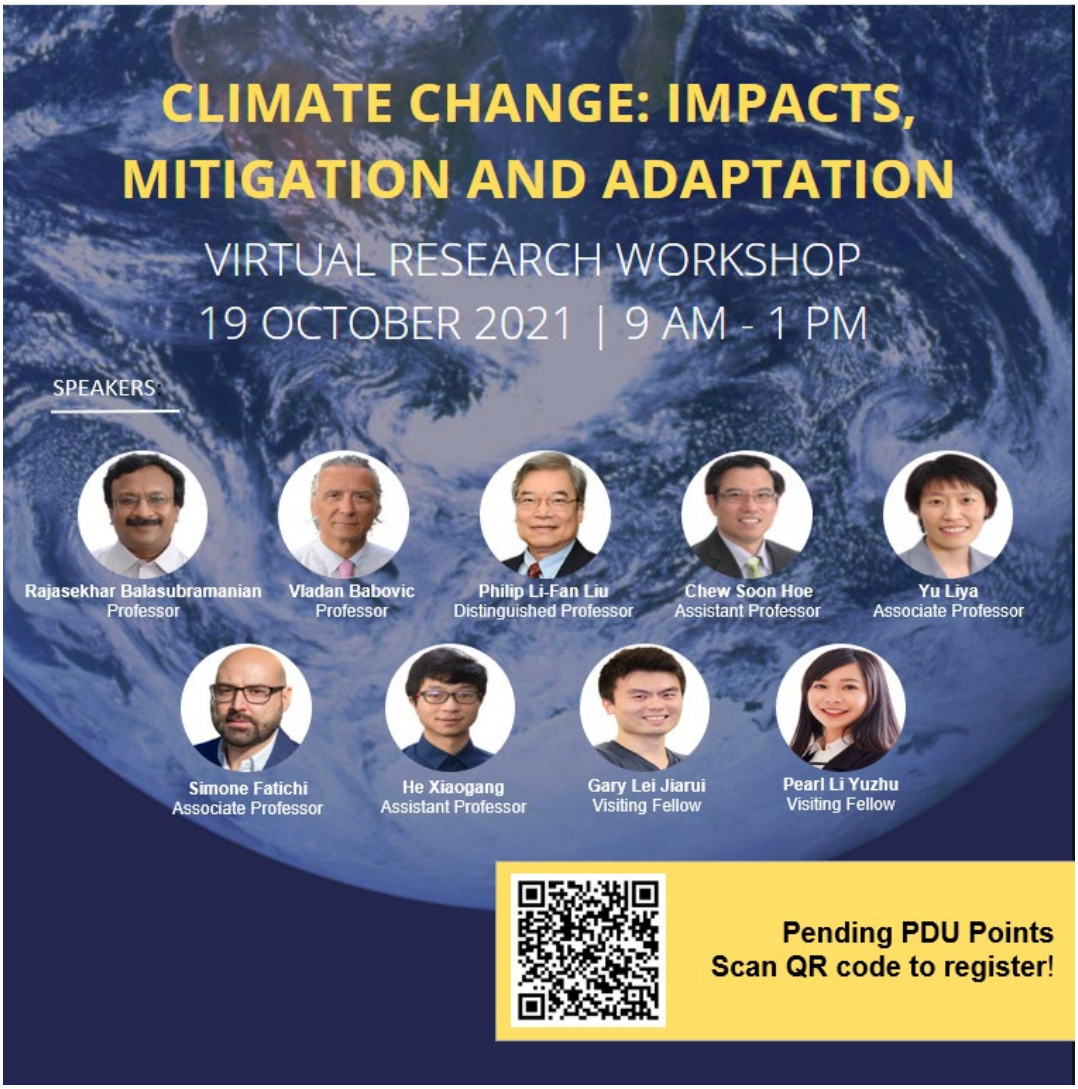
NUS National University of Singapore | Department of Civil & Environmental Engineering
Faculty of Engineering



Registration link:
https://nus-sg.zoom.us/meeting/register/tZckceCrqDkjE9QROYe7SyffoIjg6h2eUWVg

