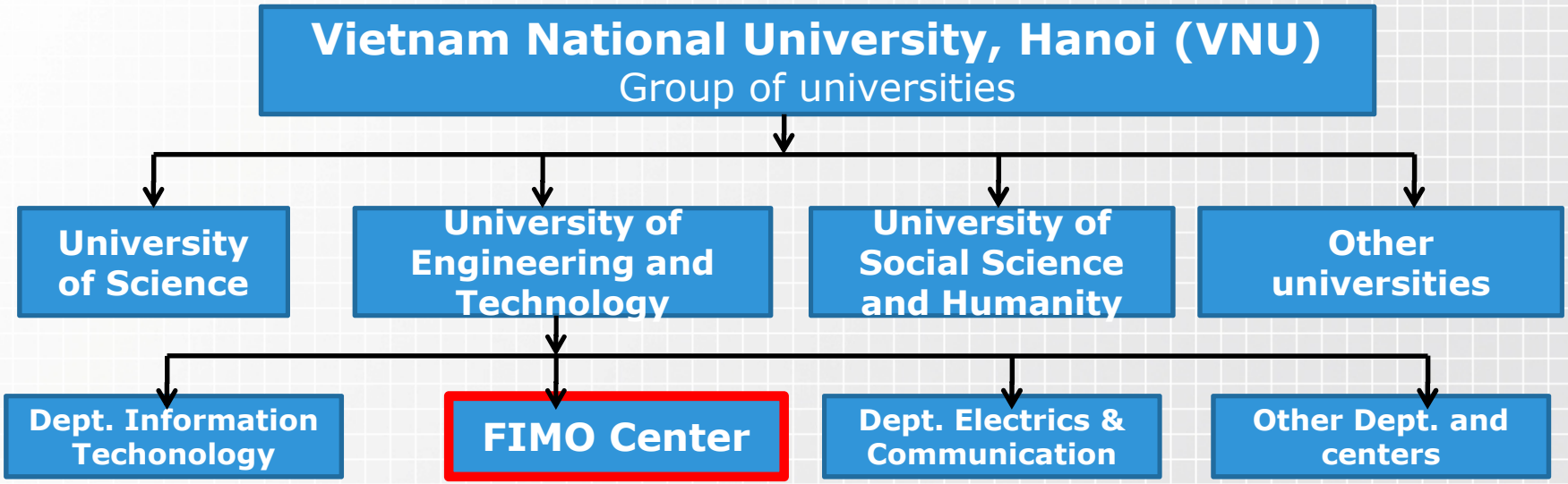
Environment Management and Disaster Mitigation Research Activities at Vietnam National University

Bui Quang Hung,
Director of FIMO Center,
University of Engineering and Technology,
Vietnam National University

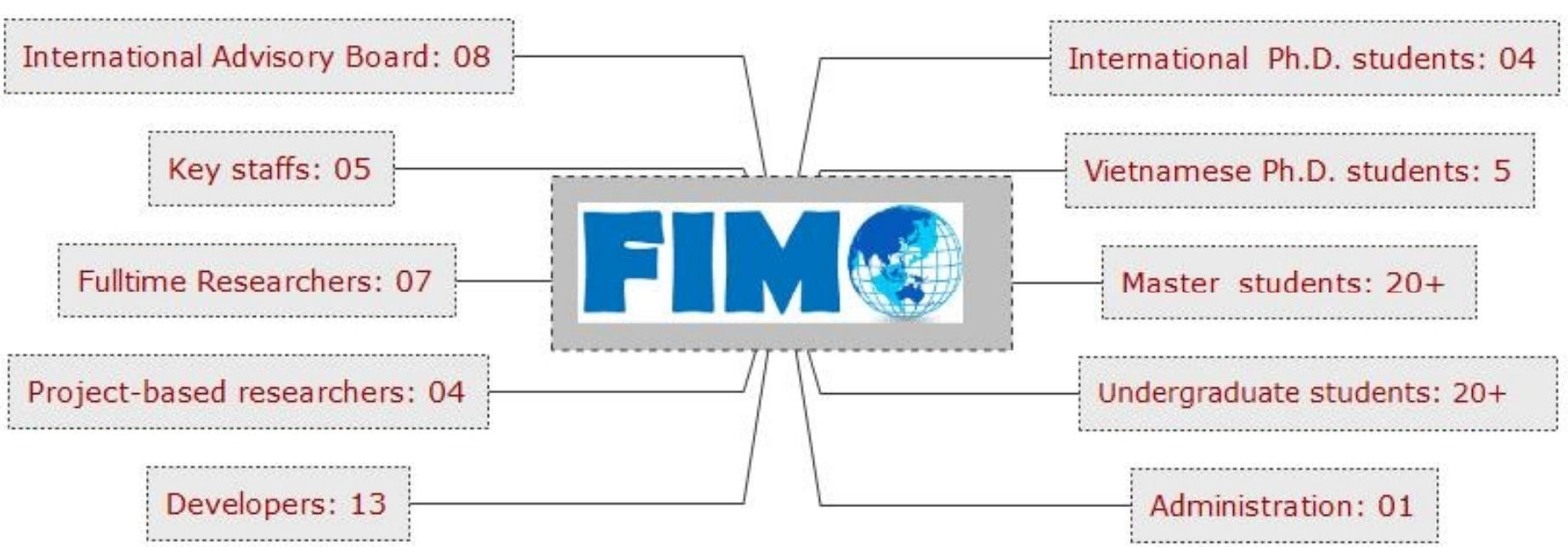
FIMO Center = FIeld Monitoring Center

Center of Multidisplinary Integrated Technologies for Field Monitoring



Multidisplinary Integrated Technologies	Field Monitoring
- GIS - Remote Sensing - Spatial Database, Spatial Datawarehouse - Big Data - Data Analysis/Mining - Cloud Computing	**Environment Management and Monitoring** - Air Pollution Monitoring - Forest Fire Monitoring - Rice Monitoring - Land cover/Land use monitoring - Biodiversity monitoring **Disaster Management and Mitigation** -Integrated database for disaster management and mitigation - Change Detection/Prediction

FIMO members



International Advisory Board

Prof. C. Justice, Chairman , Dept. of Geographical Science, University of Maryland

Prof. R. Tateishi, Director, Center for Environmental Remote Sensing, Chiba University

Prof. Jimmy Chou, Director, GIS research Center, Feng Chia University, Taiwan Asia-Pacific Regional Vice-Chair, Global Spatial Data Infrastructure

Prof. Toshimasa Ohara, National Instutute for Environment Studies, Japan

Prof Mai Trong Nhuan, Vice Chairman, Vietnam Panel for Climate Change

Prof. Pham Van Cu Director , VNU ICARGC

Prof. Nguyen Ngoc Binh Director, VNU IFI

Prof. Nguyen Thanh Thuy UET Vice Rector

Key staffs

Dr. Bui Quang Hung,
Director of the FIMO Center

Dr. Nguyen Hai Chau

Dr. Nguyen Nam Hoang

Dr. Nguyen Thi Nhat Thanh

Dr. Le Thanh Ha

FIMO in activities

International Ph.D. Candidates

Ryo Takeuchi from Kyoto University, Japan
Landcover/Landuse in Vietnam,
Ecological Economics

