

His vision for education in Singapore will be an inspiration for generations to come.

Staying grounded with underground water storage

For a small country like Singapore, maintaining the availability of fresh water for drinking and industrial use is an ongoing challenge. "We have a very limited amount of usable land in Singapore. At the same time, we need to increase our long-term water storage capacity for national safety and security reasons," said Assistant Professor Cao Bin at SCBE-NTU and SCELSSE.

That is the goal of the Land and Liveability National Innovation

Challenge (L2 NIC) programme by the Ministry of National Development (MND) and the National Research Foundation (NRF), which is to develop innovative technological solutions to increase Singapore's land capacity for our long-term development needs and provide options for future generations.

Asst. Prof. Cao is a team leader in a L2 NIC project to explore the use of underground space for water storage so that usable land can be saved for other important developments.

"This awarded project addresses the challenge of limited land capacity for sustainable development in Singapore by exploring the possible use of underground caverns for long-term water storage in urban environment," he said.

The scope of the project is to

conduct lab-scale experimental studies to examine physical, chemical and microbiological interactions and ecological modelling for prediction

of water quality. Team members of the project include colleagues from CEE, local collaborators from PUB and overseas collaborators from Australia and USA.

"Upon completion of this project, we will provide first of its kind data on physical, geochemical and microbiological interactions in cavern storage conditions in Singapore. We will also

provide recommendations on design, planning, and management of rock cavern-based long term water storage to relevant governmental agencies," he explained. Asst. Prof. Cao was awarded the L2 NIC project in December 2014.



Calendar

SCELSSE Seminars

Thursdays 9:30 - 10:30am

30 Apr: Jean Pierre Nshimyimana and Adityaa Bandla

28 May: Prasanna Jogdeo and Ding Yichen

Group Meetings

Environmental Engineering Meeting: Fridays 9am, B3 Meeting Room

Kline Group meeting: Mondays 9am, B3 Meeting Room (please check with Kimberly prior to joining).

Events

Every Tuesday: Crochet Klatch. 12:00 - 12:45pm. B2 Café Lounge.

02 Apr: SCELSSE Waterway Workshop 8:30am - 1:30pm. SCELSSE

15 Apr: SCELSSE Happy Hour. From 5:30 pm. B2 Café Lounge.

28 May: SCELSSE Outreach Event. 3:00pm - 5:00pm. SBS Lobby.

Summer Course for PhD students

19 Jul - 01 Aug: Host-microbe symbiosis: old friends and foes. Instituto Gulbenkian de Ciência, Portugal.

Conferences 2015

01 - 07 Aug: Gordon Research Conference: Marine Molecular Ecology. Hong Kong, China.

02 - 06 Aug: Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition. Philadelphia, USA.

SCELSSE at NTU Open House 2015

On Saturday the 7th of March, SCELSSE supported the Asian School of the Environment (ASE) in the NTU Open House 2015 event, which was attended by thousands of potential undergraduate students and their parents.

This is the second year that ASE is offering their Environmental Earth System Science (E2S2) undergraduate programme. The E2S2 is an interdisciplinary programme tailored to meet the professional skillset needed by government agencies, energy companies and environmental consultancy firms in the field of environmental science.

"This year, we are going to have a cohort size of about thirty students, a cohort size driven by industry demand so that our graduates will have a much better chance of getting jobs in the field," said Associate Professor Charles Rubin, Division of Earth Sciences and Head of the Asian School of the Environment.

ASE student ambassadors from the pioneer batch of the programme were on location to inform interested visitors about the details of the

E2S2 programme. These include the entry requirements, course summary and potential careers.

In addition, SCELSSE volunteers were there to work with ASE student ambassadors to raise awareness of the environmental

science field. This outreach activity is important to SCELSSE because ASE graduates will become potential employees and graduate students for Research Centres of Excellence such as SCELSSE and the Earth Observatory of Singapore (EOS).

A big thanks goes out to SCELSSE PhD students Karunanithi Jeyannathann, Hari Krishnan Anjaly Sukumaran Nair and Ng Chun Kiat Calvin for volunteering their time and effort to make this activity a success.



A key strength of the biofilm mode of life is the cooperative interaction between microbes that result in enhanced resilience of the community. Assistant Professor Yang Liang, who joined SCELSE in 2012, is immersed in the study of such interactions.

