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UNIVERSITI TEKNOLOGI MALAYSIA

Centre for
Environmental Sustainability
& Water Security (IPASA)

PROCEEDINGS OF
CONFERENCE ON **FLOOD CATASTROPHES**
IN A CHANGING **ENVIRONMENT**
"INTEGRATING EVERYTHING"

UTM INTERNATIONAL CAMPUS
KUALA LUMPUR
15th - 16th NOVEMBER 2016

Co - Organised by:



Asian Network on
Climate Science and Technology
(ANCT)



UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Malaysia-Japan
International
Institute of Technology

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WELCOME NOTE

Assalamualaikum wbt and sincere greetings to all

On behalf of the Organizing Committee of the Conference on Flood Catastrophes in a Changing Environment (CFCCE'16), it gives me a great pleasure to extend our warmest welcome to all distinguished guests and participants. This Conference is jointly co-organized by the Centre for Environmental Sustainability and Water Security (IPASA) UTM, Asian Network on Climate Science and Technology (ANCST), Southeast Asia Disaster Prevention Research Institute (SEADPRI)-UKM, and Malaysia-Japan International Institute of Technology (MJIT).



Our conference theme is unique and rather peculiar “Integrating EVERYTHING”. This does not mean that there is paucity in focus; but it is to reflect the complexity involved in order to deal with issues regarding calamity or catastrophes. This conference is aimed to cover three main phases that I would simplify as triple-Ps: Pre Disaster, Present/ during Disaster and Post disaster. These processes involve immense planning, formulation of strategy, preparedness at all levels including the community, early warning system, rescue operation, and dealing with the traumatized victims. “Integrating EVERYTHING” will broadly cover all disciplines and matters related to Flood management. We are fortunate here to have eminent speakers who are expert in flood disaster related fields. This conference is wittingly planned, targeting modest number of professionals and scientists, nevertheless emphasizing on quality of interaction time. Enabling participants to have advantageous opportunities to interact, interrelate, discuss, exchange ideas and experiences also in networking.

I would like to record my heartfelt thanks to ANCST for entrusting UTM in organizing this conference and sponsoring the international speakers. We also thank local speakers and all the participants for your time and support. This conference would not be possible without the hard work and passion of the committees, mostly young and talented individuals.

For our foreign delegates, we are delighted to welcome you to Kuala Lumpur and may you also take this opportunity to enjoy the beauty of our country. We wish you a superb conference and that your trip to Malaysia will be most enjoyable and memorable. Selamat Datang ke Malaysia!

Professor Zulkifli Yusop, FASc.

Chair

CFCCE'16 Organizing Committee

TENTATIVE PROGRAMME

15th November 2016 (Tuesday)

Venue: Dewan Jumaah

0800-0900	CFCCE Workshop Registration
0900-0915	Welcome Address
0915-0930	Opening
0930-1030	Plenary 1 (Invited Speaker 1 and 2)

PROF P.P. MUJUMDAR

Integrated urban Flood Management: Technology-driven Solutions

PROF ALFREDO LAGMAY

Preparing risk maps of future hazards

1030-1100	Coffee Break
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1100-1230	Plenary 2 (Invited Speaker 3, 4 and 5)
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PROF JAMAL HISHAM HASHIM

Health implications of major floods

PROF QI ZHANG

Flood in the largest freshwater lake (Poyang Lake) in China: Characteristics and explanations

PROF ISMAIL ABUSTAN

Advance of Flood Inundation Modelling Toward Flood Nowcasting: A Review

1230-1400	Lunch Break
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1400-1430	Plenary 3 (Invited Speaker 6)
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IR ZAKI MD AMIN

1430-1700	Oral Presentation (Parallel Sessions 1)
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Venue: Dewan Jumaah & Jamuan

1700-1715	Coffee Break
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1715-1830	ANCST Meeting (committee)
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Venue: Dewan Jumaah



16th November 2016 (Wednesday)

Venue: Dewan Jumaah

0900-1030 Plenary 4 (Invited Speaker 7, 8 and 9)

IR KHAIRI SELAMAT

Management of Flood Water as Resource

DR. PORNSAK SUPPATARATARN

Flood Modification and Management in Thailand: Cases study for Chao Phraya River Basin, and Bangkok and Hat Yai Cities

PROF ZULKIFLI YUSOP

Landuse influence on major floods in the tropics.

1030-1100 Coffee Break

1100-1200 Plenary 5 (Invited Speaker 10 and 11)

EN ABDUL JALIL HASSAN

River and Drainage Modelling-Managing the Difficulties and Challenges.

PROF JOHNNY CHAN

The Effect of Urbanization on Precipitation

1200-1300 Oral Presentation 1 (Parallel Session 2)

Venue: Dewan Jumaah & Jamuan

1300-1400 Lunch Break

1400-1500 Oral Presentation 2 (Parallel Session 2)

Venue: Dewan Jumaah & Jamuan

1500-1530 Forum and Discussions

1530-1600 Closing

1600-1615 Coffee Break

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Institute of Technology
(MJIT)



SPEAKER 1: PROF P.P. MUJUMDAR



BIOGRAPHY

Pradeep Mujumdar is currently serving as a Professor in the Department of Civil Engineering and Chairman, Interdisciplinary Centre for Water Research at IISc Bangalore. His area of specialization is Water Resources with a focus on climate change impacts on hydrology/water resources, statistical downscaling of GCM outputs, urban flooding, planning and operation of large scale water resources systems, and uncertainty modeling.

His recent research contributions include development of downscaling models with fuzzy clustering, relevance vector machines and conditional random fields, uncertainty combination in climate change impacts and reservoir operation for adaptation to climate change. He is identified as a reviewer for the Assessment Report 5 (AR5) of the IPCC, and is a recipient of the Distinguished Visiting Fellowship of the Royal Academy of Engineering, UK.

His teaching interests include Stochastic Hydrology, Water Resources Systems, Surface Water Hydrology and Urban Hydrology. His areas of professional consultancy include urban storm water drainage, floodplain management, river basin planning, reservoir operations, lift irrigation, hydropower development and impact assessment of water resources projects.

INTEGRATED URBAN FLOOD MANAGEMENT: TECHNOLOGY-DRIVEN SOLUTIONS

Pradeep Mujumdar
Indian Institute of Science, Bangalore, India

Abstract

Rapid urbanization with unplanned land use, coupled with increasing intensities of rainfall, has in recent years contributed to catastrophic flooding in many urban areas in South Asia. The problem is aggravated by aging infrastructure and a general lack of integration of scientific capabilities in forecasting and managing urban drainage systems. Recent catastrophic floods in Indian cities of Mumbai, Chennai, Kolkata, Delhi, Bangalore, Surat and Hyderabad have highlighted the importance and urgency of urban flood management in the country.

This presentation discusses the technological interventions needed to address the increasing urban floods problem in an integrated manner, especially in the rapidly developing countries like India. A technology demonstration project under Government of India is currently underway that aims to achieve a leapfrog from the current, poorly managed response to urban floods to a highly efficient, automated, and sensor technology-driven end-to-end management, thus overcoming the institutional constraints to a significant extent. An innovative use of sensor and communication technologies coupled with high resolution real-time nested forecasts of rainfall, state-of-the-art hydrologic models, downscaled results for point scale information and the Geographic Information System (GIS) are made for providing operational, real time decisions. Hydrometeorological forecasts with lead times ranging from a few hours to a day or more, are being developed using process based numerical urban weather models. The extreme rainfall events are embedded within the monsoon rainfalls but are highly localized, and difficult to predict using continental scale monsoon models. The events are also generally short lived, fast developing systems that can catch the civic planning authorities and the general public by surprise. Forecasts of high intensity rainfall are converted to flood forecasts with insitu as well as remote sensed measured data. In situ sensors monitor and provide information on rainfall intensity, and geospatial location of water levels, which are assimilated within the hydrologic models. Long term adjustments in the hydrologic designs for urban flooding are examined based on likely changes in frequencies of high intensity rainfall due to climate change.



SPEAKER 2: DR. PORNSAK SUPPATARATARN



BIOGRAPHY

Dr. Pornsak has Thirty-five years' experience in planning, study and analysis and design of flood control work, water resources development, water supply, sewerage system, coastal engineering including river works with specialization in mathematical modelling. He involve in in many flood protection and drainage projects and flood forecasting in Thailand ranging from, city, region and basin wise. He has been technical specialist positions as the mathematical modelling specialist, hydrologist, hydraulic engineer, flood protection and drainage engineer, flood control planner, flood forecasting specialist, project manager and project director. He also involve in conducting economic evaluation, cost estimation and feasibility study of various infrastructure development projects.

Dr. Pornsak had develop the River Network Mathematical model in his dissertation at AIT during 1987-1990 to analyses and forecast flood conditions in the Chao Phraya river and its' flood plain. The model has been calibrated with flood in 1980 and 1983 and used to forecast flood situations in the Chao Phraya River including flooding in 1995, 1996, 2002, 2006 and 2011 to create flood fighting strategy of the government officers. In particular, for the 2011 flood, the model is use to forecast the inundation area in the Chao Phraya river including Bangkok and its vicinity and periodically disburse the warning information to the public.

As for the projects, Dr. Pornsak has conduct flood protection and drainage in Bangkok, Jakarta, Ho Chi Minh City, many other cities in Thailand, the Chao Phraya river basin, industrial Estate and factories. He works with TEAM since 1990 and used to in charge as the head of private sector unit, director environmental department, technical director of the water resources business unit, managing director of the international business unit of TEAM, Senior Executive Director of TEAM Consulting International Co. Ltd. and presently as the Executive Vice President of TEAM Consulting Engineering and Management Co. Ltd.



FLOOD MODIFICATION AND MANAGEMENT IN THAILAND **case study for Chao Phraya River Basin, and Bangkok and Hat Yai Cities**

Dr.Pornsak Suppataratarn and Kannika Pahonepipat
TEAM Consulting Engineering and Management Co., Ltd.

