Building an Impact Scenario Assessment Platform for Earthquake Disaster Management Support

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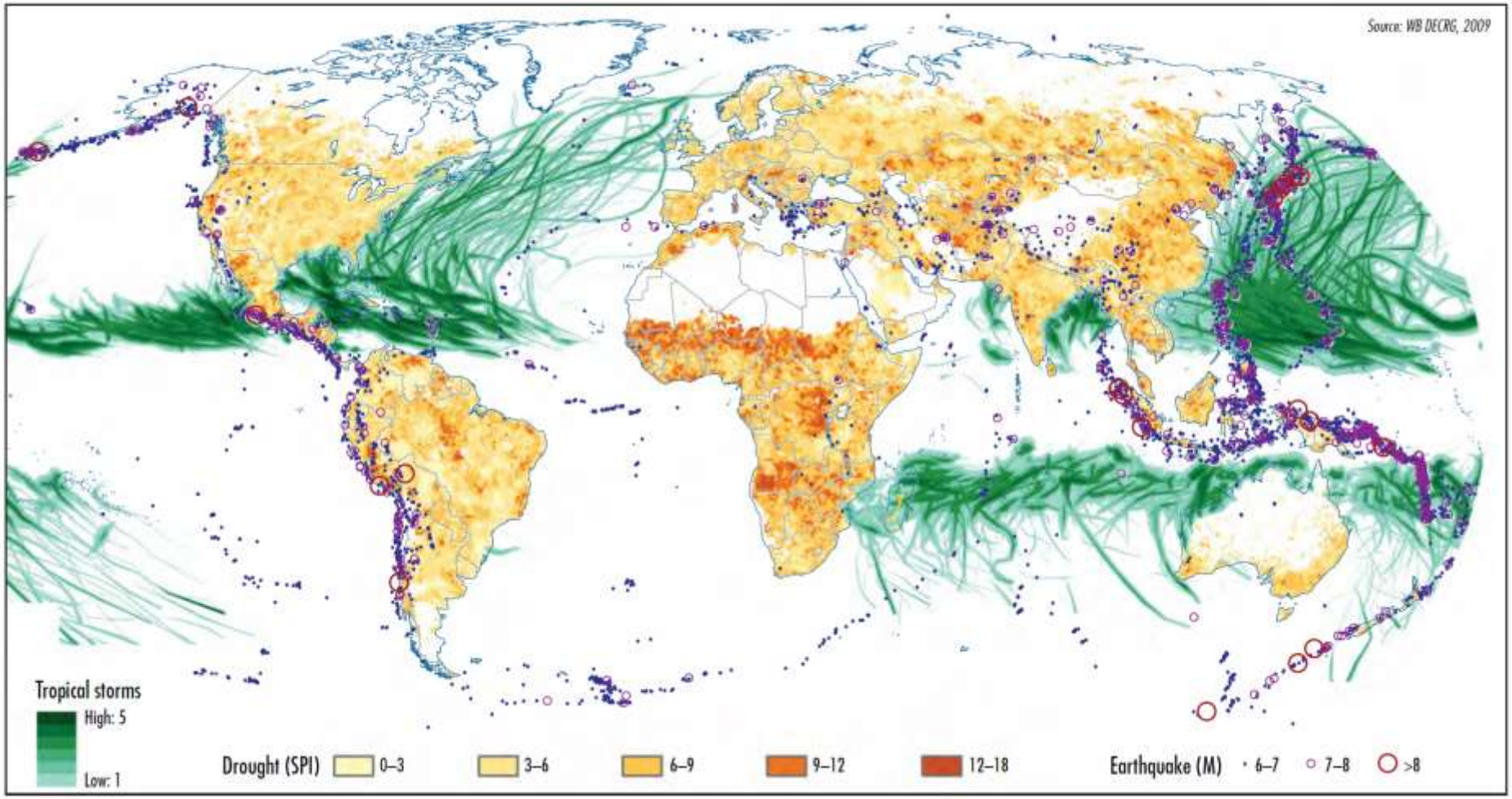
Earthquake and Man-made Disasters Division, NCDR

Outlines

- Background
- Objectives of TERIA Platform
- Framework of TERIA Platform
- Application Examples
- Conclusion and Future Work



Source: World Bank staff. Earthquakes above magnitude 6 on the Richter scale for 1950 to February 2010 (from Northern California Earthquake Data Center, www.ncedc.org); tropical storm tracks for 1975–2007; droughts based on standardized precipitation index (SPI, larger values indicate a higher probability of precipitation deficits) compiled for the Global Assessment Report 2009 (from www.preventionweb.net/english/hyogo/gar).

Major Natural Challenges

Typhoon (Morakot, 2009)

Urban flood (Nari, 2001)

Debris flow

Landslide

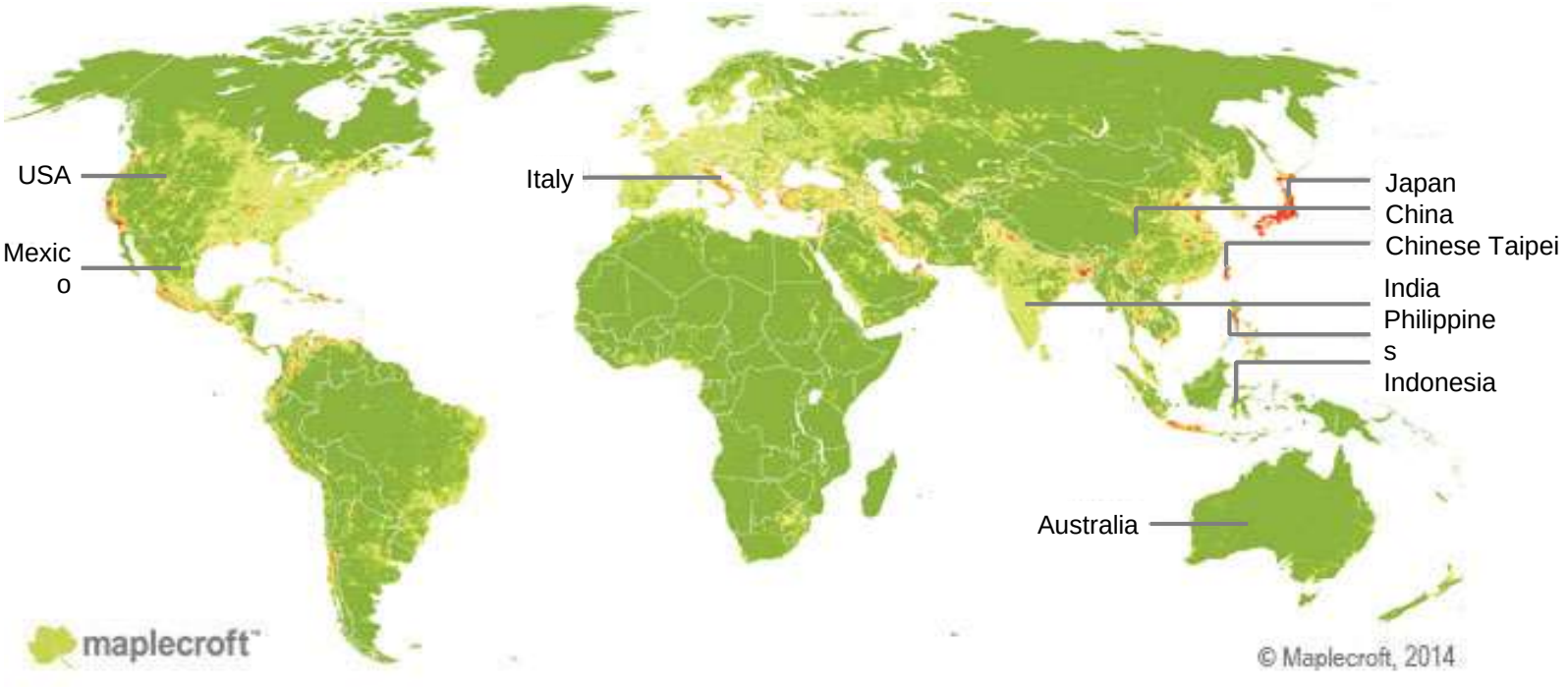
Earthquake (Chi-Chi,1999)

Residential Building

Damages to Infrastructure

Collapsed school

Natural Hazard Risk: Absolute Economic Exposure Index 2014



Rank	Country	Category
1	Japan	Extreme
2	USA	Extreme
3	**Chinese Taipei**	**Extreme**
4	China	Extreme
5	India	Extreme

Rank	Country	Category
6	Mexico	High
7	Philippines	High
8	Italy	High
9	Australia	High
10	Indonesia	Medium

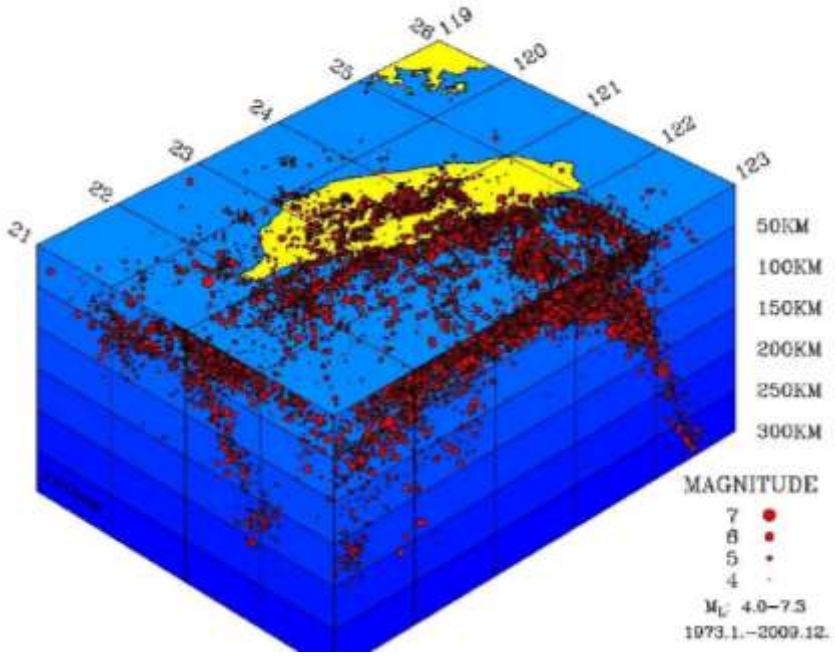
Legend

Extreme
High
Medium
Low
Extreme

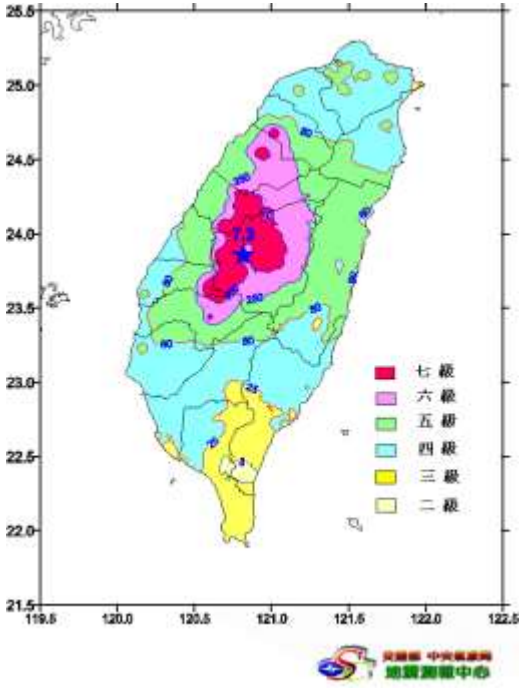
Source: Maplecroft, 2014

Taiwan Seismicity

- On the Pacific Ring of Fire
- Since 1900, total 96 fatal quakes occurred
- Every 10 year could have one destructive quake

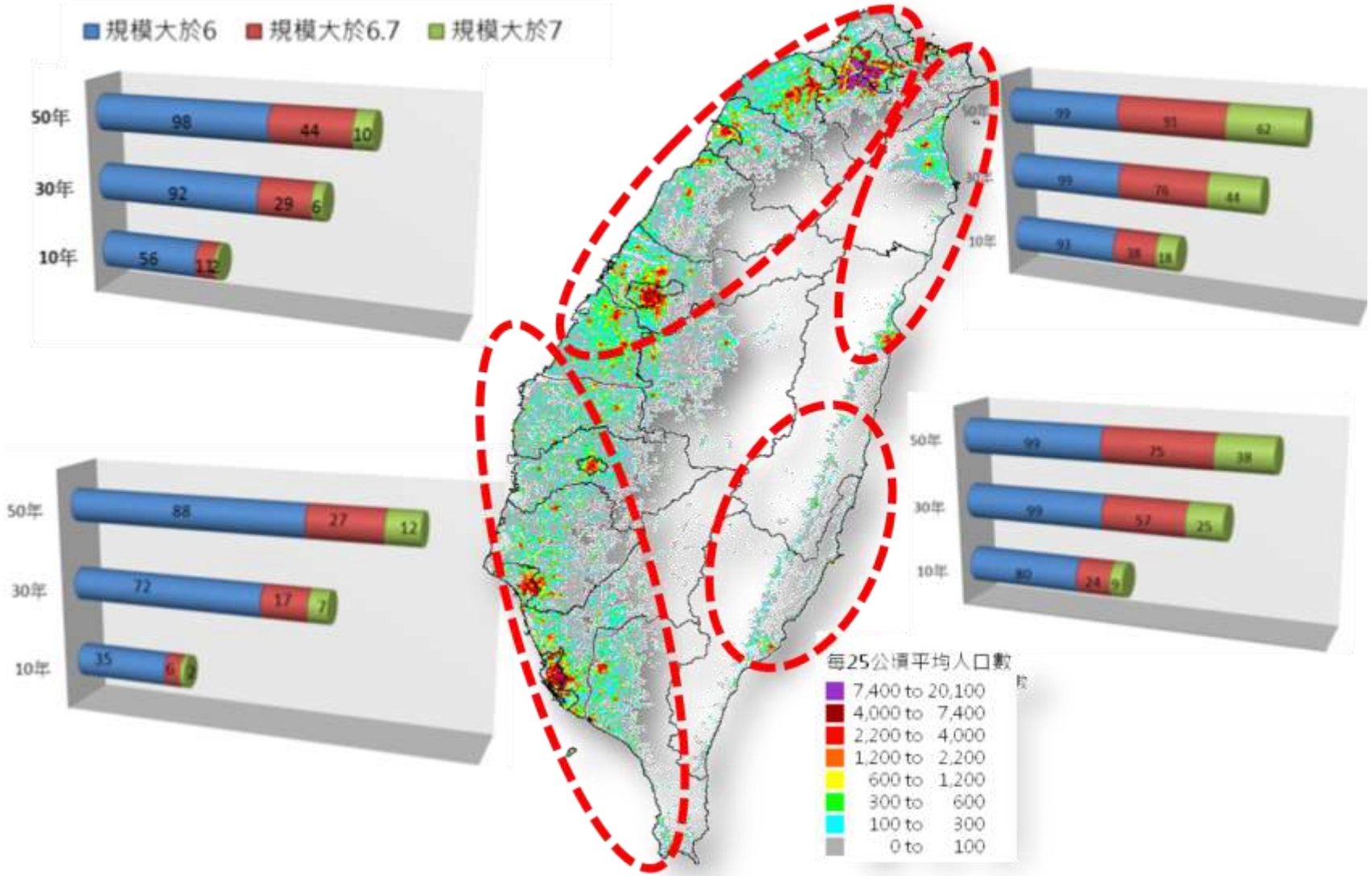


1999.9.21 Chi-Chi Earthquake



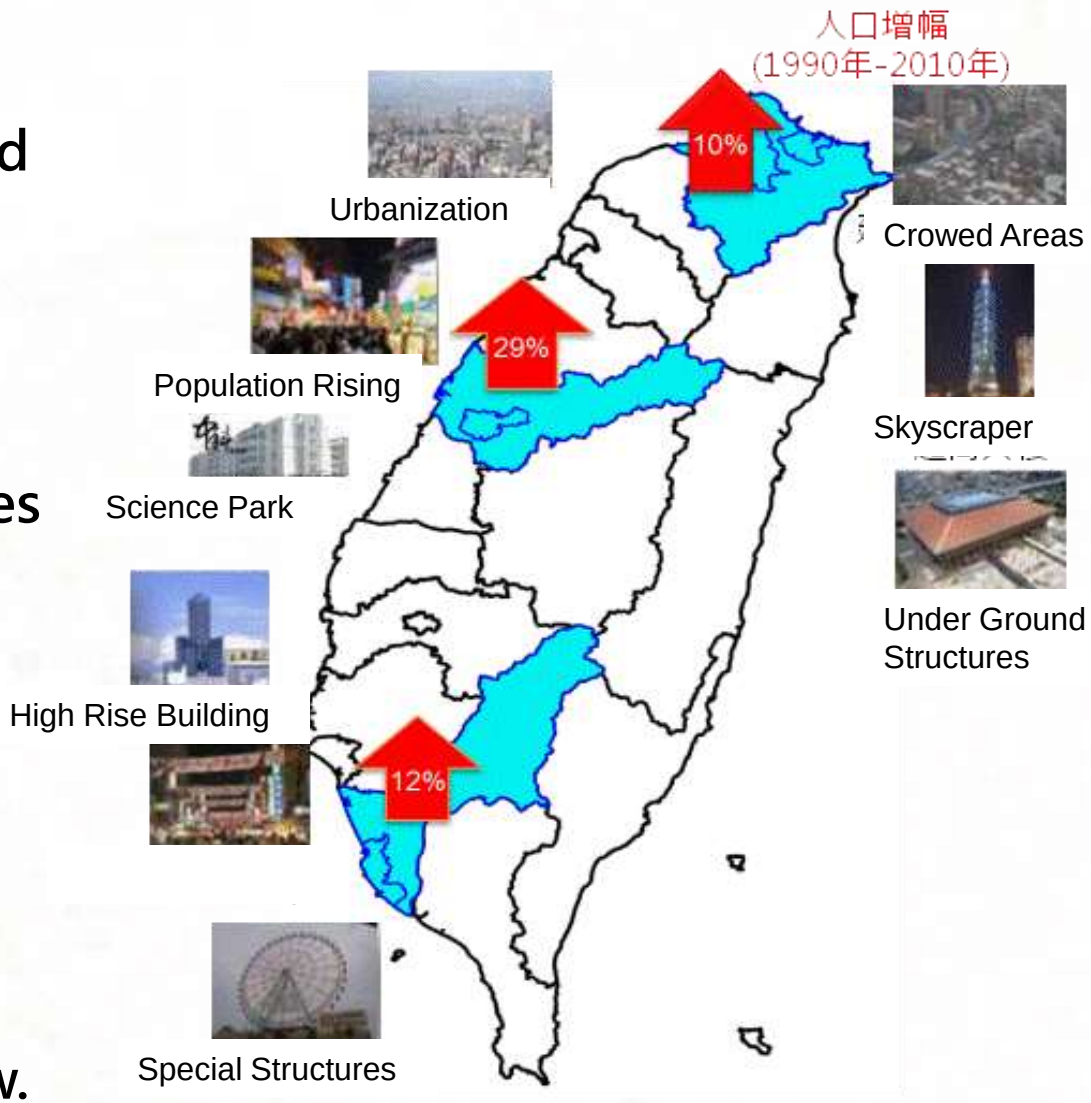
http://www.921emt.edu.tw/

High Earthquake Threats



Rapid Urbanization Further Increases the Seismic Risk

- The population and buildings are crowded, and the dependence of critical infrastructures is high.
- Increase the difficulty of rescue because of more and more special structures and underground constructions.
- Important industry is highly concentrated.
- The rate for Public and private buildings completed seismic reinforcement was still low.

