Preliminary Study of Rip Current Identification During West Monsoon In Parangtritis Coastal Area

Anak Agung Ngurah Agung[1], Nurfa Khoirunnisa[2], Bachtiar Wahyu Mutaqin[3], Sunarto[4]
[1,2]Master of Disaster Management, Postgraduate School, Universitas Gadjah Mada
[3,4]Department of Environmental Geography, Faculty of Geography,
Universitas Gadjah Mada
Email: agung.ngurah.aa@gmail.com[1], nurfa.khoirunnisa@gmail.com[2], mutaqin@ugm.ac.id[3], sunartogeo@gmail.com[4]

Abstract. Bantul Regency, as one of the five regencies in Yogyakarta Special Region, is strategically attractive for beach tourism which is visited by more than 1.6 million local and foreign tourists. Several famous beaches become tourist main destinations such as Parangtritis Beach, Parangkusumo Beach, and Depok Beach. However, the existence of rip currents spread along the shore has been threatening as danger for tourists. Rip currents can physically be characterized by the geomorphologic condition of the beach, i.e. cusps (horn like) morphology and sandbar shape (crescent moon or cresentic bar). Based on the data of SAR team in Parangtritis Beach, from January to December 2013, there were 39 casualties cases existed due to rip currents. Spatial information of rip currents distribution along the shore is particularly necessary to anticipate the number of victims then tourist could be informed the rip currents locations. This research explored the motion occurrences of rip currents within a year during west monsoon utilized middle and high resolutions imagery satellites. Wave parameters measurements were used as parameters for the methodology. The results showed that recorded wave period is about 11.17 – 18.69 seconds with the maximum of wind speed reaches 11.3 m/s and the formation of waves is 3.96 m height. This research highlighted that Kretek coast has been the greatest potential to generate the rip current than other coasts in Bantul Regency due to the 3^{O} of beach slope.

Keywords: rip current, monsoon, satellite imagery

1. Introduction

One of coastal hazards existed in Bantul Regency, Yogyakarta is rip currents, particularly in Parangtritis coasts (Susmayadi, et al. 2010). Carey and Rogers (2005) stated that rip currents are highly dangerous sea current occurred at the shores that

concentrated through the narrow path then strongly flow toward the surf zone over the breaker zone to the offshore. Rip current rashly flows back towards the offshore with the velocity about 2 meter/second and in short time, which is within 2 hours (Thurman and Trujilo 2004). The rip current energy strongly developed along the shallow slopes and offshore sandbar that forms beaches structure, where sea water flows through the narrow rift (Carey and Rogers 2005), see **Figure 1**. This figure explains that rip currents divided into 3 important parts, i.e. neck, rip head, and longshore current. The neck is where concentrated current into the rip rush past the breaker zone. The rip head is the end point of rip current which is located in the offshore. Usually, at the rip head energy of the currents has weakened. The last is feeder current, as a part of where longshore current from the opposite direction meets in one point and then fills the neck with sea water from the shoreline (Brujin 2005).

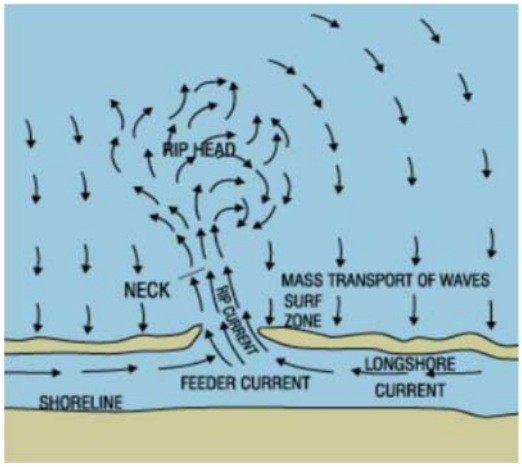

Figure 1. The scheme of rip currents (USACE 1972 cited in Brujin 2005)

