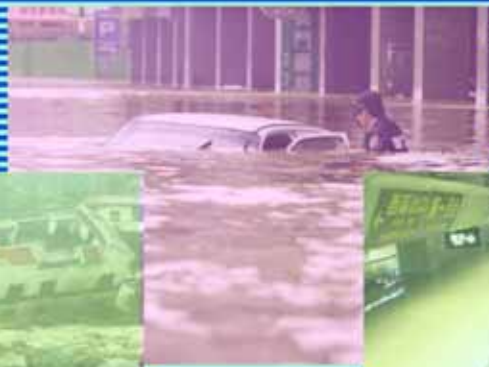


# The Experience of Developing Safe Taiwan Information System (SATIS) in Taiwan



*Dr. Hsueh-Cheng Chou*



National Science & Technology Center for Disaster Reduction

# Lessons from Natural Disasters in Taiwan



**Earthquake**

5 Major  
Disasters



**Landslide**



**Typhoon**



**Flood**



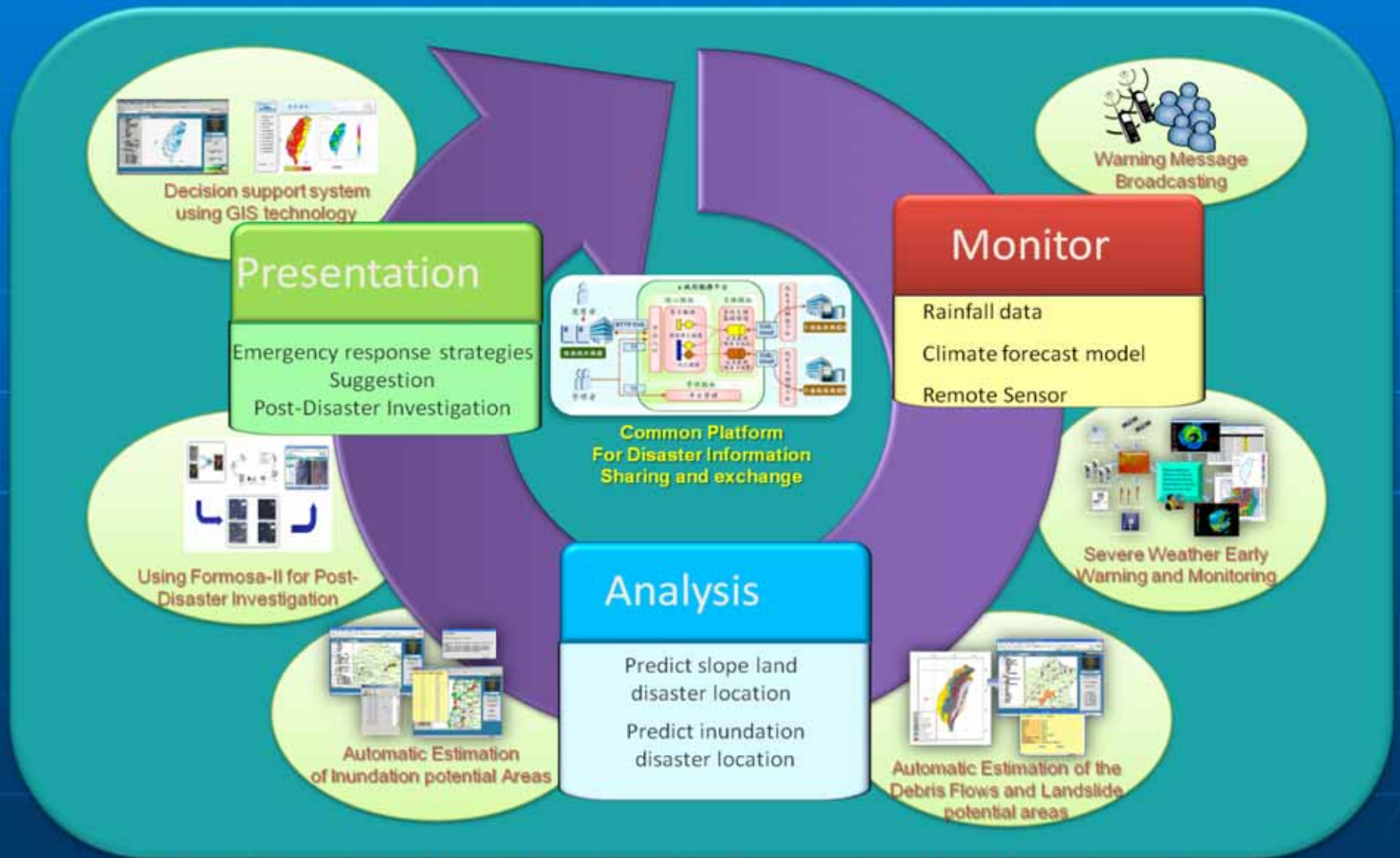
**Debris flow**



# Safe Taiwan Information System (SATIS)

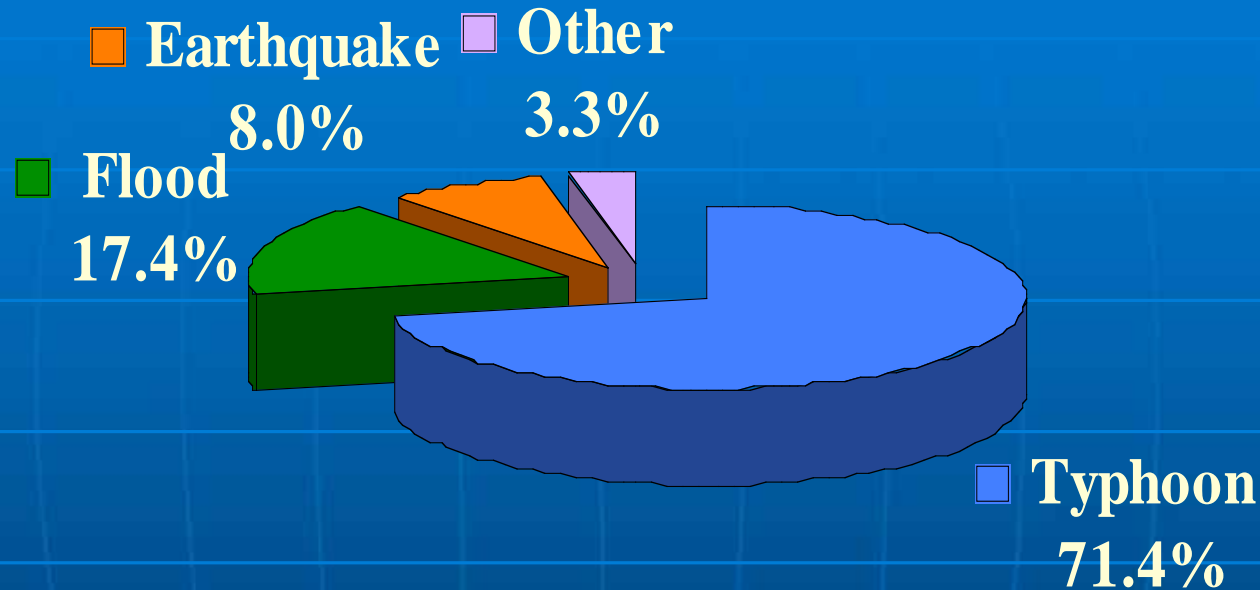
- In the past, scientific researches on earthquakes, floods, debris flows, and hazard response system had been intensively studied in Taiwan.
- To put these research results into real applications, an integrated information system is required.
- Integrating GIS tools, internet technology, dynamic hazard models and graphical user interfaces (GUIs),
- 
- Covering disaster mitigation, preparedness, response, and recovery.

# SATIS for Natural Hazards



# Typhoon Disasters in Taiwan

Total loss due to natural disasters (1958-2001)



In average, there are **3.6** typhoons touched down in Taiwan every year  
**72%** natural hazard damage is caused by typhoon Taiwan



