MEMBER REPORT

ESCAP/WMO Typhoon Committee
8th IWS/2nd TRCG Forum

2 - 6 December 2013
Macao, China

(SOCIALIST REPUBLIC OF VIET NAM)

CONTENTS

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

1. Meteorological assessment

In 2013, 17 tropical cyclones (TCs) of tropical depression (TD) intensity and tropical storm (TS) intensity had activated on Biendong Sea as the end of October. Vietnam was affected by 7 of these, with 6 making landfall. The details of these 7 TCs are described below, and their tracks are shown in Figure 1.

1.1. Tropical Storm Bebinca (1305)

Bebinca was upgraded to tropical storm (TS) intensity north east of Paracel Islands early morning on 21 June. After moving west-northwestward the next day, it passed through Hainan Island on evening of 22 June. After moving over the Gulf of Tonkin, Bebinca made landfall on June 23 east of Hanoi. A peak gust of 26m/s was recorded at Hondau (48828). A biggest amount of precipitation during time of tropical storm Bebinca was 208mm at Ninhbinh station (48824). One person was killed and two others missing due to flood in Nghean Province.

1.2. Super Tropical Storm Rumbia (1306)

Rumbia had entered Biendong Sea in the morning on 30 June. Over open waters of Biendong Sea, Rumbia resumed strengthening, and reached its peak intensity with winds of 95 km/h (50 mph) on July 1. It weakened slightly before moving ashore the Leizhou Peninsula late that day. After making landfall, Rumbia quickly weakened into a low pressure area on July 2 and eventually dissipated soon afterwards. Although did not make landfall in Vietnam but Bebinca brought heavy rains for almost mountainous areas of Vietnam. A biggest amount of precipitation total was 255mm which recorded at HaGiang station (48805).

1.3. Typhoon Jebi (1309)

Jebi was upgraded to Tropical storm (TS) intensity about 300km south-east of Paracel Island in the morning of 31 July. After drifting westwards, Jebi turned to move north-northwestward then entered Gulf of Tonkin on late night of 2 August. Tropical storm Jebi weakened as it made landfall northeastern Vietnam Saturday morning on 3 August. A peak gust of 30 m/s was recorded at QuangHa (48/50), and accumulated precipitation total during the time of Jebi over northeast part of Vietnam was 212mm which was recorded at Tamdao (48/52). A central pressure

value of 981mb was also recorded at 0230Z in TienYen (48837). Four persons were killed due to the flashflood, 5 others were injured by strong wind.

1.4. Typhoon Mangkhut (1310)

Mangkhut was upgraded to Tropical storm (TS) intensity about 250km south-east of Paracel Island in the morning of 6 August. After forming, Mangkhut moved quickly north-westward then entered Gulf of Tonkin in the morning of 7 August. Tropical storm Mangkhut weakened as it made landfall over Thanhhoa Province and Red river delta late evening on 7 August. A peak gust of 30 m/s was recorded at NamDinh (48823), and accumulated precipitation total during the time of Mangkhut over Southeast part of Vietnam was 336mm which was recorded at KyAnh (48/86). A central pressure value of 992.2mb was also recorded at 1520Z in ThanhHoa city (48840). Four persons were killed, 2 missing and 3 others were injured due to the impact of Mangkhut.

1.5. Tropical Storm Noname (1318)

NHMS of Viet Nam had upgraded a tropical depression to tropical storm (TS) intensity when the TD was over 150km south-east of Paracel Islands in the morning of 17 September. The TS Noname moved westward then weakened as tropical depression before making landfall in Danang city on late night 18 September. A peak gust of 24 m/s was recorded at Honngu Island (48/81), and accumulated precipitation total during the time of TS Noname over Middle part of Vietnam was 456mm which was recorded at Aluoi (48/91). A central pressure value of 995.3mb was also recorded at 1500Z in Danang city (48855). 24 persons were killed, 6 missing and 6 others were injured due to impact of TS Noname.

1.6. Typhoon Wutip (1321)

Wutip was upgraded to Tropical storm (TS) intensity about 500km east-southeast of Paracel Island in the morning of 27 September. After becoming a Tropical storm, Wutip moved north-westward then turned to West only from 00Z on 28 September. Wutip made landfall in late evening of 30 September in Quangbinh Province. A peak gust of 44 m/s was recorded at Badon (48847), and accumulated precipitation total during the time of Wutip over Middle part of Vietnam was 328mm which was recorded at Tayhieu (48/76). A central pressure value of 969.2mb was also recorded at 0930Z in Donghoi (48848). Eight persons were killed, 2 missing and 199 others were injured due to the impact of Wutip.

1.7. Typhoon Nari (1325)

Nari had entered East Sea in the early morning of 12 October. After that Nari moved almost westward then finally made landfall in QuangNam province early morning on 15 October. A peak gust of 31 m/s was recorded at Lyson Island (48/85), and accumulated precipitation total during the time of Wutip over Middle part of Vietnam was 433mm which was recorded at Huongkhe (48/83). A central pressure value of 980.3 mb was also recorded at 2100Z in Tamky (48/93). Three persons were killed, 2 missing and 49 others were injured due to the impact of Wutip.

1.8. Typhoon HaiYan (1330)

Super Typhoon Haiyan had entered East Sea in the evening of 8 November. After that Haiyan moved almost west-northwestward about 30 - 35 km/h. At noon on November 9, Haiyan turned to moved northwestward then continued to turn to move north-northwestward, which along the middle coastal areas of VietNam. HaiYan finally made landfall in Quangninh Province early morning on November 11. A peak gust of 41 m/s was recorded at Coto Island (48/834), and accumulated precipitation total was 461mm which was recorded at Mauson (48/86). A central pressure value of 973.8 mb was also recorded at 1830Z in BachLongvi (48839). Ten persons died in preparation for Haiyan, no one was killed when Haiyan made landfall, 4 missing and 84 others were injured due to the impact of Haiyan.