*You will receive an email confirmation with the workshop link upon registration

Programme

TIME (SGT)	PRESENTATION
09:00 – 09:10	**Welcome Speech** Professor Richard Liew Jat Yuen (Acting Head)
09:10 – 09:30	**Climate Change Mitigation: Challenges and Opportunities** Professor Rajasekhar Balasubramanian
09:30 – 09:50	**Climate Change and Water Quality of Freshwater Surface Reservoirs** Professor Vladan Babovic
09:50 - 10:10	**Uncertainties in Modelling Sea Level Anomalies with the Consideration of Climate Changes** Professor Philip Li-Fan Liu
10:10 – 10:20	Break
10:20 – 10:40	**Innovative Geotechnical Design for Climate Change Mitigation and Adaptation** Dr Chew Soon Hoe
10:40 – 11:00	**Potential Impacts of Climate Airborne Pollutants Air Quality** Associate Professor Yu Liya
11:00 – 11:20	**On the Predictability of Future Rainfall Extremes at Fine Spatial and Temporal Resolution** Associate Professor Simone Fatichi
11:20 – 11:30	Break
11:30 – 11:50	**Building a Climate Intelligent Singapore to Withstand Future Droughts and Floods** Dr He Xiaogang
11:50 – 12:10	**Aquatic Vegetation: A Nature-Based Solution to Climate Change** Dr Gary Lei Jiarui
12:10 – 12:30	**Recent Advances in the Computational Fluid Dynamics (CFD) Modelling of Coastal Threats** Dr Pearl Li Yuzhu
12:30 – 13:00	Panel Discussion and Concluding Remarks

Topic 1:

Climate Change Mitigation: Challenges and Opportunities

by Professor Rajasekhar Balasubramanian

Abstract

Urban growth is taking place on an unprecedented scale globally, and its adverse impacts on the environment and society are evident. These impacts are mainly caused by rapid population growth, and a net total growth of consumption of natural resources, combined with rapid industrialization, urbanization, mobilization, globalization, agricultural intensification, and excessive consumption driven lifestyles. One of the major environmental issues in cities worldwide is to mitigate climate change. In 2015, world leaders agreed to keep the increase in global average temperature to less than 2 °C, and ideally 1.5 °C, above preindustrial levels by the end of the century. Achieving this target requires strong commitments towards decarbonization across the electricity generation, urban transport, industrial, manufacturing and residential sectors because many human activities that address our basic needs, development, and well-being are sources of greenhouse gases. This presentation will provide evidence-based insights relevant to the design of urban decarbonization targets and policies

About the Speaker

Professor Bala's research interests cut across environmental sustainability, climate change and urban air quality. The main goal of his interdisciplinary research is to advance understanding of environmental and health impacts of air pollution on scales ranging from local to global. His work provides policy-relevant scientific inputs and contributes to development of cost-effective technologies to mitigate adverse impacts of air pollution. He has led multi-national collaborative projects related to assessment and mitigation of personal exposure to airborne particles. He is currently spearheading an international research program that aims at improving air quality in cities through global alliance with premier universities. He is a one of the Lead Authors for the UN Environment Program's Global Environment Outlook, focusing on cross-cutting issues on environment and health. He is a member of the science panel of APCAP (Asia-Pacific Clean Air Partnership), appointed by UNEP (United Nations Environment Program). He is a recipient of many research awards, notably the PROSE (Professional and Scholarly Excellence) award in recognition of his contribution to the recently published Global Environment Outlook (GEO-6) Report.

Topic 2:

Climate Change and Water Quality of Freshwater Surface Reservoirs

by Professor Vladan Babovic

Abstract

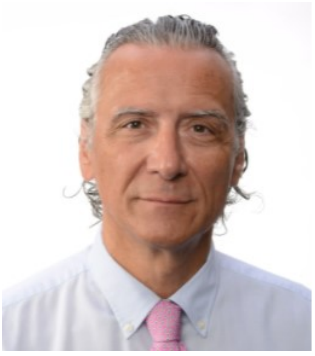
Within a short span of just 50 years, Singapore underwent a rapid transformation from a small, backwater fishing village into one of the world's leading global hubs for trade and finance. This remarkable development is a contributing factor to the rising population – more than 5.5 million people, along with the emergence of new industries. Together, these factors amplify demand for the already limited water supply. It has been forecasted that the demand for water in 2060 would rise up to 760 million gallons per day, as compared to the 380 million gallons of water per day in 2016. At the same time, international contract with Johor allowing import of 250 million gallons per day will expire in 2061.

Taken in this context, climate change, particularly when coupled with land use intensification, population growth, socio-economic development and the densification of urban areas, increase the risk of availability of water resources of a good quality.

