Report of the 1st Workshop

"HYDROINFORMATICS FOR DISASTER MANAGEMENT IN ASEAN"

by ASEAN Hydroinformatics Data Center (AHC) and ASEAN CIO Association (ACIOA)

09:00 – 12:30 hrs., 27 August 2021, Webex Thailand (Online), UTC+7

The overwhelming 90% of global natural disaster is water related. Between 1900 and 2007, water-related disasters about floods, droughts, or storms outnumbered all other types of disasters combined. Water-related disaster causes either direct impacts on damages to buildings, crops, life, and environment, or indirect impacts on economic productivity, investment risk, and human health. Despite having the massive impact in the world, the familiarity, knowledge and not to mention implementation of Hydroinformatics is either unaware or limited due to many reasons such as resources allocation or data consolidations. Hydroinformatics do demand expertise and experience which is constraint to only specific group of people.

The **"Hydroinformatics for Disaster Management in ASEAN"** is the workshop focusing on the sharing and learning from the past experiences of each ASEAN member on the implementation of "Hydroinformatics" to prepare-response-action for "Disaster Management" in particular. It is jointly organized by two ASEAN bodies, ASEAN Hydroinformatics Data Centre (AHC) and ASEAN CIO Association (ACIOA). This could be the starting point to enhance ASEAN-wide collaboration and uplifting the roles and usage of hydroinformatics to another level.

The First Workshop "Hydroinformatics for Disaster Management in ASEAN" was organized on 27th August 2021 online from 09:00 – 12:30 hrs (UTC+7), participated by 59 participants from 8 ASEAN countries: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. It was divided into 3 main sessions, the introduction, presentation of past experiences from ASEAN countries, and discussion and summary.

Introduction

Ms. Hong Sin Kwek, Global Relationship Officer, ACIOA, and the MC of the workshop greeted and introduced the workshop. She emphasized on the need to urgently take action responding to the global phenomenon on flood disaster e.g. the 21-day in Tennessee USA flood which was declared a major disaster in the southern USA. Some places received over 38 cm. of rain. From the World Meteorological Organization, water-related hazard has dominated the losses of life and economy over the last 50 years. It was always the case that the specialist needs to take action first before other people followed. She elaborated more information about the workshop's agenda and the collaboration between ACIOA and Hydro-Informatics Institute on the roles of IT for future water resource management in ASEAN.

Dr. Sutat Weesakul, Chairman of AHC has given the Opening Speech on the role of Hydroinformatics for Disaster Management. He had started with the figure of water-related disaster which was accused for 90% of the global disaster, and the current flood disaster claimed by climate change such as European, China, and Japan flood in 2021. Dr. Sutat showed the majority of disaster in ASEAN, over 60%, was accused by flood. Hydro-informatics is one of the tools to reduce disaster risk in the region. Moreover, the enhanced ASEAN collaboration is also one of the key factors to achieve this goal.

Mr. Chaicharearn Atibaedya, President of ACIOA, had given the Opening Speech on the role of CIO for Disaster Management. He emphasized the role of CIO for Disaster Management through his past experienced that he was a volunteer to support in the southern part of Thailand, after it was hit by tsunami. At that time, there was no data, technology, and communication to support disaster management and people must strive towards their security. Therefore, he mentioned that the 4C

(Communication, Connected, Collaboration, and Consolidate) are very important for a better recovery after disaster.

Presentation of past experiences from ASEAN countries

Sharing of the past experiences from ASEAN countries are the key starting point to learn the role of Hydroinformatics in each country for disaster management which will lead to the possibility of the future regional collaboration.

There were 6 countries presentation from Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam.

Indonesia

Dr. Adam Pamudji Rahardjo, Chair of Master Program in Engineering in Disaster Management, from Universitas Gadjah Mada (UGM) and AHC's Indonesian Lead Member, presented Indonesian experience in developing hydroinformatics content in Master Program in Engineering in Natural Disaster Management at Universitas Gadjah Mada (UGM). UGM has many disaster researches e.g. tsunami, flood, drought, landslide and sedimentation, and has around 300 students whose nationalities from Indonesia and other ASEAN countries. He has mentioned about their program in UGM which mainly focus on Sediment related Disaster Management, Natural Disaster Management, and Engineering in Natural Disaster Management, and also learn deeply in research methodology, data analysis, and other application for disaster preparedness and mitigation model.

