Practice of Shanghai Multi-Hazard Early Warning System (MHEWS)

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Outline

Ⅰ. Background and Practices

-- WMO demonstration project

-- Integrated services

Ⅱ. Enabling Activities

-- Technology improvements

-- Mechanisms for service delivery and decision-making

Ⅲ. Future Plan for sustaining MHEWS

Ⅰ. Background and Practices

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- Megacity of Shanghai: high exposure and vulnerability

- Shanghai aims to be the financial, trade, transportation, and shipping center of China (4 centers strategic positioning).
- Shanghai has dense population (24+ million), congested traffic (2+ million civil vehicles), and productive economic activities.
- Critical locations such as downtown, the bund, airports, harbors, etc. are highly sensitive to weather events.

Ⅰ. Background and Practices

- Severe weather disasters of Shanghai

The frequent disasters occurred in shanghai include **typhoon**, **rainstorm**, **lightning**, and **gale**.

- Magnification Effect:

  Even slight weather events can trigger significant loss of life and property due to high population density and critical economic activities.

- Domino Effect:

  Natural hazards can lead to accidents, life and economic losses. Secondary and tertiary effects of weather induced disasters can have severe short and LONG TERM consequences.

Impacts of meteorological disasters on Shanghai during 1984-2009

Type of disasters	Number of deaths (people)	Number of injuries (people)	Collapsed building(houses)	Direct economic losses (million CNY)
Rainstorm/flood	28	56	788	237
Typhoon	54	394	26030	650
Thunderstorm	85	58	108	13
……				
Total	**312**	**1928**	**38290**	**1082**

Ⅰ. Background and Practices

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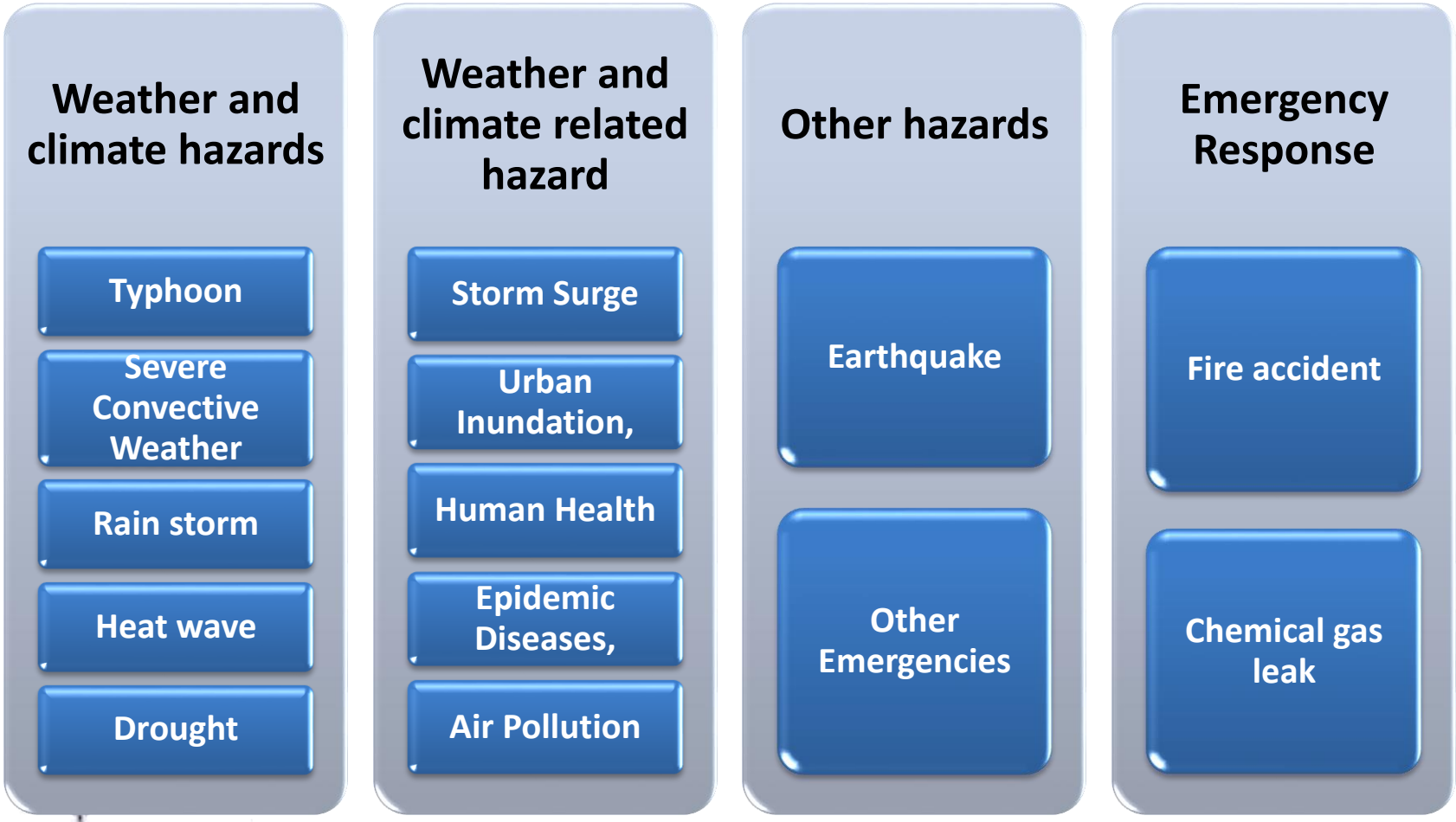
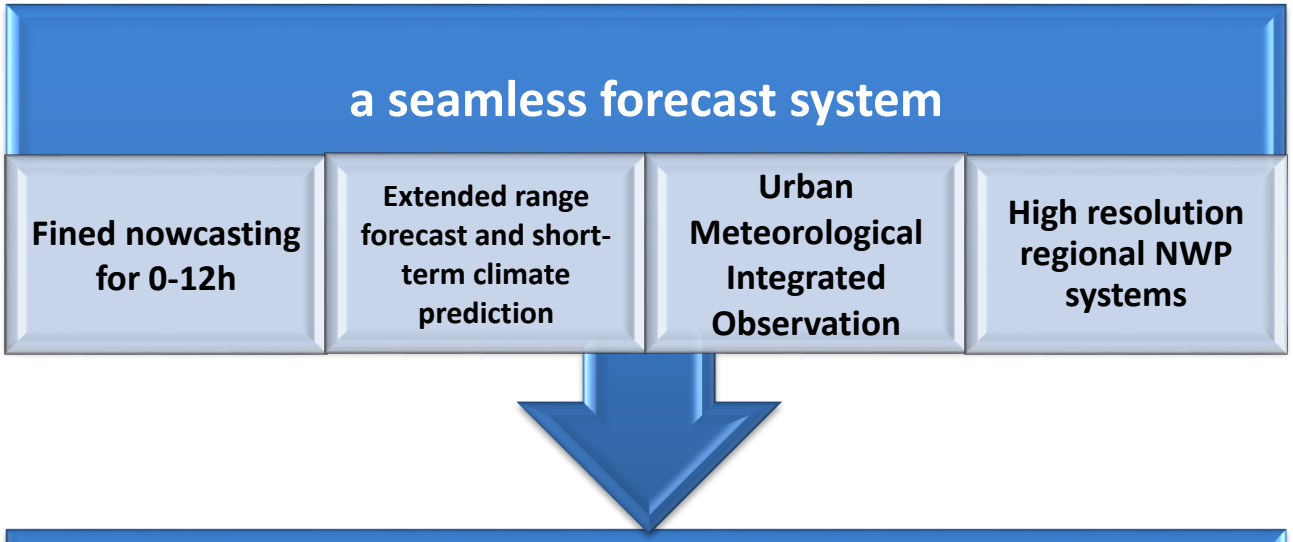
WMO identified the Shanghai MHEWS as Demonstration Project in 2007



