Field Investigation and Simulation of Water Quality Parameters in Songkhla Lake, Thailand

Tohoku University	Graduate student	○ Nguyen Trung VIET
Tohoku University	Fellow Member	Hitoshi TANAKA
Tohoku University	Member	Hiroto YAMAJI
Ishinomaki Senshu University	Member	Mitsuru TAKASAKI
Prince of Songkhla University		Somboon Pornpinatepong
Prince of Songkhla University		Kunlayanee Pornpinatepong

1. Introduction

Songkhla Lake is located in the southern part of Thailand. It is connected with the Gulf of Thailand through a narrow channel, and it comprises of three lakes: Thale Noi, Thale Luang and Thale Sap Songkhla. In the southernmost lake, Thale Sap Songkhla, aquaculture of sea bass plays an important role in area's economy. In recent years, however, the sudden dead of fishes has frequently occurred which may be due to the significant change in water quality in this lake.

In this study, field investigation and mathematical simulation have been carried out to thoroughly clarify the mechanism of the changes in water quality parameters in the Songkhla Lake. Regarding the field investigation, automated water quality measuring instruments are installed in an aquaculture area to obtain time variation of current, dissolved oxygen (DO), salinity and temperature. In addition, an artificial neural network (ANN) model is applied to evaluate the mechanism of DO concentration in the lake.

2. Study area

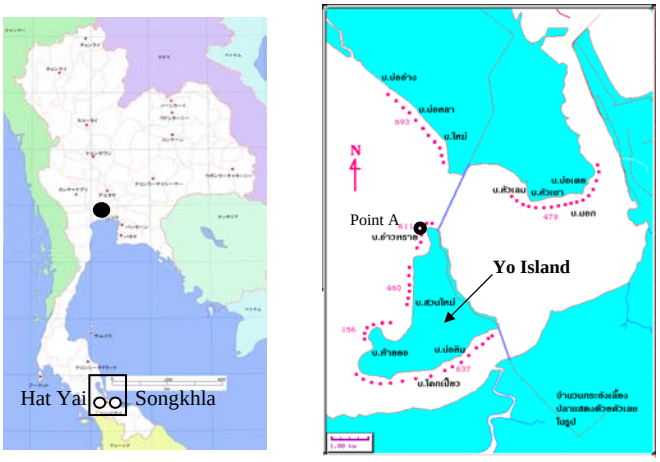

Fig. 1 Study area of the Songkhla Lake, Thailand

The Songkhla Lake is located in southern part of Thailand as seen in Fig. 1a. It has an area of about 1,182 km^2 with brackish to salt water due to tidal effects. The Songkhla lake connects to the Gulf of Thailand through the harbor entrance channel at Songkhla town. Seawater intrudes with tidal currents into the Songkhla Lake and mixes with fresh water from rivers pour to the lake.

Reduction of DO concentration becomes a severe problem in the lake due to over-fishing. Three tons of fish marine-culture around Yo Island in the Songkhla Lake was reported died in a day in August 2002. The dot along the water line in Fig. 1b indicates area with dense cultivation of sea bass.

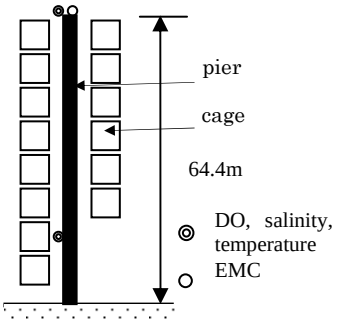

Fig. 2 Location of measuring devices

For more understanding of the mechanism of DO variation in the lake, continuous measurements have been carried out in a dense aquaculture area using automated data acquisition system to obtain current velocity, DO, temperature and salinity data. There are 8 measuring stations along the borderline of Yo Island, which collected vertical profiles. The measuring point (point A) is also installed to obtain continuous data. Field investigation of water quality was carried out from 8 to 11 October, 2006. Based on investigation data of 2005, DO concentration inside and outside of fishing cages were almost the same (Tanaka et al., 2006), therefore measurements have only been performed outside of cages.

3. Field Investigation results

Vertical profiles

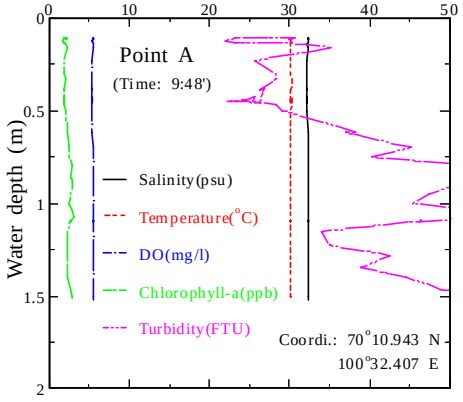

Fig. 2 Vertical profile of water quality on October 9, 2006

Figure 2 shows vertical profile of water temperature, salinity, chlorophyll-a, turbidity and DO concentration in Point A of measurement on October 9, 2006. It is

noteworthy that the whole of water quality parameters show almost uniform profiles in vertical direction.

