MEMBER REPORT

THAILAND

ESCAP/WMO Typhoon Committee
13th Integrated Workshop
Chiang Mai, Thailand
5-9 November 2018

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I. Overview of tropical cyclones which have affected/impacted Member's area since the last Committee Session

1. Meteorological Assessment (highlighting forecasting issues/impacts)

Overview of tropical cyclones which have affected/impacted Thailand from 1 October 2017 to 30 September 2018

There were 11 tropical cyclones having some effects on rainfall of Thailand from 1 October 2017 to 30 September 2018. Four tropical cyclone affected Thailand during 1st January to 30th September 2018 as tropical storm "SON-TINH" (1809) in middle July, the tropical Storm "BEBINCA" (1816) in middle August 2018, tropical storm "MANGKHUT" (1822) and tropical storm "BARIJAT" (1823) in middle September. The tropical Storm "BEBINCA" was the only one tropical cyclone entered Thailand.

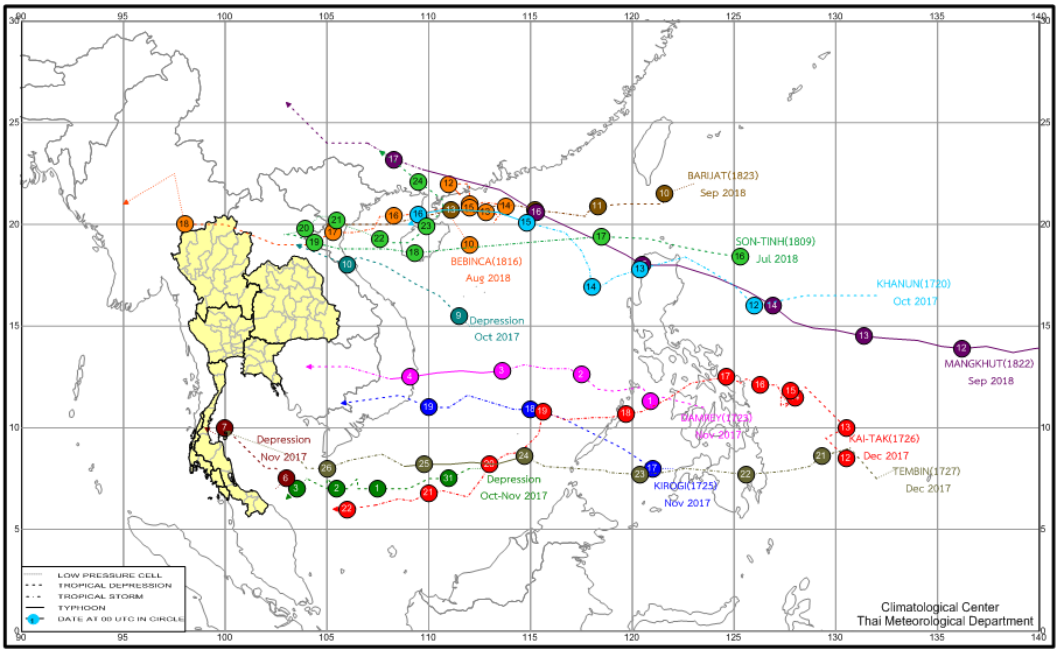

Figure 1: Tracks of tropical cyclones that affected on rainfall of Thailand from 1 October 2017 to 30 September 2018

Tropical Storm "BEBINCA" (1816)

BEBINCA was the only one tropical cyclone entered Thailand during 1st January to 30th September 2018. It formed as a tropical depression over the upper South China Sea in the afternoon of August 10. Then it moved over the coast of southern China and intensified into the tropical storm in the morning of August 13 and slowly moved westward into Gulf of Tonkin in the morning of August 16. It made landfall over upper Vietnam in the morning of August 17 passing Laos and weakened into a tropical depression in the afternoon of the same day before moving through upper Nan province into Thailand at Chiang Rai province in the early morning of August 18. After that, it moved through Chiang Mai province into Myanmar and later

degenerated into the active low pressure cell covering Myanmar. Under the influence of BEBINCA, rainfall in Thailand was relatively increased with widespread rain and heavy to very heavy rainfall in many areas at Chiang Rai, Chiang Mai, Phayao and Nan provinces on August 17. During August 16-19, the highest daily rainfall in upper Thailand was 370.0 mm at Amphoe Santi Suk in Nan province on August 16. Flash floods was reported at Chiang Rai, Phayao and Nan provinces on August 17 and at Mae Hong Son, Chiang Mai and Lampang provinces on August 18 and at Lampang and Phayao provinces on August 18 and 19 and also at Phetchabun province on August 20. For the track of BEBINCA and accumulated amount of rainfalls are shown in figure 2 and 3 respectively.

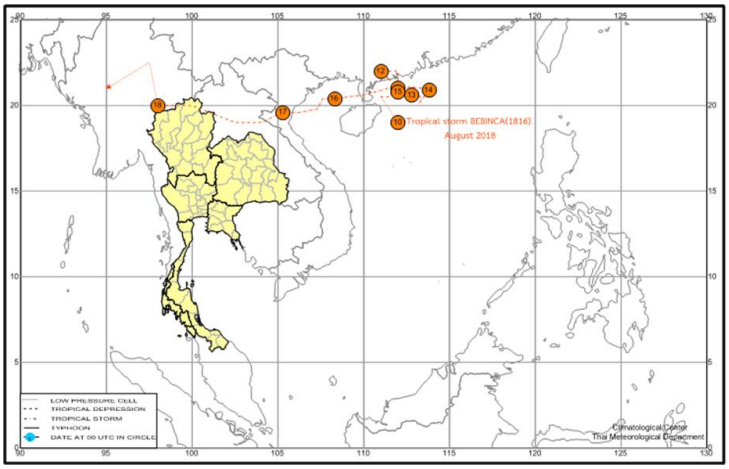

Figure 2 : Track of the tropical cyclone Tropical Storm "BEBINCA" (1816) from 1 October 2017 to 30 September 2018

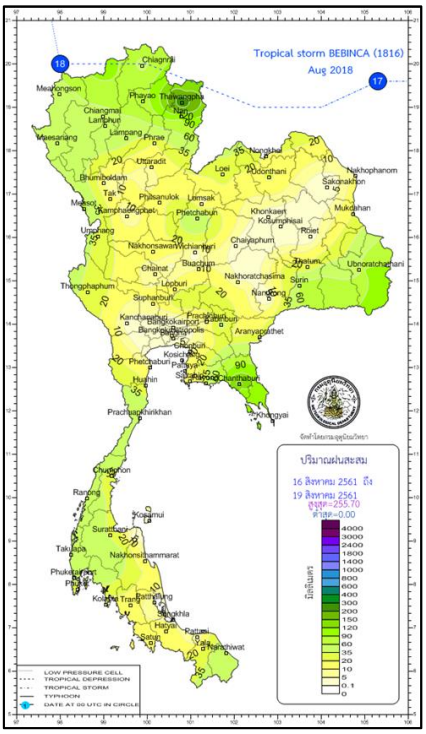

Figure 3: Accumulated amount of Rainfalls during 16-19 August 2018

Tropical Storm "SON-TINH" (1809)