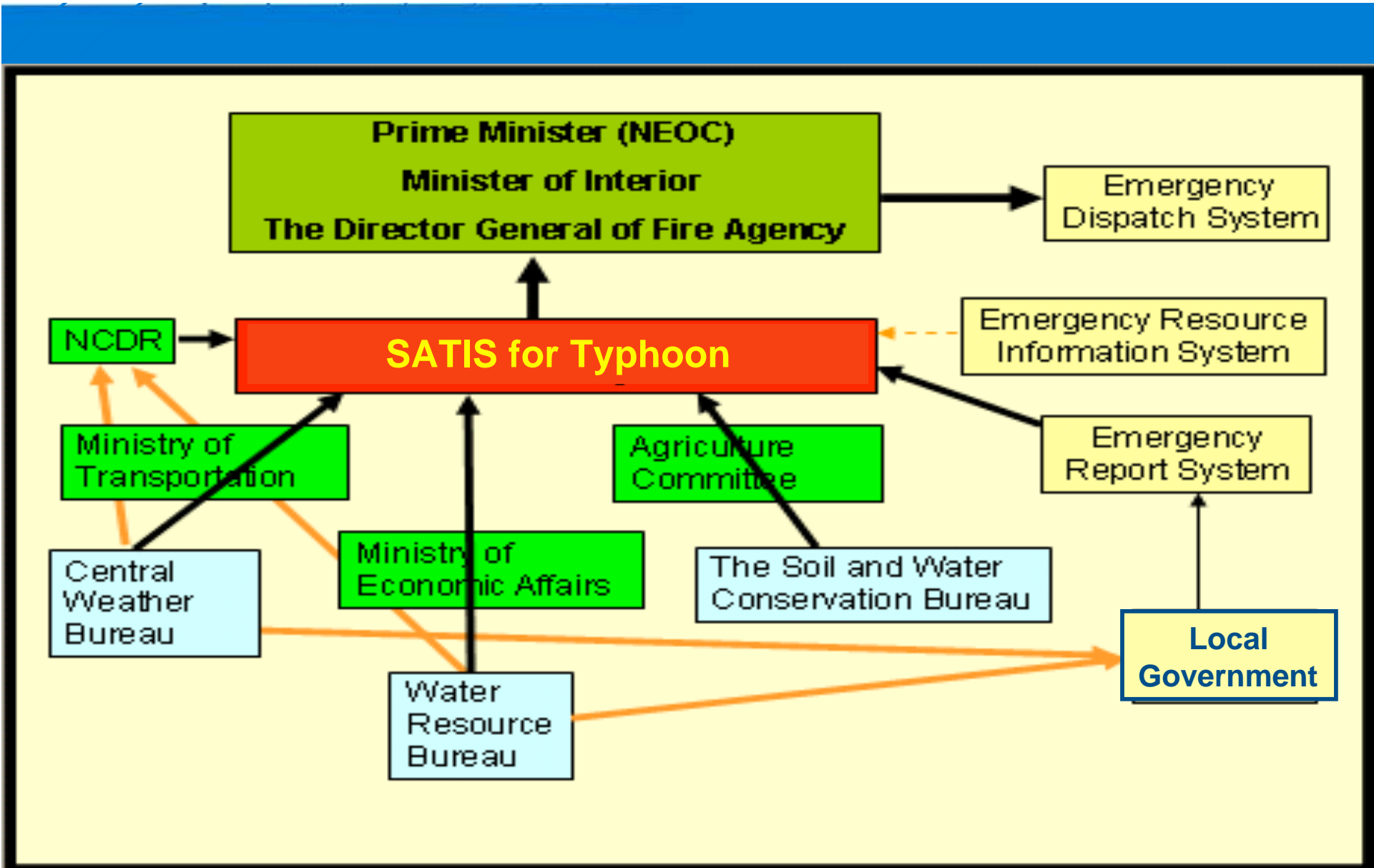


Taipei MRT



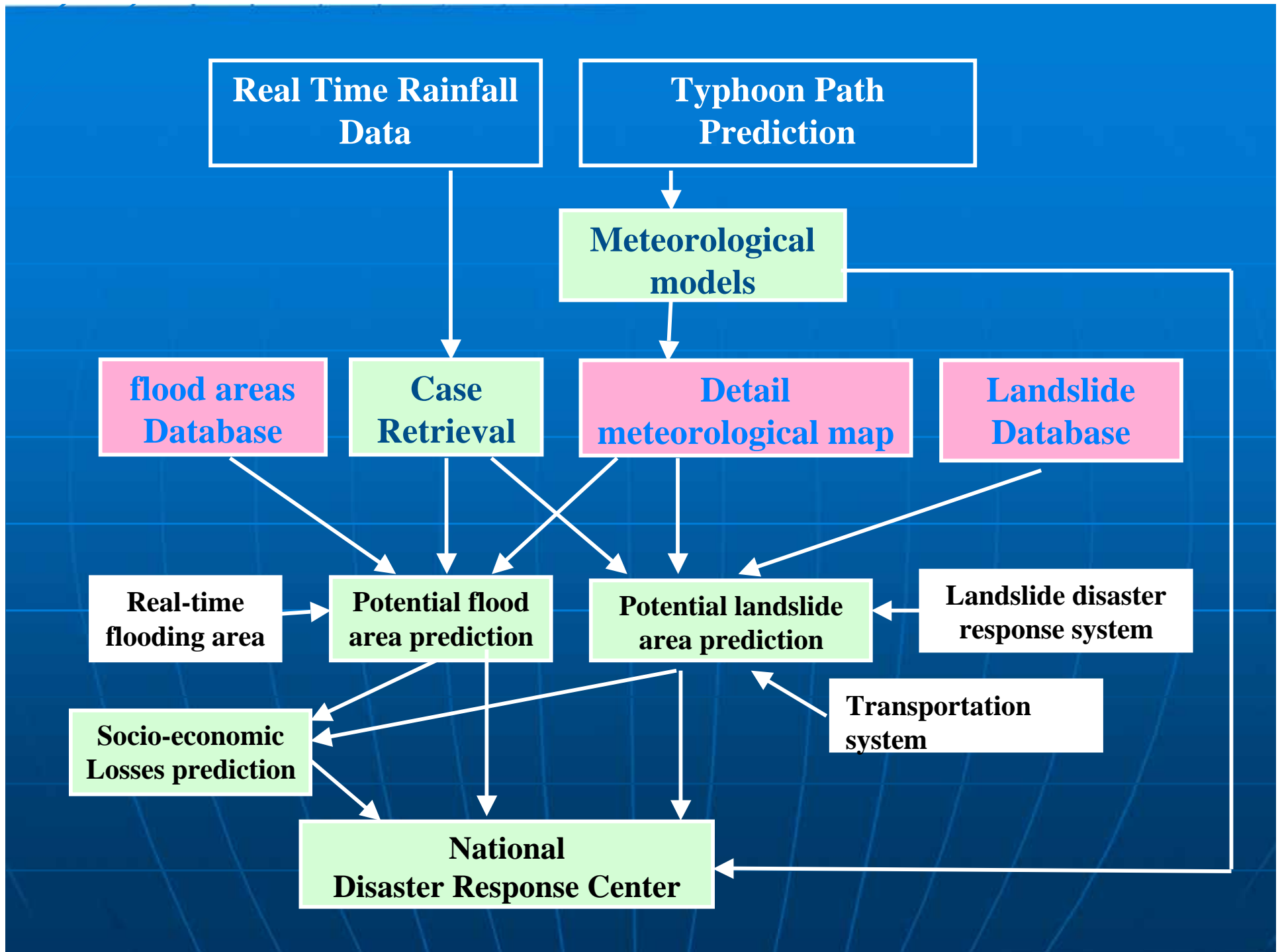


2006 National  
Emergency  
Operations  
Center  
(NEOC)



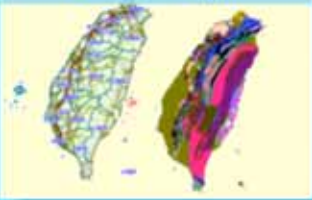
Information flow to the NEOC





# SATIS for Typhoon Hazards

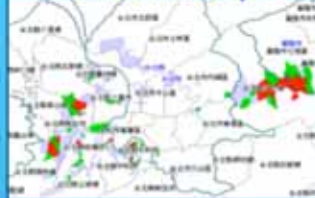
Basic Maps



Typhoon Path Prediction



Inundation Potential Maps



Debris Flow and landslide information



Rainfall forecasting by CLIPPER model



