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GEOGRAPHIC INFORMATION SYSTEM (DITAGIS)

The pre-assessment of the RRI model application capacity in the urban area Case study: Ho Chi Minh City

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1. Introduction

1.1. Necessity

1.2. Overview

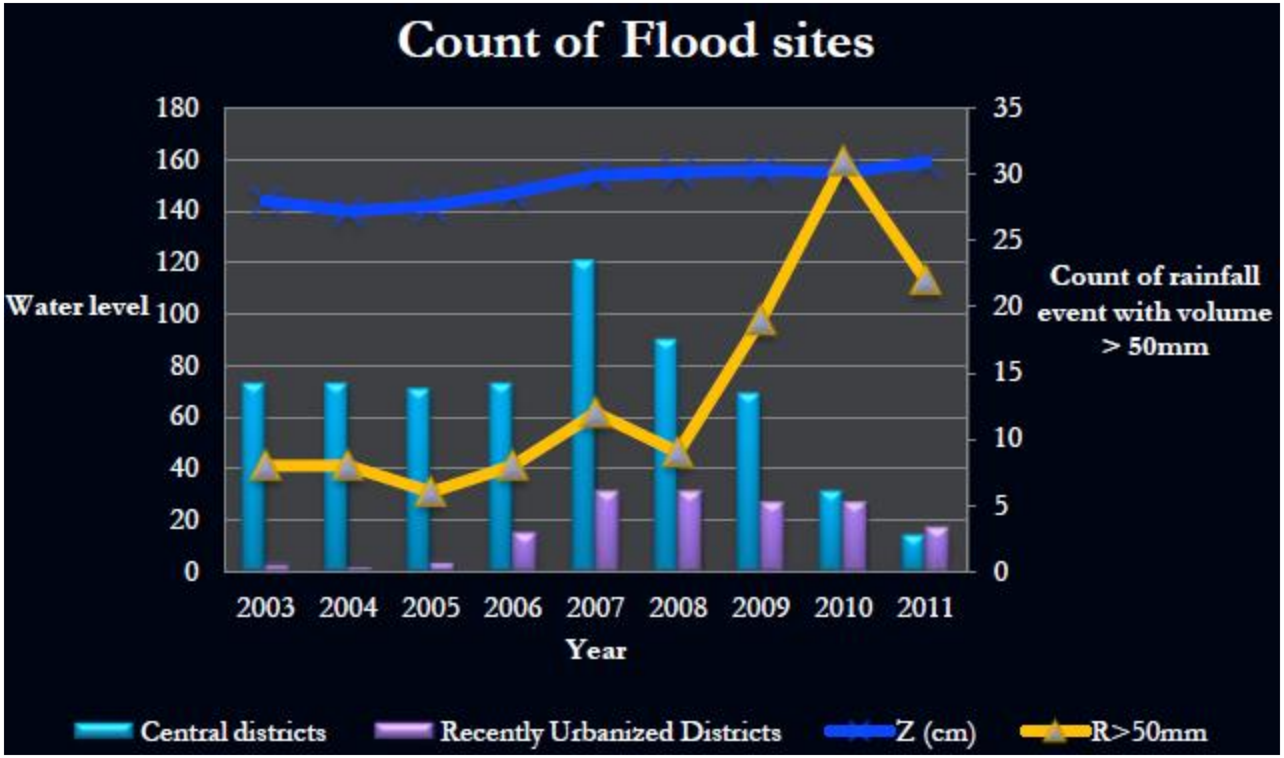
1.1. Necessity

"Flood" becomes the "brand" of HCMC

(http://laodong.com.vn/xa-hoi/ngap-lut-thanh-thuong-hieu-cua-sai-gon-164238.bld, 2013)

1.1. Necessity

Count of Flood sites



(Phi, H.L. , 2012)

1.1. Necessity

From this context:

- The model is used to predict flooding areas. From this prediction, they decide which solutions are applied for each flooding zone.
- Furthermore, managers can easily share visual and useful flooding information through maps on internet. As a result, inhabitants can be noticed and alarmed to prepare and deal with urban flooding.

1.2. Overview

1.2.1. Ho Chi Minh City

1.2.2. RRI model

1.2.1. Ho Chi Minh City

Figure 1 Effect of tide and water release by upstream areas (Trung, L.V. , 2009)

1.2.2. RRI model

- Rainfall Runoff Inundation (RRI) model is a two- dimensional model capable of simulating rainfall - runoff and flood inundation simultaneously.

