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MULTISCALE TRANSPORT PHENOMENA IN THERMAL AND ENVIRONMENTAL FLOWS

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ABSTRACT

Transport phenomena in fluid flows play a fundamental role in a wide range of engineering and environmental systems. From thermal management in advanced technologies to large-scale environmental and urban flows, the interaction between momentum, heat, and mass transport governs many important physical processes. Understanding these coupled mechanisms requires accurate numerical modeling as well as deeper physical interpretation across different spatial and temporal scales. This minisymposium focuses on recent developments in the modeling and simulation of transport phenomena in both thermal-fluid and environmental flow systems. Particular attention will be given to problems where complex interactions among fluid motion, heat transfer, and scalar transport are important. Examples include microscale and macroscale thermal systems, phase-change heat transfer, electronics cooling, atmospheric and urban wind flows, and environmental transport processes. Although these applications arise in different contexts, they share common challenges in numerical modeling and physical interpretation. Advances in computational methods have enabled increasingly detailed simulations of complex flow structures and transport processes, providing new opportunities to connect fundamental transport physics with practical applications. The goal of this minisymposium is to provide a platform for researchers working on different aspects of transport phenomena to exchange ideas and perspectives. By bringing together studies from thermal-fluid science and environmental fluid mechanics, the session aims to highlight the common physical mechanisms underlying these systems and encourage interdisciplinary discussions on emerging modeling approaches and applications.