Noelani Eidse from McGill University, Canada
Street Venders vs. Economics

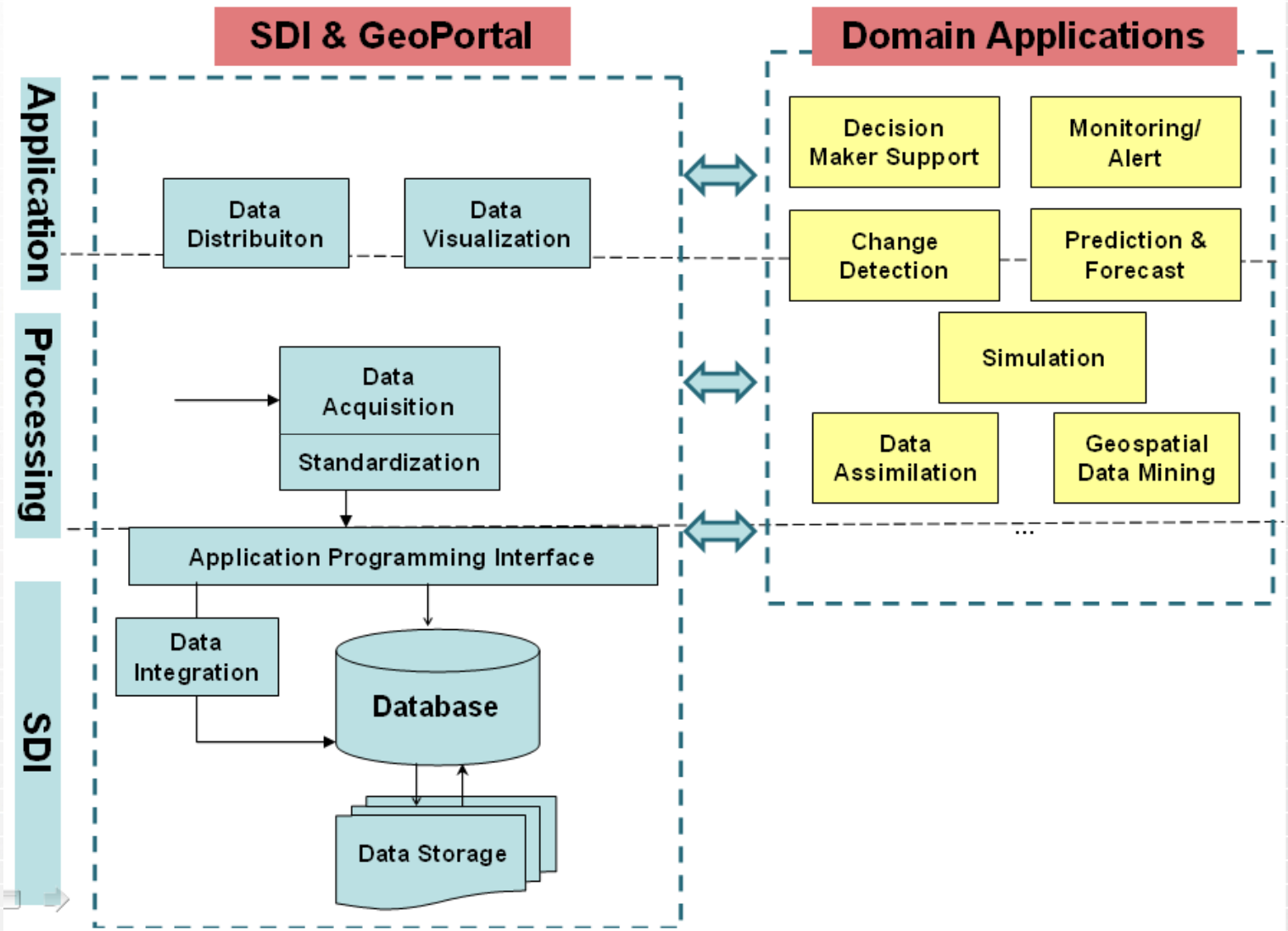
Youssef Sobhi Henein from Quebec Univ., Canada
Landcover/Landuse in Vietnam,
Urbanization vs. Economic Deveplopment

Kate Trincsi from Quebec University, Canada.
Landcover/Landuse in Vietnam
Ecological system change in North of Vietnam

FIMO Comprehensive Infrastructure

- **Data Acquisition systems:**
  - MODIS/NPP/JPSS ground station
  - Various kinds of camera
- **Spatial Data Modeling/Analysis/Mining tootls**
  - **Remote Sensing:**
    - ENVI
    - Toolkit for Radiometric Calibaration and Correction
    - Toolkit for Landcover Classification
    - Toolkit for Cloud Detection
  - **Spatial Data:**
    - **Mathlab, R**
- **GIS:**
  - ArcGIS Server Enterprise, ArcGIS Deskop
  - Opensource solutions: GeoServer, MapServer, Open Layer, QGISS,..
- **Data Storage: 610TB storage and extendable**
- **High Performance Computer System for Data Processing**
  - HP ProLiant DL580 Generation 7 (80 cores)

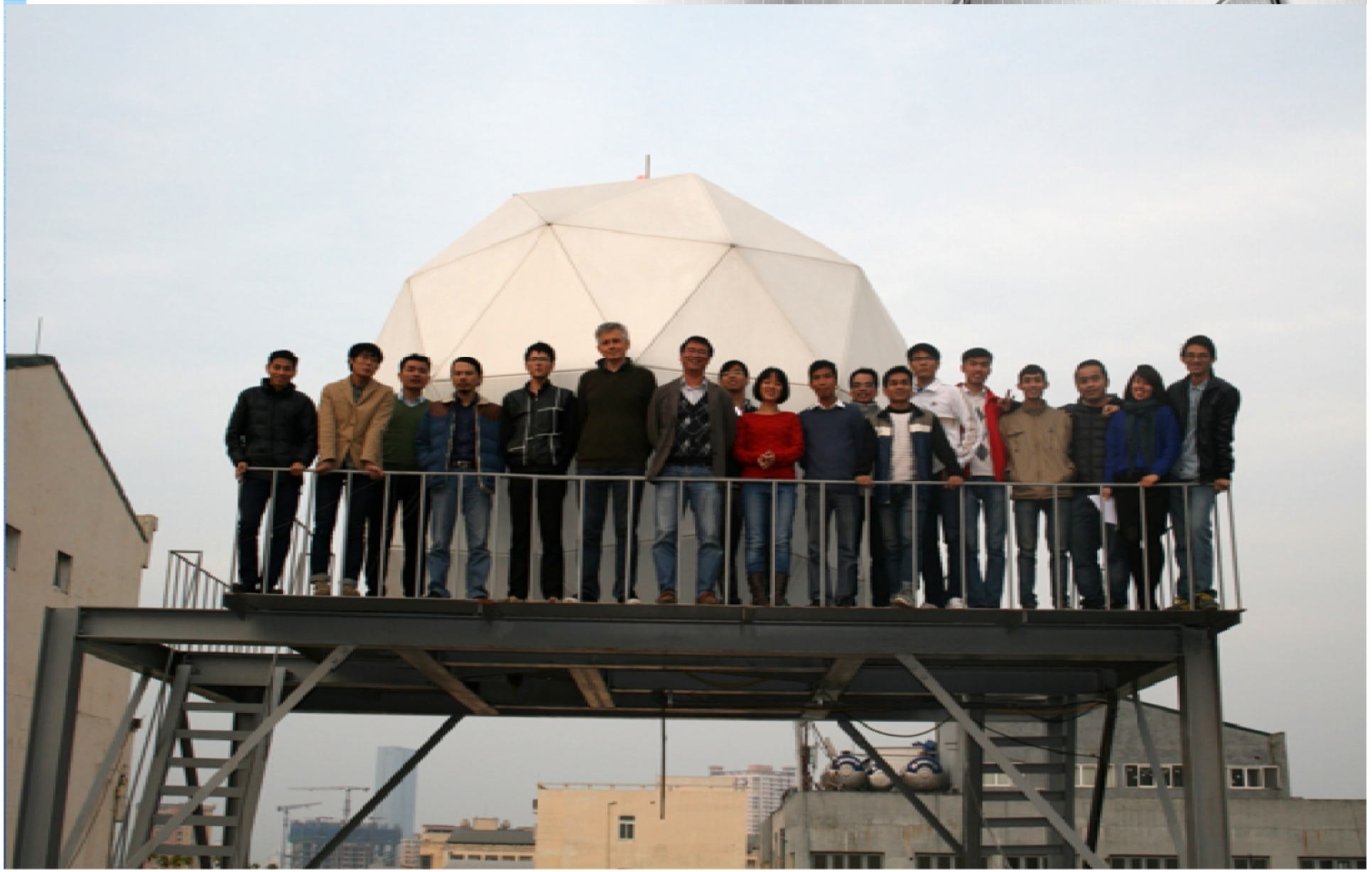
FIMO System Architecture



Current research teams

1. Building a Spatial Data Infrastructure (SDI) for Interdisciplinary Research and Education including Remote Sensing, Spatial Databases and Satellite Image Processing, Vietnam National University.
2. Developing Integrated Spatial Database System for North-Western and North-Eastern of Vietnam
3. Developing Integrated Spatial Database System for Hanoi, Vietnam
4. Developing Integrated Spatial Database System for Danang coastal city, Vietnam
5. Development of the National Biodiversity Database System of Vietnam
6. Building the Air Pollution Monitoring and Warning System of Vietnam
7. Building the Forest Fire Information System of Vietnam
8. Building the system for ship detection and monitoring
9. Landcover Classification in Vietnam
10. Landslide monitoring
11. Rice Monitoring in Vietnam
12. Spatial Database for Vietnam Transportation Safety
13. Cloud Detection for Satellite Image in Vietnam

