COMPENDIUM OF RESEARCH

2007 - 2013

Deltares
Enabling Delta Life

NUS
National University of Singapore

PUB
Water for All: Conserve, Value, Enjoy

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DIRECTOR'S MESSAGE

VLADAN BABOVIC

Singapore Delft Water Alliance
Founding Director.
February 2007 – May 2013

I am pleased to present the Compendium of Achievements of the Singapore Delft Water Alliance. This report provides a summary of the many activities the Alliance carried out between 2007 and 2012.

While this report provides a summary of the facts, there is a much greater human story behind the evolution of Singapore Delft Water Alliance (SDWA).

SDWA was founded on a vision and research agenda: we wanted to address the unprecedented challenges facing humanity: sustainable water management, climate change and natural disasters, and accelerating urbanization.

We started with little more than ambition, and then began to put the pieces in place. Faculty and colleagues from 18 NUS Departments and Research Institutes, colleagues from nine research units in Deltares, and our able colleagues from PUB set off on a hunt for the most talented global team of researchers from 26 nations around the world.

Our vision - a sketch on a scrap of paper, really – has evolved into a full-blown research entity. In just six years, SDWA has become a recognized brand in Singapore, Southeast Asia and Europe.

Today, SDWA represents excellence in a range of water- and environment-associated issues and have been involved with some iconic projects, including the Water Quality Modelling of Punggol-Serangoon Reservoirs, the development of Continuous Water Quality Monitoring and Modelling of Singapore's entire coastal environment, or the "Neptune Project", and the study of Jurong Island's Ground Water potential. Our involvement is testimony to the level of trust our stakeholders have in our team.

Crucial to our success has been the hard work, dedication and passion for science of our SDWA researchers. They have been instrumental to our most remarkable achievements - achievements that have been a highlight of my professional career.

I am also grateful for the SDWA Board of Trustees and Management Board members for their continued trust and support. The last six years have not been without challenges, but knowing they are behind us has helped us weather them and emerge stronger.

Together, we have all grown – and on many fronts. In the last six years, our team has celebrated the birth of 26 babies. They serve as a reminder of why what we are doing is important: they represent the future generations that will benefit from what we are learning – and changing – today.

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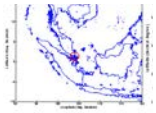

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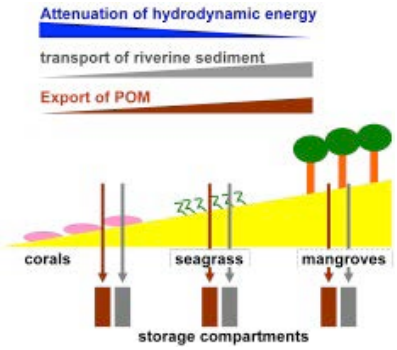

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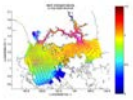

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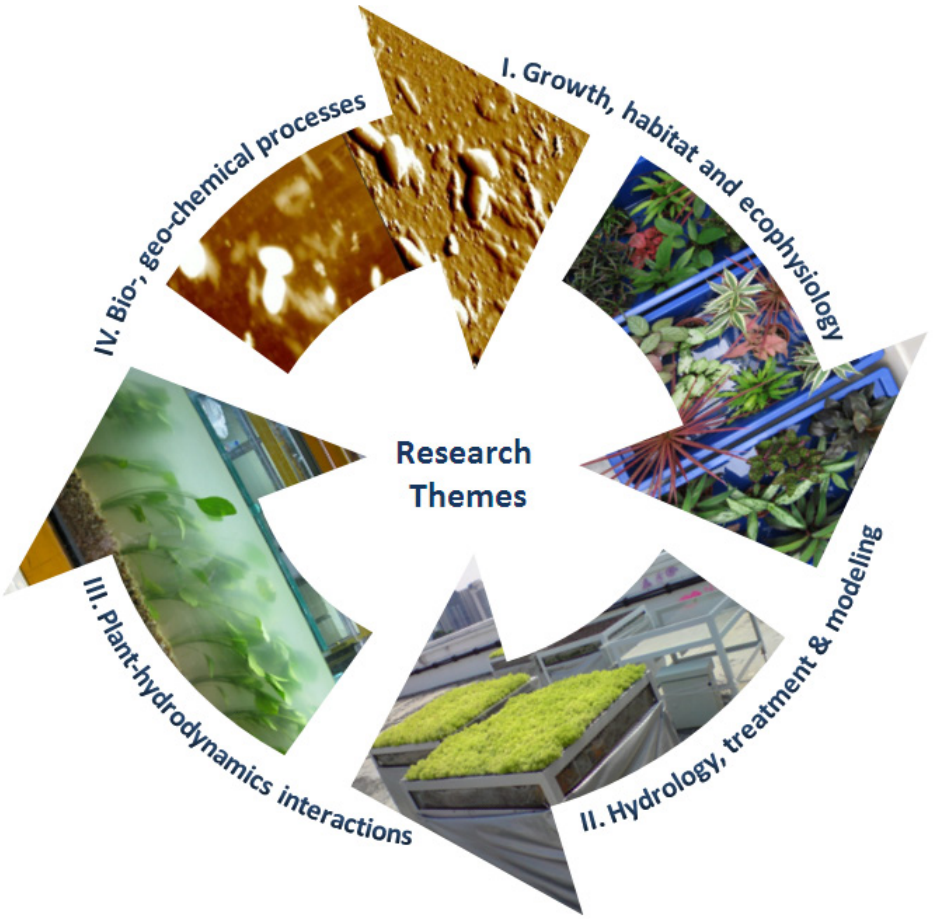
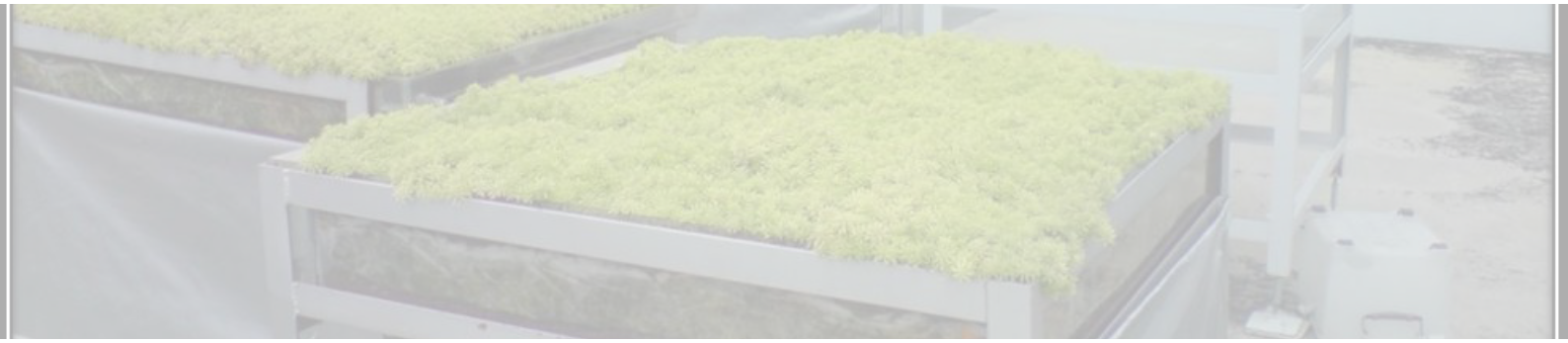
Towards improved urban water management through an Aquatic Science Centre in Singapore

Assoc. Professor Sanjay Swarup
Mr. Arthur Mynett

In urban water management, water quantity and quality are strongly interlinked with the demand for water for both anthropogenic and natural uses. Given that Singapore collects most of the rain water and re-uses it as industrial or drinking water, the management and improvement of urban drainages and aquatic ecosystems becomes a challenging problem that requires new integrated tools to define best management strategies. In order to capitalize on our natural resource of freshwater, there is a renewed call for maximum storage and reuse of freshwater for both recreation and consumption. It is hence vital to adopt innovative and cost effective approaches that (i) use low energy; (ii) reduce flooding risks; (iii) mitigate pollution and (iv) integrate with urban architectural plan designs and city plans. In order to develop this it is necessary to fully understand the urban water system (quantity and quality) by gathering knowledge on the relevant processes and their interactions.





RESEARCH TOPICS

1) To build a comprehensive knowledge base on the water quality improvement and monitoring capabilities of organisms

A diverse range of plants and animals can be used to improve and monitor water quality. The water Improvement efficiencies of plants and animals will depend on growth characteristics, uptake rate, physiological processes and exudation properties that can stimulate microbial and planktonic growth. Hence, baseline data on these complex traits needs to be established for any candidate species to be considered for field testing.

2) To develop an integrated approach for understanding, designing and controlling urban water systems

Runoff, surface water, groundwater and sewer water are subsystems of a total urban water system. In one way or another, all the subsystems interact, influencing each other, thereby influencing the total urban water system. Therefore, an integrated approach of the total urban water system is required in order to improve the system cost-effectively.

3) To quantify and model processes involved in the interaction between hydromorphology, water quality and biological organisms

Biological organisms such as macrophytes influence the flow characteristics of water, as well as other water quality parameters. Thus, the interaction between macrophytes and hydromorphology needs to be studied and data gathered from eco-hydraulics and environmental modeling was used to develop tools for analyzing and managing the aquatic environment.

4) To determine the effects on water quality by understanding the physicochemical processes at the bed-water interface

In 'created' environments, interplay of growth enhancing and retarding physicochemical conditions will govern the success or failure of various organisms present in the community. Sediments and suspended solids which may contain pollutants such as nutrients, heavy metals and organic contaminants also contribute significantly to urban freshwater chemistry. From this standpoint, both adsorbed chemicals on surface sediments and solids as well as chemical fluxes at sediment-water interfaces were studied in detail.

KEY FINDINGS

In a water-starved country like Singapore, the design for maximum storage of available water is essential. One of the challenges faced in maximizing water capture is the utilization of peak flow discharge. Besides aesthetic purposes, green roofs can serve to improve retention capacity through peak flow reduction and runoff delay. Through modifications in its implementation, water harvest from these green roofs is significantly improved. To better understand urban hydrology, models have been designed to predict runoffs from roofs and urban catchments. Enhancement of water quality of stormwater runoffs can be achieved using biosorption as well as plant-assisted bioremediation. Low cost, locally available biomaterials, such as crabshell and Sargassum sp., have been found to be good biosorbents which can be employed in green roof assemblies to improve water quality. Tropical, terrestrial plant species that can adapt to an urban freshwater habitat and remediate nutrients and heavy metals from water bodies have been identified. Plant root responses to pollutants and their remediation capacities were also quantified. Research has been carried out to study possible flooding risks posed by the introduction of plants in the waterways in which the optimized levels of plant density and degree of submergence to maximize the flow capacity of canals and minimize flooding is predicted. Introducing plants in waterways alters the microenvironment in the canals leading to changes in the organic content as well as the microbial load. To understand the microbial diversity and their functional roles in urban catchments, high throughput technologies were used to analyse water and sediments.

Our integrated approach that encompasses macro- to micro-level perspectives is able to significantly contribute towards improving urban water management. This inter-disciplinary approach will not only serve to reduce pollutants and minimize flood risks but can also be integrated into Water Sensitive Urban designs (WSUD) as part of the national water agency, PUB's Active Beautiful and Clean programme. To this end, the Van Kleef Centre @ Sungei Ulu Pandan was created as a multi-purpose facility that not only supports fundamental and applied research in water and environment resources, but also espouse education and public outreach in emerging issues related to urban water management.

MHBox

Assoc. Professor Vladan Babovic
Dr. Herman Gerritsen
Dr. Ooi Seng Keat

The Must Have Box (MHBox) project focuses on understanding the causes of residual, non-tidal sea levels and currents (anomalies) in the Singapore region and from the understanding to design a knowledge based in-situ ocean weather reporting and decision support system, resulting in an online maritime decision support kit, the "MustHaveBox"®.

THE ISSUE: SEA LEVEL ANOMALIES

Sea level anomalies (SLA's) occur due to meteorological and oceanographic conditions. Such SLA's are observed especially in areas where significant residual currents occur due to climatic conditions such as monsoon winds and non-periodic effects on smaller length and time scales. At times, effects of SLA's can dominate the regular (e.g. tidal) flow conditions introducing uncertainty for critical marine operations, such as moving large structures.

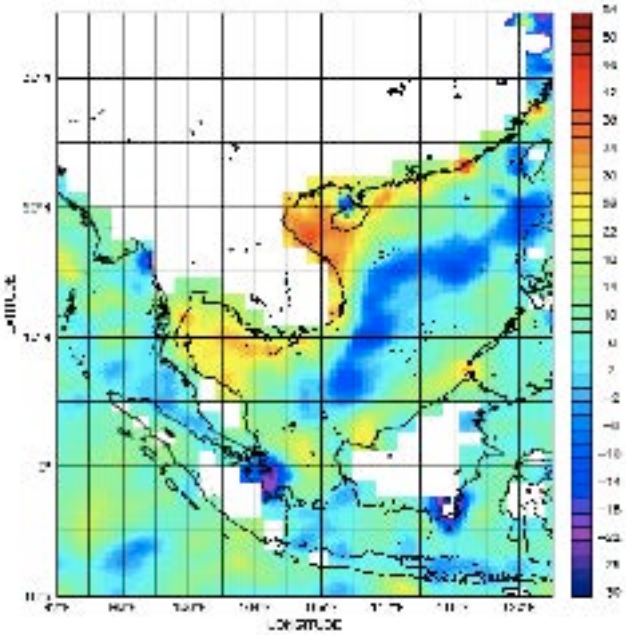
REGION OF INTEREST

The main regions of interest are the Singapore coastal waters which is part of the Sunda shelf surrounded by large ocean bodies (Andaman sea, South China sea, Indian Ocean and Java seas).

RESEARCH OBJECTIVES

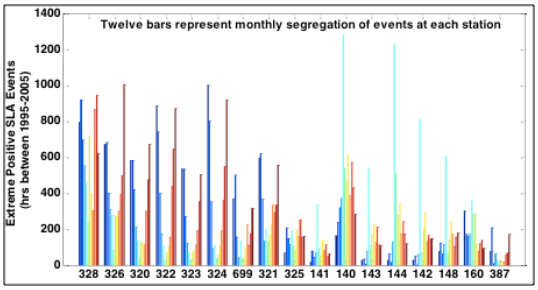
To be able to forecast, predict and provide a decision support system for SLA's the R&D for the project was focused on the following key points of innovation;

- Extracting features on spatially and temporally varying deviations (SLA's) from satellite altimetry data.
- Exploring new and innovative techniques for accurate forecasting of SLA's through optimal integration of numerical models with available observed data. Developing innovative data assimilation techniques for blending residual current forecasts into regional oceanographic model forecasts that can be used for static ship route planning.
- Improving the prototype further in terms of computational efficiency and simplification, to make it feasible for operational constraints such as expected in a commercially viable MustHaveBox®.

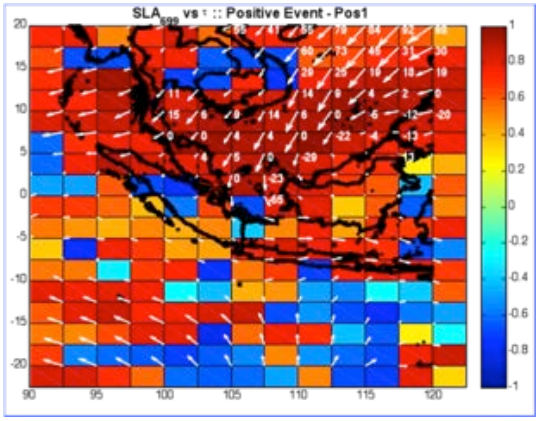


KNOWLEDGE & SKILLSETS

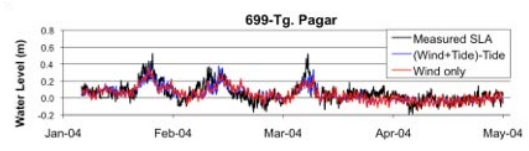
Through this project the group has been able to develop insight, new skills, and tools including those in the following areas:



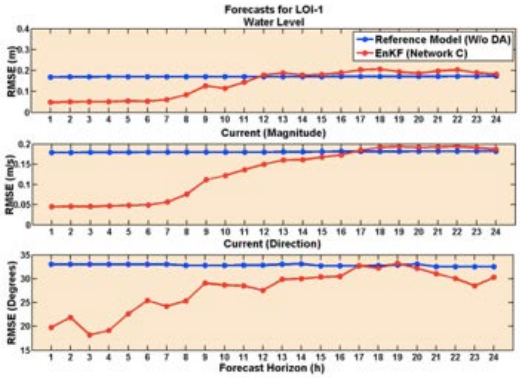
Improved understanding of the mechanisms which are behind the SLA's of different temporal scales in the region



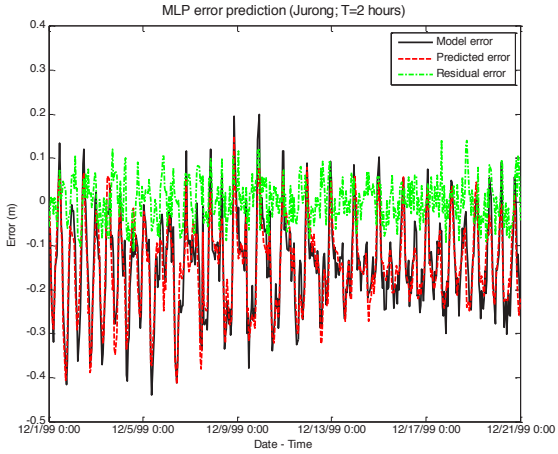
Development of data-driven tools to improve short-term forecasts (up to 4 days in advance) of water levels



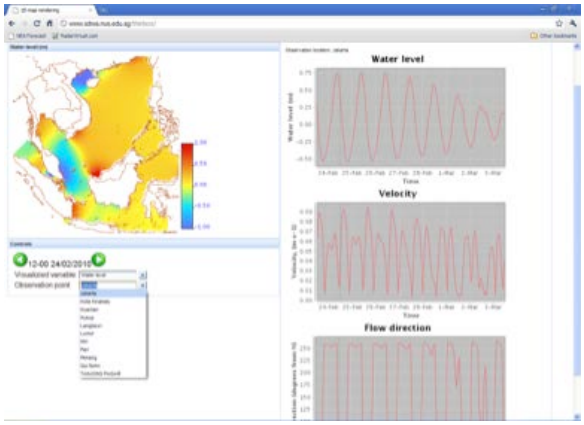
Improved model predictions of water levels and flows in the region (Singapore and South China Sea) by improving the tidal predictions of the models while including meteorological effects.



Accurate forecasting of SLA's in regions without observation stations W via Kalman filtering.



Improved long range forecasting of SLA's at unobserved locations via advanced techniques such as kriging and chaos theory based local linear modelling for spatial distribution of errors.



Development of a web-based thin-client system for general users to query, interrogate and obtain basic results

MULTI-OBJECTIVE MULTIPLE-RESERVOIR MANAGEMENT PROJECT

Dr. Adri Verwey
Dr. Liong Shie-Yu

To ensure safe water supply to the worldwide increasing demand, water resources managers aim at building reservoirs that are often connected to form complex multi-reservoir systems. Different users compete for the same water in the reservoirs with different objectives, as drinking water supply, flood protection, recreation and electricity generation. With the purpose of dealing with the presence of these conflicting objectives and with the uncertainties associated to the hydro-meteorological processes, the multiple-reservoir project aims at developing novel hydro-informatics tools for the most complex water systems, in order to support appropriate management decisions.

RESEARCH TOPICS & STUDY AREA

The study area is Singapore, whose spatial domain presents 17 partially-interconnected reservoirs in a tropical environment. Many results of the study are however applicable to similar reservoir systems. The project is characterized by four main research streams:

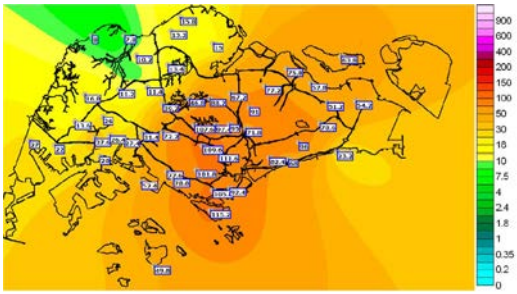
01
Improving rainfall forecasting lead time

02
Accurate simulation of rainfall-runoff processes

03
Model emulation of physically-based model

04
Development and application of advanced control schemes for reservoir networks operation

CONTENTS & RESULTS

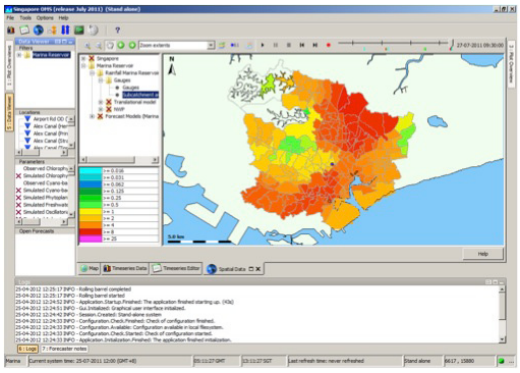


01. Rainfall Forecasting

Increasing rainfall forecast lead times and quantity accuracy is achieved by combining a high-resolution weather forecasting model (WRF), rainfall estimations from meteorological radars and data from ground monitoring stations. Results show that this system is able to produce operationally accurate forecast a few hours ahead.

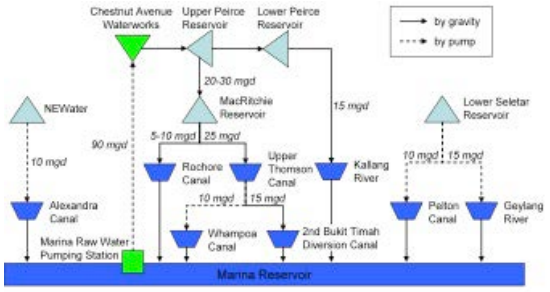
02. Rainfall-Runoff modelling

In a tropical, urban environment like Singapore a good understanding of the hydrological processes is essential to predict strong runoff events. Part of the project activities is thus dedicated to a number of field experiments and numerical modelling exercises aiming at achieving a deep knowledge of these physical processes.



03. Model emulation

Operational Management Systems for multi-reservoir systems need to provide real-time information, though many physically-based hydrodynamic, hydraulic and water quality models that are used often need hours to provide results. Model emulation provides much faster working alternatives. The project adopts a novel data-driven procedure for the emulation of the main water quality parameters (salinity, dissolved oxygen, etc.).



04. Development and application of advanced control schemes

Focus is on the satisfaction of the different water users objectives by adopting tools from optimal control theory combined with the results from rainfall forecasting, rainfall-runoff models and model emulation. The research focuses on the development of Nonlinear Model Predictive Control (NMPC) schemes, which outperform the traditional off-line controllers in terms of water quantity and quality objectives.

PEATLAND

Water, Carbon and Ecosystems
Management Research Programme

Dr. Aljosja Hooijer
Assoc. Professor Lu Xi Xi

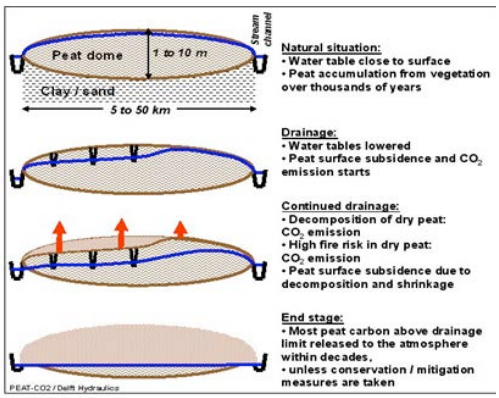
The SDWA "Peatland Water and Carbon Ecosystems Management Research Programme" aims to support large-scale science-based implementation of mitigative water management and improved spatial planning of production and conservation areas in peatlands. To achieve such implementation, awareness and understanding of the issues amongst those involved in peatland management need to be enhanced.

PEATLANDS

Peat consists of 10% plant remains that have accumulated over thousands of years, and 90% water. Hence peatlands are 'wetlands' rather than real 'land', and they should be managed as such. The plant remains are only conserved and accumulated where and when water levels remain near the peat surface and specialised peatland tree species thrive. Peatlands in Southeast Asia have a very high biodiversity value and many species still remain to be discovered. Indonesia alone has 22.5 million hectares of peatland which is approximately 12% of its land area and 83% of the peatlands in Southeast Asia. Uniquely in the world, these peatlands are covered with tropical rainforest in their natural state.

PEATLAND DEGRADATION

However, rapid peatland degradation presently occurs in Southeast Asia. Peatlands are being deforested, drained and burnt for development of plantations, agriculture and logging. Apart from resulting in globally significant CO2 emissions, these developments also threaten the remaining biodiversity and cause regional haze problems (smoke), future loss of agricultural production (through increased flooding caused by subsidence) and increased downstream flooding. Peatland management has emerged as one of the major environmental and land management problems in the region.



Schematic illustration of carbon dioxide emission from drained peatlands.

SDWA PEATLAND PROGRAMME

Tropical peatlands are relatively little studied and their water management requirements are poorly understood. The proposed SDWA programme aims to support large-scale science-based implementation of sustainable water management and improved spatial planning of production and conservation areas in peatlands. This is done through the following four work packages:

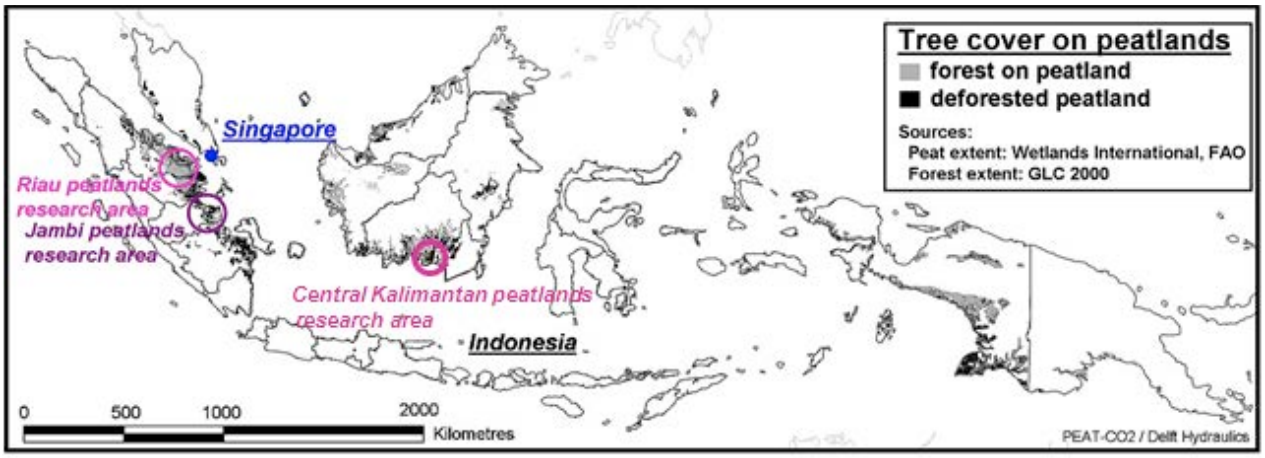
1. Development of spatial planning tools and training programmes.

2. Soil and carbon emission field studies, focusing on subsidence processes and rates of peat decomposition including microbiology.

3. Ecology and biodiversity, focusing on succession in degraded peatlands and on biodiversity surveys in intact peatlands.

4. Land use change monitoring and fire risk forecasting, focusing on application of remote sensing (satellite) techniques and on spatial analysis of patterns in peatland degradation and fires.

Studies are carried out for Kampar peninsula in Riau province, Jambi province and Central Kalimantan, Indonesia. Collaboration and information exchange with relevant organisations and existing projects is facilitated. The programme lasted 4 years and includes inputs from PhD students, assisted by MSc students, NUS researchers and Deltares | Delft Hydraulics researchers, in collaboration with external organisations. This ensured both high scientific output levels and direct application and testing of results in practical peatland management.



Peatlands in Southeast Asia and research locations

SDWA - NEA - JAMBI PEATLAND PROJECT

BACKGROUND

The SDWA - NEA - Jambi Peatland project was initiated in 2008 and was a partnership between Singapore Delft Water Alliance (SDWA), Jambi University (UnJa) and Singapore National Environment Agency (NEA).

Aims of the project include:

- To develop a training and monitoring programme to enhance water management and spatial planning in Muaro Jambi, Sumatra, Indonesia.

- To encourage better sustainable water management practices in peatland land use so that peatland fires and haze can be reduced in SE Asia region.

FIELD ACTIVITES

There are 2 main activities created in the SDWA-NEA-Jambi Peatland Collaboration Project:

- The development of a hydrology and soil monitoring system at two study sites near Kota Jambi, to demonstrate the relations between peatland water management and its impacts.

- The development of training courses and awareness materials for improved peatland management, with a focus on water management.




SDWA-NEA JAMBI PEATLAND MANAGEMENT KNOWLEDGE BASE AND TRAINING PROGRAMME

1st Technical workshop (12th -13th August 2009), 2nd Technical workshop (6th till 8th July 2010)

Workshops goals:

1. Improve understanding of peatland planning and management in Jambi province.
2. Reduce impacts on fire, carbon emissions and land subsidence from peatlands.

Participating organizations (Province and District level):
Bappeda, KLH, Public Works, Forestry Department, Agriculture Department, Office of Berbak National Park, University of Jambi, Batanghari University, LIPI

Presentors:
SDWA, Deltares, UnJa, WACLIMAD, Clinton Foundation and IAFCP

UPPER PIERCE PROJECT

Integrated Water Quality Modeling and Monitoring

Dr. David Burger
Assoc. Professor Rajasekhar Balasubramanian

Upper Peirce research program is focused on gaining better insights into the hydrological, hydrodynamic, chemical, biological, and biochemical processes of tropical reservoirs through experimental work, modeling and advanced and innovative monitoring. This research is focused on the Upper Peirce Reservoir due to its importance as a major drinking water resource for Singapore. This reservoir is being used as a natural research laboratory where a detailed water quality monitoring, modeling and pollution mitigation experimental work is being carried out.

