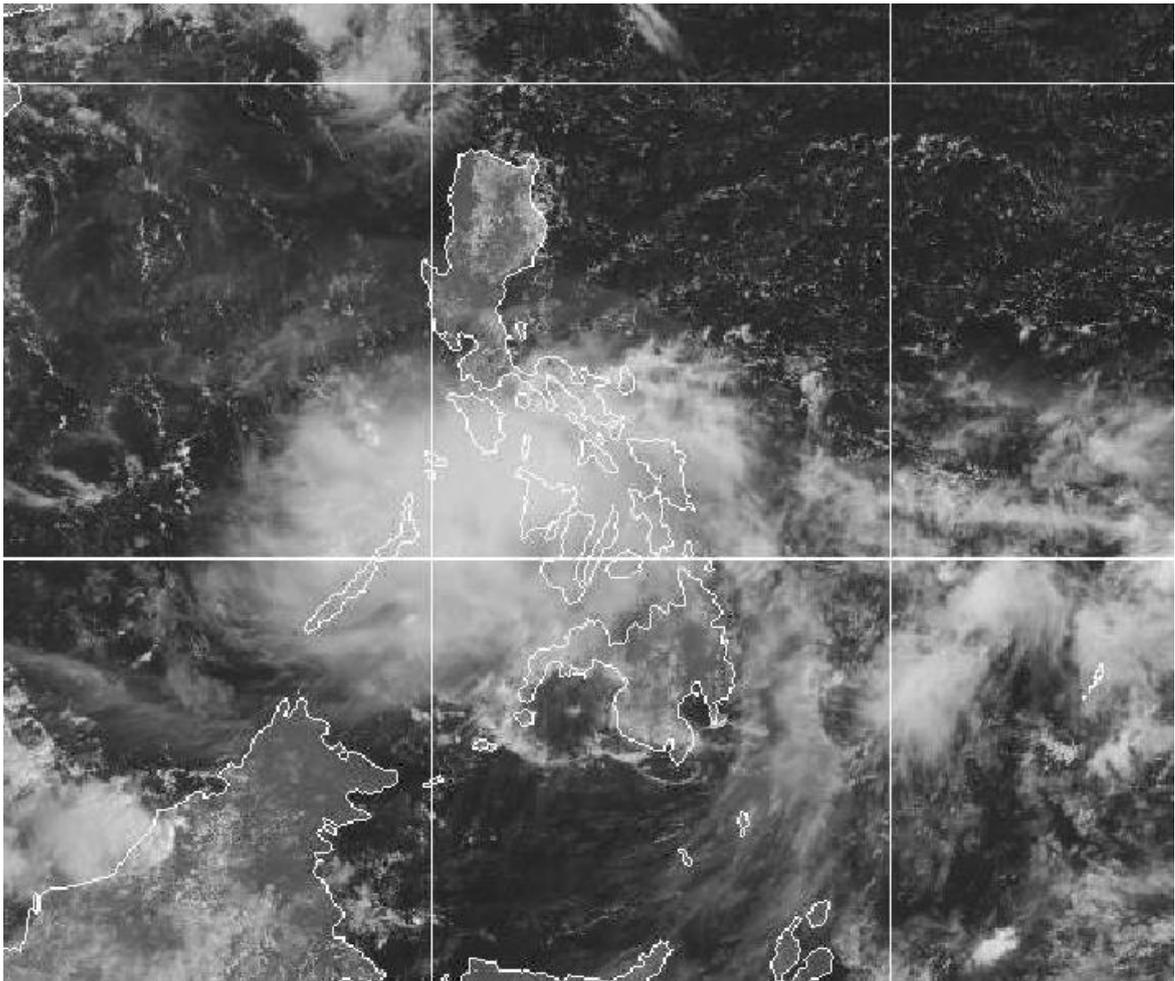


Initial Assessment of the Development of Tropical Storm Ramon (Banyan) over the Philippines

10-13 October 2011



Satellite image of Ramon (Banyan) crossing the Philippines on 12 October 2011
(Source: <http://www.goes.noaa.gov/sohemi/SHGMSVSW.JPG>)

At the beginning of October 2011, the Philippines were struck again by a Tropical Storm named Ramon (Banyan). After gaining strength over the open ocean since 9 October 2011, it moved west-northwest (WNW) and made landfall over Leyte Island and Mindoro Area before losing strength as it left the country. The winds were only a minor factor compared to the precipitation amounts, as the storm appeared to be poorly organized. However, Tropical Storm Ramon (Banyan) was quite widespread and expansive, with a diameter of around 665km. Thus, it generated heavy rainfall throughout its passage, leading to several floods and landslides. Ramon (Banyan) caused 10 confirmed casualties and injured six persons. More than 62,750 persons were affected in 11 provinces (26 municipalities) as reported by the National Disaster Risk Reduction & Management Council (NDRRMC). The estimated agricultural and infrastructure damage amounts to more than 64 million PhP.



