International Workshop on Assessment of Socio-Economic Benefits of NMHSs

Status of Studies on Meteorological Service Benefit Assessment

LI Lianshui Sep. 22, 2009

In recent ten years, natural disasters have cost more than 600,000 lives and influenced more than 2,400,000,000 people, most of whom are from developing countries. Serious natural disasters will destroy the development of years in a moment, trap millions of people in poverty and make them vulnerable to natural disasters in the future.

According to WMO's statistics, during 1980 and 2005, losses caused by meteorological disasters account for 75% of that of all kinds of natural disasters.

In December 2007, a tropical storm attacked Bengal. More than 10,000 people died and 50,000 became homeless.

During July and August 2007, flood attacked south India, Nepal, Bhudan and Bengal. It caused more than 2,000 casualties and about 30,000,000 were forced to leave their homes.

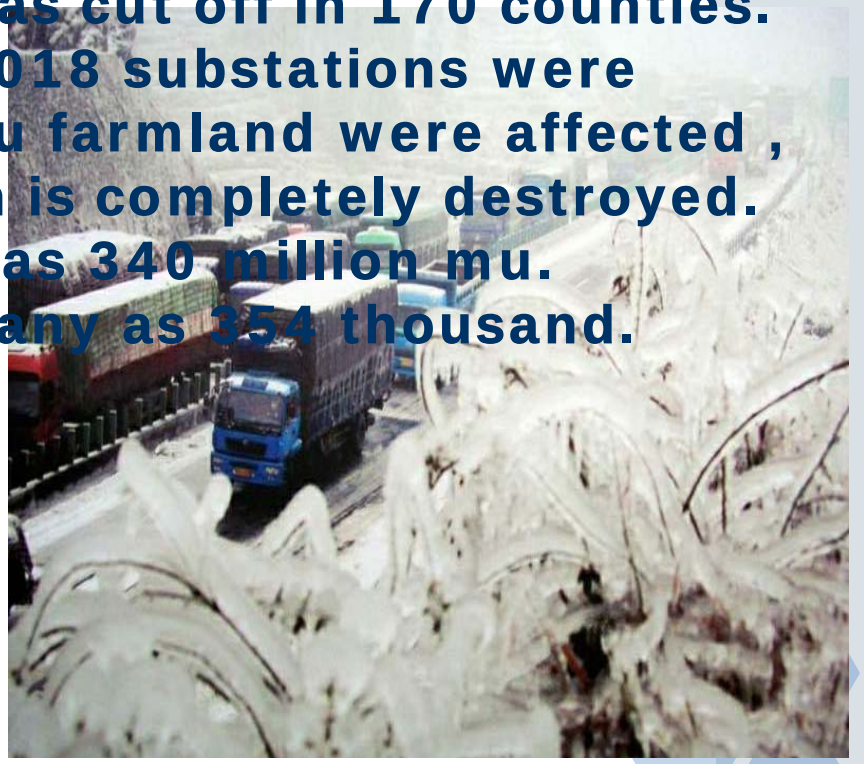
In September 2007, a hurricane cost 101 lives in America. It also attacked Honduras ,Caribbean and Nicaragua. It caused serious casualties and loss of property.

In 2008, Indonesia suffered from severe drought for more than three months. More than 9 million people were affected.

The area of crops suffering from various meteorological disasters is as large as 50 million hectares in China. The population affected by severe meteorological disasters like typhoon, storm, drought, heat wave, sand storm, lightning is more than 400 million. According to statistics from 1990 to 2006, the direct loss caused by meteorological disasters in these 17 years is as much as 185.9 billion Yuan RMB, accounting for 2.8% of China's GDP averagely. Meanwhile, other disasters caused by them like mountain torrents, geologic hazards, oceanic disasters, biological hazards and wildfire, which are threatening our national economic and ecologic construction and people's life and property safety.

In June, 2007, floods hit South China. 24 million hectares farmland were affected. The disaster caused severe economic loss and some geologic hazards.

In 2008, South China suffered grievous ice storm extreme weather. It led to great damage to the electric power system and transportation. Direct economic loss was 151.65 billion RMB. 129 people died. 4 were missing and 1.66 million were evacuated. 20,000 kilometer railways were paralyzed, 220,000 kilometer highways were in jam. 14 civil airports were closed. Electricity was cut off in 170 counties. 36,700 power lines and 2018 substations were influenced. 217 million mu farmland were affected , 30.76 million mu of which is completely destroyed. Area of suffering forest was 340 million mu. Destroyed houses is as many as 354 thousand.



