WMO Task Force on Socio-Economic Application
Geneva, 15-18 May 2006

Meteorological Services
Practice and Consideration

TANG Xu
Shanghai Regional Center
China Meteorological Administration
tangxu570512@vip.sina.com
May 16, 2006

中国气象局
China Meteorological Administration

Outline

1. Brief analysis on impact, prediction and services
2. Issues raised from current services
3. Efforts & experiences to bridge the gap
4. Discussion and consideration

Meteorology-related Economic Losses Per Year

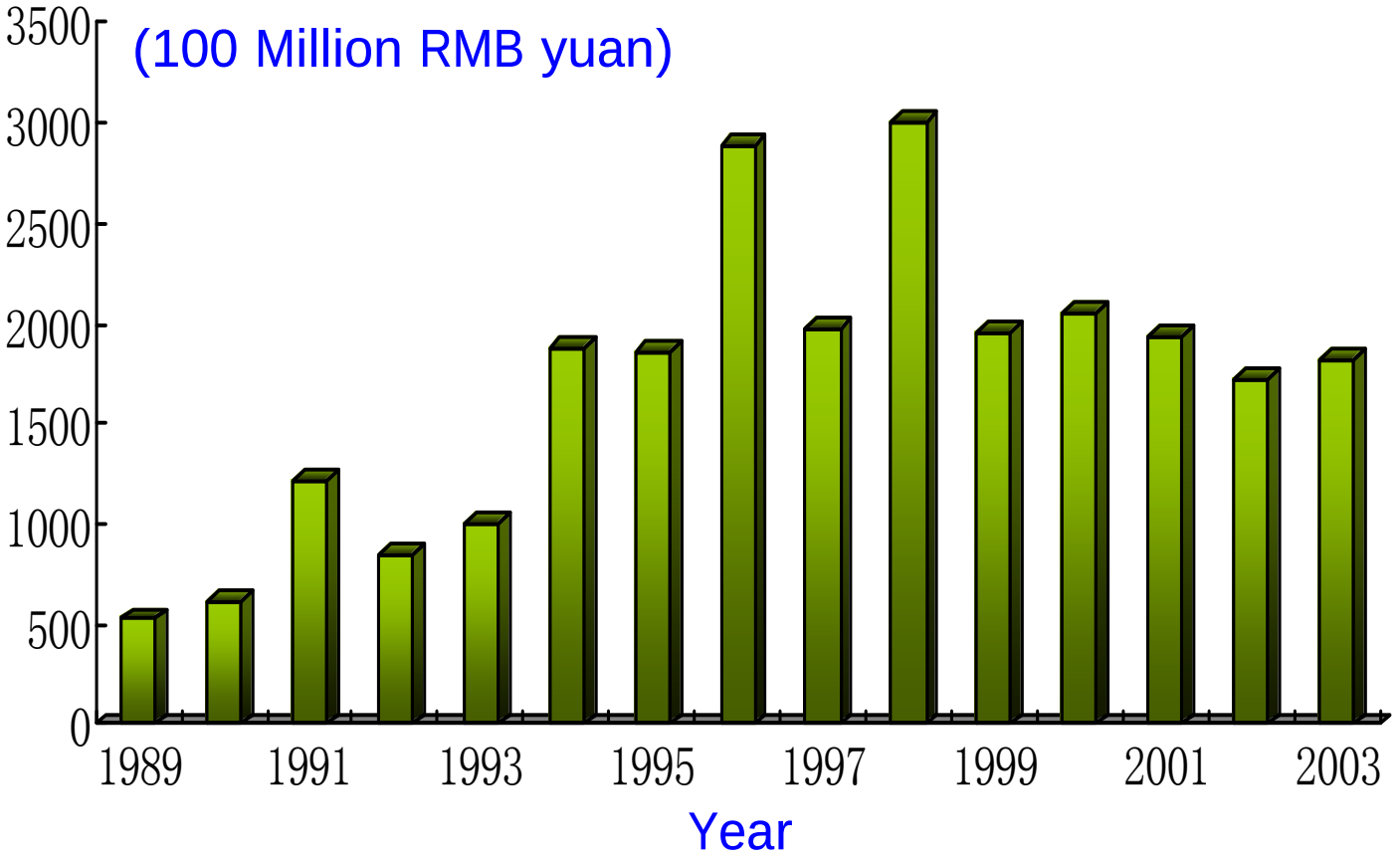
- China
  - Hundreds of billion yuan (RMB) (180 billion in 1994 and 300 billion in 1998)
  - Food reduction: 10-20 billion kg
  - 3-6% of GDP, or 10-20% of increase of GDP per year
- USA
  - Met. sensitive industries - 33% of GDP, or 3000 billion US dollars
  - Loss by drought: 6-8 billion US dollars
  - Loss by floods, hurricanes and tornadoes: 11.4 billion US dollars
  - Loss by lightning: 4-5 billion US dollars
  - Loss by airplane delay: 6 billion US dollars, 70% caused by weather

Ratio of cost to benefit 1 : 5 (in Europe)

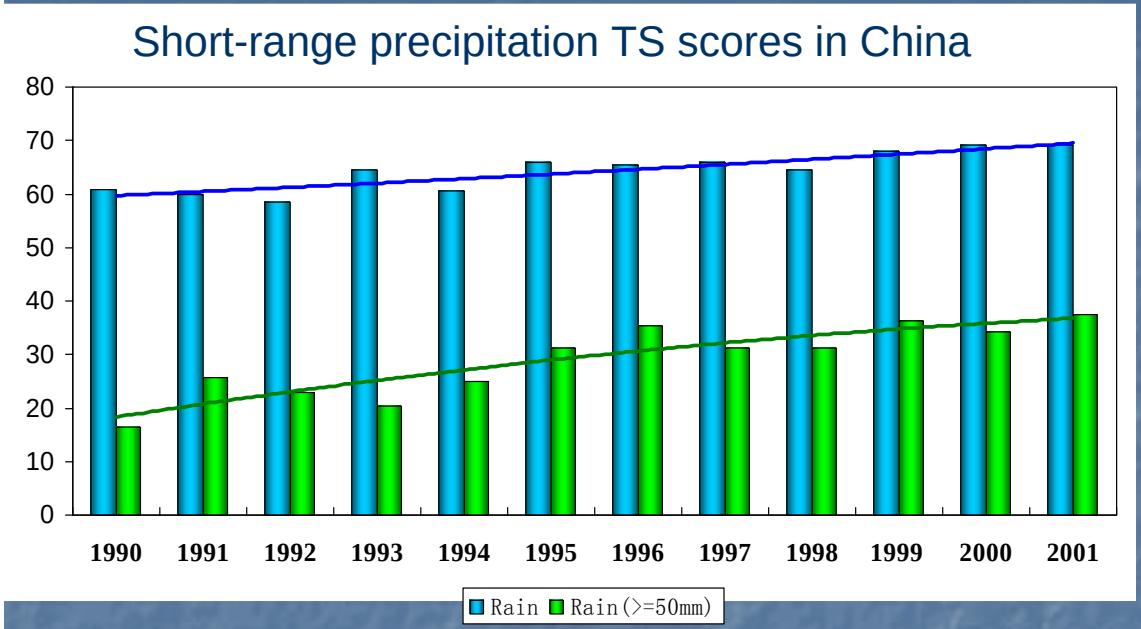
Ratio of cost to benefit 1 : 6 (in USA)

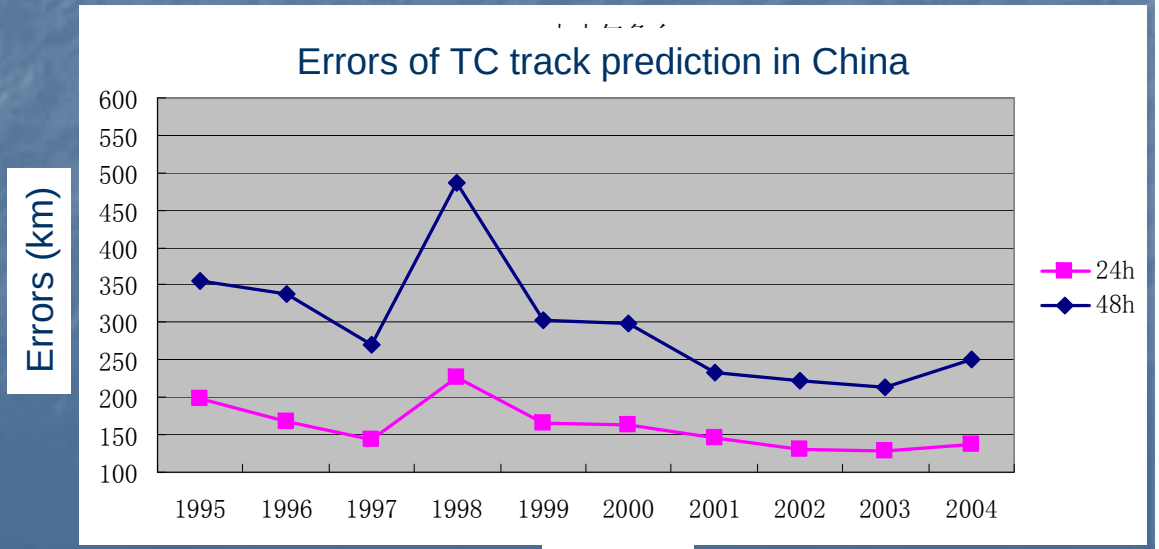
Ratio of cost to benefit 1 : ?? (other countries)

Economic and property losses of Hydro-Meteorological hazards during 1989-2003 in China



Forecast verification

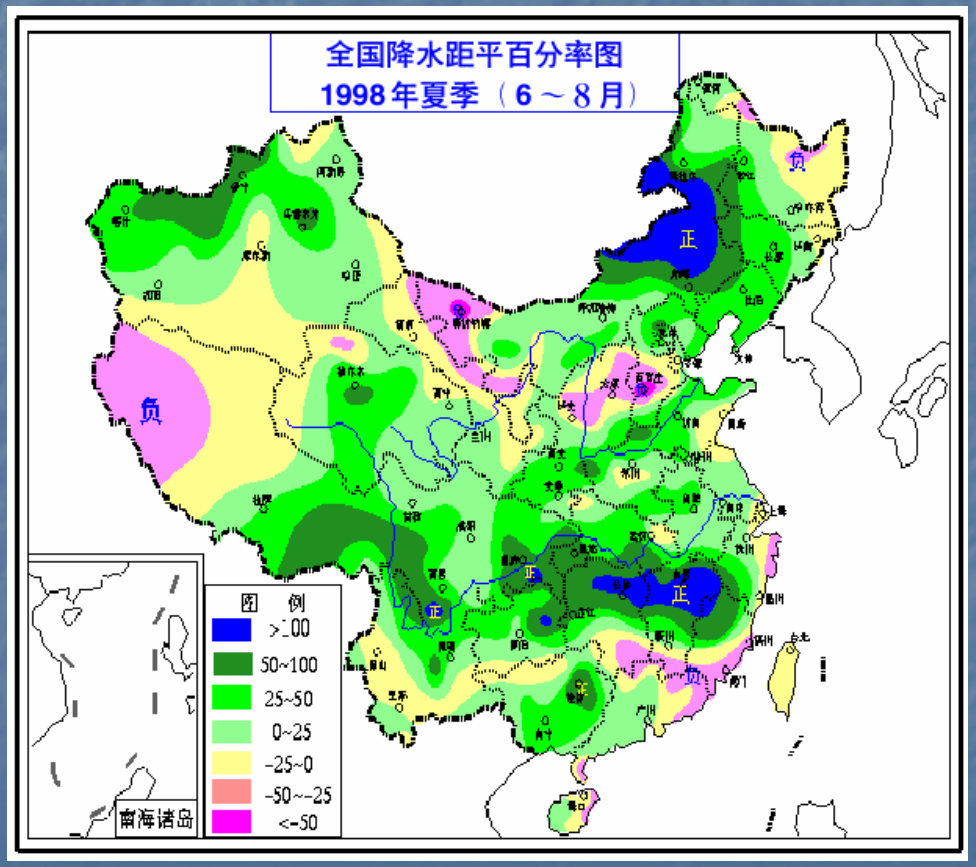




Statistics of some severe typhoons in Zhejiang province, China

TY Name	Intensity of TY when landing		Death (person)	Economic Losses (Billion Yuan) Ratio to GDP(%)
	Pressure (hPa)	Maximum Wind （m/s）		
9417	960	50	1126	17.8（4.66%）
9711	960	57	238	19.3（4.16%）
0414 Rananim	950	58.7	164	18.1（1.61%）
0509 Matsa	950	42.1	5	8.91（0.71%）
0515 Khanun	945	59.5	14	7.95（0.63%）

Short-range climate prediction verification



CMA's services cover multiple sectors :

industries, agriculture, fishery, commercial business, energy, transportation, building industry, water conservancy, land and natural resources, oceanography, salt-making industry, environment protection, tourism, aviation, telecommunication, insurance industry, fire control, etc.

