

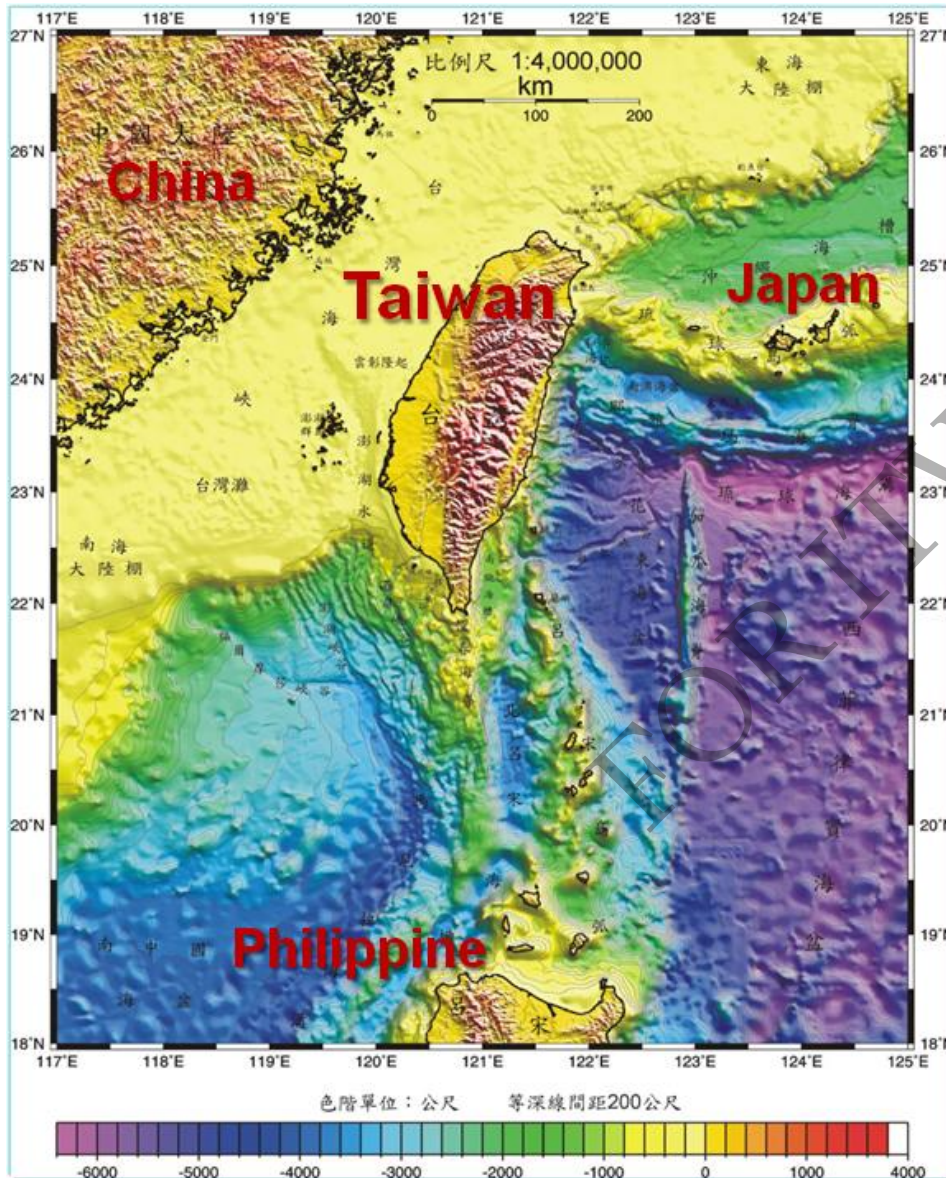


Overview of information technologies on disaster risk reduction and emergency preparedness

Hsueh-Cheng Chou



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



•Geographic features

- 400 km from north to south
- 145 km from east to west
- Area: 36,000 Km² **over 70% in slope land**

•Population (2006)

- 22,900,00 in total, **67.70% in urban areas**
- Density: 633/ Km²** , only lower than Bangladesh

•Tectonic Conjunctions:

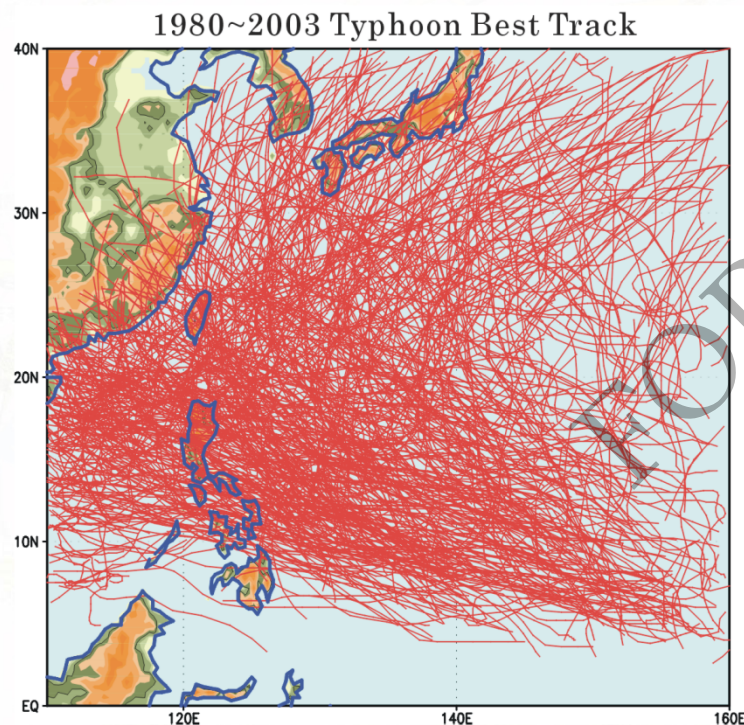
- Philippine Sea plate**
- Euro-Asia Plate**

•High risk of tropical cyclones

- 3.6 typhoons/year**

Economic Losses of Typhoon in Taiwan

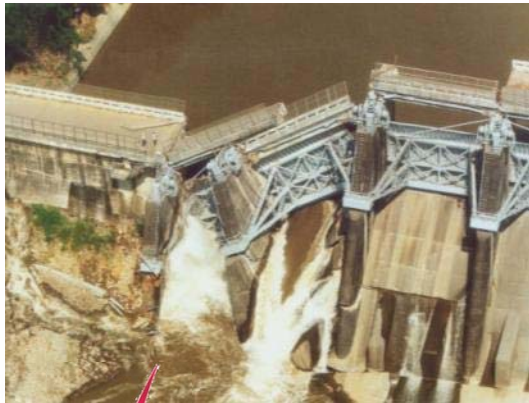
- In average, there are 3.6 typhoons touched down in Taiwan every year
 - In 2001, 8 typhoons attacked Taiwan
 - In 2004, 6 typhoons swept Taiwan
 - In 2005, 3 category-4 typhoons hit Taiwan



Typhoon	Death	Injure	Agri. Loss (\$US M) (A)	Constr. Loss (\$US M) (B)	Total (\$US M) (A+B)
Chebi	30	124	22.3	0.7	23.0
Trami	5	-	2.2	4.9	7.1
Toraji	214	188	235.7	170.6	406.4
Nari	104	265	126.5	56.7	183.1
Utor	1	6	2.9	7.6	10.5
Total	354	583	389.6	240.5	630.1



World Bank: Major Types of Natural Disasters



✓ earthquake



✓ drought



? volcano



✓ typhoon



✓ flood



✓ landslide

Countries Most Exposed to Multiple Hazards

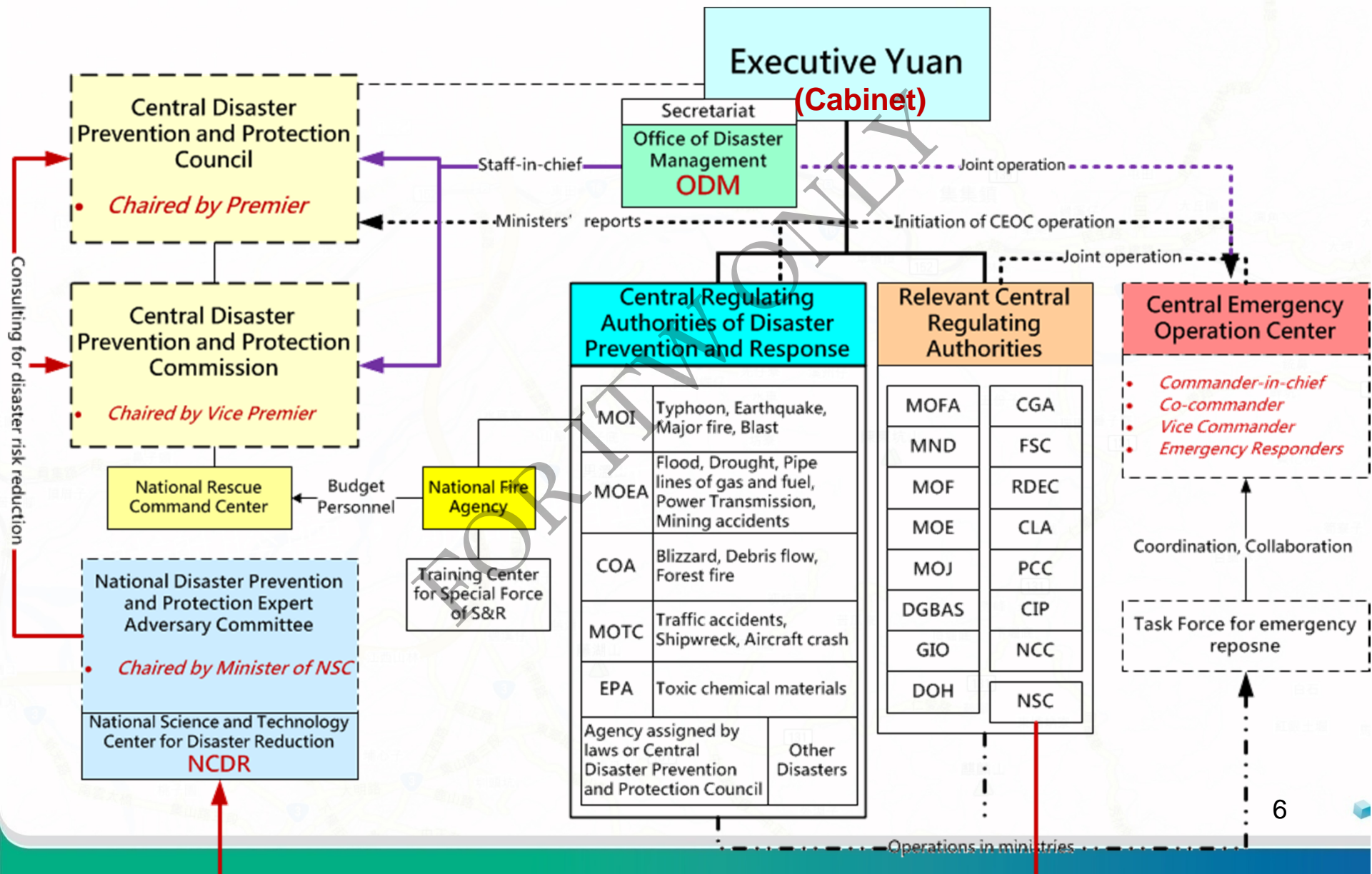
Three or more hazards (top 15 based on land area)

Country	Percent of Total Area Exposed	Percent of Population Exposed	Max. Number of Hazards
Taiwan	73.1	73.1	4
Costa Rica	36.8	41.1	4
Vanuatu	28.8	20.5	3
Philippines	22.3	36.4	5
Guatemala	21.3	40.8	5
Ecuador	13.9	23.9	5
Chile	12.9	54.0	4
Japan	10.5	15.3	4

Source: World Bank, 2005



Organization Structural of Disaster Management



Agencies for Disaster Management



Ministry of the Interior

Earthquake



Ministry of Economic Affairs

Drought



?

Volcano



Ministry of the Interior



Ministry of Economic Affairs



Council of Agriculture

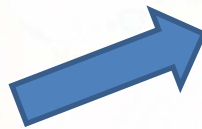
Key elements of succeed emergency response



