PROCEEDINGS

21st IAHR-APD Congress

International Association for Hydro-Environment Engineering and Research (IAHR)
Asia Pacific Division (APD)

Multi-perspective Water for Sustainable Development

Volume 1

o Keynote Speech
o River (River Hydraulics, River Basin Engineering and River Basin Management)
o Port, Harbor, Coastal Engineering and Management
o Environmental Hydraulics and Hydrology
o Irrigation, Water Supply and Sanitation

Yogyakarta, Indonesia
2-5 September 2018

LIST OF CONTENTS

VOLUME 1

KEYNOTE SPEECH

TECHNICAL PAPERS
SUBTHEME 1: RIVER (RIVER HYDRAULICS, RIVER BASIN ENGINEERING AND RIVER BASIN MANAGEMENT)

INTEGRATED WATER RESOURCES MANAGEMENT FOR BATHING AND SHELLFISH WATERS COMPLIANCE

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ABSTRACT

With increasing economic benefits associated with bathing waters and increasing consumption of shellfish in internationally, water quality in coastal and estuarine waters has attracted growing public concern in recent years. Some bathing beaches have had to be closed temporarily and shellfish cultivation suspended because Faecal Indicator Organism (FIO) levels have exceeded minimum mandatory standards for public health. The relationships between FIO sources in upstream catchments and bathing and shellfish water quality are complex, since multiple processes and driving factors affect the transport and fate of FIOs through a river basin. To obtain accurate FIO predictions and better management of bathing and shellfish water compliance a novel integrated modelling system has been developed, including dynamic FIO process predictions from catchments, Combined Sewer Overflows (CSOs), river networks etc., through to estuaries and coastal waters. Details are given of the development of a numerical modelling system for simulating the transport and dynamic decay of FIOs from catchments to the coast. The model was validated to predict the distribution of FIO levels in the bathing waters near Blackpool and the shellfish waters of the Ribble Estuary, with both regions being key sites of public health concern in the UK. Extensive measured data from the various source inputs and measured concentrations in the estuary and coastal waters provided calibration and validation data for the modelling system. Comparisons between the measured and predicted results generally showed good agreement and highlighted the significance of sediment transport in providing an import FIO transport mechanism through the system.

Keywords: Hydro-epidemiological Modelling, Bathing Waters, Shellfish Waters, Sediment Transport, Decay

1. INTRODUCTION

In recent years, and decades, there has been increasing global concern about water security including, in particular, limited water availability, water quality, water pricing and ecosystems services. In terms of limited availability, the total volume of the world's water resource is 1.4 billion km^3; however, most of this water is saline and confined to the oceans and coastal waters, with only 35 million km^3 being available as freshwater. Much of this freshwater is locked up in the form of ice in the Arctic and Antarctic and only 105 thousand km^3 is accessible for water supply, crop production, ecosystems services etc. Some key challenges associated with increasing global water stress include: climate change and increasing rainfall intensity, population growth and increasing demand for more water, food and energy (i.e. the water-food-energy nexus), aquifers are being drained much more quickly than natural groundwater recharge rates, and over two-thirds of the world's freshwater is now needed to grow food. In summary, the current demand for freshwater is not sustainable.

In terms of management of the water cycle and global water security, water falls on catchments in the form of rain; it then flows through rivers, lakes and aquifers etc. as blue water, or falls on crops and soil as green water. The blue and green water is then used to irrigate the land to grow food etc., or it is withdrawn for domestic (or consumptive) use and for industry, to produce products (including energy). These products are then either consumed internally or exported in the form of virtual water, i.e. water used to produce a product is exported to another country but the water is consumed in the country where the product is made. For example, the virtual water footprint for cotton in the UK is significant, with no cotton being produced in the UK, but with the water

EFFECTIVENESS OF A SHORE-PARALLEL CANAL FOR REDUCING TSUNAMI IMPACT

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ABSTRACT

A shore-parallel canal, called Teizan Canal, had been constructed since late 16th century along Sendai Coast, Japan mainly for navigation purpose. It is estimated that the canal contributed to tsunami mitigation to some extent during the 2011 Great East Japan Tsunami. In order to investigate its effect on tsunami energy reduction, a numerical model based on shallow water equation (SWE) is applied to simulate the 2011 Tsunami in Sendai plane area. A series of numerical experiments are carried out with different cross-section of shore-parallel canal to investigate effectiveness of canal shape for reducing tsunami energy during the extreme tsunami run-up into the land area.

