ABSTRACT BOOK

ENERGY GROUP

2ND OFFSHORE WIND SYMPOSIUM:

CABLES, PIPELINES AND SHALLOW INFRASTRUCTURE INSTALLATION

18th – 19th September 2025
The Geological Society, Burlington House,
Piccadilly, London

There have been considerable efforts by the offshore wind community (both industry and academic) to publish relevant, informative studies regarding geological and integrated ground models (GGMs and IGMs respectively) for offshore wind developments, both conceptual and factual, over the past decade. However, these studies invariably cover the standard zone of interest (<100 m below seabed) for wind turbine generator (WTG) foundations. This has led to an inherent bias in the published literature, in terms of the geo-engineering constraints and geological hazards (or 'geohazards') that form the focus of these studies, with most centring on engineering challenges for fixed foundations for WTGs. This has left a knowledge gap with regards to geohazards and geo-constraints specific to seabed and very shallow subsurface infrastructure (subsea cables and drag embedment anchors for floating WTGs), which tend to have a zone of interest of <10 m below seabed (mbsf).

This symposium aims to showcase a detailed review of geo-engineering constraints and geological hazards in the very shallow subsurface (<10 mbsf), giving attention and focus to subsea cables and drag embedment anchors, impacting installation works and performance for each type of asset. We encourage real-world case studies, that demonstrate the morphological, geophysical and/or geotechnical characteristics of constraints to installation, along with mitigation protocols and de-risking activities that have been integral to project success.

This conference aims to bring together geoscientists and engineers interested and engaged in the geological, geophysical and geotechnical characterisation and modelling of the very shallow soils. Experiences of geohazards, oceanographic investigations and conceptual, statistical and deterministic modelling welcome.

Convenors:

Peter Allan
PACE Geotechnics

Leah Arlott
RWE

Mike Brown
University of Dundee

Carol Cotterill
NGI

Stephen Eaton
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Global Maritime

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2^{nd} Offshore Wind Symposium: Cables, pipelines and shallow infrastructure installation

18^{th}-19^{th} September 2025

The Geological Society, Burlington House and Zoom

Programme

Day One	
08.30	**Registration**
08.50	**Welcome by the convenors**
	Session One: Risks and Hazards: Geological
09.00	**KEYNOTE** **What is a Seismic Diffraction?** Mark Vardy, *SAND Geophysics*
09.40	**Probabilistic Seabed Mobility Assessment for Construction Activities of Offshore Wind Farms** Vanessa Monteleone, *DNV*
10.00	**BREAK & Posters**
	Session Two: Risks and Hazards: Geological
11.00	**Risk Mapping: Semi-automated Boulder Identification** Louis McCulloch, *Global Maritime*
11.20	**2D and 3D geospatial characterisation of submerged peat properties from the Southern North Sea** Lydia Brown, *University of Leeds*
11.40	**Hydrodynamic and Engineering Implications of Glacially-derived Gravel Lag Deposits; Mapping a Geo-constraint to Shallow Offshore Infrastructure** Gareth Carter, *Arup*
12.00	**Cable routing in a seismically active region** Alexander Cattrysse, *IMDC*
12.20	**Offshore Wind Asset Integrity - a strategy for monitoring cables** Craig Dyer, *RWE Renewables*
12.40	**LUNCH & posters**
	Session Three: Risks and Hazards: Geo-Engineering
13.40	**Implications of Trenching on the Operating Temperature of Marine Power Cables** Jon Duell, *University of Southampton*
14.00	**Maximising value from UXO Risk Mitigation** Robert Mills, *RWE Renewables*
14.20	**Utilisation of reconnaissance geo-data to assess inter-array cable hazards and constraints** Lorraine O'Leary, *Fugro GB Ltd*
14.40	**Risk Monitoring of Submarine Export Cables in the UK** Christopher Brennan, *Geo-4D*
15.00	**BREAK**
	Session Four: Ground Modelling

15.30	**Integrated Ground Models for long-distance submarine cable routes: a practical approach to CBRA needs** Morgane Ravilly, *GEOxyz*
15.50	**Practical consideration in using ground models for assessment of cable trenching** Peter Allan, *PACE Geotechnics Ltd*
16.10	**The development of shallow 3D integrated ground models for cable design** Nick Pryor, *Global Maritime*
16.30	**Use of 3D Integrated Ground Models for the Development of a Burial Assessment for Tool Feasibility and Selection** Holly Cairns, *Global Maritime*
16.50	**End of day one**
17.00-18.00	**Drinks Reception**

Day Two	
08.30	**Registration**
08.50	**Summary of Day 1**
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09.00	**KEYNOTE** **CBRA: How deep is deep enough?** Mike Brown & Will Coombs, *Durham University*
09.40	**Impact of bedform migration and sediment mobility on ground modelling for submarine cables and pipelines** Charles Bloore, *Fugro GB Ltd*
10.00	**Ground Model Application in Offshore Wind – Installation Contractor Perspectives** Nawras Hamdan, *Seaway7*
10.20	**Mind the gap – integration of the nearshore transition area into cable and pipeline route ground models** Charles Bloore, *Fugro GB Ltd*
10.40	**BREAK**
	Session Six: Technical and Machine Learning
11.10	**Assessment on the Accuracy and Benefits of Subsea Cable Pre-Installation Geophysical Acoustic Imaging Surveys** Chris Williams, *Kraken Robotics*
11.30	**Advancing Thermal Design of Submarine Cables through Integrated 3D Geological and Finite Element Modelling** Sudur Roy, *Seequent*
11.50	**Automated CPT Cross-Section Generation for Offshore Cable Routes Using Dynamic Time Warping** Giuseppe Malgesini, *Geowynd*
12.10	**Quantitative Geophysical Analysis in Support of Cables** Callum Clay, *SAND Geophysics*
12.30	**LUNCH & posters**
	Session Seven: Modelling, Floating Wind, Drag Anchors
13.30	**Importance of Comprehensive Understanding of Seabed Conditions for Reducing the Risks of Submarine Cable Installation** Nusin Buket Yenigul, *Seaway7*
13.50	**An overview of the Joint Industry Project: Ground Investigation for Floating Wind (GIFT)** David Edwards, *DNV*

14.10	**Evaluating Ground Thermal Resistivity for Power Cable Design: A Comparative Analysis of Regional and Project Specific Thermal Conductivity Data** Thomas Nee, *National Grid*
14.30	**The benefits of an As-Live CBRA: risk and cost reduction during trenching operations** Adam Caton, *TernanEnergy*
14.50	**An Overview of the Geotechnical Survey & Testing Requirements for Drag Embedment Anchor's** Lloyd Inglis, *First Marine Solutions*
15.10	**Conference close**
15.20	**End of day two**

Posters
Magnetic anomalies related to young paleochannels Alex Espuñes Juberó, *Ramboll*
Integrating Aerial and Ground-Based Surveys to Characterise Submarine Cable Landfalls David Harrison, *Geo-4D*
Accelerating Seabed Planning with AI: Ocean Seeker for Shallow Infrastructure Risk Mitigation Eric Joyce, *Ocean Geophysics*
Layered Soils in the UK North Sea: Implications for Subsea Cable Burial and Risk Assessment Catriona Macdonald, *British Geological Survey*
Protection of Subsea Cables from External Threats – including Sabotage! Nicholas Mackenley, *Global Maritime*
Surface Clues, Subsurface Certainty: The Case for Geological Mapping at Landfalls Christopher Brennan, *Geo-4D*
Mapping of Seafloor Obstacles and Morphology from Multibeam Echosounder Data Paul Slater, *Global Maritime*

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Conference Sponsors:

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ORAL ABSTRACTS
(In Programme Order)

Day one

Session One: Risks and Hazards: Geological

Keynote – What is a Seismic Diffraction?

