

Jul 06, 2015 | Written by Amy Tan | 0



SINGAPORE: Using data to understand and forecast water flow in coastal urban environments in order to adapt to climate change may sound like something straight out of a science fiction movie. However, Vivien Chua, an assistant professor at the department of civil and environmental engineering at the National University of Singapore as well as co-programme director for the NUS-TUD Double Master of Science degree programme, has been making this a reality with her research.

When she was undertaking her PhD in civil and environmental engineering at Stanford University, Chua developed a state-of-the-art hydrodynamic model that allowed her to study water circulation in San Francisco Bay for her dissertation. The model enabled her to create a simulation of the ocean to gain a deeper understanding of water currents and levels. Her PhD research projects include studying storm surges and coastal inundation, salinity intrusion due to rising sea levels, and wetland habitat restoration in climate change adaptation.

Upon completing her PhD in 2012, she decided to pursue this research interest further by examining the influence of hydrologic modelling on hydrodynamic modelling for coastal urban settings. Hydrologic models are conceptual representations of a part of the hydrologic, or water, cycle. They facilitate the study of how water flows over land and its network of drainage systems and canals.

Chua's study is a breakthrough in the field in that it is the first time a coastal ocean model is combined with a hydrologic model. "Most studies focus on one or the other because it's a matter of when the technology is mature enough to allow you to develop your research into the next phase," she observes.

According to her, developing the technology needed to combine hydrologic modelling and hydrodynamic modelling requires an interdisciplinary background. She spent nine years of her education in the US and achieved first class honours for her Bachelor of Science degree in electrical and computer engineering at Georgia Institute of Technology.

During her undergraduate years, she discovered that she was interested in computing and went on to pursue a Master of Science in computational and mathematical engineering at

Stanford University. When it was time for her to decide on her PhD dissertation topic, Chua decided to apply what she had learnt to better the world. "I've always wanted to do research and because I was doing a lot of computer modelling, it was important for me to find practical applications to what I do. It's more meaningful that way," she says.

Currently, Chua is applying her hydrologic and hydrodynamic models to Singapore's coastal waters in studying the flow of pollutants. While Singapore is an urban city where canals and water flow are controlled, she highlights that the city-state is vulnerable to pollutants from Johor Baru. As such, her simulation model covers Johor Baru, the southern region of the South China Sea and the Straits of Malacca. "We introduce pollutants upstream of the Johor River and we observe how they flow down to Singapore," she explains.

Perhaps the biggest challenge for her is getting access to data. According to her, observation data is usually sparse and difficult to obtain because it is held by government agencies and used for their own purposes. At the same time, different groups of researchers at the universities here are performing their own data collection, but they may not share their findings openly.

While Chua's research does not need to rely heavily on data, some data is required to calibrate and validate the models and to verify that the model submissions are correct. "We compare it with observed data over a short period of time, so generally the accuracy is more than 90%," she says.

For her work, Chua has been recognised at EmTech Singapore 2015, an annual global emerging technologies conference hosted by MIT Technology Review. She joins nine other regional innovators under 35 years of age for selection to the Global TR25 list, which will be announced in September.

Accolades aside, Chua believes her study can be applied to other coastal environments, where understanding the flow of water will assist urban planners and policymakers in formulating adaptation strategies to cope with climate change and human influences such as pollution.

Meanwhile, she is actively involved in philanthropy. She is a co-founder of Coast-to-Coast Alumni, comprising a group of young alumni from US and UK universities living and working in Singapore. The group organises events to raise awareness and funds for good causes. She is also a changemaker for the 50for50 project, an SG50 initiative to activate 50 changemakers to raise \$5 million.

***This article appeared in the Enterprise of Issue 681 (June 15) of The Edge Singapore.***

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