Main Content

1. **Relative notion concerning meteorological service benefit assessment**
2. **The significance of meteorological service benefit assessment**
3. **Relative researches home and abroad**
4. **Our research status quo**
5. **Difficulties of the research**
6. Sequent research focus and recommendations

Ⅰ、Relative notions concerning meteorological service benefit assessment

1、Definition of meteorological service

- WMO(2002)：Meteorological service indicates the basic and special service based on relative infrastructure. Infrastructure includes meteorological observation, data exchange, data processing and data simulation with analysis. Basic service comprises weather forecast and information released to the public through mass media. Special service indicates the value-added meteorological service offered to particular users.
- ZHENG Wenqing（2007）： Meteorological service is the total of such meteorological services as weather forecast and warning, climate application analyses, agro-meteorology, weather modification offered by meteorological staff to the society or persons.
- HUA Yan（2006）： Meteorological service is the process that meteorological departments provide meteorological information and process it to be meteorological products.

2、Notion of meteorological service benefit

- CAI Jiuzhong（1995）：Meteorological service benefit means the economic benefit gained by various industries (agriculture, power, airlines, construction, insurance) after consuming meteorological service products.
- XIE Lingyun（1997）： Meteorological service benefit is the total benefit produced by meteorological services, including meteorological forecast service, climate application service, weather modification service, meteorological satellite remote-sensing service.
- OUYANG Licheng（2009）： Meteorological service benefit indicates the overall benefit gained by using meteorological products or services by all the economic organizations.

3、Our definitions

- **Meteorological services**
  - Various work and services provided to the society by meteorological departments according to social, economic, military, ecologic and disaster prevention and mitigation demands on the basis of atmospheric sciences and technology
- **Benefit**
  - In economic sense, benefit generally means the ratio of input to output in social economic activity.
- **Meteorological service benefit**
  - Generally speaking, it includes social benefit, economic benefit and ecologic benefit. The former two are not easy to be quantified while the latter can be quantitatively analyzed.
- **Meteorological service benefit assessment**
  - The process of quantitative evaluation of the input and output when offering public meteorological services, governmental decision-making service and professional meteorological services by meteorological departments by using mathematics or statistics.

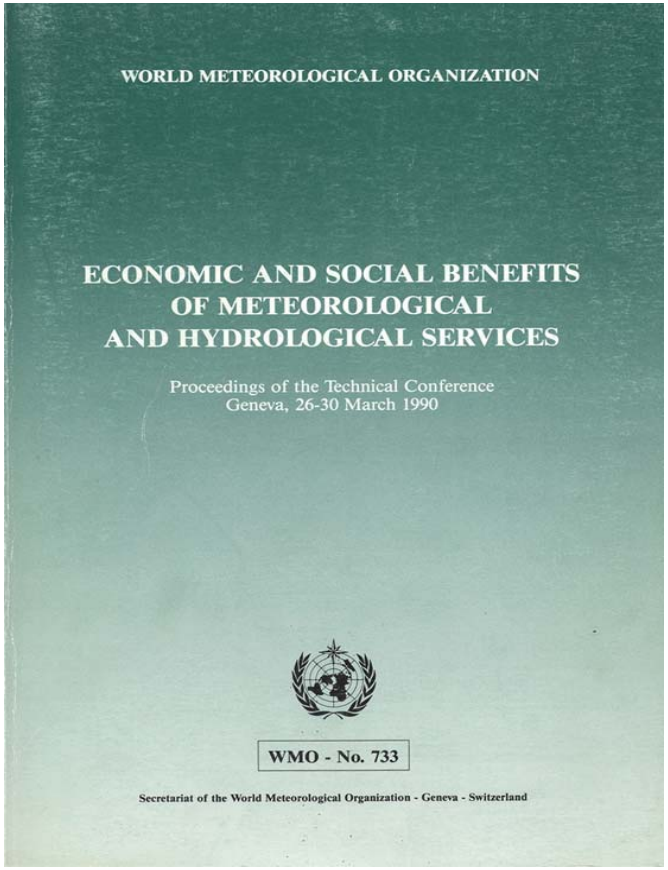
Ⅱ、 The significance of meteorological service benefit assessment

- **1.Offer basis for governmental decision-making**
  - Meteorological departments are institutions of public welfare. How much fund the government should invest in it? What contributions it can make to our national economic development? Meteorological service benefit assessment can offer basis for governmental decision-making as for how much to invest in meteorological departments.
- **2.Porvide direct guidance to meteorological services**
  - Meteorological services comprises various contents, each of which can produce different economic and social benefits. Meteorological service benefit assessment concerns many aspects of meteorological products such as content, channel, distribution methods, degree of satisfaction, willingness to pay . It will provide pertinent guidance for meteorological services. It can strengthen, maintain or reduce our work.

Ⅱ、 The significance of meteorological service benefit assessment

- 3.Supply reference to the prices of paid meteorological services
- According to <Meteorological Law>, “On condition that unpaid public welfare meteorological services are guaranteed, meteorological offices and stations may provide paid meteorological services.” Meteorological service benefit assessment can tell the price that public can accept for meteorological products, the profit of professional meteorological services and the potential benefit of decision-making service, thus offers reference to reasonable pricing of meteorological products.
- 4.Let the public understand meteorological service
  - Meteorological service benefit assessment will help meteorological departments to communicate with the public, other industries and the decision-making units. It will promote the public’s understanding of meteorological departments and the overall development of meteorological cause.

