

# APPLICATION OF GEOMATICS IN NATURAL DISASTER RISK MANAGEMENT – CASE STUDY: YENBAI CITY



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# Natural disasters in Vietnam



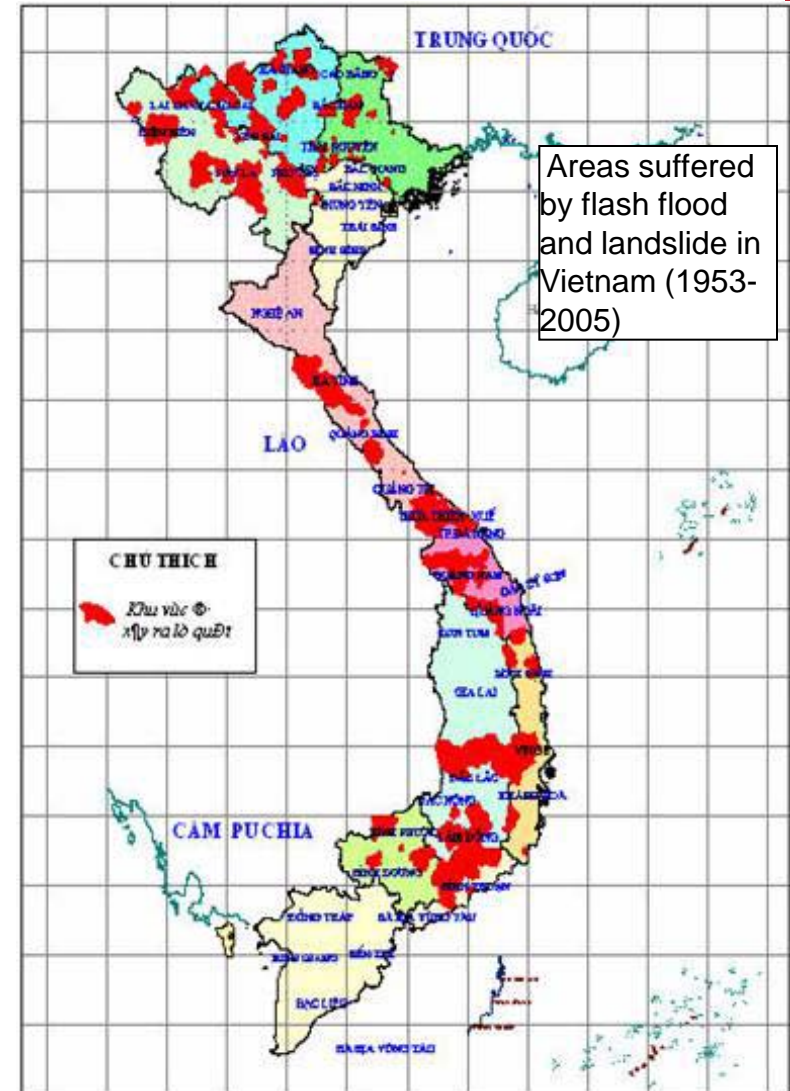
*Climate regime of VietNam : tropical monsoon*

- ✓ Storms, tropical depressions, hurricanes, and heavy rains during monsoon.
- ✓ Natural disasters: flood, landslide, flash flood, river bank erosion, drought, salinity, ...
- ✓ The problem is aggravated because of:
  - ❖ **Climate change**
  - ❖ **Landuse change due to the population growth, economic development, fast urbanisation, etc**

# Natural disasters in Vietnam



- 1990-2005: 28 flash floods in northwest provinces of Vietnam, induced a number of landslides, caused 988 death and missing, 698 injuries, 13289 houses collapsed, 114849 houses damaged and 180000 ha crop lost (IMH, 2006)



# Natural disasters in Vietnam

➤ *Storm Lekima (No 5) hit Quangbinh and Hatinh province, dated 30/9/2007 with heavy rain caused flood and flash flood in Quangbinh, Hatinh, Nghean, Thanhhoa, Thuathienhue, Ninhbinh, Sonla, Yenbai provinces*



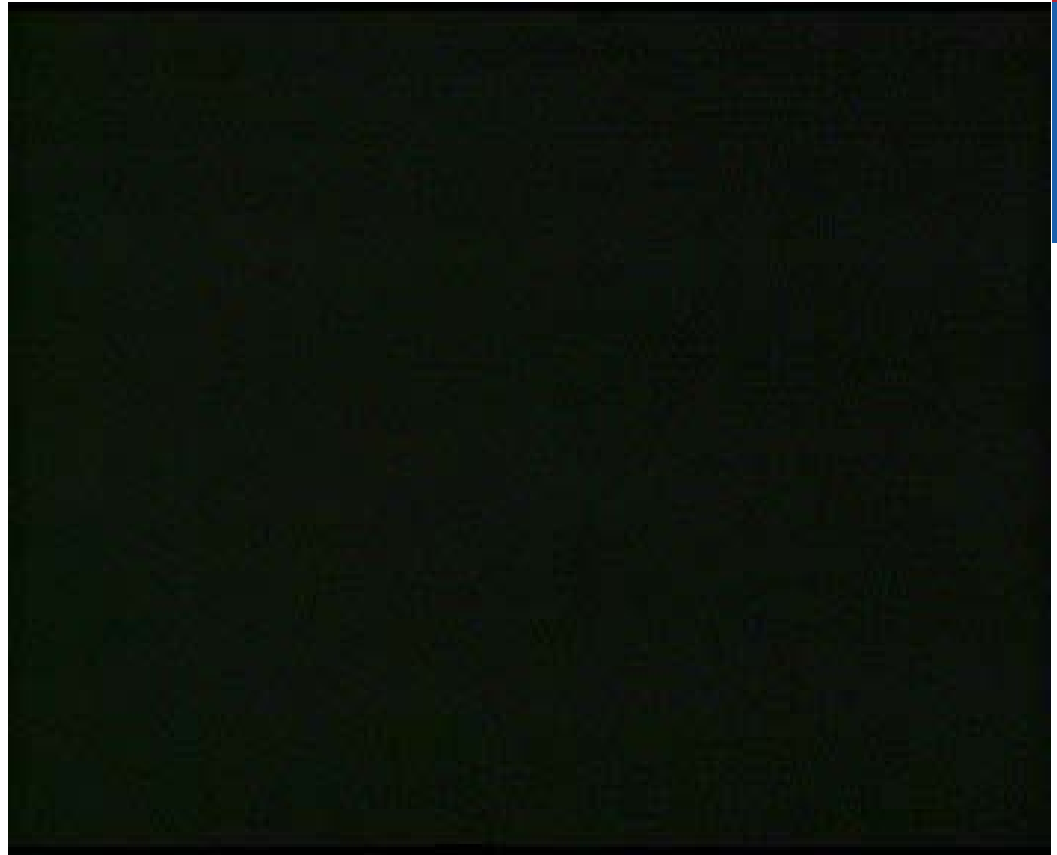
**Fatal consequence:** 6000 houses collapsed, about 50000 houses wounded, more than 200 public works damaged, about 25000 ha rice and 100000 ha crop loses, 600000 m<sup>3</sup> soil slid

# Natural disasters in Vietnam



➤ Due to heavy rain: A big mud flow occurred in the night  
13/9/2004 Batxat - Laocai

- The hazard prone is more than 400m long
- 23 deaths, 4 house collapsed, and number of crop areas loss



# Natural disasters in Vietnam

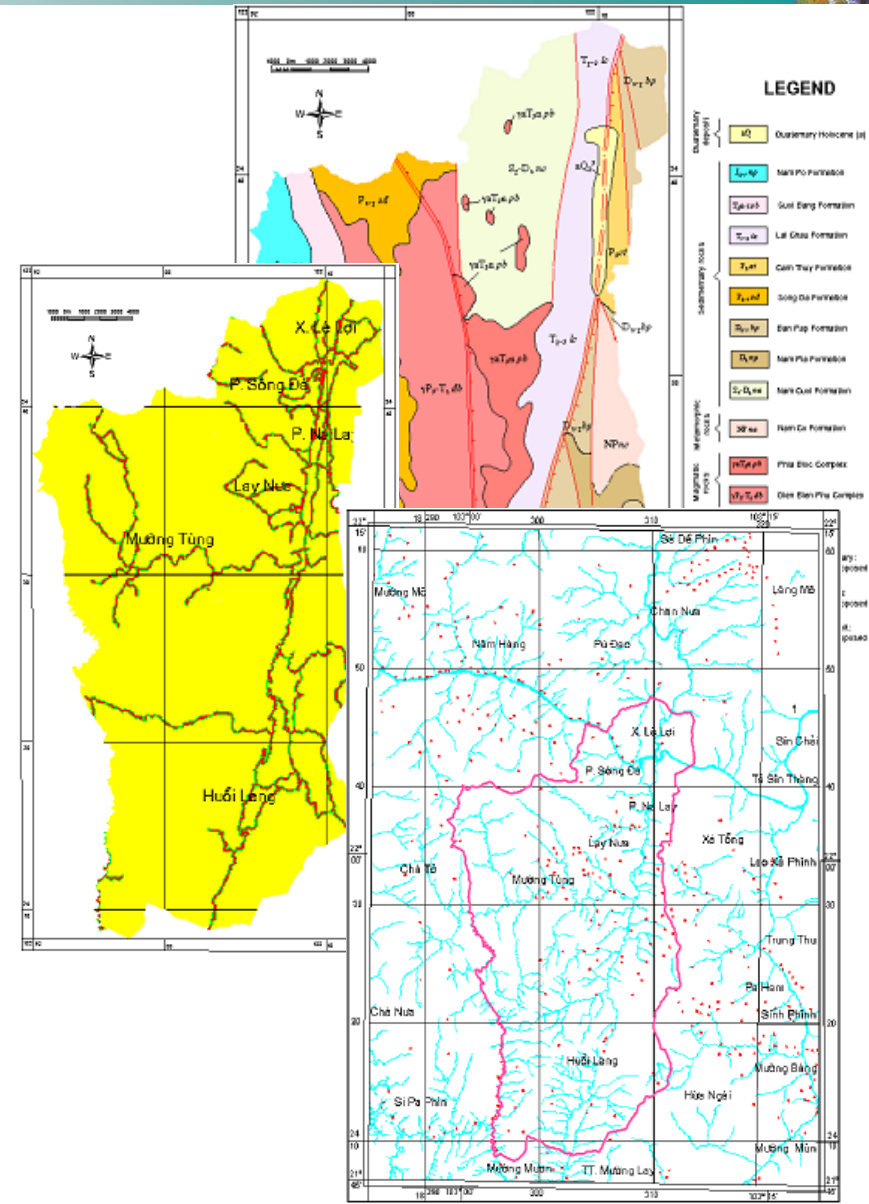


## ❖ Most serious disaster - flooding



# Disaster studies

- Disaster inventory
- GPS survey for accurate position of disaster
- Using remotely sensed data in disaster factor extraction and upgrading: disaster prone, soil characteristics, terrain, meteor-hydrological data,...
- Spatial analysis and modeling for susceptibility mapping





# Disaster studies



## ☐ Landslide susceptibility map

### Data use:

- Active landslides
- Satellite image: Landsat EMT 7+
- Topography map
- Meteo-hydrological data
- Survey data: soil, lithology,...

