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International Seminar on Science and Technology 2018

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PREFACE

It is a great pleasure for us to welcome you to the 1-st International Seminar on Science and Technology (ISST) – 2018. We have accepted fullpapers from Japan, Australia, Malaysia, and mainly from Indonesia. The focus of this research is to support innovation in sciences and technology. Coverage includes all classes of material sciences and engineering, bioscience, chemistry, computational science, environmental science, geophysics, mathematics, physics and applied physics, and statistics.

This year, ISST has attracted seventy eight authors from four countries. However, this proceeding contains 57 papers that have been carefully peer-reviewed and selected from those submitted papers to the conference.

It is a great moment for us to organize such conference which require great energy to finish with high complexity and detail, therefore we would like to express my gratitude to all members of ISST-1 2018 organizing committee for their sincere cooperation to hold this event. This ISST-1 2018 would not be possible without keynote speakers, presenters, reviewers, all participants, and Faculty of Mathematics and Natural Sciences, Tadulako University. Our sincere gratitude also goes to the IOP Publishing editors and managers for their helpful cooperation during the preparation of this proceeding.

Palu, 25 July 2018

Darmawati Darwis
The 1-st ISST 2018 Chairman



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Study of ocean wave characteristics in Lembasada, Donggala District, Central Sulawesi

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Abstract. This study discusses the characteristics of ocean waves in Lembasada waters, Banawa Selatan, Donggala District, Central Sulawesi. The characteristics of ocean waves are related to significant wave height and peak period. This study was conducted by utilizing the reanalysis data from ECMWF 1996, 2008, 2015 and bathymetry data from Seamap. The analysis is done by observing seasonal variability in the presence of ENSO and ordinary effects. Based on the results obtained, indicating that in the normal year without any ENSO influence, the wave height in these waters is likely to follow a seasonal pattern, with significant wave height lower than the ENSO effect.

1. Introduction

In marine engineering planning and studies centered on the spatial planning of coastal and coastal areas, it will require knowledge of the characteristics of ocean waves and their dynamic properties in which the dynamics process is the main factor affecting geometric shapes and coastal compositions. Generally, the waves at sea level generated by the wind are very irregular because there is the superposition of a number of waves with different frequencies, amplitudes and directions. Frequency analysis or wave period can be used to distinguish waves that are still affected by the wind or not. Local waves (sea) or waves that are still affected by wind, have high frequency (short period), whereas wave or swell that is no longer affected by wind, has low frequency or high period [1].

If the surface of the sea gets wind pressure, it will cause the wave height to form surface currents. If the wave height is large then the current velocity changes enlarge to form a strong longshore current that can cause abrasion in the beach [2]. The abrasion process can occur in many places and each shows different characteristics. The abrasion process is also observed in the coastal waters of Lembasada Village, Donggala District, Central Sulawesi. Based on information obtained from local residents that the beach building in the form of a breakwater wall built in February 2013 has suffered severe damage due to the onslaught of waves that occurred in July 2014. This event indicates that Lembasada waters including one of the water that is also vulnerable against the threat of abrasion due to ocean waves. The interaction with the surrounding waters as well as the geographical condition of these waters that enable it to gain influence dynamics of Makassar Strait waters associated with the waves and ocean currents.



To obtain data about the condition of the sea through the installation of observation equipment in marine waters, of course, require a large cost and potentially damaged by the act of irresponsible people. Hence through this study a review of wave characteristics was numerically analysed through wave modelling. Some numerical wave forecasting models have been applied to obtain an overview of ocean conditions associated with the dynamics of ocean waves. The concept of wave modeling is applied based on the concept of the balance of spectral energy that describes the growth of surface gravity waves in space and time [3-5]. The regulatory equation based on the wave motion balance concept is formulated by Komen *et al.* [6] and Young [1], both in Cartesian coordinates and in spherical coordinates, are expressed as follows:

$$\frac{\partial N}{\partial t} + \nabla \cdot (\bar{v}N) = \frac{S}{\sigma} \quad (1)$$

or

$$\frac{\partial \hat{N}}{\partial t} + \frac{\partial}{\partial \phi} c_{\phi} \hat{N} + \frac{\partial}{\partial \lambda} c_{\lambda} \hat{N} + \frac{\partial}{\partial \sigma} c_{\sigma} \hat{N} + \frac{\partial}{\partial \theta} c_{\theta} \hat{N} = \frac{\hat{S}}{\sigma} \quad (2)$$