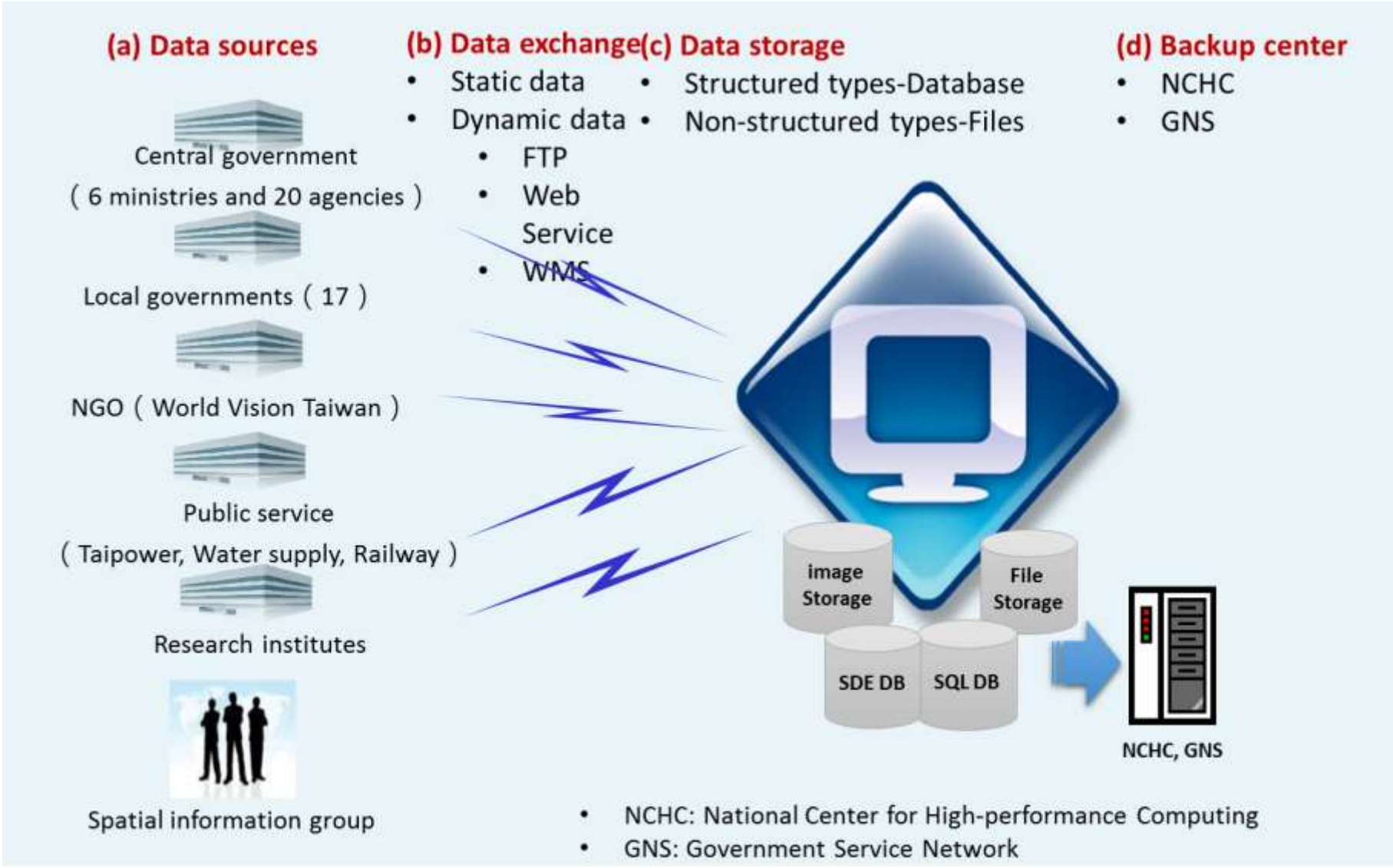


Several Factors keep Chinese Taipei resilient

- Application of S&T on DRR
  - National programs and NCDR
- Working on transparent risk
  - Website to download Risk maps of flood, landslide and debris flow
- Legal frameworks for DRR
  - Disaster Prevention and Response Act (2000~)
  - Office of Disaster Management (2009~)
- Active participation by private sector
  - NGOs and NPOs
  - Communities
  - Academia, professional groups

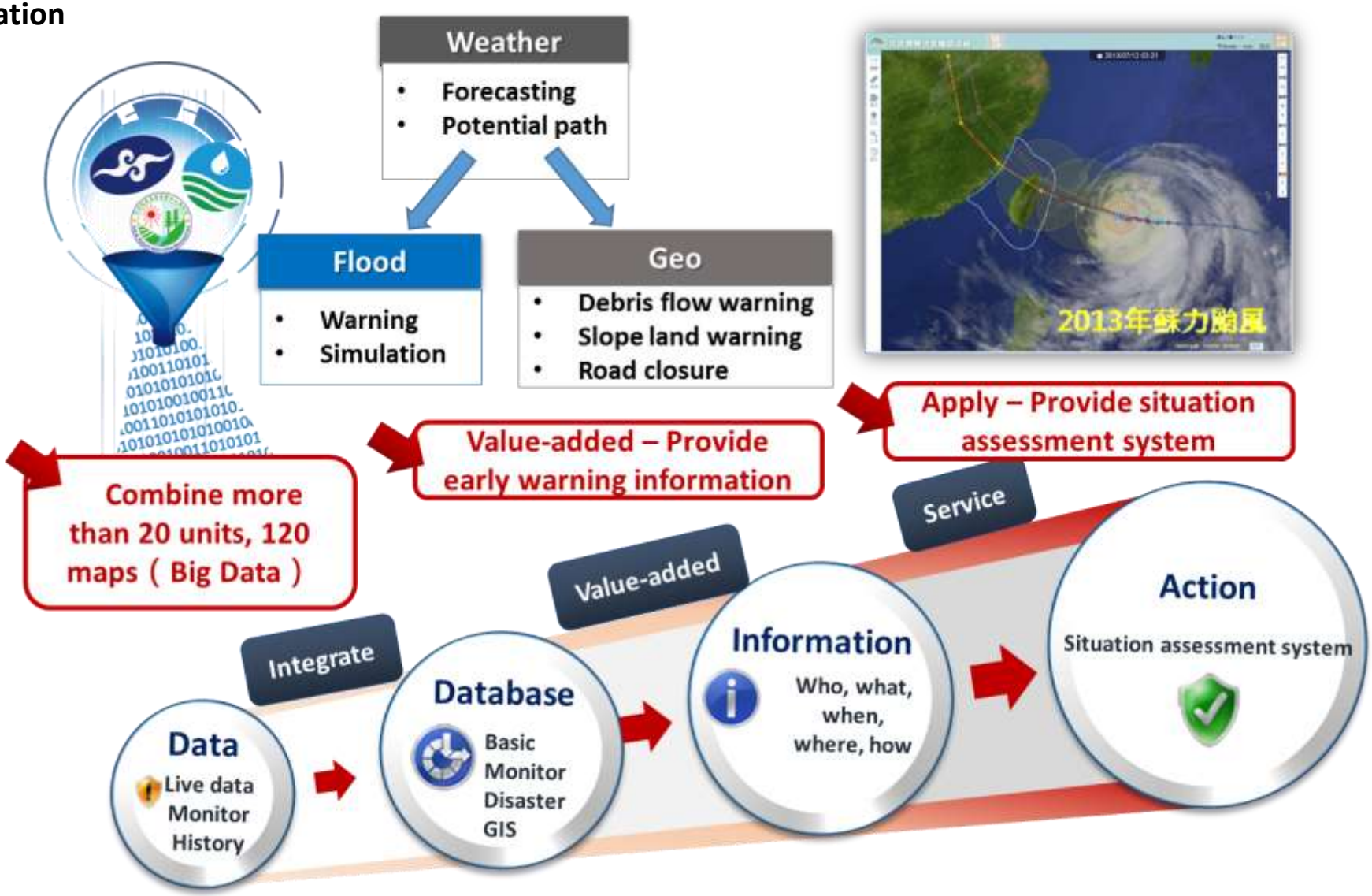
Big data backbone to support decision support system

Typhoon emergency operation



Aggregating big data for open data–
“Cross-cutting Synergy” , “Information sharing”, “Actionable”

