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## Observation pattern of water mass structure at Jeneberang river estuary

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## Observation pattern of water mass structure at Jeneberang river estuary

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**Abstract.** This research is a field study conducted in the estuary Jeneberang river. The estuary, the transitional zone formed between the river environment and the marine environment. In this region, there is the mixing of seawater with fresh water that has its own uniqueness with fluctuating salinity. This research aims to see the pattern of salinity distribution and temperature in the area of Jeneberang estuary on the tide and receding conditions. Data retrieval channeled on the area of Jeneberang estuaries with a distance between points 200 m using the ADCP (Acoustic Doppler Current Profiler) and CTD (Conductivity Temperature Depth) tools. The results showed an increase in salinity at Jeneberang estuary, which was influenced by surface and river bed.

### 1. Introduction

Periodic influences of tides and river flow from upstream to coast will be responded to by riverbed morphology and estuarine geometry resulting in flow patterns in the estuary area [1]. The river estuary functions as a drainage channel for river discharge, especially when flooded into the sea. Because of its location on the downstream end, the flow rate in the estuary is greater than that of the upstream section of the river. In addition, the estuary of the river should also pass the discharge inflicted by tides, which could be greater than the discharge of the river. In accordance with the function of the river, the estuary must be wide enough [2]. The mixture of salty water and freshwater from a river estuary is caused by tidal currents. The interactions of tidal currents, wind pressure, inner friction, and friction at the base of the waters affect the layer of the density of the water column. Turbulence resulting from internal shear forces and friction at the base of the water is a critical factor for the mixing of water density in the river estuary [3]. The mixing of river water and seawater produces a significant difference in the chemical and physical properties of the salinity of the estuary [1]. This change of salinity is being treated by tidal and tidal waters and seasons. During the dry season, the volume of the river water decreases so that the seawater can enter upstream, causing salinity in the region of the estuarine to increase. In the season of freshwater, rainfall flows from upstream to large amounts of estuarine, resulting in a decrease in its lower/low. In addition, the temperature is one of the factors causing mixing in the estuary of rivers. The season of freshwater rainfall flows from upstream to large amounts of estuarine, resulting in a decrease in its lower/low. In addition, the temperature is one of the factors causing mixing in the estuary of rivers. Water mass is formed by an interaction between the water and the atmosphere. It can be formed by a mixture of two or more types.

The mass of water acquires its properties on the surface. This is because water masses have specific temperatures and salinity. Because the difference in water mass density is not easily mixed. Usually, the



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mass of water flows over or under the water mass of another. Mild water mass flows over heavy water masses. Salinity describes the total solids in the water. After all carbon converting into oxide, all bromides and iodide are replaced by chloride, and all inorganic substances have been dioxide. Salinity is expressed in units of G/kg [4]. Salinity on the open sea surface varies between 33‰ to 38‰ with an average of 35‰. The average deviation of salinity arises from differences in evaporation and precipitation. Salinity in the estuaries varies greatly compared to open seas. In the coastal area with these two biological communities, salinity varies between 0.5 to 35‰ change throughout the year along with tidal cycles. The temperature in the estuaries is more varied than in nearby coastal waters. The temperature variation of the estuary is due to the estuarine area of water volume smaller, while the surface area is larger. Thus, in the existing atmospheric conditions, the water estuaries are faster hotter and faster cold. Another cause of this variation is the inclusion of freshwater from the river. Freshwater on the river is more influenced by the change in seasonal temperatures than seawater [5].

## 2. Methodology

This research is a field study conducted at the estuary of the Jeneberang river. Data retrieval is performed at 13 points along the estuary of the river. Field data retrieval using ADCP, CTD, and Echosounder tools. Observation of the data salinity, temperature, and water depth in the above tools is done in conjunction with the observation of the water level advances by installing pascal. The coordinate retrieval of the observation point using GPS is then mapped see figure 1. This is useful so that the position of the observation point that has been passed is not altered. The observation station point can be seen in table 1.

