

THE IMPACT OF CEMPAKA TROPICAL CYCLONE ON OCEAN AND WIND DYNAMICS (CASE STUDY IN TRACK CROSSING BAKAUHENI-MERAK PORT)

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ABSTRACT

Cempaka Tropical Cyclone has occurred on 27th November until 29th November 2017 which growth in West Indian Ocean near Bengkulu Sea. From the results of wind analysis is known that the average wind direction comes from the Southwest with an average wind speed reaches 11-17 knots. Altimetry satellite was used to determine the condition of sea level anomaly and the significant wave height. It is showed an increased sea level height but not too significant compared with the average condition before tropical cyclone growth phenomena with the sea level positive anomaly reacher 0,3-0,4 meters. The peak condition of swell reaches 0,75 meters at the growth of the tropical cyclone in Ciwandan Station and 1,99 in Panjang Maritime Station. The Delft-3D modelling was conducted to determine the sea level rise and showed an increased sea level rise up to 2,0 meters during the growth of Dahlia Tropical Cyclone. Verification of the Delft3D model simulation result compare with observation data show a correlation from medium to strong scale with the data are closely enough compare with the observational data.. This study proves that wind induced from tropical cyclones generates maximum significant wave height in Sunda Strait.

INTRODUCTION

The Indonesian Maritime Continent is an location which is free from tropical cyclones track (Tjasyono, 2004). In fact, there have been several occurrences of tropical cyclones formed in Indonesia.

No.	Tropical Cyclone	Year	Location
1.	Durga	2008	Southwest Bengkulu Waters
2.	Anggrek	2010	West Sumatera Waters
3.	Bakung	2014	Southwest Sumatera Waters
4.	Cempaka	2017	South Java Sea
5.	Dahlia	2017	South Bengkulu Waters
6.	Flamboyan	2018	West Hindia Ocean

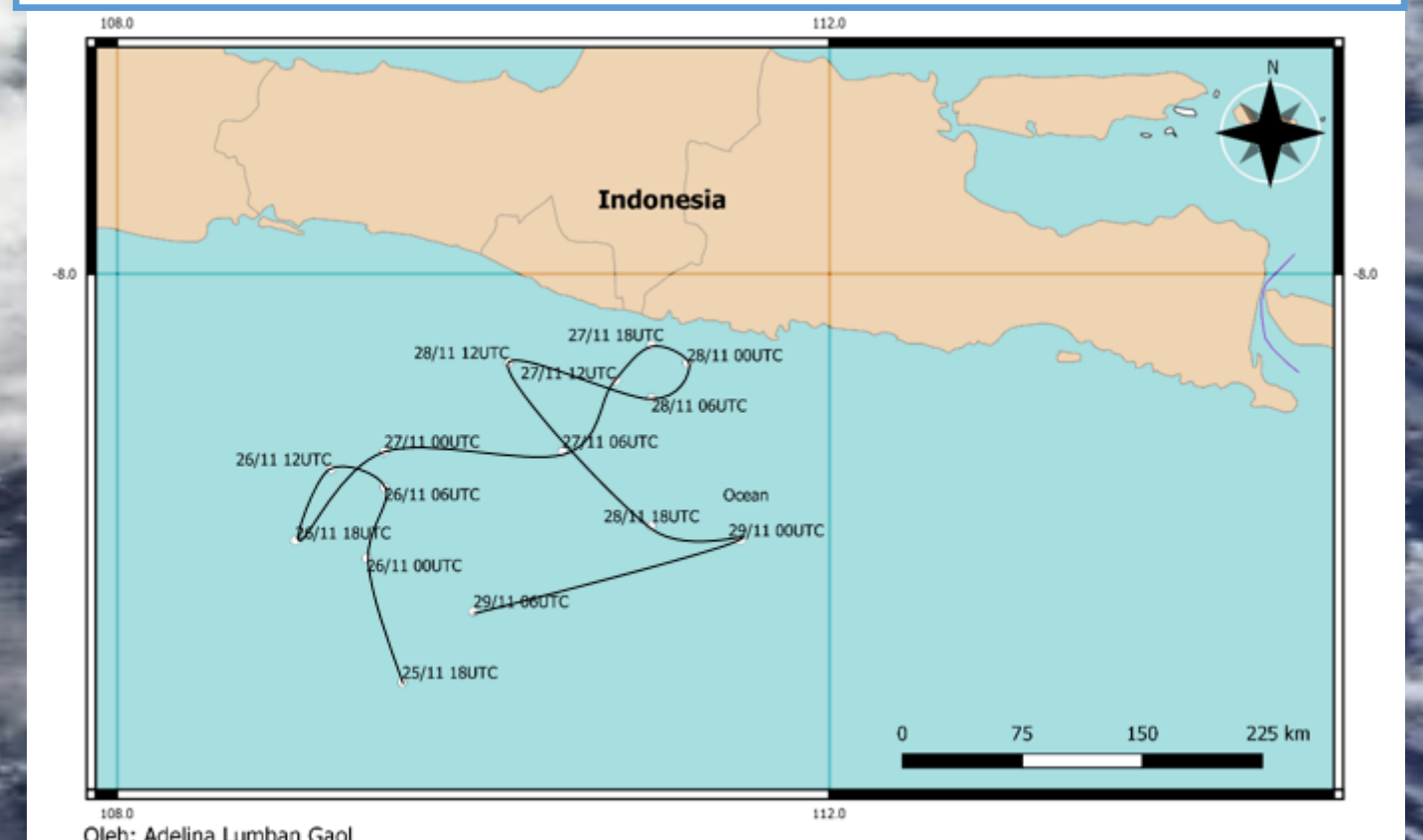
Impact of tropical cyclones:

