



**2013 SWAT  
CONFERENCE**  
**Toulouse, France**  
**July 17-19, 2013**



# Online Supporting System Flood Warning For Vu Gia Watershed, Quang Nam Province, Vietnam

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*July 18, 2013*



# Quang Nam Province problems

**Water Problems/Disasters**

(landslide, drought, flash flood, etc)

**High Growth Population,  
Social Complex**

**Economic Growth Needs**

(hydropower construction, road building, deforestation)

**Land Use  
Change/Planning**



Chú Thích

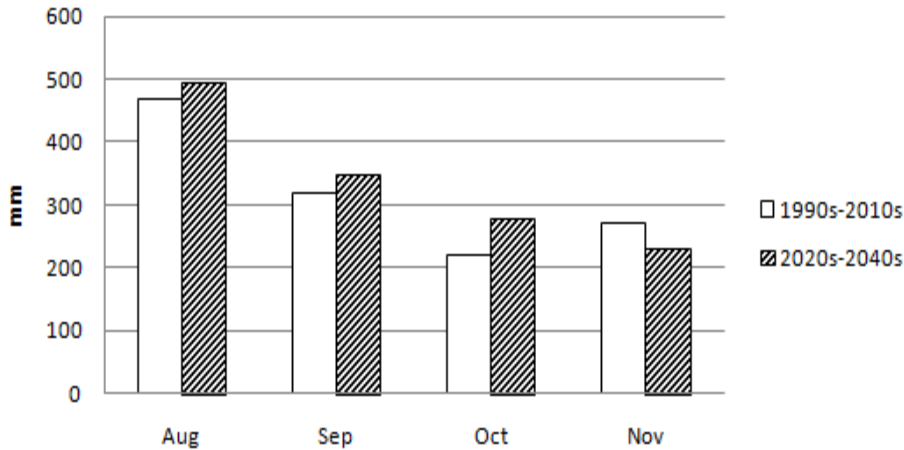
— Sông

▭ Tiểu lưu vực

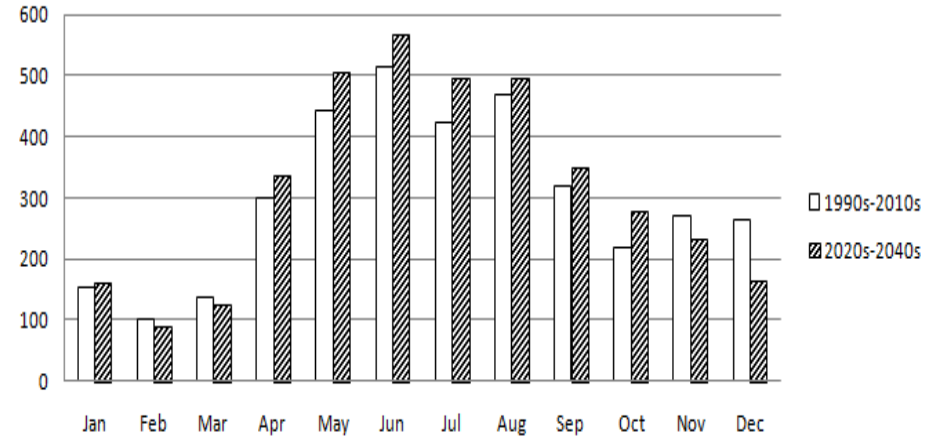
● Điểm ra lưu vực

# Climate Trend in Quang Nam province

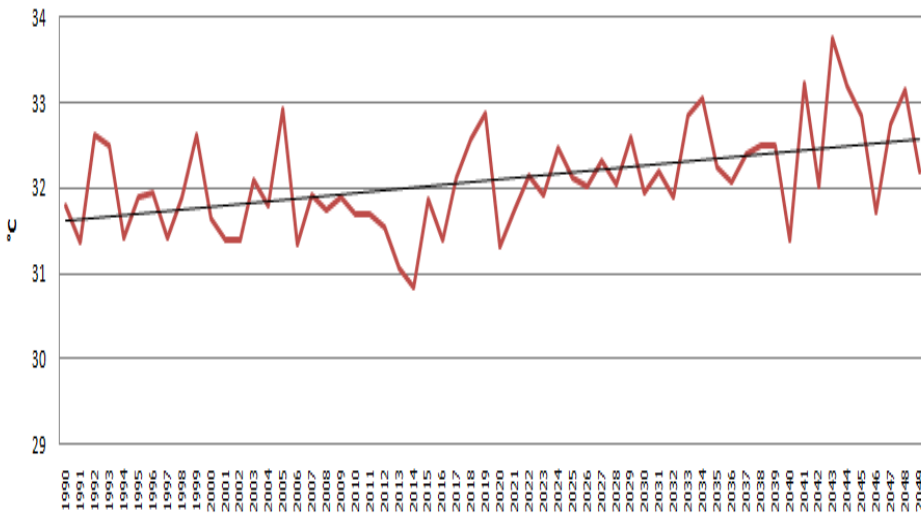
Rainfall in months of August – November : Dong Giang District



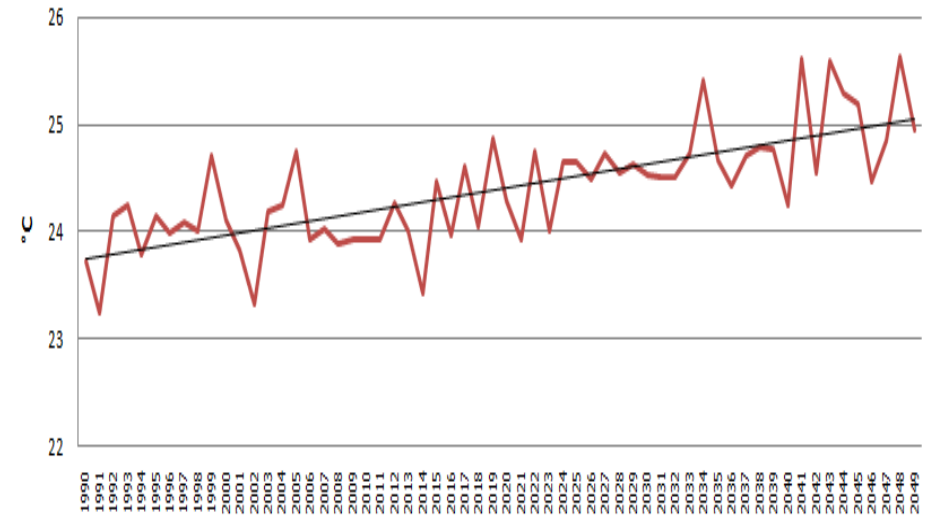
Monthly Rainfall :Dong Giang District



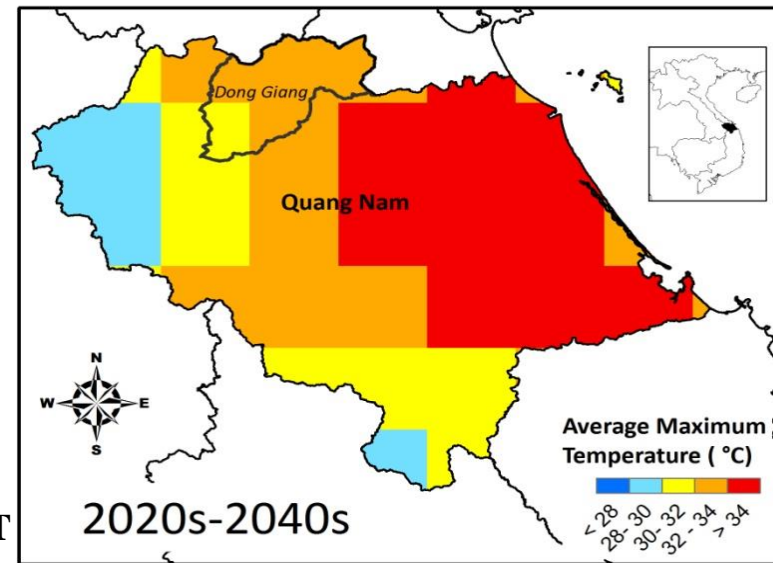
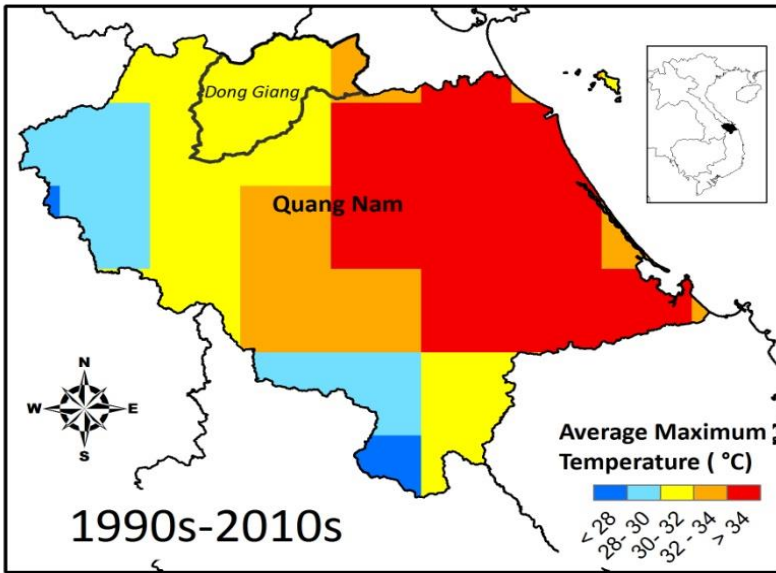
Average daily maximum temperature trend : Dong Giang District



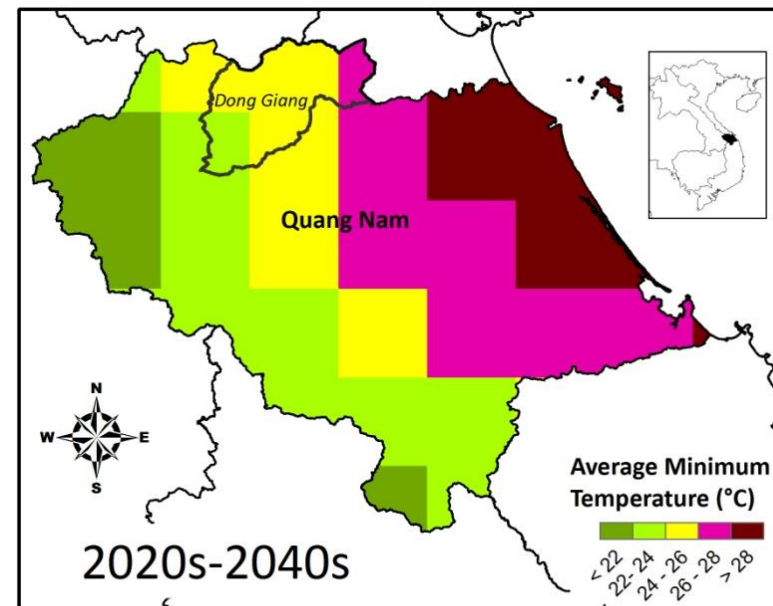
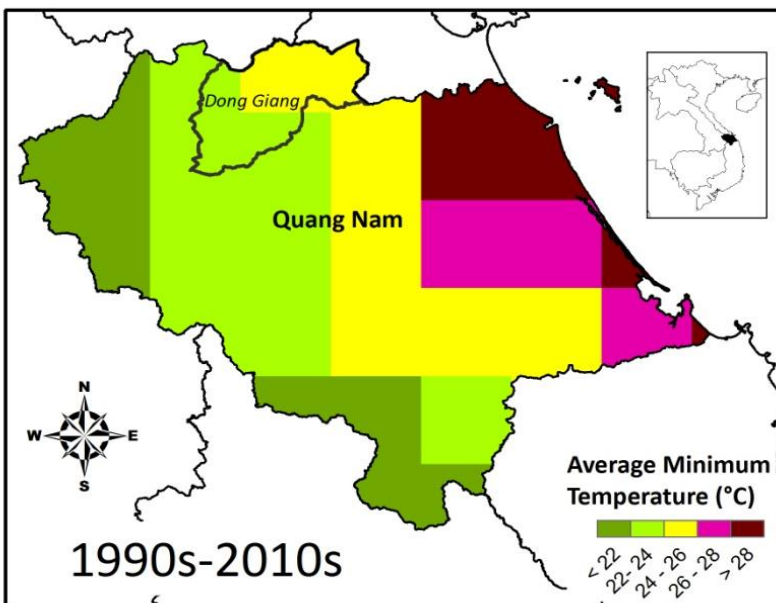
Average daily minimum temperature trend : Dong Giang District