Fig.1: Best Tracks of the seven TCs that affected Vietnam in 2013

2. Hydrological Assessment

The report present flood situation during the period of the beginning of January and the mid of November with the different flood situations along Viet Nam form the North to the South. Untill the report making time, flood season in the North almost finished and has been switching to dry season while flood stituations is stillongoing in the Central , Central highland area and the South of Viet Nam. Following statistic counted until 15 November 2013, the number of Typhoon (TY) and Tropical Storm (TS) appearances in the South China Sea were 14 in which 8 of them directly made landfall in Viet Nam and mostly influenced to the Northern part, the Central and Highland areas as major result of intensive rainfall as well as high or medium flood events.

2.1. Flood situations by Tropical cyclone in the North

The 2013 flood season in Northern part started a bit later than previous flood years. The first flood event (Tieu Man flood or early flood) in Red-Thai Binh river systems occurred in the end of May, from 24 to 30 (2-8 days later than the long-term average) with the amplitudes of 2-7m. Figure 2 illustrate 2 main river sytems in the North detailed as below:

- The Red river including Da, Thao, Lo rivers and the downstream of the Red river;
- The Thai Binh in cluding Cau, Thuong, Luc Nam and the downstream of Thai Binh river.

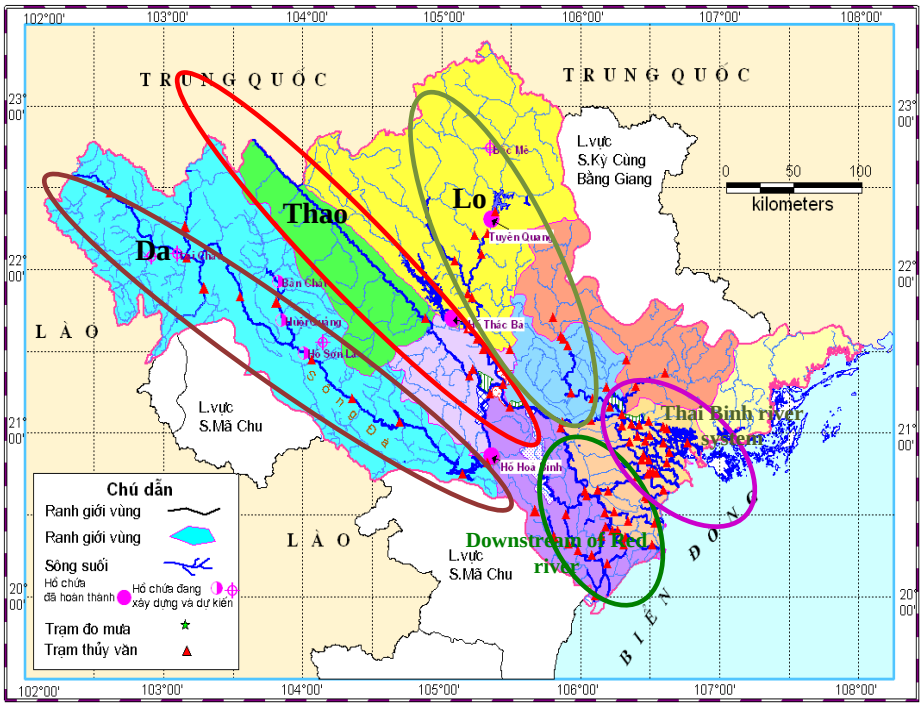
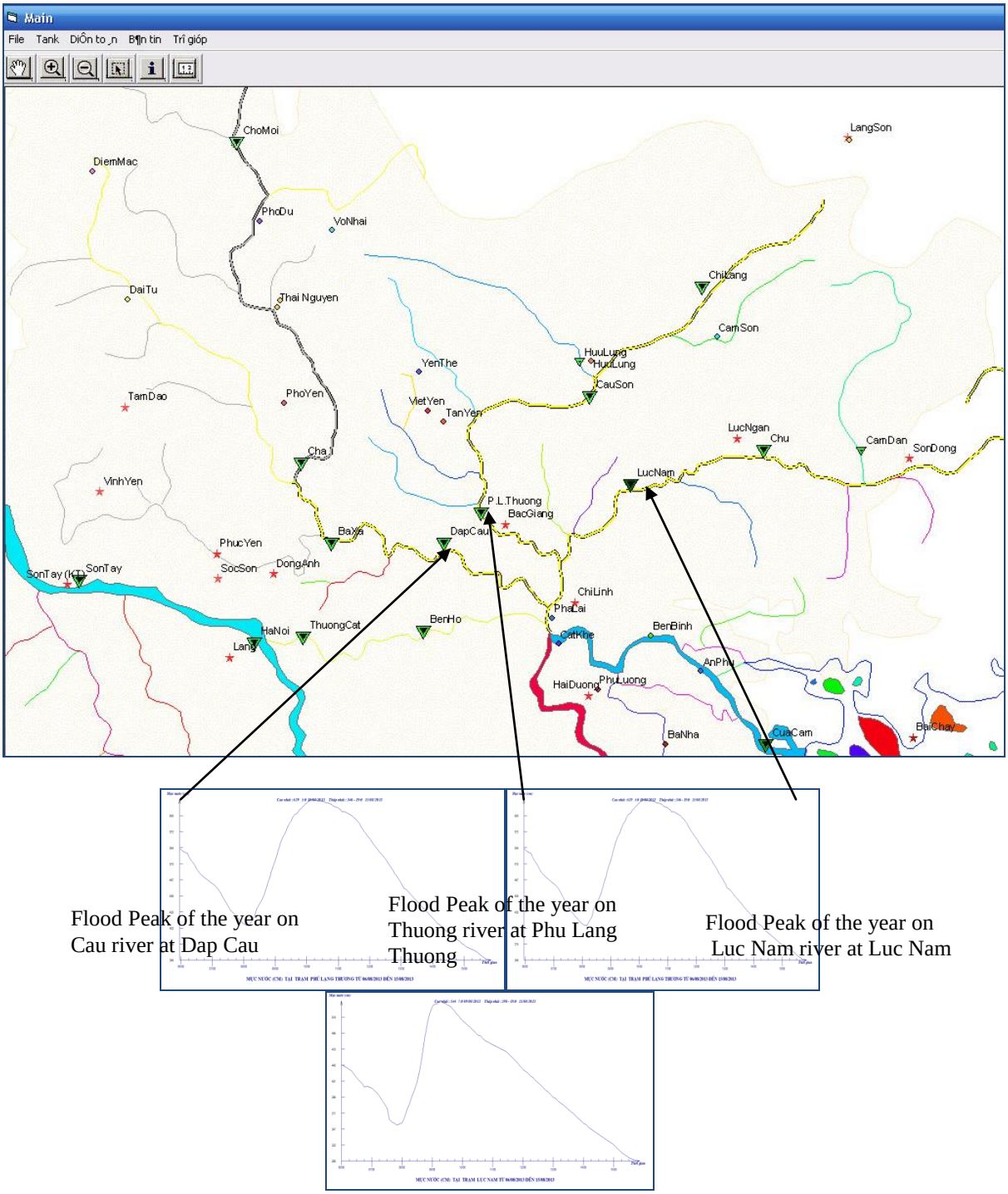