Typhoon emergency operation

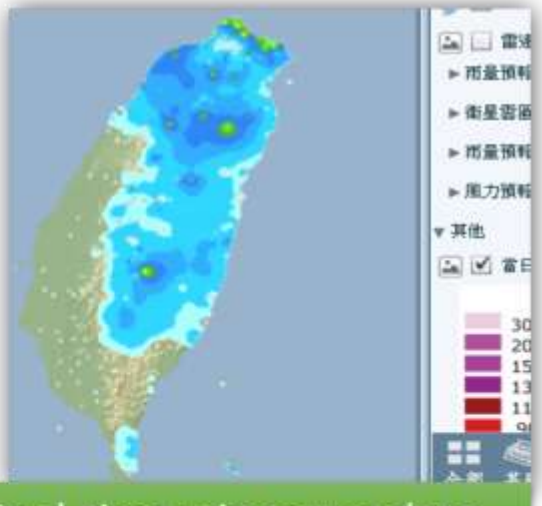


Required big data for operation

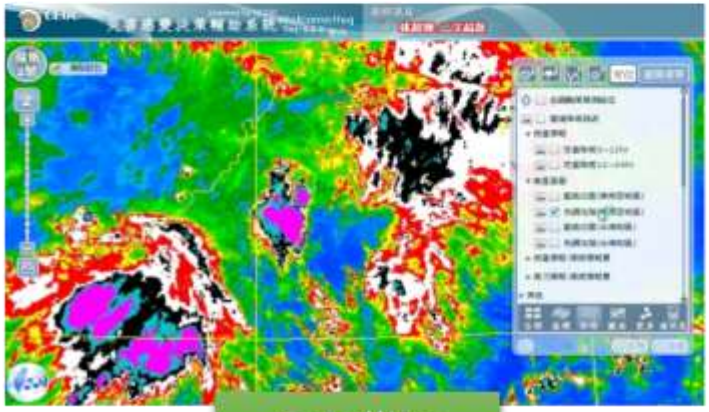
Typhoon emergency operation

Course Predictions

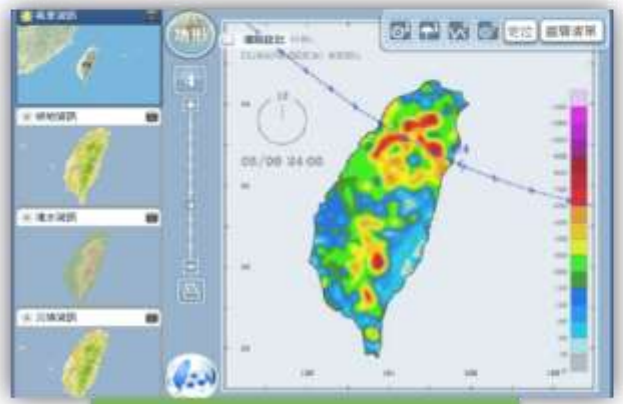
Radar



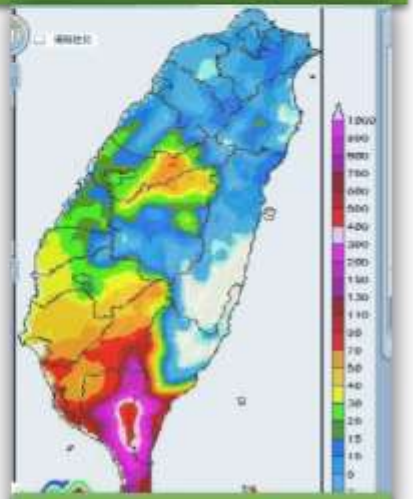
Real-time rain gauge data



Satellite

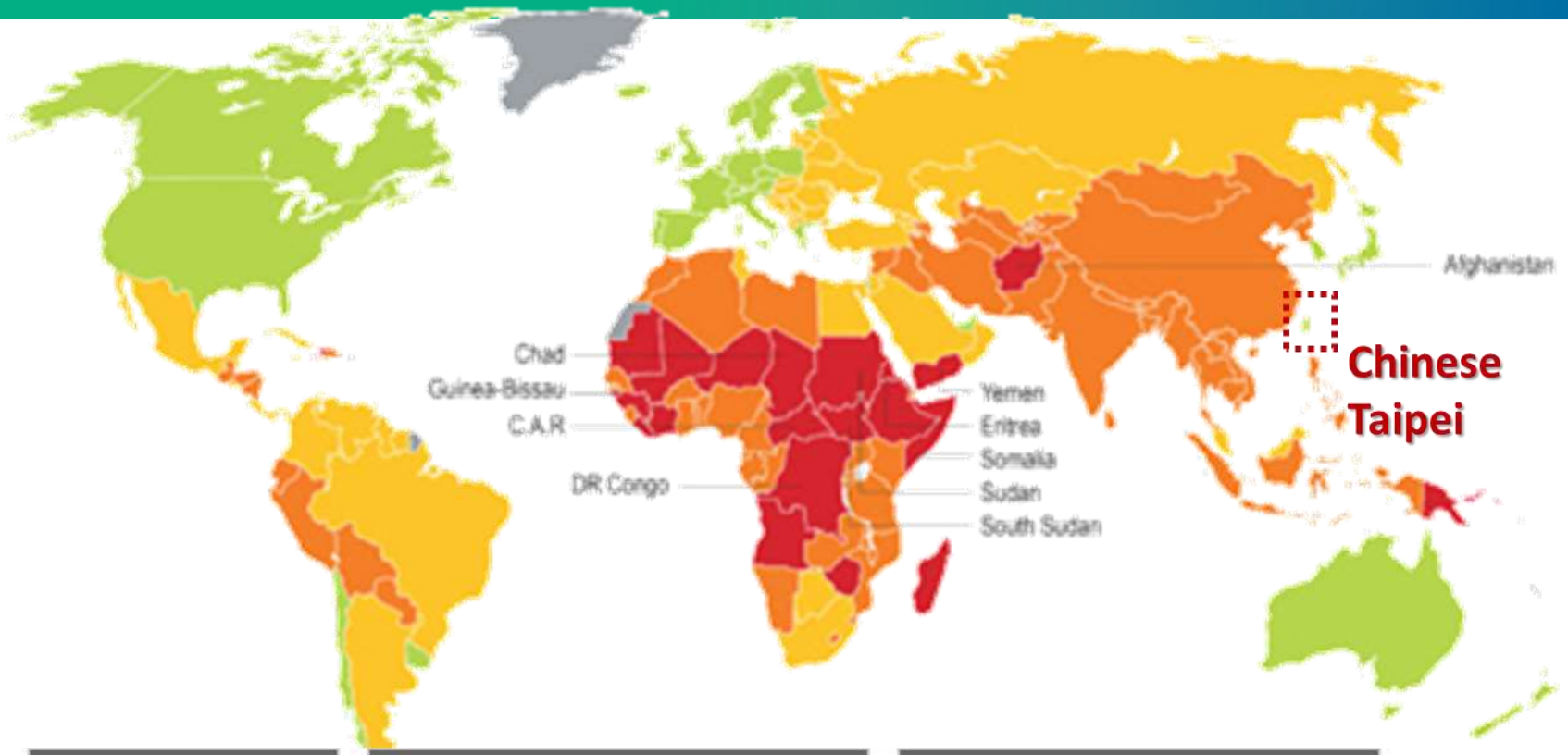


Climate model



Dynamic model

Maplecroft's Socio-economic Resilience Index 2013

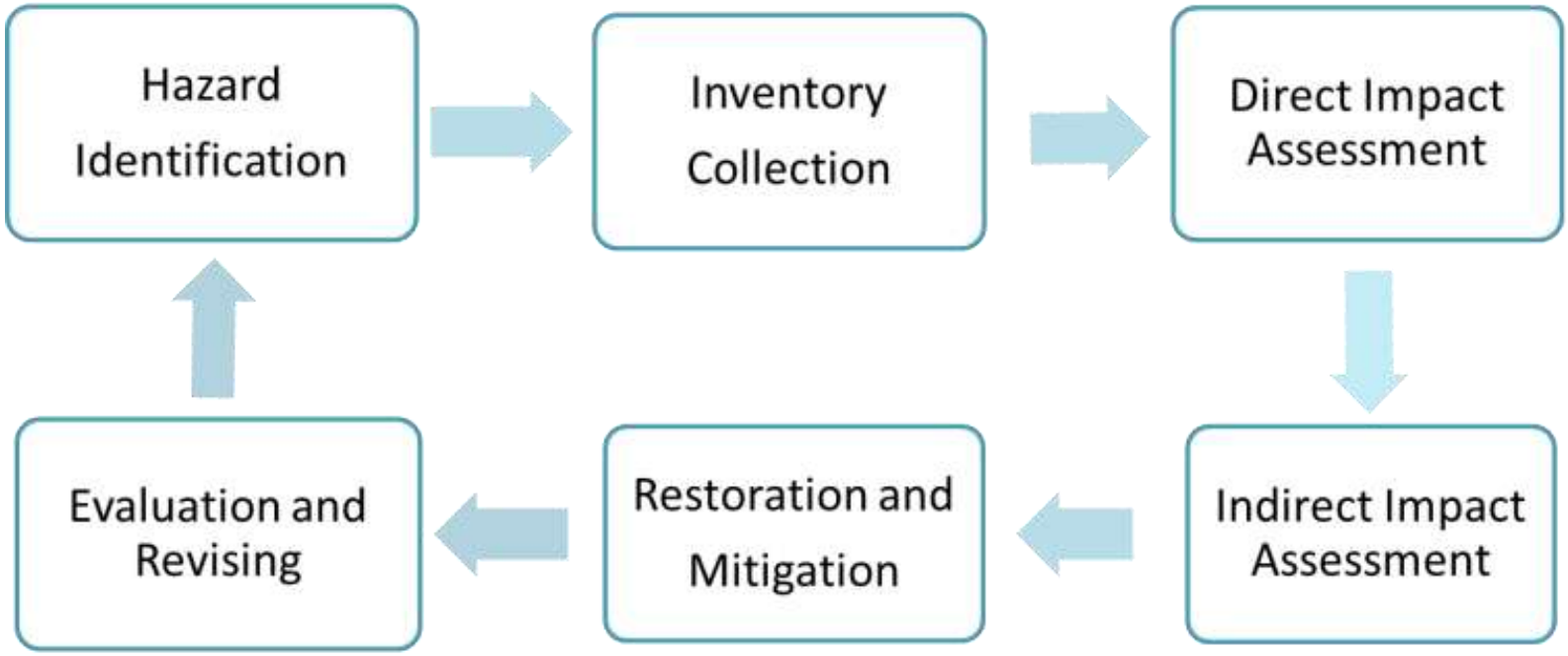


Legend	
Extreme risk	
High risk	
Medium risk	
Low risk	
No Data	

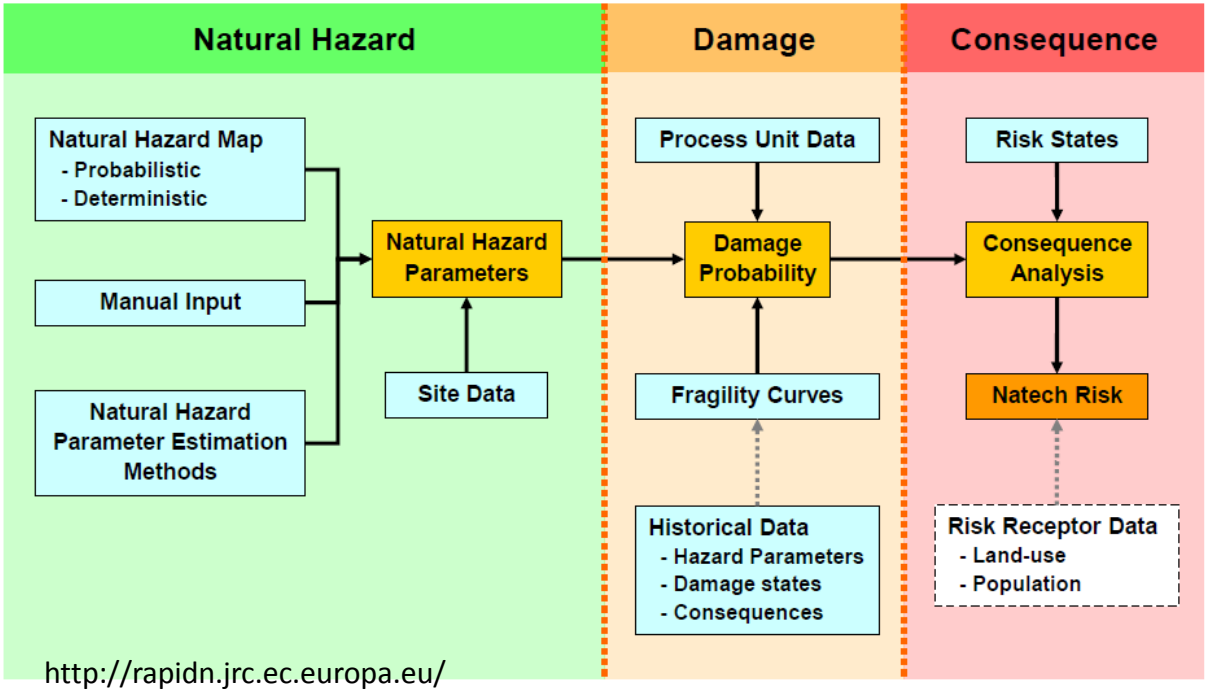
Rank	Country	Rating
1	Somalia	Extreme
2	Afghanistan	Extreme
3	DR Congo	Extreme
4	Sudan	Extreme
5	C.A.R	Extreme

Rank	Country	Rating
6	Chad	Extreme
7	South Sudan	Extreme
8	Yemen	Extreme
9	Eritrea	Extreme
10	Guinea-Bissau	Extreme

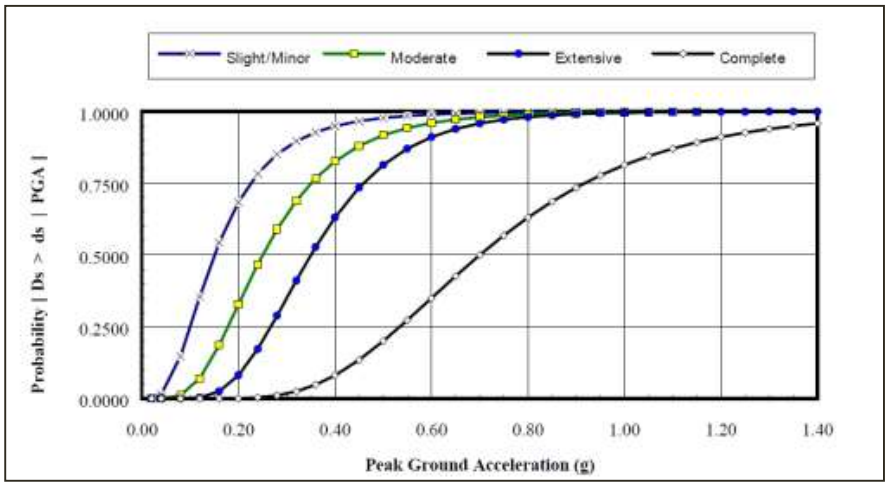
Earthquake Disaster Management



NATECH Risk Analysis



http://rapidn.jrc.ec.europa.eu/

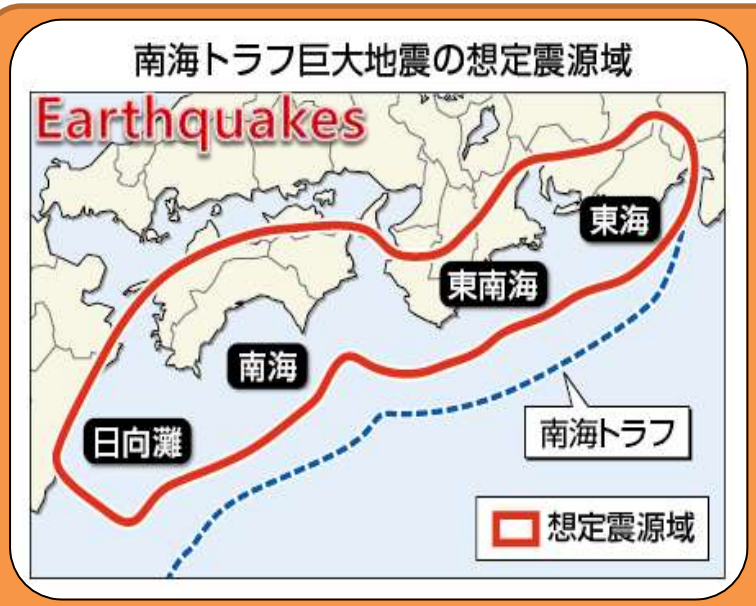


http://www.calpoly.edu/~salpteki/Personal/Earthquake/slide0009_image070.jpg

http://www.enea.it/it/produzione-scientifica/EAI/anno-2012/n.-3-maggio-giugno-2012/the-evaluation-of-the-reference-earthquake-for-the-siting-of-high-risk-industrial-plants

The Earthquake Countermeasures for Japan

East Sea, Southern East Japan Sea, and South Japan Sea



Earthquake Hazards

Disaster

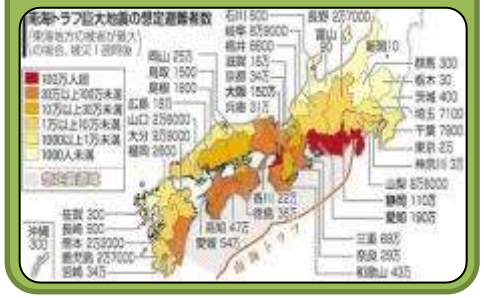
想定される主な被害

上水道断水	3440万人
下水道利用困難	3210万人
停電	2710万軒
固定電話不通	930万回線
都市ガス停止	180万戸
道路損傷	4万1000カ所
鉄道損傷	1万9000カ所
港湾損傷	5000カ所
空港浸水	中部、関西、高知、大分、宮崎
避難者	950万人
帰宅困難者	中京 110万人 京阪神 270万人
食料不足	3日で3200万食
飲料水不足	3日で4800万リットル
受診困難患者	入院15万人 外来14万人
災害廃棄物	3億1000万トン
エレベーター閉じ込め	2万3000人
コンビナート被害	流出 60施設、 破損 890施設
文化財被害	250施設
孤立集落	農業 1900 漁業 400

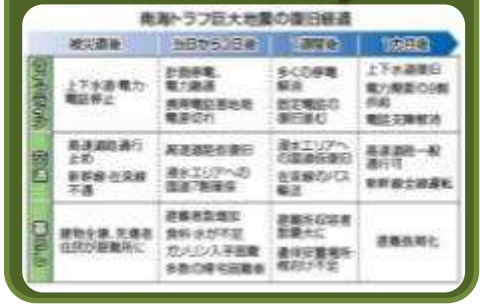
(注)数字は全て概数。被災後の最大値

Loss Estimate

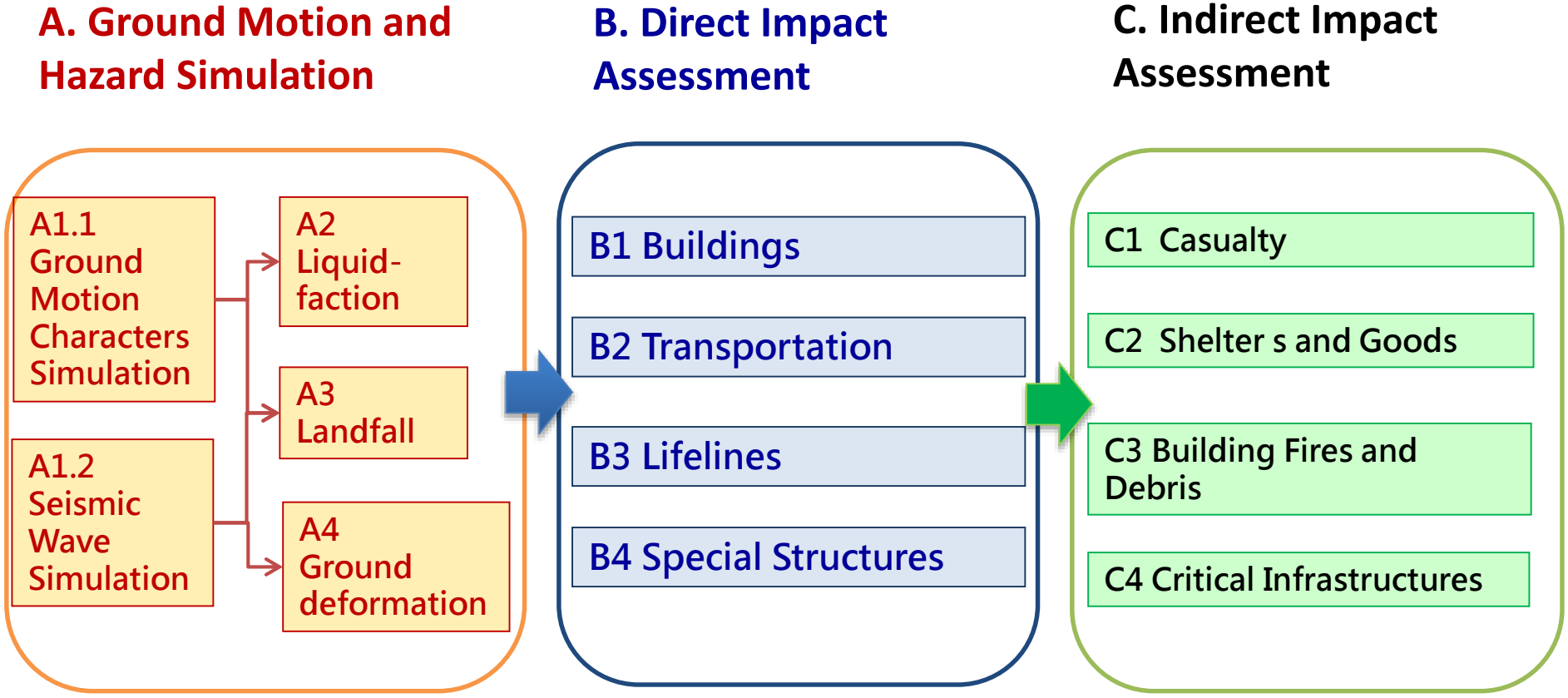
Evaculation



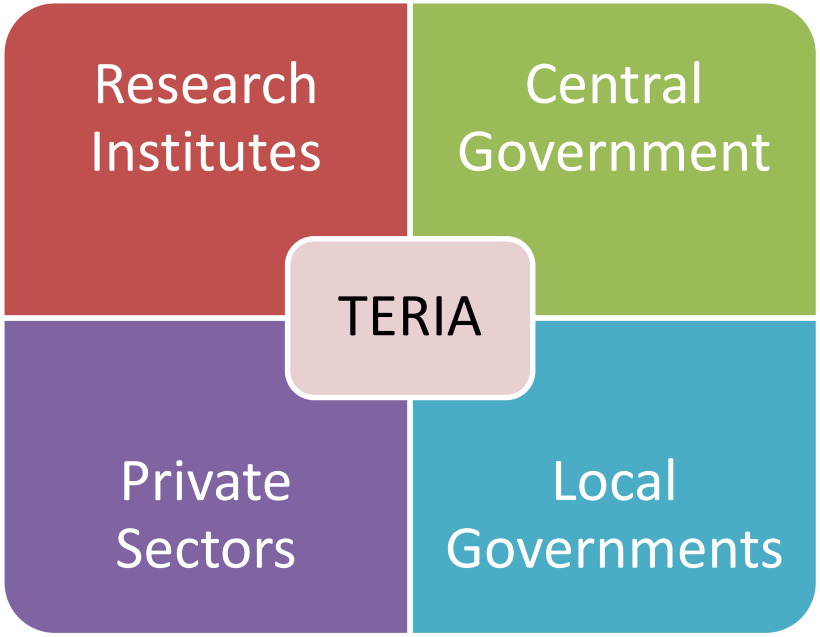
Recovery



Earthquake Impact Assessment Items



Earthquake Impact Research and Information Application (TERIA) Platform

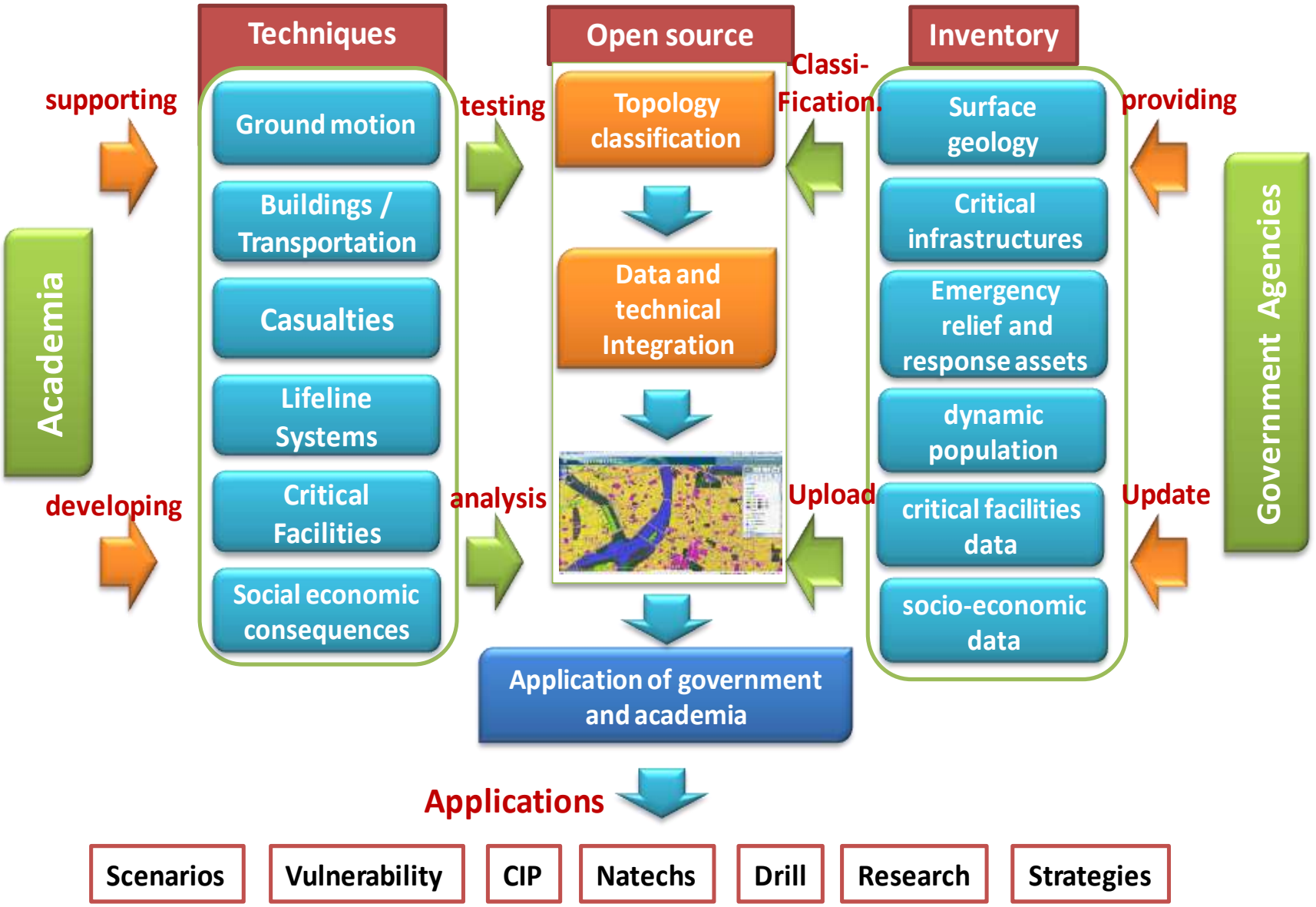


- Purpose oriented for national drill and preparedness
- Research and technology development supporting
- Disaster scenario simulation implementation and review
- Information integration and data application