Typhoon as an examples



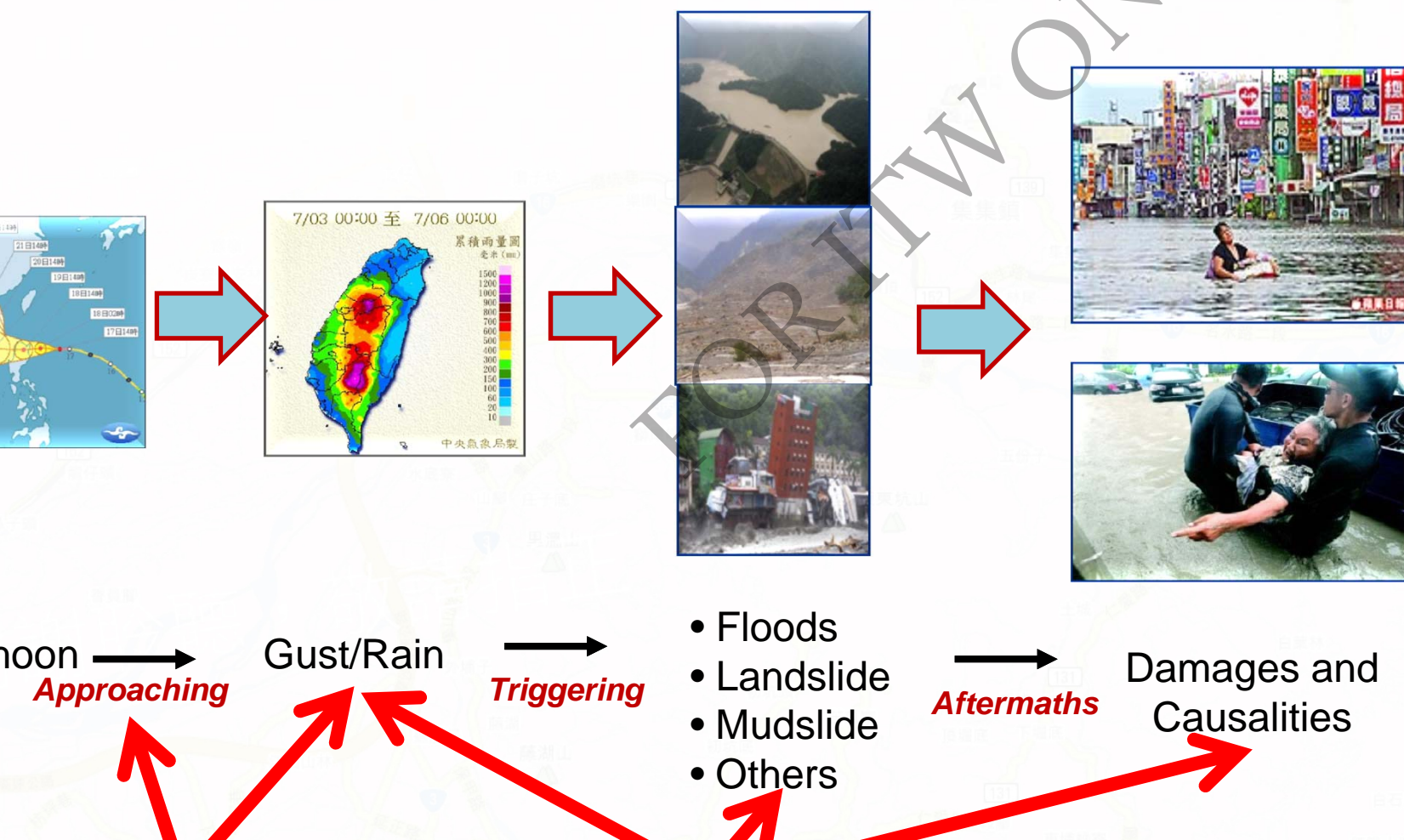
typhoon



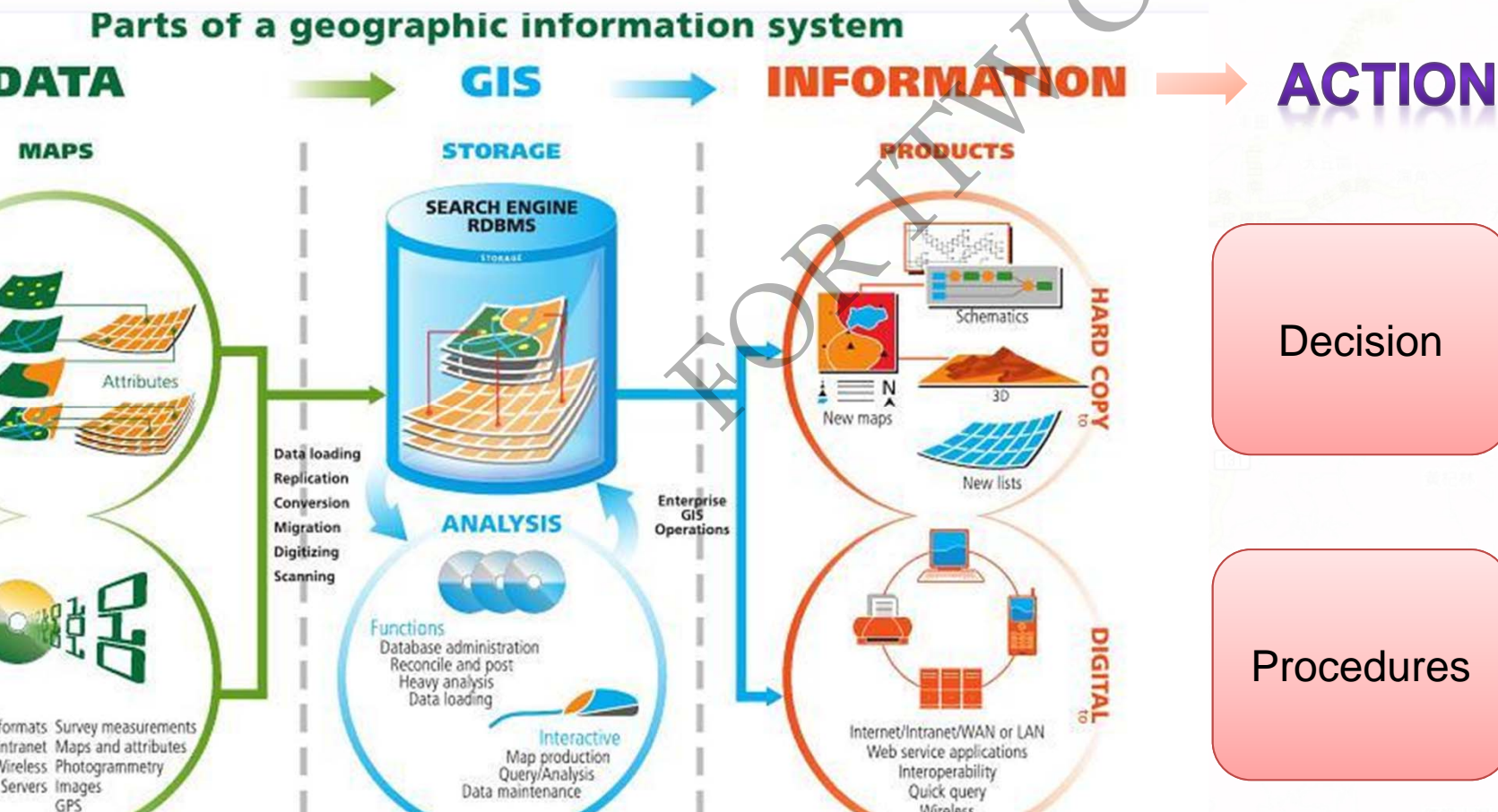
flood



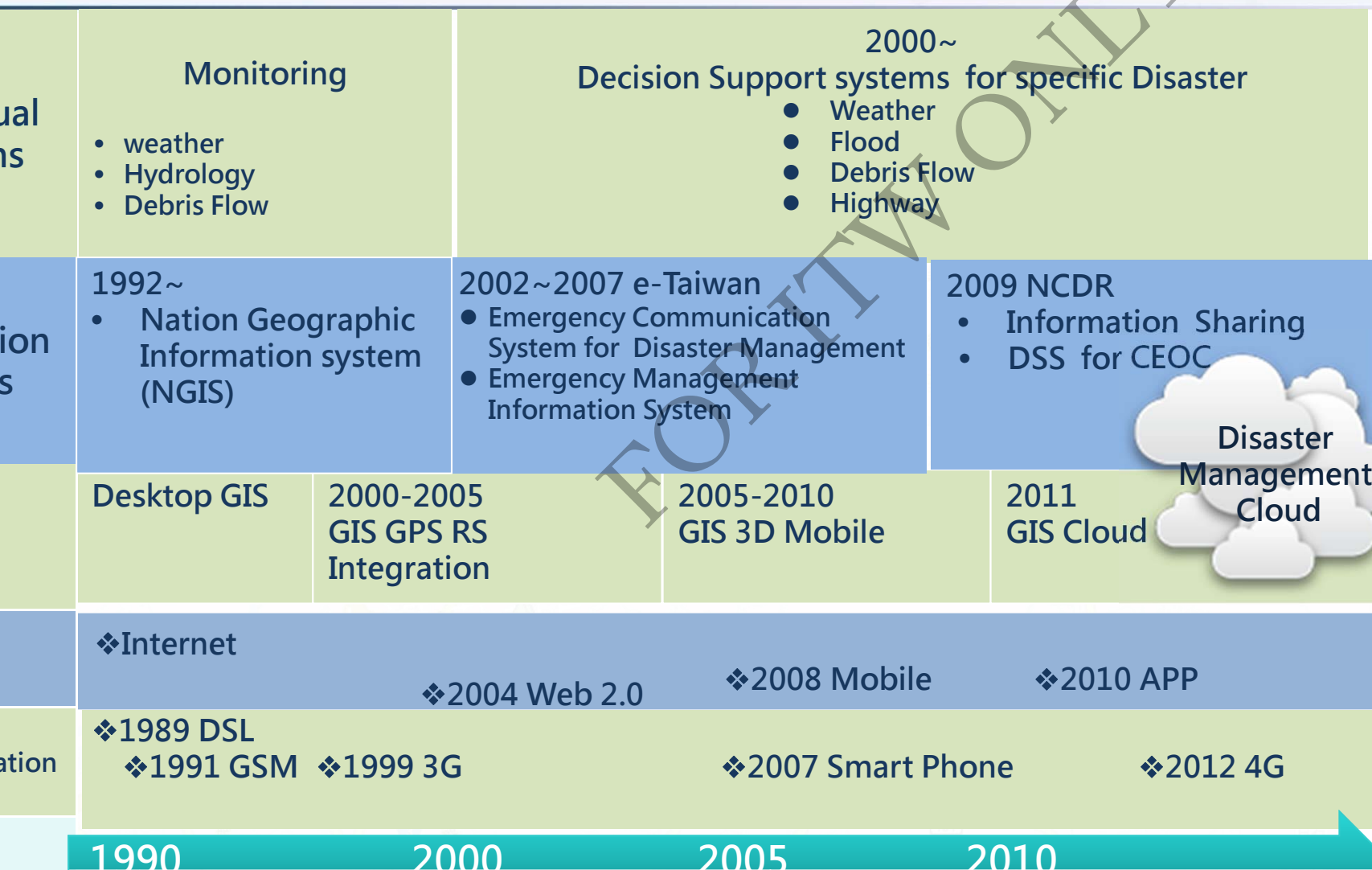
Collaboration and integration between S&T and emergency response



From Data to Action

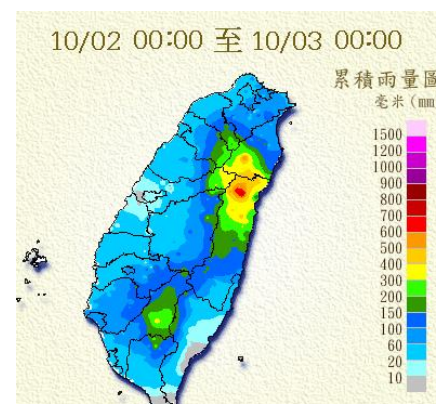
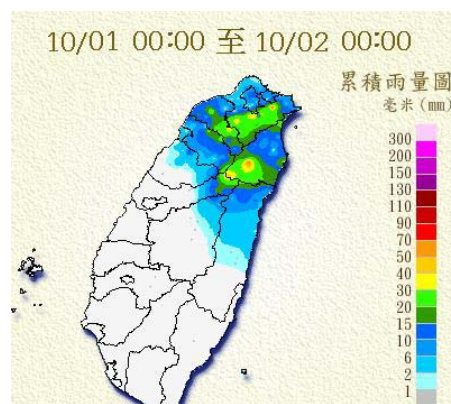
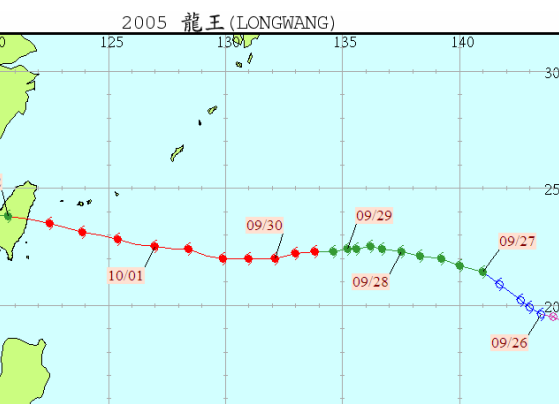
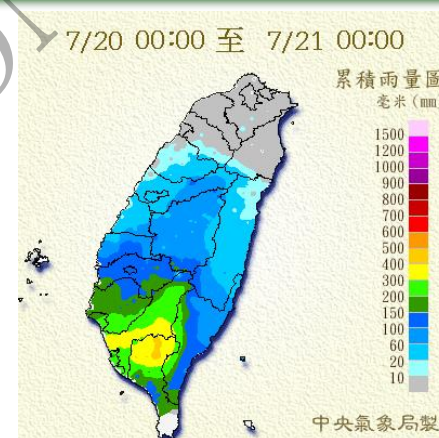
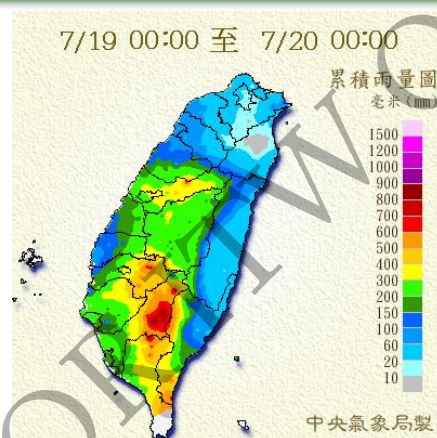
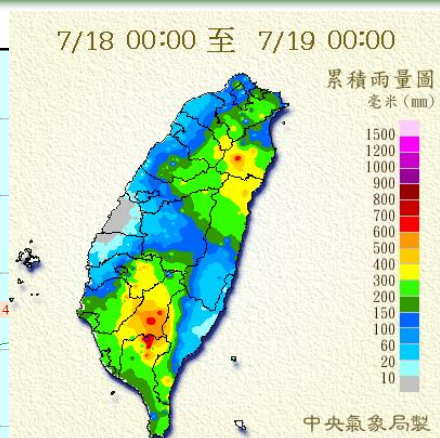
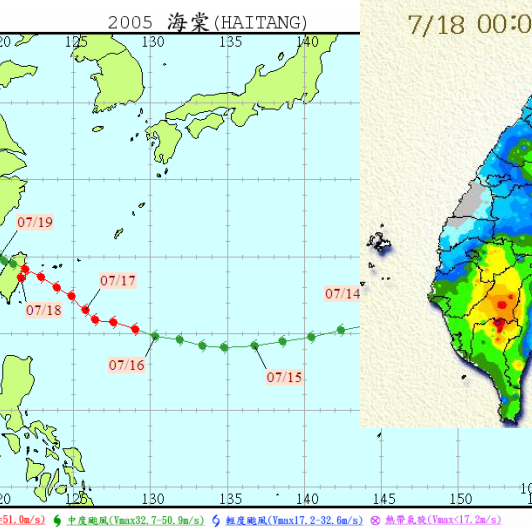


Development of Disaster Management systems

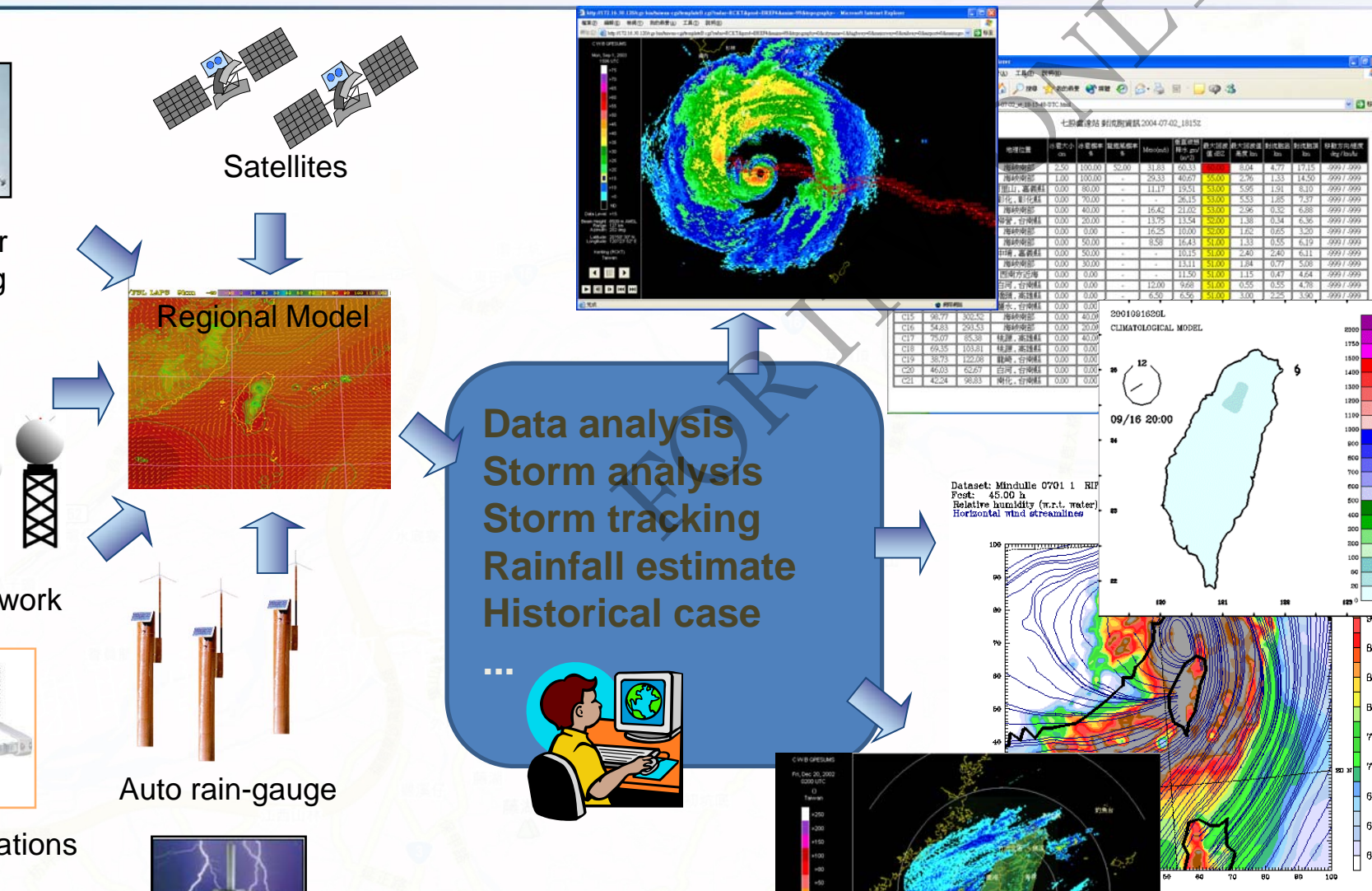


Typhoon Forecast

Central weather Bureau

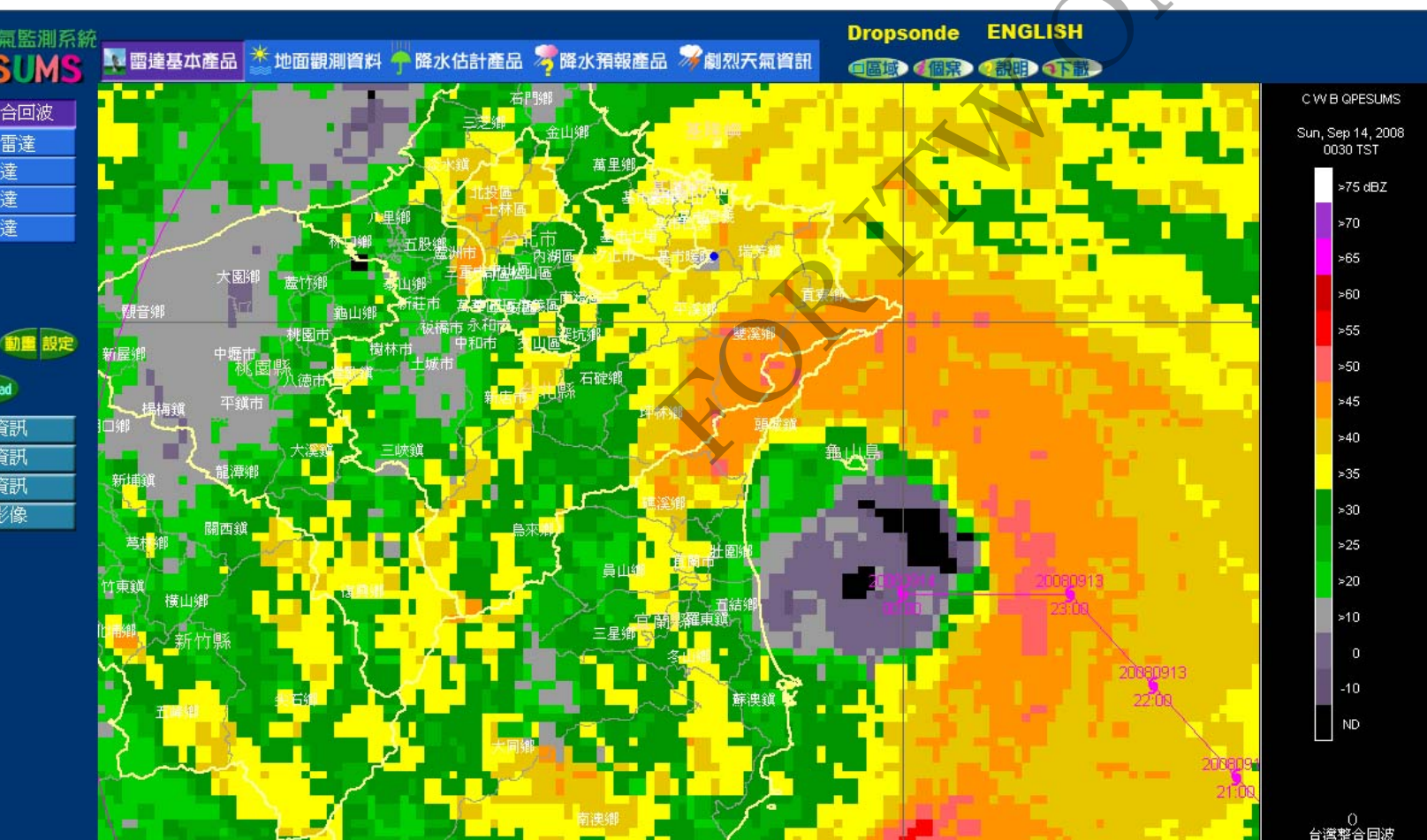


ring
www.ncdr.nat.gov.tw



Central Weather Bureau

-Rain fall monitoring and prediction



Case of Success in mitigation



Debris Flow

Soil and Water Conservation Bureau

土石流防災資訊網
行政院農業委員會水土保持局

土石流警戒基準值 | 防災簡訊 | 土石流防災行動網 | 回首頁

Google Earth 災情管理 簡介說明 + Google RSS

99年土石流潛勢溪流更新為1,552條 土石流防災業務

會員服務 觀測站影像 土石流警戒 土石流分布 即時雨量 衛星雲圖

網站導覽 相關網站

氣象資訊
土石流資訊
土石流學堂
災害紀實
防災業務
相關規定
土石流災害防救業計畫
土石流災害防救業作業手冊
歷年演練場次
歷年宣導場次
歷年自主防災社區
避難路線圖
土石流專家學者
防災教育訓練中心
重要事紀
下載區