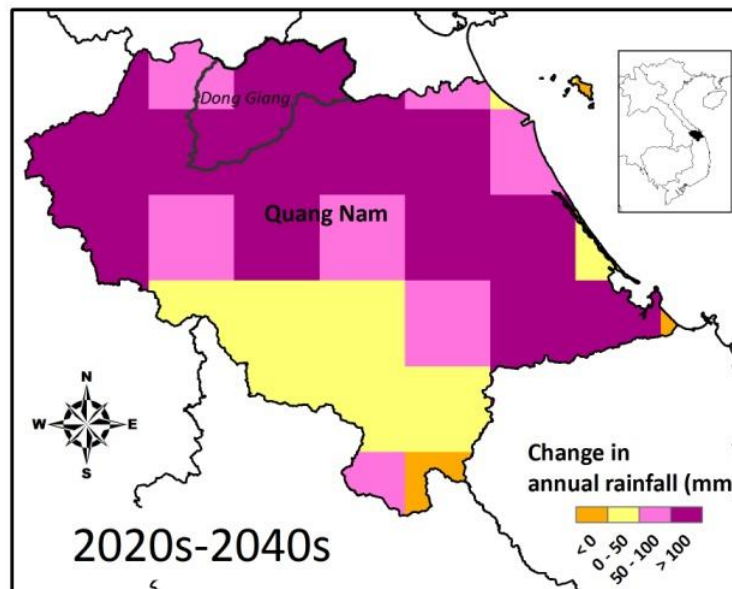
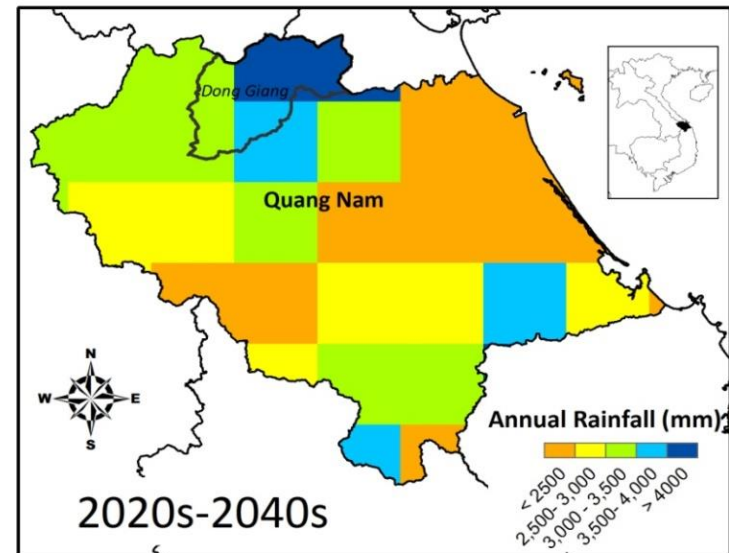
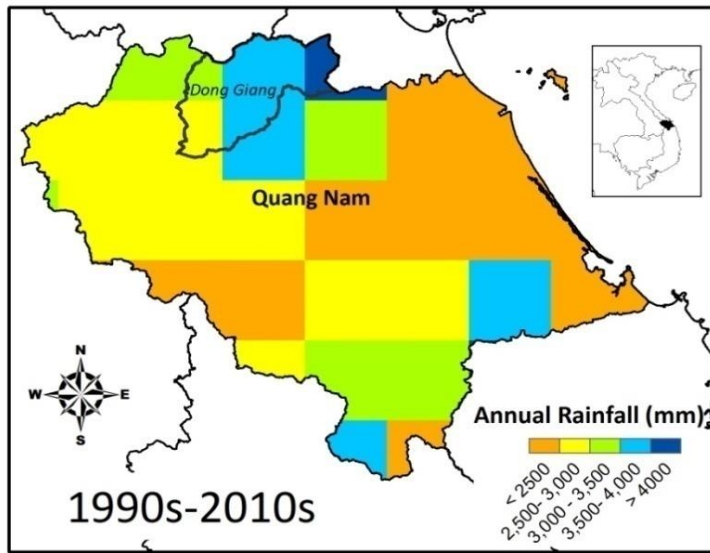
# Temperature trend in Quang Nam province



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



# Rainfall trend in Quang Nam province



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

# Objectives

In order to support farmers who live in downstream Vu Gia watershed for preventing flooding

Determine vulnerability flood area and peak flooding in Vu Gia watershed

Build the online website support information about hydrometeorology at real-time

Support farmer in vulnerability flood area by SMS message

# Data Collection

Types of data	Sources of data
<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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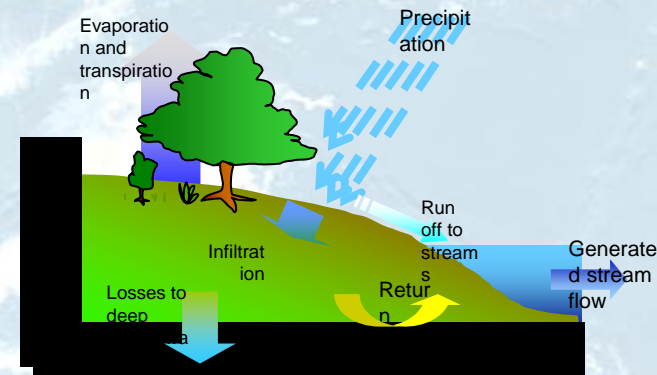
- Readily available input –  
Physically based
- Computer efficient
- Comprehensive – Process Interactions
- Simulate Management



# 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

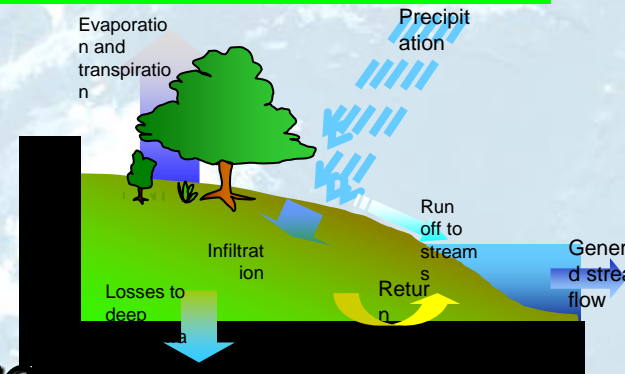
## Time Series Data

### Weather Data

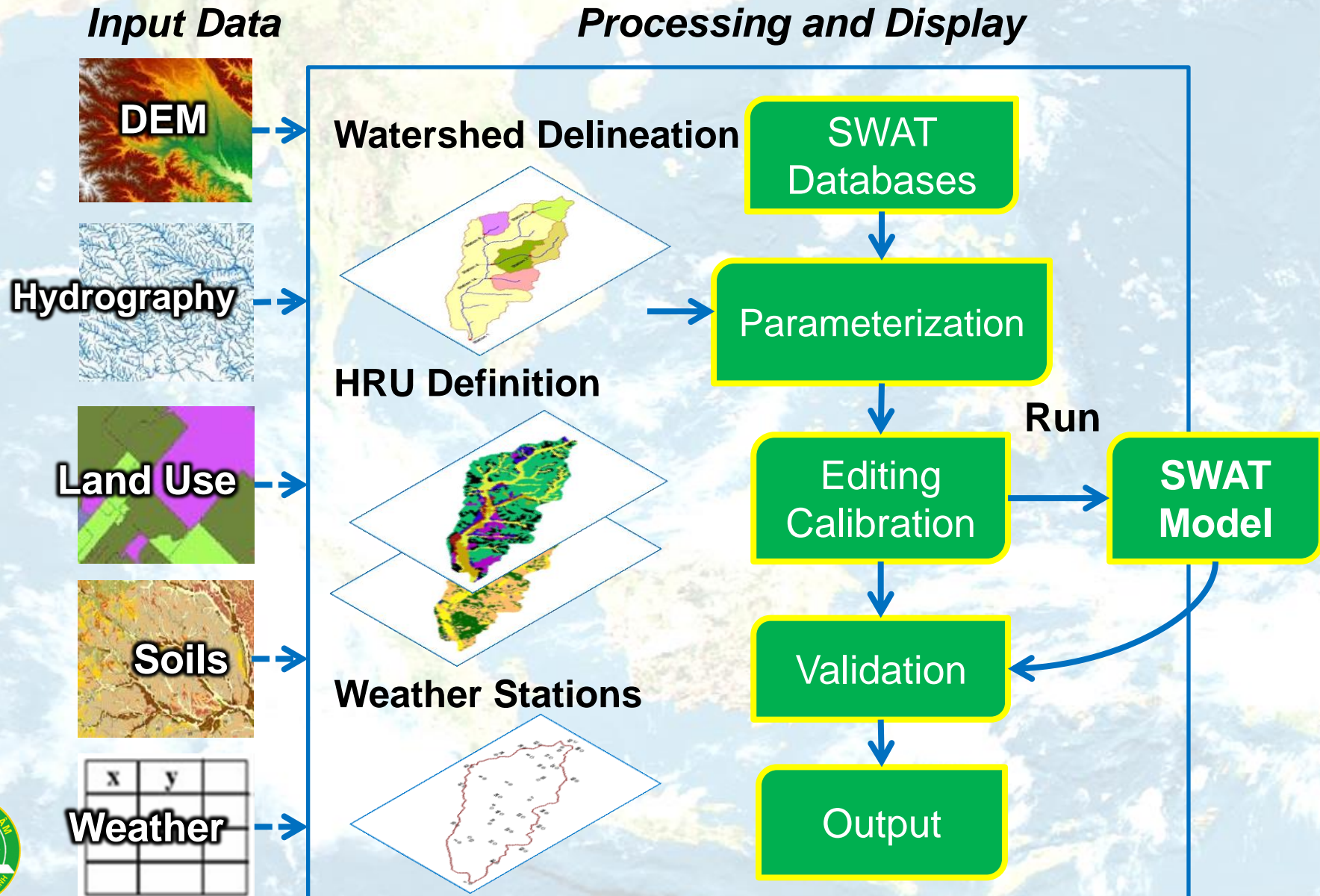
- Maximum / Minimum Temperature*
- Solar radiation*
- Wind speed*
- Relative humidity*
- Rainfall*
- Evaporation*  
*(including the locations of stations)*

