



**APEC Research Center for Typhoon and Society
(ACTS)**



Risk information Integration and Dissemination for Extreme Events

TZU-YIN CHANG

Aug 22, 2019

- **Extreme weather events review**
- **Data integration**
- **Data sharing and dissemination**
- **Conclusions**

Cold weather event in 2016



Taipei experienced a 62 hours long cold surge (1/23-1/26, 2016)
It was the **lowest temperature event in 44 years**



■ Oranges in Hsinchu



■ Strawberry in Miaoli

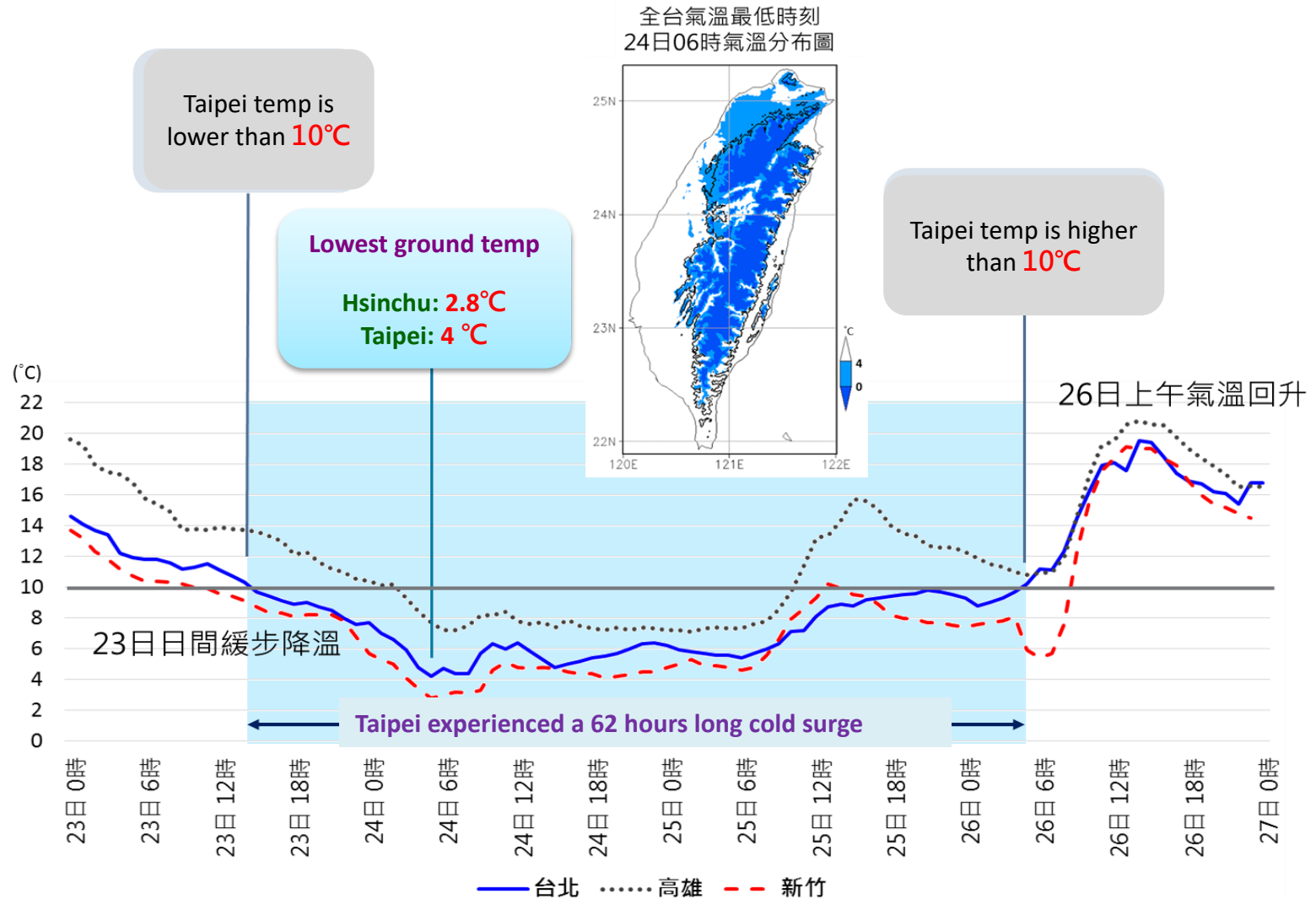


■ Grouper in Chiayi



■ Milkfish died at low temperatures in Tainan

Cold weather event in 2016



Comparison of historical cold weather events



It was the **lowest temperature event in 44 years**

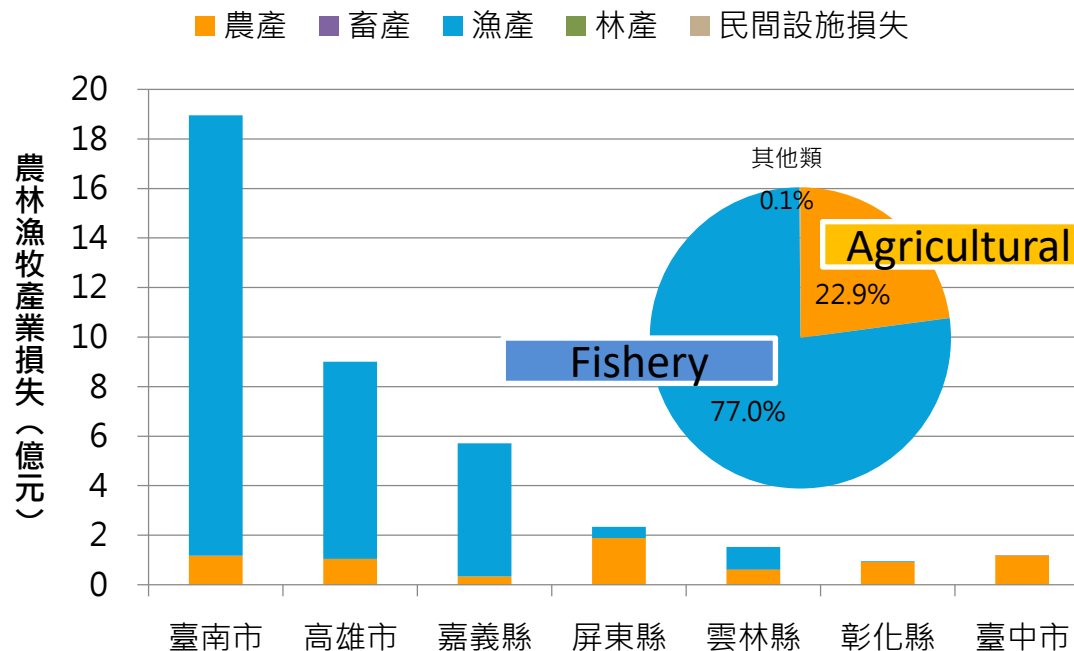
Station	Lowest ground temp (°C)	Historical low temperature event (date)	Range (Year)
Taipei	4.0	1972/03/02	44
Hsinchu	2.8	1963/01/29	53
Taichung	4.4	1986/03/03	30
Tainan	5.7	1986/01/06	30
Kaohsiung	7.0	1986/03/02	30

Impact of cold weather event



- According to the statistics from the Council of Agriculture, the total loss in agricultural, forestry, fishery and animal husbandry products and private facilities from this event is around 4.2 billion NTD, which is the highest loss of cold/low temperature events since 1999.

