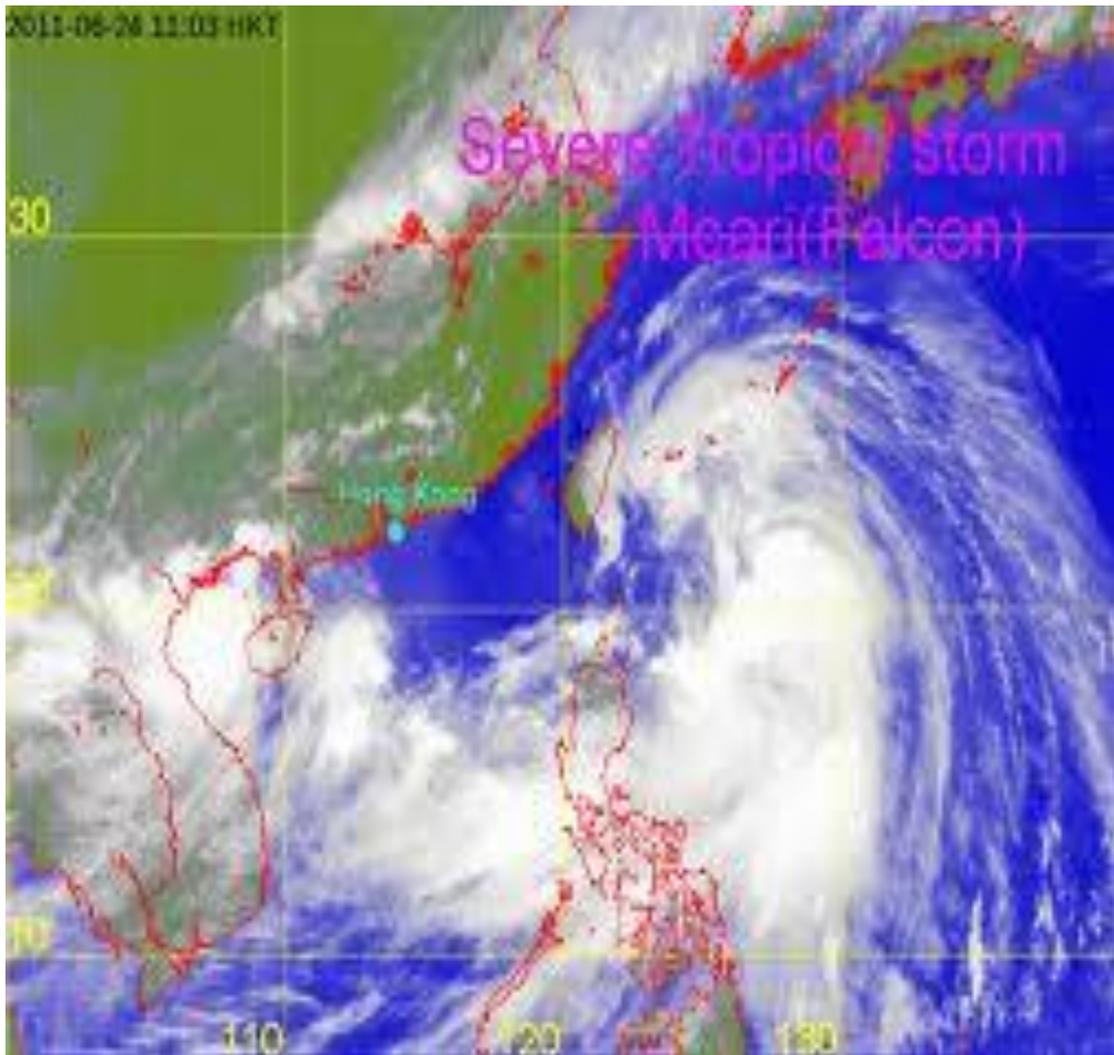# Development of Tropical Storm Falcon (Meari) over the Philippines

June 20-27, 2011

At the end of June, 2011, the Philippines were struck again by Tropical storm Falcon (Meari). After gaining strength over the open ocean since June 20, 2011, it moved north-westwards along the coast moving relatively close to some areas of central and north-east Philippines bringing thus, big amounts of precipitation. This Tropical Storm reached a minimum central pressure of 975 hPa and maximum winds of 97 km/h. According to the National Disaster Risk Reduction and Management Council (NDRRMC), a total of 370,459 families, comprising more than 1.7 million persons, have been affected by flooding in 1,188 barangays of 91 municipalities. Falcon leaves the Philippines with eight dead and 12 missing persons. The estimated cost of damages in agriculture and infrastructure amounts to almost 564 million PhP.