The occurrence of rip currents indicated by beaches characteristics in Bantul, which has cusps morphology (horn like), also nearby the shore are formed splits (cresentic bar). Inversely in the condition of crescent moon-like split, while the position is in the opposite of beach cusp, then the rip current will be exist in the end of beach cusps (This is happened in the linear bar shore) (Susmayadi, et al.). Rip current in slight eyes looks like calm seas without waves so that common people will not aware of the hazards. Rip currents do not caused people drown; nevertheless the currents bring people far to the offshore. Victims of the currents who drowned because usually they could not survive against the currents to float or swim back to

the shore. This is also triggered by the panic, frightens, exhausted, and lack of ability in swimming, or due to the combination of the factors (Carey and Rogers 2005).

The unawareness of these rip currents locations becomes one of reasons that caused victims due to rip currents hazard since tourists have no idea of the deathly currents. According to the SAR team at Parangtritis Beach from January – December 2013, there were 39 cases of drowning visitors caused by rip currents. Moreover, the National Weather Service's East Central Florida Rip Current Program in Florida Beach, the United States mentioned that from 1989 – 1999 there were 150 death cases (15 cases/year) due to rip current events (Kusmanto and Setyawan 2011). These events have described that beach as the most favorite tourist sector is also the most dangerous place that should be cautioned.

2. Objectives

The efforts to mitigate rip currents hazard in Indonesia has not been seriously put into consideration compared to what have been applied in some countries. Kusmanto and Setyawan (2011) stated that there are several methods utilized as mitigation ways for rip currents hazard, i.e. provide information, education, monitor, and control. The objectives of this research are to understand and to indicate the distribution of rip current location during the west monsoon, which the information could be an advantage to understand rip current hazard.

3. Study area

The research area is concentrated in the Parangtritis Beach, which is located in Kretek sub district (see **Figure 2**). This location was chosen as the study area based on the existing data of Bantul Regency Office (*Dinas Kabupaten Bantul*) that stated beach tourism is the most favorite of all tourism sectors in Bantul.

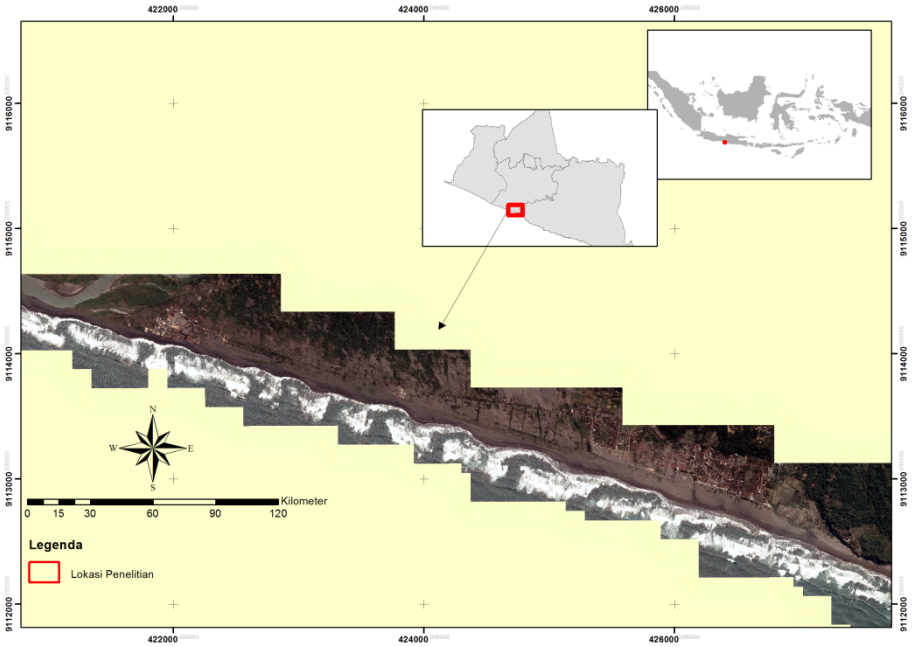

Figure 2. Research Location

One of the most famous beaches is Parangtritis Beach. This research utilizes data of Geo-Eye satellite imagery on March 2010 as secondary data. In other hand, the primary data used are parameters field work, i.e. wave periods, velocity, wind direction, and beach slope.