Keywords: The 2011 Great East Japan Tsunami, shore-parallel canal, tsunami mitigation, numerical simulation

1. INTRODUCTION

The Teizan Canal, located in Miyagi Prefecture in Japan, has length of 49km along Sendai Coast, connecting the Abukuma River and the Old Kitakami River mouths, as shown in Figure 1. Although the canal was constructed for the purpose of navigation in the old days, this canal has attracted local residents for long time as a historical inheritance. Although the canal was seriously damaged by the 2011 Great East Japan Earthquake Tsunami, it is estimated that the canal had disaster reduction effects such as delay of tsunami arrival (Figure 2) and collecting tsunami return flow (Figure 3). Hence it is now highly necessary to quantify the tsunami disaster reduction effect of the canal so that this canal is appropriately maintained as an important facility which contribute to tsunami mitigation in Sendai Bay area, not only serving a function in historical and environmental aspects. In addition, a canal system might be utilized as a part of a multilayered defense system in an area expecting a devastating tsunami disaster in the near future.
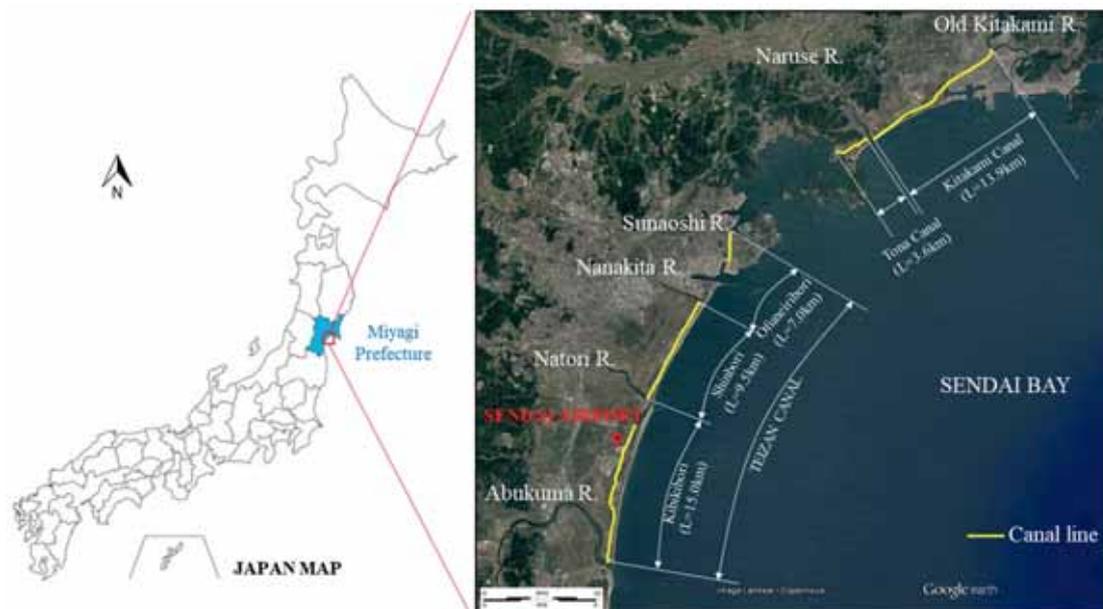

Figure 1. Shore-parallel canal along Sendai Coast

MOST COST-EFFECTIVE DEM AND RAINFALL DESIGN CURVES FOR ASSESSING FLOOD HAZARD OF PRESENT AND FUTURE CLIMATES

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ABSTRACT

Many urban cities in Southeast Asia witness severe flooding associated to increasing rainfall intensity and rapid urbanization often with poor urban planning. Two important inputs required in flood hazard assessment are: (1) high accuracy Digital Elevation Model (DEM), and (2) long rainfall record. High accuracy DEM is expensive and time consuming to acquire. Long rainfall records for areas of interest are often not available due to rapid urbanization. This study presents a notably cost-effective and efficient approach to derive high accuracy DEM and suggests to consider proxies for long rainfall data.