### Environment factors of disaster:

- Lithology, weathering layer, lineament
- Drainage density, landuse/landcover, slope
- Rainfall
- Distance to road

### Integrated modeling in GIS:

- Weights of evidence method

### Legend



River



Landslide

### Landslide susceptibility



Low



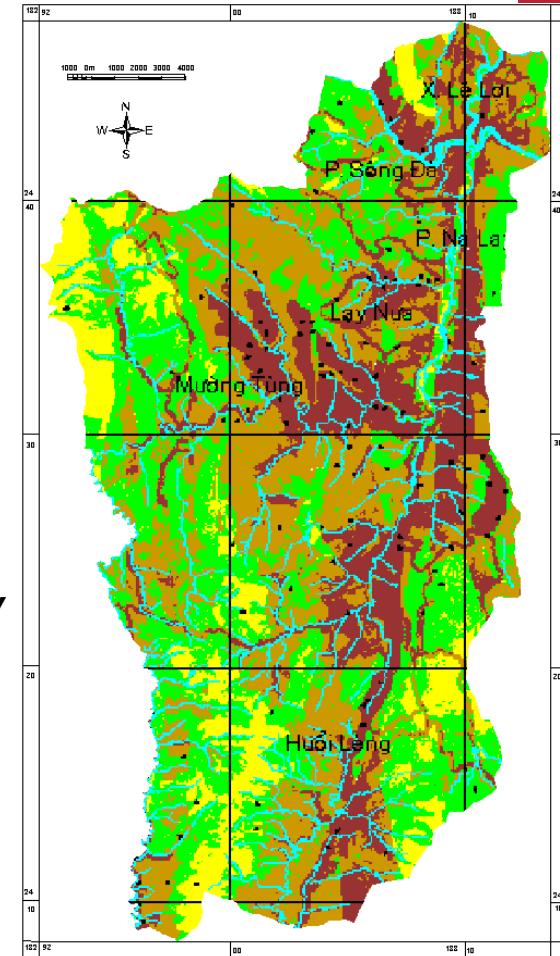
Moderate



High



Very high



(VIRGM, 2009)

*Landslide susceptibility of Muonglay – North Vietnam*

# Disaster studies

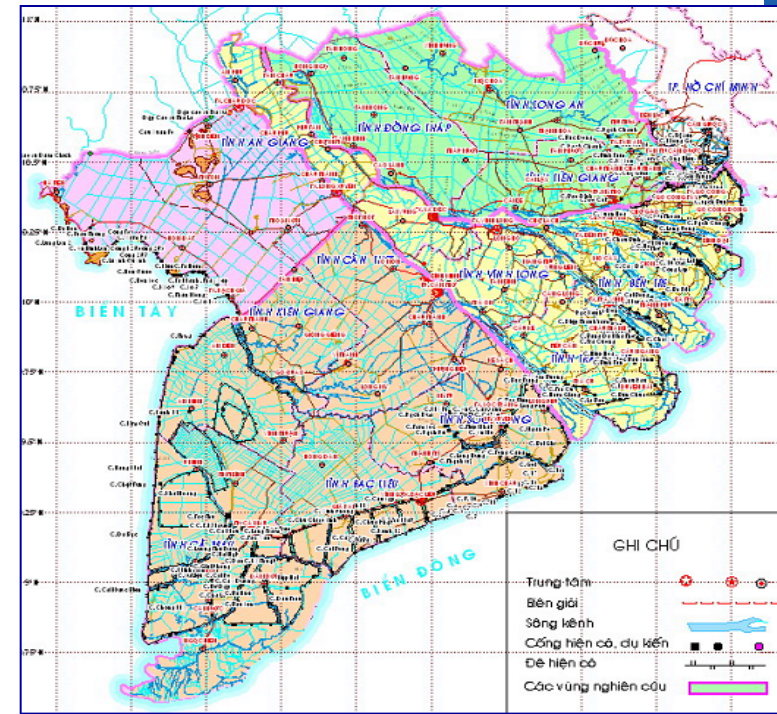
## □ Flood control in integrated water resources planning – Mekong Delta (Mekong committee)

### ■ *Types of water resources structures:*

- ✓ Canals / Ditches
- ✓ Sluices / Culverts
- ✓ Dykes / Ring dykes
- ✓ Dam/ Temporary dams
- ✓ Electricity pumping station / Small gasoline pumps

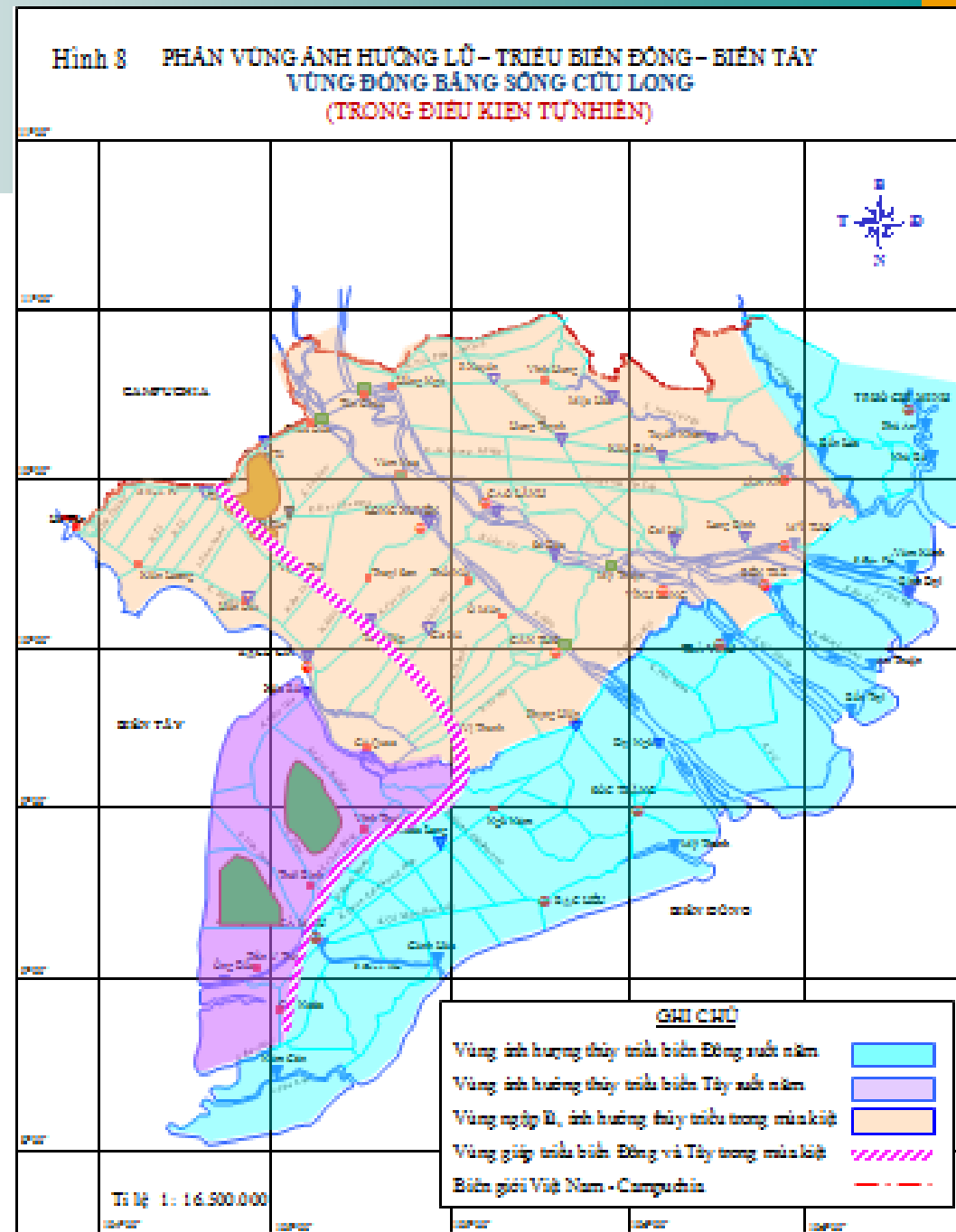
### ■ *Groups of water resource structures:*

- ✓ Flood control structures
- ✓ Salinity prevention structures
- ✓ Irrigation and drainage structures
- ✓ Sea and river mouth dyke structures



(Cont.)

- Flood zonation under natural condition (rainfall and tide) in Mekong Delta - Vietnam

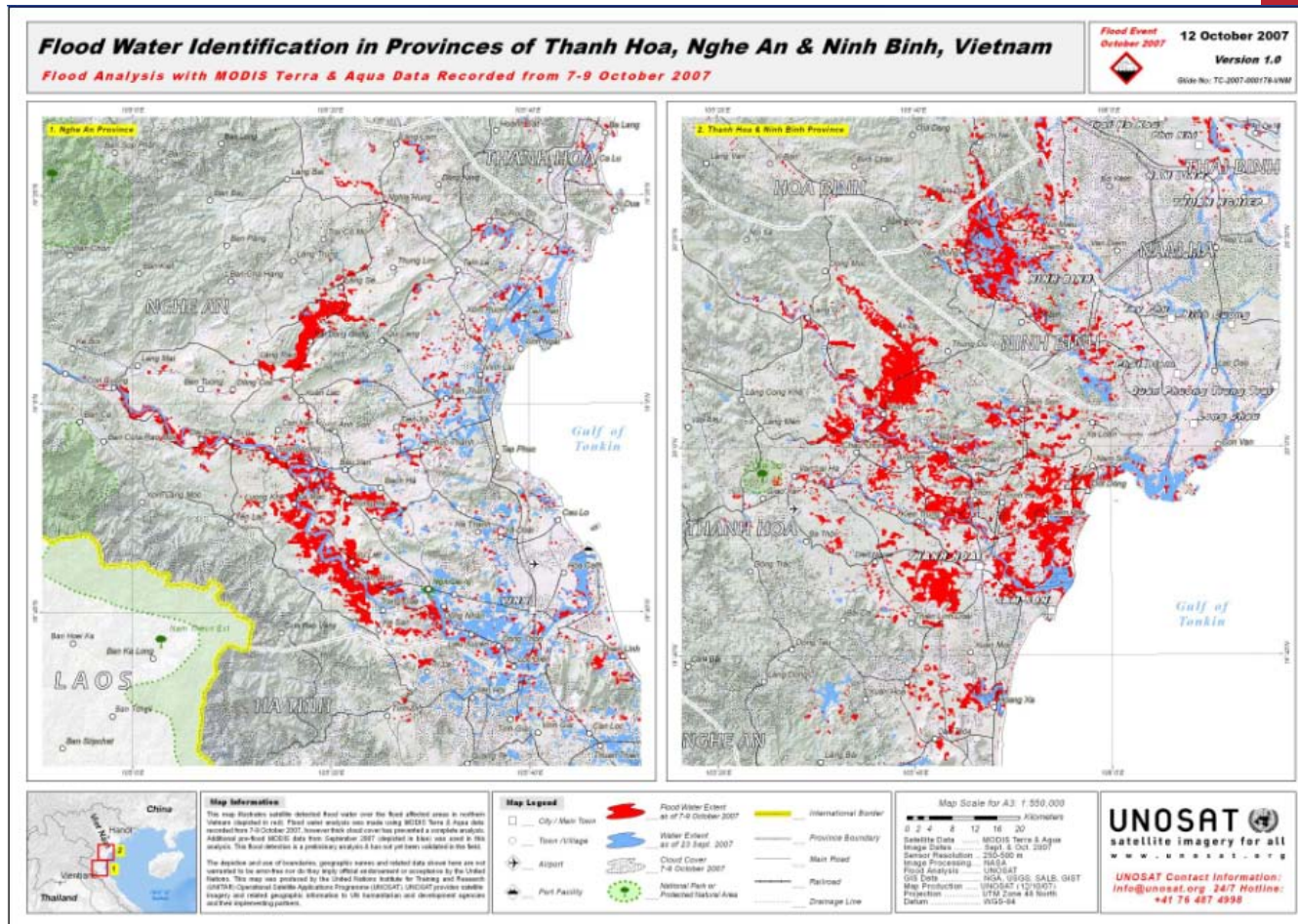


# Application of Geomatics in flood studies

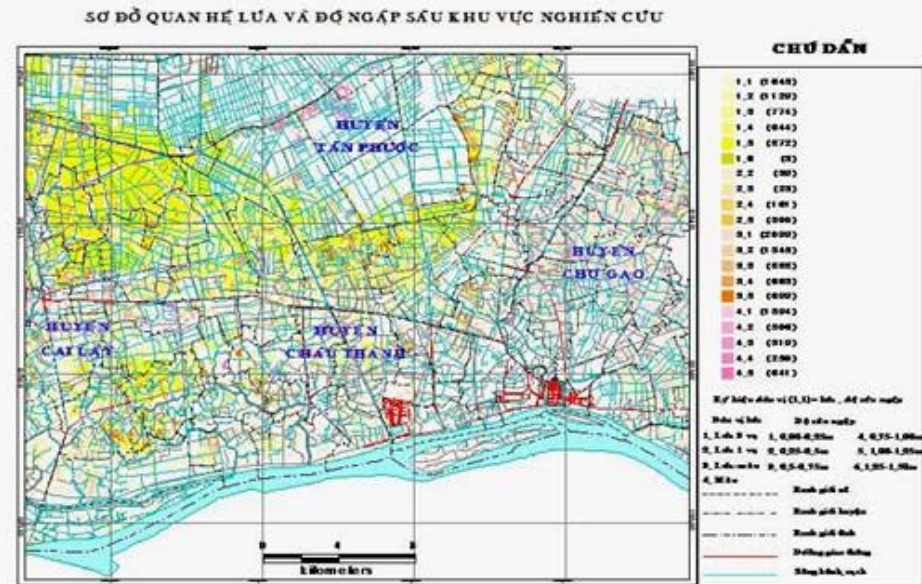


## □ Flood map

Using Modis Terra image and aqua data on 7-9 Oct. 2007 to create flood map for Thanhhoa, Nghean, and Ninhbinh provinces