4. Methods

Methods used for the research is qualitative approach. Winchester 2000 cited in Yunus 2009 stated that qualitative approach as a spatial observation is a research method that explains environment includes social and nature, which is related to geosphere characteristics on the earth surface. Meanwhile, interpreted imagery satellite is used methodology for spatial observation of rip currents.

Two approaches are used for the research, i.e.:

a. Imagery satellite interpretation

Imagery satellite in this research is utilized to identify spatial distribution of rip currents. Through Geo-Eye imagery satellite on March 2010, the location of rip currents and morphodynamic processes in the area are defined. Rip currents could be identifying by observing optical imagery and counting the spatial resolution. Retnowati (2010) stated that rip

currents observation is also applied through remote sensing by identified surf zone and breaker zone (see **Figure 3**).

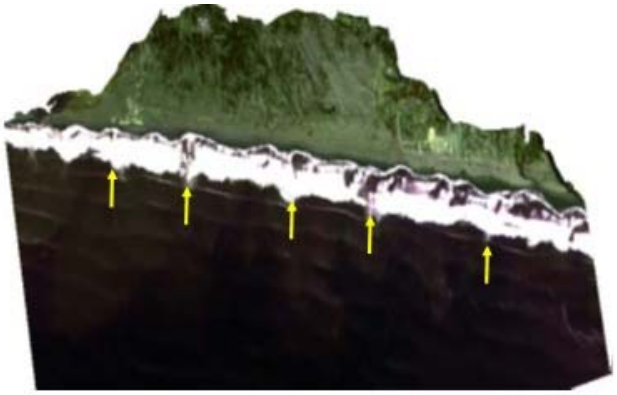

Figure 3. Rip currents identification (arrow symbol) on AVNIRR-2 imagery satellite recorded on 17 June 2008 at Parangtrities Beach, Yogyakarta (METI-JAXA)
(*Source: Retnowati 2010)*

b. Field measurement

The satellite imagery data was supported by waypoint data on the ground check while rip current identification on the field using GPS. On the moment of ground checking of each location points, slope measurement of each location using waterpass was also necessary. The Rip currents locations were visually determined by observing current circulation through the offshore horizontally cross cutting the breaker zone. Wave parameter (wave period) is necessary in this research because one of the trigger factor for rip current is waves. This is supported by Retnowati (2010) that stated rip currents physically are formed when waves come and dash down the bay. The breaker zone and surf zone is the location of which has high velocity currents that showed on the scattered currents. Besides the wave data, the velocity data and wind direction data are also necessary in this research. The velocity and wind direction data are used in the wave parameter's analysis, which is wave height. The wind velocity measurement was applied by using anemometer, whereas wind direction measurement was applied by using Brunton compass.

5. Results and discussion

Rip currents location's identification through remote sensing imagery was obtained by observing and identifying the surf zone or the breaker zone. If surf zone intersection occurred then it could be identify in the location that rip current was exist (see **Figure 4**).

Figure 4. Rip current visual observation in Parangtritis Beach

From the satellite imagery, could be seen that 11 locations of rip currents are exist. The next step was field verification and 15 locations in total were found (see **Figure 5**). In addition, hydro-oceanographic parameters were also measured, i.e. wave, wind velocity, wind direction, and beach slope. This hydro-oceanographic parameters' measurement were implemented in Kretek Sub District (coordinate UTM 49S; x: 425776 and y: 9112966). **Table 1** is the measurements result for five days field work.