January 2016 cold event -agricultural disaster report



- The loss in fishery products is nearly 3.26 billion NTD : milkfish, grouper, Wu Guoyu, Wenyu and carp
- The loss in agricultural products is nearly 0.9 billion NTD : lotus, giant grape, pear and tomato
- The total loss for Tainan City is 1.89 billion NTD, 0.960 billion NTD for Kaohsiung City, and 0.960 billion NTD for Chiayi County.

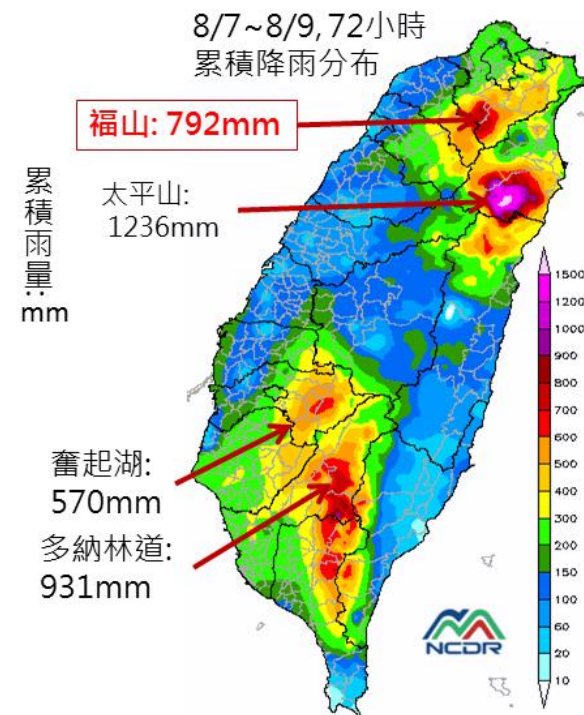
Typhoon Soudelor in August 2015



Intensive rainfall caused serious damage in Wulai



蘇迪勒颱風降雨分布特性



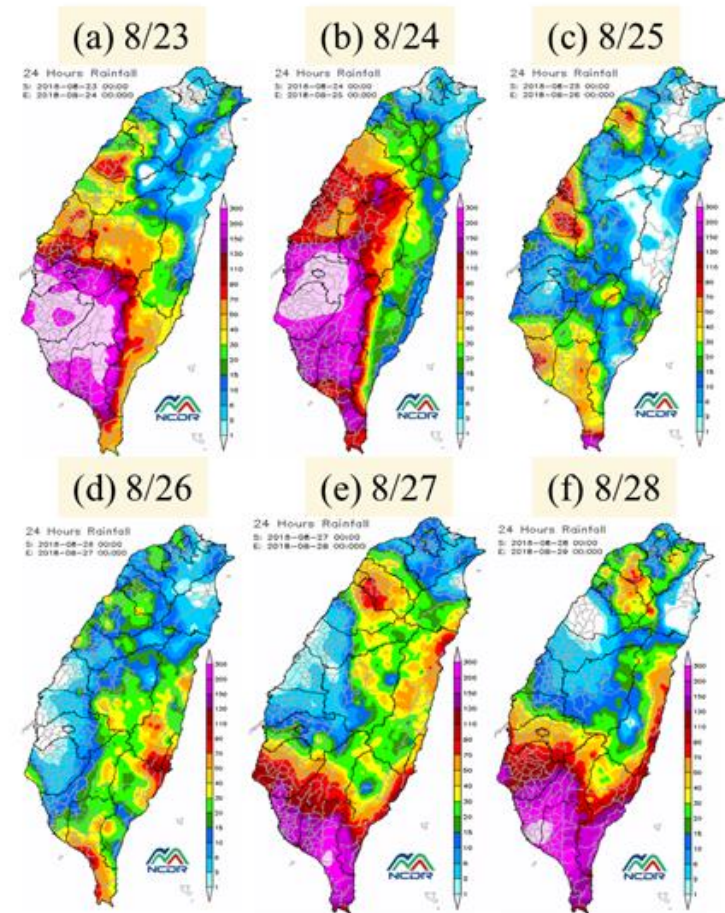
Typhoon/ Rainfall	hr (mm)	3 hrs (mm)	6 hrs (mm)	12 hrs (mm)	accumulate (mm)	tubidity (NTU)
2015 蘇迪勒	95	253	442	655	792	39300
2012 蘇拉	79	156	238	367	752	12000
2008 薔蜜	61	132	203	334	574	10500
2008 辛樂克	51	120	169	271	955	(南勢溪)

Rainfall distribution of Soudelor Typhoon

0823 T.D. in August 2018



(WP242018) T.D. Caused Serious flooding



Rainfall distribution of 0823 flooding

DATA INTEGRATION

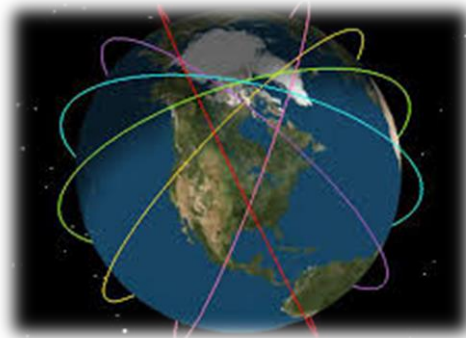
Disaster Management Phase/Data Source



Mitigation		
1	Long-term risk assessment and reduction	Satellite, 33% Crowdsourcing, 17% Sensor web and IoT, 17% Social media, 13% Mobile GPS and CDR, 12% Simulation, 8%
2	Forecasting and Predicting	Simulation, 50% Satellite, 25% Sensor web and IoT, 13% Social media, 12%

Preparedness		
1	Monitoring and detection	Social Media, 31% Sensor web and IoT, 31% Satellite, 13% Combination of various data types, 9% Spatial data, 4% Lidar, 4% Mobile GPS and CDR, 4% Crowdsourcing, 4%
2	Early warning	Social media, 29% Sensor web and IoT, 29% Simulation 14% Crowdsourcing 14% Satellite, 14%

Disaster Management Phase/Data Source



Response		
1	Damage Assessment	<p>Satellite, 53% UAV, 21% Social media, 16% Sensor web and IoT, 5% Crowdsourcing, 5%</p>
2	Post-disaster Coordination and Response	<p>Social media, 25% Satellite, 16% Sensor web and IoT, 16% Crowdsourcing, 10% UAV, 9% Simulation, 6% Spatial data, 6% Lidar, 6% Mobile GPS and CDR, 3% Combination of various data types, 3%</p>
Recovery		
		<p>Combination of various data types, 60% Crowdsourcing, 30% Satellite, 10%</p>

Reference : Yu et al., Big Data in Natural Disaster Management: A Review, Geosciences, 8(5):165 · May 2018

Integration of various data types

- More than **20** agencies **integrated**
- **Maintenance of over 200** real-time **ongoing datasets**
- **Interface more than 120** data **types**

Basic

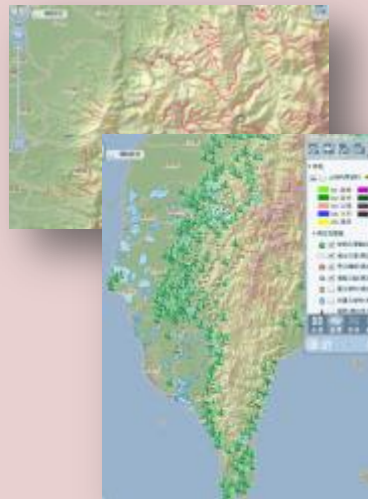
Administrative

boundaries,
road, river,
dam, dike,
Potential debris
location, historic
disaster location,
satellite imagery



