CHAPTER 5

CONCLUSION AND DISCUSSION

1. Conclusion and discussion

In this chapter, the conclusions are presented and discussed. In the following sections we describe the results, for each of the objectives of this study.

1.1 To assess the accuracy of the tide tables.

From Figures 9 we found that for two 25-hour periods the range of the direct observations is substantially greater than that given in the tide tables. However the times at which the high and low tides occur are almost exactly the same as those given in the tide tables.

The discrepancy in the water levels may be due to variation in the flow of the rivers and abnormal weather conditions are factors, which may effect the accuracy of such predictions to some extent. In addition it may be because the direct data and the tide table refer to slightly different locations. The direct observation data is measured at latitude 6° 53′ 38.3″ N and longitude 101° 16′ 40″ E while the data from tide table refers to at latitude 6° 53′ 34″ N and longitude 101° 15′ 36″ E (Hydrographic department Royal Thai Navy, 1996: 125).

1.2 To produce effective graphical displays of the successive high and low tides relative levels at Pattani for the year 1996, compare with data of the same year at Songkhla.

1.2.1 Comparison of high and low tide levels at Pattani and Songkhla

Figures 10 and 11 show the heights of successive high and low tides at the given locations during the first two months of the year. In January the highest high tide occurs at indexes 16 and 43 which correspond to 8 and 22 in January and the lowest high tides occurs at indexes 28 and 53 which correspond to 15 and 28 in January respectively. In February the highest high tide occurs at indexes 72 and 99

which correspond to 6 and 20 in February and the lowest high tides occurs at indexes 84 and 114 which correspond to 13 and 28 in February respectively. (See Table 5).

Table 5: Dates of occurrence of spring tides and neap tides in the first two months of 1996

Tides	**January**	**February**
Spring tides	8 January 1996	6 February 1996
Neap tides	15 January 1996	13 February 1996
Spring tides	22 January 1996	20 February 1996
Neap tides	28 January 1996	28 February 1996

Table 6: Phases of the moon in the first two months of 1996

Phase of moon	**January**	**February**
Full moon	6 January 1996	4 February 1996
First quarter	14 January 1996	12 February 1996
New moon	20 January 1996	19 February 1996
Last quarter	27 January 1996	26 February 1996

From the result we can see that in each month, there are two spring tides and two neap tides, so the phase of the moon affects the movement of the tides. The spring tides will occur during the new moon and the full moon but neap tides occur during the first and the last quarters of the moon. However, spring tides and neap tides are delayed by 1-2 days from the phase of the moon, spring tides occur after the full moon or new moon for 1-2 days, but neap tides will occur after the first quarter or the last quarter for 1-2 days. This may be explained by the phase inequality or phase lag which is different in each location (Siripong and Tameeyawanich, 1982: 6).

The variation of distance between the moon and the earth affects the tides. When the moon is closest to the earth (perigee) the high tide has a higher height and the low tide has a lower height compared with normal high and low tides. This phenomenon is called perigean tides. If the moon is in its apogee with respect to the

earth, the height of the variation of high and low tides is less than in normal. This phenomenon is called apogean tides (Siripong and Tameeyawanich, 1982: 6).

The perigean tides do not occur on the same day when the moon is closest to the earth but after 1-2 days. Similarly apogean tides are delayed after apogee by 1-2 days.

The variation of tides is also related to the variation of declination of the moon. If the moon is close to the equator, the height of high and low tides in the morning and afternoon is the same. But if the declination of the moon is increased the height of the tides in the morning and afternoon are different. The tides which occur when the moon is closest to the equator are called equatorial tides, while those occurring when the declination of the moon is greatest are called tropic tides (Siripong and Tameeyawanich, 1982: 6-7).

Looking at the data for the whole year (Figures 12 and 13) it was that there is a strong seasonal effect, with the water levels lower in July than in January and December. This effect may be explained by the annual monsoon wind, which blows from the East in November-January. Another reason might be because in January the sun is 91.5 million miles from the earth compared with 94.5 million miles in July.

1.2.2 Times of occurrence at Pattani and Songkhla in 1996

From figures 14 and 15, we found that the times of occurrence of each high and low tide, relative to the lunar day, separate into four clusters approximately 6 hours and 12 minutes apart. This is a standard feature of semidiurnal tide patterns. This graph is a very effective way of displaying the time of occurrence of the high and low tides, and forms the basis for further statistical analysis.

1.3 To investigate the nature of the series of high and low tides relative levels at the Pattani and Songkhla locations.

1.3.1 Modelling of times of occurrence at Pattani and Songkhla in 1996

The series of times of occurrence of high and low tides at Pattani and Songkhla were modelled, using time series analysis, as described in Chapter 2. It was that almost all of the fitted models consist of five harmonics at frequencies 12, 13, 24, 25 and 26. The results are given in Figures 16-23, and are summarised in Tables 1 and 2. These correspond to the movement of the moon around the earth. So we can conclude that the variation of times of occurrence of high and low tides at Pattani and Songkhla in 1996 depend largely on the moon. However all of the models of times of occurrence of high and low tides are extremely good. The values of the r-squared are more than 0.9 except for the model of the first low tide at Pattani and Songkhla, which are approximately 0.8.

1.3.2 Modelling of heights of high and low tides at Pattani and Songkhla in 1996

The series of heights of high and low tides at Pattani and Songkhla were modelled, using time series analysis, as described in chapter 2. It was that all of fitted models consist of six harmonics at frequencies 1, 2, 11, 13, 14 and 25. The results are given in Figures 24-31, and are summarised in Tables 3 and 4. It appears that in one year, the variation of high and low tides at Pattani and Songkhla have an effect from the sun and the moon. Because the earth's orbit around the sun approximately one year correspond to the first harmonic. While the earth orbit around the sun, it has seasonal effect. In this case corresponding to the second harmonic. The 11^{st}, 13^{th}, 14^{th} and 25^{th} harmonics are the effects from the moon orbit around the earth. It can be concluded that the variation of heights of high and low tides at Pattani and Songkhla in 1996 depend on the moon and the sun. All of the models of heights of high and low tides have an extremely good fit. The values of the r-squared are all more than 0.99. The graph of the base 10 logarithm of the periodogram gives 95% confidence intervals for the individual periodogram values. Most of the periodogram are inside these confidence limits, which indicates that the model fit the data.

The filtered noise for all series has significant autocorrelation at lag 28. This may suggest that the data for the last six months of the year is largely just a repetition of the data for the first six months, which are suspicious. And the autocorrelation function for times of occurrence of second high tide at Songkhla dosen't fit the series because variation of times of occurrence of second high tide at Songkhla does not vary much from the average.

2. Problems of the research

2.1 The derivation of the tide table needs to be better understood.

2.2 A longer series of observations (more than one year) is needed to understand the effect of the seasonal monsoon.

3. Limitation of the research

3.1 There is insufficient direct measurement observation data.

3.2 Only one year data is used in modelling.

4. Future research

The future research should:

4.1 Get further direct observation data for more extensive comparison with tide table.

4.2 Get data from tide table more than one year.