Direct Impact : The impact caused by tropical cyclones is the areas through which they pass.

Indirect Impact : wind-aggregate areas, shear line, and moisture deficits

Stockdon, et al. (2007) analyzed the effect of tropical cyclones on sea level rise in Masonboro Island, Hutaff Island, and Topsail Island by using the Delft3D FLOW hydrodynamic model, a simple model that defines coastal responses based on coastal elevation. The results show that waves are a significant contributor to knowing changes in increased of sea level rise due to storm induction.

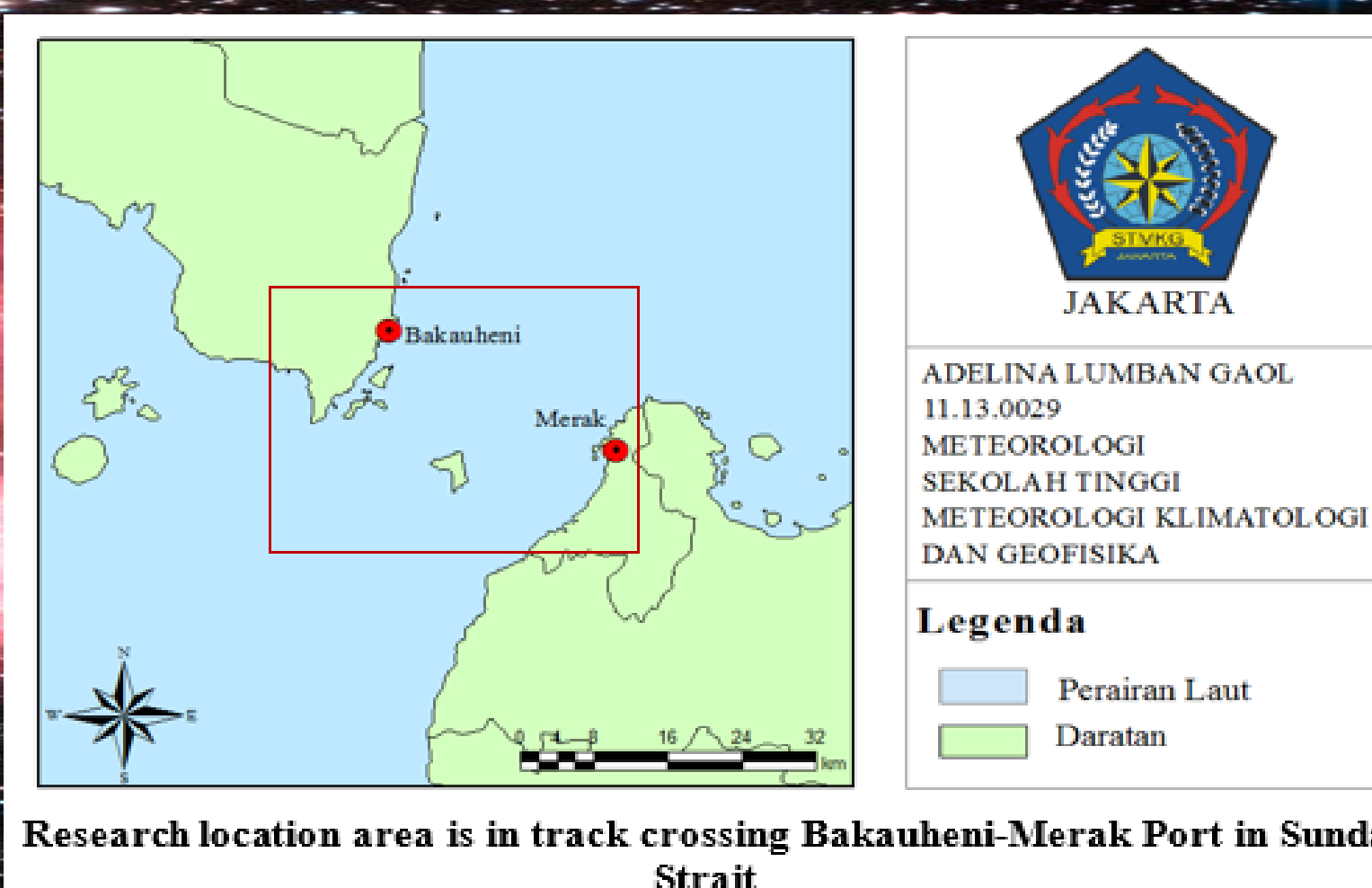
Trajectory of Cempaka Tropical cyclone



DATA AND METHOD

RESEARCH LOCATION

DATA	SOURCE
Track of Cempaka Tropical Cyclone	TCWC BMKG
FNL GRIB 2	US NOAA/NCEP
Swell and significant wave height	MFWM Model
