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Toward an Open Resources Using Services

# **Development of Spatial Decision Support System (SDSS) for Flood Risk Management: Case study in Vu Gia Thu Bon River Basin, Quang Nam province, Vietnam**

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- Project Office

- Room RD405A, Rang Dong Building
- Nong Lam University, Ho Chi Minh City



Đơn vị chủ quản Client:  Đơn vị chủ trì Host: 

» Văn phòng Đề tài cấp Nhà nước KC.01.24/11-15  
**Hệ hỗ trợ trực tuyến cảnh báo lũ cho lưu vực sông Vu Gia - Thu Bồn, tỉnh Quảng Nam**

» National Project Office | Code: KC.01.24/11-15  
**Decision Support System for Real-time Flood Warning in Vu Gia - Thu Bon river basin, Quang Nam province**

**RD405A**



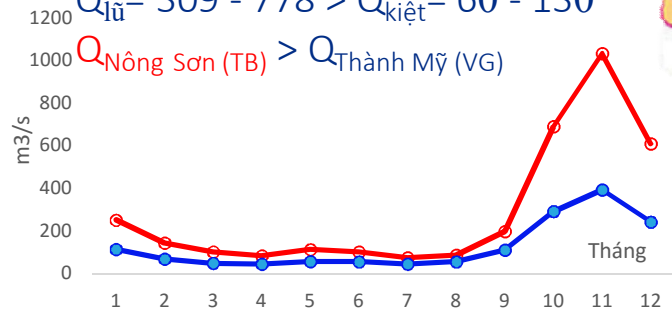
# Vu Gia - Thu Bon River Basin

$W_{bq} = 20,1 \text{ tỷ m}^3, Q_{bq} = 400 \text{ m}^3/\text{s}$

Phân phối Q ( $\text{m}^3/\text{s}$ ):

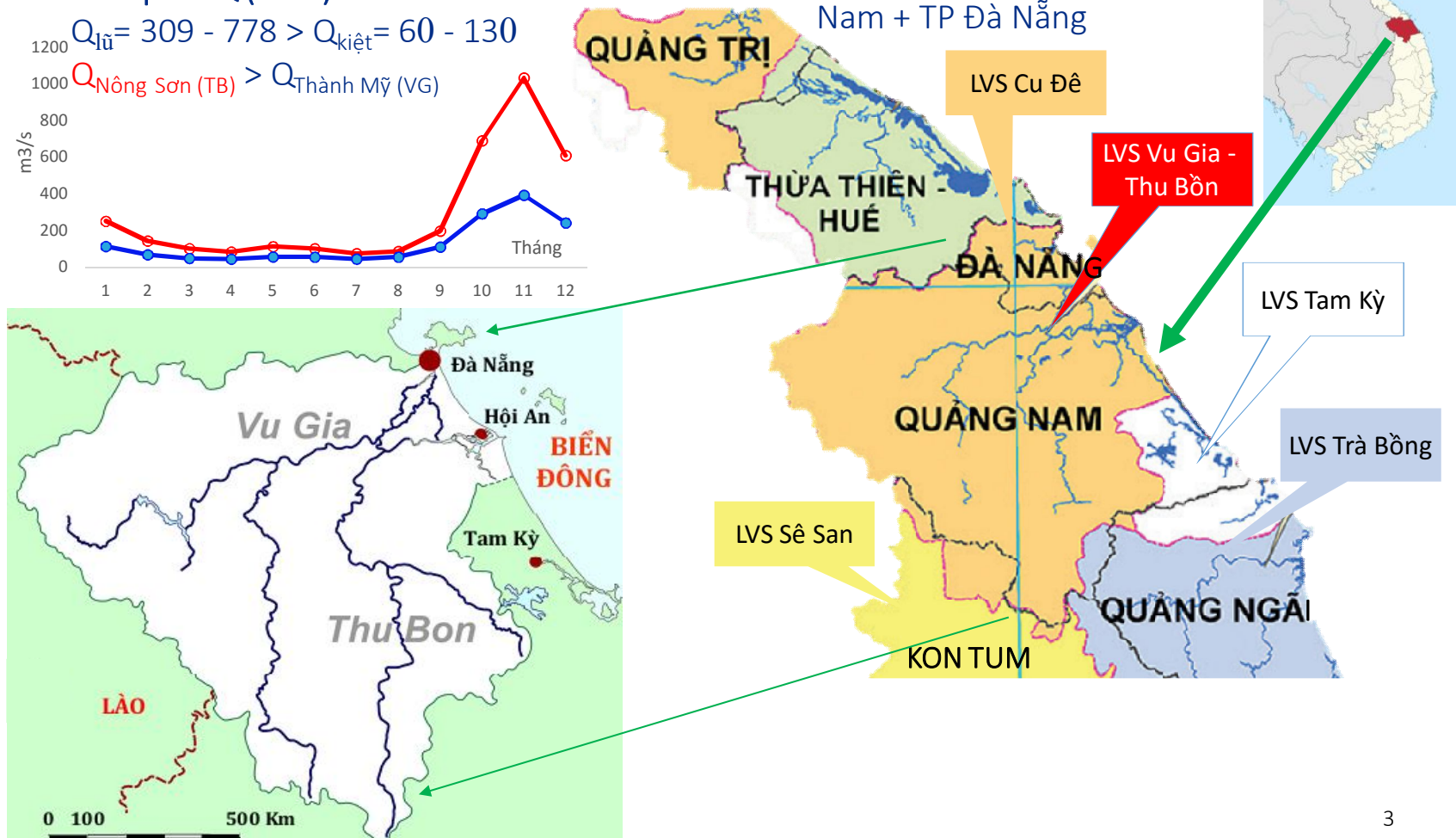
$Q_{lũ} = 309 - 778 > Q_{kiệt} = 60 - 130$

$Q_{\text{Nông Sơn (TB)}} > Q_{\text{Thành Mỹ (VG)}}$



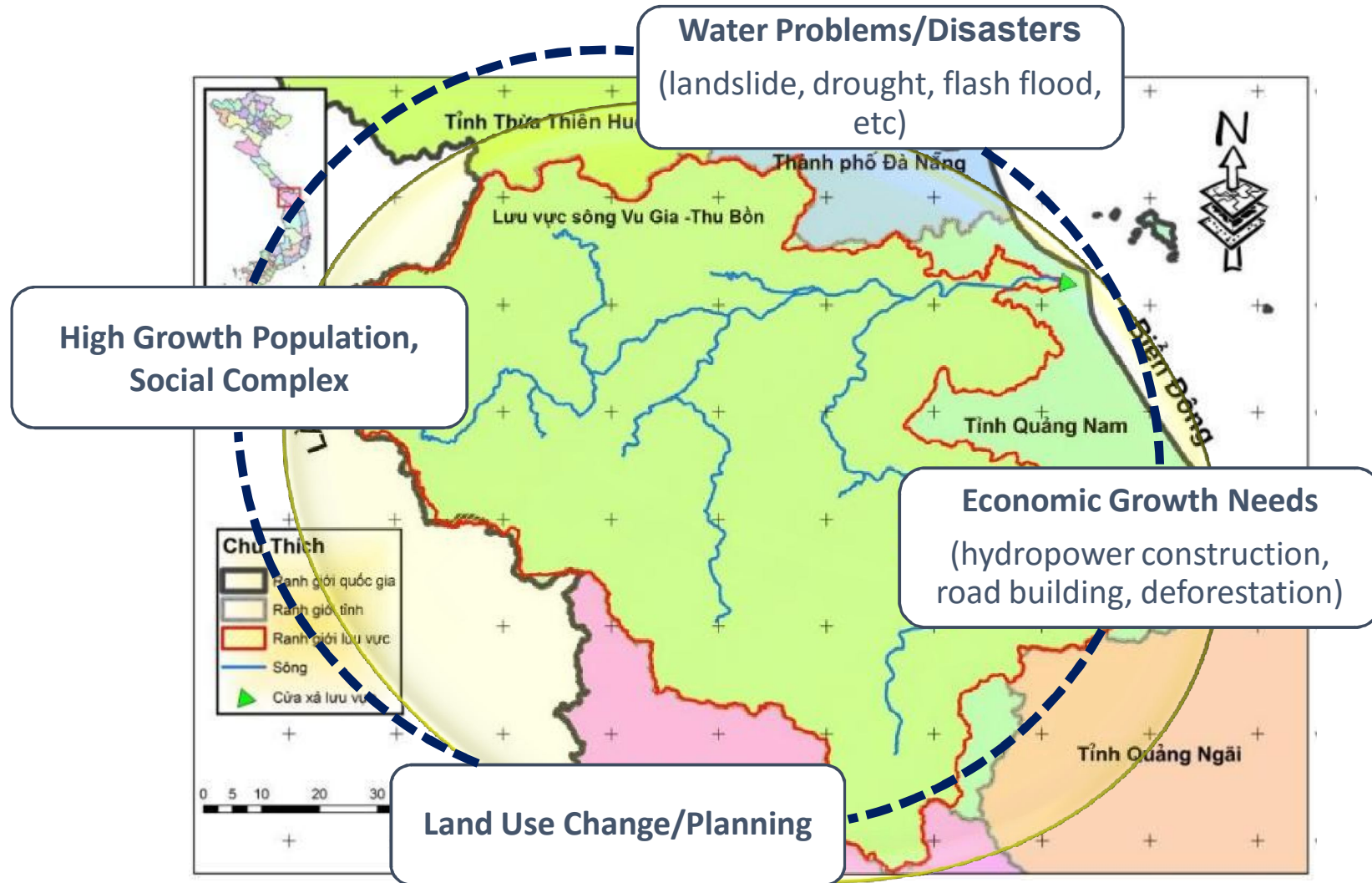
$S = 10.350 \text{ km}^2$

3 tỉnh thành: Kon Tum + Quảng Nam + TP Đà Nẵng

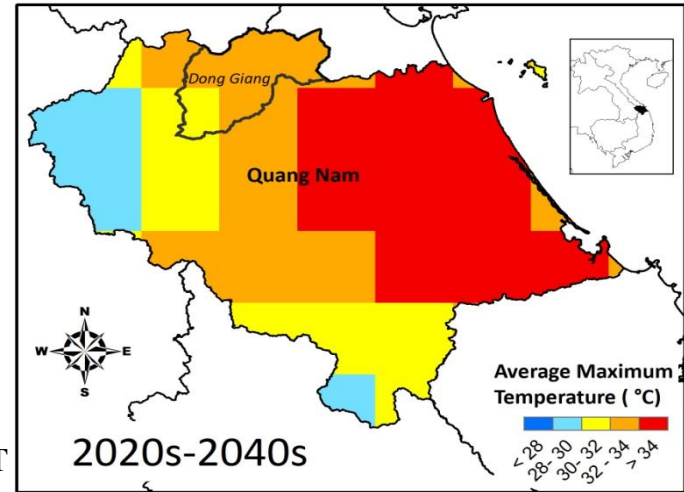
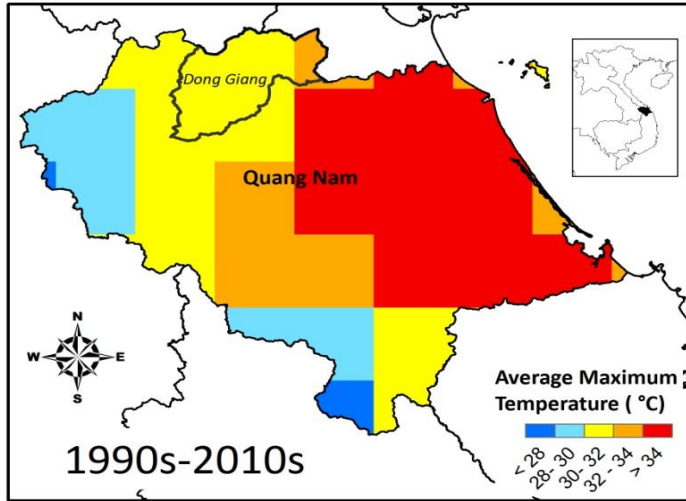




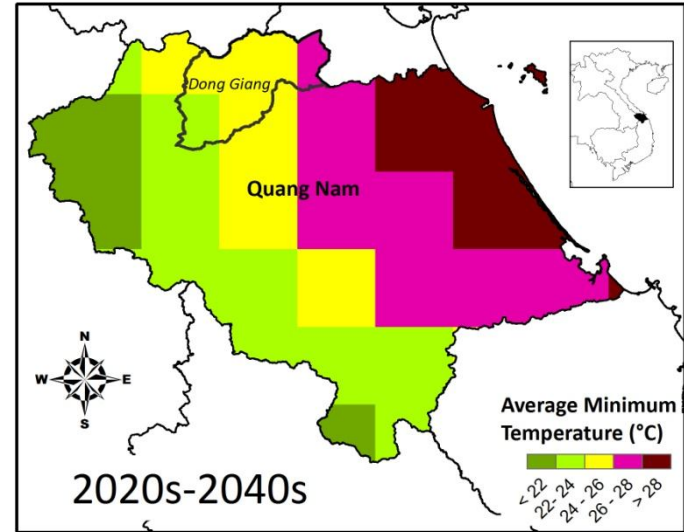
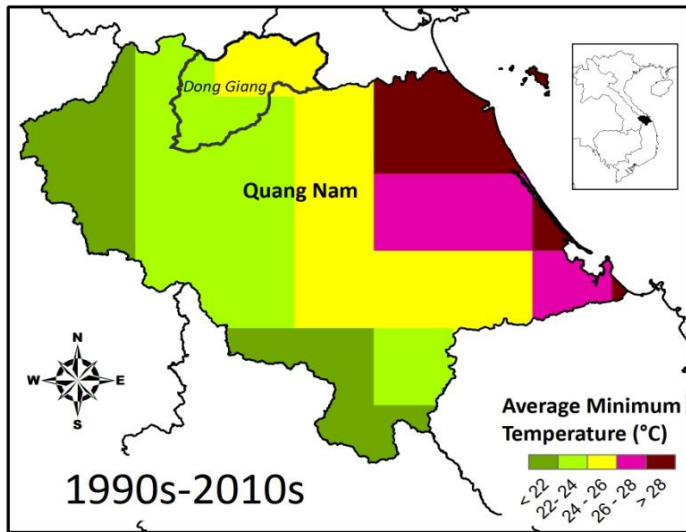
# Quang Nam province problems