Ⅲ、 Relative researches home and abroad



In 1990, WMO's first special conference

One of the earliest literature on meteorological services benefit assessment

In March 2007, in Madrid, Spain

International conference on meteorological benefit

Slogan: Secure and sustainable living: social and economic benefits of weather, climate and water services

1、Researches abroad

WMO special conferences、relative researches of NOAA in USA、Jeff Lazo。

- （1）**WMO：3 conferences**（1990.3.26-30，Geneva；1994.9.19-23，Geneva；2007.3，Madrid, Spain）。
- （2）**NOAA in USA：** the Department of Commerce of USA and NOAA publish <NOAA Economic Statistics>, which is renewed every 1-2 years. It came to the 6th version in 2008, which mentioned that 105 million families are the largest customers of NOAA's services and products. These families will consult weather forecast at least once everyday. According to NOAA's budget of 1.383 billion US dollars, every American need to pay 13 US dollars for weather forecast every year. The government spends 25 dollars on meteorological information for each family. The ratio of benefit to cost is 4.4, namely, the country gains 8.8 billion US dollars yearly.
- （3）**Researches of Jeff Lazo：** Researches of American scholars Dutton and Jeff Lazo are very typical. In one of his papers published in 2002, he used the method of quantitative analysis and reached the conclusion that in American's 9872.9 billion dollars GDP, 3859.1 billion is related to weather, accounting for 40% of the total GDP.
- （4）Australian scholars Dr. Don Gunasekera et al：He explored the political and economic framework of meteorological services and pointed out that derivants of meteorological services will enter the market and that the pricing mechanism of meteorological services will face more and more challenges.

2、Domestic researches

（**1**）**Domestic assessments**：in 1983, 1994, 2006 and 2008.

- 1）in 1985, ratio of meteorological service cost to benefit: 1:15-20;
- 2）in 1994, ratio of meteorological service cost to benefit: 1:35-40. Public meteorological service benefit was 9.2-10.1 billion RMB. Professional meteorological service benefit was 34.2-40.1 billion RMB.
- 3）in 2006, the research group led by Deputy Administrator Xu Xiaofeng pointed out that the benefit of meteorological services in the whole country was 53.5 billion RMB at least if evaluated in currency.

4）in 2008, the Public Meteorological Service Centre of CMA entrust a professional company with a public opinion poll on public meteorological service benefit. 10,430 valid samples were collected. Main conclusions are:

（**1**）The degree of satisfaction of the public to meteorological services was quite high, which was 75.6. It was higher than China's public meteorological service index and the score in 2006. In terms of geological distribution characteristics, it was higher in the north than that in the south.

（**2**）The image of meteorological departments was good with a score of 79.2. However, the accuracy of forecast needed improving.

（**3**）Meteorological information attracted much attention. The public showed little difference in behavior and custom in this aspect.

（**4**）The benefit of meteorological services was as high as 5.9-15.3 billion RMB if evaluated in currency.

2、Domestic researches

（2）domestic academic researches:

- 1）themes：public meteorological service benefit assessment, professional meteorological service benefit assessment, decision-making meteorological service benefit assessment, meteorological disaster prevention and mitigation service benefit assessment.
- 2）methods：（public meteorological service benefit assessment）Willingness to Pay, Cost Saving and Shadow Price；（professional meteorological service benefit assessment）Specialist Evaluation, Shadow Price and Case Study.
- 3）main researches：Zhou Fu（1995）、Song Shanyun，Xue Jianjun（2007）、Hu Haibo（2008）、Luo Hui（2007，2008）、Huang Zongjie（1997）et al.

- Zhou Fu（**1995**）carried out a survey on public meteorological service assessment in Zhejiang province and did simple analyses and calculation on the result.
- Song Shanyun, Xue Jianjun et al.（**2007**）did a nationwide survey on “China’s Meteorological Services Benefit Assessment” in 2006 and analyzed the 17,441 valid results.
- Hu Haibo（**2008**）did quantitative analyses of the meteorological services in terms of social economic benefit during the Beijing Olympic Games by hierarchy analysis. He pointed out that weather forecast products needed improving its timeliness and geological accuracy.
- Luo Hui（**2007，2008**）analyzed the degree of attention the public paid to meteorological risks and corresponding numbers of people by fuzzy mathematics.
- Huang Zongjie（**1997**）used shadow price to reckon the economic benefit of meteorological departments.

