MEMBER REPORT

ESCAP/WMO Typhoon Committee
7th Integrated Workshop

REPUBLIC OF KOREA

Nanjing, China
26-30 November 2012

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I. Overview of tropical cyclones which have affected/impacted Member's area in 2012

1. Meteorological Assessment (highlighting forecasting issues/impacts)

This year five typhoons, Khanun(1207), Damrey(1210), Bolaven(1215), Tembin(1214) and Sanba(1215), affected the Korean peninsula between July and September. The four typhoons (except for Damrey) made landfall on the Korean peninsula for the first time since 1962. The tracks of the typhoons were given in Fig. I-1-1. The detailed information of those five typhoons is described below.

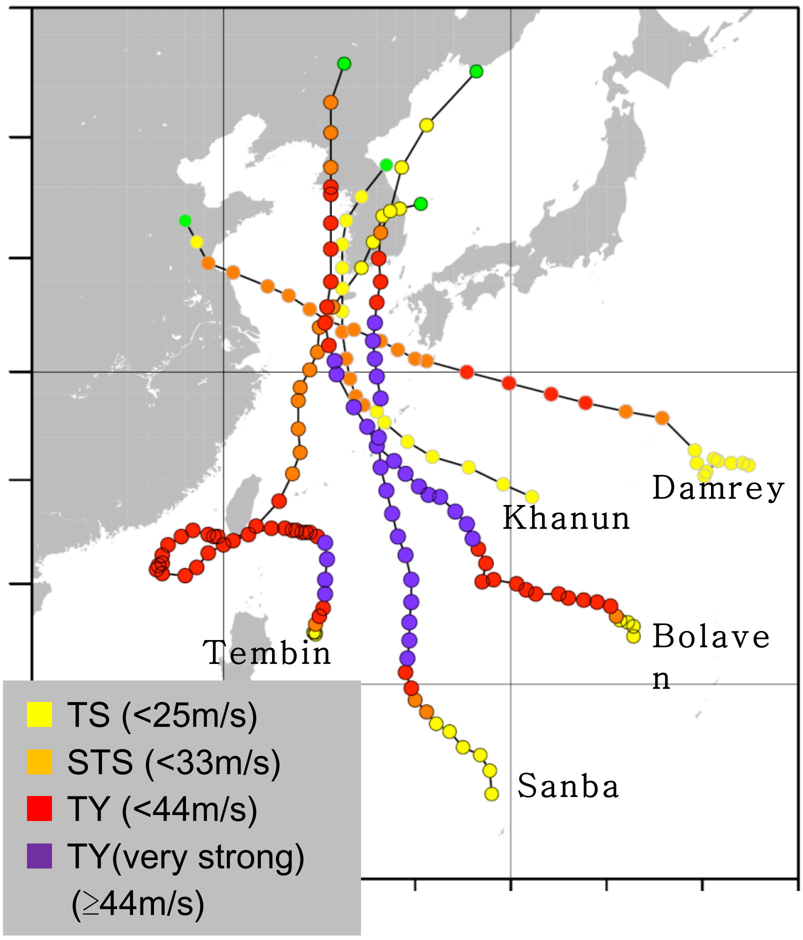


Fig. I-1-1. typhoon tracks influencing the Korean Peninsula in 2012

a. Typhoon ‘Khanum(1207)’

The typhoon ‘Khanun’ became a tropical storm around 06UTC, 16 July when it was located about 870 km ESE of Okinawa, Japan. It reached its peak intensity of only about 25m/s around 18UTC, 17 July while it moved over warm sea. After its peak, Khanun weakened rapidly as it moved northward close to the coast of western Korean Peninsula. The typhoon landed in Taean County around 21 UTC, 18 July and passed northeasterly through land. And then it dissipated around 03UTC 29, July over the East Sea about 70 km N of Sokcho.

The heavy rainfall was concentrated in the Jeju Island and the western part of Korea, recording over 40 mm. The precipitation amount around the tops of Mt. Halla and Mt. Jiri exceeded 150mm due to orographic effects. The peak gust also exceeded 30 m/s in some parts.

(a) Accumulated rainfall (18-19, July) (b) The Maximum wind speed (19 July)

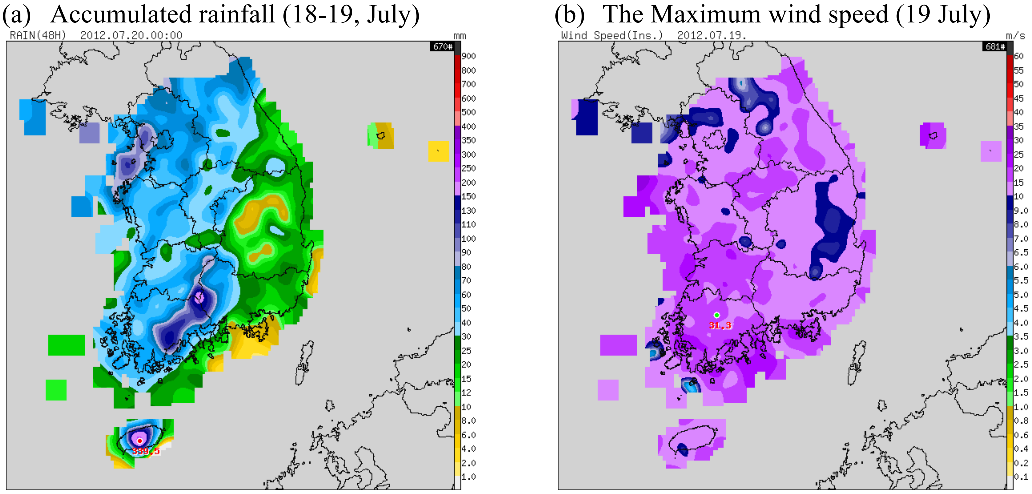


Fig. I-1-2. Distribution of Accumulated rainfall and daily maximum wind speed while Khanun(1207) was influencing the Korean peninsula

Table. I-1-1. The observed extreme values from weather stations only

	Weather station	Value Observed	Time Observed
Minimum mean see level pressure	Gosan (in western part of Jeju Island)	986.8 hPa	10:30UTC 18 July
Maximum wind speed	Wando	22.1 m/s	12:40UTC 18 July
Peak Gust	Wando	30.0 m/s	12:32UTC 18 July
Accumulated rainfall	Suncheon	135 mm	18-19 July (Local time)

b. Typhoon ‘Damrey(1210)’

Typhoon ‘Damrey’ was formed at 12UTC, 28 July over the ocean about 1330 km SE of Tokyo, Japan. It was upgraded to a typhoon around 06 UTC, 31 July while it was moving westward on the south side of strengthening WNPH during the next several days.

Because the WNPH extended westward into the Korea Peninsula in early August, Damrey did not make landfall on the Korean peninsula. So the typhoon influenced the only limited areas (Jeju Island and the southern coast).

Damrey continued to move westward and landed at 18UTC, 2 August in the southwestern coast of Qingdao, China. After landing, it quickly weakened following its extratropical transition by 06UTC, 3 August.

(a) Accumulated rainfall (1-2 August) (b) The Maximum wind speed (2 August)

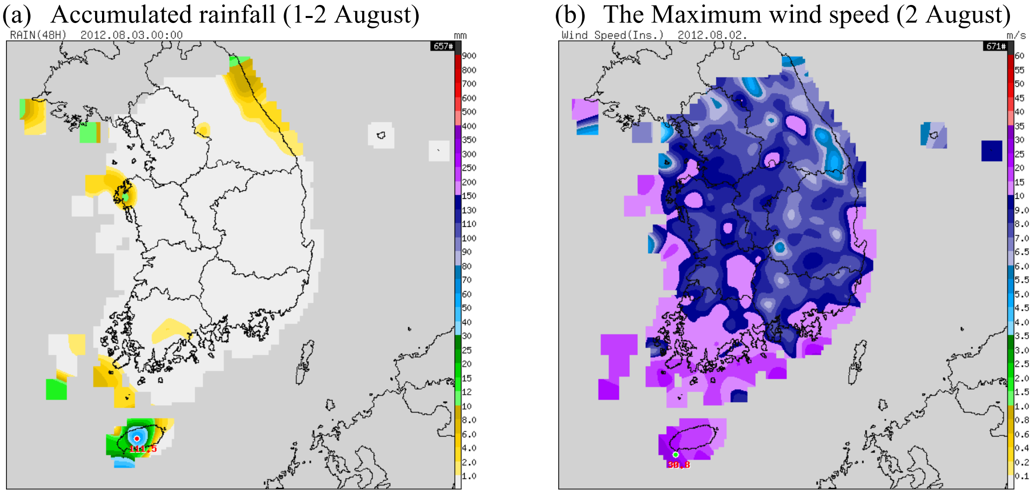


Fig. I-1-3. Distribution of Accumulated rainfall and daily maximum wind speed while Damrey(1210) was influencing the Korean peninsula

Table. I-1-2. The observed extreme values from weather stations only

	Weather station	Value Observed	Time Observed
Minimum mean see level pressure	Gosan (in western part of Jeju Island)	997.9 hPa	19:25UTC 1 August
Maximum wind speed	Gosan	16.2 m/s	18:28UTC 1 August
Peak Gust	Gosan	25.1 m/s	20:32UTC 1 August
Accumulated rainfall	Jeju city	19.5 mm	1-2 August (Local time)

c. Typhoon ‘Bolaven(1215)’

Typhoon ‘Bolaven’ was formed around 06UTC, 20 August over the ocean about 570 km NW of Guam. In the early stage of northwestward slow movement, it strengthened rapidly over warm ocean and developed a ‘very strong’ typhoon of large scale with 53 m/s maximum sustained wind and 550 km radius (of 15 m/s) around 00 UTC, 26 August. Bolaven then maintained its intensity over the next 51 hours. It was recorded the strongest typhoon which passed over Yellow-Sea since 2000.

After Bolaven reached 30°N, it was no longer intensified due to relatively colder ocean and it began to weaken. And it dissipated by 21UTC, 28 September about 220 km N of Kanggye in Pyeongan Province.

The influence of Bolaven was focused on the Jeju Island, the western and southern coast of the Korean peninsula from 27 to 28, August (Fig. I-1-4). The recorded extreme values for the couple of days were as follows: the accumulated precipitation at Jeju city in Jeju Island was 305.9mm; the maximum wind speed at Wan-do was 36.3 m/s and the peak gust was 51.8 m/s, the fifth strongest one caused by typhoons. But there was little rainfall impact because Bolaven had the shape of a ‘north-half-only’ rain band. This was due to the wind convergence northward by the jet in the southern part of the typhoon.

(a) Accumulated rainfall (27-28, August) (b) The Maximum wind speed (28 August)

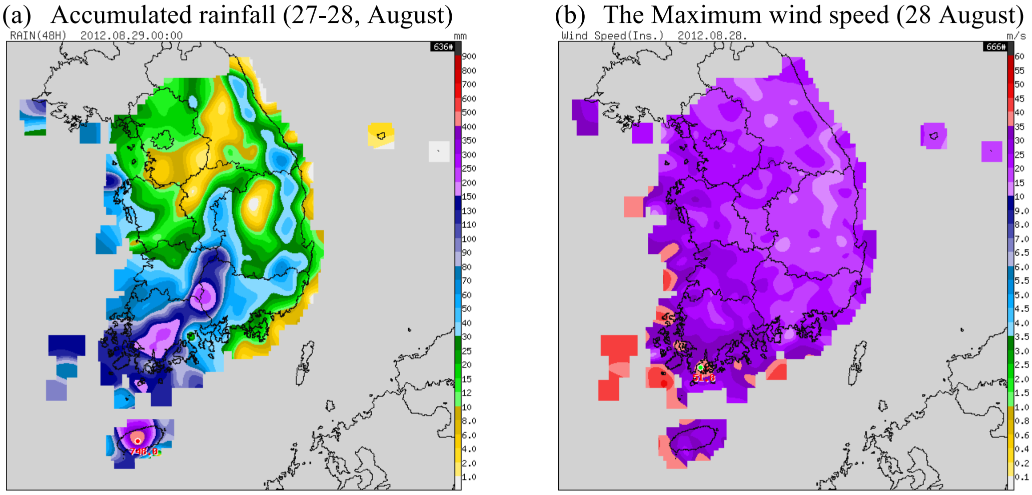


Fig. I-1-4. Distribution of Accumulated rainfall and daily maximum wind speed while Bolaven(1215) was influencing the Korean peninsula

Table. I-1-3. The observed extreme values from weather stations only

	Weather station	Value Observed	Time Observed
Minimum mean see level pressure	Heuksan-do	961.9 hPa	22:37UTC 27 August
Maximum wind speed	Wan-do	36.3 m/s	21:19UTC 27 August
Peak Gust	Wan-do	51.8 m/s	21:16UTC 27 August
Accumulated rainfall	Jeju city	305.9 mm	27-28 August (Local time)

d. Typhoon ‘Tembin(1214)’

Typhoon Tembin(1214) developed at around 00UTC, 19 August over the ocean about 530 km NE of Manila, the Philippines. As it moved slowly northward over warm ocean with relatively high heat content, it reached its peak intensity within two days later. But it weakened as it turned westward and passed the southern side of Taiwan. And it began to form a counterclockwise loop over the southwestern sea of Taiwan influenced by the relatively strong Bolaven approaching from its eastern part.

After staying over the southwestern sea of Taiwan, Tembin immediately moved toward the Korean peninsula along the track of Bolaven. Within less than 2 days, it arrived in Wan-do, Jeolla Province around 01:45UTC, 30 August. It then rapidly weakened while passing on land and dissipated by 15UTC, 30 August over the East Sea.

The heaviest rainfall was concentrated in the Jella Province and Chungcheong Province, recording over 200mm. And the peak gust exceeded 30 m/s in the Jeju Island, the western and southern cost of Korean peninsula (Fig. I-1-5). The recorded extreme values while Tembin passed through the land area was as follows:

The accumulated precipitation at Jin-do on 30-31 August was 243.5 mm; the maximum wind speed at Gosan in the western part of Jeju Island was 27.2 m/s and the peak gust was 34.1m/s .

(c) Accumulated rainfall (29-30 August) (d) The Maximum wind speed (30 August)

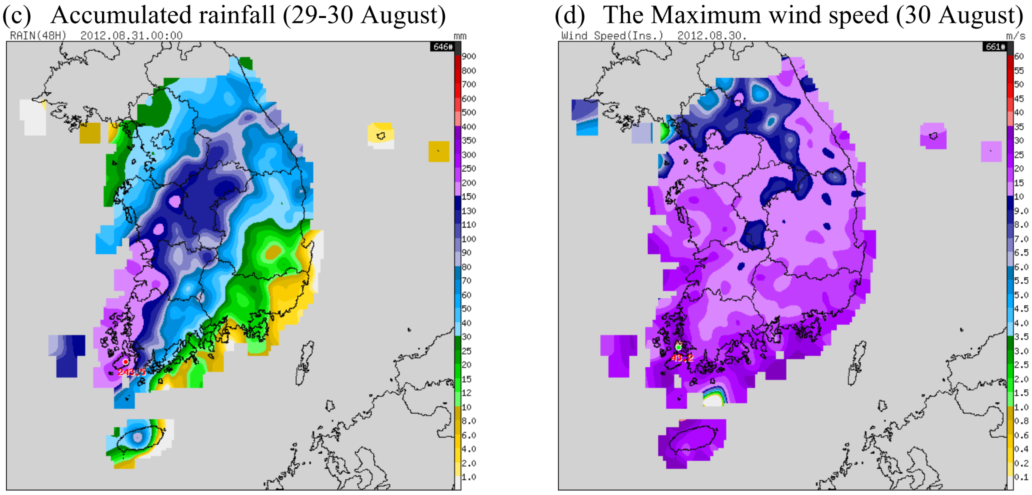


Fig. I-1-5. Distribution of Accumulated rainfall and daily maximum wind speed while Tembin(1214) was influencing the Korean peninsula

Table.I-1-4.The observed extreme values from weather stations only

	Weather station	Value Observed	Time Observed
Minimum mean see level pressure	Jeju city	984.5 hPa	22:37UTC 29 August
Maximum wind speed	Gosan	27.2 m/s	00:15UTC 30 August
Peak Gust	Gosan	34.1 m/s	00:07UTC 30 August
Accumulated rainfall	Jin-do	243.5 mm	29-30 August (Local time)

e. Typhoon ‘Sanba(1216)’

Typhoon Sanba(1216) was formed around 00UTC, 11 September over the ocean about 1530 km NE of Manila, the Philippines. Moving over relatively warm SST, it gradually intensified and reached its peak intensity of 56 m/s around 06UTC, 14 September. This is the strongest of all affected typhoons in 2012. But the typhoon rapidly weakened as it moved over cool water later.

Sanba moved northward along the western edge of WNPH and made landfall at Namhae-gun in Jeolla Province around 02:30UTC 17 September. It exited over the East Sea around 12UTC 17 September and underwent an extratropical transition over the ocean 90 km NE of Sokcho at 00 UTC next day.

Sanba mainly hit the Jeju Island and the southern and eastern coast of Korean peninsula from 16 to 17, August (Fig. I-1-6). The recorded extreme values while Sanba passed the Korean peninsula were as follows: The accumulated precipitation around the top of Mt. Halla in Jeju on 16-17 September, recorded 845 mm; peak wind recorded in Gosan was 29.3 m/s and the peak gust was 39.4 m/s in Tongyeong on 17 September (Fig.).

(e) Accumulated rainfall (16-17 September) (f) The Maximum wind speed (17 September)

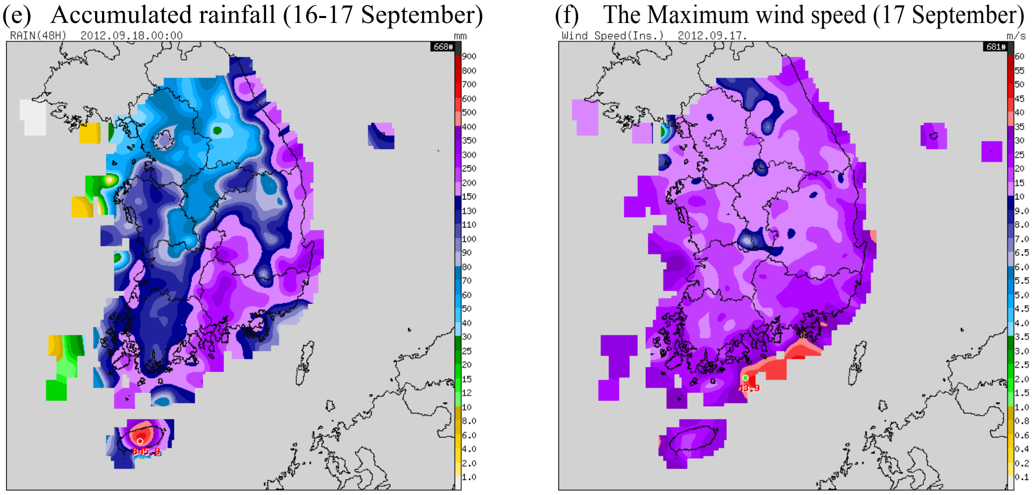


Fig. I-1-6. Distribution of Accumulated rainfall and daily maximum wind speed while Sanba(1216) was influencing the Korean peninsula

Table.I-1-5.The observed extreme values from weather stations only

	Weather station	Value Obsserved	Time Observed
Minimum mean see level pressure	Namhae (in the southern coast)	964.6 hPa	02:25UTC 17 Sept.
Maximum wind speed	Gosan	29.3 m/s	20:04UTC 16 Sept.
Peak Gust	Tongyeong	39.4 m/s	02:39UTC 17 Sept.
Accumulated rainfall	Jeju city	399.2 mm	17-18 Sept. (Local time)

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

a. Typhoon No. 7 ' Khanun' moved toward to the north direction (7. 18~19)

'Khanun' is the 7th typhoon originated from the Pacific Northwest, and influenced Korea for the first time in the year of 2012. The rainfall was mainly concentrated on Jeonnam and Gyeonggi provinces. The overall averaged precipitation of it was 43.5 mm, and regional precipitations of Suncheon city in Jeollanam-do, Jeju city in Jeju Special Self-Governing Province, and Seoul city were 97.5 mm, 53.4 mm, and 37.5 mm, respectively. On July 19th, the low-water level of Soyanggang Dam was 171.13m, and the inflow rate of water was 412.2 m^3/s with total discharged amount was 30.6 m^3/s. As of the morning on July 19th, the typhoon No. 7 'Khanun' was determined after passing through the metropolitan area on the West Sea. As a result, all typhoon warnings influenced most of the country were cleared in the afternoon.

b. Typhoon No. 15 ' Bolaven ' moved toward to the north direction

'Bolaven' is the 15th typhoon originated from the Pacific Northwest, and it was the second largest super typhoon encountered Korea after the typhoon No.4 'Guchol' with its maximum central pressure of 910 hPa. Bolaven was located 120 km away from Mokpo city on southern west direction as of 06:00AM on August 28th, and it has reached 80km distance of Seosan city on the West Sea.

Due to the influence of the typhoon, the rainfall was mainly concentrated on Chongnam province and Yeongnam mountain regions. The top three regions with the highest precipitation were Jeju city, Gangjin, and Haenam with the precipitation of 305.9 mm, 217.0 mm, and 203.5 mm, respectively. On August 28th, the low-water level of Soyanggang Dam was 178.29 m, and the inflow rate of water was 164.1 m^3/s with total discharged amount was 46.1 m^3/s. Typhoon warnings were declared on the entire nation, and the typhoon warming was cleared on the noon of Aug. 29th.

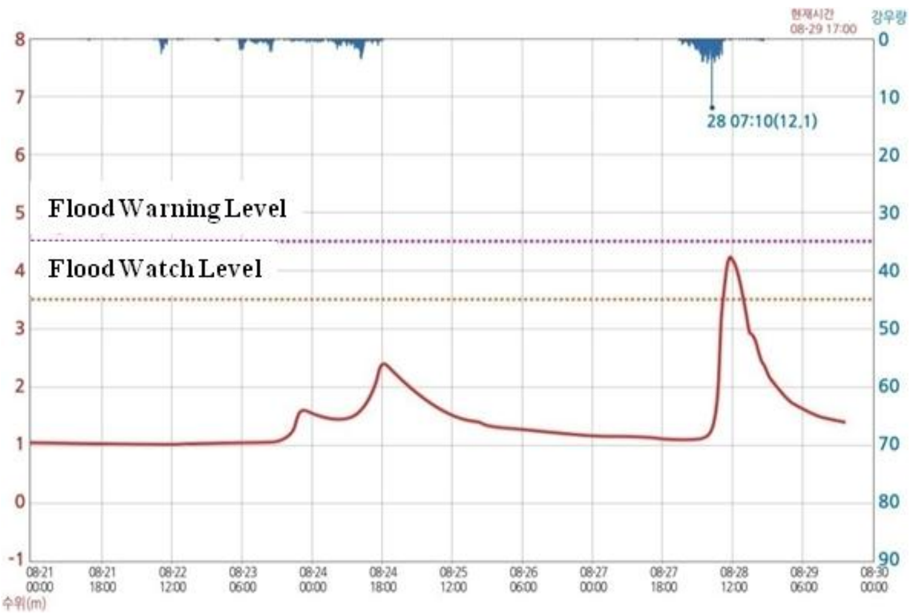


Fig. I-2-1. Flood Warning in Youngsan Riv. (1 Flood Warning, 2 Flood Watch) on 28 Aug 2012

c. Typhoon No. 14 ' Tembin ' moved toward to the north direction

‘Tembin’ is the 14th typhoon originated from the Pacific Northwest, and abnormal movement path occurred due to the fujiwhara effect caused by typhoon No. 15 Bolaven. It influenced Taiwan on both 23rd and 27th of August, and it is considered to be very rare. In addition, typhoon Tembin approached Korea right after typhoon Bolaven, and Tembin resulted in landing Korea later than the Bolaven.

