Ⅱ－46 Prediction of Time Variation of Salinity Concentration in the Hau River

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1. Introduction

Salinity is an important indicator for water quality and aquatic ecosystem in tidal rivers. The increase of salinity intrusion in a river may have an adverse effect on the aquatic environment system (Huang and Foo, 2002). It is basically caused by the difference in density between saltwater and freshwater. Saltwater intrusion is affected by other factors such as the river flow and duration, elevation of thalweg, slope of river channel, tidal magnitude, wind velocity and direction, and water temperature.

During the dry season saline water from the South China Sea and Gulf of Thailand moves upstream along the rivers and canals of Mekong delta. The salinity intrusion into the Mekong delta is very complicated. The highest salinity is usually observed in April. Currently 1.77 million ha of the delta lands are affected by saltwater intrusion, which not only affects irrigation development but also domestic water supply. Salinity reduces water quality and damages croplands. The problem is most severe during low flow season when there is not enough flow to prevent seawater intrusion. Strong tidal waters penetrate up to 50-70 km. The existing engineering infrastructure will be inadequate for coping with salinity intrusion, if water abstraction increases in the delta. The area affected by salinity is expected to increase to 2.2 million ha, if preventive measures are not taken up (WUP-JICA, 2004).

About the data availability, in term of discharge and water level, hourly data is available. In term of salinity data, however, due to the budgetary limitation they just measure some days per month and in that days just some hours such as odd hourly data. So finding the missing salinity data is an important task.

The goal of this present study is to interpolate to find out the missing salinity data in the Hau River, Vietnam by using the Artificial Neural Network (ANN) model.

2. Study area

The Hau River estuary (Latitude: $9^0$20'-$10^0$45'N, Longitude: 105°00'-$106^0$42'E) is a part of Mekong River Delta in Vietnam (see Fig.1). The total catchments area of the study site is about 490 km^2. Located in the monsoon tropical semi-equatorial climate zone, the climatic regime in the Hau River is dominated by the two monsoon seasons: the north-east (dry season, from December to April) and the south-west (rainy season, from May to November).

There are 3 main gauging-stations along the Hau River: Chau Doc (CD) station (station 1-upstream) for measuring discharge, Dai Ngai (DN) station (station 2- far from river mouth 42 km) for measuring water level and salinity concentration, and My Thanh (MT) station (station 3-at the river mouth) for measuring tidal level and salinity concentration. Along the Hau River, the distance from MT station to DN station is about 42 km, and to CD station is around 217 km.

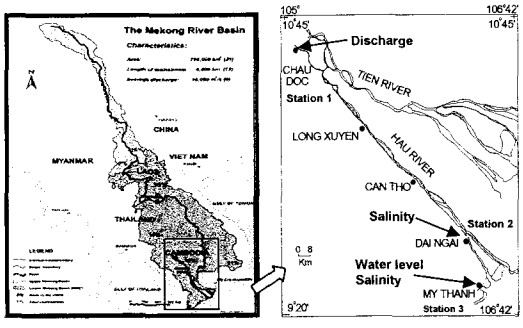

Figure 1 Study area of the Hau River estuary, Vietnam

2. Using ANN model to interpolate the missing salinity data

Up to now, various applications have been widely applied by using ANN model in forecasting natural phenomena such as time variation of rainfall, river flood, water level, salinity, shoreline changes *ect.*

ANNs are flexible mathematical structures that are capable of identifying complex non-linear relationships between input and output data sets. A neural net consists of a large number of simple processing elements that are variously called neurons, units, or nodes. Each neuron is connected to other neurons by means of direct communication links, each with an associated weight that represents information being used by the net to solve a problem. The net usually has two or more layers of processing units where each processing unit in each layer is connected to all processing units in the adjacent layer (Dibike and Solomatine, 1999).

ANN was applied for prediction of salinity twelve hours ahead at six potential water abstraction locations along the West Pearl river estuary in Macao, Hong Kong (Nguyen, 2002). The study indicated that with appropriate structures, ANNs were applicable for salinity prediction in estuary with satisfactory results. Nguyen and Tanaka (2004); Tanaka et. al, (2004) also showed that there were in very good agreement between observed and calculated salinity results. The results of Huang and Foo (2002) indicated that the backpropagation neural network model can be trained to provide satisfactory estimations of time series salinity responding to the changes of tide, river flow, and winds, while the conventional multiple regression method was unable to provide reasonable predictions.

In this study, a transfer sigmoid function and a single layer network will be used. Two inputs data are discharge at Chau Doc station (Q_1) and tidal level at My Thanh

staion (WL_3). The output result is salinity concentration at the Dai Ngai station (S_2).

The efficient index (EI) and root mean square error (RMSE) will be used in this study. Using learning process for odd hourly salinity concentration in the Hau River has EI = 92.56 % and RMSE = 0.13 psu. It can be seen that there are satisfactory between observation and calculation results (see Fig.2).

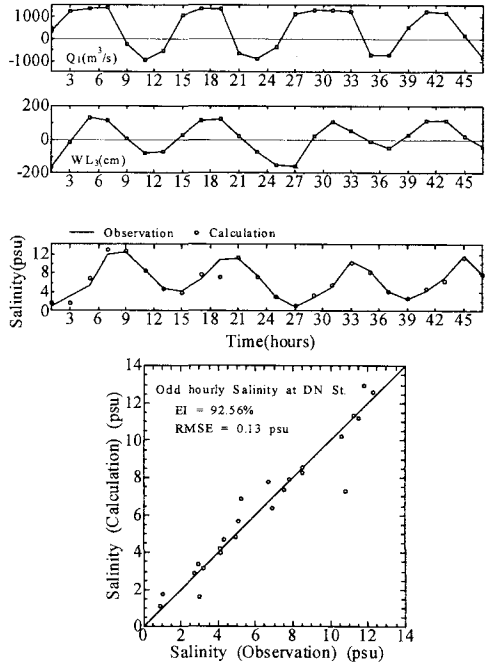

Figure 2 Learning process for odd hourly salinity in 2 days 1st and 2nd April 1998

After learning, we keep the same ANN structure for testing process to find the missing even hourly data of salinity in 3 days 5th, 6th and 7th April 1998. The results of interpolation process can be shown as Fig. 3.

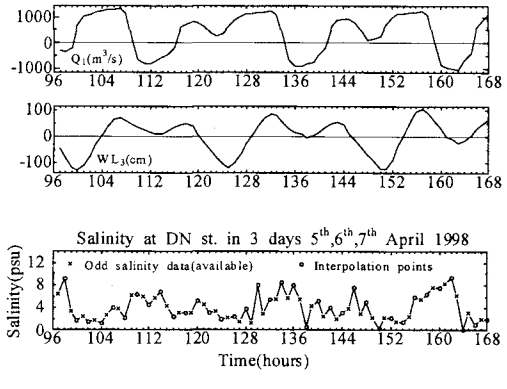

Figure 3 Interpolation for finding even hourly salinity in 3 days 5th, 6th and 7th April 1998

From the Fig. 3, it can be seen that time variation of salinity reflect its correlation agree with the trend of discharge in the upstream station and tidal level in the river mouth station.

3. Summary

Salinity intrusion is a significant issue in the lower Mekong River Delta because this delta plays an important role in Vietnam's economy and national well-being, especially rice and fish production. In the present study, we present one approach to determine the missing salinity concentration in the Hau River estuary by the use of ANN model. The results may become the necessary data for calibration or verification process of the conventional model.

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