MEMBER REPORT

SOCIALIST REPUBLIC OF VIET NAM

ESCAP/WMO Typhoon Committee

17th Integrated Workshop

(Video conferencing)

November 2022

CONTENTS

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

There have been 07 tropical storms and 02 tropical depressions in BienDong Sea of which, 03 tropical storms and 01 tropical depression have made landfall the mainland of Vietnam (Figure 1.1); 24 heavy rain events, 197 thunderstorms causing more than 200 inundation, flash floods, landslides events in Viet Nam in 2022. Those hazards caused 141 people died or missing and 263 people injured. The strongest typhoon in 2022 was Typhoon No. 4 (Noru) that landfalled in Da Nang - Quang Nam on September 28. Typhoon Noru caused extreme heavy rain with the maximum rainfall observed in Nghe An with common total of 300-500mm, particularly in Quynh Luu 662mm and Con Cuong 650mm which caused serious flooding in low-lying and along river areas such as Quynh Luu, Thanh Chuong, Hung Nguyen districts of Nghe An.

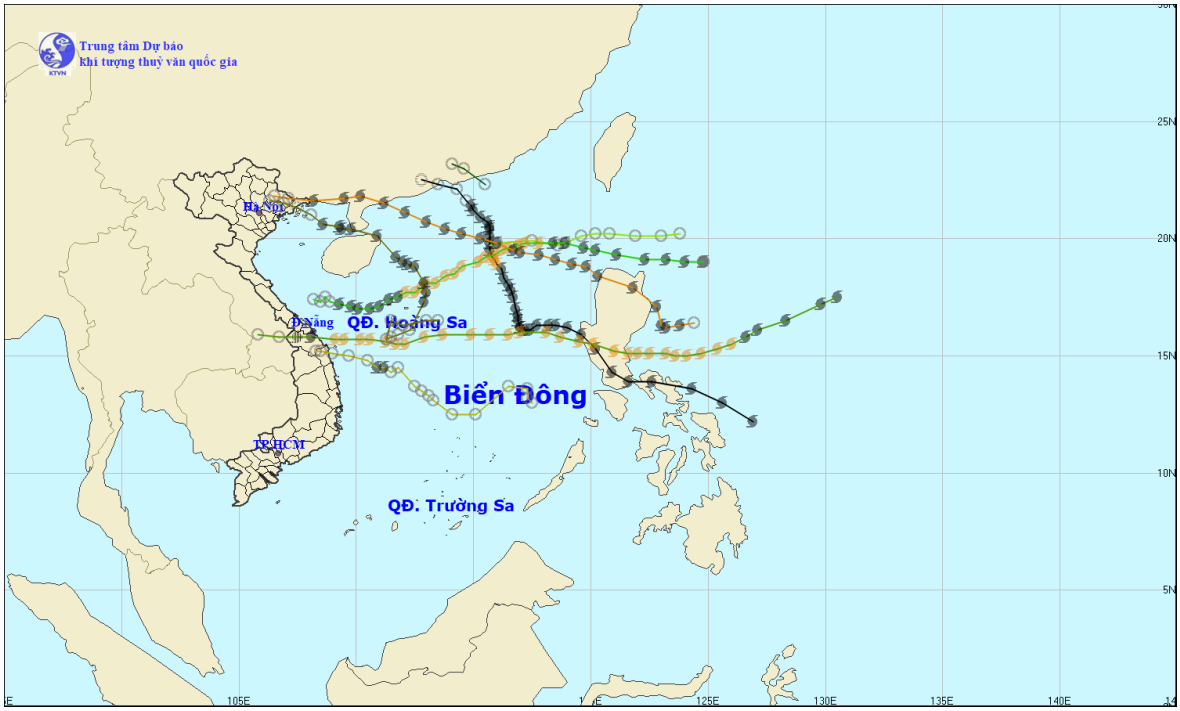

Figure 1.1. 2022 tropical cyclone tracks in Bien Dong sea

1.1. Meteorological assessment

- Storm MULAN landed in the Quang Ninh - Thai Binh area at noon on August 11, causing heavy rain of 150-300mm in coastal provinces, the Northern Delta and some mountainous provinces (Hoa Binh, Phu Tho, etc.). Ninh Binh, Thanh Hoa, Nghe An, ...). Heavy rain combined with high tide causes floods on alarm over level 3 in estuaries and coastal areas of Hai Phong, Thai Binh, and Nam Dinh; flood on at risk level 2 at upstream of

Hoang Long river (Ninh Binh), Buoi river (Thanh Hoa); Boi River (Hoa Binh). Flooding after the storm made 10 people dead or missing; 96 houses were damaged, 370 houses were flooded; 19,849ha of rice and crops were flooded and damaged; 677 positions of roads were eroded with a volume of 44,996m3; dikes and embankments have been eroded or damaged in 08 different locations.

- Storm MA-ON entered the northern mainland of Loi Chau peninsula (China) in the afternoon of August 25, weakened into tropical depression and entered the Quang Ninh - China border region, causing heavy rain for the northern provinces such as: Dien Bien, Cao Bang, Bac Kan, Bac Giang, Tuyen Quang, Phu Tho, Thai Nguyen, Hoa Binh, Vinh Phuc... A level 3 alarming flood on the upstream of Pho Day river (Vinh Phuc), level 1-2 flood on Luc rivers South, Thuong River (Bac Giang), Bui River (Hoa Binh), Bua River (Phu Tho). Flooding caused 03 deaths, 205 roofs torn off and damaged; 7,992 ha of rice, crops, 17,708 ha of fruit trees were flooded and damaged; 07 incidents of dyke erosion.

