

Effect of temperature on sea water surface increment in north sumatera indonesia

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ABSTRACT

Rule of Indonesian Republic No. 64, 2010 is about disaster mitigation in coastal area and small island. It requires data of temperature and sea water surface increment. This paper focuses on the ambient temperature and rate of temperature increment and sea water surface increment in Province of North Sumatera, Indonesia for the year of 2015. This research location is in East and West coastal area, Sumatera and coastal Nias island. The method of sea water surface increment measurement is using the photo image "coastal area susceptibility index" for the year of 2008. The research data is presented in table, graph and narration. The results show that the highest temperature in East coastal area, West coastal area and coastal Nias island are 31.8 °C, 32.2 °C and 32.2 °C, respectively with province average temperature is 27.36 °C. The rates of average temperature increment are 0.54%, 1.87 % and 3.66% for each area. The rates of maximum temperature increment are 0.25%, 1.89% and 11.3% for each area. The rates of sea water surface increment are 0.395%, 1.88% and 7.48% for each area. The sea water surface increments in 2008 and 2015 are 5-14 mm/year and 14.4-101.76 mm/year, respectively. The highest rate of sea water surface increment in coastal Nias island is 848%. Based on the data shows that a disaster mitigation in coastal Nias island is urgently required.

Keywords - temperature increment, sea water surface increment, rate of temperature increment, rate of sea water surface increment

INTRODUCTION

Indonesia has sea area of 5,800,000 km² which is connected to 17,480 islands. It has shore line of 95,181 km² which places Indonesia as the fourth shore line in the world. The province of North Sumatera is one part of provinces in Indonesia that has sea area of 10,000 km², it is 60.5% of province that is connected 162 small islands with shore line of 1,300 km. The small islands is 6 islands in East shore and 156 island in West shore, North Sumatera ⁽¹⁾. The shore and small island are

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susceptible to occur a disaster. It is due to the climate change ⁽²⁾. The climate change occurs because of global warming up. It is due to the effect of green house gas. The big number of green house gas is produced by human works. One part of the climate change effect is increasing the world temperature. The world temperature increment affects the sea water surface increment. The effect of sea water surface increment is that the shores and shore cities will be under water and it is followed by the other multiple effects. Thus, the sea water surface increment is to be one part of main environment issue.

For decreasing the effect of climate change, Indonesia government has raised a rule of Indonesian Republic No. 64, 2010 is about disaster mitigation in coastal area and small island. In its implementation, it needs the support data, one part is the data of temperature and rate of temperature increment, the data of increment and increment rate of sea water surface in every small city of shore and small island. This paper focuses on the surrounding temperature and the sea water surface increment.

LITERATURE REVIEW

Green House Gas Emission

The scientists always use Global Warning Potential (GWP) term for comparing the effect of one green house gas (GHG) on the other green house gas to global warming up. The green house gas and level of GWP are shown in Table 1 ⁽³⁾.

Table 1: Pollution level of green house gas

Level of GWP	Life Time (year)	GWP Based on Life Time		
		20 years	100 years	500 years
Methane	12	72	25	7.6
Di nitrogen oxide	114	310	298	153
HFC-23 (hydro fluorocarbon)	270	12,000	14,800	12.00
HFC-134a (hydro fluorocarbon)	14	3,830	1,430	435
Sulphur hexafluoride	3,200	16,300	22,800	32,600
Tetra flour methane	50,000	5,210	7,390	11,200
Nitrogen tri fluoride	740	12,300	17,200	20,700

The gas emission of GHG always increases. Since 1850 to 2011, it increases by multiplier of 163. The increment rate of GHG is not promotional to the population rate (7 times) of 1.2 billion to be 7 billion. The CO₂ global emission in 1850 was only 198 Mt, it increases directly in 1890, 1930, 1970 and 2011 to be 1,304 Mt, 3,855 Mt, 14,531 Mt and 32,274 Mt, respectively. If there is no effort to decrease

the gas emission, thus the earth has only around 485 Pg-C and will be empty in 2045⁽⁴⁾. The gas emission of GHG in Indonesia (2015) without a calculation of forest fire and field is 37.17 Gt that it is equivalent to CO₂ (GTCO₂e) or 1.45 % of the global gas emission of GHG. By calculating the emission of forest fire and field, the emission in Indonesia is to be 3 % of the global gas emission of GHG.

