

APEC Climate Symposium 2010
21 June - 24 June 2010
Busan, Korea

The impact of extreme events on disaster management – Lessons learned from Typhoon Morakot



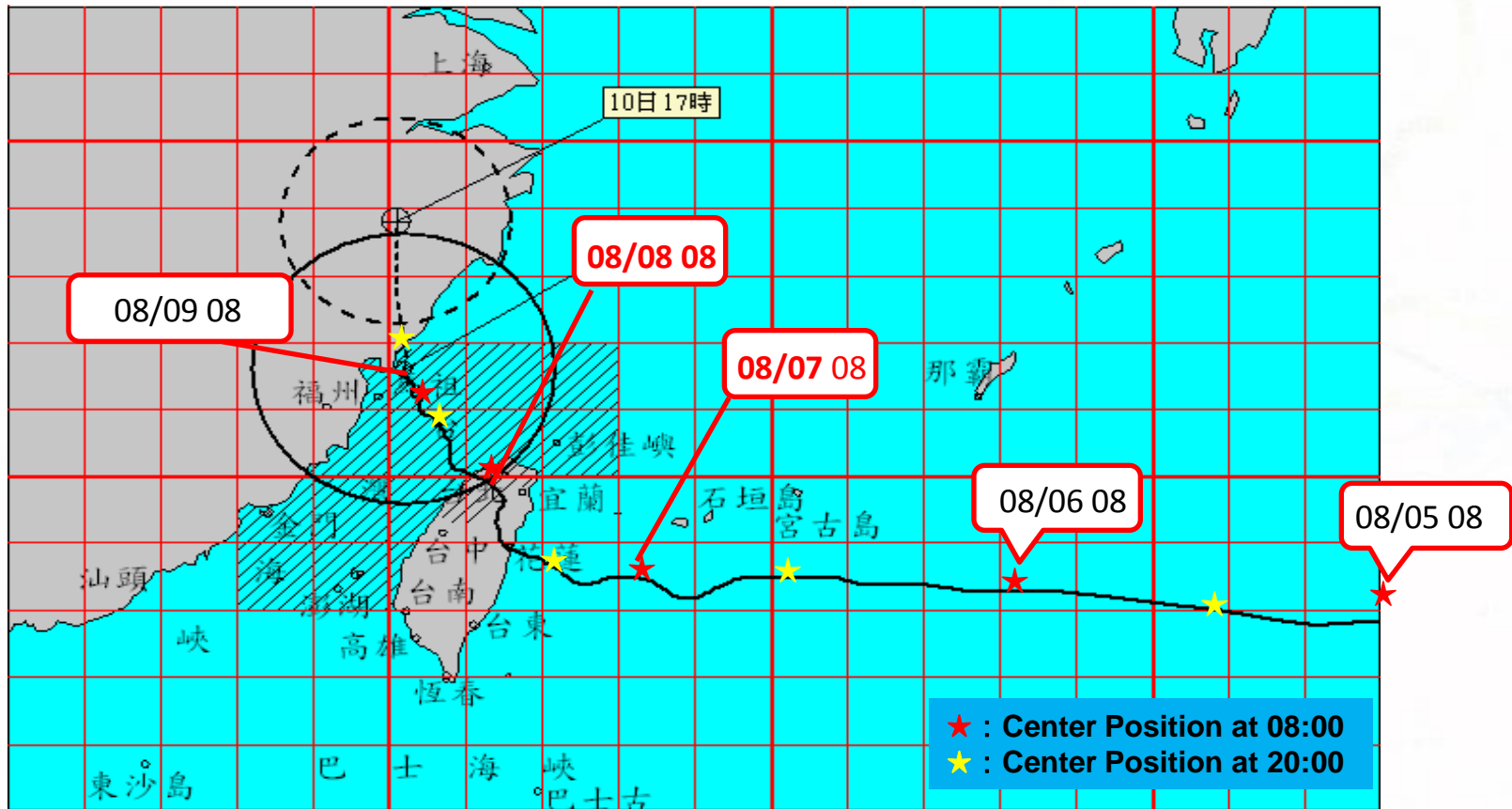
Liang-Chun Chen

*Director, National Science & Technology Center
for Disaster Reduction, Chinese Taipei*

- 1. Outline**
- 2. Brief introduction of Typhoon Morakot**
- 3. Disasters caused by Morakot**
- 4. Response after Disasters**
- 5. Conclusion**