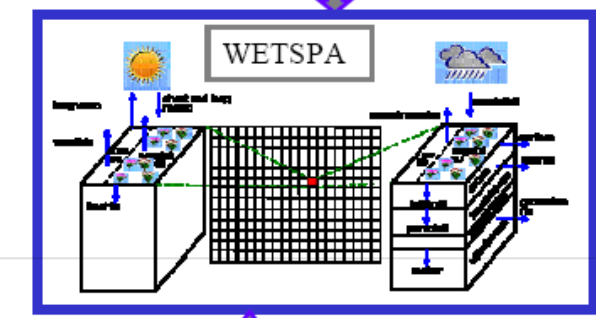
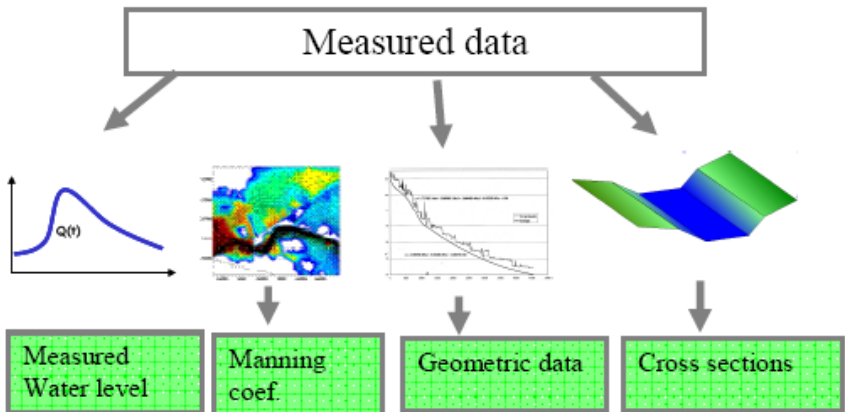
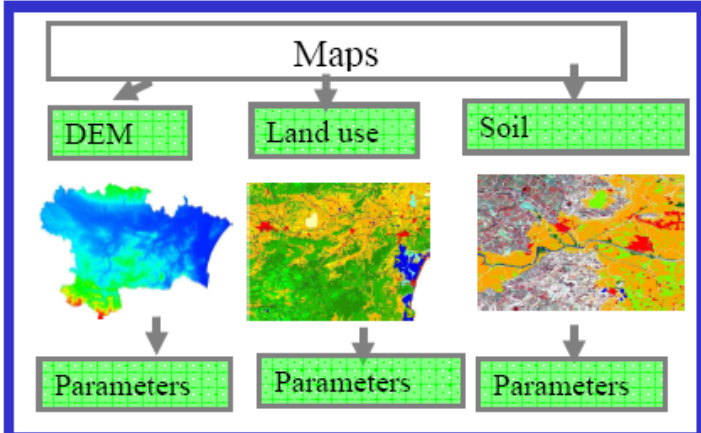
# □ Use of simple spatial overlay approach to create a map showing agriculture lands influenced by flooding



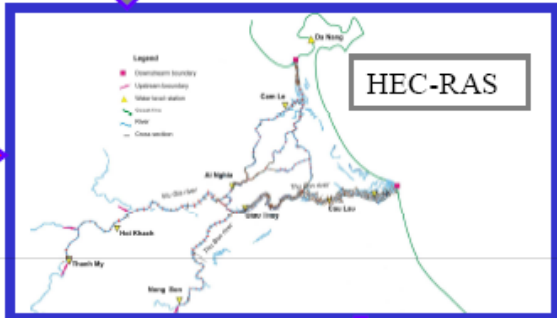
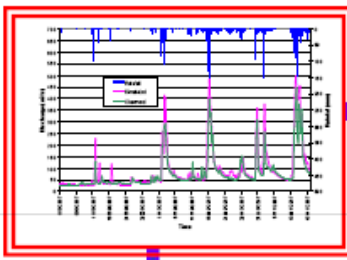
Inundation time overlays the rice field in Mekong delta (Pham Van Cu et al, 2002 )

Flooding depth overlays the rice field in Mekong delta (Pham Van Cu et al, 2002 )

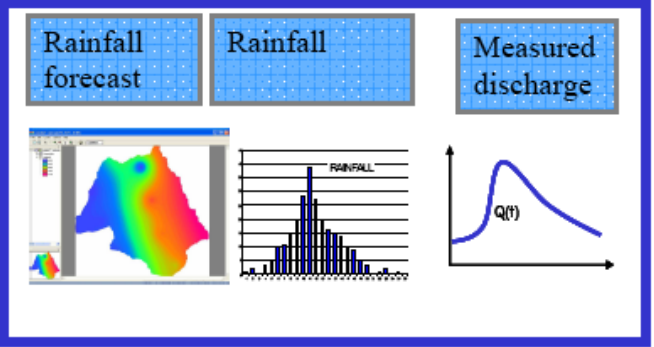
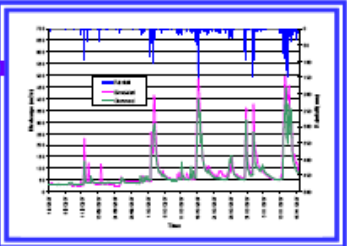
# Integrate GIS and hydrological and hydraulic model in flood forecasting system



$q(x,t)$  at upstream boundaries



$q(x,t), h(x,t)$  at cross sections and reaches



**Flood warning to end-users**

# ▪ Vugia – Thubon Operational flood forecasting system (Central Meteor – Hydrological Centre)

Thu Bon - Vu Gia operational flood forecasting system

Data WetSpa model data input WetSpa calibration WETSPA prediction HECRAS prediction About Help

2007

Tool bar

Main menus

Hydrometeorological stations

Information  
Observed data in last 24 hours  
Observed hydrograph  
Predicted hydrograph  
Bulletin

Popup menu

Map of Vu Gia - Thu bon river basin, with indication of hydro-meteorological station and location of the sub-catchments

Exit

start | wetspa | WinExpress - Văn hóa ... | chapter - Microsoft ... | VuGiaThuBon - Micros... | Thu Bon - Vu Gia oper... | Search Desktop | 4:41 PM

# ➤ **GITHRA** : GeoInformatics Technology in Hazard Risk Assessment



- **Funding:** ADB/Republic of Korea
- **To address:** deficiencies in capacity to assessing hazard-risk and developing appropriate solutions to these risks.
- **To support:** the WRU in training staff for a new program on Disaster Management and Mitigation.
- **To link:** academic and executive agencies.



# GITHRA



## ■ The team:

Management (WRU): Nguyen Quang Kim, Le Thi Chau Ha, Pham Hong Nga

National consultant:

VIGMR: Le Quoc Hung, Nguyen T. Hai Van

UET : Dang Vu Khac

IGS : Nguyen V. Hoang,

International consultant:

ITC - Holland: Dinand Alkema, Victor Jetten, Cees van Westen

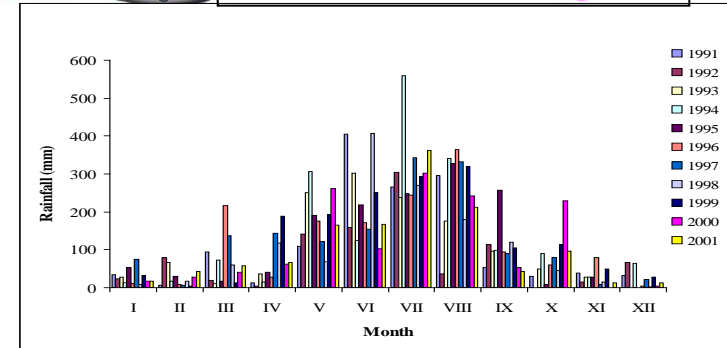
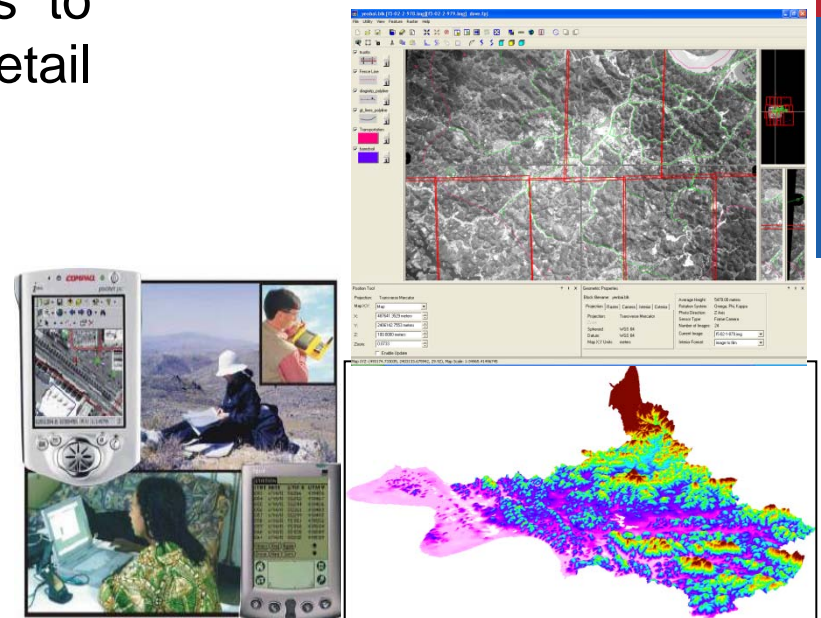
AIT and APDC– Thailand: Manzul Hazarika, Emmanuel Torrente

# GITHRA



**Disaster risk assessment: RISK = F (HAZARD,VULNERABILITY,AMOUNT)**

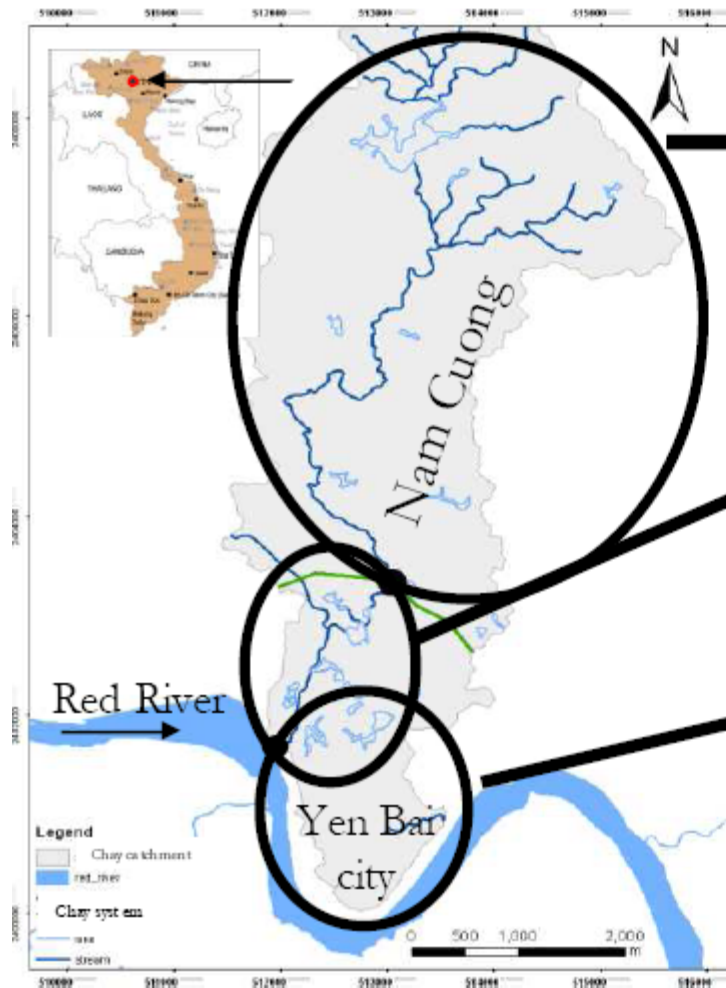
- ✓ Using high spatial resolution images to create element at risk map and detail DEM
- ✓ Using GPS and mobile equipments for automatic data collection
- ✓ Detail survey from communities
- ✓ Link with hydro-meteorological data and hydrological/hydraulic models
- ✓ Spatial modeling for risk assessment
- ✓ Integrated risk assessment due to multi-disasters occur in the same time



# GITHRA



## Case study: Yen Bai city



Area 1:  
Rainfall – Run-off and  
Flashflood generation

Area 2:  
Flood propagation  
Red River and Nam Cuong

Area 3:  
Participatory flood hazard  
and risk assessment.

