# Analysis of typhoon “Saola” – Philippines and Taiwan

Information as of 03.08.2012, 1st version

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## Content

# 1 Summary

Extensive flooding, landslides, more than 30 fatalities, many injuries, thousands of homeless people – this is the result (first estimation) of the tropical cyclone (TC) **Saola** that crossed first over the Philippines and afterwards over Taiwan in the period from 28 July to 3 August 2012. TC Saola moved very slowly over Taiwan, leading to extreme precipitation totals in excess of 1000 mm in 48 h at some stations. The track of Saola including the huge precipitation totals were not properly predicted by the weather forecast models.

# 2 Evolution of Saola

## 2.1 Development and Track

Saola was registered as tropical depression on 28 July at 4.4N 127.1E, approximately 600 km eastward of the Philippine capital Manila. Successively intensifying, Saola moved first in northwesterly, afterwards in northerly direction. On 30 July, 06 UTC, maximum mean wind speed was 65 kt (120 km/h) and Saola classified a typhoon category 1. Even though the center of Saola passed the northern Philippine main island of Luzon at a distance of several hundred kilometers, the convective cloud bands of the TC gave rise to intensive precipitation and high wind speed.

Maximum intensity was reached on 1 August between 06 and 18 UTC with mean wind speeds of 90 kt (167 km/h), equivalent to category 2.

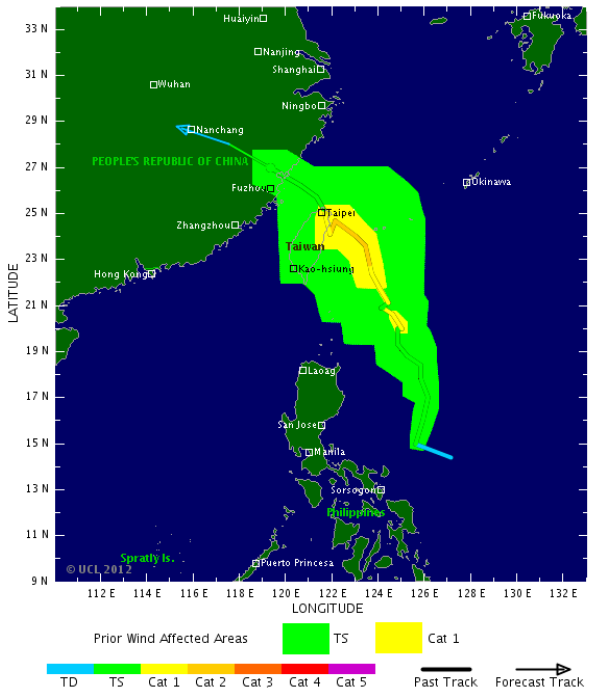



**Figure 1:**

Track of „Saola", 28.7.-03.08.2012

The green color defines the area where the 1-min average wind speed was in excess of 63 km/h, the yellow color in excess of 119 km/h (gale).

Image Credit: tropicalstormrisk.com

## 2.2 Prediction of the Storm Track

According to most of the weather forecast models, the track of Saola's center was expected to move at a distance between 100 to 200 km off Taiwan's northeast coast and, afterwards, to move towards China in northwesterly direction (Figure 2). However, in the evening of 1 August, the TC changed on another track. After a short tilt to the south, the center of the storm hit the northeastern coast of Taiwan on 2 August 03 LT – still being a category 2 storm (Figure 3). At this time, the propagation speed of the storm was very slow. Saola then moved over the agglomeration of Taipei in northern direction, and afterwards with an increasing westerly component towards the mainland of China.

The unexpected direction and low propagation speed of Saola may be a result of the interaction with TC Damrey, a typhoon that was active at the same time several hundred kilometers far away from Saola. Before that, TC Damrey brushed the southern parts of Japan (island of Kyuschu) and moved in northwestward direction towards northeast of China.