**Table 1.** Point of observation coordinates.

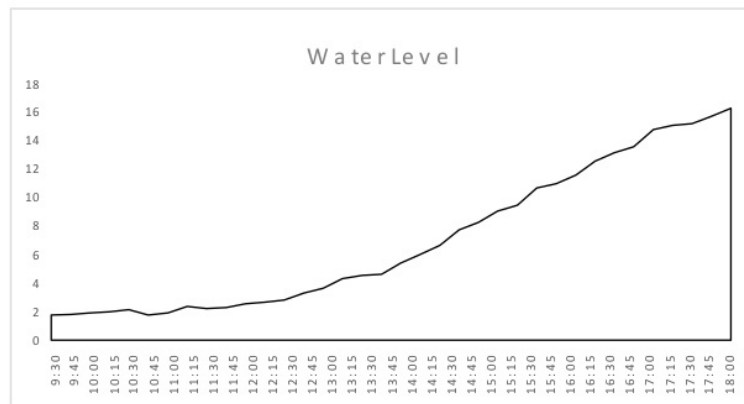
No	Sampling point	Latitude	Longitude
1	1	S5°11'40.3"	E119°24'33.1"
2	2	S5°11'36.2"	E119°24'18.6"
3	3	S5°11'31.8"	E119°24'04.5"
4	4	S5°11'32.3"	E119°23'55.2"
5	5	S5°11'32.9"	E119°23'45.3"
6	6	S5°11'34.3"	E119°23'31.8"
7	7	S5°11'35.0"	E119°23'18.0"
8	8A	S5°11'33.0"	E119°23'07.3"
9	8B	S5°11'35.9"	E119°23'05.9"
10	9A	S5°11'38.3"	E119°22'48.3"
11	9B	S5°11'31.9"	E119°22'49.3"
12	10A	S5°11'32.9"	E119°22'58.3"
13	10B	S5°11'36.9"	E119°22'57.6"

### 2.1. Water sampling

Measurements are performed horizontally and vertically. It is horizontally based on the distance of the salinity extending from the station 1 to the station 10 towards the estuary and the coast. While the vertical salinity measurement is carried out sampling based on 3 variations in depth that are surface, middle, and bottom of the river.



**Figure 1.** Point of observation coordinates.



**Figure 2.** Tidal observation results.

**2.2. Tidal observations**

Observations of tidal were made during the data retrieval salinity at 09.30 a.m. to 18.15 p.m. It is intended to get conditions of the water level, low tide conditions, and high tide conditions.

**2.3. Salinity and temperature observation**

Salinity data retrieval is carried out in two conditions of depth water level that is at low water level at 09:18 – 10:07 and high water level at 10:16 – 16:23. Temperature data retrieval is conducted in two conditions of the water level at a low water level at 09.18 – 10.07 and high water level condition at 10.16 – 16:2.

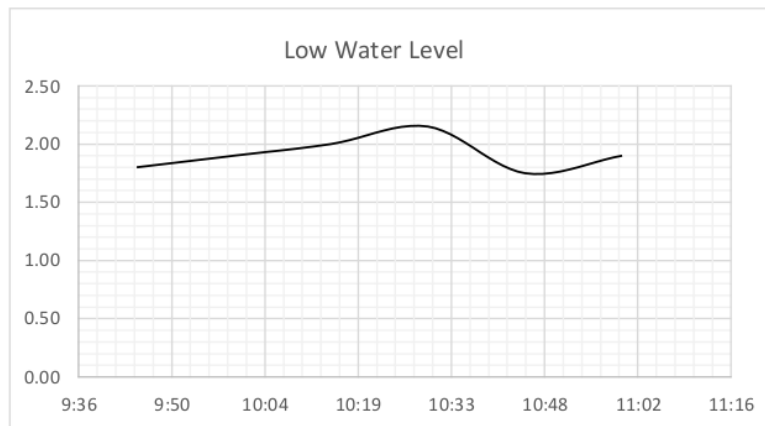


Figure 3. Low water level observation results.

