Integrated Risk Governance Under Global Change

– Case: Experiences and Lessons from the Freezing Rain and Snowstorm Disaster in China during the Early 2008

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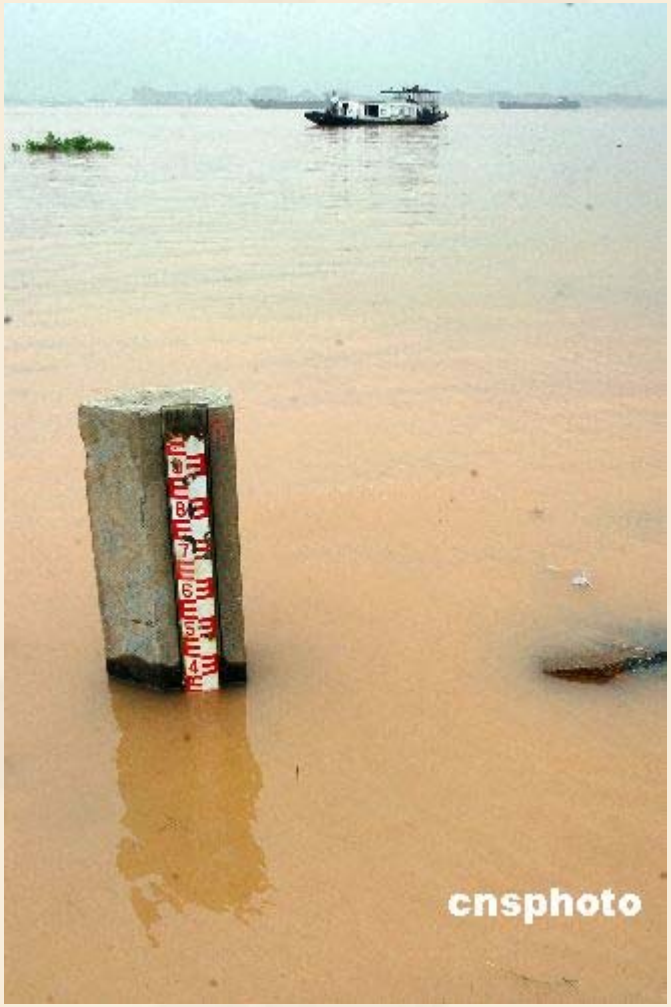
Flood Disaster Risk

Flood in Yangtze River Basin of China in Summer & Autumn,1998

Flood Risk

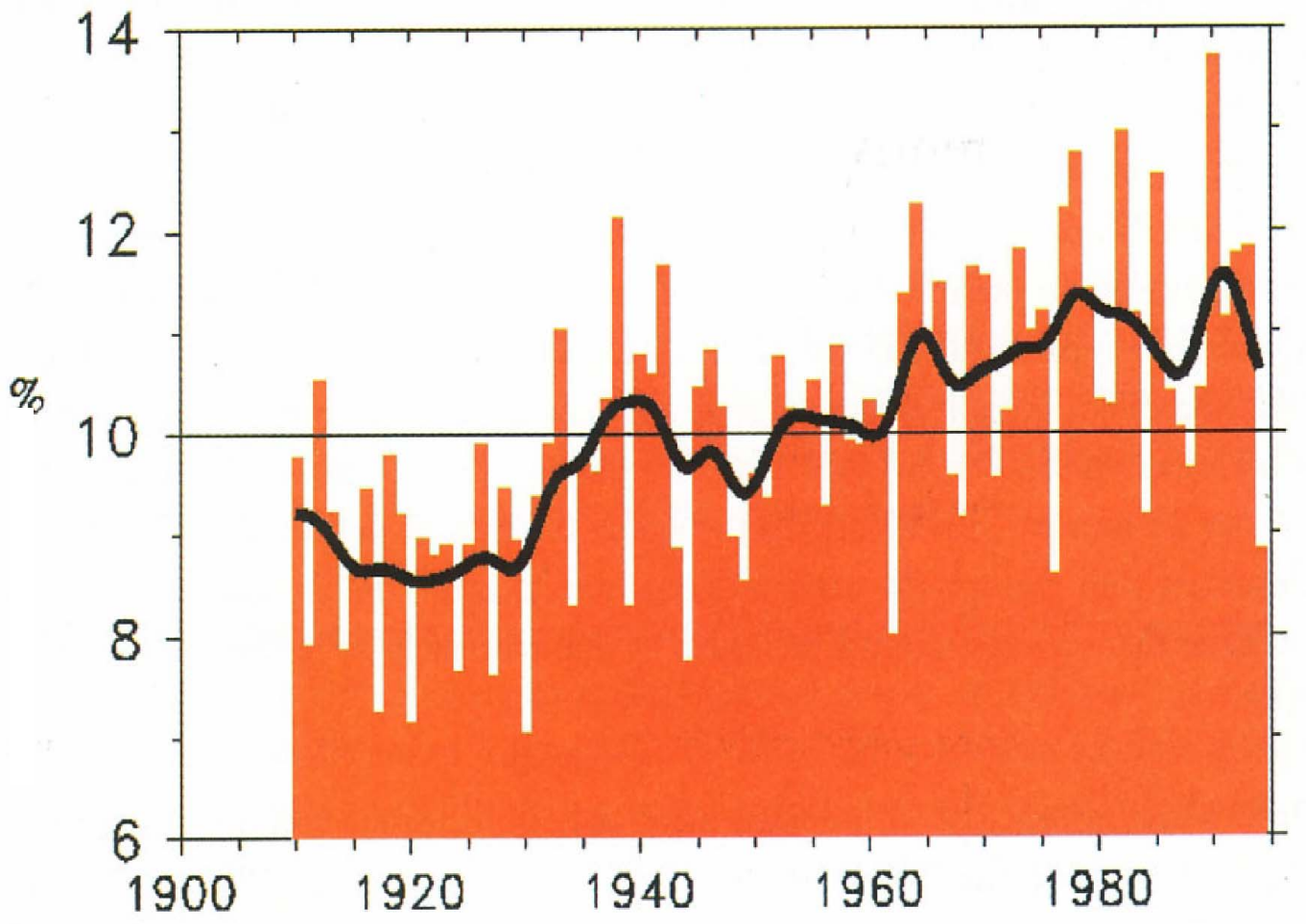


Drought Disaster Risk

Severe Drought in ChongQing, China, August, 2006

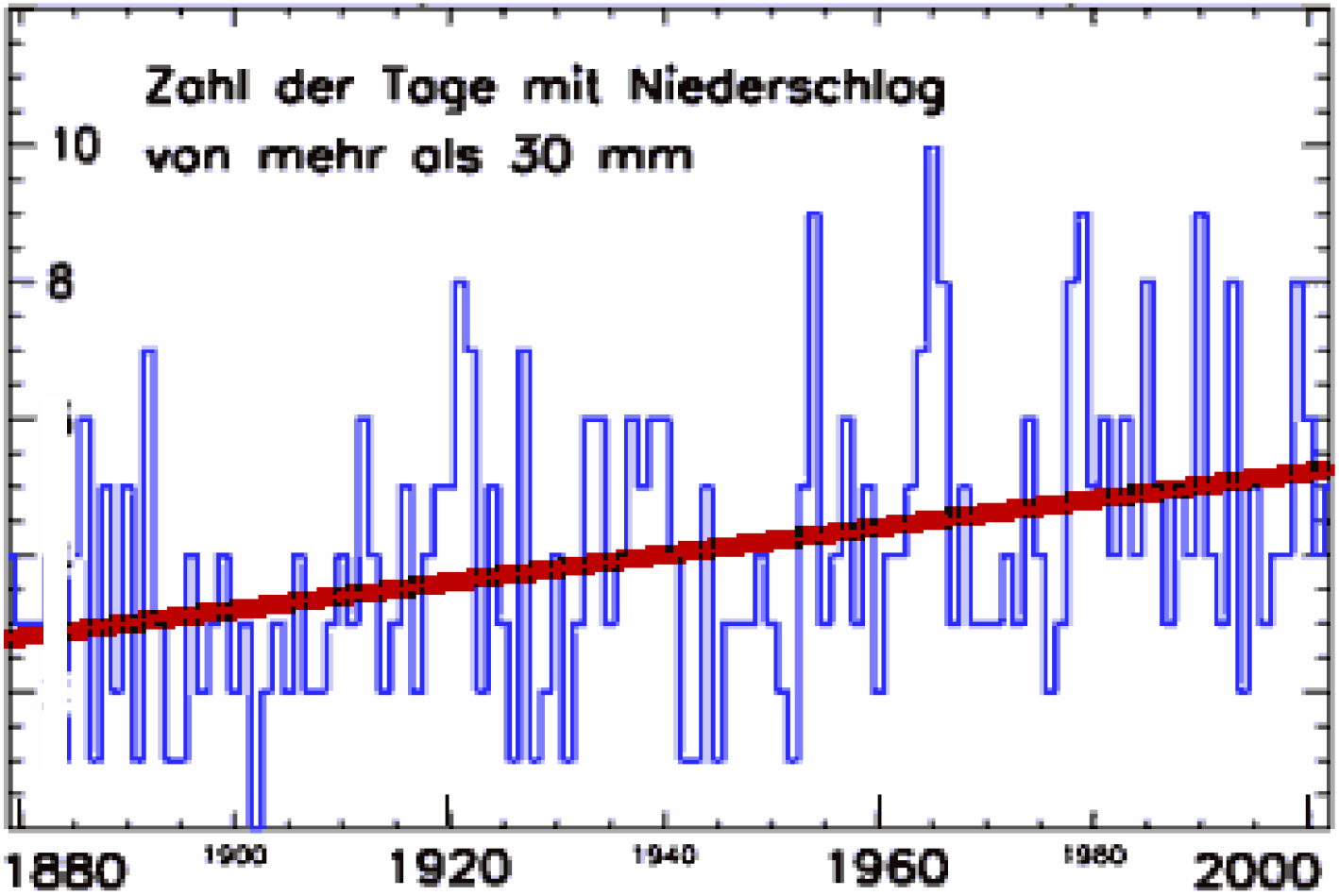
Dust Risk

Increasing trend of high intensity rains in the USA



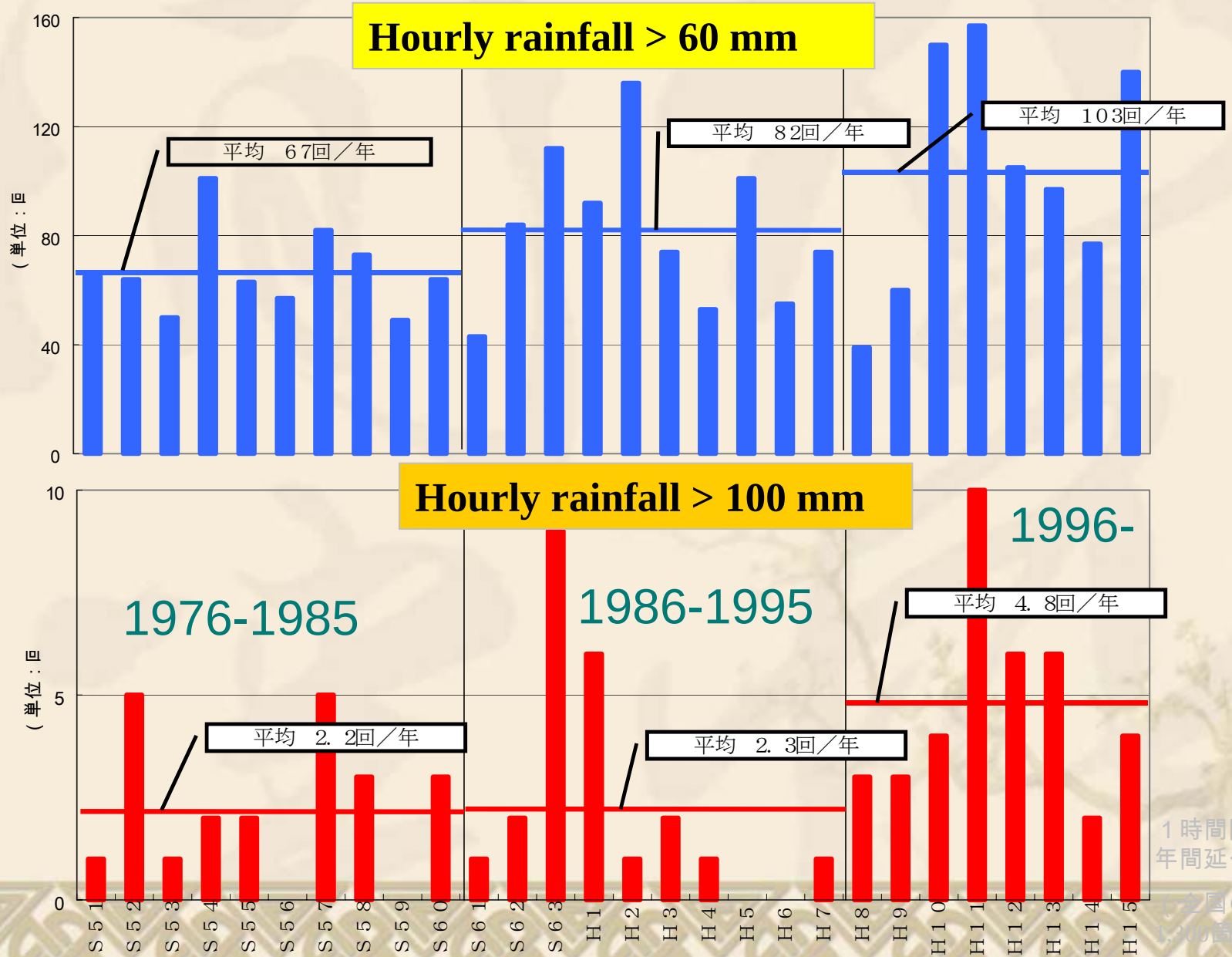
Source: http://www.ncdc.noaa.gov/ol/climate/research/gcps/papers/amsbull/amsbull.html

