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Building up the database of the Level-2 Java Sea Ecoregion based on physical oceanographic parameters

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Abstract. The Java Sea (JS) is one of the sea with unique characteristic with especially in biodiversity and oceanographic condition. The purpose of this research is to identify the EL into level 2 in Java Sea based on oceanographic condition. The Java Sea, which covers an area of 467,000 Km² with an average depth of 50m, is located on the Southeastern part of the Sunda Shelf. This research uses the temperature and salinity data provided by the INDESO, the sea surface height (SSH) data downloaded from the HYCOM website, and the level 2 Java Sea ecoregion shape file data from the Indonesian seas delineation team. The physical oceanographic conditions of the level 2 Java Sea ecoregions are influenced by the moonsoon and their respective geographical positions. The results showed that the distribution of temperature, sea current, salinity, and Sea Surface Height differed in each Java Sea Ecoregion level 2 because it is influenced by the geographical and astronomical location of each Java Sea Ecoregion level and influenced by the monsoon that exists over Indonesia. In the east of Java Sea influence from Makassar Strait and in the west affected by Karimata Strait. Within the region, EL 6.1. (Sunda Strait), the physical oceanography condition is slightly different from other Java EL because it is strongly influenced by the Indian Ocean.

1. Introduction

According to Geospatial Information Agency (BIG), the vast waters of Indonesia covers 6.376.744 km². With such vast waters, the diversity of flora, fauna, environmental conditions, and other parameters will surely be diverse. With such vast waters and the biological resources contained in it, a thorough and detailed inventory is needed. One of the database that exist now is the Indonesia Sea Ecoregion (EL) which is arranged by ministry of Environment (KLH) in 2013.

Sea ecoregion is a vast water territory that is filled with species, communities of nature, and environmental conditions that are really united in one geographic scope. Ecoregion is a geographic ecosystem, which means that the patterns of the various ecosystems and the processes between those ecosystems are bound in a geographical unit [16]. The delineation of ecoregion zones is a very important step in the process to build area of conservation [4], and Indonesia has applied this scheme.

At the present time, the Indonesian seas have been divided into 18 marine ecoregions and 11 fisheries management areas. One of the important EL Indonesia areas is the Java Sea located in the ecoregion zone 2. The Java Sea Ecoregion zone is characterized by shallow sea, whose oceanic conditions are heavily influenced by mixed-type tides predominantly diurnal, as well as Asian-



Australian Monsoon system. The Java Sea Ecoregion is also situated with relatively low bottom slope (gradient of 1-3°), although there are some areas that have a steep slope class (3-10°) [17]. The Java Sea is also located on continental exposure with a depth of 60 m, so that with the Java Sea conditions and its location within the territory of Indonesia, the Java Sea is relatively safe against earthquakes and tsunami [3]. The determination of the ecoregion zone is still at the stage of level 1 (global), which is still with the national map scale of 1: 1.000.000. On that scale, the information obtained is less detailed. Due to the marine environment, the zone classification on the global scale (level 1) is still within a limited spatial resolution, so that the accuracy of the desired information is still imperfect [12]. Zone downscaling is required to increase the EL level to level 2 with the scale of 1: 250,000 to obtain bathymetry information, current, sediment, temperature, freshwater affect, nutrient, isolation level, upwelling, and morphostructure in Java Sea accurately and specifically. The objective of this study was to identify the EL into level 2 in Java Sea based on oceanographic condition.

2. Methods

2.1. Time and area of study

This study was conducted from November 2016 to February 2017. The study area is in the EL-6 zone of Java Sea, covering an area of 437,978 km² (figure 1). Data processing and analysis will be performed at the Computer Center, Faculty of Fisheries and Marine Sciences, Padjadjaran University (UNPAD) and at the Sea and Coastal Data Laboratory, Marine Research Center, Human Resource Research Agency, Ministry of Marine Affairs and Fisheries, North Jakarta.

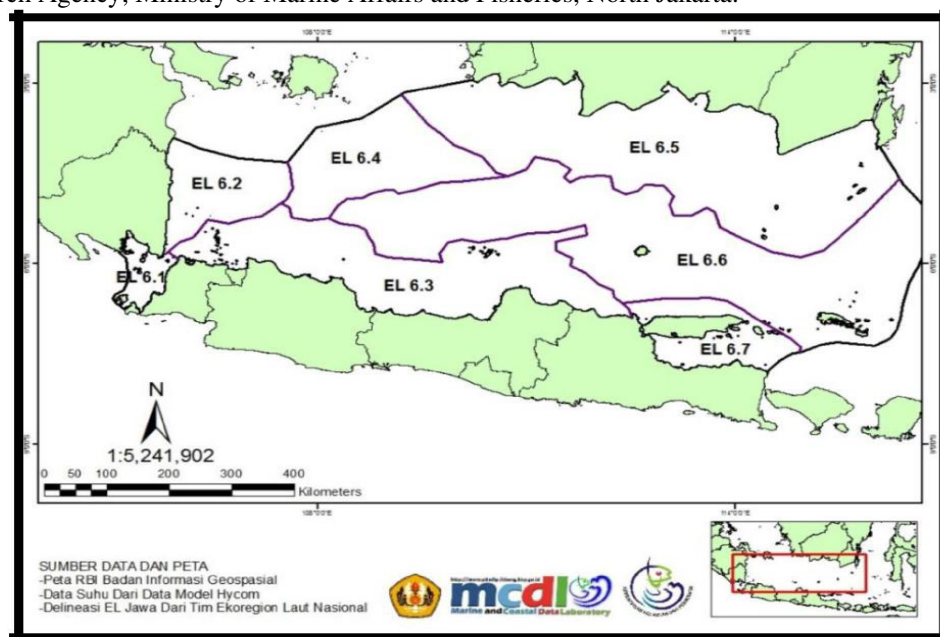


Figure 1. Indonesian sea ecoregion (EL) in Java Sea Level-2.

