European Commission

This project has received funding from the European Union under Grant Agreement No **101120236**

# IMPROVE OFFSHORE INFRASTRUCTURE RESILIENCE AGAINST GEOHAZARDS TOWARDS A CHANGING CLIMATE

posejdon

Recruitment procedure for 13 PhD Positions in
Horizon Europe
Marie Skłodowska-Curie Actions
**Doctoral Networks**

NGI
WARWICK THE UNIVERSITY OF WARWICK
UNIVERSITY OF TWENTE.
University of Bremen
CAU Christian-Albrechts-Universität zu Kiel
Ifremer
UNIVERSITY OF LIVERPOOL
OSLOMET
UBO Université de Bretagne Occidentale
NTNU
unibz
Optum CE
CATHIE
DNV
UKRI

**Call for application of 13 phd positions in the Horizon Europe Marie Skłodowska-Curie Actions Doctoral Networks "POSEIDON: imProve Offshore infraStructure rEsilience agaInst geohazarDs tOwards a chaNging climate".**

## The Project

POSEIDON focuses on the investigation of offshore critical infrastructures (OCIs), the challenges and risks associated with the maintenance of current designs, and the requirements for future OCIs to mitigate the impact of geo- and climate hazards. The programme will undertake fundamental research to quantify the complexities and differences that exist in current OCI designs, in order to enhance existing designs and provide strategies for future, robust, offshore infrastructure in the frame of safety and resiliency. Such informed design and development of robust OCIs requires the implementation and combination of novel physical and numerical models, geophysical investigations, sedimentological and geotechnical lab studies, hazards assessments and more. Our approach is unique as it also integrates and utilizes state-of-the-art data science technologies (e.g., data mining, machine learning, etc.) to their full potential. This systematic approach enables us to achieve the objective of investigating the qualitative and quantitative impact of offshore geohazards on OCIs. Our new understanding will inform the development of novel process models, as well as tools and designs for the installation of future OCIs, such as wind turbines, pipelines and cables.

## The Aim

The over-arching aim of the Doctoral Network POSEIDON is to improve the resilience of office critical infrastructure (OCI) again geo- and climate hazards. The programme brings together an interdisciplinary and intersectoral team of researchers and experts to train and equip a next-generation network of Doctoral Candidates with the necessary experience and knowledge to develop a step change in our capacity to identify, map, assess and predict offshore geohazards. Such information, in turn, will enable the development of ground-breaking methods to prevent, mitigate and boost the resilience of current offshore infrastructure under a changing climate.

## The objectives

- Create a holistic geological understanding of submarine mass wasting events, particularly landslide initiation.
- Establish a microstructural-informed continuum model to describe the fluid-solid transition of sediments, based on a fundamental understanding of hydrodynamic interactions of sediment particles in both stagnant and free-flowing regimes, via the combination of Bayesian learning and advanced micromechanical lab testing and numerical simulation methods.
- Develop hybrid numerical models and tools for highly efficient and precise simulations of the entire submarine landslide process and physics-based predictions for submarine landslide occurrence in order to quantitively assess the risk of damages to offshore infrastructures, as well as to efficiently predict the propagation of induced tsunamis over a large area. In parallel, establish a

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protocol to calibrate/validate numerical models against physical-mechanical tests carried out on sediment cores, and thus, linking landslide dynamics and emplacement processes to different environmental settings.

- Develop pathways to transform new resilience and uncertainty models, related to both ocean conditions and soil properties, into data-driven monitoring, maintenance and design solutions for existing and future OCIs.
- Assess the economic impact of offshore hazards on the offshore infrastructure system and provide guidance to investment and policy makers.
- Develop awareness training programmes to improve the public's policy makers' knowledge of offshore hazards and risk, as well as offshore infrastructure sustainable development.

## *The consortium*

The consortium is formed by experts across European countries from universities, research institutions, industry partners and a government body to cover a full training programme on scientific and transferable skills.

### Host institutions

UT: University of Twente

UBREMEN: University of Bremen

CAU: Kiel University

NGI: Norwegian Geotechnical Institute

IFREMER: French Institute for Ocean Science

### UK Associated Partners

UOW: Warwick university

UOL: University of Liverpool

### Associated Partners

CA: The Cathie Associates

DNV: Det Norske Veritas

OPTUM: Optum CE

BV: State of the Art Engineering B.V.

UKRI: UK Research and Innovation

UBO: Université de Bretagne Occidentale

UNIBZ: Free university of Bozen

OSLOMET: Oslo Metropolitan University

NTNU: Norwegian University of Science and Technology

## *The Training Program*

The Doctoral Candidates will enjoy a highly integrated, interdisciplinary and intersectoral training environment, enriched by secondments within the network of academics and non-academics. POSEIDON enables critical learning across all

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training aspects to ensure that comprehensive, robust and implementable solutions are obtained and validated to face the OCIs climate-resilient building.