Fig. 2: River system in the North of Viet Nam

Three TS directly landed over the Northern part are TS No.2 (Bebinca - 1305), TS No.5 (Jebi -1309), TS No.6 (Mangkhut – 1310) and TS No.14 (Haiyan-1330) in which flood peak of the year was observed in the end of July and in the fisrt half of August at almost main stations of the Thai Binh river system during the appearance of TS No. 5 and No. 6.



Flood Peak of the year on Cau river at Dap Cau

Flood Peak of the year on Thuong river at Phu Lang Thuong

Flood Peak of the year on Luc Nam river at Luc Nam

Figure 3: Flood peaks of the year on rivers: Cau at Dap Cau, Thuong river at Phu Lang Thuong and Luc Nam at Luc Nam

Table 1 and 2 summerized information of flood charateristics in the Red and Thai Binh river system during the end of July and the first half of August when the appearance time of 2 those TSs. Figure 2 shows the flood peaks of the year on the main rivers Cau, Thuong and Luc Nam belong Thai Binh river system as a result of TS No.6 influence.

Table 1. The charateristics of flood events for main stations in the Red-Thai Binh rivers system when TS No.5 appearance.

No	Station	River	Peak of flood event(m)	Appearance time of flood peak	Flood Amplitude (m)	Alarm Level (m)
1	Phu Lang Thuong	Thuong	5.83	1a.m 05-Aug-13	258	> AL2: 0.53m
2	Đap Cau	Cau	5.77	23p.m 05-Aug-13	2.24	> AL2: 0.47m
3	Luc Nam	Luc Nam	5.62	3a.m 04-Aug-13	2.73	> AL.2: 0.32m
4	Pha Lai	Thai Binh	4.29	1a.m 05-Aug-13	1.54	> AL.1: 0.29m
5	Yen Bai	Thao	30.68	22p.m 04-Aug-13	2.22	<AL.2: 0.32m

Table 2. The charateristics of flood events for main stations in the Red-Thai Binh rivers system when TS No.6 appearance.

No	Station	River	Peak of flood event(m)	Appearance time of flood peak	Flood Amplitude (m)	Alarm Level (m)
1	Phu Lang Thuong	Thuong	6.29	5a.m 10-Aug-13	2.06	~ AL.3
2	Đap Cau	Cau	6.42	15p.m 10-Aug-13	1.88	> AL.3: 0.12m
3	Luc Nam	Luc Nam	5.44	7a.m 09-Aug-13	1.88	> AL.2: 0.14m
4	Pha Lai	Thai Binh	4.38	7a.m 10-	0.95	> AL.1:

No	Station	River	Peak of flood event(m)	Appearance time of flood peak	Flood Amplitude (m)	Alarm Level (m)
				Aug-13		0.38m
5	Yen Bai	Thao	31.03	12a.m 9-Aug-13	1.73	> AL.2: 0.03m
6	Hung Thi	Boi	12.85	9a.m 9-Aug-13	5.41	> AL.3: 0.85m
7	Ben De	Hoang Long	3.71	17p.m 9-Aug-13	1.71	> AL.2: 0.21m

The inflows of reservoir systems in Da, Lo and Gam rivers sharply increased at the beginning of August, table 3 presente rapidly rising of inflows to Son La and Tuyen Quang reservoirs in the Da and Lo rivers.

Table 3. The quick increasing of reservoir inflow in the Da and Lo river

No	Reservoir	River	Beginning of flood event		Peak of flood event		Flood Amplitude
			Time	Q (m^3/s)	Time	Q (m^3/s)	(m^3/s)
1	Son La	Da	7a.m 3-Aug-13	3000	17p.m 4-Aug-13	6320	**3320**
2	Tuyen Quang	Lo	13p.m 3-Aug-13	650	7a.m 5-Aug-13	1450	**800**

2.2. Flood situations by Tropical cyclone in the Central and Highland area

From the beginning of the year to the mid of November, around 5 to 6 TYs anf TSs affected to provinces of the Central and Cetral highland of Viet Nam with different levels. Among of these, TSs No. 8, TS No.10 (Wutip-1321) and No.11 (NARI-1325) caused intensive rainfall stretching from provinces of Northern, Central and Southern parts of Central of Viet Nam and Highland area and resulted severe flood on rivers along of those areas. The flood situation during 3 these TSs is detailed as below.

