



# Concept of Multi-Hazard Early Warning in China and Overview of Shanghai MHEWS

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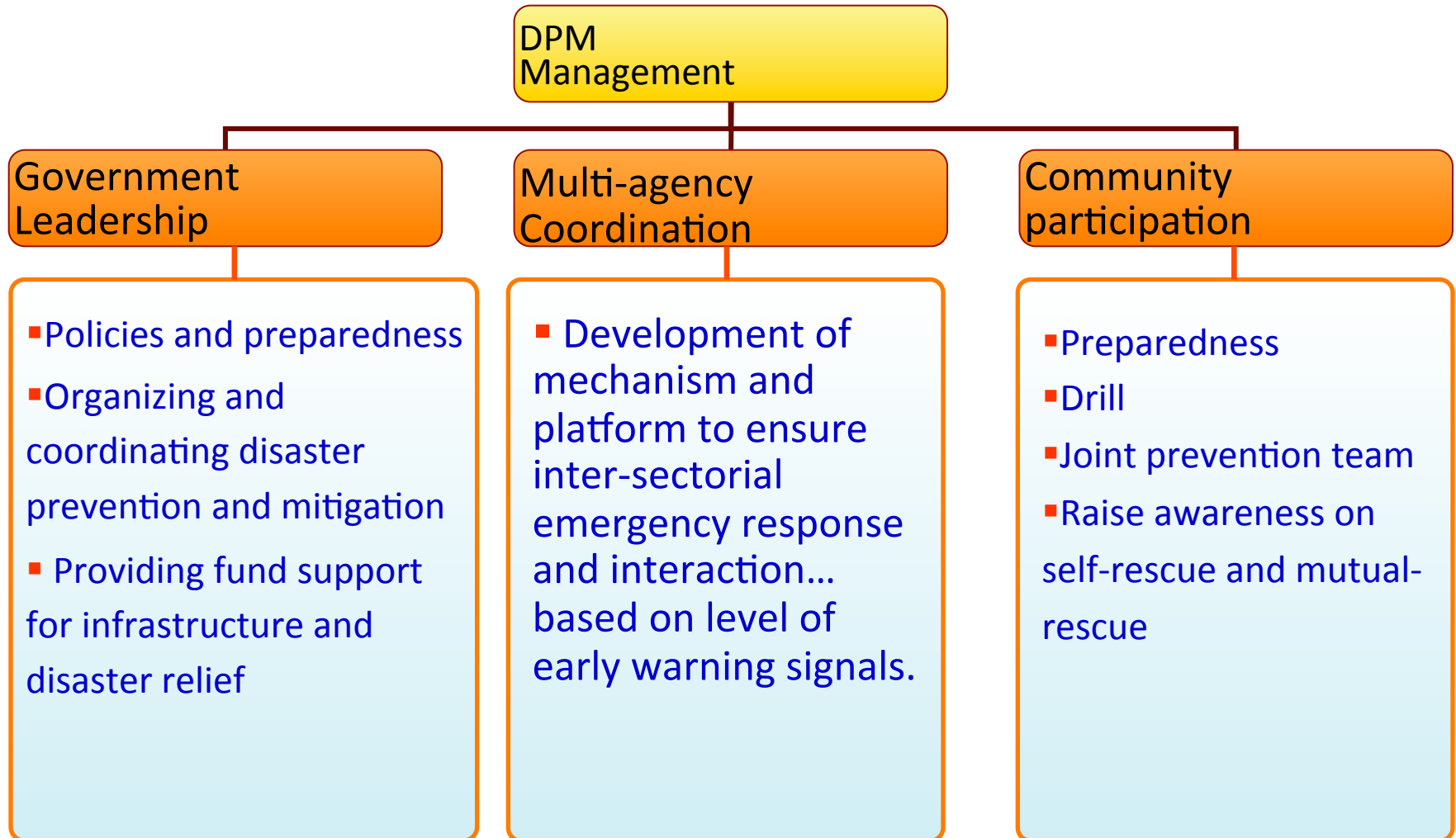
*(June 9th, 2014)*

# Outline

1. Characters of China DPM system
2. Practice of MHEWS (3 Systems)
3. Summary

# 1.1 DPM Management Characters

a) Government leadership, b) Multi-agency Coordination, c) Community Participation



# 1.2 Government Leadership: National regulations



There are two items in the 'the Public Emergency Response Law of China', they are '**Prevention and Emergency Response Preparedness**' and '**Monitoring and Warning**', in which preparedness, emergency shelter, registration and examination of risk sources, emergency response management training, professional emergency search and rescue operations, and emergency response materials are addressed.

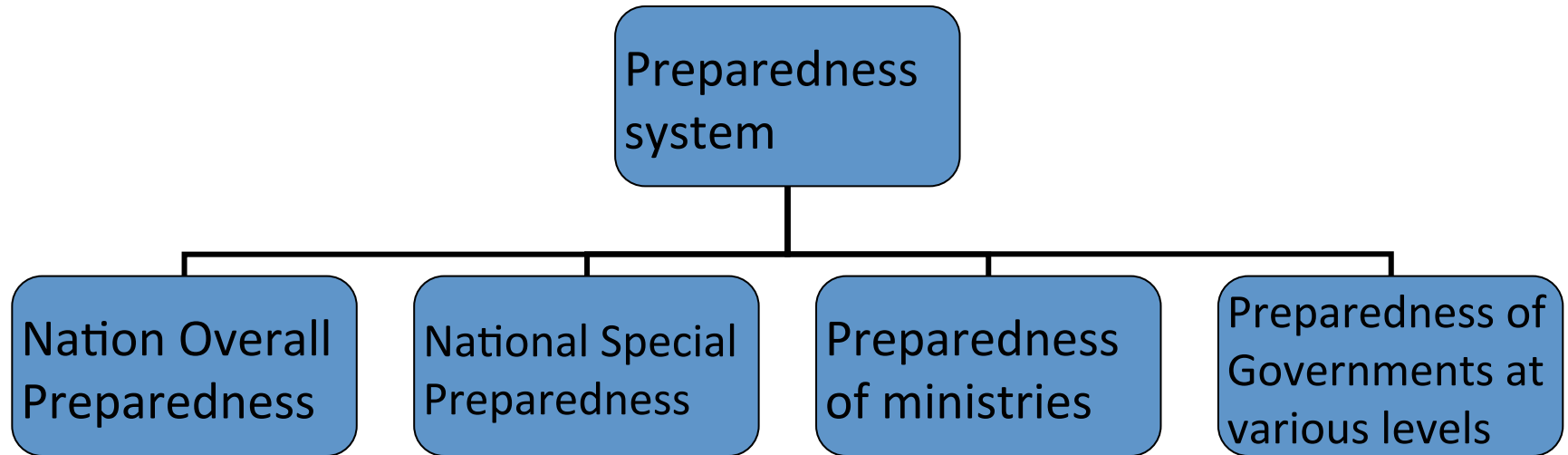


The 'Meteorology Law of China' defines the roles, responsibilities and authorities of weather departments as well as their operational functions such as construction and management of **meteorological facilities, observation systems, weather forecasts and weather warning processes, weather disaster prevention, climate resource exploitation and their implementation and maintenance.**



Item 31 of 'the Flood Control Law of China' requires establishing China's flood control system, addressing hydrology, weather, communication warning and flood disaster monitoring systems. According to item 43 of the Law, during flood season, **meteorological services should provide weather forecasts to the flood control headquarters**

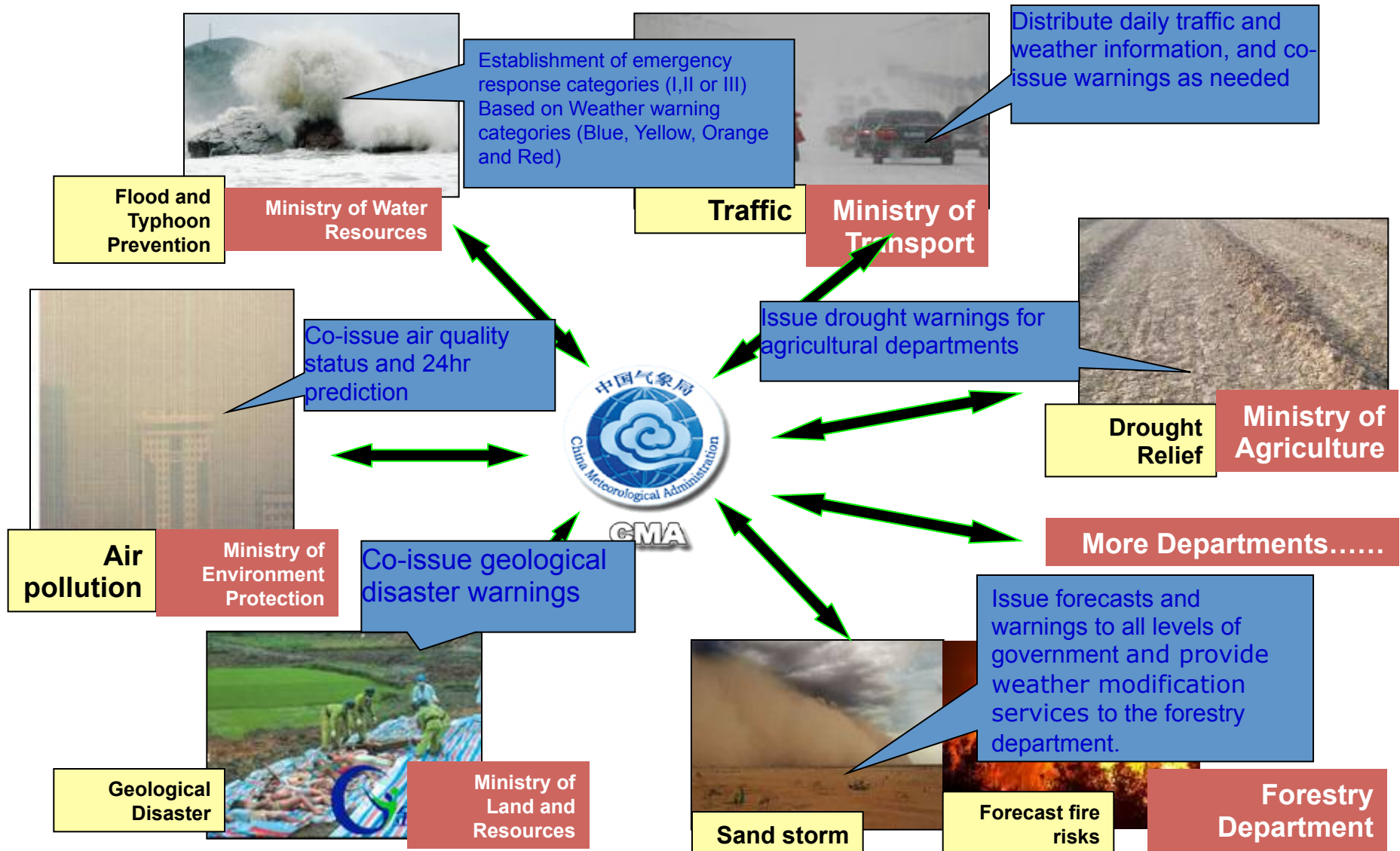
# 1.2 Government Leadership: Preparedness on Multi-hazard Early Warning



- The **National Emergency Response Plan for Meteorological Disasters** implemented from 1 January 2010.
- The Plan requests all departments, entities and social communities at all levels to take immediate actions in accordance with meteorological disaster warning signals and discharge their respective responsibilities.

# 1.3 Multi-agency Coordination: Multi-agency coordination practices

The CMA has signed over 15 agreements with several other ministries to prevent and mitigate the impact of severe weather and related disasters.



## 1.4 Community participation

- NGOs and volunteers: 490,000 people
- Training for the public: 100,000 people



Bangqun Xiao,  
meteorological volunteers of  
Anhui Tongling County  
Jinshan

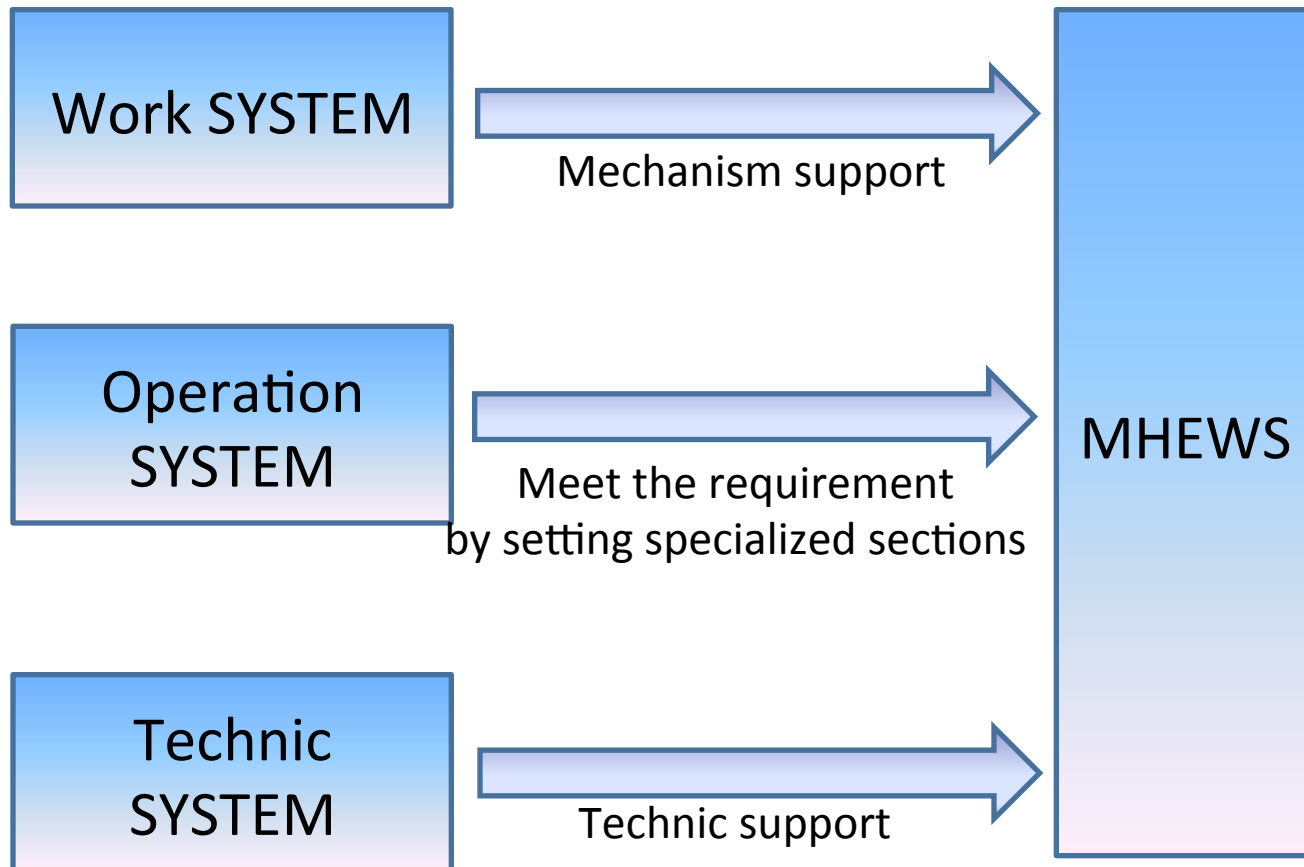


# Outline

1. Characters of China DPM system
2. Practice of MHEWS in Shanghai(3 Systems)
3. Summary

## 2. 3 Systems of MHEWS

The MHEWS include 3 systems: Work System, Operation System & Technic System.



## 2.1 Work System of MHEWS

- ◆ Shanghai has set up the framework of “Government leading, Multi-agency coordination & Community participation” by enacting legislation and establishing corresponding mechanism.
- ◆ Met Services are the first link in the chain of DPM and have a critical role in disaster detection and warning as well as a supporting role in prevention and mitigation & rescue.

## 2.1 Government Leadership: Local regulations on MHEW



上海市实施《中华人民共和国气象法》办法

On Oct.1, 2006, The Shanghai People's Congress passed “**Shanghai Implementation Regulation of the Meteorological Law of the PRC**”. It clarifies the mandate of SMS in DPM.

Weather departments should provide special services through multi-agency cooperation to, and receive support and feedback from, government departments such as **Agriculture, Fisheries, Flood Control, Traffic and Transportation, Fire Control, Police, Environmental Protection, Civil Administration, Public Health, Tourism, Harbor and Maritime management.**

‘**Decision on enhancing the capacity of weather disaster monitoring, warning and dissemination**’ was issued by the general office of SMG in Sep. 2011. 1.

In the regulation: 1) **participation in weather disaster monitoring, warning and service delivery activities** of government of all levels & relevant agencies are required, and tasked of various sectors have been clearly identified; 2) The service delivery capacity of weather service at **Grass-root level** should be enhanced; 3) The development of regulations, standards and policies should be enhanced. The **operation procedures of weather disaster early warning (early briefing, warning message, warning signal)** should be perfected.

上海市人民政府办公厅

沪府办〔2011〕81号

上海市人民政府办公厅关于进一步加强本市气象灾害监测预警及信息发布工作的意见

各区、县人民政府，市政府各委、办、局，各有关单位：

为贯彻落实《国务院办公厅关于进一步加强气象灾害监测预警及信息发布工作的意见》（国办发〔2011〕33号），维护城市运行安全，保障经济社会发展，经市政府同意，现就进一步加强本市气象灾害监测预警及信息发布工作提出如下意见。

一、明确总体要求和工作目标

（一）总体要求。深入贯彻落实科学发展观，坚持以人为本，坚持预防为主、政府主导、部门联动、规范发布、分级负责，以保障人民群众生命财产安全为根本，努力构建符合上海特大城市特点和需要的气象灾害监测预警、信息发布和应急处置的工作体系，全面提升气象

# 2.1 Multi-agency Coordination: Partnership practices

Health and Insurance departments



- 1) Establish integrated database of meteorological information and public health data;
- 2) Develop forecast model of heat wave and heatstroke, COPD and asthma.

