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Field Observation On Rip Current Formation At East Pangandaran Coast

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Abstract. *Rip current identification is carried out in various ways, such as using google earth imagery, drones, and cameras. In this study, identification is done by recording, and observing rip current directly from a high place using a camera for 9 hours, from 8 am to 5 pm, the purpose of this study is to determine the relationship between wave parameters and rip current parameters, wave parameters reviewed, namely, (Ho), (Tp), (Lo) (C) and tidal wave conditions, then the parameters of the rip current being reviewed are, the frequency of occurrence of rip currents, and the average length of rip currents. The results show that the frequency of rip current events is related to wave parameters, the greater the wave parameter, the greater the frequency of rip current occurrences, and the highest frequency of rip current occurrences occurring in sea conditions towards low tide with a wave height of 1.2 m, average duration The rip current in the Pangandaran East Coast Region is 11 seconds, the type of rip current that occurs is the flash rip.*

Keywords: *rip current, rip current parameters, rip current field observation*

INTRODUCTION

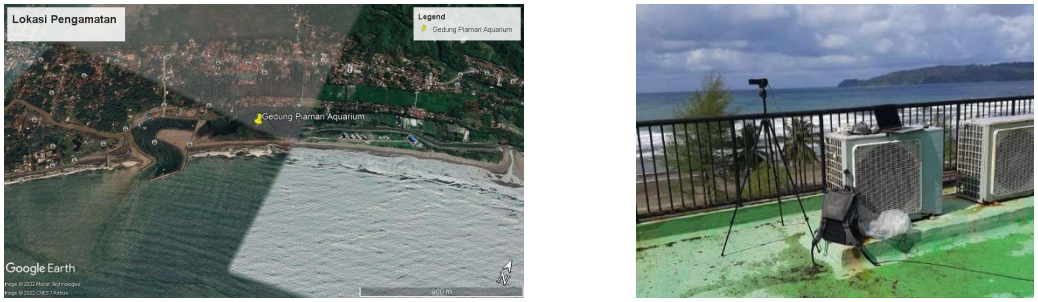
Pangandaran beach is located in West Java Province Indonesia, this beach is one of favorite destination for domestic and foreign tourist due to its nature reserve which offering a popular surf destination at several locations. However this beach is prone to hazards such as tsunami, storm surge, abrasion, earthquake and rip current. Many people have been reported drowned every year along this coast and all cases are associated with rip current (Kurniadi, Luthfiansyah, & Fattah, 2022). This current flow can quickly carry unsuspecting bathers of all swimming abilities into deep water and if the victim got exhausted and panic it result in drowning death (Brander, Bradstreet, Sherker, & MacMahan, 2011). Rip current are fundamentally driven by the action of breaking wave and therefore found on a range of beach types (Castelle, Scott, Brander, & McCarroll, 2016). Whilst Indonesia is an archipelago country and people are prone to coastal hazard, the research about rip current is still rarely done. Former rip current research in west coast of Pangandaran conducted at 2006 and 2015 observation and lead to conclude that the type of rip currents is due to topographic beach rip (Sandro, Faizal, Purba, & Yuliadi, 2018).

FIELD OBSERVATION

One of the signs of a rip current occurring is that it can be seen from the dark gap in the breaking wave formation (Sandro, Faizal, Purba, & Yuliadi, 2018), and where the presence of rip currents can be seen visually from the direction of coastal sedimentation which moves narrowly perpendicular to the coast.

Rip Current and Wave Period Observation

Observation was carried out on Sunday, July 24, 2022 on the East Coast of Pangandaran at 7°40'51.0"S and 108°40'39.1"E coordinates, precisely on the rooftop of the Piamari Aquarium Building ***(***FIGURE ***1)***. The tools used in this research are DJI Phantom Drone, Sony HDR-CX190E Handy cam with video resolution 1920 x 1080 pixel, SD Card with 64 GB capacity, and tripod with 1.55 m height. Measurement of the wave period is also done manually by observing from the crest of the wave to the next crest before the wave breaks. The average and maximum peak period results can be seen in TABLE 1 This period measurement was compared with data from hindcasting analysis and it was found that the results of the hindcasting analysis carried out with data from NOAA had a correlation coefficient value of r = 0.95, the correlation coefficient value was close to 1, therefore wind data from NOAA was used because it was considered to represent wind data in the observation area. (FIGURE 2)



(a) (b)

FIGURE 1. Field Observation Location at East Coast Pangandaran (a) and from Pangandaran Integrated Aquarium and Marine Research Institute Building roof top (b)

