Progress in Meteorological Hazard Risk Operation in China

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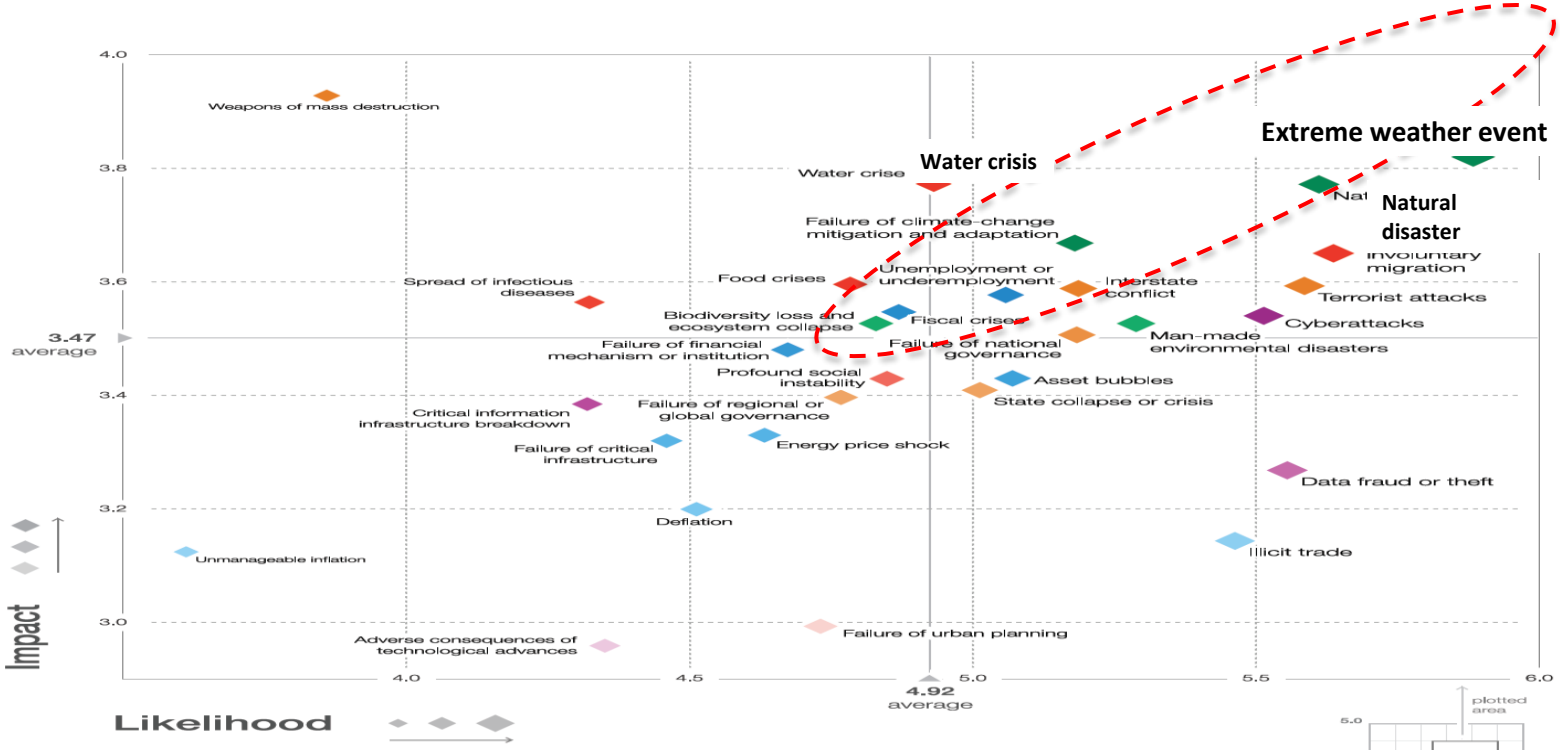
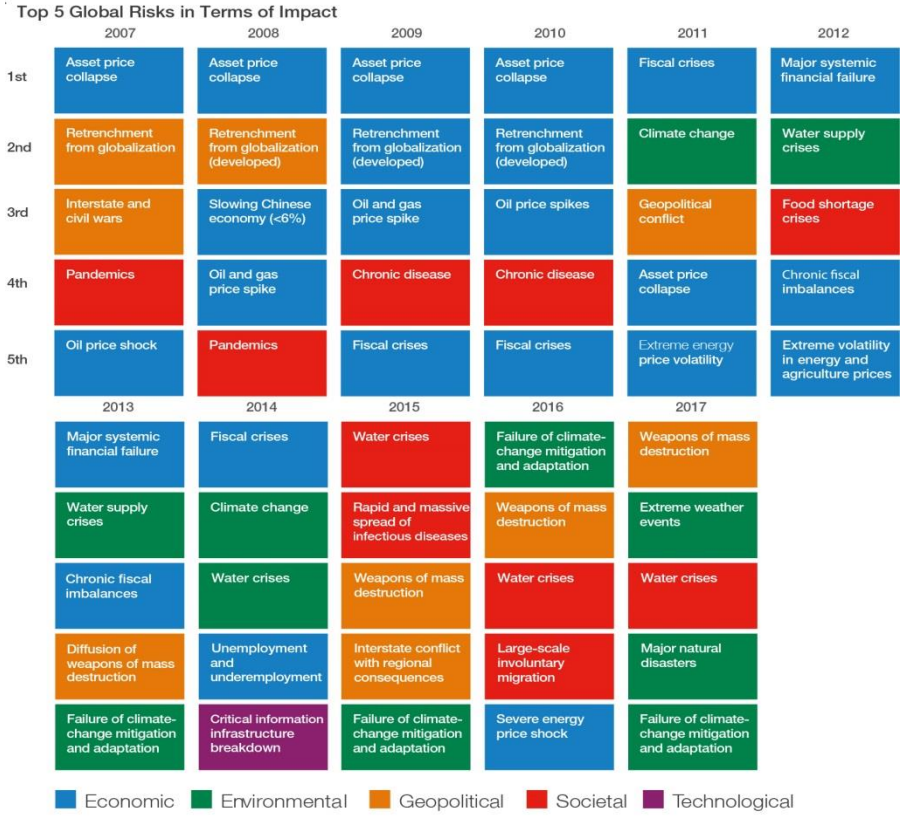
1.1 Status quo_ Current Situation of Global Risks



Davos World Economic Forum (2017)

1.1 Status quo_ Current Situation of Global Risks



2018 World Economic Forum

1.2 Status quo_ development process in UN international disaster reduction

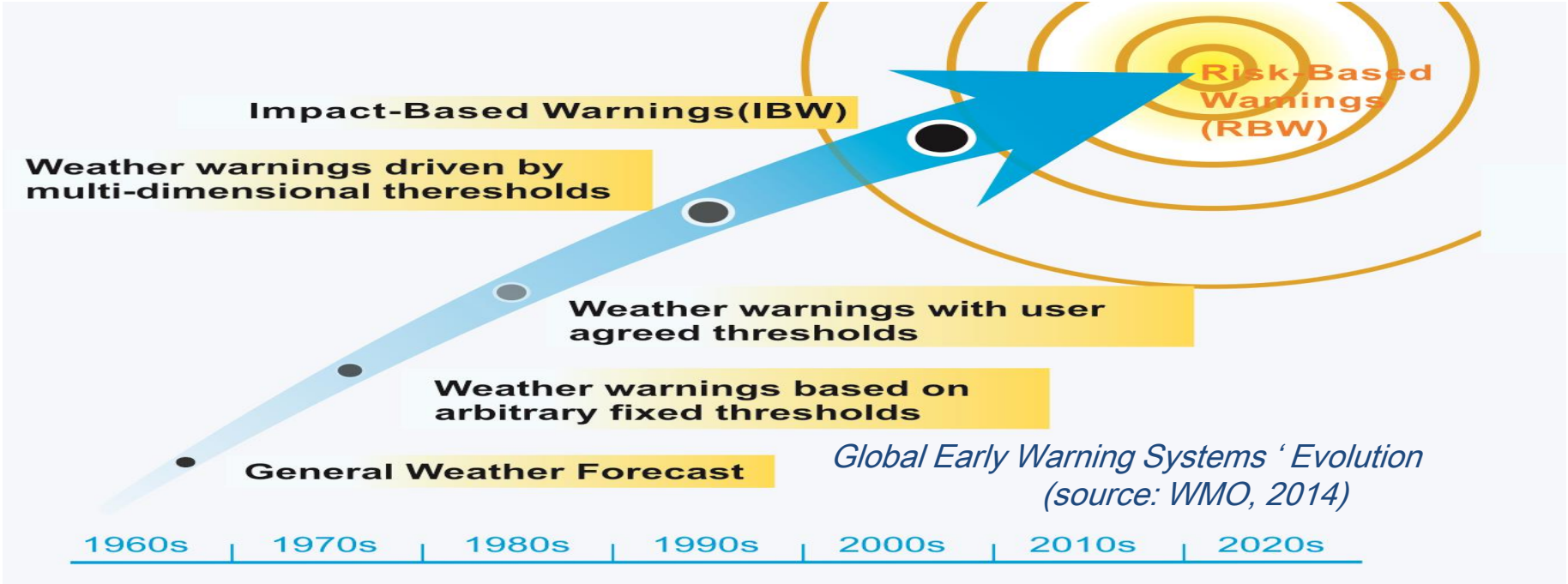
1990s	International Decade for Natural Disaster Reduction (IDNDR)
1994	The First World Conference on Natural Disasters (Yokohama) - Results <Yokohama Declaration>
1995	Hanshin-Awaji Earthquake
1998	Set-up of A
2000	Set-up of t
2005	United Na - Result: C e next 10 years. Hyogo Framewor - Setup of P International Disaster Reduction
2011	Great Eas The 3rd S
2012	World Ministerial Conference on Disaster Risk Reduction (Sendai) Fifth Asian Ministerial Conference on Disaster Risk Reduction (Indonesia)
2013	The 4th Session of the Global Platform for Disaster Risk Reduction (Geneva)
2014	Sixth Asian Ministerial Conference on Disaster Risk Reduction (Thailand)
2015	UN World Conference on Disaster Risk Reduction - Sendai, Japan

