Accelerating Offshore Insight: AI-Driven Interpretation for Seafloor Characterization

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Executive Summary

As offshore infrastructure development scales globally—across wind energy, oil and gas, and telecom sectors—the demand for efficient, accurate, and defensible marine geophysical interpretation has never been greater. Artificial Intelligence (AI) technologies are transforming how seafloor characterization datasets are processed and understood. Seafloor characterization from geophysical data provides a foundation for integrated assessments of benthic habitats, evaluation of geohazards, and siting and construction plans. This white paper introduces current AI capabilities, compares their strengths, and outlines the practical benefits and limitations for project delivery, benthic assessments, and risk mitigation. This paper also provides actionable guidance for evaluating AI-derived deliverables and writing effective RFP language for those deliverables to ensure quality and accountability.

Clarifying Terminology: Artificial Intelligence, Machine Learning, and Neural Networks

Throughout this paper, we refer to Artificial Intelligence (AI) as the overarching domain encompassing all computational methods that mimic human reasoning, pattern recognition, and decision-making. Within this domain, Machine Learning (ML) represents a subset of techniques that enable systems to learn from data and improve performance over time without explicit programming. Further nested within ML are Neural Networks (NN)—algorithms inspired by the structure of the human brain, particularly effective for complex pattern recognition tasks such as sonar image classification and bathymetric feature extraction. Thus, when we reference AI in this paper, we include both ML and NN approaches as part of the broader interpretive toolkit.

1 Introduction: Why AI Matters in High Resolution Marine Geophysics

Marine geophysical surveys generate terabytes of complex data—ranging from bathymetric grids to buried object profiles. Traditional interpretation methods are time-intensive and subject to analyst variability. AI offers a scalable solution: automating feature detection, enhancing data clarity, and accelerating reporting cycles (Fugro, 2024; Cui & Chang, 2017). Marine geophysical survey data collections have quadrupled in size over the past 10 years increasing the time required for processed and interpreted deliverables. AI technologies represent methodologies to manage these monster data sets in client-required timelines.

For offshore wind developers, oil and gas operators, and telecom cable planners, this means faster site characterization, improved risk modeling, and stronger alignment with regulatory expectations. Improvements in geophysical data outputs can also lead to more efficient benthic assessments, a critical component of offshore development. Importantly, AI may already be embedded in the processing and interpretation workflows of survey contractors—often without explicit disclosure (Hydro International, 2024). As such, managers must understand how AI is used, how its outputs are validated, and how to scope expectations clearly in the procurement / technical assessment stage.

2 Current AI Capabilities by Sensor Type

Artificial Intelligence is increasingly embedded in the interpretation workflows of marine geophysical sensors. These typical sensors include multibeam echosounder (MBES), side-scan/high-resolution synthetic aperture sonar (SSS and HiSAS), sub-bottom profiler (SBP), and magnetometer/transverse gradiometer (Mag/TVG). While some models remain in experimental phases, others have matured into operational tools with documented performance metrics. AI is reshaping how seabed features are detected, classified, and reported across sensor types. Table 1 below summarizes the types of survey sensors and the level at which AI is being used, with the sections below providing additional information.

Specific technologies, platforms, and vendors referenced in this section are provided as illustrative examples of current capabilities and workflows and are not intended as endorsements, certifications, or recommendations of any particular product or service.

Table 1. Comparative Overview of Sensor Types

Sensor Type	AI Maturity	Key Strengths	Integration Challenges
MBES	High	Grid QA, sediment mapping, feature detection	Substrate generalization
SSS / HiSAS	High	Contact picking, object detection, image clarity	Training data sensitivity
SBP	Emerging	Buried target detection, stratigraphy modeling	Sparse labeled datasets
Mag / TVG	Early	Anomaly classification, gradient modeling	High noise, limited standardization

2.1 Multibeam Echosounder (MBES)

MBES data, commonly used for bathymetric mapping and backscatter analysis, are now interpreted using machine learning models that automate feature detection, sediment classification, and geohazard identification. Random Forest classifiers and convolutional neural networks (CNNs) are frequently applied to detect seabed features such as boulders, scour marks, and anthropogenic structures. A key enabler in this domain is MB-System, developed by the Monterey Bay Aquarium Research Institute (MBARI) and maintained by the open-source community. MB-System provides robust preprocessing and QA/QC modules, including automated grid cleaning, beam editing, and backscatter analysis, which are essential for AI workflows (MBARI, 2023).