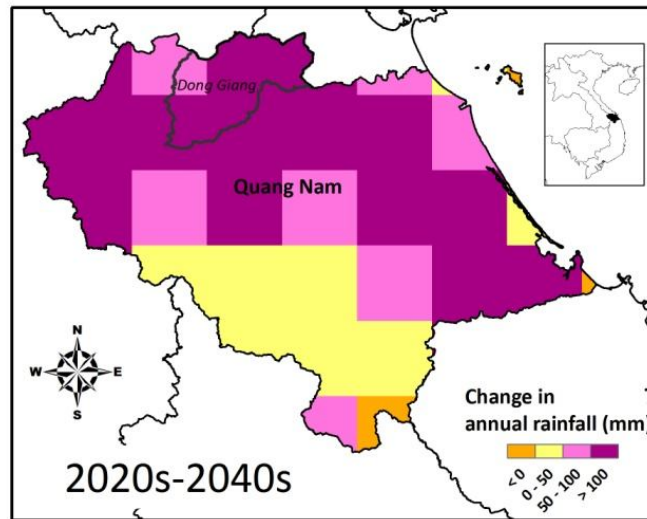
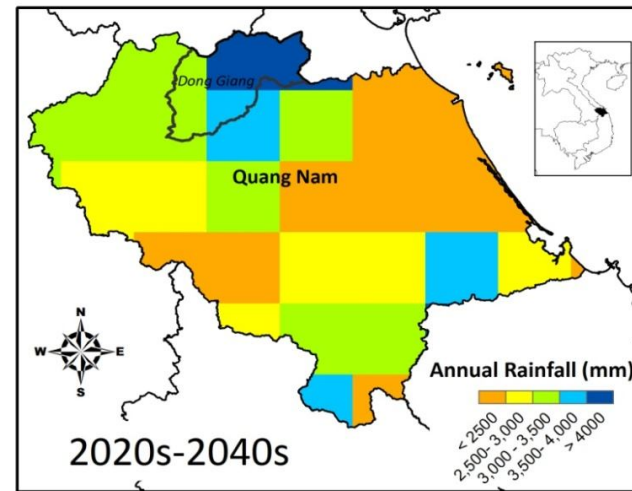
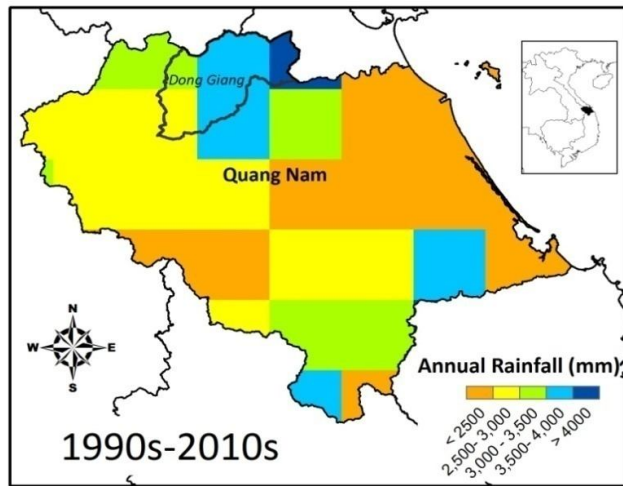
# Temperature trend in Quang Nam province



Source: SEA-START Center, RCCC-NLU, Dragon Inst.



# Rainfall trend in Quang Nam province

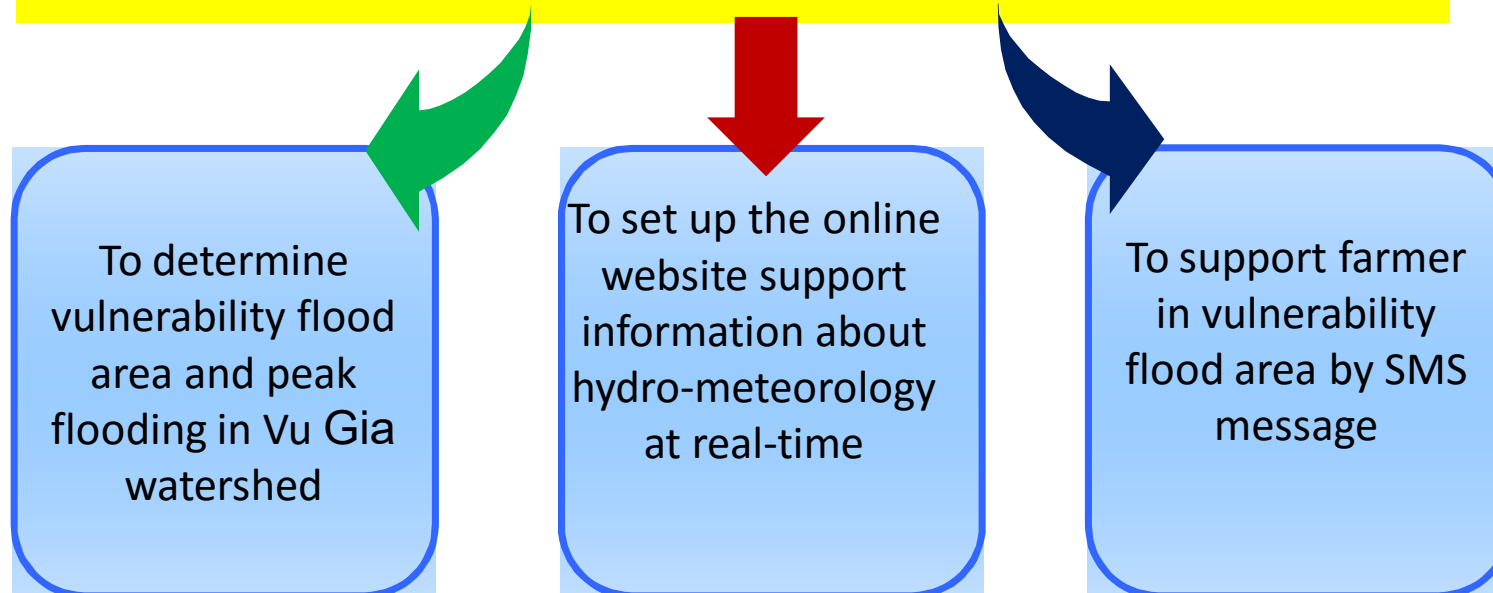


**Source: SEA-START Center, RCCC-NLU, Dragon Inst.**



## Objectives

To develop Spatial Decision Support System (SDSS) for Real – time Flood Warning in Vu Gia – Thu Bon River Basin for supporting farmers who live in downstream Vu Gia – Thu Bon River Basin using SWAT and HEC-RAS Model





# Data Collection

<b>Types of data</b>	<b>Sources of data</b>
<ul style="list-style-type: none"> <li>• Topography</li> <li>• Land use</li> <li>• Soil</li> </ul>	<ul style="list-style-type: none"> <li>• Department of Natural Resources and Environment of Quang Nam</li> <li>• Participatory Rural Appraisal</li> </ul>
<ul style="list-style-type: none"> <li>• Weather (rainfall, temperature, humidity, ...)</li> </ul>	<ul style="list-style-type: none"> <li>• The Middle-Middle Region Hydro-Meteorological Centre</li> <li>• Automatic Weather Stations</li> </ul>
<ul style="list-style-type: none"> <li>• Hydrology (water discharge, water level, ...)</li> </ul>	<ul style="list-style-type: none"> <li>• The Middle-Middle Region Hydro-Meteorological Centre</li> </ul>
<ul style="list-style-type: none"> <li>• Socio-economic</li> </ul>	<ul style="list-style-type: none"> <li>• Participatory Rural Appraisal techniques</li> </ul>



# Model Philosophy

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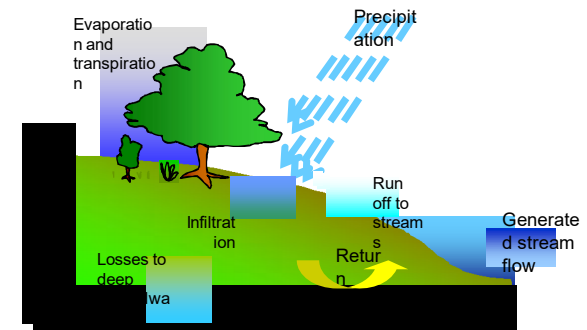
- Readily available input –  
Physically based
- Computer efficient
- Comprehensive – Process Interactions
- Simulate Management



# Data required to set-up SWAT Model

## Spatial Data

- Digital Elevation Data
- Land use /Land cover map
- Soil classification map



## Reservoir Data

- Reservoir characteristics
- Release data

## Crop Data

- Crop calendar



# Data required to set-up SWAT Model

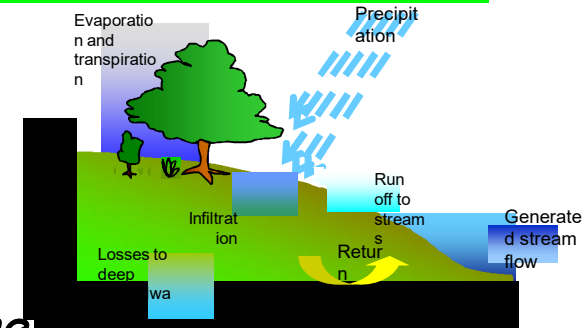
## Time Series Data

### Weather Data

- Maximum / Minimum Temperature
  - Solar radiation
  - Wind speed
  - Relative humidity
  - Rainfall
  - Evaporation
- (including the locations of stations)*

