行政法人 國家災害防救科技中心
National Science and Technology Center for Disaster Reduction

To facilitate efficiency of emergency operations through integrating knowledge and information for decision makers

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Director

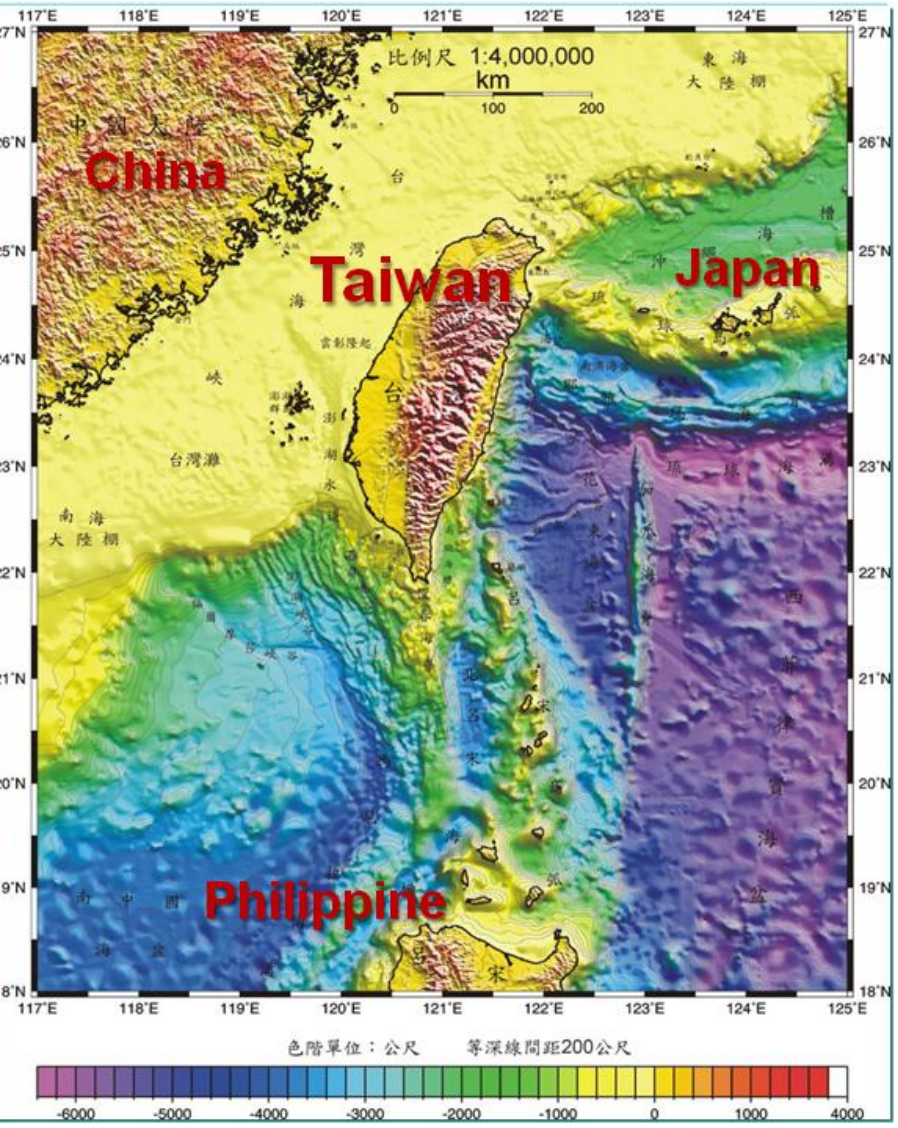
National Science and Technology Center for Disaster Reduction (NCDR)

The Second Global Summit of Research Institutes for Disaster Risk Reduction
March 19-20th, 2015, Kyoto University

Outlines

- **Brief introduction of NCDR's operation model**
  - A case of applying S&T for disaster risk reduction and management
- **Challenges found at local governments during emergency operation**
  - Experiences learned from Typhoon Morakot since 2009
- **Ways to knowledge and information for decision makers**
  1. Application 1: Flood Warning
  2. Application 2: Warning on debris flow
  3. Application 3: Early evacuation Typhoon Kong-Rey in 2013
  4. Application 4: Automation on monitoring risk highways
  5. Application 5: Information Integration and Risk Analysis
  6. Application 6: Massive Gas Explosions in Kaohsiung, Aug 1st, 2014
  7. Application 7: Information to the general public
- **Conclusions and future challenges**

Basic Information of Taiwan



- *Geographic features*
  - *400 km from north to south*
  - *145 km from east to west*
  - *Area: 36,000 Km^2 over 70% in slope land*
- *Population (July, 2014)*
  - *23,398,263 in total, 67.70% in urban areas*
  - *Density: 647/ Km^2*
- *Tectonic Conjunctions:*
  - *Philippine Sea plate*
  - *Eurasian Plate*
- *High risk of tropical cyclones*
  - *3.6 typhoons/year*

Urban-type vulnerabilities

Geo-hazards

Hydro-meteorological hazards

Disaster of Typhoon and Earthquake

Typhoon
(Morakot, 2009)

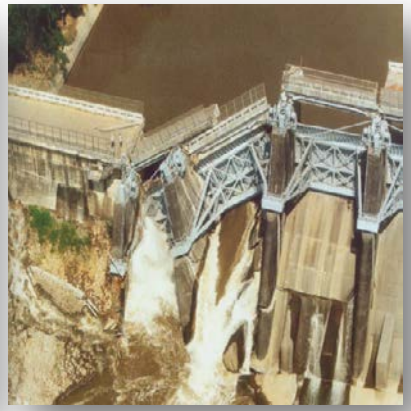
Urban flood

Debris flow

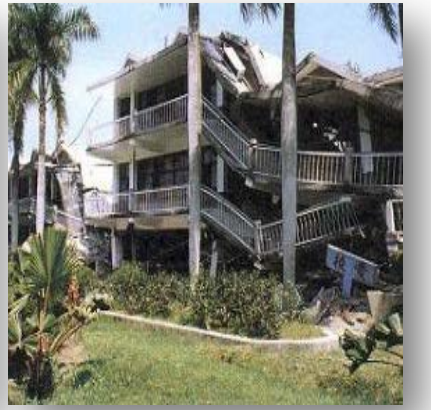
Landslide

Earthquake
(Chi-Chi,1999)

Residential
Building



Infrastructure



Collapsed
school

How NCDR applies science and technology for disaster risk reduction and management

Ministry of Sceince and Technology

Propose topics

Supervise
Provide operation funds

NCDR

Since 2003

100 full-time staff
- Natural science
- Social science
- Engineering
- Emergency management
- Business management