Time variation of water quality parameters

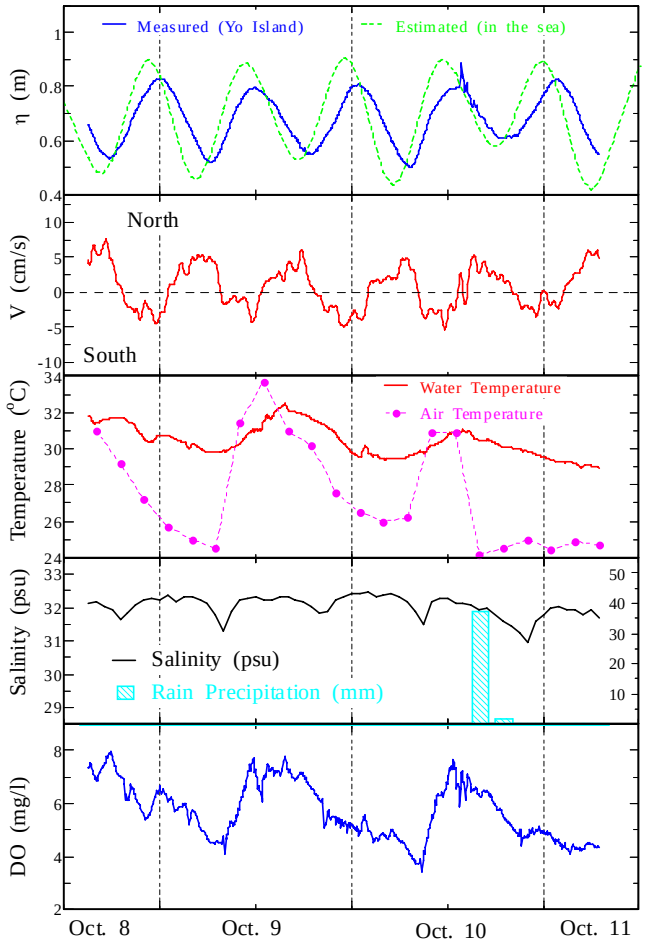

Fig. 3 Time-variation of Water level, Velocity, Water temperature, Air temperature, Salinity and DO

Figure 3 reveals time variation of water level, current velocity, water temperature, air temperature, salinity, rain precipitation and DO concentration at the point A. It can be clearly seen a good correlation between DO and both air temperature and water temperature, except period of 16h-19h on October 10, due to heavy rainfall. This interesting phenomenon well reflects the photosynthesis process affecting DO concentration in the Songkhla Lake.

4. Simulation results

In this study, a transfer sigmoid function and a single layer network is used. After checking the quantitative correlation between DO concentration and other external forces, three inputs data are selected as water temperature, air temperature and salinity. The output result is DO concentration at the point A. Detailed explanation for calculation method can be found elsewhere in Nguyen and Tanaka (2004), Nguyen et al (2005).

Figure 4 illustrates the ANN's simulation result for DO concentration. It can be seen that the simulation result fits well with observation data. A comparison between measured and calculated result is also shown in Fig. 5 with EI = 92.22% and RMSE = 0.28 mg/l.

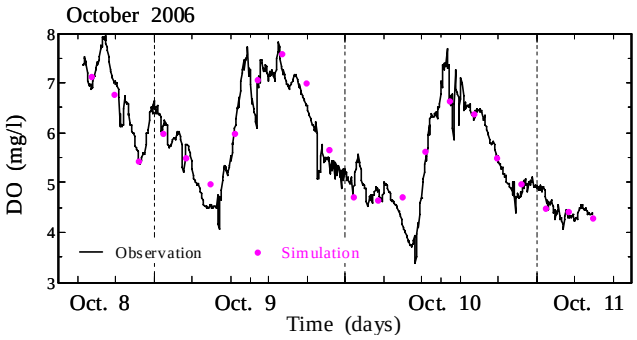

Fig. 4 Comparison of DO concentration between observation data and simulation result in October 2006 (verification)

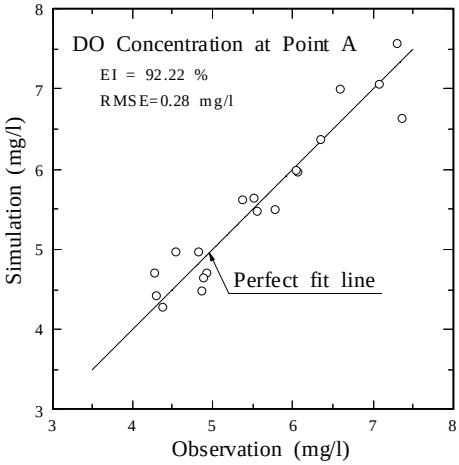

Fig. 5 Comparison between observed and simulated DO

5. Conclusions

Field investigation of water quality parameters has been thoroughly carried out in Songkhla Lake during 8-11 October 2006. In addition, simulation of DO concentration was conducted by using an ANN model. It can be recognized that the model results are in a good agreement with the measurement data, which indicates that the model is able to predict the DO concentration in the Songkhla Lake with a reasonable accuracy.

Acknowledgements

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