### Hydrological Data

- River flow for calibrating the model*

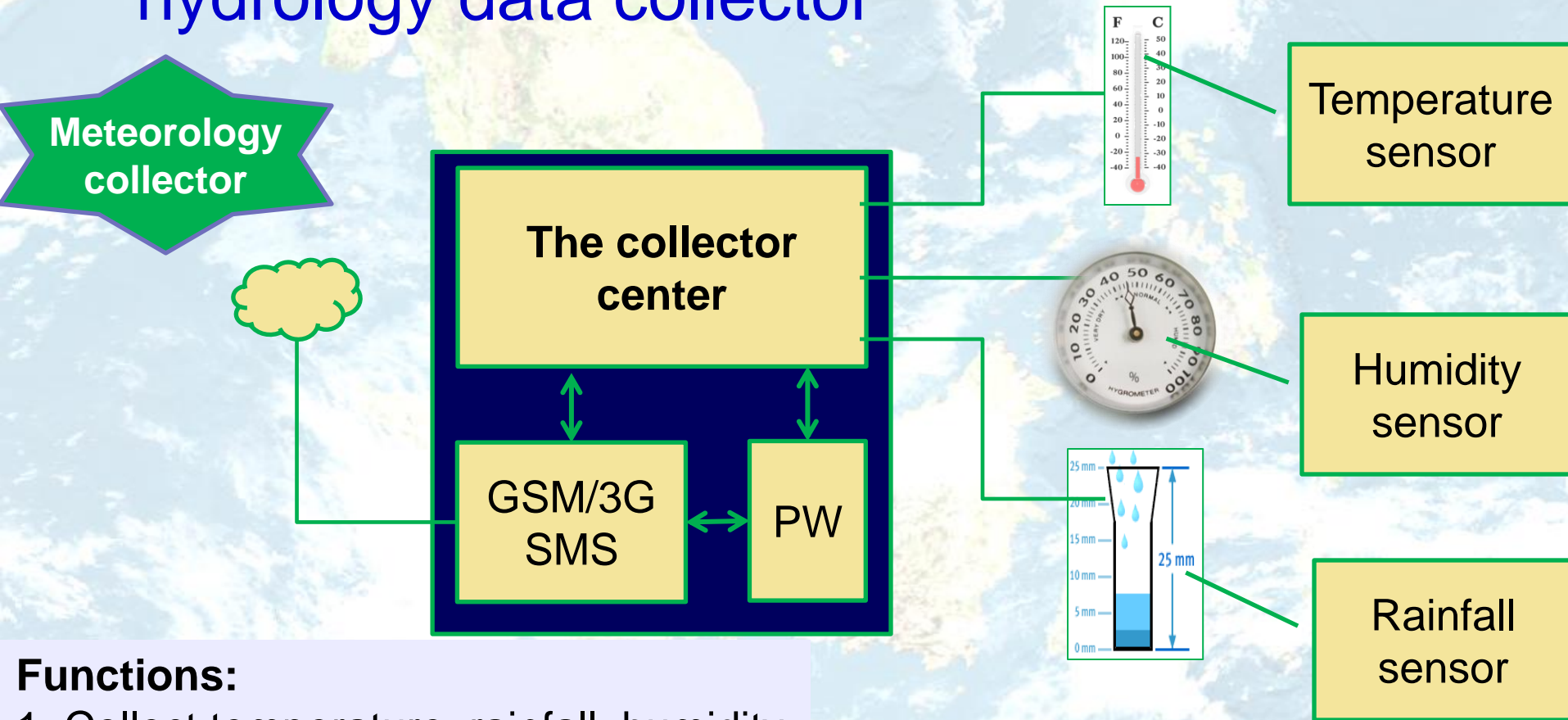


# SWAT model



# Methodology

## ■ Designing the real-time meteorology & hydrology data collector



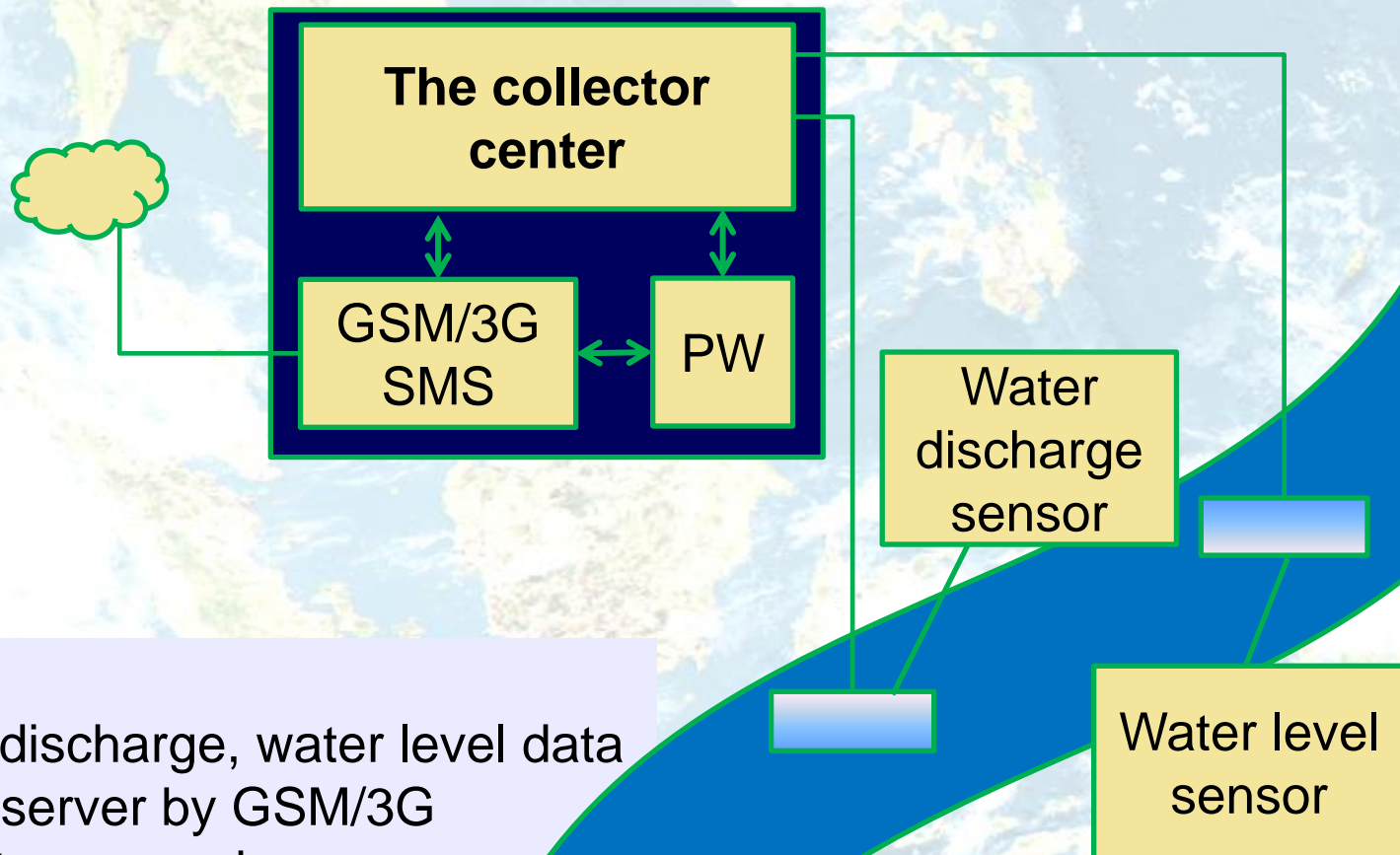
### Functions:

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

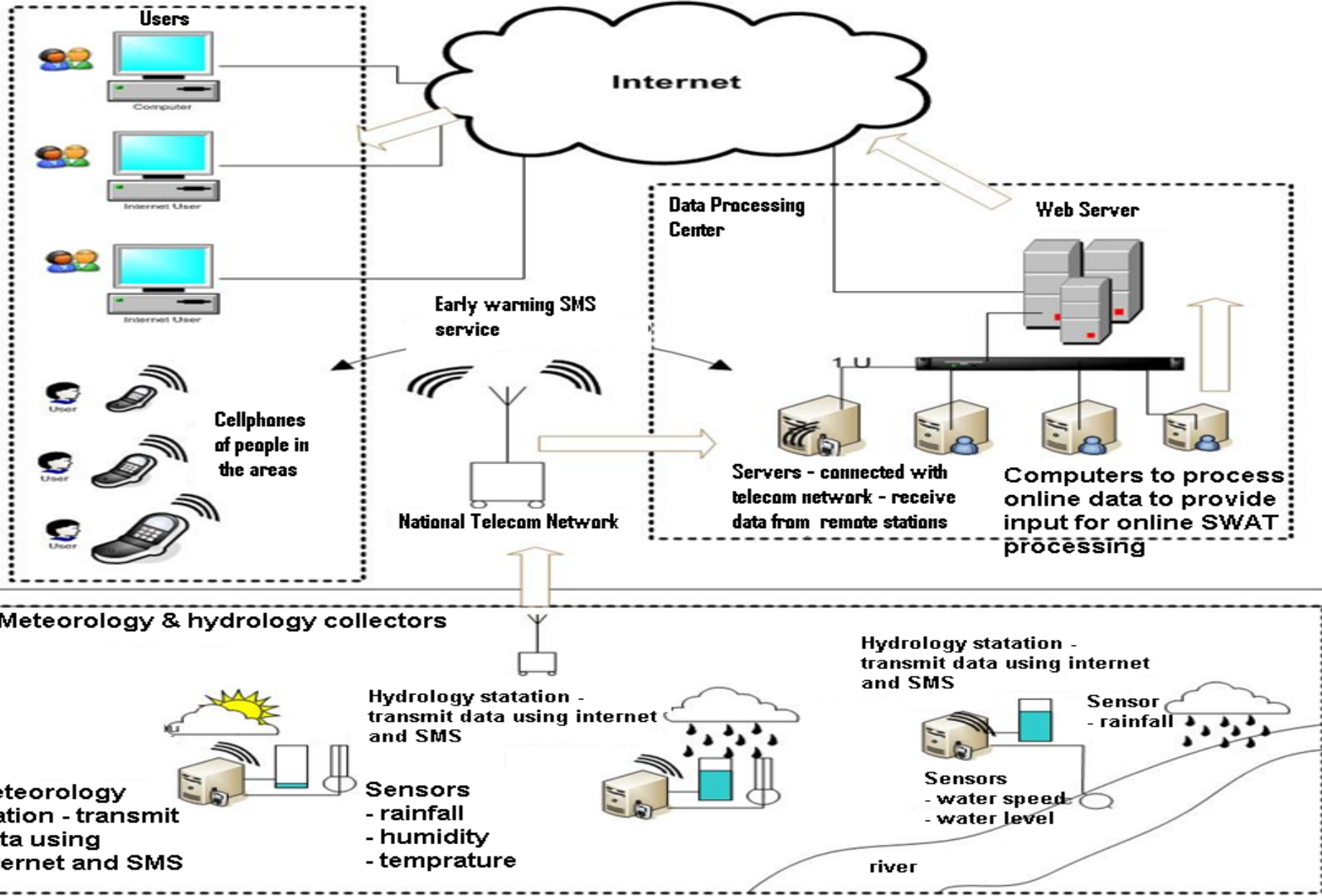
Hydrology collector



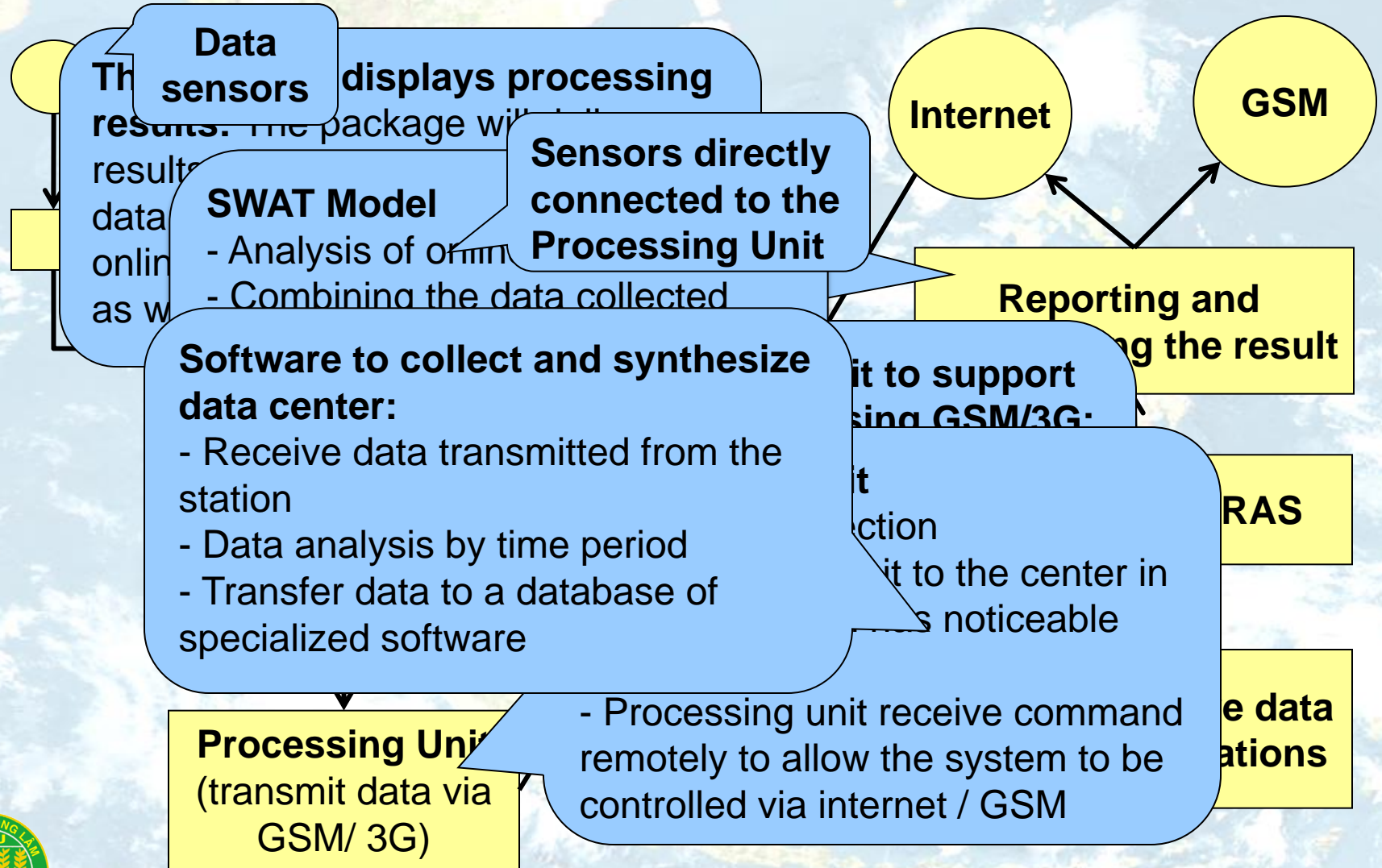
### Functions:

1. Collecting water discharge, water level data
2. Transmit data to server by GSM/3G
3. Automatically data processing

# Updating data in real-time on website



# Diagram of Information Processing



# Expectation

- A flood warning system via internet and SMS message
- Real-time meteorology & hydrology data can be used in future researches
- Database, analyses and reports
- Digital map of the area
- Devices
- Online geo-database
- Website given online information
- Solutions



## Contribution of the Project

- The real-time support for flood warning system helps to minimize losses (human life and possessions) in flash flood in the watershed.
- The Research Team hopes that this project is the starting point for building an Early Flood Warning System.
- GSM has covered almost all areas in Vietnam. Our system has been given possibility to integrate the system to any remote areas of the country.
- The website allows update information. The users are provided web interface to see current rainfall, water level at the watershed origin... The online changes of flood information are recorded and showed on the website. The information is valuable for residents. The data is even more valuable for officers / decision makers in the real cases.



# Contribution of the Project

- Data of several years is valuable input to generate flood warning function for each research location.
- The system will calibrate, update parameters based on calculating information and real data. The system will alter parameters so that the warning as close to the physical case as possible.
- The research result can be transfer to sever provinces/ cities.
- The project is a corporation of several different faculties/ majors (GIS, Information Technology, Mechanical Engineering, Natural Resource & Environment, Hydrology and Fishery).

# The Social Efficiency

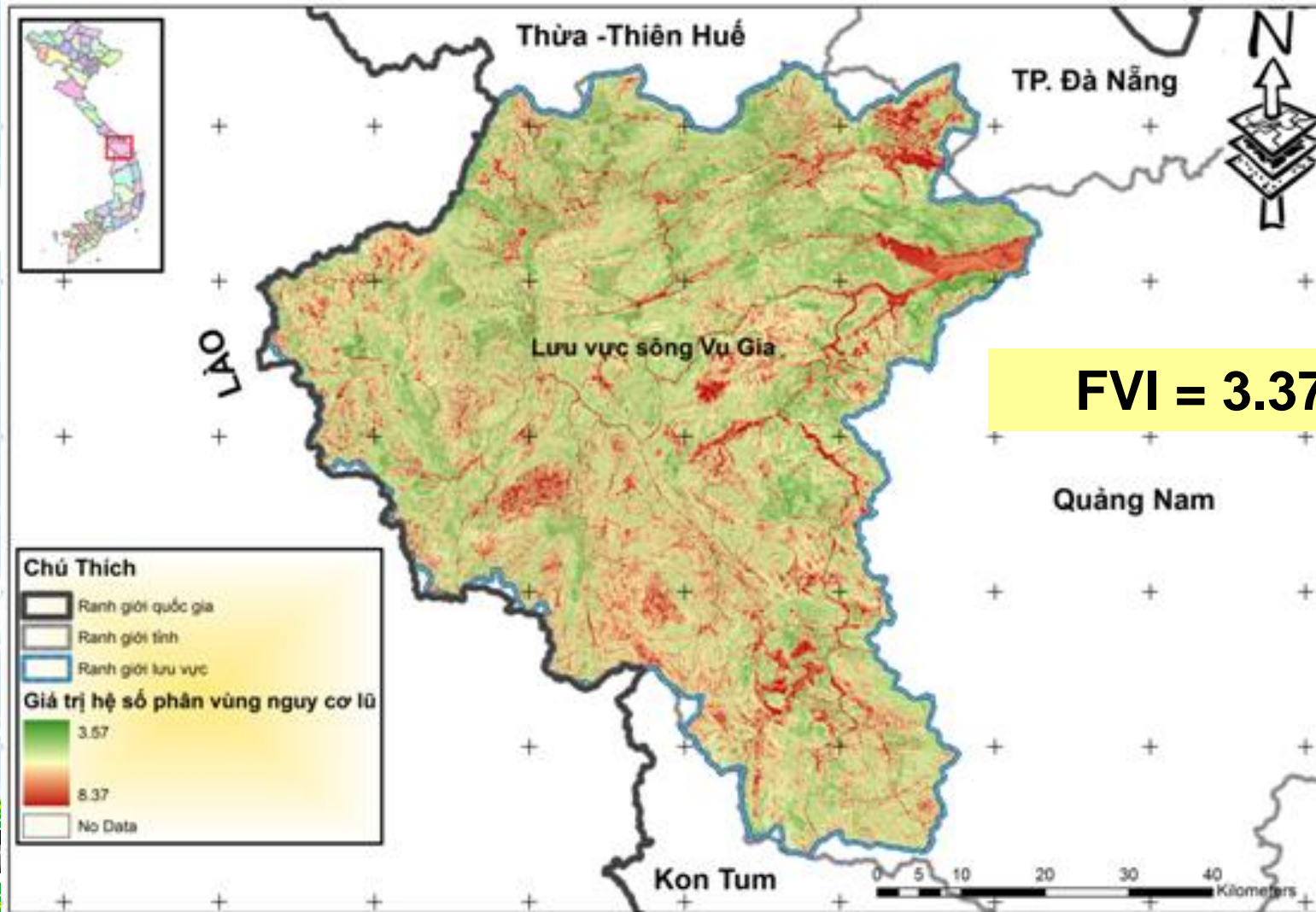
- Once the research is approved, the data processing system provides residents with valuable information to reduce their loss in flash floods every year.
- The system provides valuable information for decision makers in macro operations.
- The system provides valuable information for hydroelectricity factories in the watershed.
- The system increases awareness of deforestation since rainfall, water level, and information are updated regularly on the website.

## Possibility to apply in real cases

- 100% of the project is performed by Vietnamese researchers.
- We can transfer the idea with very low price, flexibility and extendibility.

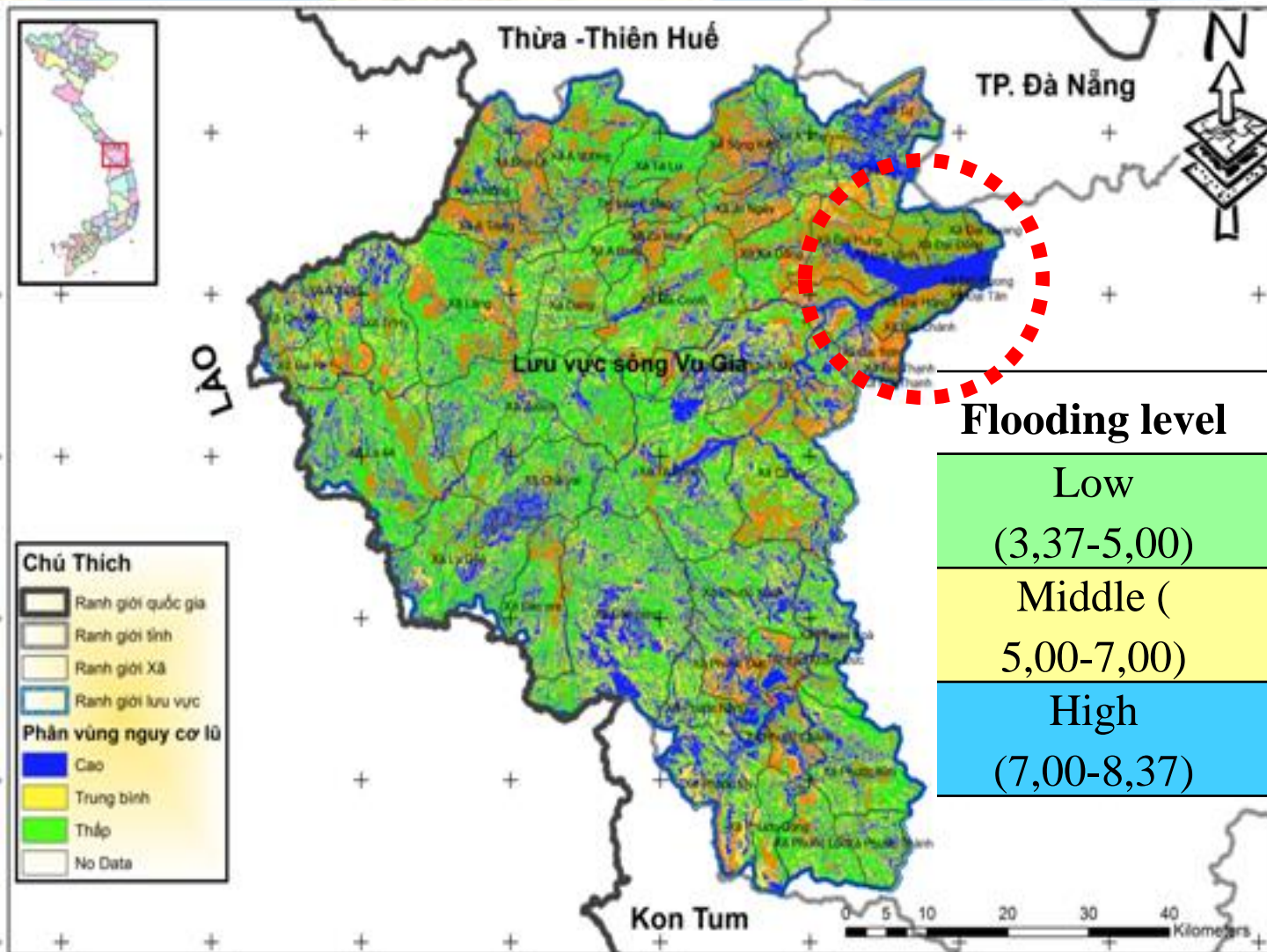
# RESULTS AND DISCUSSIONS

# Flooding Vulnerability Index (FVI)



**FVI = 3.37 to 8.37**

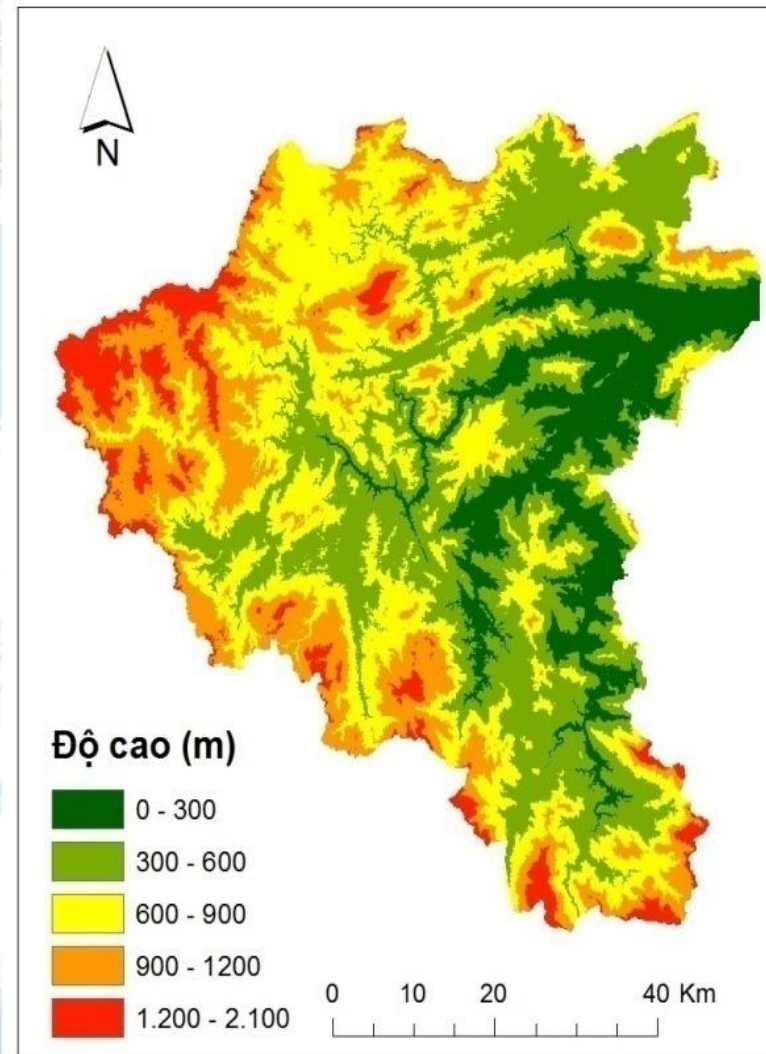
# Flooding Area Map in Vu Gia watershed



Flooding level	Area (ha)	(%)
Low (3,37-5,00)	224,364	48,20
Middle ( 5,00-7,00)	132,421	28,40
High (7,00-8,37)	109,169	23,40