Figure 1 shows a zone of Sea Ecoregion 6 (EL-6) located within the Java Sea. Administratively, EL-6 is not only composed of the Java Sea, but also some parts that are directly intersection with Karimata Strait and Makassar Strait, which is the same characteristic as the Java Sea zone. It will be incorporated into the group of EL 6 zones because the creation of an Indonesian EL zonation is based on similarity between parameters that have been set up. Location around the waters of the Jakarta Bay is not detailed on EL Level 2 with a scale of 1: 250.000, because the provincial government of DKI Jakarta has set ecoregion zone at level 3 in the territorial waters of DKI Jakarta Province.

2.2. Data collection

The dataset used in this research are seawater temperature, salinity, current, sea surface height (SSH), and shape files from delineation of Java Sea Level Ecoregion 2. The data were obtained from the Infrastructure Development of Space Oceanography (INDESO) (<http://www.indeso.web.id/>) and HYCOM (<https://hycom.org>) sites, downloaded directly from the official website. The spatial resolution used for Monsoon and Arlindo data contained in INDESO is $1/12^\circ$ or about 9.25 km. The shape data file of the 2nd level Java Sea Ecoregion was obtained from the Indonesian Geospatial Information Agency (BIG). The data were taken with an average of 0-50 m.

2.3. Data analysis

The method used in this study is a method of spatial analysis, temporal in a descriptive way. The analysis method is spatial and temporal, which is to process the secondary spatial data obtained from the official site of the institution in the field of oceanography, where the data come from the satellite measurement which are then processed using ArcGis software and the results are spatial maps and overlaid spatial maps between parameters. Spatial analysis method is used to process sea current, salinity, and seawater temperature data in the Java Sea. The MATLAB software is used to average the data that have been downloaded, and the ArcGis software is used to process the data that have been averaged. The results of the processed data are maps of complete distribution with color gradation and a map legend, which then be overlaid with the Java Sea Ecoregion level 2 delineation data shape file.

3. Results and discussion

3.1. Monthly mean of temperature distribution in Java Sea Ecoregion

The result of this study shows that the temperature in the areas of EL 6.1, EL 6.2, EL 6.3, and EL 6.7 located in the southern part of Java Sea is warmer than that the areas of EL 6.4, EL 6.5, and EL 6.6 regions in the north region (figure 2).

In the area of EL 6.1 the temperature range is 27-31.6 °C, the lowest temperature of 27 °C, occurs at all seasons in Indonesia, and the highest temperature of 31.6 °C occurs during the Monsoon Transition I (March-April-May) and East Monsoon (June-July-August). The dispersion of water temperature in EL 6.1 is not evenly distributed as shown in figure 2, as there seems to be 2 temperature groups. In areas closer to Java mainland, its temperature is warmer, which ranges between 30.5 - 31.6 °C, and in areas slightly farther from the Java mainland, the temperature is around 28.5-29 °C. This is because the areas closer to Java's mainland is still directly affected by Java's mainland activities, it is also affected by the warmer state of EL 6.2. While the position rather farther from the mainland is influenced by the Indian Ocean that has a cooler water temperature. This causes the water temperature dispersion in EL 6.1 to be uneven. The temperature distribution in EL 6.1 differs slightly from the other EL-6 sub, since EL 6.1 is mostly influenced by the Indian Ocean. The temperature distribution in EL 6.1 in November is different compared to other Java EL areas. There was a decrease in temperature when other regions experienced an increase in temperature in November. This is because of the positive IOD phenomenon that occurred in 2012 in the Indian Ocean that also affected the temperature along the Java coast; and the peak of this phenomenon is in November [10]. This phenomenon causes the pressure in Indian waters to be higher than the waters in Africa, so that the warm water mass in the mixed layer moves towards the waters in Africa [14]. The displacement of the mix-layer layer from the slough in the Indian Ocean resulted in a low temperature thermocline layer rising to fill the void, resulting that in the positive IOD, the temperature of waters in the Indian Ocean decreasing. This is what causes the temperature at EL 6.1 to decrease in November.