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1 Chronology of the Tropical Storm Ramon (Banyan)

On 9 October 2011, the Japan Meteorological Agency (JMA) upgraded the Low Pressure Area (LPA) that had already been surveying northeast of Palau into a Tropical Depression.

Early the next day, 10 October 2011, the Joint Typhoon Warning Center (JTWC) and the Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA) upgraded the system to a Tropical Depression naming it 23W and Ramon respectively.

The system continued developing and on 11 October 2011, the JMA and the JTWC upgraded it again to a Tropical Storm. JTWC updated its name from 23W to Banyan. According to PAGASA weather bulletin issued that day at 5:00 a.m., Ramon (Banyan) was located 360km east-southeast (ESE) of Hinatuan, Surigao del Sur (7.7°N, 129.7°E), with maximum sustainable winds of 55km/h near the center and moving WNW towards Eastern Visayas. Several public storm warnings were emitted for regions such as Luzon, Eastern Visayas and Northern Mindanao, where floods and winds of 45-60km/h were expected.

Early on 12 October 2011, Tropical Storm Ramon (Banyan) was located 89km east-northeast (ENE) of Surigao City (10.1°N, 126.2°E) and presented maximum sustainable winds of 65km/h near the centre and gustiness of up to 80km/h. It maintained its strength as it moved WNW at 17km/h according to PAGASA weather bulletin. Later that day, Ramon (Banyan) made landfall over Leyte Island and Mindoro Area (following PAGASA information) and lost strength being downgraded by JTWC to a Tropical Depression. Some hours later, the JMA also downgraded Ramon (Banyan) to a Tropical Depression.

As of 13 October 2011, Ramon (Banyan) continued moving WNW at slower speeds as it started moving away from the Philippines towards the West Philippine Sea after causing flooding in several provinces in the central part of the country.

According to the weather bulletin from PAGASA, issued at 5 a.m. on 13 October 2011, the Tropical Storm was located 80km WNW of San Jose in the province of Occidental Mindoro (12.6°N, 120.3°E) and moved at 11km/h. It presented maximum sustainable winds of 55km/h near the centre and already appeared as a disorganized area of convection weakening slightly. Public Storm Warning Signals had been lowered, even if moderate to heavy rainfall amounts of up to 25mm/h were still expected within 300km of the Tropical Depression diameter.

The winds were a minor factor compared to the precipitation amounts, as the storm appeared to be poorly organized. However, Tropical Storm Ramon (Banyan) was quite widespread and expansive, with a diameter of around 665km. Thus, it generated heavy rainfall over its passage leading to several floods and landslides.

According to PAGASA's weather bulletin issued on 14 October 2011, Ramon (Banyan) weakened and moved away from the Philippine Area of Responsibility (PAR), heading towards Hainan Island. The system dissipated in the South China Sea on 16 October 2011.