PRACTICAL BENEFITS

This research contributes directly to the better management of drinking water reservoirs across Singapore and enhance the knowledge of tropical freshwater systems and their functioning as a whole.

RESEARCH TOPICS

Understanding physical processes in lake environment

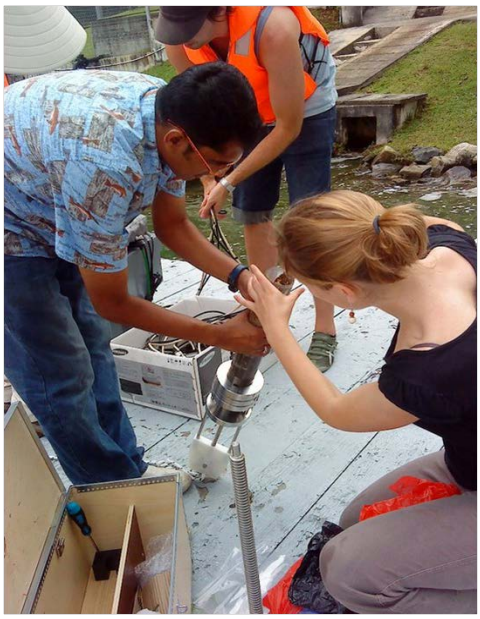
Detailed studies carried out on the physical processes like aeration and related bubble dynamics, thermal stratification and water column mixing, helps us to mitigate cyanobacterial scums and improve water quality.

Detailed water and sediment quality monitoring

Thorough examination of water quality and sediment processes (for example nitrogen, phosphorus and carbon recycling) including nutrient loading and sediment water interactions, which enhanced process and system knowledge in tropical systems. It further helped us to improve and develop these processes in a comprehensive eutrophication model to assist overall lake management.

Cyanobacterial bloom monitoring for early warning system

Understanding the phytoplankton primary production and cyanobacteria (blue-green algae) scum formation through experimental work on cell buoyancy and bloom dynamics helped in further development and validation of an advanced early warning model for forecasting bloom events. Some innovative remote sensing tools were employed to better identify and manage cyanobacterial scums and related water quality problems.



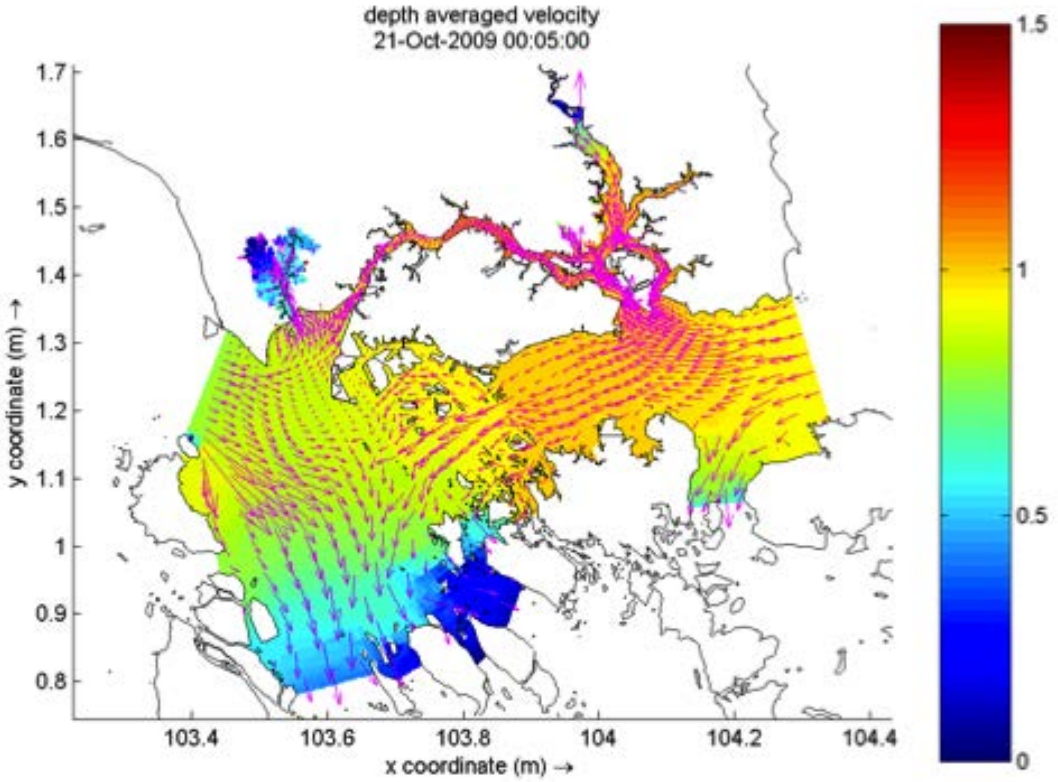
Pollution mitigation techniques

Innovative techniques for measurement and mitigation of pollutants including nutrients and algal toxins in aqueous system were developed and tested in tropical reservoir waters.

NEPTUNE

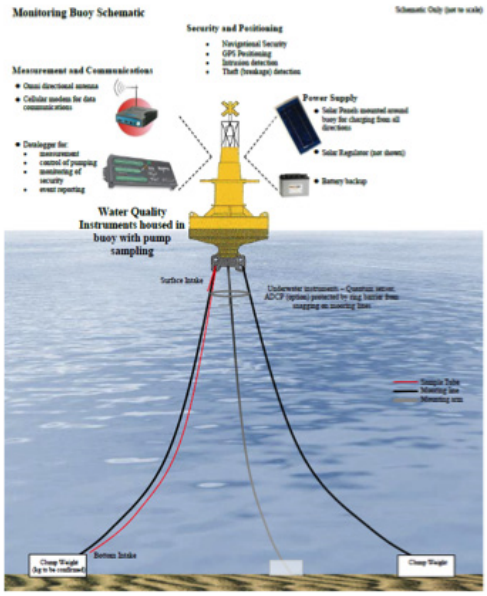
Continuous Water Quality Monitoring and Modelling of Singapore's Coastal Waters

Assoc. Professor Vladan Babovic
Mr. Mark Womersley
Dr. Nicki Villars

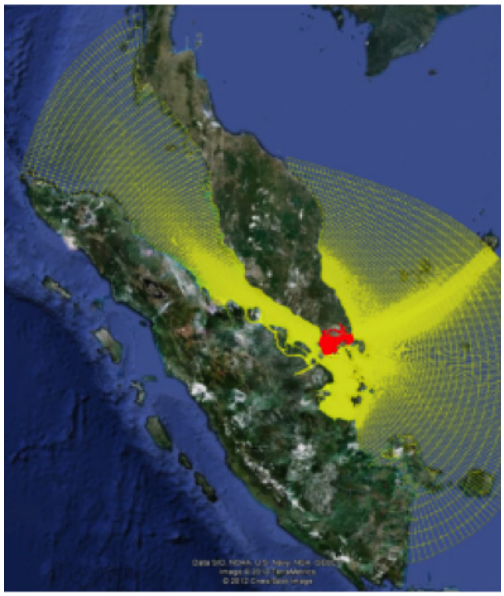


In order to support the National Environmental Agency with the management of Singapore coastal waters, the Neptune project is developing an Operational Management System (OMS) based on FEWS technology. More specifically, the OMS acts as an IT platform for the three main project components, namely in-situ water quality instrument platforms, numerical models and data assimilation algorithms. The water quality platforms make use of the recent advances in water quality monitoring tools, which can measure a wide range of parameters at a much higher temporal resolution than is possible with physical sampling. Moreover, the collected data are available in real-time and directly communicated to the OMS. While this real-time monitoring network provides data on existing water quality trends, an hydrological, hydrodynamic and water quality modelling framework runs in real-time to provide a complete spatial coverage of the on-going processes, as well as a forecast of the potential water quality concerns. The real-time information is combined with this framework through specific data-assimilation algorithms, thus providing early visibility of deteriorating water quality and enabling the OMS user to leverage real-time measurements and water quality forecasts to rapidly develop insights into the causes of poor water quality. This support system establishes a fundamental knowledge base for environmental managers to issue advisory services. In this way, unforeseen events such as harmful algal blooms, bacterial contamination and accidental oil spills can be effectively detected and predicted.

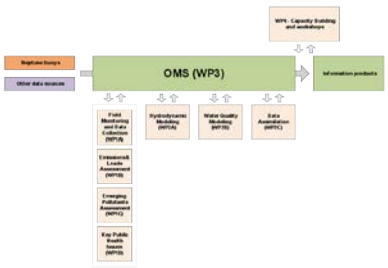
OBJECTIVES



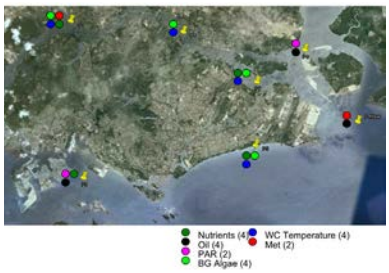
Procurement and deployment of eight water quality instrument platforms within the coastal waters of Singapore to establish a real time monitoring network



Online continuous water quality monitoring in order to realize real time assessment of the status of Singapore's coastal water quality



Development of Project Neptune's Operational Management System (OMS) and integration of live data feeds from the real time monitoring network into OMS, which manages data model integration and passes pre-processed data into the integrated modelling framework



Development of coupled hydrodynamic, water quality models for Singapore's coastal waters, which assimilate data from the monitoring network to drive water quality forecasts, that in turn inform NEA's advisory services

Deployment of the live system on NEA's platform to conduct User Acceptance Trials (UAT) based on jointly agreed criteria and transfer of the validated system to NEA, together with operational guidelines, procedures for maintenance, call out support and capacity building to realise advisory services related to water quality.

CURRENT STATUS

The project is articulated in two phases: the former is centred on the buoys deployment and models development, the latter is focused on the models improvement on the basis of the collected data. The project is currently concluding the first phase.

PUNGGOL-SERANGOON RESERVOIR STUDY

Responsible Water Resources Management in a New Township

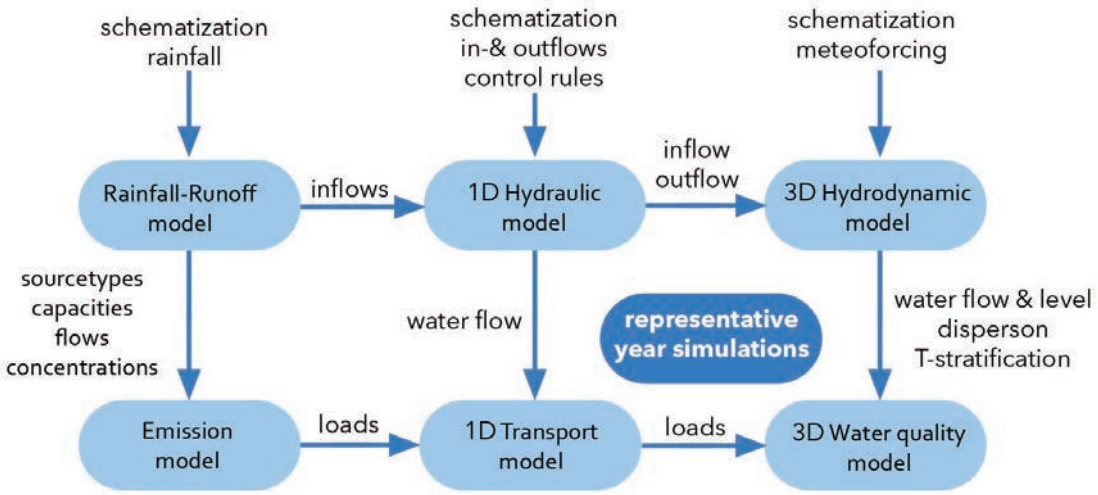
Assoc. Professor Vladan Babovic

Water supply, recreation and lifestyle functions, and flood control at the recently completed Punggol-Serangoon Reservoir Scheme in Singapore have been integrated and managed with the help of an integrated modelling framework and an operational management system developed by the National University of Singapore (NUS), Dutch applied-research institute, Deltares, and the Singapore Public Utilities Board (PUB). NUS and Deltares have since formed a water alliance, NUSDeltares, which uses the talent of both entities to address global issues in Southeast Asia and beyond.

Many cities around the world, like the city-state of Singapore, face water supply challenges. Capturing and storing more rainwater is one solution. This, however, is not easy to implement in an urban environment where runoff water contains high levels of nutrients and pollutants and where space for reservoirs is scarce. Management of water quality in urban reservoirs is of utmost importance, especially in tropical cities where high temperatures contribute to algae growth.

NEW RESERVOIRS, NEW LIFE

NUSDeltares knowledge partners Deltares and the Singapore-Delft Water Alliance, carried out the "Punggol-Serangoon Reservoir Predictive Water Quality Modelling and Study" for PUB and the Housing and Development Board of Singapore (HDB). The main aim of the study was to provide detailed information on changes of water quality in the reservoirs and the waterway and on the effects of measures for the mitigation of poor water quality. The study consisted of two phases—model calibration and water quality prediction—after the completion of Punggol Reservoir (December 2009), and an additional calibration and validation phase after the completion of the Serangoon Reservoir (October 2011).



The following were delivered as part of the study:

1. A fully calibrated, integrative and dynamic model for water-quantity and -quality on a catchment scale, including an emission model, a hydrological/hydraulic model, a hydrodynamic model and a water quality model;
2. A number of scenario prognoses related to mitigating poor water quality;
3. Hydrological studies concerning rainwater harvesting and flood control;
4. An online operational water-quality management system;
5. A water-quality management plan for decision-makers, with more than 50 recommendations on how to improve water quality; and
6. Knowledge-sharing workshops and training courses to PUB and HDB personnel.

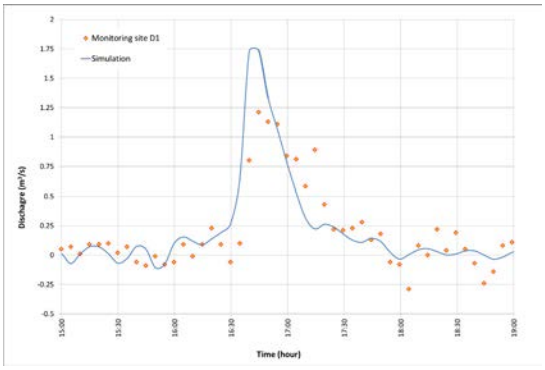
The Punggol and Serangoon reservoirs are the 16th and 17th freshwater reservoirs in Singapore. With their completion, the catchment size in Singapore has been expanded to two-thirds of the land area. The Punggol River, located in northern Singapore, and the Serangoon River, east of the Punggol River, have been blocked off from the sea to form the Punggol and Serangoon reservoirs, which are connected by a 4.5-km canal called My Waterway@Punggol. The reservoir scheme and the Waterway are located in an area where there are plans to build more than 80,000 new homes. The Punggol New Town was developed with the goal of environmental sustainability and a 'Living by the Water' concept, in which the Waterway plays an important role. The upstream catchment consists of a mix of mainly older housing estates, light industry and a former landfill.

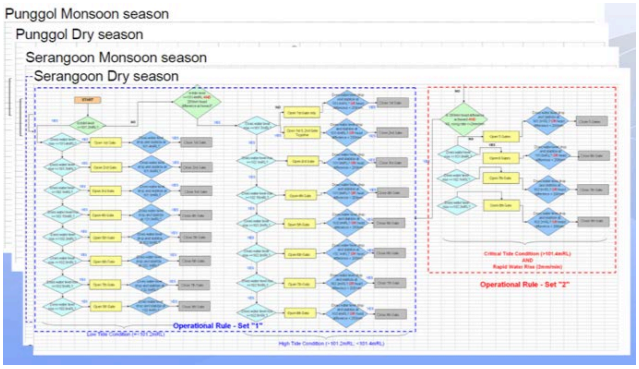
MODELLING WATER QUALITY AND QUANTITY

This modelling approach presents the first comprehensive assessment, in Singapore and the region, of changes of water-quality and -quantity, as well as status (from saline condition to freshwater) driven by changes of land use and by the climate in tropical reservoirs at catchment scales. The integrative water quality model is considered as a generic one and can be applied widely in lakes and reservoirs, both in tropical and temperate regions. It is useful both for scientists, engineers, managers and policy-makers to address "what-if " questions related to issues of changes in water-quality and -quantity. The model framework can be adapted for many purposes but it can be specifically used in the areas described below.

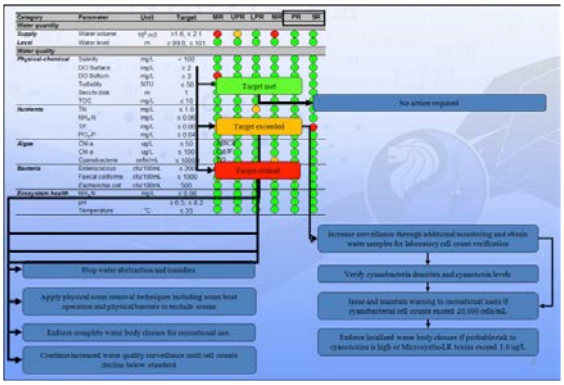
ASSESSMENT OF HARVESTED-RAINWATER STORAGE AND FLOOD CONTROL

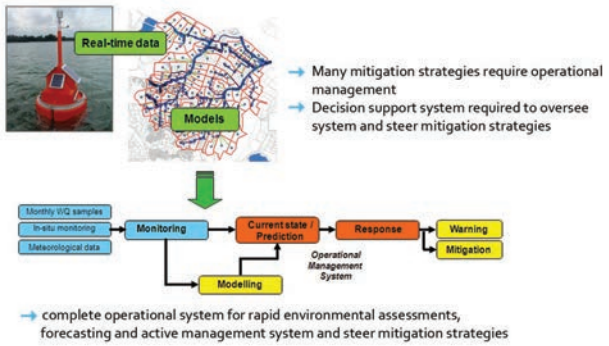
Through testing different scenarios, the model can help us to identify the best operation option for maximising the storage capacity of reservoir catchment, enhancing reservoir water movement and minimising the flood risks in low-lying areas.





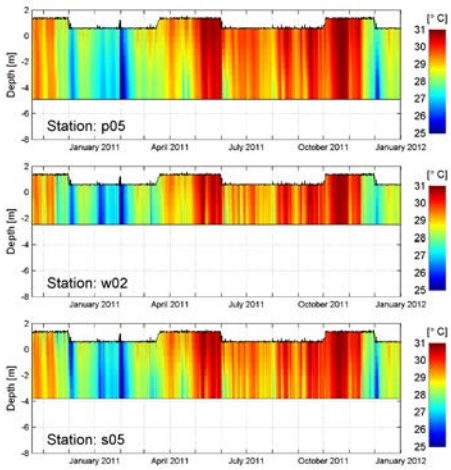
REAL-TIME, ONLINE OPERATIONAL MANAGEMENT SYSTEM





The integrative framework, combined with real-time monitoring data, provides real-time forecasting changes of water quality and the corresponding mitigation measures, using the Delft-FEWS framework.

WATER QUALITY MONITORING AND PREDICTION



The coupled hydrodynamic and water-quality model can predict variations in space and time of more than 130 water-quality parameters such as temperature, salinity, nutrients, phytoplankton species, dissolved oxygen, suspended solids and bacteria.

WATER QUALITY MANAGEMENT AND PLANNING

Measure		Target						
		Chlorophyll-a reduction	Nutrient reduction	DO increase	Transparency increase	TOC reduction	TSS and turbidity reduction	Bacteria reduction
Short term Measure (<2 years)								
Catchment	Implementation and enforcement of erosion control measures	•	•		•			
	Prevention of organic debric loading to drains					•		
	Drain maintenance					•		
	Enforcement of good practices to reduce diffuse loads				•			
	Sewer rehabitation	•	•					•
								•
In-lake	Best management practice	•	•	•				
	Active flushing regime	•	•					
	Chemical treatment			•				
	Aeration			•				
	Oxygenation							
Medium-term Measure (3-5 years)								
Catchment	Eco-drains				•			
	Relocation, diversion and/or phasing out of point sources	•	•	•				•
	Settling ponds for construction sites				•			
	Ban on phosphorus-based detergents	•	•					
	Sewer rehabitation	•	•					•
In-lake	Physical removal of cyanobacterial biomass (algae skimmer boat)	•	•					
Long-term Measure (6-10 years)								
Catchment	Phasing out of emission-factor sources (e.g. bin centres)?	•	•					•
	Phasing out of industrial sources	•	•					
	Sewer rehabitation	•	•					•
	Landfill load reduction	•	•					

A matrix of sound management of water sources can be developed, based on the modelled results, and adopted to tackle problems related to water quality degradation.

KNOWLEDGE SHARING AND TRAINING

The integrative framework as applied in this project enhances collaborative work and the relationship between scientists, engineers, managers and policy-makers. It also bridges the gap between policy decisions, scientific knowledge and technology interventions.

INTEGRATED RISK ASSESSMENT OF CHEMICAL CONTAMINANTS IN MANGROVE ECOSYSTEMS

Dr Stéphane Bayen (SDWA)
Dr Guillaume Juhel (TMSI)

Recent importance has been placed on the ecological and socio-economic importance of mangroves for adjacent populations, in terms of food resources, employment and generation of income (e.g. tourism, fisheries). Besides direct clearance, hydrological alterations, climatic changes or insect infestations, chemical pollution could be a significant contributor of mangrove degradation (Bayen, 2012). However, in Singapore, the pressure of chemical pollution on mangrove ecosystems is presently unknown.

In 2004, studies revealed the ubiquity of Persistent Organic Pollutants (POPs) and trace metals (Pb, Cd, Cu,...) at two mangrove sites in Singapore, namely Sungei Buloh and Sungei Khatib Bongsu (Bayen et al., 2005; Cuong et al, 2005). Results demonstrated the biomagnification of POPs, as their levels in tissues tended to increase with the trophic level. Since some of these chemicals are known endocrine disrupters and/or carcinogens, they represent a potential threat for organisms higher in the food chains (e.g. birds, mammals,). Besides those "conventional" contaminants, a list of emerging contaminants shows rising concern around the world.

In March 2012, the collaborative project "Integrated risk assessment of chemical contaminants in mangrove ecosystems" started between the National Parks Board and the National University of Singapore, with the support of the TCCME (Technical Committee on Coastal and Marine Environment). The overall objective of this project is to conduct an ecological risk assessment with regards to both conventional and emerging contaminants. This study will support environmental policy makers and managers in their decision-making regarding mangrove ecosystems, and nearby coastal waters.

Ecological risk assessments require two principal activities: the characterization of exposure and the characterization of ecological effects. This research adopts a multidisciplinary approach combining ecotoxicology, analytical chemistry, biology, surveying, hydrodynamic and ecological modelling and impact assessment. These various disciplines are combined to describe exposure and effects and to derive an integrated risk assessment specific to mangroves.

OBJECTIVES

The overall scope of this project comprises of the following integrated objectives, namely:

01. The monitoring of a suite of conventional and emerging contaminants in mangrove sediments and bivalves. Levels in environmental waters are investigated using passive samplers.

02. The study of a suite of biomarkers in target organisms to investigate the relationship between specific contaminants detected in Singapore mangroves and the toxic responses.

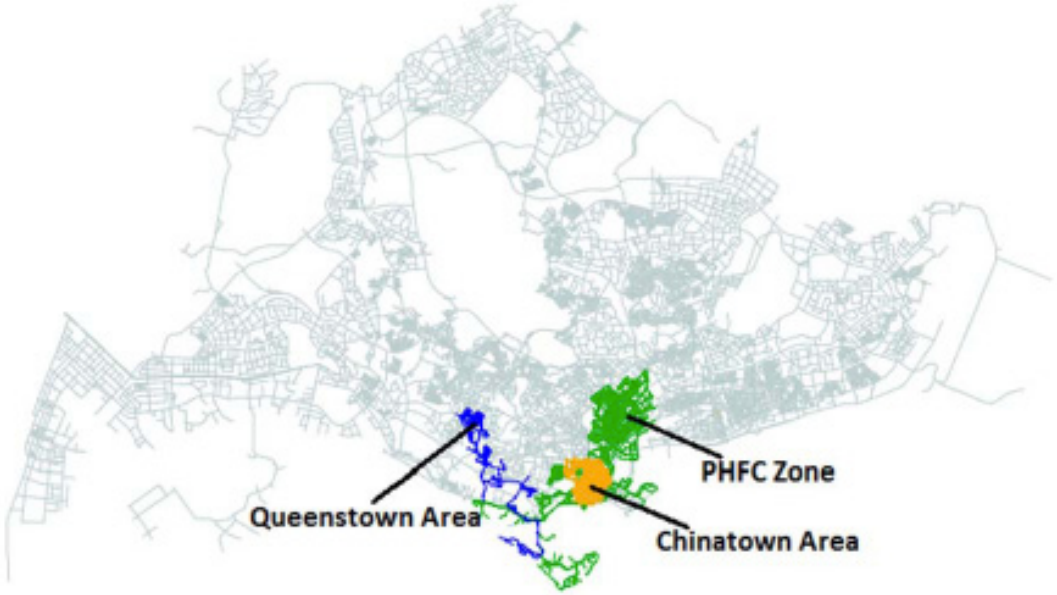
03. Research on the sources and fate of chemical pollutants in a model mangrove, Sungei Buloh Wetland Reserve, through field monitoring and use of computer-based models

04. Build-up of an ecological risk assessment for mangrove ecosystems based on risks quotients. Investigation of the combined exposure to multiple contaminants.

05. Definition of a series of recommendations for conservation management of mangrove in Singapore based on observed levels and quantified risks.

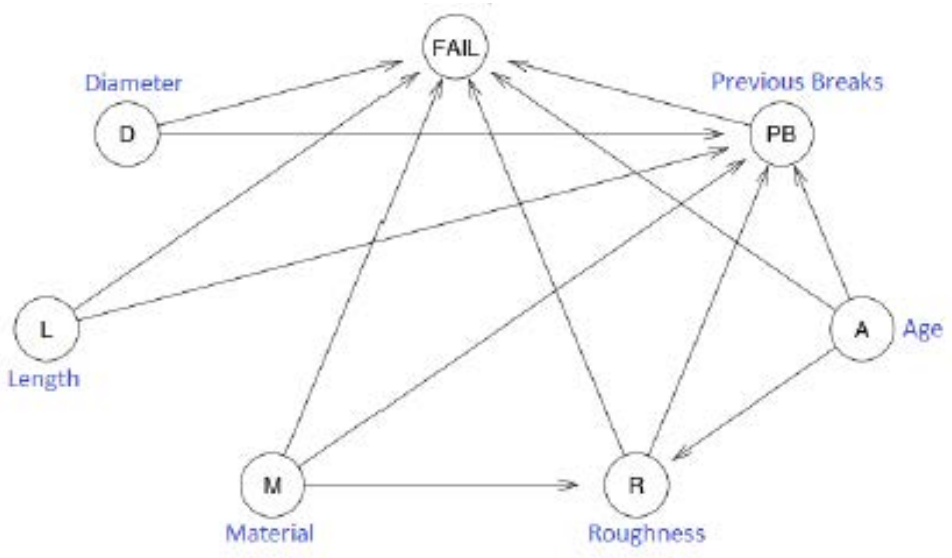
WATER DISTRIBUTION NETWORKS: AQLEO PROJECT

Assoc. Professor Vladan Babovic



Water distribution networks often account for 80% of the total expenditure involved in water supply system. As water mains deteriorate both structurally and functionally, their breakage rates increases, the network hydraulic capacity decreases, and the water quality in the distribution system may deteriorate. Scarce financial resources make it essential for decision makers to find the most cost-effective rehabilitation and renewal strategy for the pipe systems. The challenge to the decision maker is to determine the most cost effective plan in terms of what pipes in the network to be rehabilitated, by which rehabilitation method and at what time in the planning horizon. In order to take efficient preventive action, it is necessary for a decision support system to provide accurate forecasts of pipe failures and inform the pipe repair/rehabilitation program. Thus, at the core of the decision support system for pipe repair/rehabilitation program is a failure forecasting mechanism.

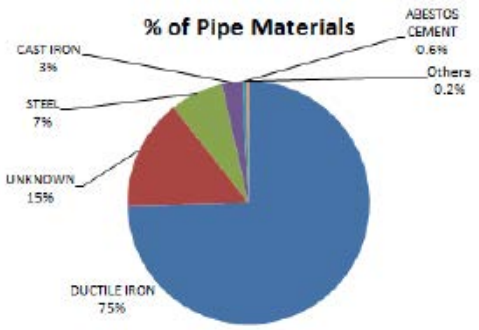
Aqleo, in collaboration with PUB and SDWA, worked on a test bed project for pipeline failure prediction in water distribution networks. In the project a subset of the entire Singapore's water distribution network was studied, i.e. water network of Queenstown area and PHFC zone, with approximately 375 km of mains. The objective of the study was to determine the pipes most vulnerable to failure in the PUB water distribution network. Further, the specific objective was to score each pipe with a metric for failure probability. This is the unique aspect of the work as opposed to leak detection/location determination that is addressed by other methods and organizations. A data-driven model based on Bayesian Network Modeling was used to predict future events based on past data.



The overall model predicts some interesting results that show the predictive power when larger data sets are available. The model identifies the hotspots where failures are most likely to occur in the water distribution network. The following conclusions were reached by Aqleo upon completion of the work

01. Prediction of pipe failures to achieve operation efficiency or for management of a pipe rehabilitation program is possible

02. Bayesian networks are highly suited for prediction.



Also, Aqleo recommended that obtaining following additional information would be useful in enhancing the prediction results. This information consists of:

- Soil condition [from LTA];
- Soil Type (% of sand/silt/clay etc.);
- pH Level of Soil;
- Moisture Content (%);
- Chemicals (mainly chloride/sulfate level);
- Traffic data;
- Pressure and other real-time sensor data;
- Rainfall.