## The Individual Research Projects

| Doctoral Position | Project title | Host Institution |
|---|---|---|
| **DC01** | GeoAcoustic Mapping and Soil Classification | IFREMER (France) |
| **DC02** | Size and distribution of submarine landslides along passive continental margins | CAU (Germany) |
| **DC03** | Understanding the influence of grain morphology and mesostructure on the initiation and runout of submarine landslides | UT (The Netherlands) |
| **DC04** | Towards a unified constitutive model for saturated granular fluids and solids | UT (The Netherlands) |
| **DC05** | Micro-structural characteristics of failure planes and weak layers – new insights from (4D) mCT measurements combined with geotechnical testing | UBREMEN (Germany) |
| **DC06** | High-performance multi-phase, volume-coupled material point method for modelling submarine landslides | UT (The Netherlands) |
| **DC07** | Efficient landslide tsunami model with generalized rheological properties | NGI (Norway) |
| **DC08** | Offshore infrastructure resilient design | NGI (Norway) |
| **DC09** | Performance-based design of offshore wind turbine foundations with Explainable Artificial Intelligence (XAI) | NGI (Norway) |
| **DC10** | Characterization of lithology endmembers – bridging the gap between micro-scale sediment characteristic and macro-scale landslide behaviour | UBREMEN (Germany) |
| **DC11** | Dynamic modelling of submarine landslides and induced tsunami propagation | UOL (United Kingdom) |
| **DC12** | Investigation on critical failure modes for resilient offshore infrastructure under extreme weather conditions | UOW (United Kingdom) |
| **DC13** | Floating offshore wind turbine anchoring systems lifecycle analysis and optimisation design | UOW (United Kingdom) |

## The recruitment

### Benefits of the Doctoral Network

- POSEIDON fellows will be employed according to the rules for doctoral candidates in MSCA-DNs and the general regulations of each host institution.
- The financial package will include the monthly researcher allowances subdivided into 1) a living allowance, 2) a mobility allowance and, 3) a family allowance, if applicable. Employer costs and other deductions depend on the recruiting host.
- The Doctoral Candidates will be given an employment contract for 36 (or 48 depending on the host institutions) months by their host institution and will be entitled to full employee benefits and inclusion in social security schemes of the host country.

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## Eligibility criteria for the Doctoral Candidates

- Applicants must be doctoral candidates, i.e., not already in possession of a doctoral degree at the date of recruitment.
  - Master of Science (M.Sc.) or equivalent, Doctoral Candidate (DC) or 0-4 yrs. (Post Graduate)
  - You are also eligible to apply, if you expect to graduate your M.Sc. or equivalent before the targeted staring date. Simply indicate this clearly in your application form and/or CV and please provide an overview of the transcripts that are already available.
  - The candidate must be working esclusively for the action.
- **Mobility rule:** researchers must not have resided or carried out their main activity (e.g., work, studies) in the country of the recruiting beneficiary for more than 12 months in the 36 months immediately before their recruitment date.
- Other eligibility criteria may apply depending on the recruiting beneficiary.
- Doctoral Candidate (DCs) must demonstrate that their ability to understand and express themselves in both written and spoken English is sufficiently high for them to derive the full benefit from the network training.

## How to apply?

POSEIDON will select 13 doctoral candidates through a 3-step recruitment process. – to be determined.

Application can be submitted via the University of Twente portal:

**https://utwentecareers.nl/en/vacancies/1606/13-phd-positions-on-the-eu-horizon-2020-marie-skiodowska-curie-project-poseidon/**

### 1st step:

Candidates **can apply for a maximum of three PhD projects** by **February 28th 2024 23:59 (GMT+1).**

Applications must be submitted in English and must include:

- **Cover Letter:** A maximum of two A4 pages, highlighting your specific interest in the position, your qualifications, and motivations for applying. This letter should clearly articulate how your background and experiences align with the requirements of this project
- **Detailed Curriculum Vitae (CV):** The CV, should include, if applicable, a list of publications;
- **Bachelor and Master transcripts**;
- **Contact Details of Referees:** Provide the names and contact information of individuals who can professionally vouch for your qualifications and suitability for this position.

### 2nd step:

The eligibility check will be carried out based on the candidates' CV, motivational letter, and eligibility criteria by a Scientific Evaluation Committee (SEC). Applicants admitted to the 3rd Step will be invited to an interview via email.

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### 3rd step:
The selected candidates will be contacted via email with the decision. The candidates will be ask to start no later than September 1st, 2024.

## Key dates
- **Jan 15, 2024**: Launch of the 13 DC Positions
- **Feb 28, 2024**: Deadline for online applications
- **Mar-Apr, 2024**: Contact the “preselected candidates”
- **Apr-May 2024**: Recruitment Event (Online)
- **Sept 2024**: Start of the DC contracts

## Contacts
For any inquiries on the recruitment procedure, please contact info@poseidon-dn.eu

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## Projects detailed descriptions

In addition to their individual scientific projects, described below and on www.poseidon-dn.eu, all doctoral candidates will benefit from further continuing education, which includes internships and secondments, a variety of training modules as well as transferable skills acquired through a unique immersive learning.