3  
3. Results and discussion

3.1. Salinity distribution pattern

Salinity observations in low tide conditions ranged from 5.9‰ – 7.3‰. At the base of the river ranged between 6.5‰ – 7.3‰, with an average salinity value of 6.82‰. Based on the results of salinity analysis at 10A – 8B points, have salinity value 6.5‰ – 7.3‰. The lowest salinity is at point 8A, and the highest salinity is at point 10B. In the middle part of the depth of the dispersion pattern of salinity has a salinity value 5.9‰-7.1‰, with an average salinity value of 6.52‰. At the surface of the river have a pattern of salinity between 6.2‰-7‰ with a mean salinity value of 6.54‰. The salinization pattern can be seen in figure 4.

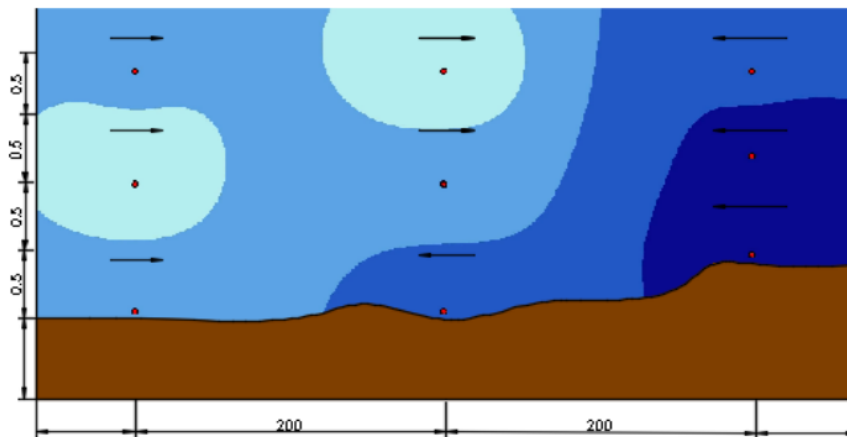
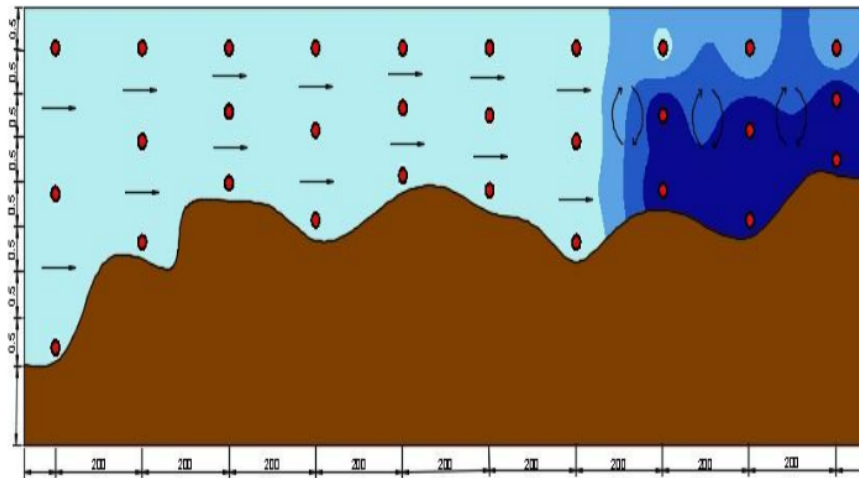


Figure 4. The pattern of salinity spread at the estuary of the Jeneberang river at low tide.

