

UTILIZATION OF MARITIME WEATHER INFORMATION FOR SHIPPING SAFETY IN ACEH

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Abstract

This community service project is entitled "Utilization of Maritime Weather Information for Shipping Safety in Aceh Province." This community service will last for one month, namely August 2023, at the Class 1 Sultan Iskandar Muda Meteorological Station BMKG office, Cot Mancang, Kuta Baro District, Aceh Besar Regency. High waves can occur due to several factors. According to the National Oceanic and Atmospheric Administration website and various other sources, these factors include strong winds, distance and travel time of the wind, differences in temperature and air pressure, interactions between waves, complex ocean currents, and underwater earthquakes. Many factors support the smooth and safe sailing of ships at sea. One of them is natural factors or weather conditions that will significantly influence shipping activities in Indonesia. Therefore, information about weather forecasts is very important in shipping activities. The purpose of this community service is to understand the importance of maritime weather information for shipping and fishermen to facilitate their activities. High waves are more common in the waters north of Sabang, the northern part of the Strait of Malacca, the waters west of Aceh, the Indian Ocean west of Aceh, and the surrounding areas. These areas frequently experience high waves because they are located in open seas, which are more prone to high waves. The waters between Sabang and Banda Aceh still have low to moderate wave heights.

Keywords: Maritime weather, Wave height, Shipping safety, Aceh

INTRODUCTION

Indonesia, situated along the equator, enjoys an energy surplus due to its abundant sunlight. This makes Indonesia a region prone to convective cloud formation and high rainfall (Rusmayadi *et al.*, 2023). Weather is a dynamic phenomenon. In recent years, the Earth's atmosphere has been constantly changing. Sea conditions impact port activities, such as sea weather, strong winds, tides, and other factors. Heavy rain causes fog to obscure captains' visibility, and strong winds and wave heights are some of the requirements before sea transportation departs (Fathurohman *et al.*, 2025). To reduce the risk of accidents, maritime weather forecasting is necessary for the next few hours (Aeni *et al.*, 2024). This service forecasts maritime weather parameters, namely wind speed and wave height at three locations for the next hour based on the previous three hours using an Extreme Learning Machine algorithm optimized for weights using the Firefly Algorithm (Vuyyuru *et al.*, 2021).

Weather is the condition of the atmosphere at a specific time and in a relatively narrow area over a short period of time. The weather in the morning, afternoon, evening, or night varies from place to place and from hour to hour. Weather is formed by a combination of weather elements: air temperature, humidity, air pressure, wind, and rainfall. Indonesia's tropical climate is characterized by high temperatures, high humidity, and rainfall.

High sea waves are a natural phenomenon in which ocean waves reach significant heights, exceeding average wave heights. High sea waves can pose a serious threat to ships, fishermen, and other maritime activities (Ouyang *et al.*, 2024). When high waves occur, ships can be hit hard and capsize. This can cause damage to vessels and endanger human lives. Therefore, it is important to pay attention to weather warnings and wave conditions before beginning any activity at sea (World Bank, UNISDR, WMO, & BMKG, 2024).

High waves can be caused by several factors. According to the National Oceanic and Atmospheric Administration website and various other sources, these factors include strong winds, distance and travel time, differences in temperature and air pressure, interactions between waves, complex ocean currents, and underwater earthquakes. Many factors contribute to the smooth and safe sailing of ships at sea. One such factor is natural factors, or weather conditions, which significantly impact shipping activities in Indonesia. Therefore, information about weather forecasts is crucial for shipping activities.

Given the importance of weather and wave height information for shipping activities, the Ministry of Transportation, the Directorate General of Sea Transportation, issues weekly Shipping Information based on monitoring results from the Meteorology, Climatology, and Geophysics Agency (BMKG). This demonstrates the Directorate General of Sea Transportation's responsibility as the government agency responsible for shipping safety.

Maritime safety is defined as the fulfillment of safety and security requirements related to transportation in waterways and ports. Numerous causes of maritime accidents range from disregard for the requirement for lashing of all vessels on board, to issues related to cargo placement that fail to consider the ship's center of gravity and stabilizing arm forces. Therefore, the cause of a ship accident cannot be definitively determined; an assessment is necessary.