MB-System outputs are commonly used as structured inputs for supervised learning models, as well as supporting Python-based AI pipelines and GIS tools for sediment classification and anomaly detection. Researchers have successfully used MB-System to generate training datasets and validate AI-driven interpretations, demonstrating its utility in hybrid workflows (Snijder & Lekkerkerk, 2022). For example, Downing et al. (2025) reported that combining MB-System with Random Forest classifiers yielded up to 83% recall and a 77% F1-score in boulder detection tasks. CNN-based models paired with MB-System preprocessing have also shown improved consistency in feature extraction across complex seabed environments.

Typical use cases for AI-enhanced MBES interpretation include geohazard mapping, cable route surveys, boulder field delineation, and benthic habitat modeling. MBES is often deployed in tandem with SSS and HiSAS to cross-validate features and improve confidence in deliverables.

2.2 Side-Scan Sonar (SSS and HiSAS)

Side-scan sonar, including high-resolution synthetic aperture systems like Kongsberg's HiSAS, remains the gold standard for seabed imaging—particularly for object detection, contact picking, and high-fidelity mosaicking. AI models in this domain have matured significantly, with YOLOv5 and YOLOv8 variants widely used for object detection in rasterized sonar imagery. These models are often embedded within fully automated detection workflows that feature graphical interfaces, enabling non-specialists to interact with AI tools (Hinz et al., 2024).

Kongsberg's HiSAS system includes an integrated Automatic Target Recognition (ATR) module, which uses machine learning to assist in real-time contact identification and classification. This onboard capability allows for rapid triage of sonar contacts, reducing manual workload and improving consistency. Performance benchmarks show mAP-50 scores of 77.83% for backscatter rasters and 70.46% for slope angle rasters. HiSAS systems routinely deliver centimeter-scale resolution, making them ideal for high-fidelity seabed surveys (Kongsberg Maritime, 2025). The HiSAS ATR module has undergone field trials and received positive operator feedback, confirming its reliability in cluttered environments

Beyond Kongsberg, several leading vendors have developed ATR capabilities tailored to side-scan sonar and synthetic aperture workflows. Ocean Infinity integrates ATR into its AUV platforms to support real-time contact classification and UXO detection, particularly in deepwater and cluttered environments. Ocean Geophysics applies AI-enhanced ATR for archaeological mapping and debris field analysis, often using custom-trained models for region-specific seabed conditions. Fugro incorporates ATR into its remote and autonomous survey systems, enabling automated contact picking and SSDM-ready outputs with reduced manual intervention (Fugro, 2024). Kraken Robotics supports ATR through its MiniSAS and TIL-format imagery, with onboard processing modules that flag anomalies and streamline mosaicking. EdgeTech's sonar systems also feature ATR-enabled workflows, particularly for high-resolution object detection in shallow water UXO and infrastructure surveys. These systems often leverage embedded AI models and graphical interfaces to support onboard triage and post-processing efficiency.

Complementing these hardware platforms, Moga Software's SeaView suite—particularly its MOSAIC module—offers AI-enhanced tools for side-scan and synthetic aperture sonar workflows. SeaView supports high-resolution mosaicking of SAS imagery, including Kraken TIL formats, and features gamma correction tools that enhance contrast without degrading resolution. It also includes automated anomaly detection in raster mosaics, which can assist in first-pass contact identification and reduce operator fatigue. These features make SeaView a practical AI-enabled interpretation platform for teams working across SSS datasets, especially when integrated with SSDM export and GIS workflows (Moga Software, 2025). StrateSea Technology's FeatureLab offers another software solution for feature detection in SSS and other imagery data sets (Figure 1). The software is built to ingest multiple file formats and provides a user-friendly interface that allows analysts to easily train the models to their data. This capability ensures that models tuned and trained in one part of the world are not applied wholesale to different locations and use cases (StrateSea Technology, 2025).