Rainfall forecasting by QPE-SUMS radar system



Real-Time Water Information of rivers by Web-Services Technology



Automatic Estimation of Inundation Area



Automatic Estimation of the potential areas of Debris Flows and Landslide



Management of Disaster Investigation



Warning Message Broadcasting



Analysis and Decision Making

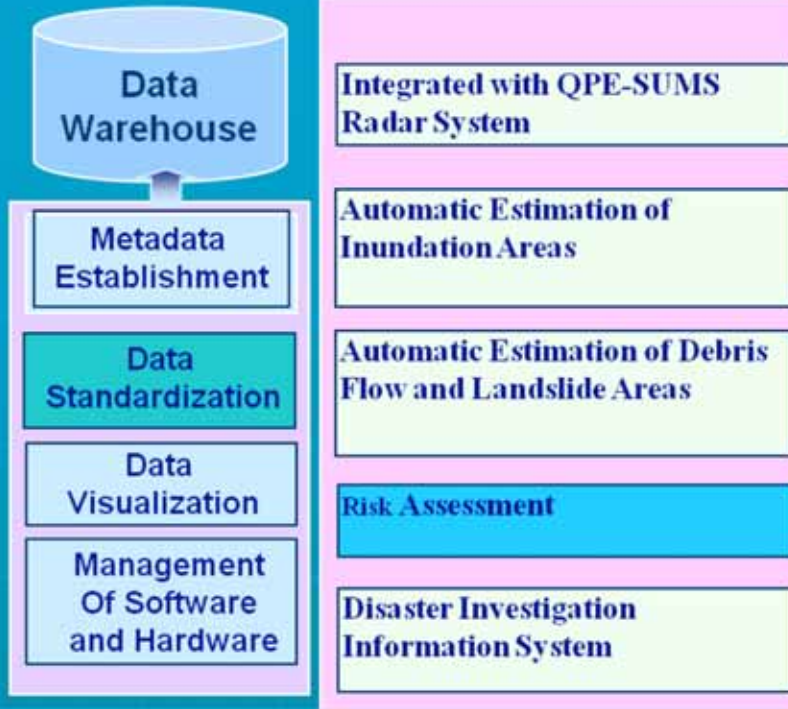
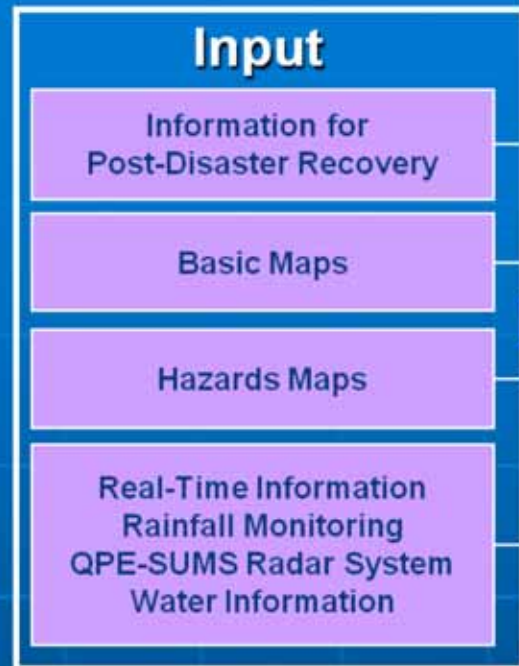