Wind speed and direction	AWS Panjang Maritime Station and Ciwandan
Tidal data	BIG
Bathymetry	GEBCO
Sea Level height	Altimetry Satellite
Sea Level Height anomaly	Altimetry Satellite



Location :

-5,5°- (-8,5)° latitude dan 104,0° – 106, 0° longitude.

This is based on the location of the study which is quite close to the location of the tropical cyclone trajectory, namely Cempaka Tropical Cyclone.

Time :

26-29 November 2017

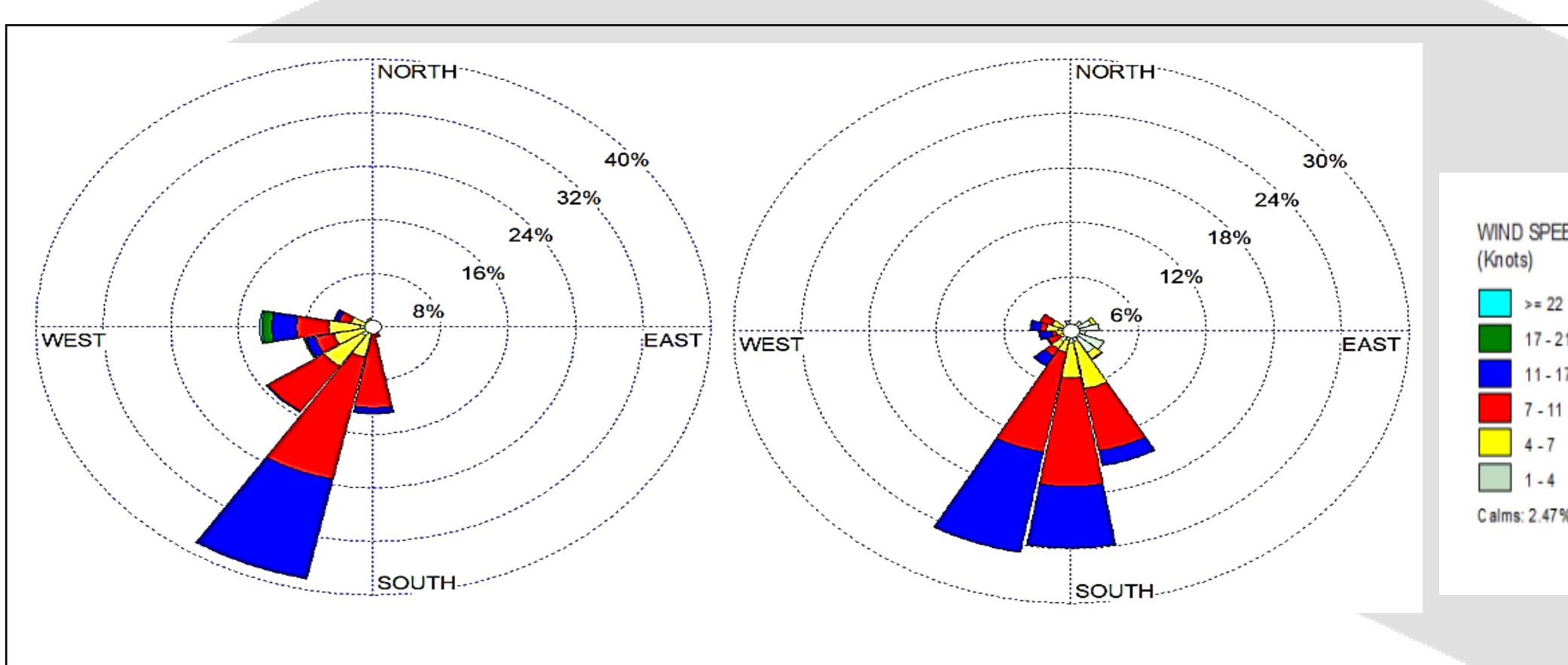
Data Collection Techniques :

Data collection techniques are carried out by taking trajectory data and maximum wind speeds from the TCWC BMKG. In addition, the sea level height data was taken from the BIG (Information and Geospatial Agency) data as a verification station, namely Panjang Station and Ciwandan Station to verify the results of the Delft3D model.