MODIS/NPP/JPSS Satellite Ground Station



MODIS/NPP/JPSS Archive

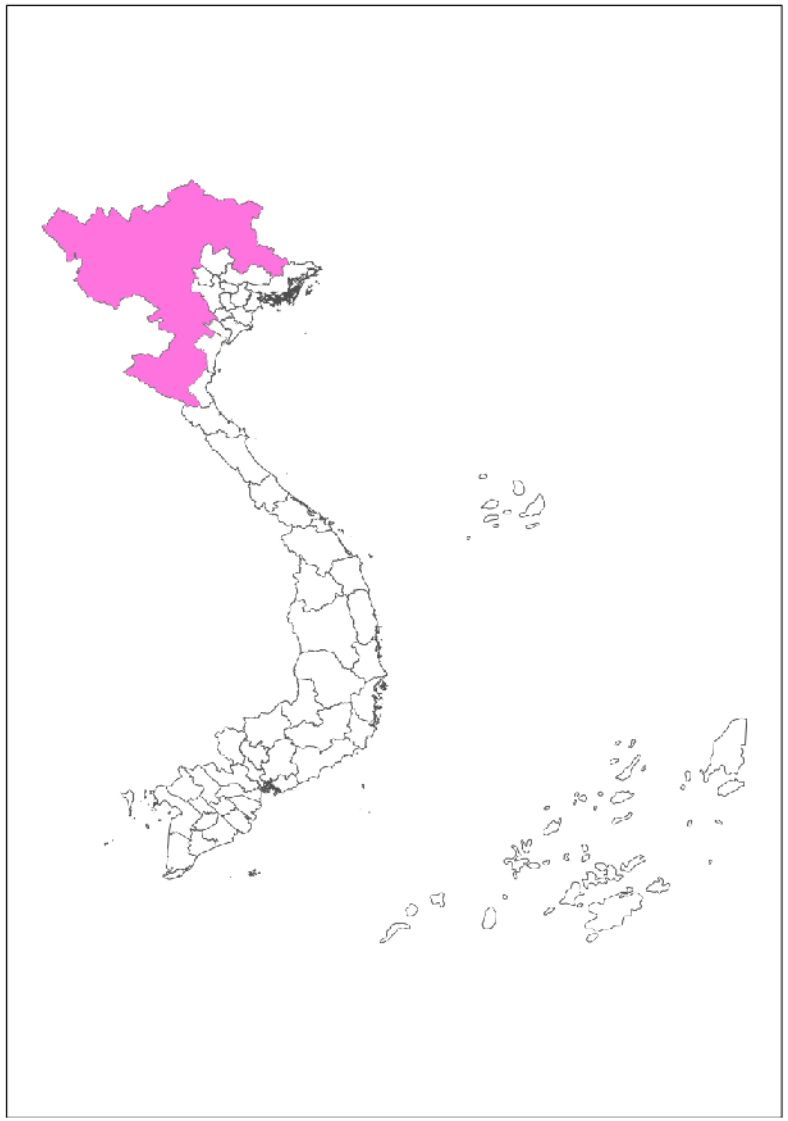
- MODIS Aqua & Terra, NPP & JPSS image
- Level 0, Level 1B, Level 2 processed images.

MODIS/NPP/JPSS Ground station

5TB storage for 1 month image data

610TB storage for MODIS/NPP/Archive

Integrated Spatial Database System for North-Western and North-Eastern of Vietnam

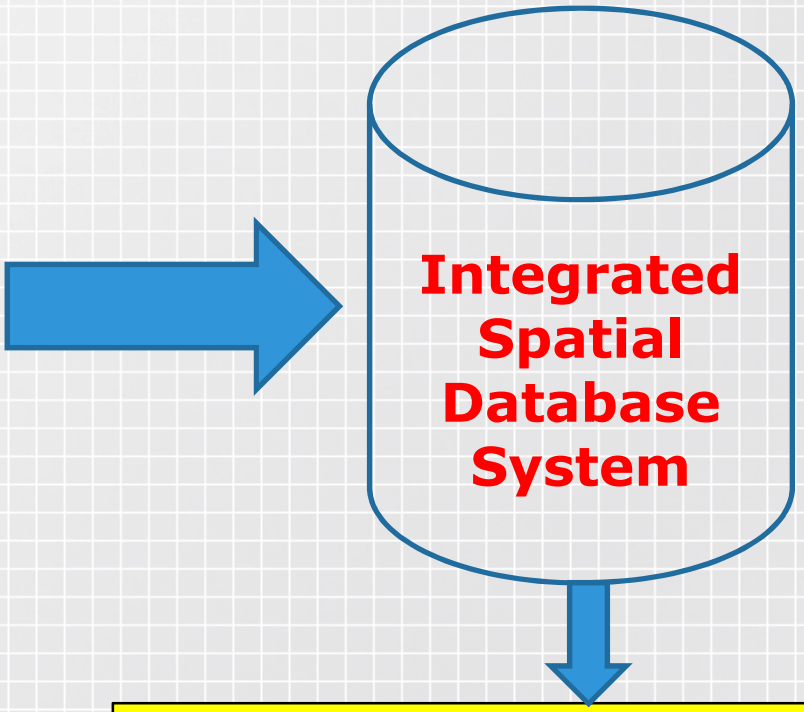


Motivation

Existent national database systems:

- Stand-alone
- Data democracy ?
- Ability to exchange data ?
- Applications ?

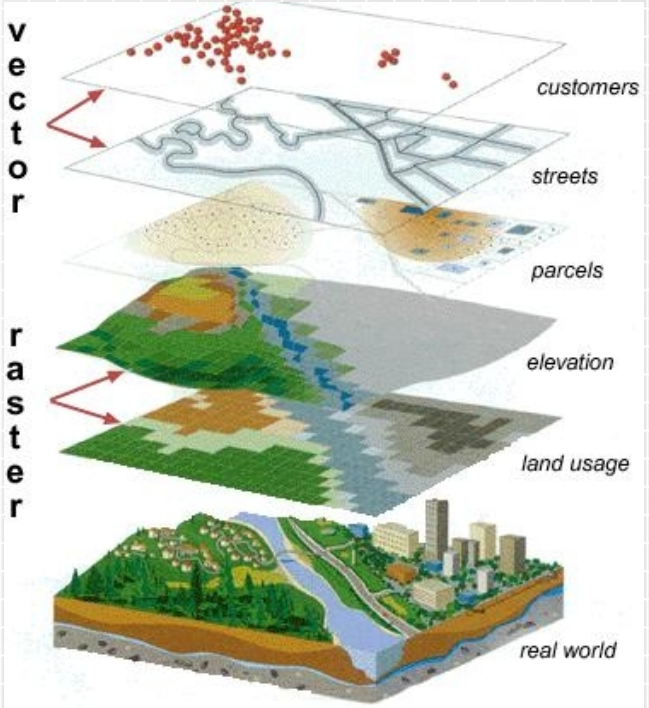
Our approach: Spatial Data Infrastructure (nation-wide/region-wide)



The first integrated spatial database in Vietnam

Integrated Spatial Database System ?

14 groups of data layers			
1	Natural Conditions	8	Culture
2	Natural Resources	9	Society
3	Enviroment	10	Healthcare
4	Biodiversity	11	Education
5	Disaster	12	Population
6	Infrastructure	13	Ethnic
7	Economy	14	Human Resource



Where the data ?

ID	Thematic data	Data Providers	Type of exist data
1	Natural Conditions	DOST – Dept. of Science and Technology DONRE- Dept. Natural Resource and Environment	Map / digital map
2	Natural Resources	DOST – DONRE	Map / digital map
3	Environment	DOST – DONRE	Map / digital map
4	Biodiversity	DOST – DONRE	Map / digital map
5	Disaster	DOST – DONRE	Map / digital map
6	Infrastructure	Dept. of Transportation Dept. of Industry and Trade	Map/ Digital map
7	Economy	Dept. of Industry and Trade	Thematic data
8	Healthcare	Dept. of Healthcare	Thematic data
9	Education	Dept. of Education and Training	Thematic data
10	Ethnic	Dept. of Home Affair Dept. of Ethnic	Thematic data
11	Population	Dept. Labour – Invalids – Social Affair	Thematic data
12	Human Resource	Dept. Labour – Invalids – Social Affair	Thematic data
13	Culture	Dept. Culture – Sport - Tourism	Thematic data

Characteristics of Integrated Spatial Database System

- **14 groups of data layers**
- **Data collected from 14 provinces of North Western and North Easter of Vietnam**
- **Multi scale data**
- **Time-series data**
- **Multi viewpoint data (DPSIR model)**
  - Driving forces
  - Pressures
  - States
  - Impacts
  - Responses
- **Applications:**
  - Automatic report on **43 sustainable development indicators** promulgated by Prime Minister
    - For monitoring the Sustainable Development Strategy of provinces and the region
  - Spatial Data Analysis tools
  - Spatial Data Mining tools
  - Decision Support tools for decision makers
- **Ability to exchange data with existent national database systems (data)**

Stakeholders of the Integrated Spatial Database System

Raw data →	**Data standardizatio** →	**Data Fusion Data Integrated** →	**Applications**
- 14 groups of raw data collections from earch province - 14 provinces →	14 standardized groups of data layers →	**Integrated Spatial Database System** →	-43 sustainable development indicators - Spatial data analysis tools -Spatial data mining tools -.....
Local province's officers, Researchers, Engineers	**Engineer**	**Researcher, Engineer**	**-Leaders** **- Government officer, Province officer, people (data democracy)**