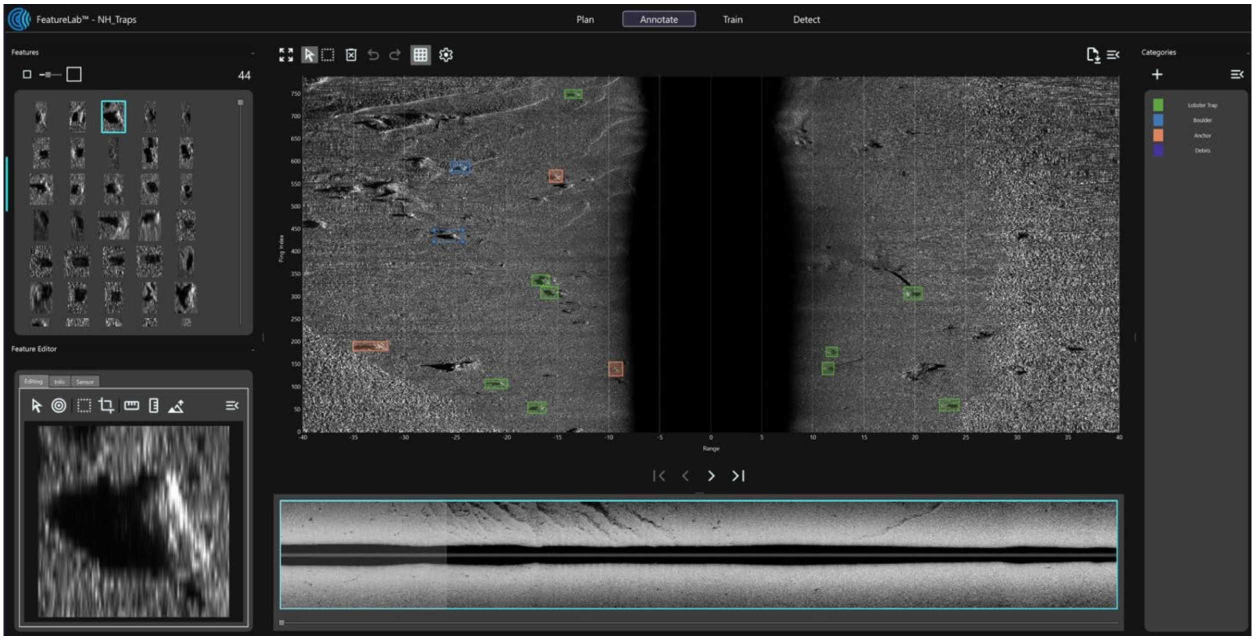

Figure 1. ***FeatureLab interface for AI feature detection with built-in training options (SSS source Klein Marine Systems).***

Use cases across these platforms and applications include UXO detection, debris mapping, archaeological surveys, search and rescue, and real-time onboard contact classification using AUVs and towfish. Together, HiSAS, SeaView, and vendor-specific ATR systems represent a robust ecosystem of hardware and software that supports AI-assisted seabed interpretation from acquisition to deliverable.

2.3 Sub-Bottom Profiler (SBP)

AI applications in sub-bottom profiler (SBP) interpretation are still emerging but show considerable promise for buried object detection, stratigraphic modeling, and shallow geohazard assessment. Model types currently in use include zero-shot learning, YOLOv5s, and pseudo-3D imaging approaches. These models are often trained on synthetic datasets due to the scarcity of labeled real-world SBP data. While synthetic training enables initial detection capabilities, geological realism remains a challenge, limiting generalizability across diverse sedimentary environments (Zhou et al., 2021). Despite these limitations, AI-enhanced SBP workflows are being actively explored for pipeline and cable burial risk assessment, as well as preliminary stratigraphic modeling to support foundation design and CCUS site screening.

Several interpretation platforms are beginning to integrate AI into SBP and ultra-high-resolution (UHR) 2D/3D workflows. GVERSE GeoGraphix, for example, supports AI-assisted reflector picking, seismic attribute extraction, and stratigraphic modeling, particularly when SBP data is formatted as SEG-Y or integrated with UHR seismic volumes (GVERSE, 2025). SubsurfaceAI offers deep learning models for buried object detection and seismic pattern recognition, with demonstrated acceleration in interpretation cycles and improved consistency across interpreters (SubsurfaceAI, 2025). Similarly, OpendTect provides neural network-based classification and fault detection tools that can be adapted to shallow seismic and SBP-style reflectors, especially when paired with custom training data. As more annotated datasets become available and vendors refine their AI pipelines, model performance and reliability are expected to improve—enabling faster, more consistent interpretation of complex near-surface environments.