Rains more than 30 mm in Germany



Source: Wetterstation Hohenpeißenberg

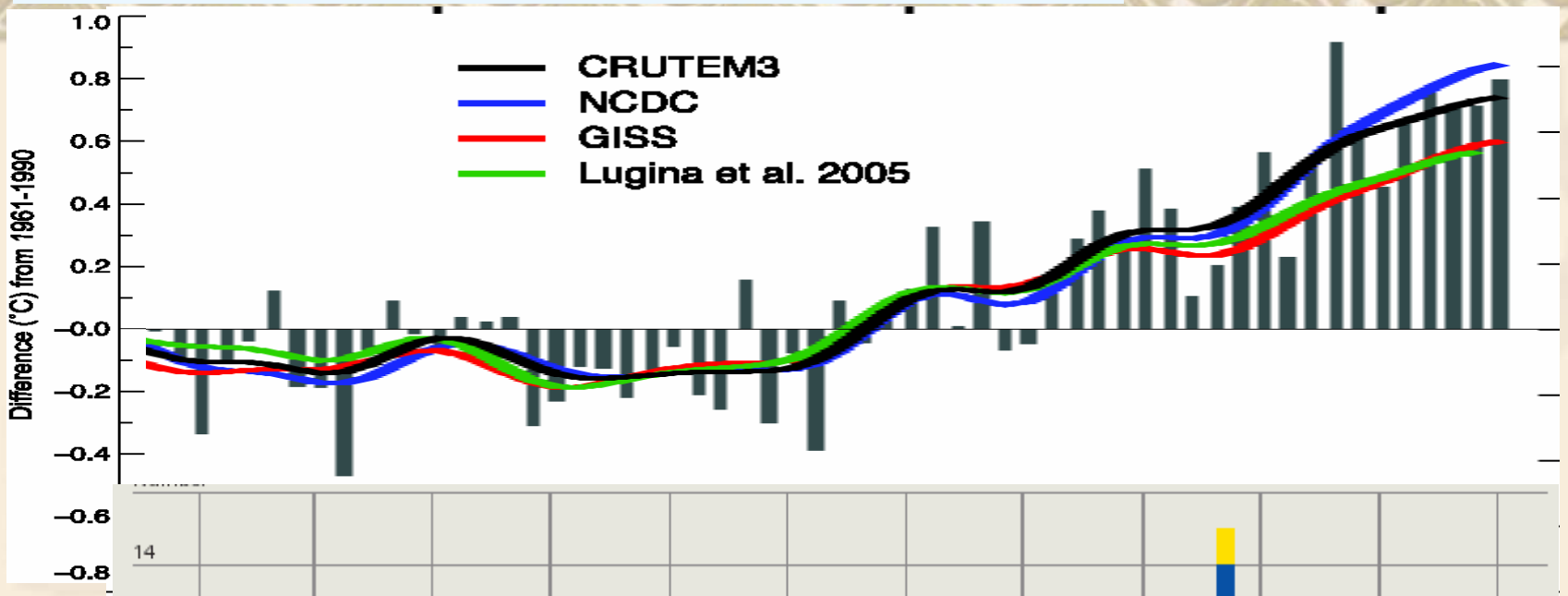
Frequency: higher intensity rainfalls all over Japan

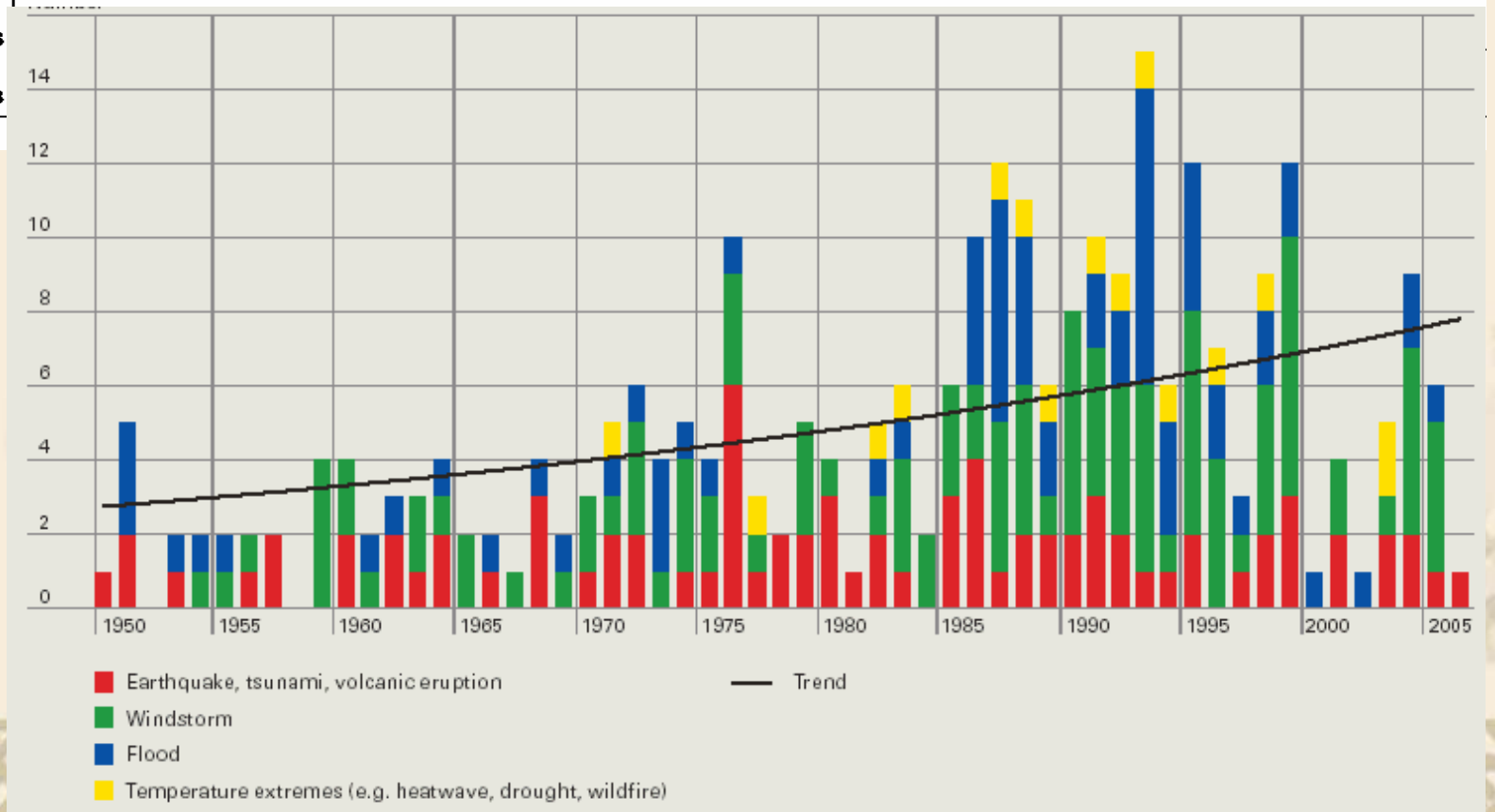


１時間降雨量における
年間延べ件数

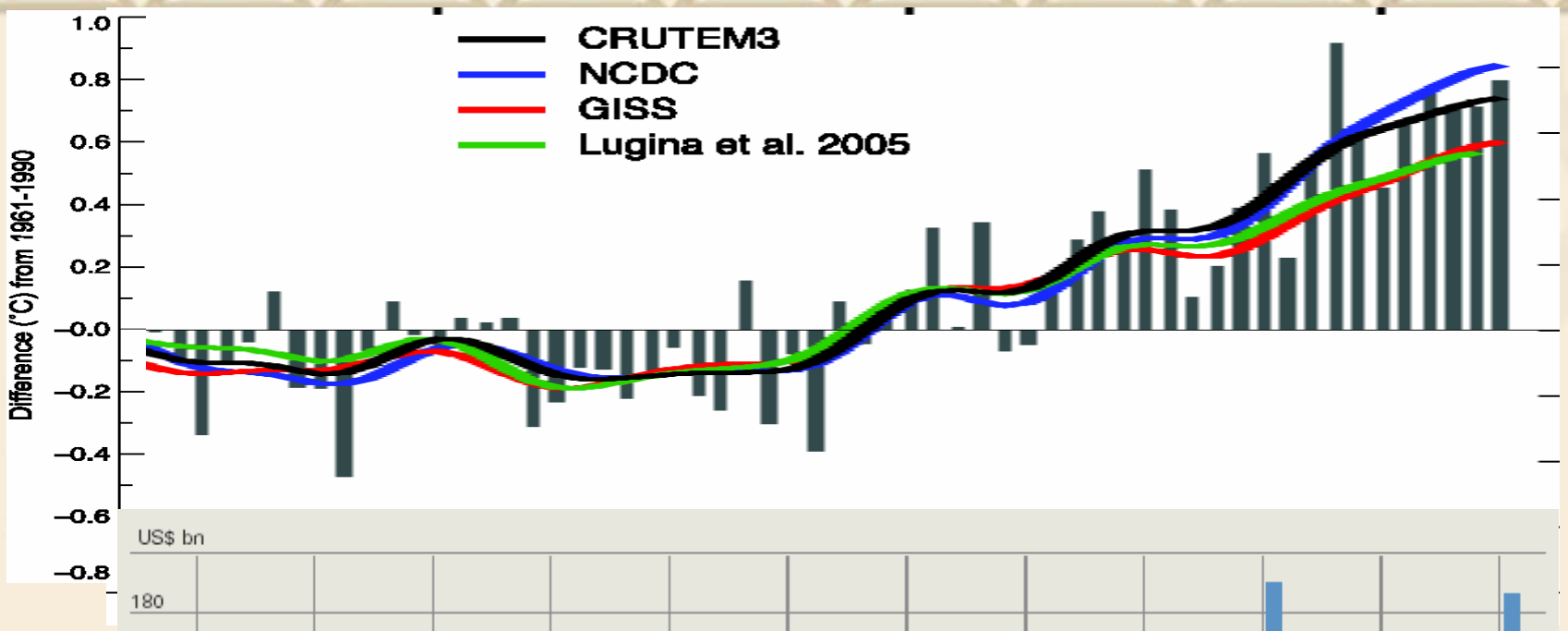
（全国のアメダス地点
1,300箇所より）

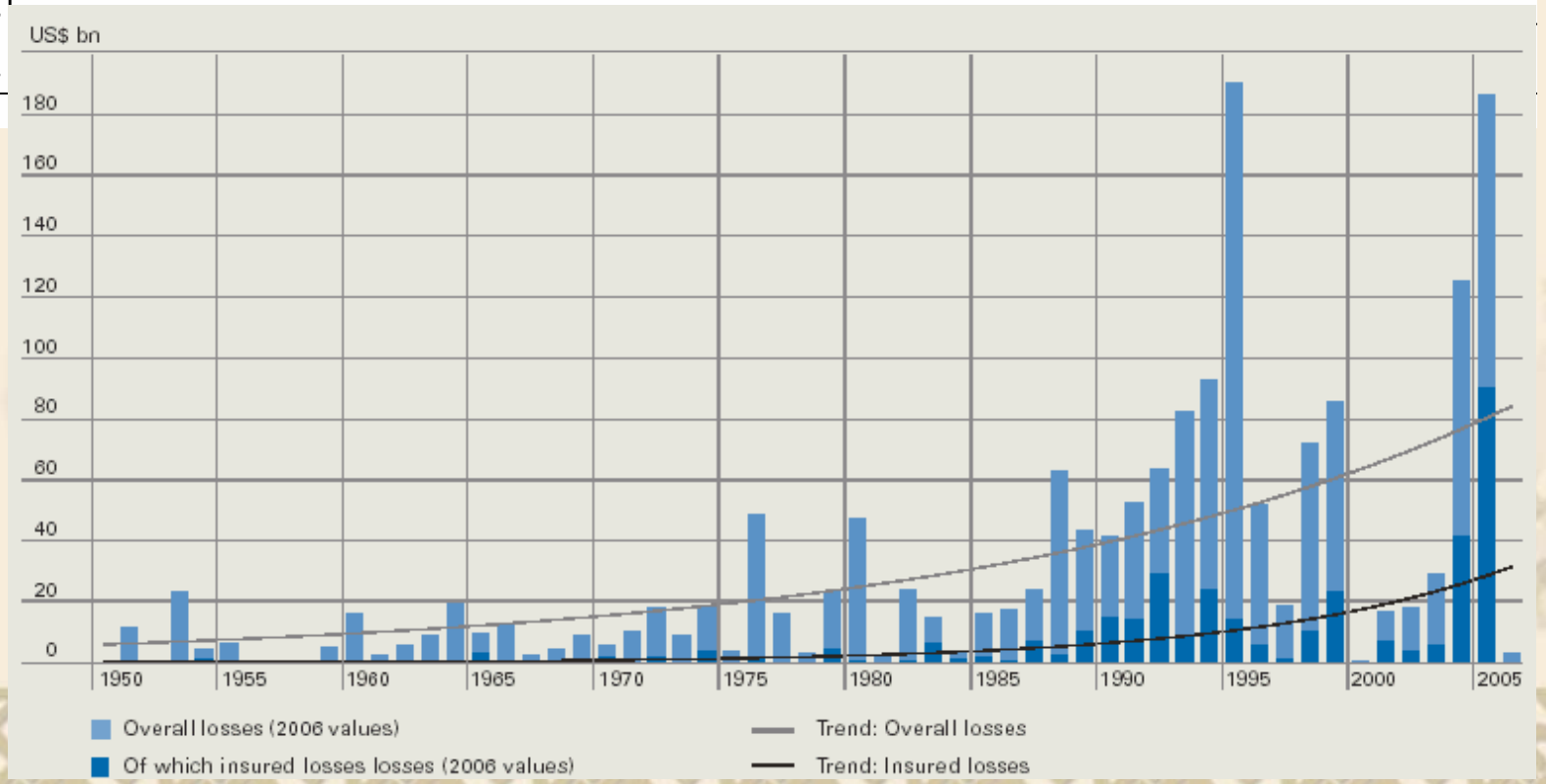
Surface Temperature Change and Main Disaster Numbers