The research described in this talk builds on the results of the 9 Global Circulation Models (GCMs) downscaled for Singapore and uses an integrated modelling framework which coupled 1D, 2D and 3D flow and water quality models to investigate the effect of climate change on the reservoir water quality in the Marina and Punggol-Serangoon catchment areas over the next 100 years. As reservoir water quality is influenced by both climatological and anthropogenic factors, three different scenarios were also developed, namely: “Green”, “Grey” and “Business-as-Usual”. Each of these scenarios accounts for a range of factors affecting the pollution loading, including population growth, present and future land use, runoff management practices, and more. Key water quality parameters in these reservoirs, such as concentrations of total nitrogen (TotN), total phosphorus (TotP), organic carbon, suspended solids (SS), algal biomass, chlorophyll-a concentration, dissolved oxygen (OXY) and bacteria (EnCoc) were simulated.

The study concludes that climate change yields only partial impact on the change of water quality. It further shows that the great effects upon water quality parameters are due to future emission scenarios. The most favourable results are obtained for the Green scenario, whilst the Grey scenario gives the most unfavourable result, suggesting that the effectiveness of planned sustainable development measures are necessary when dealing with socio-economic development and anthropogenic influence.

The mean values predicted for the three selected water quality parameters (OXY, Chlfa and Enterococci) show no significant difference for the various climate scenarios in the next 100 years, seemingly only the Green scenario yields values which can meet the water quality criteria set by national standards. In addition to analysing the water quality under different climatological and socio-economic projections, the study also looked at the impact of different water treatment practices in the Marina Catchment Reservoirs and the impact of operational water resource management practices (including water recirculation) on water quality. This was done so as to understand the efficacy of different measures that might be considered in the future. The study shows that the water quality issues that may arise in the future cannot be controlled adequately only through the proposed water recirculation schemes. It is noted that an adequate level of water treatment at the Chestnut Avenue Waterworks must be maintained, and that emission reduction in the future through implementation of green measures would have the greatest effect.



About the Speaker

Vladan Babovic is a leading scientist in the field of hydroinformatics where he has been spearheading research in data-driven research and computer modeling of hydraulics and hydrological phenomena from early 1990s. In more recent years, his work on flexibility and real options pertaining to decision-making under deep uncertainties in water- and climate-related domains gaining wider recognition.

In addition to being a leading researcher and educator, Vladan is a scientist entrepreneur who was instrumental in securing funding and subsequently lead establishment and managed growth of research institutes, 65 million Singapore Delft Water Alliance (SDWA) and NUSDeltares, for both of which he served as a founding Director. Under his leadership SDWA and NUSDeltares were recognized in March 2014 by prestigious Winsemius Awards.

Vladan is a Fellow of International Water Association, Chartered Engineer and a Member of the Institution of Engineers (Singapore).

Topic 3:

Uncertainties in Modeling Sea Level Anomalies with the Consideration of Climate Changes

by Distinguished Professor Philip Li-Fan Liu

Abstract

In this talk I will first discuss the physical processes considered in the deterministic numerical model for simulating sea level anomaly forced by a weather condition. I will demonstrate that this kind of model can be validated so as to hindcast the storm surges and significant wave heights during recent typhoons in the South China Sea region. If this kind of model were to be used for coastal planning and management purpose, the future climate and weather conditions need to be provided. I will then point out the obvious uncertainties in predicting future sea level anomalies with the consideration of climate changes. It is difficult to quantify these uncertainties and it is, therefore, a challenge to manage the expectation.

About the Speaker

Philip L.-F. Liu is the Distinguished Professor in the Department of Civil and Environmental Engineering at NUS. Liu is also an Honorary Professor in Tsinghua University, China, the Li Kwoh-Ting Chair Professor in National Central University, Taiwan, Honorary Chair Professor in National Sun Yat-Sen University, Taiwan, and the Class of 1912 Professor in Engineering, Emeritus, in Cornell University, USA.

After graduating with a B.S. degree in Civil Engineering from National Taiwan University in 1968, Prof.Liu studied at Massachusetts Institute of Technology and received a S.M. degree in Civil Engineering in 1971 and a ScD degree in 1974. He joined Cornell faculty as an Assistant Professor in the School of CEE in 1974 and was promoted to Associate Professor in 1979 and Full Professor in 1983. He served as the Associate Director of the School in 1985-1986 and as the Associate Dean for Undergraduate Studies of Engineering College in 1986-1987. Liu was the Director of the School of CEE from July 1, 2009 to June 30, 2015. From August 2015 to July 2019, Prof. Liu served as the Vice President for Research and Technology at the National University of Singapore.