TABLE 1 Wave period Observation

Wave Period (s)	Period at 10:00 AM to 13:00 PM (in seconds)	Period at 13:00 to 16:00 PM (in seconds)	Period at 16:00 PM (in seconds)
Average	4.716	5.53	4.46
Maximum	6.62	7.86	7.51

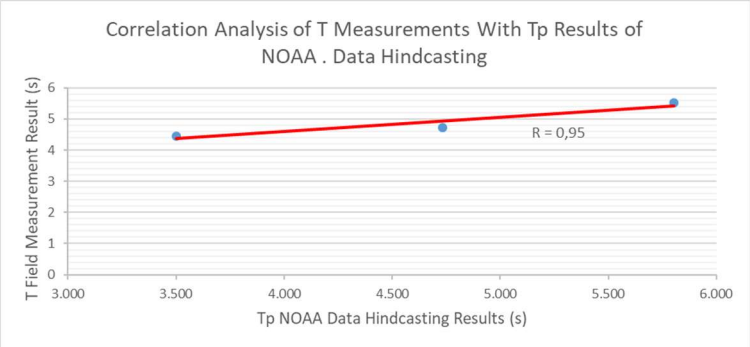


FIGURE 2. Correlation Analysis of wave period observation and wave hindcasting analysis

RESULT AND DISCUSSION

Observations were carried out from 8 AM to 5 PM observations were made at that hour due to adjusting the interval of 3-hour wind data obtained from the NOAA and BMKG websites. The observed pattern of rip currents occurred within 7 seconds, observations were made on rip currents that occurred at 12:39 WIB, and at 13.4 seconds after the rip current ended, only traces of sedimentation were seen being dragged into the middle of the sea, the pattern of occurrence of rip current can be seen in
FIGURE 3. At t = 1 until 4 seconds, there were uneven breaking wave pattern and this leads to the water surface elevation difference which will develops current in the surf zone. The variability of current flow and velocity formed a current back to deep water. At t = 5 until 7 seconds it was clearly seen that rip current formed. At t = 8 seconds, rip current has been flows aways toward the ocean.

Rip Current Occurrence Pattern At t = 1 s

Rip Current Occurrence Pattern At t = 2 s

Rip Current Occurrence Pattern At t = 3 s

Rip Current Occurrence Pattern At t = 4 s

Rip Current Occurrence Pattern At t = 5 s

Rip Current Occurrence Pattern At t = 6 s

Rip Current Occurrence Pattern at t = 7 s

Rip Current Occurrence Pattern At t = 8 s

FIGURE 3. *Rip current pattern from observation*

Rip currents occurrence frequency is obtained from the number of rip current events per hour during the observation, and then it will be processed into frequency analysis data per 3 hours with the secondary wind interval data obtained from the NOAA website. Analysis of the length of the rip current is carried out by measuring the scale. Scale measurement is carried out by finding the standard of an object and looking for the actual length of the drone's recorded image. In this case, the standard object used is the cable line. Based on drone observations, the length of the cable line is 42.1 m, then the scale is sought from the photo, then after that, calculate the average length of the rip current per 3 hours. A hindcasting analysis was carried out to obtain wave parameters such as wave height (Ho) and peak period (Tp), this analysis used the Shore Protection Manual 1984 method.

TABLE 2. Rip Current Occurrence and Average Rip Current Length

Hour	Rip Current Occurence	Average Rip Current Length (m)
06:00 – 09:00	29	45,04
09:00 – 12:00	101	39,50
12:00 – 15:00	109	35,76
15:00 – 17:00	77	31,78

Parameters of Field Measurement Results

This correlation analysis was conducted to determine the correlation of the wave period data from field observations with the frequency of occurrence of rip currents at intervals of 3 hours. It was obtained from the results of the correlation analysis between the frequency of rip current per 3 hours with T results from direct measurements in the

field, that the value of r = 0.84, from this value it can be concluded that the wave period of direct measurements has a strong correlation with the frequency of the presence of rip currents (**FIGURE *4***(a)). Another correlation analysis was conducted between wave height (H0), wave length (L0), and wave celerity per 3 hours. From the results of the analysis above, it can be seen from **FIGURE *5*** that the value of the correlation coefficient between the wave parameters and the length of the rip current is very low, and it can be concluded that the value of the wave parameter has no effect on the value of the rip current length.