Surface Temperature Change and Disaster Losses





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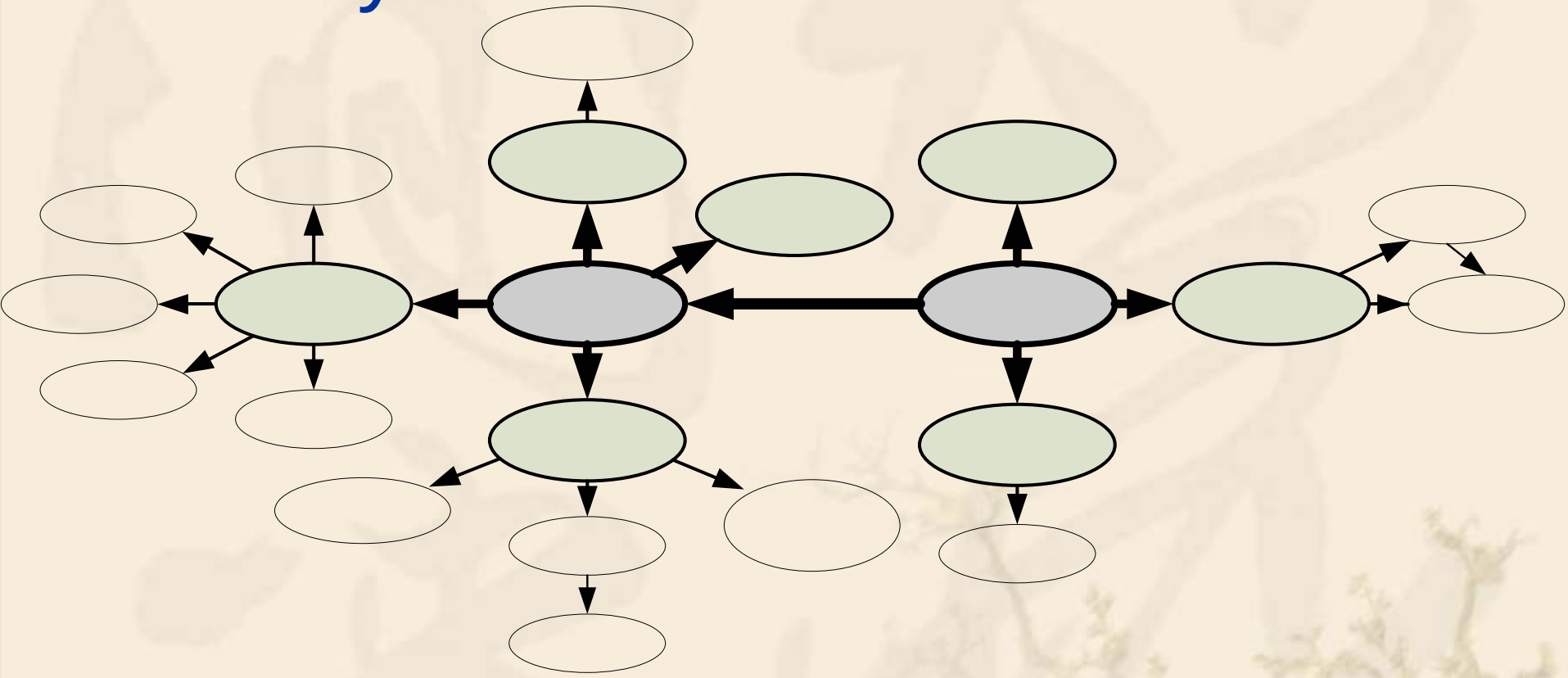
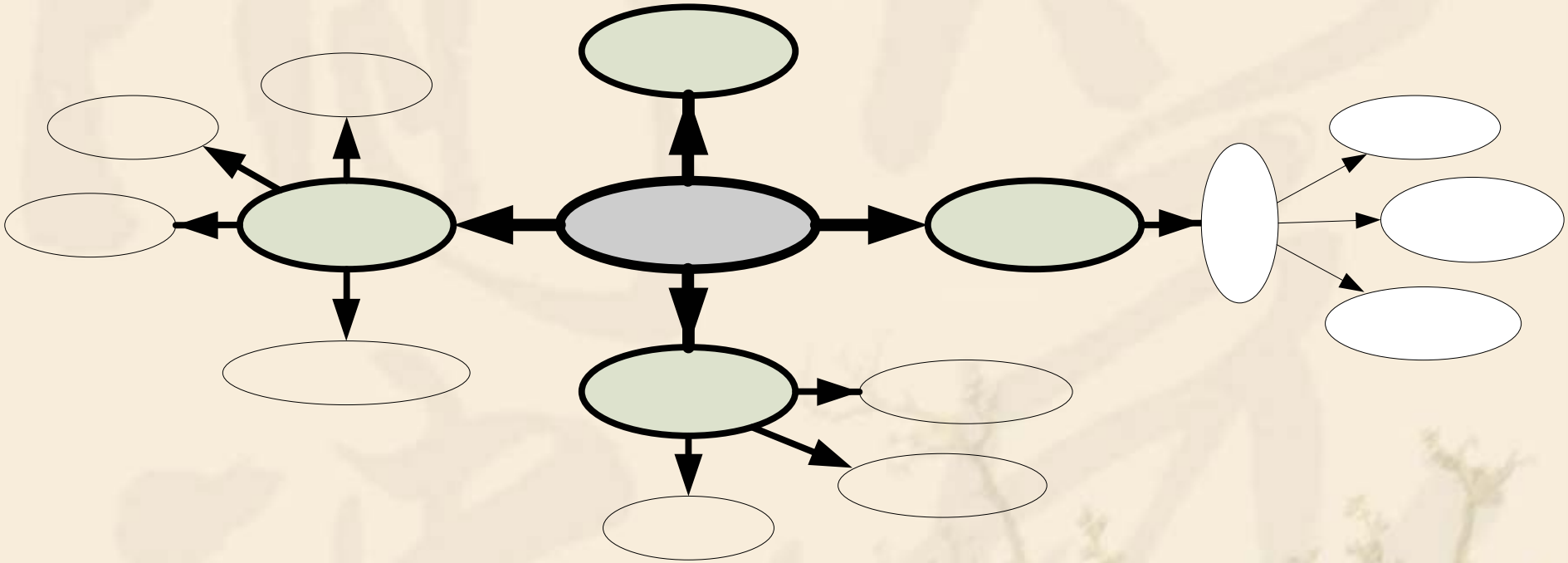
I Introduction

The System School - Disaster chains



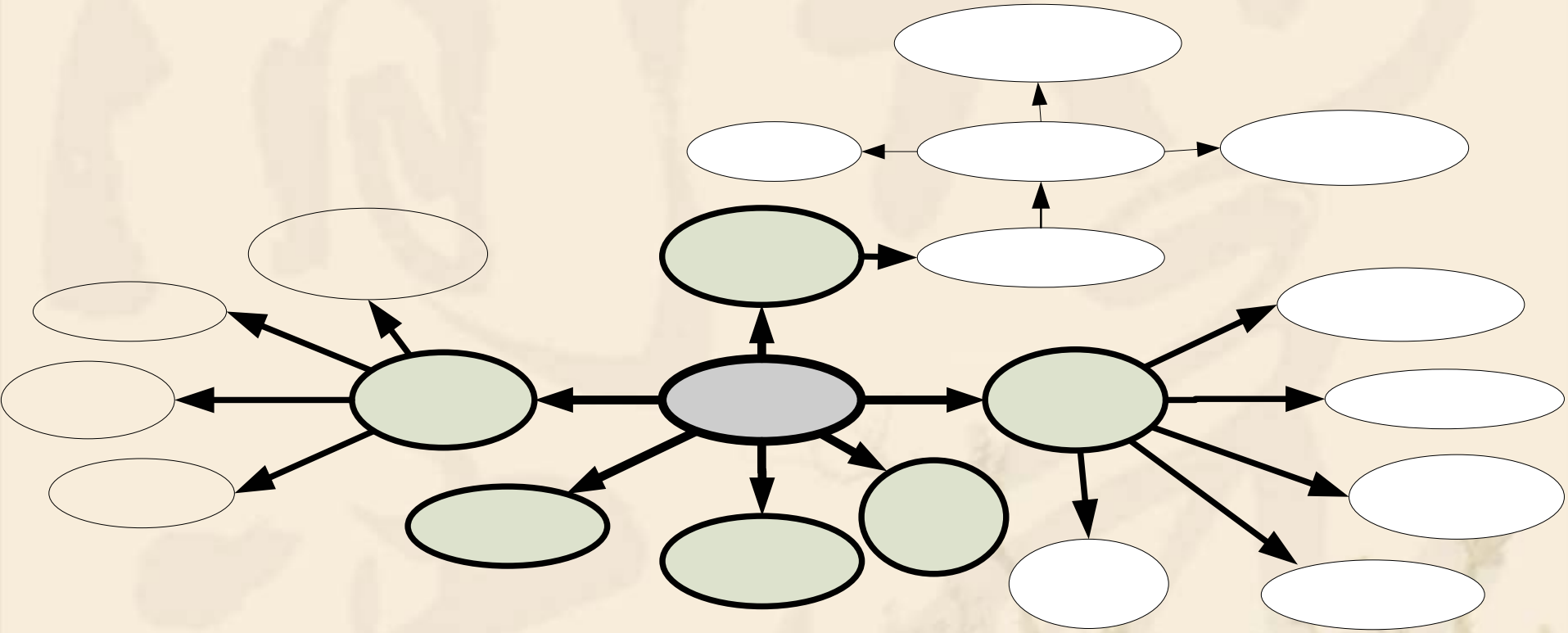
Typhoon-storm disaster chain

The System School - Disaster chains



Cold wave – wind disaster chain

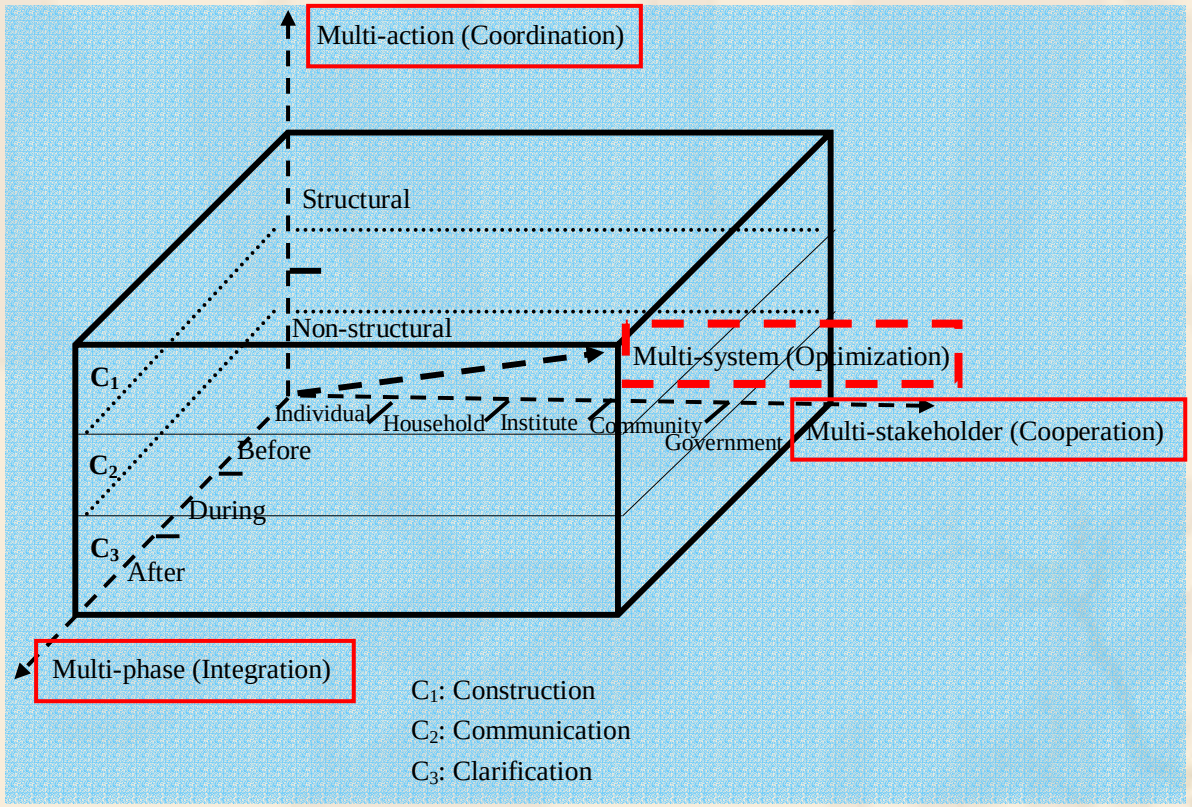
The System School - Disaster chains



Drought disaster chain

II Integrated Large-scale Disaster Risk Governance

IRG - What should be integrated?



