

Flood Risk Management

Pao-Shan Yu

Distinguished Professor & Dean
Hydraulic and Ocean Engineering
College of Engineering
National Cheng Kung University
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Flood Risk Management

- Where is the flood-prone area?
- How to protect?
- Protection is good enough?
- Where & How to escape?
- Coming again?
-
-



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Flood Risk Management

□ Topics for Flood Risk Management

- What flood information do we have? (data collection)
- How to indicate flood risk area?
- How to reduce risk?
- How to give early warning to the people in risk area?
- How and where to escape?
- Who will do this?
- How much it will cost?
- ...
- ...



Flood Risk Management

Flood Risk Management

Flood Risk Management
is to reduce flood risk

Risk Analysis

Risk Reduction

Hazard (Flood Simulation)

- Inundation depth
- Flow velocity
- Rising rate

Vulnerability (Survey)

- Population amount
- Population density
- Population structure
- Emergency shelters
- Rescue facilities
- Medical facilities

Pre-Flood

- Prevention
- Protection
- Preparedness

Flood Event

- Flood Warning
- Emergency response
 - ◆ Mobile defenses
 - ◆ Evacuation

Post-Flood

- Recovery
- Lessons learned



Flood Risk Management

□ Risk Reduction

■ Pre-Flood

□ Prevention

- Avoiding housing in present and future flood-prone areas
- Adapting future developments to the risk of flooding
- Promoting appropriate land-use control
- Planning, legislation and regulation.

□ Protection:

- Using structural/non-structural method to reduce the impact of floods

□ Preparedness:

- Informing the flood risks and what to do in the event of a flood



Flood Risk Management

□ Risk Reduction

■ Flood Event

- Flood warning
- Developing emergency response plans in the case of a flood



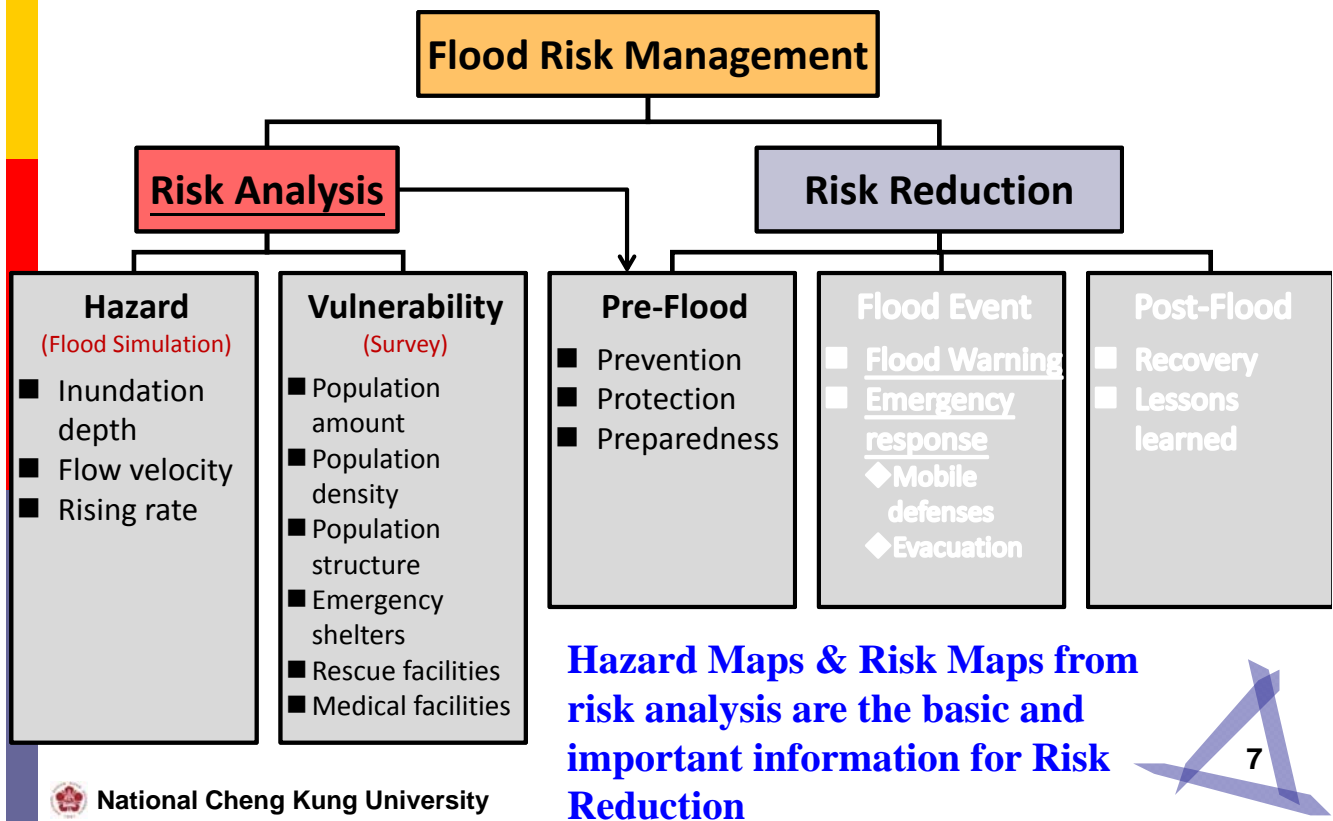
■ Post-Flood

□ Recovery and lessons learned

- Returning to normal conditions as soon as possible
- Mitigating the social, health, and economic impacts