Air Quality Management Research Team

- Main topics:
  - Particulate Matter (PM) concentration estimation using satellite images
  - Aerosol Optical Thickness (AOT) estimation for high spatial resolution satellite images
  - Air quality monitoring and warning system

PM concentration Estimation using free satellite images

- **Study Area: Vietnam**
- **Products:**
  - $PM_{2.5/10}$
  - Spatial resolution: 10x10 and 6x6 km
  - Temporal Resolution: Daily and 4 times/day (for 10 km product)
- **Data**
  - **Satellite MODIS AOT (10km/pixel, 4 times/day),**
  - **Satellite MODIS MET (5km/pixel, 4 times/day),**
  - **Satellite VIIRS AOT (6 km/pixel, 1 time/day)**
  - **Satellite VIIRS MET (6 km/pixel, 1 time/day)**
  - Ground AERONET AOT (7 stations, every 15 mins),
  - Ground CEM PM (6 stations, hourly data),
  - Ground NCHMF (RH, TEMP, RF) (98, stations, month/region)

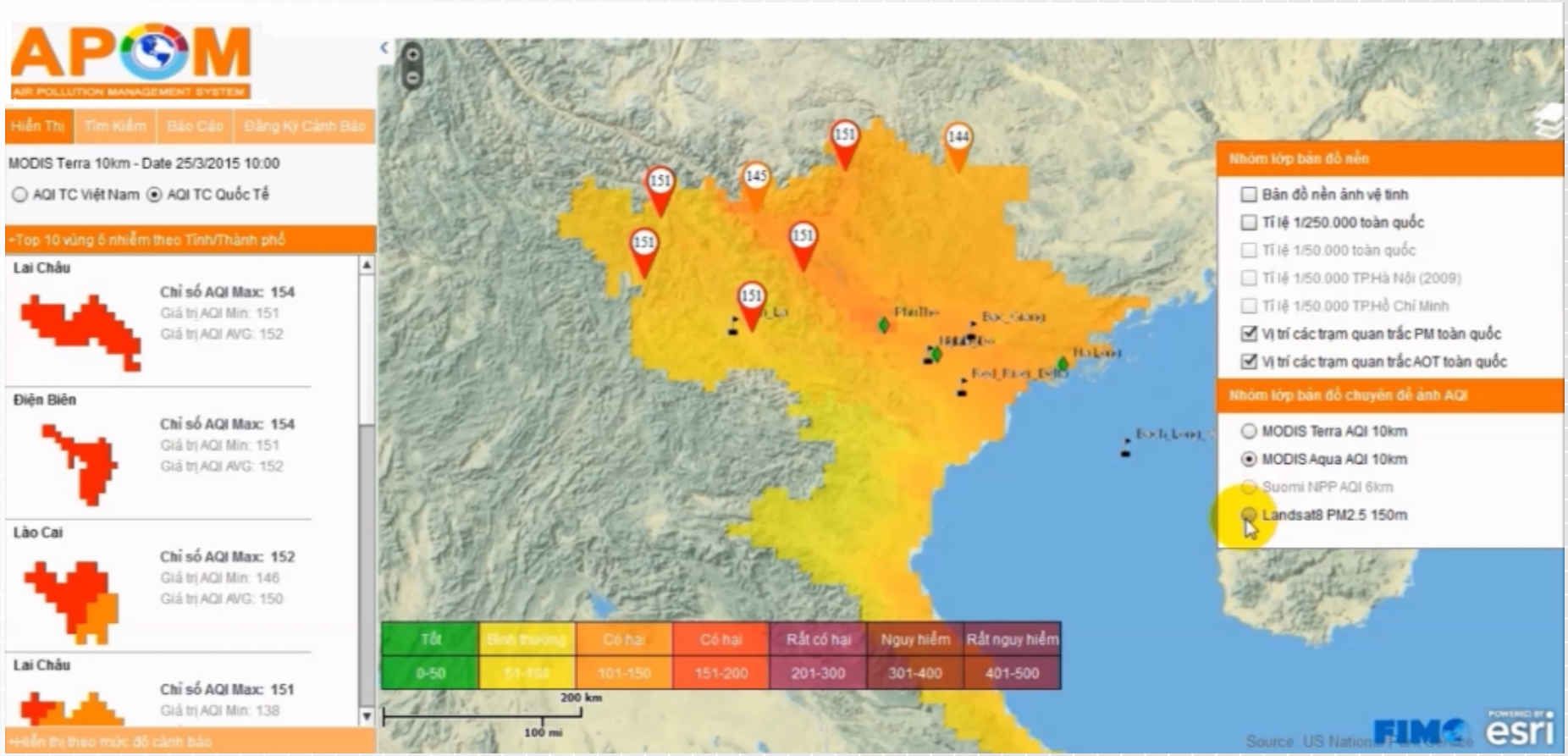
Aerosol Optical Thickness Estimation from high spatial resolution satellite images

- **Study Area: Hanoi**
- **Products:**
  - $PM_{2.5/10}$
  - Aerosol Optical Thickness
  - Spatial resolution: 60 x 60 m – 80 x 80 m
  - Temporal Resolution: 1 time/ 16 day
- **Data**
  - Satellite LandSat images/ Satellite SPOT images
  - Ground PM measurements
- **Air pollution Mapping**
  - AOT maps will be integrated to ground PM measurements in order to derive PM maps at high spatial resolution.

Air quality monitoring and warning system

Web Services	Area	Spatial Scales	Frequency	Satellite
• Monitoring, • Warning, • Report, and • Data Distribution	Vietnam	10x10 km	4 times/day	Terra, Aqua
		6 x 6 km	1 time/day	Suomi NPP
• Monitoring	Hanoi	60 x 60m – 90 x 90m	1 time/16 days	LandSat 8/ SPOT 2 – 5