UN strategic policy:

Disaster prevention and mitigation

→ risk and crisis management

1.2 Status quo_ Risk-based Early Warning Services

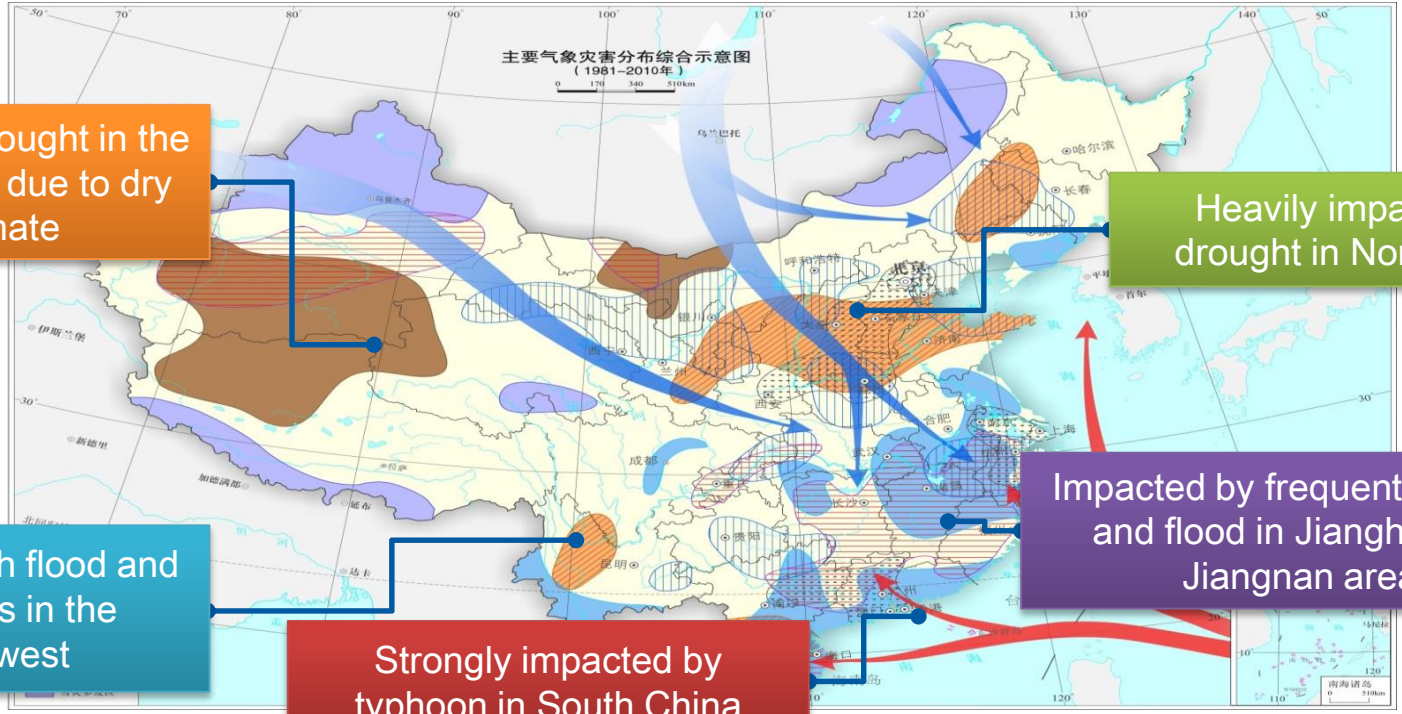


Global Early Warning Systems ' Evolution (source: WMO, 2014)

- Effective early warning systems change from the general weather forecast to the impact-based warnings (IBW) and risk-based warnings(RBW).
- Nowadays, The risk-based warning service is a crucial part in the public meteorological service of CMA and plays an important role in disaster prevention and mitigation.

1.3 Status quo_ Current Situation of Meteorological Hazards in China

The complex climatic conditions and the uneven distribution of precipitation in temporal and spatial scales lead to more frequent meteorological hazards.



Prone to drought in the Northwest due to dry climate

Heavily impacted by drought in North China

Impacted by frequent rainstorm and flood in Jianghuai and Jiangnan areas

Prone to flash flood and mudslides in the Southwest

Strongly impacted by typhoon in South China

1.3 Status quo _ Current Situation of Meteorological Hazards in China

Global climate risk index- based on *Ranking of countries most affected by extreme weather and climate events*

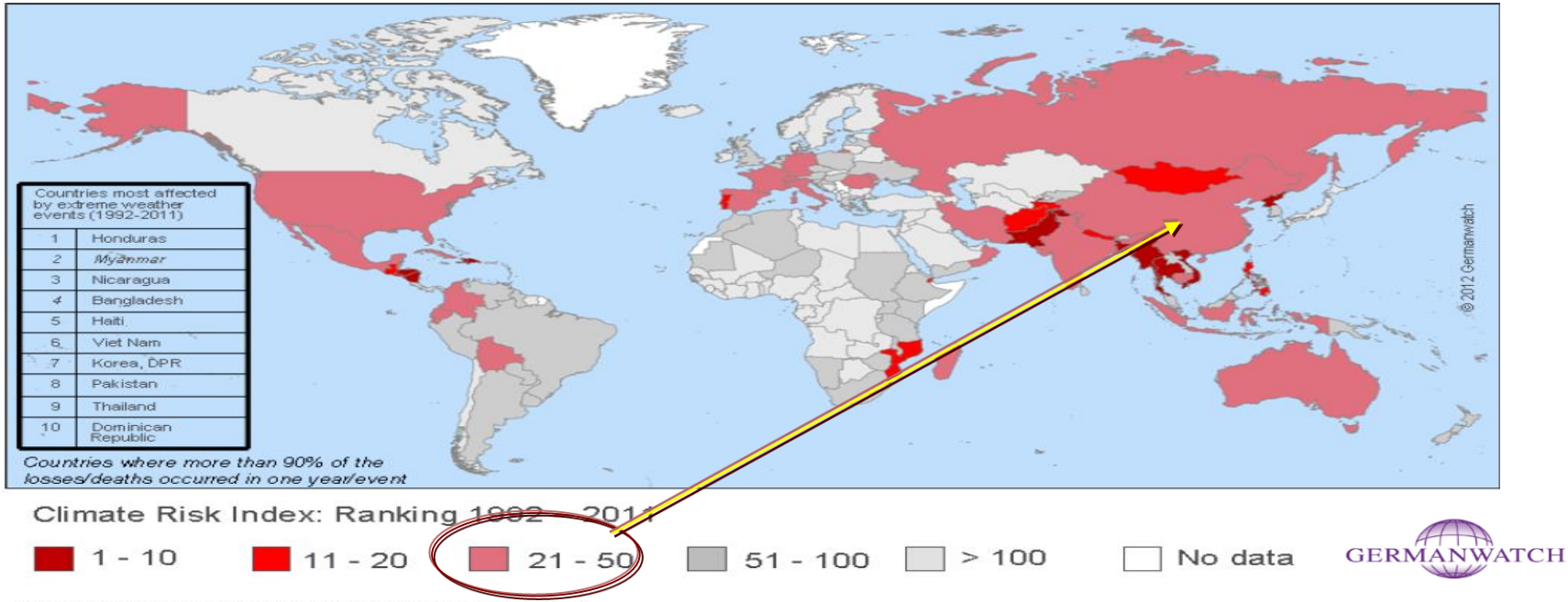


Figure 2: World Map of the Global Climate Risk Index 1992-2011

Source: Germanwatch and Munich Re NatCatSERVICE

Countries with a high global climate risk index are mainly developing countries.