Prof. Liu is a member of the National Academy of Engineering (USA), an Academician of Academia Sinica (Taiwan), a Fellow of the American Geophysical Union, and a Distinguished Member of the American Society of Civil Engineers. He also received the ASCE Walter L. Huber Civil Engineering Research Prize (1978), the J. S. Guggenheim Fellowship (1980), the ASCE John G. Maffatt & Frank N. Nichol Harbor and Coastal Engineering Award (1997), the International Coastal Engineering Award ASCE (2004), the Alexander von Humboldt Research Award (2009), and the International Award for Enhancement of Tsunami/Coastal Disaster Resilience (2017).

Prof Philip Liu's team published a paper to investigate the quantification of ocean bathymetry measurement errors and their effects on the tsunami hazard assessment in Journal of Geophysical Research. The lead author, Ignacio Sepulveda, was Prof Liu's former PhD student from Cornell. and is now a John Miles Post-doc Fellow at Scripps. Please find the paper explained (updated 7 Oct 2020) at the Scripps' web site. https://scripps.ucsd.edu/news/unveiling-accuracy-tsunami-predictions

Topic 4:

Innovative Geotechnical Design for Climate Change Mitigation and Adaptation

by Dr Chew Soon Hoe

Abstract

One of the effects of climate change and global warming is the seawater rising. Hence the coastal protection – be it nature-based or with hard structure -- needs to take into account the geotechnical aspects arising from this. The reality is that we need to "protect" our coastline against the hash wave action and deadly forces of erosion at coastal front. In addition, all these coastal protection structures are built on thick layer of soft and loose soils, typical of coastal condition. Hence, these coastal protection measures have to be carefully designed and engineered. In this seminar, the key fundamental geotechnical concerns as well as some innovative solution will be shared. Geosynthetics material, in various forms, coupled with vegetation can provide a sustainable solution. Some case studies will be discussed.

About the Speaker

Dr Chew Soon Hoe is an Assistant Professor, and Director of Safety Studies Innovative (SSI) with the Department of Civil and Environmental Engineering. He graduated his PhD from University of California-Berkeley, USA.

He is very active in conducting short course and seminar to practicing engineers under PAC (NUS), and IESA on practice-oriented courses on geotechnical engineering, coastal geotechnical structure, special pile testing, deep excavation, ground improvement, geotechnical software, erosion and sediment control, and design of ABC water features.

Dr Chew is actively involved in research and consultancy relating to various applications of ground improvement, deep excavation, geosynthetics applications in Singapore and this region. His Research Interests includes:

- Soil improvement of soft ground (Jet grouting, deep cement mixing and stone column, PVD, vacuum preloading etc),
- Geosynthetics (including reinforcement and filtration, geotubes, erosion control using bio-engineering etc),
- Geotechnical seismic study,
- Special pile testing (Rapid load test, PDA, O-cell test),
- Numerical modelling of geotechnical problems (using PLASIX, Slope/w, Seep/w and Sigma/w).

Over the years, he was the Principal Investigator for research on Jet Grouting for ground improvement and tunnelling works, PVD, geosynthetics pullout test, geofabric filtration test others. Recently he was awarded with CoT projects on Land reclamation and coastal protection related works.

He was involved in consultancy work related to many mega projects, e.g. MRT and tunnel constructions, Singapore east coast beach restoration project, containers Port Extension Port in Pasir Panjang, Singapore as well as Port expansion in PTP Port in JB, Malaysia, and many others.

Dr Chew published very extensively on soft clay and ground improvement related topics. He was awarded "Defence Technology Prize", from Chief Defence Scientist, Ministry of Defence, Singapore in

2006. He was also the recipient of the “Minister Innovative Awards” from Ministry of Transportation, 2011, on his “innovative use of geotube filled with cement mixed soft clay”. He was also awarded with “Friends of Waters” by PUB, the water agency in 2013. He latest awards is “2015 Minister’s Awards (Team)” by the Ministry of National Development on the project supporting the HDB team of engineers on “Reuse of soft clay for infilling works at Pulau Tekong”, awarded on National Day Celebration 2015.