In July 2018, there was the tropical cyclone having some effects on rainfall of Thailand namely "SON-TINH" (1809) in the upper South China Sea. It moved through Hainan Island into the Gulf of Tonkin on July 18 and made landfall over Vinh in Vietnam on July 19. After that, it weakened into tropical depression and the low pressure cell covered upper Laos on July 20 then the mentioned low pressure cell turned back to Vietnam before tracking in to the Gulf of Tonkin and re-intensified into a tropical depression on July 22. After that it moved through Hainan Island in evening of the same day into the upper South China Sea before making landfall over China on July 24 and finally degenerated into an area of active low pressure cell over south China and upper Vietnam, respectively. Under the influence of SON-TINH, plentiful rainfall over upper Thailand was increased to fairly widespread rain with heavy rainfall in several areas and very heavy rainfall in some areas during July 16-20. The highest daily rainfall of 272.4 mm was recorded at Khlong Yai in Trat province on July 17 and 175.5 mm at Ban Phaeng in Nakhon Phanim province on July 22. The weather in Southern Thailand was scattered to fairly widespread rain with heavy rainfall in some areas especially widespread rain with heavy rainfall in several areas on July 17 and 18. The highest daily rainfall amount was 88.6 mm at Takua Pa in Phang Nga province on July 17. For the track of SON-TINH is shown in Figure 4.

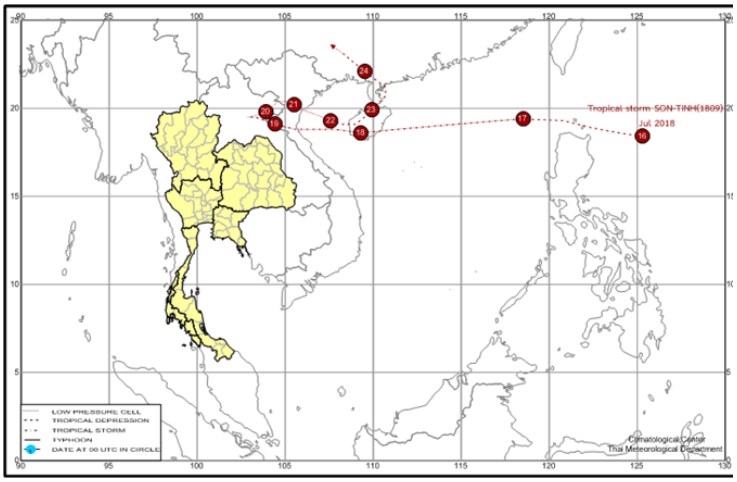

Figure 4: Track of the Tropical Storm "SON-TINH" (1809)

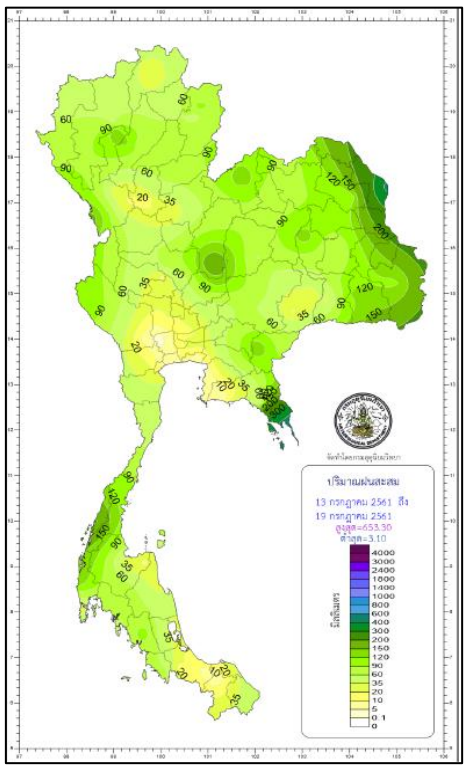

Figure 5: Accumulated amount of Rainfalls during 13-19 June 2018

Typhoon "MANGKHUT" (1822) and Tropical Storm "BARIJAT" (1823)

In September 2018, there were 2 tropical cyclones moving through the upper South China Sea to the areas nearby Thailand and having some effects on rainfall of Thailand namely "MANGKHUT" (1822) and "BARIJAT" (1823). The tropical storm BARIJAT in the upper South China Sea moved westward through Hainan, China to the Gulf of Tokin in the afternoon of September 13 and downgraded into the tropical depression. After that, it made landfall over upper Vietnam and weakened into the low pressure cell covered Laos in the evening on the same day. While typhoon MANGKHUT moving through Luzon, Philippines into the upper South China Sea on September 15 and made landfall over south China in the afternoon of the next day and respectively downgraded into the tropical storm and tropical depression before degenerated into an area of active low pressure over Yunnan Province of China in the morning of September 18 and dissipated in the next time. Under the influence of BARIJAT and MANGKHUT, rainfall over upper Thailand was increased to fairly widespread rain with heavy rainfall in several areas and very heavy rainfall in some areas. The highest daily rainfall of 303.0 mm was recorded at Amphoe Ratchasan in Chachoengsao province on September 16 with flash flood at Lopburi province on September 11, at Loei province on September 12, at Trat province on September 17 and at Nan province on September 12 and 18. Landslide occurred at Mae Hong Son on September 16. The weather in Southern Thailand was fairly widespread rain with heavy to very heavy rainfall in some areas. The highest daily rainfall amount was 134.0 mm at Ranot in Songkhla province on September 16 with flash flood at Satun province on September 15 and at Phang-Nga province on September 18.

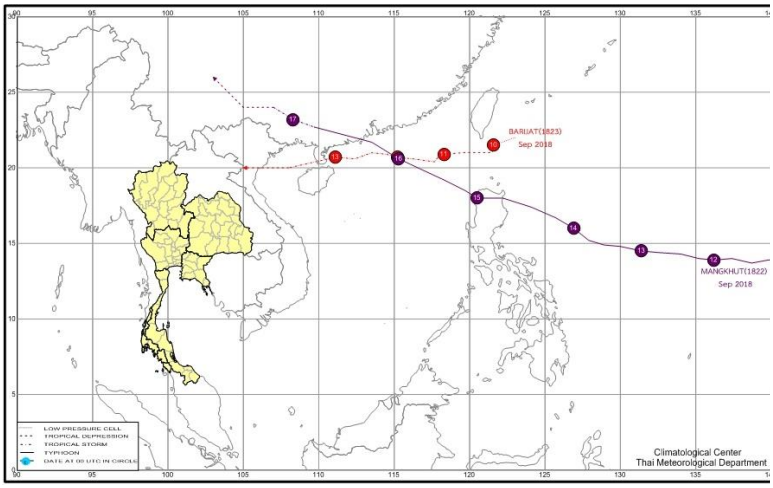

Figure 6: Track of the Typhoon "MANGKHUT" (1822) and Tropical Storm "BARIJAT" (1823)