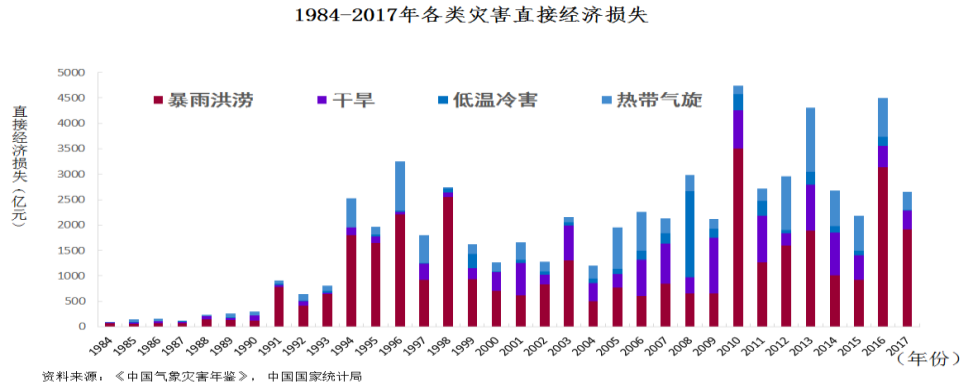
China ranks 23rd, very vulnerable to extreme weather and climate events.

1.3 Status quo _ Current Situation of Meteorological Hazards in China

IMPACTS OF METEOROLOGICAL HAZARDS

Increasing Risks of Meteorological Hazards

- floods and flash floods account for 2/3 of the total death toll related to meteorological hazards, and account for 70% or 80% of the total economic losses.
- Since2008, waterlogging and urban floods have taken place in more than 130 cities every year. In 2010, 258 cities reported waterlogging incidents. (CSREX) 2014)



it is urgent to carry out **risk operation** against rainstorm and the resulting floods and geological hazards from small and medium rivers.

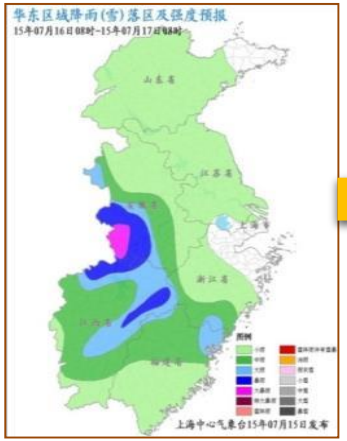
1.4 Status quo_ Transition from weather forecast to risk warning

Develop Weather Impact Forecast Service for Hydrological and Geological Hazards

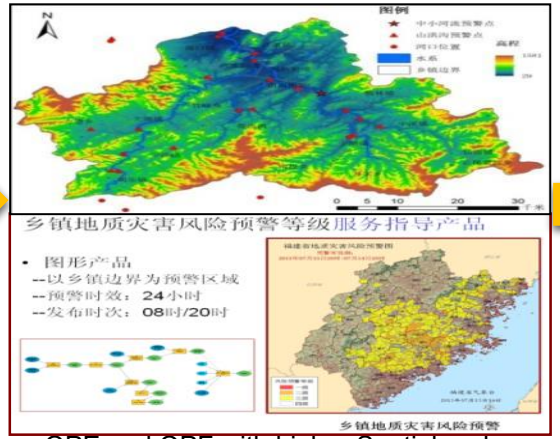
Meteorological support project for flash floods and geographical disasters warning

the ensemble meso-scale model local vulnerability and exposure

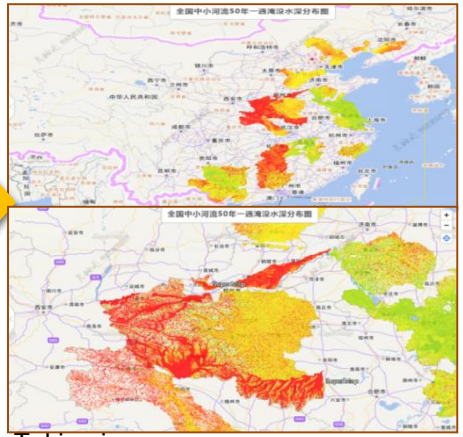
- **Risk Survey：** Risk Identification
- **Risk Mapping:** Mapping areas under risks
- **Defining Thresh-hold :** Determining thresh-hold for disasters
- **QPE and QPF:** Providing more Accurate precipitation information
- **Risk Assessment：** Estimating the population and infrastructures under impact and related losses
- **Risk Warning:** Producing and issuing warning based on risk assessment
- **Validation：** to validate the thresh-hold, accuracy of forecast and warning, and assess benefits



Tradition precipitation forecast



QPE and QPF with higher Spatial and Temporal Resolution and coupled with hydrological and geological models

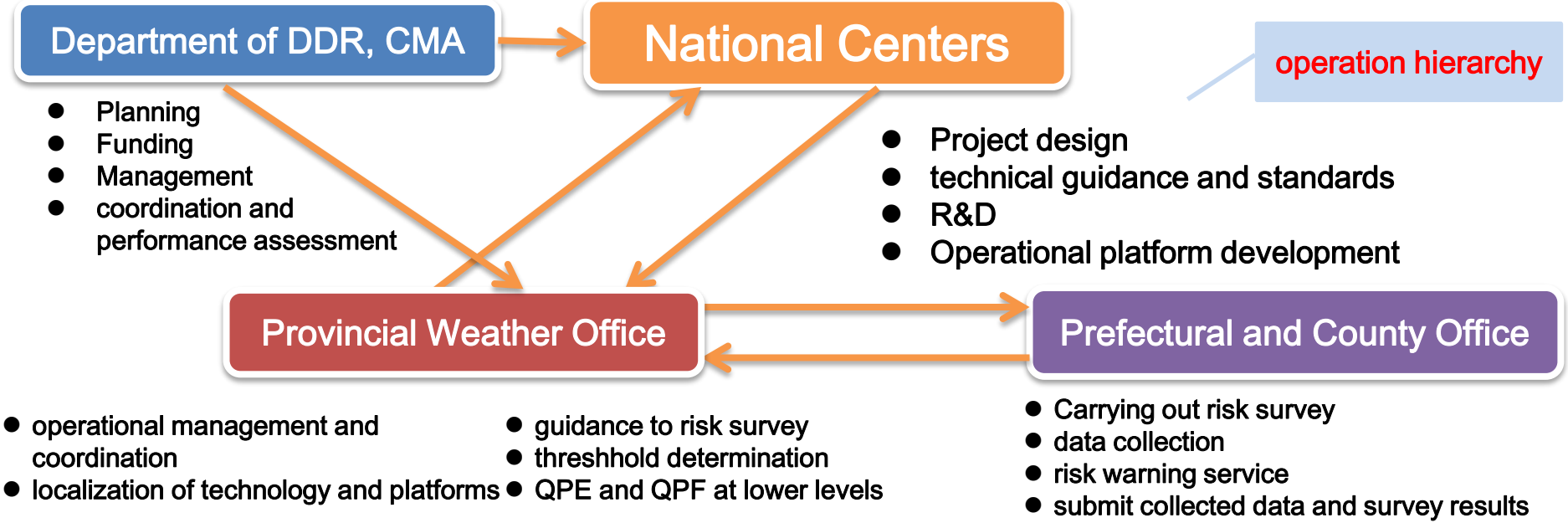


Taking in Social\Economic\Population\Geographic Information

pilot projects → Dispersion → Review → Improve-ment

1.5 Status quo_ Organization of the Project

Overall Purpose: To establish the impact-based forecast and risk-based warning service at all four levels of weather service departments, focusing on the risk warning for rain-induced hydrological and geological hazards, based on the nation-wide risk survey, mapping, QPE (quantitative precipitation estimation) and QPF (quantitative precipitation forecasting) with higher resolution



1.5 Status quo_ Organization of the Project

	Risk census (Climate Center)		Threshold-based risk warning (Meteorological Center + Meteorological Observatory)				Benefit evaluation (PWS + Meteorological Observatory)
	Update and digitization of data collected	Scientifically determine the disaster threshold	Application of thresholds in real-time operation	Refined quantitative precipitation monitoring and forecasting	Early warning service	Operational verification	Benefit evaluation
National level	Development of technical standards for census-making Development of a provincial platform	Development of technical guidelines	Collection of fixed lead time thresholds as reported by the Provincial Services	Issue QPF guidance products, National mosaic	Development of a provincial platform National mosaic	Development of methods	Development of standards, National annual reports
Provincial level	Organization of a census campaign Data compilation and entry	Determine thresholds based on census data (statistics, model method)	Provincial Climate Center determines the threshold to be converted to a fixed lead time threshold	Correction of QPF Production and upload of QPE products	Development of a localized operational platform	Organization and implementation	Reporting the benefit evaluation (post-disaster, annual)
Prefectural level	Coordination with the Provincial Services				Applications and services		Organization of filling in the questionnaire
County level	Collect and update data				Applications and services		Filling in the questionnaire

1.5 Status quo_ Organization of the Project

Improve Capacity and develop Standardized risk warning service at County Level

Pilot project in 897 counties

To put in place key operational elements

To ensure full coverage

- Operational platform
- Operational system
- Flow Chart
- Mechanism
- Regulation standards

- Basic Data cover all risky locations
- monitoring cover all risky locations
- Warnings cover all jurisdictional areas and principal

1.6 Status quo_ risk warning practice – risk identification

national census on flood and geological disaster risk induced by rainstorm has been completed

Risk census to determine threshold

Risk zoning

Small and medium rivers: 360,000 ; Flood ditch: 590,000; mud slide location: 65,000 ; potential landslide location: 280,000.
In the past five years, a total of 242,000 disaster risk thresholds have been calculated.

risk zoning maps of flood and flash flood for more than 2/3 of small and medium rivers across the country have been compiled and applied.