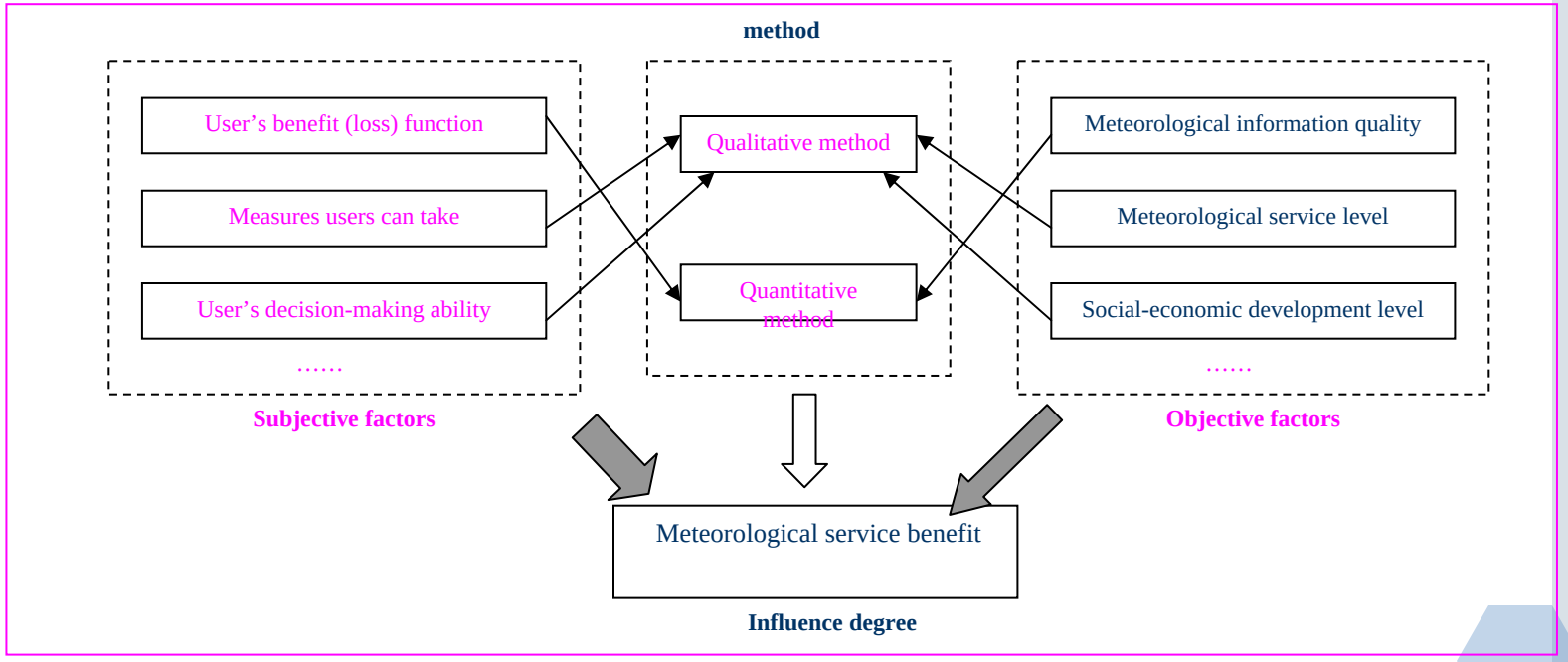
3、Main problems in current researches

- （1）The connotation and denotation of meteorological service benefit are not clear. We define meteorological service benefit as comprising economic benefit, social benefit and ecological benefit. The former definitions are limited to the benefit gained by a certain profession. Our definition has a bigger denotation.
- （2）There are various factors affecting meteorological service benefit, but researches studying the key factors were not common. There are three key factors: quality of meteorological information, distribution channels and ability to use meteorological information.
- （3）The basic statistics available for meteorological service benefit is very limited and incomplete. (In terms of public meteorological service benefit and decision-making meteorological service benefit, there was no statistics. In terms of meteorological disaster prevention and mitigation, some statistics of losses can be gained from public reports.)
- （4）The methods of meteorological service benefit assessment are monotonous, mainly relying on surveys, which is not rigorous enough.

4、Main problems we focus on

（1）**Scientific definition of connotation and denotation**, which is the basis and precondition of our research.

（2）**Factors affecting meteorological service benefit**: meteorological service benefit is related with not only user's benefit function (or loss function) but also the quality of meteorological information and the measures users can take and their decision-making ability. How to determine and evaluate these factors is the beginning of our research.



（3）**Methods of meteorological service benefit assessment** mainly include “shadow price”, “cost saving” and “paying voluntarily”. Are there any other innovative methods or models? Can statistics analysis models, quantitative economic models, mathematics and physics models or engineering models be used? This is the key to a breakthrough in our research.

（**4**）**Relative researches concerning meteorological service benefit assessment** influence of climatic (meteorological) factors on society and economy (manufacturing industry, large project); influence of meteorological disaster on society and economy; influence of meteorological factors on low-carbon economy and energy-saving & emission reduction.

Ⅳ、Our research status quo

（1）overview of main work done

（2）main conclusion of surveys

（3）amendment to assessment model

（4）assessment method and technique exploration

（5）benefit assessment on disaster prevention and mitigation

（6）other relative researches

（1）Overview of main work done

1.Relative theoretical researches

（1）**literature review** summarize, analyze theories, methods and techniques concerning meteorological benefit assessment in US and Europe; define connotation and denotation of our meteorological service products; study the methods, technical connotation and framework of meteorological benefit assessment; form a special study report;

（2）**questionnaire on public meteorological service benefit assessment** make a questionnaire on public meteorological service benefit, including 6 items, 3 topics and more than 50 questions;

（3）**academic researches on relative topics** on the topic of meteorological service benefit assessment, write more than 20 papers. By June 2009, 25 academic papers had been finished. They all have been contributed.