These efforts are undertaken to anticipate disasters at sea caused by weather factors. The primary function of weather information for shipping is to provide guidance on selecting a course so that ships can sail safely, comfortably, and safely reach their destinations on time. Without such information, numerous obstacles and inconveniences can occur during navigation, potentially leading to accidents due to inadequate weather and wave height information.

The purpose of this community service is to understand the importance of weather information (maritime weather) for shipping and fishermen, making it easier to obtain wave height information before engaging in activities at sea. This information can help reduce the risk of hydrometeorological disasters. This program is designed to assist fishermen and shipping in predicting wave heights.

The benefits of this community service include providing weather information to shipping and fishermen to help them choose the right destination for the best experience, providing

guidance on route selection for safe sailing, and raising public awareness of the importance of knowing the weather forecast before traveling to avoid potential risks.

METHODS

Time and Venue

This community service activity will be held from July 27 to November 15, 2023, at the Sultan Iskandar Muda Class I Meteorological Station, BMKG, located at Sultan Iskandar Muda Airport, Blang Bintang, Aceh Besar. The station is responsible for observing, processing data, and forecasting weather for aviation and the public. It is also responsible for weather observations for maritime purposes through the Ulee Lheue Port Maritime Services Office, operating in Aceh waters. The location of the Sultan Iskandar Muda Class I Meteorological Station, BMKG, can be seen in Figure 1.



Figure 1. Location (Source: Google Maps) and Office of the Sultan Iskandar Muda Class I Meteorological Station, BMKG

Implementation Method

The method used in this community service activity is observation to observe weather, wave height, temperature, and wind direction.

Data Collection

The data required for this community service includes: Data obtained from the BMKG (Meteorology, Climatology, and Geophysics Agency) with parameters of temperature, humidity, wind direction, currents, and wave height. The data collection process can be accessed on the BMKG website, followed by the Shipping Weather Forecast Infographic.

Frequency of Activities

The frequency of activities in this community service activity is to discuss shipping weather by providing information on weather, wave height, humidity, temperature, and wind speed. Preparations include: Data collection from the BMKG.go.id website and peta-maritim.bmkg.go.id/ofs-static. The BMKG Maritime Meteorology Center's maritime weather information website. Discussing data completeness with the team. Correcting and completing missing or inaccurate data.

Ulee Lheue BMKG Maritime Post Service

The Ulee Lheue maritime post service is responsible for providing maritime weather information for shipping safety. The office is responsible for providing weather information services for shipping activities. The parameters of this information service include daily weather forecasts and tidal data. The forecast data is generated through BMKG-OFS and INFOGRAPHICS.

Multimedia

Multimedia is responsible for creating daily and weekly infographics and video graphics. The infographics generate daily weather forecast data, including wind speed, wave height, temperature, humidity, and other parameters observed using primary meteorological equipment or data converted through the mobile application, Info BMKG, available on the Play Store and App Store. The video graphics themselves provide weather warning updates for the Aceh region and surrounding areas for the next week. The videos and infographics are then uploaded to BMKG Aceh's social media platforms, such as the BMKG Instagram account (@infobmkg_aceh).

Observation

Observers conduct hourly weather observations, and this data will be used for aviation and general purposes. Weather observation parameters include wind speed and direction, temperature and humidity, pressure, visibility, and cloud type and cover. For aviation, weather observations utilize the Automatic Weather Observing System (AWOS). AWOS is equipped with temperature and humidity sensors, solar radiation sensors, visibility meters, and cloud base height meters. AWOS detects these parameters, which are then coded by observers into METARs. The data collected by observers, which are then used as parameters in weather forecasts, is then submitted to the central office, which then processes the data into several weather forecasts for the next three or seven days, but remains broad and not detailed.

Forecaster

Forecasters are tasked with creating weather forecasts for aviation and general public use. Forecasters create weather forecast charts and models based on data processed by headquarters and collected by observers within the forecast parameters. The data models created by forecasters are more detailed and complex for each region, making it easier for the public to view the weather forecasts. Forecasters are also responsible for creating flight documents for use by aviation. Another forecaster's task is to report real-time METARs and TAFORs for the next 24 hours.

Spotter Wave Bouy

In collecting wave height data, the BMKG uses a tool called the Spotter Wave Bouy (Figure 2). The sensor on this tool can also measure sea surface temperature and sea surface air pressure. This tool is powered by solar energy and sends data automatically via satellite communication. Currently, the Maritime BMKG uses this Spotter Wave Bouy for the purpose of verifying wave predictions from the BMKG-OFS model. The performance characteristics of the spotter for wave measurement have been carried out by Raghukumar *et al.* (2019).