1.2.2. RRI model

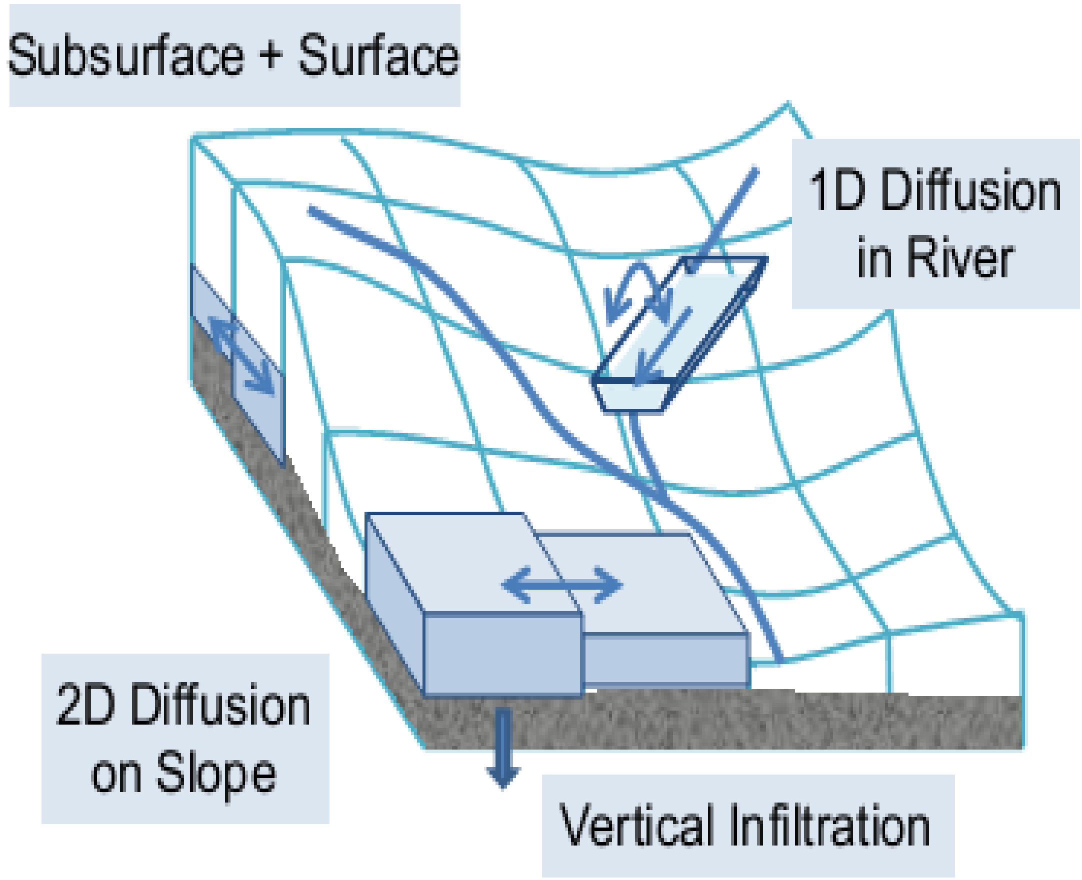


Figure 2 RRI model scheme overview (Sayama, T., 2013, p.1)

1.2.2. RRI model

- It includes three different models:

- A Rainfall-Runoff Model: It simulates the streamflow discharged from a rainfall input.
- A River Routing Model: It tracks flood wave movement along an open channel with upstream hydrograph.
- A Flood Inundation Model: It simulates the flooded water spreading on floodplains with inflow discharge.

