WORKSHOP ON DISASTER RESILIENT CITIES: ADVANCES IN METEOROLOGICAL FORECASTING AND HAZARDS ASSESSMENT [Draft 3 July 2018]

Le Méridien Kuala Lumpur, Malaysia, 28 - 29 June 2018

1.0 INTRODUCTION

Scientific and technological advances in recent decades have greatly improved the nation's capability to predict most natural hazards and disseminate warning based on those predictions. Good prediction derived from location-specific forecast information could save lives and properties. Improvements in forecast quality have enabled the development of advanced and customized applications to suit the needs of various end-users. The improvements require further research that improved the observations of meteorology, atmosphere and land surface condition. The incorporation of these observations into various scientific and numerical models may produce localized forecast information that can be translated into a product which fulfills the requirement of the end-users. This was partly the essence and motivation for convening the Mid-term DBKL Workshop for the Project of Newton-Ungku Omar Fund on Disaster Resilient Cities entitled Workshop on Disaster Resilient Cities: Advances in Meteorological Forecasting and Hazards Assessment.

The Workshop was jointly organized by Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM), Malaysian Industry-Government Group for High Technology (MIGHT), City Hall of Kuala Lumpur (DBKL), National Disaster Management Disaster Agency (NADMA), Asian Network on Climate Science and Technology (ANCST), NUOF Partners from Malaysia and UK and other agencies on 28 and 29 June 2018 in Le Méridien Kuala Lumpur. The workshop focused on advances in meteorological forecasting and hazards assessment, which is of great importance to various stakeholders including government agencies and the private sector in managing risk information, financing and investment. A total of 21 papers were presented by the invited speakers including the Members of the Newton-Ungku Omar Project from Malaysia and United Kingdom. More than 80 participants comprises of regional and Malaysian experts as well as early career researchers supported by the Malaysian Window to Cambridge at Universiti Kebangsaan Malaysia (MW2C@UKM), hosted by SEADPRI-UKM.

The Workshop began with an opening and pre-launching ceremony of the first NUOF deliverable from Malaysian Meteorological Department (MetMalaysia) who is also a partner of this project. The speech was followed by Session 1 and 2 conducted on 28 June 2018 and Session 3 on 29 June 2018.

2.0 OPENING SESSION

The Workshop commenced with an **Introductory Remarks by Prof. Joy Jacqueline Pereira of SEADPRI-UKM, Malaysian Project Leader for the NUOF Disaster Resilient Cities Project.** Prof. Pereira began her speech with a brief description of the on-going project. She highlighted in her speech that this project intends to leave not only a legacy of science-product services but also strive to promote a modality of institutional arrangement toward disaster resilience that will continuously support the decision making at the city level. In addition to that, this project is focusing on how to improve the risk communication in cities and transfer of the climate-related knowledge effectively to meet the requirement of all stakeholders in the city. She also announced the completion of the first project deliverable by MetMalaysia. The meteorological parameters such as rainfall, temperature and wind speed has been downscaled into the city level for the first time ever in the country and possibly in the region. The products will then be used to predict the susceptibility of flash flood, landslide, strong winds, air pollution and urban heat occurrence in Kuala Lumpur. She concluded her speech with a note that, this project will develop the first ever city level forecasting system in the tropics and to provide the impetus for social innovation by facilitating community-level disaster preparedness and empowering special groups to participate in disaster-risk reduction.

The **Officiating Keynote was delivered by YBhg. Datuk Hj. Mahadi bin Che Ngah, Executive Director of Project Management on behalf of the Mayor of DBKL.** YBhg. Datuk began his speech by informing that Kuala Lumpur is progressing well to becoming a more livable and world class city that strikes balance between physical economic and social development as well as environmental protection. Kuala Lumpur is now moving towards inspiring other cities to becoming more capable to resist, accommodate, transform and recover from the impacts of natural hazards in a timely and efficient manner. DBKL as a city administrator would like to enhance their capability to respond towards disaster and to attain their role as a city manager to secure the sustainable future for the city. They are looking forward to delivering essential services to respond appropriately towards disasters occurrence. The resilient and disaster risk reduction must be strengthened and strategized in the urban design to achieve the sustainable development. He also emphasized the importance of an early warning system the potential routine to face the challenges to incoming disaster.

