# Designing a Decision Support System for Disaster Management

**Hsueh-Cheng Chou** 

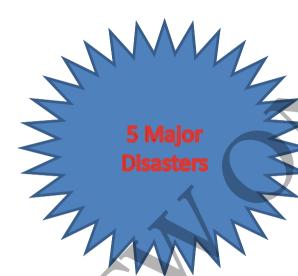


National Science & Technology Center for Disaster Reduction Department of Geography, National Taiwan Normal University

### Major Types of Natural Disasters in Taiwan



Earthquake





Landslide



Typhoon

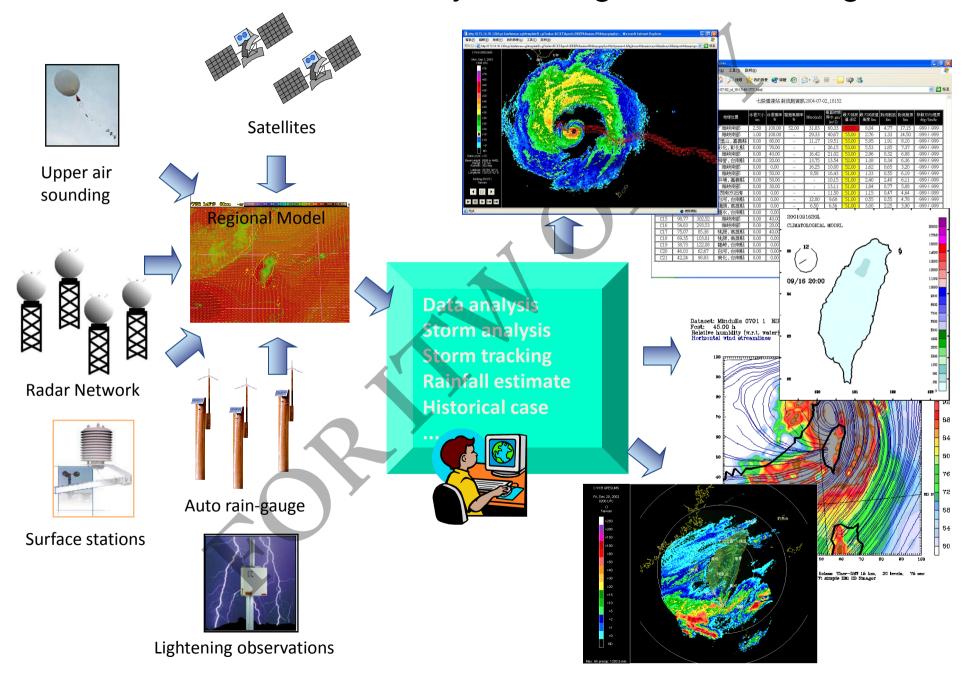


Flood

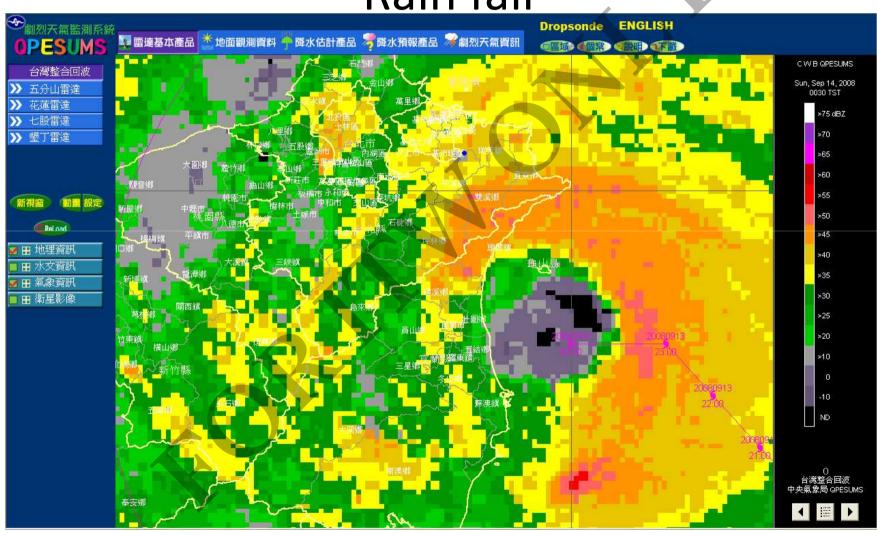


**Debris flow** 

## Severe Weather Early Warning and Monitoring



# Central Weather Bureau -Rain fall



## **Debris Flow**

## Soil and Water Conservation Bureau



## **Debris Flow Warning**

#### Meteorological data

Forecast rainfall distribution

**Threshold** 

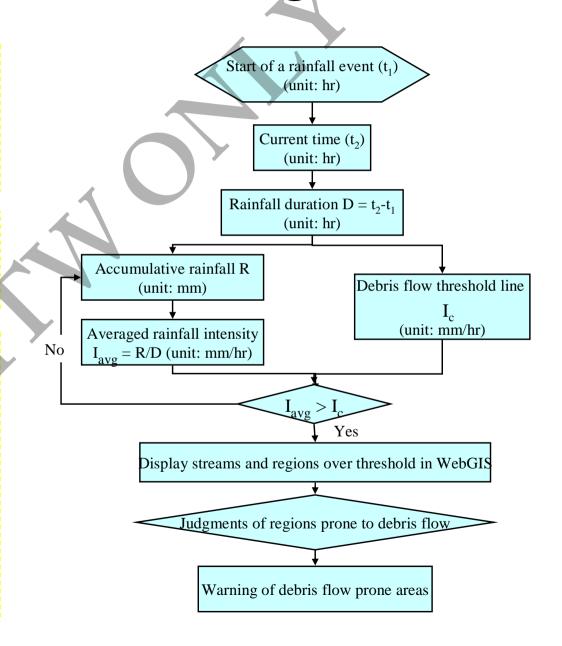
Slopeland disaster threshold

#### **Forecast disaster locations**

Disaster location of the same typhoon tracking before vs. rainfall distribution

Slopeland disaster Vulnerability

Forecast traffic interruption location



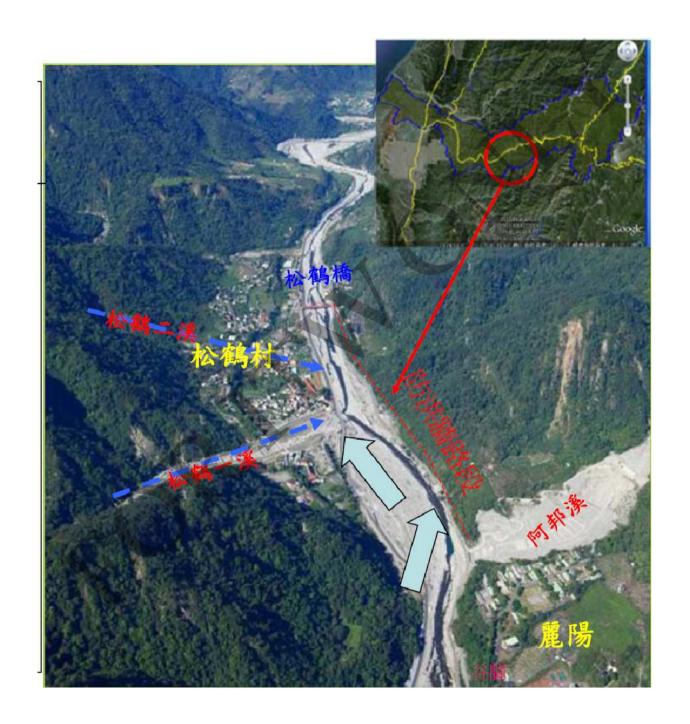
# Flooding Water Resources Agency

站上人數:003  小災資訊 水災地  摘要資訊  氣象資訊	力	k位統計	事件 <b>表</b>	2009_11	11豪雨 2009/11/21 16~ 全部水位站 <b>運出為Excel</b> 設定筆數: 15 超過一級警戒 超過二級警戒 超過三級警戒 全部水位站 1 2 3 4 5 6 7 8						
雨量資訊 水位資訊	序				目前水位		一級警戒 (公尺)	二級警戒 (公尺)	三級警戒 (公尺)	堤J (公	<b>育高</b> 尺)
	齈	河川島	站名	流域	<u>最新時間</u>	分尺	警戒差(警戒値)	警戒差(警戒値)	警戒差(警戒値)	堤頂差	堤頂高
	1	第四河川局	桶頭(2)	濁水溪	11/23 09:40	186.8	-43.2 (230.0)	-41.4 (228.2)	-40.2 (227.0)	-48.3	235.1
水位即時資訊(表)	2	第四河川局	<u> 内茅埔</u>	濁水溪	11/23 09:40	471.1	-6.5 (477.6)	-6.1 (477.2)	-3.5 (474.6)	-10.4	481.5
diversity of all the second	3	第四河川局	延平橋	濁水溪	11/23 09:40	157.3	()	()	()		
	4	第四河川局	<u> 彰雲橋</u>	濁水溪	11/23 09:40	88.3	-8.9 (97.2)	-8.2 (96.5)	-7.2 (95.5)	-14.7	103.0
員山子分洪資訊	5	第四河川局	自強大橋	濁水溪	11/23 09:40	10.7	-10.2 (20.9)	-9.5 (20.2)	-8.1 (18.8)	-13.7	24.4
Element 1	6	第四河川局	玉峰橋	濁水溪	11/23 09:40	264.3	-6.2 (270.5)	-5.5 (269.8)	-3.7 (268.0)	-10.5	274.9
