
The 1st International Online Conference on Marine Science and Engineering

24–26 November 2025 | Online



Organizing Committee

Conference Chairs

Prof. Dr. Carlos Guedes Soares
Prof. Dr. Charitha Pattiaratchi

Session Chairs

Dr. Azizur Rahman
Dr. Ilya Buynevich
Dr. Jean-Louis Pinault

Prof. Dr. Chun-Feng Li
Prof. Dr. Dong-Sheng Jeng
Prof. Dr. Rafael J. Bergillos

Scientific Committee

Dr. Ahmed Benamar
Dr. Ana Marta Gonçalves
Dr. Anabela Oliveira
Dr. Andrey Pnyushkov
Dr. Chiara Lauritano
Dr. Constantine Parinos
Dr. Felice Sfravara
Dr. Georg Umgieser
Dr. Juan José Alava
Dr. Maria Costantini
Dr. Marta Rodrigues
Dr. Md Jahir Rizvi
Dr. Pasqualino Corigliano
Dr. Pedro Aboim de Brito
Dr. Valerio Zupo
Dr. Zhaoqing Yang
Prof. Michael Lazar

Prof. Dr. Carlo Santulli
Prof. Dr. Chien Ming Wang
Prof. Dr. Chun-Feng Li
Prof. Dr. Decheng Wan
Prof. Dr. Dong Wang
Prof. Dr. Dongfang Liang
Prof. Dr. Erkan Oterkus
Prof. Dr. George Karatzas
Prof. Dr. Gino Lim
Prof. Dr. Jinyu Sheng
Prof. Dr. Juan Miguel Soria Garcia
Prof. Dr. Jun Gong
Prof. Dr. Lei Xing
Prof. Dr. Mike Meylan
Prof. Dr. Rodrigo Carballo
Prof. Dr. Weiqi Fu
Prof. Dr. Wenrui Huang

Organised by



Conference Secretariat

Email: iocmse2025@mdpi.com

Table of Contents

Welcome from the Chairs.....	1
Keynote Speaker.....	3
Invited Speakers	4
Program at a Glance	5
IOCMSE 2025 Program	6
Session A. Ocean Engineering.....	9
Session B. Coastal Engineering.....	25
Session C. Physical Oceanography.....	41
Session D. Geological Oceanography	53
Session E. Marine Environmental Science	62
Session F. Marine Biology	75

Welcome from the Chairs

Dear Marine Science and Engineering Community,

It is my privilege to welcome you to the **1st International Online Conference on Marine Science and Engineering: Current State and Future Trends (IOCMSE 2025)**. Organized by the MDPI *Journal of Marine Science and Engineering*, this three-day virtual event will take place from **24–26 November 2025**.

This conference aims to unite experts, researchers, and practitioners worldwide to exchange innovative ideas and address the pressing challenges facing marine science and engineering today. As the oceans are integral to global sustainability, research in this field is more critical than ever. We look forward to your contributions to advancing the understanding and sustainable management of marine systems.

Marine science and engineering encompass a diverse range of disciplines, reflecting the complexity and interconnectedness of oceanic systems. IOCMSE 2025 will feature sessions on key topics, including:

- A. Ocean Engineering;
- B. Coastal Engineering;
- C. Physical Oceanography;
- D. Geological Oceanography;
- E. Marine Environmental Science;
- F. Marine Biology.

Join us at IOCMSE 2025 to exchange ideas, gain valuable insights, and collaborate in advancing marine science and engineering. We warmly invite you to submit abstracts and full manuscripts that showcase advanced research or practical innovations in these fields. Together, let us navigate toward a more sustainable and resilient future.

Sincerely,



Prof. Dr. Charitha Pattiaratchi
Conference Chair
The University of Western
Australia, Perth, Australia



Prof. Dr. Carlos Guedes Soares
Conference Chair
Centre for Marine Technology and Ocean
Engineering (CENTEC), Instituto Superior
Técnico, Universidade de Lisboa, Av.
Rovisco Pais, Lisboa, Portugal



Journal of
Marine Science and Engineering
an Open Access Journal by MDPI

Journal of Marine Science and Engineering (ISSN 2077-1312) is an international, peer-reviewed open access journal which provides an advanced forum for studies related to marine science and engineering. It publishes reviews, research papers and communications. Our aim is to encourage scientists to publish their experimental and theoretical results in as much detail as possible. There is no restriction on the maximum length of the papers. The full experimental details must be provided so that the results can be reproduced. Electronic files and software regarding the full details of the calculation or experimental procedure, if unable to be published in a normal way, can be deposited as supplementary electronic material.

Impact Factor: 2.8 (2024); 5-Year Impact Factor: 2.8 (2024)

Keynote Speaker



Prof. Dr. Abdolmajid Mohammadian

Department of Civil Engineering,
University of Ottawa, Ottawa, Canada

Invited Speakers



Dr. Arthur C. Trembanis

College of Earth, Ocean, and
Environment, University of
Delaware, Newark, United States



Dr. Ilya Buynevich

Department of Earth and
Environmental Science, Temple
University, Philadelphia, PA, USA



Prof. Dr. Hermann Ehrlich

Center for Advanced
Technology, Adam Mickiewicz
University, Poznan, Poland



Prof. Dr. Tian Li

School of Civil Engineering,
Chongqing University, China

Program at a Glance

	Day 1	Day 2	Day 3
Morning	Session A. Ocean Engineering	Session B. Coastal Engineering	Session E. Marine Environmental Science
Afternoon	Session D. Geological Oceanography	Session C. Physical Oceanography	Session F. Marine Biology

IOCMSE 2025 Program

24 November 2025 (Monday)
Opening Speech (Prof. Dr. Charitha Pattiaratchi)
Session A. Ocean Engineering
Time: 9:00 (CET, Basel) | 16:00 (CST Asia, Beijing)

CET (Central European Time)	CST Asia (China Standard Time)	Speaker	Title
9:00–9:10	16:00–16:10	Event Chair Prof. Dr. Charitha Pattiaratchi	<i>Opening speech</i>
9:10–9:20	16:10–16:20	Session Chair Prof. Dr. Dong-Sheng Jeng	<i>Welcome from the session chair</i>
9:20–9:50	16:20–16:50	Invited Speaker Prof. Dr. Tian Li	Numerical and Theoretical Study on Fluid-Structure Interaction of Floating Offshore Wind Turbines
9:50–10:10	16:50–17:10	Selected Speaker Lucia Porlán	Evaluation of Reduction and Validation Strategies in the Prediction of Extreme Ocean Events
10:10–10:30	17:10–17:30	Selected Speaker Amin Nazemian	Hydrodynamic Shape Optimization of the Submarine Hull Using the Adjoint-Morphing Method
10:30–10:50	17:30–17:50	Selected Speaker Sonia Rozbiewska	From Data to Security: Machine Learning Approaches for Maritime Piracy Risk Assessment
10:50–11:10	17:50–18:10	Selected Speaker Xiang Wang	Numerical Analysis of the Penetration Process of the Bucket Foundation with a Cruciform Inner Compartment
11:10–11:30	18:10–18:30	Selected Speaker Xu Chen	Seepage Effects on Local Scour Around Twin Tandem Pipelines Under Wave Loading

Session D. Geological Oceanography
Time: 14:00 (CET, Basel) | 21:00 (CST Asia, Beijing)

CET (Central European Time)	CST Asia (China Standard Time)	Speaker	Title
14:00–14:10	21:00–21:10	Session Chairs Prof. Dr. Chun-Feng Li Dr. Ilya Buynevich	<i>Welcome from the session chairs</i>
14:10–14:40	21:10–21:40	Invited Speaker Dr. Arthur C. Trembanis	AI for the Coast: Mapping the Unseen – Detecting Carolina Bays, Seafloor Pockmarks, and Marine Debris
14:40–15:10	21:40–22:10	Invited Speaker Dr. Ilya Buynevich	Coastal Strandplain Morphostratigraphy Reflected in Remote Image-Color Intensity Patterns: Northern Black and Azov Sea Coasts, Ukraine
15:10–15:30	22:10–22:30	Selected Speaker Oksana Shvets	Evolutionary Trends of the Ustrychne Lake Baymouth Barrier (Black Sea, Ukraine): A Retrospective Analysis Using Historical Maps and Satellite Imagery (1775–2025)
15:30–15:50	22:30–22:50	Selected Speaker Yuliia Shevchuk	Comprehensive Analysis of the Evolutionary Trends of the Sukha Spit (Kinburn Peninsula, Black Sea, Ukraine)
15:50–16:10	22:50–23:10	Selected Speaker Nikolas Chtouris	Classification of High-Frequency Shallow Seismic Profiles Using CPTu and Core Geotechnical Data in the Aegean Sea, Greece
16:10–16:30	23:10–23:30	Selected Speaker Max Bouwmeester	Designing Critical Seafloor Infrastructure Against Sediment Gravity Flow Hazards: Constraining Sedimentary Processes to Propose Mitigation Strategies
16:30–16:50	23:30–23:50	Selected Speaker Konstantinos Tsapatzis	Dune-ing It Right: A 1D-Model for the Evolution of the Dutch Barrier Islands Through the Influence of Waves, Vegetation, and Wind

25 November 2025 (Tuesday)

Session B. Coastal Engineering**Time: 9:00 (CET, Basel) | 16:00 (CST Asia, Beijing)**

CET (Central European Time)	CST Asia (China Standard Time)	Speaker	Title
9:00–9:10	16:00–16:10	Session Chair Prof. Dr. Rafael J. Bergillos	<i>Welcome from the session chair</i>
9:10–9:30	16:10–16:30	Selected Speaker Anselme Muzirafuti	Four-Month Daily Beach Observations of the Capo Peloro Peninsula, Sicily
9:30–9:50	16:30–16:50	Selected Speaker Davide Carrubba	One-Line Contour Models for Equilibrium Design: The Shoreline Response Behind Diffractive Structures
9:50–10:10	16:50–17:10	Selected Speaker Sara Tuoizzo	Physical Modelling of Wave Overtopping Mitigation Through Adaptive Defence Solutions
10:10–10:30	17:10–17:30	Selected Speaker Hamza Mabchour	Analytical Investigation of Wave Interaction with a Submerged Trench Under Uniform Currents Using Evanescent Mode Theory
10:30–10:50	17:30–17:50	Selected Speaker Xu Zhang	Coastal Wind Resource Assessment Method Using BP-PSO Algorithm: A Case Study
10:50–11:10	17:50–18:10	Selected Speaker Sam Bom	Dynamic Salinity Equilibrium in a Former Estuary After Reintroducing Seawater Inflow
11:10–11:30	18:10–18:30	Selected Speaker Marcello Palomino	Immersive Virtual Reality Tsunami Evacuation Model Using High-Resolution Unmanned Aerial Vehicle Imagery and Numerical Simulation

Session C. Physical Oceanography**Time: 14:00 (CET, Basel) | 21:00 (CST Asia, Beijing)**

CET (Central European Time)	CST Asia (China Standard Time)	Speaker	Title
14:00–14:10	21:00–21:10	Session Chair Dr. Jean-Louis Pinault	<i>Welcome from the session chair</i>
14:10–14:40	21:10–21:40	Keynote Speaker Prof. Dr. Abdolmajid Mohammadian	Recent Advances in Numerical and Experimental Simulation of Marine Outfall Systems
14:40–15:00	21:40–22:00	Selected Speaker Boris Chubarenko	Estuarine Turbidity Maximum in Non-Tidal Conditions and Relations to Microplastics Retention
15:00–15:20	22:00–22:20	Selected Speaker Colin Hughes	Impacts of Topography on Wave-Current Interactions During Hurricane Arthur
15:20–15:40	22:20–22:40	Selected Speaker Prescilla Siji	Drifter Observations of Surface Currents from the Browse Basin
15:40–16:00	22:40–23:00	Selected Speaker Qiantong Pei	Storm-Induced Hydrodynamic Changes and Wave-Current Interaction over the Southeastern Canadian Shelf during Hurricane Fiona
16:00–16:20	23:00–23:20	Selected Speaker Jinyu Sheng	Examining Hydrodynamics and Variability over the Eastern Canadian Shelf using a Nested-Grid Modelling System

26 November 2025 (Wednesday)**Session E. Marine Environmental Science****Time: 9:00 (CET, Basel) | 16:00 (CST Asia, Beijing)**

CET (Central European Time)	CST Asia (China Standard Time)	Speaker	Title
9:00–9:10	16:00–16:10	Event Chair Prof. Dr. Charitha Pattiaratchi	<i>Welcome from the session chair</i>
9:10–9:30	16:10–16:30	Selected Speaker Maelys Cormont	RAMSea - Towards a Scalable System for Subsea Monitoring
9:30–9:50	16:30–16:50	Selected Speaker Noir Purba	An Inventory of Coastal Monitoring Stations in Indonesia: Opportunities and Gaps
9:50–10:10	16:50–17:10	Selected Speaker Joana Marujo Neves	Bivalve Gut Microbiome Responses to Sediment Characteristics and Anthropogenic Activities in <i>Cerastoderma edule</i> (Linnaeus, 1758)
10:10–10:30	17:10–17:30	Selected Speaker Marta Rodrigues	Managing Shellfish Aquaculture in the Ria Formosa (Portugal): CONNECT Ria Formosa
10:30–10:50	17:30–17:50	Selected Speaker Saša Marcinek	Effects of Rare Earth Elements on Marine Biota: Subtle Stressors or Negligible Risks?
10:50–11:10	17:50–18:10	Selected Speaker Silvia Gonçalves	Trace Metals Contamination Assessment in the Intertidal Environments of a Moderately Impacted Coastal Lagoon at Portugal (Óbidos Lagoon)
11:10–11:30	18:10–18:30	Selected Speaker Aditi Arun	Inoculum Optimization in <i>Chlorella</i> Cultivation: Enhancing Biomass Production for Marine Aquaculture and Environmental Remediation
11:30–11:50	18:30–18:50	Selected Speaker Muhamad Syaifudin	Environmental Influences on Heavy Metal Accumulation in Macroalgae: A Bibliometric Review of Recent Trends and Research Gaps

Session F. Marine Biology**Time: 14:00 (CET, Basel) | 21:00 (CST Asia, Beijing)**

CET (Central European Time)	CST Asia (China Standard Time)	Speaker	Title
14:00–14:10	21:00–21:10	Session Chair Dr. Azizur Rahman	<i>Welcome from the session chair</i>
14:10–14:40	21:10–21:40	Invited Speaker Prof. Dr. Hermann Ehrlich	Modern Biomaterialogy of Marine Sponges: Insights and Perspectives
14:40–15:00	21:40–22:00	Selected Speaker Konstantinos Georgoulas	Ocean Acidification and the Shifting Goldilocks Zone of Cold-Water Coral Growth
15:00–15:20	22:00–22:20	Selected Speaker Farzaneh Jahantigh	Comparative Analysis of Insoluble Fiber Content in Brown, Green, and Red Seaweed: Potential for Health and Industrial Use
15:20–15:40	22:20–22:40	Selected Speaker Rita F. T. Pires	Neustonic Zooplankton of the Madeira-Tore Seamounts: Biodiversity Insights for Conservation
15:40–16:00	22:40–23:00	Selected Speaker Ignacio Baena Vega	Description of <i>Tricleocarpa fragilis</i> Beds as a Distinct Habitat in the Columbretes Islands Marine Reserve (NW Mediterranean)
16:00–16:20	23:00–23:20	Selected Speaker Paulo Vale	Stimulating Effects of Space Weather in Toxin-Producing Marine Diatoms
16:20–16:40	23:20–23:40	Selected Speaker Sebastião Viegas Tavares Ferreira de Almeida	The Untapped Potential of Marine Bacterial Enzymes: Optimizing Hyaluronic Acid Molecular Weight for Targeted Applications

Session A. Ocean Engineering

sciforum-127155: A Review of Current Developments in Generative Artificial Intelligence for Underwater Marine Environments

Chao Feng Shih

Central Police University

This study investigates the application of generative artificial intelligence visual language models for object detection and obstacle recognition in underwater remotely operated vehicles (ROVs). By combining open-source underwater image datasets with images collected by ROVs, we systematically compare the performance of multiple advanced visual language models. The experimental design encompasses three typical underwater scenarios, aquaculture, marine exploration, and environmental monitoring, to evaluate the models' adaptability under varying underwater environmental conditions. We employ four key indicators for quantitative evaluation: accuracy, which reflects the model's ability to minimize false positives; recall, which measures the completeness of its detection of true targets; F1-score, which comprehensively balances the two; and average precision, which assesses the model's positioning accuracy under an overlap threshold of 50%. The results indicate that model performance is significantly influenced by environmental complexity. For instance, in turbid waters, the recall rate of all models decreases by approximately 15%, underscoring the unique challenges presented by underwater scenes. Additionally, we found that the models' ability to recognize small targets is generally inadequate, necessitating further optimization of the feature extraction architecture or the introduction of domain adaptation training in future work.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-135683: CHIME: A CFD–HEKF Framework for Hydrodynamic Modelling and Manoeuvring Analysis of Axisymmetric AUVs

Mahmoud Ibrahim Ibrahim^{1,2,*}, Renato Mendes^{1,3} and João Sousa¹

¹ Laboratório de Sistemas e Tecnologia Subaquática (LSTS), LAETA, Faculdade de Engenharia, Universidade do Porto, 4200-465 Porto, Portugal

² Department of Naval Architecture and Marine Engineering, Faculty of Engineering, Alexandria University, Alexandria 21544, Egypt

³ +ATLANTIC CoLAB, 1200-225 Lisbon, Portugal

In this study, conducted at the Laboratório de Sistemas e Tecnologia Subaquática (LSTS), we tackle the limitations of traditional hydrodynamic modelling approaches by introducing the CFD–HEKF Integrated Modelling and Estimation (CHIME) methodology. The framework derives all hydrodynamic coefficients solely from simulation data, eliminating the need for experimental trials. The approach combines high-fidelity Computational Fluid Dynamics (CFD) simulations with a nonlinear Hybrid Extended Kalman Filter (HEKF) estimator. First, six-Degree-of-Freedom (6 DoF) steady-state CFD simulations of the ISURUS AUV were performed using ANSYS Fluent to extract drag, lift, and fin derivatives. Added-mass coefficients were then calculated through transient simulations using dynamic mesh under free oscillation in three modes. Subsequently, diving and turning manoeuvres were simulated, and the resulting states were input into a MATLAB-based HEKF estimator to estimate unknown damping and added-mass terms. A mesh sensitivity analysis determined that a medium grid (~500,000 cells) provided the optimal trade-off between accuracy and computational cost. Turbulence modelling confirmed that the k- κ - ω model effectively captured laminar-to-transitional regimes. The CFD-derived hydrodynamic coefficients and HEKF-estimated results were benchmarked against analytical and experimental results from the literature. The results reveal that CFD-derived drag, lift, and fin coefficients are within 2% error of experimental values, while added-mass coefficients showed significant improvement over analytical methods. The manoeuvre results, including circular path, tactical diameter, yaw, pitch, and depth, matched field trials within 1-3% error. In contrast, MATLAB simulations using analytical coefficients consistently performed worse. The HEKF-based results demonstrated alignment of states and trajectory within 3% error of CFD results, with a maximum of 10% error of experimental results. The CHIME methodology offers a simulation-only, high-accuracy alternative for full hydrodynamic characterisation of axisymmetric AUVs. The approach provides a streamlined, cost-effective foundation for improving onboard state estimation and integrating it into real-time navigation and control systems.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-147918: Collective Blade Pitch Control Strategy for Floating Wind Turbines Based on Improved Tianji Horse Racing Optimization and Fuzzy Proportional Integral Double Derivative