Map Satellite Hybrid 水保局圖資

地區清單

宜蘭縣 (共 138 條)
基隆市 (共 34 條)
台北市 (共 50 條)
台北縣 (共 219 條)
桃園縣 (共 51 條)
新竹縣 (共 71 條)
苗栗縣 (共 76 條)
台中市 (共 3 條)
台中縣 (共 98 條)
彰化縣 (共 7 條)
南投縣 (共 218 條)
雲林縣 (共 9 條)
嘉義縣 (共 58 條)
台南縣 (共 48 條)
高雄市 (共 3 條)
高雄縣 (共 79 條)
屏東縣 (共 64 條)
台東縣 (共 163 條)
花蓮縣 (共 163 條)

切换地圖顯示

土石流分布圖

宜蘭縣 顯示

宜蘭DF001 顯示

土石流警戒基準值

宜蘭縣 顯示

三星鄉 顯示

避難路線圖

宜蘭縣 顯示

潛勢溪流新舊編碼查詢

宜蘭縣 顯示

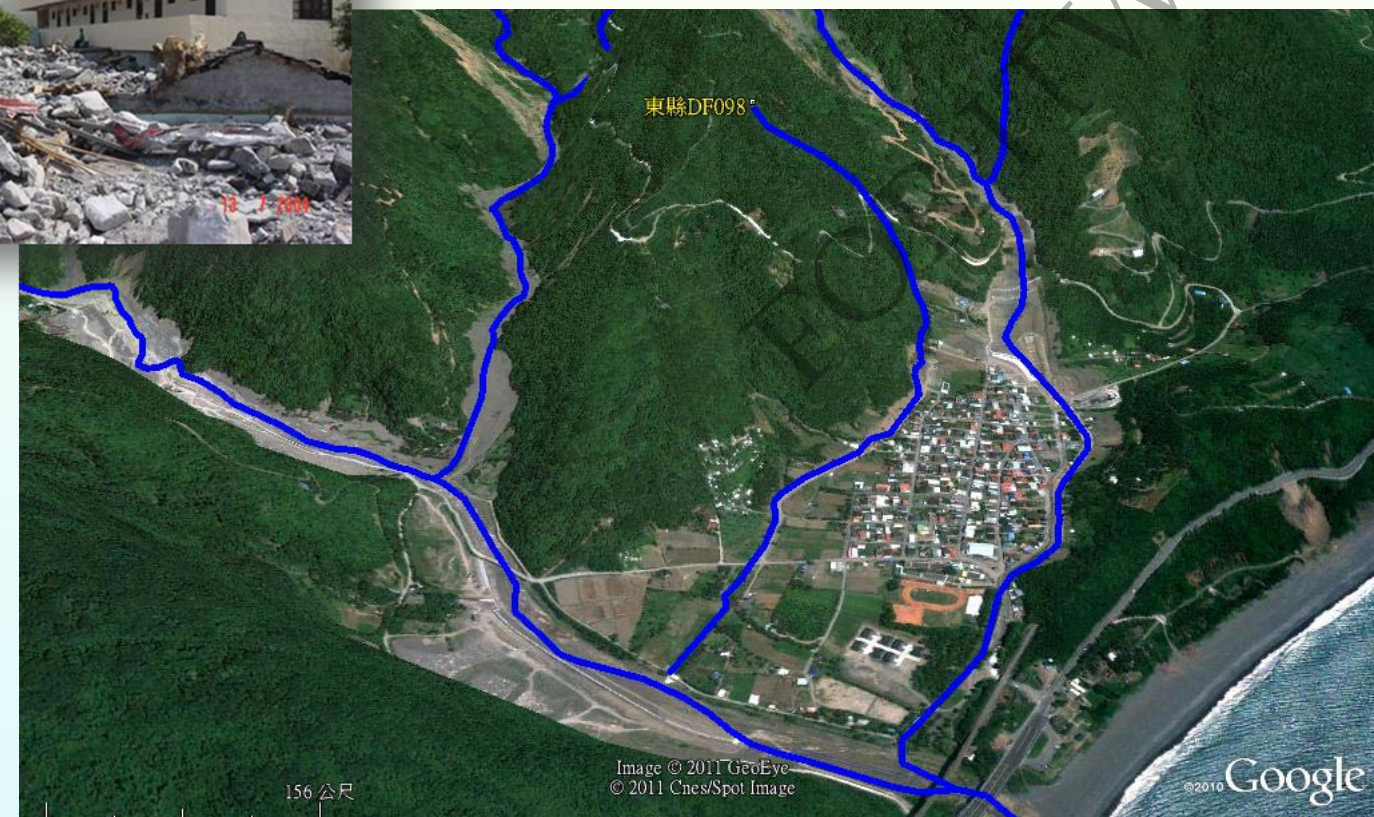
新編碼查詢：
宜蘭DF001 顯示

舊編碼查詢：
宜蘭T006 顯示

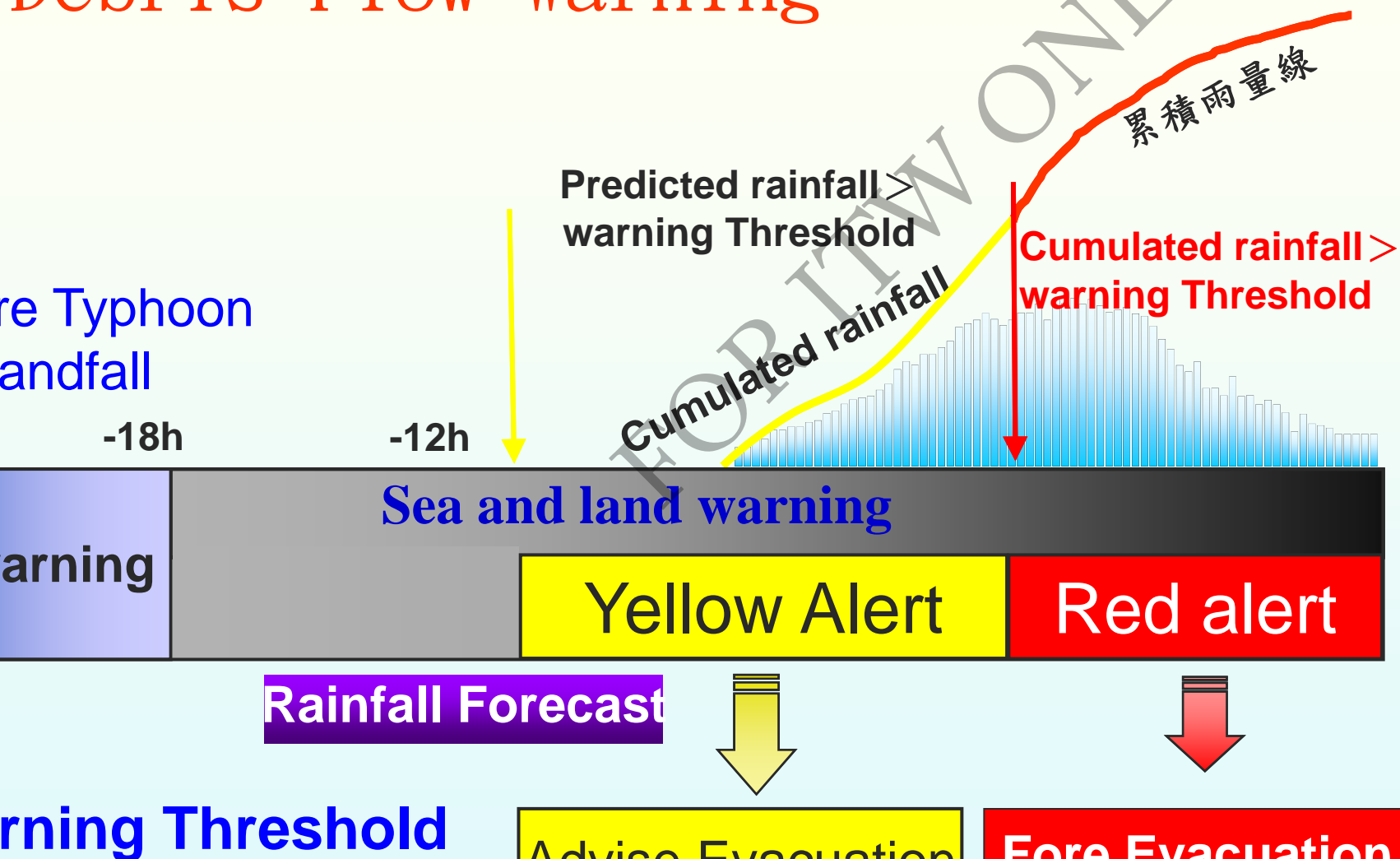
本日累積雨量排序

土石流防災教育訓練中心

Identify High Debris Flow Potential Stream



Debris Flow Warning



Case of successful pre-disaster relief during Typhoon Fanapi , in Lai-Yi



9/19

照片來源：水保局

14:00

15:00

08:40

23:00

Early warning

Evacuation operation

Typhoon landfall time

Landslide in Lai-Yi



Flooding



Flooding

Water Resources Agency



11年06月20日 星期一

今日瀏覽人數：10 累積瀏覽人數：166587

RSS



☒ 淹水警戒
 ☒ 河川水位警戒
 ☒ 水庫洩洪警戒
 ☒ 水庫濁度警戒
 ☒ 枯旱預警

水情資訊

氣象資訊

防汛整備

自主防災

水災防災知識館

淹水救助專區

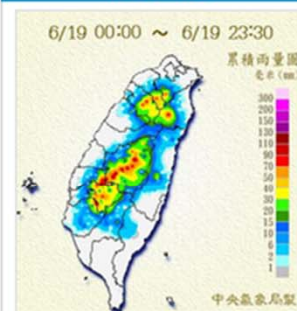
水利防災經驗學習中心

防災團隊相關網站



累積雨量

6/19 00:00 ~ 6/19 23:30



水情資訊 00:09

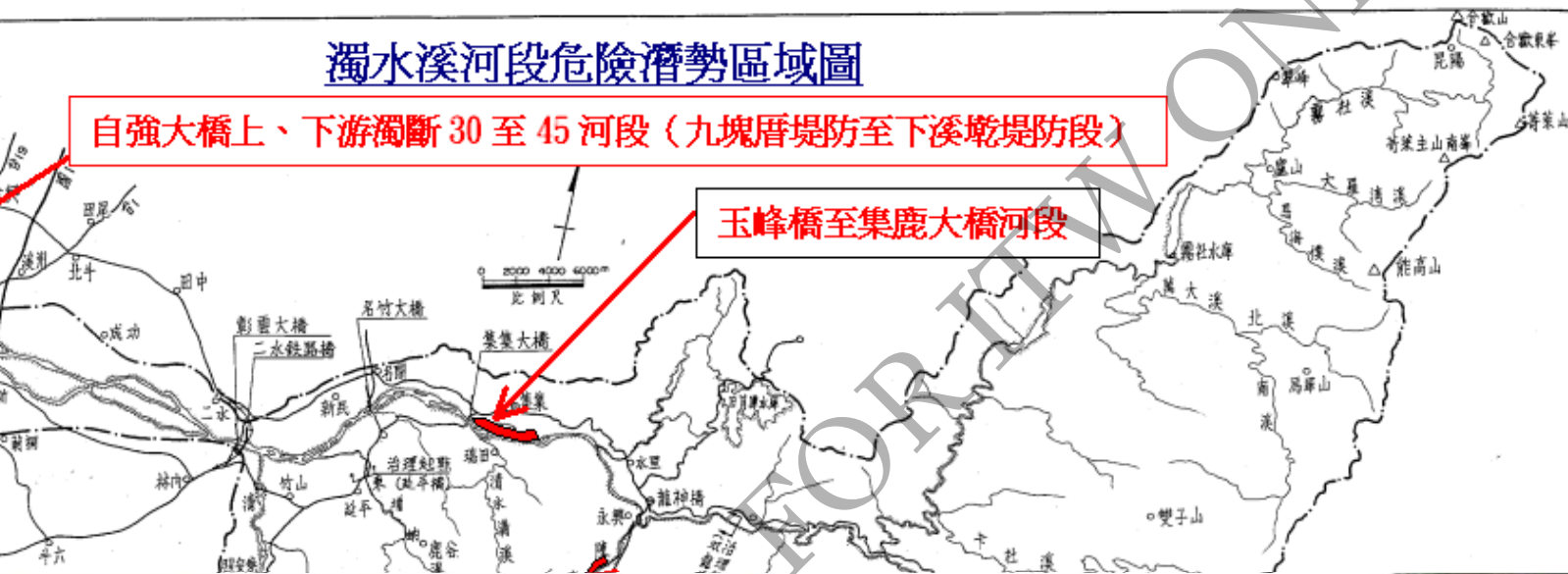
分區	雨量	水位
北區	大雨	正常
中區	豪雨	正常
南區	大雨	正常
東區	正常	正常

Identify High Risk River Stretches

濁水溪河段危險潛勢區域圖

自強大橋上、下游濁斷 30 至 45 河段（九塊厝堤防至下溪墘堤防段）

玉峰橋至集鹿大橋河段



Potential Flooding area



www.ncdr.nat.gov.tw

[illegible]

定量降水預報(Ⅰ)

發布時間：2009/08/06 05:30
有效時間：2009/08/06 08:00 ~ 2009/08/06 20:00

馬祖 0
金門 0
澎湖 0-5

中央氣象局

定量降水預報(Ⅱ)

發布時間：2009/08/06 05:30
有效時間：2009/08/06 20:00 ~ 2009/08/07 08:00

馬祖 10-20
金門 10-20
澎湖 30-40

中央氣象局

(單位：毫米)

QPESUMS and Real Time Video Analysis



Dropsonde ENGLISH

觀測資料 降水估計產品 降水預報產品 劇烈天氣資訊

區域 國家 說明 下載

CWB QPESUMS

水情監測系統

功能區

快速查詢/Search

確定

行政劃分/Regional

水利署

地理劃分/Geographical

請選擇

設施劃分/Facilities

請選擇

狀態列/Status

大坑溪監測站, 2鏡頭
寶橋, 2鏡頭
玉成抽水站, 4鏡頭

(527106,2869826)

展示區

圖層

- ☐ 雨量站
- ☐ 河川局
- ☐ 水庫集水區
- ☐ 水庫堰壩
- ☐ 水門
- ☐ 抽水站
- ☐ 河川
- ☐ 水位站
- ☒ 監視站
- ☐ 行動監視

GIS控制

06-02 16:08:04

06-04 11:35:21

湖鄉宜梧橋
寶景橋
曾文水庫
新市水庫
港東二號橋

玉成抽水站

大坑溪監測站

寶橋

玉成抽水站

Highway System Conditions

Directorate General of Highways

www.ncdr.nat.gov.tw



公路防救災資訊系統
Highway Disaster Information System
交通部運輸研究所



[災情查詢](#) [GIS 災情查詢](#)

最新消息

道路災情

縣162甲線 042K+800 路基流失約200公尺... [詳細內容](#)

僅顯示14天內未結報之災情 [更多](#)

橋梁災情

僅顯示14天內未結報之災情 [更多](#)

系統登入

帳號:

密碼:

☐ [忘記帳號密碼](#)

操作手冊

☐ [操作手冊](#)

☐ [常見問題](#)

訪客人數: 00062549人
Since 2010.05.01

媒體訊息

- 2011/6/18 上午 06:16:35
(聯合)小林村滅村 甲仙
- 2011/6/17 下午 11:35:29
(東森)中國南方豪雨災情
- 2011/6/17 上午 07:43:43
/ 白米山崩 甲仙 公路局

[更多](#)

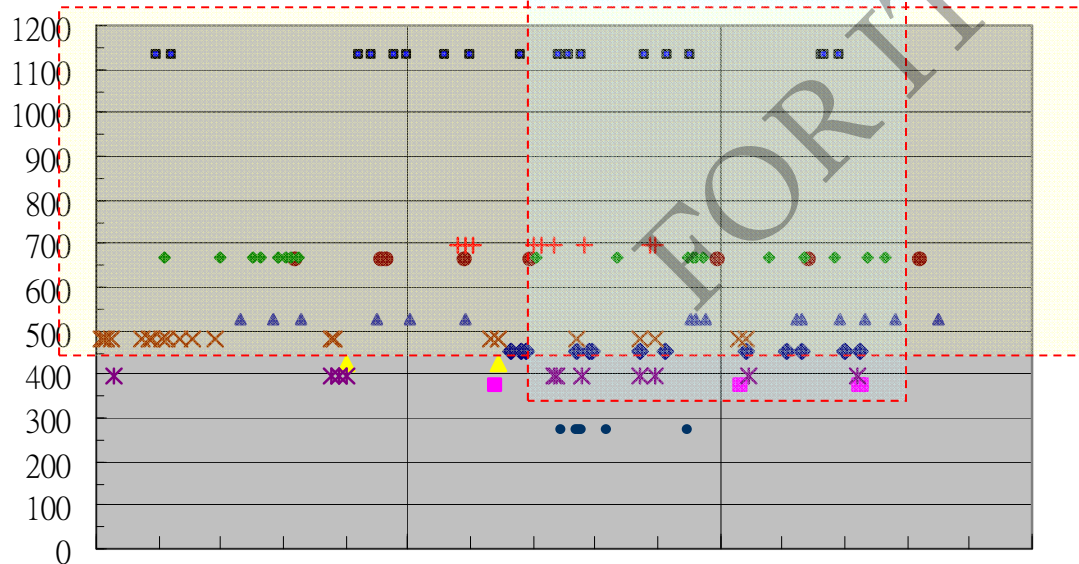


Identify High Risk Road segments



歷史颱風造成台21線公路災害統計圖

累積雨量(mm)



75k

水里

100k

同富

125k

草坪頭

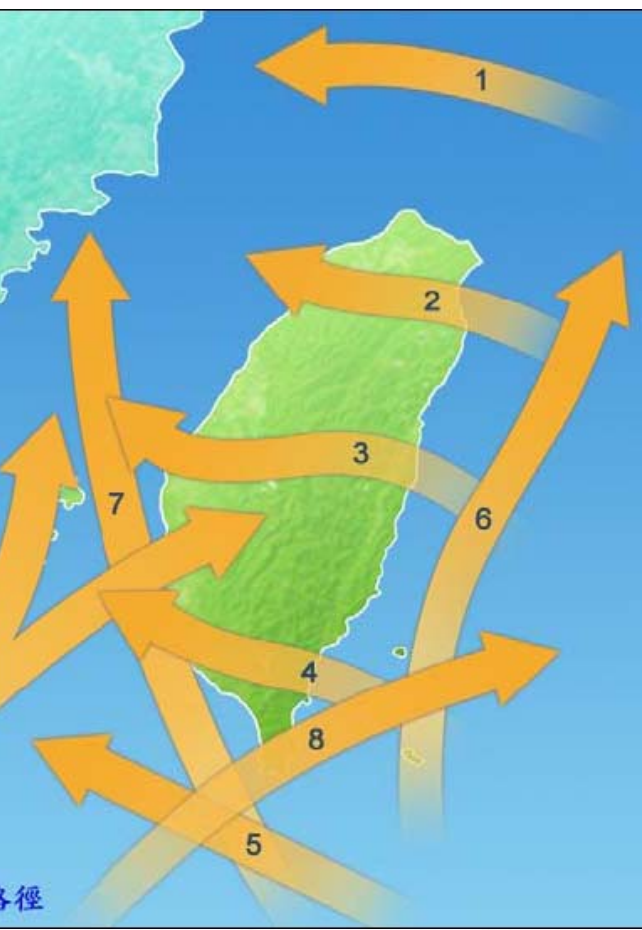
145k

塔塔加

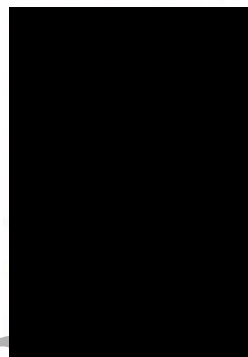
台21線里程樁號(公里)

- ◆ 93年 敏督利(453mm)
- 93年 艾利(371mm)
- ▲ 94年 泰利(427mm)
- × 94年 海棠(483mm)
- ✱ 94年 馬莎(399mm)
- 95年 56月豪雨(665mm)
- + 96年 柯羅莎(694mm)
- 96年 聖帕(271mm)
- ▲ 97年 卡玫基(527mm)
- ◆ 97年 辛樂克(670mm)
- 98年 莫拉克(1131mm)

Typhon Paths and Road Disaster



1.