Brief introduction of Typhoon Morakot

Typhoon Morakot : #8 in 2009

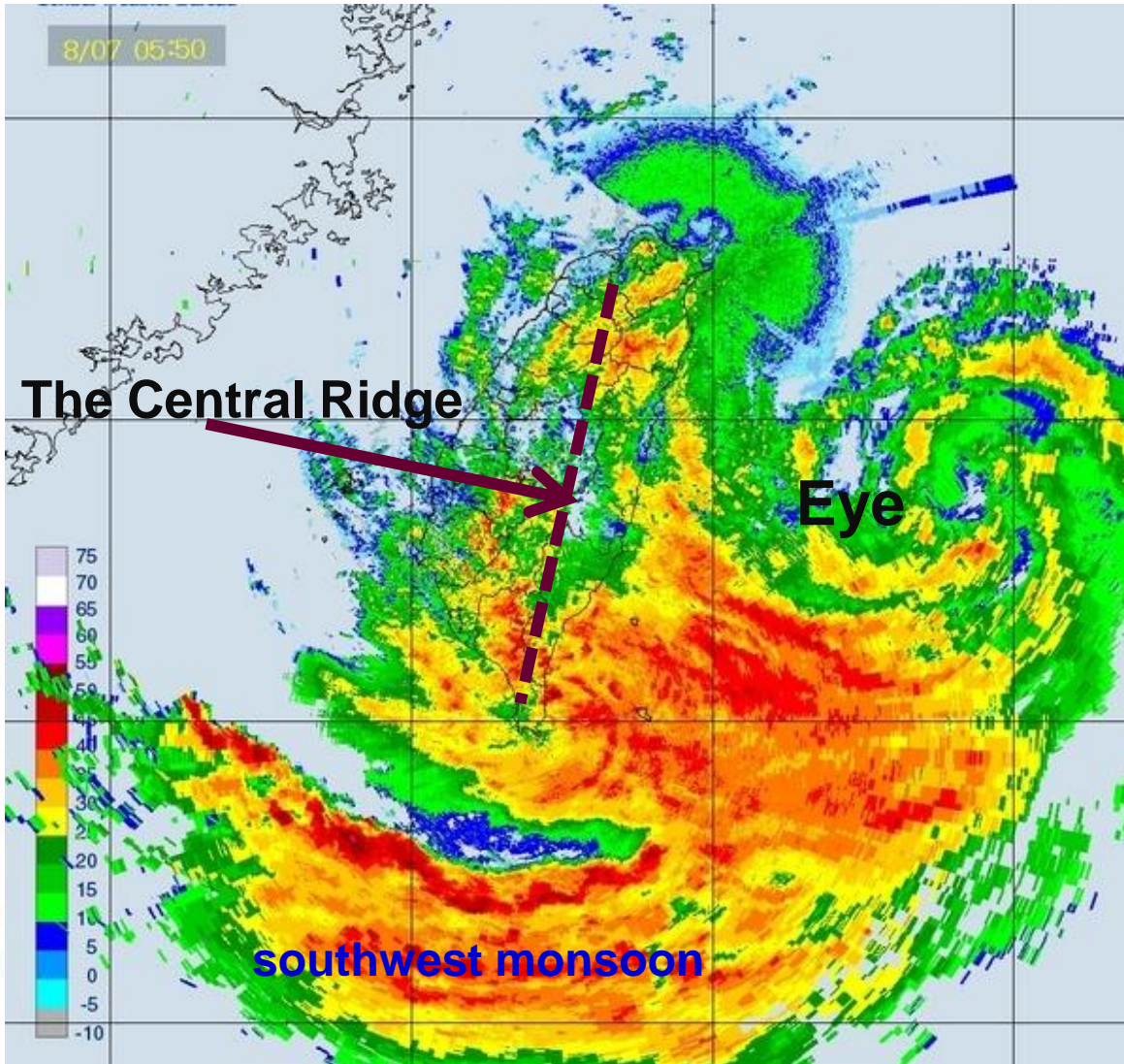


Aug 5-6: Moved fast toward Taiwan

Aug. 7 : Slowed down and out skirt touched the island

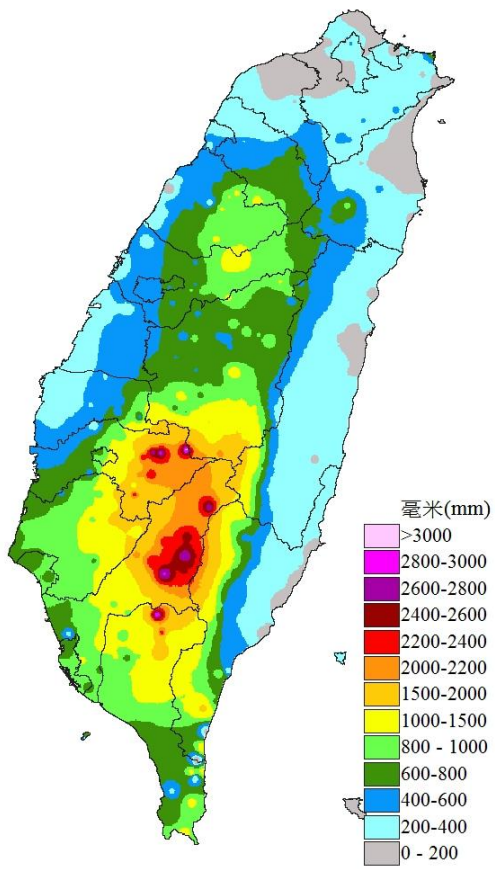
Aug. 8 : Made landfall at 00:00; Center left the island at 14:00; at very low pace; Cast influence on the whole island

Aug. 9 : Gradually moved toward China



- Asymmetrical structure of rain clouds around typhoon
- The typhoon rain cloud interacted with supplying extra moisture by southwest monsoon result large amount of rainfall in the south of the island.

2009 Morakot 0805-0810 accumulated rainfall



Record-breaking Rain-gauge Data

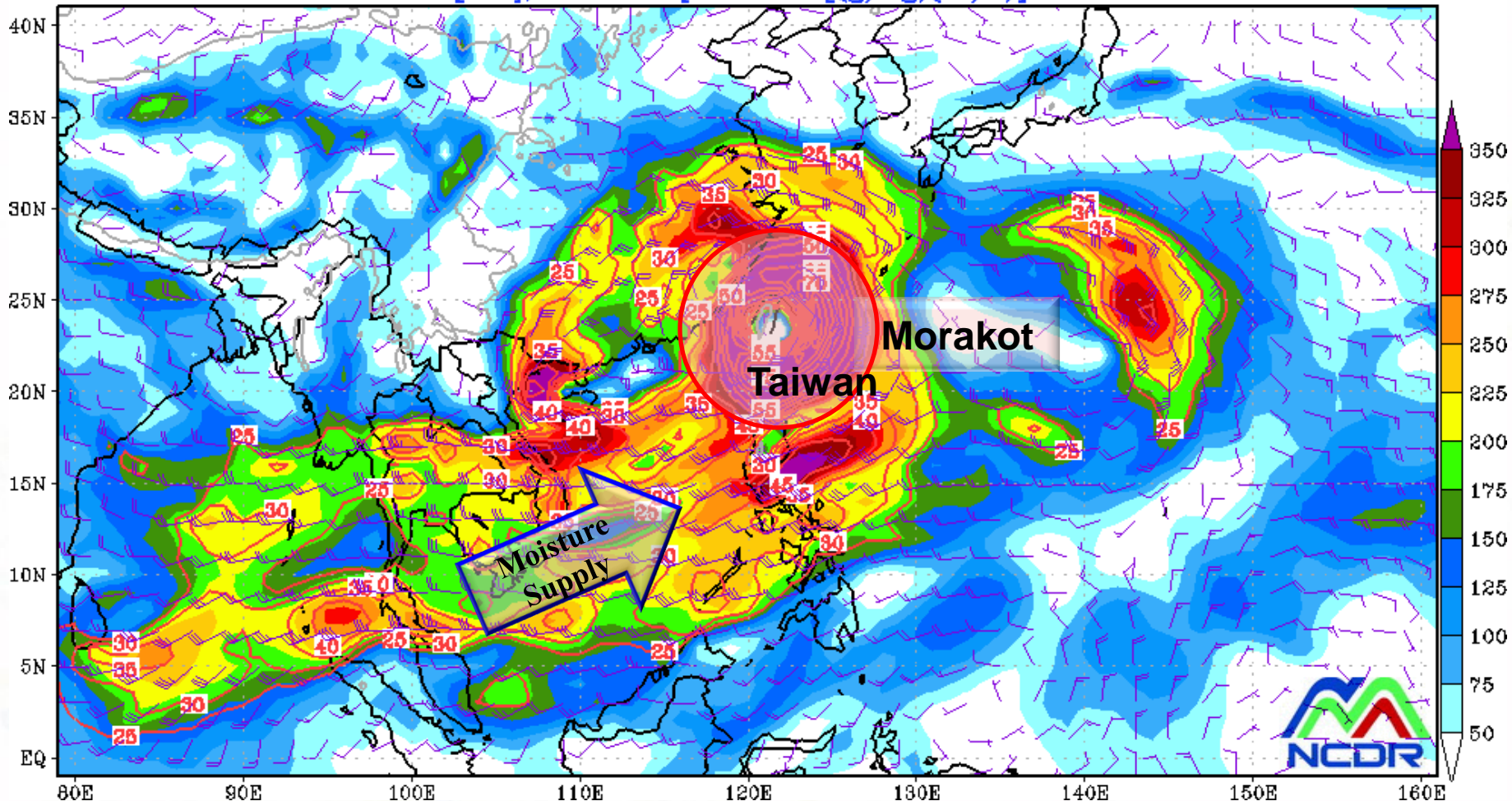
County	Township	Annual Rainfall (mm)	08/7 (mm)	08/08 (mm)	08/09 (mm)	08/10 (mm)	08/07-08/10 (mm)	08/07-08/10 vs Annual
Chiayi	Alishan	3,910	420	1,161	1,166	218	2,965	76%
Pingtung	Sandimen	3,884	745	1,402	394	332	2,872	74%
Chiayi	Jhuci	3,801	556	1,185	877	156	2,775	73%
Kaohsiung	Taoyuan	4,086	501	1,283	583	423	2,790	68%
Kaohsiung	Liouguei	3,138	236	1,178	696	351	2,461	78%
Chiayi	Fanlu	3,437	708	815	601	79	2,202	64%
Chiayi	Dapu	2,749	482	1,214	458	3	2,156	78%
Kaohsiung	Jiasian	2,861	400	1,072	345	203	2,020	71%
Nantou	Sinyi	3,254	170	717	909	134	1,929	59%
Kaohsiung	Maolin	3,152	252	743	230	179	1,404	45%
Pingtung	Wutai	2,898	206	580	208	165	1,160	40%
Kaohsiung	Cishan	2,365	91	620	128	85	924	39%

