Research Activities on Disaster Management in USM

Prof. Dr. Ismail Abustan
School of Civil Engineering

The 2nd Symposium on JASTIP Disaster Prevention International Cooperation Research (JASTIP-WP4 Symposium)
March 22-23, 2017, Kihada Hall, Obaku Plaza, Uji Campus, Kyoto University, Japan

PROGRAM RAMALAN DAN AMARAN BANJIR NEGARA

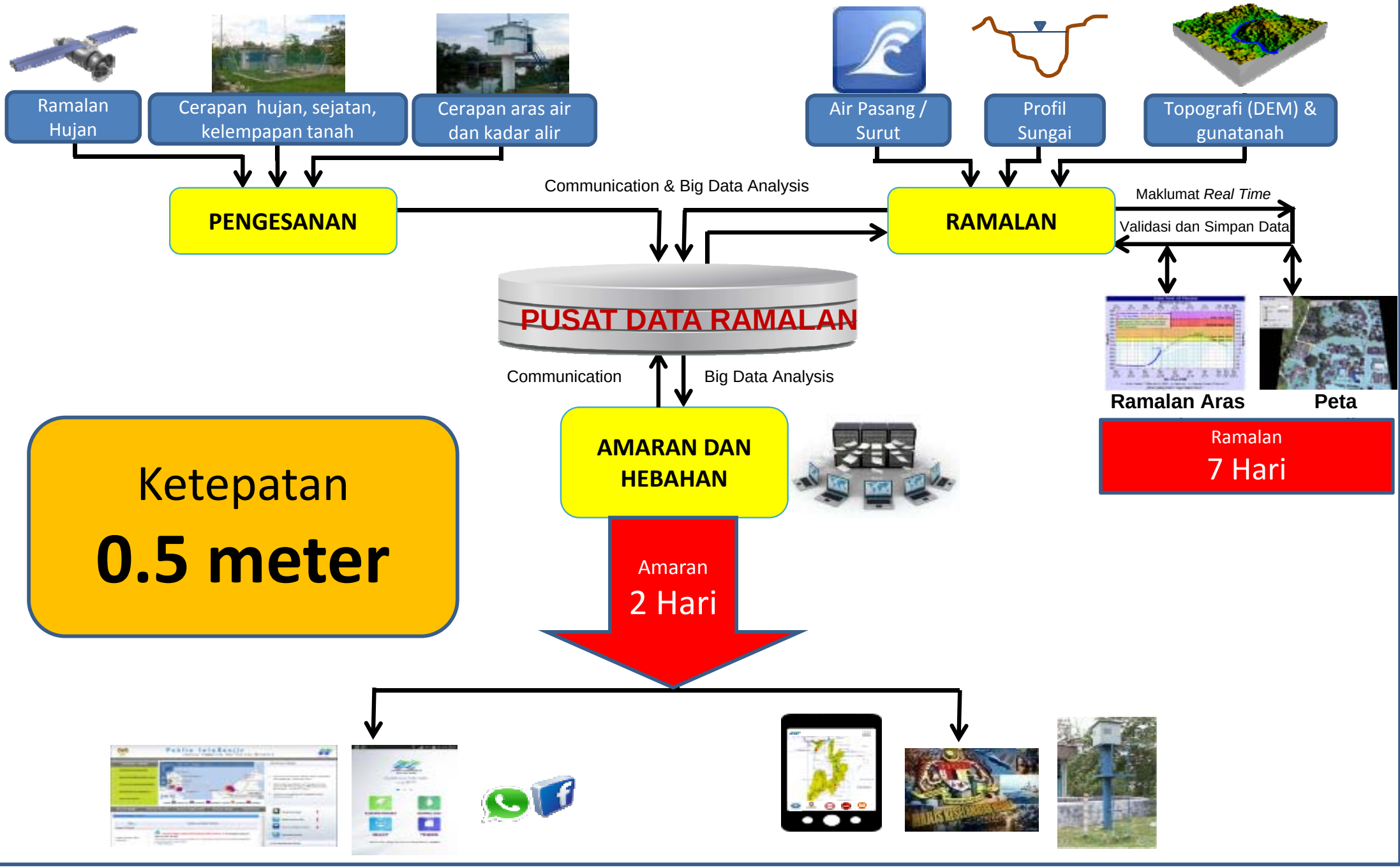
NATIONAL FLOOD FORECASTING AND DISSEMINATION PROGRAM

Sazali Osman

BAHAGIAN PENGURUSAN SUMBER AIR DAN HIDROLOGI

Water Resources Management and Hydrology Section

KOMPONEN UTAMA PROGRAM RAMALAN DAN AMARAN BANJIR NEGARA (PRAB)

