



ical disasters: (1) Transportation Accidents (2) Earthquake (3) Volcano Eruption (4) Landslide (5) Flood (6) Strong Wind.

In August 2010, they are only two wind disasters recorded by BNPB where several people injuries and property losses, no dead reported. However, the local strong wind disasters is frequently occurs. In 2009, the Ministry of Public Health reported that there are 38 Strong Wind Disasters in Indonesia [2].

The global wind influence is only come from tropical cyclone which is principally no path to Indonesia islands. It might give a good or bad weather. In 1982 the tropical cyclone Errol and Bruno in Hindia Ocean increased the level of rain volume and generates floods in several areas. Also, if the cyclone tail get in touch with Indonesia skies, it can produce heavy rains, strong winds and probably several disasters is happened. On the contrary, in February 2004, the existence of Ivy tropical cyclone in Pacific Ocean moved clouds to the cyclone center and create a clear sky and good weather to the most of Indonesia islands, just after several days of heavy rains, except Papua island because it was closed to the center of cyclone [3], [4].

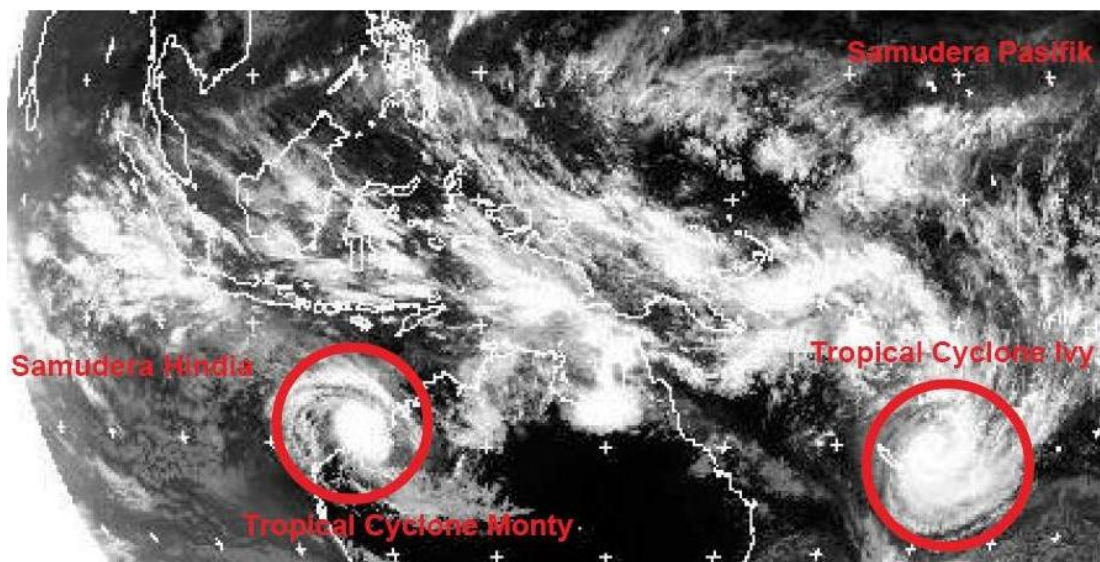


Figure 2 GMS satellite image on 27 February 2004, 03.00 GMT

Generally speaking, it can be said that many tropical cyclone in Pacific Oceans creates a good weather and many tropical cyclone in Hindia Oceans creates a bad weather [4].

## 2 LOCAL WIND

The common local winds in Indonesia islands are sea-land and mountain-valley winds, but Fohn type winds are also occurs in several locations which different names [5]:

- Wind Gending in East Jawa.
- Wind Bahorok in North Sumatera
- Wind Barubu in South Sulawesi
- Wind Kumbang in West Jawa
- Wind Wambrau in Papua

The Fohn type wind does not damages housing or kill people, but might produces serious losses to local farming. For instances, the wind Kumbang in Cirebon, West Jawa, generates problems to shrimp farmers, they profit might significantly loss due to shrimp stress. Also, the hot wind of Bahorok in North Sumatera destroys tobbaoco plantations for high quality cigarettes.

Rotational strong wind which is called in Indonesia as PUTING BELIUNG wind, is another type of local wind. It is produced by a local depression and forms a small tornado, see Figure 3 and 4.

Property loss, damages due to airborne flying debris and fall down of trees or structures are typical disasters of PUTTING BELIUNG. In some occasions, dead people are found because of structure or trees fall down.