Topic 5:

Potential Impacts of Climate Airborne Pollutants Air Quality

by Associate Professor Yu Liya

Abstract

WHO states in September 2021 that "*Effects of air pollution are more dangerous than previously thought.*" after more than sufficient evidences linking exposure to polluted air with cardiovascular issues, cancers, dementia and other diseases. Would climate changes exacerbate air pollution, worsening health impacts? How would global climate change possibly aggravate air quality in our urban environment that is vulnerable to neighboring and regional air pollutants? To provide better air quality for millions of city dwellers, knowledge gaps needing strategic endeavor will be highlighted to embrace challenges imposed by dynamic airborne pollutants in the warm and humid tropical environment.

About the Speaker

Dr. Yu is an associate professor in the Department of Civil & Environmental Engineering at NUS. Her research group investigates evolution of physicochemical properties of airborne pollutants in warm and humid urban environment. Continuous effort is given to building knowledge base of photooxidation of aerosols, impacts of cross-border biomass burning smoke on urban air quality, behavior of secondary aerosols, personal exposure to air pollutants, etc. through concurrent laboratory experiments, chemical reaction simulation and field studies. In addition to advisory and editorial boards for international scientific journals, she is a member of scientific steering committee serving the research community of International Global Atmospheric Chemistry.

Topic 6:

On the Predictability of Future Rainfall Extremes at Fine Spatial and Temporal Resolution

by Associate Professor Simone Fatichi

Abstract

Decision makers and stakeholders are usually concerned about climate change projections at local spatial scales and fine temporal resolutions. This contrasts with the reliability of climate models, which is typically higher at the global and regional scales, Therefore, there is a demand for advanced methodologies that offer the capability of transferring predictions of climate models and relative uncertainty to scales commensurate with practical applications (e.g., few square kilometres and sub-daily scale). A stochastic downscaling technique that makes use of an hourly weather generator (AWE-GEN) and of a Bayesian methodology to weight realizations from an ensemble of climate models is used to generate local scale meteorological time series of plausible “futures”. The methodology is designed to partition three main sources of uncertainty: uncertainty due to climate models (model epistemic uncertainty), anthropogenic forcings (scenario uncertainty), and internal climate variability (stochastic uncertainty). For air temperature, the magnitude of the different uncertainty sources is comparable for mid-of-the-century projections, while scenario uncertainty dominates at large lead-times. The dominant source of uncertainty for changes in precipitation mean and extremes is internal climate variability, which leaves a limited room for uncertainty reduction. However, the inference is not necessarily discouraging because the uncertainty in precipitation due to historic climate variability is already covering a large fraction of the total uncertainty for the projected future.

About the Speaker

Simone Fatichi received his BSc (cum laude) in Earth and Environmental Engineering at the University of Firenze (Italy) in 2004 and his MSc (cum laude) in Earth and Environmental Protection Engineering at the University of Firenze (Italy) in 2006. In 2010, he obtained an International PhD title (outstanding evaluation) joint between the T.U. Braunschweig (Germany) and University of Firenze (Italy) with the thesis “The modeling of hydrological cycle and its interaction with vegetation in the framework of climate change”. Subsequently, he was a researcher and lecturer at ETH Zurich Institute of Environmental Engineering from, where he graduated 5 PhD students. Simone Fatichi was a visiting researcher in the Department of Civil and Environmental Engineering at University of Michigan (USA) in 2008 and 2009, in the Institute of Applied Ecology at Auckland University of Technology (NZ) in 2014, and in the Department of Civil Engineering at Monash University (AU) in 2018. He was recipient of Evangelista Torricelli prize in 2014 and of the prestigious Antonio Feltrinelli Giovani prize in 2019.

He is mainly working on hydrology, biogeoscience, and climate change related issues. Research interests range from distributed hydrological and ecohydrological modeling, modeling of plant physiological processes and tree-leaf hydraulic, modeling of soil biogeochemistry and nutrient dynamics, weather generators and stochastic hydro-meteorological forcing realizations, downscaling techniques to study climate change impacts and uncertainties, to arrive to more general questions related to global change and its interaction with vegetation functioning, water and soil resources, carbon cycle, and ecosystem services.

