

Distribution of Suspended Solid in the Upper Gulf of Thailand in 2004-2005

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ABSTRACT

The upper gulf of Thailand is an area that is considerably affected from eroded sediments from rivers and coasts. This research, the data during 2004-2005 from 10 times survey was investigated, 2 times in the upper gulf of Thailand, 2 times from Chao Phraya-Sri Racha cruise and 6 times Bangpakong-Sri Racha cruise. Total suspended solid (TSS) at the middle of the upper gulf of Thailand had the maximum less than 0.01 g/l. TSS at the surface water near the shore had a linear relation to turbidity (TB) as $TSS = 0.0024 TB \pm 0.0012$, $r^2=0.6$. The TSS would be increased when it was near shore. During dry season, the seawater was well-mixed and not affected by the water from the land. TSS was about 0.02-0.06 g/l. During rainy season, the suspended particle is enlarged in river. The TSS at Chao Phraya and Bangpakong river mouth had nearly the same quantity about 0.20-0.02 g/l. TSS would be decreasing while far off the shore.

Key words: suspended solid, turbidity, the upper gulf of Thailand.

INTRODUCTION

The upper Gulf of Thailand covers the latitude $12^{\circ} 40'N - 13^{\circ} 30'N$ and longitude $100^{\circ} E - 101^{\circ} E$, which contact to the provinces of Phetchaburi, Samut Songkhram, Samut Sakhon, Samut Prakan and Chon Buri (Figure 1). The averaged depth of the Gulf is about 20 m and deepest is about 50 m on the eastern part near Ko Khram. Circulation of seawater is affected by tidal current and tide is the mixed tide.

Around this area, there are 4 main rivers (Mae Klong river, Tha Chin river, Chao Phraya river and Bang Pakong river). During rain season, each river let off the water with a lot of sediment. In each year, a lot of suspended solid from rivers was loaded and mixed with seawater in delta area

and near shore. But during dry season, the water runoff is very low. The sediment is decreased.

This study concerned on the distribution of suspended solid in the upper Gulf of Thailand in 2004-2005. The relation of total suspended solid (TSS) at sea surface along the coastal zone and turbidity(TB) at sea surface was found under condition that the seawater had the good mixed. The distribution pattern in the upper gulf of Thailand, Chao Phraya river mouth and Bangpakong river mouth were investigated.

MATERIALS AND METHODS

During year of 2004-2005, there were the 10 times survey in the upper Gulf of Thailand by Kasetsart 1. The Bangpakong cruise from the

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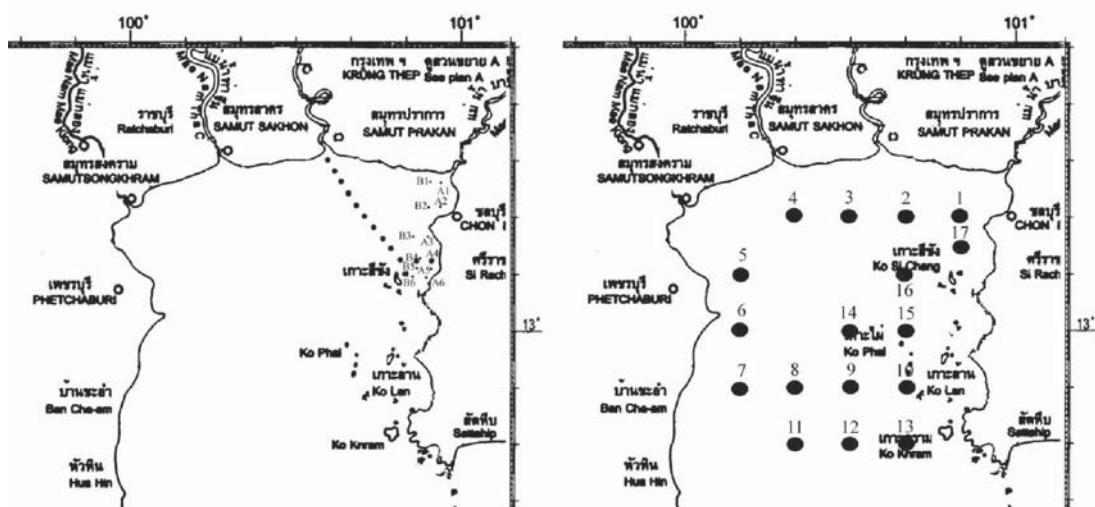


Figure 1 Site of study area.

Bangpakong river mouth to Si Chang Island were 6 times on 18/11/04, 18/01/05, 15/03/05, 19/05/05, 19/07/05 and 23/09/05. There were 12 stations in each time. The 2 times survey in the upper Gulf of Thailand, 17 stations in each time, were performed on 8/10/04 and 25/01/05. 2 times survey was operated in Chao Phraya cruise on 10/01/04 and 17/09/05. There were 12 stations in each time. The water current had been recorded at station near Ko Phai for 25 hours during 26-27 January 2005. The seawater samples at the sea surface were collected and found out the relation of the total suspended solid and turbidity.