ABSTRACT

In recent years, flood disasters in Thailand have become more severe as a result of changes in land uses. Many major cities, such as the cities along the Chao Phraya river including Bangkok and Hat Yai city have encountered serious flood damage. The flood characteristics was modified by the human interference, flood management has to be changed to cope with the change of these flood characteristic.

The great floods in 2011 in the Chao Phraya River basin is the most destructive event both in terms of flood volume and number of flood victims. The existing drainage and flood protection systems in the Chao Phraya River Basin which were initially designed for medium scale floods did not have sufficient capacity to cope with the immense cumulative flow volume of 32,876 million cubic meters generated during July –November 2011. Totally 240,000 square kilometers of land were inundated during the flood crisis, causing damages of approximately 1.4 trillion Baht and 13 million flood victims. In the past 4 decades, land uses have been significantly changed from rice field to urban communities and industrial development. Many buildings and infrastructures were constructed in response to urban growth, reducing natural retention areas. Flood characteristic has been modified and post higher risk to the development area.

As for flood management in Bangkok which is situated in large flood plain areas, cause of flooding are overflows from the Chao Phraya River, heavy local rainfall and inflow from the adjacent area. Urbanization, and land subsidence is worsen the flooding situation and make it difficult to manage. Bangkok Metropolitan Administration had implemented various flood measures to alleviate flood damage, e.g. construction of dikes, improving main drainage canals, creating sub-polder system, built up retention ponds, and construction of drainage tunnels. However, the more vital to flight with the flood is the understanding these functions and operating the facilities.

Other case study, Hat Yai Town, a city just north of Malaysia, located in U-Taphao River estuary, is habitually hit with floods from mountain upstream. The massive flood waters move quickly through the city to the Songkhla lake. The flash flood cause a huge damage and threatened the human life. The schemes to mitigate the flood is planned in the differently from Bangkok.



SPEAKER 3 PROF ALFREDO LAGMAY



BIOGRAPHY

Dr. Alfredo Mahar Francisco A. Lagmay is an Academician of the National Academy of Science and Technology (NAST) and Professor at the National Institute of Geological Sciences, University of the Philippines. He is currently the Executive Director of the DOST Nationwide Operational Assessment of Hazards (NOAH, DOST's flagship program for disaster risk reduction and management. He received his Bachelor's and Master's degrees from the University of the Philippines and holds a Ph.D. degree in Earth Sciences from the University of Cambridge (2001). He was a visiting scientist at the Geophysics Department of Stanford University from April 2006 to March 2007. His work is focused on volcano-tectonics, fluid dynamics of volcanic flows, remote sensing, and Permanent Scatterer Interferometry of faulted regions.

Upon receiving his Ph.D., he returned to the Philippines and has been involved in numerous research efforts related to natural hazards. He lectures on Philippine Disasters by virtue of having hands-on experience in search-and-rescue and forensic analyses of major Philippine catastrophes. These include the lethal Mindoro, Iloilo, Pampanga floods, Guinsaugon landslide, Mayon lahars, and the Ondoy, Pedring/Quiel, Sendong, Habagat, Pablo and Yolanda disasters. He is a recipient of the Presidential citation for search and rescue work in Guinsaugon and the 2008 Outstanding Research Award for advanced science and technology in the Philippines for innovative applications of space technology. He was also awarded the 2008 and 2011 University Scientist awards, the 2012 New Media digital heroes award and the 2012 Cyberpress best IT product of the year for development of the Project NOAH website and mobile tools. On June 20, 2013 he was presented with the Professional Regulation Commission (PRC) Outstanding Professional of the Year Award in the field of Geology for his accomplishments. In the same year, he received the 2013 Outstanding Filipino award (TOFIL), an honor given by the Junior Chamber International (JCI) Senate Philippines to Filipino men and women whose exemplary achievements are worthy of emulation. In 2014 and 2015, RED Alert, a radio program that he anchors, was recognized by numerous awarding bodies including the Catholic Mass Media Award (CMTA), Philippine Quill Awards and the Hildegard awards. He also received in 2015, on behalf of the development team of the ARKO mobile app, the World Summit Award (WSA) for best mobile app for m-inclusion and empowerment. Also in the same year of 2015, Dr. Lagmay has also been awarded with the Plinius Medal by the European Geosciences Union or EGU.



for outstanding achievements in interdisciplinary naturalhazard research and natural-disaster engagement in the Philippines. He is also the first Asian to receive such an honor. His most recent work covered the 2013 Bohol Earthquake and the 2013 Yolanda/Haiyan Supertyphoon. A consultant for World Bank and USAID, Dr. Lagmay is a leading international scientific expert on natural hazards. He has published more than 50 peer-reviewed journal articles, mostly in international ISI journals. Also an editor and regular reviewer of scientific manuscripts in world-class journals, he maintains a reputable status in his field of expertise in the international scientific community.



PREPARING RISK MAPS FOR FUTURE HAZARDS

Alfredo Mahar A. Lagmay
University of Philippines, Philippines

ABSTRACT

Disaster Risk Reduction Management in the context of Climate Change Adaptation is not limited to the current weather and their potential hazard impacts but rather to climate-related hazard scenarios that can affect vulnerable communities and areas, decades from today. As such, it is necessary to use hazard maps of the future, which incorporate possible scenarios predicted as a consequence of climate change. It is not enough to create hazard maps based solely on the historical record or interviews of individuals in the community because these may not capture the extreme hazard scenarios that are yet to come. Mainstreaming Climate Change Adaptation and Disaster Risk and Vulnerability Reduction and Management (CCA and DRVRM) into existing local development plans such as the Comprehensive Land Use Plan (CLUP), Comprehensive Development Plan (CDP) and Local Climate Change Action Plans (LCCAP) require the use of probabilistic (multi-scenario) flood and landslide hazard maps simulated using our knowledge on the physics of the flow of water and stability of rocks. With the use of probabilistic maps in traditional town planning, Climate Change impacts are properly appreciated and addressed – more lives can be saved, investments are better protected and communities more resilient. The use of probabilistic hazard maps accelerates the triangle of survival: The Paris Climate Agreement of the United Nations Framework Convention on Climate Change (UNFCCC), the Sendai Framework for Disaster Risk Reduction 2030 and the Agenda 2030, the Sustainable Development Goals (SDGs), which requires science and risk-based approaches in their formulation and implementation



SPEAKER 4: PROF JOHNNY CHAN



BIOGRAPHY

Prof. Chan is internationally renowned in the research areas of typhoons and monsoons. Recently, he has been working on the problem of global warming and its relationship with typhoon activity, as well as on tropical cyclone and monsoon climate. He has published over 170 international journal articles and given more than 200 invited talks and conference papers. According to the Essential Science Indicators, he ranks the top in the world in the number of SCI-listed journal articles related to tropical cyclones, and is the ninth most-cited author in this field during the 1996-2006 period.

Prof. Chan is currently a member of the Tropical Meteorology Research Working Group of the World Meteorological Organization and the Chair of its Tropical Cyclone Panel. He is also an associate editor of three journals: *International Journal of Climatology*, *Atmospheric and Oceanic Science Letters* and *Acta Meteorologica Sinica*, and a member of the Editorial Board of *World Scientific Series on Earth System Science in Asia*. In Hong Kong, he is a member of the Strategic Advisory Committee of the Hong Kong Observatory, and an advisor of the GreenPlus Programme and a member of the Advisory Group on Advanced Metering Infrastructure, both of China Light & Power Company Limited.

Prof. Chan's honours include Honorary Fellow of the UK Energy Institute, Fellow of the American Meteorological Society, recipient of the International Journal of Climatology Award of the Royal Meteorological Society, Distinguished Meteorologist awarded by the Hong Kong Observatory, and a Senior Research Fellowship awarded by the Croucher Foundation.



EFFECT OF URBANISATION ON PRECIPITATION

Johnny C L Chan

Guy Carpenter Asia-Pacific Climate Impact Centre, School of Energy and
Environment, City University of Hong Kong

Abstract

The rapid growth of cities all over the world, especially in Asia, has significantly modified the properties of the land surface, with subsequent changes in the interaction between the land and the atmosphere in terms of increase in surface roughness and turbulence, enhanced heat flux and reduction in moisture flux. All these have substantial effects on the convection over the cities.

This talk will summarise a few studies that examine, through numerical simulations, the effects of urbanisation on the precipitation distribution and intensity in an urbanised “mega city cluster”. It will be shown that precipitation can be enhanced through modification of the atmospheric stability. Such modification depends on the size of the city, with more substantial modification when the city size is larger. In addition, the changing background flow can also modify the location where the rainfall is a maximum. These results have important implications in estimating future changes in precipitation under global warming. Disaster preparedness efforts must therefore take such changes into consideration.



SPEAKER 5: PROF QI ZHANG



BIOGRAPHY

Qi Zhang is a Professor of Hydrology at Nanjing Institute of Geography and Limnology (CAS) since 2003. He is also appointed as the Executive Deputy Director of Key Laboratory of Watershed Geographic Sciences, Chinese Academy of Sciences, and is the leader of the Division of Land and Water Processes and Environmental Effects of the laboratory. He had his PhD at The University of Queensland, Australia in hydrology. His main research interests include: catchment hydrology, hydrological impacts of climate change and human activities, and seawater intrusion. In recent years, he has been conducting research on lake-catchment hydrological and hydrodynamic modelling, floods and droughts of the middle Yangtze River. Prof. Zhang has a long track record of positive and productive collaboration with international organizations, including CSIRO Land and Water Australia, Flinders University and University of Queensland of Australia, Christian-Albrechts-Universitat zu Kiel of Germany and the Chinese University of Hong Kong. Prof. Zhang's research achievements include co-authorship of over 100 journal articles, and many technical reports and book chapters.