2.



3.



4.



5.



6.



7.



8.



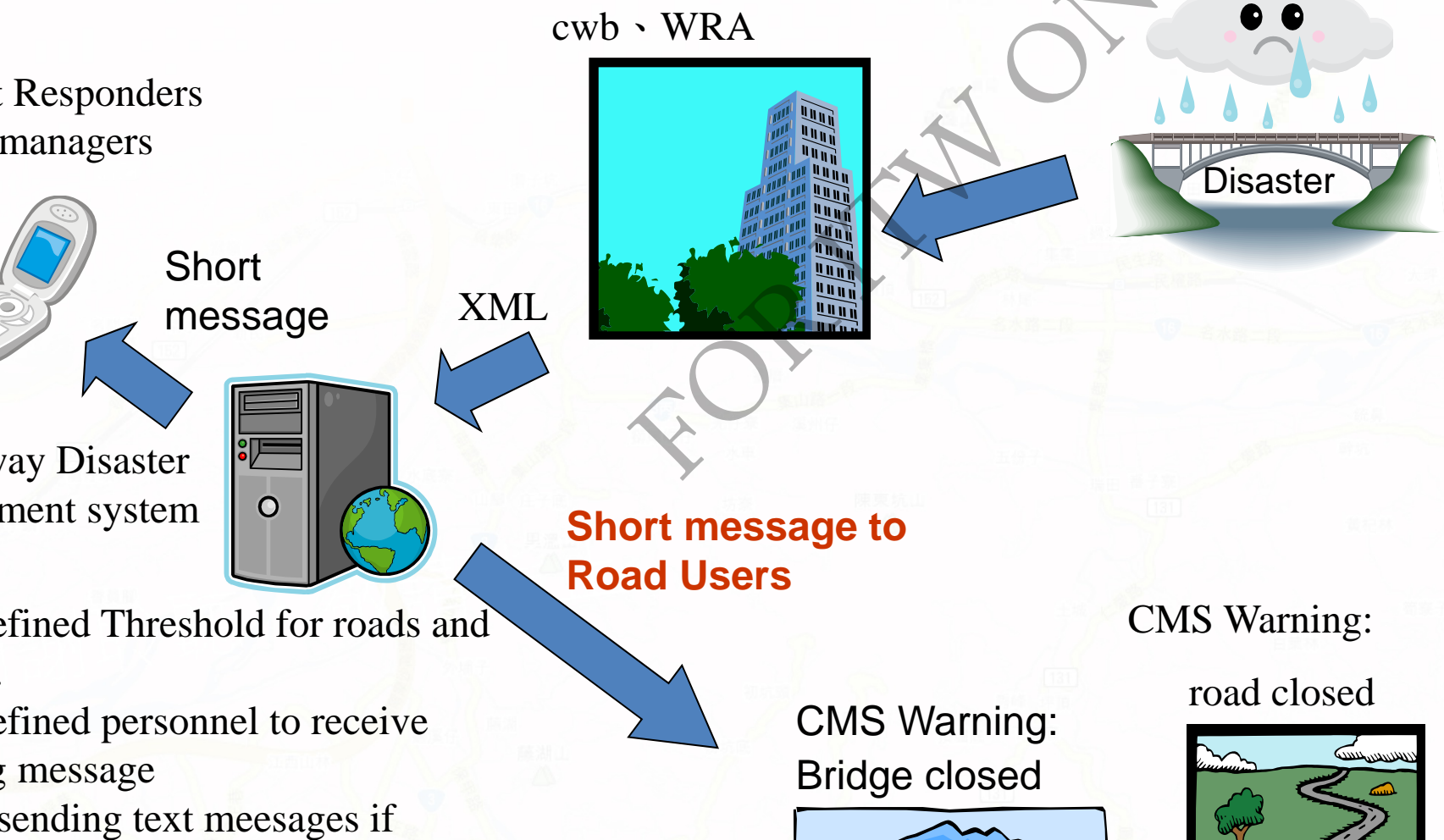
易致災省道



低



Warning Message Broadcasting



Information Sharing- National Geographic Information System



● The Background of the Ten-Year Project



Conception (1986-1987)

- 1986: The National Development Council suggested to build National Geographic Information System.



Growth (1988-1997)

- 1989: The Executive Yuan approved the Master Plan of National Geographic Information System.
- 1990: Work with the Ministry of the Interior to set up 'NGIS Steering Committee' and the grouping of nine databases. Each underlying units began to operate.
- 1992: The Ministry of the Interior completed the 'NGIS Execution Scheme'.



Execution (1998-)

- 1998: Executed six-year project of 'NGIS Spatial Data Infrastructure Plan '. Also built up priority information under NGIS framework.
- 2004: Executed four-year project of 'NGIS Plan (2nd Phase of Infrastructure Construction)'. Completed the overall promotion task, stipulation of regulations, basic information archiving and relating operating system application.
- 2006: Adjusted the structure of NGIS and elevated to the Council for Economic Planning and Development of Executive Yuan.

Emergency Communication System for Disaster Management



Emergency Management Information System



中央災害應變中心 - Microsoft Internet Explorer 是由 內政部消防署 提供

編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)

一頁 搜尋 我的最愛

http://eoc.ndppc.nat.gov.tw/center/user

中央災害應變中心 E.M.I.S. Emergency Management Information System

0606豪雨演練

內政部消防署

王勝弘

5/1 02 04 06 08 10 12 14 16 18 20 22 5/2

處置報告(8) 資源調度(0) 通報表(7) 工作會報(0) 指派任務(2) 檔案傳輸

首頁

頁面位置：首頁

一、二級開設

災情查報 <ul style="list-style-type: none">災情管制表災情班點圖(GIS)新聞監看	災情綜整 <ul style="list-style-type: none">災情總覽(GIS)道路通阻(GIS)傷亡清冊(依案件)	災情推估 <ul style="list-style-type: none">地震簡易型災損推估地震TELES需求推估	支援調度 <ul style="list-style-type: none">資源查詢(GIS)
觀測訊息 <ul style="list-style-type: none">豪雨綜合資訊颱風綜合資訊水位綜合資訊	工作會報 <ul style="list-style-type: none">工作會報事項管理工作會報事項查詢工作會報會議紀錄	指派任務 <ul style="list-style-type: none">指派任務管理指派任務回覆	復原重建 <ul style="list-style-type: none">復原重建專案

Progressive Improvement against Typhoons



Typhoon Event	Maximum Intensity (mm/hr)	Total Accumulated Rainfall (mm)	Evacuation (Person)	Ceased and Missing (Person)
7.28 Toraji	147	757	----	214
9.17 Nari	142	1,462	24,000	104
6.30 Mindulle	167	2,005	9,500	41
7.18 Haitang	177	2,124	1,208	15
9.01 Talim	119	766	1207	6
10.02 LongWang	154	776	945	2
7.12 Bilis	95	1,013	409	3
8.16 Sepat	122	1,399	2531	1
7.16 Kalmaegi	161	1,027	179	26
7.28 Fung-Wong	121	830	1,303	2
9.12 Si-fu	87	1,422	1,227	22

Precise Evacuation

Decreasing Death Toll

Typhoon Morakot record-breaking Rain fall

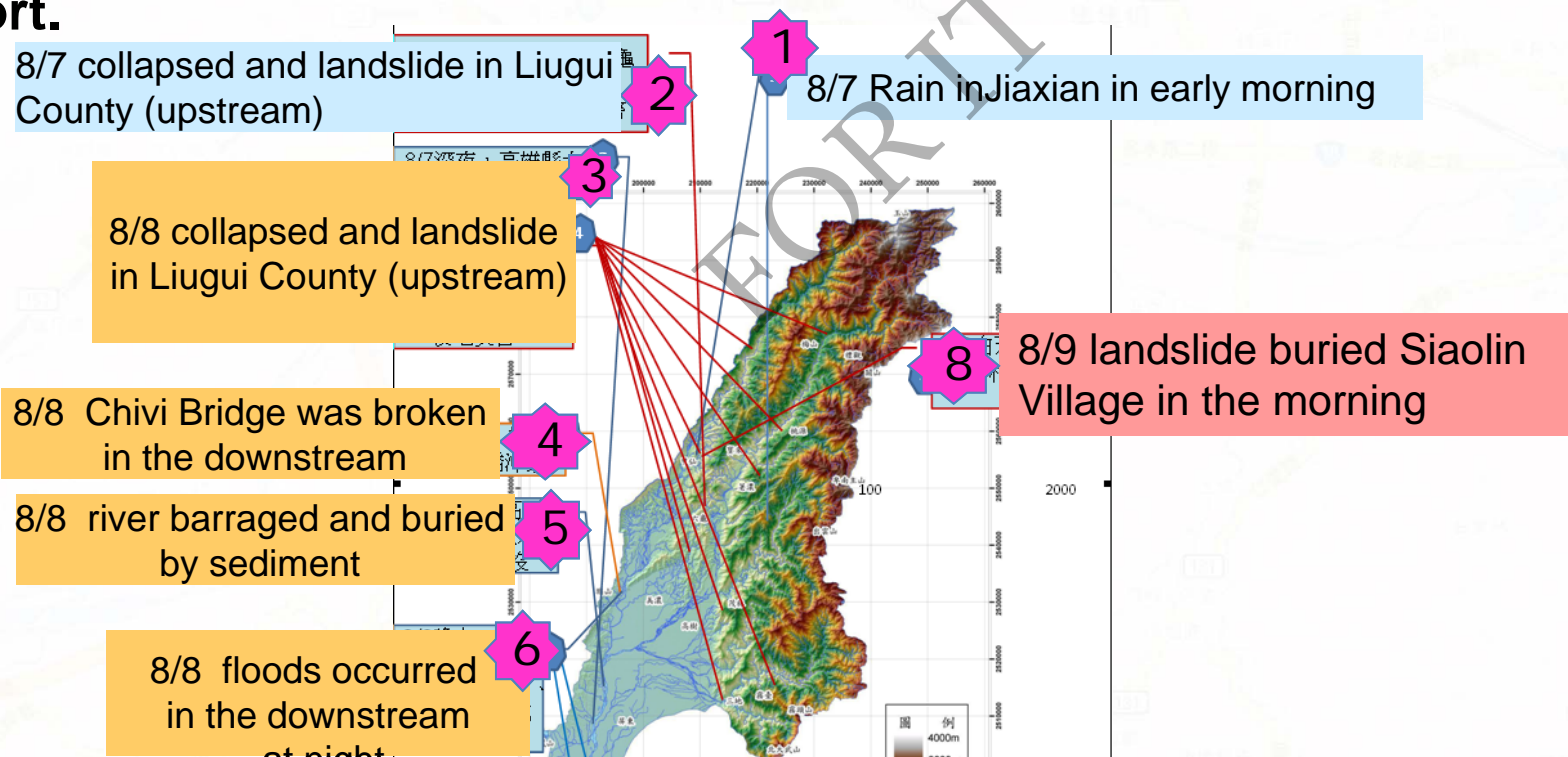


County	Township	Annual Rainfall (mm)	08/7 (mm)	08/08 (mm)	08/09 (mm)	08/10 (mm)	08/07-08/10 (mm)	08/07-08/10 vs Annual
	Alishan	3,910	420	1,161	1,166	218	2,965	76%
Yunlin	Sandimen	3,884	745	1,402	394	332	2,872	74%
	Jhuci	3,801	556	1,185	877	156	2,775	73%
Yunlin	Taoyuan	4,086	501	1,283	583	423	2,790	68%
Yunlin	Liouguei	3,138	236	1,178	696	351	2,461	78%
	Fanlu	3,437	708	815	601	79	2,202	64%
	Dapu	2,749	482	1,214	458	3	2,156	78%
Yunlin	Jiasian	2,861	400	1,072	345	203	2,020	71%
	Sinyi	3,254	170	717	909	134	1,929	59%
	Mali	2,152	252	712	622	172	1,424	45%

Disasters due to typhoon Morakot



The compound disasters caused are **more than disasters** of a **single category**. They include collapse, landslides, landslide dams, floods, driftwood, watercourse sediments and interrupted traffic. It is adding a certain degree of **difficulty to the rescue effort**.



Integrated view and coordinated Management



- 1 Rainfall
Long duration
• High intensity
• Broad extent

3 Landslide Dam

2 Collapse of extensive slopeland

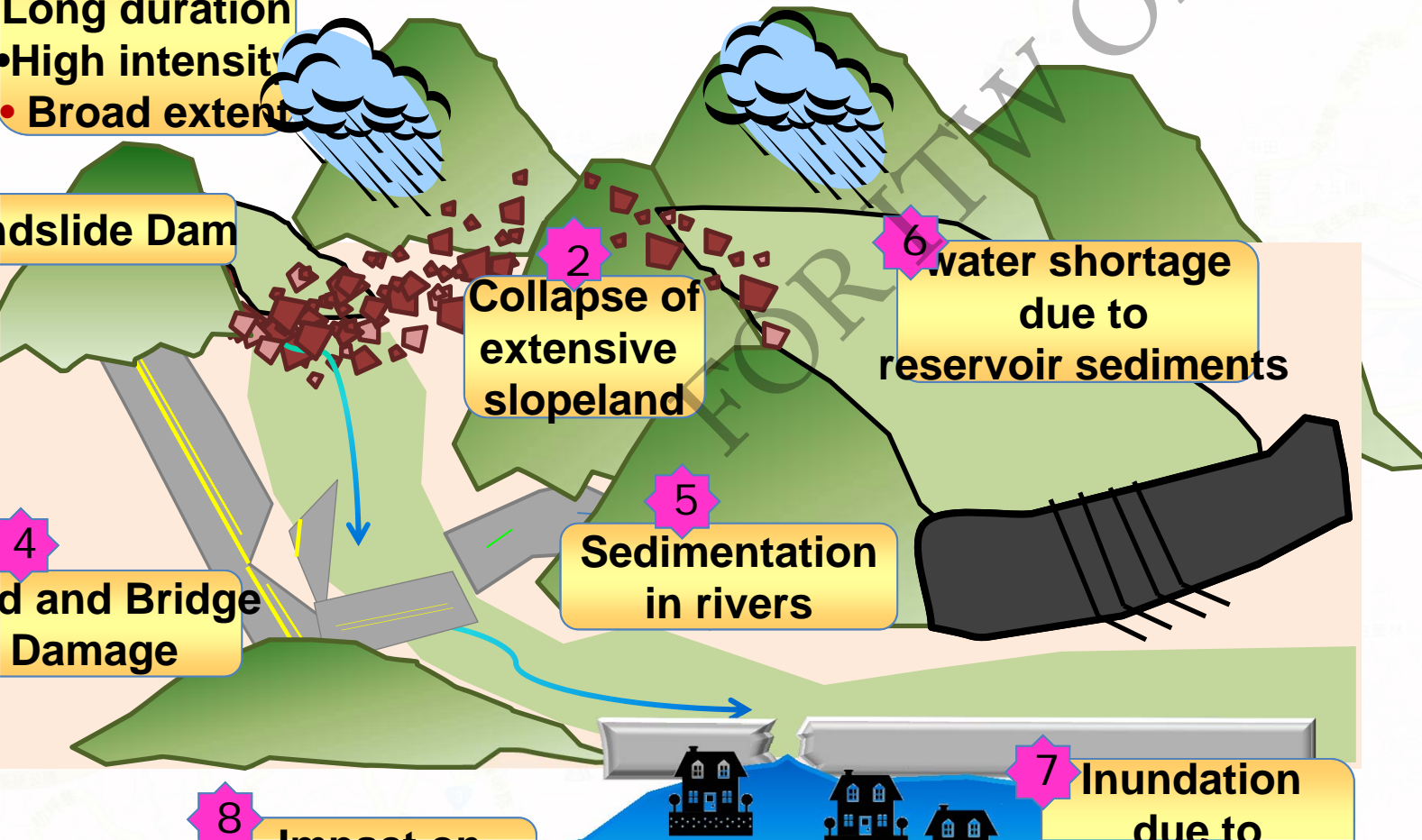
6 Water shortage due to reservoir sediments