Equation (1) is the equilibrium equation of the wave motion with Cartesian coordinates with S as the source term for the equilibrium equation of energy and equation (2) with spherical coordinates as the source and sink function terms. The source term, S, represent the superposition of the source function describing the various physical phenomena expressed as follows [7]:

$$S = S_{in} + S_{nl} + S_{ds} + S_{bot} + S_{surf} \quad (3)$$

In equation (3), S_{in} = the energy source tribe is transferred from the wind to the surface of the sea, S_{nl} = transfer of wave energy due to non-linear interaction, S_{ds} = term of dissipation whitecapping, S_{bot} = base friction dissipation term and S_{surf} = term of wave dissipation energy when propagating to a very shallow area. Application of this wave model is very effective for wave forecasting purposes in various locations. Therefore, the study related to sea wave conditions in Lembasada waters in this study was conducted by observing its characteristics which were reviewed based on seasonal variability in El Niño, La Niña and in the Normal years. The Normal year means the year in which the ENSO phenomenon does not occur.

2. Research Methods

2.1. Research Sites

The study location of wave characteristics in Lembasada waters is at TLG-1 Station (figure 1). These water are directly facing the waters of the Makassar Strait so that the dynamics of Makassar Strait water can affect the characteristics of Lembasada waters. Coordinate Station TLG-1 is 00°47'00" S and 119°38'00" E. Selection of water Lembasada location is done because it includes one of the waters are also vulnerable to the threat of abrasion due to ocean waves that can threaten the life activities of coastal water (by communication with the Head of Lembasada Village).

2.2. Data and Data Processing

This study uses secondary data in the form of wind speed and direction data reanalysis and bathymetry data. Wind speed and direction data are obtained from global data of ECMWF Data Server (<http://data-portal.ecmwf.int/>). The bathymetry data is derived from data published by the Hydro-Oceanography Bureau of Indonesian Navy (Dishidros TNI-AL) 1: 250,000 scale from the map sheet of 126 (2012), 127 (2012) and 128 (2013) used for reference model format in determining the number of spatial grids and zoning characteristics of ocean waves and data from Seamap for Makassar Straits adapted to the model input format [7]. Wind data and bathymetry data are used as wave model input data. In accordance with the objectives in this study, where the assessment will be conducted on the basis of seasonal variability

in both the ENSO and non-ENSO influences then selected for the normal year, 1996, El Nino was selected in 2015 and the year La Nina was selected in 2008 (www.bom.gov.au/climate/). The format of the input data model are expressed in *U-wind* speed (U_{10}) format (x-axis wind velocity and y-axis wind velocity) with 6-hour intervals. Data processing intended here is data processing done by utilizing MIKE 21 Model with setting up to adopt fully according to MIKE 21 Model format. Output model is then processed to obtain goals.