FLOODS IN THE LARGEST FRESHWATER LAKE (POYANG LAKE) IN CHINA: CHARACTERISTICS AND EXPLANATIONS

Qi Zhang

Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography
and Limnology, Chinese Academy of Sciences

ABSTRACT

Floods are one of the most common natural disasters recorded in the world, which cause considerable economic loss and serious damage to towns and farms, especially with their increased frequencies as an estimated impact of global warming. Strengthening the available research regarding the flood events has a very important practical significance for the flood prediction, mitigation and management. Poyang Lake is one of the most frequently flooded regions in China. The frequent large floods have caused huge damages to the environment and economy and threatened the life of approximately 10 million people. Poyang Lake connects with the Yangtze River and the five sub-tributaries in the local catchment and the lake's hydrological regime is complicated by a complex hydraulic connection and strong River-Lake interaction, especially for the extreme hydrological regime. In this study, the characteristics of historical floods in Poyang Lake were identified and examined based on several widely used indices and Mann-Kendall test. The study also analyzed the relationships between the lake-level changes and the flow regimes of Yangtze River and local catchment during the flood season and employed a physically-based hydrodynamic model to quantify their relative contributions to the development of floods.

The results show that the floods in Poyang Lake mainly occurred in mid and late July. The inter-annual variation of highest flood stages and duration showed a long-term increasing linear trend. Also, a slightly increasing linear trend in the timing of highest stages indicated the floods have occurred later and later during the last 60 years. At the decadal scale, the flood situation was most severe in 1990s, while gentle in 2000s in terms of the occurrence frequency and average duration. The study also found that the contributions of local catchment runoff and Yangtze River discharge to the floods were unevenly distributed in time and space. The local catchment imposed more influence during the period of April–May and at the central area of lake, and its influence decreased toward the north and south; In contrast, the most remarkable lake-level changes were observed in July–August and at the northern lake for the Yangtze River cases, and these changes reduced from downstream (north) to upstream (south). Moreover, Yangtze River imposed far stronger influences on the lake-level changes than the catchment runoff and dominated the duration of floods to a great extent.

The climate change was the primary influence factor for changing of flood characteristics in Poyang Lake, i.e., the abnormally large rainfall during the flood season and subsequent large discharges of Yangtze River and runoff inflow from the basin were mainly responsible for the severe floods in 1990s. Also, the smallest storage capacity of Poyang Lake in 1990s due to the intensive human activities such as the great floodplain occupancy and levee construction further increased the



severity of floods. While the rare floods in 2000s can be attributed to, on one hand, the decrease of rainfall over the middle reaches of Yangtze River which caused the low stream flow of Yangtze River and runoff inflow from the Poyang lake basin. On the other hand, the “return land to lake” policy, intensive sand mining in the lake and the flood control of Three Gorges Dam (TGD) also played an important role in mitigation of flood frequency and severity.



SPEAKER 6: PROF ZULKIFLI YUSOP



BIOGRAPHY

Zulkifli has vast experience in research and consultancy services in water related fields with strong national and international linkages. He joined UTM in 1999 after serving FRIM for 14 years. His main research interests are forest and plantation hydrology, non-point source pollution and integrated catchment management. At UTM, he holds various positions, which include as R&D Manager at Institute of Environmental and Water Resource Management (IPASA), focus group secretary on Environmental Technology, Director of IPASA and now as Dean of Water Research Alliance. He was the Chairman of Public Awareness Committee of the Malaysian International Hydrological Program (MIHP) for almost 10 years, council member of Malaysian Water Association (MWA), Secretary of the IWA's Specialist Group on Appropriate Technologies for Developing Countries and Research Committee member for Malaysian Hydrological Society. His present positions include as an Exco member of MIHP, Board of Director Lembaga Urus Air Selangor (LUAS), group leader (Hydrology and Climate Change) of Asia Core Program under the Japanese Society for the Promotion of Science (JSPS), Co-Secretary of IWA's Specialist group on Integrated Water Management and panel member of various research funds under the Ministry of Education Malaysia (MOEM) and MOSTI. In view of his active involvement in championing water issues, he was conferred Fellow of Akademi Sains Malaysia (ASM) in April 2012. Now he is chairing ASM's Task Force on Water Supply and Wastewater Management and heading study on Current Status and Needs Assessment of Water Resources Research in Malaysia. Zulkifli is also a registered Environmental Consultant under the Department of Environment Malaysia.

Zulkifli has authored and co-authored about 300 articles in various journals, book chapters and proceedings. While serving FRIM, he won three best publication awards in 1994, 1998 and 1999 and later UTM publication award in 2006. He was the Chief Editor of Jurnal Kejuruteraan Awam (2003-2005), Chief Editor of Malaysian Journal of Civil Engineering (2006-2009) and Associate Editor of Water Science and Technology (WST) – a journal published by International Water Association with 1.2 Impact factor, between 2008 and 2012. In January 2013, he was appointed as Editor of WST. He is also sitting in editorial boards of International Journal of Engineering Research and Technology, The Asian Review of Civil Engineering, Malaysian Journal of Civil Engineering and Malaysia Water Resources Journal.



Over the past 10 years he has involved in various research and consultancy work, mostly as project leader with a total funding of about RM 15.4 million. He was a key researcher for European Union (EU) research project on Innovative Decision Making for Sustainable Management of Water in Developing Countries and recipient of Eco-Frontier Fellowship Awards from the Ministry of Environment, Japan for three consecutive years (2003, 2004 and 2005). In 2012, his team won UTM's best consultancy award for carrying out water resources study in Lahad Datu, Sabah, funded by FELDA with a total cost of RM 1.09 million. He was involved in study on groundwater level rise under Nabawi Moque in Madinah and now flood risk study in Madinah Al Munawarah. Over the past three years he has been heading UTM's team to study on safe rural water supply in Cambodia with funding from MOEM.



LANDUSE INFLUENCE ON MAJOR FLOODS IN THE TROPICS

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ABSTRACT

The severity of December 2014 flood in the east coast of Peninsular Malaysia has raised concern over the adequacy of existing landuse practices and policies. This article assesses flood responses to selective logging, plantation establishment (oil palm and rubber) and their subsequent management regimes. The hydrological impacts were evaluated at two levels: on site (mostly in the upstream) and off site to reflect the cumulative impact at downstream. Results of experimental catchment studies suggest that on-site impact of flood could be kept to a minimum when selecting logging strictly adhere to the existing guidelines. However, increases in flood potential and sedimentation rate were observed with logging intensity and slope steepness. Forest conversion to plantation show the highest impacts. Except on the heavily compacted surfaces, the ground revegetation on moderately disturbed sites is rapid, usually within two years upon the cessation of logging operation.

The hydrological impacts of plantation opening and replanting could be significantly reduced once the cover crop has fully established which normally takes between three to six months after sowing. However, as oil palms grow taller and the canopy get closer, the cover crop tend to die off due to light competition, and its protecting function gradually diminishes. The exposed soil is further compacted by harvesting machinery which subsequently lead to greater overland flow and erosion rates. As such the hydrological properties of matured oil palm plantations are generally poorer than in young plantations. In hilly area, the undergrowth in rubber plantation is usually denser compared to under oil palm. The soil under rubber trees is also less compacted as latex collection is done manually. By considering the cumulative effects of land-use over space and time, selective logging seems to pose the least impact on flood potential, followed by planting rubber for latex, oil palm and Latex Timber Clone (LTC). The cumulative hydrological impact of LTC plantation is the most severe because of its shortest replanting rotation (12 to 15 years) compared to oil palm (25 years) and rubber for latex (35 years). Furthermore, the areas gazette for LTC are mostly located on steeper slopes which are more susceptible to landslide and erosion.

Forest has limited capability to store excess rainfall and is only effective in attenuating regular floods. Once the hydrologic storage is exceeded, the excess rainfall will appear as flood water. Therefore, for big floods, rainfall regime has a much bigger influence than land use. Flood control strategies under very heavy rainfall conditions require both structural such as construction of dam and best landuse practices.



SPEAKER 7: PROF ISMAIL ABUSTAN



BIOGRAPHY

Received his BSc (Civil Eng) from The George Washington University, Washington D.C and MSc (Eng) in University of New South Wales, Sydney and his Phd in water engineering from the same university. Current research focus is in field of urban and water resources Disaster Management. He was also the programme head for Advancement of the Best Waste Management Practice in the Northern Corridor Economic Region (NCER). Project head for Flood and Flood Disaster-Flood Hazard Map Utilizing Public Domain Inundation Hydrological (FRM) and HEC-RAS models and GIS.

ADVANCE OF FLOOD INUNDATION MODELLING TOWARD FLOOD NOWCASTING: A REVIEW

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ABSTRACT

Flood have been known as one of the natural hazard. Continuously increasing urbanization has led to an increasing flood risk. Although a good implementation of the flood risk management in infrastructure development planning and flood protection methods, complete protection against flood is still impossible. Recently, real-time flood forecasting also known as flood nowcasting has been a trend in research study as the alternative method to solve this problem.

Inundation modelling vastly explored recently. This type of modelling can be used for flood prediction and one of the flood predictions is real-time flood forecasting. Real-time flood forecasting commonly used to predict flash flood or flood happen with short time period (less than 3hr) and normally happen in urban area. Due to these real-time forecasting characteristic, selected the appropriate inundation modelling as part of real-time forecasting system is important. This paper review recent inundation modelling that meets the need of real-time flood forecasting.

Firstly, we review the recent progress of the available inundation model. Secondly, we review issues in flood inundation modelling in real-time flood forecasting. Lastly, we discuss on future prospects of the model.