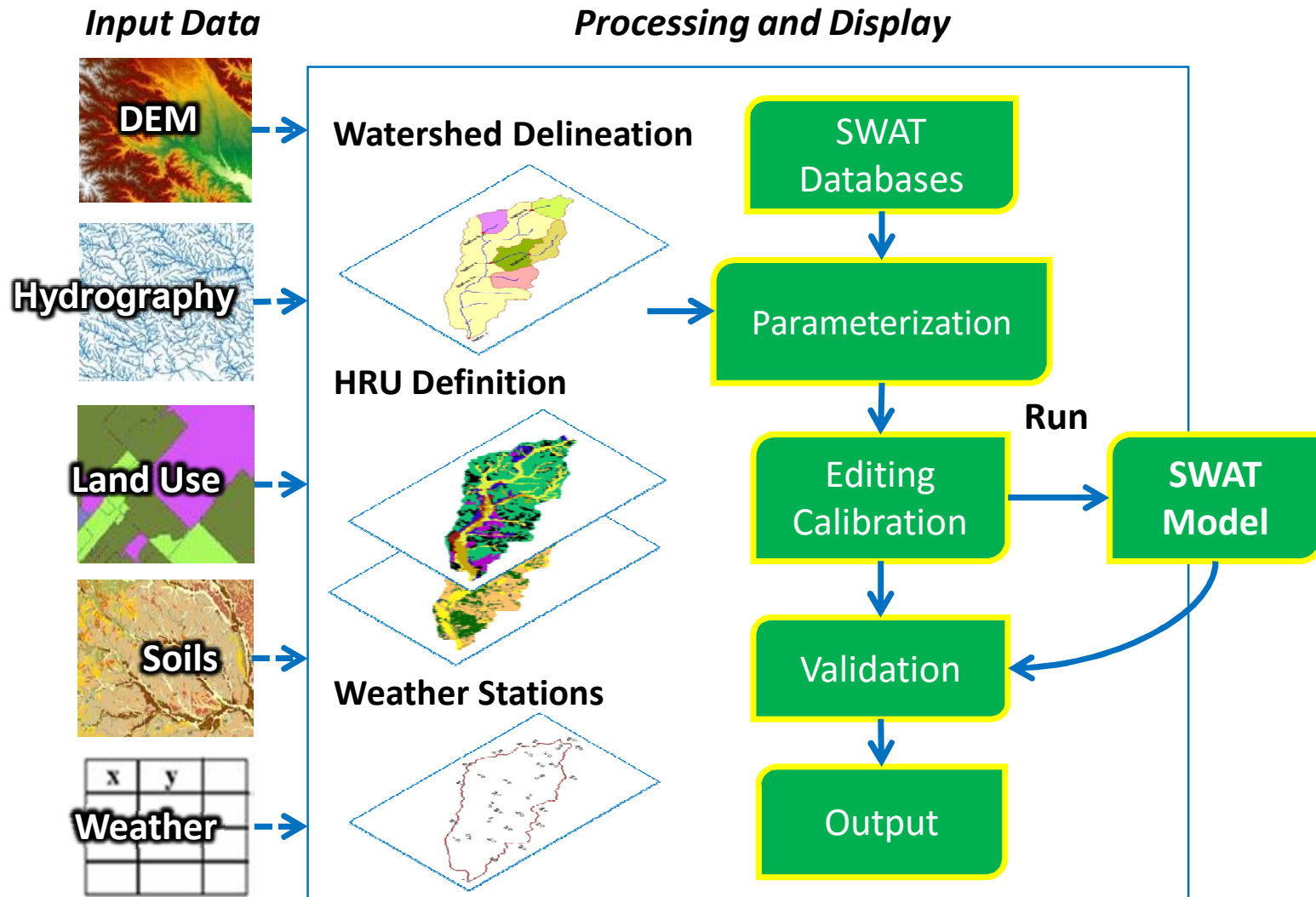
### Hydrological Data

- River flow for calibrating the model





# SWAT model



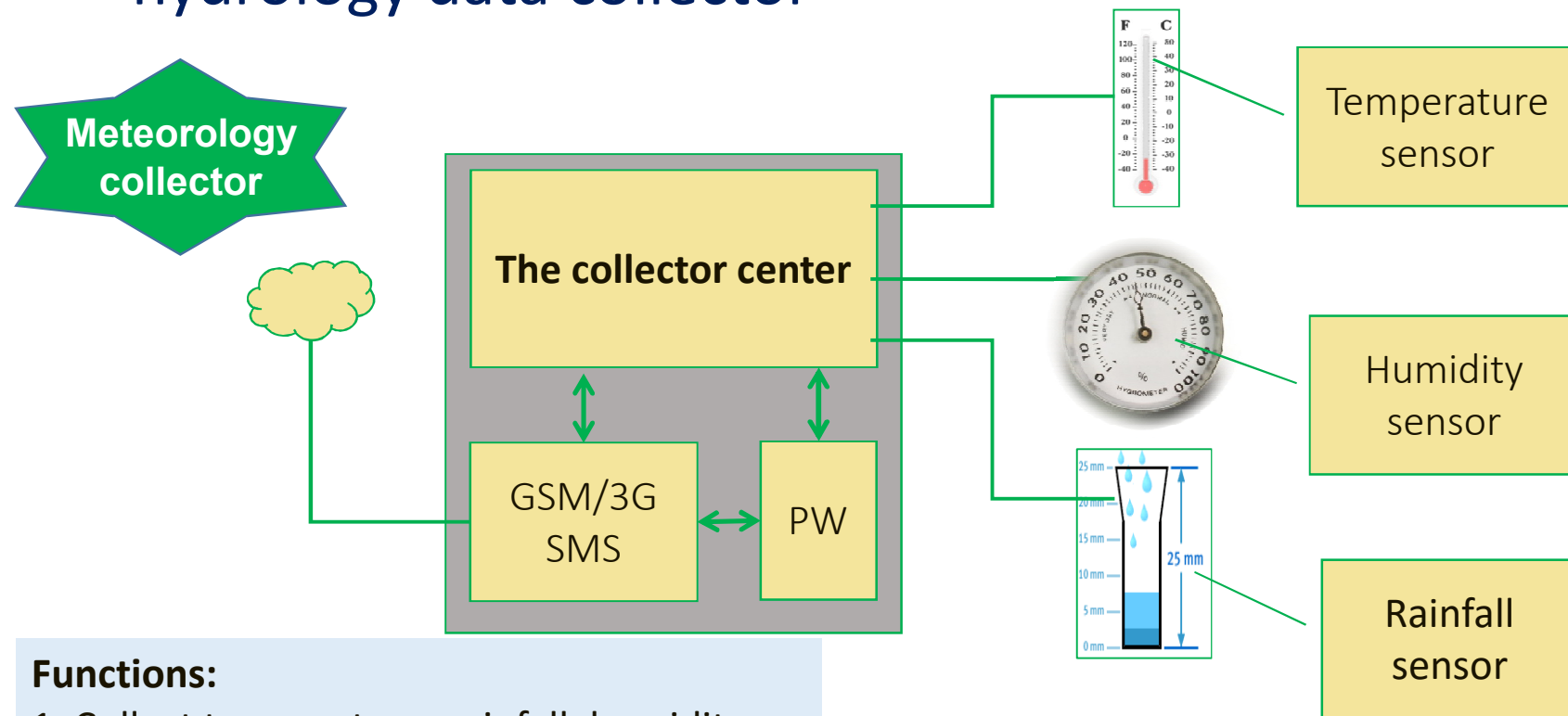


## Materials

- **Server:**
  - Database Server
  - WebGIS Server
- **Real – time Collecting Meterology and Hydrology Data**
  - 20 Meterological Stations
  - 5 Hydrological Stations
- **Software:**
  - Visual Studio .NET
  - PostgreSQL/PostGIS, Microsoft SQL
  - Source code by VisualSVN Windows Server
  - ArcGIS Desktop, ArcSWAT, VizSWAT, SWAT-CUP, HEC-RAS

# Methodology

- Designing the real-time meteorology & hydrology data collector



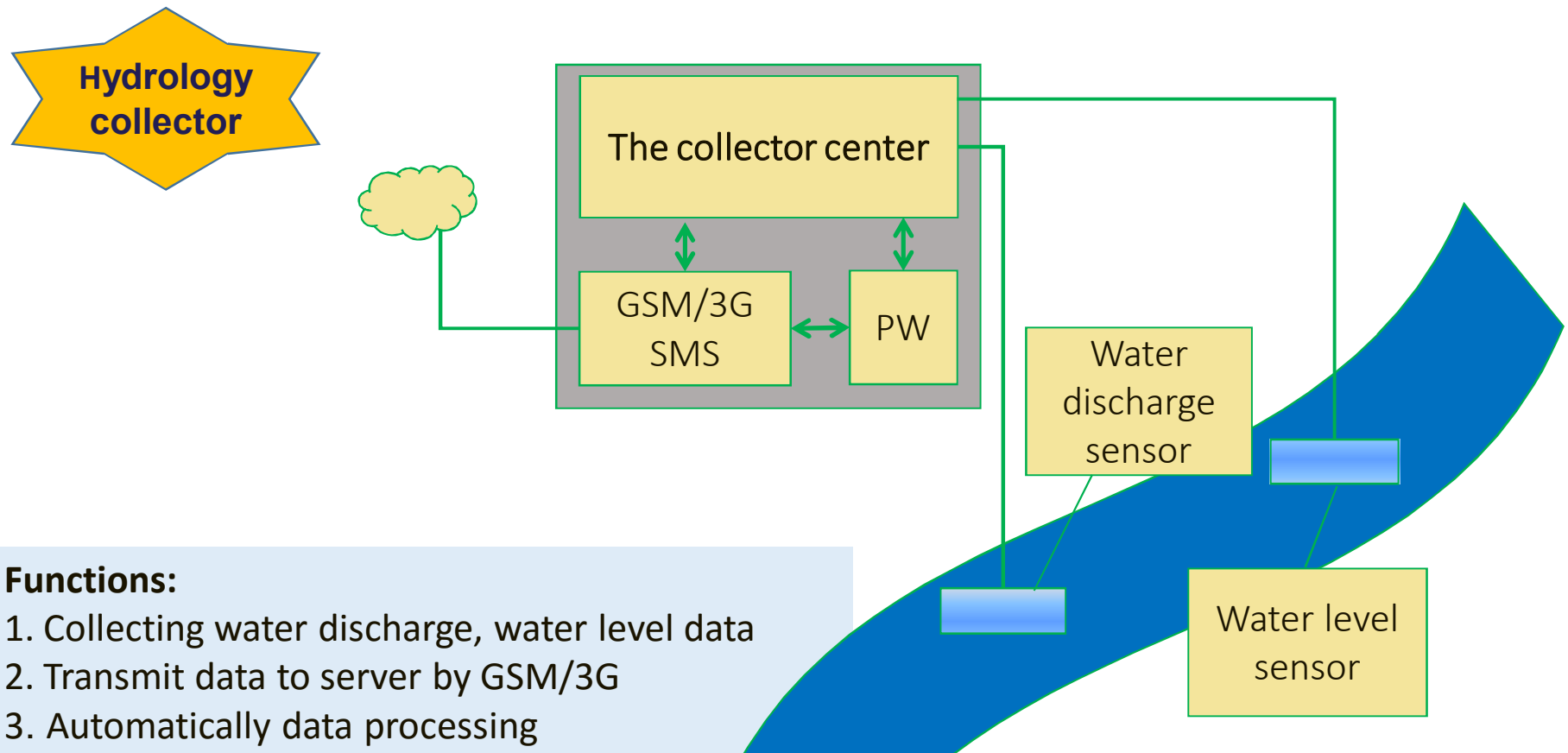
## Functions:

1. Collect temperature, rainfall, humidity
2. Transmit data to server by GSM/3G
3. Automatically data processing

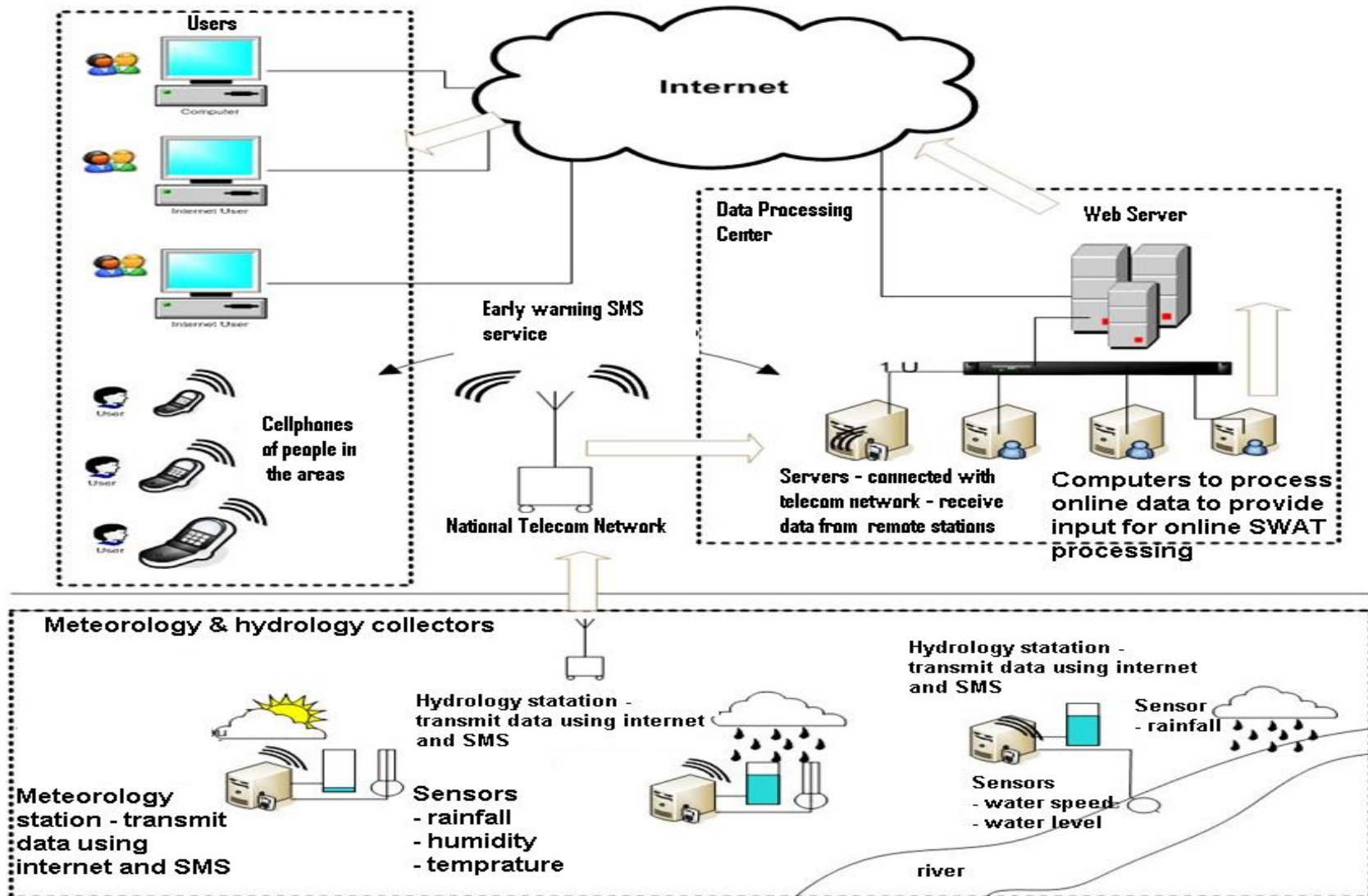


# Methodology

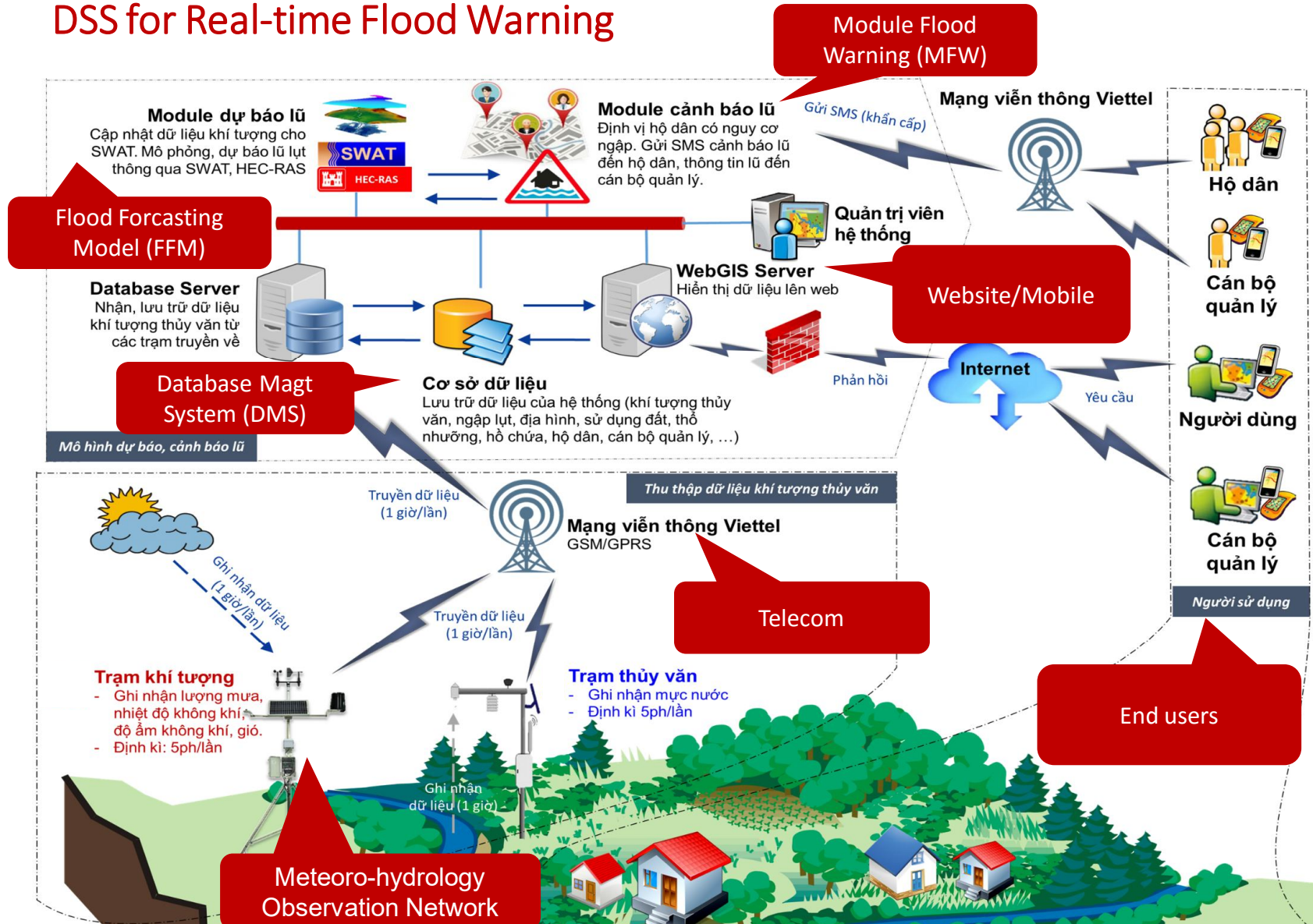
- Designing the real-time meteorology & hydrology data collector