Food and Drug Administration



- 1) Early briefing on rainy season and continuous high temperature;
- 2) Co-issue bacterial food poisoning early warning



Tourism Administration



Communications Administration



Agriculture commission



Civil affairs bureau



State grid



Education Commission

## Other Relevant Agencies:

Flood control,  
Environment Protection,  
Marine time, .....

## 2.1 Community Safety Program

**Risk Mapping, Preparedness, Drilling ,Certification (Civil administration, work safety, flood control)**



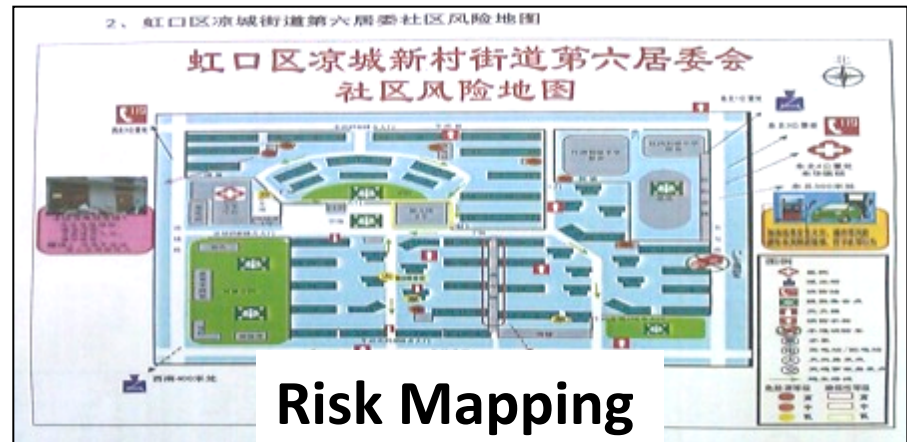
**Training**



**Drilling**



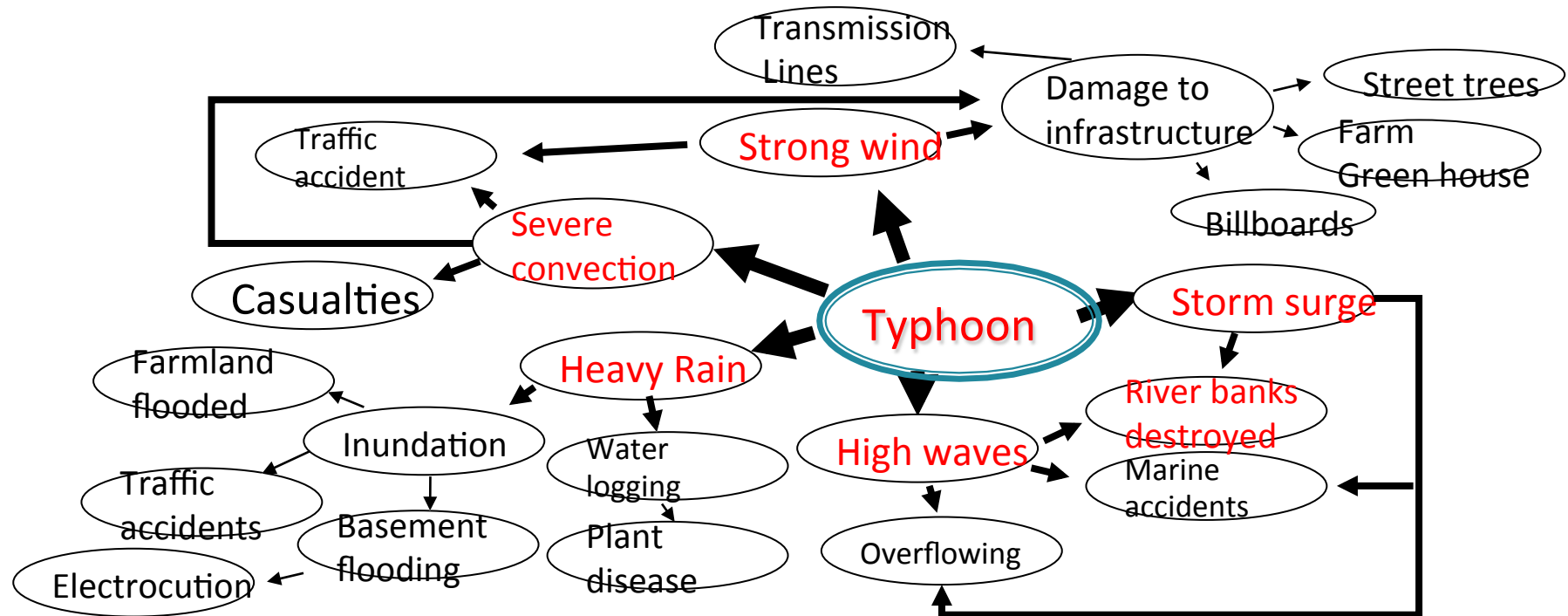
**Education & Outreach**



**Risk Mapping**

Through the cooperation between Shanghai Meteorological Service and Shanghai Civil Affairs bureau, 200 demonstration communities for risk assessment will be established within in 5 years in Shanghai to enhance the capacity of disaster management.

## 3.1 first link in the chain of DPM



Severe weather hazards may bring many other disasters, which further threaten city safety. Weather factor resembles the first piece of domino, and will impact other aspects of social activities.

## 2.1 first link in the chain of DPM

Met Services are the first link in the chain of DPM and have a critical role in disaster detection and warning as well as a supporting role in prevention and mitigation & rescue.

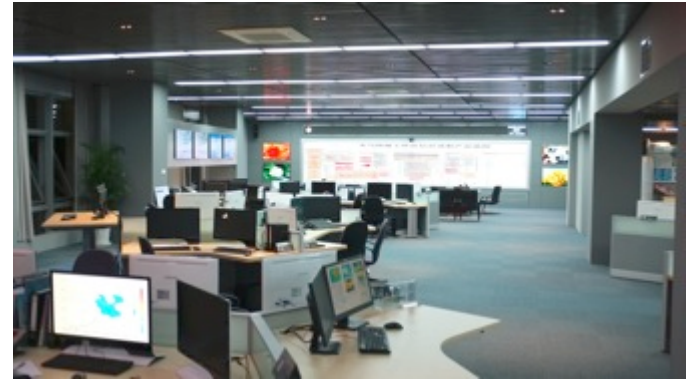


## 2.2 Operation System of MHEWS

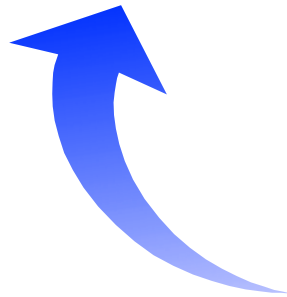
Information Flow Platform



Weather Forecast Platform



Public Service Platform



## 2.2 Operation System of MHEWS

- ◆ Forecast Area

- ◆ PWS Area

- ◆ DATA SUPPORT AND QMS

# Forecast Area

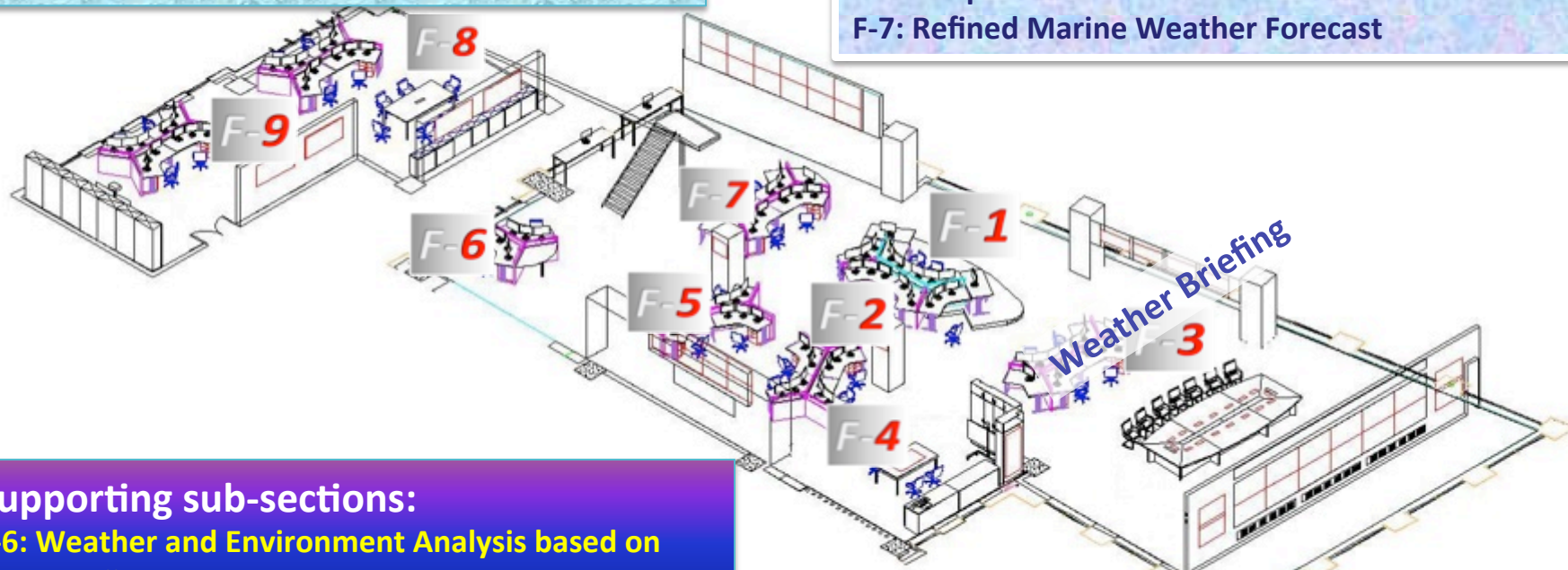
## F-1: Forecast Planning & Organization

### *Focus on high impact weather:*

- F-2: Multi-scale Weather Analysis and Forecast
- F-3: Refined Urban Weather Forecast and Early Warning based on Vulnerability
- F-7: Typhoon Early Warning

### *Focus on weather impact on critical locations:*

- F-3: Refined Urban Weather Forecast and Early Warning based on Vulnerability
- F-5: Regional Weather Forecast, Warning and Joint Preparedness
- F-7: Refined Marine Weather Forecast



### Supporting sub-sections:

- F-6: Weather and Environment Analysis based on Satellite Remote Sensing
- F-8: Regional NWP Application
- F-9: Subtropical Circulation & Abnormal Characteristic Analysis

### *Focus on weather impact on users:*

- F-4: Weather Impact Forecast Based on Ensemble NWP Analysis

➤ Subtropical Circulation & Abnormal Characteristic Analysis

- NWP products
- Uncertainty and maximum possibility analysis of NWP
- Sensitivity parallel run

- TC Location and Intensity Estimation
- Weather system dynamic analysis

Focus on High Impact Weather System

- 1 ) Basic Weather System
- 2 ) Severe Convective Weather
- 3 ) Tropical Cyclone

Tropical Early Warning

Multi-scale Wea Analysis & Fcst

Severe Convective Weather



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- Environmental Remote Sensing Monitoring and Analysis
- Weather system dynamic analysis

- Ensemble PoP
- Sea wave model product
- Hydro-meteorological coupled model

- Multi-scale weather analysis and Seamless Forecast

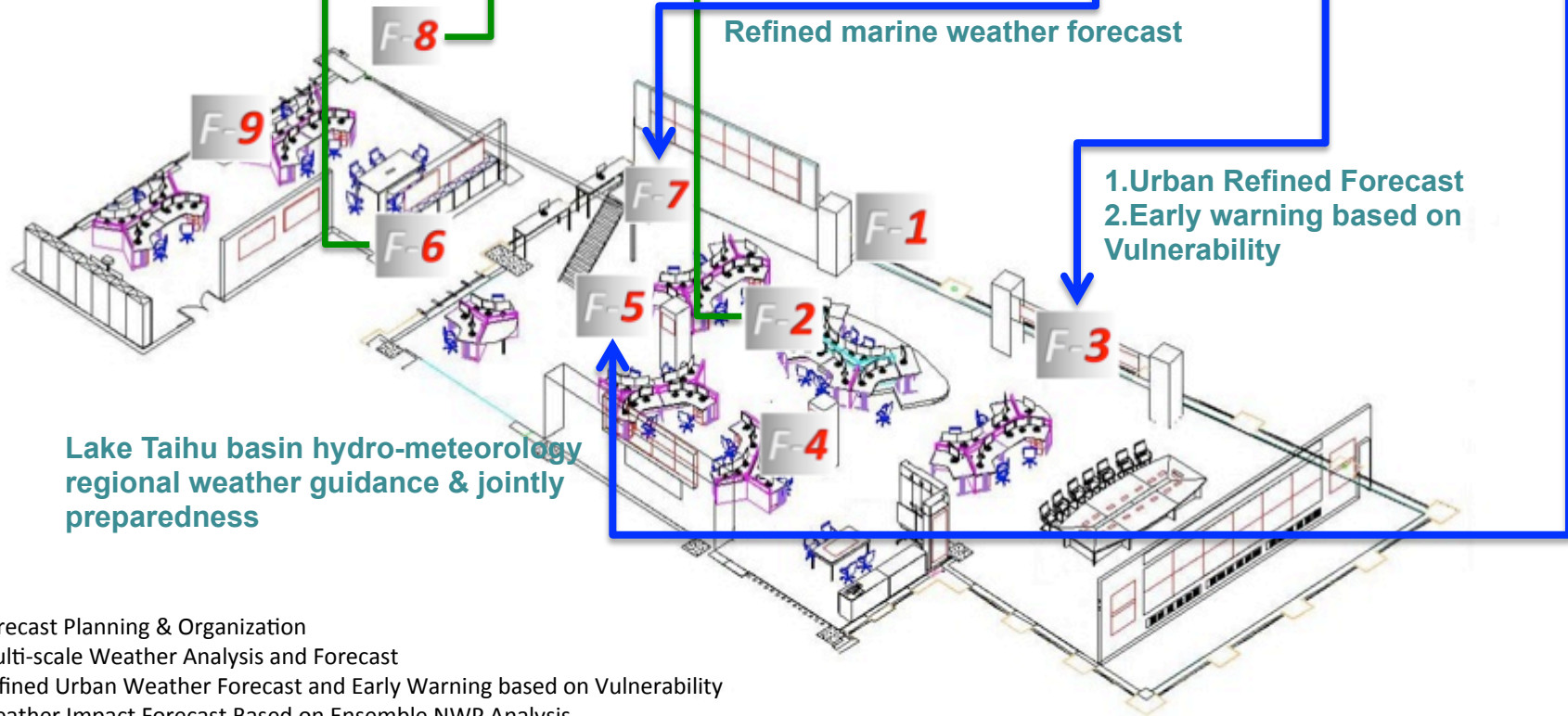
## Focus on critical locations

- 1) Shanghai, a megacity
- 2) Marine and costal areas
- 3) East China Region and Lake Taihu Basin

## Refined marine weather forecast

1. Urban Refined Forecast
2. Early warning based on Vulnerability

## Lake Taihu basin hydro-meteorology regional weather guidance & jointly preparedness



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- Environmental Remote Sensing Monitoring and Analysis
- Weather system dynamic analysis

## Focus on high sensitive users

- 1) Impact on natural environment (storm surge , haze)
- 2) Impact on urban infrastructure (power supply, transportation)
- 3) Impact on Public health (COPD, heat exhaustion)

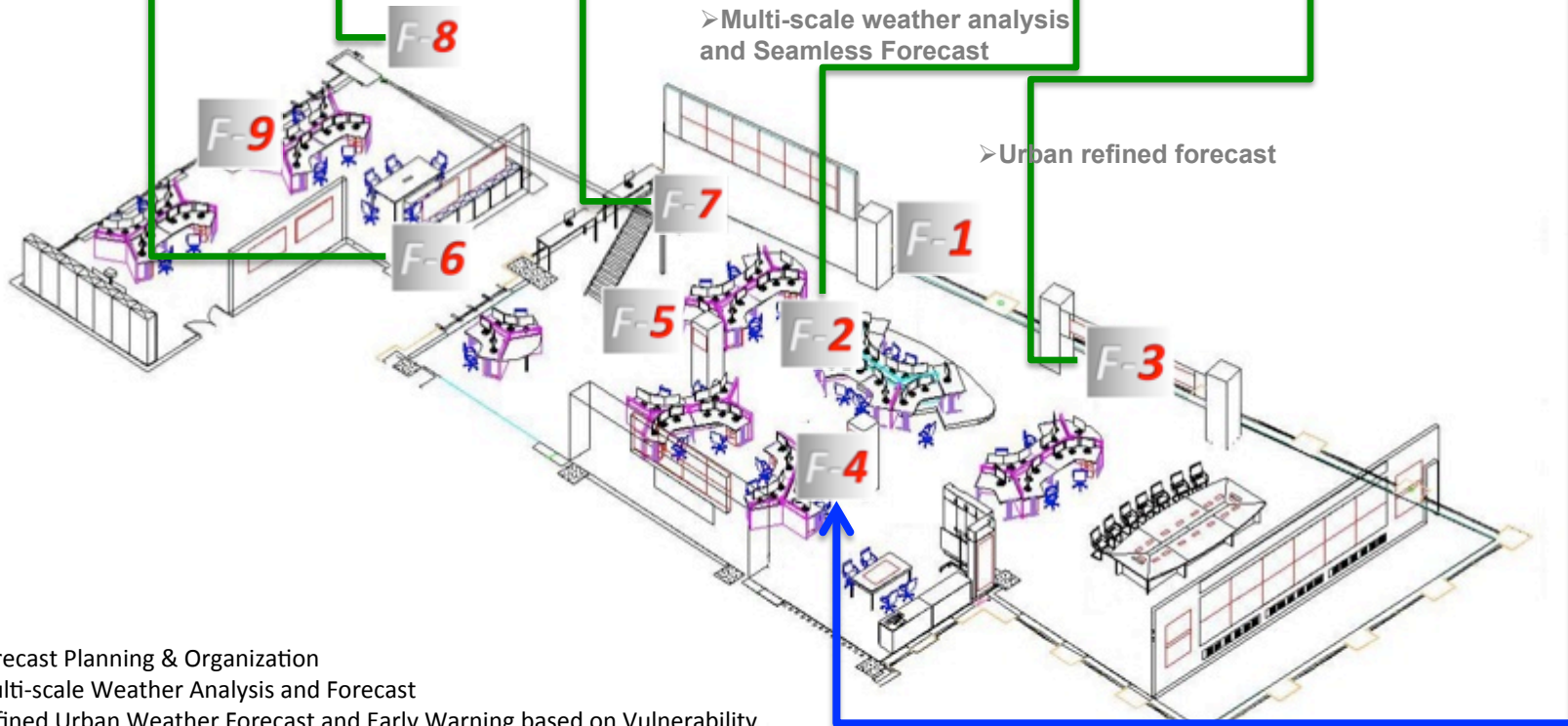
Reliability analysis and verification of NWP  
Ensemble NWP products and analysis

