Data, Observation & Modelling

Fri. Nov 13, 2026 9:00 AM - 10:30 AM JST | Fri. Nov 13, 2026 12:00 AM - 1:30 AM UTC | Room C (201) (2F)

Oral C4 Marine Biodiversity & Ecosystem Modelling

Chair: Cheng-Hao Lu, Qiang Deng

9:30 AM - 9:45 AM JST | 12:30 AM - 12:45 AM UTC

[uRAGwoU2-03] Toward a Digital Twin of Rocky Intertidal Ecosystems: From Long-Term Monitoring to Social Implementation

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With global climate change, the frequency and intensity of disturbances such as marine heatwaves and typhoons are increasing, severely impacting marine ecosystems and their services. There is, therefore, an urgent need to evaluate the impacts of these disturbances on ecosystems and predict their future states.

While constructing a "digital twin" is highly anticipated as a promising approach to this challenge, actual examples targeting coastal ecosystems remain virtually non-existent worldwide due to a severe lack of both environmental and ecological data.

In this presentation, we overcome this bottleneck by focusing on the rocky intertidal zone in Japan, where an exceptionally long-term dataset spanning over two decades across more than a hundred sites has been accumulated. Based on this rich data, we present a vision for building a rocky intertidal digital twin.

We also discuss the scalability of this model to wider geographical regions. To expand environmental data, we propose a correction model for nearshore-offshore data discrepancies. For ecological data, we plan to develop a method to extract biological information from publicly available photographs across the nation.

Furthermore, we outline the prospects for this concept to evolve beyond a purely academic proposal into a practical tool supporting socioeconomic benefits. In fisheries, it can ensure stable business management through future predictions for oysters and key seaweeds (such as Gloiopeltis and Analipus), while assisting decisions on shifting target species from declining to thriving ones. In coastal zone management, predicting biofouling organisms like barnacles can reduce port maintenance costs and enhance safety. Finally, in environmental impact assessments, this tool can contribute to corporate TNFD disclosures, future risk assessments of Marine Protected Areas (MPAs), and the selection of new candidate conservation sites.

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