- Storm NORU reached the strongest intensity at level 15, gust level 17 nearly reached the level of a super typhoon in the East Sea, weakened before landing in Da Nang - Quang Nam on September 28, causing very heavy rain in the central provinces and the Central Highlands, in which Nghe An alone rained heavily from 300-500mm (Quynh Luu 662mm; Con Cuong 650mm); causing serious flooding in low-lying areas, along rivers such as Quynh Luu, Thanh Chuong, Hung Nguyen, etc. Especially in the night of October 1st and early morning of October 2nd, the very intense rain of 273mm caused serious flash floods in the area. Ta Ca commune and Muong Xen town, Ky Son district (Figure 1.2). Flooding after the storm caused 9 deaths, 10,375 houses damaged, nearly 20,000 houses flooded; total damage was over 5,481 billion VND.

Figure 1.2: Flash flood due to heavy rainfall in Ky Son district, Nghe An province

- Storm SONCA and floods after the storm: Storm SONCA landed in the area from Quang Nam - Quang Ngai with level 6 winds, level 8 gust; Storm circulation causes heavy rain from 300-500 in the provinces from Quang Binh - Quang Nam, especially in Da Nang and Thua Thien Hue with very heavy rain from 500-800mm, concentrated from the night of October 14 to the morning of October 15 (especially in the morning of October 15) caused severe flood (Figure 1.3). In particular, in Da Nang city, the rain was very heavy at Suoi Da 831mm (surpassing the 2018 daily rainfall history of 635mm). Heavy rain has caused level 3 floods on rivers from Quang Binh - Thua Thien Hue; Severe flooding in some places up to 1.5-2.0m in Da Nang. Floods have killed 09 people; 41 houses were damaged; 96,884 houses were flooded; 122 points, roads are landslides, congested; total material damage is over 1,916 billion VND.

Figure 1.3: Flood in Hue and Hoi An (Quang Nam) province

1.2. Hydrological Assessment

In 2022, the most prominent disaster situation related hydrology in Vietnam can be mentioned as:

- In the Northern part: high frequency of flash flood, landslide occurrences concentrated in transition period between the dry and rainy seasons (May – June) with around 14 reported events; flood plain in the Red river delta area caused significant damage to agriculture, livestock, facilities and infrastructure during flood season (July – September).

- In the Central of Viet Nam: severe flooding, flash flood occurred in several provinces as results of TY Noru circulation, especially Nghe An and Ha Tinh provinces, where suffered a huge damage.

- In the Southern part, the water level on the Mekong river in the flood season of 2022 is higher than the same period in 2021.

1.2.1. Flash flood, landslide and floodplain in the North and North Central of Viet Nam

The flash floods and landslides in the North of Vietnam is likely to occur at any time of the year when localized heavy rain patterns appear. In 2022, the first landslide event appeared in the April in mountainous area. During March and August, 18 flash flood and landslide events occurrences in which concentration time is between May and July.

Most flash floods are caused by local heavy rains which appeared during a short time, on a small area - local characteristics. This is a challenge in the operational warning and forecasting in Viet Nam.

In 2022, the flash flood event occurred Pac Miau village, Mong An commune, Bao Lam District, Cao Bang province in 05 July; Ta Ca commune, Muong Xen town, Ky Son district, Nghe An province in 02 Oct was considered as samples of challenges in flash flood warning. Actually, the SEAFFGS products such as ASM, FFG, LHA LST and VNMHA 3km WRF FFFT did not show any signal related to flash flood potential for those areas.

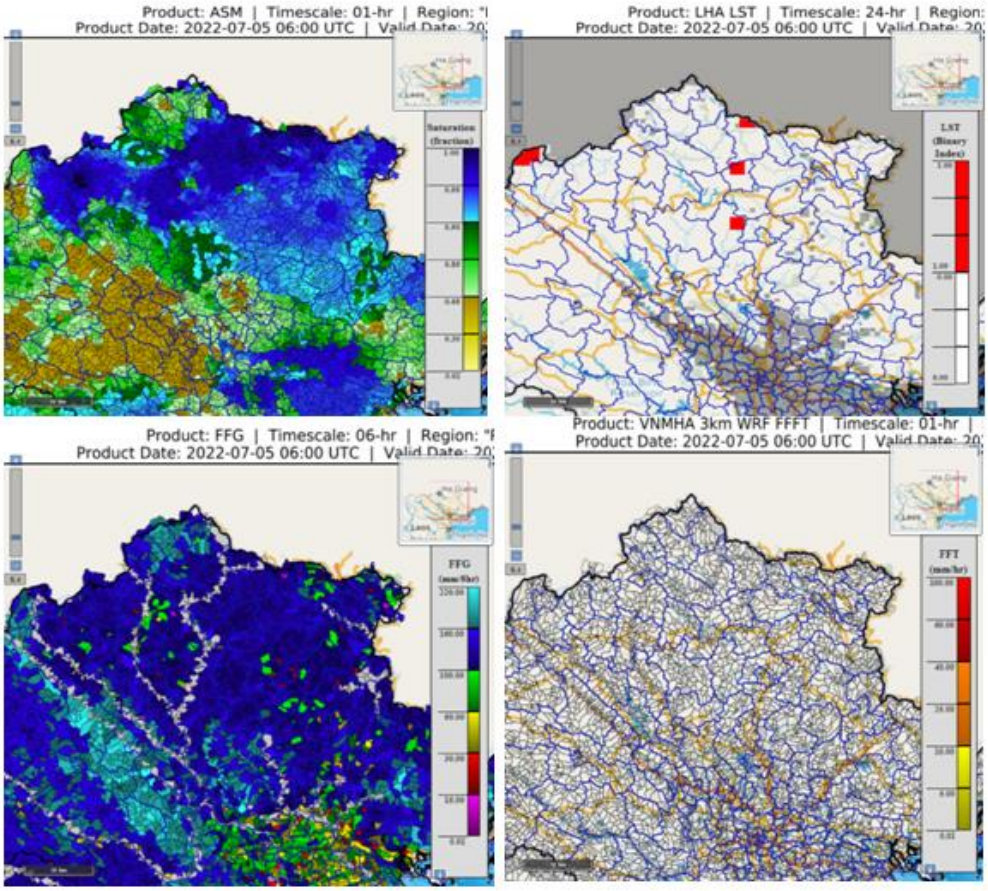

Figure 1.4. SEAFFGS references products including: ASM, FFG, LST, FFFT at 06 UTC 05/07/2022