Central Warning Declaration





## Disaster Analysis and System Integration



Governmental Agencies and NGOs



Information for Early Warning

Decision Makers



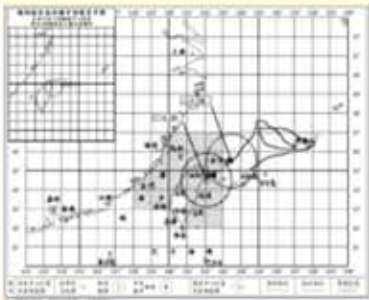
WEBGIS  
Single Signon



Users

# Monitor

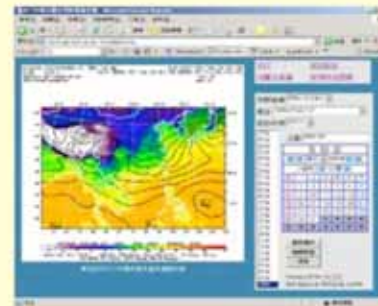
## Monitor Real time data



Typhoon forecast data



Rain gauge data



Climate forecast model



River and reservoir status



Radar estimate rainfall

- collects the typhoon information
- estimate of its future track

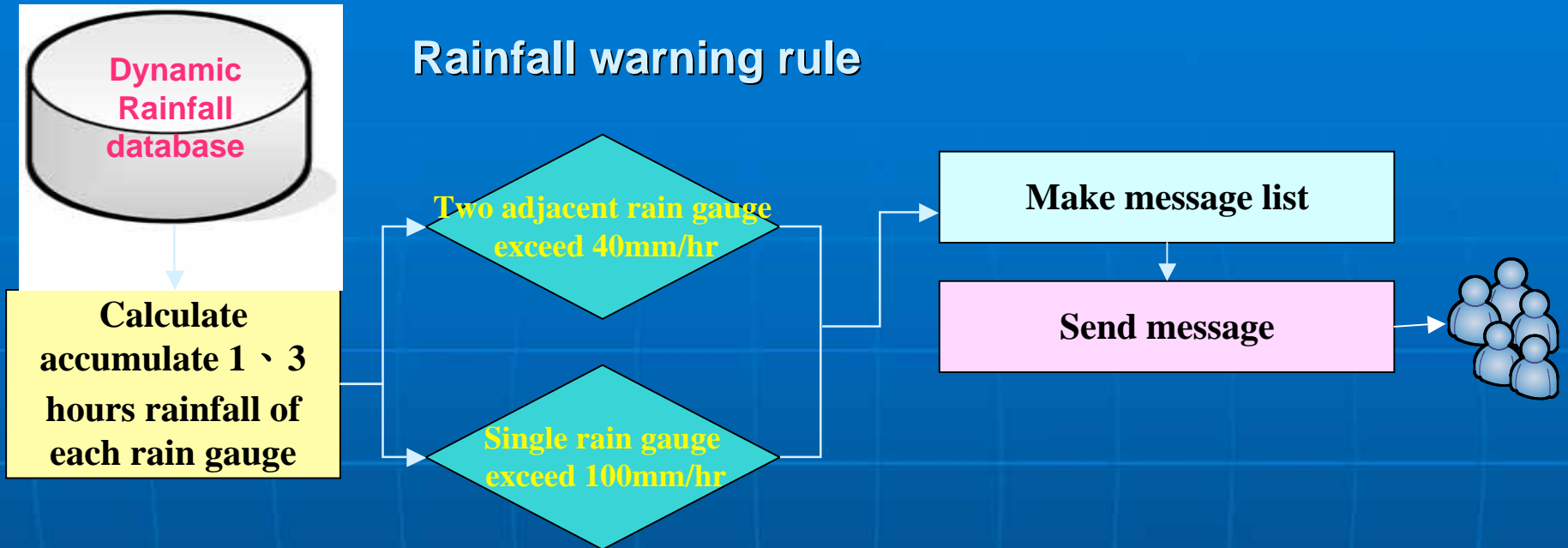
Warn instantly



Send Warning message



# Send warning message to cell phone



(May) 27 04:10

Taitung county DaRan town NanTian  
accumulate 1 hour rainfall 43mm

Taitung county DaRan town Shouka  
accumulate 1 hour rainfall 45mm



# Analysis

## Static basic data



Basic map data



Potential inundation data



Potential debris flow data



Predict slope land disaster location



Predict inundation disaster location

## Real time hazard data

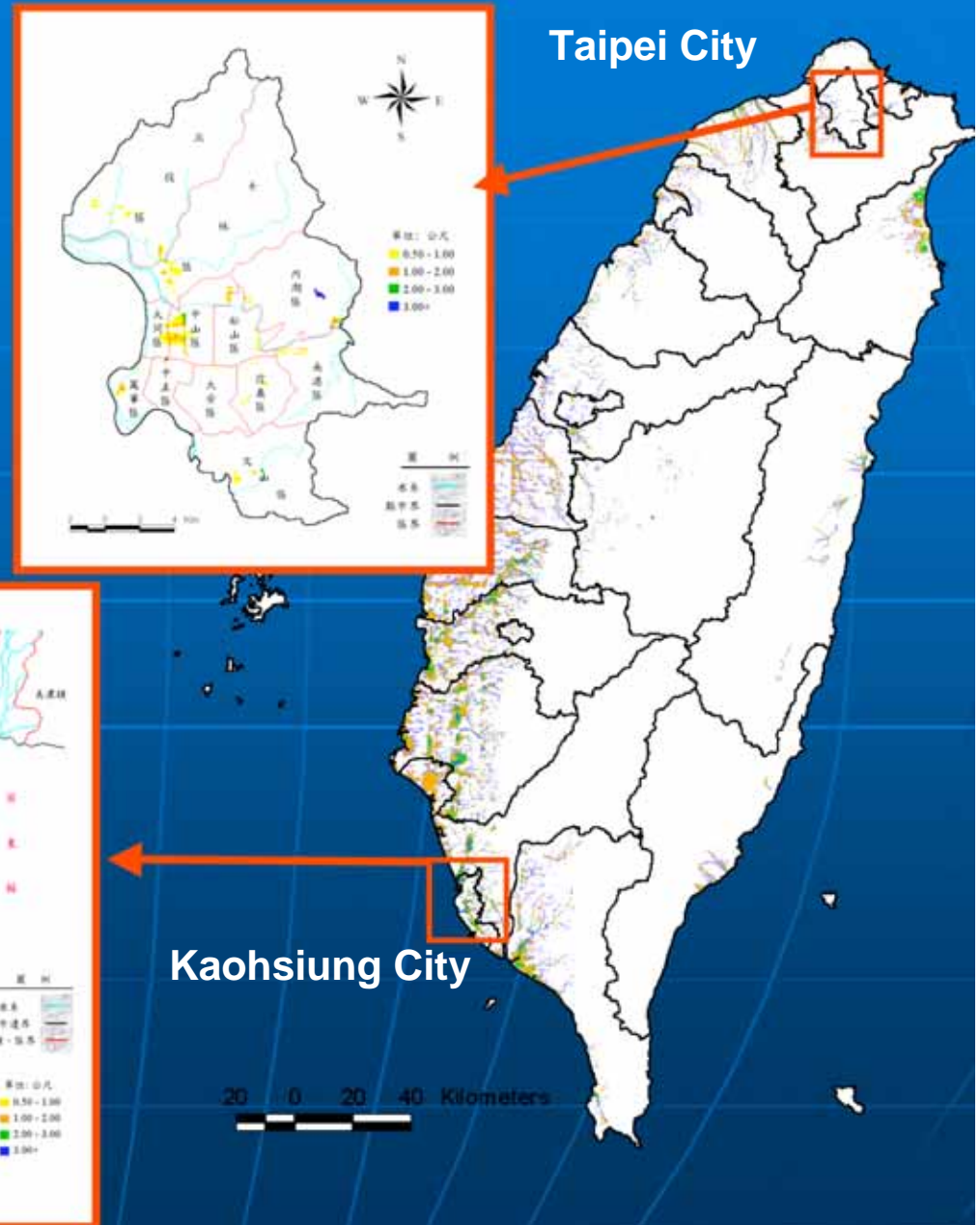


Reveal hazard location



# The Inundation Potential Maps in Taiwan

- The flood and drought mitigation research group had finished the island-wide inundation potential maps in 2001.
  - For floodplain managements
  - For flood mitigations
  - Incorporation with social-economic information



# Estimation of Inundation and Warning Issue








Real-time Rainfall Records

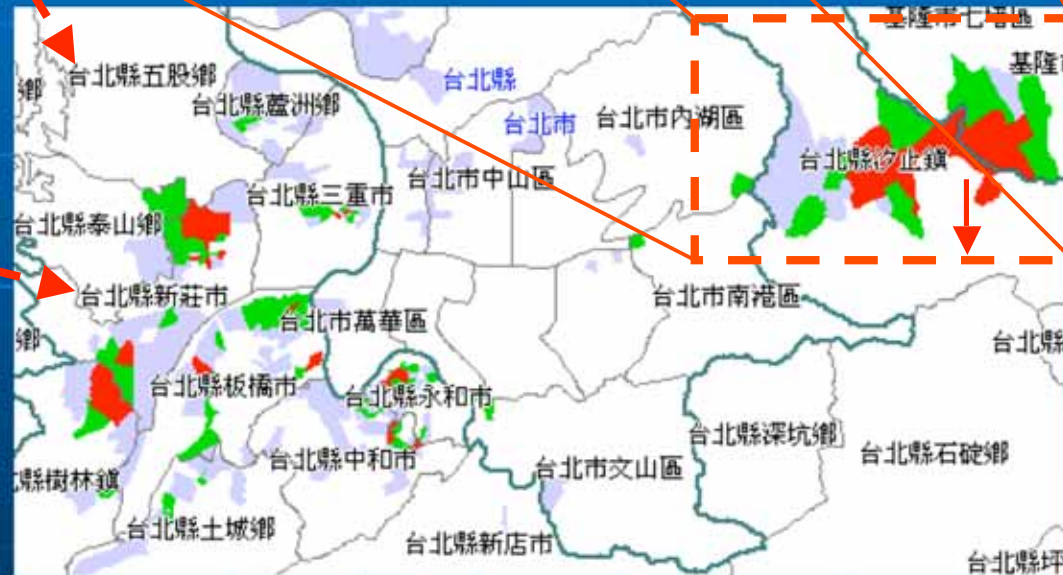
+






Rainfall Forecasting



-  River
-  County boundary
-  Township boundary
-  Highway
-  Major road



Flood Potential

-  Highest (avg. depth > 1.5 m)
-  Higher (avg. depth 1.0m – 1.5m)