Malaysia

Prof. Edy Tonnizam Mohamad, Director of Centre of Tropical Geoengineering, Universiti Teknologi Malaysia (UTM) and AHC's Malaysian Lead Member, has presented the case of Debris Flow in Malaysia. His presentation visualized the triggering factors for debris flow and the importance of risk map for a better preparation and mitigation of local people. Malaysia normally faces 2 monsoon seasons (southwest and northeast monsoon) which caused flash flood in many areas of Malaysia. Prof. Edy had presented the debris flow cases in many areas such as Gunung Jerai, Sungai Ruil, Karak, and emphasized the risk map is an important tool to prevent losses of life and economy of local people who lived in the risk area.

Myanmar

Prof. Dr. Khin Ni Ni Thein, Component 1 Director of AIRBM project, Chairperson of Myanmar Water Mother Organization, and Myanmar's AHC CIO focal point had presented the Hydroinformatics Journey for Myanmar. She has presented the abundance of natural resources in Myanmar and the need to develop local water resources through Integrated Water Resources Management (IWRM) to achieve the balanced and sustainable development of the country. The three mainstreams in Myanmar's water sector are Water, Sanitation and Hygiene (WASH), Integrated Water Resources Management (IWRM), and Water Related Disaster Risk Reduction (DRR). Myanmar's Hydro-Informatics Center is being developed to become the knowledge base and "engine room" of government agencies with multi-stakeholder engagement to support the development of new policies, sector plans, feasibility studies, and etc.

Philippines

3 AHC representatives from Department of Science and Technology (DOST), the Philippines, Engr. Socrates Jr. Paat, Assistant Weather Services Chief from Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Mr. Glenn Vincent C. Lopez, Senior Science Research Specialist from Advanced Science and Technology Institute (ASTI), and Engr. Nonilo A. Peña, Chief of Energy and Utilities Systems Technology Development Division from Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD), presented the

"Hydroinformatics in the Philippines" dividing into two sub-topics: the Mitigation of Floods and Droughts, and R&D Initiatives for the Mitigation of Water-related Disasters and Management.

Engr. Socrates Jr. Paat, the first speaker, explained the information of the Philippines which annually faced 20 tropical cyclones on average. Therefore, the country had established the Flood Forecasting and Warning System (FFWS) for River Basin and Dams for nation-wide management. For a better preparation and response, the government attempts to expand the hydrological monitoring facilities, and X-BAND radars for FFWS.

Mr. Glenn Vincent C. Lopez, the second speaker, presented 2 projects: the Meteorological Data Acquisition Stations for Information Dissemination (MASID) and Understanding Lightning and Thunderstorms Project (ULAT). MASID is a technology capable for automatically measuring weather-related information with visualization tool and crisis alarming. ULAT is the project studying weather behavior in the Philippines by correlating lightning occurrences with extreme weather disturbances.

Mr. Nonilo A. Peña, the third speaker from the Philippines, presented Hydroinformatics in the R&D perspective for the mitigation of water-related disasters and management. PCIEERD currently has various projects according to water resources management and water management intervention. Many projects are also conducted through the UK-PH Newton Agham projects.

Thailand

Dr. Sutat Weesakul, Director of Hydro-Informatics Institute Thailand and Chairman of AHC, presented the implementation of Hydroinformatics for Disaster Preparedness and Readiness in Thailand. The presentation visualized the use of hydroinformatics through two disaster cases; tropical storm "Sonca" and "Noul". The role of hydroinformatics for monitoring, analysis, preparation, warning and inter-agencies management pre-during-post disaster were emphasized in these two cases. The lessons learned from the prior event can also be applied for preparation of the latter case.

Vietnam

Dr. Quang Hung Nguyen, Vice Dean of Faculty from University of Science, Vietnam National University, Hanoi and AHC Key Opinion Leader from Vietnam has presented Urban Flood Simulation by 2D Model and Application of Low Impact Development - Case Study in Ha Tinh City. Prof. Nguyen introduced the information of Ha Tinh city, weather condition, and the drainage system. Flooding in Ha Tinh city was caused by the drainage problems from waste and sediment. Under the Mike Urban Model, it shows the possible solution for the low impact development in the city with or without new ponds.