The obligations are described in the Grant Agreement of the POSEIDON project.

### DC01

**PhD Project Title**: GeoAcoustic Mapping and Soil Classification

**Enrolment in Doctoral degree(s):** Université de Bretagne Occidentale (UBO)

**Supervisors:** Dr. Marco Terzariol, Dr. Antonio Cattaneo

**Recruitment host**: French Institute for Ocean Science (Ifremer)

**Secondment host:** Dr Emmanuelle Gautier (CA)

**Background and aim:**

Offshore acoustic high-frequency backscatter strength is typically used as a proxy of soil classification. Their correct interpretation can lead to important cost reduction in exploration, further sampling strategies and the study of seafloor natural phenomena. There is urgent need to obtain geotechnical properties from high-frequency acoustic surveys. Its low-cost respect to other exploration approaches, and the improvements in computational methods and equipment, makes it very attractive for offshore site examination. Advances in recent years were able to analytically derive and validate in laboratory the correlation between the coefficient of reflectivity and sediment's void ratio at low effective stress. However, this geotechnical approach has not been tested in natural environments yet.

Our objective is to validate and expand this new approach using artificial and natural sediments at the lab and field scale to better understand the interaction of acoustic wave backscatter strength and soil structure at low stress at various frequencies, grain size and depositional environments. We will study a natural environment (Concarneau Bay, Brittany, France) as a test site and expand our findings to other potential European locations.

**Objectives:**

i) Develop, validate and calibrate a novel methodology for soil classification from high-frequency acoustic backscatter data and surface sediment sampling in Concarneau Bay;

ii) Explore the upscaling from the lab test behavior up to field-scale interpretation;

iii) Extrapolate this approach to other potential European sites for offshore renewable energy and sediment migration monitoring (to be confirmed, depending on data availability).

**Expected Results:**

i) Validate a novel physically driven methodology of soil classification prediction from high-frequency acoustic backscatter;

ii) Better understanding of geoacoustic sediment mapping in natural environments;

iii) A major leap of understanding of soil classification and sediment migration at a large scale;

iv) Set up the guidelines for site exploration and streamline this methodology for different applications (offshore wind farms, sediment migration, etc.).

For more information on the vacancy refer to the vacancy page:
POSEIDON-DN/VACANCY/DC01

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# DC02

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| **PhD Project Title:** Size and distribution of submarine landslides along passive continental margins |
| **Enrolment in Doctoral degree(s):** Kiel University<br>**Supervisors:** Prof. Sebastian Krastel, Dr. Xue Zhang<br>**Recruitment host:** Kiel University<br>**Secondment host:** Prof. Katrin Huhn-Frehers (University of Bremen),<br>Dr. Xue Zhang (University of Liverpool) |
| **Background and aim:**<br>In recent decades, it has become widely accepted that submarine landslides are a widespread sedimentary process that plays an important role in the formation of continental margins. However, morphological, seismic and core data are sparse and may investigations of submarine landslides may be biased due to the availability of data. The main aim of the project is to compile all accessible hydroacoustic, seismic and core data of the NW-African margin and map the distribution of submarine landslides along the NW-African continental margin. The work will include the analysis of the preconditioning factors of landslides along the NW-African continental margin, the tole of submarine channels for the distribution of landslides as well as comparisons with other margins. The work will allow to proof of falsify the hypothesis that current work related to submarine landslides is heavily biased by data availability. |
| **Objectives:**<br>i) Compile all accessible hydroacoustic data of the NW-African margin and map the distribution of submarine landslides along the NW-African continental margin;<br>ii) Analyse the size distribution of landslides and test the hypothesis that current maps are heavily biased by data availability;<br>iii) Analyse the preconditioning factors of landslides along the NW-African continental margin;<br>iv) Investigate the role of submarine channels for the distribution of landslides along the NW-African continental margin;<br>v) Compare the distribution of landslides with other passive continental margin |
| **Expected Results:**<br>i) Sedimentary process map of the NW-African continental margin;<br>ii) Identification of main pre-conditioning factors for landslides along the NW-African continental margin;<br>iii) Understanding of the interaction between gravitational sediment transport on the open slope (landslides) and in channels. |
| For more information on the vacancy refer to the vacancy page:<br>[POSEIDON-DN/VACANCY/DC02](POSEIDON-DN/VACANCY/DC02) |

