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College of Design and Engineering

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Department of Civil and Environmental Engineering

Numerical simulation of turbulent, wave-current boundary layers over smooth and rough beds in the coastal ocean

by

Professor Oliver B. Fringer

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Host: Assistant Professor LEI Jiarui Gary, CEE

Date: 8 Sept 2023, Friday
Time: 11.00 am – 12.00 pm
Venue: E1-06-08
National University of Singapore
College of Design and Engineering
3 Engineering Drive 2
Singapore 117578

Admission is free. All are welcome

Abstract

Sediment resuspension and transport in coastal environments is dictated by the bottom stress induced by the superposition of oscillatory, wave-driven currents and relatively steady currents driven by tides, river flows, and winds. In coastal ocean models, the bottom stress is typically computed with a quadratic drag law such that bottom stress $\tau = C_d U^2$, where C_d is the drag coefficient and U is the mean current. Coastal models compute the mean current U over time and space scales that don't resolve the waves or the details of bottom features like variable grain sizes, bed forms, or vegetation. Instead, these processes are parameterized into the drag coefficient which is a function of wave, mean flow, and bed properties. Despite decades of research, accurately computing the drag coefficient in wave-current flows over rough beds remains a challenging problem. To this end, in this talk I will present high-resolution numerical simulations of wave-current, turbulent bottom boundary layers using a novel immersed boundary approach in which the details of sand grains are directly computed. This allows for an analysis of the bottom boundary layer and turbulence and how they relate to the bottom features and the wave and mean flow properties. Results will be discussed in the context of differences between nearshore processes which are dominated by waves and estuarine processes, where waves are typically weaker than the currents.

Speaker's Biography

Oliver Fringer is a professor in the Department of Civil and Environmental Engineering, the Department of Oceans, and the Institute for Computational and Mathematical Engineering at Stanford University, where he has been on the faculty since 2003. He received his BSE from Princeton University in Aerospace Engineering and then received an MS in Aeronautics and Astronautics, followed by a PhD in Civil and Environmental Engineering, both from Stanford University. His research focuses on the development and application of numerical models and parallel computing to the study of laboratory- and field-scale environmental flows. His specific interests include numerical methods for nonhydrostatic processes, fine sediment transport dynamics in estuaries and transport and mixing due to internal waves. Dr. Fringer received the United States Office of Naval Research (ONR) Young Investigator award in 2008 and was awarded the Presidential Early Career Award for Scientists and Engineers in 2009. He received the Tau Beta Pi Award for excellence in undergraduate teaching in 2019.

Any Enquiry email us asmidah1@nus.edu.sg

Map of Seminar Room E1-06-08, 3 Engineering Drive 2, Singapore 117578

Seminar Room (E1-06-01) is on **floor 6**.