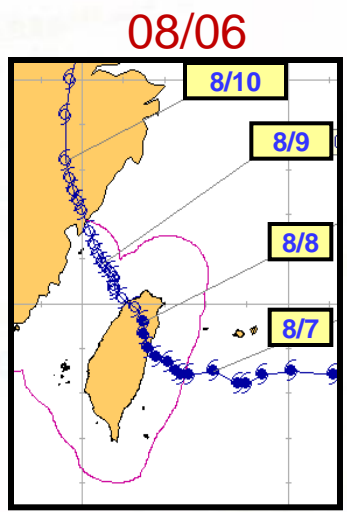
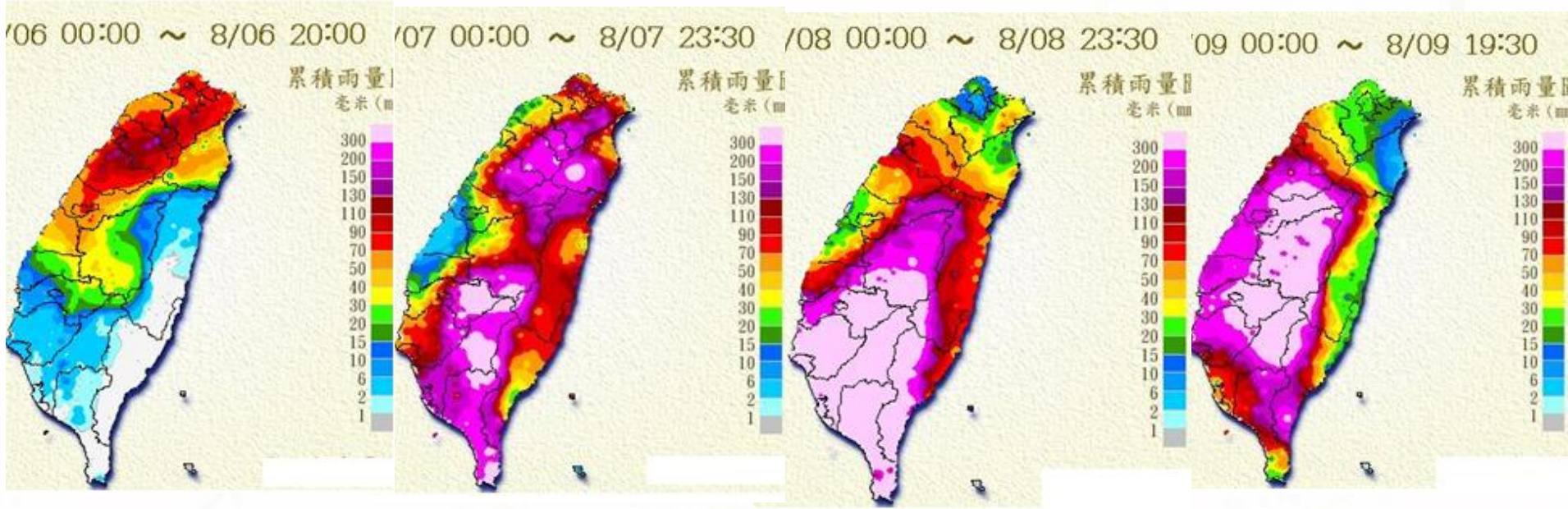
- Heavy rainfall happened island wide.
- Almost 3000 mm of rainfall is found in this event.
- For Alishan => Morakot brought 76% of annual rainfall to Alishan in 5 days.
- The strength of rainfall brought by Morakot is the strongest in historical records.



Southwest Monsoon Interacted with Morakot by Supplying Extra Moisture

NCEP GFS 1degree 08/07 12UTC run F000h
850 hPa Wind & Isotach [kts], Water Vapor Flux [(g/kg)(m/s)] Valled: 12UTC 07 AUG





08/07
Rainfalls started
concentrating in
the south



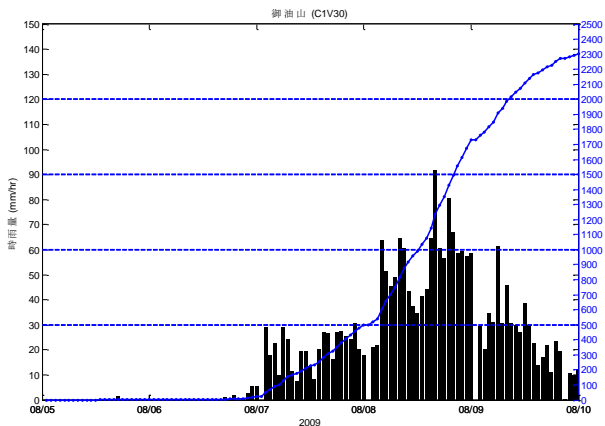
08/08
Floods along the
low-lying coastal
areas