# SWAT Database

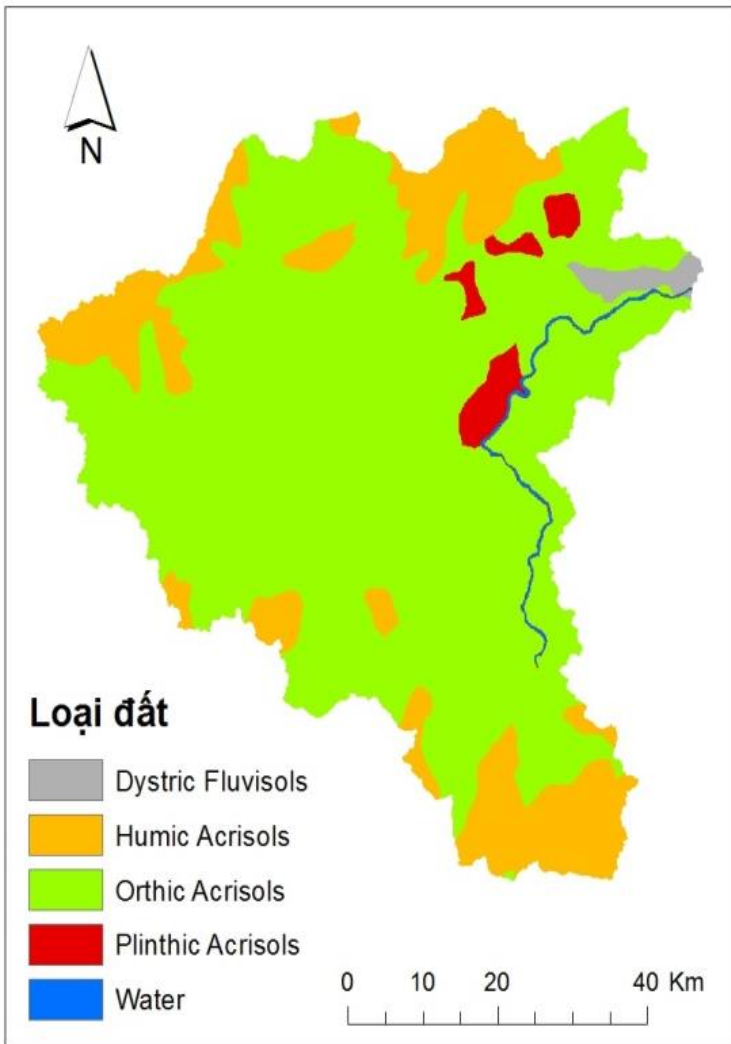
## ■ DEM





# SWAT database

## ■ Soil database

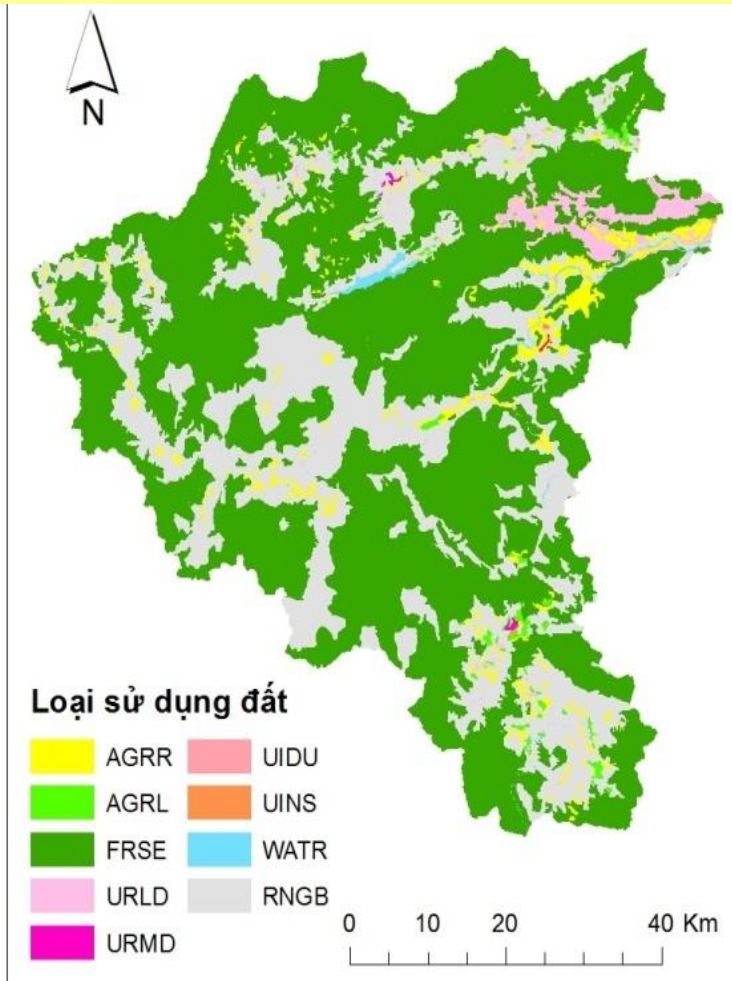


Vnese	FAO	Area(ha)
Đất phù sa	Dystric Fluvisols	5.290,00
Đất mùn vàng đỏ trên núi cao	Humic Acrisols	83.430,00
Đất xám trên phù sa cổ	Orthic Acrisols	360.140,00
Đất xám có tầng loang lổ	Plinthic Acrisols	10.650,00
Mặt nước	-	4.449,35
<b>Total</b>		<b>463.959,35</b>