Service is changing…

1. Change of service content from agriculture to more than 20 economic fields
2. Change of service means from plat-medias like newspapers to various medias such as internet, mobile phone, etc.
3. Change in basic operational capability like variety of data and products
4. Change of operation domain from weather prediction to environmental prediction including space weather
5. Change from advisory and prediction services to engineering services like weather modification and lightning protection

However,

- *While some NMHSs have changed their emphasis, all service providers must expect to transform as greater emphasis is put on users and the involvement of users in the selection and development of new services.*

------ from WMO Secretariat Concept Paper

2. Issues raised from current services

2.1 Case study

2.2 Questions raised from the cases

2.3 Current gaps in services

--- Gap analysis from NMHSs' view

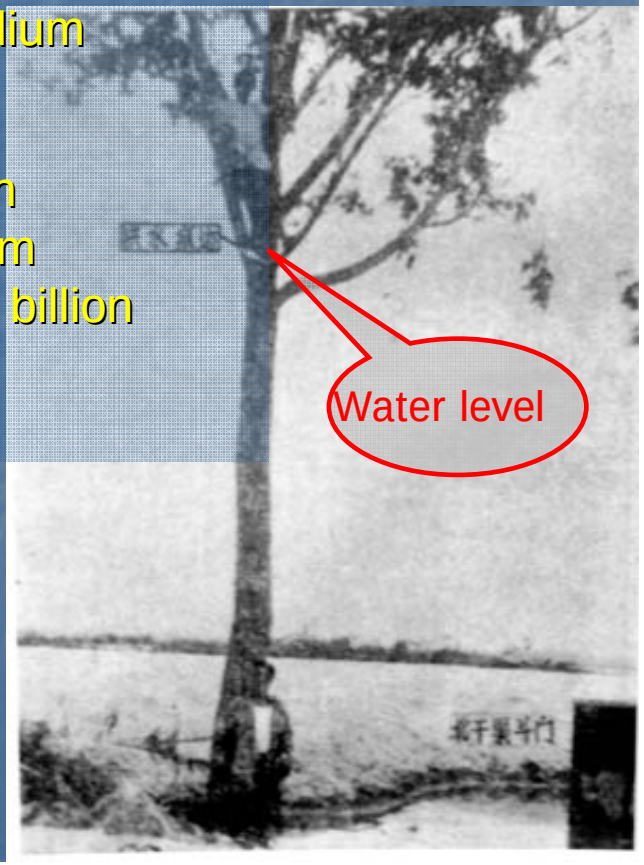
2.1 Case study

What can we learn from

the following cases…

Case 1: 1975.08 dam collapse tragedy in Zhumadian, Henan, China

- Aug.5-7, typhoon 7503
- Rainfall in Zhumadian: 830 mm/hr, 1060mm/day (1.8 times of annual rainfall)
- Dam collapse: 6 big to medium reservoirs
- Deaths: 46 000.
- House collapse: 5.24 million
- Broken railway lines: 100 km
- Economic losses: nearly 10 billion yuan (RMB)



Why did it happen?

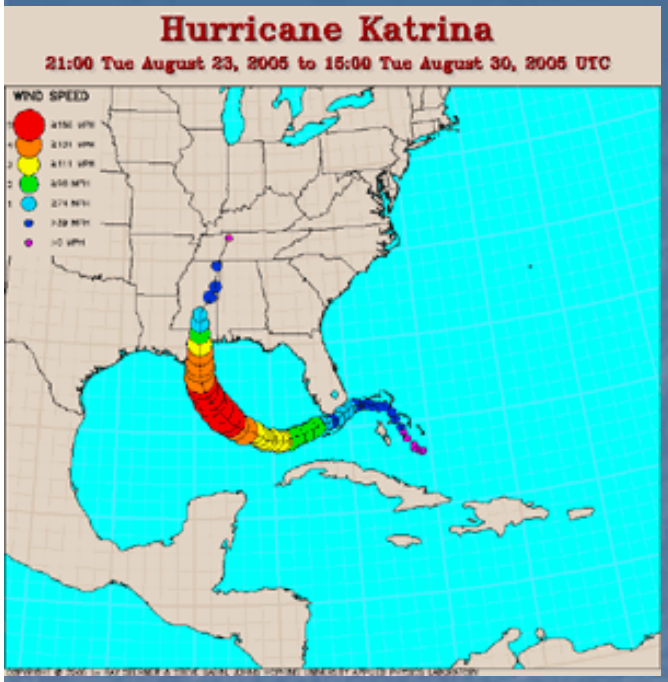
- Forecasts were not correct.
- The reservoirs and other basic facilities were not strong enough.
- No effective emergency response and management.
- …

Case 2: Hurricane Katrina

August 27, 2005

August 30, 2005

Source: NOAA and NASA web sites



The forecasts were correct. However,…

Loss of life: hundreds

Power outages: Over 1.7 million people

Flooding: 80% of New Orleans under flood water.

Why?
It is true that Katrina was severe.
But, did people know how to use weather information? Enough preparation and response?
Is it a good place for people to live here?

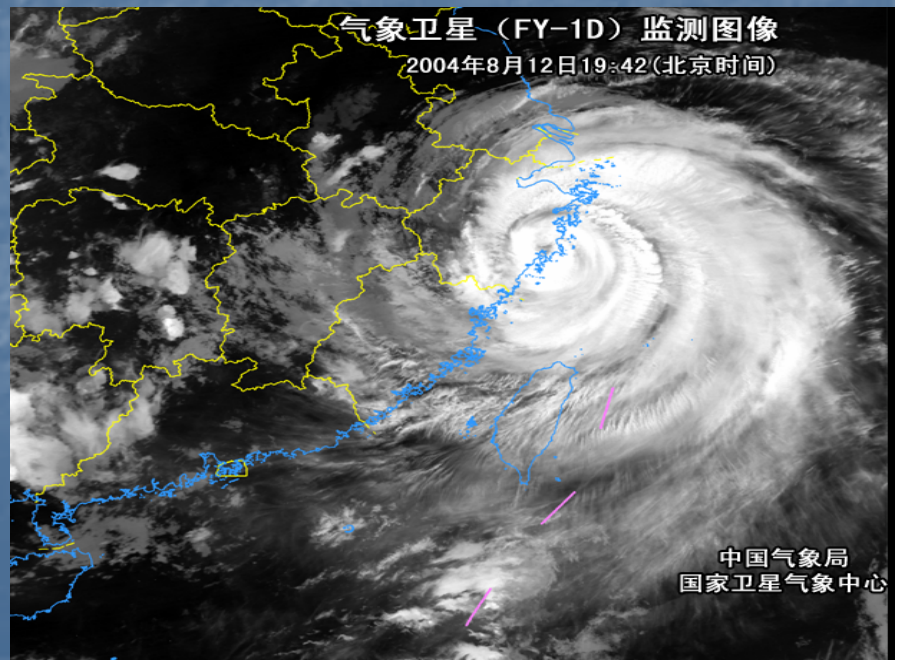
Similar case: Typhoon Rananim

12-13 Aug. 2004, Typhoon Rananim landed at WenLing, Zhejiang, China, with heavy rains and strong winds (>45 m/s).

The forecasts were correct.

However,…

164 killed, 24 missing, economic loss: 18.1 billion yuan (RMB).



Case 3: 2005.06 flash flood, Shalan town, Heilongjiang, China

June 6, 2005, Shalan town, Heilongjiang.

Flash flood caused by heavy rain.

117 killed including 105 pupils of an elementary school in Shalan town.

Case 4: A light snow in Beijing

Dec. 7, 2001, a light snow with a snowfall of 1.7mm caused a severe traffic jam in the urban area of Beijing. All main street became a huge park lot.

Is big city becoming more vulnerable?

Is non-severe weather unimportant when the requirement for meteorological services changes along with the rapid development of society and economy?

2.2 Questions raised from the cases:

- Are the forecasts correct enough? --- accurate
- Are the forecasts what users need? --- appropriate
- Are the forecasts reaching the right users? --- accessible
- Are the forecasts understood by the intended user? --- understandable
- Are the forecasts customized for users? --- customizable
- Are the forecasts used correctly? --- practical
- Are the forecasts issued in correct way? --- clear
- Are the forecasts disseminated in a timely manner? --- timely
- Is the non-severe weather unimportant? --- adaptable
- Does the disaster response system work? --- effective

Do these reflect the Gaps
between information provider and user ?

2.3 Current gaps in services --- Gap analysis from NMHSs' view

Gap Investigation & Survey

- Methodology
  - Routine user investigation (SMB's annual user symposium on weather service)
  - Special User investigation (SMB's symposium on marine meteorological service)
  - Public survey on weather forecast (BMB's survey on weather forecast)
  - Something new…?

- Results
  - Product content obstacle: For example, many users don't understand the probabilistic forecasts.
  - Product classification obstacle: For example, NMS in Shanghai thought typhoon was the most important to marine transportation, but the related user said the most dangerous weather was winter burst cyclone.
  - …

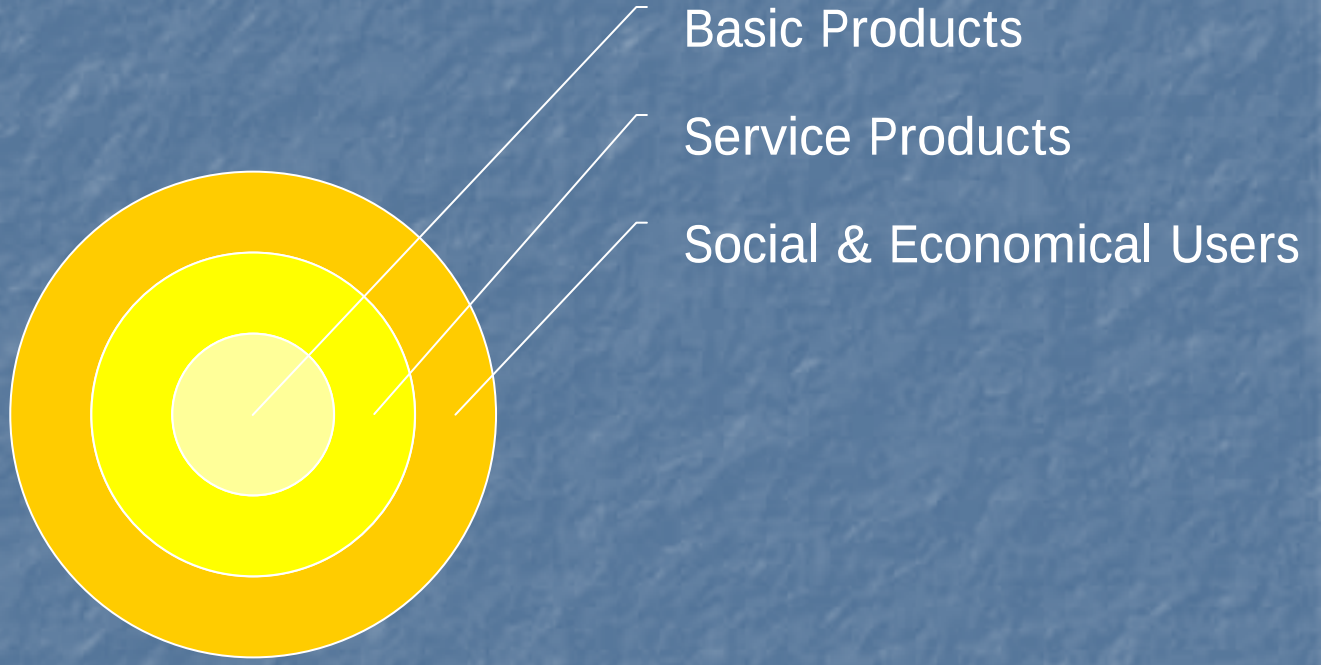
2.3 Current gaps in services(6 weak points) --- Gap analysis from NMHSs' view

- Providers are heroes. One way in service flow is a main feature. Data and forecast product don't equal to information.
- Somewhat coarse (too general) in service product and its content; somewhat scattered (not well organized) in the way to get feedback from users.
- Lack of objective, quantitative and standard verification and operational procedure to match the guidance of influence prediction or pre-evaluation.
- The service is casual and random (not standard and routine) to some extent.

