APPLICATION OF REMOTE SENSING AND HYDROLOGICAL MODELS FOR FLOOD MAPPING

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KEY WORDS: Remote Sensing, Hydrological, Flood Mapping

Abstract: Application of remote sensing and GIS technologies in the field of natural hazard was developed in the last century and is continued until now. Remote sensing imagery supply information when natural hazard occurs (before, during and after) that will be valuable to monitor, manage, assess and estimate the economic losses. In the tropical region, during flooding time, cloud is covered almost so that the optical image would be not sharp. Radar imagery is selected to extract the water boundary and estimate the area flooded instead of optical image. The research on natural hazard is focused in different looking angles. Some research is concentrated in extracting the water boundary only; the other research is going further by applying the GIS analysis to estimate the economic losses due to that natural hazard. Some function in set of GIS tools was also used for computing area of land use types under water during flooding time. Those approaches are quickly and accurately. The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) has extensive expertise in post-disaster impact assessment in 2004. Followed by ELAC methodology, evaluation of economic losses consists of three types as direct damage, indirect damage and secondary that information will help to consider where will be geographical regions or what will be social or economic sectors must be given priority in the rehabilitation and reconstruction process.

INTRODUCTION

Flooding is a common phenomenon in Vietnam, scale and frequency of damaging floods tend to occur increasingly in recent years. The Government of Vietnam is very interested in the problem of monitoring changes to flood prevention and mitigation of harmful effects at low levels. There are many studies of flooding in Vietnam over the basin in the major river systems such as the Red River delta, the Mekong and other river systems. However, not many studies on the combination of remote sensing materials and hydraulic and hydrological models for flood mapping, hydrological models often use hydraulic input data is measured data field and the map that have not applied remote sensing material.

To take advantage of the ability to take initiative in the image acquisition of the image receiving station at the National Remote Sensing Center, the article focuses mainly study the possibility of remote sensing image information to calibrate hydrological model MIKE11 hydraulic.

METHODS

Study areas

The study area was the left bank of Ca Lo River Basin included the Cau Bon River, Tranh river, Ba Hanh river with the total area about 180.3km^2 in Binh Xuyen districts, Linh Tam Duong and Vinh Phuc province. Scope of the study area has the geographical coordinates: from 21^{0}20' to 21^{0}30' North latitude and from 105^{0}30' to 105^{0}40' East longitude.

Figure 1: The network of rivers and streams and meteorological stations in study area

Method

Currently the application of GIS technology in analyzing terrain characteristics for hydrologic models, hydraulic been widely used around the world as well as in Vietnam. The effect brought by this technology has reduced the time for research as well as avoiding mistakes than do it manually. The model parameters for hydrology, hydraulics but there are differences but are based on the measured material; the type of map has been established based on other common technologies. It could be named the main parameters that remote sensing and GIS technology can support the service of hydrological models, hydraulic as follows:

- Parameter for calculating rain-flow including boundary basin (watershed), basin area, the parameters for calculating permeability, calculated parameters describing surface flow (length, wide basin, tributary length), calculating parameters describing groundwater flow...

- The parameters for hydraulic calculations: Diagram to calculate the main river hydraulics, highly related area, floodplain capacity, cross section, along the river.

- Extraction process (Figure 2) parameters for hydrological models, hydraulic done by following these steps:

Step 1: Collect material images, terrain models, depending on the number of sources whose data we have collected material can be in various forms to serve the specific research process.
Step 2: Perform a bent tuning types, analysis and creating a map of vegetation cover; correct the errors on the model number.
Step 3: Using GIS technology analyzes the input parameters required as stated above.
Step 4: Run and adjust the parameters to apply to the mathematical model.