’Tembin’ is the 14th typhoon influenced Korea in the year of 2012. The overall averaged precipitation of it was 118 mm, and strong rainfall occurred on the southwestern part of Korea. Regional precipitations of Jindo in Jeollanam-do, Mokpo city were 205 mm and 172.9 mm, respectively. A record of 30 mm/hr of rainfall was measured on Mokpo in the morning of August 30th. On August 31st, the low-water level of Soyanggang Dam was 179.63 m, and the inflow rate of water was 572.5 m^3/s with total discharged amount was 45.9 m^3/s. Since the typhoon Tembin landed the Korea on the more of right side than originally expected, and the damage to metropolitan area was less severe as a result. As a result, typhoon warnings declared on Suwon and southern portion of Gyeonggi-do were cleared as of 09:00 on Aug. 30th.

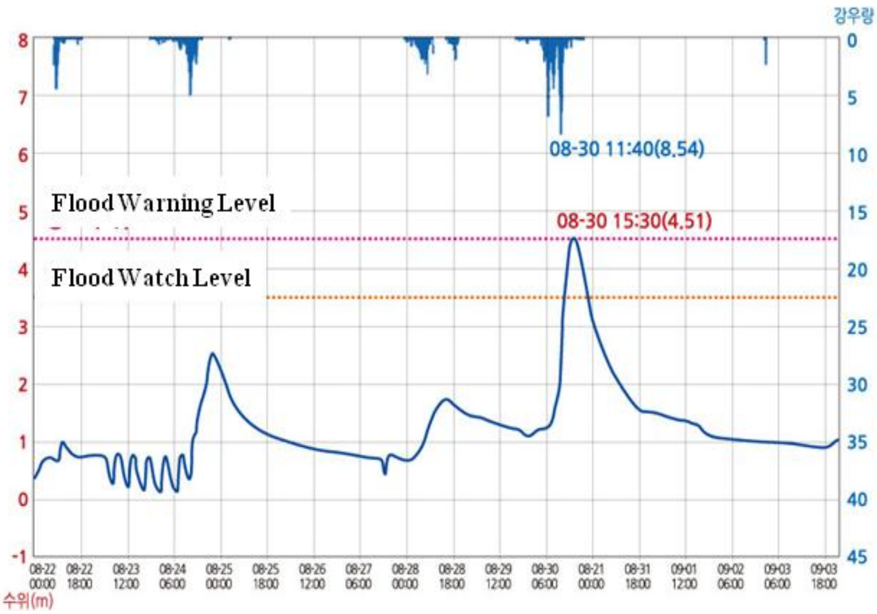


Fig. I-2-2. Flood Warning in Youngsan Riv. (1 Flood Warning, 4 Flood Watch) on 30 Aug 2012

d. Typhoon No. 16 ' Sanba' moved toward to the north direction

‘Sanba’ is the 16th typhoon originated from the Pacific Northwest, and it was the most powerful typhoon among the tropical cyclones occurred in the world in 2012. Typhoon No. 14 ‘Tembin,’ No. 15 typhoon ‘Bolaven,’ and this typhoon ‘Sanba’ were recorded as the first case of encountering three consecutive typhoons in Korea. With an additional typhoon ‘Khanun’ encountered in July, it has been the first record of getting four typhoons in a year ever since 1962.

Typhoon Sanba mainly caused heavy rain falls on East and west coasts, and Yeongnam regions. Regional precipitations of Uljin in Gyeongbuk and Yeongdoek-gun were recorded as 209.5 mm, and 120 mm, respectively. On Sep. 17th, the low-water level of Soyanggang Dam was 182.78 m, and the inflow rate of water was 443.2 m^3/s with total discharged amount was

31.4 ㎥/s. As of Sep. 17th, all typhoon warnings declared on the nation were cleared. However, a flood warning on Nakdong River was declared for the first time in 6 years due to the heavy rainfall on Yeongnam region. Maximum of 8.43 m water level on Samnangjin area, where the first flood warning was declared, was recorded in the early morning of Sep. 18th. This water level excited the 7m height of flood warning standard by more than 1 meter. This is because the typhoon 'Sanba' passed through Yeongnam region and caused a large amount of water to flow downstream of Nakdong River from its midstream.

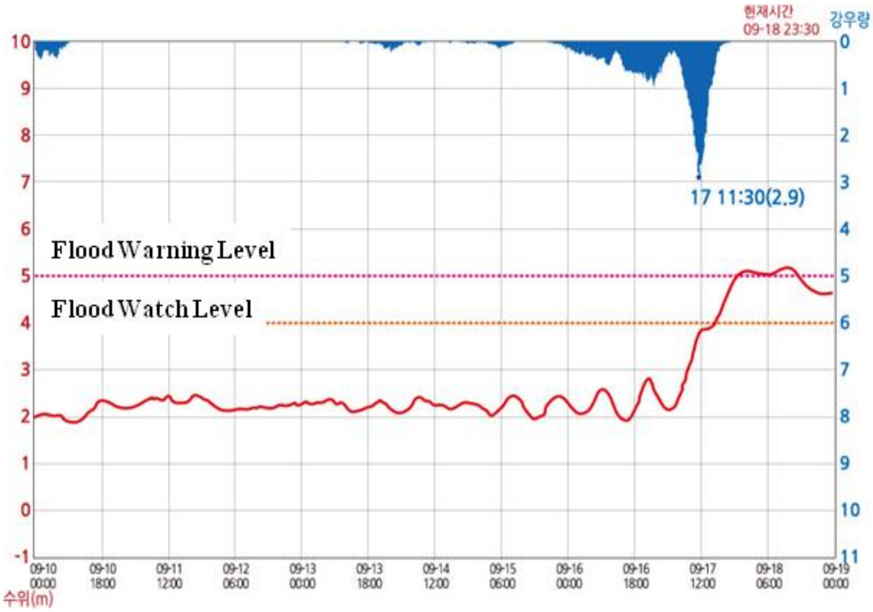


Fig. I-2-3. Flood Warning in Nakdongn Riv. (5 Flood Warning, 13 Flood Watch) on 17 Sep 2012

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

In 2012, Total 5 Typhoons (#7KHANUN, #10DAMREY, #14TEMBIN, #15BOLAVEN, #16SANBA) hit the Korean Peninsula. Among them, the 7th Typhoon KHANUN which influenced the Korean Peninsula for the first time in 2012, brought a severe drought to an end (precipitation from May to June was 30% smaller than usual). However, the 15th Typhoon BOLAVEN, the 14th Typhoon TEMBIN, and the 16th Typhoon SANBA continuously hit the Korean Peninsula during 3 weeks with large strength corresponding to Typhoon RUSA and MAEMI which caused enormous damages, particularly flooding in coastal areas. At that time, those continuous typhoons brought the tension of disaster management ministries and agencies.

However, in the face of three continuous typhoons, there were not considerable damages and losses of South Korea than expected as previously typhoon-induced disasters. It was evaluated that the governmental long term disaster risk reduction programs (e.g. Comprehensive plan for storm and flood damage reduction and so on.) having been conducted since Typhoon RUSA in 2002, helped local communities build capacity against typhoon-induced disasters. Also, the changes of public awareness on the natural disaster and disaster prevention by information sharing network using social media such as twitter, blogs, and SNS as well as central governmental disaster broadcast system were considered as good practices.

Typhoon-induced damages in 2012 with respect to five typhoons can be summarized as follows;

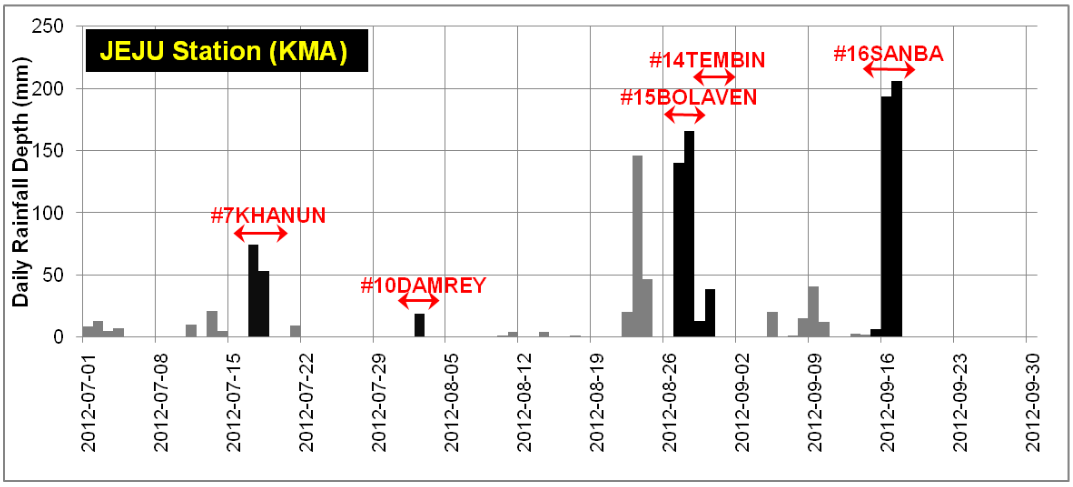


Fig. I-3-1. Temporal distribution of Typhoon-induced rainfall recorded at JEJU rain gage operated by Korean Meteorological Agency (Typhoon #14, #15, and #16 affected the Korean Peninsula continuously for three weeks with heavy rainfall)

a. KHANUN (#7)

Typhoon KHANUN (#7) hit the Korean Peninsula from 18 to 19 in July. By KHANUN, maximum accumulated rainfall and maximum instantaneous wind velocity was recorded 339mm (JINDALLEBAT station, Jeju) and 20.9m/s (SUNCHEON station, South-Jeolla) respectively. Major damages announced by National Disaster Prevention and Countermeasures Headquarters of Korea are as below;

- Causalities : 1 person (dead, wall collapse of dilapidated dwelling
- Residences : 1 (fully destruction), 28 (temporally inundated)
- Property : 13,000,000KW (about 12,000USD)
- Dam release : Namgang-dam, Boseonggang-dam
- Power outage : 26,236 households(12 districts, temporally)
- Transport cancellation : 98 ferry trips, 90 flight schedules
- Traffic control : Seoul (1), Gyeonggi (3), Incheon (3), Jeju (1)
- Windfall (fruit) : 230ha (South Jeolla, North Gyeongsang)


Flood in Pocheon (Gyeonggi district)


Flood in Anyang river basin


Flood in Yangjae river basin


Windfall (Suncheon, South Jeolla)

Fig. I-3-2. Photos related to major damages by Typhoon KHANUN.

b. DAMREY (#10)

DAMREY influenced the southern part of Korea including the Jeju island, South Gyeongsang and South Jeolla districts. It caused significant damages in China and Japan, but there were slight damages with small rainfall and relatively moderate wind compared with previous Typhoons affecting in Korea. Maximum accumulated rainfall depth was just 11.5mm (JEJU station) and maximum instantaneous wind velocity at ground level was recorded as 30.8m/s (GAPADO station). National Disaster Prevention and Countermeasures Headquarters of Korea reported that 26 schedules of ferry trips had been cancelled due to DAMREY.

Marine litter removal Telegraph pole damage

Fig. I-3-3. Photos related to major damages by Typhoon DAMREY.

c. TEMBIN (#14)

TEMBIN veered toward the Korean Peninsula due to *Fujiwara effect* by the 15th Typhoon BOLAVEN on 25 August. After BOLAVEN hit the Korean Peninsula, TEMBIN landed on the southern part of the Korean Peninsula in a day. Since BOLAVEN had influenced on South Korea with significant rainfall and storm, South Korea was expected to be affected on the subsequent damages in fluvial and coastal flooding by TEMBIN. Maximum accumulated rainfall and instantaneous wind velocity due to Typhoon TEMBIN were 244mm and 36.5m/s respectively (JINDO station). Major damages by TEMBIN are as below;

• Casualties : 2 persons (dead), 3 persons (injured)
• Residences : 2 (fully destruction), 3 (partially destruction), 75 (temporally inundated)
• Dam release : Paldang dam, Hoengseong dam, Namgang dam,
• Juam dam, Gunnam flood control dam
• Farmland inundation : 7,320ha
• Transport cancellation : 93 ferry trips, 1 flight schedules
• Traffic control : 7

Coastal inundation (Gangwon district) Road inundation (South Jeolla district)

Road collapse (South Jeolla district) Streetlight damage (Busan city)

Sewage over flow(South Jeolla district) Gochang-stream flood (North Jeolla district)

Fig. I-3-4. Photos related to major damages by Typhoon TEMBIN

d. BOLAVEN (#15)

BOLAVEN was the largest Typhoon in those hit the Korean Peninsula in 2012. Moreover, after BOLAVEN had hit South Korea, Typhoon TEMBIN was predicted to attack the Korean peninsula in a day (*Fujiwara effect*). Since the trajectory of BOLAVEN was the north direction along the West sea (the Yellow sea), the damages were caused all over the country. Maximum accumulated rainfall and instantaneous wind velocity due to Typhoon BOLAVEN were 305.9mm (JEJU station) and 51.8m/s (WANDO station) respectively. Major damages by BOLAVEN are as below;

- Casualties : 10 persons (dead), 2 persons (injured), 295persons (victims)
- Residences : 8 (fully destruction), 45 (partially destruction), 75 (temporally inundated)

• Property : non-estimated
• Ship: 96 (destruction)
• Load : 15 (destruction)
• Power outage : 1,966households
• Crop damage : 19,000ha
• Vinyl greenhouse : 4,616(destruction)
• Farmland inundation : 7,320ha
• Transport cancellation : 96 ferry trips, 453 flight schedules
• Traffic control : 11 (loads)

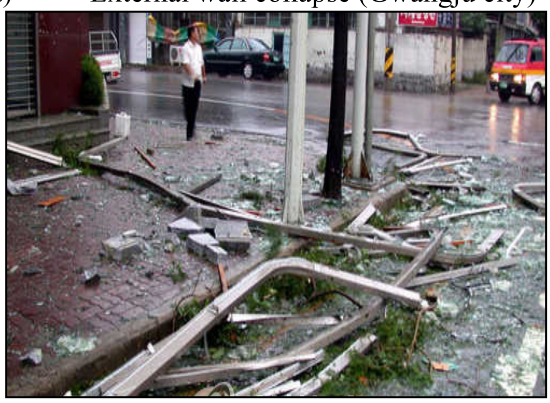
External wall collapse (South Jeolla district)

Windfall (South Jeolla district)

Temporally road installation (South Jeolla district)

External wall collapse (Gwangju city)

Street trees damage (Seoul city)



Streetlight damage (North Jeolla district)

Fig. I-3-5. Photos related to major damages by Typhoon BOLAVEN

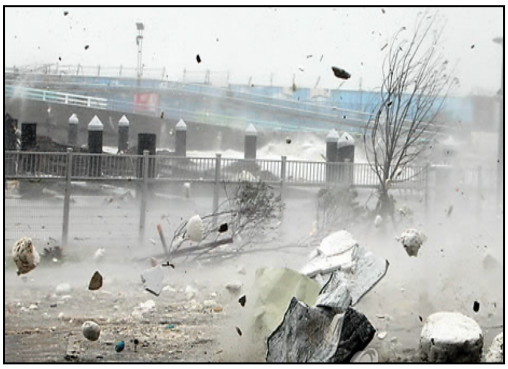
e. SANBA (#16)

Typhoon SANBA was the strongest tropical cyclone in the world after Typhoon MEAGI in 2010 (885hPa). Maximum accumulated rainfall and instantaneous wind velocity due to Typhoon SANBA were 405.2mm and 30.4m/s respectively (JEJU station). Major damages by SANBA are as below;

- Casualties : 2 persons (dead), 2 persons (injured)
- Residences : 8 (fully destruction), 315 (partially destruction)
- Commercial building :352 (temporally inundated)
- Property : non-estimated
- Dam release : Sumjigang dam, Namgang dam, Milyang dam
- Ship : 11 (inundated)
- Load : 122 (destruction)
- Power outage : 527,146 households
- Vinyl greenhouse : 578(destruction)
- Farmland inundation : 5,650ha
- Transport cancellation : 7 ferry trips, 283 flight schedules
- Traffic control : 39 (loads)

Roof damage (Gangwon district)

Landslide (South Gyeongsang district)



Coastal inundation (South Jeolla district)

Tidal gate open (Yeongsan river mouth)

Land slide (South Gyeongsang district)

Landslide (South Gyeongsang district)

Fig. I-3-6. Photos related to major damages by Typoon SANBA

4. **Regional Cooperation Assessment** (highlighting regional cooperation successes and challenges)

- Nil

II. **Summary of progress in Key Result Areas** (For achievements/results which apply to more than one Key Result Area, please describe them under the most applicable Key Result Area. Then, at the end of the description, place in parentheses ( ) the other applicable Key Result Areas)

1. **Progress on Key Result Area 1: Reduced Loss of Life from Typhoon-related Disasters. (**List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2012 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

1) 5-day Typhoon Report

KMA has launched an official 5-day Typhoon forecast since May 2012 after 2-year (2010 & 2011) beta test. KMA had reported the 3-day and 5-day Typhoon forecasts in parallel until March this year. KMA could, therefore, prepared the base of faster disaster prevention and alert people to the dangers of Typhoon 30 minutes earlier than before. The 5-day Typhoon report is the earliest information that people can get in the world. KMA's 5-day Typhoon forecast has successfully taken root since it has received positive evaluation from people and related organizations

No. 2 Typhoon SANVU

KMA | 2012.5.22 16:00

Date (UTC)	Position		Central Pressure (hPa)	Maximum Sustained Wind (m/s)		Radius of 15 m/s (km)	Intensity	Scale	Moving Direction	Moving Speed (km/h)	Radius of 70% Probability (km)
	Lat (N)	Lon (E)		m/s	km/h						
ANALYSIS 0600 UTC 22 May.	13.9	143.1	1002	18	65	180	Weak	Small	NW	26	-
FORECAST 0600 UTC 23 May.	16	141.1	1000	20	72	200	Weak	Small	NW	13	150
FORECAST 0600 UTC 24 May.	18.4	139.7	996	22	79	230	Weak	Small	NNW	13	250
FORECAST 0600 UTC 25 May.	21.3	139.7	994	23	83	250	Weak	Small	N	13	400
FORECAST 0600 UTC 26 May.	24	140.8	996	22	79	230	Weak	Small	NNE	14	550
FORECAST 0600 UTC 27 May.	26.3	143.4	998	21	76	200	Weak	Small	NE	15	700

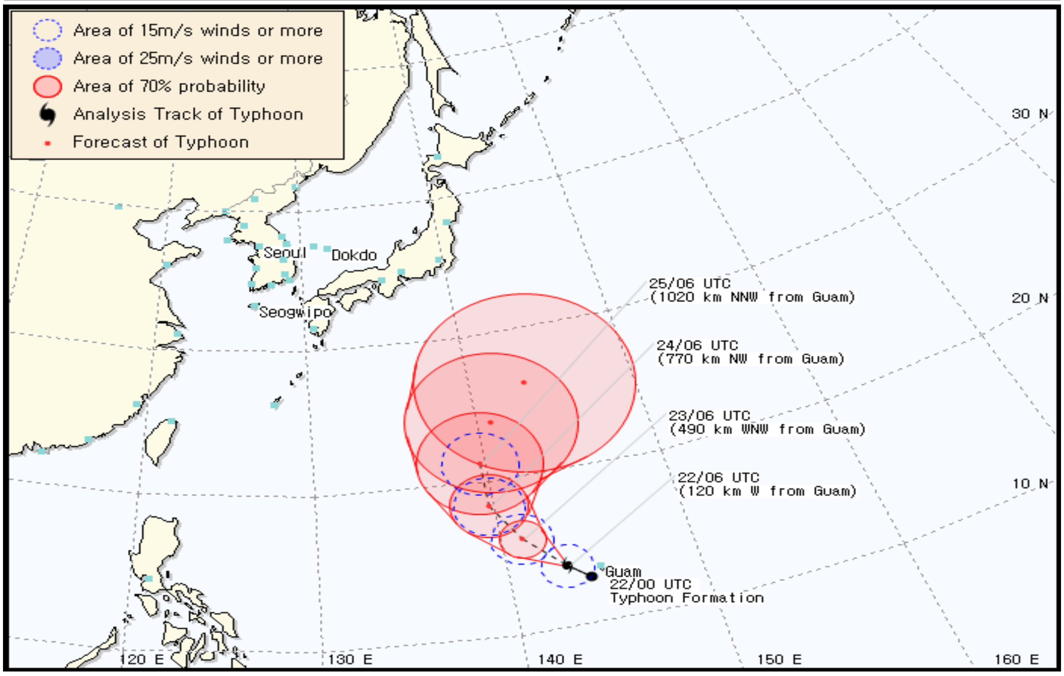


Fig. II-1-1. A sample of 5-day Typhoon Report

2) Development of web-based typhoon seasonal prediction system portal

Construction of web-based portal system to aid typhoon seasonal prediction information is underway. This system will be linked to National Typhoon Center of KMA homepage (http://typ.kma.go.kr/eng). The portal pages are consisted of prediction products, model information, model verification, and reference board (Fig. II-1-2). Three types of typhoon seasonal prediction models – NTC_KNU(multiple linear regression), NTC_SNU(hybrid of statistical-dynamical), NTC_COAPS(global spectral model) prediction results for summer(JJA) and fall(ASO) season are provided.