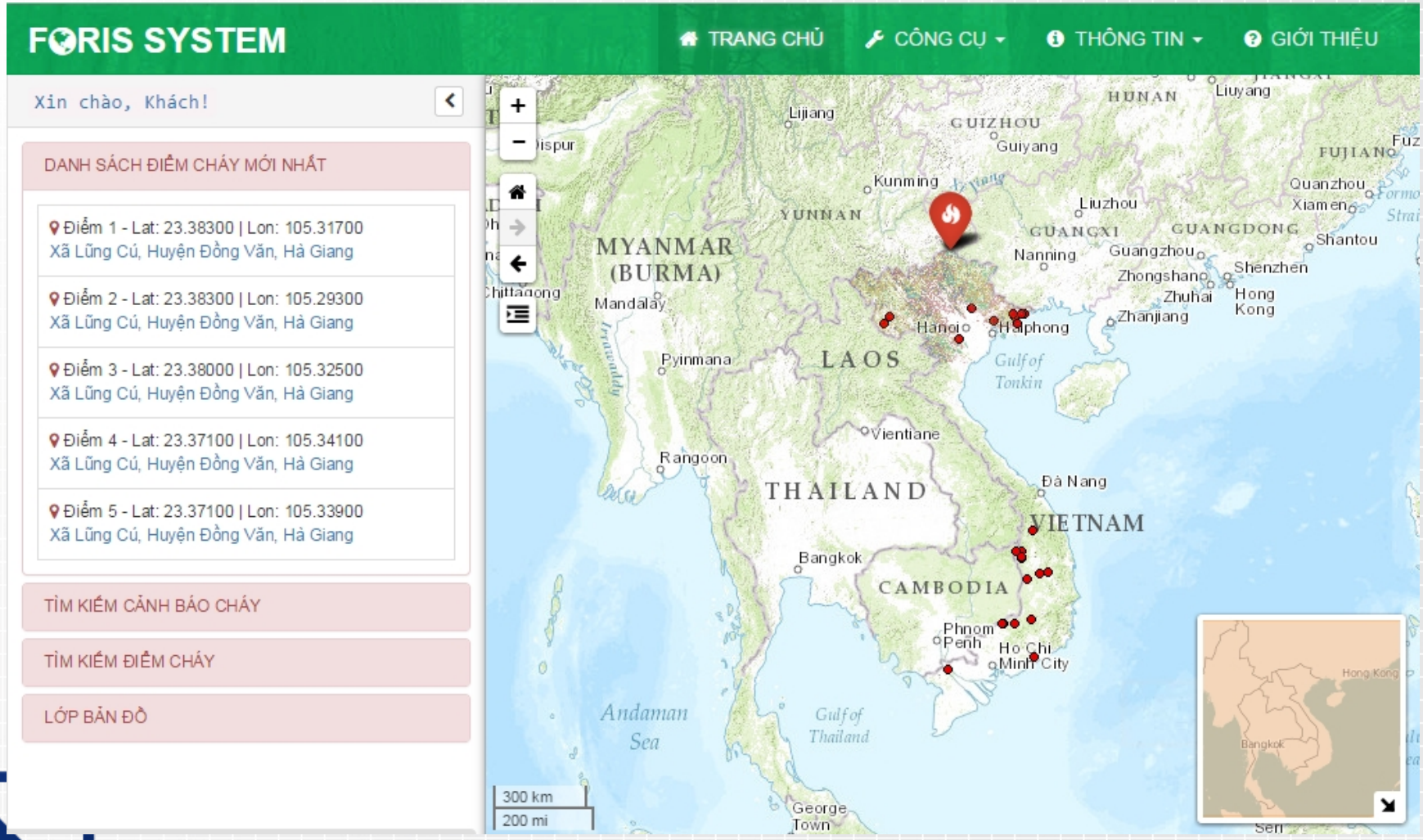
APOM system


APOM
AIR POLLUTION MANAGEMENT SYSTEM
Hiển Thị
Tìm Kiếm
Báo Cáo
Đăng Ký Cảnh Báo
MODIS Terra 10km - Date 25/3/2015 10:00
AQI TC Việt Nam
AQI TC Quốc Tế
+Top 10 vùng ô nhiễm theo Tỉnh/Thành phố
Lai Châu
Chỉ số AQI Max: 154
Giá trị AQI Min: 151
Giá trị AQI AVG: 152
Điện Biên
Chỉ số AQI Max: 154
Giá trị AQI Min: 151
Giá trị AQI AVG: 152
Lào Cai
Chỉ số AQI Max: 152
Giá trị AQI Min: 146
Giá trị AQI AVG: 150
Lai Châu
Chỉ số AQI Max: 151
Giá trị AQI Min: 138
+Hiển thị theo mức độ cảnh báo
Nhóm lớp bản đồ nền
Bản đồ nền ảnh vệ tinh
Tỉ lệ 1/250.000 toàn quốc
Tỉ lệ 1/50.000 toàn quốc
Tỉ lệ 1/50.000 TP.Hà Nội (2009)
Tỉ lệ 1/50.000 TP.Hồ Chí Minh
Vị trí các trạm quan trắc PM toàn quốc
Vị trí các trạm quan trắc AOT toàn quốc
Nhóm lớp bản đồ chuyên đề ảnh AQI
MODIS Terra AQI 10km
MODIS Aqua AQI 10km
Suomi NPP AQI 6km
Landsat8 PM2.5 150m
Tốt
Bình thường
Có hại
Có hại
Rất có hại
Nguy hiểm
Rất nguy hiểm
0-50
101-150
151-200
201-300
301-400
401-500
200 km
100 mi
Source: US National
FIMO
POWERED BY esri

Forest Fire Information System Research

- **Forest Fire Risk Early Warning System**
  - Study Area: Vietnam
  - Products:
    - TIF image
    - Spatial resolution: 0.1^{o}x0.1^{o}
    - Temporal Resolution: Daily
  - Data
    - Satellite TRMM (0.25^{o}x0.25^{o}, every 3 hours),
    - Ground NCHMF (RH, TEMP, RF) (98, stations, month/region)
- **Forest Fire Detection using MODIS Imagery**
  - Study Area: Vietnam
  - Products:
    - MOD14
    - Spatial resolution: 1km x 1km
    - Temporal Resolution: Daily
  - Data
    - **Satellite MODIS MOD02 (1km/pixel, 4 times/day)**
    - Satellite MODIS MOD03 (1km/pixel, 4 times/day)

FORIS system (Forest Fire Information System)

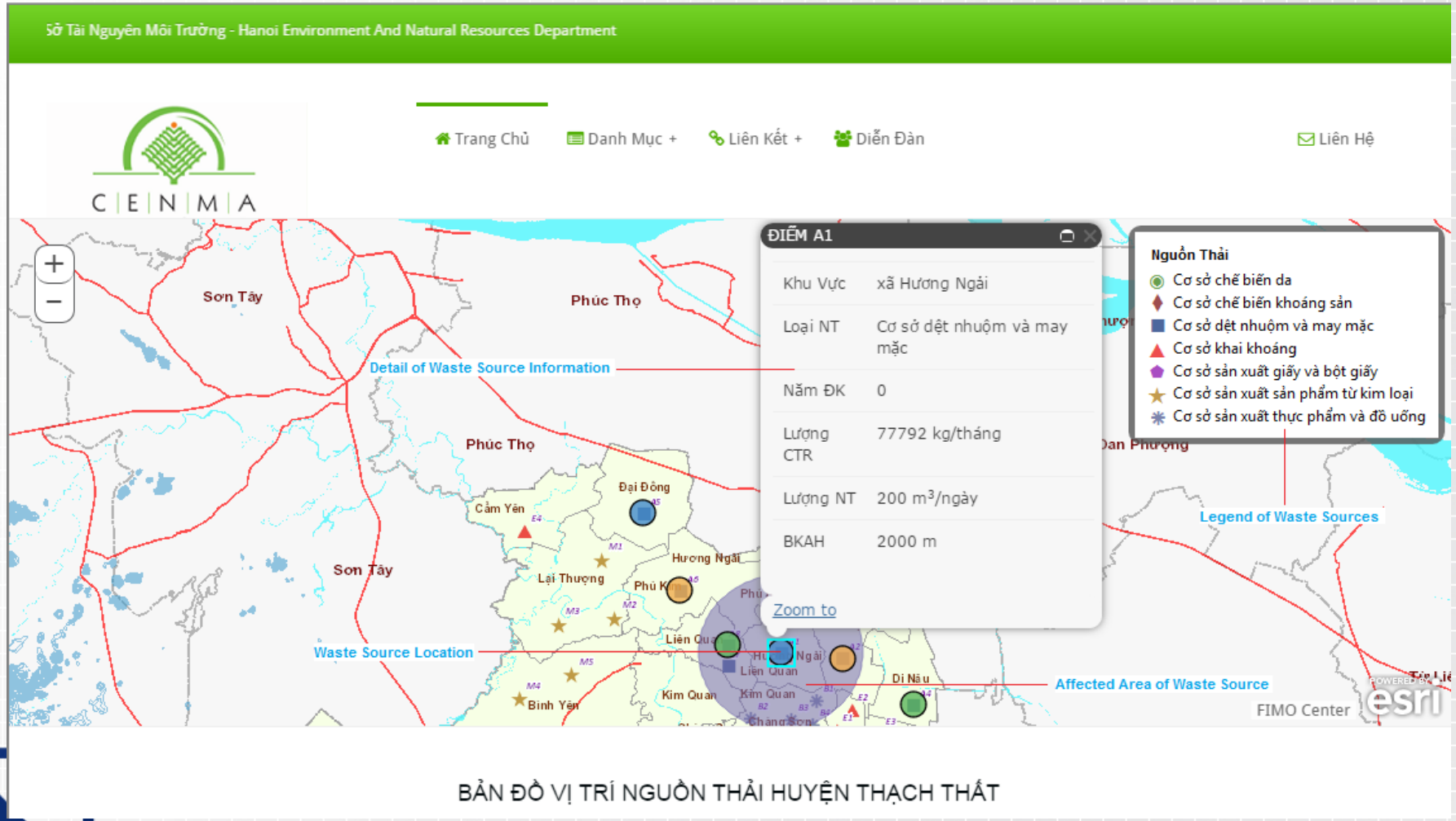


WaSOM: Waste Source Monitoring System

Collaboration between FIMO and Hanoi Department of Natural Resources and Environment