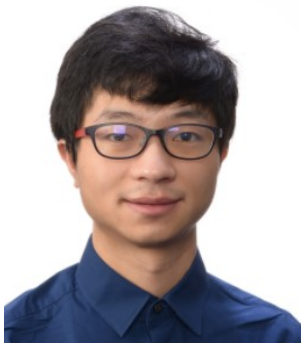
Topic 7:

Building a Climate Intelligent Singapore to Withstand Future Droughts and Floods

by Dr He Xiaogang

Abstract

Hydrological extremes, in the form of droughts and floods, have huge impacts on a wide range of sectors including, most prominently, water availability, food security, and energy production, among others. The expectation of heightened drought and flood risk in Singapore under climate change, coupled with population growth and economic development, poses unprecedented challenges for the nation to boost its resilience to these natural hazards, mitigate their extreme impact, and develop effective and actionable solutions towards sustainable development. In this workshop, I will talk about (1) how nature-based climate solutions can be deployed to simultaneously reduce flood and drought risks, and (2) how a **PREP-NexT** (**P**athways for **RE**silient **P**lanning of water-energy-food **Nex**us **T**ransformation) platform can enhance resilience and reduce vulnerabilities to droughts and floods across a wide range of spatial and temporal scales over entire Southeast Asia, and (3) how PREP-NexT can guide robust and adaptive strategies towards a sustainable water, energy, and food future.



About the Speaker

Xiaogang He is a Princeton-trained Ph.D. Hydrologist with experience in economics, machine learning, and environmental policy. His research interests focus on the fundamental understanding of how climate change, variability, and human interventions affect drought and flood risk across scales, and how to implement an integrative framework (e.g., hydrological modeling, remote sensing, artificial intelligence, nexus approaches) to reduce their societal impact. Before joining NUS, he is a Water in the West Postdoc Fellow at Stanford University working on sustainable groundwater management. Xiaogang received his M.A. in Civil and Environmental Engineering from Princeton University in 2016; M.E. in Civil Engineering from the University of Tokyo in 2013; B.Eng (Major, with honors) in Hydraulic Engineering, and B.Sc (Dual) in School of Economics and Management from Tsinghua University, China, in 2011.

Topic 8:

Aquatic Vegetation: A Nature-based Solution to Climate Change

by Dr Gary Lei Jiarui

Abstract

The Lei lab studies the interaction of water with aquatic vegetation and the feedbacks to flow development, sediment transport, and ecosystem function. We develop theoretical models for physical processes that determine how vegetated habitats, such as mangroves, seagrasses, and salt marsh, provide coastal protection and store blue carbon. These models will be used as guidelines to improve the restoration and management of aquatic ecosystems. To validate the proposed models, we conducted a combination of laboratory and field experiments. Specifically, we measured the flow velocity, turbulence kinetic energy, wave height, percentage carbon, and sedimentation rate with various techniques. Our results revealed that the blue carbon sequestration rate increased with decreasing hydrodynamic intensity. Also, we were able to predict the effects of vegetation on wave attenuation.

About the Speaker

Jiarui “Gary” LEI is an MIT-trained Ph.D. with experience in environmental fluid mechanics. He has worked extensively in aquatic environments studying the interaction between water and various types of plants. Specifically, he focuses on understanding how hydrodynamics may affect the plants’ survival, growth, and ability to curb erosion. Dr. Lei also extends his research into seagrass/mangrove ecosystems, where he studies how carbon sequestration is connected to the local hydrodynamics.

Topic 9:

Recent Advances in the Computational Fluid Dynamics (CFD) Modelling of Coastal Threats

by Dr Pearl Li Yuzhu

Abstract

Coastal regions provide valuable natural resources in the form of recreation, food, commerce, and energy. Due to both climate change and human factors, however, coastal regions are under continuous threat by factors at both the surface and the sea bottom. At the sea surface increased frequency of extreme waves can cause large hydrodynamic loads on coastal structures. Large waves (including breaking) can in turn transport massive amounts of sediment at the sea bottom, leading to coastline recession, which may compound in the face of anticipated sea level rise. Large waves can likewise cause scour around coastal structures, which may affect their stability. This presentation will focus on recent research breakthroughs in computational fluid dynamics (CFD) modelling of coastal engineering problems, with focus on three areas: (1) breaking waves and their impact on coastal structures, (2) waves-structure-seabed interactions and (3) hydroelastic design and optimization of coastal structures.

About the Speaker

Dr. Pearl Li Yuzhu is Assistant Professor at the Department of Civil and Environmental Engineering at NUS and is a former Marie Skłodowska-Curie Scholar. Her research focuses on many aspects of coastal engineering, including: fluid-structure-seabed interaction, scour, liquefaction, turbulence modelling and breaking waves, with particular focus on computational fluid dynamics modelling and numerical investigation of coastal engineering problems. She currently serves as an Editorial Advisory Board member of the OpenFOAM® Journal and is a regular topic organizer on e.g. Coastal Engineering at the annual OMAE (International Conference on Ocean, Offshore & Arctic Engineering) conference.