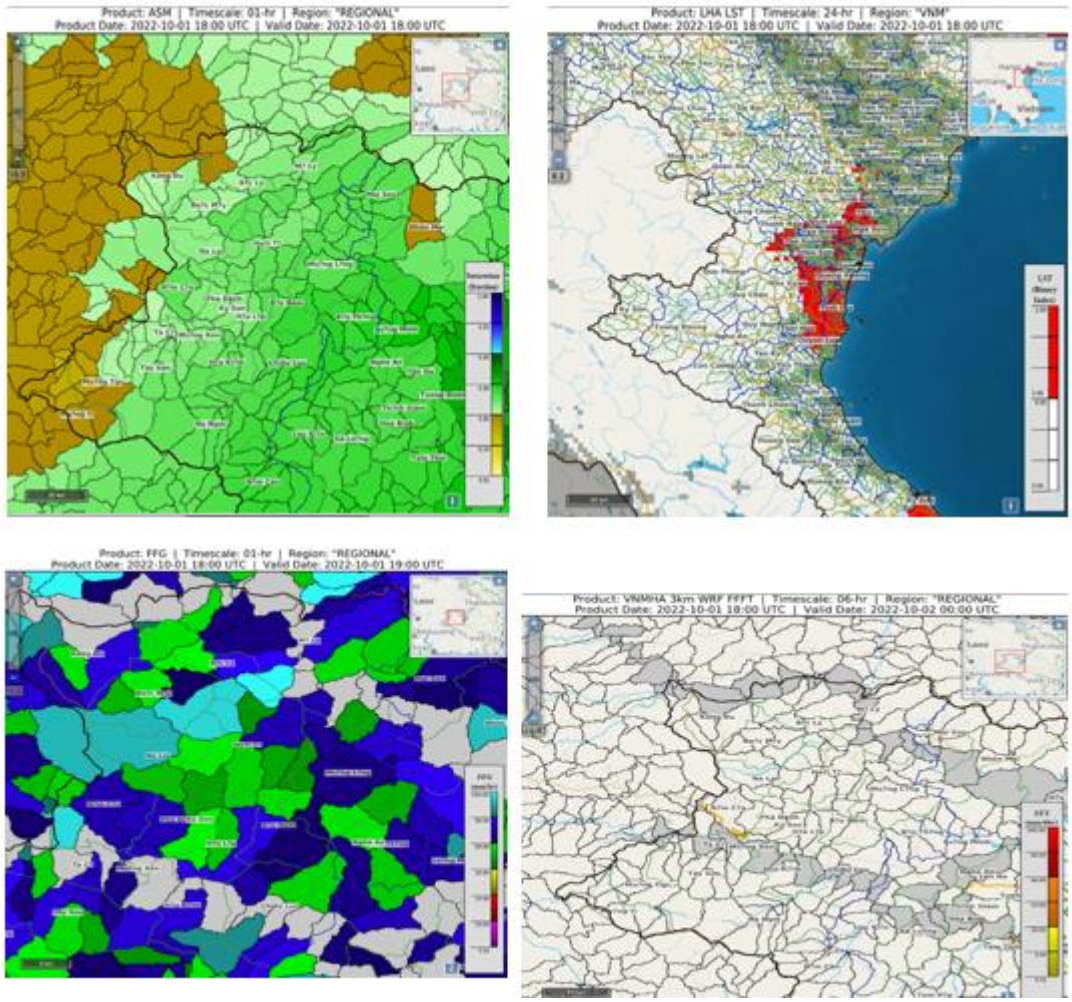

Figure 1.5. SEAFFGS references products including: ASM, FFG, LST, FFFT at 18 UTC 01/10/2022

Figure 1.6. Automatic rainfall data from Vietnam Meteorological nad Hydrological Administration

On the other hand, based on automatic rainfall data collected from VNMHA, it shown that there was almost no rainfall from 10.00 –16.00 (LCT)

of 05th Jul in this area. Therefore, in this case, there was no flash flood and landslide bulletins being issued.

Figure 1.7. Flash Flood occurred at Pac Miau village, Mong An commune, Bao Lam District, Cao Bang province.

Figure 1.8. Flash Flood occurred at Ta Ca commune, Muong Xen town, Ky Son district, Nghe An

In facts, flash flood in Pac Miau village led to 4 missing people and 2 houses were damaged; flash flood happened in Ta Ca commune, Muong Xen town caused 01 missing people, 14 houses swept away, 85 houses under flooding, 19 houses broken, 02 cars swept away, many eroded roads.

During the flood season 2022, there were 8 heavy rainfall periods leading to floods in 23 small tributaries, in which, 6 flood events were recorded the flood peaks higher than the Alarm level (AL) 3 and the remaining flood peaks were recorded around the Alarm level 2. However, in

this year, floodplain are main caused severe damage to the human life, poverties and infrastructures.

As a result of severe upstream flood, water level on the Bui and Tich rivers (small tributaries of the Red river system) in delta area sharply increased, leading to flooding in Chuong My district, Ha Noi. A lot of communes in Chuong My district, Xuan Mai town were under in water, evacuation was implemented in a large area.

Figure 1.9. Floodplain position and overflow through the dyke on Bui river

1.2.2. Severe flooding in the Central of Viet Nam

In the first eight months of 2022, several flood events occured in Central and Highland provinces as Thanh Hoa, Nghe An, Quang Binh to Bình Dinh, in which, flood peaks were recorded from AL 1 to AL2.

At the end of September 2022 (from 27 Sep to 1 Oct), a big flood event occurred in the rivers in the provinces from Nghe An to Quang Ngai. During the Typhoon Noru affected to Central of Viet Nam, floods, flash floods, and landslides occurred in the provinces from Quang Binh to Quang Nam and Kon Tum from September 27-29, 2022. Flood situation on rivers in Quang Nam, Kon Tum upto AL2-AL3 and above AL3; other rivers at AL1-AL2.