RESULT AND ANALYSIS

Date	Time (UTC)	Latitude (°)	Longitude (°)	Pressure (mb)	Maximum Wind Speed (knot)
11/25/2017	18.00	9.60	109.40	1003.0	25.0
11/27/2017	18.00	8.50	111.20	999.0	35.0
11/29/2017	0.00	9.90	110.00	1003.0	25.0

TC Depression
Max. Wind Speed
TC Depression



Wind speed and direction are observed in (a) Merak Station and (b) Panjang Maritime Station during tropical cyclone events

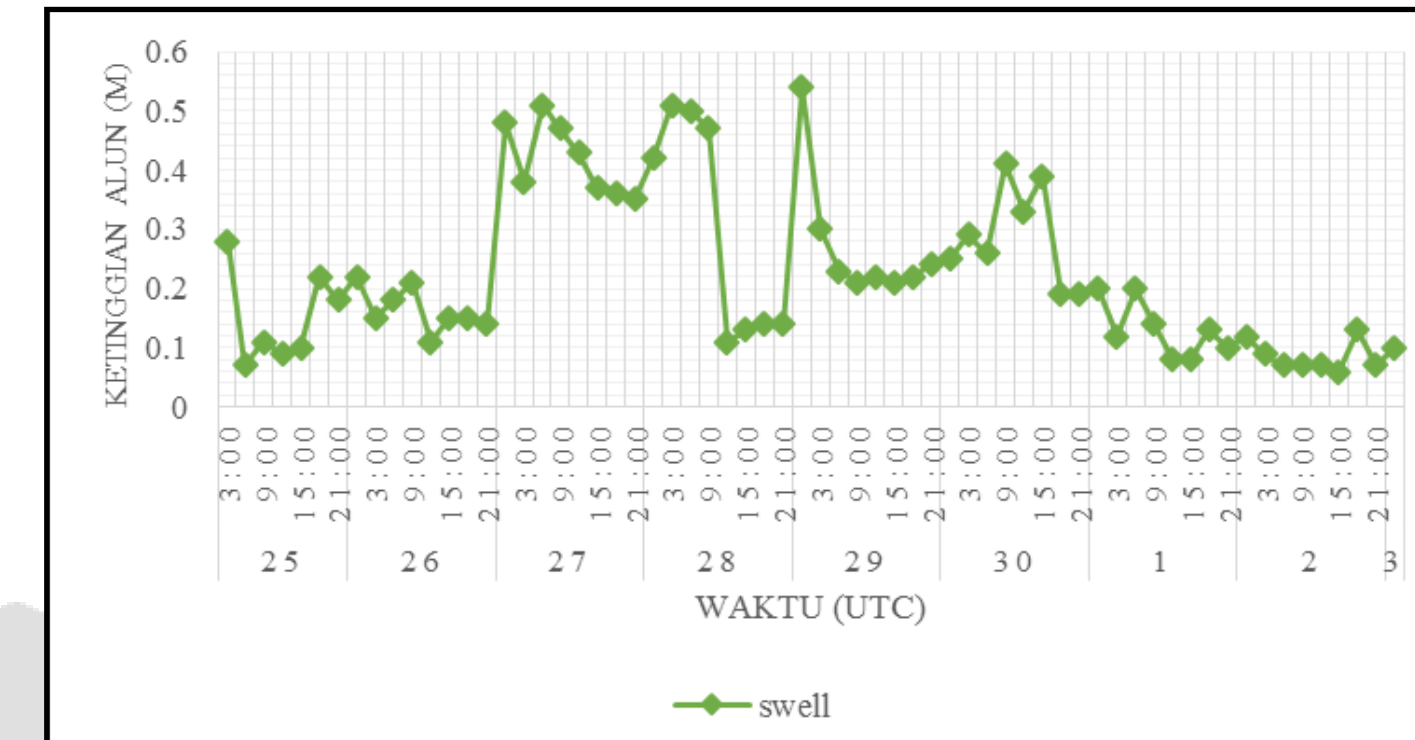
Wind Characterization in Panjang Station

Wind Identification	Value
Average wind speed	8.7 knot
Average wind direction	Southwest
Maximum wind speed (30 November 2017 at 10.50 UTC)	27.4 knot