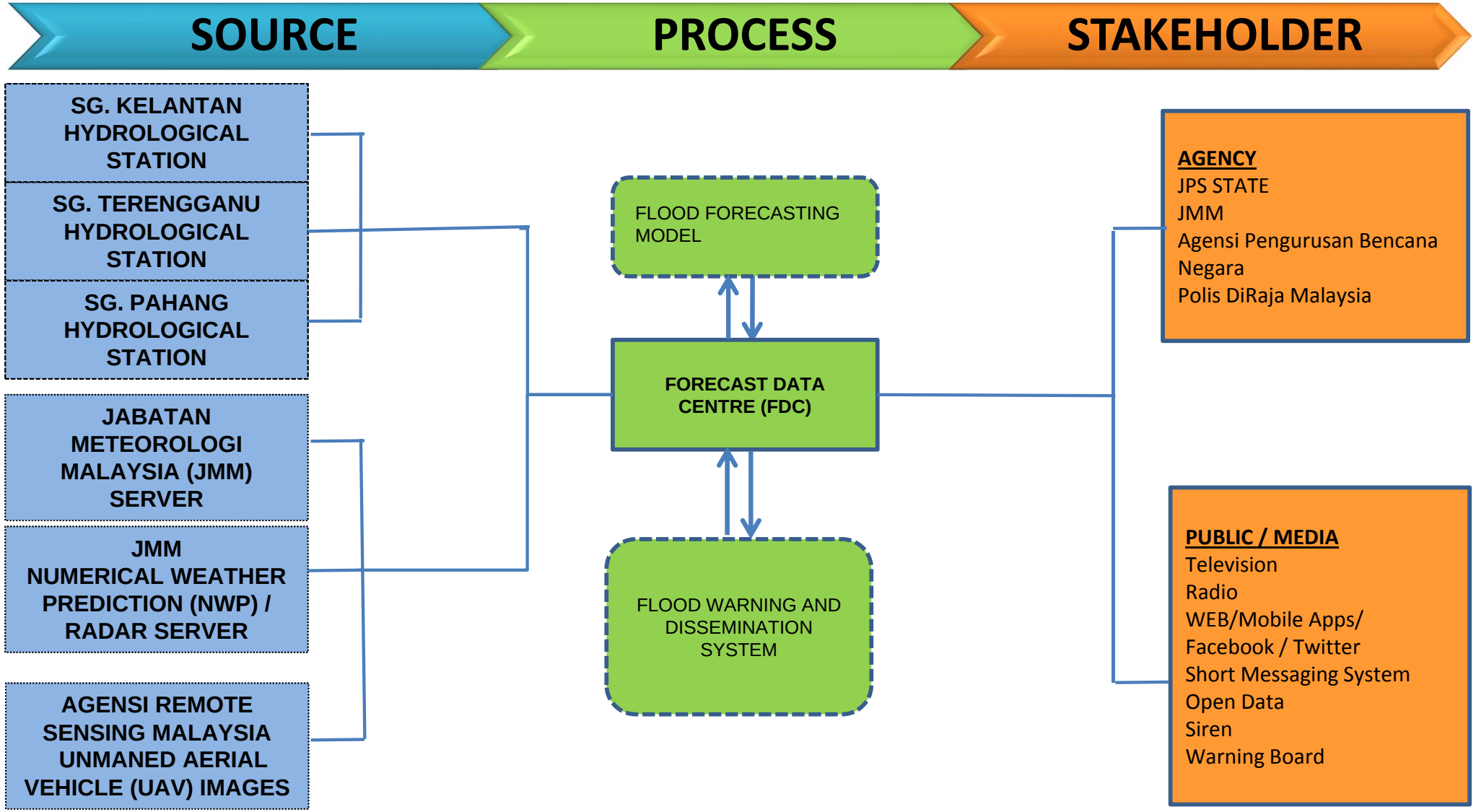


Ketepatan

0.5 meter

8.0 INOVASI SISTEM PENGHANTARAN DATA

Sistem Penghantaran Data Bagi Sistem PRABF1

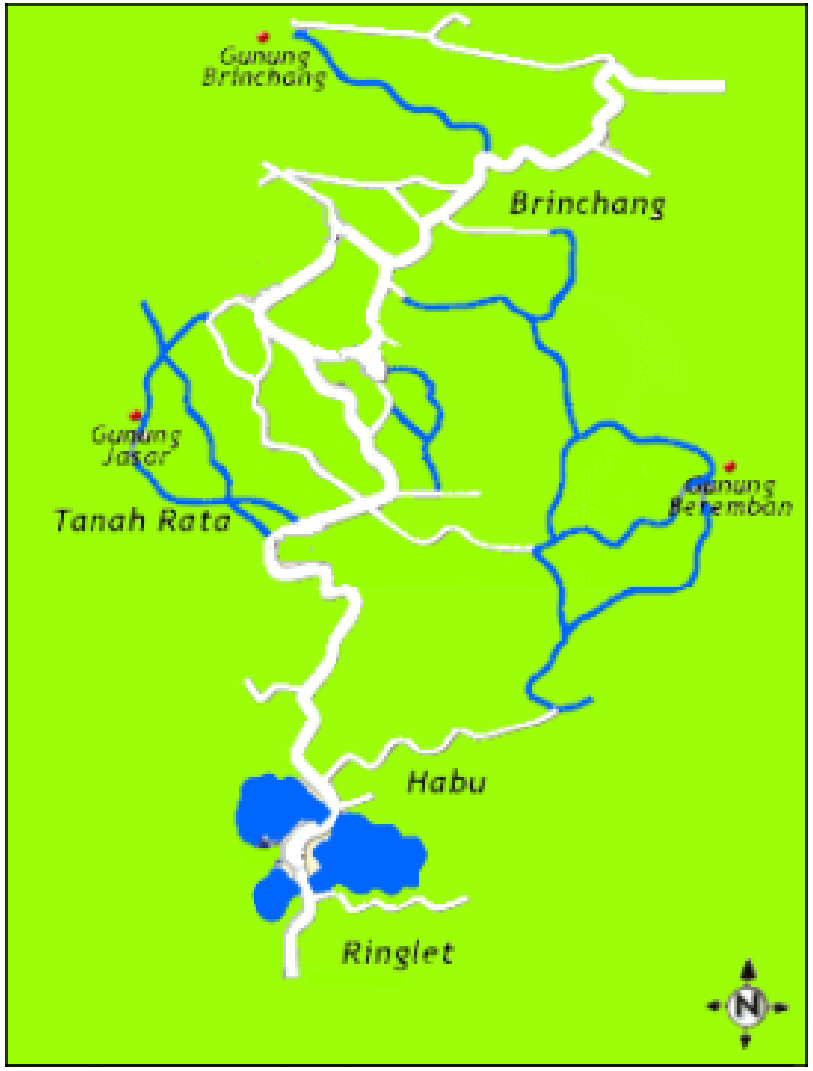


Debris and Mudflow Warning System in Cameron Highlands, Pahang

Prepared by Dr. Norlida Md Dom (norlidamd@water.gov.my), Humid Tropic Center Kuala Lumpur (HTC)

Debris and Mudflow Warning System (DMFWS)

Introduction



Map of Cameron Highlands

Department of Irrigation and Drainage (DID) is a member of National Disaster Committee Malaysia and is responsible for providing flood forecasting and warning service to the public including on-line rainfall and river levels information.

This webpage is generated from the study of the development of debris and mudflow prediction and warning system **(DMFWS)** based on existing rainfall data in Cameron Highlands following the guidelines and methodology provided during the Typhoon Committee Hydrology Component Workshop.

The main objectives of the **DMFWS** is to provide advance warning to the public and relevant agencies for disaster relief on the possibility of occurrence of an impending landslide or mudflow in high-risk and sensitive areas, like cut shapes of highway and recreation areas. The **DMFWS** is able to alert the appropriate agencies for disaster relief.

This is an opportunity for DID to expand it's scope of warning in the possibility of debris movement. A successful model hopefully lead DID as one of local Government Agency that can provide Operational Debris Flow Warning System in Malaysia.