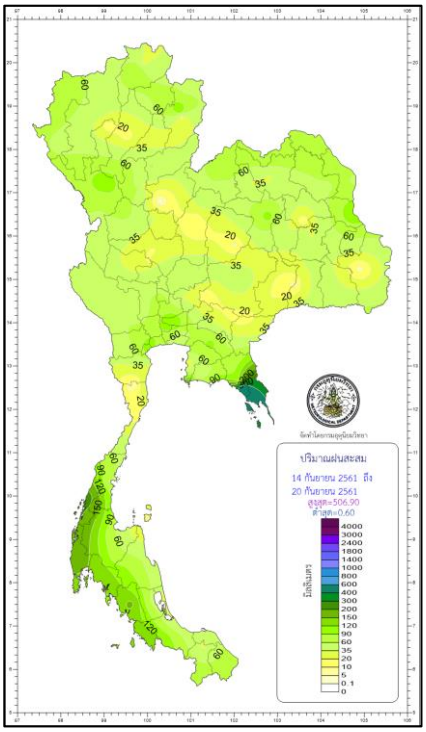

Figure 7: Accumulated amount of Rainfalls during 14-20 September 2018

Rainfall

The average rainfall over Thailand from 1 October 2017 to 30 September 2018 was 1739.8 mm or about 10 % above normal. Figure 8 showed that monthly rainfall during October 2017 to July 2018 was above the 1981-2010 normal especially in January which was 37.7 mm or 222% above normal over the whole areas. These affected from the prevailing of westerly wind in upper level over upper northern part and the easterly wind blowing over most areas of upper Thailand causing intermittent rainfall in upper Thailand mainly during the beginning and the end of January. In southern part, the influence of northeast monsoon prevailed over the Gulf of Thailand during the beginning and the middle of January and the easterly wind prevailed over southern part during the end of January resulted in isolated to scattered rain almost the whole month, particularly during intensified northeast monsoon bringing major rainfall events with heavy to very heavy rainfall in some areas. During summer season from March to late-May unseasonable rain occasionally occurred with thundershower, gusty wind and hail in some areas of upper Thailand due to the influence of the high pressure area from China extending its ridge to cover upper Thailand caused unusual rainfall in some places. Rainy season was started on May 26 and the southwest monsoon which prevailed over the Andaman Sea, Thailand and the Gulf of Thailand was strengthened in addition with the monsoon through lay across Thailand in some period and the influence of low pressure cell near Thailand causing above normal rainfall in most areas of Thailand from May to July. However, rainfall in Thailand was below normal in August and September resulted in 13% and 17% below normal over Thailand, respectively.

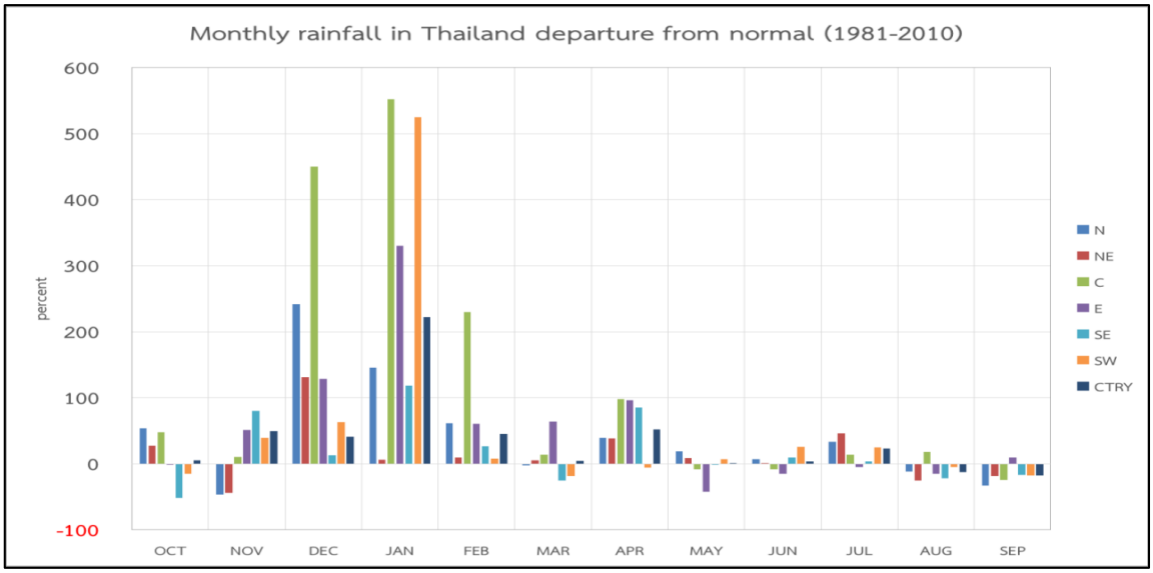

Figure 8: The monthly rainfall in Thailand departure from normal (1981-2010)

Temperature

Monthly temperature of Thailand from 1 October 2017 to 30 September 2018 was dominated by warmer and wetter conditions in most of the regions. Mean temperature over Thailand was above the 1981-2010 normal nearly the whole period mainly in November 2017 and January 2018 which was 0.8°C above normal with the mean temperature rising to 1.5 °C and 1.4°C respectively above normal in northern part. Mean temperature in February, March, April and May 2018 was below normal especially in April 2018 which was 0.8°C below normal with the mean temperature dropping to 1.2°C and 1.1°C below normal in northeastern and central parts, respectively. Thailand's monthly temperature is shown in Figure 9.

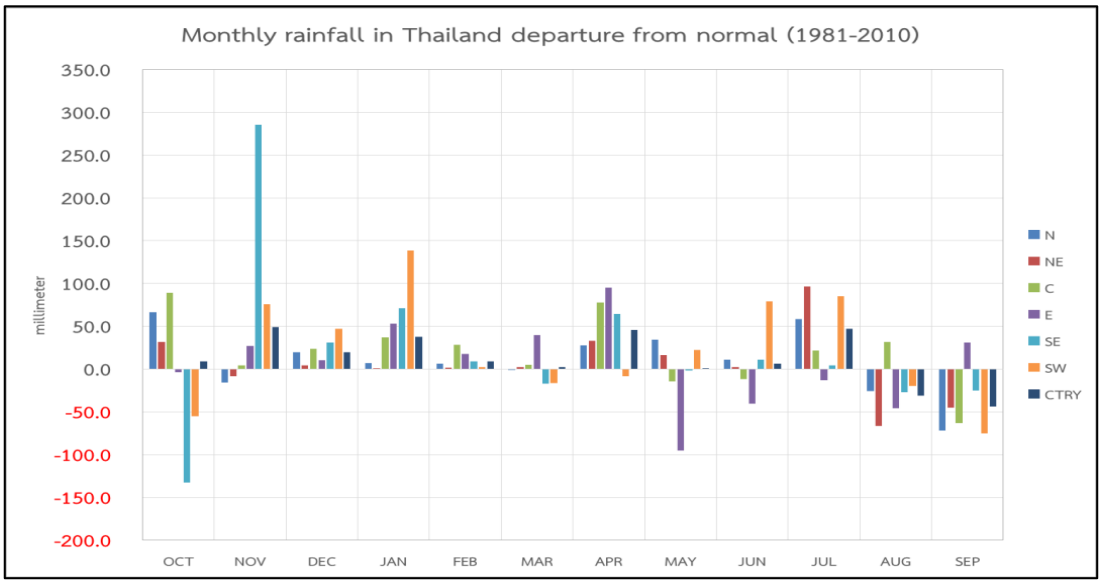

Figure 9: The mean annual rainfall in Thailand departure from normal (1981-2010) in percent