# GITHRA

## ✓ Satellite images: Quickbird and Worldview



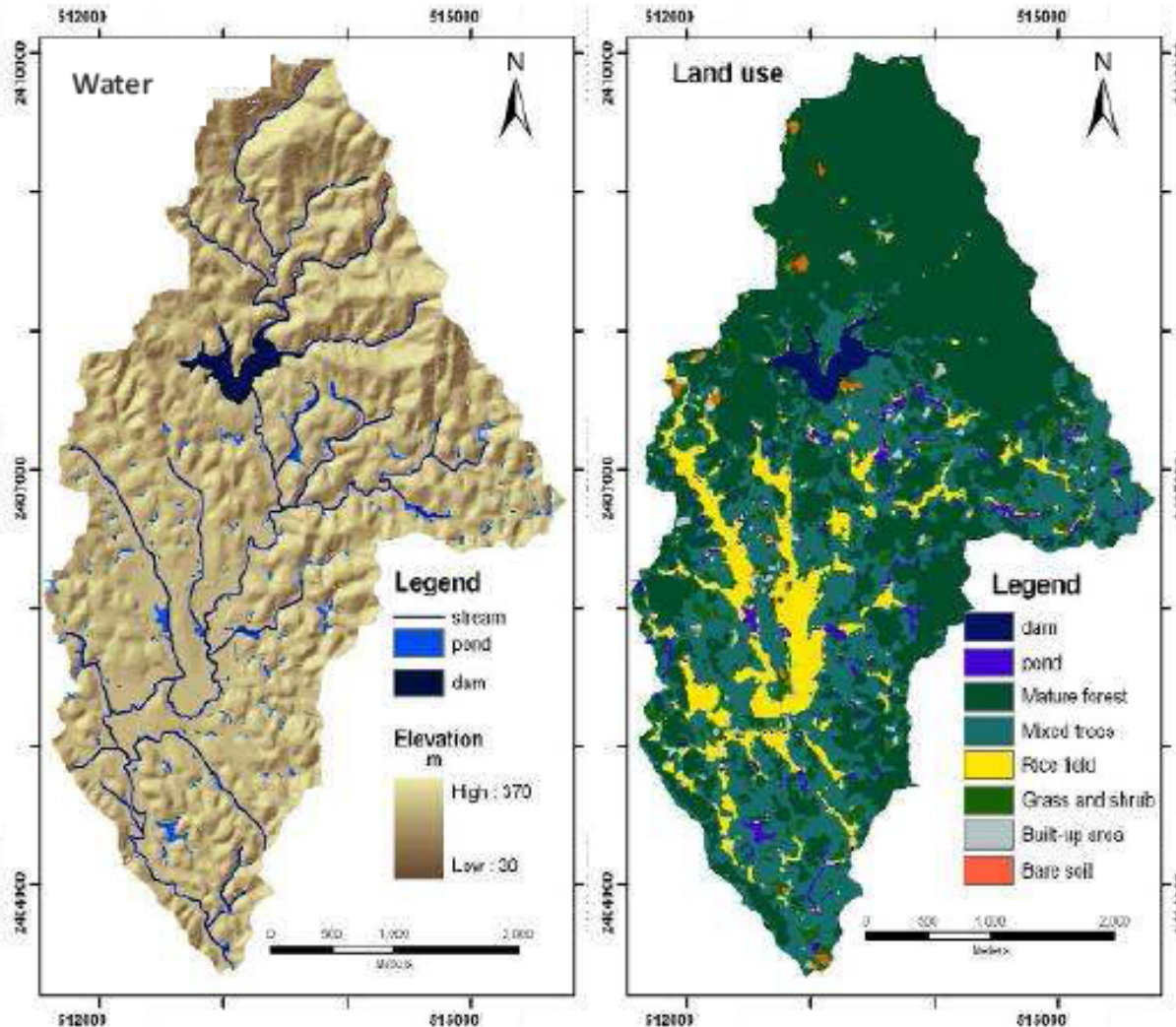
*Quick-Bird Image of Yen Bai; Ground resolution 0.65 meter; Date: 2 Aug. 2006*



*WorldView Image of Yen Bai; Ground resolution 0.7 meter; Date: 12 May 2008)*

# GITHRA

## ✓ Spatial information



**Land use**  
influenced by  
topography:

**Upslope:** forests,  
tea and  
plantations (80%)

**Valleys:** rice +  
other paddy crops  
(9%)

**Water bodies**  
also an important  
land use in the  
catchment (2%)

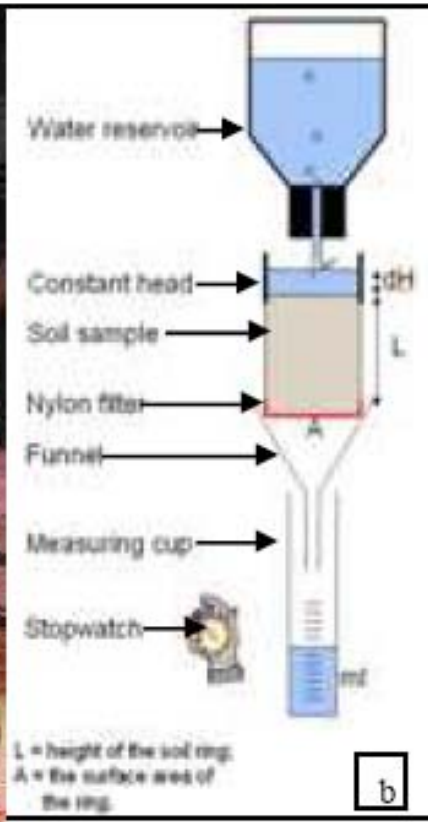
**Other (9%)**

# GITHRA



## ✓ Field data collection and analysis

Field work experiment



Laboratory experiment: permeameter



# GITHRA



Weather station



Diver (downstream)



Diver (upstream)



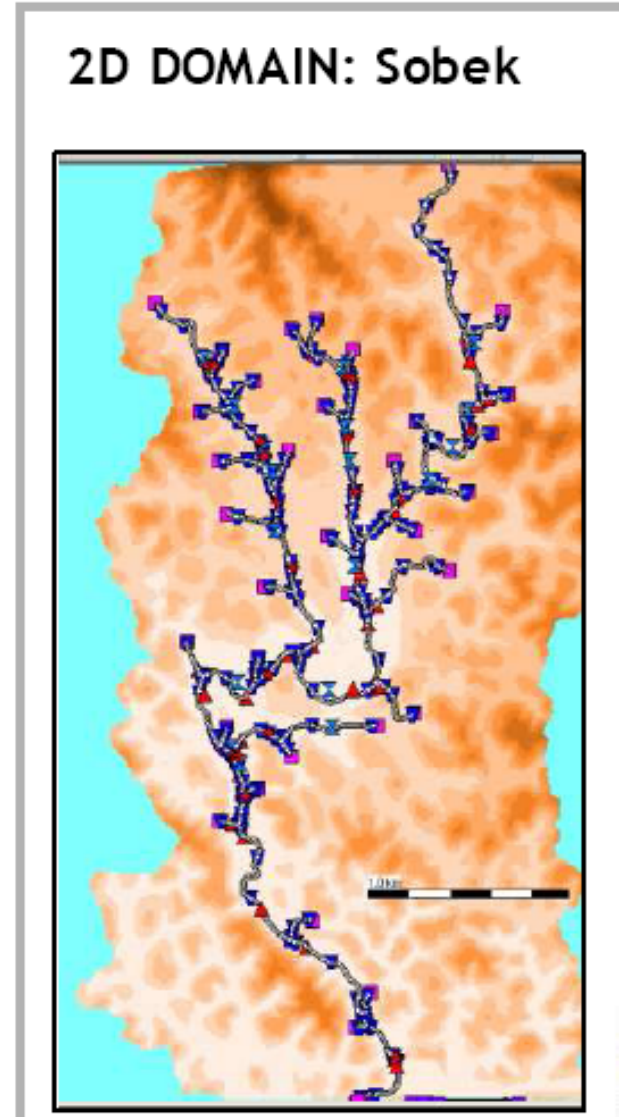
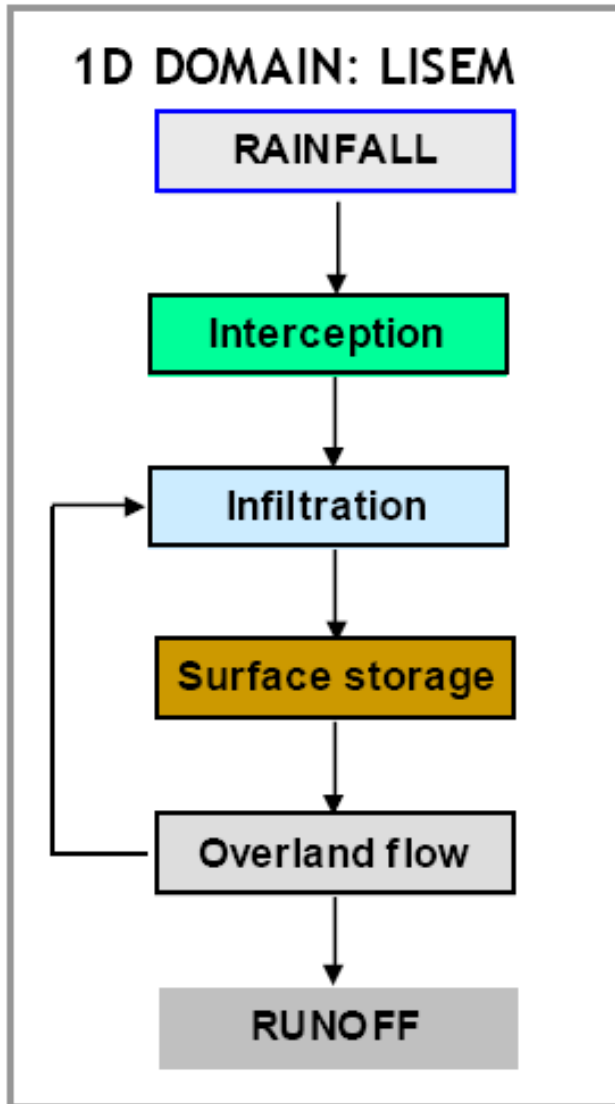