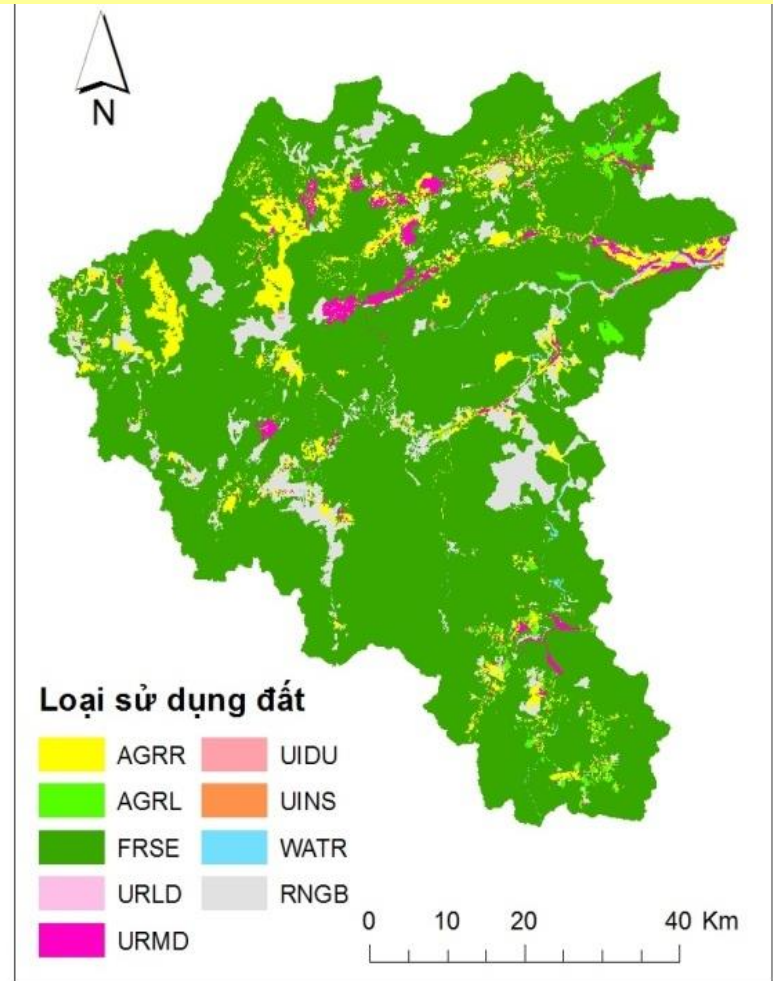
# SWAT database

## ■ Land use database

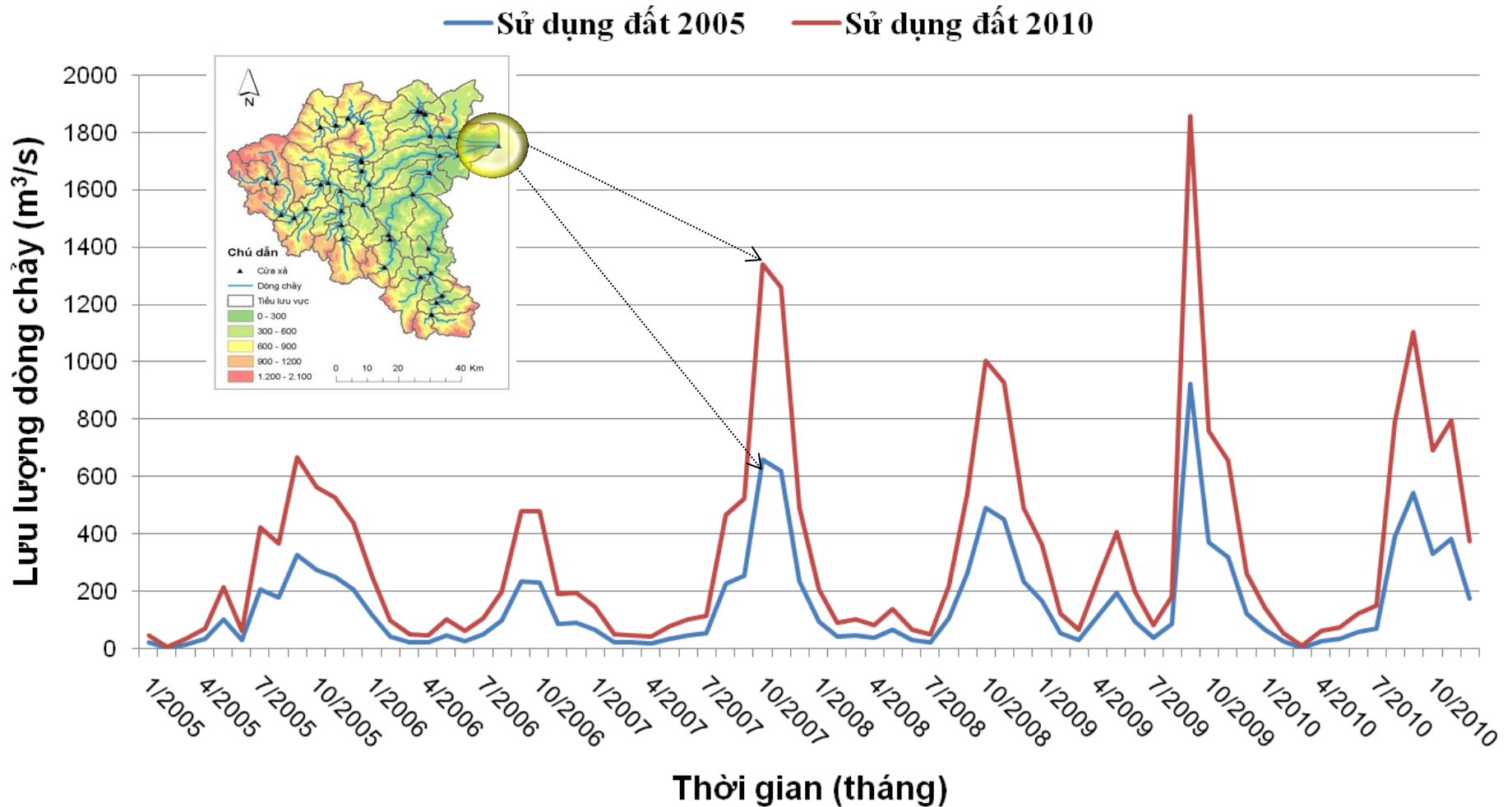
2005



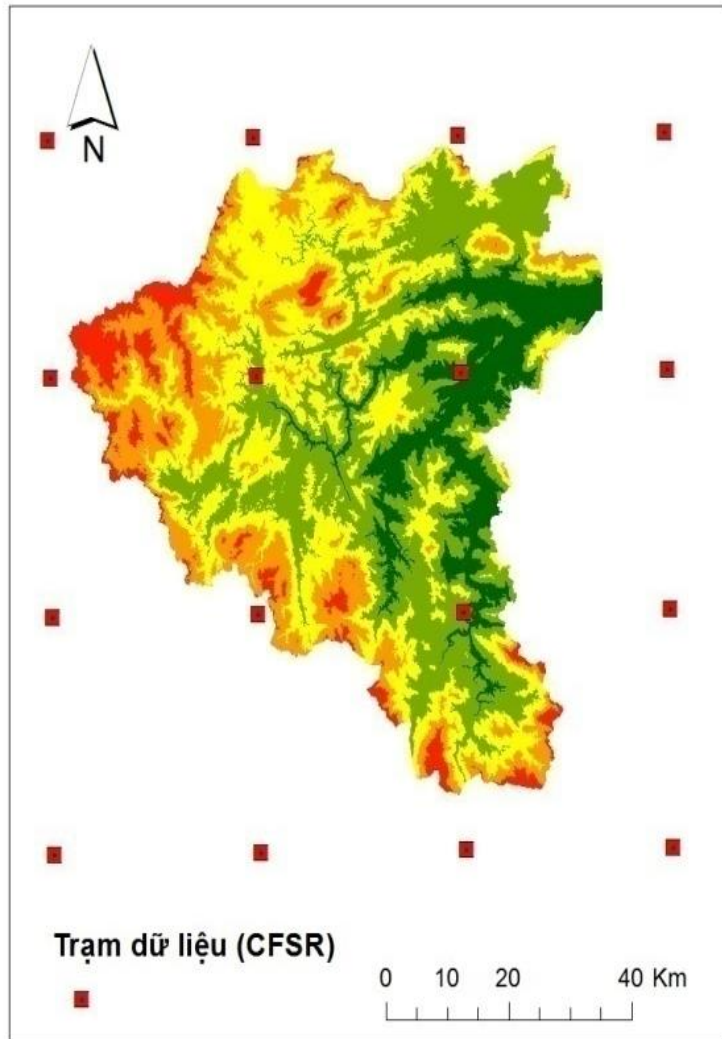
2010



# Effect of Land use/Land cover change on Water discharger



## ■ Weather database



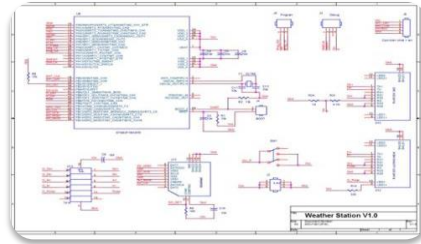
**Station:** 16 stations  
**During:** 1990-2010

- Rainfall,
- Temperature,
- Relative Humidity,
- Win speed,
- Solar radiation

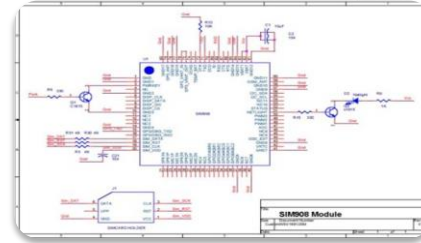
# Automatic Meteorology/ Hydrology Weather Stations



Sensor  
mức nước



Module  
vi xử lý



Module truyền dữ liệu  
GSM/3G



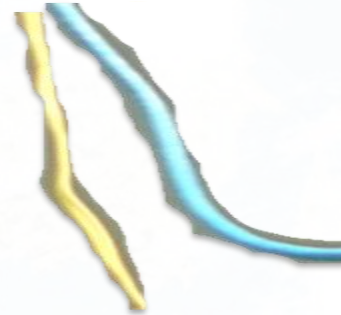
Ắc quy



Anten GSM bộ  
truyền dữ liệu



Panel năng lượng



Cáp truyền dẫn



Hộp bảo vệ

## ■ Automatic Weather Stations



# Automatic Meteorology/ Hydrology Weather Stations



# Automatic Meteorology/ Hydrology Weather Stations







# GISlab Nong Lam University

Men love to wonder and that is the seed of science (Ralph Waldo Emerson)

[TRANG CHỦ](#) [GIỚI THIỆU »](#) [TIN TỨC & SỰ KIỆN](#) [ĐỀ TÀI & DỰ ÁN KHCN »](#) [TÀI NGUYÊN »](#) [LOGIN](#)



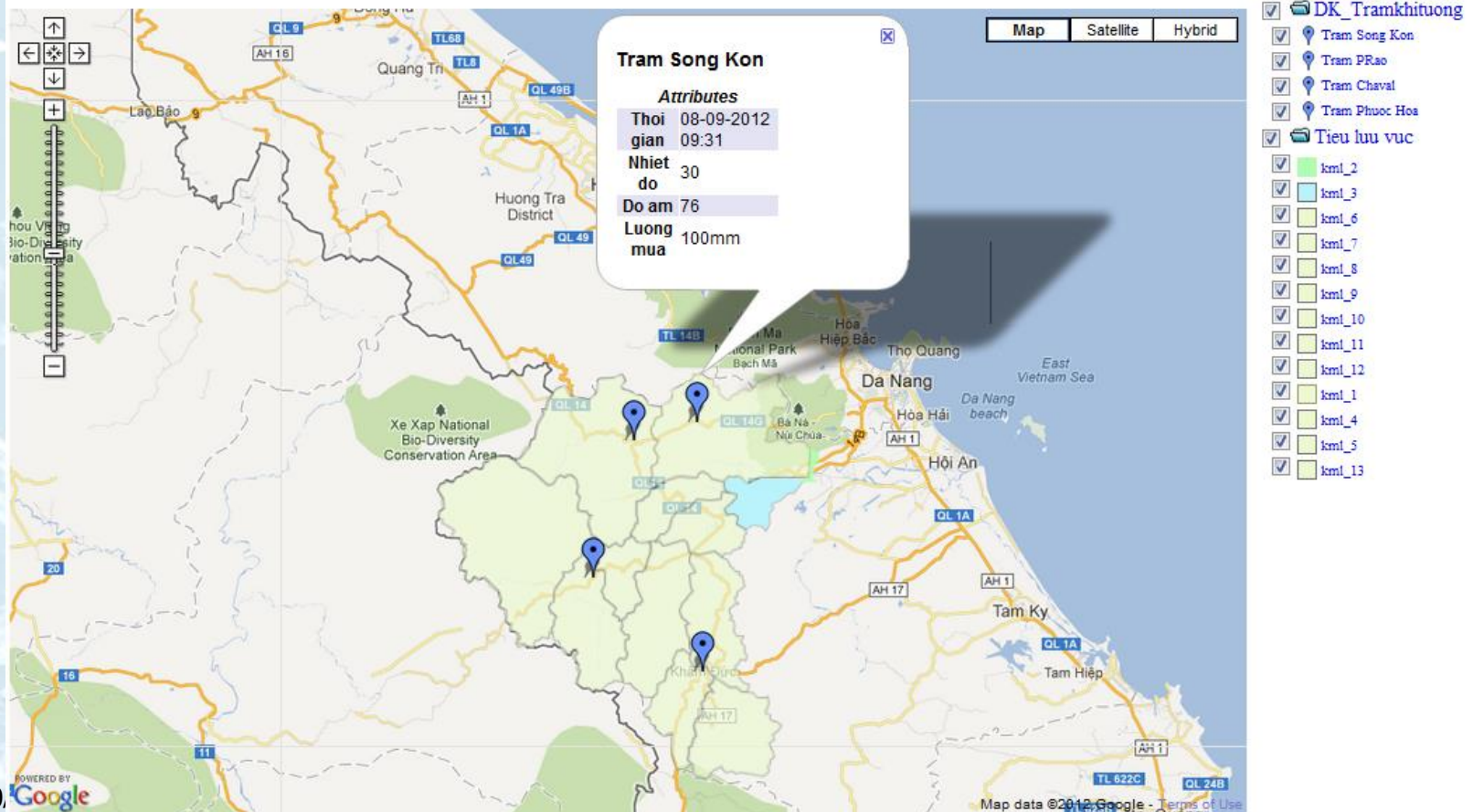
## Hệ hỗ trợ trực tuyến cảnh báo lũ cho lưu vực sông Vu Gia, tỉnh Quảng Nam

Đề tài Khoa học Công nghệ trọng điểm cấp Nhà nước, KC.01.TN18/11-15 [Chi tiết »](#)

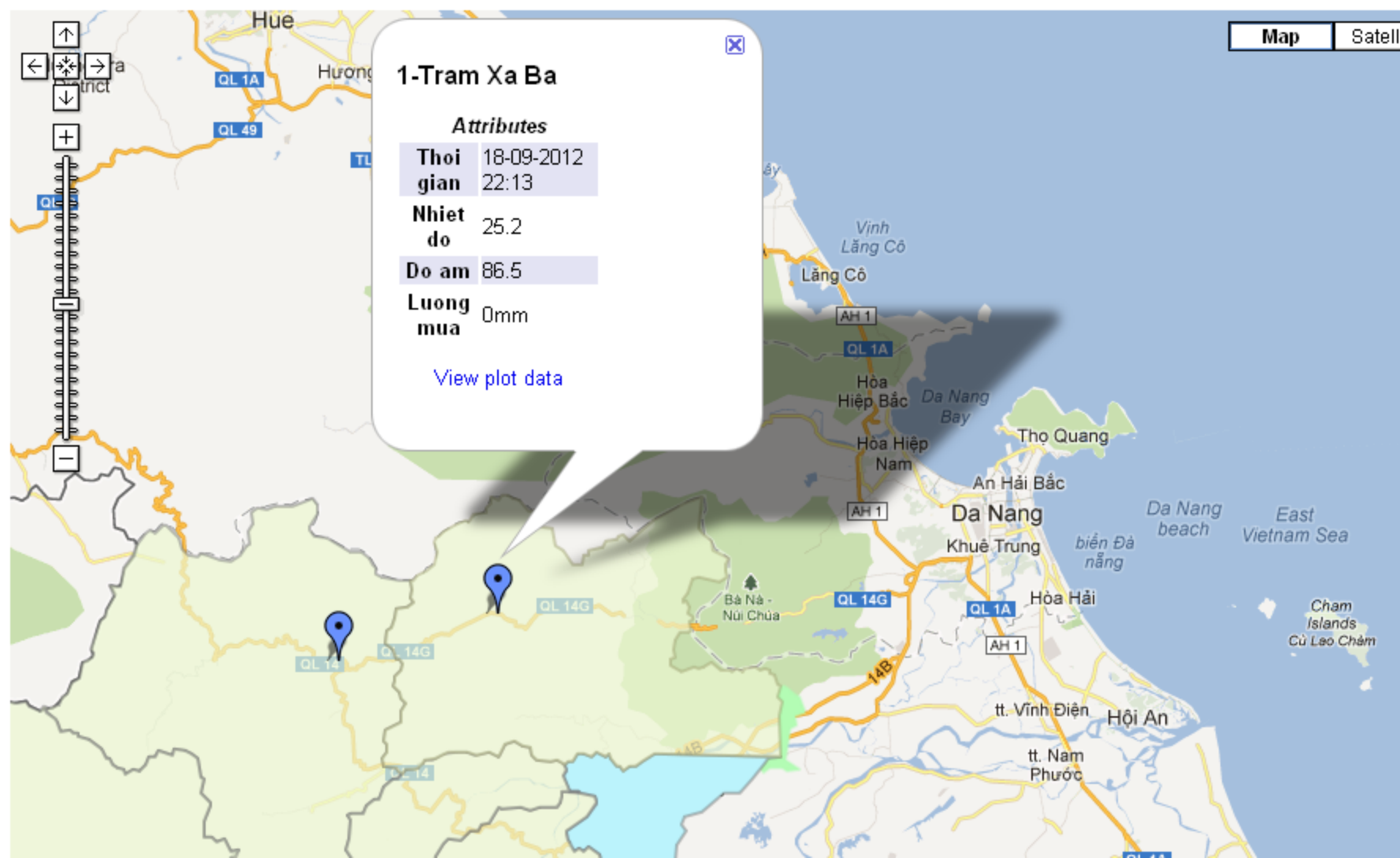
■ Updating weather data in real-time on website