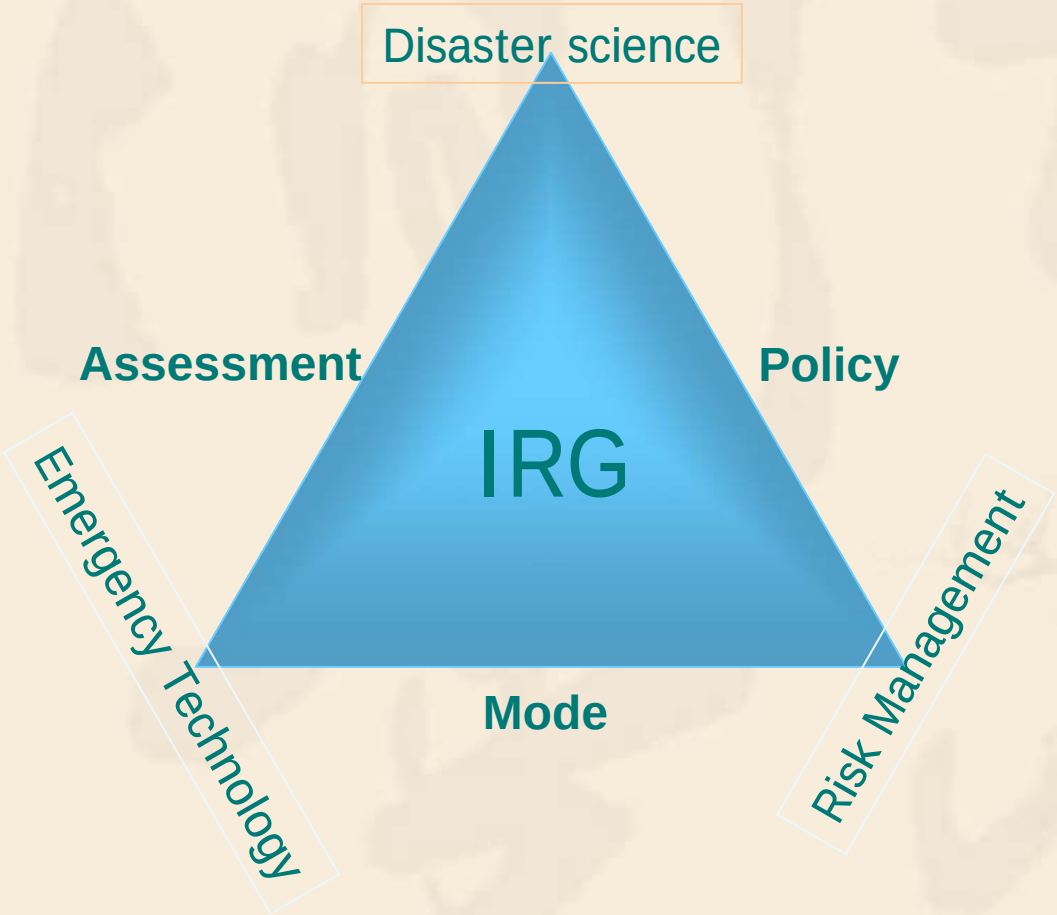
Introducing the notion of independent dimensions of **Multi-stakeholder, Multi-action,** and **Multi-phase activities**

Three Dimensional Paradigm of IRG

IRG –How to integrate?

- Conferences, forums and workshops—“Brainstorming”
  - **IDRC**
  - **WCDR**
  - **IRGC**
  - **IIASA-DPRI**
- Information sharing network
  - **Global Platform for Disaster Risk Reduction (GP/DRR, UN/ISDR)**
  - **DRH-Asian (Japan)**
  - **Integrated Risk Governance Network (iRiskNet|IRG-China)**
- Integrated Risk Maps
  - **Hotspots of Global Disaster Risk (UNDP&WB)**
  - **The national first generation integrated risk map in China**
- Modeling and Simulation
  - **Alliance for Global Open Risk Analysis (Japan)**
  - **System for System (Old Dominion Univ., US)**
  - **Integrated Risk Governance Simulation and Dynamics (BNU, China)**

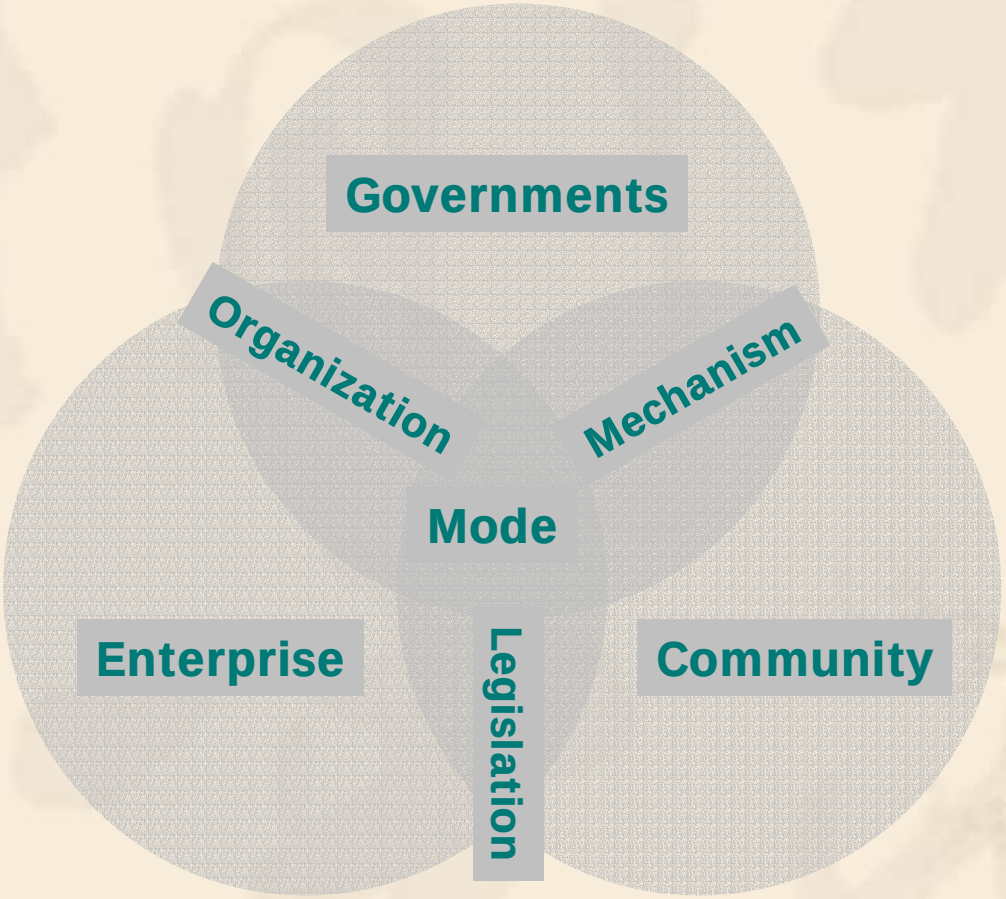
Disaster Risk Science



- Disaster Science:
  - Formation Mechanism of DS
  - Change Process of DS
  - Disaster Reduction Countermeasure
- Emergency Technology:
  - Contingency Plan
  - Contingency Action
  - Contingency Command
- Risk Management:
  - Risk Identification
  - Risk Classification
  - Risk Assessment
  - Modeling
  - Response
  - Adaptation

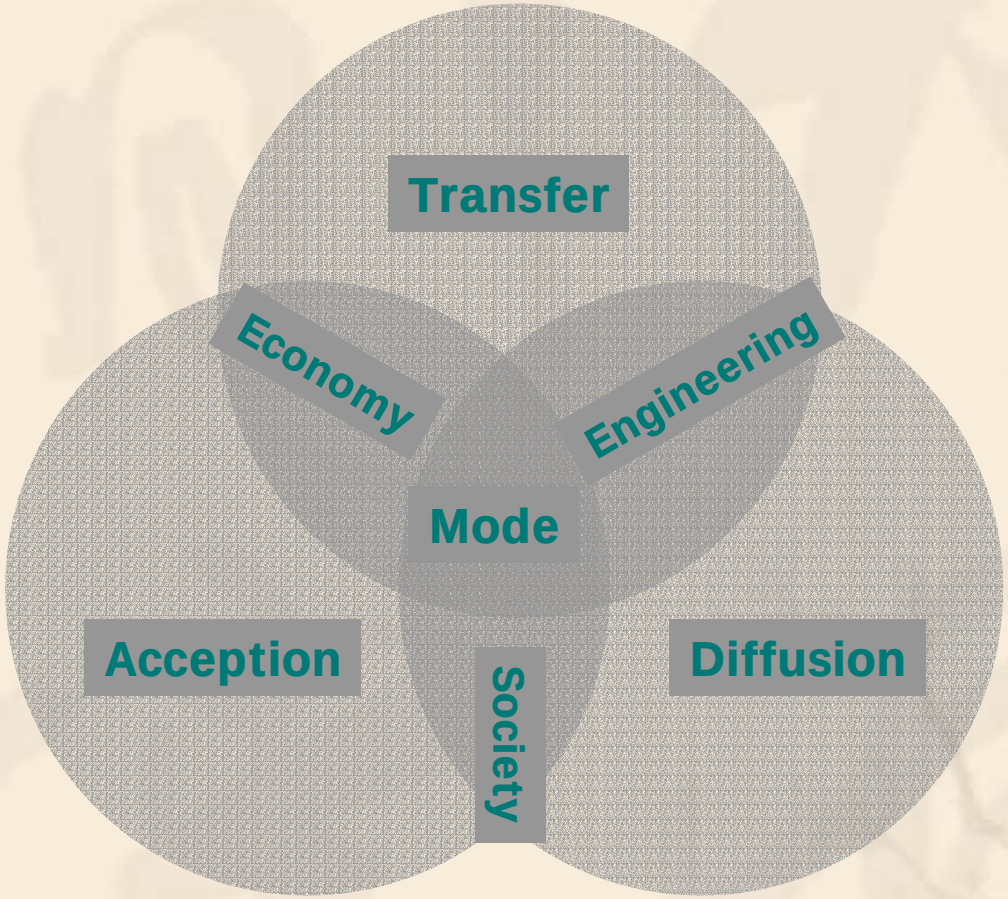
Disaster Risk Science

IRG - Integrated Disaster Risk Governance Mode



In view of research to practice, integrate the regional disaster risk management and sustainable development. Improve global and regional society response strategy and policy to catastrophe risk, provide operational assessment tools.

IRG - Approach for Catastrophe Risk Transfer



In view of the inter-disciplinary (natural sciences, social sciences and human sciences, technology and engineering, management), go deep in exploring approaches for transfer of catastrophe risks.