Mark Vardy, SAND Geophysics; Callum Clay, SAND Geophysics; Callum Fry, SAND Geophysics; Ben Owen, SAND Geophysics; Giuseppe Provenzano, SAND Geophysics

Offshore renewable energy sources, such as wind, wave and tidal, are seen as key elements in the new energy approach, offering the possibility to generate clean energy on an extremely large scale. All of these green energy solutions involve the installation of thousands of km of high-voltage inter-array and export cables in the shallow subsurface to transport energy between the offshore generation infrastructure and onshore energy grid(s). The installation of these infrastructure is time consuming and expensive, involving large seafloor machinery that faces challenges when encountering discrete heterogeneities, such as boulders and cobbles. Similarly, controlling the burial depth of these infrastructure is critical in ensuring optimal performance and longevity. Seismic reflection techniques utilizing sub-bottom profiler sources are a commonly used technique for both boulder hazard mapping and cable depth-of-burial assessment. When applied in this way, discrete homogeneities (such as boulders and cobbles) and buried cables are both identified on the seismic amplitude sections by way of seismic diffractions, rather than the laterally continuous reflections typical of geological bedding and interfaces. However, seismic diffractions as seen on a seismic amplitude sections are a complex acoustic wavefield response created in part by the way these data are positioned and processed. Diffracted wavefronts can be generated from a large number of different geological and anthropogenic structures, of which boulders, cobbles and cables are a small subset. Here we present examples, using both synthetic models and real data, showing various ways in which diffractions can appear within seismic amplitude sections, as well as how the size and composition of heterogeneities influences the seismic response. We conclude by discussing how these data might be best utilized for cable-related projects.

Probabilistic Seabed Mobility Assessment for Construction Activities of Offshore Wind Farms

Ramtin Hosseini-Kamal, DNV; Mehmet Ilcioglu, DNV; **Vanessa Monteleone, DNV**

Generally, the main focus in obtaining offshore geophysical and geotechnical data is related to fixed structures, namely foundations, cables and platforms. Less planning and data is acquired for the installation and construction activities such as those related to Wind Turbine Installation Vessels. Based on the existing guidelines, the acceptable seabed survey validity is 6 months for WTIVs. While survey validity periods can be extended up to two years in areas with minimal or no seabed mobility and no activities that could introduce seabed or sub-seabed hazards, there is currently no clear guidance on how to assess the acceptable seabed mobility and corresponding survey validity period.

To address this gap for several OWFs in Europe and US, a probabilistic seabed mobility risk assessment methodology is proposed to evaluate the suitability of extending the validity period of seabed surveys for Wind Turbine Installation Vessels (WTIVs). The method assesses risks using geophysical and geotechnical data and based on the presence of potential unexploded ordnance (UXO), seabed features and morphology, sediment types, surface boulders and debris, seabed gradients, and the potential for punch-through at jacking locations.

Each risk factor is assigned a risk coefficient based on site-specific conditions. These are then aggregated and multiplied by an apparent mobility factor, calculated by comparing site-specific bed shear stresses with the threshold of sediment motion. The resulting total risk rating is expressed as a probability distribution, with the 5th and 95th percentiles representing the minimum and maximum risk bounds, respectively.
Based on the quantified risk level, the seabed survey validity period may be extended—up to two years—using six-month intervals. This methodology enables developers to optimize survey schedules in stable seabed environments, potentially reducing costs while maintaining safety and compliance.

Session Two: Risks and Hazards: Geological

Risk Mapping: Semi-automated Boulder Identification

Louis McCulloch, Global Maritime; Paul Slater, Global Maritime; Nicholas Mackenley, Global Maritime; Grace Brown, University of Liverpool

Identifying boulders and other debris on the seabed is challenging, yet critical in the offshore renewable energy industry. The presence of prominent seabed targets, including boulders and debris, are a significant geohazard to the design and installation of export and inter-array cables, jack-up vessel operations and wind turbine generator (WTG) installations. Data to identify these targets is collected using suitable sensor technologies such as bathymetry from multibeam echosounders (MBES) and side-scan sonar (SSS) imaging. Currently, the boulder identification process can be slow and labour intensive, requiring manual input for location and dimension attributes. The subjective nature of manual boulder identification opens the possibility of inconsistent results due to differing methods / analysts. Furthermore, the existing automated workflows utilise third party software, which can be expensive to license, and require hardware at a higher specification. Here, Global Maritime present an approach that semi-automates the identification and dimensioning of boulders and debris along the seabed using commonly available desktop GIS software. The workflow uses a digital elevation model (DEM) derived from MBES surveys and where available, point data from SSS imagery. Raster interpretation and manual verification between datasets ensures the most accurate location from MBES and dimension information from SSS. This methodology enables reduced processing times, increased accuracy of boulder size and location and utilisation on commonly available desktop GIS software.

2D and 3D Geospatial Characterisation of Submerged Peat Properties from the Southern North Sea

Lydia Brown, University of Leeds; Professor David Hodgson, Dr Mark Thomas, Professor Natasha Barlow

Post-glacial marine transgression during the early Holocene resulted in inundation of the North Sea and burial of laterally extensive peatlands. These submerged peats exhibit highly variable material properties, within individual layers and across different deposits, influenced by organic content, decomposition state, and depositional environment. Geotechnically, peat is characterised by low shear strength, high compressibility and limited bearing capacity. Deposits have a low thermal conductivity and elevated thermal resistivity.

The spatial variability in both the presence or absence of peat, and the material properties of preserved peat presents substantial challenges to offshore windfarm construction. Mechanical instability increases the risk of slumping and subsidence during installation, while poor thermal performance can lead to overheating and reduced efficiency in buried submarine cables. Therefore, improved geological characterisation of preserved peat in the planning phase of cable routing could reduce uncertainties. Here, shallow subsurface peats and bounding units have been mapped in detail across the Ten noorden van de Waddeneilanden (TNW) area, Southern North Sea, integrating 2D and 3D seismic reflection datasets alongside engineering borehole and CPT data. The results allow for better geospatial constraints on peat character in order to inform route optimisation and geohazard mitigation for submarine cable infrastructure, and for comparison of 2D and 3D seismic reflection datasets in their ability to outline these deposits.