SPEAKER 8: IR MOHD ZAKI MAT AMIN



BIOGRAPHY

Ir Mohd Zaki, holds a M.Sc. in Hydrology Engineering from National University of Ireland, Galway. He has expertise in a wide range of hydraulic issues including urban, rural and forest hydrology, hydrology analysis, design and synthesis, rainfall runoff modelling, watershed modelling, water resources assessment, flood forecasting and warning system, dam hydrologic modelling, climate change projection and modelling, climate change impact assessment, climate change vulnerability assessment and adaptation to climate change. He is also affiliated to Board of Engineers Malaysia, and is a Committee Member of Malaysia Hydrology Society.

BIG DATA ANALYTICS (BDA) FOR CLIMATE RESILIENCE: ENHANCING HAZARD MANAGEMENT

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Abstract

Natural hazards driven by climate variability and climate change pose major risks to developing countries such as Malaysia. Long-standing patterns and rapid development expose communities to more natural hazards and leave them less resilient hazards do occur. The resulting disasters take more lives and lead to more damage such as extreme flood occurred in the East Coast State of Peninsular Malaysia in December 2014. Assessing a system's resilience to natural hazard especially driven by climatic factor requires consideration of possible unforeseen consequences of current actions and appropriate analysis tools in the larger context. Climate change further complicates this scenario by increasing the likelihood of extreme events in uneven patterns around the globe which would impact communities at national and local level.

In this context, this paper explores applications of Big Data Analytics (BDA) tool for examining projected climate change large data set to uncover hidden patterns and unknown correlations based on 10 billion data set that consist of 3 main hydroclimate parameters such as rainfall, runoff and flow in Peninsular Malaysia for period 2010-2100. The BDA will be able to visualize the study grids, detect future pattern of extreme rainfall and identify the corresponding flood flow magnitude and pattern after-effects based on designated watershed areas. Furthermore, the effect of future rainfall intensity and magnitude by means of climate change factor were also examined. In general, this paper emphasizes on the application of BDA technology to the generated future climate change large data set for reinforcing climate related resilience particularly in the context of natural hazard management mainly due to hydro-meteorological hazard. The BDA output produced the rainfall-storm pattern with identification of storm center and quantification of streamflow volume of flood events under climate change condition which will help preparedness and readiness of hazard due to extreme flood in future.



SPEAKER 9: PROF JAMAL HISHAM HASHIM



BIOGRAPHY

Jamal Hisham Hashim is a research fellow and a professor of environmental health at the International Institute for Global Health, United Nations University (UNU). He was a former professor at the National University of Malaysia (UKM). Prof. Jamal obtained his PhD in environmental health from the University of Michigan. He has been teaching, conducting research and consultancy in environmental and occupational health at UKM and UNU for the past 33 years. His research interests are mainly on the health effects of heavy metals, pesticides, solvents, air pollution, risk assessment, and recently, climate change. He has been the principal and co-investigator of 18 research projects, and has over 310 publications and presentations to date, including 70 full articles in refereed journals. He has been engaged as an environmental health consultant in over 60 local and overseas projects, primarily in the area of environmental health impact and risk assessment. He has also been consulted by the World Health Organization, International Atomic Energy Agency, Risk Science Institute and the Institute of Medicine in the U.S., the governments of Malaysia, Cambodia, Indonesia and Saudi Arabia on various environmental health issues. He is a registered environmental impact assessment consultant with the Department of Environment, Malaysia, a member of the Chartered Institute of Environmental Health in the U.K., an honorary fellow of the Academy of Occupational and Environmental Medicine Malaysia and a council member of the Asia Chapter of the International Society for Environmental Epidemiology.



HEALTH IMPLICATIONS OF MAJOR FLOODS

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ABSTRACT

One of the more obvious impacts of climate change has to be extreme weather events. According to the Intergovernmental Panel on Climate Change, changes in many extreme weather and climate events have been observed since around 1950. A single extreme weather event cannot be solely linked to anthropogenic climate change. However, scientists believe that climate change is an increasingly important factor for changing the odds of occurrence and the intensity of these events. Among these extreme weather events, floods are the most common. Between 1980 and 2011, there were a total of 3,455 flood events worldwide, increasing gradually and peaking in 2006 with 226 flood events. In the United Kingdom, 20th century greenhouse gas emissions are believed to have increased the risk of floods in England and Wales in autumn of 2000 by 20% in 9 out of 10 simulations of the precipitation runoff model. Among the impacts of floods, health implications are the most critical. The health impacts of floods include mortality, injuries, faecal-oral diseases, vector-borne diseases, rodent-borne diseases, chronic diseases and mental health. Our research into the 2014 Kelantan flood event indicated that there was a drastic increase in the incidence of leptospirosis during and after the flood which was related to distance from water bodies and proximity to temporary waste dump sites. Other administrative shortcomings that may have resulted in poor responses to health emergencies included lack of disaster and emergency response plan for severe flooding, poor interagency coordination, communication breakdown, limited usable transportation means, shortage of food and water supply, inadequate number of aid workers, post-flood solid waste disposal, overcrowding of relocation centres and inadequate post-flood temporary shelters.



SPEAKER 10: IR HJ MAD KHAIRI SELAMAT
MANAGEMENT OF FLOOD WATER AS RESOURCE



MANAGEMENT OF FLOOD WATER AS RESOURCE

Md Khairi Selamat

Department of Irrigation and Drainage Malaysia

ABSTRACT

Malaysia is situated in the equatorial region. The climate is influenced by the alternating north-east monsoon during October to March and the south-west monsoon during May to September. With average annual rainfall of 2940 mm (971 BCM) and 494 BCM surface runoff, Malaysia is rich in water resources. During the monsoon, the rain can cause flooding. On the other scenario, there is insufficient water due to increasing demand during dry season. Managing water resources is a complex and involve multiple levels, stakeholders, issues and factors. To ensure sufficient availability of water to meet the demand from various sector ranging from water supply to an environment, therefore the management of river basin in an integrated approach is a crucial. Due to excessive storm water, as much as 9% of the country's total land areas especially the low-lying areas are susceptible to annual flooding which potentially can be a storage area. On the other hand, the occurrence of drought is getting more frequent and severe, resulting in water stress in many regions throughout the country. It is essential to utilise flood water opportunity before its discharge to the sea. This approach adopted to ensure water as key driver of economic and social development and has a basic function in maintaining the integrity of the natural environment. National Water Resources Study, 2011 indicated five states experiencing water stress area under the condition of unregulated river flow. Drivers such as demographic and climatic changes further increase the stress on water resources. The traditional fragmented approach is no longer viable and a more holistic approach to water management is required. Therefore, relevant initiative must be considered to optimise the usage of floodwater and building water resources infrastructure such as storage to improve the water resources availability to meet the current and future demand. Rapid development and population growth changing the water situation for the country from relatively abundance to one of scarcity.



SPEAKER 11: EN ABDUL JALIL HASSAN**BIOGRAPHY**

Abd Jalil obtained his Bachelor in Civil Engineering from University of Malaya in 1986. He joined Department of Irrigation and Drainage Malaysia from 1987 till 2007. He worked as a Senior Researcher at National Hydraulic Research Institute (NAHRIM) from 2003 till 2006. During this time, he earned his MSc in River Management from University Sains Malaysia in 2006. After a long stint with the government's department, he joined Wallingford Software Asia Sdn. Bhd. as the Technical Director in 2007 and presently he is managing his own consulting firm, River Net Consulting while supporting HR Wallingford in marketing and technical support.

He has more than 20 years experience in river and drainage modelling which involves Drainage masterplan, Flood mitigation works, Flood Forecasting, Flood mapping using 1D and 2D and also water quality analysis. To date, he has developed nearly 100 river and drainage models including technical support to modellers from consulting firms and universities. He has also published two books on river modelling with, "Permodelan Hidrodinamik Sungai Menggunakan InfoWorks RS" and "River and Flood Plain Modelling".

His third book, titled "River and Drainage Modelling – Managing the Difficulties and Challenges" is expected to the market in early 2017. The book elaborates on many issues, including basic requirement for modellers to start modelling work, data acquisition and processing problem, challenges in calibration, software capabilities and data sharing faced by modeller. The book also discusses on phases that modellers should be aware of during the modelling works.

RIVER AND DRAINAGE MODELLING – MANAGING THE DIFFICULTIES AND CHALLENGES

Abd Jalil bin Hassan
Technical Director, HR Wallingford

ABSTRACT

Flood has a very complex behaviour which we need to understand properly before we solve its problems. From this perspective, modelling the river and drainage is indispensable in the current practice. There are various software packages either free or commercial is available in the market to carry out flood analysis. As compared to free software, commercial software provides more integrated tools to carry out hydrology and hydraulic simulation in a single model. Software packages are also equipped with capabilities to simulate flow routing using dynamic wave equation, thus being to solve the energy and momentum equation together with storage effect. They are integrated with various tools to compute the effect of structures in the channel as well as two dimensional engine, which has become a common tool to flood plain analysis.

However, to fully benefit from the available tools and in order to produce quality results, we must take into consideration other factors that can cause problems to the modelling exercise. We should not get carried away by the software capabilities alone. This book discusses the challenges that could arise during the modelling process which include data reliability, human resources capabilities and handling possible uncertainty.

Discussions in this book are based on the experience of the author, who has been involved in flood modelling for more than 20 years. It also comes from author's observation when providing technical support to government agencies, consultants and universities.