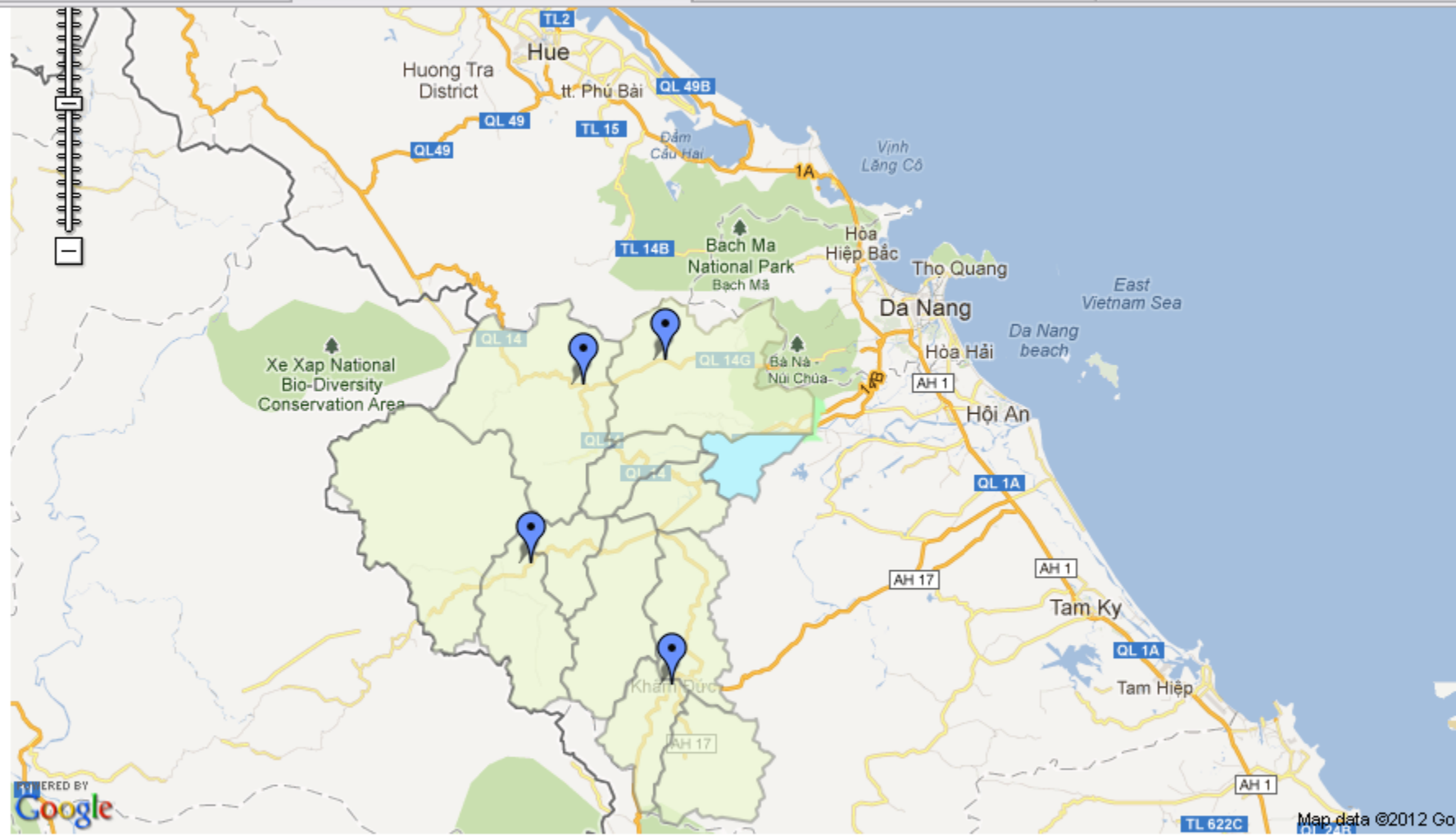
<http://gislab.hcmuaf.edu.vn/vugia/>

Vu Gia testpage

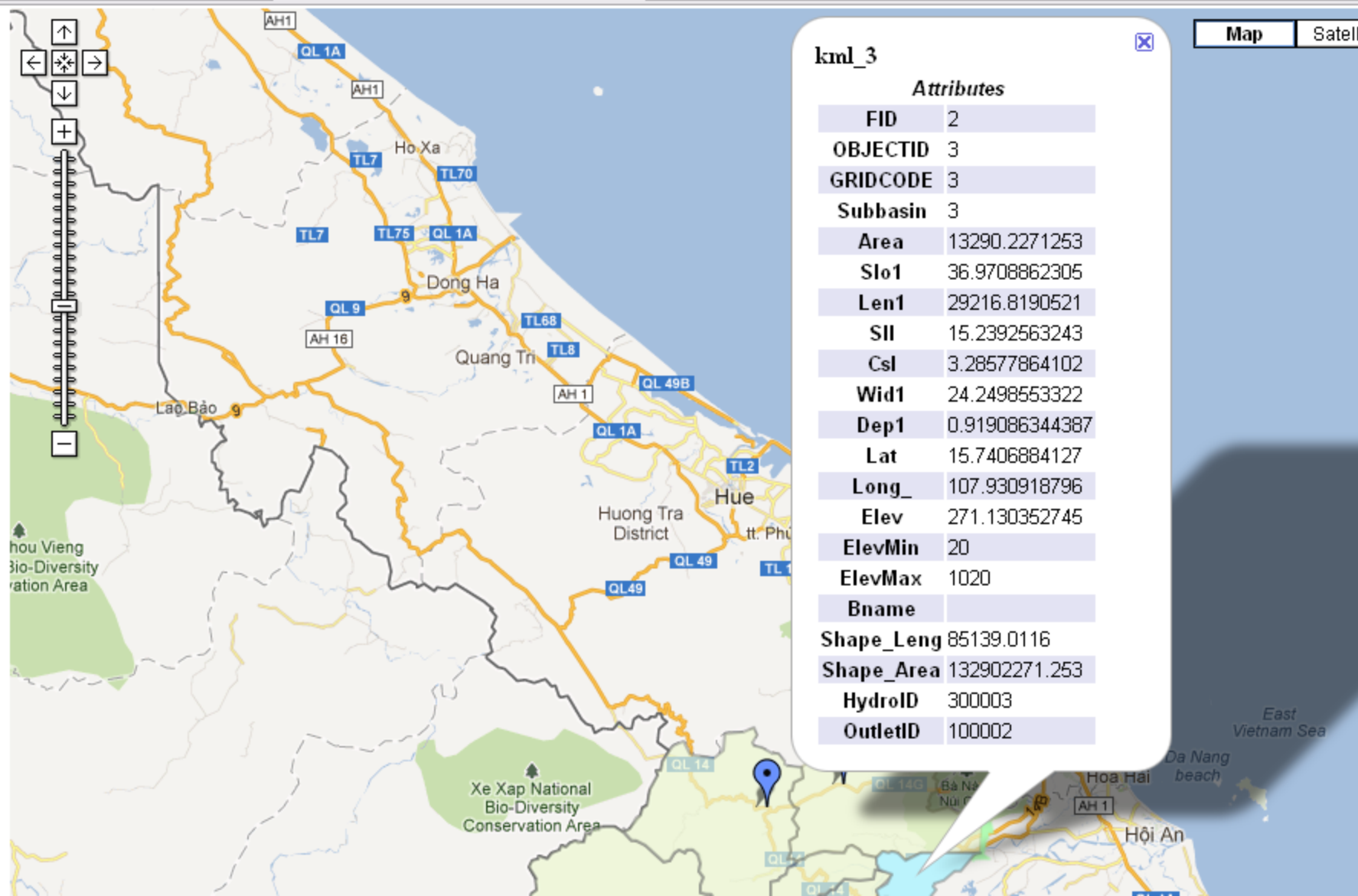


## Vu Gia testpage





Dự án Cảnh báo lũ lưu vực sông Vu Gia - Quảng Nam  
 VP: Phòng R.304 - Đại Học Nông Lâm TP.HCM  
 Khu phố 6, Phường Linh Trung, Quận Thủ Đức, TP.HCM  
 Tel: 08-37242522 - Email: ngkloi@hcmuaf.edu.vn



■ Online automatic updated at website  
([http://gislab.hcmuaf.edu.vn/add\\_data/](http://gislab.hcmuaf.edu.vn/add_data/))

Automatic updated data for 30mins

Real Time Weather Monitoring

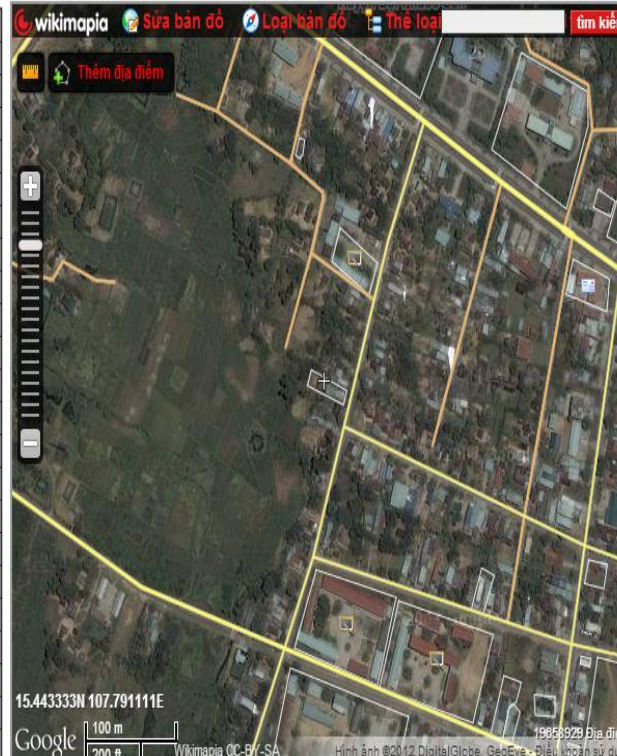
Station Code,

Station: 4

Xa Ba | Prao | Cha Val | Kham Duc

Daily statistics

Time	Temperature	Humidity	Rainfall	Batt/Solar
28-10-2012 13:00	29.9	72.1	0.00	13.1/20.9
28-10-2012 12:30	30.1	72.4	0.00	13.1/21.1
28-10-2012 12:00	29.7	73.3	0.00	13.1/21.2
28-10-2012 11:30	29.7	71.3	0.00	13.0/20.9
28-10-2012 11:00	29.5	70.1	0.00	13.0/21.4
28-10-2012 10:30	28.9	76.6	0.00	12.9/21.3
28-10-2012 10:00	28.3	79.1	0.00	12.9/21.1
28-10-2012 09:30	27.6	83.1	0.00	12.8/21.6
28-10-2012 09:00	27.2	84.7	0.00	12.7/21.7
28-10-2012 08:30	25.6	89.3	0.00	12.9/20.8
28-10-2012 08:00	25.3	88.4	0.00	12.9/20.1
28-10-2012 07:30	24.6	90.2	0.00	12.9/20.0
28-10-2012 05:00	23.2	93.4	0.00	12.5/0.0
28-10-2012 04:30	23.3	93.5	0.00	12.5/0.0
28-10-2012 04:00	23.3	93.4	0.00	12.6/0.0
28-10-2012 02:30	23.5	93	0.00	12.6/0.0
28-10-2012 02:00	23.5	92.7	0.00	12.6/0.0
28-10-2012 01:30	23.7	91.9	0.00	12.6/0.0
28-10-2012 01:00	23.7	92.4	0.00	12.6/0.0
28-10-2012 00:30	23.6	92.7	0.00	12.6/0.0
27-10-2012 22:00	23.8	92.1	31.35	12.7/0.0
27-10-2012 21:30	23.9	91.7	31.35	12.7/0.0