Monitor

precipitation, river
level, dam level,
tide, radar image



Model

Precipitation
Forecast, Flood
Warning area,
debris warning area



Loss

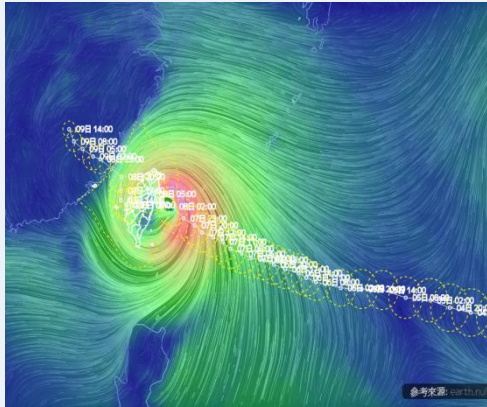
People Injured, Road
and Bridge Broken,
Flood Disaster, Slope
Land Disaster,
Evacuation
condition, Electricity
Interrupted



Simulation Data



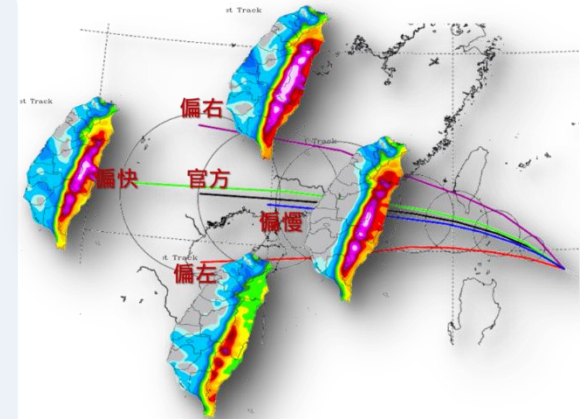
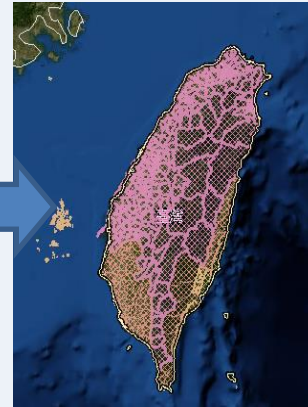
Path Forecast



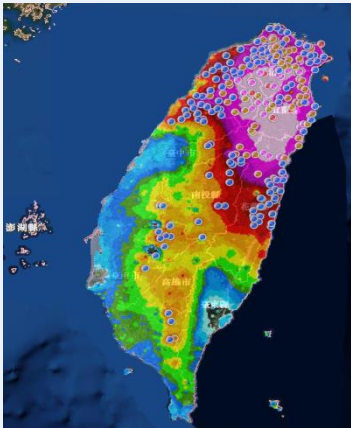
Warning



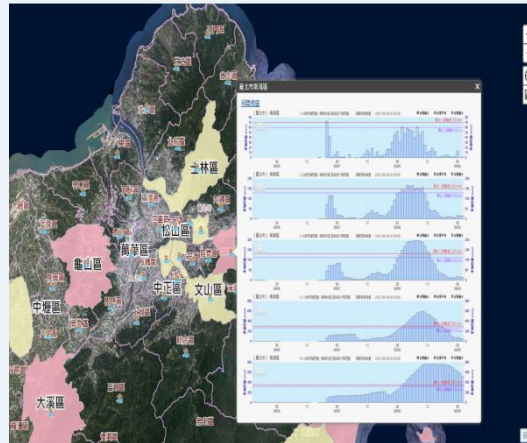
Torrential rain



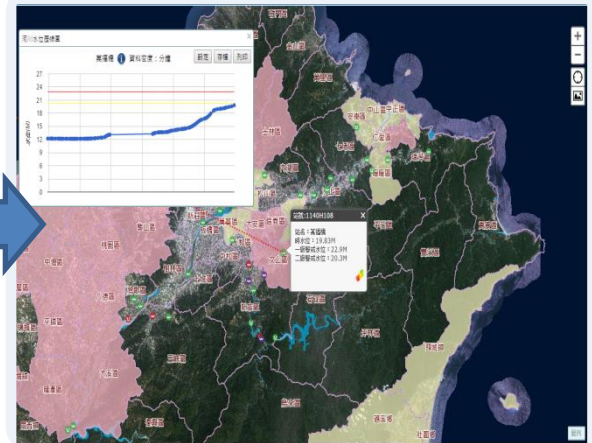
Precipitation Obs.



Flood Forecast



Real-time water level



Risk Assessment on Flood

災害情資網 線上人數: 2人
Welcome: wrsu

| 近期地震 | 情資研判下載 | 相關連結

03/09 06:10 濃霧特報發布 07FW27091 中央氣象局濃霧特報: 1 0 5 年 3 月 9 日 6 時 1 0 分 發布 濃霧特報: 今 (9) 日 臺灣 西 半 部 地 區 及 澎 湖、金 門、馬 祖 易 有 局 部 濃 霧, 目 前 金 門 (0 5 時 5 0 分) 有 濃 霧 發 生, 能 見 度 不 足 1 8 0 公 尺, 請...

Intro
蘇迪勒情境
地震展示(臺南)
0206美濃地震
本日情勢(即時)
豪大雨情資
颱風情資
近期災害事件
地震情資
災害潛勢地圖
本日情勢(展示)
地震(展示)

颱風影響時間
趨勢研判
淹水災害風險研判
淹水災害模擬
坡地災害風險研判
歷史重點災情
綜合建議

蘇迪勒淹水 2015/08/16 下午 4:55

2016/6/16 10:39:35

CCTV

Use CCTV to watch area.

Image © 2015 DigitalGlobe
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Image © 2015 CNES / Astrium

Google earth

資訊綜覽

宜蘭淹水災害模擬與監測

強降雨發生前後(7日入夜及8日凌晨), 宜蘭地區須嚴防淹水災情的發生。

The typhoon packing sustained winds with gusts will bring in torrential rain, so that the low lying area has to prevent flood.

雨量站排序

地震區域統計

雨量統計

地震震度統計

河川水位

水庫統計

時間: 03/09/2016 13:30:00 [更多](#)

地點	24小時累積雨量(mm)
苗栗	~28
造橋	~22
大粗坑	~20
三和	~18
大坪	~15

Sensor web -CCTV



災害情資網 線上人數: 2人 Welcome · wrsu

03/09 10:20 陸上強風特報發布 07fW25092 中央氣象局陸上強風特報: 1 0 5年3月9日10時20分發布 陸上強風特報: 強烈東北風影響, 今(9日)下午起臺南以北、東半部、恆春半島及蘭嶼、綠島、澎湖、金門、馬祖空曠地區及鄰近海...

