THE SURVEY OF VERTICAL TEMPERATURE DISTRIBUTION WITHIN SEA WATER COLUMN USING GEOINFORMATICS TECHNOLOGY, CASE STUDY: THE UPPER GULF OF THAILAND

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ABSTRACT

Global warming and climate change are the current situation. This research focused on vertical temperature distribution within seawater column by using geoinformatics technology at the upper Gulf of Thailand. Sea temperature data were collected 2 seasons, wet season on 9-12 October 2019 and dry season on 8-11 March 2020. There were 20 sampling stations. The upper Gulf section maps of sea temperature distribution from both sampling presented similar heat distribution patterns which spread from the top to the bottom by the same highest temperature at around 12 A.M. – 4 P.M. The average of temperature difference, 9 A.M. – 5 P.M., between surface and bottom were 1.6ºC in wet season and 1.2 ºC in dry season while at low light time, 5 P.M.-9 A.M., were 0.01 ºC and 0.4 ºC respectively. From the linear correlation analysis, patterns of sea vertical temperature distribution from both samplings were correlated by the coefficient of determination (R^2) was 0.84. These sea temperature distribution patterns can be used for sea temperature prediction in the future for sea observation and monitoring.

Keywords: Vertical distribution, Sea temperature, The upper Gulf of Thailand (uGoT)

1. INTRODUCTION

At present, the warmer sea effected on every marine organisms' life including metabolic rate and population growth. Apart from marine organisms, the ecosystem also took damages from this situation such as coral bleaching. Moreover, the warmer sea affected the dissolved oxygen ability decreasing (Weis, 2015) that inversed with increase oxygen demand of marine organisms from their growth metabolic rates. For reducing damage and coping method preparation, the usual monitoring was routine necessary. Currently, geoinformatics technology was begun as an optional tool for better environmental monitor analysis. The tool could be used to presented better distributed pattern visualization and analysis.

Apart from marine environmental impact, the raised sea temperature also effects on marine agriculture. By the increased metabolic rate of marine organisms, marine parasites or pathogens gained this situation to outbreak (The UN Environment Programme World Conservation Monitoring Centre, 2009). In the same way, marine agriculture areas are affected by low oxygen conditions such as fishery, oyster farming etc. Higher sea temperature could reduce fish size 5% at each 1oC increasing (Forster, 2012). From above reasons, the economics of marine business was one of factors that was significantly affected.

The Upper Gulf of Thailand (uGoT) is the important area of Thais who takes several advantages including transportation, tourism, fishery, and marine agriculture. The uGoT had high diversity and resourcefulness because of various types of coastal zones, including beaches, marsh, rocky coasts, and coastal wetlands. Presently, the uGoT is affected by warmer sea especially coral reef where is marine larvae's habitat and important tourism site that influence economic directly. From above reason, this study focused on using geoinformatics technology to vertical investigation of temperature distribution within sea water column of the uGoT.

2. METHODOLOGY

The collections were assigned at the Upper Gulf of Thailand 2 times, wet season on October 9-12, 2019 (Oct) and dry season on March 8-11, 2020 (Mar). For covering all stations, the sampling spent 4 days per collection. The collection time was between 6 A.M – 6 P.M. The Buoy-data logger was floated approximately 40-45 minutes each station. The data logger, HOBO Pendant® Temp/Light,8K Part: UA-002-08, was set for temperature detecting every 5 minutes at all depth. The raw collected data was transferred to The Microsoft Excel files for correlation analysis between sea depth and temperature and was performed by line graph. The gathered data were analyzed by geographic information system (GIS) application using ArcGIS software and Ocean Data View (ODV), a free software, for mapping and vertical sea temperature distribution (Schlitzer and Reiner, 2021).