Having said that, YBhg. Datuk emphasized the need of DBKL to foster strong alliances and draw participation at the local level. This will include collaboration with the research institutions and the academia. This collaboration will facilitate the decision-making processes by offering solution or system which will assist DBKL to face the disasters. Hence, the NUOF Project on Disaster Resilient Cities is expected to be a pioneer towards the new system. The first deliverable of the project is expected to enhance the local level forecast and detail for DBKL. YBhg. Datuk ended his speech by highlighting their slogan “Ready to Contribute towards an Excellent City” and convinced that their mission to make Kuala Lumpur a world class city by the year 2020 can be successfully achieved. He then declared the Workshop and launched the first deliverable of the NUOF Project on Disaster Resilient Cities.

The **Session Keynote was delivered by Prof. Lord Julian Hunt of University of Cambridge, UK Project Leader for the NUOF Disaster Resilient Cities Project.** The title of the Keynote was Applications of Atmospheric Observations and Forecasts to Hazard Warnings and Resilience. Prof. Hunt commenced his presentation by acknowledging the NUOF UK Partners and gave some brief idea how this research-bridge project was initiated between both countries, Malaysia and UK. He then talked on the insufficiency of cities’ environmental studies all over the world. Thus he initiated himself to write a book on London’s Environment in 2005, however, more readings material for many other major cities such as New York, Paris or even in Kuala Lumpur are not available for reference. The study on city environment is crucial as the population grow very rapidly in cities as well as the increment of haze and air pollution problem derived from heavy traffic and manufacture industries which are detrimental to human health. Therefore, a useful and powerful model that able to predict and forecast the potential risk using the wind speed, wind direction and temperature as an input should be employed. Such example of modeling application has been used in 2005 for Olympics events for the better pollution forecasting and activities planning.

Prof. Hunt further explained that there is a difference between a small and big city in terms of pollutant pathway length. In a larger city, the pollutant dissemination is high and the pollutant is not concentrated at one place. However, people travel in a long distance in a big city is highly vulnerable to the pollutants compared to those who travel in a shorter distance in a small city. He then concluded that the size of the city plays an important role in determining the pollutions impacts and policy planning. He also emphasized that the data collection is important to ensure the reliability of forecasting environmental hazards. To ensure the continuity of the research, this existing collaboration linked in this project should be maintained and serves as a role model for successful city around the world.

3.0 HIGHLIGHTS ON SESSION 1: METEOROLOGY-ATMOSPHERIC FORECASTING AND HAZARDS ASSESSMENT

The Challenges of City Scale Weather Forecasting: Kuala Lumpur mainly focused on historical studies on rainfall; wind speed and wind direction; relative humidity; dew point depression; and mean sea level pressure. The parameters were measured by few meteorological stations by Malaysian Meteorological Department in Klang Valley. It was emphasized that weather and climate related disasters in Malaysia including monsoon flood, flash flood, dry spell are complicated by location, moisture, heat and complex orography. Moreover, the presentation also touched on WRF Model Configuration which had applied to have an overview of rainfall and precipitation forecasting around Kuala Lumpur areas. The speakers had compared the application of few Dataset such as The Tropical Rainfall Measuring Mission (TRMM), Global Forecast System (GFS) and ERA5. In conclusion, the distribution of the deep mesoscale convective systems in this monsoonal region is strongly influenced by its unique topographic orientation and thus can differ significantly from those of other regions. Improvement of systematic observation network was suggested for better understanding of Atmospheric Convention and monsoon break (Abdullah et al. 2018).

The Emission Inventory of Kuala Lumpur: issues and challenges presentation aimed to introduce the audience to the emission inventory case study in Kuala Lumpur which involving the process of data collection from point sources and non-point sources emissions. It described the important of emission inventory calculation which involving the parameter of emission factor, activity data and emission rate. Various uses of emission inventory including quantification of actual emissions, emissions projections, environmental monitoring, environmental impact assessment and development of policies to prevent and control emissions (ACAP, 2011). The emission inventory guides which was listed and explained includes Guideline for Developing Emission Inventory in East Asia 2011, European Monitoring and Evaluation Program/European Environmental Agency Emission Inventory Guidebook 2016, Danish Emission Inventories For Road Transport And Other Mobile Sources/Combustion Sources and The National Emission Inventory (NEI) by USEPA (ACAP, 2011; USEPA, 2013; Winther, 2015; EEA 2016).