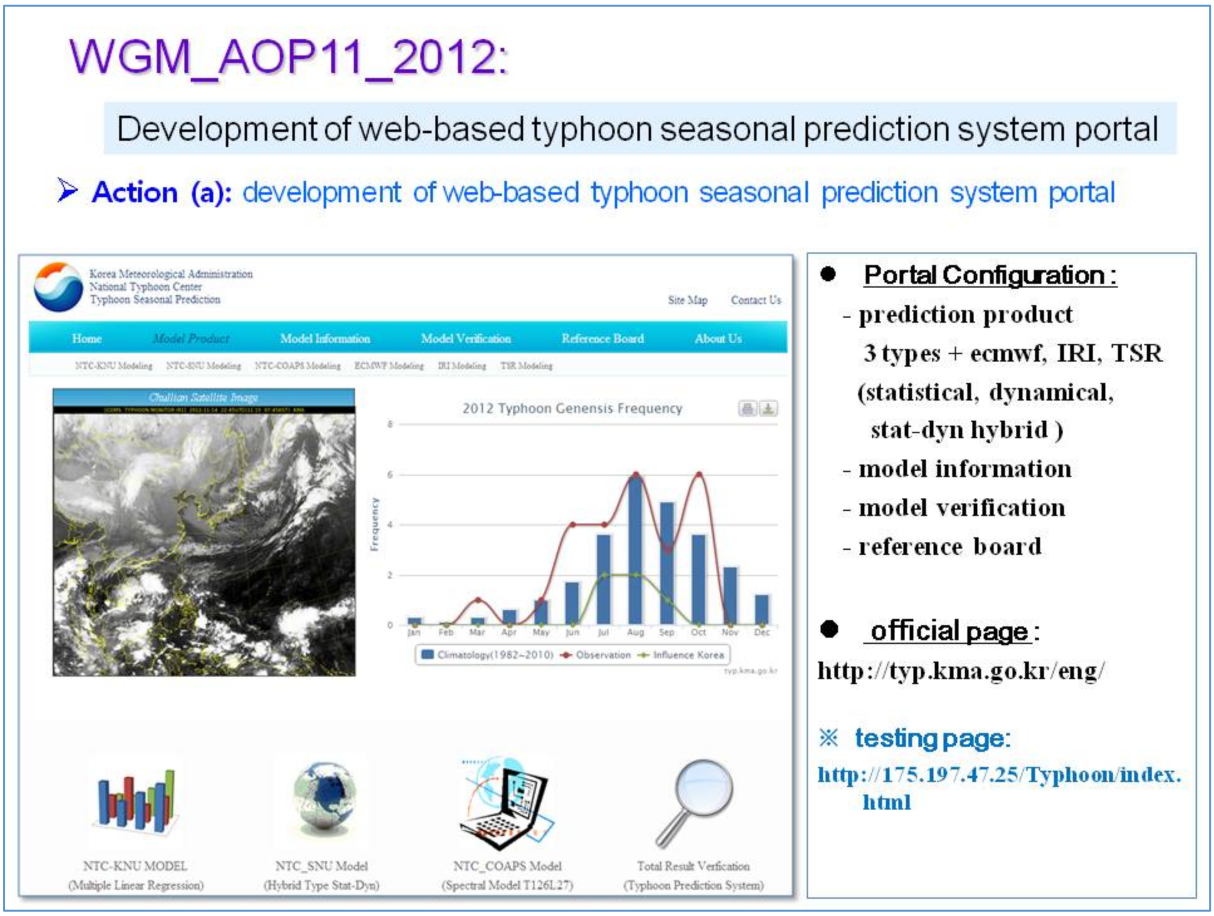


Fig. II-1-2. The web-based typhoon seasonal prediction system portal homepage.

b. Hydrological Achievements/Results

1) Four Rivers Restoration Project

Due to insufficient investments on flood prevention facilities and rapidly increased damages from floods, excessive amount of financial cost has occurred to recover from damages from floods. 0.17 trillion KRW of annually invested money in 1970 has been increased up to 2.7 trillion KRW. In addition, 8 x 10^8 m^3 and 10 x 10^8 m^3 of water is expected to be short in the year of 2011 and 2016, respectively. However, constructing multipurpose dams as a fundamental solution became difficult due to various reasons including environmental issues.

The purpose of conducting the Four Rivers Restoration project is primarily to establish a flood prevention method. According to the provided table below, 0.4 ~ 3.9 m of flood level reduction was achieved due to this project.

Table.II-1-1. Flood level reduction effect due to the Four Rivers Restoration Project

Major locations		**Measured flow rate**(㎥/s)	**Before**('08) (m)	**After**('12) (m)	**Reduction** (m)	**Comment**
Han River	Yeoju	5,177	6.2	3.1	**3.1**	Typhoon 'Tembin'
Nakdong River	Nakdong	5,517	7.2	2.3	**4.9**	Typhoon 'Sanba'
	Jindong	14,742	12.2	8.9	**3.3**	Typhoon 'Sanba'
Geum River	Geumnam	1,668	3.1	2.0	**1.1**	Typhoon 'Sanba'
Youngsan River	Naju	2,978	8.5	5.7	**2.8**	Typhoon 'Tembin'

In addition, stability of flood can also be obtained by enhancing estuary weirs and river sluices of old dikes. Due to the influence of this project, 1.1m and 0.3 m of water level reduction was observed in Nakdong River and Youngsan River regions, respectively. Effects of increasing 0.5 x 108 ㎥ of capacity can be also secured by installing facilities on flood control and riverside detention regions.

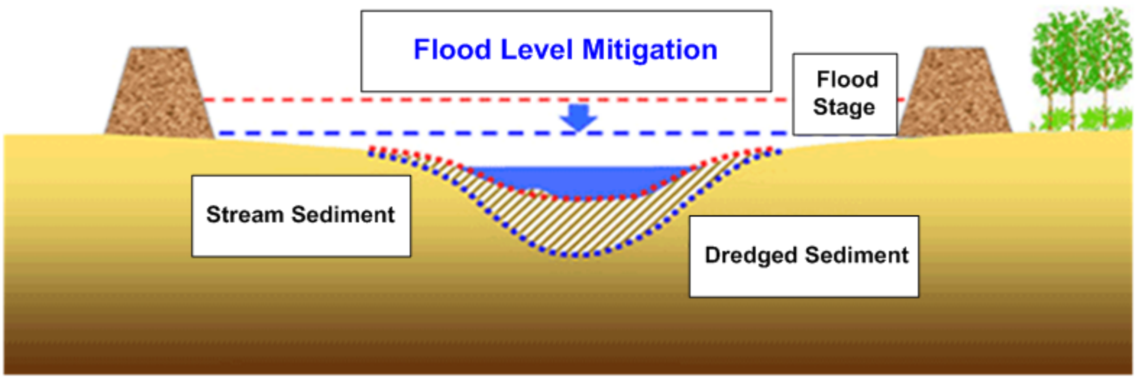


Fig. II-1-3. Four Rivers Restoration Project

At last, water quality improvement and healthy ecosystem can be established while fundamentally solving the shortage of water. The figure below demonstrates the fabrication processes of the project and possible improvements of public spaces.

Ipo weir in the Han river

Edge of the river

Nakdong River Cultural Center

Bikes roads

Fig. II-1-4. Public spaces after completion of the project

2) Development of Flood Defense Technology for Next Generation

Abnormal weather and heavy rain fall is causing increased amount of damages casualties, and the diverse types of flood damages are occurring. Flood defense system can't be simply adapted from foreign countries due to strong local geometrical properties. Developments of such technologies and products can't be properly handled from a private company level, and national efforts encouraging and developing such technologies are required. The purpose of this institution is to build cutting-edge flood defense systems by creating advanced monitoring technologies and national flood management system. With such equipped technologies, enhancement of measurement ability and development of watershed flood response technologies and management ability would be our final target.

The research process can be broadly divided into developing real time cutting-edge flood defense system and developing technologies which can efficiently manage on a basin level. By utilizing IT technologies, our primary target is to convert the previous old forecast system to a continuous-flow forecasting system to efficiently deliver forecast result and build early prevention system. However, the frequency of regional torrential rains has increased in recent years, and developments of technologies to actively resolve excessive torrential rain fall was carried out.

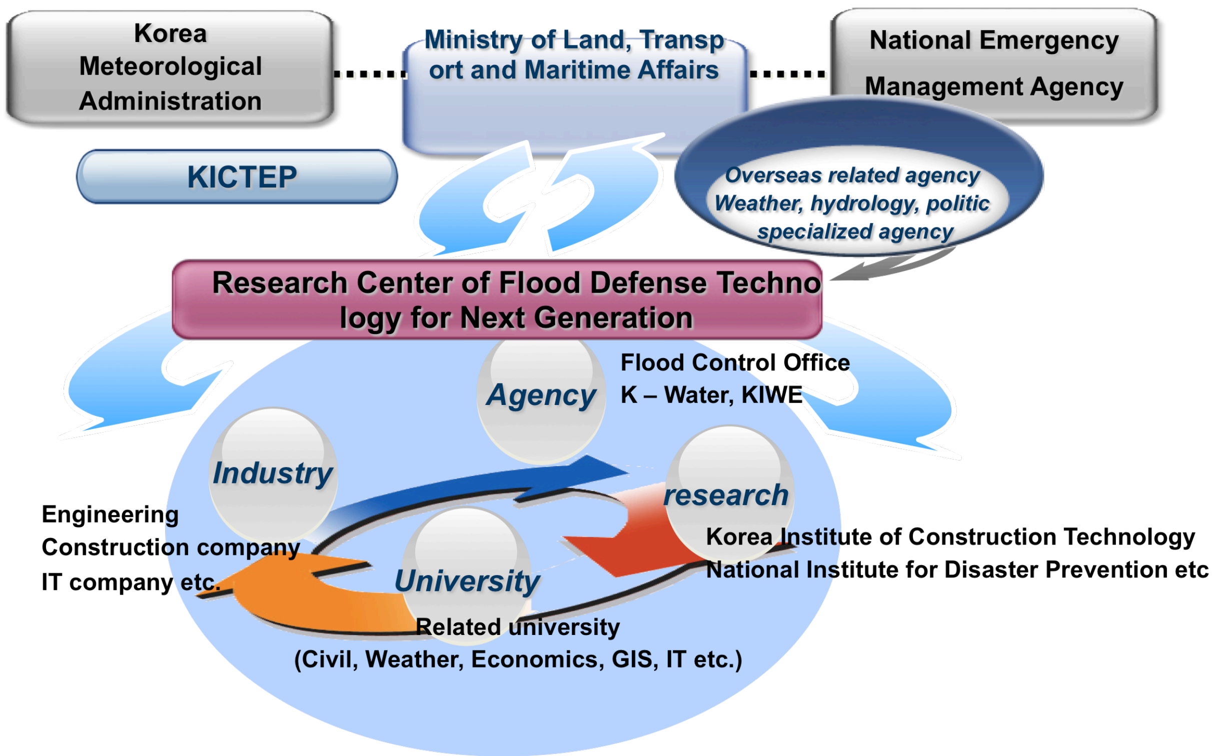


Fig. II-1-5. Research Center of Flood Defense Technology for Next Generation

As a research accomplishment of 2012, Flood Information System (FIS) is applied to enable flood prediction range objective.

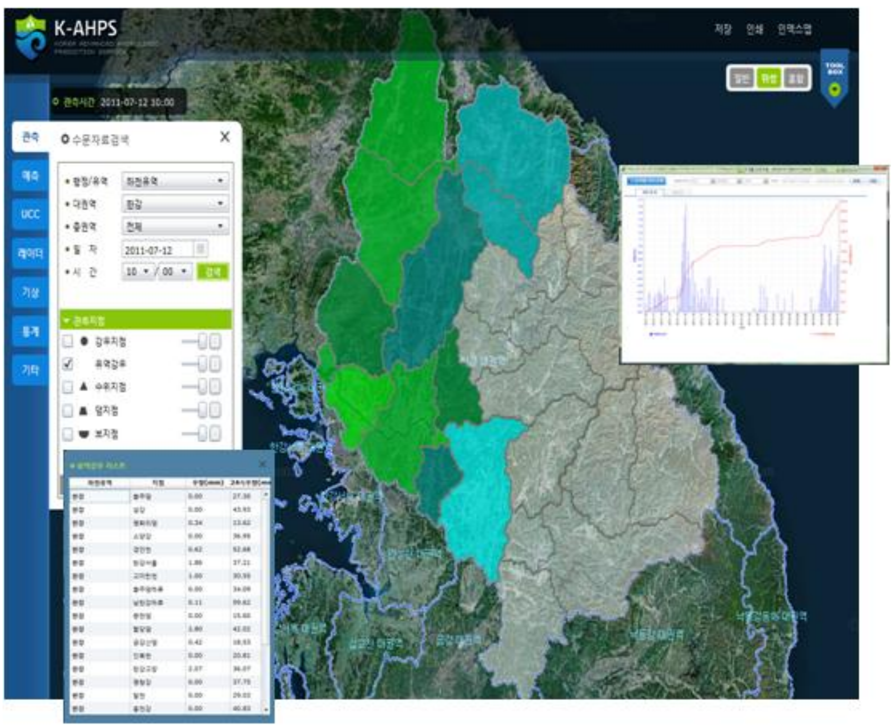


Fig. II-1-6. Flood Information System

When it also occur flash flood, it is essential that K-FFG(Flash Flood Guidance) should be prepared for flood defense and this result has been confirmed to be more accurate when the prediction from the model is compared with actual measured amount of run-off discharge.

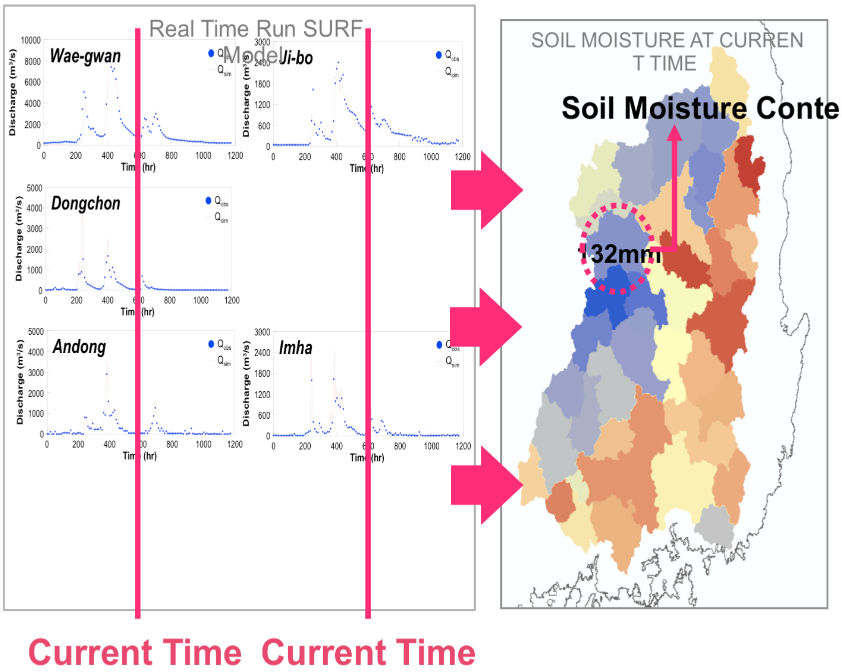


Fig. II-1-7. K-FFG(Flash Flood Guidance)

Its value from the point of hydrological study has been verified. We have researched a method where deduced indexes from the model will be comprehensively considered to quantitatively evaluate the accuracy of rainfall. A further development of programs to verify laser adjustment and its accuracy is required.

c. Disaster Risk Reduction Achievements/Results

See Socio-Economic Assessment in ***Overview of tropical cyclones which have affected/impacted Member's area in 2012***

d. Research, Training, and Other Achievements/Results

- Nil

e. Regional Cooperation Achievements/Results

- Nil

f. Identified Opportunities/Challenges for Future Achievements/Results

- Nil

2. **Progress on Key Result Area 2: Minimized Typhoon-related Social and Economic Impacts.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2012 Typhoon Committee Annual Operating Plan goals)

a. **Meteorological Achievements/Results**

– Nil

b. **Hydrological Achievements/Results**

1) Assessment System of Flood Control Measures on Socio-economic Impacts

Due to extreme weather environment such as global warming and greenhouse effect, the risks of having flood damage has been increased with larger scale of flood damages. Therefore, it became necessary to consider modifying climate change, flood damage and its scale to the previous dimension measurement evaluation system. The standards of dimension measurement evaluation system should be set according to hydrological studies with social and economic parameters as well. Such approach will enable policy makers and designers to appropriately establish proper system based on objective indexes.

By adjusting and complementing previously set dimension evaluation system, a method of utilizing the system to members of Typhoon Committee should be proposed. To explore requirements from the user's point of view by many countries, we have successively placed an international workshop. Opinions from the members of the committee were accepted and applied to the system, and active international activities were performed as a result.

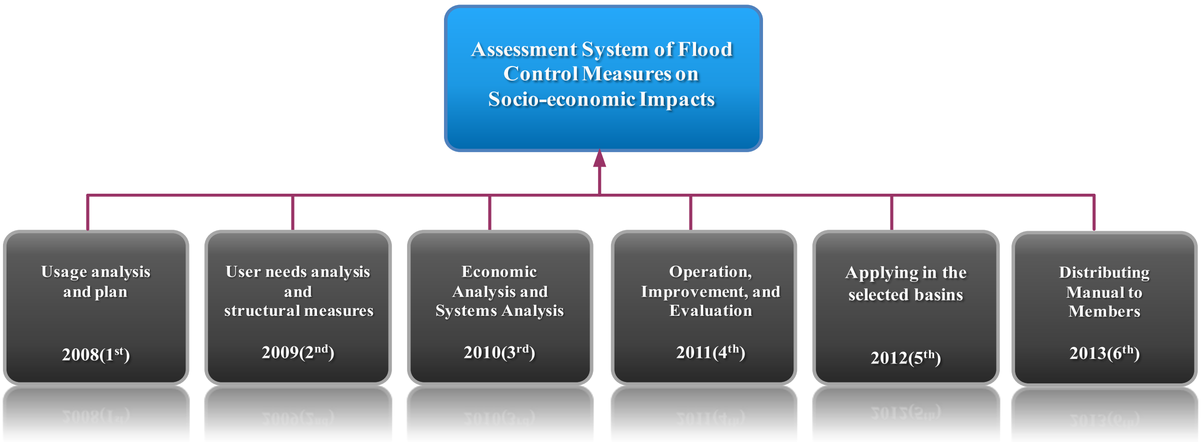


Fig. II-2-1. Long term plan of Dimension Measurement and Evaluation System

In the year of 2012, Applying ASFCM to the pilot basins were performed regarding Assessment System of Flood Control Measures on Socio-economic Impacts. To provide the comfort of the member nations which will utilize this system, the user's manual and technical reports were supplemented.

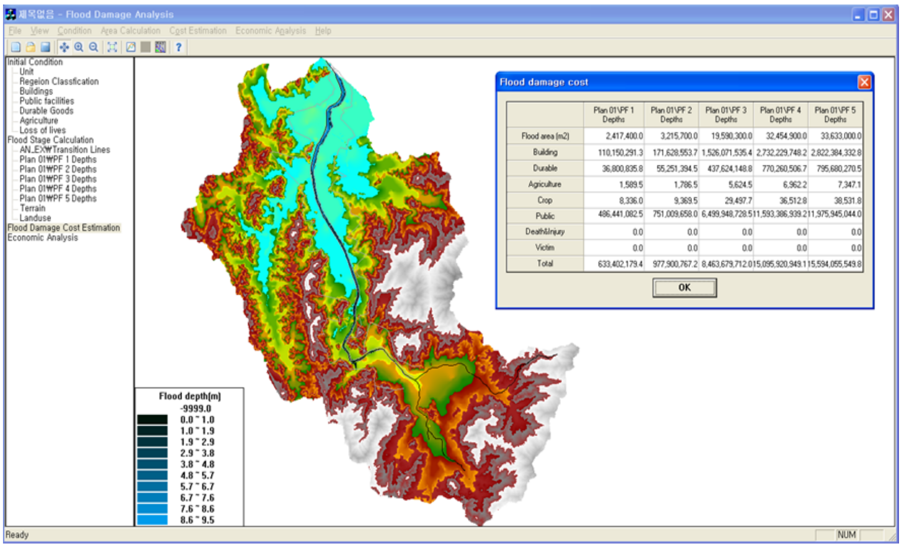


Fig. II-2-2. ASFCM Application

As an additional complementary work, we are planning to apply the upgraded ASFCM to targets in basins in Malaysia. In addition, support links will be added on the website of Korea Typhoon Committee in 2013 to distribute the materials on the Typhoon Committee WGH Workshop.

c. Disaster Risk Reduction Achievements/Results

1) National Disaster Management System (NDMS)

National Disaster Management System (NDMS) includes disaster management support systems which are installed in the central government and 16 cities and provinces nationwide to take action against natural disaster and man-made disaster. NDMS is nationwide information system to connect functional information systems which are managed by central administration and affiliated organizations. When natural disaster and man-made disaster occur, NDMS supports to expedite the establishment of action system. Also, NDMS performs the tasks which include precaution, preparation, rapid restoration, ex-post analysis and assessment and safety management activities for the factors which can threaten human life and properties.

System composition

Following figure shows system composition of NDMS. NDMS is composited with central system in National Emergency Management Agency (NEMA) and local systems which are installed in 16 cities and provinces nationwide. Also, NDMS includes the system for data collection from Korea Meteorological Administration (KMA) and Flood Control Offices

(FCO) in Han River, Geum River, Nakdong River, Yeoungsan River, Sumjin River. NDMS is web based system and uses can access to system through internet. Central system collects data from 16 cities and provinces and constructs the integrated information database. Based on integrated information database, NDMS takes charge of work process for central user. Local systems in 16 cities and provinces are used for local users in 231 cities and provinces. Local users can access to their regional site and work for disaster prevention.

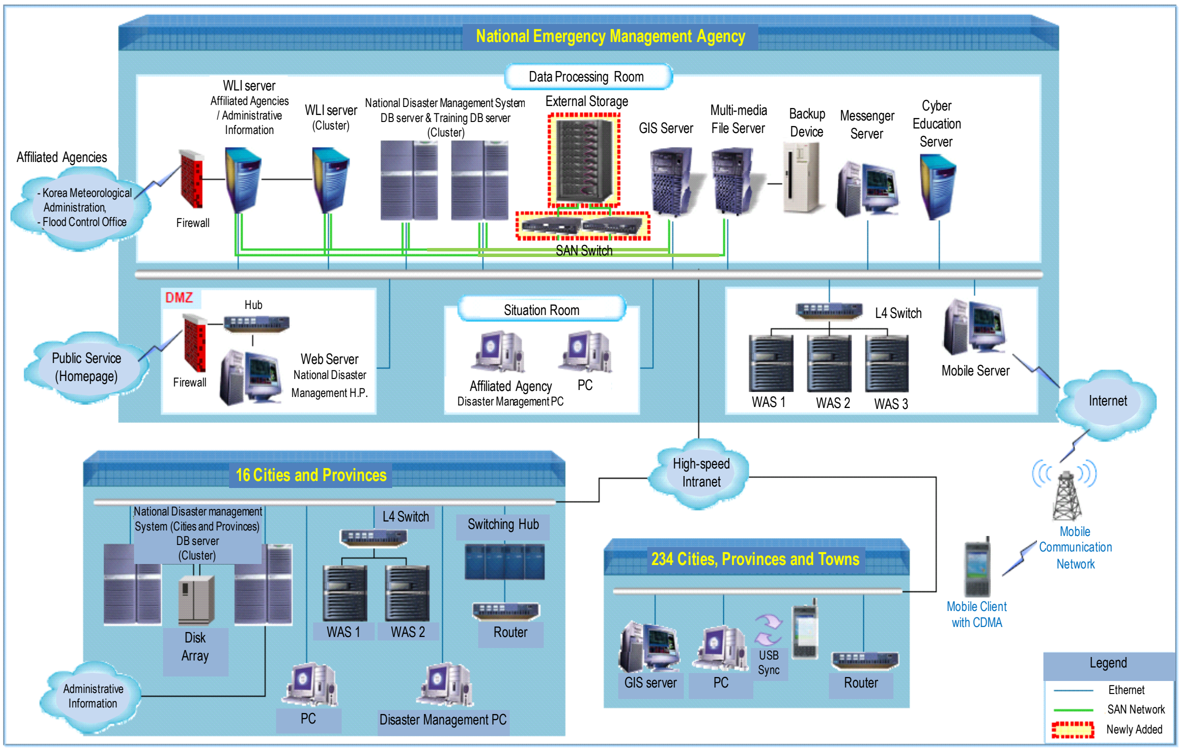


Fig .II-2-3. Composition of National Disaster Management System (NDMS)

2) Comprehensive plan for storm and flood damage reduction (CPSFDR)

Comprehensive Plan for Storm and Flood Damage Reduction (CPSFDR) establishes realistic and effective measures by inspecting risk elements which exist in cities and provinces. This plan sets up the priority for investment by estimating approximate construction expenses and generally manages the disaster prevention plan of local government.