➤ TC wind and rain fcst

➤ Multi-scale weather analysis  
and Seamless Forecast

➤ Urban refined forecast

Forecast Area



Synoptic mapping & forecasting for weather impact  
Probabilistic weather impact forecast based on EP

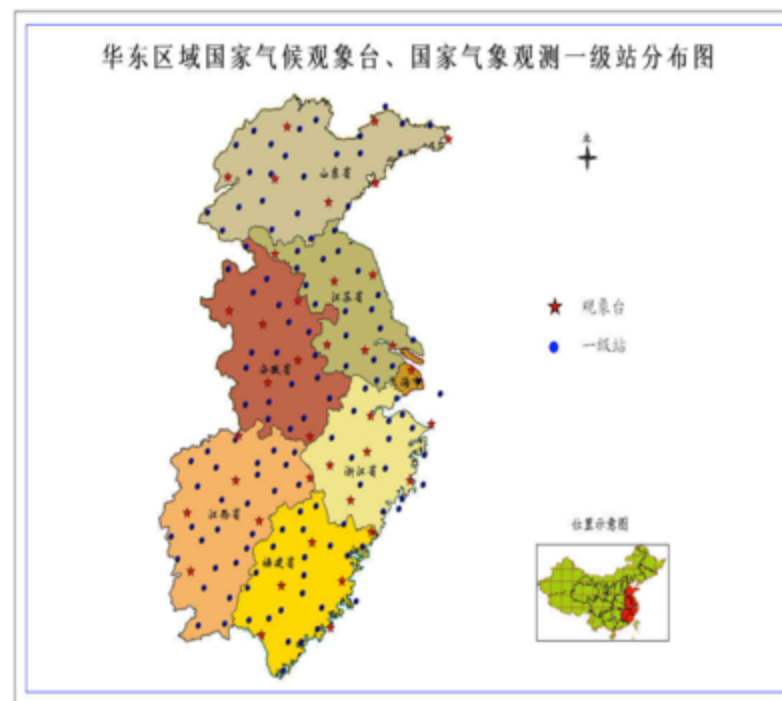
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## F5: Regional Weather Forecast, Warning and Joint Preparedness

**As the First Regional Meteorological Center in China**, it takes charge of :

- ◆ Technical guidance in routine weather forecast and warning
- ◆ Joint preparedness
- ◆ Hydrometeorology (Flash Flood and geological Hazards Risk/ River flood)
- ◆ Environmental meteorology
- ◆ Information Sharing

in East China, which covers the provinces of Shandong, Anhui, Jiangsu, Shanghai, Zhejiang, Jiangxi, Fujian and some other cities.



# Forecast Area

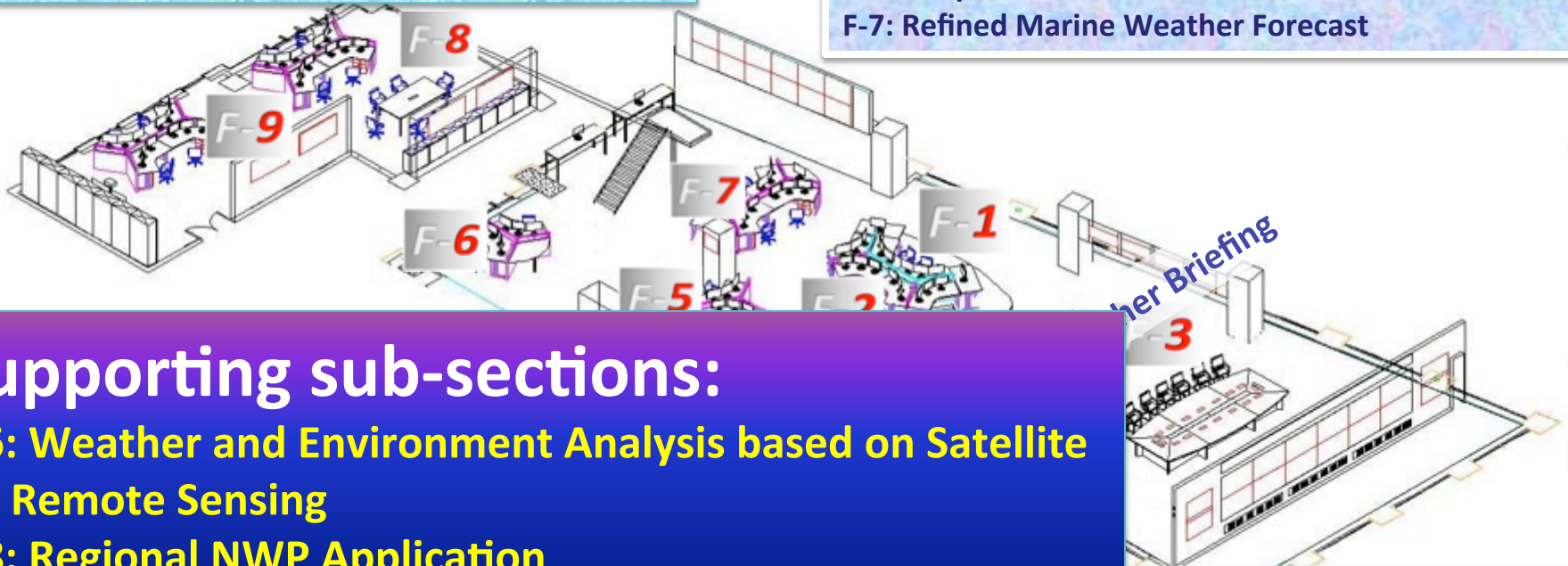
## F-1: Forecast Planning & Organization

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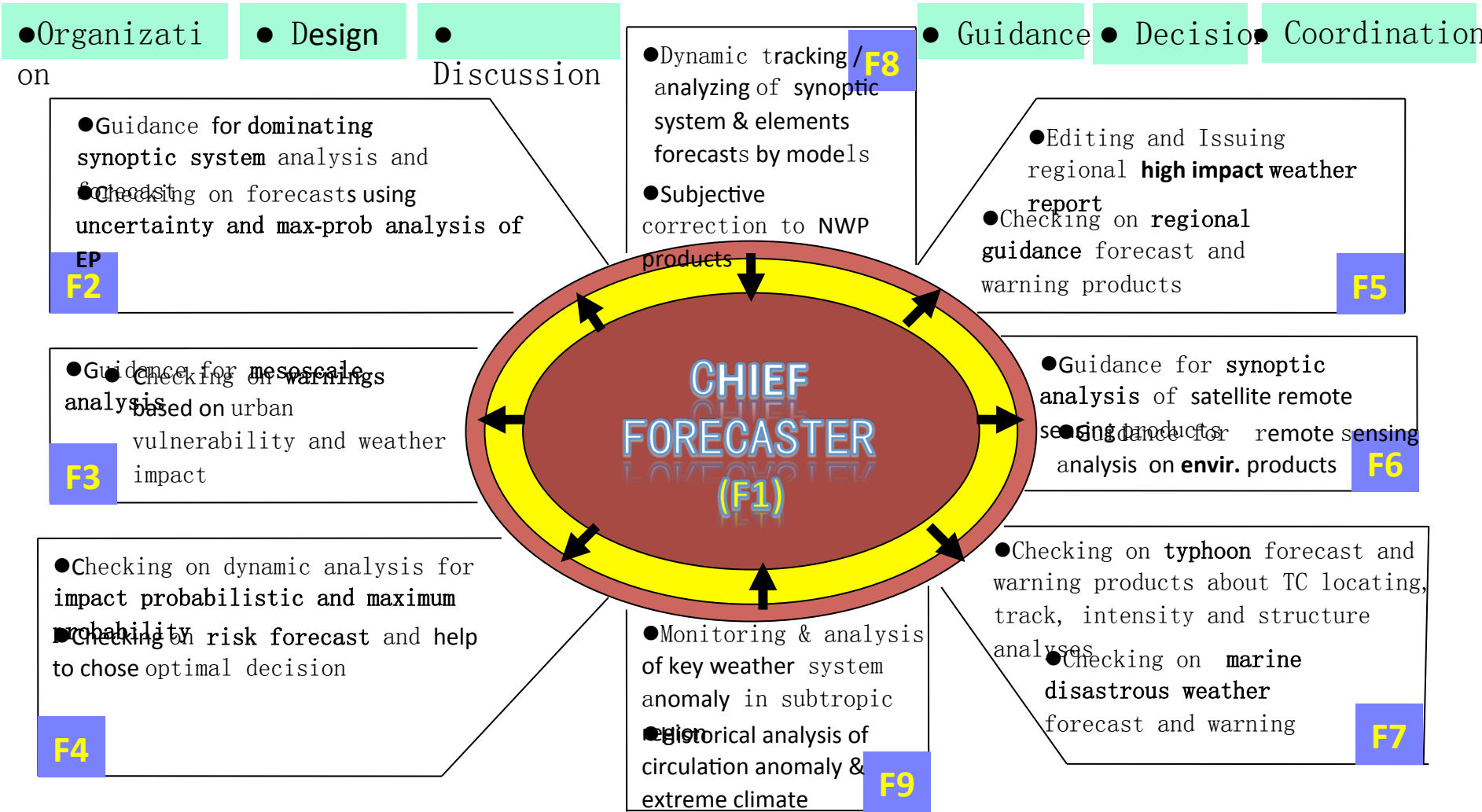
## Supporting sub-sections:

- F-6: Weather and Environment Analysis based on Satellite Remote Sensing
- F-8: Regional NWP Application
- F-9: Subtropical Circulation & Abnormal Characteristic Analysis

### *Weather impact on users:*

Forecast Based on Ensemble NWP

## THE ROLE OF CHIEF FORECASTER



To coordinate the consistence of forecasts from different sub-sections...

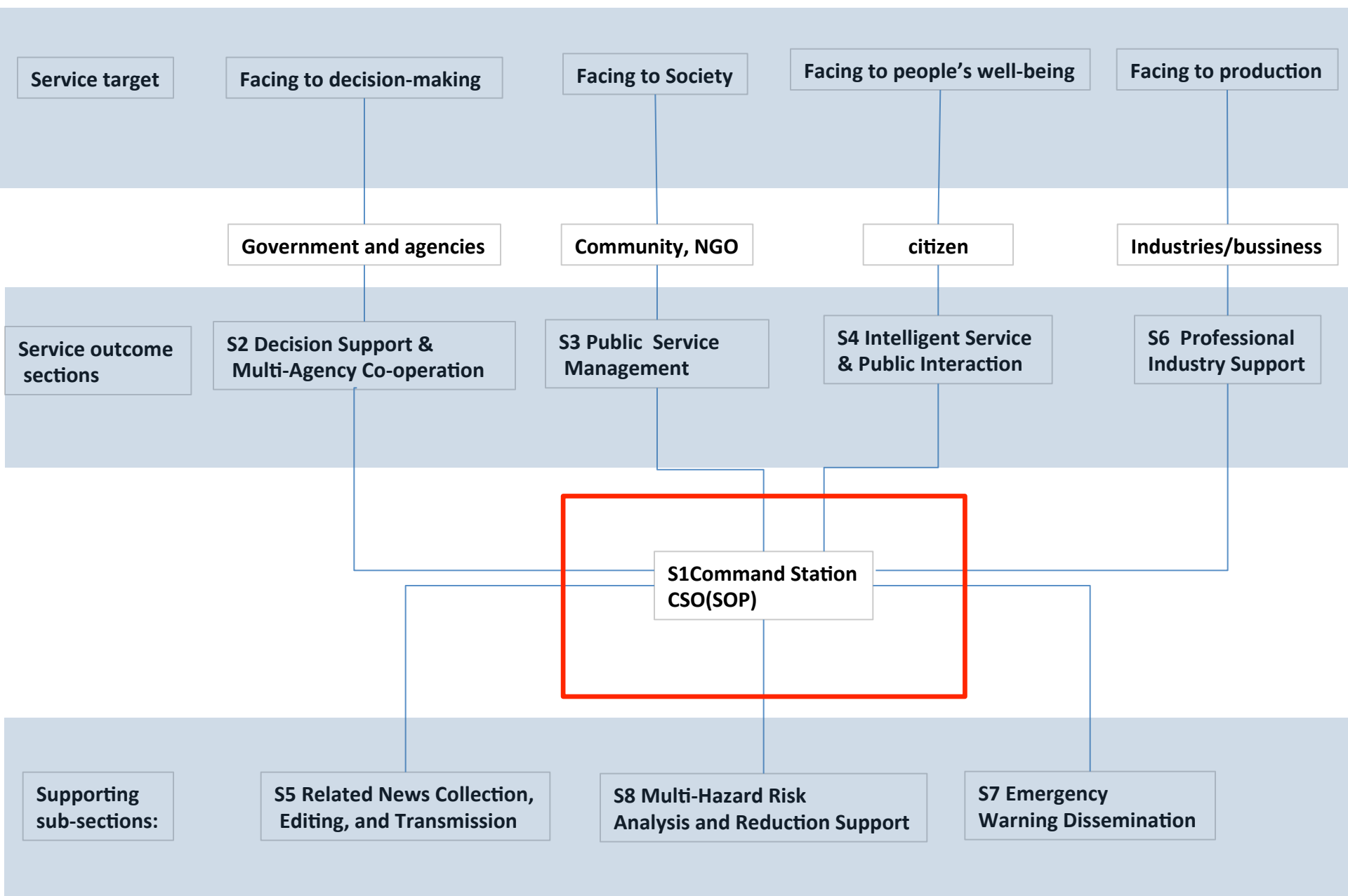
Focus on **high-impact weather**, **key weather system**, and high-uncertainty weather.