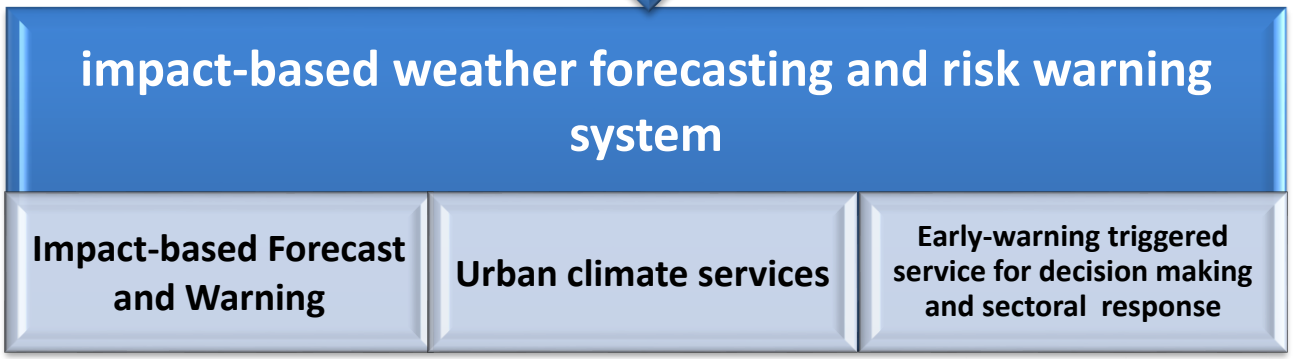
Ⅰ. Background and Practices

Integrated Urban Weather and Climate Service : Two integrations

1. Integration of weather forecast and climate prediction

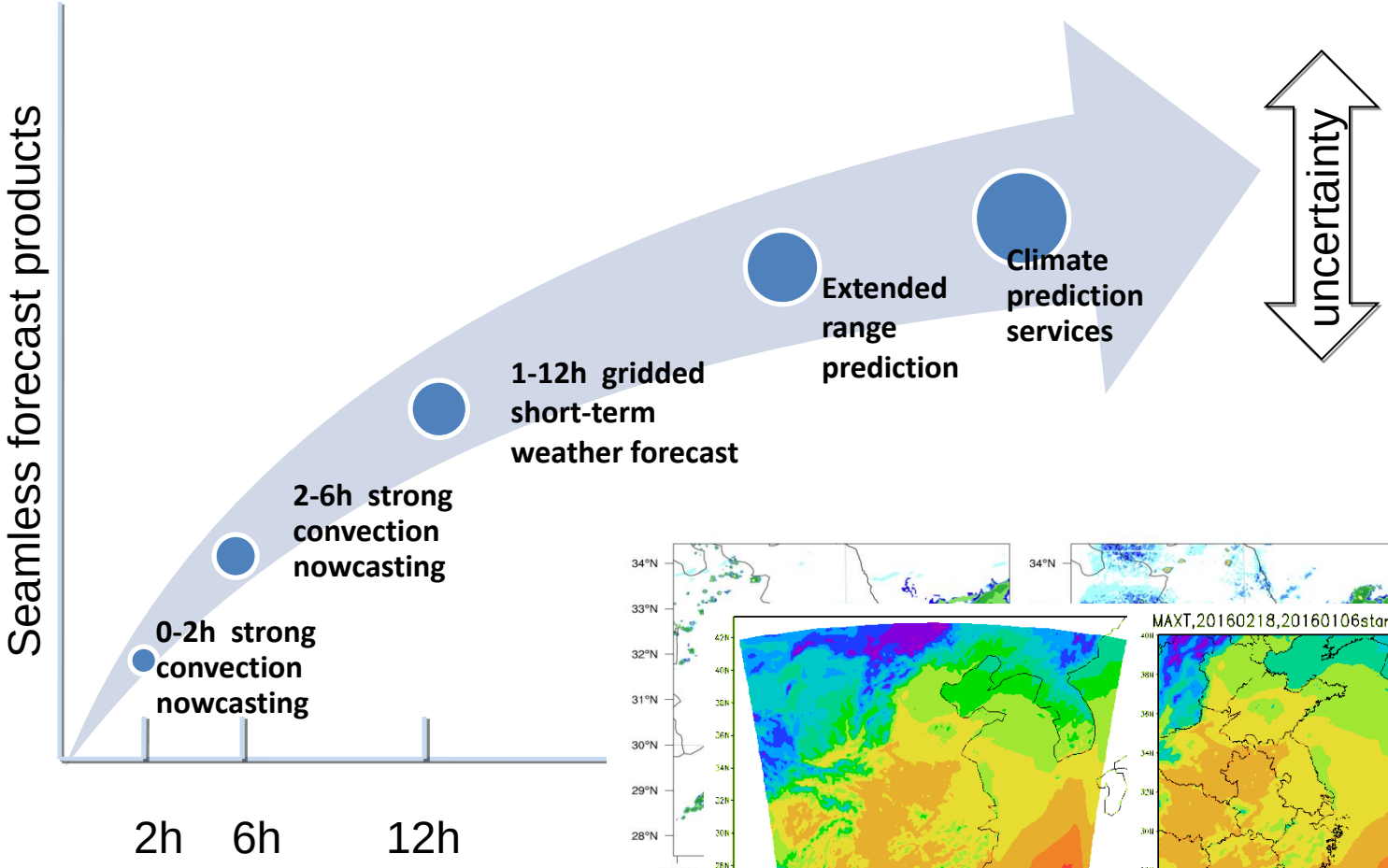


2. Integration of Met services and risk management



Ⅰ. Background and Practices