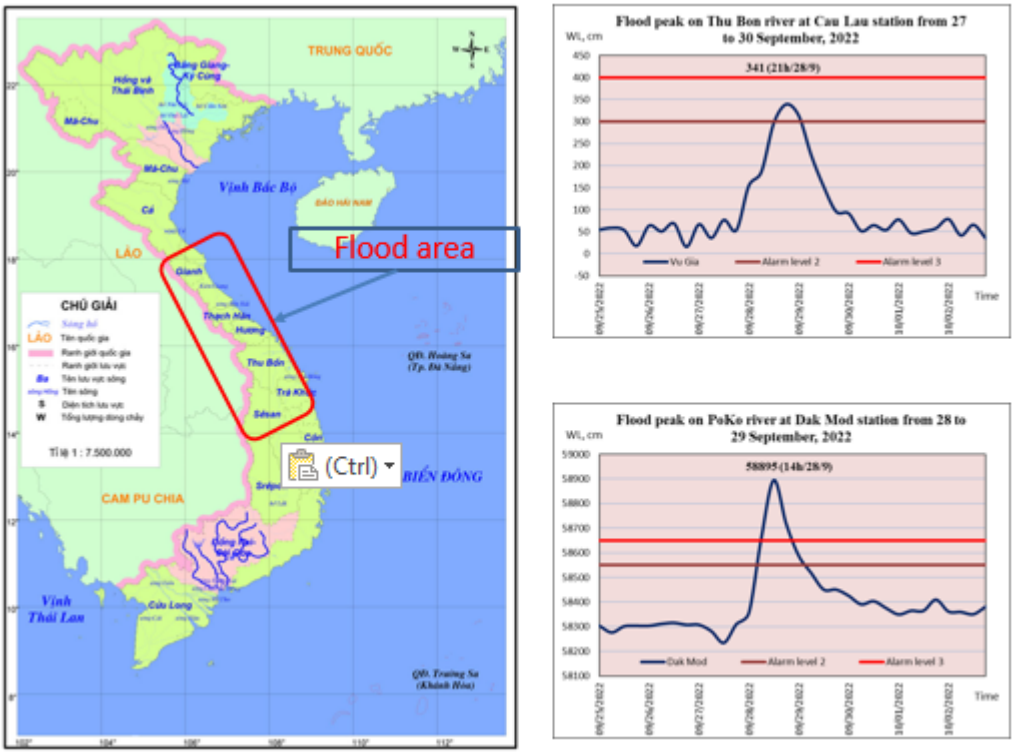

Figure 1.10. Flood stage in the middle Central of Viet Nam

Beside, as a result of TY Noru, heavy rainfall appeared in the North Central region with recording as 250-350mm, in some places over 500mm. Widespread flooding occurred in Nghe An, Ha Tinh. Flood on some large rivers from Thanh Hoa to Ha Tinh provinces (Ngan Pho -Ha Tinh, downstream of the Ca River - Nghe An) up to AL2-AL3; other rivers reached AL1-AL2.

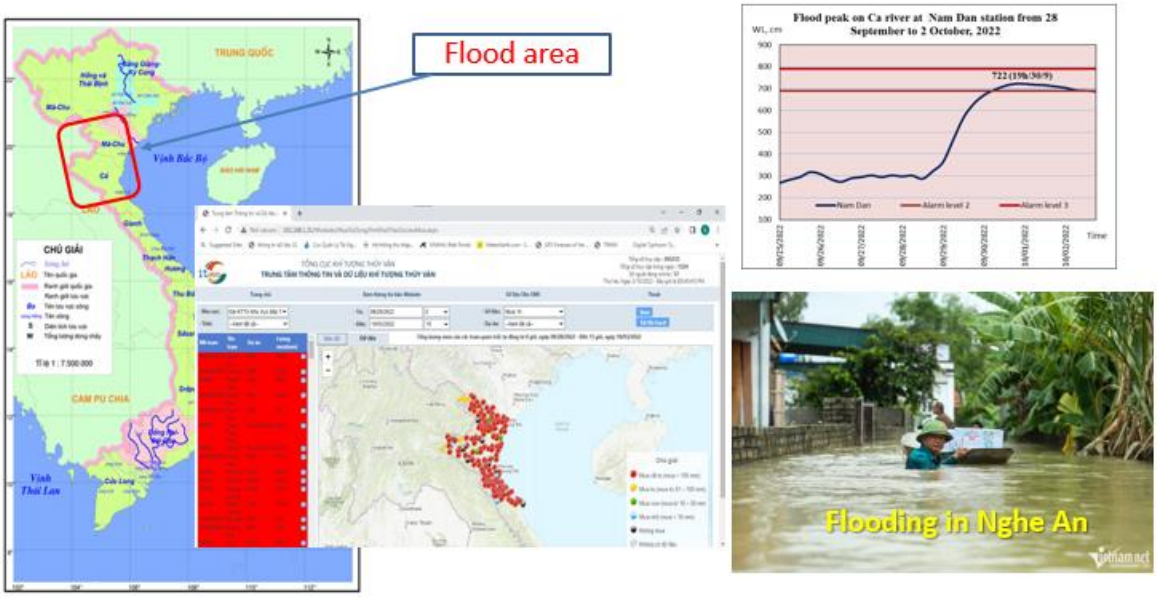

Figure 1.11. Flood stage in the Nghe An, Ha Tinh provinces

Nghe An, Ha Tinh provinces are the places suffering the most severe flooding, landslide illustrated in the Fig. 2.7.