Discussion

The discussion session was moderated by Dr. Veerachai Tanpipat from HII and Dr. Pattarawan Prasarnphanich from ACIOA on 3 main focuses; contribution of ASEAN, potential action, and future communication channel.

All the representative agreed the interactive and sharing among the participants and other ASEAN members would facilitate a better disaster preparation and management. Example of the sharing of information for better preparation was made in the case of HII Thailand which are using Malaysian radar information to monitor storm in the southern part of Thailand. The composited radar information in HII's ThaiWater website can also be shared for Cambodia, Lao PDR, Myanmar, and Vietnam for storm tracking.

The representative from Myanmar has addressed this collaboration should based on 5 aspects: 1. data and experience sharing, 2. comfortability and willingness, 3. comfortableness 4. the use of existing bodies and organizations and 5. the use of social media to build up ASEAN water friendship.

The participants had a consensus on the importance of sharing and contribution of beneficial and sharable hydroinformatics or other common information. Some information has already been shared

through other channels e.g. Typhoon Committee, which will be discussed in more details later by the organizer of the workshop.

With the time constraint, the AHC secretariat will reach out to each other participants for a possible contribution of each member.

The communication channel has been addressed in the discussion to identify the most suitable channels for ASEAN members. The participants finally agreed on the 3 official channels:

- AHC website (www.aseanwater.net) – by AHC secretariat
- WhatsApp mobile application – by AHC secretariat
- ASEAN Water Hub Facebook page – contributed by AHC Myanmar representative

Summary

ASEAN participants will start their contribution during the monsoon period from September 2021 to December 2021. The contributed information will be provided by each member after the workshop. There are 3 formal communication channels for co-monitoring and warning: 1) AHC website, 2) WhatsApp mobile application, and 3) Facebook page contributed by AHC Myanmar representative.

The next meeting is scheduled at the end of September 2021 for the follow up and updated information from each participated member.

Report of the 1st follow up meeting of

"HYDROINFORMATICS FOR DISASTER MANAGEMENT IN ASEAN"

by ASEAN Hydroinformatics Data Center (AHC) and ASEAN CIO Association (ACIOA)

10:00 – 12:00 hrs., 1 October 2021, WebEx Thailand (Online), UTC+7

The overwhelming 90% of global natural disaster is water-related. Between 1900 and 2007, water-related disasters about floods, droughts, or storms outnumbered all other types of disasters combined. Water-related disaster causes either direct impacts on damages to buildings, crops, life, and environment, or indirect impacts on economic productivity, investment risk, and human health. Despite having a massive impact in the world, the familiarity, knowledge and not to mention implementation of Hydroinformatics is either unaware or limited due to many reasons such as resources allocation or data consolidations. Hydroinformatics do demand expertise and experience which is the constraint to only a specific group of people.

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The First Workshop "Hydroinformatics for Disaster Management in ASEAN" was organized on 27th August 2021 online to encourage ASEAN members to share their experience on the implementation of Hydroinformatics for Disaster Management. The workshop was participated by 59 participants from 8 ASEAN countries: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, and the participants learned experiences from 6 ASEAN countries: Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam. In the discussion session, all participants agreed to set the co-monitoring and warning activity during the 4 months (September - December 2021) via 3 communication channels: 1) AHC Website, 2) WhatsApp group and 3) Facebook Page "ASEAN Water Hub" contributed by AHC Myanmar. AHC secretariat has created the online form "Contribution to be shared with ASEAN" and circulated it to every member to fill their potential contribution to others.

The outcome of the first workshop has encouraged ASEAN countries to actively prepare for the approaching disaster by the communication of information within the region for better disaster preparation and risk reduction.

The 1st follow up meeting of "Hydroinformatics for Disaster Management in ASEAN" was organized on 1st October 2021 online from 10:00 – 12:00 hrs. (UTC+7), participated by 29 participants from 8 ASEAN countries: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. This meeting was the first co-monitoring and warning activity during the 4 months (September - December 2021). It was divided into 3 main sessions: 1) introduction, 2) comments, feedbacks, responses on the information sharing activity, and 3) summary and way forward.