Seamless forecast



Ⅰ. Background and Practices

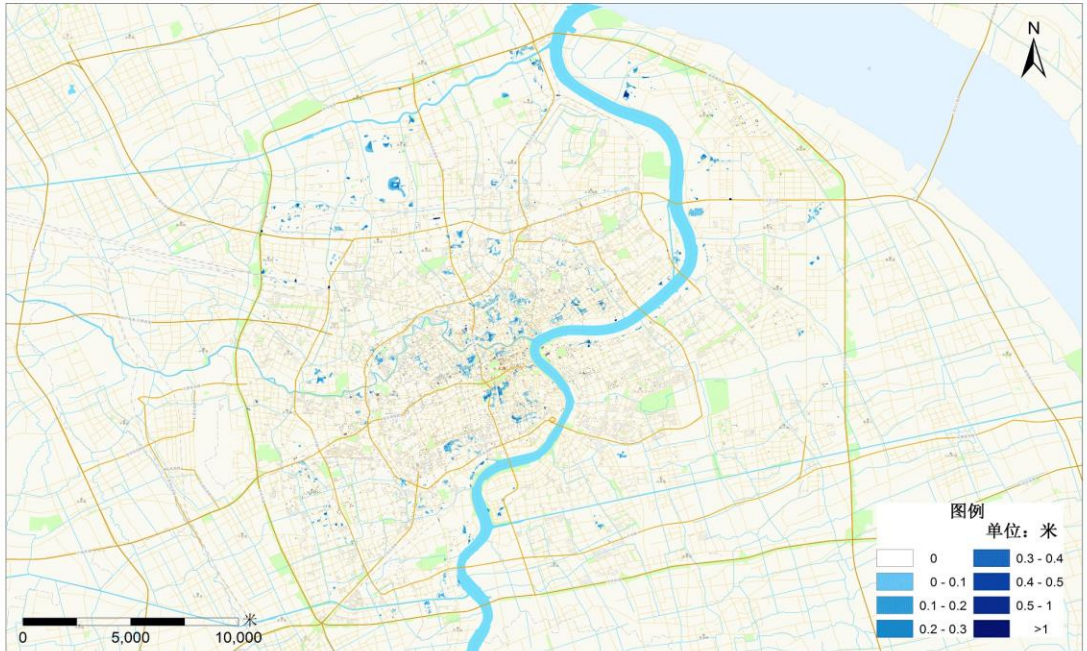
Impact-based Forecasting and Warning : Urban Flooding

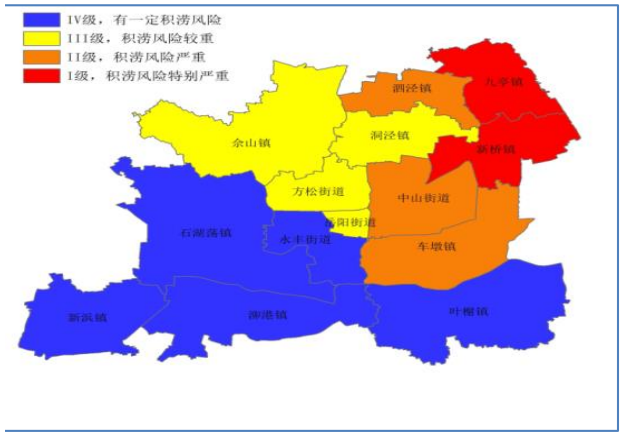
-- The threshold for Flooding risk warning is docked with community four-level response and linkage standards.