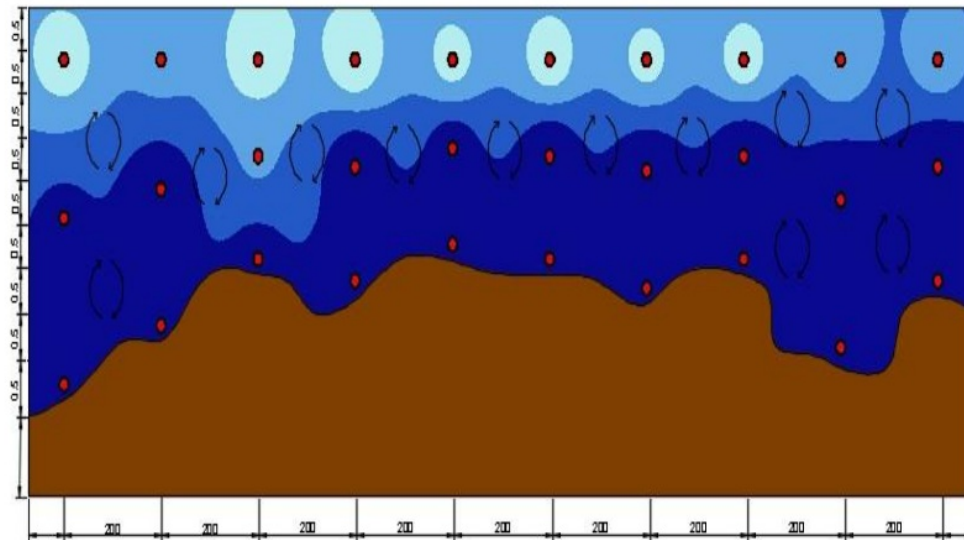
On the tide condition, salinity value ranges from 4.7‰ – 31.1‰. Data retrieval starts from point 7 to point 1 from 11:22 until at 12:29 hours and then continues to point 8A at 14:12 hours and ends at point 9A at 15:18 hours. In this condition, the water face is at the lowest low point to the top of the tide,

i.e. at 11.15 – 15.30. At the bottom of the river, the highest salinity at the point of 10A is 33‰, which lies at the mouth of the estuary with a depth of 2.7 m and the lowest salinity at point 3 with a depth of 1.9 m, namely 4.7‰. From the above image, we can see that there is a tidal influence on salinity on the Jeneberang river. The higher the tide of seawater, the higher the salinity occurs at the mouth of the Jeneberang river. In the middle of the depth of the water's face, salinity spreads range from 4.9‰ – 3.31‰, where the average salinity value is 17.85‰. The highest salinity at 10 A point of 33.1‰ located at the mouth of the estuary with a depth of 1.35 m and the lowest salinity at point 7 with a depth of 1.35 m i.e. 4.9‰. From the observation showing the higher tide, the sea is the higher the salinity that occurs at the mouth of the river Jeneberang. At the surface of the salinity range in this condition ranges from 4.7‰ – 11.7‰, where the average salinity value is 7.79‰. The estuary of the Jeneberang river has been a mixture of water dominated by the sea. At point 2, there is an increase in salinity value with a value of 7.6‰ due to the inclusion of seawater in the direction of the upstream, so the value of salinity increases.