Zhiyuan Zhang * and Bo jiao

School of Naval Architecture and Port Engineering, Shandong Jiaotong University, Weihai 264209, China

This study aims to reduce the impact of wind and wave loads on the output power, rotor speed, and motion fluctuations of a floating wind turbine, while enhancing the anti-interference capability and addressing the strong coupling of the wind turbine system. Using a joint simulation based on OpenFAST and Simulink, this study focuses on offshore floating wind turbines consisting of the NREL 5MW turbine and a semi-submersible platform. A Fuzzy PIDD² (FPIDD²) collective pitch controller is designed, building on the OpenFAST baseline controller. The collective pitch controller helps mitigate wind and wave disturbances and improve the system resistance to external forces. Furthermore, to address the problem of rapid population diversity decline and the tendency to fall into local optima caused by the grouping competition mechanism in the Tianji Horse Racing Optimization (THRO) algorithm, an improved version, ITHRO, is proposed. This hybrid algorithm is applied to optimally tune the parameters of the FPIDD² controller, thereby enhancing its control performance. Finally, the control performance of the FPIDD² controller is compared with that of Fuzzy PID (FPID), PIDD², and the OpenFAST baseline controllers under varying wind and wave conditions. The results indicate that the FPIDD² controller significantly improves the stability of generator output power and rotor speed, while also reducing the motion fluctuations of the floating platform.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-136801: Engineering Sustainable Escape Lighting Systems for Marine Vessels: A Photovoltaic and ATS-Based Approach

Luis García Rodríguez ^{1,2}, Laura Castro-Santos ¹ and María Isabel Lamas Galdo ^{1,*}

¹ Universidade da Coruña

² Universidad de Cantabria

Ships are highly advanced marine structures that incorporate state-of-the-art technologies. Nevertheless, they still depend on outdated systems in certain critical areas, such as escape lighting. Escape lighting systems are vital components of shipboard safety infrastructure. However, conventional systems rely heavily on decentralized battery-powered luminaires and manual testing, leading to high maintenance costs and environmental burdens. This study addresses these challenges through an engineering-driven redesign of escape lighting systems. A novel system architecture was developed, integrating photovoltaic energy sources with centralized battery storage and Automatic Testing Systems (ATSs) compliant with the IEC 62034 standard. The system interfaces with both main and emergency power networks, reducing reliance on fossil fuels and minimizing battery usage. Engineering simulations and operational data indicate a 20% reduction in fuel oil consumption per escape light and a threefold decrease in maintenance costs over a vessel's lifecycle. For a standard vessel equipped with 350 luminaires, the system demonstrates significant operational efficiency and environmental benefits, including reduced emissions and hazardous waste. This work exemplifies how ocean engineering innovations can enhance vessel safety while promoting sustainability. The integration of renewable energy and automated diagnostics into critical shipboard systems represents a forward-looking approach to marine engineering, aligning with global goals for greener maritime operations. Moreover, the proposed system supports compliance with evolving maritime regulations and offers a scalable solution adaptable to various vessel types and operational profiles.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-132261: Evaluation of Reduction and Validation Strategies in the Prediction of Extreme Ocean Events

Lucia Porlán^{1,*}, J. David Nuñez-Gonzalez², Alain Ulazia Manterola³, Nahia Martinez-turricastillo⁴ and John V. Ringwood⁴

¹ UPV / EHU

² Applied Mathematics Department, University of the Basque Country (UPV/EHU)

³ Energy Engineering Department, University of the Basque Country (UPV/EHU),

⁴ Centre for Ocean Energy Research, Maynooth University, W23 F2H6 Maynooth, Ireland

Introduction - Climate change is intensifying extreme ocean phenomena, such as increased wave height, posing significant risks to marine infrastructure. This study aims to improve the prediction of maximum wave height (Hmax) and its ratio to significant wave height (Hmax/Hs), using real buoy data from Bilbao-Vizcaya, Cabo de Peñas, Estaca de Bares, and Villano-Sisargas.

Methods -Three predictive models were applied: Linear Regression (LM), Support Vector Regression (SVR), and Random Forest (RF). The study was divided into two phases. In the first, data reduction techniques were analyzed, including instance reduction (through ordered removal of rows) and variable reduction (by eliminating features with low correlation to the target variable). In the second phase, validation techniques were evaluated, specifically Walk-Forward and Rolling Window, testing different window sizes and training set compositions (with observed or predicted values).

Results - Results showed that reducing both the number of instances and variables is feasible without significantly impacting performance metrics (MSE, MAE, RMSE, R^2). LM and SVR yielded the best results. While both validation strategies performed similarly, Rolling Window proved faster and more effective with larger windows. However, incorporating predicted values into the training set notably degraded model performance.

Conclusion - This work demonstrates the feasibility of deploying predictive models in real-world settings, enabling early warnings of potentially destructive wave events using real-time buoy data, thereby improving planning and safety in ocean engineering.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-149218: From Data to Security: Machine Learning Approaches for Maritime Piracy Risk Assessment

Sonia Rozbiewska

Doctoral School, Maritime University of Szczecin, 70-500 Szczecin, Poland

The main purpose of this research was to investigate the factors that most strongly affect the occurrence of maritime piracy incidents within the period of 2015–2024. In order to achieve this, statistical data were collected, aggregated, and analyzed with the aim of identifying variables that significantly contribute to the risk of pirate attacks at sea. These variables were then used as essential input for the development of a predictive model constructed with the use of artificial intelligence (AI) and machine learning (ML) techniques. The dataset covered several important dimensions, including the geographical regions where incidents occurred, the classification of different attack types, the nature and degree of violence used, and the tools and methods employed by the perpetrators.

To establish the relative importance of these features, advanced algorithmic approaches to feature selection were applied, with particular emphasis on classifiers based on the Random Forest method. This technique allowed the identification of variables that exert the greatest influence on the likelihood of future piracy incidents. The results demonstrated that three factors stand out as having the strongest impact: geographical location (with Southeast Asia and Africa highlighted as the most vulnerable regions), the type of attack (especially cases involving boarding of vessels), and direct violence against crews, including hostage-taking and kidnappings carried out for ransom.

The outcomes of this study provide a solid basis for the design and implementation of AI-powered early warning systems. Such tools can play an important role for a wide range of stakeholders, including shipping companies, governmental agencies, and international organizations concerned with maritime safety. By integrating predictive analytics into maritime security strategies, it becomes possible to monitor risks dynamically, recognize potential threats in real time, plan safer navigational routes, and allocate protective resources in a more efficient and cost-effective manner. Ultimately, this research highlights the potential of combining data-driven methods with AI to strengthen maritime security and reduce the human and economic costs associated with piracy.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-141273: Hydrodynamic shape optimization of the submarine hull using the adjoint-morphing method

Amin Nazemian^{1,*}, Evangelos Boulougouris² and Myo Zin Aung³

¹ Research Associate

² Professor, Maritime Safety Research Centre (MSRC), Department of Naval Architecture, Ocean and Marine Engineering, University of Strathclyde, Glasgow G4 0LZ, UK

³ Research Fellow, Maritime Safety Research Centre (MSRC), Department of Naval Architecture, Ocean and Marine Engineering, University of Strathclyde, Glasgow G4 0LZ, UK

This study presents a hydrodynamic shape optimization of the DARPA Suboff submarine hull using a discrete adjoint solver coupled with mesh morphing techniques within the computational fluid dynamics (CFD). The objective is to minimize total resistance (drag) under steady, uniform flow conditions. A baseline hull form is first analyzed using a Reynolds-Averaged Navier–Stokes (RANS) solver to establish reference resistance values. The adjoint solver is then applied to calculate sensitivity fields, identifying regions where geometric modifications yield the most significant drag reductions. Mesh morphing is employed at the mesh level to iteratively update the geometry based on these sensitivities without requiring re-meshing. The optimization process incorporates a Free Form Deformation (FFD) approach to ensure smooth and continuous shape changes. Validation against experimental data demonstrates accurate predictions of resistance for the baseline hull. Through five optimization iterations, the total drag force is reduced by 6.43%. Analysis of the optimized geometry reveals that the most effective shape modifications occur near the aft section of the hull, reducing pressure gradients and improving flow separation characteristics. The results highlight the potential of adjoint-based methods integrated with mesh morphing for fluid-exposed geometry optimization of complex underwater vehicles. This methodology provides a robust, computationally efficient framework for submarine hull optimization and can be extended to other marine vehicles and hydrodynamic objectives in future applications.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148400: Influence of Wave Environment on Vessel Response and Fatigue Life Assessment

Claudio Alacqua *, Pasqualino Corigliano and Giulia Palomba

Department of Engineering, University of Messina, 98166 Messina, Italy

Marine navigation is strongly influenced by oceanographic factors such as currents, rapidly changing sea conditions, and complex wave interactions. These elements affect both the structural integrity of a vessel and its overall operational safety, especially when navigating in harsh or unpredictable marine environments. Understanding how ships respond to different sea states is therefore essential for safe design and efficient operation.

This study investigates the impact of sea states on vessel motions and vertical bending moments, using a representative case study. Hydrodynamic analyses were performed through a panel-based numerical approach under stationary and advancing conditions, considering head and beam seas. Both frequency- and time-domain simulations were carried out, including the derivation of Response Amplitude Operators (RAOs) in regular waves and structural responses in irregular seas based on an empirical spectrum. The resulting hydrodynamic loads were applied to stress and fatigue assessments, and fatigue life predictions were made under extreme conditions. Comparisons with classification society rules provided further evaluation of structural performance.

The outcomes contribute to a better understanding of vessel response in complex wave environments, supporting design optimization and operational safety. The methodology also provides a foundation for integration with finite element modeling and machine learning for real-time structural health monitoring, with potential applicability across different ship types and scales.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-145951: Investigation in Wave Fatigue Assessment for Risers in Ultra-Deepwater Environments

Diego Garcia Barroso * and Mohammad Mobasher Amini

Engineering, Subsea 7, Rio de Janeiro, Brazil

Wave motion analysis plays a crucial role in ensuring accurate and reliable fatigue life predictions for deepwater risers. This study investigates how different modeling approaches and key parameters affect wave-induced motion fatigue damage, using representative metocean conditions typically found in ultra-deepwater risers connected to floating units. Both irregular and regular wave methodologies are considered through time-domain dynamic analysis.

Irregular sea states are modeled using the JONSWAP spectrum, while regular waves follow Airy wave theory. The study also explores the influence of specific wave parameters on fatigue assessments, including wave seed numbers for stochastic realizations, individual wave components, and critical environmental and operational factors that affect wave-riser interactions. A range of riser configurations is analyzed to capture variations in hydrodynamic input and their impact on fatigue loading.

Different strategies are applied to identify critical cases. While irregular wave analysis requires longer simulation times, regular wave methods offer faster alternatives. The study compares their accuracy and relevance for different scenarios. Results show that the choice of parameters and approach significantly affects fatigue predictions, with measurable correlations observed under complex ocean conditions.

Based on these findings, the study offers practical recommendations for selecting appropriate analysis methods depending on riser configuration and wave characteristics. These insights aim to support offshore engineers in improving the reliability of riser design and enhancing the resilience of deepwater systems.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148428: Methodological Proposal for the Dynamic Design of Ship Scale Models for Pilot Training in Confined Waters

Miguel Moreno *, Luis Carral and Isabel Lama

Department of Naval and Industrial Engineering, Ferrol Campus, Universidade da Coruña, Ferrol, 15403, Spain

The training of pilots in the Panama Canal relies on several tools and methodologies, one of which is the use of ship scale models, such as those used at the Panama Canal Authority Training Center, where Froude similarity ensures the hydrodynamic validity of maneuvers. These physical models are derived from the geometry of real vessels and adjusted experimentally through the distribution of ballast until the target draft, displacement, and inertia properties are achieved. This process, while robust, is largely iterative and depends on successive adjustments carried out during the construction and testing phases. In parallel, computational fluid dynamics (CFD) simulations are increasingly applied to investigate maneuvering performance and flow interactions in confined waters, offering highly detailed information but at the cost of significant computational resources and time. Together, these approaches constitute the current reference framework for the design and validation of ship behavior in restricted channels.

This work proposes an alternative methodology intended to support the dynamic design of ship scale models for pilot training. The approach is based on potential flow theory combined with Schwarz–Christoffel conformal transformations, enabling the analytical prescription of the dynamic conditions (drafts, displacement, and inertia properties) that must be satisfied for scale models to reproduce the maneuvering response of full-scale vessels.

The methodology aims to reduce the reliance on purely experimental adjustments, support the early stages of design, and provide an approach that complements both experimental and numerical methods. This contribution is limited to the formulation and scope of the methodology, which may serve as a foundation for subsequent validation through experiments and high-fidelity simulations.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-143898: MobyGlobal: Real-Time Right Whale Detection Network Powered by a Two-Branch Ensemble Learning Model on 3D-Printed Buoys

Taha Rawjani * and Matthew Li

Academies of Loudoun

Over 300,000 cetaceans die every year due to human activity—primarily ship collisions and fishing entanglements—with roughly 67% of all whale deaths attributed to human interactions. Many whale and dolphin populations are in decline, facing the threat of near-extinction. The North Atlantic Right Whale, specifically, is critically endangered, numbering only ~350. To combat this issue, a real-time Right Whale detection network is proposed in this paper, to be composed of 3D-printed buoys deployed across the Atlantic Ocean. The goal is to prevent human-caused Right Whale deaths through monitoring whale locations and guiding ships and fishing nets away from collisions through early warnings. The proposed detection network uses a three-step approach where captured audio is recorded on a buoy and then sent to a cloud-based server that processes and classifies whether auditory cues of whales are detected. Finally, client applications are updated using an online API, conveying real-time locations of whales. Each buoy consists of an ESP32, solar panels, and a hydrophone, costing significantly less than current buoys. The system runs a two-branch Ensemble Learning model that employs a 2D Convolutional Neural Network (CNN) with a Custom Convolutional Block Attention Module (CBAM) in one branch, while the other branch utilizes a Bidirectional Long Short-Term Memory (Bi-LSTM) model. Both branches use extracted spectral, temporal, and harmonic features to detect Right Whales based on their vocalizations. This model was trained on datasets from Cornell University and Watkins Marine Mammal Database, achieving a 0.977 AUROC score with a standard deviation of 0.002, surpassing the 0.7214 benchmark set by Cornell while using fewer parameters at 343,877 compared to pre-trained models. In testing, the design demonstrated reliability, potential scalability, and accuracy. Furthermore, promising results were found when extrapolating to the classification of multiple cetacean species, significantly enhancing marine conservation.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148440: Numerical Analysis of Sediment Transport and Siltation in a South West Coast Harbour of India, Using MIKE21 LITPACK

Sreelakshmi R ¹, Dr. Athul Krishna K. R ² and Akhila K A ^{3,*}

¹ Department of Ocean Engineering, Kerala University of Fisheries and Ocean Studies (KUFOS), India – M.Tech Student

² Assistant Professor, Department of Ocean Engineering, Kerala University of Fisheries and Ocean Studies, Kochi, Kerala, India

³ Research Scholar, Department of Ocean Engineering, Kerala University of Fisheries and Ocean studies, Kochi, Kerala, India

Chellanam Harbour, located on the south west coast of India, is a fishing village and mechanised fishing operations, yet it is increasingly hindered by sediment accumulation that restricts navigation and disrupts daily activities. This study applies the MIKE21 LITPACK numerical modelling suite, developed by DHI, to investigate sediment transport pathways and evaluate wave conditions influencing Chellanam harbour tranquillity. Bathymetric inputs were obtained from GEBCO, while hydrodynamic and meteorological forcing were sourced from ERA5 reanalysis products. Simulations conducted within the MIKE21 Toolbox mapped spatial and temporal patterns of sediment deposition, identifying an average annual siltation rate of 0.144 m, with the most rapid build-up occurring in the entrance channel. This area is critical to safe vessel manoeuvring. The findings offer a predictive framework for optimising dredging cycles, improving sediment management, and guiding infrastructure modifications to sustain operational efficiency. While grounded in a specific regional context, the methodology is transferable to other small tropical harbours worldwide, where similar challenges are magnified by climate-driven changes in coastal processes. By linking applied coastal engineering with global resilience objectives, this research supports UN Sustainable Development Goals on climate action, sustainable fisheries, and resilient infrastructure, contributing to the long-term viability of working waterfronts in developing maritime economies.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139821: Numerical Analysis of the Penetration Process of the Bucket Foundation with a Cruciform Inner Compartment

Zhong Xiao ¹, Xiang Wang ^{1,*}, Donghai Zhang ¹, Pan Hu ², Feng Wu ³ and Yuhong Wang ⁴

¹ Tianjin University

² Western Sydney University

³ CCCC Shanghai Harbour Engineering Design and Research Institute Co., LTD.

⁴ CCCC First Harbor Consultants CO., LTD

Bucket foundations possess the characteristics of excellent bearing capacity, relatively low economic cost and being suitable for soft clay foundations. These advantages have led to their gradual adoption in various coastal and offshore engineering structures. Recently, bucket foundations with internal compartments have emerged as a preferred choice for the foundations of structures that need to bear large moment loads, such as offshore wind turbines. The inclusion of inner compartments in bucket foundations significantly influences soil flow, soil softening and penetration resistance. In addition, the soil heave and softening generated during their penetration can adversely affect its subsequent bearing capacity, often resulting in a lower bearing capacity than that of the fully embedded foundations. Therefore, it is crucial to investigate the installation process and the bearing capacity of bucket foundations with inner compartments. Based on a series of numerical analyses using the Coupled Eulerian-Lagrangian (CEL) method, this study examined the penetration and installation process and the post-installation bearing capacity of bucket foundations with cruciform inner compartments. Parameters including soil strength heterogeneity, soil sensitivity, relative ductility, soil stiffness coefficient, and the foundation wall thickness ratio have been evaluated. Detailed analyses were conducted on soil flow, soil heave, soil softening and penetration resistance. Furthermore, a formula was proposed to calculate the penetration resistance of bucket foundations with cruciform inner compartments, incorporating the soil strain softening and strain rate effects.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-137404: Performance Optimization of Offshore Production Wells Using PIPESIM Simulation: A case study of the Horizon Oilfield

Sampson Kennie Wayoe^{1,*} and Rebecca Dedeyo Wayoe²

¹ Marine engineering department, regional maritime university, Ghana

² Material engineering department, sunyani technical university, Ghana

Offshore oil and gas production poses unique problems due to complex reservoir behaviour, limited accessibility, and the high expenditures of subsea infrastructure. Optimizing the performance of offshore production wells is thus critical to ensuring maximum hydrocarbon recovery, economic viability, and long-term field sustainability. Alpha, Beta, Gamma, Delta, and Epsilon are the five anticipated oil-producing wells that are expected to provide a 20-year production span from the Horizon Oilfield, which is situated offshore in south-west Ghana. The purpose of this study is to use PIPESIM to maximize these wells' performance in both natural flow and artificial lift scenarios. Sensitivity experiments on tube size, gas-liquid ratio (GLR), water cut, and reservoir pressure depletion were carried out in addition to Inflow Performance Relationship (IPR) and Vertical Lift Performance (VLP) evaluations. The findings show that by reducing frictional losses, a 7-inch tubing diameter optimizes flow-rate. However, because of hydro-static and back pressure accumulation, increases in GLR and water cut have a negative impact on well performance. The pressures associated with reservoir abandonment varied from 500 to 1000 psia. Electric Submersible Pumps (ESPs) were designed and selected for all wells to sustain production in the late phases of life, resulting in considerable improvements in drawdown and production rates even at 100% water cut. The findings provide strategic insights for optimizing well productivity and recovery in offshore reservoirs with long-term production.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-136959: Seepage effects on local scour around twin tandem pipelines under wave loading

Xu Chen^{1,*} and Dongsheng Jeng²

¹ College of Civil Engineering, Qingdao University of Technology, Qingdao, 266520, China

² School of Engineering and Built Environment, Griffith University Gold Coast Campus, QLD 4222, Australia

Offshore twin pipelines are increasingly deployed for oil and gas transportation, where wave-induced local scour poses significant threats to structural stability. When waves propagate over submarine pipelines, complex interactions between wave dynamics, seabed response, and sediment transport occur. The seabed generates excess pore pressures and seepage flows that modify sediment stability conditions under wave loading. Previous investigations have primarily focused on single pipeline scour under pure hydrodynamic conditions (Chiew, 1991; Fuhrman et al., 2014). Recent studies examined twin pipeline configurations, with Zhao et al. (2015) and Hu et al. (2019) investigating scour under current conditions, while Li et al. (2020) explored combined wave-current effects. However, these works neglected seabed response mechanisms. Limited research by Guo et al. (2019) demonstrated that upward seepage significantly influences sediment incipient motion around single structures, but comprehensive analysis of wave-induced seabed response effects on twin pipeline scour remains unexplored.