Intro 蘇迪勒情境 地質展示(臺南) 0206美濃地震 本日情勢(即時) 豪大雨情資 颱風情資 近期災害事件 地震情資 災害潛勢地圖 本日情勢(展示) 地震(展示)

震源與地動分佈 鄰近震源地質剖面 影響人數分佈 老舊建物分佈 交通通阻評估 重要設施衝擊風險 避難空地分佈 地震CCTV監看 臺南市評估

快速公路84號(麻豆交流道到下營系統交流道)
加入監看
位置: 臺南市大內區 快速公路84號(麻豆交流道到下營系統交流道)
影像來源: 縣市政府及運研所
2016-03-09 14:05:28
台84線 麻豆交流道平面17K+553西

Road

曾文水庫
加入監看
位置: 嘉義縣大埔鄉 曾文水庫
影像來源: 水利署

reservoir

台29線63K+450[2-3]
加入監看
位置: 高雄市旗山區 台29線63K+450[2-3]
影像來源: 公路總局

Road

鯤潭橋
加入監看
位置: 臺南市仁德區 鯤潭橋
影像來源: 台南水利局

Bridge

雨量站排序 雨量統計 河川水位 水庫統計
地震區域統計 地震震度統計

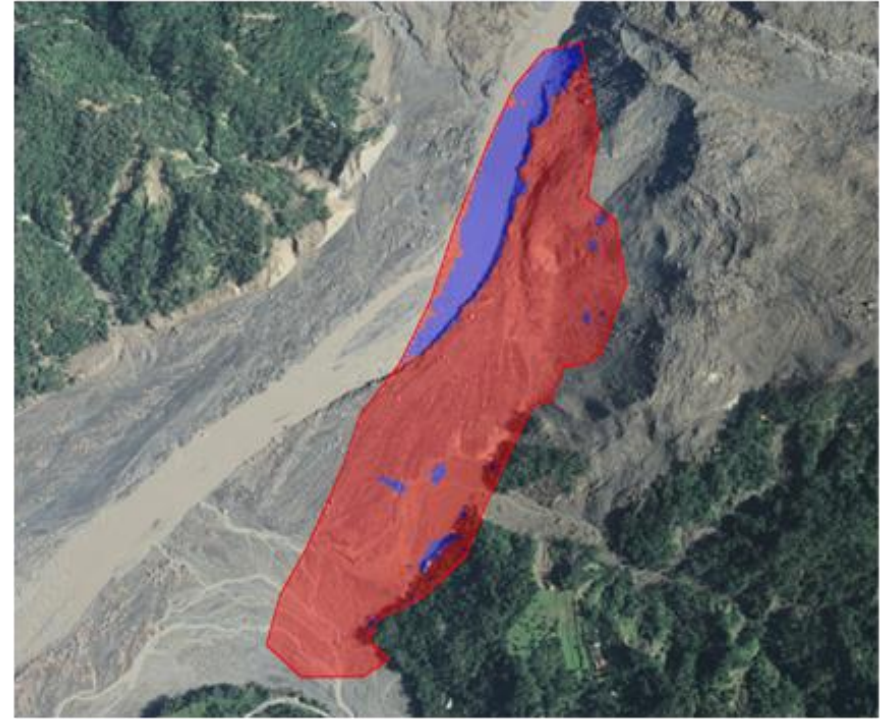
雨量站	24小時累積雨量(mm)
三爺宮	1.00
南化(2)	1.00
北門	1.00
學甲	0.50
將軍	0.50

時間: 03/09/2016 13:50:00 更多

Remote Sensing Imagery



Before Disaster



After Disaster

Estimation of sediment yields 1,550,591 cubic meters covered Siaolin Village in Kaohsiung County.

Social media- Landslide



Current situation: HW #21 has been suspended, but **sliding on hill side continues**



07/30 07:52 HW#21 115K+540

Source: FB post at 9:30 am

07/30 15:52 Source: FB post



Cold weather module for decision maker



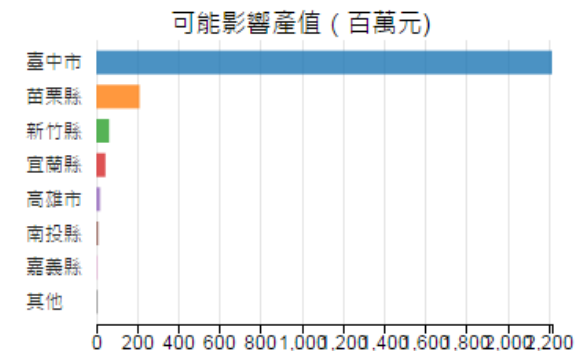
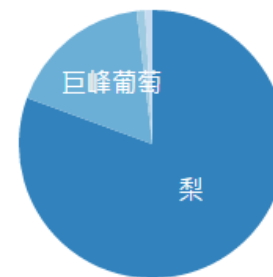
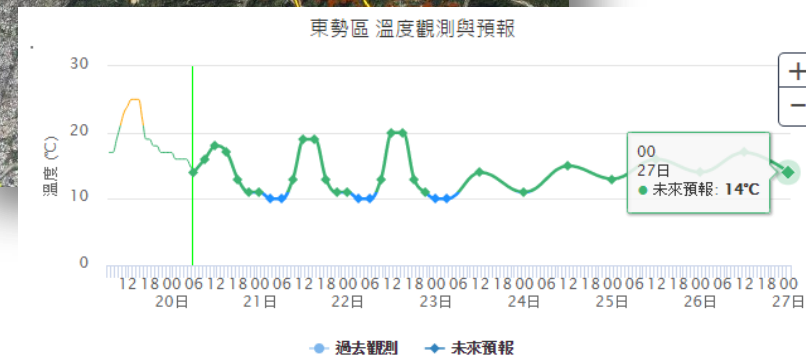
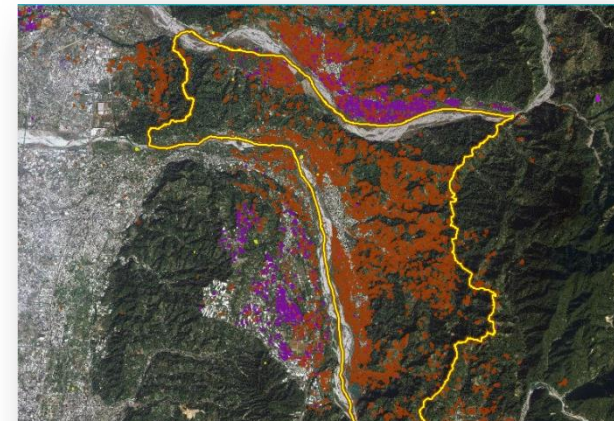
■ User : **Decision Maker**

■ Purpose :

- Decision makers can quickly understand the impact of cold weather on **agriculture** and **fishery** for the coming week

■ Data Set :

- 2 days to 1 week of **the forecasting** temperature in township level
- Knowledge of crops and fishes susceptible to cold damage