As a result of TY. Noru, a huge damages of human life, losing of houses, crops, poultries, and castles was listed as follow (primary report in 01/10):

- People: 7 deaths (Nghe An);

- Houses: 14033 houses under water (Nghe An: 11969; Ha Tinh:1991; Thanh Hoa: 73);

- Agriculture: 2407 ha rice field & 9028 ha vegetable fields; 3803 ha industrial and perennial crops inundation; 1102 cattles and 154338 poultries died;

- Infractructure: 44 schools affected;

1.3. Damage Assessment

Since the beginning of 2022, there has been 21 types of hazards (out of 22) occurred in Viet Nam, including 04 tropical storms, 01 tropical depression, 185 heavy rains causing floods, 05 flash floods and 81 river bank erosion. There also were 218 earthsquake and 02 extreme cold weather. Till November 2022, natural disasters in Viet Nam caused: 133 dead and missing, 154 people injured; 656 houses completely collapsed, 12,441 houses were damaged, roof blown; more than 500,000 cattles and poultry died and swept away; 240,388 ha of rice, vegetables; 34,579 hectares of crops were damaged; 226m of dikes, embankments, canals and canals are damaged or eroded; 121,642 km of roads were damaged

Estimated economic damage in 2021 due to natural disasters: about 4,229 billion VND, equivalent to 170 million US$.

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

1.4.1 Hanoi Regional Forecasting Support Centre (RFSC) of the Severe Weather Forecasting Project (SWFP)

Since the Regional Subproject Management Team (RSMT) meeting in 2015, there were some training desks has been organized at/by RFSC Ha Noi in May 2018, March 2019. It was online trainings for 2020 and 2021 with topics on IBF. The latest training workshop in March 2022 on severe weather and impact-based forecasting and warning services.

In 2022, RFSC Ha Noi has been updating new interface for the web-portal of the project based on GIS for warning guidance and station forecast products (Fig. 1.12).

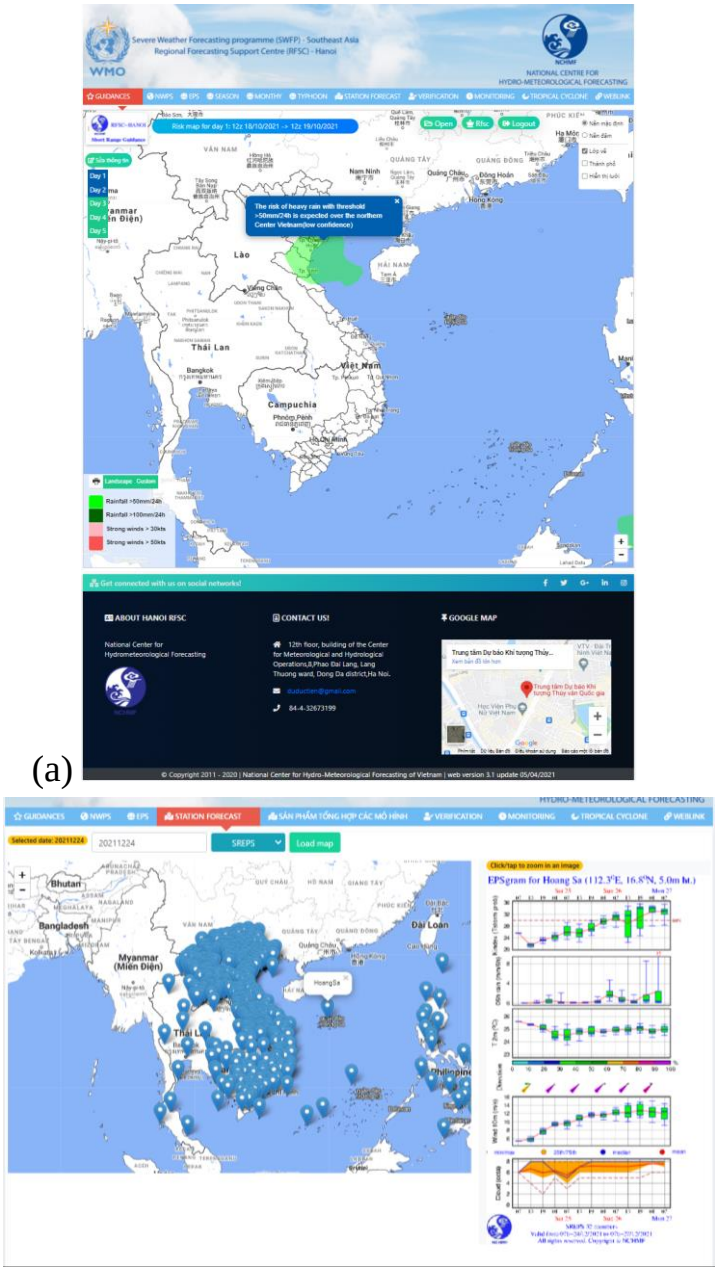

Figure 1.12: New interface of web-portal for sharing products for the WMO Severe Weather Forecasting Programme for Southeast Asia (a: guidance products, b: station forecast products)

1.4.2. Development of Southeast Asian Flash Flood Guidance System (SeAFFGS)

The Southeast Asia component CREWS project has achieved great success when establishing the Flash Flood Guidance System for Southeast Asia, which is part of the Global Flash Flood Guidance System (GFFGS). The Viet Nam Meteorology and Hydrology Administration (VNMHA) is

honored to be chosen place for organizing this Meeting and also being Regional Centre of the SEAFFFGS. From 28 June 2022, the SEAFFGS has been officially launch into operation of flash flood warning for member countries, together with WMO's GFFGS, creating connection and cooperation between SEAFFGS Regional Centers with other FFGS Regional Centers in the world. The SEAFFGS is one of the GFFGS that integrates many types of including satellites, radars, and data from real-time automatic stations and topographic of member countries in order to assist forecasters with effective information for flash floods and landslides warning. To be specific, the SEAFFGS is the first Flash Flood Guidance System using Nowcast Precipitation Product and being integrated many data sources from member countries in the Southeast Asia including: satellites, radars, real time automatic stations, 4 NWP products and historical data… Landslide module also developed and completed for Vietnam.

During the project process, the WMO organized total 7 training courses (in which 3 online training courses organized in 2021) and 4 conferences were organized for 4 countries members including Vietnam, Lao PDR, Thailand and Cambodia.

