Mechanical Engineering Department Seminar

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1130 Mechanical Engineering
111 Church Street SE, Minneapolis, MN 55455

A Small-Scale Perspective on Multiphase Geophysical Flows

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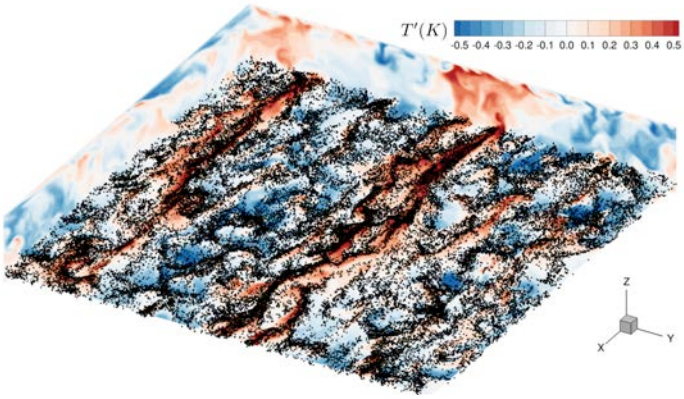
In the natural environment, water and air move over enormous ranges of temporal and spatial scales, and are typically subject to a wide variety of complex physical and chemical processes. While this already makes systematic and rigorous observation difficult in practice, studying these flows can be further inhibited by hazardous or inaccessible conditions which preclude direct measurements or analyses. This in turn negatively impacts the accuracy and reliability of large-scale modeling efforts which require robust knowledge of small-scale details -- for example in hurricane forecasting models, climate models, or contaminant dispersion models.

In this talk I will present ongoing work dedicated to using direct numerical simulations coupled with Lagrangian point particles as an experimental tool for understanding and parameterizing basic physical processes in multiphase environmental flows where measurements are almost completely lacking. In particular, energy and momentum transfer at the high-wind, spray-laden air-sea interface will be used as an example to show, fundamentally, what the ejection and suspension of evaporating water droplets can (and cannot) do to the budgets of momentum, heat, and moisture flux in the near-surface turbulent boundary layer. The implications of these findings will be interpreted in the context of the actual “outside” flows and larger-scale model development, and the extension of this problem to other environmental dispersed phase flows (e.g., dust transport, riverbed dynamics, blowing snow, etc.) will be discussed.



Bio: Dr. Richter is an Assistant Professor of Civil and Environmental Engineering and Earth Sciences at the University of Notre Dame. He received his B.S. in Mechanical Engineering from the University of Massachusetts in 2002, and his M.S. and Ph.D. in Mechanical Engineering from Stanford University in 2011. His dissertation, advised by Eric Shaqfeh and Gianluca Iaccarino, focused on the turbulent transition of viscoelastic flows using numerical simulations. Following his Ph.D. he received the Advanced Study Program Postdoctoral Fellowship from the National Center for Atmospheric Research in Boulder, CO, where he shifted his research focus towards turbulent, multiphase processes in the environment. He is a recent recipient of the Office of Naval Research Young Investigator Award, and his current research attempts to understand phenomena including air-sea interactions within hurricanes, dust transport in the atmosphere, and sediment transport within rivers and streams.