Global Warming

Some factors which affect to global warming are; (a) radiation fluctuation of sun electromagnetic wave, (b) distance change between earth to sun, (c) aerosol phenomenon and cloud in atmosphere, (d) clear color earth surface and (e) effect of green house phenomenon⁽³⁾. At first, the increment of surrounding temperature was very slow (0.2 °C) from the year of 1000 to early century of 19. The increment of temperature increase to be 0.35 °C (in 1910 - 1940) and 0.55 °C (in 1940 – 2000)⁽³⁾ as shown in Figure 1 and Figure 2.

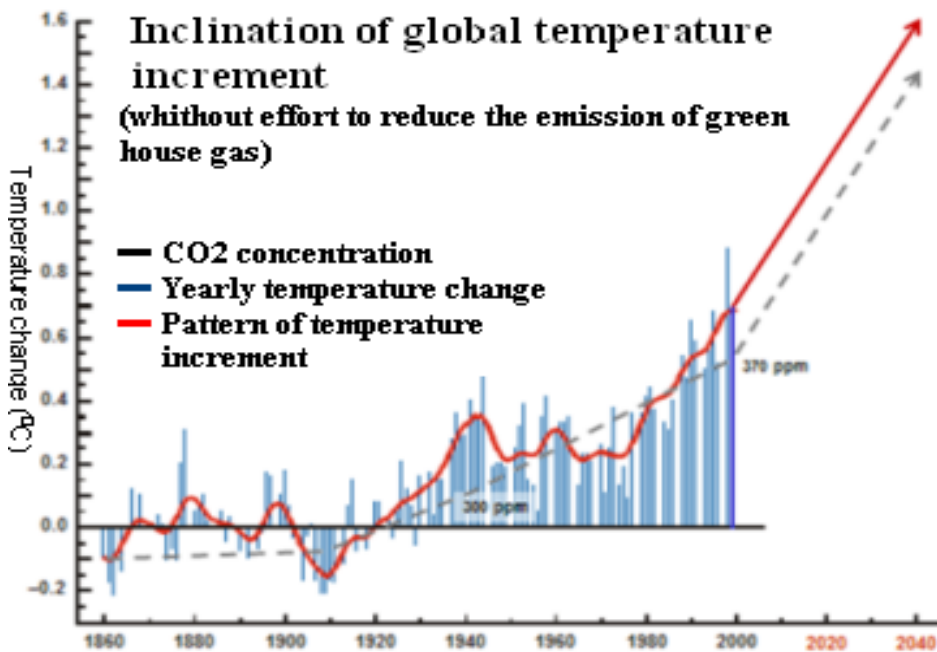


Figure 1: Increment rate of global temperature

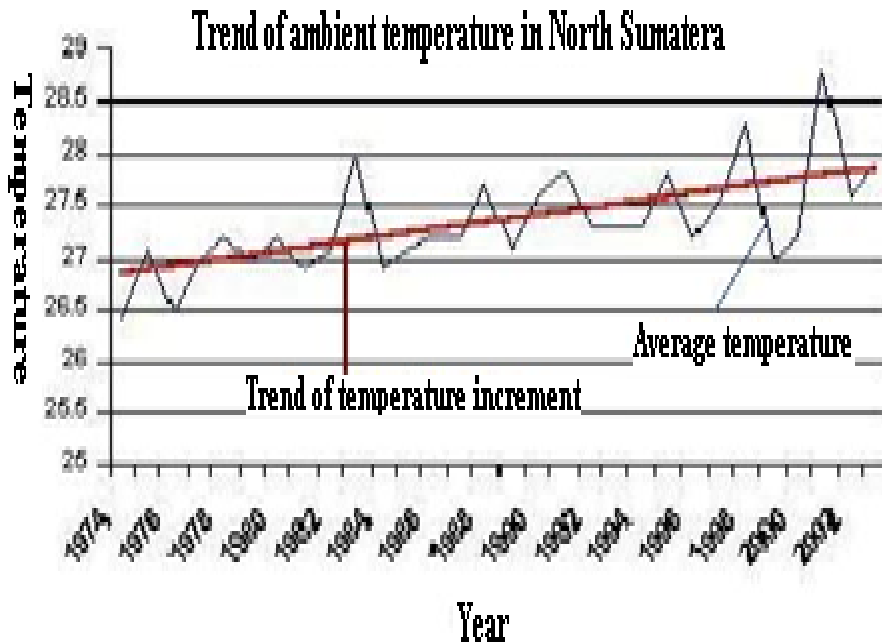


Figure 2: Temperature increment in North Sumatera

The highest surface temperature at North cross has been recorded was 56.7 °C in Furnace Greek, Greenland, California, America on 10th July 1913, in South cross was 50.7 °C in Oodnadatta, Australia. The increment of surrounding temperature, if there is no reduction of emission is to be 4 °C to 5 °C in 2100. To restrain the temperature increment rate, panel of government for climate change of United Nation has decided scenario of safety temperature increment of 2 °C in 2100. The increment rate of global temperature ⁽⁵⁾ and regional ⁽⁶⁾ are shown in Figure 1 and Figure 2.

Sea Surface Increment

The global warming has triggered the ice liquefaction in pole region and affects the sea water surface increment ⁽³⁾. The best scenario is to restrain the maximum temperature increment of 2 °C as decision of the United Nation in Konpenhagen, Denmark in 2009 ⁽⁴⁾. If the scenario is not executed, thus the sea water