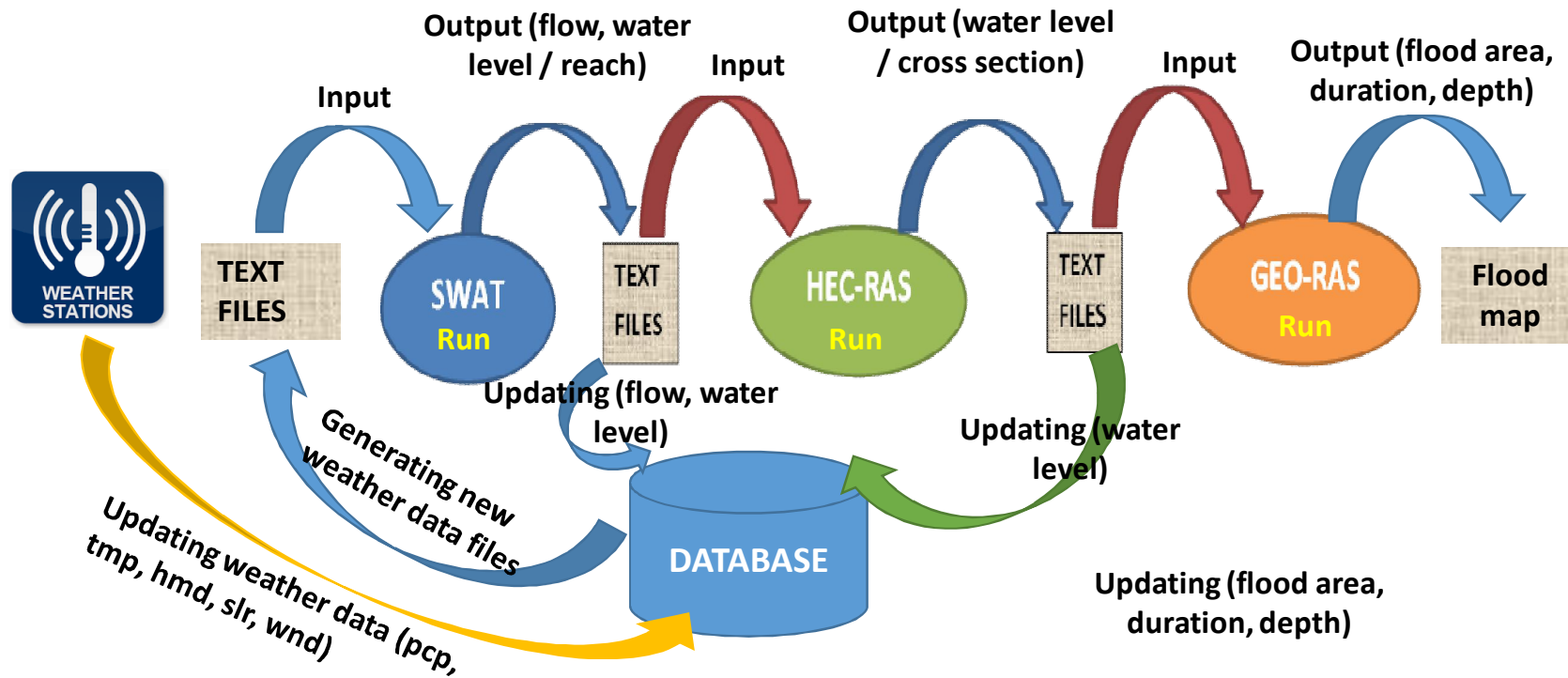




# DSS for Real-time Flood Warning

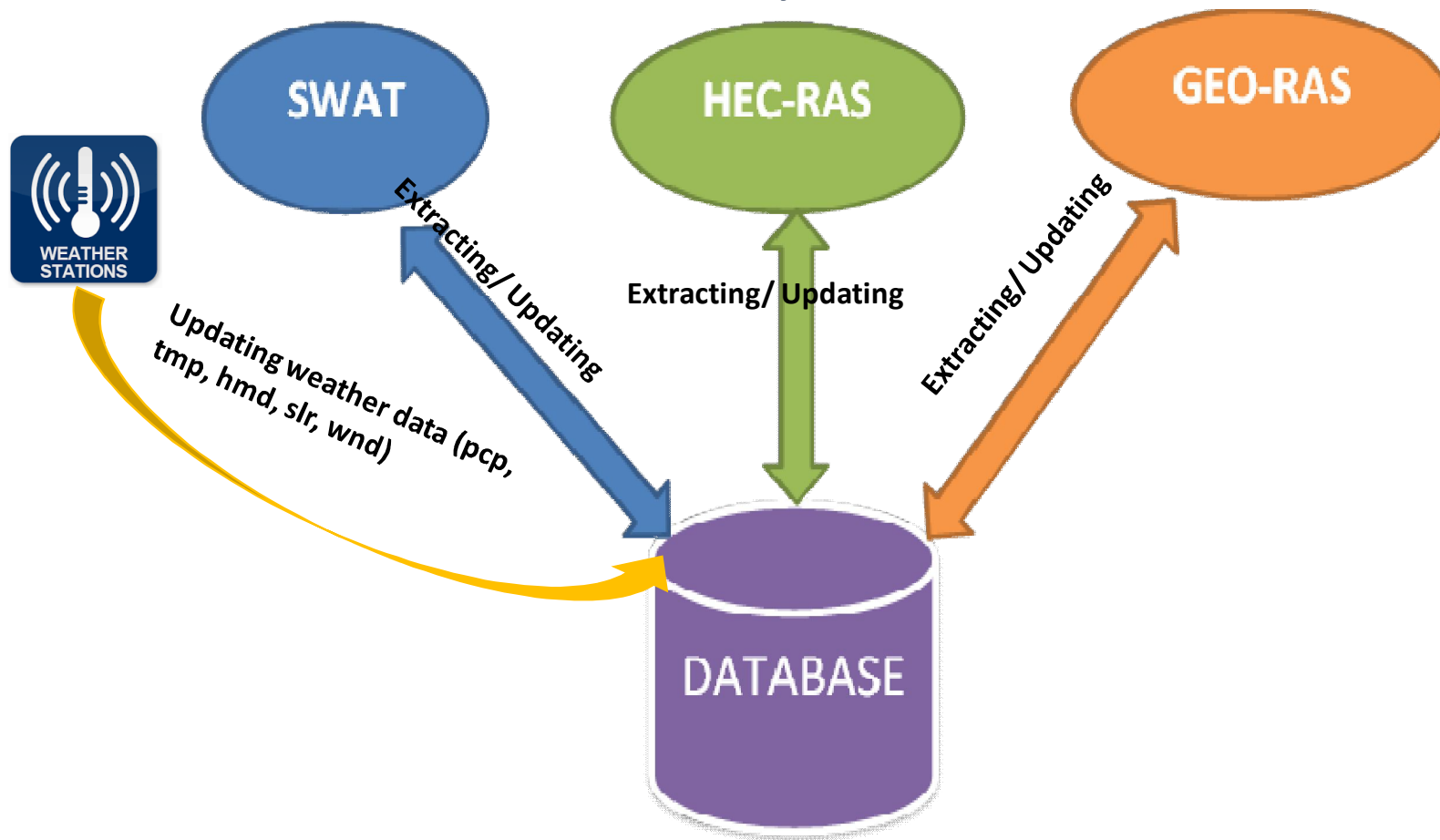


# Coupling/ automatic processing models





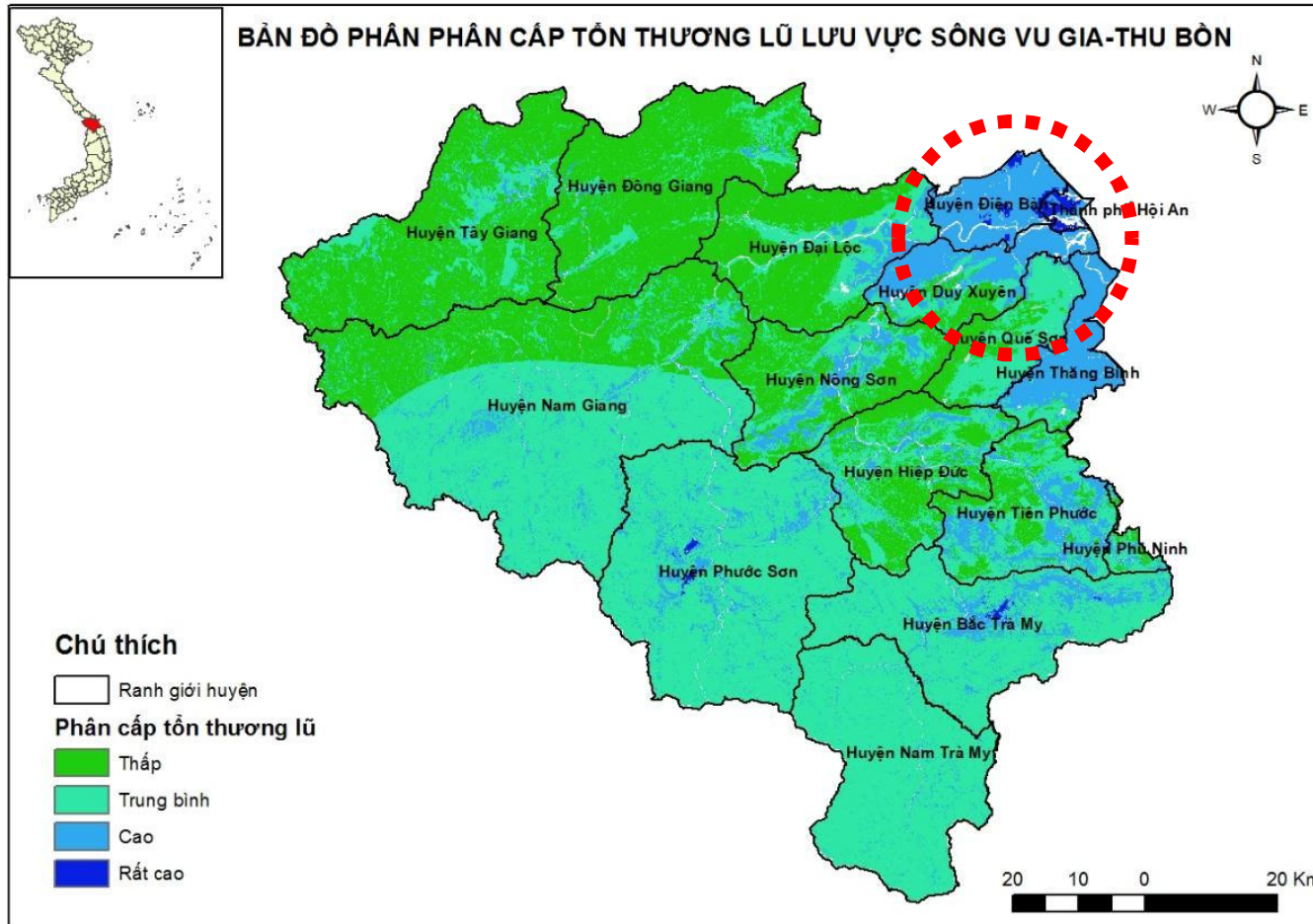
# Integrated Text files (SWAT) vs. Database (HEC-RAS)





# Results

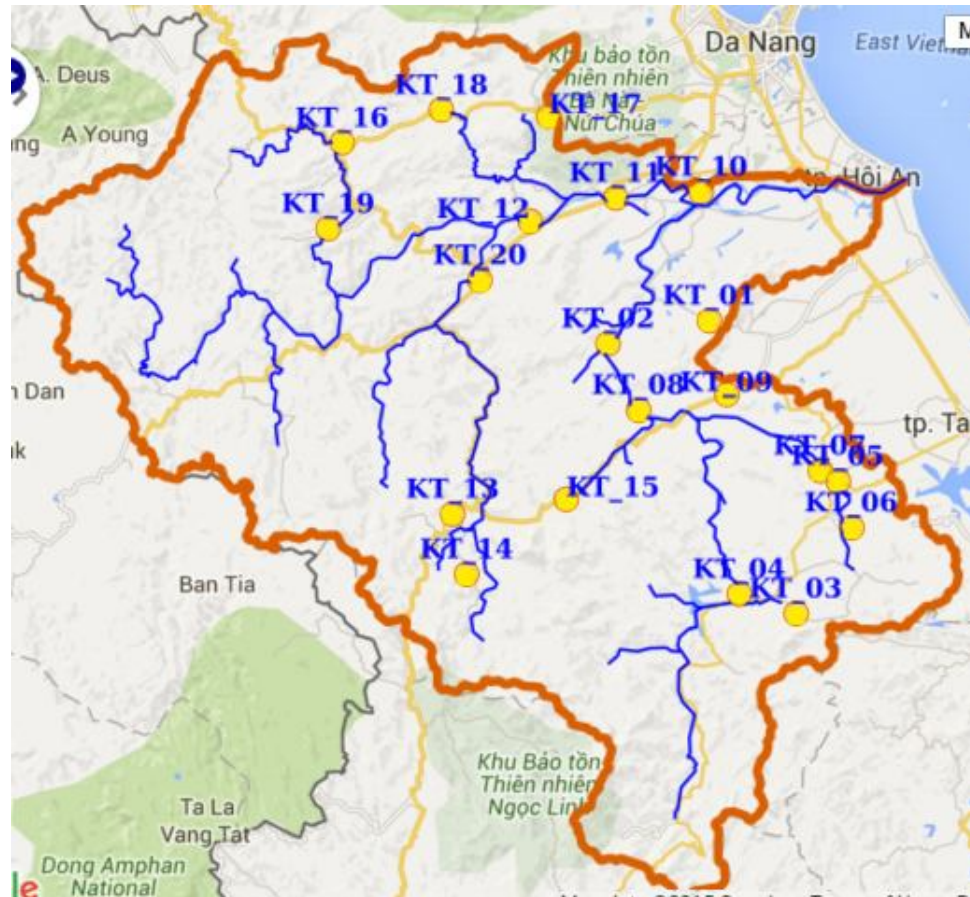
- Flood Vulnerability Area in Vu Gia – Thu Bon Watershed