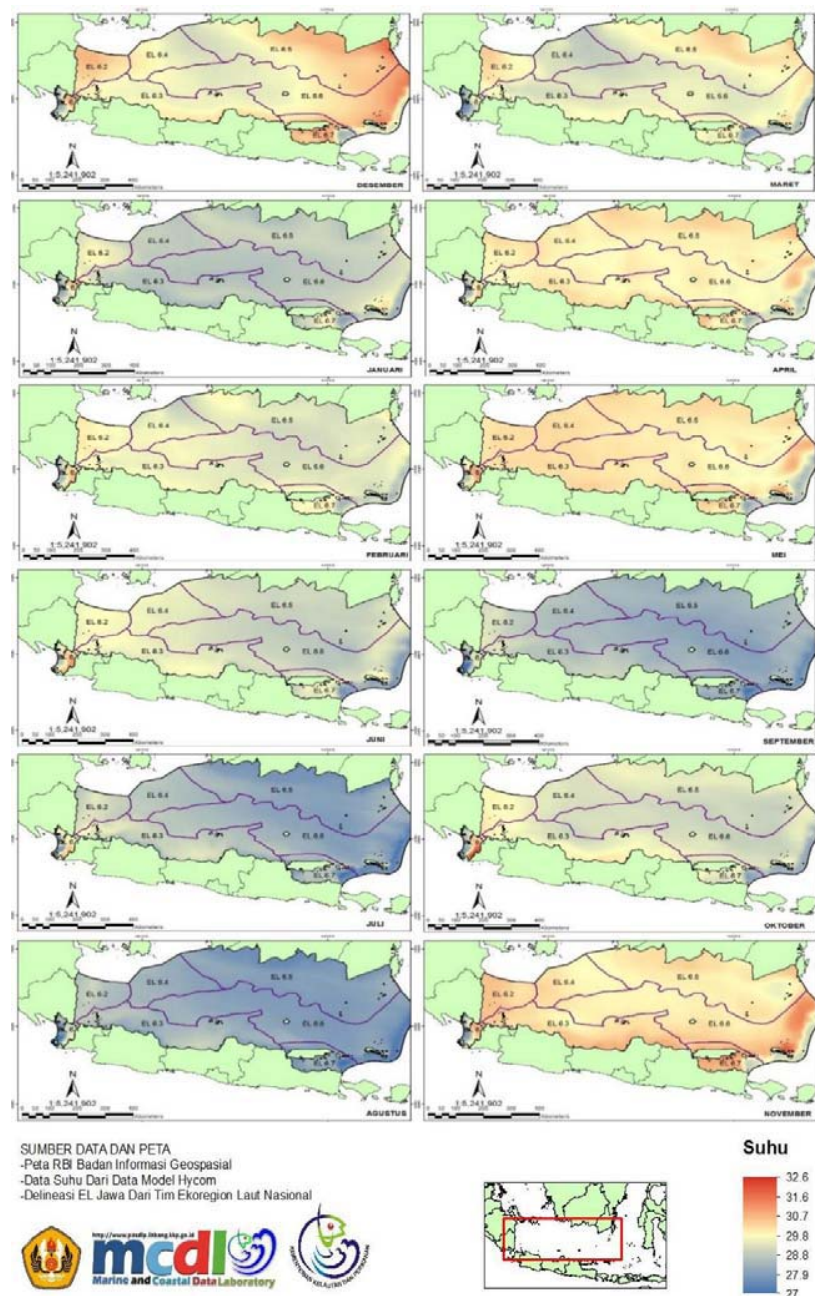


Figure 2. Temperature distribution in the Java Sea Ecoregion in 2012.

In the areas of EL 6.2, EL 6.3, EL 6.4, and EL 6.5, the temperature distribution is also uniform, because the area is not directly in contact with the oceans. Area EL 6.2 has a temperature range of 28.5-30.5 °C, and EL 6.3 also has the same temperature distribution range with EL 6.2 with a value of 28.5-30.5 °C. This happens because EL 6.2 and EL 6.3 affect each other. In EL 6.6, the temperature spread has a value of 27-31.6 °C, but the temperature distribution in EL section 6.6 is uneven. The eastern part of EL 6.6 has a lower temperature spread than other EL 6.6 regions. It can be seen from the figure that during East Season, the eastern region of EL 6.6 has the lowest temperature. The time of the East Season showed the same thing, that is getting a cooler Water Mass from the East [5].

The lower temperature distribution conditions in the eastern part of EL 6.6 are also influenced by Arlindo [15]. At the peak of Arlindo (East Monsoon, May-October), the western part of the Java Sea Temperature ranges from 28-30.5 °C, while in the east it varies between 27-29 °C, especially in the eastern part of EL 6.6. At the time of Arlindo, Java Sea always gets influence from South China Sea Water Mass in West Monsoon and also get influence of Water Mass from East (in North of Makassar Strait).

3.2. Monthly mean of salinity distribution in Java Sea Ecoregion

The value of salinity during the Western Monsoon is lower than at the time of the East Monsoon, ranging from 29.5 to 33 psu. This is in agreement with [8], which stated that the Java Sea experiences the rainy season due to the water vapor that the wind takes as it passes the Pacific Ocean and South China Sea, resulting in a decrease in salinity (low salinity) due to the entering of fresh water and precipitation in large quantities. The distribution of salinity in the Java Sea Ecoregion at the time of West Monsoon and the Monsoon transition I is shown in figure 3.

According to [6], at the time of the West Monsoon, the water mass with low salinity of the Java Sea is pushed back to the southern Makassar Strait. This water mass exchange causes the pressure of water mass to go to the northern Makassar Strait. At the time of the East Monsoon, the winds on the Java Sea carry a surface water mass that is higher than the Banda Sea to the Makassar Strait. [17] argued that the Southern Equatorial Current (SEC) water supply comes from the southern Indian Ocean, an upwelling region between Indonesia and Australia, the Timor Sea and Indonesian Waters, and Equatorial Counter Current (ECC) that turn southwards in the loose waters of the western Sumatra coast. According to [6], at the time of the West Monsoon, the water mass with low salinity of the Java Sea was pushed to the South of the Makassar Strait. This water mass exchange causes the pressure of water mass to go to the northern Makassar Strait. At the time of the East Monsoon, the wind on the Java Sea carries the surface water mass that is higher than the Banda Sea to the Makassar Strait.