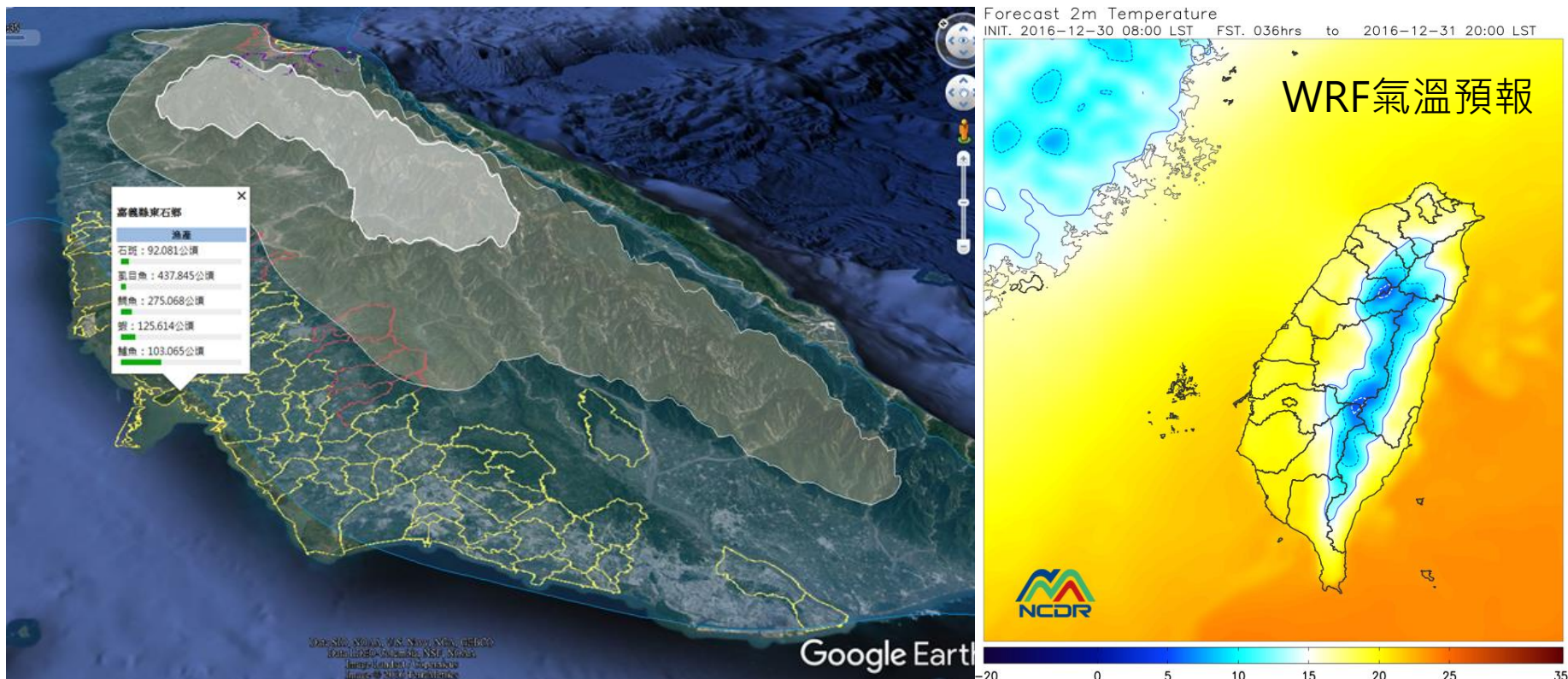


Temperature forecast and agricultural/fishery information



Temperature forecast and agricultural/fishery information

- Three-day temperature forecasting information
- Temperature warning for agriculture and fishery (10, 6, 0 °C)
- List agricultural production (mango, pear, grape...) in the warning area
- List fish farm (salmon, squid...) in the warning area

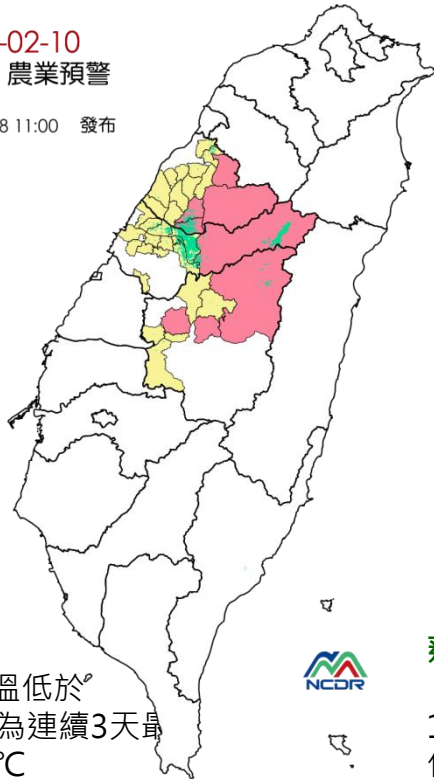


Low temperature warning: Agriculture



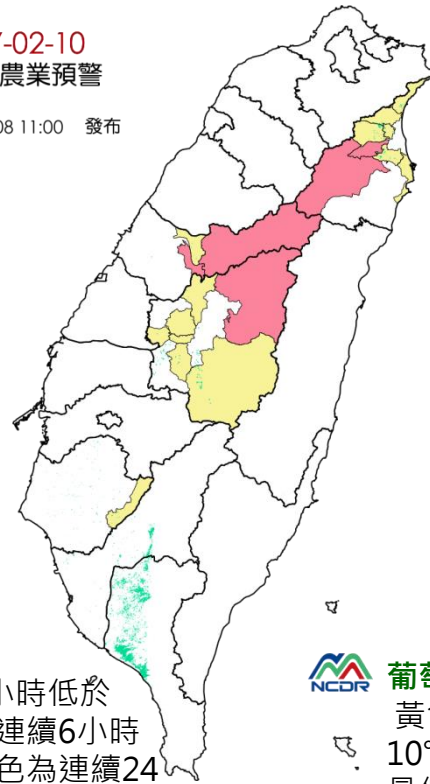
- The area-of-influence by cold weather are **in the northern and central regions**, the pear farm in Miaoli County, Taichung City and Nantou County; the bell apple farm in Yilan County, Taichung City, Nantou County, Tainan City, and Miaoli County and Taichung City. Grape farm in Changhua County, Yunlin County, and Nantou County will need to pay attention

2017-02-10
高接梨 農業預警
2017-02-08 11:00 發布



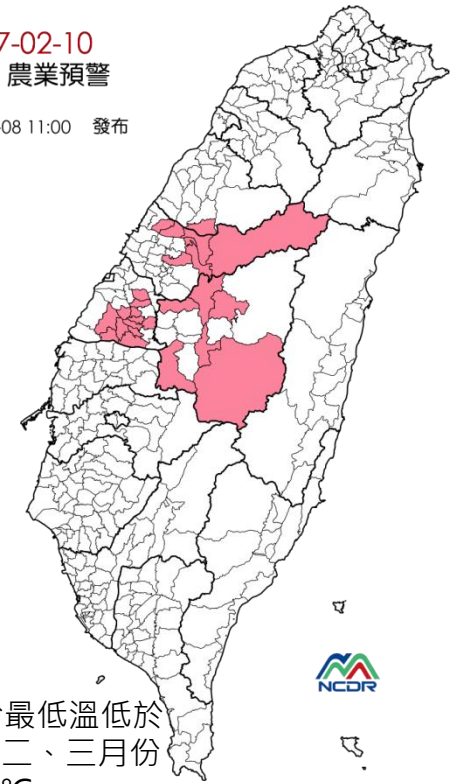
高接梨圖例
黃色為最低溫低於
10°C、紅色為連續3天最
低溫低於10°C
淺綠色：農業種植區域