1.2.2. RRI model

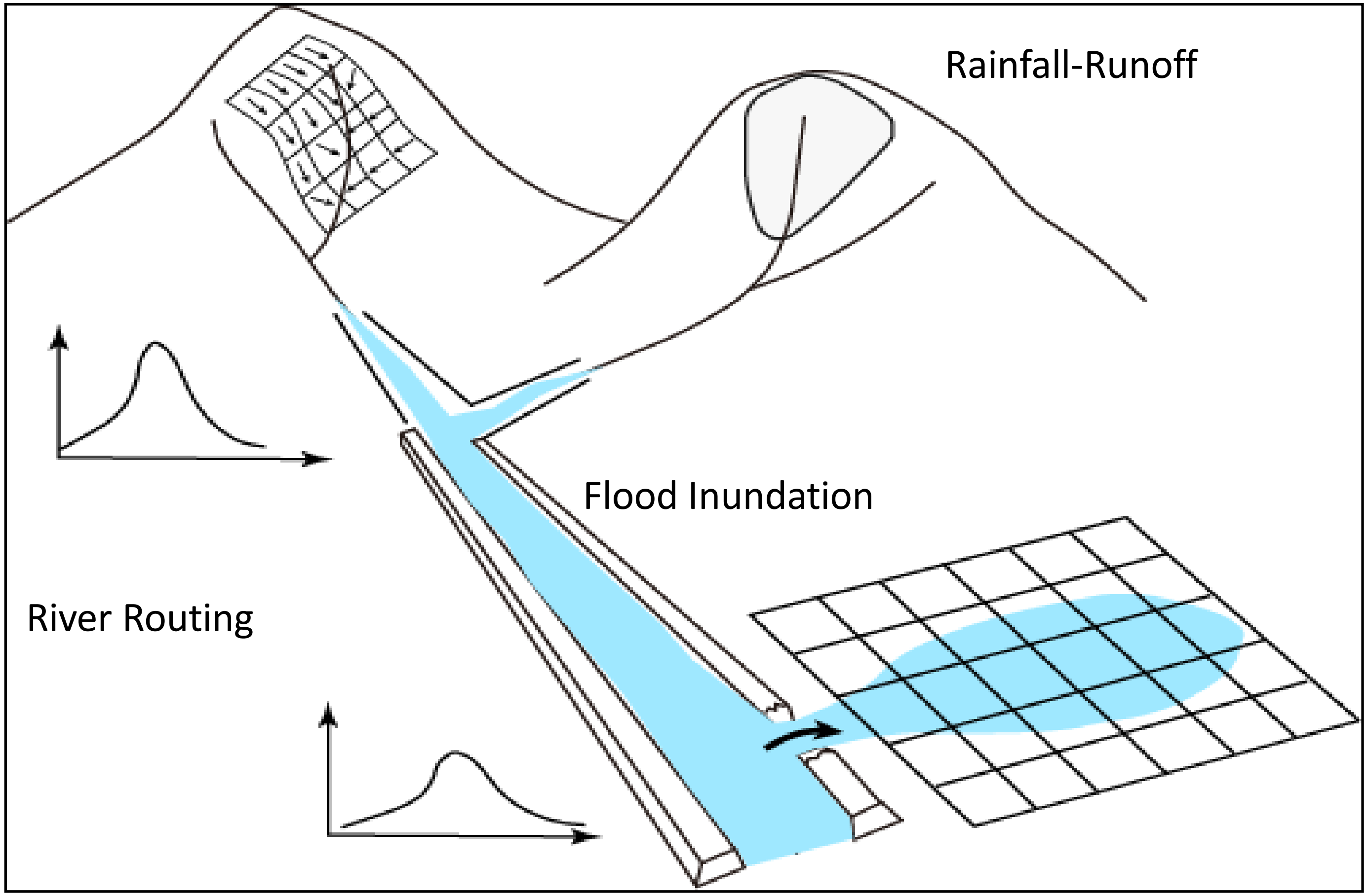


Figure 3 Three models forming the RRI Model (Sayama, T. et al, 2012)

2. Process

2.1. Input data

2.2. Main process

2.1. Input data

2.1.1. Process terrain data

2.1.2. Processing rainfall data

2.1.3. Process the flood situation

2.1.4. Process land use data

2.1.5. Prepare additional parameters

2.1.1. Process terrain data

- DEM is provided by HydroSHEDS
- Its resolution is 3 arcseconds
- From this DEM and ArcGIS (the arcHydro toolset), we can obtain the drainage direction and the accumulation flow. Those three data constitute the topological dataset that are used in the RRI model.

2.1.1. Process terrain data

- The RRI model contains the tool **"demadjust"** that can lift and curve the DEM. This tool is recommended because it corrects the eventual inconsistencies of the drainage direction data.