DHI

Contents

WATER ● ENVIRONMENT ● HEALTH

1   Chronology of Tropical Storm Falcon (Meari)

Early on **June 20, 2011**, an area of low pressure about 760 km east of the Philippines began to be monitored by the Japanese Meteorological Agency (JMA). That evening, the Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA) upgraded the system into a Tropical Depression, naming it Falcon. At the time of the upgrade, Falcon was located about 1,000 km, east-north-east (ENE) of Cebu City and had maximum sustainable winds of 55 km/h near the centre.

During the evening of **June 21, 2011**, Falcon maintained its strength as it moved north-westward (NW) with still maximum sustainable winds of 55 km/h. On **June 22, 2011,** JMA upgraded Falcon into a tropical storm, and named it Meari. It enhanced however, the Southwest Monsoon bringing rains over Visayas and Mindanao.

On **June 23, 2011,** Falcon (Meari) merged with the low pressure area and intensified slightly as it moved NW with maximum sustainable winds of 75 km/h and gusts of up to 90 km/h (see track in Figure 1.1).

In the afternoon on **June 24, 2011**, the JMA upgraded Falcon (Meari) to a Severe Tropical Storm as it moved away from the Philippines direction to Okinawa, Japan. Falcon had maximum sustainable winds of 95 km/h near the centre and gusts of up to 120 km/h. It continued to enhance the Southwest Monsoon and to bring some rains over Luzon and Western Visayas.

On **June 25, 2011**, the Tropical Storm Falcon (Meari) gained more strength and further accelerated as it continued moving away from the country with maximum sustainable winds of 105 km/h and gusts of up to 135 km/h. The Southwest Monsoon was still enhanced by the whole circulation of the typhoon and bringing high amount of precipitation to the north-west area of the Philippines.

On **June 26, 2011**, Falcon (Meari) rapidly moved to the Yellow Sea but slowly passed Weihai in Shandong, China, and then the JMA downgraded Falcon (Meari) to a Tropical Storm on the same day. On **June 27, 2011**, the Joint Typhoon Warning Center (JTWC) downgraded Falcon (Meari) to a Tropical Depression before it made landfall in North Korea.

From **June 25-27, 2011**, the Southwest Monsoon, enhanced by the passage of the Tropical Depression Falcon, brought however large quantities of rainfall to the north-west and central Philippines, resulting in occasional flooding. **Pangasinan, La Union, Metro Manila and Ilocos Norte and Sur** experienced continuous heavy rain, causing the swelling of several rivers in these provinces.