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# DC03

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| **PhD Project Title**: Understanding the influence of grain morphology and mesostructure on the initiation and runout of submarine landslides |
| **Enrolment in Doctoral degree(s):** University of Twente<br><br>**Supervisors:** prof. V. Magnanimo and dr. Hongyang Cheng<br><br>**Recruitment host**: University of Twente<br><br>**Secondment host:** Dr. Nallathamby Sivasithamparam (Norvegian Geotechnical Institute),<br>Dr. Michele Larcher (Free University of Bolzano) |
| **Background and aim:**<br><br>Hydromechanical phenomena at the pore scale, such as the development of elevated water pressure, and how they are coupled to the soil's mesostructure, are key to the initiation and runout of submarine landslides. The fact that different regimes, e.g., quasi-static or fast-flowing, of the coupled particle-fluid systems interplay with the material's particle- and meso-scale structures makes the prediction of submarine granular flows, from initiation to run-out, a scientific as well as a practical challenge.<br><br>Fully-resolved simulations of particle-fluid systems can be used to study the macroscopic behaviour of saturated granular materials. The effects of particle shapes and the mesostructure on the hydrodynamic coupling to the pore fluid can all be investigated with the coupled Lattice Boltzmann-Discrete Element Method.<br><br>We **aim to develop a hydro-micromechanical** model of realistic granular soils using fully-resolved direct numerical simulation techniques, focusing on representative volume elements (RVEs). The goal is to understand the role of grain morphology and mesostructure in the avalanching and resting processes during submarine landslides, at various overpressure conditions. |
| **Objectives:**<br><br>i) Apply an existing LBM-DEM numerical model to simulate the collapse of dense/loose granular masses over an inclined plane subjected to sudden increase of pore pressure;<br><br>ii) Incorporate realistic particle shapes in the LBM-DEM model and study the effect of grain morphology hydromechanical behaviour at NGI;<br><br>iii) Compare and validate the simulations at point i) and ii) with the pilot-scale laboratory experiments on granular–liquid mixtures at the Free University of Bolzano;<br><br>iv) Coarse grain particle scale information into continuum fields and understand the mass/momentum transfer and energy dissipation mechanisms that contribute to the triggering and runout of saturated granular flows. |
| **Expected Results:**<br><br>i) A novel hydro-micromechanical numerical tool for modelling saturated granular masses in submarine landslides;<br><br>ii) A deep understanding of the interplay between structural properties (e.g., morphology and mesostructure) and pore water pressure on the saturated granular flows. |
| For more information on the vacancy refer to the vacancy page:<br>POSEIDON-DN/VACANCY/DC03 |

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# DC04

**PhD Project Title**: Towards a unified constitutive model for saturated granular fluids and solids

**Enrolment in Doctoral degree(s):** University of Twente

**Supervisors:** prof. S. Luding and dr. Hongyang Cheng

**Recruitment host**: University of Twente

**Secondment host:** Dr Xue Zhang (University of Liverpool),
Norvegian Geotechnical Institute,
Mr. Willem Hendrik Pater (State of the Art Engineering BV)

**Background and aim:**

Submarine landslides, from the mobilization to the transport of fluid-saturated sediments, involve the understanding and modelling of geomechanical processes at multiple length and time scales. One of the main challenges in submarine granular flows is the complex yielding transition from static to motion, which is governed by the spatially and/or temporally varying length scales, i.e., landslide threshold, and back to static conditions. This gap creates considerable difficulty in predicting the initiation and post-failure behaviour of submarine landslides. Questions such as the runout distance cannot be answered without understanding and quantifying the dissipation during this fluid-solid transition and back. The current frameworks (e.g., plasticity and effective stress theories) for modelling soil-fluid interactions going from fluid saturated solids to a fluid-dominated mixture have to be revised and improved.

Based on the simulation data of particle-fluid interaction (developed in a parallel DC project) and machine learning tools (GrainLearning) that aid constitutive modelling established in the group, we will enrich existing constitutive frameworks for describing the behaviour of saturated granular masses in the solid and fluid regimes, and their transition. Particle-scale simulations provide the essential data for this task, as they uniquely can inform the continuum framework. The end goal is to come up with a sensible model structure for a unified granular micromechanically based solid-fluid model by learning model structures from fully-resolved simulations particle-fluid systems, with the help of Bayesian learning.

**Objectives:**

i) Understand the capabilities of fluid-solid models for granular media and their limitations to model the collapse of saturated granular flows;

ii) Study the complex transitions from static to motion and back using coarse grained fluid-DEM simulations;

iii) Implement the unified model in a continuum solver to accurately predict the runout distance of submarine landslide and compare the results with experimental data.