	7	第四河川局	水里	濁水溪	11/23 09:40	264.9	-4.6 (269.5)	-4.2 (269.1)	-2.6 (267.5)	-8.1	273.0 '
<b>淹水資訊</b>	8	第四河川局	溪州大橋	濁水溪	11/23 09:40	20.6	-8.9 (29.5)	-7.9 (28.5)	-5.7 (26.3)	-13.1	33.7
水庫資訊 一選度資訊	9	第四河川島	<u>簪石橋</u>	濁水溪	11/23 09:40	346.8	()	()	()		
海岸資訊	10	第四河川局	西濱大橋	濁水溪	11/23 09:40	3.6	()	()	()		
開設、値勤及整備資訊	11	第十河川局	新海大橋	淡水河	11/23 09:30	-0.7	-10.9 (10.2)	-8.4 (7.7)	-3.5 (2.8)	-12.3	11.6
抽水機資訊 災情資訊	12	第十河川局	台北橋	淡水河	11/23 09:30	-1.1	-9.6 (8.5)	-7.8 (6.7)	-3.3 (2.2)	-11.1	10.1
常用網站	13	第十河川局	土地公鼻	淡水河	11/23 09:30	-2.4	()	()	()	-12.4	10.0

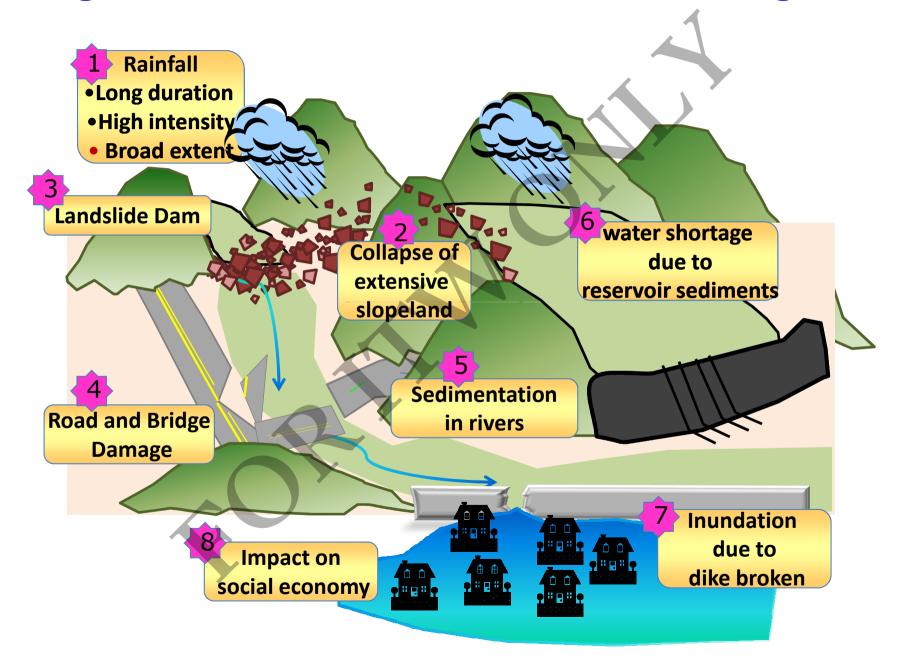
## **Highway System Conditions**

**Directorate General of Highways** 





## Integrated view and coordinated Management



# Complex IT System Top-down design or bottom-up approach

Hazard Management Sloped Land Hazard Management **Debris flow Evacuation** 

# Keys to Integration - Dialog



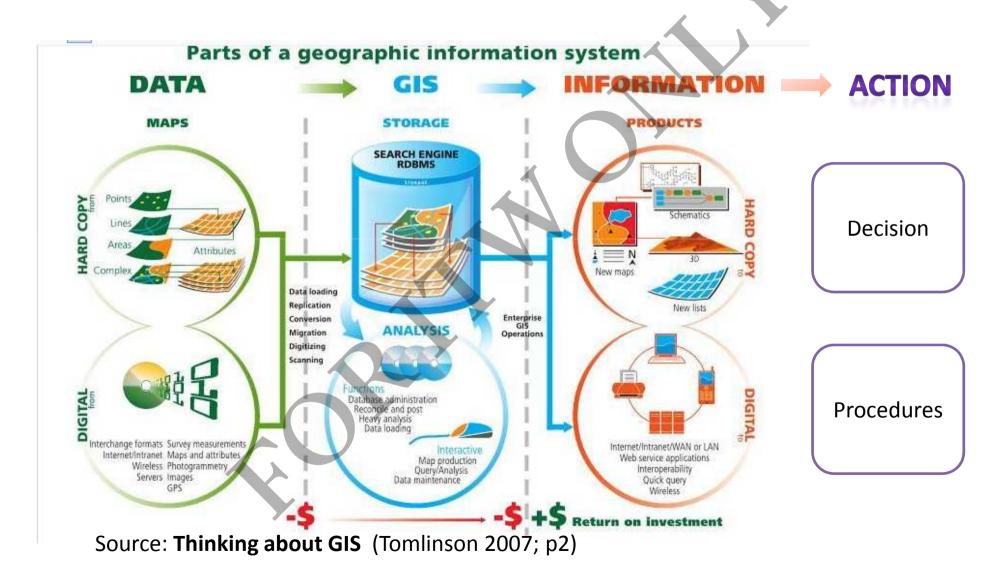
## 2011中央災害應變中心 颱風豪雨災害情資研判作業研習會

- Managers/ Directors
- Domain ExpertsIT Professionals

# Keys to Integration – Information Sharing



## From Data to Action



# Components of DSS

#### Personnel

- Programmer
- Domain Expert
- Weatherman

#### Hardware

- Computers
- network

### GOAL

- whom
- where
- What

#### Software

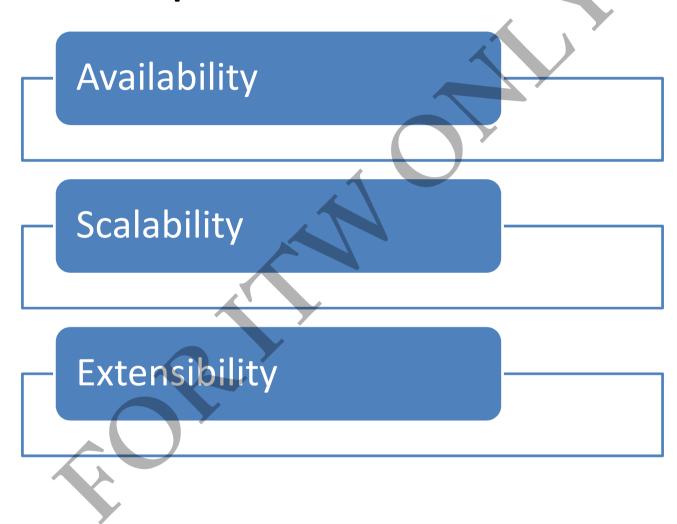
- GIS
- Models
- OS

#### Data

- Quality
- Format



# Requirements of DS\$



## Scalability

#### **Disaster Response**

**Global Incident Viewer** 

**GIS Aids Disaster Relief** 

#### Get maps and assistance for the following incidents









**Earthquakes** 

Flooding

Severe Weather

Wildfires

#### We can help provide you with

- Esri software temporary or replacement software for what has been lost or destroyed
- Data and Imagery
- · Consulting, project assistance, and technical support