This study applies the PORO-FSSI-SCOUR model (Zhai and Jeng, 2024) to investigate seepage effects on scour around twin tandem pipelines. The computational framework couples hydrodynamic simulation with poro-elastic seabed analysis and incorporates seepage-modified Shields parameters for sediment transport. Parametric studies examine pipeline spacing ratios ($G/D = 1-5$) and soil properties, including permeability (ks) and the degree of saturation (Sr).

Results indicate that wave-induced seabed seepage substantially enhances scour development compared to conventional models without soil response. The seepage correction factor consistently exceeds unity, and upstream pipelines experience greater scour than downstream structures. Scour interactions intensify as G/D increases from 1 to 4, but twin pipelines exhibit independent behaviour at $G/D = 5$. ks influences scour magnitude more than Sr . Seabed response mechanisms significantly modify sediment transport around twin pipelines, emphasising the importance of considering soil-structure interactions in offshore pipeline design and stability assessment.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Session B. Coastal Engineering

sciforum-139768: Nearshore Morphological Change Assessment of the Beach of San Montano, Ischia (Italy): Beach Nourishment Implications

Anselme Muzirafuti

Dipartimento Scienze Matematiche e Informatiche, Scienze Fisiche e Scienze della Terra, Università Degli Studi di Messina, Via F. Stagno d'Alcontres, 31-98166 Messina, Italy

The current study seeks to improve beach nourishment operations by proposing a methodological monitoring approach aiming at identifying and excavating the sediment needed for such operations. Here, we propose the nearshore morphological change assessment approach as a tool for the coastal monitoring and protection remediations. Such a tool would help policy makers and scientists working to find solutions and mitigate the impacts of climate in coastal and low-lying areas. This study was conducted on the beach of San Montano located on the Island of Ischia in the Gulf of Naples; this area has been subject to processes of erosion and accretion recorded for the last 50 years. In addition, meteo-marine events observed in this area have increased coastal erosion processes. However, given the fact that this area is a naturally semi-protected beach, previous studies have indicated that the natural and anthropological events did contribute to the total loss of sediments far from the shoreline. In this case, morphological and hydrodynamic analyses would help to monitor and reuse the sediment involved in nourishment processes. Four topo-bathymetry surveys were conducted using a single-beam echosounder and GPS; in addition bottom sea current measurements were conducted to evaluate morphological variations of the submerged and emerged beaches. The results indicate that the sediments have been deposited in the shallow water of about 4 to 6 meters. In addition, the results obtained from the analyses of the direction and the velocity of the bottom sea current indicate that the distribution of the sediments used for the beach nourishment can be estimated with high precision. The overall results indicate that the proposed monitoring methodological approach would be a resilient and cost-effective strategy for the mitigation of the impact of coastal erosion.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139195: A Simplified Methodology for Tsunami Casualty Estimation Using Geospatial Analysis and Numerical Simulation

Angel Quesquen^{1,2,*}, Carlos Davila^{1,2}, Fernando Garcia^{1,2}, Marcello Palomino^{1,2}, Jorge Morales³, Erick Mas³, Bruno Adriano³, Erika Flores² and Miguel Estrada^{1,2}

¹ GeoGiRD Research Group, Facultad de Ingenieria Civil, Universidad Nacional de Ingenieria, Lima 15333, Peru

² Centro Peruano Japonés de Investigaciones Sísmicas y Mitigación de Desastres, Facultad de Ingeniería Civil, Universidad Nacional de Ingeniería, Lima 15333, Peru

³ Graduate School of Engineering, Tohoku University, Sendai 980-8579, Japan

Recent tsunami-related studies have employed numerical simulations to estimate inundation areas and integrated these results with geospatial demographic data to determine the number of potentially affected individuals. While this methodology is useful for estimating economic losses, particularly for real estate, it often overlooks evacuation dynamics that significantly influence casualty estimations.

Evacuation modeling frequently relies on computationally intensive techniques, such as agent-based models (ABMs), to simulate human movement. In this study, we propose a simplified evacuation model that estimates a hypothetical location for population groups, defined by census blocks within the affected area. This model integrates geospatial road network data to better approximate feasible evacuation routes, improving spatial realism while drastically reducing processing time and storage requirements.

Tsunami inundation scenarios were analyzed using the TUNAMI-N2 numerical model for multiple seismic sources along the Central Peru subduction zone, obtaining maps of inundation depths and arrival times. The population was categorized into three age groups, each with differentiated displacement capacities, and assigned hypothetical shelter points based on proximity and access through the local road network.

The simplified approach enabled estimating the quantity of people affected, injured, and fatalities. Additionally, the variation of these statistics for different parameters, such as displacement velocity and response time, was analyzed. The proposed model provides an efficient and scalable tool for coastal cities, offering valuable insights to support decision-making processes in Disaster Risk Reduction (DRR).



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-138679: Analytical Investigation of Wave Interaction with a Submerged Trench under Uniform Currents Using Evanescent Mode Theory

Hamza Mabchour *, Hasna Akarni, Laila Elaarabi and Soumia Mordane

Department of Physics, Faculty of Sciences, University Hassan II of Casablanca, Casablanca 20650, Morocco

Ocean surface waves are strongly affected by various physical processes, leading to the formation of gravity waves propagating from offshore toward coastal areas. The interaction between these waves and submerged structures presents critical challenges in ocean engineering. This study presents an analytical investigation of surface wave interaction with a single submerged rectangular trench in the presence of a uniform current, which may be co-directional or counter-directional with respect to the direction of wave propagation.

The wave dynamics are analyzed within the framework of linear potential flow theory, assuming an incompressible, inviscid, and irrotational fluid. The analytical model is based on the evanescent mode expansion technique, which allows the representation of the velocity potential as a series of propagating and decaying modes. Boundary conditions are rigorously applied at the free surface, trench interfaces, and channel bottom. The method ensures continuity of potential and velocity across trench boundaries, accounting for the influence of current on dispersion relations.

The results show that the presence and direction of the current significantly modify the wave reflection characteristics. The trench geometry, including depth and width, also has a substantial impact on the reflection and transmission behavior. The study confirms the ability of evanescent mode theory to capture complex interactions in wave–structure systems more accurately than simpler approximations.

This work enhances the understanding of wave attenuation mechanisms due to submerged structures and supports the development of efficient analytical models for coastal protection. The findings provide guidance for future experimental validation and practical applications in marine and coastal engineering.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-137602: Automated Forecasting System for Tsunami Hazard and Exposure Reports Using Numerical Simulations and Web-Based Geospatial Visualization

Carlos Davila^{1,2,*}, **Angel Quesquen**^{1,2}, **Jhianpiere Salinas**², **Fernando Garcia**^{1,2}, **Jairo Cueva**² and **Miguel Estrada**^{1,2}

¹ GeoGiRD Research Group, Facultad de Ingenieria Civil, Universidad Nacional de Ingenieria, Lima 15333, Peru

² Centro Peruano Japonés de Investigaciones Sísmicas y Mitigación de Desastres, Lima 15333, Peru

Tsunamis pose a major threat to coastal regions in seismic zones such as Peru. Current tsunami response protocols require time-intensive technical procedures to generate reports, delaying critical decision-making. This study presents the development of a forecasting system that automatically generates standardized technical tsunami reports within minutes. The system integrates numerical simulations, geospatial exposure analysis, and interactive web visualization.

The proposed system employs bathymetric and topographic data, combined with seismic parameters, to automatically define simulation domains along the Peruvian coast. The tsunami generation and propagation are modeled using the Okada and TUNAMI-N2 formulations. Subsequently, census and cadastral data are geospatially intersected with inundation maps to quantify exposed populations and infrastructure, stratified by hazard and exposure levels.

A dynamic web-based platform was developed to visualize simulation outputs and generate downloadable, interactive reports, including wave arrival times, maximum inundation heights, and exposure statistics. The system was tested using historical tsunami scenarios (Camaná 2001 and Pisco 2007), demonstrating its capability to generate technical reports in minutes.

This innovation has direct application for disaster response agencies, national risk management systems, and local governments. The system supports rapid decision-making under emergency conditions and provides a scalable framework for future multi-hazard integration. The proposed tool represents a significant advancement in coastal engineering and disaster risk management for tsunami-prone regions.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139814: Coastal Inundation from Non-Landfalling Tropical Cyclones along the Central Coast of Vietnam

Tam T. Trinh^{1,*}, Charitha Pattiaratchi² and Minh Q. Nguyen³

¹ National Center for Hydro-Meteorological Forecasting, Huynh Thuc Khang, Hanoi, Vietnam

² UWA Oceans Institute, University of Western Australia, 6009 Perth, Australia

³ Institute of Oceanography and Environment, Van Mieu-Quoc Tu Giam, Hanoi, Vietnam

Tropical cyclones, even without making direct landfall, can generate severe coastal inundation through multiple mechanisms. These events are increasingly recognized as critical hazards for Vietnam's central coast, where narrow continental shelves and complex coastal topography amplify hydrodynamic responses. This study examines several historical tropical cyclones, including Typhoon Rai (2021), which caused significant flooding in parts of Vietnam's central coast. Using meteorological reanalysis and tide-gauge records, we quantified water-level anomalies and identified the dominant forcing mechanisms. Results indicate that inundation during these events was not primarily controlled by pressure-driven storm surge but rather by the combined effects of low-frequency waves, wind setup, and local bathymetric amplification. The findings highlight that non-landfalling storms represent a significant yet underappreciated coastal flood hazard for Vietnam. Conventional early warning systems, which often focus on landfalling tracks, may underestimate inundation risk when storms remain offshore but retain strong intensity. Incorporating offshore storm scenarios, wave-surge coupling, and site-specific geomorphological factors into forecasting frameworks will improve predictive skill and strengthen coastal resilience. This research enhances understanding of the impacts of non-landfalling tropical cyclones in the context of coastal engineering and disaster preparedness, providing a scientific foundation for improved early warning strategies and adaptive coastal management in Vietnam and other cyclone-prone regions with similar geomorphic settings.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-138562: Coastal Wind Resource Assessment Method using BP-PSO method Algorithm: A Case Study

Xu Zhang^{1,*}, ShuJie Jiang¹, Jia Yi Jin¹ and Shu Dai²

¹ School of Energy and Engineering, University of Shanghai for Science and Technology, Shanghai 200093, China

² Shanghai Investigation, Design, and Research Institute, Shanghai 200335, China

Accurate offshore wind speed forecasting plays a crucial role in site selection, turbine layout, and energy yield estimation for wind farms. This study presents an enhanced data-driven prediction framework based on a Backpropagation (BP) neural network optimized by Particle Swarm Optimization (PSO), aiming to improve short-term wind speed prediction accuracy under data-limited conditions. The model is trained using hourly wind speed data from 2020 to 2022, collected at a coastal meteorological station in northeastern China. Two modeling strategies are implemented: (1) a multi-year unified training approach capturing long-term temporal dependencies, and (2) a seasonal decomposition strategy in which spring, summer, autumn, and winter data are modeled independently using dedicated BP-PSO models.

To evaluate forecast performance, model predictions are compared with measured wind speed from January to July 2023. The multi-year model achieves superior performance with RMSE = 1.235 and MAE = 0.924, indicating strong generalization across different seasonal conditions. Seasonal models demonstrate varying accuracy: spring (RMSE = 1.243), summer (RMSE = 1.324), and combined seasonal (RMSE = 1.255). These results suggest that although season-specific training may enhance interpretability, it does not necessarily outperform global training due to limited seasonal data and lack of hyperparameter adaptation.

In conclusion, the proposed BP-PSO model offers a robust and low-cost solution for wind speed forecasting in offshore applications. The multi-year framework demonstrates better generalization, while seasonal modeling provides insight into intra-annual wind variations. These findings support the use of hybrid optimization algorithms in enhancing wind resource assessments under real-world operational constraints.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-135619: Dynamic salinity equilibrium in a former estuary after reintroducing seawater inflow

Sam Bom^{1,*}, **Bas van Leeuwen**¹, **Lennard Spaans**¹, **Wouter M Kranenburg**^{2,3}

¹ Svasek Hydraulics, Rotterdam, The Netherlands

² Department of Hydraulic Engineering, Delft University of Technology, Delft, The Netherlands

³ Deltares, Delft, The Netherlands

Introduction

Estuaries worldwide have been closed off from marine influence for flood protection and freshwater supply management. While effective for these societal needs, this strategy significantly alters estuarine ecosystems by eliminating tidal dynamics and disrupting marine-freshwater interactions, leading to blocked fish migration routes and reduced biodiversity. Consequently, there is growing interest in reintroducing controlled saltwater inflows to restore estuarine functions without compromising freshwater availability.

A key challenge in this approach is to establish a dynamic equilibrium in which saltwater inflow and outflow balance over a tidal cycle. Achieving this balance is critical to preventing salt intrusion into upstream freshwater zones. It requires detailed insight into complex hydrodynamic processes – such as stratification, mixing, and the flow dynamics in (former) tidal channels – that govern the salinity distribution in the estuary. Understanding these processes is essential for developing effective management strategies

This study focuses on the Haringvliet, a former estuary in the Rhine-Meuse Delta in the Netherlands, where controlled saltwater inflow has been reintroduced via regulated sluice operations. These trials are supported by extensive ecological monitoring and measurements of hydrodynamics and salinity. Observations show that flushing salt from the estuary's channels is difficult (Kranenburg et al., 2023), emphasizing the need for optimized sluice management.. However, presently it is still unknown what saltwater inflow duration and timing result in acceptable or excessive salt intrusion.

To address this, we investigate the conditions needed to establish a dynamic equilibrium in the Haringvliet. An approach is developed that combines a detailed 3D numerical model with a simplified analytical model. The analytical model serves two major purposes: (1) to develop a sluice operation protocol that optimizes controlled saltwater inflow while preserving upstream freshwater conditions, and (2) to enhance understanding of the stratified hydrodynamics in the Haringvliet, offering valuable knowledge for future estuarine restoration and management efforts.

Methods

The field measurements from the saltwater reintroduction trials, especially salinity and velocity profiles in the deeper pit structures, provided critical insights into the estuary's response (Kranenburg et al., 2023). Achieving a stable dynamic equilibrium during these trials proved challenging. Therefore, the field data are not used directly to define equilibrium states but instead serve to validate controlled 3D numerical simulations, which allow for a systematic exploration of equilibrium states under known and reproducible conditions.

A detailed 3D D-HYDRO model of the Haringvliet (Deltares, 2023) was used, a hydrostatic model with an unstructured horizontal mesh (typical cell side lengths of 60 m) and a combined z-sigma vertical grid (z-layer resolution of 0.125 m) to accurately resolve halocline dynamics. The model was validated against field data and used to simulate various combinations of sluice operations and sea salinity conditions with steady tidal forcing, to systematically explore conditions that lead to dynamic equilibrium. Due to the high computational cost, only a limited number of scenarios could be explored.

To overcome this limitation, a simplified analytical model of the Haringvliet system was developed, enabling broader exploration of the parameter space. The estuary is schematized horizontally into pits and channels, connected by sills of fixed height, each with a defined hypsometry. Vertical stratification is represented by a two-layer system, with denser saltwater down in the channels and pits and freshwater above. The model simulates three processes: (1)

saltwater inflow through the sluices, using dilution relationships derived from the 3D model; (2) vertical mixing at the salt–freshwater interface, parameterized using the Richardson number and calibrated with 3D model outputs; and (3) outflow of the upper layer. With this approach, the analytical model computes the salt intrusion length for the dynamic equilibrium state in the estuary based on an inflow, outflow and sea salinity conditions.

Results

Using the 3D model, 59 simulations were conducted, covering six distinct sea salinity levels (1,000–10,000 mg/L), inlet volumes ranging from 1.3 to 20 million m³ per tide, and outflow volumes between 10 and 80 million m³ per tide. For each simulation, the establishment of a dynamic equilibrium was assessed, along with the extent of salt intrusion into the system. Results align well with field trial observations. The 3D model allowed partial filling of the parameter space and provided insight into how equilibrium location depends on system parameters. However, due to limited resolution in the simulated parameter space, these relationships remain approximate.

The analytical model was calibrated with the vertical mixing parameter using 3D model results. The calibrated mixing intensity varies with outflow volume: stronger mixing for lower outflows and reduced mixing at higher outflows. The calibrated model closely reproduced both the presence of equilibrium and the salt intrusion length observed in the 3D simulations and field data, making it a fast and reliable alternative for predicting system behaviour without the computational cost of 3D modelling.

After calibration, the analytical model was used to perform nearly 10,000 simulations, enabling high-resolution exploration of the parameter space – something not feasible with the 3D model alone.

Both models showed that the formation of a dynamic equilibrium is highly sensitive to sea salinity levels. At higher salinities, equilibrium can only be maintained with small inflow volumes and is generally confined to the first pit in the system. Once inflow volumes become large enough for saltwater to pass the first sill, salt intrusion becomes difficult to control, regardless of outflow capacity. In contrast, at lower sea salinities, equilibrium can be sustained over a broader range of inflow volumes. In such cases, salt intrusion may extend farther upstream, requiring sufficiently large outflow volumes to maintain control.

Conclusions

This study demonstrates that achieving a dynamic equilibrium in former estuarine systems with controlled saltwater inflow critically depends on the interplay between sea salinity, inflow and outflow volumes. By calibrating an analytical model using results from a detailed 3D numerical model, we identified the parameter ranges under which salt intrusion can be effectively managed.

The analytical model captures key physical processes, including vertical stratification, and closely reproduces both 3D model results and field observations. It offers a fast and practical tool for designing sluice operation protocols, without the need for extensive computational resources.

These findings support to the development of effective management strategies for estuarine restoration, while safeguarding upstream freshwater resources, with broader applicability to similar modified estuarine systems worldwide.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139760: Four-month Daily Beach Observations of the Capo Peloro Peninsula, Sicily.