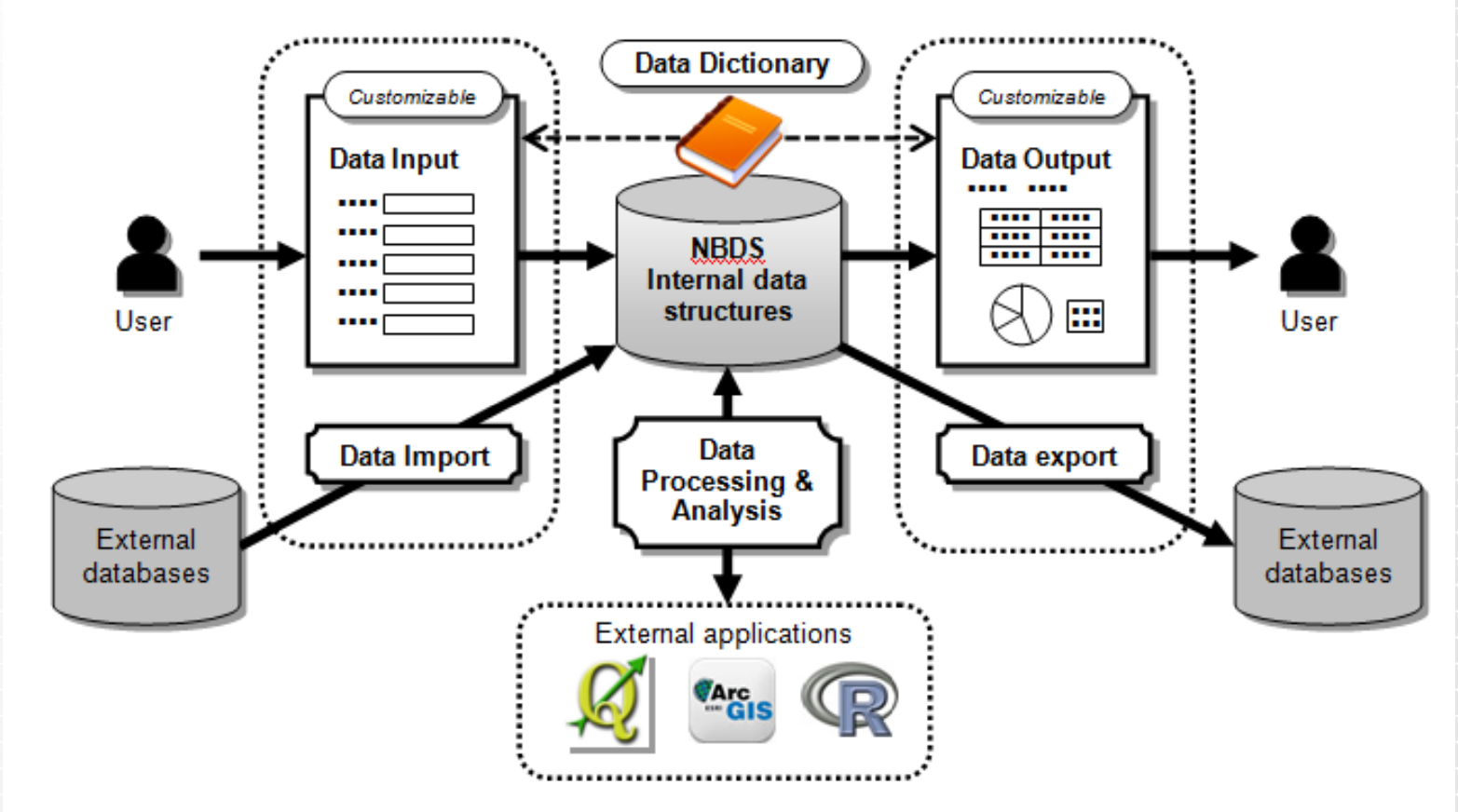
- **Main functions:**
  - Monitor waste sources of all communes in Hanoi and visualize data on map.
  - Provide information of waste sources include: volume of waste, affected distance, location, chemicals used, etc.
  - Analyze waste related data to asses effectiveness and its effected based on interpolation models.
  - Generate detailed reports instantly for sharing with management and other stakeholders.
  - Import/Export waste data for administration.
  - Available for Web and Mobile.

WaSOM system



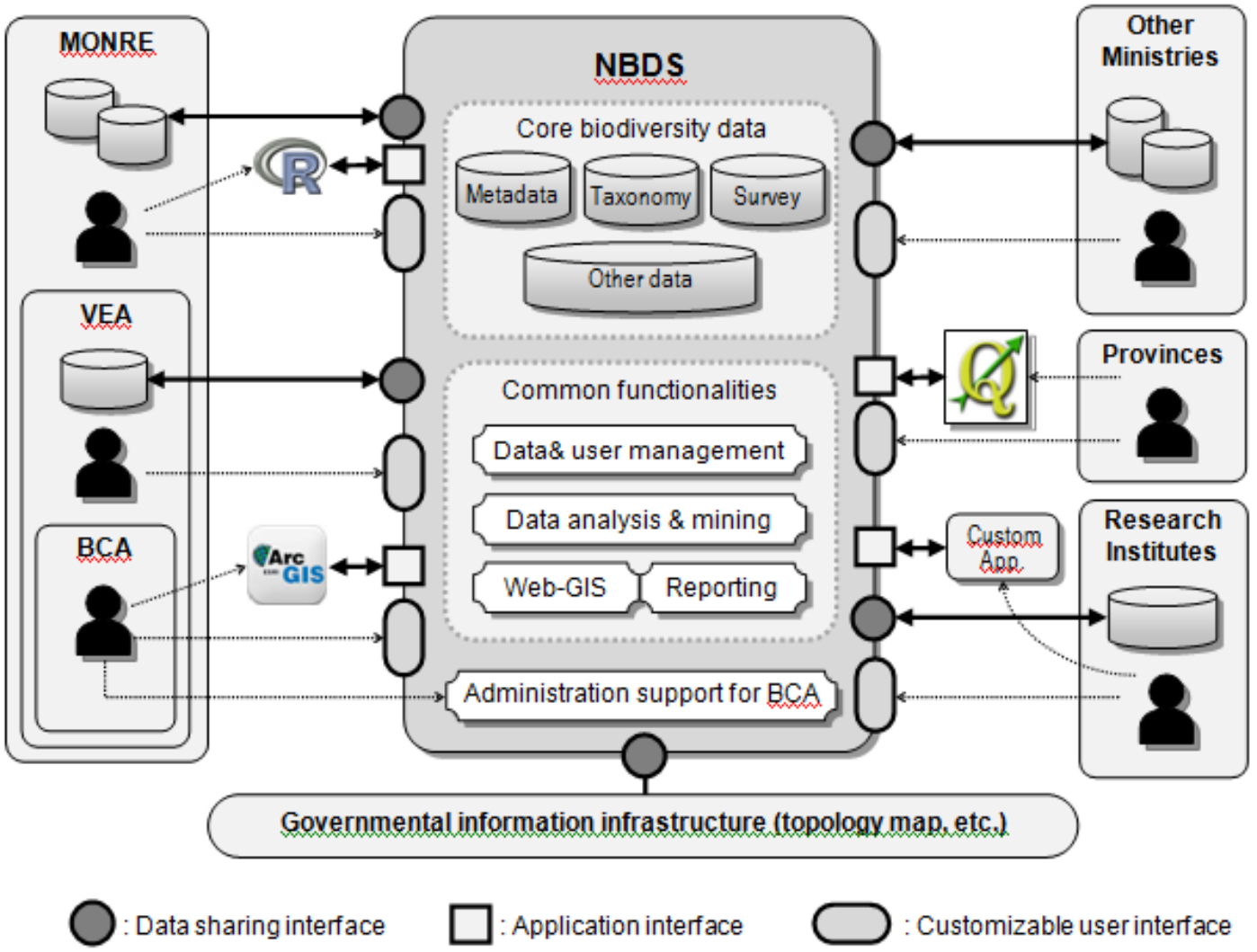
BẢN ĐỒ VỊ TRÍ NGUỒN THẢI HUYỆN THẠCH THẤT