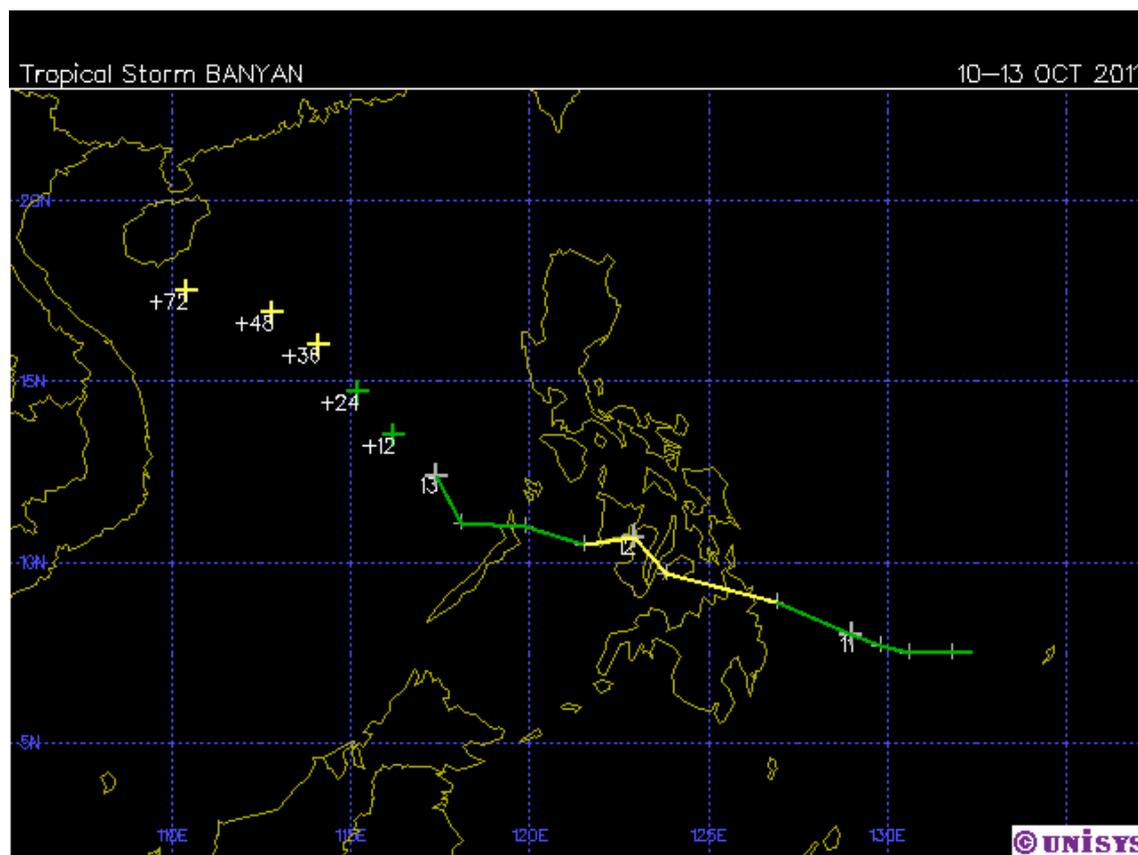


Figure 1.1 Typhoon Track, (Source: <http://weather.unisys.com/>)

Ramon (Banyan) had caused 10 confirmed casualties and six injured persons. More than 62,750 persons have been affected in 11 provinces (26 municipalities), as reported by the NDRRMC on 16 October 2011 (Sitrep No. 14). The estimated agricultural and infrastructure damage amounts to more than 64 million PHP.

2 Setup of the Typhoon Trigger and Assessment of Monitored Data

2.1 Assessment of the Monitored Data

A novel insurance product aims to protect cooperatives in the Philippines from insolvency following typhoons. DHI Water & Environment (S) Pte. Ltd. (DHI) provides online real-time monitoring of weather events all over the country, serving as the basis for the insurer's pay-out scheme.

Wind and rainfall were previously identified by DHI as the two major causes of insurance loss and threshold values (so called triggers) set up for these two parameters. That enables DHI to categorize the severity of a weather event into a 10-year, 15-year or 20-year event.

In order to supply the most accurate information, DHI's "Typhoon Trigger" integrates different kinds of independent data, thereby forming a coherent picture of the actual weather situation in the Philippines.

The Typhoon Trigger recognizes a typhoon event from the moment a tropical depression hits the PAR with maximum wind speeds superior to 30 knots (55.6km/h).

2.1.1 Rainfall Data

The rainfall trigger is based on satellite data provided by the Tropical Rainfall Measuring Mission (TRMM), a joint mission of National Aeronautics and Space Administration (NASA) and the Japan Aerospace Exploration Agency (JAXA) designed to monitor and study tropical rainfall. Data are available on a three-hour basis in grids of 0.25°, which are approximately squares of 27x27km. Hence, the Philippines are covered by 852 data squares, each containing the level of rain for this area. Thereby, TRMM offers a dense coverage of the Philippines, both in time and space.

Raw data from the TRMM satellite use eight different stations to validate local data and make the necessary calibration. The closest validation station for the Philippines is located in Taiwan. After quality control operations, TRMM data are regarded as a reliable qualitative and totally independent data source useful to the hazard analysis and the development of the trigger.