4 Road and Bridge Damage

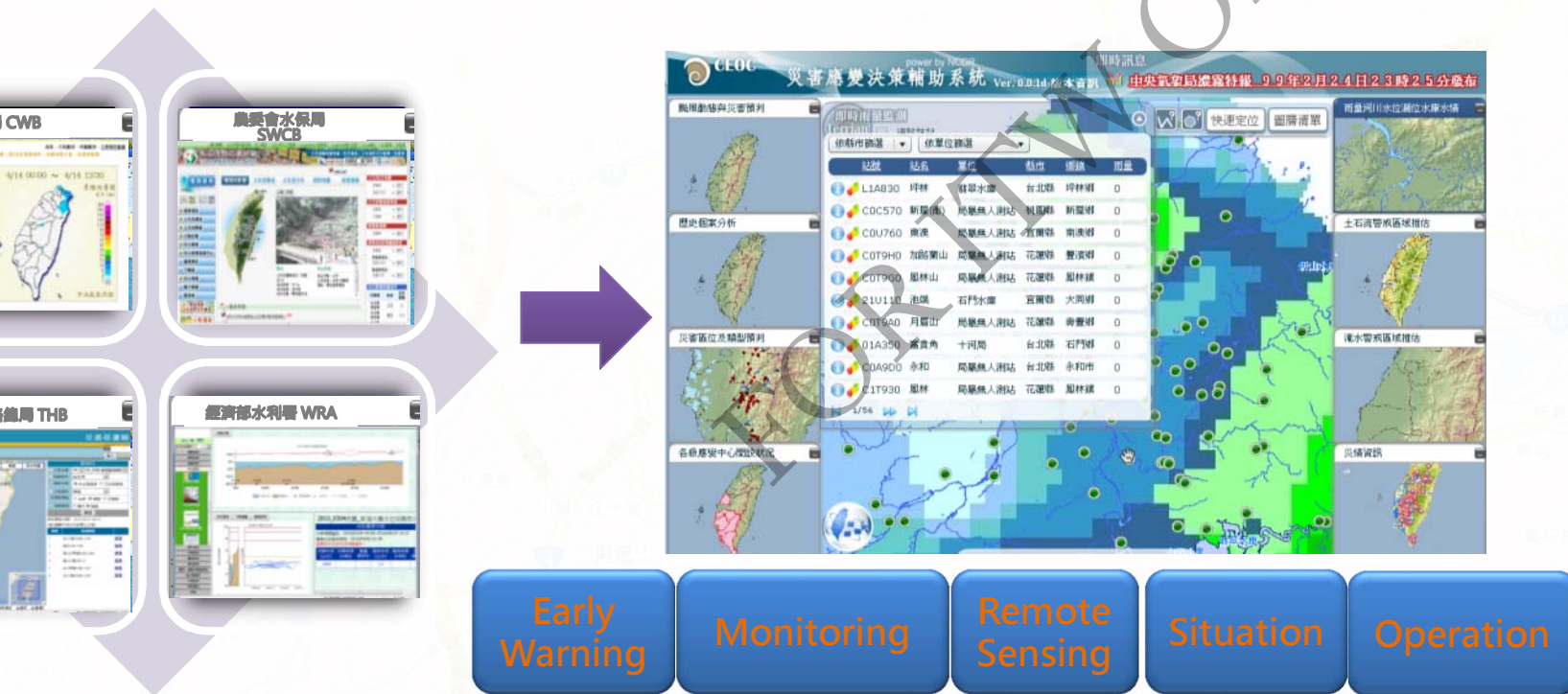
5 Sedimentation in rivers

7 Inundation due to

8 Impact on



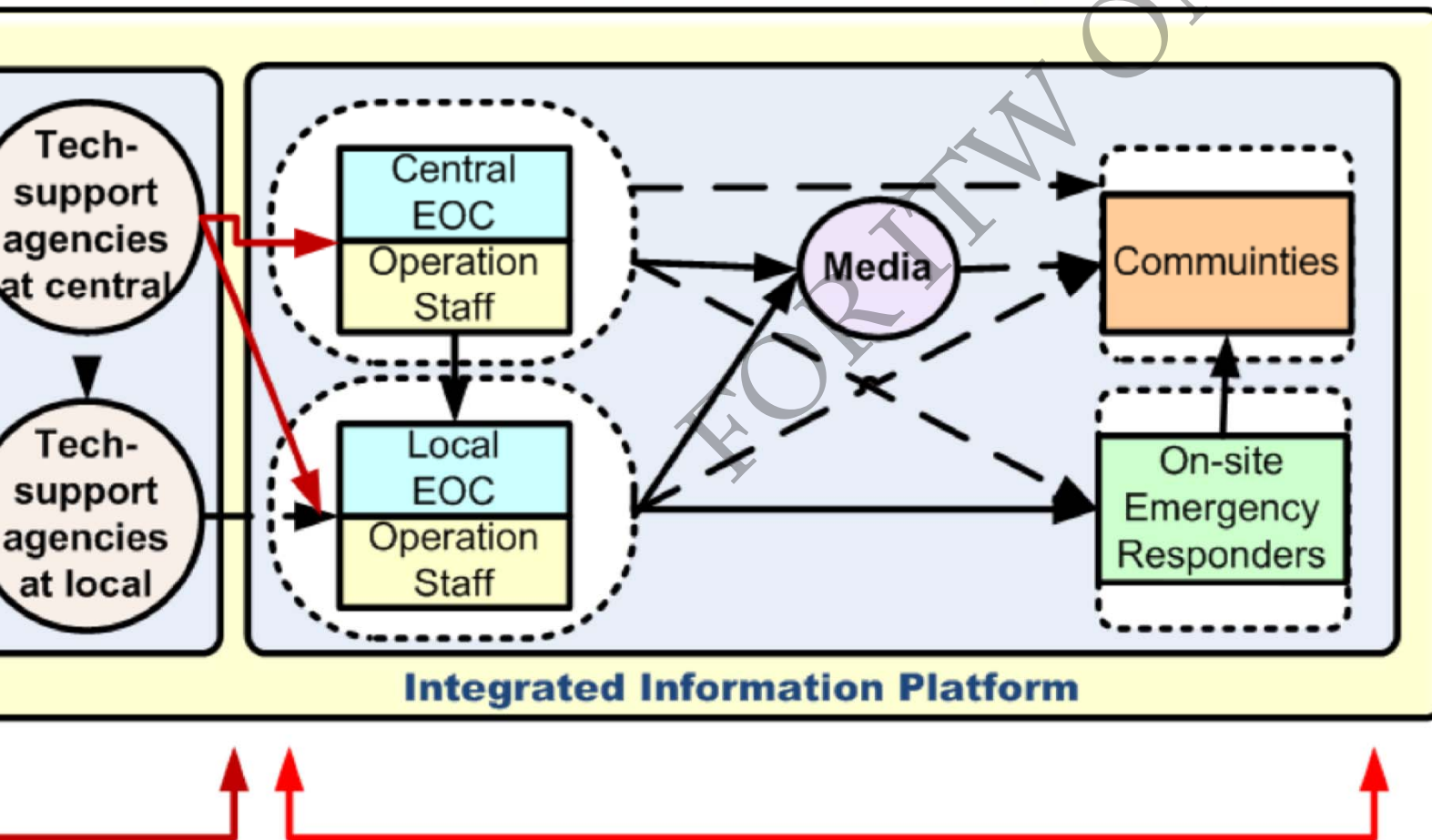
Common Operational Picture



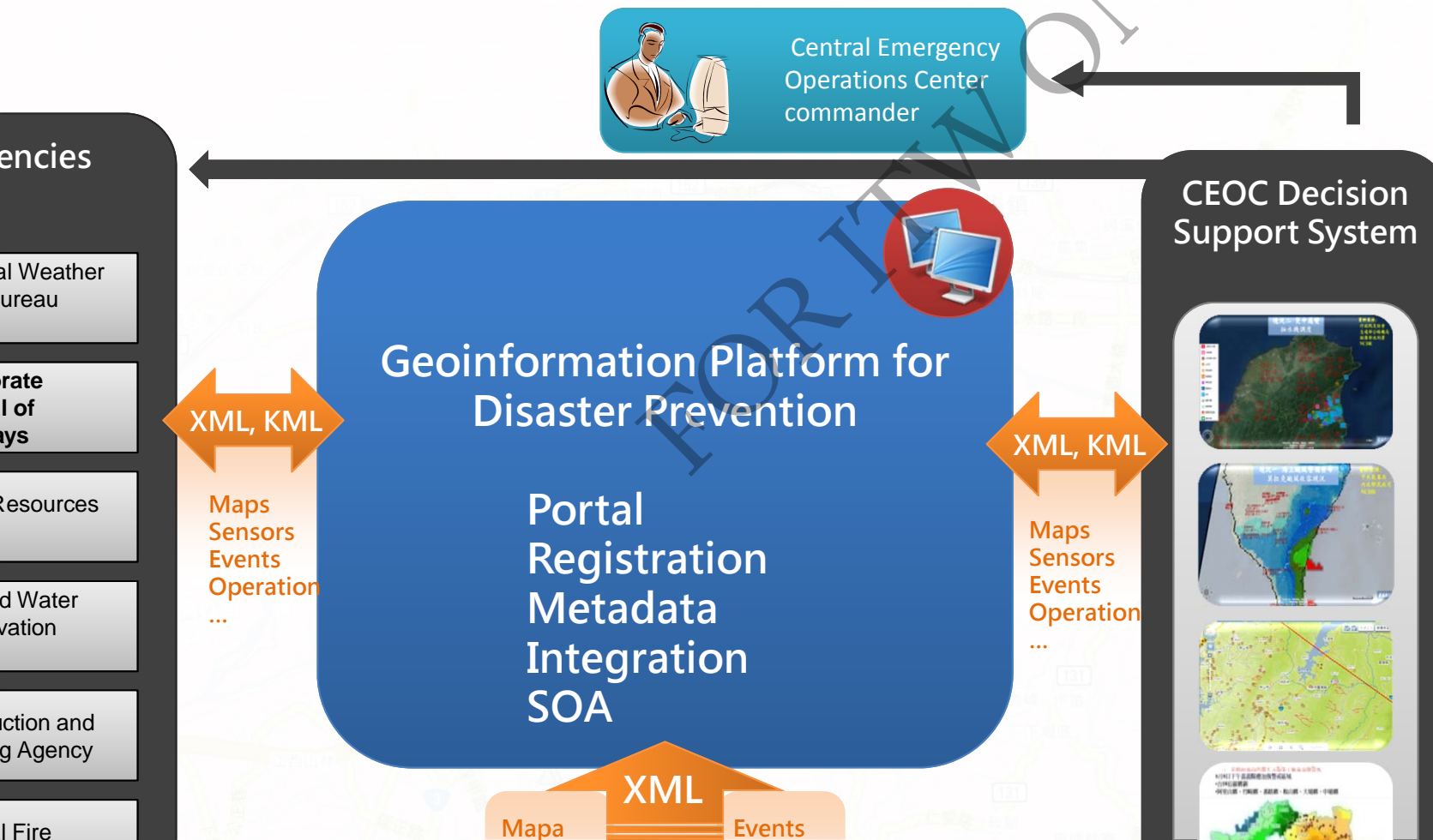
Existing Systems in
Government agencies

A common operational Picture

Common Operational Picture



National Geographic Information System Disaster Prevention Working Group





EOC (4F)



NCDR's Role in Emergency Response



NCDR

Internal Meeting every
3hrs
Provide Analysis
Rainfall estimation
Flood potential
Debris flow potential
Precaution notice

CEOC

- Assessment Meeting every 3hrs
- Generate Suggestions
 1. Warning zones
 2. Evacuation
 3. Reinforcement
 4. Bulletin to local government

CEOC

- Working Meeting
- Overall Review
 1. Situation reports
 2. Readiness report
 3. Assistance and deployment
 4. Emergency response

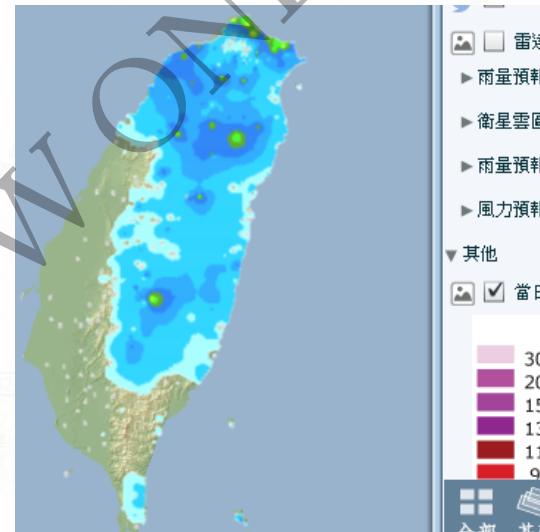
Information Integration –Weather Data



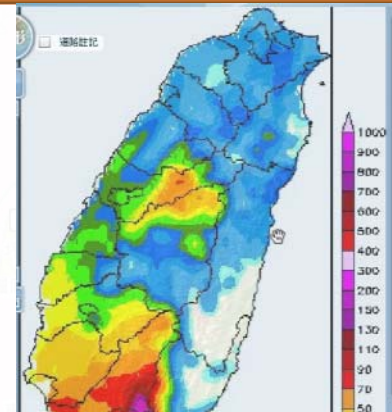
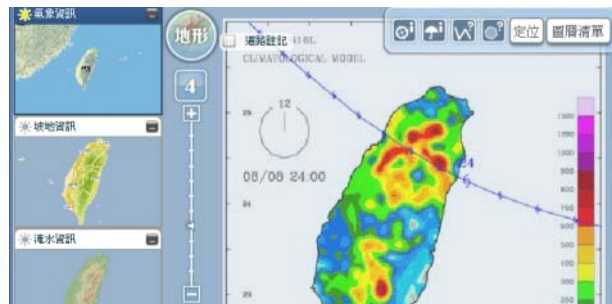
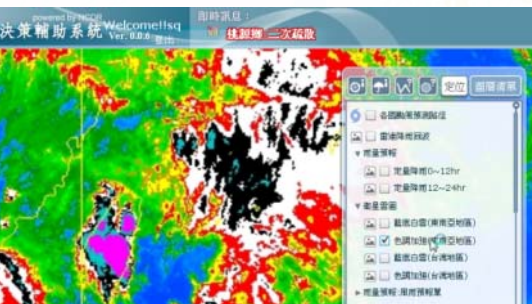
se Predictions