Hydrodynamic and Engineering Implications of Glacially-derived Gravel Lag Deposits; Mapping a Geo-constraint to Shallow Offshore Infrastructure

Gareth Carter, Arup; R. Birchall, SSE Renewables; M. Rose, SSE Renewables; A. Flint, SSE Renewables; C. Cotterill, NGI; L. Arlott, RWE Renewables; G. Wood, bp; B Bellwald, NGI

Quaternary (2.58 Ma – present) soil deposits located across previously glaciated margins can contain, by the nature of their depositional environment, a high content of gravels and cobbles. These coarser-grained soils can either be deposited and remain in situ, for instance as glaciofluvial channel infill material, or they can be accumulated into denser lag deposits as Holocene marine inundation of the previously terrestrial surface reworked the glacigenic soils, winnowing out the fine-grained material. These coarse-grained soils can be classified as an engineering geological constraint (geo-constraint) to Offshore Wind projects in several ways, including during Site Investigation campaigns (e.g., early refusal of CPT), subsea cable trenching works (e.g., unfavourable for jetting, plough deviation) and during Wind Turbine Generator (WTG) foundation installation works (e.g., high degree of soil heterogeneity at a proposed suction caisson location). However, by using an integrated dataset comprising shallow, high-resolution seismic (e.g., pinger), multibeam backscatter, seabed grab samples, and vibrocores, an assessment can be made of how prevalent these deposits are across a lease area or a cable route, and maps can be generated to reveal where lag deposits are likely to occur not only at seabed but also where buried beneath a veneer of modern surface sands. Here, we demonstrate this approach across a wind farm development zone in the North Sea, focusing on inter-array cable burial depths (i.e., gravel and cobble lags within 2 m below seabed zone). Mapping was undertaken in S&P Global Kingdom, identifying horizons with multiple hyperbolae (diffractions) which are often caused by these soil types, and final grids were validated in a GIS against backscatter and the ground-truthing datasets stated above. The results showed a good correlation between the picked horizons and the validation dataset and provided a tool to de-risk cable trenching operations across the array area.

Cable Routing in a Seismically Active Region

Alexander Cattrysse, IMDC

A first stage to de-risk any subsea power cable project for offshore renewable energy is to gather all available public & client-owned data. The gathered dataset can then be used to define a first conceptual route for export cables based on which future site investigations can be planned.

The routing of the cable needs to take into account a plethora of criteria:
- Anthropogenic constraints & hazards
- Environmental constraints
- Geohazards
- Operational a maintenance constraints

From the conceptual stage, the routing should be aimed at reducing these hazards and constraints as much as feasible. The cable routing is conducted with the aim to of finding the path with the lowest “cost”, in this case being the least hazardous and constrained path. In order to find this path a cost raster is created by combining a scoring attributed for each hazard category, and by weighing each category via an analytic hierarchy process.

Based on the resultant raster a path is generated between two points assuming a least cost path analysis. A major geohazard for the area under investigation is the high seismic activity and large occurrence probability of resultant earthquakes.

Finally, the path is refined based on consultant experience as often a trade-off is to be made between hazard mitigation and financial cost.

Cable routing – Seismic activity – Offshore wind

Offshore Wind Asset Integrity - A Strategy for Monitoring Cables

Craig Dyer, RWE Renewables

Anchor–cable interactions currently account for between 70-80% of subsea cable failures, a figure expected to rise (ICPC) with the continued expansion of offshore wind. To mitigate this risk, it is essential that subsea cables are installed at appropriate depths. Current industry guidance – namely the Carbon Trust's 2015 "Cable Burial Risk Assessment" (CBRA) methodology - recommends burial depths up to 5 m below seafloor (mbsf), depending on ground conditions but assumes soil homogeneity within that range. This overlooks the geotechnical complexity of layered soil profiles, where vertical contrasts in soil type, and the strength and density profile, can significantly influence anchor penetration. We present the spatial distribution of soil layering combinations in the UK North Sea based on analysis of over 20,000 samples, compiled from open-source geotechnical datasets (e.g. BGS Offshore GeoIndex, Marine Data Exchange). We demonstrate that layered soil conditions within the upper 5 mbsf are widespread and we identify samples with layered soil combinations and geotechnical transitions that are likely to impact CBRA outputs. Case studies from this analysis have informed complementary physical and numerical anchor-penetration modelling (e.g., Sharif et al., 2023; Bird et al., 2023a, b) within the EPSRC-funded project "Offshore Cable Burial: How deep is deep enough?". These results highlight the need to refine CBRA methodologies to account for the variability of layered soils. The compiled core database and resulting maps provide a practical tool for early-stage planning, enabling improved prediction of Depth of Lowering (DoL) and reducing risk in future offshore cable developments.

Implications of Trenching on the Operating Temperature of Marine Power Cables

Jon Duell, University of Southampton (UoS) and Global Maritime; Justin Dix, UoS; George Callender, UoS; Tim Henstock, UoS; Lorenza Salza, UoS; Dave White, UoS

The thermal resistivity of the burial medium has significant implications for the operation (ampacity), design (cross-sectional area) and subsequent efficiency, longevity, CAPEX and profitability of submarine power cables. Typical ampacity models (e.g. IEC-60287) assume the cable is set within a homogeneous medium, with thermal properties determined from conservative thermal resistivity statistics derived from the ambient sediment measurements. Cables, however, are typically trenched 1-3m below the seabed, and the thermal properties of the trenched backfill could be thermally distinct from these ambient measurements. If so, a realistic ampacity model must consider a cable set within a rectangular to trapezoidal trench, backfilled with a thermally distinct medium from the ambient sediment. The relationship between the thermal properties of trenched and ambient sediments measured during the offshore campaign is still not well understood. As a result, the implications of trenching—specifically trench geometry and the relationship between the trench backfill and the surrounding environment—on the ampacity of marine power cables can only be speculated upon.

This study investigated the thermal resistivity distributions of pure saturated SAND (S), GRAVEL (G), and FINES (F) (i.e., ambient), as well as two samples (S:G & S:F) mixed at different volume ratios (i.e. trenched), using the standard laboratory-based needle probe method. The results demonstrate that when the thermal resistivity distributions of ambient sources are comparable, conservative statistics for ambient lithologies can accurately reflect those of trench backfills. However, if there are differences in thermal resistivity—such as when fines are more resistive than sand—these statistics tend to overestimate the properties of sand-dominated backfills. In contrast, fines-dominated backfills exhibit greater thermal resistivity than the ambient sources, resulting in an underestimation of trench backfill characteristics. Trench geometry and the relationship between trench and ambient thermal resistivity significantly influences ampacity outcomes.

A Pragmatic Approach to UXO Risk Mitigation

Robert Mills, RWE Renewables

Many offshore wind projects in the North Sea have significant risks from Unexploded Ordnance (UXO). Mitigating these risks to As Low As Reasonably Practicable (ALARP) level is a subjective exercise which is often discussed extensively between stakeholders prior to windfarm construction, resulting in delays and additional costs. This is amplified when additional complications (such as mobile bedforms) are present. We present a case study of a North Sea wind farm which has utilised a pragmatic risk mitigation approach to maximise data value and reduce mitigation costs on line with the ALARP principle. Seabed mobility data was utilised to accurately determine the significance of the UXO burial risk. Full site UXO data was acquired to optimise the survey schedule and maximise data value. Lastly, various innovations were used to reduce the number of potential UXO targets requiring ROV investigation and minimise costs prior to construction. This demonstrates a robust ALARP strategy for stakeholder alignment without accruing unnecessary costs and delays that are disproportional to the UXO risk on site.

Utilisation of Reconnaissance Geo-data to Assess Inter-array Cable Hazards and Constraints

Lorriane O'Leary, Fugro GB Limited; **Charles Bloore, Fugro GB Limited**; Devan Scanlan, Fugro GB Limited

Early-stage ground modelling for offshore windfarms (OWF) typically utilises reconnaissance data as the primary, site-specific input where turbine, cable layouts and infrastructure designs are often unknown. These reconnaissance data are generally limited by the spacing of geophysical lines and number and spatial coverage of geotechnical data points across a site. The reconnaissance surveys and early-stage ground models often focus on understanding the deeper subsurface for foundation design.

The Princess Elisabeth Zone, in the Belgian sector of the North Sea, is characterised by a variable seafloor morphology which poses a consideration for cable design and installation. The ground model was developed using reconnaissance geophysical and geotechnical data with initial interpretation focussed on identifying the top and composition of pre-Quaternary sediments.