## 2.2 Operation System of MHEWS

- ◆ Forecast Area


- ◆ PWS Area

- ◆ DATA SUPPORT AND QMS

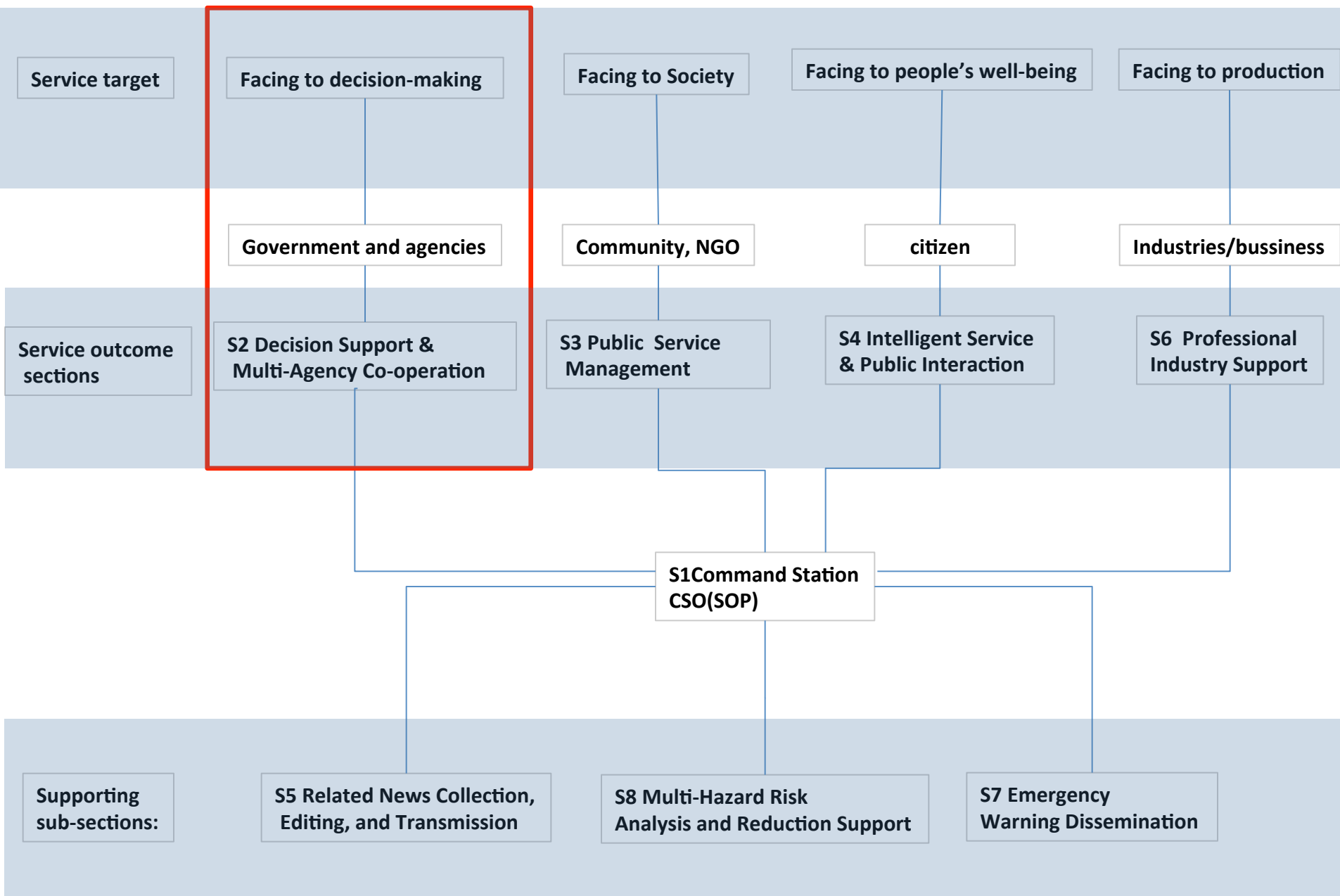


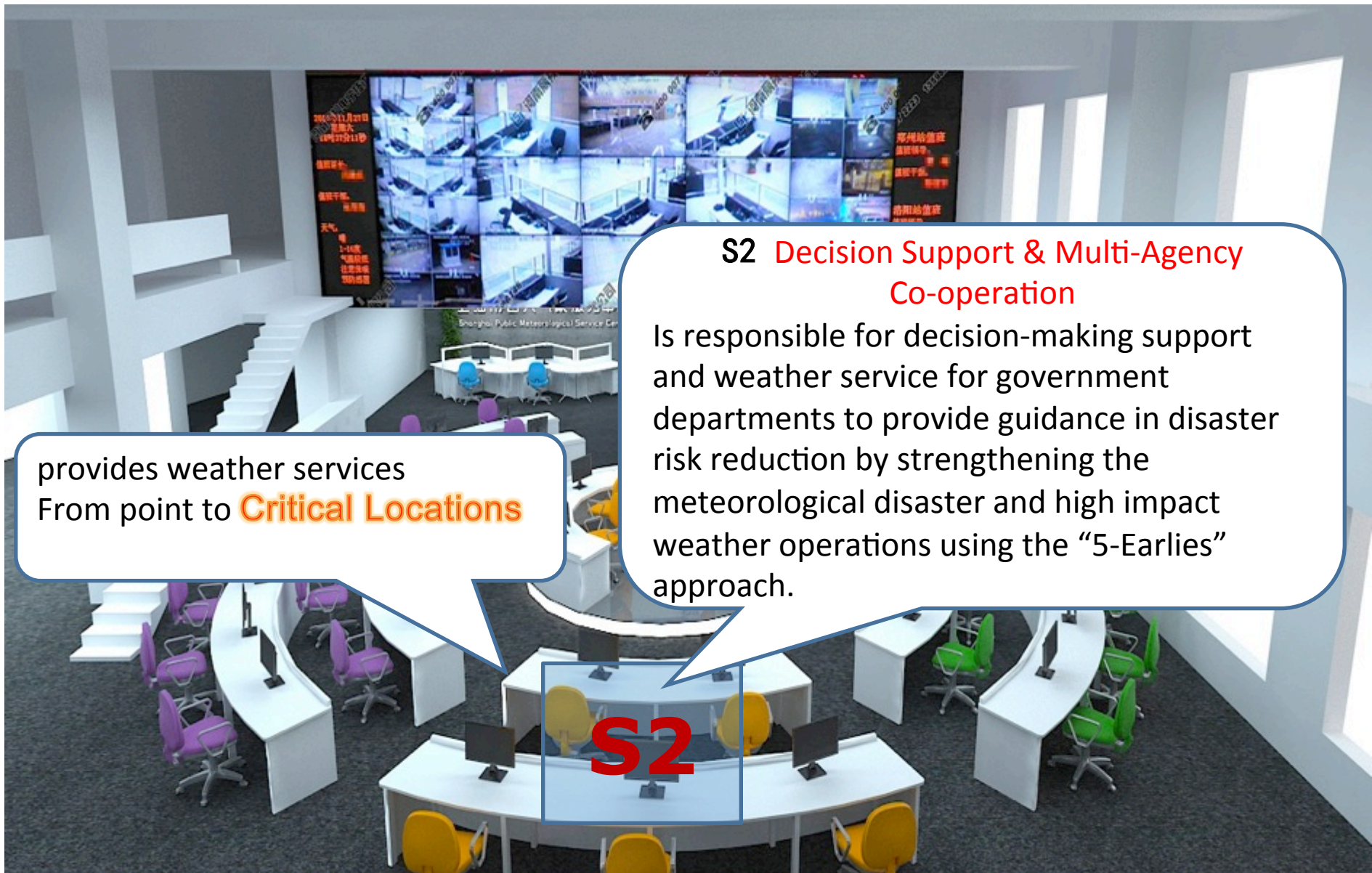
## S1 Command Station

The command station is responsible for planning, organizing and execution of the entire service operation through a Chief Service Officer (CSO) and command personnel.



A 3D architectural rendering of a modern command center. The room features a central circular desk with yellow chairs, labeled 'S1' in large red letters. Surrounding this central area are several curved white desks with computer monitors and chairs in purple, green, and yellow. In the background, a large video wall displays multiple security camera feeds. To the left, a white staircase leads to an upper level. The room has large windows on the right side, providing natural light.





provides weather services  
From point to **Critical Locations**

## S2 Decision Support & Multi-Agency Co-operation

Is responsible for decision-making support and weather service for government departments to provide guidance in disaster risk reduction by strengthening the meteorological disaster and high impact weather operations using the “5-Earlies” approach.

**S2**

# S2 Decision Support & Multi-Agency Co-operation

Heat wave



Public health



Air pollution



Urban flood



Harbor schedule



Weather impacts



Road traffic



Energy utilization



Urban security



Aviation



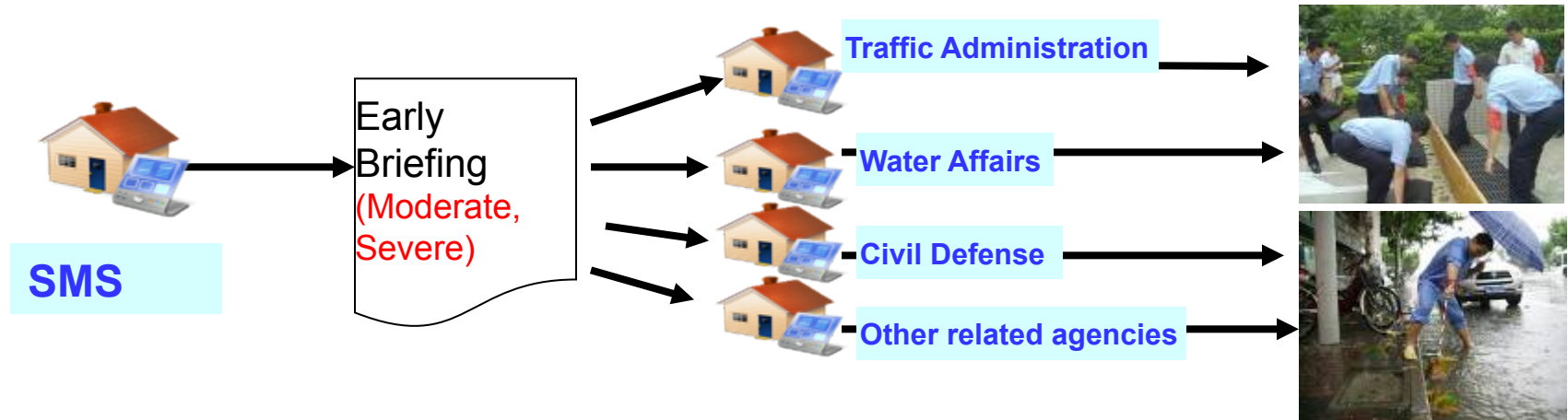
◆ Weather impacts all the social activities from urban security and public life.

◆ Impact forecast is based on science and concern for the need of potential users from weather.

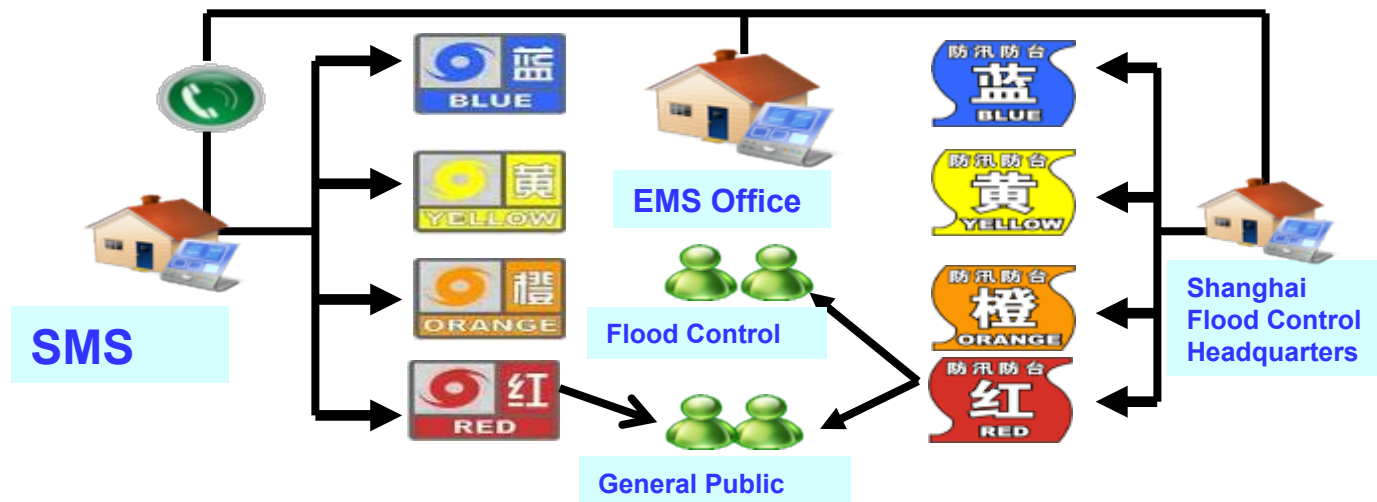
◆ Particularly focus on haze, air quality and public health in Shanghai megacity.

# S2 Standard Operation Procedures (SOPs)

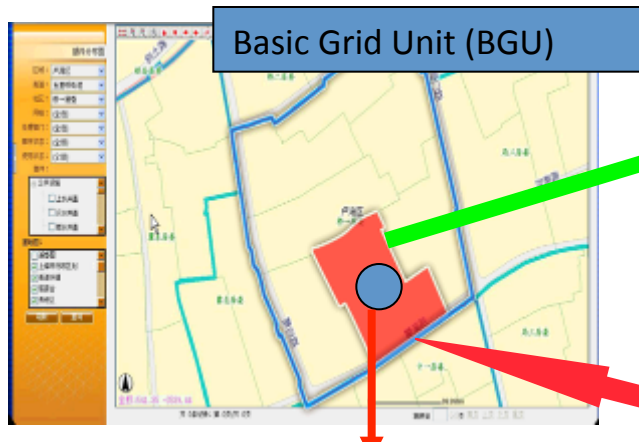
## Early Briefing Mechanism



## Joint Response Action(25agencies,36SOPS)



The Basic Grid Unit is a uniquely Shanghai Institution. Approximately 2,000 BGU supervisors monitor 1,620 Basic Grid Units area (35,970 BGU Points, which covered 1186 square kilometers) with operations 24 hours a day.



Underground Car Park  
flood prevention



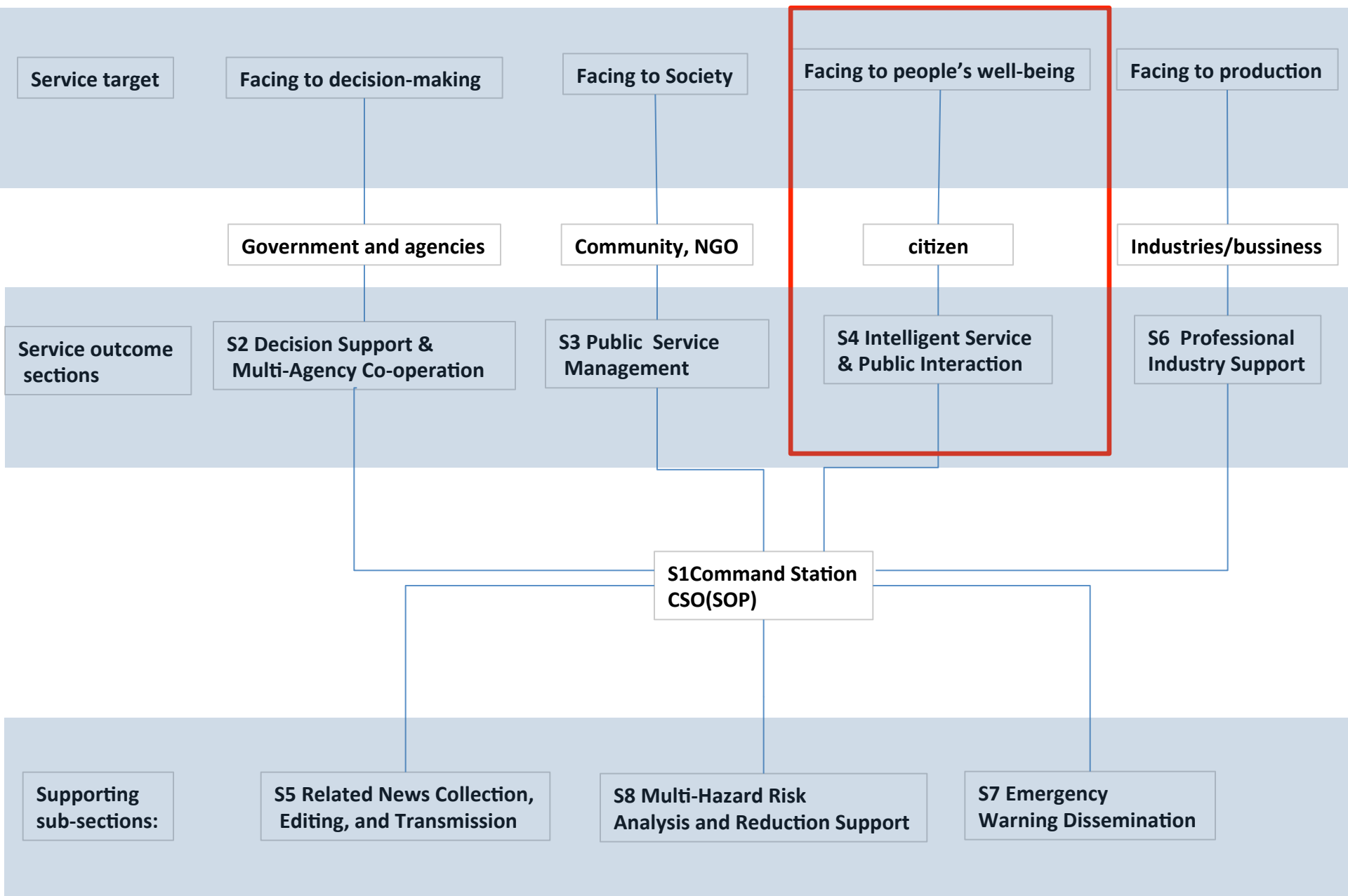
Evacuations



Classification Sub-Center for  
Emergency Events



Emergency  
Response Center



## S4 Intelligent Service & Public Interaction

Direct interaction with the general public through an intelligent online customer service system that provides weather services for individual needs.

provides weather services  
From point to **People**

**S4**

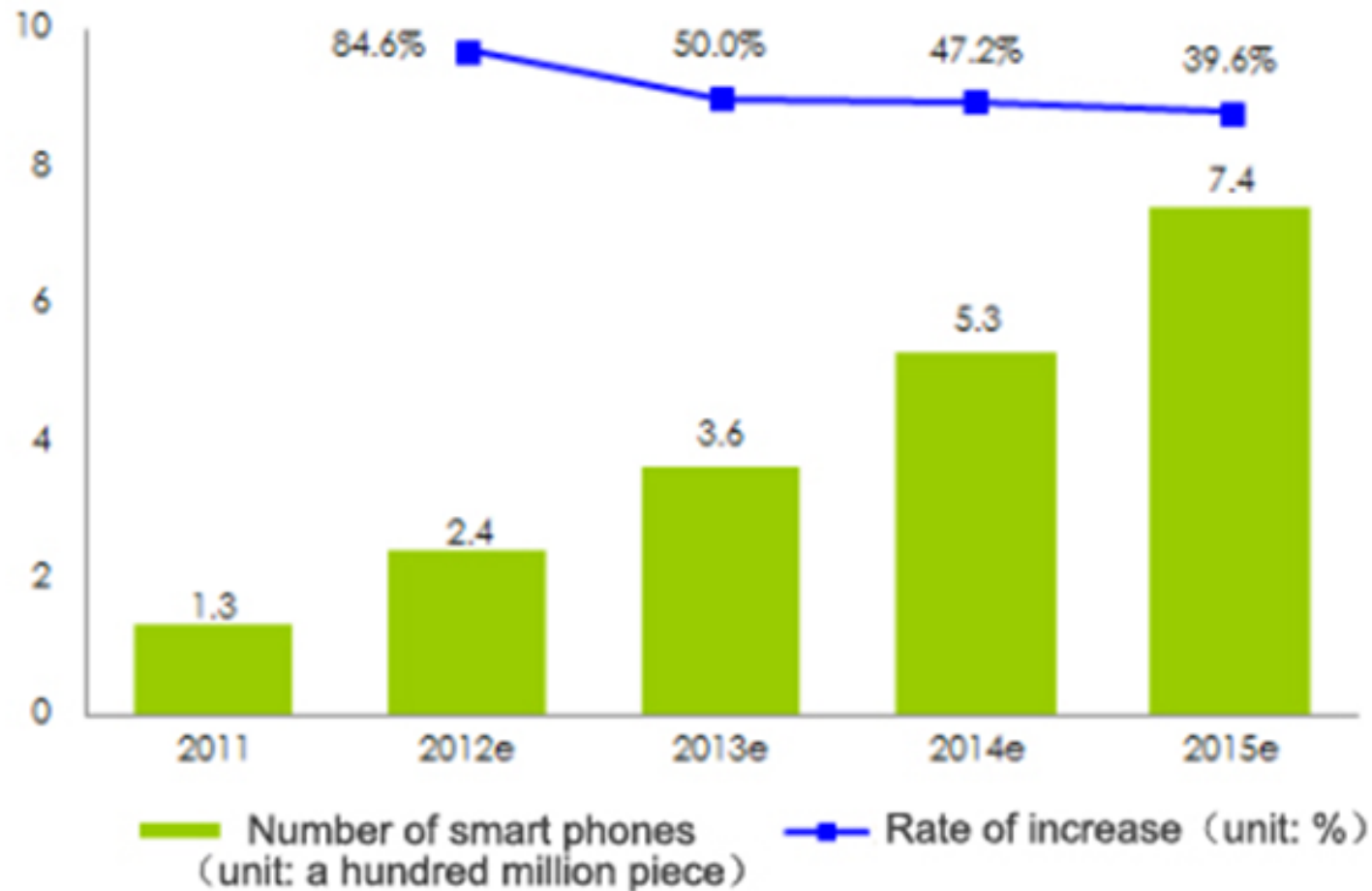


## intelligent online customer service system -----Background

- Shanghai's **Smart City action plan (2011-2013)**, aims to **digital, networked, intelligent**. The SMS's contribution to this action plan is **Smart Meteorological Engineering**.
- The SMS provide first choice, first voice, first warning for the public to meet their need of getting weather information anytime and anywhere.