It is important to keep in mind that the direct comparison between rain gauges and the TRMM rainfall data is very difficult due to the different approaches in the measurement of rainfall.

2.1.2 Categorisation and Triggering

In order to evaluate the rain trigger, an extreme value analysis is carried out on the 24-hour TRMM rainfall data for each municipality. Comparing the maximum 24-hour rainfall to the calculated 10-year, 15-year or 20-year rain events, the event return period is calculated for each of the municipalities. Finally, checking each of the municipalities against the trigger criteria, the triggered municipalities are sought out.

2.1.3 Tracking Tropical Storm Ramon (Banyan)

DHI's system was able to track Ramon's (Banyan's) precipitation over the affected areas of the Philippines during the evolution of the Tropical Storm.

As shown in Figure 2.1, the monitoring system clearly reveals the Philippine's central areas that have been affected by the heavy rains during the approach of Ramon (Banyan) on 11 October 2011 and following landfall the 12 October 2011, over Leyte Island in Eastern Visayas before crossing over the mountainous islands of central and Western Visayas.

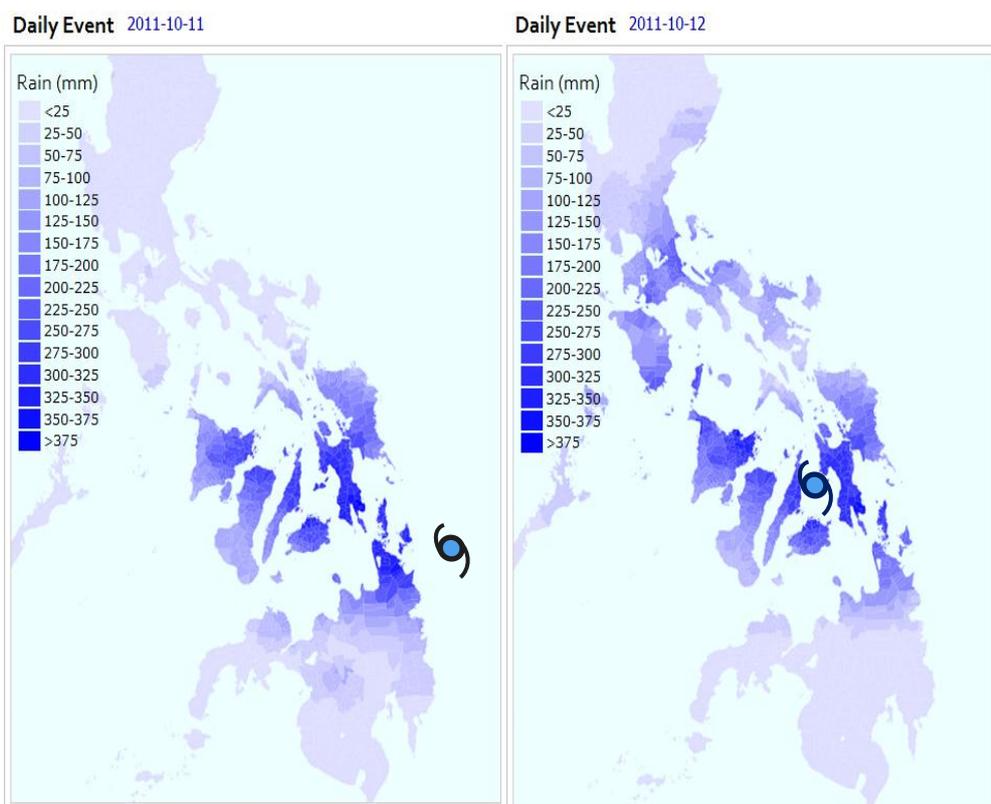


Figure 2.1 DHI's rainfall real-time monitoring system on 11 October 2011 (left panel) and 12 October 2011 (right panel). Heavy rainfall is represented in dark blue. The legend displays the maximum 24-hr rainfall values measured by satellite TRMM.



Approximate location of Ramon (Banyan) for each day.

3 Linking Damage to Triggered Municipalities/Provinces

During 11 October 2011 and 12 October 2011, the areas of Eastern Visayas, Caraga, Northern Mindanao, Central and Western Visayas received between 200 and almost 400mm of rain over 24 hours, experiencing several types of flood and landslide casualties as reported by NDRRMC (see Figure 3.1 and Figure 3.2 for a close-up on the region).