National Biodiversity Database System (NBDS) – a JICA project

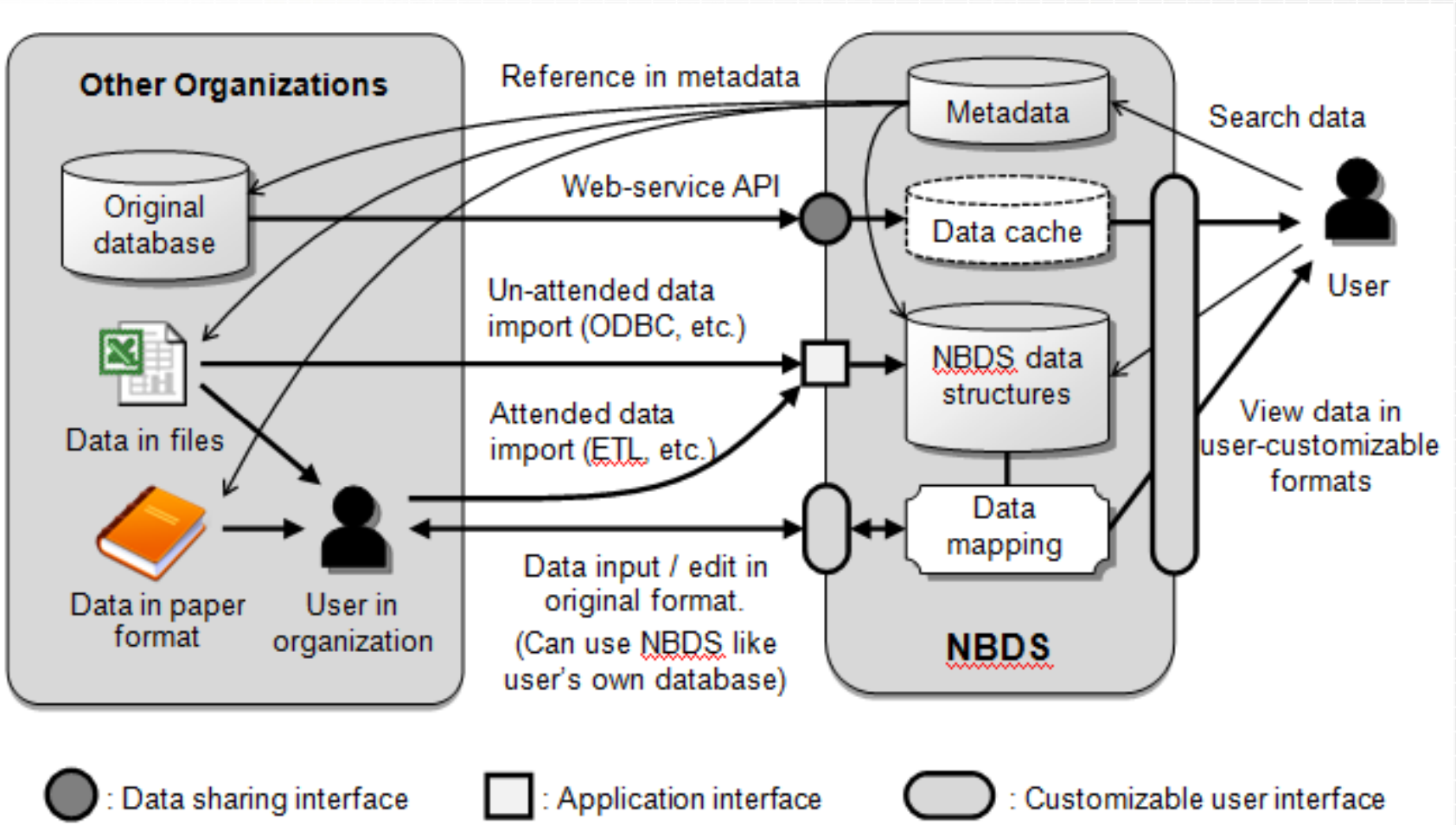


Overview of NBDS functionalities

NBDS in connections

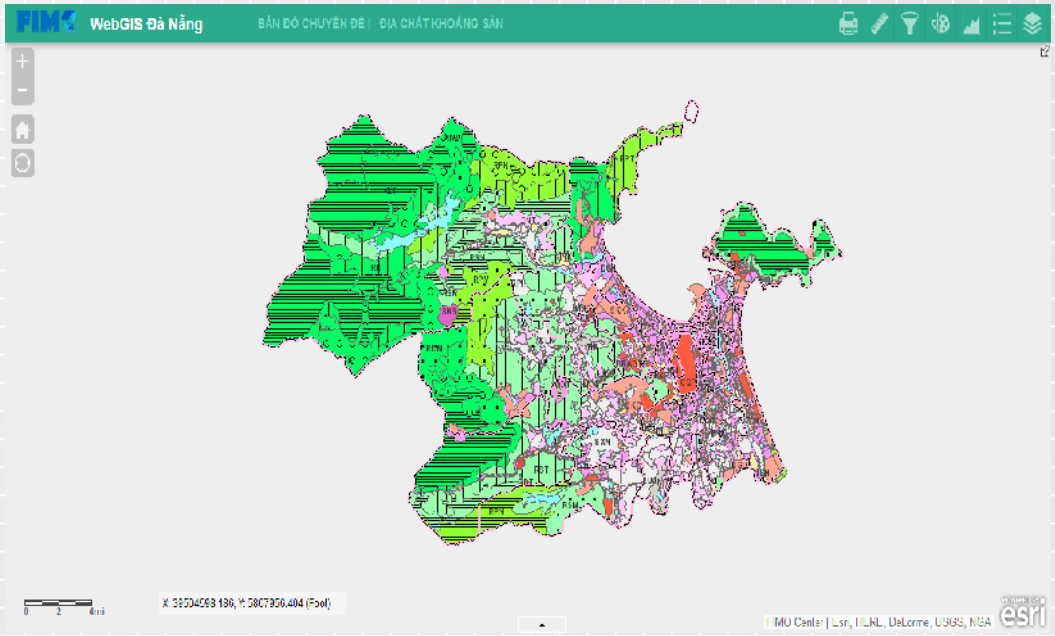


Data storage policy of NBDS



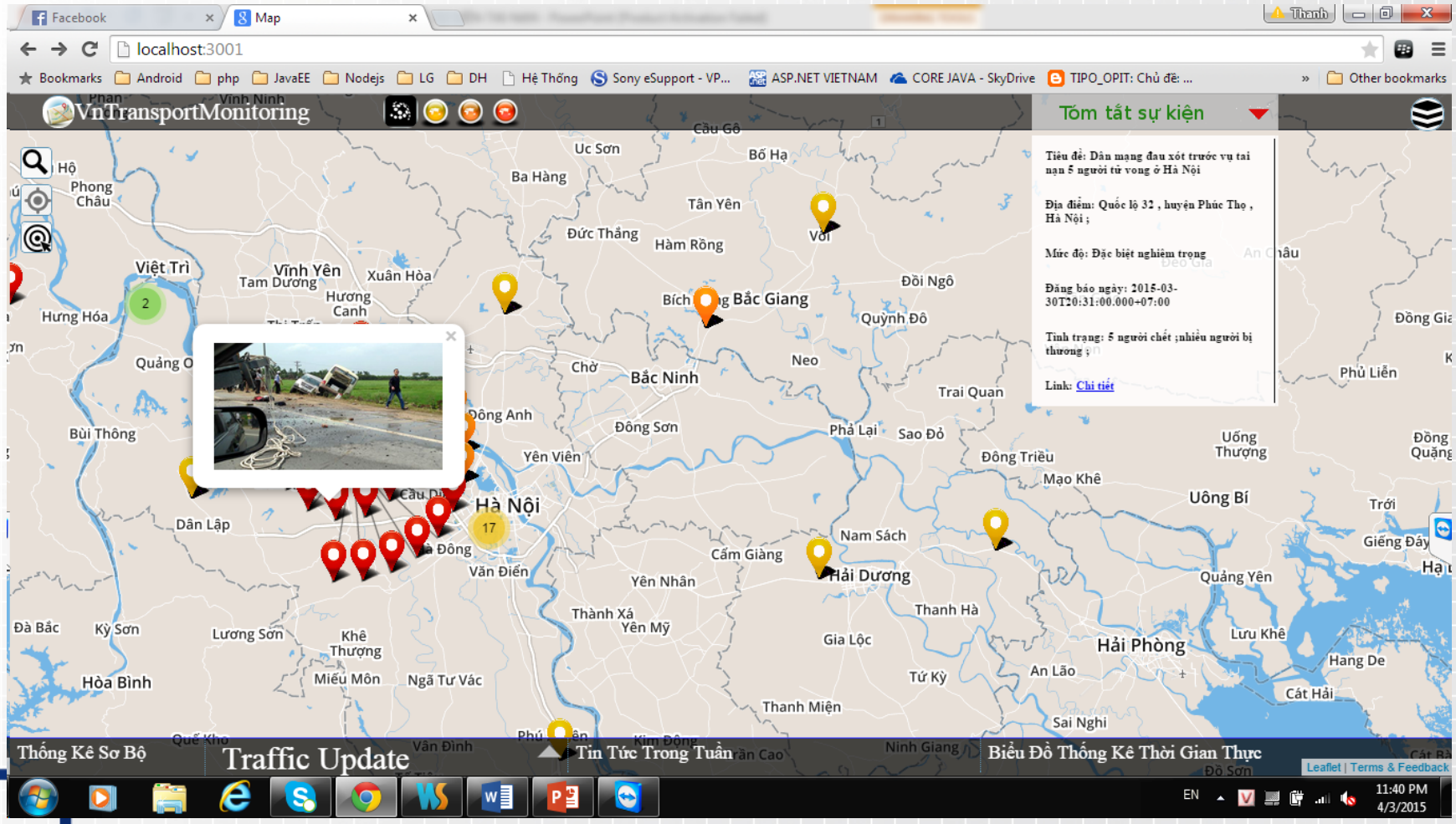
WebGIS System for Coastal Urban Management

- **5 urbans: Hai Phong, Nha Trang, Da Nang, Rach Gia, TP Ho Chi Minh.**
- **Main functions:**
  - Display
  - Search
  - Statistical Analysis
  - Decision Maker Support



Vietnam Transportation Monitoring System

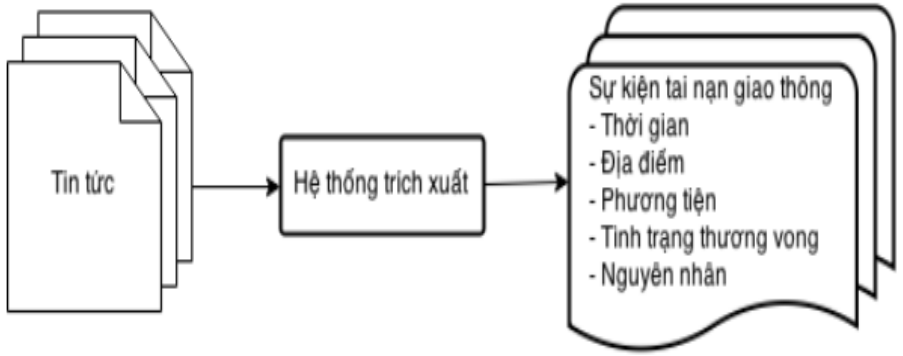
Collaboration between FIMO – National Traffic Safety Committee



Data extraction

Input: Tin tức gồm các thuộc tính tiêu đề, thời gian, tóm tắt, nội dung đầy đủ.