Introduction and Recap from the 1st Workshop on Hydroinformatics for Disaster Management in ASEAN

Ms. Hong Sin Kwek, Global Relationship Officer, ACIOA, and the MC of the meeting greeted and wrapped up the past activity, the 1st workshop "Hydroinformatics for Disaster Management in ASEAN" which was organized in August 2021. The workshop has been smoothly finished with the great collaboration among members and produced various knowledge. Currently, there is a lot of effort of each member states to reduce disaster risk and lessen disaster effect to their own country. This

sharing channel can be the source of information for those in need. Moreover, Ms. Kwek had mentioned hydroinformatics should be included in the important global agenda e.g. the COP meeting which is a global meeting on weather and climate change.

Furthermore, Dr. Sutat Weesakul, Director of Hydro-Informatics Institute Thailand and Chairman of AHC, mentioned about the current rainy season which cause a big flood over ASEAN especially from "Dianmu" tropical storm. Thailand was at the critical flood situation and hope to pass it. Therefore, this is a good time to expose to the capability of ASEAN and friends. This style of working in the actual condition and new atmosphere will change ASEAN working style. Not talking nor thinking about one self but ASEAN. Then we can go successfully in ASEAN.

Presentation of Information Sharing from ASEAN countries

Information sharing from ASEAN countries are the tool for all to prepare-response-action for reducing disaster risk and managing the approaching disaster. The collaboration is trusted to potentially bring about regional collaboration in the future. This session was moderated by Dr. Veerachai Tanpipat, Consultant of Hydro-Informatics Institute, Thailand. There were 4 presentations from Thailand, Singapore, the Philippines, and Vietnam to share their information which can be distributed to other members in the ASEAN.

Thailand

Dr. Veerachai Tanpipat, Consultant of Hydro-Informatics Institute, Thailand, emphasized three main communication channels which were AHC Website (www.aseanwater.net), WhatsApp Group "Hydro Disaster MNGT", and Facebook Page "ASEAN Water Hub". Besides the three communication channel, AHC secretariat has summarized the contribution of each country to visualize the overall contributed hydroinformatics information of this region. The shared information maybe provided in their native language; however, the story itself can build up some understanding for others. Dr. Tanpipat encouraged all ASEAN members to join WhatsApp Group which currently provide daily rain forecast images by WRF-ROMS, and flash flood warning from various ASEAN agencies.

Philippines

Mr. Maximo F. Peralta, Assistant Weather Services Chief from Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Department of Science and Technology (DOST), presented "Weather monitoring website in the Philippines". Mr. Peralta explained the information in PAGASA website (https://www.pagasa.dost.gov.ph/) that displays all the water and weather information for a close monitoring. The information has also been publicised through PAGASA Facebook page (https://www.facebook.com/hmd.ffws).

Vietnam

Dr. Thi Thuy Ngo, Researcher from Vietnam Institute of Meteorology, Hydrology and Climate Change (IMHEN), has mentioned that IMHEN is willing to share its data which includes rain forecasting, risk warning assessment, and knowledge sharing on numerical models, experiences in hydrology, and optimization algorithms apply to water resources. Dr. Ngo has also presented the website (http://thuyloivietnam.vn/home#antoan) which provide "waterworks information and operation" and "water level and rainfall observation" in Vietnam free of charge to everybody.

Singapore

Dr. Peipei Yang, Senior Research Fellow from Nanyang Technological University, mentioned Singapore is currently collaborated with many related agencies to support for the next chairmanship of AHC which will start from January next year. As for the contribution, the list of shared information will be finalized within this week. However, the real-time flood data in Singapore will be one of this

collaboration. Dr. Yang has presented their current project, "Development of 3D Visualization Platform for Compound Flooding and Transport Resiliency in Coastal Cities", which can also be shared to AHC. The project is a combine of 2D urban inundation flood with coastal flood and integrated with transportation model. The purpose of this modeling is the compound flood targeting storm surge and rainfall. For city, the vertical dimension is important. The 3D visualization is useful for people to understand flood impact which can later bring about resilience to the community. This 3D will incorporate real time forecasting of flood risk by smart sensor to provide accurate data which is useful for communication with the community for flood risk protection and preparedness.