The TSS at sea surface was found by used the Glass Microfibre filters (GF/C 47 mm, Whatman). The dry weight before and after the water sample 1 liter factorization were checked. The increase dry weight of 3 filters in each station would be averaged. This value would be represented TSS at sea surface at each station.

The turbidity of seawater was 3 times measured at each station by using the LaMotte 2020 TURBIDIMETER. The averaged value would be represented the turbidity at each station. The water current was recorded 25 hours by used SD6000 every 10 minutes. The distribution patterns of TSS in upper gulf of Thailand, Chao

Phraya river mouth and Bangpakong river mouth were presented by application program.

RESULTS AND DISCUSSION

From the 10 times survey in the upper Gulf of Thailand, the TSS at the sea surface were shown in tables 1-3. The TSS in the eastern part of the gulf of Thailand from Bang Pakong to Sri Racha Island had the maximum near the Bang Pakong river mouth. During dry season the TSS were about 0.02-0.06 g/l and turbidity were about 8-16 NTU. The averaged TSS near shore were about 0.0106-0.019 g/l and turbidity were about 3.9-5.2 NTU. The reports (Vashrangsi, 1978; Vashrangsi *et al.*, 1981) which were studied around the eastern coast of the gulf of Thailand from Khlong Dan to Bang Lamung, showed that the quantity of the TSS had been about $0.008-0.226 \pm 0.164$ g/l.

TSS in the middle of the upper gulf of Thailand was about 0.002-0.004 g/l less than 0.01 g/l. The TSS increased near Si Chang Island and near Laem Phak Bia. The TSS near shore was about 0.02-0.06 g/l during dry season. During rain season the TSS was increased about 0.2-0.02 g/l because of the loaded particle from the river as

shown in Figure 3. The report (Doydee and Anongponyoskun, 2004) that studied on remote sensing for determining the total suspended solids in the inner gulf of Thailand found that the TSS was abundance near the river mouth and coastal

area. It was decrease in offshore area.

The TSS and turbidity of seawater at sea surface near shore had the linear relation. When TSS unit was g/l and turbidity TB unit was NTU, the relation could be rewritten as below.

Table 1 The total suspended solid on 8/10/2004 and 25/01/05 around upper gulf of Thailand.

| Station | Position | | TSS(g/l) | |
|---------|------------|-------------|-----------|----------|
| | Latitude | Longitude | 8/10/2004 | 25/01/05 |
| 1 | 13 20.00'N | 100 50.00'E | 0.0031 | 0.0031 |
| 2 | 13 20.00'N | 100 40.00'E | 0.0036 | 0.0051 |
| 3 | 13 20.00'N | 100 30.00'E | 0.0022 | 0.0045 |
| 4 | 13 20.00'N | 100 20.00'E | 0.0034 | 0.0049 |
| 5 | 13 10.00'N | 100 10.00'E | 0.0022 | 0.002 |
| 6 | 13 00.00'N | 100 10.00'E | 0.005 | 0.0039 |
| 7 | 12 50.00'N | 100 10.00'E | 0.0021 | 0.0043 |
| 8 | 12 50.00'N | 100 20.00'E | 0.0012 | 0.0038 |
| 9 | 12 50.00'N | 100 30.00'E | 0.0008 | 0.0031 |
| 10 | 12 50.00'N | 100 40.00'E | 0.0007 | 0.003 |
| 11 | 12 40.00'N | 100 20.00'E | 0.0011 | 0.0026 |
| 12 | 12 40.00'N | 100 30.00'E | 0.0011 | 0.0029 |
| 13 | 12 40.00'N | 100 40.00'E | 0.0009 | 0.0038 |
| 14 | 13 00.00'N | 100 30.00'E | 0.001 | 0.0036 |
| 15 | 13 00.00'N | 100 40.00'E | 0.0011 | 0.0051 |
| 16 | 13 10.00'N | 100 40.00'E | 0.0013 | 0.0095 |
| 17 | 13 10.00'N | 100 50.00'E | 0.0044 | 0.0049 |

Table 2 The total suspended solid in years 2004-2005 from Samutprakan to Sri-Racha.