Consideration of the geological processes and in particular the focus on characterising the site for inter-array cables, led to the geophysical data being reviewed and reinterpreted in order to characterise the shallower geohazards and constraints. This resulted in the reinterpretation of boundaries within the Quaternary. This re-interpretation identified two separate phases of deposition occurred during the Quaternary and the geological model was updated. In addition, re-interpretation showed multiple phases and scales of bedforms developed during the Quaternary including large sand banks and smaller scale sand waves and ripples.

This presentation will highlight the importance of understanding geological processes to develop the ground model, utilising the available geo-data to assess the hazards and constraints for inter-array cables and not just for deeper turbine foundations.

Risk Monitoring of Submarine Export Cables in the UK

Christoper Brennan, Geo-4D; David Harrison, Geo-4D

In the early days of offshore wind, generated electricity from turbines was transferred along one, sometimes two, relatively short (10-20km long) export cables. Over time, routes have become longer and more complex, with the latest wind farms requiring two or more export cables over 70km in length which traverse a variety of natural and anthropogenic hazards.

Therefore a comprehensive and consistent approach to monitoring cable risks after installation is crucial for managing cable assets and identifying potential issues before they result in cable downtime.

A robust approach to monitoring export cables over their lifespan begins with a detailed forensic review of available pre-installation, installation and post-installation data, to understand the key risks to the cable(s). A ground-model approach works well, allowing all geophysical, geotechnical, geological and engineering data to be collated and reviewed, typically within a GIS environment. Hazard appraisal consists of cable burial risk assessments, sediment mobility modelling, fishing risk analysis and probabilistic anchor strike risk modelling. Site conditions should be summarised in a baseline interpretive report which can be used to reference future datasets, guide monitoring surveys and accurately characterise key risks to mitigate against any potential issues before they result in cable damage.

Often not all risks are identified, predicted or fully characterised prior to cable installation, and therefore a proactive approach to risk identification, quantification and management is required. This allows for potential cable exposures, freespans, anchor strikes etc., to be identified early on and mitigated, ensuring maximum cable operability over the lifetime of the development.

Session Four: Ground Modelling

Integrated Ground Models for Long-distance Submarine Cable Routes: A Practical Approach to CBRA Needs

Morgane Ravilly, GEOxyz; Davide Mencaroni, GEOxyz; Iciar Martinez, GEOxyz

Methodologies for building shallow integrated ground models are still evolving, though they have seen significant development in recent years. This progress has been largely driven by offshore windfarm investigations, which require identification and 3D visualization of soil units over wide areas. The introduction of dedicated software has supported the integration of geophysical and geotechnical datasets, enabling the definition of geotechnical provinces and parameters for design. These models reduce risk by combining geological, geophysical, and geotechnical data in a coherent framework and provide valuable information for decision-making in the following phases of development.

A similar approach is required for long submarine cable routes, where Cable Burial Risk Assessment (CBRA) and environmental impact studies demand integrated ground models. In cable route projects, accurate seafloor characterization plays an even more critical role than in offshore windfarms. These models must combine seabed features, sediment mobility, bathymetry (e.g. slope gradients), and sub-seabed conditions, along with the identification of geohazards and anthropogenic risks. Although the level of geotechnical characterization is typically lower than for offshore windfarms, visualizing all these variables along routes extending hundreds of kilometres remains a challenge. In such cases, the problem is essentially two-dimensional, and conventional 3D tools are often not effective for representing ground conditions along long routes.

We propose a workflow to improve visualization and analysis of long-distance 2D ground models, focusing on the upper stratigraphy relevant to cable burial. The method integrates calibrated acoustic units, derived from the correlation of sub-bottom profiles with CPT and vibrocore data, with key seafloor properties such as sediment type, bathymetric features and seabed mobility, to define unique “Terrain Units”.

Terrain Units group areas with similar seabed and sub-seabed conditions, enabling consistent analysis and interpretation along the route. The approach provides a clearer understanding of ground conditions expected during cable trenching and installation.

Practical Consideration in Using Ground Models for Assessment of Cable Trenching

Peter Allan, PACE Geotechnics Limited

Ground models are often developed for windfarm sites with the primary consideration being identification of strata to around 50 m depth for foundation design. This results in the shallow soils, which are critical for cable burial operations, being poorly defined. Even when well defined, there are often short comings in the ground model developed.

This presentation looks at the use of ground models from a contractors perspective and shows how they are used and discusses the contractual implications of a ground model. Suggestions are made for the presentation of appropriate ground models , how the different soil units should be identified and how the models impact on selection and performance prediction of different trenching tools.

The Development of Shallow 3D Integrated Ground Models for Cable Design

Nick Pryor, Global Maritime; Kieran Hill, Global Maritime; Jon Duell, Global Maritime; Liam Murray, Global Maritime; Matthew Laing, Global Maritime

The development of shallow 3D integrated ground models is transforming the design and risk assessment of buried cable infrastructure. These models combine geological, geotechnical, and geophysical data into a continuous, high-resolution representation of the near-surface zone (typically 0–10 m), providing detailed spatial insight far beyond traditional methods.

Shallow models are often developed in parallel with or derived from deeper ground models originally constructed for wind turbine foundation design. These deeper models provide valuable context, continuity, and geotechnical unitisation at depth, which can be refined and extended to create high-resolution shallow models. This integration ensures consistency across ground interpretations and enables a seamless transition from foundation to array or cable corridor characterisation.

The unitisation of stratigraphy in the 3D model allows for the derivation of strength versus depth relationships, which are essential for trench stability analysis, mechanical protection assessments, and burial feasibility studies. In addition, thermal parameters such as thermal conductivity and thermal resistivity can be spatially assigned and used directly in cable heat dissipation and ampacity models, supporting accurate thermal design for high-voltage and high-capacity systems.

A major application of shallow 3D models is the generation of high-resolution burial risk assessments. By mapping spatial variations in lithology and geotechnical strength, the model enables quantitative, geo-referenced risk profiling along the cable route. This allows for early identification of zones of elevated anchor strike risk, but also burial risk such as shallow refusal, unstable trench zones, or thermal bottlenecks—and supports proactive mitigation during the design phase.

By leveraging deeper models from foundation design and enriching them with near-surface detail, shallow 3D integrated ground models create a predictive, risk-aware framework for cable routing and burial. This leads to improved design certainty, optimised construction planning, and more resilient, cost-effective infrastructure delivery.

Use of 3D Integrated Ground Models for the Development of a Burial Assessment for Tool Feasibility and Selection

Holly Cairns, Global Maritime; Emma Lee, Global Maritime

Burial assessment studies (BAS) in the early phases of project development are a crucial step of planned subsea cable installation works, with the study discussing assessing the suitability of multiple burial tools for the installation of subsea cables. Geological conditions, seabed objects, target trench depth, and morphology are considered to inform tool selection, with engineering judgement, experience of the capabilities and limitations of available tools, and project experience applied to ensure that the most efficient, safe and effective decisions are made.
Geological conditions are considered as a shallow ground model, derived from a two-layered cable burial risk assessment (CBRA) model and characterised by the geotechnical properties of the soil. The target trench depth is calculated from the depth of lowering from stable seabed level, as defined within the preceding CBRA. The morphology of the seabed may limit the tools that can operate on the seabed within safe pitch and roll limits.
Typically, burial tools are assessed on a cable-by-cable basis, whereas Global Maritime take a spatial, 3D approach to BAS by categorising a cable corridor or wind farm area according to the input parameters to generate a 3D gridded traffic-light matrix of each burial tool's suitability to perform effective cable burial within the study area. Each cell contains information as to whether the burial tool is suitable, not suitable, or partially suitable for use in installation. The resultant matrix surfaces can be re-used to extract suitability information along any alternative, proposed cable routes, increasing efficiency within the project timeline. The surfaces can also be used to inform cable route engineering through optimised installation operations, and the avoidance of key risks to achieving the target burial depth.