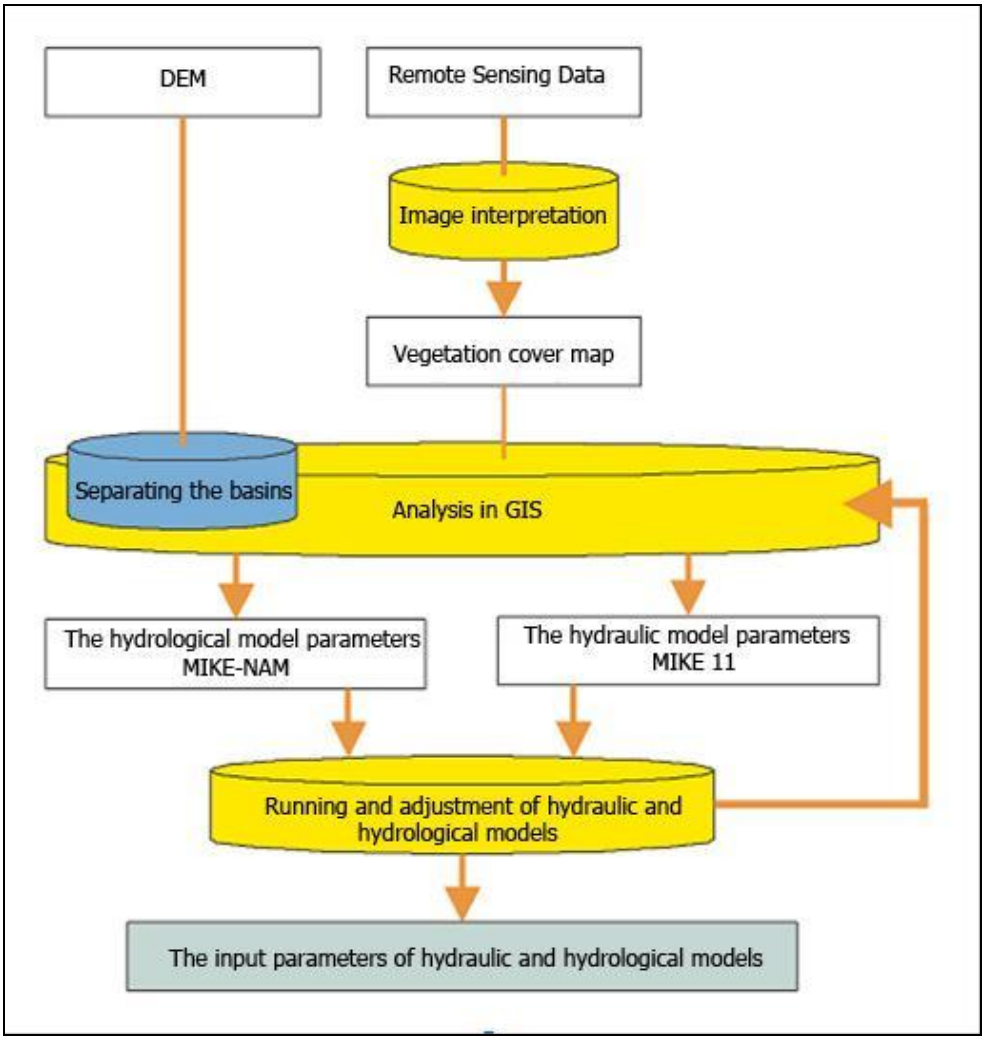

Figure 2: The process of extraction parameters and adjust hydraulic and hydrological models

APPLY AND ADJUST MODEL MIKE11

Based on the study area boundaries, hydraulic diagram is established for the study of river systems with two main rivers Pictures, Bon River Bridge (Bridge Ton) with the rivers to the sea. Cross section measurement system includes over 1,000 cross-sectional and longitudinal. According to this diagram (Figure 3), river systems and includes 2 minutes on the bottom edge; in addition to the border areas between different import for receiving direct input from the rain. Apart from the sections, to evaluate the effects of water overflowed its banks, the study adds to the cell containing the calculation diagram (Figure 4), the cells associated with this cross-sectional and longitudinal section through works as a spillway.