ID001: IDENTIFYING ROOT CAUSES OF RECURRENT FLOODS IN THE UPPER STREAM OF PAHANG RIVER BASIN FOR EFFECTIVE FLOOD RISK MANAGEMENT DECISIONS

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Flood has the greatest damage potential of all natural disasters and in recent decades it is evident that both the frequency and intensity of flood have increased. In Malaysia, flood stands out to be one of the most destructive natural catastrophes which bring the maximum damage annually. Monsoon flood is a commonly experienced natural hazard in Malaysia and in 2014 -2015 it had experienced one of the worst floods in the recent decades. It is estimated that about 90% of the damage associated to natural disasters in this country is caused by flood. Therefore, it might not be wrong to state that existing flood management system is not adequate to reduce the people's vulnerabilities due to flooding. This paper aims to identify the root causes and people vulnerabilities caused due to flooding in the up-stream of the Pahang River Basin. The District of Temerloh is selected as study area which is located on the banks of the Pahang River, frequently experiences economic and physical destructions due to floods. It is predicted that heavy rainfall and congested drainage systems caused by anthropogenic development activities are major among the reasons for frequent floods in Temerloh. The study is based on a survey and interviews of flood victims, local officials and community leaders. The result indicates that the main cause of frequent and adverse flood occurrence are due to rapid urbanization and expansion of commercial agriculture along the rivers, poor drainage system and deforestation. Findings of this study suggest to taking care of natural resources and using them in a sustainable manner will reduce the damage associated with flood. We anticipate the findings may support sustainable decision making process for long-term flood disaster management in the region.

Keywords: *Flooding, community engagement, natural hazards, urbanization, drainage system., decision science*

ID002: A REVIEW OF FLOOD DAMAGE MODELS FOR MALAYSIA

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Flood damage models are widely been developed with different approaches for economic damage assessment. The most simple adopted damage model is the stage-damage functions in which flood depth is always considered as the main flood influencing factor contribute flood damage. Derivation of new damage function for specific landuse classes is strongly dependent on local characteristics. Flood damage are underestimated if only take one flood parameter into consideration as it only assess partial damage. Flood damage can also be caused by other flood characteristics, such as duration, velocity, in which by taking other flood characteristics into considerations it may improve the predictive capability of damage model. The main limitation of using such damage function where it exclude non-hazard parameters such as precautions and warning system. Anyhow, a reliable flood damage model is much more dependent on model structure, for example, Bayesian Network, provide a consistent framework to comprehensively consider uncertainty. In addition, validation damage models is very important to improve the reliability of flood damage models by collecting more evidence of every reported flood. In Malaysia, we has limited actual flood damage data and other data-related to flood precaution. It is big challenge to develop complex damage model rather than simple damage model.

Keywords: *Flood damage model, damage functions, uncertainty*

ID003: A LONG TERM TREND AND CHANGE ANALYSIS OF URBAN EXPOSURE TO FLOOD: A CASE STUDY OF KUALA LUMPUR

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Rapid urbanization increases risks of the flash flood in the cities. Kuala Lumpur, the capital of Malaysia, is exposed to several natural hazards. Among all floods are most common and frequent. The city is situated in a valley which gives some unique geographical characteristics to the city. Having two major rivers, Gombak River and Klang River, flows through the city and becoming congested by constructions all over the city; it is becoming more and more exposed to floods day by day. The continued development in urban areas changes physical characteristics of hydrological system. This increases the flood risk because of the high rain fall rate, poor drainage system to pass storm water away and inadequate flood catchment facility. As a result, the level of exposed properties, people, infrastructure, economic and business factors are increasing. And thus risk of increasing the level of loss and damage may also go up. Therefore, the purpose of this paper is to investigate the changes of flood exposure in long-term period took place in the city. This will help researchers and policy makers to predict the level of loss and damage can be incurred in future flood events. This investigation is a quantitative approach focusing on land use and population method to see the changes in property, infrastructure and population exposure to both flash flood and river flood. This paper looks for 50 years to see the change which falls within 1965 to 2015. The result shows that between 1970 till 2010 the exposure to flood increases significantly. The population exposed to flood has also increased in Kuala Lumpur during the same period.

Keywords: 3-4 Economic exposure, Loss and damage, Urban disaster loss

ID004: COMMUNITY BASED FLOOD DISASTER PREPAREDNESS, MITIGATION AND MANAGEMENT: A CRITICAL DISCOURSE ANALYSIS OF COMMUNITY MEMBERS' EXPERIENCE OF THE FLOODS

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Historically being a riverine society, floods have always been a concern for Malaysia. It was thus, always perceived as a part of the daily lives of an agrarian society. However, after the 2014 floods that devastated many parts of Malaysia, flooding has become a priority whereby it has been 'rebranded' as 'Disaster' and Flood Disaster Risk Reduction (FDRR) has since become a priority for the government. A new Centre of Excellence for Research on disaster management was set up and RM20mil in special grants was offered for research into disaster management and flood mitigation. Although the government has taken such measures, most efforts and resources have been spent on addressing problems and issues that arise after the flood occurs, in other words, post-disaster measures and in improving infrastructure. Furthermore, while many other disaster prone countries such as Bangladesh, Sri Lanka, Ecuador, Cuba and United States have recognized the role of volunteerism and the mobilization of flood risk communities as an important component of any disaster risk management strategy to foster community recovery, Malaysia has much to learn on how to utilize and draw upon the communal spirit that was evident, that had come together via the many volunteers, donations, and support of the Malaysian people during the 2014 flood disaster. In this paper, we discuss how a formalized national service platform for FDRR to mobilize people via volunteerism during disasters and specifically, the empowerment of communities as part of a community based disaster preparedness, mitigation and management (CBDPMM) programme could benefit Malaysia. Our discussion would also share the preliminary findings of a critical discourse analytic perspective of the perceptions of members from a flood prone community, and how the discourses they evoke to construct and represent their experience of floods have a direct impact on the success of implementing a CBDPMM programme in Malaysia.

Keywords: *Critical Discourse Analysis, Flood Disaster Risk Reduction, Community Based Disaster Preparedness, Mitigation and Management*

ID005: FLOOD DISASTER PREDICTION MODEL IN KUALA KANGSAR, PERAK

Nurul Syarafina Shahrir, Norulhusna Ahmad, Robiah Ahmad, Rudzidatul Akmam Dziyaudin

Natural flood disaster frequently happens in Malaysia especially during monsoon season and Kuala Kangsar, Perak is one of the city with the frequent record of a natural flood disaster. Previous flood disaster faced by this city showed the failure in notifying the citizen with sufficient time for preparation and evacuation. The authority in charge of the flood disaster in Kuala Kangsar depends on the real-time monitoring from the hydrological sensor located at several stations along the main river. The real-time information from hydrological sensor failed to provide early notification and warning to the public. Although many hydrological sensors available at the stations, only water level sensors and rainfall sensors are used by authority for flood monitoring. This study developed flood prediction model using artificial intelligent to predict the incoming flood in Kuala Kangsar area based on Artificial Neural Network (ANN). The flood prediction model is expected to predict the incoming flood disaster by using information from the variety of hydrological sensors. The study finds that the proposed ANN model based on Nonlinear Autoregressive Network with Exogenous Inputs (NARX) have better performance than other models with the correlation coefficient is equal to 0.9579, that have the best performance is Nonlinear Autoregressive Network with Exogenous Inputs (NARX). The NARX model of flood prediction developed in this study can referred to future flood prediction model in Kuala Kangsar, Perak.

Keywords: Flood Prediction, Artificial Neural Network, NARX

ID006: GEOLOGICAL CONTROL OF SOIL EROSION: CASE STUDY FROM GUA MUSANG, KELANTAN

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Soil erosion is a hazard traditionally associated with agriculture and occurs in tropical and semiarid climate which experience high rainfall intensity over the year. It also causes sedimentation when the eroded soil is washed away by water and enters water bodies and causing river shallowing. This sedimentation into downstream river reduces the capacity of rivers and drainage channel, increasing the risk of flooding, blocking irrigation canals and shortening the design life of reservoirs. Gua Musang, Kelantan is one of the locations that faces soil erosion and was chosen as study area for this research. This study focuses on the Universal Soil Loss Equation (USLE) parameters which are rainfall erosivity (R) factor, slope length (LS) factor, soil erodibility (K) factor, vegetation cover (C) factor and erosion control (P) factor. To estimate the annual Soil Erosion Loss, numerical values have to be established for all the factors. In this study, the emphasis was on the soil erodibility (K) parameter as well as the slope length (LS) parameter which are directly influence by the bedrock geology. The results for soil derived from the weathering granite bedrock respectively were soil erodibility (K) factor from 0.36 to 0.48 and the slope length (LS) parameter was from 89.05m to 189.70m. Similar for the soils derived from the weathering of the metasedimentary rocks respectively were soil erodibility (K) factor from 0.55 to 0.89 and slope length (LS) parameter was from 53.61m to 306.00m. Therefore this study shows that soil derived from the weathering of metasediments are erodible compared to granite soils. Furthermore the topography of metasedimentary bedrock areas is steeper as reflected in the higher LS factor. Thus, areas underlain by metasedimentary rocks in this study area are more prone to erosion.

Keywords: soil erosion; soil erodibility; slope length; flooding;

ID007: EVALUATION OF INUNDATION AREAS USING INVESTIGATION AND NUMERICAL SIMULATION: CASE STUDY IN KELANTAN RIVER BASIN

Hiroki Ohashi¹, Mitsuru Yabe¹, Ryo Miyazaki¹, Shinji Uehara¹

¹OYO CORPORATION

In the Kelantan River basin located in the north eastern part of Peninsular Malaysia, A flood occurs frequently during the North-East Monsoon between mid-October and mid-January. To mitigation and relief for pre, during and post flood management activities, Malaysian government have built early warning systems and have been monitoring river water levels and rainfalls. But, for getting a further effect or doing countermeasures, flood hazard maps that indicate the risk for flooding throughout an area are needed. The flood risk zones are determined based on historical data and by modeling the effects of a major flood. So, we studied the biggest flood occurred in 2014 in the Kelantan River basin by inundation area investigations, analysis of observation data, and flood runoff simulations based on these. In this paper, we report when and where were flooded in 2014's flood.

Keywords: *an inundation area investigation , a flood runoff simulation , the Kelantan River basin*

ID008: HOW CAPABLE ARE LOCAL RESIDENTS AND LOCAL GOVERNMENTS IN COPING WITH FLOOD DISASTERS IN MALAYSIAN TOWNS?