"My research is dedicated to understanding intercellular signaling, interspecies interactions and microbial evolution in the context of the biofilm lifestyle, at the fundamental, applied and translational levels," he explained. So far, Liang's strategy has yielded bountiful results.

"In 2013, our group identified a concealed novel pathogen *Elizabethkingia anophelis*, which can be carried by mosquito malaria vectors and may form biofilms in the hospital environment," Liang said.

"Last year, we found that dispersed cells from biofilms represent a novel virulent lifestyle and might enhance dissemination of infections.

"We are currently working together with the Singapore Infection Control Team to map the dynamics and evolution of drug resistant genes from hundreds of samples around Singapore," he said.



Within SCELSE, Liang collaborates closely with the Environmental Engineering, Meta-omics and Systems Biology and Microbial Biofilm clusters.

Externally, he has established a partnership with NTU-SPMS and NUS researchers to identify next generation antimicrobial agents. His group also works closely with clinician scientists from NUH, TTSH and several hospitals in China to investigate the dissemination of drug resistant genes among pathogens.

Liang obtained his BSc in Biological Sciences in 2004 at Nankai University in Tianjin, China. He then went to the Technical University of Denmark, attaining his MSc in 2006 and PhD in 2009.

After completing his PhD, Liang was awarded a research grant by the Danish Council for Independent Research in 2010 to work on the characterisation of *Pseudomonas aeruginosa* cystic fibrosis infections. A year later he was awarded an Alexander von Humboldt Research Fellowship at the University of Hamburg, Germany and in 2012 arrived at SCELSE, with support from

the Nanyang Assistant Professorship under the mentorship of Prof. Mike Givskov.

Liang enjoys the collaborative culture here at SCELSE that parallels the microbial interactions in his research field.

"In SCELSE, I can learn a lot from other researchers about genomics, biophysics and engineering just by walking from B1 to B3, which means that I can evaluate our projects from different points of view, reducing bias," he said.

"Managing a big group really takes a lot of time and I hardly have the time to improve myself. I would like to learn programming but I don't have the time because I need to read manuscripts, teach and do some administrative work," he lamented.

For students embarking on their research careers, he has this advice: "Be ready to acquire new knowledge from others and remember to give them credit. Link your fundamental research to a practical field, because you need to show people how your work is useful." When asked about what he liked most about life in Singapore, he said: "Food. I gained 10kg since I arrived here!" He also enjoys travelling, photography and watching thrillers.

Publication profile

Membrane bioreactors (MBR) are widely used for wastewater treatment due to the advantages over conventional gravity dependent methods, such as smaller treatment space and higher quality of effluent. However, MBR systems are prone to biofouling, which occurs when microbes form biofilms on the membrane surface, leading to the clogging of the membrane and resulting in higher operating costs.

Despite the diversity and adaptability

Archaea: Fouling under pressure

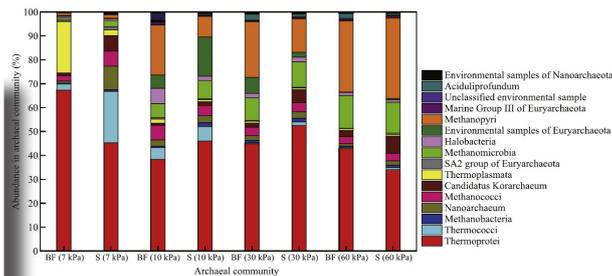
of archaea, there have been limited studies on their roles in biofilm formation on MBR Membranes. To begin addressing this gap, SCELSE researchers have characterised archaeal communities on hollow fibre membranes and in activated sludge using high-throughput sequencing of the 16S rRNA gene.

Their phylotypes were determined in correlation with increasing transmembrane pressure (TMP) over a 110-day period. Results show that the diversity and richness of the archaeal community in the biofilm with increasing TMP to become comparable to

that of the sludge.

In addition, different classes of archaea predominated in low pressure biofilms compared to high pressure biofilms, suggesting that the formation of biofilms by the initial archaeal residents facilitated the colonisation of other sludge archaeal groups.

These results help to enhance the understanding of how archaea contribute to biofouling, and assist with developing approaches for preventing archaeal biofilm formation or promoting their dispersal.



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Characterization of the archaeal community fouling a membrane bioreactor

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