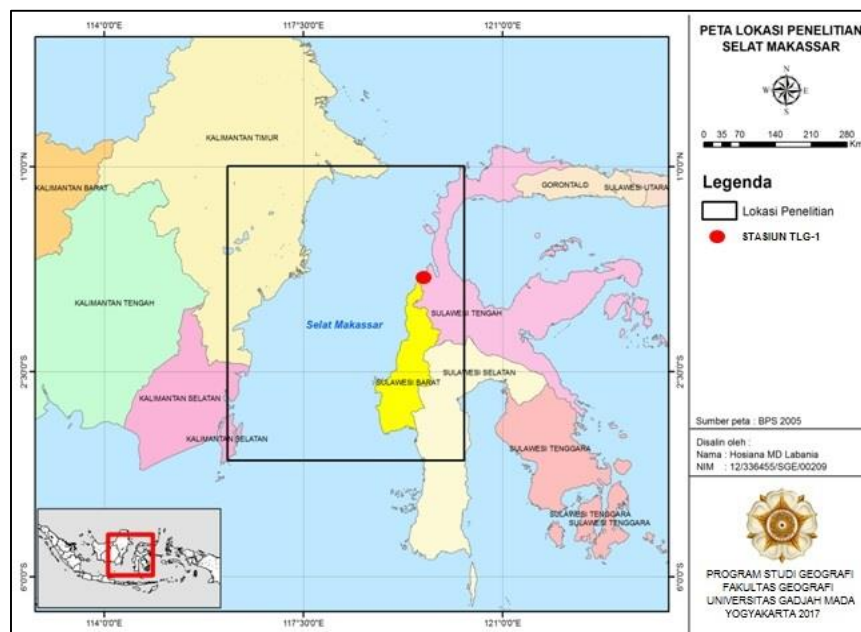


Figure 1. Domain Model and Output Station

2.3. Analysis of Output Data Model

In the practice of marine meteorology, the most commonly used terminology for expressing ocean wave height is the significant wave height, which associated with the wave recording data, is the mean wave height of the 1/3 maximum wave height ($H_{1/3}$ or H_s) at the time of measurement [5][8][9]. In relation to the MIKE 21 wave model [1], the meaning of wave heights is theoretically related to the spectral moment, defined as $H_{mo} = 4\sqrt{m_0}$. The analysis of wave characteristics is examined by looking at the trend patterns of the significant wave height (H_{mo}) and peak wave periods in the form of time series with and without the ENSO phenomenon (normal year = 1996; El Nino year = 2015; La Nina year = 2008). The determining criteria for the analysis of seasonal variability refers to a monsoonal pattern expressed by 4 seasons, namely West Season (December, January-February), East Season (June-August), Transitional Season I (March-May) and Transitional Season II (September- November), where these four seasons occur in normal years [10].

3. Discussion and Results

Lembasada waters are located on the western side of Sulawesi Island, including in the South Banawa District of Donggala Regency, Central Sulawesi. Ocean waters condition is still influenced by the dynamics of oceanography Makassar Strait waters with topography tend to ramps [11]. Local wind patterns tend to follow the pattern of monsoonal wind movement, north-south-east and vice versa, as well as the Makassar Strait waters. Strong winds and the chances of the occurrence of high waves reaching Lembasada beach this could happen and naturally can be a threat for people who live in coastal waters. The problem of severe weather with high wave incidence and unpredictable fluctuations will be strongly coupled through a wave forecast approach model with local meteorological conditions.

To find out the wave height conditions at TLG-1 Station, the significant wave height H_{mo} and peak period T_p are shown in the time series data form El Nino, La Nina and normal year (figure 2, figure 3 and figure 4). These results provide information on the tendency for high waves in these locations by observing the difference in normal times as well as when there is an influence of El Nino and La Nina.

Based on the results obtained above, in particular related to the time series of significant wave height (H_{mo}) and peak wave periods T_p in three different years, it generally shows that all wave events throughout the year provide a fairly fluctuating picture, where incidence of waves is more likely occurred in the year there was the El Nino and La Nina performances (based on data analysis). Throughout 1996, the highest significant wave height occurred in the West Season in February, reaching 0.61 m with a peak period of 3.36 s and in December reaching 0.61 m with a peak period of 3.926 s. For the year 2008 (figure 5), the highest significant wave height occurred in March ($H_{mo} = 0.64$ m, $T_p = 3.46$ s), May ($H_{mo} = 0.65$ m, $T_p = 3.97$ s), July ($H_{mo} = 0.74$ m, $T_p = 4.31$ s) and October ($H_{mo} = 0.69$ m, $T_p = 3.97$ s).

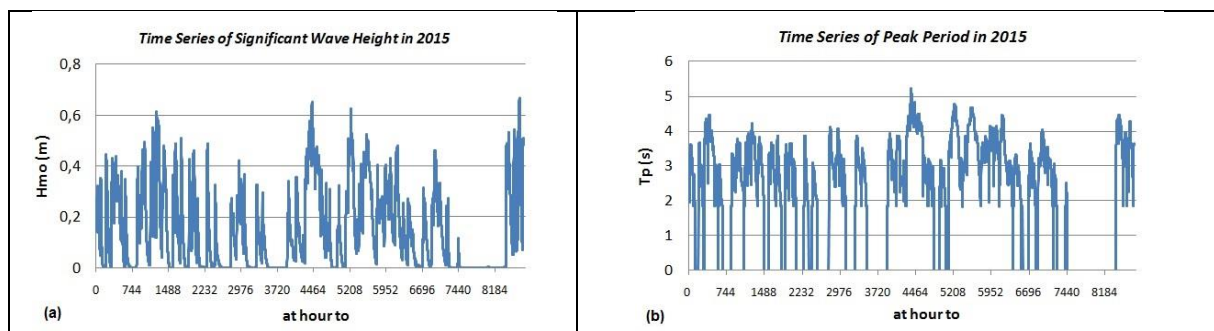


Figure 2. Time Series of Significant Wave Height (a) and Peak Wave Period (b) For El Nino Year