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To understand how well local residents and local authorities are able to cope with and adapt to 2006/2007 floods in Malaysian towns, this research presents the results of interviews with affected residents and local authorities in Kota Tinggi and Segamat. This research found that the town exposed to huge flooding once after many years would have experiences more on coping and less on adaptation (Kota Tinggi). Whereas, the town exposed to frequent but smaller flooding, would have both the coping as well as adaptation experiences (Segamat). Most common weakness identified in these towns in terms of coping with and adapting to flooding was: Local residents deal with flooding issues individually, without collaborating with their neighbors. The local authorities' capability to warn and rescue flood affected residents is limited. Their zoning map does not show flood risk areas in town. The authorities have not engaged local residents in coping flood disaster.

Key words: *Flood disaster; coping and adapting; flood rescue and relief; vulnerability; flood governance*

ID009: KELANTAN DAILY RAINFALL DATA SETS: PERSISTENCE IN NATURE

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There is evidence that a stationary short memory process that encounters occasional structural break can show the properties of long memory processes or persistence behavior which may lead to extreme weather condition. In this paper, we applied three techniques for testing the long memory for six daily rainfall data sets in Kelantan area. The results explained that all the data sets exhibit long memory. An empirical fluctuation process was employed to test for structural changes using the ordinary least square (OLS)-based cumulative sum (CUSUM) test. The result shows that structural change were spotted in all data sets. A long memory testing was engaged to the data sets that were subdivided into their respective break and the results displayed that the subseries tails the same pattern as the original series. Hence this indicated that there exist a true long memory in the data generating process (DGP) although structural break occurs within the data series.

Keywords: Long memory; Structural change; ARFIMA model

ID010: DERIVATION OF REGION SPECIFIC CURVE NUMBER FOR AN IMPROVED RUNOFF PREDICTION ACCURACY

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The U.S. Department of Agriculture (USDA), Soil Conservation Services (SCS) rainfall-runoff model has been applied worldwide for hydrological problem simulations and engineering designs since 1954. It was also incorporated into many types of software and adopted by Malaysian government agencies. However, hydrologists argue the accuracy of the predicted runoff results from this model in recent decades. The validity of the key parameter, initial abstraction ratio coefficient (λ) within the model and its conventional curve number (CN) system are under challenge and scrutiny. Malaysia does not have a regional specific curve numbers available for the use in rainfall-runoff modelling, and therefore SCS-CN practitioner has no option but to adopt its guideline and handbook values which are specific to US region. The selection of Curve Number (CN) to represent a watershed becomes subjective, ambiguous and even inconsistent to represent similar land cover area. Unlike the conventional SCS-CN technique, the proposed calibration methodology in this paper discarded the use of CN as input to the SCS model, rearranged the model equation and derived statistically significant CN value(s) of a specific region through rainfall-runoff events directly under the guide of inferential statistics. The SCS rainfall-runoff framework can be calibrated quickly to address urban runoff prediction challenge under rapid land use and land cover changes. This study also derives corrected equations to existing SCS model to improve runoff prediction accuracy at Melana watershed in Johor, Malaysia. The derived λ is 0.015 while $\lambda = 0.20$ was rejected at $\alpha = 0.01$ level. Optimum CN is 88.9 with 99% confident interval range from 87.4 to 96.6. Residual sum of square (RSS) was reduced by 79% while the runoff model Nash-Sutcliffe was improved by 233%. The study can provide CN adjustment guidelines for SCS practitioners and any software which incorporated the model.

Keywords: *Bootstrapping, Curve Number, Runoff prediction, Inferential Statistics*



ID011: DISASTER RESILIENT STRUCTURAL MATERIAL FOR FLOOD RISK REDUCTION IN PAHANG RIVER BASIN, MALAYSIA

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Structural and non-structural measures are common practices in disaster risk reduction for flood disasters. The livelihoods of the affected community determines the successful attempts of such measures. The flood disaster in 2014 that affected the residents living along the Pahang River prompted this study to be conducted to assess the structural and non-structural measures that can reduce the flood risk to the rural and urban landscapes of the Pahang River basin. A sustainable livelihood approach was taken to identify the types of structural and non-structural measures to be implemented for disaster risk management. Bamboo was identified as one of the potential sustainable structural material for flood risk reduction. Additionally, ecotourism is suggested to be an option for flood disaster risk reduction in the area. These and other sustainable measure for flood risk reduction is recommended to be considered by the authorities in charge of local and national flood management.

Keywords: *local material, ecotourism, resilience, bamboo*



ID012: FLOOD DISASTER MANAGEMENT IN PAHANG RIVER BASIN: CASE OF TEMERLOH

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Flood, is one of the most common disasters in Malaysia especially during north-eastern monsoon season (Nov-Mac). This article analyses flood disaster management strategies in Pahang on preparations and vulnerabilities of the local communities along the Pahang River Basin, especially in Temerloh. In Malaysia, the National Security Council (MKN) is the organization that is fully responsible in managing the National Disaster Management System, which provides an effective relieve mechanism for flood disaster. The data collected for this study was from the primary and secondary sources. The primary data was collected in June 2015 through a survey of 202 respondents affected by the flood by using a semi-structured questionnaires through an interview conducted in person. Meanwhile, the secondary data was collected from the local authorities. From both sources, the survey shows that 30% of the population in Temerloh did not get an early warning notifications, more than half involving those in the rural area. About 78% of respondents have been relocated to the relief centres around Temerloh. Agricultural income dropped by 31.2% as the result of damaged crops and cessation of small businesses, which contributed to the increase in hardcore-poor category by 6.5%. The vulnerability factors affecting the local communities are lack of efficient early warning system, lack of land-ownerships, housing land instability, food security threats, and also, large number of households headed by female. The study concludes that it is essential to review the effectiveness of flood disaster management strategies in Pahang to minimize the impact of the aftermath of flooding to the community.

Keywords: Disaster management strategies, flood disaster, flood in Pahang, flood vulnerability

ID013: IMPACT OF CLIMATE CHANGE ON FLOOD FREQUENCY IN A TROPICAL RIVER BASIN

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Hydrological cycle will be the first and most affected system by climatic change. Therefore, estimation of the impacts of climate change on hydrological processes is one of the major concerns in recent years. The objective of this study is to assess the impacts of climate change on river flow in a catchment located in the eastern coastal region of peninsular Malaysia with uncertainty. Statistical downscaling models are used to downscale daily precipitation projected by an ensemble of eight Couple Model Intercomparison phase 5 (CMIP5) general circulation models (GCMs) under four representative concentration pathways (RCP) scenarios namely, RCP2.6, RCP4.5, RCP6.0 and RCP8.5. Support vector machine (SVM) is used for the development of downscaling models and quantile mapping (QM) approach is used to remove biases in GCMs. A physically based rainfall-runoff model SIMHYD is calibrated and validated using historical rainfall and temperature data and then used for future projection of streamflow. Nash-Sutcliffe coefficient of 0.57 during model validation indicates that SIMHYD is capable to simulate streamflow satisfactorily. The study reveals that increase in the mean of rainfall and temperature may result increase runoff in the study area. A comparison between historical and future river flow shows increasing rate of high flow events in response to climate change which indicates likelihood of happening more frequent flood under all climate change scenarios. However, the uncertainty analysis of projected streamflow shows higher uncertainty for high flow values. Furthermore, increase in uncertainty with time was observed which means more uncertainty in streamflow projection for later part of the century compared to near future. It means that the prediction of the occurrence of floods in the region, particularly during last part of the century is prone to large uncertainty. Therefore, the projections made and conclusions derived based on hydrological simulation should be cautiously assessed.

Keywords: *Climate change, flood, RCP, CMIP5, SIMHYD*

ID014: RAINFALL-RUNOFF MODELLING IN AN ARID CATCHMENT UNDER CMIP5 RCP SCENARIOS

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Global warming due to increasing concentration of greenhouse gases is likely to have a significant impact on precipitation, run-off processes and water resources of arid and semi-arid regions. The study aims to assess the impact of climate change on the stream flow in Dasht river basin located in arid province Balochistan, Pakistan. Precipitation data obtained from Global Precipitation Climatology Centre (GPCC) were used to downscale the historical precipitation and simulate the historical runoff using state of the art support vector machine (SVM). The ensemble of seven global circulation models (GCM) from coupled model intercomparison project phase 5 (CMIP5) under four representative concentration pathways (RCP) emission scenarios were used to study the future flow. The model performance was assessed based on statistical measures including mean absolute error (MAE), root mean square error (RMSE), Nash–Sutcliffe model efficiency (NSE) and coefficient of determination (R^2). Results showed the SVM model downscale precipitation and simulate runoff in the basin very well showing a high correlation with less error. The ensemble of GCMs projected an increase in runoff ranging from 15% to 18%, 16% to 22%, 18% to 24%, and 20% to 30% under RCP2.6, RCP4.5, RCP6.0 and RCP8.5 scenarios, respectively. Therefore, it is expected that findings of the study provide valuable information for guiding future water resource management in the Dasht river basin and other rivers located in arid and semi-arid regions.