Learn more about GIS for disaster relief

#### Global Incident Viewer

See where volcanoes, earthquakes, fires, and cyclones are happening right now.

Launch map



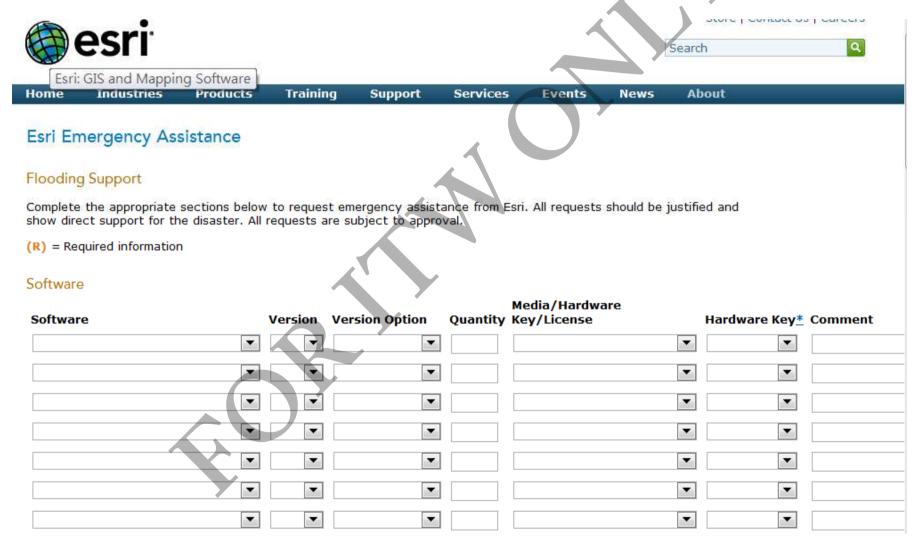
Contact Us

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| Site Map

Source: http://www.esri.com/services/disaster-response/

## Request for Software



Source: http://www.esri.com/apps/company/assist/index.cfm?eventID=121



# An Integrated DSS for CEOC

### DSSs of Agencies





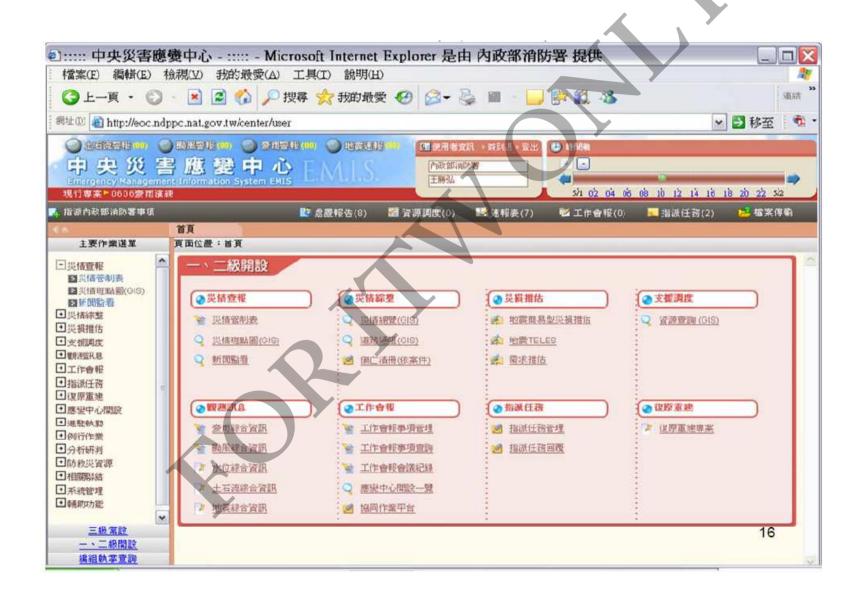




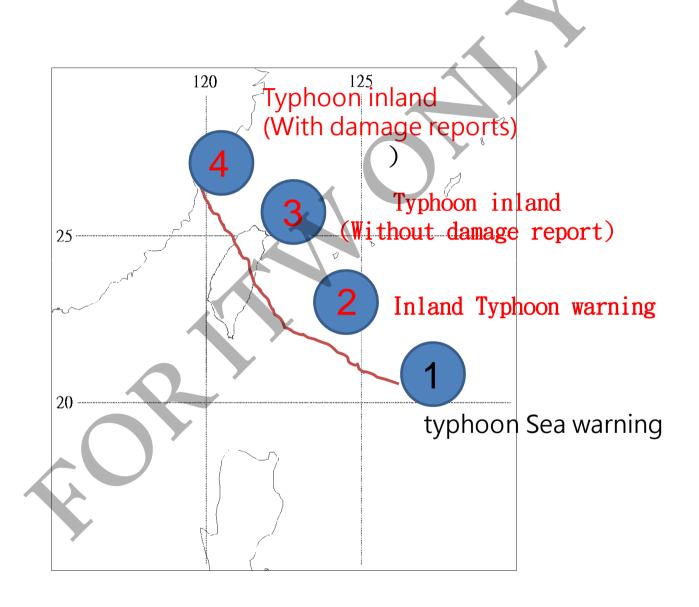
#### Integrated View at CEOC



## **Emergency Management Information System**



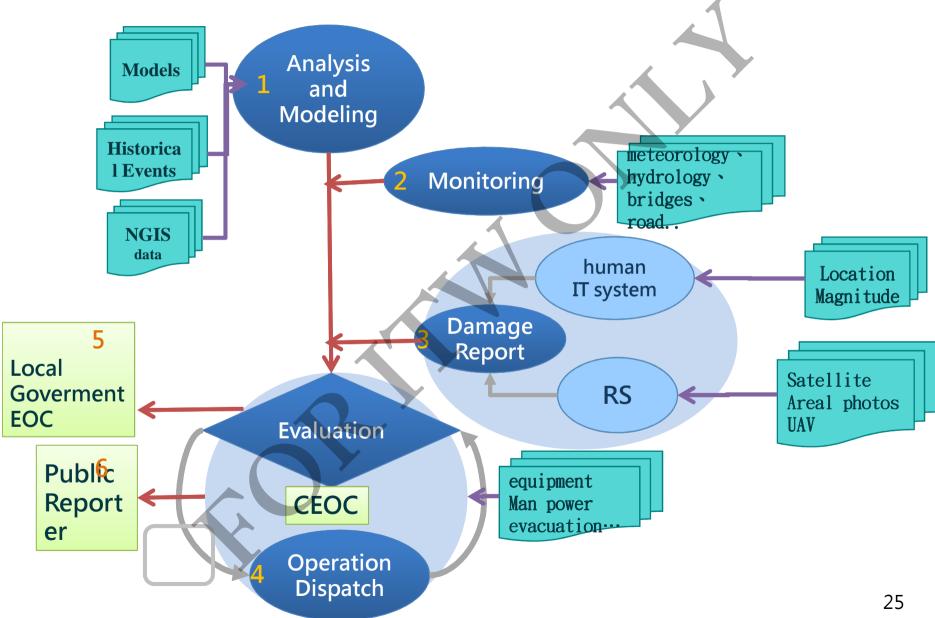
## Different Phrases of a Typhoon Eve



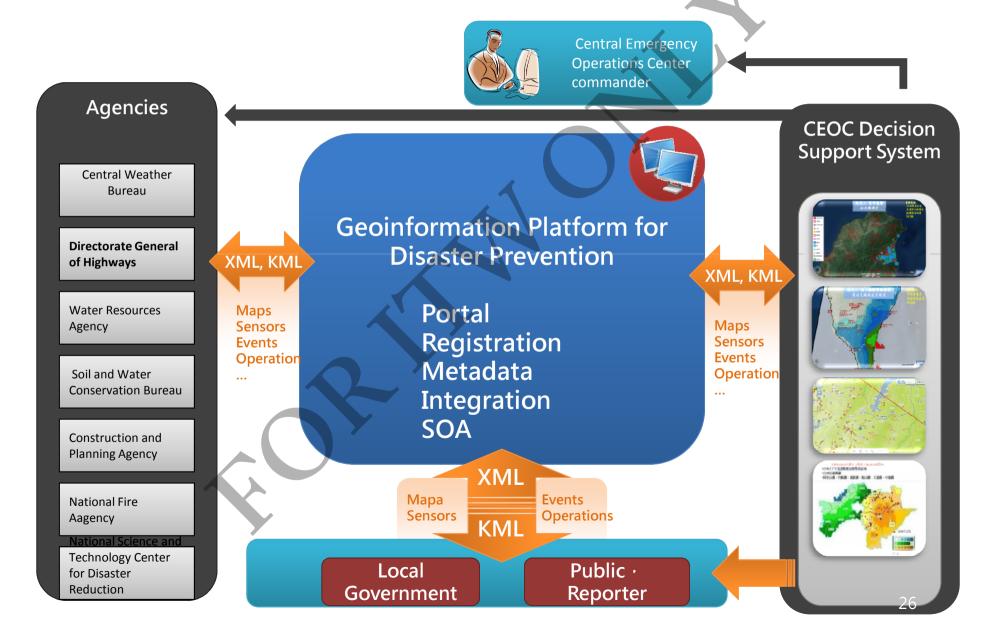
## Information Required at Different Phrases of a Typhoon Event

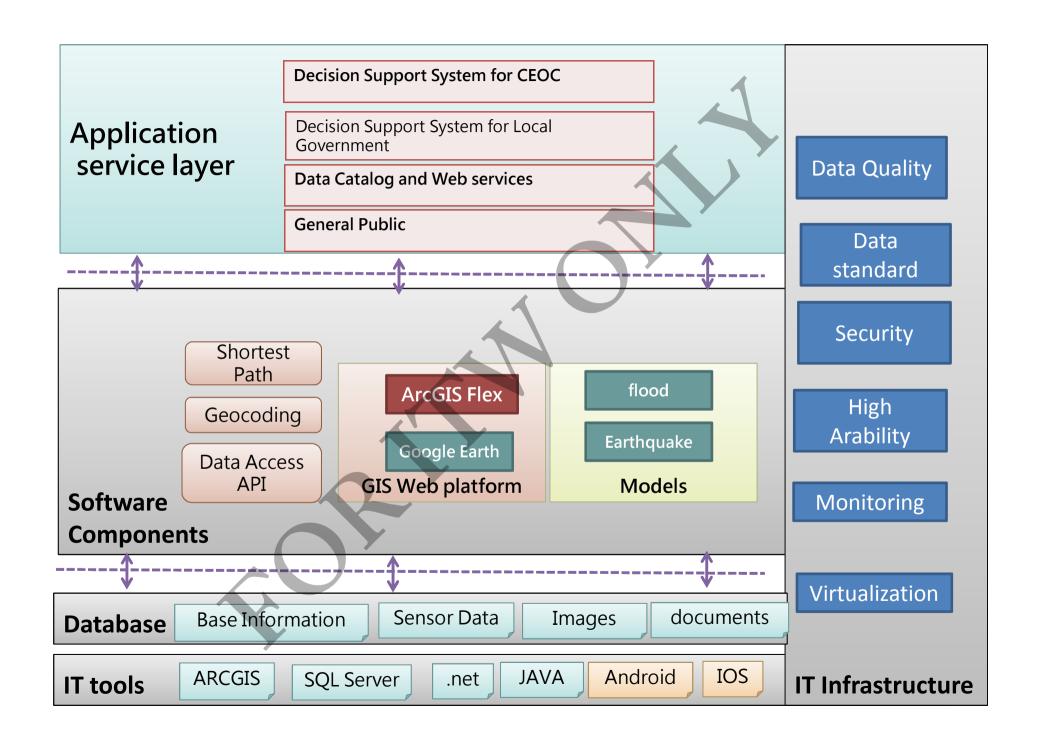
	Phases	Information requirement
1	typhoon sea warning	<ul> <li>✓ Historical Typhoons with similar path</li> <li>✓ Rainfall at different scenario</li> <li>✓ Reservoir, water level and tidal information</li> <li>✓ Possible affected Areas</li> <li>✓ Area requrid special concern</li> </ul>