PLANT SELECTION STUDY FOR APPLICATION IN BIORETENTION SYSTEMS

Assoc. Professor Hugh Tan Tiang Wah
Dr. Carol Han



Parallel with growing urban populations, the spread of urban land use around the world presents new challenges to water resource management. Urban development invariably leads to land use modifications such as the removal of vegetation, expansion of impervious surfaces and alterations to drainage infrastructure. Urbanisation also exerts a detrimental impact on water quality. In developed cities and towns, water environments are increasingly valued in urban areas as aesthetic and recreational resources, prompting growing governmental and public community attention to the importance of environmental management of urban stormwater. Urban stormwater best management practices (BMPs) work to intercept, attenuate and retain stormwater as well as improve their quality through a variety of new stormwater handling and treatment techniques. These methods are based on small-scale, environmentally sound technologies that involve natural or constructed biological systems such as green roofs, permeable pavements, wetlands and bioretention systems.

Of the range of treatment approaches, the implementation of bioretention systems in landscape design is fast gaining popularity due to its design flexibility in terms of location, size, configuration and appearance. Bioretention systems operate by percolating stormwater runoff vertically through a prescribed filter medium, which provides treatment through fine filtration, extended detention treatment and biological uptake. These treatments make use of vegetation to provide filtering surface area and reduce flow velocities, allow sedimentation as well as provide a substrate for biofilm growth, which enhances biological uptake of soluble pollutants.

Common horticultural plants in tropical Singapore were studied for their suitability for application in bioretention systems. The use of vegetation in bioretention systems was shown to significantly improve the efficiency of pollutant removal, particularly nitrate. However, plant species have considerably different effect on nutrient removal, possibly due to intrinsic morphological and physiological variations among species. Owing to its high hydraulic conductivity, the bioretention filter media may essentially be ill-suited to support sustainable plant growth, particularly over long periods of dry weather. Thus, the selection of plants should not only be based on their treatment performance, but also on their capacity to tolerate potentially stressful growth conditions, such as drought periods. Species mixtures are also recommended for aesthetic purposes as well as to support biodiversity in an urban landscape.

WATER QUALITY MONITORING AT BEDOK RESERVOIR PARK

Assoc. Professor Sanjay Swarup
Dr. Umid Man Joshi

In Singapore, parks are developed island wide to provide open spaces to cater to the recreational needs of an urban population. Maintenance regimes in the parks include pruning, application of fertilizers and compost and the occasional use of pesticides. Yet, it is unknown if these practices pose as probable sources of pollution that may contaminate groundwater and surface runoffs. Many parks in Singapore are located in the vicinity of water catchment areas and proximal to large water bodies. Hence, it is important to gain understanding on whether park runoffs contribute pollutants to the environment.

In this project we investigated the water quality from two sections of park during major rainfall events. Several rainfall events were captured during 'normal park usage' and several more rain events were captured after application of fertilizer. Results of water quality monitoring was correlated to management practices in the park.

EAST COAST PARK POND REHABILITATION

Dr. Umid Man Joshi

Shallow water bodies form an integral part of Singapore's landscape. Many experience poor water quality such as high nutrient concentrations and algal biomass, which may impact recreational values and ecosystem functioning. In this study we assessed the efficacy of a range of treatment technologies to improve water quality. Experiments were conducted in enclosures in a small test pond to evaluate potential changes in water quality under controlled and semi-natural conditions. This was supported by laboratory experiments and chemical modeling. The results of the study created new knowledge on remedial strategies to underpin further management and restoration of water quality in tropical water bodies in Singapore and Southeast Asia.

OBJECTIVES

The study included water balance to estimate mean inflows, outflows and water retention time through water quality monitoring and hydrological modelling:

1. To evaluate the effectiveness of in-pond chemical treatment to reduce water column nutrient concentrations through a one-off dosing using an effective sorbent

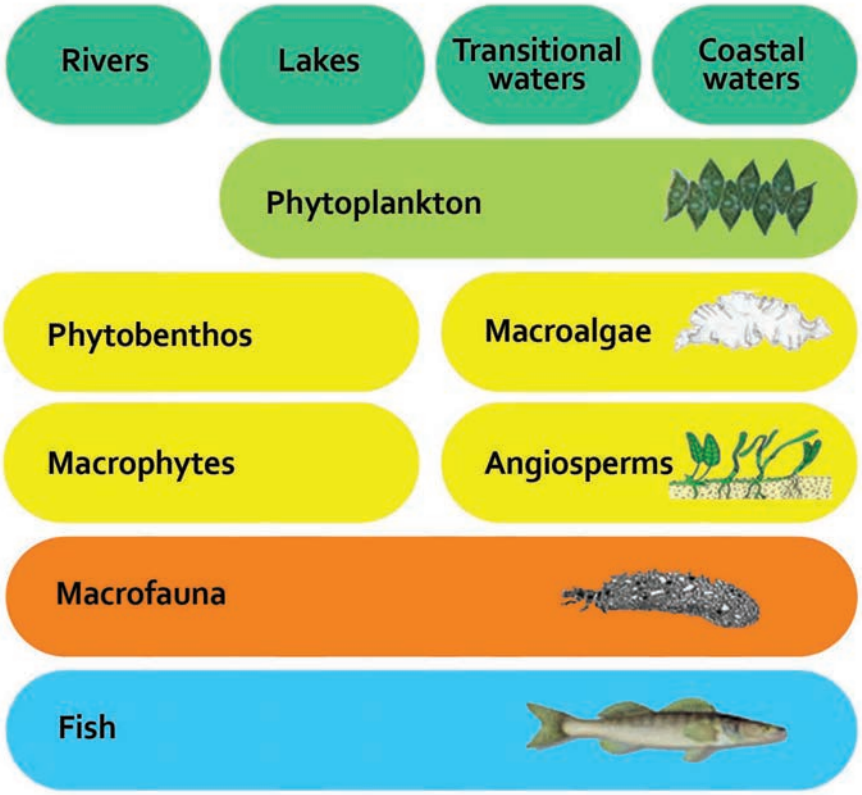
2. To evaluate the effectiveness of bed-side filtration for reducing external pollutant with a range of substrate and adsorbent materials

3. To evaluate the effectiveness of a range of surface, vegetated treatment elements comprised of different vegetation pond nutrients concentrations

4. Develop relevant and quantifiable habitat surveying tools and protocols for evaluation of pond biodiversity status in the local Singapore environment

ECOLOGICAL GUIDELINES FOR AQUATIC SYSTEMS IN SINGAPORE

Assoc. Professor Vladan Babovic
Dr. David Burger
Dr. Esther Clews



There are more than 358 parks and recreational areas in Singapore consisting of city and heritage parks, community parks, coastal parks, riverine parks, botanical gardens and nature parks. These parks are important for a wide range of recreational, social, aesthetic and ecological uses, and are developed within a mostly urbanised environment. Water is an integral feature of the park landscape, with many parks now centred around aquatic habitats such as artificial or natural ponds, fountains and wetland areas. The management, conservation and restoration of species biodiversity and natural ecological habitats are important for sustaining these features.

The development of ecological guidelines for aquatic systems will enable better assessment and classification of the existing ecological and water quality status of individual water bodies. These guidelines would provide a starting point for setting relevant and obtainable ecological objectives to steer further ecological management and conservation objectives. Further, the implementation of standards for water quality would provide greater direction to local park managers tasked with routine assessment, and problem identification and mitigation, providing them with a framework for comparing the overall status of all ponds at a national level.

This three-part definition study evaluated the feasibility of implementing water quality guidelines and ecological standards for use across Singapore ponds. Field assessments were conducted across all ponds to better understand existing water quality and ecology status, concerns, and management practices. A framework and roadmap were created to provide direction to the ongoing development and implementation of ecological guidelines across all aquatic habitats in Singapore. Water quality guidelines and monitoring protocols for common water quality parameters, to identify water systems at risk, were also developed and will be implemented in future.

GARDENS BY THE BAY

Centre for Urban Greenery and Ecology Project

Dr. Stephane Bayen
Mr. Chakravarthy Kalyan Mynampati

The Gardens by the Bay is Singapore's biggest tourist draw, with one of the world's most technologically-advanced green spaces - the climate controlled Cloud Forest and the Flower dome. These large greenhouses along with 12 "Supertrees" share the remaining area with an assortment of themed gardens and lakes that add aesthetic and educational values to the park (Fig. 1). The two major lakes – Kingfisher lake and Dragonfly lake - at the opposite ends of the Bay – are connected through a waterway system that flows around the peripheries of the Bay. The water sensitive urban designs placed around the garden, such as filter beds and wetlands, act as natural filters to clean the rainfall-runoff water before it enters the lakes.

In the context of public health and ecological sustainability, the water quality in the two lakes may represent concerns, such as low dissolved oxygen concentrations, high chlorophyll-a concentrations and the risk of algal blooms and scum events. High phytoplankton biomass could occur as a result of elevated water column nutrient concentrations.

Therefore, NParks and SDWA have agreed to collaborate on -

1. SDWA to assist NParks in procuring a water quality monitoring platform for the Gardens by the Bay Lake System.

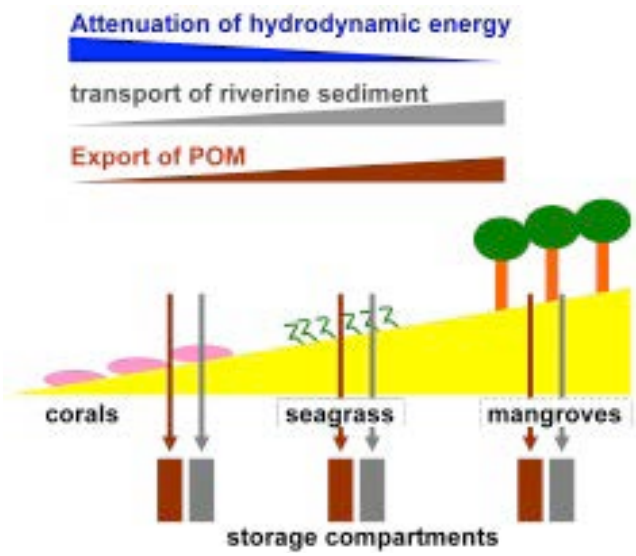
2. SDWA provides assessment and evaluation of water quality trends in the Gardens by the Bay Lake System, based on data collected through the platforms as well as other water quality measurements provided by NParks.

Water quality monitoring platforms allow a range of water quality parameters to be monitored at a much higher temporal resolution than is possible with routine monitoring. The collected data can be made available in real time for rapid water quality assessments and trend analysis and potential water quality problems can be identified as they occur, making early intervention with potential management strategies more feasible, for example the operational control of aeration systems. The collection of such high frequency data can be further applied to support hydrodynamic and water quality modelling inputs, calibration and validation. The use of instrument platforms allow integration of real time water quality data with the models to form a complete early warning system should this be desired.

TOWARDS DESIGNING INNOVATIVE COASTAL PROTECTION USING ECOSYSTEM-BASED APPROACHES; DERIVING UNDERLYING ECOLOGICAL KNOWLEDGE

This is a Joint Building with Nature- EWI (JBE) project

Assoc. Professor Alan Ziegler
Dr. Peter Alan Todd



The majority of present-day coastal infrastructure designs have not been optimized to perform or facilitate ecological functions. Many coastal ecosystems are known to contribute significantly to coastal protection and to provide many valuable ecosystem services. Hence, infrastructural works in coastal ecosystems could benefit greatly from the ability to incorporate designs that enhance coastal protection and local biodiversity. This project aims at deriving the ecological knowledge that is specifically needed for ecosystem-based designs for building infrastructural works and/or restoring coastlines in tropical environments. These ecosystem-based designs should ideally both enhance biodiversity and coastal protection in tropical environments. This will be done by a combination of two closely related work packages:

WORK PACKAGE A

Including soft bottom ecosystems in coastal designs

The research in this work package aims at identifying the importance of self-facilitating and large-scale facilitation by ecosystem connections as critical factors needed for ecosystem-based designs for building (and restoring) ecological coastlines that both enhance biodiversity and coastal protection in tropical environments. This objective will be met by the combination of the three principal research activities: 1) Large-scale habitat analysis; 2) Experiments to assess the importance of facilitation by ecosystem connections, 3) Experiments to assess the role of self-facilitation for the critical thresholds for settlement.

WORK PACKAGE B

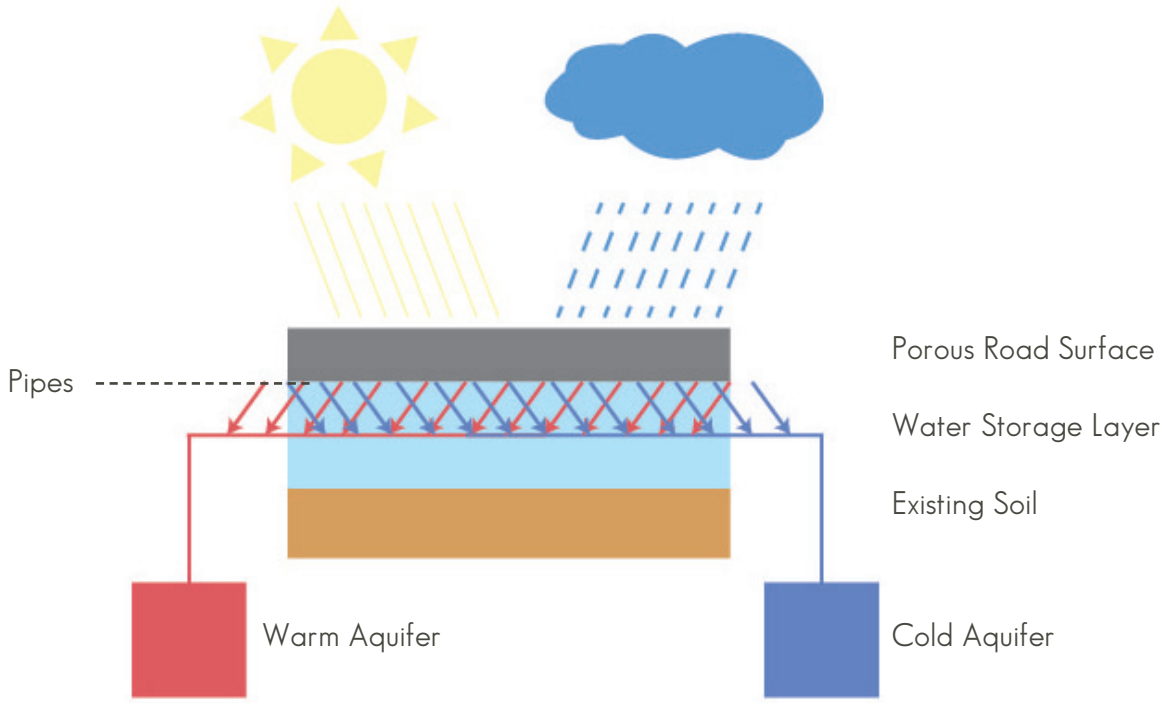
Designing eco-friendly & bio-diverse hard structures

In project B, we aim to identify designs that can be incorporated in hard coastal constructions to ensure greater biodiversity of tropical benthic marine organisms when compared to more traditional granite or concrete sea defences. This objective will be met by the carrying out the following principal research activities: 1) a literature & expert inventory of existing knowledge; 2) experimental assessment of the colonisation and use of constructed habitats by marine benthos; 3) experiments to identify suitable materials and construction for up-scaling.

The project is innovative and relevant, as it represents a paradigm shift from minimizing ecosystem damage towards ecosystem-based design, offering opportunities to improve and extend coastal ecosystems while at the same time achieving engineering targets. The economical benefits of such approach are likely to be positive, as many ecosystems offer valuable ecosystem services.

WATER ENERGY NEXUS

Assoc. Professor Vladan Babovic



SDWA is developing projects to address water-energy related questions. The current focus is on combining enlarging rainwater storage capacity & reducing peak discharge, in-situ water treatment by bioremediation, and energy recovery by using temperature differences in aquifers.

Energy and water are interrelated: we use energy for water and we use water for energy. For example, we use energy to heat, treat and move water. Water heating alone is responsible for 9% of residential electricity consumption. At the same time, water and wastewater treatment and distribution combined require more than 7% of electricity.

In addition to using energy for water, we also use water for energy. We use water as a coolant for thermoelectric power plants, and as a critical input for production of biofuels. In the USA alone, cooling of power plants is responsible for withdrawal of nearly 200 billion gallons of water per day. This accounts for 49% of all water withdrawals when including saline withdrawals, and around 40% of all freshwater withdrawals.

Unfortunately, the energy-water relationship introduces vulnerabilities whereby a constraint on one resource introduces constraints in the other. However, it is important to note that while there are reciprocal constraints, the corollary of the relationship is also true. That is, both resources can be enabling for each other. While the energy-water relationship is already under strain today, particularly in cities, trends imply that the strain will be exacerbated unless we take appropriate action. There are several components in this overall trend:

- Population growth, which drives up total demand for energy and water. Cities, being the main driver of economic growth are locations of the most pronounced stress in the relationship.
- Economic growth, which can drive-up per capita demand for both energy and water.
- Climate change, which intensifies hydrological cycle and manifests itself through distortion of regular weather patterns and depletion of water sources.

Our projects offers to realize opportunity associated with reclaiming the heat and making full advantage of it. Furthermore, our project simultaneously attempt to address number of issues associated with heat and water pollution which are strongly pronounced in urban areas. In this fashion, it is argued, state of the environmental conditions within cities will be manifold enhanced.

PUNGGOL WATERWAY

Study to propose measures to minimise water exchange between the Punggol and Serangoon Reservoirs

Assoc. Professor Vladan Babovic
Dr. Joost Buurman

In 2010, HDB commissioned SDWA (and Deltares) to study the effect of the Punggol Waterway construction (subsequently completed in late 2010) on Punggol Reservoir. Based on observations by PUB, the water quality in the Serangoon Reservoir is expected to be poorer than the water quality in the Punggol Reservoir (although the water quality in the Serangoon Reservoir is expected to improve over time). To avoid poorer quality water flowing from the Serangoon Reservoir into the Punggol Reservoir through the Waterway, PUB requires that a mechanism be installed to separate the two systems. A physical barrier in the form of a gate has been proposed, but as the water quality situation is expected to be temporary, a temporary construction is preferred over a permanent construction. Furthermore, a gate in the Waterway is not in agreement with the vision of an open Waterway and would obstruct recreational activities, such as canoeing. Hence, alternative solutions are explored, such as the use of air curtains, an inflatable barrier, and a combination of both or other technical solutions.

Based on the activities described above, the study came to the following recommendations:

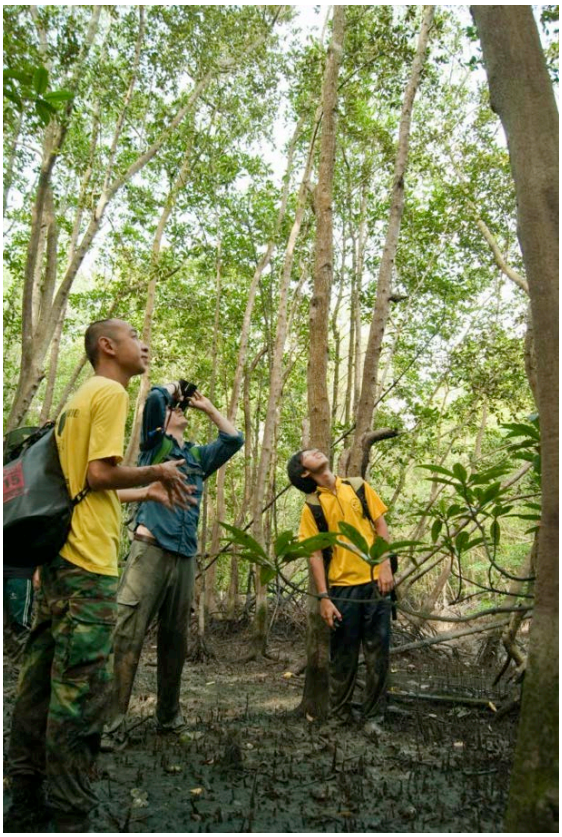
• The construction of a permanent control gate is only likely to be effective if flows between the water transfer pipe between the Punggol and Serangoon Reservoirs are also controlled. Therefore inclusion of some form of control structure on the transfer pipe should be considered.

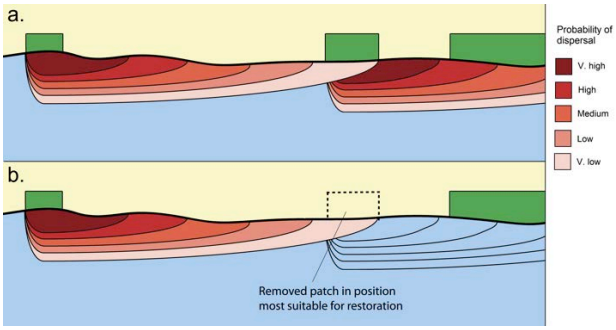
• The construction of a permanent control gate is only likely to be effective if gate closure is activated immediately commencing the start of a rainfall event. Therefore some form of automated gate control should be considered.

• Only the long-term remediation of both the Punggol and Serangoon Reservoir catchments to reduce external pollutant loads will ultimately lead to an improvement in the water quality of both reservoirs as well as the Punggol Waterway.

MANGROVE PROPAGULE DISPERSAL IN SINGAPORE'S WATERS AND THE BROADER THAI-MALAY PENINSULA

Asst. Professor Dan Friess





JUSTIFICATION

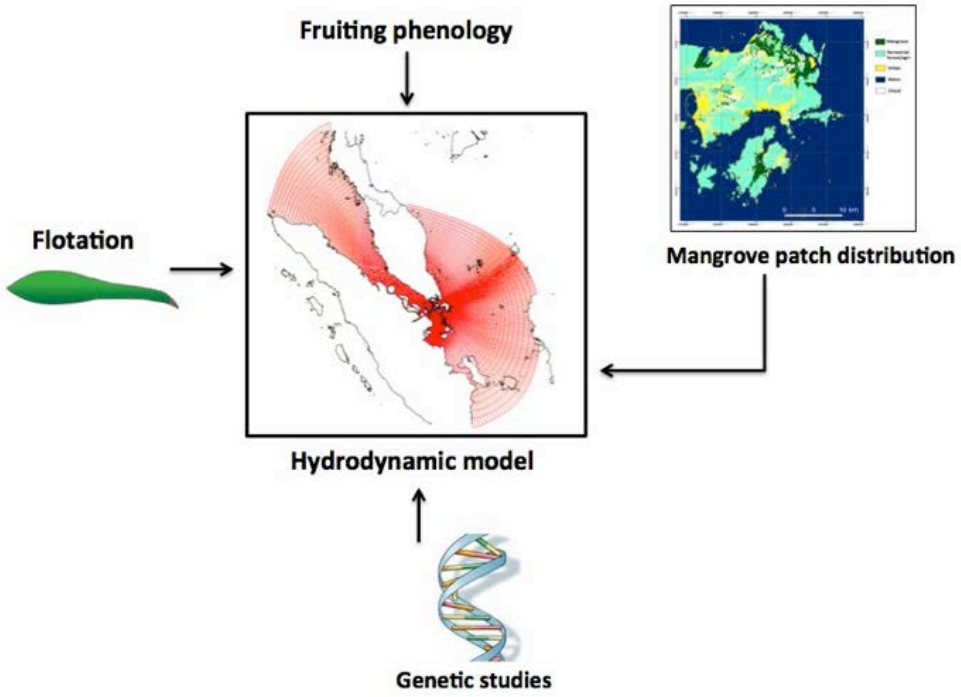
The mangroves of Singapore and Southeast Asia have experienced severe decline in area over the last century. Land reclamation and reservoir construction have fragmented Singapore's original mangrove cover and increased the distance between habitat patches. Habitat fragmentation is an important issue for all ecosystems, as it can significantly reduce habitat connectivity and the flow of pollinators, seeds and genetic material that cannot cross the inter-patch matrix. Without this exchange, Singapore's mangroves will not be able to regenerate lost vegetation, and will be less resilient and adaptable to physical changes caused by global climate change. Mangroves are unique in that their seeds (propagules) are dispersed by water (ocean currents etc), so modelling their dispersal may provide clues for their long-term stability.

FUTURE USE

We are using these results to support management guidelines that identify isolated mangrove patches at risk of genetic disconnection, and highlight areas suitable for restoration within the landscape to restore large-scale connectivity.

THIS STUDY

The aim of this study is to a) determine the vulnerability of Singapore's mangroves to habitat fragmentation, and b) investigate the relationship between Singapore's mangroves and the wider region. This requires a truly interdisciplinary approach to predict how mangrove seeds will disperse across seas and oceans. This approach combines phenology, genetic, ecology, remote sensing/GIS and physical hydrodynamic modelling datasets in four steps:



01. Fruiting phenology

For the past 12 months students and staff have been monitoring the fruiting cycle of four species in three different mangrove habitats across Singapore. This is providing us with information on how many propagules are available, and the time of year they are most likely to be dispersed.

02. Propagule flotation

An experiment from July 2010 to December 2012 has measured the flotation abilities of hundreds of propagules from multiple species, in order to estimate how long they float and remain viable. Flotation period determines how long and how far a propagule may disperse. Some Rhizophora propagules in this experiment have been floating for more than one year!

03. Local-scale hydrodynamic modelling

The information from 1. and 2. is informing a hydrodynamic model of Singapore, to estimate where propagules may float to.

04. Regional-scale hydrodynamic modelling

Biological and ecological information is being inputted into a regional model in SDWA, to show large-scale connectivity. These results are also being compared to genetic data that suggests some connectivity between populations in Singapore, Malaysia and Thailand.

MARINE PROGRAMME

Turbidity of the coastal waters in Singapore has been gradually increasing over the past decades, threatening sensitive ecosystems such as coral reefs and seagrass beds and reducing the recreational value of the coastal waters. The SDWA marine research programme ("Interactions between Sediments, Ecology and Engineering") consists of three interrelated projects that each address specific aspects of this societal turbidity issue.

These projects are:
1. Large-scale sediment transport and turbidity in Singapore"D5s coastal waters
2. Dredging and infrastructure development near critical marine ecosystems
3. Relating ecosystem functioning and ecosystem services by mangroves: a case study on sediment dynamics

LARGE-SCALE SEDIMENT TRANSPORT AND TURBIDITY IN THE SINGAPORE COASTAL WATER

Dr. Liew Soo Chin, Dr. Bas van Maren (Deltares), Dr. Claire Jeuken (Deltares)

The turbidity in the coastal waters of Singapore has been increasing steadily in the past decades. This increased turbidity threatens coastal ecosystems such as coral reefs and seagrass fields, but also reduces the recreational value of the coastal waters. The reasons for this increase are however often unknown, but probably related to a number of issues, such as land clearance and use increasing fluvial sediment input, large-scale construction works and dredging, coastal erosion, etc. Quantifying the mechanisms responsible for such an increased turbidity is, however, not straight forward because

- there is often very little data available on sediment pathways, bed sediment composition, sediment concentration, and hydrodynamics; also historic data to compare current with natural conditions are often scarce;
- the sediments, both in the water column and on/in the bed often consists of mixtures of sand, silt and clay. The physical behavior of these mixtures, such as settling, segregation and erosion / resuspension is still insufficiently understood.

AIMS

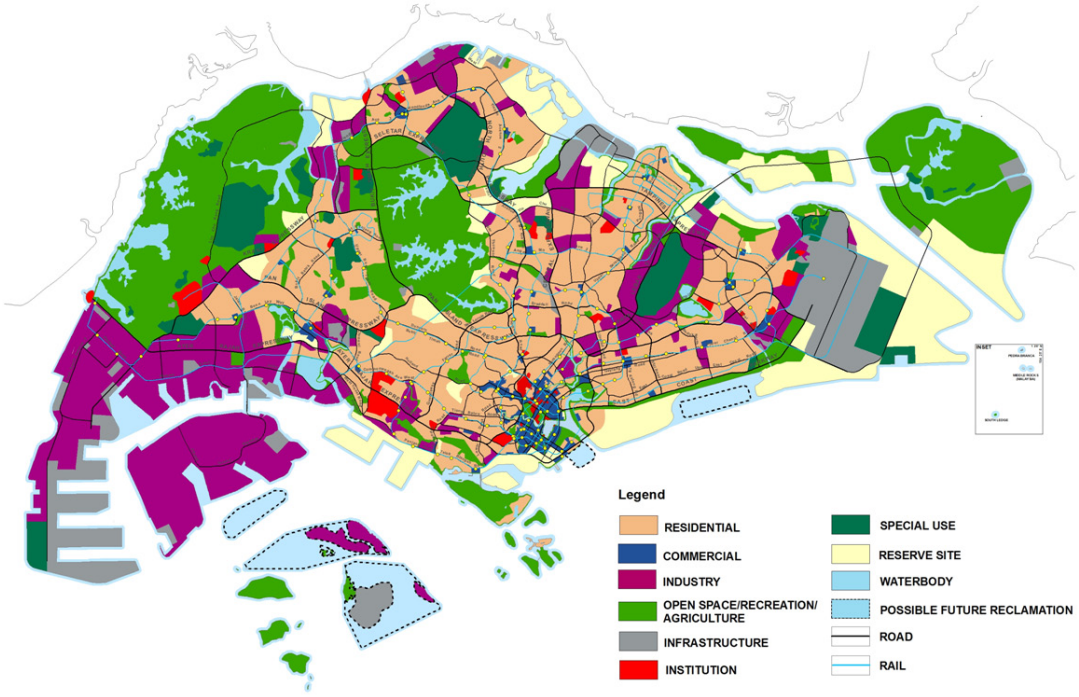
This project aims to determine the processes responsible for the increased turbidity by identification of a sediment budget of the Singapore coastal waters, including the main sources and sinks (and the changes thereof) and of the dominant sediment transport mechanisms.