Region of EL 6.1 shows that its range of exchanges is almost constant in every turn of seasons in Indonesia, but the areas in EL 6.1 that is close to the mainland of Java and Sumatra have lower salinity. The salinity of the waters close to the mainland is about 30.4-31 psu. This happens because the waters close to the mainland have been mixed with fresh water coming from the river that empties into the shore. Influenced by several factors, which includes precipitation, evaporation, freshwater input (runoff), mixing process, and changes in the current due to the changing seasons. The areas of EL 6.1 which are directly linked to the Indian Ocean has high salinity, even occupying the highest range in each season, 34 psu. The salinity distribution conditions in EL 6.1 at the time of March are different from the conditions of distribution of salinity of other EL 6 areas. By March, the salinity distribution conditions in EL 6.1 area increased, while in other regions decreased. This is because the location of EL 6.1 located in the Sunda Strait is strongly influenced by the characteristics of the Indian Ocean. Research by [1] says that at the time of the West Monsoon, the Sunda Strait received mass water input from the Indian Ocean that has high temperatures and salinity. The condition is also influenced by the negative IOD phenomenon, which occurred in 2012 in the waters of the Indian Ocean. The negative IOD phenomenon and its peak occurred in March [10], which brings warmer water masses and higher salinity to the waters of the Indian Ocean. The South Java Current (SJC) entering EL 6.1 carrying a mass of water from the Indian Ocean affects the distribution of salinity in EL 6.1, so that the salinity in March at EL 6.1 increases.

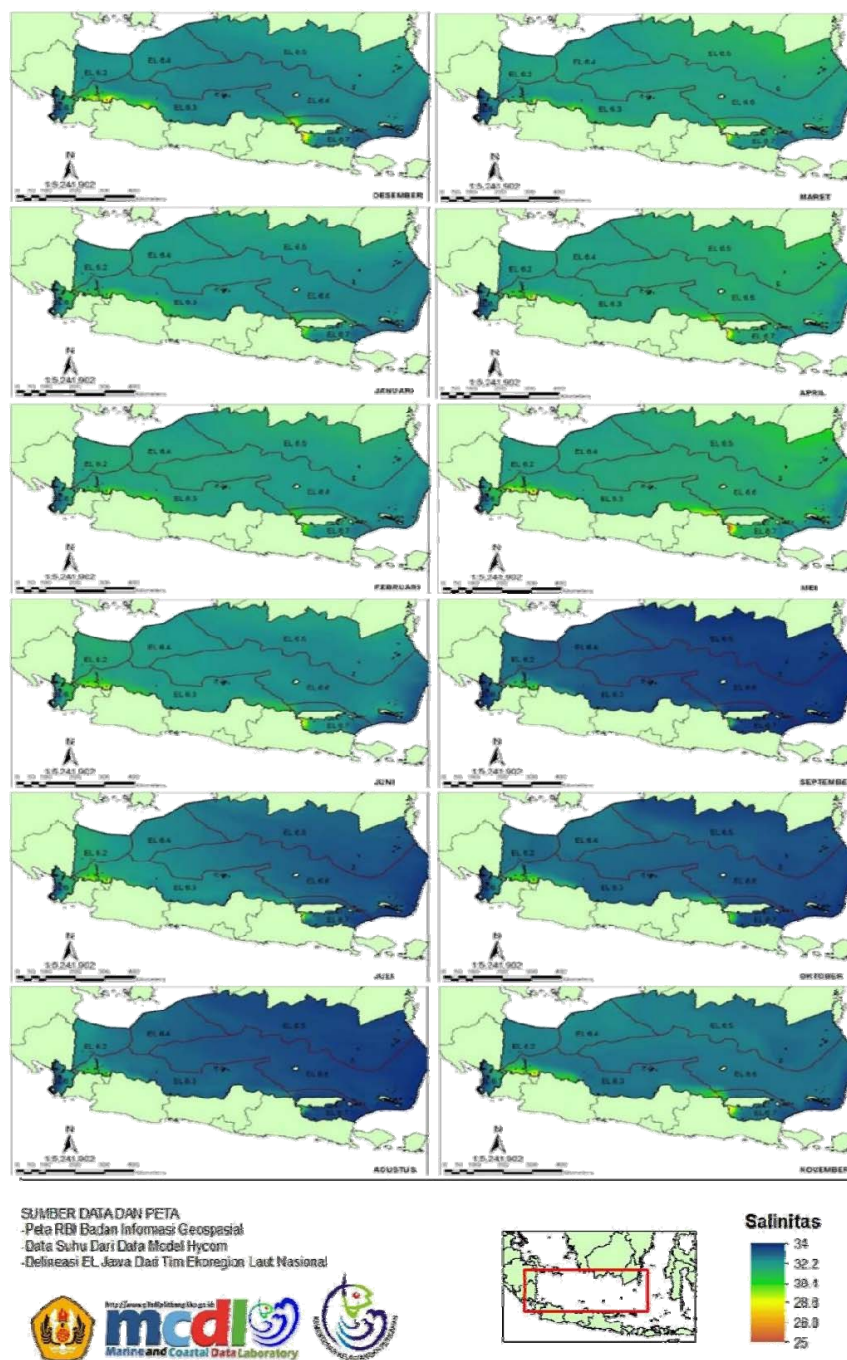


Figure 3. Distribution of Salinity in the Java Sea Ecoregion in 2012.

In the area of EL 6.2, the distribution of salinity is more evenly distributed, as is in the EL region 6.4. In area EL 6.2 has the lowest salinity with 31 psu, and in area EL 6.4, the lowest salinity level is 32 psu. The situation occurred during the West Monsoon and the Transitional Monsoon. At the time of the East Monsoon, both areas experienced the highest salinity level, which is 34 psu. This result is consistent with the research by [15] which found that the lowest salinity was during the West Monsoon, and the highest salinity was during the East Monsoon.