# GITHRA



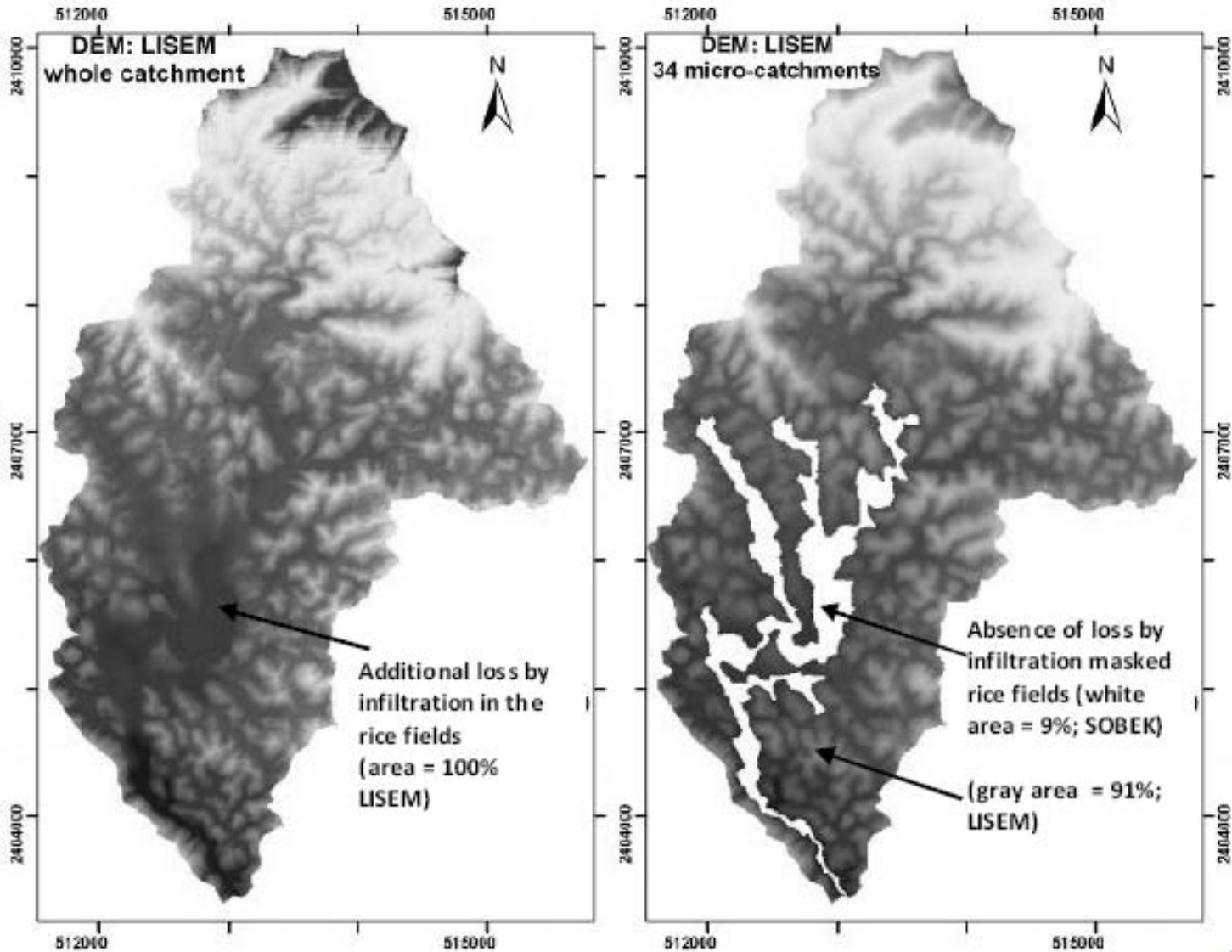
# GITHRA

## Hydrological/Hydraulic Modelling



# GITHRA

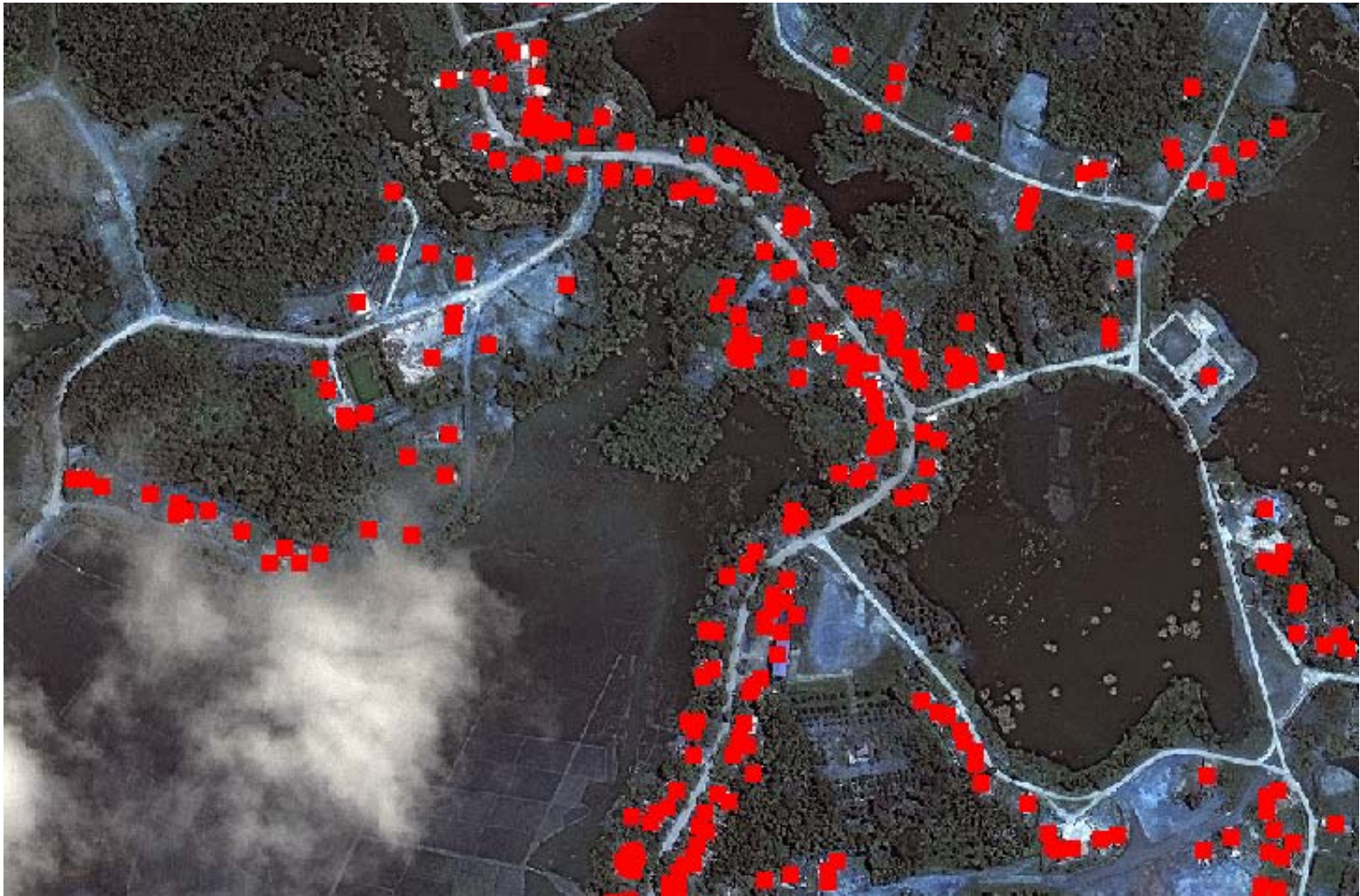
## Some results



# GITHRA

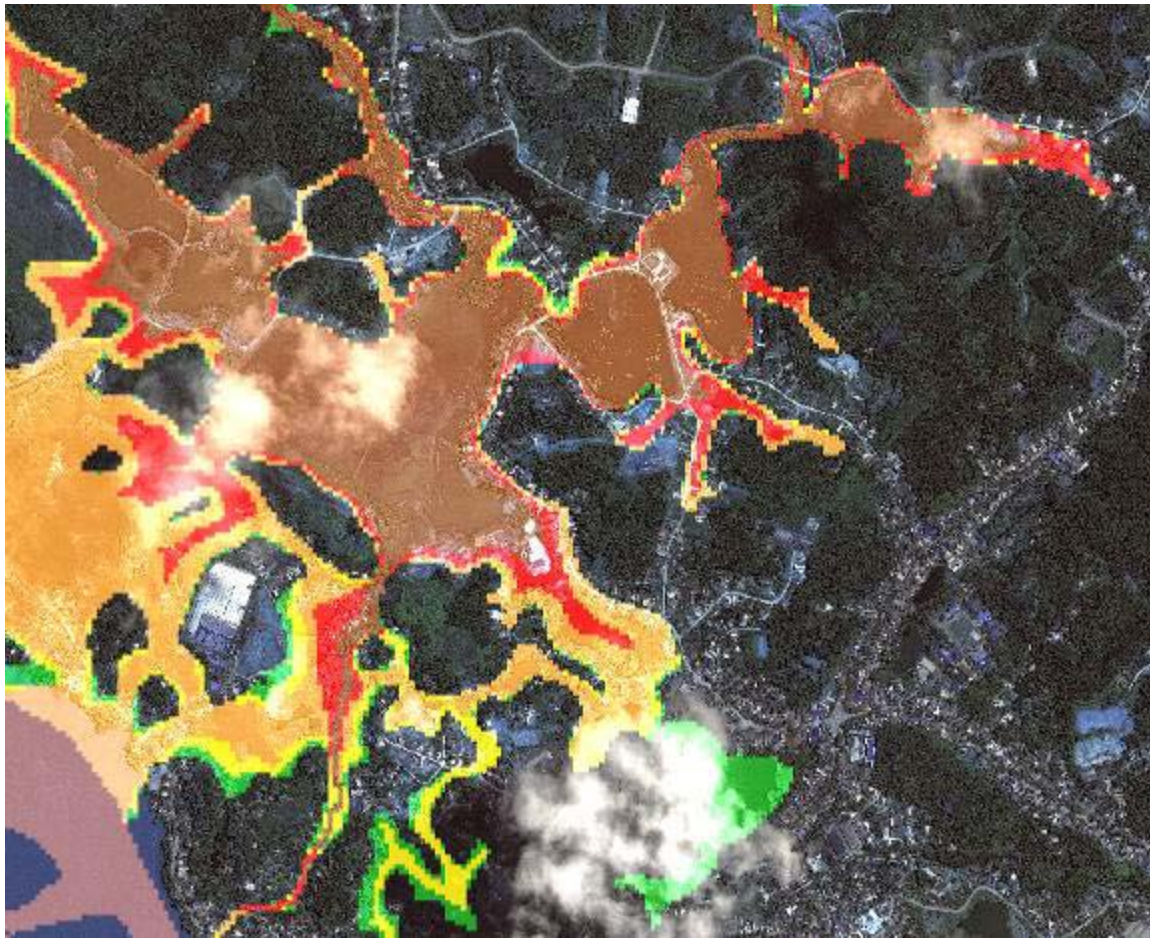
## Some results

Update building distribution map





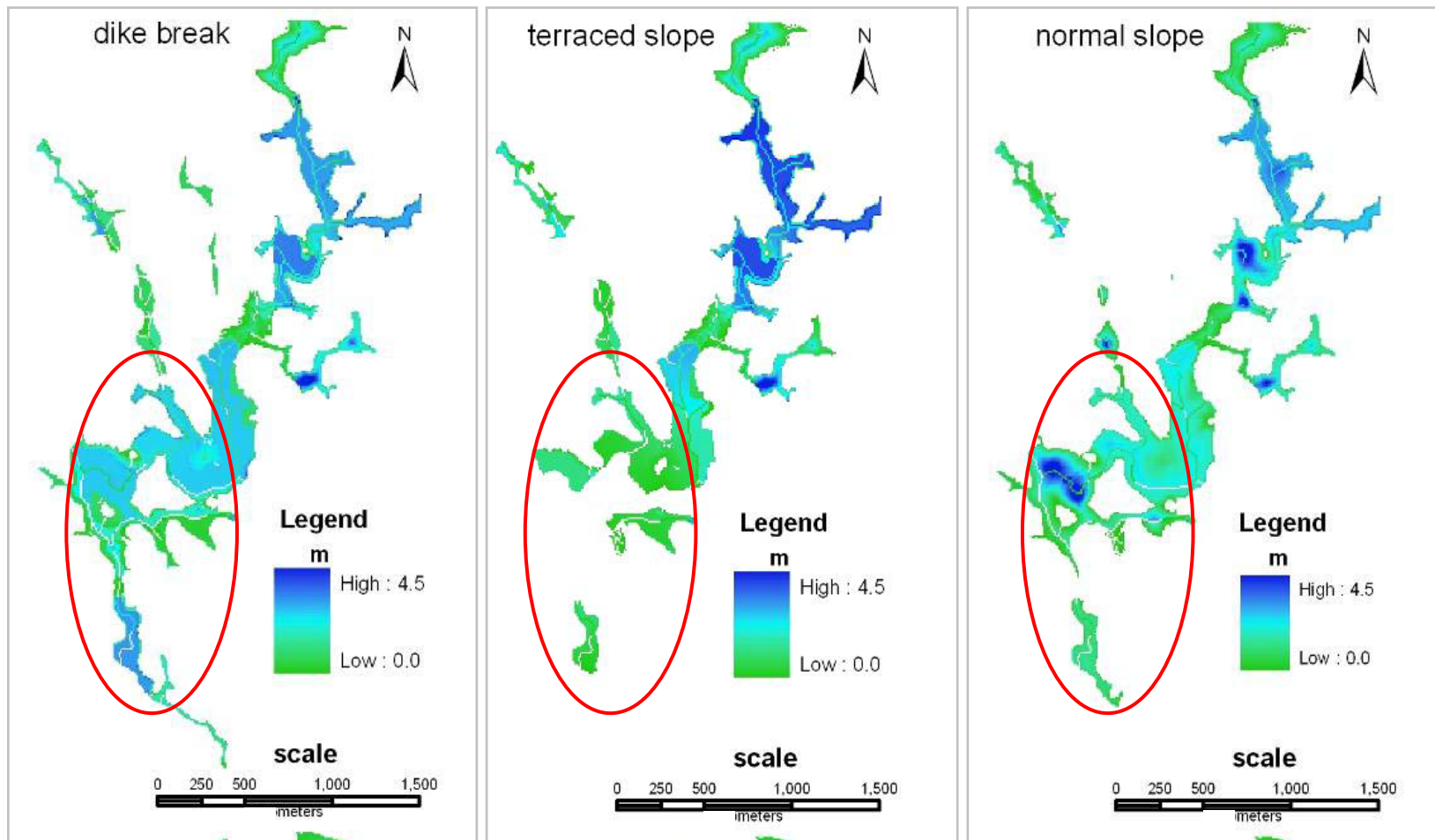
## Flood hazard map of combined Red River and Nam Cuong floods