2.3 Current gaps in services
----Gap analysis from NMHSs' view (cont.)

- A general public forecast service is substitute for the specialized service. This means user-oriented requirements are not clear by NMHSs. A typical example is "why are users not willing to use the forecast in probability term?"
- Lack of effective manner and integrated structure to organize the service into the routine operation.
- Specialized service covers all walks of life. What should NMHSs do? To let all kinds of specialized service under control or using different mechanism? …

Service is the Interface between basic Operation &Users



A basic operation centered structure
(Inner-outer, gaps exist)

Changing Society,
Changing Requirement,
Changing Services
Changing Gap?
How to narrow?

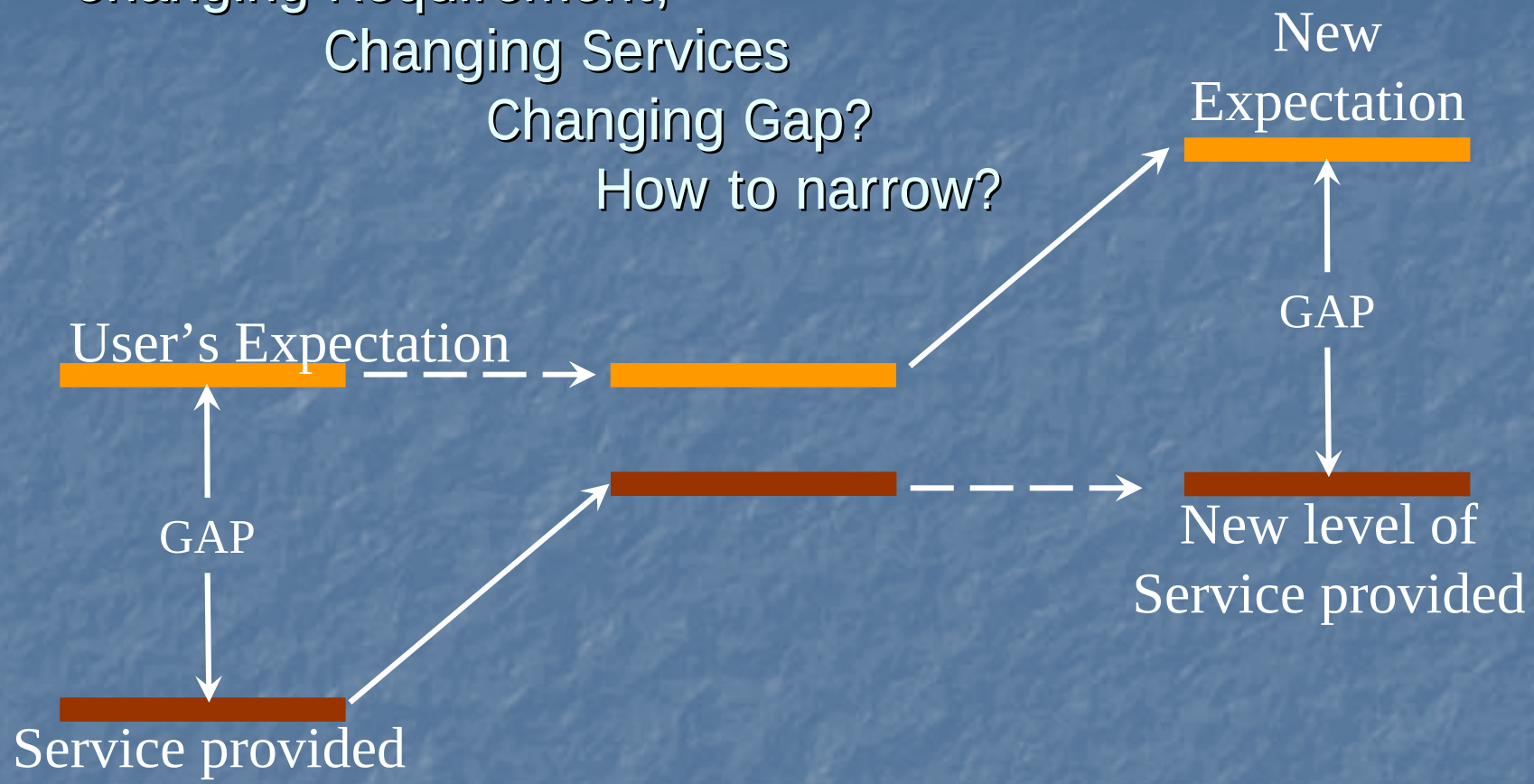
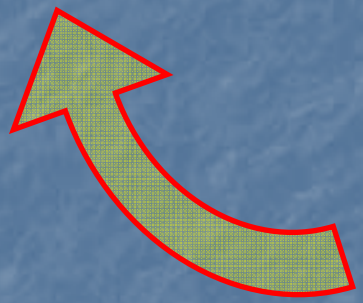


Diagram derived from C.Y. Lam (HK Observatory)

How to

Bridge



Gap?

3. Efforts & experiences to bridge the gap

3.1 Legislation

3.2 Specialized Organization Structure

3.3 Techniques

3.4 Mechanisms

3.1 Legislation

A variety of laws and regulations, official documents by governments at central and local levels for the specialized service provided by NMHSs.

- Meteorology Law of P.R. China (National Congress, Jan. 2000)
- National plan on natural disaster emergency response (State Council, Jan. 2006)
- Regulations on administration of weather modification (State Council, May, 2002)
- No. 3 document in 2006 issued by State Council- “For the enhancement of the development of Chinese meteorological drive in 2006-2010”

3.1 Legislation: Meteorological Law of China

Article 3 Meteorological service is a basic public welfare service for economic development, national defense, social development and people's well-being. Public welfare meteorological services shall be the first priority in meteorological work.

On condition that unpaid public welfare meteorological services are guaranteed, meteorological offices and stations may provide paid meteorological services in accordance with law.

Article 4 Meteorological offices and stations subordinate to the competent meteorological departments of counties or cities shall chiefly serve agricultural production, providing, on their own initiative and in a timely manner, public welfare meteorological information services needed by local agricultural production.

3.1 Legislation: Meteorological Law of China (cont.)

Article 22 The State applies a unified system for the issue of public meteorological forecast and severe weather warning.

Meteorological offices and stations subordinate the competent meteorological departments at different levels shall, in compliance with their functions and duties, issue to the community public meteorological forecast and severe weather warning, with timely supplements or corrections added as the weather changes. No other organizations or individuals may issue to the community such forecast or warning.

Meteorological offices and stations subordinate to other relevant departments under the State Council or under the people's governments of provinces, autonomous regions or municipalities directly under the Central Government may issue specialized meteorological forecast to be used within the framework of their departments

The competent meteorological departments at different levels and the meteorological offices and stations subordinate to them shall issue public meteorological forecast and severe weather warning with improved accuracy, timeliness and service.

3.1 Legislation: Meteorological Law of China (cont.)

Article 23 Where necessary，meteorological offices and stations subordinate to the competent meteorological departments at various levels shall issue specialized meteorological forecasts for agriculture，urban environment，classified fire-risks.

Article 27 People's governments at or above the county level shall improve their monitoring and warning systems for meteorological disasters, make arrangements for relevant departments to work out plans for prevention of meteorological disasters，and take effective measures to increase the capability of preventing such disasters.

Article 28 Competent meteorological departments at all levels shall make arrangements for joint among monitoring and forecast of significant weather events among regions or departments，propose timely measures for preventing meteorological disasters and make assessment of severe weather disasters，which shall serve as the decision-making basis for the people's governments at the corresponding levels to arrange prevention of meteorological disasters.

3.2 Specialized Organization Structure

Emphasis on application and service :

- Operational offices for specialized service in NMHSs (CMA)

--------Leading role in providing the specialized service to many walks of life

- Special operational offices in all level of CMA for specialized service provided to decision-makers of government

--------Important role in the organization of multi-hazard mitigation and emergency response system

- Joint R&D institute (i.e., Joint Engineering Lab. for Met. Disaster Prevention by SMB's and Tongji University)

3.3 Techniques

3.3.1 Some practices to bridge the gap

3.3.2 Joint-issued special service products

3.3.3 Application of new technology in service dissemination

3.3.1 Some practices to bridge the gap

- Meteorological service in bridge construction
- Feasibility Evaluation of Meteorological Condition for Yangshan Harbor

A case of SMB:
Bridge the gap in bridge constructions

- Facts

  Mechanism and personnel: A special group was organized in SMB to serve a series of bridge construction projects. (5 projects in 15 years)

  Service contents: climate evaluation, weather forecasts. especially in-situ services

  Key point in service: Bridge conjunction is an air temperature sensitive work. SMB helped the bridge builder to choose proper dates for bridge conjunction by excellent service.

- Benefit & Significance

  Impetus to meteorological technology upgrade: Feedback from the users stimulated the improvement of SMB. i.e. the idea of using GPRS technique to transfer real-time observations to the SMB weather office. Now the data temporal interval of SMB's automatic surface weather observation network is 1 min.

  Direct benefit to projects:

  If one project had one day delay due to wrong calculation of connection date, it would cost half a million *Yuan* which included salaries, rent fees and other terms.

- The gap was decreasing significantly in the process of special services.

Feasibility Evaluation of Met. Condition for Yangshan Harbor

- Fact

Same data, different method, different result

New estimation considering reality of

harbor operation: 345 d

Difference: 70d

-------Analyzing method should adapt to the reality of the service.

- Significance & Benefit:
  - Strategic influence on regional economical development: If the old result of 275d was adopted, the harbor would not be constructed according to the standard of over 300d operational day.
  - Obvious benefit: the direct profit of the 1st construction stage of the Yangshan harbor in 70d is about 70 million *Yuan* *(70*5*2000*100=70 million)*
  - The cost of construction for natural hazard defensive infrastructure is largely reduced according to the second result.

    For example, the total cost of the 1st construction stage of the Yangshan harbor is 7.2 billion *Yuan*, if the cost of defensive infrastructure construction was 1% of the total cost, the choice of the 345d result would save 36 million *Yuan.*

3.3.2 Joint-issued specialized products

How to raise application ability with users?

Described as the following categories:

A- Agriculture B- Water Resources

C- Constructions D- Risk management

E- Energy sector F- Transport

G- the Public H- Public Health

I- Tourism J- Utilities

Risk Management

Severe weather warning signals and Guidance

11 types of warning signals : Ranked ***3-4 levels***: blue, yellow, orange and red.

