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EDITED AND REVIEWED BY
Wenfang Lu,
Sun Yat-sen University, China

*CORRESPONDENCE
Elodie Martinez
elodie.martinez@ird.fr

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Editorial: AI and remote sensing in ocean sciences

Gustau Camps-Valls[1], Elodie Martinez[2]*, Ronan Fablet[3] and Cédric Jamet[4]

[1]Image Processing Laboratory (IPL), Universitat de València, València, Spain, [2]Univ Brest, CNRS, Ifremer, IRD, Laboratoire d'Océanographie Physique et Spatiale (LOPS), IUEM, Plouzané, France, [3]IMT Atlantique Bretagne-Pays de la Loire, Nantes, France, [4]Université du Littoral Côte d'Opale, Université de Lille, CNRS, IRD, UMR 8187-LOG-Laboratoire d'Océanologie et de Géosciences, Wimereux, France

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Editorial on the Research Topic
AI and remote sensing in ocean sciences

Over the last decades, remote sensing has revolutionised the field of oceanographic research by providing synoptic information on the global ocean with unprecedented spatial resolution. This technology has allowed scientists to gain valuable insights into the complex dynamics of the marine environment. However, remote sensing images' sheer volume and diversity pose significant challenges for data analysis and processing. In this context, machine learning approaches, particularly deep learning, have emerged as powerful tools for addressing these challenges and unlocking the full potential of remote sensing data.

The Research Topic of "Frontiers in Marine Science" on *AI and remote sensing in ocean sciences* brings together leading researchers who have significantly contributed to applying data-driven approaches and machine learning techniques in remote sensing for oceanographic research. This Research Topic of high-quality papers sheds light on the innovative methodologies and computational strategies that have enabled the extraction of meaningful information from vast amounts of observational remote sensing data.

The works included in this Research Topic treat a wide diversity of issues: enhancing prediction capabilities, reconstruction and modeling, unveiling dynamics and classifications, presenting advances in network architectures,

Several papers in this Research Topic tackle the important prediction task in oceanographic research. Liu et al. present a deep learning framework for short-term daily prediction of sea ice concentration. By leveraging a gradient loss function, the authors demonstrate improved accuracy and efficiency in predicting sea ice dynamics. Wei and Guan propose a 3DConv-LSTM model for seven-day sea surface temperature prediction, showcasing the potential of combining convolutional and recurrent neural networks to capture spatio-temporal dependencies.

Reconstructing and modelling oceanic phenomena is another crucial aspect of understanding marine systems. Iafolla et al. investigate the reconstruction of sea wave data using micro-seismic measurements and machine learning methods, demonstrating the feasibility of using non-conventional data sources to infer wave properties. Huang et al. focus on data-driven modelling of dissolved iron in the global ocean, shedding light on the biogeochemical cycling of this essential micronutrient.

Earth observation and machine learning techniques enable exploring dynamic processes and identifying key features in marine environments. Jebri et al. use these methods to reveal the dynamics of productive upwelling regimes on the Agulhas Bank. Their findings provide valuable insights into the interactions between oceanic dynamics and regional productivity. Baek et al. investigate the role of aerosols in spring blooms in the Central Yellow Sea during the COVID-19 lockdown by China, highlighting the complex relationship between atmospheric conditions, human activities, and marine ecosystems.

Developing novel network architectures is critical for enhancing the performance and efficiency of machine learning algorithms in remote sensing applications. Zhu et al. introduce YOLO-Rip, a modified lightweight network for rip current detection. Their work addresses the challenges of real-time detection in dynamic coastal environments. Ma et al. propose KECANet, a convolutional kernel network with limited labelled data for ocean synthetic aperture radar (SAR) scene classification. Their approach demonstrates the potential of leveraging limited labelled data to achieve accurate classification results.

The eight high-quality papers featured in this Research Topic of "Frontiers in Marine Science" showcase the transformative power of data-driven approaches and machine learning techniques in remote sensing for oceanographic research. These studies highlight the capacity of machine learning to extract meaningful information from vast amounts of remote sensing data, providing new insights into ocean dynamics, improving prediction capabilities, and enhancing our understanding of marine systems. As the dominant approach in machine learning, deep learning offers significant potential for further advancements in this field.

We hope this Research Topic will inspire and encourage further exploration of data-driven and learning-based methodologies in remote sensing for oceanographic research. The convergence of oceanography, data science, and machine learning holds great promise for improving the quality of research and our understanding of the marine environment. The interdisciplinary nature of this Research Topic opens avenues for collaboration among researchers across different domains, fostering innovation and driving progress in this rapidly evolving field.

Author contributions

GC-V: Writing – original draft. EM: Writing – review & editing. RF: Writing – review & editing. CJ: Writing – review & editing.

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Conflict of interest

Author RF has two industrial collaborations: - Research Grant from Microsoft EU for Oceans AI award - Ongoing industrial partnerships with NavalGroup, Eodyn, CLS, OceanDataLab, OceanNext and Mercator Ocean Intl.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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