The project consists of two work packages:
1. Determination of a sediment budget in coastal areas with limited data availability; and
2. The erosion and large scale transport of sand, mud and sand-mud mixtures.

The aim of the first work package is to develop methodologies to establish sediment budgets in coastal areas, in particular tropical coastal areas with limited data availability, by using satellite imagesand numerical models. The aim of the second work package is to improve our understanding of the physical behavior of sediment mixtures in general and of mixtures of mud and sand in particular. This requires laboratory analyses and field work, which will result in improved algorithms for the erosion of fine sediment mixtures, which will be implemented and tested in a numerical model.

SIGNIFICANCE

In the last 50 years the turbidity of the Singapore coastal waters is gradually increasing. This increase in turbidity is most likely related to extensive human interferences, such as dredging, increasing sediment input from local rivers, large-scale construction works and/or destruction of mangrove forests. Sediment-related research in Singapore has so far mainly focused on pollution of marine sediments (Wood et al., 1997, Tang et al., 1998, Nayar et al, 2004) and local effects of increased sedimentation rates on coral reefs (Chou et al., 2004), Dikou and van Woesik, 2006). However, the sediment budget, and associated major changes in the sediment sources and sinks in the past decades, still remains to be quantified.



Source: Ministry of National Development, Singapore

APPROACH

The sediment budget is determined through a combination of satellite image interpretation, model application, and data analysis. Satellite images are converted to surface sediment maps using ground truth data, and to depth averaged concentrations using sediment concentration profile measurements and a numerical model. This numerical model simulates tide-driven currents, wind-driven currents (including the monsoons), density-driven currents (forced by river plumes) and waves. This model is subsequently applied to compute the transport of fine sediment (mud) and the sand transport potential. The model is calibrated with available data and data obtained in field campaigns, and with satellite data. The properties of fine sediments in the Singapore coastal waters (flocculation, settling velocity, erosion) are determined through laboratory analyses. Flow velocity profiles and sediment concentration profiles are retrieved from existing dataset when available, supplemented with field campaigns and monitoring. The erosion of sand and silt, and mud mixtures will be studied using a numerical model in combination with laboratory analyses and field measurements. This work includes the mapping of the seabed sediments in the Singapore coastal waters, *in situ* erosion measurements, and determination of soil properties in the laboratory. Existing formulations on the erosion of sand/silt/mud mixtures will be improved, implemented, and tested in a numerical model. The research is proposed to take place in two work packages. Although both work packages focus on the large-scale sediment transport, and partly overlap, the first has a strong data-orientation, including the analysis of satellite data, whereas the second work package focuses on small scale physical processes and numerical model development, application, and analysis.

INNOVATION

The innovation within this project is partly fundamental but also contains some regional applications. Fundamental research issues that will be addressed are:
1) The use of satellite images for the determination of a sediment budget, especially in combination with numerical models.
2) Sediment transport studies in areas with large residual transport rates and spatial variation (large tidal current asymmetries and residual flows)
3) Improving the fundamental knowledge on the erosion and transport of sand-silt mixtures

Innovations on a more regional level are:
1) The determination of a sediment budget, including sources and sinks, for the Singapore coastal zone.
2) A detailed analysis of the fine sediment transport processes in the coastal zone.
3) The determination of sediment properties in the Singapore coastal zone.

DREDGING AND INFRASTRUCTURE DEVELOPMENT NEAR CRITICAL MARINE ECOSYSTEMS

Dr. Peter Alan Todd, Dr Tjeerd Bouma (Deltares)

The project focuses on the ecological effects of turbidity and sedimentation on coral reefs and seagrass meadows. Increased turbidity and sedimentation as a result of anthropogenic perturbations (including both land-based and maritime activities) constitute one of the most significant threats to sensitive but critical ecosystems such as coral reefs and seagrass beds in tropical coastal waters. At the same time, however, natural variability in background turbidity and sedimentation in such waters due to storms, wind and wave induced resuspension and seasonal river plumes suggests that these ecosystems must have developed a certain degree of plasticity and resilience to tolerate, adapt to, and/or recover from such stress events.

HYPOTHESIS

This leads to the hypothesis that coral and seagrass ecosystems will be able to tolerate anthropogenic sediment disturbances (e.g. from dredging and reclamation works) that fall within the range, frequency and duration of the natural variability of these parameters.

SPECIFIC AIMS

To test this hypothesis, the present research project aims to:

- Improve our understanding of the natural dynamics of critical marine ecosystems (coral reefs and seagrass beds) in tropical coastal waters in response to environmental variability in turbidity and sedimentation;
- Generate advanced knowledge about stress responses and resilience of critical marine ecosystems (coral reefs and seagrass beds) to turbidity and sedimentation in tropical coastal waters;
- Deepen our understanding of factors determining the success and scale of (post-impact) recovery of critical marine ecosystems (coral reefs and seagrass beds) in tropical coastal waters (including the role of recruitment).

APPROACH

The proposed research project is structured by means of the following 3 work packages:

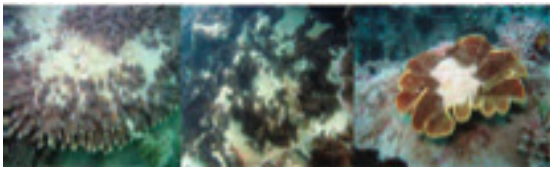
1. Dynamics & variability
2. Stress response & resilience
3. Recovery & recruitment

EXPERIMENTS

This research involves field and mesocosm experiments in which corals and seagrasses will be subjected to variable levels of shading and sedimentation. In the experiments, not only the magnitude but also the duration of the stress factor will be manipulated, and the differential response of tolerant and sensitive coral/seagrass species will be compared. Post-stress recovery (including the role of recruitment) and the effect of repetitive stress events on corals and seagrasses will also be examined. The effect of increased turbidity and sedimentation on recruitment and recovery of coral reefs and seagrass beds will also be examined by monitoring coral settlement on artificial substrates under different environmental conditions and seagrass recovery in experimental gaps and artificially buried plots.

INNOVATION

Specific attention in this research project for the interactive role of duration, magnitude and frequency of sediment disturbances in determining the level of impact on critical marine ecosystems, as well as research into the resilience and post-impact recovery of tropical seagrass beds is all new and much needed to fill major gaps in current knowledge. At a larger scale, the research project presented here is part of the SDWA-Marine Research Program, a cluster of three projects that together represent a new and innovative approach to a truly integrated assessment of interactions between sediment behaviour, marine ecology and (eco) engineering. Through the application of acquired system knowledge and innovative use of biogeomorphological principles, this program aims to contribute to a paradigm shift towards ecosystem- based design of maritime infrastructure developments and operational practices and a more sustainable sediment management in Singapore's coastal waters.


RESULTS

This research generated fundamental knowledge on the stress response behaviour and critical thresholds of these valuable ecosystems and on the factors that contribute to their resilience and recovery potential. Such knowledge is essential to improve the predictability of the effects of dredging and marine infrastructure development (of particular relevance to both Singapore and the Netherlands), that aid in the setting of realistic and ecologically meaningful criteria and restrictions for dredging operations, and contribute markedly to the sustainable management and recovery of these critical ecosystems, both in Singapore and elsewhere in the world. At the same time, this research has generated a much better understanding of the physical boundary conditions required for the successful creation of (new) habitats and the effective restoration of these ecosystems.

RELATING ECOSYSTEMS FUNCTIONING AND ECOSYSTEM SERVICES BY MANGROVES: A CASE STUDY ON SEDIMENT DYNAMICS

Assoc. Professor Edward Webb, Dr Tjeerd Bouma (Deltares)

Mangrove forests are intertidal ecosystems that fringe coastal waters in tropical and sub tropical climates. Mangroves provide a broad range of ecosystem services. In the present project, we focus predominantly on the extent to which mangroves can contribute to the clearing of coastal waters that suffer from anthropogenic sediment inputs, by trapping sediment. Due to a variety of anthropogenic influences, mangrove areas decline on a global scale, while remaining mangroves are exposed to rapidly changing abiotic conditions. The latter makes it difficult to predict both the short-term sediment dynamics and the longterm biogeomorphological development of mangroves. Hence, the net effect of sediment trapping by mangroves and its contribution to the clearing of coastal waters is hard to predict.

AIMS

In this study, we will quantify how the short-term bio-physical interactions between flow and vegetation govern the long-term biogeomorphologic development of mangrove ecosystems and vice versa. This question will be addressed by combining field studies, flume studies, mesocosm experiments and process-based morphodynamic modeling. The results will be generic, in that the project will provide quantitative insight in how these interactions are affected by hydrodynamic forcing and ecosystem scale.

Specific Research Objectives:

1) Quantify the bio-physical interactions that control the attenuation of hydrodynamic energy and local gross sediment transport fluxes in mangrove vegetations.
2) Develop a process-based hydrodynamic model that can be used to describe the attenuation of hydrodynamic energy by bio-physical interactions within mangrove vegetations.
3) Use the model to predict the potential use of mangroves for attenuating hydrodynamic energy.
4) Quantify the relation of the gross short-term sediment fluxes, and their seasonal variation, with the long-term net sediment dynamics (and thus sediment storage) in mangroves.
5) Identify growth rules for mangrove species in order to obtain a plant growth algorithm that can be used for modeling the long-term mangrove development under contrasting abiotic conditions.
6) Develop a coupled hydrodynamic, morphodynamic and plant-growth model that can be used to simulate the longterm bio- geomorphologic development of mangroves, under different scenario's of sediment loading, sea level rise and hydrodynamic forcing.

APPROACH

The research will be carried out by two closely collaborating PhD students, with PhD 1 focussing on quantifying the short-term bio-physical interactions that govern local hydrodynamics and gross sediment fluxes in the mangroves, and PhD 2 focussing on the long-term bio-geomorphologic mangrove development. Both PhD studies will combine field measurements with flume studies and modelling. Top level researchers in this field are involved in the guidance and embedding of this project. State-of-the-art research tools from Dutch research institutes will be made available to stimulate research progress.

SIGNIFICANCE

Mangroves have been rapidly disappearing over the last decades along the coastline of many tropical countries, including those of Singapore. However, mangroves provide a broad range of ecosystem services (fish production, safety, sediment trapping). Improving the understanding of the growth and effect of mangroves will therefore:

1) Increase the awareness and support to keep existing mangrove areas intact, in Singapore as well as in neighbouring countries.
2) Improve the capabilities to restore mangrove forests (how, where, what type of mangrove species).
3) Increase the capability to manage water quality and improve ecosystem functioning by dedicated mangrove restoration projects.

As such, it will contribute to knowledge, scientific but also practical, on how to improve the tropical marine environment and to increase safety. Last but not least, the project will provide two PhD's with a state of the art scientific research training, by combining experimental research on and modelling of biophysical interactions. This kind of training is increasingly needed in coastal engineering and coastal management around the world. As a result of this project, a new avenue of bio-physical research has been initiated in Singapore, backed by an international group of expert researchers, experimental facilities and dedicated software, as a firm basis for continuing research in the future.

INNOVATION

Scientific
Understanding how bio-physical interactions affect landscape formation via self- organizing processes is an important novel research area that has gained a lot of attention in the last few years. Although these bio-physical interactions are highly important in mangroves, they are still relatively poorly studied compared to other ecosystems such as salt marshes and fluvial systems. The present study addresses gaps in current knowledge, and will yield valuable modeling tools that allow scenario studies to predict the response of mangroves to ongoing global change processes and anthropogenic disturbances.

Applied
The total area of mangroves in Singapore is low, and the mangrove areas in surrounding countries are rapidly declining due to anthropogenic influences. The impact of the latter on water quality (for example, turbidity) is still poorly understood by lack of in depth knowledge on both the short- and long-term sediment dynamics within mangrove. Developing the proposed models will support a balanced evaluation of the benefits of mangrove restoration and protection in both the Singapore area and the neighbouring countries. It will identify to what extent, and on which time scales, mangroves can i) act as buffering mechanism against anthropogenic sediment inputs; ii) reduce turbidity in coastal waters; (iii) maintain water depth of nearby tidal channels and iv) contribute to coastal protection.

RESULTS

In addition to the innovative aspects mentioned above the modeling tools that will be developed in the project, enables scenario studies to predict the response of mangroves to ongoing global change processes and anthropogenic disturbances. Overall, the project will gain fundamental insights needed for mangrove restoration and the use of mangrove forests to improve water quality and ecosystem functioning in Singapore and neighbouring countries.


adidas

KNOWLEDGE BUILDING & DISSEMINATION

DOUBLE DEGREE PROGRAMME, PhD PROGRAMME, ATTACHMENT STUDENTS, SHORT COURSES

In collaboration with the National University of Singapore (NUS), Delft University of Technology (TU Delft) and Deltares, SDWA offers an extensive knowledge dissemination and building programme. This includes a Double Degree, Ph.D. students, attachment students and short courses programmes.

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43 STUDENTS
11 COUNTRIES

DOUBLE DEGREE PROGRAMME

SDWA contributes to an innovative double M.Sc. programme in Hydraulic Engineering and Water Resources Management offered in collaboration between the National University of Singapore (NUS) and the Delft University of Technology (TUD). These two universities have a rich combined heritage of over 250 years and are both globally ranked among the top 20 technology universities in the world (THE-QS ranking). The Double Degree Programme is based on an institutionally innovative concept under which students spend one year of study each in Singapore and The Netherlands and receive two M.Sc. degrees, one from each University. It is offered annually with its inaugural cohort started in August 2009.

33 STUDENTS
10 DEPARTMENTS

PHD PROGRAMME

At SDWA, Ph.D. students get the opportunity to perform cutting-edge research in a multidisciplinary environment. Ph.D students typically spend part of their time at their "home department", which can be any Department involved in any of the research programmes at SDWA. Currently we host Ph.D. students from Departments at Engineering, Biology and Geography. Each of the Departments has their own requirements regarding admission criteria, coursework requirements, etc. Ph.D. students are hired for the individual research programmes and provided scholarships. In addition, a Memorandum of Understanding has been undertaken between NUS and TU Delft which allows joint supervision of Ph.D. students. SDWA plans to take full advantage of this understanding in order to strengthen programmes associated with Ph.D degree. At SDWA, we aim to provide our students with a wide-ranging education that will nurture their talents and prepare them to be outstanding researchers. About 6 students have completed their PhD through SDWA, while 31 have joined the graduate program under SDWA umbrella.

16 STUDENTS

ATTACHMENT STUDENTS

SDWA trains Polytechnic, Honors and M.Sc. students in various multidisciplinary areas by providing attachment project opportunities. These students are given expert supervision by SDWA Staff. These projects not only help students in their course completion requirements but also provide an opportunity to work first hand in challenging applied projects. A total of 16 students have been engaged to such projects in the past 5 years in SDWA.

19 COURSES
493 PARTICIPANTS

SHORT COURSES

SDWA offers training and short courses for professional engineers to address practical and advanced topics in water resources and environmental engineering. We also give training and organize tailor made courses within the wider region of South East Asia, according to the requirements of our customers and water industry related parties. So far, SDWA has provided 19 courses, with a total of 493 participants.

IAHR-NUS STUDENT CHAPTER

The IAHR National University of Singapore (NUS) Student Chapter (SC) was created on December 2008 and is the first IAHR student chapter in Singapore. The founding members of the IAHR NUS student chapter are a group of 11 NUS students who are part of the Singapore-Delft Water Alliance (SDWA) in NUS. SDWA is a multi-national, interdisciplinary research Centre of Excellence for Water Knowledge involving PUB (Singapore), National University of Singapore and Deltares (The Netherlands), established through an initiative of the National Research Foundation in Singapore.

Objectives

The objectives of this organization that are stated in By-Laws of National University of Singapore Student Chapter are:

- To actively involve students in the international community of research and best practice in fluid mechanics; hydraulic; and water and environmental engineering and management;

- To enable student affiliates to gain experience and contacts for their future careers through involvement in an influential international water association;

- To further and broaden the knowledge of student affiliates in the field of hydraulic engineering and research, through participation in field excursions, seminar activity, international collaboration with other Student Chapters, participation in IAHR Congresses and other meetings, etc;.

- To provide information to the members which is useful for their careers;

- To further, within its locality, the purposes and programs of the International Association of Hydraulic Engineering and Research

DOUBLE DEGREE PROGRAMME

The NUS-TUD Double M.Sc. Degree Programme (DDP) is a two-year full-time programme. To graduate, students must complete an exciting mix of coursework and research. Students are expected to spend two semesters at each institution. Due to the difference in academic calendars between NUS and TUD, the first semester of the first academic year must be completed in NUS and the second semester of the same academic year in TUD. The 3rd and 4th semesters may be completed at either institution depending on the choice of electives and the location of the primary supervisor for the M.Sc.

Admission Criteria

Prospective students should have a relevant bachelor's degree with 2nd class honours and/or a B.Sc. with a Cumulative Grade Point Average (CGPA) of at least 75% of the scale maximum. A good TOEFL/IELTS score is required for students who are not nationals of the USA, UK, Ireland, Australia, New Zealand and Canada. Note that NUS students who are not nationals of the above countries are also required to take TOEFL/IELTS.

Application for Admissions

All applications are submitted through the Graduate Studies Office, Faculty of Engineering:

Vice-Dean (Graduate Studies)
Graduate Studies Office,
Faculty of Engineering
Block EA Level 6 Room 16
National University of Singapore
9 Engineering Drive 1
Singapore 117576

Contact Ms. Cecilia Dewi at ceciliadewi@nus.edu.sg

Curriculum

The curriculum consists of core modules, M.Sc. thesis, elective modules, additional research requirements and breadth requirements.

NUS Core Modules

1. Hydroinformatics
2. Environmental Modeling with Computers
3. Wave Hydrodynamic and Physical Oceanography
4. Coastal Processes and Sediment Transport

TUD Core Modules
(leading to Hydraulic Engineering Track)

1. Probabilistic Design
2. Bed, Bank and Shoreline Protection
3. Ports and Waterways 1
4. Computational Modeling of Flow and Transport
5. River Engineering / River Mechanics

TUD Core Modules
(leading to Water Management Track)

1. Irrigation and Drainage
2. Integrated Water Management
3. Fundamentals of Urban Drainage
4. Hydrology of Rivers, Catchments & Deltas
5. Fundamentals of Drinking Water and Waste Water
6. Geohydrology

Elective Requirements

Students will be able to select the elective requirements from a list of more than 30 modules in consultation with potential thesis supervisors. To see the brief description of each module, please browse through NUS and TUD offered modules in respective websites.

Additional Research Requirements

Students may choose to carry out projects and/or internships in Singapore or Delft as approved by their supervisors. This may be done with a company or institution.

Study Grant

Students who meet criteria will be offered a study grant. It is open to NUS as well as international students without any obligation after graduation.

The study grant amount is reviewed and revised as necessary every year depending on the current circumstances. It is generally intended to cover the difference in cost of living between Singapore and The Netherlands. Students are expected to have prepared funds to study in their home institution, or in the case of international students, one year of study either in NUS or TU Delft. The grant may then be utilized to pay for expenses in the partner university.

*Information valid from 2009-2012.

Tuition Fees

AY2012/2013 Subsidized NUS Fees (annual):

Singapore Citizen: SGD 7,590
Singapore PR: SGD 10,020
International Students: SGD 23,310

AY2012/2013 TUD Fees (annual) - subject to changes:

1,771 Euros (EU, amount may vary depending on age group)
12,650 Euros (non-EU)

Industry Partners

SDWA is working with organizations to provide relevant internships and thesis projects for students. The projects provide students with a significant enhancement of their understanding of integrating theory with practice. From the opposite angle, the organizations providing this support to students benefit from more visibility and brand awareness among students within NUS and TUD. The internships also serve as an effective recruitment platform.

British Marine Technology (BMT), SG

Keppel Integrated Engineering, SG

Haskoning Sdn Bhd, Malaysia

Camp Dresser and McKee

TAUW, NL

CH2MHill, SG

NParks, SG

Oasen Drinkwater

PUB, SG

Stichting Deltares, NL

Memsys Clearwater

PhD PROGRAMME

Abhay Anand

Coordinating Multiple Model Predictive Model Predictive Controllers for Large-Scale Systems

August 2009 - August 2013

Large-scale systems are formed by the interconnection of several subsystems, whose different spatial and temporal characteristics make them significantly heterogeneous. The aim of this research is to improve the real-time control of such systems, with particular interest for water reservoir networks. In this regard, coordination and distributed optimization techniques are developed.

Main supervisor:
Assoc. Prof. Lakshminarayanan Samavedham

Department of Chemical and Biomolecular Engineering

Alamsyah Kurniawan

Improved Tidal and Non-Tidal Representation of Numerical Models through Data-Model Integration

August 2009 - August 2013

The main objective of this research is to understand, examine and develop effective and efficient methods to improve tidal and non-tidal representation in Singapore Regional Waters through numerical modelling and data-model integration approaches. It is expected that the developed models can be applied to study the tide-surge interaction and tide forecasting.

Main supervisor:
Assoc. Prof. Vladan Babovic

Department of Civil Engineering

Albert Goedbloed

A real-time optimal control approach for water quality and quantity management: Marina Reservoir case study

August 2009 - August 2013

The main objective of this research is to design a management system to account for both water quantity and quality targets in urban water reservoirs, with Marina Reservoir (Singapore) considered as a case study. Core of this system is a real-time optimization scheme that takes into account the measured and predicted hydrological variables to operate the reservoir hydraulic structures.

Main supervisor:
Assoc. Prof. Vladan Babovic

Department of Civil and Environmental Engineering

Ali Meshgi

Enhancing Knowledge of Rainfall-Runoff Process through Physically-Based Numerical and Data Driven Modelling

January 2011 - December 2014

Scope of this study is to better understand the hydrological processes in Singapore by looking at rainfall-runoff processes as influenced by infiltration capacity in urbanized areas. To reach this goal, a small catchment within NUS campus is chosen to set up a monitoring network and an extensive modelling exercise of the whole hydrological cycle.

Main supervisor:
Assoc. Prof. Vladan Babovic

Department of Civil Engineering

Arunoda Basnayake

Water quality emulation with data driven techniques with improved forecast

August 2008 - August 2012

The purpose of this research is to: i) improve the forecasting accuracy of data-driven techniques (as a function of the forecasting horizon) in hydrological applications, ii) explore the possibility of using data-driven techniques as model emulation tools to reproduce complex non-linear water quality processes.

Main supervisor:
Assoc. Prof. Vladan Babovic

Department of Civil and Environmental Engineering

Gourvendu Saxena

Adaptation Of Microbial Communities And Their Functions To Environmental Pressures In An Urban Freshwater Catchment

Aug 2009 - June 2013

The overall goal of this PhD project is to understand the geochemical processes in urban catchments governed by microbes and their responses to increasing anthropogenic pressure. Catchment of Sungei Ulu Pandan (Singapore) is adopted as a model study area.

Main supervisor:
Assoc. Prof. Sanjay Swarup

Department of Biological Sciences

Grace Blackham

Ecological Degradation and Recovery in the Ex-Mega Rice Project tropical peatland ecosystem, Central Kalimantan, Indonesia.

September 2009 - August 2013

The aim of my doctoral research is to explore the natural regeneration potential of woody vegetation in degraded tropical peatland, focussing on seed dispersal as the major filter limiting forest recovery. The effect of peatland drainage, fire and nutrient availability on natural regeneration is also investigated.

Main supervisor:
Assoc. Prof. Edward Webb

Department of Biological Sciences

Hongjuan Han

Development and application of comprehensive aquatic system model for facilitating understanding and sound management of the Upper Peirce Reservoir, Singapore

January 2010 - January 2015

My doctoral research is focused on Upper Pierce Reservoir, the largest freshwater impound in Singapore. The aim is to improve our understanding of the major factors that affect the water quality of this tropical reservoir, and identify suitable remediation methods for water quality enhancement. A comprehensive aquatic system model is thus being developed.

Main supervisor:
Assoc. Professor Lu Xi Xi

Department of Geography

Erik Horstman

On the contribution of mangroves to coastal safety, as revealed by short-term biogeophysical interactions.

June 2009 - June 2013

This work addresses the issue of enhanced coastal safety through mangrove forests as induced by sediment trapping and wave attenuation. In order to study these features, a comprehensive 7-months long field campaign has been executed, covering coastal mangroves sites in the estuaries of the Kantang and Palian river.

Main supervisor:
Prof. Dr. S.J.M.H. Hulscher
Dr. C.M. Dohmen-Janssen

Department of Water Engineering and Management, UTE, Netherlands

Chakravarthy Mynampati Kalyan

Data-driven modling of the dynamic dose-time metabolomic response of plants exposed to organic toxicants in water

September 2008 - August 2013

In this dissertation, a metabolic profiling approach to investigate the chemical stress experienced by plants and microbes around the root zone (rhizosphere) in fresh water systems is developed. A novel bioreactor was designed for direct and non-destructive extraction of metabolites released in the rhizosphere.

Main supervisor:
Assoc. Prof. Lakshminarayanan Samavedham

Department of Chemical and Biomolecular Engineering

Javier Rodriguez

Model order reduction of nonlinear models (approximate title)

June 2009 - October 2015 (expected)

In this work, big nonlinear models, composed of thousands of state variables, are reduced to simpler models containing tens of variables. Proper Orthogonal Decomposition, a tool often used for linear time-invariant models, is applied to provide the variable reduction, while Data Driven Modelling is applied to generate the reduced nonlinear models.

TU Delft supervisor:
To be determined

SDWA supervisor:
Assoc. Prof. Vladan Babovic

Linda Tan Siew Li

Variational approximation for complex regression models

August 2009 to August 2013 (expected)

The trend to larger datasets has resulted in the need for more flexible models and fast computational approximations. My thesis addresses these themes by considering highly flexible regression models and developing fast variational approximation methods for fitting them.

Main supervisor:
Assoc. Prof. David John Nott

Faculty of Science, Department of Statistics and Applied Probability

Thorsten Balke

Biogeomorphology of mangroves: Implications for restoration

July 2009 - July 2013

Understanding the basic mechanisms is needed for better management and restoration of threatened mangroves worldwide. With a series of mesocosm and wave flume experiments we determined how physical disturbance by water movement and sediment transport can lead to failure of mangrove seedling establishment.

Main supervisor:
Dr. Tjeerd Bouma (Deltares/NIOZ),
Assoc. Prof. Edward Webb (NUS-DBS),
Prof. Peter Herman (NIOZ, Radboud University Nijmegen)

Deltares

Serene Tay Hui Xin

Data-Model Integration in an operational forecast framework; an application to the South China Sea

August 2010 - July 2014

The present study focuses on predicting the flow conditions in the South China Sea using data-model integration approach for operational forecast. The study of the flow condition is classified into two categories: tidal and non-tidal phenomena.

Main supervisor:
Assoc. Prof. Vladan Babovic

Department of Civil and Environmental Engineering

Shailendra Mishra

Relationship between land use change, biogeochemistry and greenhouse gas emissions in tropical peatlands

August 2009 - July 2014

Tropical peatlands are under threat from anthropogenic activities, and this leads to oxidation of peat biomass by microbial processes to produce nearly 0.8 Gicatons of CO2. This doctoral research studies the microbial processes affecting such drivers and develops sustainable mitigation measures.

Main supervisor:
Assoc. Prof. Sanjay Swarup

Department of Biological Sciences

Siti Maryam Yaakub

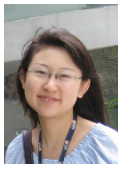
Exploring resilience in tropical seagrass habitats: the role of light reduction and disturbance

August 2009 - August 2013

Coastal areas around the world are experiencing rapid changes, which results in the modification of coastlines. These activities impact marine ecosystems such as coral reefs and seagrass habitats.
This project aims to examine the dynamics, stress responses, resilience factors and recovery mechanisms of tropical seagrass ecosystems in relation to the combined stressors of light reduction and disturbance.

Main supervisor:
Dr. Peter A. Todd (DBS, SDWA) &
Dr. Tjeerd Bouma (NIOZ, SDWA)

Department of Biological Sciences



Xuan Wang

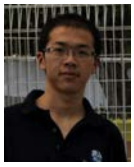
Residue-Correction-Based Data Assimilation in Coastal Hydrodynamics (With an Application to Singapore Regional Model)

January 2008 - October 2012

This study focuses on a data assimilation approach to enhance the performance of Singapore Regional Model, used to predict the water motion in Singapore Strait. Based on the concept of model residual prediction, distribution and correction, several data-driven techniques are implemented to improve the forecast accuracy of the model.

Main supervisor:
Assoc. Prof. Vladan Babovic

Department of Civil and Environmental Engineering



Xiaofeng Zhang

An investigation on the root system of mangroves and its influence on current flow

August 2010 - August 2014

The circulation of water is expected to influence the transport of sediments, salt, pollutants and nutrients in such systems. In this study, the geometric properties of the root systems of the Rhizosphora and the Avicennia and Sonneratia are studied using a photogrammetric method, and subsequently validated against manual measurements.

Main supervisor:
Prof. Cheong Hin Fatt & Dr. Chua Pei Wen, Vivien

Department of Civil and Environmental Engineering

Xu Zhang

Architecting flexible projects and systems using portfolios of real options: a decision support framework and two case studies

September 2006 - August 2010

Flexibility provides important leverage against uncertainty, but flexible decision-making processes are complex. This study inherits the prevailing real options practices in framing decisions as real options and establishing the cause-and-effect relationships between flexibility and project value under uncertainty.