Tropical Storm No. 8 (1318), which was formed in the South China Sea on 12th September, caused heavy rain in provinces of Northern part, coastal provinces from the North to Centre of Central of Viet Nam and especially in Northern part of

Highland area. Medium to high flood occurred on rivers from Quang Binh to Quang Ngai and Northern part of Highland provinces from the 18th to the 20th September and on rivers from Nghe An to Quang Binh and Kontum provinces from the 20th to 23rd September. Flood peaks at many main stations were recorded the levels that are around or above AL.2, in which some of flood peaks reached AL.3. The summary of flood stituation during TS No.8 occurrence is shown in table 4.

Tropical Storm No.10 (WUTIP) made landfall over Ha Tinh – Quang Binh provinces in the Central of Viet Nam on the 30th September. As a result of the TS and TS's circulation together with an appearence of cold air mass, small to medium flood were observed during the 30th September and the 4th October on rivers in provinces from North to South of Central and the North of Highland. Table 5 presents flood stituation at main stations on the main rivers in Central and Highland area when TS No.10 appearance and figure 3 illustrates a flood peak at Auynpa was recording that is above AL.3.

Table 4. The summary of flood situation at main stations in rivers of Central and Highland area when TS No.8 appearance.

No	Station	River	Peak of flood (m)	Appearance time of flood peak	Alarm Level (m)	Remarks
1	Mai Hoa	Gianh	5.05	8a.m 20-Sep-13	> AL.2: 0.05m	From 18-20 Sep
2	Le Thuy	Kien Giang	2.37	13p.m 18-Sep-13	> AL.2: 0.17m	
3	Thach Han	Thach Han	5.18	10a.m 19-Sep-13	< AL.3: 0.32m	
4	Kim Long	Huong	1.6	1a.m 19-Sep-13	< AL.2: 0.4m	
5	Ai Nghia	Vu Gia	9.16	5a.m 19-Sep-13	> AL.3: 0.16m	
6	Cau Lau	Thu Bon	2.55	11a.m 19-Sep-13	< AL.2: 0.45m	
7	Tra Khuc	Tra Khuc	3.84	19p.m 18-Sep-13	> AL.1: 0.34m	
8	Kontum	Dak Bla	518.81	13p.m 18-Sep-13	> AL.1: 0.81m	
9	Nam Dan	Ca	7.38	22p.m 22-Sep-13	> AL.2: 0.48m	From 20-23 Sep
10	Linh Cam	La	4.26	8a.m 22-Sep-13	< AL.1: 0.24m	
11	Hoa Duyet	Ngan Sau	8.34	7a.m 21-Sep-13	< AL.2: 0.66m	
12	Le Thuy	Kien Giang	2.33	8a.m 20-Sep-13	> AL.2: 0.13m	
13	DakMod	Po Ko	586.4	10a.m 23-Sep-13	< AL.3: 0.1m	
14	Konplong	Dak Bla	594.04	10a.m 23-Sep-13	< AL.3: 0.46m	

No	Station	River	Peak of flood (m)	Appearance time of flood peak	Alarm Level (m)	Remarks
15	Kontum		519.79	14p.m 23-Sep-13	> AL.2: 0.29m	

Table 5 . The summary of flood situation at main stations in rivers of Central and Highland area when TS No.10 appearance.

No	Station	River	Peak of flood (m)	Appearance time of flood peak	Alarm Level (m)	Remarks
1	Mai Hoa	Gianh	5.64	1a.m 01-Oct-13	> AL.2: 0.64m	TS No10
2	Le Thuy	Kien Giang	1.8	1a.m 01-Oct-13	< AL.2: 0.4m	
3	Nam Dan	Ca	6.48	5a.m 04-Oct-13	< AL.2: 0.42m	
4	Linh Cam	La	3.87	7a.m 04-Oct-13	< AL.1: 0.63m	
5	Tra Khuc	Tra Khuc	4.3	13p.m 04-Oct-13	< AL.2: 0.7m	
6	Auynpa	Ba	157.05	21p.m 03-Oct-13	> AL.3: 1.05m	
7	Cung Son		33.04	13p.m 04-Oct-13	> AL.2: 1.04m	
8	Phu Lam		2.94	21p.m 04-Oct-13	> AL.2: 0.25m	
9	Kontum	Dak Bla	518.03	9a.m 03-Oct-13	> AL.1: 0.03m	

Tropical Storm No.11 (NARI) directly influenced to Viet Nam from 14 Oct to 16 Oct, 2013. During 15 – 16 Oct, medium to high flood were observed on rivers in Central provinces from Nghe An to Quang Nam and Kontum with high amplitude. Some main stations were recording the water levels that are around or above AL.3. A summary of flood stituation and illutration of high flood peaks are presented in table 6 and figures of 4 – 6.

Table 6 . The summary of flood situation at main stations in rivers of Central and Highland area when TS No.11 appearance.