-- Flooding Risk products released to the public, community manager and shared with flood control sector.

-- Cooperation with the Civil Affairs Department and flood control sector

Rainstorm waterlogging simulation（50mm/h）





flood risk warning in Songjiang district

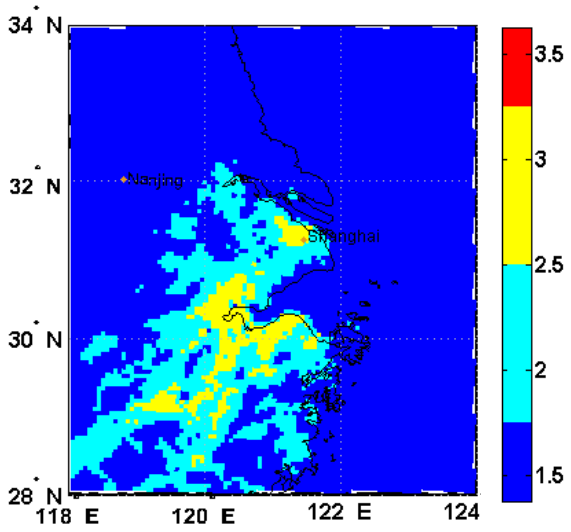
Ⅰ. Background and Practices

Impact-based Forecasting and Warning : Human Health

-- SMS Issues impacts forecasts for respiratory diseases, such as common cold, children's asthma and COPD (Chronic Obstructive Pulmonary Disease) in cooperation with Shanghai municipal center for disease control and prevention.

-- Health forecast service has been delivered to schools, community health service centers, elderly service centers, catering industries and construction sites.

-- Evaluation showed that average number of cold attack for children in intervention group was 10% lower than that of non-intervention, and over the half of the respondents considered cold forecast be helpful for reducing family health care cost.



health forecast in hospitals

Ⅰ. Background and Practices

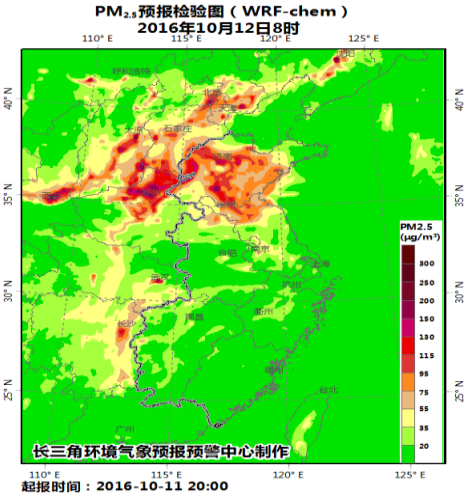
Impact-based Forecasting and Warning : Environment

-- Jointly issue the AQI prediction and waring with Shanghai Environment Protection Agency.

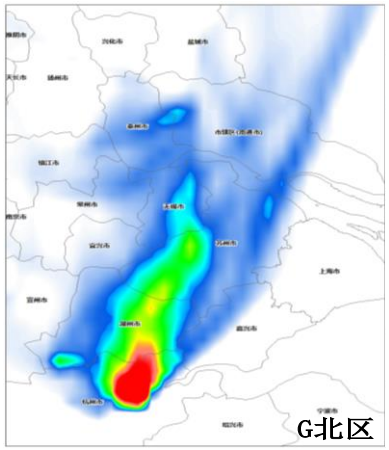
-- Extend the air quality forecast to 10d for emergent emission reduction to mitigate severe air pollution events.

-- Evaluate the cost effect of local clean air action plan to support the decision making for emission control.

AQI forecast in Shanghai



Regional $PM_{2.5}$ numerical prediction



Source area for emission control derived by air pathway analysis

Ⅰ. Background and Practices

Impact-based Forecasting and Warning : Rail Transport

-- Cooperation with Shanghai Metro to develop technical platform and carry out impact forecast and risk warning services for rail transport.

-- In response to risk warnings, Metro line 16 and line 2 suspended operations during the period of typhoon ‘chan-hom’ in Shanghai.

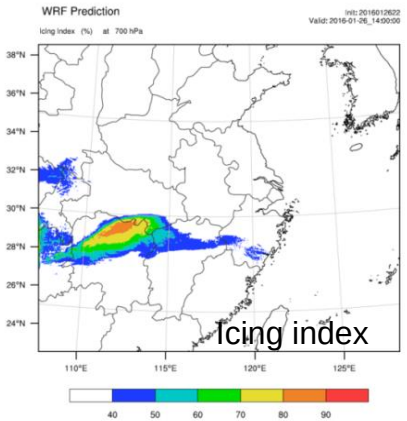
The gale risk warning of Metro Line 16 during typhoon’ Chan-Hom’ attacking Shanghai in 2014