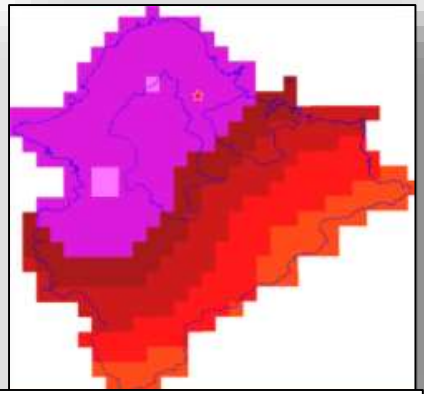
Objectives

- Incorporating state-of-the-art assessment models
- Creating a trustable environment for information integration and data application
- Assessing and reviewing more detailed impact scenarios
- Supporting earthquake impact simulation research and model development
- Supporting compound-disaster studies, preparedness and recovery studies, government policy and strategy enactment

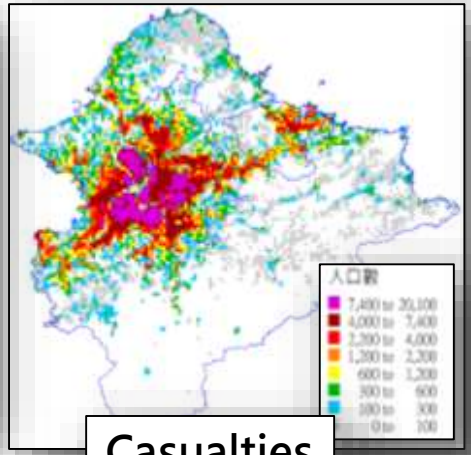
TERIA Platform Framework



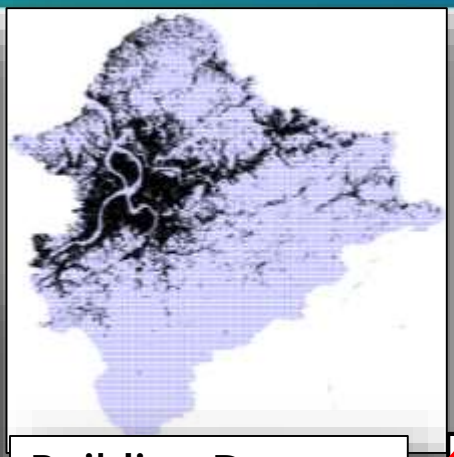
Impact Assessments on Each Mesh



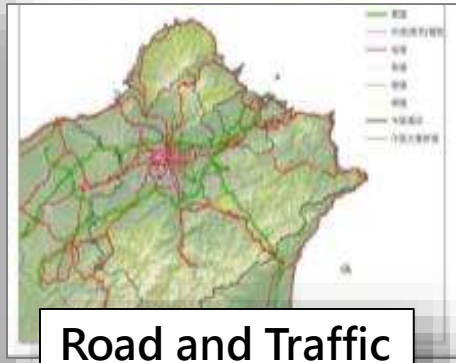
Ground Motion Sim.



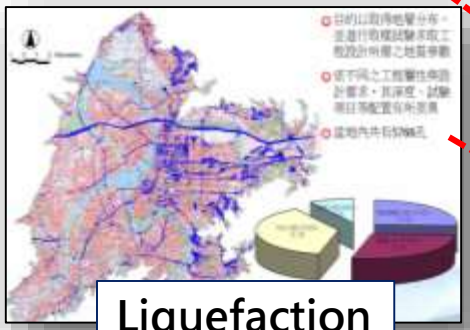
Casualties



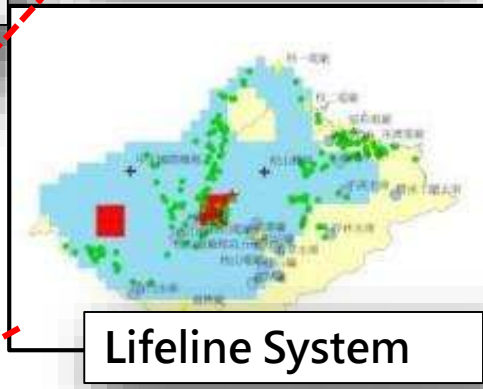
Building Damage



Road and Traffic

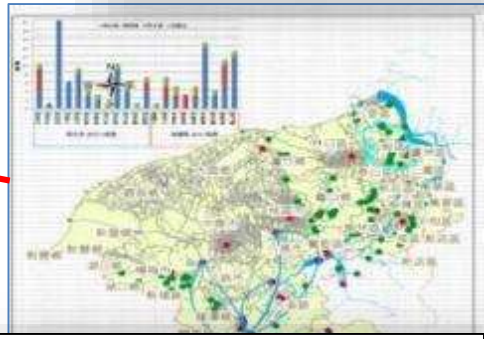


Liquefaction



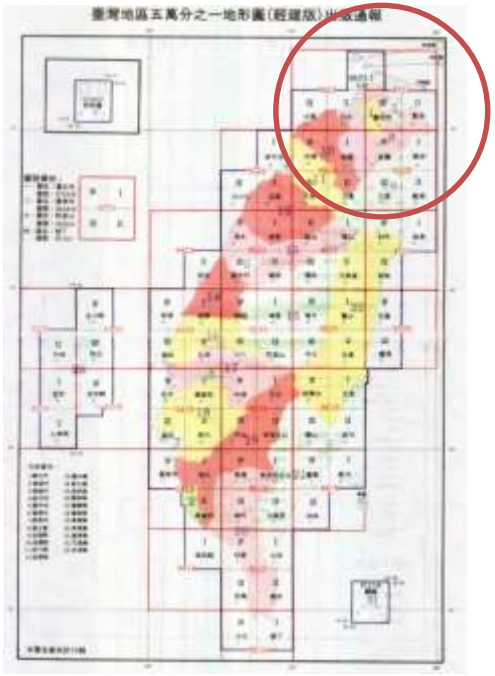
Lifeline System

Landslide Analysis



Critical Infrastructure

Geospatial Meshed Data

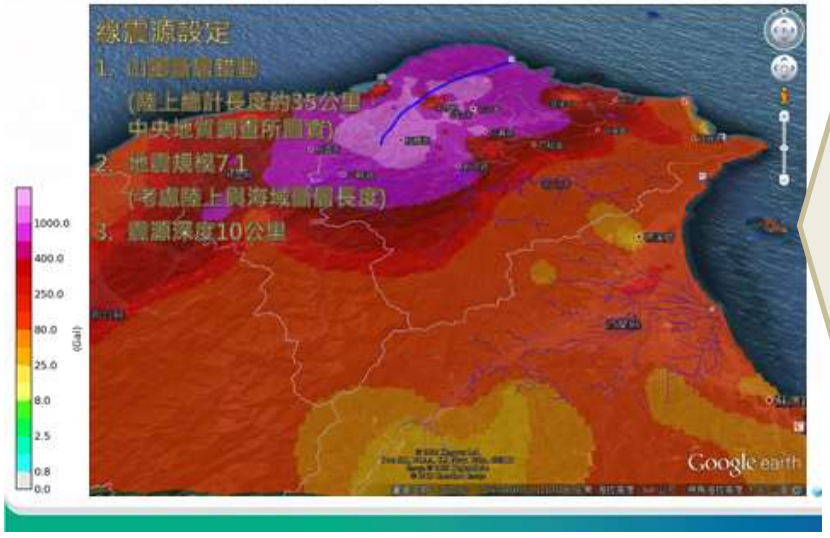


500mx500 m
Meshed Map Sheet

Greater Taipei Area: 9,213

Ground Motion Assessment

模擬震度分布—PGA

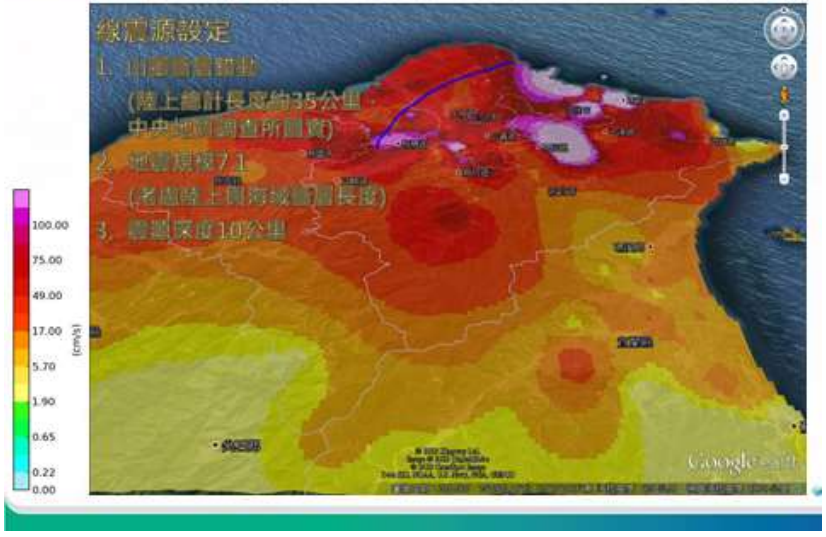


GIS

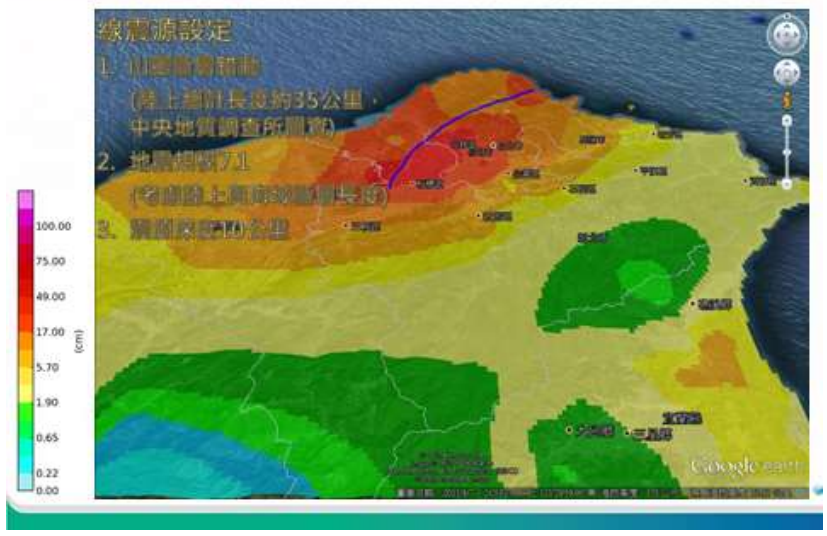
1. Shanjiao fault (all)

- ArcGIS (shp)
- MapInfo (mif)
- Google (kml, kmz)

