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ADVANCED NUMERICAL METHODS AND HIGH-PERFORMANCE COMPUTING FOR ENVIRONMENTAL SUSTAINABILITY

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ABSTRACT

Addressing the challenges of environmental sustainability requires accurate mathematical models and efficient numerical methods capable of simulating complex, multiscale, multiphysics, and stochastic phenomena.

This Session focuses on recent advances in numerical analysis, scientific computing, and High-Performance Computing (HPC) for the simulation, optimization, and control of systems relevant to environmental sustainability and sustainable technological innovation. It aims to bring together researchers working on advanced numerical methods for differential and integral equations, including stiff, nonlocal, and stochastic problems, alongside experts in parallel computing, scalable numerical linear algebra and numerical optimization. Particular attention will be devoted to efficient time integration techniques, adaptive discretizations, structure-preserving methods, matrix-oriented approaches, High-Performance numerical solvers, model order reduction, data-driven methods, scientific machine learning, and digital twins, as well as energy-aware computing, resource-efficient algorithms, and sustainable HPC infrastructures will also be addressed.

Application areas include renewable energy and energy-efficient technologies, electrochemical processes and energy storage systems, sustainable industrial processes, climate and atmospheric modelling, air quality assessment, precision agriculture and irrigation, soil resource management, ecosystem dynamics and biodiversity, environmental monitoring, and the simulation and mitigation of natural and climate-related hazards, including wildfires and seismic risks.

By bridging methodological advances and real-world challenges, the minisymposium seeks to foster interdisciplinary collaboration and highlight the role of accurate, scalable, and computationally sustainable numerical methods in strengthening environmental resilience, promoting efficient resource management, and supporting the transition towards a more sustainable society.