

MEMBER REPORT

ESCAP/WMO Typhoon Committee

12th IWS

SOCIALIST REPUBLIC OF VIET NAM

October 2017

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

1. Meteorological assessment

1.1. Severe Tropical Storm TALAS

On July 13th, 2017 a low pressure was formed over center Bien Dong sea (East Sea). Then, the low pressure moved northward at about 5-10 km/h. In the afternoon of July 14th, the low pressure intensified to tropical depression over Hoang Sa. One day later, on July 15th tropical depression intensified to Severe Tropical Storm, internationally named Talas. After intensification, TS Talas entered Bac Bo gulf with intensity of force 9-10, gust 11-12 grade in Beaufort scale, moved westward at about 20 km per hour (See Fig. 1). At 06UTC on July 17th, TS Talas made landfall in Nghe An-Ha Tinh area, then continued to move WNW in the Central and Upper Laos PDR. The strongest wind in the coastal and mainland in Nghe An - Ha Tinh from 06UTC-10UTC on July 17th.



Fig. 1: The best track of TS. Talas (NHMS of Viet Nam).

Intensity when TS Talas landfalled: Strong winds force 7-8 has been observed in Nghe An-Ha Tinh such as: Dien Chau, Cua Hoi force 8, gust 10; Quynh Luu, Vinh force 7, gust 10; Hoanh Son force 7, gust 11. In Hon Ngu island has observed the wind force 8, gust 12; from Nam Dinh to Thanh Hoa wind force 6-7, gust 8-9 and gust force 6-7 at Quang Ninh, Hai Phong and Quang Binh. Thanh Hoa to Thua Thien Hue have subjected heavy rain of 100-200mm, with some extreme exception such as: Ha Tinh to Quang Binh 200-300mm, Ha Tinh city 311mm, Hoanh Son (Ha Tinh) 364mm, Ba Don (Quang Binh) 323mm.

Particular trait of TS Talas: Formed in the Bien Dong Sea, moved fast because tropical high pressure moved west, average speed 15-20 km/h, when in Bac Bo gulf average speed 20km/h. Wind force 10 radius of about 20-30 km, STS No.2 caused heavy rain (200-300 mm/day) for provinces in the north of Viet Nam.

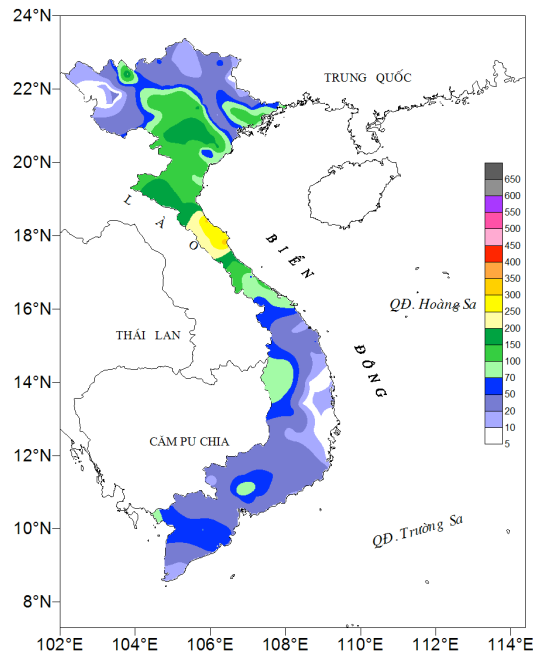


Fig. 2: The distribution of total rainfall from 16 to 18 July 2017 in Vietnam during TS Talas showing heavy rain of more than 200mm for Ha Tinh to Quang Binh area

1.2. Tropical Storm SONCA

In the morning of July 21st, a low pressure was formed over north Bien Dong sea, the low pressure intensified to tropical depression in the afternoon and moved slowly westward before intensified to tropical storm No.4 in Bien Dong in 2017, named SONCA. From July 23rd to July 24th, TS No.4 was almost stationary. At night July 24th TS No.4 started to move westward about 5 km/h before geared up to 15-10 km per hour before making landfall (See Fig. 3).



Fig. 3: The best track of TS. Sonca (NHMS of Viet Nam).

At about 08 UTC on July 25th, TS No. 4 made landfall in the north of Quang Tri province and weakened to tropical depression quickly in the Central Laos PDR. From 00 UTC to 09 UTC on July 25th strongest wind in the coastal area of Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri and inland area of Quang Binh, Quang Tri.

Strongest wind of TS Sonca has been observed at force 8-9, gust 10 in the south of BacBo gulf. When TS No.4 made landfall weaken to tropical depression with wind force 7, gust 8-9. TS No.4 has caused heavy rain of 50-150mm in popular on July 25th in Thanh Hoa to Da Nang, except in Quang Tri 200 mm.

Particular trait of TS Sonca: Formed in the BienDong Sea, on 23rd-24th July moved slowly because impact of the TS No.3 moved upto Hong Kong (China). When storm No.3 weaken and tropical high pressure move west; from late afternoon July 24th TS No.4 move fast, especially in near the coast.

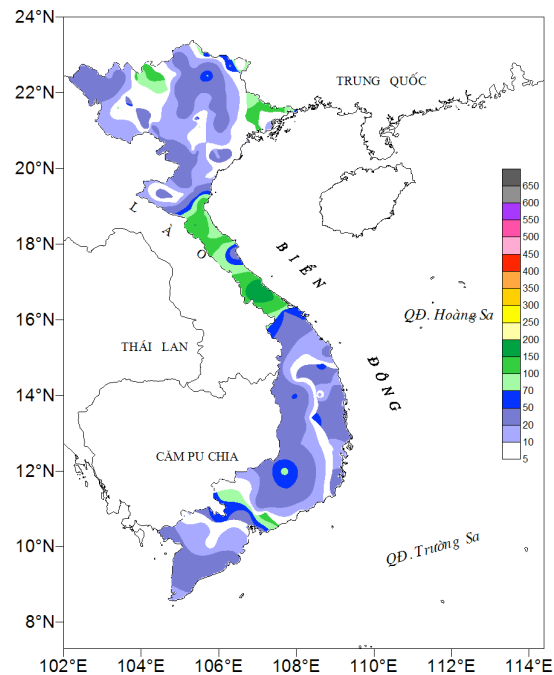


Fig. 4: The distribution of total rainfall in Vietnam on 24th July 2017 during TS Sonca showing heavy rain of more than 50-150mm for Thanh Hoa to Da Nang area.

1.3. Tropical Storm HATO

In the afternoon of August 20th, 2017 a tropical depression in Northwestern Pacific intensified to tropical storm named Hato, moved to Bien Dong and became TS Hato in August 22th morning At speed of 25-30 km/h. At noon of August 23rd, TS Hato made landfall in south Kwangtung (China), then move WNW and weaken to low pressure in Quang Tay province (China). In Cao Bang, Lang Son, wind force 6. TS HATO did not cause any gale wind of force 6 and more in Vietnam land but heavy rain (popularly 50-100 mm) for provinces in the north of Viet Nam; with some exception such as: Ha Giang 182 mm, Dinh Hoa (Thai Nguyen) 316 mm. On August 24-26th, provinces from Thanh Hoa to Thua Thien Hue have also experienced heavy rain, popularly 50-100mm; some places greater rainfall such as: Nhu Xuan (Thanh Hoa) 141mm, Ky Anh (Ha Tinh) 105mm.



Fig. 5: The best track of TS. Hato (NHMS of Viet Nam).

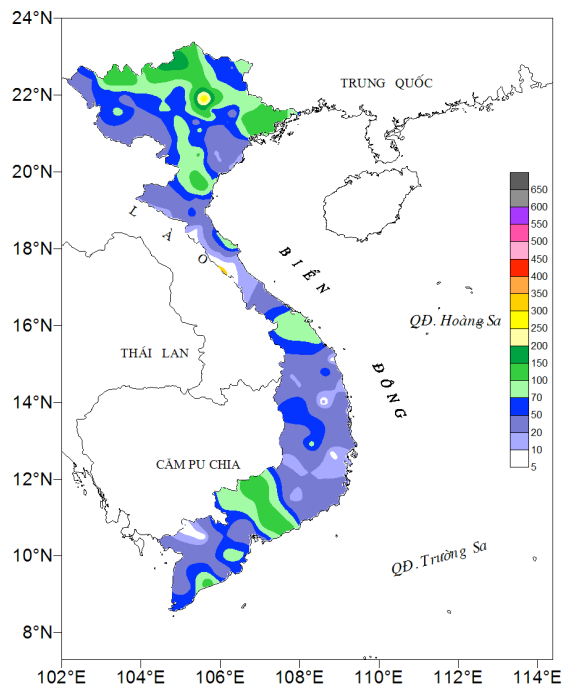


Fig. 6: The distribution of total rainfall from 24 to 26 October 2017 in Vietnam during TS Hato causing medium to heavy rain of more than 50-100mm for North Vietnam

1.4. Tropical Storm PAKHAR

In the afternoon of August 24th, a tropical depression was formed in the Northwest Pacific and then it intensified to tropical storm, internationally named Pakhar. Early on August 26th, Pakhar crossed the northern part of LuDong Island (Philippines) and entered Bien Dong Sea, this is the seventh tropical storm in Bien Dong Sea in 2017. Pakhar moved northwest at about 30 km/h and landfalled in the south of Guangdong Province (China) in the afternoon, then it moved continuously at about 25 -30km/h and weaken to tropical depression in Guangxi before weakening to a low pressure area and gradually dissipated. Thus, the tropical storm No. 7 did not directly landed in Vietnam.



Fig. 7: The best track of TS. Pakhar (NHMS of Viet Nam).

1.5. Tropical Storm DOKSURI

On September 11th, a low pressure area was formed over east coast of the Philippines and it intensified to a tropical depression. After intensification, the tropical depression crossed the south of Luzon(Philippines), entered Bien Dong Sea and intensified a tropical storm in the late afternoon of September 12th. This is the 10th tropical storm in Bien Dong Sea in 2017, internationally named Doksuri. TS Doksuri quickly moved northwest with an average speed of 20-25km/h. On September 14th, after crossed Hoang Sa Islands, TS Doksuri had strengthened with gale wind of force 12, and entered the South of Bac Bo gulf, reaching gale of force 13, gust 15 in Beaufort scale. At noon of September 15th, TY No.10 made landfall in Ha Tinh - Quang Binh and continuously moved west to northwest, finally dissipated in Central Laos PDR.