# GITHRA



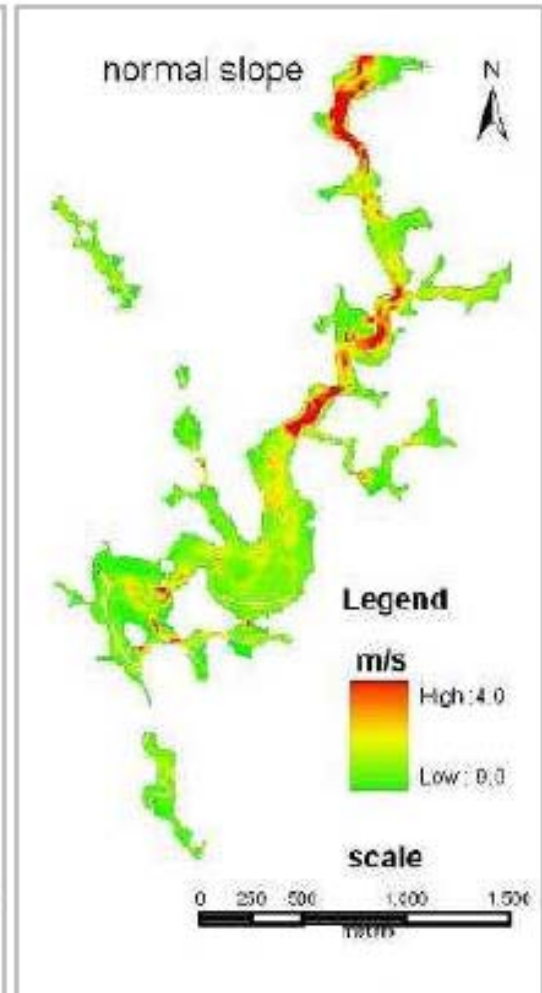
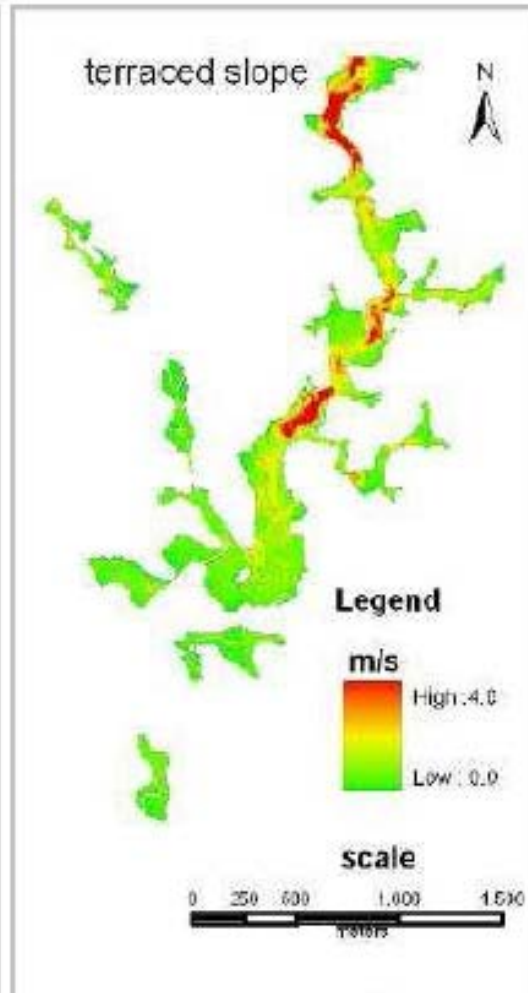
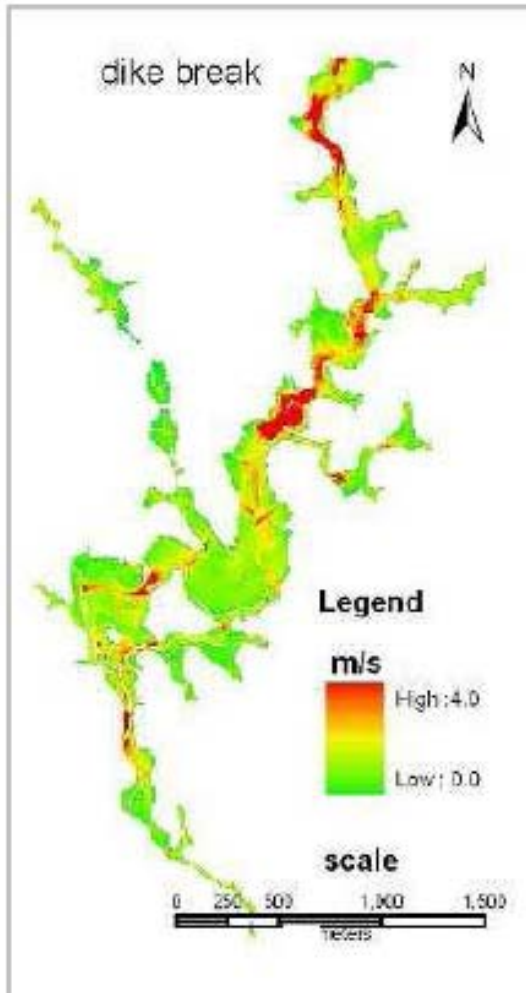
## Area 1: MAX flood depth and extent. Return period 25 years