**Figure 5.** Salinity distribution pattern at Jeneberang river estuary during tide conditions.

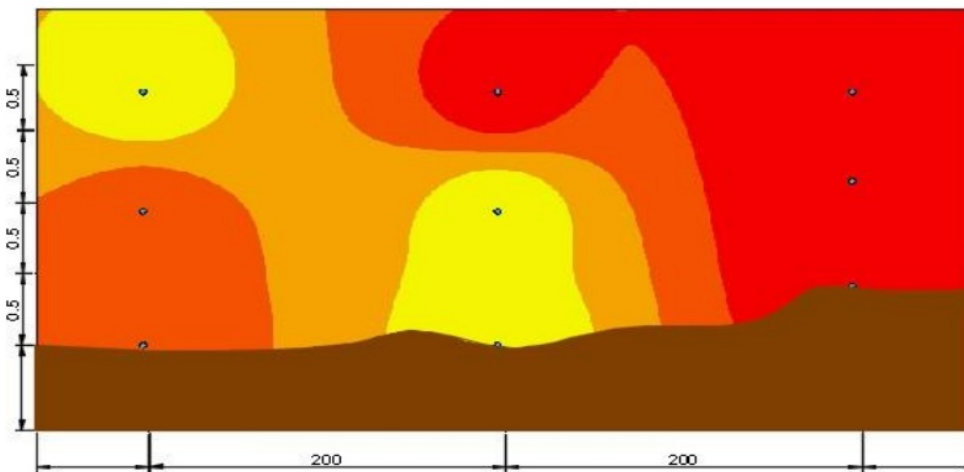
The retrieval of salinity data on high tide conditions was carried out on the base, middle, and surface of the river water in the hours 15:36 to 18:10. In this condition, salinity has a value of 4.6‰ – 32.8‰. Data retrieval starts from point 7 at 15:36 hours to go to point 1 at 16:54 and then continues to the 10A point at 17:18 hours and ends at the 8B point at 17:58 hours. In this condition, the water surface is at the halfway condition from the top of the tide, which is at 15.30 – 18.15. On the base of the river, the spread of salinity value from 2.7‰ – 32.7‰, the average salinity value is 30.59‰. The value of salinity at the base of the highest estuary at point 9A is 32.7‰ in the mouth of the estuary with a depth of 4 m and the lowest salinity at point 6 with a depth of 2.8 m, which is 27‰. The deeper the river is, the higher the salinity that occurs at the estuary of the Jeneberang river. At the center of the water depth of the river salinity range from 17.6‰ – 32.8‰, the average salinity value is 30.46‰. The highest salinity value is at point 7 and 10 for 32.8‰, which is at the mouth of the estuary with a depth of 2 m and the lowest salinity at point 3 with a depth of 1.4 m, i.e. 17.6‰. At the surface of the salinity distribution pattern in the tide conditions of two river surfaces range from 4.6‰ – 16.6‰, where the average salinity value is 9.5‰. This results in the estuary of the river of Jeneberang has occurred a mixture of seawater.



**Figure 6.** Water temperature distribution pattern at the mouth of the Jeneberang river at a low water level.

*3.2. Temperature distribution pattern*

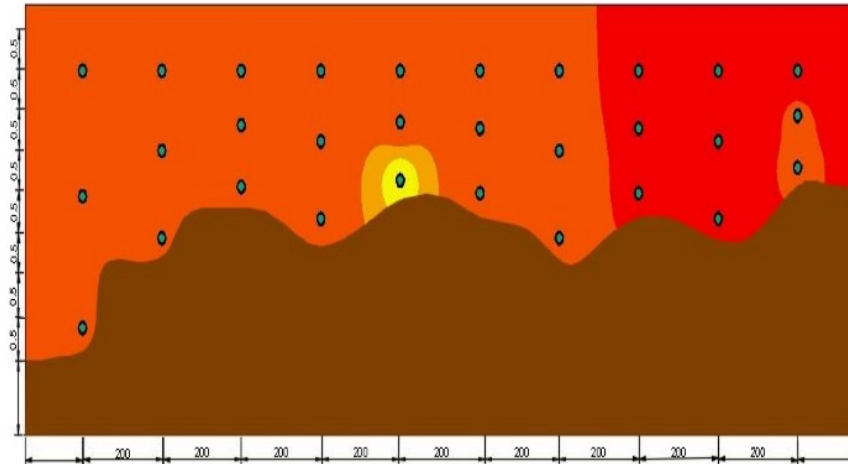
Temperature measurements in low tide conditions are carried out at 10:16 to 11:15. The measurement results show the temperature value of 31.2 °C – 31.5 °C. Figure 6 shows the temperature at low tide conditions.