2.1.1. Process terrain data

- Use GRASS GIS to create sub-basins

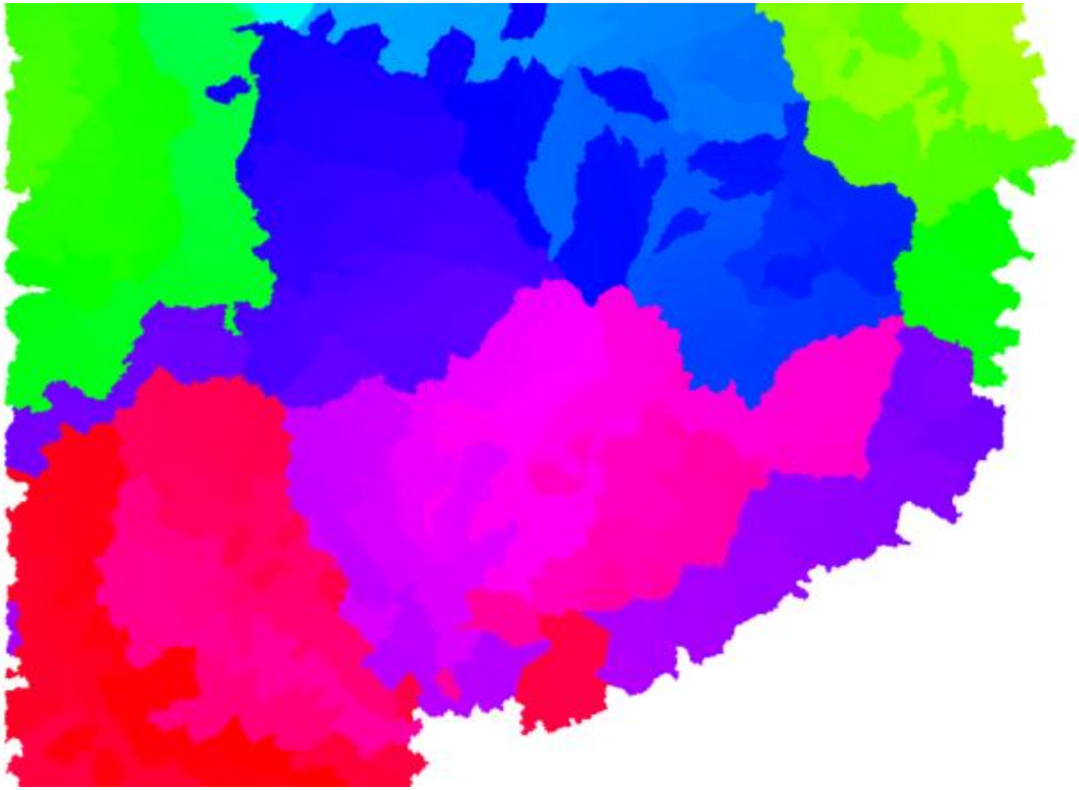


Figure 4 Delineation of the sub basins of the large zone

2.1.1. Process terrain data

- Select the research area: the center of HCM

Figure 6 DEM, drainage direction, accumulation flow of the center of HCMC

Figure 5 The selected research area (blue color) is the center of HCMC

2.1.2. Processing rainfall data

- Data is taken from Urban Drainage Company Single Member Ltd.
- Data is taken from GSMaP. GSMaP data is 0.1 decimal degree which is around 11km
- Use the tool **“rainThiessen”** of RRI model together with the spatial interpolation of ArcGIS

