CHAPTER 5 CONCLUSION

The sea level in the Gulf of Thailand (GoT) and the South China Sea (SCS) have been investigated. The observed sea level are taken from tide gauge records of organizations of Thailand and the Permanent Service for Mean Sea Level (PSMSL). The least square linear regression and periodic cubic spline approximation are used to examine the trends of sea level observed in the GoT and the SCS. The trends of sea level from tide gauge stations has been increased in the GoT and the SCS during 1977 - 2007, except for Quinhon station the sea level has been fallen. The rates of rising are 0.81 - 19.02 mm/yr, 1.07 - 3.20 mm/yr, 1.69 - 2.77 mm/yr and 3.02 - 13.00 mm/yr along the coast of the GoT, the coast of Malaysia, the coast of China and in the Philippines, respectively. These rising rates are agree with Yanagi and Akaki (1994), Wong, et al. (2003), IPCC (2007) and NOAA (2010) but sea level at Ko Lak station do not agree with Vongvisessomjai (2006), Niemnil and Trisirisatayawong (2006) and NOAA (2010). In the upper of the GoT, the two highest rising rates of sea level 19.02 and 15.36 mm/yr are the rates of sea level at Samutsakorn station and Samutsongkram station, respectively. The monthly sea level in the GoT are considered during 1998 - 2006 by separating the time domain before and after the year 2000, that is the periods 1988 - 2000 and 2001 - 2006. Normally, the sea level would fall in the summer season and would increase in rainy season. In this study, results show the monthly sea level in the period 2001 - 2006 is higher than the past period 1988 - 2000.

The data grids of monthly sea surface height anomaly (SSHA) observed from TOPEX/ERS satellite altimeter and monthly sea surface heights (SSHs) resulting from OCCAM with resolutions of 1/4° and 1/12° and POM are investigated in the GoT and the SCS during February 1993 to January 2003. In this study, the domain is divided into two regions: the GoT region which covers 98°E to 105°E and 5.5°N to 14°N and the SCS which covers 105°E to 123°E and 0°N to 25°N. There are four grided data sources for analysis in the GoT, that is SSHA from TOPEX/ERS, SSH from OCCAM with a resolution of 1/4°, SSH from OCCAM with a resolution of 1/12° and SSH from POM. There are two grided data sources for analysis in the SCS such as SSHA from TOPEX/ERS and SSH from OCCAM with a resolution of 1/4°. The Empirical Orthogonal Function (EOF) analysis and wavelet analysis are applied to investigate the characterizations of observation and results from numerical ocean models. In this study, the first two modes and the first three modes of data grids are analyzed in the GoT and the SCS, respectively.

EOFs of results from numerical ocean models in the GoT reveal that the first two modes of SSHs from OCCAM with resolutions of 1/4° and 1/12° are similarly features for each mode and they show features in the southern of the GoT which is the same feature as of SSH from POM for the 1st mode, but in the 2nd modes of SSHs from OCCAM are not agree with the 2nd mode of SSH from POM. The first two modes of SSHA from TOPEX/ERS are different to the first two modes of SSHs from OCCAM with resolutions of 1/4° and 1/12°. Likewise, the first two modes of SSHA

from TOPEX/ERS are different to the first two modes of SSHs from POM for each mode. In the SCS, EOFs of SSHA from TOPEX/ERS and SSH from OCCAM with a resolution of 1/4° reveals the first two modes of them are different for each mode but the 3rd modes of them are agree features in the northern and the southern of the SCS.

The analysis of wavelet transform on principal components of variations supported the EOF analysis. In the GoT, the 1st modes of wavelet power spectrum of SSHA from TOPEX/ERS, SSHs from OCCAM with resolutions of 1/4° and 1/12° and SSH from POM reveal the annual signal in February 1993 - January 2003. The 2nd mode of wavelet power spectrum of SSHA from TOPEX/ERS and SSHs from OCCAM with resolutions of 1/4° and 1/12° have similarly signal in late 1997 - 1998 with period of 1.5 - 4 years while the 2nd mode of wavelet power spectrum of SSH from POM has signals in 1997 and 2000 with period 1 - 1.5 years. In the SCS, the wavelet power spectrum of SSHA from TOPEX/ERS and SSH from OCCAM with a resolution of 1/4° are discussed. The 1st mode corresponding to an annual significant peaks of SSHA from TOPEX/ERS and SSH from OCCAM with a resolution of 1/4° in February 1993 - January 2003 with period of 1 - 1.5 years. The wavelet power spectrum of SSHA from TOPEX/ERS and SSH from OCCAM with a resolution of 1/4° have similarly signal in late 1997 - 1998 but the wavelet power spectrum of SSH from OCCAM has longer period more than the wavelet power spectrum of SSHA from TOPEX/ERS for the 2nd and the 3rd modes.

The wavelet coherence are applied to inquire the correlations between the SSHA from observation and SSHs from results of numerical ocean models in the GoT and the SCS. In the GoT, the relations for each mode of principal components of SSHA from TOPEX/ERS and SSH from OCCAM with a resolution of 1/4° are same behavior as relations between principal components of SSHA from TOPEX/ERS and SSH from OCCAM with a resolution of 1/12°. The high coherence are anti-phase variations in 1994 - 2001 and in-phase in 1997 and in 1995 - 2000 for the 1st mode and the 2nd mode, respectively. The high coherence of the 1st mode of SSHA from TOPEX/ERS and SSH from POM occurs in 1994 - 2001 which SSHA lag SSH by approximately 4.5 months. The 2nd mode, the coherence which are in-phase occur in late 1994 and in 1997 - 1998. In the SCS, the principal components mode 1 of SSHA from TOPEX/ERS lead SSH from OCCAM with a resolution of 1/4° by 0.5 - 1 month and 2.3 - 4.7 months occurring in 1995 - 1996 and in late 1995 - 2000, respectively. The coherence is in-phase relationship during 1996 - 1999 for the 2nd mode. The 3rd mode, the high coherence occur in 1994 - 1996 and 1999 - 2001 which are in-phase for each time.

This study indicates that the sea level have been risen in the GoT and the SCS, especially in the upper of the GoT. Moreover, the results from numerical ocean models corresponding to the observations in some periods and some areas, especially in extreme events such as the El Niño and La Niña events. The applications of this study can be used in many fields such as oceanography, environment management and concerned research.