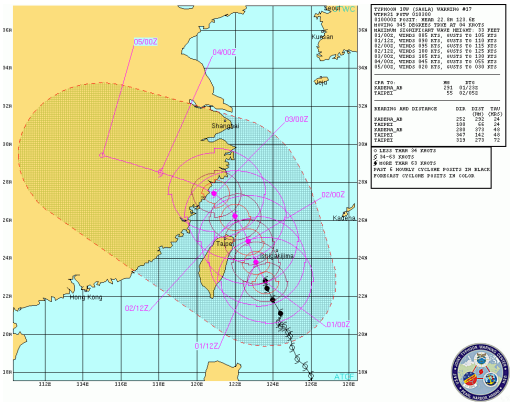



**Figure 2:**

Storm track forecast of Saola, published on 1 August 2012, 00 UTC

Image Credit: Joint Typhoon Warning Center

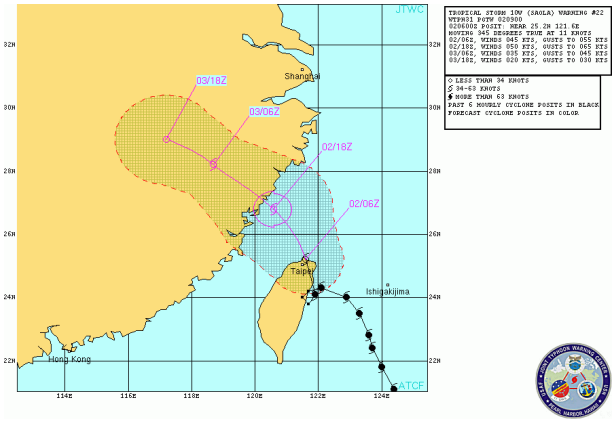



**Figure 3:**

Storm track forecast of Saola, published on 2. August 2012, 06 UTC

Image Credit: Joint Typhoon Warning Center

# 3 Impacts caused by Saola in Taiwan and Philippines

## 3.1 Information on Taiwan

With an area of around 36.000 km², Taiwan has a size comparable to Switzerland, but with 23 million inhabitants (Switzerland: approx. 8 million). The population density is very high with 639 inhabitants per km². The main settlement and industrial areas with the two urban agglomerations of Taichung and Tainan, the southern seaport of Kaohsiung (second largest town), and the capital Taipeh in the north are located in the western plains. By contrast, the mountainous area is nearly uninhabited. Taiwan is a mountainous area, in particular on the eastern side, with a maximum elevation of 3952 m (Yu Shan).

Similar to the Philippines, Taiwan is one of the areas mostly affected by TC. Each year, Taiwan is hit by several TCs, leading frequently to flooding, landslides and damage to infrastructure and agriculture.


**Figure 4:**

Map of Taiwan (towns in red, administrative districts in black)

Image Credit: Uwe Dedering / Wikipedia

## 3.2 Impact of Saola in Taiwan

Due to the low propagation speed of Saola, the precipitation totals were very high, in particular over the mountain areas. At several regions, more than 100 mm of rainfall were recorded within one hour. All over the northern and western parts of the island, daily precipitation was in excess 200 mm, at some (larger) areas even more than 500 mm (see Table 1). The highest total of 1216 mm within 2.5 days (!) was registered at the station of Taipingshan. By contrast, a small area in the southwest of Taiwan remained almost dry.