No	Station	River	Peak of flood (m)	Appearance time of flood peak	Alarm Level (m)	Remarks
1	Nam Dan	Ca	6.72	24a.m 17-Oct-13	< AL.2: 0.18m	TS No

2	Chu Le	Ngan Sau	14.42	19p.m 16-Oct-13	> AL.3: 0.92m	11
3	Son Diem	Ngan Pho	14.62	17p.m 16-Oct-13	> AL.3: 1.62m	
4	Linh Cam	La	5.74	16p.m 17-Oct-13	> AL.2: 0.24m	
3	Mai Hoa	Gianh	7.93	17p.m 16-Oct-13	> AL.3: 1.43m	
4	Le Thuy	Kien Giang	2.15	4a.m 16-Oct-13	~ AL.2	
5	Thach Han	Thach Han	5.08	23p.m 15-Oct-13	< AL.3: 0.42m	
6	Phu Oc	Bo	4.38	10a.m 15-Oct-13	< AL.3: 0.12m	
7	Kim Long	Huong	2.71	10a.m 15-Oct-13	> AL.2: 0.71m	
8	Ai Nghia	Vu Gia	9.28	18p.m 15-Oct-13	> AL.3: 0.28m	
9	Cau Lau	Thu Bon	3.2	24a.m 15-Oct-13	> AL.2: 0.2m	
10	Kontum	Dak Bla	520.45	18p.m 15-Oct-13	~ AL.3	