The presentation then focusing on the emission inventory case study in Kuala Lumpur that demonstrated the road emission and point source emission contour plot analyses using Atmospheric Dispersion Modelling System (ADMS-Urban). The development of emission inventory in Kuala Lumpur is fairly new and although limited data are available, various guidelines are available on how to overcome the challenges. It was pointed out that the lack of data on current emission database and insufficient detailed investigation on individual streets and industrial emissions are among the main challenges of building an emission inventory in Kuala Lumpur apart from the fact that emission of pollutant and emission factor changes over time (Brimblecombe et al. 2015). Improvement in collection of information is necessary in order to build a better emission inventory and provide a better picture of emissions condition in Kuala Lumpur (Latif et al. 2018).

The Monitoring the Impact of Different Land Uses on the Climate of Kuala Lumpur is a case study which started with the importance of temperature and humidity study due to heatwave hazard and urban heat island in the city area. A brief information study on the monitoring of temperature and humidity in Kuala Lumpur was displayed on a map showing location of the sensor around Kuala Lumpur City Center. The location for the sensor deployment was based on four types of landuse area which were high rise high density area; low rise low density; road; and green area where the measurement was applied using Ibutton sensor. The preliminary results showed that the highest daily mean temperature was at low rise low density and road areas which are approximately 2 ºC higher than green area. It was also stated that higher risk of heatwave was identified at the built up area such as high rise high density area; low rise low density area and road areas. Summary of the studies was on the need of scientific urban and building planning studied which can contribute to mitigation on operational energy consumption, human comfort and human health (Wang et al. 2018).

The Near-Real-Time Atmospheric Hazard Platforms was about the development of the Newton Ungku-Omar Fund Multihazard Platform. It mainly discussed the importance of forecasting urban heat as well as air pollution. It also touched on the problem in developing a forecast model which lies in the lack of understanding of concentration of ambient air pollutant by public and government decision makers in general. In order to overcome this issue, the air quality index can be displayed in colours and defined range such as 1-500. The presentation was then displayed the existing air quality platforms such in London with airTEXT platform and other countries which that also using ADMS-urban for air quality platform in Barcelona, Riga and Hong Kong (Jackson et al. 2018).

The Forecasting Meteorology and Air quality in Urban Area: Status and Challenges started on air quality in urban areas and some comparison of PM_{10} and $PM_{2.5}$ concentration in few cities in India. It mainly focused on the source contribution of air pollution in India that related to the high number of vehicles, fuel consumption and road dust. There was also contribution of stubble burning in Punjab which becoming source contribution of ambient air pollution in Delhi. It was observed that during the smog episode, higher $PM_{2.5}$ concentration was observed compared to the Diwali period indicating greater contribution due to the regional pollution from farm fires. Delhi was described as gas chamber due to its geography which is prone to a meteorological phenomenon called inversion where warm air rests above the colder air closer to the ground, preventing it from mixing upwards thereby trapping all the pollutant. It was suggested that the application of air quality forecasting to forecast the composition of the atmosphere for the location of interest and also described the recent improvement by Weather Prediction in India where new High Resolution Ensemble Prediction Systems for Probabilistic Weather Forecasts was started it operation on the year 2017. Moreover, some modelling studied was also performed by Indian Institute of Technology, New Delhi with application of WRF-Chem for atmospheric forecasting purposes. Continues improvement of data, emission inventory, and assimilation of data were suggested to improved forecasting studies (Mohan 2018).

Association between Air Quality and impact factors in Beijing discussed on the spatio-temporal variation of air quality including NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10}. Air quality is affected by many factors including meteorology and traffic pollutants. It was emphasized that it is difficult to model air quality with clear formula. It is also difficult to know the dependency among multi variable. Air quality-Traffic–

Meteorology Maximum Information Entropy (ATM-MIE) method is proposed to reveal combined functions of traffic restrictions and meteorological factors. Association rules for $PM_{2.5}$ and O_3 under different meteorology are good indexes for understanding and controlling complex air pollution. It was stated that more data-driven method to analyse the air pollution to find out the routine pollution path and to predict the inflection points and sudden changes for heavy air pollution (Wu and Hu, 2018).