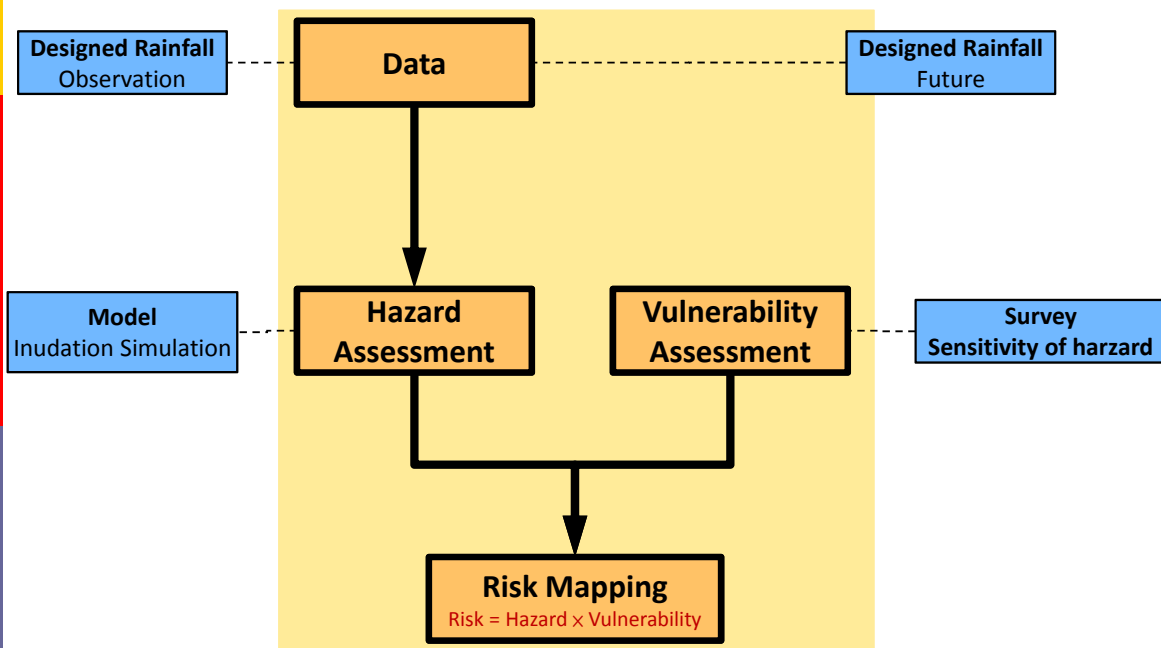


Flood Risk Management



1. Risk Analysis

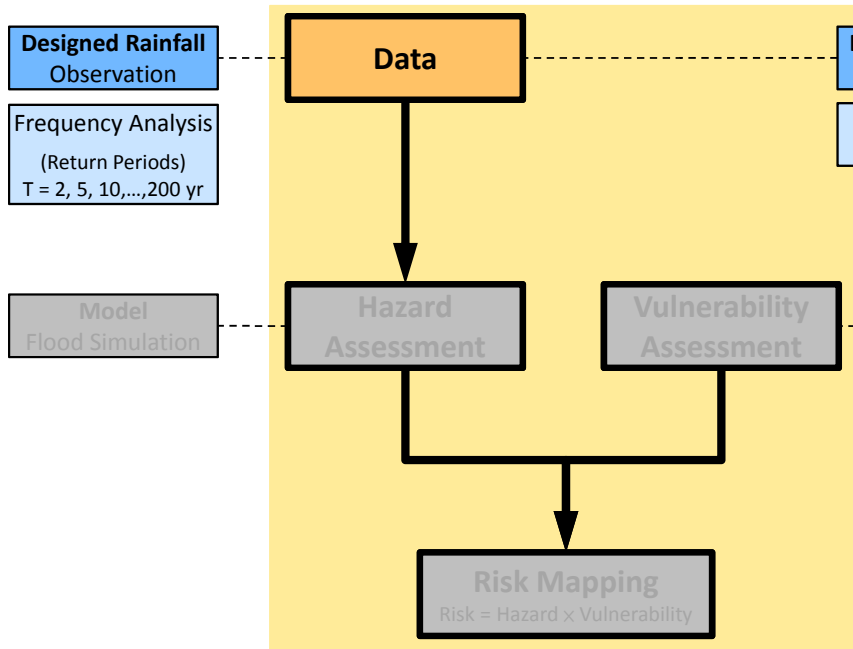
□ Framework for risk analysis



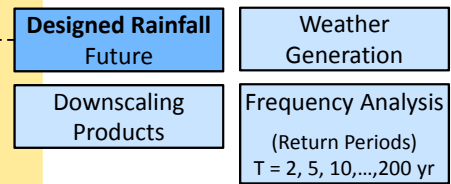
1. Risk Analysis

□ Framework

Present Risk Analysis



Future Risk Analysis

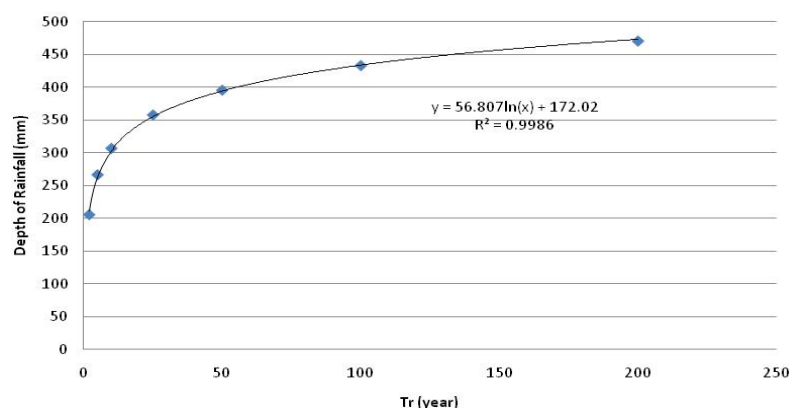


1. Risk Analysis

□ Data for present risk analysis

■ Frequency analysis

- Collect 1-day and 2-day annual maximum rainfalls frequency analysis
- Protection level depends on various return periods for design storms. e.g. 10, 25, 50, 100, 200 years

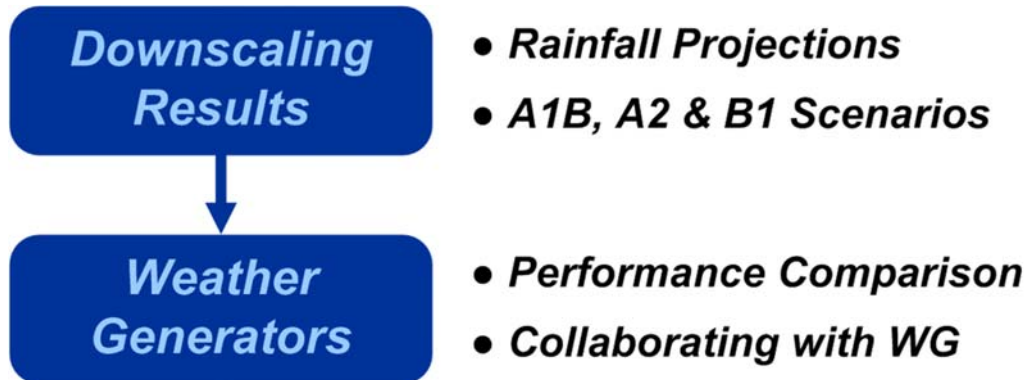


1. Risk Analysis

□ Data for future risk analysis

■ Future rainfall

□ Downscaling Monthly Rainfall



Downscaling monthly rainfalls in a 25km×25km grid mesh



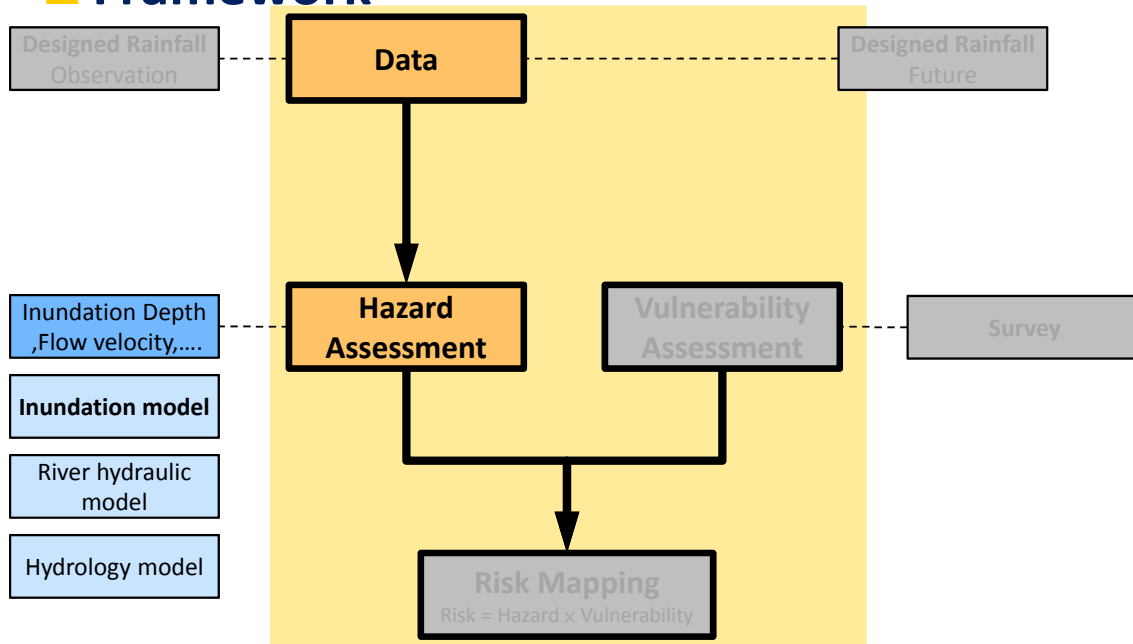
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Two climate impact conditions

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1. Risk Analysis

□ Framework

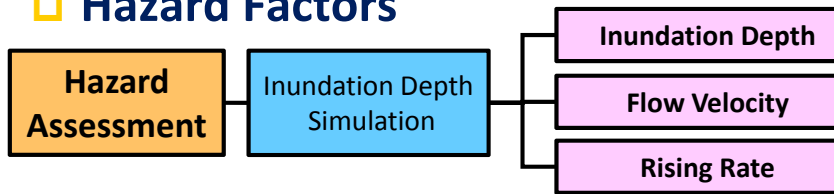


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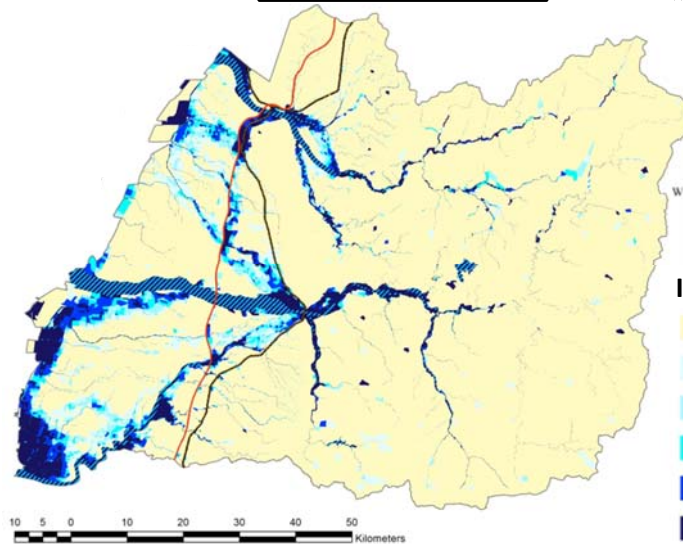
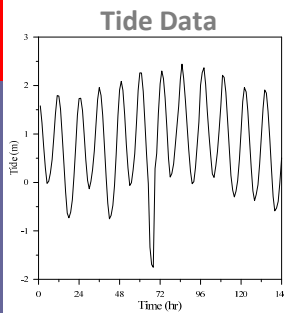
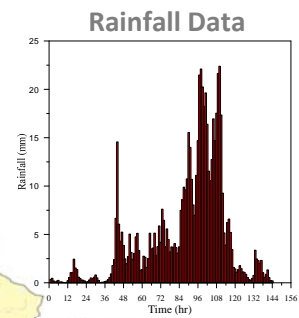
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1.Risk Analysis

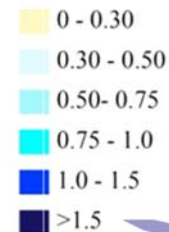
□ Hazard Factors



Inundation Model
Flood Routing Model
Hydrology Model



Inundation Depth



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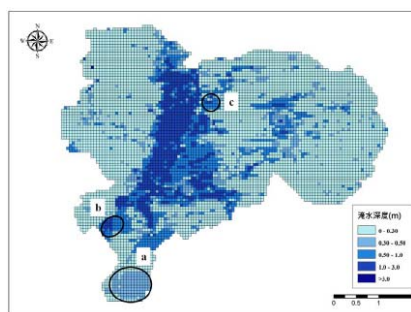
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1.Risk Analysis

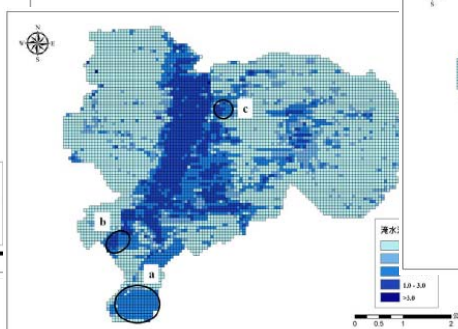
□ Hazard Maps

■ Inundation simulation under different protect criteria (frequencies)