2	Inland Typhoon warning	<ul> <li>✓ Rainfall at different scenario</li> <li>✓ Reservoir, water level and tidal information</li> <li>✓ Possible affected Areas</li> <li>✓ Area requrid special concern</li> <li>✓ Pre-position of resources</li> </ul>
3	Typhoon inland ( Without damage report)	<ul> <li>✓ Present Rainfall and future trend</li> <li>✓ Reservoir, water level and tidal information</li> <li>✓ Area requrid special concern</li> <li>✓ Possible affected Areas</li> <li>✓ Evacuation situation</li> <li>✓ Operational status of disaster prevention facilities</li> </ul>
4	Typhoon inland ( With damage reports)	<ul> <li>✓ Present Rainfall and future trend</li> <li>✓ Reservoir, water level and tidal information</li> <li>✓ Real-time disaster report</li> <li>✓ Prelimitary analysis of disasters cause</li> <li>✓ Shelter \ transportation \ utlitities</li> <li>✓ Disaster relief situation</li> <li>✓ Coordination of disaster relief resources to be deployed</li> </ul>

## Integrated Information Flow

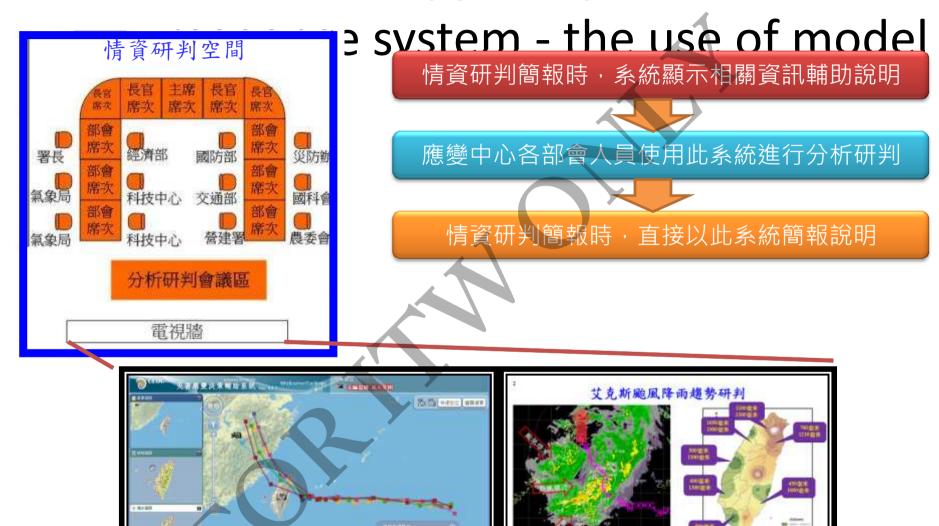


## National Geographic Information System Disaster Prevention Working Group





## Decision support systems disaster



電視牆畫面

· 既累特而受土率山區向營之超過注1908~2200元素。平地注1933元票以上;中南 群山區市起源1290-1290元素。平地超過200~1500元素。東平軍地區降南諸道港 減減。東灣總域有機會引進市南亞道。中南部山區仍有機會在運動等向議意。 東洋原本仍立衛工、建展西山仍發展化向降由等。目前立於繁空即經過,且原施