08/09
Landslide and
Mudslide in the
souther part



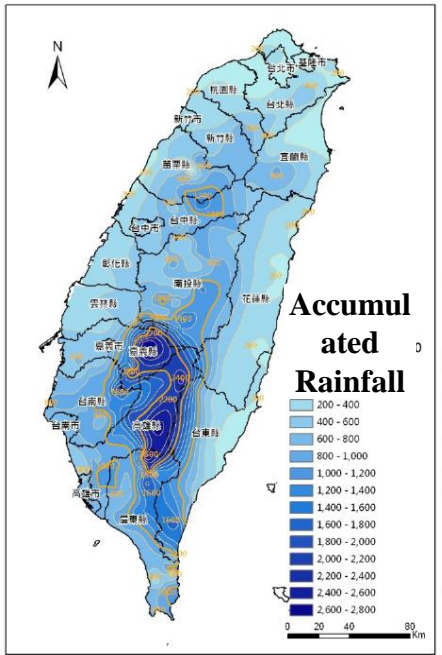
Long duration of heavy rainfall



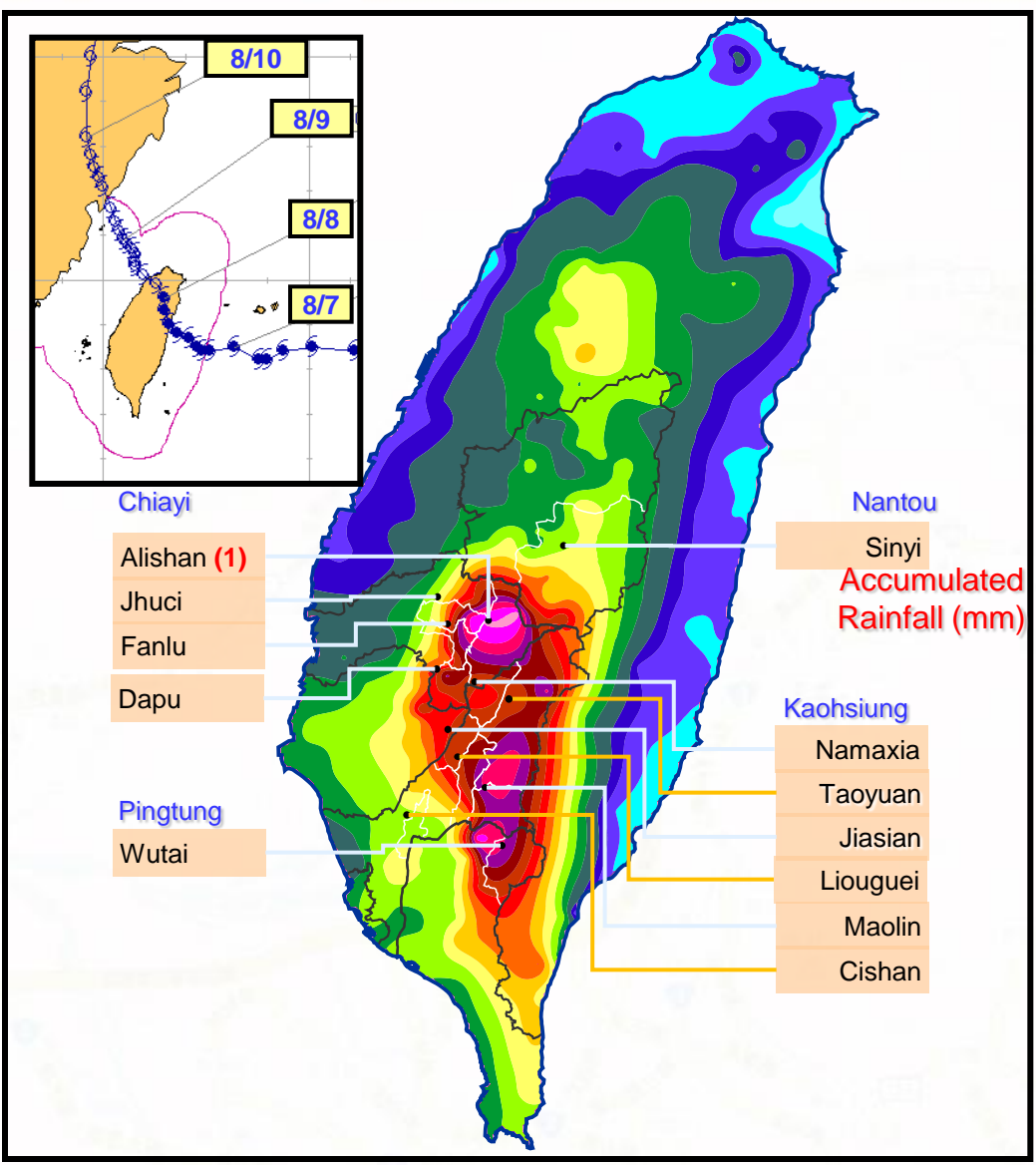
Complex topography



Extreme rainfall



- Heavy rainfall(50-60 mm/hr) lasts for over 24 hours.
- Area of the Island is about 36000 Km^2 , **over 70% in slope land.**
- *Extreme rainfall is observed mainly in mountain areas.*



- Long duration, high intensity, high accumulated rainfall depth
- About 9% area of Chinese Taipei was covered under the heavy rainfall ($\geq 2000\text{mm}$)
- Rainfall $> 2,000\text{mm}$ \Rightarrow the most serious area

Disasters caused by Morakot

(1) Wide area of *Flooding*



Source: 成功大學防災中心、元智大學



(2) Numerous places of *Land slope disaster*



Source: MPRC

(3) Massive deep landsliding



More than 400 killed at this area



32 killed at this area

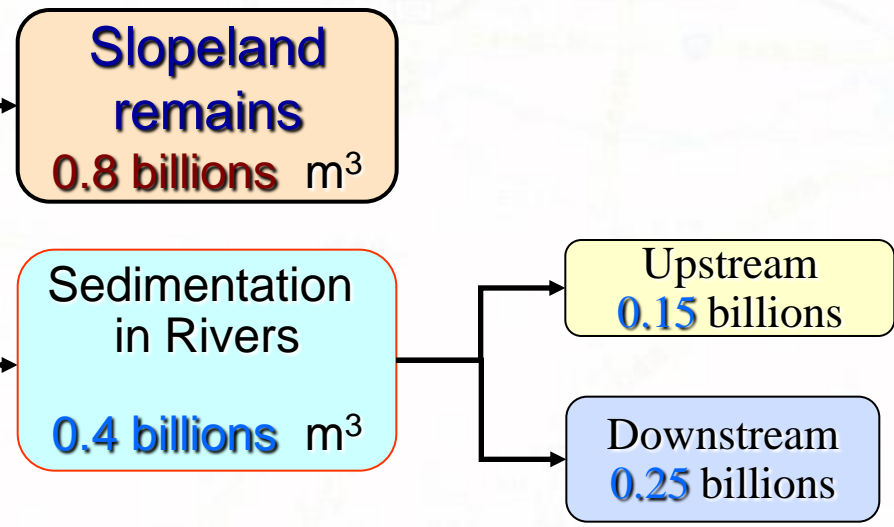
Soil Deposition in Rivers

- More than **394.92 km²** hill collapse or landslide during Morakot
- The land collapse produced **1.2 billion m³** sediment. Only **0.4 billion m³** was taken with flood, **0.8 billion m³** sediment was still accumulated on hill slope



Sediment Yields

1.2 billions m³ = [Image of Taipei 101] × 650



Source: SWCB

Before



After

(4) Damages of infrastructure



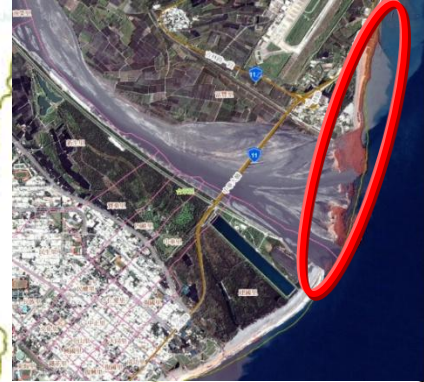
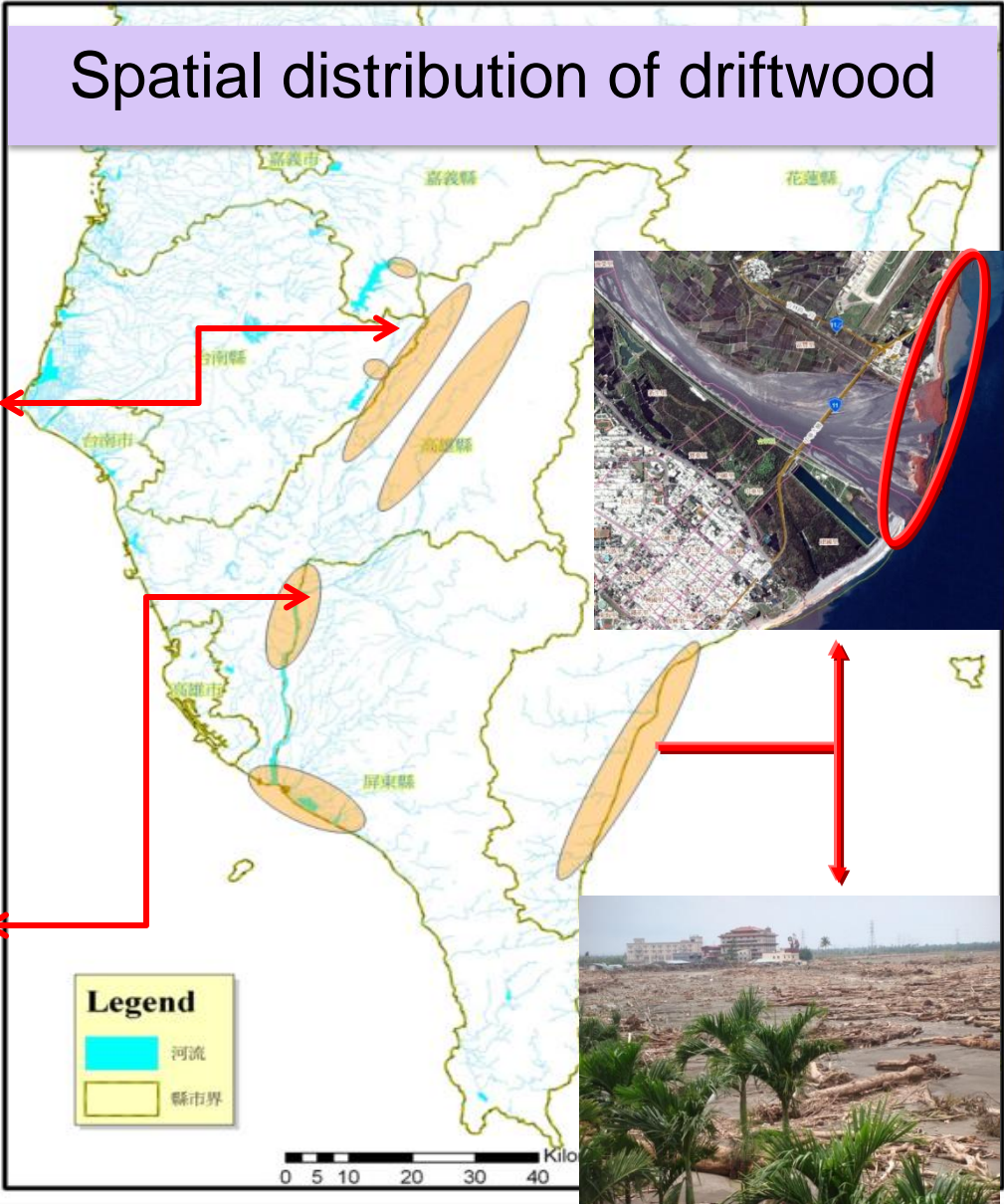
Roads