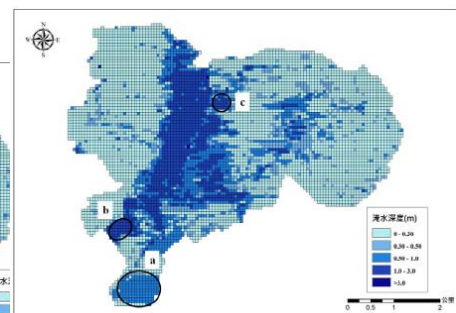
- Use 1-day(24 hours) and 2-day(48 hours) maximum rainfalls for different return periods(e.g. 10, 25, 50, 100, 200 years) analysis
- Hourly distributed by the design hyetographs as the input for assessing impacts on flood inundation



T=10



T=25



T=50



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1. Risk Analysis

Application of Hazard Maps

Pre-Flood

Prevention

- To identify the present and future flood-prone areas to avoid housing in.
- Appropriate land-use control to adapt future developments for reducing the flood risk

Preparedness:

- Informing the flood risks and what to do in the event of a flood to plan evacuation routes, shelters and risk potential

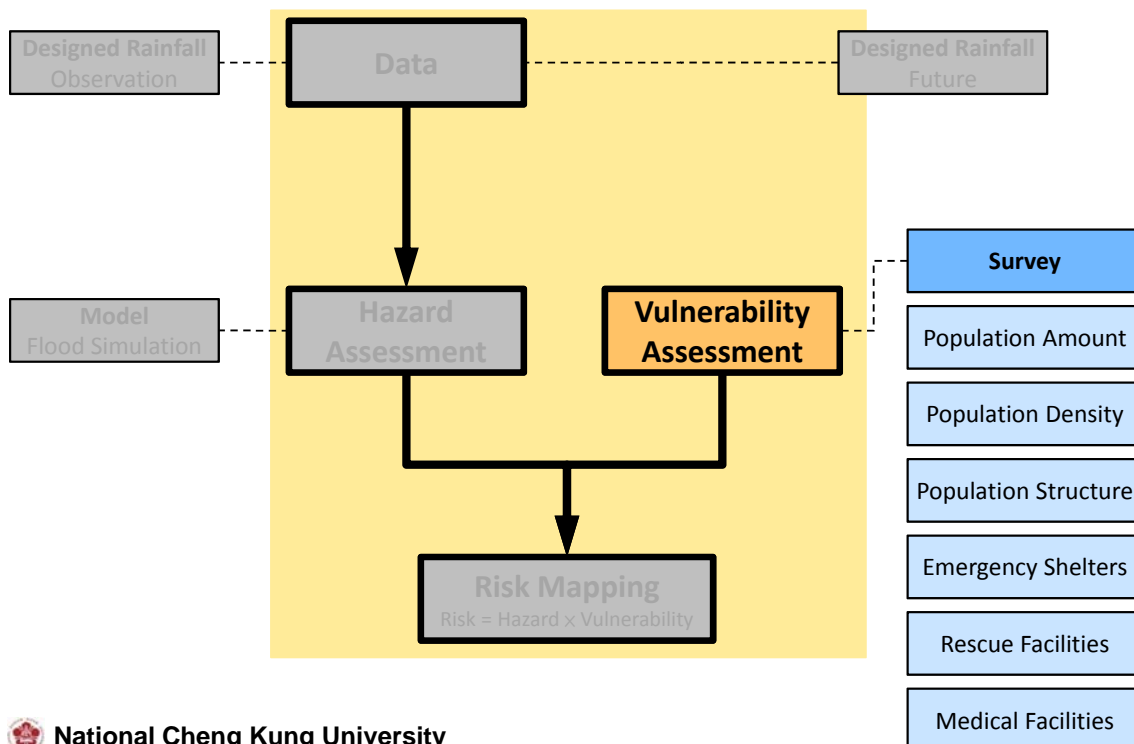
Is Hazard maps enough for Risk amnagement?

- Vulnerability analysis will further be carried out to take into account the **sensitivity of hazard**.



1. Risk Analysis

Framework



1. Risk Analysis

□ Vulnerability Factors

Vulnerability Assessment = Factors \times Weights

Conducting Surveys

Population Amount

Population Density

Population Structure

Emergency Shelters

Rescue Facilities

Medical Facilities

Analytical Hierarchy Process (AHP)

Weight₁

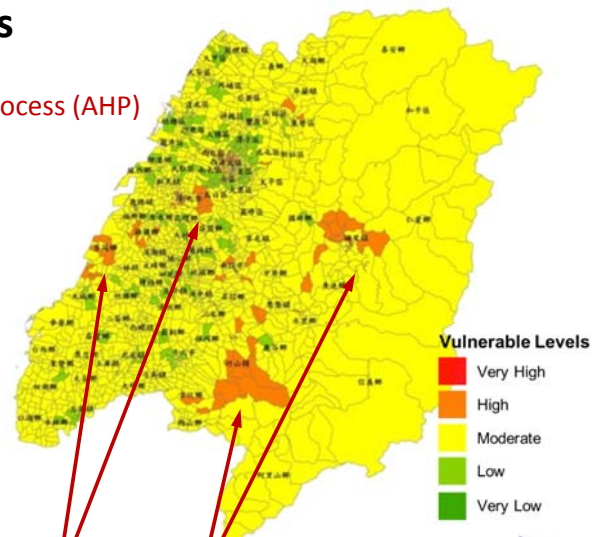
Weight₂

Weight₃

Weight₄

Weight₅

Weight₆



Vulnerable parts of a system can be identified!

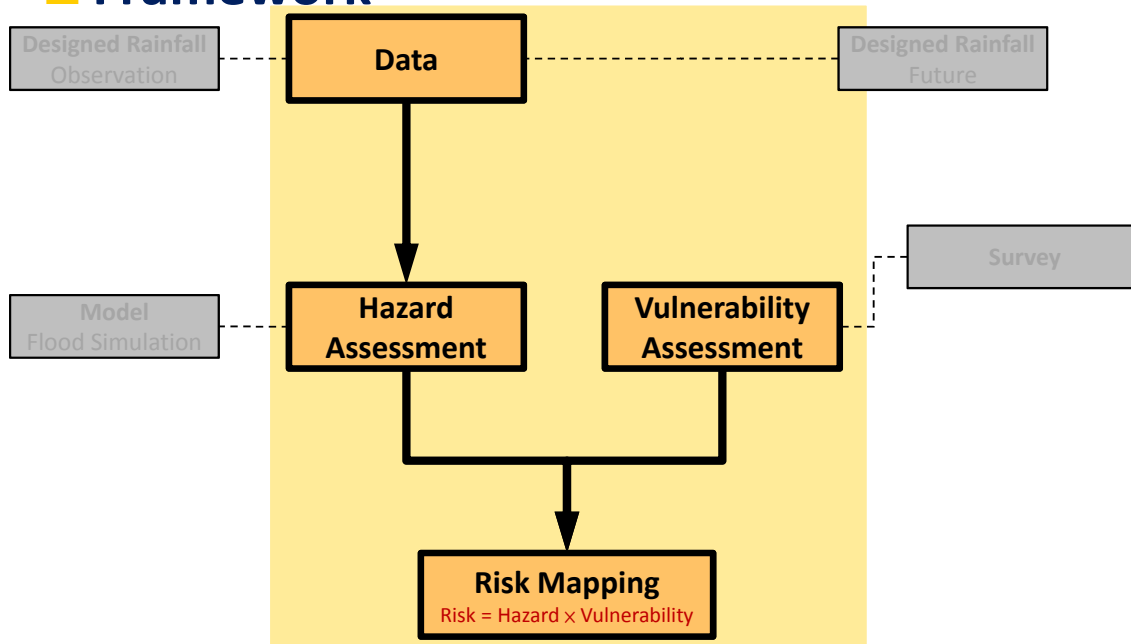
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1. Risk Analysis