To derive a high accuracy DEM, an approach with Artificial Neural Network (ANN) considers data from two freely accessible satellite data: Shuttle Radar Topography Mission (SRTM) and Sentinel-2 multispectral imagery. The study shows a significant DEM improvement; this DEM is then used in the flood simulations to generate flood maps useful for flood mitigation measures. Proxies for rainfall data resulting from climate change downscaling are proposed for urban planning and drainage system designs for areas where long rainfall data records are not available. Precipitation outputs from a Regional Climate Model (RCM) Weather Research and Forecasting (WRF) is used to derive the Intensity Duration Frequency (IDF) curves for the study area. Design storms, calculated from the IDF curves with different return periods, are then applied to numerical flood simulations to identify flood prone areas. The approach is demonstrated in a flood hazard study in Yogyakarta, Indonesia.

Keywords: Artificial Neural Network, Climate Change, Downscaling, Remote Sensing, Flood Hazard

1. INTRODUCTION

Floods cause significant social cost and loss of lives. Economic damage caused by floods have increased over the past several decades due increases in extreme rainfall events and urbanization. Most of the national governments, insurance companies and research institutes in developed countries have developed flood hazard assessment models for evaluating social and economic impacts. However, there are many limitations in using these developed models in most of countries in Southeast Asia. High accuracy Digital Elevation Model (DEM) and long rainfall records are important in flood hazard assessment. High accuracy DEM is cost demanding and

URBAN STORMWATER MODELLING

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ABSTRACT

In the absence of monitored data from an urban catchment, modelling of the catchment is an accepted methodology for generating data necessary for the management of those systems. The catchment modelling systems used to generate the data are not exact and hence the generated data will contain errors. The purpose of model calibration is the minimisation of these errors. While these errors can be developed from a variety of sources, it is the errors arising from parameter values that usually are the focus of the calibration process. Presented herein is a discussion focussing on urban catchments of issues associated with parameter value identification in distributed catchment modelling systems.

Keywords: Stormwater, Model, Hydroinformatics, Uncertainty, Urban

1. INTRODUCTION

Catchment modelling, in hydrology, generally refers to an approach for generation of streamflow at selected points where the observed flow is not available. This unavailability of data may arise from the lack of monitored data, a change in catchment conditions, or a change in climatic state. Irrespective of the source of the unavailability, the purpose of the catchment modelling is to generate the data that would have been recorded if the catchment and climatic conditions were to occur.

Application of a catchment modelling system involves a system of models (see Ball, 1992) to:

1. Estimate input data across the catchment (generation component);
2. Simulate the hydrologic processes across the catchment (hydrologic component);
3. Simulate the hydraulic processes across the catchment (hydraulic component); and
4. Dispose of the water from the catchment (disposal component).

The philosophical basis of a catchment modelling system is the generation of data that would have been recorded if a monitoring system were present at the location(s) of the predictions. This type of catchment modelling system application is deterministic; using the selected parameter values and other input data with the catchment model results in reproduction of the event(s) being analysed. Furthermore, it is premised on the recorded data being a correct representation of the true catchment response.

Typically, the suitability of a catchment modelling system for prediction of unknown events is evaluated by assessing the capacity for simulation of a recorded catchment response. Hence, to determine the suitability of a catchment model, it is necessary to test the predictions obtained from the catchment model against recorded data; this process usually is referred to as the calibration and validation of the catchment modelling system.