Thailand (Updated situation in Thailand)

Dr. Surajate Boonya-aroonnet, Director of Hydro-Informatics Innovation Division from HII, updated the water situation in Thailand 2021 which was considered a year of "contrast". The first half of the year is a "dry" year. While in the wet season, the second half of the year, there was heavy precipitation in the downstream of reservoir and eventually flow to the sea. To minimize the risk, the good long- and short-term weather forecast are required. HII has developed the "Short-range weather forecast model" which currently have 70% accuracy and shared to ASEAN through AHC website for the short-term forecasting, and the "Seasonal precipitation forecasts" for long-term weather forecasting.

Discussion

Indonesia

Dr. Adam Pamudji Rahardjo, Chair of the Master Program in Engineering in Natural Disaster Management, from Universitas Gadjah Mada (UGM) and AHC's Indonesian Lead Member, commented his background is not from the climatology field. However, Indonesian BMKG (Meteorology, Climatology, and Geophysical Agency) plays the lead role in the monitoring and warning in Indonesia including earthquake, Tsunami, rainfall, and storm.

Myanmar

Dr. Win Win Zin, Professor of Yangon Technological University, and AHC's Myanmar Key Opinion Leader, mentioned she can share some related research paper to the AHC. Dr. Win Win Zin had introduced Mr. Zaw Myo Khaing, the representative from Department of Meteorology and Hydrology (DMH). Mr. Zaw Myo Khaing mentioned the Myanmar will later discussed about their contribution to the AHC.

Philippines

The information which is currently been shared in PAGASA website is useful for other member. The AHC secretariat will later discuss with PAGASA for a potential contribution to the AHC.

Summary

Ms. Hong Sin Kwek, Global Relationship Officer, ACIOA, addressed her pleasure to witness this sharing environment. Ms. Kwek encouraged the ASEAN people to think about the possibility of sharing to the region. She gently reminded all ASEAN participants to join the 3 formal communication channels: 1) AHC website, 2) WhatsApp mobile application, and 3) Facebook page: ASEAN Water Hub. It would be grateful if all the ASEAN country can update their potential contribution in the online for provided by AHC secretariat. Ms. Kwek has, again, emphasized AHC should participate in the future COP meeting presented the AHC collaboration with 24/7 automatic information sharing.

Report of the 2nd follow up meeting of

"HYDROINFORMATICS FOR DISASTER MANAGEMENT IN ASEAN"

by ASEAN Hydroinformatics Data Centre (AHC) and ASEAN CIO Association (ACIOA)

10:00 – 12:00 hrs., 18 November 2021, Webex Thailand (Online), UTC+7

The **"Hydroinformatics for Disaster Management in ASEAN"** is the workshop focusing on the sharing and learning from the past experiences of each ASEAN member on the implementation of "Hydroinformatics" to prepare-response-action for "Disaster Management" in particular. It is jointly organized by two ASEAN bodies, ASEAN Hydroinformatics Data Centre (AHC) and ASEAN CIO Association (ACIOA). The first workshop was organized on 27th August 2021 online to encourage ASEAN members to share their experiences on the implementation of Hydroinformatics for Disaster Management. In the discussion session, all participants agreed to set the co-monitoring and warning activity during September - December 2021 via 3 communication channels: 1) AHC Website, 2) WhatsApp group, and 3) Facebook Page "ASEAN Water Hub" contributed by AHC Myanmar. The outcome of the first workshop has encouraged ASEAN countries to actively prepare for the approaching disaster by the communication of information within the region for better disaster preparation and risk reduction.

The 1st follow up meeting was organized on 1st October 2021 online, participated by 29 participants from 8 ASEAN countries. The meeting was divided into 3 main sessions: 1) introduction, 2) comments, feedbacks, responses on the information sharing activity, and 3) summary and way forward. This meeting visualized the information which has been actively shared by ASEAN members such as Rainfall and Weather Forecast via the agreed communication channels, especially in AHC Website and WhatsApp group. It successful strengthened ASEAN countries to be aware of the approaching disaster and disaster risk reduction.