# Results

- Real-time meteoro-hydrology data collecting
  - 20 Meteorological Stations

Danh sách trạm khí tượng		
Mã số trạm	Tên trạm	Huyện
KT_01	xã Sơn Viên	Nông Sơn
KT_02	xã Quế Phước	Nông Sơn
KT_03	xã Trà Giang	Bắc Trà My
KT_04	xã Trà Đốc	Bắc Trà My
KT_05	UBND huyện Tiên Phước	Tiên Phước
KT_06	xã Tiên An	Tiên Phước
KT_07	xã Tiên Châu	Tiên Phước
KT_08	xã Hiệp Hoà	Hiệp Đức
KT_09	xã Quế Thọ	Hiệp Đức
KT_10	xã Đại Hòa	Đại Lộc
KT_11	xã Đại Đồng	Đại Lộc
KT_12	xã Đại Sơn	Đại Lộc
KT_13	UBND huyện Phước Sơn	Phước Sơn
KT_14	xã Phước Chánh	Phước Sơn
KT_15	xã Phước Hiệp	Phước Sơn
KT_16	UBND Huyện Đông Giang	Đông Giang
KT_17	xã Ba	Đông Giang
KT_18	xã Sông Kôn	Đông Giang
KT_19	xã Mã Cooih	Đông Giang
KT_20	UBND Huyện Nam Giang	Nam Giang







## Results

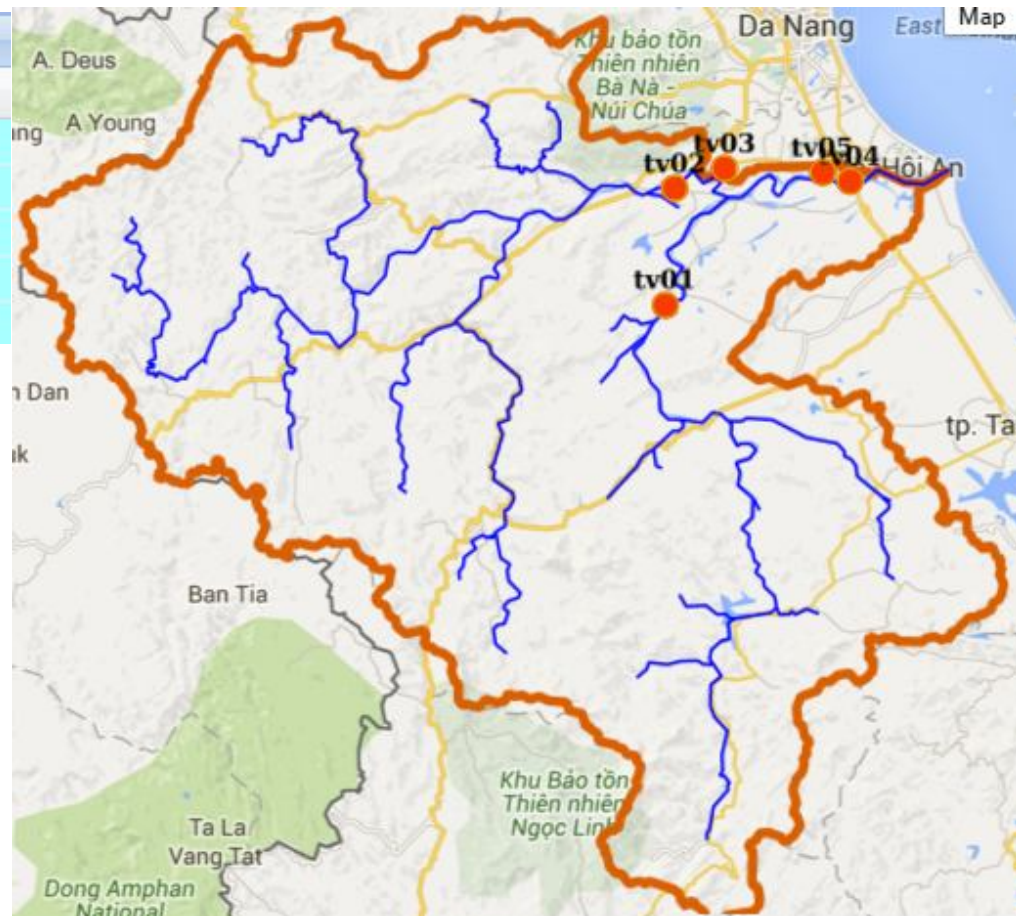
- Real-time meteoro-hydrology data collecting
  - 20 Meteorological Stations



## Results

- Real-time meteoro-hydrology data collecting
  - 5 Hydrological Stations

Danh sách trạm thủy văn		
Mã số trạm	Tên trạm	Huyện
tv01	Cầu Nông Sơn	Nông Sơn
tv02	xã Đại Phong	Đại Lộc
tv03	TT. Ái Nghĩa	Đại Lộc
tv04	Cầu Câu Lâu	Điện Bàn
tv05	xã Điện Phong	Điện Bàn