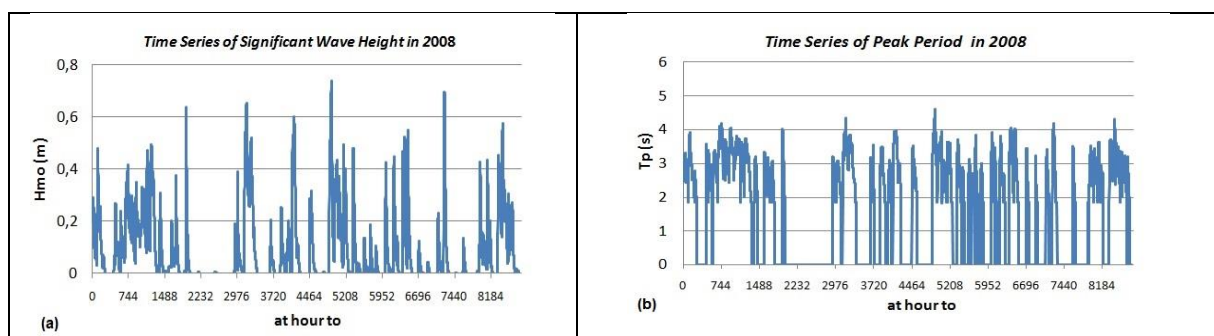


Figure 3. Time Series of Significant Wave Height (a) and Peak Wave Period (b) For La Nina Year

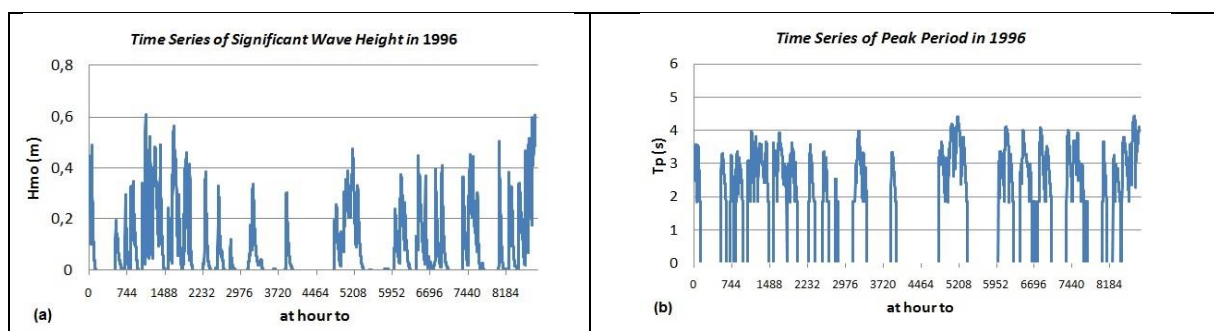


Figure 4. Time Series of Significant Wave Height (a) and Peak Wave Period (b) For Normal Year

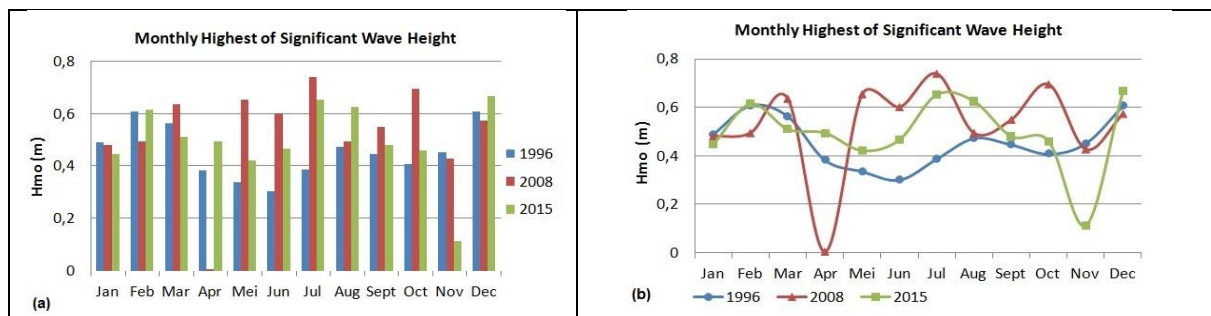


Figure 5. Histogram Graph (a) and Line Graph (b) of Monthly Highest Significant Wave Height

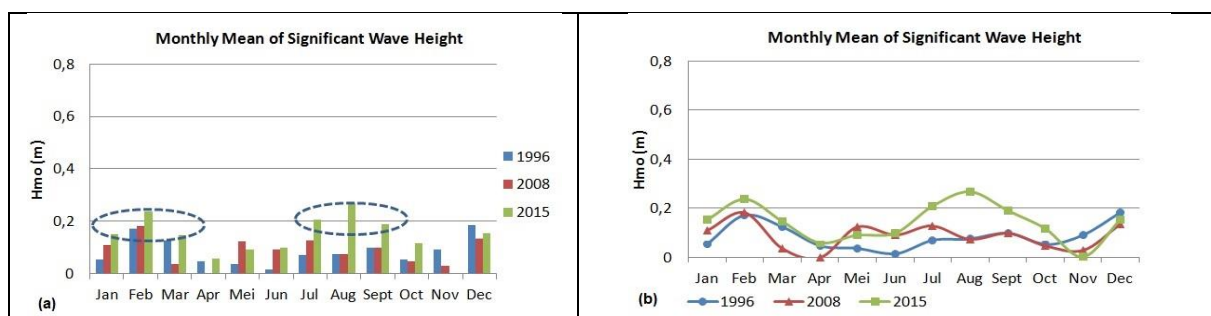


Figure 6. Histogram Graph (a) and Line Graph (b) of Monthly Mean Significant Wave Height