2.4 Magnetometer / Transverse Gradiometer (Mag / TVG)

AI applications in magnetic data interpretation are at an early stage but offer potential for anomaly classification and gradient modeling. Gradient-based classifiers, CNNs, and signal denoising algorithms are being tested to isolate UXO, debris, and cable signatures from noisy magnetic datasets. Validation is typically qualitative, relying on known targets and ground-truthing rather than large-scale benchmarking.

Noise levels, sensor drift, and lack of standardized formats pose challenges for consistent model performance. Nonetheless, AI-enhanced magnetic workflows are being used for UXO clearance, cable tracking, and magnetic baseline mapping. As data quality and annotation standards improve, these models may become more robust and widely adopted.

Interpretation note: Reported AI performance metrics in this section are context-dependent and should not be assumed to translate directly to permitting-grade offshore surveys without project-specific validation and expert review.

3 Strategic Benefits for Offshore Projects[1]

Artificial Intelligence offers several strategic advantages for offshore wind, oil and gas, and telecom infrastructure projects. One of the most immediate benefits is efficiency: AI can reduce manual interpretation time by up to 60% in certain workflows, allowing teams to process large datasets more rapidly and redirect expert effort toward higher-order analysis. During acquisition, real-time AI-driven quality control enables adaptive decision-making and early anomaly detection, improving field responsiveness and reducing the risk of costly rework (Fugro, 2024).

In terms of deliverables, AI ensures consistency across teams and survey phases, producing standardized outputs that enhance visual clarity and facilitate stakeholder and regulatory review

[1] Reported efficiency and cost ranges are drawn from published case studies and vendor reports and are highly project- and context-dependent. They should not be assumed to apply to permitting-grade surveys without project-specific validation and expert review.

(Hydro International, 2024). Perhaps most critically, AI models support early identification of buried hazards, sediment anomalies, unexploded ordnance (UXO), and complex hard bottom seafloor habitats —factors that directly impact cable routing, pipeline installation, and foundation design. By flagging these risks early in the interpretation cycle, AI contributes to safer, more predictable project execution (Seequent, 2023).

Quantifying cost savings from AI adoption in marine geophysics reveals compelling operational and financial efficiencies. By automating first-pass interpretation, anomaly detection, and quality control across MBES, SSS, SBP, and MAG datasets, AI can reduce manual processing time by 40–60%, translating into significant reductions in labor hours and vessel time (Fugro, 2024). For offshore campaigns where vessel costs often exceed $50,000 per day, even a one-day reduction in turnaround can yield five-figure savings. Additionally, early anomaly detection enabled by AI minimizes the risk of costly re-surveys and mitigates potential delays in permitting or construction phases. When scaled across multi-week survey programs, AI-enhanced workflows have been reported to reduce total interpretation costs by 20–30%, while improving deliverable consistency and regulatory defensibility (Hydro International, 2024; Seequent, 2023). AI approaches are also seen as critical to handling the exponential increase in data acquisition volume as more and more AUVs deployed. These savings are particularly impactful in high-stakes environments such as UXO clearance, cable routing, and foundation risk modeling, where time, accuracy, and stakeholder confidence are tightly coupled.

3.1 Benefits for Benthic Assessments

Geophysical data are foundational to benthic habitat assessments. Preliminary geophysical results are often used to plan environmental surveys. Use of AI for on-vessel feature detection allows operators to flag distinct and anomalous areas to target for additional environmental data collection. This approach increases the likelihood that these data are collected across the full range of seafloor habitats within the survey area during a single mobilization.

Because the *in situ* structure and distribution of seafloor sediments, particularly larger gravels, are critical elements for understanding functional ecological habitats for benthic taxa and demersal fish, sediment grab samples on their own are not sufficient to ground-truth geophysical data in complex environments (Guarinello and Carey 2020). In addition to providing these elements, non-extractive imagery-based collections (video, plan view, and sediment profile imagery) can be used to inform and guide clients in critical and time-sensitive decision-making.