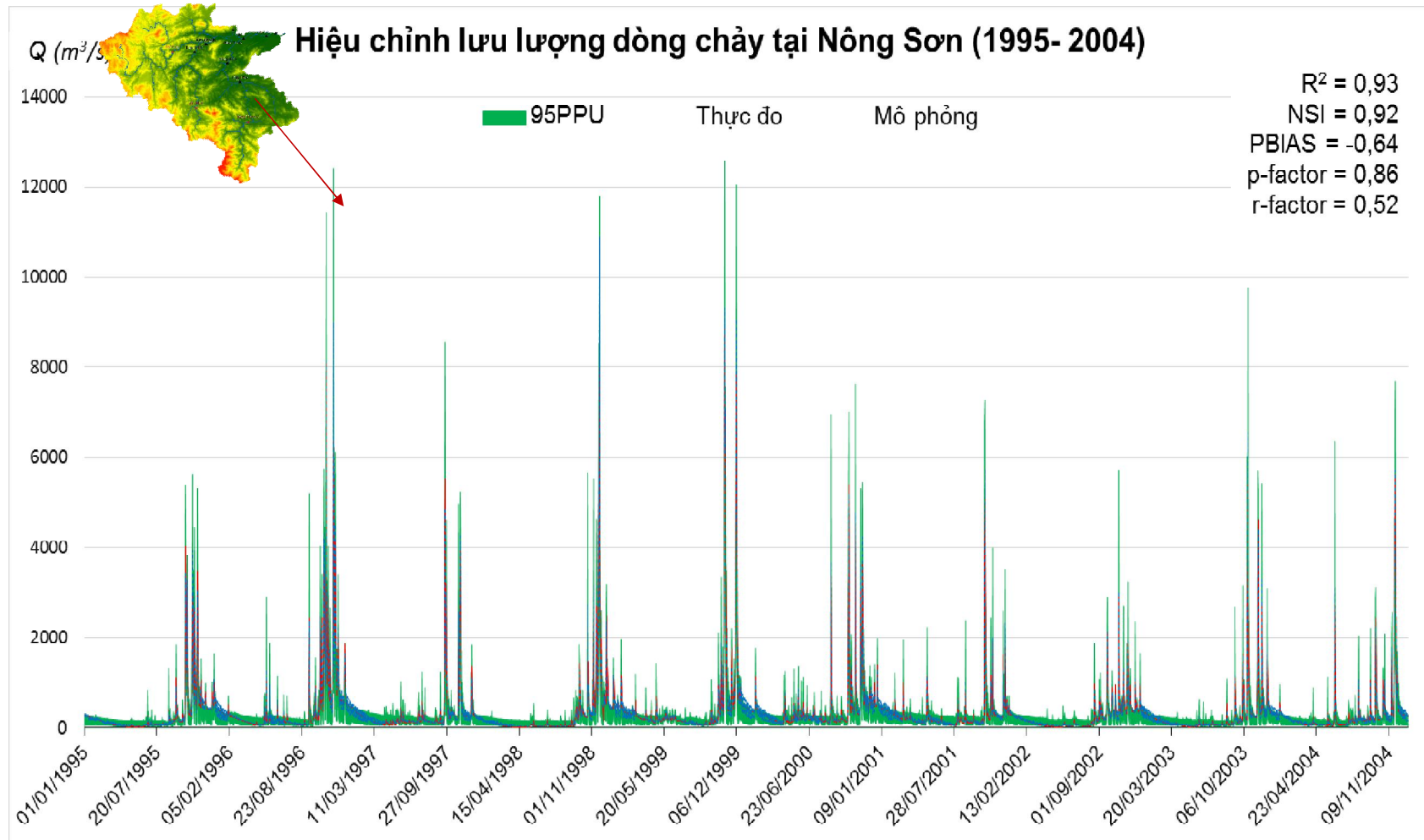
## Results

- Real-time meteorology-hydrology data collecting
  - 5 Hydrological Stations



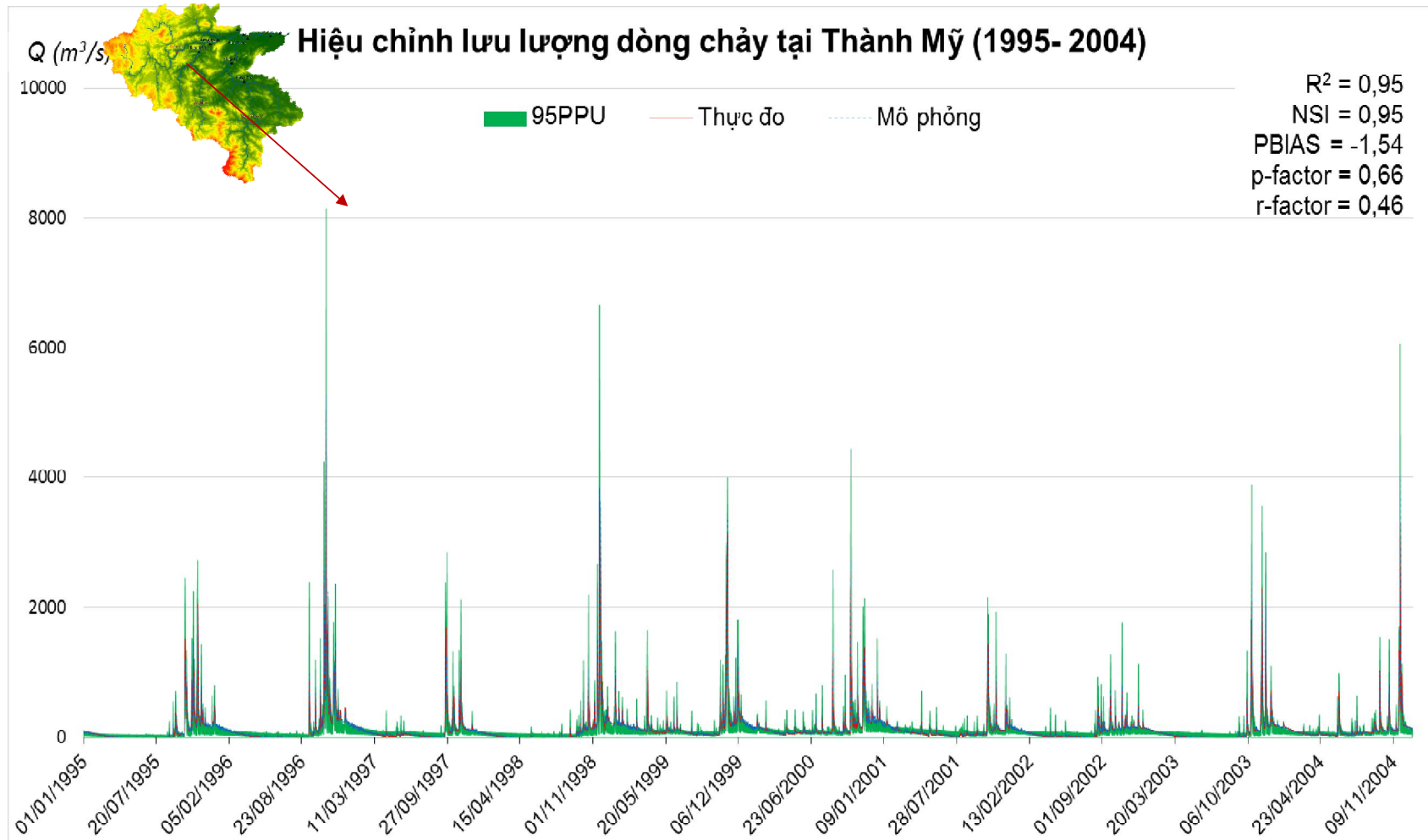
# Results

- Set-up, Calibration, Validation SWAT Model



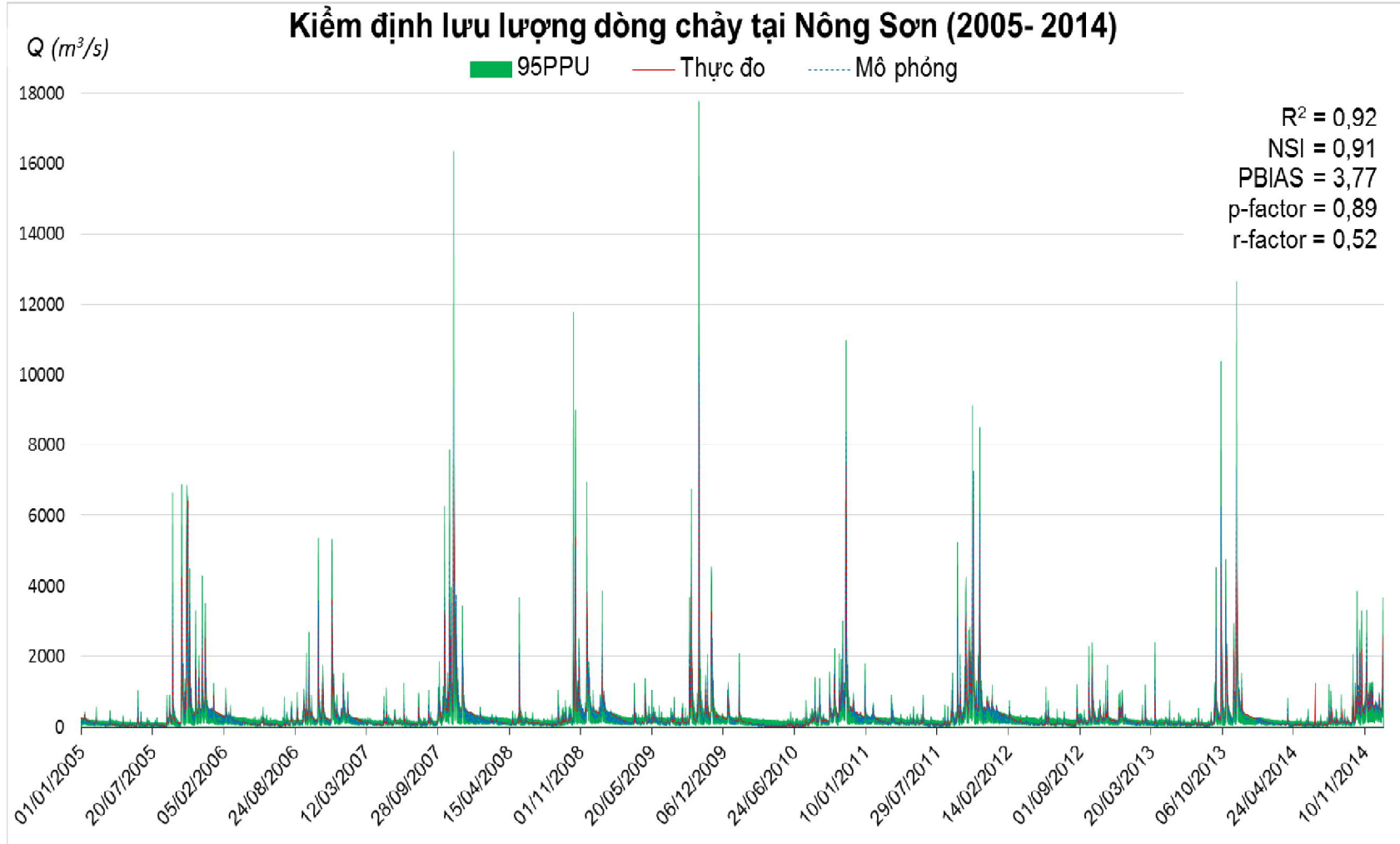
# Results

- Set-up, Calibration, Validation SWAT Model



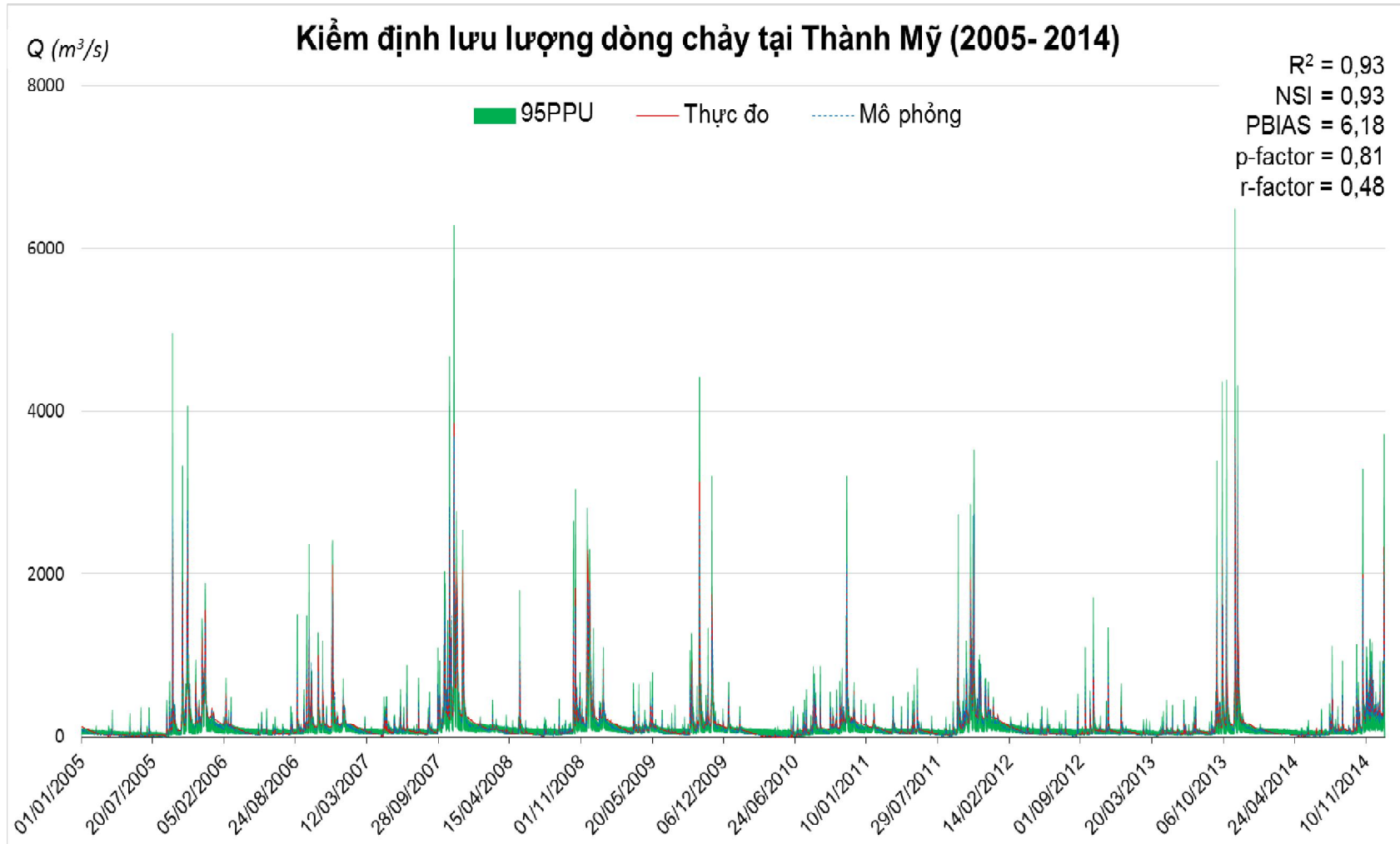
# Results

- Set-up, Calibration, Validation SWAT Model



# Results

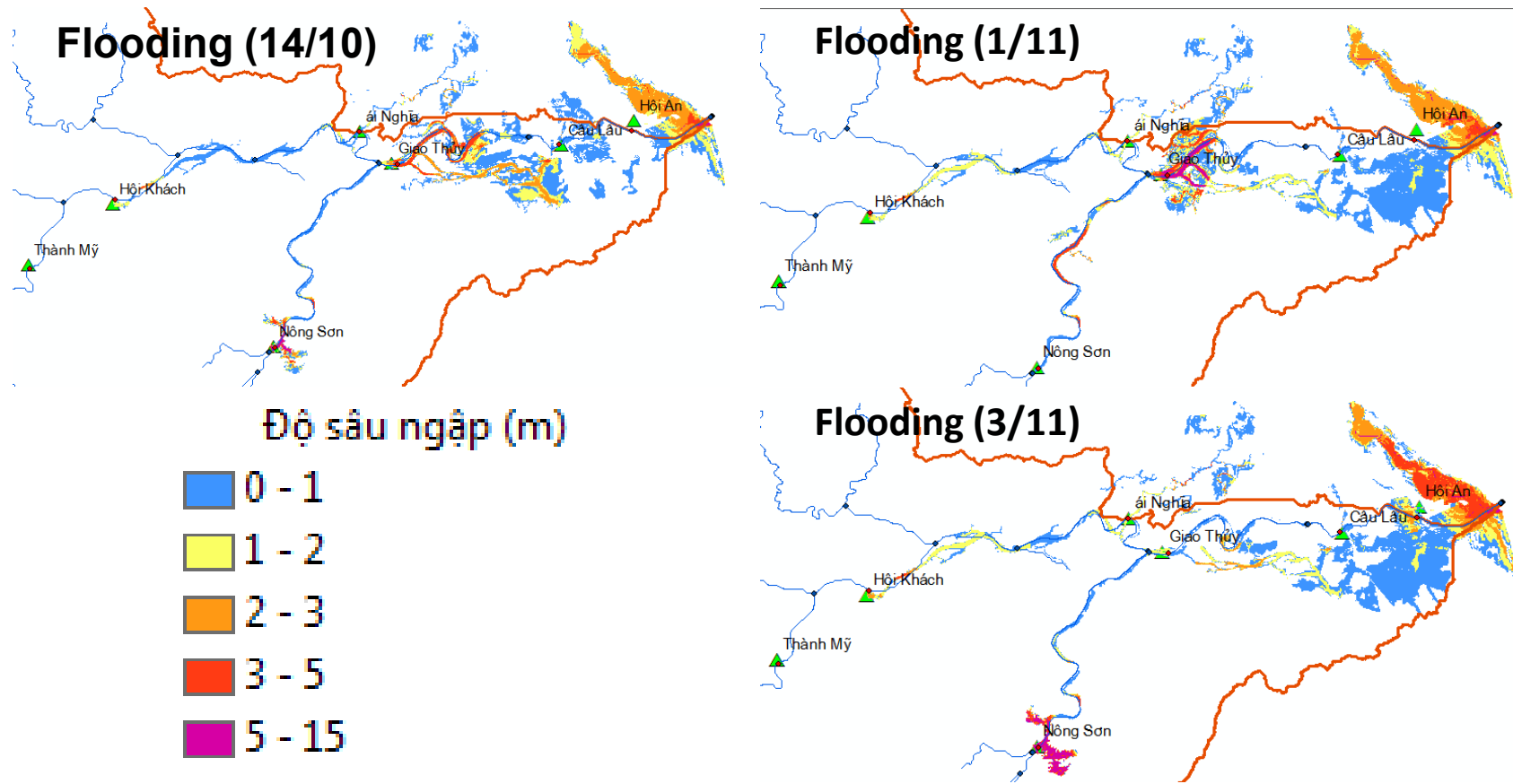
- Set-up, Calibration, Validation SWAT Model





# Results

- Integrated Automatic SWAT and HEC-RAS for Flood Warning



# Results

- Module cung cấp thông tin dự báo, cảnh báo lũ

Updated List of End user (District, Province level)

Xin chào Trần Mỹ Hạnh (Quản trị) [Thoát](#)

## DANH SÁCH NGƯỜI DÙNG

Thêm Người Dùng | Quản Lý Hộ dân | Gửi Tin nhắn SMS | Nhật Ký SMS

STT	Họ Tên	Tên đăng nhập	Cấp độ		
1	Trần Văn Bảy	user	Thành viên	Sửa	Xoá
2	Nguyễn Minh Thành	admin	Quản trị	Sửa	Xoá
3	Trần Mỹ Hạnh	test	Quản trị	Sửa	Xoá

SMS

Updated List of Farmer (Flood Areas)

Xin chào Trần Mỹ Hạnh (Quản trị) [Thoát](#)

## DANH SÁCH HỘ DÂN

Thêm Hộ Dân | Quản Lý Người Dùng | Gửi Tin nhắn SMS | Nhật Ký SMS

< Trước | 1 | 2 | Sau >

STT	Họ Tên	Địa Chỉ	Giới Tính	Điện Thoại	Toạ độ X	Toạ độ Y		
1	Nguyễn Thị Tinh	Trần Nhân Tông, Vĩnh Điện, Điện Bàn	Nữ	0978195826	1759290	848043	Sửa	Xoá

SMS Recording

Xin chào Trần Mỹ Hạnh (Quản trị) [Thoát](#)

## GỬI TIN NHẮN SMS

Quản Lý Người Dùng | Quản Lý Hộ dân | Nhật Ký SMS

Số điện thoại (0xxxxxxxxx): 0978195826:0978195820;

Nội dung (max 160 ký tự): Ngày 20/12/2015 lúc 11:52 - Du báo vùng này trong thời gian tới sẽ bị ngập lên đến 2m

Gửi

Xin chào Trần Mỹ Hạnh (Quản trị) [Thoát](#)

## NHẬT KÝ SMS

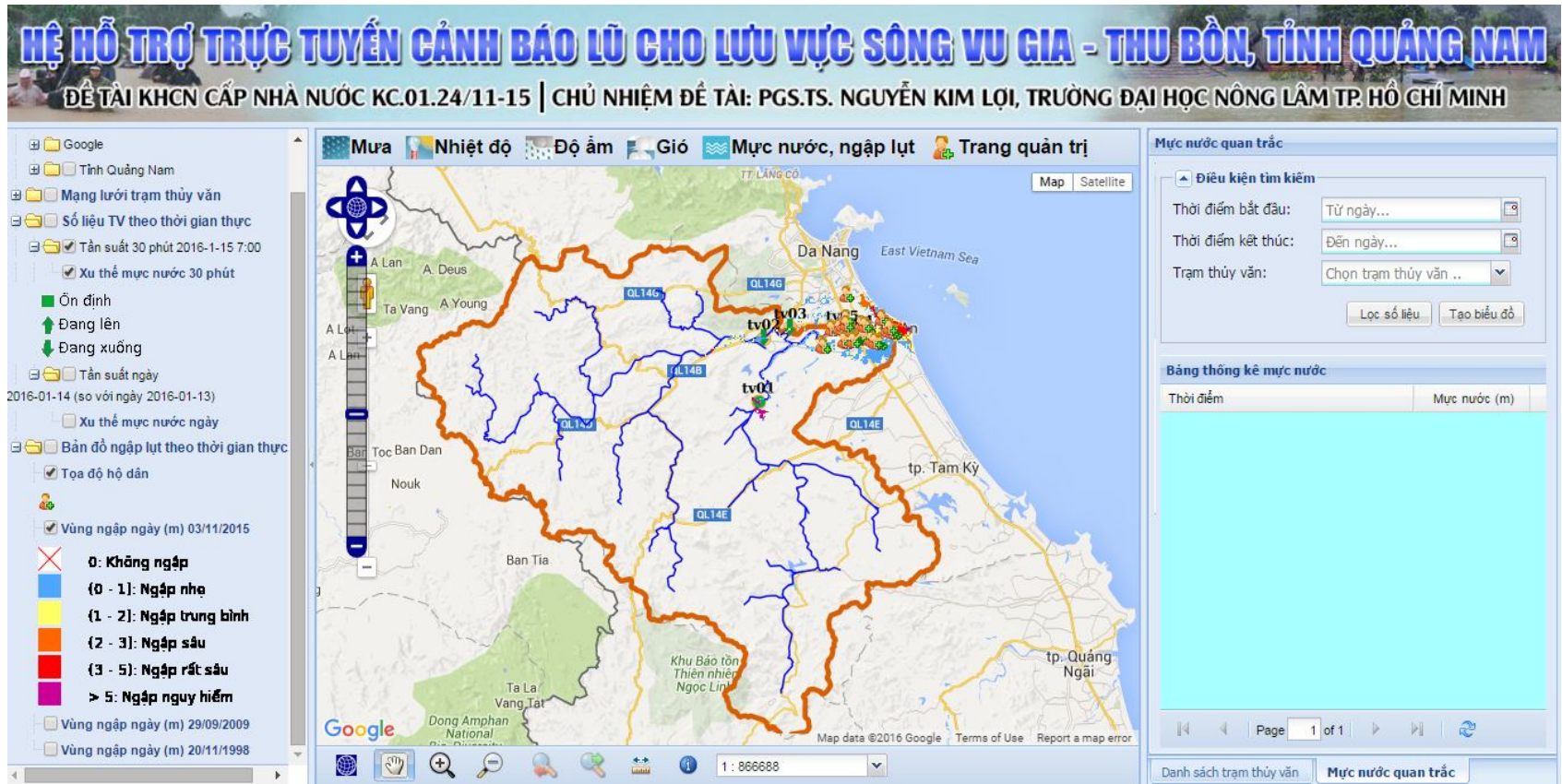
Quản Lý Người Dùng | Quản Lý Hộ dân | Gửi tin nhắn SMS

