

*Evaluation Study about Climatic Environment Comfort of Commercial  
Pedestrian-streets in Winter Cities in Ecological Planning  
——Harbin Central Street as an Example*

Harbin Institute of Technology

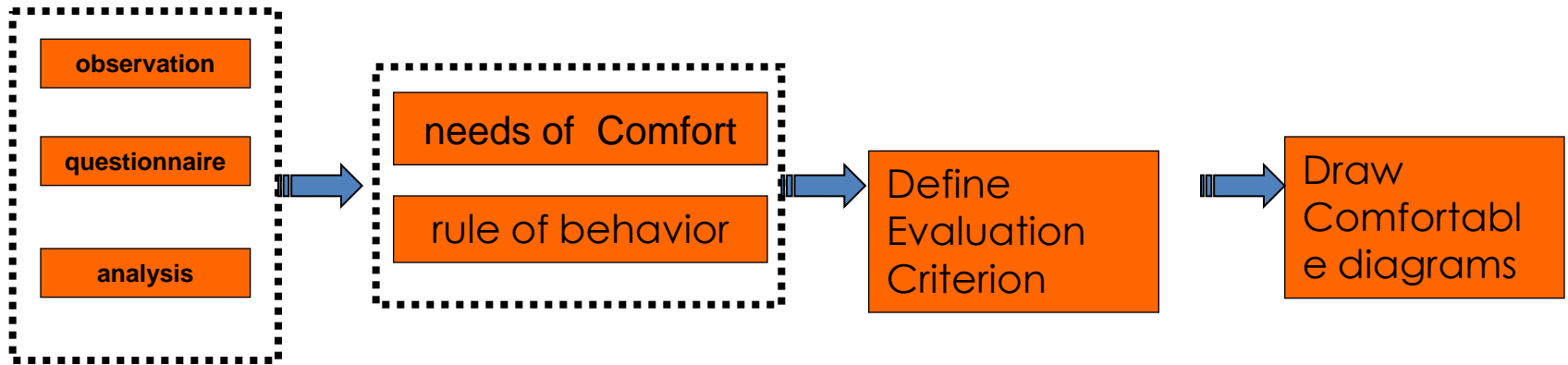
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# 1 The outline

Process :

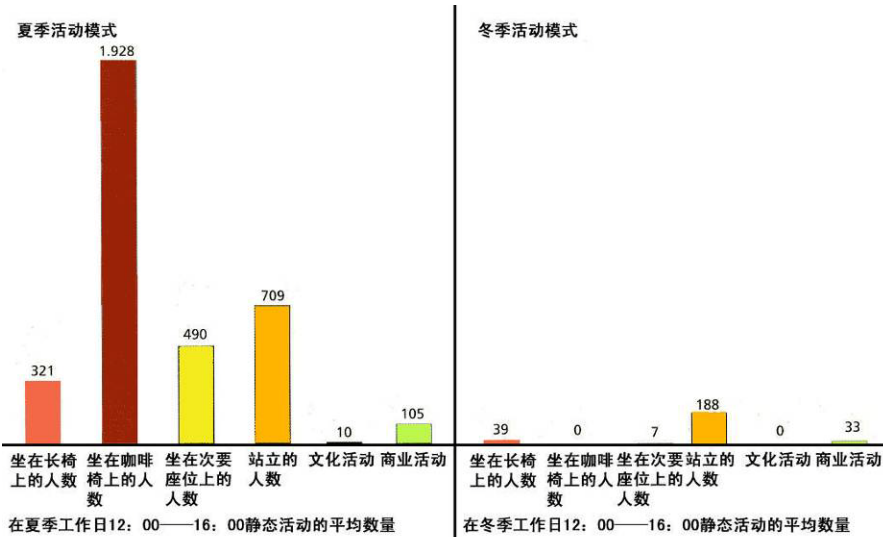


Methods :

Using the comparative analytical method and combination of qualitative and quantitative analysis

1

## The spur of climatic research efforts in winter city



### the influence of winter city climate

- cold
- Ice and snow
- cold wind
- harsh microclimate conditions
- space are not sufficiently utilized
- The limitation of action model
- the activity of urban public space drop

The contrasts of activity mode between summer and winter in winter city

## 2 cornerstones of the study—the relationship of city climate, street and people

### 1 the influence of cold weather on commercial pedestrian-streets

- (1) visual landscape
- (2) street comfort
- (3) energy and facilities consumption
- (4) pattern of behavior

### 2 The relationship between cold weather and human body comfortableness

#### •temperature humidity

In extremely cold conditions

#### •wind

affected too much wind change frequently

#### •sunshine duration

sunshine duration and daytime are especially short

#### •snow frozen

precipitation is often in form of snow  
  
freeze frequently

# 3 Current status investigations — The existing situation of microclimate environment

- existing situation
- broad public space
- famous landmark

- weather and climate
- the average temperature of Harbin is about  $4.7^{\circ}\text{C}$ , and the mean air temperature of the coldest month is less than  $-16.7^{\circ}\text{C}$ .