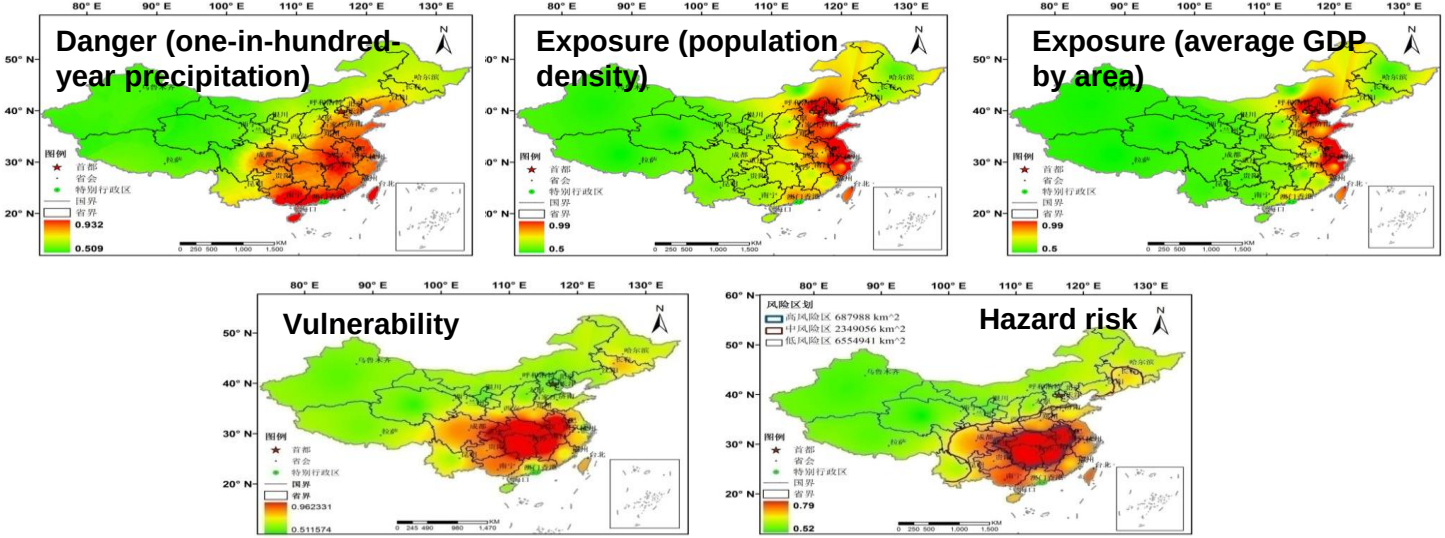
Meteorological disaster risk management system

Integration of census information for hazard inquiry has been achieved

1.6 Status quo_ risk warning practice – risk assessment

Assessment of the location, extent and range of severe weather impacts

- Hazard risk assessment of rainstorm and flood
- Impact assessment and risk estimation of typhoons, heavy rains, droughts, urban water logging, etc.

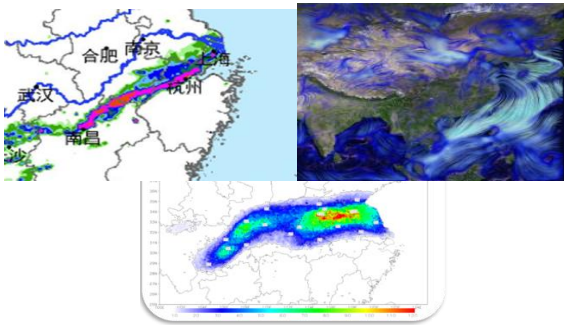


The provinces in the eastern coastal areas and in the middle and lower reaches of the Yangtze River are of high risk for heavy rains and floods.

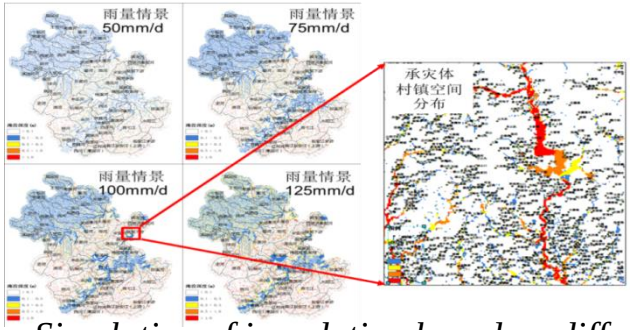
1.6 Status quo_ risk warning practice - risk warning service

Technology and model

- Based on observations and numerical weather prediction, develop refined QPE and QPF techniques to achieve the transformation from the zone-based to gridded and digital forecasting.
- Operate quantitative forecasting of river flood through the localized application of hydrological model
- Study how a landslide or a mudslide turns into a disaster based on coupled water-soil processes to develop a coupled “meteorological-hydrological-geological” forecasting model.



Detailed forecasting model and system



Simulation of inundation based on different precipitation scenarios and hydrological and hydrodynamic models

1.6 Status quo_ risk warning practice - risk warning service

accuracy of QPE and QPF

2016

QPE:5KM | QPF:10KM

Risk Survey

Thresh-hold | Risk Analysis

Risk Warning

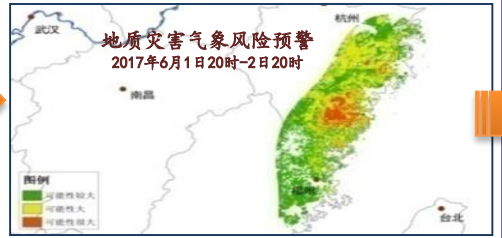
County-wide, 24h

2017

QPE 1KM | QPF 5KM

impact forecast (10KM)

Quantitative Estimate



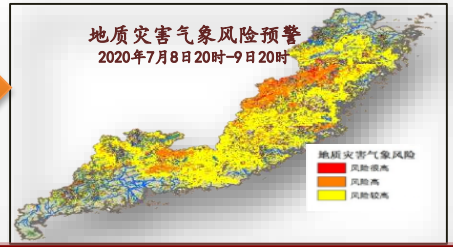
5-10km, 72h

2020

QPE 0.5KM | QPF 2.5KM | 集合预报 5KM

Coupled Model (1-5KM)

Impact-based Ensemble Forecast

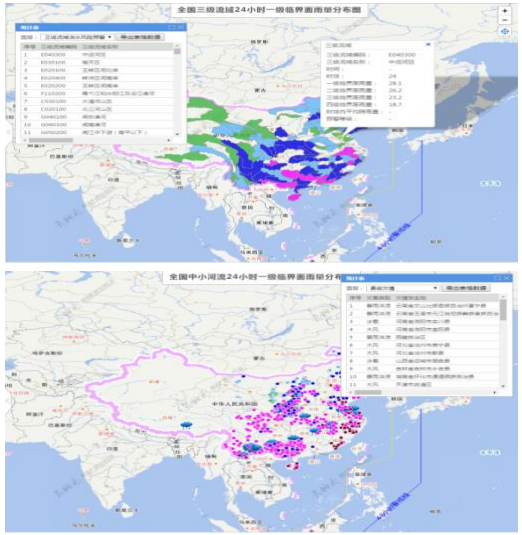


1-3km, 72h
Ensemble: 5km, 3-7d

1.6 Status quo_ risk warning practice - risk warning service

Meteorological disaster risk management system

- Developed meteorological disaster data platform, disaster information collection system and rainstorm& flood disaster system , achieved major operational functions ranging from disaster monitoring and identification, impact assessment to quantitative risk zoning and early warning
- Completed the unified management of basic data on meteorological disaster risk and data sharing at provincial and national levels to ensure the system's application in provinces and cities



1.6 Status quo_ risk warning practice - risk warning service

- geological hazard risk warning service carried out in 1880 counties
- flash flood risk warning service carried out in 1618 counties
- risk warning services for various sectors such as highways, shipping and maritime transportation

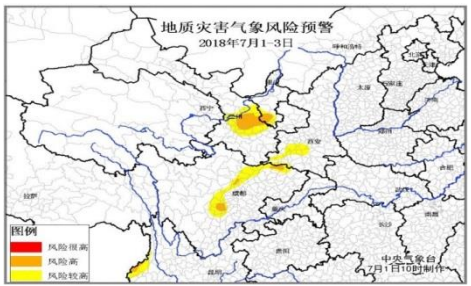
+ Release jointly with the Ministry of Water Resources