Maximum significant wave height during 2015, occurs both in the West and East Season. For the West season occurred in February ($H_{mo} = 0.61$ m, $T_p = 3.70$ s) and December 2015 ($H_{mo} = 0.67$ m, $T_p = 4.08$ s), while in East Season, occurred in July with $H_{mo} = 0.65$ m, $T_p = 4.31$ s. From the results obtained it can be said that highest significant wave height more likely to occur when there is influence ENSO both at El Nino and La Nina when compared with years without the influence of ENSO (based on analysis data). Under normal conditions, Lembasada's waters are generally still influenced by the dynamics of the surrounding waters (Makassar Strait) so the tendency of high waves more follows the monsoonal pattern that is common in West Season. In this study, the highest significant wave height during El Nino occurred in East Season, and during La Nina, occurred almost in all seasons with the maximum chance of occurrence in East Season.

When viewed from the monthly mean significant wave height (figure 6) in Lembasada's waters, it is observed that for 2015, it is more likely to be high, compared to the mean significant wave height for the other two years, occurring both in West Season (February) and East Season (July, August). Furthermore, if the average yield of significant wave heights of the three years under review, the average pattern shows the pattern of 2 peaks, tending to peak in the West and East Seasons, following a monsoonal pattern. Thus, looking at the results shown in this study, specifically for Lembasada waters, indicates that wave characteristics associated with significant wave heights in Lembasada waters tend to have patterns associated with monsoonal patterns.

The result of MIKE 21 wave model simulation is then verified with in situ observation data conducted in Lembasada waters on 28 - 30 August 2015 (figure 7). The comparison graph shows different results between the observations and the outcome of the model where the model output shows slightly higher initial estimate values but at subsequent times, tends to be the same pattern as the data relationships tend to fluctuate correlated under estimate. This difference value may be related to model resolution with decreasing accuracy as it approaches the shore [1]. However, on the basis of the results obtained, it can generally be said that the outcome of the model is good enough to provide an overview or information

of marine meteorology in inter-season forecasts that tend to follow the monsoonal pattern in Lembasada waters.

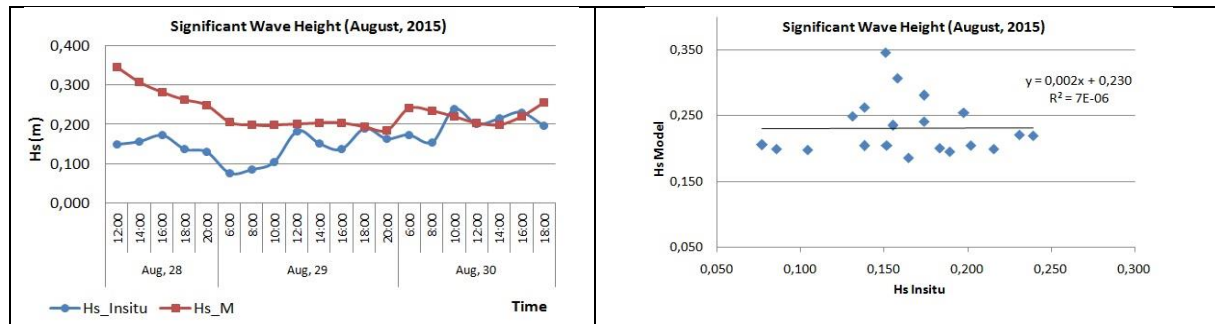


Figure 7. Comparison Between Significant Wave Height Observation Results and Output Model (histogram - left; line - right)

4. Conclusion

Based on the results obtained, it can be concluded that wave characteristics in Lembasada waters tend to be associated with monsoonal patterns with variations in monthly mean and seasonally significant wave height indicating a pattern of two peaks seen at El Nino. Monthly mean of significant wave height occurs in East Season during El Nino, while at normal, monthly mean of significant wave height occurs in the West Season. Maximum significant wave height occurs during La Nina, then followed by El Nino and the lowest during normal year.

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