Anselme Muzirafuti

Dipartimento Scienze Matematiche e Informatiche, Scienze Fisiche e Scienze della Terra, Università Degli Studi di Messina, Via F. Stagno d'Alcontres, 31-98166 Messina, Italy

Located at the intersection of land, sea and the air, shoreline is an indispensable parameter for coastal erosion and coastal vulnerability studies. It is well known that the shoreline position is subjected to longshore and cross-shore sediment transports. Such dynamics are typically observed during the winter and summer seasons mainly due to the action of the waves and currents; and consequently, affect the coast and the beach's morphologies. However, not all the beaches and the coasts respond to these processes the same way. Recent study indicated that waves conditions and physical settings of the beaches are adequately diverse to adapt regular seasonal cycles of erosion and accretion. Our study intends to investigate the governing processes involved in morphological changes of the highly dynamic sandy beach located on the Capo Peloro Peninsula, Sicily. Four-month daily observations were conducted using remote sensing imagery and fieldwork surveys. Sentinel-2 satellite images acquired in September, October, November and December 2024 were analyzed to extract information related to the shoreline positions. The images were obtained from the Copernicus data space ecosystem. Feature extraction methodological approach was performed using image segmentation to obtain time-series shoreline vector files. Furthermore, the digital shoreline analysis system (DSAS) was used for shoreline statistical change calculations. For the same period, in-situ geomorphological analysis was conducted aiming for the estimation and interpretation of horizontal and vertical beach behaviors. The results obtained suggest that Capo Peloro beach respects the classic winter erosion and summer accretion cycles with smaller waves moving beach materials inland during the summer while larger waves causing the movement of the beach material offshore during the winter season. In addition, we observed longshore beach materials transportation due to the alternative of NE-SW and NW-SW wave actions. It is important to note that this beach is located on the junction of Tyrrhenian and Ionian seas with different water densities and temperatures which play a role on the persistence and duration of wave direction and wave power resulting in long-term configuration of the beach morphology.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-137952: Immersive Virtual Reality Tsunami Evacuation Model using High-Resolution Unmanned Aerial Vehicle Imagery and Numerical Simulation

Marcello Palomino^{1,2,*}, **Carlos Davila**^{1,2}, **Angel Quesquen**^{1,2}, **Sebastian Monterola**³, **Fernando Garcia**^{1,2}, **Jose Rios**² and **Miguel Estrada**^{1,2}

¹ GeoGiRD Research Group, Facultad de Ingenieria Civil, Universidad Nacional de Ingenieria, Lima 15333, Peru

² Centro Peruano Japonés de Investigaciones Sísmicas y Mitigación de Desastres, Lima 15333, Peru

³ Instituto SISE, Cercado de Lima, Lima 15046, Peru

Traditional tsunami risk communication tools, such as static inundation maps and educational videos, often lack interactivity and realism, which can limit community engagement and preparedness. In this study, an immersive virtual reality (VR) tsunami evacuation model was developed by integrating high-resolution Unmanned Aerial Vehicle (UAV) imagery and numerical simulation. The model was implemented in Ancon Bay, Lima, Peru, a tsunami-prone coastal zone of Central Peru.

Oblique UAV photogrammetry was used to generate a detailed 3D model of the study area, which was subsequently processed to produce a digital terrain model (DTM) suitable for both numerical modeling and VR integration. A high-resolution tsunami simulation was conducted using the TUNAMI-N2 model under a worst-case scenario that may affect the Central Peru subduction zone. The output inundation data, including flow depths and arrival times, were incorporated into the virtual environment to simulate flood progression over time.

The 3D model and simulation results were imported into a commercial game engine to construct an interactive VR system. This system allows users to explore evacuation routes, observe tsunami impacts from a first-person perspective, and engage with key preparedness elements such as signage, warning systems, and emergency protocols. The application provided an immersive and context-specific risk communication tool, designed to enhance public understanding and institutional training for tsunami evacuation.

This model demonstrates the feasibility of combining UAV-based photogrammetry, numerical modeling, and immersive visualization for disaster risk reduction. The approach is replicable in other coastal areas and offers a novel tool to bridge the gap between scientific hazard assessments and community-level preparedness strategies.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-135417: Modeling coastal morphology with sediment transport and Kelvin–Voigt seabed behavior

Maria Antonietta Scarcella * and Manuela Carini

Department of Environmental Engineering (DIAM), University of Calabria, via Pietro Bucci, 87036 Arcavacata di Rende, Italy

Coastal erosion poses a major threat in the context of global environmental change and is influenced by both natural and anthropogenic processes. Traditional shallow water models often neglect the mechanical response of the seabed, limiting their predictive capacity in simulating sediment redistribution and shoreline evolution. This study extends the classical one-dimensional Saint-Venant shallow water equations by incorporating sediment transport, bottom friction, wave dispersion, and viscoelastic seabed behavior. The latter is modeled using the Kelvin–Voigt constitutive relation, which captures both elastic deformation and time-dependent viscous damping. The coupled system is implemented in the COMSOL Multiphysics platform as a set of partial differential equations. Theoretical case studies with different bathymetric configurations (steps or depressions on the seabed) are simulated to assess the influence of friction, dispersion, and seabed rheology. The numerical simulations highlight the stabilizing effects of viscoelastic behavior, especially when combined with dissipative mechanisms such as friction and dispersion. While the classical Saint-Venant model reproduces basic hydrodynamic responses, the inclusion of rheological terms leads to smoother water surface profiles and more realistic sediment redistribution. Notably, cases with viscoelastic seabeds exhibit damped morphological evolution, with reduced local instabilities and better agreement with observed erosion–deposition patterns in natural systems. The results demonstrate that incorporating viscoelastic properties into morphodynamic models improves the physical realism of simulations and enhances predictive capabilities. These findings support the integration of rheological behavior in coastal modeling frameworks, with potential applications in sediment management, risk assessment, and nature-based coastal defense design.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148451: ONE-LINE CONTOUR MODELS FOR EQUILIBRIUM DESIGN: THE SHORELINE RESPONSE BEHIND DIFFRACTIVE STRUCTURES

Davide Carrubba^{1,*}, Sara TuoZZo¹, Bas Huisman², Mariano Buccino¹ and Dano Roelvink^{3,4}

¹ Department of Civil, Architectural and Environmental Engineering, University of Napoli “Federico II”, Via Claudio 21, 80125 Napoli, Italy

² Department of Applied Morphology, Deltares, P.O. Box 177, 2600MH Delft, The Netherlands

³ IHE Delft Institute for Water Education, Coastal and Urban Risk and Resilience, 2601 DA Delft, The Netherlands

⁴ Deltares, Marine and Coastal Systems, Boussinesqweg 1, 2629 HV Delft, The Netherlands

Beach erosion is one of the main critical issues affecting coastal areas; its mitigation and prevention are significant challenges for the engineering community. The “headland control” approach indeed represents an interesting solution, since using diffractive structures might induce shoreline responses characterized by a static equilibrium condition (Hsu and Silvester, 1990).

In this work, we have examined the capability of two different one-line models in reproducing such a behavior. In particular, we have compared the well-established one-line model GENESIS (Hanson 1989) with the new one ShorelineS, which has been recently developed by IHE Delft and Deltares (Roelvink et al. 2018). The models differ in various aspects, such as the diffraction modelling and the numerical approach adopted (i.e., ShorelineS is a flexible vector-based model, while GENESIS exploits a fixed grid). Therefore, the present study aims to assess whether the novelties introduced in ShorelineS make it a more robust and reliable model for predicting shoreline changes behind diffractive structures.

Specifically, we have modelled the static equilibrium profiles behind isolated detached breakwaters and the so-called headland bay beaches and compared numerical outcomes with literature benchmarks. Although GENESIS has provided consistent results, it exhibits some drawbacks that might influence the accuracy of predictions. On the other hand, ShorelineS has proved to be a promising tool able to remarkably predict shoreline equilibrium beaches ruled by diffractive structures.

References

1. Hanson, Hans (1989). “GENESIS: a generalized shoreline change numerical model”. In: Journal of Coastal research, pp. 1–27.
2. Hsu, John RC and Richard Silvester (1990). “Accretion behind single offshore breakwater”. In: Journal of waterway, port, coastal, and ocean engineering 116.3, pp. 362–380.
3. Roelvink, D, B Huisman, and A Elghandour (2018). “Efficient modelling of complex coastal evolution at monthly to century time scales”. In: Proceedings of the Sixth International Conference on Estuaries and Coasts (ICEC-2018), Caen, France, pp. 20–23.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148450: Physical modelling of wave overtopping mitigation through adaptive defence solutions

Sara Tuozzo *, Antonia Menzione, Mario Calabrese and Mariano Buccino

Department of Civil, Architectural and Environmental Engineering, University of Napoli "Federico II", Via Claudio 21, 80125 Napoli, Italy

Wave overtopping and flooding hazards represent critical issues for coastal areas. To contain their related risks, which will be seemingly amplified by various climate change effects, the engineering community is resorting to the so-called "adaptive solutions", namely, the enhancement of existing defensive structures. In this study, we investigate the efficacy of two different adaptive solutions in reducing the mean overtopping discharge at a vertical seawall. Specifically, this study examines either a wall protected by rubble mound breakwaters or rubble mounds combined with ReefBall modules; while a few studies have recently addressed the former solution, the second one represents a novelty.

To analyze the behavior of these two layouts, we have performed a physical experimental campaign in the small-scale flume of the University of Naples Federico II. Four regular wave conditions have been run to measure the mean overtopping discharge at both an unprotected and a protected vertical wall. In particular, we have tested different rubble mound configurations by varying geometrical features, as well as several arrangements of ReefBall modules on the crown of the breakwater. Laboratory results have indicated that rubble mounds do not exhibit a significant overtopping reducing power, especially for submerged structures. On the other hand, the presence of ReefBalls remarkably lessens the mean flow rate at the wall, especially for certain modules' dispositions. The present work, hence, explores and highlights the effective capabilities of these adaptive solutions in reducing coastal flooding risks.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-147943: Sea-Level Rise Scenarios up to 2150 for the Tuscany Coast: The Case of the Northern Sector

Francesca Iacono^{1,*}, Daniele Trippanera², Tommaso Alberti², Marina Bisson¹, Alessandro Bosman³, Carlo Alberto Brunori² and Marco Anzidei²

¹ Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Via Cesare Battisti 53, 56125 Pisa, Italy

² Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy

³ Istituto di Geologia Ambientale e Geoingegneria, Consiglio Nazionale Delle Ricerche, CNR-IGAG, RU Sapienza DICEA, Roma, Italy

Coastal zones, long favored for fertile lands, trade, and mild climates, are now highly exposed to climate change impacts, particularly sea-level rise (SLR) and erosion. By 2060, global low-elevation areas may host over one billion people, facing growing flood risks. Regional sea-level is influenced by climatic drivers, tectonics, isostatic adjustments, and circulation. In particular, in the Mediterranean, land subsidence and global warming intensify hazards, threatening infrastructure and heritage. This study examines future SLR along the northern Tuscany coast, between Pisa and Massa-Carrara, to support adaptation strategies.

A multidisciplinary study was launched to project local SLR and generate flood maps up to 2150 by using sea-level data from local stations (PSMSL; ISPRA) and vertical land motion as derived from GNSS networks and MT-InSAR data analysis. High-resolution LiDAR topography (2008–2010), referenced to the ITALGEO 2005 geoid, supported inundation mapping. Results were combined with IPCC-AR6 projections under the high-emission SSP5-8.5 scenario. Local subsidence was considered, assuming no major tectonic or volcanic events.

By 2150, under SSP5-8.5, sea level along the northern Tuscany coast (465km²) could rise up to 1.5m, flooding 170.7km². Estimates were obtained using a passive approach, where land below projected water level is considered inundated, regardless of direct sea connection.

Results highlight the vulnerability of northern Tuscany's infrastructure and settlements. They stress the need for proactive planning, stronger coastal defences, and integration of climate risk into development policies. Interdisciplinary collaboration among scientists, planners, and policymakers is essential for resilient and sustainable coastal management under future SLR.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-147751: The Impact of Procedural Factors on Granulometric Analysis: Implications for the Economic Viability and Success of Coastal Nourishment Projects.

Patricia Lopez-Garcia^{1,*}, **Patricio Poulet**², **Antonio Contreras**¹, **Bismarck Jigena**¹, **Francisco Contreras**¹ and **Juan J. Munoz-Perez**¹

¹ Coastal Engineering Research Group, University of Cadiz, 11150 Puerto Real, Spain

² Coastal Directorate, Ministry of Environment, Marianista Cubillo 7 (Cadiz), Spain

Coastal erosion represents a major challenge for shoreline management globally, with beach nourishment being the most widespread mitigation strategy. The effectiveness and longevity of these projects critically depend on the granulometric compatibility between borrow and native sediments, requiring a precise characterization of both materials. However, the characterization of borrow sediment is influenced by a set of factors during the analysis procedure that can introduce considerable uncertainty into the results. Essential variables such as the sampling technique, sediment variability within the dredge hopper, sieving specifications (e.g., column diameter and sieving time), and the sample drying method have been shown to have a substantial quantitative impact on the final findings. This work presents a comprehensive review of research quantifying the influence of these factors on the accuracy of granulometric analysis. The magnitude of the cumulative error is assessed, demonstrating how minor procedural inconsistencies can lead to significant deviations in key sediment parameters like mean grain size and sorting. Such deviations have direct implications for calculating the required nourishment volume, resulting in significant errors in the estimated quantity. These miscalculations directly compromise the economic viability of the project by creating a critical mismatch between the designed and the truly necessary sand volume. In response, standardized protocols are proposed to mitigate these uncertainties and enhance the predictability and effectiveness of future nourishment interventions.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Session C. Physical Oceanography

sciforum-121638: Analysis of the Main Physical Properties of Seawater Along the Coast of Angola

Fernao M. Guilherme^{1,*}, Maria C. Neves² and Paulo Relvas³

¹ Department of Geophysics, Faculty of Natural Sciences, Agostinho Neto University (UAN), Luanda 815, Angola

² Department of Marine and Environmental Sciences (DCTMA), Faculty of Sciences and Technology (FCT), Universidade do Algarve, 8005-139 Faro, Portugal

³ Campus de Gambelas, Centro de Ciências do Mar (CCMAR), Universidade do Algarve, 8005-139 Faro, Portugal

This article is part of a doctoral thesis to be presented during the Doctoral Program in Marine Sciences of Agostinho Neto University, Supported by the European Union through the UNI.AO program.

The topic is “Analysis of the Main Physical Properties of Seawater Along the Coast of Angola.”

As we know, the ocean has several important properties. However, the primary physical oceanographic properties are: water temperature, salinity and density. Studying the variation of these properties allows us to conclude about the general circulation of the oceans. This article aims to analyze the temporal and spatial variation of these properties along the Angolan coast. To achieve the objectives, were used data from the *World Ocean Database*, and processed using software *Ocean Data View*, and graphical representations of these oceanographic variables. Thus, was possible to describe oceanographic phenomena observed.

After analyzing the results, it was possible to identify the stratification and seasonality of seawater along the coast of Angola based on its main oceanographic properties.

Thus, this scientific research is relevant because, it provides concrete results on the variation of oceanographic properties such as seawater temperature, salinity, and density along the coast of Angola.

The study is structured as follows: an introduction, which highlights the relevance of the topic and the methodology used; a theoretical framework, where the main concepts related to the subject are defined; a data analysis and discussion section, where the results are examined; and finally, the conclusions.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139472: ASSESSMENT OF THE SEA ICE AGE COMPOSITION AND THE FORMING IT MAIN FACTORS IN THE LAPTEV SEA

Anna Timofeeva^{1*}, Ruslan I. May^{2,3} and Andrey Rubchenia⁴

¹ Arctic and Antarctic Research Institute, 199397 Saint Petersburg, Russia

² Department of oceanology, St. Petersburg State University, St. Petersburg, Russia

³ Krylov State Research Center, St. Petersburg, Russia

⁴ N.N.Zubov's State Oceanographic Institute, Roshydromet, Moscow, Russia

The age composition of the Laptev Sea ice cover is considered. The seasonal course of the ice development, as well as interannual changes, was estimated from October to May in 1997-2024. Regional Laptev Sea charts of the ice conditions, compiled by the AARI (available in the electronic catalog of the World Sea Ice Data Center) were used as the data source. Regional charts are the result of analyzing satellite information in 2-3 days made as SIGRID-3 format. The spatial and temporal variability of sea ice with different stage of development (new ice, nilas, gray and gray-white ice, one-year thin, medium, thick and old ice) was analyzed using the method of probability calculating by polygon intersections.

Assessing the interannual variability of age composition during winter season a tendency was revealed to shift the terms of the transition to the next age gradation to later ones, as well as a tendency to reduce the amount of the old and thick one-year ice, while the number of medium and young ice increased. The main factors determining the interannual changes in the area of ice of various age gradations for certain areas of the Laptev Sea were also considered. For this purpose, physico-statistical equations with the highest coefficients of correlation and determination were constructed and optimal combinations of predictors were found to describe changes in the age composition of the sea ice cover.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-135838: Coastal Polynyas of the White Sea: temporal and spatial variability

Andrey Rubchenia^{1,*}, Ruslan I. May² and Anna B. Timofeeva³

¹ N.N.Zubov's State Oceanographic Institute, Roshydromet, Moscow, Russia

² Department of oceanology, St. Petersburg State University, St. Petersburg, Russia

³ Sea Ice Regime and Forecast Department, Arctic and Antarctic Research Institute, St. Petersburg, Russia

The White Sea is a semi-enclosed basin of the Arctic Ocean connected to the Barents Sea by the narrow Gorlo Strait. Coastal polynyas of the White Sea are sections of open water or thin ice near the coast. Wind and dynamic processes, such as currents and tides, maintain them. The tides in the White Sea have a significant impact on the water's dynamics. Strong semidiurnal tides with amplitudes up to 9 m propagate through Gorlo, creating vigorous tidal currents throughout the sea. This large tidal range also causes daily reversed flow and intense mixing at straits, affecting polynyas situated in the Gorlo Strait and nearby areas. Landfast ice extends only a few kilometers from the shore. Tidal oscillations break it up. Polynyas vary yearly with ice conditions. Coastal polynyas influence regional climate, warming the surrounding areas. New young ice forms in polynyas. Brine rejection in polynyas affects local salinity, water density and mixing. Tidal forcing maintains coastal open-water areas via mechanical stirring and amplifies mixing in the coastal shelf, reinforcing the thermal- and haline-related effects of polynyas. Coastal polynyas detected from the coastal polynyas of the White Sea have not been well studied. Kupetsky was among the first to publish on this topic in the mid-20th century (Kupetsky, 1959). The complex configuration of the coastline and the presence of narrow bays determine the heterogeneous impact of the wind and consequently the location of polynyas. Due to water dynamics, modeling coastal sloughs is difficult and often yields inconsistent results. Therefore, satellite data seem to be a good option for studying the dynamics of polynyas. The initial data of the regional charts of the sea ice conditions in the White Sea from the World Sea Ice Data Center (<http://wdc.aari.ru/datasets/>) from 1999 to 2025 was used to prepare a dataset of polynya characteristics, including area, spatial position, and variability over time. The spatial and temporal variability of polynyas during the specified period was analyzed using the obtained time series.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139488: SEASONAL AND INTERANNUAL VARIABILITY OF THE LAPTEV SEA ICE MASSIFS

Anna Timofeeva^{1*}, Ruslan I. May^{2,3} and Andrey Rubchenia⁴

¹ Arctic and Antarctic Research Institute, 199397 Saint Petersburg, Russia

² Department of oceanology, St. Petersburg State University, St. Petersburg, Russia

³ Krylov State Research Center St. Petersburg, Russia

⁴ N.N.Zubov's State Oceanographic Institute, Roshydromet, Moscow, Russia

The ice massif is a significant quasi-stationary accumulation of close or very close sea ice (with the ice concentration from 7 to 10 tenths, and the concentration is the ratio expressed in tenths describing the amount of the sea surface covered by ice as a fraction of the whole area being considered, according to WMO Sea Ice Nomenclature). Ice massifs cover hundreds of square kilometers which is found in the same region every summer melting period.