The discussion revolved around how meteorology, air pollution forecast and hazard assessment can be improvised. In order to reduce complex air pollutants, it emphasized how the industry has now been eradicated from main cities and only exist in the peripheral surrounding of a city, phenomena as observed in Beijing and Kuala Lumpur (Wu 2018). It was brought to attention to how the focus of science change in the perspective on particulate matter as pollutants. As in 1978, the health people started to realize the importance of PM_{10}. The USEPA then promulgated primary and secondary PM_{10} standards in 1987 due to the health impact it exerts (Chow et al. 1993). Over the time, new researches of $PM_{2.5}$ found to have severely impacting human health which has driven the establishment of policy standard. However, there is some time lagged between policy makings, implementation and research due to recent finding, new instruments and standards that were introduced (Mohan 2018). It is important for policymakers to be on top of their effort in making progress in reducing emissions therefore reducing the transboundary transport of pollutants (Mohan 2018; Latif, 2018).

In the aspect of meteorology and atmospheric forecasting, the importance of the fundamental science and understanding how to overcome the challenges and address the issues of meteorology-atmospheric science and forecasting was highlighted. As most equations and model developed originate from higher and middle latitudes environment, various modifications, downscaling to regional model and more appropriate parameterizations are important to overcome the issues in using them in tropical region as the meteorology and atmospheric condition in the tropical region is much more complicated with the heat transport, convection and chemistry (Abdullah 2018). It was also emphasized that the validation of a model is important so we totally understand the model and limitation, and the needs to be properly communicated with the public.

4.0 HIGHLIGHTS ON SESSION 2: GEOPHYSICAL HAZARDS ASSESSMENT AND FORECASTING APPROACHES

Flood disasters are gaining more exposure and attention as it is the nation's most frequent severe weather threat and the costliest natural disaster faced by the nation. This catastrophic events have forced sudden awareness nationwide and intensified efforts from various agencies and the government to reduce the risk of a similar or a bigger scale hazard in the future. Flood events are currently monitored and managed under a national framework for flood management (Komoo et al., 2011). As research found that the poor community are more vulnerable and at a higher risk of flood disaster, the developing countries must urgently install reliable coping mechanism in the area. Nonetheless, urban flooding in Kuala Lumpur is becoming a serious issue due to the number of people and infrastructure affected in an urban area are increasing despite various mitigation measures taken by the city hall. Although actions taken during and post-disaster are important, pre-disaster measures such as flood forecasting through high-resolution modelling are useful to predict the scale and intensity of a probable hazard and the impact it brings. Flash flood is generally defined as surface water flooding from pluvial origin that occur within a flood plain. The main influencing factor includes blockage, or the inability to discharge water, and the low capacity of old drains to withhold water (Ismail et al., 2018). JBA Risk conducted a number of flood assessment in Malaysia which includes KL Flood Validation on October 2014 in Jalan Sultan Ismail and Jalan Ampang, on May 2016 in Jalan Perpaduan, and in year 2017 along Jalan Tun Razak where floods also occurred in the year 2011.

Flash flood modelling is an exhaustive process that takes into account a range of factors which uses inputs from Digital Terrain Model and 2D hydraulic modelling (JFlow). These models are also used to monitor urban drainage and defences. KL flash flood maps is one of JBA task which conducted with an aim to effectively implement disaster risk reduction priorities in Kuala Lumpur. Structural investments have the greatest cost-benefit (Willis 2018). These analyses are significant in assisting the decision makers on future land use and development planning besides being a great use in forecasting and emergency response. JBA Flood Foresight is an example of detailed and precise foresight system that is able to predict flood severity within days in advance allowing effective actions arrangement by local emergency team to mitigation, planning and response.

Malaysia is endowed with substantial amount of water resources however better management on preservation and conservation initiatives must be done to ensure the water supply is used efficiently and sustainably. In terms of flood mitigation, the Department of Drainage and Irrigation Malaysia (DID) implemented various structural measures and soft measures which encompasses Flood Hazard map, Master Plan Studies on River Basins and Flood Mitigation which further strengthen by the development of a Drainage Master Plan Study. A study conducted by DID found that there are approximately 30-50% of annual increment in rainfall as a result of climate change whereas area inflicted by draught are worsening across the nation. Some of the comprehensive and effective initiative conducted by DID is the National Water Balance Management System (NAWABS) of which through its project a 2 month forecast and 14 days warning system had been developed and used to overcome challenges on water resource management.