Figure 2. Wave Height Detector

RESULTS AND DISCUSSION

Results

The results obtained from the collected data for August 2023 are shown in Table 1. The data presented in Table 1 represents temperature, humidity, and wave height parameters. This data is used in creating weather forecasts for maritime and non-maritime areas.

Table 1. Infographic Data Results for August 2023

No	Date	Temperature (°C)	Humidity (%)	Wind velocity and direction (km/h)	Wave height (m)
1	August, 1 2023	24 – 33	55 – 95	10/Southwest	0.01 – 1.25
2	August, 2 2023	25 – 34	55 – 95	10/Southwest	0.01 – 1.25
3	August, 3 2023	24 – 32	65 – 95	10/Southwest	0.01 – 1.25
4	August, 4 2023	25 – 35	50 – 85	10/West	0.01 – 1.25
5	August, 5 2023	24 – 33	60 – 95	10/West	0.01 – 1.25
6	August, 6 2023	24 – 32	65 – 90	10/Southwest	0.01 – 1.25

7	August, 7 2023	24 – 32	60 - 95	10/Southwest	0.01 – 1.5
8	August, 8 2023	24 – 32	60 – 90	20/Southwest	0.50 – 2.50
9	August, 9 2023	24 – 31	65 – 95	10/West	0.50 – 2.50
10	August, 10 2023	24 – 32	65 – 95	10/Northwest	0.50 – 2.50
11	August, 11 2023	24 – 32	55 – 90	10/Southwest	0.01 – 1.25
12	August, 12 2023	24 – 32	65 – 95	20/Southwest	0.50 – 2.50
13	August, 13 2023	24 – 31	70 – 90	20/West	0.01 – 1.25
14	August, 14 2023	24 – 32	65 – 95	20/Southwest	0.01 – 1.25
15	August, 15 2023	24 – 32	65 – 95	20/West	0.01 – 1.25
16	August, 16 2023	23 – 33	60 – 95	20/West	0.01 – 1.25
17	August, 17 2023	23 – 33	60 – 95	10/West	0.01 – 1.25
18	August, 18 2023	24 – 33	60 – 95	20/West	0.01 – 1.25
19	August, 19 2023	24 – 33	60 – 95	20/West	0.01 – 0.50
20	August, 20 2023	23 – 34	55 – 90	20/Southwest	0.01 – 1.25
21	August, 21 2023	24 – 33	60 – 90	10/Southwest	0.01 – 1.25
22	August, 22 2023	24 – 34	60 – 95	10/Northwest	0.01 – 1.25
23	August, 23 2023	24 – 34	60 – 95	10/Northwest	0.01 – 1.25
24	August, 24 2023	24 – 31	70 – 95	10/Northwest	0.01 – 1.25
25	August, 25 2023	23 – 32	65 – 95	10/Southwest	0.01 – 1.25
26	August, 26 2023	23 – 34	55 – 90	10/Northwest	0.01 – 1.25
27	August, 27 2023	23 – 34	55 – 95	10/West	0.01 – 0.50
28	August, 28 2023	24 – 34	60 – 95	20/Southwest	0.01 – 1.25
29	August, 29 2023	24 – 33	60 – 90	10/Southwest	0.01 – 1.25
30	August, 30 2023	23 – 33	65 – 95	20/Southwest	0.01 – 1.25
31	August, 31 2023	25 – 33	60 – 85	20/Southwest	0.01 – 1.25