On **June 27, 2011**, the Southwest Monsoon was qualified as moderate, yet still expected to bring occasional rain over Northern and Central Luzon becoming widespread rain over the western section.
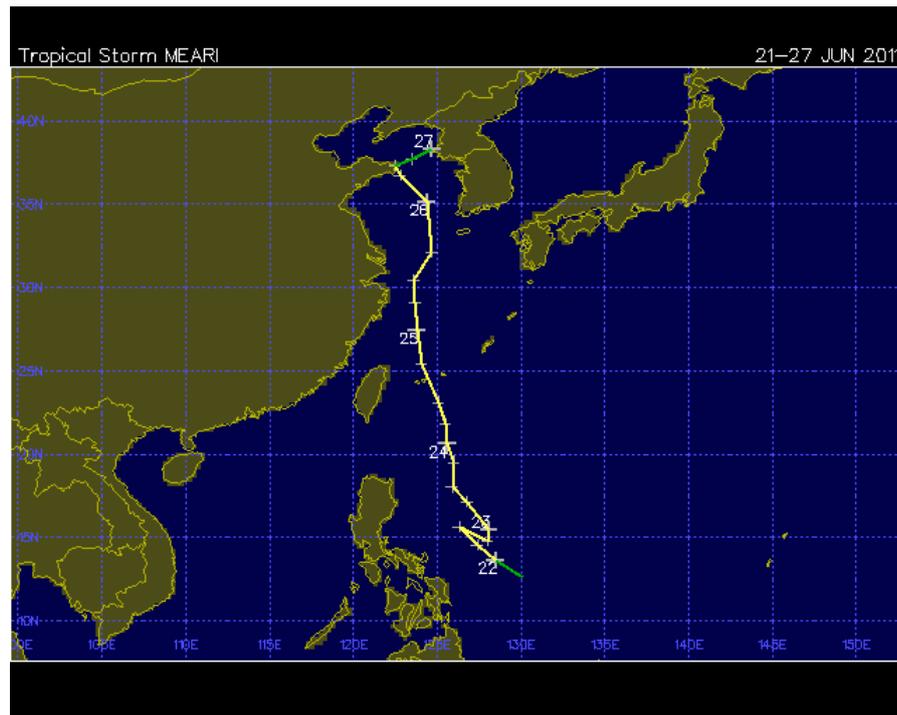
Figure 1.1   Cyclone Track, source: http://weather.unisys.com/

According to the NDRRMC, a total of 370,459 families, comprising more than 1.7 million persons, have been affected by flooding in 1188 barangays of 91 municipalities. Falcon leaves The Philippines with eight dead and 12 missing persons. The estimated cost of damages in agriculture and infrastructure amounts to almost 564 million PhP.

2 Setup of the Typhoon Trigger and Assessment of Monitored Data

A novel insurance product aims to protect cooperatives in the Philippines from insolvency following typhoons. DHI provides online real-time monitoring of weather events all over the country, serving as the basis for the insurer's payout scheme.

Wind and rainfall were previously identified by DHI Water & Environment (S) Pte. Ltd. (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 so-called "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 Philippines Area of Responsibility (PAR) with maximum wind speeds superior to 30 knots (55.6 km/h).

2.1 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 27x27 km. 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.

2.2 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.

2.3 Tracking Falcon (Meari)

DHI's system was able to track Tropical Storm Falcon's rainfall and wind over the affected areas of The Philippines.

From Figure 2.1 and Figure 2.2, the monitoring system clearly shows the areas affected by the rains during the northwest displacement of Falcon (Meari) during June 22, 2011 and June 23, 2011.
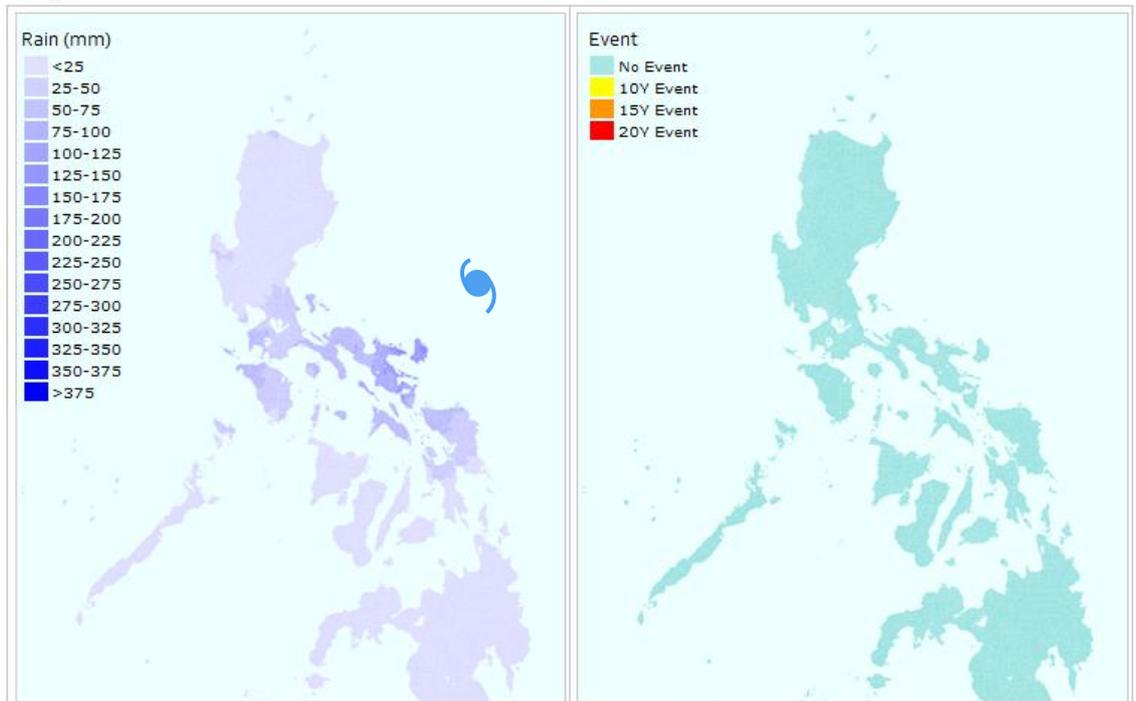
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Figure 2.1   DHI's rainfall (left panel) and event (right panel) real-time monitoring system on Jun 22, 2011. Heavy rainfall is represented as dark blue areas in the left panel. The rainfall values measured by satellite TRMM are described by the legend on top left of the first panel.