Bridges

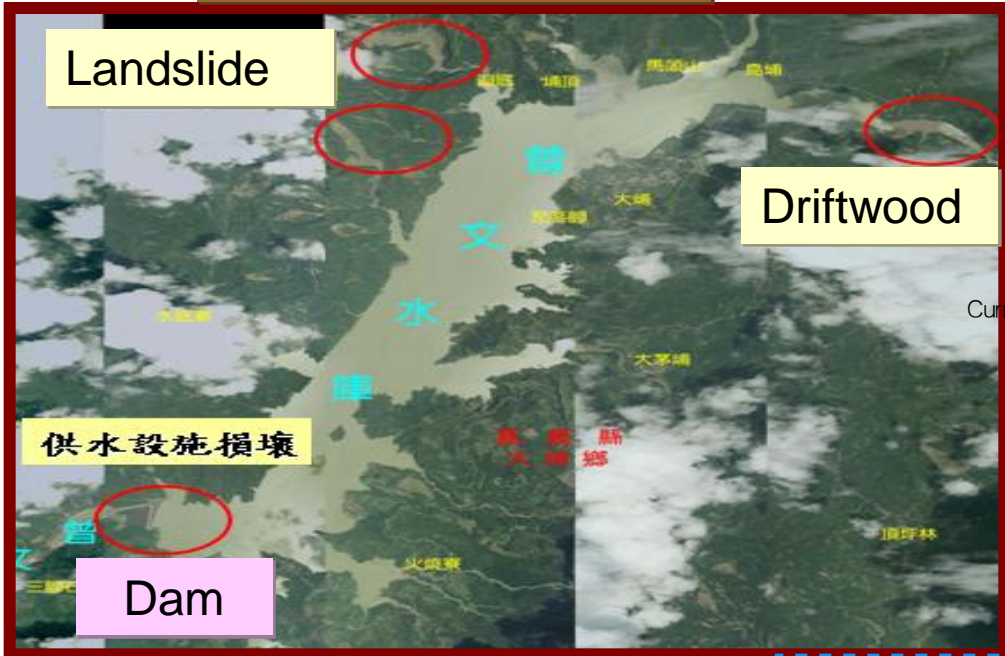
(5) Problem of driftwood

Total amount of driftwood is about **1.33 million ton**
(Forestry Bureau)

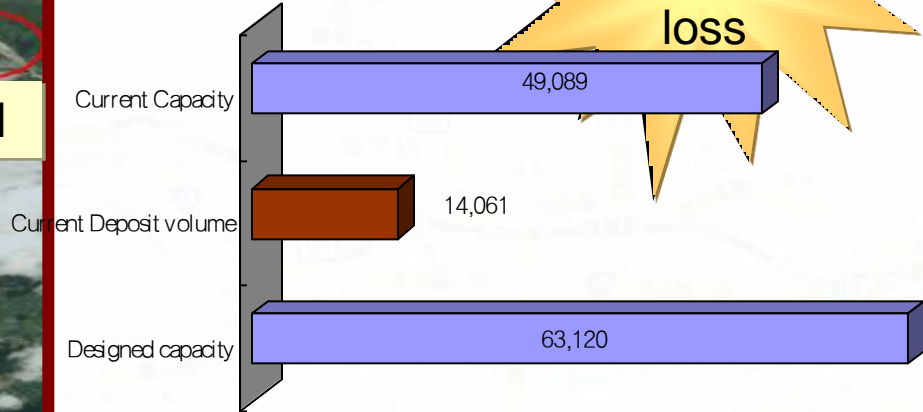
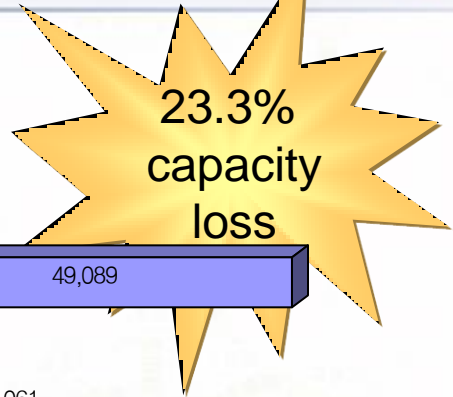


(6) Increase of deposition in Reservoir

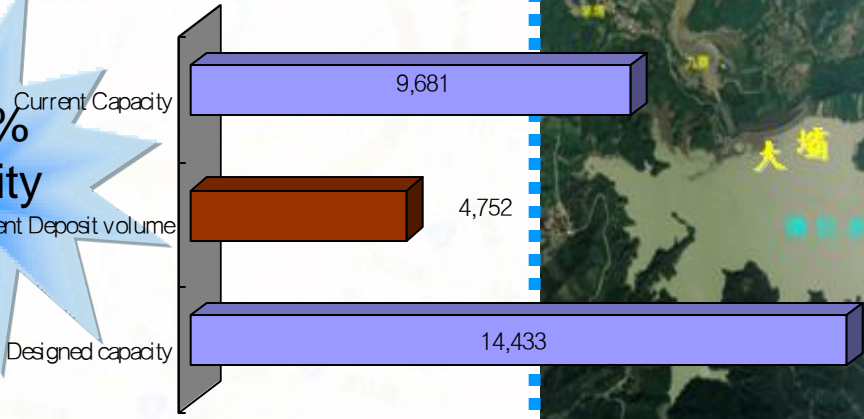
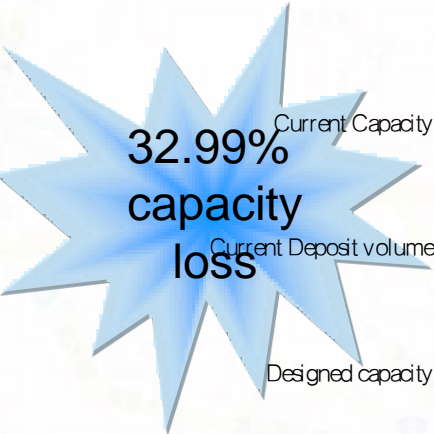
Tseng-wen reservoir