The areas of EL 6.3, EL 6.5, and EL 6.7 have unequal distribution of salinity distribution. The area around the mainland has a lower salinity than the areas further away from the mainland. The lowest value of 28.5 psu is during the West Monsoon. This is especially true in the West Monsoon, in which the mainland of Borneo and Java has its rainy season, so that rivers on the land carry large amounts of freshwater, as freshwater and seawater are mixed in the coastal areas, resulting in salinity reduction. In the East Monsoon and the Monsoon Transition II, the distribution of salinity was almost evenly distributed, either at a point close to the land, or further away from the land. Its salinity distribution is 33.5-34 psu. This occurs because during the East Monsoon, the dry season occurs in the mainland, so that the mass of water carried by rivers in the land is a few, so it does not affect the distribution of salinity in the area.

The area of EL 6.6 also has a uniform distribution of salinity in each season. The lowest salinity distribution in EL 6.6 occurred during Transition Season I on a scale of 31.5-33 psu. The highest salinity distribution occurred during East Monsoon and Monsoon Transition II on a scale of 32.2-34 psu. The eastern conditions of the EL region 6.6 shown in figures 3 have the highest salinity values for each season. The salinity of the area is 34 psu. This is due to the current flowing through Indonesia passing through the Lombok Strait which brings the masses of water with high salinity. The same can be seen in the easternmost areas of EL 6.7. The currents passing through the areas of EL 6.6 and EL 6.7 carry the mass of water from the South China Sea, so the distribution of salinity is influenced by the salinity conditions of the waters of the South China Sea. During the West Monsoon, currents move from west to east, because in the West Monsoon, the wind blows from west to east. The depth of the Java Sea is not deep, so that the current that moves in the Java Sea is, on average, affected by the Monsoon wind. The water mass of the West Monsoon is a mass of water from the South China Sea coming from the Pacific Ocean through the Luzon Strait [7]. Then it goes through the Karimata Strait, whose depth is below 45 meters, so that West Monsoon greatly affect the flow from the Karimata Strait to the Java Sea. The water vapor, carried by the Monsoon wind as it passes through the South China Sea, causes a decrease in the value of Salinity (low Salinity) due to large quantities of freshwater input and precipitation [8]. The current moves from the Java Sea to the east in the Western Monsoon, because at the time of the West Monsoon, the Ekman current suppresses the surface current with a low Salinity from the Java Sea to the south of the Makassar Strait [6].

The Java Sea has always been influenced by the mass of South China Sea waters in the West Monsoon and is influenced by the Water Mass from the East (South of Makassar Strait) in the East Monsoon. As seen in figure 3, at the time of West Monsoon, EL 6.1, 6.2, 6.3, and 6.4, which are located on the western part of EL Java, were affected by lower Water Mass. This happens because the wind blows from the West to the East. The time of the East Monsoon shows the same thing, that is getting the influence of water masses from the East [5].

3.3. Monthly mean of ocean current distribution in Java Sea Ecoregion

The mass movement of the seawater arises from the effect of the resultant forces acting and the factors that influence it [2]. The movement of the current direction and its velocity on the Java Sea Ecoregion at the time of West Monsoon and Transition I Monsoon is shown in figure 4.