Major services
- S&T transfer
- S&T innovation
- Knowledge base
- Data base
- International collaboration

Major products
- Applied and inter-disciplinary research
- Policy of DRR for central and local government
- Information integration
- Emergency operation (not search and rescue)
- Identification of urgent needs and long-term demands
- Integration of potential risk maps

Partners and key stakeholders

Public sector
- **Central government**
  - Ministries and agencies
- **Local Government**
  - Municipalities and townships

Private sector
- Universities, research institutes
- **NGOs, NPOs**
- **Communities**

International outreach
- IRDR, ICoE Taipei
- ADRC, NIED, DPRI (JP)
- PDC (US)
- ADPC (TH)
- NDMI (KR)
- APEC EPWG

NCDR has comprehensive teamwork with public and private sector – from top decision makers to local communities

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Challenges found at local governments during emergency operation – observations from Typhoon Marokot since 2009

Too much or too little information during emergency response

- Channel to acquire useful information
- System of systems to integrate information

Lack of common operating picture to coordinate actions

- Potential risk maps for planning
- Situation maps for operation

When and how to make timely decisions

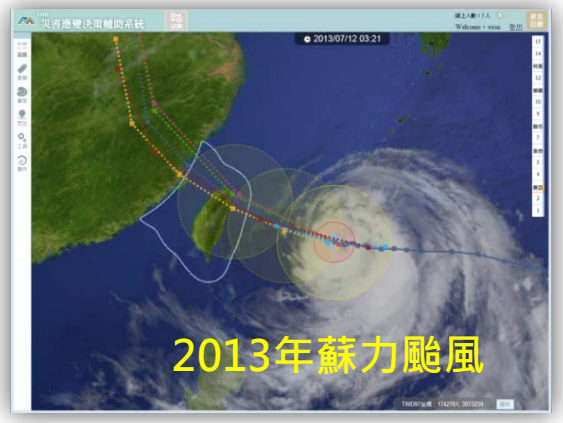
- No well-defined plans in advance
- No experienced staff to make suggestions

Elements to succeed decision support – "Cross-cutting Synergy" and "Information sharing"