Climate vulnerability and disaster risk assessment are imperative where development planning for communities is concerned. The Philippines are located along the typhoon belt, hence this assessment is especially crucial during the monsoon season where typhoons disaster are commonly occur. This natural disaster often leads to other occurrences such as flood and landslides. Rainfall data should be incorporated in hazard maps and models for better forecast and planning by the government that involves the community at risk through interviews and expert opinion. The community at all levels will have to team up to collaborate to fulfill the objectives of Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA). The awareness of DRR-CCA should include communities from the Science & Engineering Fields, Social Sciences, Humanities, Arts, NGO, LGU Stakeholders and others. Emphasis should be placed on developing an open data which is accessible by the community to aid a better understanding for what interventions should be done for future preparedness.

The increasing number of small and medium-sized enterprises (SMEs) is a result of rapid development. These SMEs play important role in its' business continuity management (ABCM) and business continuity plan (ABCP) which is utilized to improve the resilience of local economies to disasters and simultaneously the facilitate business continuation of the industrial agglomerated area as a whole (Baba et al. 2013). The assessment of natural disaster risk is vital for the identification of potential threat and disturbance that can risk area business continuity (Jaapar et al., 2018). This is in line with the rapid growth of SMEs in hazard-prone areas. A preliminary study was done in Kuala Lumpur Golden Triangle where flooding events are common. The survey showed that most of the SMEs are not aware of the BCP and rely on their own formulated safety measure and coping mechanism. A more detailed study and an increased awareness should be done to formulate and optimize the ABCP (Figure 1).

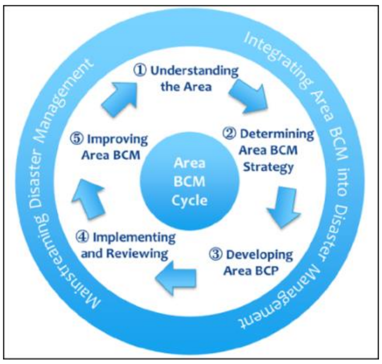

Figure 1: Area BCP Formulation and Area BCM Cycle (after Jaapar et al.,

Overall, this session highlighted the need of comprehensive high-resolution model on hazard forecast which is indispensable to countries that face extreme weather events. Capacity building and awareness measures should be intensified to local level communities, science communities, stakeholders and the government to further enhance disaster resilience of an area in terms of planning, response and mitigation. It is inevitable for communities from the different disciplines to complement each other to ensure an optimal land use development. An open data access is an encouraged initiative among all stakeholders to better facilitate the process of geohazard assessment and forecast approaches in the country.

5.0 HIGHLIGHTS ON SESSION 3: MW2C@UKM - REGIONAL CASE STUDIES ON HAZARDS ASSESSMENT

Mangrove Forest Rehabilitation and Models Simulation to Mitigate Extreme Weather Events in Karachi and Promote Resilience against Disaster by Mr. Adnan Arshad, China Agricultural University

Karachi is the largest city in Pakistan with 16.22 million populations within its area and has been considered as a 7th largest metropolitan city in the world with 50 % of the population lives in informal and unplanned settlements. This coastal city of Karachi consists of mangrove forests spread for about 350-km long, 129,000 hectares 129-km along the city coast. However, mangroves are being destroyed so rapidly in Karachi for development and urbanization. Based on the remote sensing assessment, the mangrove area in the year of 2000 to 2017 is reducing in size compared to the year of 1976 to 2000. According to the Pakistan Meteorological Department, Pakistan experienced a very high temperature in April 2018 with the maximum temperature escalated as high as 50.2°. The range of heat wave data recorded for 4 consecutive years were 43-49 °C (2015),44-47 °C (2016), 42-45 °C (2017), 46-50.2 °C (2018). This unusual extreme weather event happened due to rapid deforestation of mangrove area. Based on modelling result, 2/3 of the Karachi CO^2 stock can be absorbed by mangrove forest and model projected that forest area has an ability to absorb CO^2 emissions up to 55.4 million tons. This high-carbon storage suggests that mangroves could play an important role in carbon sinks/carbon sequestration/climate mitigation which can reduce the regional temperature. Mangrove forests store more carbon than most other tropical forests, in particular, mangrove-sediment stores about five times more carbon compared to temperate, boreal and tropical terrestrial forests.