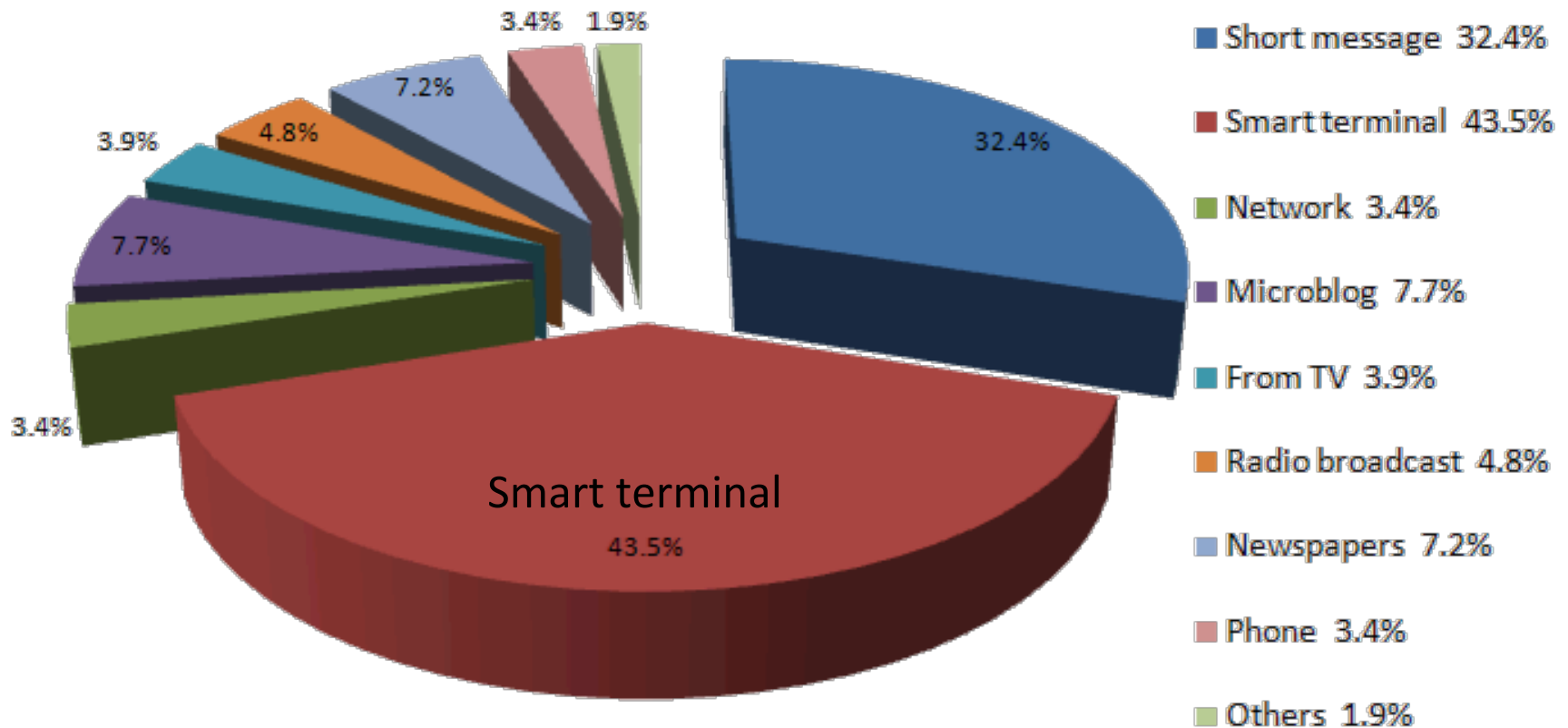
## intelligent online customer service system -----Background

**Number of smart phones in China from 2011-2015**



## intelligent online customer service system -----Background

Q: How do you get your weather information? (18-49 years old)



Survey conducted in February, 2013

# intelligent online customer service system ----- Apps by the SMS



On the China App store

- “Wish”(weather in shanghai)

**Personalized weather terminal**

- “Xiao Chao(weather chat robot)

**Weather tailor**

# intelligent online customer service system---functions

## First choice – Refined weather forecast



partition forecasts      hourly forecasts      time-of-day forecasts      partition early warnings  
(for the urban area only)

# intelligent online customer service system---functions

## First warning - Push service



Strong cold air will affect Shanghai ,please wear warmer.

intelligent online customer service system---functions

Weather information collected - User participation and feedback



January of 2013: sun, rain, snow, fog, haze, and frost

# intelligent online customer service system

## Weather chat robot - Weather tailor

- Chat robot
- Virtual Chief Service Officer(CSO)

*I'm Xiao Chao, What Can I do for you?*



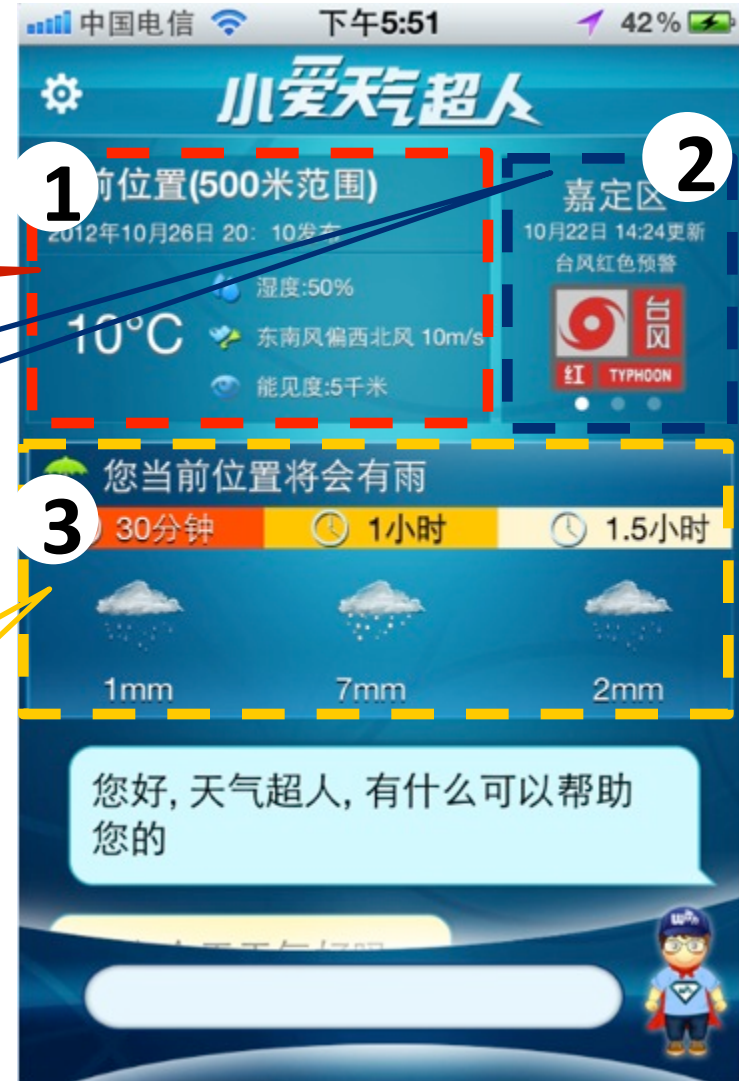
## Personalized service

Location technology (500m<sup>2</sup>) pushes live data to provide a personalized service.

Site specific real time information

MHEWS Warnings  
(scroll function if multiple warnings are issued simultaneously)

30 to 90 minute precipitation nowcasting



## Virtual CSO

Users can ask questions to the Chat Robot, and it can answer you automatically.

Example:

Q1: What's the weather going to be like tomorrow?

A1: Rainy, with a temperature 12 degrees centigrade.

Q2: What should I wear tomorrow?

A2: You should wear a sweater and jacket.

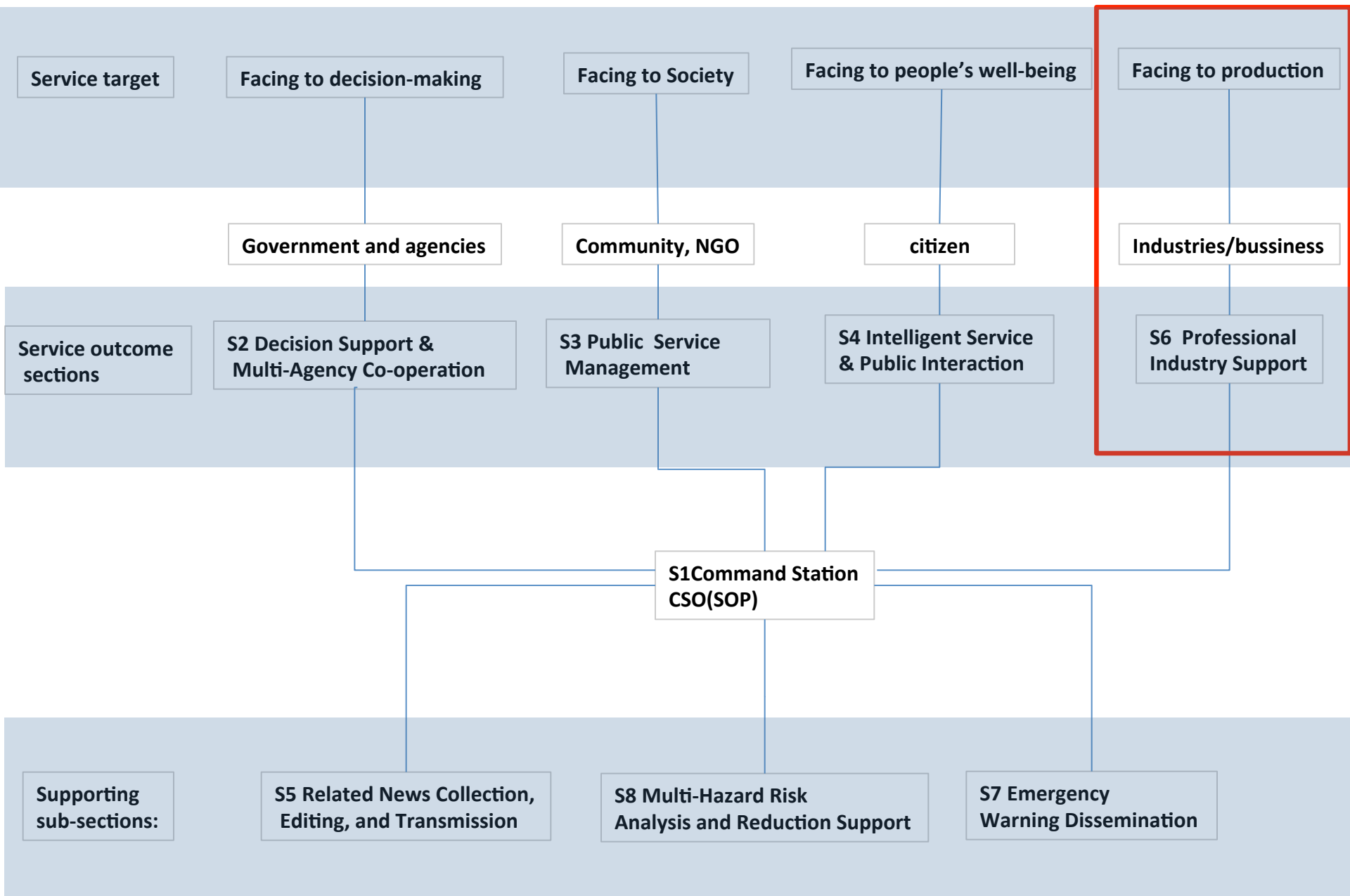


Chat window



# In the future, the scene of the intelligent service and public interaction





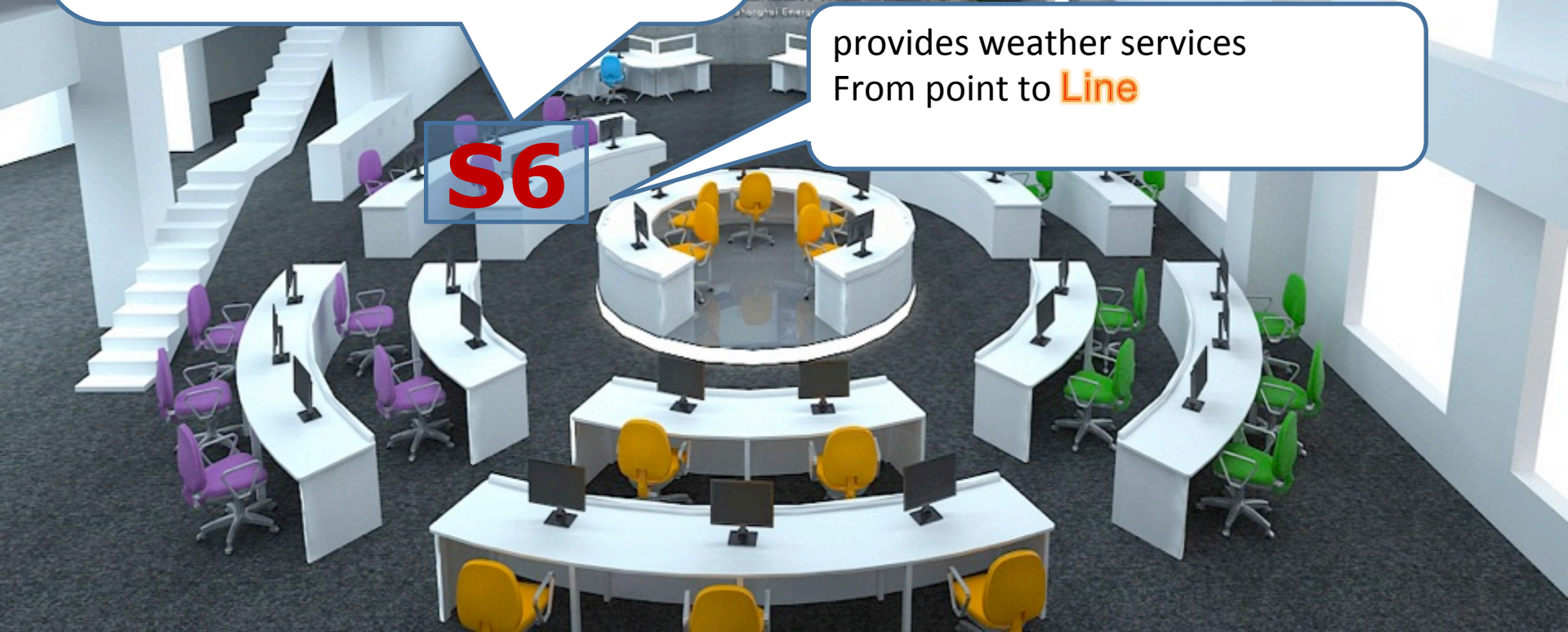
## S6 Professional Industry Support

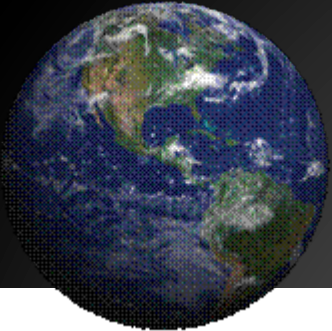
Is responsible for tailored industry support, according to the demands of users. Improves meteorological services by organizing and evaluating economic benefit in services such as agriculture, utilities, and transportation.