Weather
- Forecasting
- Potential path

Flood
- Warning
- Simulation

Geo
- Debris flow warning
- Slope land warning
- Road closure



Apply – Provide situation assessment system

Value-added – Provide early warning information

Combine more than 20 units, 120 maps （Big Data）

Service

Value-added

Integrate

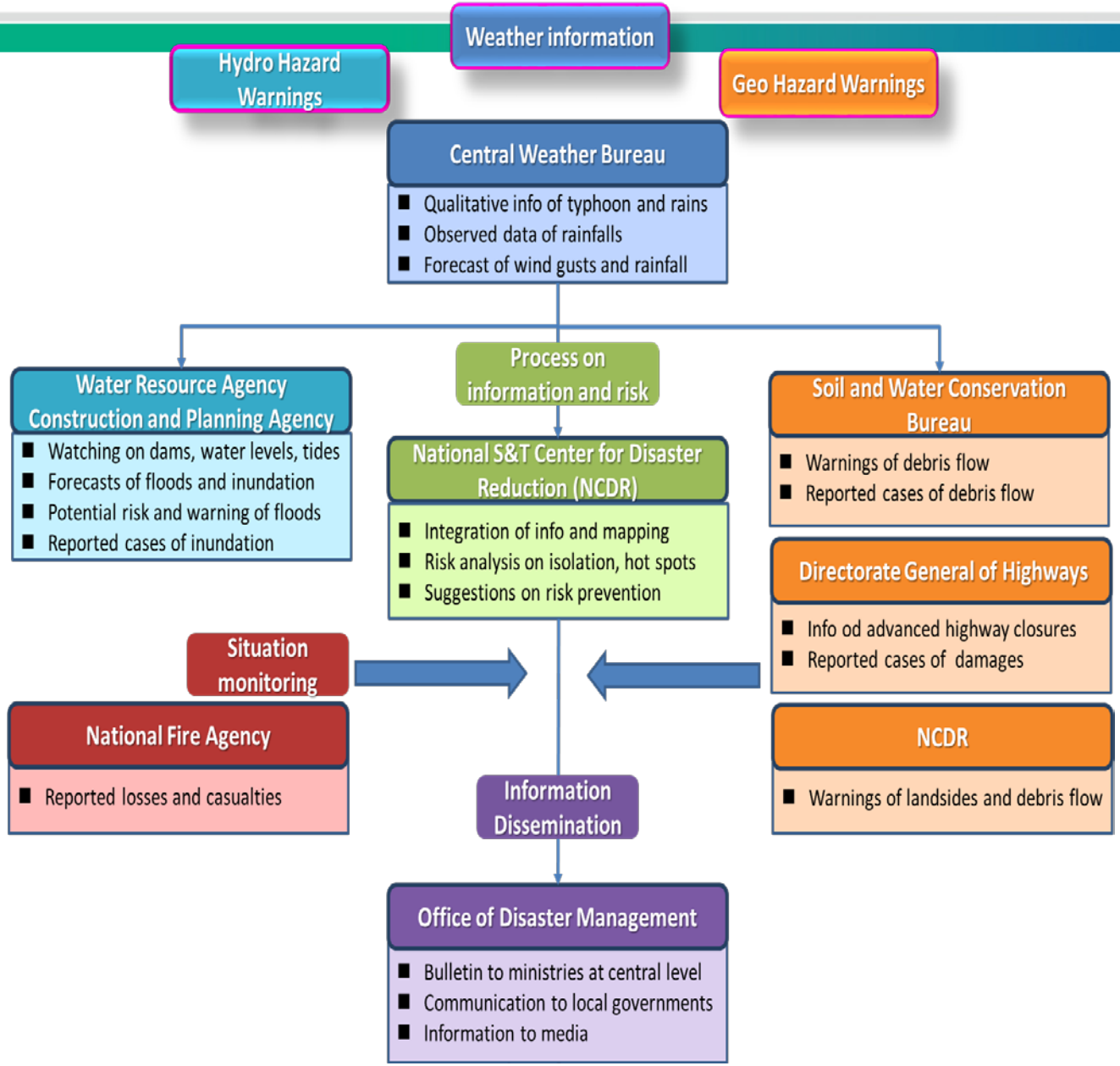
Data
Live data
Monitor
History

Database
Basic
Monitor
Disaster
GIS

Information
Who, what, when, where, how

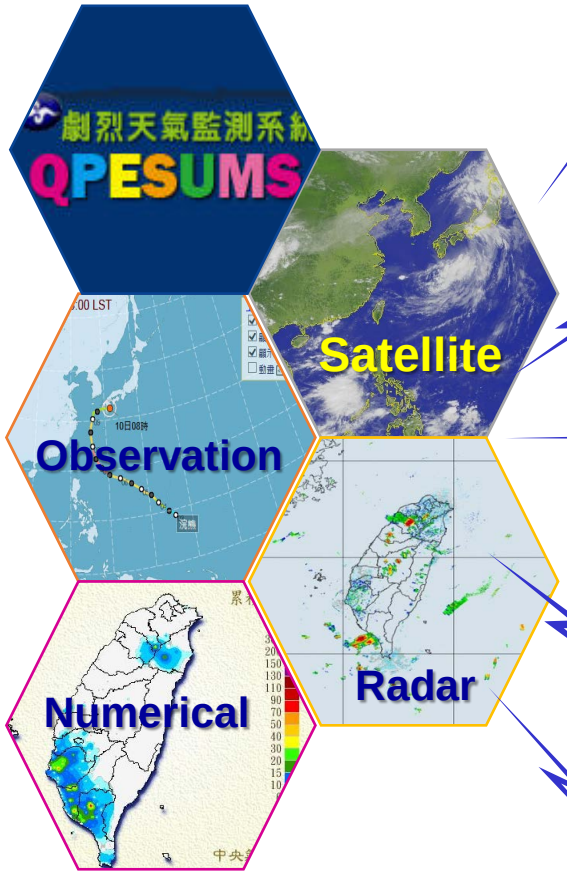
Action
Situation assessment system

Information flows and synergy for typhoon emergency operation



Value-added applications of weather information - service-oriented information

Weather Info



Warnings of hydro-hazards

Water Resources Agency
- Flood Warning
- Flood simulation & forecast

Construction and Planning Agency
- Sewer early warning

Warnings of geo-hazards

Soil and Water Conservation Bureau
- Debris flow red warning

Directorate General of Highways
- Road closure warning

N C D R

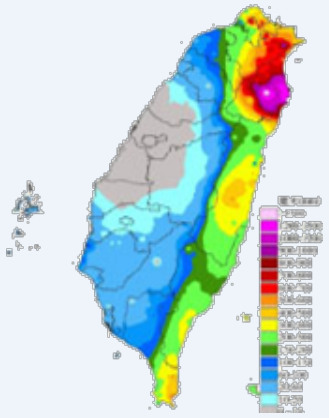
- Integrated Early Warning Info
- Disaster Risk Analysis
- Disaster Info Sharing

Early Warning System

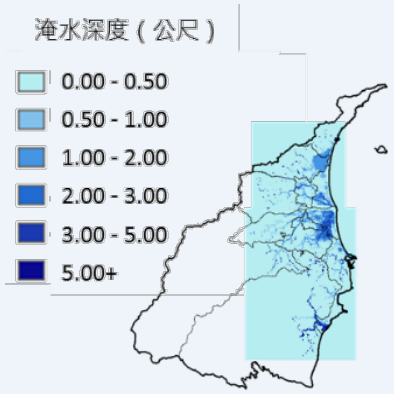
The early warning Process for the disasters assessment