Ouput: Đưa ra thông tin liên quan đến sự kiện tai nạn giao thông: địa điểm, thời gian, phương tiện, mức độ thiệt hại và nguyên nhân gây ra tai nạn giao thông



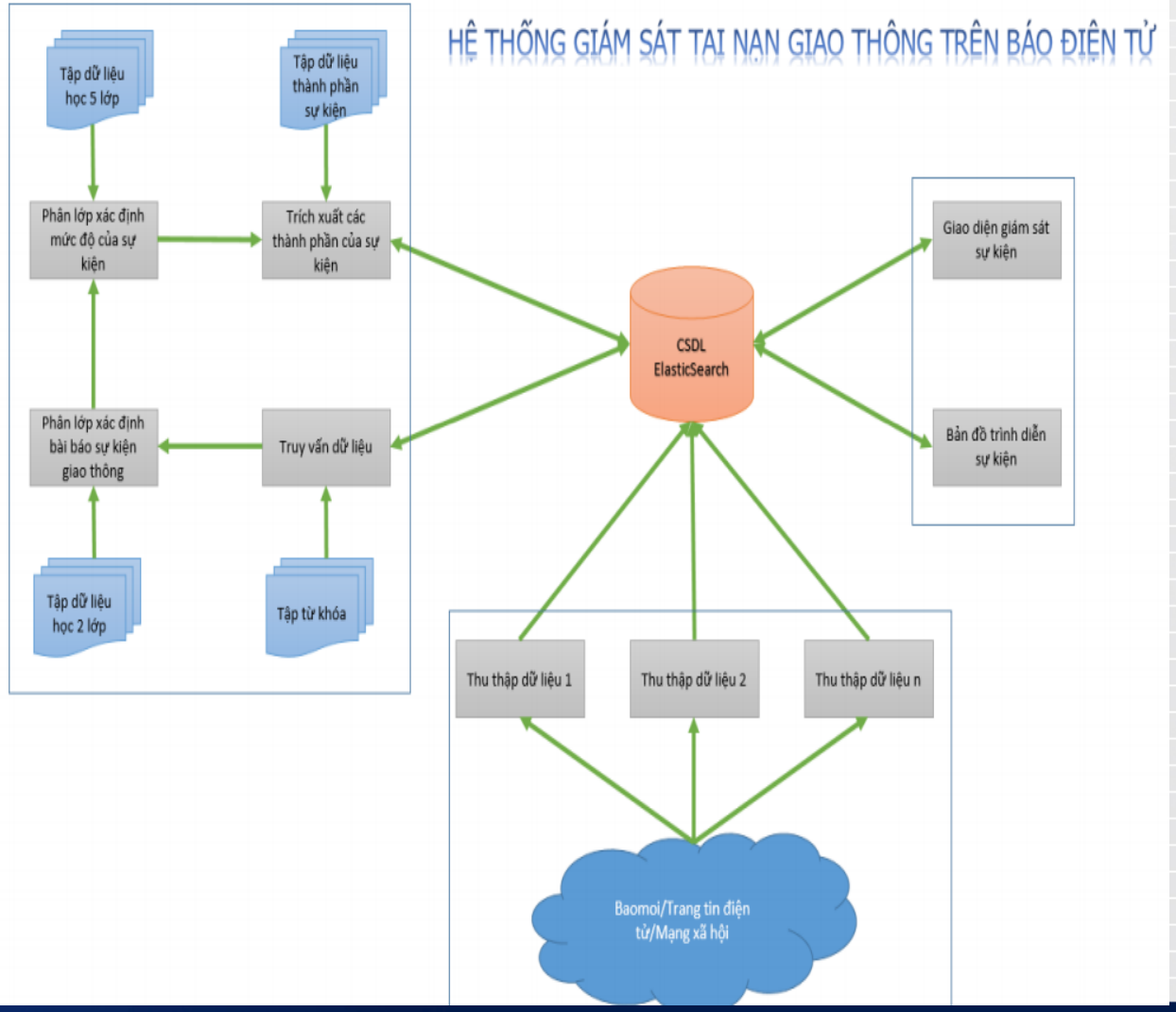
[1]Vào khoảng 12h20 phút ngày 21/6, một chiếc ô tô mất lái đâm vào một nhà dân trên đường Cầu Giấy (Hà Nội) khiến một người bị trọng thương, nhiều phương tiện bị hư hỏng nặng...

[1]http://baophapluat.vn/

Trích xuất

Thuộc tính	Giá trị thuộc tính
Thời gian	12h20 phút ngày 21/6
Địa điểm	Đường Cầu Giấy (Hà Nội)
Phương tiện	Ô tô
Mức độ thương vong	Một người bị trọng thương
Nguyên nhân	Mất lái

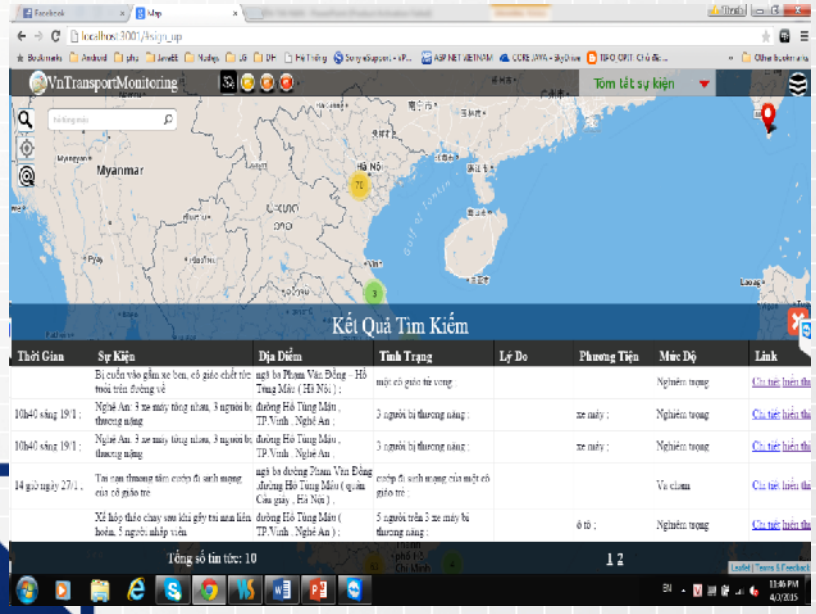
Data Collection

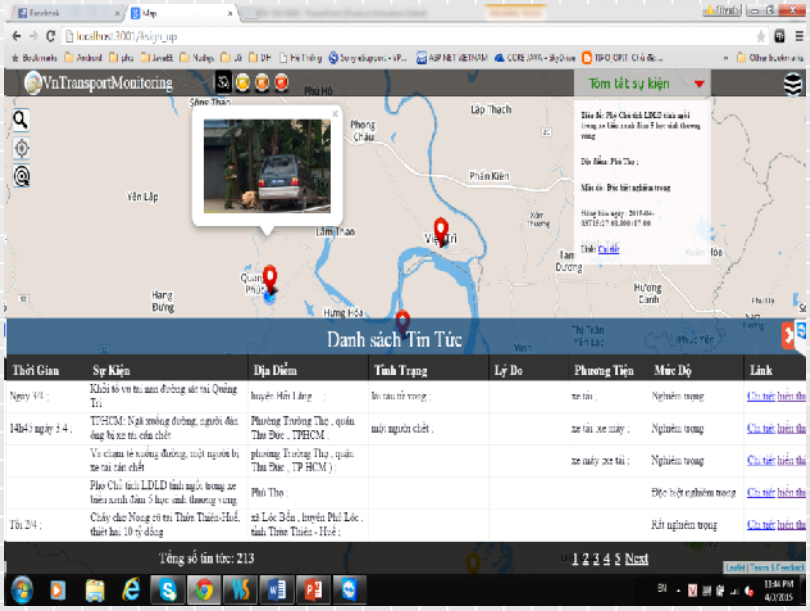


- More than 13 millions pages from 2006 - 2015
- 84.000 extracted accidents

VNTM System

- Data visualization
- Search by location, time,...
- Hotspot identification





Mission & Core Values

- **Mission:**
  - Nation-wide Spatial Data Infrastructure Development
  - Field Monitoring Tools Development
- **Core-values:**
  - Ambitious
  - No 1. university-based
  - Excellent Advisory Board
  - Teamwork and Inheritance

Thank you!