Research on Assessing Climate Change Impacts on Flood in Vu Gia – Thu Bon River Basin, Vietnam by Mr. Dung Vu Trung, Asian Institute of Technology

Vu Gia population as on 2014 is recorded as 2.8 million people within 10,350km2 of area. 60% of this area comprises of mountainous area with an estimated elevation of 552m and average slope of 25%. The area where this river basin located experiences tropical monsoon climate with high rainfall intensity. Due to narrow basin with short and steep channels, floods often have a short transmission time, therefore causing huge damages to the downstream areas. This research is intended to project the change in climate and evaluate the flood characteristic as influenced by the climate change. Several steps of methodology were adapted including assessment of future climate projection (Linear Bias Correction Method), rainfall return period analysis, designing rainfall events, rainfall-runoff model, hydrodynamic model development and flood mapping production. Based on the analysis, the average annual rainfall in the period 2050s is predicted to increase up to 13.1% and 21% for scenario RCP 4.5 and RCP 8.5 respectively. From January to April, the future average monthly rainfall changes insignificantly compared to the base line period, and the remaining months show a sharp upward trend. Inundation area expands to 20.7% and 27.5% with scenarios RCP 4.5 and 8.5 respectively for return period of 20 years; 25.6 % and 37.1% for return period of 100 years and flood peak increases up to 1.5 to 2 times compared to historical flood. As a conclusion, the flood changes in a rapid expanding trend under the impact of climate change. .

Drought Detection in Sumatera using BFAST (Breaks For Additive Season and Trend)Ms. Juwita Nirmala Sari, ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management

Low rainfall intensity for 30-60 days periods could trigger a high potential of drought events for area in Sumenep, Trenggalek, Tuban Probolinggo, and Bangkalan. The agricultural activities are one of the sectors that would be adversely impacted due to prolonged drought. Hence, this research intends to develop a warning application and drought spot prediction to alert public for the incoming drought events by using BFAST (Break Detection in the Seasonal and Trend). It is a package installed in R software that integrates the decomposition of time series into trend, seasonal, and remainder components with methods for detecting abrupt changes. It can be applied to other disciplines dealing with seasonal or non-seasonal time series, such as hydrology, climatology, and econometrics. NDVI (Normalized Difference Vegetation Index) data extracted from MODIS has been used as an input for this system development. The early result showed there were two lowest NDVI value on around 2004 and 2015 and the data has been validated by the SPEI Global Drought Monitor. Result and the prediction on drought spot will be shared to the publics, particularly the farmers via mobile application. The pilot simulation of this application is still on going. However, by using this early prediction system, farmers could prepare for an early precaution step and increase their level of preparedness to response to drought events.

Climate Change Impact on Intensity-Duration-Frequency Curves in Ho Chi Minh City by Ms. Minh Truong Ha, Vietnam Institute of Meteorology, Hydrology and Climate Change

Ho Chi Minh City (HCMC) is the biggest city of Vietnam, lies on the Mekong River delta. HCMC is ranked among the top 10 cities in the world and is most likely to be severely affected by climate change. Its annual mean temperature is between 26.5 – 27.5°C, and the highest months is about 28 – 29°C with the lowest months is 24 - 26°C. The average of their annual rainfall is ranging from 1600 mm to 2000 mm, with rainy season occurs from May to October. Unpredictable extreme events increase year by year and heavy rainfall in Hanoi recorded a range between 600 to 800 mm/3 days in 2008 and the similar event also was recorded in Quang Ninh in 2015. Those extreme events trigger a high magnitude of flood leads to inundation of certain areas consequently damaging many properties. Hence, the goal of this research is to examine the impact of climate change on rainfall IDF (intensity-duration-frequency) for Ho Chi Minh city (HCMC), Vietnam by downscaling the rainfall from regional climate model outputs and construct a rainfall IDF curves for current as well as future periods. Four regional climate models (RCM) have been used for this research including CCAM, PRECIS, clWRF and RegCM. Each RCM has been used to calculate different climate projections based on the results from GCMs of IPCC. In total, there are 24 projections from the 4 models with 2 RCP (4.5 and 8.5). For observation data, daily rainfall at Tan Son Hoa station, was used for bias correction. Rainfall in short duration (15 min, 30 min, 45 min, 1 hr, 1.5 hr, 2 hr, 3 hr, 6 hr and 12 hr), were used for construction of rainfall IDF relationship for current climate. The results suggest that intensities of rainfall extreme events versus various durations with different return periods are all likely to increase over time in comparison with baseline period: [11, 60]% in 2050s, and [15, 69]% in 2090s under most likely case; and [38, 141]% in 2050s, and [28, 105]% in 2090s under high impact case. Base on this consistent increment, rainfall events are likely to occur more frequently in the future due to climate change.