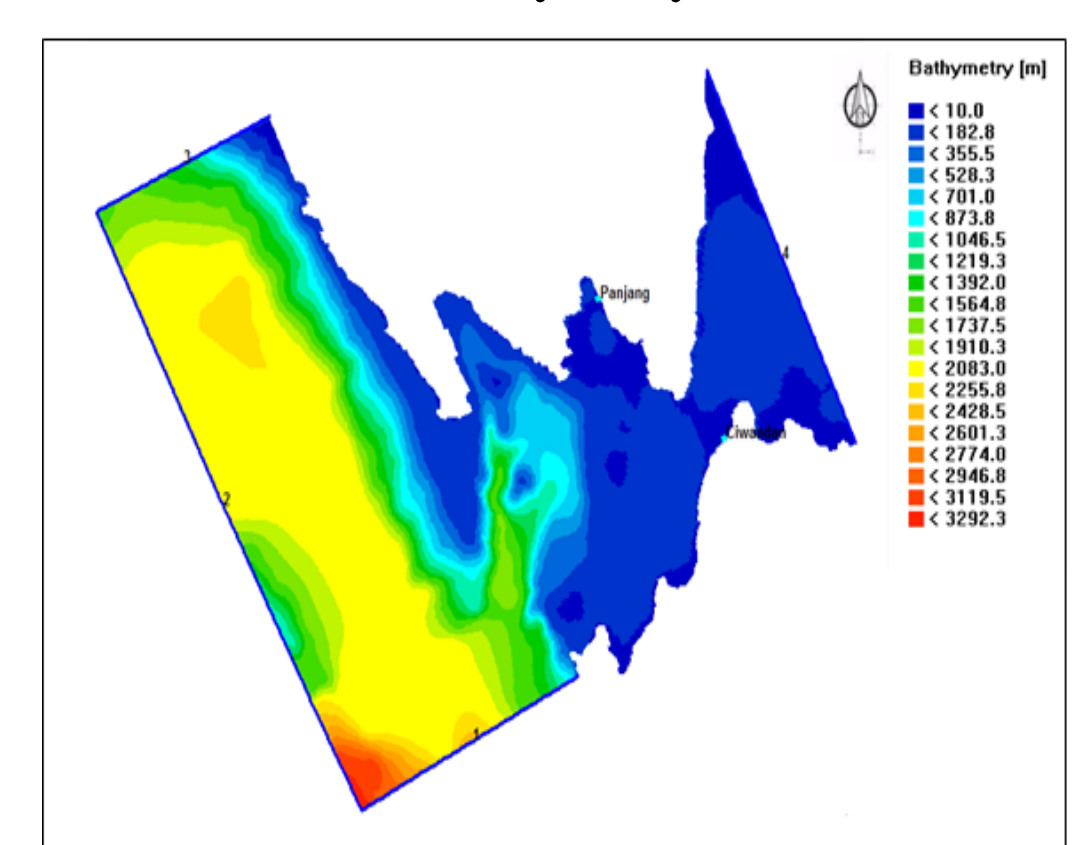
Wind Characterization in Ciwandan Station

Wind identification	Value
Average wind speed	7.8 knot
Average wind direction	Southwest
Maximum wind speed (30 November 2017 at 10.50 UTC)	20.2 knot