Being an obstacle to navigation, the ice massifs began to be explored back in the 1940s with a help of air reconnaissance. These are also of interest now, since the development of the Arctic Seas shelf and related activities require safety and timing of work. We used data from electronical archive of Arctic and Antarctic Research Institute (AARI). The archive contains information on the year-round distribution of the ice cover in the form of maps and quantitative estimates of Arctic ice cover, including ice massifs. For assesment of interannual variability of ice massifs we used data set of quantitative estimates since 1940 to 2024 for June-September. For assessment of spatial distribution we used regional Laptev Sea charts of the ice conditions, compiled by the AARI for June-September in 1997-2024. These data were analyzed using the method of probability calculating by polygon intersections. There are two ice massifs in the Laptev Sea: the Yansky ice massif, formed by fast ice in the eastern part of the sea, and the Taimyrsky ice massif, formed by a narrow fast ice and drifting ice in the western part of the sea. In summer, the Taimyrsky ice massif is fed by ice coming from the Arctic basin. By the end of the melting period, the Taimyrsky ice massif rarely disappears completely during the all observation period since 1940. However during last decades the frequency of these event is increased. The Yansky massif consists mainly of fast ice, it lasts for a long time at the beginning of the summer period and quickly collapses after fast ice destroying. The Yansky massif disappears completely with very high frequency.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-136481: Tide-Induced Residual Circulation in a Semi-Enclosed Basin: Simulations and Observation Results

Ruslan I. May¹, Andrey Rubchenya^{2,*} and Victor V. Ionov¹

¹ Department of oceanology, St. Petersburg State University St. Petersburg, Russia

² N.N.Zubov's State Oceanographic Institute, Roshydromet, Moscow, Russia

Tidal fluctuations in sea level and currents are represented by special set of harmonical functions. In a linear approximation, averaging of tidal fluctuations give a result close to zero. However, in reality, due to nonlinear effects, such averaging will give a result different from zero. This mechanism will lead to the appearance of a static sea level rise and the generation of a constant current. The change in the average sea level due to nonlinear effects is known as the residual tidal level. Permanent currents resulting from the transfer of energy from semi-diurnal and diurnal tidal waves are known as residual tidal currents, and the system they constitute is called residual tidal circulation.

The first description and explanation of residual tidal currents was given in the work (Timonov, 1960). Since then, numerous works have appeared describing residual tidal currents in various water areas. As a rule, residual tidal circulation was described based on the results of numerical hydrodynamic models. Specific conditions are required for reliable identification of residual tidal circulation in measurement data: strong tidal currents and limited influence of currents caused by other factors. Such conditions are observed in the semi-enclosed waters of the Keret Bay, where the Department of Oceanology of St. Petersburg State University has been conducting long-term research.

The investigation focused on Keret Bay in the Chupa Estuary and Kandalaksha Bay in the White Sea. There are small straits and bays, including semi-enclosed Lebyazya Bay. The waters in a semi-enclosed basin have special features due to tidal cycles and topography. Numerical simulations and field observations revealed the unique characteristics of tide-induced circulation.

We employed a combination of numerous measurements and results of hydrodynamic simulations. The residual level and residual tidal circulation were calculated based on 30-day numerical experiment results. Filtering was performed twice using a moving average with a step of one day to eliminate harmonic components whose period is not a multiple of the length of the series. The values of the residual current and residual sea level were then determined from the filtered data.

The residual tidal sea level in the whole Keret Bay is practically absent. The deviation of the residual tidal level from the average sea level does not exceed a few millimeters. This is less than the accuracy of the methods used for analysis. The freshwater runoff from the Keret River will change the average sea level. It will also cause additional nonlinear effects associated with the interaction of river runoff and tidal waves.

The residual tidal currents obtained from model calculations are of most interest. Lebyazya Bay's permanent circulation, caused by tidal dynamics, is one of the most interesting special features. The characteristic flow velocities are 1-3 cm/s, reaching 5 cm/s. This circulation is a tide-induced permanent residual circulation, which is the result of the complex interaction of tides and topography.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139633: Drifter observations of surface currents from the Browse Basin

Prescilla Siji * and Charitha Pattiaratchi

School of Engineering and UWA Oceans Institute, The University of Western Australia, 35 Stirling Highway,
Perth 6009, Australia

Drifting objects are the best proxy to elucidate the nature of the ocean surface currents. With the advancement of satellite tracked GPS, drifter observations offers a more comprehensive understanding of the spatial and temporal aspects of the ocean surface currents. North of Australia is a data sparse region from the oceanographers viewpoint. In the Browse Basin of Australia, The University of Western deployed over 150 surface drifters during 2019 to 2022. This data was used to examine the seasonality in Lagrangian characteristics of the Browse basin surface currents, in the light of the wind data from the Adele island meteorological station of the Bureau of Meteorology. This extensive deployment revealed that the prominent mean currents in the region during the first indigenous season, Mangala (December to January) was directed northeastward due to winds from the southwestward direction. For the Marrul (April), Wirralburu (May), Barrgana (June-August), Wirlburu (September) through Laja (October-November) the surface currents were directed in a westward direction following the southeasterly winds. Furthermore, our drifters could capture the high frequency to low frequency variabilities in the surface currents like tides, inertial currents and eddies, which were not always captured in the satellite observations. The drifters also revealed a region of higher mixing which is in agreement with the higher kinetic energy imagery from satellite data.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-149892: Estuarine turbidity maximum in non-tidal conditions and relations to microplastics retention

Boris Chubarenko

Shirshov Institute of Oceanology, Russian Academy of Sciences, 117997 Moscow, Russia

The estuarine turbidity maximum (ETM) is typically found in tidal estuaries. The research on the ETM in non-tidal estuaries is comparatively limited. The presentation is focused on the ETM in the context of non-tidal Baltic Sea estuaries, particularly that of the Pregolya River, and is the first attempt to estimate the presence of ETM in the Baltic Sea river mouths environment. The study presents field measurement results examining the spatial distribution of temperature, salinity, turbidity, and suspended matter content along the Pregolya River estuary (South-Eastern Baltic). Measurements were taken monthly in 2024 to determine seasonal changes in these characteristics. It was found that ETM did not appear during the spring increase in river runoff, but formed during the period of low water, especially during the wind surges in the autumn. Biogenic component of suspended matter prevailed during the warm season. Lithogenic component prevailed at other times of the year (except during the spring runoff period). Results showed that ETM can occur under non-tidal conditions, exhibiting seasonal cyclicity and being driven by processes associated with the gravitational, colloidal-sorption, and biogenic stages. The microplastics (0.3-5 mm) and mesoplastics (5-25 mm) were investigated for the first time. The mean abundance of all plastics (0.3-25 mm) ranged from 7.7 ± 5.1 to 15.7 ± 4.9 items per litre. Fibres accounted for 98% of all plastic particles found. Two maxima in number and mass of plastic debris were found along the estuary, and it was hypothesised that the microplastics maximum is gradually formed by seasonal dynamics.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-136878: Examining Hydrodynamics and Variability over the Eastern Canadian Shelf using a Nested-Grid Modelling System

Jinyu Sheng *, Qiantong Albert Pei and Kyoko Ohashi

Department of Oceanography, Dalhousie University, Halifax, NS B3H 4R2, Canada

A coupled circulation-ice modelling system with multi-grid nesting capacity was developed for the northwest Atlantic (CCIMS-nwA) based on the Regional Ocean Modeling System (ROMS) and Los Alamos Sea Ice Model (CICE). CCIMS-nwA is forced by atmospheric forcing (including winds, atmospheric pressure at the mean sea level and net heat and freshwater fluxes) at the surface, tidal forcing, inflows, hydrography and ice conditions specified at lateral open boundaries. The model external forcing also includes riverine freshwater discharges, and continental runoff due to melting of ice and snow over land. This paper provides an overview on different nested-grid setups developed by the regional modelling group at Dalhousie University for different projects. Performance of CCIMS-nwA is assessed using various data including in-situ oceanographic observations, satellite remote sensing data, and ocean reanalysis. Model results in two applications demonstrate the feasibility and skills of CCIMs-nwA in simulating both the large-scale hydrodynamics over the eastern Canadian shelf and fine-resolution currents and hydrography over three different coastal waters. These two different coastal waters include (a) southwestern Scotian Shelf, (b) Bras d'Or Lake of Cape Breton. The temporal and spatial variability of three-dimensional (3D) currents and hydrography simulated by this modelling system for these three coastal waters were examined based on time-dependent 3D model results.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-128880: Impacts of Anthropogenically Driven Changes in Sediment Dynamics on Depositional Records in the Pearl River Estuary, China

Dezheng Liu ^{1,*}, Kailin Wu ², Haotian Wu ³ and Liangwne Jia ¹

¹ Institute of Estuary and Coast, Sun Yat-sen University, Zhuhai 519082, China

² The Key Laboratory of Coast and Island Development of Ministry of Education, Nanjing University, Nanjing 210023, China

³ Hydrology and Water Resources Department, Nanjing Hydraulic Research Institute, Nanjing 210017, China

Extensive research has established that both anthropogenic activities and river-tide interactions are significant factors affecting the sediment dynamics in estuarine and coastal regions. Particularly, it is considered that the narrowing and deepening of estuarine topography and decline in upstream discharge and sediment supply by anthropogenic activities (including reservoirs or dam construction, coastal reclamation, sand excavation, and channel dredging) may exert profound changes in the sediment dynamics characteristics of the Pearl River Estuary (PRE), a key region within the Guangdong-Hong Kong-Macao Greater Bay Area. To investigate the resulting impacts on sedimentary records, this study analyzed grain size distribution and loss-on-ignition (Organic matter; OM) content from sediment cores collected from both eastern and western regions of the LE, the largest sub-estuary of the PRE, based on a ²¹⁰Pb-based chronological framework. The results reveal shifts in estuarine dynamics around 1994, marked by a 33 % reduction in sediment flux and amplified tidal energy, transforming the originally river-dominated estuary into a tide-dominated regime. Spatial heterogeneity in sedimentary responses was observed. In the eastern Lingdingyang Estuary (LE), sediment coarsening and improved sorting due to intensified tidal currents, while the western LE showed mixed deposition and poorer sorting linked to constrained ebb flows and sediment trapping effects. Furthermore, OM enrichment was strongly correlated with clay content, particularly in the western LE, indicating flocculation processes under tidal influence. OM accumulation increased westward but declined in the east. Our findings demonstrate that anthropogenic interventions dominate over natural processes in controlling estuarine sediment dynamics, provide essential understandings for sustainable management of the PRE and the Greater Bay Area, while also offering a valuable reference for other heavily modified estuary systems worldwide.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139893: Impacts of topography on wave-current interactions during Hurricane Arthur

Colin J Hughes^{1,2,*}, Jinyu Sheng¹ and William Perrie^{2,3}

¹ Department of Oceanography, Dalhousie University, Halifax, NS B3H 4R2, Canada

² Fisheries and Oceans Canada, Bedford Institute of Oceanography, Dartmouth, NS B2Y 2N6, Canada

³ Department of Engineering Mathematics & Internetworking, Dalhousie University, Halifax, NS B3J 1B6, Canada

During hurricanes and other extreme weather events, wave-current interactions are important over shelf and coastal waters. A state-of-the-art circulation-wave modelling system with parameterizations of Langmuir turbulence (LT) and wave breaking (WB) is used in this study to examine wave-current interactions during Hurricane Arthur (2014). Unlike previous studies, the effects of local topography on wave-current interactions are investigated during Hurricane Arthur. In particular, we focused on the dynamics within the Gulf of Maine and Gulf of St. Lawrence. The significant wave heights, vertical mixing and near-inertial currents all have highly asymmetric spatial distributions due to the proximity of the storm track to the coastline, which limits the fetch. Both LT and WB alter the storm-induced changes to the temperature and circulation in our results. Due to LT, the cold wake over the Mid-Atlantic Bight is enhanced by 0.5 °C. There is also clear LT-enhanced cooling over the area between the Gulf of Maine and the Scotian Shelf. However, the LT-enhanced cooling in the Gulf of St. Lawrence is mostly a cumulative effect from earlier storms. In the Mid-Atlantic Bight, WB increases horizontal advection. WB affects the momentum and cooling in the Gulf of Maine and Scotian Shelf asymmetrically, with larger impacts to the right of the storm track. WB also enhances the surface cooling in the southern part of the Gulf of St. Lawrence. Both LT and WB have a much bigger impact on the upper-ocean dynamics than the wave-induced bottom boundary layer and conservative Stokes drift effects.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-138007: Storm-Induced Hydrodynamic Changes and Wave-Current Interaction over the Southeastern Canadian Shelf during Hurricane Fiona

Qiantong Pei * and Jinyu Sheng

Department of Oceanography, Dalhousie University, Halifax, NS B3H 4R2, Canada

Hurricane Fiona in late September 2022 was a large and destructive Category-4 Atlantic hurricane, with the wind gusts of about 180 km/h recorded at Arisaig of Nova Scotia. This storm was the most intense (and costly) extreme storm to hit Atlantic Canada on record, resulting in an insured loss of over 800 million Canadian dollar. A coupled wave-circulation model is used in this study to examine the storm-induced hydrodynamic changes and effects of wave-current interaction (WCI) during Hurricane Fiona. The coupled modelling system is based on the Regional Ocean Modeling System (ROMS) and the Simulating Waves Nearshore model (SWAN). Analysis of model results demonstrates very intense vertical mixing and currents generated by Hurricane Fiona in the surface mixed layer, both of which are biased to the right of the storm track. In addition to the strong wind forcing and large atmospheric pressure perturbations, the WCI plays a very important role in the hydrodynamic changes in the top ~80 m over the eastern Scotian Shelf and adjacent waters. Over the offshore deep waters (coastal waters) of the study region, the maximum significant wave heights (SWHs) reach up to 21 m (16 m), biased to the right of the storm track. The storm-induced near inertial currents are significantly stronger over the slope and deep waters compared to coastal and shelf waters.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Session D. Geological Oceanography

sciforum-134212: Dune-ing it Right: A 1D-model for the evolution of the Dutch Barrier Islands through the influence of waves, vegetation, and wind.

Konstantinos Tsapatzis

¹ Department of Geophysics, Fugro, Notdorp 2631 RK, The Netherlands

² Department of Physical Geography, Utrecht University, Utrecht 3584 CS, The Netherlands

Barrier islands serve as a moving coastal border for bays, estuaries, and mainland coastal areas. They protect these more vulnerable habitats from coastal winds, waves, and storm surges. These islands exhibit diverse dune morphologies, ranging from high to low dunes, with intermediate zones named transitional dunes, as seen in the eastern part of the Dutch Barrier Islands.

This study examines the intricate interplay between aeolian transport, vegetation, wave dynamics, and storm events in shaping these dune forms, investigating the morphological parameters that govern dune formation and susceptibility to storms, waves, and vegetation dynamics. A one-dimensional (cross-shore) numerical model was developed to simulate the sandy barrier island evolution spanning years to decades, as a function of the interplay between storminess, vegetation characteristics, and barrier morphology. The model was validated using historical data from the Wadden Sea. Unlike previous studies that typically examine these processes separately, this model combines these processes into a unified framework, facilitating a more holistic depiction of long-term barrier island evolution, revealing beach width as a key control on dune state.

The research highlights that wide beaches with abundant sediment supply promote the formation of high dunes, whereas narrow, sediment-limited beaches tend to form transitional or low dunes. These findings enhance the understanding of the interdependencies among coastal processes and offer predictive tools for coastal management under environmental conditions.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-138216: 3D Structure of the Mesozoic Tan-Lu Fault Zone and Its Impact on Basin Evolution: Insights from the Southern Bohai Bay Basin, NE China

Yancheng Xu * and Jianye Ren

College of Marine Science and Technology, China University of Geosciences, Wuhan, China

The Cenozoic Tan-Lu Fault Zone, as the largest strike-slip fault system in eastern China, features complex deformation patterns and mechanisms and a tectonic evolution process that has been investigated by previous studies. Here, we present high-resolution seismic profiles across the whole southern Bohai Bay basin, linked to the Tan-Lu Fault Zone that allow us to observe two types of Mesozoic fault systems: an E-W trending basement fault set, and a NNE trending basement fault set. Considering the tectonic events that have happened since the Mesozoic and the intersection relationship between the two fault systems, we propose that the E-W trending basement faults are thrust faults, which can be attributed to the Triassic collision between the South China Block and the North China craton. The NNE trending basement faults are interpreted as strike-slip faults formed during transpression, due to multiple phases of subduction of the Pacific plate during Jurassic to Late Cretaceous. Both fault systems have been reactivated as normal faults during Early Cretaceous rifting, leading to the formation of a conjugate rift basin. The widespread Early Cretaceous extension promoted volcanic activity, allowing significant volumes of deep-seated magmatic material to rise along these two sets of faults and to erupt onto the surface. The spatial distribution of the volcanic products was structurally controlled by fault boundaries, leading to the formation of a large-scale, quadrangular Mesozoic volcanic basin.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-137758: Classification of High-Frequency Shallow Seismic Profiles Using CPTu and Core Geotechnical Data in the Aegean Sea, Greece

Nikolas Kimon Chtouris* and Thomas Hasiotis

Department of Marine Sciences, University of the Aegean, Lesvos Isl., 81100 Mitilini, Greece

Geophysical and geotechnical data have been collated over the years from various sites in the Aegean Sea for the purpose of demarcating safe routes for submarine cables between mainland Greece and non-interconnected islands. Geodatabases have been developed for the assessment of cable burial, which includes piezocone tests (CPTu), vibro-cores and high-frequency (3.5 kHz) shallow seismic profiles. A comprehensive geodatabase has been constructed to provide discrete qualitative classifications of acoustic response, based on calibrated CPTu and vibro-core data, from three sites (Evia-Skiathos, Lavrio-Evia and Lavrio-Agios Georgios). Classification is initially based on CPTu, according to basic parameters (qt, u₂, fs and Rf), followed by additional CPTu information (SBT charts, Su, etc.) and vibro-core analysis. Four main acoustic groups have been identified across the three sites. The first group exhibits facies of low amplitude to transparent reflection with some level of faint-to-moderate layering at deeper sections. qt exhibits values between 0 and 5 MPa, along with positive pore pressures, consisting of cohesive sediments of high-to-medium plasticity to silty sands. The second and third group display high-amplitude surficial reflectors with restricted penetration and represent intermediary CPTu response, with qt of 5-10 MPa and 10-20 MPa, respectively. Pore pressure is either variable or close to pressure equilibrium, with sediments consisting mainly of silty sands to sands. The fourth group shows high qt values (≥ 20 MPa) that correspond to coarser lithology (sands/silty sands to gravel) and harder substrates, with some CPTu tests exhibiting refusal, with a varied to negative pore pressure. Seismic facies show high-amplitude chaotic reflection, with occasional patches of medium-amplitude reflection. Results from the seismic facies-geotechnical correlation offer insights into the geological and geotechnical factors affecting CPTu and by extension the acoustic response of shallow stratigraphy.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-135742: Coastal Strandplain Morphostratigraphy Reflected in Remote Image-Color Intensity Patterns: Northern Black and Azov Sea Coasts, Ukraine

Ilya Buynevich^{1,*}, Oleksiy Davydov^{2,3}

¹ Department of Earth and Environmental Science, Temple University, Philadelphia, PA 19122, USA

² Nature Research Centre, 08412 Vilnius, Lithuania

³ Department of Geography and Ecology, Kherson State University, 73000 Kherson, Ukraine