Approach for Catastrophe Risk Transfer

Integrated Disaster Reduction

III Case: the freezing rain and snow disaster in China during the early 2008

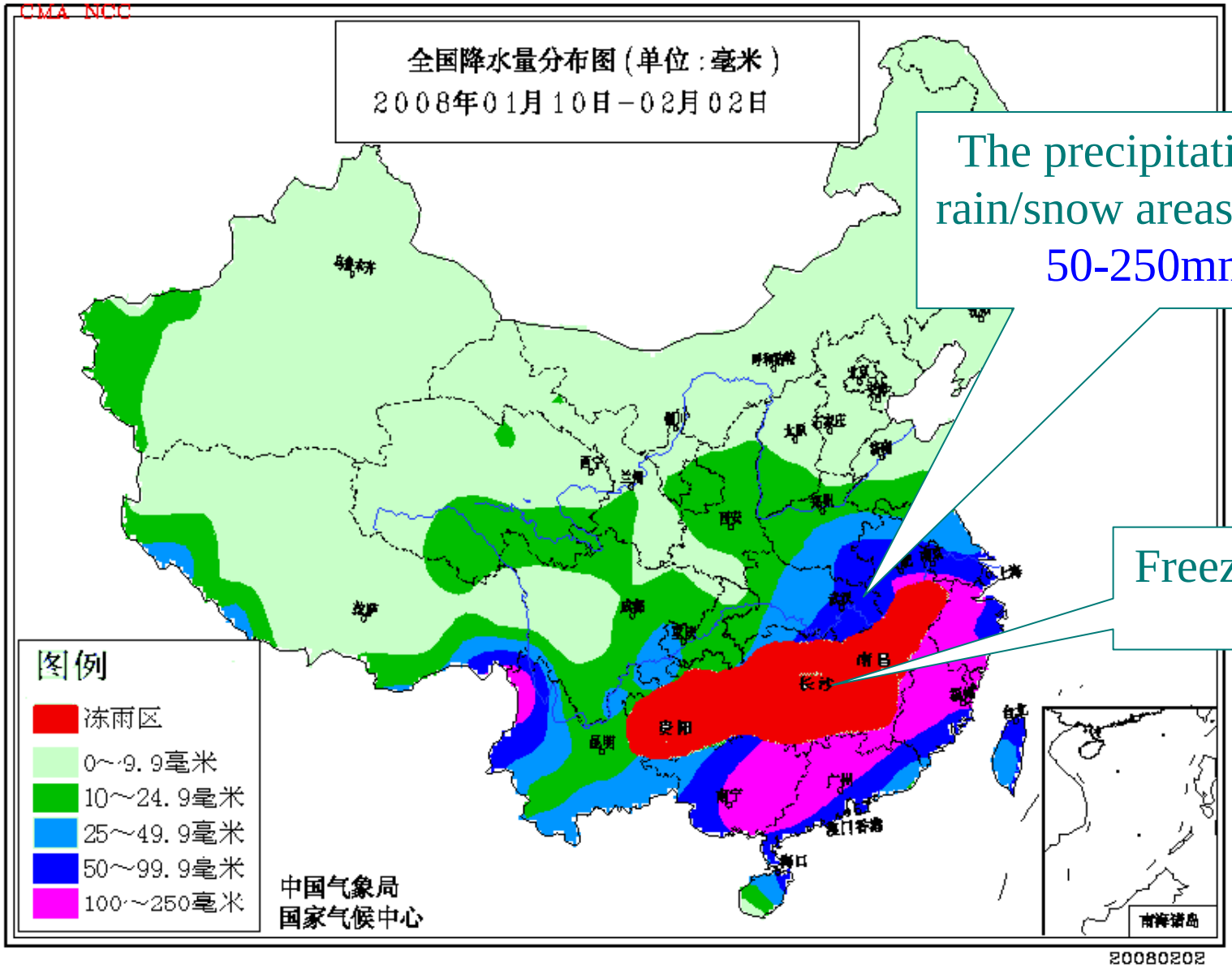
3.1 Hazards

3.2 Disaster Loss

3.3 Response

3.4 Lessons and Experiences

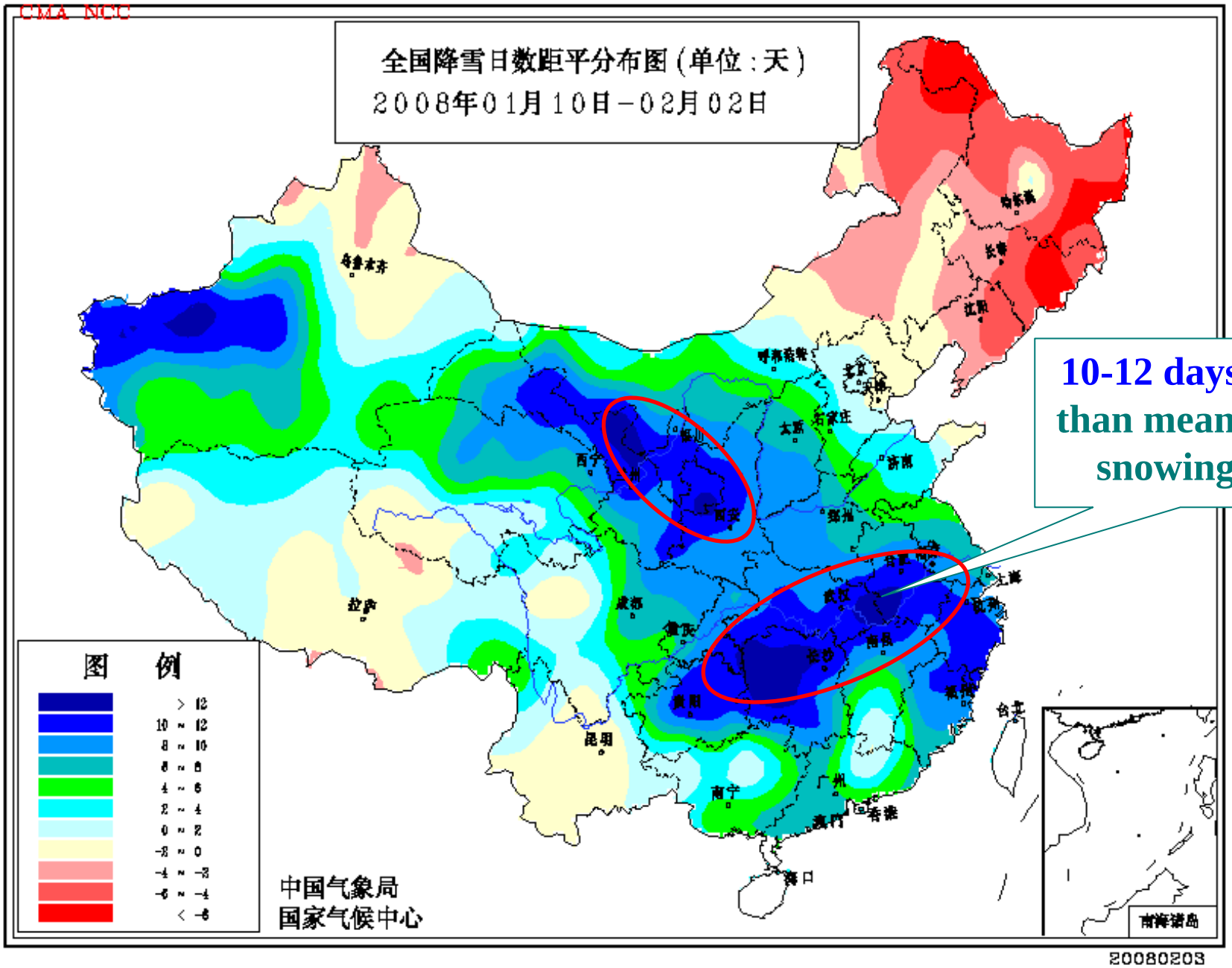
3.1 Hazards → Precipitation (Jan. 10 ~ Feb.2)



The precipitation in heavy rain/snow areas amounts to : 50-250mm/event

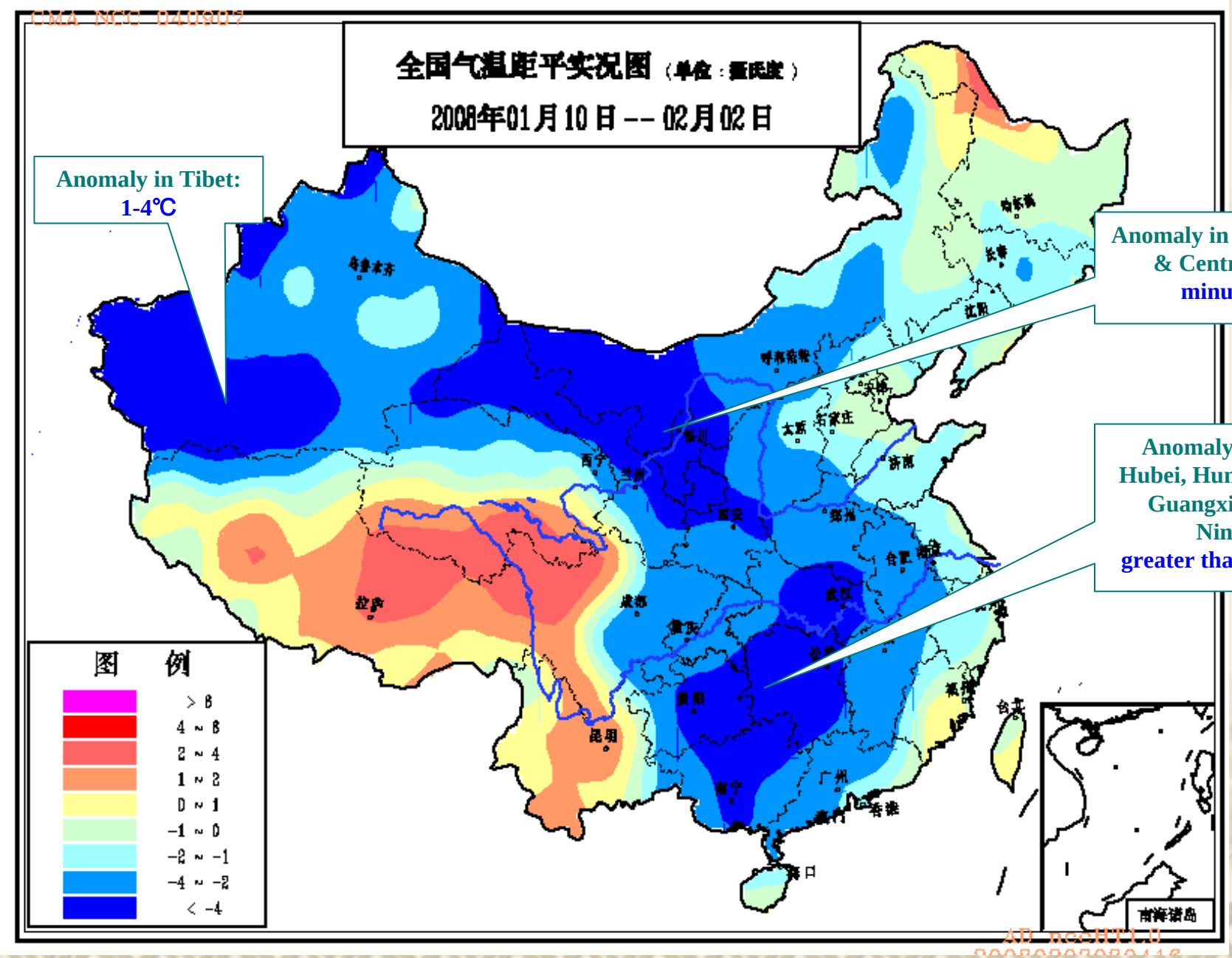
Freezing rain area **(in red)**

Hazards → Snowing-Day Anomaly



10-12 days longer than mean annual snowing days

Hazards → Temperature Anomaly (Jan.10~ Feb.2)

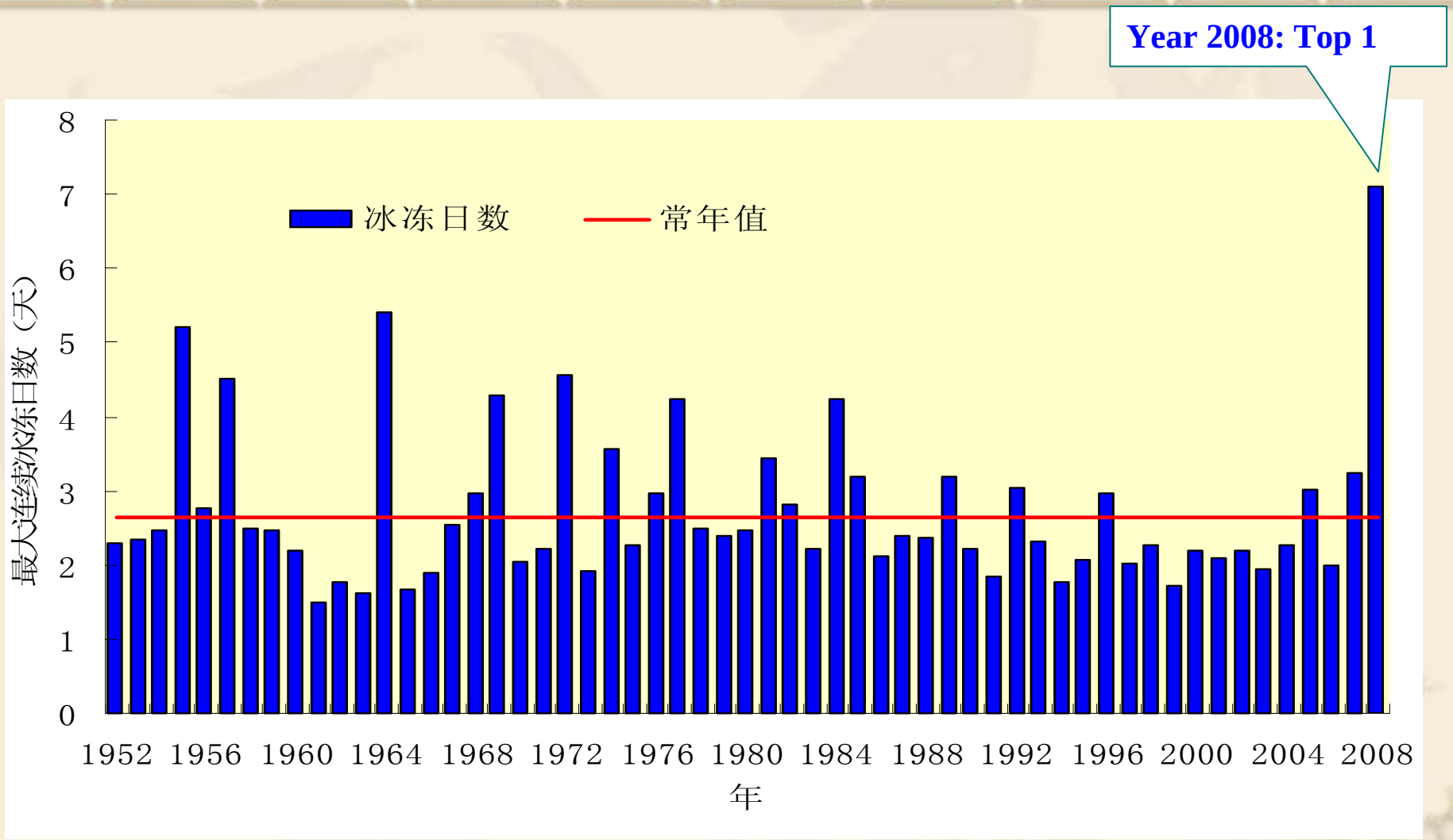


Anomaly in Tibet:
1-4℃

Anomaly in Northwestern & Central China:
minus 2-4℃

Anomaly in parts of Hubei, Hunan, Guizhou, Guangxi, Gansu & Ningxia :
greater than minus -4℃