2. Hydrological Assessment (highlighting water-related issues/impact)

From January to September 2018, there are 4 tropical storms approached to Thailand as SONTINH, BEBINCA, MANGKHUT and BARIJAT. Even though they were downcast to depression and low pressure, SONTINH and BEBINCA still made the strong effect in the north and northeast regions of Thailand. An integration of various related agencies were discussed through sub-committee meetings at least every week to monitor and analyze flood situations.

Royal Irrigation Department of Thailand, by SWOC (Smart Water Operation Center), is in charge of monitoring 24-hour flood situations by integrating meteo-hydrological data as well as hydraulics structures data from related agencies in order to set up operation plans and making warning messages for the expected risky area through the RIO (Regional Irrigation Office) and relate to the local government.

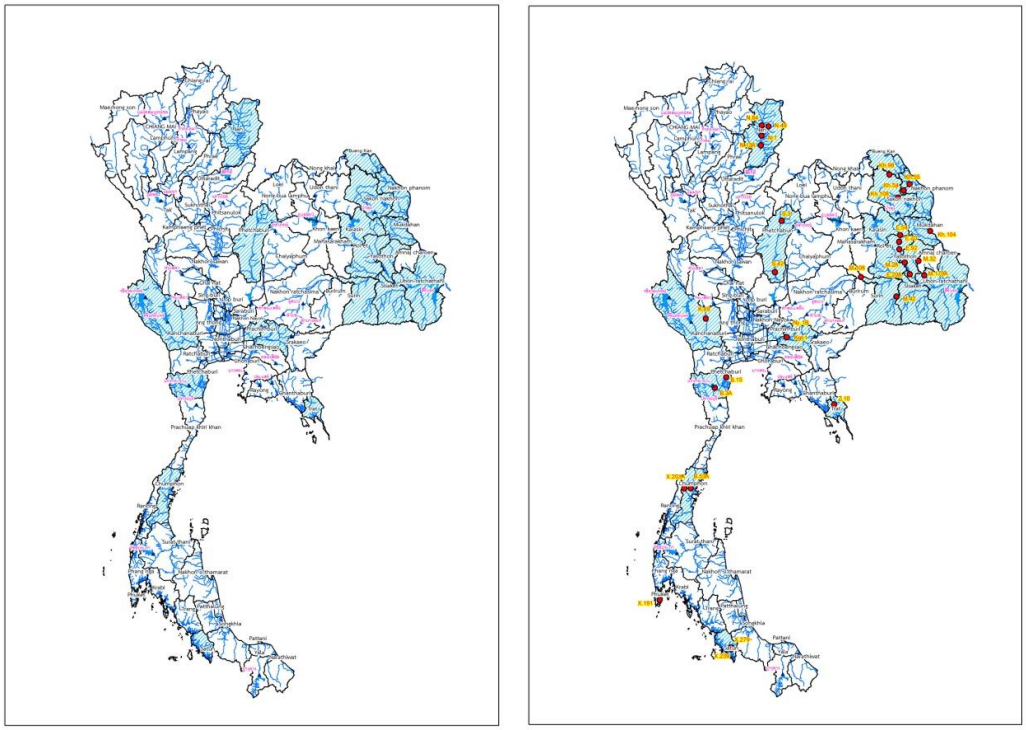

Figure 10: The provinces and hydrological observation stations that happened the flood situation in 2018 (total: 31 stations of 20 provinces)

In July, the SONTINH caused heavy rainfall in the northeastern part of Thailand. Inundation was found in many provinces particularly ones located near Maekhong River, such as Bueng Kan and Nakhon Phanom Provinces. The inundation period was 2-3 days in community area and up to 1-6 weeks in the lowland area. In addition, there was one broken dike that made inundation in the agriculture area. However it was fixed within few days.

Figure 11: The broken dike at Yang River in A.Selaphum, Roi-Ed province from SONTINH

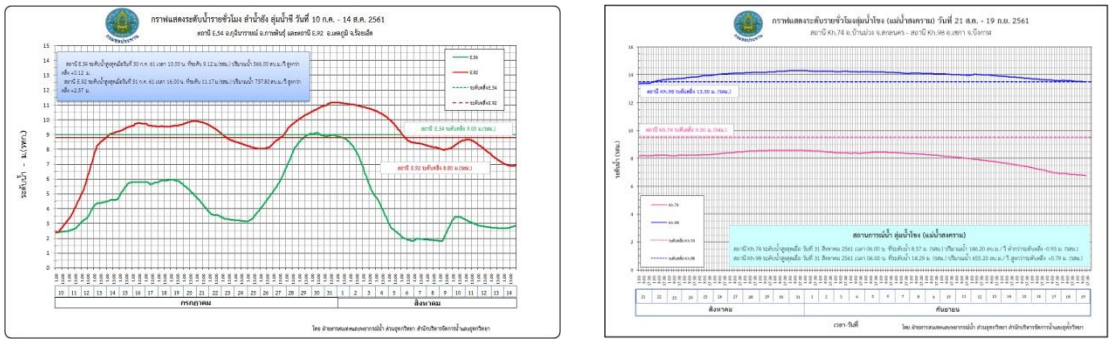

Figure 12: Hydrograph of Yang River at E.54 , E.92 and Songkhram River at Kh.74 , Kh.98 effected from SONTINH and BEBINCA

After that, in early August, the BEBINCA impacted the northern part of Thailand. Nan, Phayao and Petchabun Provinces were the provinces where flood occurred in the area especially in Nan City. Landslide in a village located in mountainous zone was also reported.

Likewise, the strong south-west monsoon brought the large amount of precipitations to the western and the upper southern parts of Thailand in the same period. The reservoir operation was strongly concerned by related agencies and carefully monitor inflow and outflow as well as operate the storage water not higher than the upper rule curve.