In generally, storm and flood disaster includes river disaster, slope disaster, mud flow disaster, coastal disaster, and wind disaster etc. After investigating and analyzing comprehensively risk elements in local site, the plan presents structural and non-structural measures for damage mitigation and prevention. CPSFDR is the highest comprehensive plan in disaster prevention field. The goal year of CPSFDR is ten years from now which considers the period of redevelopment. After establishing the plan, validity reexamination should be performed to modify the plan every five years.

3) Preliminary Assessment Consultation of Disaster Impacts (PACDI)

Preliminary Assessment Consultation of Disaster Impacts (PACDI) predicts and analyzes disaster risk elements which can be occurred by various administrative plans and development projects. The lists of administrative plans and developments which should take the preliminary assessment consultation of disaster impacts are as followed;

1) Land and city development
2) Industry and distribution complex construction
3) Energy development
4) Transportation facility construction
5) River use and development
6) Water resources and coast development
7) Tourism complex and athletic facility construction

4) Storm and Flood Insurance (SFI)

Storm and Flood Insurance (SFI) is controlled by National Emergency Management Agency (NEMA) and operated by private insurance company. In SFI, central government and local government support a part of insurance premium to the customer, so, customer can actively cope with unexpected storm and flood such as typhoon, flood, torrential rainfall, tsunami, strong wind, wind and waves, and heavy snow with inexpensive insurance premium. Following table presents the disaster standards for compensation in SFI.

Table. II-2-1. Disaster standard for compensation in SFI

Disaster		Standards
Typhoon		When the size of typhoon meets the weather advisory in Korean Meteorological Administration (KMO)
Torrential rainfall		Over 80mm during 12 hours
Flood		Unusual increase of water level in unexpected area by above typhoon or torrential rainfall
Strong wind		Land : wind velocity 14 m/s, instantaneous wind velocity 20m/s Mountain area : wind velocity 14 m/s, instantaneous wind velocity 25m/s
Wind and waves		On the sea : continuous wind velocity 14m/s more than 3 hours Characteristics wave height : over 3m
tsunami	windstorm	Over the standard of the weather advisory
	Earthquake	Occurrence of tsunami by submarine earthquake
Heavy snow		Over 5 cm of fresh snow cover during 24 hours

5) White paper for response in climate change and the improvement of disaster management (the Prime Minister's Office)

Prime Minister's Office (PMO) organized joint task force of government and private institute for improving disaster in August 2011. TF team made the measures for disaster management and the scenarios for climate change. Basic policy of the measures from TF team includes the improvement of the disaster and meteorology prediction, safe city from disaster, powerful land development for disaster by customized investment, development of integrated disaster management system, and constitutional remedies for future disaster management. The measures of TF team are as followed;

- Development of high-resolution prediction model for meteorological forecast
- Expansion of sewerage facilities and rainfall runoff reduction facilities
- Development of high-resolution prediction model for meteorological forecast
- Maintenance of local danger zones and including steep slope around residential area
- Higher construction standards for disaster prevention facility

6) Budget formulation for prevention and restoration (White paper, Prime Minister's Office)

After TF team operation of prime minister's office, Korean government decides to change the direction of the investment from restoration to prevention. Therefore, the purpose of the decision is increasing the investment for prevention and decreasing the burden of restoration. Based on the stability assessment for disaster vulnerable areas and facilities, Korean government makes the priority by dangerousness and urgency to increase the effectiveness of investment. In case of the project of flood control facility in current year, government orders it in the beginning of the year and the project should be completed before June through July in rainy season. Investment of disaster prevention will be included in mid-term financial plan and national financial management plan to secure finances stably. Also, it is planned to operate consultation for investment adjustment by the ministry of strategy and finance (MOSF) for effective investment between agencies. In 2012, financial investment plan of approximate 6.7 billion won (6 million dollars) which is 21 percent increased more than 2011 budget is set up. Based on 2012 budget, mid-term financial plan is organized and stable investment of approximate 35 billion (31 million dollars) to 40 billion won (36 million dollars) is secured.

d. Research, Training, and Other Achievements/Results

- Nil

e. Regional Cooperation Achievements/Results

- Nil

f. Identified Opportunities/Challenges for Future Achievements/Results

- Nil

3. **Progress on Key Result Area 3: Enhanced Beneficial Typhoon-related Effects for the Betterment of Quality of life.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2012 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

- Nil

b. Hydrological Achievements/Results

In the year of 2012, extreme weathers such as drought, heat wave, and typhoon influenced Korea significantly. As a result, efficient utilization of multipurpose dam was required to treat such extreme weathers. Korea has been selected as a nation with insufficient water resources with the water resource/person of 2,629 m^3 / year which is just about one third of the world average value of 16,427 m^3 / year. In addition, more than 70% of annual precipitation is concentrated in June ~ September, and only 27% of total water resource is utilized.

Due to droughts which began in May, only 47.4% of precipitation occurred last year rained. Such phenomenon occurred throughout the nation, and severe drought occurred in Seoul, Gyeonggi, and Cheong regions which may occur once in 200 years.

Fig. II-3-1. Severe drought and water quality problems relived by typhoon

After the rainy season, record-breaking heat wave and drought occurred in nationwide from July/20 to Aug/10, which caused only 7.4% of precipitation compared to last year. Such extreme heat wave caused to grow excessive algae and resulted in various public issues.

The amount of inflow and outflow were 136.9 x 10^8 m^3 and 84.1 10^8 m^3, respectively. The numerical values are 110% and 62% of the measured recorded in last year. Therefore, the water reserve rate was 98.4 x 10^8 m^3 (78%), and this value is 126% of the measured value in last year, 78.0 x 10^8 m^3. This the reserve rate exceeded the targeted dam reservation (more than 90 x 10^8 m^3), it is expected to resolve algae issues while securing sufficient water resources.

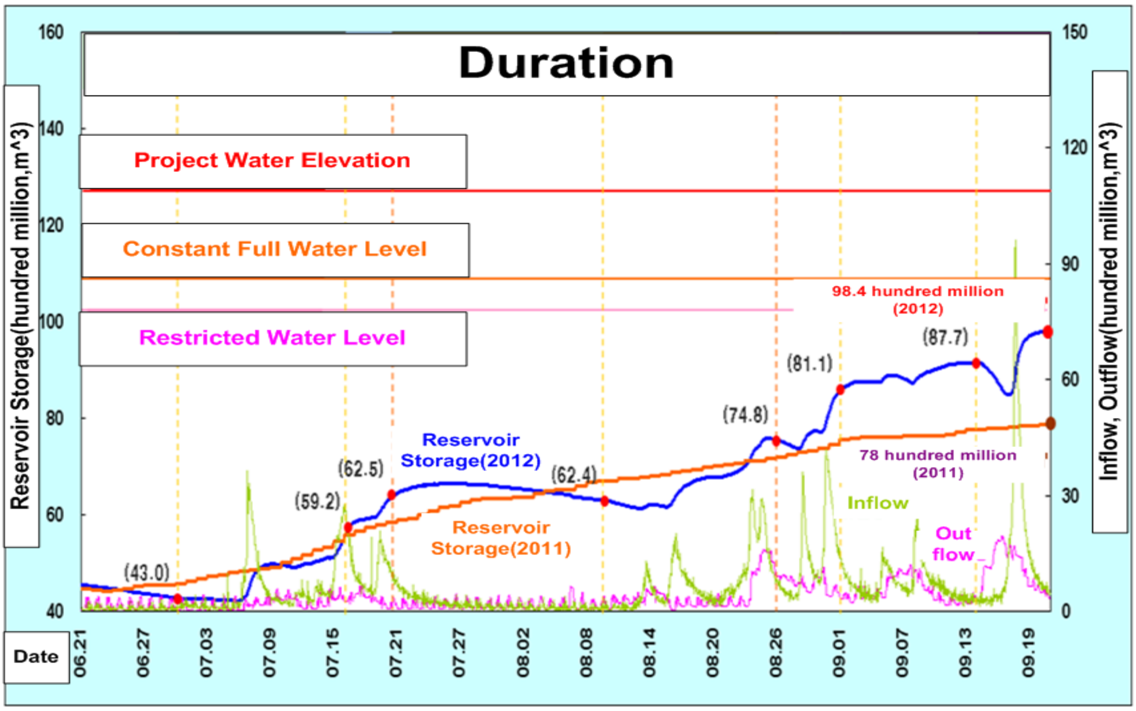


Fig. II-3-2. Total reservoir storage in Korea over year 2012

c. **Disaster Risk Reduction Achievements/Results**
- Nil

d. **Research, Training, and Other Achievements/Results**
- Nil

e. **Regional Cooperation Achievements/Results**
- Nil

f. **Identified Opportunities/Challenges for Future Achievements/Results**
- Nil

4. **Progress on Key Result Area 4: Improved Typhoon-related Disaster Risk Management in Various Sectors**. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2012 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

1) Operational provision of COMS data and satellite-based typhoon analyses

Korea's first geostationary satellite, COMS (Communication, Ocean, Meteorological Satellite) was successfully launched on 26 June 2010, after an in-orbit testing. COMS MI (Meteorological Imager) data service started on 1 April 2011. The validation of COMS data has completed on 15m/s radius of strong wind of 2011 typhoons. Using data from the COMS satellite data KMA has been providing satellite analyses on every typhoon occurred since 2012 including information on typhoon's center and intensity

KMA's typhoon analysis system is a user-friendly web-based system developed in 2005 based on the Advanced Objective Dvorak Technique (AODT) of SSEC/UW-Madison (Space Science Engineering Center/University of Wisconsin-Madison). In 2012, KMA upgraded version 8.1.3 of its web-based typhoon analysis system, and it has provided stable estimates of typhoon intensity by allowing analysts to choose cloud patterns in his/her own judgment.

The KMA has also developed a system to produce satellite-based typhoon analysis reports (such as Fig. Ⅱ-4-1). This report will include essential typhoon information such as location of the center, maximum wind speed, central pressure, 15m/s radius of strong wind, mean wind speed/direction for 3 hours, typhoon pattern and accuracy of typhoon center estimations.

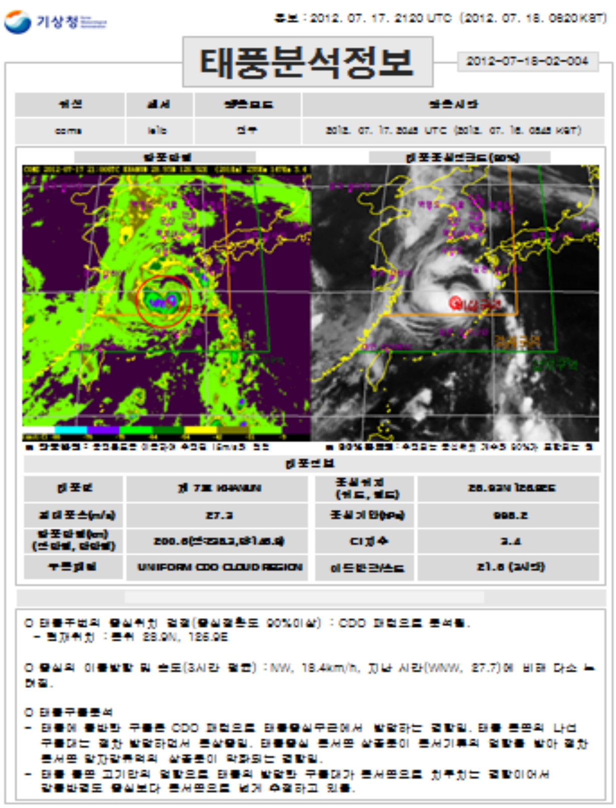


Fig. Ⅱ-4-1. A sample of typhoon analysis report provided by satellite analysts on an operational basis COMS data.

b. Hydrological Achievements/Results

1) Climate Change Assessment & Projection for Hydrology in Korea

In Korea, the study of hydrological effects began in the middle of 1990's. However, standardization was not accomplished due to randomly conducted studies with inconsistent study results. This is what caused lack of applying studied results into useful policies, and they were not even applicable for constructing basic database as an international cooperation. The purpose of researching hydrological influences due to climate changes is to forecast future water resources and standardizing technologies to help prepare extreme conditions (flood and drought) while securing quantitative water cycling technologies.

In this year, we have studied basin-level flood forecast technologies with visualized scale, evaluation of water cycling systems in Korea, and forecast of supplying water resources as the climate changes.

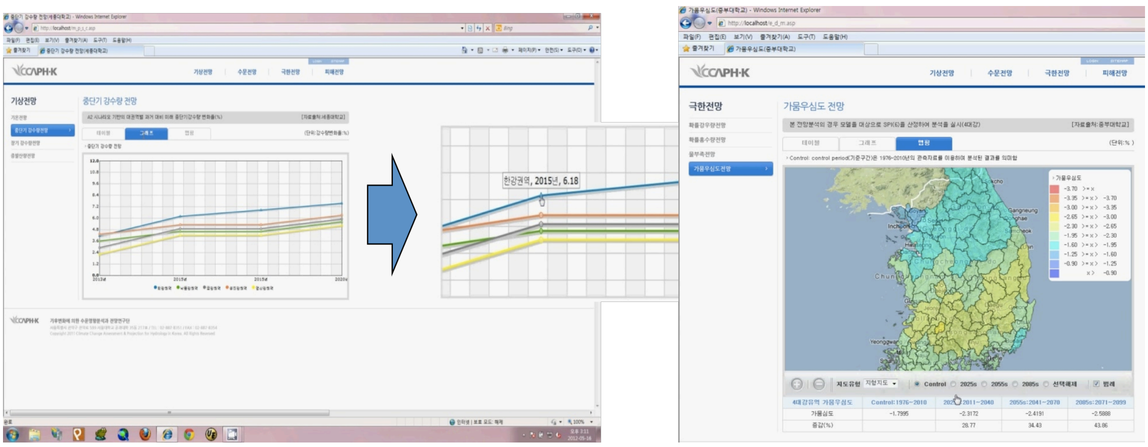


Fig. II-4-2. Forecasting for extreme scenarios (Extreme flood, Extreme drought)

In the future, Korea will be exporting climate change related technologies to developing countries and participate in global issues. By conducting Low-carbon Green Growth project which is one of the major national projects, we will be able to provide the blueprint in future water resource field, and encourage private corporations to contribute in creating green Earth environment.

2) River flow management system

As the time of era changes, the purpose of utilizing water has been changed and the main purpose of using water was for human. Water was utilized as Agricultural and industrial purposes in the past to improve the quality of people's lives. With the recent introduction of environment protection concept, the needs of utilizing water to preserve the nature made the management of basin extremely important parameter.

We are planning to establish a system which can comprehensively handle the amount of usable water resource, predicting regions with insufficient water supply, and how issues will be resolved. To efficiently manage the amount of river discharge, analysis of water cycle with flux, the amount of cycling water is necessary. Special management of water in various situations would be required as well. The establishment of the studied system is subjected to Han, Nakdong, Geum, Seomjin, and Yeonsan rivers. Previously divided 73 regions were expanded and standardized into 646 standard basins.

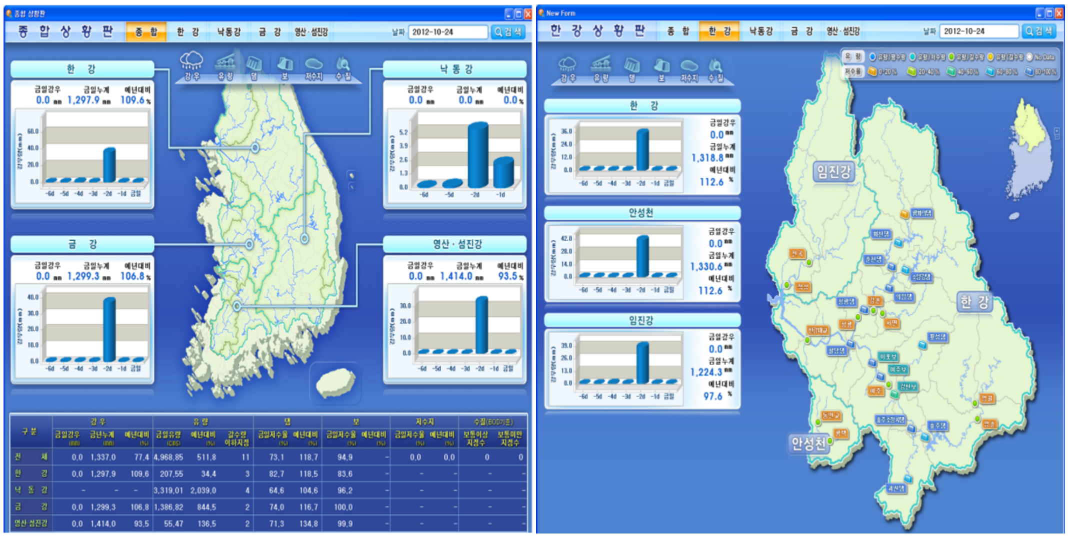


Fig. II-4-3. Establishment of automated river flow management system

By establishing the management system, annual, seasonal, and monthly river discharge became predictable with improved accuracy of major basin area prediction result. To maintain the natural features of basins, it is recommended to set a target water flow of newly included basins by the nation to maintain at least its minimum function as basins.

3) Rainfall radar observatory

The rainfall radar emits electromagnetic waves in regions where precipitation detects the intensity of rainfall, and it serves to prevent floods occurred by strongly varying intensities, abrupt and locally concentrated heavy rain falls. By utilizing regional climate information, regional torrential rains may be forecasted up to maximum of 3 hours ahead of time and result in reducing flood damages.

To maximize the efficiency of the system, overall operation system needs to be established while consistently providing qualified rain fall radar data, rainfall estimation database.

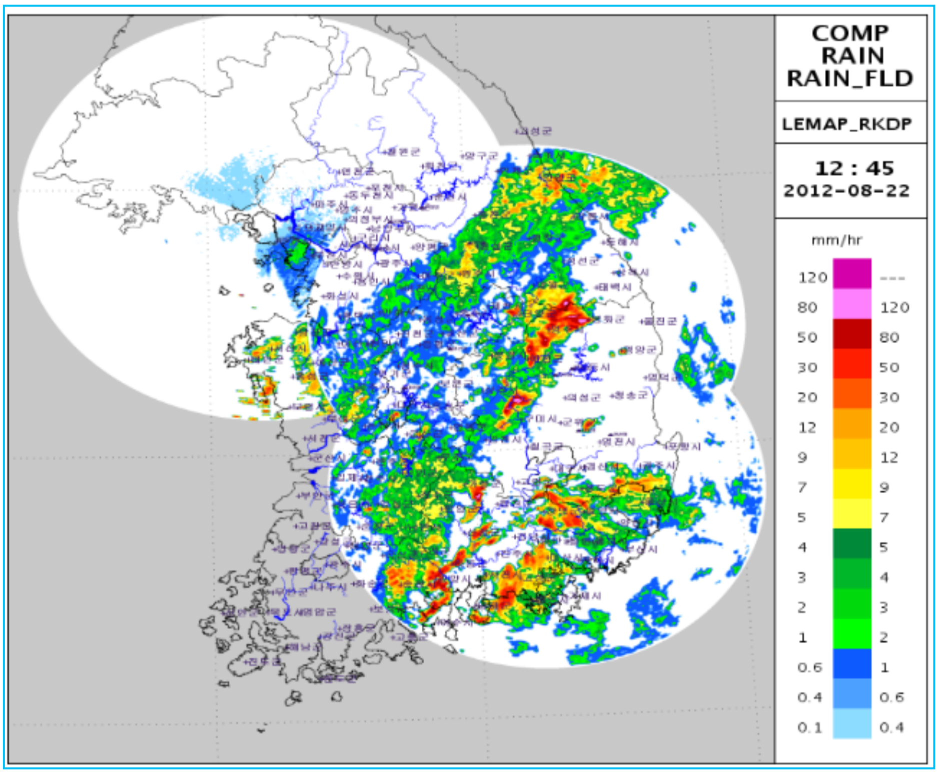


Fig. II-4-4. Compositing nationwide radar rain data

As of October in this year, two observatories are operated in Biseul and Sobaeksan mountain regions. Three observatories are currently under construction, and additional radar is expected to be constructed in Yebong mountain.

Fig. II-4-5.Rain Radar in Limjin, Biseul, Sobaek

4) Flood Hazard Map Upgrade in the Han river basin

Flood Hazard Map is considered to be one of non-structural methods to minimize casualties and property damages due to floods. Information such as flood regions, depth of flood, and evacuation places are included in the Flood Hazard Map. Analysis of expected flood damage regions, collection of various data, and creation of flood warning map would be required as well.

Proper understanding of using hydrological models while accurately applying the property of the nature based on flood scenarios should be accompanied as the research study is conducted.

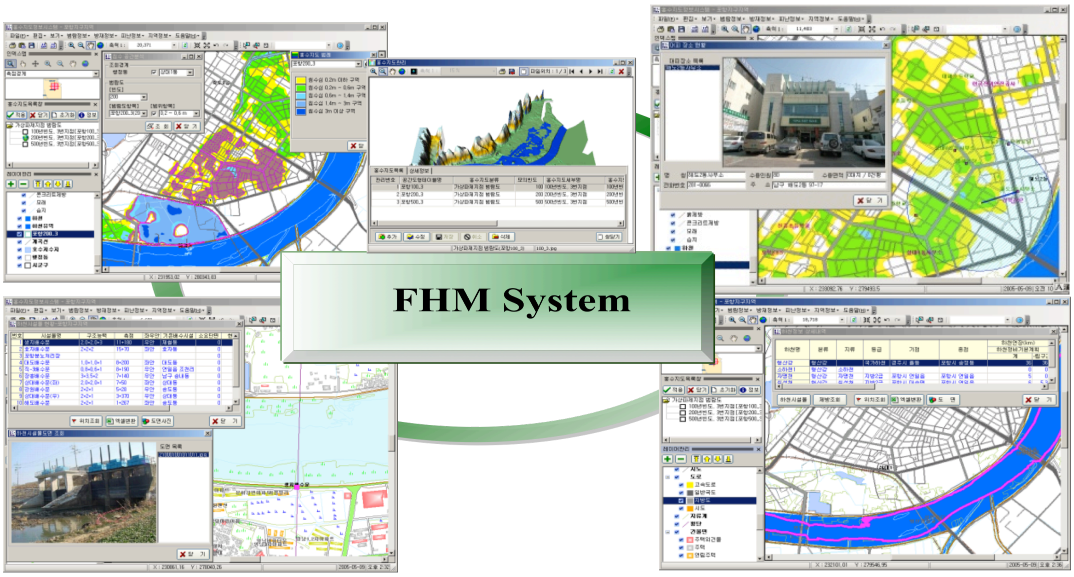


Fig. II-4-6. Establishment of FHM System

In this study, flood analysis of Han river is conducted. The frequency of flood is assumed to be once in 100 years, and standard flood depth is assumed to be more than 0.5 m with flood hazard area of 1,909.6ha.