2.1.2. Processing rainfall data

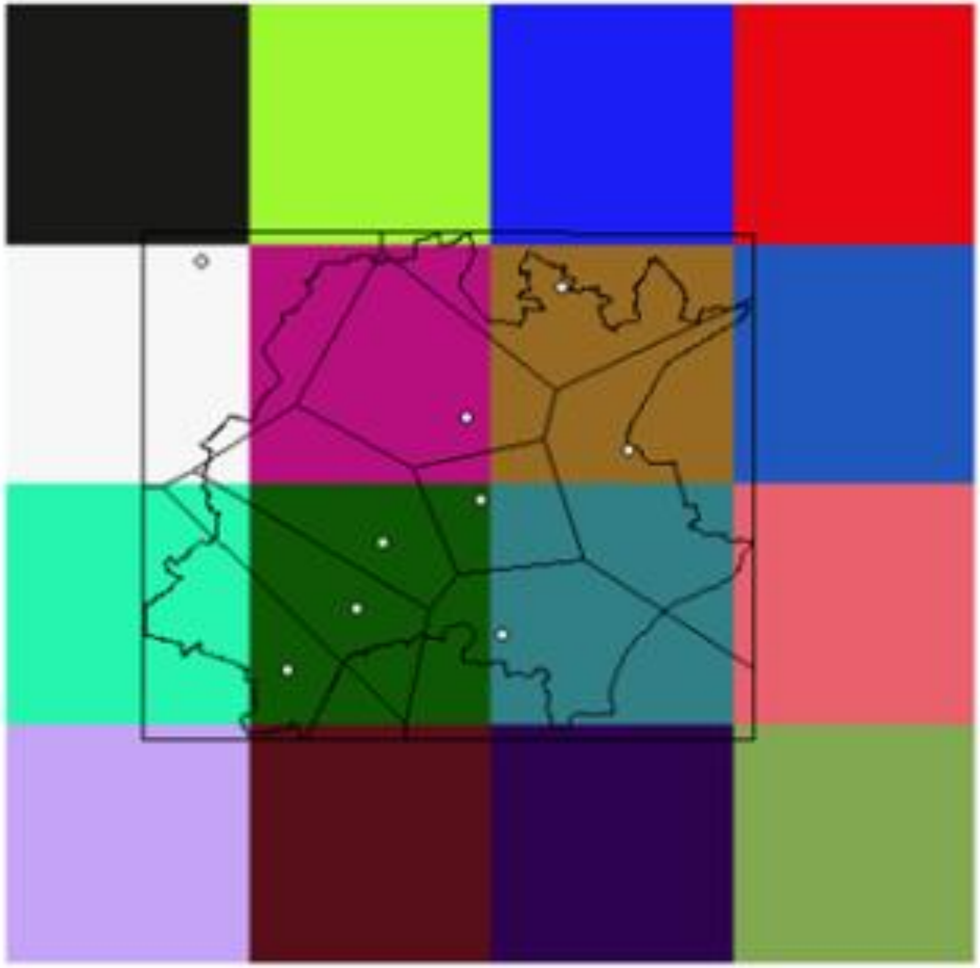


Figure 7 Overview of the different sources and format of the rainfall data

2.1.3. Process the flood situation

- Use ArcGIS to digitalize flood data

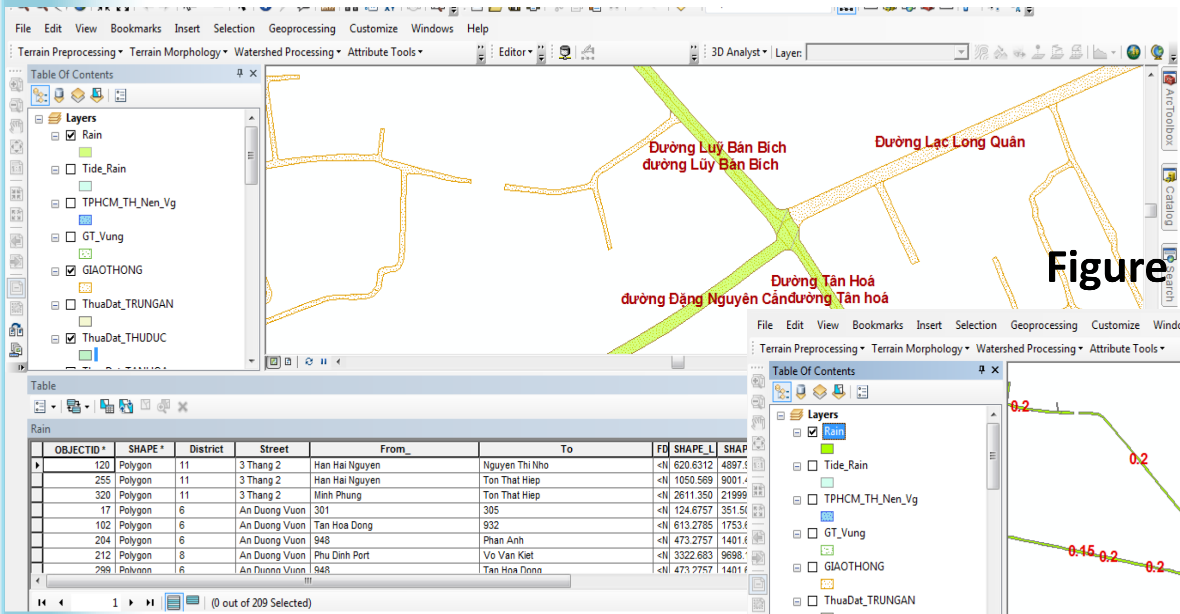


Figure 9 The set of flooding data in ArcGIS

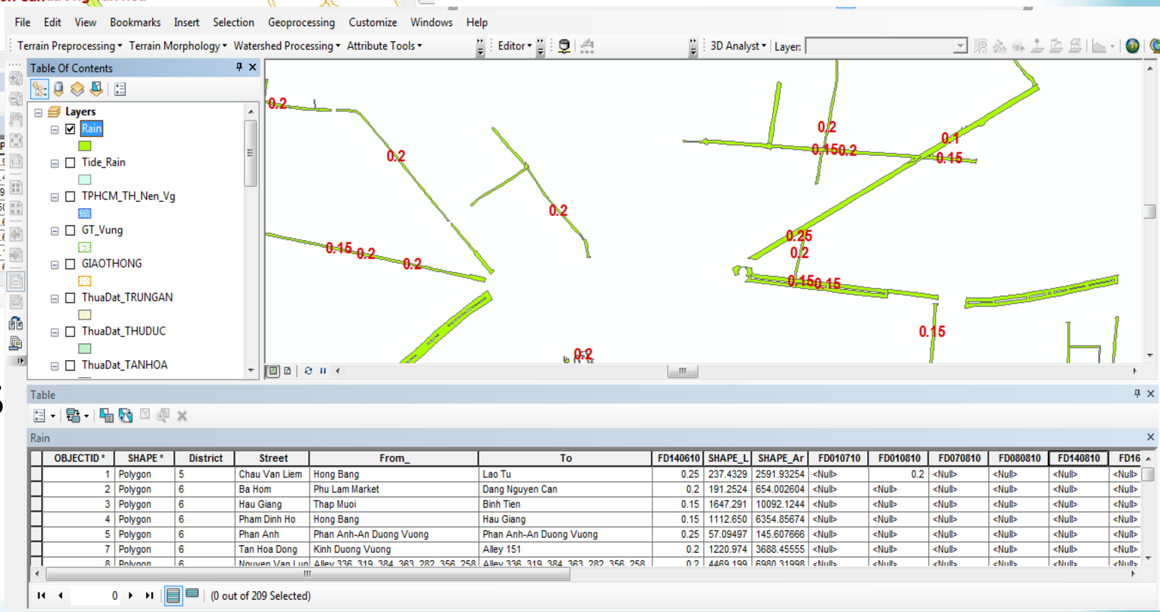


Figure 8 Draw flooding areas in ArcGIS

2.1.4. Process land use data

- Use the **“maximum livelihood”** method in ESRI to classify the land use.

Figure 16 Land use classified in 4 classes

2.1.5. Prepare other parameters

- The evapotranspiration (set up one value for the entire area)
- The Manning's roughness

2.2. Main process