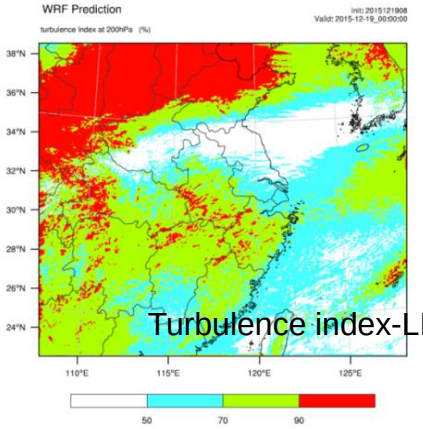
Ⅰ. Background and Practices

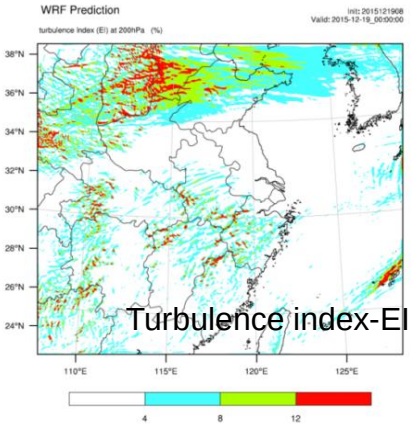
Impact-based Forecasting and Warning : Aviation

-- WMO Pilot Project (AvRDP): Developed high impacted weather analysis and forecast platform for aviation based on the integrated MET and ATM information. The system has been applied on trail to support east China ATMB and east China Airlines etc.

-- Based on high resolution numerical weather prediction model, aviation index including icing and clear air turbulence has been developed in support of C919 flight test.







Ⅰ. Background and Practices

Urban climate service : City Planning to Build Resilience

The climate risk analysis results were adopted by the 13th Five-Year plan of Shanghai Energy Conservation and Climate Change Adaptation

Shanghai Future Climate Change Risk Assessment Matrix

Climate Change Risk Assessment

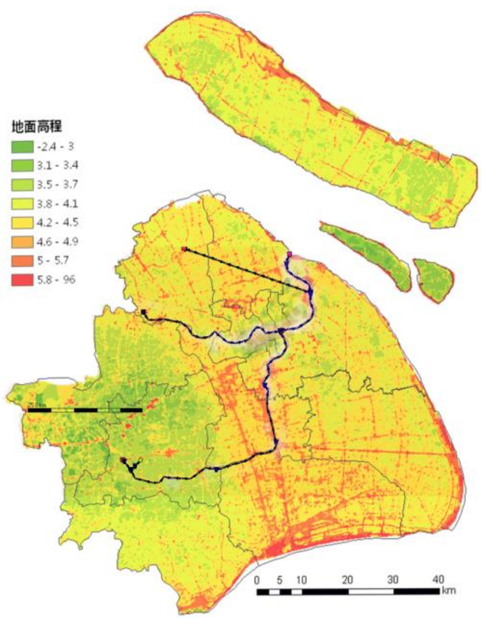
High Risk Medium Risk Low Risk

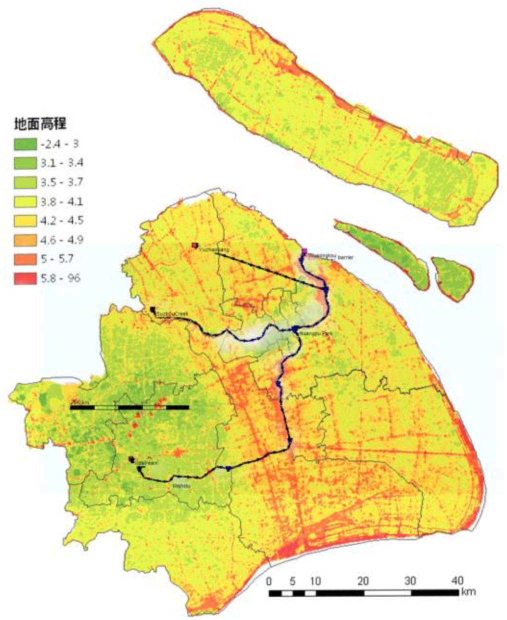
Impact Analysis \ Affected Sector		Transportation				Water			Energy			Eco-environment			
		Road	Aviation	Water Transport	Rail Transit	Flood Control	Water Logging	Water Supply	Energy Supply	Gas Supply	Energy Infrastructure	Green Area Space	Wet land	Agriculture	Air quality
Extreme Climate Event	Sea Level Rise														
	Typhoon Rainstorm														
	Heat Wave														
	Cold Wave														
	Storm Surge														
	Fog														
Vulnerable Area		Airport, subway and other urban transportation center during busy period; urban elevated road; underpass of the elevated road which is susceptible to waterlogging				Crucial flood control area including Huangpu River, Suzhou Creek; underpass of the elevated road which is susceptible to waterlogging; typhoon affected costal port area			Yangshan port gas station; underground and transmission line cluster area; costal wind power station susceptible to typhoon			Chongming east shore wet land; Huangpu River water source region; Dianshan lake; urban major green area and agriculture base.			

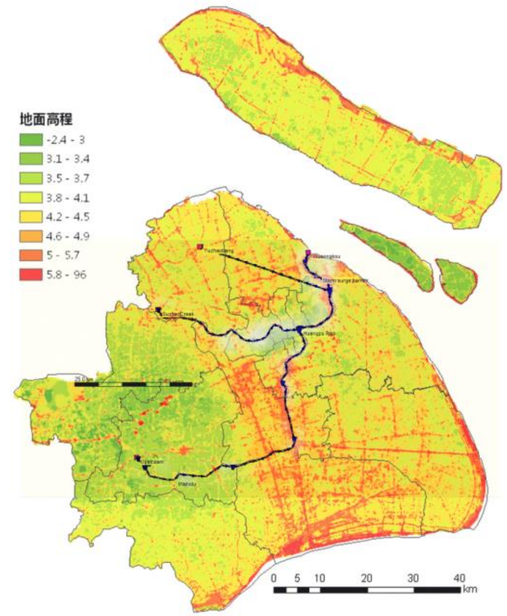
Ⅰ. Background and Practices

Urban climate service: Infrastructure Construction

In order to lower the risk when “Four extremes (Typhoon, rainstorm, astronomical tide, upstream flood) meet ”, the Shanghai government intends to build a barrier at the mouth of Huangpu River. The evaluation of different engineering measures under a thousand years flood scenario were conducted by Shanghai Meteorological Service.