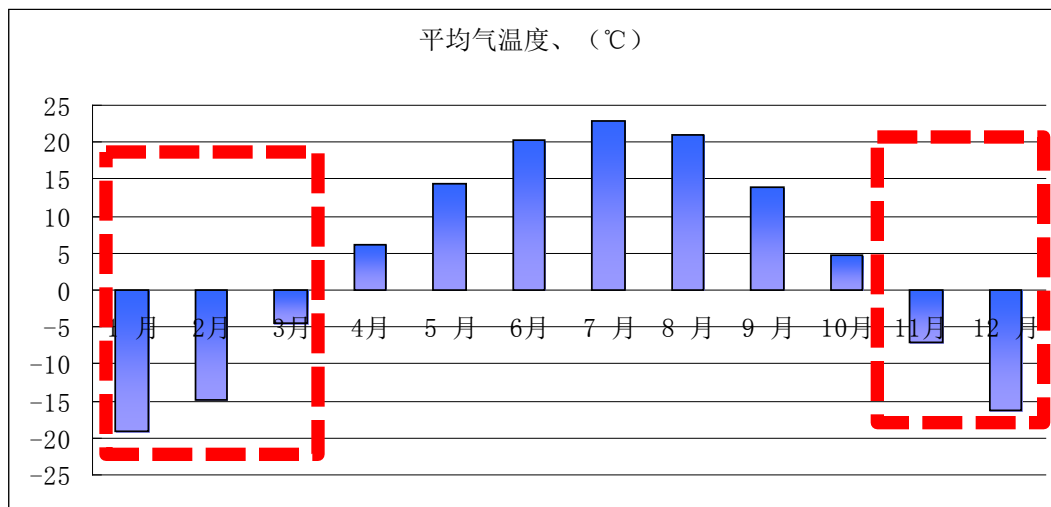


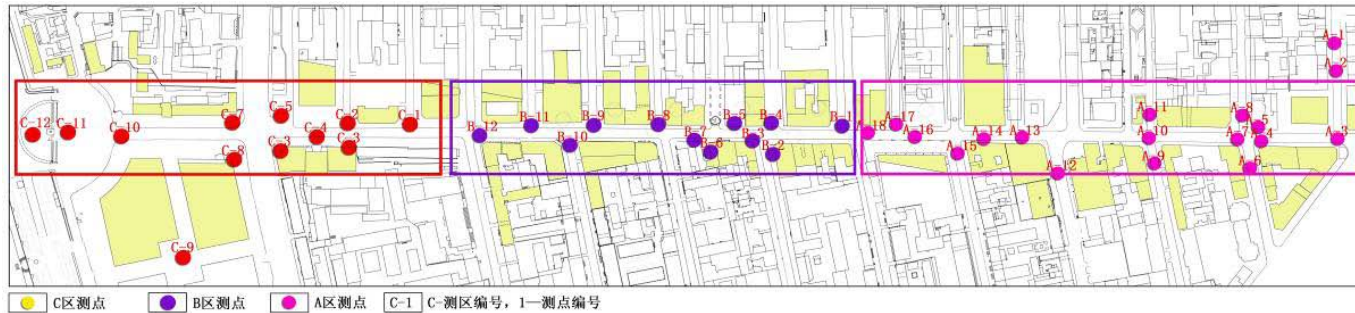
fig: Statistics for the monthly data for the physical environment of Harbin Central Street in winter (1961-1990)

## the major adverse factors of the climate

- sunshine duration
- the change of wind pressure, wind speed, wind direction
- freeze frequently

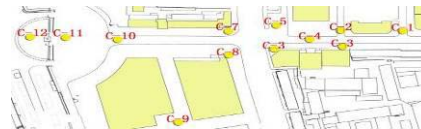
# Current status investigations — microclimate data