The Buoy-data logger preparation

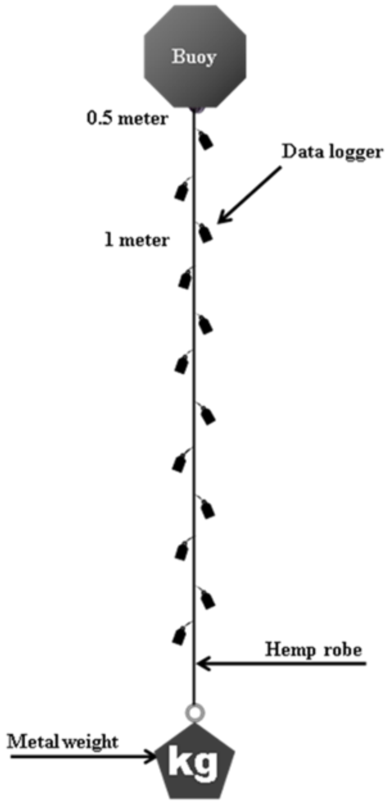

Figure 1. the model of the Buoy-data logger

- Prepared hemp rope 30 – 35 meters approximately.
- Fasten the data logger with the robe by cable tile or fishing line.
- Space between the data loggers was 1 meter each, except the first data logger at 0.5-meter, (Figure 1.)
- Adding metal weight at the end of robe for located the station to sea bottom.
- Binding the buoy at the top of the robe.

3. RESULTS AND DISCUSSION

3.1 Sea Temperature Profile

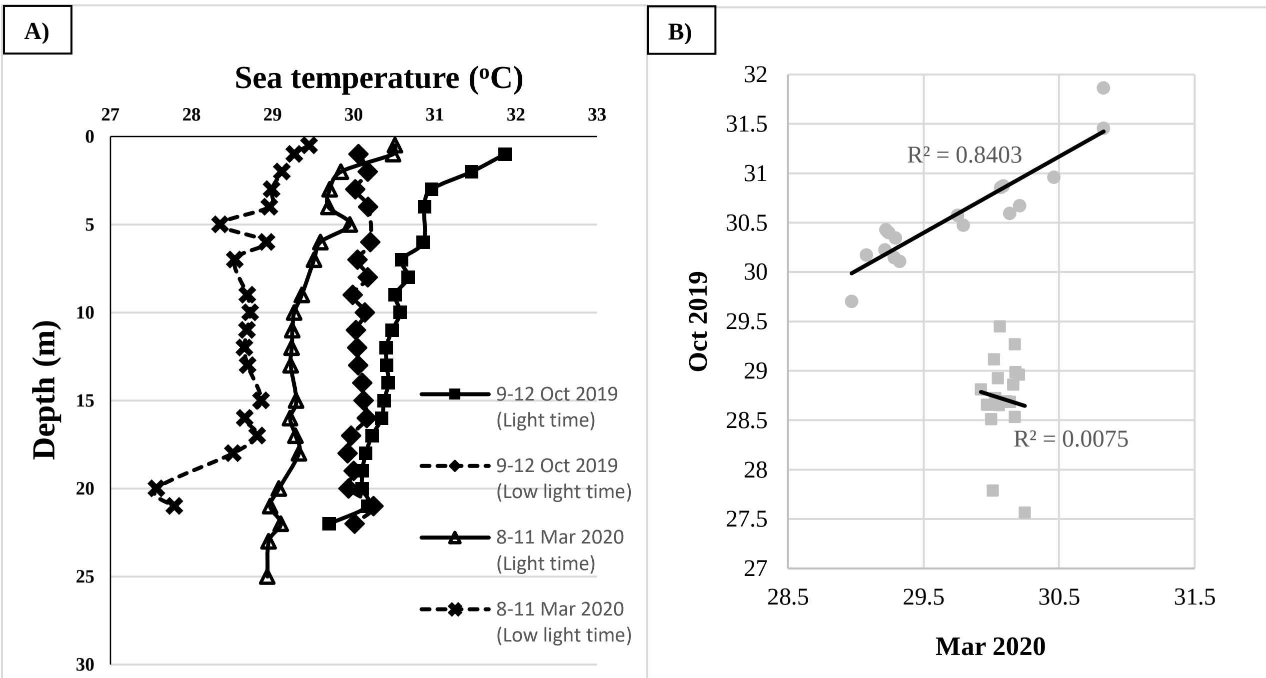

Figure 2. A shows the average of sea temperature profile of light time (around 9 A.M. – 5 P.M.) and low light time (around 5 P.M. – 9 A.M.) of the uGoT and B shows the linear correlation between the temperature of light time (●) and low light time (■)

The average sea surface temperature of 9-12 October 2019 and 8-11 March 2020 were 31.87°C and 30.51°C at light time while low light time were 30.06 and 29.45 respectively. The maximum of sea surface temperature of was 33.33 °C and 31.608 °C respectively at light time and 30.49 °C and 28.53 °C at low light time respectively. The minimum of sea surface temperature at light time was 30.26 and 28.12 while the low light time was 29.69 and 28.53 on 9-12 October 2019 and 8-11 March 2020 respectively. From surface to the bottom, the temperature will decrease apparently while both of seasons of temperature distribution at low light time were pretty stable because the sea surface was not affected by infrared rays from sun light directly as light time (Phongsathorn, 2019). Moreover, when comparing the average temperature of each depth follow by figure 2, the sea temperature profile of Oct 2019 and Mar 2020 are similar pattern because the linear correlation analysis (R^2) of light time between 2 profiles was 0.84 while the linear correlation of lightless time had no correlation, R^2 is 0.0075.