-  High (avg. depth 0.5m – 1.0 m)

Automatically selects the inundation potential layers every 10 minutes



# Forecasting of the Potential Inundation Areas

The screenshot displays the DSSER (Decision Support System for Emergency Response) interface. It features a main map of Taipei with various flood risk zones highlighted in red, orange, and green. A sidebar on the left contains a legend and a list of data sources. A central window shows a table of model parameters, and a bottom window displays a log of system operations.

**Table 1: Model Parameters**

模型區	模型區名	潛勢區	潛勢區時間
1	taipe1	0	600
2	taipe2	0	600
3	taipe3	0	600
4	taoyuan	0	300
5	hsinchu1	0	400
6	hsinchu2	0	600
7	hsinchu3	0	180
8	hsinchu4	0	600
9	taichung1	0	300
10	taichung2	0	480
11	taichung3	0	600
12	changhsa	0	0
13	nantou1	0	600
14	nantou2	0	0
15	nantou3	0	0
16	yuansh	0	0

**Table 2: System Log**

```

自動執行 取消執行
Run Upload@ 2005/9/14 下午 01:27:56
Run model@ 2005/9/14 下午 01:33:07
Run Upload@ 2005/9/14 下午 01:37:17
Run model@ 2005/9/14 下午 01:42:17
Run Upload@ 2005/9/14 下午 01:47:28
Run model@ 2005/9/14 下午 01:52:38
Run Upload@ 2005/9/14 下午 01:57:49
Run model@ 2005/9/14 下午 02:02:59
Run Upload@ 2005/9/14 下午 02:08:10
Run model@ 2005/9/14 下午 02:12:20
Run Upload@ 2005/9/14 下午 02:17:31
Run model@ 2005/9/14 下午 02:22:41
Run Upload@ 2005/9/14 下午 02:27:52
Run model@ 2005/9/14 下午 02:33:03
Run Upload@ 2005/9/14 下午 02:37:19
    
```

Be modified manually via the user interface of DSSER

# Potential Streams of Debris Flow



Geology Zoning of 1420 Potential Hazard Streams

土石流潛勢溪流 (1420 條) - 屬性查詢

溪流代碼	台北A137
溪流名稱	孔子溪
溪流型態	溪流型
地標	福山國小
鄉鎮	烏來鄉
村里	福山村
地質	古第三紀亞變質
優先釐治順序 (水保局)	高潛勢
保全對象聯絡人	高英村
保全對象聯絡住址	烏來鄉福山村大羅蘭25號