By using imagery-based collections as the primary ground-truth data for geophysical campaign, clients need not wait months for an integrated assessment of seafloor geological and ecological risks. Benthic ecologists skilled at synthesizing geophysical and ground-truth data can provide initial assessments of siting and permitting risks within weeks of delivery of preliminary geophysical data and imagery. This type of phased delivery of benthic assessment results supports clients under increasing pressure to make decisions quickly with significant financial and project timeline implications.

4 A Balanced Path Forward: AI as a First-Pass Tool

Artificial Intelligence is most effective when deployed as a first-pass tool, particularly for off-the-boat interpretation and quality control. In this role, AI enables rapid triage of incoming survey data, allowing acquisition teams to receive immediate feedback and adjust operations in real time (EAGE, 2023). However, AI outputs alone are not sufficient for final interpretation. A qualified geophysicist must review the full dataset—including raw records and processed results—to ensure that geological context, depositional history, and project-specific risks are properly assessed (SEG, 2023). This layered approach combines the speed and consistency of AI with the domain expertise required for defensible reporting. The benefits of this hybrid workflow include faster turnaround for preliminary deliverables, improved field efficiency, reduced manual workload, and stronger defensibility in both regulatory submissions and client-facing reports.

For projects with environmental permitting and essential fish habitat (EFH) (U.S.) or Annex 1 Directive (UK) consultations, benthic ecologists often receive interpreted seabed data from geophysical firms and must assess, and may need to refine, these results for environmental permitting purposes. We recommend that information about the AI tools and processes utilized, as well as details of the quality assurance checks performed by qualified geophysicists, accompany every data and interpreted product deliverable. Sharing this information will support appropriate use, understanding of uncertainty, and help guide additional analyses and/or refinement of the data for purposes beyond geophysical site characterization.