## 1 Distribution map of test points in Harbin Central Street



sampling inquiry :the activity field

the surrounding environment of facilities and large building

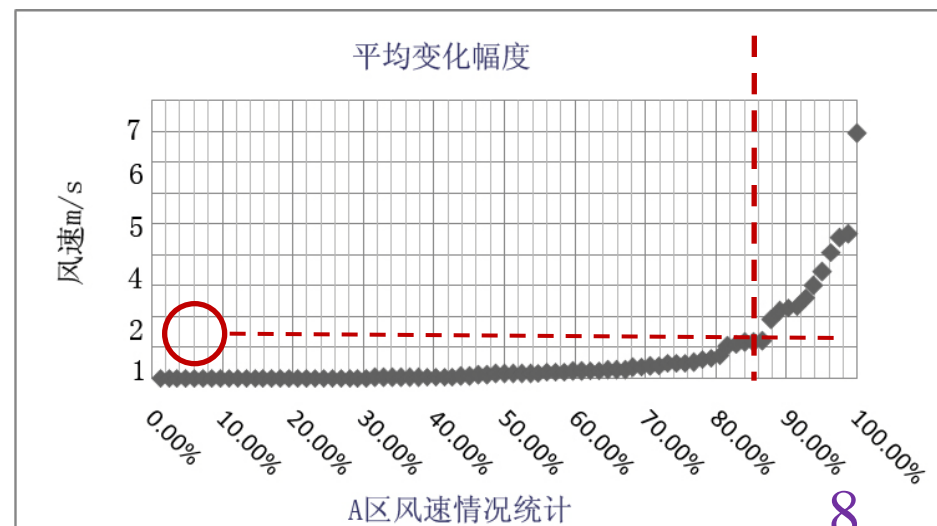
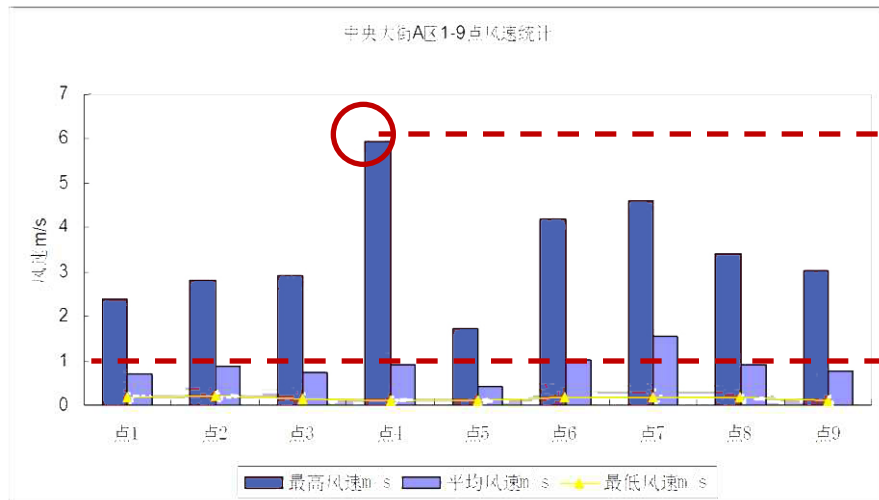
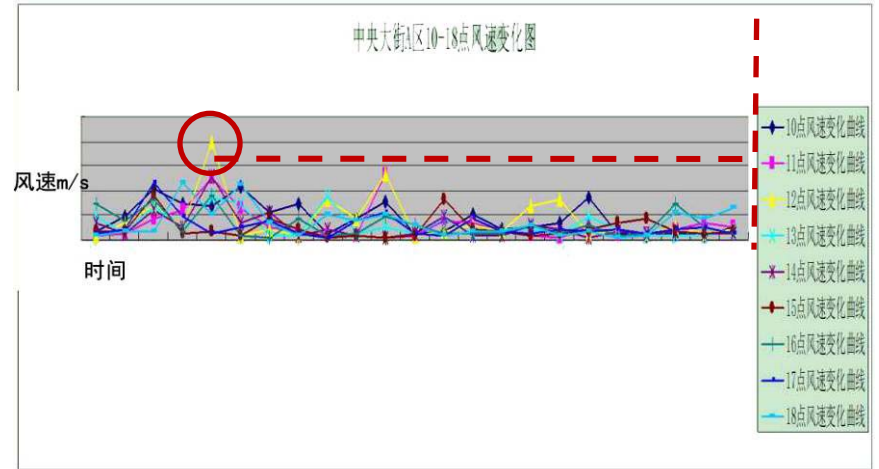
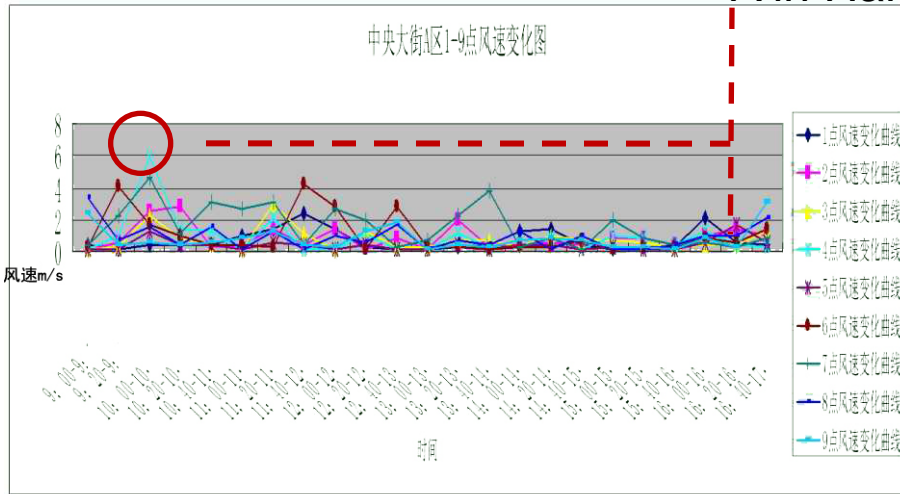


### measure-point classification

- Open space
- Scenery and leisure area
- main stem
- intersection
- enclosed space
- Shaded spaces around to large building