□ Framework



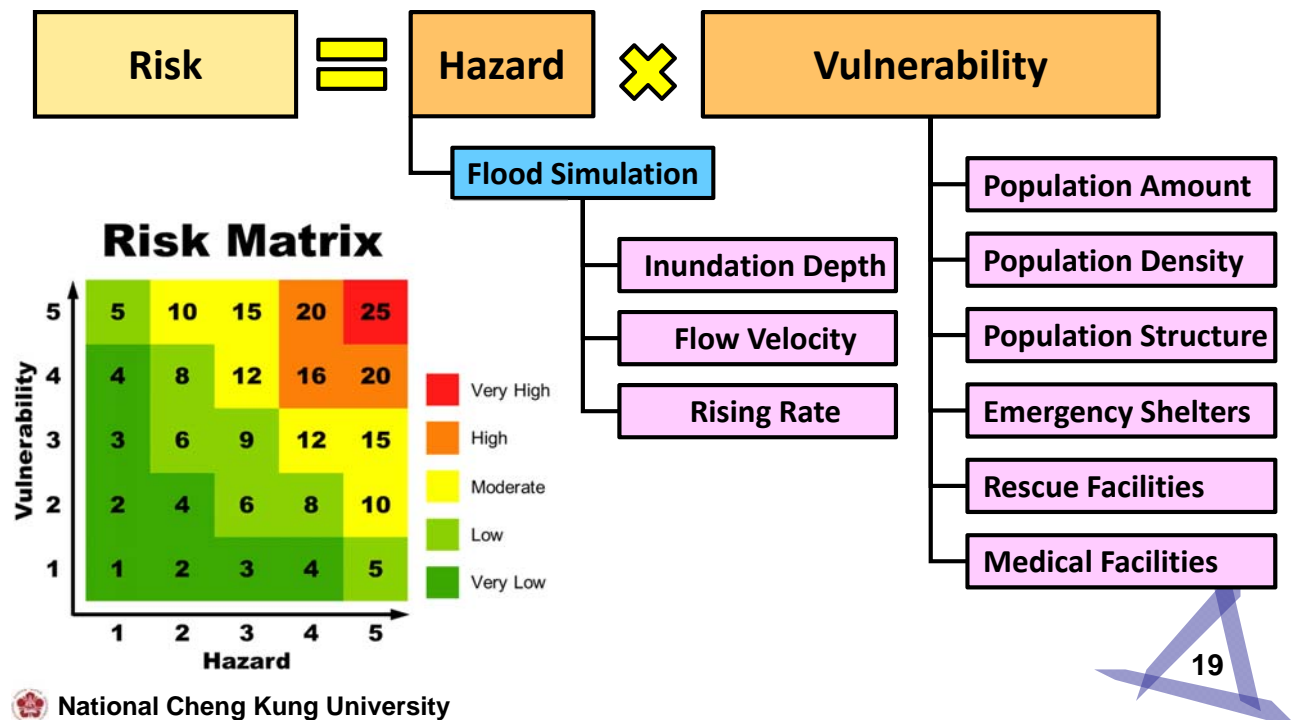
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1.Risk Analysis

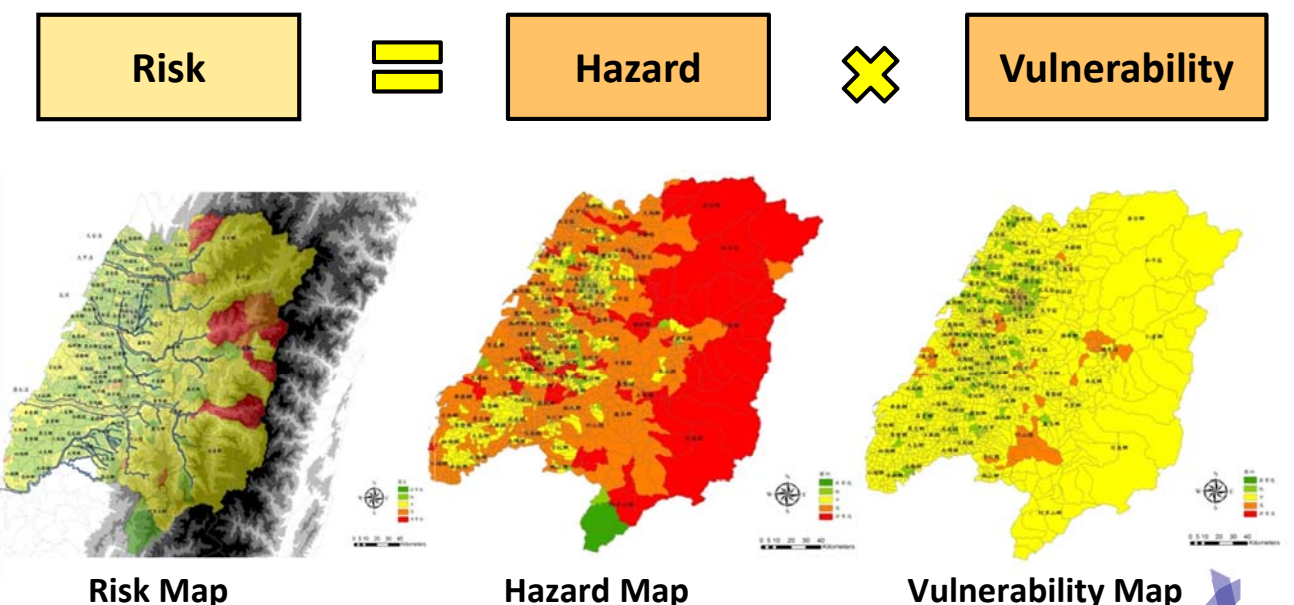
□ Definition of Risk



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1.Risk Analysis

□ Definition of Risk

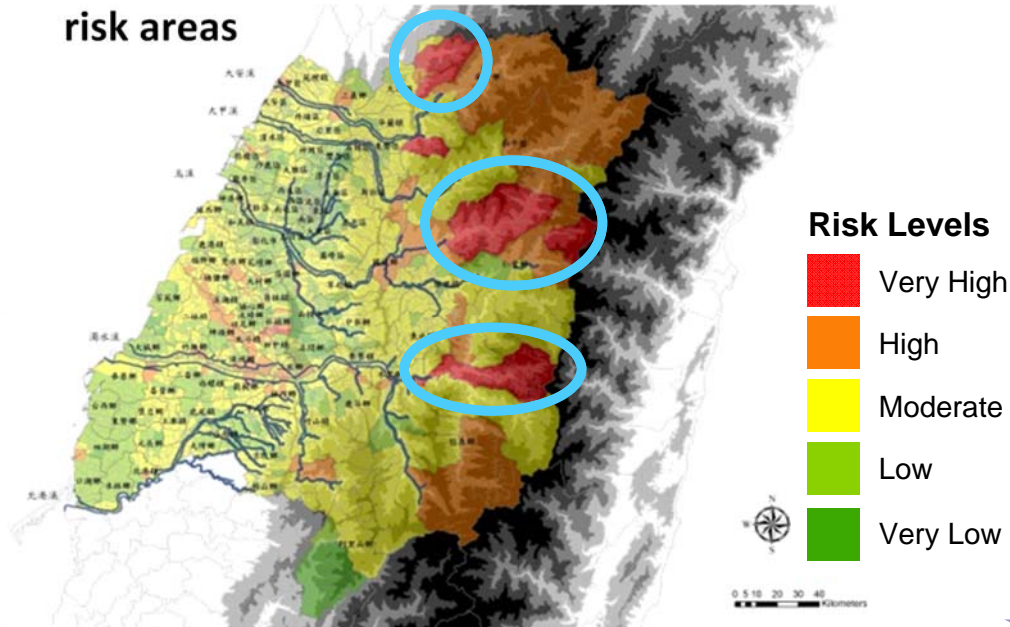


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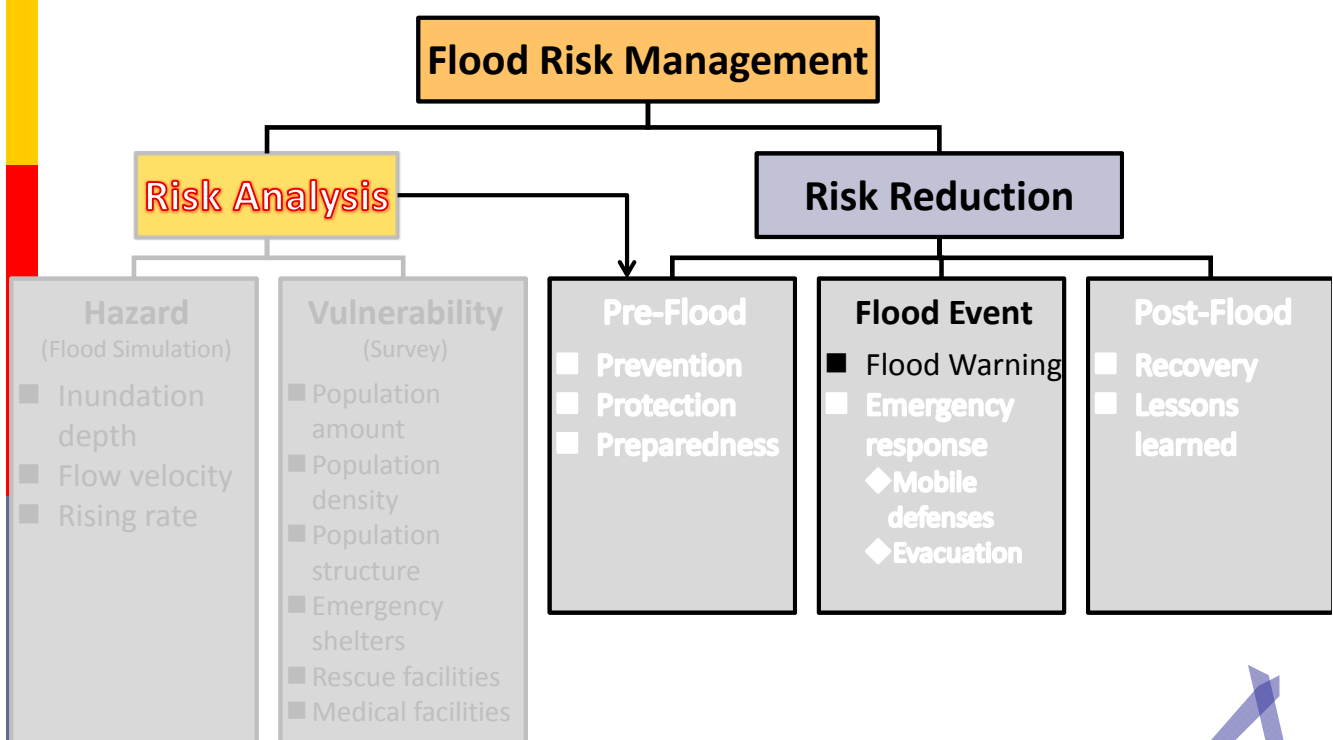
1.Risk Analysis