UNIVERSITI SAINS MALAYSIA

www.usm.my

WATER SECURITY

Prof Dr Ir Mohd Nordin Adlan, School of Civil Engineering
(cenordin@usm.my)

Corporate Social Responsibility (CSR) – 'Water For Life'

Water Supply For Underprivileged Community Kg Langkor Sungai Siput (U) Perak

USM TRANSFERS KNOWLEDGE TO 43 'ORANG ASLI' FAMILIES AT KAMPUNG LANGKOR

SUNGAI SIPUT, 1 February 2016 – The 'orang asli' population in Kampung Langkor, a village in northern Sungai Siput, Perak could not hide their feelings of gratitude and was thankful when receiving a visit by a delegation from Universiti Sains Malaysia (USM) recently.

Evaluation of Seismic Vulnerability of an Existing Moment Resisting Reinforced Concrete Frame in Malaysia by Means of Fragility Curves Approach

UNIVERSITI SAINS MALAYSIA
www.usm.my

Prepared by Dr. Fadzli Mohamed Nazri (cefmn@usm.my) , School of Civil Engineering

In seismic risk mitigation policies, fragility functions of existing buildings play a fundamental role. In this study, a procedure to evaluate the analytical fragility curves for Moment Resisting Frame of Reinforced Concrete buildings will be presented. The design of the selected building typologies will performed according to the codes at the time of construction using force-based methods and the state of the practice at the time of construction. A different building classes will be identified, considering different ages, number of storeys, infill panels, plan dimensions, beam stiffness, and concrete strength.

The investigated buildings can be considered low-engineered buildings, using no seismic codes or current seismic codes. The seismic capacity of the selected models representing the existing RC buildings will be evaluated through non-linear dynamic simulations. Seismic response has been analyzed, considering various peak and integral intensity measures and various response parameters, such as ductility demands and drift ratio. A new relationship among structural performance, damage levels and interstorey drift ratios for each studied type will be investigated, which is calibrated using the damage levels. It is important to highlight that in this study, the fragility curve for each type of buildings based on different building classes will be performed to evaluate the seismic vulnerability of the particular buildings.

Landslide Hazard Based on Probability of Seismic and Rainfall Analyses For Kundasang and Ranau, Sabah

Prepared by Mastura binti Azmi (cemastura@usm.my), School of Civil Engineering

Landslide hazard map is needed in order to determine future probability of landslides in Malaysia. The aim of this study is to understand external factors such as rainfall and earthquakes that are usually the main reasons of failure in slopes and tries to connect the possibility of landslide occurrence with regards to rainfall and earthquakes. At the end of this study, critical threshold of rainfall intensity (with relation to groundwater level) and Peak Ground Acceleration (PGA) can be determined. These results will also help to develop future early warning system for Kundasang and Ranau, Sabah.

Using results from combining several probabilistic methods and soil strength parameters to check on the stability of slopes are relatively new especially in Malaysia. This study will provide necessary information needed to plan for future response with regards to slope stability as well as future planning on slope monitoring and risk reduction.

The actual results at the end of the study are aimed towards the assessment of:

- Combination of probabilistic analyses of earthquake and rainfall on Kundasang and Ranau, Sabah.
- Effect of earthquake and rainfall on Kundasang and Ranau, Sabah slopes.
- Determination of critical threshold of rainfall intensity and PGA that can trigger landslide events in Kundasang and Ranau, Sabah.

Disaster continues: A house standing precariously moments before it collapses into a crater brought about by heavy rains in Kampung Mesilau, Sabah. See reports on pages 2 & 3. – Bernama

Villagers still on edge after rockfalls and mudslides

Fleeing the danger zone: Samsul preparing to move out from Kg Mesilau to safer ground.

KUNDASANG: Lingering fears of more rockfalls and mudslides are keeping villagers on the foothills of Mount Kinabalu on edge.

Most of the 700 villagers at Kg Mesilau here have been on standby mode as they prepare to flee their homes at a moment's notice following Monday's massive mudslides, which saw large boulders tumbling down Sg Mesilau.

"I spent the night at the Kundasang mini-hall. I have returned to pack up documents and clothes. I have not decided whether to leave.

"Our village is at risk if mud and rockslides recur in heavy rains. It is washing down the mountain," said Samsul Lasim, 48, a father of four children.

Muadin Saidin, 63, said he had never felt so vulnerable in all his life at Mesilau.

"The river has always been calm and even if there were mudslides, they were always minor," Muadin said, adding that the fish had disappeared since the June 5 Mount Kinabalu earthquake that killed 18 guides and trekkers.

The problem, he said, was that water flowing down the river had uprooted trees and displaced huge boulders, creating mini dams along the slopes. Then, when it rains heavily, it overflows and causes problems downstream.

"I am ready to take people to the upper reaches of the river to inspect these areas and help other villagers to clear these dams," said the Dusun farmer.

Ranau district officer Faimin Kamin said although the situation had calmed down somewhat, villagers should not take things lightly.

He urged the 28 families still staying put at Kg Mesilau to move to safer ground as soon as possible.

The Fire and Safety Department issued an evacuation order on Monday night as a precautionary measure, he said.

Faimin said no houses or buildings were reported damaged but there were many inaccessible areas.

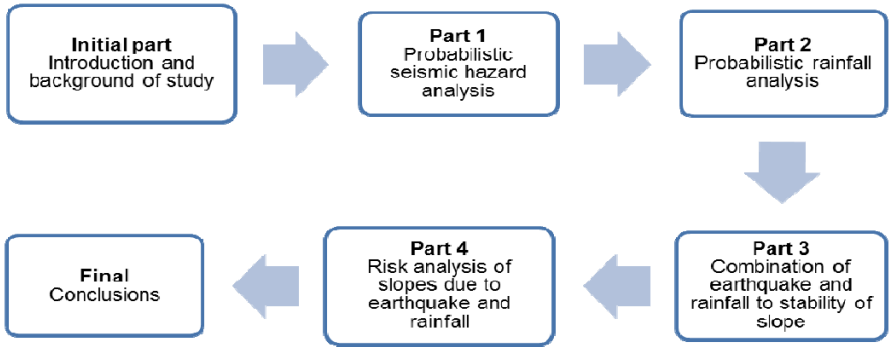
However, it is understood that a road and bridge linking the Mesilau nature resort were wiped out by 12m-high floodwaters.