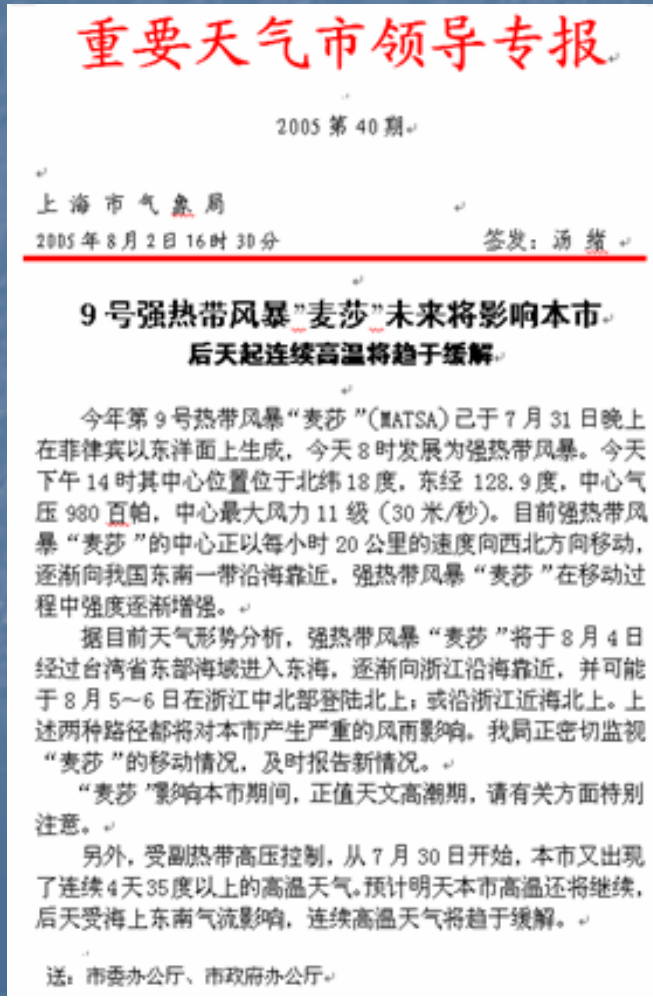
Table 2 example of some severe weather warning signals issued in Shanghai

Severe weather	Level	Description	Signals
Typhoon	Blue	Tropical cyclone has been predicted to affect city within 24 hr with maximum wind force over 6(The Beaufort Scale)	
	Yellow	Tropical cyclone has been predicted to affect city within 24 hr with maximum wind force over 8(The Beaufort Scale)	
	Orange	Tropical cyclone has been predicted to affect city within12hr with maximum wind force over 10(The Beaufort Scale) and possible with rainstorm.	
	Red	Tropical cyclone has been predicted to affect city with 6 hr with maximum wind force over 12 (The Beaufort Scale) and possible with rainstorm.	
Rainstorm	Yellow	6 hr rain above 50mm or 1 hr rain reach 20mm	
	Orange	3 hr rain above 50mm or 1 hr rain reach 30mm	
	Red	3 hr rain above 100mm or 1 hr rain reach 60mm	
Hot Weather	Yellow	Maximum temperature will climb up to 35℃ within 24 hrs.	
	Orange	Maximum temperature will climb up to 37℃ within 24 hrs.	
	Red	Maximum temperature will climb up to 40℃ within 24 hrs.	
Fog	Yellow	Thick fog with visibility <500 m has occurred or been predicated within 12 hrs.	
	Orange	Thick fog with visibility <200 m has occurred or been predicated within 6 hrs.	
	Red	Thick fog with visibility < 50 m has occurred or been predicated within 2 hrs.	

Policymakers' direct line

- A "Red phone" in Shanghai Meteorological Bureau connects to mayor office.
- Weather advisory and report

Weather advisory for policymakers



重要天气市领导专报

2005 第 40 期

上 海 市 气 象 局

2005 年 8 月 2 日 16 时 30 分　　签发：汤 燕

9 号强热带风暴"麦莎"未来将影响本市
后天起连续高温将趋于缓解

今年第 9 号热带风暴"麦莎"(MATSA)已于 7 月 31 日晚上在菲律宾以东洋面上生成，今天 8 时发展为强热带风暴。今天下午 14 时其中心位置位于北纬 18 度，东经 128.9 度，中心气压 980 百帕，中心最大风力 11 级（30 米/秒）。目前强热带风暴"麦莎"的中心正以每小时 20 公里的速度向西北方向移动，逐渐向我国东南一带沿海靠近，强热带风暴"麦莎"在移动过程中强度逐渐增强。

据目前天气形势分析，强热带风暴"麦莎"将于 8 月 4 日经过台湾省东部海域进入东海，逐渐向浙江沿海靠近，并可能于 8 月 5～6 日在浙江中北部登陆北上；或沿浙江近海北上。上述两种路径都将对本市产生严重的风雨影响。我局正密切监视"麦莎"的移动情况，及时报告新情况。

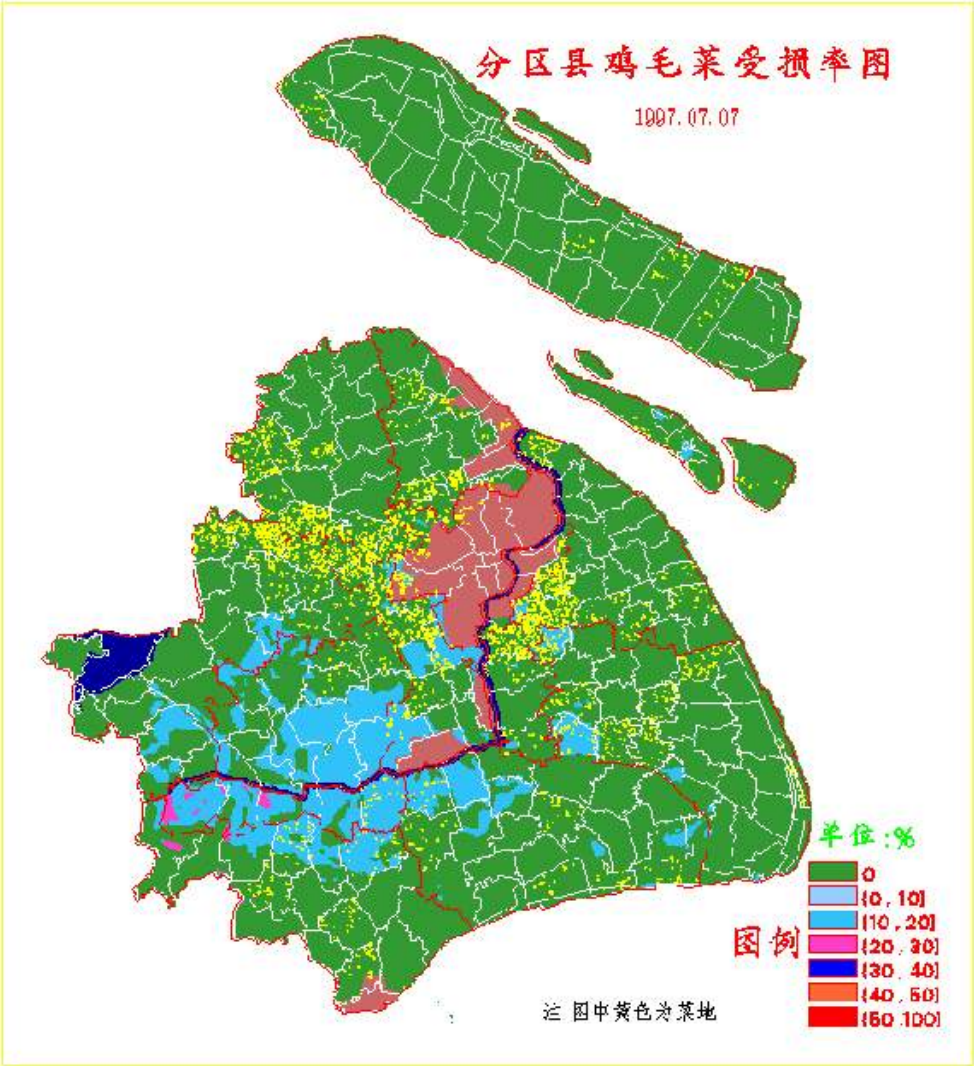
"麦莎"影响本市期间，正值天文高潮期，请有关方面特别注意。

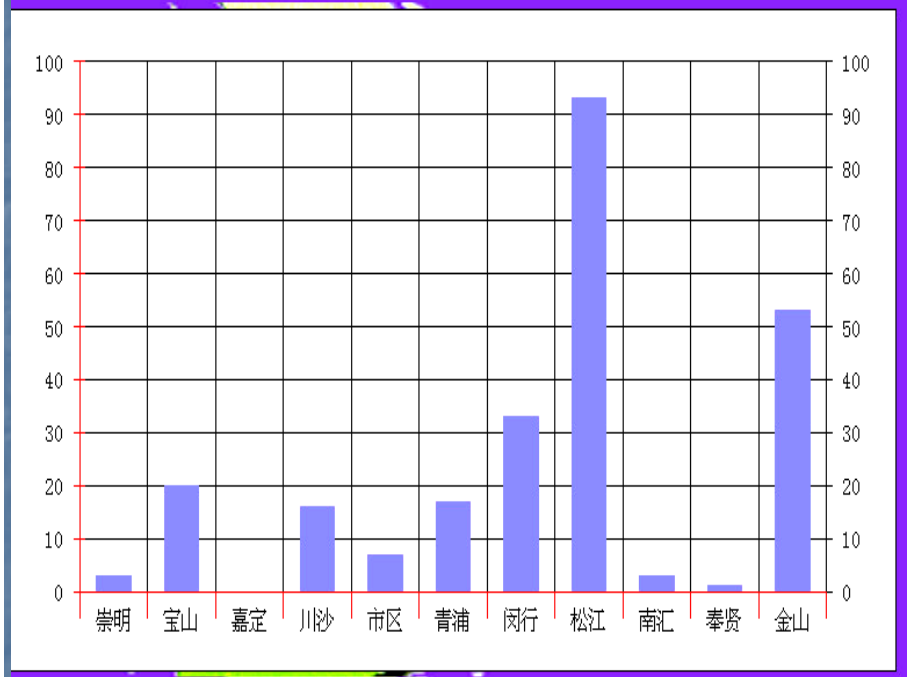
另外，受副热带高压控制，从 7 月 30 日开始，本市又出现了连续 4 天 35 度以上的高温天气。预计明天本市高温还将继续，后天受海上东南气流影响，连续高温天气将趋于缓解。

送：市委办公厅、市政府办公厅

Agriculture - Food Production and Security
Provided for Agricultural agencies

Assessment of the vegetable losses in Shanghai after a heavy rain

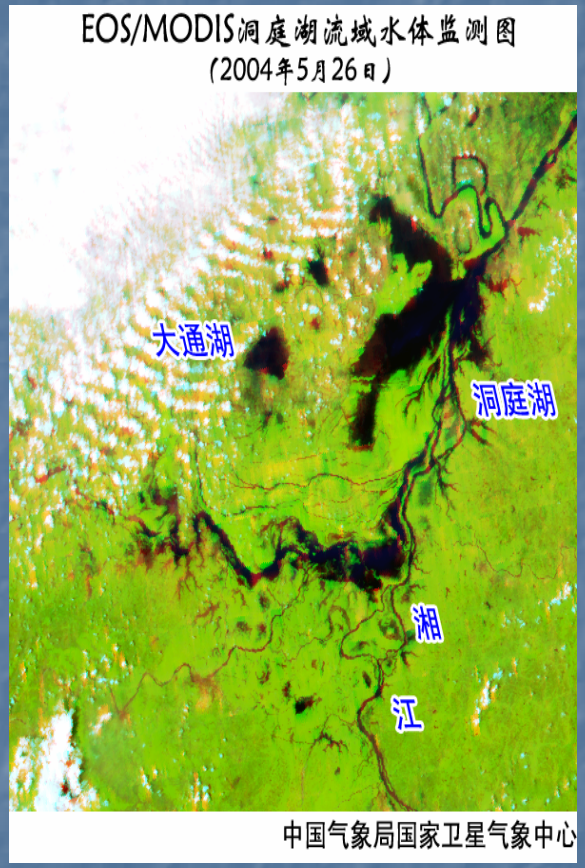




	COD_AD	XIAN	SUM_AREA	SUM_Y_AREA	BL
	310230	崇明	1135.212722	41.600943	3
	310113	宝山	463.600423	94.343908	20
	310114	嘉定	458.394107	0	0
	310115	川沙	429.495498	69.624551	16
	310100	市区	317.583552	23.003495	7
	310229	青浦	673.78962	120.177991	17
	310112	闵行	394.026846	131.153223	33
	310227	松江	597.209014	557.844922	93
	310225	南汇	698.192762	26.029863	3
	310226	奉贤	696.292052	9.960472	1
	310228	金山	595.266307	316.07811	53