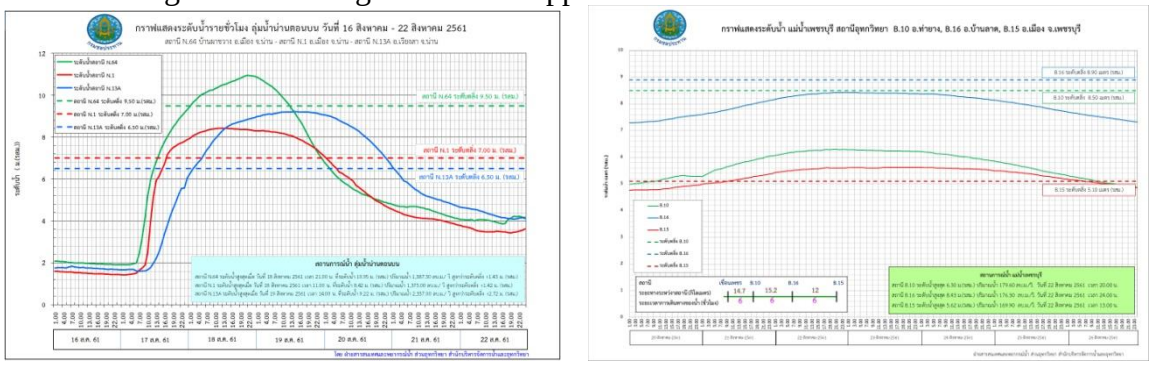

Figure 13: Hydrograph of Nan River at N.64, N.1, N.13A and Petchburi River at B.10, B.16 , B.15 that flood occurred in the city.

At least two large-scale dams named Vajiralongkorn and Kaeng Krajan Dams, located in Kanchanaburi and Petchaburi Provinces respectively were over 90% of their storage capacities. Excess water spilled out via their spillways of such dams. The joint committee such as RID and EGAT (Electricity Generating Authority of Thailand) had announced to release the excess water stored in the dams with consideration of minimizing damages in downstream community.

Figure 14: Flood occurred at the resort that locate downstream of the Dam after the operation and announcement.

Meanwhile the flood events were occurred in the northern, upper northeastern, western, and upper southern regions of Thailand, totally 31 hydrological stations of 20 provinces; in contrast, a lack of water was found in the lower northeastern and some central regions of Thailand because of less amount of rainfall.

3. Socio-Economic Assessment (highlighting socio-economic and DRR issues/impacts)

Heavy rainfall, low pressures and Tropical Strom SON -TINH, BEBINCA, BARIJAT and Typhoon Mangkhut are the main caused of flood in 2018. Flood started since June until now. In June 19 provinces, 88,014 Households and 174,205 people got effect from cyclone in China southern sea. In July, 27 provinces, 39,909 Households and 131,299 people got effect from typhoon SON-TINH. Flood situation continues until now especially in southern part of Thailand. (As of 30 Aug 2018)

4. Regional Cooperation Assessment (highlighting regional cooperation success and challenges.

Thailand has endorsed Global Framework such as SDGs and Sendai Framework, Department of Disaster Prevention and Mitigation will have online survey from Ministerial DRR Focal and report online Sendai Monitor to UNISDR by 15 October, 2018. There are some challenges of baseline data and segregated information in our countries. DDPM has requested technical assistance from ESCAP's Statistics Division to develop the baseline data.

II. Summary of Progress in Priorities supporting Key Result Areas

1. Improving Numerical Weather Prediction System
2. Improving Meteorological Satellite Data Analysis
3. Improving Tropical cyclone Forecasting
4. The regional experimental data exchange of radar data for composite map
5. Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM)
6. CBDRM Project
7. Disaster Early Warning Networks Training Course

1. Improving Numerical Weather Prediction System

Main text:

TMD upgrades a High-Performance Computing Weather Forecasting system for simulation atmospheric modeling to develop the weather forecast system which its hardware and software had been established since November 2017. The High-Performance Computer (HPC) system types is HPE Apollo 2000 series Proliant XL170r Gen 9, 172 Nodes (compute), Performance: 228 TF, Main memory: 128 GiB per node, High-speed storage: 3 PB with Linux Operating system.

The model is composed of 3 domains: Domain-1 is resolution grid 18-kilometer square, Domain-2 is resolution grid 6-kilometer square, and Domain-3 is resolution grid 2-kilometer square. High resolution WRF Bangkok model (resolution1x1 km. vertical 35 levels) was run at TMD for urban weather forecast and improvement for Bangkok and vicinity short range weather forecast.

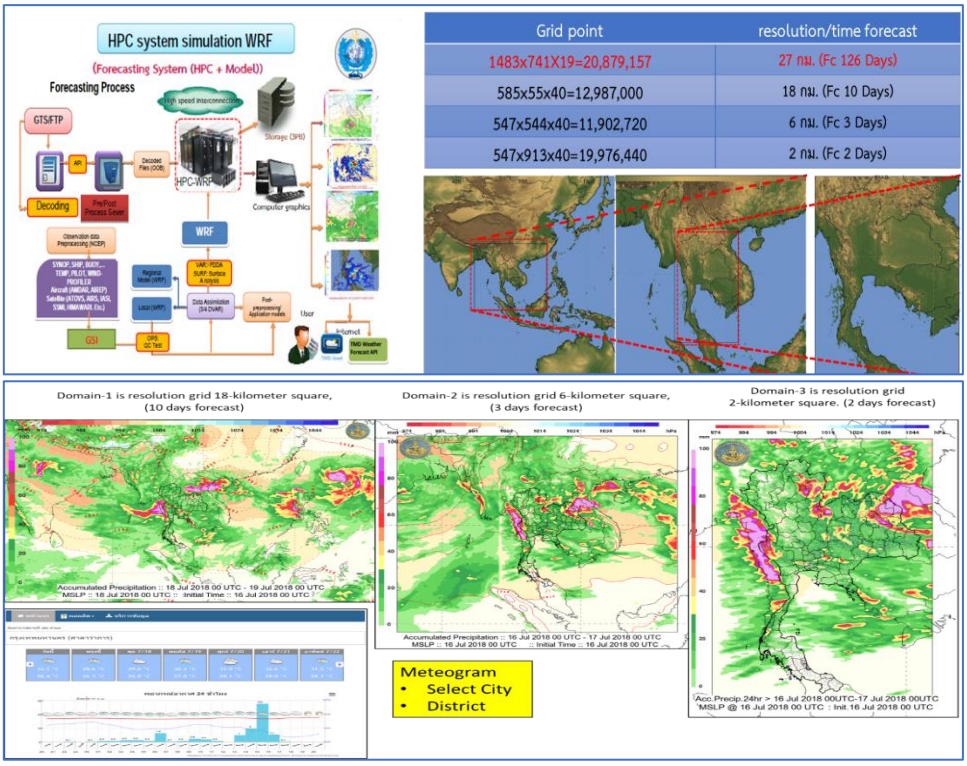

Figure 14: HPC system simulation WRF and Products.