□ Risk-Based Information

- Risk mapping can be an efficient way to identify the high risk areas



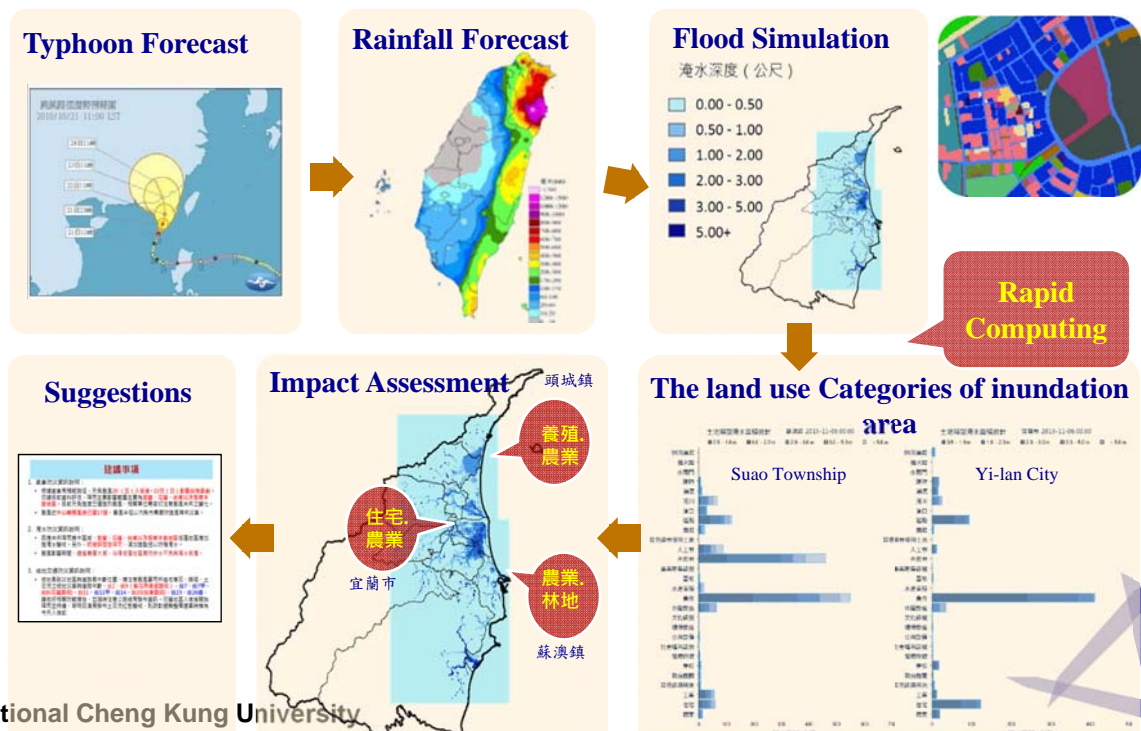
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2.Early Warning System

-Cited from NCDR

The early warning Process for the disasters assessment



2.Early Warning System

-Cited from NCDR

Example : Water Resources Agency – Flood Warning

Estimated floods in 24hrs based on forecast issued by CWB

Major flooded areas

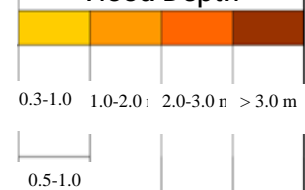


Warning

Latest 24hr (200mm/24hr)
Yilan County: Warning areas

Toucheng Jiaoxi
Zhuangwei Yilan City
Yuanshan Wujie
Sanxin Luodong
Dongshan
Suao

Flood Depth

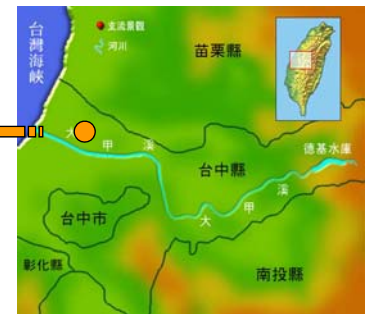


Disclosed info: time, locations and scientific scenario

2.Early Flood Warning

Example : A Warning System for Bridge safety

- In 2008, Ho-Fon Bridge break during super typhoon Sinlaku (2 persons died and 4 missing).
- Traffic was interrupted for 21 months.

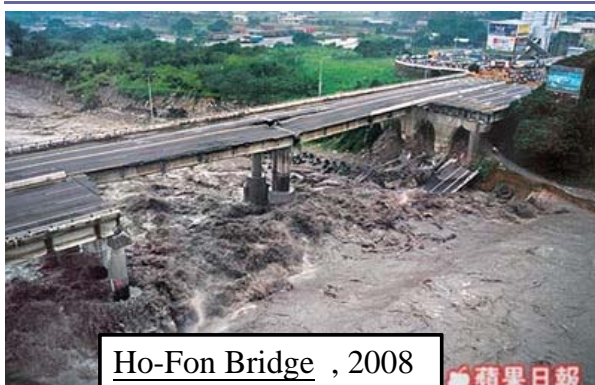


Ho-Fon Bridge was damaged by the flood.



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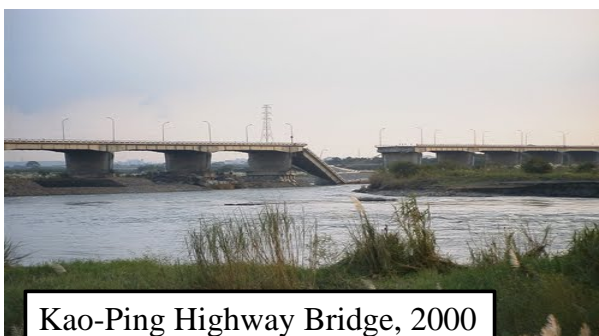
2.Early Flood Warning