# **CEOC Decision Support System**



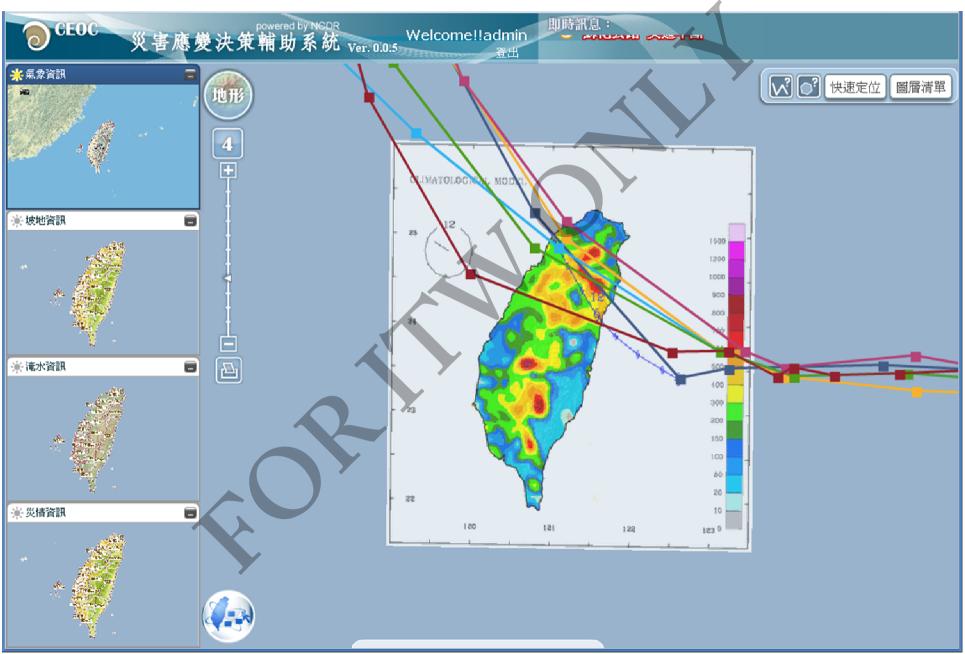
Modules

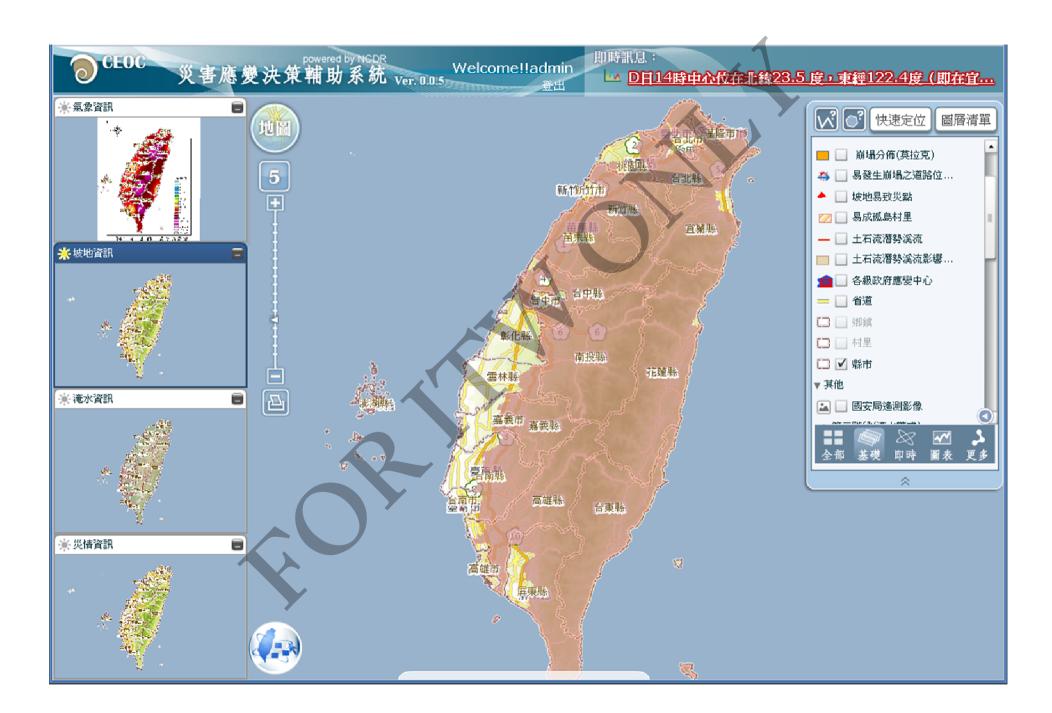


## **Typhoon Path Prediction**

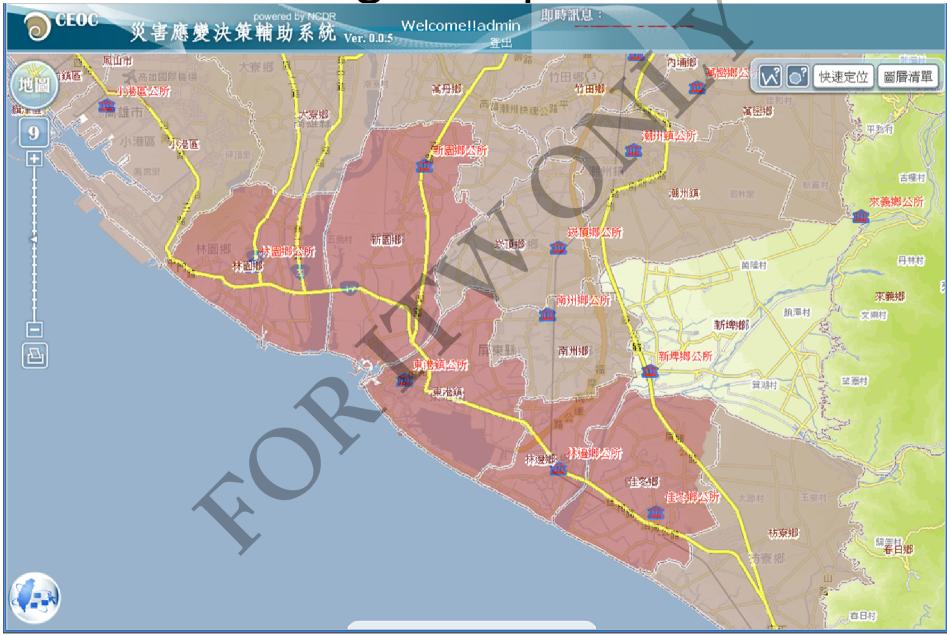


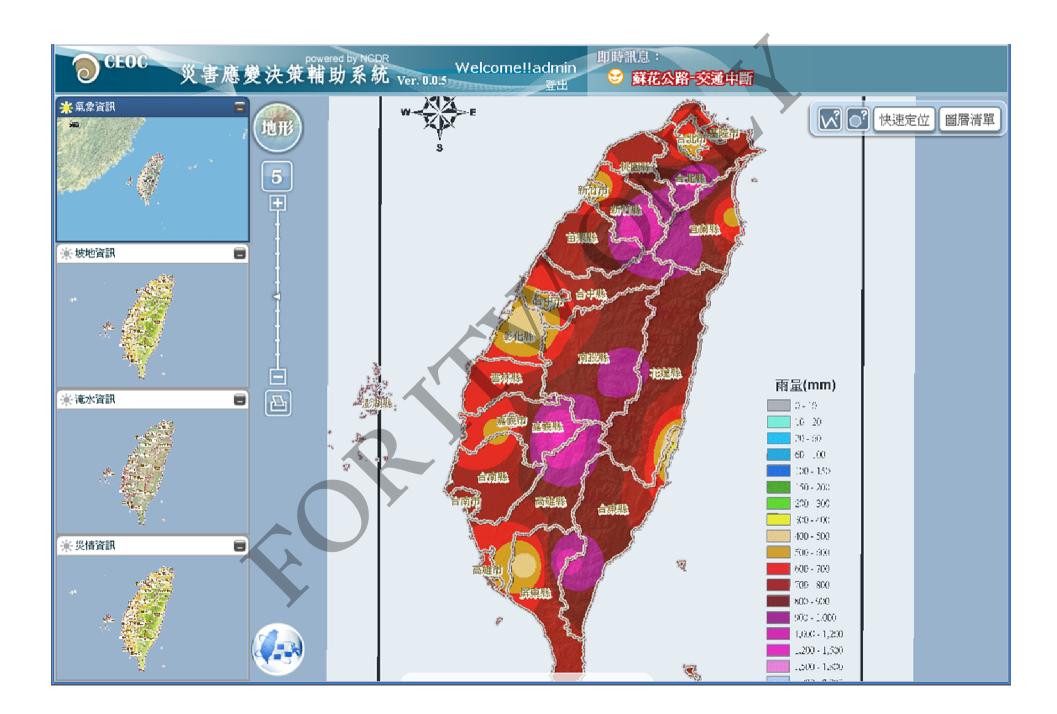
