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Collaborative intelligence for modelling marine social-ecological systems

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Abstract: The demand for marine resources upon which the growing Blue Economy is predicated will re-shape the way industries and communities use the Oceans. Understanding, a priori, how these novel and dynamic anthropogenic forces will interact with marine ecologies is critical for ensuring that already threatened and/or depleted ecosystems are not further impacted. However, our ability to predict and plan for future scenarios of marine production are constrained by our ability to employ suitable models for the range of socio-ecological systems that are being proposed for development. Whilst numerous sophisticated modelling frameworks (Atlantis, Mizer, Ecopath with Ecosim, eg. (Hyder et al., 2015)) exist for specific geographic or socio-ecological contexts, adapting or building new ecosystem models for novel contexts is a time consuming and costly endeavour. As marine development accelerates and more is asked from the Oceans, building additional capacity to model marine socio-ecological systems will be critical for the transfer of timely and salient advice from the marine modelling community to decision-makers.

In recent years, machine learning and other artificial intelligence/machine learning (AI/ML) tools have exploded in popularity and sophistication and hold the promise of transforming many of the stages of the modelling process (Irrgang et al., 2021). Whilst automating many of the steps of ecosystem modelling is attractive, there remain many uncertainties as to the suitability of AI/ML approaches across the modelling workflow. This uncertainty has generated interest in understanding how to develop and implement collaborative intelligence frameworks where AI agents and humans collaborate to achieve common goals and obtain outcomes unattainable by either working alone (Schleiger et al., 2023). Future best modelling practices then will require striking a balance between automated and collaborative AI approaches by identifying when and where AI/ML tools can be used to automate modelling processes, and where human decision-making remains critical for positive outcomes.

This project will explore the strengths and weaknesses of humans and AI agents within modelling collaborations, the features and capabilities that can be built into AI/ML systems that enable human collaborators to develop good modelling practices, and the skills and capabilities that will be required from humans to successfully collaborate with AI agents.

We will use leading marine ecosystem models, such as Atlantis and Mizer, as case studies to explore these questions, and to highlight the benefits, challenges, and dangers of these approaches in the context of improving outcomes in socio-ecological systems. The tools and learnings developed from this project will enable a step-change in the way marine ecosystem models are developed and implemented. This will both lower the barrier to sophisticated and advanced modelling guidance for communities and decision-makers and will also inform a blueprint for the future of human and AI collaboration in understanding marine socio-ecological systems.

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