Seasonal Forecast (http://weather.tmd.go.th/seasonal/)

Main text:

The Thai Meteorological Department (TMD) applied the Latest Releases, Weather and Research Forecast System (WRF) Version 4.0 to predicted short term and long term weather and climate for the whole country with the initial data from National Center for Environmental Prediction (NCEP). The seasonal prediction with 27-kilometers spatial resolution processes every day around 6:00 AM for forecasting up to 397 days. The selected data of precipitation, temperature and pressure is an update on the Monday. The following chart show the precipitation temperature and mean sea level pressure results at the weather observation station and interested area of each polygon such as, country, provinces, climate zone, and basin. Our long-range weather forecasts are currently experimental and are produced using techniques that have not been validated for accuracy. All features on the site including forecasts and data are provided on an 'as is' or 'if available' basis and services.

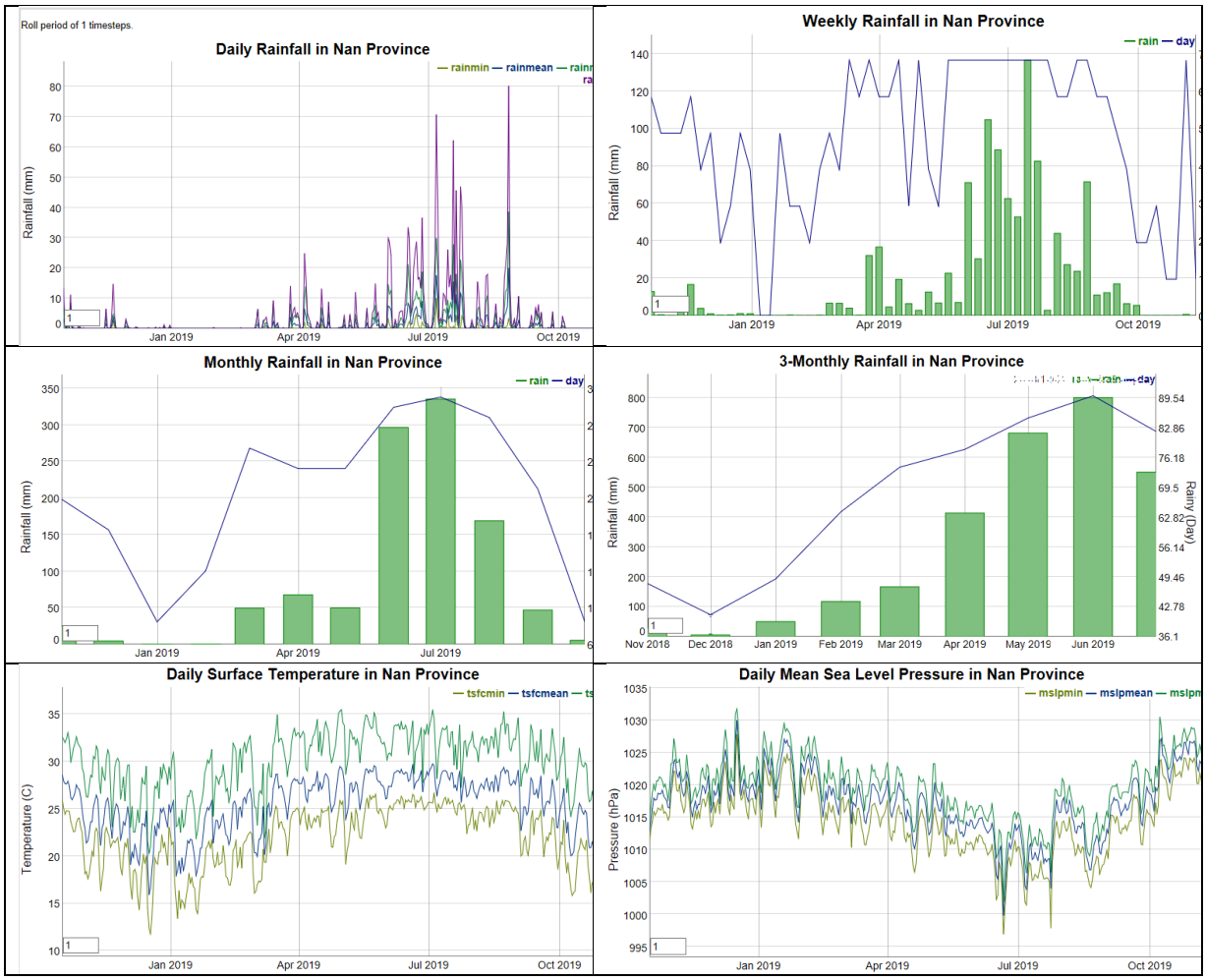

Figure 15: The forecast chart of the precipitation, temperature and mean sea level pressure at Nan Province, Thailand.

Identified opportunities/challenges, if any, for further development or collaboration:

Intend to improving the comparison and verification of the forecast with observations.

Increasing the knowledge and implementations of Data Assimilation.

The main challenge is briefing for including forecast inputs from local expert of Thailand climate and strike for a balance between consistencies among all inputs (model and local expert) before making a forecast.

Priority Areas Addressed:

Enhance the capacity to monitor and forecast typhoon activities particularly in genesis, intensity and structure change.

KRA 2: Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.

KRA 4: Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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2. Meteorological Satellite Data

Main text:

Meteorological satellites are very important to track the formation of storms. The enhance the satellite data reception equipment to support satellites, with the Himawari receiving and analysis facilities provided in kind by Japan Government via WMO's trust fund. Also, cloud-top height technique is used to classify cloud-top temperatures, and Global Satellite Mapping of Precipitation (GSMaP) technique is to estimate the rainfall from satellites. The two techniques helped weather forecasters analyze the storms and make better decisions on warnings. The outputs of satellite were available on the website (http://www.satda.tmd.go.th/monitoring/) that agencies and People are able to follow and apply them at all times.

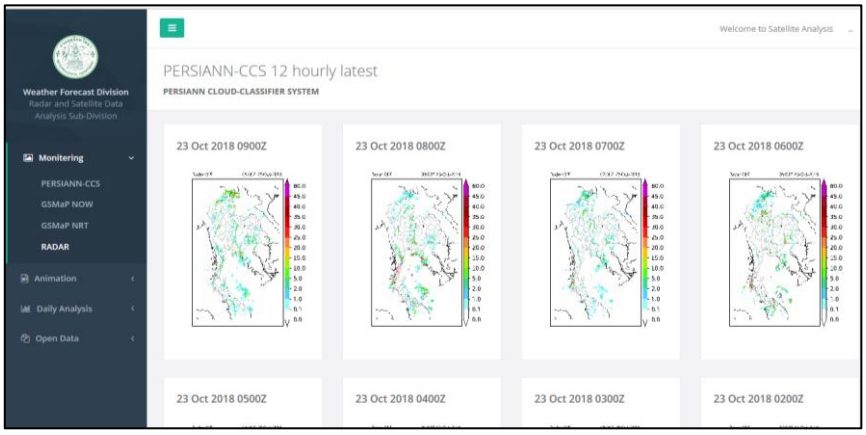

Figure 16: The console of Meteorological Satellite Data (http://www.satda.tmd.go.th/monitoring/)

Identified opportunities/challenges, if any, for further development or collaboration:

We intend to improving the estimate rainfall technique from satellite data and Radar Composite Data.