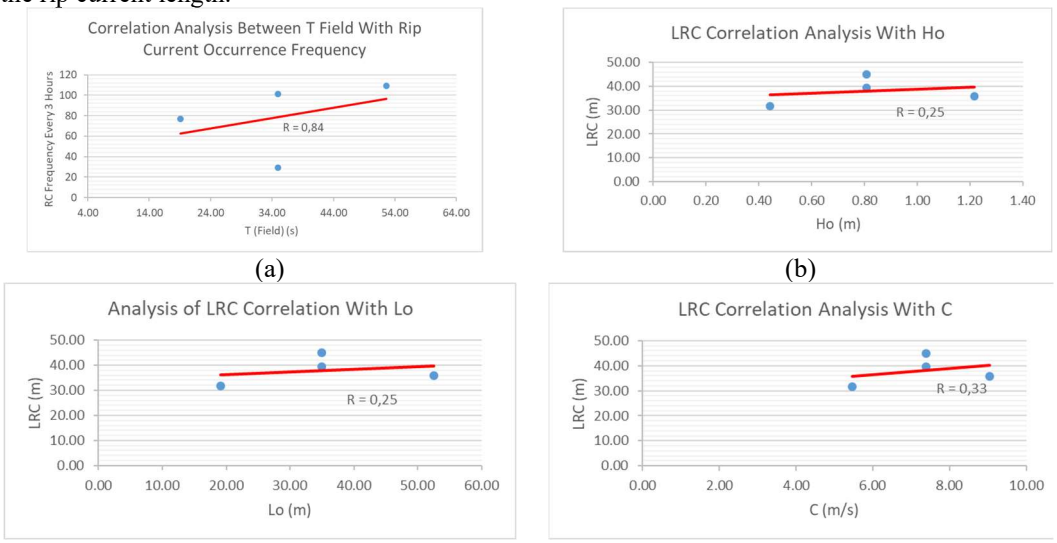


FIGURE 4. *Analysis of Rip Current Length Correlation with wave parameter*

The correlation between wave parameter and rip current frequency was carried out by comparing the data. From the graph of the previous relationship, it can be concluded that the highest frequency of rip current occurs when the speed of wave C = 9.05 m/s, wavelength Lo = 52.55 m, wave period Tp = 5.8 s, and wave height Ho = 1.22 m, and also from the analysis of the rip current frequency with the wave height, it can be concluded that the higher the wave, the greater the rip current frequency that occurs. The results of the above analysis support the theory which states that the wave period with the highest rip current frequency occurs at Tp = 6 s, and the wave height at H = 1.2 m to > 1.6 m, and also the higher the wave, the higher it will be. the frequency of the rip current that occurs, (Reinhart, 2016). Another correlation was compared between rip current occurrence and tidal. In **FIGURE *6*** shows that red line indicates the elevation of the tide, when the red line is going up it indicates a high tide, and when the red line is decreasing, it indicates a low tide. From the graph above, it can be seen that the highest frequency of rip currents occurs at low tide, and during low tide conditions, the frequency of rip currents is at the highest value, the results of this analysis are in accordance with the statement from Pangandaran Coast Guard, which states that most currents usually occur at low tide.