**Expected Results:**

i) Assessment of the suitability of theoretical frameworks to describe solid-to-fluid (collapse) and fluid-to-solid (runout) transition in saturated granular masses;

ii) Micromechanical-based unified constitutive models that correctly capture these transitions;

iii) Comparison and validation via laboratory experiments

For more information on the vacancy refer to the vacancy page:
POSEIDON-DN/VACANCY/DC04

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# DC05

**PhD Project Title**: Micro-structural characteristics of failure planes and weak layers – new insights from (4D) µCT measurements combined with geotechnical testing

**Enrolment in Doctoral degree(s):** University of Bremen

**Supervisors:** Prof. Dr. Katrin Huhn-Frehers , Dr. Ricarda Gatter

**Recruitment host**: University of Bremen

**Secondment host:** Prof. Dr. Sebastian Krastel (CAU)

**Background and aim:**

Nowadays, the *weak layer concept*, i.e. failure planes of submarine landslides coinciding with mechanically weaker layers embedded within the slope stratigraphy, is commonly accepted. These weak layers are typically associated with material inhomogeneities, such as alternating sequences of clay with sand or highly porous fossiliferous layers. Liquefaction or particle breakage under loading along such sediment sequences can cause pore pressure fluctuations and subsequent failure. Although many studies exist, the characteristics of weak layers and the failure mechanisms that ultimately lead to failure are still poorly understood. DC05 will focus on investigating the role of sediment composition and slope stratigraphy on the localisation of failure planes of submarine landslides.

We aim to develop methodological standards, including a standardised workflow and novel (machine learning) algorithms for the application and interpretation of micro-Computed Tomography (µCT) to investigate natural sediments. The goal of this project is to understand the relative influence of different sediment lithologies on weak layer formation and submarine landslide initiation.

**Objectives:**

i) Investigation of the key role of sediment composition and slope stratigraphy on localization of potential failure planes of submarine landslides;

ii) Testing the commonly accepted weak layer concept utilizing newest 3D and 4D µCT measurements in addition to classical geotechnical experiments;

iii) Gaining a deeper insight into the relative influence of particle interlocking and particle breakage, or variations in sediment type e.g. different contents of fossiliferous sediments on failure plane formation;

iv) Development of new machine learning routines for the automated evaluation of µCT datasets.

**Expected Results:**

i) Ground-truthing of the weak layer concept;

ii) Development of new methodological standards for the evaluation of µCT data;

iii) Development of machine learning algorithms for a faster and also more efficient interpretation of (µ)CT and geotechnical data.

For more information on the vacancy refer to the vacancy page:
POSEIDON-DN/VACANCY/DC05

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# DC06

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| **PhD Project Title**: High-performance multi-phase, volume-coupled material point method for modelling submarine landslides |
| **Enrolment in Doctoral degree(s):** University of Twente<br><br>**Supervisors:** dr. Hongyang Cheng, prof. S. Luding and prof. V. Magnanimo<br><br>**Recruitment host**: University of Twente<br><br>**Secondment host:** Dr. Michele Larcher (Free University of Bolzano);<br>Dr. Xue Zhang (University of Liverpool) |
| **Background and aim:**<br><br>Submarine landslides involve the movement of saturated sediments down a slope, interacting with seawater and/or offshore infrastructure. During landslides, the bulk of the sediment material (usually considered as a porous medium), transits from solid-like to fluid-like, i.e., from stagnant to continuously flowing. In addition, the coupling between seawater and sediment is crucial in the landslide dynamics. Recent studies have shown that the material point method (MPM) can describe the movement of saturated sediment and the hydrodynamic coupling between soil skeleton and seawater, within a multiple-phase framework. Nevertheless, to accurately predict the dynamics of and dissipation within the sliding masses, the transition between solid and flowing states of sediments must be incorporated.<br><br>The doctoral candidate will implement constitutive models for saturated sediments in fluid- and solid-like states into an existing GPU-MPM code. The exchange of momentum, mass, and energy between these admissible states of saturated sediments will be achieved with overlapping subdomains where the transition can potentially take place. To further improve the computational efficiency, machine learning surrogates will be used to partially replace the expensive physics-based models to allow large-scale industrial applications. The project aims to provide more accurate, highly efficient, and physics-based predictions for submarine landslides in order to quantitively assess the risk of damages to offshore infrastructures (e.g., foundations anchors) and induced disasters (e.g., tsunamis). |
| **Objectives:**<br><br>i) Extend an existing MPM code from single-phase to multi-phase based on a volume-coupled formulation that incorporates mass, momentum, and energy exchange between slow- and fast-flowing sediments and water;<br><br>ii) Develop a reduced-order model of the multi-phase system using machine learning and integrate it into the volume-coupled numerical framework;<br><br>iii) Perform simulations of submarine landslides and assess their impact on offshore infrastructures;<br><br>iv) Calibrate model parameters using existing experimental data and compare the model predictions with experimental data obtained from laboratory flume experiments. |
| **Expected Results:**<br><br>i) A novel volume-coupled formulation to consider the transport and coupling of multiple phases;<br><br>ii) An open-source, multi-phase GPU-based MPM code with clear documentation, tutorials, and examples for future users;<br><br>iii) Benchmark cases validated using experimental data from laboratory-scale physical tests. |
| For more information on the vacancy refer to the vacancy page:<br>POSEIDON-DN/VACANCY/DC06 |