As the suitability of a catchment model is related to the prediction errors (i.e. the difference between the predicted and the recorded catchment response), there is a need to consider the sources of errors in the predictions obtained from the catchment model. As discussed by Kuczera et al., (2006), the sources of error in a catchment modelling system may be classified as:

- Input data errors – these errors occur from the need, for example, to extrapolate point rainfalls to spatial rainfalls; see, for example, Umakhanthan and Ball (2005);
- Model errors (see, for example, Renard et al., 2010) which consist of the following:
    - Parameter errors – these are errors attributable to the selected parameter values; and
    - Structural errors – these errors arise from the need for the real system to be simplified in a mathematical framework; in other words, the real process is represented by a set of mathematical relationships. These mathematical frameworks often require numerical solutions

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21st Congress of International Association for Hydro-Environment Engineering and Research (IAHR), Asia Pacific Division (APD), in conjunction with 6th Regional Conference on Natural Disaster (RCND), Yogyakarta, INDONESIA, 2-5 September 2018

"Multi-perspective Water for Sustainable Development"

Dear Colleagues,

Thank you for having participated in the 21st Congress of Asia and Pacific Division of International Association for Hydro-Environment Engineering and Research (IAHR-APD) that was held in Yogyakarta, Indonesia, on 2nd – 5th September 2018. We hope you have found wonderful friends, fruitful mission, and memorable journey.

Wish you a happy return and see you again in the upcoming 22nd Congress of IAHR-APD to be held in Hokkaido, Sapporo, Japan.

Sincerely yours,

Local Organizing Committee
Radianta Triatmadja

Keynote Speakers

Dr. Basuki Hadimulyono

He was born in Solo, Indonesia, 5 November 1954, graduate (Ir. Degree) from the Department of Geological Engineering, Faculty of Engineering, Universitas Gadjah Mada (1979), Master of Science in Civil Engineering, Colorado State University, USA (1989) and got his Ph.D degree in Civil Engineering, Colorado State University, USA (1992). He is currently the Minister of Public Works of Indonesia for the period of 2014-2019. Several

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strategic tasks have been assigned to him by the government of Indonesia, these include the he Team Leader of the Countermeasure of Sidoarjo Mudflow National Disaster (2006-2007). From 2007-2013, he was assigned as the General Inspectorate of the Public Works Ministry. Prior to the assignment as a Minister of Public Works Ministry in 2014, during 2013, he was the Director General of the Spatial Planning, Ministry of Public Works.

His long experience in contributing various idea regarding the problems on water resources development in Indonesia is really worth to be shared with countries in the Asia Pacific Region.

Prof. Roger A. Falconer

He is Professor of Water Management, School of Engineering, Cardiff University, Computational Hydraulics, Flood Risk Modelling, Marine Renewable Energy, Water Security, Water Management, Cardiff, United Kingdom. He was elected a Fellow of the Royal Academy of Engineering in 1997, Fellow of the City and Guilds Institute of London in 1997 and Fellow of the Learned Society of Wales in 2011. He was President of the International Association for Hydro-Environment Engineer and Research (2011-15) and is currently a Member of the Board of Trustees for the Chartered Institution of Water and Environmental Management. He was Chair of the Civil and Construction Engineering Sub-Panel for the 2014 Research Excellence Framework REF2014 and was a member of the Civil Engineering Sub-Panel for the 2008 Research Assessment Exercise RAE2008. Prior to joining Cardiff University, he was a Lecturer in Hydraulic Engineering at the University of Birmingham (1977-86), and Professor of Water Engineering (1987-97) and Head of the Department of Civil Engineering (1993-97) at the University of Bradford. He has also interacted extensively with consulting engineering companies and regulatory agencies, through the provision of his hydro-environmental computer models. He has also participated extensively in TV and Press interviews, on a wide range of topics, most notably: the Severn Barrage, flooding, and global water security etc

Prof. Dr. Junji KIYONO

He is a professor at Kyoto University. Prof Kiyono's research topics include the investigation of the time-space characteristics of strong ground motions in the seismic fault zone, wave propagating and site amplification effects. He also developed numerical simulation techniques and applied to the analysis of evacuation behavior during an earthquake. He has produced a lot of papers in respected journals and seminars.