Unit: $10^4 m^3$



Nan-hua reservoir

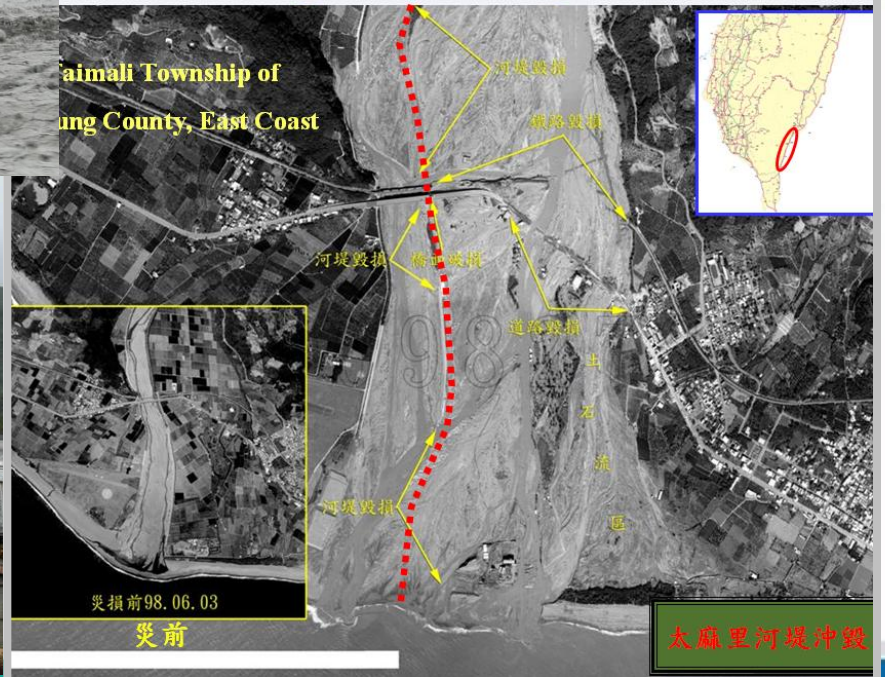




(7) Collapsed buildings along rivers and Levees



Damaged Levees by Flood





(8) Damaged villages and isolated Island

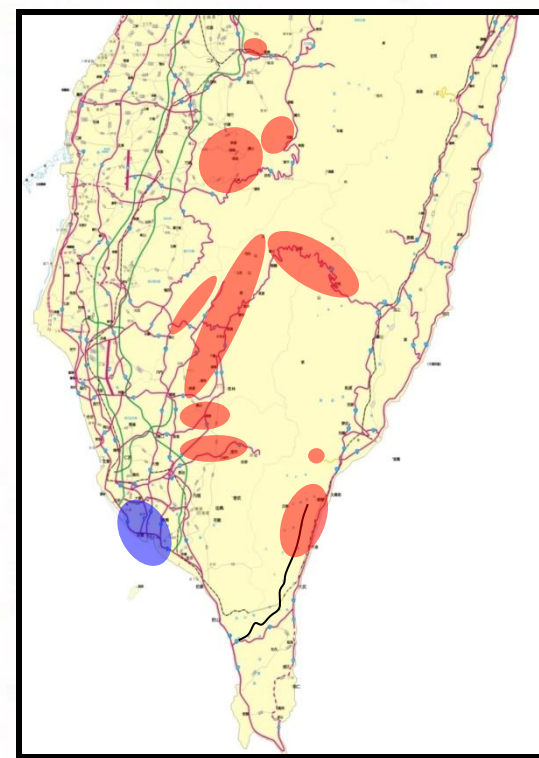


Source: MPRC

Damaged houses in village

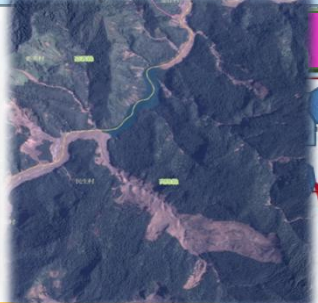
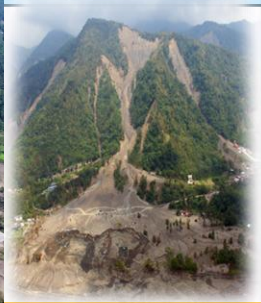


isolated Island



Compound Disaster

8/7 ~8/8 collapsed and landslide in the upstream



1 8/7 Rain in Jiaxian in early morning

2

3 8/8 Chivi Bridge was broken in the downstream

3



6 8/9 landslide buried Siaolin Village in the morning

6



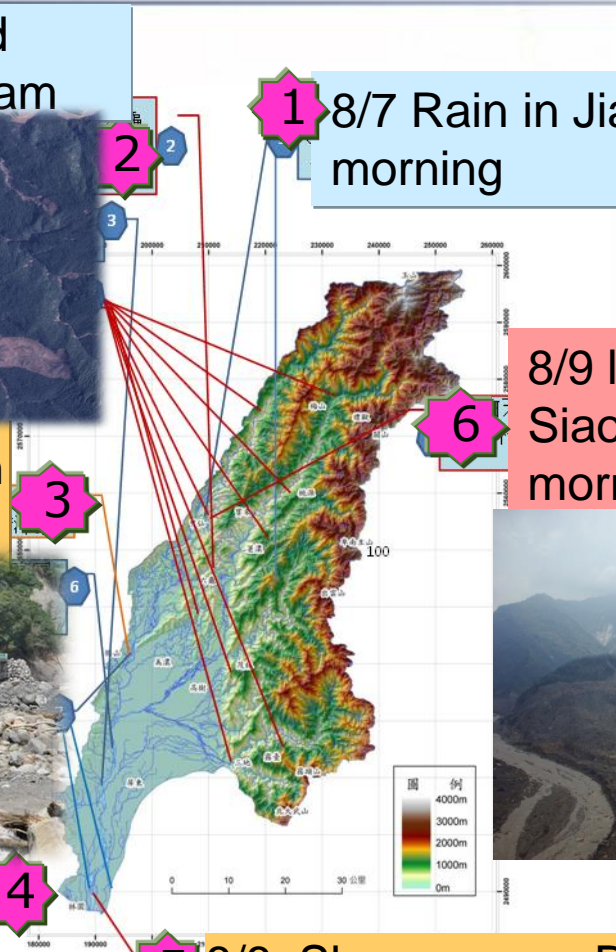
4 8/8 floods occurred in the Downstream at night

