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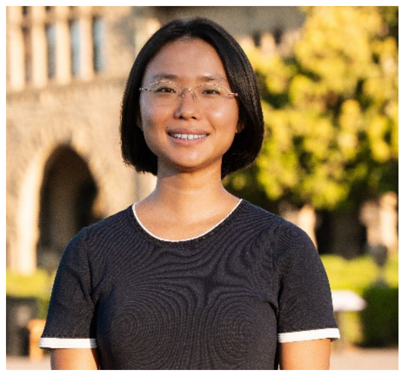
Center for Environmental & Applied Fluid Mechanics

3:00 PM, Friday, March 13, 2026
Gilman Hall 50
Zoom: https://wse.zoom.us/j/93762992307
Link for Spring 2026 recordings



Prof. Yue (Olivia) Meng
Department of Civil Engineering
Purdue University

"From Fracture to Flow: How Calving Ice Sheets Drive Mélange and Fjord Dynamics?"

Abstract: The Greenland Ice Sheet (GrIS) is rapidly losing mass, focusing attention on glacial fjords where enhanced submarine melting may trigger glacier retreat and increasing freshwater discharge can reshape coastal ecosystems, sea level, and climate. In front of fast-flowing outlet glaciers, calved icebergs, bergy bits, and sea ice form proglacial ice mélange. Yet the mechanical coupling between the ocean and mélange—especially during calving seasons—remains poorly understood. Observations show that after calving events, mélange can surge away from the terminus at speeds up to ~1.5 m/s, decaying to near zero within about an hour. These one-hour impulses recur daily to weekly across the GrIS for months. Because calving-driven mélange speeds exceed typical fjord velocities from shelf forcing (~0.5 m/s) and the summer mean flow (~0.04 m/s), the moving mélange can impose substantial shear stress on the upper ocean, from the surface down to the mélange keel (10–800 m). This surface-to-depth drag has the potential to drive fjord circulation, enhance mixing, and alter water-mass structure, with feedbacks on submarine melting, mélange buttressing, calving rates, and freshwater export.

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In this seminar, I present a new mechanism for fjord circulation forced by calving-induced mélange surges and quantify its impacts across scales. We combine (i) benchmark flume experiments to develop a parameterization for the mélange–ocean drag coefficient, informed by mélange keel depths estimated from digital elevation models; (ii) a coupled computational fluid dynamics-discrete element model (CFD-DEM) to quantify the energy budget of iceberg capsizing within the glacier–mélange–ocean system; and (iii) MITgcm simulations to upscale these dynamics and assess fjord-scale (10–100 km) circulation and mixing responses. Together, these approaches reveal how rapid mélange motion can strengthen mixing and potentially enhance submarine melt, reduce buttressing, promote calving, and modulate freshwater discharge from Greenland's fjords.

For more details, visit:
https://engineering.purdue.edu/Engr/People/ptProfile?resource_id=312605

Hosted by: Prof. Thomas Haine (EPS)