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# DC07

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| **PhD Project Title:** Efficient landslide tsunami model with generalized rheological properties |
| **Enrolment in Doctoral degree(s):** Oslo Metropolitan University<br>**Supervisors:** dr. Finn Løvholt and dr. André Brodtkorb<br>**Recruitment host:** Norvegian Geotechnical Institute<br>**Secondment host:** University of Liverpool |
| **Work description:**<br><br>NGI is seeking candidates for a PhD position related to numerical modelling of landslide tsunamis within our Section of Geohazards and Dynamics under the Offshore Energy Market Area. For more information about NGI, see www.ngi.no. The candidate will further be enrolled in the PhD program at OsloMet - Oslo Metropolitan University.<br><br>The position is attached to the Horizon Europe POSEIDON project (https://poseidon-dn.eu/) which is a Doctoral Training Network under the MSCA, including 13 individual Doctoral Candidates. The position is entitled “Efficient landslide tsunami model with generalized rheological properties” and has the number DC07 within the project. The overall objective of POSEIDON is to improve offshore infrastructure resilience against geohazards towards a changing climate. The topic for this PhD grant is to improve prediction capabilities related to submarine and subaerial landslide tsunamis.<br><br>The candidate will be responsible for developing a coupled landslide-tsunami model with optimized dispersion and to prepare and use the model for different types of scientific investigations to shed light on the physics of the tsunami generation processes. These scientific investigations may range from modeling benchmark tests, simulations of past events, and future hazard applications. An important focus of the model development will be to embed a realistic time-dependent material model into the landslide model to improve our conceptual understanding of the tsunami generation processes. The work should also include investigation of additional features such as landslide erosion and curvature effects on tsunami-genesis. We foresee developing a depth-averaged layered model applicable for both fully subaqueous landslides and landslides originating subaerially that will be implemented in a realistic 3D topography/bathymetry. We further envision that the model will be implemented using a Finite Volume scheme using GPUs to ensure a rapid execution time of the code.<br><br>The applicant is expected to visit partners from the POSEIDON consortium from other European countries for secondments of up to approximately six months and will have to participate in joint network-wide training activities abroad. |
| For more information on the vacancy refer to the vacancy page:<br>POSEIDON-DN/VACANCY/DC07 |

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## DC08

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| **PhD Project Title:** Offshore infrastructure resilient design |
| **Enrolment in Doctoral degree(s):** Norwegian University of Science and Technology<br>**Supervisors:** dr. Nallathamby Sivasithamparam and dr. Zhongqiang Liu.<br>**Recruitment host:** Norvegian Geotechnical Institute<br>**Secondment host:** DNV,<br>University of Warwick |

**Work description:**

NGI is seeking candidates for a PhD position related to "*Offshore infrastructure resilient design*" within the Advanced Geomodelling department under the Offshore Energy Market Area. For more information about NGI, see www.ngi.no. The candidate will further be enrolled in the PhD program at the Norwegian University of Science and Technology, NTNU.

The position is attached to the Horizon Europe POSEIDON project (https://poseidon-dn.eu/) which is a Doctoral Training Network under the MSCA, including 13 individual Doctoral Candidates. The position is entitled "Offshore infrastructure resilient design" and has the number DC8 within the project. The overall objective of POSEIDON is to improve offshore infrastructure resilience against geohazards towards a changing climate. The topic for this PhD grant is advancing the knowledge of hybrid foundation behaviour under cyclic loading for offshore wind turbines.

The candidate will be responsible for developing design procedure for hybrid foundation and incorporate within the current design practices, such as PISA method, and conducting uncertainty quantification, encompassing the modelling of transformation uncertainty and spatial variability. Additionally, the research will delve into an integrated reliability-based design, specifically addressing load actions.

The successful completion of this PhD research is anticipated to yield significant contributions to the field of offshore wind turbine foundation engineering, with the following expected outcomes:

1. Hybrid Foundation: Develop an innovative hybrid monopile foundation that offers enhanced performance and cost-effectiveness compared to conventional foundations, e.g., monopiles, suction caissons.
2. Statistical Framework Establishment: Establish a generic statistical framework for quantifying and propagating uncertainties in soil properties. This will provide a valuable tool for probabilistic foundation design and risk assessment.
3. Reliability-based Design Procedure: Formulate a simple and practical procedure for reliability- and resilience-based offshore infrastructure design. This will enable risk-informed decision-making in the face of uncertainties in soil properties and extreme metocean conditions.

The applicant is expected to visit partners from the POSEIDON consortium other European countries for extended secondments of up to approximately six months and will have to participate in joint network-wide training activities abroad.

