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REDUCED ORDER MODELS FOR ENVIRONMENTAL APPLICATIONS IN OCEAN AND ATMOSPHERE

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ABSTRACT

This minisymposium focuses on the development and application of Reduced Order Models (ROMs) for complex environmental systems, with particular emphasis on oceanic and atmospheric processes (e.g., circulation, waves, and wave-structure interactions). ROMs offer efficient alternatives to high-fidelity simulations by simplifying large-scale models while preserving critical system dynamics, making them highly valuable for real-time prediction and analysis.

Oceanic and atmospheric flows have significant societal impacts, but due to the massive physical scales involved, they pose severe computational challenges for operational forecasting. Machine learning and data-driven models—applying techniques such as dynamic mode decomposition (DMD) and its variants, physics-informed neural networks (PINNs), and generative AI approaches—are proving able to bridge this gap.

The minisymposium invites researchers and practitioners from diverse computational fields to discuss advancements in creating these reduced-order frameworks. Participants are encouraged to contribute to the ongoing dialogue on the advantages, limitations, and future directions of using hybrid or purely data-driven approaches to model complex physical processes that traditionally require prohibitive computational resources.