provides weather services  
From point to **Line**

**S6**





# which industry is under threaten?



**Life and Property**



**Aviation**



**Maritime**



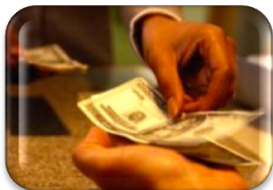
**Space Operations**



**Forests**



**Emergency Management**



**Commerce**



**Ports**



**Energy**



**Hydropower**



**Reservoir Control**



**Infrastructure**



**Construction**



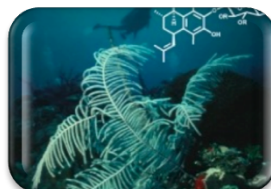
**Agriculture**



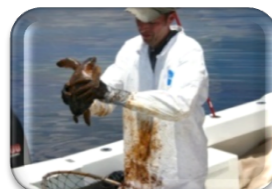
**Recreation**



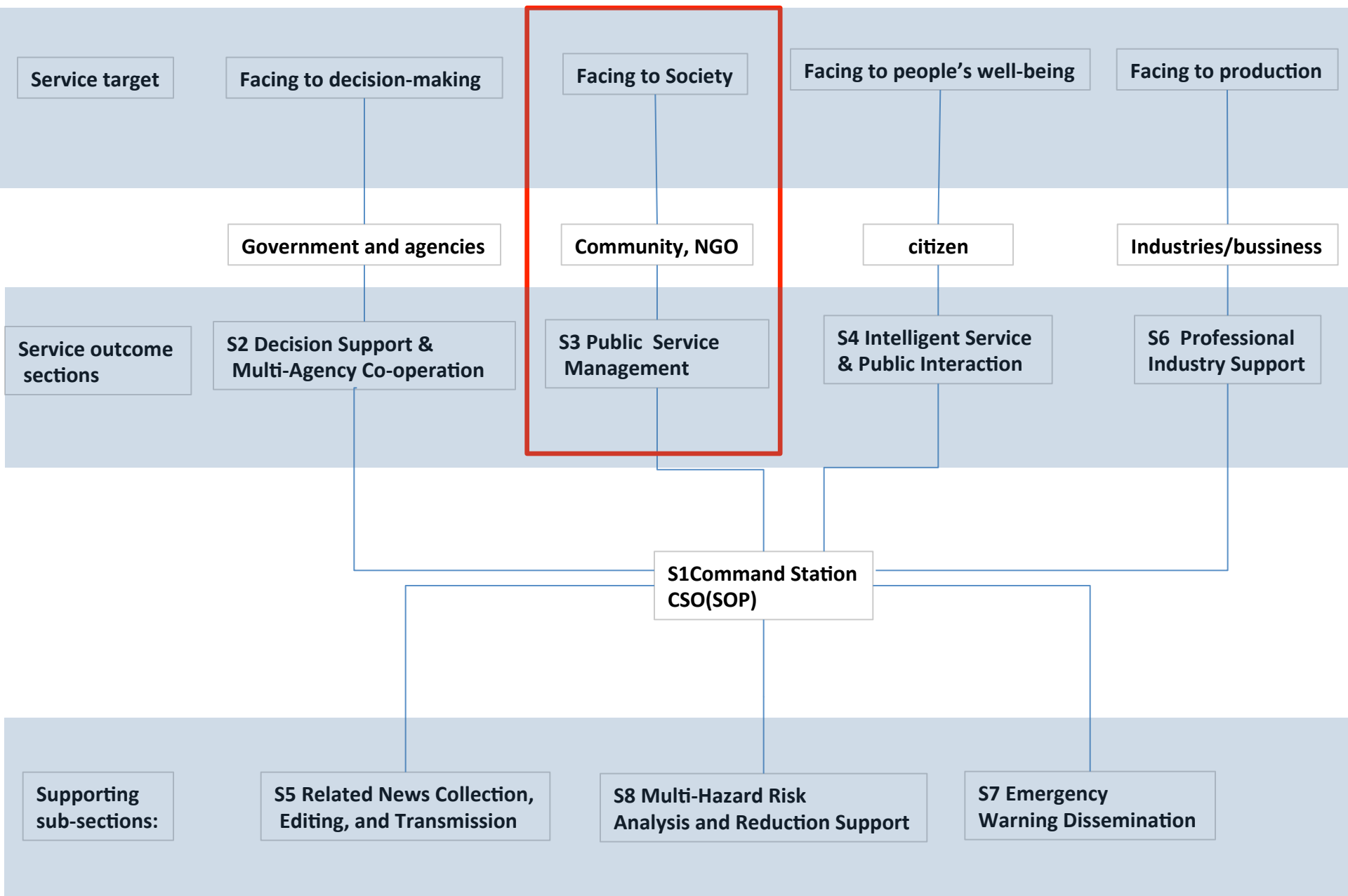
**Ecosystems**



**Health**



**Environment**



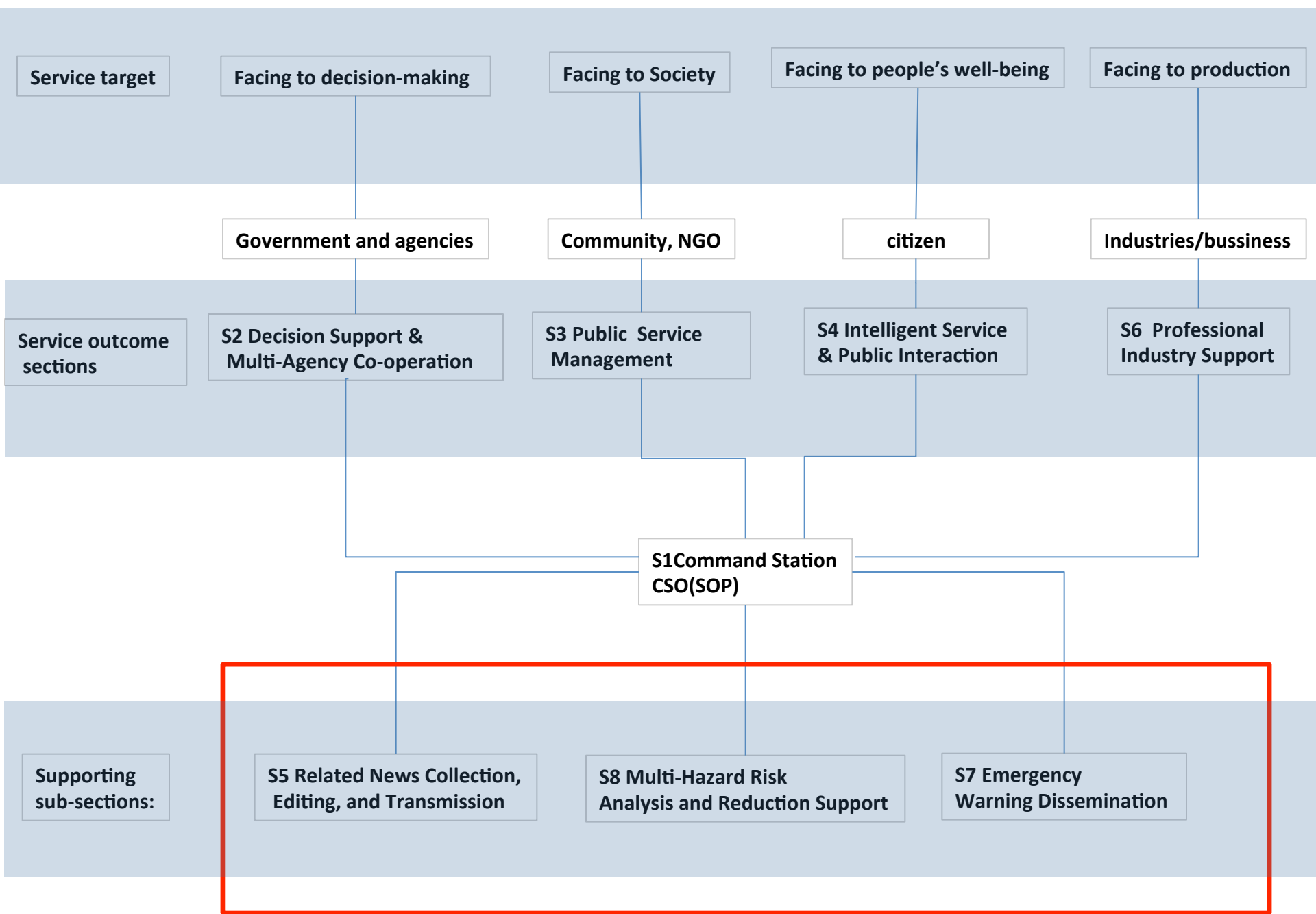
### S3 Public Service Management

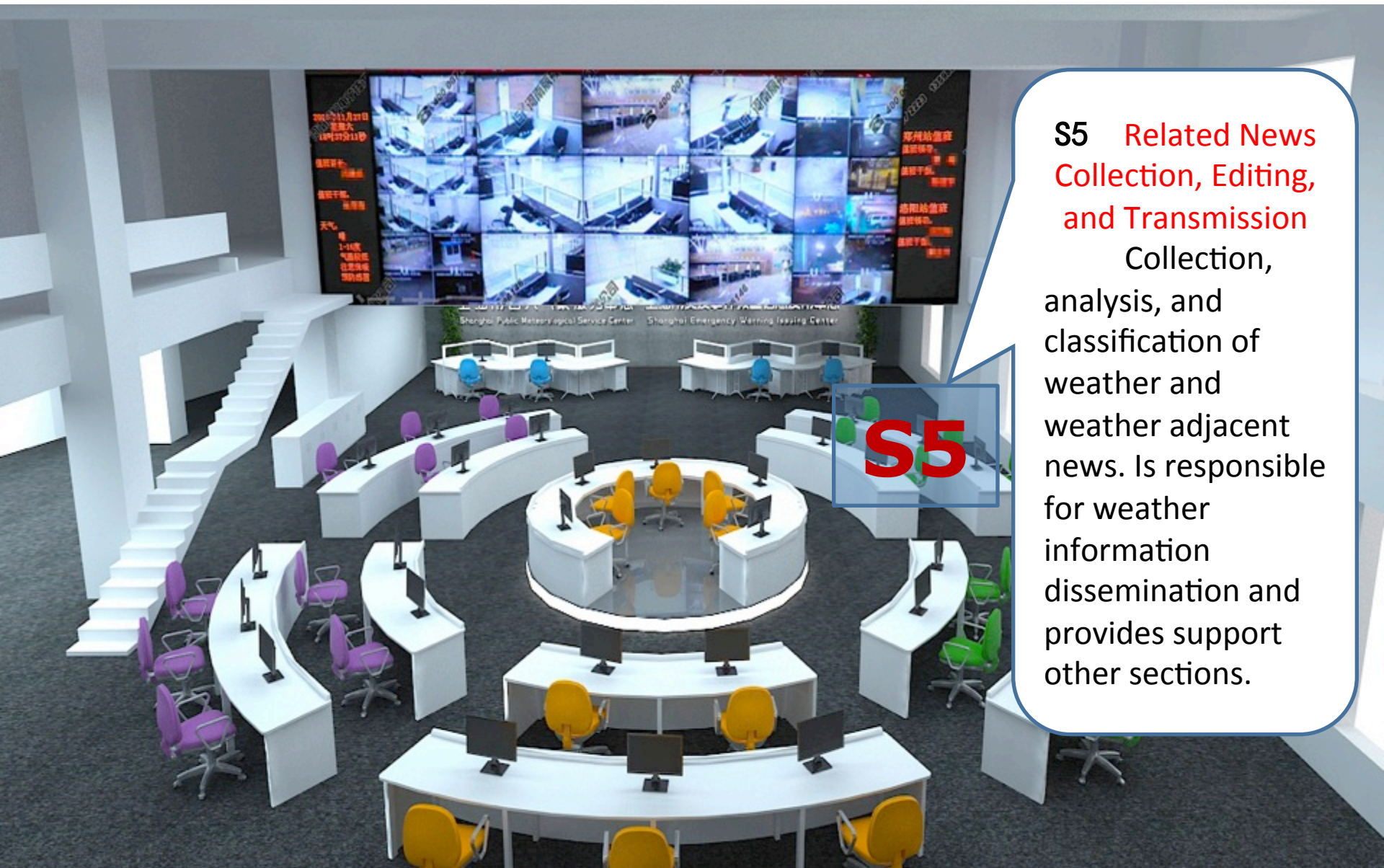
Is responsible for promoting the public's capabilities in disaster prevention and reduction. Works to promote the organizational ability in basic levels of disaster prevention and reduction. Also supervising the social media weather information.

provides weather services  
From point to **Area**

**S3**







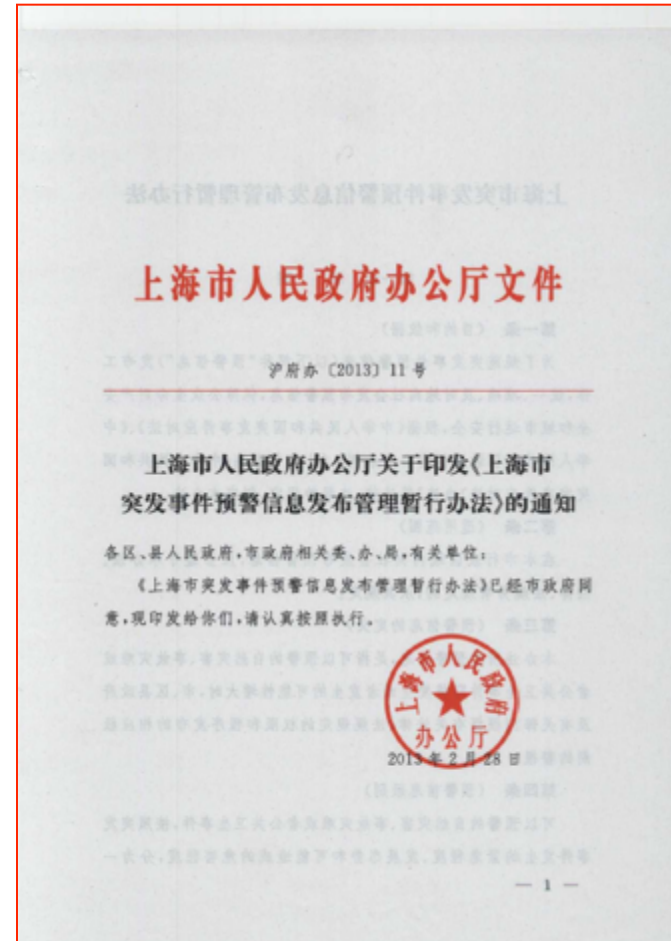
**S5** Related News Collection, Editing, and Transmission  
Collection, analysis, and classification of weather and weather adjacent news. Is responsible for weather information dissemination and provides support other sections.

## S7 Emergency Warning Dissemination

This section is responsible for Disseminating emergency warnings in Shanghai, and connecting with the National Early Warning Information Dissemination System. This station also makes sure that warning infrastructure across the city is functioning normally.

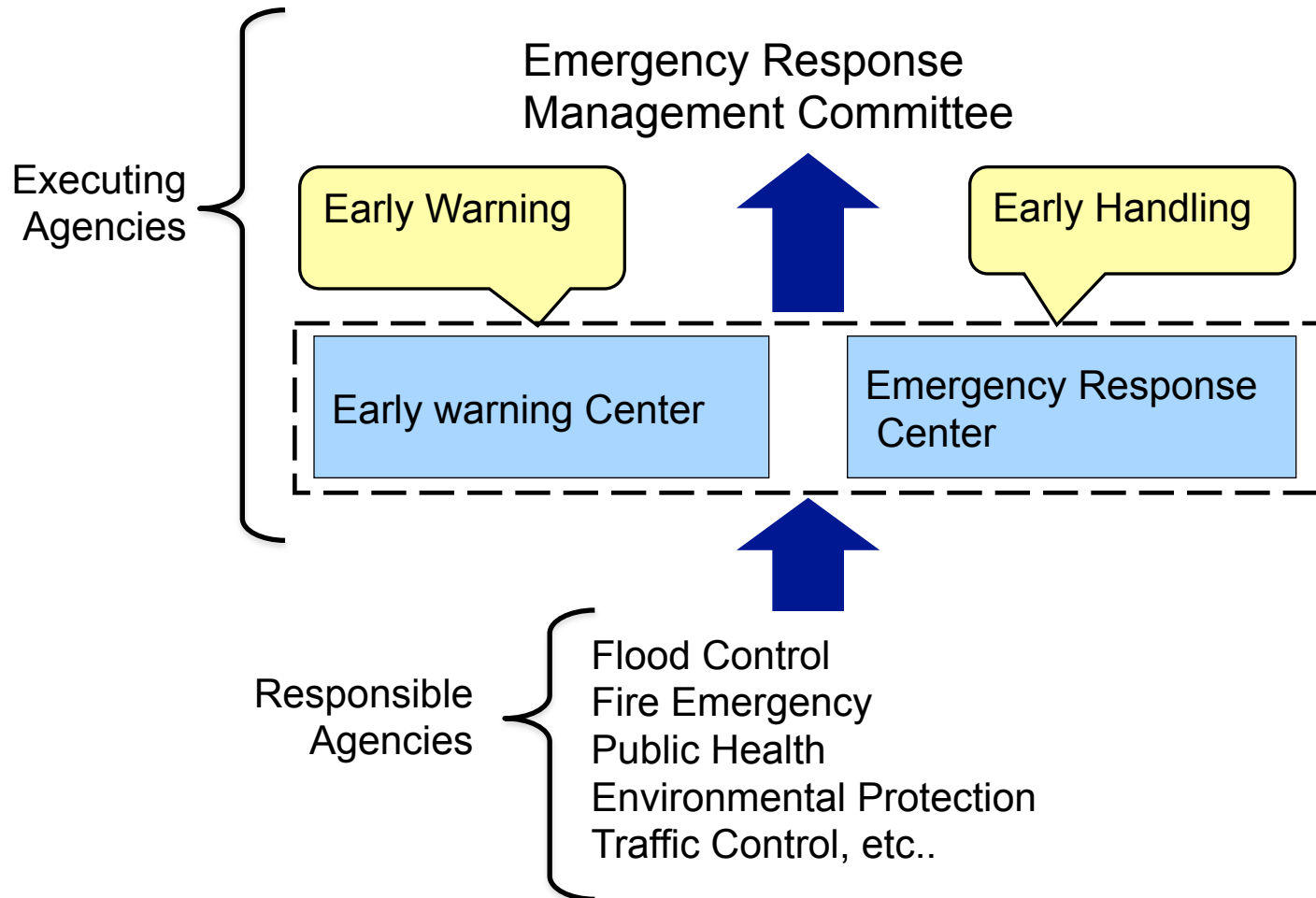


# Shanghai Emergency Warning Center



# Shanghai Emergency Warning Center

Shanghai Early Warning Center (Municipal level) streamline responses to **any** emergency by bringing all stakeholders and relevant agencies under one roof.