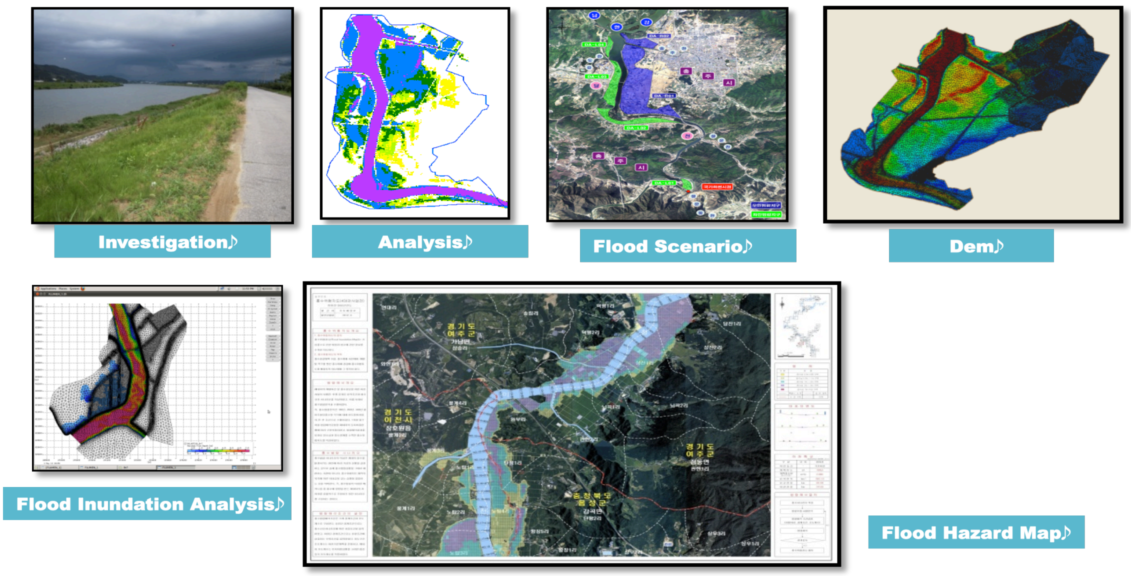


Fig. II-4-7. Predicting inundated Area (FHM in process)

As a result of conducted simulation on flood regions, the average depth of flood was reduced with decreased area of flood dangerous regions.

Table. . II-4-1. Simulation results of flood danged regions

Depth(m)	Flood area (ha)		
	Before the project	After the project	After regions were divided
0.0~0.5	3,418.75	2,985.35	2,340.02
0.5~1.0	3,006.40	2,545.84	1,909.61
1.0~2.0	2,655.30	2,140.66	1,564.09
2.0~5.0	1,962.02	1,418.06	975.05
Above 5.0	438.95	212.17	100.99
Average depth	2.29	2.09	1.98

c. Disaster Risk Reduction Achievements/Results

(Enhanced WEB GIS Based Typhoon Committee Disaster Information System)

1) Collection of natural disaster damage information

Lao PDR has been collecting the damage date from 2005 through 2009 and damage data is collected by province data of 32 provinces. Also, damage data in Lao PDR is divided into the damage of flash flood, flood, and typhoon. Damage data in Lao PDR consist of total 14 kinds of damages such as death, victim, areas, amount, house, ship, farm, livestock, river, transport, schools, hospital, other, and private.

In case of Japan, about 50 years of damage data from 1951 through 2009 were collected and the number of the data is 170. Also, damage data of Japan include earthquake, torrential rainfall, and typhoon. Detailed information of the damage data in Japan consists of 9 components including dead, missing, dead or missing, injured, destroyed houses, flooded houses, flooded land (ha), destroyed ships, and burned down forests (ha). There is no division for damage area, but it provides damage data for whole Japan area.

2) Analysis of damage data

In case of damage data in Lao PDR, damage would increase when Typhoon (tropical cyclone) and Monson occur in same time. Also, data represents that damage by rainfall under tropical low pressure situation is larger than direct damage by Typhoon. In Japan data case, it could be identified that damage from earthquake is very huge beside other natural disaster damage.

3) Development of natural disaster damage database

Database of natural disaster damage in Lao PDR and Japan were developed and also, damage data of Korea, Viet Nam, and Hong Kong were built into the database. Table including damage information, damage code, and disaster code was created. Created table would be used to present the disaster information in TCDIS. Also, mapping work was performed to display the disaster damage database effectively.

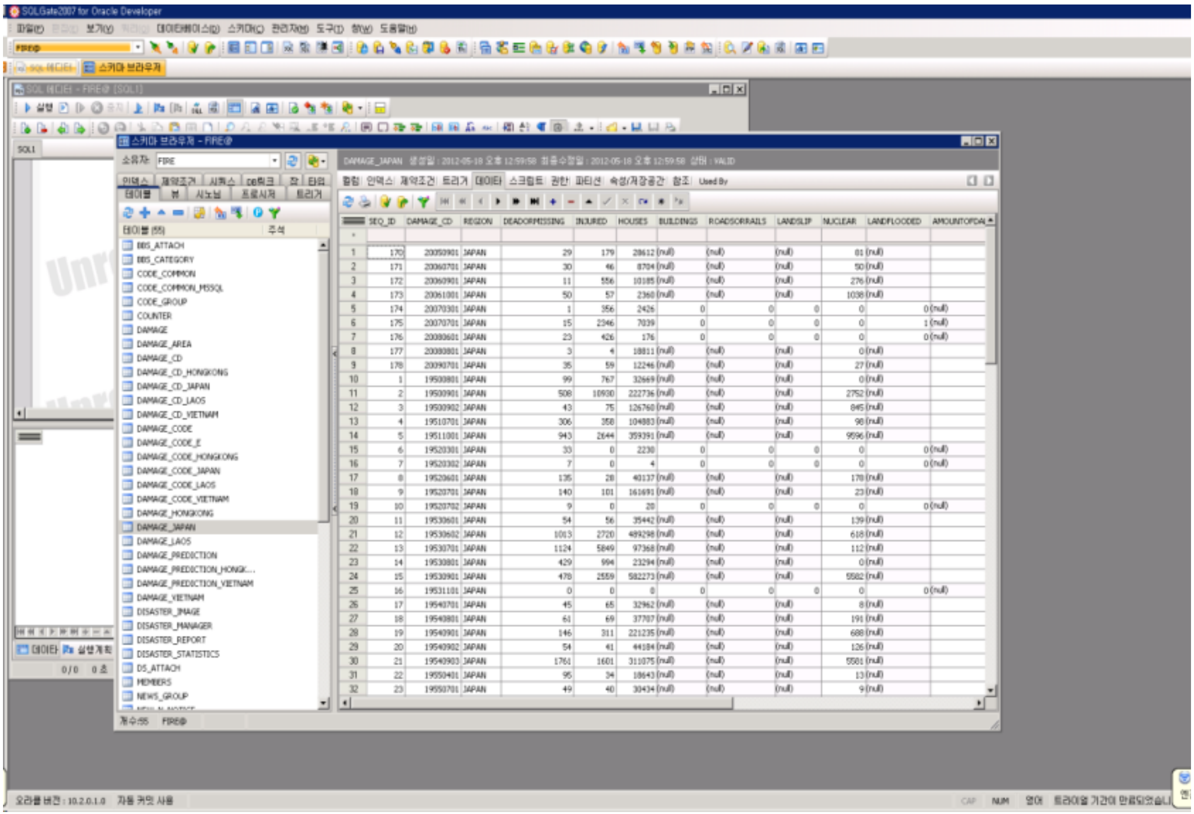


Fig.II-4-8. Database Table

4) Collection and development of database for meteorological data

It would be need to define what kinds of meteorological information exist to extract the common information from database of Lao PDR and Japan. In this part, meteorological information such as location information of the station, maximum and average values of wind, rainfall, snowfall, temperature are used to estimate the disaster size. Because rainfall and snowfall could be different by latitude and longitude, it is very difficult to define the criteria for the common facts. Another difficulty is taking over the database which includes real meteorological measured data from each member countries. Hence, this research collected meteorological data from National Climate Data Center (NCDC) in National Oceanic and Atmospheric Administration (NOAA).

5) Display of Typhoon information and meteorological data

Typhoon information of Lao PDR and Japan are embodied in TCDIS. Also, meteorological data from NCDC would be displayed in TCDIS. Following figures present the display of the meteorological data.

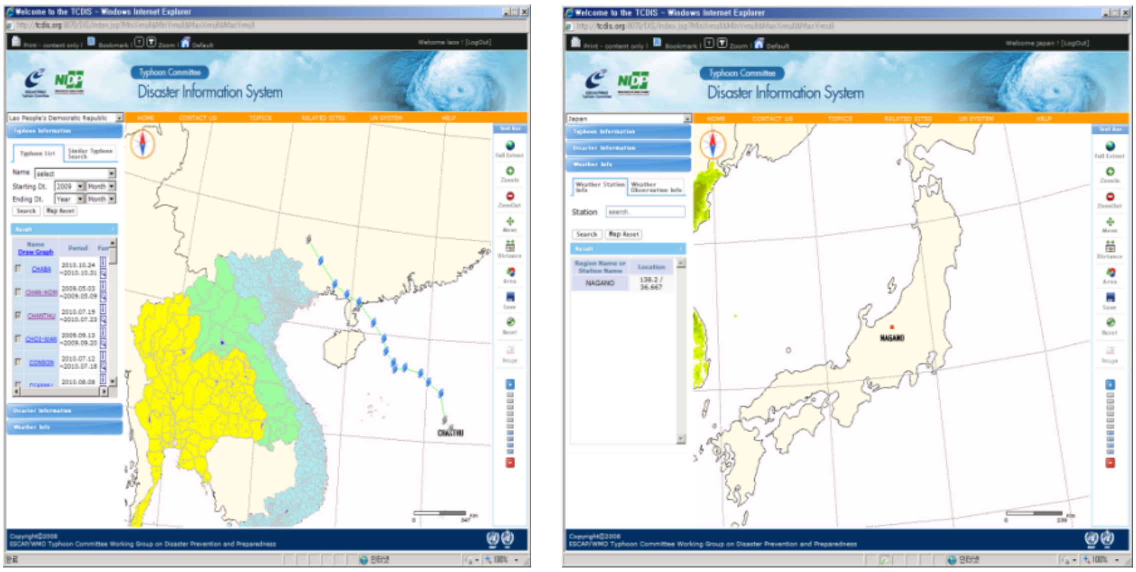


Fig. II-4-9. Display of Typhoon information of Lao PDR (L) and meteorological data of Japan (R)

6) Display of the disaster information

The system can display the disaster information of Lao PDR and Japan with same function of the display for the disaster information of other member countries.

7) Improvement on the display of meeting documents for TCDIS

Because of lack of TCDIS utilization, the meeting documents including annual TC meeting report for TCDIS could not be managed. In this project, meeting reports in 2008, 2009, and 2010 are uploaded in TCDIS. The work for updating the report will be continuous.

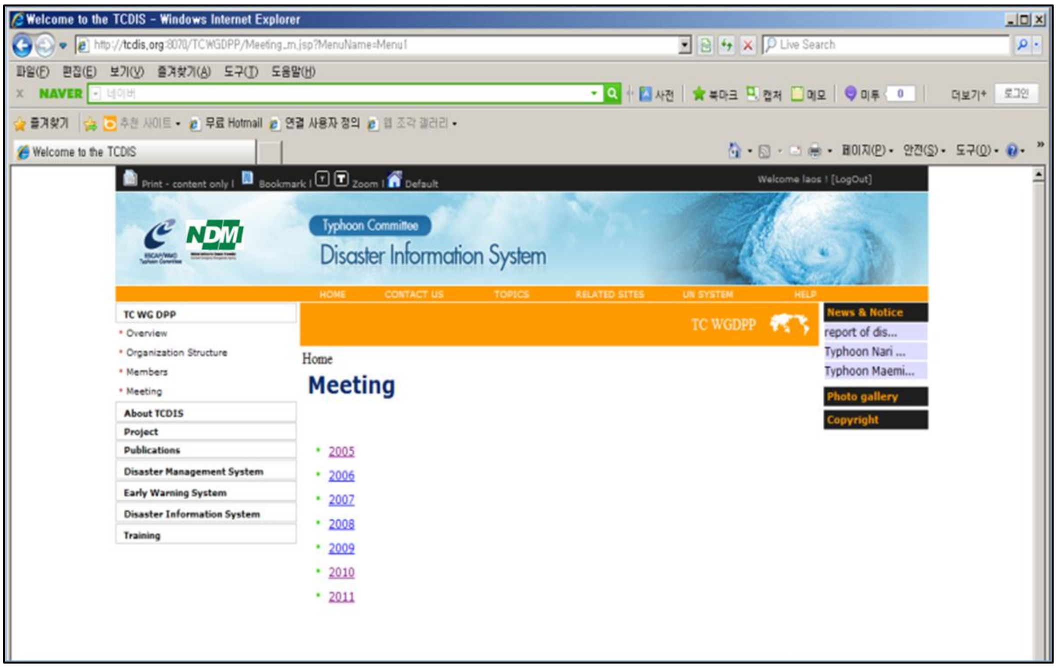


Fig. II-4-10. Addition of TCDIS meeting documents from 2008 through 2011

8) Correction of the errors in *Publication* menu

In past TCDIS, it was difficult to upload the documents in Publications menu because unknown error. Unknown error which was occurred when users upload PDF files would be corrected.

9) Correction of the display error in start-up screen in TCDIS

In updated start-up screen in TCDIS, it presents the map of Southeast Asia including TC member countries and real time movement of Typhoon.

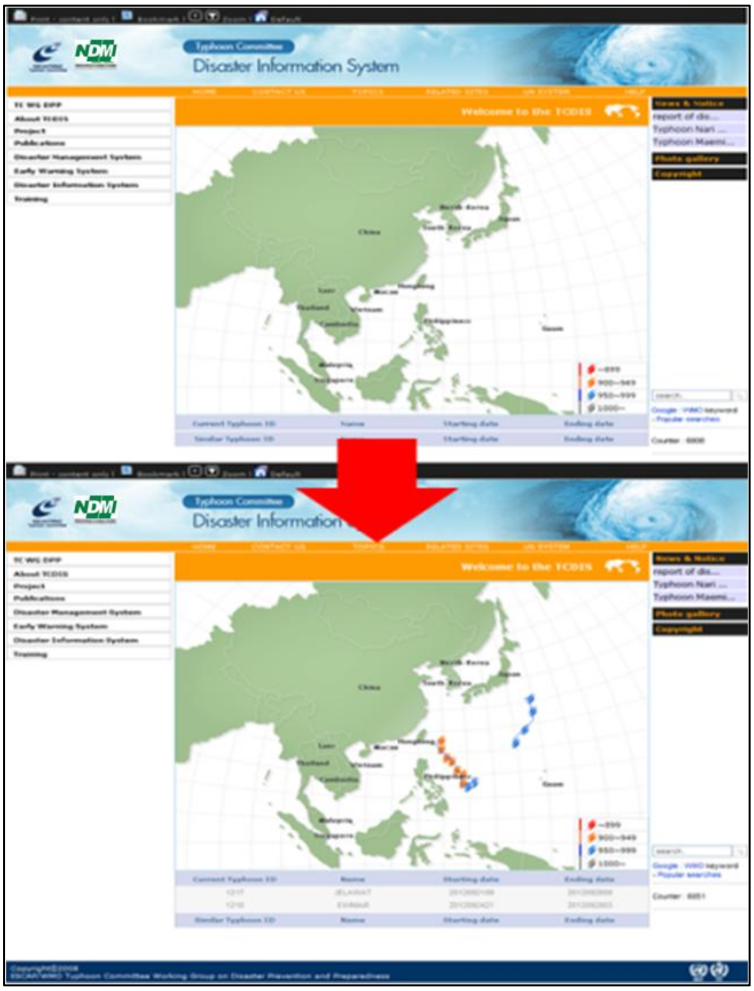


Fig. II-4-11. Start-up screen before and after correction

10) Correction and supplementation of Typhoon information collecting program

TCDIS had used Typhoon information from Korea Meteorological Administration (KMA). However, after the website of KMA was changed, it was difficult to collect the Typhoon information. In this project, a program for collecting Typhoon information was developed and tested. After finishing the calibration, the program will be used to gather the Typhoon information in TCDIS.

11) Addition of disaster damage information after 2007 in Korea

Disaster damage information from 2007 through 2010 in Korea were added. The information was collected through Disaster Chronology. Following figure shows data in Microsoft-Excel and displayed image in TCDIS.

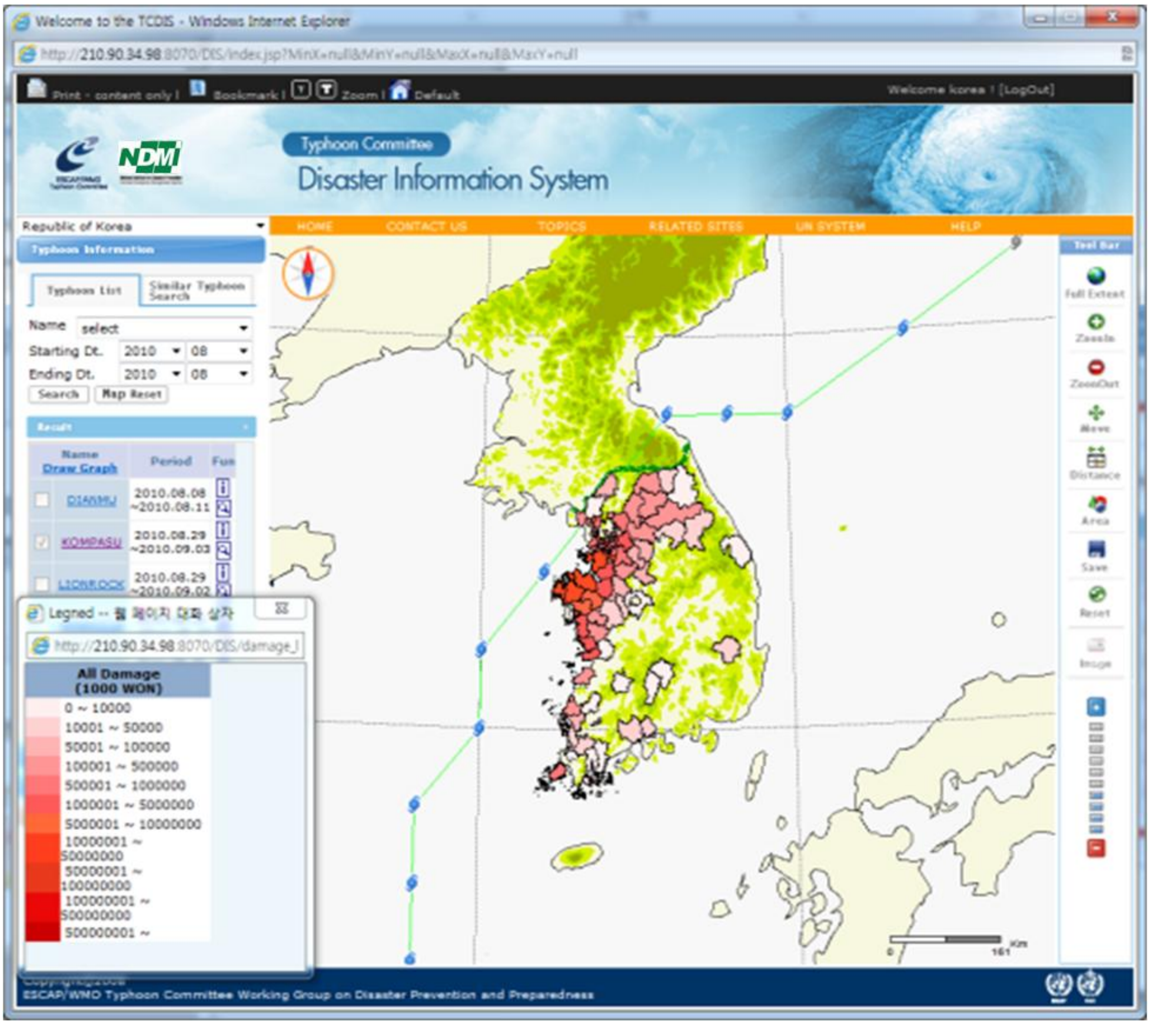


Fig. II-4-12.Display of total damages by Typhoon KOMPASU (2010)

12) Additional function for display damage size in GIS

Searched damage information can be displayed through each administrative district. User can search the damage occurred in interested area by searching damage information and choosing the kind of the disasters. Total 11 kinds of the damage would be defined in search option.