surface increment will increase drastically. The United Nation in 2013 estimates that the sea surface increase 30-200 cm ⁽⁷⁾ and the other modelling predicts that the increasing is 1,140 cm in 2100. The best scenario figure of sea water surface increment ⁽⁴⁾ as shown in Figure 3.

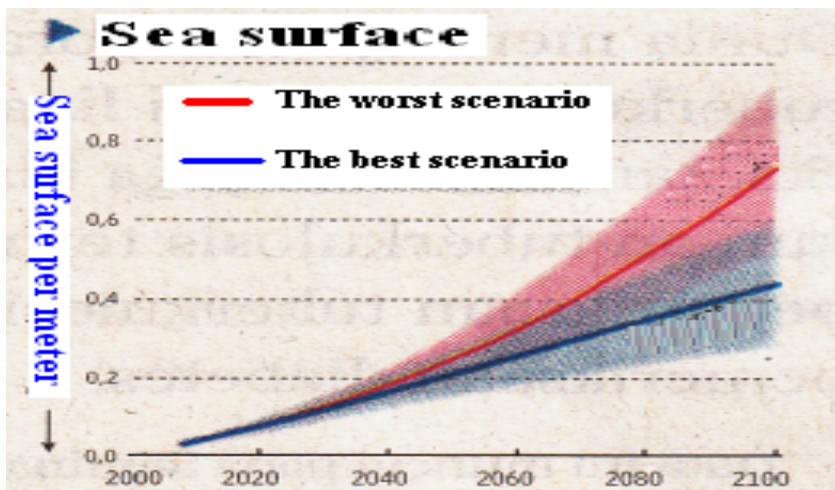


Figure 3: Scenario of sea surface increment

RESEARCH METHODOLOGY

This research focuses on the increment level of sea water in cities of shore, North Sumatera Indonesia. This research is worked in 2015 and located on 30 observation points in cities of shore and small island, North Sumatera, Indonesia. It is categorized in three groups, the first one is East coastal area, Sumatera island, the second one is West coastal area, Sumatera Island, and the last one is coastal Nias island. Ten cities and islands are observed for each group. The location map is shown in Figure 4.

The method used to record the sea water surface increment in small city of North Sumatera province is photo image ⁽⁷⁾ by analyzing the color “coastal area susceptibility index in 2008” that it is published by Department of naval and fishery, Republic of Indonesia. The data of temperature is collected from secondary data (Statistical Centre Board, 2006 - 2015).



Figure 4: Province of North Sumatera

RESULTS AND DISCUSSION

Temperature Increment in East Coastal Area

The temperature increment in East coastal, North Sumatera is analyzed based on the data of maximum and minimum temperature from Agency of Meteorological Climatology and Geophysics in Belawan for the year of 2006 – 2015. The analysis result is shown in Figure 5.