Rapid, effective, and low-cost topographic rendition and quantitative analysis of coastal landforms aids in revealing patterns of long-term (century-to-millennial-scale) trends. The morphostratigraphic record is mediated mainly by temporal patterns of wind forcing, wave climate, and storminess in a regime of changing sea level. To complement traditional ground-based methods, remote sensing technologies (satellite imagery, small UAVs) offer high-definition data. These are especially critical in regions of military conflict, such as the functionally non-tidal northern Black and Azov Sea coasts of Ukraine. To demonstrate the use of threshold-based image color-intensity (ICI) analysis of land-cover as a means of characterizing ridge-swale topography, we use shore-normal (dip-section) profiles across complex recurved strandplains at the termini of drift-aligned spits (Dovgyy, Tendra, Dzharylhach, Biryuchyy, Obytichna) and across swash-aligned cusped forelands (Bakalska, Bilosarayska, Kryva). Along very wide (>3 km) strandplains, hundreds of beach/dune ridges have 30–50% higher ICI (0–256 grayscale) values than intervening vegetated or flooded swales. Areas of exposed bioclastic sand, as well as salt-encrusted and snow-covered surfaces, will have anomalously high grayscale values (>200). Where ridge tops are darker (lower grayscale values), an inverted ICI scale is used for visual representation of topography. In the post-war period, removal of land and sea mines will hamper field investigations (coring, trenching), necessitating reliance on non-invasive geophysical (georadar) and remote sensing techniques for coastal geological, ecological, and conservation research.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148269: Comprehensive analysis of the evolutionary trends of the Sukha Spit (Kinburn Peninsula, Black Sea, Ukraine)

Yuliia Shevchuk^{1,*} and Oleksiy Davydov^{1,2}

¹ Laboratory of Geoenvironmental Research, Nature Research Centre, Vilnius, Lithuania

² Department of Geography and Ecology, Kherson State University, Kherson, Ukraine

About 13% of the world's shorelines are barrier coasts. Most formed in the late Holocene; therefore, research now focuses on present-day geological and geomorphological controls. The Sukha Spit on the southwestern margin of the Kinburn Peninsula is Ukraine's youngest accumulative coastal landform (~45 years), enabling assessment of its current morphodynamic setting and a reliable reconstruction of its evolution. This study combines field observations (2019–2021), a retrospective analysis of cartographic materials (1775–1986), and the interpretation of satellite data (1975–2025). ArcGIS Pro and RStudio were used to assess the spatiotemporal dynamics of the spit. Historical sources indicate that the subaerial portion of the barrier began to form in the first half of the twentieth century, proceeding episodically and punctuated by erosional events. The modern phase is linked to a reorganization of the subaqueous sandbar in the late 1970s and the 1981 storm. Satellite records show net progradation: spit length increased from ~1.07 km (1985) to ~4.10 km (2025). Growth is episodic, with periods of elongation alternating with stabilization and erosion, consistent with field observations from 2019 to 2021. The evolution of the Sukha Spit reflects directed yet episodic growth of accretionary forms governed by hydrodynamic forcing and the availability of nearshore marine sediments. This site refines understanding of barrier formation mechanisms in the Black Sea and provides a model for analogous coasts.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139705: Continent-ocean transition and sedimentary records in the SW South China Sea: Insights from seismic evidence of the margin

yuanyuan Gao * and jianye Ren

College of Marine Science and Technology, China University of Geosciences, Wuhan, China

The South China Sea (SCS) serves as an ideal natural laboratory for investigating the breakup of old plate and the formation of new plate boundary. Recent IODP drilling has significantly advanced our understanding of lithospheric breakup and seafloor spreading in the eastern sub-basin of SCS. Yet, the lack of drilling evidence means that continent to ocean transition process in the southwestern sub-basin of SCS, particularly its final rifting stage, remains debated. This study utilizes a newly processed high-resolution seismic reflection profile from the magnetic anomaly termination zone in the SW-SCS to investigate its crustal architecture, tectonic-stratigraphic framework, and magmatic history. The results reveal the continental crustal and lithospheric breakup points defined by three first-order interfaces: the seafloor, top of basement, and Moho. This allows us to divide the margin into three major tectonic domains: thinning continental crust, continent-ocean transition (COT), and oceanic crust. These domains correspond respectively to syn-extensional, syn-breakup, and post-rift stratigraphic sequences, reflecting distinct evolutionary stages: continental crust breakup, continent-ocean transition (lithospheric breakup), and post-rift phases. The COT domain crust consists of igneous rocks where tops are fault-controlled wedge-shaped lava flows. Our kinematic restoration of southwestern sub-basin complete extension and seafloor spreading history, based on integrated tectonic-stratigraphic and magmatic evidence, suggests: (1) continental crustal breakup was primarily detachment fault-driven with minor magmatic contribution; whereas (2) lithospheric breakup was magma-dominated, with faults acting as pathways for magma migration. This work provides critical insights into the lithospheric final rifting of the SCS and their implications for Southeast Asian tectonic evolution.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148190: Designing critical seafloor infrastructure against sediment gravity flow hazards: constraining sedimentary processes to propose mitigation strategies

Max Bouwmeester^{1*}, Willem Bodde², Liesbeth Jorissen¹, Mike Clare³ and Daniel Dusseljee¹

¹ Witteveen+Bos Raadgevende ingenieurs B.V., Utrecht, The Netherlands

² Witteveen+Bos Raadgevende ingenieurs B.V., Rotterdam, The Netherlands

³ National Oceanography Centre, Southampton, United Kingdom

Sediment gravity flows are the world's largest sediment movements, consisting of mixtures of sand, mud, and water that episodically travel down subaqueous slopes. They are reported to damage or destroy critical seabed infrastructure along the world's continental margins, such as internet cables, pipelines, or windfarm anchors. However, due to their large-scale and inaccessible environments, little is known about their triggering mechanisms, behaviour, and interactions with engineered objects. This makes the design and maintenance of offshore structures extremely challenging.

Using repeat bathymetric surveys spanning over a decade, we reveal patterns of erosion and deposition in a submarine channel where turbidity currents have impacted and continue to impact critical seafloor infrastructure. We compare the erosion patterns through time to external triggers like typhoons and earthquakes and conclude that episodic increased sediment supply during typhoons is an important priming condition but far from a universal predictor of catastrophic events. By analysing yearly to weekly seafloor change, we are able to constrain the extent of erosion, predict future patterns, and propose effective mitigation strategies. We demonstrate that erosion and deposition along the submarine channel is driven by knickpoint migration, with areas of localised catastrophic erosion while in other parts of the channel net deposition occurs. This highlights the need for large-area surveying and an integral sedimentary system approach in order to design effectively, tailoring to these dynamic and catastrophic environments.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148410: Evolutionary Trends of the Ustrychne Lake Baymouth Barrier (Black Sea, Ukraine): A Retrospective Analysis Using Historical Maps and Satellite Imagery (1775–2025)

Oksana Shvets ^{1,*} and **Oleksiy Davydov** ²

¹ Quaternary Research Laboratory, Nature Research Centre, Vilnius, Lithuania

² Laboratory of Geoenvironmental Research, Nature Research Centre, Vilnius, Lithuania

Along the northwestern Black Sea coast, diverse types of coastal barriers are widely distributed, formed predominantly by wind-driven wave dynamics and meteorologically induced sea-level fluctuations. The baymouth barrier of Lake Ustrychne lies within the continental part of the Tendra–Dzharylgach system, separating the coastal lake from Karkinit Bay. The absence of coastal protection structures at the barrier enables its morphodynamic evolution to be assessed under relatively undisturbed natural conditions. A retrospective analysis of historical maps (1775–1970s) and satellite imagery from Landsat and Sentinel-2 missions (1980s–2025) was used to identify the evolutionary trends of the Ustrychne Lake baymouth barrier. Shoreline extraction was performed in QGIS using satellite imagery, while shoreline position change analysis was conducted with the Digital Shoreline Analysis System (DSAS). Data from the Global Surface Water Explorer was utilized to assess fluctuations in the surface area of Ustrychne Lake. Cartographic records from 1784 to 1855 demonstrate that the body of water initially developed as an open liman. Following the formation of the barrier in 1859, however, it transitioned into a coastal lake system. Periodic breaching was observed within the established barrier. Historical sources document breaches in 1956 and 1972, while satellite data indicate their occurrence in the eastern part of the baymouth barrier during the 1980s. Since 2001, the barrier has been undergoing a process of widening, driven by the gradual decrease in surface area of the lake. The frontal shoreline of the barrier can be characterized as dynamically stable. The barrier underwent substantial morphological changes during Storm Bettina in November 2023. Frontal shoreline erosion and inlet formation have reduced the body of the barrier. The baymouth barrier of Ustrychne Lake has undergone significant morphological and dynamic changes over the past 250 years. Its sensitivity to hydrometeorological forcing is highlighted by periodic breaching events and shoreline fluctuations.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Session E. Marine Environmental Science

sciforum-139853: Inoculum Optimization in *Chlorella* Cultivation: Enhancing Biomass Production for Marine Aquaculture and Environmental Remediation

Aditi Arun *, AbdulrahmanAhmed Mohammed Hassanein and Ali Parsaeimehr

Department of Biology & Microbiology, College of Natural Sciences, South Dakota State University, Brookings, SD, USA.

Chlorella, a unicellular microalga, is widely recognized for its rapid growth and high nutritional value. This study investigated the effect of different inoculum concentrations on the growth performance of *Chlorella* spp. over nine days in batch culture. Cultures were grown in 250-mL Erlenmeyer flasks containing BG-11 medium under a 14-hour light (4800 lux)/10-hour dark photoperiod at 27°C. The initial inoculation density was set to 2×10^6 cells/mL, and five inoculum concentrations (2.5%, 5%, 10%, 15%, and 20%) were prepared from cultures harvested at the early stationary phase and tested under controlled laboratory conditions. Optical density (OD_{680}) was measured daily to monitor growth. All cultures exhibited exponential growth during the first five days, reflecting favorable environmental conditions and active cellular metabolism. By day seven, the 15% and 20% inocula achieved the highest biomass, reaching a maximum OD_{680} of approximately 1.5–1.6. The 15% inoculum was identified as optimal, balancing biomass yield and resource efficiency by achieving comparable productivity to the 20% inoculum while requiring less initial biomass input. These results provide important insights into optimizing *Chlorella* spp. cultivation, particularly regarding inoculum concentration as a key factor for maximizing biomass productivity. The observed growth dynamics and biomass yields highlight the suitability of *Chlorella* spp. for integration into marine aquaculture systems, where efficient nutrient recycling and high-value biomass production are essential. Moreover, the robust growth under controlled conditions supports its potential application in biotechnology-based environmental remediation, such as wastewater treatment and carbon sequestration, due to its capacity to absorb excess nutrients and pollutants from aquatic environments.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-147984: An Inventory of Coastal Monitoring Stations in Indonesia: Opportunities and Gaps

Noir Primadona Purba^{1,*}, Yuniarty MS¹, Muhammad H Ilmi², Muhammad R.A. Mahendra³, Raihan W Ramadhan² and Rangga A Mulya²

¹ Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Padjadjaran, Bandung 40600, Indonesia

² KomitmenX Research Group, Universitas Padjadjaran, Sumedang, 45363, Indonesia

³ Bandung Institute of Technology, Bandung, Indonesia

Indonesia, the world's largest archipelagic country, lies between the Pacific and Indian Oceans, making it a critical region for studying oceanographic and climate processes. Understanding these dynamics requires long-term, continuous observations. However, coastal monitoring in Indonesia remains fragmented, with data scattered across regions and institutions. This study compiles information from multiple sources, including research institutions, international initiatives, official repositories, and national monitoring programs. A total of 550 coastal monitoring sites were identified, covering diverse measurements with varying levels of data quality and availability. Analysis of temporal coverage reveals that most sites are short-term: 81 stations (2 years) and 185 stations (2–5 years). Only 45 stations (5–10 years) provide mid-term records, while none extend beyond 10 years. Furthermore, 239 stations lack sufficient metadata to determine monitoring duration, reflecting persistent challenges in data management and accessibility. The distribution highlights significant gaps in Indonesia's coastal observation capacity. While short-term datasets support localized studies and project-based assessments, the absence of long-term (>10 years) time series restricts the ability to detect climate-driven trends, seasonal variability, and ecosystem responses. The imbalance is also spatial, with more coverage in western Indonesia compared to eastern and remote areas. Strengthening Indonesia's coastal monitoring requires coordinated efforts to extend observation durations, promote standardized measurement protocols, and enhance open access data sharing. Establishing sustained monitoring sites would not only improve national capacity but also support global initiatives under the UN Ocean Decade and the Sustainable Development Goals, ensuring science-based management of marine resources in a changing climate.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-138211: Between Sand and Concrete: Mapping the Fate of a Dune Lily

Alexandra Čulibrk*, Markos Fournarakis and Ourania Tzoraki

Department of Marine Sciences, School of Environment, University of the Aegean, 81100 Mytilene, Greece

The natural processes taking place in coastal zones—such as erosion, sea level rise, and alien species invasion—combined with increasing anthropogenic pressure, have significantly affected the population of *Pancratium maritimum* in Greece. This is particularly evident in regions like northwestern Crete, where the dual identity of intense tourist development and ecological significance creates a challenging management landscape. The present study focuses on a 22 km stretch of the NW coastline of Chania, a part of Crete that not only includes Natura 2000 protected areas but also exemplifies the island's role as a tourism hotspot, contributing directly to 33% of Greece's tourism GDP. Sampling involved recording the presence and abundance of the species, as well as soil parameters such as soil moisture, temperature, pH, and intervention factors (irrigation, fencing, pollution, existence of umbrellas). Principal component analysis (PCA) revealed two distinct axes of pressure. The first Principal Axis, PC1 was mainly associated with anthropogenic parameters, while PC2 was mainly associated with natural/environmental factors (soil moisture, temperature, and pH). Through the visualization of heat maps of PC1 and PC2, sections of the coastline with intense anthropogenic pressures were highlighted, as well as areas with more natural, favorable dynamics for the presence of the plant. Classification through k-means clustering grouped the study points into three categories depending on the pressure profiles. Finally, a GLM (Quasi-Poisson) model highlighted soil temperature as the most important factor that negatively affects the presence of *Pancratium maritimum*. The findings underscore the importance of targeted coastal ecosystem management tailored to the ecological needs of priority species, particularly in high pressure areas where economic and environmental interests intersect.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139879: Bivalve gut microbiome responses to sediment characteristics and anthropogenic activities in *Cerastoderma edule* (Linnaeus, 1758)

Joana Marujo Neves^{1,2*}, **Mário Mil-Homens**^{2,3}, **Marta Martins**⁴, **Helena Adão**^{5,6},
Sara Gutierrez-Patricio⁷, **Jorge R. Osman**⁷, **Ana Z. Miller**^{6,7}, **Jorge Lobo-Arteaga**^{2,4}

¹ MARE - Marine and Environmental Sciences Centre, ARNET - Aquatic Research Network Associate Laboratory, Department of Environmental Sciences and Engineering, NOVA School of Science and Technology, NOVA University Lisbon, Caparica, Portugal

² IPMA - Portuguese Institute for Sea and Atmosphere, I.P., Av. Alfredo Magalhães Ramalho 6, 1495-165 Algés, Portugal.

³ CIIMAR/CIMAR-LA, Centro Interdisciplinar de Investigação Marinha e Ambiental, Universidade do Porto, Terminal de Cruzeiros de Leixões, Av. General Norton de Matos s/n, 4450-208 Matosinhos, Portugal

⁴ MARE - Marine and Environmental Sciences Centre, ARNET - Aquatic Research Network Associate Laboratory, Department of Environmental Sciences and Engineering, NOVA School of Science and Technology, NOVA University Lisbon, Caparica, Portugal.

⁵ MARE - Marine and Environmental Sciences Centre / ARNET - Aquatic Research Network, Universidade de Évora, Escola de Ciências e Tecnologia, Apartado 94, 7002-554, Évora, Portugal

⁶ HERCULES Laboratory, University of Évora, Largo Marquês de Marialva 8, 7000-809 Évora, Portugal.

⁷ BIOGEOCOM research group, Instituto de Recursos Naturales y Agrobiología de Sevilla - Consejo Superior de Investigaciones Científicas (IRNAS-CSIC), Av. Reina Mercedes 10, 41012 Seville, Spain.

Estuaries are highly dynamic ecosystems that are influenced by fluctuating environmental conditions and sediment-associated contamination. These factors can significantly affect microbiomes associated with their hosts. In this study, we investigated the gut microbiome of the bivalve *Cerastoderma edule* by integrating bacteria (16S rRNA) and fungal (ITS) diversity data with sediment physicochemical parameters across three estuarine sites subjected to varying degrees of anthropogenic pressure. Sampling was conducted in the Sado Estuary (Portugal), a warm-temperate, mesotidal system. The selected areas, Tróia (TR), Gâmbia (GAM), and Navigator (NAV), represent contrasting environmental settings, from low-contaminated (TR) to more impacted zones influenced by industrial and aquaculture activities (GAM and NAV). Microbial diversity and composition were assessed on a seasonal basis using next-generation sequencing and multivariate analyses. Alpha diversity metrics revealed differences in bacterial communities between sites and seasons, whereas fungal diversity remained relatively stable across locations. This suggests that gut-associated fungi are more resilient to environmental pressures, although specific compositional shifts were observed in the impacted areas, with some taxa showing correlations with trace metal concentrations. Principal Component Analysis (PCA) indicated strong associations between gut microbial composition and sediment parameters, including organic matter, salinity, and trace metals. In particular, the bacterial communities exhibited strong responses to trace metals, such as Hg, Zn, and Pb. Functional inference (FAPROTAX) highlighted the microbial involvement in nitrogen, sulfur, and carbon cycling, indicating potential adaptive responses to contamination. Together, these findings support the utility of the *C. edule* gut microbiome as a sensitive indicator of estuarine environmental status and host-environment interactions. Moreover, they underscored the importance of including both bacterial and fungal components to obtain a more holistic understanding of microbiome-mediated ecosystem functions.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-122010: Comparative Analysis of Satellite Efficiency in Detecting Marine Pollution Within the Cleanseanet System

Ante Kamber¹, Zaloe Sanchez-Varela^{2,*} and Zlatko Boko²

¹ Military Naval Studies, Dr Franjo Tudjman Defence and Security University, Split, Croatia

² Faculty of Maritime Studies, University of Split, 21000 Split, Croatia

CleanSeaNet is a satellite-based monitoring service operated by the European Maritime Safety Agency (EMSA), aimed at detecting oil spills and other forms of marine pollution across European Union waters. As one of the key operational tools supporting maritime surveillance and environmental protection, the service provides national authorities with near-real-time information that can be used for both immediate response and long-term policy development. This study evaluates and compares the performance of individual satellites contributing to the CleanSeaNet system, focusing on their effectiveness in identifying surface-level pollution events. Using a comprehensive dataset collected over the past five years, detected spills were categorised according to the confirmation method employed—such as aerial surveillance, vessel reports, or follow-up inspections—and subsequently classified as either real pollution events or false positives. The primary objective of this analysis is to assess the detection accuracy of each satellite across a range of spill types, while also identifying potential patterns in reliability. The findings indicate that satellite performance is not uniform. Instead, significant variations emerge that support the hypothesis that detection efficiency depends on multiple interrelated factors, including sensor technology, orbital characteristics, and prevailing environmental conditions such as sea state or wind. These insights provide valuable guidance for optimising monitoring strategies and improving the overall robustness of CleanSeaNet.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-148466: Effects of rare earth elements on marine biota: Subtle stressors or negligible risks?