< Trước | 1 | 2 | 3 | 4 | Sau >

STT	Ngày	Giờ	Họ tên	Điện thoại	Trạng thái	Nội dung
1	2015-09-23	16:41:41	Nguyễn Thị Tinh	0978195826	Đã gửi	Vùng này có nguy cơ ngập cao đến 2m
2	2015-09-30	13:17:25	Nguyễn Thị Tinh	0978195826	Đã gửi	Vùng này có nguy cơ ngập cao đến 2m
3	2015-09-30	11:18:17	Trần Minh Tân	0978195820	Đã gửi	Vùng này có nguy cơ ngập cao đến 2m
4	2015-09-30	13:17:25	Trần Minh Tân	0978195820	Đã gửi	Vùng này có nguy cơ ngập cao đến 2m
5	2015-09-30	13:18:36	Trần Minh Tân	0978195820	Đã gửi	Vùng này có nguy cơ ngập cao đến 2m

# Results

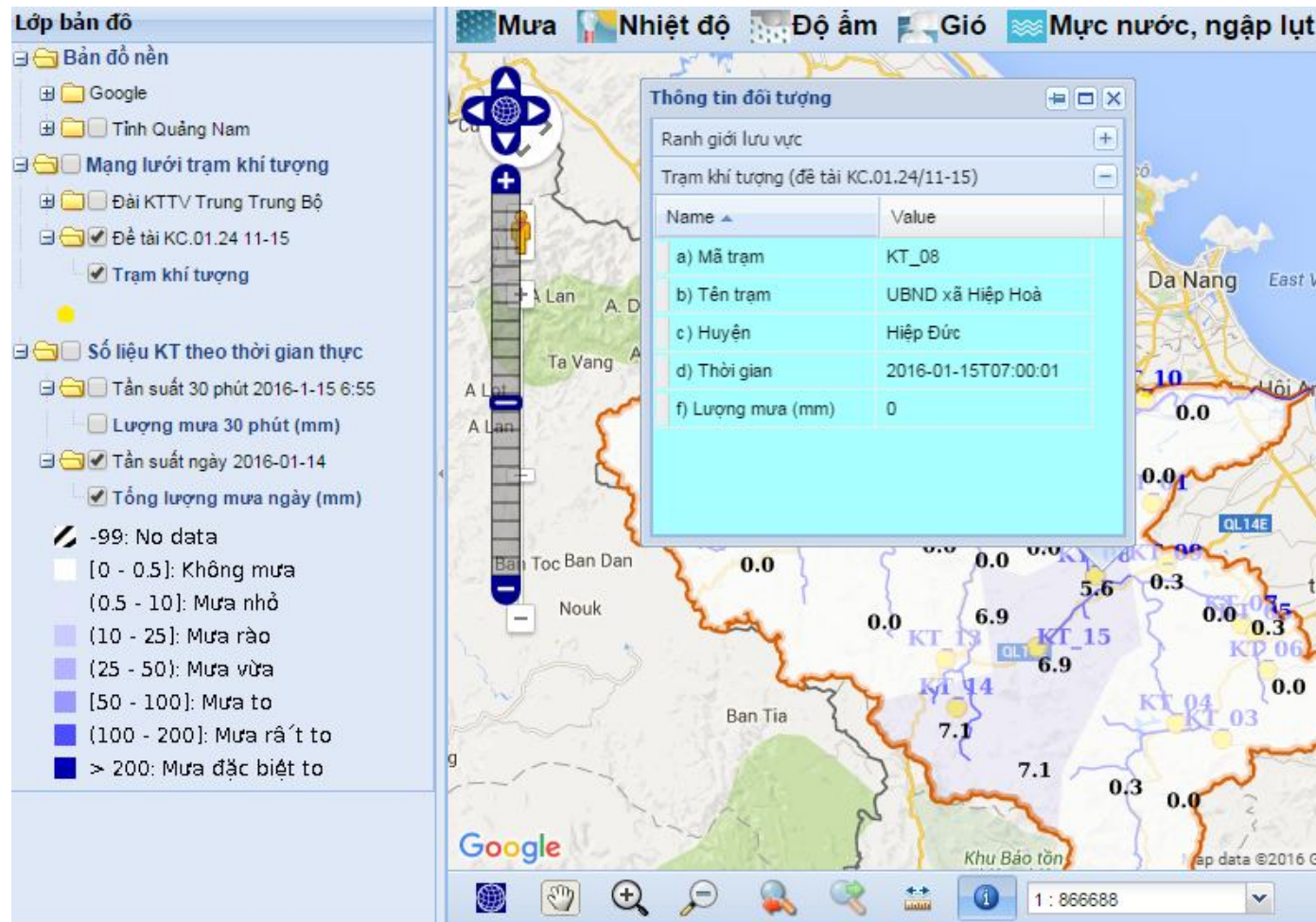
- WebGIS <http://vgtb.hcmuaf.edu.vn/>





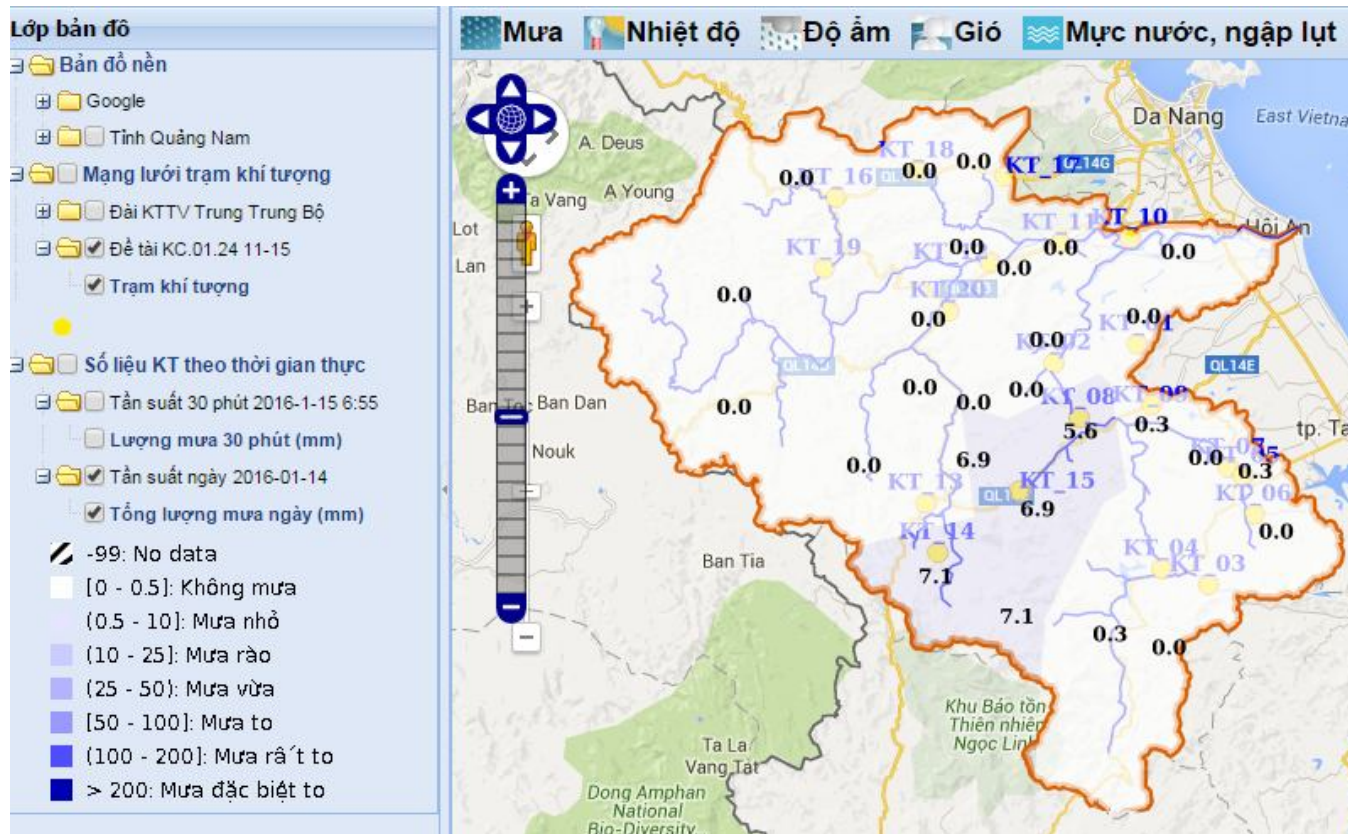
# Results

- WebGIS <http://vgtb.hcmuaf.edu.vn/>



# Results

- WebGIS <http://vgtb.hcmuaf.edu.vn/>



## Results

- WebGIS <http://vgtb.hcmuaf.edu.vn/>
- 5 min, 30 min, day

The screenshots show the 'Lượng mưa quan trắc' (Rainfall Monitoring) interface. The search criteria are: Station: KT\_02, Start Date: 2015-12-01, End Date: 2015-12-18. The data is presented in a table with columns 'Thời điểm' (Time) and 'Lượng mưa (mm)' (Rainfall (mm)).

**Screenshot 1: 5 min interval**

Thời điểm	Lượng mưa (mm)
2015-12-20 23:00:01	0
2015-12-20 22:55:01	0
2015-12-20 22:50:01	0
2015-12-20 22:45:01	0
2015-12-20 22:40:01	0
2015-12-20 22:35:01	0
2015-12-20 22:30:01	0
2015-12-20 22:25:01	0
2015-12-20 22:20:01	0
2015-12-20 22:15:01	0
2015-12-20 22:10:01	0

**Screenshot 2: 30 min interval**

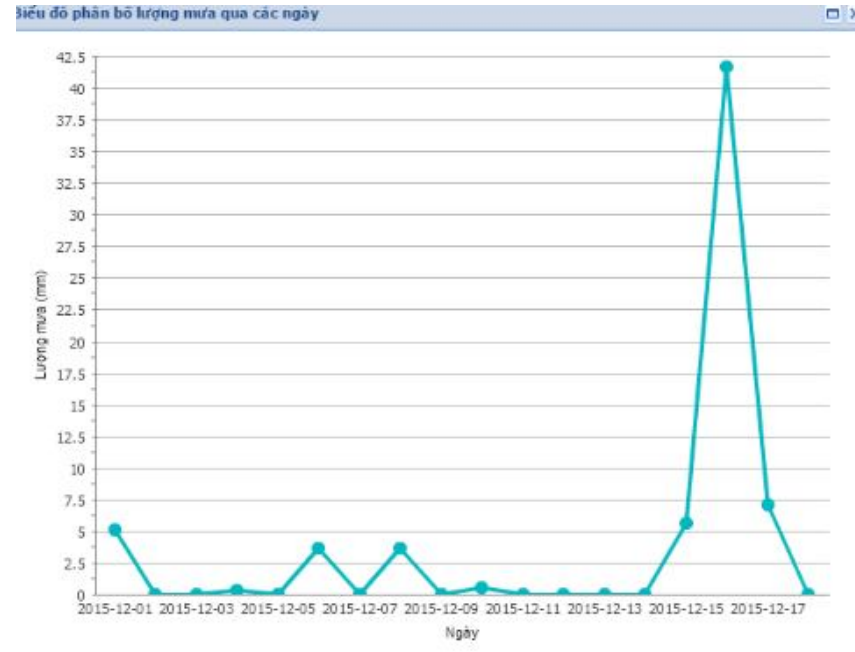
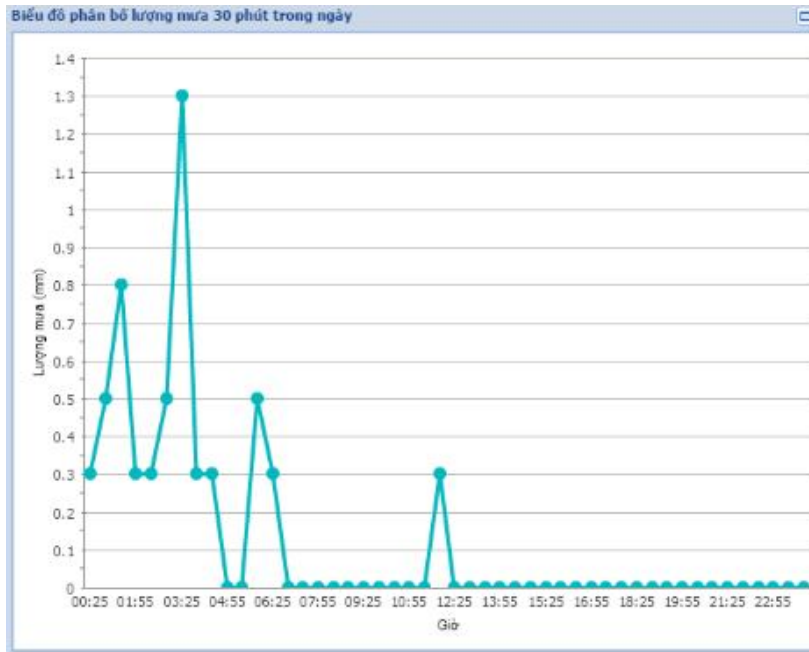
Thời điểm	Lượng mưa (mm)
2015-12-01	5.1
2015-12-02	0
2015-12-03	0
2015-12-04	0.3
2015-12-05	0
2015-12-06	3.6
2015-12-07	0
2015-12-08	3.6
2015-12-09	0
2015-12-10	0.5
2015-12-11	0