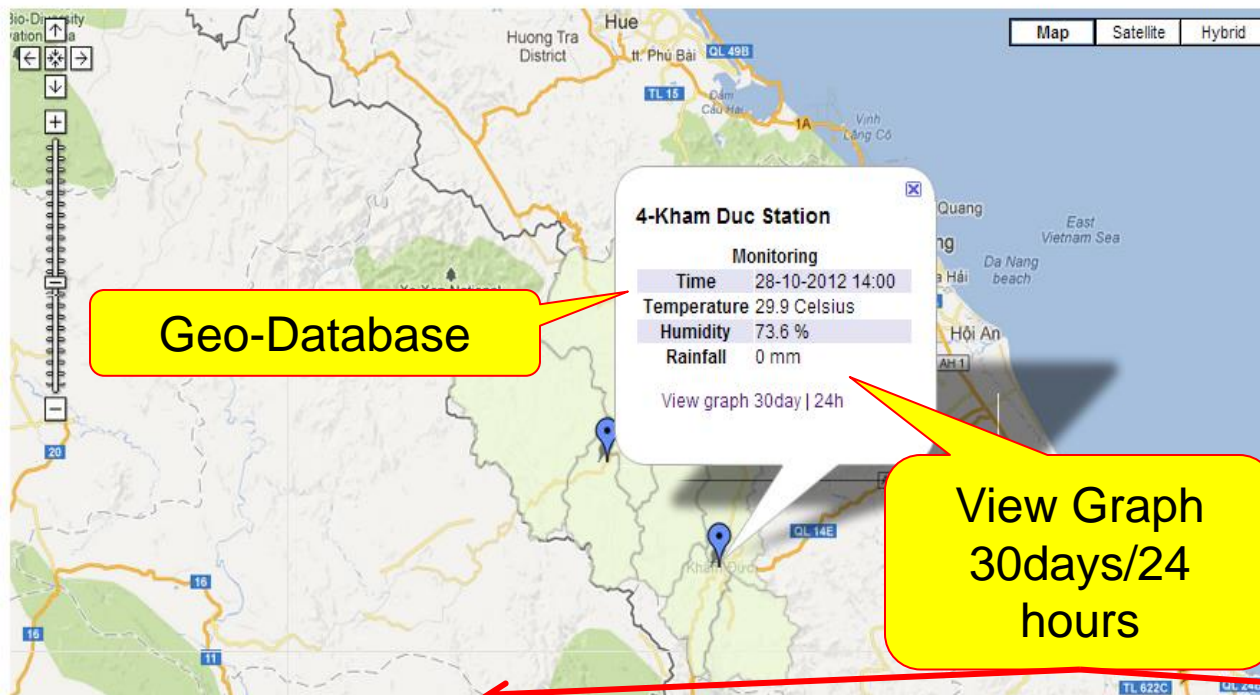


Daily weather data at Station 4

Day	Max Temperature	Min Temperature	Rainfall
20-09-2012	32	27.9	0.00
21-09-2012	33.4	26.1	0.00
22-09-2012	33.9	25.9	0.00
23-09-2012	32.9	24.5	0.00
24-09-2012	33.8	25.4	0.00
25-09-2012	33.7	25.7	0.00
26-09-2012	30.1	25.7	15.95
27-09-2012	30	24.3	57.30
28-09-2012	25.9	23.5	31.62
29-09-2012	23.5	22.5	4.05
30-09-2012	27.1	22.2	2.70
01-10-2012	26.8	22.6	0.00
02-10-2012	30.1	23.1	0.00
03-10-2012	31.2	24.7	0.00
04-10-2012	31.6	24.4	0.00
05-10-2012	30.5	24.9	0.30
06-10-2012	24.7	22.1	160.30
07-10-2012	26.1	22.9	17.80

# WebGIS for Flooding Control

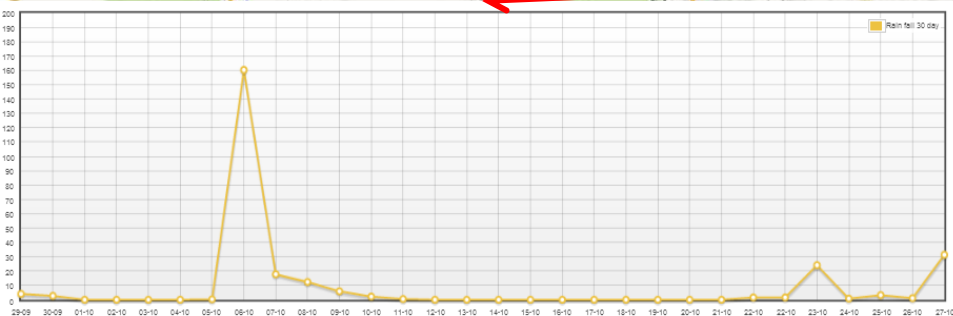
WebGIS based flood forecasting in Vu Gia watershed, Quang Nam province, Vietnam



- Vu Gia Watershed
- Weather Stations
  - 1-Xa Ba Station
  - 2-Prao Station
  - 3-Cha Val Station
  - 4-Kham Duc Station
- Subbasins
  - kcm1\_2
  - kcm1\_3
  - kcm1\_6
  - kcm1\_7
  - kcm1\_8
  - kcm1\_9
  - kcm1\_10
  - kcm1\_11
  - kcm1\_12
  - kcm1\_1
  - kcm1\_4
  - kcm1\_5
  - kcm1\_13

Rainfall Stations

Sub-basin

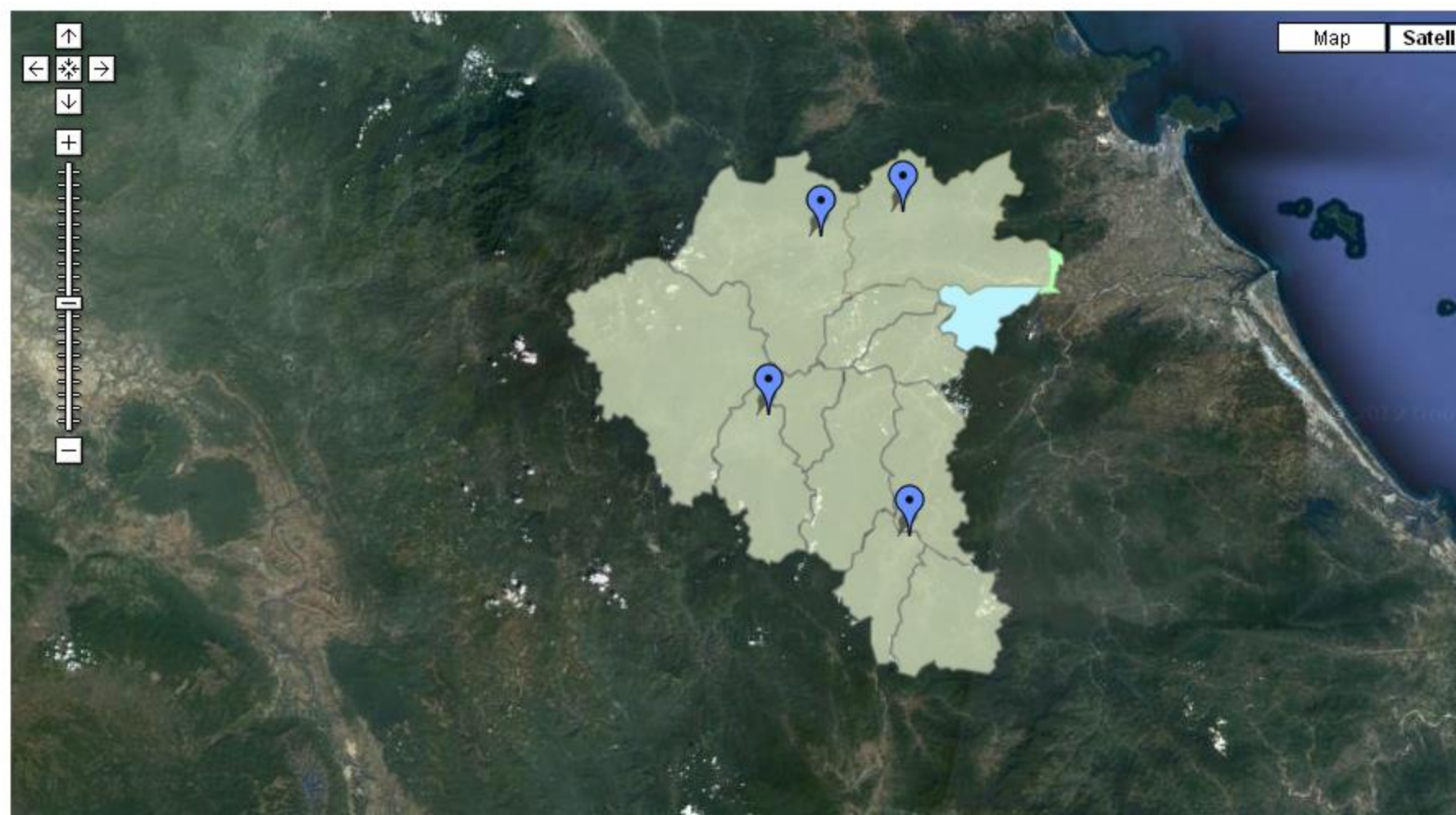


Station	XBtmp, PRtmp, CVtmp, KDtmp,			
Lat1	16.0	15.9	15.6	15.4
Long	107.9	107.6	107.6	107.8
Elev	369	536	294	490
1990001031.	9.9031.9020.9031.9020.9031.9020.9			
1990002031.	8020.8031.8020.8031.8020.8031.8020.8			
1990003032.	3021.3032.3021.3032.3021.3032.3021.3			
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1990005031.	3020.3031.3020.3031.3020.3031.3020.3			
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1990017030.	9019.9030.9019.9030.9019.9030.9019.9			
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1990019031.	4020.4031.4020.4031.4020.4031.4020.4			
1990020030.	8019.8030.8019.8030.8019.8030.8019.8			
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1990025031.	4020.4031.4020.4031.4020.4031.4020.4			
1990026030.	9019.9030.9019.9030.9019.9030.9019.9			
1990027030.	9019.9030.9019.9030.9019.9030.9019.9			
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1990032031.	2020.2031.2020.2031.2020.2031.2020.2			
1990033030.	5019.5030.5019.5030.5019.5030.5019.5			
1990034031.	5020.5031.5020.5031.5020.5031.5020.5			
1990035031.	5020.5031.5020.5031.5020.5031.5020.5			
1990036032.	1021.1032.1021.1032.1021.1032.1021.1			
1990037033.	6022.6033.6022.6033.6022.6033.6022.6			
1990038032.	4021.4032.4021.4032.4021.4032.4021.4			
1990039031.	7020.7031.7020.7031.7020.7031.7020.7			
1990040031.	5020.5031.5020.5031.5020.5031.5020.5			





# Vu Gia testpage





# CONCLUSIONS

- This research is just the first step apply SWAT and HEC-RAS model in Vu Gia watershed. The SWAT 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 watershed, Quang Nam province, Vietnam - tropical conditions.



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**Thank you for your attention!**

