PROCEEDINGS

International Symposium on GeoInformatics for Spatial-Infrastructure Development in Earth and Allied Sciences

Hanoi, Vietnam, 16-18 September 2004

Symposium Chairs: Nghiem Vu Khai & Takashi Fujita

Editors: Venkatesh Raghavan, Hoang Minh Hien & Nguyen Dinh Duong

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16-18 September 2004, Hanoi, Vietnam.[1]

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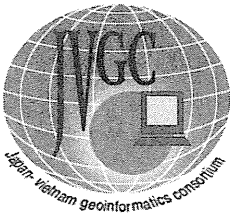

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INTEGRATION OF GIS, WEB TECHNOLOGY AND MODEL FOR MONITORING SURFACE WATER QUALITY OF BASIN RIVER: A CASE STUDY OF HUONG RIVER

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ABSTRACT

Huong River plays an important role of socio - economic development of Hue City and Thua Thien Hue province. In the today strategy of sustainable development, water environment protection of Huong River is urgent and has a high reality.

General assessment of surface water quality of Huong River, which supplies water for Hue City, is research objects in many levels. These researches show that general assessment of surface water quality of Huong River is a complex problem, because there are many external temporal factors affect surface water environment of Huong River. As a result, it is necessary to develop and apply system approaches as well as information technology tools.

This paper represents some results of applying information technology and modeling method for Huong River. Furthermore, it also takes a notice of Huong River characters and present data of Thua Thien Hue Province. Main product of these researches is ENVIMSH (ENVironmental Information Management system for Song Huong river) - software, using GIS (Geographic Information System) Technology, Database and Web Technology, has many utilities for users to look up as well as compute in different scenarios. Main functions of ENVIMSH are monitoring data management of water quality, sewer and gutter management, pollutant dispersion simulation with models and environment information for users who are interested in their quality.

1. INTRODUCTION

Aim of this research is to build an integrated tool of environmental database, GIS, model and Web technology for monitoring and management of river water quality, a case study: Huong River. All we know that general environment quality assessment is really a complex problem, because there are many external factors which usually change and they affect in environment as well as inhomogeneous characters of studied objects on time and space. In order to define environment quality, we must pay attention to mutual impacts of

data of physical, chemical, and biological processes. As a result, it is necessary to develop and apply information technology as well as environment database.

In recent years, study and apply Information Technology in general and Geographic Information System (GIS) Technology in particular in environmental management have been developed strongly in many Vietnamese science and technology centers (Bui Ta Long, et.al, 2002 - 2004). These results allow building information tools for data management relating to environmental problems as well as allow managers make decisions.

In recent years, a research group of Dr. Bui Ta Long, Institute of Applied Mechanics – Vietnamese Academy of Science and Technology carried out and made some studies and a series of software for environment management of Vietnam. Their main functions are management of monitoring data of water, air quality, of point sources, sewages; computation of pollutant dispersion and environment information. Some software INSEMAG, ENVIM have been applied in environment management, monitor for some cities and provinces of Vietnam, such as An Giang, Ba Ria – Vung Tau.

2 STRUCTURE OF ENVIMSH

Based on our past researches (Bui Ta Long, et.al, 2002, 2004), this study proposes a structure of software ENVIMSH in Figure 1. ENVIMSH includes main functions as shown in Figure 2. Main blocks and relationship between information streams in ENVIMSH are shown in Figure 3.

ENVIMSH has aims:

- Explain easily environment information;
- Support analysis of environment information;

Provide tools for analysis, assessment of different scenarios. Geographic Information System (GIS) plays an integrated basis for ENVIMSH. GIS organizes spatial information so that ENVIMSH can show maps, charts, graphs. GIS provides techniques for analysis of environment data layers and for display of relationships. ENVIMSH has a friendly-user interface. Zoom ability of ENVIMSH allows users to have a strong tool for environment analysis.

ENVIMSH includes different components for environment data analysis. These are:

- Assessment tools (data exploitation, graph drawing) which allow to analyse a heap of data;
- Utilities help to look up documents for environment monitoring and management;
- Automatic reports which help users to have a convenient tool for making reports basing on monitoring data from database.