The Typhoon Trigger covers the Philippines at the municipal level based on the probability of both rain and wind exposures during a typhoon event. The real-time monitoring system updates the data every three hours, at the same time adjusting the affected municipalities and well as the event category for each of them.

Several 10-year, 15-year and 20-year rain events had been triggered by DHI's monitoring system during the passage of Tropical Storm Ramon (Banyan), which had been quite widespread but poorly organized bringing more intense precipitation than strong winds. The areas most affected by the heavy rains had been the province of Cebu, Bohol, Negros Occidental, Capiz, and Iloilo (see event category on the right panels of Figure 3.1 and Figure 3.2).

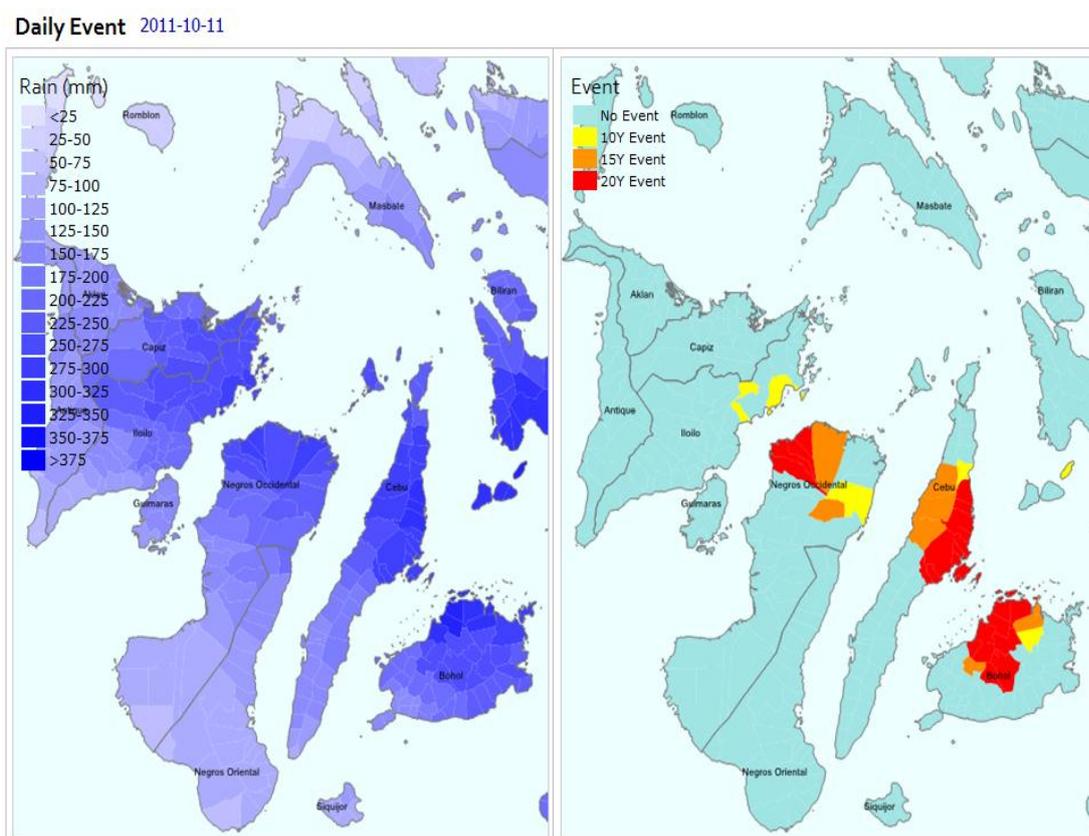


Figure 3.1 Close-up of DHI's rainfall real-time monitoring system on 11 October 2011, and the corresponding triggered events (right panel). The legend (left panel) displays the maximum 24-hr rainfall values measured by satellite TRMM and (right panel) the category of the event in function of the return period.