Keywords: Rainfall-runoff, support vector machine, climate change projection, global circulation model, CMIP5 representative concentration pathways



ID015: INTEGRATED APPROACH OF FLOOD MANAGEMENT TO DEAL WITH CHANGING ENVIRONMENT IN PAHANG RIVER BASIN

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The Pahang river basin is the largest river basin in the Pahang State, with total catchment area covering 29300km². Floods of Pahang river basin have become an annual natural disaster event where all the stakeholders have their own responsibility and parts to take care of it. Heavy rainfall for 9 to 11 days with high intensity of rainfall (600 mm in 2 days) carried by northeast monsoon was expected as the main cause of the flood. Other flood factors caused by human activities related to the use of land and water bodies within the basin might also contribute to higher flood magnitude that can change natural ecosystem functions. Generally, this study aims to implement integrated approach of flood management to deal with changing environment in Pahang river basin. Objectives of this study are to understand the basin characteristics of Pahang River basin and identify the source of flood disaster as well as to deal with the changing environment for the sustainable implementation. This study involved primary data collection which include questionnaire, interview with community and consultation workshop with stakeholders while the secondary data collection include raw data from several government agencies, reports from DID and districts, previous studies on Pahang River basin from books, reports and papers. The data then being analysed qualitatively and quantitatively. Results showed several issues related to flood in Pahang River Basin that need to be overcome with strategic and integrated approach i.e reduction of wetland area, massive land clearing for agriculture, shallow river, sedimentation and basin management. An institutional framework that consist of all river basin stakeholders from government, non-government organizations and individual is suggested in this study based on the issues arised which cover the scope for planner, implementer, user and preserver of the basin especially the land and water bodies. Integrated management approach is essential as it controls human activities in the basin that might affect the natural ecosystem functions and natural flood defence. Thus, integrated approach of flood management is also an effort of dealing with changing environment in Pahang river basin.

KEYWORDS: *Integrated, Flood Management, Changing Environment, Pahang River Basin.*

ID016: DEVELOPMENT OF INTENSITY–DURATION–FREQUENCY (IDF) CURVES UNDER REPRESENTATIVE CONCENTRATION PATHWAYS SCENARIOS

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The objective of the present study is to propose intensity–duration–frequency (IDF) curves under different climate change scenarios in order to assist engineers in designing water related infrastructure for climate change adaptation. Statistical downscaling models are used to downscale daily precipitation projected by an ensemble of 8 Couple Model Intercomparison phase 5 (CMIP5) general circulation models (GCMs) under four representative concentration pathways (RCP) scenarios namely, RCP2.6, RCP4.5, RCP6.0 and RCP8.5. Support vector machine (SVM) is used for the development of downscaling models and quantile mapping (QM) approach to remove biases in GCMs. Artificial neural network is used to generate hourly maximum rainfall values from projected rainfall data for the development of future IDF curves. Obtained results show that mean bias was near to zero and Nash-Sutcliffe efficiency was above 0.64 in downscaling of almost all the GCM simulated rainfall. Generated hourly rainfall maxima are found to replicate the historical rainfall maxima reliably. The IDF curves developed under climate change scenarios are found much deviated from historical IDF curves. The IDF curves under RCP8.5 scenario are found most deviated compared to other scenarios.

Keywords: *Climate change, intensity–duration–frequency curves, CMIP GCMs, RCP*

ID017: FLOOD MONITORING SYSTEM USING MOBILE SCADA BASED ON MULTIPLE ENVIRONMENT INDICATION

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Mitigating flood occurrence impact in the rural and urban areas has become crucial as it has affected government policies for countries that are prone to flood disaster. Effort and fund been put up to a higher level of capabilities to ensure the basis of coping and managing flood disaster could be resolved. Several initiatives made in managing flood are; effectively monitor the potential at risk inundated area, improving the river water irrigation and drainage, and undertaking the environmental pollution. In this paper, basically focusing more on the improvement of flood monitoring system device at the potential flood area. The approach of ubiquitous mobile scada offering low cost, portable, minimized size and easy access data of flood monitoring system device. An easy web monitoring of environment surrounding anywhere and at any time offers a real-time data updated at a very minimum delay of each of every environment data required. The features of this particular monitoring system that could be easily access wirelessly, very light in weight and small in size made it easily used and handled. There are several sensors equipped together in one small monitoring system platform which are of ultrasonic, sound, temperature and humidity, water drop and vibration sensors. The alert of water level condition is notify through a beeping buzzer and light LED notation of various colors of green, yellow and red, notifying of any overwhelm of water exceeded. The platform is powered by a rechargeable battery that allows the platform to be mobile and portable. Hence, flood monitoring system platform promotes low cost, easy to handle and ubiquitous data updated device for a better monitoring system platform.

Keywords: *mobile SCADA, flood monitoring, ubiquitous*

ID018: FLOOD MITIGATION AND ADAPTATION STRATEGIES FOR PAHANG RIVER BASIN, MALAYSIA

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This article explores the ways in which residents in Pekan, Kuantan and Temerloh districts dealt with extreme floods in the Pahang River Basin. The data was based on a survey of 602 respondents that was affected by the floods, using a set of questionnaire in a face-to-face interview conducted in June 2015. Results of the study show that the flood has destructed the livelihood, crops and small business activities of the affected communities. Vulnerabilities of the communities are linked to the lack of flood warning, landlessness, unstable housing and food insecurity, in addition to female-headed households with financial burden. Community empowerment is necessary for recovering and reducing the loss and damages incurred and improving the quality of life. The prevention and coping measures aim to reduce risk of disasters for the communities in areas that are most vulnerable and less resilient. Flood preparedness is a good preventive measure to limit negative impacts of extreme flood in the future. Upgrading of communication system, diversification of income and strengthening of social institution networks are most appropriately recommended for flood adaptation and mitigation strategies.

Keywords: *Flood, flood mitigation, adaption strategies and Pahang River Basin*

ID019: COMPARISON OF TIME BASED AND NON-TIME BASED CLUSTERING IN THE IDENTIFICATION OF RIVER DISCHARGE PATTERN DURING NORTH EAST MONSOON SEASON IN JOHOR

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This study compares the river flow pattern based on river discharge data in the Johor river basin during the North East monsoon season using two different clustering method: time based and non-time based clustering. In this paper, the daily discharge time series data measured at the Rantau Panjang station in the Johor river for 28 monsoon periods (1980-2008) are analysed. A frequency domain representation by using Discrete Fourier Transform (DFT) of the time domain of discharge data and two different distance measure (Euclidean and Dynamic Time Warping (DTW)) are used to detect the similarity of river flow pattern. The true reflection of identified high-flow river discharge pattern through hierarchical clustering dendogram distance to pairwise distance is then validated by Cophenetic Correlation Coefficient (CPCC). Result shows that employing both DTW and DFT in the clustering process has increased CPCC measure thus improves the efficiency of identification of river discharge pattern of Johor river during north east monsoon season.

Keywords: River flow, Euclidean, Dynamic Time Warping (DTW), Cophenetic Correlation Coefficient (CPCC), time based clustering

ID020: EXPERIMENTAL INVESTIGATION ON LIGHTWEIGHT COMPOSITE SLAB FOR FLOATING STRUCTURES

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Composite slabs are gaining wide acceptance in many countries as they lend themselves to faster, lighter and economical in construction buildings. The ultimate behaviour of steel-concrete composite slab system is experimentally investigated in this paper. The strength of composite slabs system relies on the bonding action between the concrete and the steel deck, the shear connections and the cross sectional resistance of steel beam. However, structural behaviour of composite slab is complex phenomenon and therefore experimental study is often conducted to establish the strength of the structure under ultimate load capacity. The main objective of this study is to determine the structural behaviour of composite slab system. Total of two specimens are examined in order to obtain failure mechanism of the composite structure under full load capacity. A new design approach of composite slab for roofing system are proposed in this study to construct a composite slab system that can float in the water but not wash away by flood. The lightweight materials that are considered in the construction are cold-formed steel and foam concrete. The system focuses on the concept of Industrialised building system (IBS) to reduce the cost and to reduce the construction time.

Keywords: *lightweight composite slab; structural behaviour; industrialised building system; cold-formed steel section*

ID021: LAND USE CHANGE AN IMPACT ON THE FLOOD RIVER BASIN

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This paper discusses the changes concerning uncontrolled land use impact the environment ecosystem before this. Through these changes will provide the environment and the vulnerability of people affected by the development process in terms of agriculture, urbanization and industrialization. Starting from 1970 the government has given serious attention to environmental problems, especially in the implementation of development plans. However, in order to implement this policy the government will be pragmatic, based on the fact that the efforts of this development to some extent will cause environmental problems. Actions taken to minimize environmental impacts particularly in the form of soil erosion and flooding. Construction of roads, settlements and new towns require environmental sloppy directly. Enhanced agricultural forest area requires more effort. Industry also requires the rapid development of the city and it also affects the environment. Deforestation can change the ecology and the more rural areas suffer floods during heavy rains. In addition, water for domestic consumption interrupted due to lack of underground water. Environmental changes associated here involves the reaction between the physical system and the human system. Physical systems involving air, water, vegetation, soil and physical environment including terrain. This system of mutual dependency between each other. When an incident affects any element of the system, the events that occur will move amendments on other elements. For the human system, various parts relate and interact with each other. To meet the necessities of life, people need homes, jobs, shopping and so on. Therefore, they need to create a group of people that have administrative systems. Their movements are determined by the requirements and it has been determined by the political system and administrative policies. When there is a change in one part, the other part also changed. Therefore, this paper will focus on land use changes in the Pahang river basin which can cause flooding. Flooding is one of the aspects on vulnerability that can give problems for human in the quality of life. Relevance of vulnerability to floods in the context of society and the environment cannot be separated. This is because vulnerability is viewed from the context of the group, the place and the system will be threatened by pressures such as climate change, land degradation, demographic changes and changes in technology. The definition of vulnerability of Adger et al. (2000) trace the origin of the Latin word meaning vulnerable "vulnerare" or capacity to do. They also stated that the word vulnerability itself is taken from the Latin word "vulnerabilis" used by the Romans to describe the soldiers who lay wounded on the battlefield and is exposed to the risk of further attacks. Vulnerability can also be interpreted as a criterion of individual, group, community or society itself in relation to its capacity to respond, collaborate, survive and recover from the impact as a result of changes in the environment (Vogel, 1998). Therefore, it presents a challenge to the people who receive the flood to find a clear explanation about the cause and effect of environmental changes. Understanding of the vulnerability is important to understand that any action will be taken to achieve the sustainability of the community and its environment. Implications for flooding to power for habitation will be discussed in this study to look at the challenges facing society, involving quality of life. Viscosity concept linked to take into account the relationship between humans and the environment are significant in understanding the vulnerability of people due to the viscosity difference is simply a system's ability to return to its natural state after the disruption of the system. Therefore, the viscosity also identified to assess the degree of viscosity of society in the face of disaster. These two concepts are connected in integrating developing adaptation planning and implementation in the face of disaster. This is because, the concept of vulnerability is useful for determining the structure of the political-economic issues that contribute to the risk of unequal power density while offering the potential to identify and explain adaptations in revenue will come after the change.