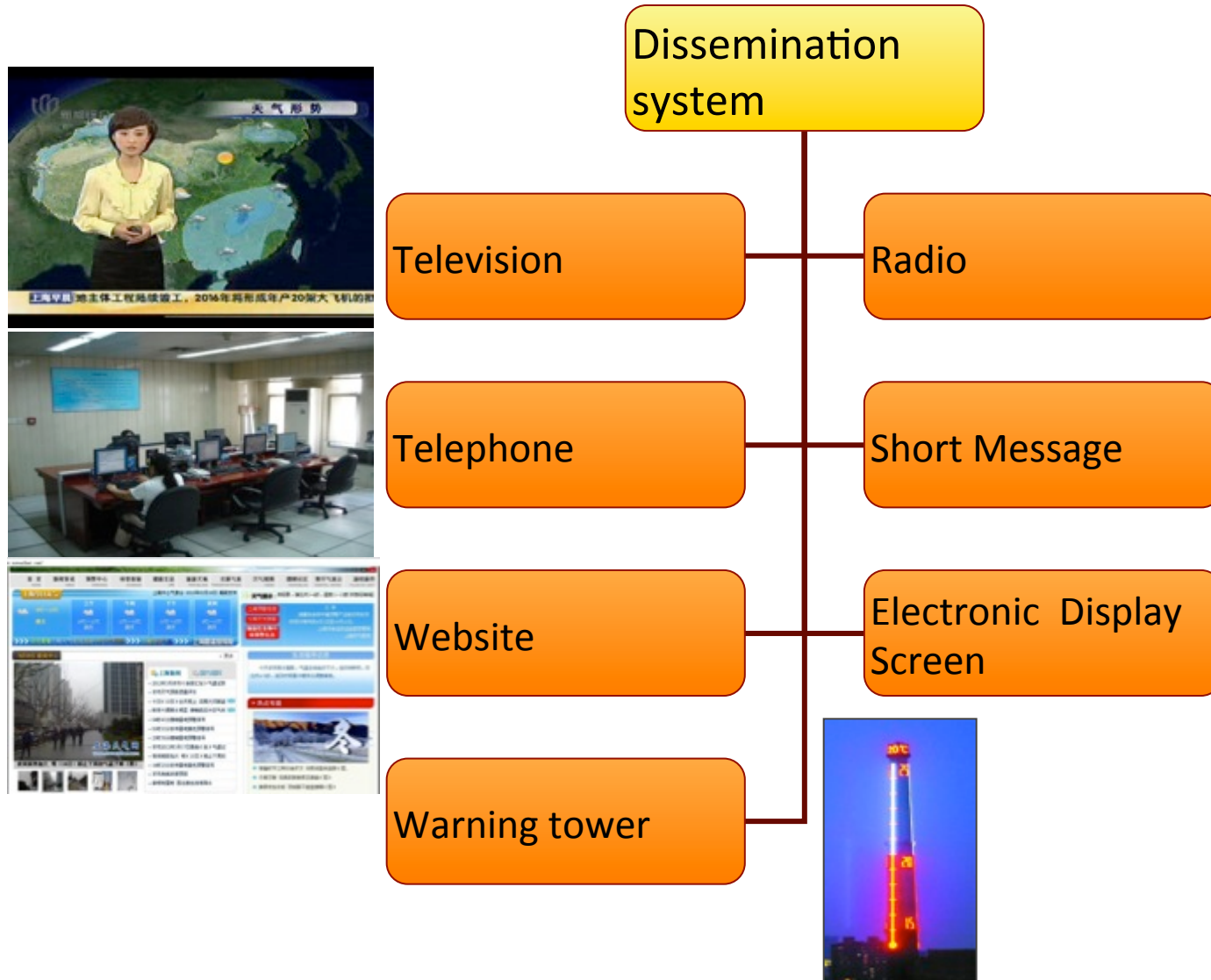


## S7 Warning dissemination

No.	Agencies	Warnings
1	Headquarters for Flood Control	Flood and typhoon control Warning
2	Shanghai Earthquake Bureau	Earthquake prediction and warning
3	Shanghai Water Affairs Bureau	Ocean disaster warnings such as storm surge, sea wave, and tsunami
4	Shanghai Planning and Land & Resource Management Bureau	Geological hazards warning
5	Shanghai Public Health Bureau	Public health emergency warning
6	Shanghai Food and Drug Administration	Drug safety emergency warning
7	Shanghai Agriculture Committee	Severe animal epidemic emergency warning Severe plant disease and pest emergency warning
8	Shanghai Environment Protection Bureau	Severe environmental pollution emergency warning
9	Shanghai Network Security Office	Internet and information security emergency warning
10	Shanghai Work Safety Administration	Guidance on work safety accident prevention
11	Shanghai Tourism Administration	Guidance on travel safety
	.....	

# S7 Warning dissemination

## 3. Dissemination system



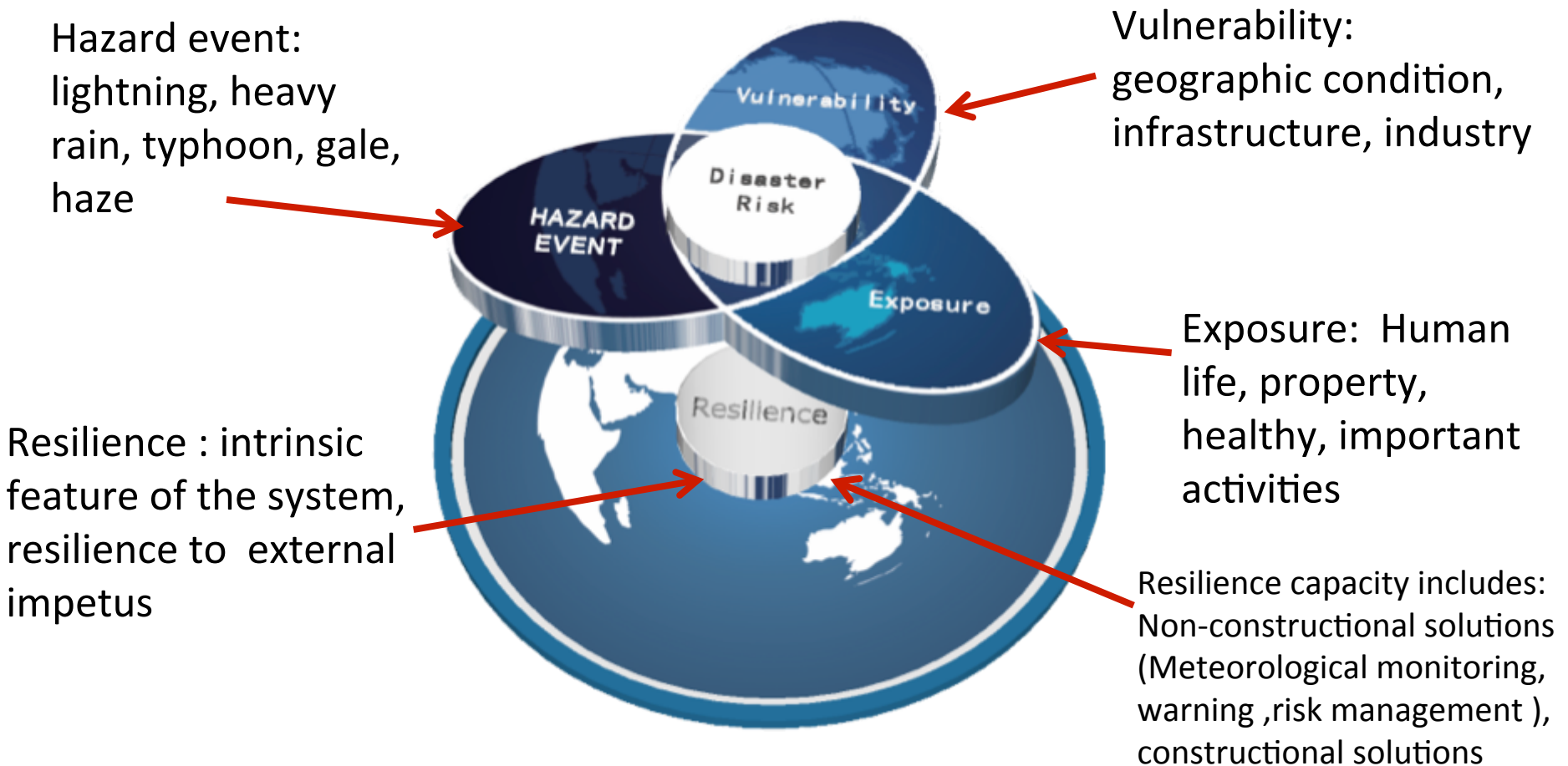


**S8**

### **S8 Multi-Hazard Risk Analysis and Reduction Support:**

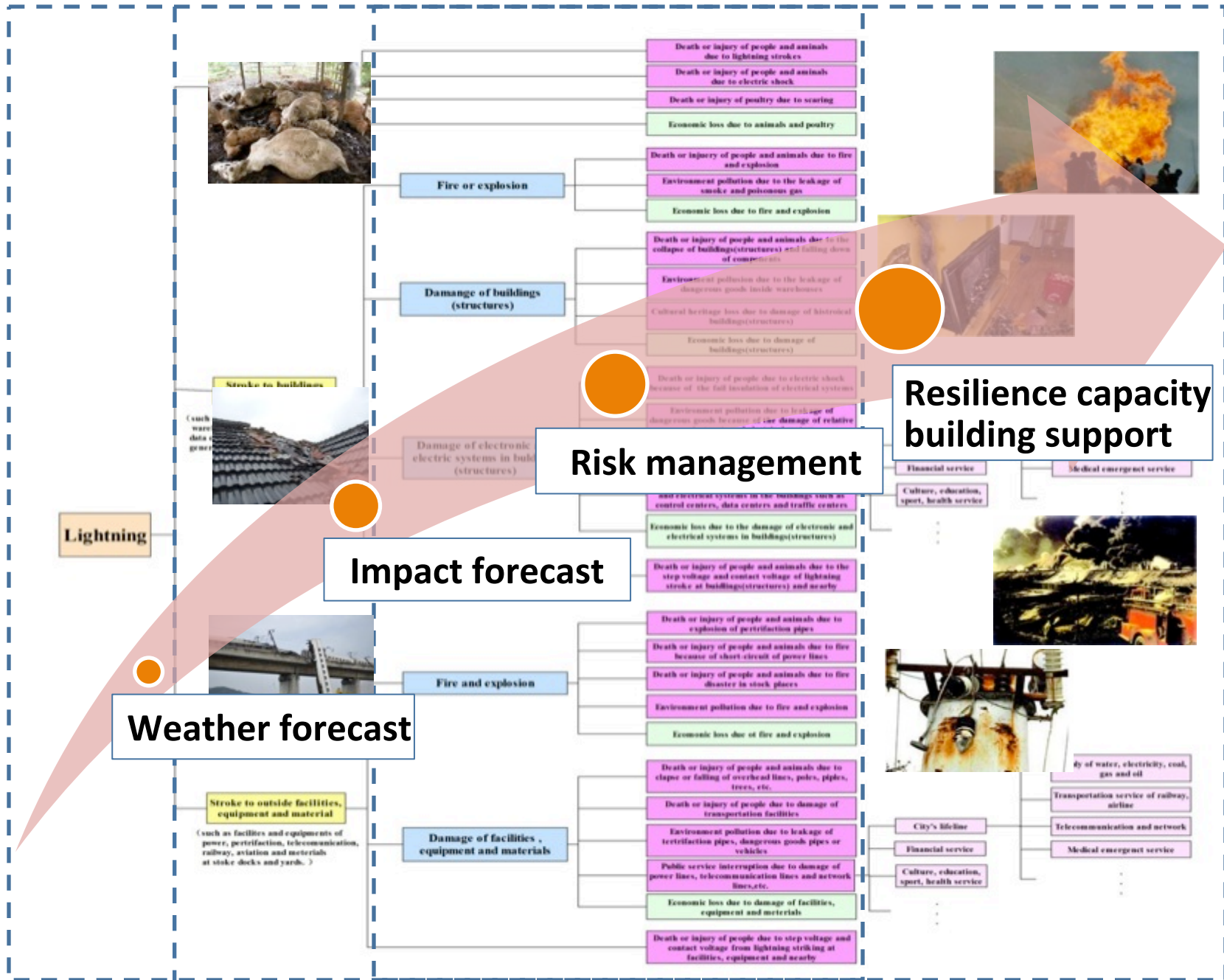
The task of this section is to identify the disaster risk of the high-impact weather based on the integration of hazard, vulnerability and exposure. The aim is to support the enhancement of the city's resilience capacity (constructional & non-constructional) and capacity of risk management.

# S8Multi-Hazard Risk Analysis and Reduction Support



Multi-Hazard Risk Analysis and Reduction Support

# Disaster chain of high impact weather



## 2.2 Operation System of MHEWS

- ◆ Forecast Area

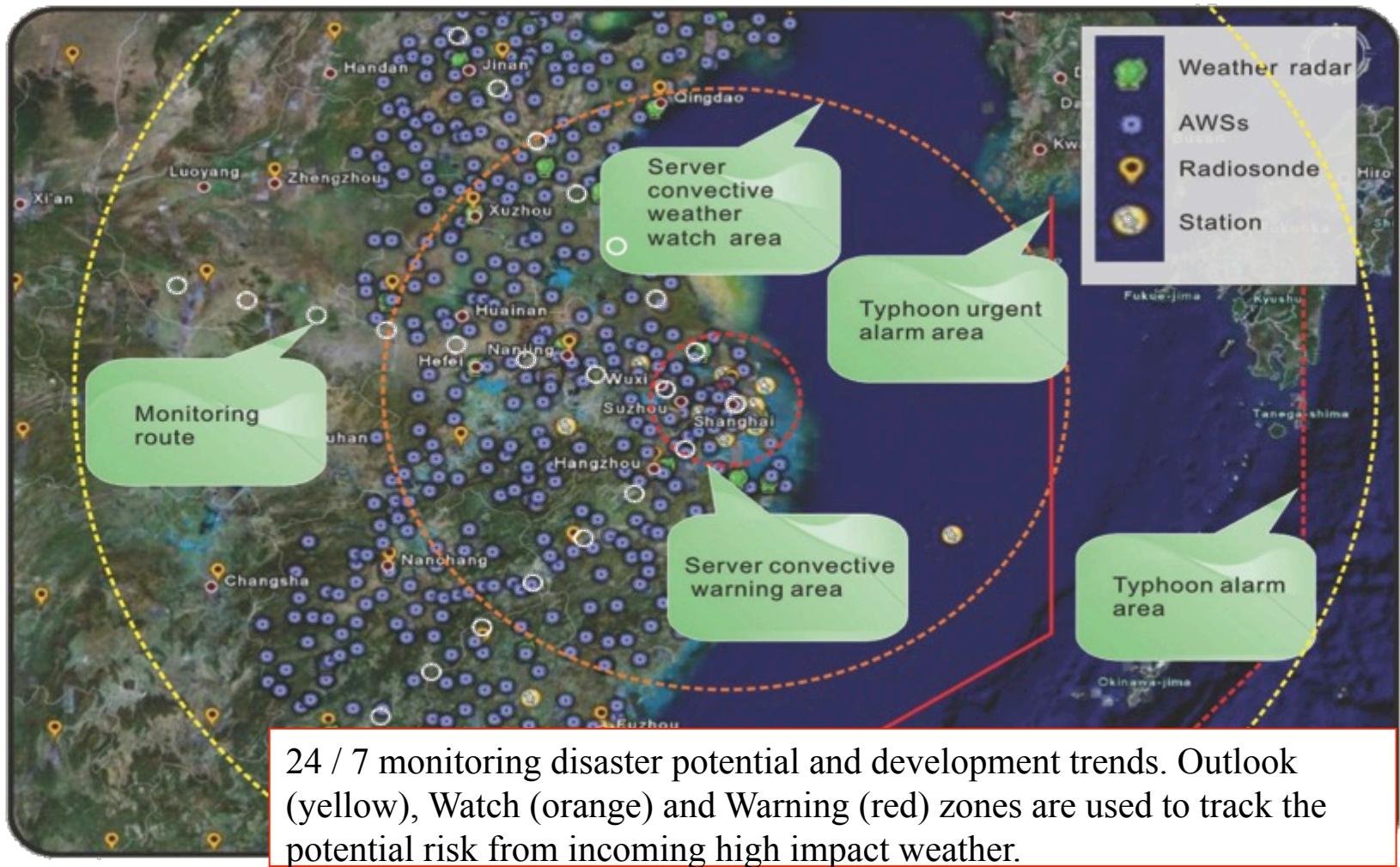
- ◆ PWS Area

- ◆ DATA SUPPORT AND QMS

# DATA SUPPORT--Early detection and monitoring

1. Aims of the platform: to develop local early monitoring network at critical locations for multi-hazards.

## Outlook -watch-warning method



# DATA SUPPORT--Early detection and monitoring

## 2.Overview of high dense urban monitoring network in Shanghai



Wind profiler



Lightning positioning System



1 GPS-met network consisting of 14 reference stations

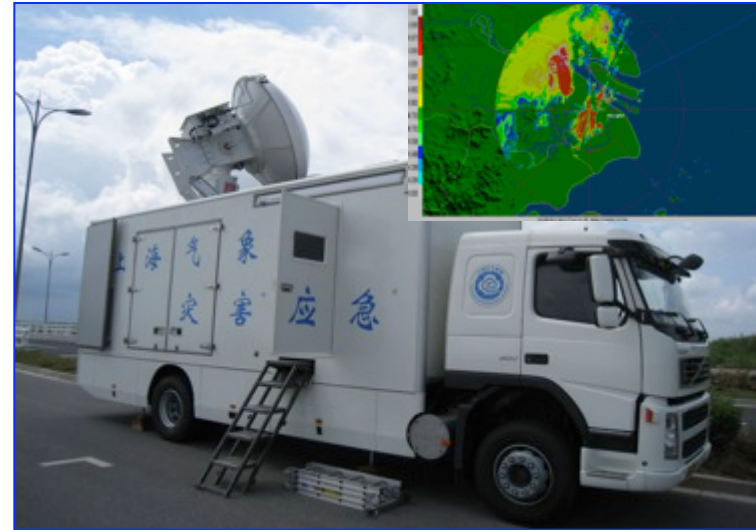
AWS ( 5 – 6 km)	256	1 min
Weather radar	2	6 min
Wind profiler	10	30 min
Met-towers	13	1 min
L-band radiosonde	1	6 h
Lightning positioning system	7	1 s
GPS/MET	31	30 min
Satellite receivers	9	30m/1h
Atmospheric component	10	1 min
Video monitoring	27	Real-time
Mobile observation	5	



weather radar (WSR-88D)