Ⅱ. Enabling Activities

Technology improvements: Enhancement of the Urban Integrated Meteorological Observation

-- Experimental studies on adaptive layout of the synoptic network in Yangtze River Delta.

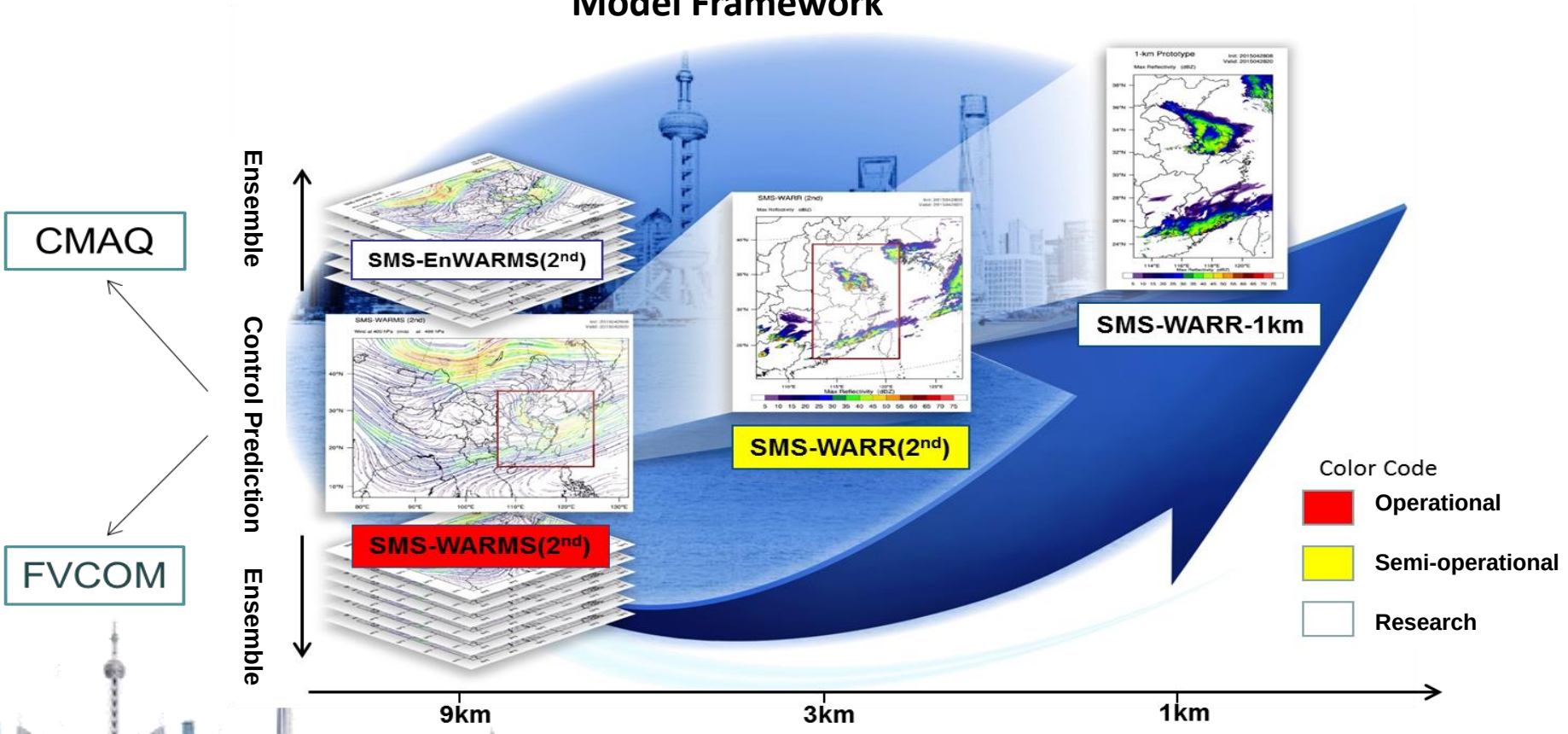
-- Establishment of the integrated meteorological observation system, enhance the city's meteorological disaster monitoring and early warning.

Automatic station	256
radar	2
Wind profiler	10
Gradient observation station	13
L band sounding	1
Lightning location	7
GPS/Met	31
Satellite remote sensing	9
Atmospheric composition	10
Real monitor	27
Mobile observation car	5

Ⅱ. Enabling Activities

Technology improvements: High Resolution Regional Weather Forecasting System

SMS Holistic Multi-scale Regional High-resolution Assimilation and Model Framework



Ⅱ. Enabling Activities

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Mechanisms for service delivery and decision making

A regulation was issued in 2014: Improving Contingency Plan and making the color coded weather warnings the real trigger for actions.