It was the same at another bridge adjacent to the Mount Kinabalu Golf Club that links Mesilau vegetable farms and many small chalets and private homes.

Most of the chalets and homestays in the Kundasang area were closed after more than 60 aftershocks struck the area after the 5.9-magnitude quake.

Geologists explained that the earthquake had loosened many parts of the mountain and rockslides and landslips would occur until earth movement settles down.

A Public Works Department spokesman in Ranau said work to set up an alternative route into the affected areas was under way while water and electricity supply was being restored in affected areas.



The Effects of Local Soil Dynamic Properties on Non-Seismically Designed Reinforced Concrete Buildings due to Soil Excitation

Prepared by Taksiah A. Majid (taksiah@usm.my), Tan Chee Ghuan, School of Civil Engineering

The buildings in Malaysia are not designed to the resistance of seismic loading. The vulnerability of non-seismic designed buildings caused by far field earthquakes (Sumatra and Philippines) or local earthquakes (Sabah and Bukit Tinggi) may significantly increase due the low performance of joint ductility. The investigation of on-site dynamic performance and seismic capacity of critical buildings will be performed to avoid any losses in future, especially the low to medium rise buildings that are more susceptible to vibration cause by near field earthquakes. The on-site measurement of soil dynamic response and on-site measurement of building dynamic response will be performed to evaluate the actual dynamic behaviour of site and seismic performance of the building. The seismic demand and capacity analysis of the buildings will be performed.

This study will developed (i) an empirical relationship of fundamental period and height of building; (ii) an empirical relationship of damping and mode shape of building and (iii) the seismic demand and capacity of the building. These results can be incorporated to the technical guideline for the earthquake resistant design of buildings. This study will benefit the construction industry in predicting the vulnerability index of the existing non-seismic designed buildings subjected to most probable earthquake (2% in 50 years). Hence, retrofitting decision can be made if necessary. In addition, the procedure of designing and evaluation employed in the project will be useful for design engineer in providing a safe design especially for high-rise building to reduce the urbanization risk due to pre- and post-earthquake events for sustainability of public facilities in Malaysia.

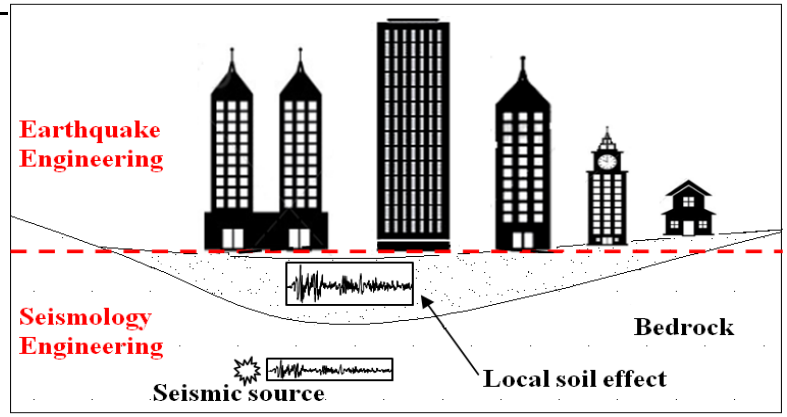


Figure 1: The amplification of seismic wave due local soil effect

Figure 2: Structural damages of non-seismically designed buildings caused by local earthquake in Ranau, Sabah

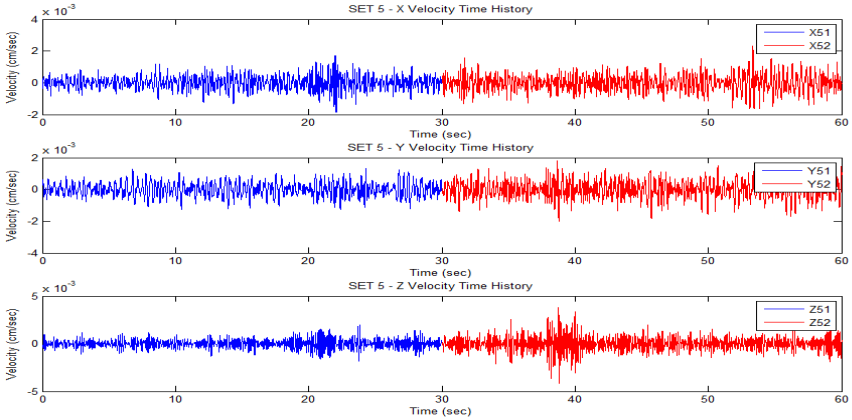
Determination of Dynamic Characteristics of Ground and Buildings in Ranau, Sabah using Microtremor Technique

UNIVERSITI SAINS MALAYSIA
www.usm.my

Prepared by Assoc. Prof. Dr. Lau Tze Liang (celau@usm.my) School of Civil Engineering

The occurrence of 2015 Ranau earthquake has attracted the attention of public and professionals on the safety of non-seismically designed buildings under earthquake ground motions. Due to the lack of research and information available for the dynamic characteristics of the site in Ranau, microtremor observation is one of the feasible techniques that could be applied. This technique requires less manpower, cost and time consumption. This method involves the measurement of low amplitude of ambient vibration caused by human-made or atmospheric disturbance. It has been proven to that this technique is able to predict the behaviour of ground due to earthquake.

Earthquake resistant design is essential for buildings in order to withstand the earthquake force. Fundamental period and damping ratio are dynamic properties of building that play important roles in dynamic analysis. Microtremor observation will be adopted in this research in order to record the motion of buildings. Nakamura's method will be adopted to determine the fundamental period of buildings. The damping ratio will be estimated based on half power bandwidth method. The obtained findings will help in the analysis of building in Ranau subjected to earthquake loading.