Web site for agriculture economy co-organized by Meteorological office and Agriculture department
（http://www.agri.gov.cn)

Water resources monitoring for water management department

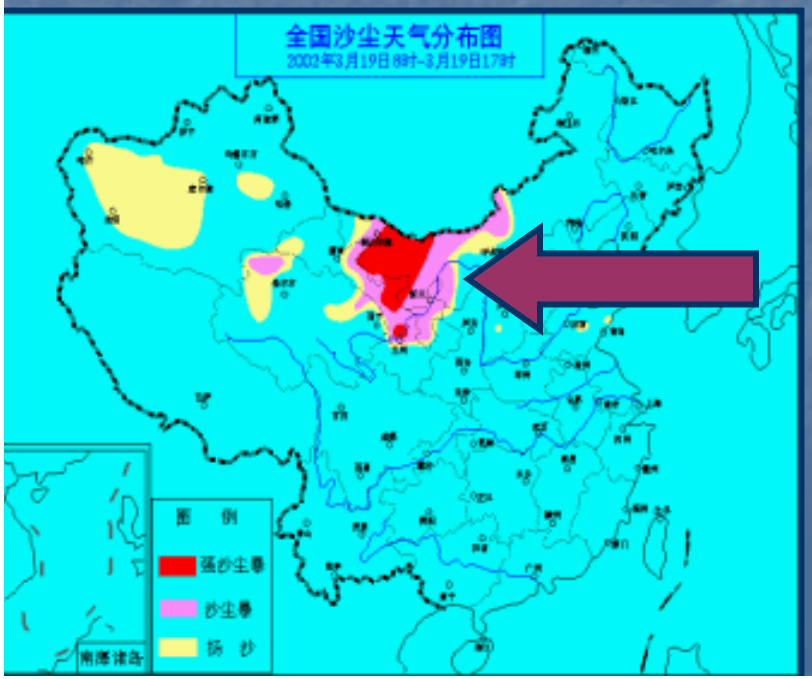


Provied by NSMC/CMA

Provide by NSMC/CMA

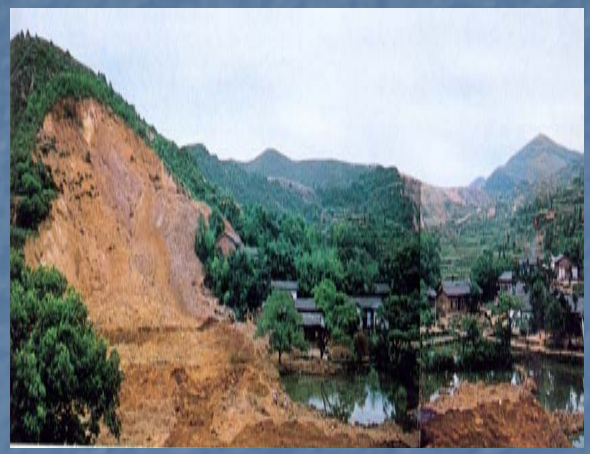
Sand/dust Storm Forecasts

Co-issued by CMA and SEPA

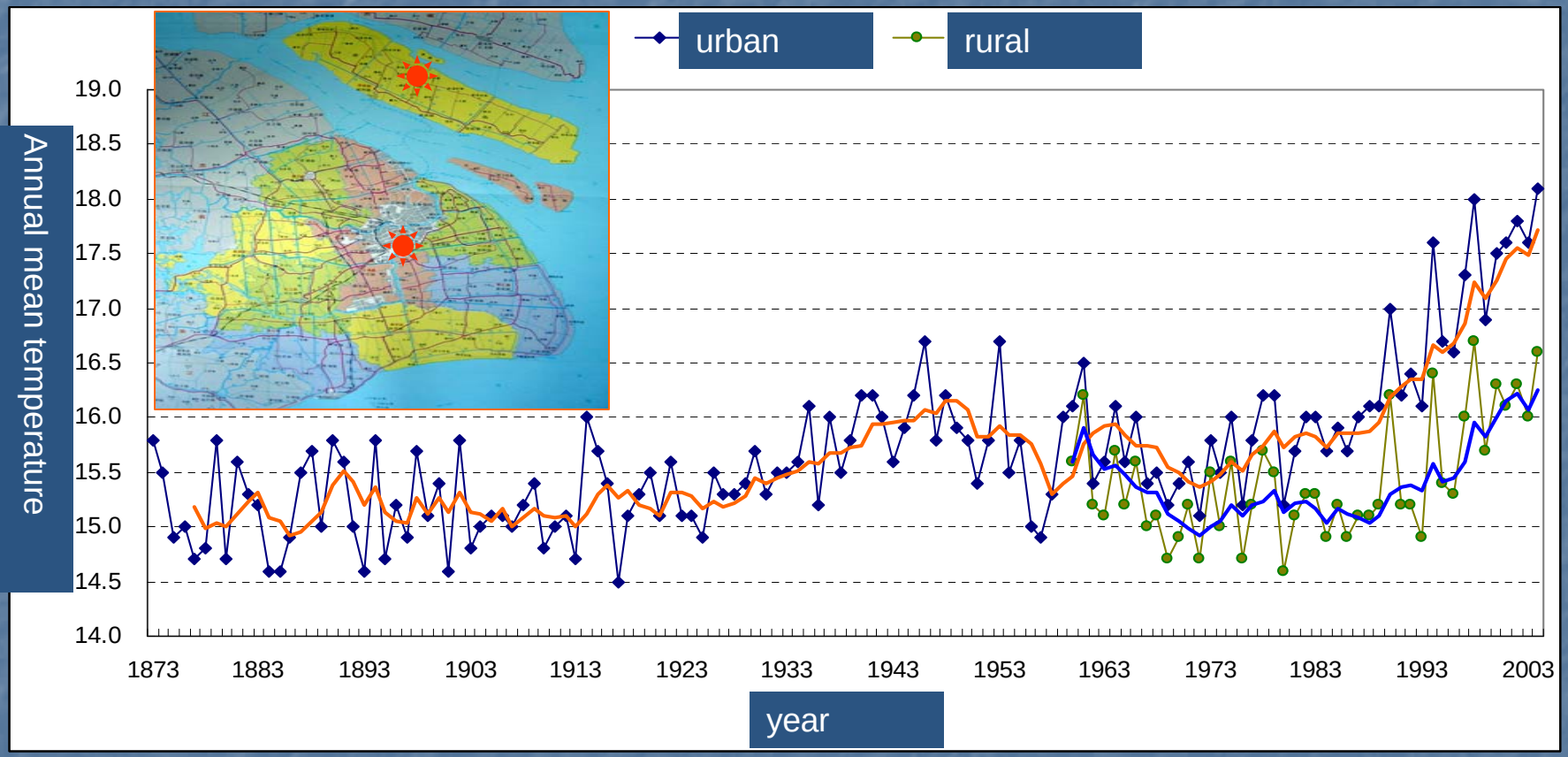


Geological Disaster Warning

Landslide, Debris flow warning
Co-issued by CMA and Ministry of Land and Resource



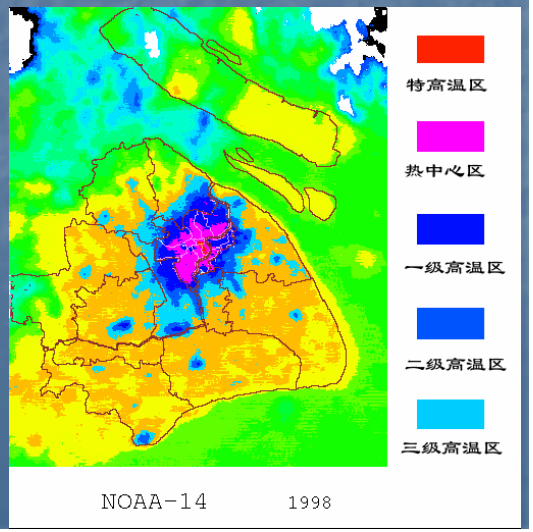
Products for Health Agencies and the Public



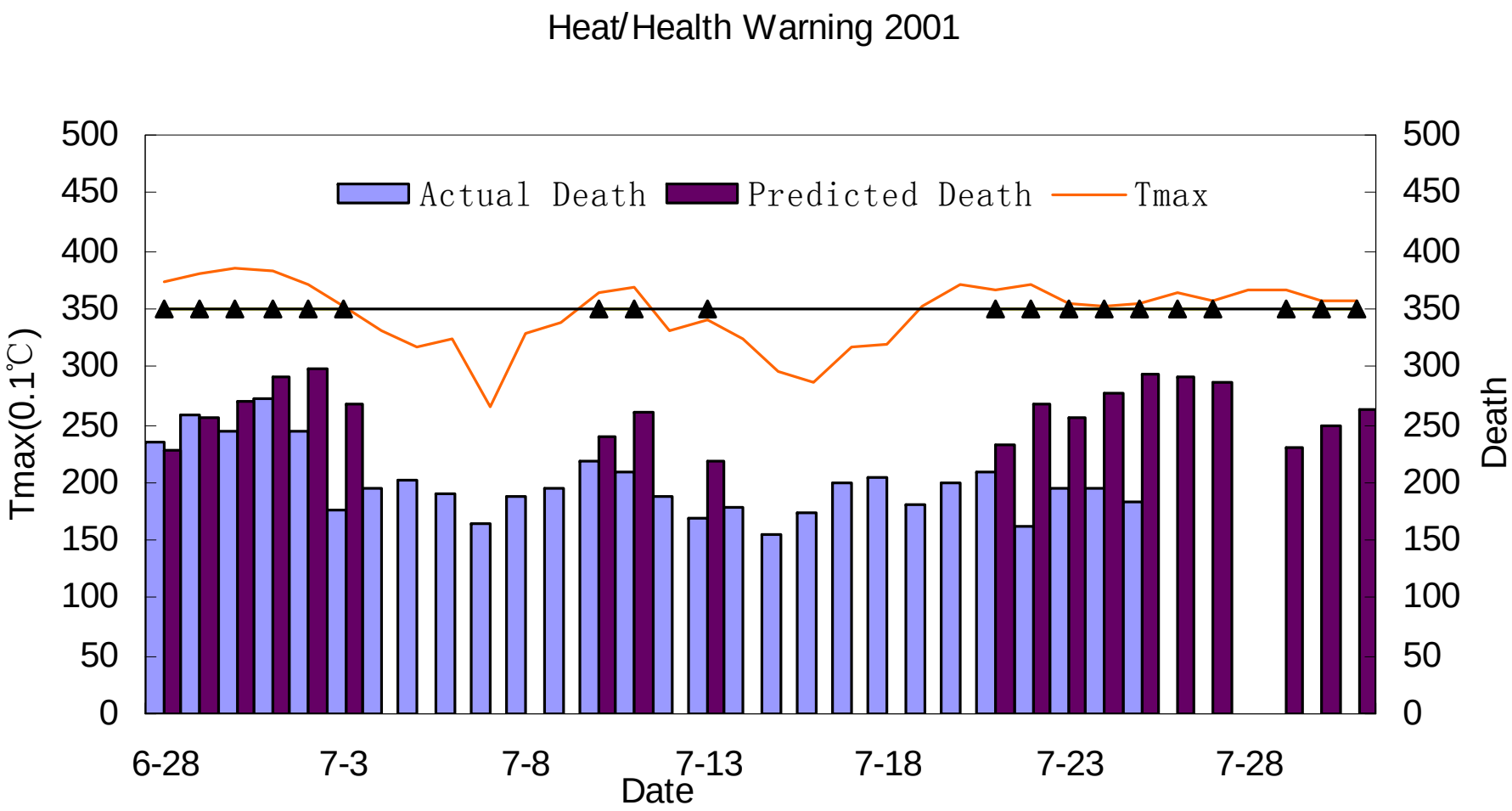
Environmental products
Tourism products

Products:

UV, Pollen Index, Commercial products, Air pollution Index, Heat Wave Index, Water and Energy Control Forecasts, Medical Weather Index, etc.