Figure 1.13. The official launch of the Southeast Asia Flash Flood Guidance System (SeAFFGS) in Ha Noi, Viet Nam on 28 June, 2022.

From 25-29 July 2022, the VNMHA organized a Training on “Exploitation and application of the SeAFFGS in flash floods and landslides warning” for hydrological forecasters in The National Centre for Hydrology-Meteorological Forecasting and 9 Regional Centers. Currently, the NCHMF and 9 Regional Centers have implemented the operational procedure of SEAFFGS in flash flood warning.

1.4.3. Other collaborations

In 2022, VNMHA keeps posting our discussion and questions on tropical cyclone analysis and forecast in RSMC Tokyo forum at https://my.redmine.jp/tc_communication/login. This has been a efficient communication channel for operational TC forecasters in Viet Nam.

In 2021, VNMHA continued to maintain the bilateral cooperation with International Research Institute for Climate and Society (IRI) on developing climate services in Vietnam, including but not limited to building up the National Framework for Climate Service in Vietnam.

Vietnam has also joined The Weather and Climate Science for Service Partnership (WCSSP) Southeast Asia which currently involving four partner countries: the Philippines, Malaysia, Indonesia and Vietnam. This project aims to jointly develop and improve underpinning capability in global and regional forecasting systems, and advance the understanding of high-impact weather events in order to provide better advice and mitigate their socio-economic impacts. This cooperation has been renewed in 2022 and 2023.

- Vietnam has been keeping close coordination with multilateral organizations such as the World Bank, Asian Development Bank, UN agencies, JICA, etc. has been promoted to seek for technical assistances and financial supports as well as high quality human resources of disaster prevention and control.

II. Summary of Progress in Priorities supporting Key Result Areas

2.1. Central Data Hub, HPC and forecast supporting system

Central Data Hub (CDH) is a part of the information integration system that provides the forecasting sub-systems access to all required data sources. The CDH will support and provide each separate forecasting sub-system the access to different data sources such as synoptic manual observation, automatic weather station, automatic rain-gauge, water level and sea level data, radar and satellite data will be also stored in CDH. The CDH and the forecasting sub-systems are independent systems but they are closely linked, with the CDH has a key role in collecting (near) real-time data from all required sources, so latest available data is always available from CDH, and for providing forecast data to the services, provided by VNMHA.

Regarding the issue of providing information to Members through the SWFP's portal of RFSC Hanoi, the Figure 2.1 shows access statistics from

Members including Viet Nam, Laos, the Philippines and Cambodia forecasters in 2021.

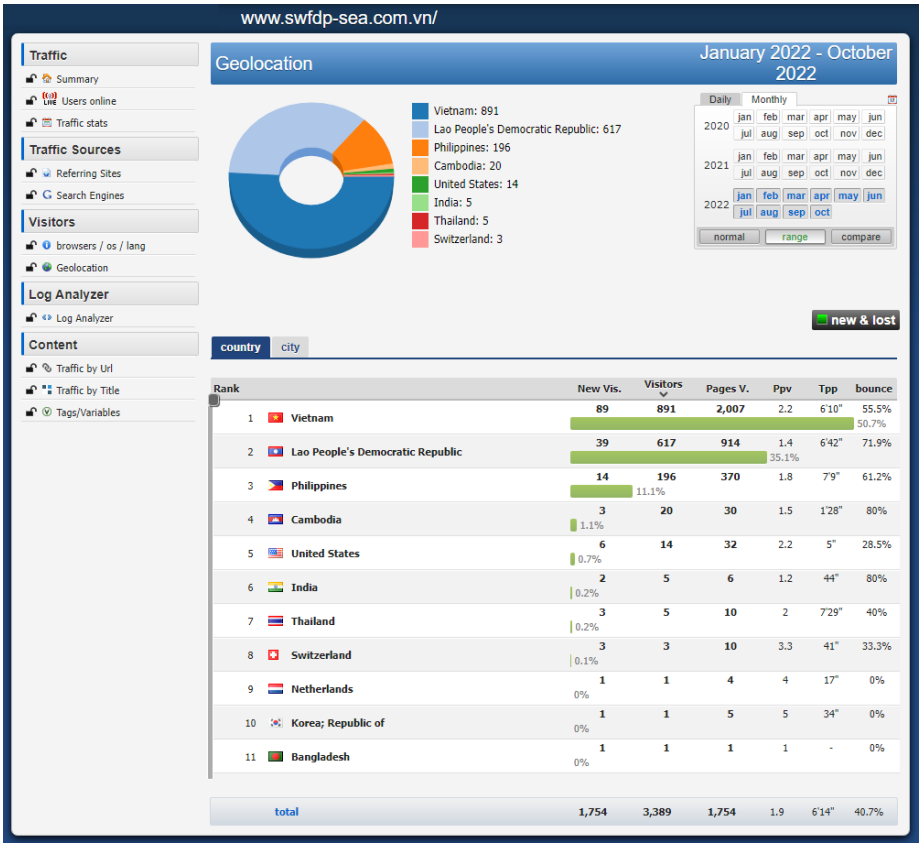

Figure 2.1. The statistics of website swfdp-sea.com.vn from Jan-Oct 2022

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

VNMHA is providing severe weather warning for short-range and medium range everyday and NWPs on SWFDP-SeA website for member countries to use in daily severe weather forecast and warning. Feedbacks and suggestions from members are welcome for a better information design and delivery.

Priority Areas Addressed:

KRA 1: To mitigate against the damaging impacts of typhoons and enhance the beneficial typhoon related effects for the betterment of quality of life through scientific research, technological development and operational enhancement.