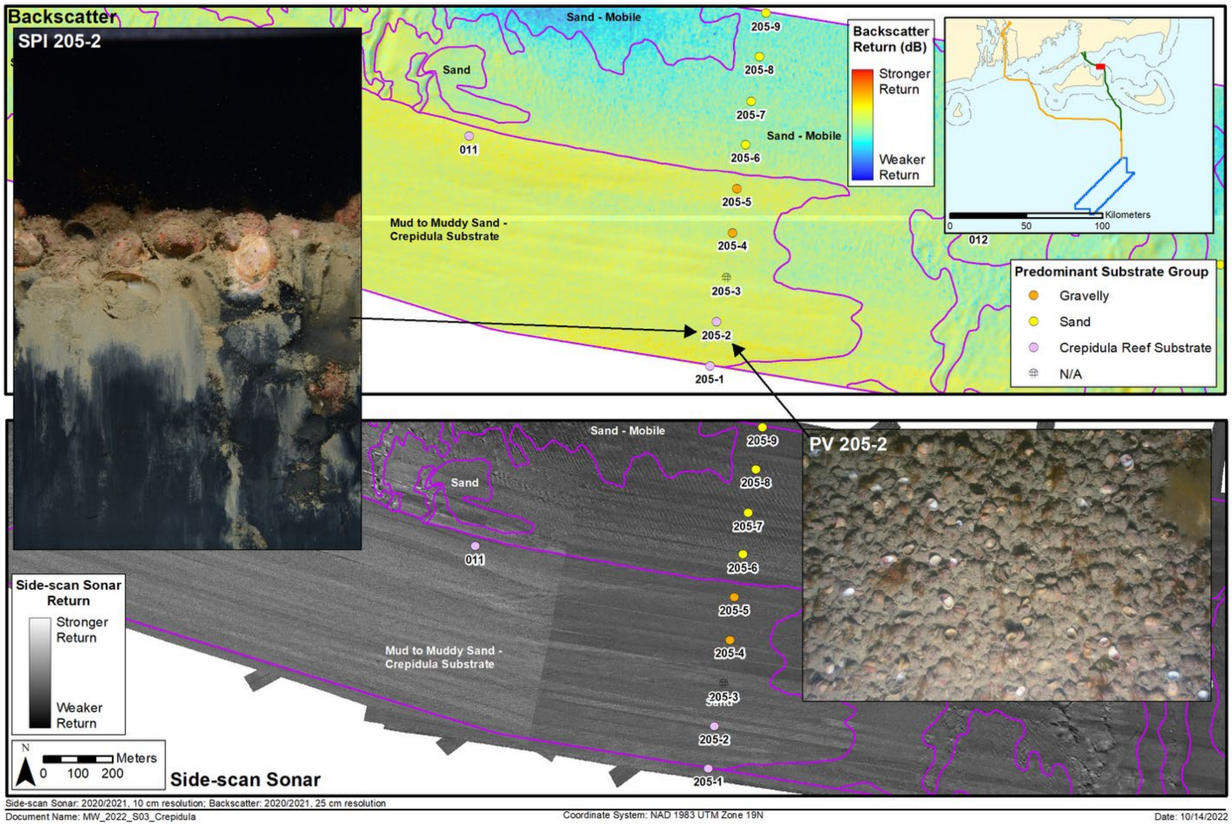

Figure 2. Mud to Muddy Sand – Crepidula Substrate habitat as detected in backscatter data over hillshaded bathymetry (top), side-scan sonar (bottom), and predominant Substrate Group assessed from ground-truth data; PV image from Station 205-2 shows complete cover of Crepidula and SPI shows the underlying muddy sediments (INSPIRE 2022)

5 Trust and Procurement: What Managers Should Ask

As AI becomes increasingly embedded in marine geophysical workflows, project managers must ask a fundamental question: Can I trust AI-derived results? This question should not be deferred until data delivery—it must be addressed during the technical review stage prior to project award, when expectations, validation protocols, and oversight responsibilities can be clearly defined. Alignment on how AI can be used to support phased delivery of results to the client and the level of uncertainty that is acceptable at each stage should also be documented. Trust in AI interpretation depends on three pillars: transparency of methods, validation against known standards, and expert oversight by qualified geophysicists (EAGE, 2023; SEG, 2023).

In practice, most vendors already incorporate some form of machine learning or automated processing into their deliverables, whether disclosed explicitly or not (Hydro International, 2024). For managers, it is essential to understand what level of machine-based interpretation is being conducted—whether AI is used for first-pass triage, final deliverables, or embedded in acquisition software—and to assess whether that level aligns with the project's risk profile and defensibility requirements. During technical review, managers should ask: Will AI be used for first-pass or final interpretation? What training data and validation methods will be applied? Will results be reviewed by a qualified geophysicist? Will the entire dataset be reviewed—not just AI outputs? And will AI-derived features be traceable and auditable?

To support internal discussion between technical, procurement, and legal teams, the following example illustrates how AI use and oversight might be addressed in RFP documentation. This example is for discussion purposes only and should be adapted through project-specific technical and legal review.

> "Survey deliverables may incorporate AI-assisted processing and interpretation. All AI-derived outputs must be reviewed and validated by a qualified geophysicist. The geophysicist shall review the full dataset—including raw and processed records—not just AI-generated results. The contractor shall document the AI model used, training data sources, and validation procedures. This information will be documented and provided to other users of the geophysical data who are producing interpreted results and recommendations for the client (e.g., benthic experts) and will accompany data delivery to these entities. Final deliverables must include traceable interpretation logs, manual QC annotations, and clear disclosure of any automated methods used."

This language ensures transparency, reinforces professional oversight, and aligns deliverables with regulatory and stakeholder expectations across offshore wind, oil and gas, and telecom sectors.

6 Considerations and Limitations

While AI offers compelling advantages in marine geophysical interpretation, its deployment must be tempered by a clear understanding of its limitations. One of the most critical concerns is model bias. AI performance is highly dependent on the quality, diversity, and geological representativeness of its training data. Models trained on limited or region-specific datasets may misclassify features when applied to unfamiliar seabed conditions, leading to false positives or overlooked hazards (Springer, 2024). This underscores the importance of curating training sets that reflect the full spectrum of geological variability expected across offshore wind, oil and gas, and telecom projects. Software, such as FeatureLab, that permits iterative training on the data as they are collected and processed may present some advantages here as well (StrateSea Technology, 2025).