3.2 The section map of sea temperature distribution

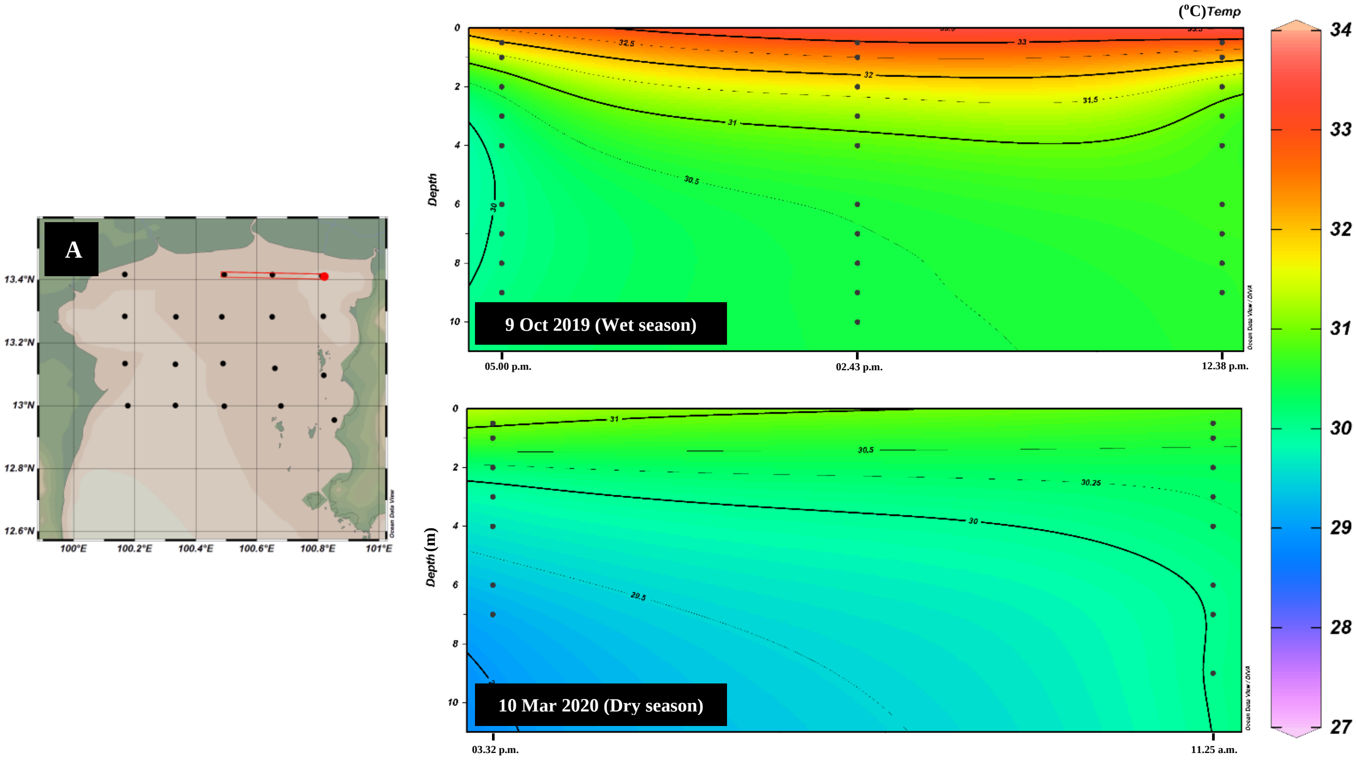

Figure 3. The selective section maps of wet and dry seasons and A is the selective stations