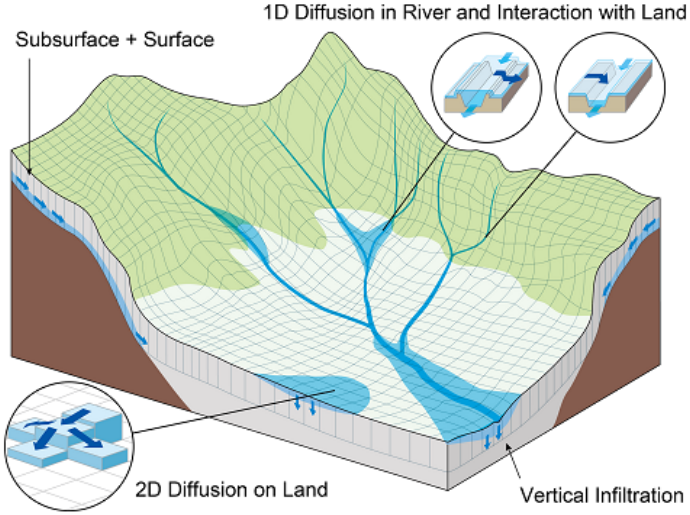


The Application of Rainfall-Runoff-Inundation (RRI) Model on the 2014 Kelantan Extreme Flood

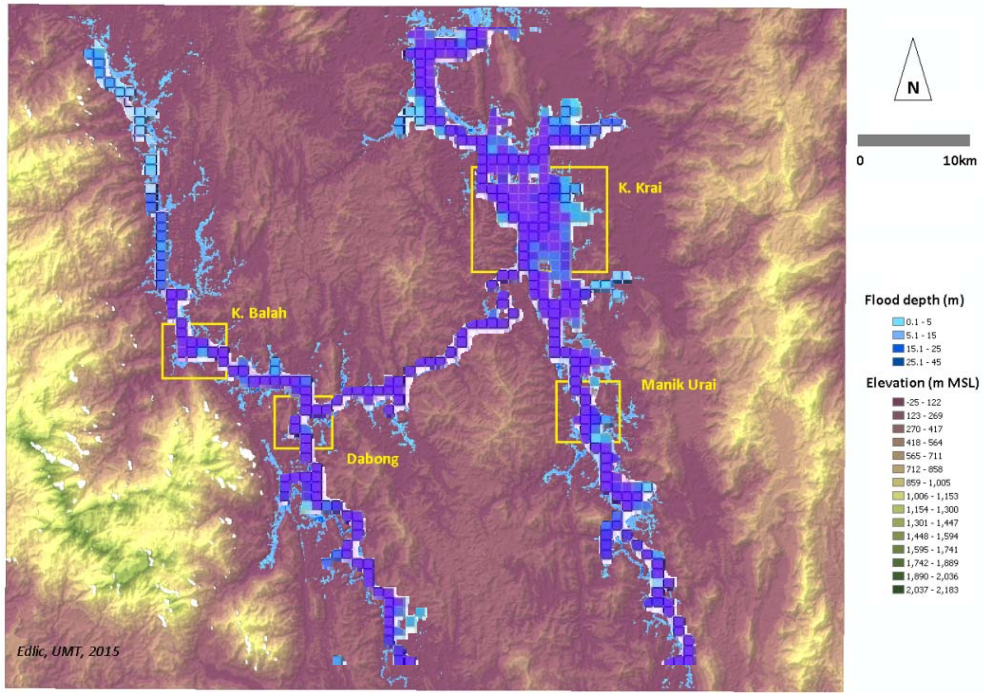
UNIVERSITI SAINS MALAYSIA
www.usm.my

Prepared by Prof. Dr. Hj Ismail Abustan School of Civil Engineering in Colabration og DPRI, Kyoto University, ceismail@usm.my

Sungai Kelantan catchment suffered a devastating flood disaster in late December 2014 and this lead to destructive damages with 45,467 people evacuated in Kelantan (26th Dec 2014). The chronology of the extreme flood started with torrential rains on the 17th of December, 2014 which led to flash flooding that forced 3390 people in Kuala Krai, Kelantan to be evacuated from their homes. Continuous heavy rain for over three days (from the 21st to the 23rd of December, 2014) set a rainfall record of 1 295 mm, equivalent to the amount of rain usually seen in a span of 64 days. This paper describes the assessment made on the potential of Rainfall-Runoff-Inundation (RRI) model to simulate the flood inundation for the Sungai Kelantan catchment based on two-dimensional diffusion wave equations. The RRI model was used to develop the actual extent of the December 2014 flood for Kuala Kerai, Kelantan. A simulation for the whole month of December 2014 was also carried out using the RRI model to capture initial catchment conditions. Initial simulation without rivers cross sectional information was found to lead to inaccurate inundation analysis. The results however were found to be improved with a good agreement when the cross sectional of Sungai Galas and Sungai Lebir were included as model input. The RRI model was also found to simulate the observed flood inundation by remote sensing map for the 26th December 2014 flood well. The monthly simulated result showed the two peaks discharges and flood inundation for 19th December and 25th December 2014 to be similar to the ones reported by DID 2014 Flood Report. These findings led to the conclusion that the RRI model is useful as a flood analysis tool and provider on related flood inundation information.



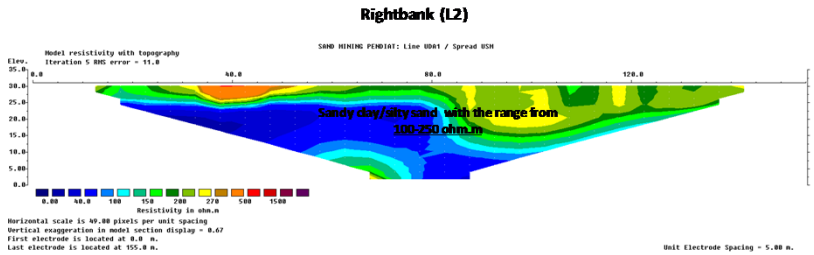
Schematic diagram of the rainfall–runoff–inundation (RRI) model (Sayama et al., 2012).



Study on the Sustainable Sand Removal Capacity of Sungai Perak

Prepared by Prof. Dr. Hj Ismail Abustan School of Civil Engineering in collaboration with Dept of Irrigation and Drainage Malaysia (ceismail@usm.my)

Universiti Sains Malaysia is requested by Drainage and Irrigation Department of Perak to study on the sustainable sand removal capacity of Sungai Perak at Bota Kanan, Perak.