Radar



Real-time rain gauge data



Interface Design Concept -1



Overall concept

Integrate information
Provide situation awareness

Main window

Provide real-time map and other
information for browse and
overlay analysis

Bookmark

Predefined map layer
combinations

Map control panel

Map switch, locate and
analyze tools

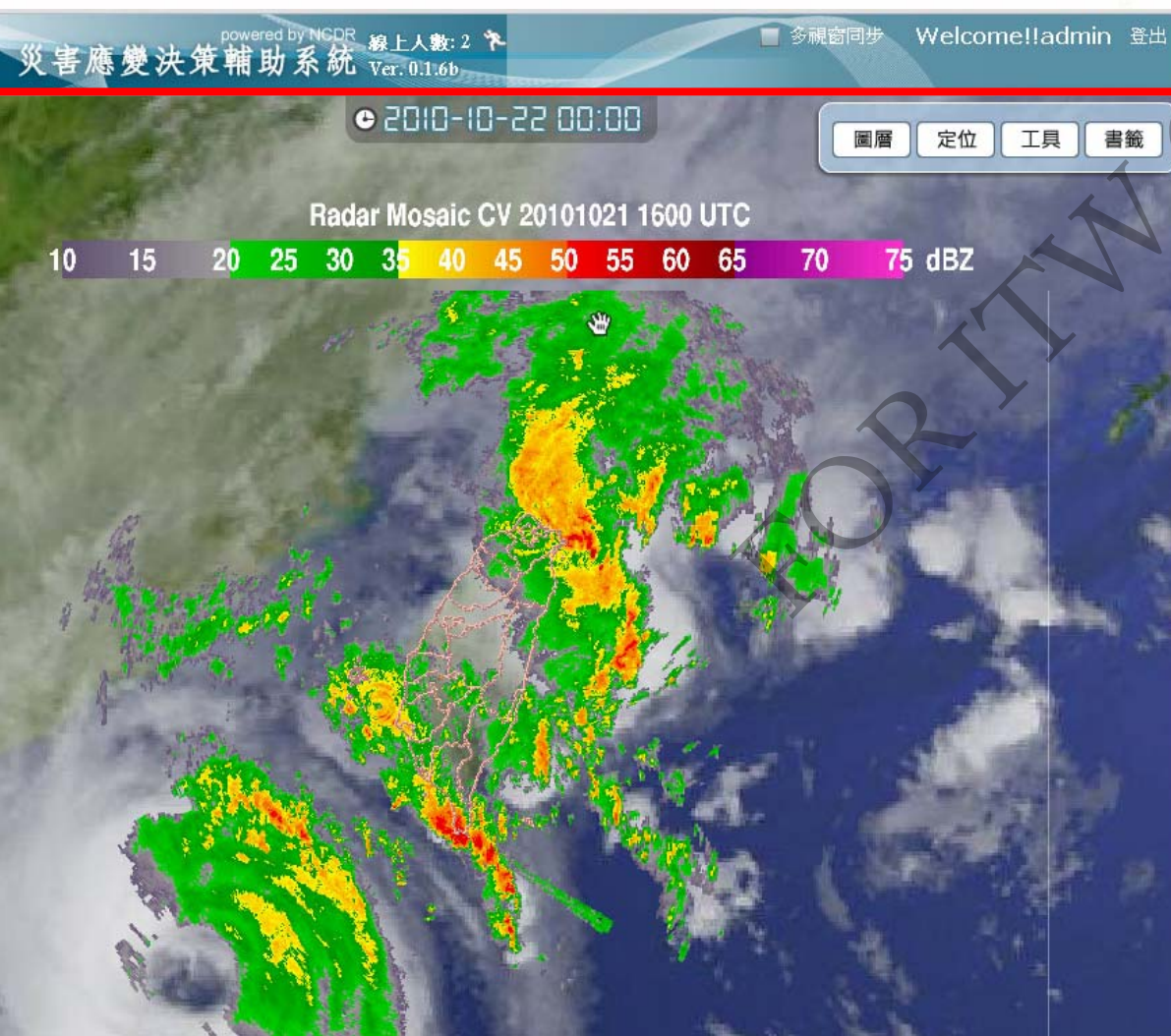
Time line

Back to see any historic event

Imagery comparison

Remote sensing

Interface Design Concept -2



Overall concept

Integrate information
Provide situation awareness

Main window

Provide real-time map and other
information for browse and
overlay analysis

Bookmark

Predefined map layer
combinations

Map control panel

Map switch, locate and
analyze tools

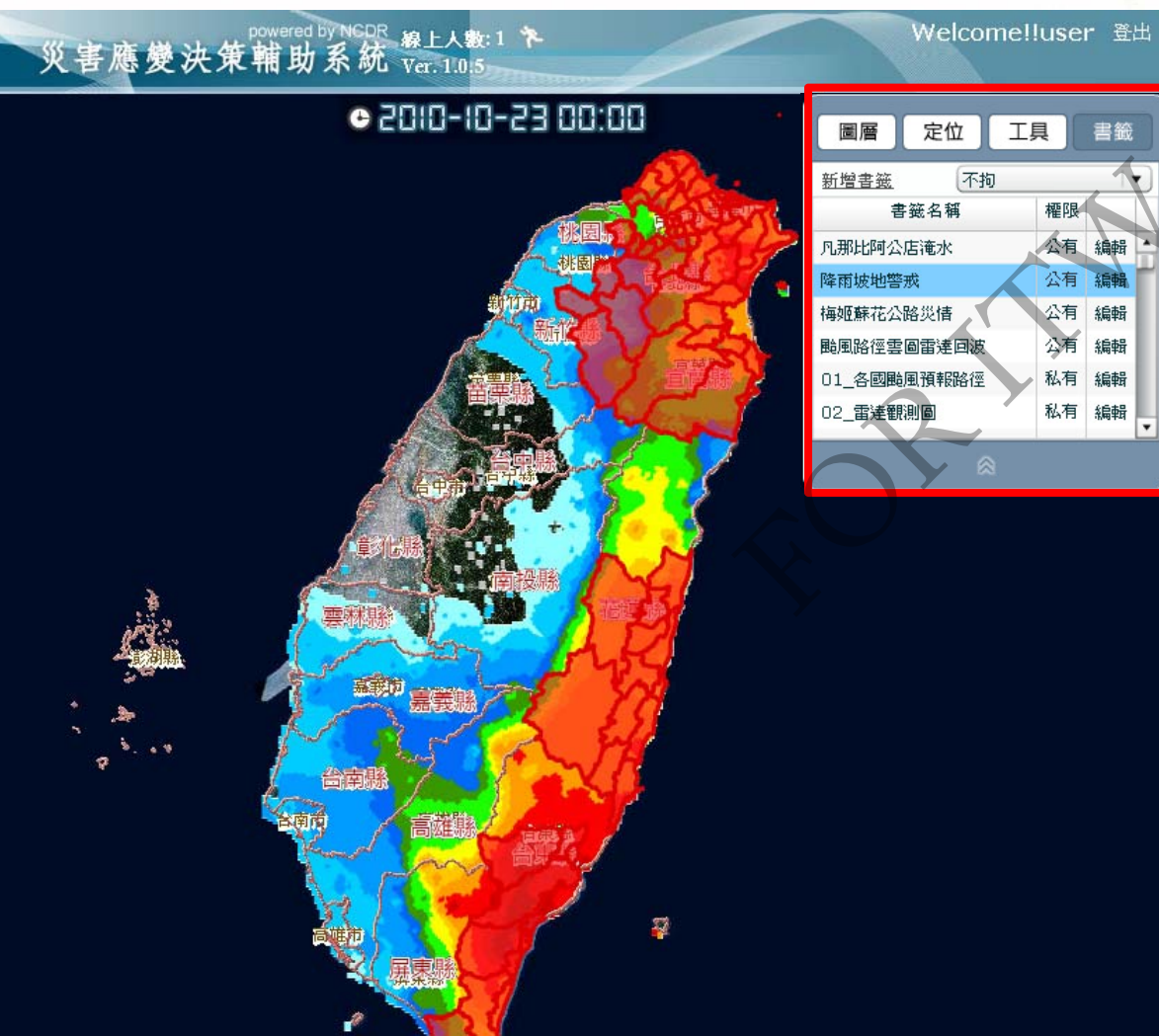
Time line

Back to see any historic event

Imagery comparison

Remote sensing

Interface Design Concept -3



Overall concept

Integrate information
Provide situation awareness

Main window

Provide real-time map and other
information for browse and
overlay analysis

Bookmark

Predefined map layer
combinations

Map control panel

Map switch, locate and
analyze tools

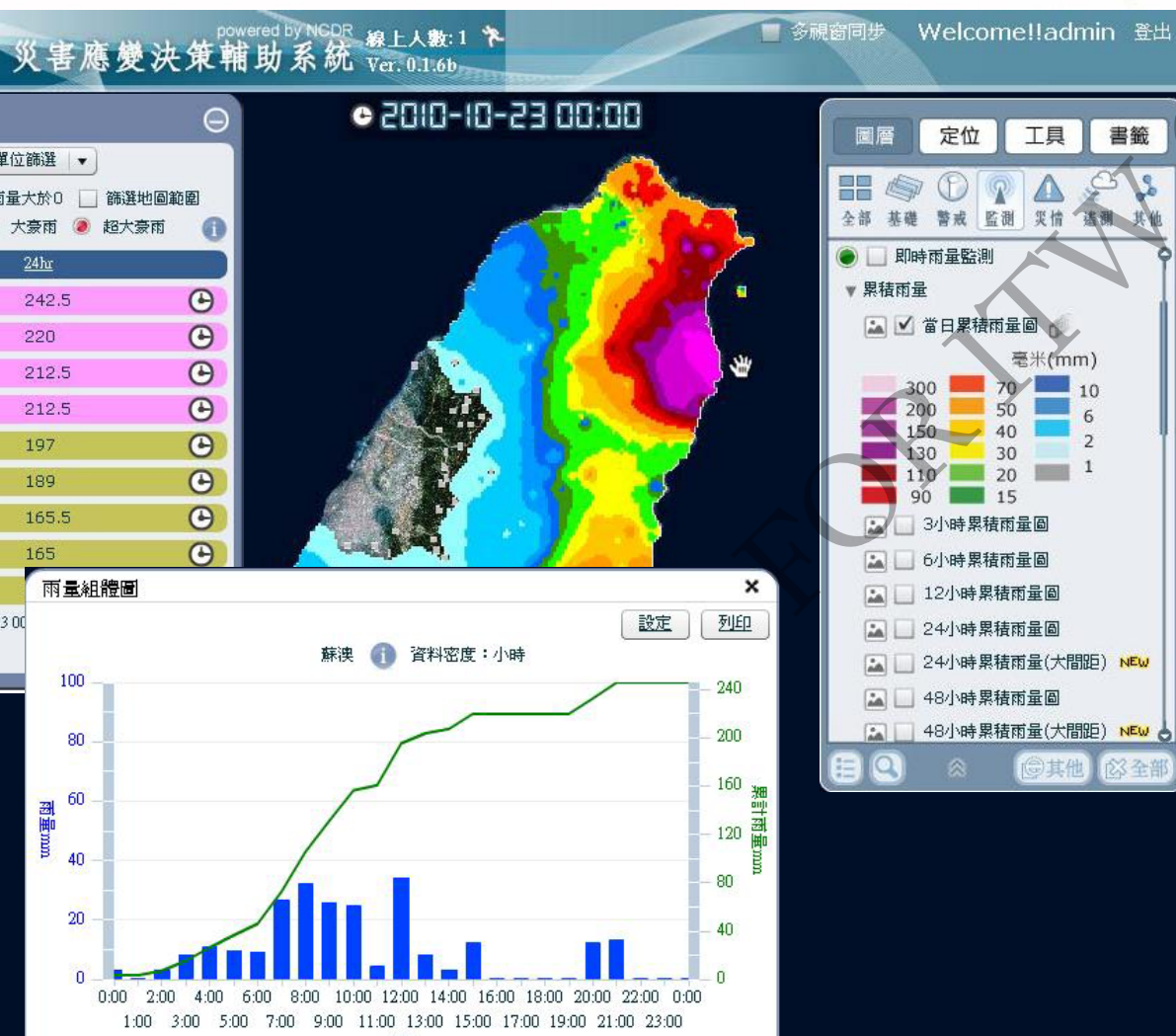
Time line

Back to see any historic event

Imagery comparison

Remote sensing

Interface Design Concept -4



Overall concept

Integrate information
Provide situation awareness

Main window

Provide real-time map and other
information for browse and
overlay analysis

Bookmark

Predefined map layer
combinations

Map control panel

Map switch, locate and
analyze tools

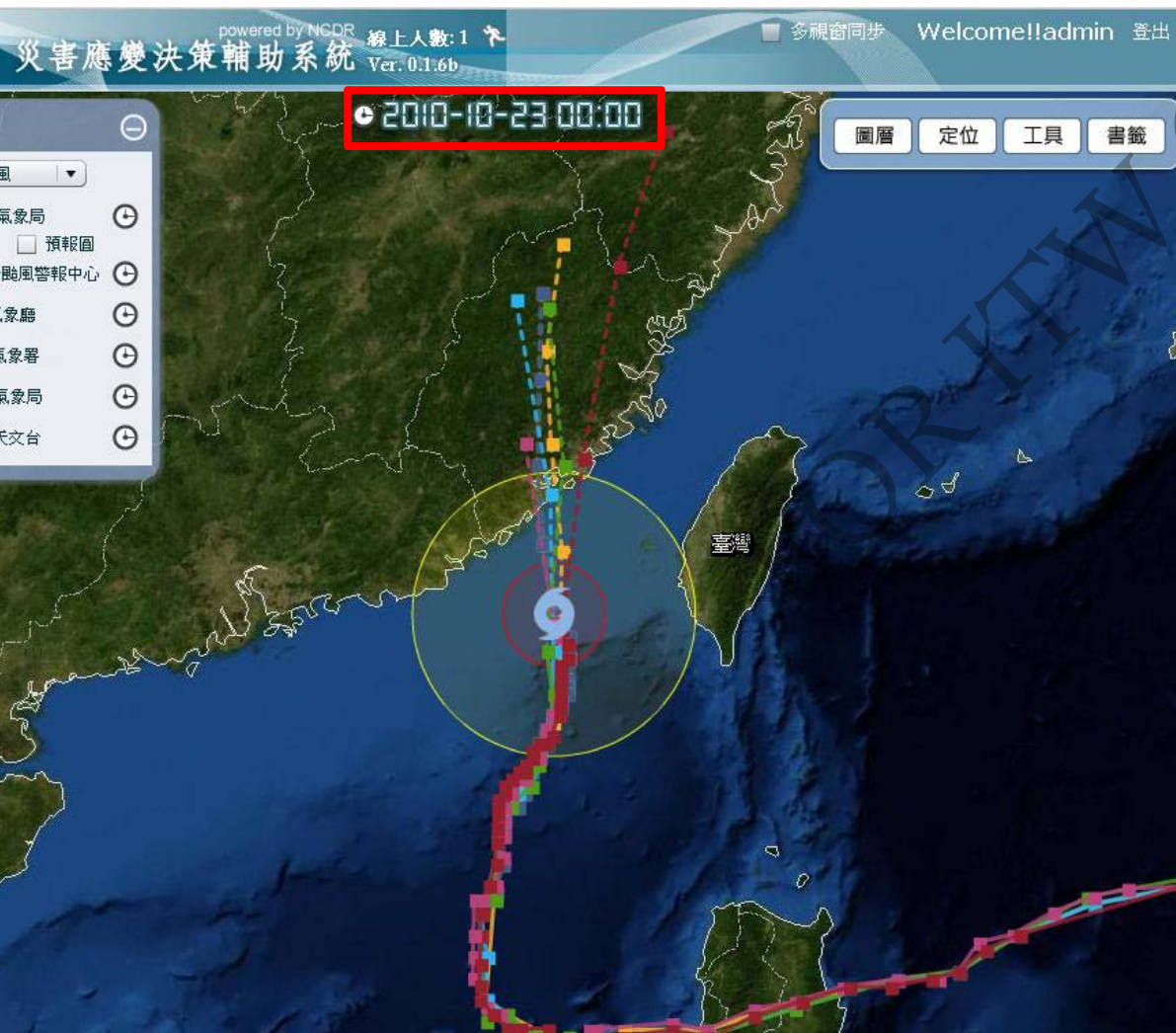
Time line

Back to see any historic event

