COASTAL AND OFFSHORE ENGINEERING:
Energy Production and Transport, Port and Offshore Structures, Water Quality, Measurements and Monitoring, Data Processing and Services, Digital Twins, Economic-Environmental Assessment, Regulatory Context

This session on coastal and offshore engineering aims at bringing together presentations of scientific works dealing with the following topics: energy production and transport, port and offshore structures, water quality, measurements and monitoring, data processing and services, digital twins, economic-environmental assessment and regulatory context. The session successfully met its objective, bringing together 21 researchers who presented their work. Of these, 19 submitted full papers, which are now published in these conference proceedings.

Most of the papers (8 out of 19) focus on water quality issues related to various pollutants, including chemical substances, plastic particles, and oil spills (Compa and Sureda 2024, Ballerini et al. 2024, Liubartseva et al. 2024, Özkaynak and İçemer 2024, Galeano et al. 2024, Morales-Aragón et al. 2024, Mance et al. 2024a, Locuratolo et al. 2024). The implications of climate change, particularly sea level rise and its consequences for coastal protection and salinization, are addressed in four papers (Sabattini et al. 2024, Simoncini 2024, Zannella et al. 2024, Mance et al. 2024b). Two articles (de Virgilio et al. 2024 and Azzopardi 2024) explore the use of machine learning techniques to predict meteomarine conditions and algal blooms. The remaining articles present research on numerical wave flumes and tanks by using computational fluid dynamics (Liu et al. 2024 and Abdollahpour et al. 2024), data management (Pecci et al. 2024), digital twinning (Tsaimou and Tsoukala 2024), and marine renewable energies (Marini and Sulis 2024).

Compa and Sureda (2024) and Ballerini et al. (2024) both highlight the serious issue of plastic pollution in marine environments. Compa and Sureda emphasize the ecological and economic consequences of plastic pollution, including harm to marine life, damage to infrastructure, and negative impacts on tourism. They stress the need for stricter global regulations to address this issue. Ballerini et al. provide a quantitative assessment of plastic pollution on Tuscan beaches, revealing high levels of contamination. They analyze the environmental measures implemented by local municipalities, identifying both strengths (e.g., potential for local action) and weaknesses (e.g., resource constraints, regulatory limitations). Both studies underscore the importance of collaborative efforts between municipalities, research institutions, and citizens to develop effective strategies for reducing plastic pollution and transitioning towards more sustainable practices.

Liubartseva et al. (2024) presented a work on oils spill focused on the HAVEN oil spill of 1991, a significant event with long-lasting ecological and economic consequences. The researchers used the MEDSLIK-II model to simulate the oil spill's trajectory and once validated the model was used to assess future risks by

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means of stochastic simulations of the HAVEN spill scenario in different Med. Sea sites. This analysis identified areas of high oil pollution hazard, particularly the Algerian subbasin, eastern Alboran Sea, Liguro-Provençal subbasin, and central Ionian Sea. The results of this study are valuable for organizations involved in oil spill response and preparedness planning, as they provide insights into potential future scenarios and areas of high risk.

Özkaynak and İçemer (2024) studied the amount of ballast water discharged by ships in Antalya Bay. They found that using deadweight tonnage to estimate ballast water can be inaccurate, potentially affecting assessments of environmental impact. They emphasize the need for future research to analyze the presence of harmful organisms and pathogens in ballast water to better understand its ecological consequences. The study also highlights the importance of proper ballast water management in ports, emphasizing the need for regulations to ensure that waste reception facilities handle ballast water to mitigate environmental risks.