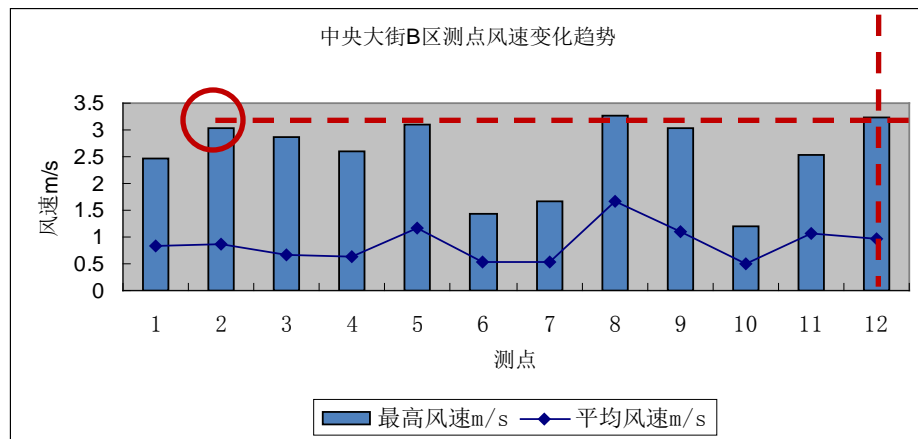
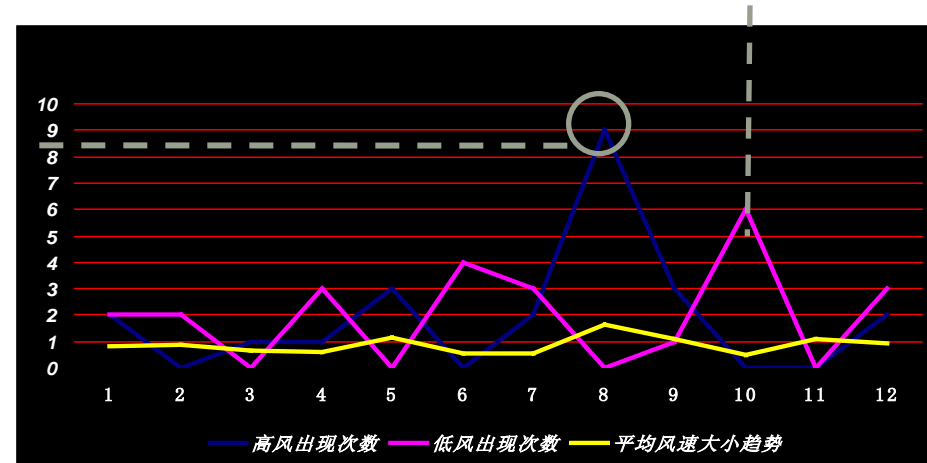
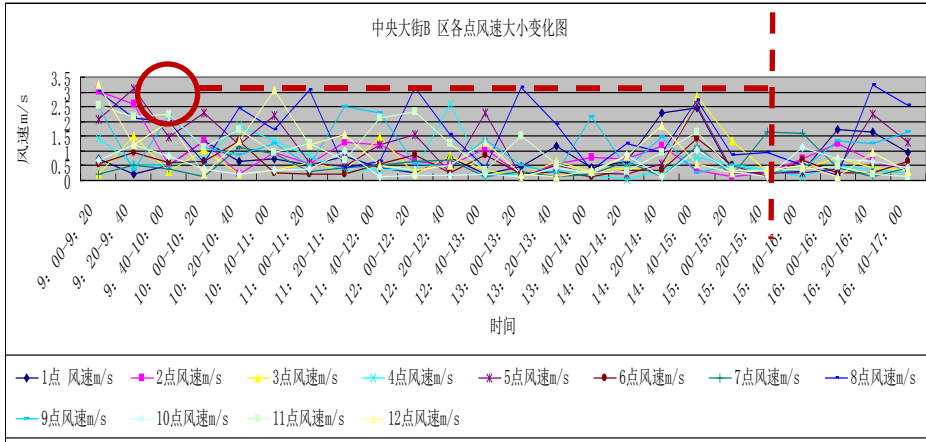
# Current status investigations — Observations of microclimate data

## Statistics for the hourly data for the wind environment of survey area A in Harbin Central Street



# Current status investigations — Observations of microclimate data

## Statistics for the hourly data for the wind environment of survey area B in Harbin Central Street



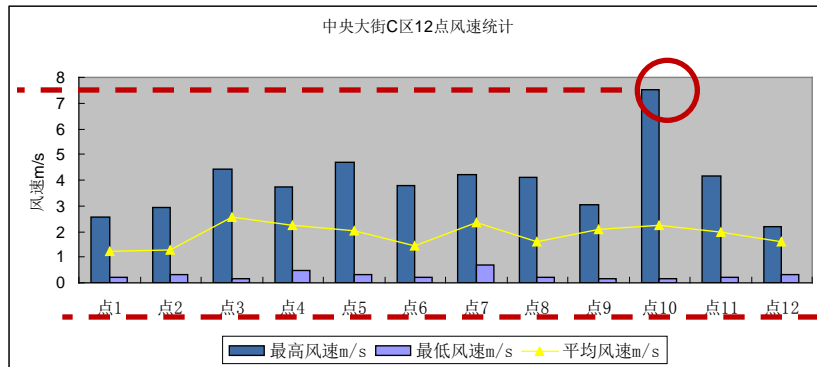
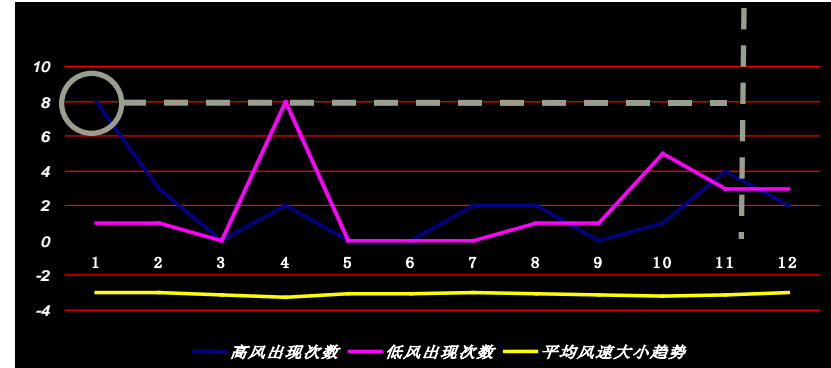
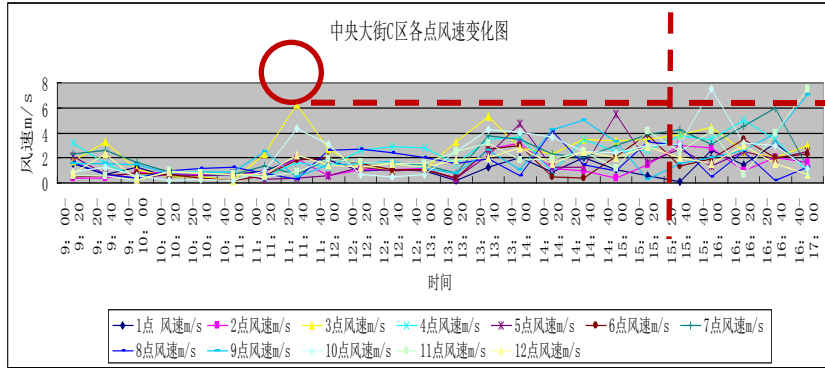
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### Statistics for extreme wind-speed