- The model includes two tools to process the output. These are CalcPeak and CalcHydro.
- CalcPeak creates a new ASCII file compiling all the highest values of the water depth for each cell. We can the display it using gnuplot. It is also possible to create an image (gif) for every hour of the simulation with gnuplot and then to use the tool makeKML to create a kml file which will allow to display the results on Google Earth.

2.2. Main process

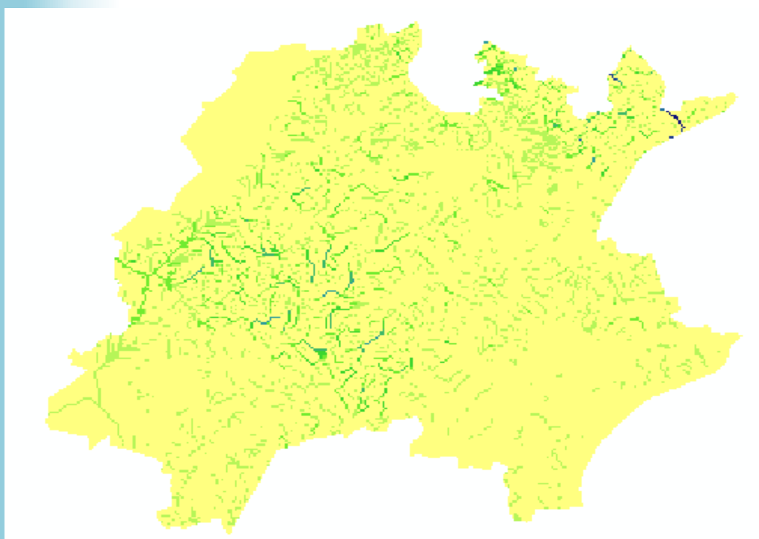


Figure 17 An example of CalcPeak results displayed with gnuplot

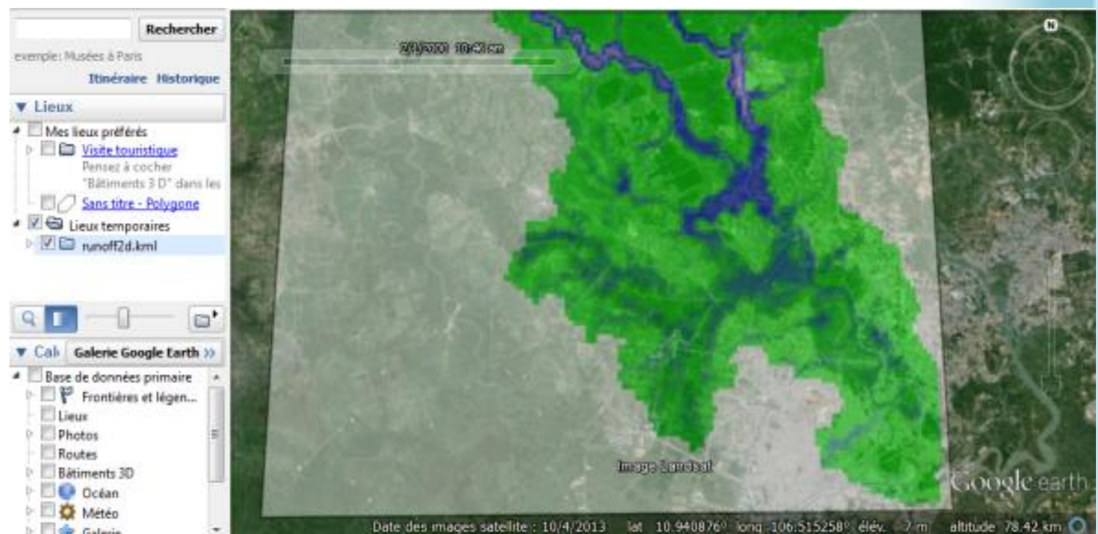


Figure 18 Display on Google Earth of the results of a simulation on the south part of Sai Gon river watershed