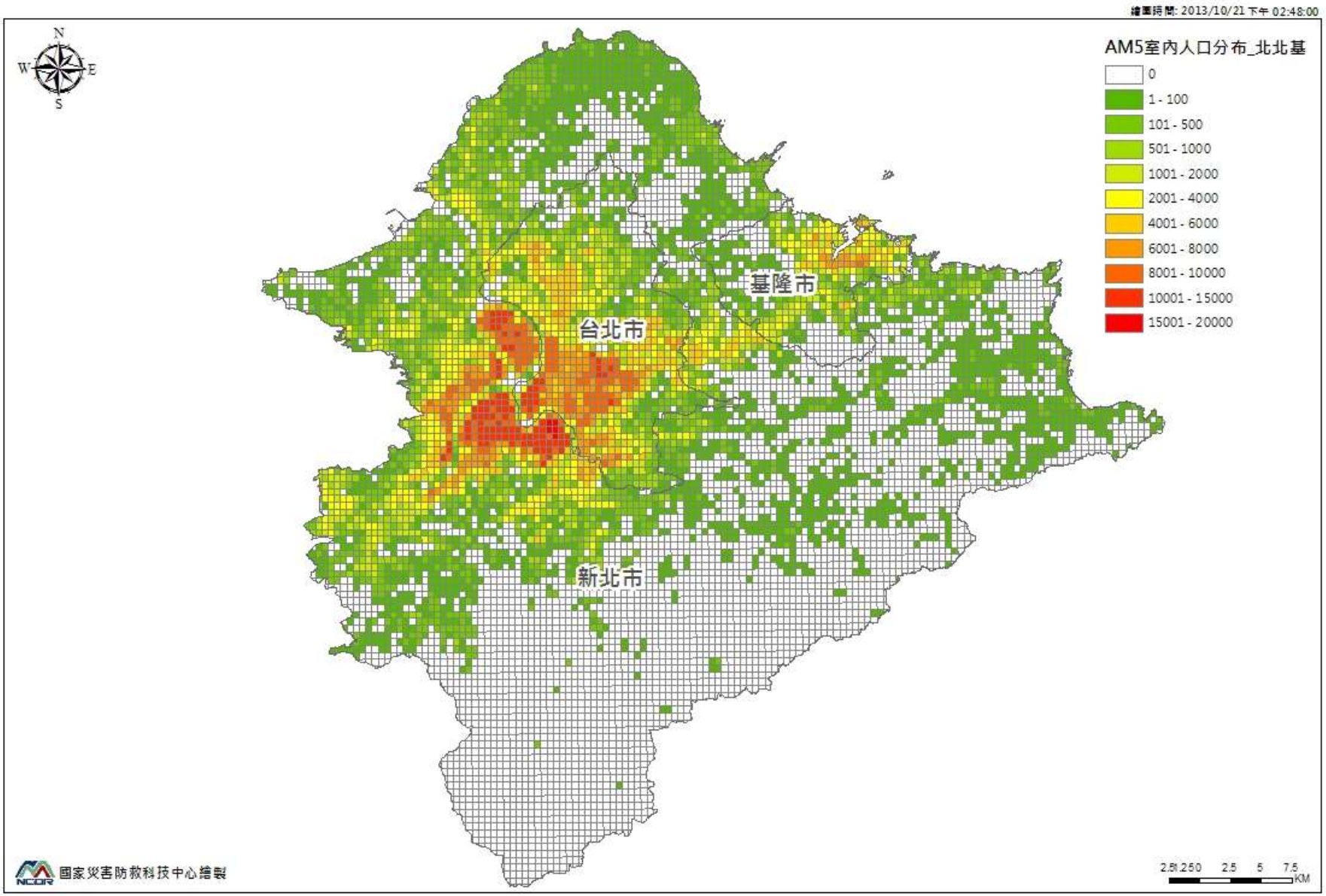
模擬震度分布—PGV



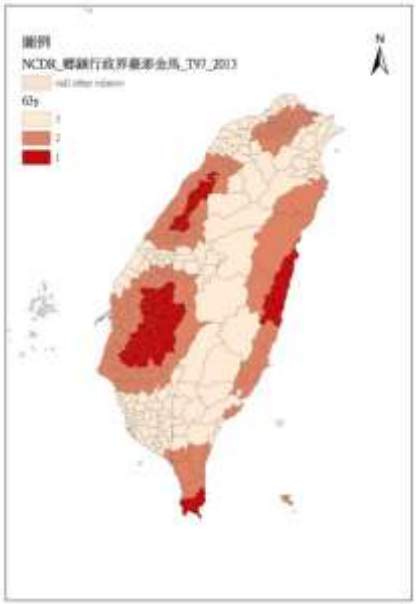
模擬震度分布—PGD



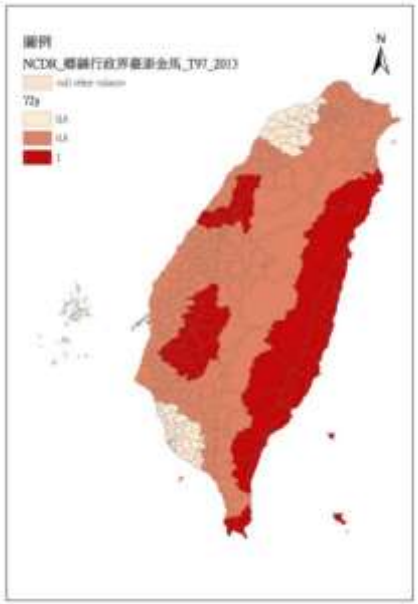
Population Patents



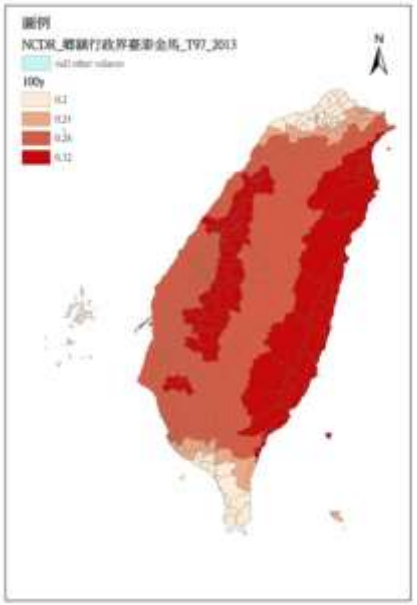
Seismic Resistance Status of Buildings



1974~1982



1983~2000

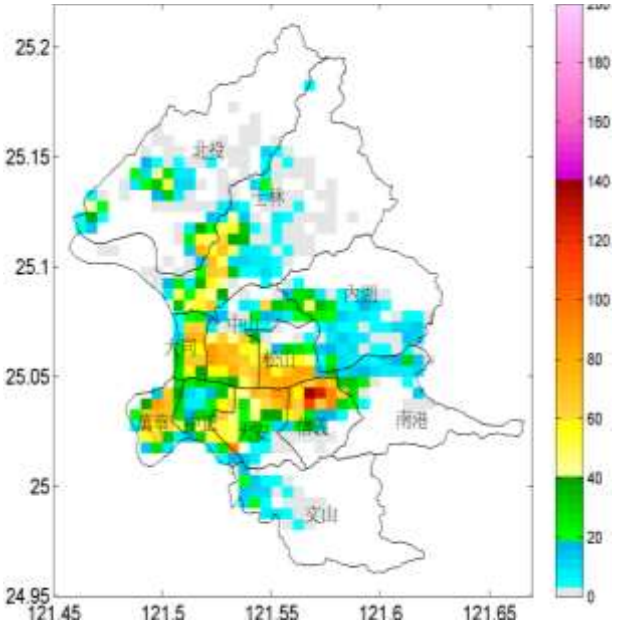


2005~2010,2011~

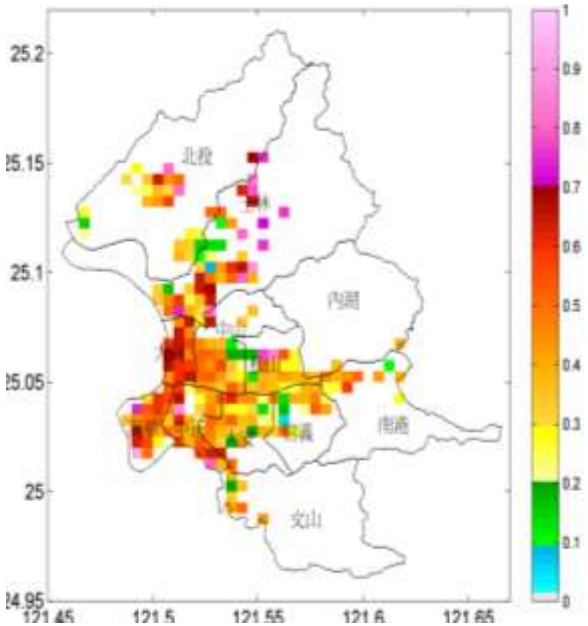
- Total residential houses in Taipei: ~ 1.1 millions
- The number of houses over 30 years in Taipei: ~ 495,000.

Building Damage Analysis

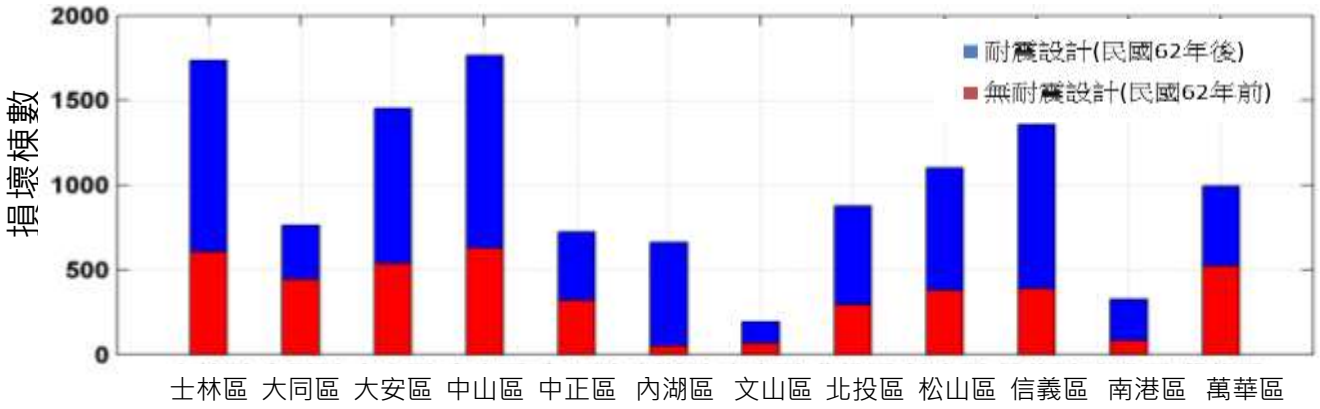
Complete Damage Buildings

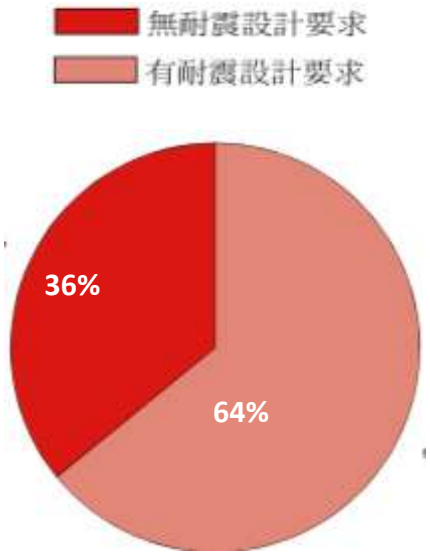


Percentage of old buildings



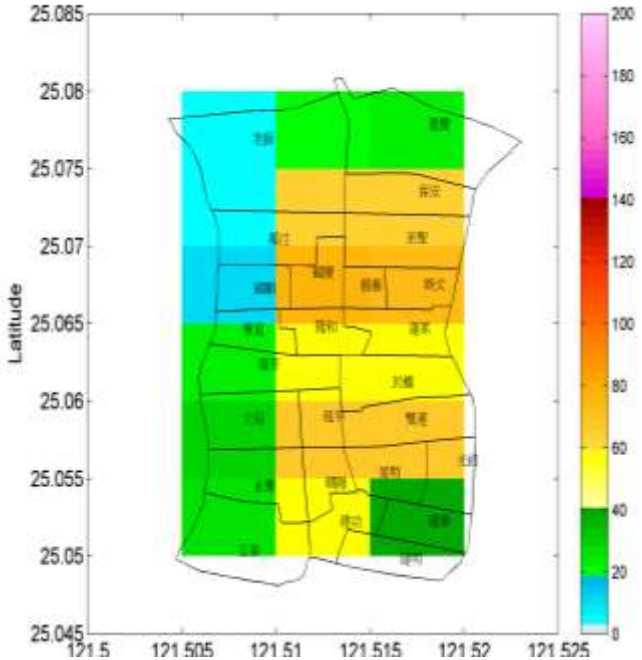
23,000 building are damaged severely in Taipei.



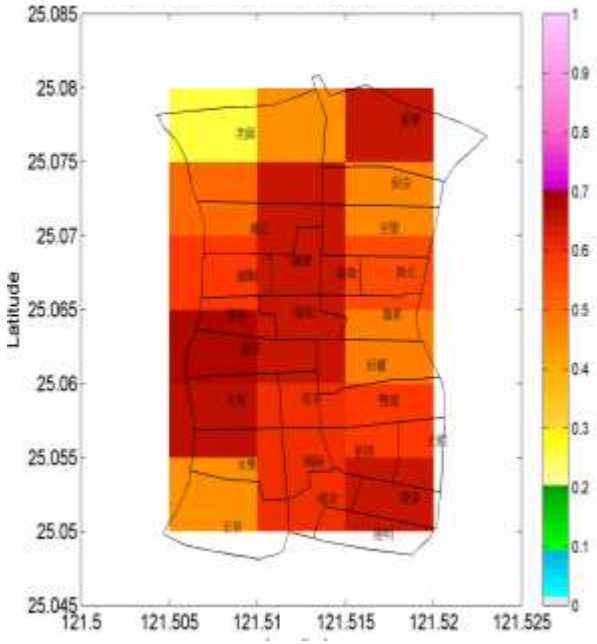


台北市大同區 Building Damage Statists

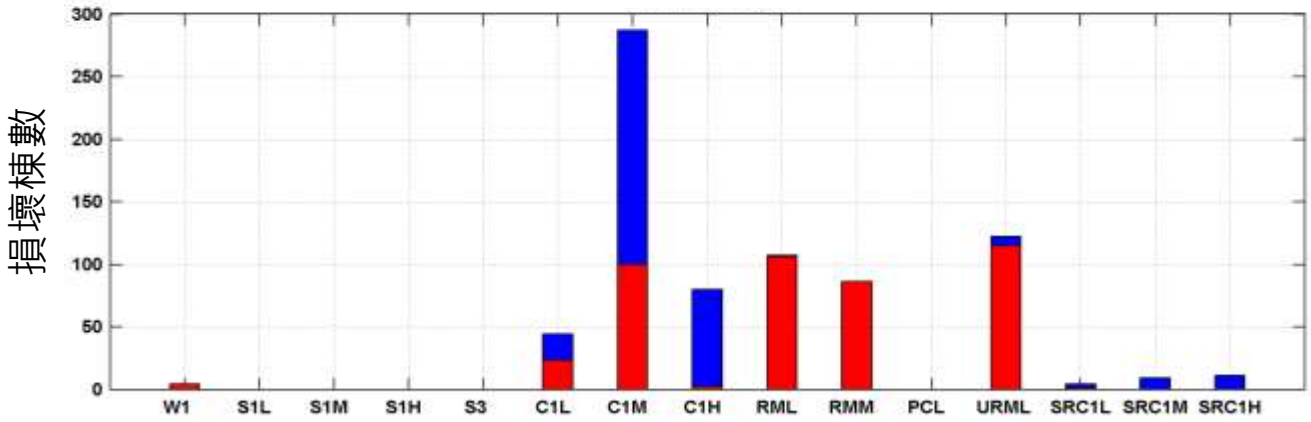
所有建物完全損壞（棟數）



損壞建物中無耐震設計比例

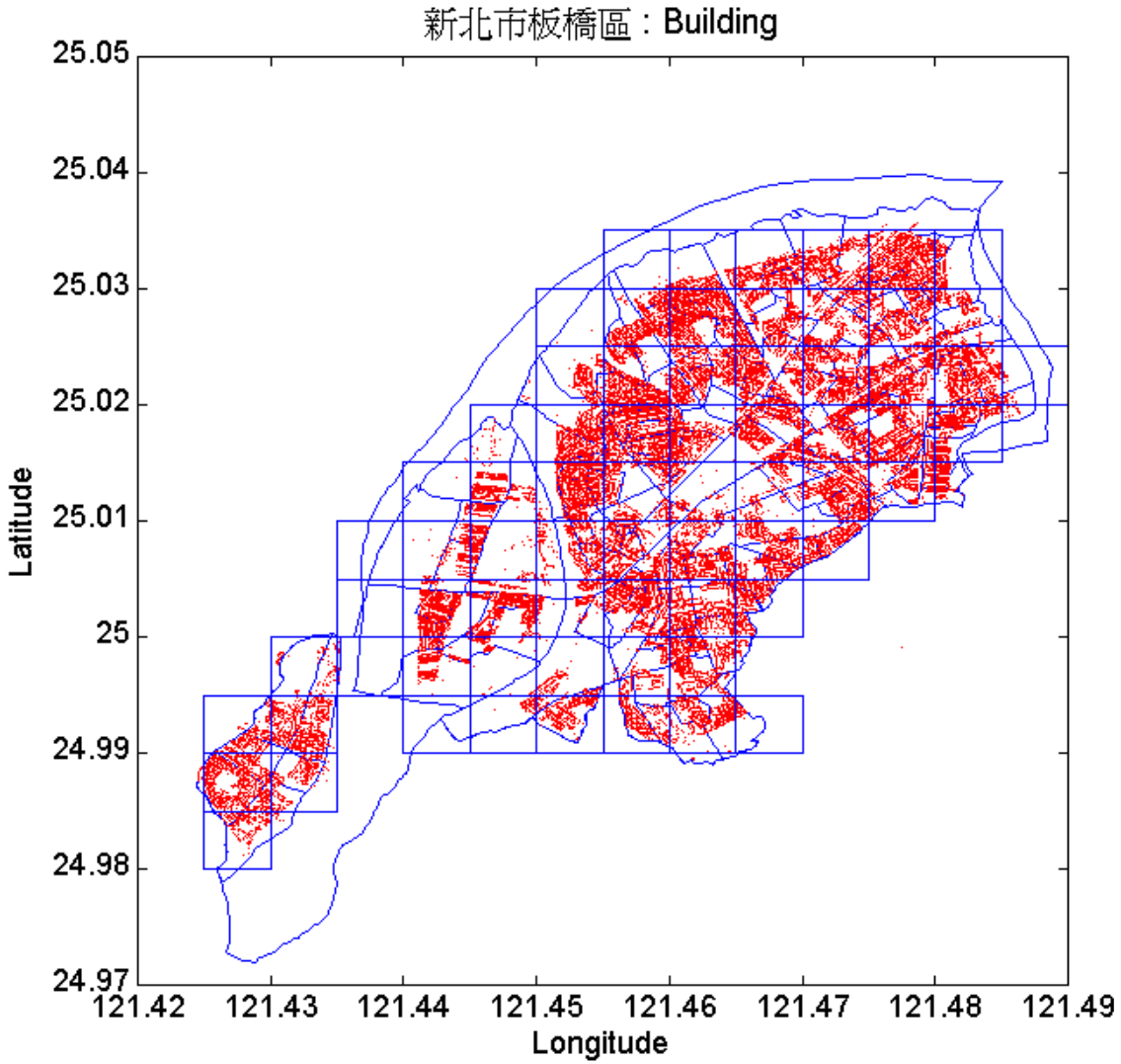


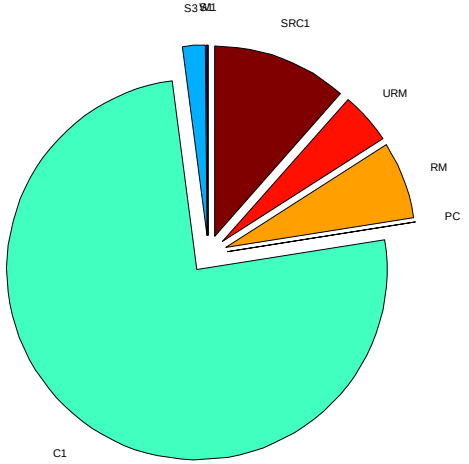
台北市大同區



W1	木造
S1L S1M S1H	鋼構造 (低:1~3層) 鋼構造 (中:4~7層) 鋼構造 (高: 8層以上)
S3	輕鋼構 (低樓層)
C1L C1M C1H	鋼筋混凝土構造 (低) 鋼筋混凝土構造 (中) 鋼筋混凝土構造 (高)
PCL	預鑄混凝土構造 (低)
RML RMM	加強磚造 (低樓層) 加強磚造 (中樓層)
URML	磚造 (低樓層)
SRC1L SRC1M SRC1H	鋼骨鋼筋混凝土 (低) 鋼骨鋼筋混凝土 (中) 鋼骨鋼筋混凝土 (高)