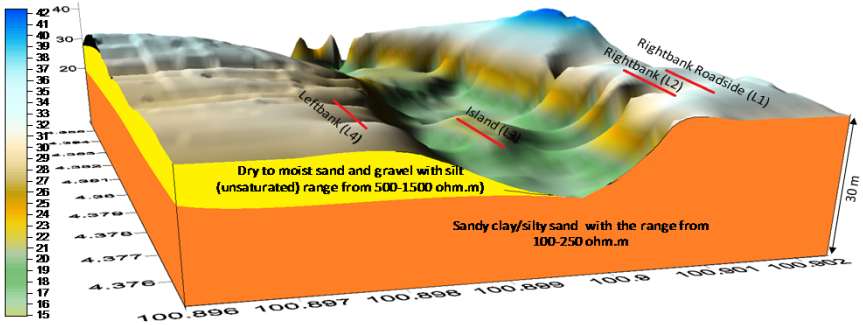
OBJECTIVES OF THE STUDY

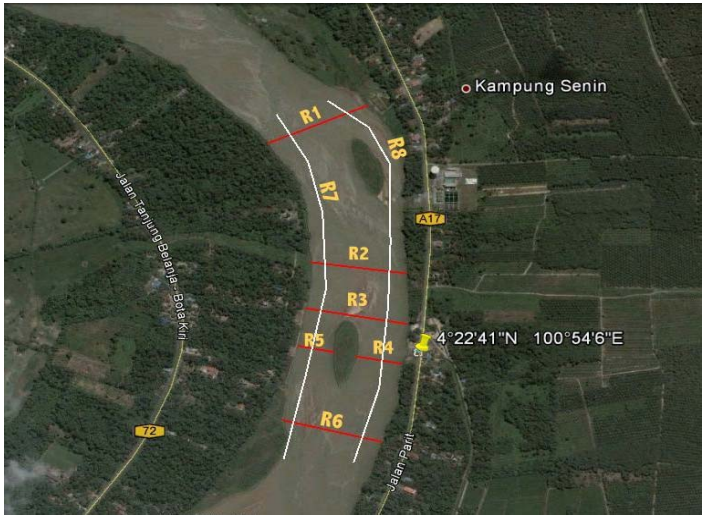
The objective of the study are :

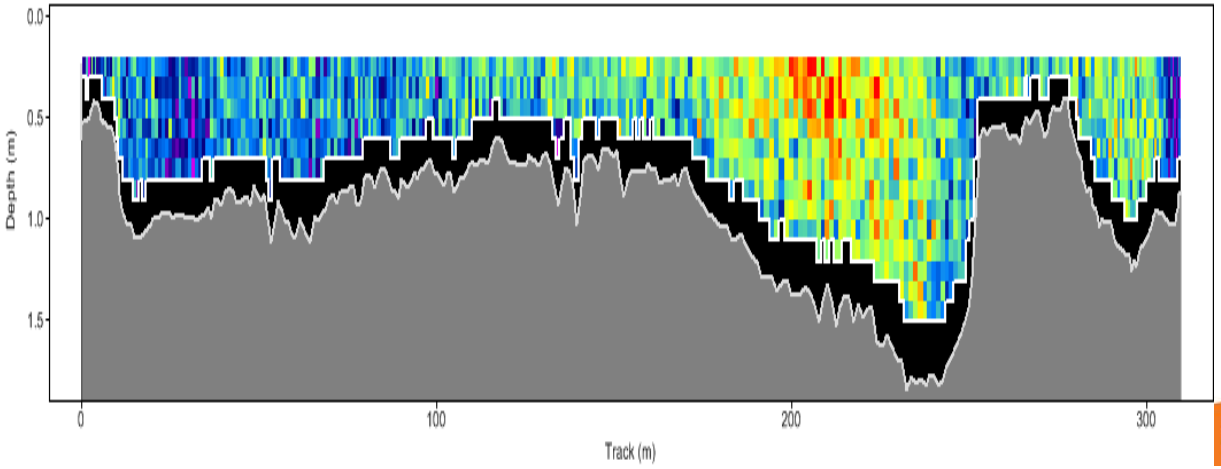
a. to determine the potential volume of minable sand on the Sungai Perak, at Bota Kanan

b. to evaluate whether the proposed site is economically viable and environmentally suitable.

This study includes field examinations consist of geological/geotechnical/geophysical explorations, river discharge measurement and grab sediment sampling which is integrated their application to meet the objectives.







Climate Change : Designing New Labyrinth Spillway in Mengkubau Dam, Brunei DarusSalam and Mengkuang Dam, Penang, Malaysia

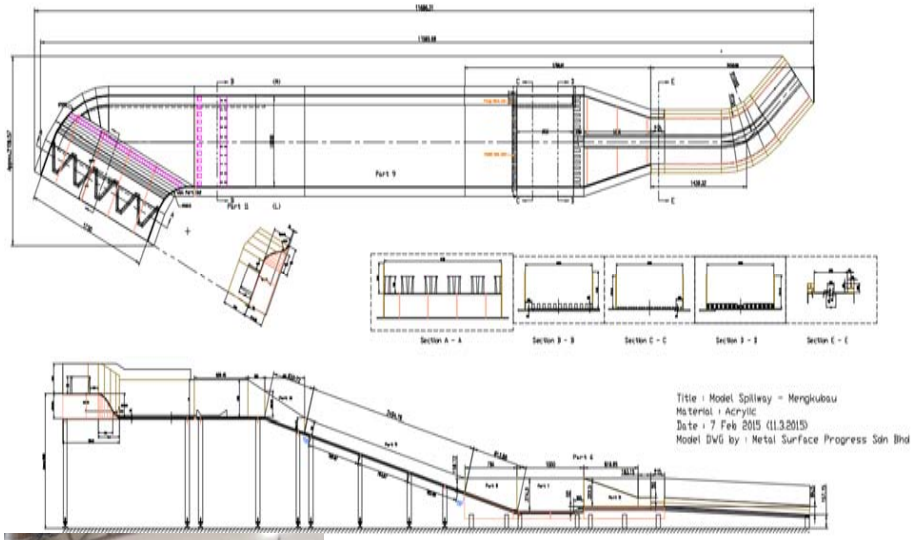
UNIVERSITI SAINS MALAYSIA
www.usm.my

Prepared by Prof. Dr. Hj Ismail Abustan and Dr Mohd Remy Rozainy School of Civil Engineering (ceismail@usm.my)

The government of Brunei Darussalam awarded the contract to SWEE Sendirian Berhad to upgrade the existing Mengkubau Dam reservoir storage capacity in order to meet the increasing demand of Brunei Muara area community.