Assessment tools in GIS environment allow users to estimate a chosen region, organize information, and display results. Computation modules allow users to value effect of pollutant discharge on a chosen region. ENVIMSH is designed mainly for environmental monitoring data management. In Vietnam idea of building databank for environment management is just in initial phase. In future, when Vietnam has national databanks, ENVIMSH will be expanded to directly access environmental databanks.

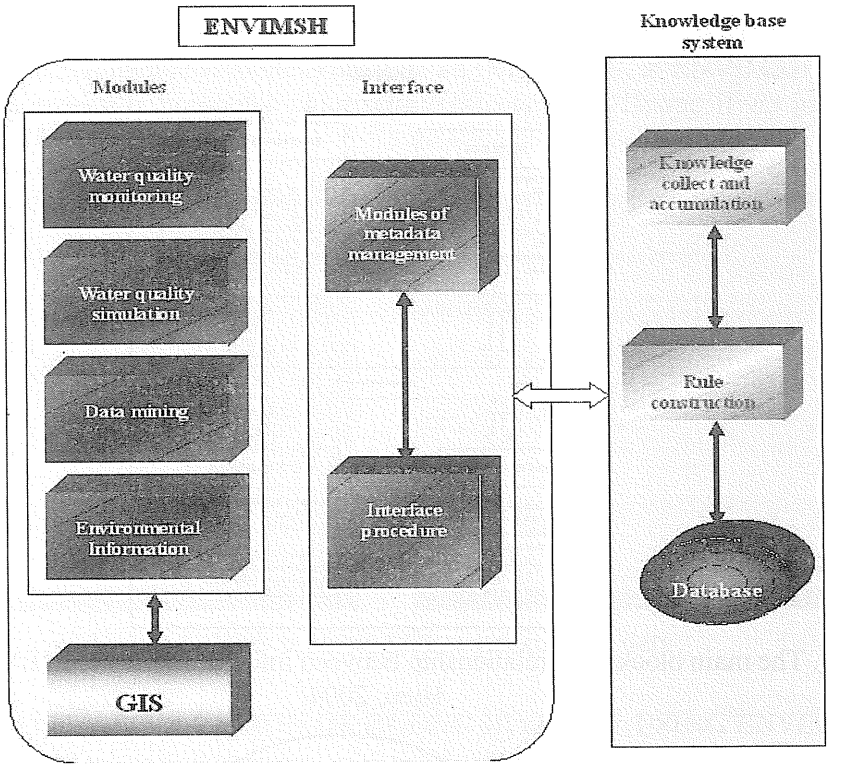

Figure 1. The principal scheme of the ENVIMSH

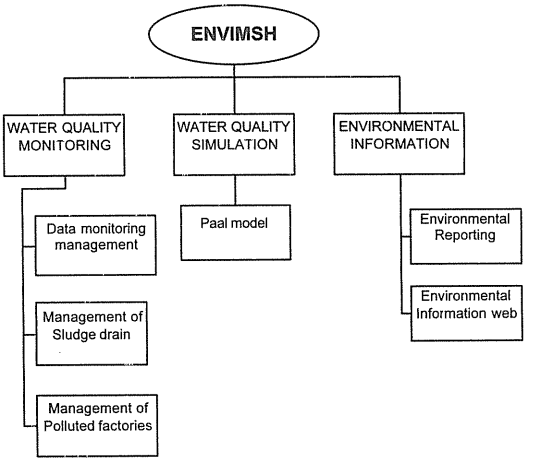

Figure 2. ENVIMSH information units /Ngoc Hieu,2004/

Water quality monitoring is one of main functions of ENVIMSH, based on actual situation of data collection in Hue, ENVIMSH integrated data from different departments, branches, centers as shown in Figure 4. Web reporting for monitoring data are shown on Figure 6.

