COMPLEX SYSTEMS, COMPUTING AND INFRASTRUCTURE FRONTIERS

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Dr. Momen is Principal Investigator of the Environmental Fluid Mechanics Laboratory at the Cullen College of Engineering. He obtained his Ph.D. from Princeton University, where he was awarded the Gordon Y.S. Wu Fellowship in Engineering. His thesis was focused on the modeling of inherent complexities of atmospheric boundary layers that have been largely overlooked. In addition to this, he worked on a reservoir drainage problem, which had many applications such as in spillway breakage and hydraulics engineering. Dr. Momen has also conducted research on the hydrologic cycle, ecohydrology, and remote sensing with a focus on the effect of water availability on vegetation dynamics during his postdoc at Stanford. His research interests include environmental fluid mechanics and turbulence, computational fluid dynamics and fluid-structure interaction, sustainability and resiliency under extreme weather events, big data science and machine learning, and renewable energy. He is currently conducting various simulations of hurricane systems such as high-resolution wind turbulence, large-scale hurricane evolutions, storm surge dynamics, and their impacts on infrastructure as well as wind-energy integration and coastal resiliency problems.

Publications

1. Cheikh, M. and Momen, M., 2020: "The interacting effects of storm surge intensification and sea-level rise on coastal resiliency: A high-resolution turbulence resolving case study," Accepted, Env. Res. Comm.

2. Momen, M., E. Bou-Zeid, M. Parlange, and M. Giometto, 2018: "Modulation of Mean Wind and Turbulence in the Atmospheric Boundary Layer by Baroclinicity", J. Atmos. Sci. DOI:10.1175/-JAS-D-18-0159.1.

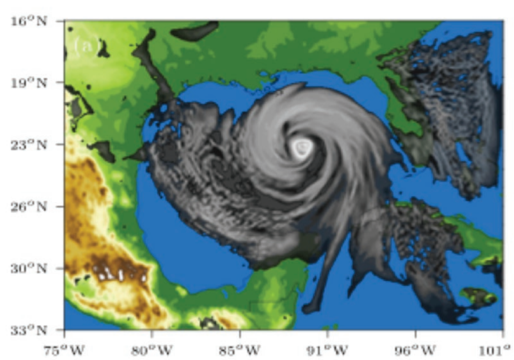
3. Momen, M., Z. Zheng, E. Bou-Zeid, and H. A. Stone, 2017, Inertial gravity currents produced by fluid drainage from an edge, J. Fluid Mech. DOI: 10.1017/jfm.2017.480

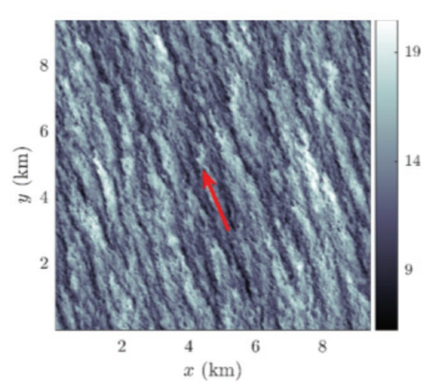
4. Momen, M., K. Novick, J. Wood, et al., 2017, Interacting Effects of Leaf Water Potential and Canopy Biomass on VOD, J. Geophy. Res. DOI: 10.1002/2017JG004145 – Featured as a research spotlight on http://Eos.org.

FLUID DYNAMICS AND HIGH-PERFORMANCE COMPUTING

The societal, economic, and ecosystem consequences of extreme weather events are predicted to increase with global warming in the near future. Hurricanes have become the costliest natural disasters in US history by causing billions of dollars in damage every year. Strong hurricane winds and storm surge can endanger infrastructure such as ports, marinas, buildings, roads, oil decks, and industrial complexes. It is thus imperative to develop accurate models of hurricane flows, which will lead to better estimations of wind and water loads and help the design of structures that are resilient to such extreme events.

Dr. Momens's interdisciplinary research aims to address the current and future grand challenges of complex environmental flow systems (air and water) by integrating numerical, data science, and experimental approaches. To achieve this goal, Dr. Momen's group employs state-of-the-art high-performance computing techniques on supercomputers, including high-resolution fluid-structure simulations, large-scale weather models, satellite data analysis, and machine learning in novel ways. These codes have been been thoroughly validated against observations and laboratory experiments in Dr. Momen's group. His research innovations are instrumental for a wide range of industries that are vulnerable to extreme weather events and require accurate meteorological data; including energy, insurance, construction, aviation, and agriculture industries.





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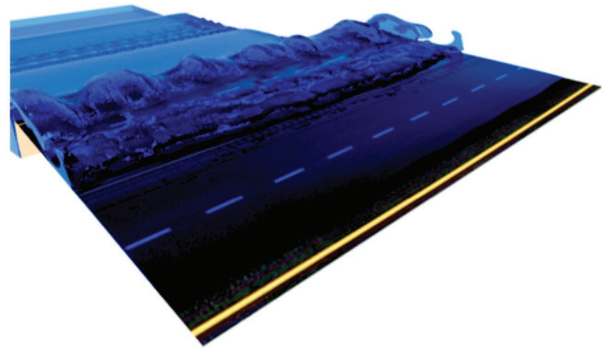

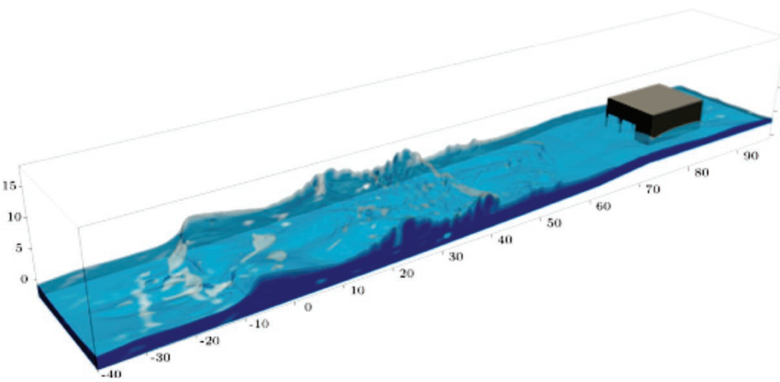

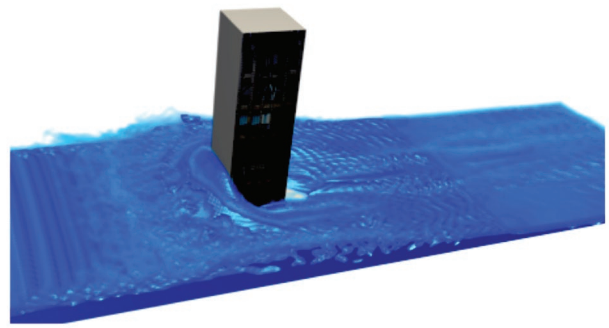

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