**Figure 7.** Water temperature distribution pattern at the mouth of the Jeneberang river at a low water level.

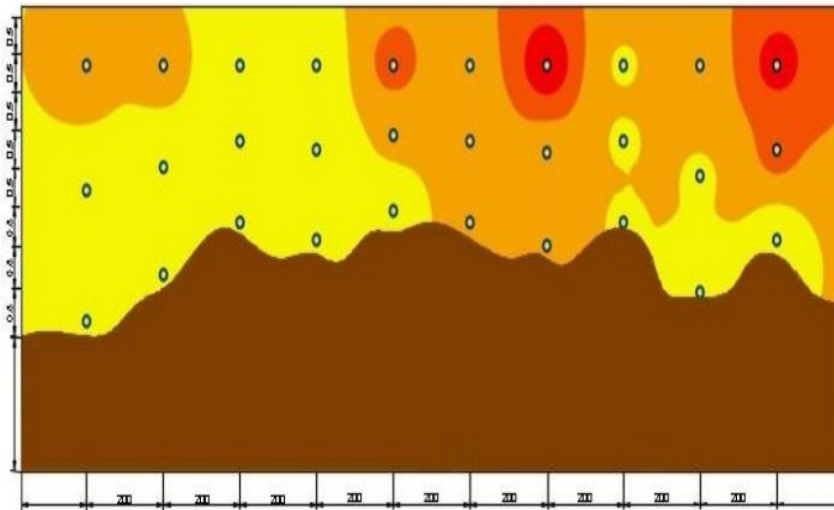
Temperature measurements in the tide condition are performed at 11:22 to 15:25. Temperatures have a value range of 28.8 °c – 33 °c. The measurement started from point 7 at 11:22 o'clock to point 1 at

12:29 and then continued to the point 8A at 14:12 hours and ended at Point 9A at the time of 15:18. Tide condition is at the lowest low point to high tide condition, which is at 11.15 – 15.30. Figure 8 shows the temperature distribution pattern of the tide condition.



**Figure 8.** The pattern of spreading temperature at the mouth of the Jeneberang river at high water level condition.

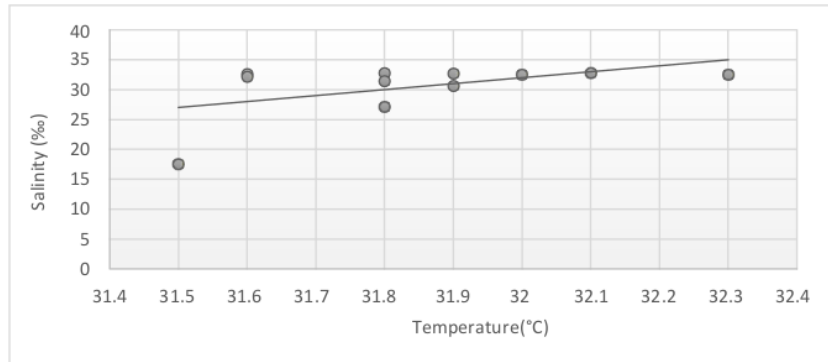
Temperature measurements in high tide condition performed at 15:36 to 18:10. At high water level condition, the temperature has a value range of 31.5 °C – 32.9 °C. The temperature measurement starts from point 7 at 15.36 hours to the point 1 at 16:54 and then continues to the 10A point at 17:18 hours and ends at the 8B point at 17:58 hours. The high tide condition starting from 15:30 – 18:15. Figure 9 shows the temperature distribution pattern on the high tide condition.



**Figure 9.** The pattern of temperature distribution at the estuary of the Jeneberang river on the high water level condition.

### 3.3. Salinity with temperature

Based on the observation data, a linear relationship is obtained between salinity and temperature. The higher the temperature, the higher the salinity value.



**Figure 10.** Graph of the relationship between salinity and temperature.

## 4. Conclusions

At the time of tides, there is an increase in the value of salinity, the higher the tide, the higher the salinity value in the estuary. The depth of the water shows the effect on the salinity value, the more the base, the greater the salinity value. The effect of seawater is seen in the estuary, and at point 2 there has been an increase in salinity caused by the influx of tides. The effect of seawater is also seen at high tides with salinity values increasing at the riverbed, and this shows the entry of seawater from the estuary towards the upstream river.

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