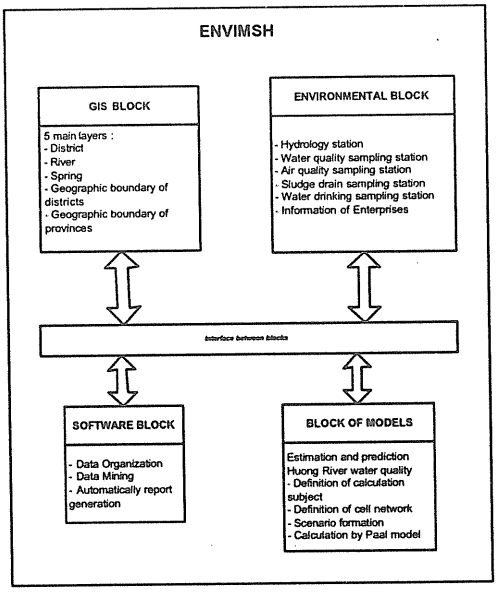

Figure 3. The main blocks and relationship between information flows in ENVIMSH /Ngoc Hieu, 2004/

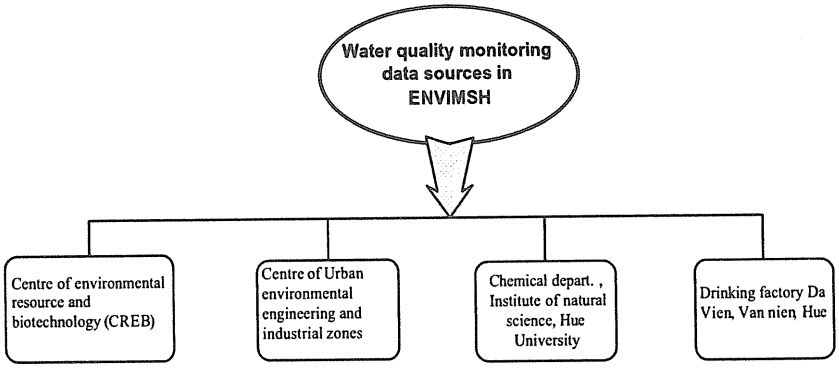

Figure 4. Water quality data sources integrated in ENVIMSH /Ngoc Hieu, 2004/

Based on experience of building software INSEMAG, ENVIM /Bui Ta Long, 2002/ and based on actual situation analysis of Huong River, this research has studied and built an environment database for ENVIMSH.

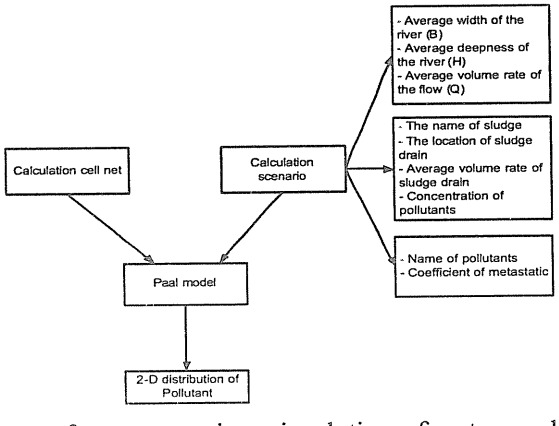

Figure 5. Automatic phases for computation, simulation of water quality in ENVIMSH/Ngoc Hieu, 2004/

Based on the mathematical model Paal /Bui Ta Long, 2002/, in ENVIMSH, we built a module which automatically computes point source effects along Huong River in the scope and limit of the subject /see Figure 5/.