🌀 Approximate location of Tropical Storm Falcon (Meari) on Jun 22, 2011.

The following Figures (Fig. 2.3 to Fig. 2.5) show how Falcon (Meari) has enhanced the Southwest Monsoon over the north-west and central Philippines as reported by NDRRMC.
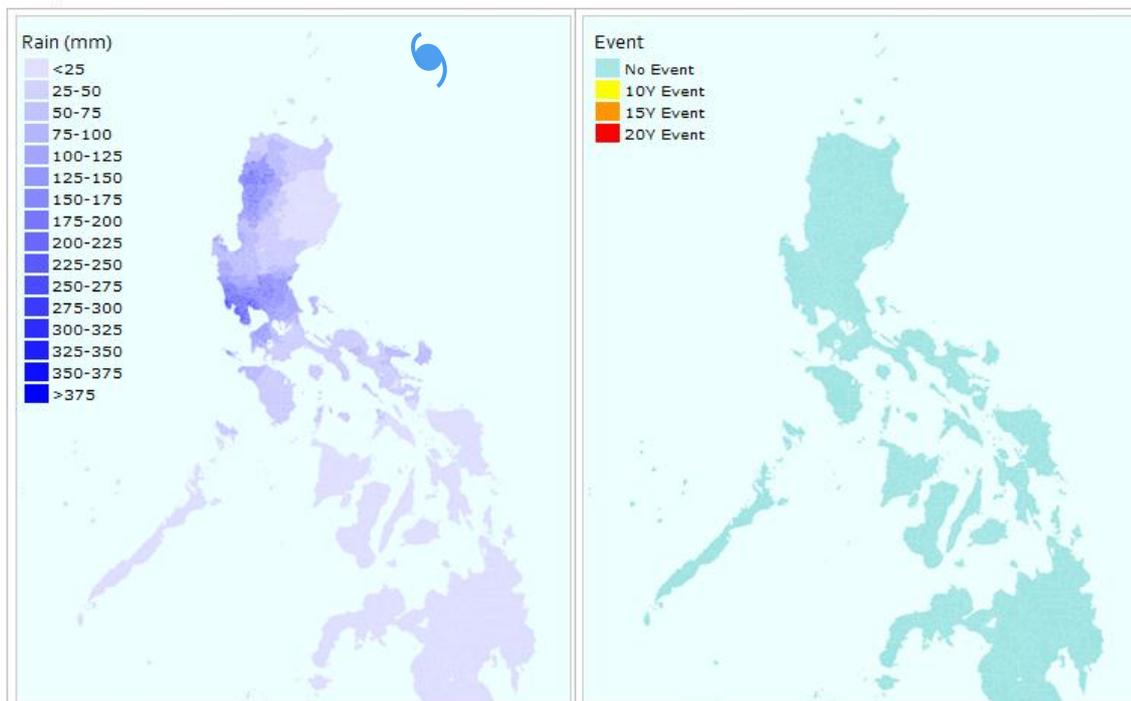