Typhoon Forecast

Rainfall Forecast

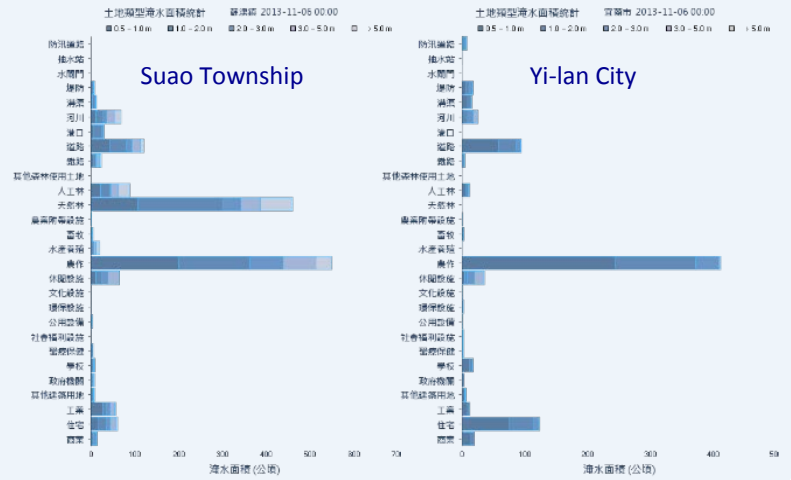


Flood Simulation

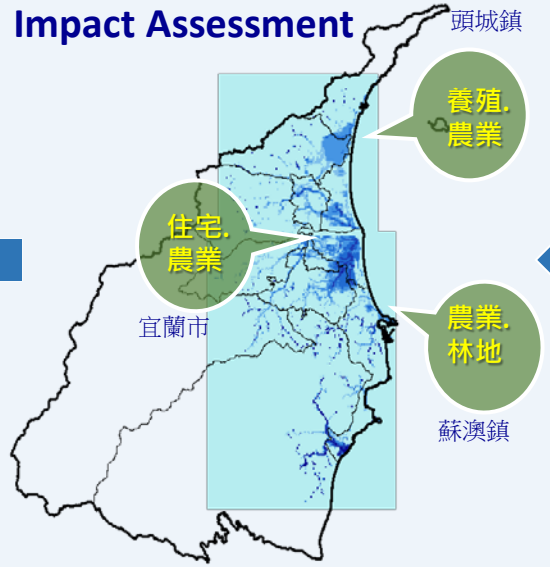


Rapid Computing

The land use Categories of inundation area



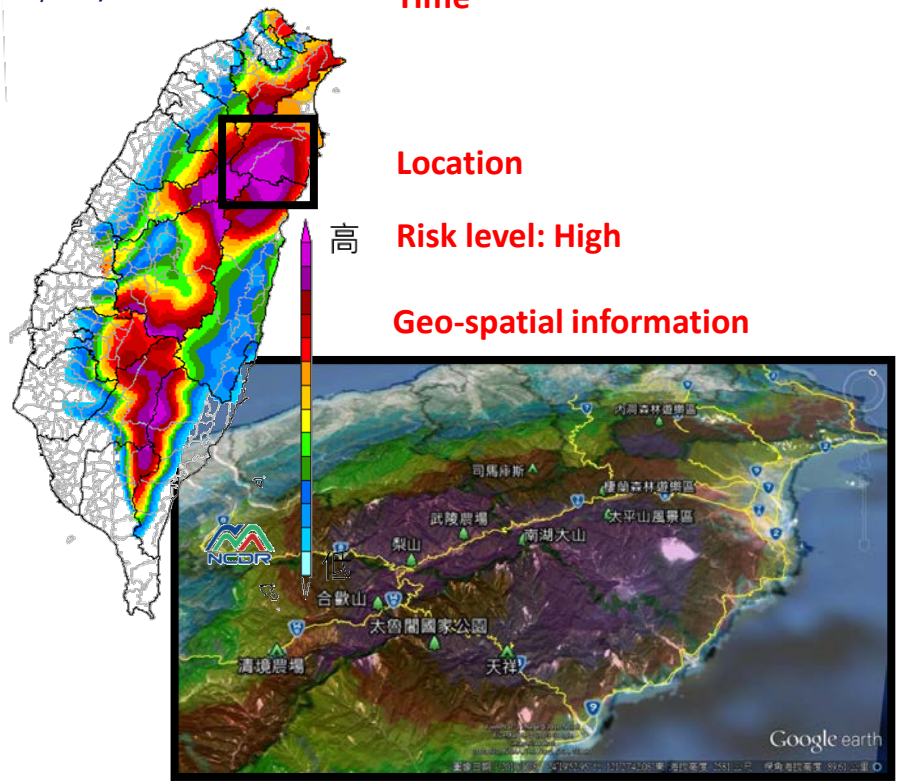
Impact Assessment



Suggestions

Three principles to integrate information for typhoon emergency operation by assistance of S&T

Estimate potential risk of landslide
2014, 07/23 06：00 am



- **Scenario-based description** for deployment and response in advance
- **Cross-cutting information exchange** to monitor evolving situations
- **Graph and table plus GIS** to show spatial and time-dependent factors

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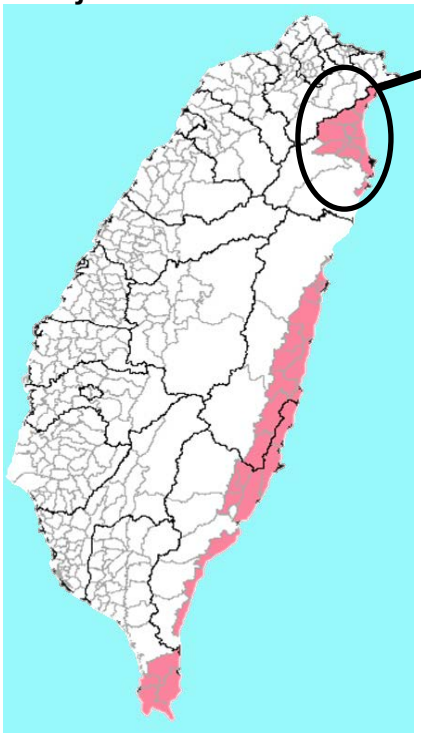
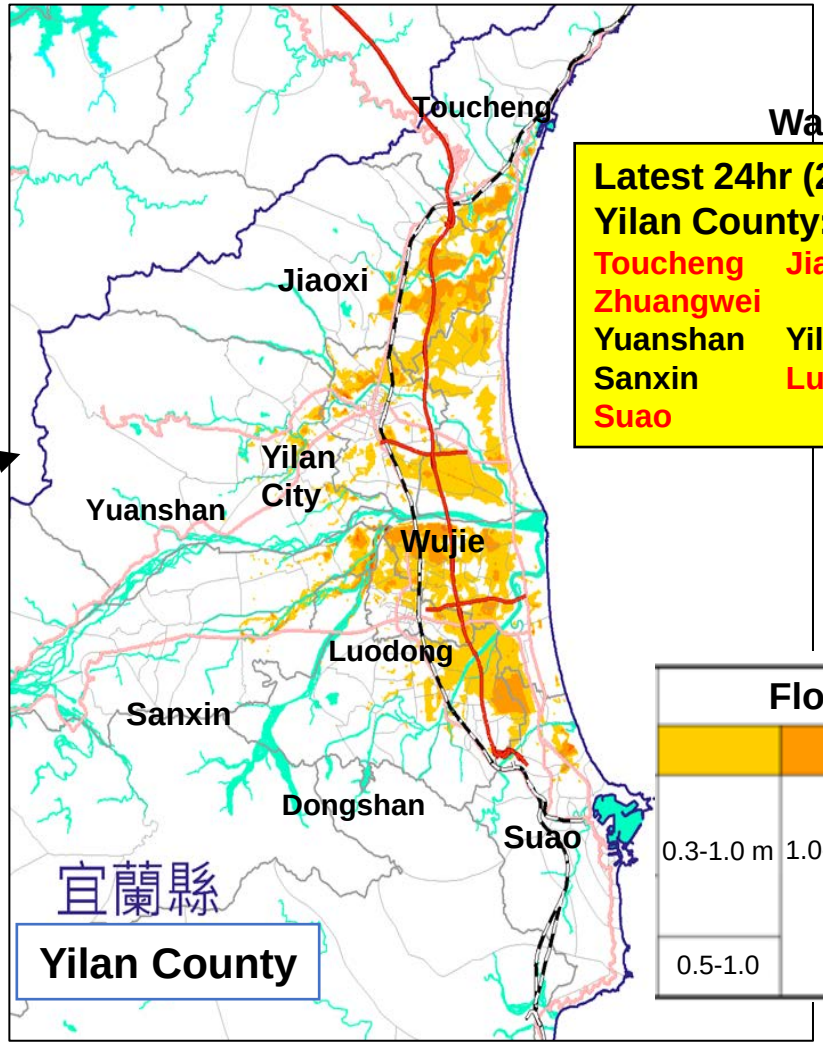
Application 1: Water Resources Agency – Flood Warning