Automatically identifies the potential areas of debris flow and landslide every one hour



# The User Interface for the Forecasting of the Slope Land Disaster Locations

The interface consists of several main components:

- Search Window (Top Left):** A window titled "土石流潛勢區域 - Microsoft Internet Explorer" with search criteria for start time (2004/6/29 01:00) and end time (2004/07/01 10:00). It includes buttons for "輸出警戒村里" and "輸出警戒鄉鎮".
- Search Results (Middle Left):** Lists search results for "花蓮縣 玉里鎮" and "卓溪鄉", showing search ranges and a total of 2警戒村里 (警戒村里).
- Data Table (Bottom Left):** A table with columns: 代碼, 平均降雨強度, 平均降雨強度門限值, 差異, 累積雨量(公厘), and 時間.
 

代碼	平均降雨強度	平均降雨強度門限值	差異	累積雨量(公厘)	時間
花蓮A154	8.8	7.8	13%	256.0	
花蓮A147	7.5	6.9	9%	253.6	2004/06/30 00:00
花蓮A148	7.5	6.9	8%	253.5	2004/06/30 00:00
花蓮A155	7.4	6.9	8%	253.3	2004/06/30 00:00
花蓮A153	7.4	6.9	8%	252.1	2004/06/30 00:00
- Map (Center):** A map of the study area showing slope land disaster locations in orange. Labels include "花蓮縣卓溪鄉" and "卓溪村".
- Property Query Window (Top Right):** A window titled "土石流潛勢溪流 (1420條) - 屬性查詢" showing details for a specific stream:
 

溪流代碼	花蓮050
溪流名稱	卓溪
溪流型態	溪流型
地標	卓溪
鄉鎮	卓溪鄉
村里	卓溪村
海拔	1022.0公尺
- Rainfall Graph (Bottom Right):** A graph titled "溪流 花蓮A148 平均降雨量線圖" showing rainfall intensity over time. The x-axis is labeled "Hour" (0-23) and the y-axis is labeled "mm" (0-15). Below the graph, it shows "目前資訊" (Current Info) for time 2004/6/30 00:00, with "即時雨量: 0.5" and "累積雨量: 0.5".

# Presentation

Image and  
3D land form data



Information  
dashboard



3D demonstration

Decision making

Central  
Emergency  
Operations  
Center



Response and  
arrange resource



# Presentation by Web GIS

國家災害防救科技中心災害應變作業支援系統 - Microsoft Internet Explorer

檔案(E) 編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)

網址(D) http://map2.ncdr.nat.gov.tw/main.asp

Google Go Bookmarks Popups okay Check AutoLink AutoFill Send to Settings

顯示比例尺 行政區定位

- 地層資料
- 基本圖層
  - 水庫
  - 雨量站(標準代碼)
  - QPESUMS網格
  - 水位站
  - 國道
  - 省道
  - 集水區界
  - 流域界
  - 縣市界
- 25萬分之一地質圖
- 淹水潛勢
  - 淹水警戒圖\_人工
  - 淹水警戒圖\_自動
  - 淹水警戒圖(600公)
- 降雨分佈圖
  - 過去7天雨量
  - 過去3天雨量
  - 過去24小時雨量
  - 過去12小時雨量
  - 過去6小時雨量
  - 過去3小時雨量
  - 過去1小時雨量

1:3,309,265 299 x 260 (mi)