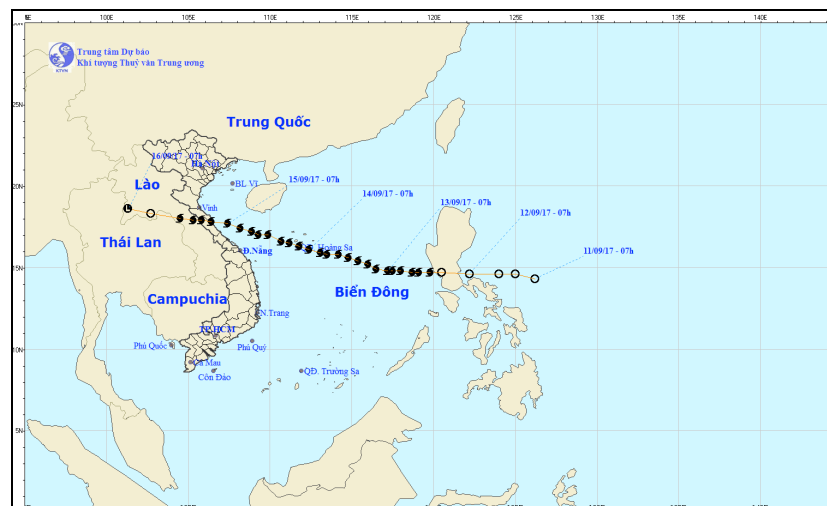


Fig. 8: The best track of TS. Doksuri (NHMS of Viet Nam).

TS. Doksuri caused strong winds in Ky Anh force 10, gust 13; Hoanh Son reached of force 11, gust 15; Cam Nhuong force 10, gust 12; Tan My force 8, gust 13; Dong Hoi City force 8, gust 12. Con Co Island has observed strongest wind of force 11, and gust 14; Cua Viet (Quang Tri) with strong wind of force 8, gust 10. Further in land of provinces from Quang Ninh to Da Nang has observed strong wind of force 6-7 grade, gust 8-9 grade in Beaufort scale.

TS. Doksuri made landfall in Ha Tinh-Quang Binh provinces during the period of high tide combined with storm surge, it made overflowing many sea dikes, many construction and marine farms was destroyed. Storm surge has observed at Hon Dau was 0.9m, Sam Son 1.8m, Cua Hoi and Cua Nhuong were 1.9m and wave of 6.0 m has been observed at Hon Ngu. From September 14th to September 16th, in the North of Vietnam and Thanh Hoa- Quang Nam provinces have experienced heavy rainfall in many places. In the North of Vietnam with total precipitation about 70-150mm, at some stations has observed higher rainfall such as: Chi Ne (Hoa Binh) 263mm, Viet Tri 241mm, Ba Vi 278mm; the precipitation about 100-200mm from Thanh Hoa-Quang Ngai, and 200-300mm from Ha Tinh- Quang Tri, some stations observed higher rainfall such as: Ha Tinh city 331mm, Dong Hoi 334mm, Con Co Island 356mm, Dong Ha 335mm.

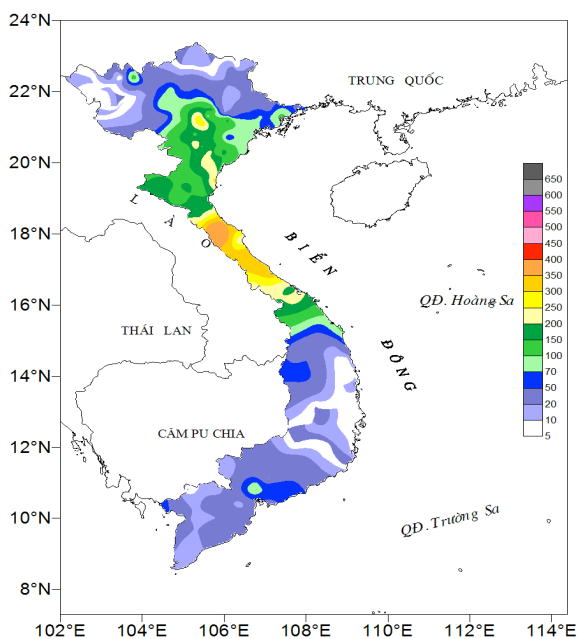


Fig. 9: The distribution of total rainfall from 14 to 16 September 2017 in Vietnam during TS Doksuri causing heavy rainfall of more than 100mm in the North of Vietnam and more than 300mm in some areas from Thanh Hoa to Quang Nam.

1.6. Tropical Depression in September

On September 23rd, a low pressure area was formed on Inter Tropical Convergence Zone (ITCZ) in the western of the Lu-Dong (Philippines) island has strengthened into a tropical depression, then it quickly moved west to northwest with average speed at about 25-30 km/h. On the morning September 25th, TD crossed Hainan island (China) and entered Bac Bo gulf, then made landfall in Quang Ninh-Hai Phong area before weakened into a low pressure area (See Fig. 10). This TD caused strong winds of force 6-7 grade in the Bac Bo Gulf, and force 6 in the coastal area of Quang Ninh. On the mainland of Hai Phong, Thai Binh and Nam Dinh has recorded gust wind of force 6-7 in Beaufort scale.



Fig. 10: The best track of TD in September 2017 (NHMS of Viet Nam).

Tropical depression produced medium to heavy rainfall in the North North East of Vietnam and Thanh Hoa province on 24-25th September with the popular rainfall of 30-60mm, some stations has observed more, such as: Hon Dau (Hai Phong) 107mm, Phu Lien (Hai Phong) 76mm, Cuc Phuong (Ninh Binh) 73mm, Thanh Hoa 94mm, Nhu Xuan (Thanh Hoa) 124mm, Chi Ne (Hoa Binh) 94mm.

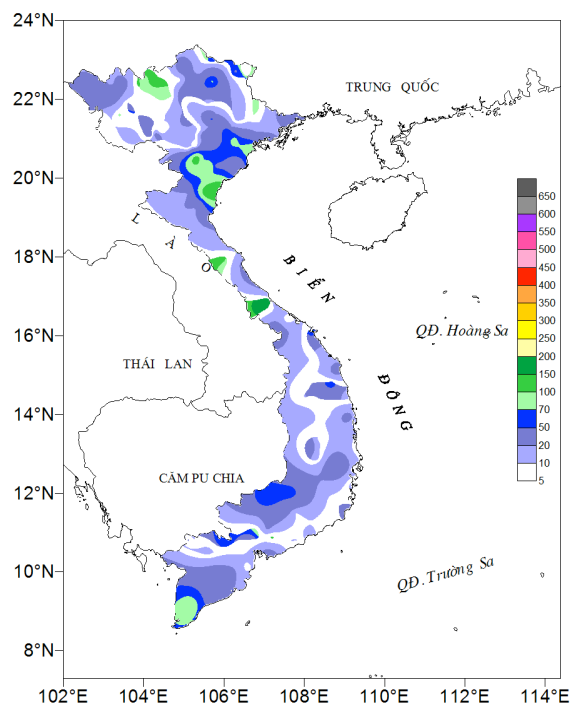


Fig. 11: The distribution of total rainfall from 24 to 25 September 2017 in Vietnam during the tropical depression causing medium to heavy rain North North East area.

1.7. Tropical Depression in October

In the afternoon of October 07th, a low pressure in the east Lu-Dong island (Philippines) intensified to a tropical depression. In the morning of October 8th, it moved into Bien Dong Sea and become TD in 2017 in Bien Dong Sea. TD then moved west and southwestward heading Hoang Sa island. After crossing Hoang Sa

island it moved west to and made landfall in Nghe An - Ha Tinh early morning of October 10th (See Fig. 12).

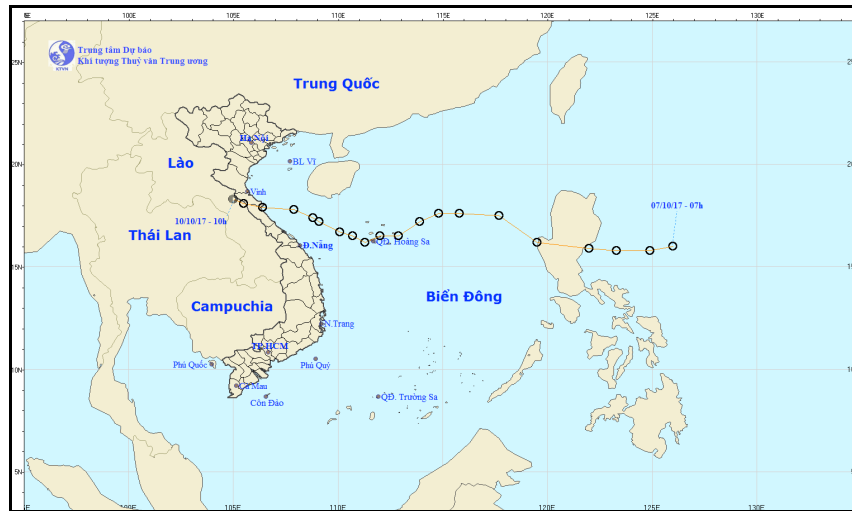


Fig. 12: The best track of TD in October (NHMS of Viet Nam).

Strong winds force 7, gust 9 has been observed in Hon Ngu island (Nghe An); in Ky Anh (Ha Tinh), Ba Don (Quang Binh) wind gust force 7; Con Co island (Quang Tri) gust force 9; Ly Son island gust force 8; Van Ly (Nam Dinh) wind force 8, gust 9; near the coast in Nam Dinh, Thai Binh, Thanh Hoa to Ha Tinh wind force 5-6, gust 8. The combination of TD and easterly wind caused heavy rain (100-200mm) for provinces in the north of Viet Nam and from Thanh Hoa to Quang Ngai from October 9th - 10th, with some places over 300mm such as: Kim Boi (Hoa Binh) 469 mm, Minh Dai (Phu Tho) 318 mm, Cuc Phuong (Ninh Binh) 374mm, Yen Dinh (Thanh Hoa) 421 mm, Vinh 401 mm, ... (see Fig. 13 for details)

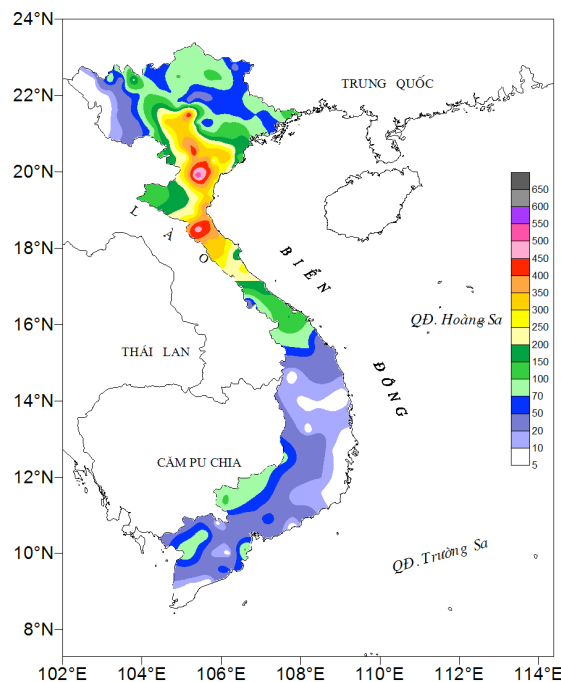


Fig. 13: The distribution of total rainfall from 09 to 10 October 2017 in Vietnam caused by the combination of tropical depression and easterly winds showing the area of torrential rain of more than 400mm in the North Vietnam and Thanh Hoa-Quang Ngai area.