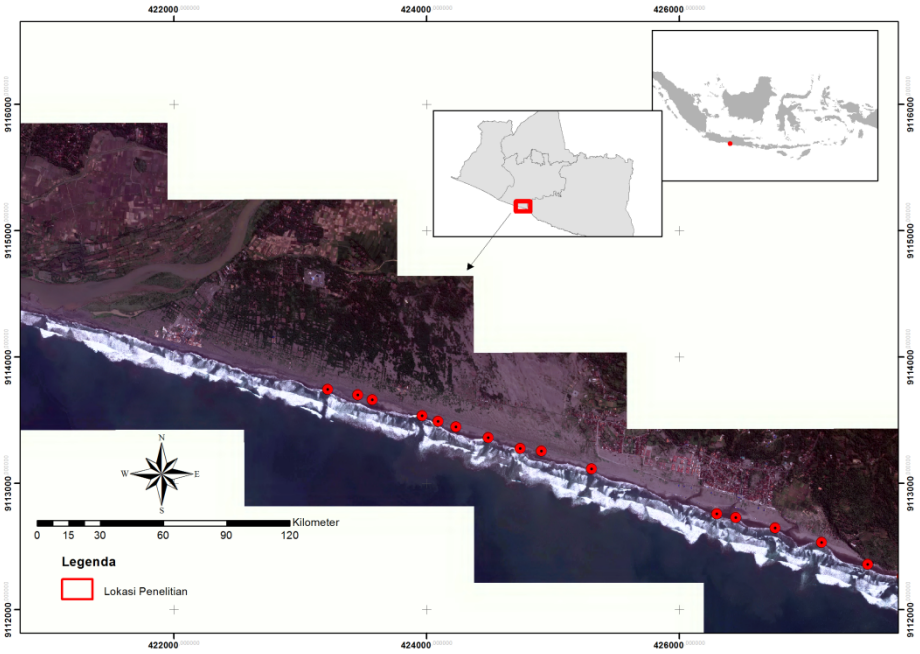

Figure 5. Existing locations of rip currents on June 2014

Table 1. Measurements result in Kretek Sub District

No.	Date	Time	Wave Period (T) (second)	Wind Direction (degree)	Wind Velocity (m/s)	Temp (C)
1	Monday, Juni 16 2014	08.59	18.34	352	4.2	30.6
2		12.11	15.13	346	8.4	30.4
3		15.44	14.69	330	7.3	29.8
4	Tuesday, Juni 17 2014	08.02	17.54	340	0.8	29.5
5		11.53	14.83	336	6.6	31.1
6		14.46	15.43	326	7.5	29.8
7	Wednesday, Juni 18 2014	08.45	11.17	340	2.3	30.6
8		13.57	14.21	330	9.3	31.4
9		15.14	15.62	346	9.6	30.5
10	Thursday, Juni 19 2014	08.22	15.69	163	2.7	29.8
11		12.15	18.69	42	4.2	28.6
12		15.16	18.35	34	2.1	29.4
13	Friday, Juni 20 2014	07.52	16.96	36	1.5	29.7
14		12.20	16.3	336	10.5	29
15		15.20	12.6	352	11.3	29.3

(*Source: Field measurements between 16 June 2014 – 20 June 2014*)

The wind velocity and wind direction condition is extremely influence the wave generation. In this case, rip currents energy is influenced by wave height. The higher the wave height, the stronger the rip currents are. During the field measurement, the wind direction patterns were mostly similar. The winds were mostly blown to the North-West that indicated the wind blew to the constant direction for relatively long periods. This fact was supported by the condition of sand dunes along the coast that changed to the North-West.