Imagery comparison

Remote sensing

Interface Design Concept -5



Overall concept

Integrate information
Provide situation awareness

Main window

Provide real-time map and other
information for browse and
overlay analysis

Bookmark

Predefined map layer
combinations

Map control panel

Map switch, locate and
analyze tools

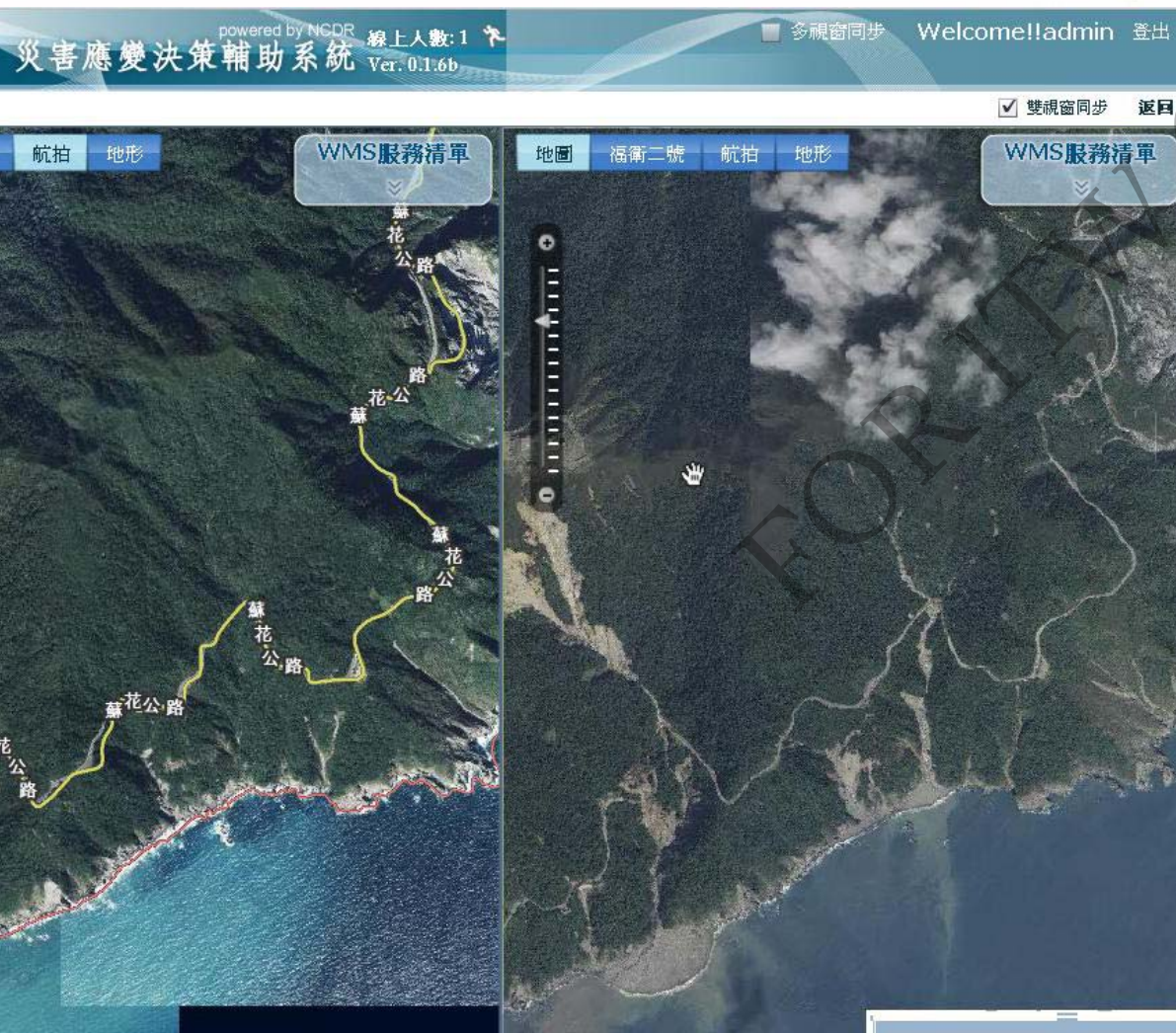
Time line

Back to see any historic event

Imagery comparison

Remote sensing

Interface Design Concept -6



Overall concept

Integrate information
Provide situation awareness

Main window

Provide real-time map and other
information for browse and
overlay analysis

Bookmark

Predefined map layer
combinations

Map control panel

Map switch, locate and
analyze tools

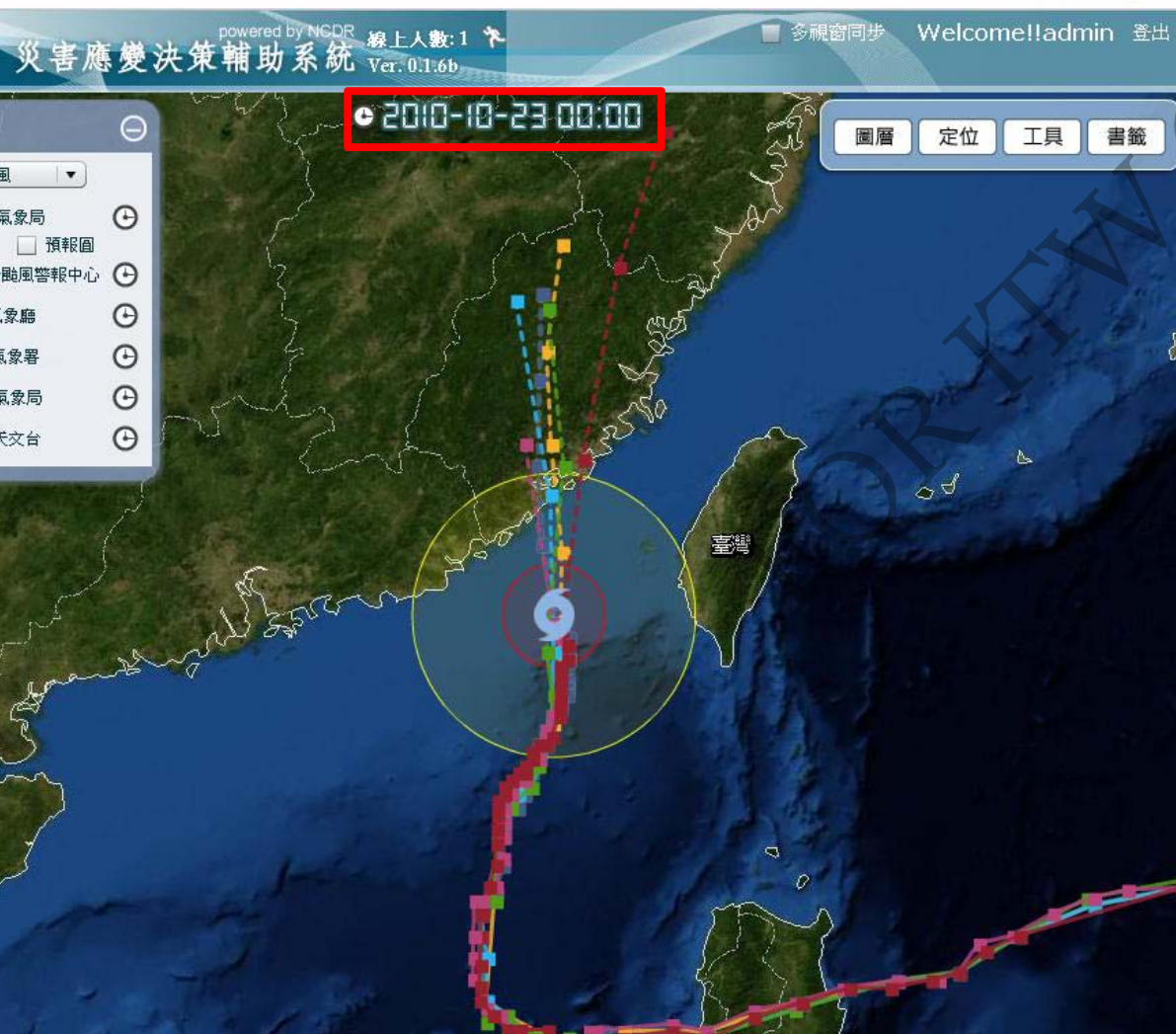
Time line

Back to see any historic event

Imagery comparison

Remote sensing

災害應變決策輔助系統-設計概念



整體概念

整合加值應變空間資訊
提供應變作戰決策地圖

主功能視窗

依據災害時程需求
提供應變資訊呈現

決策書籤

依據時程需求重點
提供決策主題資訊

圖層操控功能版

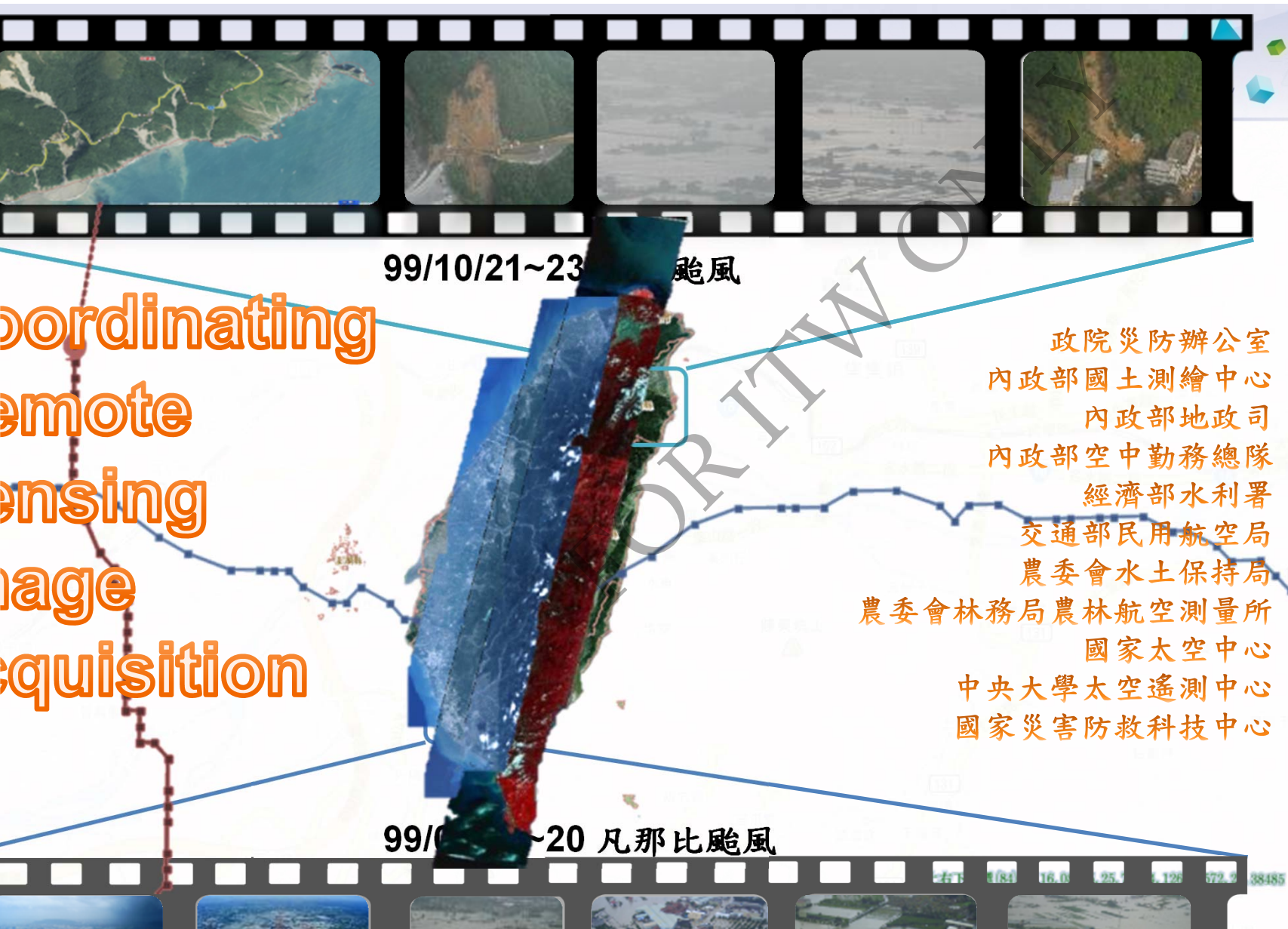
以使用者需求服務為導向
提供全方位圖層清單及工具

時間回溯

掌握歷史災害資訊
快速檢視歷史災害發生歷程

影像比對

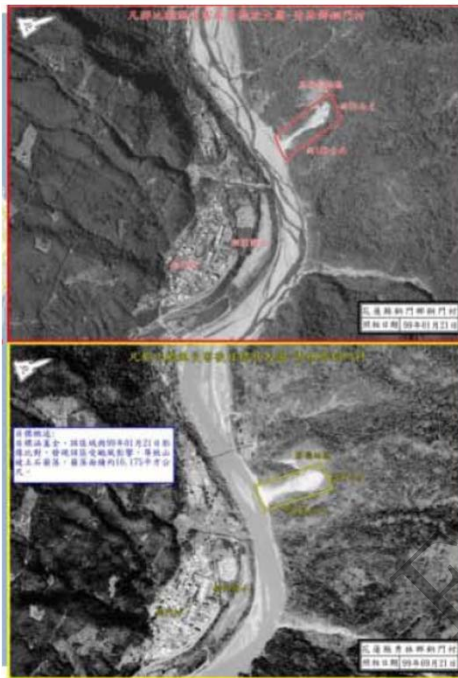
提供前後影像比對功能



Multi-Image Sources



Satellites



Airplanes



UAVs



Helicopters

Coordinating via Video Conference

那比颱風

板 視訊會議 桌面分享 視窗(W)

Life

1/18上午

1/18下午

國3北上18+000

國3北上27+400

國道5號統一里程

國道3號統一里程82K處

國道1號124k+400~800

國道3號150k+100~150k+585

國道3號138k+650

國道1號187k+189k

台灣國道6號

南投服務區邊坡雙向

國道3號北上292k+700

國道1號曾文溪橋(309k+150~310k+230)

國道3號363k+000~100

中寮隧道南口

1/19上午

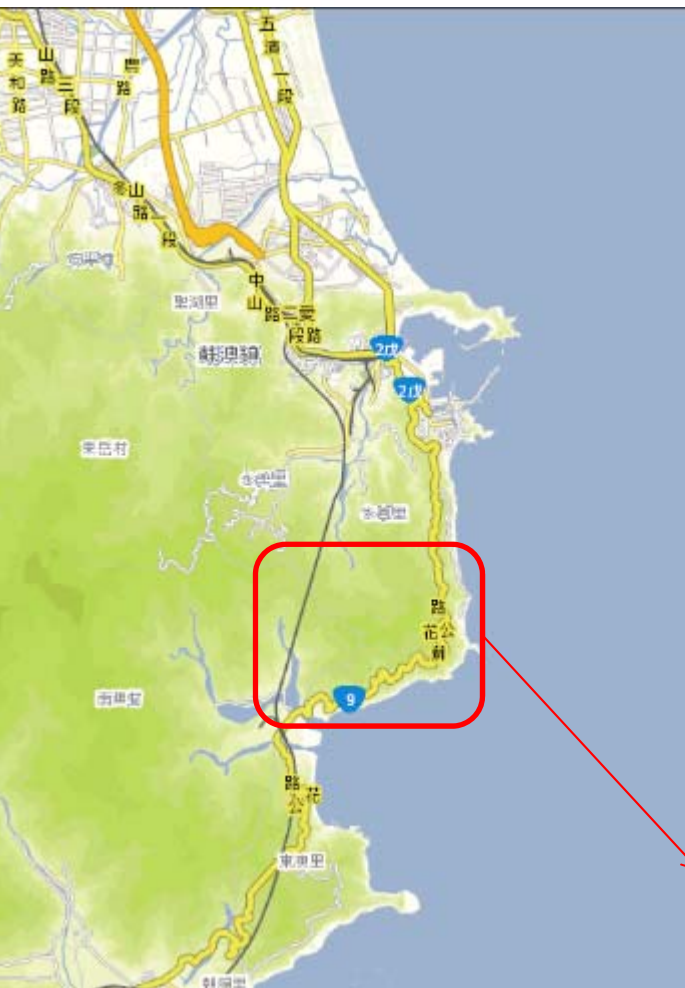
我的畫面

王韻皓 (afasi)

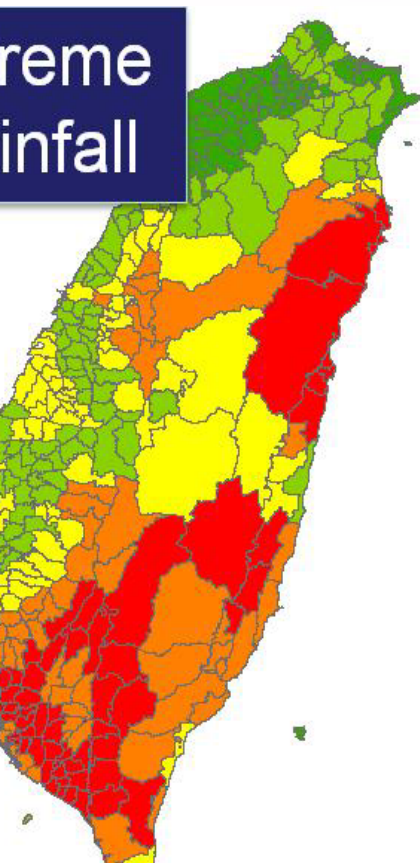
科技中心資訊組 (NCDRINFO)

中央人員 (WRAMOEAA)