Main supervisor:
Assoc. Prof. Vladan Babovic

Department of Engineering & Tech Management

He Shan

Ho Jiahui

Jayashree Chadalawda

Laurence Chan

Minh Ngoc

Nguyen Ngoc Hien

Phua Yong Bin

Sun Yabin

Wang Jianjun

Wang Li

ATTACHMENT STUDENTS

*There were 16 attachment students from the year 2009 - 2012

2009

Fam Kai Deng
March-June 2009
Ngee Ann Poly (Singapore)

Supervisor:
Assoc. Prof. Sanjay Swarup

Nicole Chua
March-June 2009
Ngee Ann Poly (Singapore)

Supervisor:
Assoc. Prof. Sanjay Swarup

2010

Cecile Garcia
June - August 2010
LCPC (France)

Supervisor:
Assoc. Prof. Balasubramanian Rajasekhar

Eva vam den Elzen
November 2010 - February 2011
Nijmegen University (The Netherlands)

Supervisor:
Assoc. Prof. Edward L. Webb

Jim van Spengen
January - April 2010
TU Delft (The Netherlands)

Supervisor:
Assoc. Prof. Balasubramanian Rajasekhar

2011-2012

Abbas Roozbahani
August 2011 – March 2012
University of Teheran (Iran)

Supervisor:
Assoc. Prof. Vladan Babovic

Anusha Jagannathan
February – August 2011
Centre for Biotechnology
Anna University (India)

Supervisor:
Assoc. Prof. Balasubramanian Rajasekhar

Daniel Martens
October 2012 - January 2013
TU Delft

Supervisor:
Assoc.Prof. Vladan Babovic,
Dr. Ooi Seng Keat

Henry Schwartz
May - July 2011
University of Wisconsin-Whitewater (USA)

Supervisor:
Assoc. Prof. Vladan Babovic

Lorenzo Cozzi
August - December 2012
Politecnico di Milano (Italy)

Supervisor:
Dr. Stefano Galelli

Meghan Jensen
May - July 2011
University of Wisconsin-Whitewater (USA)

Supervisor:
Assoc. Prof. Vladan Babovic

Panagiota Gkavakou
April - August 2011
Technical University of Catalonia (Spain)

Supervisor: Mr. Adri Verwey

Rafael Goncalves
April - August 2011
Technical University of Catalonia (Spain)

Supervisor: Mr. Adri Verwey

Robbert Antonius de Bruijn
July - October 2011
TU Delft (The Netherlands)

Supervisor:
Assoc. Prof. Vladan Babovic

Stefania Caietti Marin
September 2011 - January 2012
Politecnico di Milano (Italy)

Supervisor:
Dr. Stefano Galelli

Sunny Gupta
May - June 2011
Department of Environmental Science and Engineering
Indian School of Mines (India)

Supervisor:
Assoc. Prof. Sanjay Swarup,
Supervision on a daily basis by Dr Umid Man Joshi & Dr Sheela Rueben

Christopher Paul Kent
May - July 2011
University of Wisconsin-Whitewater (USA)

Supervisor:
Assoc. Prof. Vladan Babovic

SHORT COURSES

*There were 19 short courses held from 2009-2012.

2009

MATLAB Basics - Data Analysis and Visualization
16-17 February

Attendance: 21

BCA Executive Course on Innovative Approaches to Coastal Management and Defense
17 February

Attendance: 101

NEA - Jambi
12-13 August

Attendance: 40

HDB Delft 3D Course
30 September - 2 October

Attendance: 40

Introductory Delft 3D-Flow/Sed Course
12-13 November, 16-17 November

Attendance: 14

Sobek (under PSRS for PUB/HDB/SDWA)
24-26 November

Attendance: 10

2010

Water Quality Course (under PSRS for PUB/HDB/SDWA)
24-25 March

Attendance: 8

NEA - Jambi
6-7 July

Attendance: 59

Sobek
10-11 November

Attendance: 9

Delft 3D Modelling
22-26 November

Attendance: 16

2011

Building with Nature: Marine Eco-Dynamics Design
20-21 January

Attendance: 14

Mathematical Science of Understanding and Predicting Regional Climate: A Workshop
7-11 March

Attendance: 78

2012

Hydrology Training, Delft
13-24 February

Attendance: 9

Introduction to Hydrodynamic Modeling in Delft3D
16-18 April

Attendance: 10

Environmental Modeling in Delft3D
18-20 April

Attendance: 17

Singapore Seagrass Workshop
2 July

Attendance: 38

PUB Sobek 1D/2D Course
27 August - 2 October

Attendance: 13

PUB Sobek Course
15-18 October

Attendance: 18

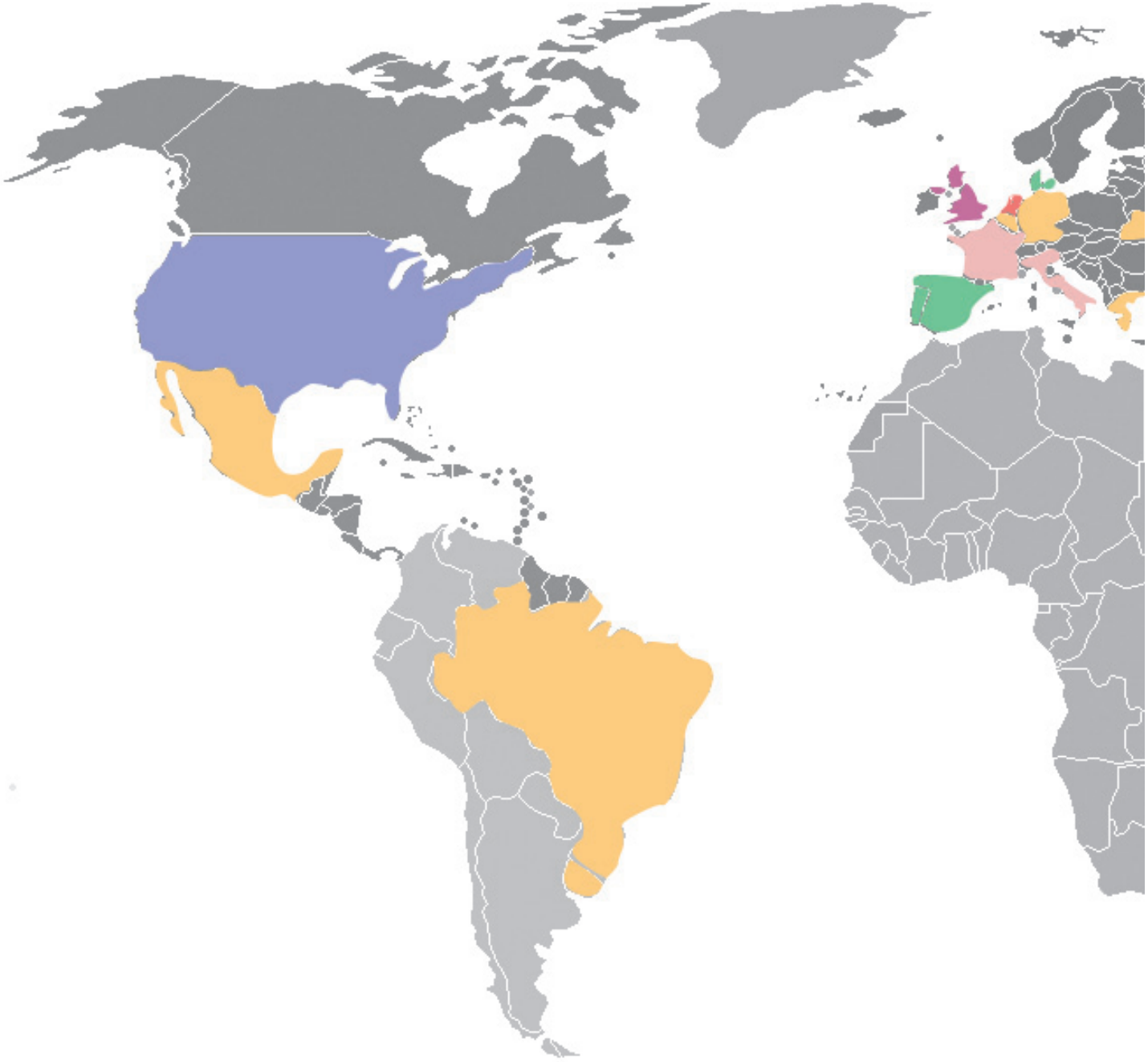
Operational Management System Knowledge Dvt Programme (OMS)
15 October - 9 November

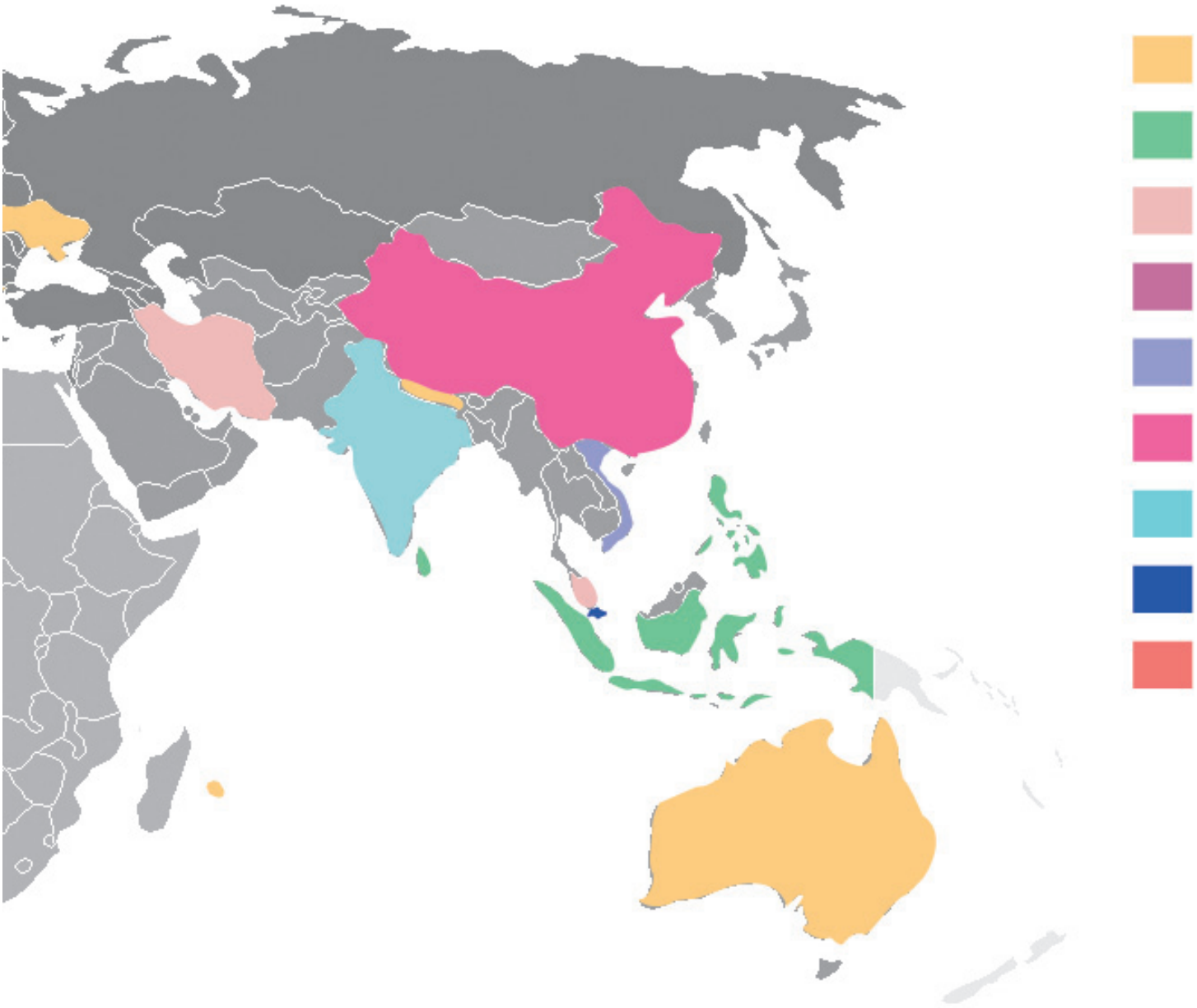
Attendance: 4

PEOPLE

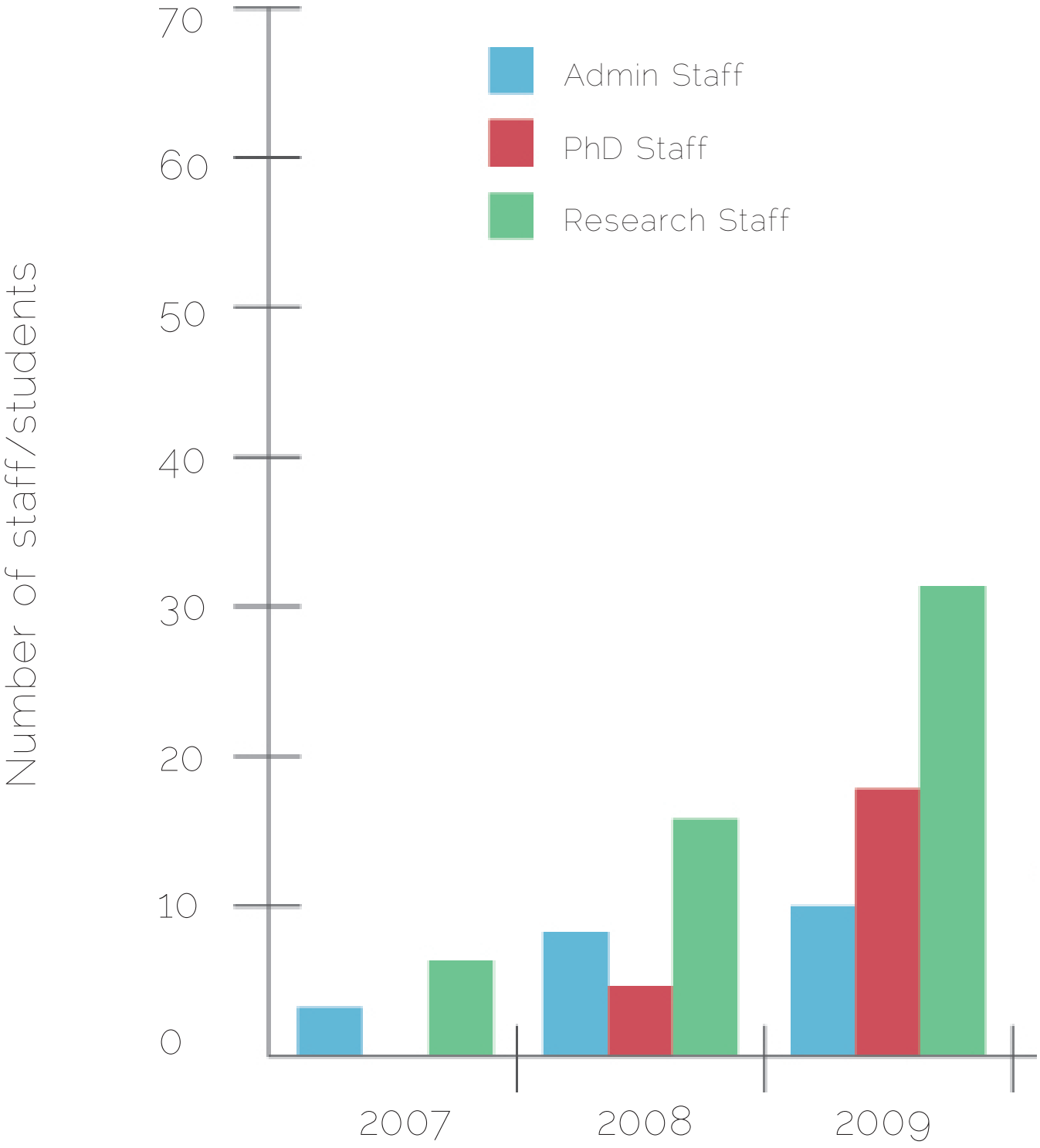
STAFF, ACADEMIC VISITORS, OVERSEAS & NUS COLLABORATORS, VISITING ARTISTS

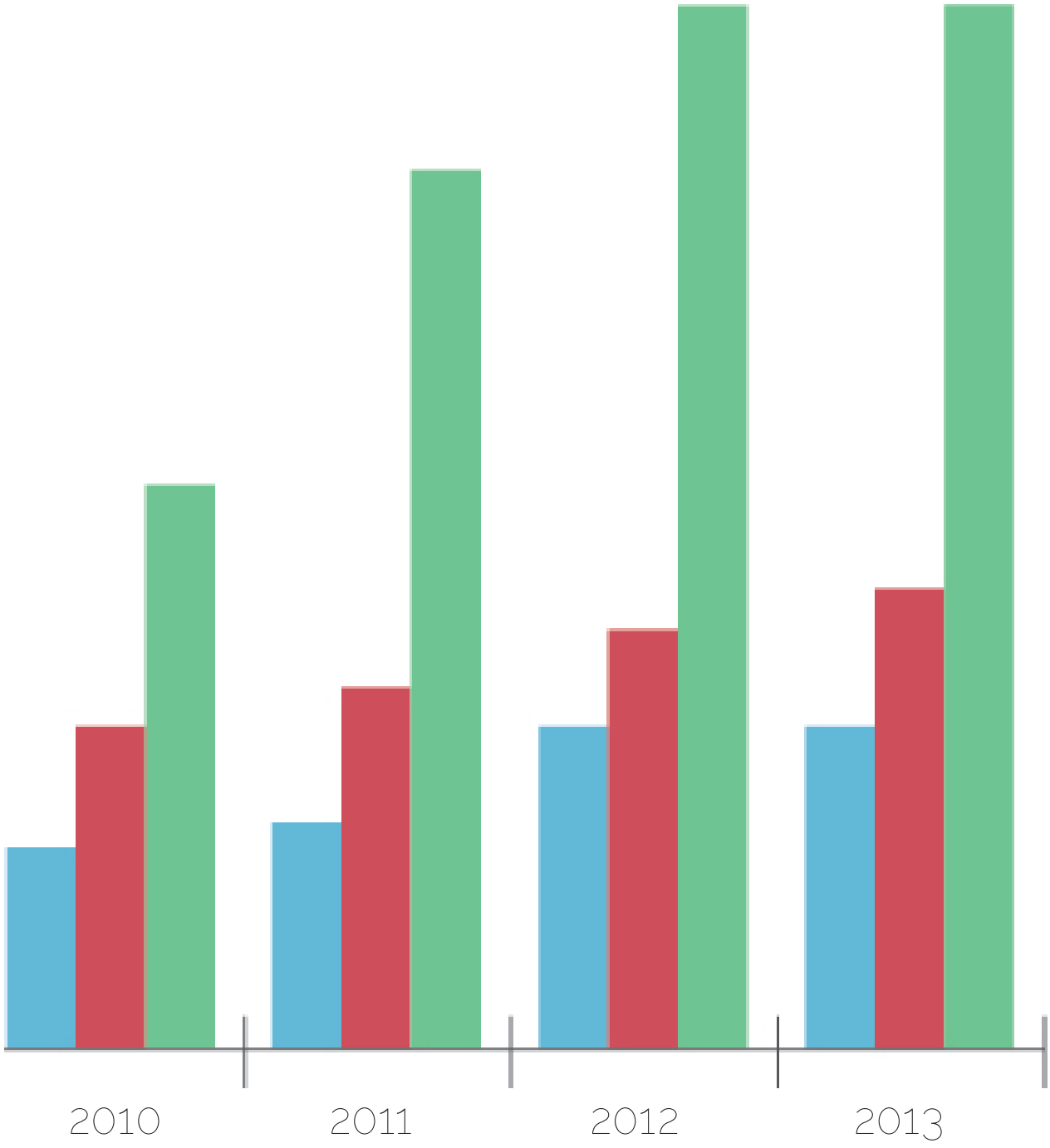
PEOPLE FROM AROUND THE WORLD





MANPOWER GROWTH IN SDWA




2010
2011
2012
2013

BOARD OF TRUSTEES

Barry Halliwell

Deputy President (Research and Technology)

Professor Barry Halliwell is Deputy President (Research and Technology) at the National University of Singapore. He works closely with the Deputy President and Provost to promote research excellence and is responsible for driving the University's research agenda. He is involved in planning and establishing research institutes, centres and programmes that are of strategic importance as well as in formulating policies and agreements relating to intellectual property rights in which NUS has equity. He oversees the functions of the Office of Research and Office of Life Sciences as well as the NUS research institutes and centres. His responsibilities also include overseeing the expansion and allocation of research funding.

Harry Baayen

Director of the Marine and Coastal System of Deltares

Ir A.J. (Harry) Baayen is a degree in Housing and Architecture from Delft University (1975). After his studies he joined the Ministry of Housing, Spatial Planning and the Environment where he held different positions over a period of 30 years. In the year 2000 Mr. Baayen was appointed Deputy Director-General of the Government Building Agency. In 2006 he started preparing the establishment of Deltares, the new institute formed by WL | Delft Hydraulics, GeoDelft, parts of TNO Built Environment and Geosciences, and Rijkswaterstaat/DWW, RIKZ and RIZA. In 2008 he became Managing Director of Deltares.

MANAGEMENT BOARD

Chan Eng Soon

Dean of Engineering, NUS

Areas of expertise:
Professor Chan Eng Soon joined NUS as a Senior Tutor in 1981 immediately after his Bachelor's Degree. He was subsequently awarded a NUS Overseas Scholarship to pursue doctoral studies at the Massachusetts Institute of Technology. He returned to the Department of Civil Engineering, NUS, with a Doctor of Science in Hydrodynamics in 1985 and has since been teaching in the Department. In 1995, he was appointed Head of the Physical Oceanography Research Laboratory, a laboratory set up to pursue research on coastal and offshore processes pertaining to tropical marine waters. Since then, he has also been appointed as the Director of the Tropical Marine Science Institute, Head of Civil Engineering Department and Executive Director of Centre for Offshore Research and Engineering.

Professor Chan's research interests and activities are focussed on marine processes, including marine hydrodynamics, wave-structure interactions, sediment transport and coastal protection. In more recent years, Professor Chan has also focussed on the study of tidal hydrodynamics and circulation in tropical waters, with a special emphasis on Singapore waters. Following his experimental work on breaking waves, he pursues active research in the theoretical modelling of bubble entrainment, bubble acoustics, and turbulence intensities associated with surface wave breaking. These concepts are incorporated into three-dimensional hydrodynamic models for the enhanced prediction of tidal mixing and transport. Such circulation models are used to describe the transport of contaminants.

Tom Schilperoort

Managing Director of Deltares

Areas of expertise:
Mr. Schilperoort is currently the Director of the Unit Marine and Coastal Systems at Deltares (formerly WL | Delft Hydraulics). As such, he overseas more than 100 professionals in the specialities of environmental hydrodynamics, water quality, sediment dynamics, morphology, ecology, operational forecasting, policy support and planning. He represents Deltares in various professional networks, both in the Netherlands and abroad. Since recently, he also holds the position of Director Singapore operations, coordinating all Deltares operations in Singapore, and responsible for the Deltares Singapore strategy. He also sits in the Management Board of Singapore Delft Water Alliance. Since 1994 he is Member of the Board of Marine Information Services B.V. As project director he has been responsible for various projects in the Netherlands and abroad (India, Europe, the Philippines). With his scientific background in the area of systemstheory he has been contributing to a large number and a wide variety of research- and consultancy projects. Moreover, he has been teaching courses on projectmanagement, operational monitoring, applied statistics and times series analysis.

DIRECTORS

Vladan Babovic

Director, SDWA

Ph.D. (UNESCO-IHE), Ph.D. (Delft University of Technology), Degree in Business (Switzerland)

Research Interests: hydroinformatics, machine learning, data mining and knowledge discovery, real options and systems architecting
He has received Talent Award by Danish Academy of Technical Sciences and Dr Arthur Ippen Award by International Association for Hydro-Environmental Research. In 2012, International Water Association bestowed on him a rank of IWA Fellow. He has authored more than 100 peer-reviewed journal papers and book chapters as well as more that 80 conference papers. He has presented keynote/ invited lectures in some 50 international conferences and served on organizing and advisory committees for many international conferences and events.

Mark Womersley

Associate Director (Research)

Research Interests: Environmental decision making, environmental risk assessment and environmental impact assessment; marine environmental informatics, integrated catchment and coastal management and water governance.
Mark has managed large interdisciplinary research projects in Singapore for the Maritime and Port Authority of Singapore (MPA), acted as a Principal Investigator in marine environmental informatics research for the National Environment Agency of Singapore (NEA). Currently, he is not only associate Director of SDWA but also manages NUSDeltares. He supervises, coaches and mentors Senior Research Fellows in water research.

Arun Mahadevan

Research Engineer

BSc in Environmental Engineering

Research Interests: Wastewater treatment and characterization, Characterization of nutrients and metals in urban runoff, Environmental biotechnology/microbiology

Bui Du Duong

Research Fellow

Ph. D. (Hydrological sciences and water resources)

Research Interests: Hydrological modelling, urban water management, surface- and ground-water interaction, hydrological impacts of climate change and water-related risk management

Carol Han Ping

Research Fellow

Ph.D. (Cell and Molecular Biology),

Research Interests: Urban ecology, bioremediation, plant physiology, molecular biology, water quality improvement and monitoring capabilities of flora and fauna

Chakravarthy Mynampati Kalyan

Research Engineer

M.S (Bioengineering)

Water Quality Modelling, Analysis, & Management; Ecotoxicology; WSUD (Water Sensitive Urban Design)

Chen Siaw Fun

Research Engineer

B. Eng. (Hons.) Environmental Engineering

Research Interests: Phytoremediation, Ecotoxicology, Environmental risk assessment, Water quality management

Desmond Lee Wan Aik

Research Fellow

Ph.D. (Geography)

Research Interests: Groundwater, Geographic Information Systems, Urban hydrology and modeling, urban water pollution studies, Environment Impact Assessment (EIA)

RESEARCH STAFF

Elvagris Segovia

Research Assistant

M.Sc. in Environmental Engineering

Research interests: biosphere-atmosphere interactions, environmental pollution, source, fate, transfer and impact of pollutants from urban areas to surrounding environments.

Galelli Stefano

Cluster Leader

Ph.D. (Information and communication technology)

Data Assimilation and Hydroinformatics

Research Interests: Data-driven modelling, feature extraction and selection, optimization and control, water resources management

Hasan Jahid

Senior Research Fellow

Ph.D. (Civil Engineering)

Research Interests: Hydrodynamics, sediment transport, morphological evolution and remote sensing of coastal dynamics and numerical modelling.

Jair Smits

Research Associate

M.Sc. (Water Resources Management

Research Interests: Water Footprint, Water Energy Nexus, Water Governance and Cross Boundary Water Management, Innovation & business development of applied water research, Remote Sensing

Jani Tanzil

Research Associate

M.Sc. in Tropical Coastal Management

Research Interests: Coral ecology, coral growth patterns, water quality, coral luminescence.

She is currently a PhD candidate at the University of Amsterdam

Joost Buurman

Senior Research Fellow

Ph.D (Economics)

WWvResearch Interests: Water economics, Water resources management, Disaster management and Damage modeling, Spatial analysis & planning, Geographical Information Systems

Karri Rama Rao

Research Fellow

Ph.D. (Chemical Engineering -Process Control)

Research Interests: Data mining, data assimilation, data driven modelling, data model integration, state estimation, Optimization and operational forecast

Krishna Sanmugam

Lab Technologist

Van Kleef Centre

Operations management at Van Kleef Centre

Lee Wei Kit

Research Assistant

B.Sc. (Hons.) in Life Sciences; Research Assistant

Research Interests: mangrove ecology, sustainable development, socio-ecological system and conservation economy

Loh Lay Leng

Research Assistant

Masters in Sustainable Water Management

Research Interest: Microbial ecology, water quality, sustainable water management

She is currently pursuing PhD in Department of Civil and Environmental Engineering.

Lynette Loke

Research Associate

Research interests: marine community ecology, effects of habitat structure on biodiversity, experimental design and statistical analysis.

She is currently pursuing her Master's program.

Mehrunisa Zafar

Research Associate

M.Sc. (Environment and Development)

Research Interests: Research interests include water governance, environmental valuation, environmental policy and integrated approaches to sustainable agriculture

RESEARCH STAFF

Ooi Seng Keat

Senior Research Fellow

Ph.D. (Civil and Environmental Engineering),
Numerical Modelling Cluster Leader;

Research Interests: Physical and numerical modelling of environmental flows, developing data assimilation tools for environmental flows.

Pavlo Zemskky

Research Associate

Research Interests: Design Support Systems, GIS Development, Computational Fluid Dynamics, Computational Geometry

Petra Schmitter

Research Fellow

Ph.D. (Agr. Science)

Research Interests: Catchment hydrology, land use change, water management, water quality, hydrological processes and sustainable development

Rajni Kaushik

Research Associate

Research Interests: Water quality monitoring, bacterial pathogens detection in water, bacterial pathogens detection in airborne particles, microbial monitoring of water.

Currently pursuing Ph.D. in Department of Civil and Environmental Engineering.

Rickson Tan

Research Assistant

B.Sc. (Hons.) in Social Sciences (Geography)

Research Interests: Human-nature interactions, mangroves propagule dispersion

Samantha Lai

Research Assistant

B.Sc. (Hons.) in Life Sciences

Research Interests: Marine community ecology, coral reef restoration and conservation

She is currently purusing Master's program.

RESEARCH STAFF

Samuel Jolivet

Research Fellow

Ph.D. (Atmospheric Physics - Meteorology)

Research Interests: Tropical meteorology, NWP, radar based nowcasting, precipitation, severe weather forecasting

Sheela Reuben

Research Fellow

Ph.D. (Biological Sciences)

Research Interests: Microbial ecology, water quality, water sensitive urban designs, Rhizosphere biology, bioinformatics, metabolomics

Stephane Bayen

Senior Research Fellow

Ph.D. (Chemistry)

Environmental Monitoring and Assessment (EMA) Cluster Leader

Research Interests: Ecotoxicology & Environmental Chemistry, Environmental Monitoring and Environmental and Human Health Risk Assessment.