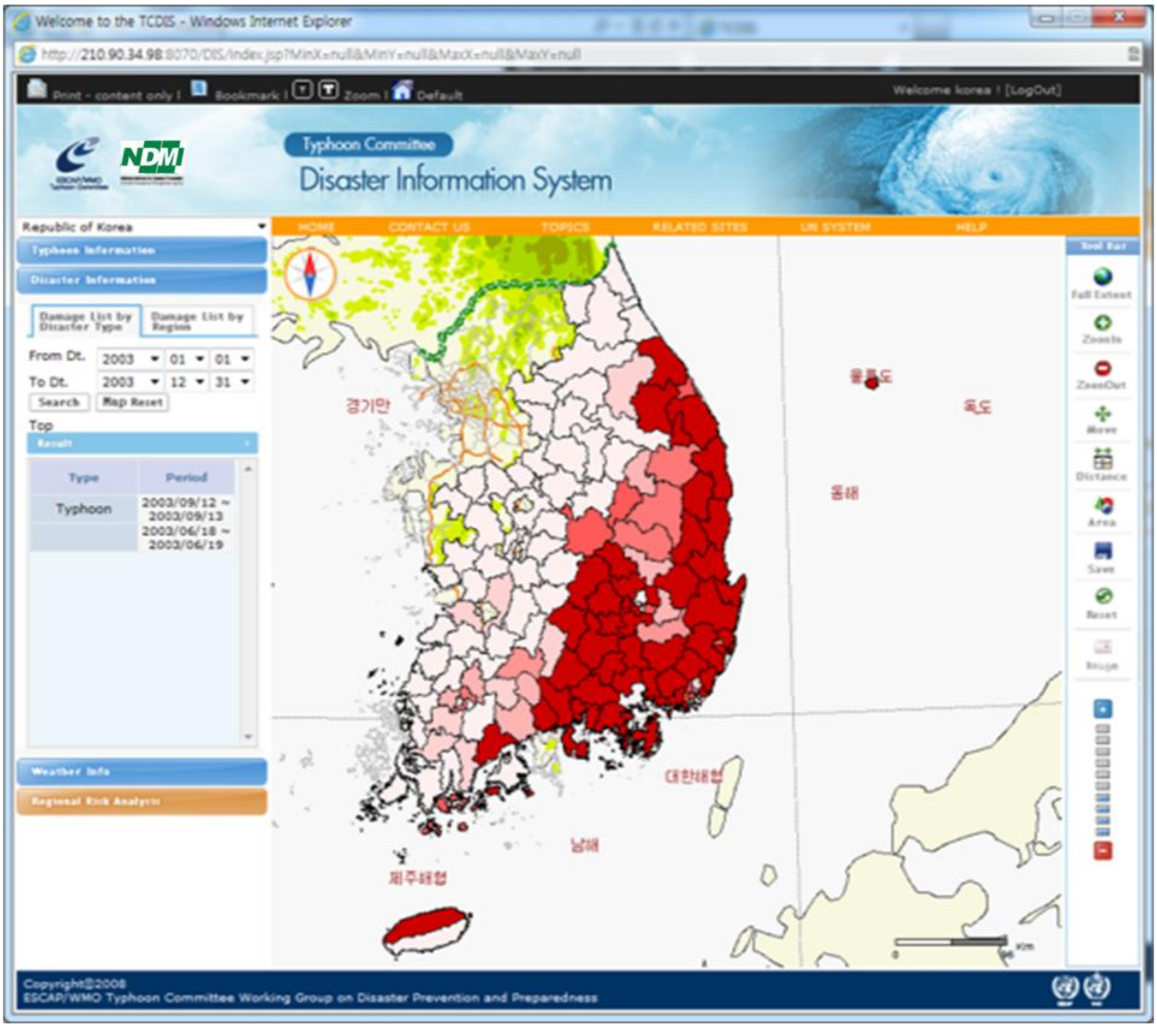


Fig. II-4-13. Displayed the amount of the damage by Typhoon Maemi (2003)

d. Research, Training, and Other Achievements/Results

- Nil

e. Regional Cooperation Achievements/Results

- Nil

f. Identified Opportunities/Challenges for Future Achievements/Results

- Nil

5. **Progress on Key Result Area 5: Strengthened Resilience of Communities to Typhoon-related Disasters.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2012 Typhoon Committee Annual Operating Plan goals)

   a. **Meteorological Achievements/Results**
      - Nil

   b. **Hydrological Achievements/Results**
      - Nil

   c. **Disaster Risk Reduction Achievements/Results**
      - Nil

   d. **Research, Training, and Other Achievements/Results**
      - Nil

   e. **Regional Cooperation Achievements/Results**
      - Nil

   f. **Identified Opportunities/Challenges for Future Achievements/Results**
      - Nil

6. **Progress on Key Result Area 6: Improved Capacity to Generate and Provide Accurate, Timely, and understandable Information on Typhoon-related Threats.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

1) The Model Data Adding to Typhoon Analysis and Prediction System (TAPS)

For the efficiency of typhoon forecast, TAPS has been developed and used operationally in the NTC/KMA. The TAPS has many functions to help typhoon forecast including its track, central pressure, the area of 15 m/s, etc. One of the functions is to display the prediction results for typhoon track and central pressure of other centers and models. So far, we have used total 11 models. This year, the eight models' data have been newly added. Some are the data shared through the TIGGE (THORPEX Interactive Grand Global Ensemble) project. Also, the result of numerical prediction model of STI (Shanghai Typhoon Institute) will be included according to the agreement made at the 4th Korea-China joint workshop. The data from STI model is expect to be of great use for track forecasting.

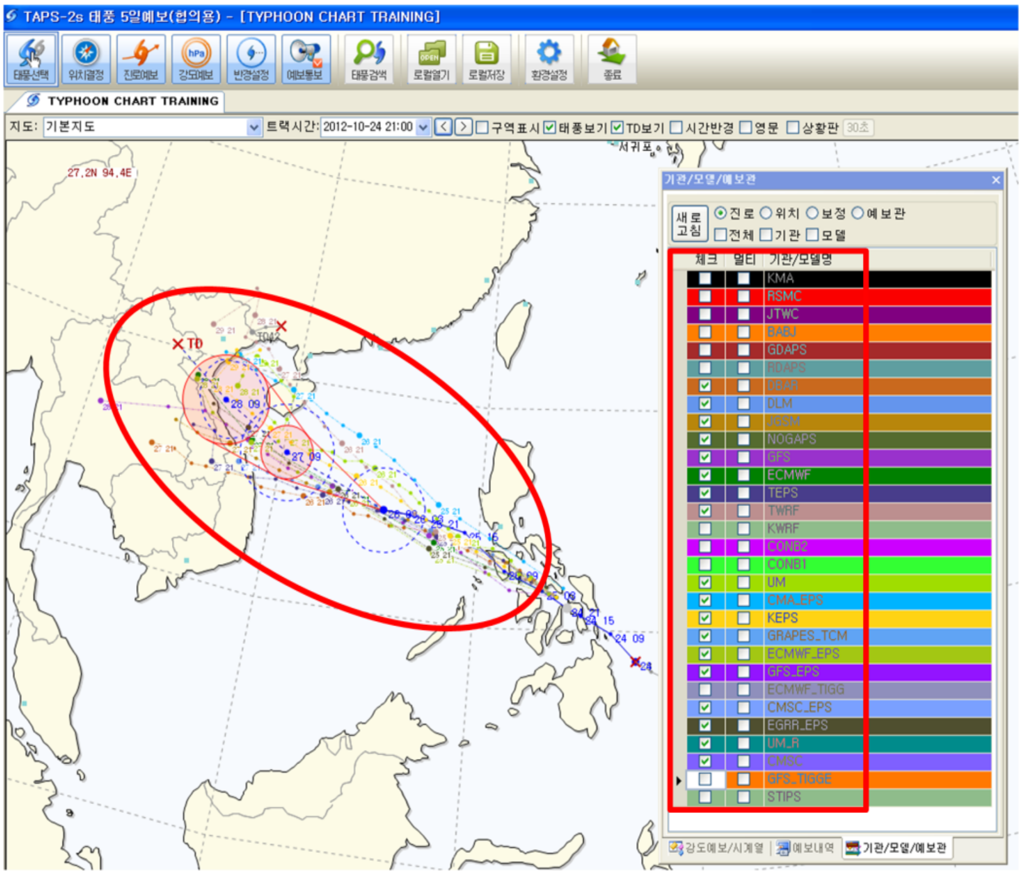


Fig. II-6-1.*An example of the displayed model data for typhoon SON-TINH(1223).*

2) The system for Tropical Cyclone Analysis and Forecast (TCAF)

Every year 26 typhoons on average develops over the north western pacific. Some of them are rapidly formed in the high-latitude and move fast to the seashore and cause serious damage to people within short time. Also, NTC has experimentally started 24-hour forecast for TD since this year. Therefore, the importance for watching typhoons in its prior stage, in other words, detection for tropical depression in the early stage, has been emphasized. For the reason, the Tropical Formation Guidance (TFOG) was introduced in 2006 by using the 10 factors which is well known to be associated with typhoon genesis. These factors are calculated from GDAPS (UM N512L70). The TFOG was run operationally 4 times a day (00, 06, 12, 18 UTC) and provided information of the possibility for TD genesis. However, it couldn't classify before TD stage. We upgraded the TFOG system in 2010 by subdividing the 10 factors and named TCAF (Tropical Cyclone Analysis and Forecast). The TCAF produces the information before TD stage by dividing the stage as Low, Medium and High depending on tropical cyclone development. The information of 24-hour forecast is also produced as well as analysis. The results are displayed on the KMA intranet homepage with COMS IR image and used as one of the data for typhoon forecasters.

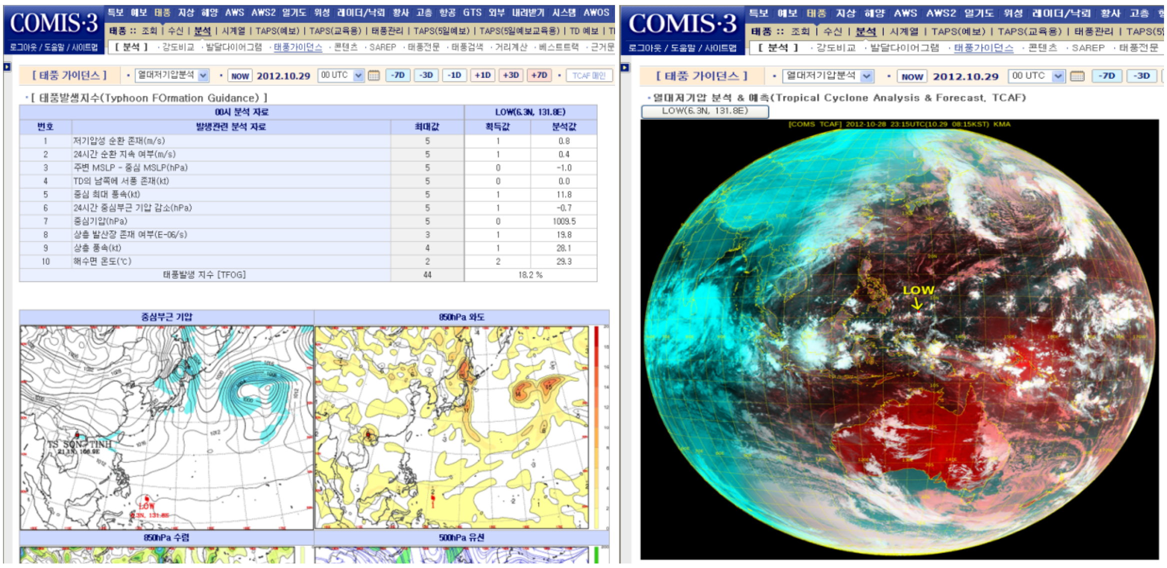
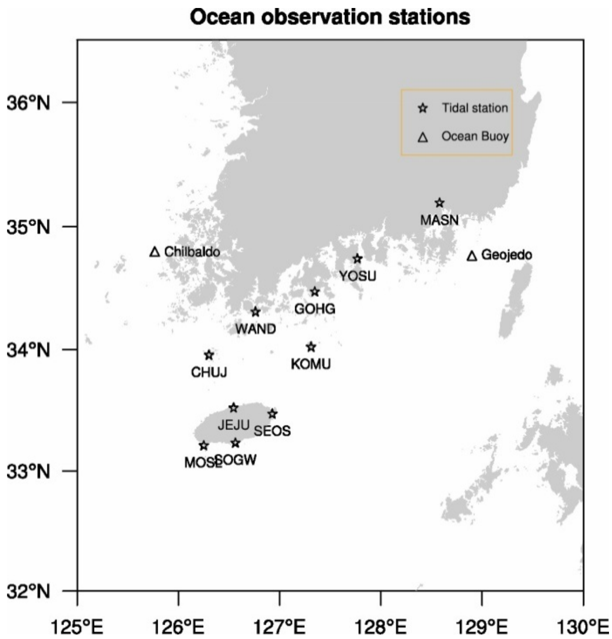


Fig. Ⅱ-6-2. An example of the results through the TCAF at 00 UTC 29 October 2012.

3) Operate a Regional Tide/Storm surge Model for the storm surge prediction



(a) Obs stations

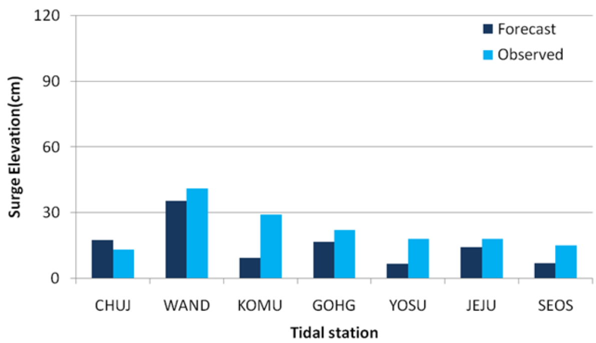
For the prediction for the storm surge, KMA has been running operational Regional Tide/Storm Surge Model since1 July 2006.

Figure (b) and (c) compare seven sea-level observations from tidal stations located along the southern coast of the Republic of Korea with the prediction results of regional storm surge model during Typhoon Tembin and Bolaven.

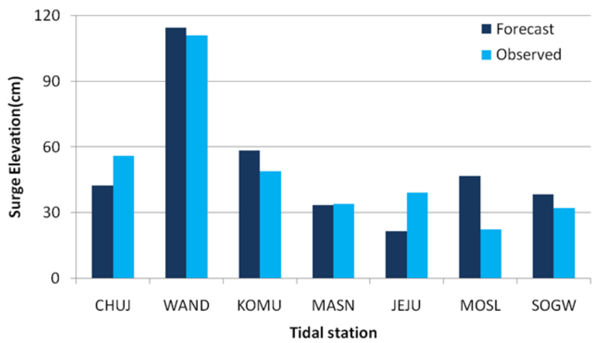
During Typhoon Tembin period the prediction results were generally underestimated except for HUJ (Chujado).

During Typhoon Bolaven the predicted storm surges considerably fit with the observed ones. In Wando the maximum storm surges was over 1.0 meter.

Since accurate prediction of storm surge height depends on the strength, path and track speed of typhoons, it seems that sophisticated method such as ensemble storm surge prediction is required to correct these deficiencies.



(b) Tembin(1214)



(c) Bolaven(1215)

Fig. Ⅱ-6-3. Forecast and observed Surge Elevations from 7 stations during the Typhoon 'Tembin' and 'Bolaven'-affected period

b. Hydrological Achievements/Results

1) National Hydrological Data Quality Control System

Korea has varying topographical and hydrological nature with severe hydrological characteristics, and recent global warming and abnormal climates are causing the climatic variability even greater. As a result, national level of consistently collecting high quality hydrological data is necessary to understand the phenomenon and to be prepared for efficient supply of water resources if flood or drought is occurred.

As a result of this study, it can be stated that the qualified nation hydrological data management system is established which enables to commercialization of such system with improved reliability.

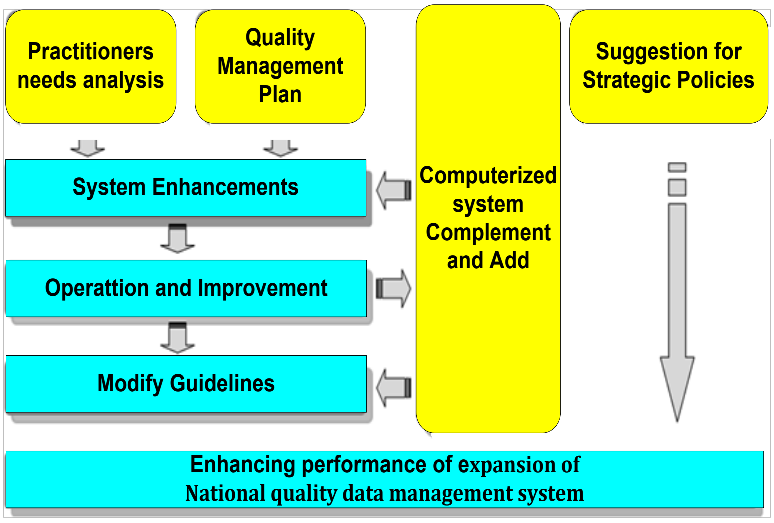


Fig. II-6-4. Flowchart for national hydrological data quality control system

As an accomplishment of the conducted study in this year, the standard of automatically detecting an outlier is adjusted. A previous outlier inspection criterion was more than 5 cm of water level change in 10 minutes. However, the criterion is newly adjusted to be more than 20 cm of water level change in 10 minutes.

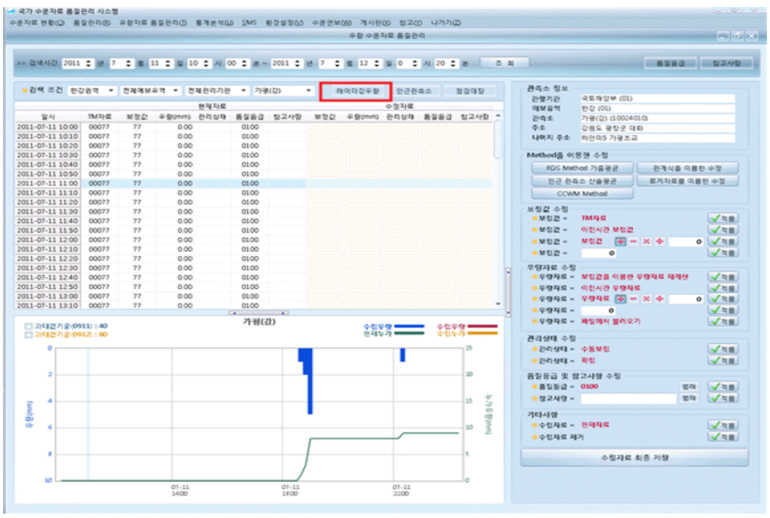


Fig. II-6-5. Automatic inspection result after alleviating the inspection criteria

As a complementary features of the quality management system, expansion of database, modification of annual Hydrological Gate Report program, and co-utilization system will be established. In addition, developments of various programs to more efficiently search, modify, and act properly against outlier data.

2) Improvement of WAMIS features

Water Management Information System (WAMIS) scientifically organizes measurement data regarding water related institutions and generates necessary data with analysis system. To expand the influence of the WAMIS system to entire people in Korea, establishments of more easily accessible system and education system are required.

Fig. II-6-6. Main screen of WAMIS

At first, it is necessary to improve the user's interface system with expanded fields of water related information on the system. In addition, preparing organized data both in Korean and English is necessary as the importance of international cooperation is becoming significant.

Fig. II-6-7. Main page

Fig. II-6-8. Searching for measuring stations

Fig. II-6-9. Measured data

As a part of targeted system establishment, we are focused to provide more information through smart phone Apps. The ArcGIS Server will enable providing mapping service on Smartphone devices. A study which includes climate changes and environmental issues is currently conducted from our organization.

3) Water Management Information Networking System (WINS)

The Water Management Information Networking System (WINS) is established to utilize collected water resource related information from 11 water related administrations with 5 ministries on line.

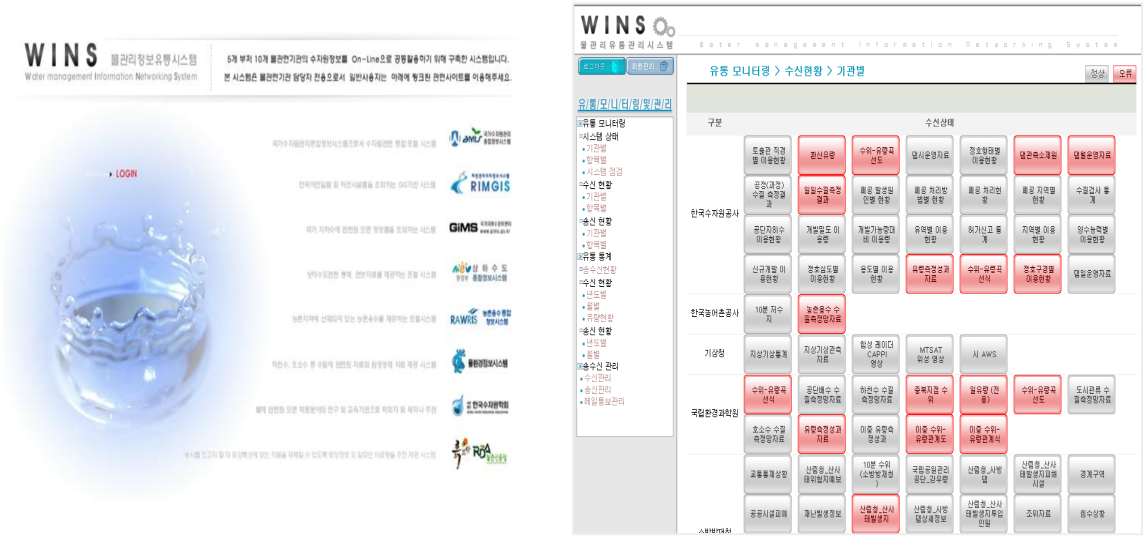


Fig. II-6-10. Access for WINS in progress.

The previous system had its limitation of collecting and providing real-time local data, and only overall water resource information existed. Locating errors on the server was difficult as well. In this year, detailed water resource status can be provided to local managers with visualized graphical chart aids and table chart data organization search feature.

4) Platform of spatial flood forecasting system

The purpose of establishing Spatial Flood Warning System is to compare simulation results to actually measured data on selected regions. The importance of the system has become important as flood damages increases due to increased facilities near basins, and eco-friendly areas.

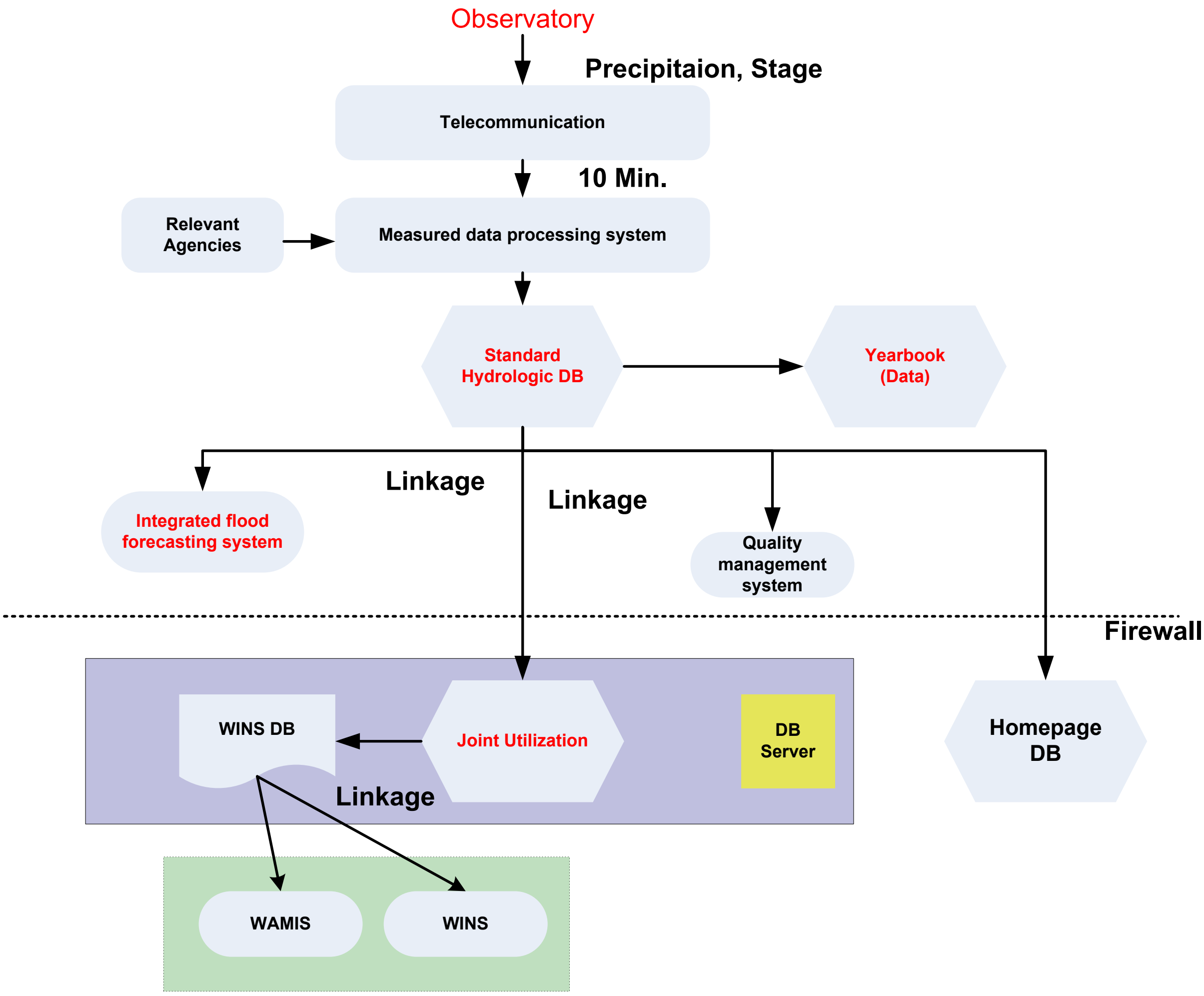


Fig. II-6-11. Flowchart of Spatial Flood forecasting System

5) Integrated Water Resources Management

The primary purpose of operating dam is to control the water flow by supplying stable amount of water from basins with controlled water gates. The secondary goal is to establish an operational system to manage floods and water resources. The last purpose would be to maintain the water level of basins and groundwater.