Ho-Fon Bridge , 2008



Shuang-yuan Bridge, 2009



Kao-Ping Highway Bridge, 2000

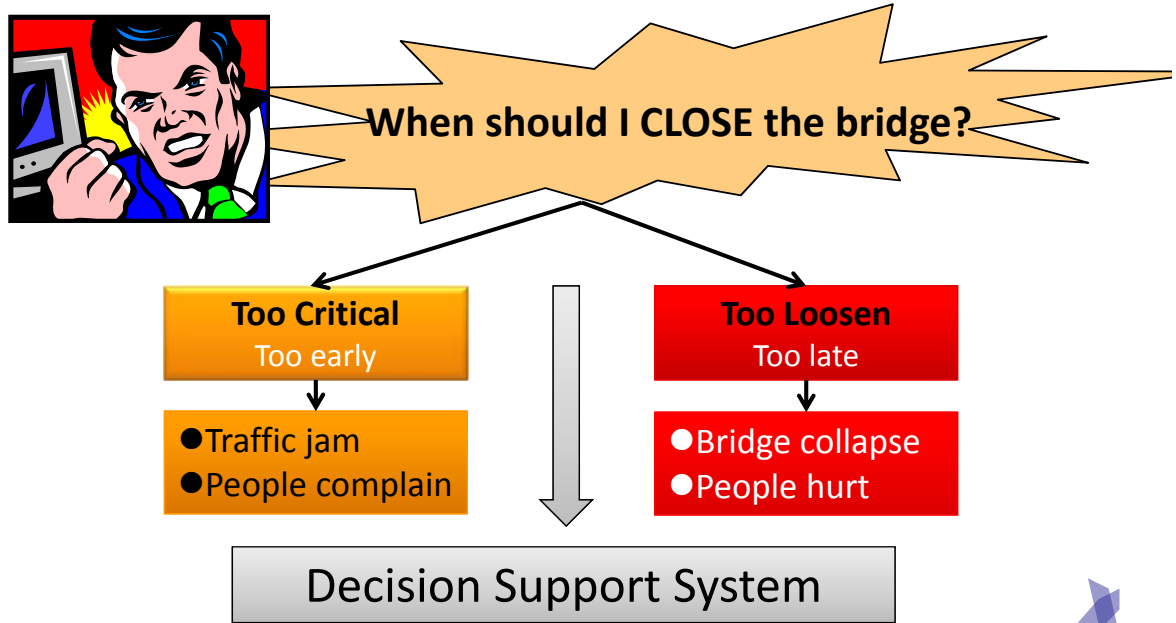


Kao-Ping Railway Bridge, 2005



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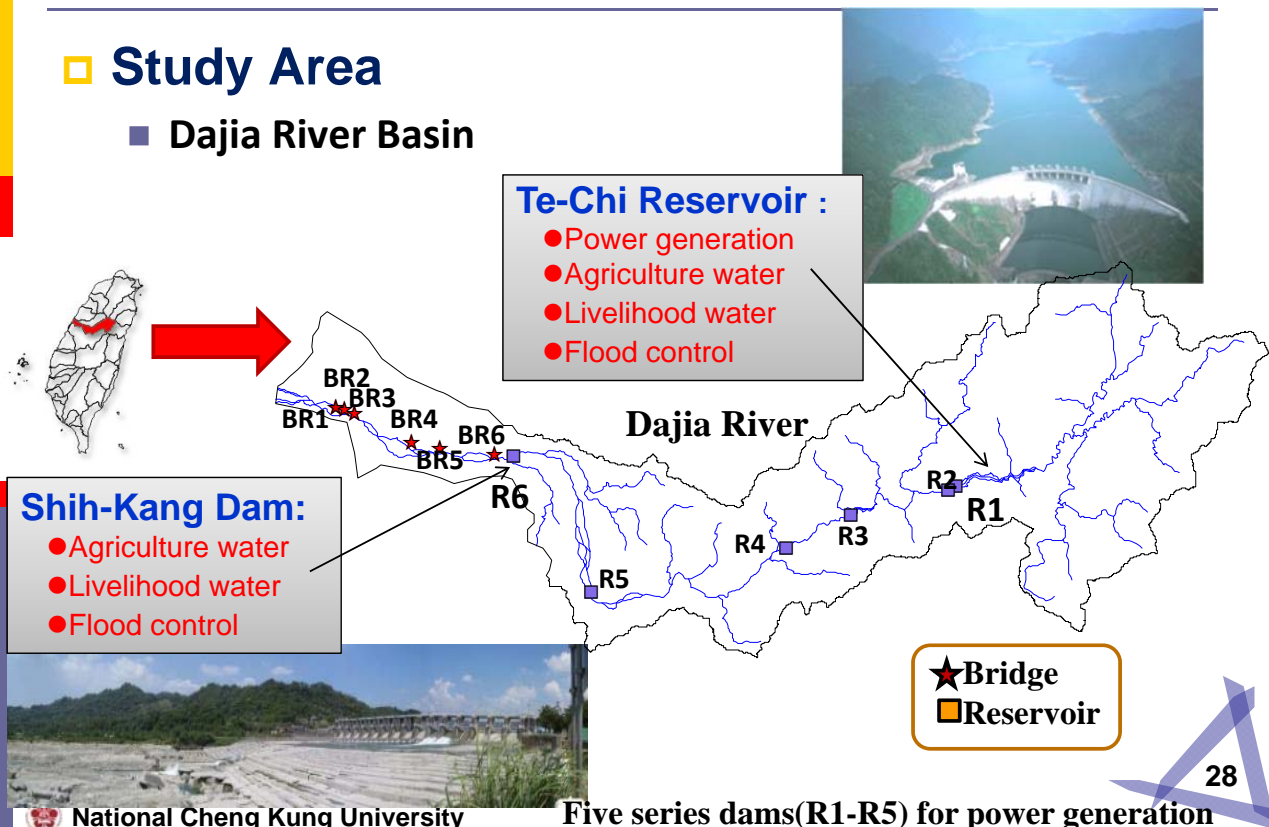
2.Early Flood Warning



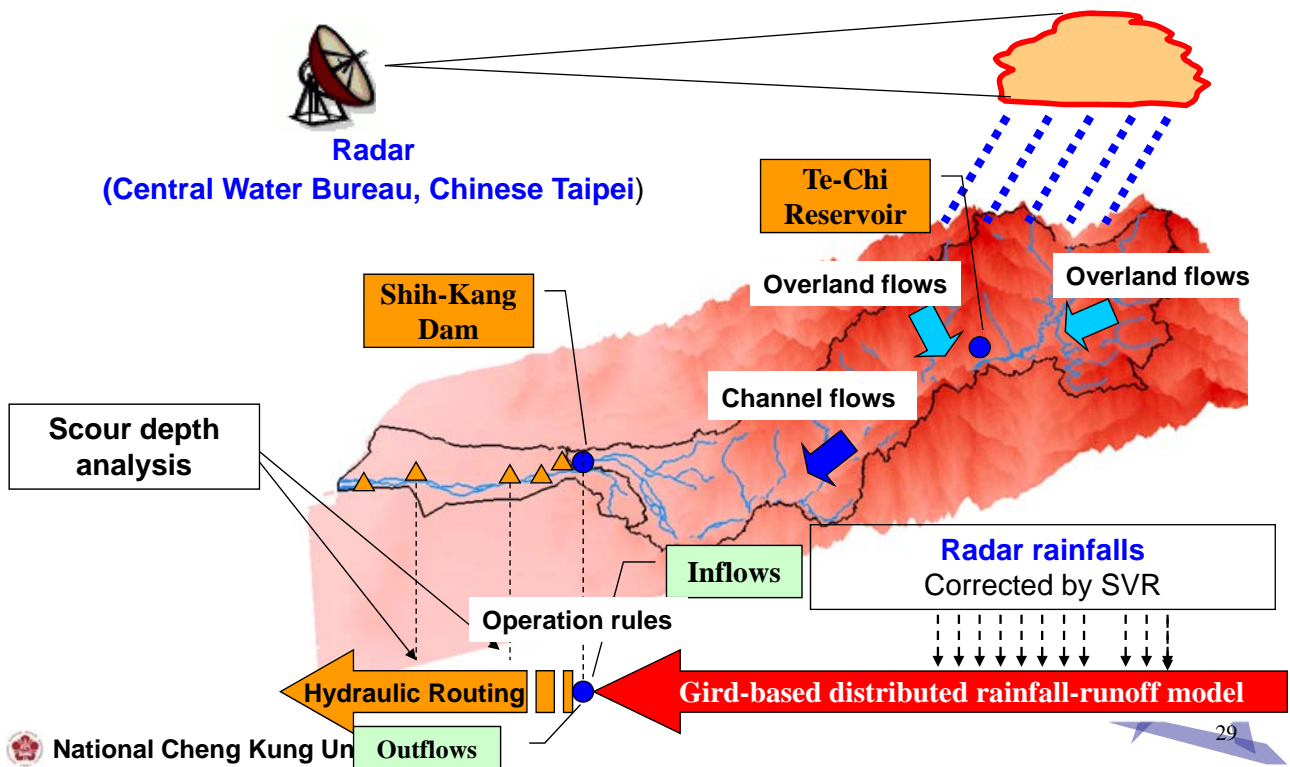
2.Early Flood Warning

Study Area

Dajia River Basin

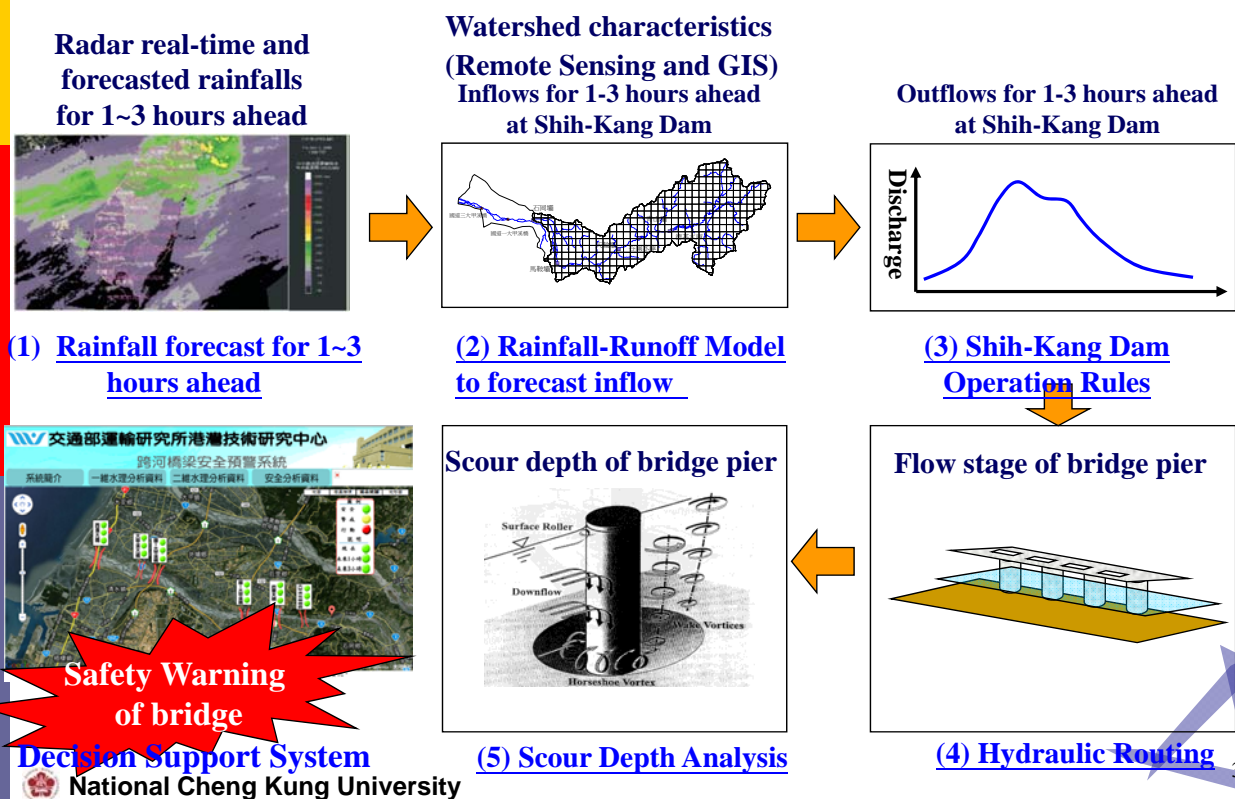


2.Early Flood Warning



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2.Early Flood Warning



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2.Early Flood Warning

□ Flood Warning

- Rainfall forecast is a key element to reasonably predict the possible flooding area
- Specially, hourly rainfall forecast still has high uncertainty