1.8. Tropical Storm Khanun

In the morning of October 11th, a low pressure in Western Pacific intensified to tropical depression. One day later, it moved westward and strengthened into a tropical storm, this is the 20th tropical storm in Western Pacific in 2017, named Khanun. In the morning of October 13th, TS Khanun cross-overed the north of Luzon island (Philippine) and entered Bien Dong Sea, became the 11th tropical storm in 2017 in Bien Dong Sea. After entering Bien Dong Sea, TS No. 11 moved southwest before recurving to northwest in early morning of October 15th. TS No 11 reached maximum intensity of force 12-13, gust 16 in Beaufort scale. After that, TS Khanun moved westward and crossed-over Loi Chau peninsula before entering Bac Bo Gulf on October 16th. TS Khanun then quickly weakened and finally it moved southward and dissipated in the evening of October 16th (See Fig. 14).



Fig. 14: The best track of TS. Khanun (NHMS of Viet Nam).

2. Hydrological Assessment

2.1. Hydrological Assessment in Northern areas

An abnormal flood had appeared on the Da, Thao, Chay and Gam rivers with flood amplitude of 1.5 - 3m in the mid of January, 2017. During the time of dry season, flooding on the main rivers provided precious water resource for agriculture and hydro-power generation.

In 2017, big flood concentrated during the July and the August. There are 11 flood events occurring mostly in the upstream of the Red river system. Flood peaks were recorded over 2 - 5m in the upper area and 1,5 - 3m in the lower area. Several big flood events occurred in the mid of August in which flood peak in some locations on the Red river system (including Da, Thao, Lo rivers) were recorded over the alert level 2 or 3. One extremes flood has appeared in the mid of October.

Due to effects of tropical storms TALAS, HATO and PAKHAR from the end of July to the end of August, big floods occurred on upper reaches of the Red river system in which flood peaks were recorded above the alert level 3 at some positions. In the end of August, inflow to Lai Chau and Son La reservoirs on Da river increased sharply as a result of heavy rain in the long duration together with a

big transboundary flow from China. Lai Chau, Son La, Hoa Binh and Tuyen Quang reservoirs had to be operated 2 - 3 gates for safety reservoir regulation causing steady rising of water level in downstream of Red river. Table 1 summarized information of flood characteristics on the river systems in the North of Viet Nam during July and August. Figure 2 illustrated the flood situation on the Thao river at Yen Bai and on Chay river at Bao Yen where the flood peaks were over the alert level 3 leading to serious flooding in the Yen Bai city.

From the 10th to the 12th of Oct, the combination of tropical depression and easterly winds have caused heavy rainfall of 200-400mm in South of Bac Bo region. As results, historical flood was recorded on Hoang Long river basin and extreme floods were occurred in Thao and Da river basin. In the first time, Hoa Binh reservoir had to open 8 gates for safety reservoir regulation leading to sharp rising of water level in downstream area. Flood and inundation caused terrible damage for many provinces, cities in the North of Viet Nam. Characteristics of the biggest flood event in the 2017 are shown in table 2. Figure 3 illustrates the flood on the Thao river at Yen Bai, Hoang Long river at Ben De and inflow to Hoa Binh reservoir in Da river.

Table 1. The characteristics of flood events for main stations and reservoirs on rivers in the North of Viet Nam from May to August, 2017

No	Duration	Weather preterm	Station	River	Flood peak m ³ /s	Time of flood peak	Flood Amplitude (m)	Compare to Alert levels (m)
1	8-16 /7	Compres sed low pressure trough	Tuyen Quang	Lo	21.52m	(21h/8/7)	3.01m	< AL1 : 0.48m
			Bao Yen	Chay	73.30m	(14h/9/7)	3.04m	> AL2 : 0.3m
			Yen Bai	Thao	30.60m	(7h/12/7)	1.81m	> AL1 : 0.6m
			Inflow to Thac Ba reservoir	Chay	2390 m ³ /s	(7h/13/7)		
2	18 - 24 /7	TS TALAS (No 2)	Lao Cai	Thao	81.84m	(16h/21/7)	3.21m	< AL2 : 0.16m
			Yen Bai		32.15m 31.97m	(6h/18/7) (9h/22/7)	3.25m 1.77m	> AL 3: 0.15m ~ AL3
			Bao Yen	Chay	76.27m	(23h/20/7)	6.84m	> AL 3: 1.27m
			Ben De	Hoang Long	2.97m	(7h/18/7)	1.5m	< AL 1: 0.03m
			Phu Ly	Day	3.50 m	(17h/21/7)	1.80m	~ AL 2

No	Duration	Weather preterm	Station	River	Flood peak m ³ /s	Time of flood peak	Flood Amplitude (m)	Compare to Alert levels (m)
3	31/7 -7/8	Low pressure trough with the axis through Northern part	Inflow to Lai Chau reservoir	Da	8140m ³ /s	(12h/2/8)	6360m ³ /s	
			Inflow to Son La reservoir	Da	9860m ³ /s	(17h/2/8)	7470m ³ /s	
			Yen Bai	Thao	30,81m	(8h/6/8)	2.14m	< AL2 : 0.19m
4	11-19 /8	(Low pressure trough with the axis through Northern part	Yen Bai	Thao	31.28m	(10h/18/8)	1.96m	> AL2: 0.28m
			Bao Yen	Chay	74.38m	(4h/18/8)	2.59m	> AL2 : 1.38m
			Ha Giang	Lo	101.17 m	(19h/17/8)	2.87m	> AL 2: 0,17m
			Tuyen Quang		21.02m	(23h/18/8)	1.58m	< AL 1: 0.98m
5	23-25 /8	TS HATO (No 6)	Bao Yen	Chay	72.25m	(11h/25/8)	3.09m	> AL1 : 1.25m
			Lao Cai	Thao	81.99m	(9h/26/8)	4.77m	< AL2 : 0.01m
			Yen Bai		31.28m	(3h/27/8)	3.4m	> AL2: 0,28m
			Ha Giang	Lo	101.64 m	(5h/25/8)	5.8m	> AL2 : 0.64m
			Tuyen Quang		22.32m	(3h/27/8)	4.77m	>AL1 0.32m
			Ha Noi	Red	8.08	(4h/28/8)	3.5m	
6	27-28 /8	TS PAKHARR (No 7)	Yen Bai	Thao	30.28m	(22h 30/8)	1.09m	>AL1: 0.28m
			Bao Yen	Chay	73.65m	(11h 25/8)	3.09m	> AL 2: 0.65m
			Tuyen Quang	Lo	21.92m	(19h 29/8)	1m	< AL 1: 0.08m

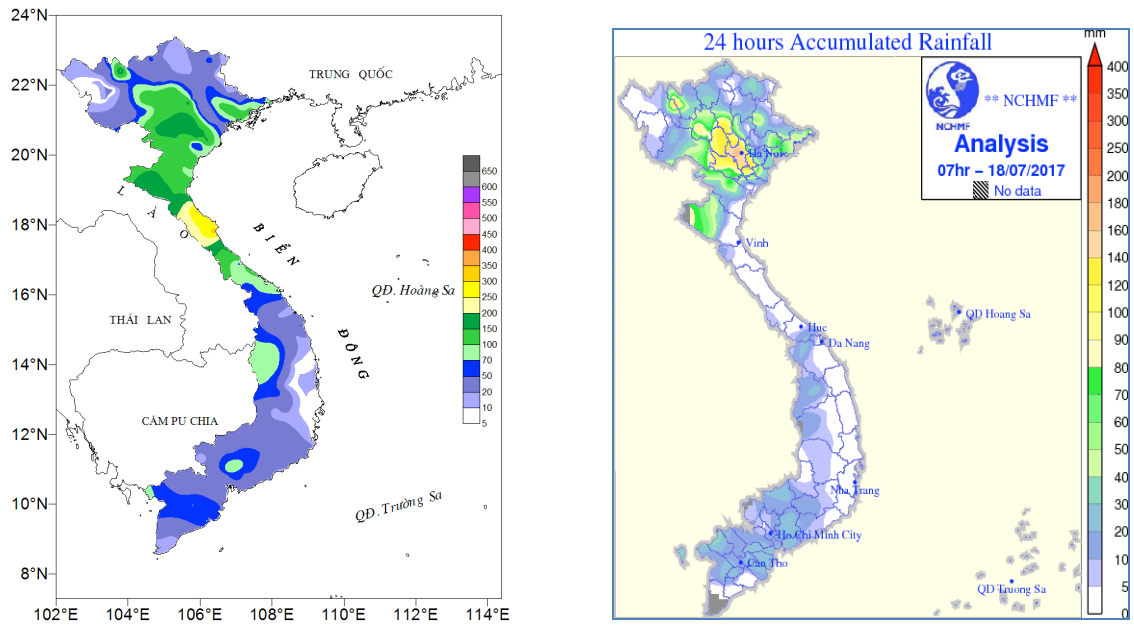


Fig. 15: The distribution of total rainfall from 16 to 18 July 2017 and 24h accumulated rainfall on 18th July during TS Talas showing heavy rain of more than 200mm for Ha Tinh to Quang Binh area