Estimated floods in 24hrs based on forecast issued by CBW

Major flooded areas





Warning

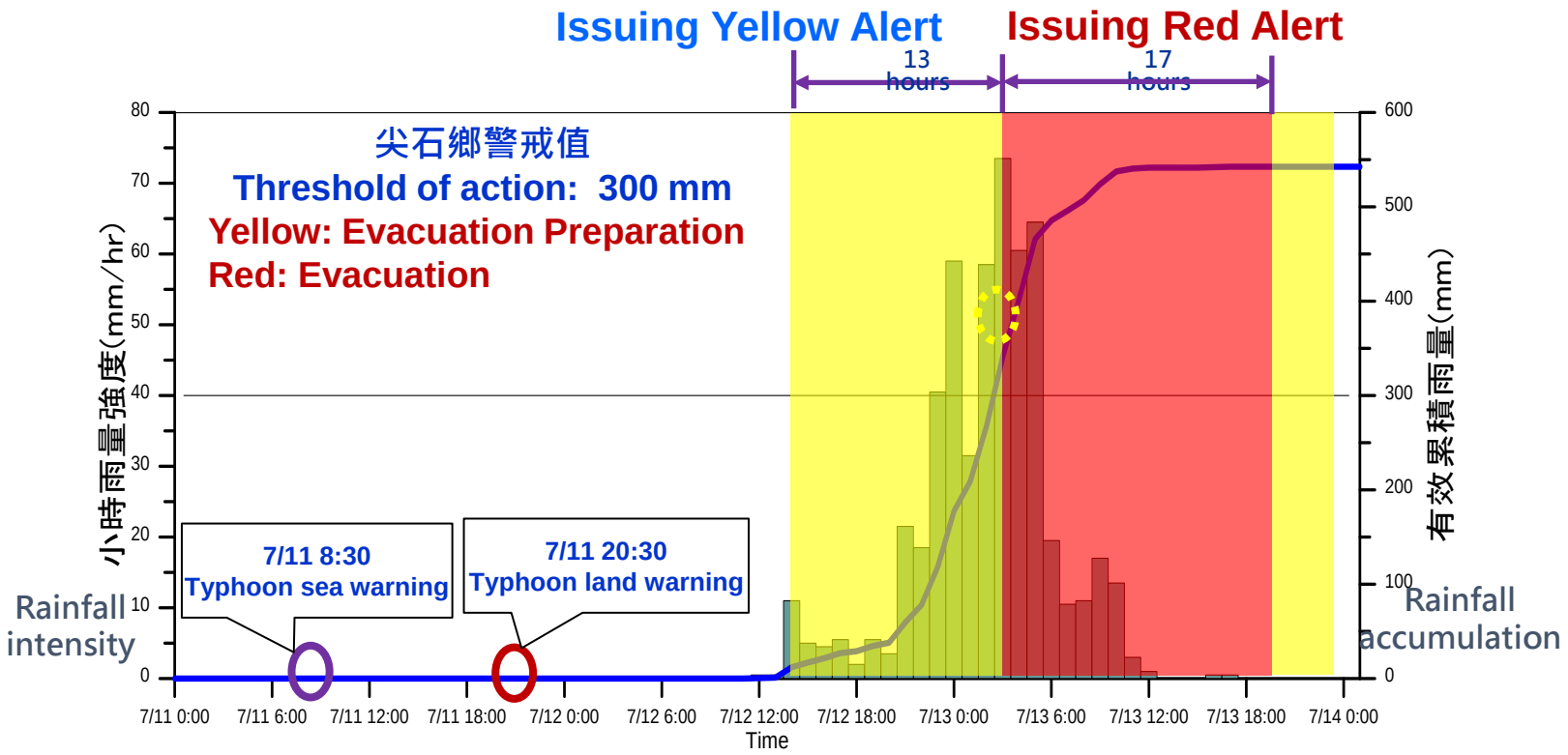
Latest 24hr (200mm/24hr)
Yilan County: Warning areas
Toucheng Jiaoxi Zhuangwei
Yuanshan Yilan City Wujie
Sanxin Luodong Dongshan
Suao

Flood Depth

0.5-1.0	0.3-1.0 m	1.0-2.0 m	2.0-3.0 m	> 3.0 m

Disclosed info: time, locations and scientific scenario

Application 2: Soil and Water Conservation Bureau –Warning on debris flow

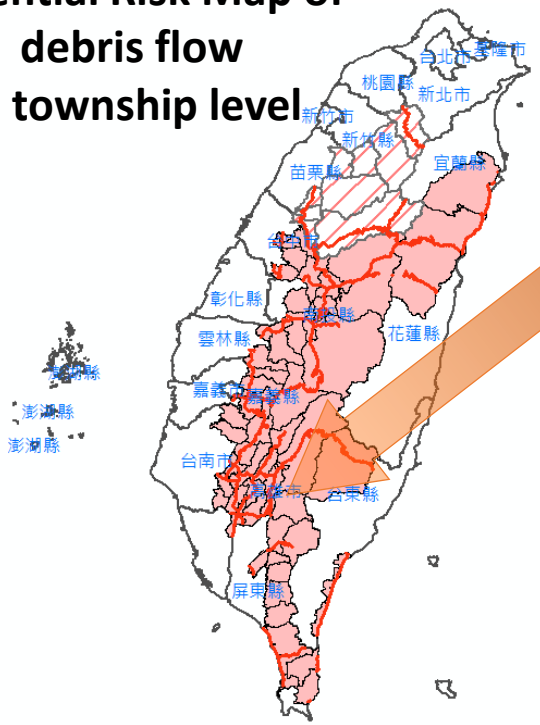


Date and Time	Forecasts or observations of rain	Warning on debris flow
7/12 14:00	24hr forecast on rain, 500-800mm	**Issue Yell Alert**
7/12 20:00	Observation< 50mm	**Keep Yellow Alert**
7/12 23:00	Observation reached 110mm	**Keep Yellow Alert**
7/13 03:00	Observation > 300mm	**Issue Red Alert**

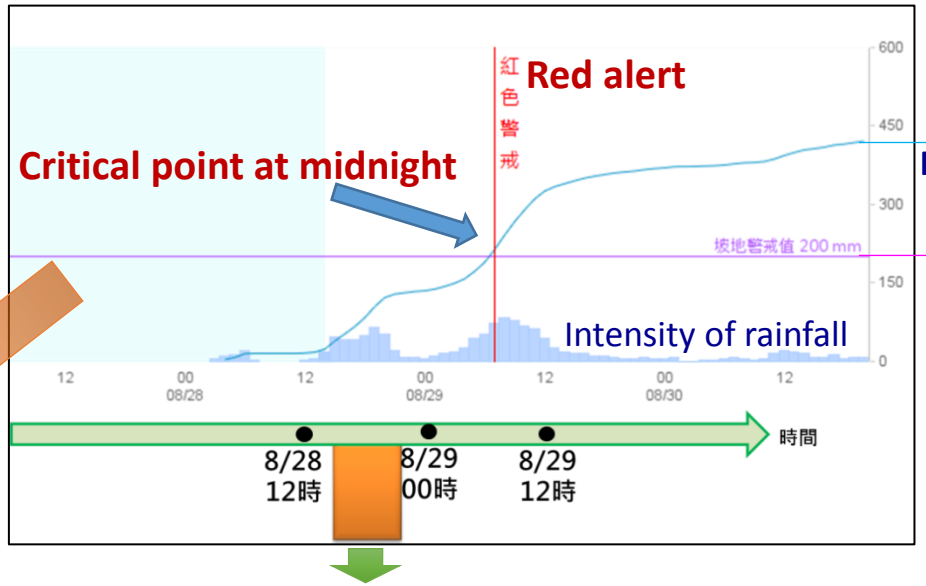
Disclosed info: time, locations and scientific scenario