Rainfall
forecasting

Flood routing

Possible flooding
area



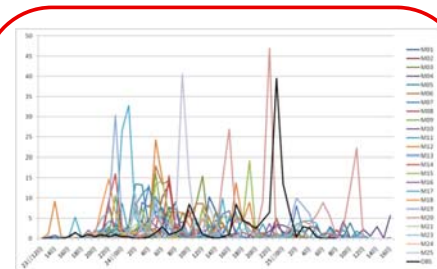
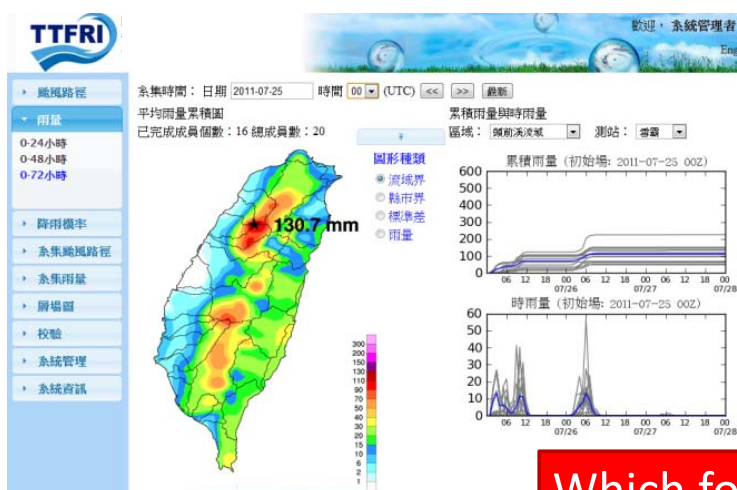
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2.Early Flood Warning

□ Rainfall forecast

- TTFRI provides 21 WRF different forecasting results
- Provide 6 hours ahead rainfall forecast



Not all WRFs forecasting showed good performance to Obs.

Which forecasting is good?



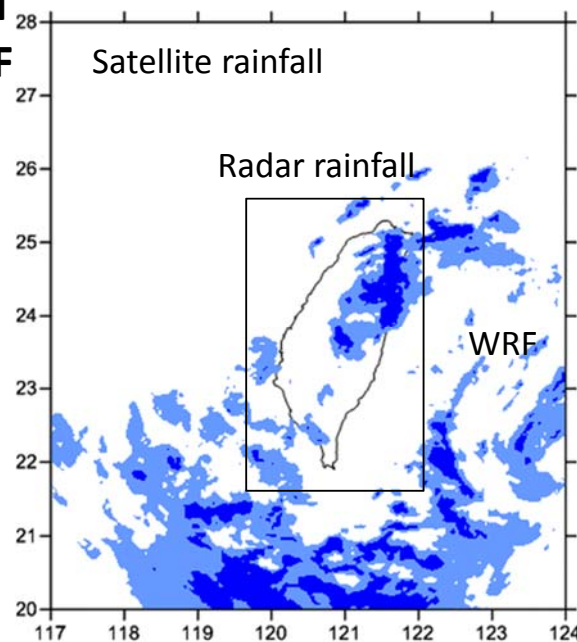
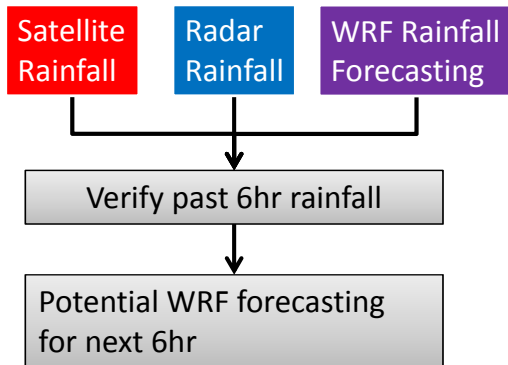
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2.Early Flood Warning

□ Rainfall forecasting

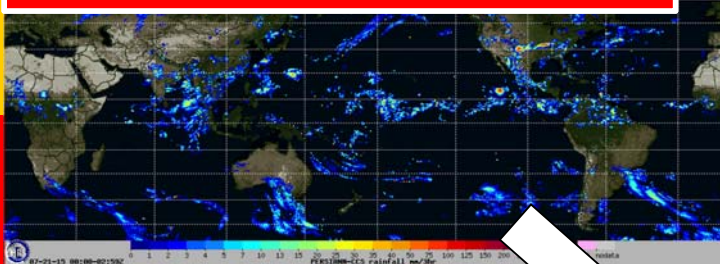
- Using real-time rainfall to select available WRF rainfall forecasting



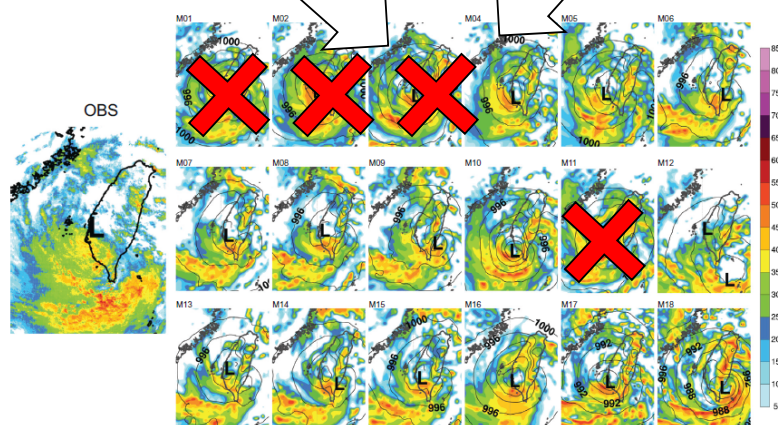
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2.Early Flood Warning

PERSIANN-CCS satellite rainfall from CHRS, UCI



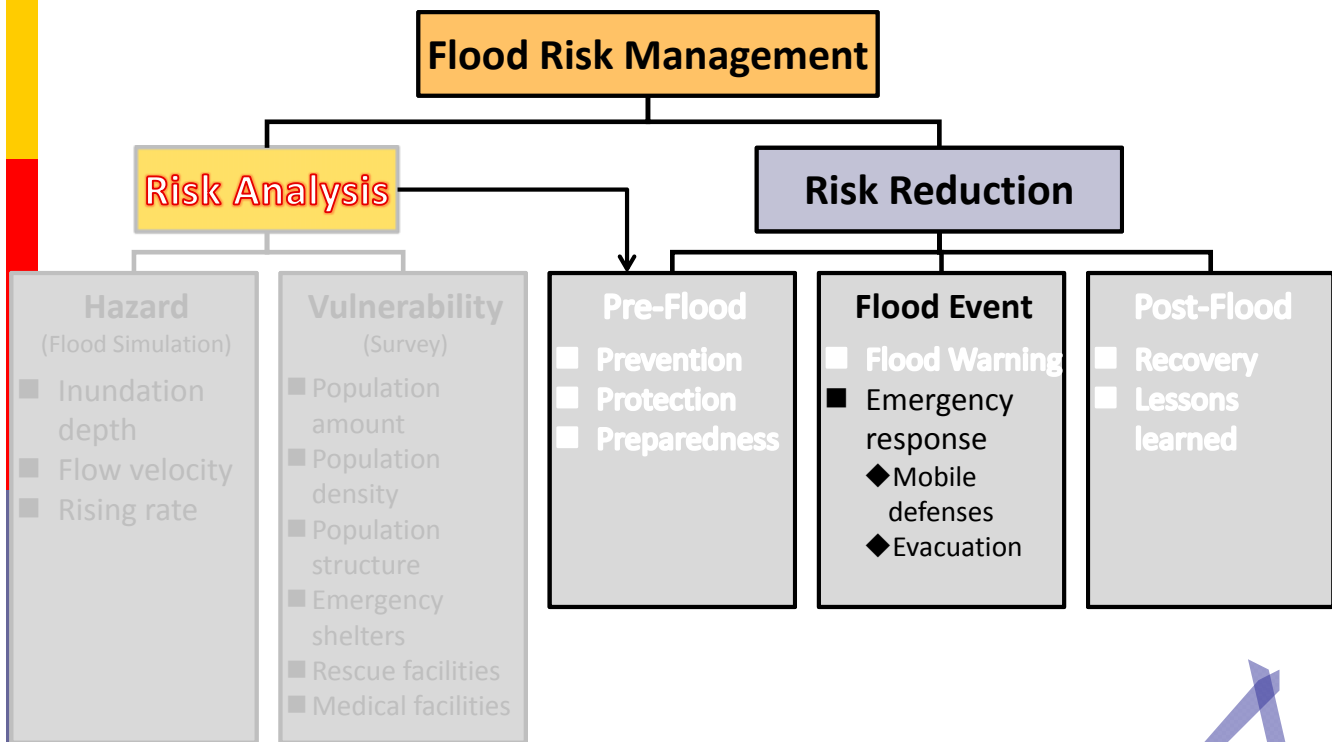
QPESUMS radar rainfall from CWB



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WRF rainfall forecasting from TTFRI