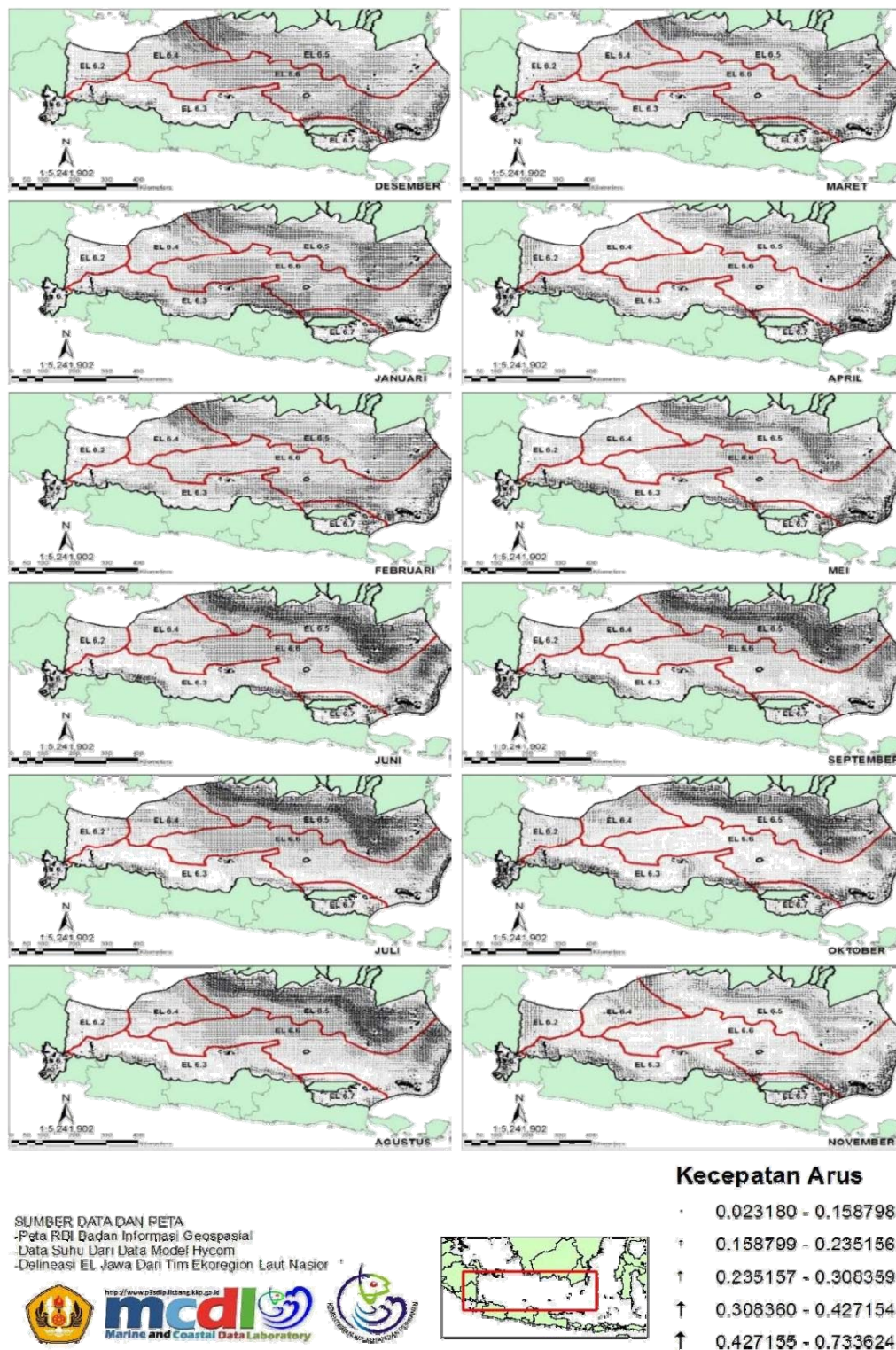


Figure 4. Distribution of Salinity in the Java Sea Ecoregion in 2012.

EL 6.1 is an area directly linked to the Indian Ocean. The direction of current movement and velocity in EL 6.1 is influenced by the movement of currents from the Indian Ocean, as well as the Monsoon. At

the time of the West Monsoon, the current velocity in EL 6.1 was 0.158-0.235 m/s, and at the time of East Monsoon, 0.158-0.308 m/s. The pattern of current movement in EL 6.1 is irregular. This occurs because the current in EL 6.1 is affected by the topographic condition of EL 6.1 topographic shape of the ocean floor and the surrounding islands. Some of the major ocean systems in the world are limited by land masses from three sides and islands by equatorial current counters on all four sides. These limits produce a nearly closed system of flow and tends to make the flow lead into a circular shape or makes the direction of the current to become irregular [2].

The current velocity in EL 6.3 is 0.023-0.15 m/s. This is in accordance with the opinion of which states that the area around the north coast of Java is not directly influenced by Monsoon. In coastal areas, currents move slightly faster. The further away toward the sea, the flow rate will be smaller. The Monsoon affects only the direction and speed of the wind on the Javanese soil, so that local wind affects the current velocity in EL 6.3. The direction of the land wind, influenced by Monsoon, also influences the direction of the current movement in EL 6.3. It is seen in the picture that during the West Season, the direction of the current is headed south, while at the time of East Monsoon, the direction of the current movement is to the north.

EL 6.6 is of part of Java EL area that is in direct contact to EL 6.3 on the north. In EL 6.6. the motion pattern and current velocity are not significantly different from those in EL 6.3. The current velocity in EL 6.6 is 0.158-0.308 m/s, and it is the same in each monsoon. This happens because in this area, the wind season that blows has many buffer factors. The Javanese mainland will be a buffer to the wind that blows on East Monsoon, so it cannot have direct wind influence on East Monsoon, while the mainland of West Borneo and Bangka Belitung Island become buffers in the wind that blows in the West Monsoon. Current velocity in EL 6.6 is influenced by the local wind. The current and current velocity patterns in EL 6.4 are similar to those in EL 6.6.

In EL 6.5, the current velocity patterns in vary each season. During the West Monsoon, the current velocity in EL 6.5 is lower than during East Monsoon. At the time of the West Monsoon the current velocity in EL 6.5 is 0.158-0.235 m/s. This happens because of the inhibition of the wind that blows on the sea surface. But it is different with the western part of EL 6.5 in the same season, in which the current velocity in the area is higher, which is about 0.235-0.308 m/s. This is because the situation in that area is directly influenced by the moving currents of the South China Sea, and the area also lacks buffers, so the wind that blows as a result of the Asian Monsoons directly affects the velocity of the ocean currents. During the East Monsoon, the current velocity at EL 6.5 is 0.308-0.733 m/s. This speed is the highest current velocity found in EL areas in Java. This occurs because the wind that blows during East Season directly affects the current surface conditions in EL 6.5. The wind gives rise to viscosity at sea level. The viscosity force at sea level is caused by the movement of the wind on the surface of the sea, causing the exchange of adjacent water mass periodically, this is due to the pressure difference in the fluid [15].

3.4. Spatial and Temporal Analysis of Sea Surface Height (SSH) in the Java Sea Ecoregion

Sea level can change on variety of timescales due to number of factors. Usually, the seasonal changes are influenced by tides and current movements. Monthly distribution of sea surface height (SSH) in Java EL in 2012 is shown in figure 5.