## rainfall Predication



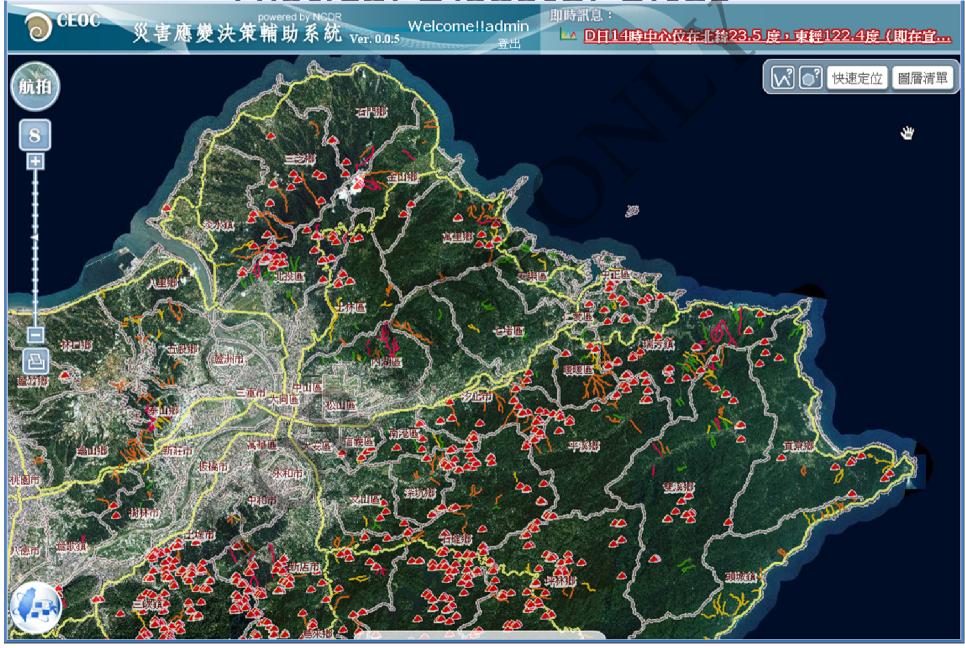


Flooding Area prediction

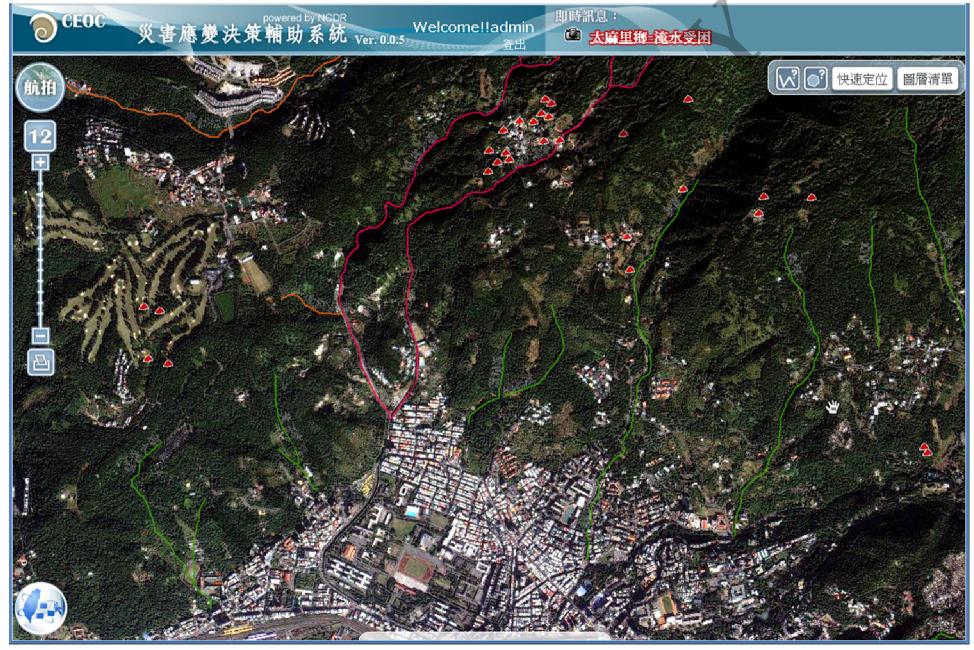




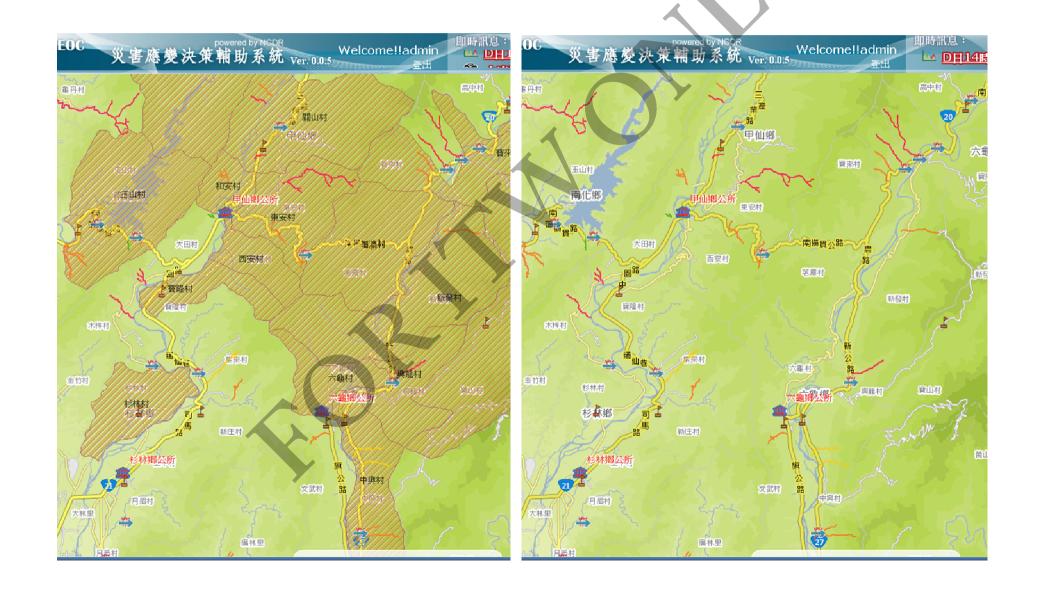
**Histical Disaster Sites** 



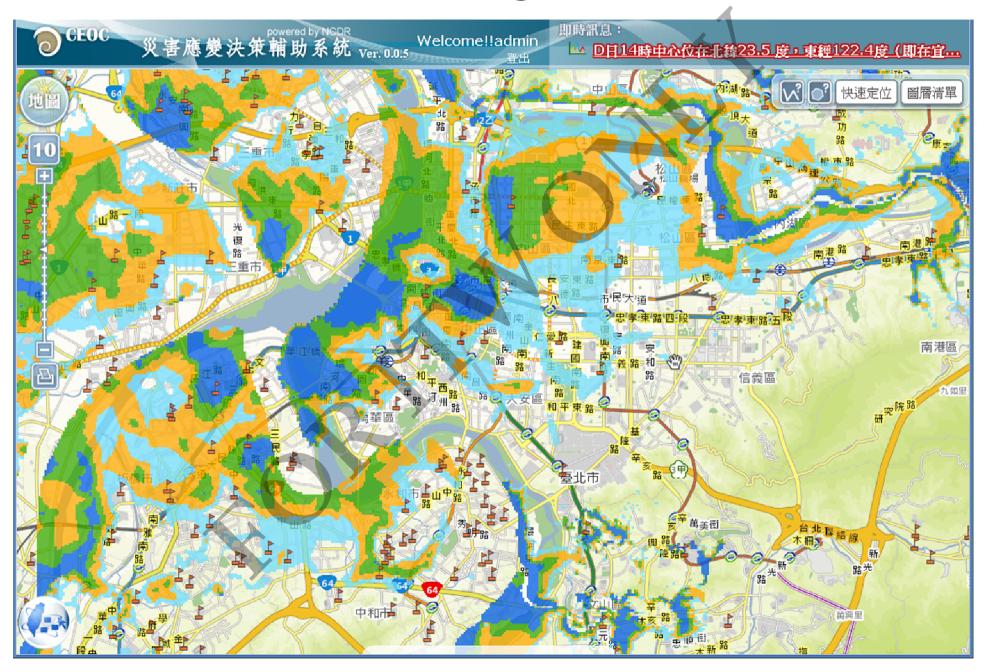
#### Histical Disaster Sites and Predicted debris flows