4

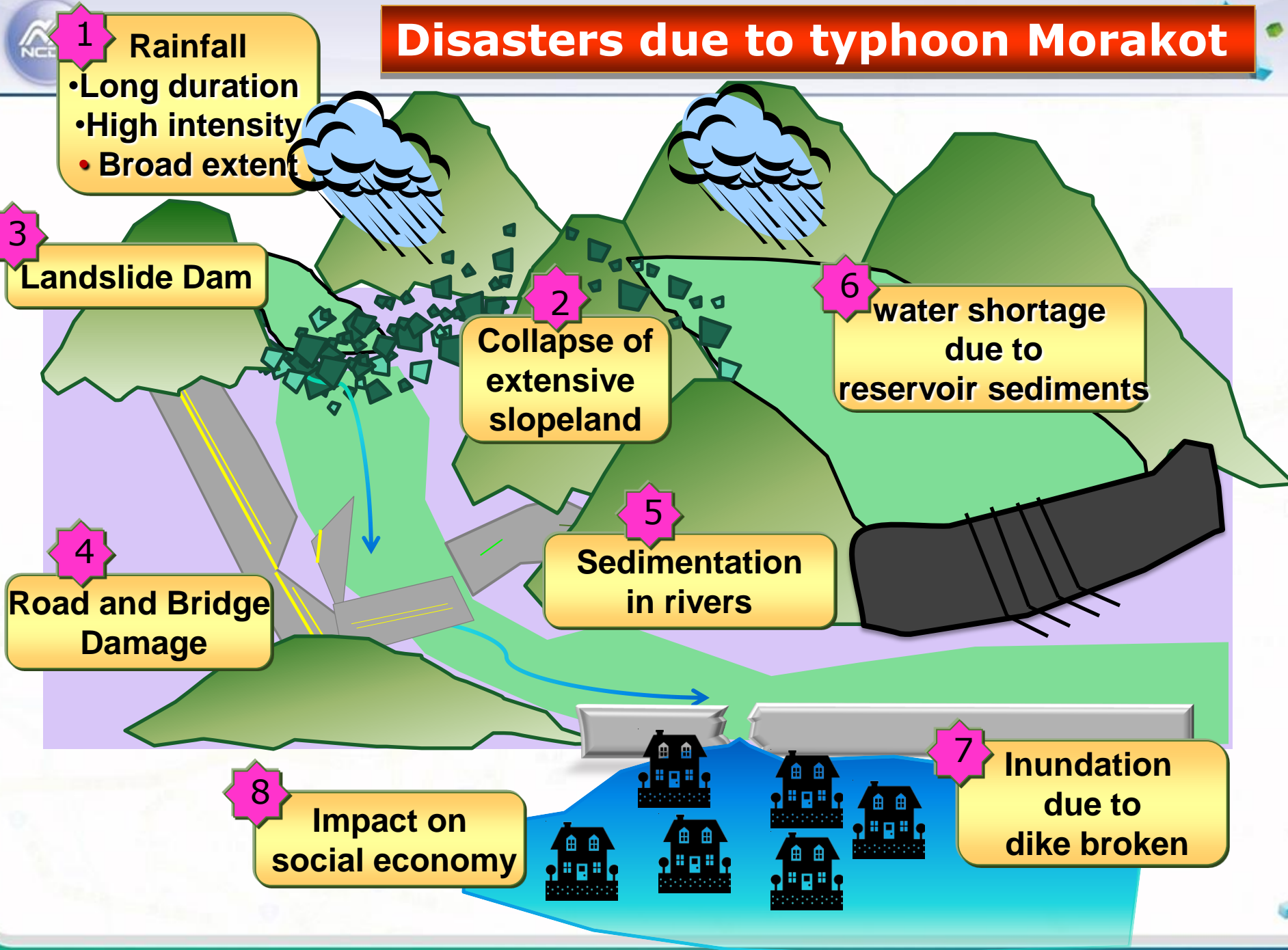


5 8/8 Shuangyuan Bridge broken

5



Disasters due to typhoon Morakot



3. Responses after disasters

Lesson learned

- 1. Large-areas and compound disaster**
- 2. Extreme weather which never happened before (ex: rainfall with long duration and high intensity), hard to predict/forecast**
- 3. Difficulty of disaster information acquisition during large-scale compound disaster**
- 4. Insufficient of the emergency response capability in large-areas**
- 5. Vulnerability of various land use in high disaster risk areas**

- 1. Enhancement of the capability of the monitoring and pre-warning capacity of extreme weather (especially rainfall) and disaster**
- 2. The improvement and establishment of the integrated information system for disaster information collecting and emergency response decision supporting**
- 3. Strengthening the Emergency Response and Relief at all Levels**
- 4. Improving Land Use Management and Land Conservation Planning**



Strategies for short-term improvement



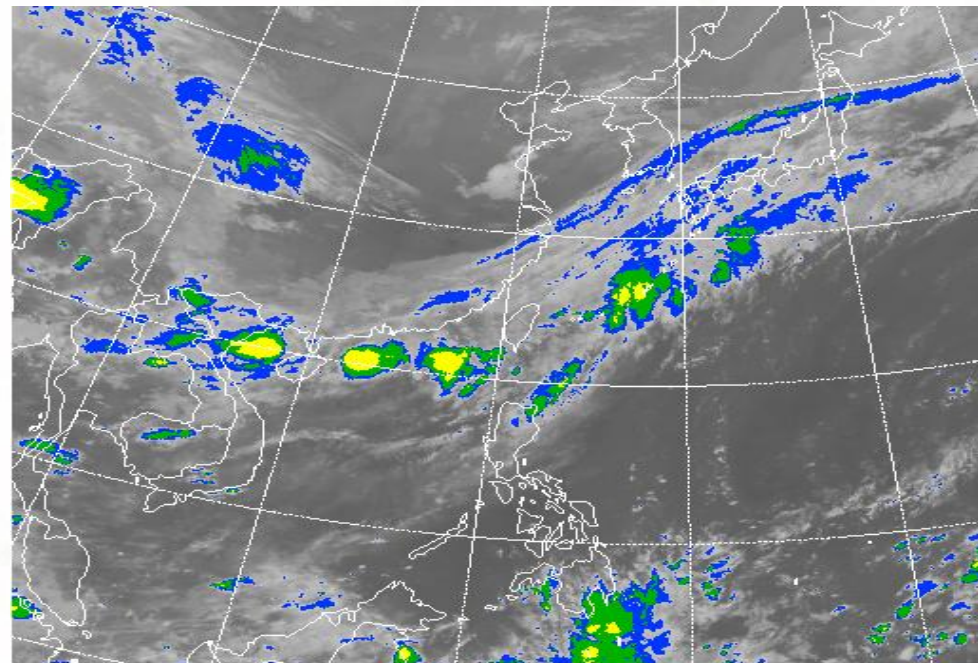
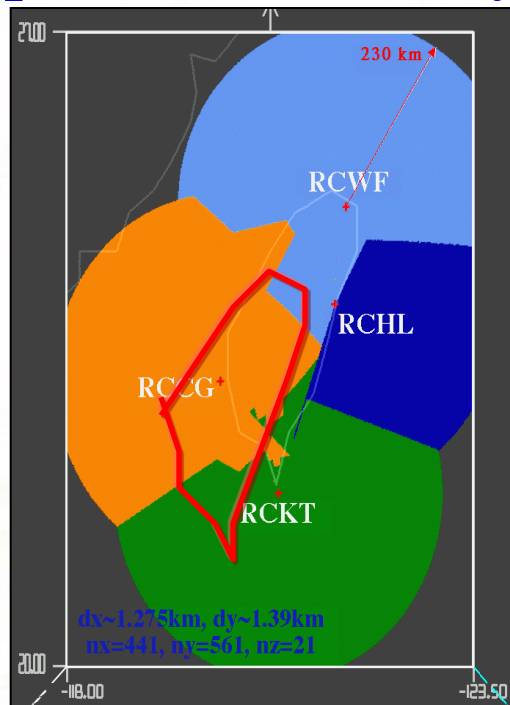
Real-Time warning and forecasting systems

Comprehensive Disaster information
support system

Emergency operation system survey

Local capacity building

- Though we have 406 real-time rainfall gauges and 4 Doppler radar stations around the island, it is still insufficient to emergency response for large scale weather variations.
- A regional weather information platform is needed to improve the accuracy of rainfall forecasts.





• Three Steps to Emergency Response

Real-time Monitoring

- Provide updated data based on gauges
- Tool for pinpointing blind areas by forecast
- Reference for revising decision support
- Limited by number, location, transmission



Scientific Prediction

- Provide forecasting based on models
- Tool for pre-disaster deployment
- Reference for decision support
- Limited by technology development