Figure 2.2   DHI's rainfall (left panel) and event (right panel) real-time monitoring system on Jun 23, 2011. Heavy rainfall is represented as dark blue areas in the left panel

🌀 Approximate location of Tropical Storm Falcon (Meari) on Jun 23, 2011

Daily Event 2011-06-24

Figure 2.3   DHI's rainfall (left panel) and event (right panel) real-time monitoring system on Jun 24, 2011. Heavy rainfall is represented as dark blue areas in the left panel.

🌀   Approximate location of Tropical Storm Falcon (Meari) on Jun 24, 2011
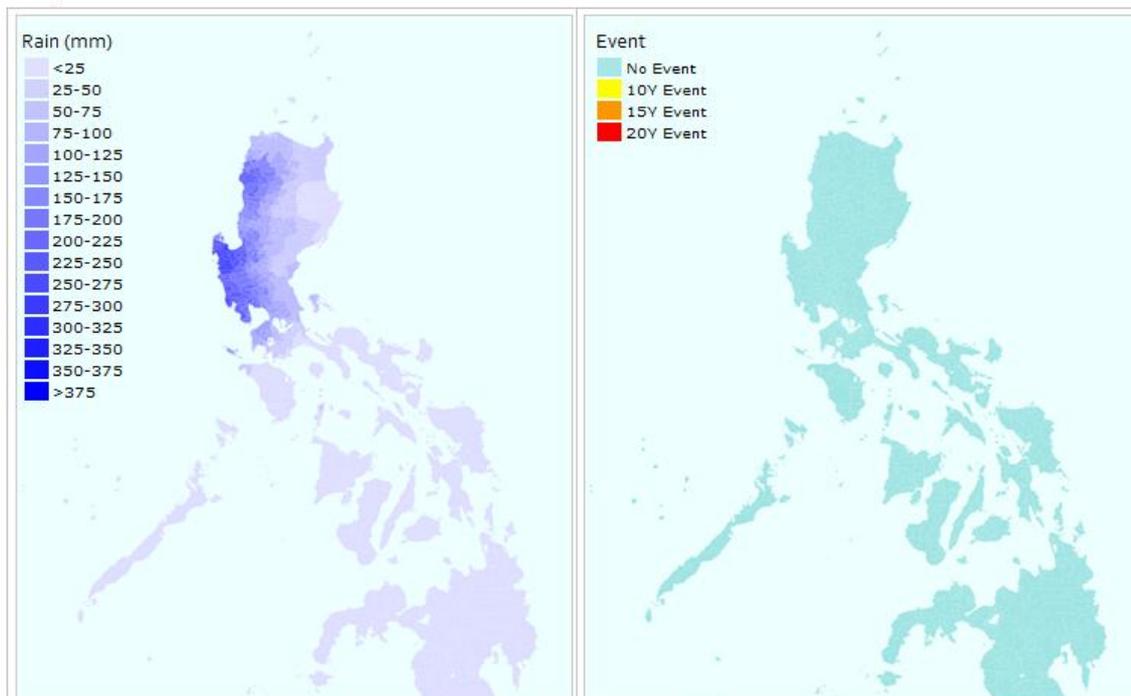

Daily Event 2011-06-25

Figure 2.4   DHI's rainfall (left panel) and event (right panel) real-time monitoring system on Jun 25, 2011. Heavy rainfall is represented as dark blue areas in the left panel

During the following days, on Jun 25, 2011 and June 26, 2011, the areas of Pangasinan, La Union, Metro Manila and Ilocos Norte and Sur received on average almost 200 mm of rain. For example, the city of Ologampo in Zambales that have reported a landslide, received a total of 194 mm on June 26, 2011. However, no municipality overpassed the amounts of around 350 mm necessary to trigger a 10-year event.