臺南市 基隆市 桃園縣 台北縣 新竹縣 苗栗縣 宜蘭縣 台中縣 彰化縣 南投縣 雲林縣 嘉義縣 台南縣 高雄縣 台東縣 屏東縣 台東縣

登出系統

降雨監測

淹水潛勢

土石流潛勢

地震

災情

--氣象資訊--

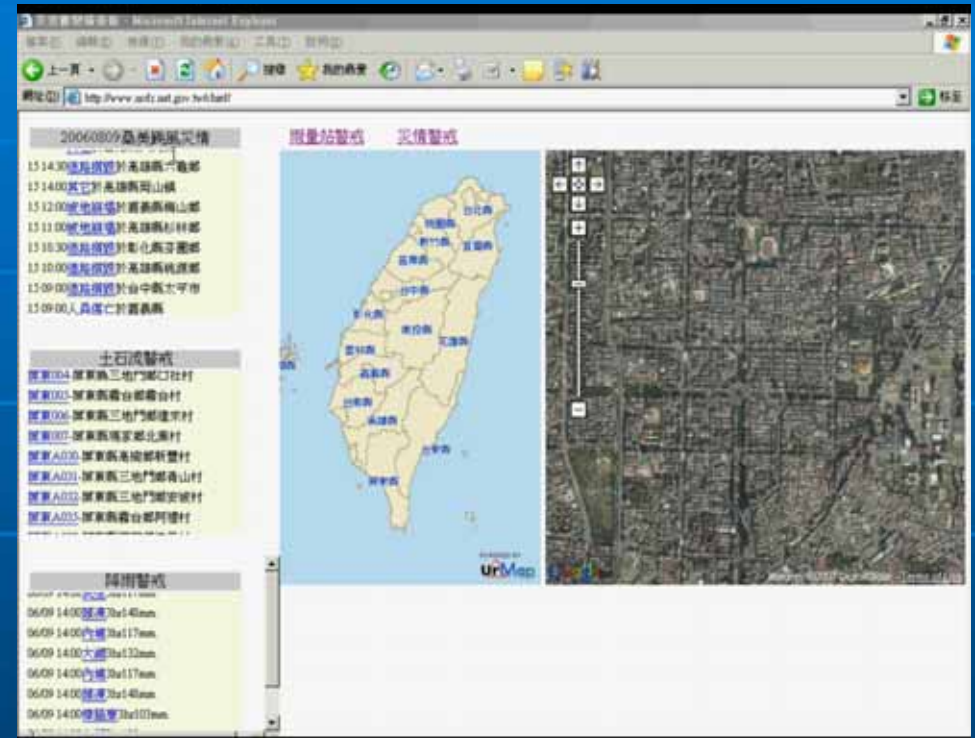
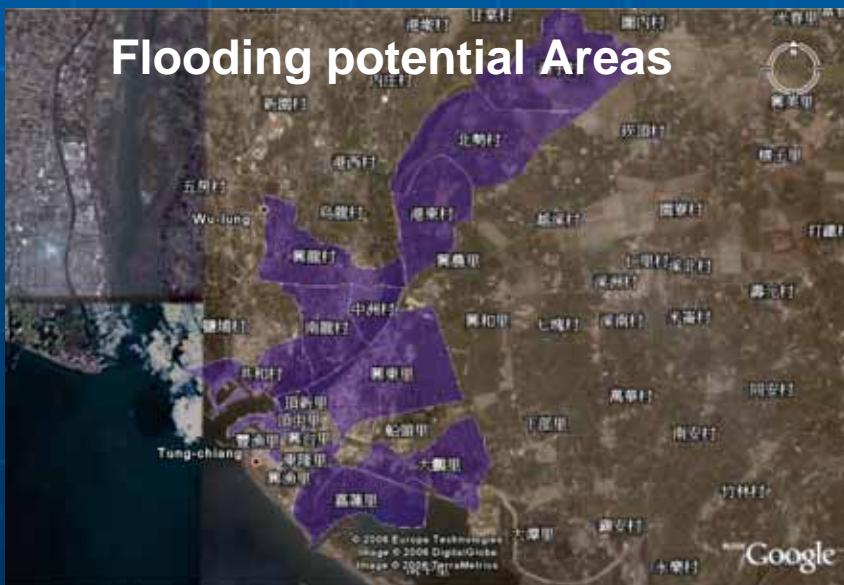
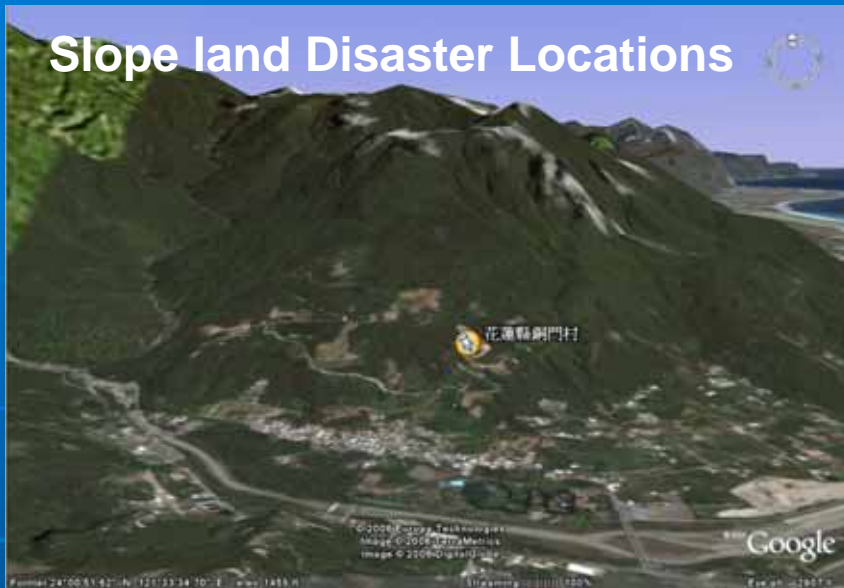
即時雨量站: 1/29 11:10  
QPESUMS: 1/29 11:10  
降雨潛勢: 9/15 17:00  
更新

雨量站累積降雨排序:  
請選擇

累積降雨分佈圖:  
過去7天

0	5	10	15	20	30
40	60	80	100	150	200
250	300	400	500	600	700

# Visualization of the disaster Information Using Google Earth / Map





# Early Warning Messages for Decision Maker

## Early Warning Messages For Typhoon hazard



National Science and Technology Center for Disaster Reduction

### Typhoon Forecasting

#### Route

#### Distribution of Rainfall

#### Rainfall Period

#### Inundation

#### Potential areas

#### Landslide

#### Potential areas

#### Suggestion

- 未來應加強淹水警戒區域包括**台北縣、宜蘭縣及基隆市**等沿海及低窪地區。
- 石門水庫、翡翠水庫及鯉魚潭水庫洩洪中，沿岸低窪地區民眾請加強防範淹水。
- 受颱風降雨影響，石門水庫水質濁度可能造成影響，應持續加以監測，並建議此區域居民儲水備用。
- 建請相關單位掌握抽水機、發電機、吊運車輛、操作人員、消波塊、沙包、機具設備等救災搶修資源及備置。
- 捷運及相關工程施工地區應加強整備，防範淹水情形。

# Future Developments

- **SATIS for other types of Hazard**
- **Historical Disasters Database**
- **Improving Forecasting Methods**
- **Social-Economic Impact Modeling**
- **Applying New Geo-technology**



**Thank you  
for your attention!!!**