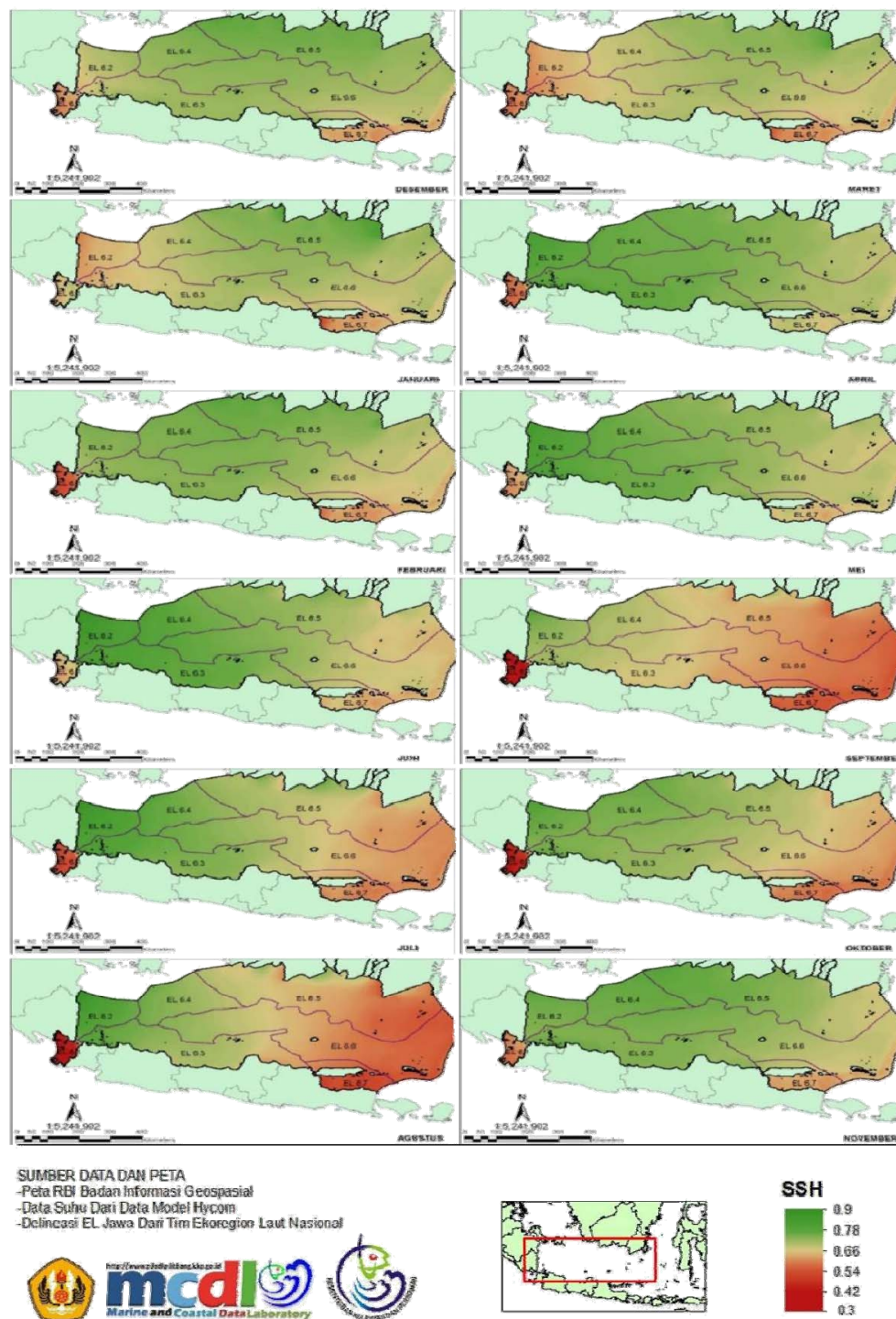


Figure 5. The distribution of Sea Surface Height in the Java Sea Ecoregion in 2012

Sea Surface Height is affected by surface wind and movement of water masses [11]. In Java EL, the movement of water mass is influenced by temperature, pressure, and current. And it all directly related to the four seasons contained in Indonesia. The Water Mass Exchange in Java Sea can be caused by

Monsoon periodicity. The Water Mass Exchange is characterized by differences in Temperature and Salinity values based on Monsoon periodicity. The difference in sea level that is affected by the position of the sun also affects the height of sea level during East Monsoon and Monsoon Transition II to be different from during West Monsoon and Monsoon Transition I.

EL 6.1 is part of the Java EL which is located geographically flanked by the island of Java and the island of Sumatra. EL 6.1, as shown in the image, has the lowest average SSH each season compared to other parts of EL Java. At the time of the West Season, the SSH of EL 6.1 is 0.42-0.7 m, at the time of the Monsoon Transition I it is 0.54-0.66 m, during East Monsoon, 0.3-0.6 m, and during the Monsoon Transition II, 0.3-0.54 m. From these results, it can be seen that the highest SSH values in the EL 6.1 area are during the West Monsoon, and the lowest SSH values occurred during East Monsoon and Monsoon Transition II. This is especially true during the West Monsoon where a high air pressure center is developed over the Asian Continent and the center of low air pressure occurred over the Australian Continent so that the wind blows from the northwest to the southeast in the Java Sea in the West Monsoon [18]. In the West Monsoon, most of the Sea Water Mass in the Java EL gets the Water Mass from the South China Sea and the Karimata Strait. Because the location of EL 6.1 is flanked by the Java Island and the Sumatra Island, the water mass carried from the South China Sea and the Karimata Strait did not exert a great impact on SSH in EL 6.1. Figure 5 also show that the SSH conditions in the Northern part of EL 6.1 are higher than that of the Southwest EL 6.1. This happens because of the topographical differences in the area. Amri and friends says that the depth of the Sunda Strait in the North is about 40 m, then towards the southwest of the strait, the depth grows to about 75-100 m; at the time of his research, Amri and friends also found the upwelling phenomenon on the month of August and September [1]. Upwelling phenomenon occurs because of the mass water void in the water column, so the water level becomes lower than usually.