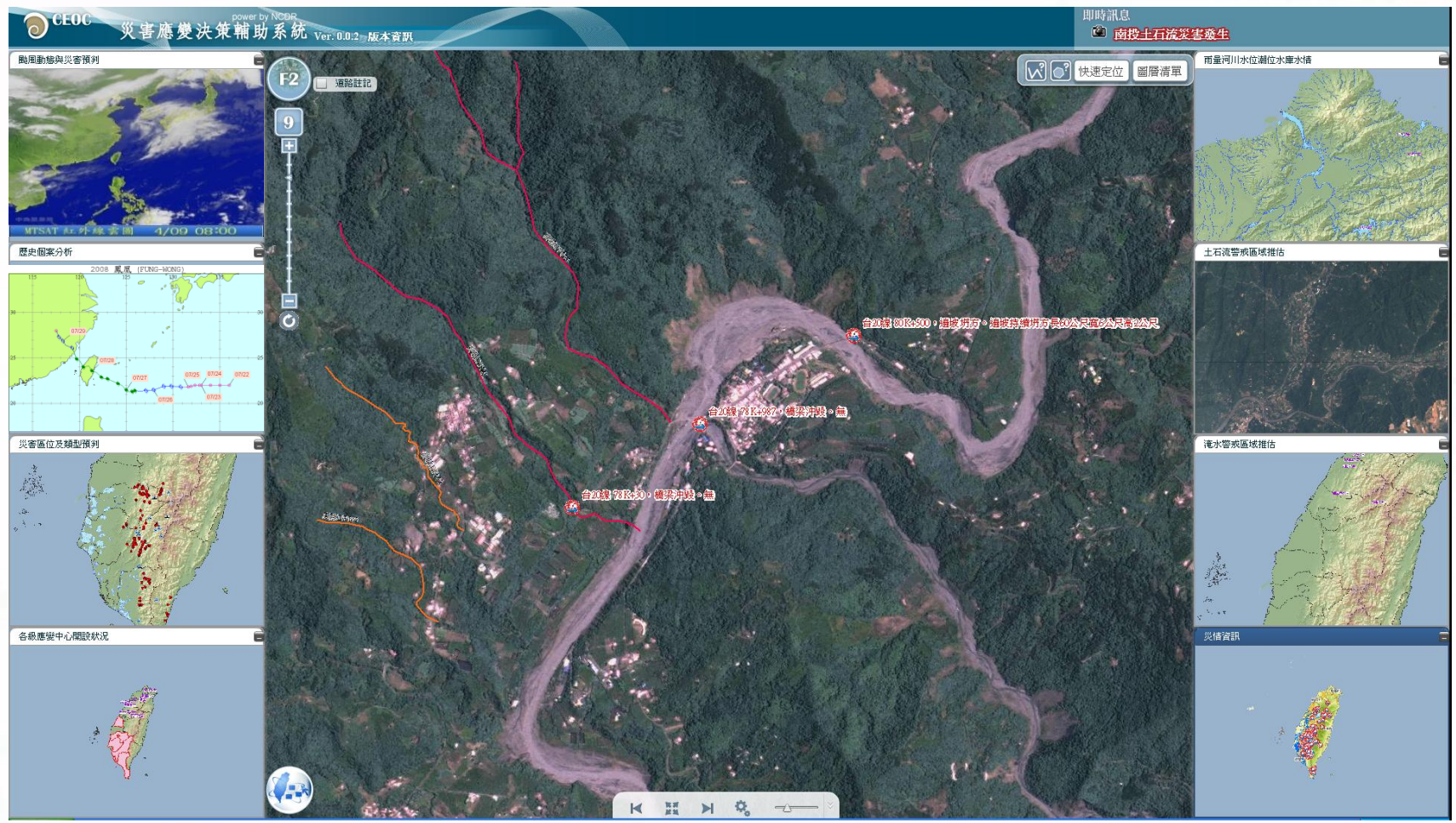


In-time Operation

- Provide reaction based on well-defined plan
- Tool for saving more time before it's too late
- Reference for allocating emergency support
- Limited by determination of all-level administrators



- ✓ Module designed
- ✓ Integrate present corresponding Ministries' system/website

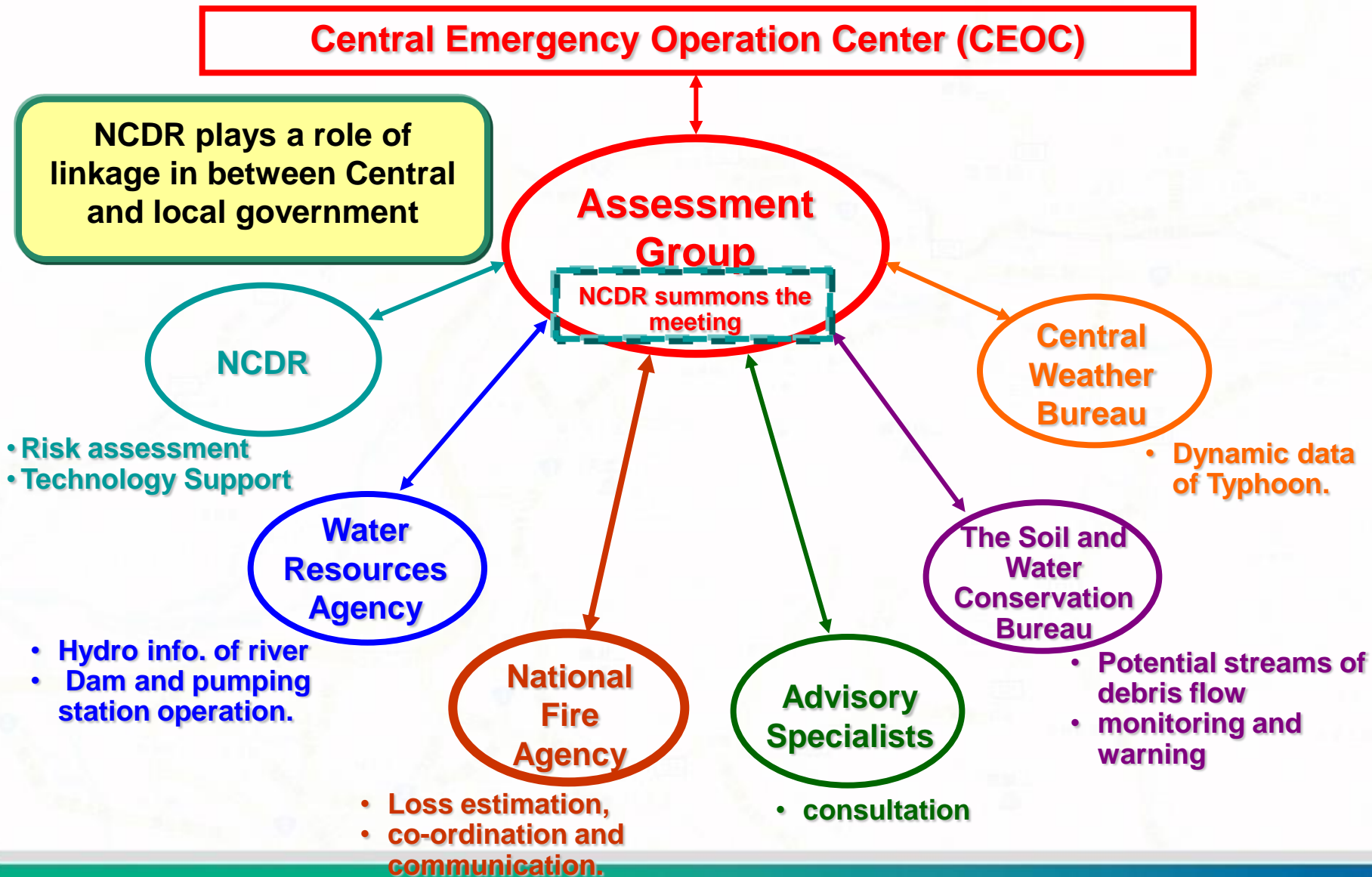


✓ The information came from different corresponding ministries can be overlapped on one map, provide the commander more comprehensive information



✓ Integrate the disaster spatial information, visualized as an Operation Map, could provide disaster condition effectively

Operation of the CEOC Assessment Group (Typhoon Response)



Strengthening of emergency response mechanism



- Mobilization of Military Sectors to Speed up Emergency Response and Post-Disaster Recovery
- Open up the flow of operation system from Central → Local → Community

Strengthening disaster preparedness measures and rescue resources in local community

- Community residents are the executors.
- Through various activities to encourages participation
- Provide needed knowledge and resources.



discussion



workshop



lecture



education



meeting



parties



field survey



mapping



training



training



exercise

Strategy of Land Use

**Comprehensive River Basin
Management**

Adaptation of Climate Change

**Mechanism of operation coping with
climate disasters**

Conclusion (1)

- **Extreme rainfall** brought by typhoon Morakot is associated with **the speed of movement, southwest wind, and complex topography**
- Typhoon Morakot brought us the experience of the compound disaster induced by the extreme weather which never happened in the past.

Conclusion (2)

- **A new early warnings system for the compound disaster should be developed to reduce disasters and to cope with extreme weather and climate change in the future.**
- **“Comprehensive river basin management” should be executed immediately to reduce occurrence of compound disasters.**
- **It is required to build the data base of professional knowledge concerning disasters.**

The background image is an aerial photograph of a river valley. A large, dark, and rocky area, likely a landslide or debris flow, dominates the center of the valley. The surrounding hills are covered in dense green forest. The sky is overcast with grey clouds.

Thank You for Your Attention!

**Disasters always knock at a door when
we are slacking**