Application 3: Evidence-based emergency operation – Early evacuation Typhoon Kong-Rey in 2013

Potential Risk Map of debris flow at township level



Scientific evidence to carry out early evacuation



Forecast of rainfall

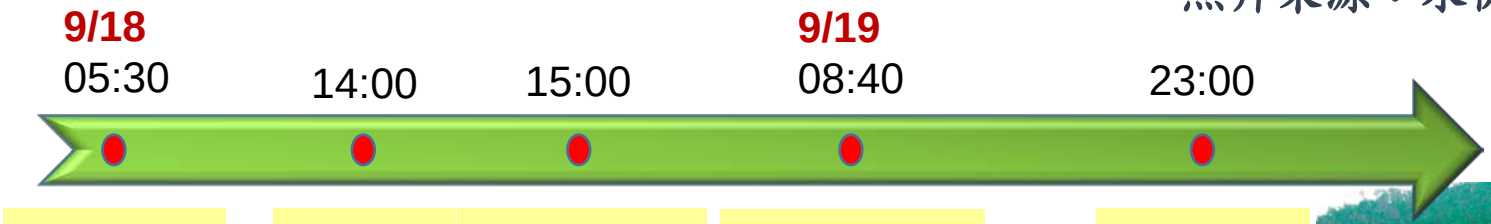
Threshold value of debris flow

200 mm accumulated rainfall in 24hrs

The best period of time to evacuate residents

Case of successful early evacuation during Typhoon Fanapi , in Lai-Yi village, Sep. 2010

照片來源：水保局



Issue land warning | Early warning | Evacuation operation | Typhoon landfall time | Landside in Lai-Yi

32 hours ahead

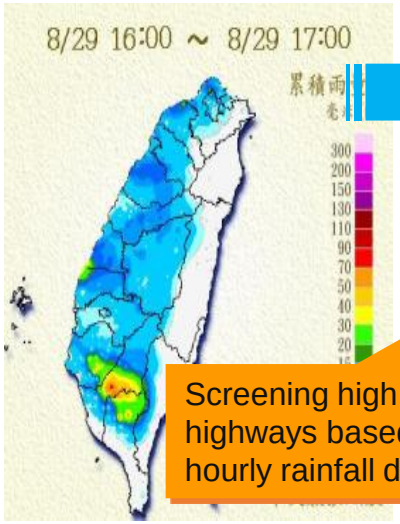
Progressive Improvements for Typhoons in Taiwan

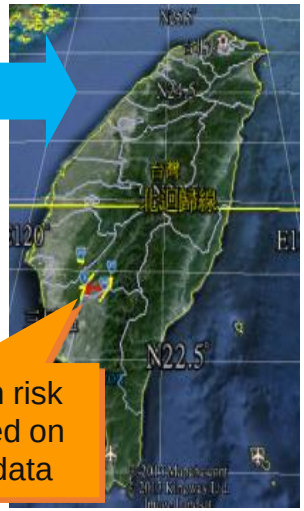
Typhoon	Max.Intensity (mm/hr)	Accumulated Rainfall (mm)	Evacuation (Person)	Ceased or Missing (Person)	
2001.07.28 Toraji	147	757	----	214	
2001.09.17 Nari	142	1,462	24,000	104	
2004.06.30 Mindulle	167	2,005	9,500	41	
2005.07.18 Haitang	177	2,124	1,208	15	
2005.09.01 Talim	119	766	1207	6	
2005.10.02 LongWang	154	776	945	2	
2006.07.12 Bilis	95	1,013	409	3	
2007.08.16 Sepat	122	1,399	2,531	1	
2008.07.16 Kalmaegi	161	1,027	179	26	Compound Disaster
2008.07.28 Fung-Wong	121	830	1,303	2	
2008.09.10 Sinlaku	97	1,608	1,987	22	Compound Disaster
2008.09.27 Jangmi	85	1,137	3,361	4	Compound Disaster
2009.08.07 Morakot	100	2,965	24,775	695	Extreme weather
2010.09.19 Fanapi	125	1,128	16,568	2	
2010.10.21 Megi	183	1,195	3,453	38	Compound Disaster

NCDR Joined EOC

Application 4: Directorate General of Highways – Automation on monitoring risk highways