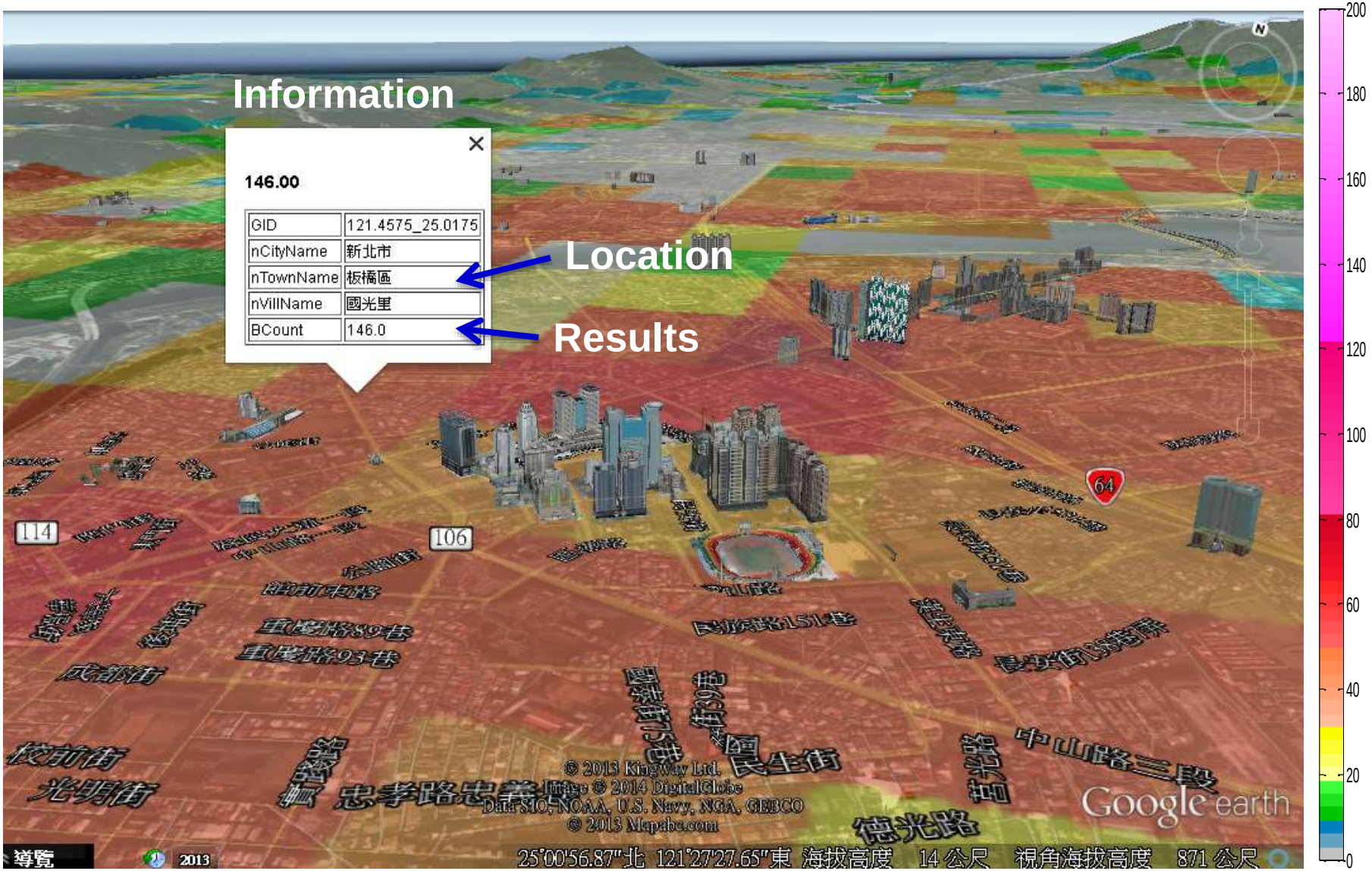
Building Distribution Analysis



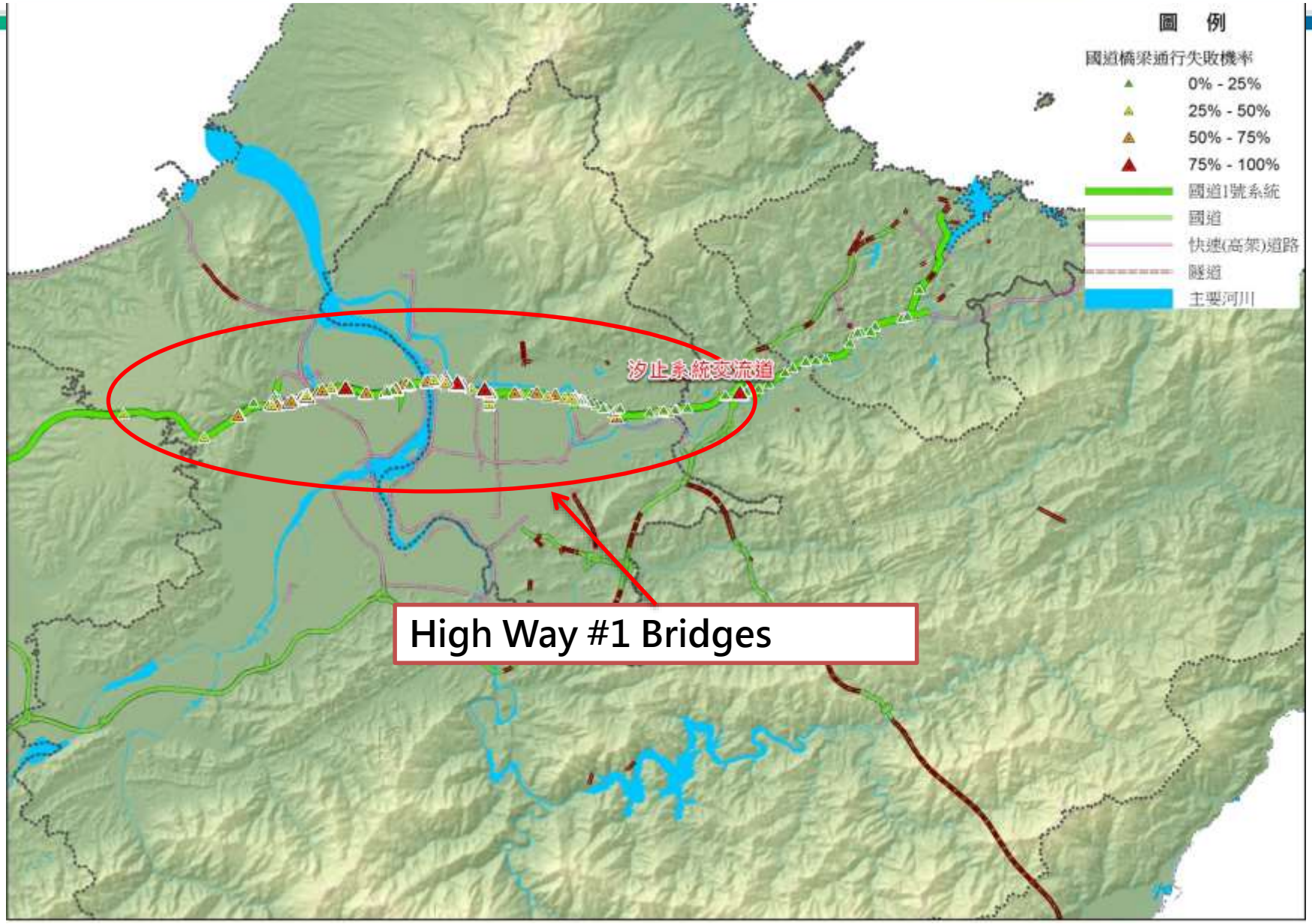


Building Type	
W1	木造
S1	鋼構造
S3	輕鋼構
C1	鋼筋混凝土構造
PC	預鑄混凝土構造
RM	加強磚造
URM	磚造
SRC1	鋼骨鋼筋混凝土

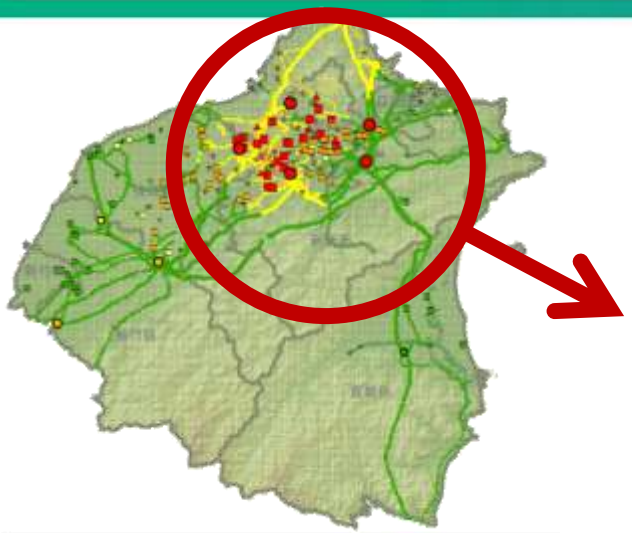
Illustration (Google Earth)

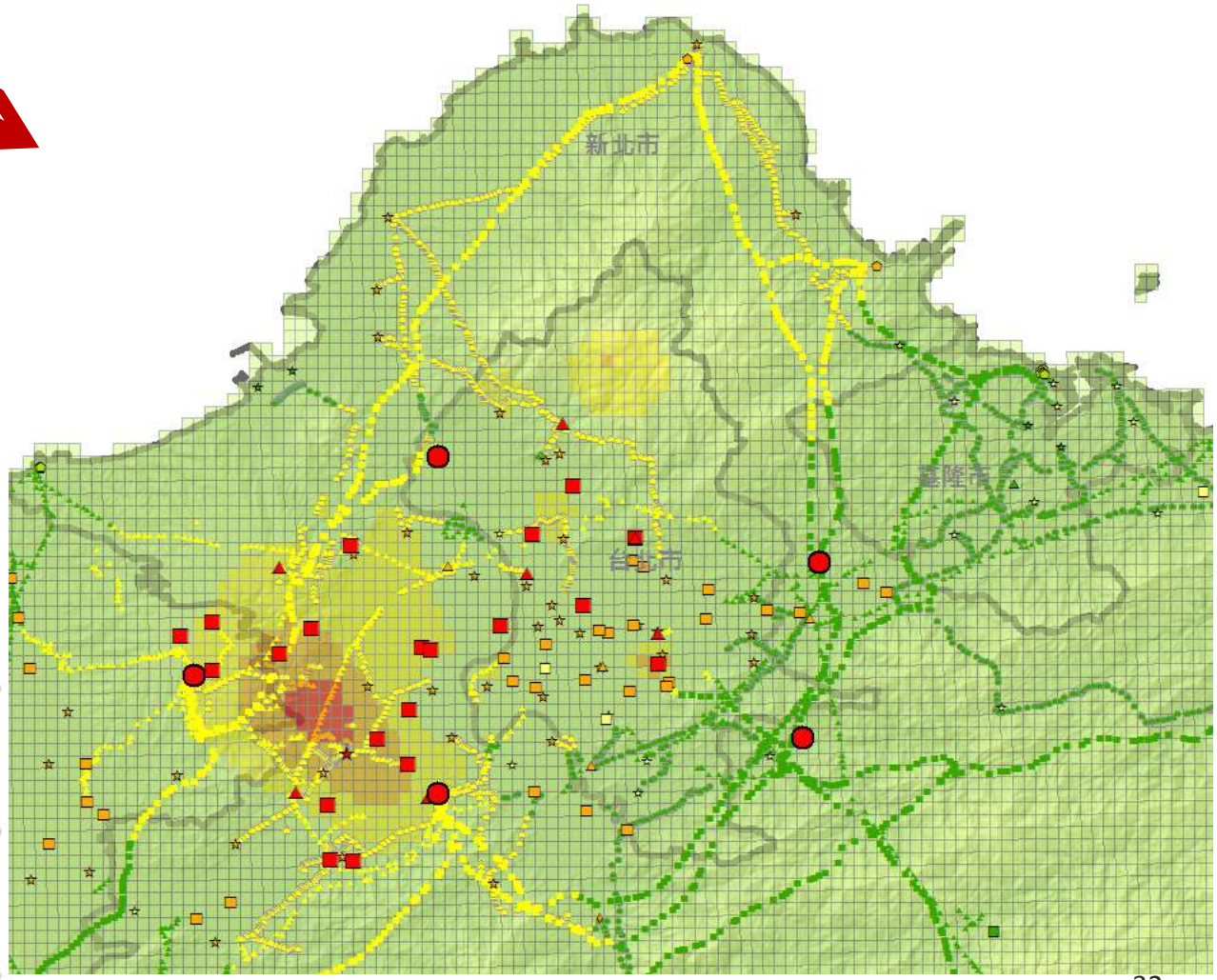


#1 National Highway System



Power System Status





圖例

345KV
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%
- 161KV_PGA
- 69KV_PGA

電網
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%

大型發電廠_PGA_FC
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%

小型發電廠_PGA_FC
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%

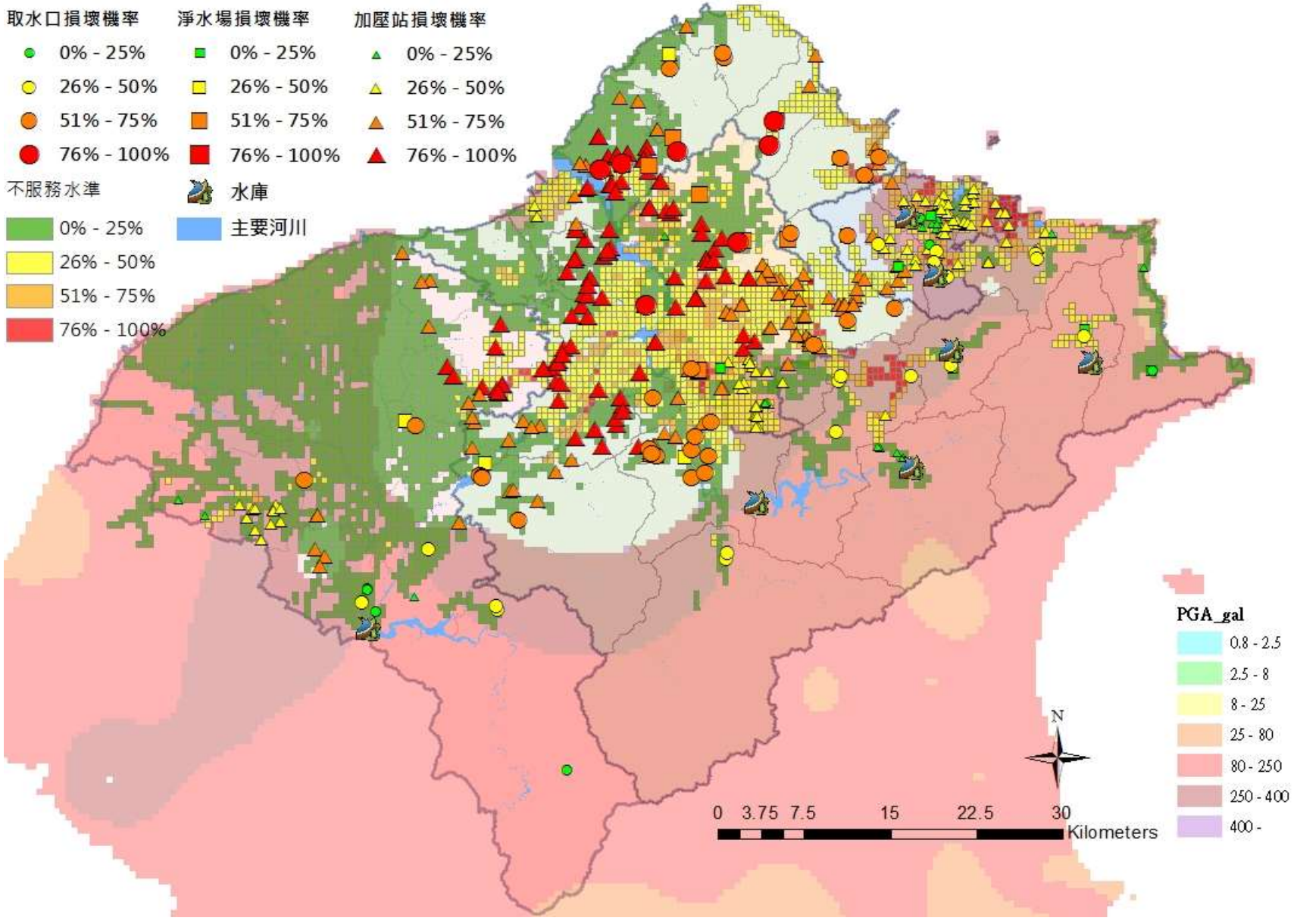
FS_PGA_FC
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%

PS_PGA_FC
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%

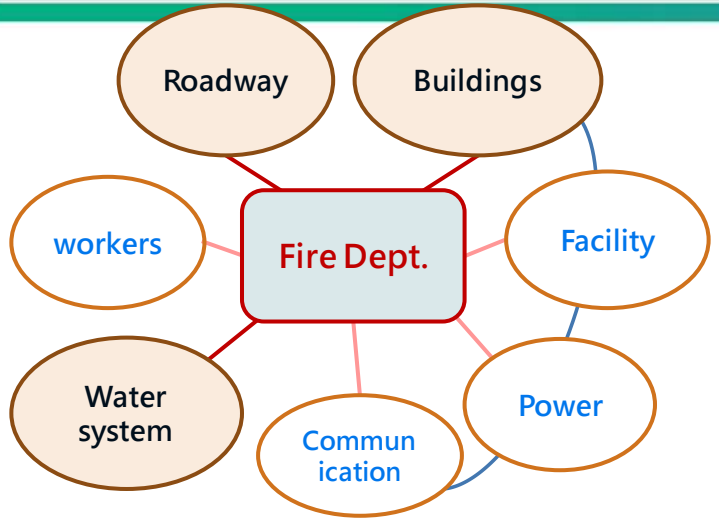
DS_PGA_FC
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%