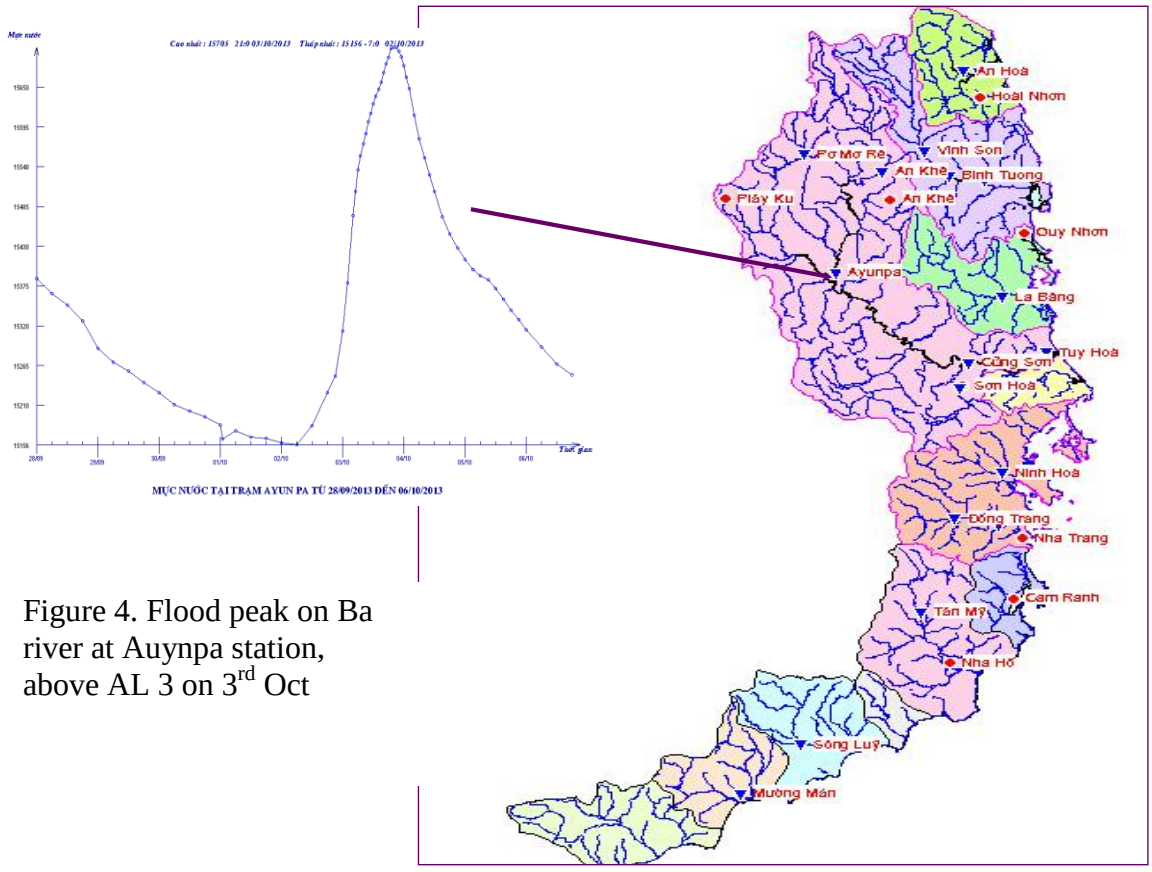


Figure 4. Flood peak on Ba river at Auynpa station, above AL 3 on 3rd Oct

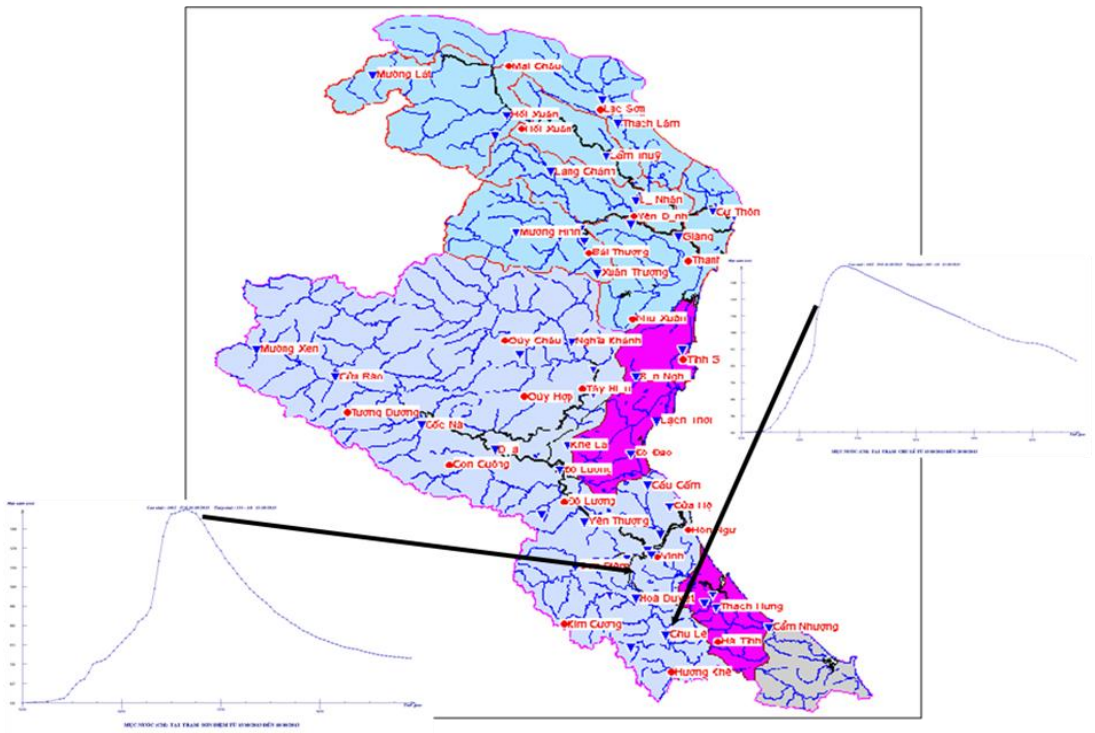


Figure 5. Flood peaks on rivers in Northern part of Central Viet Nam: Ngan Sau at Chu Le; Ngan Pho at Son Diem, above AL 3 on 16th Oct

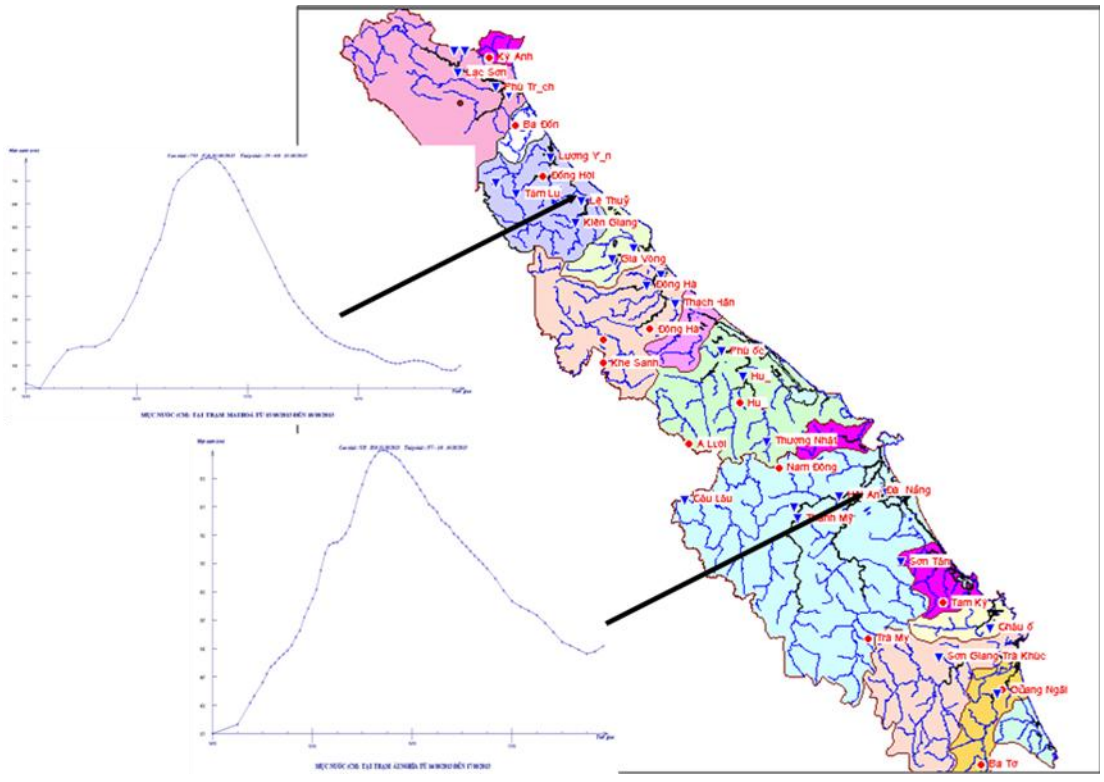


Figure 6. Flood peaks on rivers in Centre part of Central Viet Nam: Vu Gia at Ai Nghia; Giang at Mai Hoa, above AL 3 on 15th and 16th Oct