In EL 6.2, the highest SSH average occurred during the East Monsoon. Figure 5 shows that at the time of West Monsoon, it has a value of SSH 0.6-0.7 m. During Monsoon Transition II, the SSH values were 0.6-0.78 m, at the East Monsoon, 0.78-0.8 m, and during the Monsoon Transition II, the SSH value was 0.7-0.78 m. The highest SSH value in EL 6.2 area occurred during the East Monsoon, that is 0.8 m, and the lowest SSH value occurred at West Monsoon and Monsoon Transition I with 0.6 m. This is because the wind that blows during the East Monsoon has a much stronger effect than the wind that blows during the West Monsoon. During the West Monsoon, the mass of water carried by the current flowing from the Karimata Strait and the South China Sea is blocked by the islands of Bangka and Belitung and the island of Sumatra. While during East Season, moving water masses of EL 6.3 and 6.6 directly affect SSH in EL 6.2.

In figure 5, there is a difference in sea level (SSH) in EL 6.3. During the West Monsoon, SSH in the western part of EL 6.3 is lower than the eastern part. While in the East Monsoon, the East part is lower than the West in EL 6.3. In the West Monsoon, the SSH value in EL 6.3 in the West part is 0.6-0.7 m, while in the East of EL 6.3 is 0.7-0.8 m. At the time of the Transition Monsoon I, SSH value in the West is 0.6-0.8 m and the eastern part 0.7-0.8 m. In the Eastern Monsoon, the western part of EL 6.3 has a SSH value of 0.6-0.85 m and in the east 0.66-0.8 m. During the Monsoon Transition, the SSH value in the western part of EL 6.3 is 0.66-0.78 m, whereas the eastern part of EL 6.3 has a SSH value of 0.54-0.75 m. At the time of the West Monsoon, the sun on the Southern earth causes the wind to move southward. The wind that moves towards the South affect the movement of seawater, so that the sea water also moves to the south [7].

In EL 6.4, its SSH values also vary. At the time of West Monsoon, the SSH value is 0.66-0.8 m. At the time of Convertible Monsoon Transition I, 0.66-0.78 m. At the East Monsoon, 0.66-0.85 m. And at the time of the transition Monsoon II, 0.66-0.78 m. From that result, it is seen that the highest SSH value occurs at the time of the East Monsoon with the SSH value that reach 0.85 m, and the lowest SSH value occurs in all four seasons with the value of 0.66 m. At the time of the West Monsoon, the current moving from the South China Sea led the mass of water into the Java EL passing through EL 6.3 and 6.4, so that at the time of West Monsoon, the SSH of EL 6.4 region, which is directly tied to the Karimata Strait, has a higher SSH value compared to the areas covered by Bangka and Belitung Islands. In contrast, at the

time of the East Monsoon, the highest SSH value reached is found in the areas covered by the island of Bangka and Belitung.

Figure 5 show that in area 6.5, the highest SSH value in each season occurs in the waters closer to the land. This is consistent with those of Yang and Liu who said that in closed waters, the farther from the coast, the lower the water level [11]. At the time of the West Monsoon, the value of SSH reached 0.88 m, while the value in areas far from the mainland of Borneo is 0.66 m. At the time of the West Monsoon, the current that moved in the area of EL 6.5 is not as strong as during the East Monsoon. This resulted in the movement of water masses to be not too fast in EL 6.5 at the time of the West Monsoon. While at the East Monsoon, the SSH value is 0.5-0.7 m. The lowest SSH value occurs in the areas far from land. At the time of the East Monsoon, the current that moved faster than at the time of West Monsoon, resulted in the mass of water that also moves faster, so that the value of SSH in EL 6.5 at the time of the East Monsoon is lower than the SSH at the time of West Monsoon. The highest average SSH value occurred at the time of the Monsoon Transition I. The SSH value at the time of Transition Monsoon I was 0.85 m.

In the EL region of 6.7, during the West Monsoon, the SSH value in EL 6.7 is 0.6-0.66 cm, and at the time of the Monsoon Transition I is 0.6-0.7 m. While at the East Monsoon is 0.4-0.6 m, and during the Transitional Monsoon is 54-0.6 m. In the area of EL 6.7, the average SSH values were lower than in the other EL 6 regions. This occurs because the location of EL 6.7 is geographically located in the bay, so that the mass of water that moves due to the seasonal wind blow does not directly affect it, whereas [13] says that the Monsoon affects the circulation of seawater movement. Because the location of EL 6.7 which is embraced by the current movement that occurs in EL Java is not too affected. figure 5 also shows that the SSH in the area is low, and because of the conditions that are embraced, the current is obstructed by the land to enter into the area so that the water mass exchange is also not very significant and the SSH value in EL 6.7 is relatively low.

4. Conclusion

Based on the result of the research, it can be concluded that the distribution of temperature, sea current, salinity, and Sea Surface Height differed in each Java Sea Ecoregion level 2 because it is influenced by the geographical and astronomical location of each Java Sea Ecoregion level and influenced by the monsoon that exists over Indonesia. Because the position of EL 6.1 is in the Sunda Strait, the physical oceanography condition of EL 6.1 is slightly different from other Java EL because it is strongly influenced by the Indian Ocean.

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