As for the reported cases of state of calamity as in province of Pampaga (170 mm on the 25 June, 2011), Tartac (123 mm), San Clemente (176 mm), the values of a 10-year event are however established around 250 mm.
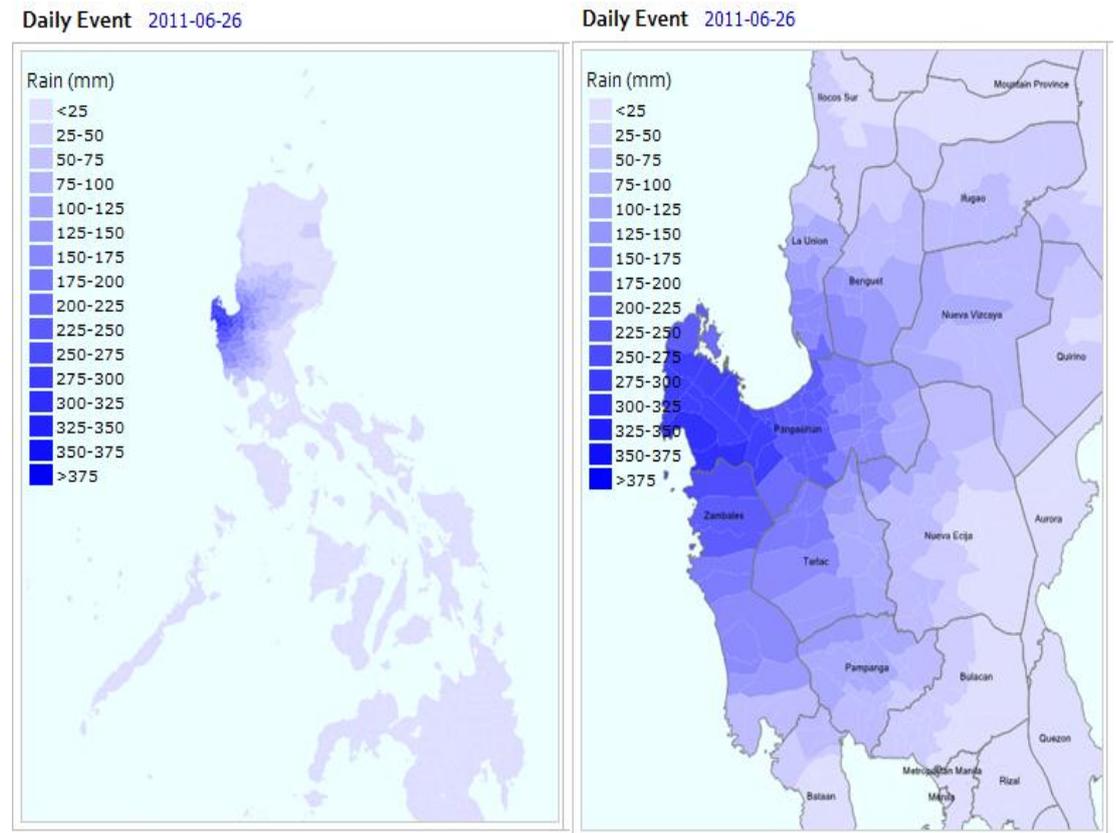

Figure 2.5   DHI's rainfall (left panel) and zoom over Luzon region (right panel) on Jun 26, 2011. Heavy rainfall is represented as dark blue areas in the left panel.

3   Linking Damage to Triggered Municipalities/Provinces

The Typhoon Trigger covers the Philippines at a 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, adjusting at the same time the affected municipalities as well as the event category for each of them.

During the passage of Tropical Storm Falcon (Meari), DHI's monitoring system didn't measure sufficient amounts of rain to categorize the rain over the municipalities as an extreme event.