Priority Areas Addressed:

Enhance the capacity to monitor and forecast typhoon activities particularly in genesis, intensity and structure change.

KRA 2: Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.

KRA 4: Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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3. Development of regional radar network (Annual Operating Plan (AOP) 2018

Main text:

TMD will have been applying the lowest level intensity (EIL) to produces Nationwide Radar Composite Map, update table angle with news radar configuration, and modify radar operation control command. TMD have sharing experienced knowledge on radar data exchange to the participate from Lao PDR, Vie Nam, Philippines during the technical meeting from 22 to 26 October 2018 on regional weather radar network in Southeast Asia at Japan Meteorological Agency (JMA).

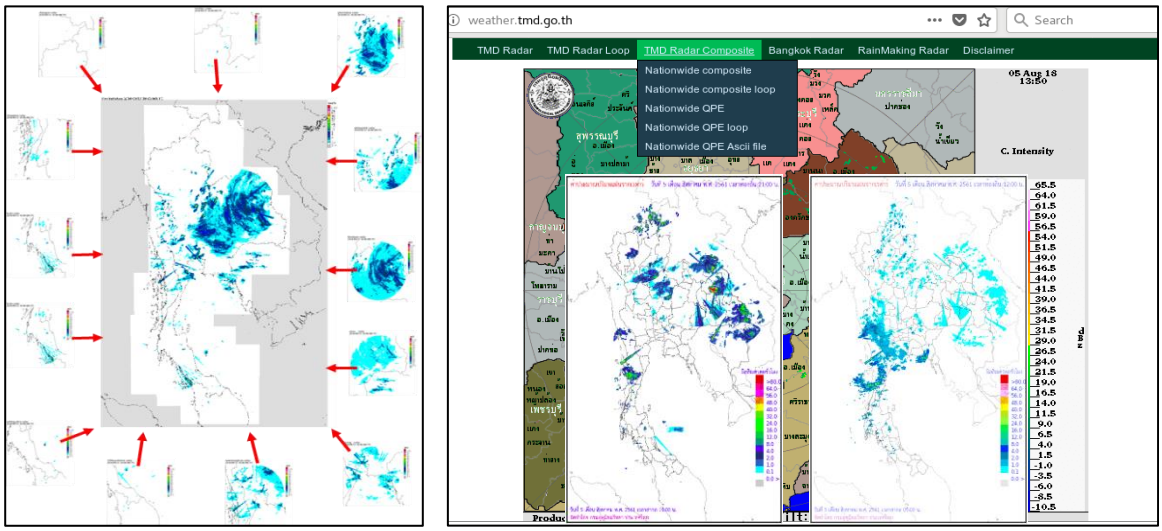

Figure 17: TMD Radar Composite nationwide QPE and Radar Composite map at 10 UTC on 13 September 2016 (http://weather.tmd.go.th/)

Identified opportunities/challenges, if any, for further development or collaboration:

To continue experimental test of radar data sharing among JMA, TMD, and MMD, and to share the experiences of the test with the RA II WIGOS project related to radar techniques in Southeast Asia.

Priority Areas Addressed:

Enhance collaborative activities with other regional/international frameworks/organizations, including TC and PTC cooperation mechanism

KRA 5: Enhance Typhoon Committee's Regional and International collaboration mechanism.

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4. Improving Tropical Cyclone Forecasting

Main text:

KMA visited TMD during 11-12 October 2018 and installed Typhoon Operation System (TOS). Forecasters can produce typhoon information with multi ensemble function for intensity and track forecast by using NWP data. TMD applied TOS to monitor the Tropical depression moving across Thailand during 19-21 October 2018.

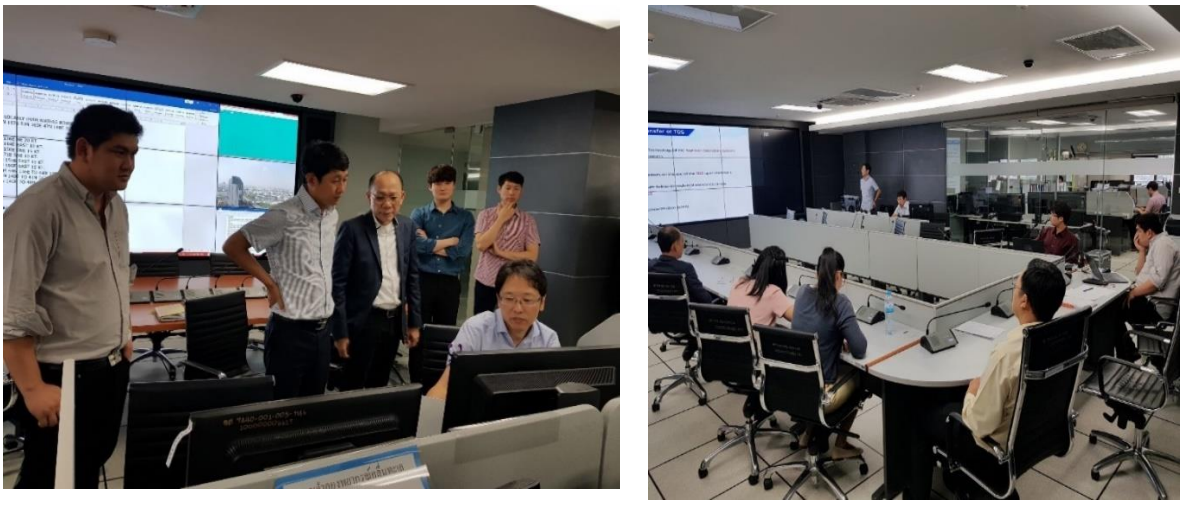

Figure 18: Experts from KMA transferred and installed Typhoon Operation System (TOS) at Weather Forecast Division, TMD during 11-12 October 2018.

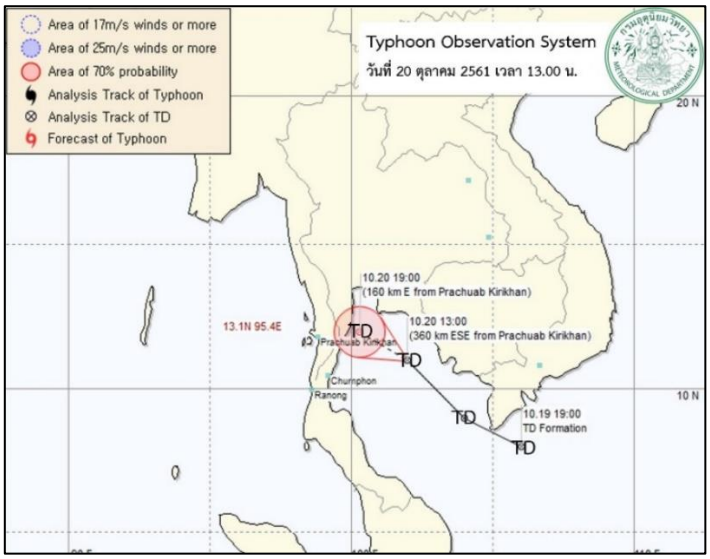

Figure 19: Forecast track of Tropical Depression by using TOS system, issued on 20 October 2018 at 06 UTC

Identified opportunities/challenges, if any, for further development or collaboration:

To continue experimental test of Typhoon Operation System (TOS) and improving identify tropical cyclone centered in the Gulf of Thailand by Radar data.