- Low wind speeds
- 03.04.06.07.10
- High wind speeds
- 08.05.09.11.12

• intersection and high-rise Buildings

## Statistics for the hourly data for the wind environment of survey area C in Harbin Central Street



### 4 Statistics for extreme wind-speed

- Low wind speeds
- 01.02. 06
- High wind speeds
- 03.07. 04.10.09
- 

waterfront、high-rise Buildings

## Wind speed — the analysis of research result

### 1 differences caused by spatial variations

along the river > ancillary street > Main Street

### 2 differences caused by time variations

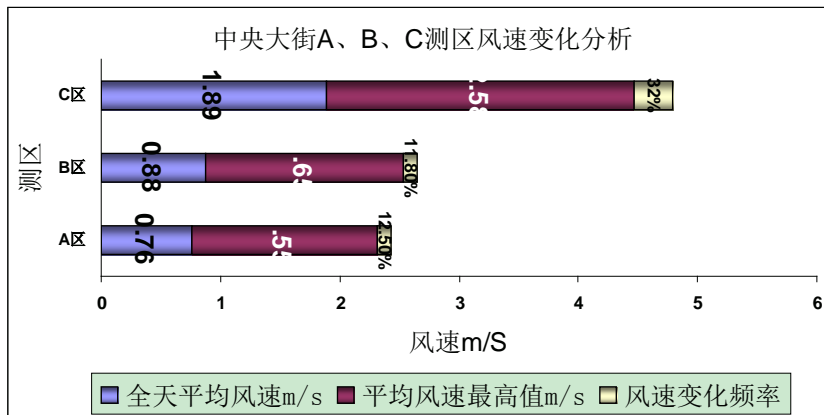
morning > noontime > Evening

### 3 Comparison: survey area A,B,C

C > A > B

characteristics of these differences

- Song Hua River
- The entrance
- The angle contained by dominant wind
- Building height , forms, layout



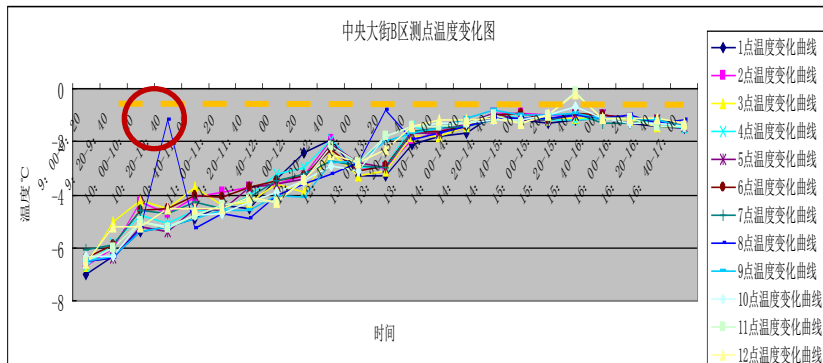
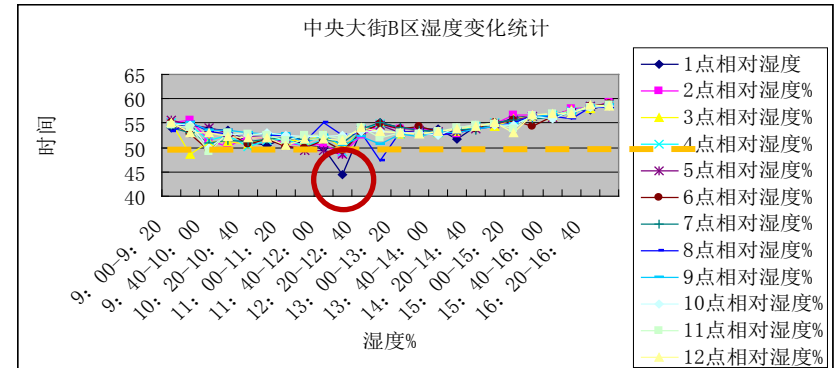
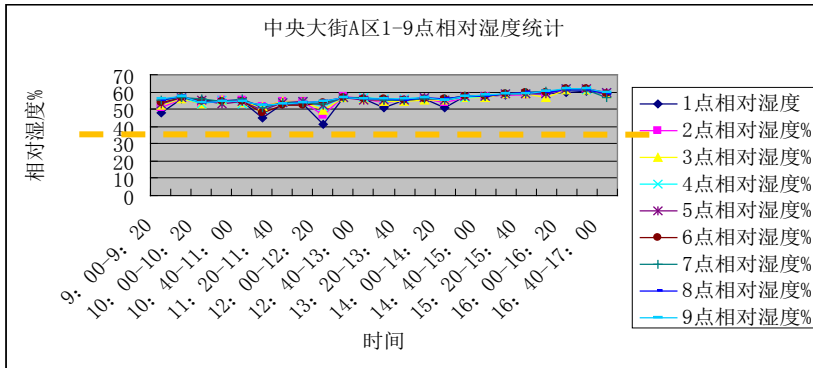
the temperature in testing zone C changes drastically