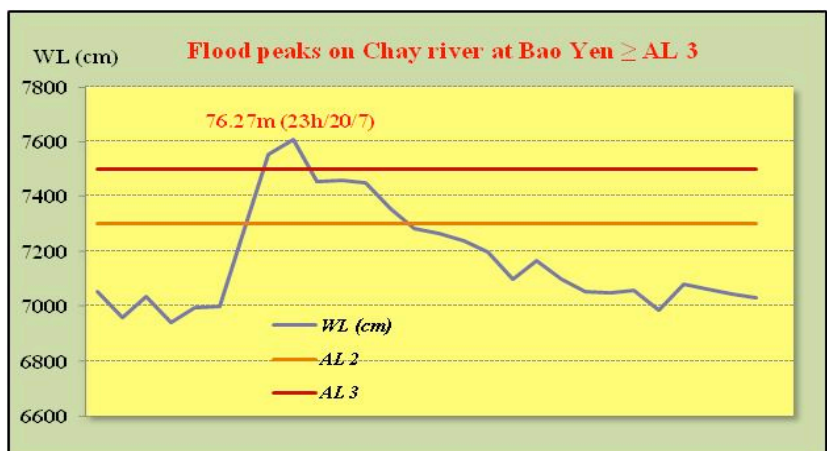
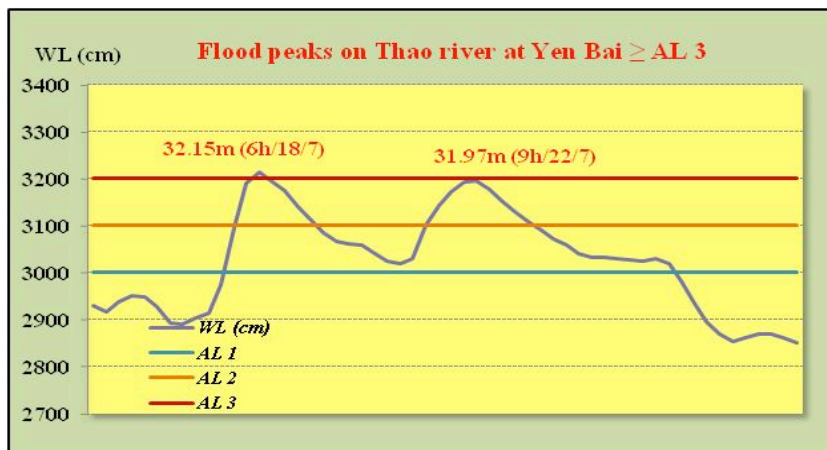


Fig.16: Flood peaks on Thao river at Yen Bai and on Chay river at Bao Yen

Table 2. Flood characteristic of severe flood event in 2017 in October

Duration	Station	River	Flood peak m/ m ³ /s	Time of flood peak	Flood Amplitude (m)	Compare to Alert levels (m)
10-12 /10	Inflow to Hoa Binh reservoir	Da	15940 m ³ /s	(12h/11/10)	14340 m ³ /s	> AL 3: 3940 m ³ /s
	Yen Bai Phu Tho	Thao	32.39m 18.40m	(24h/11/10) (23h/11/10)	4.68m 3.39m	> AL 3: 0.39m > AL2 : 0.2m
	Ben De	Hoang Long	5.53m	(6h/12/10)	3.89m	> AL 3: 1.53m > Histo. Record: 0.29m

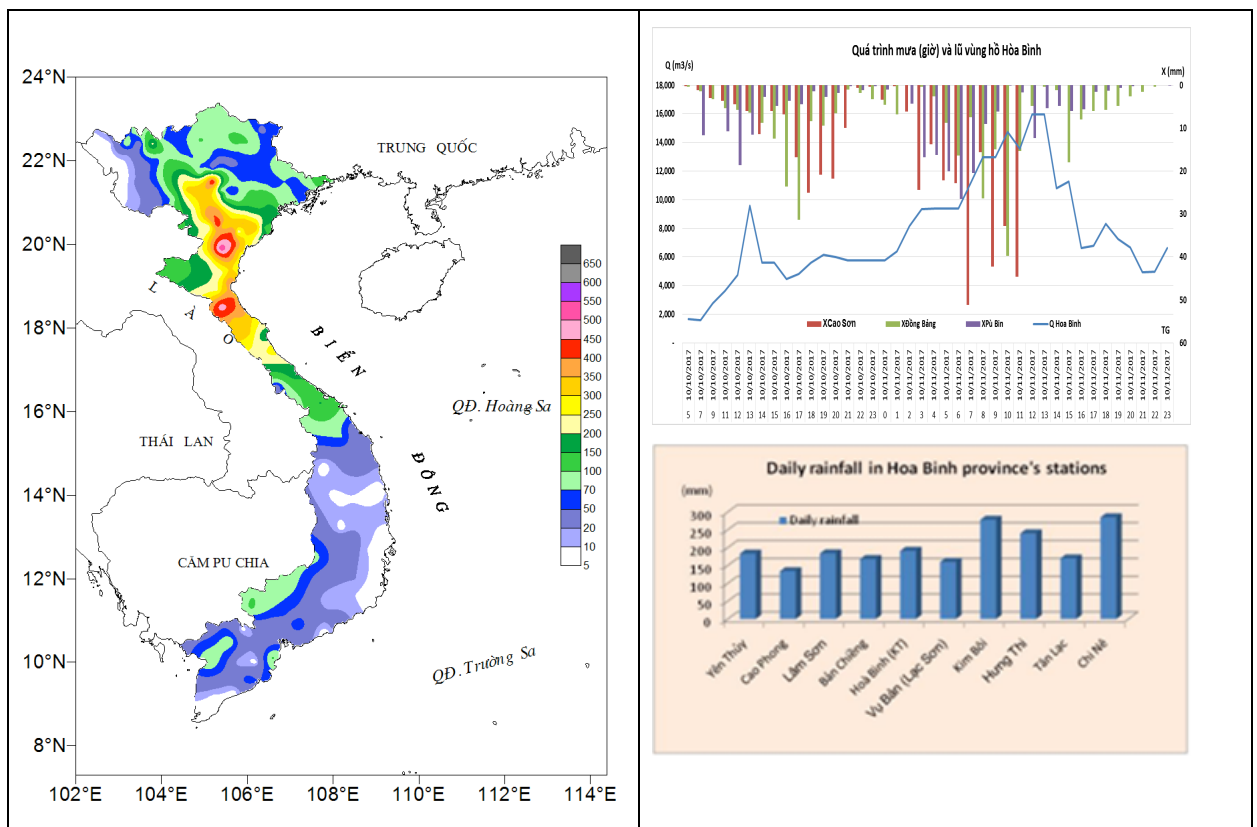


Fig. 17: The distribution of total rainfall from 09 to 10 October 2017 caused by the combination of tropical depression and easterly winds showing the area of torrential rain of more than 400mm in the North Vietnam and Thanh Hoa - Quang Ngai area.

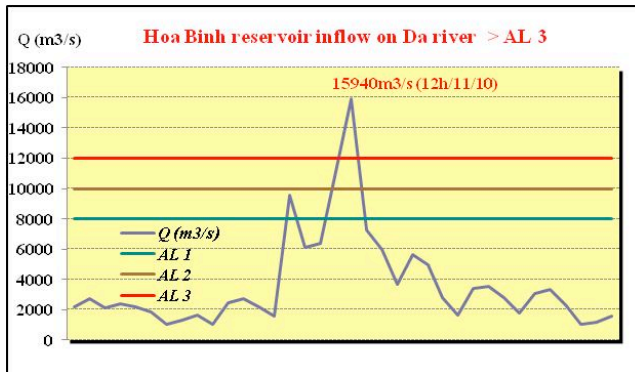
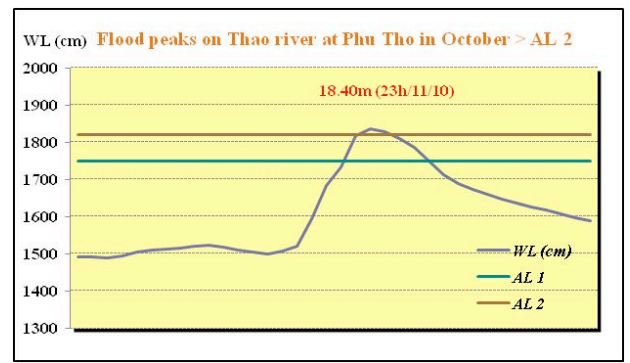
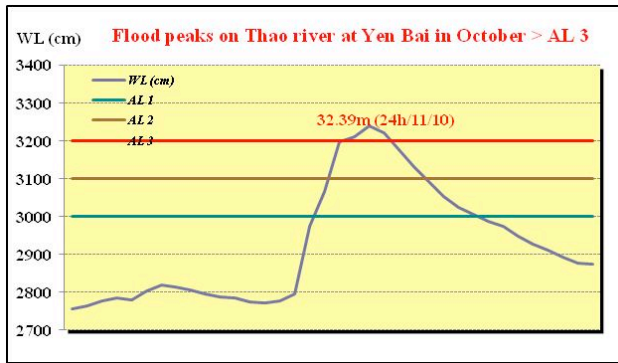


Fig. 18: Flood on Thao river at Yen Bai, Phu Tho and Hoa Binh reservoir

Flash flood and land slide: Severe flash flood, landslide have occurred in mountainous areas in the North of Viet Nam during flood season 2017 causing huge losses of human, properties, infracstrutures and agricuture production as well. The largest flash flood situation concentrated on the beginning of August in the Northwestern mountainous areas. Muong Lay district in Son La and Mu Cang Chai district in Yen Bai province were suffered the most severe disaster in their history during the 2nd and the 3rd August.



Fig. 19: Flash flood at Nam Pam Village, Muong Lay district, Son La

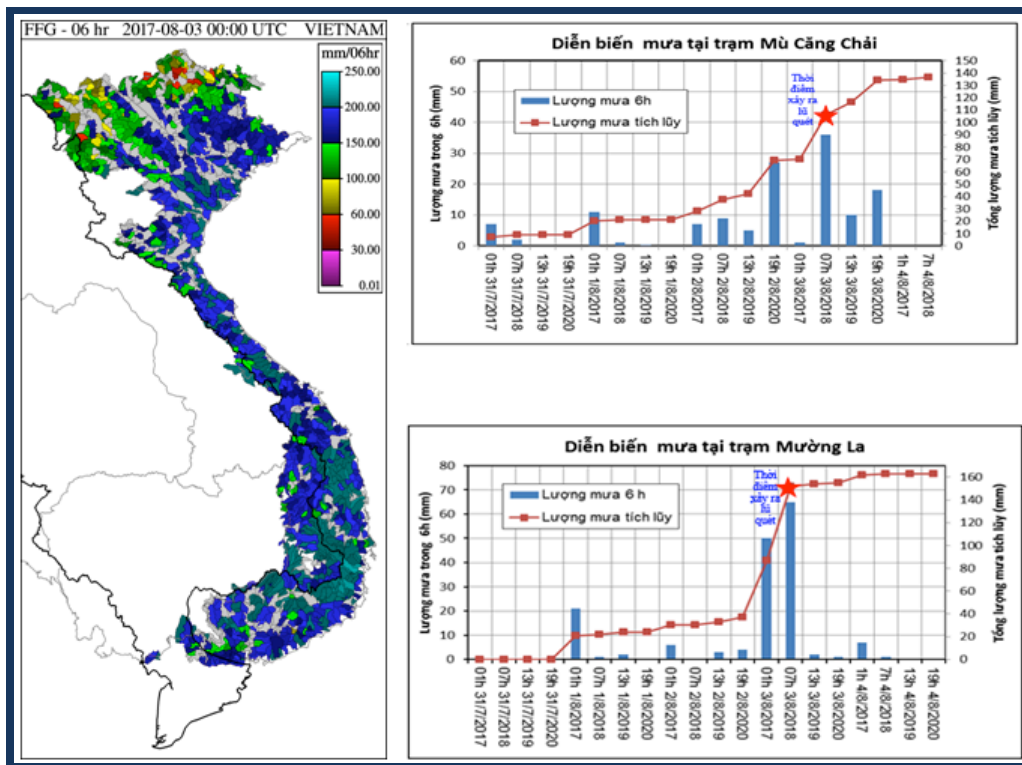


Fig. 20: Warning mapping of flash flood risk as product of the Flash Flood Guidance System (FFGS) and accumulated rainfall at Mu Cang Chai and Muong Lay on the 3rd August



Fig. 21: Flash flood at Mu Cang Chai district, Yen Bai province

A sudden flash flood in Trinh Tuong commune, Bat Xat district, Lao Cai provinces appeared in the early morning 26th August as a result of TS PAKHAR circulation.