# GITHRA

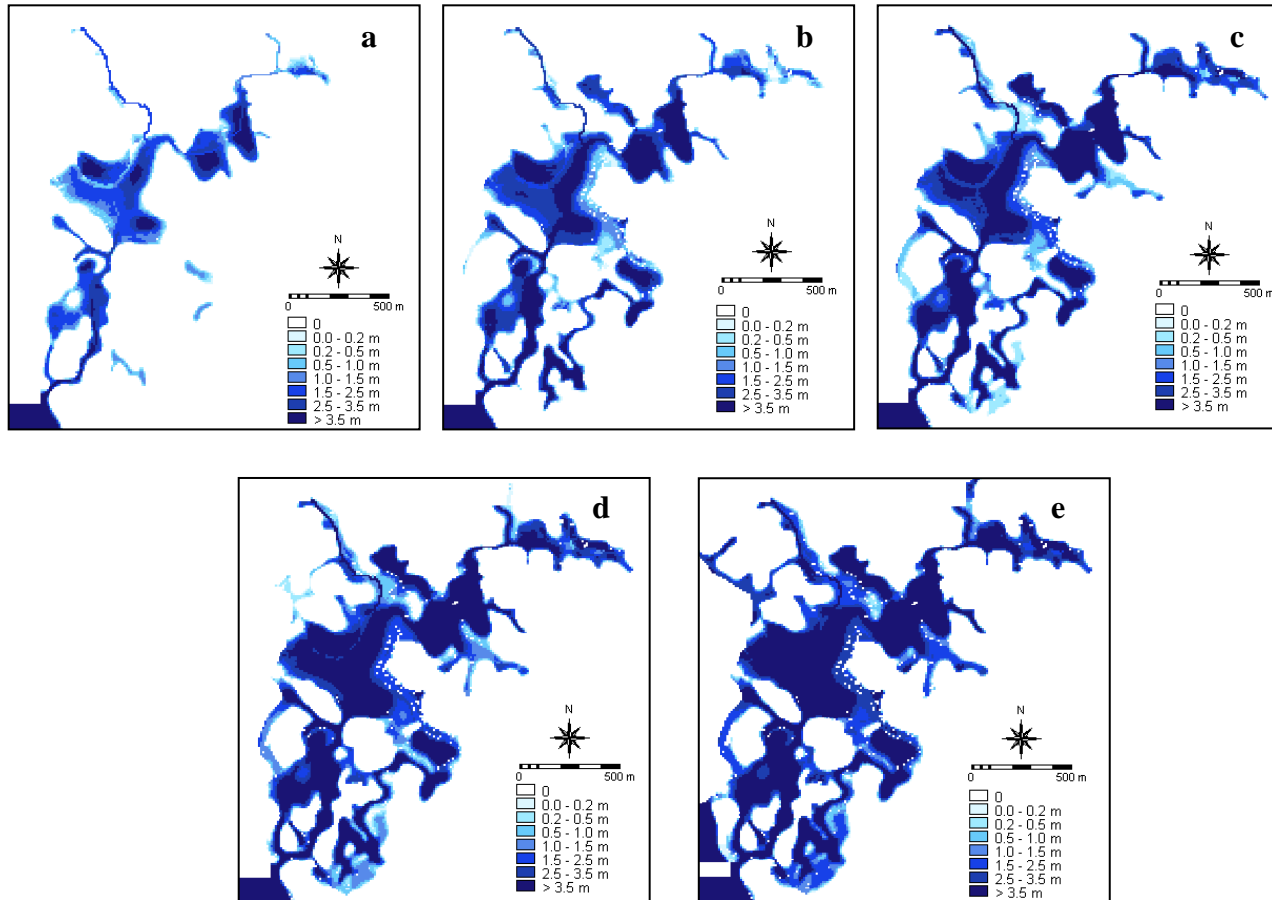


## Area 1: Maximum velocity



# GITHRA

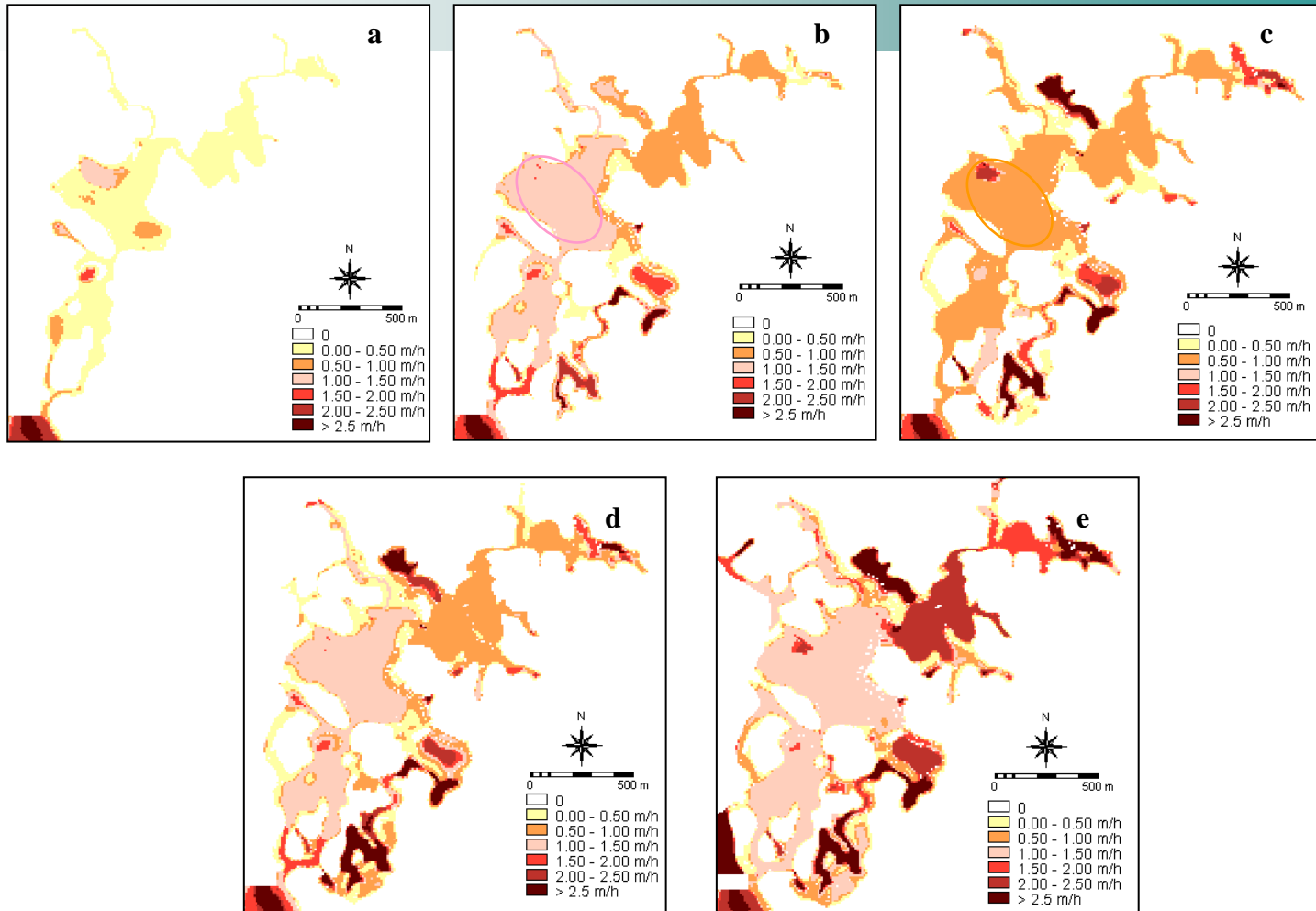
## Area 2: flood depth



*Maximum water depth maps for Red River floods with different return periods: a) 5 years; b) 10 years; c) 25 years; d) 50 years; and, e) 100 years.*

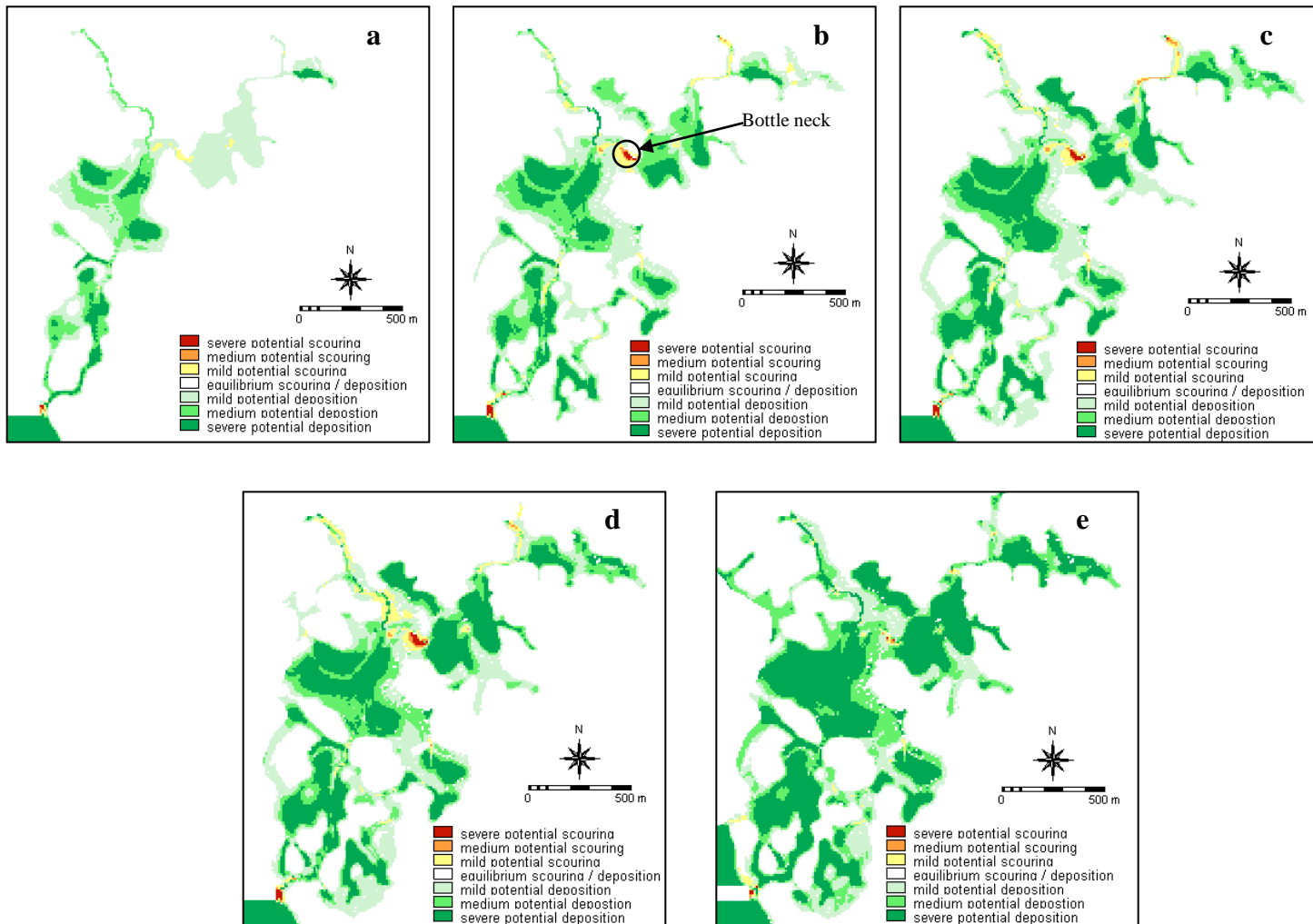


## Area 2: flood speed



*Maximum speed of rising of the water level for Red River floods with different return periods: a) 5 years; b) 10 years; c) 25 years; d) 50 years; and, e) 100 years.*

## Area 2: Sediment deposition

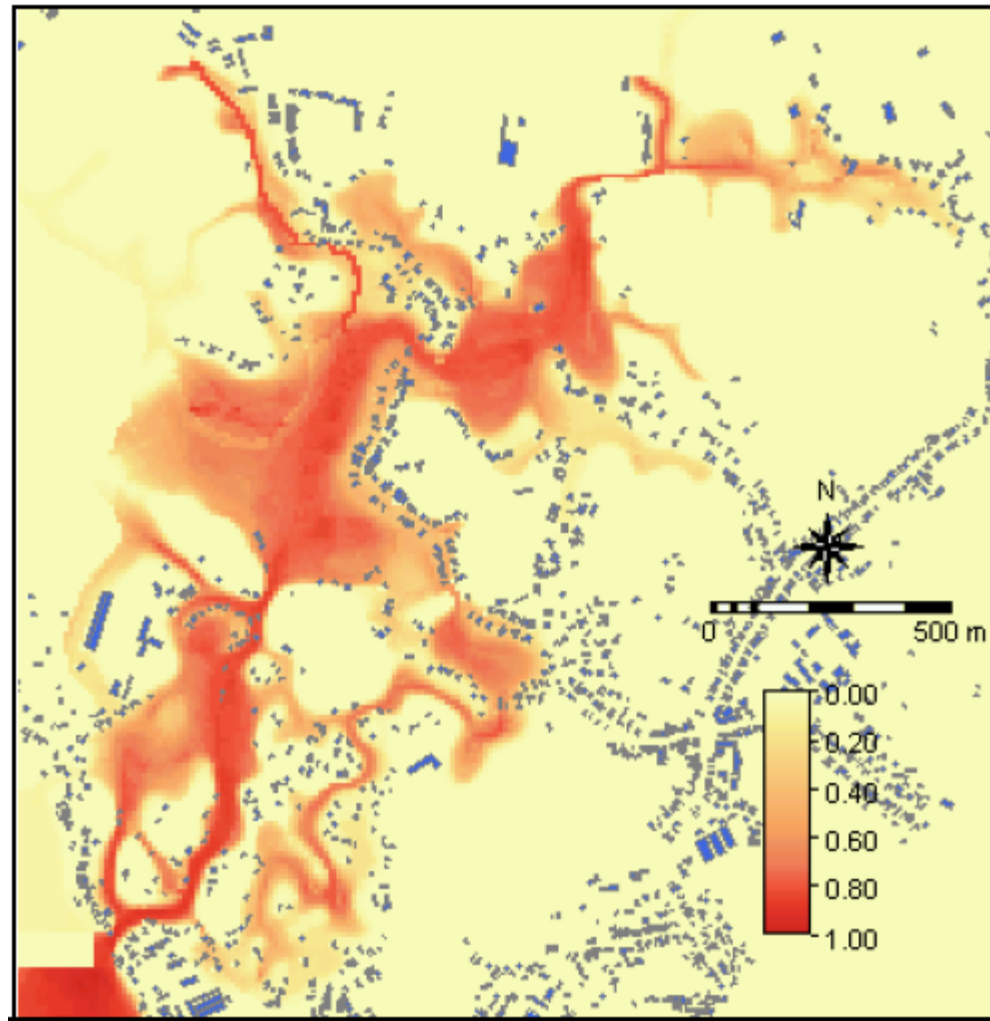


*Estimate of sediment deposition and scouring for Red River floods with different return periods: a) 5 years; b) 10 years; c) 25 years; d) 50 years; and, e) 100 years.*

# GITHRA

## Area 2: Disaster risk map

(using *Spatial Multi Criteria Evaluation* )