2.2. Main process

- CalcHydro allows us to create hydrographs of the discharge values for selected points on the river channel. The output of the CalcHydro tool is a text file containing the value of the discharge at a selected point for every hours of the simulation. Then it is possible to display the graph with gnuplot.

2.2. Main process

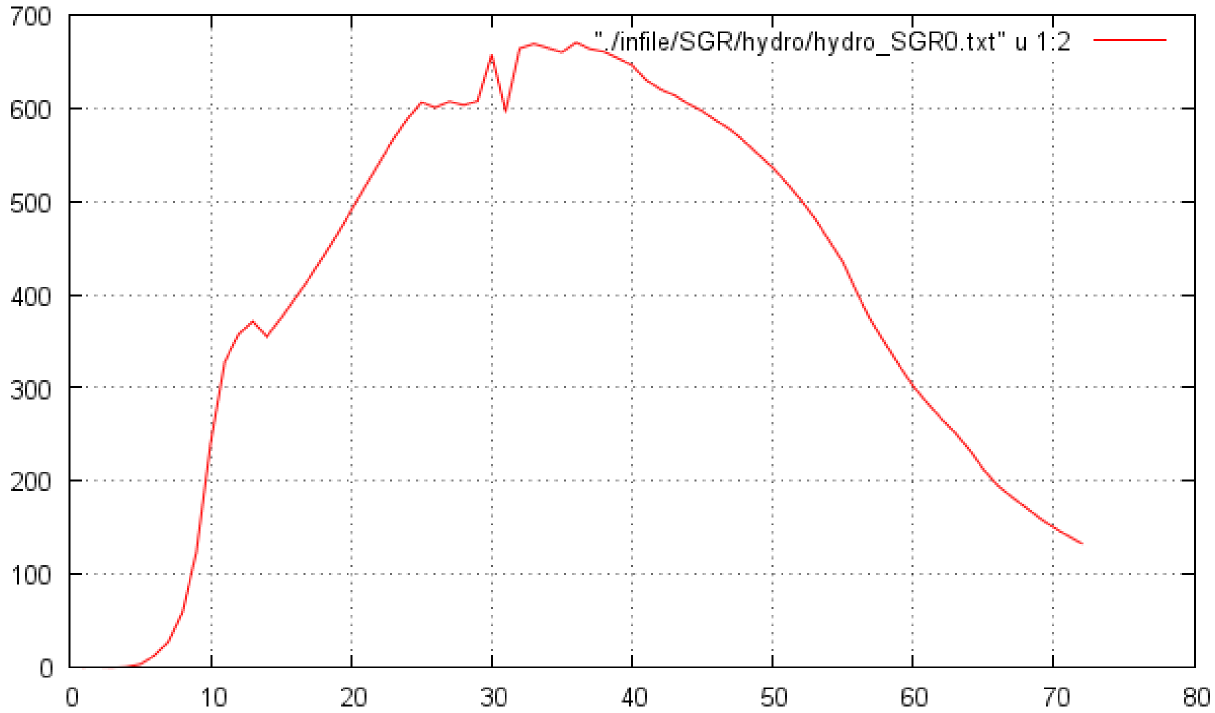


Figure 19 Hydrograph made with CalcHydro and gnuplot

3. Result & Discussion

The RRI model produces three types of outputs:

- The water depths on slope (in [m])
- The water depth on river (in [m])
- The discharge on river (in [m3/s])

In this study, the only considered output is the water depth on slope.