Saša Marcinek^{1,2,*}, **Andrea Cordero de Castro**¹, **Antonio Cobelo-García**³, **Cristiano V.M. Araújo**¹, **Julián Blasco**¹, **Antonio Tovar-Sánchez**¹ and **Araceli Rodríguez-Romero**¹

¹ Institute of Marine Sciences of Andalusia (CSIC), Cádiz, Puerto Real 11519, Spain

² Ruđer Bošković Institute, Zagreb 10000, Croatia

³ Marine Research Institute (CSIC), Vigo, Pontevedra 36208, Spain

Rare earth elements (REEs) are increasingly important for modern technologies, from electronics to renewable energy, leading to rising environmental inputs and their recognition as emerging contaminants. Yet, our understanding of the ecological implications of REEs in marine ecosystems remains limited. This presentation will provide a brief overview of current knowledge on the ecotoxicological effects of REEs in marine organisms, integrating evidence from laboratory and field studies across multiple trophic levels. Although the majority of studies focus on bivalves, planktonic species at the base of the food web, where impacts could propagate through the ecosystem, remain largely unstudied. We will report novel experimental investigations on the marine branchiopod crustacean *Artemia franciscana*, a well-established model for preliminary toxicity screening and a key component of marine food webs, including seabirds and fish. Early life stages were exposed to Ce, Nd, Gd, and La for mortality assessment (48 h; 0.1–500 µg/L). Cerium is typically present at the highest concentration in seawater relative to other REEs, followed by Nd and La, while Gd shows increasing anthropogenic inputs because of its uses in medicine, with persistent Gd anomalies now commonly observed in coastal waters near urban areas. Additional assessments focused on Ce and Gd, assessing their effects on behavioural endpoints in juvenile and adult stages, specifically avoidance responses, swimming speed, and social interaction, in order to capture potential sublethal effects. Avoidance responses were tested in a six-compartment setup (0–600 µg/L), while movement and social spacing were quantified by tracking 10 adults for 3 min at five concentrations (0.1–500 µg/L), with movement speed, exploration area, and social spacing analysed using AnimalTA software. Even though *A. franciscana* is tolerant to a variety of environmental stressors, results revealed sublethal yet potentially ecologically relevant effects that may influence population dynamics, warranting further research on more sensitive planktonic species. Overall, this study contributes to the understanding of potential ecological implications of REEs in marine systems and highlights the need for further research to better assess their environmental relevance and long-term impacts.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-136014: Environmental Influences on Heavy Metal Accumulation in Macroalgae: A Bibliometric Review of Recent Trends and Research Gaps

Muhamad Syaifudin *, Jiahui Chen, Tangcheng Li and Hong Du

Guangdong Provincial Key Laboratory of Marine Disaster Prediction and Prevention, Shantou University, Shantou 515063, China.

Heavy metal accumulation in seaweed poses significant ecological and human health risks, with environmental factors like salinity, temperature, and pH profoundly influencing these processes. Despite the critical need for effective monitoring and remediation strategies, a comprehensive, data-driven understanding of global research trends and gaps in this field remains elusive. Addressing this, our study presents the first bibliometric analysis of the literature to systematically map the evolution of research on environmental factors and heavy metal accumulation in seaweed. The initial search in the Web of Science Core Collection yielded 723 references. After refining the dataset to include English-language research articles published between 2005 and 2024, a final set of 619 papers was selected for analysis. This novel, data-driven approach provides a macroscopic view of the field's intellectual structure and dynamic shifts.

Our analysis reveals a robust field anchored by 'heavy metals,' 'algae,' and 'cadmium' as foundational themes. Key co-occurrence clusters delineate three dominant research thrusts: environmental monitoring and risk assessment, mechanistic understanding of physiological responses and bio-solutions, and the development of remediation technologies. Thematic mapping indicates that core concepts like 'macroalgae,' 'pollution,' and 'accumulation' are actively gaining centrality, evolving towards 'Motor' themes that drive the field. Concurrently, 'biosorption' and 'adsorption' are identified as mature, specialized areas, suggesting a focus on refinement. Trend analysis highlights sustained interest in established concepts alongside the emergence of new frontiers such as 'biochar' for sustainable solutions and 'oxidative stress' for deeper biochemical insights. Geographic analysis reveals that China dominates the research landscape (227 papers), followed by India (125) and Spain (102). This integrated perspective identifies critical research gaps, including the pressing need for multi-stressor interaction studies, the scaling of real-world applications, and research on understudied species and ecosystems. These findings offer crucial, actionable directions for future research to develop more effective and sustainable mitigation strategies against marine heavy metal contamination, ultimately contributing to healthier marine environments and safer seafood.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-143019: Filter Feeders, Pollution Readers: *Mytilus galloprovincialis* as Bioindicators for Microplastic Pollution in Bulgaria's Coastal Waters

Vesela Yancheva

Department of Ecology and Environmental Conservation, Faculty of Biology, Plovdiv University, 4000 Plovdiv, Bulgaria

The Black Sea is increasingly impacted by pollution originating predominantly from land-based sources, with transboundary rivers such as the Danube, Don, and Dnieper serving as major conduits for plastic waste. These rivers introduce a complex mixture of plastic particles—macro-, meso-, micro-, and nanoplastics—into the marine environment. These particles not only persist but also act as vectors for various hazardous substances, including heavy metals, persistent organic pollutants (POPs), bisphenol A, and phthalates, all of which pose ecological and human health risks. While the global impacts of microplastics (MPs) on marine organisms are well documented, studies evaluating MP contamination in the Bulgarian sector of the Black Sea remain extremely limited, particularly in commercially important mussel species. This study addresses a critical knowledge gap by assessing, for the first time in Bulgaria, the presence, quantity, composition, and size distribution of MPs in *Mytilus galloprovincialis*, surface waters, and sediments from the Black Sea. The project also examines the potential biological effects of MPs on mussels through the use of selected biochemical biomarkers indicative of physiological stress or toxicity. Furthermore, an evaluation of the potential risk to human health from the consumption of MP-contaminated mussels will be conducted. Environmental samples will be processed using advanced analytical techniques, including quantum cascade laser spectroscopy with the Agilent 8700 Laser Direct Infrared Chemical Imaging System, in collaboration with an accredited laboratory. The integrated approach of this project aims to contribute to a better understanding of the environmental and health implications of microplastic pollution in the Black Sea region.

Acknowledgement:

This study is funded by the Department of Scientific Research at the University of Plovdiv under project MUPD25BF001: *“Research and assessment of the quantity, composition, and size of microplastic particles in commercially important mussels from the Black Sea area, their negative impact on specific biomarkers, and the risk to human health.”*



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139710: Insights into marine cell adhesion to surfaces: a Computational Fluid Dynamics approach

Ricardo F. S. Pereira^{1,2,*}, **José M. C. Pereira**³, **Carla C. C. R. de Carvalho**^{1,2}

¹ iBB—Institute for Bioengineering and Biosciences, Department of Bioengineering, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa

² Associate Laboratory i4HB—Institute for Health and Bioeconomy, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal

³ IDMEC, Instituto Superior Técnico, Universidade de Lisboa, Pav. Mecânica I, LASEF, Av. Rovisco Pais, 1, 1049-001 Lisboa, Portugal

Marine bacteria usually attach to available wetted surfaces, as a response to environmental conditions, and live in communities called biofilms. The hydrodynamic conditions of the local environment influence biofilm development, structure and population dynamics. It has been observed during bacteria cultivation under laboratory conditions in shake flasks that rotating fluid creates hydrodynamic shear in multiple directions and different mass transfer conditions, and cell adhesion occurs at the highest point reached by the rotating liquid. A multiphysics Computational Fluid Dynamics (CFD) model was developed to represent cultivation broth hydrodynamics in Erlenmeyer flasks to assess the conditions that physically lead to the cells adhering to the walls of the flasks and the formation of a biofilm. To validate the CFD model, a prodigiosin production bioprocess using a marine *Serratia rubidaea* strain was used. This choice was based on experimental observations showing cell adhesion at the highest point reached by the rotating liquid, as evidenced by the formation of a red halo. The value for the highest liquid height reached was used as a parameter to validate the equations of motion for the model. With the CFD model, it was possible to determine that low friction against the passage of the liquid and frequent wetting favoured cell adhesion onto the glass. Insights into how the flask geometry affects the dissolved oxygen concentration in the liquid could also be obtained.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-137901: Managing shellfish aquaculture in the Ria Formosa (Portugal): CONNECT Ria Formosa

Marta Rodrigues^{1,*}, André B. Fortunato¹, Ricardo Martins¹, Alexandra Cravo², Erwan Garel², José Jacob², Gonçalo Jesus¹, Ernestina Rodrigues², Anabela Oliveira¹, Ana Brito³, José Lino Costa³, Carlos Alexandre⁴ and Helena Adão⁴

¹ National Laboratory for Civil Engineering, Avenida do Brasil, 101, 1700-066 Lisbon, Portugal

² Centre for Marine and Environmental Research (CIMA), ARNET–Aquatic Research Network, Universidade do Algarve, Campus of Gambelas, 8005-139 Faro, Portugal

³ MARE–Marine and Environmental Sciences Centre, Faculdade de Ciências, Universidade de Lisboa, Campo Grande 16, 1749-016 Lisbon, Portugal

⁴ MARE–Centro de Ciências do Mar e do Ambiente, Universidade de Évora, 7002-554 Évora, Portugal

Ria Formosa, located in the Algarve region of Portugal, is a vital habitat for marine biodiversity and supports key economic activities. Recognized as both a Natural Park and a Ramsar site, this coastal lagoon accounts for approximately 80% of Portugal's clam production.

CONNECT Ria Formosa is a high-resolution coastal monitoring and forecasting service tailored to the Ria Formosa lagoon. The service integrates model-based forecasts with in-situ and satellite observations to provide real-time and forecast information on physical, chemical, and biological variables. It extends the broader CONNECT coastal service by introducing capabilities specifically designed to support shellfish aquaculture and ecosystem management. These include:

- high-resolution daily forecasts of physical (e.g., water levels, currents, temperature, salinity, waves), biogeochemical (e.g., chlorophyll-a, dissolved oxygen), and microbiological (e.g., *Escherichia coli*, *Enterococcus*) variables, through downscaling of the Copernicus Marine Service's regional IBI model;
- enhanced access to new near-real-time in-situ observations and high-resolution satellite data from the Copernicus Marine Service;
- physical and water quality indicators, including those specific to shellfish waters;
- on-demand simulation of discharges using a high-resolution particle tracking model.

The coastal service supports decision-making in areas such as compliance with the Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD), shellfish aquaculture management, and environmental risk assessment. By delivering high-resolution and timely information, the service enhances the monitoring and management of water quality, ecosystem health, and aquaculture operations in one of Portugal's most valuable coastal regions.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-147764: RAMSea – Towards a Scalable System for Subsea Monitoring

Eugene Lamnek¹ and Maelys Pauline Cormont^{2,*}

¹ School of Mechanical Engineering, The Adelaide University, Adelaide 5005, Australia

² Campus of Brest, ENSTA, Brest 29200, France

The Research Assistant Module for Subsea Exploration and Analysis (RAMSea) is a scalable, low-cost underwater environmental monitoring system that integrates artificial intelligence (AI), data processing, and water quality sensors. Housed within a small watertight enclosure and designed to be either operated by a diver, or controlled remotely, the system integrates AI for real-time fish recognition, implemented on a Raspberry Pi using the YOLOv8 deep learning algorithms. External to the enclosure are a suite of environmental sensors measuring depth, temperature, salinity, and dissolved oxygen. By correlating fish species observations with environmental parameters directly in the field, RAMSea provides a simple but comprehensive approach to marine ecosystem analysis. The system will offer a significant improvement over traditional manual survey methods by providing richer, real-time data to inform environmental management, aquaculture practices, and biodiversity monitoring.

Initiated through a student internship program in May 2025, RAMSea has been designed to provide an innovative monitoring solution for the current Harmful Algal Bloom (HAB) impacting over 500 km of South Australia's coastline. Over the period of just a few months, this natural disaster has seen large numbers of dead marine animals washed up across South Australian coastlines, and has resulted in unprecedented impact on commercial and recreational fishing industries within the State. When fully developed, the RAMSea system could provide an effective solution to monitor the impact and evolution of this type of event. Not limited to the monitoring of HABs, RAMSea could also be applied to a multitude of other applications such as supporting reef conservation programs in the Great Barrier Reef, enhancing aquaculture health monitoring, and contributing to long-term climate impact studies.

While initial deployment of RAMSea will be via a trained scuba diver, the project team is concurrently developing a remotely operated vehicle (ROV) that will carry the sensor module as a payload, thus alleviating the need for a trained diver. A future enhancement to the system will include an autonomous surface vehicle (ASV) capable of autonomously controlling the ROV and sensor module from the surface while also communicating collected data to the cloud. This flexible configuration will deliver a modular and adaptable platform capable of operating in diver-operated, remotely operated, or fully autonomous modes.

The first prototype of RAMSea has been designed and constructed. Several tests have been conducted including qualifying the waterproof enclosure in a test tank, and sea testing from a jetty to validate the environmental sensors, the camera and the control code. Due to the low visibility in the water during the jetty test program, the fish recognition system could not be tested in the field. Instead, the real-time fish recognition system has undergone initial testing in a simulated environment involving various videos of fish in their natural environment. Field testing of the fish recognition system will take place in the upcoming test program, currently scheduled for March 2026. The results obtained from these trials have been promising and have already contributed to iterative improvements in both hardware and software and have validated the usability of the system.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-140985: Trace metals contamination assessment in the intertidal environments of a moderately impacted coastal lagoon at Portugal (Óbidos Lagoon)

Catarina S. Bruno, Carmen A. Pedro, Monique S. Sarly and Sílvia C. Gonçalves *

MARE – Marine and Environmental Sciences Centre/ARNET, ESTM, Polytechnic of Leiria, 2520-641 Peniche, Portugal

Estuarine environments are highly productive coastal ecosystems with a large intrinsic ecological value. Notwithstanding, they are often impacted by chemical contamination originating from several types of pollutants. Among these, trace metals are highly toxic, have an accumulative behaviour and can be transported for long ranges in suspended particles, representing a large environmental burden. This study aimed to assess the levels of contamination by the trace metals cadmium (Cd), copper (Cu), iron (Fe), manganese (Mn), lead (Pb), and zinc (Zn) in the intertidal environments of the Óbidos Lagoon. The concentrations of metals were determined in water (dissolved and suspended fractions) and sediment samples, collected seasonally and during 1 year in the intertidal water margins from 4 different sampling stations at the upper lagoon (*Barrosa's Branch* - BB, *Arnóia* and *Real* rivers - AR, *Covão dos Musaranhos* - CM and *Poça das Ferrarias* - PF). In the water samples, Mn, Fe and Cd were the only metals observed in the dissolved fractions, while all the trace metals analysed were detected in the suspended fractions. The concentrations of the elements reflected the following patterns: Mn ($0.077 \pm 0.037 \text{ mg.L}^{-1}$) > Fe ($0.026 \pm 0.003 \text{ mg.L}^{-1}$) > Cd ($0.026 \pm 0.007 \mu\text{g.L}^{-1}$) for the dissolved fraction and Fe ($14.553 \pm 3.278 \text{ mg.L}^{-1}$) > Mn ($1.116 \pm 0.239 \text{ mg.L}^{-1}$) > Cu ($0.028 \pm 0.008 \text{ mg.L}^{-1}$) > Zn ($0.021 \pm 0.011 \text{ mg.L}^{-1}$) > Pb ($3.060 \pm 1.147 \mu\text{g.L}^{-1}$) > Cd ($0.073 \pm 0.051 \mu\text{g.L}^{-1}$) for the suspended fraction. The highest concentrations of metals in the water column were observed at BB and AR stations during winter, highlighting the influence of precipitation and of the higher freshwater discharges from the main tributaries of the lagoon during this season. Sediments enriched with clay and with higher organic matter contents were prone to metals accumulation, presenting higher concentrations of all the analysed metals. Contamination by trace metals at the upper area of Óbidos Lagoon revealed to be of concern, and especial caution as well as continuous monitoring should be encouraged for Cd and Pb.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Session F. Marine Biology

sciforum-148301: Evidence of tropicalization of infralittoral communities in the Balearic Islands (Western Mediterranean)

Nuria R. de la Ballina^{1,*}, José Antonio Caballero-Herrera², Yulimar González-Rodríguez³,
Francesco Maresca¹, Alejandro Martín-Arjona², Sergio Moreno-Borges³,
Jaime Ezequiel Rodríguez-Riesco³, Ignacio Baena-Vega¹, David Díaz¹, Susana Lorena Díez¹,
Enric Real¹ and Sandra Mallo¹

¹ Centro Oceanográfico de Baleares (IEO-CSIC), 07015, Palma de Mallorca, Spain

² Centro Oceanográfico de Málaga (IEO, CSIC), 29002, Málaga, Spain

³ Centro Oceanográfico de Canarias (IEO, CSIC), 38180, Santa Cruz de Tenerife, Spain

Monitoring programs are important tools that enable scientists to identify marine species assemblages, to assess their status, and to detect environmental changes or disturbances that might influence benthic communities. The increase in seawater temperature constitutes one of such changes, and it may result in rising proportions of thermophilic biota of marine habitats in temperate regions. The arrival and establishment of tropical and subtropical species, a phenomenon known as tropicalization, has been reported in many areas in the Mediterranean Sea as global warming intensifies. With the aim of evaluating the environmental status of Mediterranean infralittoral rocky bottoms as part of the Marine Strategy Framework Directive (MSFD) (2008/56/EC), underwater visual censuses (UVCs) were conducted in 22 stations of the Balearic Archipelago. At each sampling station, scuba divers surveyed fish and benthic communities along 50-meter transects (four replicates per dive). This study was restricted to rocky bottoms between 5 and 18 m depth. Fish were identified, and their abundance and size were recorded within a 50 x 5 m belt transect. Macroinvertebrates were surveyed using 50 x 50 cm quadrats placed every two meters along each transect. Within each quadrat, species and abundances were recorded. Finally, macroalgae coverage was measured recording the species found every 20 cm along each transect. Surveys were conducted in 2022 and repeated in the same stations in 2025. Comparisons between both periods revealed increases in the frequency of warm-affinity species such as the fish *Sparisoma cretense* (Linnaeus, 1758) (Teleostea, Scaridae) and *Caranx crysos* (Mitchill, 1815) (Teleostea, Carangidae); the invertebrates *Hermodice carunculata* (Pallas, 1766) (Annelida, Polychaeta, Amphinomidae) and *Telmatactis cricoides* (Duchassaing, 1850) (Cnidaria, Anthozoa, Actiniaria); and the algae *Penicillus capitatus* (Lamarck, 1813) (Chlorophyta, Halimedaceae). Our findings highlight the importance of monitoring programs to identify evidence of processes such as tropicalization and provide timely information to respond to shifting marine ecosystems.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-149874: SEALNet: An Efficient Lightweight Network for Seabed Object Detection.

Rao Weibo

College of Marine Science and Technology, China University of Geosciences, Wuhan 430074, China.