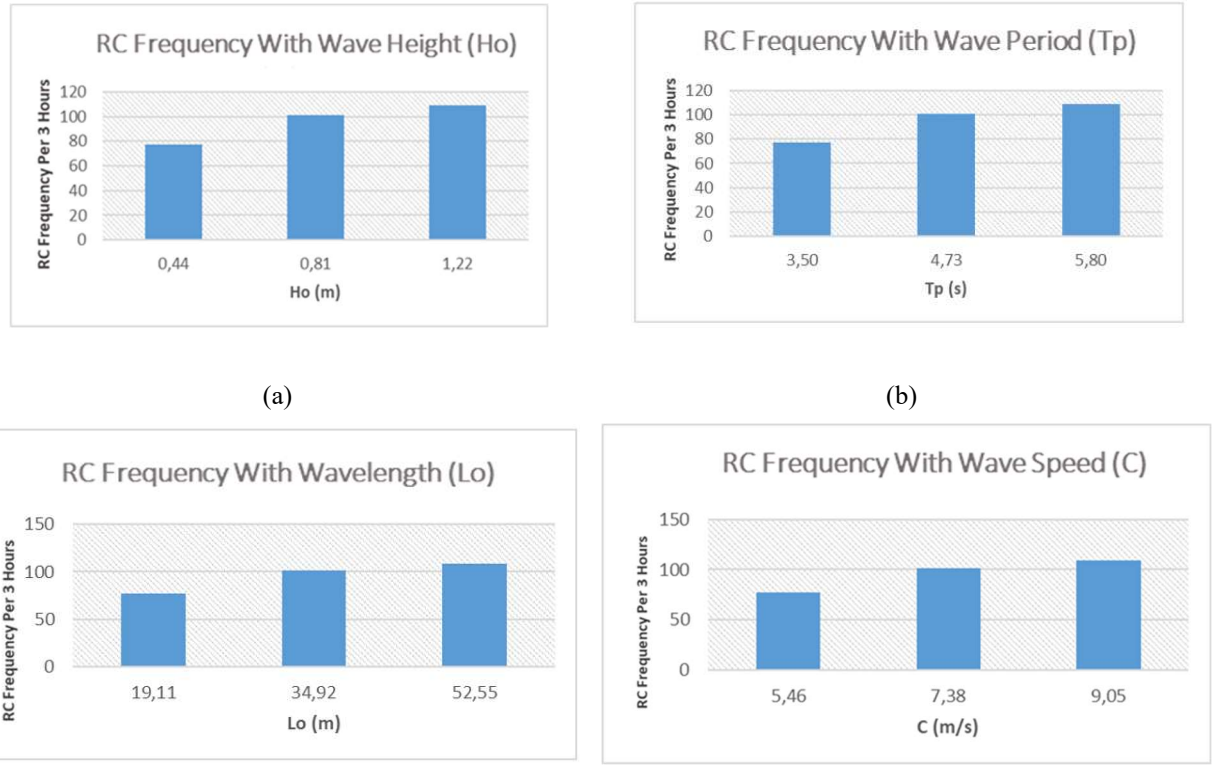


FIGURE 5 Rip current frequency with wave parameters

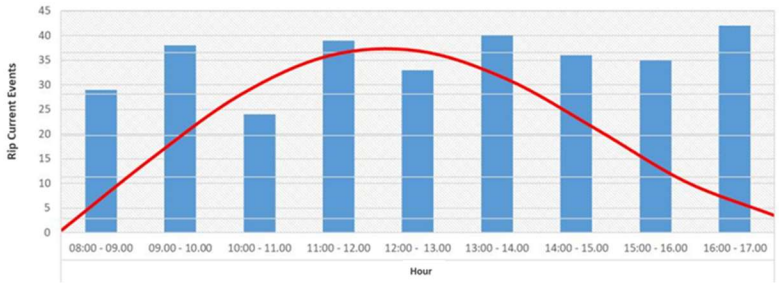


FIGURE 6 *Rip Current Occurrence with Tidal Data*

Rip Current Types

Determination of the types of rip currents is done by visual observation using a camera, from the results of these visual observations it can be concluded that, the type of rip current that occurs is flash-rip. This can be proven by 2 characteristics, namely, the location changes, and the average size The smaller average rip current is 37.15 m, compared to the average length of the rip current on the west coast of Pangandaran, which is 390.5 m.

TABLE 3. *Rip Current Types And Characteristics*

Characteristics	Rip Current Types According to (Markland, Brander, 2022)					
	Channelised-Rips		*Boundary-Rips*		*Flash-Rips*	
	theoretical	Actual	theoretical	Actual	theoretical	Actual
Topographical Forms of Coastlines Forming Channels	√					
Fixed Locations For Long Periods	√		√			
There is a Perpendicular Structure of the Beach			√			
Changeable Location					√	√
Rip Current Small Size					√	√
Compatibility of Rip Current Characteristics Rip Current Types According to the Rip Current Safety Website (Markland, Brander, 2022)	0/2		0/2		2/2	
	0%		0%		100%	

CONCLUSION

The conclusions obtained from the analyzes carried out in this study are: (1) from the field observations, it can be seen that the movement pattern of the rip current every second is, at t = 2 s to at t = 8 s the rip current is visible, and at t = 9 s the rip current is not visible, but at t = 13 s, The traces of sedimentation from the former rip current event will be visible, and from these results, it can also be seen that the average duration of the rip current occurrence in the East Coast of Pangandaran is 11 seconds. (2) from the results of visual observations, it can be concluded that the types of rip currents that occur on the East Coast of Pangandaran are flash rips. After looking at some of the analyzes it can be concluded that, all wave heights obtained from the data during observation can be the cause of rip currents. And from the results of the analysis of this study, it can also be concluded that the potential for rip currents is very large at wave height conditions (Ho) i.e. 1.2 m at low tide, and from the graph of the relationship between the frequency of rip current events and wave parameters. , it can be concluded that the higher or greater the value of the wave parameter, the greater the frequency of the rip current that occurs, but on the graph the relationship between the length of the rip current and the wave parameters has no effect on the value of the length of the rip current. From the results of the correlation analysis between the length of the rip current and the wave parameters, it can be concluded that all of the wave parameters reviewed, such as wave height (Ho), wavelength (Lo), wave period (Tp), wave speed (C), have weak relationship and linkage with rip length, current that occurs.

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