2017-02-10
蓮霧 農業預警
2017-02-08 11:00 發布



蓮霧圖例
黃色為連續3小時低於
10°C、紅色為連續6小時
低於10°C、紫色為連續24
小時低於10°C

2017-02-10
葡萄 農業預警
2017-02-08 11:00 發布

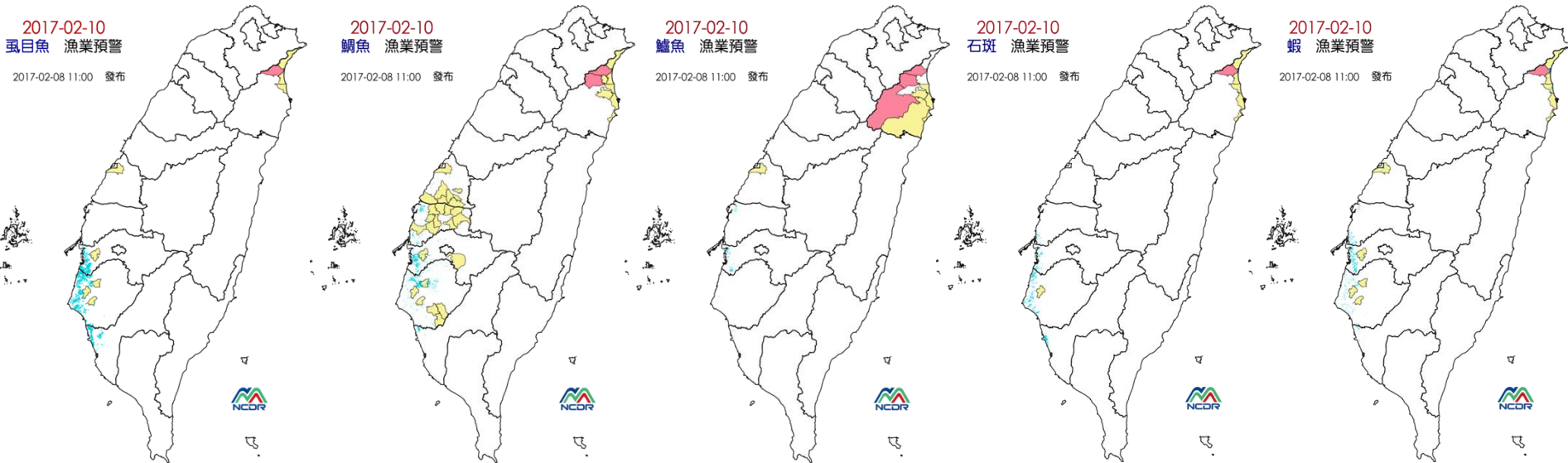


葡萄圖例
黃色為一月份最低溫低於
10°C、紅色為二、三月份
最低溫低於10°C

Low temperature warning: Fishery



- On 10th February, the farmed fish in Yilan County, Changhua County, Yunlin County, Chiayi County and Tainan City are affected by low temperature, including milkfish, shrimp farm.



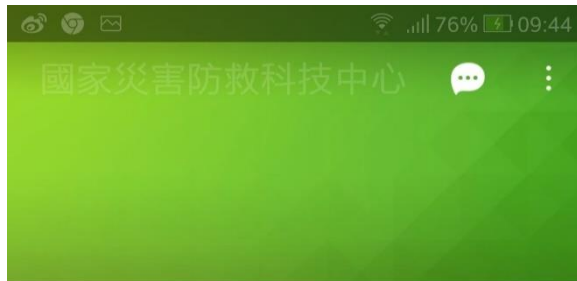
漁業圖例

警戒值使用最低溫
低於10°C連續天數為標準
黃色為連續1-2天、
紅色為連續三天、
紫色為連續四天
淺藍色：漁種養殖區域

Low temperature warning for public



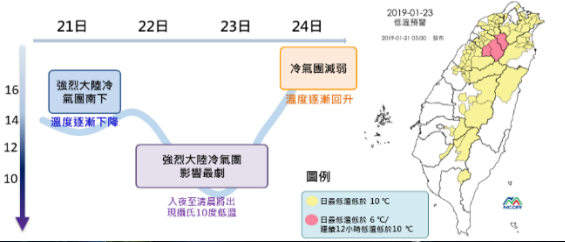
- Low temperature warning for public via social media such as LINE and FB



國家災害防救科技中心

強大大陸冷氣團低溫預警

- 強大大陸冷氣團將影響，22日入夜至23日清晨溫度最低
- 北部、宜蘭及中南部山區等地受低溫影響，請多留意家中長者與小孩身體健康，並注意用火安全與室內通風，避免火災與一氧化碳中毒
- 請農漁民留意低溫變化趨勢，並預作準備，以降低農作物及養殖漁業之衝擊



分享 124

10月3 17:03

facebook 註冊

電子郵件或電話 密碼 登入

忘記帳號?

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

加入社團 更多 加入此社團以發表貼文和留言。

最新動態

傅金城 分享了 1 條連結。
1 小時

強大大陸冷氣團低溫預警

- 強大大陸冷氣團將影響，22日入夜至23日清晨溫度最低
- 北部、宜蘭及中南部山區等地受低溫影響，請多留意家中長者與小孩身體健康，並注意用火安全與室內通風，避免火災與一氧化碳中毒
- 請農漁民留意低溫變化趨勢，並預作準備，以降低農作物及養殖漁業之衝擊

讚 1

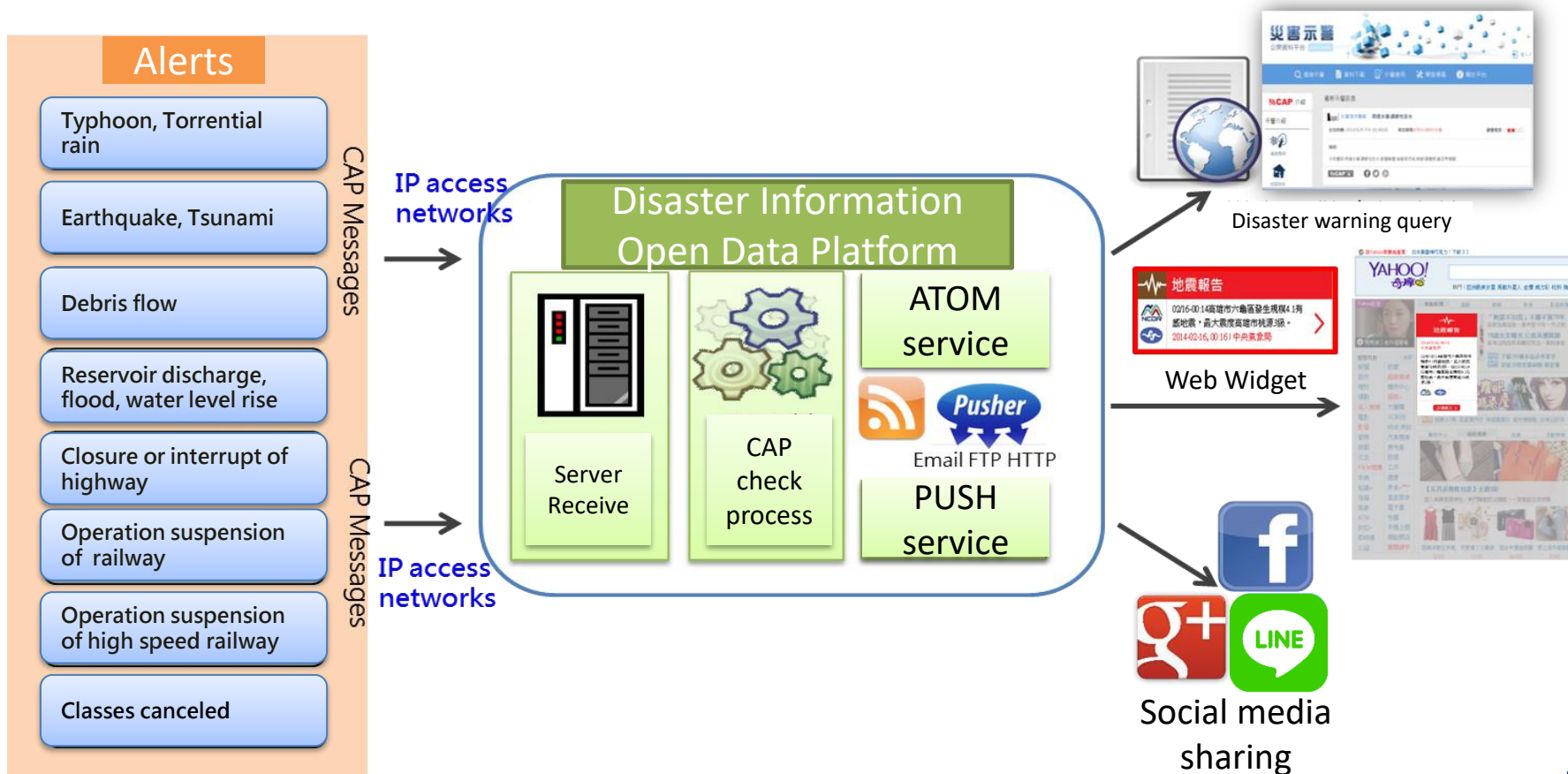
讚 留言 分享

information sharing and dissemination

One Stop-Alert Platform(1/2)