Meteorological flood risk warning
for small and medium rivers

+ Release jointly with the Ministry of Natural Resources

Meteorological risk warning for
geological disaster

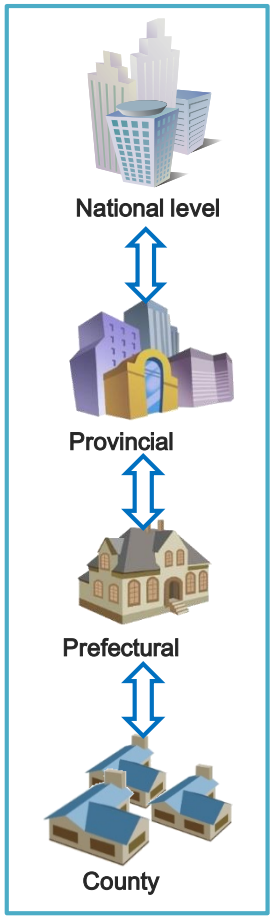
Risk warning



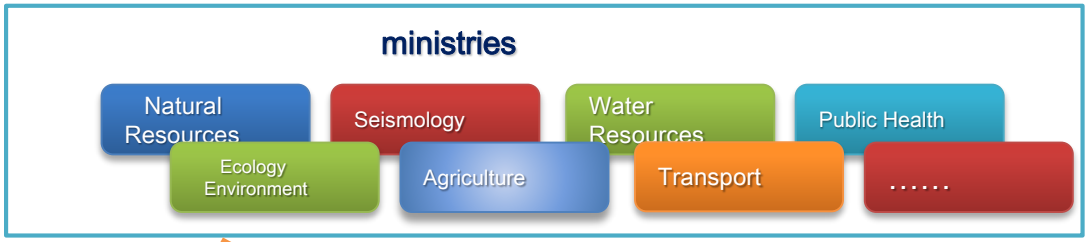
+Ministry of Transport

Meteorological risk warning for
airmass fog on road

1.6 Status quo_ risk warning practice - risk warning service

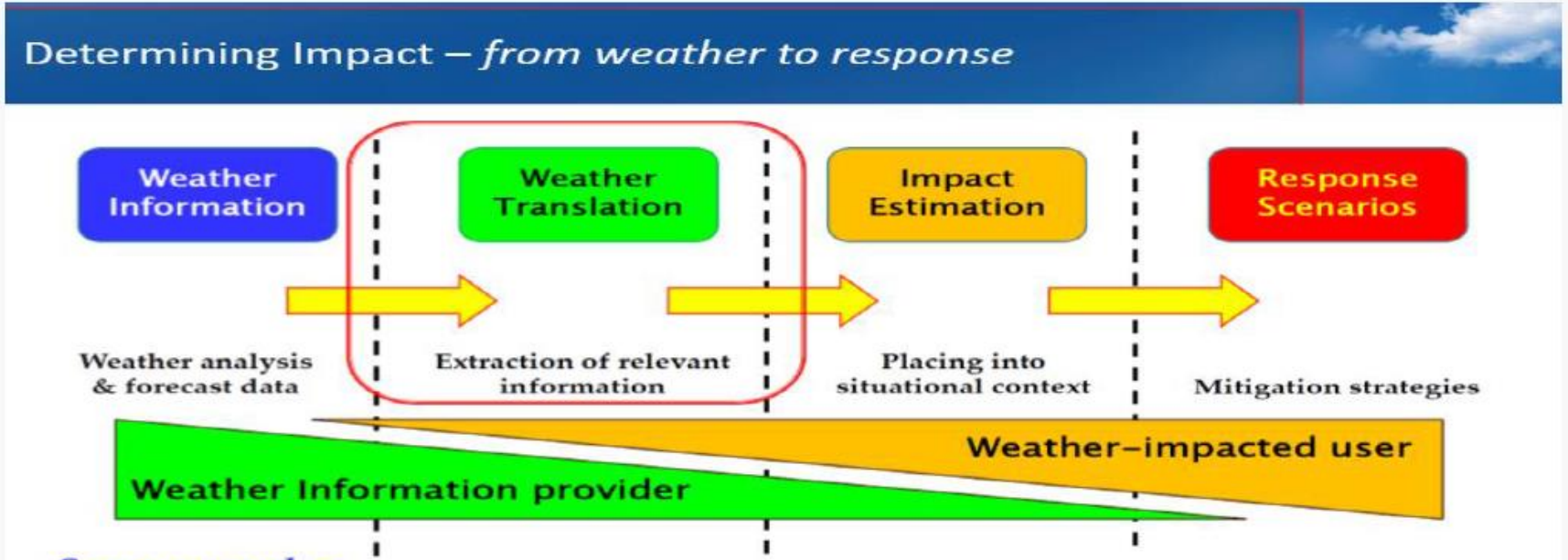


information sharing



- Decision making information for disaster prevention, mitigation and relief will be given to government and relevant authorities in time by local meteorological departments.
- Timely risk warnings will be issued to the public via radio, TV, SMS, web, loudspeaker, LED, etc

1.6 Status quo_ Risk warning practice – Institutional arrangemnt



Some examples:

Airport operation	Ceiling & visibility (flight categories)	Reduced capacity (arrival rates)	Ground delay programs
Dam operation	Precipitation & runoff (water level)	Overflow or breaking, minimal discharge	Controlled release of water
Power plant operation	Winds below/above critical thresholds	Reduced power generation	Balancing grid with other power sources

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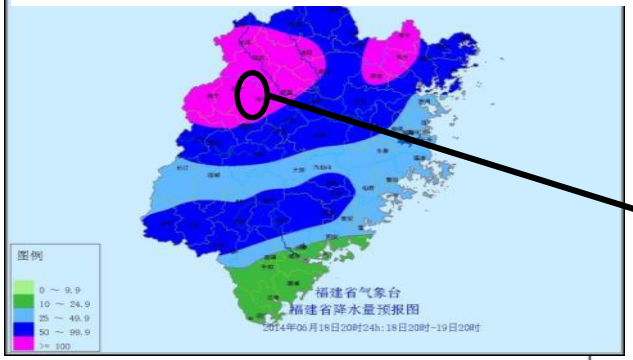
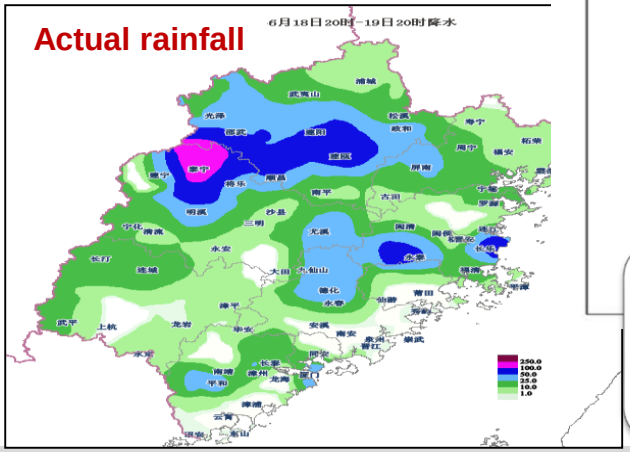
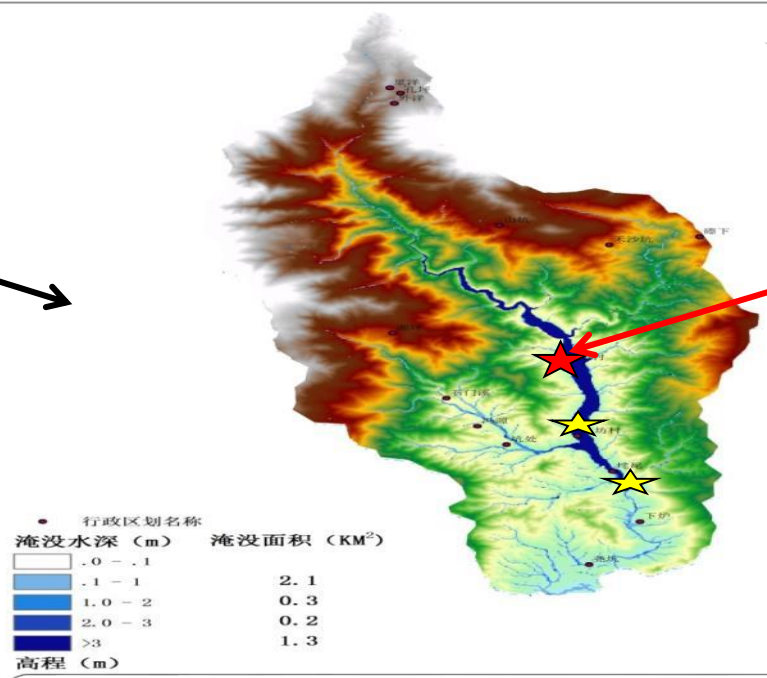
2.1 Case1_ Meteorological disaster risk warning service for flash flood in Fujian