**Figure 3. Initial Rotational Strong Wind (Bandung)**



**Figure 4. Further Rotational Strong Wind (Yogyakarta)**



**Figure 5. Damages in slum area**



**Figure 6. Damage to Station Hall**



**Figure 7. Damage due to bill board overturning**



**Figure 8. Damage due to city trees**

The PUTING BELIUNG is rather difficult to predict, the attack can be immediately happened in very short time, it often comes with heavy rains and thunder. The only indications is thick clouds. The government of Indonesia include the attack of PUTTING BELIUNG wind as one of serious disaster. The Indonesian agency for disaster mitigation (BNPB) releases regular warnings to region or local government which is potentially have PUTING BELIUNG, see Figure 9. The red areas are potentially highest occurrence and the green are potentially lowest.

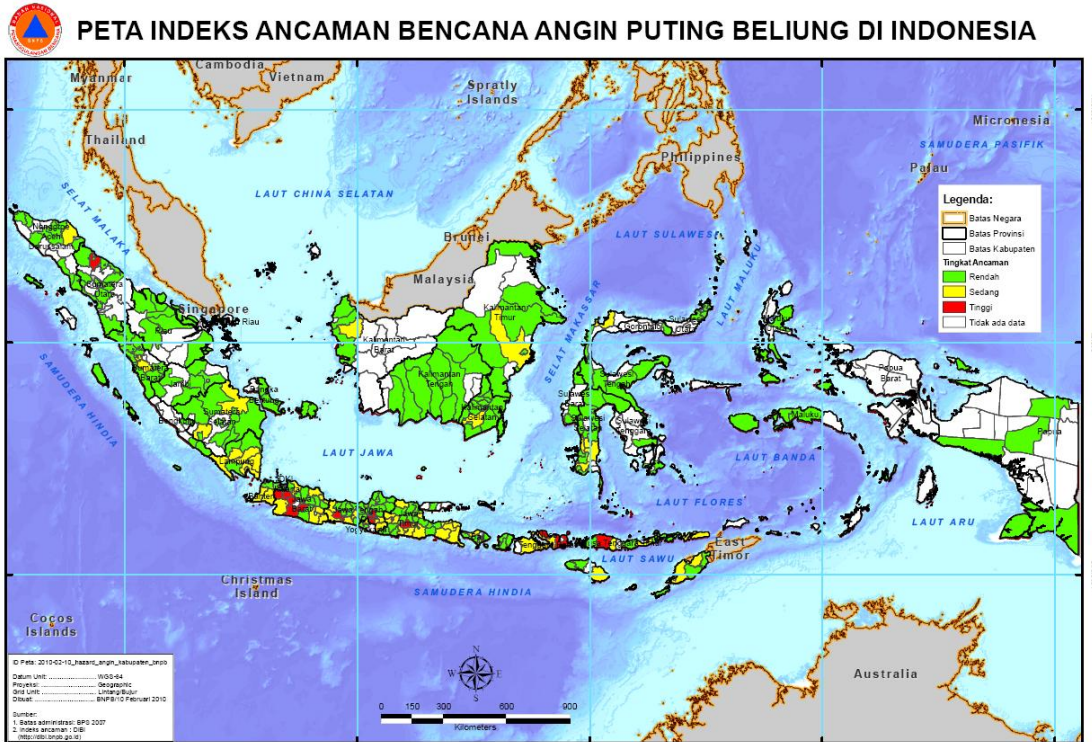


Figure 9. Typical warning for PUTTING BELIUNG attack in February 2010 (Courtesy of BNPB)



Figure 10. Strong wind wear down the coast



Figure 11. High Tide in Semarang, Middle of Jawa

Indonesia has many islands with populated coast line, therefore the strong sea-land wind is a common to people. However, the Indonesia agency for meteorology and climatology (BMKG) always prepares a warnings system whenever a severe wind storm, high

tide and strong sea wave attacks are coming. The damage often happen on their coast line housing. A typical rob (high tide) occurred in Semarang last year.

It is found that, the strong sea-land wind and followed by high tide in several coast line in Indonesia was influenced by occurrence of depression or tropical cyclone, on the Pacific or Hindia Oceans. In 2004 found that the depressions in Sunda Straits was able to increase rain volume and drives flood in Java and Sumatera.