KRA 4: To enhance capacity to generate and provide accurate, timely and understandable information on typhoon-related threats

2.2 Impact-based forecast and warning services in Viet Nam

Viet Nam Meteorology, Hydrology Administration (VNMHA) keeps moving toward an impact-based forecast and risk-based warning for meteorological and hydrological phenomena. Since 2017, VNMHA has been changing the way of information design and delivery to the disaster risk management section, local governments and the public through traditional media (TV, printed papers) as well as social media and online papers. The target of impact-based forecast and impact-based warning is to warn the risk of natural hazards for different regions, different users. It requires the VNMHA an extra effort collaborating with other stakeholdes in understanding the possible impacts of severe weather phenomena, especially tropical cyclones.

In late 2019 and 2020, Vietnam received support from WMO Public Weather Services Delivery (PWSD) Programme of the DRR and Public Services Branches to set up a project named Viet Nam Public Weather Service Delivery Project on Impact-based Forecast and Warning (IBFWS) and Communication under sponsor of CREWS-Canada. In this project, UNESCAP and WMO support VNMHA to complete the IBF Manual for Operationalizing Impact-based Forecasting and Warning Services (IBFWS) for Viet Nam with online training session attached. UK Met Office is supporting VNMHA to equip a TV studio and training VNMHA forecasters to use those studio equipments and software to produce weather forecast presenting videos to broadcast on TV national channels and VNMHA’s social media channels.

In 2022, VNMHA has produced so far more than 20 videos of weather and climate forecast to broadcast on facebook fanpages. VNMHA has also cooperatate with National Channel for Disaster Risk and Environment (VTC14) to train our forecasters in presenting the forecast. In summer 2022, VNMHA and VTC14 have broadcasted about 10 live short program for thunderstorm and inundation warning for Hanoi captipal area.

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

VNMHA understands that to have a complete impact-based forecast system, VNMHA need to cooperate with different stakeholders in disaster risk management to have a common agreement on the possible impacts of severe weather in Viet Nam as well as the international cooperation and support with developed countries. With this additional support from WMO,

especially the Public Service Branch, together with previous collaboration of VNMHA and Finland Meteorology Institute (FMI), UK Met Office and other international partners, Viet Nam will soon have an impact-based forecast system in near future. The cooperation projects PROMOSERV3 with FMI and WCSSP with UK Met Office are two ongoing projects that will support Viet Nam in those area. The PROMOSERV3 will provide a toolkit to produce and distribute the impact forecast of meteorological phenomena such as heavy rain, strong wind… and part of WCSSP project will guide VNMHA forecasters and staffs on how to build an impact matrix and step by step to get an impact-based forecast system.

Priority Areas Addressed:

KRA 1: To mitigate against the damaging impacts of typhoons and enhance the beneficial typhoon related effects for the betterment of quality of life through scientific research, technological development and operational enhancement.

KRA 2: To strengthen typhoon related disaster risk management in various sectors, including hydrological and aviation sectors, through strategic partnerships and collaboration.

KRA 3: To strengthen the resilience of communities to extreme weather and typhoon related disasters through the intelligent use of data, information and communication technology.

KRA 4: To enhance capacity to generate and provide accurate, timely and understandable information on typhoon-related threats

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2.3 Short-range Regional Ensemble Prediction System (SREP-32)

With the new HPC system (CrayXC40) at VNMHA, since 2019, the regional NWP products have been significantly upgraded, especially of very high resolution of deterministic forecast (3km, Southeast Asia domain) with boundary conditions (from ECMWF) and the regional ensemble forecast was also upgraded by using the Weather Research and Forecasting Model with Advanced Research with ARW dynamical core (WRF-ARW) with various physical model configurations (generated from different typical cumulus, shortwave radiation, boundary layer and from simple to complex cloud micro-physic schemes).

VNMHA has been applying the data assimilation for WRF-ARW at 3km horizontal resolution using almost quality controlled observation data from NCEP and Vietnam's local observation since 2020. This new data assimilation products, named as WRF3km-IFS-DA, has been sharing via SWFP for SeA portal for all members of the project.

The current ensemble products are shared on Hanoi SWFP web portal which is swfdp-sea.com.vn. Those products include (but not limited to) the following parameters:

- Rainfall probability for different thresholds (5, 20, 50, 100mm/day)
- Strong wind probability
- Meteogram for city forecast for many locations suggested by member contries.

An example of high resolution products for improving short range forecast of heavy rain over the northern Vietnam is shown in Figure 2.2.