Impact of Climate Change to Flood in the Klang River Basin by Ms. Ummi Hani Mahamad Anuar, Universiti Teknologi Malaysia

Klang River Basin is one of the main rivers in Malaysia and located between Selangor and Wilayah Persekutuan Kuala Lumpur. With a channel length of 120 km, Klang river basin comprises a total area of 1,288 km^2 harboring more than 3.6 million population within its catchment boundary. The rapid urbanization and climate change increase the risk of flood inside the river basin and leads to major lost to the city of Kuala Lumpur and its nearby area. Based on three future projections generated under A2 scenario (HadCM3 GCMs) using the observed historical annual daily maximum rainfall from 1975 to 2001, the increasing precipitation trend is projected up to year 2080. This GCM model has a 20 km resolution climate projections and the scenario was used is RCP8.5. For flood model development, a 1D model of HEC-RAS was adopted using rainfall and geometry data as inputs. Flood risk map will be generated by integrating hazard map and vulnerability map. The expected finding of this research is to produce flood hazard map and flood risk map for Klang River Basin. The development of flood hazard and risk map can enhance city's flood mitigation and preparedness planning and also will aid public understand the risk of flood in their surroundings.

The Big One: The Magnitude 7.2 West Valley Fault Earthquake by Mr. Kristian Azul, University of the Philippines Diliman

This study is conducted to understand the risks and establish a survival plan when a strong earthquake of magnitude 7.2 shakes Metro Manila and surrounding provinces. The West Valley Fault, which traverses various parts of Metro Manila and surrounding provinces, is expected to greatly affect the country since the region is not only highly populated but, it also hosts the seat of government and the country's business capital. This West Valley Fault earthquake (The Big One) is predicted to have a less than 500-year cycle, 3 segments [30km, 37km, 29 km (based on measurement from the map on Earthquake Impact Reduction Study for Metropolitan Manila, Republic of the Philippines: MMEIRS Report). This Valley Fault System is one of the segments of an active fault in the Philippines. The presentation on the impacts of the earthquake includes structure damage or collapse, geotechnical Issues (landslides, liquefaction, etc.), fire hazard, evacuation difficulty, damage of communication lines/utilities and damage of roads/access to various places. Precaution steps are taken based on previous earthquake cases, such as establishment of evacuation plans, information drives, drills, retrofitting of structures, better design of new structures (building) and alternative plans (connection/transport/communication).

The Managing of Landslide in Local Area at Tambon Nam Phai, Amphoe Nam Phad, Uttaradit Province, Thailand by Mr. Sitthinon Kultaksayos

Tambon Nam Phai is situated in Amphoe Nam Phad, Uttaradit province, northern part of Thailand. The presentation highlighted the previous landslide incidence that occurred in September 2011. The landslides took 6 lives, one missing person, and fully and partly destroyed 109 houses. About 6,720 sq.km. of farmland is also ruined during the incidents and the cost of damage is estimated at more than 1.6 million US dollars. The significant factors that contribute to this landslide are; i. geology feature (Uttaradit province locates near the suture zone between Sibumasu Terrane and Indochina Terrane (it created steep slopes antiform and synform of sedimentary rocks), ii. rain (this area prolonged heavy rain almost the year. The rain water in high volume is significant factor that causing landslide), iii. weathering (this area is in suture zone with numerous faults. The faults, create cracks in rocks so it causes high-rate weathering) and iv. Forest encroachment and deforestation (at mountain slope, the coherence between surficial soil and basement rock is destroyed thus sliding of soil).