- ✓ **Standardizing formats and protocols** of public alerts
- ✓ **Sharing information** via a **open data** platform
- ✓ **Promoting the applications** of public disaster alerts



One Stop-Alert Platform(2/2)



- ✓ Integrating **36 different kinds** of CAP alerts issued by **14 agencies**
- ✓ Releasing **13 kinds of real-time layers**

The screenshot shows the homepage of the '災害示警' (Disaster Alert) platform. The main content area is titled '最新示警訊息' (Latest Alert Messages) and displays three alert cards. The first card is for '水庫漫溢警報 鯉魚潭水庫-自由溢流' (Reservoir Overflow Alert - Linyuan Reservoir - Free Overflow), issued on 2014/5/3 at 08:00:00. The second card is for '降雨警報 大雨特報' (Rainfall Alert - Heavy Rain Special Report), issued on 2014/5/3 at 04:50:00. The third card is for '道路封閉警報 台8線87K+400-0K+000道路封閉' (Road Closure Alert - Highway 8 Line 87K+400-0K+000 Road Closure), issued on 2014/5/26 at 06:00:00. A left sidebar contains navigation icons for various alert types like '颱風警報' (Typhoon Alert), '土石流警報' (Landslide Alert), and '水災警報' (Flood Alert).

The screenshot shows the '即時資料' (Real-time Data) section of the platform. It features a table listing real-time data layers from various agencies. The table has columns for the agency name, the data layer name, the date and time, and a 'Meta data' link. The data is as follows:

Agency	Data Layer	Date/Time	Meta data
水土保持局	台東縣土石流警報(kmz)	2014/05/22 04:59	Meta data
	花蓮縣土石流警報(kmz)	2014/05/21 11:30	Meta data
	台南市土石流警報(kmz)	2014/05/21 11:34	Meta data
	花蓮縣土石流警報(kmz)	2014/05/22 04:59	Meta data
	花蓮縣土石流警報(含該縣避難路線及避難處所)(kmz)	2014/05/22 04:59	Meta data
	南投縣土石流警報(kmz)	2014/05/22 04:59	Meta data
	嘉義縣土石流警報(kmz)	2014/05/21 11:34	Meta data
	苗栗縣土石流警報(kmz)	2014/05/22 04:59	Meta data
	屏東縣土石流警報(kmz)	2014/05/21 11:35	Meta data
	基隆市土石流警報(kmz)	2014/05/21 11:35	Meta data
	南投縣土石流警報(kmz)	2014/05/21 11:35	Meta data
	高雄縣土石流警報(kmz)	2014/05/22 04:59	Meta data
	雲林縣土石流警報(kmz)	2014/05/22 04:59	Meta data

Debris Flow



土石流紅色警戒：苗栗縣泰安

接下來的 18 分鐘內有效
地點：苗栗縣泰安鄉梅園村

Type: debris flow

發佈時間：1 小時 42 分鐘前 - 農委會水土保持局

可能性：■■■■ 預計發生時間：■■■■ 嚴重程度：■■■■

Urgency
Certainty
Severity

依據中央氣象局風雨資料研判：計1條土石流潛勢溪流達紅色警戒(相關土石流防災資訊網(<http://211.229.248.100>))

建議作為

Recommendation

請配合鄉(鎮、市、區)公所及當地警消單位指示，儘早撤離或前往避難處所避難，並與當地避難處所保持聯繫，有關當地避難處所相關聯絡資訊，請詳土石流疏散避難圖。

來源: 水土保持局

當行政院農業委員會發布土石流警戒時，建議民眾遵從下列建議事項：

黃色警戒：請隨時觀察環境變化，留意最新訊息，做好疏散避難準備並保持聯絡管道暢通。

紅色警戒：請配合鄉(鎮、市、區)公所及當地警消單位指示，儘早撤離或前往避難處所避難。

查詢土石流相關資訊可上土石流防災資訊網獲得最新資訊

事前準備：

應熟悉了解居住區域環境的避難路線、緊急避難處所的位置。

準備避難時所需之緊急避難包、隨身衣物與重要證件。

隨時注意收聽氣象報告與廣播電視等訊息。

清理排水溝，暢通水路。

期間應變：

攜帶緊急避難包、隨身衣物與重要證件。

疏散至村內緊急避難處所，若有災害擴大之處，則疏散至外地收容所。

通知親友你已疏散至那個避難處所。



■ 受影響的地區

Affected
area

這個地區的其他警報

颱風警報：北臺灣、東臺灣、中臺灣、南臺灣、外島
中央氣象局 - 更新時間：2 小時 12 分鐘前

豪雨特報：北臺灣、中臺灣、東臺灣、南臺灣
中央氣象局 - 更新時間：19 小時前

豪雨特報：北臺灣、中臺灣、東臺灣、南臺灣
中央氣象局 - 更新時間：2 小時 12 分鐘前

Flooding Warning



淹水警戒：臺中市和平區

接下來的 53 分鐘內有效

地點：臺中市和平區

Type: flooding warning

發佈時間：7 分鐘前 - 水利署

可能性：■■■■ 預計發生時間：■■■■ 嚴重程度：■■■■

水利署訊：臺中市和平區淹水二級警戒(上谷關站3小時雨量134mm)，如持續可能3小時內開始積淹水(如：和平區-博愛里、天輪里、自由里、台8線、台7甲線)，建請即時注意淹水通報及應變。

建議作為

Recommendation

準備沙包擋水牆防淹水

來源：水利署

事前準備：

- 主動清除住家周邊水溝。
- 準備物資（如乾糧、礦泉水）及防災器材（沙包、防水閘門、手電筒、收音機）等。
- 將貴重財物及汽機車移放安全地方。
- 事先瞭解如要疏散避難之收容所地點。
- 隨時注意村(里)廣播或與村(里)保持聯繫。
- 隨時透過電視、廣播或網路等媒體關心天氣動態。
- 事先下載行動水情APP或由水利署防災資訊服務網登錄手機門號或住家電話號碼(僅提供一級淹水警戒)，俾利災中取得住家所在鄉鎮市區發布之淹水警戒資訊。

期間應變：

- 儘量避免外出，以免發生危險。若外出行駛道路須注意積水高度以免熄火或導致汽機車泡水故障並小心駕駛該路段。
- 隨時透過電視、廣播或網路等媒體關心天氣動態，或上防災資訊服務網查詢即時警戒情況。
- 因應水庫濁度過高等狀況而導致停水，事先儲水備用。
- 提早使用擋水閘門，若時間充裕，可於閘門細縫填塞報紙或DM，再由外部封貼易撕膠帶，防水效果更佳。

Urgency
Certainty
Severity



受影響的地區

Affected area

這個地區的其他警報

颱風警報：北臺灣、東臺灣、中臺灣、南臺灣、外島
中央氣象局 - 更新時間：2 小時 16 分鐘前

豪雨特報：北臺灣、中臺灣、東臺灣、南臺灣
中央氣象局 - 更新時間：20 小時前

豪雨特報：北臺灣、中臺灣、東臺灣、南臺灣
中央氣象局 - 更新時間：2 小時 16 分鐘前

土石流紅色警戒
農委會水土保持局 - 更新時間：1 小時 46 分鐘前

Applications



個人行動助理 Google Now



村里生活圈 Village APP



Web Widget 4 types of content x 5 layouts

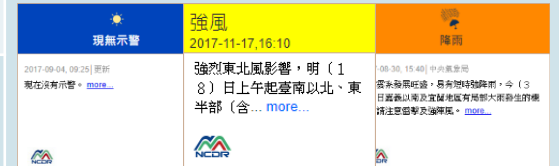
Severity-
Extreme
(Province)



