies.

In environmental monitoring, multi-temporal analysis of satellite imagery enables faster identification of trends such as shoreline erosion, vegetation change, or water level fluctuations.

In emergency response, rapid comparison of pre- and post-event imagery can provide immediate situational awareness, helping teams prioritize resources during critical events.

Across these use cases, the common thread is speed: reducing the time between data acquisition and actionable insight.

Designing for trust, transparency, and scale

As AI takes on a larger role in geospatial workflows, trust becomes essential. Decision makers need to understand how results are generated, particularly in regulated or high-stakes environments.

Agentic systems must provide transparency by recording analytical steps, parameters, and data sources to create reproducible outputs and auditable workflows. Human oversight remains a critical component, ensuring that AI-driven processes align with domain expertise and operational requirements.

Scalability is equally important. GeoAI systems must operate across enterprise environments,

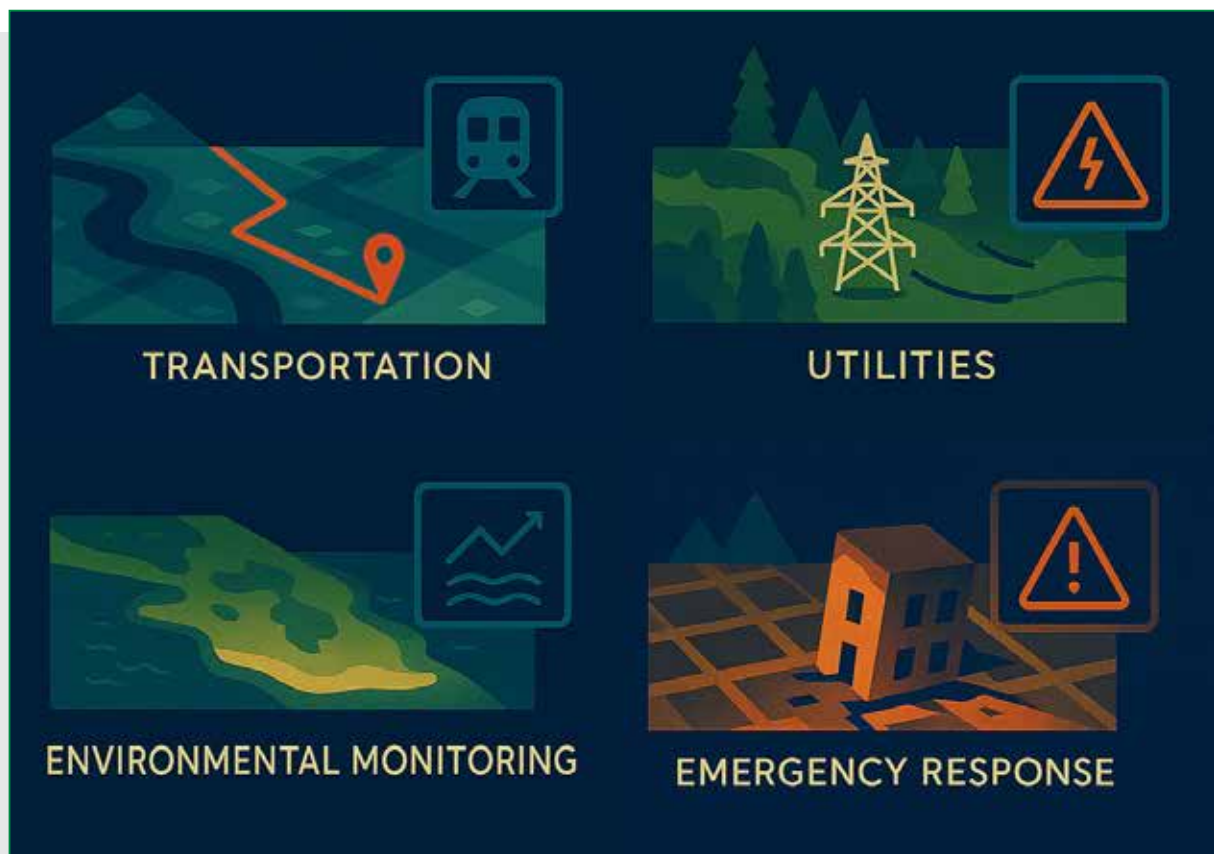
handling large data volumes while maintaining performance and reliability. This requires thoughtful architectural design, including scalable compute, modular systems, and clear governance frameworks.

GeoAI Is not a Plug-in, it's a Partnership

Ultimately, GeoAI is not a product that can simply be installed. It is a capability that must be developed, integrated, and continuously refined. Organizations that succeed in this space recognize that AI adoption requires more than technology. It requires alignment between data, systems, workflows, and decision-making processes. It also requires a partner with both geospatial expertise and AI experience, one who can guide strategy, design architecture, and implement solutions that deliver real operational value.

Based on decades of experience and real-world AI implementations, NV5 has developed a structured GeoAI practice designed to move organizations from concept to operation capability. Successful engagements follow a lifecycle approach:

- Readiness: Defining use cases, assessing data and systems, and establishing a roadmap
- Enablement: Preparing data, integrating sy-



stems, and deploying initial workflows

- Operationalization: Scaling workflows, monitoring performance, and embedding AI into day-to-day decision making.

This approach reflects what we've seen consistently in the field: AI delivers value when introduced with clarity and integrated deliberately and supported by ongoing capability rather than a one-time implementation.

From insight to action

The geospatial industry has spent decades improving how data is collected. The next phase of innovation will focus on how that data is used. By combining architectural thinking, consultative implementation, and emerging technologies such as agentic AI, organizations can move beyond fragmented workflows toward integrated systems that deliver intelligence at scale.

The goal is not simply to analyze more data, but to make better decisions faster, with greater confidence, and across the entire enterprise.

ABSTRACT

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AUTHOR

DAN GRUIDEL
DAN.GRUIDEL@NV5.COM,
NV5 - GEOSPATIAL



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