Umid Man Joshi

Research Fellow

Ph. D. (Environmental Engineering);

Scientific Program Manager- Van Kleef Centre

Research Interests: Rainfall-runoff processes, green roof technology, biosorption, fate and transport of pollutants in the environment, water quality, environmental monitoring

Wang Xuan

Research Fellow

Ph.D. (Civil and Environmental Engineering),

Research Interests: Data assimilation, hydroinformatics, time series forecasting, water quality modeling and operational research

Zhang Jingjie

Senior Research Fellow

Ph.D. (Environmental and Ecological modelling);

Research Interests: Ecosystem health and environmental impact assessment, mathematical modelling for aquatic ecosystem properties and watershed modelling

Cecilia Shanti Dewi

Assistant Manager

M.Sc. and Double Degree Programmes (DDP)

She supports the academic administration of DDP and also organises field trips and events for students

Ho Eng Choo

Senior Executive (NUSDeltares)

Office of the Deputy President (Research & Technology)

She supports in accounting and reporting functions

Ivy Poh

Assistant Manager

Human Resources

Responsibilities include overall administration of recruitment and staffing, and other HR functions.

Noor Julihati Jufri

MAO (Finance)

She is involved in Research project administration, invoice payments and research expenditure management

Rachel Kwek

CPA, SIngapore

Manager (Finance), SDWA & NUSDeltares

She handles account operations and is currently also responsible for Finance/Accounting operations of SDWA and NUSDeltares.

Sahrilawati Binte Abd Karim

MAO (HR)

Management Assistant Officer (Human Resource)

Sahrilawati assist Ms Ivy Poh in executing the HR functions in Singapore-Delft Water Alliance

Sally Teh

MAO

Personal Assistant to Director

Sally Teh is the secretary to the Directors, manages all appointments & meetings. She also handles purchases and maintains daily office operations.

PREVIOUS STAFF

RESEARCH STAFF

Pham Ngoc	Research Fellow
Abhijit Badwe	Research Fellow
Huang Weidong	Research Fellow
Mary Posa	Research Fellow
Huang Yilong	Research Fellow
Rao Raghuraj	Research Fellow
Ann Sisomphon	Research Fellow
Doan Chi Dung	Research Fellow
Vijayaraghavan Srivatsan	Research Fellow
Nguyen Ngoc Son	Research Fellow
Mark Fielding	Research Fellow
Pramanik Niranjan	Research Fellow
Nguyen Hoang Huy	Research Fellow
Augustine Quek	Research Fellow
Oliver Wurl	Research Fellow
Ester Clews	Research Fellow
Kuppussamy Vijay	Research Fellow
Muthuswamy Satishkumar	Research Fellow
Shruti Pavagadhi	Research Engineer
Daniel Friess	Research Fellow
Kelvin Loh	Research Engineer
He Jun	Research Associate
Rosa Celia	Research Assistant
Sun Yabin	Research Associate
Demis Galli	Research Engineer
Ambarish Biswas	Research Associate
Yeo Chow Khoon	Research Engineer
Nyi Nyi Naing	Research Engineer
Lei Fengyang	Research Associate
Quek Rop Fun	Research Assistant
Joakim Bergenwall	Research Assistant
Guilaume De La Fons	Research Associate
Jeremy Woodford	Lab Technician
Wang Jianjun	Research Engineer
Rick Leong	Research Assistant
Ng Kim Hoe	Lab Technologist

ADMINISTRATIVE STAFF

Lai Tz An, Anne	Manager
Sae'dah Ibrahim	MAO
Zuleeza Sari	MAO
Hilwa Abdullah	MAO
Edward Chia	Lab Executive
Raymond Koo	MAO
Avan Neo	Engineer
Desmond Hang	Manager
Frederick Chng	Manager
Jayashri Krishnan	Manager

CIVIL AND ENVIRONMENTAL ENGINEERING STAFF SUPPORT

Sit Beng Chiat,

Mr Semawi Bin Sadi

Mr Koh Seng Chee, Roger

Mr Shaja Khan

Mr Ang Beng Oon

Mr Foo Chee Kiong

Mdm Jamilah Bte Mohd

Ms Tan Xiaolan

Mr Chandrasegaran S/O Govindaraju

Ms Lee Leng Leng

Ms Chia Yuit Ching, Susan

Mr Mohamed Sidek Bin Ahmad

Mr Sukiantor Bin Tokiman

Ms Tan Hwee Bee

Mr Tan Seck Wei, Adrian

Dr. Shen Wei

Ms Siti Rohani Bte Mohammed Sani

Ms Yap-Chong Wei Leng

Mr Lim Huay Bak

Mr Heng Hiang Cheow

Madam Oh Siew Choo

Hans S. Eikaas

Principal Limnologist

Ph.D. (Environmental Science);

Research Interests: Numerical water quality & quantity modelling, stream and river ecology, stream ecosystem processes and sustainable development, toxicology, wetland ecology and protection, water treatment technologies, limnology

Michelle Sim Cheng Hua

Principal Biologist

Ph.D. (Environmental Science);

Research Interests: Treatment wetland technology; Wetland restoration; Phytoremediation; Water quality and ecology management; limnology

Others

Twinkle Tom

Kok Meng Tan

VISITING ARTISTS

Clea T. Waite

Clea T. Waite is a research-artist whose computer animation, stereoscopic, multi-channel video-installation, hemispherical digital-film, and collaboration with several hundred tropical spiders examine the meta-meanings found in unlikely correspondences between science and myth. Trained as a physicist and computer scientist at MIT, Waite's artistic process incorporates a dual path of inquiry, balancing aesthetics, exploration with innovative, technical realization. Native to New York City, she studied Electronic Optics (SB) at MIT and 3D Computer Graphics and Animation (SMVis) at the MIT Media Laboratory. Dividing her time between NYC and Berlin, she's held positions as Adjunct Asst. Professor - Computer Graphics, Pratt Institute, NY, and Assoc. Professor - Digital Artistic Montage, Academy of Film and Television "Konrad Wolf', Babelsberg, Germany. She has been a research-artist fellow in many academic and scientific institutions, most recently at the Radcliffe Institute for Advanced Study at Harvard University. She was an artist in residence for iSEA, the International Symposium on Electronic Art, 2008, with the Singapore Delft Water Alliance at National University of Singapore.

The Water Book is an interactive film-installation in which water is the subject, the substance, the form, and the interface of the work. The piece advocates "water literacy", examining this tacit player's role in issues of environment, health, distribution of wealth, and political power, as well as science, spirituality, culture, and beauty.

Marc Böhlen

Associate Professor ,
Department of media studies
Director of graduate studies at
University at Buffalo

Artist-Engineer Marc Böhlen aka RealTechSupport (CH/US) offers the kind of support technology really needs. Böhlen designs and builds information processing systems that critically reflect on information as a cultural value through speculative robotics interventions. His projects query the relationship between people and automation systems in fundamental ways, with a current focus on public computational media: the making of information for shared concerns in the public realm. Böhlen is Director of Graduate Studies in the Department of Media Study at the University at Buffalo. His work has

WaterBar:
The installation WaterBar imagines a future when clean water is simply not good enough. WaterBar geo-engineers mineralized water by circulating water through a filter media with particular properties. It begins with a cleaning stage via an anthracite filter for odor control. The water then passes through a filter bank of rocks and minerals with select properties. These properties are real: physically, due to their ability to impart trace elements and culturally, due to their origin and history.

ACADEMIC VISITORS

Dr. Christopher Ellis

Sr. Research Associate, St. Anthony Falls Laboratory, University of Minnesota

Prof. David Goldberg

Professor of General Engineering, University of Illinois, He is the director of Illinois genetic algorithms laboratory (IlliGAL) and also the chief scientist of Nextumi Inc.

Dr. Jaap Kaandorp

Associate Professor, Section Computational Science, Faculty of Science University of Amsterdam, Netherlands

Prof. Kyle Patrick Graham

Deputy Executive Director of Louisiana's Coastal Protection and Restoration Authority.

Dr. Lord Hunt Julian Charles Roland

Professor of Fluid Mechanics, University of Cambridge

Prof. Maria da Conceição Cunha

Professor at the Civil Engineering Department, University of Coimbra

Prof. Michael Barber

Vice-Chancellor, Flinders University

Dr. Nicole Cormier

Ecologist for the US Geological Survey, National Wetlands Research Center, in Lafayette, Louisiana

Dr. Philippe Gachon

McGill University (Montreal, QC) Research Scientist - Climate Scenarios and Downscaling Research

Prof. Sithanandam Sundaramoorthy

Pondicherry Engineering College, India

Dr. Van Tanh Van Nguyen

Civil Engineering and Applied Mechanics; Brace Professor of Civil Engineering and Associate Directors, Global Environmental and Climate Change Centre, Brace Centre for Water Resources Management

A. (Adri) Verwey

Senior Specialist

Modelling Systems

Research Interests: Urban Drainage, SOBEK model simulations, mathematical modelling ; 2D hydrodynamic models

A.J.J. (Toine) Vergroesen

Senior Hydrologist

Ph.D. (Applied Mathematics and Numerical Analysis); Oceanography

Research Interests: Experimental research and hydrological model development; groundwater modeler; Sustainable Urban Drainage Systems; urban rainfall-runoff processes

dr. A. (Aljosja) Hooijer

Senior Advisor

Peatland management

Research Interests: Hydrology and soils' monitoring, emission quantification and reduction, macro-zoning and physical mapping; Assessing peatland vulnerability

Ann Piyamarn Leangruxa Sisomphon

Researcher/Advisor

PhD in Coastal Geosciences & Engineering

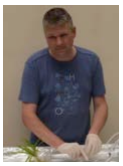
Research topics: Hydrodynamics and real-time operational systems, Modelling of sea level and current anomalies, Data assimilation, water quality monitoring

Arthur E. Mynett

Director

Strategic Research; Professor of Environmental Hydroinformatics

Research Interests: civil and maritime engineering, applications of information and communication technologies in environmental hydroscience and engineering



Arjan Wijdeveld

Investigator

Drs. (Geochemistry);

Research Interests: Water quality, Ecotoxicology, Degradation of pollutants, Pond and River restoration (by capping), Sediment/water interaction of pollutants, Rhizosphere biology, Metabolomics

dr. M.C.J.L. (Claire) Jeuken

Senior Advisor

Marine and Coastal Systems

Research Interests: estuarine and coastal systems, morphology, hydrodynamics, eco-engineering,sustainable management

D.J. (Daniel) Twigt

Researcher/Advisor

Marine and Coastal Systems

Research Interests: Hydrodynamic modelling of free surface flows; forecasting systems based on hydrodynamic and water quality models

Dr. David Burger

Water Quality Scientist/Advisor

Ph.D (Limnology)

Research Interests: Water Quality and Ecosystems Management, Freshwater ecology and lakes water quality management and restoration; ecological guidelines

D.K. (Deepak) Vatvani

Senior Advisor

Hydrodynamics;

Research Interests: Hydrodynamic modelling; Storm surge and Tsunami flood hazard mapping; Cyclone Early Warning Systems; water quality modelling

Dick Verploegh

Senior Assistant

Marine Coastal Systems

Research Interests: Impact of bubble plumes on salinity and thermal stratification; hydrodynamic simulations; Environment Impact assessments

Dirk Schwanenberg

Senior Engineer

Operational Water Management Group, Inland Water Systems Division

Design and development of a Decision Support Systems; Hydro Modeling Software; flood early warning system (FEWS); flood forecasting

Dirk Sebastian (Bas) van Maren

Senior Researcher/ Consultant

Ph.D. (Physical Geography);

Research Interests: Fine sediment transport, tidal dynamics, estuarine morphology, density-driven flows, port- and channel siltation

Dr. Ellis Penning

Aquatic Ecologist

Research Interests: Aquatic ecology, macrophytes, instream wetlands, bioremediation, ecohydraulics, ecological status assessments, water quality, management of urban waters, shallow lakes ecology (limnology)

Frank Kleissen

Senior Researcher/Advisor

Research topics: water quality modelling, Oil spill modelling, Operational Management System, hydrodynamic modelling

Firmijn Zijl

Researcher/Advisor

Marine and Coastal Systems Division

Research topics: hydrodynamic modelling of free surface flows; simulation of near- and far-field buoyant jets and plumes; modelling complex tidal systems

Geert Prinsen

Senior Advisor/Researcher

M. Sc. (Applied Mathematics);

Research Interests: hydrology, water distribution, real time control, hydrodynamics, flooding

G.Y.H. (Ghada) El Serafy

Specialist

Ph.D, Hydrodynamic operational forecasting systems

Research Interests: Hydraulics, Hydrology, Groundwater, Sedimentology and Morphology, data assimilation in ecological systems and morphological changes

Hans Los

Specialist Ecology

Ph.D. (Environmental Sciences); Specialist Ecology

Research Interests: Eco Hydrodynamics, primary production, algae blooms, management of reservoirs and coastal waters, integrated ecosystems approach, real time forecasting, modelling

Harm Duel

Head

Freshwater Ecology and Water Quality Department

Research Topics: Wetlands, ecological rehabilitation of rivers and lakes, ecological models and habitat suitability evaluation, ecological impact assessment

dr. H.F.P. (Henk) van den Boogaard

Specialist

Modelling and Data Analysis

Research Interests: Neural networks, model calibration , to analyse trends and uncertainties in time series data, detection and correction of gaps, software tools for data preprocessing

Dr. H. (Herman) Gerritsen

Senior Researcher

Ph.D. (Applied Mathematics and Numerical Analysis); Oceanography

Research Interests: Data model integration / data assimilation, open seas and estuarine flow and transport modelling, tidal predictions, storm surge modelling and forecasts

I.J.P. (Irv) Elshoff

Computer Scientist

MSc

Key words: information and communication technology, design and implementation of software modelling systems, read-time data acquisition and processing

Dr. J. (Jaap) Schellekens

Expert Advisor

Ph.D. (Tropical forest hydrology and hydrological modelling); Catchment hydrology department

Research Interests: Hydrological modelling, watershed management and flood forecasting; hydrometeorological measurement techniques

J.J. (JanJaap) Brinkman

Senior Advisor

Water resources, environmental, database and coastal zone management

Research Interests: water quality management, river and coastal zone ecology and Decision Support System development, GIS, marine pollution, environmental impact assessment

J.M. (Jamie) Lescinski

Engineering Researcher and Consultant

MSc, Ocean Engineering

Research Interests: Project management, Building with Nature, Recirculation and plume dispersion, pipe design, modelling storm impacts

Jasper Tjaard Dijkstra

Researcher/Advisor

Ph.D, Hydraulic Engineering

Research Topics: biota-flow interactions, environmental impact study, water quality, ecology

J.C.(Han) Winterwerp

Prof. dr.ir

Senior Specialist Morphodynamics & Sediment transport

Research interests: estuarine morphology, fine sediment dynamics, sediment mixtures, sediment-fluid interactions, mangrove-mud coasts, wetlands

J.M. (John) Cornelisse

Senior Researcher/Advisor

Marine and Coastal Systems;

Research Interests: Behaviour of cohesive sediments; erosion by currents and waves, deposition and flocculation of mud; developing and building instruments and measuring techniques

Johannes Smits

Expert Researcher/Advisor

MSc. (Chemical Engineering);

Research Interests: water and sediment water quality, pollutant emissions, water quality modeling, biogeochemistry, water quality management, water and sediment quality processes, model development

Leo Postma

Senior Water Quality Specialist

MSc Applied Mathematics,

Specialties: multi-dimensional transport and water quality modelling, mathematical formulations of water quality and ecological processes, expert judgement in practical water quality situations.

drs. M. (Marjolijn) Haasnoot

Environmental Scientist

Water management and environmental modelling

Reserach Interests: Impact assessments; water management strategies, integrated river basin management, ecohydrological and habitat models

Marmix Pieter Van der Vat

Senior Advisor

Research Interests: Hydrological modeling; river basin planning; modelling in GIS of subsidence and emissions; modelling of surface and groundwater; water resources management; flood damage assessment

Martin Verlaan

Senior Researcher

Ph.D. Applied Mathematics
Data Assimilation & Operational forecasting

Research topics: Open DA, storm surge forecasting, marine operational forecasting, automated calibration, operational databases and tidal prediction

Dr. Meinte Blaas

Senior Researcher/Advisor

Environmental Hydrodynamics and Water Quality Monitoring

Research Interests: Dredging information systems; water quality and phytoplankton transport; tsunamis; suspended matter monitoring; Impact assessment

drs. M.B. (Mindert) de Vries

Specialist Advisor

Eco-Engineering

Research Interests: Building with Nature; Saltmarsh restoration; biogeomorphology; water quality control; mangrove degradation; environmental impact assessment

Nicki Villars

Senior Advisor

M.Sc. Civil and Environmental Engineering;

Research Interests: Water quality modelling and monitoring, water quality assessments, remote sensing, operational information systems

dr. P. (Paolo) Reggiani

Senior Specialist

Senior Water Resources and Environmental Specialist

Research Interests: Hydrology, water resources management ; flood and low flow forecasting; distributed hydrological modeling systems and climate impact assessment

Paul Erftemeijer

Senior Advisor

Marine Ecology

Research Interests: ecology and management of coastal and marine ecosystems; coastal wetland conservation; mangrove research; ecological impact assessments, habitat studies

dr.ir. R.E. (Rob) Uitenbogaard

Senior Specialist

Hydrodynamics of natural waters

Research Interests: geophysical flows, stratified tidal flows, physics of 2D and 3D turbulence, turbulence modelling, internal waves and wave-current interactions

Robert M. (Bob) Hoogendoorn

Applied Scientist

Ph.D in Geology

Research topics: architecture of sedimentary systems, project management and business development in geosciences

Ronald Vernimmen

Hydrologist/ Researcher/Advisor

MSc (environmental sciences)

Research interests: Peatland subsidence, Peatland hydrology, Peatland mapping, fire and drought early warning

R.J. (Ruben) Dahm

Researcher/ Advisor

Research topics: hydrology and flooding, modeling water systems using SOBEK, model schematizations, uncertainty analyses and calibration

S. (Sandra) Gaytan Aguilar

Researcher

MSc

Key expertise/research interest: Data Assimilation, Parameter optimization, Model validation, Uncertainty and Sensitivity analysis, Correlation analysis, Remote sensing data, Evaluation of measurements networks.

Stef Hummel

Specialist Software Architecture

Research topics:Model Integration, Open DA, integrated water models, water distribution optimisation, Delft 3D

S.K.H. (Stephanie) Janssen

Consultant

Integrated Spatial Development

Research Interests: Building with Nature, knowledge in decision making, integrated spatial development, stakeholder analysis, governance, interdisciplinary research

dr. T.C. (Theo) Prins

Senior Researcher/ Advisor

Ph.D., Marine Ecology

Research Interests: Marine eutrophication, data analysis, ecological guidelines

Thijs van Kessel

Chemical Engineer

Research interests: fine sediment transport modelling; analysis of sediment samples, system understanding of the fine sediment dynamics, sediment parameter settings for the sediment model.

Tjeerd Bouma

Researcher

Research topics: restoration ecology; dredging near sensitive ecosystems; coastal defence; wave attenuation; biogoemorphology; biophysical interactions; ecosystem engineers; erosion; sediment accretion

OVERSEAS COLLABORATORS

University of Helsinki, Finland

Jyrki Jauhiainen

University of Twente, The Netherlands

Suzanne Hulscher
Marjolein Dohmen-Janssen

University of Leicester, UK

Susan Page

Radboud University Nijmegen, The Netherlands

Peter Herman

University of Minho, Portugal

Jose Manual Pereira
Jose Luis Da Silva Pinho

University of Amsterdam, The Netherlands

Peter Sloot
Jaap A. Kaandorp

Massachusetts Institute of Technology Cambridge, USA

Karen Wilcox

McGill University, Canada

Van Thanh Van Nguyen
Phillippe Gachon
Tan Danh Nguyen

National Centre for Atmospheric Research, USA

Gregory Holland
Brant Foote

Delft University of Technology

Peter Jules Van Overloop

University of Bologna, Italy

Vincenzo Levizzani

Universiti Putra Malaysia

Mohd. Nazre Saleh

Ecoshape

Jan van de Meene

Porifarma, Amsterdam

Ir. Jasper Merjin

Flinders University

Michael Barber
Elda Markovic
Stephen Clarke

University College London, UK

Julian Hunt

University of Illinois,IL

David Goldberg

Pondicherry Engineering College, India

Sundaramoorthy

Collins Kumarasinghe Associates

Michael Collins

US Geological Survey, National Wetlands Research Centre, USA

Kenneth Krauss
Nicole Cormier

University of Minnesota, USA

Christopher Ellis

University of Minnesota, USA

V.Balaji

NUS COLLABORATORS AND INVESTIGATORS

Sanjay Swarup

Associate Professor

A multidisciplinary approach incorporating hydraulics, genomics, metabolomics, computational and graphical modelling, and high-resolution imaging to study mechanisms that govern biofilm formation and plant metabolic processes in urban freshwater conditions is undertaken.

Peter Todd

Assistant Professor

His research interests are marine biology, evolutionary ecology, phenotypic plasticity, the function of colours and morphology and behaviour; symmetry in scleractinian corals; crypsis and polymorphism crabs, multivariate statistics

Edward L. Webb

Associate Professor

He is interested in applied plant ecology as it pertains to the conservation and management of plants in tropical and subtropical forests. This includes basic quantitative descriptions of habitat composition and structure.

Hugh Tan Tiang Wah

Associate Professor

His research interests include conservation biology, restoration ecology, plant systematics, urban agriculture. The main focus of his research is biological conservation of the vascular plants, especially those of Singapore.

Peter Ng Kee Lin

Professor

His research interests include systematics and ecology of crabs (Indo-West Pacific), larval development and ecology of crabs and Crustaceans and freshwater fish taxonomy and ecology (Southeast Asia)

Ong Bee Lian

Assistant Professor

Her research is actively focused on studies on developmental, physiological and biochemical processes in tropical plants, so as to understand how they adapt to environmental stresses such as high light, drought, salt stress, high/low N and anoxia.

DEPARTMENT OF BIOLOGICAL SCIENCES

Prakash Kumar

Professor

His research areas include plant development, tissue culture, plant physiology and molecular biology. His main research aims at understanding physiological and molecular aspects of the regulation of shoot development.

Chou Loke Ming

Professor

His research interests are coral reef biology, coastal management and conservation. His research focusses on habitat restoration/remediation based on good science in Southeast Asia where intense anthropogenic pressure has significantly depressed

Tan Heok Hui

Lecturer

Fish Taxanomy

Kelvin Lim Kok Peng

Collections Manager

Curator of vertebrate (fish, amphibian, reptile, bird and mammal) collections

Tan Swee Hee

Project Manager

Lee Kong Chian Natural History Museum Proje

Sivasothi N

Senior Lecturer

Biodiversity

DEPARTMENT OF GEOGRAPHY

Alan Ziegler

Associate Professor

His interests include determining if intensive agrarian systems on sloping lands in SE Asia are environmentally sustainable in terms of water availability, water quality, land degradation processes (erosion, landslides), biodiversity, and carbon sequestration.

Wang Yi-Chen

Assistant Professor

She is a member of the Biogeography Specialty Group of the American Association of Geographers. She is also part of the Tropical Environmental Change Group.

Daniel Friess

Associate Professor

Dan is a coastal geomorphologist and remote sensing scientist. His research concerns geomorphological (especially sea level rise) and human land use threats to mangrove ecosystems in SE Asia. He uses ground surveying and satellite remote sensing techniques for these studies.

Lu Xixi

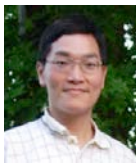
Associate Professor

He is an associate editor of International Journal of Sediment Research, and a member of the editorial boards of Hydrological Processes, Earth Surface Processes and Landforms, Singapore Journal of Tropical Geography

David Higgit

Professor

His research is focused on sediment delivery processes – the temporal and spatial dynamics of sediment production and transfer. His work encompasses soil erosion assessment and land degradation, construction of sediment budgets and the interactions between erosion processes and surface characteristics.



Feng Chen-Chieh

Assistant Professor

Dr Chen-Chieh Feng sits on the Undergraduate Sub-Committee (USC) and also part of the Tropical Environmental Change Group. He is also a member of the Infrastructure Sub-Committee (ISC).

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Balasubramanian Rajasekhar

Associate Professor

His research interests include Air Quality, Climate Change, Aerosol Science and Technology, Environmental and Health Risk Assessment, and Water Quality.

Cheong Hin Fatt

Professor

His research was focusses on the statistical properties of alluvial bed forms and the stochastic analysis of the motion of sand grains along the alluvial bed in an open channel flow.

Chew Soon Hoe

Assistant Professor

His research interests include soil improvement of soft ground, Geosynthetics, Geotechnical seismic study and Numerical modelling of geotechnical problems.

May Chui

Assistant Professor

Research Interests: Environmental Fluid Mechanics and Hydrology, modeling the hydrologic interactions between an aging reservoir and the surrounding groundwater, modeling the coupled hydrologic and vegetation responses in freshwater wetlands.

Vivien Chua Pei Wen

Assistant Professor

Dr. Chua's research interests lie in the study of processes that influence the dynamics of the coastal ocean, rivers, lakes and estuaries, and the implications of storm surge inundation on coastal areas.

Ong Say Leong

Professor

Professor Ong is a registered professional engineer and has been involved in consulting jobs on water and wastewater treatment and water quality management. He also serves in editorial positions in 10 international journals in the area of water environment.

Karina Gin Yew-Hoong

Associate Professor

Her research specialisation is in the area of water quality, fate and transport of emerging contaminants and ecosystem processes. She is a co-recipient of the Technology Enterprise Challenge Innovator Award for Enhanced Engineered Wetland Technology.

Barry C. Kelly

Assistant Professor

Dr. Kelly has experience in developing fugacity-based computer simulation models representing chemical fate and bioaccumulation in aquatic and terrestrial systems. He specializes in the field of environmental chemistry and toxicology.

CENTRE FOR REMOTE IMAGING, SENSING AND PROCESSING

Liew Soo Chin

Principal Research Scientist

His research is mainly focused on atmospheric correction of hyperspectral data, hyperspectral data analysis and applications in land cover classification, derivation of optical properties and water quality parameters of sea and inland waters from remote sensing reflectance data

TROPICAL MARINE SCIENCE INSTITUTE

Liong Shie-Yui

Deputy Director and Principal Research Fellow

His research interests include hydroinformatics; hydrology and water resources; integrated water resources management; climate change downscaling and impacts and eco-Hydraulics.

Sin Tsai Min

Senior Research Fellow

Ph.D. (Biological Sciences)

Research interests: Coral reef ecosystems and marine biogeography, benthic invertebrate biodiversity, taxonomy and ecology of tropical coral reef fish.

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Lakshminarayanan Samavedham

Associate Professor

His research interests are informatics: Machine Learning and Data Analysis; PSE Applications in Medicine; Control: Biomedical Applications and Chemical Process Applications

SCHOOL OF DESIGN AND ENVIRONMENT

Lim Guan Tiong

Senior Lecturer

His research Interests include structural system and architectural space and form and architecture as an ecosystem (plants and buildings)

Tan Puay Yok

Associate Professor

His research areas are functional performance of urban landscapes, urban greenery solutions for the built environment and urban ecology

Herbert Dreiseitl

Visiting Associate Professor

His research areas include design theory, design aesthetics and the design process in landscape architecture and urban infrastructure; water sensitive urban design, water management in urban areas; human interaction with infrastructures in urban landscapes

DEPARTMENT OF MECHANICAL ENGINEERING

Khoo Boo Cheong

Professor

His research interests lies in the fields of computational fluid dynamics and numerical methods

DEPARTMENT OF PHYSIOLOGY

Manoor Prakash Hande

Associate Professor

His research areas includes molecular biology especially study of telomeres and telomerase in ageing and cancer, DNA damage response and repair; toxicology especially toxicogenomics and environmental toxicology; radiation biology - biological response markers of exposure and experimental therapeutics

DEPARTMENT OF STATISTICS AND APPLIED PROBABILITY

David Nott

Associate Professor

His research interests include Bayesian model selection, Bayesian nonparametrics, hierarchical models, Markov chain Monte Carlo, spatio-temporal modelling.

DEPARTMENT OF CHEMISTRY

Lee Hian Kee

Professor

His research interests are focused on capillary electrophoresis, chromatography-mass spectrometry, developing extraction procedures like cartridge- and disk-based solid-phase extraction, and solventless and solvent-minimised extraction procedures

EVENTS

SEMINARS. WORKSHOPS. CONFERENCES

In an effort to disseminate scientific knowledge, SDWA organises seminars, workshops, public lectures and conferences. Every Wednesday evening research seminars are organized in which SDWA staff or invited speakers present their research. Research seminars are open to all.

SDWA has about 194 scientific seminars to its credit in the past 5 years. SDWA hosts biannual scientific workshops alternating in Delft and Singapore every year. These workshops aim at updating the scientific work conducted at SDWA.

SDWA is a regular participant at the Singapore International Water Week (SIWW) every year

Since inception in 2007 till 2012, SDWA has hosted about 51 events some of which were very high profile visits such as the Royal visit by Her Majesty Queen of Netherlands, His Highness Prince of Orange and Princess Maxima for the renaming of the Aquatic Science Centre to Van Kleef Centre. This visit was also witnessed by the Ambassador at large – Prof. Tommy Koh and NUS Chairman Mr. Wong Ngit Liong.

Another important visit was the reception for H.E. Dr Jan Peter Balkenende, then Prime Minister of Netherlands and the naming of the private road to Van Kleef Centre as Albert Winsemius Lane on 23 Oct 2009.

Dr. Vivian Balakrishnan, Minister of the Environment and Water Resources officiated at the opening ceremony of the Van Kleef Centre on 6th July 2011, then known as the Aquatic Science Centre@ Sungei Ulu Pandan.

Environment and Water Resources Minister, Dr Yaacob Ibrahim officiated at the Launch of Aquatic Science Centre 02 Jul 2008.