The wind velocity is moderate in B without any obvious strong wind in A

Fig. comparative analysis of wind velocity in A,B,C

# Current status investigations — Observations of microclimate data

## humidity、temperature — Observations



### 4 Statistics for extreme temperature

extreme temperatures  
 waterfront、Shaded spaces  
 The difference in temperatures  
 sunlight time, wind velocity, wind pressure  
 Moderate moisture

# Current status investigations ——— computer simulation

1 target location -Central-mall leisure area

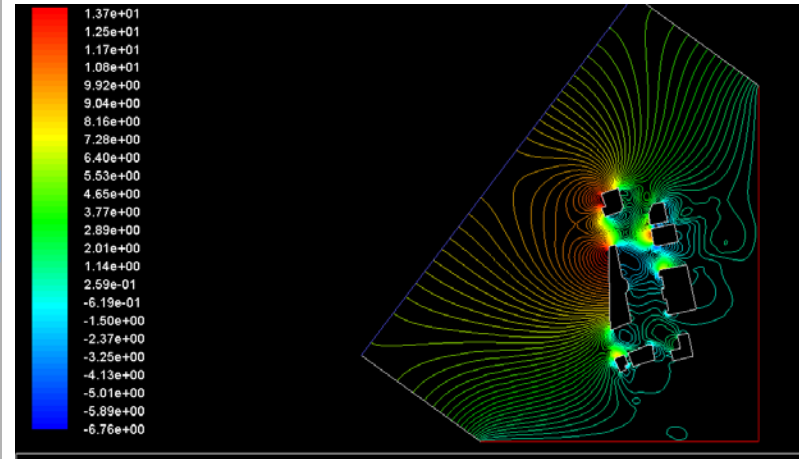
**primary functions :transportation and activity**

2 wind velocity & sunlight condition simulated

**Low incident angle**

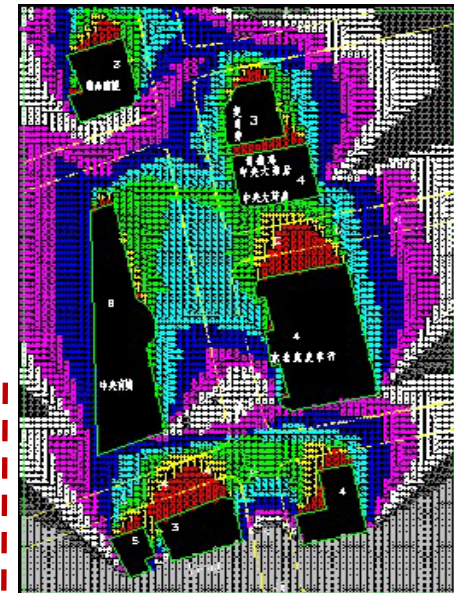
**Narrow ancillary stem**

**architectural graphic design , scale the corner of high-rise**



As shows the red area is long time in shadow

orange area in high wind velocity and wind pressure



The simulation results are identical to the observational trends

# 4Evaluation Study —— Climatic Environment Comfort



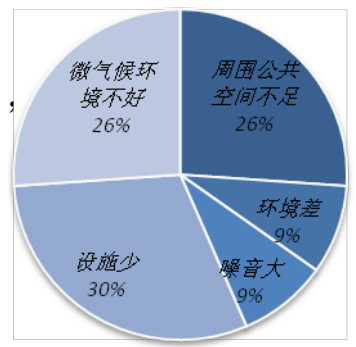
## Methods and procedures

- ① Determine the function of the evaluation area and the physical environment needs under this function.
- ② According to the functional requirements, determine the natural elements of each corresponding evaluation area.
- ③ According to the relationship of the climate and physical environment ; Determine the natural factors that corresponds to the user needs
- ④ Add all these need factors together, and then plot all these figures on a graph in order to reflect the gradient change of the comfort under the definite rules.
- ⑤ Determine the relationship between the internal functions of evaluation areas and physical elements of climate and environment,
- ⑥ Set the constraints and advantages of the natural factors to overlay, combined with the previous rule, plotting a graph which could describe the comfort of the evaluation areas under this function.
  
- ⑦ A comprehensive map has drawn to show the use of various functions with the most highly comfortable way of regional distribution.

# 4Evaluation Study —— Climatic Environment Comfort

- 1 **Comfort factors of Wind Environment**  
strengthen protective measures, settling facilities avoidance of dangerous wind environment marking system
- 2 **Comfort factors of temperature Environment**  
the temperature that arise from street heat-preservation measures , arrangement of low temperatures space
- 3 **Comfort factors of sunlight Environment**  
present sunlight situation 、 the measures of raising sunlight、 The treatment for shadowspace
- 4 **behavioral comfortable factors**  
Space selective 、 facilities complex 、 climate adaptive of facilities 、 approbation of color 、 approbation of visible

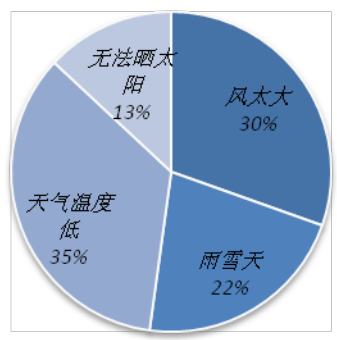
图1-影响中央大街空间环境的因素



## Step 1 classification of the various factors

- strong winds account for 40% become a major climatic influence to users
- 66.7% of people chose a wind shelter place as an ideal activity spaces
- evaluation factors can be classified as two types: **wind and temperature.**