As a result of heavy rain caused by the combination of tropical depression and easterly winds from 9 - 12 October, serious flash flood occurred in Yen Bai and Hoa Binh leading to 9 peoples death and missing; 6 wounded; 26 houses washed away in Hat village of Tram Tau district, Yen Bai and 18 death in Phu Cuong village, Tan Lac district, Hoa Binh.



Fig. 22: Flash flood at Phu Cuong village, Tan Lac district, Hoa Binh province

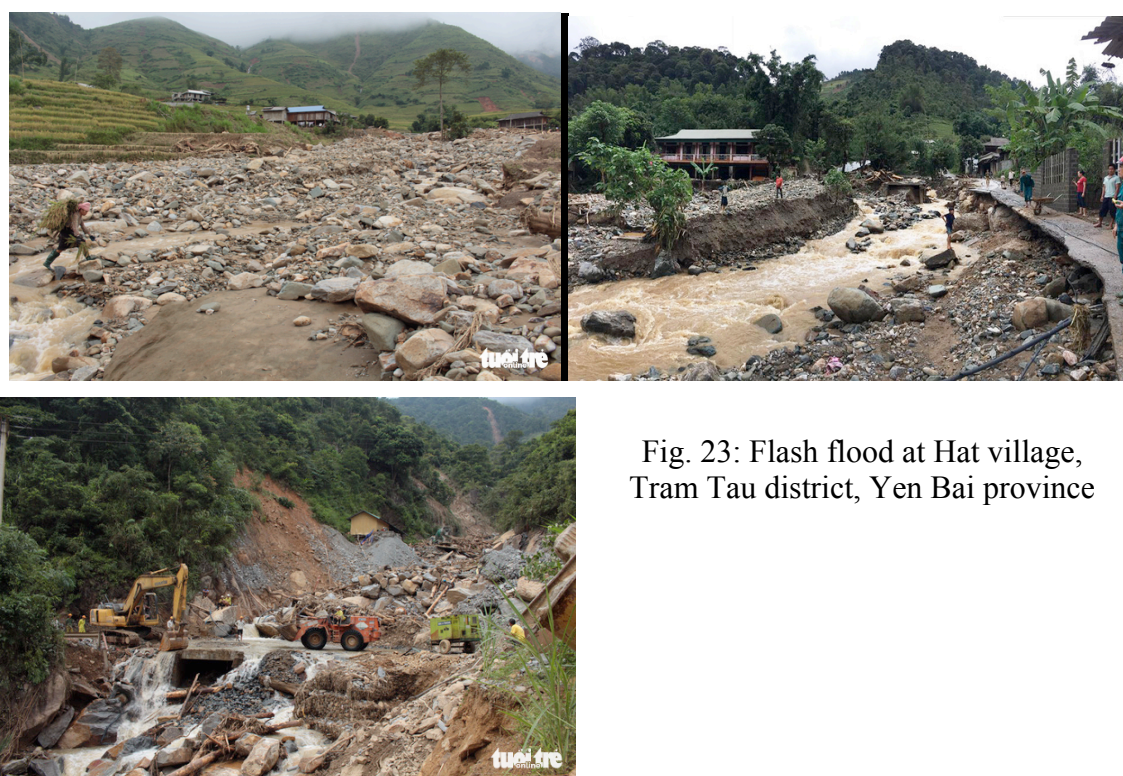


Fig. 23: Flash flood at Hat village, Tram Tau district, Yen Bai province

Flooding situation: Serious flooding and inundation were appeared in low-land areas in Hoa Binh, Phu Tho, Ninh Binh provinces and Ha Noi as a result of extreme heavy rainfall, sharp rising of water level on Thao, Hoang Long, Red rivers and water release from 8 outlets of Hoa Binh reservoir during 1 day. The cities, districts and provinces faced inundation, flooding were listed below:

- Inundation in Luong Son district (Hoa Binh province);
- Flooding in Gia Vien, Nho Quan, Hoa Lu, Ninh Binh cities of Ninh Binh province, Thanh Son, Tan Son districts of Phu Tho province;

- Flooding in Chuong My district, Xuan Mai town of Ha Noi in 12th Oct caused by broken dyke;



Inundation in Luong Son district – Hoa Binh province



Broken dyke on Bui river in Chuong My district and Xuan Mai town, Ha Noi

2.2. Hydrological Assessment in Central, Highland and Southern area

2.2.1. In Central and Highland area

The water level on the river systems of the Central and Highland of Vietnam was generally low and did not change significantly from January to Mid of May. Because of reservoir regulation and changing of the river-bed, the water level on some rivers of the Central was the lowest in this period. The lowest water levels on Ma river at Ly Nhan, Cam Thuy stations, Ta Trach river at Thuong Nhat station, Cai Nha Trang river at Dong Trang station was recorded. End of May and June, some rivers of the Central and Highland appeared two small floods with the recorded amplitudes from 0.5 to 1.5m. The higher floods of this period appeared on the rivers of Ha Tinh, Binh Dinh, Ninh Thuan and Gia Lai provinces from May 25 to May 30 with the recorded amplitudes from 1m to 4m. Peak floods on some rivers were below the alert level 1; however peak floods of Cai Phan Rang river and Cai Ninh Hoa rivers at Tan My station reached the alert level 3.

In July, four small flood events were appeared on the rivers from Thanh Hoa province to Quang Tri province and Highland area. Flood amplitudes were from 3m to 3,5m in upstream areas and 1m to 3m in downstream areas, respectively. Particularly in flood events from July 25 to July 27, peak floods on Ngan Pho river at Son Diem station and Ngan Sau river at Chu Le station were recorded over the alert level 2 from 0.1m to 0.15 m, peak floods on the Cam Ly river at Thanh Binh station and Dak Nong River at Dak Nong station were recorded at the alert level 3.

Table 3. The characteristics of flood events for main stations from 25-27/7/2017

TT	River	Station	Peak of flood		Alarm Level
			Time and date	H	(cm)
1	Ngan Pho	Son Diem	23h/25/7	928	< Alarm level 1: 0,72m
		Son Diem	15h/26/7	1162	> Alarm level 2: 0,12m

2	Ngan Sau	Chu Le	20h/26/7	1215	> Alarm level 2: 0,15m
3	Ngan Sau	Hoa Duyet	7h/27/7	752	Alarm level 1
4	La	Linh Cam	22h/26/7	305	< Alarm level 1: 1,45m
5	Gianh	Dong Tam	22h/25/7	795	> Alarm level 1: 0,95m
6	Gianh	Mai Hoa	24h/25/7	225	< Alarm level 1: 0,75m
7	Kien Giang	Kien Giang	22h/25/7	939	> Alarm level 1: 1,39m
8	Kien Giang	Le Thuy	2h/26/7	161	> Alarm level 1: 0,41m
9	ĐakKrong	ĐakKrong	19h/25/7	2864	
10	Thach Han	Thach Han	4h/26/7	261	> Alarm level 1: 0,11m
11	Cam Ly	Thanh Binh	5h/25/7	83282	< Alarm level 3: 0,18m
		Thanh Binh	10h/26/7	83274	< Alarm level 3: 0,26m
12	Đak Nong	Đak Nong	15h/25/7	59051	Alarm level 3

In August, 3 flood events were occurred on some rivers of Thanh Hoa, Ninh Thuan, Binh Thuan, Lam Dong and Dak Nong provinces with the flood amplitudes from 1.5m - 3.0m in large rivers and from 3.5m to 4.5m in some small rivers. The peak floods were under the alert level 1 on the rivers of the Central and from Alert level 1 to alert level 2 in Highland area, respectively. Especially, peak flood on Cam Ly river at Thanh Binh station was recorded above the alert level 2.

Table 4: The characteristics of flood events for main stations from 16-19/8/2017

TT	River	Station	Peak of flood		Alarm Level (cm)
			Time and date	H	
1	Buoi	Kim Tân	9h/18/7	1030	> Alarm level 1: 0,3
2	Ma	Hoi Xuan	14h/17/7	5860	
3	Ma	Cam Thuy	20h/17/7	1769	> Alarm level 1: 0,19
4	Ma	Ly Nhan	3h/18/7	841	
5	Ma	Giang	7h/18/7	295	< Alarm level 1: 1,05m
6	Chu	Bai Thuong	8h/17/7	1507	Alarm level 1

7	Chu	Xuan Khanh	21h/17/7	573	
8	Ca	Dua	02h/18/7	2015	
9	Ca	Nam Dan	01h/19/7	447	< Alarm level 1: 0,93m
10	Ngan Pho	Son Diem	10h/17/7	928	
11	Ngan Sau	Chu Le	9h/17/7	1154	< Alarm level 2: 0,46m
12	Ngan Sau	Hoa Duyet	15h/17/7	664	
13	Song Gianh	Dong Tam	08h/17/7	1020	< Alarm level 2: 1,80m
14	Song Gianh	Mai Hoa	7h/17/7	431	< Alarm level 2: 0,69m
15	Cam Ly	Thanh Binh	11h/17/7	83212	> Alarm level 2: 0,12m

In September, 2 flood events were occurred on some rivers from Thanh Hoa to Binh Thuan and north of the highland. The flood amplitudes on upstream rivers of Thanh Hoa, Quang Binh, Quang Tri provinces were from 6,0m to 7,5m; on rivers of north of the Highland area were from 0,6m to 0,8m; on downstream rivers of Quang Binh and Quang Tri provinces were from 1,0m to 5,5m. The flood peaks were higher than the alert level 1 on rivers of Thanh Hoa provinces. The flood peaks were higher than the alert level 2 from 0,6m to 0,9m in Quang Binh province.