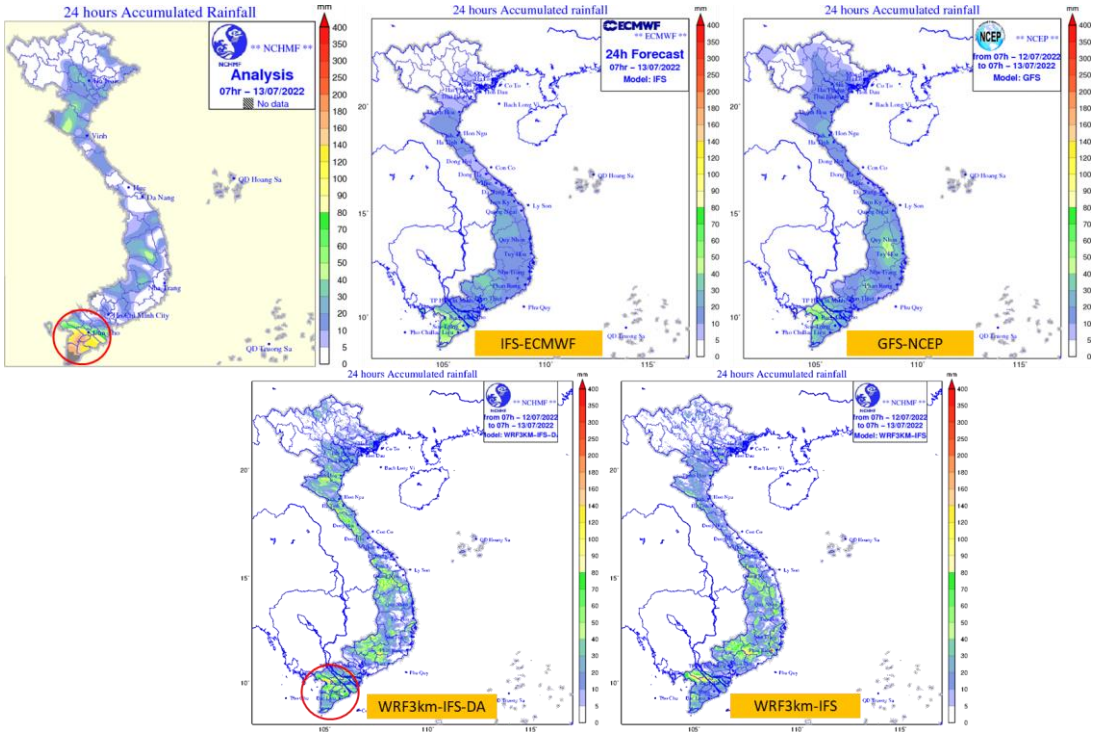

Figure 2.2. Comparison of observations (top-left from Vietnam's observation) and models: IFS-ECMWF, GFS-NCEP, WRF3km-IFS and new data assimilation product WRF3km-IFS-DA for heavy rainfall over the southern Vietnam on 13-Jul-2022.

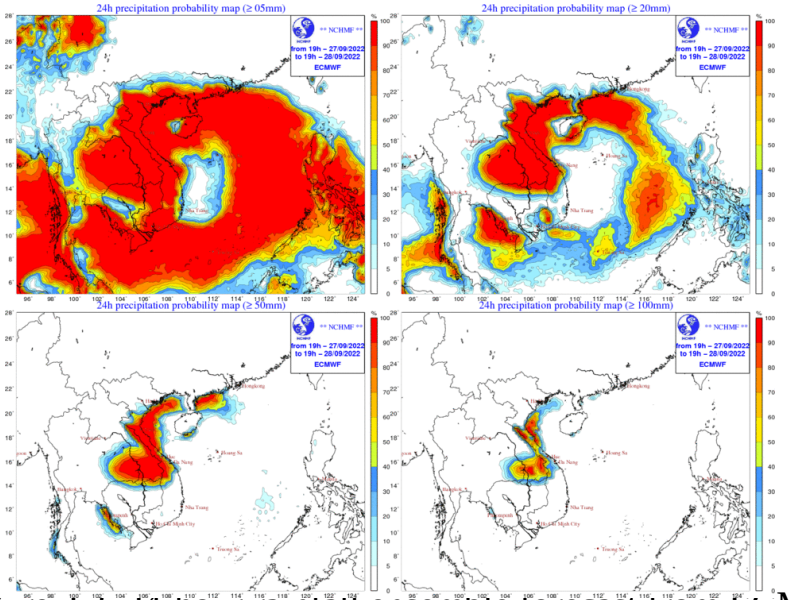

Figure 2.3. 24-hour rainfall ensemble forecast from ECMWF (51 members) at 12 UTC (19 LT) of 28 September 2022

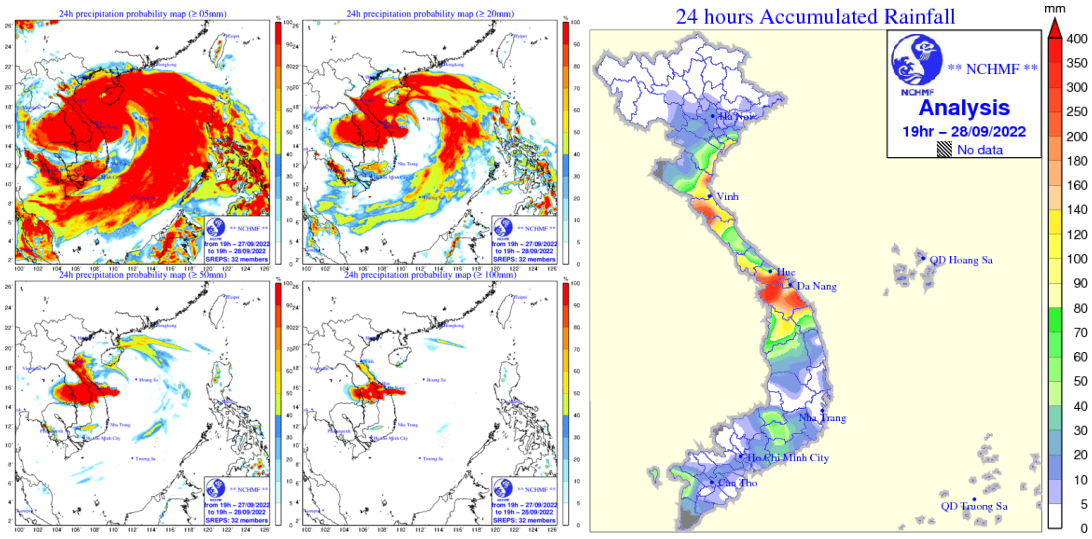

Figure 2.4. 24-hour rainfall ensemble forecast from SREPS-32 (left) and observation (right) at 12UTC (19 LT) of 28 September 2022

Regarding the regional ensemble system, the resolution of 32 ensemble members is 9km and using GFS-NCEP as boundary conditions. Figure 2.3 to 2.5 are examples of 32-member SREPS and ECMWF's ensemble forecast for a heavy rainfall case in 2022 with probability map products at different thresholds.

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

VNMHA is providing high resolution NWPs (WRF3kmIFS, WRF3kmIFS-DA) and the regional ensemble SREPS-32 products on

SWFDP-SeA website for Member countries to use in daily severe weather forecast and warning. Feedbacks and suggestions from Members are welcome for a better information design and delivery.

Priority Areas Addressed:

KRA 1: To mitigate against the damaging impacts of typhoons and enhance the beneficial typhoon related effects for the betterment of quality of life through scientific research, technological development and operational enhancement.

KRA 4: To enhance capacity to generate and provide accurate, timely and understandable information on typhoon-related threats

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