Severity-
Severe
(Province)



Severity-
Extreme
(County)



Severity-
Severe
(County)



- **LINE@ Official Account**

- 25 warning information are provided with **customized subscription services** including heavy rainfall, earthquake, low temperature, strong wind, air quality, etc.
- The public can check the real-time warnings in Taiwan, and subscribe to receive real-time information on **meteorology, hydrology, transportation, and livelihood information**

1. Adding NCDR@ 2. Adding NCDR@

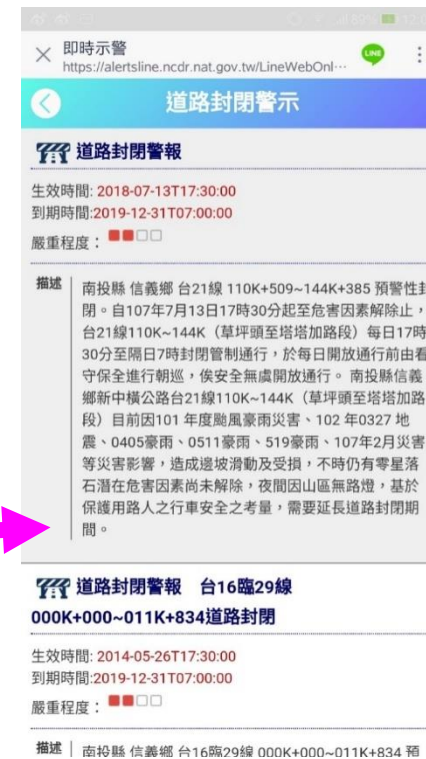
QR code



Official Account
(ID: @NCDR)



- Instant alerts – users can query the alerts according to the administrative area in Taiwan



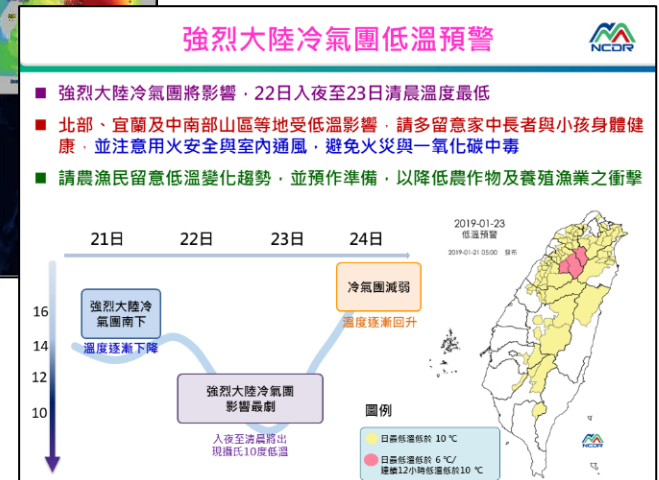
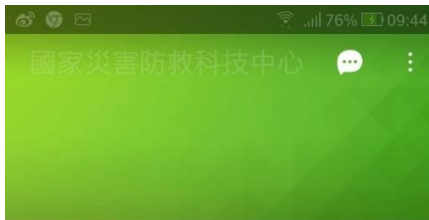
Subscribe to Alerts



- Multi-Optional locations and alerts selected for user



- Situations and suggestions with graphic information are presented for easy understanding and sharing



Cell Broadcast Service



CAP



CMAC



- Government**
- Central Weather Bureau
 - Water Resources Agency
 - Soil and Water Conservation Bureau
 - National Police Agency
 - National Fire Agency
 - Atomic Energy Council
 - Centers for Disease Control
 - City Government

- CBE**
- Format Transfer
 - Message examination
 - Message logging and report

- 5 Telecom Operators**
3G, 4G network
- 中華電信 Chungwa Telecom
 - Taiwan Mobile 台灣大哥大
 - 遠東電信 FAREASTONE
 - T STAR 台灣之星
 - 亞太電信 G4 4G



CAP : Common Alerting Protocol
 CMAC : Commercial Mobile Alert for C Interface

CBS Alert Types



Natural



Torrential Rain



Earthquake



Tsunami



Typhoon Strong Wind



Debris Flow

Infrastructure



Road Closure



Electric Outage



Water Outage



Reservoir Discharge



Nuclear Accident

Civil



Explosion



Air Raid Alert



Missile Air Raid Alert



Infectious Disease



Evacuation

2018/06/22 CBS Heavy Rainfall Warning



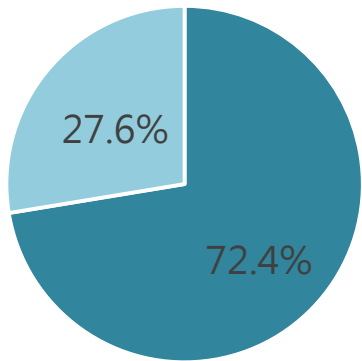
- Heavy rainfall event was predicted by CWB at 14:00 06/22
- CWB sent “**Torrential rain alert this area til 15:15 06/22**” to public via CBS
- Social media: Flash Flooding at Xingshan Elementary School and Junior High School





Results from Telephone Questionnaire

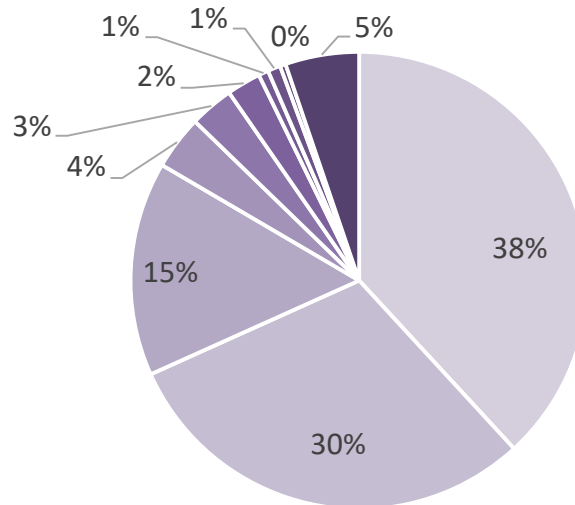
Have you ever received CBS messages?



■ YES ■ No

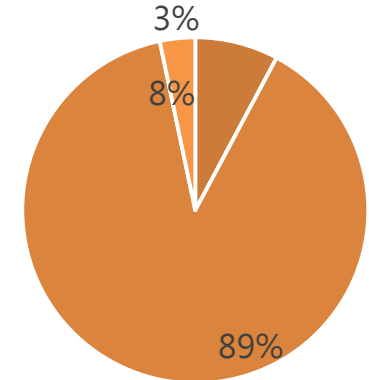
72.4% respondents received CBS messages

Which type of alerts have you received ?



- Earthquake
- Quake Early Warning
- Animal and plant epidemic
- Air Raid
- Typhoon Strong Wind
- Torrential Rain
- Road Closure
- Debris Flow

Are you satisfied with CB service?



■ Very Good ■ Good ■ Bad

89% respondents were satisfied with CBS

Conclusions



- Learn from extreme events to improve the early warning systems
- Integrate various data to provide risk information for decision maker
- **The alert dissemination policy has been changed.** In past years, we provided open data to enterprise for the value-added purpose. Now, we focus on using multi-channels for delivering alerts to public.

Thank you for your attention