The works by Galeano et al. 2024, Morales-Aragón et al. 2024, Mance et al. 2024a, and Locuratolo et al. 2024 are all related to water quality, focusing on different aspects. The work of Galeano et al. 2024 presents the results of the Italian Coast Guard surveillance. Over 2000 checks carried out led to the detection of numerous crimes, both administrative and penal, regarding waste and in particular water discharges. Morales-Aragón et al. (2024) developed a new lightweight, autonomous profiler designed for monitoring shallow marine environments. This innovative tool can contribute to better understanding and management of shallow marine ecosystems, particularly in relation to hydrodynamic modeling and the prevention of adverse events like anoxia. Mance et al. (2024a) compared different methods for assessing the quality of marine bathing waters. They found that while parametric methods are more rigorous, they often require normally distributed data, which is not always the case for bacteriological water pollution. Non-parametric methods, like the Hazen method, may be more suitable for these situations. However, the authors caution that the results may not be fully representative due to the limited number of sites studied. Locuratolo et al. (2024) used a numerical model to simulate the dispersion of pollutants from a combined sewer overflow in Bari, Italy, during and after heavy rainfall. The model successfully reproduced the observed patterns of turbidity and bacterial contamination in the surrounding waters. While the model provided valuable insights, the researchers noted limitations in the available data, particularly regarding oceanographic conditions. Despite these limitations, the model can be a useful tool for early warning systems to predict and mitigate the impact of pollution events on bathing water quality.

The works by Sabattini et al. (2024) and Mance et al. (2024b) both focus on the issue of salinization in coastal areas and climate change effects. Sabattini et al. studied seawater intrusion in the Magra River estuary and alluvial plain (Italy), particularly during a recent period of severe drought. They found that Magra river discharge and wind speed significantly influence saltwater intrusion. The natural weir at Romito currently limits seawater intrusion, but future sea level rise could compromise this natural barrier. Mance et al. investigated salinization in springs in Bakar Bay (Croatia). They concluded that seawater intrusion, combined with increased temperatures and evaporation rates, is responsible for the rising chloride concentrations in these springs. This highlights the vulnerability of karst regions to climate change impacts.

Simoncini (2024) and Zannella et al. (2024) both focused on the impact of climate change on coastal areas. Simoncini (2024) used Miami as a case study to highlight potential adaptation strategies for Mediterranean coasts, including elevating infrastructure, implementing water management systems, and constructing storm surge barriers. Zannella et al. (2024 presented a specific case study in Marina di Pisa, Italy, where a novel storm defence system involving artificial gravel nourishments and submerged breakwaters was implemented to mitigate coastal flooding.

The works by de Virgilio et al. (2024) and Azzopardi (2024) explored the application of artificial intelligence (AI) in marine science. De Virgilio et al. used AI to predict the occurrence of harmful algal blooms (O. ovata) based on weather parameters. They found that a small set of weather data can accurately predict these blooms. Azzopardi (2024) employed AI to extend marine weather forecasts. Their research emphasized the importance of large datasets for training AI models, suggesting that models trained on global data or data from nearby stations often outperform those trained on limited local data.

Liu et al. (2024) and Abdollahpour et al. (2024) presented work on the development of numerical wave flumes and basins using computational fluid dynamics (CFD) methodology. This demonstrates the power of CFD as a tool for studying complex wave-structure interactions and the potential benefits of leveraging high-performance computing.

Pecci et al. (2024) presented the EMODnet Data Ingestion initiative, which aims to promote data sharing and reuse in marine science. By making data openly accessible, this initiative facilitates knowledge dissemination and fosters a culture of data sharing among researchers.

Tsaimou and Tsoukala (2024) proposed guidelines for developing digital twins (DT) of port infrastructure, specifically focusing on concrete pavements and rubble mound structures. The DT would integrate data from various sources, including remote sensing inspections, condition assessments, and GIS-based geospatial data. This information can be used to monitor structural changes, detect damage, and inform maintenance decisions. By leveraging DT technology, port authorities can implement smart maintenance practices and improve the overall management of their infrastructure.

Marini and Sulis (2024) explored the potential of wind and wave energy in Sardinian coastal areas. They argue that these renewable energy sources, especially when combined in small-scale devices, can have a minimal visual impact. Additionally, they emphasize the importance of energy communities in promoting public acceptance and attracting investment in clean energy projects.

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