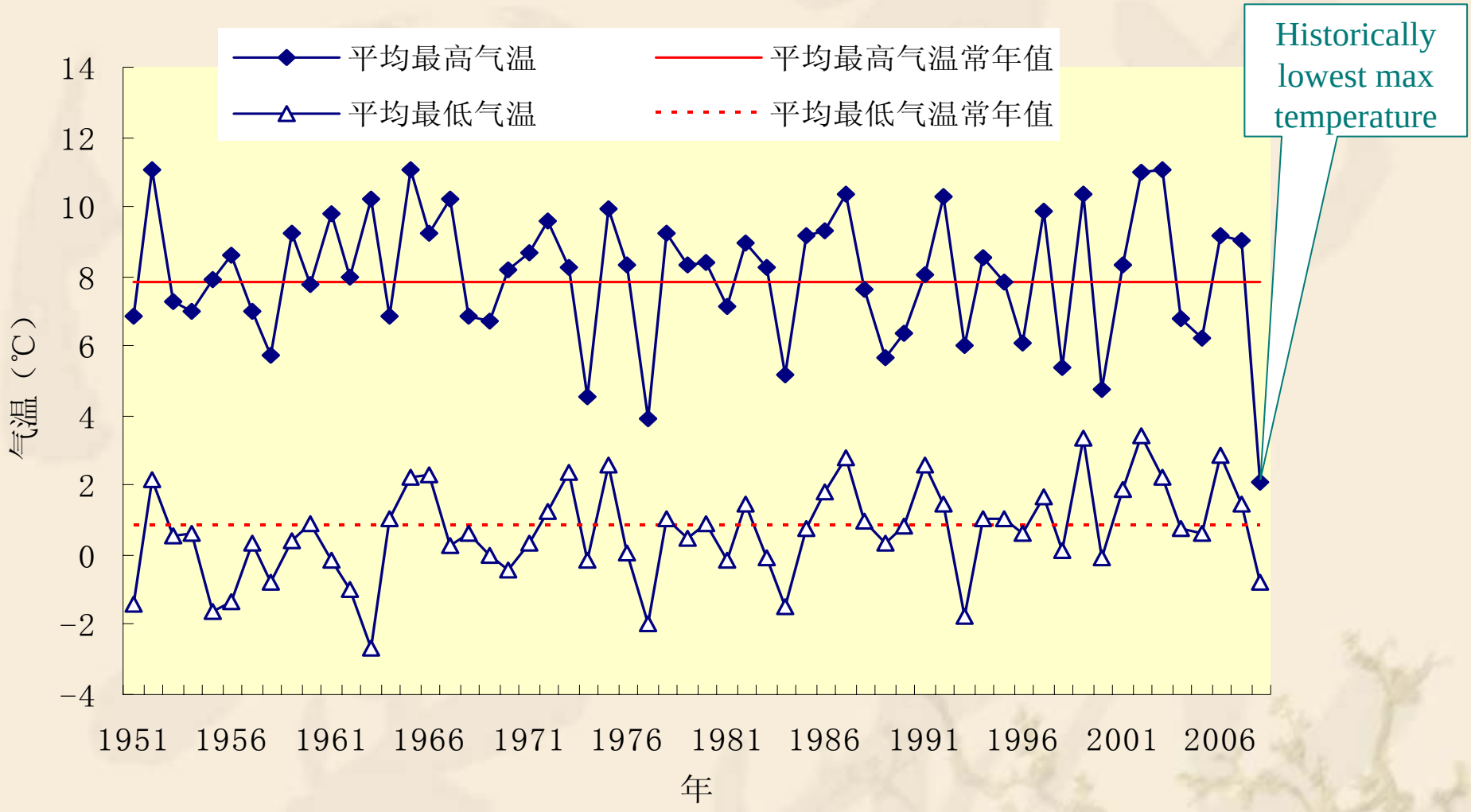
Hazards → Annual Continuous Freezing days in Yangtze River Basin



Annual continuous freezing days along the middle stream and downstream of Yangtze River (including Hunan, Hubei, Jiangxi Anhui, Shanghai, Jiangsu and Guizhou)

Note:data for year 2007-2008 is from Dec,1 2007 to Feb.2, 2008

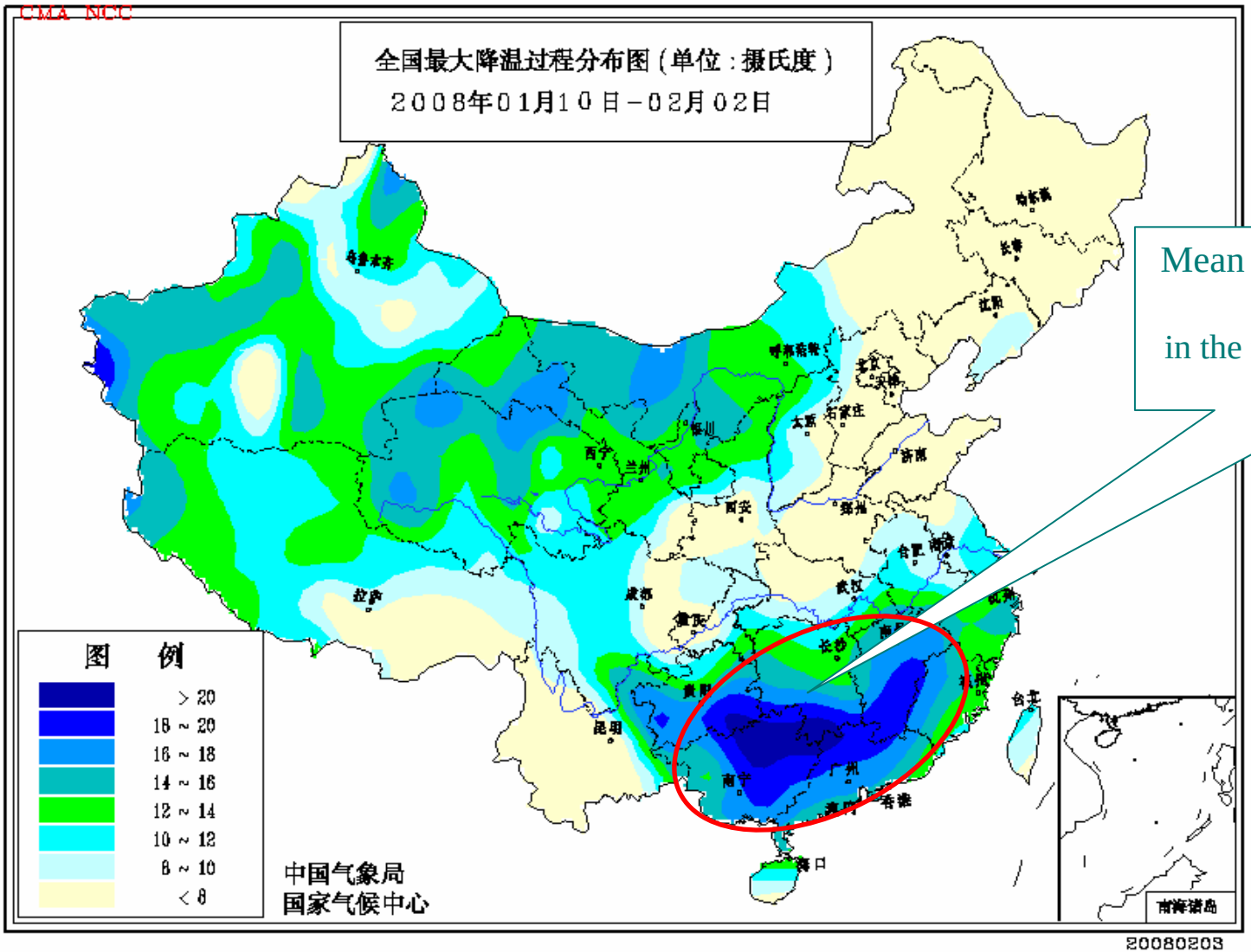
Hazards → Mean and maximum daily temperature in Yangtze River Basin



The mean and maximum daily temperature of the middle and downstream of Yangtze River (including Hunan, Hubei, Jiangxi Anhui, Shanghai, Jiangsu provinces) and Guizhou

Note:data range Jan.10 ~Feb.1

Hazards → Dramatic Temperature Decrease from Jan.10 to Feb.2



Mean temperature decreased 10-20℃ in the middle and downstream of Yangtze River

- Temperature dropped to -6～0℃ in the middle and downstream of Yangtze River.
- Diurnal temperature range (DTN) was very small or near to zero.

Hazards → Summary

Hazards	**Four weather events:** Jan.10~Jan16; Jan. 18~Jan.22; Jan.25~Jan.29; Jan.31~Feb.2
Features	●**Large Impacted Area**: around 1.3 million km^2 were affected; ●**High Intensity**: return period ranging from 50 yrs in most areas and 100 yrs in some areas; ●**Long Duration Time**: 4 continuous weather events lasted over 20 days.

Disaster loss

Casualty	: 129 people
Missing	: 4 people
Relocated Population	: 1.66 million
Impacted Crop area	: 11,874.2 kha
Collapsed house	: 0.485 million rooms
Damaged house	: 1.686 million rooms
Direct Economic Loss	: 151.65 billion RMB

Disaster Losses

Province (City)	Impacted Pop (k person)	Death (person)	Missing (person)	Displaced Pop (k person)	Affected crops (kha)	Destroyed crops (kha)	Collapsed bldg (k rooms)	Damaged bldg (k rooms)	Direct Economic Loss (billion RMB)
Shanghai	-	2	-	2	10.7	0.0	0	1	0.16
Jiang Su	2453	7	-	21	232.4	12.0	9	17	2.78
Zhejiang	23819	9	-	136	832.9	40.8	4	0	17.43
Anhui	13423	12	-	131	695.3	63.6	91	173	13.23
Fujian	1676	-	-	5	32.8	1.2	1	213	3.09
Jiangxi	22100	7	-	226	1468.0	353.0	42	231	27.20
Henan	941	-	-	8	139.4	2.7	3	6	0.68
Hubei	22798	13	-	217	1417.7	112.0	98	170	11.42
Hunan	39277	20	-	277	2500.1	458.7	67	300	17.20
Guangdong	4190	-	-	290	414.7	21.2	2	1	3.36
Guangxi	13990	2	-	58	861.1	49.1	59	72	20.00
Chongqing	5486	2	-	6	246.3	27.7	3	14	0.96
Sichuan	10599	5	-	45	535.6	54.0	21	88	5.83
Guizhou	26548	27	-	112	1489.7	317.5	31	128	19.83
Yunan	11396	22	4	110	590.9	110.7	39	197	5.08
Shannxi	1850	-	-	10	253.3	20.0	4	9	0.46
Gansu	4480	-	-	-	135.8	45.3	4	33	1.78
Qinghai	705	-	-	-	0.0	0.0	5	14	0.42
Ningxia	1166	-	-	5	10.8	1.1	3	9	0.47
Xinjiang	378	1	-	-	6.7	-	1	10	0.3
Sum	**207275**	**129**	**4**	**1660**	**11874.2**	**1690.6**	**485**	**1686**	**151.65**

Disaster Loss → A closer look

Impacted Areas	●Hunan*, Guizhou*, Jiangxi*, Guangxi*, Hubei*, Anhui*, Sichuan*, Yunnan*, *(heavily impacted provinces)* ●Chongqing, Sichuan, Shanghai, Guangdong, Fujian, Yunan, Henan, Gansu, Qinghai, Shannxi, Tibet, Shanxi, Jiangsu, Xinjiang *(less impacted provinces)*
Indirect Impacts	●**Railway**: Jingguang (Beijing~Guangdong) Railway partially stopped functioning; ●**Highway**: Jingzhu (Beijing~Zhuhai) highway partially stopped functioning; many national roads were influenced or closed temporarily; ●**Airport**: dozens of them were closed for several days or temporarily; ●**Power**: 6700 power lines failed and about 90 counties were influenced; ●**Communication**: More than 3000 wireless base station failed to work; ●**Urban Infrastructure**: Partially failed to work and some towns/cities experienced power failure longer than 10 days; ●**Induced disasters**: geo-disasters; pollution, agro-eco system damages; Sanity/health related disasters; infrastructure damages; ●**Other Life lines and production lines**: seriously influenced.