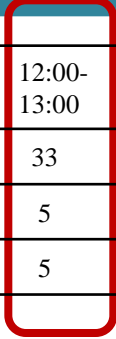
图2-阻碍人们在中央大街活动的不良气候因素



# Current status investigations — behaviors observations recorded

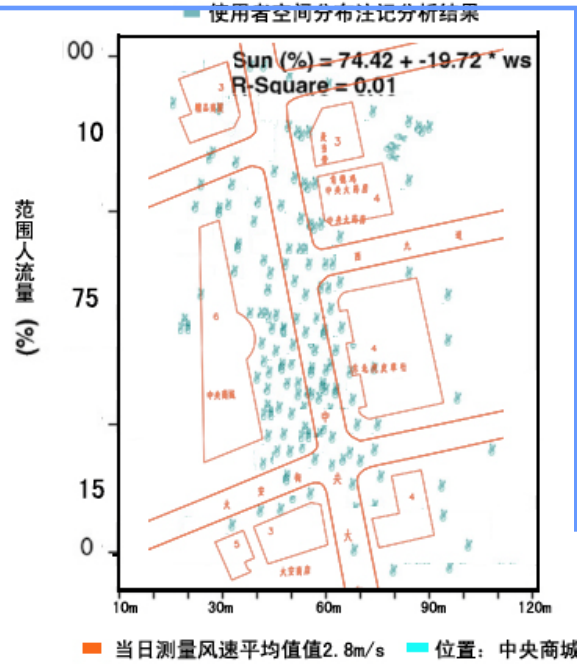
## 1 target location -Central-mall leisure area

时间	9:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00
人数	15	25	29	33	30	31	24	21
老人	7	6	7	5	4	6	4	3
儿童	3	4	5	5	8	6	4	6

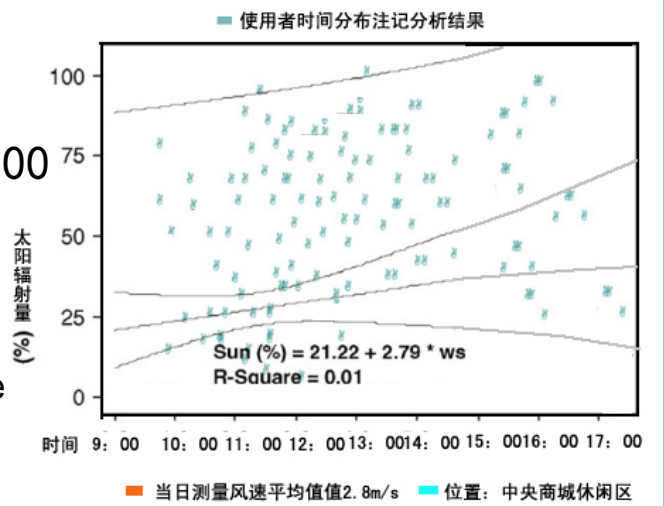


### space distribution

### temporal distribution



- concentrated using time
- 1) winter 11: 00-16:00
  - 2) above 80%
- concentrated using space
- activity space of L-shaped or U-shaped
  - 2) 66.7%

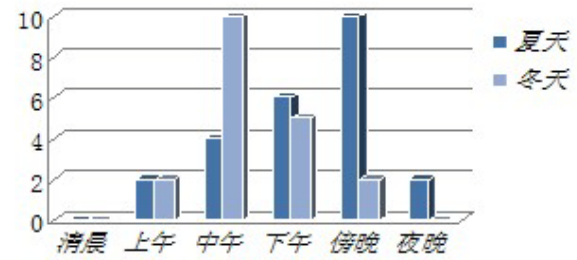


factors: wind velocity & sunlight condition

# 4Evaluation Study —— Climatic Environment Comfort

## Step 1 classification of the various factors

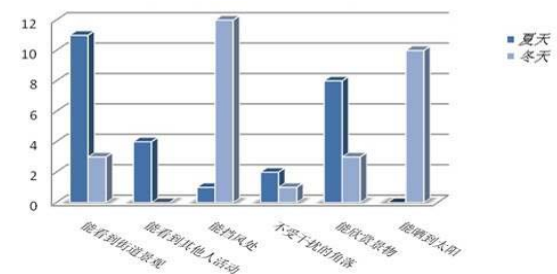
- the variation of temperature tended to be stable over time
- temperature in the evaluation will be graded in three levels 、 wind speed factor is divided into four levels



The ideal hours to the street

## Step 2 The order of the influence for wind and temperature dominated by the positional function

For example ,temperatures in the evaluation of the traffic space from warm to cold were scored to 1,1,3.