Day two

Session Five: Ground Modelling

Keynote – CBRA: How Deep is Deep Enough

Mike Brown, Will Cooms,

Impact of Bedform Migration and Sediment Mobility on Ground Modelling for Submarine Cables and Pipelines

Arthur Blouin, Fugro France SAS; Kathryn Lehmann, Figaro GB Limited; **Charles Bloore, Fugro GB Limited**; Devan Scanlan, Fugro GB Limited; Jordan Wilson, Fugro GB Limited; Lorraine O'Leary, Fugro GB Limited

Bedform migration and sediment mobility represent a major constraint for the design and installation of submarine cables and pipelines. Inaccurate assessment of their evolution over time may lead to installation, design or maintenance issues. If unexpected burial of cables occurs this can affect the thermal characteristics of the shallow soil section, potentially leading to overheating if cables are not appropriately designed. Additionally, sediment mobility may expose cables at seafloor leading to spanning issues and increased risk of damage from anthropogenic activities. Bedform migration and sediment mobility may also lead to scour around infrastructure which can result in increased risk of instability and damage.

An assessment of bedforms and sediment mobility using publicly available data can inform developers at an early stage on risks and areas of uncertainty. Based on this preliminary assessment, optimized and focused shallow geophysical data (multibeam echosounder, side scan sonar, sub-bottom profiler), shallow geotechnical data (grab samples, cone penetration tests and vibrocores), as well as metocean data (wave height, current values) should be acquired prior to the design and installation of submarine cables and pipelines. The comprehensive integration of these data for a cable route can significantly improve the understanding of the rate of bedform migration and sediment mobility. Results should then be applied to ground models, sediment mobility studies and scour analysis.

This presentation provides examples of diverse submarine cable and pipeline projects, where site-specific data were acquired and integrated into ground models. It demonstrates the need for “live” ground models that implement up-to-date information as they are acquired to reduce or account for uncertainties relating to bedform migration and sediment mobility during the design, installation and life span of a cable or pipeline.

Ground Model Application in Offshore Wind – Installation Contractor Perspectives

Nawras Hamdan, Seaway7; Buket Yenigul, Jennie Morgan

Offshore Wind Farms (OWFs) span over much larger areas compared to the oil and gas fields. Understanding ground conditions is a key to minimise installation time and associated risks making projects less costly to Developers. For this a Ground Model is typically developed throughout the various geophysical and geotechnical campaigns completed during the development stage of a project. This paper addresses various application of the Ground Model, e.g.; geo-hazards and their impact on cable routing and micro-routing, foundation micro-siting and jack-up Installation Vessel locations. Examples for various applications are presented to emphasise on the important of the ground model and accuracy of geophysical techniques.

Mind the Gap – Integration of the Nearshore Transition Area into Cable and Pipeline Route Ground Models

Kathryn Lehmann, Fugro GB Limited; **Charles Bloore, Fugro GB Limited**; Arthur Blouin, Fugro MSC France; Lorraine O'Leary, Fugro GB Limited; Devan Scanlan, Fugro GB Limited; Jordan Wilson, Fugro GB Limited

The nearshore area of a cable or pipeline route, between the landfall and the offshore, is a transition area where differing data sources and installation considerations meet. This nearshore transition area is defined as the area between 0 m and 10 m to 20 m water depths. Intersecting data sources and installation methods in this nearshore transition area can lead to potential issues when deriving cable and pipeline route ground models.
Issues related to the nearshore transition area include change in geophysical data survey and geotechnical data acquisition types and techniques, overlap of data types leading to potential correlation inconsistencies, water depth datum changes, potential data gaps, depth of interest changes due to different installation methods and changes in quality, resolution and confidence of publicly available data.
These potential issues can cause data integration difficulties and can affect the continuity of the cable or pipeline route ground model ultimately leading to an incorrect classification of the geological and geotechnical conditions.
This presentation will detail examples of previously encountered nearshore transition area data source integration issues and how they were resolved using a robust integrated ground model approach.

Session Six: Technical and Machine Learning

Assessment on the Accuracy and Benefits of Subsea Cable Pre-Installation Geophysical Acoustic Imaging Surveys

Chris Williams, Kraken Robotics

Successful subsea cable installation comes down to proper planning and adequate installation methods based on the geological conditions of the installation route. Understanding what is required for different geological conditions is common practice across the industry. The challenging part is accurately defining the geological conditions along the entire installation route, as a misinterpretation, or an incomplete understanding can result in project delay, unachievable targets, inadequate methods, unanswered questions, damaged products, and/or loss of profit.

Kraken Robotics' Sub-Bottom Imager™ (SBI) technology has the capability to image sub-surface features by producing a three dimension (3D) volumetric model. With this we have been able to assess the sub-surface for geological conditions which would influence the successful installation of subsea cables. Alongside this, Kraken Robotics were provided the opportunity to image the sub-surface following the cable installation to determine the final depth of cover. This gave us the unique opportunity to examine the results from both the pre-lay and post-installation surveys, determining the accuracy of geological interpretations with the goal to highlight the importance and benefits of performing a pre-installation sub-surface geophysical survey.

This assessment involved combining the results from not only the pre- and post- installation SBI surveys, but also the results from trenching and ploughing logs, SBF surveys, geotechnical and isopach reports. This provided information on how well the results from the pre-installation geological survey correlated with the final DoC and other surveys, logs, and reports. It was found that of the 117.684 km of comparable data, the SBI allowed for accurate sub-surface geological interpretation for 87.18% of the survey area with an additional 4.22% reported through other means. It was also found that 16.70% (17.201 km) of the data which had accurate sub-surface geological interpretation contained trenching obstructions which were unidentified in the other geohazard surveys and assessments.

Advancing Thermal Design of Submarine Cables through Integrated 3D Geological and Finite Element Modelling

Sudur Roy, Seequent; Jack Green, Seequent

Submarine power cables are critical to offshore wind farms and interconnector systems, yet traditional design methods often oversimplify the thermal behaviour of the shallow marine subsurface. Assumptions of homogeneous seabed conditions can lead to overly conservative cable sizing – raising material costs and increasing environmental impact.

This study presents a novel workflow that integrates 3D geological modelling with transient thermal finite element analysis to develop a more accurate and sustainable approach to subsea cable design. A detailed 3D geological model is first created using Leapfrog, capturing spatial variability in sediment types and their thermal properties. These geological units are then assigned appropriate thermal parameters, accounting for natural heterogeneity and installation effects. Thermal testing data are used to construct a 3D thermal model, which is combined with the geological model to produce an integrated ground model. While the study focuses on thermal hazards, the ground model can address all subsurface hazards and integrate other data types such as geophysical, CPT, and surface mapping.

Using Temp/W – a finite element software – transient thermal behaviour can be simulated along selected cross sections of cable routes. This allows precise prediction of cable operating temperatures and enables optimisation of conductor sizing, improving material efficiency without compromising reliability. The framework also supports back-analysis of thermal performance for existing infrastructure with potential for optimisation and dynamic load management.