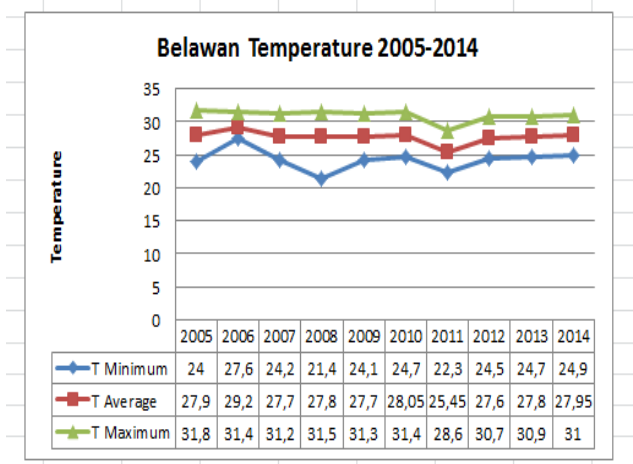


Figure 5: Temperature graph for Belawan

Figure 5 shows the temperature increment for ten years. The measurement of minimum temperature increases from 24.0 °C in 2005 becomes 24.9 °C in 2014 with increment rate of 3.75 % per ten years. It is also for the measurement of average temperature of 27.9 °C in 2005 becomes 27.95 °C in 2014, it reaches 28.05 °C in 2010. The highest maximum increment rate is 0.54 % per ten years. For the maximum temperature of 31.8 °C in 2005 becomes 31.0 °C with trend of reduction is 0.25 % per ten years.

Temperature Increment in West Coastal Area

The temperature increment in West coastal, North Sumatera is analyzed based on the data of maximum and minimum temperature from Agency of Meteorological Climatology and Geophysics in Pinang Sori for the year of 2005 – 2014. The analysis result is shown in Figure 6.

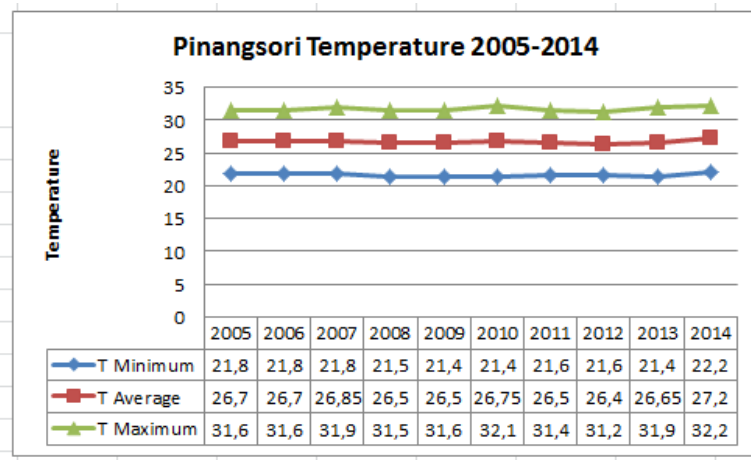


Figure 6: Temperature graph for Pinang Sori

Figure 6 shows the measurement of minimum temperature that it increases from 21.8 °C in 2005 becomes 22.2 °C in 2014 with increment rate of 1.83 % per ten years. It is also for the measurement of average temperature of 26.7 °C in 2005 becomes 27.20 °C in 2014 with the increment rate is 1.87 %. The maximum temperature of 31.6 °C in 2005 becomes 32.20 °C with increment rate of 1.89 % per ten years.

Temperature Increment in Coastal Nias Island

The temperature increment in coastal Nias island, North Sumatera is analyzed based on the data of maximum and minimum temperature from Agency of Meteorological Climatology and Geophysics in Binaka for the year of 2005 – 2014. The analysis result is shown in Figure7.