3. Result & Discussion

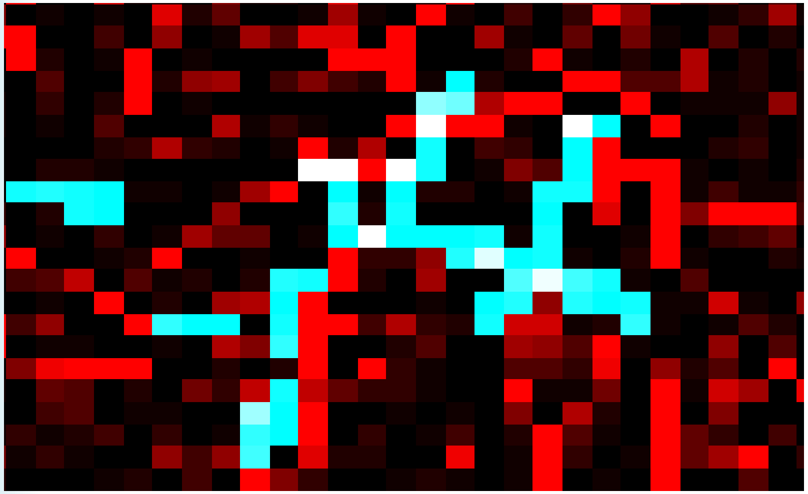


Figure 22 Two bands raster, calcPeak results and flood situation

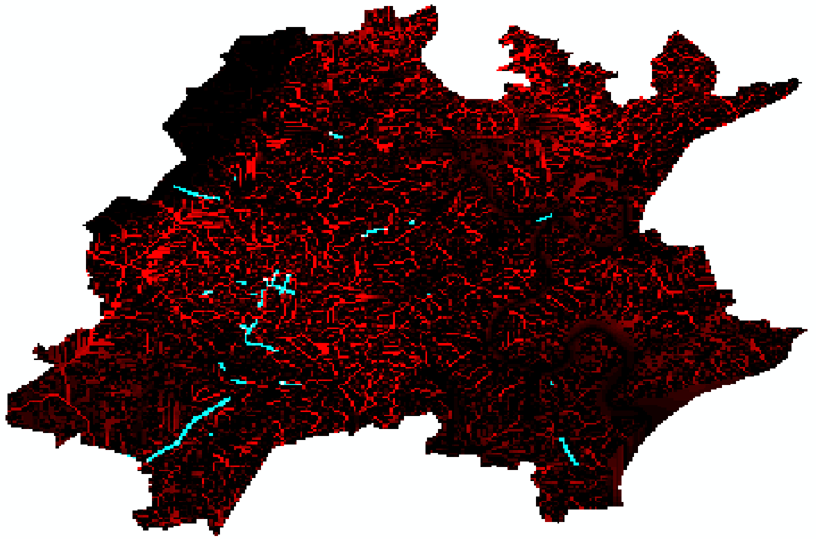


Figure 23 Entire comparison of the results

	Simulation	Flood situation
Black	low	low
Red	high	low
Cyan	low	high
White	high	high

3. Result & Discussion

- The **“Red”** zone is predominant in the result. The simulation is higher than the reality.
- The **“Back”** zone is also dominant.
- Thus, for the data of this study, the model can predict for the low water level. In the high water level zone, we need to find more data to predict it precisely.

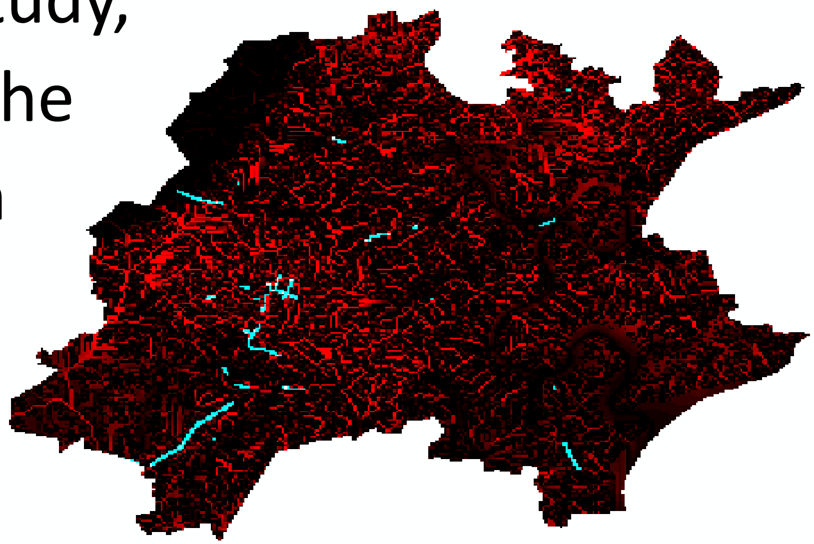


Figure 23 Entire comparison of the results

4. Conclusion & Recommendation

- Conclusion
- – From this study, the process of building a model, which can predict the flood through the rainfall, is representing detailedly
- – Nevertheless, the case study for HCMC is experimented so that it has some limitations. The result is not appropriate to the reality in the high level water zone.

4. Conclusion & Recommendation

- Recommendation:

Due to resolve these limitations , we must implement these things:

- Get the hourly rainfall
- Get the discharge data along Sai Gon River
- Get the set of dams along Sai Gon River
- Get the land use and the filtration parameter data of HCMC precisely

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