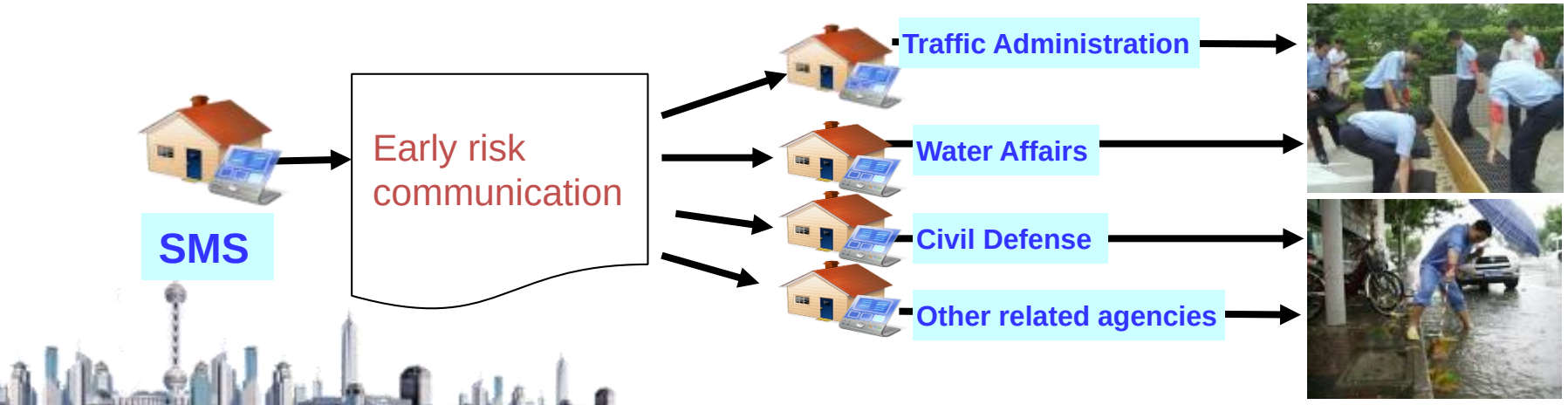
- All citizens can automatically decide whether or not to go to work, and schools are given the option to close in case of red warnings.
- The related agencies are requested to take actions immediately, and to upgrade their reaction to the highest level once a red warning was issued.
- The media should provide green channels to deliver red warnings through every channel to maximize the efficiency of warnings.

Ⅱ. Enabling Activities

Mechanisms for service delivery and decision making

Early Communication: proved effective in reducing the impacts of disastrous weather events

SMS usually provides Early Risk Communications to special users and agencies (Emergency Management office, Flood Control, Construction and transportation administration, etc..) well in advance of public warnings so that the related agencies could have enough time for reactions and do adequate preparation.



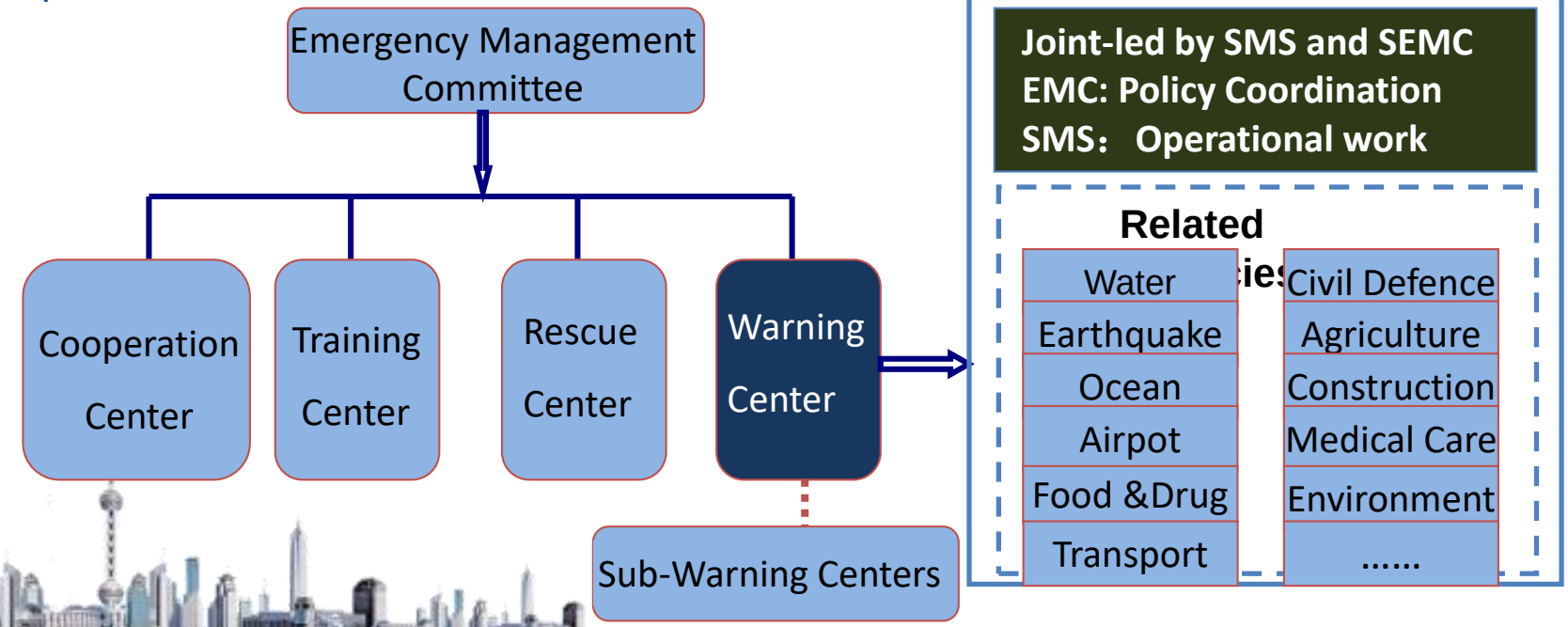
Ⅱ. Enabling Activities

Mechanisms for service delivery and decision making

Nationwide MHEWS: effective platform for emergency response

National: CMA sponsored the early warning system for all natural disasters and public events in cooperation with the State Council Emergency Response Office.