2012

APRIL

- 19th. SWIN Nite!
  Aquatic Science Centre @ Sg Ulu Pandan

JULY

- 1st-5th. SIWW 2012
  Marina Bay Sands

2011

JANUARY

- 3rd-6th. IPWE2011 (4th International Perspective on Water Resources & the Environment)
  FoE, Singapore
- 20th-21st. Marine Eco-Dynamic Design
  SDAH, Singapore

APRIL

- 18th-20th. 10th SDWA Workshop
  Delft, The Netherlands

OCTOBER

- 2nd. 2nd Singapore-Netherlands Water Challenge

  Aquatic Science Centre @ Sg Ulu Pandan

- 24th. Seminar on Biological Approaches to Coastal Enhancement and Restoration

  University Hall Auditorium, NUS

JULY

- 4th-7th. Singapore International Water Week 2011

  Suntec City Convention

- 6th. Opening of Aquatic Science Centre

  No 3 Albert Winsemius Lane

JUNE

- 8th-9th. Round table discussion on integration of Deep Thunder and Hydrological Modelling

  SDWA, Singapore

- 27th-28th. Urban Sustainability Congress

  Biopolis, Singapore

SEPTEMBER

- 24th. Singapore Biodiversity Symposium

  NUS

2010

APRIL

20th-21st. 7th SDWA Workshop

SFAH, Singapore

JUNE

28th-1st July Singapore International Water Week 2010

Suntec City Convention

2009

JANUARY

22nd. Microbial Genomics, Genomics Technology and Environmental Applications

Professor Jizhong Zhou

FEBRUARY

9th-11th. Multi-Reservoir Workshop WP 3 & 4

Dr Adri Verwey / Dr Liong Shie-Yui

MARCH

11th-13th. SolGel + SmartSoil Workshop

A/Prof Sanjay Swarup / Prof Stephen Clarke

APRIL

20th-22nd. 5th SDWA Workshop

All projects PIs

SEPTEMBER

- 22nd-24th. 8th SDWA Workshop
  Delft, The Netherlands

NOVEMBER

- 14th-16th. 9th SDWA Workshop
  Uhall, Singapore

JUNE

- 3rd-5th. Kick-off Meeting Upper Peirce Project
  A/P Bala Rajasekhar
- 22nd-25th. Singapore International Water Week 09
  Suntec City
- 29th The Missing Basics: What Engineers Don't Learn and Why They Don't Learn It
  Prof David Goldberg

SEPTEMBER

- 28th-2nd Oct. Delft3D course for HDB
  Dr Joost Buurman
- 22nd-25th. Punggol-Serangoon Kick-off Meeting
  Dr Joost Buurman

OCTOBER

- 23rd. Visit of Prime Minister of the Netherlands, H.E. dr Jan Peter Balkenende
  A/Prof Vladan Babovic
- 29th. Water Management in global perspective: from Multi-governance of water to multi-level water governance
  Prof Theo Toonen

NOVEMBER

- 12th-13th. SDWA & Deltares Introductory Delft3D-Flow Workshop
  SDWA
- 18th-20th. 6th SDWA Workshop
  SDWA
- 24th-26th. SOBEK Course
  SDWA

2008

FEBRUARY

- 21st-22nd. NUS Career Day 2008

MARCH

- 26th. Integrated water resources management and floor control with hydrologic modeling

  Prof Fabio Castelli

APRIL

- 2nd. Visit by Deputy Permanent Secretary – 2DS Ministry of National Development
- 17th. Modelling waves and currents in the coastal Zone

  Prof G. S. Stelling
- 21st-23rd. 2nd SDWA Workshop

JUNE

- 19th-20th. 3rd SDWA Workshop

  All Project Leaders
- 24th-26th. SIWW
- 25th Signing of MOU with Flinders University on ARC Linkage Project

2007

AUGUST

- 30th. Ecohydromorphology; linking abiotic and biotic factors in water management

  Ms Ellis Penning
- 31st. SDWA Logo Competition

SEPTEMBER

- 10th. 1st ASC Pandan Workshop

  ASC Pandan Team Members

JULY

- 2nd. Launch of ASC Pandan at Sg Ulu Pandan

OCTOBER

- 14th. Urban land & water management for creating a better living environment

  Dr. ir. Frans H. M. van de Ven

NOVEMBER

- 27th. The Marina Barrage
- 17th-19th. 4th SDWA Workshop

DECEMBER

- 8th - 10th. Multi-Reservoir Workshop WP 1 & 2

  Dr Adri Verwey / Dr Liong Shie-Yui

OCTOBER

- 3rd. From genetic Algorithms to Invention Machines & Creativity Support

  Prof David E. Goldberg

- 5th. The distinguish Lecture Series: The Creativity Imperative and the Technology Professional of the Future

  Prof David E. Goldberg

- 29th-31st. 1st SDWA Workshop

NOVEMBER

- 10th. 5th Life Science Career Day 2007

SDWA WEEKLY RESEARCH SEMINAR/ TALK

2012

Flexible Decision Frameworks for Long-term Water Resources Planning

Ms Melanie Wong

Modular data driven approach for rainfall-runoff modelling

Ms Lekhangani Arunoda Basnayake

Climate Change Uncertainties and Policies with Real Options

Mr Lawrence Chan

Water-Soluable Organic Nitrogen in precipitation and fine particles over a Suburban Area

Ms Elvagris Segovia

Enhancing wave prediction through model residue correction based on Chaos theory and Kriging

Dr Wang Xuan

Development of an Integrated Camera System for water quality monitoring in tropical and moderate climates

Mr Philipp Grötsch

Experiencing and Understanding the 2011 Bangkok Flood Disaster

Dr Adri Verwey

Australia's new National Eco-Hydrologic Modelling Platform – the eWater Source suite. Urban capabilities and applications

Dr Robert Carr

Understanding Water Resource issues in the Red River Delta, Vietnam

Dr Bui Du Duong

A Systematic Evaluation of Pond Habitats in Singapore

Mr Adam Quek

An Empirical Method for Approximating Canopy Throughfall

Ms Trinh Dieu Huong

Effects of Sediments, Water and Land use patterns in Shaping Microbial Community Composition and Functioning in Urban Freshwater System

Mr Gouvendu Saxena

Research Challenges from the Punggol-Serangoon Reservoir Project

Mr Chakravarthy Mynampati Kalyan

Improved dynamic emulation modeling by time-series clustering: the case study of Marina Reservoir, Singapore

Ms Stefania Caietti Marin

Model Predictive Control on a large scale water system: the South-North water diversion project in Jiangsu, China

Mr Meinte Vierstra

Hydrological data processing and modeling for effective flood forecasting

Dr Petra S. Dr Rama R. Dr Bui DD and team

Developing Integrated Forecast System with FEWs Framework

Mr Pavlo Zemskyy

WaterBar

Prof Marc Böhlen

Proposed Model for Multi-Criteria Decision Making And its Applicability in Evaluating the Sustainability of Water Management Plans

Ms Bui Nuong Thi

Model order reduction of nonlinear models

Mr Javier Rodríguez

Thermally induced mass coral bleaching around the Thai-Malay Peninsula: Effect on growth of massive porites corals

Ms Jani Thuaibah Isa Tanzil

Numerical Considerations in Unstructured-Grid Estuarine Modelling

Dr Vivien Chua P.W.

Advances in applied modeling for sedimentary geology

Dr R. M. Hoogendoorn

Beyond CO2: clarifying and quantifying interactions between 'haze' and the climate system

Asst Prof Jason Blake Cohen

Bacteria in rainwater and run off samples: Detection and Quantification

Ms Rajni Kaushik

Data-driven stream flow predictions in an urban tropical catchment

Mr Lorenzo Cozzi

PhD thesis: Connectivity beyond biodiversity: Are physical fluxes important in the tropical coastal seascape

Ms Lucy Gwen Gilllis

Coral, sediment and snot

Ms Michelle Lee Ai Chin

Understanding microbes in urban freshwater systems - diversity and function

Dr Sheela Reuben

On improving sea level anomalies (surge) modeling in Singapore Regional Water using multi scale modeling approach

Mr Alamsyah Kurniawan

On the persistence of high turbidities in the Markermee shallow closed sea arm in The Netherlands

Mr Miguel de Lucas

A Crash Course in Coastal Remote Sensing

Mr James Francis Bramante

Real Options Analysis for CO2 Reduction Investments Under Uncertainty

Mr Laurence Chan

Water Infrastructure through design

Mr Tobias Baur

An investigation on the root system of mangroves and its influence on current flow

Mr Zhang Xiaofeng

Parameter sensitivity analysis and optimal model structures of IHACRES rainfall-runoff model within a tropical catchment

Mr Rickson Tan

Impact of human interventions on estuarine dynamics

Professor Han Winterwerp

Relationship between land use change, biogeochemistry and greenhouse gas emission in tropical peatlands

Mr Shailendra Mishra

2011

Bacterial Pathogens in Rainwater: Identification and Quantification

Ms Rajni Kaushik

Fine Root Productivity Varies Along Nitrogen, Phosphorus, and Stress Gradients in High-rainfall Mangrove Forests

Dr Nicole Cormier

Model Reduction for Design, Optimization, Inverse Problems and Quantification of Uncertainty in Large-scale Systems

Assoc Prof Karen Wilcox

Monitoring water quality of coastal and inland waters using high resolution satellite data

Dr Liew Soo Chin

Microbial Contaminants in Surface Waters

Assoc Prof Karina Gin

A first look at the seagrasses of Singapore

Ms Siti Maryam Yaakub

Model Predictive Control Strategies for Multiple-Objective Multi-Reservoir Management

Mr Abhay Anand

Dialogue with Lord Julian Hunt: Implications of Climate Change For Expanding Cities Worldwide

Lord Julian Hunt

Are all intertidal wetlands created equal?

Dr Dan Friess

Rainfall forecast with ensemble performance of translation model and numerical weather prediction

Dr. Nguyen Ngoc Son

3Di, Flooding simulation with 3D visualization based on detailed DTM's

Prof Guus Stelling

Data-driven dynamic emulation modelling for the optimal management of environmental systems

Dr Stefano Galelli

Water Quality Modelling and Consultancy

Mr Leo Postma

Examples of recent hydraulic engineering projects at Deltares

Dr Martijn de Jong

Monitoring dikes and levees

Ir Sven J. Plasman

Soil CO2 emission of oil palm plantation and open degraded ecosystem in drained peatland, Indonesia

Dr Huang Yilong

Potential and Application of Hydrodynamic Modeling on Unstructured Grids

Ir Adri Verwey

The applicability of the Particle Level Set Method to the modeling of sloshing fluids and breaking waves

Dr Philip Archer

Impacts of Drainage on Peatland Subsidence

Dr Desmond Lee

Reflections on Applied Research and Specialist Consultancy in an Industry Setting

Mr Mark Womersley

Preventive Maintenance of Water Distribution Networks

Mr Abbas Roozbahani

A Study of the Relationship between Pollutant Load and Roof Runoff in an Urban Area

Mr Phua Yong Bin

Fate, Bioaccumulation and Exposure Risks of Emerging Contaminants in Aquatic Ecosystems

Asst Prof Barry Kelly

The short life of mangroves: Thresholds to seedling establishment

Mr Thorsten Balke and Ms Eva van den Elzen

The biodiversity and conservation of tropical peat swamp forests

Dr Mary Rose C. Posa

Modeling of Sea Level and Current Anomalies in the Singapore Region

Mr Alamsyah Kurniawan

Field and Field-Scale Water Resource Experiments and Measurements

Dr Christopher R. Ellis

Developing High Resolution Digital TERRAIN ELEVATION DATA (DTED) Through Field Based And Airborne Techniques

Dr Durairaju Kumaran Raju

Development and Application of Comprehensive Aquatic System Model for Facilitating Understanding and Sound Management of Coastal Zone Ecosystems

Dr Zhang Jingjie

Closing Singapore's Water Loop

Dr Teo Kwang Meng

"Conventional" and "emerging" pollutants: occurrence and bioavailability

Dr Stéphane Bayen

Design of Complex Infrastructure Systems forUncertainty and Flexibility: A Taxonomy of Methods and Processes

Dr Michel Alexandre Cardin

Improving cost-effectiveness of reef restoration by optimising coral rearing time

Ms Samantha Lai W.Y.

Assessment of Phytoplankton Speciation in Upper Peirce Reservoir

Ms Lim Jin Zhi

Phytoplankton growth change due to bypassing of the inflow into Urayama Reservoir

Dr Hiroshi Yajima

The Role of Sediment Models And Mass Balance In Water Quality Modeling

Mr Arun Mahadevan

A real-time optimal control approach for water quality and quantity management: Marina Reservoir case study

Mr Albert Goedbloed

Rainfall-Runoff modelling of tropical urban catchment

Mr Rafael G. Assumpcao And Ms Panagiota Gkavakou

Brown Bag Lunch Talk
Forecasting the impact of sea level rise on coastal wetlands: the role of models

Dr Glenn R. Guntenspergen

Introduction of MODFLOW model in managing groundwater resources

Dr Desmond Lee

Manipulating topographic heterogeneity for enhancing diversity on seawalls

Ms Lynette Loke

Application of water quality models in sound management of aquatic ecosystems

Dr Zhang Jingjie and Mr Kalyan CM

Water Quality Modelling of Surface Water Systems: An Introduction

Ms Serene Tay HX

The impact of reservoirs and irrigation on carbon and nitrogen redistribution within lowlands in tropical mountainous areas

Dr Petra Schmitter

High resolution mesoscale modeling of tropical cyclone: orographic influence during TC Dina

Dr Samuel Jolivet

Improving predictions of non-tidal water levels and currents for Singapore regional waters through Data Assimilation

Dr Karri Rama Rao

Application of Numerical Modeling to Estimate the Soil Hydraulic Properties from Tension Infiltrometer Data

Mr Ali Meshgi

Exploration of Eco-Dynamic Design Potential: A Case Study of Possible Reclamation of Additional Land in front of East Coast Park, Singapore

Robbert de Bruijn, Simon den Hengst, Robert Hasselaar and Andrzej Tusinski

Accumulation of Potentially Toxic Elements in Road Deposited Sediments in Residential and Light Industrial Neighborhoods of Singapore

Ms J.Q. Yuen

DOES SINGAPORE HAVE CLEAN AIR? Review of Singapore's Air Quality and Greenhouse Gas Emissions

Dr Erik Velasco

2010

Water Quality Modelling based on Data Driven Techniques

Ms Arunoda Basnayake

Bioaccumulation studies in chromium contaminated land

Mr Shailendra Mishra

Land Cover Changes in the Sumatra Peatland Regions

Mr Wang Jianjun

Modelling hydrologic and vegetation responses to management in freshwater wetlands

Dr Chui Ting Fong, May

"How difficult is weather forecasting – A high resolution NWP model study"

Dr Srivatsan Vijayaraghavan

Constructing Sediment Budgets for Forested Streams in Singapore

Prof David Higgitt

A Composite Modelling application using error correction procedures

Dr Herman Gerristen

Automatic Differentiation in Model Predictive Control

Mr Mark Fielding

Macronutrients in plants

Dr Ong Bee Lian

Parameter Optimization and Data Assimilation to improve the tidal prediction of the Singapore Regional Model

Prof Guus Stelling

Mesoscopic modelling of growth and form

Prof Peter Sloot

Towards real-time realistic non-linear finite element simulations

Prof Karol Miller

Simulations of Vortex Rings and the Pursuit of Breaking Waves

Dr Philip John Archer

Power and Politics : The Bakun Dam in Sarawak, Malaysia

Dr Lee Poh Onn

Microbes: Drivers of geochemical cycles

Mr Gourvendu Saxena

The best way of Measuring Flow Patternson on Tidal Marshes

Mr Erik Horstman

Stress Physiology and Water Use of Tidal Freshwater Forested Wetlands and Mangroves of the Southeastern United States

Dr Ken Krauss

Quantitative analysis of Directional Strengths in Multivariate Processes

Dr Lakshiminarayanan Samavedham

Application of Residue-Correction-Based Data assimilation to Signapore Region Model

Ms Wang Xuan

Hydrodynamic modelling of a large flood prone river in Eastern India under limited cross-section data

Mr Niranjan Pramanik

Soft Sensor Based Nonlinear Control of a Chaotic Reactor

Mr Karri Rama Rao

The effect of large-scale green roof implementation on the rainfall-runoff in a tropical urbanized catchment: A Singapore City case study

Mr Jim van Spengen

On the probability of sliding of stacked containers under a storm condition

Prof Cheong Hin Fatt

Towards Coordinating Multiple Model Predictive Controllers for Multi-Reservoir Management

Mr Abhay Anand

Tree vs. Tide - How mangroves colonise bare mudflats

Mr Thorsten Balke

Modeling water quality in fresh water lakes

Mr Kaylan C. Mynampathi

Regime shifts in muddy systems

Dr Han Winterwerp

Remediation of Surface Water Systems Contaminated with Heavy Metals

Mr Augustine Quek

Woody Plants for the Phytoremediation Of Tropical Wetlands

Mr Yeo Chow Khoon

Green technologies for recovering noble metals

Dr Sathishkumar Muthuswamy

Rainfall-runoff modeling of urban catchments in Singapore

Mr Niranjan Pramanik

Inspiration = Rainfall & Evaporation

Dr Rob Uittenbogaard

Ecological Degradation and Recovery in the ex-Mega Rice Project Peat-Swamp Ecosystem, Central Kalimantan, Indonesia

Ms Grace Blackham

Typhoon-Induced Extreme Water Levels near Singapore – A Numerical Model Investigation

Ms Serene Tay HX

Flood Damage Assessment In The Mekong Delta, Vietnam

Dr Pham Ngoc

Model + Data – Toward accurate forecasting

Dr Abhijit Badwe

The art of poisoning

Mr Arjan Wijdeveld / Mr Kalyan Mynampati

Real Options for Rare Events in Climate Change

Mr Laurence Chan

The Must Have Box Project: Looking back and looking forward

Dr Ooi Seng Keat

Detection and Removal of Microcystins

Ms Rajni Kaushik

Evaluation and prediction of ecological change in freshwater systems

Dr Esther Clews

2009

Cyanotoxins: An important Water contaminant

Ms Rajni Kaushik

Metal accumulation by a strangler, *Ficus benjamina*

Mr Rajdev Narayanasamy

Changes in glutathione and related metabolism in rats exposed to high fluoride through drinking water and protection by methanollic extract of Terminalia arjuna

Ms Shruti Pavagadhi

Hydro-Ecological Approach to Predict the Potential Impact of Anthropogenic Inundation Change on Aquatic Species Diversity In Tropical Floodplains: A Case In The Tram Chim National Park, The Mekong Delta, Vietnam

Dr Pham Ngoc

Coral Reefs: Facing climate change and anthropogenic stress

Ms Jani Thuaibah

Multi-Reservoir Project – Progress in WP4

Dr Dirk Schwanenberg

Gaussian process emulation and MCMC schemes in the calibration of Sobek

Dr Mark James Fielding

From the gene to the ecosystem: mangrove reproductive ecology in a changing world

Dr Edward Webb

Assessment of community forest management in western Thailand

Mr Demis Galli

Part I: Synthetic time series Part II: Operational decision-making in forecasting

Dr Henk van den Boogaard

Architecture of Lagrangian particle tracking model, integrated into MINT environment and its applications

Mr Pavlo Zemskyy

Improving a decision support system in The Netherlands

Mr Albert Goedbloed

Real Options Analysis – Application to Singapore Water Supply System via Monte Carlo Simulation

Mr Nguyen Tan Thai Hung

A numerical study of intrusive gravity currents

Dr Ooi Seng Keat

A Personal Approach to the Multi-Cultural, Multi-Disciplinary SDWA and the Multi-Objective, Multi-Reservoir Management Project

Mr Javier Rodriguez

NO real option, A real option, to Portfolios of real options – system design in an uncertain world

Mr Stephen Zhang

Coastal Habitats and Coastal Protection: physical-ecological relationships

Dr Dan Friess

The state and conservation of Southeast Asian Biodiversity

Dr Mary Rose Posa

Research ID: How it can help you?

Dr Dirk Schwanenberg

Roadmap for microbial ecology in water industry & environment: Outcomes from IWA-ISME-PUB workshop

A/Prof Sanjay Swarup

Suppression of Algae/Cyanobacteria Blooms by Bubble Plumes

Dr Rob Uittenbogaard

Urban Greenery - more than just aesthetics

Dr Han Ping, Carol

Damage and casualties modeling as part of a vulnerability assessment for tsunami hazards: a case study from Aceh, Indonesia

Dr Joost Buurman & Mr Alamsyah Kurniawan

Knock Knock who's there? A peek into peatland microbiology

Dr Sheela Reuben

Profiling aquatic ecosystems – How to unravel the unknown?

Mr Chakravarthy M. Kalyan

A novel biological process for treatment of textile industry effluents

Dr Sathiskumar Muthuswammy

Water Management in global perspective: from multi-governance of water to multi-level water governance

Prof Theo Toonen

Towards Coordinating Local Model Predictive Controllers for Multi-Reservoirs Systems

Dr S. Sundaramoorthy

Neural Networks as Routine for Error Correction in Singapore Regional Model

Mr Sun Yabin

Selecting The Hydrologic Design For Management Of Tropical FloodPlain Ecosystem

Dr Pham Ngoc

Exuberant Singapore, A Love Story of Radical Ambition in the face of Ecological Catastrophe

A/Prof Erik G L Heureux

Rainfall Nowcast System with Radar Images

Dr Doan Chi Dung

Analysis of Vegetation-Induced Roughness in Petabyte Age or Man vs Machine

A/Prof Vladan Babovic

The Exchange of Persistent Organic Pollutants Across The Air-Sea Interface In Singapore's Coastal Environment

Mr He Jun

datPAV – internet based data processing, analysis and visualization tool for experimental data exploration

Dr Raghuraj Rao

Peatland water depth, water management and fire risk

Dr Aljosja Hooijer / Mr Ronald Vernimmen

Climate change in Singapore

Dr Elspeth Thomson

2008

Efficient data assimilation method based on chaos theory and Kalman filter with an application

Mr Sun Yabin

Overview of Peatland Project

Dr Aljosja Hooijer

Problems and Solutions of Tsunami forecasting

Dr Pavel Tkalich

Biosorption: A potential technology to improve water quality

Dr Kuppusamy Vijayaraghavan

Groundwater, Usable in Singapore?

Dr Toine Vergroesen

An Introduction to the Optiqua Optical Sensor Technology

Mr Melchior van Wijlen

TechTalk @ Singapore Delft Water Alliance

Mr Georg Tremmel

Modeling of Singapore's Coastal Waters

Ms Tay Hui Xin, Serene

Multivariate Statistics for Analyzing Large Scale Environmental and Biological Systems

Mr Raghuraj Rao

Use of Naturally Growing Aquatic Plants for Waste Water Purification

Ms Carol Han

Metabolomics and its role in Aquatic Biology

Ms Sheela Reuben

METDAT: A Software approach to improve Mass Spec. data and visualization

Mr Ambarish Biswas

The Water Book (An Encyclopedia of Water)

Ms Clea t. Waite

Mass Fish Mortality: When WQ Results Leaves you Puzzles – A Model Approach!

Dr Hans Eikaas

TechTalk @ Singapore Delft Water Alliance (Back by popular demand)

Mr Georg Tremmel

A Bioengineer's Computational toolkit for the Genomic

Mr Chakravarthy M. Kalyan

Use of Micro-probes for Sediment/ water boundary layer research

Dr Arjan Wijdeveld

Remote Sensing of Water Turbidity and Suspended Sediment

Dr Liew Soo Chin

Urban Runoff: Current Challenges and Future Prospects

Mr Umid Joshi

Breakwaters and Silt Dynamics in Lake Marken

Mr Klaas Pieter Visser

Integrated Water Resources Management

Dr Liong Shie-Yui

Insight from the Singapore International Water Week

Dr Carol Han & Mr Umid Joshi

Atmospheric Inputs of Nutrients to Aquatic EcoSystems

Assoc. Prof. Rajasekhar Balasubramanian

Sediment response in Singapore residential catchments

Mr Lee Wan Aik, Desmond

Modelling a High Speed Ferry in open water using a Viscous Computational Fluid Dynamic Code

Dr Ooi Seng Keat

Advances in Precipitation measurements from space

Dr Vincenzo Levizzani

Insights from a Microbial Ecology Symposium: ISME 12, Cairns, Australia

Dr Sheela Reuben

Woody native Plants for the Urban Waterways Environment in Singapore

Assoc. Prof Hugh Tan TW

Application of Microsolid phase extration to monitor photocatalytic degradation of pharmaceutical compounds in aqueous solution

Mr Naing Nyi Nyi

Insights from an International Conference on "Integrated Diffuse Pollution Management", Khon Kaen,

Mr Umid Joshi

Wavelet Transforms – potential data analysis tool for variety of applications

Dr Raghuraj Rao

Towards Self Sufficiency: Singapore's Water Management Strategy

Dr Lee Poh Onn

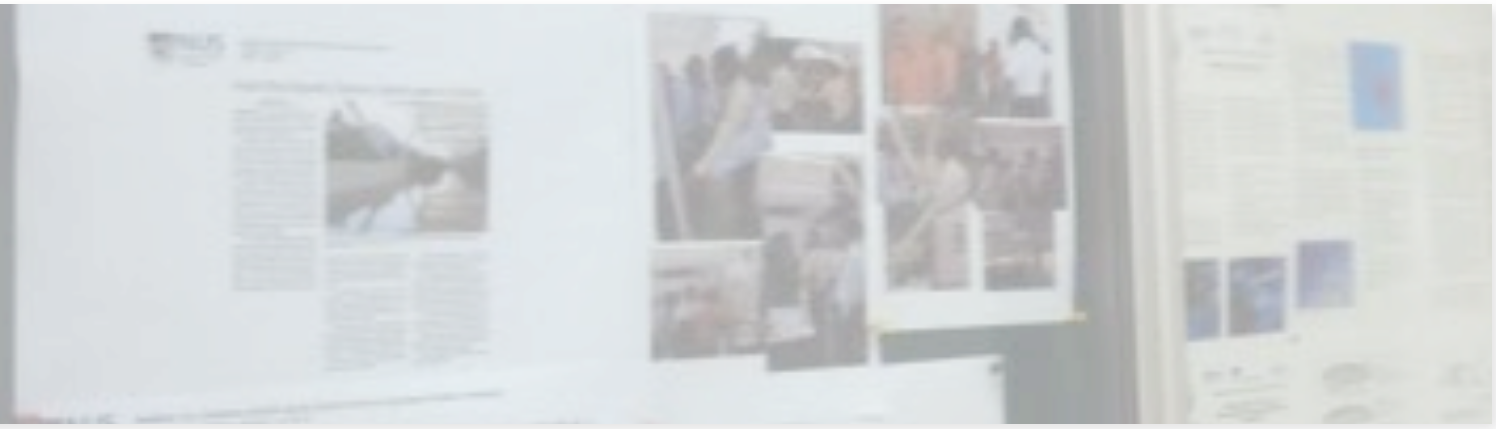
On the computation of surf zone waves using non-linear shallow water equations with non hydrostatic pressure

Professor G.S. Stelling


MABUHAY! MINGKO
GREGOR

FACILITIES

VAN KLEEF CENTRE



ADMINISTRATION & RESEARCH OFFICES BLOCK E1 NO. 1

VAN KLEEF CENTRE 3 ALBERT WINSEMIUS LANE SINGAPORE

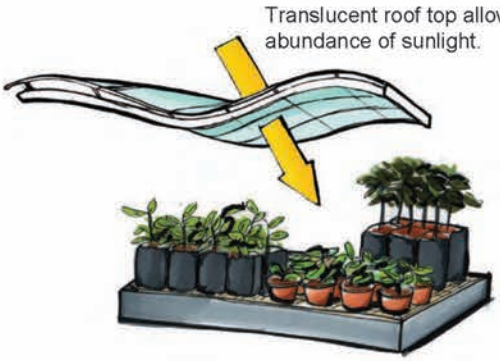
RESEARCH OFFICES BLOCK EW1 NO. 2 ENGINEERING DRIVE 2 #02-05

ENGINEERING DRIVE 2 #08-25 SINGAPORE 117576

SINGAPORE 117577

AQUATIC SCIENCE CENTRE

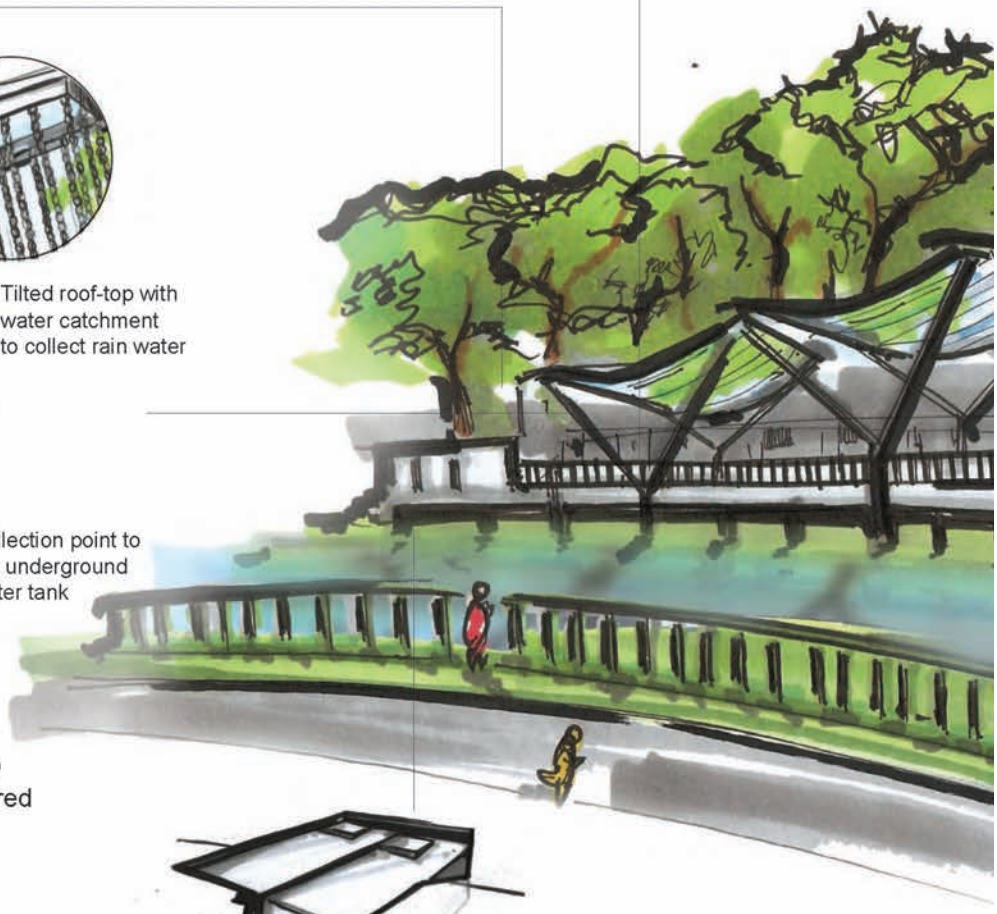
Research Laboratory
Conduct lab experiments.