# Isolated villages 1



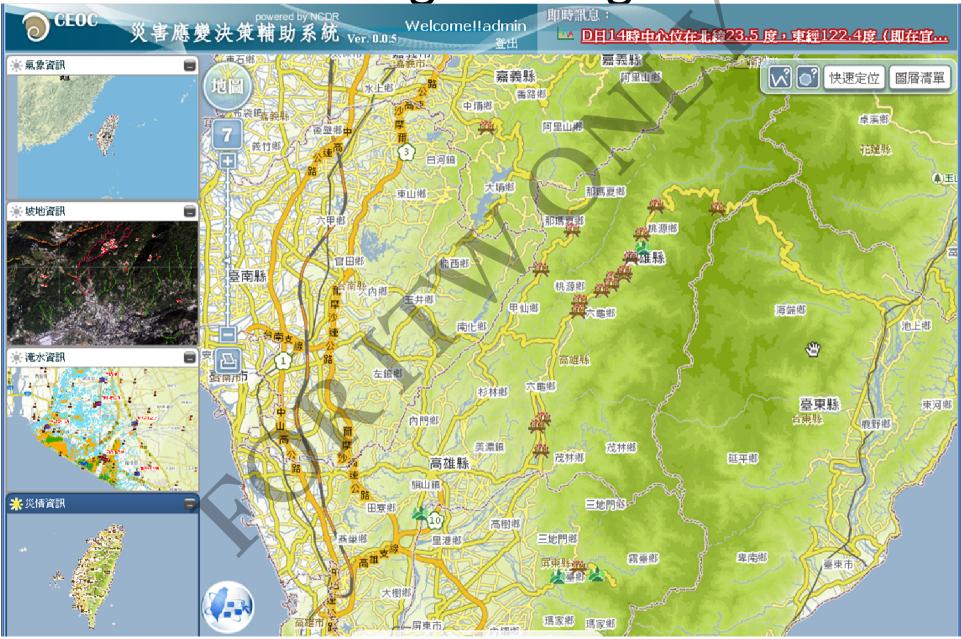
### Flooding Area



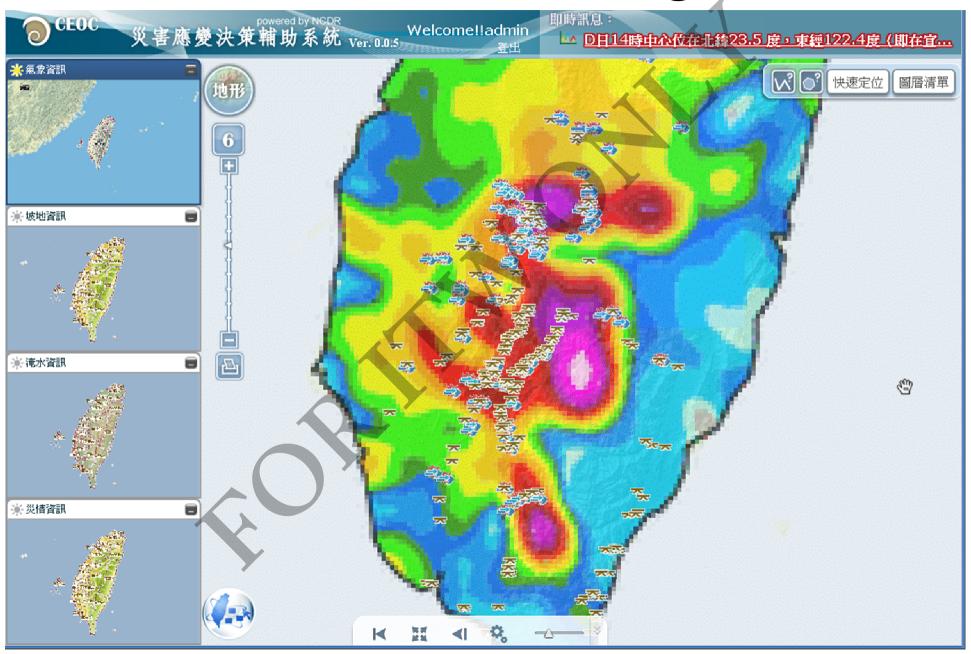
### Damage Reports



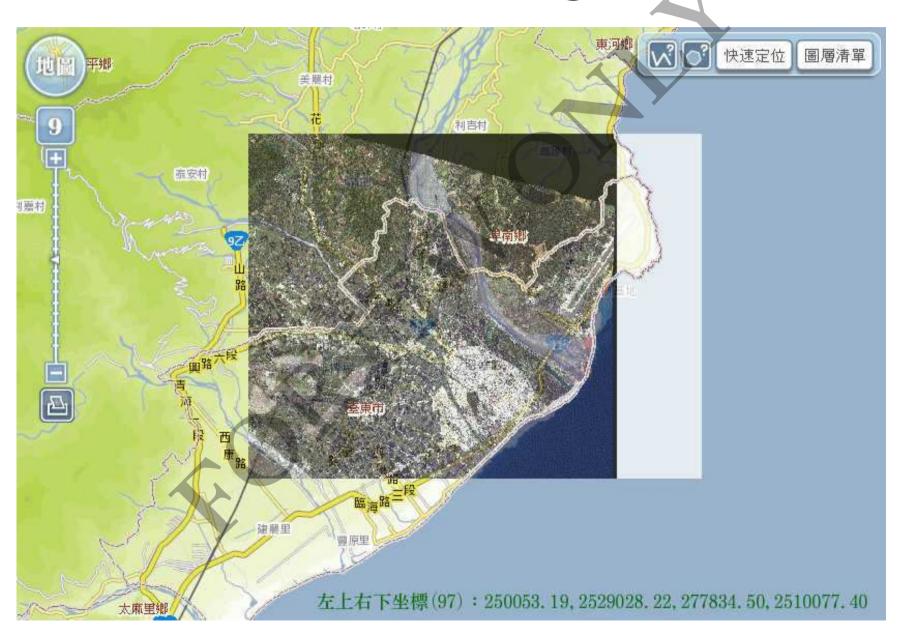
Damaged Bridges

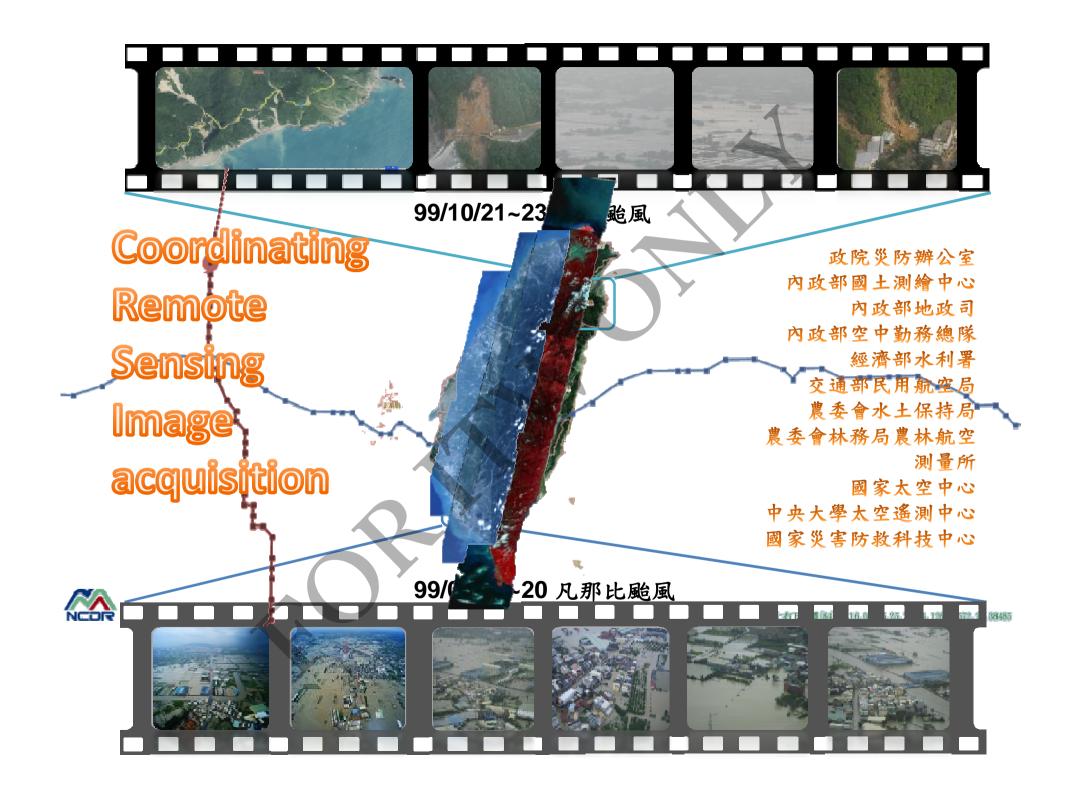