| Station | Position | | TSS(g/l) | |
|---------|------------|-------------|-----------|----------|
| | Latitude | Longitude | 10/1/2004 | 17/09/05 |
| 1 | 13-28-26 N | 100-38-89 E | 0.01503 | 0.21907 |
| 2 | 13-25-36 N | 100-38-99 E | 0.03953 | 0.0314 |
| 3 | 13-23-41 N | 100-40-44 E | 0.00235 | 0.0178 |
| 4 | 13-22-22 N | 100-41-64 E | 0.0136 | 0.0204 |
| 5 | 13-20-18 N | 100-43-45 E | 0.00207 | 0.01287 |
| 6 | 13-18-50 N | 100-44-95 E | 0.0002 | 0.00853 |
| 7 | 13-17-03 N | 100-46-13 E | 0.00153 | 0.0186 |
| 8 | 13-15-11 N | 100-47-54 E | 0.00155 | 0.0126 |
| 9 | 13-13-52 N | 100-48-78 E | 0.00143 | 0.01813 |
| 10 | 13-11-85 N | 100-50-49 E | 0.0008 | 0.01227 |
| 11 | 13-11-56 N | 100-51-89 E | 0.00293 | 0.01447 |
| 12 | 13-10-94 N | 100-53-69 E | 0.0016 | 0.01993 |

Table 3 The total suspended solid in years 2004-2005 from Bangpakong to Sri-Racha.

| Station | Position | | TSS(g/l) | | | | | |
|---------|-------------|------------|----------|----------|----------|----------|----------|----------|
| | Longitude | Latitude | 18/11/04 | 18/01/05 | 15/03/05 | 19/05/05 | 19/07/05 | 23/09/05 |
| A1 | 100 56.63'E | 13 26.58'N | 0.0233 | 0.0206 | 0.0325 | 0.0604 | 0.1451 | 0.2191 |
| B1 | 100 53.95'E | 13 26.64'N | 0.0608 | 0.0176 | 0.0213 | 0.1199 | 0.0702 | 0.0314 |
| A2 | 100 55.92'E | 13 22.34'N | 0.0085 | 0.0131 | 0.0096 | 0.0157 | 0.0209 | 0.0178 |
| B2 | 100 54.47'E | 13 22.10'N | 0.0087 | 0.0185 | 0.0152 | 0.0163 | 0.0413 | 0.0204 |
| A3 | 100 53.52'E | 13 16.91'N | 0.0112 | 0.0097 | 0.007 | 0.0067 | 0.0073 | 0.0129 |
| B3 | 100 50.81'E | 13 16.91'N | 0.0073 | 0.0046 | 0.0064 | 0.0054 | 0.0111 | 0.0085 |
| A4 | 100 54.56'E | 13 12.34'N | 0.0043 | 0.0098 | 0.0082 | 0.0097 | 0.0041 | 0.0186 |
| B4 | 100 52.00'E | 13 12.22'N | 0.0003 | 0.0071 | 0.0069 | 0.008 | 0.0059 | 0.0126 |
| A5 | 100 53.50'E | 13 11.01'N | 0.0032 | 0.0114 | 0.0048 | 0.0075 | 0.0069 | 0.0181 |
| B5 | 100 51.55'E | 13 10.95'N | 0.0054 | 0.0055 | 0.0052 | 0.0071 | 0.0068 | 0.0123 |
| A6 | 100 50.45'E | 13 09.83'N | 0.0059 | 0.0097 | 0.0046 | 0.0061 | 0.0068 | 0.0145 |
| B6 | 100 53.52'E | 13 10.00'N | 0.0042 | 0.003 | 0.0054 | 0.0087 | 0.0095 | 0.0199 |

$$\text{TSS}=0.0024 \text{ TB} \pm 0.0012, r^2 = 0.6 \quad (1)$$

Figure 2 shown TM LANDSAT 5 image on 5 December 2003. It showed the distribution of TSS in the upper gulf of Thailand. The TSS was densely near the river mouth, coastal zone and domestic area. The off shore area, TSS were less than 0.001 g/l. The near shore of the coastal zone, the TSS were about 0.010-0.015 g/l (Doydee and Anongponyoskun, 2004)

During 26-27 January 2005, the seawater



Figure 2 Image figure of TM LANDSAT 5 in the upper gulf of Thailand on 5 December 2003.

velocity was recorded for 25 hours by used SD6000 every 10 minutes. The velocity of flow during ebb tide and flood tide had the magnitude about 1 m/sec, the direction was the southward and northward flow respectively.

In the upper Gulf of Thailand, the water circulation is depend on the effected of tidal current. Around this area, Anongponyoskun (2004) reported that the tide in the upper Gulf of Thailand is mixed tide. The magnitudes of velocity were about 0.5-1 m/sec. The velocity data showed that the main direction of flow was north-south component. Anongponyoskun, 1998 reported that the velocity of main flow at Si Chang Island during ebb tide and flood tide was about 1.0 m/sec in north-south component.

The report (Vito, 1977) showed that the size of particle has the relation with the settling velocity as

$$w \propto D^2 \quad (2)$$

w = settling velocity

D = diameter of the particle

The relation showed that the velocity about 0.1 m/sec could move the particle smaller than 0.5 mm away from the bed. So if it has the movement of seawater the particle suspension can be happened.