The 2nd follow up meeting of "Hydroinformatics for Disaster Management in ASEAN" was organized on 18th November 2021 online from 10:00 – 12:00 hrs. (UTC+7), participated by 33 participants from 7 ASEAN countries: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, and Thailand. This meeting was the last meeting to follow up co-monitoring and warning activity which has been conducted for 4 months. There were 5 main sessions in this meeting: 1) Introduction, 2) Information sharing on the Japanese Geostationary Meteorological Satellite "Himawari" in ASEAN, 3) Situation update from ASEAN, 4) Discussion, and 5) Summary and way forward.

Introduction and Recap from the 2nd follow up meeting of "Hydroinformatics for Disaster Management in ASEAN"

Ms. Hong Sin Kwek, Global Relationship Officer of ASEAN CIO Association (ACIOA), as an MC for this workshop, has welcomed all the participants to the workshop. She had made a quick introduction on how the workshop on Hydroinformatics for Disaster Management in ASEAN had started. With the collaboration from ASEAN's ICT and Hydroinformatics community, this workshop was not just a simply sharing and learning activity. The workshop has enhancing the ASEAN in term of "Hydroinformatics" and the alignment from the majority of people that every industries that use "water" has also to be mindful in the work they were doing. Building resiliency for a sustainable ASEAN in term of water management and water disaster is fundamental for the future of the region.

From the previous workshops, AHC members had shared a lot of visual materials to everyone. A lot of water-related information in ASEAN has been distributed in many websites, compiling and integrating them into an easy-to-access information pool would be beneficial for all.

Ms. Kwek had recapped the pass activity from the first follow up workshop which has been taking on 1st October 2021. In the meeting, speakers from Philippines, Singapore, Thailand, and Vietnam had introduced their shared information which was already published in their own websites, and some of them had directly linked in AHC website. Ms. Kwek had also encouraged ASEAN members to participate in this collaboration which could easily be started by joining any of the three information sharing platforms, AHC website, WhatsApp, or Facebook Page. The support and engagement from everybody was very welcomed and important to start this region-wide collaboration.

Presentation of information sharing on the Japanese Geostationary Meteorological Satellite "Himawari" in ASEAN

This presentation is a highlight information sharing from partner outside ASEAN to the AHC. The information is developed by HII, Thailand. Mr. Kritanai Torsri, Model Developer (Senior Professional Level) of Climate and Weather Section, from Hydro-Informatics Institute, Thailand, has presented the information and its usage to understand the benefits of Himawari-8 under the topic "The Japanese Geostationary Meteorological Satellite "Himawari" in ASEAN".

Mr. Torsri has presented the fact and possible applications of Himawari which the information itself was provided by Japan Aerospace Exploration Agency (JAXA). All AHC members can access to acquire data in hourly, daily, and monthly format. Himawari-8 product is the champion for Geostationary Weather Satellite from Japan that can provide true images with very high spatial, take a photo every 10 minutes, and can provide near real-time monitoring. It can be used for monitoring of tropical cyclones over the region. The information of Weather Monitoring in ASEAN Region by Himawari-8 is now available in the AHC Website (www.aseanwater.net/wp/) for everyone.

Presentation of Situation Update from ASEAN countries

Situation update from ASEAN countries are the good guideline for ASEAN participants to aware and alert to prepare-response-action for approaching disaster which will strengthen future regional collaboration among ASEAN countries. There were 2 countries presentation from Singapore and Thailand to share their contribution which can be a good sample for ASEAN countries.

Singapore

Presentation from Singapore is separated to 2 topics by 2 speakers: 1) "Flash Flood Updates in Singapore" presented by Dr. Nguyen Khac Tien Phouc, Senior Engineer from Public Utilities Board (PUB) Singapore's National Water Agency, and 2) "Regional weather data from Singapore presented" presented by Dr. Pei Pei Yang, Senior Research Fellow from Nanyang Technological University.

Dr. Nguyen Khac Tien Phouc, the first speaker, started by explaining the flash food situations in Singapore. It is generally not a big flood but some part of the road was flooded for 15 minutes up to an hour. This is the reason for Singapore to design the drainage system for big flood preparation and management. He mentioned the PUB's website (https://app.pub.gov.sg/waterlevel/pages/waterlevelsensors.aspx) is created for a near real-time water level monitoring with CCTV observation for flood management in Singapore. This website also provides its own SMS alert to their members for water level warning in crisis situations. Moreover, they have created mobile application named "myENV" from the Ministry of Sustainability and the Environment (MSE), PUB Facebook (https://m.facebook.com/PUBSg), and Twitter

(http://twitter.com/PUBSingapore) for the sharing of information on rainfall forecast, water, weather and air quality.