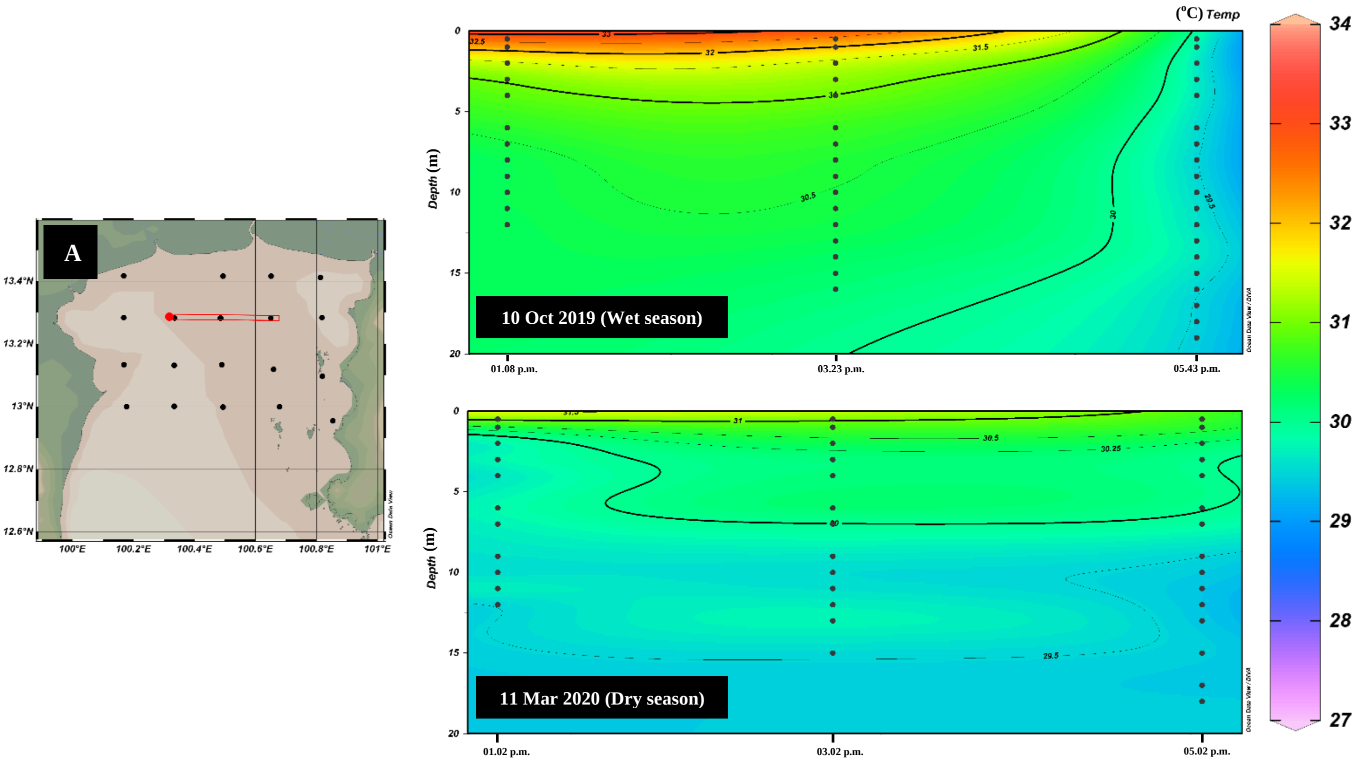

Figure 4. The selective section maps of wet and dry seasons and A is the selective stations