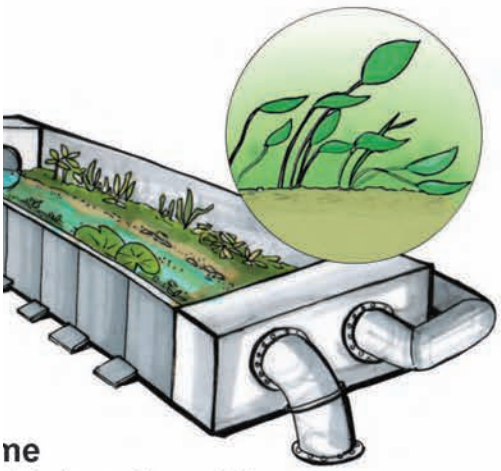
Plant Nursery
To propagate and house plants for research.

Bio-flur
Experimer
near-natu

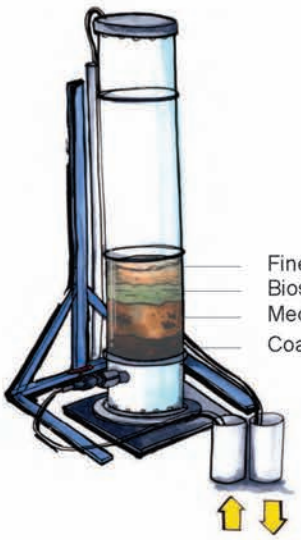
Wavelike Roof-top
Allow rainfall to be captured easily.



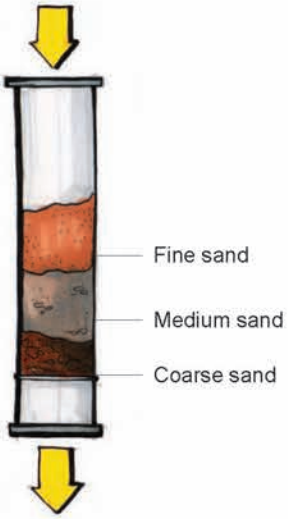
Underground Water Tank
To pump water from canal and to store rainwater for research purpose.



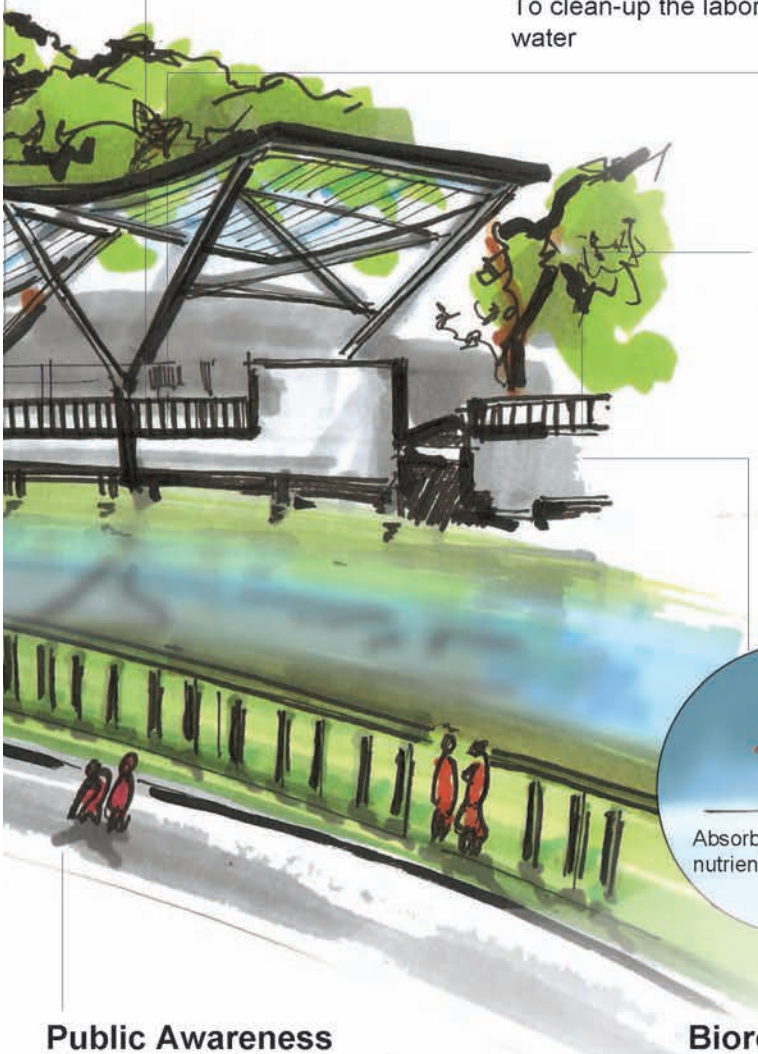
ne
ntal channel to model
ral flow conditions.

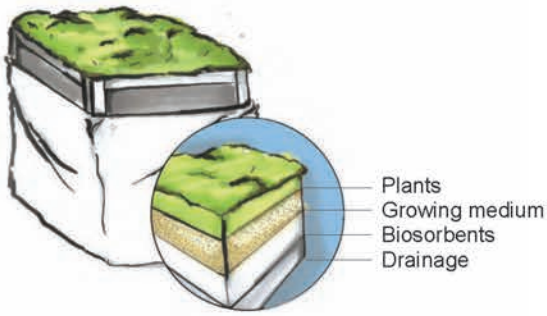


In-house Water Treatment
To clean-up the laboratory waste water

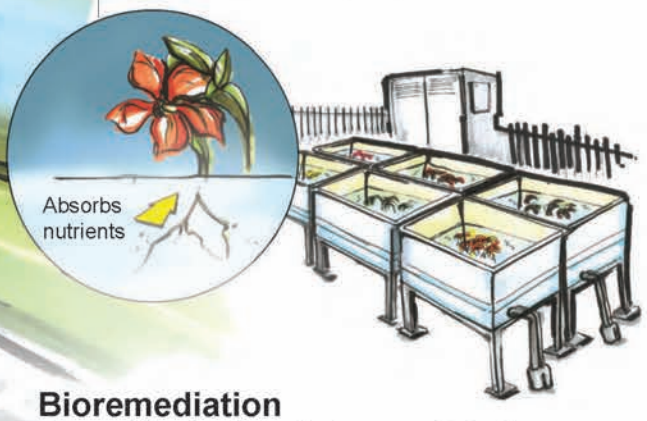


Sand Filtration
Water is filtered through layers of different sediments.





Roof-top Assembly
Biosorption layer to tackle the adverse runoff water quality.



Public Awareness
Allow general public to view the research activities.

Bioremediation
An eco-friendly, biological approach for the environmental cleanup.

Artist Impression by Chang Mei Zhen, Chua Heng Huat

VAN KLEEF CENTRE

Aquatic Science Centre, now renamed as Van Kleef Centre, is one and only facility for aquatic research test bedding in Singapore. This facility aims to understand the fundamental processes so as to adopt intelligent strategies for cost effective and efficient water management and to dissipate this knowledge to the community by outreach and educational activities.

Aquatic Science centre (ASC) is housed at 3, Albert Winsemius Lane (off Sunset Lane, Clementi Road). It is one of the environmental friendly building and has procured the Gold Award for Leadership in Energy and Environmental Design (LEED) by US Green Building Council and the green mark Gold-Plus Award by Building and Construction Authority of Singapore (BCA) for its Green features.

The facility is built on an open laboratory concept, strategically across a park connector enabling public to get a clear view of all experiments conducted in the facility. The tilted 95-m long wave-like transparent roof with channeling at the edges and chains ensure rain water harvesting and transparency of the roof promotes natural conditions for plant growth.

ASC has a well equipped indoor laboratory for environmental sample analyses and a cutting edge outdoor laboratory. The outdoor working space includes an array of laboratories with

1. State-of-the-art experimental channel called bioflume equipped with high precision scanning gadgets which enables modeling of near-natural flow conditions that characterize hydrodynamics and its impact on changes and variability in nutrient conditions;

2. Flow tanks for small scale mesocosm studies;

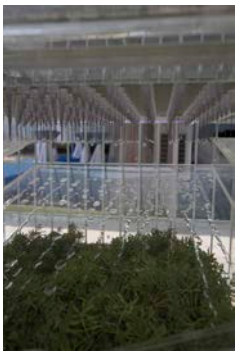
3. Plant nursery to breed plant species required for experiments

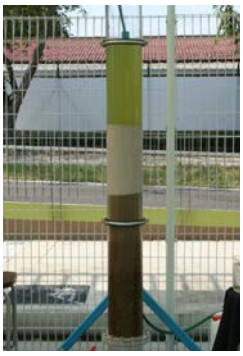
4. Biosorption columns for efficient water treatment;

5. Bioretention set ups for controlled studies

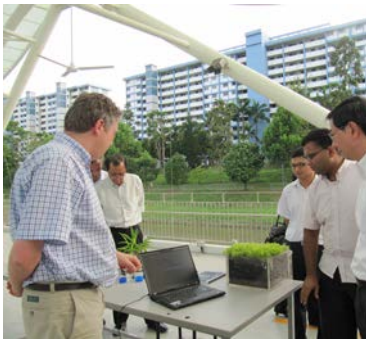
6. Meteorological station for continuous monitoring of weather conditions such as rainfall, temperature and wind speed.





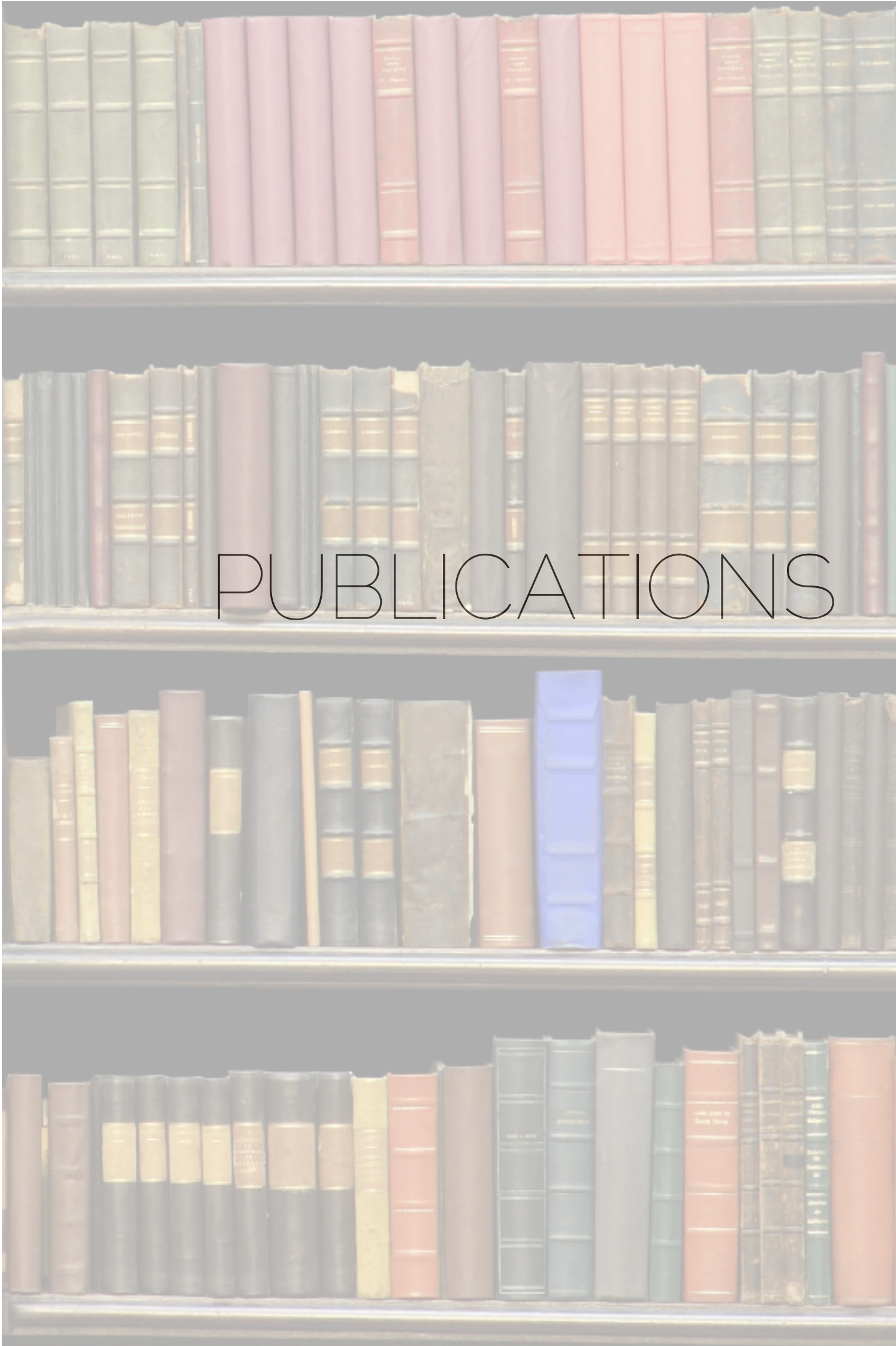
Working in partnership with the Public Utilities Board (PUB), the ASC-@Sungei Ulu Pandan will serve as a physical site for in-depth scientific investigations and facilitate the translation of the research activities into real world application. ASC will focus on bioremediation, biosorption, ecotoxicological studies and other fundamental as well as applied aspects of water management. Sediments and suspended solids, which contain pollutants such as nutrients, heavy metals and organic contaminants and other adsorbed chemicals on surfaces of sediments as well as chemical fluxes at sediment-water interfaces, will be studied. In addition, water improvement efficiencies of plants including their growth characteristics, uptake rates, physiological processes and exudation properties that can stimulate microbial and planktonic growth will be studied. Improving water quality and managing quantity of runoff, surface water, and groundwater will be another aspect of research at ASC.





Aquatic science centre aims to educate a diverse workforce of future scientists and engineers through interdisciplinary engagement of critical water problems. An integrated exhibition introduces and highlights to visitors the importance of water bodies in Singapore and how to enhance and sustain its use as a resource and for recreation. Visitors will learn about the importance of the research work in improving the quality of water in our water bodies through a variety of exhibits, models, simulations and graphic panels. The personnel in ASC explains to visitors on how the different experimental set ups work and the expected outcomes of integrated research.

Groups visiting ASC receive an introductory briefing, go through the exhibition as well as tour the research lab and facilities. Groups have the opportunity to meet and interact with researchers to find out about the research work that they do. Attachment programmes allow students to carry out mini aquatic research projects of their own under the supervision of the researchers themselves. Hands-on aquatic-science related workshop and laboratory based activities will also be developed and made available for student groups at ASC. Examples of such activities will include water sampling, water flow and pollution monitoring & treatment. School groups visit the exhibition and lab facilities as well as to participate in the hands-on activities.



PUBLICATIONS

Publications from Jul 2007 - Dec 2012

266

Publications
in various fields

3-4

Publications per month

Published in

60

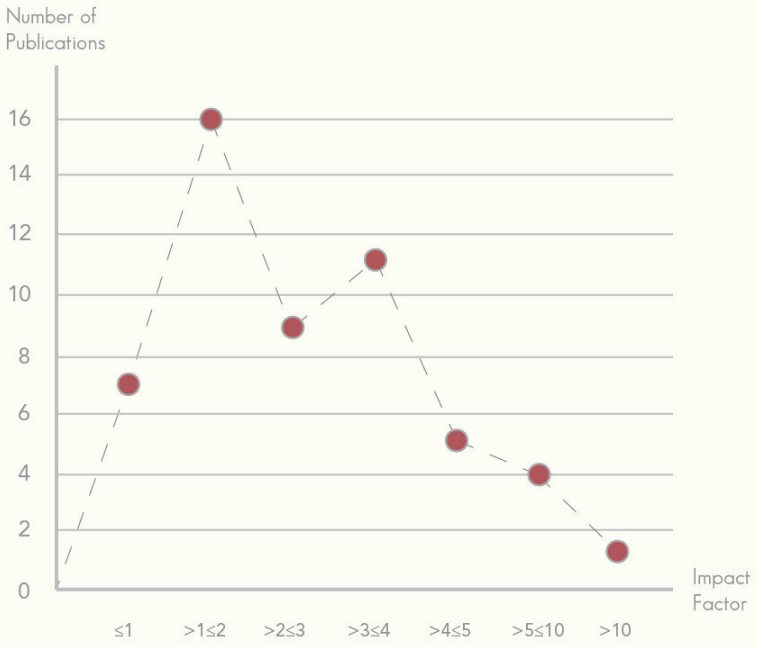
different journals

Presented in more than

140

international conferences

Statistics


Number of Publications
16
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12
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>2≤3
>3≤4
>4≤5
>5≤10
>10
Impact Factor


Number of Publications
2007
2
2008
13
2009
44
2010
61
2011
65
2012
64
Accepted
17

BIODIVERSITY & ECOLOGY

Conway, K.W., Kottelat, M., Tan, H.H., Review of the Southeast Asian miniature cyprinid genus Sundadanio with descriptions of seven new species from Indonesia and Malaysia. (Accepted). *Ichtyological Exploration of Freshwaters*

Kottelat, M., Tan, H. H., Systomus xouthos, a new cyprinid fish from Borneo, and revalidation of Puntius pulcher. (Accepted). *Ichtyological Exploration of Freshwaters.*

Kottelat, M., Tan, H. H., Identity of Rasbora beauforti, a cyprinid fish from Borneo. (Accepted). *Ichtyological Exploration of Freshwaters.*

Liao, T.-Y., Tan H.H., Brevibora cheeya, a new species of cyprinid fish from Malay Peninsula and Sumatra. *The Raffles Bulletin of Zoology, 2011. 59(1): p. 77-82.*

Ng, H.H. and H.H. Tan, Silurichthys ligneolus, a new catfish (Teleostei: Siluridae) from southern Borneo, Indonesia. *Zootaxa, 2011(2793): p. 56-62.*

Posa, M.R.C., Peat swamp forest avifauna of Central Kalimantan, Indonesia: Effects of habitat loss and degradation. *Biological Conservation, 2011. 144(10): p. 2548-2556.*

Posa, M.R.C., LS. Wijedasa, R.T. Corlett, Biodiversity and Conservation of Tropical Peat Swamp Forests. *Bioscience, 2011. 61(1): p. 49-57*

Sodhi, N.S., et al., Conserving Southeast Asian forest biodiversity in human-modified landscapes. *Biological Conservation, 2010. 143(10): p. 2375-2384.*

Tan, H.T.W., Yeo, C.K., Ng, A.B.C., Native and naturalised biodiversity for Singapore waterways and water bodies No.1 Ficus microcarpa, Malayan Banyan. *2010, Raffles Museum of Biodiversity Research.*

Webb, E.L., et al., Environment-Friendly Reform in Myanmar. *Science, 2012. 336(6079): p. 295-295.*

BIOREMEDIATION

Posa, M.R.C., Peat swamp forest avifauna of Central Kalimantan, Indonesia: Effects of habitat loss and degradation. *Biological Conservation, 2011. 144(10): p. 2548-2556.*

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BIOSORPTION

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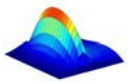

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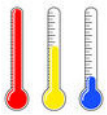

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ACCOLADES

DR. KUPPUSAMY VIJAYARAGHAVAN

Humboldt Research Fellowship Award

Dr. Vijayaraghavan Kuppusamy has received the Humboldt Research Singapore fellowship in the field of water supply and water management reserach. He was hosted by Dr.-Ing. Stephan Fuchs, Karlsruher Institut fur Technologie (KIT) for 6 months in 2010. Dr Vijay was a Research fellow at SIngapore Delft Water Alliance.

DR. PETRA SCHMITTER

Wissenschaftspreises des Universitätsbundes Hohenheim e.V., 2012

Dr. Petra Schmitter has received the 'Wissenschaftspreises des Universitätsbundes Hohenheim e.V.' for outstanding research, performed during her PhD at the University of Hohenheim (Germany). The work contributed to the identification and quantification of sediment-associated nutrient redistribution processes and its impact on rice production in intensified mountainous landscapes. The research was conducted at the Institute of Plant Production and Agro-Ecology in the Tropics and Subtropics (Prof. Georg Cadisch) within the special research program "The Uplands Program SFB 564 funded by the German Research Foundation (DFG). The long-term interdisciplinary research program is a joint effort between German-Thai and Vietnamese Universities and Governmental institutions focusing on the conservation of natural resources and rural development in Southeast Asia. Dr. Schmitter is currently a Research Fellow at the Singapore-Delft Water Alliance.

MS. ARUNODA BASNAYAKE

Bronze medal - student competition award - 18th IAHR-APD2012 conference

Ms. Arunoda Basnayake has won the 'Bronze Award' in the student competition for her paper entitled 'Integration of domain knowledge and analytical techniques for improving rainfall-runoff modelling'. This award was obtained at the 18th Congress of the Asia and Pacific Division of the International Association for Hydro-Environment Engineering and Research. Ms. Arunoda has completed her PhD degree at SDWA under the supervision of Associate Professor Babovic.

DR. STEFANO GALELLI

Outstanding Reviewer Award 2011 for Environmental Modelling & Software, 2012

Dr. Stefano Galelli has won the 'Outstanding Reviewer Award' from Environmental Modelling and Software, a high-impact scientific journal. Dr. Galelli has received this award for the high-quality reviews he provided the journal in 2011. This award recognizes his exceptional efforts and valuable contribution to Environmental Modelling and Software. The awards will be presented at this year's International Congress on Environmental Modelling and Software in Leipzig, Germany (iEMSs 2012). Dr. Galelli is Research Fellow and Cluster Head at SDWA.

Science Mentorship Programme (SMP) Outstanding Mentor Award, 2010

DR. SHEELA REUBEN

Congratulations to our own Dr Sheela Reuben, who received the "Science Mentorship Programme (SMP) Outstanding Mentor Award" at the 16th Youth Science Conference, held at Ngee Ann Polytechnic, Convention Centre on 18 September 2010. The conference showcases all the projects in the Science Mentorship Programmes (SMP) to an audience of peers, teachers and scientists through posters and oral presentations. These projects are also judged by panels of professional scientists and awarded with prizes. Dr Sheela had participated in the NUS-SMP and mentored students on a project in the SDWA ASC Pandan. Dr Sheela Reuben is a research fellow with the Singapore-Delft Water Alliance. Her present research interests are in biofilms, microbial ecology of freshwater systems, data analysis tools and metabolomics studies with respect to aquatic systems.

International Water Association (IWA) Fellowship, 2012

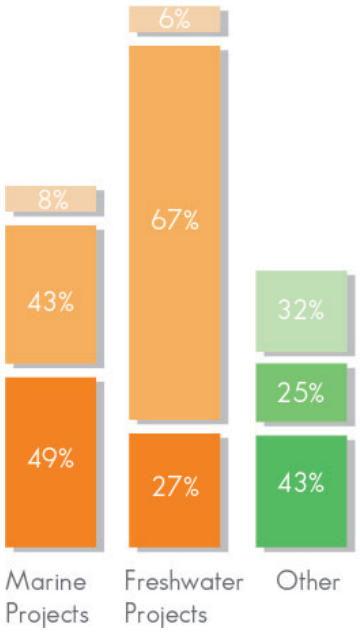
PROF. VLADAN BABOVIC

At biennial World Water Congress held in Busan (South Korea) between September 16 and 21, 2012 International Water Association (IWA) bestowed upon Professor Vladan Babovic a prestigious rank of IWA Fellow. Fellows are elected by the IWA Board of Directors and represent a small select group of internationally leading water professionals who have made and are continuing to make a distinguished contribution to the fields of water science, technology and management. The IWA Fellows Program seeks to recognize extraordinary individuals within the community of water professionals and to enlist their commitment and skills in advancing the knowledge and practice of water management through IWA. Fellows are active ambassadors for the IWA demonstrating the very best of its membership. Vladan Babovic is a leading researcher in filed hydroinformatics where he has been spearheading research in data-driven modelling research 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 domain is starting to gain wider recognition. In addition to being an active member of IWA, Vladan contributes to several other professional associations, such as IAHR, IAHS and ASCE. He serves on scientific boards of range of journals and conferences. One of Vladan's passions is creating enthusiasm towards water related issues among students and general community. Establishment of IAHR Student Chapter at the National University of Singapore; Aquatic Science Centre @ Sungei Ulu Pandan and Singapore Netherlands Water Challenge are but few initiatives he has spearheaded. 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, such as Singapore Delft Water Alliance and NUSDeltares, both of which he is founding Director.

FINANCIAL OVERVIEW

SDWA FINANCE OVERVIEW

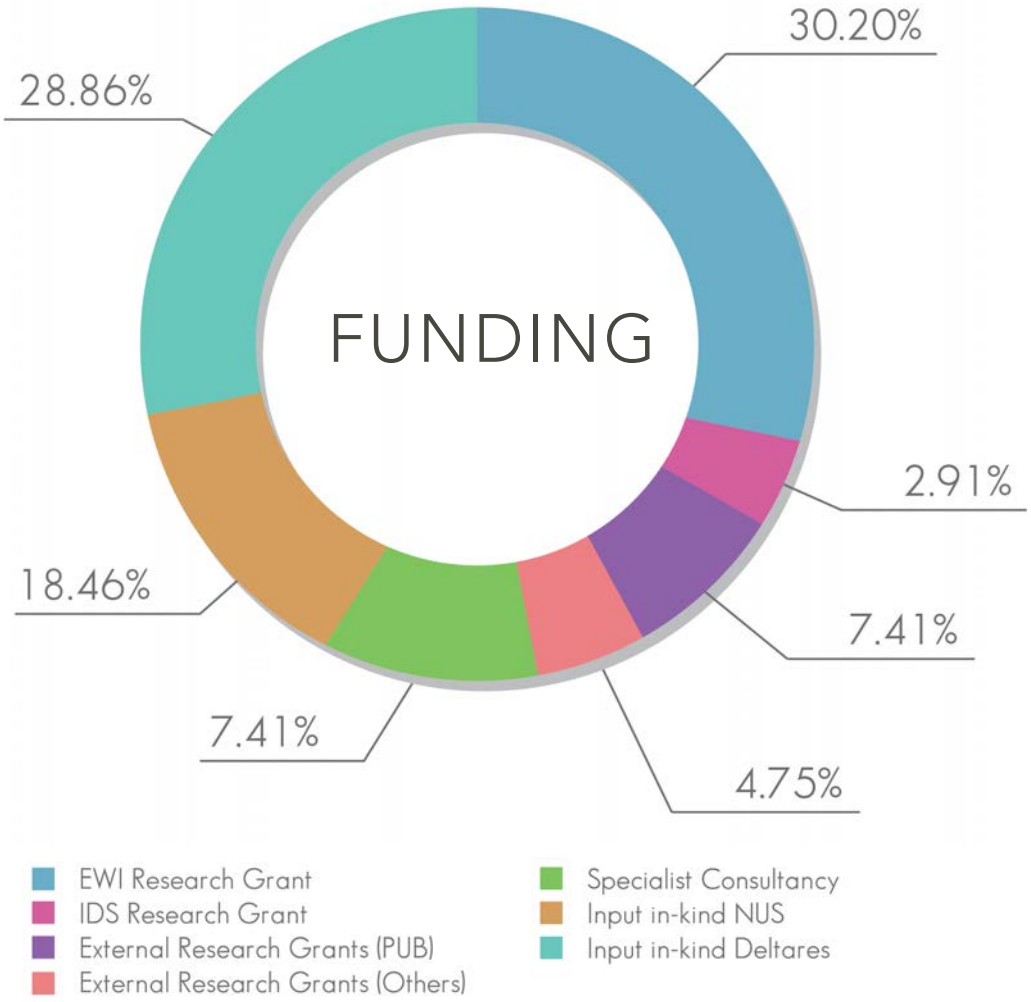
2007-2012



SPENDING BY TOPIC

- Modelling
- Experimental
- Desktop & Other
- General
- Education
- Facilities

	Marine Projects (millions)	Freshwater Projects (millions)	Other (millions)	Total (millions)
Modelling	$11,647	$ 8,757		$20,404
Experimental	$10,145	$21,676		$31,821
Desktop & Other	$ 1,959	$ 1,897		$ 3,856
General			$ 9,254	$ 9,254
Education			$ 5,339	$ 5,339
Facilities			$ 7,000	$ 7,000
				$77,674



	(millions)
EWI Research Grant	$24,000
IDS Research Grant	$ 2,310
External Research Grants from PUB	$ 5,887
External Research Grants from other agencies	$ 3,778
Specialist Consultancy	$ 5,893
	$41,868
Input in-kind NUS	$14,671
Input in-kind Deltares	$22,942
	$37,613
Total Research Budget	$79,481

*The difference between the total research budget and spending is work in progress.

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