Precipitation predicted on 19 Jun. 2014



Actual rainfall





flood scene

Flood depth: 1.8m
Precipitation: 92mm
Affected villages: 3

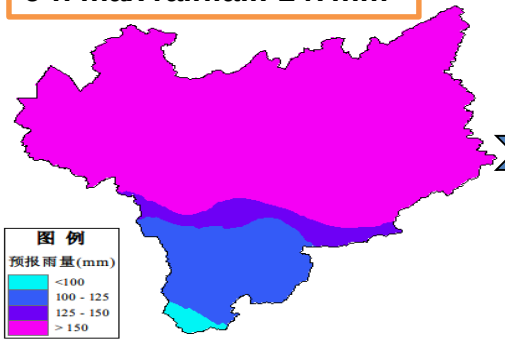
the highest level(first level) meteorological disaster risk warning Issued by Local Meteorological Service

- **Emergency response: 121 people evacuated**
- **Effectiveness: no casualties reported**

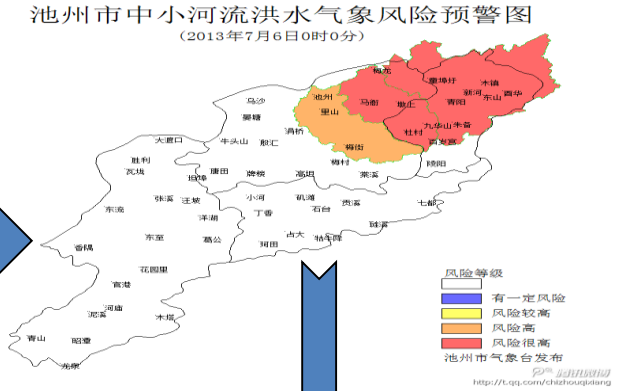
2.1 Case2_ Warning of flood risks for small and medium rivers in Anhui

Predicted precipitation for 5 Jul. 2013

3-h max rainfall: 114mm
6-h max rainfall: 147mm



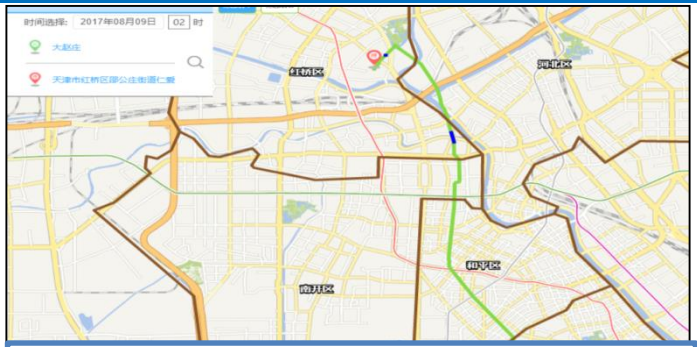
Potential danger sites	Predicted depth
Muzhen	1.2
Rongcheng	0.7
Dingqiao	1.1
Maotian	0.3
xinqiao	0.6



The government timely launched the emergency response to flood and geological disasters, and organized relevant authorities to mitigate and respond to risks.

- Emergency response: 2576 people evacuated
- Effectiveness: no casualties reported

2.1 Case3_ Meteorological disaster risk warning for urban waterlogging in Guangzhou



waterlogging forecast-based road routing

Actual rainfall depth at Jinan University:100cm
Predicted depth: 126cm

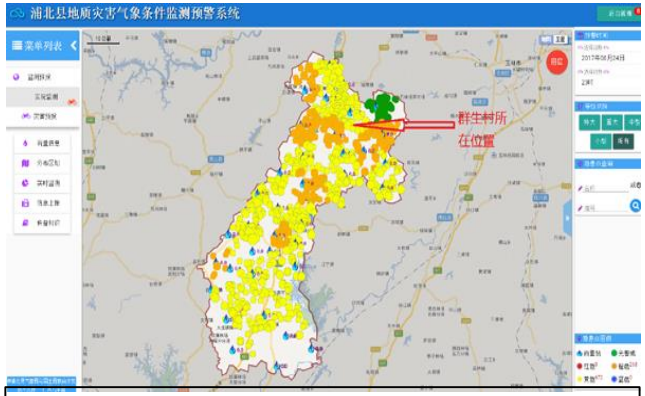
Actual rainfall depth at Tianhe Road: 70cm
Predicted depth: 86cm

Actual depth inGangding:60cm
Predicted depth: 76cm

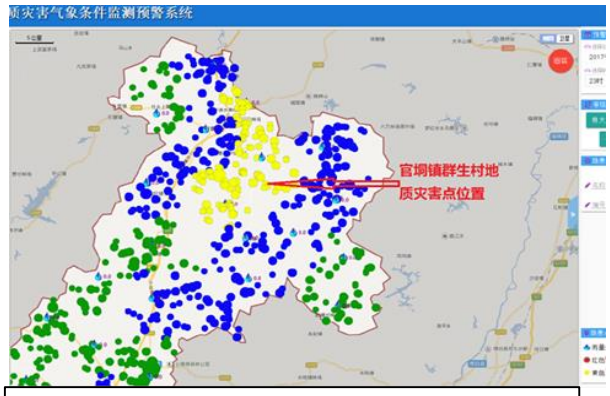
The urban waterlogging warning service are used for urban traffic management, road routing, and response to location-based user requests. The urban risk forecasts for potential waterlogging sites in Guangzhou can achieve **76% in accuracy**.

2.1 Case4_Landslide warning in Qunsheng Village of Guangxi

On 28 August, 2017, a landslide happened in Qunsheng Village of Guangxi. the meteorological and land authorities released the warnings for potential geological disaster sites with a lead time of 4 days, the government timely launched the emergency plan,and a successful evacuation was organized, with 124 people being protected from casualties.