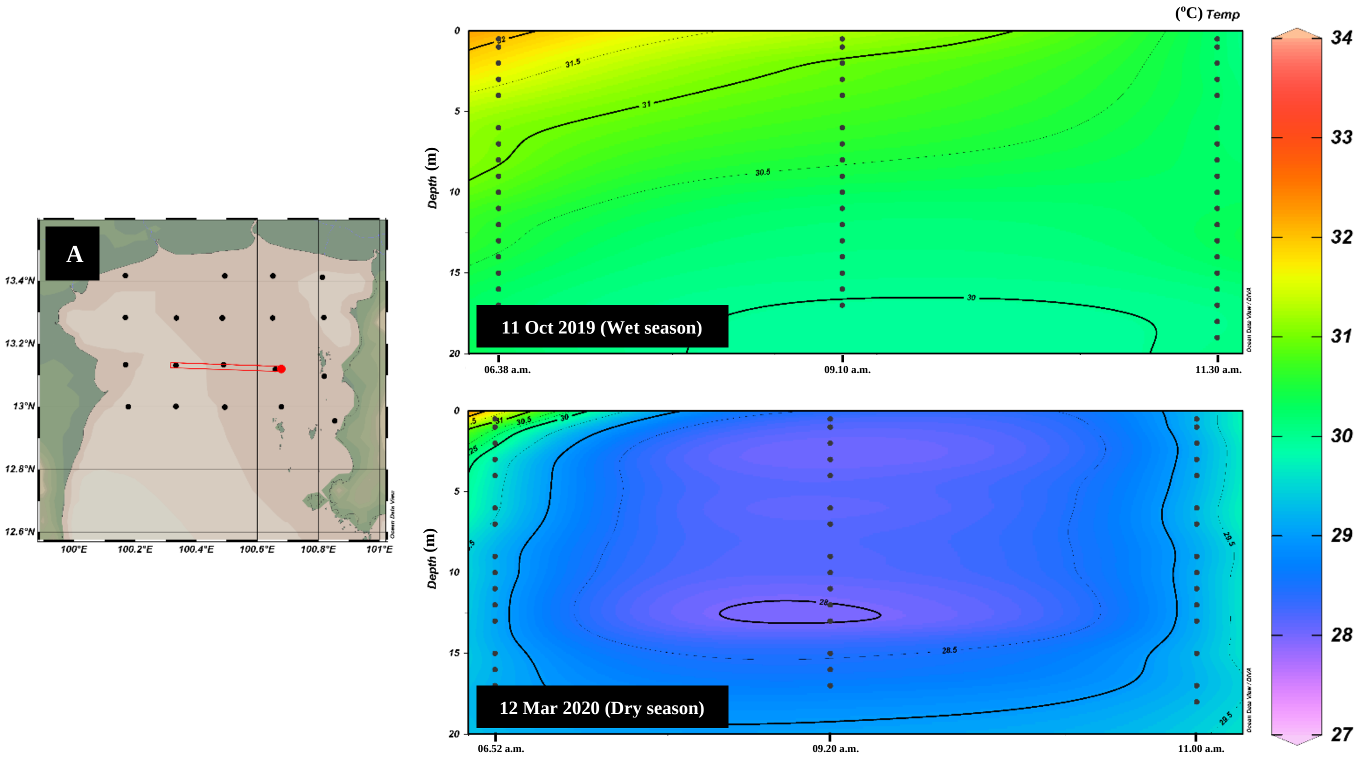

Figure 5. The selective section maps of wet and dry seasons and A is the selective stations

From the vertical temperature distribution maps which were developed from collected data within a day of both samplings (Oct 2019 and Mar 2020), the heat spread from the top to the bottom obviously. Light time collections between 9 A.M. – 5 P.M., sea water temperature raised at around 11 A.M. – 4 P.M. and cool down at low light time around 6 P.M. – 8 A.M. (Figure 3,4 and 5). Temperature difference between surface and bottom at the light time were 1.6°C (n=15) in wet season and 1.2°C (n=13) in dry season while the evening and the dawn, called low light time were 0.01°C (n=5) in wet season and 0.4°C (n=5) in dry season. The average of temperature difference of surface and bottom were 2.2°C in wet season and 1.6°C in dry season at light time. This temperature pattern results were correlated to the study of Thanyarat., (2019)'s which gathered temperature data in 24 hours at Map Ta Phut coastal zone, Rayong Province, and found sea surface temperature had increased rapidly around 8 - 11 A.M. The highest sea surface temperature is approximately 11 A.M. – 1 P.M. and decreased slowly from the highest around 1 P.M. – 5 P.M. From Figure 3-5, the temperature distribution was found higher temperature at the sea surface and decreased in the water column to bottom in every sampling station and both seasons. The average sea temperature of wet season was higher than dry season's both sea surface and within the water column.

4. CONCLUSION

1.The vertical distribution pattern of the light time (9 A.M.-5 P.M.) of Oct 2019 and Mar 2020 was similar by the linear correlation (R^2) = 0.84.

2.The sea surface temperature vertically distributed well at the time around 11 A.M. – 4 P.M. because the sea surface takes the heat directly from sunlight that affected the average of temperature difference of surface and bottom were 1.6°C in wet season and 1.2°C in dry season. After that, the sea temperature will cool down around 6 P.M. – 8 A.M.

3. The average sea temperature of wet season was higher than dry season's both sea surface and within the water column. The temperature was highest at sea surface at all sampling station and both seasons.

4. The sea temperature patterns might be furthermore studied to develop temperature forecasting models from the surface temperature that could be collaborated with remote survey technology such as satellite images for improvement sea temperature monitoring in the future.

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