Prof. Tetsuya HIRAISHI

Tetsuya Hiraishi is Professor of Coastal Sedimentation and Environment Laboratory in Fluvial Disaster Research Center of Disaster Prevention Research Institute, Kyoto University. He has a long experience as governmental engineer of the Port and Airport Research Institute in Yokosuka, Knagawa Prefecture, Japan. His research involves the mechanism and countermeasure of long period waves, the study on countermeasure against impulsive force due to tsunami, the development of new type removable tsunami breakwater and so on. Right now he is managing the stability tests of tidal wall protecting nuclear power plants located in coastal areas. He served as Director, Hydraulic and Marine Environment Section, Port and Airport Research Institute (2008-2010) and Professor of Disaster Prevention Research Institute, Kyoto University (2010 – present).

Dr. Tang Xinhua

He is the Secretary General of Chinese Hydraulic Engineering Society (CHES). He has vast experience in Hydraulics, Water and *Hydro-power*. He was responsible in a number of important positions in China Water & Power Press in which he became the President of China Water & Power Press from 1998 to 2017. He is the Secretary General of Chinese Hydraulic Engineering Society since then.

His Technological achievements and major works include: *Hydraulic and Hydro-power Dictionary in English, German, French, Dutch, and Chinese (co-editor), History of China Water* (co-author)*, Generate Benefits and Mitigate Hazards to Contribute to the Prosperity of the Nation and the Interest of the People – 60 Years' Water Development in China* (deputy chief editor)*, The Comprehensive Value of Hydro-power and its Evaluation Method* (author).

He was/is also active in a number of Association and Organizations namely Industrial Committee of Chinese Science Writers' Association (1998-2017), Chinese Hydraulic Engineering Society (1998-2017), China Society for Hydro-power Engineering (1998-2017), Publishers Association of China and deputy director of Working Committee of Scientific and Technical Publishing (1998-2018), Board of Governors of World Water Council (from November 2015 up to now)

Prof. Hitoshi Tanaka

He was born in November 1956, and currently a Professor in the Department of Civil and Environmental Engineering, University of Tohuku, Japan. His research fields include water control science (Hydraulic Engineering), water control science (Coastal Engineering) and water control science (Environmental Hydraulic Engineering). His three newest honors and awards are as follow:

- Excellence in Research Award, the Foundation of River and Watershed Environmental Management, July 2015(2015)
- Excellence in Research Award, the Foundation of River and Watershed Environmental Management, July 2015(2016)
- Distinguished IAHR-APD Membership Award in recognition of distinguished contribution to the scientific activities of the IAHR-Asian and Pacific Regional Division(2016)

Prof. Shie-Yui Liong

Prof. Liong has been with Tropical Marine Science Institute of National University of Singapore (NUS) since 2004 after spending about 20 years with the Department of Civil and Environmental Engineering of NUS. He received his Dipl.-Ing. and Ph.D. degrees from University of Karlsruhe (Germany) and Iowa Institute of Hydraulics Research of University of Iowa (USA) respectively.

Prof. Liong's most recent research focus is on climate downscaling for Southeast Asia domain and deriving valuable information from the downscaled climate to evaluate the impacts of climate change on water resources, flooding, saltwater intrusion, crop yields, etc. He is also leading a team of researchers from different disciplines to develop an Eco-Hydraulics model for NeeSoon Swamp Forest.

He is currently an associate editor of Journal of Environmental Science and Policy (2011 – present) and was an associate editor of Journal of Hydroinformatics (2004-2011). He was the President of Hydrological Science Section of AOGS (2008-2010), and Chairman of Joint IAHR-IWA-IAHS Hydroinfomatics Committee (2009-2012).

Prof. James Ball

James Ball is a Professor in the School of Civil and Environmental Engineering at the University of Technology Sydney, in Sydney Australia. His primary research interest is in the development and application of catchment modeling systems for flood estimation in both Urban and rural catchments. This includes the determination of parameters for these systems and the use of information technology in the determination of these parameters. Through these research activities, he has published a number of book chapters, over 50 journal papers and 170 refereed conference papers. In 2011 he was awarded the JC Stevens Award by the ASCE for his publication in the Journal of Hydraulic Engineering. Prior to joining the University of Technology Sydney, Professor Ball obtained experience through research undertaken at universities in Australia, Canada, and USA. Professor Ball also obtained experience as a Consulting Engineer and in Government Authorities. He is a member of the editorial boards for the Urban Water Journal, the Journal of Hydroinformatics, and is an Associate Editor for Water Science and Technology and the Journal of Applied Water Engineering and Research. Retrieved from:

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Prof. Shahbaz Khan

Professor Shahbaz Khan is Director Regional Science Bureau for Asia and the Pacific and UNESCO Representative for Brunei Darussalam, Indonesia, Malaysia, the Philippines, and Timor-Leste. He has multidisciplinary academic background and professional experience in engineering, environmental law, economics and international diplomacy. He is a Fellow, Chartered Engineer and Engineering Executive of Engineers Australia, Hon Fellow of Institution of Engineers, Malaysia, Fellow of the ASEAN Academy of Engineers, Hon Fellow of the Myanmar Engineering Society, Founding Fellow of the Academy of Engineering and Technology of the Developing World and Fellow of the Modelling and Simulation Society of Australia and New Zealand. Shahbaz is currently Adjunct Professor at the University of Canberra and Western Sydney University, Australia, Adjunct Professor at the Lincoln University, New Zealand, Distinguished Professor at the National University of Science and Technology, Pakistan and Distinguished Professor at the Capital Normal University, China.

Prof Khan's work has been widely recognized through receipt of many awards such as the Great Wall Friendship Award China 2017, FEIAP Engineer of the Year Award 2016, UNESCO Team Award for Managing Hydro Hazards 2009, Land and Water Australia's Eureka Prize 2007, CSIRO Medal 2007, Biennial Medal of the Modelling and Simulation Society of Australia and New Zealand. He has widely published in the area of water, environment and sustainable development and received several outstanding publications awards.

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Prof. Hermann Fritz

Dr. Hermann Fritz is an associate professor of civil engineering at the Georgia Institute of Technology (Georgia Tech). He is an expert on tsunamis and coastal hazards, such as hurricane storm surges and submarine landslides, as well as their mitigation and coastal protection. Dr. Fritz has led or participated in more than a dozen post-disaster reconnaissance campaigns encompassing tsunami, hurricane, landslide, and earthquake events. **Tsunami Surveys**: 2004 Indian Ocean (Indonesia, Sri Lanka, Maldives, Somalia, Madagascar, Oman, Yemen, Comoros), 2006 Java, 2007 Solomon Islands and Peru, 2009 Samoa, American Samoa, and Tonga, 2010 Solomon Islands, Haiti, Chile, and Mentawai Islands, 2011 Japan, 2012 El Salvador, 2013 Solomon Islands, 2014 Chile. **Hurricane Surveys**: 2005 Hurricane Katrina, 2007 Tropical Cyclone Gonu (Oman), 2008 Tropical Cyclone Nargis (Myanmar), 2013 Typhoon Haiyan (Philippines), 2015 Tropical Cyclone Pam (Vanuatu). Dr. Fritz's research centers on fluid dynamic aspects of natural hazards such as tsunamis, hurricane storm surges and landslides as well as their mitigation and coastal protection. Dr. Fritz obtained his Doctorate degree (Dr. sc. ETH Zurich) in 2002 from the Swiss Federal Institute of Technology in Zurich (Switzerland).
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He was born in Solo, Indonesia, 12 November 1952, graduate (Ir. Degree) from the Department of Civil Engineering, Faculty of Engineering, Universitas Gadjah Mada in 1979, and got his Ph.D. degree in Water Engineering, in The City University, London U.K (1986). His further educational program in the form of pursuing the postdoctoral program in the University of Iowa USA (in 1988-1989) and training on sediment-related disaster management in various universities in Japan has inspired him in developing his career in water & sediment related disaster management and the countermeasures. He was the Indonesian Executive Committee member of the IAHR-APD in 2012 – 2014. He is currently a Professor in the Civil and Environmental Engineering Department, Universitas Gadjah Mada and also an Editor in Chief of the Journal of the Civil Engineering Forum (JCEF), a growing and promising journal related to Civil and Environmental Engineering issues. During the last ten years, he has been involving very intensively on the conducting the education, training, and research related to the development of warning criteria against the water & sediment-related disasters triggered by heavy rainfall and the countermeasures.

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