Beyond design efficiency, this approach helps assess thermal impacts on the surrounding seabed - mitigating risks such as hot spot generation, sediment fluidization, geochemical alteration and habitat disruption.

By leveraging commonly available site investigation data, the methodology delivers technical, economic, and ecological benefits that support more resilient and sustainable offshore energy development.

Automated CPT Cross-Section Generation for Offshore Cable Routes Using Dynamic Time Warping

Giuseppe Malgesini, Geowynd; Omar Zanoli, Geowynd; David O'Dowd, Geowynd

Subsurface characterisation along offshore cable routes is crucial for wind farm development, affecting route selection, installation methods, and long-term asset performance.
Accurate geotechnical characterisation requires robust geological interpretation from typically sparse CPT data, calling for methods that can effectively bridge gaps between widely spaced investigated locations.
Machine learning and seismic inversion for synthetic CPT generation show promise for filling data gaps, but these approaches often require extensive calibration, carry uncertainties from model assumptions, and can struggle with variable ground conditions.
This paper presents a practical alternative: semi-automated cross section generation using Dynamic Time Warping (DTW). The method aligns measured CPT parameters (tip resistance, sleeve friction, etc.) between locations while accounting for geological variability and layer thickness differences that are critical for reliable stratigraphic correlation.
While the approach is applicable to various subsurface modelling tasks, including full Integrated Ground Models (IGMs), it's particularly suited to offshore cable route assessments. These projects typically involve shallow investigation depths, lower chances of structural deformation or glaciotectonic disruption, and an essentially two-dimensional problem geometry where DTW performs best.
The method respects existing seismic horizons and stratigraphic units from the IGM, ensuring CPT correlations stay consistent with broader geological interpretations and support integrated modelling across disciplines.
By working directly with measured CPT data to create optimized alignment pathways , this approach allows for rapid, reliable, and geologically sound model construction. It offers a practical alternative to synthetic data generation for linear offshore projects.
Real-world examples will illustrate how the technique improves efficiency, consistency, and interpretability in cable route ground modelling.

Quantitative Geophysical Analysis In Support of Cables

Callum Clay, SAND Geophysics UK; Neil Dyer, Cathie Associates, UK; Giuseppe Provenzano, SAND Geophysics, UK; Kieran Blacker, Cathie Associates, UK; Mark E. Vardy, SAND Geophysics, UK

To meet the carbon dioxide emissions pledges made by governments across the globe, there needs to be a drastic, worldwide shift in energy sources towards a mixed renewables solution that can balance demand, reliability and cost. Offshore renewable energy sources, such as wind, wave and tidal, are seen as key elements in this new energy approach, offering the possibility to generate clean energy on an extremely large scale. All of these green energy solutions involve the installation of thousands of km of high-voltage inter-array and export cable in the shallow subsurface to transport energy between the offshore generation infrastructure and onshore energy grid(s). While there has been significant recent interest in leveraging quantitative information from both the geotechnical and geophysical measurements to optimize timelines and reduce risks in foundation design/installation by reducing uncertainty away from sample locations, very little equivalent work has been done in support of cable installation or performance. There are similar benefits to deriving more spatially continuous quantitative ground information for both inter-array and export cables. Route planning, cable installation, cable performance, and cable longevity are all influenced by the nature of the ground, such as whether the soils are granular or cohesive, level of compaction, and organic material content. In particularly, sudden and/or highly localized changes in conditions can provide significant operational challenges. Here we present examples where quantitative information on the spatial and stratigraphic variability in key ground conditions for cables are derived from geophysical data. The thermal regime and level of compaction are mapped as spatially continuous parameters that can be of direct benefit at different stages of a cable project.

Importance of Comprehensive Understanding of Seabed Conditions for Reducing the Risks of Submarine Cable Installation

Nusin Buket Yenigul, Seaway7

The rapid expansion of the offshore wind industry has introduced significant engineering challenges, particularly in the installation and protection of submarine cables. Cables are buried to mitigate risks from external threats such as fishing gear, dropped objects, and anchoring. However, subsea cable burial remains challenging and identified as one of the most high-risk offshore operations.

Several factors contribute to the cable burial risk profile with seabed properties and incomplete soil data being among the most critical. Submarine cables often span several kilometers, traversing diverse and dynamic seabed conditions, including varying sediment types, geohazard-prone areas (e.g. subsea landslides, sand waves and boulder fields). These environmental complexities significantly increase the uncertainty and operational risk associated with cable installation and long-term stability.

This risk tends to be proportional to the shape and composition of the seabed. For example, trenching across a flat seabed in sand or soft clay conditions may proceed relatively smoothly whereas in harder and heterogeneous seabed conditions, such as glacial till, boulder clays, cemented carbonate soils burial can be very difficult. Nowadays, another increasing trend in the offshore wind industry is the construction of wind farms in locations with less favorable seabed conditions, characterized by such soils.

Poor understanding of ground conditions often leads to the oversight of critical geohazards, resulting in suboptimal cable route design, project delays and cost overruns. Therefore, the successful execution of cable installation primarily depends on a comprehensive understanding of seabed conditions by integration of desk studies, geophysical and geotechnical surveys, in-situ and laboratory testing. This integrated approach enables us to identify potential hazards, installation constraints, conduct reliable burial assessments, select appropriate trenching tools and develop mitigation strategies critical to the success of subsea cable projects. A case study from the North Sea is presented to demonstrate the use of such an integrated approach

An Overview of the Joint Industry Project: Ground Investigation for Floating Wind (GIFT)

David Edwards, DNV; Alejandro Borobia Moreno, DNV; Amy Beeston, Yiorgos Perikleous, DNV

This presentation will provide an overview of an ambitious Joint Industry Project called Ground Investigation for Floating Wind (GIFT) that DNV has recently launched. The project aims to develop a new approach for performing ground investigations and ground characterisation for offshore windfarms. The guidance will encompass floating wind turbine anchoring solutions, fixed-bottom foundations and the shallow seabed zone including application to seabed cables.
This JIP brings together more than 20 industry partners, comprising operators, designers, contractors, regulatory authorities and academic institutions who will work towards developing an industry practice for the derivation of appropriate design soil profiles for installation and in-place performance.
The procedure that will be developed by the JIP aims to move away from the need for position-specific (anchor/foundation) in-situ testing. This will utilize both geophysical and geotechnical SI and state-of-the-art ground modelling, aligned with project timelines, whilst ensuring adequate knowledge of the ground conditions to facilitate reliable anchor design, accommodate design flexibility, and de-risk installation.
Such an approach has the potential to remove the site investigation from the critical path of project development for both floating and bottom-fixed WTG or cable corridors, de-associating the site investigations from the final wind farm layout and hence allow for the efficient of late layout and/or design changes.

Evaluating Ground Thermal Resistivity for Power Cable Design: A Comparative Analysis of Regional and Project Specific Thermal Conductivity Data

Bambang Sampurno, Fugro; **Thomas Nee, National Grid**

Thermal resistivity (inverse of thermal conductivity) of the ground is a critical design parameter which should be established through in situ testing and/or laboratory testing (DNV, 2021). Ground thermal resistivity significantly influences the current carrying capacity or ampacity ratings of a cable.

Increasing complexities and constraints in the energy supply chain often requires earlier procurement decisions within tighter timescales. This means reliable characterisation of thermal resistivity is essential to support accurate specification and timely procurement of power cables.