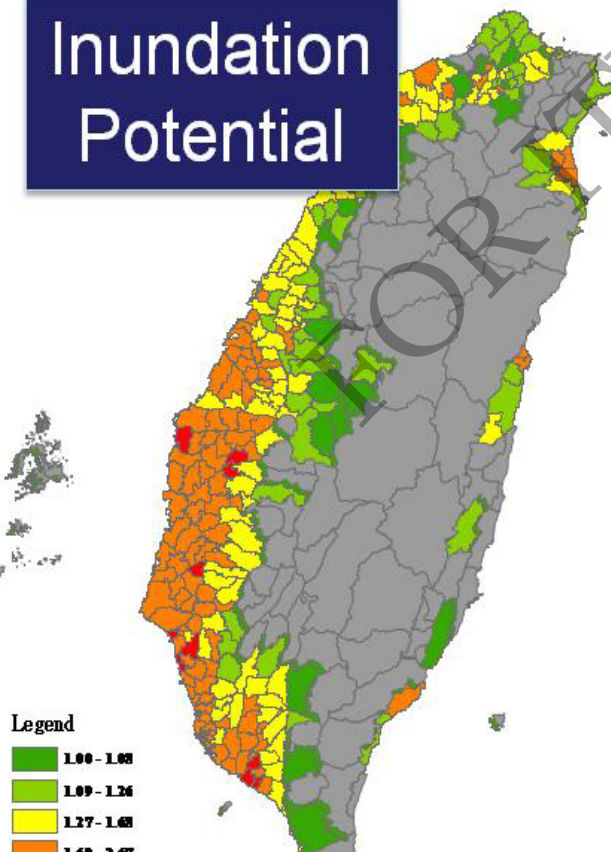
Image Processing and Interpretation



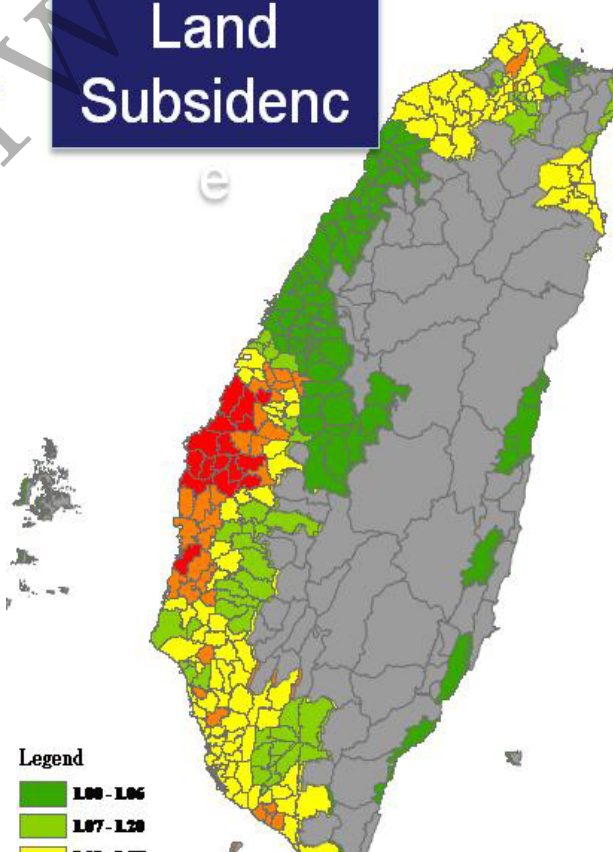
Building up risk maps



Inundation
Potential



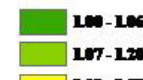
Land
Subsidence

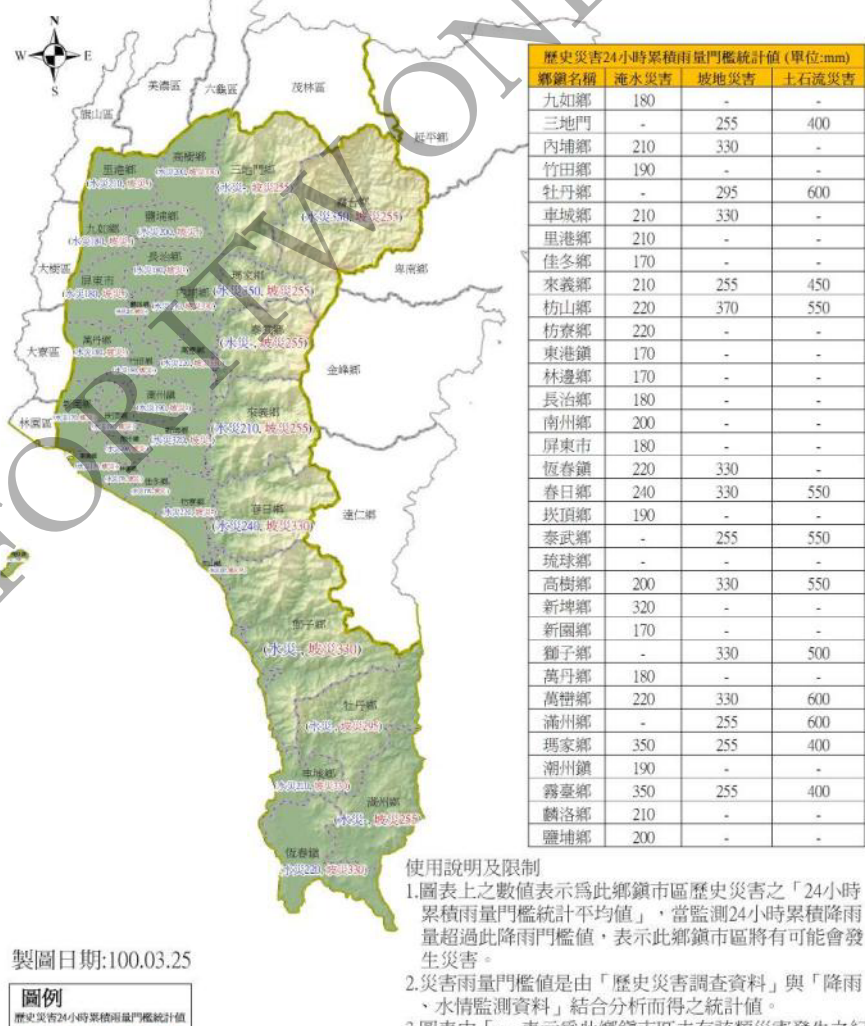


Legend



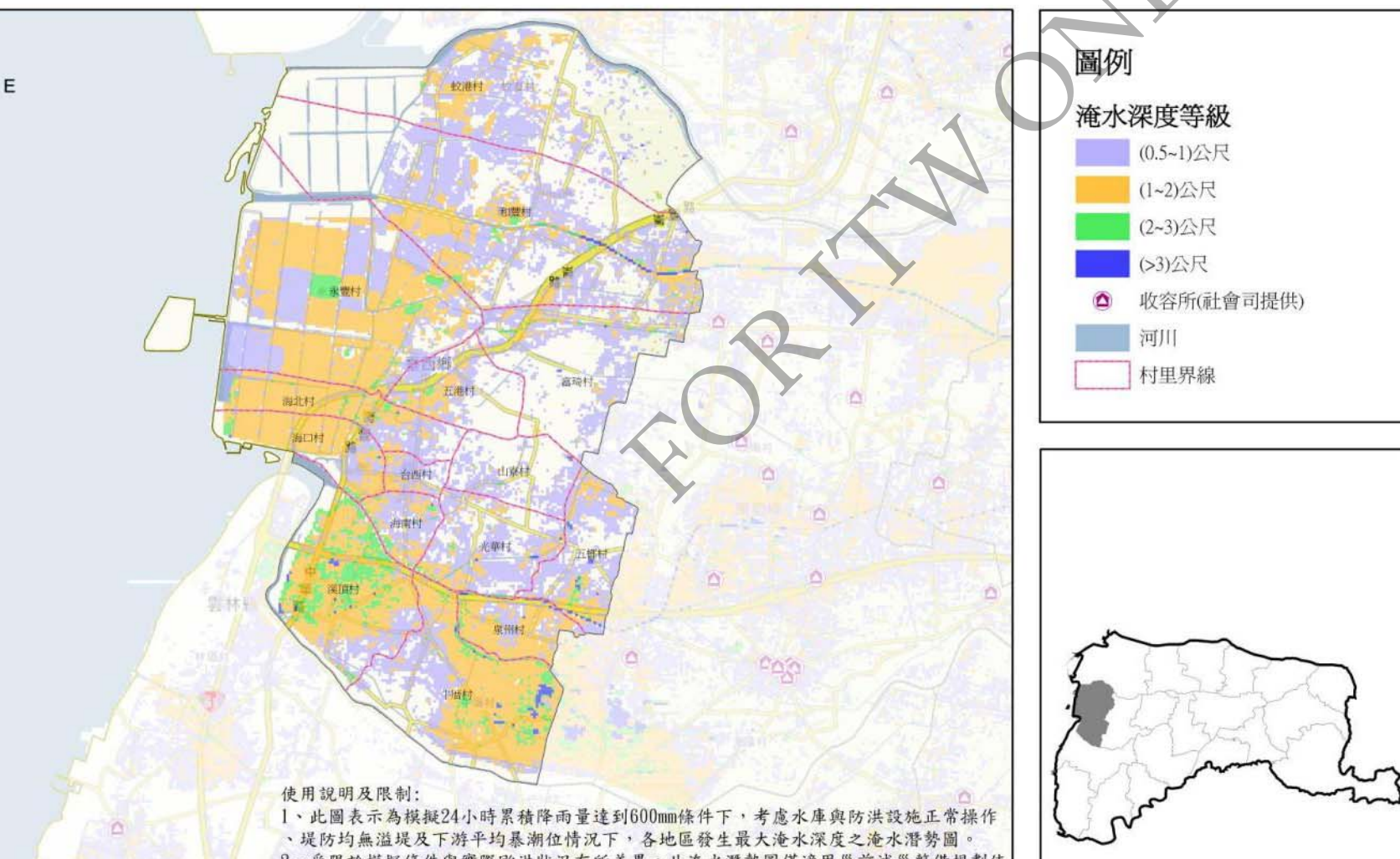
Legend



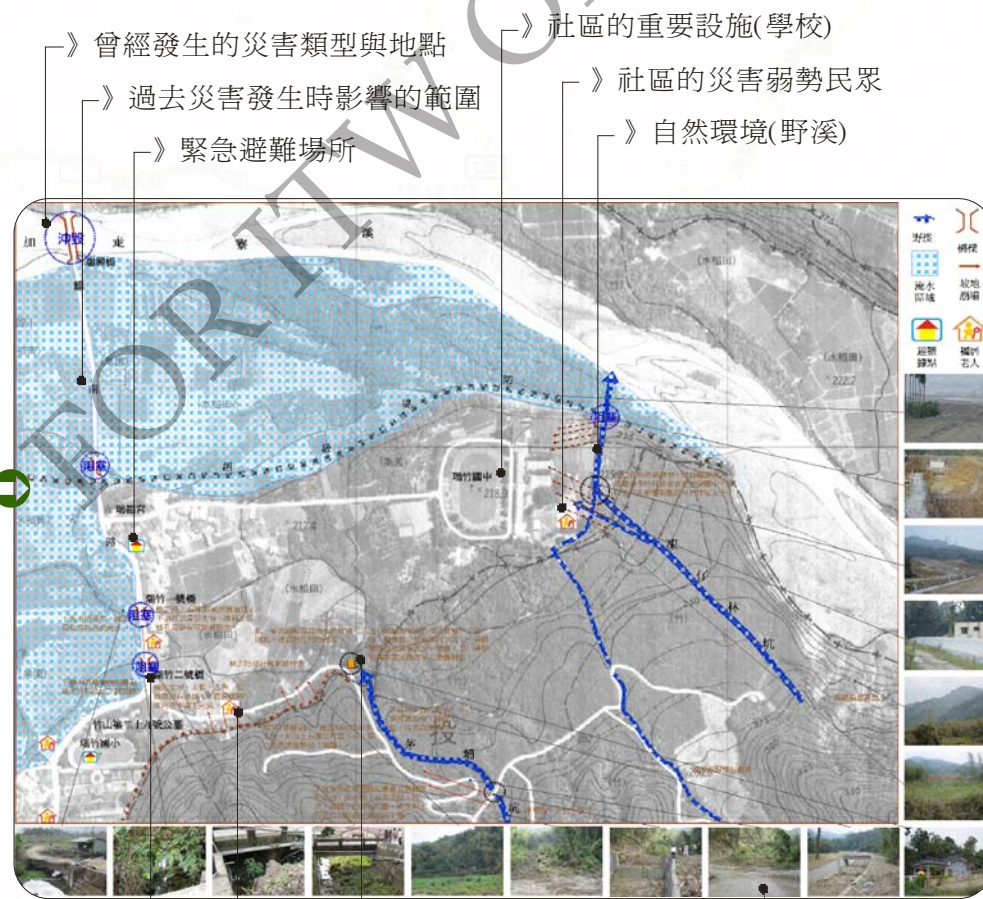
[illegible]

Hazard Maps (NCDR)

雲林縣麥寮鄉淹水潛勢圖(模擬24小時累積雨量600mm)



www.ncdr.nat.gov.tw



Development on earthquake risk reduction – planning, response, warning



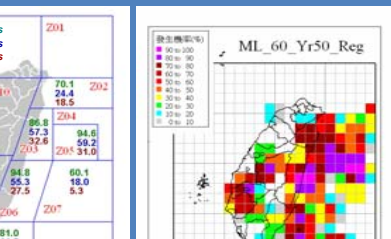
Estimation of the Occurrence Probabilities for the high potential Earthquake

Collaborate with CWB, NCEC, CGS, and other relevant divisions

Compilation and earthquake catalog

Estimation of occurrence probabilities of earthquake

Recurrence model



Earthquake Disaster Response Framework

- SOP
- Division of labor
- Information decision system

NCDC provide decision making suggestions for the commander with the Earthquake Rapid Report by CWB and disaster estimation information by TELES

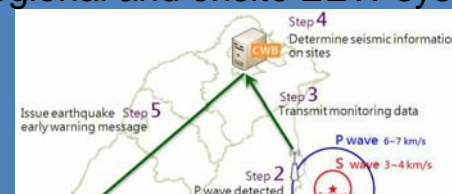


Promotion Planning of Earthquake Early Warning System

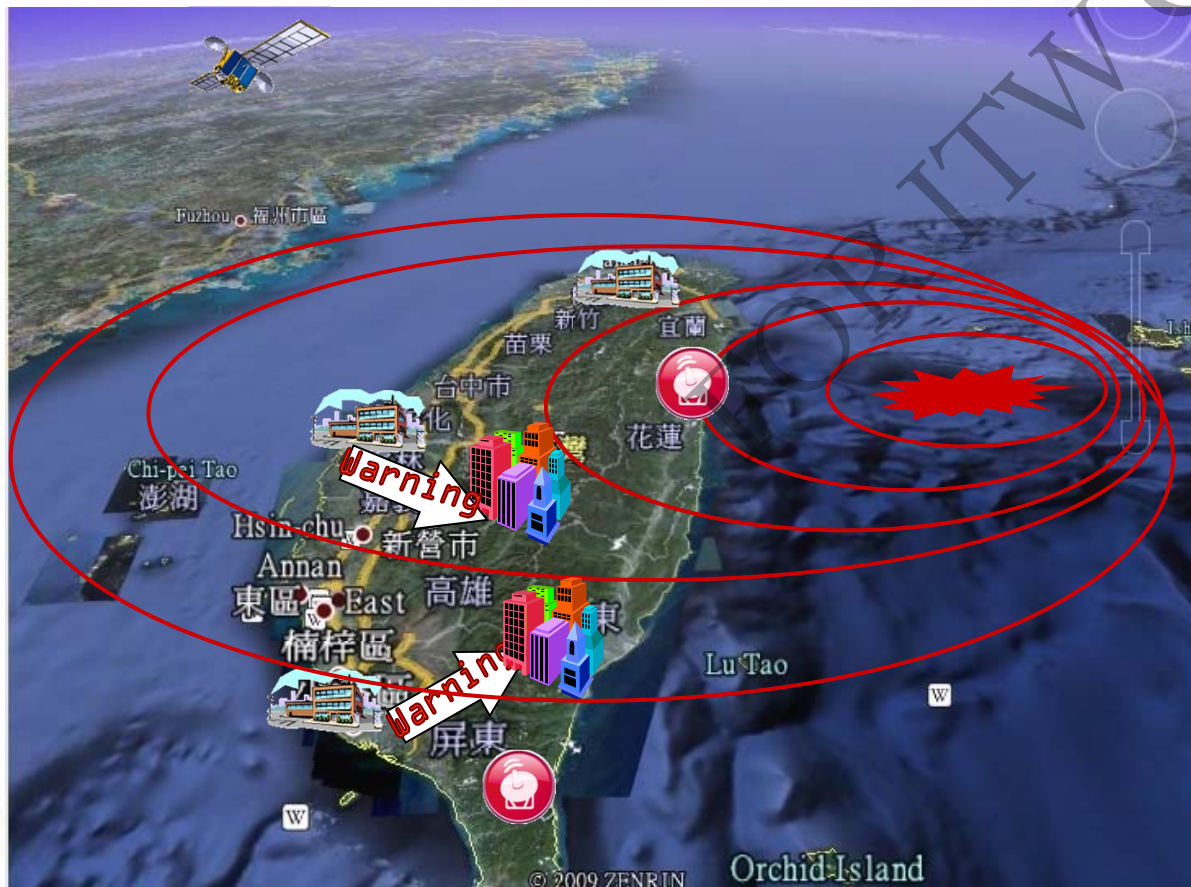
- Collaborate with CWB, NCREE, NCHPC
- Refer to Japan and direct by REIC
- Regional and onsite EEW systems will be promoted simultaneously



Regional and onsite EEW systems

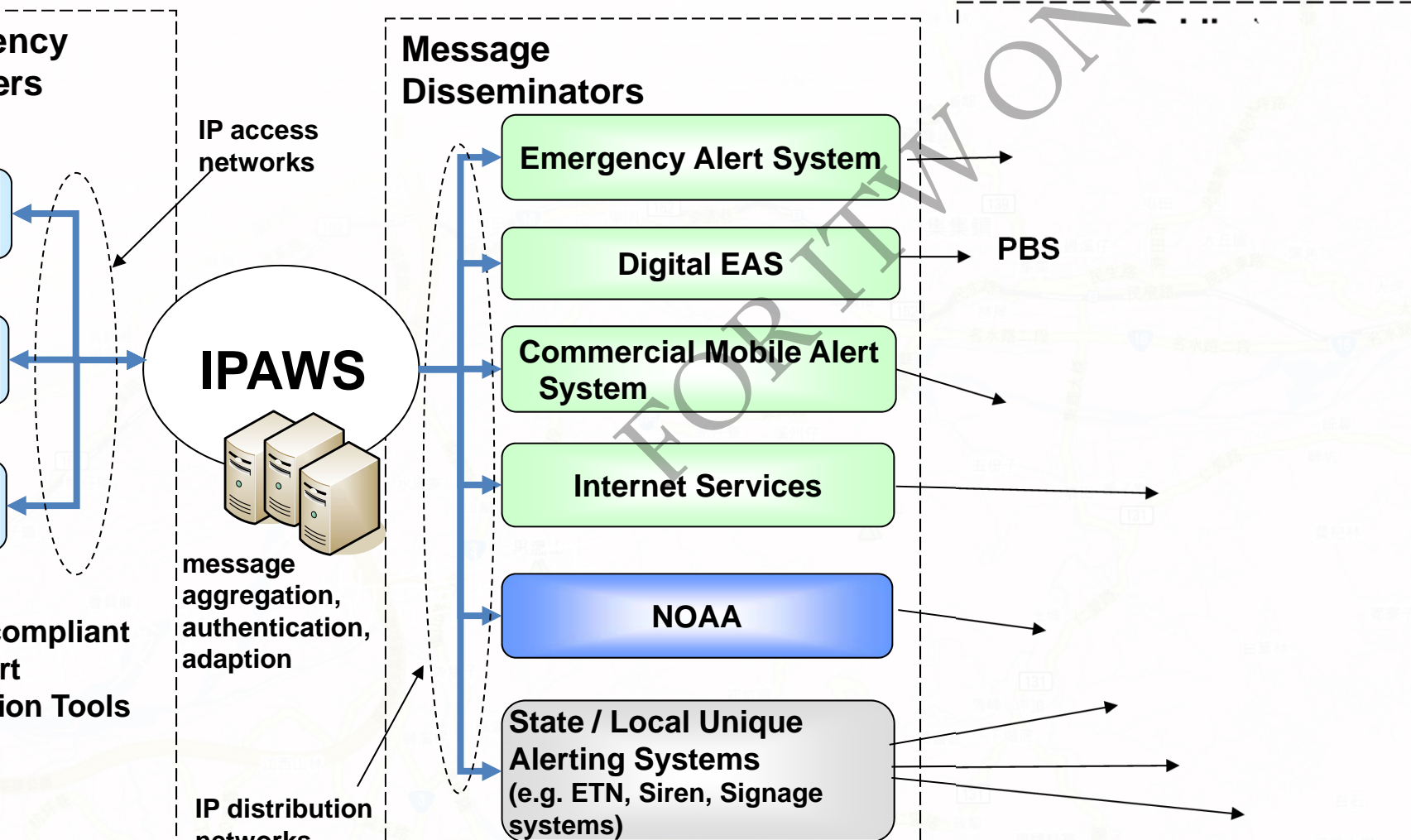


Earthquake Early Warning System

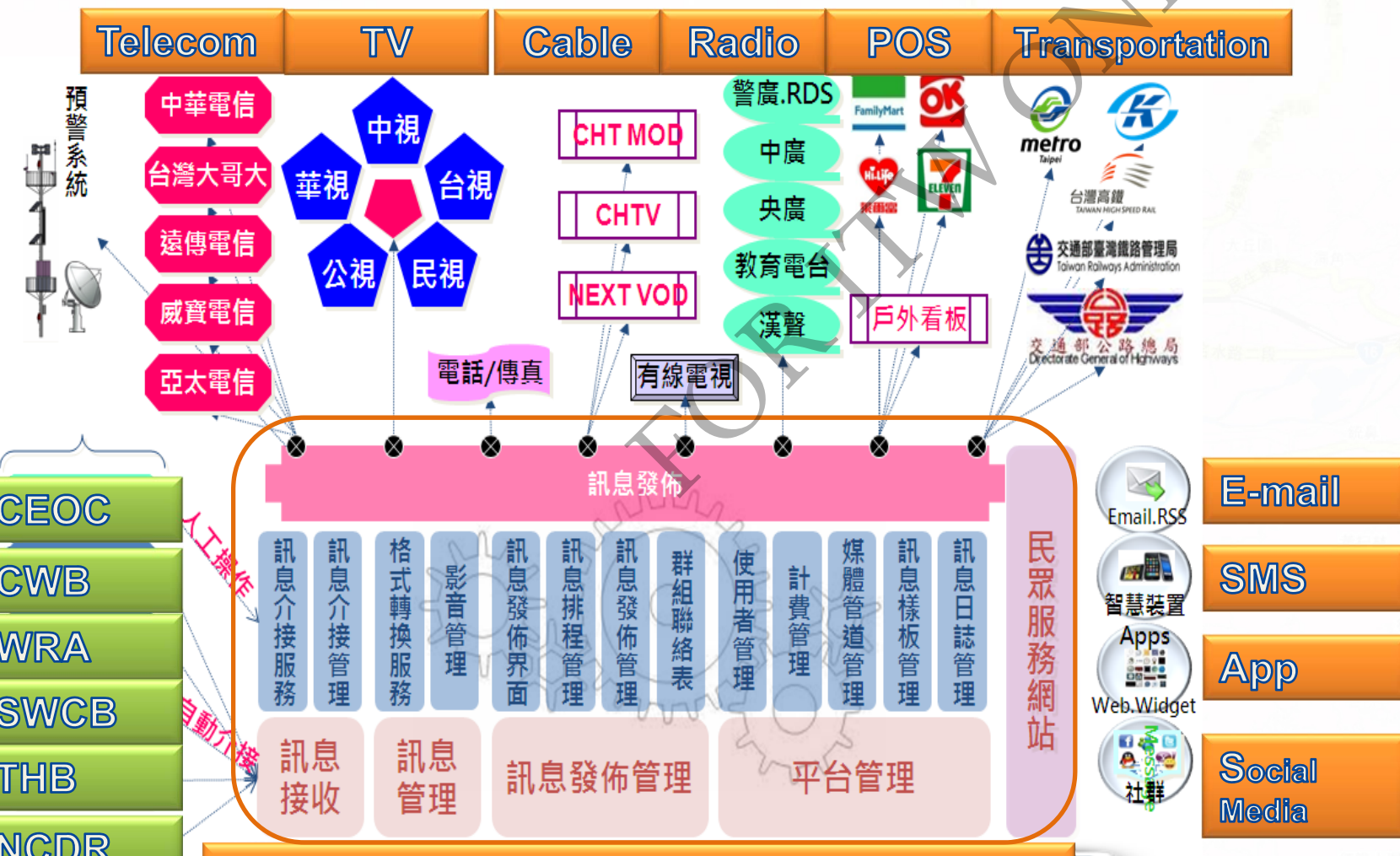


IPAWS Vision Architecture

Standards Based Alert Message data exchange format, alert message aggregation, shared, trusted access & distribution networks, alerts delivered to more public interface devices



Disaster Messages Broadcasting Platform



THANK YOU

FOR ITW ONLY