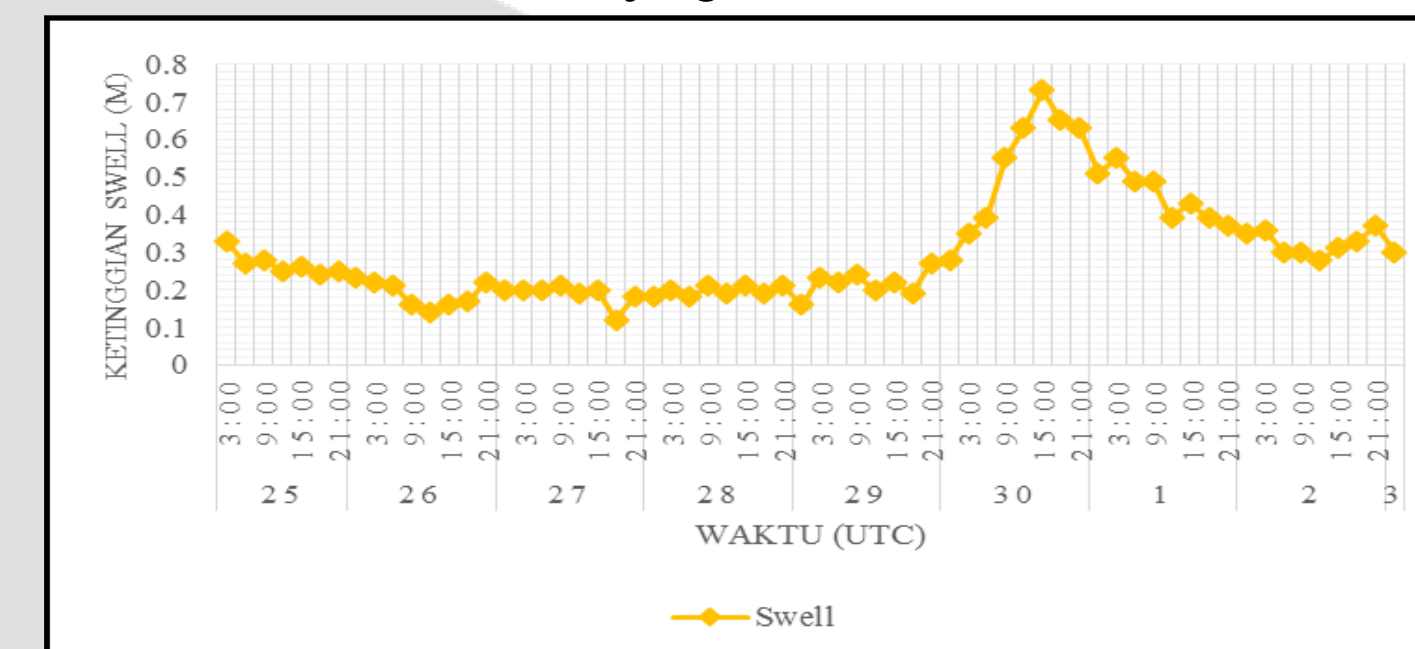
Swell of Ciwandan Station



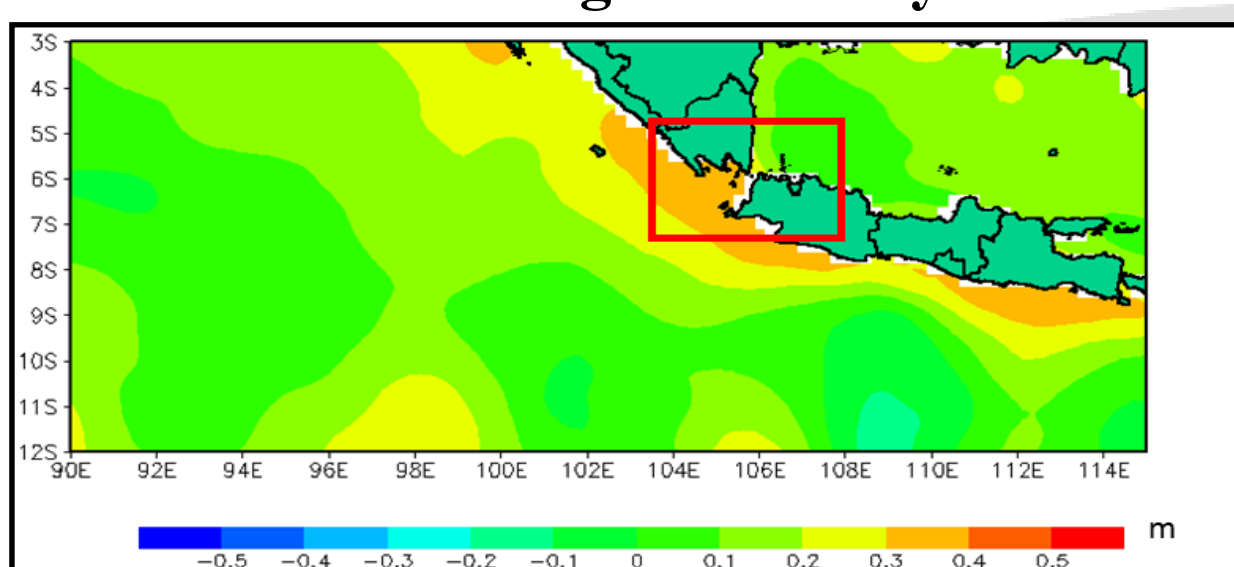
Bathymetry



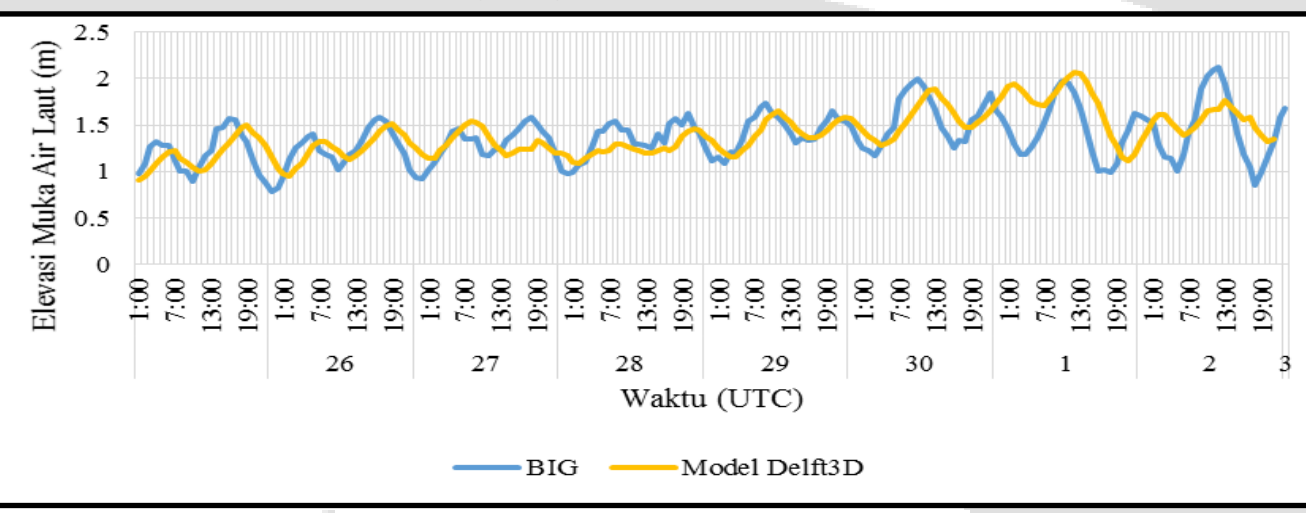
Swell of Panjang Maritime Station



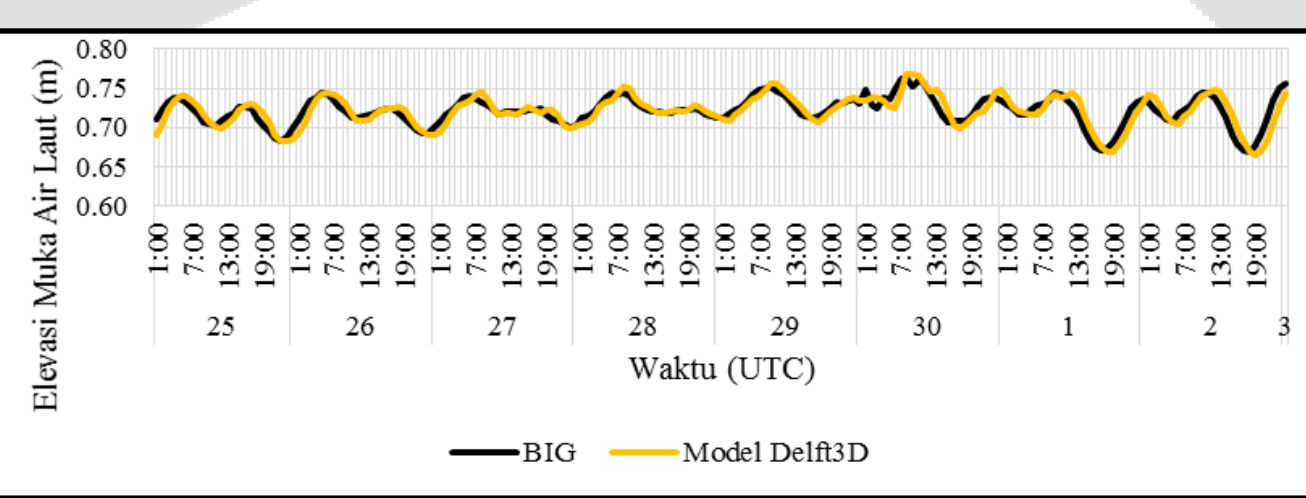