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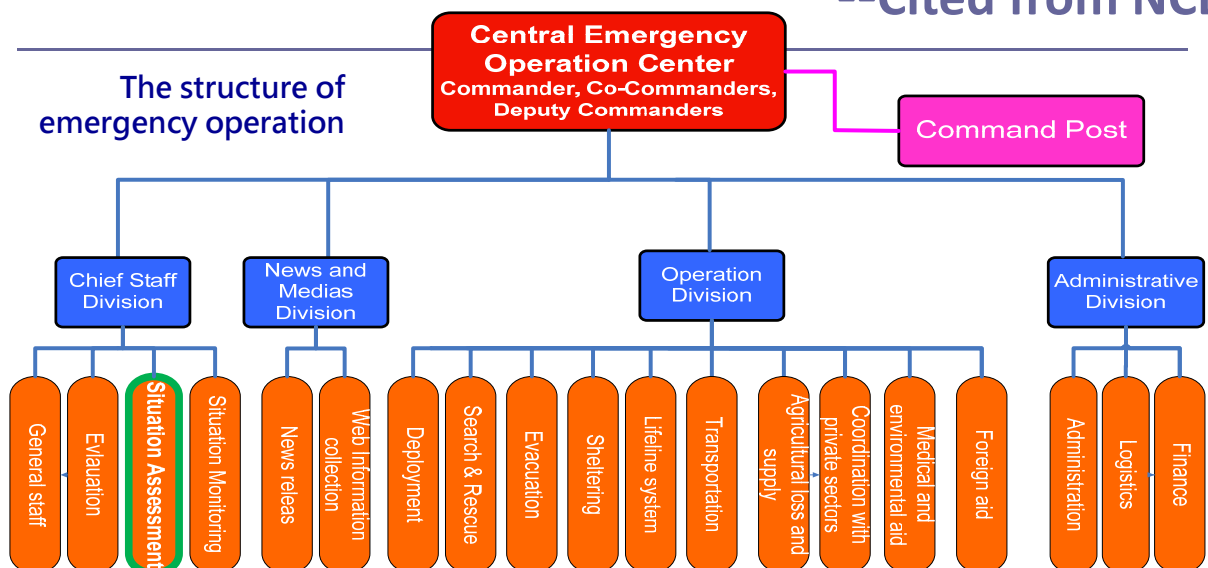


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3. Emergency response

--Cited from NCDR



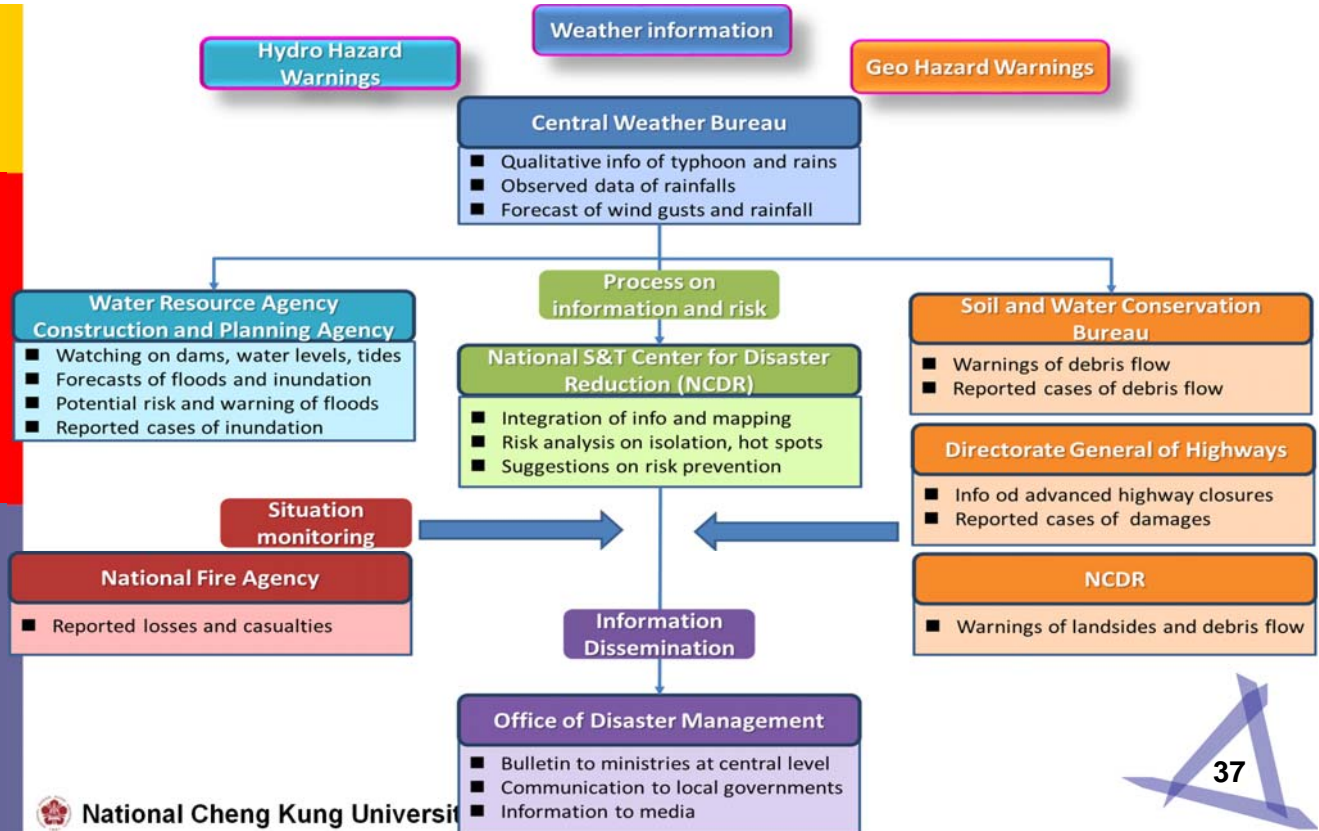
Situation Assessment Group

- Central Weather Bureau (CWB)
- National Science & Technology Center for Disaster Reduction(NCDR)
- Soil and Water Conservation Bureau (SWCB)
- Forestry Bureau(FB)
- Water Resources Agency(WRA)
- Construction and Planning Agency (CPA)
- Directorate General of Highways(DGH)
- National Fire Agency(NFA)
- Council of Indigenous Peoples(CIP)
- Government Information Office(GIO)
- (Ministry of National Defense(MND))
- (Department of Civil/Social Affairs)
- (Office of Disaster Management)

3. Emergency response

--Cited from NCDR

Information flows and synergy for typhoon emergency operation



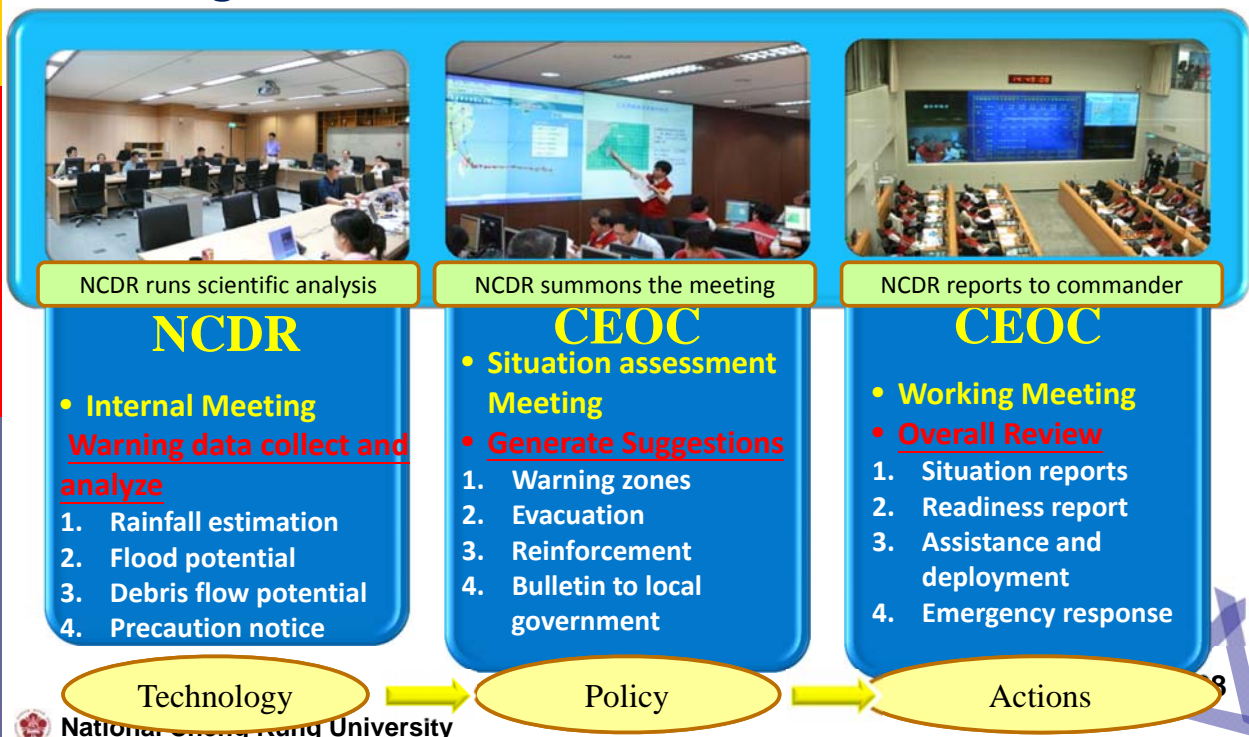
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3. Emergency response

--Cited from NCDR

Emergence Plans



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Conclusions

□ Risk analysis

■ Risk maps

- Provides potential risk area
- Prevention strategy or planning in advance

■ Cross-field corporation is required

- Integrated hazard maps into urban planning

□ Early flood warning

■ Flood forecasting

- Provide real-time potential hazard area
- Provide information for evacuate action

■ Precise rainfall forecasting is required

- Reduce the uncertainty of flood forecasting