Update Time: 2012/08/03 18:47:08

| County | Rainfall | Station Code | Station Name | Location |
|---|---|---|---|---|
| Keelung City | 359.0 | 01B03 | Wudu | Qidu District, Keelung City |
| New Taipei City | 751.0 | 01AG1 | Xiongkongshan | Sanxia District, New Taipei City |
| Taipei City | 691.0 | 46691 | Anbu | Yangmingshan, Taipei City |
| Taoyuan | 781.5 | C0C46 | Fuxing | Fuxing Township, Taoyuan County |
| Hsinchu City | 415.5 | C0D57 | Xiangshan | Xiangshan District, Hsinchu City |
| Hsinchu | 838.0 | C1D40 | Niaozuishan | Jianshi Township, Hsinchu County |
| Miaoli | 1030.5 | C1E70 | Bagua | Tai-an Township, Miaoli County |
| Taichung City | 855.0 | C0F99 | Hengshan | Daya District, Taichung City |
| Changhua | 446.5 | C0G62 | Fenyuan | Fenyuan Township, Changhua County |
| Nantou | 927.0 | C1I22 | Zhanghu | Guoxing Township, Nantou County |
| Yunlin | 852.5 | C0K24 | Caoling | Gukeng Township, Yunlin County |
| Chiayi | 200.5 | 46748 | Chiayi | Chiayi City |
| Chiayi City | 872.5 | N/A | Fengshan | Alishan Township, Chiayi County (SWCB) |
| Tainan City | 373.5 | C1O87 | Dadongshan | Baihe District, Tainan City |
| Kaohsiung City | 392.5 | C1V16 | Minsheng | Namaxia District, Kaohsiung City |
| Pingtung | 394.0 | C1R12 | Shangdewen | Sandimen Township, Pingtung County |
| Yilan | 1216.0 | C0U71 | Taipingshan | Datong Township, Yilan County |
| Hualien | 714.0 | C0T9D | Hezhong | Xiulin Township, Hualien County |
| Taitung | 207.0 | C0S75 | Xiangyang | Haiduan Township, Taitung County |
| Penghu | 86.0 | 46735 | Penghu | Magong City, Penghu County |
| Kinmen | 11.5 | A0W03 | Kinmen (Exclusive Observation Station) | Kinmen County |
| Lienchiang | 131.0 | 46799 | Matsu | Nangan Township, Lienchiang County |

**Table 1:**

Maximum precipitation totals in Taiwan je district between 1 August 2012 00:00 and 3 August 21:40 local time (LT).

Source: Central Weather Bureau, Taiwan

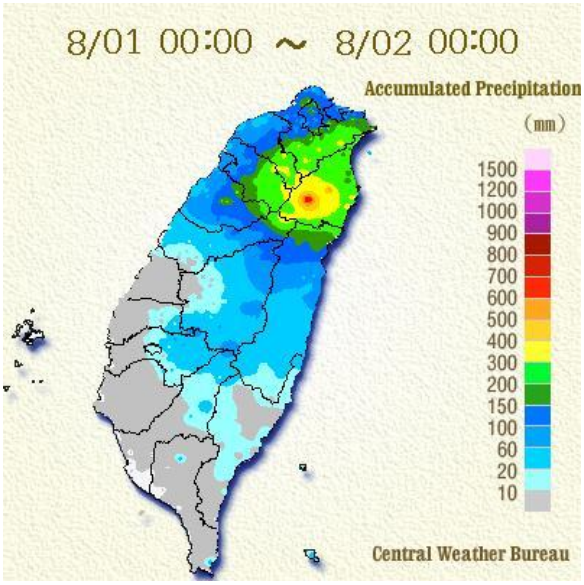



**Figure 5:**

Daily precipitation totals between1 August 00:00 and 2 August 00:00 LT

Most of the heavy precipitation was restricted to the northeastern parts of Taiwan.

Image Credit: Central Weather Bureau, Taiwan

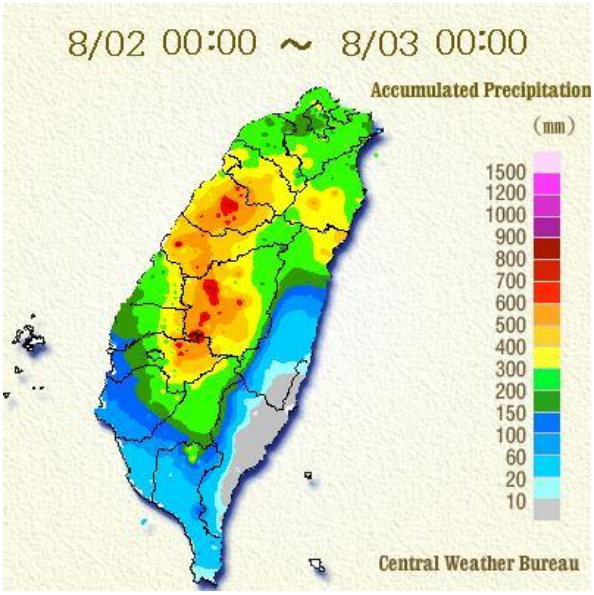



**Figure 6:**

Daily precipitation totals between2 August 00:00 and 3 August 00:00 LT

Totals in excess of 500 mm were observed at several locations.