For more information on the vacancy refer to the vacancy page:
POSEIDON-DN/VACANCY/DC08

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# DC09

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| **PhD Project Title:** Performance-based design of offshore wind turbine foundations with Explainable Artificial Intelligence (XAI) |
| **Enrolment in Doctoral degree(s):** Norwegian University of Science and Technology<br>**Supervisors:** dr. Zhongqiang Liu and dr. Nallathamby Sivasithamparam<br>**Recruitment host:** Norvegian Geotechnical Institute<br>**Secondment host:** DNV,<br>University of Warwick |
| **Work description:**<br><br>NGI is seeking candidates for a PhD position related to performance-based design of offshore wind turbine foundations within the Risk Assessment and Slope Stability department under the Natural Hazards Market Area. For more information about NGI, see www.ngi.no. The candidate will further be enrolled in the PhD program at the Norwegian University of Science and Technology, NTNU.<br><br>The position is attached to the Horizon Europe POSEIDON project (https://poseidon-dn.eu/) which is a Doctoral Training Network under the MSCA, and will include 13 individual Doctoral Candidates (DCs). The position is entitled “Performance-based design of offshore wind turbine foundations with Explainable Artificial Intelligence (XAI)” and is position DC09 within the project. The overall project objective is to improve offshore infrastructure resilience against geohazards towards a changing climate. The topic for this PhD grant is related to develop an XAI framework for performance-based design of FOWT foundations.<br><br>The candidate will be responsible for exploiting the recent advances in performance-based approaches and machine learning (ML) to develop a fully probabilistic performance-based assessment method for floating offshore wind turbines (FOWT) foundation design. To ensure safety in the design, the performance of FOWT foundations subjected to aero- and hydrodynamic loadings should be quantified. The method will take into account stochastic metocean conditions and variability of soil properties. Explainable Artificial Intelligence (XAI) techniques will be utilised to model the fragility function of FOWT foundations over a range of loading intensities. The performance-based design model will capture the uncertainties present in the data as well as in the XAI-driven physics-based model.<br><br>The applicant is expected to visit partners from the POSEIDON consortium other European countries for extended secondments of up to approximately six months and will have to participate in joint network-wide training activities abroad. |
| For more information on the vacancy refer to the vacancy page:<br>POSEIDON-DN/VACANCY/DC09 |

This project has received funding from the European Union under Grant Agreement No **101120236**.

# DC10

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| **Project Title:** Characterization of lithology endmembers – bridging the gap between micro-scale sediment characteristics and macro-scale landslide behaviour |
| **Enrolment in Doctoral degree(s):** University of Bremen<br><br>**Supervisors:** Prof. Dr. Katrin Huhn-Frehers; Prof. Dr. Sebastian Krastel<br><br>**Recruitment host**: University of Bremen<br><br>**Secondment host:** Prof. Dr. Sebastian Krastel (CAU),<br>Prof. Dr. Vanessa Magnanimo (UT) |
| **Background and aim:**<br><br>Submarine landslides are gravity-driven mass movements that occur in underwater slope settings worldwide. In recent years, great effort has been put into the mapping of submarine landslides. Still, there is a clear lack in information regarding the internal structure and composition of submarine landslides and their failure planes, i.e. from sediment cores and in-situ measurements. Such information, however, is crucial for e.g. quantifying the relationship between landslide occurrence/behaviour and sediment lithology. DC10 will focus on investigating the impact of different lithologies on submarine landslide formation and behaviour.<br><br>We aim to compile a comprehensive dataset of key geophysical, sedimentological and geotechnical characteristics of different lithological endmembers that favour landslide formation and develop a standardized workflow for sediment core analyses. The goal of this project is to gain a deep understanding of the interplay between sediment lithology, depositional environment and landslide behaviour. |
| **Objectives:**<br><br>The overall objective is to perform geophysical identification combined with multidisciplinary sediment core analyses from different geological environments to gain deeper insights into the key role of lithology endmembers on mass movement kinematics, dynamics and emplacement processes. Specifically, the project will focus on:<br><br>i)Standard core-logging and sedimentological analyses to provide insight into landslide dynamics and emplacement behaviour;<br><br>ii) Comparison of sediments from different environments to shed light onto the key role of prevailing lithologies on landslide behaviour;<br><br>iii) Identification of prominent lithologies in high-resolution geophysical data, e.g. hydroacoustic and reflection seismic profiles;<br><br>iii) Combination of standard sedimentological analyses and geotechnical experiments to enable core-seismic correlations to bridge the gap between micro- and macro-scaled information, and to provide input data for numerical process simulations. |
| **Expected Results:**<br><br>i) Accurate study of key characteristics, in particular grain size distribution, porosity and permeability as well as shear strength and consolidation state, of lithology endmembers and their relative influence on sliding behaviour;<br><br>ii) Development of standardized workflows for sediment core analyses;<br><br>iii) Core-seismic integration to transfer local core information across the depth profile;<br><br>iv) A deep understanding of the interplay between sediment lithology, depositional environment and landslide behaviour. |
| For more information on the vacancy refer to the vacancy page:<br>POSEIDON-DN/VACANCY/DC10 |

This project has received funding from the European Union under Grant Agreement No **101120236**.