### 3 GLOBAL WIND INFLUENCES

Basically Indonesia will not in touch with tropical cyclones path, they occurs in north or south of equator, Pacific or Hindia Oceans. However, the cyclone might induced extreme weathers and strong local wind. Mostly, the disasters is caused by floods after several days of heavy rains. In Mei 2003, it is reported that a tropical cyclone tail has driven heavy rains, strong wind, floods and landslides in Ende, West Nusa Tenggara [4].

The tropical cyclone also increase the rain volume in several cities in Indonesia as presented in Table 1.

**Table 1. Raining volume level deviations from normal level [4]**

Weather Station in City of	Rain Volume Deviations %
Padang	168.2
Bengkulu	122.6
Tanjung Karang	154.5
Banyuwangi	214.5
Sumbawa Besar	284.1
Ternate	310.1
Amahi	354.8
Manokwari	279.7
Sarmi	241.8
Jayapura	174.3

As part of global cooperation on meteorology, the BMKG has set up a tropical cyclone warning center in Bali. It can watch the growing of tropical cyclone from very beginning and predict its path of moving, the related weather situation is also described.

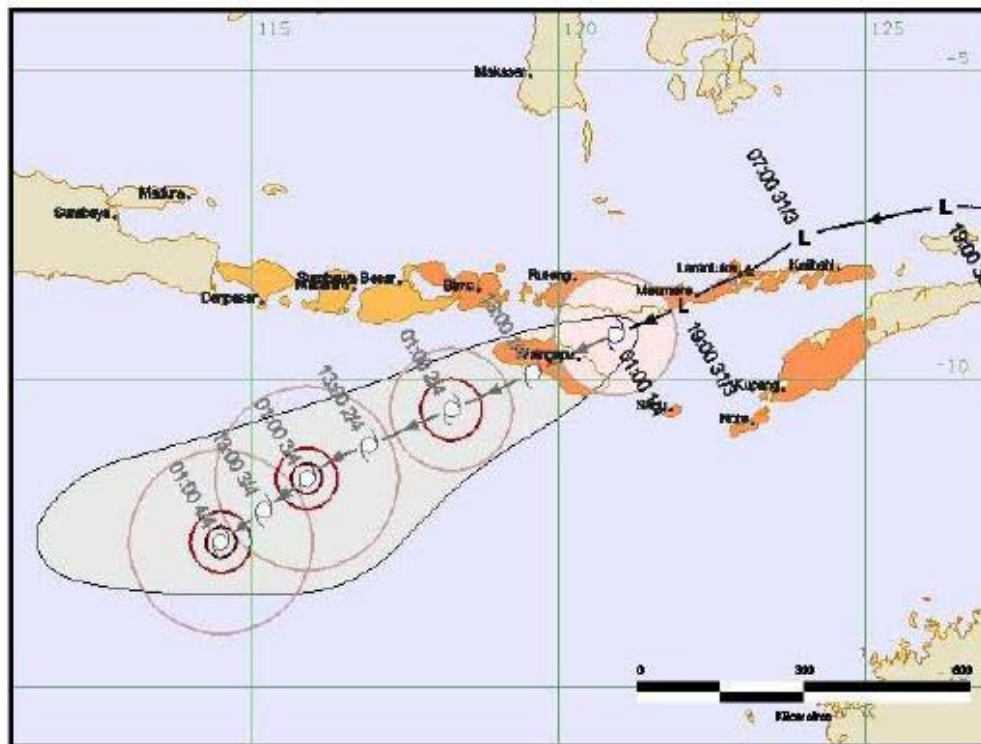


BADAN METEOROLOGI DAN GEOFISIKA  
Tropical Cyclone Warning Centre (TCWC) JAKARTA

## PETA LINTASAN SIKLON TROPIS DAN WILAYAH YANG TERPENGARUH

### Siklon Tropis Inigo

Berdasarkan Pelebaran Dini Cuaca Bunk Nomor 5,  
Dikeluarkan pada 22:40 WIB Monday 3 December 2007



Waktu dinyatakan dalam WIB.