Sea Level Height Anomaly



Sea Level Height Ratio between BIG and Delft3D Model in Panjang Maritime Station



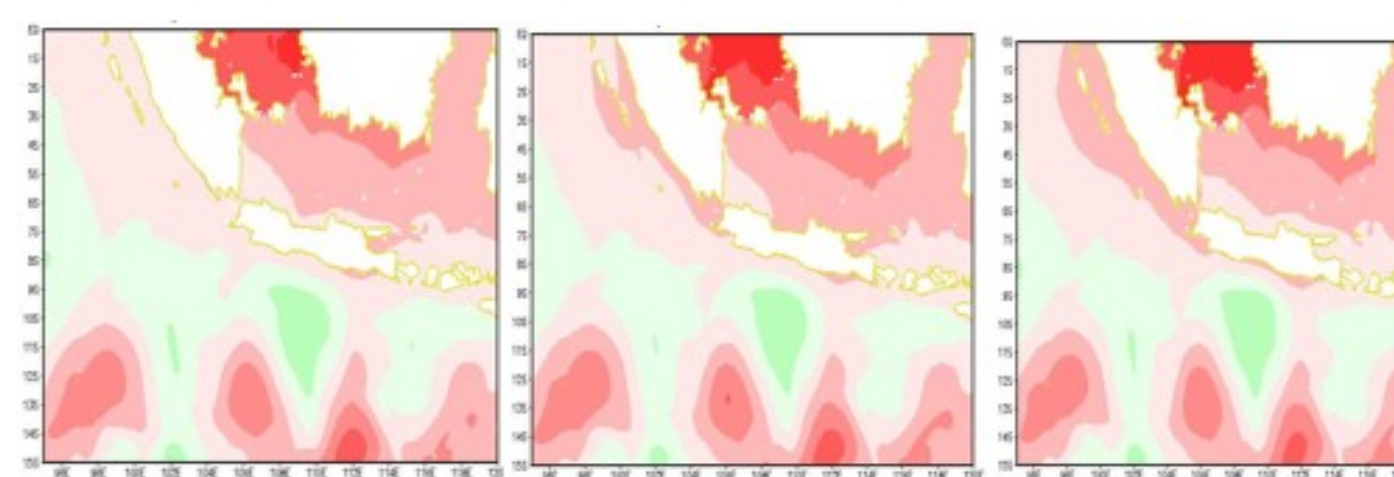
Sea Level Height Ratio between BIG and Delft3D Model in Ciwandan Station