Table 5: The characteristics of flood events for main stations from 14-17/9/2017

STT	River	Station	Peak of flood		Alarm Level
			Time and date	H	(cm)
1	Buoi	Kim Tân	01h/17/9	1070	> Alarm level 1: 0,70m
2	Ma	Cam Thuy	19h/14/9	1490	< Alarm level 1: 2,60m
		Cam Thuy	13h/16/9	1775	> Alarm level 1: 0,25m
3	Ma	Ly Nhan	19h/16/9	836	< Alarm level 1: 1,14m
4	Ma	Giang	20h/16/9	329	< Alarm level 1: 0,71m
5	Ca	Dua	11h/17/9	1954	< Alarm level 1: 0,96m
6	Ca	Nam Dan	18h/17/9	450	< Alarm level 1: 0,90m
7	Ngan Pho	Son Diem	23h/15/9	989	< Alarm level 1: 0,11m
8	Ngan Sau	Chu Le	01h/16/9	1264	> Alarm level 2 0,64m

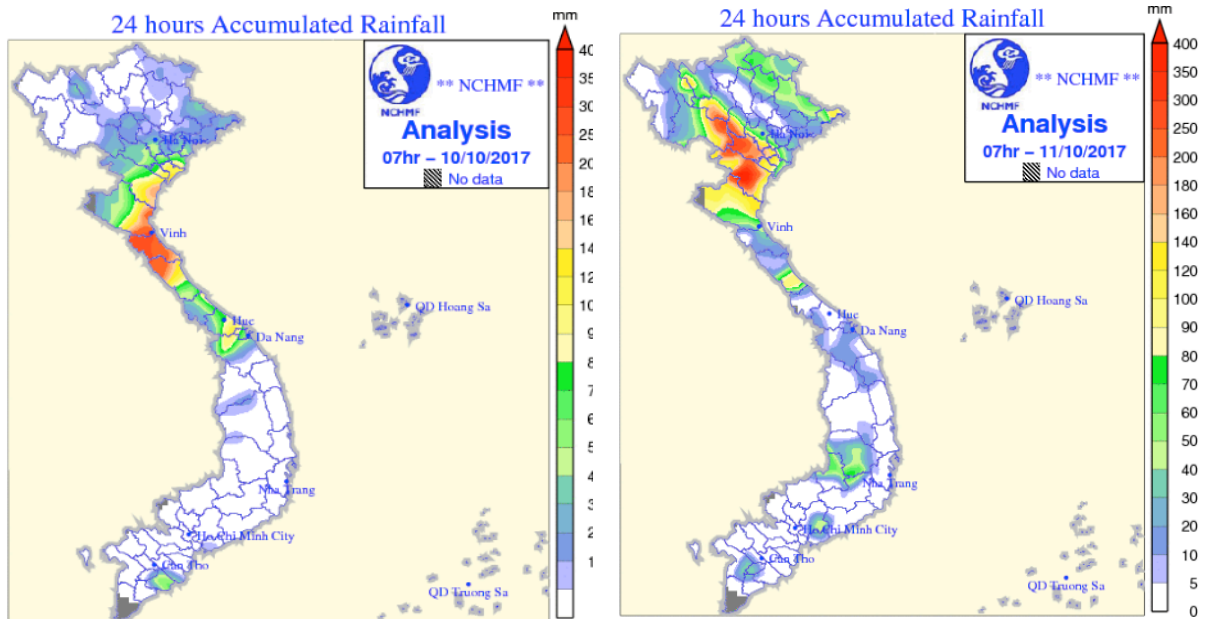
9	Ngan Sau	Hoa Duyet	21h/16/9	710	< Alarm level 1: 0,40m
10	La	Linh Cam	15h/15/6	288	< Alarm level 1: 1,62m
11	Gianh	Dong Tam	22h/15/9	1296	> Alarm level 2: 0,96m
12	Gianh	Mai Hoa	22h/15/9	589	> Alarm level 2: 0,89m
13	Kien Giang	Kien Giang	13h/15/9	1073	< Alarm level 2: 0,27m
14	Kien Giang	Le Thuy	16h/15/9	227	> Alarm level 2: 0,07m
15	ĐakKrong	ĐakKrong	10h/15/9	2850	
16	Thach Han	Thach Han	19h/15/9	295	> Alarm level 1: 0,45m
17	Huong	Kim Long	07h/15/9	111	> Alarm level 1: 0,11m
18	Bo	Phu Oc	13h/15/9	149	Alarm level 1
19	Vu Gia	Ai Nghia	15h/15/9	591	< Alarm level 1: 0,59m

From 9-12 October, extreme flood has appeared on the rivers from Thanh Hoa to Quang Binh provinces. The peak flood higher than the alert level 3 at some stations were recorded on the Ma river. The peak flood on Buoi river at Kim Tan station were 13,89m (above the alert level 3: 1.89m); on Ma river at Cam Thuy were 21,05m (above the alert level 3: 0,85m), at Giang were 7,26m (above the alert level 3: 0,76m); on Ngan Sau river at Chu Le 13,31m (above the alert level 3: 0,19m).

Table 6. The characteristics of flood events for main stations from 9-12/10/2017

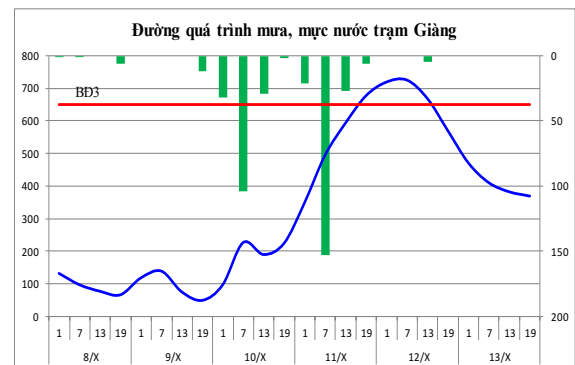
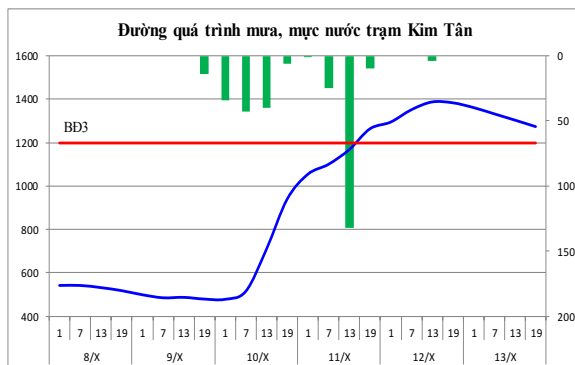
No	River	Station	Peak of flood		Compare to Alert level (m)
			Time and date	Water level (cm)	
1	Buoi	Kim Tan	16h/12/10	1389	>Alert level 3 1,89m
2	Ma	Cam Thuy	10h/11/10	2105	>Alert level 3 0,85m
3	Ma	Ly Nhan	02h/12/10	1160	<Alert level 3 0,4m
4	Ma	Giang	04h/12/10	726	>Alert level 3 0,76m
5	Chu	Bai Thuong	14h/11/10	2064	>Alert level 3 2,64m
6	Chu	Xuan Khanh	22h/11/10	1187	<Alert level 3 0,13m
7	Yen	Chuoï	16h/11/10	411	>Alert level 3 0,61m
8	Ca	Dua	19h/12/10	2191	<Alert level 2 0,59m
9	Ca	Nam Đan	17h/13/10	645	<Alert level 2 0,45m
10	Ngan Pho	Son Diem	7h/9/10	1003	>Alert level 1 0,03m
		Son Diem	10h/10/10	1316	>Alert level 3 0,16m

11	Ngan Sau	Chu Le	14h/10/10	1331	<Alert level 3 0,19m
12	Ngan Sau	Hoa Duyet	6h/11/10	867	<Alert level 2 0,33m
13	La	Linh Cẩm	8h/11/10	434	<Alert level 1 0,16m
14	Gianh	Dong Tam	11h/10/10	1145	<Alert level 2 0,55m
15	Gianh	Mai Hoa	11h/10/10	550	>Alert level 2 0,5m
16	Kien Giang	Kien Giang	01h/10/10	786	<Alert level 1 0,14m



Accumulated rainfall during Otc 9, 2017

Accumulated rainfall during Otc11, 2017



Water level process at Kim Tan station during Otc 9-12, 2017

Water level process at Giang station during Otc 9-12, 2017

Fig. 24: The distribution of daily rainfall and flood at Song Ma river.

In the first nine months of the year, the flows on almost of the rivers of the Central and Highland regions were in high levels, increasing 10 to 30% when compared with the annual average. Some rivers in Quang Nam, Quang Ngai, Phu Yen, Binh Thuan provinces were about 70% higher than the annual average.

Especially, the flow on Thu Bon river at Nong Son station and Song Luy river at Song Luy station were significantly higher with recorded level of over 200%. The flow on some rivers in Thua Thien Hue, Khanh Hoa, Binh Thuan provinces were at low levels, decreasing from 20 to 40% when compared with the annual average. Particularly, Flow on Ta Trach River at Thuong Nhat station and Cai Nha Trang river at Dong Trang station were 50 to 80% lower than the annual average.

2.2.2. Southern

From January to May, the water level on upstream of Mekong river system was higher than the annual average of 0,45m to 0,55m. At the end of May, due to the influence of upstream flood combined with flood-tide, the water levels at Tan Chau and Chau Doc stations were higher than 0.1m to 0.3m compared to the same period in 2000.

Flood on the Mekong River were appeared in the second half of July, The water levels at all stations on the Mekong mainstream were higher than 1.0m to 4.0 m compared to the annual average. In June and July, the flows recorded at mainstream stations were higher than the annual average from 20% to 40%. The flows recorded at the downstream stations of Mekong Basin (from Cambodia) are equal to the values in 2011. The water levels on Cuu Long River at Tan Chau and Chau Doc stations were higher than 0.3m to 0.6m compared to the annual average because of affect of the tide.

During in the dry months, salinity intrusion in the Mekong Delta was basically lower than recent years, causing less effect to the agricultural production and people's livelihood.

In the first nine months, the water levels on the Mekong River were lower than 0.2m to 2.0m compared to the annual average. The water levels on the downstream of Mekong River were strongly influenced by the tides and always in lower levels when compared with recent years from 0,2m to 0,4m.