Transportation—Highway & Road

Transportation —Railway

Transportation—Flight

Electricity—Power line

Electricity—Power line

Communication—Wireless base station

Agriculture—Vegetable, grain, forest

Disaster Loss → Why? A. hazards beyond temperature and precipitation: Amplified low temperature

- Temperature decreases along with the increase of elevation
- Disaster took place in low mountainous areas and plateau area, especially in Yungui Plateau and Nanling Area
  - Altitude > 300-500m
- Chenzhou City in Hunan
  - Most area: elevation > 300m
  - 30% of area: elevation > 500m
  - Temperature: -2.0℃--8.0 ℃

Disaster Loss → Why? A. hazards beyond temperature and precipitation: Extremely Low wind speed

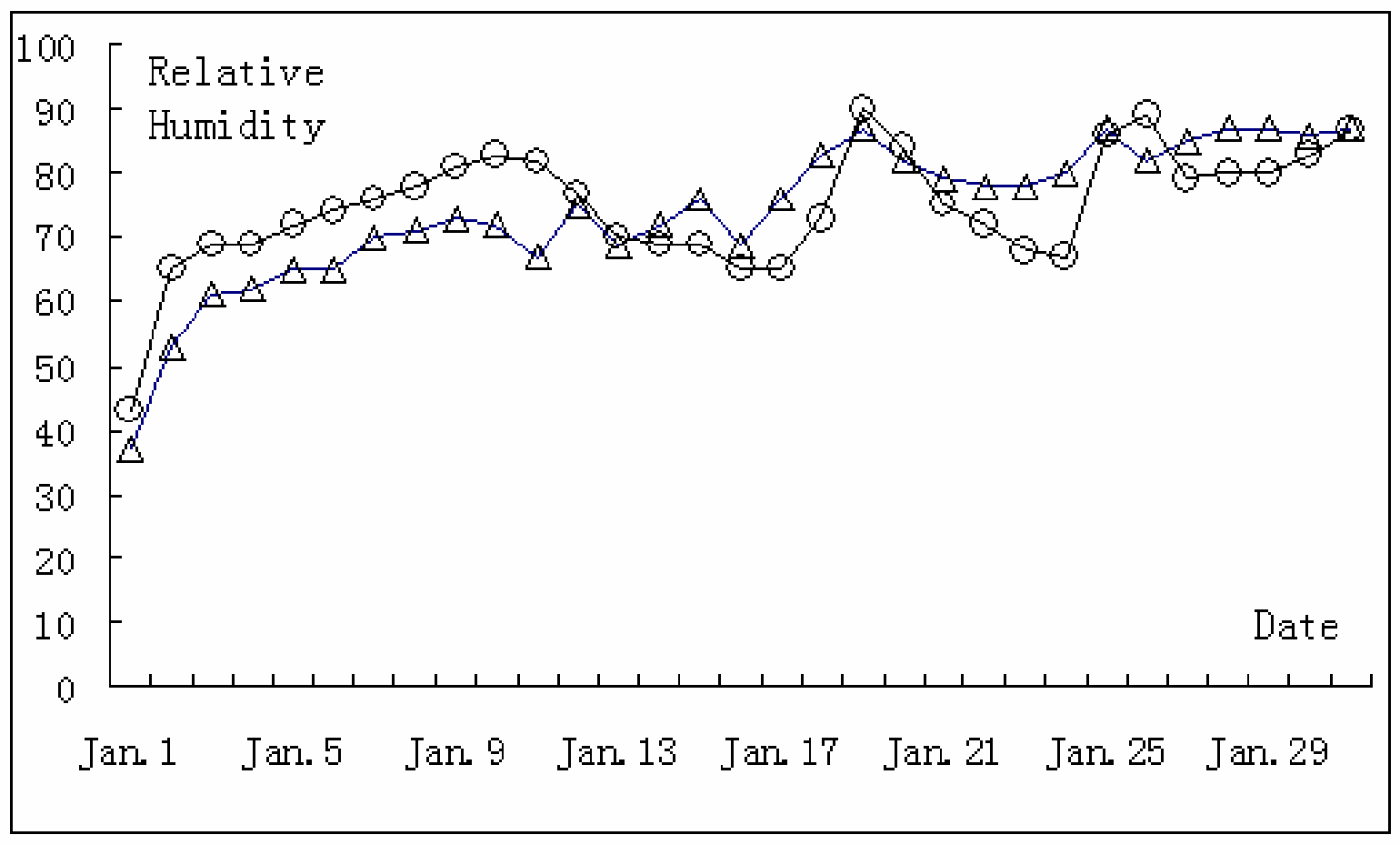
- Snow was accumulated due to low wind speed
- Some ground wind speed numbers in Chenzhou Area
  - Critical wind speed: 5m/s
  - Daily mean wind speed <1.8m/s

    Daily mean maximum wind speed <3.5m/s (Observed by Yizhang weather station in Hunan)
  - Mean relative humidity >75%

    Mean relative humidity >80% in the last two weather process

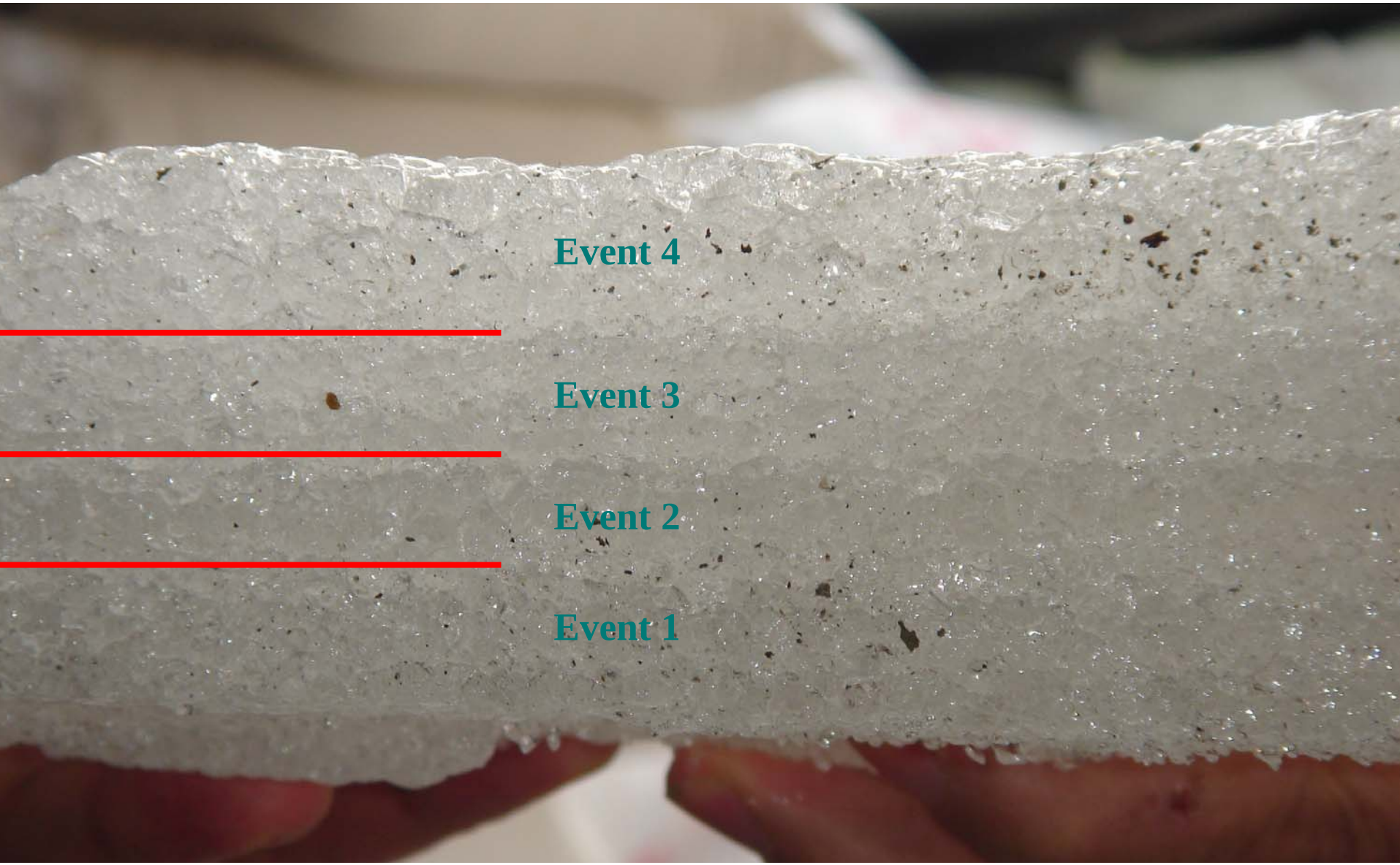
Disaster Loss → Why? A. hazards beyond temperature and precipitation:
Very high humidity

- Snow/Ice difficult to evaporate due to high humidity



Relative humidity of Yizhang (宜章) and Lechang(乐昌)

Disaster Loss → Why? A. hazards beyond temperature and precipitation: Multiple Events



Four weather events in Chenzhou of Hunan Province (ice/snow thickness → 40cm）

Disaster Loss → Why?

B. Vulnerability and Resilience

- **Social Dimension**: lack of insurance consciousness, good in-disaster action ability
- **Economic Dimension**: Mountainous areas (economy less-developed areas) are more vulnerable; Some more developed areas like are more resilient areas
- **Organizational dimension**: Inefficient communication among central government, local governments and sectors (ministries), strong support from governments and PLA
- **Technical dimension**: Lack of disaster mitigation infrastructures & capacity (electricity, transportation, communication & materials), provincial level cooperation may help increase mitigation capacity
- **Natural dimension**: land and agricultural system recoverability, influenced by agriculture cultivation system, crop types, land use structure and intensity, etc.

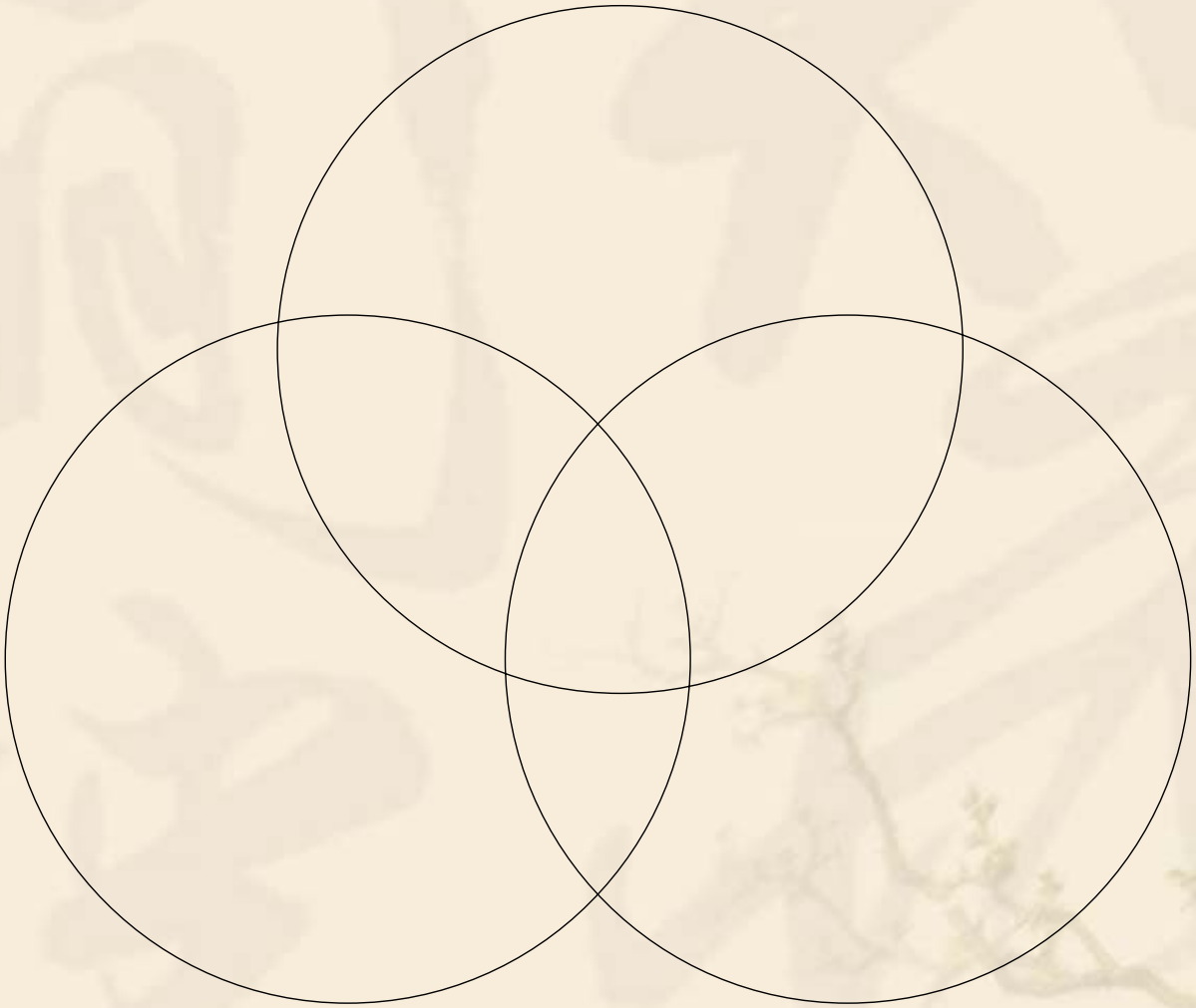
C. Disaster Chain

0. **Extreme weather events →**
1. **Natural disaster: Low temperature–rainfall and snowfall-freezing→**
2. **Production Accidents: Power off-water shortage-traffic jam-airport shutdown→**
3. **Social security: Station overcrowded-passengers stranded →**
4. **Public Health Incidents: Living environment destroyed-water pollution-food quality effected.**

-Not just a natural extreme weather event-

Disaster Loss → Why?

D. Perspective of Disaster System



3.3 Response→ Response of Central Government/State Council

Jan. 27: Tele-conference of disaster coping;
Jan. 29: Meeting of the Central Committee of the C.P.C.;
Jan. 29: Establishing emergency response working group for Hunan
Jan. 31: Establishing emergency response and command center for coal /electricity/oil supplement and transportation;
Feb. 01: State Council Meeting;
Feb. 03: Standing meeting of the Central Committee of the C.P.C.