Equally important is expert oversight. AI models—no matter how advanced—cannot yet replicate the nuanced judgment of a qualified senior geophysicist. Subtle depositional features, tectonic structures, or anthropogenic anomalies may be missed without human validation, especially in complex or transitional environments (SEG, 2023). Therefore, AI should be viewed as a decision-support tool, not a replacement for professional interpretation. Geophysical data also support environmental permitting and related siting optimization; review of final geophysical data products alongside ground-truth imagery-derived data, which may also be supported by AI, should be conducted by benthic ecologists skilled in this cross-disciplinary synthesis.

Finally, workflow integration remains a practical challenge. Many clients and regulators still rely on legacy formats such as the IOGP's Seabed Survey Data Model (SSDM), which may not natively support AI-derived annotations or metadata. Ensuring compatibility between AI outputs and client-specific deliverable standards requires careful planning and, in some cases, custom translation layers or manual reconciliation (IOGP, 2022). Addressing these limitations proactively will help ensure that AI-enhanced workflows remain defensible, interoperable, and aligned with stakeholder expectations.

7 Conclusion

AI-enhanced interpretation tools are reshaping the landscape of offshore wind, oil and gas, and telecom infrastructure development. By accelerating timelines and improving data fidelity these technologies offer a powerful means of scaling geophysical insight without compromising quality. When deployed as a first-pass tool—particularly during acquisition and early triage—AI enables rapid decision-making and operational agility. Yet its true value is unlocked only when paired with expert review, ensuring that automated outputs are contextualized within geological frameworks and project-specific risk profiles. Pairing geophysical data with benthic imagery and collaborating with benthic experts increases value to the client and allows the phased provisioning of information needed to support time-critical decisions related to siting, cable route optioneering (Carey et al. 2019), and potential permitting challenges. For projects requiring environmental permitting and EFH consultation, AI should be viewed as a screening and prioritization tool rather than a substitute for imagery-based ground-truthing and expert ecological interpretation.

Managers can place confidence in AI-derived deliverables when they are transparently documented, professionally validated, and clearly scoped within procurement. This means knowing not just what the AI did, but how it was trained, how it was reviewed, and how its outputs align with regulatory and client expectations across disciplines. Ultimately, the most effective approach is to trust—but verify; embrace AI for its efficiency, but ensure every interpretation is grounded in defensible methodology and human oversight.

While many of these technologies remain in their infancy, the pace of innovation is accelerating. New models, training datasets, and vendor-integrated workflows are emerging at a rapid clip—reshaping what's possible in seabed imaging, stratigraphic modeling, and hazard detection. It therefore behooves the marine project manager to stay actively engaged with these developments, not only to leverage emerging capabilities, but to ensure that procurement strategies, QA/QC protocols, and stakeholder communications evolve in step with the technology. Strategic adoption—balancing automation with domain expertise—will be key to maximizing utility while safeguarding technical integrity and stakeholder confidence across the offshore sector.

As AI capabilities continue to evolve, the role of multidisciplinary expert teams becomes more critical. Geophysicists and benthic ecologists provide the interpretive oversight required to ensure that AI-assisted workflows remain scientifically defensible and fit for regulatory review. Strategic adoption of AI in offshore projects, therefore, depends on maintaining rigorous quality control, transparent documentation, and clear communication of uncertainty. In this context, the most effective use of AI is as a powerful tool that enhances expert judgment.

8 References

Carey, D., Doolittle, D, & Smith, K. (2019). Forward scouting: use of sediment profile imagery in conjunction with multibeam echosounder mapping for offshore wind cable routes and site characterization. Proceedings of the Offshore Technology Conference. Manuscript OTC-29220-MS.