To upgrade the dams' reservoir capacity, the modeller designed the dam crest to be raised from 31.00m BSD to 34.7m BSD. This enables the FLS to be increased to 32.9m BSD from the existing FSL of 28.7m BSD. To limit the flood rising level, a special Labyrinth type spillway will be constructed and it will efficiently convey the excess floodwater downstream, through the existing chute.

Hydraulic modelling is the science of creating a model of an existing civil structure considering all possible factors in order to replicate the structure whilst considering the cost. The model is then used by the researcher to study the natural behaviour of the water towards the hydraulic structure as a basis to predict any possible occurrences. The researcher is, in a very short time, able to test various scenarios without the risk of life or equipment. The data collected from these tests are then used to further determine the feasibility of a site and to ensure proper structures/systems are designed for the project.



Flood Mitigation on Sarawak Barrage : Physical and Numerical Model

Prepared by Dr. Mohd Remy Rozainy .School of Civil Engineering (ceremy@usm.my)

The **Sungai Sarawak Regulation Scheme** is a major civil engineering project in Kuching Sarawak, Malaysia. This project incorporates a 3-in-1 infrastructure (barrage, shiploc and bridge) which is the first of its kind in SEA.

The purpose of the physical hydraulic and numerical models to achieve the following objectives:-

1. To determine the scouring effects on the down stream of the barrage in the physical model
2. To propose a mitigation concept to reduce the effects of scouring and upstream flooding
2. To report dynamic response of the original and modified the scouring downstream of the barrage.

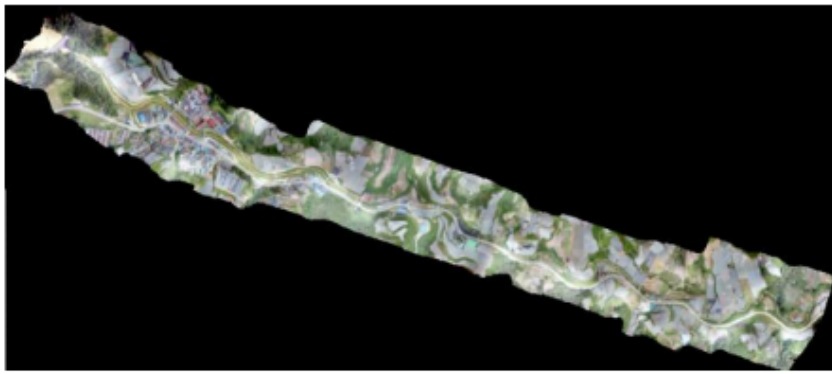
Gated Spillway Hydraulic Modelling of Sultan Abu Bakar (SAB) Dam and the Structural Analysis Of The Tilting Gate

Prepared by Prof. Dr. Hj Ismail Abustan and Dr Mohd Remy Rozainy, School of Civil Engineering (ceismail@usm.my)

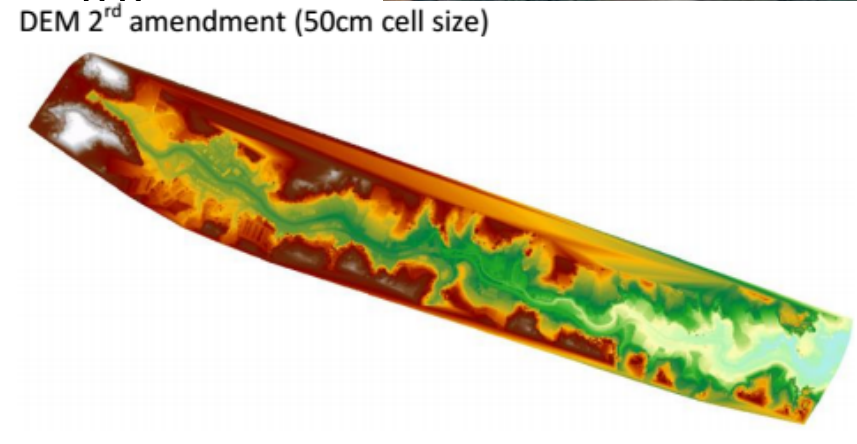
The purpose of the physical hydraulic and numerical models to achieve the following objectives:-

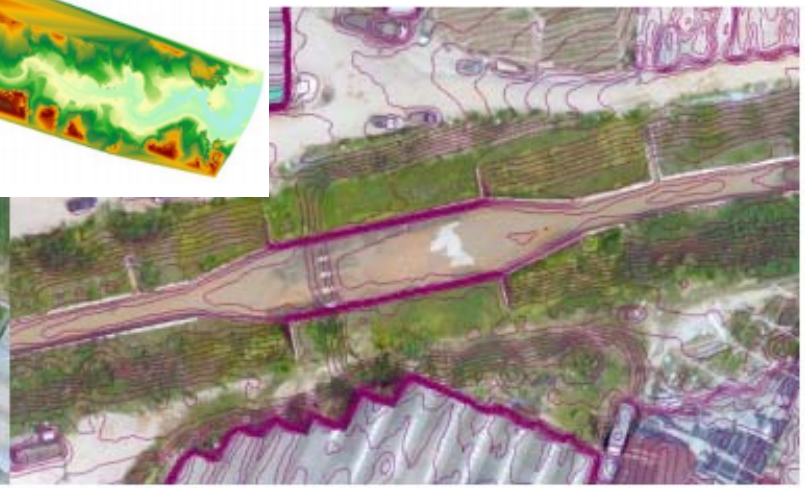
1. To establish the correlation between discharge and gate opening of Sultan Abu Bakar (SAB) Dam
2. To establish the correlation between discharge and downstream water level of Sultan Abu Bakar (SAB) Dam for the distance of at least 4 km
3. To report on the structural integrity and dynamic response of the original and modified tilting gate.