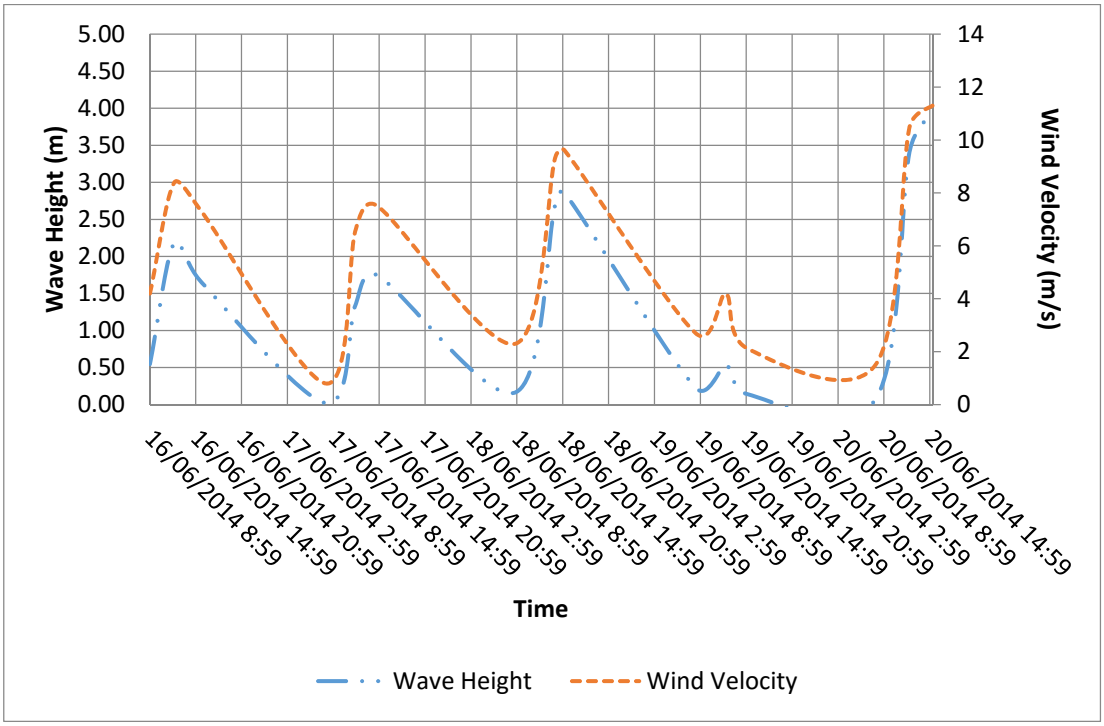

Figure 6. Graph of relation between wave height and wind velocity

As displayed in Figure 6, the graph of high wave's event was triggered by high wind velocity that happened during the day. This graph means that rip current energy reached its peak on the day. The wind velocity increasing could be proceed by the highly difference temperature's pressure between land and sea. Based on the field observation, the days were dense by tourists (see **Figure 7**).

Figure 7. Tourist activities along the coast of Parangtritis Beach

Proper watch by the SAR team is necessary needed due to the dangerous rip currents' condition. Routine patrols or Rip current's location guards are required as alternative of mitigation acts.

The condition of Bantul coastal area without wind measurement's stations made the wind data for Parangtritis Beach were obtained from the Meteorological Station *(Badan Meteorologi, Klimatologi dan Geofisika – BMKG)* and NOAA. However, the wind data of both institutions could not represent the research area condition because: 1) the station's location is significantly far from research location, which is in Adisucipto Airport and Pacitan, and 2) The wind data is classified into global scale data. Hence, the field measured data determined the quality of research's results.

6. Conclusions

The formation of rip currents in Parangtritis beach and surrounding has been the hazard potency faces by communities who have activity in that area. Parantritis coastal area is also one of the most favorite tourism both for domestic and foreign tourists. This means also increases the rip current's element of risk. This research

should do continuously, and then mitigation acts could be planned based on the intensity of rip currents forming to the time of tourists' visitation. Besides, education for tourists is necessary about the coast hazard. SAR team, who responsible for visitor's safety has obligatory to always watch for the field condition to anticipate victims of rip currents.

Rip currents have also positive impact that could be used by local community to sail and to fish. Therefore, the effects of rip currents could be controlled so that not caused negative impact. Field observation is one of the efforts to identify rip currents existence in scientific way, but local community has also knowledge to identify rip currents and advantage it.

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