（1）overview of main work done

number	title
1	Research Status of Meteorological Service Benefit Assessment Overseas
2	Review of Domestic Research Status of Meteorological Service Benefit Assessment
3	Review of International Research Methods of Meteorological Service Benefit Assessment
4	Study on Domestic Meteorological Service Benefit Assessment
5	Research on Public Meteorological Service Assessment Index System and Satisfaction
6	Review of Studies on Meteorological Benefit in Meteorological Sensitive Industries in China and Foreign Countries
7	Historical Changes in China’s Meteorological Regulations and Policies
8	Amendments to Public Meteorological Service Benefit Assessment Model
9	Study on Model of Public Satisfaction of Meteorological Service Based on SEM
10	Study on Meteorological Service Benefit Assessment Based on AHM
11	Study on Meteorological Disaster Assessment Based on AHM
12	Network Structure of Public Meteorological Benefit Assessment Based on OGSA
13	Study on Methods of Meteorological Benefit Assessment Data Quality Control

（1） overview of main work done

number	title
14	Discussion on Quantitative Methods and Models of Professional Meteorological Service Benefit
15	Studies of Meteorological Sensitive Industries in Jiangsu, Anhui, and Henan Provinces
16	Assessment of the Strength of Typhoon Landing on Zhejiang Province Based on Fuzzy Mathematics
17	Assessment of Social Influence of Typhoon Based on AHP
18	Study on Meteorological Service Status Quo and Benefit Assessment Methods in Huaihe Valley
19	Study on Meteorological Service Status Quo and Benefit Assessment Methods in China and Foreign Countries
20	Channels to Release Public Information Products----A Case Study on Meteorological Information
21	Study on Cost Compensation Mechanism of Public Meteorological Service Products
22	Study on Classification and Supply Mechanism of Meteorological Products
23	Study on Influence of Meteorological Factors' Abnormity Index on Four Provinces in Huadong Area
24	Study on Relationship Between Economic Development and Meteorological Conditions in Shanghai
	Study on Factors Affecting Carbon Emission in Manufacturing Industry Based on

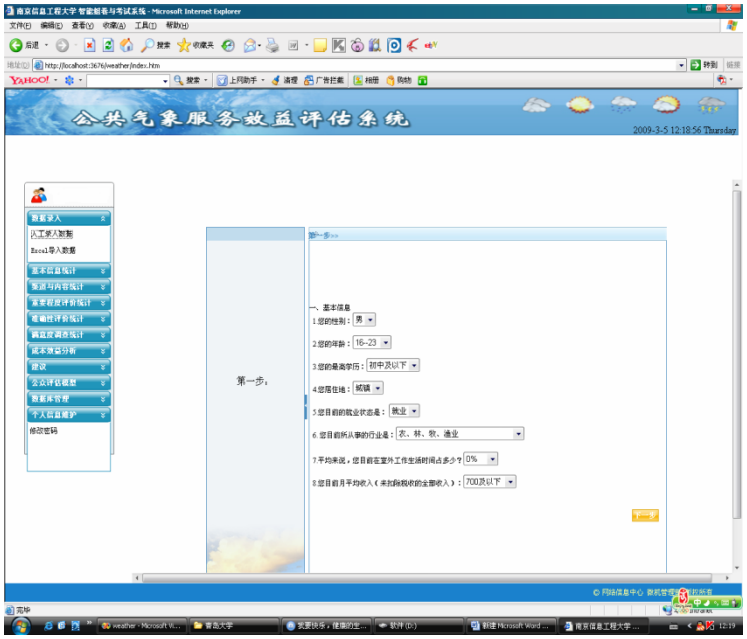
（1） overview of main work done

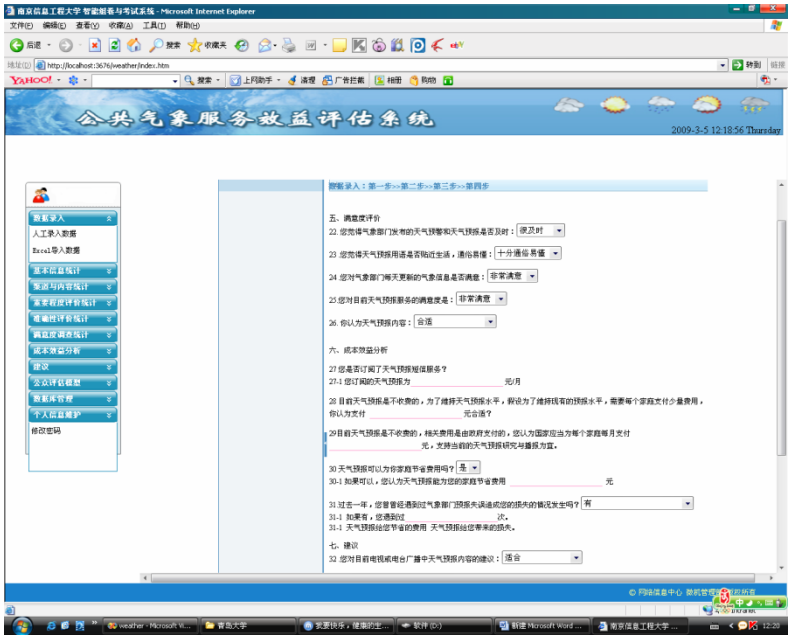
1、**Construction of Data Platform** Construct platform on “Meteorological Service Benefit Assessment Survey” of C# language, report forms (Crystal Report), database (SQL Server2005), system model (B/S). It includes 8 sub models like on-line survey. Now, the platform has been put on the website of Public Meteorological Service Center CMA and NUIST.