## Rain fall and Damages

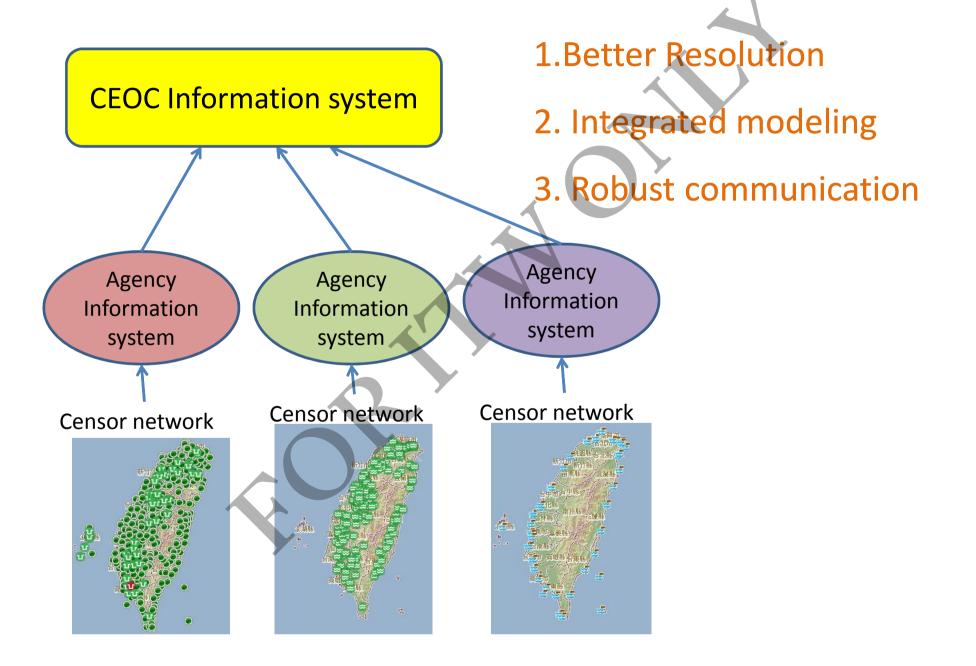


#### Remote Sensing Data

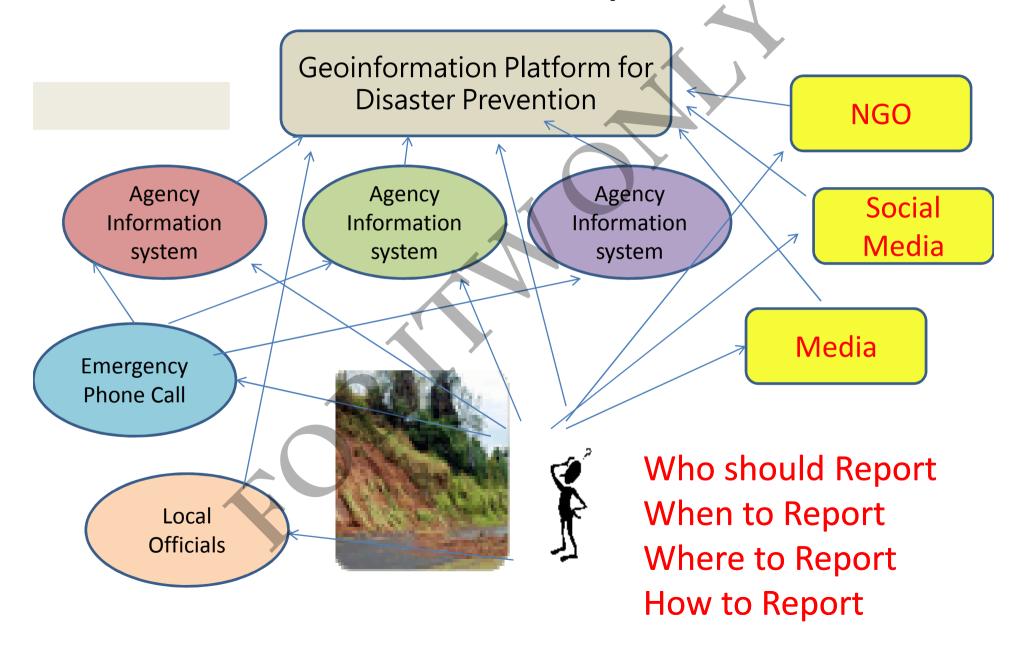




#### Improving Information Flow



#### Situation Reports



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