The thermal resistivity of soil and rock can be quantified by characterising the thermal conductivity using laboratory and/or in situ testing methods (The Carbon Trust, 2024). Laboratory testing is commonly preferred as they are relatively inexpensive, quick and reliable provided that the testing is performed with strict control of hydraulic and thermal gradients.

The ASTM D5334 (ASTM International, 2022) standard outlines a widely adopted method using a thermal needle probe to determine soils and/or rock thermal conductivity. This technique provides reliable measurements for intact, remoulded and reconstituted specimens under controlled laboratory conditions. However, the standard does not fully address how to ensure that laboratory results accurately reflect in-situ conditions.
This paper analyses thermal conductivity values and ground condition classifications from publicly available datasets, primarily from the Rijksdienst voor Ondernemend Nederland (RVO). Project specific offshore thermal conductivity measurements, from a National Grid marine cable site investigation, are integrated with the publicly available datasets to support data reliability assessment and effective prioritisation for further site-specific thermal characterisation. The study also considers key parameters influencing thermal conductivity results, including soil water content, void ratio, porosity and saturation.

The Benefits of an As-Live CBRA: Risk and Cost Reduction During Trenching Operations

Aggie Georgiopoulou, Ternan Energy; Adam Caton, Ternan Energy; and the Ternan Energy team

Cable Burial Risk Assessments (CBRAs) are common practice to assess the risk of damage to a cable by anchors and fishing gear. A CBRA is a probabilistic assessment of the likelihood of anchor strike on a cable. All hazards and ground conditions are taken into consideration to calculate a required depth of lowering (burial) where the cable is protected during the lifetime of a project. During installation trenching operations will attempt to reach the required depth of lowering, but this is not always easily achievable. Standard practice dictates that post installation a new CBRA is performed, the as-built CBRA. This calculates the residual risk to the cable given the achieved depth of lowering. Further mobilisation may then be required to address the residual risk adding significant costs.

Ternan Energy has developed a CBRA approach that takes place during installation which can calculate the residual risk in real time. At all times the achieved depth of lowering is assessed against the originally calculated risk and recommendations are made in real time about whether additional trenching passes would reduce the risk. Zones that may require additional mechanical protection, e.g., by rock dump, can be identified at the same time. As a result decisions can be made in real time potentially reducing days on site and eliminating the need for an additional mobilisation post-installation, making significant savings.

An Overview of the Geotechnical Survey and Testing Requirements for Drag Embedment Anchors

Lloyd Inglis, First Marine Solutions; Andrew Brennan, University of Dundee; Craig Davidson, University of Dundee

The capacity of a Drag Embedment Anchor (DEA) is dependent on the burial depth that it can achieve in a given soil medium and profile, with its performance being affected by a number of variables relating to the site-specific soil conditions. It is therefore important for a geotechnical survey & testing campaign in which DEAs are being considered is optimised to investigate the parameters of the soil conditions that are important to its performance, as these can vary when compared to other anchor types, such as driven piles or suction caissons.

The paper presents the results of scaled tests (both 1g and centrifuge) that have been undertaken for DEAs in varying soil conditions. The tests are used to highlight the soil properties affect the DEAs performance, and the implication for their use in offshore floating wind projects.

It then follows by discussing what soil properties are required to generate a ground model that enables an accurate assessment of DEAs and how this defines the geotechnical survey & testing campaign requirements for sites in which DEAs are to be used in.

Poster Abstracts

Magnetic Anomalies Related to Young Paleochannels

Alex Espuñes Juberó, Ramboll; **Margrethe Thorup Dalgaard, Ramboll**; Tu Anh Nguyen, Ramboll; Silja Rindom, Ramboll; Aleksandra Zubkova, Ramboll; Lupamudra Sharma, Ramboll

Magnetic anomaly maps are commonly used for UXO detection for offshore projects, but they might also offer important information about the subsurface paleo landscapes and thus for risk evaluation for e.g. offshore wind projects.
In the German North Sea, it has been found that meandering magnetic anomalies correlate with subsurface Late Pleistocene-Holocene paleo channels (Site N-9.1, 2023) formed and drowned during the transgressional period after the Last Glacial Maximum. Potential presence of gas correlates with the young paleochannels, often containing basal peat, both potential geohazards for future wind farm projects, thus the interpretation of these shallow channels is highly relevant. Additionally, based on the magnetic anomaly maps, broader and deeper Paleocene tunnel valleys have been observed to cut through clay-rich areas of increased magnetic response.
The geological relations of the magnetic signal to hinterland or depositional environment are not well understood. A better understanding of this relationship might support the use of magnetic anomaly maps for geological structure interpretation, which is more time-efficient than interpretating 2D seismic data. The magnetic minerals are likely to have a ferrous composition and may have either a terrigenous or authigenic origin. Terrigenous mineral supply in the area, has previously been suggested to be linked to coastal erosion with magnetic minerals coming from the German Bight or the East Anglian Plume (Özmaral et al., 2022), an increase of erratic terrigenous material due to a headwater glaciation (Gibbard & Lewin, 2016), or linked to clay deposits. Authigenic formation of ferrous minerals may be associated to organic-rich sediments drowned during transgression, linking the magnetic signal to the shallow channel’s basal peat deposits (Van der Brenk et al., 2023).
Further research on the possible origins of the magnetic anomalies could improve the risk assessments and geological interpretations for future offshore projects.

Integrating Aerial and Ground-Based Surveys to Characterise Submarine Cable Landfalls

David Harrison, Geo-4D

The landfall portion of a submarine cable can be challenging in terms of site characterisation, cable engineering, installation, monitoring and maintenance. The challenges largely stem from the highly dynamic nature of landfalls, with a variety of complex and dynamic coastal processes resulting in difficult site access, complex geological conditions and unpredictable sediment mobility. If not characterised appropriately, these challenges result in poorly understood landfall conditions and processes, resulting in increased uncertainty and project risk.

The recent growth in offshore wind power generation and power sharing networks has created a significant demand for landfall surveys. However, landfall survey requirements can be poorly considered, with reliance on outdated, low resolution and potentially unsafe survey techniques.

Over the last 10 years, a combination of rapid technological advances, hardware miniaturisation and the rise of unoccupied vehicles (aerial and sea-based) allows for rapid and comprehensive landfall surveys to be conducted, with reduced risk exposure to survey personnel, increased data resolution and reduced survey costs. However, it is crucial that the limitations of such new technologies are understood, and that traditional survey and site investigation techniques are also used appropriately to supplement the more advanced survey methods.

This presentation will detail the latest technological developments in landfall survey techniques, with an aim to better inform cable developers, operators and survey contractors of the benefits and shortcomings of various high-tech survey techniques, whilst setting out a multidisciplinary high-tech approach to assessing complex landfall environments.

Accelerating Seabed Planning with AI: Ocean Seeker for Shallow Infrastructure Risk Mitigation

Eric Joyce, Ocean Geophysics

Subsea cable and drag anchor installations are increasingly challenged by complex, shallow-subsurface conditions that are often under-characterised in early project phases. Ocean Geophysics presents Ocean Seeker, our proprietary AI-assisted detection and classification software designed specifically for shallow geohazard mapping and seabed feature recognition. Ocean Seeker has been developed to support rapid and scalable interpretation of high-resolution geophysical datasets, identifying boulders, debris fields, scour, and morphological irregularities in the upper 10 mbsf, the critical zone for cable and anchor installation.