2、**Data collection and arrangement** The on-line survey lasting for one month got 20,082 public survey data. Nearly 20,000 samples were collected from NUIST. More than 7000 samples were collected from meteorological specialists within the Yangtse Delta. By 11 July 2009, we have got 47,456 valid samples and 4,033,760 data.

（1） overview of main work done

3、Database Construction On the basis of the survey, we constructed “China’s Meteorological Service Benefit Assessment Database”.





（2）Main Conclusion of surveys

The meteorological information obtained through the following main channels: internet, TV and SMS

Table 1. The public obtains the meteorological information from the following channels（%）

	TV	Inter-net	SMS	Broad-casting	Paper	Telephone	Bulletin or Electronic Screen	Heard From Others	Others	Invalid Tickets
Teacher	41.7	31.4	12.7	5.3	3.5	0.1	0.9	2.9	0.6	0.9
Student	11.3	36.6	33.1	3	1.9	0.2	1.2	11.5	0.8	0.4
Internet Survey	19.5	61.7	11.7	3.1	2.1	0.4	0.5	0.9	0.1	0

（2） Main Conclusion of surveys

2、The internet and SMS are the channels the public hope to get the meteorological information

Table 2. channels the public hope to obtains meteorological information

（%）

	TV	Internet	SMS	Broad-casting	Paper	Telephone	Bulletin or Electronic Screen	Heard From Others	Others	Invalid Tickets
Teacher	28.4	26.2	32.9	3.3	2.2	0.5	3.1	1.6	0.6	1.2
Student	8.8	24.1	53.3	2.7	0.8	0.7	5.1	3.1	1	0.4
Internet Survey	13.9	52.4	27.6	2.5	1	0.4	1.7	0.4	0.1	0

（2） Main Conclusion of surveys

3、The primary concerned weather forecast contents are the routine weather forecast and live weather

Table 3. The weather forecast content of the public primary concerns （%）

	Routine Weather Forecast	Sever Weather Forecast and Warning	Satellite Cloud Map	Weather Live	Professional Weather Forecast for Farming, transportation and ocean	Others	Invalid Tickets
Teacher	77.4	9.3	1.9	7.7	2.1	0.3	1.3
Student	74.9	7.9	1.9	11.6	2.6	0.7	0.4
Internet Survey	72.2	7.9	3.5	13.6	2.5	0.3	0

（2） Main Conclusion of surveys

4、The primary concerned routine forecast is the 1-3 day forecasts

Table 4. The routine forecast content of the public primary concerns （%）

	12 hour nowcasting	1-3 day forecasts	4-10 day forecasts	11-30 day tending forecasts	Invalid Tickets
Teacher	14.5	77.4	6.8	0.7	0.6
Student	16.7	77.5	4.6	0.8	0.4
Internet Survey	13.6	72	13.5	0.9	0

（2） Main Conclusion of surveys

5、The teacher and the internet investigator are primarily concerned with the clothing index and the air pollution index, whereas the student is primarily concerned with the comfort index and the ultraviolet index.

6、More than about 40% surveyors do not obtain the weather forecasts at a fixed time, they get the weather information from the internet when they need (e.g. about 45.4% students give this answer, and the teacher paid attention to weather forecast between 18：00—20：00).

7、The weather forecast information of the public primary concern is the temperature next for the precipitation (snow) and severe weather (about this point there are not significant differences among the teacher, student and the internet surveyor).

8、The public uses the weather forecast information for making the plans, such as clothing (for oneself or families), working, studying , shopping and so on.

9、The most influential severe weather is the high temperature and the rainstorm for the public in Jiangsu. In teacher’s opinion, the rainstorm is the most influential weather disaster, and the high temperature the second, whereas the student thought the high temperature is the first and rainstorm the second.

（2） Main Conclusion of surveys

10、More than 90% public consider the weather forecast to be accurate. Teacher:94.2%; Student: 92%; The public outside the school: 97.7%.

11、The public considers the longer the period of the weather forecast is, the more inaccurate the weather forecast is.

12、Over 90% public consider the weather forecast warning and the weather early warning signals issued by the meteorological departments to be accurate.