Shanghai: Emergency Warning Center(EWC) was officially established in 2013. The local regulation requests that all the emergency warnings should be issued through the EWC platform.



Ⅱ. Enabling Activities

Mechanisms for service delivery and decision making

New legal instrument came into force on 1 march 2017

Highlights :

-- Enhancing governmental role in long term planning and annual performance appraisal
-- Enabling risk assessment and early communications with affected sectors for response actions
-- Encouraging innovation for reducing prediction uncertainty and issuing impact forecast and risk warning
-- Identifying key weather ready units and related obligations for risk reduction
-- Strengthening the red warning triggered emergency response for lockout and class suspension
-- ……

上海市人民政府令

第 51 号

《上海市气象灾害防御办法》已经 2017 年 1 月 3 日市政府第 138 次常务会议通过，现予公布，自 2017 年 3 月 1 日起施行。

市 长

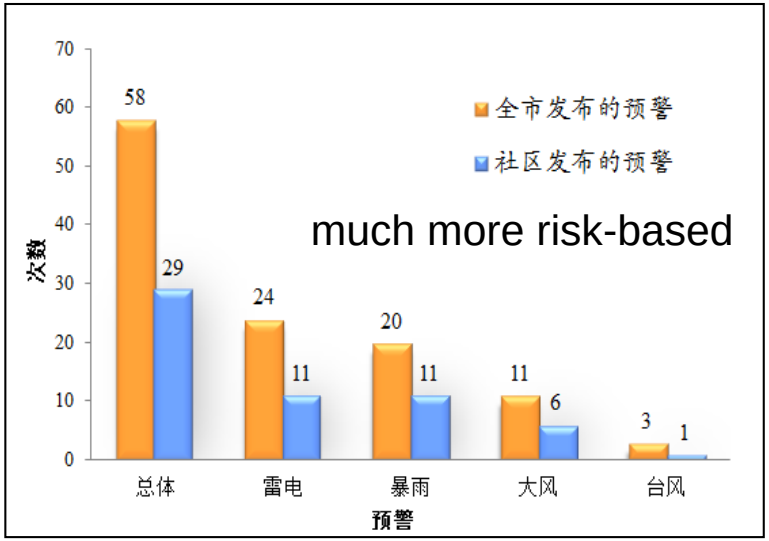
2017 年 1 月 23 日

Regulation on Meteorological Disaster Prevention and Mitigation

Ⅱ. Enabling Activities

Benefit assessment

- ‘Government Leading, multi-agency cooperation, public participation’ mechanism has been established, making meteorological service the first link in the DRR Chain. Partnership among sectors strengthened.
- The accuracy and efficiency of forecast and warning has been enhanced. Impact-based forecast and risk-based warning was implemented from the city level to community level.
- Enhancement of warning efficiency and effectiveness: both warning numbers and time spent decreased nearly 50%.
- With the support of SMG and CMA, new facilities and platforms have been set up. Shanghai Emergency Warning Center played a key role for data sharing and coherent sectoral actions.



June-October, 2014

Ⅲ. Future Plan for Sustaining MHEWS

- Focus on smart city

- Establishment of the big data platform with access of related departments, enterprises and social media.
- Establishment of the Artificial Intelligence meteorological operational system (NWP +), including urban digital tools for integrated simulation, urban super site for integrated observation, and impact forecast & risk warning.
- Establishment of the Shanghai e-weather service platform (**E3** Platform), including **E**arly warning triggered service for decision making, **E**nterprises tailored service for economy activity, and **E**veryone empowered service for general public.

Ⅲ. Future Plan for Sustaining MHEWS

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- Focus on impact-based forecast and risk-informed warning

- Impact-based forecasts and risk-informed warnings focusing on urban flooding, aviation, marine navigation, health and transportation will be developed based on high resolution numerical weather forecasting products.
- Transition from basic forecasts to impact-based forecasts through establishment of impact assessment model based on coordination between SMS and partners.
- Transition from warnings based on fixed meteorological thresholds to that based on users' risk matrix with the integration of user decision making mechanisms.

Ⅲ. Future Plan for Sustaining MHEWS

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- Focus on integrated weather and climate service

The Shanghai urban climate service are being developed and delivered to government decision-makers, industrious sectors, and the public:

- Anomaly monitoring and Intra-seasonal and seasonal Prediction
- Weather disaster risk assessment for urban planning, infrastructure construction and big events
- Wind and solar resource assessment and predication
- **Implement The Action Plan of Climate Change Adaption in Shanghai**

Ⅲ. Future Plan for Sustaining MHEWS

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- Focus on improving community's resilience

- Develop the refined weather warnings at the sub-district level and deliver services for communities at risk and in need.
- Organize the identifications of Met Safety Communities jointly with emergency management office and civil affair agency.
- Encourage the NGOs and volunteers to participate in the disaster risk survey, feedback communication and DRR service delivery.

Ⅲ. Future Plan for Sustaining MHEWS

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- Focus on risk reduction and transfer

- Develop Standards for construction of hazards resilient infrastructure. For examples: Urban lifeline (electricity, gas, transportation) standards such as wind resistance, lightning prevention standards.
- Engage with insurance sector to support financing recovery from disasters such as typhoon and rain storm etc..

Thanks for your Attention !

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