Stage 1
Risk identification

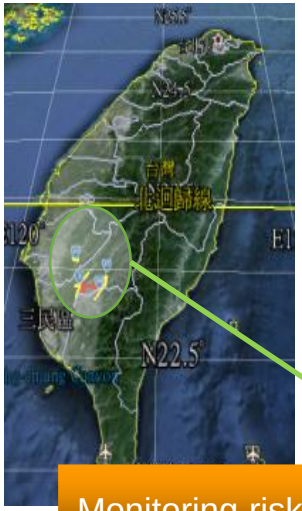


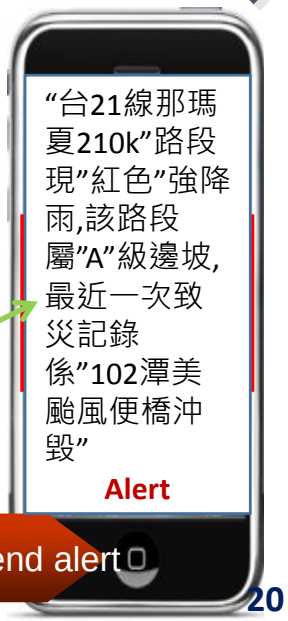


Screening high risk highways based on hourly rainfall data

Sorting sensitive slopes

Stage 2
Alert dispatch





Monitoring risks

If risk reaches level B, send alert

Application 5: NCDR
- Information Integration and Risk Analysis

Weather

Flood

Geo

NCDR

Geo

Slope land risk analysis

Geo

Road closure analysis

Flood

Flood high risk area

Disaster impact and suggestion

Disaster preparedness focus

Application 6: Massive Gas Explosions in Kaohsiung, Aug 1st, 2014

AP Photo

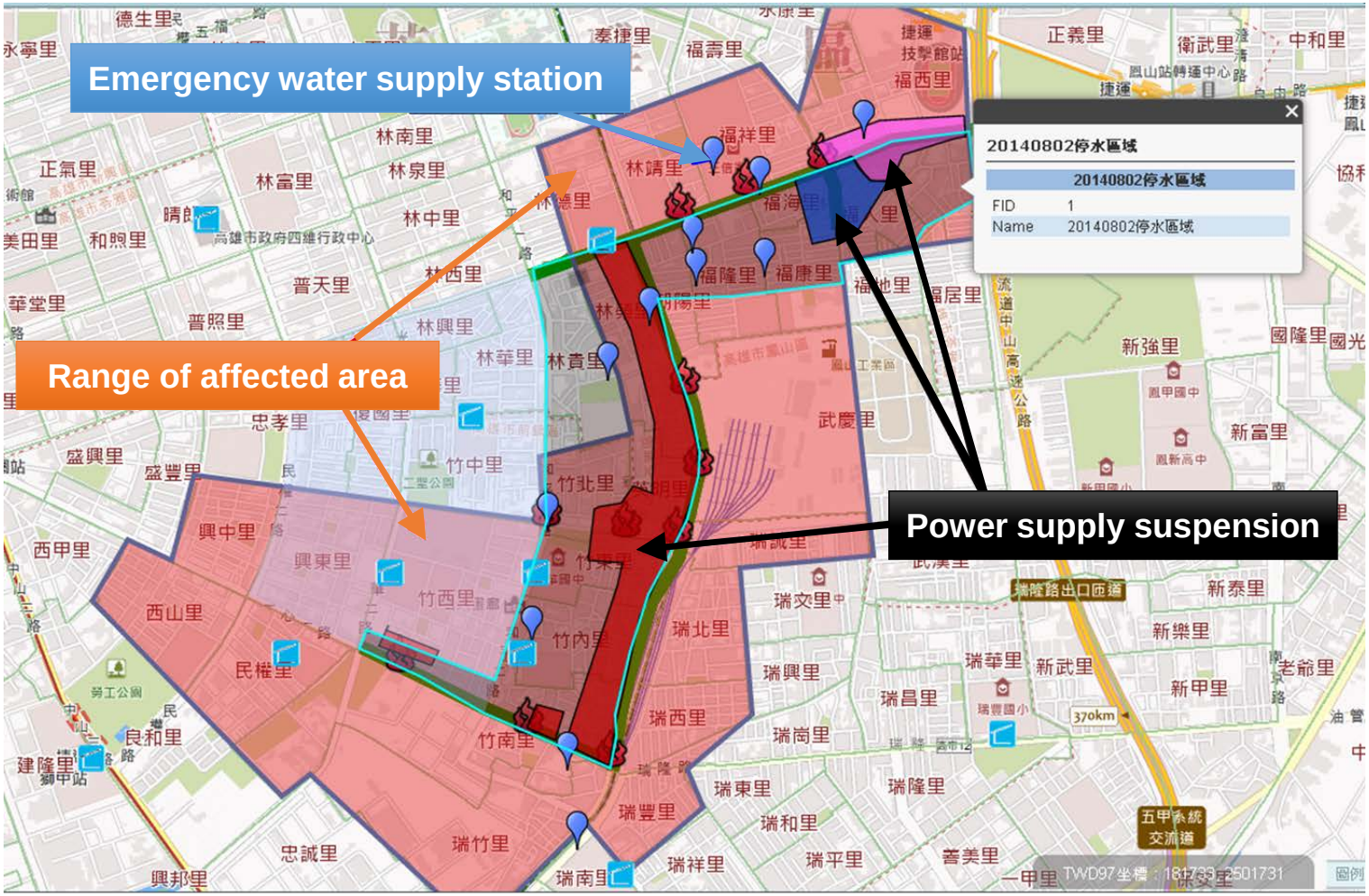
Direct Impact and Loss

- Affected area: 2~3 km^2
- Destroyed street: 14 km
- 32 dead, 321 injured

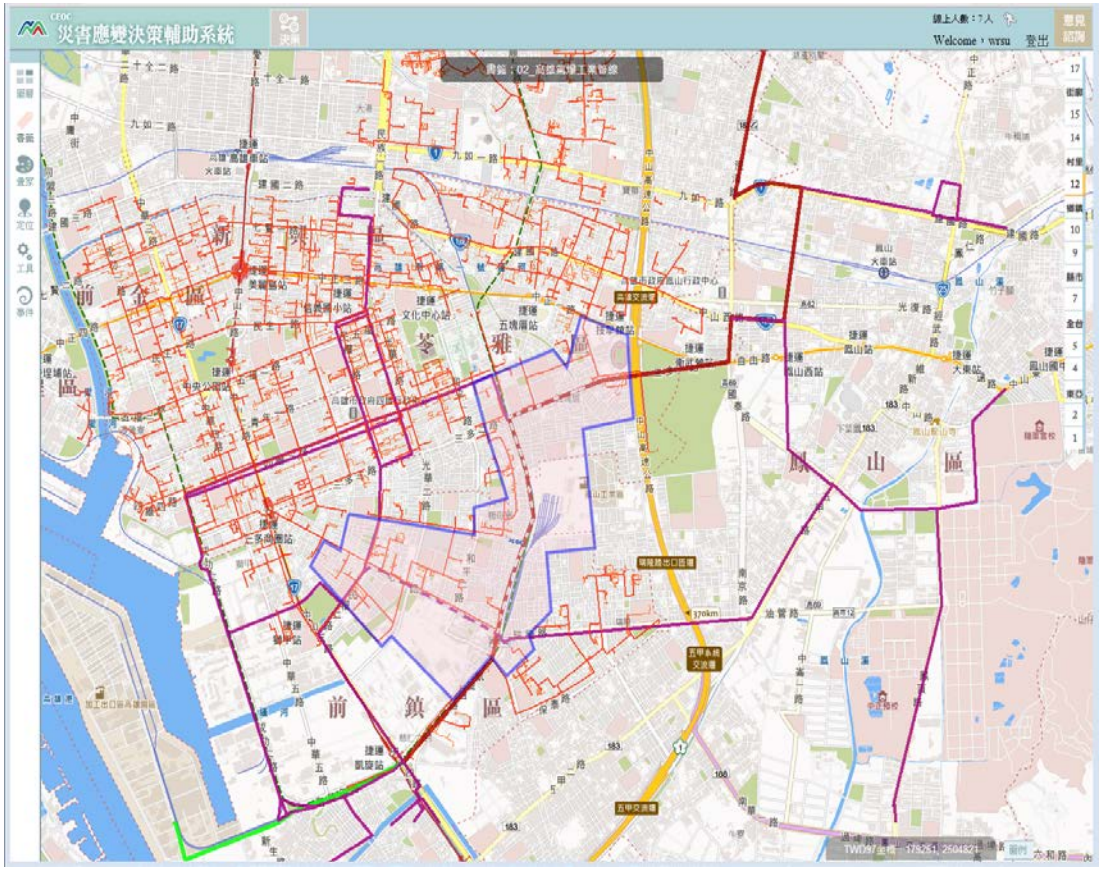
Causes

- Propane leaking from a rusty petrochemical pipe to the sewer system and explode

To identify suspensions of public services, emergency water supply station and affected area