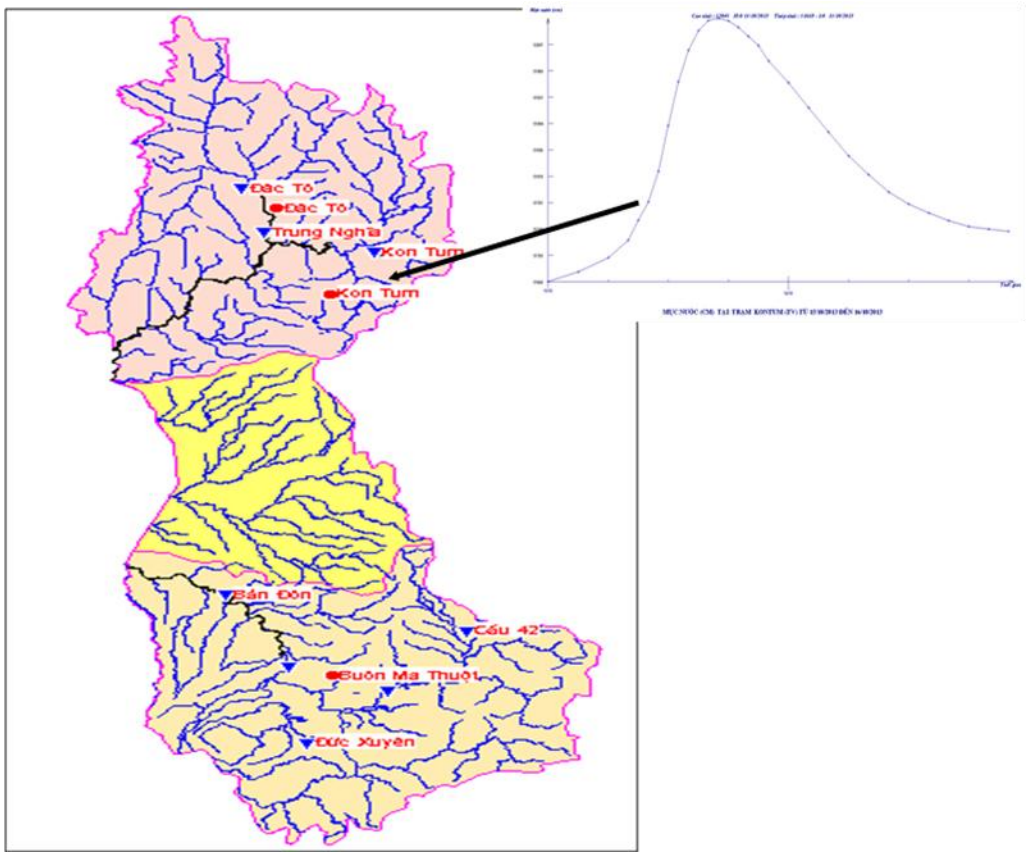


Figure 7. Flood peak on river Dak Bla at Kontum in Highland area around AL 3 on 15th Oct

3. Socio-Economic Assessment

3.1. Damage Situation in 2013

From the begining of this year until now, there had been 264 dead and missing people; 800 injured ones; 11,851 collapesed and drifted houses, 706,786 houses were flooded, damaged and unroofed, 122,449 hectares of rice were damaged; 206,172 ha of crops were damaged; 86,491 ha of industrial crops and fruit fields were damaged; 105,058 ha of aquatic products lost; 17,379 million m3 of soil, stone and roads tumbled down. Estimated total value of material damage was about 25,021 billion (in the storm number 15, the damage statistic only synthesized dead or missing people, the other types of damages are being intergrated by other localities and will be reported later) (detailed appendices are attached).

3.2. Damage Situation in 2012

In year 2012, there were 10 hurricanes and 02 tropical depression operating in the South China Sea; there were 11 earthquakes of magnitude 3.3 to 4.7 degrees and there were several thunderstorms and tornadoes with hails.

These natural calamities have created 258 dead and missing people, 408 injured ones, 6,292 collapesed and drifted houses; 101,756 houses were flooded, damaged and unroofed, 408 383 hectares of rice crops were damaged; 3240,069 m3 of of soil, stone and roads tumbled down Estimated total value of material damage was about 16,000 billion (Prime Minister had decided to support the local areas, departments and ministries affected by natural calamities to hunger relief and overcome consequences with a total amount of: 1445.8 billion VND and 6,500 tons of rice).

3.3. Damage Situation in 2011

In year 2011, there were 7 hurricanes and 07 tropical depression operating in the South China Sea, more rains, floods in the central region , the Central Highlands and the Mekong Delta, there are over 70 thunderstorms, tornadoes associated with hail in many provinces in the country. Also there were some earthquakes in Cao Bang province, Son La province.... but with lower intensity, they did not create much damage. These natural calamities have created 295 dead and missing people, 274 injured ones, 2170 collapesed and drifted houses; 447,694 houses were flooded, damaged and unroofed, 350,367 hectares of rice crops were damaged; 9689.559 m3 of of soil, stone and roads tumbled down Estimated total value of material damage was about 12703 billion (Prime Minister had decided to support the local areas, departments and ministries affected by natural calamities to hunger relief and overcome consequences with a total amount of: 1922 billion VND and 11600 tons of rice).

3.4. Remedial work from the beginning of the year to mid-November 2013

The Prime Minister had decided to support the local people to relief hunger, recover disaster, provide plant and seed varieties and animal breeds with total budget of 1159.1 billion dong and 9,786 tons of rice. The localities have proactively used local reserved budget to handle the urgent need of the people. The Ministry has also used funds to support local direct management infrastructure such as electric power, communication, transportation, schools, health care center. Central Committee of the Vietnam Fatherland Front organization called for the support of the community and distributed support to localities where experienced serious damage.

Regarding agriculture, forestry and fisheries: many localities were lack of sample seed crop to recover production in time (winter season). Some provinces have large areas of broken down rubber trees many need support to recover.

Recently, a number of irrigation reservoirs, hydropower has to open floodgates, which has caused flooding in downstream areas. This has created

pressing in the public community. When heavy rainfall exceeds the capacity of water storage, the opening of floodgates is unavoidable. However, in order to avoid possible damage, we need to build warning system and regulations to implement the warnings, instructions to direct people to the implementation of preventive measures. On the other hand, in the long-term, we need to plan the downstream population, create safe corridors drainage. Infrastructure for transportation, dykes, irrigation dams, schools, health centers and other public buildings is only a temporary fix to operate , require investment to upgrade permanent safety before the next disaster .