**Screenshot 3: Day interval**

Thời điểm	Lượng mưa (mm)
2015-12-01	5.1
2015-12-02	0
2015-12-03	0
2015-12-04	0.3
2015-12-05	0
2015-12-06	3.6
2015-12-07	0
2015-12-08	3.6
2015-12-09	0
2015-12-10	0.5
2015-12-11	0

# Results

- WebGIS <http://vgtb.hcmuaf.edu.vn/>

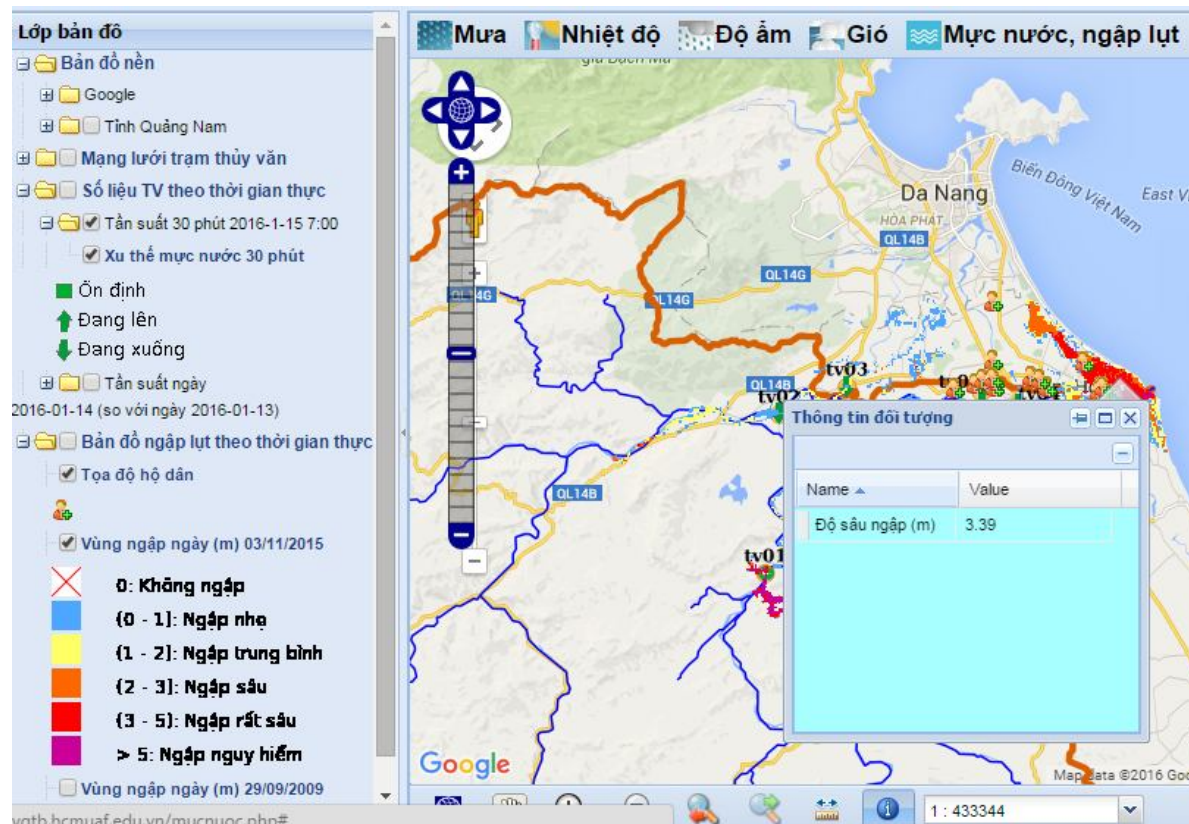






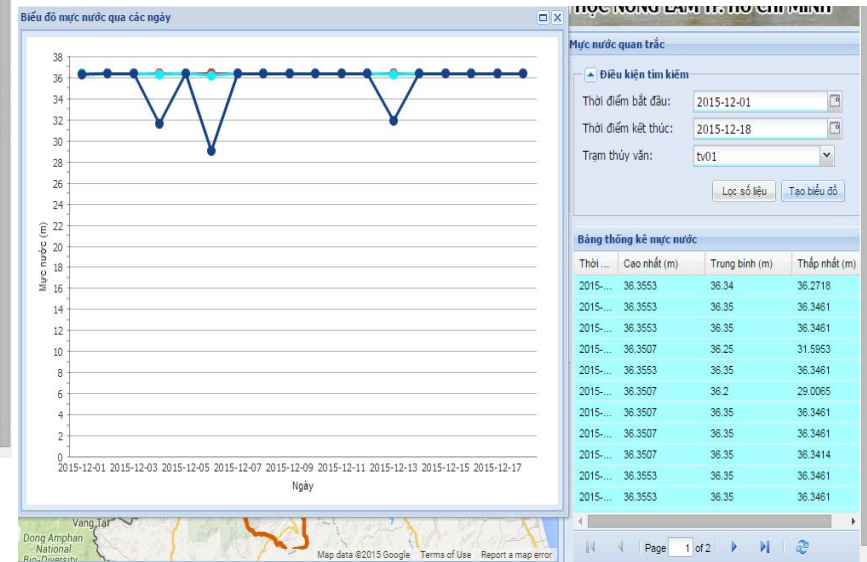
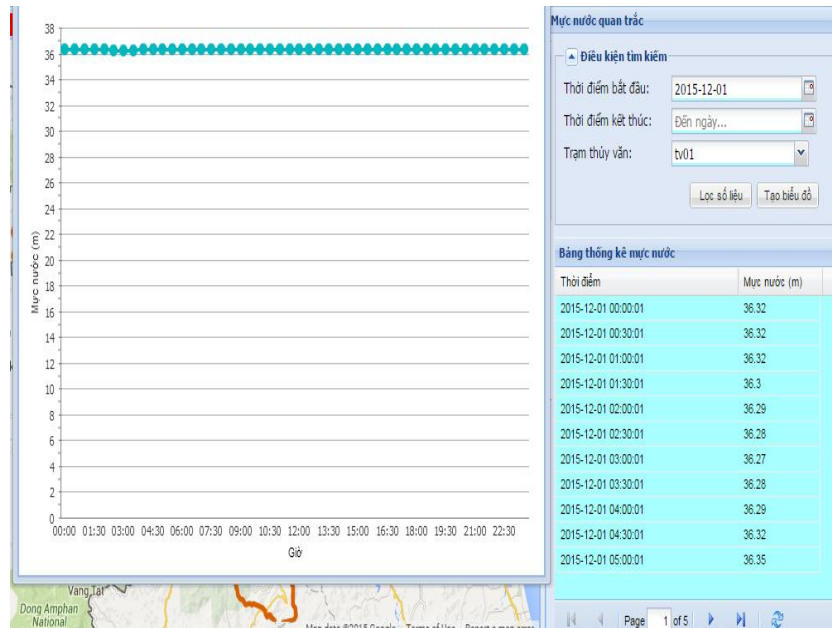
# Results

- WebGIS <http://vgtb.hcmuaf.edu.vn/>
- Real-time Flooding Mapping (05 min, 30 min)



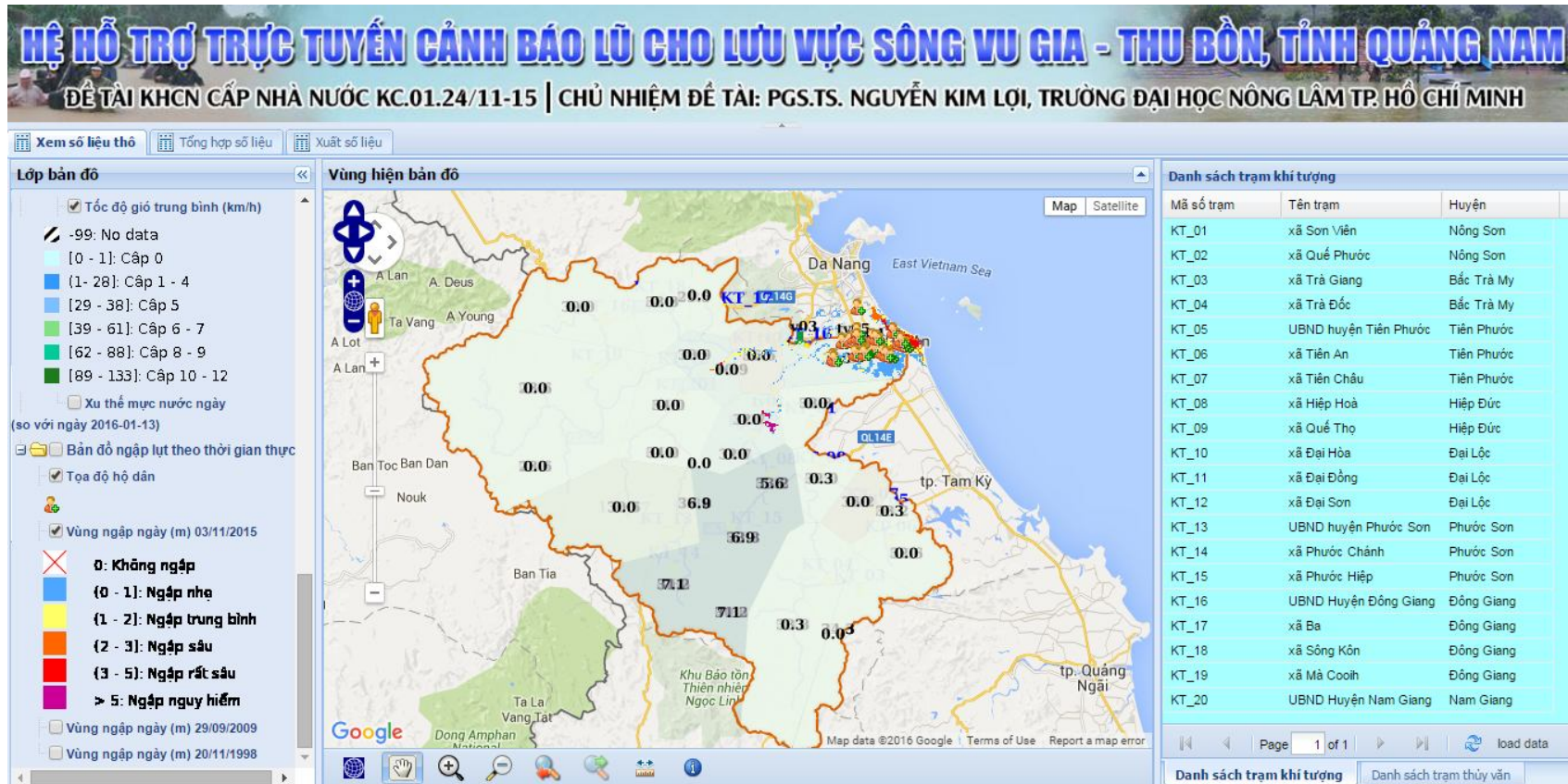
# Results

- WebGIS <http://vgtb.hcmuaf.edu.vn/>



# Results

- WebGIS <http://vgtb.hcmuaf.edu.vn/admin/>









# Training and Transfer





## Conclusions

- This research is just the first step applied SWAT and HEC-RAS model in Vu Gia – Thu Bon watershed. The SWAT and HEC-RAS model performed well in simulating the general trend of surface runoff at watershed over time for secondly, hourly, daily, monthly time intervals. This paper provides an insight of how the HEC-RAS model can be a useful tool for providing important information about river flow fluctuations affected by extreme rainfall events. Future studies are needed to evaluate with more detail each land management practice. Work is still in progress to improve SWAT and HEC-RAS data bases to Vu Gia – Thu Bon watershed, Quang Nam province, Vietnam - tropical conditions.



## ACKNOWLEDGEMENTS

The authors acknowledge the MOST (Ministry of Science and Technology) funded “**Decision Support System (DSS) for Real -time Flood Warning in Vu Gia Thu Bon River Basin, Quang Nam province**” project for funding this research.



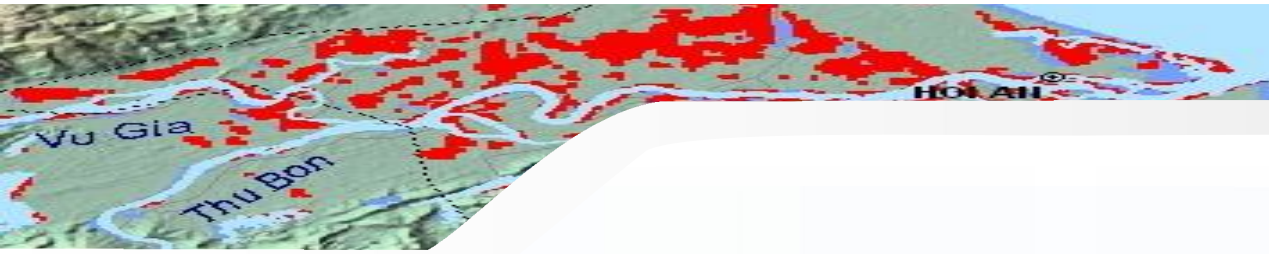


*Positive thinkings are brighter*

***THANK YOU***

*Negative ones are darker*

STEVE LOHR



Thank you for your attention!



Logo of your  
institution here

Co-funded by the  
Erasmus+ Programme  
of the European Union