The wind intensities that developed during cyclone Falcon were not strong enough to exceed the trigger values that were estimated, on the affected areas, to values between 65 km/h to 80 km/h. Figure 3.1 shows that the wind values estimated for this event do not exceed 40 km/h over the most affected areas.
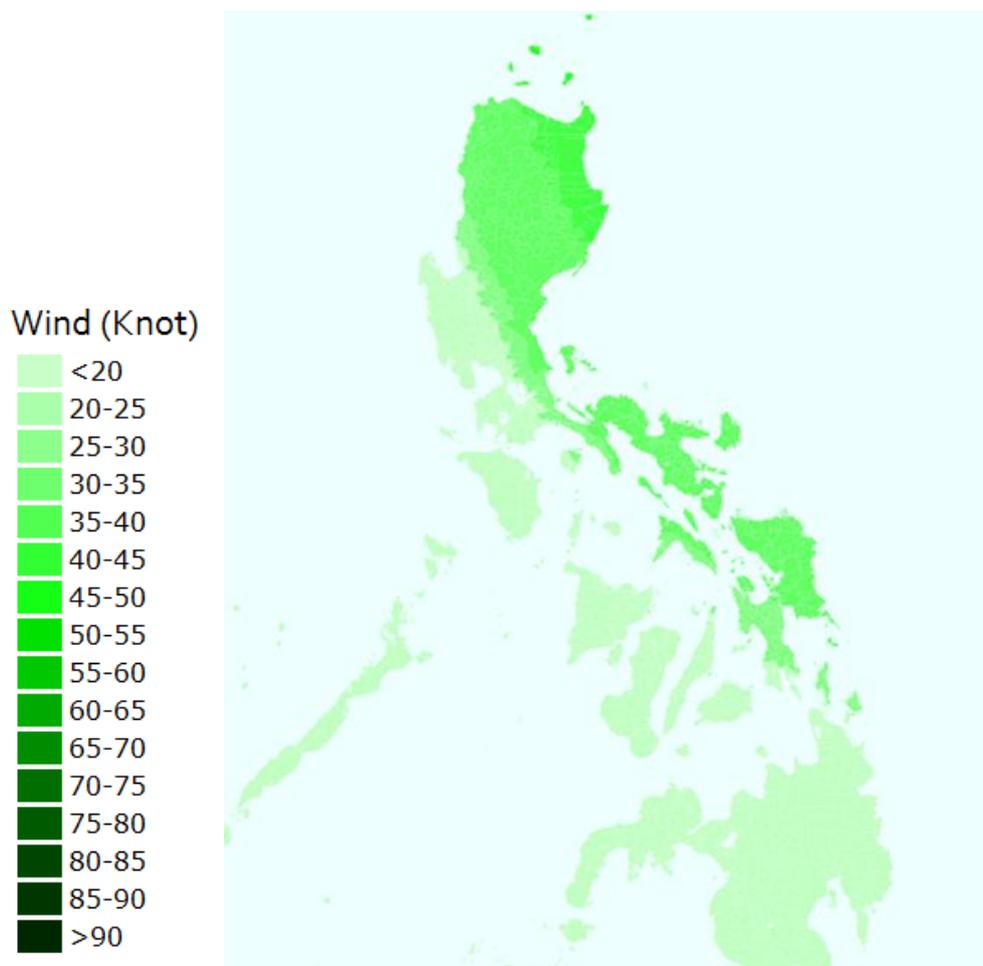

Figure 3.1   DHI's wind monitoring system for the whole event. The legend on the left show the corresponding wind values.

4 State of Calamity Reported by NDRRMC

The NDRRMC reported three cases of the state of calamity on Region III following:

- The Sangguniang Panlalawigan of Pampanga declared the Province of Pampanga under a State of Calamity, as per SP Resolution No. 2277 dated June 27, 2011

- The Sangguniang Panlalawigan of Tarlac declared the Municipalities of Camiling, Paniqui, Concepcion, La Paz and San Clemente under a State of Calamity as per SP Resolution No. 076-2011 dated June 27, 2011

- The Office of Sangguniang Bayan of San Mateo, Rizal through its SB Resolution No. 2011-082 declared the town of San Mateo, Rizal under a State of Calamity dated June 28, 2011