The ocean contains a vast amount of rich and stable remote sensing data. Utilizing these data to realize intelligent real-time recognition of marine organisms is a critical task in marine remote sensing. Especially in complex seabed environments, where monitoring equipment is limited by computing power, oceanographers urgently require a detection algorithm with low computational complexity that can be widely deployed on various simple marine remote sensing devices. This is of great significance for marine remote sensing applications requiring real-time positioning of marine life, such as ecological protection and fishery management. This study proposes SEALNet, a novel fast detection network for seabed objects. The model integrates Mamba and YOLO principles to enable efficient lightweight benthic organism detection. For SEALNet's neck, the original concatenation modules are improved, which efficiently aggregates feature layer information across backbone stages for cross-scale fusion. To further reduce the computational requirements of SEALNet, a new detection head module based on group normalization and shared convolution operations is designed. These improvements maintain a reasonable computational load while enhancing the precision of the object detection network. EUDD dataset tests indicate SEALNet's performance: the detection precision achieves 90.6% (sea cucumbers), 91.6% (sea urchins), and 93.5% (scallops). Comparisons with mainstream models confirm its superiority in detecting benthic organisms. This work is expected to provide new insights and approaches for intelligent remote sensing and analysis in marine ranches.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-142182: Comparative Analysis of Insoluble Fiber Content in Brown, Green, and Red Seaweed: Potential for Health and Industrial Use

Farzaneh Jahantigh *, Cristina Soares, Valentina Maria Fernandes Domingues and Cristina Delerue-Matos

REQUIMTE/LAQV, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Porto, Portugal

Nowadays, seaweeds play a grand role in digestive health because they are a valuable source of dietary fibers, especially insoluble fibers that have potential industrial applications. This study aims to evaluate the insoluble fiber content of three seaweed species classified as brown, green, and red algae using the acid detergent fiber (ADF) method with 0.5 M H₂SO₄. The outcomes demonstrated significant variations in fiber content among species, with brown algae displaying the highest levels. *Fucus vesiculosus*, as a brown algae, was found to have the highest fiber content at 42.73%. Across the algae, red algae *Prophyra dioica* showed an average fiber content of 36.24%, while the green algae *Ulva Lactuca* contained 33.85% fibers. Statistical analysis was conducted with Python version 3.9 software, incorporating the NumPy and SciPy libraries. A two-way analysis of variance was performed for each experiment to determine the differences between the experimentally acquired ADF values and those reported in the literature, highlighting inconsistencies in fiber quantification methods. These discrepancies demonstrate the superiority of using consistent measurement techniques and underscore the need for further investigation into the functional properties of seaweed fibers. The ADF method for insoluble fiber was validated by direct comparison with the standard AOAC enzymatic–gravimetric dietary fiber procedure on the same seaweed samples, obtaining less than a 5% difference between the AOAC enzymatic–gravimetric and the ADF method. The high-level fiber content in brown algae illustrates them as favorable candidates for the development of functional foods and other industrial applications, in addition to emphasizing the potential of seaweeds as sustainable sources of dietary fiber.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139796: Description of *Tricleocarpa fragilis* beds as a distinct habitat in the Columbretes Islands Marine Reserve (NW Mediterranean)

Ignacio Baena Vega *, Nuria R. de la Ballina, Susana Díez, Sandra Mallol, Francesco Maresca, Enric Real and David Díaz

Centre Oceanogràfic de les Balears, Instituto Español de Oceanografía (IEO-CSIC), 07015 Palma, Spain

Tricleocarpa fragilis (L.) Huisman & R.A. Townsend (1993) is a species of calcified red seaweed found in tropical and subtropical regions of the Atlantic, Pacific and Indian Oceans, as well as in the Mediterranean Sea. *T. fragilis* presence in the Mediterranean is likely the result of Lessepsian migration through the Suez Canal. In this region, it is typically found as small, isolated individuals inhabiting the infralittoral zone, attached to rocks, dead corals, and mollusk shells. Despite its presence, no in-depth studies of the species have been conducted in the Mediterranean Sea to date as it has never shown a significant role in benthic habitats. The objective of this study is to provide the first description of a newly observed habitat characterized by the density and persistence of *T. fragilis* large beds (~14700 m²) that have remained stable over time in specific areas within the Columbretes Islands Marine Reserve. To characterize this habitat we have described its depth range (24-38 m), area coverage (~100%), size of individuals (up to 20 cm), height of the algal coverage (10-20 cm) and associated community. Additionally, we have mapped the location of the meadows within the Marine Reserve. Next steps will focus on laboratory analysis of collected samples to determine the size and weight of *T. fragilis* specimens as well as to identify associated species of microorganisms aiming to delve deeper into its ecological importance, including its potential function as a recruitment site for other species. The presence of *T. fragilis* forming a fully calcareous habitat in the Columbretes Islands Marine Reserve shows a new and unique formation for this population. Furthermore, its location inside a marine protected area makes it an especially valuable habitat for future monitoring in a changing ocean.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-123599: Enhancing Marine Biology Education Through Game- Based Augmented Reality: A STEAM-Driven Approach Using AI-Generated 3D Marine Life Models

Krishan Mohan Patel^{1,2,3}

¹ Pädagogische Hochschule Steiermark, Graz, Austria

² Technical University in Graz, Graz, Austria

³ Arishna IoT Solutions, Graz, Austria

Marine biology education presents unique challenges due to the complexity and vastness of underwater ecosystems. Traditional teaching methods often lack the visual and interactive elements needed to effectively engage students and convey the depth of marine life knowledge. To address this gap, we propose an Augmented Reality (AR)-based game designed to enhance marine biology education within the STEAM (Science, Technology, Engineering, Arts, and Mathematics) framework. The application leverages AI-generated 3D models of marine species, allowing students to explore dynamic and immersive underwater environments. Using Unity and advanced generative techniques such as GANs and neural rendering, lifelike octopuses, corals, and fish are visualized in AR scenarios aligned with curriculum standards. Students interact with marine ecosystems through gameplay that reinforces learning objectives, such as ecological balance, food chains, and environmental threats. The game includes assessments embedded within the experience to measure student progress and adapt learning paths accordingly. This approach not only supports knowledge retention through visualization and interactivity but also fosters curiosity and critical thinking. The integration of AR and AI technologies into game-based learning aims to revolutionize marine science education, making it more accessible, engaging, and impactful. The project contributes toward a sustainable and digitally-enhanced future for STEM/STEAM learning environments.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-150544: Marine Invertebrates as a Source of Antiviral Agents: Implications for Aquaculture and Human Health

Raul Bonet-García ^{1,*}, Marta Narváez-Asensio ², Mikolaj Adamek ³, Marta López DeDiego ⁴, Alberto Falcó ², Enrique Barrajon-Catalán ¹ and Melissa Belló-Perez ⁵

¹ Institute for Research, Development and Innovation in Health Biotechnology of Elche, Miguel Hernández University (IDIbE, UMH), Elche, Spain

² Fish Pathology Group, Institute of Aquaculture Torre de la Sal, Spanish National Research Council (IATS, CSIC), Castellón, Spain

³ Fish Disease Research Unit, Institute for Parasitology, University of Veterinary Medicine Hannover, Hannover, Germany

⁴ National Center for Biotechnology, Spanish National Research Council (CNB, CSIC), Madrid, Spain

⁵ Fisabio, Hospital General Universitario de Elche, Elche, Alicante 03203, Spain

Marine ecosystems harbor a remarkable chemical diversity that remains largely unexplored, with marine invertebrates standing out as prolific producers of bioactive secondary metabolites. Viral diseases continue to pose major challenges, both for aquaculture—where outbreaks compromise productivity and sustainability—and for human health, where effective treatments are still lacking against many pathogens.

In this context, the present study investigated the antiviral activity of crude extracts obtained from two nudibranchs (NA and NB), one holothurian (PS), and one soft coral (CR). Extracts were tested against a panel of eight viruses, including human respiratory viruses (HCoV-229E, hMPV, RSV, IAV) and fish viruses (VHSV, CyHV-3, TiLV, CCPV), using complementary *in vitro* assays that evaluated direct virucidal effects, pre-treatment of host cells, and continuous exposure during infection.

The nudibranch extracts exhibited the strongest and most consistent antiviral effects, significantly reducing infection across both human and fish viruses. In contrast, the holothurian extract showed selective antiviral activity but was limited by cytotoxicity at certain concentrations. The results suggest that nudibranchs contain metabolites with broad-spectrum antiviral potential, acting through mechanisms that may involve both viral inactivation and cellular protection.

These findings are highly relevant for the development of innovative strategies in aquaculture, where sustainable viral control remains a critical bottleneck, and they also highlight promising prospects for human therapeutics. By demonstrating the value of marine biodiversity as a reservoir of novel antiviral agents, this work underscores the importance of sustainable marine bioprospecting as part of the Blue Economy, advancing marine biotechnology toward solutions with cross-sectoral impact.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139834: Neustonic zooplankton of the Madeira-Tore seamounts: Biodiversity insights for conservation

Rita F. T. Pires^{1,2,*}, **Cátia Bartilotti**^{1,3}, **Clara Lopes**^{1,2} and **Jorge Arteaga**^{1,3}

¹ Portuguese Institute for the Sea and Atmosphere (IPMA), Sea and Marine Resource Department, Av. Doutor Alfredo Magalhães Ramalho 6, 1495-165 Algés, Portugal

² Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Terminal de Cruzeiros de Leixões. Av. General Norton de Matos s/n 4450-208 Matosinhos, Portugal

³ Marine and Environmental Sciences Centre (MARE), ARNET – Aquatic Research Network Associate Laboratory, Universidade NOVA de Lisboa, Campus de Caparica, 2829-516 Caparica, Portugal

In the open ocean, seamounts hold high ecological relevance for local communities. Zooplankton aggregations are often observed above these topographic features, supporting the spawning and foraging of a wide diversity of species. This study provides novel insights into the zooplankton communities inhabiting the Madeira-Tore seamount complex, located in the northeastern Atlantic Ocean. The findings contribute with valuable information to ongoing efforts in biodiversity assessment and marine conservation planning. Zooplankton samples were collected from the neustonic layer of the Madeira-Tore region using a Manta trawl net, during an oceanographic research survey conducted in 2022. The organisms were morphologically identified and taxonomic analyses revealed highly diverse communities, including copepods, gelatinous zooplankton, decapod larvae, amphipods, polychaetes, and fish larvae. Notably, several species rarely observed in coastal areas, and some newly recorded for the region, were documented, highlighting the uniqueness and ecological value of these offshore habitats. In selected cases, integrative taxonomy was applied, combining morphological observations with molecular tools to confirm the species identity and resolve taxonomic uncertainties. The findings emphasized the ecological significance of the Madeira-Tore complex and added important data to understand the dynamic and understudied ocean-atmosphere interface. The study underscores the need to integrate zooplankton data into marine spatial planning and the designation of Marine Protected Areas, while also contributing to a broader understanding of trophic dynamics and biogeochemical cycling in open-ocean ecosystems.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-135526: New Records of Digenea (Platyhelminthes) in Labrid Fishes from the Algerian Coast

Fatima Zohra Zedam

Biodiversity and Environment: Interactions-Genomes (LBEIG), University of Science and Technology Houari Boumediene, Algiers, Algeria

New Records of Digenea (Platyhelminthes) in Labrid Fishes from the Algerian Coast

A study was conducted to investigate the biodiversity of Digenea (Metazoa, Platyhelminthes), intestinal mesoparasites infecting two teleost fish species of the family Labridae: *Symphodus tinca* (Linnaeus, 1758) and *Xyrichtys novacula* (Linnaeus, 1758). Between 2019 and 2022, the intestines of 243 Labridae specimens, belonging to these two species, were examined for the presence of Digenean parasites. Fish were collected from several localities along the Algiers coast, located in the southwestern Mediterranean Sea.

A detailed taxonomic and morpho-anatomical analysis of the recovered parasites led to the identification of four Digenean species: *Proctoeces maculatus* Looss, 1901; *Gaevskajatrema perezi* Mathias, 1926; *Helicometra fasciata* Rudolphi, 1819; and one unidentified species of the genus *Helicometra* (*Helicometra* sp.). These parasites were assigned to two families: Opecoelidae Ozaki, 1925 and Fellodistomidae Nicoll, 1909. Although previously recorded in other parts of the Mediterranean Sea, these species are reported here for the first time in teleost hosts from Algerian coastal waters.

These new records broaden our current understanding of the geographic distribution, host range, and biodiversity of Digenean parasites in North African marine ecosystems.

Our project, based at the Biodiversity and Environment: Interactions-Genomes (LBEIG), aims to significantly increase the number of Digeneans known from Algeria through an intensive survey of teleost fishes.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-129330: New Records of Some Digenetic Trematodes in Some Marine Fishes From Algeria

Fatima Zohra Zedam

Biodiversity and Environment: Interactions-Genomes (LBEIG), University of Science and Technology Houari Boumediene, Algiers, Algeria

Our research, based at the Laboratory of Biodiversity and Environment, Interactions - Genomes (LBEIG), USTHB, aims to significantly increase the number of Digenea species. Digenea are flatworm parasites that live mainly in the digestive tracts of teleost fish. However, our understanding of these parasites along the Algerian coast is limited. A parasitological investigation of digenetic trematodes in three fish species from Algeria marine fish was conducted from 2022 to 2023. The study identified three trematodes species belonging to the Opcoelidae family, and their identification was based on morphological data with key identification. We have given a very detailed morphological description, illustrating for the first time the male and female genitalia with the whole body. *Gaevskajatrema perezii* (Mathias, 1926), Gibson & Bray, 1982, was found in the intestines of the *Symphodus tinca* Linnaeus, 1758 (Labridae); *Allopodocotyle israelensis*, Fischthal (1980), was recorded from the intestine in the *Pomadasys incisus* (Bowdich, 1825). Additionally, *Bathycreadium elongatum* (Maillard, 1970), Bray, 1973, was recorded in the intestine of the *Phycis phycis* (Brünnich) (Gadiformes: Phycidae); all of these parasites were recorded for the first time in Algeria. This study contributes to the knowledge of Digenean diversity by documenting newly recorded species in Algerian waters, either through new host associations or from previously unreported localities. The morphological data are provided to support this new host and locality record, enriching the parasitological inventory of Mediterranean marine fish.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-147124: Ocean acidification and the shifting goldilocks zone of cold-water coral growth

Konstantinos Georgoulas^{1,*}, Sebastian J Hennige², Yeaw Chu Lee³ and Evangelos Boulougouris¹

¹ Department of Naval Architecture, Ocean and Marine Engineering, University of Strathclyde, Glasgow, UK

² School of GeoSciences, University of Edinburgh, Edinburgh, UK

³ School of Engineering, Computing and Mathematics, University of Plymouth, Plymouth, UK

Cold-water corals build three-dimensional frameworks that support a wide range of marine life and provide important ecosystem services. These reefs provide a shelter and feeding grounds to myriads of organisms, and they act as long-term carbon stores. Previous modelling work has shown how their survival depends on prey capture within a hydrodynamic Goldilocks zone, where currents are strong enough to deliver food but not so strong that they prevent coral polyps to catch prey. But flow conditions and food availability are only part of the story; ocean acidification is emerging as a serious challenge to the persistence of cold-water coral reefs, threatening their skeletons and putting in danger all the marine life that depends on them.

In aragonite under-saturated waters, dead coral frameworks can dissolve. Experiments have shown that once living tissue is lost, exposed skeleton becomes porous, fragile, and prone to crumbling. This process steadily erodes the complex frameworks that these corals have built over centuries. To explore this mechanism in more detail, a numerical model was developed using Smoothed Particle Hydrodynamics (SPH) to capture the balance between reef growth, dissolution, and recovery under different acidification scenarios.

The results reveal that, although living corals can continue to grow, the supporting dead skeleton is far more vulnerable. Once dissolution rates exceed calcification rates, reef accretion becomes negative, and colonies fragment into smaller, isolated patches. Simulations also show that, if acidification pressures ease, surviving colonies can regrow and rebuild lost structure, though recovery times are strongly dependent on the extent of initial damage. In some cases, regrowth is fast early on where the competition is reduced, but long-term recovery depends on whether the reef framework remains intact enough to support additional expansion.

The coupling of reef growth and energetic demands models with dissolution processes offers a more complete perspective on how cold-water corals respond to ocean acidification. It highlights that while colonies can persist and survive, the loss of dead framework leads to a decline in habitat complexity. Future expansion of this model will create a predictive tool for that will be able to guide conservation strategies and inform the design of restoration initiatives, accounting for different environmental stressors.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-134781: Stimulating Effects of Space Weather in Toxin-Producing Marine Diatoms

Paulo Vale

Instituto Português do Mar e da Atmosfera, Av. Alfredo Magalhães Ramalho 6, 1495-165 Algés, Portugal

Introduction

Solar-derived geomagnetic activity (GMA) has been related to biological effects in living beings, mainly in humans. Biological time series have only been sparsely associated with the 11-year sunspot cycle. Blooms of toxin-producing marine phytoplankton and the respective accumulation of biotoxins in bivalves present an unpredictable large intra- and inter-annual variability worldwide. In Portugal, high contamination of bivalves with paralytic shellfish poisoning toxins has been related previously with periods of low solar activity. The bioaccumulation of amnesic shellfish poisoning toxins (ASTs), derived from the marine diatom *Pseudo-nitzschia* spp., was related here with GMA.

Methods

ASTs in bivalves are monitored weekly in all production areas using liquid chromatography (HPLC) coupled with UV detection. It sometimes exceeds the regulatory limit in force in the European Union for shellfish flesh, leading to harvest bans.

Results and Discussion

Maximal monthly AST's bioaccumulation during 1997-2024 in the Ria de Aveiro's (NW coast) cockles (*Cerastoderma edule*) presented a stronger incidence in the years of highest geomagnetic activity rather than in the years of highest sunspot numbers. In other world regions, such as Galicia (Spain), Northern Ireland, Washington State (USA) and British Columbia (Canada), AST's bioaccumulation in bivalves was most common during periods of higher GMA. During the 2006-2012 period of low GMA disturbance, toxin accumulation was low in all the time series reported from these regions.

GMA presents annual maxima during the equinoxes, and AST's accumulation in Portugal also presented their highest maxima following the spring equinox (in April and May) and a secondary maximum following the autumnal equinox (in October). ASTs surpassed 5 mg/kg in 46% of these months when the monthly GMA index was above average (18.4 nT) but only in 18% of these months when the GMA index was below this average. ASTs also peaked during both equinox periods in other world regions, such as Galicia or Canada.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

sciforum-139015: The Untapped Potential of Marine Bacterial Enzymes: Optimizing Hyaluronic Acid Molecular Weight for Targeted Applications

Sebastião Viegas Tavares Ferreira de Almeida^{1,2,*} and Carla C. C. R. de Carvalho^{1,2}

¹ Department of Bioengineering, iBB-Institute for Bioengineering and Biosciences, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisbon, Portugal

² Associate Laboratory I4HB—Institute for Health and Bioeconomy, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisbon, Portugal

Hyaluronic acid (HA) is a linear biopolymer naturally found in animal cells that functions as a lubricant, shock absorber, stabilizer of joint structure, and plays an important role in many biological signalling processes. However, the molecular weight of HA directly influences its physiochemical properties and determines its suitability for specific applications. As such, precise control over HA molecular weight during production or postproduction is essential to meet specific functional requirements. While chemical and physical methods to cut down HA are cheap, they allow low control of the molecular weight, can lead to environmental issues, and may be time consuming. Therefore, enzymatic treatment may be an effective alternative method to cut down HA to specific molecular weights. A promising and sustainable solution lies in the use of marine bacteria, which have the potential to produce novel enzymes that can depolymerize HA into defined lower molecular weight fragments. Due to the environment where they live in, marine microorganisms produce putatively more robust enzymes than terrestrial counterparts and may be more suitable for industrial applications. This study aimed to identify marine bacterial strains capable of producing enzymes that selectively depolymerize HA into defined molecular weight fragments. Following the isolation of several marine bacteria, screening demonstrated that several species produced enzymes that were able to cut down high molecular weight HA. Notably, a *Bacillus salacetis* strain showed complete depolymerization efficiency. This strain was further evaluated in a membrane bioreactor system, where the cells were physically separated from the reaction medium. Even under these conditions, the strain achieved 100% conversion of high molecular weight HA into lower molecular weight fragments.



© 2025 by the author(s). Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

MDPI AG
Grosspeteranlage 5
4052 Basel
Switzerland
Tel.: +41 61 683 77 34

JMSE Editorial Office
E-mail: jmse@mdpi.com
www.mdpi.com/journal/jmse



Disclaimer/Publishers' Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.