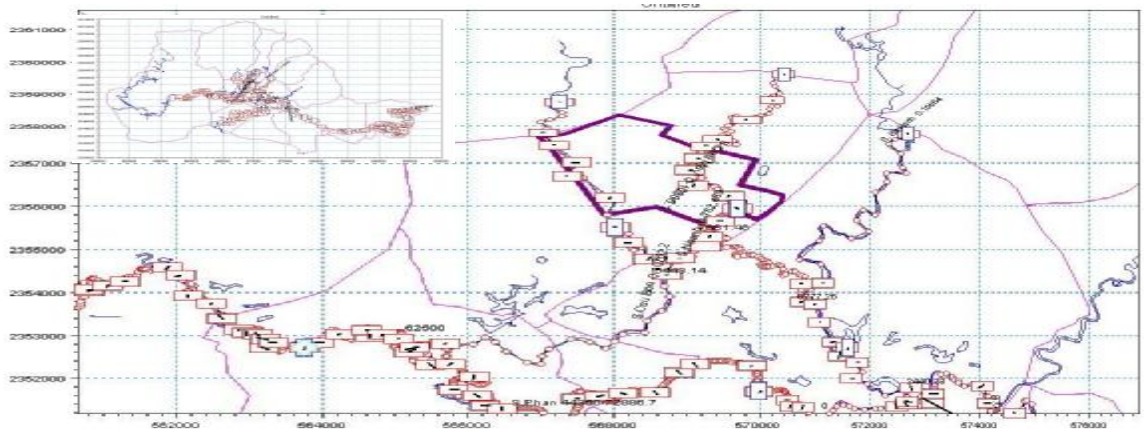

Figure 3: Diagram of network computing river hydraulic model MIKE 11

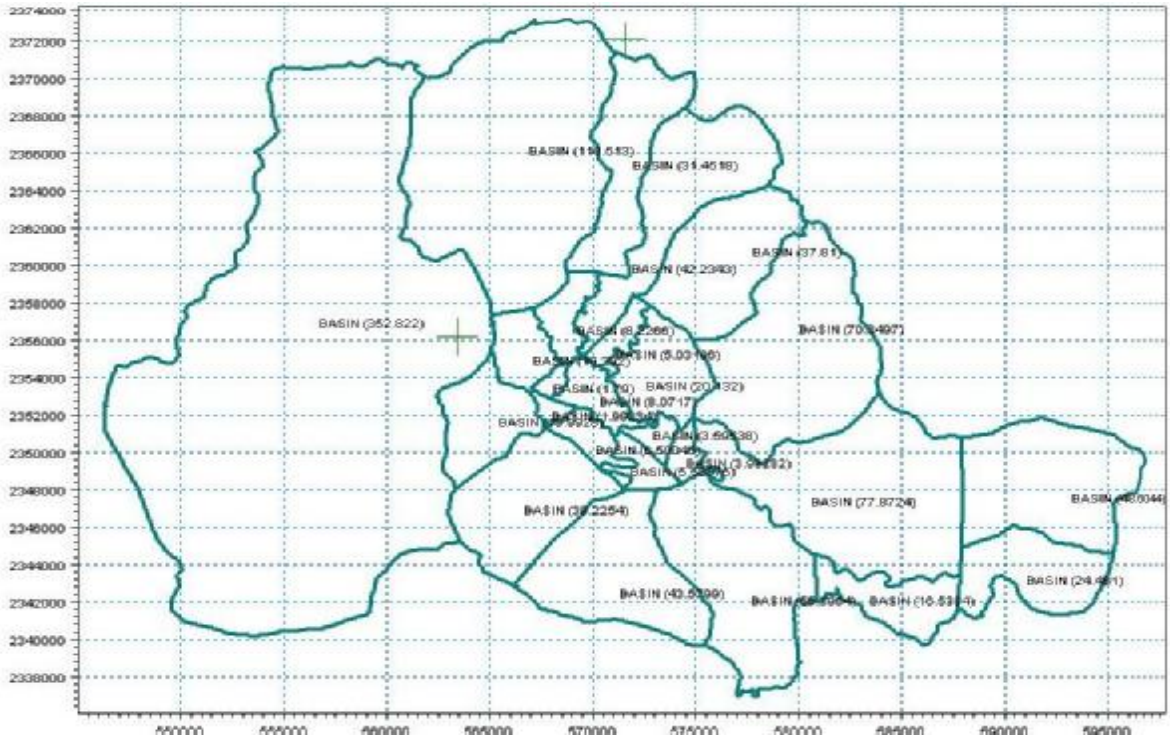

Figure 4: Schematic division of the department basin (km^2)

The system of cells after division, MIKE11 modeling analyzes, calculations relationship Z ~ F (high-area relationship). This result is integrated directly into the river to cross hydraulic simulation.