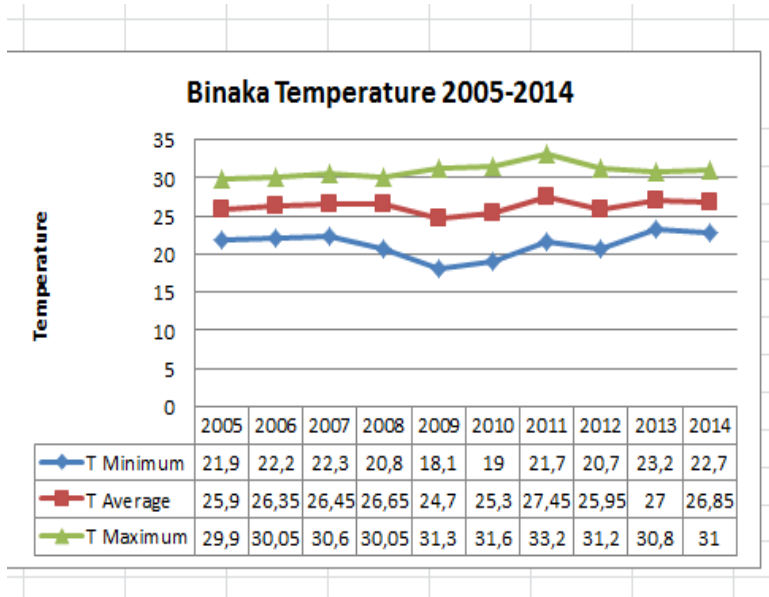


Figure 7: Temperature graph for Binaka

Figure 7 shows the measurement of minimum temperature that it increases from 21.9 °C in 2005 becomes 22.7 °C in 2014 with increment rate of 3.65 % per ten years. It is also for the measurement of average temperature of 25.9 °C in 2005 becomes 26.85 °C in 2014 with the increment rate is 3.66 %. The maximum temperature of 29.9 °C in 2005 becomes 31.0 °C, it has been in 33.2 °C with increment rate of 11.03 % per ten years.

Based on the analysis above shows that the highest average temperature for East coastal area, West coastal area and coastal Nias island are 28.5 °C, 27.2 °C and 26,85 °C, respectively with the average temperature in Province of North Sumatere is 27.36 °C. The average temperature increment rate is 2.02 %. The highest temperature is recorded in East coastal area, West coastal area and coastal Nias island are 31.8 °C, 32.2 °C and 33.2 °C, respectively with the maximum temperature increment rate is 11.3 % per ten years in Nias island.

Sea Surface Increment

The sea surface level increment in the shores for the small island and small cities in North Sumatera in 1998 is obtained from the photo image “coastal area susceptibility index in 1998”. Based on the concept that the sea water surface increment per year can be recorded from each city and small island. For the works of sea water surface increment, it correlates to the temperature increment. The average temperature increment rate in East coastal area, West coastal area and coastal Nias island are 0.54 %, 1.87 % and 3.66 %, respectively. The maximum

temperature increment rate in East coastal area, West coastal area and coastal Nias island are 0.25 %, 1.89 % and 11.3 %, respectively. It is analyzed based on assuming that the temperature rate is proportional to the sea water increment rate, thus the sea water surface increment rate in East coastal area, West coastal area and coastal Nias island are 0.395 %, 1.88 % and 7.48 %, respectively for ten years. Therefore, the sea water surface increment level can be obtained in cities and small island in North Sumatera in 2015. The data of sea water surface increment in 2008 and 2015 are shown in Table 2.

Table 2: Sea water surface increment in 2008 and 2015

East coastal area			West coastal area			Coastal Nias island		
City/ Island	Temperature increment (°C)		City/ Island	Temperature increment (°C)		City/ Island	Temperature increment (°C)	
	2008	2015		2008	2015		2008	2015
P.Sembilan	14.0	19.53	Barus	5.0	14.4	Tuhemberua	12.0	101.76
Pk. Susu	14.0	19.53	Sibolga	5.0	14.4	Gn.Sitoli	12.0	101.76
Tapak Kuda	13.5	18.83	Pandan	5.0	14.4	Hiliana	12.0	101.76
Belawan	13.5	18.83	P.Mursala	5.0	14.4	T. Dalam	12.0	101.76
Percut	13.0	18.14	Bt.Mundon	12.0	34.56	Sirombu	12.0	101.76
Pt. Cermin	13.0	18.14	Singkuang	12.0	34.56	P.Pini	12.0	101.76
S. Buah	13.0	18.14	Tabuyung	12.0	34.56	P.Tana Masa	12.0	101.76
Pk. Luduk	12.5	17.44	Taluk	12.0	34.56	P.Bala	12.0	101.76
Tj. Tiram	12.5	17.44	Natal	12.0	34.56	P.Simuk	12.0	101.76
S.Pt. Pukat	12.5	17.44	Batahan	12.0	34.56	P. Wunga	12.0	101.76