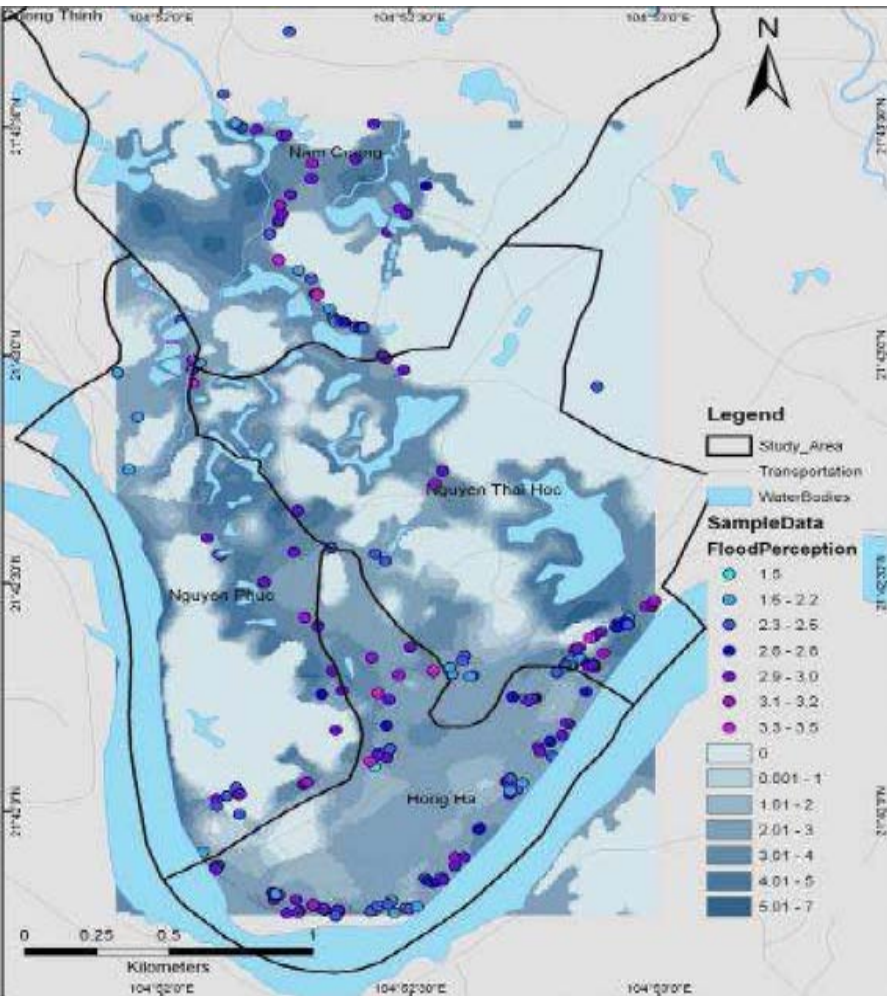


# GITHRA

## Some results



### Area 3: Anticipatory GIS



*Flood perception*

0.3: Ankle

0.6: Knee

1.6: Waist

2.1 Chest

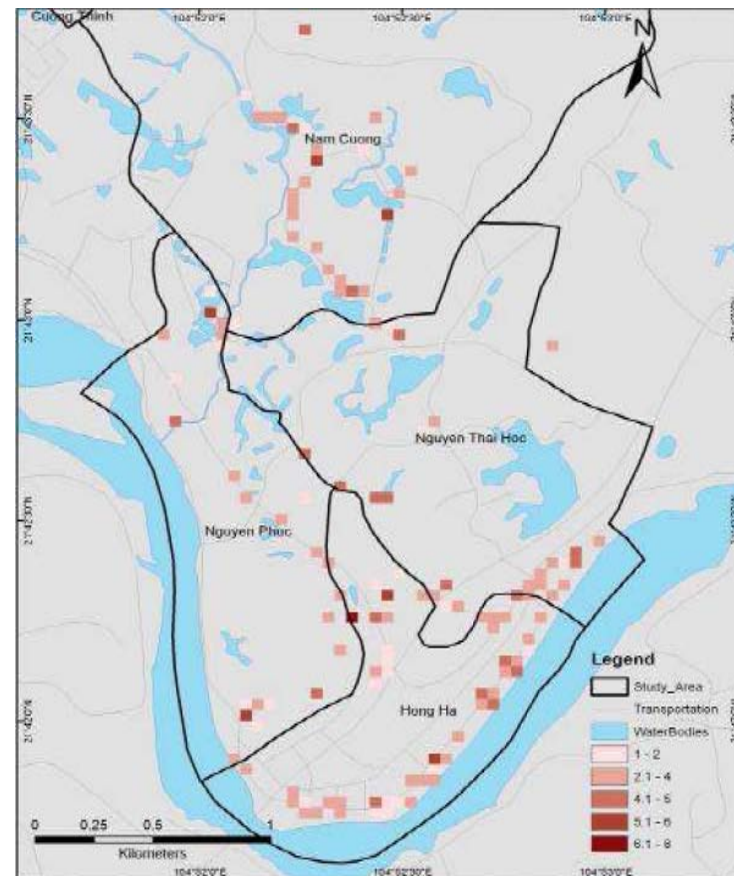
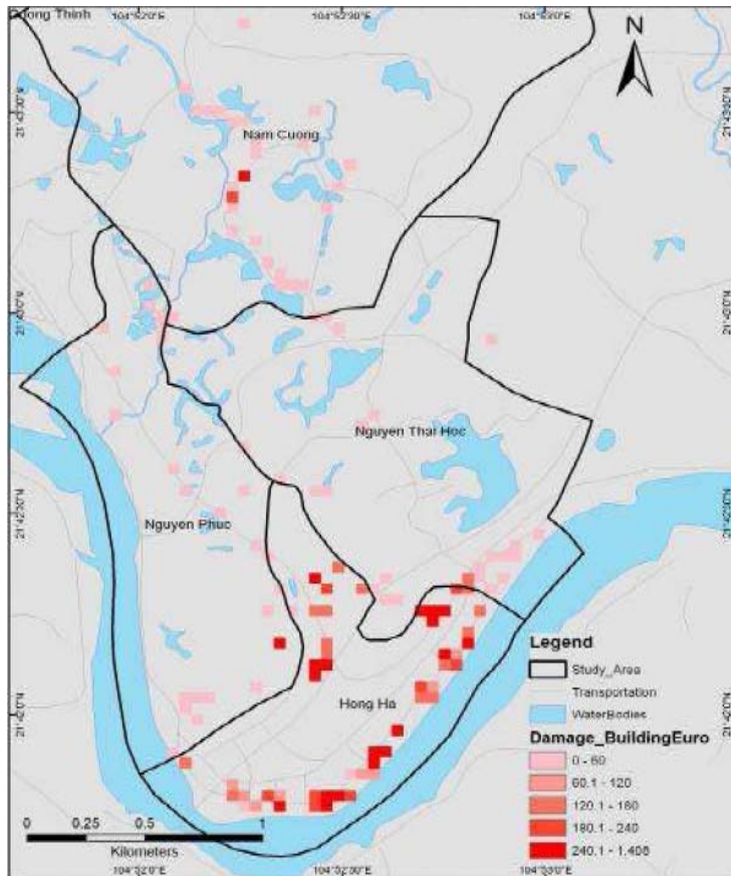
2.6 < Higher



# GITHRA



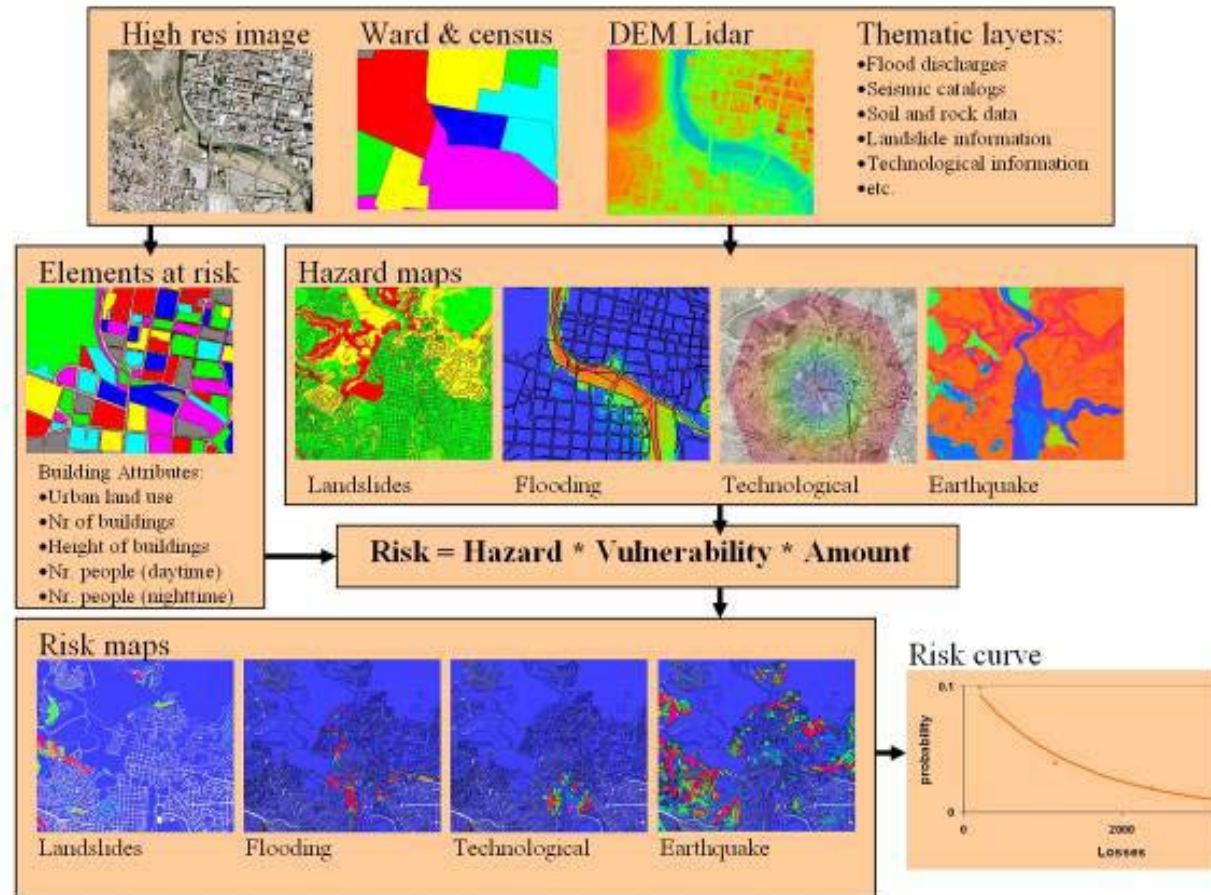
## Building damage and people injured - 2008 scenarios



# GITHRA



- More to go:**
- Training of the trainer
  - Multi-hazard risk assessment



# GITHRA



## ❖ Challenge

- Real-time weather data from satellite images: temperature, evaporation, etc.

## ❖ Looking for

- GEONETCast (<http://www.earthobservations.org/geonetcast.shtml>)
- Other image sources ????

Meteosat image data

GOES East and West image data

FY-2 image data

Land and Ocean Sea Ice Satellite

Application Facility (SAF) products

EUMETSAT meteorological products

NOAA-NESDIS meteorological products

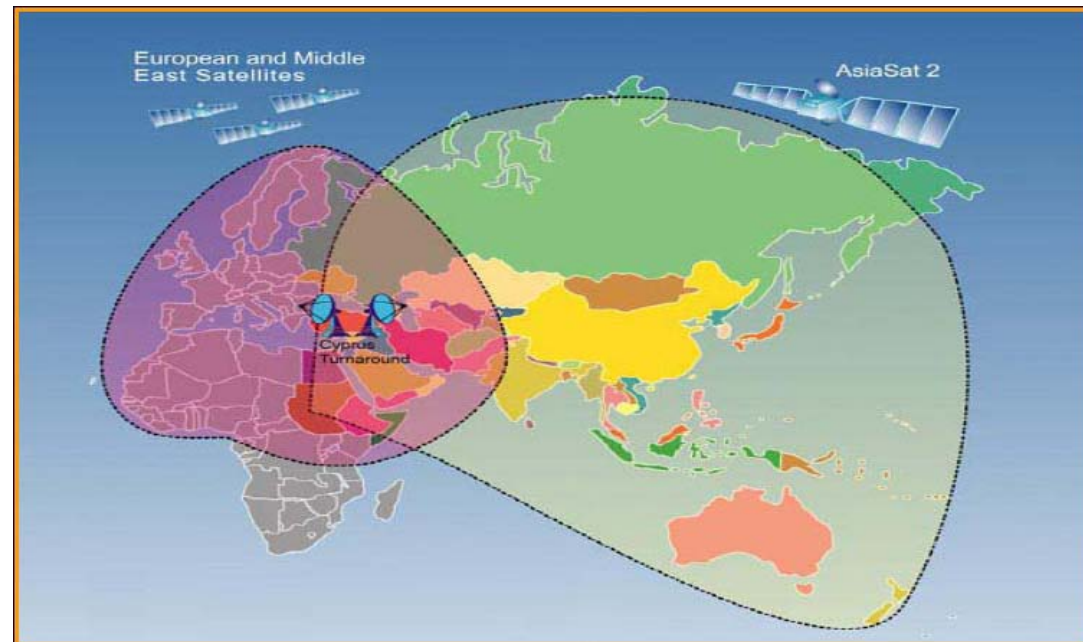
NOAA-NESDIS Ocean colour and sea

surface temperature products

VEGETATION products from VITO

MODIS Ocean colour products

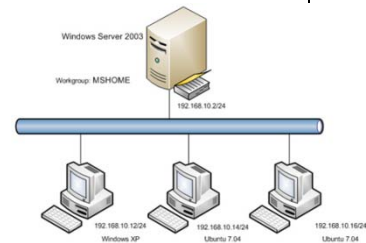
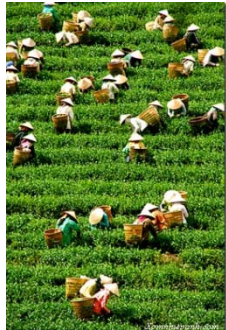
In-situ and observational data



# PROBLEMS OF VIETNAM



- Research cooperation
- Information dissemination
- Advanced space technology
- Disaster monitoring and early warning



**WebGIS**  
**Public media**  
**Data sharing**  
**Policy**  
**Planning**  
**Perception of community**



*Thank you*