The barrage management regulation rules can be broadly separated in to setting standard water levels of barrages, and operations in dry and flood seasons. Regarding setting standard water levels, a standard value is first set and it is flexibly adjusted based on the flux of local basins. During the dry season, maximum levels and management levels are set upon an operation.

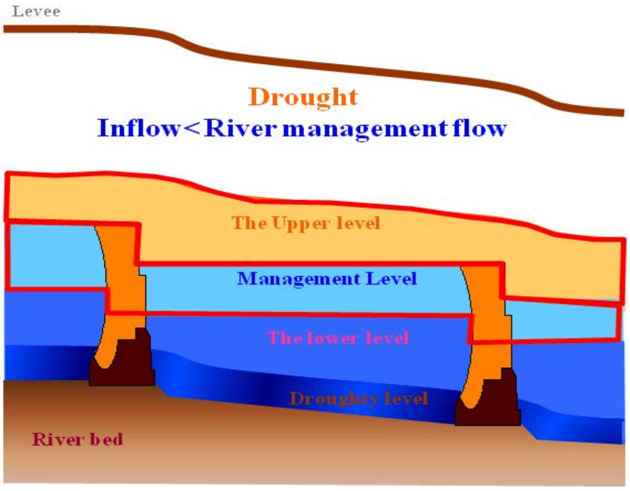


Fig. II-6-12.Operation of weirs during dry seasons

Targeted water level is set during the flood season, and water gates will be utilized to control proper water levels.

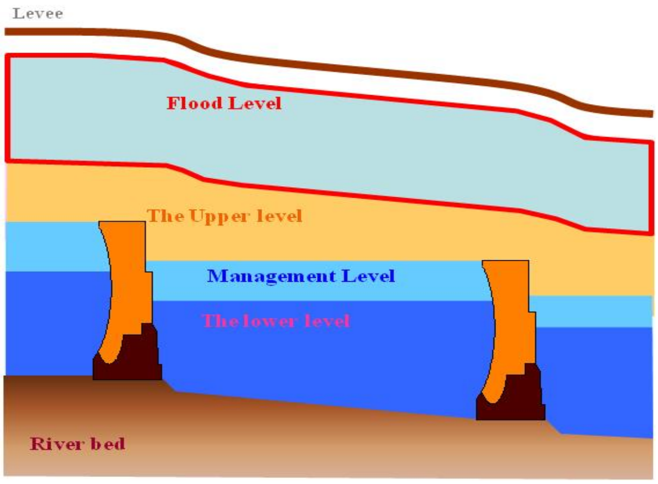


Fig. II-6-13. Operation of weirs during flood seasons

At the same time, interagency cooperation is needed to apply multi-reservoir operation efficiently. For this reason, there is the regular meeting about integrated water resources management. At the commission, it is also proposed for integrated operating plan.

The committee is comprised of three groups (government officials, facilities operators, specialists and etc).

Fig. II-6-14. Integrated Water Resources Management Commission

c. Disaster Risk Reduction Achievements/Results

Integrated Assessment and Countermeasures against Natural Disaster of the Korean Peninsula

1) Motivations

- Need for comprehensive and practical disaster prevention research
  : By securing the effectiveness and efficiency using a large number of the technologies developed previously in Korea
  : By finding the integrated, quantitative, and objective risk assessment on natural disasters
  : By reviewing the old (e.g. historical policies, measures, record and data) related to natural disasters and their managements
  : By predicting the future environment of natural disaster (e.g. change of climate, political status, and so on.)
  : By integrating the engineering-based technologies and the socio-economical sciences

2) Overview

- *Temporal scope*: Investigation of DRM knowledge and policy including PAST, PRESENT and FUTURE concepts
- *Spatial scope*: Entire Korean Peninsula Considering Un-gauged regions in Risk Assessments
- *Targets*: Natural disasters, particularly flooding, earthquake, landslide, tsunami
- *Methodology*: Integration of structural and nonstructural measures against Natural Disaster including the economy evaluation of disaster management

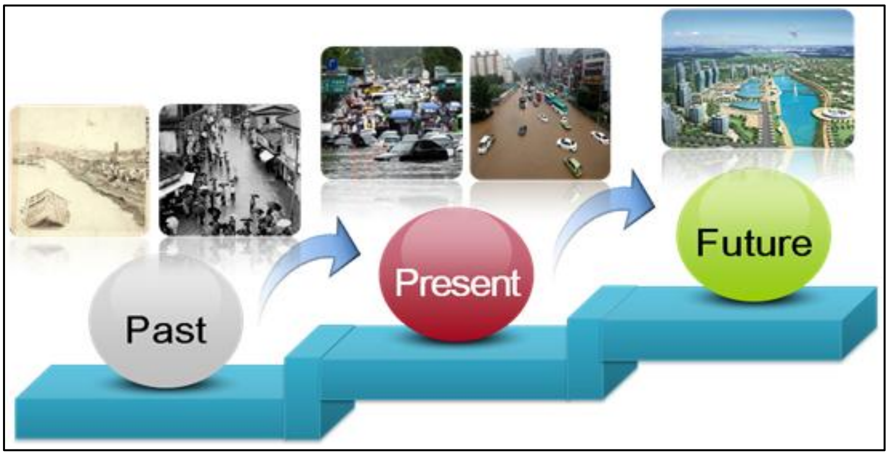


Fig. II-6-15. Spatio-temporal scope of the research

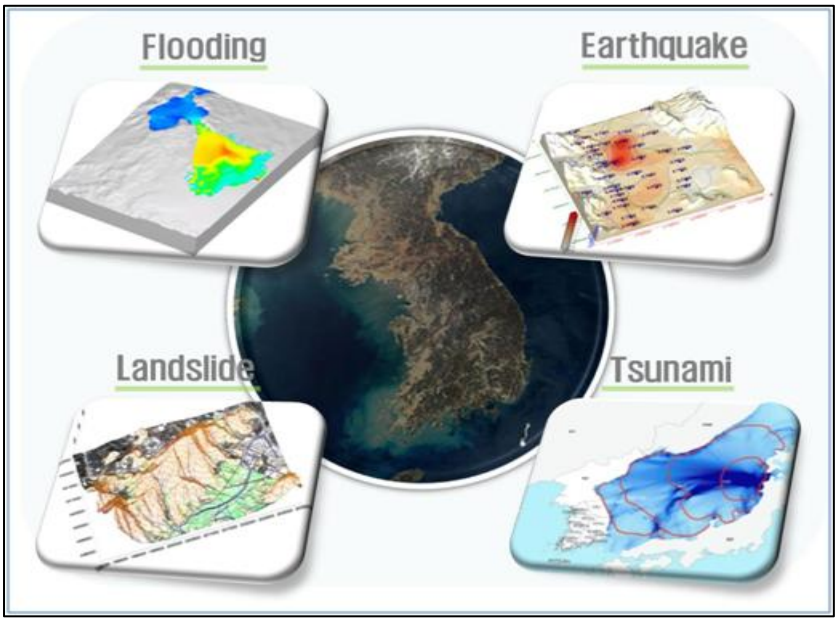


Fig. II-6-16. Major targets to be solved in this research

- *Expected outcomes*: Integrated Disaster Assessment System including modules with respect to disaster types focusing on the Korean Peninsula, and the cutting edge technologies reflecting PAST, PRESENT and FUTURE concepts

3) Examples

- ‘Review the old and learn the new’ (溫故知新)
  • Policies and measures of the ancestors related to preparedness and recovery of natural disasters
  • Lessons learned from the Top 10 worst disaster in the world
  • Relationship between disaster and place name

Fig. II-6-17. Examples of historical data (L) and Top 10 worst disaster in the world (R)

- Updating of current Disaster Management technologies
  - • Disaster Monitoring System
  - • Disaster Warning System
  - • Disaster Recovery System
  - • Countermeasures for Disaster Preparedness, Prevention, Response and Recovery
- Predicting of Future Disaster Environments
  - • Change of driving forces due to climate change
  - • Unification of South and North Korea
  - • Change of social and economic environments

d. Research, Training, and Other Achievements/Results.

1) Operation of the Typhoon Research Fellowship Program

The 2012 Typhoon Research Fellowship Program, as part of the Training and Research Coordination Group (TRCG) Fellowship Program of the ESCAP/WMO Typhoon Committee was successfully operated. Three typhoon forecasters who are from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), Department of Meteorology and Hydrology (DMH) of the Lao PDR, and the Thailand Meteorological Department (TMD) were trained during two months (1 May to 30 June 2012) under instruction of the staffs of the National Typhoon Center of the Korea Meteorological Administration (NTC/KMA) and the TAPS system developer, OPENSNS Ltd. The trainees carried out training and research on optimizing typhoon forecast using TAPS as well as on analyzing the genesis and dissipation of tropical cyclones. They performed successfully their missions, drafting a training report in spite of the short period. They improved their typhoon analysis and forecast skill as well as shared their ideas and plans to apply the TAPS system for their own country.

Fig. Ⅱ-6-18.Presentation by research fellowship recipients

e. Regional Cooperation Achievements/Results

- Nil

f. Identified Opportunities/Challenges for Future Achievements/Results

- Nil

7. **Progress on Key Result Area 7: Enhanced Typhoon Committee's Effectiveness, Efficiency and International Collaboration.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

1) 2012 ESCAP/WMO Typhoon Committee AWG Meeting

The AWG meeting of the ESCAP/WMO Typhoon Committee was held on 28-29 May in the headquarters of KMA, Seoul, Republic of Korea.

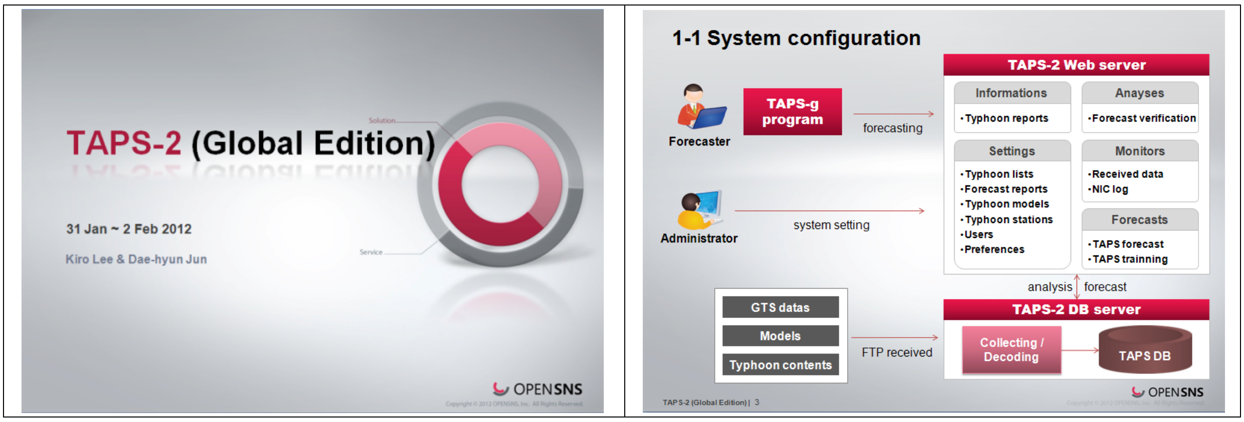
AWG members who are representatives of ESCAP and WMO, working group chairs of the Typhoon Committee, and staff from TCS and KMA were attended the meeting.

At the meeting, the rules, operational procedures, terms of references were reviewed for the competency of the Typhoon Committee for the benefit of all members. And many issues were raised and intensively discussed, including the reorganization of the meetings such as the IWS and the TC session, updates of the TC's main legal documents, follow-up of the decisions and recommendations made at the 44th Session.

Fig. II-7-1. Group photo of participants in the ESCAP/WMO Typhoon Committee AWG meeting

2) KMA's technology transfer for TAPS[1] to NCHMF/NHMS[2]

KMA transferred the technology on TAPS to NCHMF/NHMS Feb. 2012 as a part of the agreement on the importance of scientific and technical cooperation in meteorology. Successful technology transfer for TAPS to Viet Nam generates a positive influence to Southeast Asian nations and NCHMF/NHMS expressed their will to introduce TAPS to neighboring countries. KMA will extend continuous technical assistance to NCHMF/NHMS for the stable and suitable operation of TAPS and develop an upgraded version of TAPS to support more accurate Typhoon analysis and information. In particular, Typhoon reports in local languages are needed along with TAPS package which contains a server. While promoting TAPS to WMO member nations, KMA intends to transfer technology for TAPS to other countries wishing to introduce it. To this end, KMA needs to secure budgets for expert exchange visits and technical cooperation



[1] TAPS : Typhoon Analysis and Prediction System
[2] NCHMF/NHMS : National Centre for HydroMeteorological Forecasting, the National HydroMeteorological Service, Viet Nam

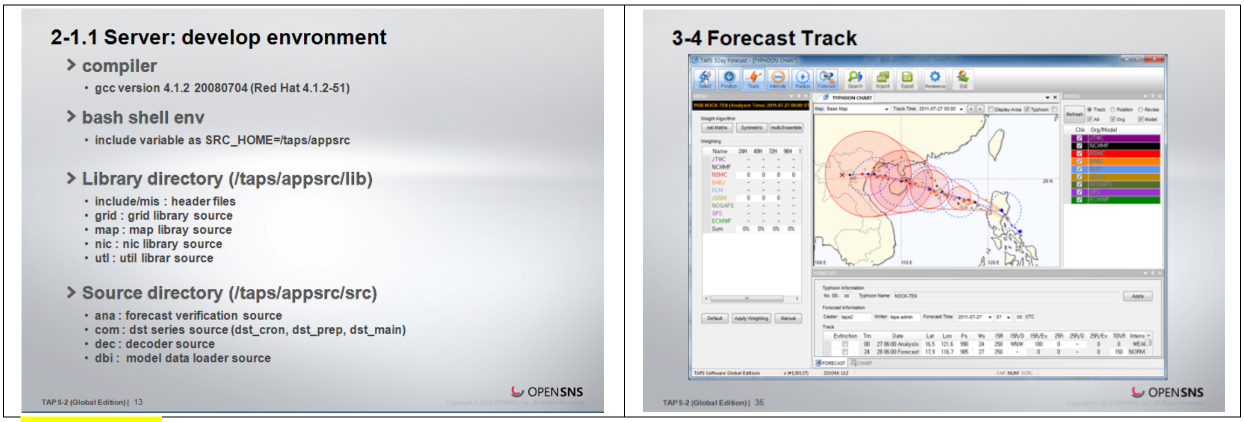


Fig. II-7-2.

3) The completion of the Establishment of an Early Warning and Monitoring System for Disaster Mitigation in Metro Manila (KOICA Project)

The Project entitled "The Establishment of an Early Warning and Monitoring System for Disaster Mitigation in Metro Manila" was successfully completed in January 2012.

The three-year $300M KOICA Project is to aim at establishing a flood forecast and warning system for the Pasig-Marikina River basin. Flood forecasts will be made using observations from four AWSs, seven rain gauges and ten water level gauges through three relay stations, and warning messages will be issued through the twenty warning posts alongside the rivers and seven emergent warning units installed at local DRR offices.

The system is expected to contribute to reducing property and human losses by providing timely flood warnings and information to the Metropolitan citizens.

4) The implementation of a project for improving Disaster Risk Reduction in Lao People's Democratic Republic(Lao PDR) using COMS

The Project entitled "Improving Disaster Risk Reduction in Lao People's Democratic Republic(Lao PDR) using COMS" aims to improve early detection of and responses to severe weather events in Lao PDR by providing supports for establishing a satellite receiving system.

KMA will promote this project with a budget of approximately 260,000 USD in cooperation with the WMO. It is planned to establish a set of COMS receiving system, its related application system and support local optimization and capacity building for its operating from November of this year to April 2013.

b. Hydrological Achievements/Results

1) 44th UNESCAP / WMO Typhoon Committee meeting (2012.02.06 ~ 2012.02.11, Hangzhou, China)

Various policies such as hydrologic, weather, disaster, and sectional meetings for the years of 2012 – 2016 were established from the 44th UNESCAP / WMO Typhoon Committee meeting. In addition, explanation of new projects and future agenda were presented, and approximately 100 people from 11 member nations (Cambodia, Laos, with absent of North Korea) have attended the meeting. The main agenda of the meeting can be summarized as an annual action plan (AOP 6), presented by Philippines, and the annual action plan (AOP 7) presented by Korea, and a development of extreme flood maneuver system (AOP 6). To develop the extreme flood maneuver system, previous flood cases and systems on Philippines and Thailand is to be investigated.

Fig. II-7-3. 44th UNESCAP / WMO Typhoon Committee meeting

2) Visit of the Prime Minister of Thailand, Yingluck Shinawatra, to Han River Flood Control Office (2012. 03. 25)

Due to heavy rain falls in August of last year in Thailand, more than 70% of the entire nation was flooded with accompanied 400 casualties and financial damage equivalent to 18 trillion KRW. In this March, Yingluck Shinawatra , the Prime Minister of Thailand, visited the Han River Flood Control Office operated by Ministry of Land, Transport and Maritime Affairs with special interests in Korea's integrated water resource management technologies and flood prevention systems. Korea's accurate rainfall prediction system, flexible management, scientific water flow control, construction of expanded storage unit has influenced Thailand's flood control system.

Fig. II-7-4. Visit of the Prime Minister of Thailand, Yingluck Shinawatra

3) Investigation of historical extreme floods and flood forecasting & warning systems (2012. 06. 05 ~ 2012. 06. 15, Thailand, Philippines)

Pampanga River Basin in Philippine and Chao Phraya River Basin in Bangkok, Thailand were visited to study places with extreme flooded regions. This visit was initiated from the UNESCAP/WMO which is led by Ministry of Land, Transport and Maritime Affairs, and the purpose was to perform annual action plan (AOP6) and to investigate the research subject of 「Typhoon Committee Flood Management Studies」.

The data of operation methods and flood warning systems of corresponding locations where extreme floods had occurred were obtained, and the current status of flood warning systems on Philippines and Thailand were shared together.

Fig. II-7-5. PAGASA, Philippines

Fig. II-7-6. Royal Irrigation Department, Thailand

4) More than 2,000 of government officials in Thailand 2,000 visited the Han River Flood Control Office
(2012. 07. 05 ~ 2012. 08. 30)

Local government of Thailand dispatched their officials to the Han River Flood Control Office in Seoul to learn Korea's flood warning system, and integrated water management technologies. The officials of Thailand was composed of Governor, Mayor, local councilors, the Local Officials, and each visit included approximately 150 ~ 200 people, with total of 2,000 visitors from Thailand from July 5th to August 30th. This was the first time for Korea to have visitors from foreign nation to show Korea's water related technologies, and we believe that this will lead us to opening new technical exchange era followed by Korean culture and medical tourism.

Fig. II-7-7. Visit of government officials from Thailand in Han River Flood Control Office

5) The 1st meeting of TC Working Group on Hydrology, Seoul, Korea (2012. 10. 7~ 2012. 10. 10)

As the occurrence of typhoons and heavy rain falls are concentrated on Asia and Pacific region, corresponding water related damages has rapidly increased. This is why the international organization UNESCAP/WMO typhoon committee request Korea to hold hydrology conference with our advanced water management technologies.

Workshops on typhoon and hydrology are expected to be placed every year in the future, and continue researches on many nations in Asia other than Thailand and Philippine shall be conducted to improve their water treatment technologies.

Fig. II-7-8. Participant in the 1st meeting of TC WGH

c. Disaster Risk Reduction Achievements/Results

1) The 7th Working Group on Disaster Risk Reduction (WGDRR) Annual Meeting

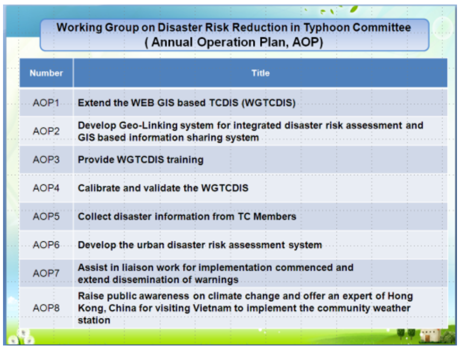
Today, all across the world, typhoon-related disasters have constantly been taking place. Furthermore, no country can be guaranteed safety from these disasters. Management of large-scale and compound disaster risks are no longer just one nation's problem. It must be a collaborative effort to find solutions.

Since 2006, WGDRR meeting has been held in Seoul yearly to produce meaningful results for reducing the disaster impacts related to Typhoon. Main purpose of the meeting is to share the disaster prevention technologies and ideas to implement international cooperation.

The 7th WGDRR meeting was held in Seoul during 30-31 May, 2012 at 63 building convention center and NDMI. Main topic of the meeting is "Strengthening on Management Strategies for Typhoon and Implementation of International Cooperation Research". Due to its highest disaster related to Typhoon, it was agreed to specifically focus DRR activities on sharing the disaster prevention technologies such as Flash Flooding Alert System (FFAS), SWIdget by performing international cooperation research.