To coordinate the collaboration among sectors and provinces

Targets: To ensure transportation, power supply & residents' living

Response→ Response of Governmental Sectors & State Companies

- **China Meteorological Administration**
  - Jan.25: Class-III emergency response;
  - Jan.27: Class-II emergency response;
  - Feb.06: Emergency response stopped;
- **Ministry of Civil Affairs**
  - Jan.26: Class IV Response;
  - Jan.29: Class-II emergency response;
- **National Development and Reform Commission**
  - Jan.27: Initiated Emergency Coordination Mechanism to ensure coal, oil, power supplement and transportation ;
- **Ministry of Railways/Ministry of Transportation/Central Administration of Aviation**
  - Jan.27: Emergency meeting on transportation; flight companies started their Spring Festival Plan;
- **State Electricity Regulatory Commission/State Administration of Work Safety/State Grid Corporation**
  - Jan.27: Electricity and Coal Supplement conference;
- **PLA & Military Police**
  - Jan.30: Join to fight FRSC2000;
- **Ministry of Education**
  - Jan.30: Issued emergency notice about FRSC2008;
  - Feb.02: Issued emergency notice and counter measures about FRSC2008

Response→ Response of Local Governments/Social System

- Local Governments
  - Hunan Province

    Jan.26: Establishing FRSD Coping working ground and command center
  - Jiangxi Province

    Jan.26: Freezing and snowstorm plan was started;
  - Anhui Province

    Jan.26: Change Class III emergency response to Class IV
  - Guangxi Province

    Jan.26: Change Class II emergency response

- Social System
  - Donation and Vonenteer (Domestic and international), ~ Feb.07, 1.02 billion + RMB was donated

Response→ Disaster Relief Materials

- **Ministry of Civil Affairs**

  ~Feb.09: 0.525 billion RMB (0.331billion for emergency response & rest for recovery and reconstruction)

- **State Development and Reform Commission**

  Issued 16 emergency announcement, covering coal, electricity, oil, transportation, disaster relief, agriculture, forestry, environments, geology, infrastructure, public sanity, etc.

- **PLA**

  ~ Feb.05: PLA 0.594 million people*times; Reserve Army 1.832 million people * time; vehicles 34,000; Airplan 84 times;

- **State Insurance Regulatory Commission**

  ~ Feb.09, 1 billion + RMB was claimed (less than 5%);

- **Donation**

  ~ Feb.07, 1.02 billion + RMB was donated

Emergency Response

Response→ Gallery

胡锦涛在山西河北考察煤炭生产供应

温家宝攀山视察贵州电网

Coal, Electricity, Oil & Transportation Supply

Science for the understanding of hazards

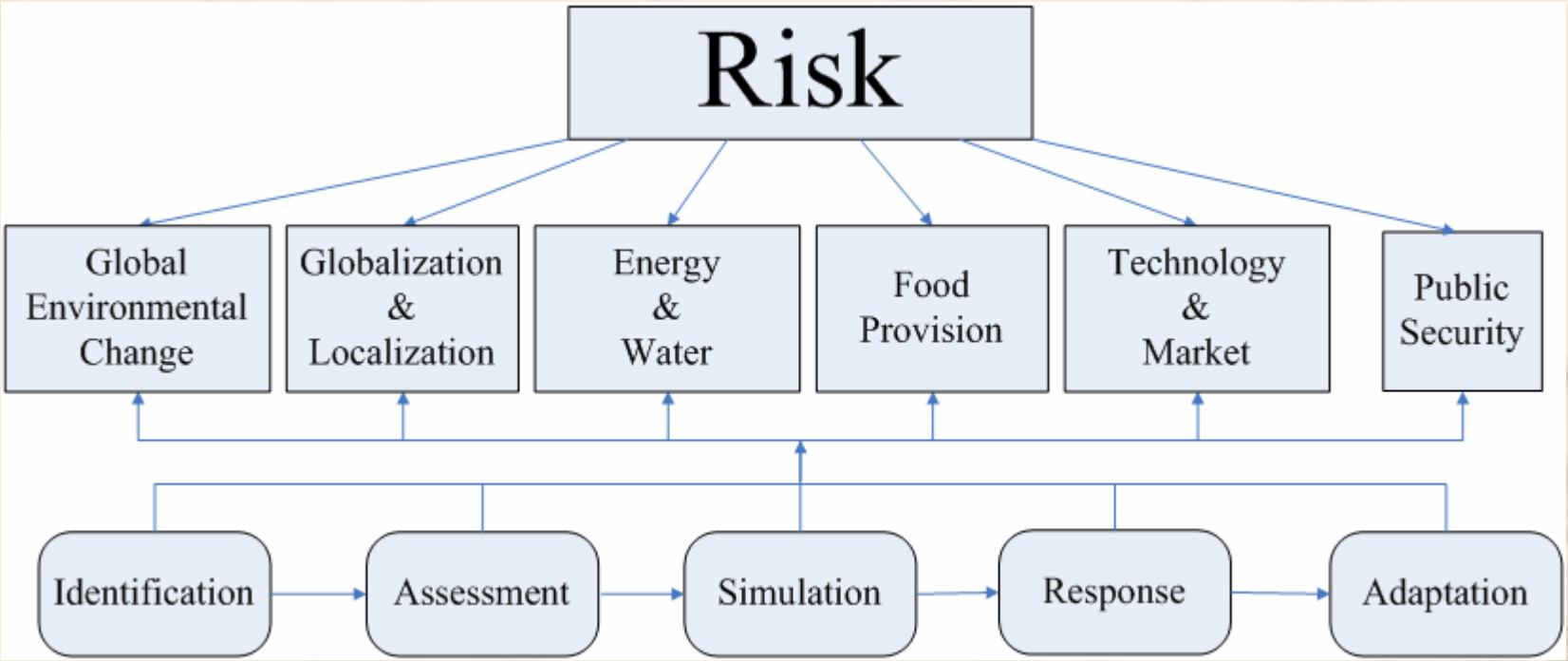
Climate and weather system modeling, mid-term & short-term forecast; early warning;

- Weather forecast techs to be improved scientifically, esp. meso-scale models
- Transforming from weather event forecast/alarm to natural disaster warning

Science for integrated risk governance

- For example: land-use regulation: risk modeling→risk zone mapping → land-use regulation → restraining land-use in high-risk areas;

Integrated Risk Governance



Emergency Technical Plan

Current emergency plan: the main contents of the 4-level emergency plan of China is to administratively regulate the responsibility and actions of government officials

Scenario simulation: no technical emergency plan based on risk modeling, large-scale disaster scenario simulation, or disaster chain simulation

Material/resources storage/planning

no technical plan → no disaster mitigation materials/resources prepared in advance

For FRSD2008: no/lack of power generator, candle, machine for removing snow/ice in highway

Infrastructure standards

Spatial planning and standard: trade-off between cost-benefit (for example: improve standard of electricity power tower and power line after FRSD2008)

Centralize V.S. Decentralize: centralized to economically decrease infrastructure cost, and decentralize to decrease vulnerability and improve resilience

Information integration and sharing:

platform and communication infrastructure

Catastrophe Risk modeling:

Lack of catastrophe modeling system based on Chinese disaster loss (like HAZUS in the U.S.)

International commercial catastrophe models (like RMS, AIR and EQE) are black boxes and their parameters are not open

Policy making based on experts knowledge

Roles of experts and policy makers: experts to provide information, policy-makers to balance the interests of different groups of people

Risk uncertainty: listening to different experts and weighting on different opinions, to have a self-learning mechanism

Policy making based on experts knowledge

Roles of experts and policy makers: experts to provide information, policy-makers to balance the interests of different groups of people

Risk uncertainty: listening to different experts and weighting on different opinions, to have a self-learning mechanism

Inter-sector coordination:

Lack of a powerful permanent inter-ministry level commanding and coordination sector, though state council has a office/sector to coordinate ministries

Current practice: temporary inter-ministry level working group to be established after disaster happens (usually it is already too late)

For FRSD2008: the COAL-Electricity-Oil-Transport working group was organized after the third event)

Emergency Plan Triggering

Level I Emergency plan should have been triggered during FRSD2008

Ministry-local government coordination

Ministries are fiscally supported by central government; incentives/motivations to serve local government?

Centralized government and de-centralized governments

Centralized government: once motivated, more powerful and prompt disaster mitigation and recovery actions, and usually based on a large mitigation or recovery cost

Decentralized government: better cost-benefit balance

System design:

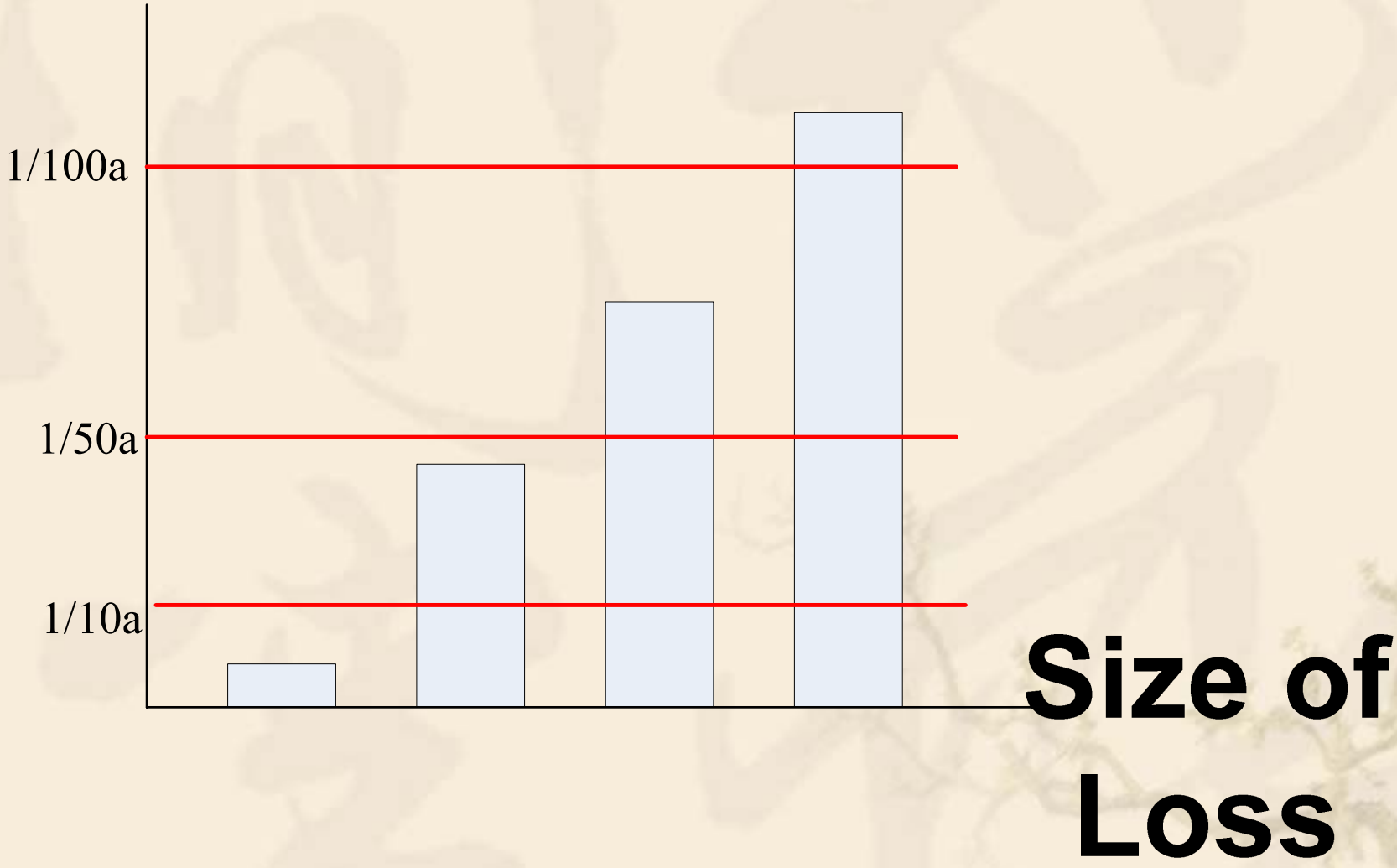
to design a system to balance the interests of property owners, insurers, re-insurers and capital market

Coverage rate:

only 1~1.5% of the total FRSD2008 loss was covered (for Katrina Hurricane larger than 40%)

Lessons/experiences → Risk Transfer

The large-scale catastrophe insurance mode



Disaster risk sharing mechanism according to disaster intensity

Central government and ministry/experts

Efficiency: temporal center

Misunderstanding: hazard and disaster impact→ concepts of vulnerability resilience should be promoted

Lesson learned: underestimated the impact of FRSD2008, overestimated the capacity of infrastructure system (esp. transportation and electricity) → announced the recovery of infrastructure too early

Local governments and ministry/experts:

Responsibility, obligation

Trust between public and authority:

Good or not? Problem of over-trusting

Communication Techs

TV: Public may not trust TV

Mobile phone: group message compulsorily, larger group of users: over 500 million users and still increasing very fast

Internet: information inaccurate, public may not trust;

Failure of communication techs

Lessons/experiences →Social capital

Chinese culture

Family-orientated, helping relatives and neighbors

Local community

Volunteers

Internet Community

Risk communication and volunteers

Thank you for your attention !