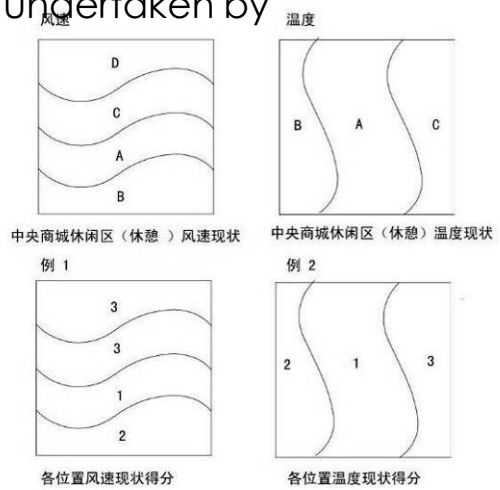
The ideal position to activity in the street 16

# 4Evaluation Study —— Climatic Environment Comfort

## Step 2 A gradation reference to the major function undertaken by evaluation area.

步骤 2 参照评价区域主要承担功能，对因子的每一类型进行排序

因子分类		例 1	例 2	
风速	A	1	1	
	B	1	2	
	C	2	3	
	D	3	3	
温度	A	1	1	1-舒适度一级
	B	1	2	2-舒适度二级
	C	3	3	3-舒适度三级



The quantizing analysis about the influence of physical climate conditions on body comfortableness dominated by the positional function

## Step 3 evaluate based on actually surveyed data , referred to the evaluation standard

风速评价	因子现状情况分类	所属范围	对应舒适度级别	评分	对应测点
风速评价	A (微风)	平均风速小于0.5	一	1	测点16
	B (微风到中风)	平均风速0.5—0.7m/s之间	二	2	测点15
	C (中风)	平均风速0.7—1m/s之间	三	3	测点17
	D (大风)	平均风速超过1m/s以上	三	3	测点18

日照+温度评价	测点	温度等级	日照等级	评价等级
日照+温度评价	15	2	1	3
	16	1	1	2
	17	2	3	6
	18	3	2	4

rating level of wind environment Central-mall leisure area

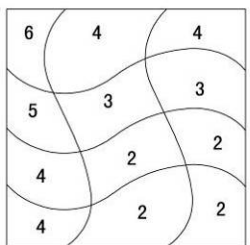
sunlight and temperature

# 4Evaluation Study —— Climatic Environment Comfort

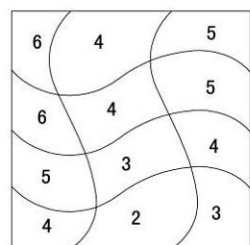
## Step 4

the comprehensive analysis and evaluation plan is being obtained by overlying the comfort evaluation value of each factor corresponding each block in evaluation region.

步骤 4 将评价区域每个地块利用对应的各单因子舒适性分析叠加，得到综合分析图



交通 A区



休憩 A区

低数值代表评价区域该功能舒适性最佳

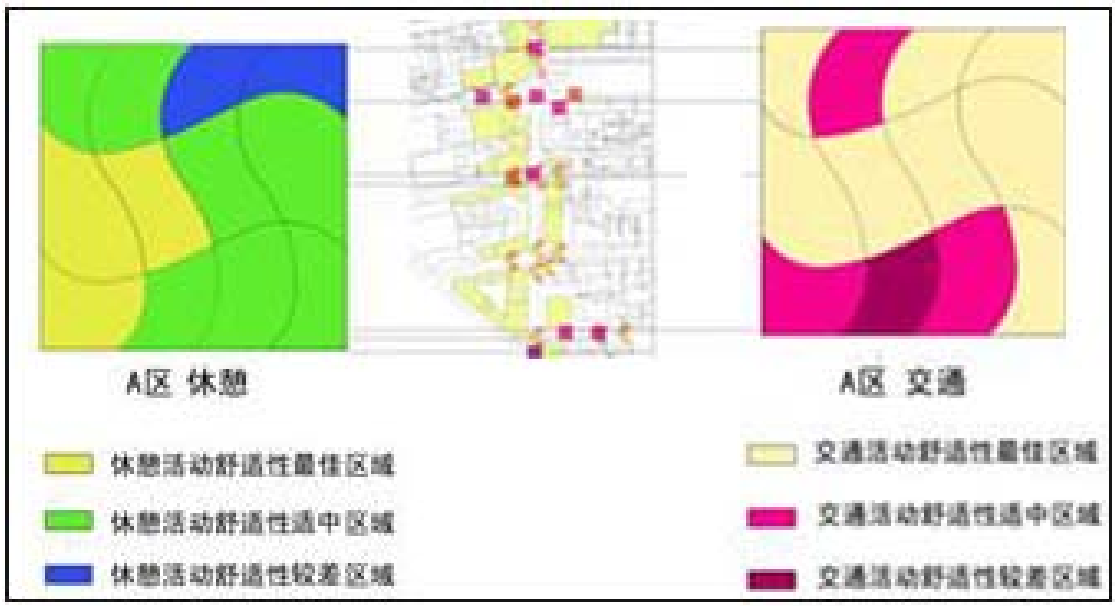
高数值代表该评价区域该功能舒适性较差

- the map is charted which describes the comfort within the function in evaluation region
- the limitations and advantages of the physical factors are overlaid each other under the rules established in the previous

Comfortable evaluate results in traffic space of in testing zone A

# 4Evaluation Study —— Climatic Environment Comfort

➤ Comfortable evaluate results in open space of in testing zone A



it make up for lack of consideration of single factor and not being explicit emphasis of every factor.

## Result analysis

### 1 Comfortable evaluate results in open space

- comprehensive effect of river wind on north side
- The comfort of traffic space near the river was the lowest
- human activities that increase its comfort

### 2 Comfortable evaluate results in traffic space

- the difference in optimizing comfort zone of traffic space is not obvious
- From the evaluation result, if the open space is set-up in test zone B, the optimal comfort would be suitable for pedestrian.

### 3 adopt the effective protective measures prolonging the visitors' staying time

### 4 raising comfort of public spaces in winter and the season with alternant changes in temperature

# 5 ENDING

- **Thanks**
- I hope you have found this useful

**Sun Yu**