Peringatan Bahaya	Informasi Sebelumnya
<p><b>Wilayah SIAGA:</b> Cuaca ekstrem dengan kemungkinan terjadinya hujan deras (<math>\geq 60</math>mm/jam) dan atau angin kencang (<math>\geq 60</math>km/jam) dalam 24 jam ke depan.</p> <p><b>Wilayah WASPADA:</b> Cuaca ekstrem dengan kemungkinan terjadinya hujan deras (<math>\geq 50</math>mm/jam) dan atau angin kencang (<math>\geq 50</math>km/jam) dalam 48 jam ke depan.</p>	<p>Lokasi Yang Lalu</p> <p>Lintasan dan Pergerakan Yang Lalu</p>

Figure 12. Typical Warning Sheet of Tropical Cyclone [1]

INDONESIAN AGENCY FOR METEOROLOGY AND GEOPHYSICS  
Tropical Cyclone Warning Centre (TCWC) Jakarta

EXTREME WEATHER WARNING

Issued by JAKARTA TROPICAL CYCLONE WARNING CENTRE  
At: 04:45 WIB 01/04/2003

EXTREME WEATHER WARNING NUMBER 5

A CYCLONE WARNING for a Tropical Cyclone continues for areas Bima, Dompu, Alor, Belu, Ende, Flores Timur, Kupang, Manggarai, Ngada, Sikka, Sumba Barat, Sumba Timur, Timor Tengah Selatan and Timor Tengah Utara.

A CYCLONE WATCH for a Tropical Cyclone is now current for areas Badung, Bangli, Buleleng, Gianyar, Jembrana, Karang Asem, Klungkung, Kodya Bali, Tabanan, Lombok Barat, Lombok Tengah, Lombok Timur and Sumbawa.

At 01:00 WIB Tropical Cyclone Inigo was estimated to be 80 kilometres northeast of Waingapu and 160 kilometres west southwest of Maumere and moving west southwest at 22 kilometres per hour towards Sumba.

Extreme weather is expected to develop caused by this tropical cyclone.

GALE FORCE WINDS more than 35 knots or 65 km/hr affecting southern Flores will extend to Sumba this morning. STRONG WINDS more than 25 knots or 50 km/hr and HEAVY RAIN more than 50 mm/day continuing over eastern Sumbawa, northern Flores, west Timor, Rote and Sabu, extending to western Sumbawa, Lombok and Bali tomorrow.

HIGH WAVES could reach 5 metres or higher along the north coast of Sumba and up to 3 metres along the south coast of Flores and western coast of Sumba. Tides will be HIGHER THAN NORMAL on the south coast of Flores and the north and west coasts of Sumba during today.

Details of Tropical Cyclone Inigo at 01:00 WIB:

- . Centre located near..... 9.3 degrees south 120.9 degrees east
- . Location accuracy..... within 55 kilometres
- . Recent movement..... towards the west southwest at 22 kilometres per hour
- . Central pressure..... 992 hectoPascals
- . Maximum wind speed..... 65 kilometres per hour

The next advice will be issued by 11:00 WIB Tuesday 01 April.  
This advice is available on telephone 021-6546314, 4246321 ext 377

Tropical Cyclone Warning Centre JAKARTA

**Figure 13. Typical Warning Sheet of Tropical Cyclone and Extreme Weather [1]**

#### 4 CONCLUSION

Wind disaster in Indonesia is less frequent than other natural disasters: seismic, flood and landslide. However, the strong wind might initiate other disasters, when it is followed by heavy rains. The severe effect of tropical cyclone surrounding Indonesia is increasing rain volume which causes flood or landslide disasters.

To cope with disaster problems, Indonesian government prepares a mitigation system. There are at least two agencies and two ministries responsible to disaster mitigation: BNPB, BMKG, Ministry of Health and Ministry of Social Affairs. The only way to minimize disaster is,

- Enforce a reliable housing standard to people
- Do not allow to built a wind sensitive structure, such as big bill-board, too close to public activities or transportation facilities
- The central or local government have to have a reserve fund for disaster mitigation

## 5 REFERENCES

- 1 [maritim.bmg.go.id/cyclones/](http://maritim.bmg.go.id/cyclones/)
- 2 Ministry of Public Health Republic Indonesia, [www.health.go.id](http://www.health.go.id)
- 3 [www.lapanrs.com](http://www.lapanrs.com)
- 4 Putra, D. and Khomarudin, M.R., Depresi dan Siklon Tropis Pengaruhi Cuaca Indonesia, Berita Inderaja Vol. III no. 5, Juli 2004
- 5 Suardi, Y. (2010), Pola Umum Angin di Indonesia, [www.ilmukelautan.com/oseanografi/fisika-oseanografi](http://www.ilmukelautan.com/oseanografi/fisika-oseanografi)