II. Summary of progress in Key Result Areas

Title of item: Progress in interpreting Regional Forecasting Support Center - Ha Noi in SWFDP of WMO at South-East Asia

Main text:

The SWFDP-SeA webpage is developed and taken into operationally since June 2012 under the link of http://www.swfdp-sea.com.vn (username: swfdp-sea and password: RA2 - in case sensitive) for NHMSs of Lao PDR, Combodia, Thailand to access and use available products (see Fig. 1 and 2). At present, the following products are operationally provided through the SWFDP-SeA portal:

- Short range (1-2 days) and Medium range (3-5 days) Guidance products: the guidance is made by forecasters of NHMS of Vietnam and operationally issued at 00UTC. The guidance includes warning maps related to severe weather such as heavy rainfall, strong wind for responsible areas and categorical warning table for all given locations of relevant countries.

- MTSAT-2's IR1 and VIS products: horizontal resolution of 5km x 5km, 48 pictures per day, update every 30 minutes

- Global Satellite Mapping of Precipitation (GSMAP) is global rainfall estimates by the retrieval algorithm for brightness temperatures from satellite-born microwave radiometers. The horizontal resolution is 0.25 x 0.25 deg, 24 pictures per day, update every 1 hour. The delayed time is about 4 hours

- Storm tracks: this product is developed by NHMS of Vietnam in order to issue warning the direction and speed of the movements of deep convective systems of up to 3 hours. The algorithms are based on 3 steps: motion vector fields are derived two successive images using multi-scale variational method; deep convective clouds are simply recognized by multi-threshold method from MTSAT-2 data (infrared channels); and convective systems are separated by deep first searching (DFS) algorithm

- ASCAT: this product provides a measure of wind speed and direction near the sea surface. The measurements are obtained through the processing of scatterometer data originating from the ASCAT instrument on EUMETSAT's Metop-A satellite.

- Global deterministic NWP products from GSM model of JMA, GFS of NCEP and NOGAPS of US Navy, GEM of CMC and GME of DWD. The products of GSM, GFS and NOGAPS has resolution of 0.5 x 0.5 deg. Meanwhile, GEM and GME products have respectively resolution of 0.6 x 0.6 deg and 0.3 x 0.3 deg. All of global model products is updated every 6 hours at 00UTC, 06UTC, 12UTC and 18UTC. The available surface forecasting products include charts for precipitation, pressure of mean sea level, temperature at 2 meters, wind at 10 meters, 1000-500mb thickness. For upper levels (850, 700, 500 and 300mb), the forecasting charts of wind and geo-potential height, relative humidity, relative vorticity and vertical velocity is also provided.

- Global Ensemble Prediction Products based on 21 ensemble members of GFS ensemble system (NAEPS) for forecasting 5-10 day ahead: these products have resolution of 1.0 x 1.0 deg and are updated every 12 hours at 00UTC and 12UTC. The available EPS products include charts for ensemble mean (i.e. pressure of mean sea level, wind and geo-potential height at 850mb and temperature at 850mb), stamp map of 24-hours accumulated precipitation, and probabilistic maps (i.e. 24-hours precipitation quartile, 24-hours precipitation probability, 24-hours maximum wind-gust probability, 24-hours maximum CAPE probability, etc). In addition, the EPS-diagram for the 22 locations of Cambodia, 17 locations of Lao PDR and 16 locations of Thailand are also provided.

- Regional Ensemble Prediction Products based on two operational EPS of NHMS of Vietnam, namely is SREPS and LEPS. The SREPS (Short Range Ensemble Prediction System) is multi-model multi analysis EPS in which running HRM (High resolution Regional Model of DWD) and WRF (with two dynamic cores ARW and NMM) with initial and boundary conditions separately from 5 global models including GSM, GEM, GFS, GEM and NOGAPS. The SREPS has 15 members with resolution of 0.15 x 0.15 deg and is updated every 6 hours at 00UTC, 06UTC, 12UTC and 18UTC. The main aim of SREPS is in order to provide ensemble products for forecasting 1-3 days ahead. The LEPS is developed to provide ensemble products from 3 to 5 days ahead by running HRM model with initial and boundary conditions separately from 21 members of global EPS of GFS model. The LEPS has 15 members with resolution of 0.2 x 0.2 deg and is updated every 12 hours at 00UTC, and 12UTC. All available ensemble mean and probabilistic products of SREPS and LEPS is the same as with NAEFS.

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

The SWFDP-SeA webpage is taken into operationally since June 2012 and the forecasters of NHMS's Lao PDR, Combodia, Thailand can access and use available products as above mentioned. Recently, NHMS's of Philippines and Myanmar are interested in the SWFDP-

SeA webpage and asked NHMS's Vietnam to expand responsible areas of specific products to cover these countries. In order to ensure all functions of WMO's RFSC and improve predictability of severe weather phenomena for South-East Asia in SWFDP project, the key task in 2014 will be more paid attention to:

- Provide forecast product of the motion of observed precipitation areas up to 3 hours ahead (1 hour cycle) using Semi-Lagrangian advection scheme in combination with satellite data

- Provide tropical cyclone track and intensity forecasting products based on RSMCs and NWP models

- Provide verification products for guidance and near real-time NWP verification products

- Provide weather forecasting charts from regional non-hydrostatic model with 2-5km resolution to increase predictability of severe weather phenomena

- Add "Forecast Forum" tool in SWFDP-SeA website in order to NHMS's forecaster can discuss and share information

Summary Table of relevant KRAs and components:

KRA =	1	2	3	4	5	6	7
Meteorology	☒	☒	☐	☒	☒	☒	☒
Hydrology	☒	☒	☐	☒	☒	☒	☒
DRR	☒	☒	☐	☒	☒	☒	☒
Training and research	☒	☒	☐	☒	☐	☐	☐
Resource mobilization or regional collaboration	☐	☐	☐	☐	☐	☐	☐

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