Cui, Y., & Chang, Y. (2017). Anomaly Detection in Multibeam Bathymetric Point Clouds. Semantic Scholar. Retrieved from https://www.semanticscholar.org/paper/Anomaly-Detection-in-Multibeam-Bathymetric-Point-Cui-Chang/6ddf48f0973b8c66cddd48aa8d49a220a54cde71

dGB Earth Sciences (2025). *OpendTect Machine Learning Plugins*. Retrieved from https://www.opendtect.org

Downing, E., et al. (2025). A Semi-Automated, Hybrid GIS-AI Approach to Seabed Boulder Detection. Remote Sensing, 17(15), 2711. Retrieved from https://www.mdpi.com/2072-4292/17/15/2711

EAGE (2023). Role of Geophysicists in AI Validation. Workshop Proceedings. Retrieved from https://eage.org/event/role-of-geophysicists-in-ai-validation

EdgeTech (2025). *Side Scan Sonar Systems with ATR*. Retrieved from https://www.edgetech.com/products/side-scan-sonar/

Fugro (2024). AI in Real-Time Survey QC. Innovation Report. Retrieved from https://www.fugro.com/media-centre/news/ai-in-real-time-survey-qc

Guarinello, M., & Carey, D. (2020). Multi-modal Approach for Benthic Impact Assessment in Moraine Habitats: a Case Study from Block Island Wind Farm. Estuaries and Coasts, https://doi.org/10.1007/s12237-020-00818-w.

GVERSE (2025). *GeoGraphix 2025 Release Overview*. Retrieved from https://www.gverse.com/geographix

Hinz, M., et al. (2024). AI-Based Boulder Detection in Sonar Data: Bridging the Gap from Experimentation to Application. International Hydrographic Review. Retrieved from https://ihr.iho.int/articles/ai-based-boulder-detection-in-sonar-data-bridging-the-gap-from-experimentation-to-application/

Hydro International (2024). GeoAI in the Marine Domain. Hydro International. Retrieved from https://www.hydro-international.com/content/article/geoai-in-the-marine-domain

INSPIRE Environmental. 2022b. Mayflower Wind Benthic Habitat Mapping to Support Essential Fish Habitat Consultation. Prepared for SouthCoast Wind for submittal to the Bureau of Ocean Energy Management as Appendix M.3. of the Construction and Operations Plan. Document No. MW01-COR-COP-ENG-0092. August 2022.

IOGP (2022). SSDM Integration Guidelines. International Association of Oil & Gas Producers. Retrieved from https://www.iogp.org/bookstore/product/ssdm-standard-for-survey-deliverables/

Kongsberg Maritime (2025). HiSAS Synthetic Aperture Sonar Systems and ATR Module. Kongsberg Discovery. Retrieved from https://www.kongsberg.com/maritime/products/underwater-navigation-and-sonar/synthetic-aperture-sonar/hisas/

Kraken Robotics (2025). *MiniSAS and SAS ATR Systems*. Retrieved from https://krakenrobotics.com/products/minisas/

MBARI (2023). MB-System Documentation. Monterey Bay Aquarium Research Institute. Retrieved from https://www.mbari.org/products/mb-system

Moga Software (2025). SeaView Product Overview. Retrieved from https://www.mogasw.com/seaview/

Seequent (2023). UXO Risk Modeling with AI. Technical Brief. Retrieved from https://www.seequent.com/resources/technical-briefs/uxo-risk-modeling-with-ai

Ocean Infinity (2025). Autonomous Survey Systems. Retrieved from https://oceaninfinity.com/technology/

Ocean Geophysics (2025). AI-Enhanced Interpretation Services. Retrieved from https://oceangeophysics.com/services/

SEG (2023). Human Oversight in AI Interpretation. SEG Technical Program. Retrieved from https://seg.org/events/human-oversight-in-ai-interpretation

Snijder, R., & Lekkerkerk, H.J. (2022). MBES Feature Detection Using Machine Learning. Hydro International. Retrieved from https://www.hydro-international.com/content/article/mbes-feature-detection-using-machine-learning

Springer (2024). Bias in Marine ML Models. GeoAI Special Issue. Retrieved from https://link.springer.com/journal/geoai

StrateSea Technology (2025). *FeatureLab*. Retrieved from https://www.stratesea.com/products

SubsurfaceAI (2025). *AI-Driven Subsurface Interpretation Platform*. Retrieved from https://subsurfaceai.ca

Zhou, Y., Liu, X., & Chen, H. (2021). Zero-Shot Pipeline Detection for SBP. Remote Sensing, 13(21), 4401. Retrieved from https://www.mdpi.com/2072-4292/13/21/4401