Based on the Table 2 that the lowest sea water surface increments are around Barus, Sibolga, Pandan and Mursala island, they are 5 mm/year. The sea increment level in the four locations include in the lowest increments in some locations in Indonesia. The sea water increment level in East coastal area, North Sumatera gives a trend that it goes to North from 12.5-14 mm/year and coastal Nias island is 12 mm/year. The sea water surface increment in 2015 in the West coastal area and East coastal area are from 14.4 mm to 34.56 mm, 17.44 mm to 19.53 mm, respectively. Whereas, the sea water surface increment in Nias island is 101.76 mm with its increment rate is 848 %. The highest sea water surface increment needs more comprehensive disaster mitigation. A graph of sea water surface increment in 2008 and 2015 and also the sea water surface increment rate are shown in Figure 8.

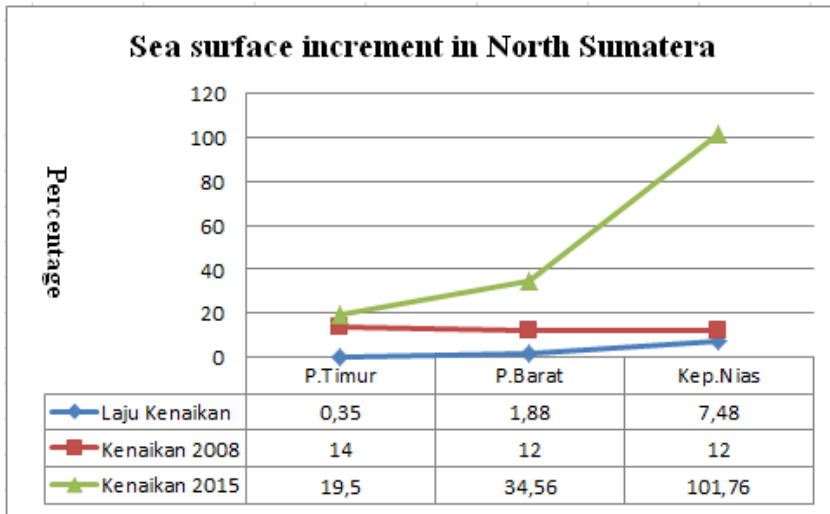


Figure 8: The sea water surface increment in North Sumatera

CONCLUSIONS

The highest average temperature in East coastal area, west coastal area and coastal Nias island are 28.5 °C, 27.2 °C and 26.85 °C, respectively with average temperature in Province of North Sumatera is 27.36 °C. The highest temperature in East coastal area, west coastal area and coastal Nias island are 31.8 °C, 32.2 °C and 32.2 °C.

The average temperature increment rate in the East coastal area, west coastal area and coastal Nias island are 0.54 %, 1.87 % and 3.66 %, respectively with the average temperature increment rate in Province of North Sumatera is 2.02 %. The maximum temperature increment rate in the East coastal area, west coastal area and coastal Nias island are 0.25 %, 1.89 % and 11.3 %.

The sea water surface increment rate the time of ten years in the East coastal area, west coastal area and coastal Nias island are 0.395 %, 1.88 % and 7.48 %, respectively.

The sea water level increment for the year of 2008 in the East coastal area, west coastal area and coastal Nias island are 12.5-14 mm/year, 5-12 mm/year and 12 mm/year, respectively. The sea water surface increment for the year of 2014 in the East coastal area, west coastal area and coastal Nias island are 14.4 mm – 34.56 mm, 17.44 mm – 19.53 mm and 101.76 mm, respectively. The sea water surface increment rate in Nias island is 848 %.

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