With reference to the development of WGTCDIS, PTC member was invited to discuss the expansion of TCDIS to tropical cyclone. In present, TCDIS is upgrading by NDMI and various components for upgrading TCDIS was discussed in the 7th WGDRR annual meeting. The contents of each session in the meeting are as follows;

<Session I, day 1>
○ Review of 2012 AOP of WGDRR (Olavo Rasquiho, TCS Secretary)



- Extend the WEB GIS based TCDIS (WGTCDIS)
- Develop Geo-Linking system for integrated disaster risk assessment and GIS based information sharing system
- Provide WGTCIDS training
- Calibrate and validate the WGTCDIS
- Collect disaster information from TC members
- Develop the urban disaster risk assessment system
- Assist in liaison work for implementation commenced and extend dissemination of warnings
- Raise public awareness on climate change and offer an expert of Hong Kong, China for visiting Vietnam to implement the community weather station

<Session II, day 1>

○ Typhoon Committee Disaster Information System (Chihun Lee, NDMI)

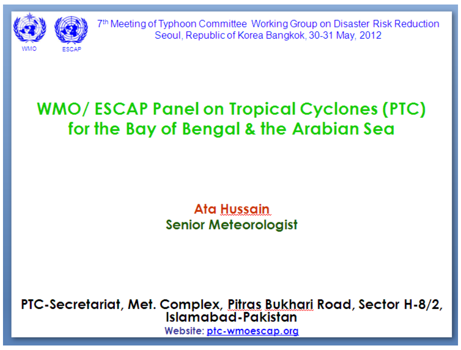
- Development history of TCDIS
- Collection of Typhoon disaster information from member countries and DB Analysis
- Basic concept and future plan for TCDIS
- Upgrade of similarity analysis for Typhoon search algorithm

○ TCDIS Running Plan (Jitae Kim, SDM)

- Collection of Typhoon disaster information from member countries and DB analysis
- Upgrade of similarity analysis for Typhoon search algorithm
- 2012 plan for upgrading TCDIS
- Future plan for TCDIS

○ WMO/ ESCAP Panel on Tropical Cyclones (PTC) for the Bay of Bengal & the Arabian Sea

- Introduction of PTC
- Technical activities in PTC
- Mission of the Panel
- Priorities of the Panel

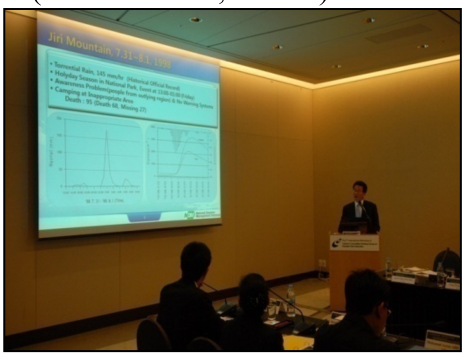


<Session III, day 1>

○ Report on 2012 Philippine Expert Mission (Jae Hyun Shim, NDMI)

- Training of TCDIS in PAGASA
- Introduction of NDMI's technologies for DRR
- Field investigation in Mindanao island in Philippines
- Future expert mission plan

○ Flash Flood Alert System (FFAS) in Korea (Yun Tae Kim, NDMI)



- Examples of the flash flood damages in Korea
- The beginning of flash flood warning
- Developing of Flash Flood Alert System (FFAS)
- Future plan for upgrading FFAS

<Session IV, day 1>

○ Flood Management in Typhoon Committee Members (Hwi Rin Kim, HRFCO)

- Examples of extreme flood occurrences in member countries
- 2012 AOP in WGH
- Projects of WGH related to TC activities

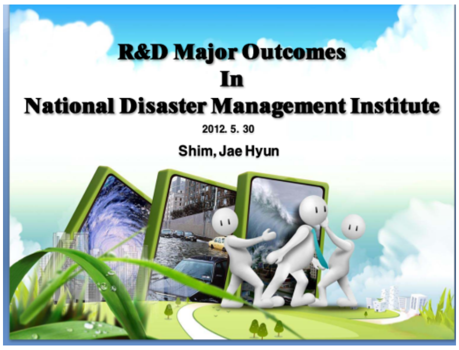
○ Assessment System of Flood Control Management (Gunhui Chung, KICT)

- Development of flood damage data
- Development of the module for calculating flooding area
- The property of D/B construction of flooding area
- Frequency based flood estimation
- Damage estimation system construction
- Multi-Dimension Flood Damage Analysis (MD-FDA)

○ Korea's ODA and KOICA (Na, Hyeon,KOICA)

- Korea's ODA
- KOICA's organization and strategy
- KOICA's ODA performance

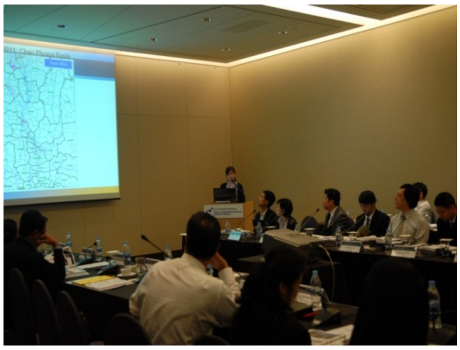
○ R&D Major Outcomes in National Disaster Management Institute (Jae Hyun Shim, NDMI)



- Research projects in NDMI
- Major outcomes in NDMI (Disaster Prevention Technologies)
- Future plan

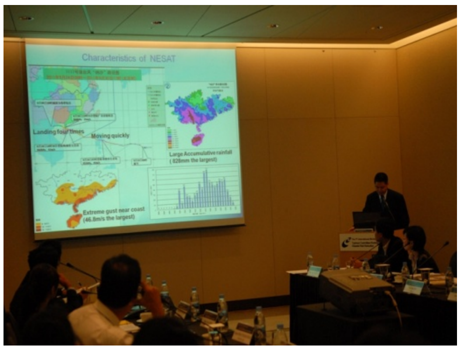
<Session V, day 1>

○ Information Technology for Disaster Management (Khueanta Thanita, Thailand)



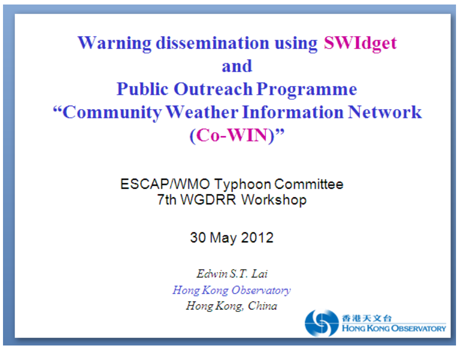
- 2011 Big flood in Thailand
- Conceptual of Disaster Data Warehouse
- Introduction of disaster data collection system in Thailand

○ Typhoon Disaster Risk Management in China (Xue Jianjun, China)



- Overview of TC’s activities in 2011
- Progress in disaster warning and prevention
- Risk on TC disaster risk management

○ Warning Dissemination using SWIdget and Public Outreach Programme "Community Weather information Network" (Edwin S.T. Lai, Hong Kong)



- Introduction of SWIdget
- Mechanism of how the warning dissemination works
- Latest development of SWIdget
- Community weather station project
- Future development plan

○ Macao Country Report (Cecilia Leong Fong Peng, Macao)

- Overview of tropical cyclones affected Macao in 2011 - Mechanism of how the warning dissemination works
- Damages induced by tropical cyclones in 2011
- Introduction of disaster prevention technology in Macao
- Suggestion for international cooperation research for Macao regarding disaster prevention technology

○ Disaster in Viet Nam (Xuan Tung NGUYEN, Viet Nam)
- Natural disasters in Viet Nam
- 2011 disaster in Viet Nam
- Disaster prevention technology in Viet Nam
- Natural disaster response and mitigation
- Structural and non-structural measures for DRM
- National strategy for DRM

○ Promoting Disaster Reduction through Multi-National Cooperation in Asia region (Junji MORIWAKI, Japan)

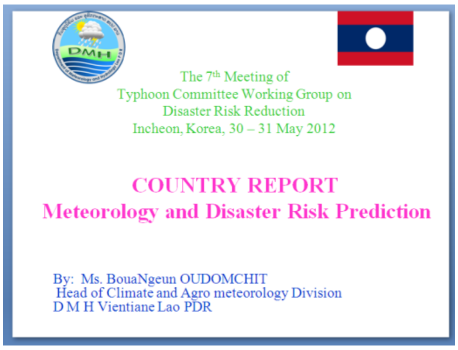
- About Asian Disaster Reduction Center, ADRC
- ADRC activity – Information sharing on DRR
- ADRC activity – Human Resources Development
- ADRC activity – Technical Cooperation

○ Country presentation on Disaster Prevention Technology in Malaysia (Muhamad Azren Abdul Aziz, Malaysia)

- Disaster Management in Malaysia
- ICT applications
- ICT against disaster

○ Country Report (Meteorology and Disaster Risk Reduction in Lao PDR (BouaNgeun OUDOMCHIT, Lao PDR)

- Meteorological and hydrological network in Lao PDR
- Tropical cyclone monitoring
- Big flood in August, 2008
- National disaster management framework



○ Disaster Prevention Strategies in Korea (Jae Hyun Shim, NDMI)

- Introduction of NDMI
- International activities for DRM in NDMI
- Future research strategies

<Session VI, day 2>

○ The 7th WGDRR Annual Meeting Summary (Cecilia Leong Fong Peng, Macao)

- Summary and discussion

<Participants>

No.	Photo	Name	Nationality	Organization	Position/Title
Domestic Relative Organizations					
1		Ki-Sung BANG	Korea	National Emergency Management Agency	Deputy Administrator
2		Yong Sun YOON	Korea	National Emergency Management Agency	Secretary
3		Sang Won BAE	Korea	National Emergency Management Agency	Deputy Director
4		Seok-geun IN	Korea	Ministry of Public Administration and Security	Deputy Director
5		Jae-hwan JUNG	Korea	Ministry of Public Administration and Security	Deputy Director

6		Sang Heon LEE	Korea	Han River Flood Control Office	Head of Center
7		Dong Ryul LEE	Korea	Korea Institute of Construction Technology	Head of Department
8		Jitae KIM	Korea	SDM Engineering	President
9		Eun Mi CHANG	Korea	ZIIN Consulting	CEO
10		Gunhui CHUNG	Korea	Korea Institute of Construction Technology	Researcher
11		Hwi-Rin KIM	Korea	Han River Flood Control Office	Researcher

12		Hyeon NA	Korea	Korea International Cooperation Agency	Head of Team
TC Members					
13		Khueanta THANITA	Thailand	Department of Disaster Prevention and Mitigation	Human Resource Development Officer
14		Jianjun XUE	China	China Meteorological Administration	Director
15		Sau-tak LAI	Hong Kong	Hong Kong Observatory	Senior Scientific Officer
16		Su Hon HO	Macau	Security Forces Coordination Office	Superintendent
17		Jose LAM	Macau	Security Forces Coordination Office	Chief Inspector

18		Fong Peng LEONG	Macau	Security Forces Coordination Office	Technician
19		Xuan Tung NGUYEN	Vietnam	Department of Dyke Management and Flood, Storm Control	Officer
20		Muhamad Azren ABD AZIZ	Malaysia	National Security Council Prime Minister's Department	Assistant Secretary
21		Junji MORIWAKI	Japan	Asian Disaster Reduction Center	Researcher
22		BouaNgeun OUDOMCHIT	Lao PDR	Department of Meteorology and Hydrology	Head of Climate Division
International Organizations					
23		Olavo RASQUINHO	Macau	TC Secretariat	Secretary

24		Denise LAU	Macau	TC Secretariat	Senior Secretary
25		Jinping LIU	China	TC Secretariat	Hydrologist
26		Kai Hong LEONG	Macau	TC Secretariat	Meteorologist
27		Ata HUSSAIN	Pakistan	Panel on Tropical Cyclone	Assistant Secretary
28		Mari SAWAI	Japan	UN Economic and Social Commission for Asia and the Pacific	Associate Social Affairs Officer
29		Yuko KITADA	Japan	UN Economic and Social Commission for Asia and the Pacific	Associate Social Affairs Officer

30		Koji KUROIWA	Japan	World Meteorological Organization	Chief
31		Glenn DOLCEMAS COLO	USA	UN International Strategy for Disaster Reduction	Chief
32		Yong Kyun KIM	Korea	UN International Strategy for Disaster Reduction	Secretary
National Disaster Management Institute, Korea					
33		Woon Kwang YEO	Korea	National Disaster Management Institute	President
34		Hoon CHOI	Korea	National Disaster Management Institute	Division Head

35		Jae Hyun SHIM	Korea	National Disaster Management Institute	Division Head
36		Jong Kook LEE	Korea	National Disaster Management Institute	Division Head
37		Jong Seol LEE	Korea	National Disaster Management Institute	Division Head
38		Yun Tae KIM	Korea	National Disaster Management Institute	Senior Researcher
39		Geum Ho OH	Korea	National Disaster Management Institute	Senior Researcher

40		Chi Hun LEE	Korea	National Disaster Management Institute	Researcher
41		Taek Jo KO	Korea	National Disaster Management Institute	Researcher
42		Hoon LEE	Korea	National Disaster Management Institute	Researcher
43		Do Joon JUNG	Korea	National Disaster Management Institute	Researcher
44		Seng Yong CHOI	Korea	National Disaster Management Institute	Researcher
45		Su Min CHOI	Korea	National Disaster Management Institute	Researcher

46		Kyoung Jun KIM	Korea	National Disaster Management Institute	Researcher

Fig. II-7-9. Commemorative photograph with TC members (L) and meeting view (R)

2) 2012 Expert Mission in Philippines

<Introduction>

The Working Group on Disaster Risk Reduction (WGDRR) commenced implementation of its first project, the Typhoon Committee Disaster Information System in 2005. WGTCDIS is a platform for information exchange among the TC Members. It has been noted that hitherto not all members have submitted the required information for implementation of the WGTCDIS. In this respect, the TC decided that an expert mission would be conducted in 2008 to promote the WGTCDIS and to assist members in data collection and entry to the WGTCDIS.

During 44th Typhoon committee session held in Hangzhou, China from 6 to 11 February, 2011, Working Group on Disaster Risk Reduction (WGDRR) decided to send expert missions on the WGTCIDS to 3 TC members namely Malaysia, Philippines, and USA in 2012. Also, the committee was informed that a TC expert from the three Working Groups will visit Philippines to assess the impacts of tropical storm “Washi”.

By above decisions, NDMI dispatched experts to Philippines and investigated the damage of tropical storm “Washi”.

▷ Period : 2012. 4. 22 ~ 4. 28

▷ Place : Philippine Manila (PAGASA), Cagayan de Oro in Mindanao island

▷ Objectives

- Investigation of damages by tropical storm “Washi”
- Education and training of WGTCDIS
- Introduction of disaster prevention technologies
- Discussion about international cooperation research
- Discussion about Northern Mindanao Project with PAGASA

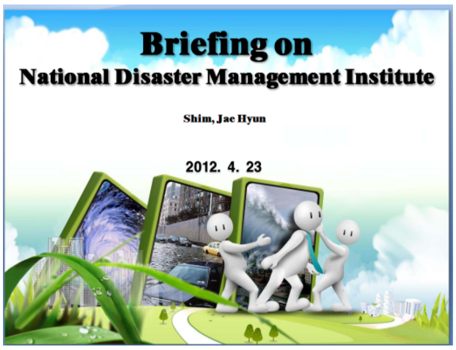
<Program>

Even though main program of the Expert Mission was for training WGTCDIS, new education programs were added to make the expert mission more productive. New education programs include i) Flash Flood Alert System (FFAS), ii) Frequency Analysis for Rainfall Data (FARD), iii) Case study of disaster recovery, iv) Disaster prevention policies in Korea v) Soil Erosion Model for Mountainous Area (SEMMA).

Expert mission in Philippines was held in PAGASA at Manila. Total 33 participants who came from different divisions in PAGASA, Office of Civil Defense attended on the Expert Mission.

Field investigation for damage assessment of tropical storm "Washi" was performed in Cagayan de Oro, Mindanao. People who came from UNECAP, UNDP, CDO, DPWH, MGB, and DILG attended on field investigation and discussed about disaster risk management. During the field investigation, NDMI, PAGASA, and CDO discussed about Northern Mindanao Project which will install the Flash Flood Alert System in Northern Mindanao area. The project will start in 2013 by NDMI. Main presentations in the Expert Mission are as follows;

○ Briefing on National Disaster Management Institute (Jae Hyun Shim, NDMI)



- Introduction of NDMI
- Major research outcomes from NDMI
- International activities for DRM in NDMI
- Future research strategies

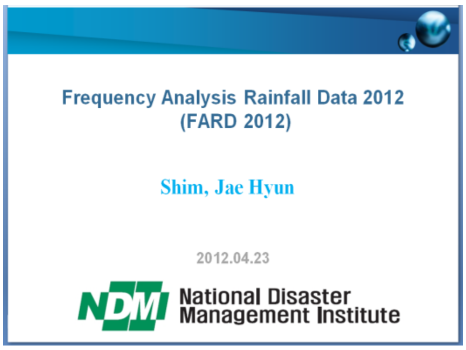
○ Typhoon Committee Disaster Information System (Chihun Lee, NDMI)

- Introduction of TCDIS
- Data collection and development of Web GIS-based Management
- Upgraded TCDIS
- Future plan for expanding TCDIS components

○ Flash Flood Alert System in Korea (Jae Hyun Shim, NDMI)

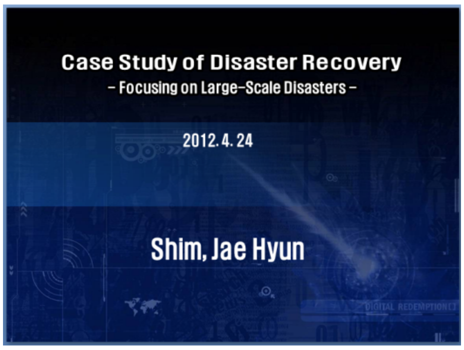
- Introduction of ARWS (Automated Rainfall Warning System)
- Flash Flood Alert System
- Application of FFAS
- Future plan for upgrading FFAS

○ Frequency Analysis Rainfall Data (Jae Hyun Shim, NDMI)



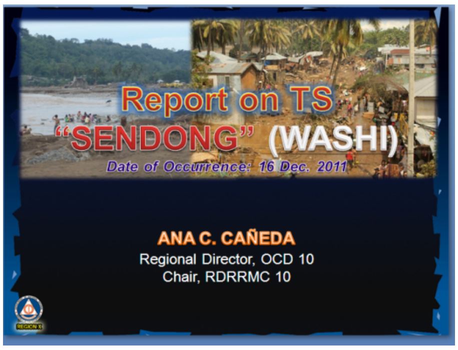
- Introduction of FARD 2012
- Fundamental theory
- Program structure
- Program function

○ Case Study of Disaster Recovery (Jae Hyun Shim, NDMI)



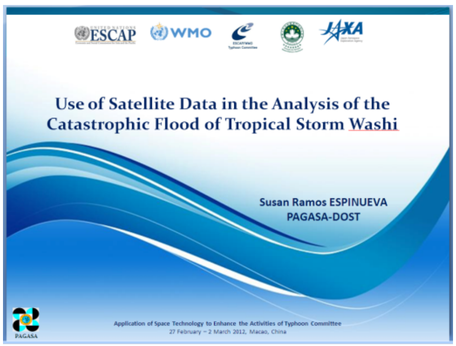
- Disaster environment of Korea
- Occurrence of disaster
- Recovery support system
- Case study of large-scale natural disaster recovery

○ Report on TS "Sendong" (Ana C. Caneda, OCD)



- Current situation
- Recovery and rehabilitation initiatives
- Financial assistance
- Inter cluster coordination

○ Use of Satellite Data in the Analysis of the Catastrophic Flood of Tropical Storm Washi (Susan Ramos ESPINUEVA, PAGASA)



- TC statistics in the Philippines
- Focusing mechanisms
- Application of SBT in the assessment of TS Washi

Figure) Field Investigation for Damage Assessment of TC Washi

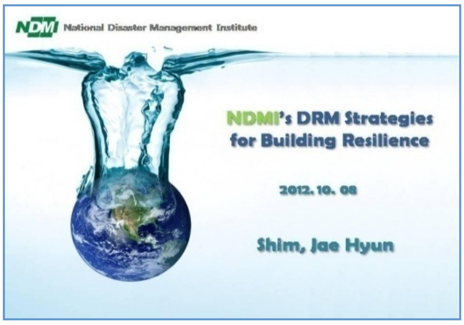
Fig. II-7-10. Commemorative photograph of Expert Mission (L) and Field Investigation(R)

3) 2012 Expert Mission in Guam and Malaysia

Second mission was led by NDMI to form the expert team. An expert team was organized which five experts from NDMI, Olavo Rasquinho (Guam), and Leong Kai Hong, Derek (Malaysia) from TCS to educate and train WGTCDIS. Especially, in this mission, NDMI's research plan of "Urban Flood Damage Analysis & Development of an Integrated Inundation Analysis Technology on Ground and Underground in Inland Area" was introduced and discussed with members. Also, Flash Flood Alert System (FFAS) and Frequency Analysis for Rainfall Data (FARD) are introduced to the participants in the Expert Mission. With reference to FARD, NDMI notified that FARD can be provided freely through NDMI to member countries.

▷ Period : 2012. 10. 06 ~ 10. 14 ▷ Place : Guam (Homeland Security Office of Civil Defense), Malaysia (National Security Council) ▷ Objectives • Education and training of WGTCDIS • Introduction of disaster prevention technologies • Discussion about international cooperation research for DRM

○ NDMI's DRM Strategies for Building Resilience (Jae Hyun Shim, NDMI)

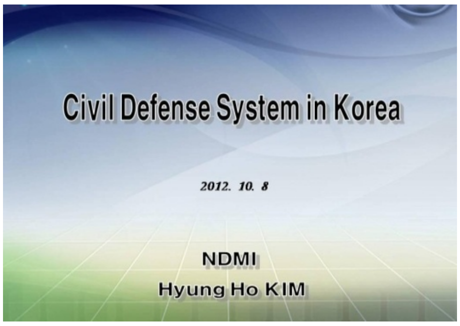


- Major research outcomes
- Future research strategies
- International cooperation work for DRM

○ NDMI's DRM Strategies for Building Resilience (Jae Hyun Shim, NDMI)

- Introduction of FARD 2012
- Fundamental theory
- Program structure
- Program function

○ Civil Defense System in Korea (Hyung Ho Kim, NDMI)



- Role of civil defense system
- Symbol of civil defense system
- Organization of civil defense
- Manual for civil defense emergency

○ Urban Flood Damage Analysis & Development of an Integrated Inundation Analysis Technology on Ground and Underground in Inland Area (Seungyong Choi, NDMI)

- Casual of urban flood disaster
- Urban flood damage case
- Disaster prevention measures for future urban flood
- NDMI's measures & strategy for urban flood mitigation

○ TCDIS Running Plan (Chihun Lee, NDMI)

- Introduction of TCDIS
- Data collection and development of Web GIS-based Management
- Upgraded TCDIS
- Future plan for expanding TCDIS components

○ Flash Flood Alert System (FFAS) in Korea (Yun Tae Kim, NDMI)

- Introduction of ARWS (Automated Rainfall Warning System)
- Flash Flood Alert System
- Application of FFAS

Figure) Commemorative photograph of Expert Mission in Guam (L) and Malaysia (R)

d. Research, Training, and Other Achievements/Results
- Nil

e. Regional Cooperation Achievements/Results
- Nil

f. Identified Opportunities/Challenges for Future Achievements/Results
- Nil

Ⅲ. Resource Mobilization Activities
- Nil

Ⅳ. Update of Members' Working Groups representatives

1. Working Group on Meteorology

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3. Working Group on Disaster Risk Reduction

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President of National Disaster Management Institute (NDMI)
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Fax : 82-2-2078-7719
E-mail : yeo602@korea.kr

Mr. SHIM, Jae Hyun
Head of Disaster Prevention Research Division, National Disaster Management Institute (NDMI)
#135, Mapodaero, Mapo-Gu, Seoul, Rep. of Korea
Tel : 82-2-2078-7800
Fax : 82-2-2078-7719
E-mail : shim1001@korea.kr

4. Training and Research Coordinating Group

Dr. CHANG, Ki-Ho
Senior Scientist, National Typhoon Center, Korea Meteorological Administration
1622-1, Hannam-ri, Namwon-eup, Seogwipo, Jeju, 699-942, Republic of Korea
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