Image Credit: Central Weather Bureau, Taiwan

According to available press reports (Associate Press, Voice of America), the high precipitation and related extremes claimed the lives of five people. A great number of flights were cancelled at the international airport of Taipei, the railway traffic was interrupted over the whole island. As a precautionary measure, large amounts of water were released from all seven large water reservoirs to avoid breaking of dikes. The Ministry of Defense mobilized 48.000 soldiers to help mitigating the impacts of the TC and to organize supporting measures.

## 3.3 Impacts of Saola on the Philippines

Even if – compared to Taiwan – rain totals of Saola on the Philippines were much lower, they also resulted in large-scale flooding, leading to approx. 30 fatalities. Over the northern and central parts of the country, more than 2.700 houses were damaged or destroyed. Approximately 1.200 people needed shelter. Schools were closed and more than three provinces experienced electricity blackout.

# 4 The TCs Saola und Damrey on Satellite and Radar Images

## 4.1 Satellite Images

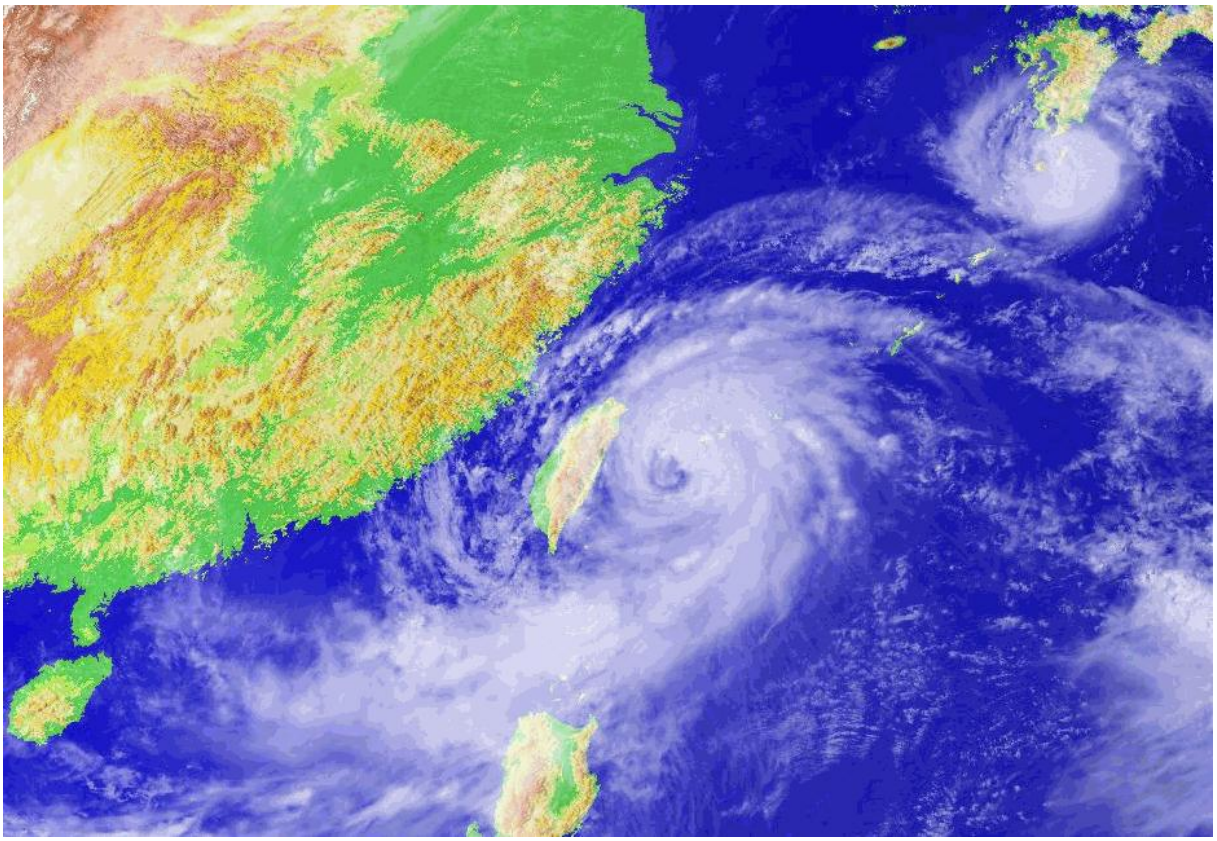


**Figure 7:**

Satellite image, 1 August 2012, 06 UTC

At this time, TC Saola is located eastwards of Taiwan, whereas Damrey is found south of Japan.

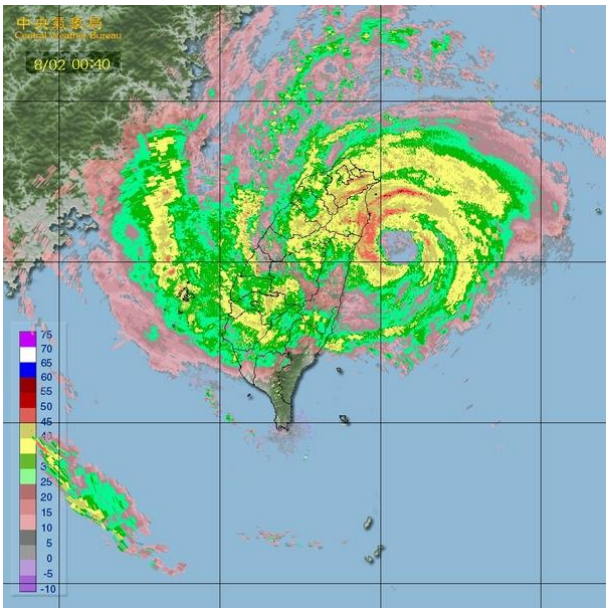
Image Credit: www.digitaltyphoon.org


**Figure 8:**

Satellite image, 1 August 2012, MODIS, Terra-Satellite

TC Saola is located with its center around 200 km east of the coast of Taiwan; TC Damrey moves towards the coast of China and made a landfall on 2/3 August north of Shanghai.

Image Credit: http://earthobservatory.nasa.gov/



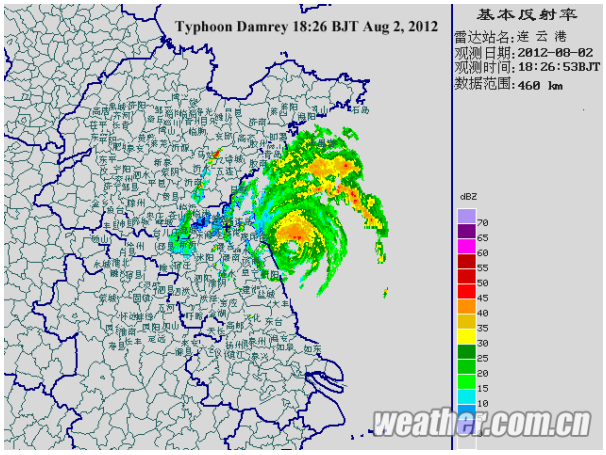




**Figure 9:**

Radar image, 2 August 2012, 00:40 LT

TC Saola prior to the landfall over northeast of Taiwan

Image Credit: Central Weather Bureau, Taiwan

**Figure 10:**

Radar image, 2. August 2012, 18:26 LT

TC Damrey prior to the landfall over northeast of China

Image Credit: eather.com.cn

# 5 References

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