13、The public is quite satisfied with the weather forecast services (about 93.8% public), timeliness of early warning (about 96.18% public), language used in weather forecast and the renewal times of the weather forecast (about 93.73%).

14、About 30% public consider the time of the weather forecast after CCTV news is too short, and the content is less than enough.

（2） Main Conclusion of surveys

15、The teacher, student and internet surveyors are willing to pay 18, 16.5 and 14.9 Yuan, respectively, for the public meteorological services.

16、 If sponsored by the government budget, the public think that every year the government pays about 40 Yuan for each family.

17、The SMS subscriptions of the different communities are different. The subscription proportion of teacher is approximately 20%, the student's is more than 30% and the internet surveyor's is about 30%.

18、Nearly 50% public consider the weather forecast could save family expenses of about 300 Yuan every year.

19、The meteorological department forecast faults bring losses to about one third of the public more than once.

20、 The public thought what most needs to be improved is the weather forecast accuracy (above 50%), and next is to increase the distribution channels.

（3） Amendment to assessment model

The assessment methods and technologies of the meteorological service benefits are carried out from different regions, levels and categories. By using a lot of quantitative analysis methods comprehensively, we are to build the methodological and technological support systems of China’s meteorological service benefits, then the assessment model of China’s meteorological service benefits will be established.

1、The Appraising Model of the Meteorological Service Satisfaction based on the SEM Analysis

Based on the core concepts and structures of the traditional appraising model of custom satisfaction, combining the unique of the meteorological services, the equations and structures of the appraising model about the meteorological service satisfaction are formatted. The research about the model are carried on.

2、The AHM Method Research of the Meteorological Service Benefits Evaluation

（4）The Assessment Methods and Technology of the Professional Meteorological Service benefits

1、 **The meteorological sensitive profession:** Agriculture, forest, herd, fishery; Transportation; Construction; Energy production and supply; Financial industry and insurance business; Cultural sports and entertainment; Trade; Urban management and so on.

2、 **The economic development has significant depending on the meteorological factors.**

Agriculture is the most sensitive profession, the meteorological sensitive of the other professions are differences in the different regions.

For example, the tertiary industry in the Jiangsu and Anhui province is great affected by the meteorological factors, whereas the secondary industry especially construction is a high meteorological sensitive profession in Henan province.

1、The Zhejiang Typhoon Intensity Index Assessment based on the Fuzzy method

Based on the fuzzy mathematics method, the typhoon index is calculated and the relationship between the intensity index and the economic losses has been investigated, which provides data and materials for other researches.

2、 Typhoon Social Impact Quality Synthetic Evaluation based on AHP Method

Choosing the physical index of typhoon, the losses index and the geography difference, the typhoon social influence index are obtained through the analytic hierarchy process.

（6） Other relative researches

1、 Based on principles of public economics , A preliminary classification of the meteorological service products.

Table10 Classification of Products of meteorological service

		Exclusiveness	
		There be	Without
Competitiveness	There be	1. **Private Goods** （Ships, aircraft navigation, meteorological services of business decision-making personalized products, insurance, futures, business celebrations, Lightning monitoring ）	3. **Public Resources** （Free Customer Service Hotline、 The protection of major projects, etc.）
	Without	2. **Club Products** （The charges of Auto-Answer inquiry phone、 Mobile weather service、 Digital TV weather service） （Local governments payments for the major events 、 Artificial Rainfall hail suppression、 Commercial TV、 Newspapers and network weather service products）	4. **Public Goods** （Government decision-making, national defense, foreign weather services, meteorological disaster warning; Government's public welfare activities、 Artificial Rainfall hail suppression； broadcasting; public service television, newspapers, Internet weather services, etc.）

（6） Other relative researches

2、 The quasi-public weather services products are divided into the marginal cost of increasing type 、Regressive model and Essentially the same type. The cost-recovery mechanism of the different types of meteorological services is investigated. Finally, we discuss the possible supply mode.

Table11 **The supply mechanism of the different meteorological service products**

No.	Type	Features	Product examples	Supply pattern
1	The marginal cost of increasing type of quasi-public goods	Large externalities	Local governments payments for the major events 、Artificial Rainfall hail suppression	Provide by government
		Small Externalities	The protection of major projects	Provided by personal
		Different supply elasticity	Varies according to the product	Provide by government; Provide by personal; government subsidy；
2	The marginal cost of decreasing type of quasi public goods		Newspapers and network weather service products	Provide by government; Several private companies provide together.
3	Marginal cost is essentially the same quasi-public goods	Marginal cost is zero、Marginal congestion cost is zero	Digital TV weather service、Commercial TV weather programs	Provide by government , Taxation together
		Marginal production cost is zero, there is the marginal cost of congestion	The charges of Auto-Answer inquiry phone、Mobile weather service	Provide by government, charge in accordance with Marginal congestion costs; provided by personal, government give financial subsidies.
		Marginal production cost is zero, And the constant is a positive number	Free Customer Service Hotline	Provide by government, charge in accordance with Marginal congestion costs; Provide by personal, government give financial subsidies.