Daily Event 2011-10-12

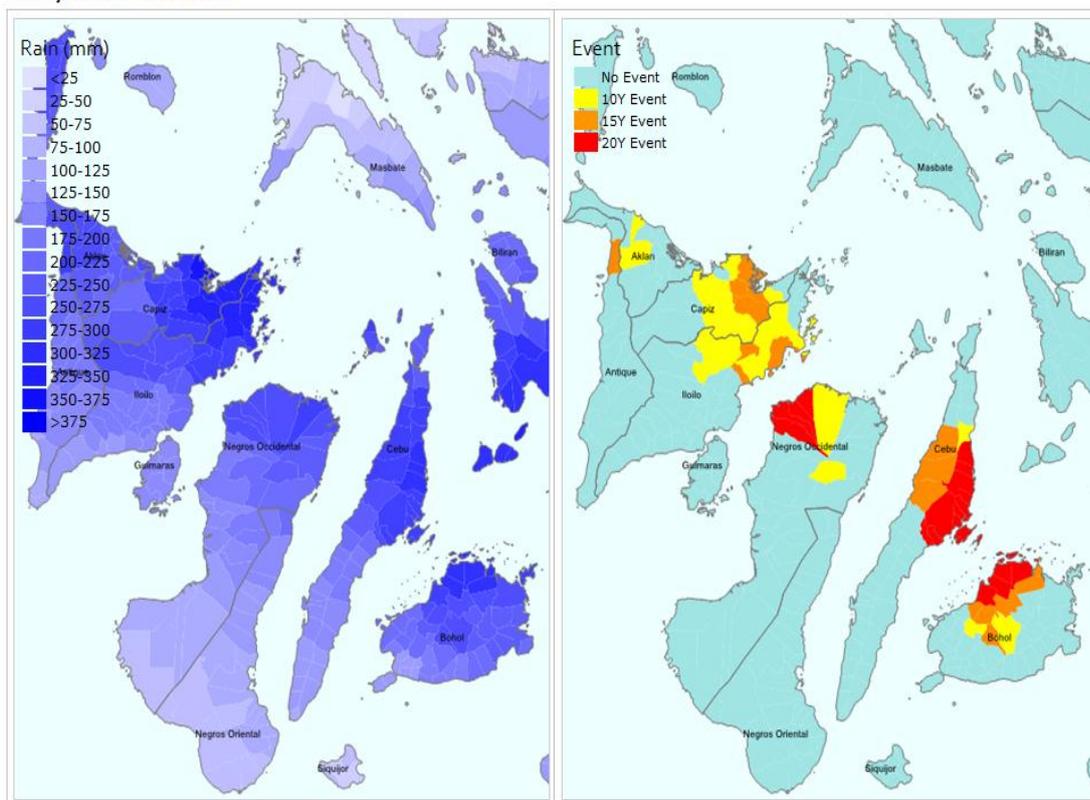


Figure 3.2 Close-up of DHI's rainfall real-time monitoring system on 12 October 2011, and the corresponding triggered events (right panel). The legend (left panel) displays the maximum 24-hr rainfall values measured by satellite TRMM and (right panel) the category of the event in function of the return period.

The Table 3.1 lists some of the municipalities triggered by DHI's system due to the passage of typhoon Ramon (Banyan) on 11 & 12 October 2011 and also mentioned in the NDRRMC report where different casualties had been reported. The table also shows the maximum values estimated by DHI's monitoring system, from TRMM satellite over 24 hours, and the corresponding event triggered.

Table 3.1 List of affected municipalities as reported by NDRRMC and DHI's monitoring system during the passage of Tropical Storm Ramon (Banyan).

Municipality (Province)	Measured Rainfall (mm/24 hr)	Estimated Rainfall Event (Return Period in Years)
Roxas City (Capiz)	280	10
President Roxas (Capiz)	308,8	10
Panay (Capiz)	330,1	15
Estancia (Iloilo)	306 (308mm/24h for a10-year event)	/
Ajuy (Iloilo)	250,2	15
Silay City (Negros Occidental)	228,1	20
Cebu City (Cebu)	258	20
Mandaue City (Cebu)	258	20
Cordoba (Cebu)	255,2	20
St. Bernard (Southern Leyte)	362,4189,7 (376mm/24h for a10-year event)	/
Libagon (Southernm Leyte)	370,3 (381mm/24h for a10-year event)	/
Hinunangan (Southernm Leyte)	358,7 (392mm/24h for a10-year event)	/

4 State of Calamity Reported by NDRRMC

The NDRRMC did not report any state of calamity during the passage of Tropical Storm Ramon (Banyan) following the last report (Sitrep No. 14) issued on 16 October 2011, at 6:00 a.m. However, Mandaue City declared their flooded barangays under State of Calamity.