Department of Civil & Environmental Engineering

Geotechnical Engineering Faculty Search

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Geotechnical Engineering in Riverine and Coastal Environments

Thursday July 14, 2022, From 1:30 PM to 2:30 PM
Harker Lab, Room 207 (ISE207)

Abstract:

Coastal environments are in the center of many modern societal and global challenges, including climate change with increasing storm frequency and intensity, sea level rise, increasing temperature of ocean waters and associated environmental impacts, coastal erosion, habitat loss, groundwater salinization, amongst others. Nevertheless, urban and industrial developments and the population in coastal environments are continuously increasing domestically and globally. Additionally, the worldwide emerging energy crises is focusing efforts on the harvesting of renewable energy with offshore wind, wave and tidal energy conversion directly interacting with the coastal zone. Finally, understanding coastal environments and processes represents a key need for many naval applications including navigation, trafficability, sensor and effector networks, and the detection and management of unexploded ordnances.

Coastal environments and processes can vary significantly spatially and temporally; however, sediments and geomaterials are a key component of all riverine and coastal environments. In the past, sediment particle properties such as grain size and particle density were predominantly considered for subaquatic sediment dynamics. However, over the last decades, it has been acknowledged that geotechnical properties including textural properties, strength properties, and soil behavior affect key processes such as sediment erosion, deposition, and consolidation, groundwater dynamics, scour, and liquefaction, and thus, are directly relevant for coastal geomorphodynamics and coastline evolution, as well as for the interaction with infrastructure, naval applications, prediction and mitigation of impacts of extreme events, habitat conditions, and coastal community sustainability and resilience.

Measuring geotechnical properties in coastal and riverine environments can be challenging. Traditional geotechnical testing procedures are rarely adapted to nearshore and coastal conditions or strong river flows, and often struggle to capture in-situ and rapidly changing seabed surface

conditions. Recently, novel and modified sets of tools such as portable free fall penetrometers designed for deployment in energetic nearshore environments, wave gages deployed as pore pressure sensors, and data fusion with geoacoustic surveying and remotely sensed data offer new pathways to collect data despite energetic conditions, limited access, and even under unknown conditions from impacts of extreme events or in remote locations.

This presentation will provide an overview of the potential role of geotechnical engineering in modern coastal sciences and engineering and for riverine flood protection, recent method developments with focus on field data collection, current challenges, and case study examples from the speaker's work related to hurricane and flood reconnaissance, coastal erosion in the context of sea level rise, Arctic coastal erosion, and naval applications.

Bio:

Dr. Nina Stark received a Diploma (MSc) in Geophysics in 2007 from the Westphalian Wilhelms University of Muenster, Germany. For her thesis ("Characterization of seafloor sediments using eXpendable Bottom Penetrometer) she collaborated with Dr. Thomas Wever from the Institute for Underwater Acoustics and Geophysics of the German Navy in Kiel. She received her PhD in Marine Geotechnics in 2011 from MARUM-Center for Marine and Environmental Sciences at the University of Bremen, Germany where she worked on the "Geotechnical investigation of sediment remobilization processes using dynamic penetrometers" under the supervision of Prof. Achim Kopf. She was a postdoctoral fellow in 2011 in the marine geotechnics group at MARUM under supervision of Prof. Achim Kopf, and from 2012-2013, in the physical oceanography group at Dalhousie University, Halifax, Canada, under the supervision of Dr. Alex Hay, before being appointed assistant professor in the Charles E. Via, Jr., Department of Civil and Environmental Engineering at Virginia Tech in Fall 2013. Her research focuses on coastal and marine geotechnics including instrument and method development, the geotechnical investigation of subaqueous sediment dynamics and coastal erosion, beach dynamics and coastal evolution in the context of climate change, navigation channel deepening and maintenance, beach trafficability, and geotechnical site characterization in coastal environments for naval applications and energy harvesting developments. She developed the free-fall penetrometer "Nimrod" in the framework of her PhD, and collaborated with BlueCDesigns on the design of "BlueDrop". To-date she has conducted more than 50 field surveys in the North Sea, Baltic Sea, Northern Atlantic, Arctic, Northern, Central and Southern Pacific, as well as in a number of lakes and rivers. Nina has received the NSF CAREER award and the ONR Young Investigator award in 2018. She was appointed associate professor with tenure at Virginia Tech in 2019. She was a team member in the project that received the 2021 project of the year award for the munitions response program of the Department of Defense's Strategic Environmental Research and Development Program, and was selected to participate in NASA's PI Launchpad workshop in 2021. She has presented multiple keynote and invited lectures at international research conferences, and is conducting active research sponsored by the NSF, ONR, DoD SERDP, NRL, and NSWC.