2.2.3. Flash Floods:

On July27, 2017, a heavy rain caused the severe flash floods in Nhan Cu, Nhan Ly, Ban Canhvillages in Ta Ca commune, Ky Xuan district, Nghe An province. The flood damaged people's livelihood.



Fig. 25: Flash flood at Ta Ca, Nghe An

3. Socio-Economic Assessment

3.1. Damage situation in 2016

In 2016, the disaster situation in our country is complicated with high magnitude of impacts and abnormalities such as damaging cold, ice in Northern provinces and droughts, seawater intrusion in the provinces of the Mekong and Delta South Central, Central Highlands which has reached historical level, 10 storms and 7 tropical depressions in the East Sea (within 6 storms and tropical depressions hitting in Vietnam directly), and other hazards that was caused unseasonal big rains and floods happened in Central region; also river bank, coastline erosion, thunderstorms, and strong winds occur in many regions of the country. Natural disasters in 2016 caused serious human resources and assets losses, including:

- Casualties: 264 were killed and/or reported missing (215 by storm, floods, flash floods, land erosion and post-storm rains and floods, 49 by tornados and thunderbolts, tides, strong wind on the sea and other natural disasters); 431 were injured.

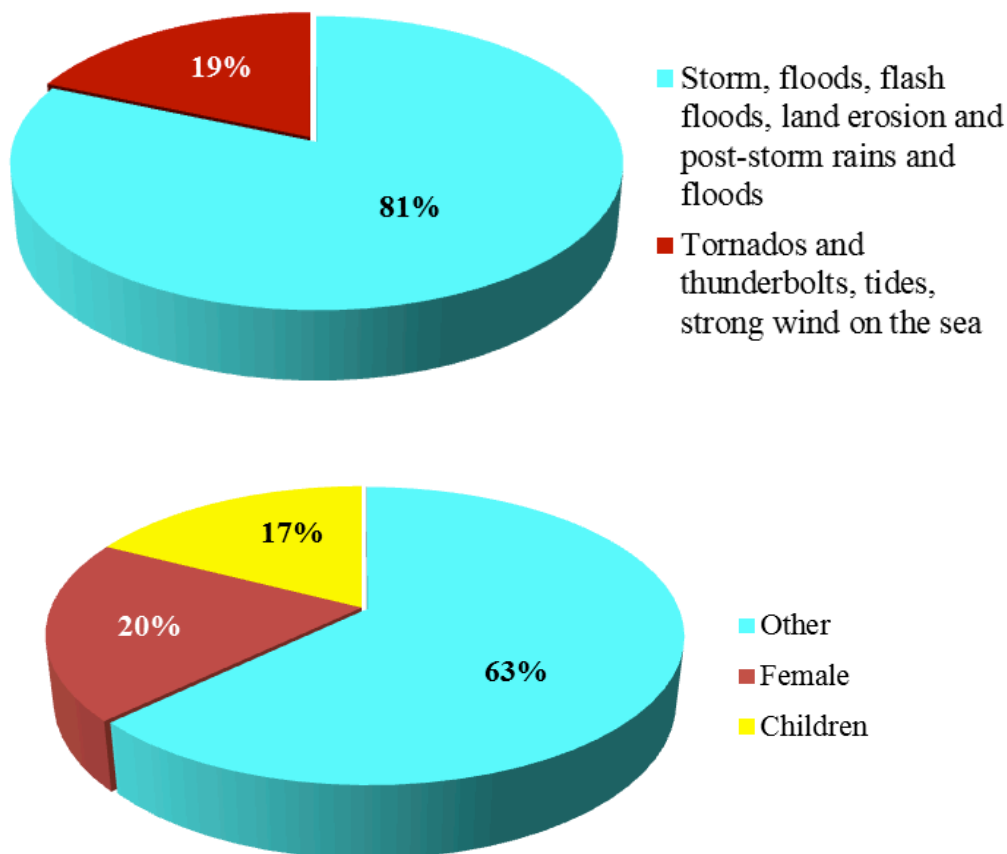


Fig 26: Total human resources and assets losses

- Houses: 5,134 houses were down and/or swept away; 364,997 houses were flooded, damaged, and/or unroofed.

- Agriculture: 828,661 ha of rice and crops, 263,445 ha of industrial and fruit crops were damaged, 75,874 cattle and 1,860,026 livestocks were killed.

- Irrigation: 7,112m dykes of grade 3 and special grades, 43,104m dykes below grade 4, 64,866m of embankments, 937,858m of canals, and 538 small lakes and dams were damaged.

- Transportation: 2,698,182m³ of soil and rocks were caused to erode from national, provincial and rural transport roads, 927 bridges and drains were damaged.

- Aquaculture: 109,341 ha of aquaculture area and 3016 cages of fish culture were damaged

Total asset damages were estimated about 39,726 billion VND.

3.2. Damage Situation in 2017 (From January to September 01st)

Since early 2017, the disaster situation in our country is complicated, unusual and extreme for various types of natural disasters such as heavy rain, flooding in the Northern, Southern Central provinces and Central Highlands, the extreme hot weather in the Northern provinces and from Thanh Hoa to Phu Yen, flash floods, landslides in the Northern mountainous provinces, whirlwinds, lightning occurring many places across the country, and especially the No. 10th typhoons hits Ha Tinh - Quang Binh which is the strongest storm in nearly 30 years historical record (since 1990), reach to level 4 of the Level of risk.

- Casualties: 245 people dead or missing (including storms, floods, flash floods: 218 people; tornado, lightning and other natural disasters: 27 people); 317 people were injured;

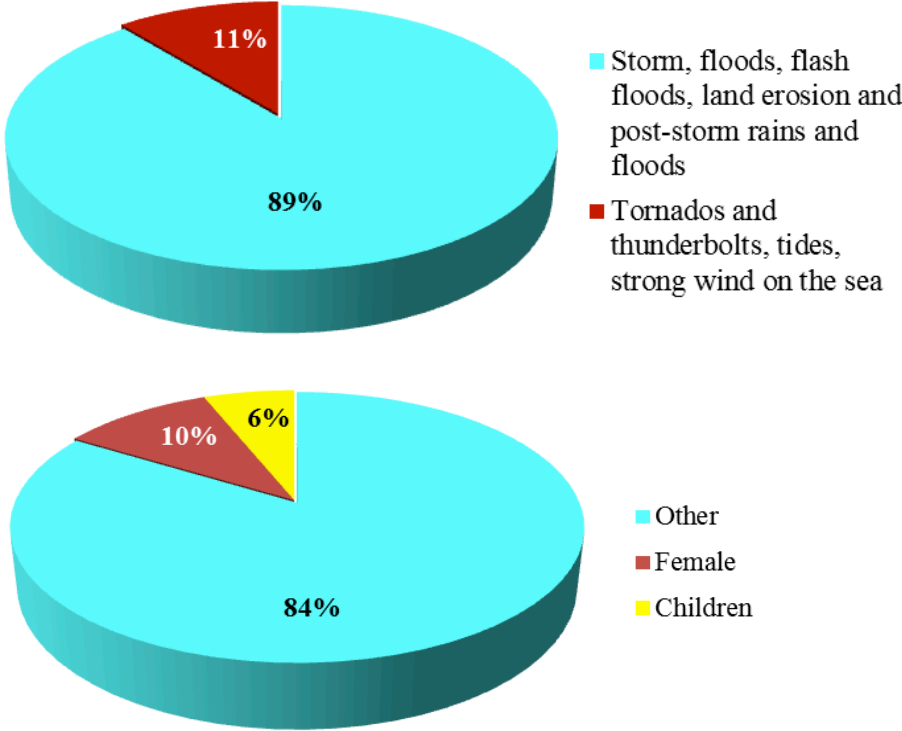


Fig. 27: Total human resources and assets losses

- Houses: 4,509 houses collapsed and washed away; 273,873 houses were flooded, unroofed and destroyed;

- Agriculture: 305,446 hectares of rice and crops; 71,824 ha of industrial crops, fruit trees, perennial crops damaged; 12,090 cattle and 281,153 livestock; 11,899 ha of aquaculture area and 2,644 damaged cages; 13,624 electric poles were broken, pouring.

- Transportation: 1,920,100m³ of soil and rocks eroded roads;

- Irrigation: 110 lakes, small dams were damaged, 216,646m of canals damaged; 43,793m embankments were eroded;

Total damage is estimated at **25,967 billion VND**.

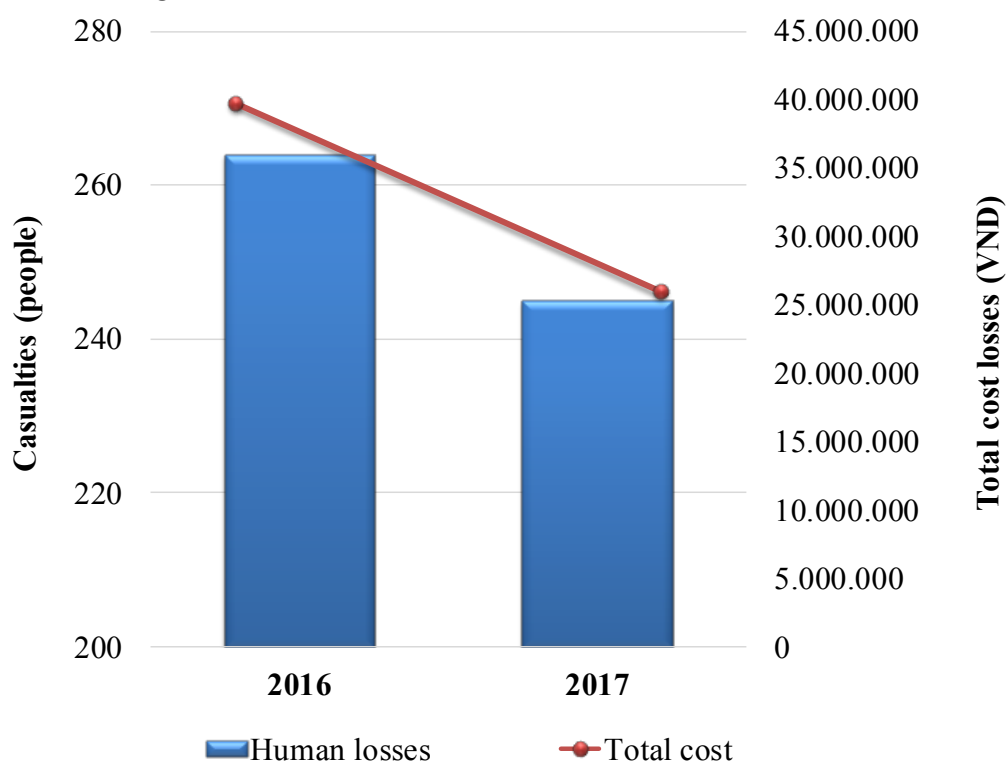


Fig. 28: Compare human resources and assets losses in 2016 and 2017

II. Summary of progress in Key Result Areas

1. Activities of Regional Forecasting Support Center (RFSC) on the Severe Weather Forecasting Demonstration Project (SWFDP) for Southeast Asia

The Severe Weather Forecasting Demonstration Project (SWFDP) is a WMO Commission of Basic Systems (CBS) initiative, commenced in 2005, to demonstrate how warning services provided by NMHSs in developing countries can be enhanced and linked with disaster management authorities improved through cooperative work among meteorological centers. The WMO GDPFS has been recognizing the role of a new class of Regional Forecasting Support Centre (RFSC) in the context of the SWFDP. The most suitable center to fulfill the functions of a Regional Centre in an SWFDP subproject may not always be a WMO-designated RSMC. In this situation, an SWFDP RFSC may perform similar functions to an existing RSMC (with geographical specialization) within its Regional Association, but also provide regional severe weather forecasting guidance products for the SWFDP, for a group of meteorological services in the close vicinity of the RSFC, and for the short- to medium-range only (initially up to 5 days ahead).