Data input:

- Minutes on, the minutes below the water level in hydro stations.
- Cross-sectional data, along the river.
- The degree of roughness can hinder the flow for each river.
- Map DEM: digital elevation model with a resolution 5m.

RESULTS

Figure 5: Results of model testing at Phuc Luong
According to measured data from 9 to August 14, 2008

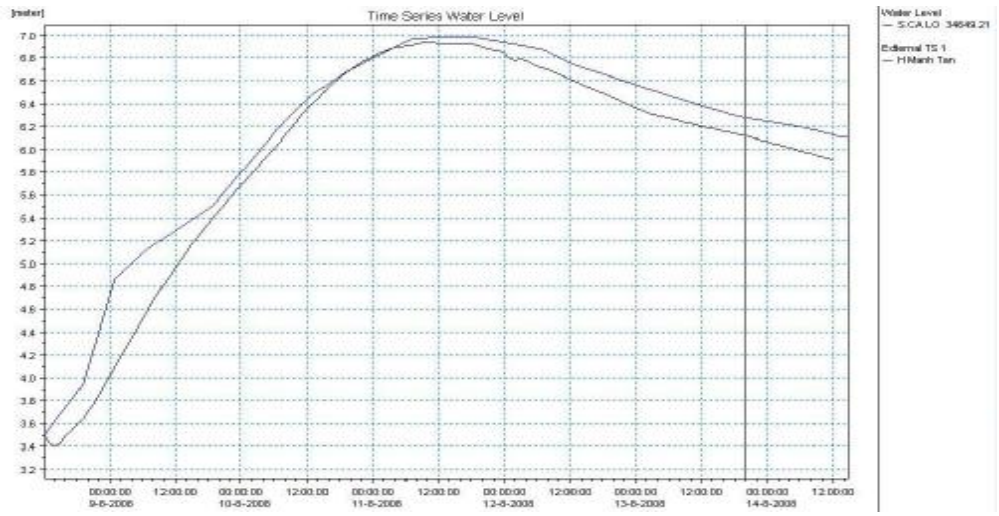

Figure 6: Results of model testing at Manh Tan
According to measured data from 9 to August 14, 2008

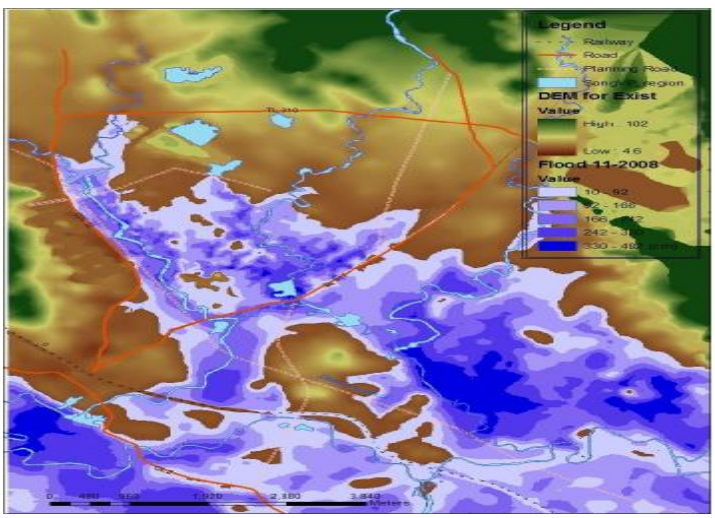

Figure 7: Depth of inundation maps for the study area (November 2008)

Figure 8: Overview of flood inundation history in November 2008 at Huong Canh

CONCLUSION

Based on the results derived from MIKE 11 model, researchers have used MIKE 11 GIS to build maps with some flood water level. Topography and data extraction from remote sensing images of the area were built with detailed precision has contributed significantly to the construction of the flood map. The initial results show that the model MIKE 11 GIS is appropriate to apply conditions in the study area of Vinh Phuc province.

ACKNOWLEDGEMENT

We are very grateful to the NAFOSTED organization for supporting me to attend this conference

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