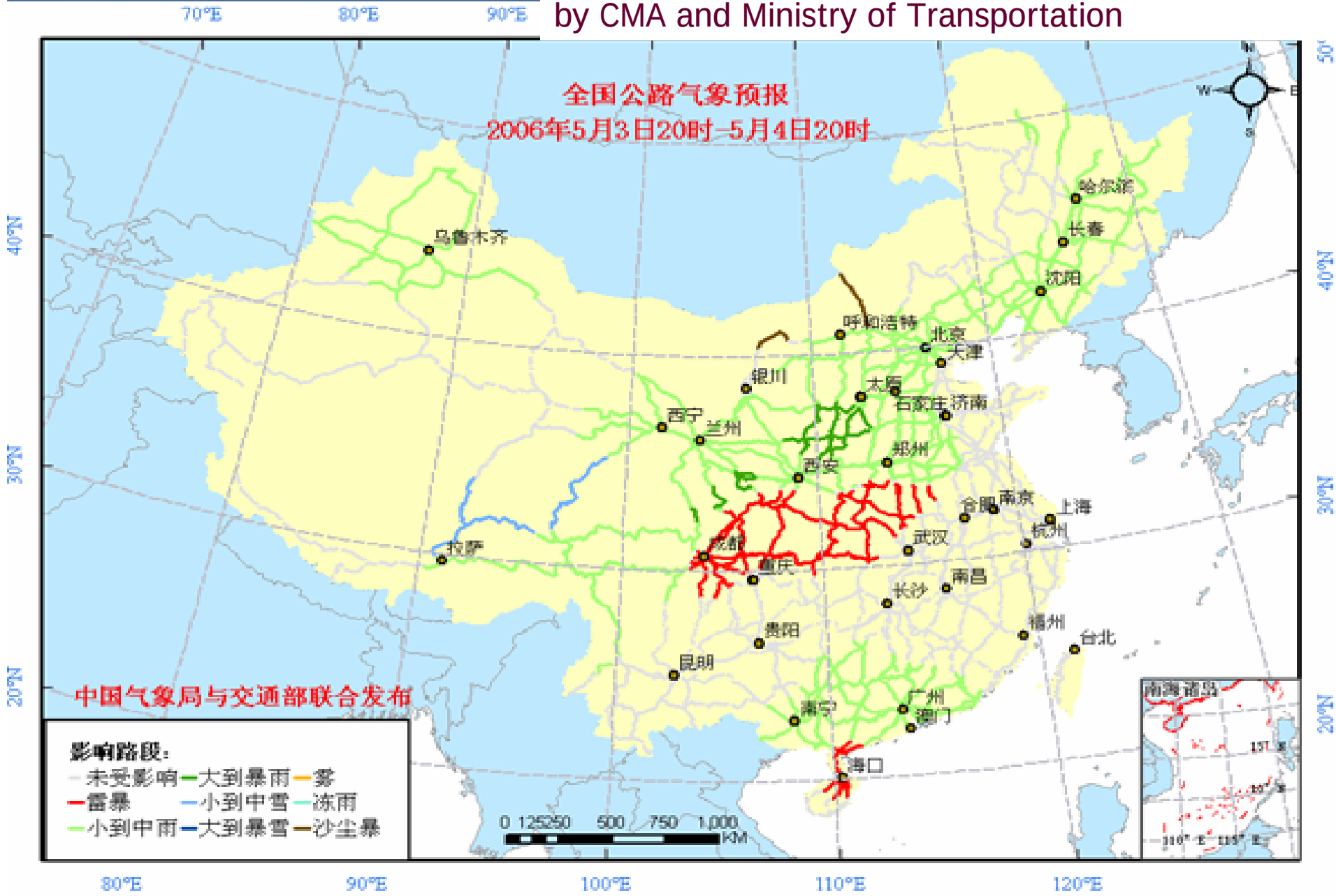


Heat/Health Warning



Transportation

Road Meteorological Condition Forecasts co-issued by CMA and Ministry of Transportation

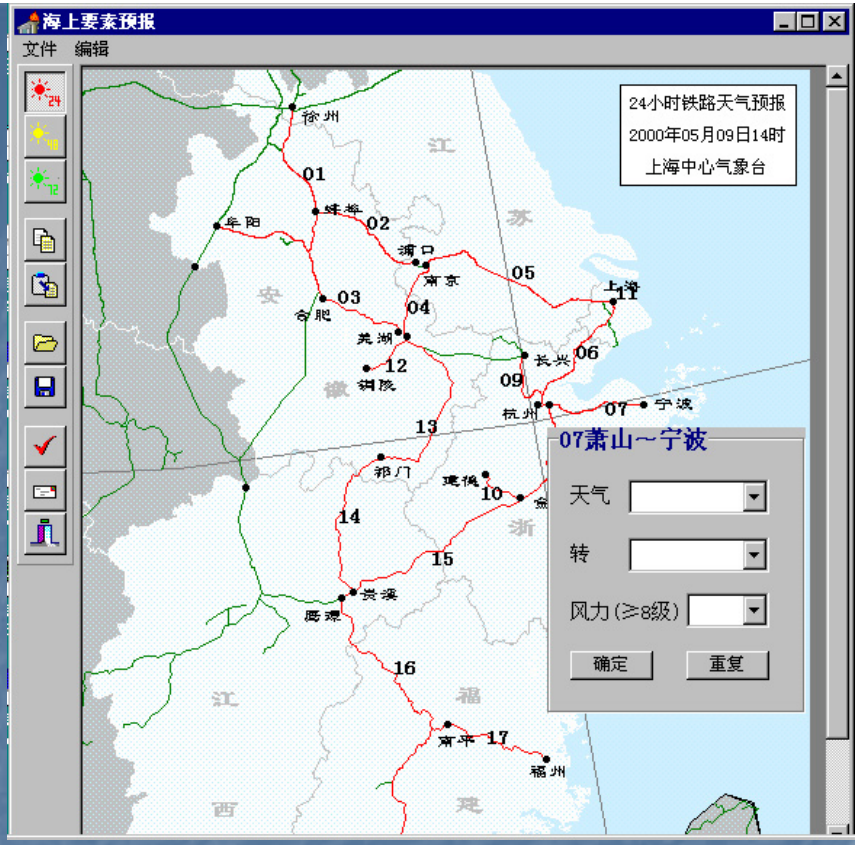


Transportation

Railway Meteorological Services System

Weather services for railway network started in 1994 in East-China.

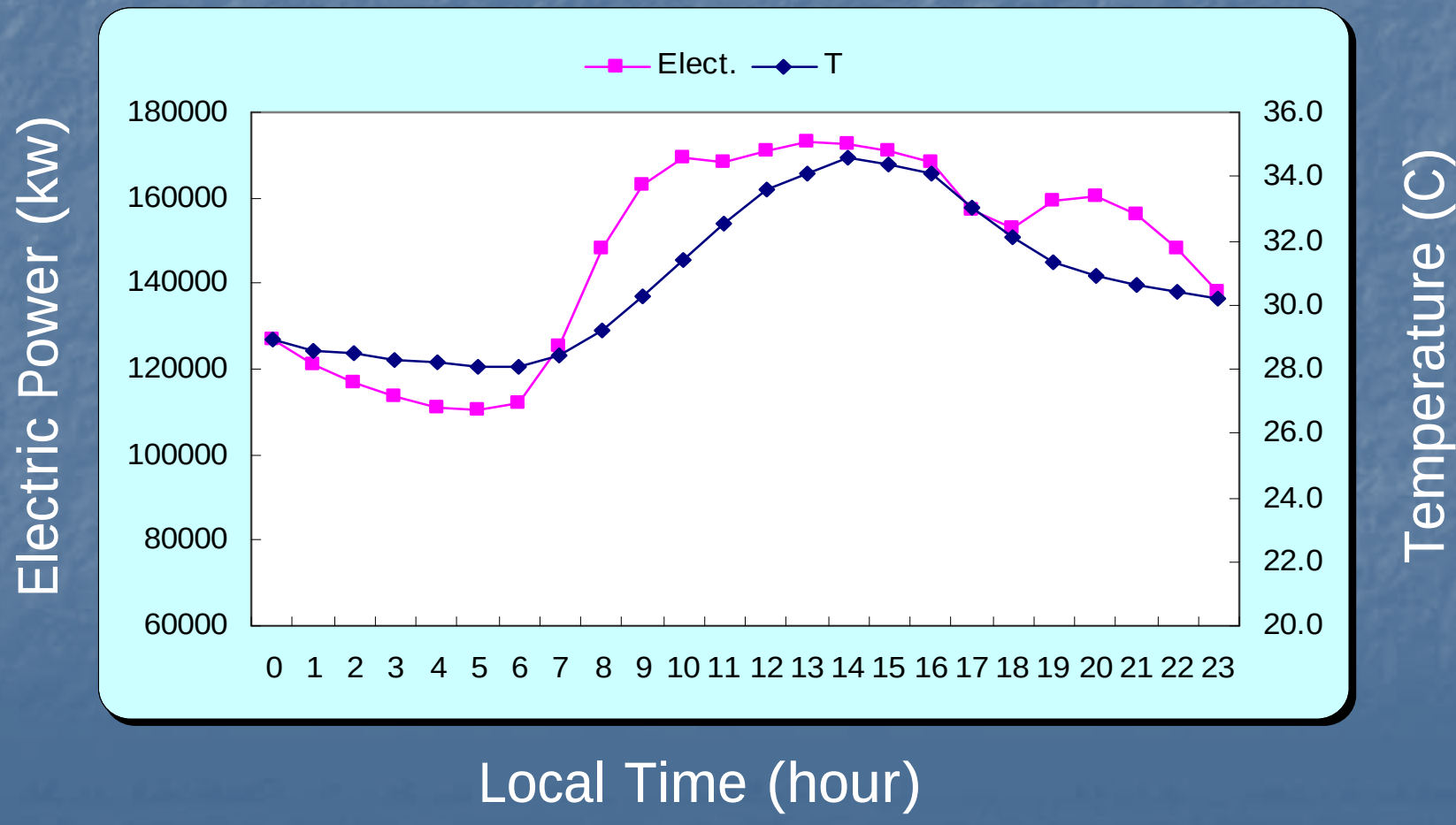
Visibility Monitoring and forecasting for high ways.



Weather & Energy

- Temperature forecasts help the local government plan and manage the electric power production and consumption.