# DATA SUPPORT--Early detection and monitoring

## 3.Mobile Observation

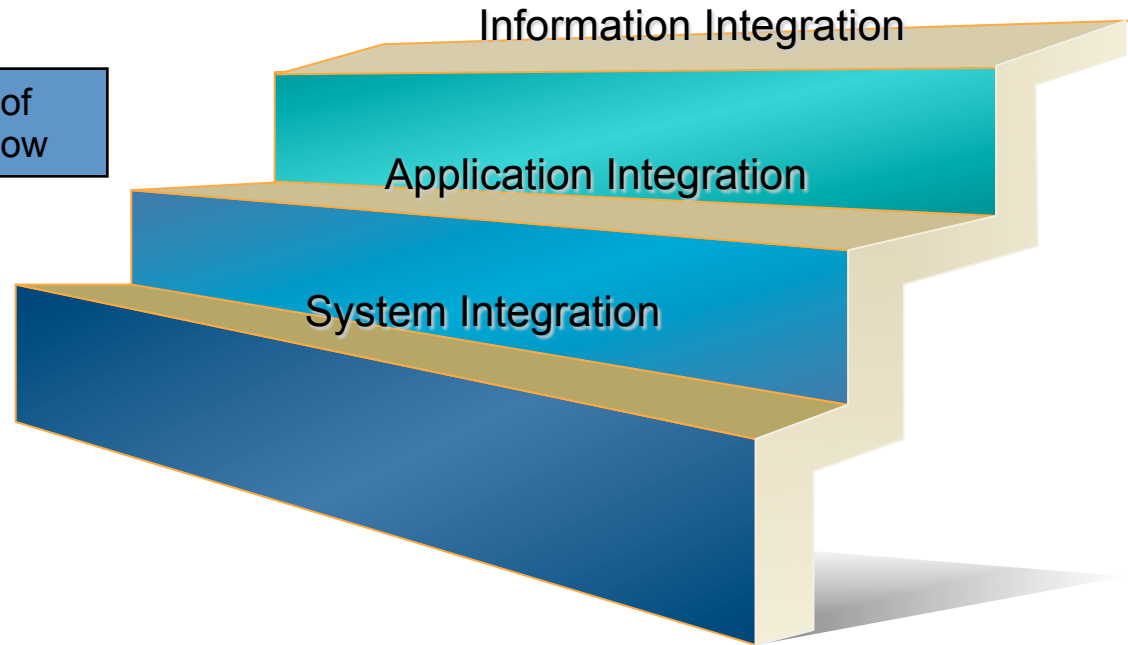
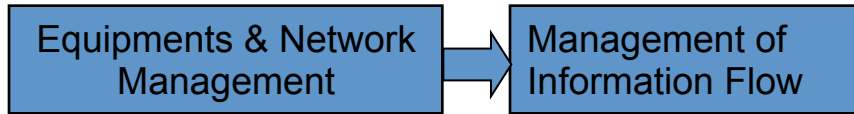
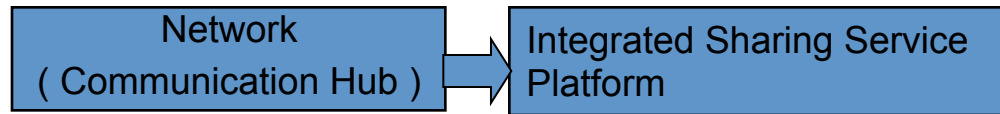


- **Vehicle AWS**
- **Mobile GPS Sounding**
- **Mobile Wind Profile**
- **Mobile Dual-polarimetric Doppler Radar of X-band**
- **Mobile satellite communication system**



# Quality Management System

To establish the service-oriented QMS according to ISO/20000 information service management standards.



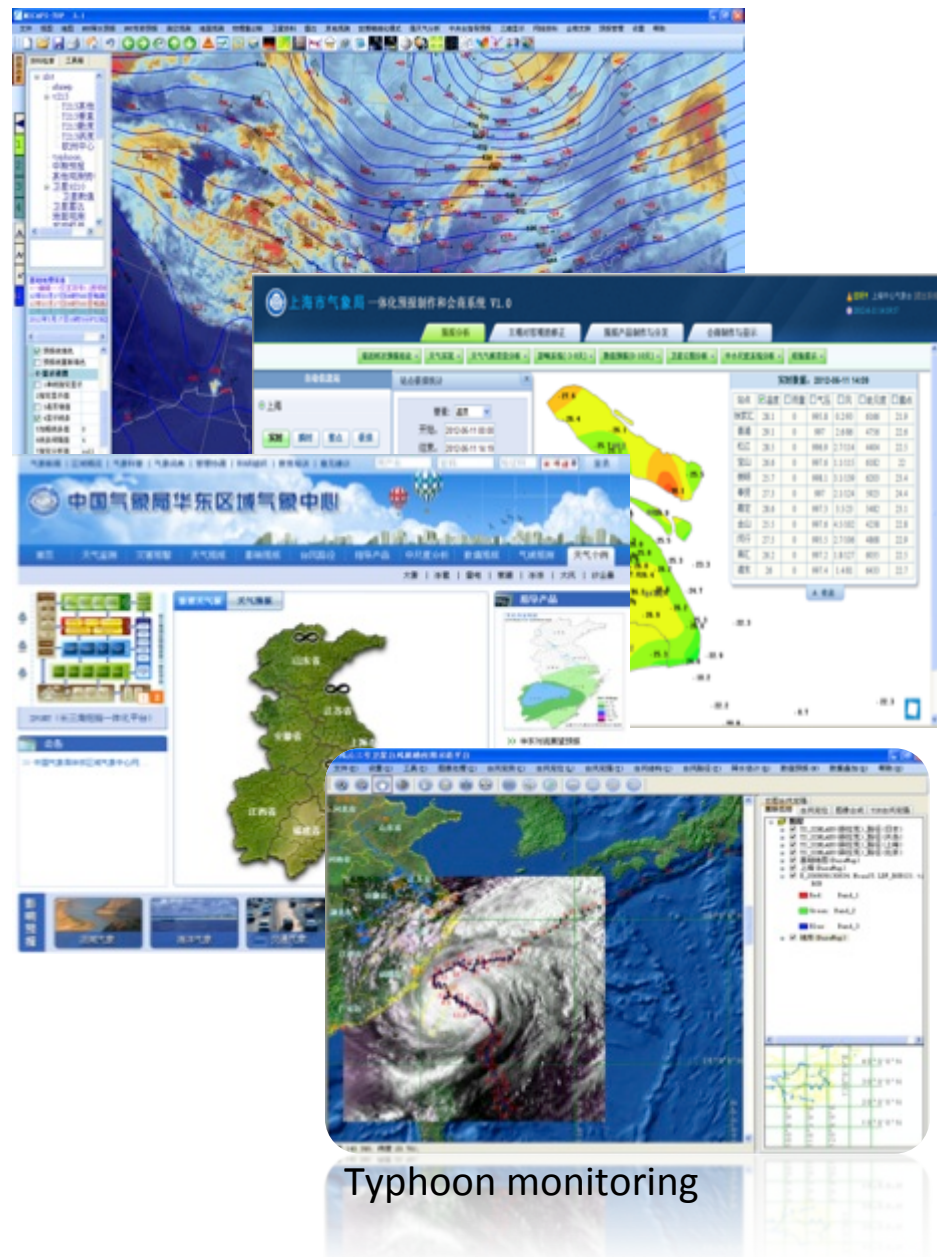
## 2.3 Technic System of MHEWS

- ◆ Shanghai has set up the framework of “Government leading, Multi-agency coordination & Community participation” by enacting legislation and establishing corresponding mechanism.
- ◆ Met Services are the first link in the chain of DPM and have a critical role in disaster detection and warning as well as a supporting role in prevention and mitigation & rescue.

## 2.3 Technic Systems

### 1. Forecasting:

- Platforms:
  - MICAPS: developed by CMA
  - Integrated Information Platform of the Yangtze River Delta
  - NoCAWS (NowCasting and Warning System)
  - SWAN (Severe Weather Automatic Nowcast system) developed by CMA
- NWP Systems:
  - SMB-WARR (WRF ADAS-3DVAR Rapid Refresh System)
  - SMB-WARMS (WRF ADAS Real-time Modeling System)
  - SMB-EnWARMS (Ensemble WARMS)
  - Typhoon model: GRAPES-TCM
  - Marine model : WaveWatchII
  - Chemical model : CAPPS, WRF-chem
  - Pollution dispersion model : HYSPLIT
  - Urban boundary layer model: UBLM



## 2.3 TECH Systems

### 2.PWS : Decision-making:

- Visible Consulting System with Emergency Management Agency
- Visible Consulting System with Flood Prevention Agency
- Emergency Reporting System of Shanghai
- Bacterial Food Poisoning (BFP) Warning System
- Public Related Health Operation System
- Agricultural Weather Service Platform
- CMA Disaster Reporting System
- Direct reporting system for Weather Information
- Intergrated weather service system
- Multi-Hazard Risk Analysis and Reduction system
- .....



## 2.3 TECH Systems

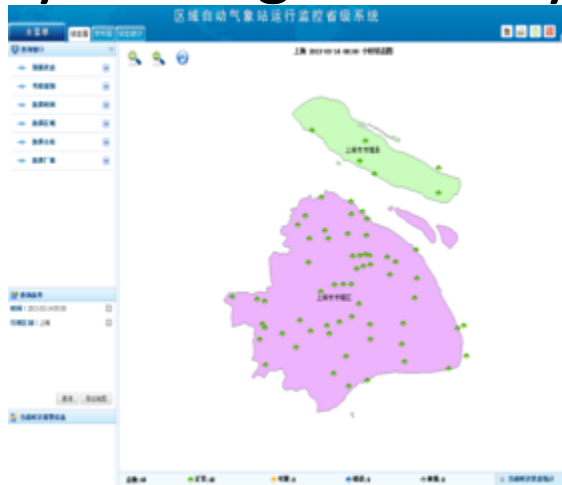
### 2. PWS: Dissemination:

- TV Programming System (41 TV Programs on 9 Separate Channels)
- Radio Broadcast System (410 minutes)
- Special Radio Receiver System (Base on current broadcast system, SCA technology can add a new program to the broadcast)
- 969221 Weather Hot Line
- 400 Provincial Weather Service Hot Line
- SMS System
- Online Weather Service [www.soweather.com](http://www.soweather.com)
- Official Weibo (like Twitter) : Shanghai Weather
- Electronic Screen Display System
- Weather Signal Tower
- Emergency warning information system



## 2.3 TECH Systems

### 3. Quality Management System



Instruments Monitoring (AWS)



Data Statistics



Data Quality Control



Data Integration

# Outline

1. Characters of China DPM system
2. Practice of MHEWS in Shanghai(3 Systems)
3. Summary

## Lesson 1

1. Establish work system, operation system and technic system, each system has an particular emphasis to meet the requirement from the users.
2. Each area owns Integrated, specialized function sectors . The whole operational work is organized based on the sectors.
3. Establish SOPs at the core of CFO&CSO.
4. Focus on QMS, set up standard systems.

# Lesson 2

## ‘CLAP’ Approach: Critical locations, Line, Area & People

### Critical Locations

"Critical locations" : PWS delivery should focus on the city's safety sensitive hot spots such as airports, public transportation network, and logistics infrastructure.

### Area

"Area" Combination of Emergency response mechanism with the daily *Urban Grid Management System*. Efforts to enlarge coverage of warning are also important.

### Line

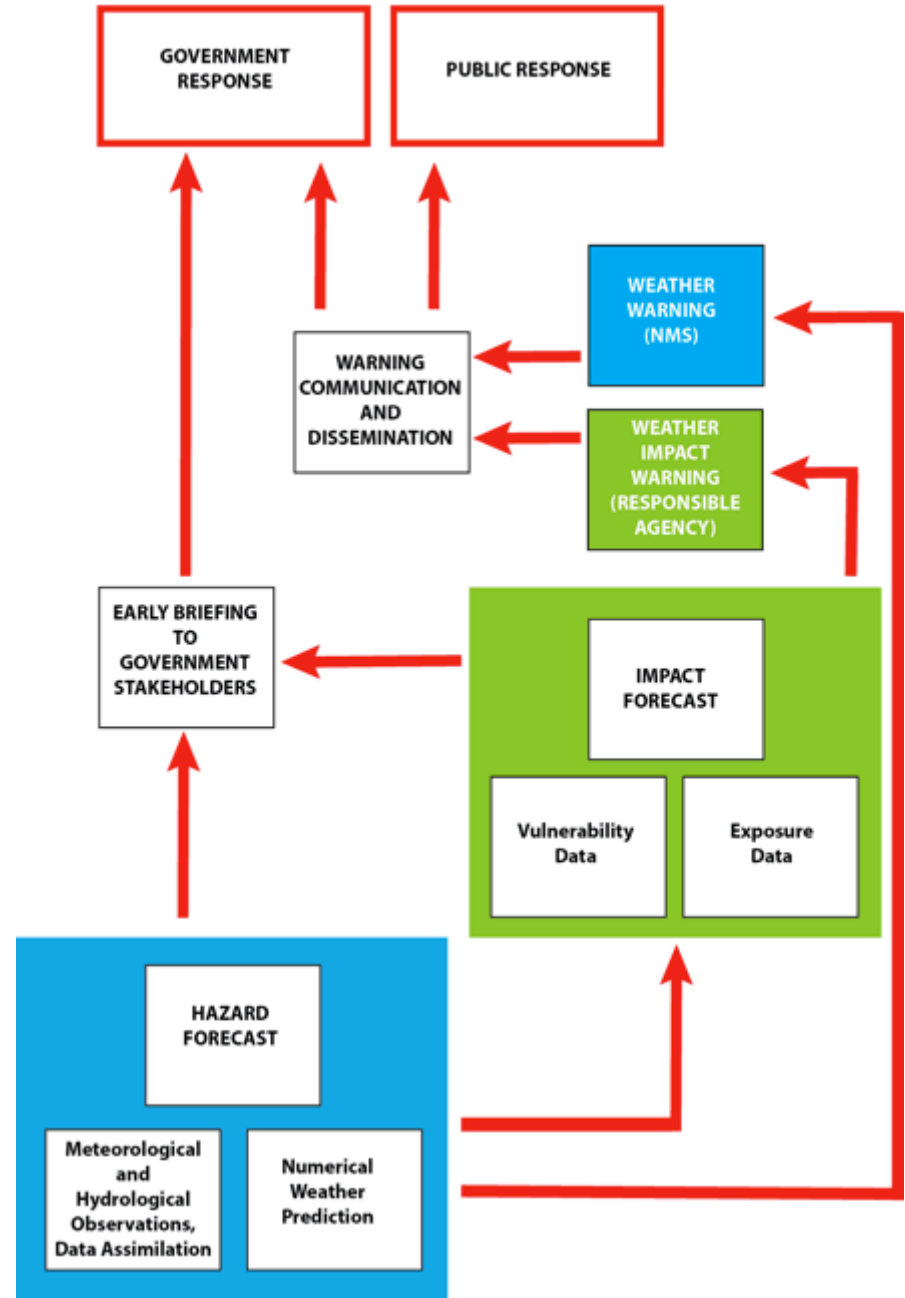
"Line" : Delivery of PWS as one chain from monitoring, warning, prevention, mitigation, and rescue

### People

"People" : PWS is critical for decision-makers, social groups, individuals, and the general public. Capacity Building @ the community level

## Lesson 3

1. Impact Forecast is more useful than the ordinary one.
2. Vulnerability and Exposure data has to be intergrated.
3. Risk-based Warning can bring more benefit.
4. Medias play an critical role in this SOP.



**Thank You!**