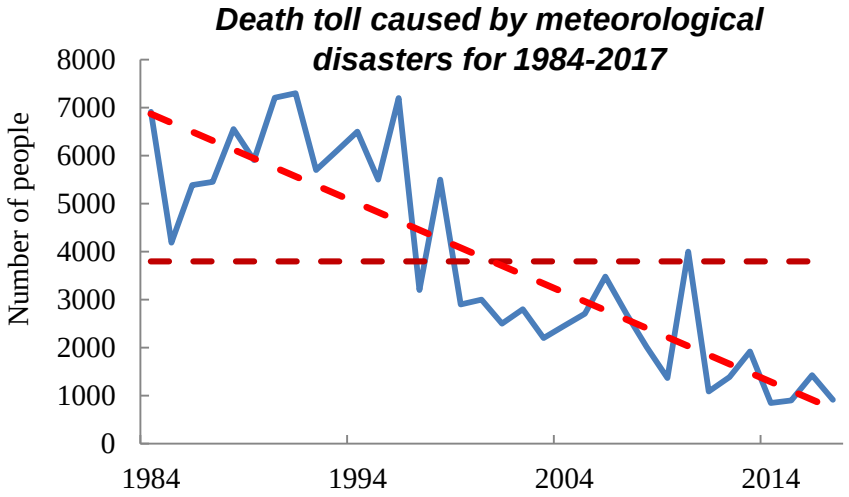
Warning, 24 Aug. 2017

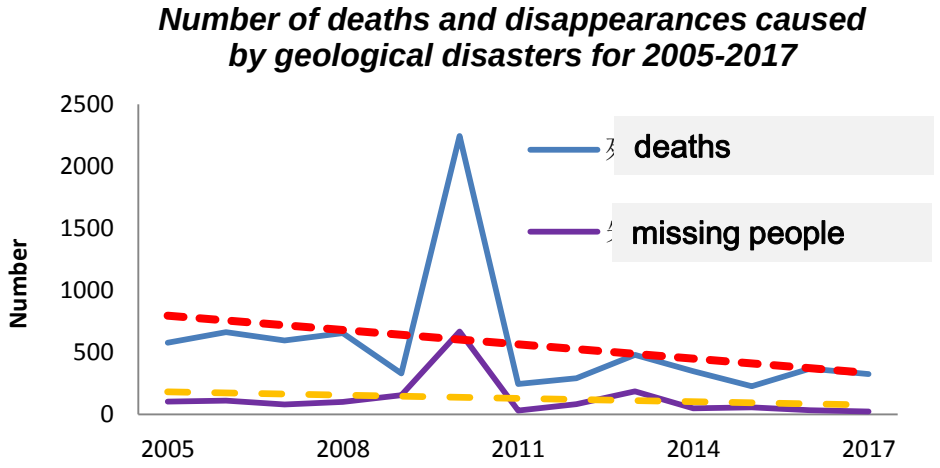


Warning, 27 Aug. 2017

Aerial image of mountain cracks

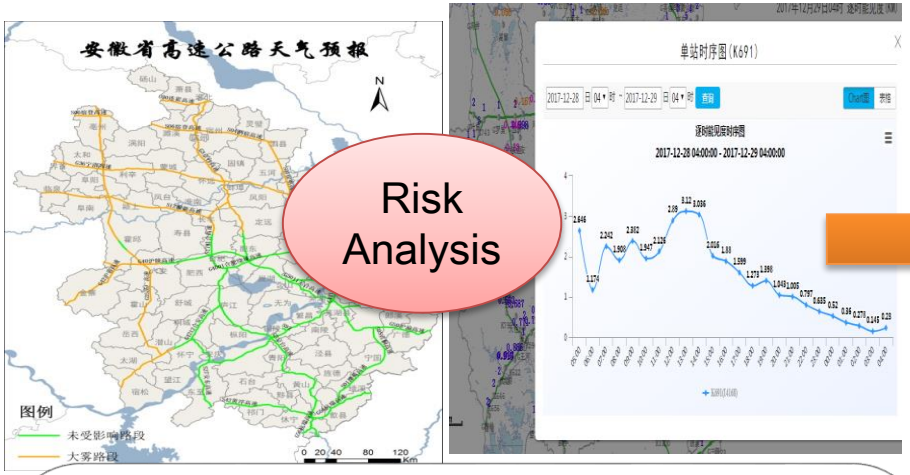
2.2 Effectiveness





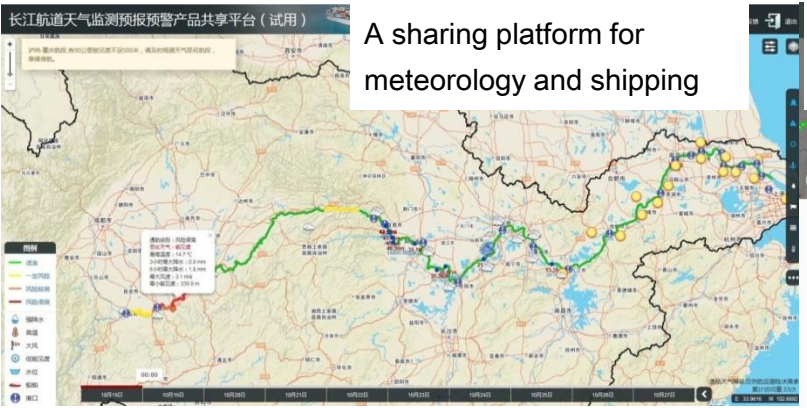
The significant benefits have been achieved in meteorological disaster prevention and mitigation.In recent years, the losses and casualties caused by meteorological disasters in China **decrease yearly**, So does the number of deaths and missing people

2.3 Expand 1_ Meteorological disaster risk warning service for expressway in Anhui

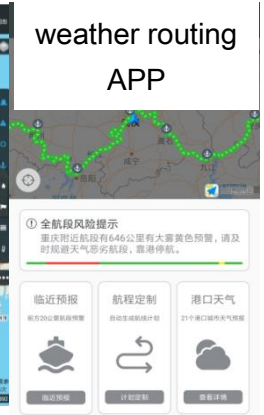


- Conducted census on transport-oriented meteorological disaster risks
- Analyzed expressway section-specific meteorological disaster impact risks
- Carried out real-time tracking and monitoring of transport meteorological disaster
- Issued risk warning information to the traffic and railway police, road administration and public

2.3 Expand2_Meteorological disaster risk warning service for Yangtze shipping

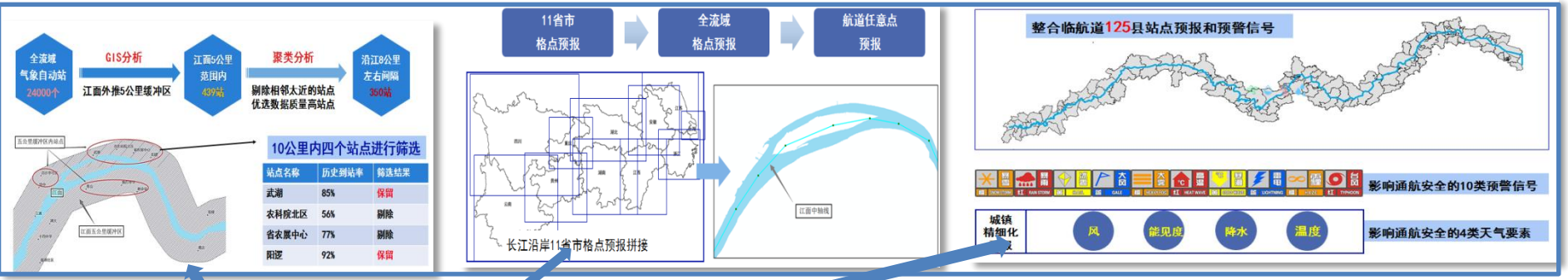


A sharing platform for meteorology and shipping



weather routing APP

- Focus on Weather for shipping level
- Established a sharing platform and a weather routing APP to issue meteorological risk warning service for Yangtze shipping every 10-min、every hour and every 10-day, which are on trial at Changjiang Maritime Safety Administration and local maritime authorities along the River

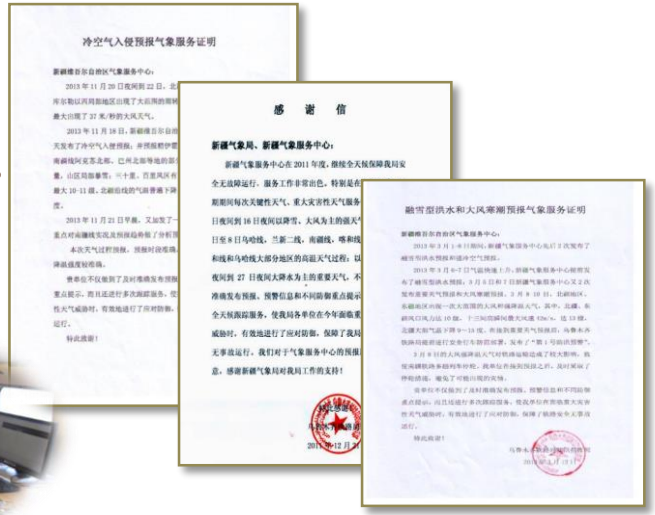


Real-time monitoring + Grid forecasting + Service warning + Level threshold = Weather for shipping level

2.3 Expand3 _Meteorological disaster risk warning service for railway in Xinjiang

- developed refined risk warning service for gale disasters to ensure the safe and secure operation of the railway sector
- over the past 3 years, the direct economic losses of RMB 150 million have been avoided.

Meteorological disaster risk warning service for railways



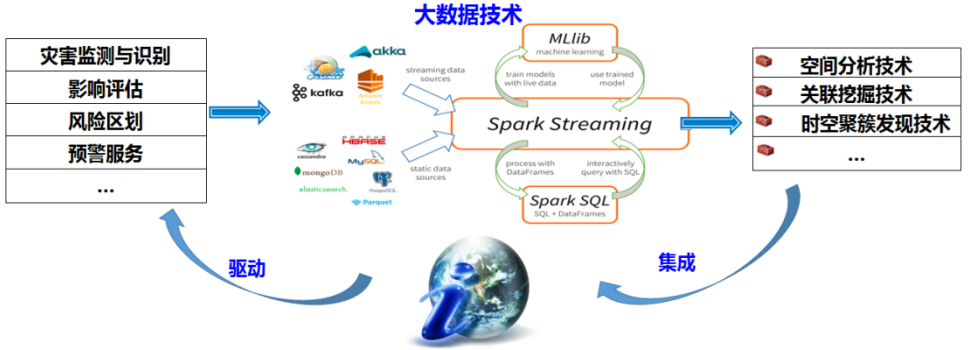
CONTENTS

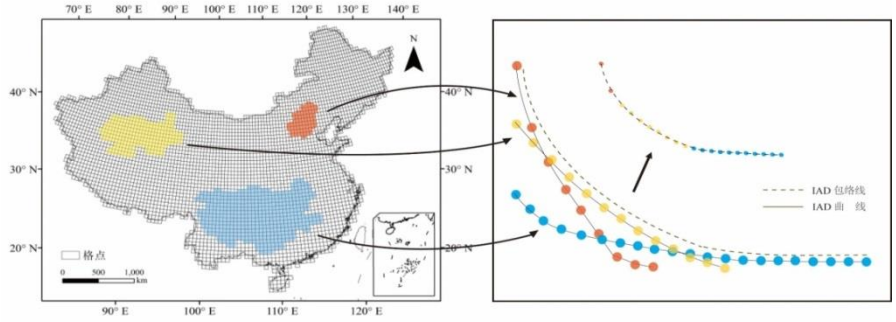
3.1 Raise awareness of an all-the-way meteorological disaster risk management

- Transition from disaster relief to disaster preparedness
- Transition from disaster loss reduction to disaster risk reduction
- Comprehensively improving the general resilience of the whole society to natural disasters

3.2 Develop key technology for meteorological disaster risks

- Meteorological disaster risks identification
- Risk occurrence mechanism and model
- Dynamic quantitative risk monitoring and evaluation
- Risk warning and service





I (Intensity) : disaster intensity;
A (Area): contiguous range area affected by disaster;
D(Duration): duration of disaster

Identification of meteorological disaster risk events: manual -> dynamic, automatic, intelligent