A case of diurnal distribution of electric power (kw) in Shanghai



Weather & Energy

Analysis on the relation of air conditioner to electric power consumption in Shanghai

- There are 5 million air conditioners in Shanghai, each with a power of 2500 w on average.
- If 60% air conditioners work, the power needed could be: 60% x 5 million x 2500 w = 7.5 million kw, which is about 45% of the historic record power of Shanghai, 16.8 million kw.
- Energy cost of all air conditioners per day (8 hr) : 60 million yuan,

  and 31 days with a temperature over 35 C in 2005.
- When hot weather is forecasted, the local government energy agency will plan to produce more electric power or purchase power from other provinces.
- When high temperature warning signals (T= 35 C or higher) are issued, a power saving mode will be triggered by the local government. Some factories are asked to stop working.

------Higher temperature, higher power consumption, higher cost

Correct forecasts and appropriate allocation ensure energy security.

Special Service for Important Social Activities

Specialized Services for 2008's Olympic Games in Beijing and 2010's World Expo in Shanghai

Variety of action plans

3.3.3 Application of new technology in service dissemination

- The efforts to have weather information covered city area in Shanghai.

Meteorological Services are sent to residential communities (more than 8000), factories (22,000), villages(12,000) and schools(200)

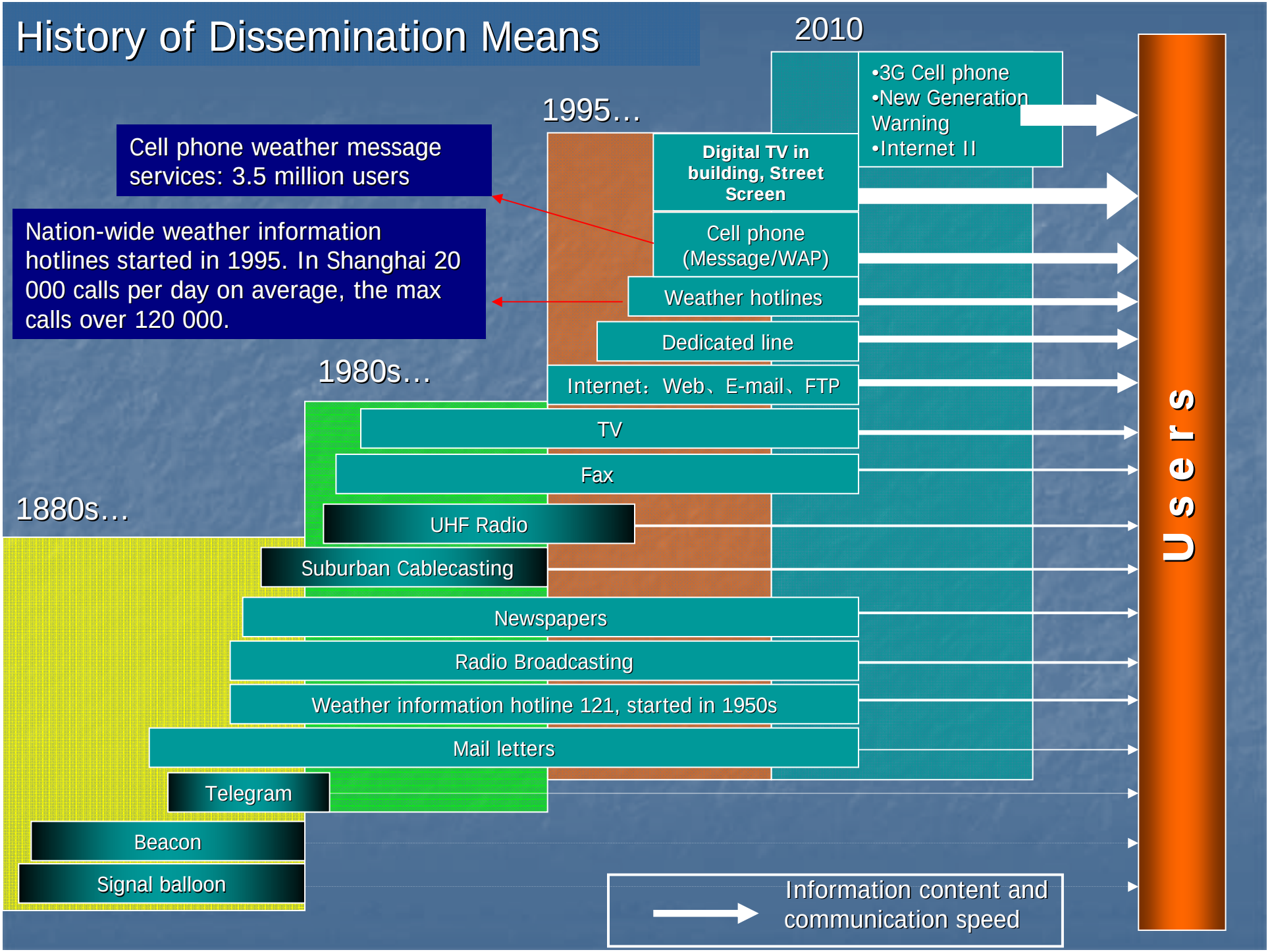
New technology applied to inform the public

- TV : 7 Channels
- Radio: 3 frequencies
- News papers: >10 offices
- Cell phone users: > 0.4 million (3.3 million nation-wide)
- Internet: available
- Digital TV in public(mansions, traffic tools): available
- Electron screens in public:>7000
- Weather hotlines: 12121 / 969221
- Citizen email box: available
- Severe weather Signal tower on Bund
- Meteorological Services in residential communities (8000), factories, villages and schools

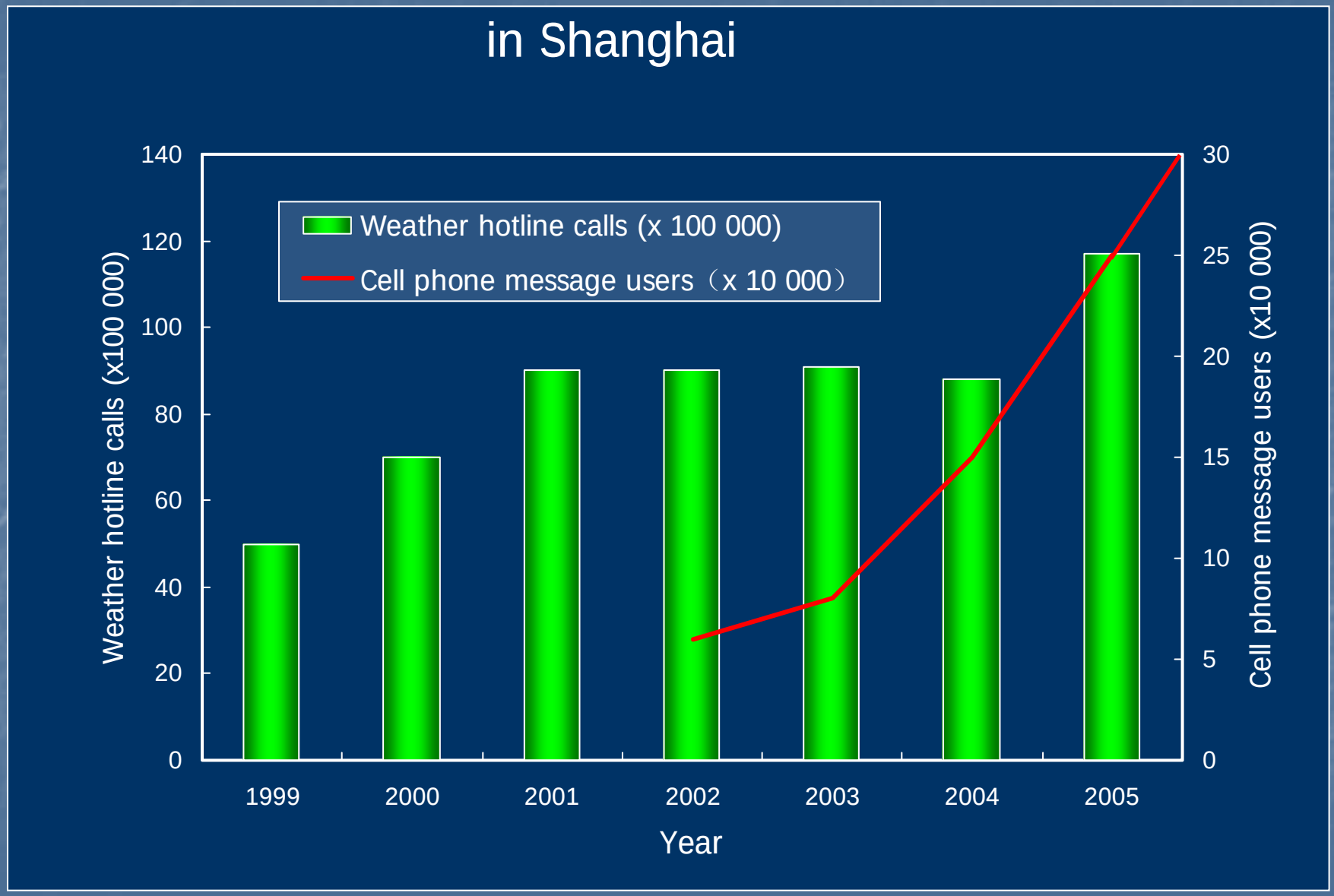
"Seamless" Service

Four 'Right's:

Right information to Right people at Right time at the Right place


History of Dissemination Means
2010
•3G Cell phone
•New Generation Warning
•Internet II
1995…
Digital TV in building, Street Screen
Cell phone (Message/WAP)
Weather hotlines
Dedicated line
Internet：Web、E-mail、FTP
Cell phone weather message services: 3.5 million users
Nation-wide weather information hotlines started in 1995. In Shanghai 20 000 calls per day on average, the max calls over 120 000.
1980s…
TV
Fax
UHF Radio
Suburban Cablecasting
Newspapers
Radio Broadcasting
Weather information hotline 121, started in 1950s
Mail letters
1880s…
Telegram
Beacon
Signal balloon
Users
Information content and communication speed

Users (through China-Telecom) Meteorological services in Shanghai



CMA's web page of specialized products
(http://www.cma.gov.cn)

Weather Services

Domestic | world | Tour

NMC

May 5 20:00

Beijing

Beijing search

Weather: Clear – Thunderstorm

Wind Dir: NE

Wind Spd: 3 m/s

Temp: 27 – 14 C


Low temperature observation


Radar mosaic


Satellite


Space weather

Severe weather warning

0-3 day forecast

0-10 day trend

Sandstorm forecast

Highway weather observations

Forest fire risk forecast

Drought/flood Climate advisory

Drought/flood monitoring

UV category forecast

Environmental weather

High impact weather monitoring

Agricultural weather

3.4 Mechanisms

A- Partnership

B- “Push & Pull

C- Cost recovery

D- Social volunteers

E- Education and training

F- Multi-hazard multi-agency in risk management

A- Partnership

- Close cooperation between NMHSs and other agencies, such as universities, government departments, NGO is essential to provide effective services.
- The main parts of specialized service with other agencies should become a basic operation in NMHSs. The policy to encourage other agencies to play an important role in the other parts of specialized service is needed.

  CMA has reached collaboration agreement with the ministries of agriculture, transportation, health, IT industry, Land and resources, and administrations of forest, tourism, environmental protection. Also, CMA has a general cooperation agreement with Shanghai Municipal Government.

  CMA and other agencies: Ministry of Science and Technology, National Science foundation, Academy of Science will jointly organize a Scientific and Technology Conference on 18-19, May 2006 to enhance the development of meteorological operation through R&D.

Partnership — closer collaboration

B- “Push & Pull”

- “Veteran captain in Met. office ” for marine weather service
- “Met. official in harbor” to involve in the safety operation

C- Cost recovery

---- a mechanism to encourage both providers and users to concern deepened application of service information

- Industrial services provided by NMHSs
- Outreaches for enterprises

  China-Telecom (Weather hotlines, Cell phone weather message service)

  Lightning protection engineering for users
- Broker for commercial weather services

D- Social volunteers: social activities to bridge the gap are very important based on “ Grassroots “ conception.

NMHSs should pay much attention to the field.