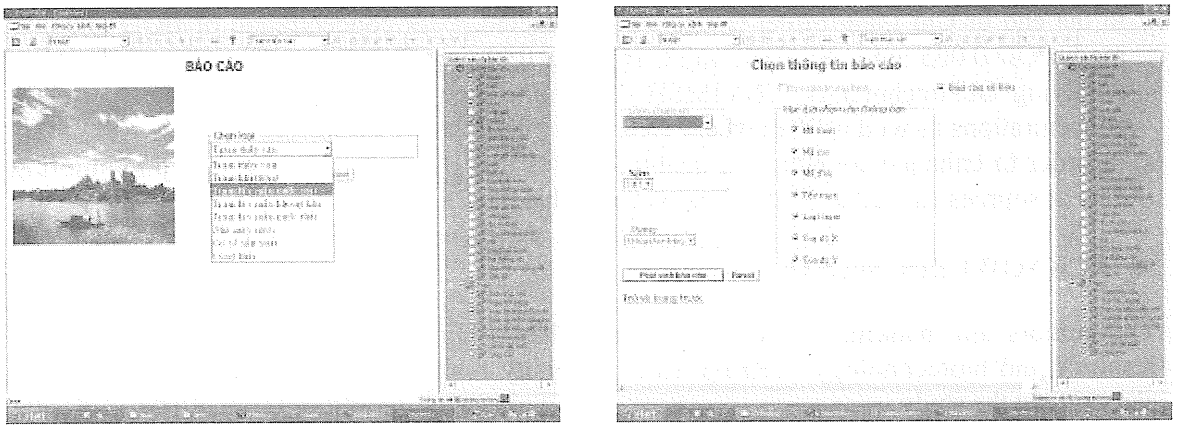

Figure 6. Web reporting for water quality data

3 WATER QUALITY SIMULATION OF HUONG RIVER BY USING ENVIMSH

Based on the above mathematical model, ENVIMSH can compute selected pollutant distribution in sites near the pollution source. Computation scope includes 12 drains from the beginning of Le Loi Street to the end of Chi Lang Street. Due to lack of data, the following computation results are not to include all of factors as well as accuracy of computation. Therefore its simulation focuses on quality than quantity.

Based on collected data, we will compute and simulate 12 drains from the beginning of Le Loi Street to the end of Chi Lang Street. In order to apply ENVIMSH, these drains are divided into 2 computation grids : grid 1 includes 8 drains (Figure 7), marked from SH1 to SH8, grid 2 includes 4 drains, marked from SH9 to SH12.

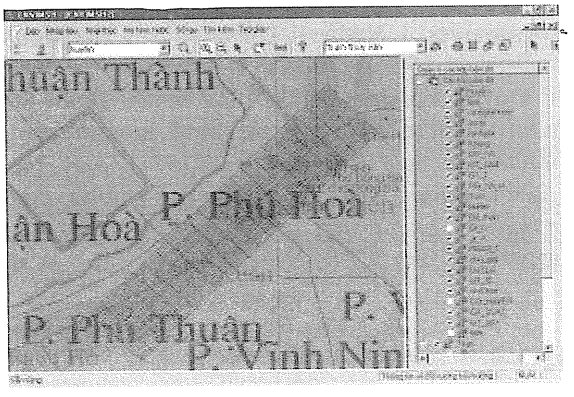

Figure 7. Computation mesh for drains from Ho Chi Minh Museum to Dap Da

Based on computed simulation results with Paal Model for Huong River, we can have some conclusions:

- According to history data (2002 – 2003), computation by ENVIMSH shows that water quality of Huong River reach from the beginning of Le Loi Street to the end of Chi Lang

Street is rarely affected by dismissed drains. Peak concentration of BOD is 0.00047 mg/l, COD 0.0024 mg/l, SS 0.0015 mg/l, and TDS 0.0015 mg/l.

- According to forecasted data to the year 2010, computation results by ENVIMSH show that water quality of Huong River in dismissed drains from the beginning of Le Loi Street to the end of Chi Lang Street is also rarely affected. Peak concentration of BOD is 0.002 mg/l, COD 0.005 mg/l, SS 0.012 mg/l, and TDS 0.018 mg/l.
- Applying GIS technology, ENVIMSH can define picture of 2D distribution of pollutant concentrations as well as sites where their concentrations are peak.
- In order to enhance computation quality of ENVIMSH, we should have more monitoring data at sources as well as hydraulic, hydrographic data.

4 ACKNOWLEDGMENTS

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