3.2 Development of key technology for meteorological disaster risks

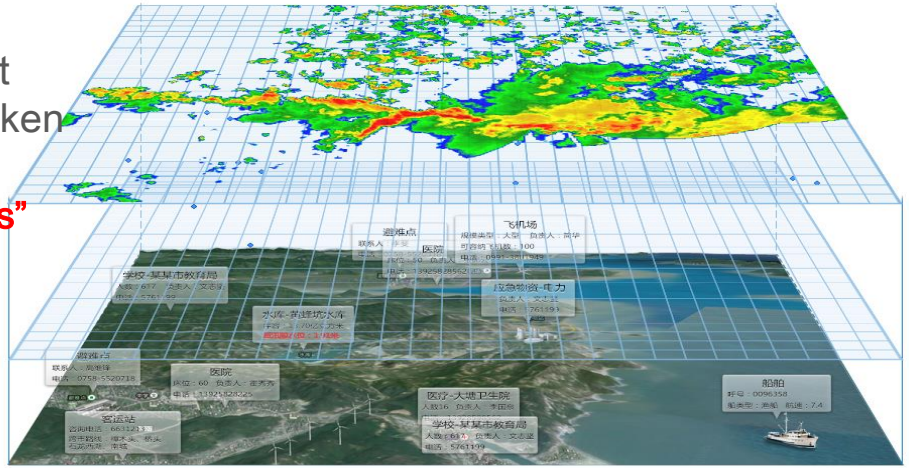
Guangdong Smarter Decision Support System

Decision support system
—on targeted hazard warnings, real time impact assessment and recommended actions to be taken

Innovative design called **"One Grid plus One Atlas"**

One Grid：Meteorological Information from **Seamless Digital Grid**: Monitoring, Warning, Forecast for anytime and any location

One Atlas：Underlying information charted together including natural, social and economic information (such as population/industrial activities)

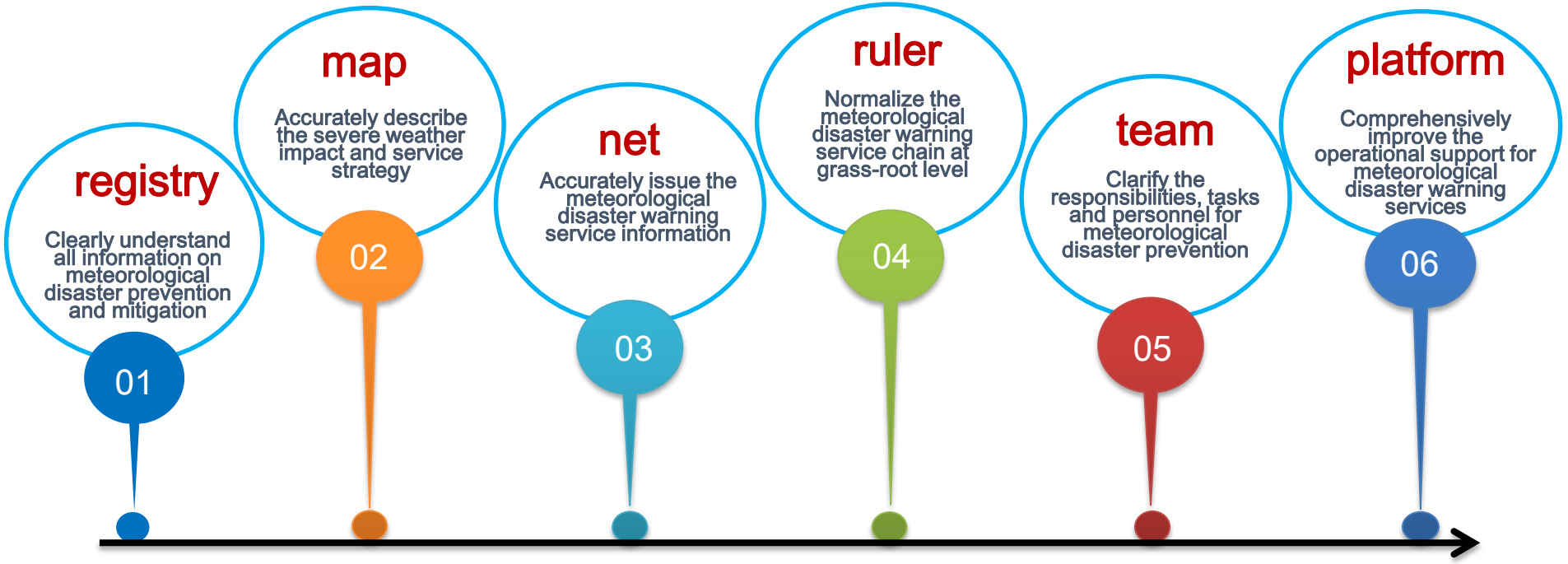


(The coupling of digital forecast Grid with multi-source atlas for targeted warning)

What weather will be and what weather will do

3.3 Improve capacity in meteorological disaster warning services at lower level

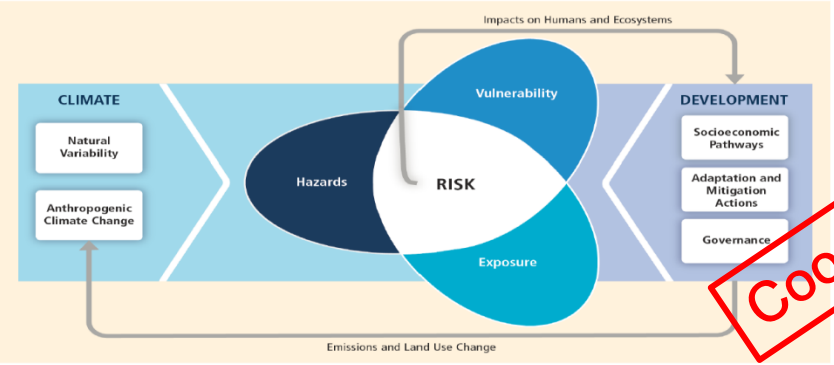
Based on the projects to strengthen disaster prevention and mitigation at lower level, a risk operational system is developed to enhance meteorological services and resilience. By 2020, the so called **"six ones" capacities** will be built in **all counties nationwide**.



3.4 Discussion challenges &solutions

Challenge I : Understand risk based warning

Challenges



- Access to sufficient information on hazardous factors, exposure and vulnerability
- Full understanding of the formation and development of hazards

Solution

Cooperation

Partnership and cross-disciplinary information sharing

- Data Sharing and Exchange with :
  - Land and Resource Sectors
  - Hydrological Sectors
  - Civil Affair Sectors
- Jointly Issuing Warnings
- R&D Cooperation with Universities

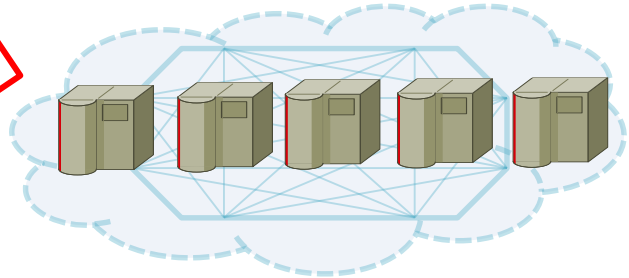
3.4 Discussion challenges &solutions

Challenge II：Improve accuracy of QPE&QPF

Challenges

Model and Tech.

Solution



- Improving accuracy of quantitative precipitation forecasts to support reliable hazard risk warnings fulfilling specific needs

- Developing high resolution models, and nowcasting, ensemble probability techniques to improve NMHSs' capability on heavy rainfall

3.4 Discussion challenges &solutions

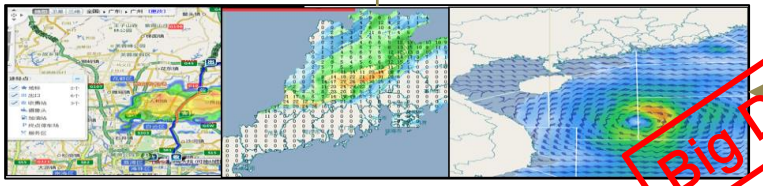
Challenge III： Deliver Smart Service

Challenges

“Meteorology + “ AI

(SMART) Translation

On-demand, Precise, Targeted



Seamless Digital Gridded Forecast

- Short lead time of hazard warning which makes it difficult to early disseminate and deliver warnings to impacted areas, esp. remote mountainous areas
- Smart service is a challenge ：
  precise , on-demand , foreseeing

Big Data Analysis

User Driven

Solution

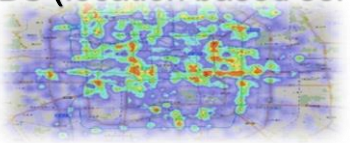
Impact Forecast
Smart Service

Weather Services Interaction

AI

Big Data Analysis

LBS (location based service)



User Profiles　　User Scenarios

User profiles of mobility and demography

- One stop dissemination technique for faster warning delivery

Thank you for your attention ！