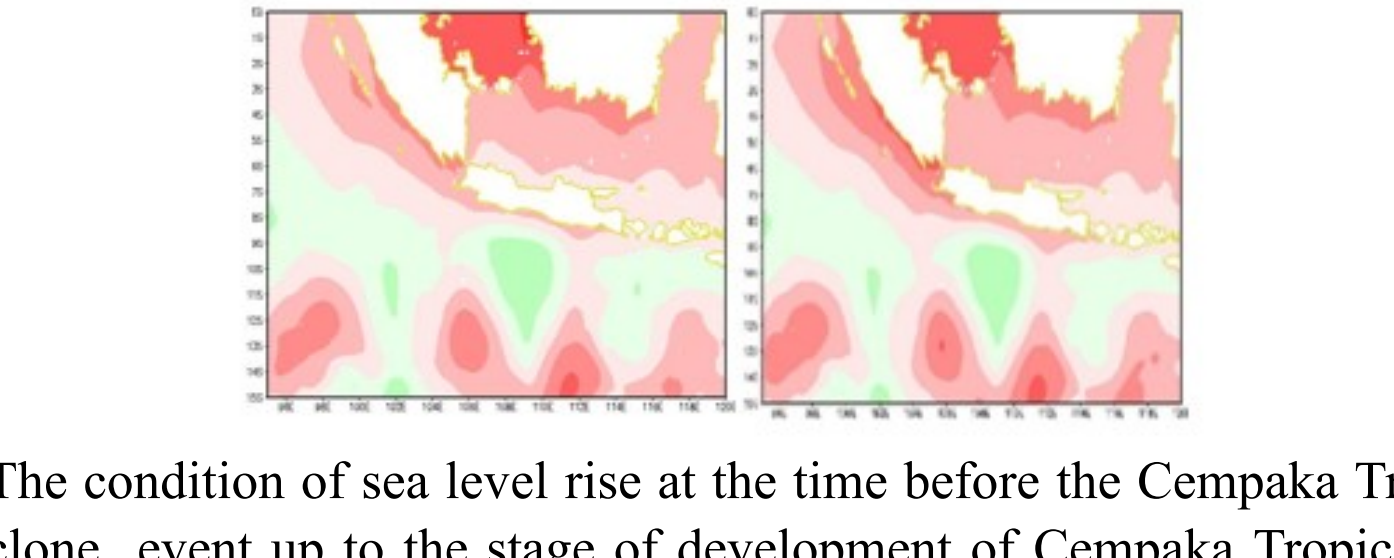
positive anomaly of sea level height reach 0,3-0,4 meters in Sunda Starait

Type	Panjang Maritime Station	Ciwandan Station
Max	2.12	0.764
RMSE	0.24	0.01
Korelasi	0.55	0.87
MBE	0.03	0.01
Character	Moderate correlation	High correlation

Significant wave heights of Panjang Maritime Station



Significant wave heights of Ciwandan Station



The condition of sea level rise at the time before the Cempaka Tropical Cyclone event up to the stage of development of Cempaka Tropical cyclone. Conditions of sea level rise when the cyclone incident reached 0.6-0.9 me-

CONCLUSION

- Cempaka Tropical Cyclones affect the dynamics of the sea in the Sunda Strait region.
- The results of the analysis of sea level elevation through observation and simulation models of the Delft3D model indicate that there is an anomaly of sea level rise at Panjang and Ciwandan Stations, but it did not experience significant changes from the previous conditions.
- Significant wave increases and plots are caused by wind induction from Cempaka tropical cyclone. From spatial wind analysis, it can be seen that wind influences waves and squares which can be indicated by AWS data that shows the wind direction mostly from the Southwest direction at speeds reaching 17 knots during the occurrence of Cempaka tropical cyclones
- This shows the important role of wind induction on the condition of sea level rise, significant waves, and swell during the occurrence of Cempaka Tropical Cyclones in the Sunda Strait region.

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