香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

土木及環境工程學系
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

SEMINAR

HYDRODYNAMICS OF MARINE FOG

Speaker

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Abstract

Marine fog is defined as a turbulent air layer contiguous the ocean surface, laden with ~ 1-30 microns sized water droplets, characterized by the Meteorological Optical Range (i.e., visibility) less than 1 km. Fog disrupts transportation, poses security threats, disorients human perception and impacts communications and ecosystems. Net deposition of water vapor on hygroscopic aerosols in near-saturated marine environments leads to marine fog through collusion of dynamic, thermodynamic and physicochemical processes. On larger scales, temperature inhomogeneities of synoptic [low-pressure, colder] weather systems break down to the dissipation (Obukhov-Corrsin) scales, providing an entrée for marine-fog genesis. Evolving fog droplets and their aerosol nuclei are embedded in the smallest (Kolmogorov) eddies of atmospheric turbulence, and a host of two-phase microphysical process involving deposition/evaporation on/from the droplets, droplet surface tension, and eddy straining motions affect the growth, maturation and dissipation (i.e., lifecycle) of fog. This presentation will describe some major findings of a five-year (2021-26) multidisciplinary, multi-investigator, integrative project dubbed Fatima (Fog and turbulence interactions in the marine atmosphere) on marine fog. Ship and land/platform-based field observations in Grand Banks, Sable Island (an islet in the region where warm Gulf Stream and cold Labrador waters mix) and Hibernia Oil Platform. in 2022 as well as multi-ship and aircraft observations in the Yellow Sea (off-coast of the Republic of Korea) in 2023, all accompanied by high-resolution and numerical weather prediction (NWP) model simulations, elicited new meteorological and [bio]physicochemical processes associated with fog lifecycle. The results elicited new physical processes, and indicated some commonly used concepts on fog dynamics need revisiting. This work was funded by the Grant N00014-21-1-2296 of the US Office of Naval Research, administered by the Marine Meteorology and Space Weather Program.

Biography

Harindra Joseph Fernando is currently the Wayne and Diana Murdy Endowed Professor of Engineering and Geosciences at University of Notre Dame. He was educated at the University of Sri Lanka (BS), the Johns Hopkins University (MA, PhD) and was a post-doctoral fellow at Caltech. His academic career started at the Arizona State University in 1984, and was a professor of mechanical and aerospace engineering and the Director of the Board of Regents' Environmental Fluid Dynamics Center during 1992-2010. He joined University of Notre Dame in 2010. He is a Fellow of the American Society of Mechanical Engineers (ASME), American Physical Society (APS), American Meteorological Society (AMS), American Association for the Advancement of Science (AAAS), American Geophysical Union (AGU) and International Association of Hydro-Environment Research (IAHR). He was elected to the European Academy in 2009. He received docteur honoris causa from University of Grenoble, France, in 2014 and Doctor of Laws Honoris Causa from University of Dundee, Scotland in 2016. He is the Editor-in-Chief of the Journal of Environmental Fluid Dynamics and is on the editorial boards of Theoretical and Computational Fluid Dynamics, Non-Linear Processes in Geophysics and the Proceedings of the Royal Society A (London). He conducts theoretical, experimental, numerical and field experimental research on various environmental flows. He was a Principal Investigator of many international field experiments, including MATERHORN, PERDIGAO, CASPER, ASIRI, ASIRI-RAWI, MISO-BOB, IFFEx0, C-FOG and FATIMA (https://efmlab.nd.edu/

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