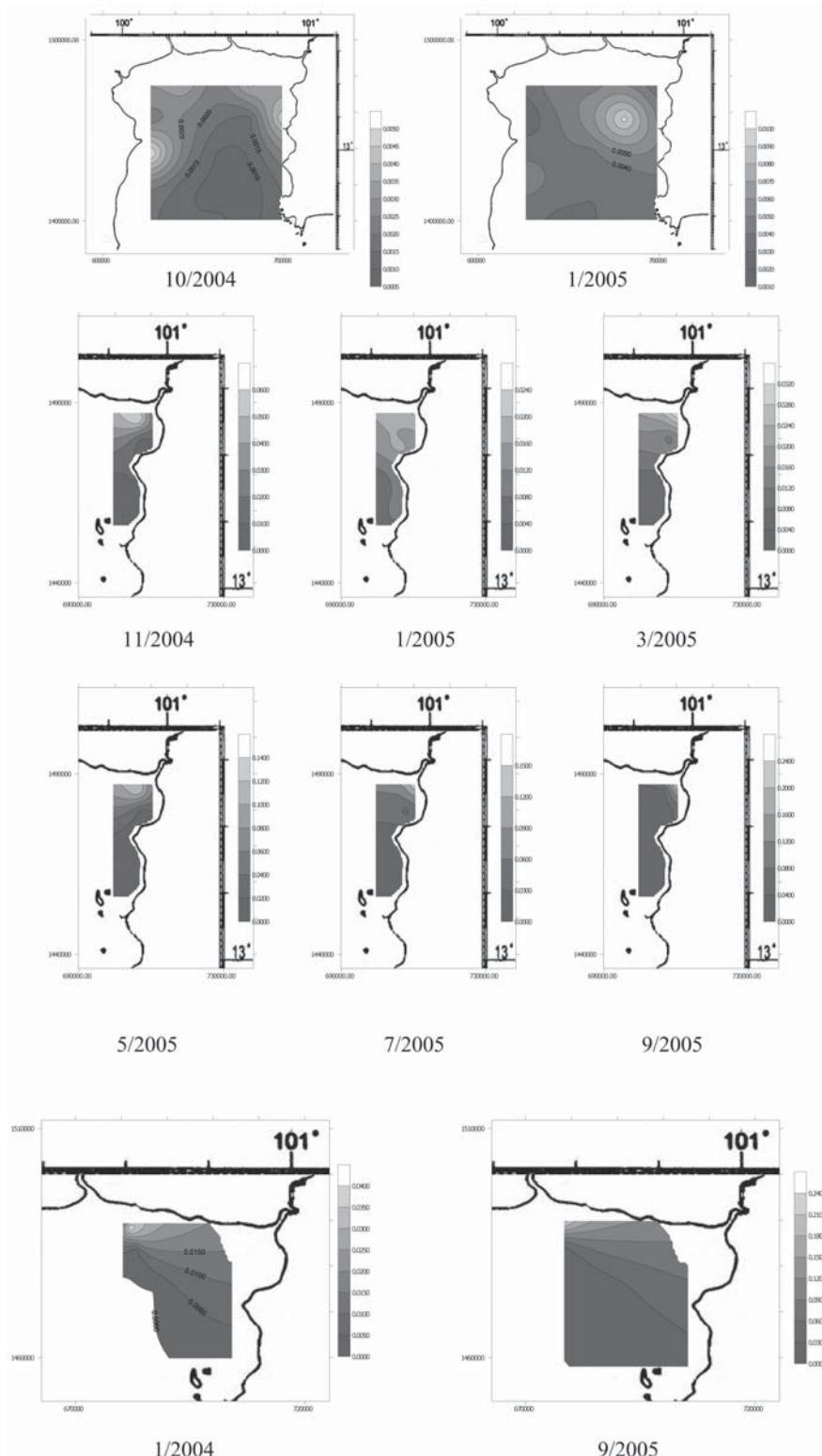


Figure 3 The distribution maps of suspended solid in upper gulf of Thailand during 2004-2005.

CONCLUSION

The TSS in the upper gulf of Thailand was abundance near the river mouth and coastal area. It was decrease in offshore area. Distribution of suspended solid in the Upper Gulf of Thailand in 2004-2005 could be concluded that

1. The TSS solid at the surface water offshore or the middle of upper gulf of Thailand had the maximum less than 0.01 g/l.

2. The TSS at the surface water near shore (TSS) had the linear relation to the turbidity of seawater (TB) as $TSS=0.0024 TB \pm 0.0012$, $r^2=0.6$

3. The TSS would be increased near shore. During dry season, the seawater was well-mixed and was not affected by the water from the land. The TSS solid were about 0.02-0.06 g/l. During rain season, there are a lot of loaded particle, TSS was about 0.20-0.02 g/l.

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