Dr. Peipei Yang, the second speaker, shared about monitoring website in regional level especially in ASEAN countries. This website is provided by ASEAN Specialised Meteorological Centre (ASMC) (http://asmc.asean.org/subseasonal-weather-outlook-15-28-november-2021/) which is the formal ASEAN Center located in Singapore. ASMC mainly provided weather data in weekly and monthly, and rainfall data analysis in monthly and yearly. Dr. Yang has also mentioned Singapore usually monitor Tsunami and earthquake prediction from National Environment Agency (NEA) which is one of the satellite image.

Thailand

Dr. Royboon Rassameethes, Deputy Director of Hydro-Informatics Institute, Thailand, presented the collaboration of HII and the Friends in Need (of "Pa") Volunteers Foundation (FOP) on early warning and disaster preparedness in the Southern Thailand under the title "Community Early Warning and Disaster Preparedness Network: Case study of Southern Thailand". Dr. Rassameethes shared the concept of the community network which was allocated by the storm movement which has an effect in the country. The disaster preparation in 2021 of each community has been well planned and prepared in advance with supporting technologies and information from HII. All the relevant sectors can use the information from either www.ThaiWater.net or ThaiWater mobile application, providing by HII, to monitor water situation which might have an effect in their area. However, communication during the crisis is also important. HII and FOP have used LINE, which the majority of Thai people use the app, as the main channel to communicate and report the updated situation among members under the group named "Community Disaster Warning Network". The Community Disaster Warning Framework for normal, pre-hazard, during-hazard, and post-hazard situation has also been presented.

Discussion session

The discussion session was facilitated by Dr. Veerachai Tanpipat from HII. Since Dr. Tanpipat was the lead person from HII who facilitated and reported HII's daily WRF result to ASEAN through WhatsApp group, he mentioned there was still limited interaction in the group. The participants discussed how to make the conversation more effective and receive more interaction from other members. To draw more attention from other members, Dr. Edwin Phuoc from Singapore suggested the group can set a discussion topic and discuss via other easier-to-response social application e.g., Telegram.

Dr. Hidayat from Indonesia mentioned about the need of warning system which should be learned and enhanced from the practice of Thailand to ASEAN. Dr. Rassameethes from Thailand informed HII is pleased to elaborate and collaborate with Indonesia for more information.

As for the next step, Mr. Phuoc recommended the hydroinformatics collaboration from this network, e.g., hydroinformatics information from Thailand, should be expanded to other related networks such as Mekong River Commission (MRC). Dr. Sutat Weesakul from Thailand had clarified HII had an intention to link and support MRC; however, there was international protocols to follow which sometimes could delay or hamper the collaboration possibility. Prof. Adrian Law from Singapore had emphasized the protocol was the thing needed to follow; however, AHC can be an alternative channel for communication and information sharing. The meeting had also discussed the possibility of networking with other relevant centres such as ASEAN Specialised Centre of Meteorology (ASMC) and World Meteorology Organization (WMO). Both centres/agencies are now based in Singapore and Prof. Law, as a next Chairman of AHC, will continue to search for the collaboration possibility.

Ms. Kwek encouraged ASEAN to join the "Open innovation" strategy to engage more diversity of participants. The inclusiveness of all ages may provide different solutions which is applicable for various situations.

Summary and way forward

The Hydroinformatics for Disaster Management in ASEAN is the pioneer cross-sectoral collaboration in ASEAN aiming for the sustainable of ASEAN water management. The work should be continued with more inclusive and linkages with other relevant partners in the region.

The outcome and overview summary of this series will be summarized and reported to the AHC and other relevant governing bodies such as SCMIT and ASEAN COSTI respectively. However, the 3 communication channels: 1) AHC Website, 2) WhatsApp group, and 3) Facebook Page "ASEAN Water Hub" will be kept active for further communication among the group.