Following the “*SWFDP Guidebook for planning Regional Subprojects*”, a SWFDP-SeA Implementation Plan was developed for the anticipated meeting of the RSMT, wherein the responsibilities and functions of the Regional Forecasting Support Centre (RFSC) in Hanoi are described, as follows:

- to redirect toward the NMHSs relevant products issued from the global centre (if necessary);
- to provide NMHSs with its own interpretation of the medium-range guidance, including EPS products;
- to provide the NMHSs with the short-range NWP guidance (including products adapted to severe weather events), as frequently as possible;
- to indicate existing satellite/radar imagery and satellite/radar based products that could be used for now casting purposes;
- to issue Daily Severe Weather Forecasting Guidance products summarizing interpretation of NWP products with respect to severe weather over the responsibility area of the NMHSs;
- to provide the other centers with short-range NWP guidance and EPS output including probabilistic products specially adapted to the concerned severe weather events;
- to tailor products to the requirements of the National Centers including the provision of sub-domains and probabilistic products;
- to evaluate its own interpretation of EPS products as well as its NWP guidance;
- to provide global centers with a feedback about the usefulness and efficiency of global products;

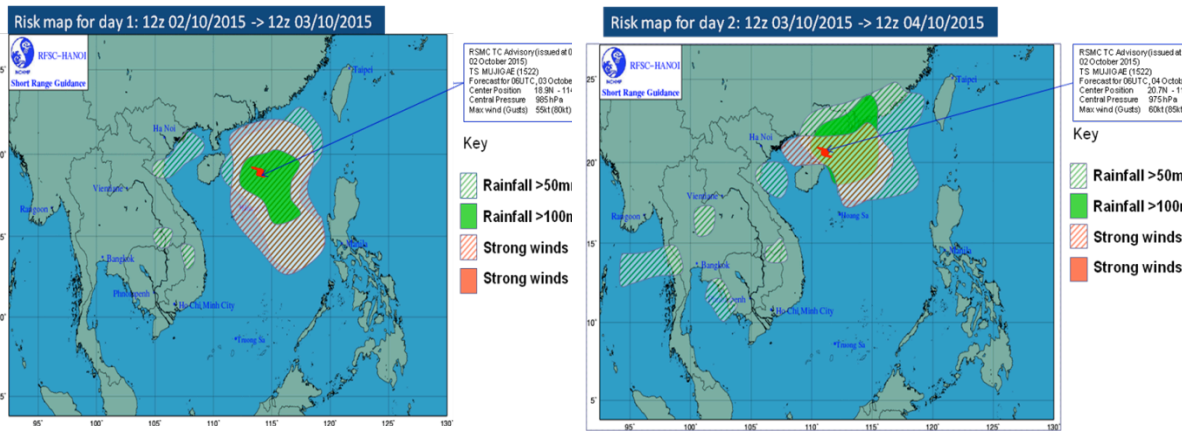
The above additional functions of RFSC Hanoi in the context of the SWFDP regional subproject is not intended to affect the existing national responsibilities of National Center of Hydro-Meteorological Forecasting of Vietnam (NCHMF).

Current activities

Currently, all the SWFDP-SeA activities over web portal (NWP products, guidance) are maintained by the numerical weather prediction and remote sensing division of NCHMF. The guidance has been provided by forecasters operationally since January 1, 2016 on 24/7 basis in the third phase or demonstration phase of this project. All products have been sharing on a password-protected website <http://www.swfdp-sea.com.vn/index>. As dedicated in plan, the guidance domain was also expanded to cover Myanmar domain.

In terms of technology, the HimawariCast Receiving and Processing Systems were installed in NHMSs in 2015 under the support of WMO and JMA. In terms of guidance, RFSC Hanoi has presented the highly support by enhancing the minute description of short and medium range guidance through the collaboration with RMSC Tokyo to release the guidance in the case of tropical storm (TS) and tropical cyclone (TC) occurred over the Southeast Asia domain. Figure 1 illustrates an example of risk maps and guidance issued during the occurrence of Tropical Storm

MUJIGAE in October, 2015. In the short range guidance, RMSC Hanoi referred to RMSC TC Advisory and pointed out the important parameters such as the center position, center pressure and maximum wind as well as indicated the risk of heavy precipitation and strong winds at respective thresholds with degree of confidence.



Regional Forecasting Support Centre (RFSC)
Hanoi

RFSC Guidance Product for SWFDP-Southeast Asia
SHORT-RANGE (DAY 1 and DAY 2)

Issue time: 0800Z Fri 02nd Oct, 2015

Valid time: DAY1: 1200Z Fri 02nd Oct to 1200Z Sat 03rd Oct 2015
DAY2: 1200Z Sat 03rd Oct to 1200Z Sun 04th Oct 2015

Preamble

RFSC Guidance Products are based on a skillful evaluation of both Global and Regional model outputs for the domain area, satellite imagery at the hour of the issue and expert interpretation that takes into consideration interactions with the local features. For generating the guidance products, the following criteria are used:

- Heavy precipitation: > 50mm/24h & > 100mm/24h (the risk over 200mm/24 shall be described in discussion text)
- Strong Winds: > 30 Knots (over land and Sea) > 60 Knots (over Sea)

Assessment Scale for the Degree of Confidence of Forecast:
Confidence Level >75% (High), Confidence Level 50-75% (Medium), and Confidence Level <50% (Low)

Synoptic Situation BOTH DAYS:
Over the Southeast Asia domain:

- A continent high system (located in China) is expected to be decreased in DAY1 and then it is expected to be increased in DAY2
- A trough lies across the center of Vietnam connect to the Tropical Storm MUJIGAE which will affect Bien Dong Sea next day. This trough axis is expected to move northward
- The southwest monsoon prevailing over the south of the Sea domain has moderate to strong intensity
- Tropical Storm name "MUJIGAE" (1522), located approximately 16.7N-118.7E at 06:45UTC, 02nd October 2015 (more details see <http://www.ima.ap.jma.go.jp/eng/trph/>)

Risk over Southeast Asia domain next 24h and 48h and degree of Confidence

- In DAY1:
 - The risk of strong wind with threshold >30kts is expected over the north and center of Bien Dong Sea (high confidence)
 - The risk of heavy rain is expected over the north and center of Bien Dong Sea with threshold 50-100 mm/24h (high confidence) and 100-150mm/24h (medium confidence)
 - The risk of heavy rain with threshold 40-60mm/24h is expected over the Tonkin Gulf (low confidence)
 - The risk of heavy rain with threshold 40-60mm/24h is expected over the center of Vietnam (low confidence)
 - The risk of heavy rain with threshold 40-60mm/24h is expected over the area between Laos and Thailand (low confidence)
- In DAY 2:
 - The risk of strong wind with threshold >30kts is expected over the north of Bien Dong Sea and the Tonkin Gulf (high confidence)
 - The risk of heavy rain is expected over the north of Bien Dong Sea with threshold 50-100mm/24h (high confidence) and 100-160mm/24h (high confidence)
 - The risk of heavy rain with threshold 40-60mm/24h is expected over the Tonkin Gulf (medium confidence)
 - The risk of heavy rain with threshold 40-60mm/24h is expected over the south of Laos (medium confidence)
 - The risk of heavy rain with threshold 40-60mm/24h is expected over the center of Thailand (low confidence)
 - The risk of heavy rain with threshold 40-60mm/24h is expected over the Thailand Gulf and the west of Cambodia (medium confidence)

Surface analysis maps:

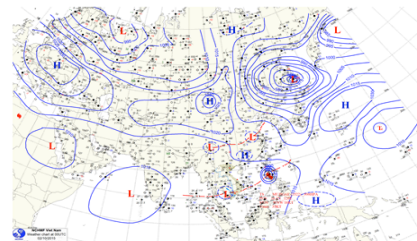


Fig. 29: Example of risk map during tropical storm MUJIGAE

Nevertheless, in the first quarter of 2017, all products were managed to stopped temporarily due to the relocation of NHMS's main building and NCHMF's HPC system. Therefore, there were a significant of products that were unable to access through SWFDP website during this time.

Future plans

For improving the SWFDP, there are still some future considerations that should be taken into account. Firstly, in order to improve the quality of guidance bulletins, RFSC's Hanoi needs to enhance the knowledge of forecast experiences over different countries in Southeast Asian domain. The training desk with experts from Hong Kong Observatory (invited by WMO) will be held in Hanoi (1-2 weeks) in 2017-2018. The object of the training desk is to improve the guidance between RFSC and SWFDP participating NHMSs.

Secondly, the plan of applying the results of WMO fellowship program at ECMWF with the main topic on verification for Vietnam as well as for other countries over SeA (need local data and global/regional NWP archives) need to be taken as soon as possible.

Moreover, the limitation of regional NWP including horizontal resolution, data assimilation of local data such as radar and observation, and verification information of different countries. Therefore, it is essential to update HPC system at NCHMF in 2017-2020 to 80-100Tflops which would facilitate the downscaling simulation of NWP models to 2-3 kilometers in operation over SeA domain. Last but not least, a discussion with WMO and member of SWFDP-SeA is needed to indicate the next steps of RFSC and SWFDP-SeA (capabilities of Vietnam).

Working group for RFSC in Hanoi



III. Update of Members' Working Groups representatives

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