- Collecting feedback from the public
- Participating forecast evaluation
- Distributing service information
- Operating school-based observation network

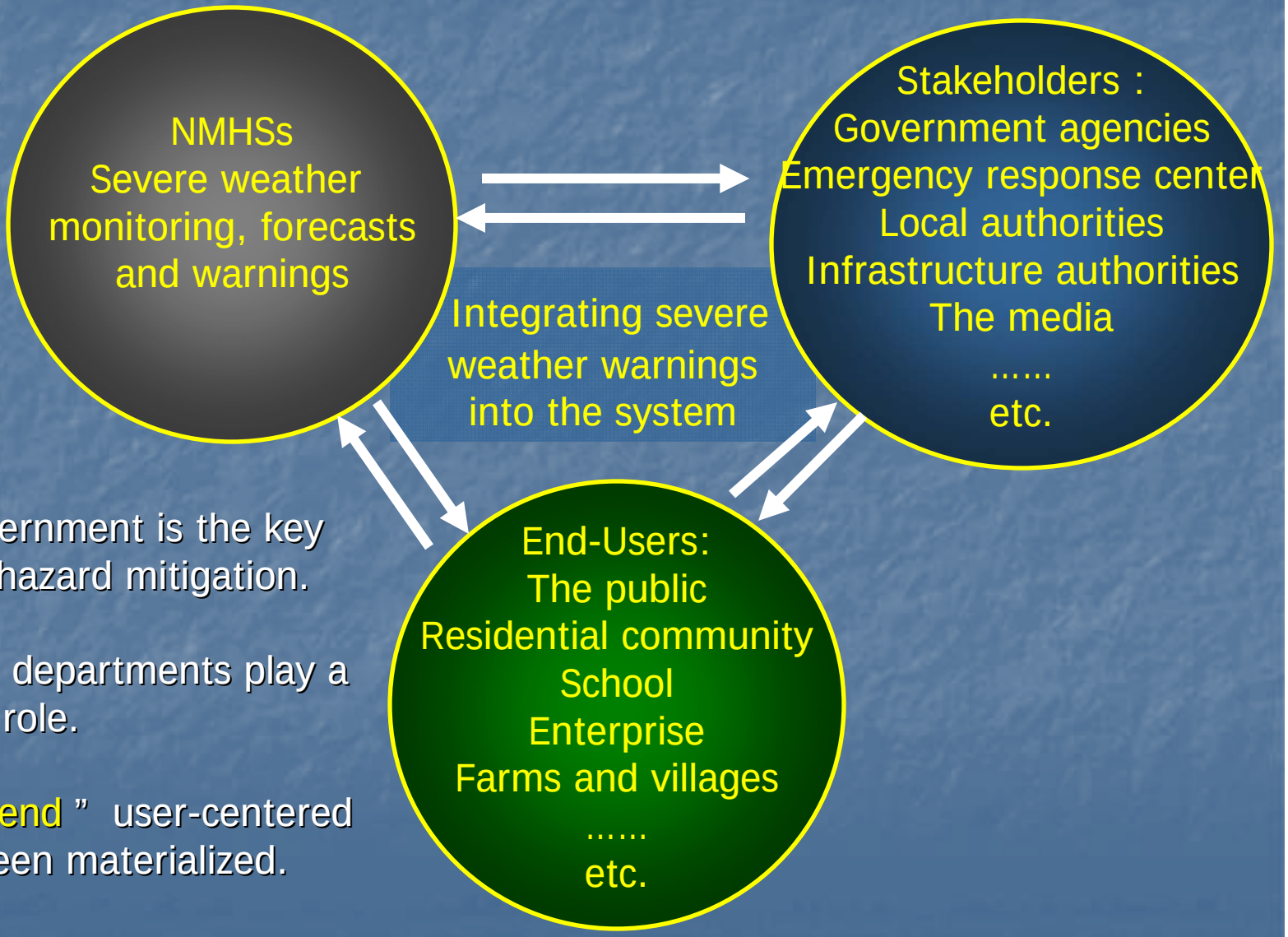
E- Education and training for:

- NMHSs’ users
- the public
- the policymakers

F- Multi-agency co-operation in risk management

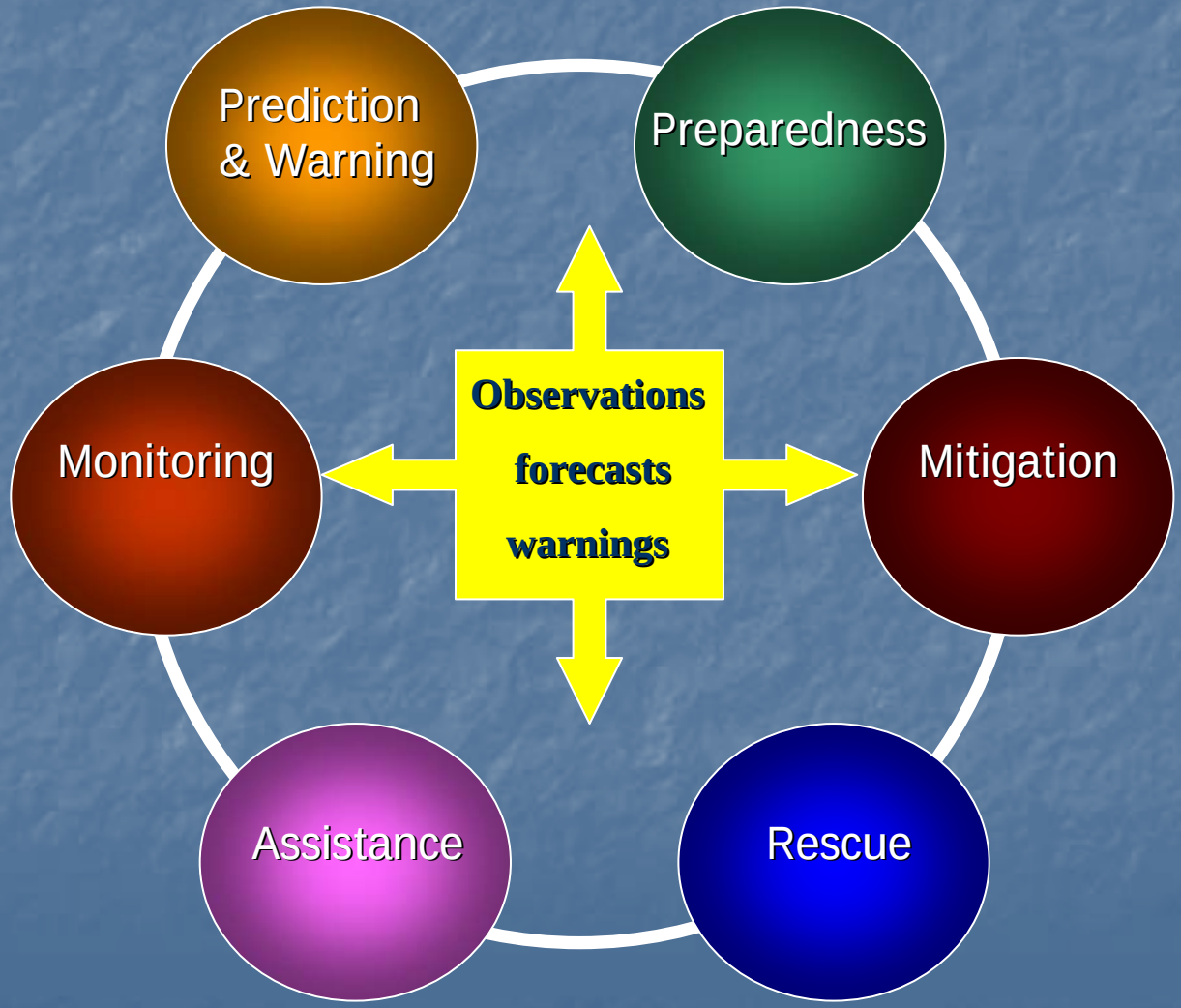
- multi-hazard mitigation and emergency response

Meteorological Services in Multi-Hazard Mitigation



- A powerful government is the key factor for multi-hazard mitigation.
- Meteorological departments play a very important role.
- "End to end to end" user-centered approach has been materialized.

Integrated Multi-Hazard Emergency Response Framework in Shanghai



4. Discussion and Consideration

-----"You can't find the user who has no requirement to the provider; however, you can find the provider whose service is not in position. – "User Centered concept".

However, The sense of protagonist should be established by NMHSs in operating coordination and partnership with other counterparts.

-- Bridgeman

- Services should change from provider-centered to social and economical users-centered
- Operations should change from product-centered to information-centered. The concept needs interaction from both side.
- So the structure should be reversed from "in-out" to "out-in"
- The leading role of NMHSs to bridge the gap should be emphasized

4. Discussion and Consideration

4.1 Legislation

4.2 Operation restructuring

4.3 Various mechanisms

4.4 Applied techniques

4.5 Education and training

4.1 Legislation

The legislation for bridging gap should be emphasized as followings:

----the basic role of NMHSs in early warning mechanism for multi-hazard mitigation and emergency response

----the responsibility of NMHSs in the application of service information in decision procedure of social and economic activities

----the basic role of NMHSs in providing basic products and an unique role in issuing severe weather warning by NMHSs

----un-substitution of the services provided by NMHSs to important users and fields which are heavily concerned by different levels of governments; The policy to encourage other agencies to play an important role in the other parts of specialized service is needed.

----flexibility and expansibility of the services with the increase of the requirements from users

----social involvement in specialized service should be encouraged.

----diversification trend of the services with different service mechanisms (public service, industrial service, etc.) should be clarified.

4.2 Operation Restructuring

- A well classification is needed for many kinds of services which are abundant in variety and distributed widely. The classification should accord with a classification in which different fields and vocations are sensitive to weather and climate. In the meantime, it should accord with the hotspots and important fields in the different periods of national social and economic development. Therefore, the kind of services should become multi-trail operations in NMHSs.

- Such kind of service requires a dimensional division of service operations in technical systems, i.e. centralized operation in developing basic product and distributed operation in the product of special service development. A corresponding structure of organization is required.

4.2 Operation Restructuring (cont.)

- All kinds of operational techniques and methodologies for different industries and specialties are needed while high quality human resources and other resources like financial support are also required.
- International, regional and specialized centers, national prediction centers and related specialized centers are required to do the centralized operation in basic product development.
- Operational office for specialized service needs to have strong and clear direction in specific service fields and industries. Meanwhile, customized features in the service are emphasized.
- …

4.3 Various Mechanisms

- Agreement structure needs to be established between NMHSs and other government agencies, academe, and NGO etc..
- Strong governmental support of both finance and policy for NMHSs to deepened application of the service as public goods is required.
- The “PUSH AND PULL” mechanism like “veteran captain in marine weather services” and “met-official in harbor” needs to be set up.

4.4 Applied Techniques

- Methodologies applied in the operation of requirement feedback and application effectiveness in the user's decision procedure
- A new operational influence prediction system for both positive and negative pre-evaluation
- Refined specialized service products by joint efforts
- Techniques of integrating meteorological service information into decision procedure of social and economic activities

4.4 Applied Techniques (cont.)

- Evaluation and verification system for operational service emphasizing on application benefit
- Integrated information platform based on NMHSs for multi-hazard mitigation and risk management
- Joint R&D with users and academic community to develop new application techniques for service operation
- ...

4.5 Education and Training

- For the NMHSs
  - Will be presented in the following session.
- For the users
  - Understanding of the limitation of prediction
  - Understanding of the information of prediction, i.e., probabilistic forecasts
  - Learning to use specialized service products
- For the public
  - Understanding of the limitation of prediction
  - Understanding of the information of prediction, i.e., general description for location, intensity, and time period of precipitation.
  - Learning to use specialized service products, i.e., heat wave index
- Approach for E&T
  - Identification of prototype
  - Development of E&T modules
  - E&T seminar, course, workshop and exercise.
  - Effect evaluation

Thanks for Your Attention

Comments and questions?