SS_PGA_FC
- 0% - 25%
- 25% - 50%
- 50% - 75%
- 75% - 100%

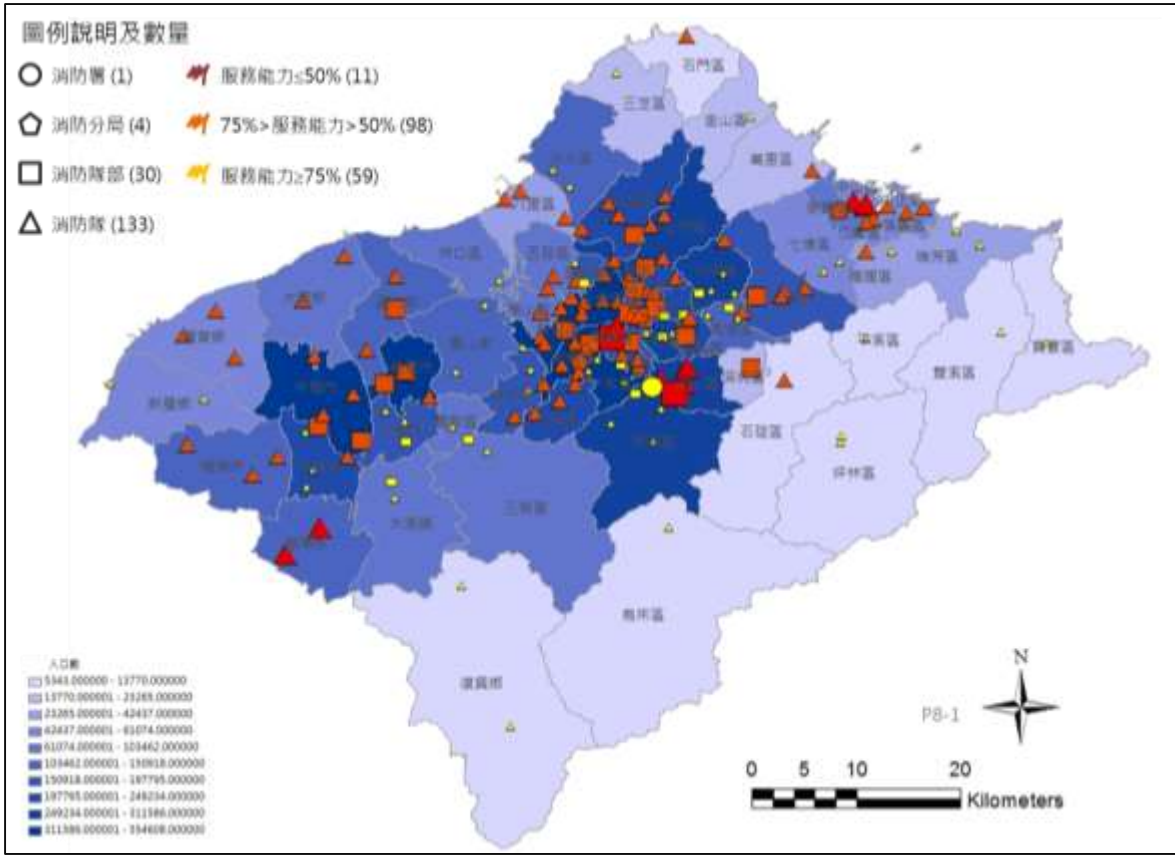
Water System Damage Status

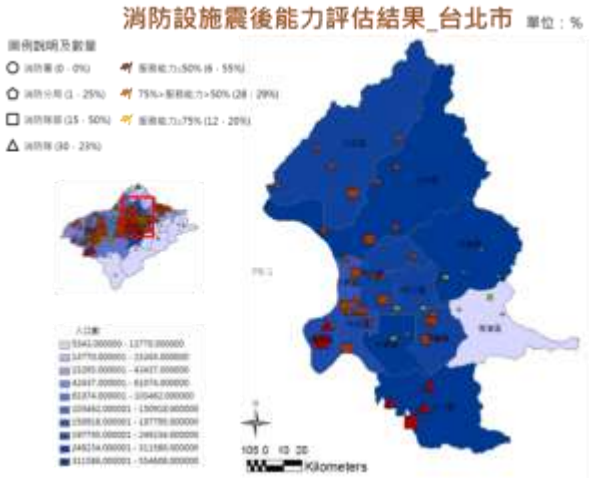


Ex: Status of fire depts. after earthquake



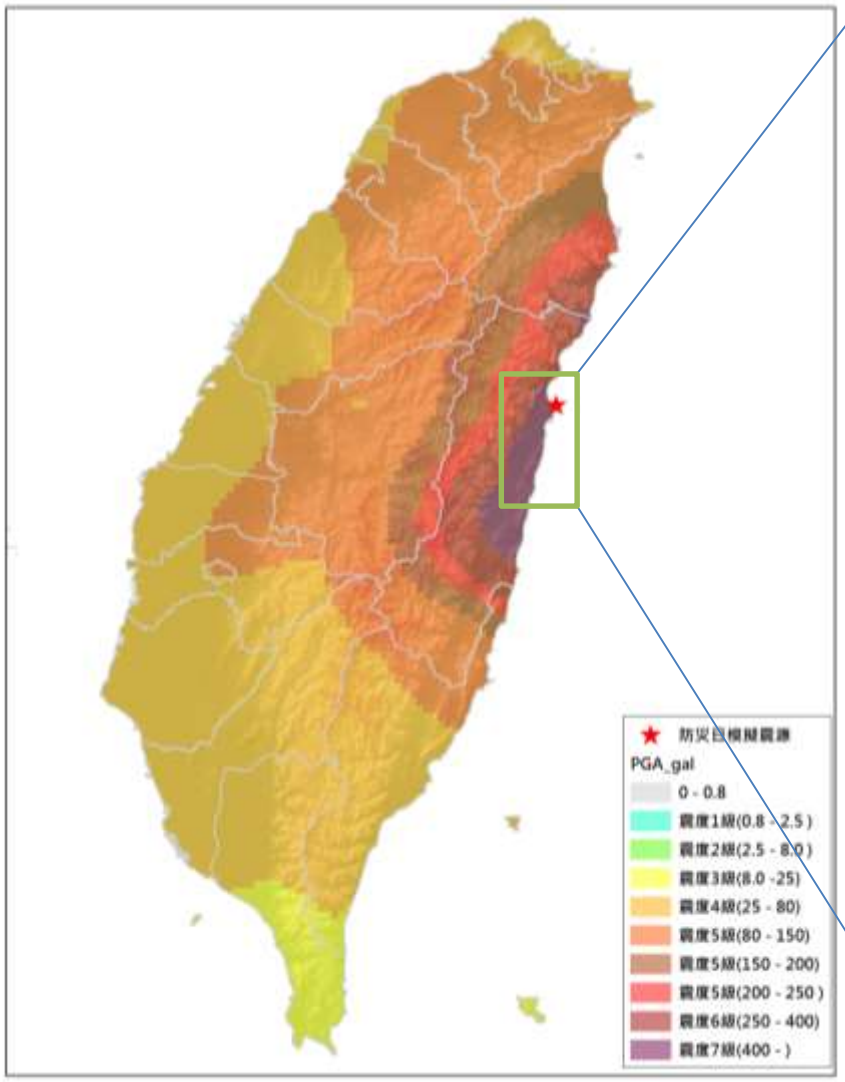
Operation Factors

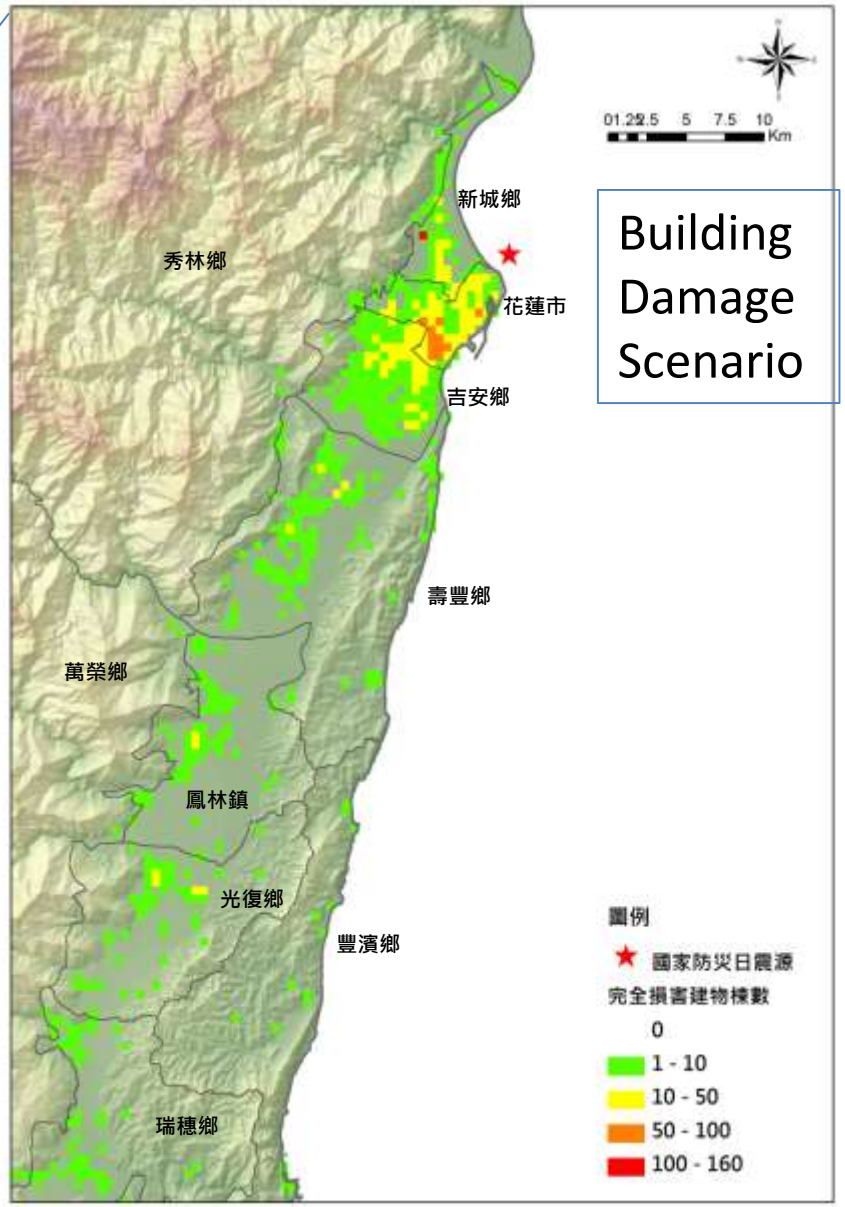




2014 National Drill Day Application

PGA Distribution

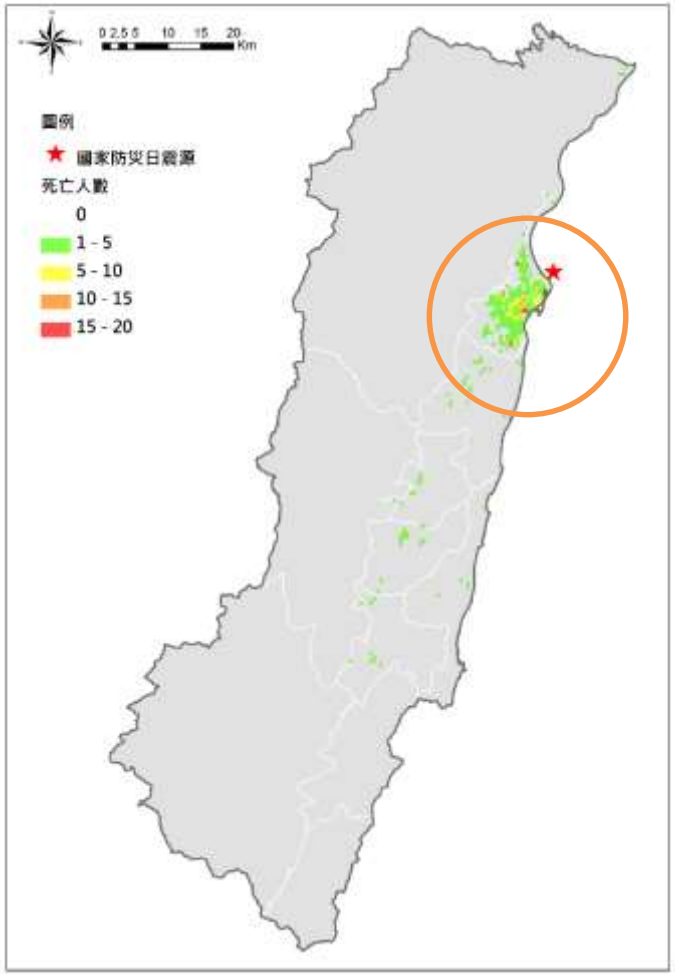


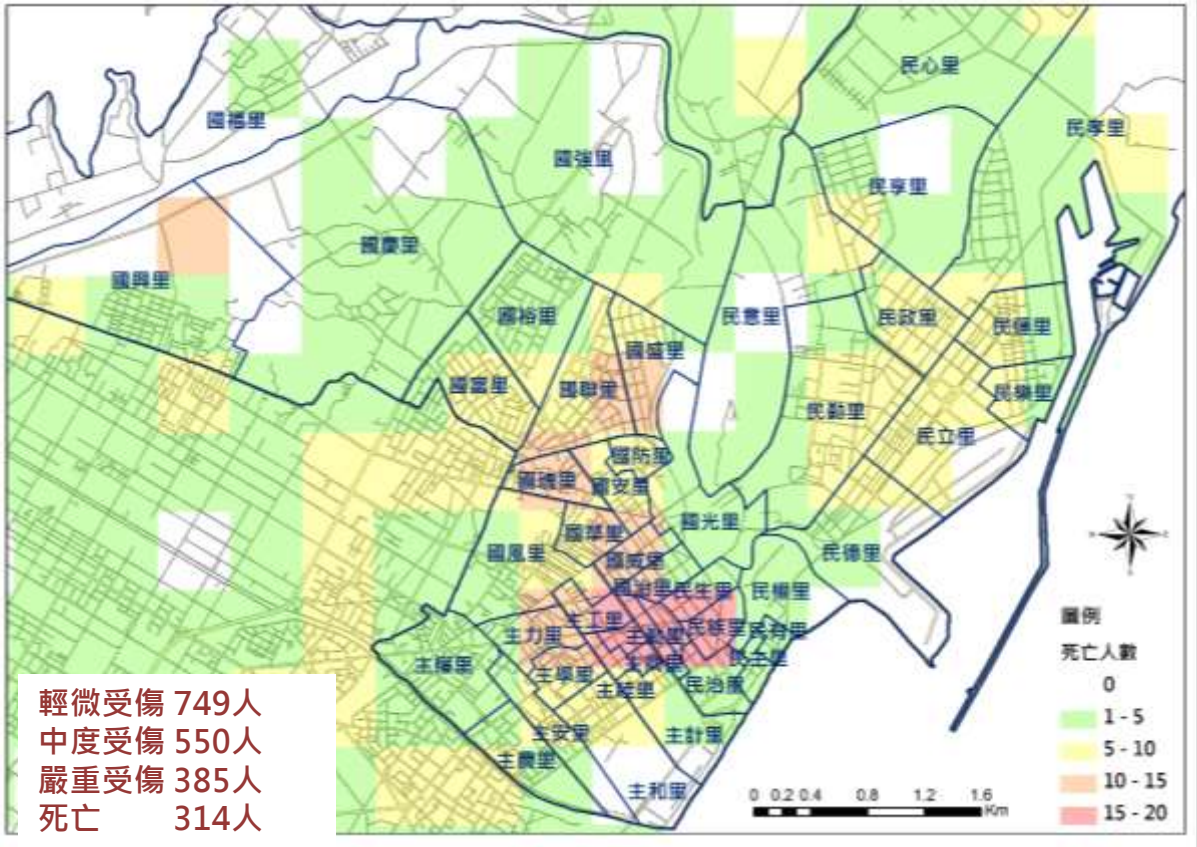


Building Damage Scenario

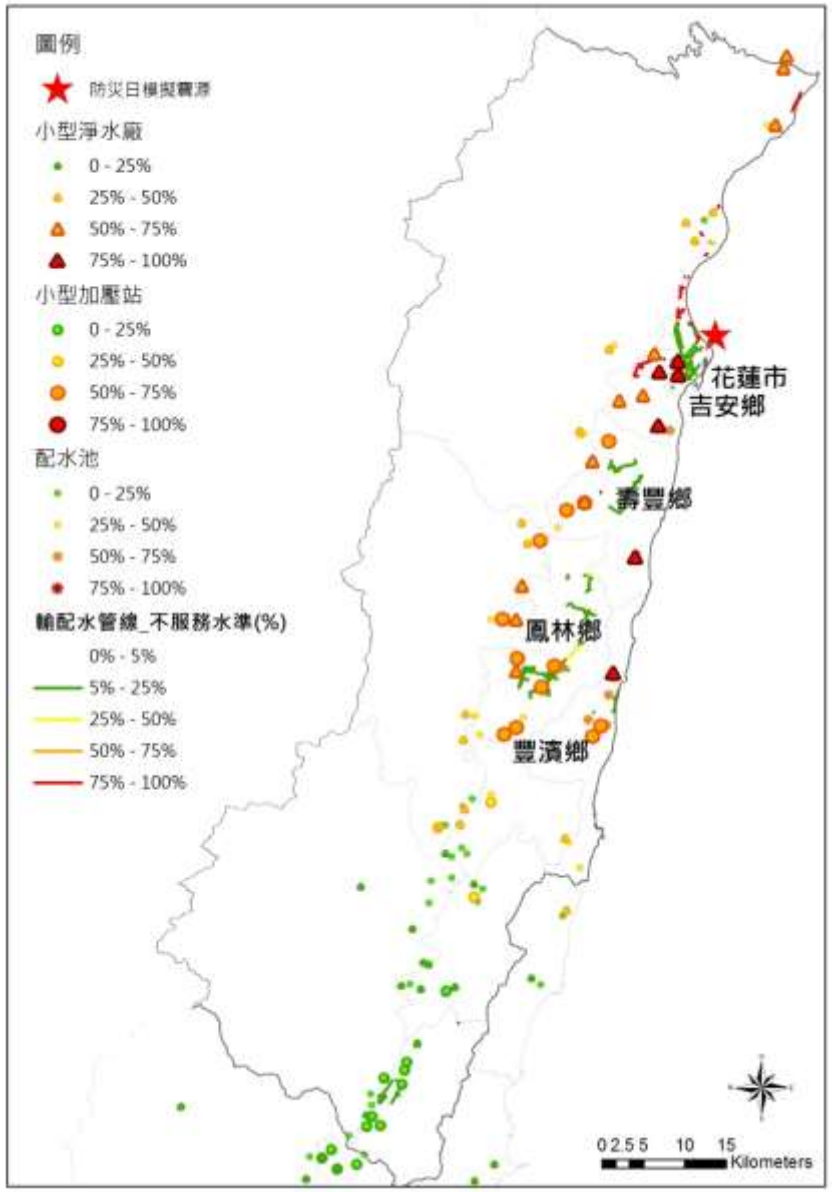
2014 National Drill Day Application

Scenario of Casualty:





Water System Damage Status



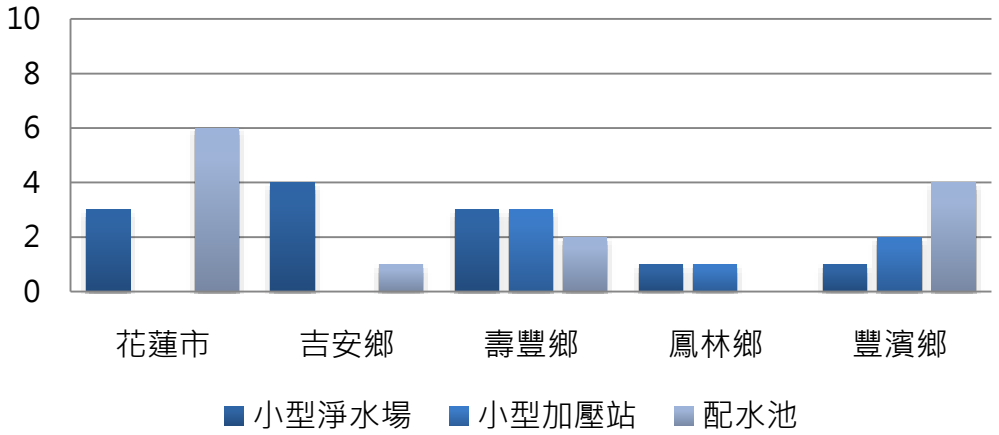
- Affected Areas：

  花蓮市、吉安鄉、壽豐鄉、鳳林鄉、豐濱鄉

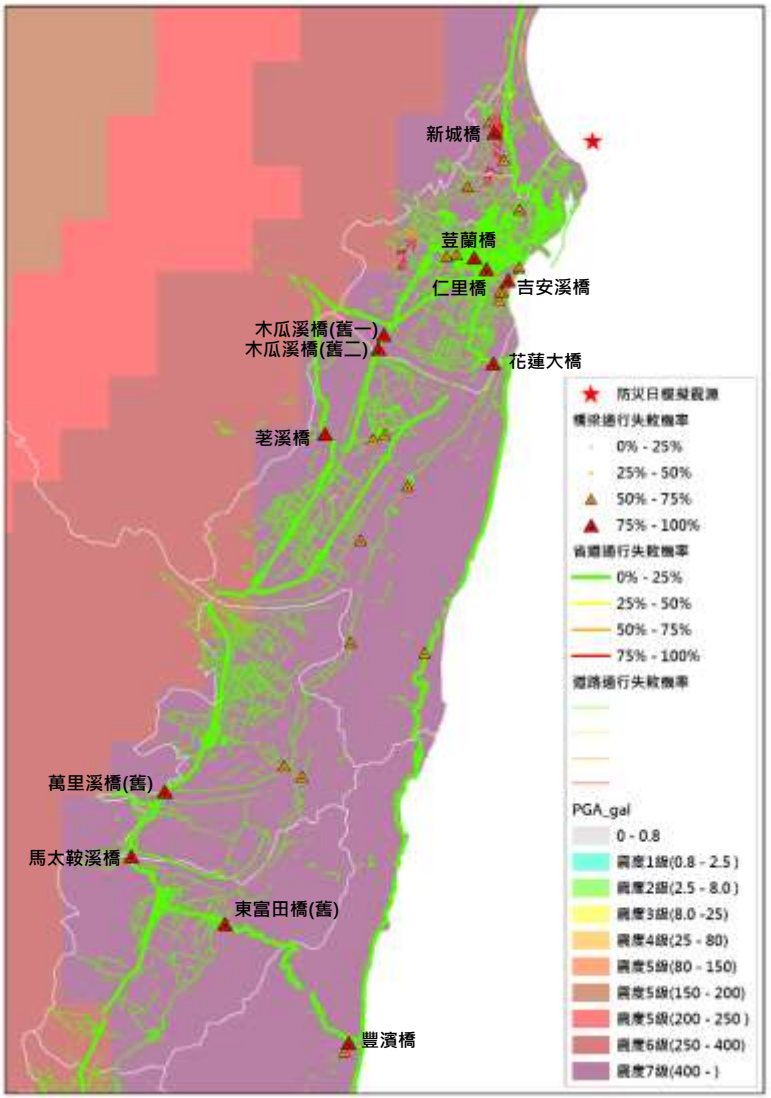
- Water treatment plants：

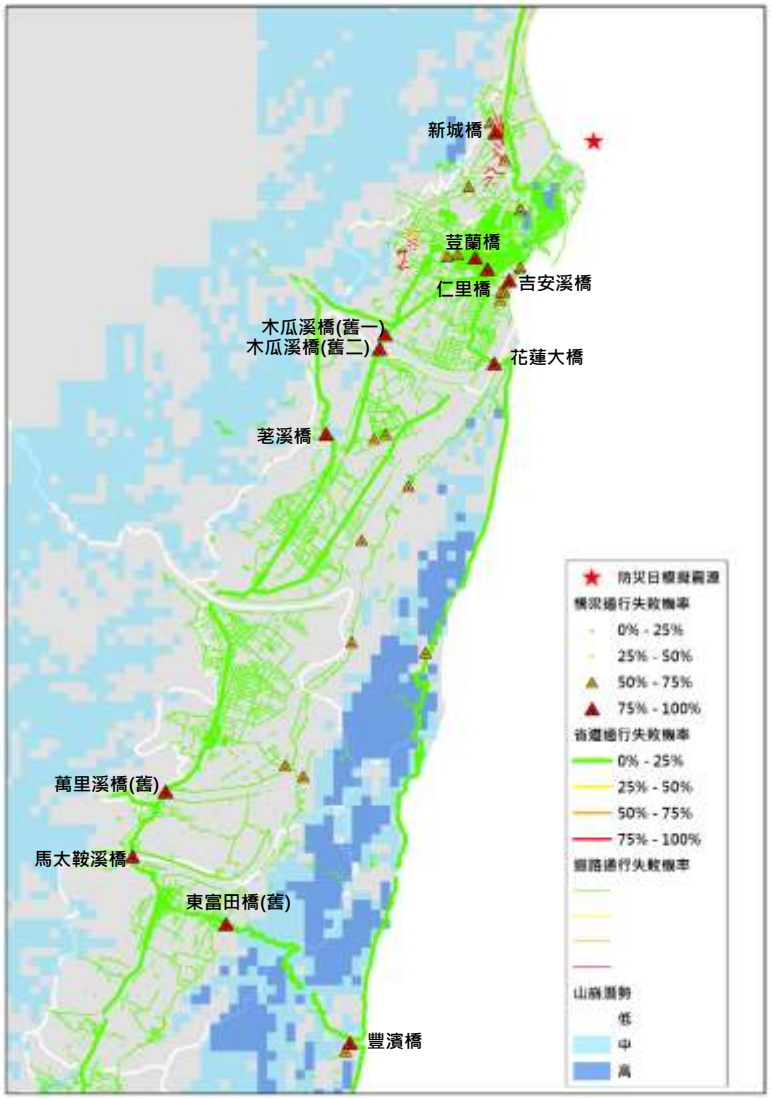
  尚志、光華、美崙、北昌、水璉、新社

Number of Damaged Facility



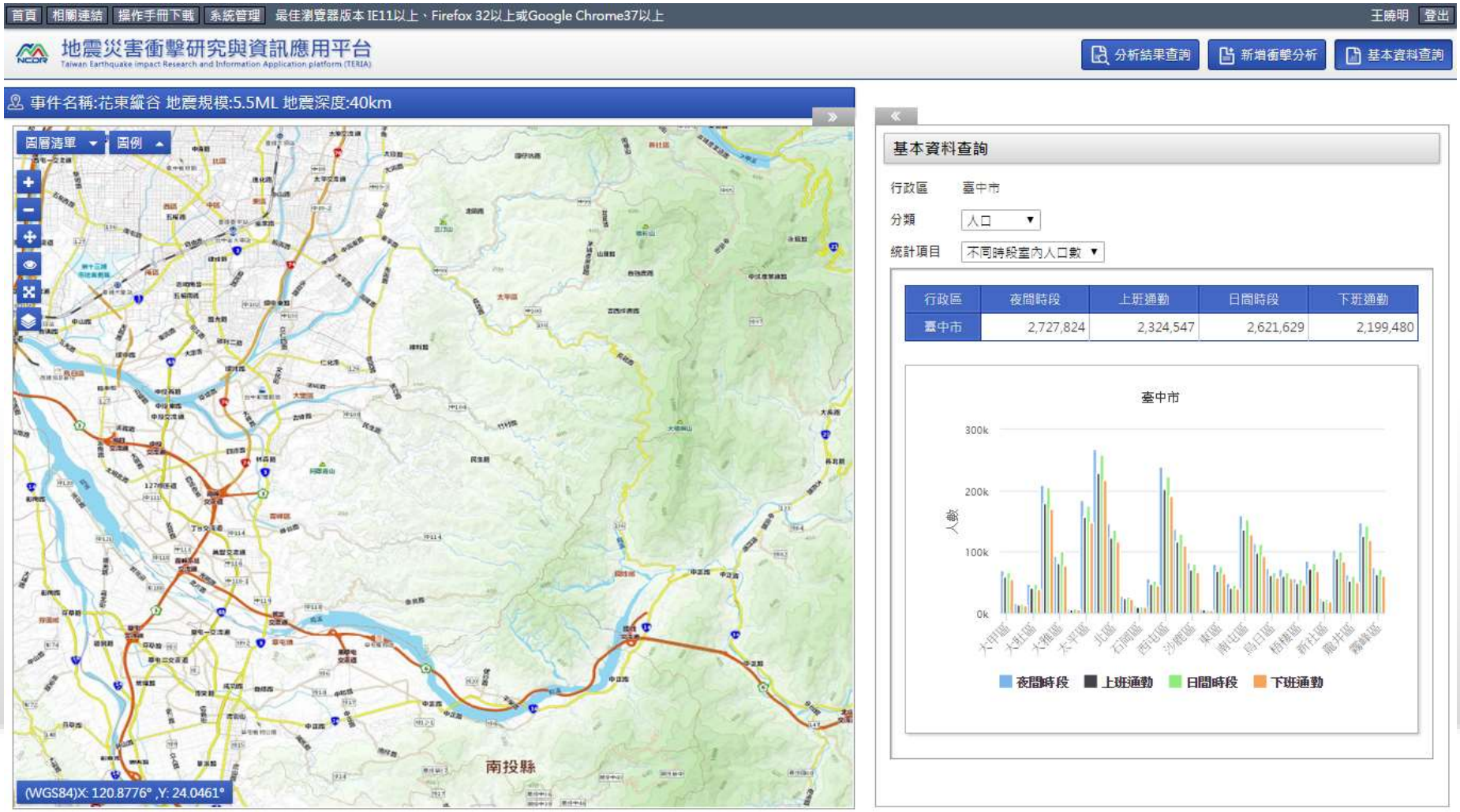
PGA, Roads and Bridges, landslide due to earthquake





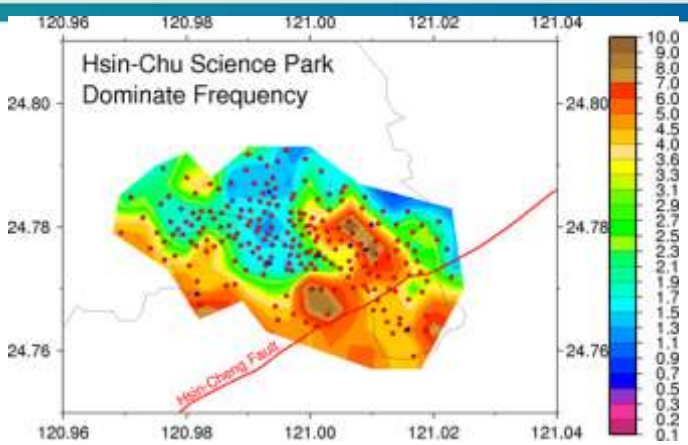
基本資料查詢(建物統計圖表)-建物棟數

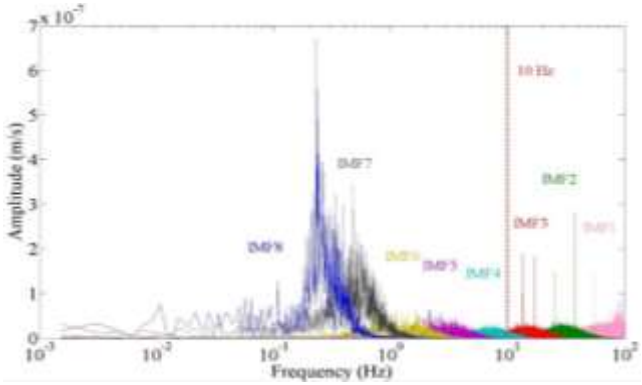
基本資料查詢(人口統計圖表)-不同時段室內人口數

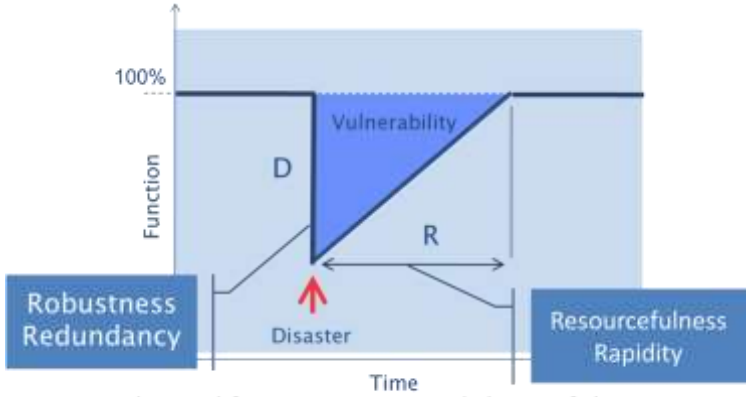


Scenario Checking and 10 Steps for BCM

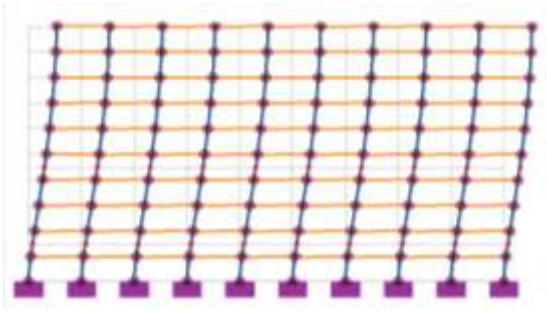
1. Determine BCP purpose, scope and team.
2. Prioritized activities and Recovery Time Objective
3. What do you need to resume key activities?
4. Risk assessment – know your tragic scenarios
5. Do not forget pre-disaster protection and mitigation
6. Emergency response to disaster
7. BC Strategies to early resumption
8. Be financially prepared
9. Exercise makes your plan functional
10. Ongoing review and improvement



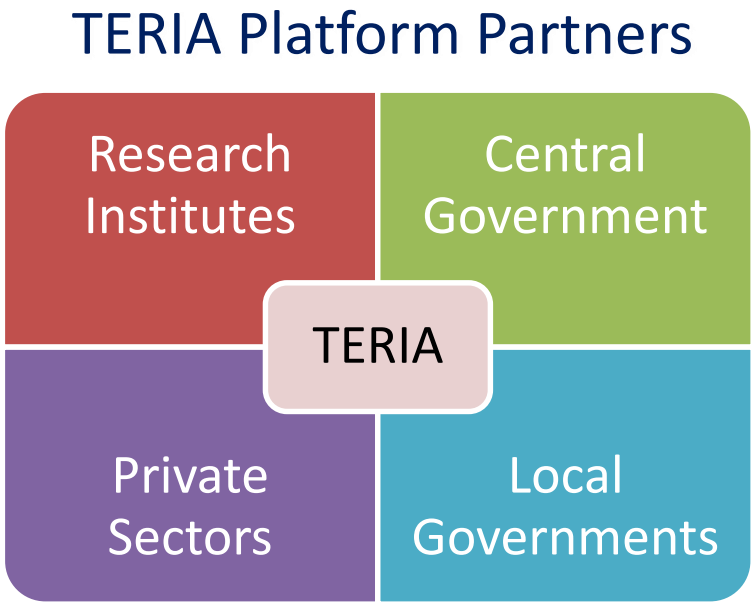




Adapted from MCEER model on Lifeline



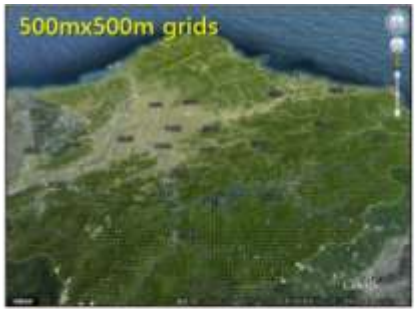
Conclusion

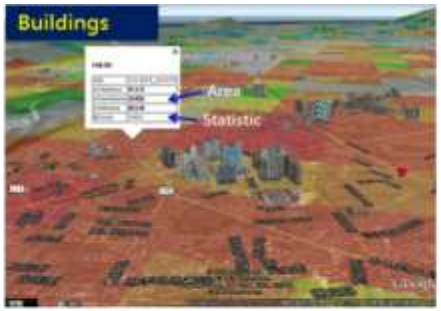


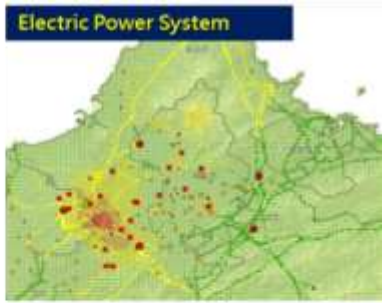
- TERIA is designed and developed to be a open platform, emphasizing interdisciplinary cooperation, information sharing, and to satisfy the practical needs for earthquake disaster management.

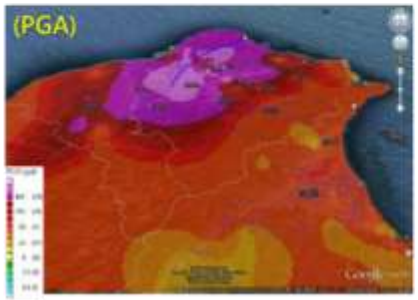
Future Work

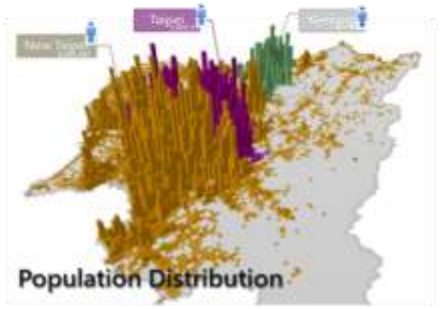
- Build up platform partnership
- Develop user interface
- Enhance data completeness
- Incorporate state-of-the-art assessment models
- Assess the effects of system interdependency

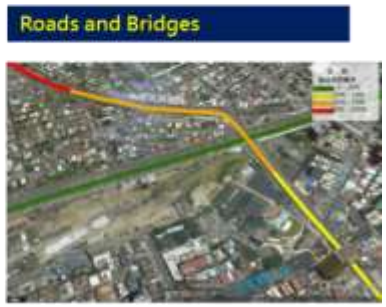












Thank you

for your attention