Local scale landslide hazard map is created based on investigation and study on previous landslide traces, damaged areas, safe areas, rain water volume monitoring network and upstream monitoring network. The landslide hazard map is then classed into 3 classes with 3 color coded (Red: 1st order of landslide risk, the soil will slide when rain water 100ml/day, no vegetation on the surface and more than 30 degrees sloping; Yellow: 2nd order of landslide risk, rain water 200ml/day; and Green: 3rd order of landslide risk, water 300ml/day).

Precursor Phenomena of Landslide in Thir Seint Gon Village: A Case Study by Mr. Wai Phyo Kyaw Naing

Thir Seint Gon Village is situated in Mogok Township (Gemstone Tract), Myanmar. The population is very small and mostly inhabited by Lisu race. A landslide occurs on September 2017 and creates initial crack signs and uplifting the car road. The factors that contributed to the landslide in that area are i. the mountain is 1320 m (above sea level) and the gradient slope >50°, ii. Lack of vegetation, iii. The Torrential rainfall [The annual rainfall is 2000mm to 4000mm (Humid Climate)], iv. Earth material on the slope is mainly composed of weathered leuco-granite (Sandy soil), v. Poor Drainage System (Increasing Pore Water Pressure), vi. Local fault and direction of crack signs. (Generally = 70°) and vii. Human Activities (Old pit of Gemstone Mining activities). To prevent the landslide from occurring again, mitigation works needs to done by carrying out a drainage system on the surface and underground, reinforce and planting earth wall and planting with the guide of a Geotechnical engineer.

General status Environmental Geology & Hydrogeology in Cambodia & A Case Study of River Bank Erosion in Vietnam by Mr. Kim Seng

River bank sliding is a threat to life and property of local people living by the rivers. This has become a common phenomenon in the recent decades, concomitantly restraining the economic development process of the important South-West economic region of Vietnam. In order to reduce such damages, a scientific base for training plan of the river system and riverside development, a national project KC08-15 “Research on the river bank erosion and sedimentation prediction and solution suggestions for river system of the Lower Mekong Delta” has been established. To date, there have been 1 city, 2 towns, and 4 country town being under a danger of the river bank’s sliding. Moreover, riverbank erosion is one of the reasons of sediment deposition in the water line, causing the obstruction of navigation of the line to Cambodia and area at the mouth of Dinh An, Can Tho port, and the rising peak level of the flood. The erosion of riverbank tends to increase in both scale and speed. The erosion has been endangered the towns in the area such as Tan Chau, Hong Ngu, Sa Dec, Vinh Long,Long Xuyen.

In the current condition of the Vietnamese economy, it is impossible to construct protection for stability of the river bank and river bed. This research aims to predict the erosion period and hotspots to possibly offer a protection for people and property.

Modeling of Urban Development Pressure to Slope Failures in Pulau Pinang, Malaysia by Dr. Nuriah Abd Majid

Penang Island was selected for this study due to the frequent occurrence of landslides in recent years. Records of the past landslide were captured from historical reports, newspaper, and archived data. Data on Recent landslide (323 landslides) occurrence were collected through field work. These landslides then classified and sorted on the basis of their types which of majority are of rotational and translational type. Landslide influencing factors such as elevation topography, steepness, slope aspect, distance to urban, lithology and distance to lineament, soil series, urban development index, rainfall, and landuse are considered in using Logistic Regression approach to identify and improve our understanding of the impact of urban development pressure on slope failure.

6.0 CLOSING REMARKS

The closing remarks was delivered by Ms. Ida Semurni Abdullah, the Project Manager of Science to Action from MIGHT. The Disaster Resilient Cities project is one of the five projects being funded by the program. MIGHT Malaysia are very pleased to witness the collaboration between Malaysia and UK under the leadership of Professor Joy Jacqueline Pereira and Professor Lord Julian Hunt. The collaboration has developed and will be producing improved model to forecast hazard and disasters in Kuala Lumpur. MIGHT also please to acknowledge the first product of the project has been completed for DBKL. This downscale product would be the basis to develop more reliable forecast for other hazards like landslide and flash flood not only for the country but also in the tropical region. MIGHT Malaysia would also like to recommend and is looking forwards of peer reviewed of the product by the expert in this area especially the participants of this workshop before it is handed over to DBKL. Most importantly, the information and its utility can be benefited by the public. This representatives of MIGHT then applaud the team for their hard work on the project.

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