（6） Other relative researches

3、 The factors affecting carbon emissions of the manufacturing sector

The effect of the demographic , Wealth and technological factors on the carbon emissions of Chinese manufacturing industry have been investigated by analyzing the STIRPAT model which is solved by the ridge estimation. Basic conclusions are followed:

(1) Population (Manufacturing employees) has great effect on the carbon emissions of Chinese manufacturing industry increase, from one side reveals the process of development of Chinese manufacturing industry, and energy-intensive industries could absorb a larger proportion of the labor force.

(2) Wealth (manufacturing output per capita) also causes the increase in carbon emissions of Chinese manufacturing industry. This is a direct reflection that the economic growth of Chinese manufacturing industry is a main factor of the carbon emissions increase.

(3) Technology (manufacturing energy intensity) demonstrates the role of the reduce carbon emissions of Chinese manufacturing sector. However, this reduction exhaust effect is small comparison with growth of population and wealth. The proportion only 48.48% and 37.61% of population and wealth, respectively.

(4) By analyzing the introduction of population and wealth items STIRPAT quadratic model found that, quadratic coefficients entry is positive. These Show that the Circumstances Kuznets inverted u-curve doesn't apply to Chinese current manufacturing carbon emissions. Carbon emissions of Chinese manufacturing industry has sounded the alarm.

（7）Our main contributions

Our contribution is mainly reflected in the following aspects:

- (1) The Innovation of the Survey Sampling. Topics using A overall way of sampling to conducted a survey of 20000 students and nearly 2,000 teachers in a school. In addition to the general public to investigate, also conducted a survey of the public who work on the weather department and weather-sensitive profession.
- (2) Not only estimating the economic benefits to the public weather service, but also using the structural equation models to analyze the public weather service satisfaction. Primarily reflects the social benefits of meteorological services is the public weather service benefits.
- (3) Take the typhoon as an example, the benefits in the prevention and reduction meteorological disaster service were investigated.
- (4) From the perspective of willingness to pay, in this survey the payment unit is the household, closing to the individual units of the previous three surveys paid, so the input-output ratio of this survey is about one third of the before.

Ⅴ、The difficulties of the research

- **1. The deficiencies of traditional assessment methods**
- **Voluntary payment method and cost method.**

  How to truly and accurately reflect the psychology of consumers feel? (for example, people who in favor of the viewpoint usually exaggerate his wishes, the people who not much in favor of this would belittle the service benefits)
- **Shadow price method.**

  which shadow should be chosen.
- **Delphi method.**

  In the case of personal knowledge is not complete, How to choose the right expert?

Ⅴ、The difficulties of the research

- **2. Assessment of Benefits of the public meteorological service**
- Under the referring the satisfaction research from domestic and foreign, the CSI models and methods situations, and combing the practice experiences of the Chinese meteorological service, how to construct the satisfaction appraising model which is suitable for our national realities?
- How to design the questionnaire of the public meteorological service benefit reasonably?
- How to obtain the authentic assessment of the meteorological service benefit from public?
- In the official inquiry, which methods can attract more public participation?
- In the internet survey, how to calculate the deviation of the samples (the internet surveyors can not represent all public)？
- How to get the collected information feed back to the practice of the public meteorological service?

Ⅴ、The difficulties of the research

- **3.The Assessment of the Benefits of Severe Weather Service**
- How to evaluate the latent risk of the meteorological disaster under the information not completely?
- How to check the rank and the scope of the meteorological disaster?
- How to assess the influences of the extreme meteorological disaster?
- How to reasonable develop the assessment of the meteorological disaster before the disaster happens, the disaster happens and after the disaster occurred?
- The searching range, precision, space and time resolution, project, type of the monitor facilities are inaccurate, the basic data lacks seriously. Under these conditions, how to evaluate the losses which some kind of meteorological disaster causes? (e.g. During the freezing rain and heavy snow in 2008, the monitor data which we obtained only the wire covered ice.)

Ⅴ、The difficulties of the research

- **4. Benefit evaluation of professional meteorological service**
- Professional time-series data is wider (generally the smallest unit is month), but the time-series data of meteorological elements is narrow (generally the smallest unit is minute). How to fit the different data in order to confirm the high sensitivity of meteorology effectively?
- Different industry、corporation has different production process and increase in value, how to account the meteorological service benefit value in different industry.
- Meteorological service products have the characteristics of information products, diffusion cost almost close to zero. How to scientifically evaluate cost-benefit of professional meteorological service products?

Ⅵ. Focus of subsequent researches and recommendations

- Benefit evaluation method of the meteorological disaster prevention and mitigation services
- Analysis on satisfaction of public meteorological services
- How to test the validity of voluntary payment (try to do it through subscription for message)
- Benefit Evaluation of meteorological service for decision-making

Possible innovations:

- Building satisfaction evaluation model of public meteorological service
- Solving the problem of validity of voluntary payment

Thank You!