Priority Areas Addressed:

Enhance the capacity to monitor and forecast typhoon activities particularly in genesis intensity, and structure change.

Develop and enhance typhoon analysis and forecast technique from short to long term.

KRA 5: Enhance Typhoon Committee's Regional and International collaboration mechanism.

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5. Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM)

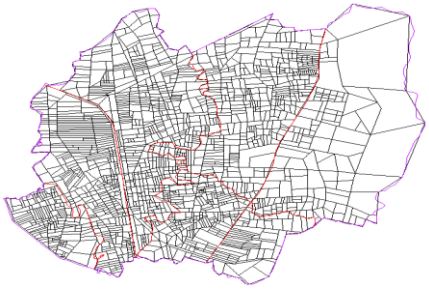
Main text:

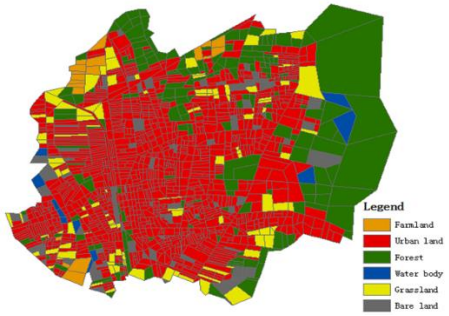
Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) project is the one of the AOP for the Working Group on Hydrology (WGH). Lead by Prof. Yangbo Chen from Sun Yat-Sen University, China, in collaboration with the Royal Irrigation Department of Thailand which Hat Yai City in Thailand is the pilot city.

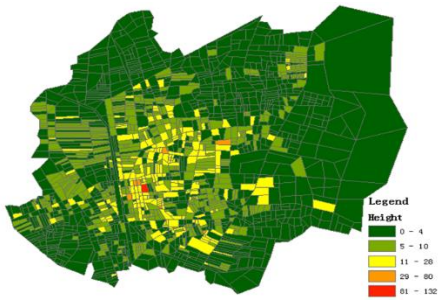
Identified opportunities/challenges, if any, for further development or collaboration:

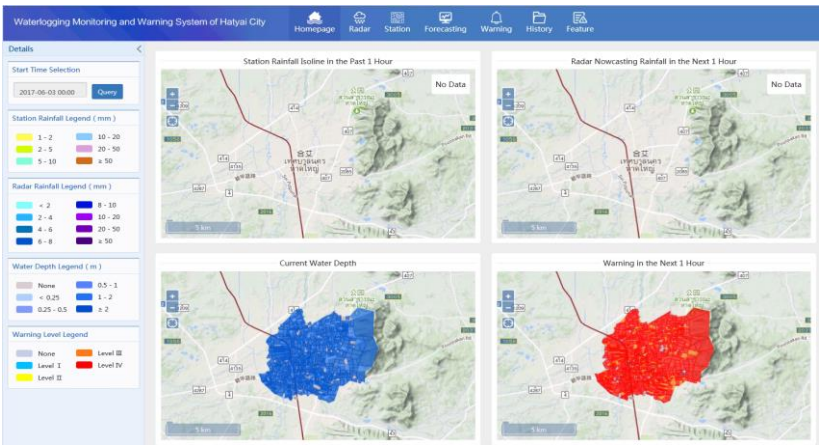
This program is the operation system for urban flood and will be very useful for the local officers to monitoring, forecasting, mitigation and decision making in flood situation. The progress is to set up the urban flood model and operating system in Thailand after finish the operating system in Dongguan City, China.

For Hat Yai City up to date, we are done for the field survey and the main data collection. The forecasting model, the operational system and main page are now done in the lab as below.

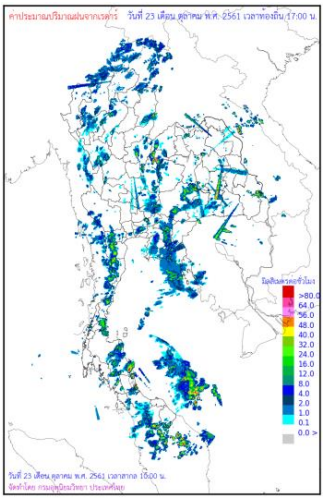








To improve the operation system, the radar component will be very useful for this project so the collaboration between WGH and WGM as the Thailand Meteorological Department is very appreciated. This monitoring and operating system will be installed in Thailand soon.



Priority Areas Addressed:

KRA 2: Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings
KRA 3: Improve typhoon related flood control and integrated water resource management

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6. CBDRM Project

Main text:

Department of Disaster Prevention and Mitigation and DDPM provincial offices have conducted Community Based Disaster Risk Management (CBDRM) in risk prone communities. It is a main Department Agenda for Disaster Preparedness.

Identified opportunities/challenges, if any, for further development or collaboration:

From our report, there are 26,297 flood and land slide risk prone communities, In 2018, DDPM conducted CBDRM in 975 communities and the total amount of CBDRM training course from 2005 – 2017 was 13,908 communities. There are still approximately half of risk prone areas do not have conduct CBDRM course. Budget allocation for CBDRM is varying year by year.

Priority Areas Addressed:

KRA 4: Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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7. Disaster Early Warning Networks Training Course

Main text:

National Disaster Warning Center (NDWC) is merged under the umbrella of Department of Disaster Prevention and Mitigation (DDPM) has conducted Disaster Early Warning Networks Training Course in 18 Disaster Prevention and Mitigation Regional Centers. In 2018, there are 2,908 participants attended the above training course.

This training course is encouraging people who live in risk prone area to support the government sector to disseminate effectively early warning messages to reduce loss of lives and properties.

Objectives

1. To provide knowledge of natural disaster and early warning system to people sector for disaster resilience
2. To enhance understanding National Disaster Warning Center roles and responsibility for people sector networks. Additionally, this people sector networks are able to disseminate information and early warning to the public.

3. To request the maintenance support of early warning tools and equipment from the people sector networks.
4. To increase early warning volunteers at the risk prone area and they are able to report disaster situation to National Disaster Warning Center

Identified opportunities/challenges, if any, for further development or collaboration:

There are good opportunities for National Disaster Warning Center of Department of Disaster Prevention and Mitigation to have closed collaboration with local networks, both sides will improve nearly real time monitoring system.

This training course will improve good collaboration among relevant agencies namely; The Thai Meteorological Department, Royal Irrigation Department and Department of Public Relations.

Priority Areas Addressed:

KRA 4: Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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