Keyword: Flood, Land use, Vulnerability, Resilience

ID022: APPLICABILITY OF NUMERICAL FLOOD MODELING - RAINFALL-RUNOFF MODEL: MALAYSIA AS A CASE STUDY

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The occurrence of flood has greater impact towards human life and socio economic related issues. In particular Malaysia has recently faced with huge flood impacts in comparison to previous years. Kelantan River basin located in Northeast of Peninsular Malaysia is mostly prone to flood due to heavy monsoons rainfall and climate changes. In this study, application of numerical flood modeling known as Integrated Flood Analysis System (IFAS) has been made for the downstream reach of Kelantan river basin. This will help in minimizing the loss and damages caused by flooding to the lowest level as non-structural countermeasure. The consequence of flood was found to vary according to the location, duration, depth, speed, vulnerability and value of the affected natural and constructed environment. The discharge stations at different location and significant rainfall data at the upper catchment area was also analyzed especially for the devastating flood. This applied rainfall-runoff model will be helpful for determining the early flood warnings for the downstream area. As a conclusion, it can be suggested that there is further need to study the flood mitigation and recognition of critical hydrological phenomena for coming up with sustainable strategies in Kelantan watershed. Moreover, this research will help in providing primary information as baseline study for upcoming research related to water resource management projects.

Keywords: *Flood forecast modeling; Rainfall-runoff; Integrated Flood Analysis System; River basin*

ID023: DEVELOPMENT OF STATISTICAL-STOCHASTIC FLOOD FORECASTING MODEL (SFFM) FOR KELANTAN RIVER BASIN- TECHNICAL REPORT

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The development of statistical relationships between local hydro climates and large-scale atmospheric variables enhances the understanding of hydro climate variability. The statistical-stochastic flood forecasting model (SFFM) is basically a statistical method for implementing flood forecasting using different types of approach and methodology. The historical data, including rainfall and flow data of the selected stations was used for this study to setup the model. Hydrological data analysis of missing data, trend and periodicity of the data series were checked before the application of model application. The study basin of Kelantan River basin was facilitated with 73 rainfall stations, 9 streamflow stations and 10 water level stations. However, selected hydrological stations were assessed intensively to obtain the best SFFM formulation, which was later calibrated and validated upon number of selected events. The SFFM helped in determining the association between adjacent hydrological stations for flood forecasting purposes.

Keywords: Statistical/Stochastic Flood Forecasting Model (SFFM), Kelantan river basin, Forecast Modeling, Rainfall Station.

ID024: DEVELOPMENT OF INTELLIGENT FLOOD MANAGEMENT SOFTWARE (I-FLOOD) FOR DISASTER MANAGEMENT

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i-FLOOD (Intelligent Flood Management Software) is an integrated building assessment model (incorporating of damage pattern, RFID technology & cost evaluation) designed to enable engineers to adopt a systematic and efficient actions for distribution of emergency relief and fund allocation for building damage. Malaysia is a country very prone to flood risks, mostly by nature of its physical as well as its human geography. Between years 2006 till 2008 due to heavy monsoon rainfalls, a number of floods were occurred along Malaysia's in different parts of the country. The critical zones in term of flood damage are located in the east coast of peninsular Malaysia in the states of Kelantan, Terengganu and Pahang. Manek Urai, as a rural area due to its type of buildings was one of the most vulnerable areas during Kelantan flood in 2014. As a proven fact, the government agencies need to inform flood victims the availability of fund allocation. The evaluation of building shall be conducted immediately and effectively. It is a clear fact that building damage survey using proper damage chart is more effective. This paper presents the results of site investigation according to the damage chart for damage assessment, and classifies photographic data of Manek Urai area, based on the damage chart. In addition, the damage chart of timber structures affected by liquefaction is localized. The paper then, discusses the process of encapsulating the framework into computer-based prototype system and system evaluation. The main findings revealed that government agencies still do not have any structured and objective methods that support the assessment of building damage.

Keywords: *construction, disaster management, framework, site management practices.*

ID025: TRENDS IN EXTREME DAILY RAINFALL SERIES IN PENINSULAR MALAYSIA

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Based on quality-controlled daily rainfall data, long-term trends in extreme daily rainfall indices were examined for Peninsular Malaysia during 1948-2010 using non-parametric Mann Kendall trend test. The effects of significant lag-1 serial correlation were eliminated from series by the trend-free pre-whitening (TFPW) method prior to the trend analysis. Homogeneity of the daily series was assessed by means of bivariate test and standard normal homogeneity test (SNHT) considering correlation, distance and altitude of neighboring stations. The average trend for total annual precipitation in wet days (PrctpTOT) indicator showed a significant decreasing trend (-40.77 mm/decade). Despite that, the contribution of very wet days in total annual precipitation indicator (R95pTOT) showed significant increasing trend in some region. It implies that extreme rainfalls are increasing disproportionately more quickly than the total and one consequence of this change is the increased frequency and severity of flash floods in those sub-regions. Trends in annual maximum 1-day and 5-day precipitation amount (Rx1Day & Rx5Day) indicators, which represent one of the most important inputs to assessments of flood risk, were also investigated. Significant increasing trends in Rx1Day were observed in northwest and northeast regions. This study provides a more detailed picture of coherent trends at a station scale and documents changes that have occurred during 1948-2010, both of which have implications in effective management strategies.

Keywords: *Trend, rainfall, extreme rainfall indices, Mann-Kendall, Peninsular Malaysia*

ID026: PERCEPTIONS OF THE KELANTAN PEOPLE TOWARDS THE DECEMBER 2014 BIG YELLOW FLOOD

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The December 2014 Kelantan Flood was the worst recorded and experienced by the people in Kelantan. The event shocked the whole country as the aftermath of the flood was similar due to a tsunami like disaster. Popular concern regarding the flood was the sensation made by the media on the uncontrolled logging activities within the Kelantan forest as the main cause of the flood. This paper highlights the perceptions of the Kelantan people towards the flood events. Censuses include the awareness of the people on flood season, their perceptions on the flood cause and previous knowledge of similar magnitude flood event experienced before. Results show that nearly half of the people (45%) were aware of the coming flood season. The awareness on flood season was found to be not significantly biased by age and education levels. When asked on the perception on the cause of the flood, majority answered extreme rainfall (57%), followed by poor maintenance of drainage system (17%) and then uncontrolled logging (13%). Despite the controversial logging issue, majority still understood that the main reason of the flood was due to the extreme rainfall events. Results on previous extreme flood experienced before, residents living longer than 20 years within the flooded location majority answered they had never experienced such event.

Keywords: Flood, Kelantan December 2014, community perception, Kelantan flood history

ID027: SEDIMENT FINGERPRINTING APPROACH AS FORENSIC EVIDENCE: LINKING LAND-USE AND SOURCE OF SUSPENDED SEDIMENT IN KELANTAN RIVER BASIN, MALAYSIA

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Researchers have developed sediment-fingerprinting approach over the past couple of decades for watershed sediment transport research. Sediment fingerprinting is a method to allocate sediment nonpoint source pollutants in a watershed through the use of natural tracer technology with a combination of field data collection, laboratory analyses of sediments, and statistical modeling techniques. The method acts as a valuable tool to aid in developing efficient remediation strategies for pollution in watersheds. Detailed methodological steps of sediment fingerprinting including classification of sediment sources in a watershed, identification of unique tracers for each sediment source, representation of sediment sources and sinks using field sampling, accounting for sediment and tracer fate during transport from source to sink, and utilization of an unmixing model to allocate sediment sources are discussed in detail. Unmixing models showed that about 56% of the stream suspended sediment originated from Lebir River. Better understanding of the sources of fine sediment has practical implications on the type of sediment control measures to be adopted.

Keywords: *Sediment fingerprinting, geochemical tracers, oil palm, rubber, logging*

ID028: APPLICATION OF INTERACTIVE DAM SAFETY DECISION SUPPORT SYSTEM (INSPIRE) FOR FLOOD EMERGENCY RESPONSE PLAN (ERP) OF SULTAN ABU BAKAR DAM MALAYSIA

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Flood Emergency Response Plan (ERP) is a plan that guides responsibilities for proper operation of Sultan Abu Bakar (SAB) dam in respond to emergency incidents affecting the dam by high water storage capacity. Based on this study four major responsibilities are needed for SAB dam owing to protect any probable risk for downstream which they can be Incident Commander, Deputy Incident Commander, On-Scene Commander and Civil Engineer. By having organization charts based on ERP exercise can be helpful for decreasing the probable risks in any projects such as Abu Bakar Dam and it is a way to identify and suspected and actual dam safety emergencies. A dam safety emergency is an event which could potentially lead to dam break and need to be taken care with a massive plan. To mitigate the hydro hazard due to dam break, UNITEN has developed a new application software known as INSPIRE (Interactive Dam Safety Decision Support System). INSPIRE as an intelligent dam safety is developed to address emergency situations which demand fast, decision making and effective multi-agency collaboration due to SAB dam break event. INSPIRE will contribute towards the sustainability of SAB dam's owner as corporate reputations can be ruined through dam structural failures that can affect the economy of the nation and enhance the quality of life of the people.

Keywords: Application software, Flood, Dam Break, ERP

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