# DC11

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| **Project Title:** Dynamic modelling of submarine landslides and induced tsunami propagation |
| **Enrolment in Doctoral degree(s):** University of Liverpool<br>**Supervisors:** Dr Xue Zhang ; Prof. Kristian Krabbenhoft<br>**Recruitment host**: University of Liverpool<br>**Secondment host:** Dr Hongyang Cheng (UT),<br>Dr Kristian Krabbenhoft (OTUM) |
| **Objectives:**<br>i) Develop suitable models accounting for coupled interaction between sliding geomaterials and water in submarine landslides;<br>ii) Develop open-source PFEM software package with intense computing parallelization for modelling submarine landslide and induced tsunamis;<br>iii) Quantitatively validate the model and tool via physical modelling tests;<br>iv) Investigate the sliding mechanism of submarine porous mass and its role in generating hazardous wave. |
| **Expected Results:**<br>i) Numerical models and open-source numerical tools for modelling submarine landslides and their consequences;<br>ii) A better understanding of mass transport in submarine landslides and its impact;<br>iii) A novel physical modelling method for submarine landslides and experimental data |
| **Planned Secondment(s):**<br>Dr Hongyang Cheng (UT 3 months): Discuss and compare the macro and micro simulation results;<br>Dr Kristian Krabbenhoft (OPTUM, 3 months): Stability analysis of a real offshore slope |
| For more information on the vacancy refer to the vacancy page:<br>POSEIDON-DN/VACANCY/DC11 |

This project has received funding from the European Union under Grant Agreement No **101120236**.

# DC12

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| **Project Title:** Investigation on critical failure modes for resilient offshore infrastructure under extreme weather conditions | |
| **Enrolment in Doctoral degree(s):** University of Warwick<br>**Supervisors:** Prof. Dr Xueyu Geng ; Prof. Kristian Krabbenhoft<br>**Recruitment host**: University of Warwick<br>**Secondment host:** Dr Nallathamby Sivasithamparam (NGI),<br>Dr Kristian Krabbenhoft (OTUM) | |
| **Objectives:**<br>i) understand and application of data mining methodologies, develop machine learning algorithms (Gaussian processes, neural network, etc.), basic and advanced statistical methods and virtual analytics for the identification of relevant features explaining OCIs failure phenomena;<br>ii) develop predictive models for assessing the physical and time scale of scour development around the offshore foundation and subsea structures;<br>iii) integrate the scour prediction mode, structure-soil interaction model and machine learning model to investigate the scour effect on the soil strength beneath the structures under combined wave-current environmental conditions;<br>iv) develop optimised procedures for designing resilient offshore infrastructure | |
| **Expected Results:**<br>i) development, adaptation and programming of machine learning (data mining) methods and tools for geospatial data, weather data, tide data etc. forecasting and uncertainty quantification;<br>ii) develop an efficient screening model for identifying seabed instabilities along the route of electric cables from the landfall to the deep-water offshore renewable sites;<br>iii) identification of failure mechanisms for offshore wind turbines foundation (monopiles and suction buckets);<br>iv) Optimised foundation design methodologies, considering relevant critical conditions | |
| **Planned Secondment(s):**<br>Dr Nallathamby Sivasithamparam (NGI 3 months): Current design requirements, detailed design software from NGI ;<br>Dr Kristian Krabbenhoft (OPTUM, 2 months): Software package discussion to be considered for OPTUM | |
| For more information on the vacancy refer to the vacancy page:<br>POSEIDON-DN/VACANCY/DC12 | |

This project has received funding from the European Union under Grant Agreement No **101120236**.

# DC13

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| **Project Title:** Floating offshore wind turbine anchoring systems lifecycle analysis and optimisation design |
| **Enrolment in Doctoral degree(s):** University of Warwick<br>**Supervisors:** Prof. Dr Xueyu Geng ; Dr Zhongqiang Liu<br>**Recruitment host**: University of Warwick<br>**Secondment host:** Dr Zhongqiang Liu (NGI) |
| **Objectives:**<br>i) improve understanding of the new operating conditions and more complex load regimes (infrastructure natural frequency, foundation stiffness, changes in foundation damping during the lifetime etc.);<br>ii) to understand the requirements of novel floating structures related to function, safety, cost, operation and sustainability;<br>iii) develop new concepts for the anchoring design of floating renewable facilities |
| **Expected Results:**<br>i) a numerical model (macro-model) for interaction between an anchor line/chain and soil;<br>ii) design concept for the anchoring design of floating renewable facilities |
| **Planned Secondment(s):**<br>Dr Zhongqiang Liu (NGI 3 months): Discuss the latest design requirement for floating offshore infrastructure;<br>Dr Zhongqiang Liu (NGI 6 months): Model development and calibration, design concept discussion . |
| For more information on the vacancy refer to the vacancy page: POSEIDON-DN/VACANCY/DC13 |

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