Ortho



DEM 2rd amendment (50cm cell size)





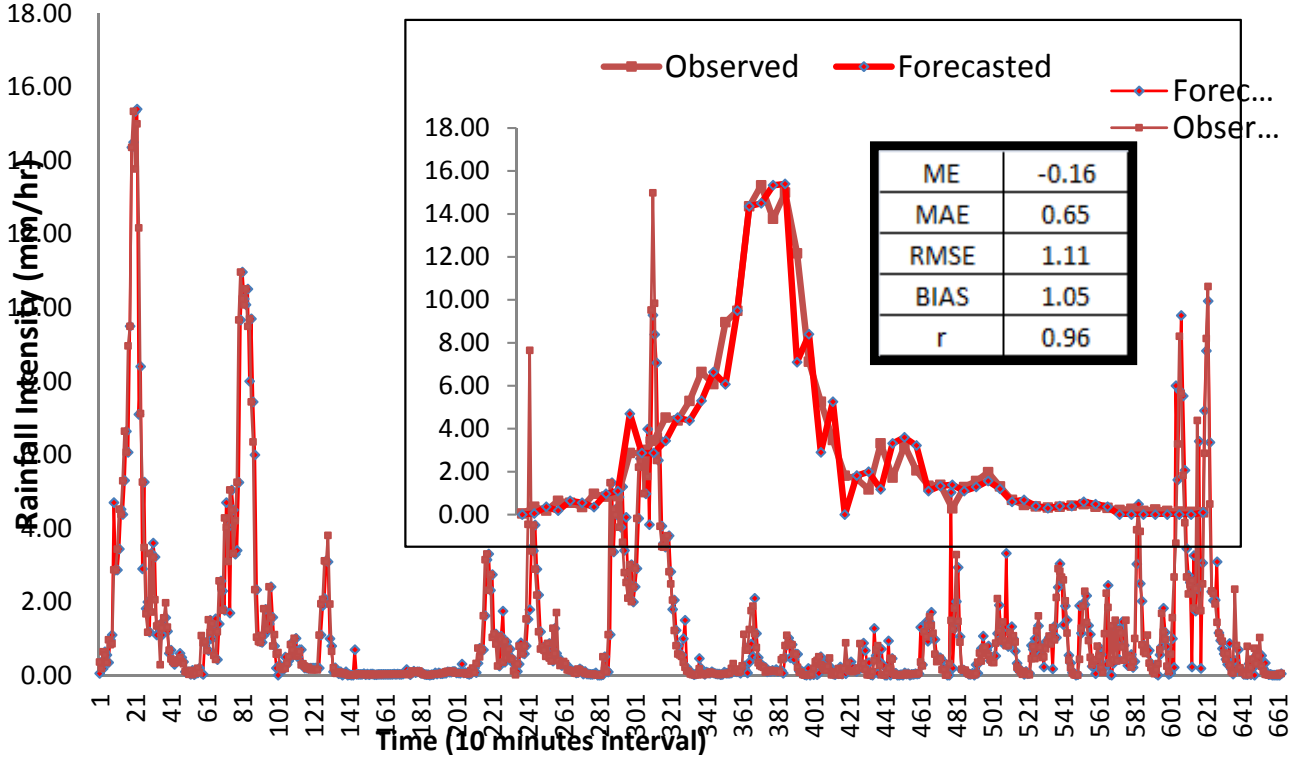
Short Term Rainfall Forecasting using Persistence Forecast

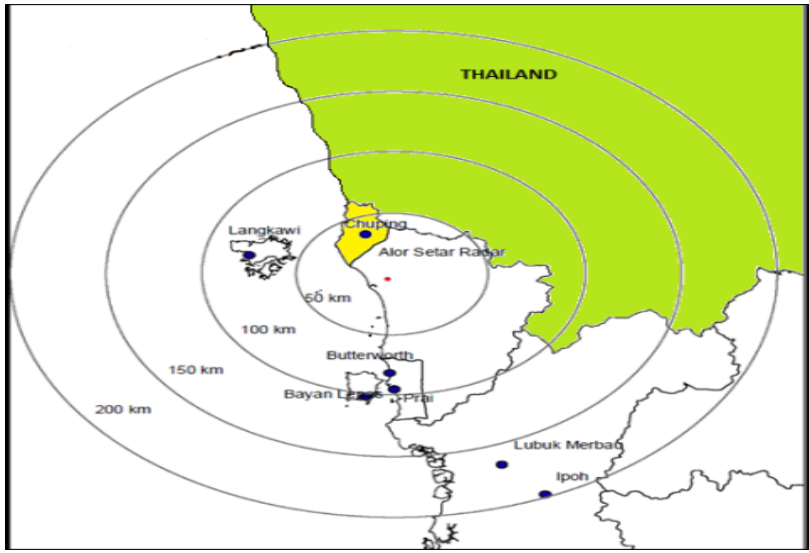
Prepared by Dr Mahyun Abdul Wahab (UniMAP) and Prof. Dr. Hj Ismail Abustan , School of Civil Engineering (ceismail@usm.my)

Knowledge of precipitation can lead to other research such as **rainfall forecasting, flood forecasting, flood mitigation and others.**

Research on rainfall forecasting can be **a good start** before the implementation of flood forecasting and warning

Most of flood forecasting and warning systems (FWS) are totally depending on the **accuracy of rainfall forecasting**





	$Z = 10R^{1.6}$	$Z = 30R^{1.6}$	$Z = 40R^{1.6}$	$Z = 50R^{1.6}$	$Z = 200R^{1.6}$
ME	-26.84	-1.52	**2.69**	5.48	-16.26
MAE	27.21	5.43	**3.75**	5.73	16.26
RMSE	31.40	7.24	**7.06**	8.51	18.38
BIAS	2.11	1.06	**0.89**	0.77	3.07
R^2	0.679	0.679	**0.679**	0.678	0.680
r	0.82	0.82	**0.82**	0.82	0.83

SIMULATION OF EVACUATION PROCESS AGAINST TSUNAMI DISASTER IN MALAYSIA
Case studies : The Miami Beach, Penang by Dr Muhammad Salleh Abustan (UTHM) and Dr Noorhazlinda Abd Rahman (USM)

- The Miami Beach:
  - Popular tourist attraction;
  - Experienced tsunami attack (2004);
  - Record more than 5 fatalities;
  - Topography different from other beaches - crop rocks around the beach.
- Motives of the study:
  - To plan appropriate evacuation routes and evacuation place;
  - To obtain quick and safe evacuation.

- Scope of study:
  - Used CBS-DE model, developed at Laboratory of Hitoshi Gotoh in the year 2004.
  - Sim-1: current situation with one evacuation place
  - Sim-2: improvement with two evacuation place

UNIVERSITI SAINS MALAYSIA

JASTIP
Japan - ASEAN
Science, Technology and
Innovation Platform

THANK YOU
TERIMA KASIH

ceismail@usm.my

ismail_abustan@yahoo.com