In this talk, we demonstrate how Ocean Seeker has transformed project planning timelines, enabling near real-time interpretation workflows that deliver actionable outputs within days of acquisition. Using real-world case studies, we explore its effectiveness in reducing human bias, improving repeatability and increasing confidence in geotechnical desk studies and engineering assessments. Our examples focus on derisking through early identification of mobile sediments, buried features, and anthropogenic objects, feeding directly into geotechnical model refinement and installation design.

Ocean Seeker bridges the gap between traditional manual interpretation and next-generation data automation. Its integration into shallow infrastructure planning helps streamline workflows, reduce delays and increase safety margins; ultimately enabling faster, smarter decisions for offshore wind developments.

Layered Soils in the UK North Sea: Implications for Subsea Cable Burial and Risk Assessment

Catriona Macdonald, British Geological Survey; D Stevens, BGS; G.D.O Carter, Arup; C.E Augarde, Durham University; W.M. Coombs, Durham University; R.E. Bird, Durham University; M.J Brown, University of Dundee; Y.U Sharif, University of Dundee

Anchor–cable interactions currently account for between 70-80% of subsea cable failures, a figure expected to rise (ICPC) with the continued expansion of offshore wind. To mitigate this risk, it is essential that subsea cables are installed at appropriate depths. Current industry guidance – namely the Carbon Trust's 2015 "Cable Burial Risk Assessment" (CBRA) methodology - recommends burial depths up to 5 m below seafloor (mbsf), depending on ground conditions but assumes soil homogeneity within that range. This overlooks the geotechnical complexity of layered soil profiles, where vertical contrasts in soil type, and the strength and density profile, can significantly influence anchor penetration. We present the spatial distribution of soil layering combinations in the UK North Sea based on analysis of over 20,000 samples, compiled from open-source geotechnical datasets (e.g. BGS Offshore GeoIndex, Marine Data Exchange). We demonstrate that layered soil conditions within the upper 5 mbsf are widespread and we identify samples with layered soil combinations and geotechnical transitions that are likely to impact CBRA outputs. Case studies from this analysis have informed complementary physical and numerical anchor-penetration modelling (e.g., Sharif et al., 2023; Bird et al., 2023a, b) within the EPSRC-funded project "Offshore Cable Burial: How deep is deep enough?". These results highlight the need to refine CBRA methodologies to account for the variability of layered soils. The compiled core database and resulting maps provide a practical tool for early-stage planning, enabling improved prediction of Depth of Lowering (DoL) and reducing risk in future offshore cable developments.

Protection of Subsea Cables from External Threats – Including Sabotage!

Nicholas Mackenley, Global Maritime; Jon Duell, GM; Francis Dick, GM

Accidental damage caused by fishing gear and vessel anchors are the primary threat to subsea cables, accounting for ~70% of faults annually. However, with increasing reliance on subsea infrastructure and rising political tensions, the risk of deliberate sabotage is seemingly escalating.

This case study utilises geotechnical, vessel traffic density, and recent cable burial depth data as part of GM's 3D CBRA methodology to assess the strike risk on a geopolitically vulnerable cable that was recently damaged. It evaluates the likelihood of sabotage and explores the potential for reducing the risk of both intentional and unintentional damage by increasing the cable's burial depth during repair.

Analysis based upon the most recent depth of burial data produced a very low return period indicating that there was limited protection prior to the damage. The high risk was attributed to the combination of high vessel traffic density and the presence of very soft clays, prevalent along the route down to 5m below seabed, posing significant limitations to the effectiveness of cable burial to mitigate accidental and/or intentional damage.

Further sensitivity analysis was conducted, assuming deep burial along the vulnerable section, with no significant increase in return period.

These findings raised critical questions:
• In environments where unavoidable very soft clays limit burial effectiveness, what practical options exist to adequately protect subsea cables?
• If the return period based upon the most recent depth of burial survey was so low, was this an inevitable outcome driven by geological conditions and vessel traffic – or is it possible this was an act of sabotage?

This case study, along with the combination of external geopolitical, vessel traffic density, and geotechnical factors, highlighted the potential need for site-specific protection strategies as an alternative to traditional cable burial in areas of extremely soft sediment and high vessel traffic.

Surface Clues, Subsurface Certainty: The Case for Geological Mapping at Landfalls

Christopher Brennan, Geo-4D; David Harrison, Geo-4D

Geological mapping is a core skill taught during undergraduate geoscience degrees; however, its true value often isn't leveraged in industry as often as it should be.

In an age of high-tech survey methods, many anticipate accurate characterisation of the geological conditions at site to be straightforward based on the geophysical and geotechnical datasets. Although geotechnical data is relatively quick and cheap to acquire onshore, spatially extensive sub-bottom geophysical data can be laborious to acquire and provided limited fidelity and penetration from which robust interpretations can be made.

As an increasing amount of offshore infrastructure is connected into the onshore grid, the number of landfall surveys is increasing, often with highly complex geological conditions that require accurate characterisation for horizontally directionally drilled (HDD) duct installation. Detailed field mapping provides the first layer of certainty and is a low-cost and an effective means of validating geophysical interpretations and guiding targeted geotechnical investigations at landfall sites.

This poster presents a case study where detailed geological mapping along a coastal transect played a vital role in developing an integrated ground model prior to horizontal directional drilling (HDD) works at an interconnector landfall. The poster will also make a case for inclusion of traditional geological field mapping techniques in landfall survey scopes of work, for integration with the geophysical and geotechnical datasets and ground modelling workflows.

Mapping of Seafloor Obstacles and Morphology from Multibeam Echosounder Data

Paul Slater, Global Maritime

Many constraints encountered in the design of offshore infrastructure are defined by the shape and nature of the seafloor. Typical constraints may be seabed gradient, anthropogenic objects, natural features, sediment types, seabed texture as well as other constraints specific to regional and geological setting. The most reliable way to map constraints is to obtain a multibeam echosounder (MBES) survey and sidescan sonar (SSS) survey. The two can be interpreted and correlated to provide highly accurate location information from MBES and details of surface type from SSS, which can be provided to contractors and consultants as a data package deliverable in a suitable GIS format. To scope and specify the required seabed survey it is usually necessary to perform some basic design of an asset to determine the extent of survey required. For many sites MBES data already exists in some form, which can greatly assist with this basic design.

Global Maritime will outline a workflow that broadly categorises the seabed from MBES data alone, to be used for early-stage design, heatmapping, automated routing, or to further refine an interpreted survey data package for use in detailed design. This method looks at mapping areas of upwardly convex and inwardly concave seabed. Results are expected to show a convex seabed highlighting features such as clusters of boulders/debris, anthropogenic objects, dykes, outcrops, bedforms and edges of depressions. Concave features may highlight pockmarks, spudcan depressions, iceberg scars and trenches. Both results combined highlight patterns where for example a planned cable could freespan or a foundation could be placed on uneven seabed, therefore informing early-stage asset design. The results will be trialled on a number of seabed surveys at varying resolutions, then compared against traditionally interpreted data for validation.

Geological Society
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Lecture Theatre
Exit at front of theatre (by screen) onto Courtyard or via side door out to Piccadilly entrance or via the doors that link to the Lower Library and to the staff entrance.

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The ladies toilets are situated in the basement at the bottom of the staircase outside the Lecture Theatre.

The Gents toilets are situated on the ground floor in the corridor leading to the Arthur Holmes Room.

The cloakroom is located along the corridor to the Arthur Holmes Room.

Ground Floor Plan of The Geological Society