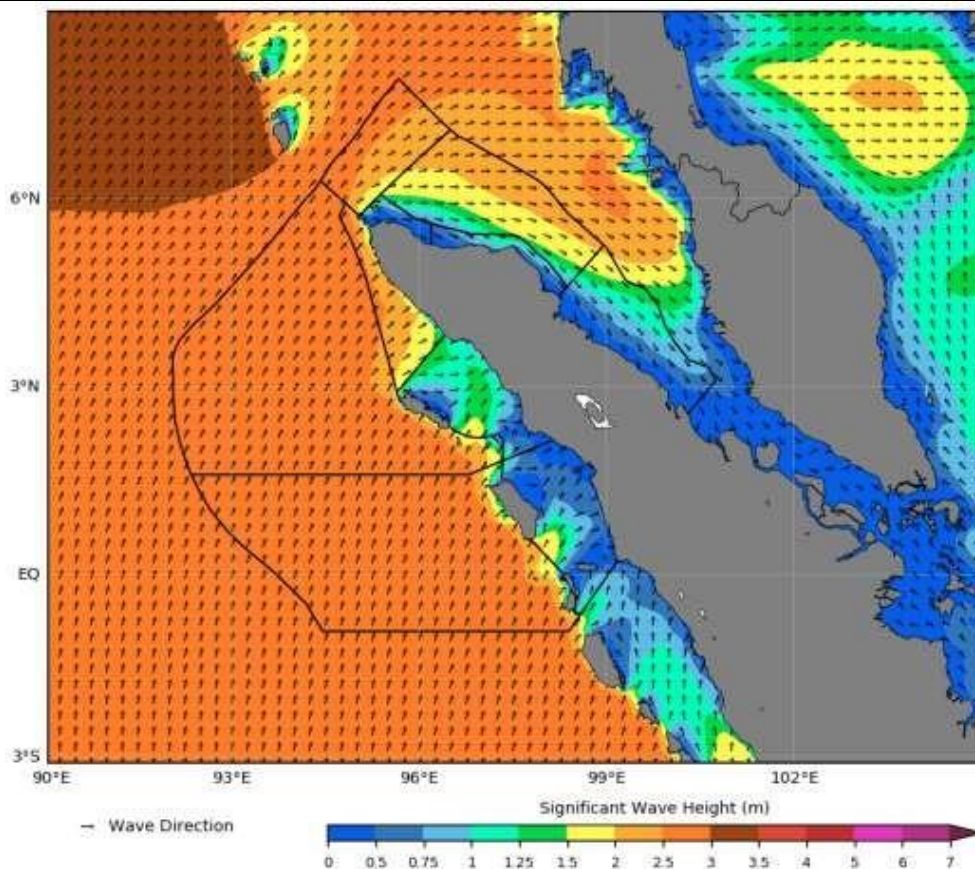


Figure 3. Significant wave height

Discussion

High waves occur due to wind moving above the surface, and are influenced by the gravitational force of the moon which creates waves (Li *et al.*, 2023). In addition, other factors that influence the formation of high waves also include height, length, time period, and steepness. The interpretation of the wave model used is the high-resolution BMKG-Ocean Forecast System (OFS) wave model (<https://peta-maritim.bmkg.go.id/ofs-static>) with the latest update cycle (00.00 or 12 UTC) [Qiao & Akhir, 2024]. The interpretation of the wave model used is the high-resolution BMKG-OFS significant with provisions in the afternoon before 19.00 WIB which is valid for the next 12 hours with a validity period of 19.00-07.00 WIB. The wave criteria used in daily ocean wave and weather forecasts are in accordance with the World Meteorological Organization (WMO) Sea State Code:

- Wave height 0.5–1.25 m (Low)
- Wave height 1.25–2.5 m (Medium)
- Wave height 2.5–4.0 m (High)
- Wave height 4.0–6.0 m (Very High)

The use of wave height information for shipping is essential (Table 1 and Figure 3). Many factors contribute to the smooth and safe operation of ships at sea. One such factor is natural factors or weather conditions, which significantly influence shipping activities. Therefore, information about weather forecasts is crucial for shipping activities. Given the importance of weather and wave height information for shipping activities, the Ministry of Transportation, cq., the Directorate General of Sea Transportation, issues a Shipping Information every week based on monitoring results from the Meteorology, Climatologi, and Geophysical Agency (BMKG). This demonstrates the Directorate General of Sea Transportation's responsibility as the government agency responsible for shipping safety.

CONCLUSION

The conclusion of the community service, based on the collected data, is that in August 2023, wave heights were still classified as low to moderate. This level of wave height is still very safe for maritime transportation. Therefore, wave height warnings are crucial for shipping safety. High waves are more frequent in the waters north of Sabang, the northern part of the Strait of Malacca, the waters west of Aceh, the Indian Ocean west of Aceh, and the surrounding areas. These areas are prone to high waves because they are located in open seas, which are more prone to high waves. The waters between Sabang and Banda Aceh are still classified as low to moderate

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