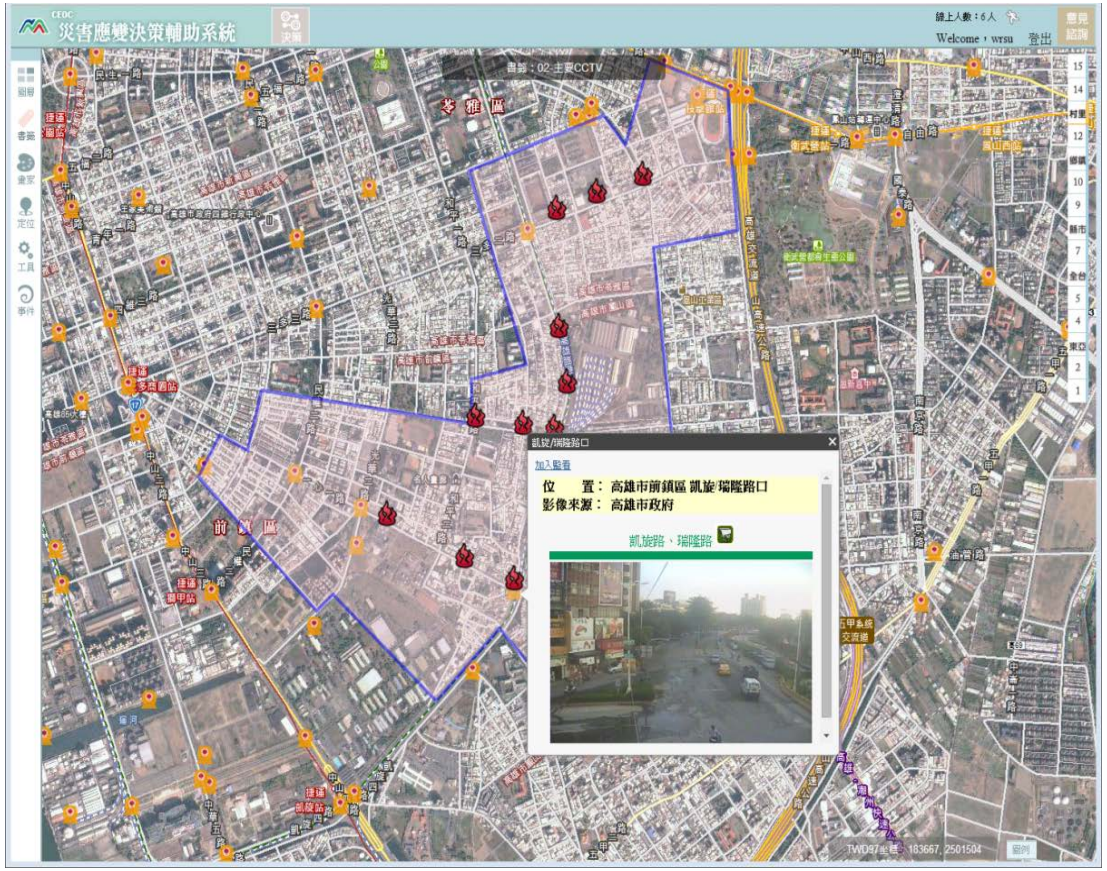
Pipelines under the area including natural gas and petrochemical material



Required data for geo-spatial construction

- Street maps
- Pipeline system: **petrochemical material, tap water, natural gas, power, telecommunications and drainage**
- Locations explosion with time factors
- Aerial images of Prior-and post-explosion
- Locations of shelters
- Affected areas
- Time frame of recovery work
- Data sources: **central and local governments, industrial sector and crowd sourcing**

Thought functions of CCTV to monitor the affected site

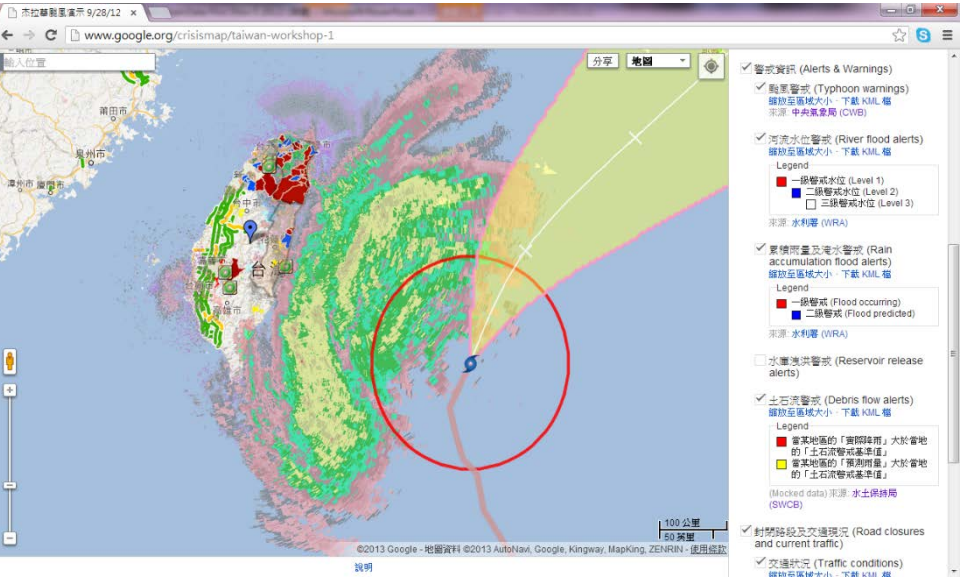


Application of CCTV

- Original purposes
  - **Observations of flash flood, road closure, water levels, reservoir operations, landslide and etc.**
- For monitoring gas explosion
  - **Traffic volume, traffic control, progress of recovery and etc.**
- Locations of explosion with time factors
  - **Central and local governments, industrial sector and crowd sourcing**
- Next phase
  - To include all IP CCTV in urban areas

Application 7:
Information to the general public
– collaboration with Google's services

- **Industry, government, academia and personal APP developer, all apply for interfacing alert data**
- **Google services starts in 2013/07/10, using our platform's service**
- **In 2014, 15 million of users ever visited to check during two typhoons**



Google Crisis Map

Google Alerts

Make "Big data" "open and actionable"

Conclusions and future challenges

- **In order to apply "Big data" for better emergency preparedness, the major challenges to overcome**
  1. **Volume: overwhelming amount of data sets, how to identify relationship for integration**
  2. **Velocity: during urgent moments, pop-up situations and information could hamper decision making**
  3. **Varity: different and diverse data sets are required to delivered information or maps by request**
  4. **Verification: duplications or rumors from difference sources need rules and synergy to focus real issues**


Thanks for your
listening